USDA Natural Resources
Conservation Service

Ecological site R053CY012SD
Thin Upland

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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.

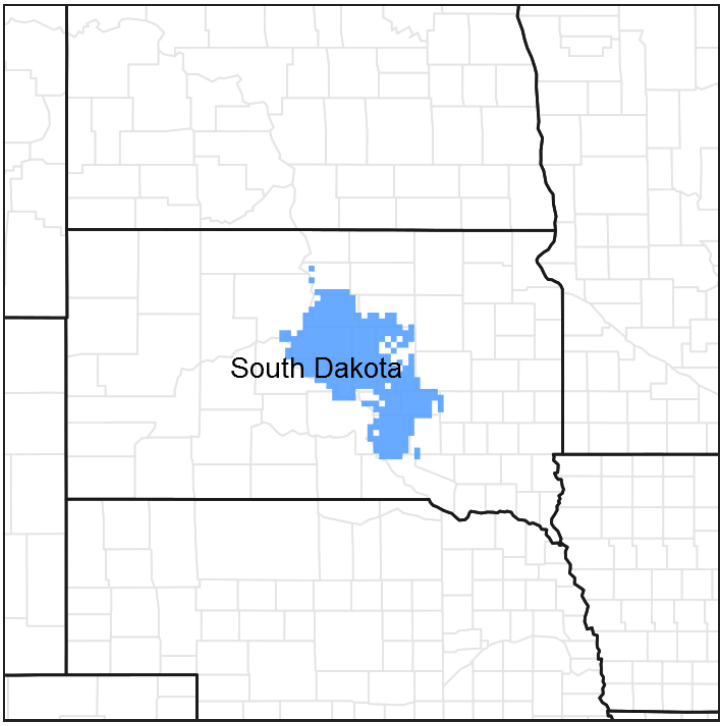

Figure 1. Mapped extent

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): 053C–Southern Dark Brown Glaciated Plains

The Southern Dark Brown Glaciated Plains (53C) is located within the Northern Great Plains Region. It is entirely in South Dakota encompassing about 3,990 square miles

(Figure 1). The elevation ranges from 1,300 to 2,300 feet. The MLRA is level to gently rolling till plains including many areas of potholes. A terminal moraine occurs in the southern end of the MLRA. Moderately steep and steep slopes are adjacent to the major valleys. The headwaters of many creeks in central South Dakota occur in the high-lying MLRA. (USDA-NRCS 2006).

The dominant soil orders in this MLRA are Mollisols and Inceptisols. The soils in the area dominantly have a mesic soil temperature regime, an ustic soil moisture regime, and mixed or smectitic mineralogy. They generally are very deep, well drained, or moderately well drained, and are loamy or clayey. This area supports natural prairie vegetation characterized by western wheatgrass (Pascopyrum smithii), big bluestem (Andropogon gerardii), needleandthread (*Hesperostipa comata*), and green needlegrass (Nassella viridula). Little bluestem (Schizachyrium scoparium), sideoats grama (Bouteloua curtipendula), and prairie sandreed (*Calamovilfa longifolia*) are important species on steeper sites. Western snowberry (Symphoricarpos occidentalis) and prairie rose (Rosa arkansana) are commonly dispersed throughout the area. (USDA-NRCS 2006).

Classification relationships

Major Land Resource Area (MLRA): Southern Dark Brown Glaciated Plains (53C) (USDA-NRCS 2006)

USFS Subregions: Northeastern Glaciated Plains Section (331E); Missouri Coteau Subsection (331Ea); Western Great Plains Section (331F); Missouri Breaks Subsection (331Fe); Western Glaciated Plains Section (332B); Southern Missouri Coteau Slope Subsection (332Bd, 332Be); North Central Great Plains Section (332D); Southern Missouri Coteau Slope Subsection (332Dd); Southern Missouri Coteau Subsection (332De) - (Cleland et al. 2007).

US EPA Level IV Ecoregion: Missouri Coteau (42a); Southern Missouri Coteau (42e); Southern Missouri Coteau Slope (42f) - (USEPA 2013)

Ecological site concept

The Thin Upland ecological site occurs on the shoulder slopes in the upland areas. Soils are well drained and will effervesce with acid at or near the surface. Precipitation tends to runoff, leaving less soil moisture for plant growth, production is lower, and species composition will tend towards more drought tolerant. In some areas the surface layer may consist of stony to extremely stony. Slopes can range from 0 to 40 percent.

Vegetation in the Reference State includes bluestems and needlegrasses. Forbs include cudweed sagewort, prairie coneflower, and western yarrow. Non-native grasses such as Kentucky bluegrass, smooth brome and invasive woody species such as Eastern red cedar may invade the site due to changes in disturbance regime.

Associated sites

R053CY010SD	**Loamy** These sites occur on upland areas. The soils are well drained and have less than 40 percent clay in the surface and subsoil. The central concept soil series is Agar, Glenham, and Highmore, but other series are included.
R053CY011SD	**Clayey** These sites occur on upland areas. The soils are well drained and have greater than 40 percent clay in the surface and subsoil. The central concept soil series is Peno and Raber, but other series are included.
R053CY020SD	**Loamy Overflow** These sites occur in upland swales. The Soils are moderately well drained, which have water flow into and over or through the site. The central concept soil series are Mobridge, Onita, and Prosper but other series are included.

Similar sites

R053CY010SD	**Loamy** The Loamy site occurs in a backslope landscape position and do not effervesce with acid at or near the surface. It also has less little bluestem and higher vegetative production.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Schizachyrium scoparium*

Physiographic features

This site occurs on slightly sloping to steeply sloping uplands.

