USDA Natural Resources
Conservation Service

Ecological site R061XN012SD
Thin Upland-North (18-22" PZ)

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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.

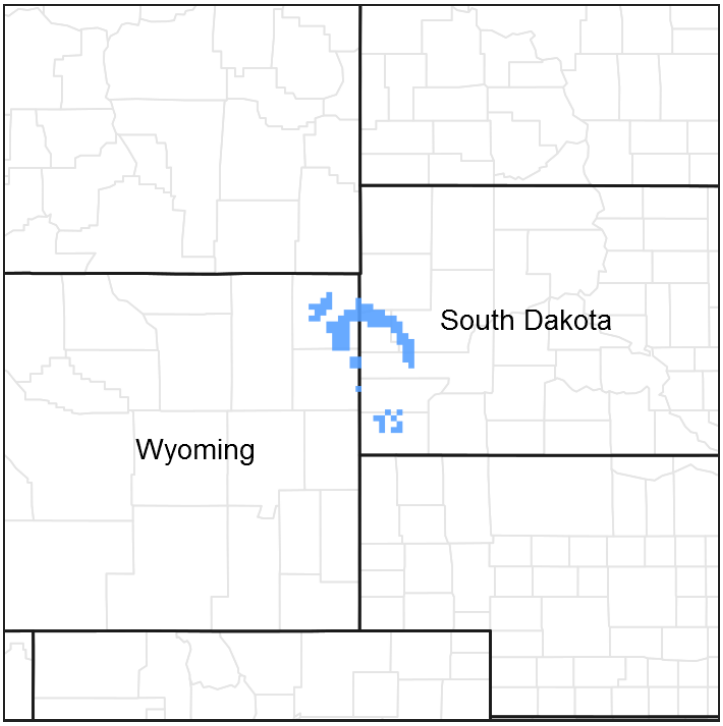


Figure 1. Mapped extent

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. The

towns of Spearfish, Sturgis, and Hot Springs, South Dakota, and Newcastle and Sundance, Wyoming, are all in 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 also in MLRA 61. Devils Tower was the 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 and dipped away from the core of the mountains. The Lower Cretaceous Fall River and Lakota (Inyan Kara Group) sandstones, which are on the outside edge of the area, are referred to as the Dakota Hogback. The next geologic formation is the Triassic-aged red beds of the Spearfish shale. It forms a low valley. This "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 flowing through MLRA 61. It passes through Hulett, Wyoming.

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

Average annual precipitation is 16 to 22 inches. The majority of rainfall occurs early in the growing season. Some high-intensity thunderstorms occur in 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 bluestem, 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 urban expansion, wind erosion, water erosion, and water quality.

MLRA 61 is 54 percent 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 of the MLRA 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 Thin Upland 18-22" PZ ecological site is found throughout the northern portion of MLRA 61. The soils correlated to the Thin Upland ecological site are entisols. They exhibit little to no soil development other than the presence of an identifiable “A” horizon. This site is located on upland landscapes and does not receive additional moisture from runoff or overflow. The typical slope range is from 5 to 30 percent. Soils are deep to very deep, exceeding 20 inches in depth. The surface textures range from loam to silt loam and are 4 to 8 inches thick. Subsurface textures range from very fine sandy loam to silt loam. These soils are calcareous at or within 6 inches of the surface.

In the Reference State (1.0) warm-season grasses are dominant and cool-season grasses are subdominant. The major grasses include little bluestem, needle and thread, sideoats grama, porcupine grass, and big bluestem. Forbs are common and diverse. Shrubs, such as leadplant, western snowberry, and rose are most always present. The Thin Upland 18-22” PZ site is susceptible to invasion of non-native cool-season grasses and encroachment of conifers from adjacent sites.

Associated sites

R061XN010SD	**Loamy-North (18-22" PZ)** The Loamy 18-22” PZ ecological site is found on near level to gently sloping uplands adjacent to the Thin Upland 18-22” PZ ecological site.
R061XN024SD	**Shallow Loamy-North (18-22" PZ)** The Shallow Loamy 18-22” PZ ecological site is found on steep slopes adjacent to the Thins Upland 18-22” PZ ecological site.
R061XY029SD	**Stony Hills** The Stony Hills ecological site is found on rocky slopes adjacent to the Thin Upland 18-22” PZ ecological site.

