USDA Natural Resources
Conservation Service

Ecological site R061XY017SD
Shallow Clayey

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General information

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

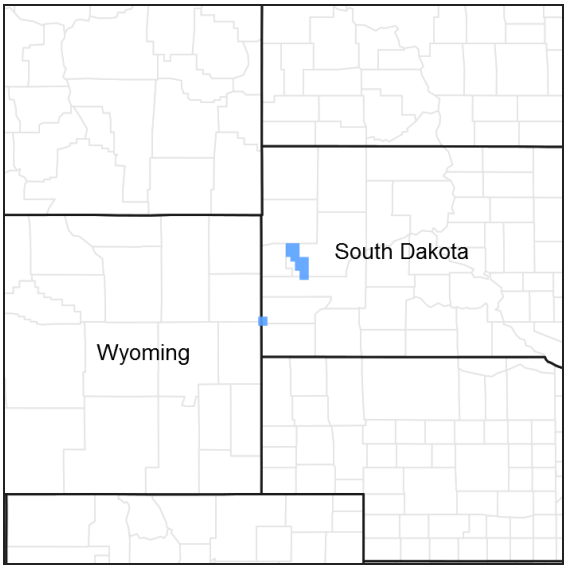


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 061X–Black Hills Foot Slopes

The Black Hills Foot Slopes (MLRA 61) is shared between Wyoming (WY) (58 percent) and South Dakota (SD) (42 percent). The MLRA is approximately 1,865 square miles in size. The towns of Spearfish, Sturgis, and Hot Springs, South Dakota and Newcastle and Sundance, Wyoming are all within the boundary of this MLRA. Rapid City, South Dakota is on the eastern edge of the MLRA. Wind Cave National Park, Devils Tower National Monument, and parts of Thunder Basin National Grassland and the Black Hills National Forest are located in MLRA 61. Devils Tower was our nation’s first National Monument, designated by President Theodore Roosevelt in 1906.

The Black Hills Foot Slopes consists of steeply dipping rocks circling the domed mountains of the Black Hills. As the mountains were uplifted, older sediments were tipped up, so they dip away from the core of the mountains. The Lower Cretaceous Fall River and Lakota (Inyan Kara Group) sandstones that occur on the outside boundary of the area are referred to as the Dakota Hogback. The next geologic formation is the Triassic-aged red beds of the Spearfish shale which form a low valley. The “red valley” surrounds the Black Hills between the two ridges formed by the Inyan Kara (hogback) and Minnekahta Formations associated with the Black Hills (MLRA 62). The Lakota referred to the red valley as the “Big Racecourse or the Red Racetrack.” The red beds have gypsum and anhydrous layers. Ground water seepage can dissolve these layers, creating sinkholes on the surface.

The average elevation of MLRA 61 ranges from 2,950 to 3,940 feet with extremes to 5,580 feet. Slopes are

generally hilly; however, the interior red beds are nearly level to moderately sloping. The exterior hogback is steep, erosion-resistant rock. The Belle Fourche River is the only river to flow through MLRA 61, near Hulett, Wyoming.

The dominant soil orders in this MLRA are Alfisols, Entisols, and Mollisols. The soils in the area have predominantly frigid or mesic soil temperature regimes, and aridic or ustic soil moisture regimes. Soils are shallow to very deep, generally well drained, and loamy.

Annual precipitation is 16-22 inches. The majority of rainfall occurs early in the growing season with some high-intensity thunderstorms occurring mid-late summer. This MLRA supports open grassland, open ponderosa forest, and savanna-like vegetation. The grassland is characterized by native grasses, such as big and little bluestem, western wheatgrass, needle and thread, prairie dropseed, and green needlegrass. Bur oak grows throughout the northern area and can develop into nearly pure stands.

The major resource concerns are water quality, wind and water erosion, and urban expansion.

Of the total acreage making up MLRA 61, 54 percent is privately owned rangeland and 19 percent forest land. Federal lands make up 7 percent of the rangeland and 5 percent of the forest land. The remaining 15 percent is privately owned cropland and urban development (USDA, NRCS. 2006. Ag Handbook 296).

LRU notes

For development of ecological sites, MLRA 61 is divided into three precipitation zones (PZ).
The northern area (18–22” PZ) extends from just south of Rapid City, South Dakota, north to the Wyoming border.

The southern area (16–18” PZ) extends from Newcastle, Wyoming, south to Hot Springs, South Dakota, then north to just south of Rapid City.

The western area (16–20” PZ) is primarily located in Wyoming, extending from Newcastle in the south, to north of the Bear Lodge Mountains, then south through the gap between the Bear Lodge Mountains and the Black Hills.

One additional grouping of ecological sites represents sites that are common for the entire MLRA and do not have a precipitation zone designation.

The forest lands in MLRA 61 are represented by three forest ecological sites, which are currently correlated to MLRA 62 Black Hills.

Classification relationships

USDA Land Resource Region G – Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA) 61 - Black Hills Foot Slopes

US Environmental Protection Agency (EPA)
Level IV Ecoregions of the Conterminous United States:
Black Hills Foothills - 17a

USDA Forest Service
Ecological Subregions: Sections and Subsections of Conterminous United States:
Black Hills Coniferous Forest Province - M334,
Black Hills Foothills Subsection - M334Aa

Ecological site concept

The Shallow Clayey ecological site occurs throughout MLRA 61. It is located on upland landscapes and does not receive additional moisture from runoff or overflow. The typical slopes range from 5 to 40 percent. Soils are shallow, between 10 and 20 inches in depth, with a surface texture of silty clay loam, 3 to 5 inches thick. Subsurface textures range from silty clay loam to clay.

The vegetation in the Reference State (1.0) is dominated by cool-season grasses, with warm-season grasses being

subdominant. Rhizomatous wheatgrass, green needlegrass, little bluestem, and sideoats grama are the major grass species. Forbs are common and diverse. Shrubs, such as leadplant, rose, winterfat, and fringed sagewort are almost always present in minor amounts. The Shallow Clayey site is susceptible to invasion of non-native cool-season grasses and encroachment of conifers from adjacent sites.

Associated sites

R061XN012SD	**Thin Upland-North (18-22" PZ)** The Thin Upland 16-18” PZ ecological site is found on steep slopes adjacent to the Shallow Clayey ecological site.
R061XY168WY	**Thin Upland-West (16-20" PZ)** The Thin Upland 16-20” PZ ecological site is found on steep slopes adjacent to the Shallow Clayey ecological site.
R061XN011SD	**Clayey-North (18-22" PZ)** The Clayey 16-18” PZ ecological site is found on near level to gently sloping uplands adjacent to the Shallow Clayey ecological site.
R061XW104WY	**Clayey-West (16-20" PZ)** The Clayey 16-20” PZ ecological site is found on near level to gently sloping uplands adjacent to the Shallow Clayey ecological site.