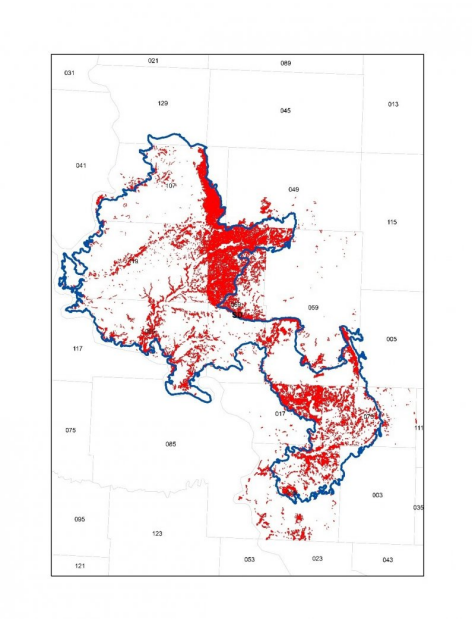

Figure 2. Distribution map

Table 2. Representative physiographic features

Landforms	(1) Escarpment (2) Ridge (3) Moraine
Flooding frequency	None
Ponding frequency	None
Elevation	1,300–2,300 ft
Slope	5–33%
Water table depth	80 in
Aspect	Aspect is not a significant factor

Climatic features

MLRA 53C is considered to have a continental climate – cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the Northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation typically ranges from 15 to 25 inches per year. The average annual temperature is about 45°F. January is the coldest month with average temperatures ranging from about 15°F (Stephan, South Dakota (SD)), to about 16°F (Onida 4 NW, SD). July is the warmest month with temperatures averaging from about 72°F (Stephan, SD), to about 74°F (Onida 4 NW, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 58°F. This large annual range attests to the continental nature of this area's climate. Hourly winds are estimated to average about

12 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 11 mph during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 mph.

Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and continue to early or mid-September. Greenup 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)	107-127 days
Freeze-free period (characteristic range)	128-150 days
Precipitation total (characteristic range)	20-21 in
Frost-free period (actual range)	104-129 days
Freeze-free period (actual range)	127-159 days
Precipitation total (actual range)	19-24 in
Frost-free period (average)	117 days
Freeze-free period (average)	139 days
Precipitation total (average)	21 in

Climate stations used

- (1) GETTYSBURG 13W [USC00393302], Gettysburg, SD
- (2) GETTYSBURG [USC00393294], Gettysburg, SD
- (3) HIGHMORE 23 N [USC00393838], Highmore, SD
- (4) ONIDA 4 NW [USC00396292], Onida, SD
- (5) PIERRE RGNL AP [USW00024025], Pierre, SD
- (6) HARROLD 12 SSW [USC00393608], Pierre, SD
- (7) STEPHAN 2 NW [USC00397992], Highmore, SD
- (8) WESSINGTON SPRINGS [USC00399070], Wessington Springs, SD

Influencing water features

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

Soil features

The Thin Upland site occurs on the shoulder slopes in the upland areas. Soils are well drained and will effervesce with acid at or near the surface. In some areas the surface

layer may consist of stony to extremely stony. The central concept soil series is Betts, Ethan, and Java, but other series are included. The surface layer is 3 to 11 inches thick. The texture of the subsurface layers ranges from loam to silty clay loam. The soils have a slow to very slow infiltration rate. These soils are typically calcareous at or near the surface. This site should show slight to no evidence of rills, wind scoured areas or pedestalled plants. Water flow paths are broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers. The soil surface is stable and intact.

These soils are susceptible to wind and water erosion. The hazard of water erosion increases on slopes greater than about 15 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.

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

Table 4. Representative soil features

Surface texture	(1) Loam (2) Clay loam (3) Clay
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow to slow
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–2%
Available water capacity (0-40in)	6–7 in
Calcium carbonate equivalent (0-40in)	0–30%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0–4
Soil reaction (1:1 water) (0-40in)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–9%
Subsurface fragment volume >3" (Depth not specified)	0–27%

Ecological dynamics

The site which is located in the Southern Dark Brown Glaciated Plains Region developed under Northern Great Plains climatic conditions and included natural influence of large herding herbivores and occasional fire. Changes will occur in the plant communities due to weather fluctuations and/or management actions. Under adverse impacts, a relatively rapid decline in vegetative vigor and composition can occur. Under favorable conditions the site has the potential to resemble the Reference State. Interpretations for this site are based primarily on the 1.1 Little Bluestem-Porcupine Grass Plant Community Phase. This community phase and the Reference State have 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 considered. Due to a general invasion of exotic species (such as Kentucky bluegrass (*Poa pratensis*) and smooth bromegrass (*Bromus inermis*)) across the MLRA within this site, returning to the 1.1 Little Bluestem-Porcupine Grass Plant Community Phase may not be possible.

This ecological site (ES) has been grazed by domestic livestock since they have been introduced into the area. The introduction of domestic livestock and the use of fencing and reliable water sources have changed the ecological dynamics of this site. Continuous season-long grazing (during the typical growing season of May through October) and/or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following grazing events causes departure from the 3.1 Little Bluestem-Sidoats Grama-Porcupine Grass Plant Community Phase. Blue grama will eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Green needlegrass, needleandthread, porcupine grass, sideoats grama, big bluestem, and little bluestem will decrease in frequency and production. Extended periods of nonuse and/or lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as Kentucky bluegrass, smooth bromegrass, and cheatgrass (*Bromus tectorum*). Extended periods of no surface fire could result in the invasion of conifers in which eastern red cedar (*Juniperus virginiana*) and Rocky Mountain juniper (*Juniperus scopulorum*) will increase and could eventually dominate the site.