Similar sites

R061XY029SD	**Stony Hills** The Stony Hills ecological site will have more big bluestem and ponderosa pine, and higher vegetative production than the Thin Upland 18-22” PZ ecological site.
R061XN024SD	**Shallow Loamy-North (18-22" PZ)** The Shallow Loamy 18-22” PZ ecological site will have less little bluestem and lower vegetative production than the Thin Upland 18-22” PZ ecological site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Hesperostipa comata ssp. comata*

Physiographic features

The Thin Upland 18-22” PZ ecological site occurs on moderately steep to steeply sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Upland > Hogback (2) Upland > Hill (3) Upland > Plain
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	884–1,524 m
Slope	5–30%
Aspect	Aspect is not a significant factor

Climatic features

The climate in the Northern Land Resource Unit (LRU) of 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 18 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 46°F. January is the coldest month with average temperatures ranging from about 26°F (Fort Meade, SD) to about 30°F (Spearfish, SD). July is the warmest month with temperatures averaging from about 75°F (Spearfish, SD) to about 69°F (Fort Meade, SD). The range of average monthly temperatures between the coldest and warmest months is about 45°F. Hourly winds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring months to about 10 miles per hour during the summertime. Daytime winds are generally stronger than nighttime and occasional storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

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)	113-118 days
Freeze-free period (characteristic range)	136-148 days

Precipitation total (characteristic range)	508-559 mm
Frost-free period (actual range)	112-119 days
Freeze-free period (actual range)	134-153 days
Precipitation total (actual range)	483-559 mm
Frost-free period (average)	116 days
Freeze-free period (average)	143 days
Precipitation total (average)	533 mm

Climate stations used

- (1) BEAR RIDGE [USC00390554], Spearfish, SD
- (2) FT MEADE [USC00393069], Fort Meade, SD
- (3) RAPID CITY 4NW [USC00396947], Rapid City, SD
- (4) SPEARFISH [USC00397882], Spearfish, SD

Influencing water features

No riparian areas or wetland features are directly associated with the Thin Upland 18-22” PZ ecological site.

Wetland description

Not Applicable.

Soil features

Soils common to the Thin Upland ecological site are entisols and exhibit little to no soil development other than the presence of an identifiable “A” horizon. Common features of these soils are a 4 to 8-inch-thick loam to silt loam surface layer. The subsurface textures range from very fine sandy loam to silt loam. The typical slope range is 5 to 30 percent. The soils in this site are well drained and formed in residuum and colluvium. Carbonates will be present at or within 6 inches of the surface. The soils have a moderately-slow to slow infiltration rates. Subsurface soil layers are nonrestrictive to water movement and root penetration.

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 Thin Upland 18-22” PZ ecological site: Colby, Colnevee, Delridge, Gypnevee, Iwait, Nevee, Pesowyo, Ucross, and Ziggy.

If the carbonates are located below 6 inches the following soils are correlated to the Loamy 18-22” PZ ecological site: Nevee, Ucross, and Ziggy.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 10 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 production.

More information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more details specific to your area of interest or use the internet to access USDA’s Web Soil Survey.

Table 4. Representative soil features

Parent material	(1) Colluvium (2) Residuum
Surface texture	(1) Loam (2) Silt loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Slow to moderately slow
Soil depth	102–203 cm
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–15%
Available water capacity (0-101.6cm)	15.24–20.32 cm
Calcium carbonate equivalent (0-101.6cm)	5–40%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–1
Soil reaction (1:1 water) (0-101.6cm)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–30%
Subsurface fragment volume >3" (Depth not specified)	0–12%

Ecological dynamics

The Thin Upland 18-22” PZ ecological site developed under 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 will occur in the plant communities due to short-term weather variations, impacts of native and exotic plant and animal species, and management actions. While the following plant community descriptions 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 species composition.