Similar sites

R061XS012SD	**Thin Upland-South (16-18" PZ)** The Thin Upland 16-18” PZ ecological site will be calcareous at or near the soil surface, have more little bluestem and sideoats grama, and less western wheatgrass and big bluestem than the Shallow Clayey ecological site.
R061XY168WY	**Thin Upland-West (16-20" PZ)** The Thin Upland 16-20” PZ ecological site will be calcareous at or near the soil surface, have more little bluestem and sideoats grama, and less western wheatgrass than the Shallow Clayey ecological site.

Table 1. Dominant plant species

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

Physiographic features

The Shallow Clayey ecological site occurs on moderately to steeply sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Upland > Hill (2) Upland > Hogback (3) Upland > Ridge
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,900–4,000 ft
Slope	5–40%
Aspect	Aspect is not a significant factor

Climatic features

The climate in MLRA 61 is typical of the drier portions of the Northern Great Plains where sagebrush steppes to the west yield to grassland steppes to the east. Annual precipitation ranges from 16 to 22 inches per year, with most falling during the growing season. Temperatures show a wide range between the summer and winter months and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in the winter and bring rapid rises in temperature. Extreme storms may occur during the winter months, but most severely affect ranch operations during late winter and spring.

The average annual temperature is about 47°F. January and December are the coldest months with average temperatures ranging from about 23°F (NNW of Edgemont, SD) to about 26°F (Fort Meade, SD). July is the warmest month with temperatures averaging from about 69°F (Fort Meade, WY) to about 73°F (Hot Springs, SD). The range of average monthly temperatures between the coldest and warmest months is about 47°F. 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 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. Cool-season plants may green-up in September and October if adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	96-117 days
Freeze-free period (characteristic range)	120-143 days
Precipitation total (characteristic range)	18-21 in
Frost-free period (actual range)	80-124 days
Freeze-free period (actual range)	115-157 days
Precipitation total (actual range)	16-22 in
Frost-free period (average)	107 days
Freeze-free period (average)	133 days
Precipitation total (average)	19 in

Climate stations used

- (1) BEAR RIDGE [USC00390554], Spearfish, SD
- (2) EDGEMONT [USC00392557], Edgemont, SD
- (3) EDGEMONT 23 NNW [USC00392565], Custer, SD
- (4) FT MEADE [USC00393069], Fort Meade, SD
- (5) HOT SPRINGS [USC00394007], Hot Springs, SD
- (6) RAPID CITY WFO [USC00396948], Rapid City, SD
- (7) RAPID CITY 4NW [USC00396947], Rapid City, SD
- (8) SPEARFISH [USC00397882], Spearfish, SD
- (9) DEVILS TWR #2 [USC00482466], Devils Tower, WY
- (10) HULETT [USC00484760], Hulett, WY
- (11) NEWCASTLE [USC00486660], Newcastle, WY
- (12) SUNDANCE [USC00488705], Sundance, WY
- (13) UPTON 14ENE [USC00489208], Newcastle, WY

Influencing water features

No riparian areas or wetland features are directly associated with the Shallow Clayey ecological site.

Wetland description

Not Applicable.

Soil features

Soils common to this site have a silty clay loam surface texture that is 3 to 5 inches thick. Soils are shallow (10 to 20 inches in depth) and formed in residuum derived from shale. Subsurface textures are clayey to silty clay loam. Some soil series will have an impervious shale layer at 10 to 20 inches however, other soil series will have a fractured shale layer with up to 50 percent by volume of fine to very fine, soft weathered shale fragment. Soils are well-drained and have a slow to very slow infiltration rate. Slopes range from 5 to 40 percent. Some soil series have a restrictive layer of shale bedrock, at about 16 inches in depth, which impedes water movement and root penetration. Other series with weathered shale chips can allow water to infiltrate and roots to extend to a depth of 30 inches.

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.

Major Soils correlated to the Shallow Clayey ecological site include, Lismas, Samoist, and Samsil.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 20 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. Available water capacity and permeability will strongly influence the soil-water-plant relationship.

More information regarding the soil is available in soil survey reports. Contact the local USDA Service Center or use the Web Soil Survey online for details specific to your area of interest.

Table 4. Representative soil features

Parent material	(1) Residuum–shale
Surface texture	(1) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow to slow
Soil depth	10–20 in
Surface fragment cover <=3"	0–14%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	2–3 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	2–4 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–4%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Shallow Clayey ecological site developed under the Northern Great Plains climatic conditions; light to severe grazing by bison and other large herbivores; sporadic, natural or human-caused wildfire (often of light intensities); and other biotic and abiotic factors that typically influence soil and site development. Changes occur in the plant communities due to short-term weather variations, effects of native and exotic plant and animal species, and management actions. Although the following plant community descriptions are typical of the transitions between communities, 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 species composition.