Following the state and transition diagram are narratives for each of the described states and community phases. These may not represent every possibility, but they are the most prevalent and repeatable states/community phases. The plant composition tables shown below have been developed from the best available knowledge at the time of this revision. As more data are collected, some of these community phases and/or states may be revised or removed, and new ones may be added. The main purpose for including the descriptions here is to capture the current knowledge and experience at the time of this revision.

The following is a diagram that illustrates the common plant community phases that can

occur on the site and the transition and community pathways between them. The ecological processes will be discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Thin Upland – R053CY012SD

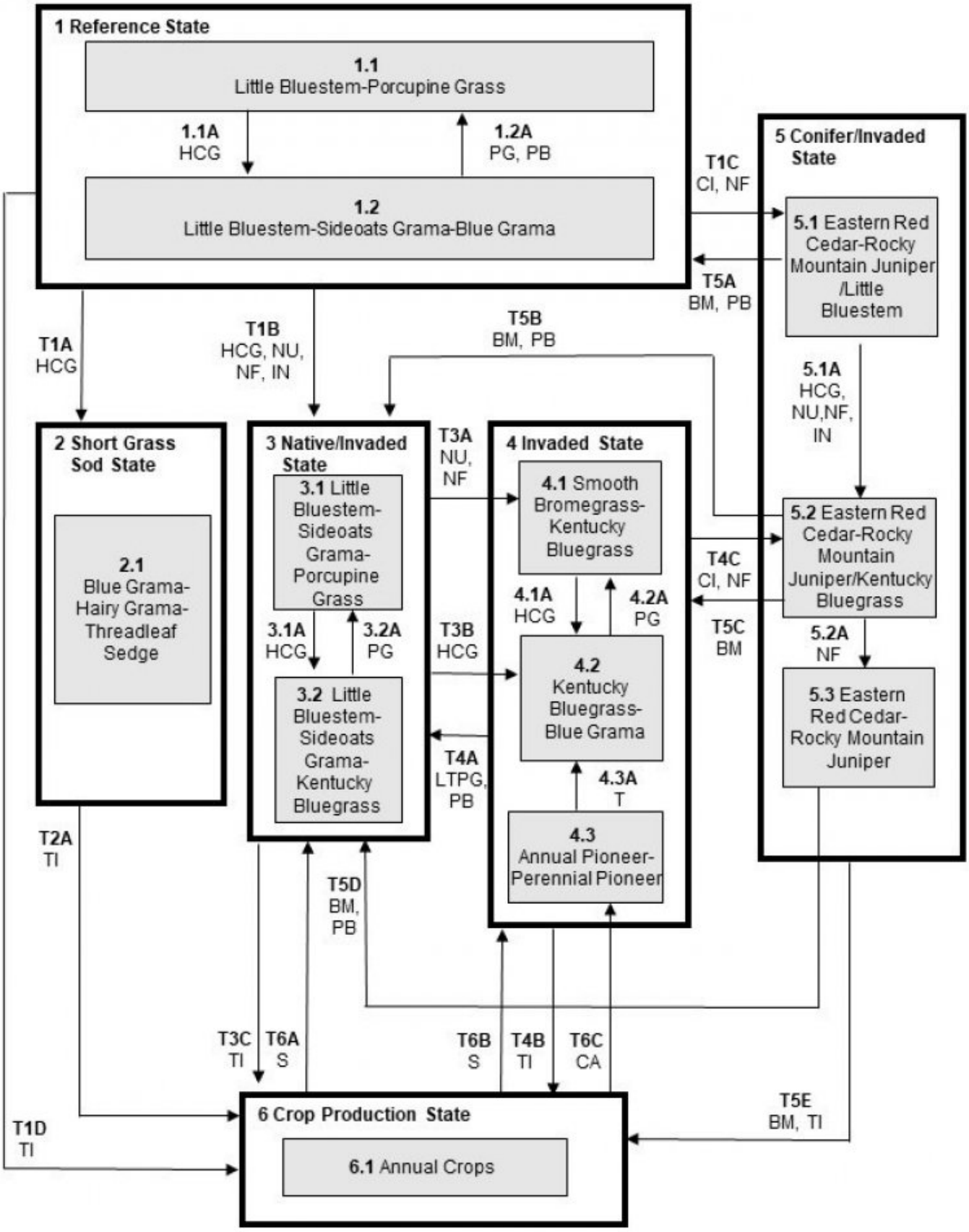

Figure 9. State-And-Transition model

Thin Upland – R053CY012SD

LEGEND
Thin Upland – R053CY012SD

BM – Brush management
CA – Cropped and abandoned
CI – Conifer invasion
HCG – Heavy continuous grazing
IN – Invasion
LTPG – Long-term prescribed grazing
NU – Non-use
NF – No fire
PB – Prescribed burning
PG – Prescribed grazing
S – Seeding
T – Time w/wo disturbances
TI – Tillage

Figure 10. Legend

Code	Process
T1A	Heavy continuous grazing
T1B	Heavy continuous grazing, non-use, no fire, invasion
T1C	Conifer invasion, no fire
T1D	Tillage
T2A	Tillage
T3A	Non-use, no fire
T3B	Heavy continuous grazing
T3C	Tillage
T4A	Long term prescribed grazing, prescribed burning
T4B	Tillage
T4C	Conifer invasion, no fire
T5A	Brush management, prescribed burning
T5B	Brush management, prescribed burning
T5C	Brush management
T5D	Brush management, prescribed burning
T5E	Brush management, tillage
T6A	Seeding
T6B	Seeding
T6C	Cropped and abandoned
1.1A	Heavy continuous grazing
1.2A	Prescribed grazing with recovery periods, prescribed burning
3.1A	Heavy continuous grazing
3.2A	Prescribed grazing with recovery periods
4.1A	Heavy continuous grazing
4.2A	Prescribed grazing with recovery periods
4.3A	Time w/wo disturbances
5.1A	Heavy continuous grazing, non-use, no fire, invasion
5.2A	No fire