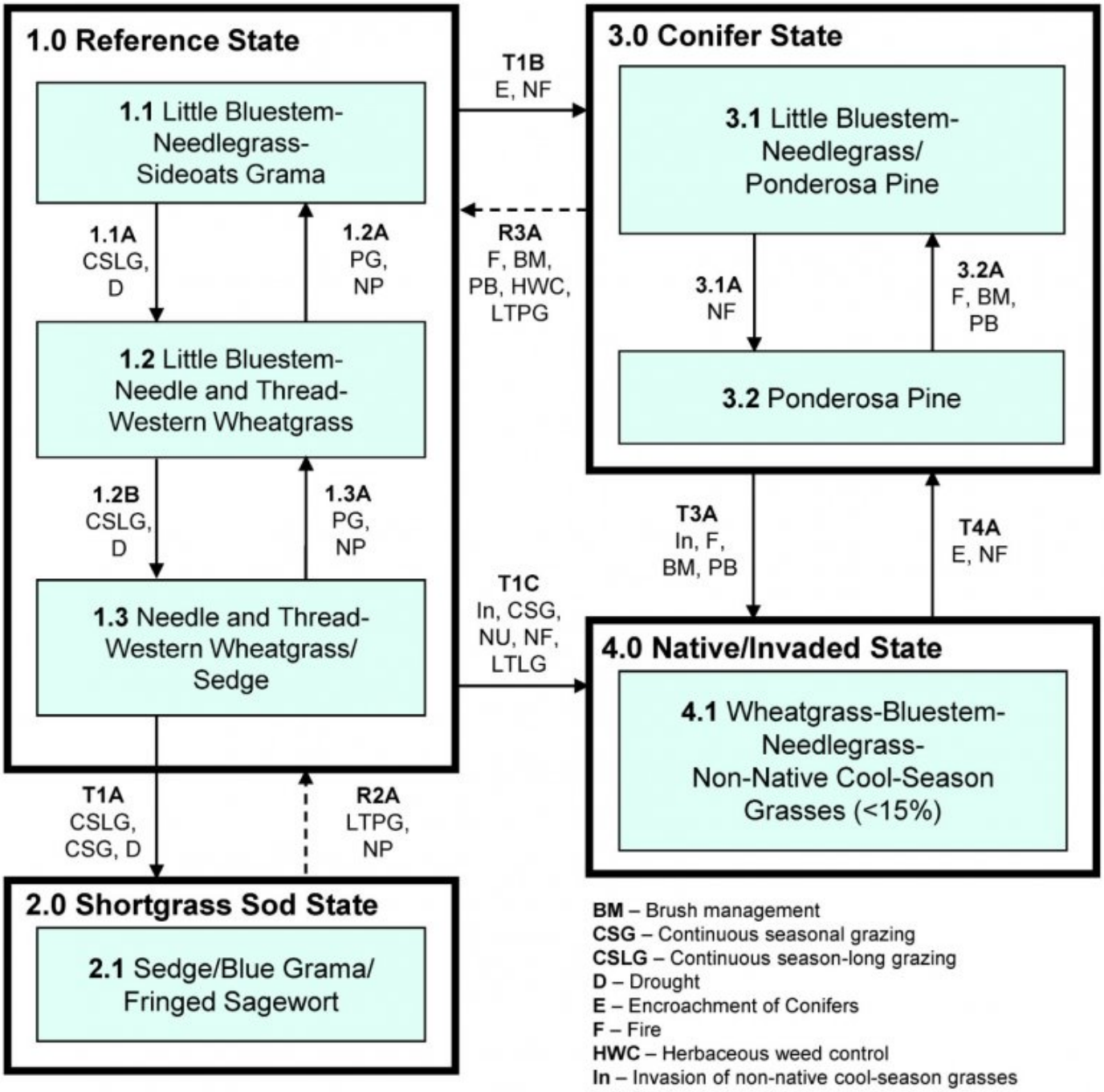
Continuous season-long grazing (e.g., grazing at moderate to heavy stocking levels for the full growing season each year) without adequate recovery periods following grazing events will causes a departure from the Little Bluestem-Needlegrass-Sideoats Grama Plant Community (1.1). Blue grama and sedges will increase and eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Needle and thread, green needlegrass, sideoats grama, big bluestem, and little bluestem will decrease in frequency and production. Excessive defoliation can cause threeawn and annuals to increase and dominate the site. Extended periods of non-use and lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as green needlegrass, western wheatgrass, Kentucky bluegrass, smooth bromegrass, and cheatgrass.

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

The following is a State-and-Transition diagram that illustrates the common plant communities that can occur on the site and the transition pathways between communities. The ecological processes will be discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Thin Upland 18-22" PZ – R061XN012SD 7/23/19



BM – Brush management
CSG – Continuous seasonal grazing
CSLG – Continuous season-long grazing
D – Drought
E – Encroachment of Conifers
F – Fire
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
- - - → Transition may not be fast or feasible

Diagram Legend: Thin Upland 18-22" PZ - R061XN012SD

T1A	1.0 to 2.0	Continuous season-long grazing; continuous seasonal grazing; or heavy grazing in combination with drought.
T1B	1.0 to 3.0	Encroachment of conifers and no fire.
T1C	1.0 to 4.0	Invasion of non-native cool-season grasses; continuous seasonal grazing (summer); long-term light grazing; or non-use and no fire.
T3A	3.0 to 4.0	Invasion of non-native cool-season grasses; fire, mechanical brush management, or prescribed burning to remove conifers.
T4A	4.0 to 3.0	Encroachment of conifers and no fire.

R2A	2.0 to 1.0	Long-term prescribed grazing with proper stocking rates, change in season of use, adequate time for recovery; a return to normal precipitation patterns following drought. This transition may not be fast or feasible.
R3A	3.0 to 1.0	Fire, mechanical brush management, or prescribed burning to remove conifer encroachment; possibly herbaceous weed control; followed by 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; and a return to normal precipitation patterns.
1.2B	1.2 to 1.3	Continuous season-long grazing; or heavy grazing in combination with drought.
1.3A	1.3 to 1.2	Prescribed grazing with proper stocking, change in season of use, adequate time for recovery; and a return to normal precipitation patterns.
3.1A	3.1 to 3.2	No fire; no brush management activity.
3.2A	3.2 to 3.1	Fire; mechanical brush management; or prescribed burning to remove conifers .