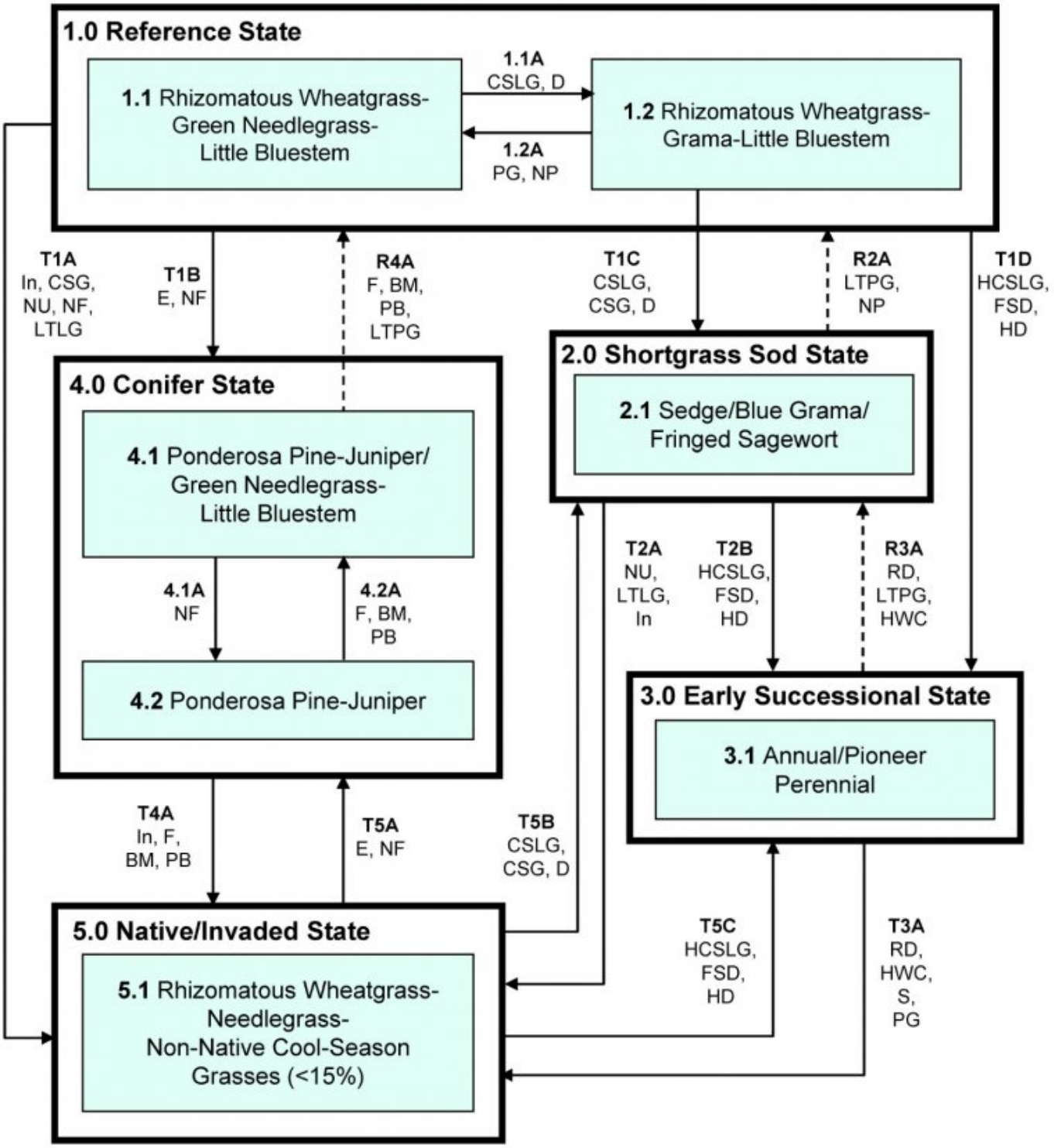
Continuous grazing (e.g., every spring and/or every summer at moderate to heavy stocking levels) without adequate recovery periods following grazing events causes departure from the Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem Plant Community (1.1). Blue grama and sedge can increase and eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Needle and thread, green needlegrass, big bluestem, sideoats grama, and little bluestem will decrease in frequency and production. Excessive defoliation can cause threeawn and annuals to increase and dominate the site. A few mature trees comprised of ponderosa pine and Rocky Mountain juniper occupy this site. With extended periods of no fire, trees will begin to encroach into the herbaceous community and may eventually dominate the site.

Interpretations are primarily based on the Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem 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. Plant community phases, states, transitional pathways, and thresholds have been determined through similar studies and experience.

The following state-and-transition diagram illustrates the common plant communities on the site and the transition pathways between communities. The ecological processes are discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Shallow Clayey – R061XY017SD 2/10/20



BM – Brush management
CSG – Continuous seasonal grazing
CSLG – Continuous season-long grazing
D – Drought
E – Encroachment of Conifers
F – Fire
FSD – Frequent and severe defoliation
HD – Heavy disturbance
HCSLG – Heavy, continuous season-long grazing
HWC – Herbaceous weed control

In – Invasion of non-native cool-season grasses
LTLG – Long-term light grazing
LTPG – Long-term prescribed grazing
NP – Normal precipitation
NF – No fire
NU – No use
PB – Prescribed burning
PG – Prescribed grazing
RD – Removal of disturbance
S – Seeding
- - - → Transition may not be rapid or feasible

Diagram Legend: Shallow Clayey - R061XY017SD

T1A	1.0 to 5.0	Invasion of non-native cool-season grasses; continuous seasonal grazing (summer); long-term light grazing; or non-use and no fire.
T1B	1.0 to 4.0	Encroachment of conifers and no fire.
T1C	1.0 to 2.0	Continuous season-long grazing; continuous seasonal grazing; or heavy grazing in combination with drought.
T1D	1.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T2A	2.0 to 5.0	No use; long-term light grazing; the invasion of non-native cool-season grasses.
T2B	2.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T3A	3.0 to 5.0	Removal of management induced disturbance; herbaceous weed control; seeding to native species: prescribed grazing with proper stocking rates, change in season of use, and adequate time for recovery following grazing event.
T4A	4.0 to 5.0	Invasion of non-native cool-season grasses; fire, mechanical brush management, or prescribed burning to remove conifers.
T5A	5.0 to 4.0	Encroachment of conifers and no fire.
T5B	5.0 to 2.0	Continuous season-long grazing; continuous seasonal grazing; or heavy grazing in combination with drought.
T5C	5.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.

R2A	2.0 to 1.0	Long-term prescribed grazing with proper stocking rates, change in season of use, adequate time for recovery following grazing event; a return to normal precipitation patterns following drought. This transition may not be fast or feasible.
R3A	3.0 to 2.0	Removal of management induced disturbance followed by long-term prescribed grazing with proper stocking rates, change in season of use, adequate time for recovery following grazing event. Herbaceous weed control may be required. This transition may not be fast or feasible.
R4A	4.0 to 1.0	Fire, brush management, or prescribed burning to remove conifer encroachment; possibly herbaceous weed control; long-term prescribed grazing with change in season of use, proper stocking rates, and adequate time for recovery. This transition may not be fast or feasible.

1.1A	1.1 to 1.2	Continuous season-long grazing, or heavy grazing in combination with drought.
1.2A	1.2 to 1.1	Prescribed grazing with proper stocking, change in season of use, adequate time for recovery; a return to normal precipitation patterns.
4.1A	4.1 to 4.2	No fire or brush management.
4.2A	4.2 to 4.1	Fire, brush management, and prescribed burning.

State 1
Reference State

The Reference State represents the best estimate of the natural range of variability that dominated the dynamics of the Shallow Clayey ecological site prior to European settlement. This state is dominated by cool-season grasses, with warm-season grasses being subdominant. In pre-European times, the primary disturbance mechanisms included occasional 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. Taller cool- and warm-season grasses would have declined and a corresponding increase in short-statured grasses and grass-like species would have occurred. Today, a similar state can be found on areas that are properly managed with grazing and prescribed burning and sometimes on areas receiving occasional short periods of rest. The Reference State is susceptible to invasion of non-native cool-season grasses and the encroachment of conifers from adjacent sites.