Figure 11. Matrix

State 1

Reference State

The Thin Upland site occurs on the shoulder slopes in the upland areas. Soils are well drained and will effervesce with acid at or near the surface. In some areas the surface layer may consist of stony to extremely stony. The central concept soil series is Betts, Ethan, and Java, but other series are included. This state represents the natural range of variability that dominated the dynamics of this ecological site (ES). This state was dominated by warm-season grasses, with cool-season grasses being subdominant. In pre-European times, the primary disturbance mechanisms for this site in the reference condition included periods of below and/or above average precipitation, periodic fire, and herbivory by insects and large ungulates. Timing of fires and herbivory coupled with weather events dictated the dynamics that occurred within the natural range of variability. In some locations, this site likely received relatively heavy grazing pressure. Cool-season and tall warm-season grasses would have declined and corresponding increase in short warm-season grasses would have occurred. Today, a similar state, the Native/Invaded State (State 3) can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest.

Community 1.1
Little Bluestem-Porcupine Grass

Interpretations are based primarily on the 1.1 Little Bluestem-Porcupine Grass Plant Community Phase (this is also considered to be climax). The potential vegetation was about 90 percent grasses or grass-like plants, 7 percent forbs, and 3 percent shrubs. The community was dominated by warm-season grasses, with cool-season grasses being subdominant. The major grasses included little bluestem, big bluestem, porcupine grass, needleandthread (*Hesperostipa comata*), and sideoats grama. Other grass or grass-like species included western wheatgrass, plains muhly (*Muhlenbergia cuspidata*), Canada wildrye (Elymus Canadensis), prairie sandreed (*Calamovilfa longifolia*), switchgrass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*), blue grama (*Bouteloua gracilis*), and sedges (Cyperaceae). This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allowed for high drought tolerance. This was a sustainable plant community in regards to site/soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1450	2136	2795
Forb	105	180	275
Shrub/Vine	45	84	130
Total	**1600**	**2400**	**3200**

Figure 13. Plant community growth curve (percent production by month).

SD5304, Southern Dark Brown Glaciated Plains, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

Community 1.2
Little Bluestem-Sideoats Grama-Blue Grama

This plant community evolved under heavy continuous grazing or from over utilization during extended drought periods. The potential plant community was made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. Dominant grasses included little bluestem, blue grama, sideoats grama, sedge (Carex) and porcupine grass. Grasses of secondary importance included big bluestem, western wheatgrass, green needlegrass, and needleandthread. Forbs commonly found in this plant community included cudweed sagewort (*Artemisia ludoviciana*), prairie coneflower (Ratibida), and western yarrow (*Achillea millefolium*). This plant community had similar plant composition to the 3.2 Little Bluestem-Sideoats Grama-Kentucky Bluegrass Plant Community Phase. The main difference is that this plant community phase did not have the presence of nonnative invasive species such as Kentucky bluegrass and smooth bromegrass. When compared to the 1.1 Little Bluestem-Porcupine Grass Plant Community Phase, sideoats grama, blue grama, and sedges increased. Big bluestem, western wheatgrass, porcupine grass, and green needlegrass decreased, and production of cool-season and tall warm-season grasses was also reduced. This plant community was moderately resistant to change. The herbaceous species present were well adapted to grazing; however, species composition could be altered through long-term overgrazing. If the herbaceous component was intact, it tended to be resilient if the disturbance was not long-term. Most of the components of the ecological processes would have been functioning at optimum levels. However, the vigor and reproductive capability of the tall warm-season grasses would have been reduced due to grazing pressure or a combination of stressors. A reduction of this dominant functional group allowed for an increase in shorter-statured (and shallower rooted) species.

Figure 14. Plant community growth curve (percent production by month). SD5305, Southern Dark Brown Glaciated Plains, warm-season dominant.. Warm-season dominant..

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

Pathway 1.1A
Community 1.1 to 1.2

Heavy continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of

below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites will shift this community to the 1.2 Little Bluestem-Sideoats Grama-Blue Grama Plant Community Phase.

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing, and/or prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels and frequencies or periodic light to moderate grazing possibly including periodic rest will convert this plant community converted this plant community to the 1.1 Little Bluestem-Porcupine Grass Plant Community Phase

State 2
Shortgrass Sod State

This state is the result of heavy continuous grazing, and in the absence of periodic fire due to fire suppression. This state is dominated by blue grama, hairy grama (*Bouteloua hirsuta*), and threadleaf sedge (*Carex filifolia*) forming a dense sod layer that effectively blocks introduction of other plants into the system. Taller cool-season species will decline and a corresponding increase in short statured grass will occur. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the sod grass dominance.

Community 2.1
Blue Grama-Hairy Grama-Threadleaf Sedge

This plant community evolved under heavy continuous season grazing or from over utilization during extended drought periods. The potential plant community was made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. Dominant grasses included blue grama, hairy grama, and threadleaf sedge. Forbs commonly found in this plant community included cudweed sagewort, fringed sagewort (*Artemisia frigida*), green sagewort (*Artemisia dracunculus*), and western yarrow. When compared to the 1.1 Little Bluestem-Porcupine Grass Plant Community Phase, the more grazing tolerant species such as blue grama, hairy grama, and threadleaf sedge were dominant on this plant community. Tall and mid- grasses decreased significantly. This vegetation state was very resistant to change especially if the disturbance continued and the short-statured species such as blue grama increased. The herbaceous species present were well adapted to grazing. This plant community was less productive than other phases. The thick sod increased runoff and prevented other species from getting established.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	675	1099	1510
Forb	115	163	220
Shrub/Vine	10	38	70
Total	**800**	**1300**	**1800**

Figure 16. Plant community growth curve (percent production by month). SD5305, Southern Dark Brown Glaciated Plains, warm-season dominant.. Warm-season dominant..