State 1
Reference State

The Reference State represents what is believed to show the natural range of variability that dominated the dynamics of the ecological site prior to European settlement. This site in the Reference State (1.0) is dominated by warm-season grasses, with cool-season grasses being subdominant. In pre-European times the primary disturbance mechanisms 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. Taller cool- and warm-season grasses would have declined and a corresponding increase in short statured grass 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 very susceptible to invasion of non-native cool-season grasses and the encroachment of conifers from adjacent sites.

Community 1.1
Little Bluestem-Needlegrass-Sideoats Grama

IInterpretations are based primarily on the Little Bluestem-Needlegrass-Sideoats Grama Plant Community, which is also considered to be the Reference Plant Community (1.1). 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 warm-season grasses with cool-season grasses being subdominant. The major grasses include little bluestem, needle and thread, sideoats grama, porcupine grass, and big bluestem. Other grasses include western wheatgrass, plains muhly, slender wheatgrass, green needlegrass, prairie dropseed, prairie sandreed, blue grama, and a variety of other grass and grass-like species. Forbs are common and diverse, leadplant, western snowberry, and rose are common shrubs. 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 soil and site 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	1536	2273	2998
Shrub/Vine	129	202	280
Forb	129	202	280
Tree	–	13	28
Total	**1794**	**2690**	**3586**

Figure 9. 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		

Community 1.2
Little Bluestem-Needle and Thread-Western Wheatgrass

This plant community developed under continuous season-long grazing (grazing at moderate to heavy stocking levels for the full growing season each year) 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, and 10 percent shrubs and trees. Dominant grasses include little bluestem, needle and thread, and western wheatgrass. Grasses and grass-likes species of secondary importance include sideoats grama, porcupine grass, big bluestem, threadleaf sedge, and blue grama. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), goldenrod, white prairie aster, and scurfpea. When compared to the Little Bluestem-Needlegrass-Sideoats Grama Community (1.1), blue grama, sedge, and western wheatgrass have increased, and tall warm-season grasses have decreased. Herbaceous production has also been reduced. Needle and thread will persist in this plant community. This plant community is moderately resistant to change. 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.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1356	1894	2427
Shrub/Vine	106	168	230
Forb	106	168	230
Tree	–	11	28
Total	**1568**	**2241**	**2915**

Figure 11. Plant community growth curve (percent production by month). SD6103, Black Hills Foot Slopes, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

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

Community 1.3
Needle and Thread-Western Wheatgrass/Sedge

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, and 10 percent shrubs and trees. Dominant grass and grass-like species include needle and thread, western wheatgrass, threadleaf sedge, and blue grama. Grasses of secondary importance include little bluestem, hairy grama, sideoats grama, big bluestem, and green needlegrass. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), goldenrod, white prairie aster, scurfpea, and green sagewort. When compared to the Little Bluestem-Needlegrass-Sideoats Grama Plant Community (1.1), blue grama, sedge, and western wheatgrass have increased and tall and mid-warm-season grasses have decreased. Herbaceous production has also declined. 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 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 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1177	1515	1849
Shrub/Vine	84	135	185
Forb	84	135	185
Tree	–	9	22
Total	**1345**	**1794**	**2241**

Figure 13. 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 Reference Plant Community (1.1) to the Little Bluestem-Needle and Thread-Western

Wheatgrass 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) or periodic light to moderate grazing possibly including periodic rest, or a return to normal precipitation patterns following drought will convert the Little Bluestem-Needle and Thread-Western Wheatgrass Plant Community (1.2) to the Little Bluestem-Needlegrass-Sideoats Grama Plant Community (1.1).

Conservation practices

Prescribed Grazing

Pathway 1.2B
Community 1.2 to 1.3

Continuous season-long grazing (stocking levels above carrying capacity for extended portions of the growing season) or heavy grazing in combination with drought will shift the Little Bluestem-Needle and Thread-Western Wheatgrass Plant Community (1.2) to the Needle and Thread-Western Wheatgrass/Sedge Plant Community (1.3).

Pathway 1.3A
Community 1.3 to 1.2

Prescribed grazing (proper stocking, alternating season of use, and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest; or a return to normal precipitation patterns following drought will convert the Needle and Thread-Western Wheatgrass/Sedge Plant Community (1.3) to the Little Bluestem-Needle and Thread-Western Wheatgrass Plant Community (1.2).