Community 1.1
Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem

Interpretations are based primarily on the Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem Plant Community. This is also considered the Reference Plant Community (1.1). The potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, 10 percent shrubs, and scattered mature trees. The community is dominated by cool-season grasses, with warm-season grasses being subdominant. The major grasses include western wheatgrass, green needlegrass, sideoats grama, and little bluestem. Other grass and grass-like species include plains muhly, big bluestem, needle and thread, bluebunch wheatgrass, blue grama, and needleleaf sedge. 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 regard to soils and site 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	1040	1428	1815
Forb	80	128	175
Shrub/Vine	80	128	175
Tree	0	16	35
Total	**1200**	**1700**	**2200**

Figure 9. Plant community growth curve (percent production by month). SD6102, Black Hills Foot Slopes, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant.

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

Community 1.2
Rhizomatous Wheatgrass-Grama-Little Bluestem

This plant community developed under continuous season-long grazing or from over utilization during extended drought periods. This community can also develop where this site occurs near water sources. The potential plant community is made up of approximately 80 percent grasses and grass-like species, 10 percent forbs, 10 percent shrubs, and a minor amount of mature trees scattered randomly across the site. Dominant grass and grass-like species include western wheatgrass, green needlegrass, sideoats grama, blue grama, needleleaf sedge, and little bluestem. Grasses of secondary importance include needle and thread, buffalograss, prairie Junegrass, and bottlebrush squirreltail. Forbs commonly found in this plant community include cudweed sagewort, desert biscuitroot, goldenpea, milkvetch, scarlet globemallow, silverleaf scurfpea, and white prairie aster. Dominant shrubs include fringed sagewort and yucca. When compared to the Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem Plant Community (1.1), blue grama and needleleaf sedge have increased. Tall and mid-cool- and warm-season grasses have decreased, and vegetative production has also been reduced. This plant community is moderately resistant to change. This is due in part to the shallow rooted nature of the shortgrass species which decreases infiltration especially to the deeper rooted tall and mid-grass species. The herbaceous species present are well adapted to grazing; however, species composition can be altered through continued overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term. This plant community phase is reaching a critical point where continued overgrazing will likely shift this community over a threshold leading to a short grass and grass-like dominated state. The shorter, more grazing tolerant species tend to self-perpetuate as the shallow, dense rooting structure takes advantage of rainfall and reduces deeper infiltration to the taller species.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	870	1176	1480
Forb	65	105	145
Shrub/Vine	65	105	145
Tree	0	14	30
Total	**1000**	**1400**	**1800**

Figure 11. Plant community growth curve (percent production by month). SD6102, Black Hills Foot Slopes, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant.

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

Pathway 1.1A
Community 1.1 to 1.2

Continuous season-long grazing (stocking levels above carrying capacity for extended portions of the growing season), or heavy grazing in combination with drought will lead the Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem Plant Community (1.1) to the Rhizomatous Wheatgrass-Grama-Little Bluestem Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing (proper stocking, alternating season of use, and providing adequate recovery periods); periodic light to moderate grazing possibly including periodic rest; or a return to normal precipitation patterns following drought will convert this plant community to the Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem Plant Community (1.1).

Conservation practices

Prescribed Grazing

State 2
Shortgrass Sod State

This state is a result of overgrazing (individual plants of selected species being repeatedly grazed due to continuous grazing systems which allow for long paddock occupation periods). This type of grazing causes reduced vigor of the selected species (i.e., typically the most desired by grazing ungulates). As the photosynthetic area of these species is repeatedly removed, carbohydrate production needed for root respiration is inadequate and the root systems of these species begin to falter. The shorter, more grazing tolerant species are given the advantage and will dominate the site. In the early stages of this state, tall and mid-grass remnants may be present in sufficient quantities to allow for recovery to the Reference State (1.0). Over time, this recovery will become less likely due to higher runoff and reduced infiltration.

Community 2.1
Sedge/Blue Grama/Fringed Sagewort

This plant community evolved under continuous seasonal grazing; continuous season-long 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, 15 percent shrubs, and scattered mature trees. Dominant grass and grass-like species include needleleaf sedge and blue grama. Other grasses include western wheatgrass, sideoats grama, buffalograss, and a variety of other grasses. Cheatgrass may also invade and become quite prevalent. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), silverleaf scurfpea, and white prairie aster. When compared to the Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem Plant Community (1.1), short statured species are dominant on this plant community. Tall and mid-grasses have decreased significantly. This vegetation state is very resistant to change due to the increase in the root mat near the surface of the soil which further reduces infiltration. The herbaceous species present are well adapted to grazing. This plant community is less productive than other plant community 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 give the short statured species a competitive advantage. Soil erosion will be minimal due to the sod forming habit of dominant species in this phase.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	600	897	1190
Shrub/Vine	50	110	170
Forb	50	83	115
Tree	0	10	25
Total	**700**	**1100**	**1500**

Figure 13. Plant community growth curve (percent production by month). SD6104, Black Hills Foot Slopes, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		3	7	17	25	25	15	7	1		

State 3
Early Successional State

The Early Successional State is the result of very heavy, concentrated disturbance such as intense rodent activity, or livestock concentration areas. This state can also develop as a result of invasion by highly competitive or noxious weed species. 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.

Community 3.1
Annual/Pioneer Perennial

This plant community developed under heavy, continuous season-long grazing; frequent and severe defoliation; or other heavy disturbances (e.g., heavy use areas). The potential plant community is made up of approximately 40 to 80 percent grasses and grass-like species, 20 to 60 percent forbs, and 0 to 5 percent shrubs. The species present in this phase are highly variable, but often include non-native invasive and early seral species. 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.

State 4
Conifer State

This Conifer State consists of areas where tree canopy increases to a level that impedes the reproductive capability of the major native perennial grass species. The increase in tree canopy is a result of a disruption of the natural historic fire regime that kept the trees at an immature stage. This state is reached when mature tree canopy reaches approximately 25 percent or more. Tree canopy typically is dominated by ponderosa pine, but Rocky Mountain juniper may also be present in varying amounts.

Community 4.1
Ponderosa Pine-Juniper/Green Needlegrass-Little Bluestem

This plant community develops where trees from adjacent sites encroach or trees naturally occurring on the site increase and begin to shade out the herbaceous component. Ponderosa pine is the most common species to occupy the site, but encroachment of Rocky Mountain juniper can also occur. These species expand on this site due to suppression of fire. The mature tree canopy is 25 percent or greater. The potential plant community is made up of approximately 35 percent grasses and grass-like species, 5 percent forbs, 10 percent shrubs, and 50 percent

trees. Dominant grass and grass-like species include little bluestem, green needlegrass, needle and thread, blue grama, threeawn, and needleleaf sedge. As the canopy increases, warm-season grasses tend to decrease as the cool-season grasses initially increase. Forbs commonly found in this community include cudweed sagewort, white prairie aster, silverleaf scurfpea, and pussytoes. Non-native species such as cheatgrass and bluegrass will tend to invade. Compared to the Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem Plant Community (1.1), tree canopy increases significantly. The grass component decreases dramatically with increased shading and the buildup of duff. Annual herbaceous production also decreases significantly. While the tree canopy provides excellent protection from the weather for both livestock and wildlife, it is not capable of supporting large numbers of wildlife and livestock due to decreased production. A significant reduction of tree canopy can be accomplished through fire, mechanical brush management, or prescribed burning. The vegetation in the understory is capable of enduring fire; however, very hot crown fires will have a detrimental effect to the plant community.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	585	618	820
Tree	220	520	650
Shrub/Vine	60	98	135
Forb	35	64	95
Total	**900**	**1300**	**1700**