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

State 3
Native/Invaded State

This state represents the more common range of variability that exists with higher levels of grazing management but in the absence of periodic fire due to fire suppression. This state is dominated by cool- and warm-season grasses. It can be found on areas that are properly managed with grazing and/or prescribed burning and sometimes on areas receiving occasional short periods of rest. Taller warm-season species can decline and a corresponding increase in short statured grass will occur.

Community 3.1
Little Bluestem-Sideoats Grama-Porcupine Grass

This plant community phase is similar to the 1.1 Little Bluestem-Porcupine Grass Plant Community Phase but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 20 percent by air-dry weight). The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. This community is dominated by warm-season grasses, with cool-season grasses being subdominant. The major grasses include little bluestem, big bluestem, green needlegrass, porcupine grass, and sideoats grama. Other grass or grass-like species include needleandthread, western wheatgrass, plains muhly, Canada wildrye, prairie sandreed, switchgrass, Indiangrass, blue grama, Kentucky bluegrass, and threadleaf 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 regards to site/soil stability, watershed function, and biologic integrity.

Figure 17. Plant community growth curve (percent production by month). SD5304, Southern Dark Brown Glaciated Plains, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season

subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

Community 3.2
Little Bluestem-Sideoats Grama-Kentucky Bluegrass

This plant community is a result of heavy continuous grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. Dominant grasses include little bluestem, sideoats grama, Kentucky Bluegrass, and blue grama. Grasses of secondary importance include needleandthread, big bluestem, buffalograss (*Bouteloua dactyloides*), smooth bromegrass, and threadleaf sedge. Forbs commonly found in this plant community include cudweed sagewort, fringed sagewort, prairie coneflower, and western yarrow. When compared to the 1.1 Little Bluestem-Porcupine Grass Plant Community Phase, western wheatgrass, sideoats grama, and sedges have increased. Big bluestem, porcupine grass, and blue grama decreased. Production of mid- and tall warm-season grasses is also reduced. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term. Most of the components of the ecological processes are functioning at optimum levels. However, the vigor and reproductive capability of the tall warm-season grasses are reduced due to grazing pressure or a combination of stressors. A reduction of this dominant functional group allows for an increase in shorter-statured (and shallower rooted) species. The introduction of non-native invasive species such as Kentucky bluegrass and smooth bromegrass results in alterations to the soil profile. Organic matter levels tend to decrease and begin to be concentrated more in the surface layers, and the structure will begin to be modified. These changes favor the shallow-rooted species and hasten their eventual dominance if steps are not taken to reduce these species.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1405	1820	2210
Forb	95	130	180
Shrub/Vine	0	50	110
Total	**1500**	**2000**	**2500**

Figure 19. Plant community growth curve (percent production by month). SD5304, Southern Dark Brown Glaciated Plains, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

Pathway 3.1A
Community 3.1 to 3.2

Heavy continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites will shift this community to the 3.2 Little Bluestem-Sideoats Grama-Kentucky Bluegrass Plant Community Phase.

Pathway 3.2A
Community 3.2 to 3.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the 3.1 Little Bluestem-Sideoats Grama-Porcupine Grass Plant Community Phase.

Conservation practices

Prescribed Grazing

State 4
Invaded State

This state is a result of encroachment mainly by invasive introduced cool-season grasses. The ecological processes are not functioning, especially the biotic processes and the hydrologic functions. The introduced cool-season grasses cause reduced infiltration and increased runoff. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition. The opportunity for high intensity spring burns is severely reduced by early green up and increased moisture and humidity at the soil surface and grazing pressure cannot cause a reduction in sodgrass dominance. Production is limited to the sod forming species. Infiltration continues to decrease and runoff increases and energy capture into the system is restricted to early season low producing species. Nutrient cycling is limited by root depth of the dominant species.

Community 4.1
Smooth Bromegrass-Kentucky Bluegrass

This plant community phase is a result of extended periods of nonuse and no fire or occasionally light levels of grazing over several years. It is characterized by dominance of smooth bromegrass and Kentucky bluegrass. The dominance is at times so complete that other species are difficult to find on the site. A thick duff layer also accumulates at or above the soil surface and eventually a thatch-mat layer may develop at the surface. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. When dominated by smooth bromegrass, infiltration is moderately reduced and runoff is moderate. Production can be equal to or higher than the interpretive plant community. However, when dominated by Kentucky bluegrass, infiltration is greatly reduced and runoff is high. Production in this case will likely be significantly less. In either case, the period that palatability is high is relatively short as these cool-season species mature rapidly. Energy capture is also reduced. The dominance of these introduced species has been shown to alter the biotic component of the soil, as well as, organic matter levels and eventually the soil structure. These alterations perpetuate the dominance of Kentucky bluegrass and smooth bromegrass and tend to make establishment of native species extremely difficult.

Community 4.2
Kentucky Bluegrass-Blue Grama

This plant community phase is a result of heavy continuous grazing or a combination of disturbances such as extended periods of below-average precipitation combined with heavy continuous grazing. It is characterized by a dominance of Kentucky bluegrass and blue grama. The dominance is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate at or above the soil surface and a thatch-mat layer often develops at the surface. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. Infiltration is greatly reduced and runoff is high. Production will be significantly reduced when compared to the interpretive plant community. The period that palatability is high is relatively short, as Kentucky bluegrass matures rapidly. Energy capture is also reduced. Biological activity in the soil is likely reduced significantly in this phase.