Conservation practices

Prescribed Grazing

State 2
Shortgrass Sod State

This state is a result of long-term continuous season-long grazing (grazing at moderate to heavy stocking levels for the full growing season each year) or long-term continuous seasonal grazing (grazing at moderate to heavy stocking levels at the same time of year each year), without adequate recovery periods following each grazing occurrence. 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, mid- and tall 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 (grazing at moderate to heavy stocking levels at the same time of year each year) without adequate recovery periods following each grazing occurrence; continuous season-long grazing (grazing at moderate to heavy stocking levels for the full growing season each year); or from over utilization during extended drought periods. The potential plant community is made up of approximately 70 percent grasses and grass-like species, 15 percent forbs, and 15 percent shrubs and trees. Dominant grass and grass-like species include threadleaf sedge, blue grama, and threeawn. Grasses of secondary importance include western wheatgrass, needle and thread, little bluestem, sideoats grama, hairy grama, and prairie Junegrass. Cheatgrass may also invade and become quite prevalent. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), goldenrod, spiny phlox, and green sagewort. When compared to the Little Bluestem-Needlegrass-Sideoats Grama Community Phase (1.1), short statured species are dominant on this plant community. Tall and mid-grasses have decreased significantly. This plant community is very resistant to change due to the increase in the root mat near the surface of the soil which further reduces water infiltration. The herbaceous species present are well adapted to grazing. This plant community is less productive than other plant communities. 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 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	773	1069	1362
Shrub/Vine	62	135	207
Forb	62	135	207
Tree	–	7	17
Total	**897**	**1346**	**1793**

Figure 15. Plant community growth curve (percent production by month). SD6103, Black Hills Foot Slopes, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

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

State 3
Conifer State

This 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 conifer trees at an immature stage. This state is reached when mature tree canopy cover reaches approximately 25 percent or more. Tree canopy typically is dominated by ponderosa pine, but bur oak, and Rocky Mountain juniper may also be present in varying amounts.

Community 3.1
Little Bluestem-Needlegrass/Ponderosa Pine

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 Rocky Mountain juniper can also occur. These species expand on this site due to suppression of fire. The tree canopy is 25 percent or greater. The potential plant community is made up of approximately 45 percent grasses and grass-like species, 10 percent forbs, 10 percent shrubs, and 35 percent trees. Dominant grass and grass-like species include little bluestem, needle and thread, green needlegrass, sideoats grama, western wheatgrass, and threadleaf 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 white sagebrush (cudweed sagewort), goldenrod, and western yarrow. Non-native species such as Kentucky bluegrass, smooth brome, and annual brome grasses will tend to invade. Compared to the Little Bluestem-Needlegrass-Sideoats Grama 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. The total annual production of the understory can range from nearly non-existent under a closed canopy to about 700 pounds per acre (air-dry weight) under a medium canopy.

Figure 16. 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 3.2
Ponderosa Pine

This plant community developed with long-term fire suppression; over time the tree canopy will become closed. Once the tree canopy reaches 45 percent or higher, competition will slow the growth rate of 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 fire that has enough energy to cause crowning of the trees. This plant community will also be accompanied by a relatively thick layer of acidic duff from the pine needles which will further reduce the establishment of herbaceous species.

Pathway 2.1A
Community 3.1 to 3.2

No fire or no brush treatment for an extended period of time will cause the tree canopy to continue to increase and shift the Little Bluestem-Needlegrass/Ponderosa Pine Plant Community (3.1) to the Ponderosa Pine Plant Community (3.2).

Pathway 2.2A
Community 3.2 to 3.1

Fire, brush management, and 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 to the Little Bluestem-Needle and Thread/Ponderosa Pine-Juniper Plant Community (3.1).

Conservation practices

Brush Management
Prescribed Burning

State 4
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 would appear to be properly managed with grazing and possibly prescribed burning. Extended periods of non-use and no fire, or long-term light grazing can result in the invasion and establishment of non-native cool-season grasses onto this site. 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, smooth brome, Kentucky bluegrass, timothy, cheatgrass, and field brome.

Community 4.1
Wheatgrass-Bluestem-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 site's 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 bromegrass, 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 17. 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 T1A
State 1 to 2

Continuous season-long grazing (stocking levels above carrying capacity for extended portions of the growing season); or continuous seasonal grazing (spring or fall); or 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 Needle and Thread-Western Wheatgrass/Sedge Plant Community (1.3).

Transition T1B
State 1 to 3

Encroachment or natural 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 (3.0). This threshold will be crossed when tree canopy reaches approximately 25 percent or more of mature trees.

Transition T1C
State 1 to 4

Continuous seasonal grazing (summer); long-term light grazing; or no use and no fire; and the invasion of non-native cool-season grasses will transition the Reference State (1.0) to the Native/Invaded State (4.0).