Figure 15. Plant community growth curve (percent production by month). SD6111, Black Hills Foot Slopes, heavy conifer canopy. Mature ponderosa pine/juniper overstory.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	7	11	24	27	12	5	4	3	2	1

Community 4.2
Ponderosa Pine-Juniper

This plant community is a result of continued suppression of fire and no brush management. The tree canopy eventually becomes closed and most of the herbaceous understory is lost. Mature tree canopy approaches 45 percent or higher and competition slows the growth rate of the trees. A few cool-season species may survive, as well as, shrubs and possibly vines. This plant community may only be altered through brush management or possibly a wildfire that has enough energy to cause crowning of the trees. This plant community phase will also be accompanied by a relatively thick layer of acidic duff from the needles of the trees which will further reduce the establishment of herbaceous species.

Pathway 4.1A
Community 4.1 to 4.2

No fire or no brush treatment for an extended period of time will cause the tree canopy to continue to increase and shift this plant community (4.1) to the Ponderosa Pine-Juniper Plant Community (4.2).

Pathway 4.2A
Community 4.2 to 4.1

Fire; brush management; or prescribed burning will be required to shift this plant community away from this phase. Reproductive propagules of native herbaceous species will need to be present to result in a shift from the Ponderosa Pine-Juniper Plant Community (4.2) to the Ponderosa Pine-Juniper/Green Needlegrass-Little Bluestem Plant Community (4.1).

Conservation practices

Brush Management

Prescribed Burning

State 5
Native/Invaded State

The Native/Invaded State is dominated by native cool- and warm-season grasses, and subdominant non-native cool-season grasses. It can be found on areas that are properly managed with grazing and possibly prescribed burning, and on areas receiving occasional short periods of rest. If the native cool-season grasses decline a corresponding increase of non-native cool-season grasses can occur. The non-native cool-season grasses will include Kentucky bluegrass, smooth brome, cheatgrass, and field brome.

Community 5.1
Rhizomatous Wheatgrass-Needlegrass-Non-Native Cool-Season Grasses (<15%)

This plant community develops when non-native cool-season grasses, such as Kentucky bluegrass or smooth brome invade and become established on the site. This may occur due to the sites close proximity to seed sources, expansion from road ditches, improved pastures, other invaded sites, or from contaminated hay. Repeated seasonal grazing (typically during the summer), or long-term light grazing, or extended periods of non-use and no fire, will allow these non-native cool-season grasses to increase in the plant community. Plant litter accumulates in large amounts when this community first develops. Litter buildup reduces mature native plant vigor and density, and seedling recruitment declines. Eventually litter levels become high enough that plant density decreases. Typically, rhizomatous grasses form small colonies because of a lack of tiller stimulation. The potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs and trees. The community is dominated by cool-season grasses. The major grasses include western wheatgrass, needle and thread, green needlegrass, Kentucky bluegrass, and smooth brome. Other grass and grass-like species include little bluestem, blue grama, sideoats grama, and needleleaf sedge. This is a sustainable plant community in regard to soil and site stability, watershed function, and biologic integrity. However, the presence of smooth brome, Kentucky bluegrass, and other invasive species will begin to alter the soil biotic community and potentially lead to further invasion of non-native species.

Figure 16. Plant community growth curve (percent production by month). SD6102, Black Hills Foot Slopes, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant.

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

Transition T1C
State 1 to 2

Continuous season-long grazing (stocking levels above carrying capacity for extended portions of the growing season); continuous seasonal grazing (spring or fall); heavy grazing in combination with drought will result in a transition from the Reference State (1.0) to the Shortgrass Sod State (2.0). This transition will most likely occur from the Rhizomatous Wheatgrass-Grama-Little Bluestem Plant Community (1.2).

Transition T1D
State 1 to 3

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance will transition the Reference State (1.0) to the Early Successional State (3.0).

Transition T1B
State 1 to 4

Encroachment or increase in canopy cover of native coniferous tree species, and no fire will lead the Reference State (1.0) over a threshold to the Conifer State (4.0). This threshold will be crossed when tree canopy reaches approximately 25 percent or more of mature trees.

Transition T1A
State 1 to 5

Continuous seasonal grazing (summer); long-term light grazing; or no use and no fire; the invasion of non-native cool-season grasses will transition the Reference State (1.0) to the Native/Invaded State (5.0).

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing including proper stocking rates, change in season of use, adequate time for recovery and a return to normal precipitation patterns following drought will transition the Shortgrass Sod State (2.0) to the Reference State (1.0). This transition may not be fast or feasible.

Conservation practices

Prescribed Grazing

Transition T2B
State 2 to 3

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance will transition the Shortgrass Sod State (2.0) to the Early Successional State (3.0).

Transition T2A
State 2 to 5

No use, or long-term light grazing, and the invasion of non-native cool-season grasses will likely transition the Shortgrass Sod (2.0) State to the Native/Invaded State (5.0).

Restoration pathway R3A
State 3 to 2

Removal of disturbances coupled with long-term prescribed grazing with change in season of use, and adequate recovery time following grazing may return the Early Successional State (3.0) to the Shortgrass Sod State (2.0). Herbaceous weed control may also be needed. This transition could require significant time and input to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Grazing
Herbaceous Weed Control

Transition T3A
State 3 to 5

Removal of disturbances, herbaceous weed control, possibly seeding to native species, followed by prescribed grazing that includes proper stocking, change in season of use, and deferment that provides time for adequate recovery will transition this state to the Native/Invaded State (5.0).

Conservation practices

Prescribed Grazing
Herbaceous Weed Control

Restoration pathway R4A

State 4 to 1

Fire; prescribed burning; or mechanical brush management in conjunction with long-term prescribed grazing may lead the Conifer State (4.0) across a threshold back to the Reference State (1.0). This would need to take place before the trees reach maturity and are still susceptible to fire, and reproductive propagules of the perennial grasses are still present. After trees reach maturity, a stand replacing fire or brush management would be needed to move this state over the threshold back to the Reference State (1.0).

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

Transition T4A
State 4 to 5

Invasion of non-native cool-season grasses; fire, mechanical brush management, or prescribed burning to remove conifers will transition the Conifer/Herbaceous State (4.0) to the Native/Invaded State (5.0).