Community 4.3
Annual Pioneer-Perennial Pioneer

This plant community developed under continuous heavy grazing or other excessive disturbances. 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 nonnative invasive and/or 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.

Pathway 4.1A
Community 4.1 to 4.2

Heavy continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites will shift this community to the 4.2 Kentucky Bluegrass-Blue Grama Plant Community Phase.

Pathway 4.2A
Community 4.2 to 4.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the 4.1 Smooth Bromegrass-Kentucky Bluegrass Plant Community Phase.

Pathway 4.3A
Community 4.3 to 4.2

This community pathway occurs with the passage of time as successional processes take place and perennial plants gradually begin to establish on the site again. This pathway will lead to the 4.2 Kentucky Bluegrass-Blue Grama Plant Community Phase.

State 5
Conifer/Invaded State

This state is dominated (canopy exceeds 20 percent of total surface area) by areas where trees have become established or have encroached onto the site due to the absence of periodic fire. This state is dominated by eastern redcedar and/or Rocky Mountain juniper with cool-season grasses being subdominant. The plant community can develop into a closed canopy that impedes the reproductive capability of the major native perennial grass species. A single eastern red cedar tree with a 7 foot crown diameter eliminates the equivalent of 3 pounds of forage. Further, the forage potential of a pasture with 250 mature eastern red cedar trees per acre (or one tree every thirteen feet) is reduce by 50 percent. It is suggested that reducing stocking rates by 10 percent for every 50 trees per acre. The increase in tree canopy which is a result of a disruption of the natural, and human related fire regimes that occurred prior to European settlement, which kept trees from encroaching much of the grasslands.

Community 5.1
Eastern Red Cedar-Rocky Mountain Juniper/Little Bluestem

This plant community evolved due to the invasion of conifers, such as eastern red cedar and Rocky Mountain juniper. This phase was a result of the absence of periodic fire. These events may cause a reduction in warm-season grasses and an increase in cool-season grasses and allow for the encroachment of conifers. The potential plant community is made up of approximately 50 percent grasses and grass-like species, 10 percent forbs, 10 percent shrubs, and 30 percent trees. Dominant grasses and grass-likes include little bluestem, big bluestem, porcupine grass, western wheatgrass, and blue grama. As the canopy increases, warm-season grasses tend to decrease as the cool-season grasses increase. Forbs will be diverse. Trees species will include eastern red cedar and Rocky Mountain juniper. When compared to the 1.1 Little Bluestem-Porcupine Grass Plant Community, coniferous trees have increased significantly and herbaceous component has decreased. This plant community is susceptible to the encroachment of eastern red cedar and Rocky Mountain juniper.

Community 5.2
Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass

This plant community phase is a result of heavy, continuous seasonal grazing or heavy, continuous season-long grazing or non-use and/or no surface fire for extended periods of time (typically for 10 or more years). When compared to the 5.1 Eastern Red Cedar-Rocky Mountain Juniper/Little Bluestem Plant Community, the amount of nonnative invasive cool-season grasses such as Kentucky bluegrass and smooth bromegrass have increased significantly. It is characterized by a dominance of Kentucky bluegrass, smooth bromegrass, and blue grama. The dominance of Kentucky bluegrass is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate at or above the soil surface and a thatch-mat layer often develops at the surface. Production is limited to the sod forming species. The period that palatability is high is relatively short, as Kentucky bluegrass matures rapidly. Infiltration continues to decrease and runoff increases, energy capture into the system is restricted to early season low producing species. Nutrient cycling is limited by root depth of the dominate species. Biological activity in the soil is likely reduced significantly in this phase.

Community 5.3
Eastern Red Cedar-Rocky Mountain Juniper

This plant community phase is a result of no surface fire for extended periods of time (typically for 10 or more years). Coniferous trees have increased significantly, and the herbaceous component has decreased. With the dominance of the coniferous trees such as eastern red cedar and Rocky Mountain juniper, the canopy covers the area and grass species are unable to survive. Grass production for livestock is severely limited. Prescribed burning before the juniper species reach maturity and are still susceptible to fire (< 5 foot in height), or mechanical brush management can be used to maintain or

recover 5.3 Eastern Red Cedar-Rocky Mountain Juniper Plant Community Phase.

Pathway 5.1A
Community 5.1 to 5.2

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, and/or heavy continuous grazing or invasion of non-native plant species will shift this plant community to the 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase.

Pathway 5.2A
Community 5.2 to 5.3

No surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, will shift this plant community to the 5.3 Eastern Red Cedar-Rocky Mountain Juniper Plant Community Phase.

State 6
Crop Production State

This state is characterized by the production of annual crops using a variety of tillage and cropping systems along with management practices.

Community 6.1
Annual Crops

This plant community developed with the use of a variety of tillage systems and cropping systems for the production of annual crops including corn, soybeans, wheat, and a variety of other crops.

Transition T1A
State 1 to 2

Heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season and often at the same time of year each year), typically beginning early in the season) will convert this plant community to the 2.1 Blue Grama-Hairy Grama-Threadleaf Sedge Plant Community Phase within the Short Grass Sod State (State 2).

Transition T1B
State 1 to 3

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, and/or heavy continuous grazing or invasion of non-native plant species will likely lead this state over a threshold resulting in the Native/Invaded State (State 3).

Transition T1C
State 1 to 5

No surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, and invasion of conifer will likely lead this state over a threshold leading to the 5.1 Eastern Red Cedar-Rocky Mountain Juniper/Little Bluestem Plant Community Phase within the Conifer/Invaded State (State 5).

Transition T1D
State 1 to 6

Tillage will cause a shift over a threshold leading to the 6.1 Annual Crops Plant Community Phase within the Crop Production State (State 6).