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

Restoration pathway R3A
State 3 to 1

Prescribed burning or mechanical brush management in conjunction with long-term prescribed grazing may lead this plant community across a threshold back to the Reference State (1.0). This would have to take place before the trees reach maturity and are still susceptible to fire, and reproductive propagules of the perennial grasses that are still present. After trees reach maturity, a stand replacing fire or brush management would be needed to move this plant community over the threshold back to the Reference State (1.0). Herbaceous weed control may also be needed for treatment of weedy species following fire.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing
Herbaceous Weed Control

Transition T3A
State 3 to 4

The removal of conifers through fire, mechanical brush management, or prescribed burning, and the invasion of non-native cool-season grasses will transition the Conifer State (3.0) to the Native/Invaded State (4.0).

Conservation practices

Brush Management
Prescribed Burning

Transition T4A
State 4 to 3

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 (3.0). This threshold will be crossed when tree canopy cover 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 (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid- Warm-Season Grasses**			673–1076	
	little bluestem	SCSC	*Schizachyrium scoparium*	404–1076	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	135–404	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	27–215	–
2	**Cool-Season Bunchgrass**			269–673	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	135–538	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	54–404	–
	green needlegrass	NAVI4	*Nassella viridula*	27–135	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–135	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–135	–
3	**Tall Warm-Season Grasses**			135–404	
	big bluestem	ANGE	*Andropogon gerardii*	135–404	–

	big bluestem	ANGE	*Andropogon gerardii*	135–404	
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–168	–
4	**Rhizomatous Wheatgrass**			135–269	
	western wheatgrass	PASM	*Pascopyrum smithii*	135–269	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–135	–
5	**Short Warm-Season Grasses**			27–135	
	blue grama	BOGR2	*Bouteloua gracilis*	27–135	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–81	–
	threeawn	ARIST	*Aristida*	0–27	–
6	**Other Native Grasses**			27–135	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–108	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	27–81	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–54	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–27	–
7	**Grass-likes**			27–135	
	threadleaf sedge	CAFI	*Carex filifolia*	27–135	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–81	–
8	**Non-Native Cool-Season Grasses**			–	
Forb					
9	**Forbs**			135–269	
	upright prairie coneflower	RACO3	*Ratibida columnifera*	27–81	–
	Forb, native	2FN	*Forb, native*	27–81	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	27–54	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	27–54	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	27–54	–
	beardtongue	PENST	*Penstemon*	27–54	–
	prairie clover	DALEA	*Dalea*	27–54	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	27–54	–
	scurfpea	PSORA2	*Psoralidium*	27–54	–
	goldenrod	SOLID	*Solidago*	27–54	–
	American vetch	VIAM	*Vicia americana*	27–54	–

	nineanther prairie clover	DAEN	*Dalea enneandra*	0–54	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	27–54	–
	dotted blazing star	LIPU	*Liatris punctata*	27–54	–
	downy Indian paintbrush	CAPU11	*Castilleja purpurea*	0–27	–
	field sagewort	ARCA12	*Artemisia campestris*	0–27	–
	groundplum milkvetch	ASCR2	*Astragalus crassicarpus*	0–27	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–27	–
	spiny phlox	PHHO	*Phlox hoodii*	0–27	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–27	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	0–27	–
	pussytoes	ANTEN	*Antennaria*	0–27	–
Shrub/Vine					
10	**Shrubs**			135–269	
	leadplant	AMCA6	*Amorpha canescens*	27–108	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	27–81	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–81	–
	rose	ROSA5	*Rosa*	27–54	–
	prairie sagewort	ARFR4	*Artemisia frigida*	27–54	–
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	0–27	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–27	–
	pricklypear	OPUNT	*Opuntia*	0–27	–
	elderberry	SAMBU	*Sambucus*	0–27	–
Tree					
11	**Trees**			0–27	
	bur oak	QUMA2	*Quercus macrocarpa*	0–27	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–27	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–27	–
	Tree	2TREE	*Tree*	0–27	–

Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid- Warm-Season Grasses**			336–673	
	little bluestem	SCSC	*Schizachyrium scoparium*	224–673	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	45–224	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–67	–
2	**Cool-Season Bunchgrass**			224–560	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	224–560	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–179	–
	green needlegrass	NAVI4	*Nassella viridula*	0–90	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–67	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–22	–
3	**Tall Warm-Season Grasses**			22–224	
	big bluestem	ANGE	*Andropogon gerardii*	22–179	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–140	–
4	**Rhizomatous Wheatgrass**			112–336	
	western wheatgrass	PASM	*Pascopyrum smithii*	112–336	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–67	–
5	**Short Warm-Season Grasses**			22–224	
	blue grama	BOGR2	*Bouteloua gracilis*	22–179	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–112	–
	threeawn	ARIST	*Aristida*	0–45	–
6	**Other Native Grasses**			22–112	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–67	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	22–67	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
7	**Grass-likes**			22–179	
	threadleaf sedge	CAFI	*Carex filifolia*	22–179	–