Conservation practices

Brush Management
Prescribed Burning

Transition T5B
State 5 to 2

Continuous season-long grazing (stocking levels above carrying capacity for extended portions of the growing season); continuous seasonal grazing (spring or fall); or heavy grazing in combination with drought will result in a transition from the Native/Invaded State (5.0) to the Shortgrass Sod State (2.0).

Transition T5C
State 5 to 3

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance will transition the Native/Invaded State (5.0) to the Early Successional State (3.0).

Transition T5A
State 5 to 4

Encroachment or an increase in canopy cover of native coniferous tree species, and no fire will lead the Native/Invaded State (5.0) over a threshold to the Conifer State (4.0). This threshold will be crossed when tree canopy reaches approximately 25 percent or more of mature trees.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			255–595	
	western wheatgrass	PASM	*Pascopyrum smithii*	255–595	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–595	–
2	**Cool-Season Bunchgrass**			170–425	

	green needlegrass	NAVI4	*Nassella viridula*	170–425	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–425	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–85	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–85	–
3	**Mid- Warm-Season Grasses**			255–425	
	sideoats grama	BOCU	*Bouteloua curtipendula*	85–425	–
	little bluestem	SCSC	*Schizachyrium scoparium*	85–340	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–255	–
4	**Short Warm-Season Grasses**			85–170	
	blue grama	BOGR2	*Bouteloua gracilis*	34–170	–
	buffalograss	BODA2	*Bouteloua dactyloides*	17–119	–
	threeawn	ARIST	*Aristida*	0–68	–
5	**Other Native Grasses**			51–136	
	big bluestem	ANGE	*Andropogon gerardii*	0–136	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	17–85	–
	squirreltail	ELEL5	*Elymus elymoides*	0–51	–
	Sandberg bluegrass	POSE	*Poa secunda*	17–34	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	17–34	–
	onespike danthonia	DAUN	*Danthonia unispicata*	0–34	–
	timber oatgrass	DAIN	*Danthonia intermedia*	0–34	–
	Grass, perennial	2GP	*Grass, perennial*	0–34	–
6	**Grass-likes**			34–119	
	needleleaf sedge	CADU6	*Carex duriuscula*	34–119	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–119	–
7	**Non-Native Cool-Season Grasses**			0	
Forb					
8	**Forbs**			85–170	
	bluebells	MERTE	*Mertensia*	0–170	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	17–34	–
	desert biscuitroot	LOFO	*Lomatium foeniculaceum*	17–34	–
	false boneset	BREU	*Brickellia eupatorioides*	0–34	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–34	–
	groundplum milkvetch	ASCR2	*Astragalus crassicarpus*	0–34	–
	milkvetch	ASTRA	*Astragalus*	17–34	–
	beardtongue	PENST	*Penstemon*	17–34	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	17–34	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	17–34	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–34	–
	pussytoes	ANTEN	*Antennaria*	0–34	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	17–34	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	17–34	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–34	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–34	–

	western wallflower	ERAS2	*Erysimum asperum*	0–34	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	17	–
	Wyoming besseya	BEWY	*Besseya wyomingensis*	0–17	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–17	–
	Forb, native	2FN	*Forb, native*	17	–
	textile onion	ALTE	*Allium textile*	17	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	17	–
	Indian breadroot	PEDIO2	*Pediomelum*	0–17	–
Shrub/Vine					
9	**Shrubs**			85–170	
	prairie sagewort	ARFR4	*Artemisia frigida*	17–170	–
	rose	ROSA5	*Rosa*	17–51	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–51	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	17–51	–
	soapweed yucca	YUGL	*Yucca glauca*	0–34	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–34	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–34	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–34	–
	leadplant	AMCA6	*Amorpha canescens*	17–34	–
Tree					
10	**Trees**			0–34	
	juniper	JUNIP	*Juniperus*	0–34	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–34	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–34	–
	Tree	2TREE	*Tree*	0–34	–

Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			280–560	
	western wheatgrass	PASM	*Pascopyrum smithii*	280–560	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–210	–
2	**Cool-Season Bunchgrass**			70–210	
	green needlegrass	NAVI4	*Nassella viridula*	70–210	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–70	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–70	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–28	–
3	**Mid- Warm-Season Grasses**			70–210	
	sideoats grama	BOCU	*Bouteloua curtipendula*	70–210	–
	little bluestem	SCSC	*Schizachyrium scoparium*	14–98	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–28	–
4	**Short Warm-Season Grasses**			98–210	
	blue grama	BOGR2	*Bouteloua gracilis*	70–210	–

	buffalograss	BODA2	*Bouteloua dactyloides*	14–98	–
	threeawn	ARIST	*Aristida*	14–42	–
5	**Other Native Grasses**			14–70	
	prairie Junegrass	KOMA	*Koeleria macrantha*	14–42	–
	squirreltail	ELEL5	*Elymus elymoides*	0–42	–
	Grass, perennial	2GP	*Grass, perennial*	0–42	–
	Sandberg bluegrass	POSE	*Poa secunda*	14–28	–
	big bluestem	ANGE	*Andropogon gerardii*	0–28	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–14	–
	onespike danthonia	DAUN	*Danthonia unispicata*	0–14	–
	timber oatgrass	DAIN	*Danthonia intermedia*	0–14	–
6	**Grass-likes**			70–182	
	needleleaf sedge	CADU6	*Carex duriuscula*	70–168	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–70	–
7	**Non-Native Cool-Season Grasses**			0	
Forb					
8	**Forbs**			70–140	
	white sagebrush	ARLU	*Artemisia ludoviciana*	14–42	–
	Forb, native	2FN	*Forb, native*	14–42	–
	Forb, introduced	2FI	*Forb, introduced*	0–42	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	14–28	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	14–28	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	14–28	–
	desert biscuitroot	LOFO	*Lomatium foeniculaceum*	0–28	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–28	–
	milkvetch	ASTRA	*Astragalus*	14–28	–
	beardtongue	PENST	*Penstemon*	0–14	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–14	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–14	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–14	–
	pussytoes	ANTEN	*Antennaria*	0–14	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–14	–
	Indian breadroot	PEDIO2	*Pediomelum*	0–14	–
	false boneset	BREU	*Brickellia eupatorioides*	0–14	–
	bluebells	MERTE	*Mertensia*	0–14	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–14	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–14	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–14	–
	textile onion	ALTE	*Allium textile*	0–14	–
	western wallflower	ERAS2	*Erysimum asperum*	0–14	–
Shrub/Vine					
9	**Shrubs**			70–140	
	prairie sagewort	ARFR4	*Artemisia frigida*	14–56	–

	soapweed yucca	YUGL	*Yucca glauca*	14–56	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–56	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–28	–
	rose	ROSA5	*Rosa*	14–28	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–28	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–28	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–14	–
	leadplant	AMCA6	*Amorpha canescens*	0–14	–
Tree					
10	**Trees**			0–28	
	juniper	JUNIP	*Juniperus*	0–28	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–28	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–28	–
	Tree	2TREE	*Tree*	0–28	–