Transition T2A
State 2 to 6

Tillage will cause a shift over a threshold leading to the 6.1 Annual Crops within the Crop Production State (State 6).

Transition T3A
State 3 to 4

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, will likely lead this state over a threshold leading to the 4.1 Smooth Bromegrass-Kentucky Bluegrass Plant Community Phase within the Invaded State (State 4).

Transition T3C
State 3 to 6

Tillage will cause a shift over a threshold leading to the 6.1 Annual Crops Plant Community Phase within the Crop Production State (State 6).

Restoration pathway T4A
State 4 to 3

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery

periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels may lead this plant community phase over a threshold to the Native/Invaded State (State 3).

Transition T4C
State 4 to 5

No surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, and invasion of conifer will likely lead this state over a threshold leading to the 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase within the Conifer/Invaded State (State 5).

Transition T4B
State 4 to 6

Tillage will cause a shift over a threshold leading to the 6.1 Annual Crops Plant Community Phase within the Crop Production State (State 6).

Restoration pathway T5A
State 5 to 1

Brush management which would include the mechanical removal of the conifers, coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels may lead this 5.1 Eastern Red Cedar-Rocky Mountain Juniper/Little Bluestem Plant Community Phase within the Conifer/Invaded State (State 5) over a threshold to the Reference State (State 1).

Restoration pathway T5B & T5D
State 5 to 3

Brush management which would include the mechanical removal of the conifers, coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels may lead this 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase within the Conifer/Invaded State (State 5) over a threshold to the Native/Invaded State (State 3). Brush management which would include the mechanical removal of the conifers, coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels may lead this 5.3 Eastern Red Cedar-Rocky Mountain Juniper Plant Community Phase within the Conifer/Invaded State (State 5) over a threshold to the Native/Invaded State (State 3).

Restoration pathway T5C
State 5 to 4

Brush management which would include the mechanical removal of the conifers may lead this 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase within the Conifer/Invaded State (State 5) over a threshold to the Invaded State (State 4).

Transition T5E
State 5 to 6

Brush management which would include the mechanical removal of the conifers, coupled with tillage will cause a shift over a threshold leading to the 6.1 Annual Crops Plant Community Phase within the Crop Production State (State 6).

Restoration pathway T6A
State 6 to 3

Seeding may lead this Crop Production State (State 6) over a threshold to the Native/Invaded State (State 3).

Restoration pathway T6B & T6C
State 6 to 4

Seeding may lead this Crop Production State (State 6) over a threshold to the Invaded State (State 4). Cropping followed by abandonment may lead this plant community phase over a threshold to the 4.3 Annual Pioneer-Perennial Pioneer Plant Community Phase within the Invaded State (State 4).

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			480–840	
	big bluestem	ANGE	*Andropogon gerardii*	360–840	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–120	–
	switchgrass	PAVI2	*Panicum virgatum*	24–120	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–120	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–72	–

2	**Mid Warm-Season Grasses**			480–840	
	little bluestem	SCSC	*Schizachyrium scoparium*	360–840	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	120–360	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–120	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–120	–
3	**Cool-Season Bunchgrasses**			240–432	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–360	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	120–360	–
	green needlegrass	NAVI4	*Nassella viridula*	0–240	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–72	–
4	**Wheatgrass**			48–240	
	western wheatgrass	PASM	*Pascopyrum smithii*	48–240	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–120	–
5	**Short Warm-Season Grasses**			48–192	
	blue grama	BOGR2	*Bouteloua gracilis*	48–192	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–120	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–72	–
6	**Other Native Grasses**			24–96	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–96	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	24–72	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–48	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–48	–
7	**Grass-likes**			24–120	
	sedge	CAREX	*Carex*	24–120	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–72	–
Forb					
8	**Forbs**			120–240	
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	24–96	–
	Forb, native	2FN	*Forb, native*	24–96	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	24–72	–
	dotted blazing star	LIPU	*Liatris punctata*	24–48	–

	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	24–48	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	24–48	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–48	–
	purple prairie clover	DAPU5	*Dalea purpurea*	24–48	–
	scurfpea	PSORA2	*Psoralidium*	24–48	–
	cutleaf anemone	PUPAM	*Pulsatilla patens ssp. multifida*	0–48	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	24–48	–
	goldenrod	SOLID	*Solidago*	24–48	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–48	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	0–24	–
	American vetch	VIAM	*Vicia americana*	0–24	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–24	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–24	–
	large Indian breadroot	PEES	*Pediomelum esculentum*	0–24	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–24	–
Shrub/Vine					
9	**Shrubs**			48–120	
	leadplant	AMCA6	*Amorpha canescens*	24–96	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–72	–
	rose	ROSA5	*Rosa*	24–48	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–48	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–24	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–24	–

Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			13–130	
	big bluestem	ANGE	*Andropogon gerardii*	13–91	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–65	–

2	**Mid Warm-Season Grasses**			65–195	
	sideoats grama	BOCU	*Bouteloua curtipendula*	13–156	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–91	–
3	**Cool-Season Bunchgrasses**			0–65	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–39	–
	green needlegrass	NAVI4	*Nassella viridula*	0–39	–
4	**Wheatgrass**			0–65	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–65	–
5	**Short Warm-Season Grasses**			260–520	
	blue grama	BOGR2	*Bouteloua gracilis*	195–325	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	65–260	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–65	–
6	**Other Native Grasses**			13–65	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–65	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–26	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–26	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	13–26	–
7	**Grass-likes**			130–260	
	sedge	CAREX	*Carex*	130–260	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–65	–
8	**Non-Native Grasses**			26–130	
	bluegrass	POA	*Poa*	13–130	–
	brome	BROMU	*Bromus*	13–39	–
Forb					
9	**Forbs**			130–195	
	Forb, introduced	2FI	*Forb, introduced*	13–130	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	13–65	–
	goldenrod	SOLID	*Solidago*	13–65	–
	white heath aster	SYER	*Symphyotrichum ericoides*	13–39	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	13–39	–
	Forb, native	2FN	*Forb, native*	0–39	–
	scurfpea	PSORA2	*Psoralidium*	13–39	

	scurfpea	PSORA2	*Psoralidium*	13–39	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–13	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–13	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–13	–
Shrub/Vine					
10	**Shrubs**			13–65	
	prairie sagewort	ARFR4	*Artemisia frigida*	13–65	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–26	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–26	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–26	–
	rose	ROSA5	*Rosa*	0–13	–