	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–67	–
8	**Non-Native Cool-Season Grasses**			–	
Forb					
9	**Forbs**			112–224	
	goldenrod	SOLID	*Solidago*	22–67	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	22–67	–
	scurfpea	PSORA2	*Psoralidium*	22–67	–
	Forb, native	2FN	*Forb, native*	22–67	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	22–45	–
	prairie clover	DALEA	*Dalea*	0–45	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–45	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	22–45	–
	field sagewort	ARCA12	*Artemisia campestris*	0–45	–
	groundplum milkvetch	ASCR2	*Astragalus crassicarpus*	0–22	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–22	–
	beardtongue	PENST	*Penstemon*	0–22	–
	American vetch	VIAM	*Vicia americana*	0–22	–
	nineanther prairie clover	DAEN	*Dalea enneandra*	0–22	–
	pussytoes	ANTEN	*Antennaria*	0–22	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–22	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–22	–
	dotted blazing star	LIPU	*Liatris punctata*	0–22	–
	spiny phlox	PHHO	*Phlox hoodii*	0–22	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–22	–
	downy Indian paintbrush	CAPU11	*Castilleja purpurea*	–	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	–	–
Shrub/Vine					
10	**Shrubs**			112–224	

	western snowberry	SYOC	*Symphoricarpos occidentalis*	22–90	–
	prairie sagewort	ARFR4	*Artemisia frigida*	22–67	–
	leadplant	AMCA6	*Amorpha canescens*	0–45	–
	rose	ROSA5	*Rosa*	22–45	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–45	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–22	–
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	0–22	–
	pricklypear	OPUNT	*Opuntia*	0–22	–
Tree					
11	**Trees**			0–22	
	bur oak	QUMA2	*Quercus macrocarpa*	0–22	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–22	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–22	–
	Tree	2TREE	*Tree*	0–22	–

Table 11. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid- Warm-Season Grasses**			36–179	
	little bluestem	SCSC	*Schizachyrium scoparium*	18–179	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	18–126	–
2	**Cool-Season Bunchgrass**			269–538	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	269–538	–
	green needlegrass	NAVI4	*Nassella viridula*	0–72	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–54	–
3	**Tall Warm-Season Grasses**			0–90	
	big bluestem	ANGE	*Andropogon gerardii*	0–90	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–54	–
4	**Rhizomatous Wheatgrass**			179–359	
	western wheatgrass	PASM	*Pascopyrum smithii*	179–359	–

	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–179	–
5	**Short Warm-Season Grasses**			90–269	
	blue grama	BOGR2	*Bouteloua gracilis*	36–215	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–126	–
	threeawn	ARIST	*Aristida*	0–54	–
6	**Other Native Grasses**			18–90	
	prairie Junegrass	KOMA	*Koeleria macrantha*	18–72	–
	Grass, perennial	2GP	*Grass, perennial*	0–72	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–36	–
7	**Grass-likes**			90–269	
	threadleaf sedge	CAFI	*Carex filifolia*	90–269	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–90	–
8	**Non-Native Cool-Season Grasses**			–	
Forb					
9	**Forbs**			90–179	
	goldenrod	SOLID	*Solidago*	18–72	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	18–72	–
	scurfpea	PSORA2	*Psoralidium*	18–54	–
	spiny phlox	PHHO	*Phlox hoodii*	18–36	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	18–36	–
	Forb, native	2FN	*Forb, native*	0–36	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–36	–
	field sagewort	ARCA12	*Artemisia campestris*	18–36	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–18	–
	prairie clover	DALEA	*Dalea*	0–18	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–18	–
	pussytoes	ANTEN	*Antennaria*	0–18	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–18	–
	dotted blazing star	LIPU	*Liatris punctata*	0–18	–

	American vetch	VIAM	*Vicia americana*	0–18	–
Shrub/Vine					
10	**Shrubs**			90–179	
	prairie sagewort	ARFR4	*Artemisia frigida*	18–90	–
	rose	ROSA5	*Rosa*	0–54	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	18–54	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–54	–
	pricklypear	OPUNT	*Opuntia*	0–36	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–18	–
Tree					
11	**Trees**			0–18	
	bur oak	QUMA2	*Quercus macrocarpa*	0–18	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–18	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–18	–
	Tree	2TREE	*Tree*	0–18	–