Table 11. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			11–88	
	western wheatgrass	PASM	*Pascopyrum smithii*	11–88	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–22	–
2	**Cool-Season Bunchgrass**			0–55	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–55	–
	green needlegrass	NAVI4	*Nassella viridula*	0–44	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–22	–
3	**Mid- Warm-Season Grasses**			11–110	
	sideoats grama	BOCU	*Bouteloua curtipendula*	11–88	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–55	–
4	**Short Warm-Season Grasses**			110–330	
	blue grama	BOGR2	*Bouteloua gracilis*	88–275	–
	buffalograss	BODA2	*Bouteloua dactyloides*	11–88	–
	threeawn	ARIST	*Aristida*	0–55	–
5	**Other Native Grasses**			11–55	
	squirreltail	ELEL5	*Elymus elymoides*	0–33	–
	Grass, perennial	2GP	*Grass, perennial*	0–33	–
	Sandberg bluegrass	POSE	*Poa secunda*	11–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	11–22	–
	onespike danthonia	DAUN	*Danthonia unispicata*	0–11	–
	timber oatgrass	DAIN	*Danthonia intermedia*	0–11	–
6	**Grass-likes**			110–330	
	needleleaf sedge	CADU6	*Carex duriuscula*	110–275	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–88	–

7	**Non-Native Cool-Season Grasses**			22–110	
	Kentucky bluegrass	POPR	*Poa pratensis*	11–88	–
	cheatgrass	BRTE	*Bromus tectorum*	11–88	–
	field brome	BRAR5	*Bromus arvensis*	0–55	–
	smooth brome	BRIN2	*Bromus inermis*	0–55	–
Forb					
8	**Forbs**			55–110	
	Forb, introduced	2FI	*Forb, introduced*	11–77	–
	Forb, native	2FN	*Forb, native*	11–44	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	11–33	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	11–33	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	11–22	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–22	–
	milkvetch	ASTRA	*Astragalus*	11–22	–
	pussytoes	ANTEN	*Antennaria*	0–22	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	11–22	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–11	–
	textile onion	ALTE	*Allium textile*	0–11	–
	western wallflower	ERAS2	*Erysimum asperum*	0–11	–
Shrub/Vine					
9	**Shrubs**			55–165	
	soapweed yucca	YUGL	*Yucca glauca*	11–88	–
	prairie sagewort	ARFR4	*Artemisia frigida*	33–88	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–55	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–22	–
	rose	ROSA5	*Rosa*	0–22	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–22	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–11	–
Tree					
10	**Trees**			0–22	
	juniper	JUNIP	*Juniperus*	0–22	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–22	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–22	–
	Tree	2TREE	*Tree*	0–22	–

Table 12. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			0–39	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–39	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–13	–
2	**Cool-Season Bunchgrass**			26–130	
	green needlegrass	NAVI4	*Nassella viridula*	13–104	–

	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	13–91	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–26	–
3	**Mid- Warm-Season Grasses**			13–130	
	little bluestem	SCSC	*Schizachyrium scoparium*	13–104	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–52	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–26	–
4	**Short Warm-Season Grasses**			26–130	
	threeawn	ARIST	*Aristida*	13–91	–
	blue grama	BOGR2	*Bouteloua gracilis*	13–78	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–52	–
5	**Other Native Grasses**			26–65	
	prairie Junegrass	KOMA	*Koeleria macrantha*	13–39	–
	squirreltail	ELEL5	*Elymus elymoides*	0–39	–
	Sandberg bluegrass	POSE	*Poa secunda*	13–26	–
	Grass, perennial	2GP	*Grass, perennial*	0–26	–
	onespike danthonia	DAUN	*Danthonia unispicata*	0–13	–
	timber oatgrass	DAIN	*Danthonia intermedia*	0–13	–
6	**Grass-likes**			13–130	
	needleleaf sedge	CADU6	*Carex duriuscula*	13–130	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–65	–
7	**Non-Native Cool-Season Grasses**			13–130	
	cheatgrass	BRTE	*Bromus tectorum*	13–104	–
	field brome	BRAR5	*Bromus arvensis*	0–65	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–52	–
	smooth brome	BRIN2	*Bromus inermis*	0–26	–
Forb					
8	**Forbs**			39–91	
	Forb, native	2FN	*Forb, native*	0–39	–
	Forb, introduced	2FI	*Forb, introduced*	13–39	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	13–26	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	13–26	–
	pussytoes	ANTEN	*Antennaria*	0–26	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–26	–
	textile onion	ALTE	*Allium textile*	0–13	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–13	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–13	–
	milkvetch	ASTRA	*Astragalus*	0–13	–
	bluebells	MERTE	*Mertensia*	0–13	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–13	–
Shrub/Vine					
9	**Shrubs**			65–130	
	prairie sagewort	ARFR4	*Artemisia frigida*	13–78	–
	soapweed yucca	YUGL	*Yucca glauca*	13–65	–

	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–52	–
	rose	ROSA5	*Rosa*	0–39	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–39	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–13	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–13	–
Tree					
10	**Trees**			390–650	
	ponderosa pine	PIPO	*Pinus ponderosa*	325–585	–
	juniper	JUNIP	*Juniperus*	26–195	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–65	–
	Tree	2TREE	*Tree*	0–65	–

Animal community

Wildlife Interpretations:
MLRA 61 lies within the drier portion of the northern mixed-grass prairie ecosystem where sagebrush steppes to the west yield to grassland steppes to the east. Prior to European settlement, this area consisted of diverse grass- and shrubland habitats interspersed with varying densities of depressional instream wetlands and woody riparian corridors. These habitats provided critical life cycle components for many users. Many species of grassland birds, small mammals, reptiles, amphibians, and herds of roaming bison, elk, and pronghorn were among the inhabitants adapted to this semi-arid region. Roaming herbivores, as well as several small mammal and insect species, were the primary consumers linking the grassland resources to predators such as the gray wolf, mountain lion, and grizzly bear, and smaller carnivores such as the coyote, bobcat, fox, and raptors. The prairie dog was once abundant; however, the species remains a keystone species within its range. The black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, and swift fox were associated with prairie dog complexes.

Historically, the northern mixed-grass prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary disturbance factors either singly or in combination. Following European settlement, livestock grazing, cropland conversion, elimination of fire, energy development, and other anthropogenic factors influenced species composition and abundance. Introduced and invasive species further impacted plant and animal communities. The bison was a historical keystone species but had been extirpated in this area as a free-ranging herbivore. The loss of the bison and reduction of prairie dog populations and fire as ecological drivers greatly influenced the character of the remaining native plant communities and altered wildlife habitats. Human development has reduced habitat quality for area-sensitive species.