Table 10. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			20–140	
	big bluestem	ANGE	*Andropogon gerardii*	20–140	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–100	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–40	–
	switchgrass	PAVI2	*Panicum virgatum*	0–20	–
2	**Mid Warm-Season Grasses**			400–600	
	little bluestem	SCSC	*Schizachyrium scoparium*	200–500	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	200–400	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–40	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–20	–
3	**Cool-Season Bunchgrasses**			100–360	
	porcupinegrass	HESP11	*Hesperostipa spartea*	40–300	–
	green needlegrass	NAVI4	*Nassella viridula*	0–100	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–100	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–20	–
4	**Wheatgrass**			0–200	

	western wheatgrass	PASM	*Pascopyrum smithii*	0–200	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–40	–
5	**Short Warm-Season Grasses**			100–300	
	blue grama	BOGR2	*Bouteloua gracilis*	100–200	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–100	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–80	–
6	**Other Native Grasses**			20–100	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–100	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	20–60	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–40	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–40	–
7	**Grass-likes**			60–240	
	sedge	CAREX	*Carex*	60–240	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–60	–
8	**Non-Native Grasses**			100–400	
	bluegrass	POA	*Poa*	60–360	–
	brome	BROMU	*Bromus*	40–240	–
Forb					
9	**Forbs**			100–160	
	Forb, introduced	2FI	*Forb, introduced*	20–100	–
	Forb, native	2FN	*Forb, native*	20–60	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–60	–
	goldenrod	SOLID	*Solidago*	20–60	–
	scurfpea	PSORA2	*Psoralidium*	20–60	–
	cutleaf anemone	PUPAM	*Pulsatilla patens ssp. multifida*	0–40	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–40	–
	white heath aster	SYER	*Symphyotrichum ericoides*	20–40	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–40	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	20–40	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–40	–
	American vetch	VIAM	*Vicia americana*	0–40	–

	dotted blazing star	LIPU	*Liatris punctata*	0–20	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–20	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–20	–
	Indian breadroot	PEDIO2	*Pediomelum*	0–20	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–20	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	0–20	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–20	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–20	–
Shrub/Vine					
10	**Shrubs**			0–100	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–60	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–60	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–60	–
	rose	ROSA5	*Rosa*	20–40	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–40	–
	leadplant	AMCA6	*Amorpha canescens*	0–20	–

Animal community

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

Bluestem/Needlegrass (1.1)
Average Annual Production (lbs./acre, air-dry): 2,400
Stocking Rate* (AUM/acre): 0.66

Blue Grama/Hairy Grama/Forbs (2.1)
Average Annual Production (lbs./acre, air-dry): 1,300
Stocking Rate* (AUM/acre): 0.36

Little Bluestem/Sideoats Grama/Kentucky Bluegrass (3.2)
Average Annual Production (lbs./acre, air-dry): 2,000
Stocking Rate* (AUM/acre): 0.55

*Based on 912 lbs./acre (air-dry weight) per Animal Unit Month (AUM), and on 25 percent harvest efficiency (refer to United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) National Range and Pasture Handbook).

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

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is typically dominated by soils in hydrologic group 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, and/or smooth bromegrass will result in reduced infiltration and increased runoff. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Recreational uses

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

Wood products

No appreciable wood products are typically present on this site.

Other products

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

Other information

• SD107 Potter County, SD did not use the (RbD) Raber-Gettys complex, 6 to 15 percent slopes (national symbol cwx7) (R53BY012SD ESD) as used in the adjoining SD129 Walworth County. SD129 Walworth County, SD (RbD) Raber-Gettys complex, 6 to 15 percent slopes (national symbol cwx7) (R53BY012SD ESD) will need to be split correlated to match SD069 Hyde County, SD ESD.
• SD119 Sully County, SD did not use the (JgB) Glenham-Java-Prosper loams, 1 to 6 percent slopes (national symbol 2wkp1) as used in the adjoining SD107 Potter County, SD.
• SD119 Sully County, SD did not use the (GmB) Glenham-Java-Prosper loams, 1 to 6 percent slopes (national symbol 2wkp1) as used in the adjoining SD069 Hyde County, SD.
• SD059 Hand County, SD did not use the (GmB) Glenham-Java-Prosper loams, 1 to 6 percent slopes (national symbol 2wkp1) as used in the adjoining SD069 Hyde County, SD.
• SD059 Hand County, SD did not use the (PgD) Peno-Gettys clay loams, 1 to 6 percent slopes (national symbol 2wkqf) as used in the adjoining SD069 Hyde County, SD.
• SD059 Hand County, SD did not use the (GkB) Glenham-Java-Prosper loams, 1 to 6 percent slopes (national symbol 2wkp1) as used in the adjoining SD017 Buffalo County, SD (SD603 Brule and Buffalo Counties Soil survey).
• SD059 Hand County, SD did not use the (JgC) Java- Glenham loams, 1 to 6 percent slopes (national symbol cxy3) as used in the adjoining SD017 Buffalo County, SD (SD603 