Table 12. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid- Warm-Season Grasses**			0–67	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–54	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–40	–
2	**Cool-Season Bunchgrass**			0–135	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–135	–
3	**Tall Warm-Season Grasses**			0–13	
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–13	–
4	**Rhizomatous Wheatgrass**			0–135	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–135	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–54	–
5	**Short Warm-Season Grasses**			135–404	

	blue grama	BOGR2	*Bouteloua gracilis*	135–404	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–135	–
	threeawn	ARIST	*Aristida*	0–67	–
6	**Other Native Grasses**			13–67	
	prairie Junegrass	KOMA	*Koeleria macrantha*	13–40	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–40	–
	Grass, perennial	2GP	*Grass, perennial*	0–40	–
7	**Grass-Likes**			135–404	
	threadleaf sedge	CAFI	*Carex filifolia*	135–404	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–108	–
8	**Non-Native Cool-Season Grasses**			0–135	
	cheatgrass	BRTE	*Bromus tectorum*	0–94	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–67	–
	smooth brome	BRIN2	*Bromus inermis*	0–27	–
	field brome	BRAR5	*Bromus arvensis*	0–27	–
Forb					
9	**Forbs**			67–202	
	Forb, introduced	2FI	*Forb, introduced*	13–94	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	13–67	–
	goldenrod	SOLID	*Solidago*	13–67	–
	field sagewort	ARCA12	*Artemisia campestris*	13–54	–
	scurfpea	PSORA2	*Psoralidium*	13–40	–
	spiny phlox	PHHO	*Phlox hoodii*	13–27	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–27	–
	Forb, native	2FN	*Forb, native*	0–27	–
	pussytoes	ANTEN	*Antennaria*	0–27	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–13	–
Shrub/Vine					
10	**Shrubs**			67–202	
	prairie sagewort	ARFR4	*Artemisia frigida*	27–135	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	13–94	–

	pricklypear	OPUNT	*Opuntia*	0–54	–
	rose	ROSA5	*Rosa*	0–40	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–27	–
Tree					
11	**Trees**			0–13	
	bur oak	QUMA2	*Quercus macrocarpa*	0–13	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–13	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–13	–
	Tree	2TREE	*Tree*	0–13	–

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 Thin Upland 18-22” PZ 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 Thin Upland 18-22” PZ 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 provides annual suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Therefore, a resource inventory is necessary to document plant composition and production. More accurate carrying capacity estimates should eventually be calculated, using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

The following initial suggested 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 (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: Little Bluestem-Needlegrass-Sideoats Grama (1.1)
Average Production (lbs./acre, air-dry): 2,400
Stocking Rate (AUM/acre): 0.66

Plant Community: Little Bluestem-Needle and Thread-Western Wheatgrass (1.2)
Average Production (lbs./acre, air-dry): 2,000
Stocking Rate (AUM/acre): 0.55

Plant Community: Needle and Thread-Western Wheatgrass/Sedge (1.3)
Average Production (lbs./acre, air-dry): 1,600

Stocking Rate (AUM/acre): 0.44

Plant Community: Sedge/Blue Grama/Fringed Sagewort (2.1)
Average Production (lbs./acre, air-dry): 1,200*
Stocking Rate (AUM/acre): 0.33*

Plant Community: Little Bluestem-Needlegrass/Ponderosa Pine (3.1)
Average Production (lbs./acre, air-dry): 700**
Stocking Rate (AUM/acre): 0.19**

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

* Total annual production and stocking rates are highly variable and will require on-site sampling.

** Total annual production on-site may contain vegetation deemed undesirable or untargeted by the grazing animal. Therefore, annual production and 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 will likely be lacking protein to meet livestock requirements and added protein will allow ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic groups B. Infiltration and runoff potential for this site varies from moderate to high depending on soil hydrologic group, slope, and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Dominance by blue grama, buffalograss, bluegrass, or 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 for hydrologic soil groups, runoff quantities, and hydrologic curves, Part 630.)

Recreational uses

This site provides hunting, hiking, photography, bird watching and other opportunities. The wide variety 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

Harvesting the seeds of native plants 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 description. This is an updated “Previously Approved” ESD that 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.

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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Contributors

Stan C. Boltz
Rick L. Peterson

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.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an

assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	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:** Rills not typically present. If present, very short (usually less than 6 inches long), sporadic, and discontinuous.

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

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3. **Number and height of erosional pedestals or terracettes:** Few pedastalled plants typically on steeper slopes, roots not exposed. Terracettes typically non-existent.

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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 less than 10 percent and patches less than 2 inches in diameter.

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

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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.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate stability ratings should typically be 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):** Soil surface structure is typically granular, sometimes platy parting to granular, and mollic (higher organic matter) colors of A-horizon about 4 to 5 inches deep. If conditions are other than this, refer to map unit component descriptions for component on which the site occurs.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Healthy, deep rooted native grasses enhance infiltration and reduce runoff.

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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):** No compaction layer should be evident.

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

    Dominant: Mid, warm-season grasses >

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

    Other: Wheatgrasses (mid, cool-season) = forbs = shrubs > short, warm-season grasses =

grass-like species

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 to no 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):** 75 to 85 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 1,600 to 3,200 pounds/acre. Reference value is 2,400 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.