Within MLRA 61, the Shallow Clayey ecological site provides upland grassland cover with an associated forb component. It was typically part of an expansive grassland landscape that included combinations of Clayey, Loamy, Stony Hills, Overflow, Subirrigated, and Terrace ecological sites.

This site provided habitat for species requiring unfragmented grassland. Important habitat features, and components found commonly or exclusively on this site may include sharp-tailed grouse leks; upland nesting habitat for grassland birds, forbs and insects for brood habitat; and a forage source for small and large herbivores. Many grassland and shrub steppe nesting bird populations are declining. Extirpated species include free-ranging American bison, grizzly bear, gray wolf, black-footed ferret, mountain plover, Rocky Mountain locust, and swift fox.

The majority of the Shallow Clayey ecological site has remained relatively intact and provides increasingly important habitat for grassland and shrub steppe nesting birds, small rodents, coyote, and a variety of reptiles, amphibians, and insects. Invasive species such as Kentucky bluegrass, smooth brome, and annual brome grasses have impacted the biological integrity of the site for some grassland birds. Changes in historic fire regime and domestic grazing have impacted the forb/shrub/grass percentages.

Grazing Interpretations:
The following list suggests annual, initial stocking rates for average growing conditions. These estimates are

conservative and should be used only as guidelines in the initial stages of conservation planning. Commonly, 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 estimates of carrying capacity 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. In consultation with the land manager, a more intensive grazing management program that results in improved harvest efficiencies and increased carrying capacity may be developed.

The following suggested initial stocking rates are based on 912 lb/acre (air-dry weight) per animal-unit-month (AUM) with a 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA-NRCS, National Range and Pasture Handbook). An AUM is defined as the equivalent amount of forage required by a 1,000-pound cow, with or without calf, for one month.

Plant Community: Rhizomatous Wheatgrass-Green Needlegrass-Little Bluestem (1.1)
Average Production (lb/acre, air-dry): 1,700
Stocking Rate (AUM/acre): 0.47

Plant Community: Rhizomatous Wheatgrass-Grama-Little Bluestem (1.2)
Average Production (lb/acre, air-dry): 1,400
Stocking Rate (AUM/acre): 0.38

Plant Community: Sedge/Blue Grama/Fringed Sagewort (2.1)
Average Production (lb/acre, air-dry): 1,100*
Stocking Rate (AUM/acre): 0.30*

Plant Community: Ponderosa Pine-Juniper/Green Needlegrass-Little Bluestem (4.1)
Average Production (lb/acre, air-dry): 1,300**
Stocking Rate (AUM/acre): 0.19**

Plant Community: All other plant communities identified in this document have variable annual production values and require onsite sampling to determine initial stocking rates.

* Total annual production and stocking rates are highly variable and require onsite sampling.

** Total onsite annual production 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 for livestock. During the dormant period, the forage for livestock likely have insufficient protein to meet livestock requirements. Added protein allows 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 shortgrass forms a strong sod and dominate the site. Dominance by blue grama, buffalograss, bluegrass, and smooth brome 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 the USDA-NRCS National Engineering Handbook, Part 630, for hydrologic soil groups, runoff quantities, and hydrologic curves.

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants that bloom from spring until fall have aesthetic value that are appealing to visitors.

Wood products

No appreciable wood products are typically present on this site.

Other products

Harvesting the seeds of native plants can provide additional income on this site.

Other information

Revision Notes: “Previously Approved” Provisional
This Provisional ecological site description (ESD) has passed Quality Control (QC) and Quality Assurance (QA) to ensure the it meets the 2014 NESH standards for a Provisional ecological site description.

This ESD is an updated “Previously Approved” ESD that represented 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 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 may not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but it is expected that it will continue refinement toward an “Approved” status.

Site Development and Testing Plan
Future work, as described in an official project plan, is necessary to validate the information in this provisional ecological site description. The plan will include field activities for low-, medium-, and high-intensity sampling, soil correlations, and analysis of the data. Annual field reviews should be done by soil scientists and vegetation specialists. Final field review, peer review, quality control, and quality assurance reviews are required to produce the final document.

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: Stan Boltz, Range Management Specialist, NRCS; Cynthia Englebert, Range Management Specialist, Forest Service; George Gamblin, Range Management Specialist, NRCS; Ryan Murray, Range Management Specialist, NRCS; Cheryl Nielsen, Range Management Specialist, NRCS; L. Michael Stirling, Range Management Specialist, NRCS; Jim Westerman, Soil Scientist, NRCS.

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Approval

Suzanne Mayne-Kinney, 7/17/2024

Acknowledgments

All ecological sites were written to the Provisional Level by Rick L. Peterson, ESS, Rapid City, SSO in FY20.

The ESDs were reviewed for quality control by Emily Helms, John Hartung, Mitch Faulkner, and Ryan Murray.

All ecological sites were then reviewed and approved at the Provisional Level by David Kraft, Regional ESS, Salina, KS in September 2020.

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	09/30/2009
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** If present, rills are short (roughly 6 inches long or less), sporadic, and discontinuous.

Typically on steeper slopes.

2. **Presence of water flow patterns:** None, or barely visible and discontinuous with numerous debris dams when present.

3. **Number and height of erosional pedestals or terracettes:** Few pedastalled plants typically on steeper slopes. Terracettes not present.

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

5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present.

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

7. **Amount of litter movement (describe size and distance expected to travel):** Small size litter classes will generally move short distances, some medium size class litter will move very short distances. Litter debris dams are occasionally present.

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.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface structure is typically granular, and mollic (higher organic matter) colors of A-horizon about 3 inches deep. If conditions are other than this, refer to map unit component descriptions for component on which the site occurs.

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- and warm-season grasses) with fine and coarse roots positively influences infiltration.

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 rhizomatous grasses) >

Sub-dominant: Mid and tall, cool-season bunchgrasses = mid, warm-season grasses >

Other: Short, warm-season grasses = forbs = shrubs > grass-likes species > trees

Additional: Other grasses occur in other functional groups 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):** 60 to 70 percent plant litter cover, roughly 0.25 to 0.5 inch depth. Litter cover is in contact with soil surface.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Ranges from 1,300 to 2,200 pounds/acre. Reference value is 1,700 pounds/acre (air-dry weight 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:** Refer to State and Local Noxious Weed List.

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17. **Perennial plant reproductive capability:** All species exhibit high vigor relative to climatic conditions. Do not rate based solely on seed production. Perennial grasses typically have vigorous rhizomes or tillers.
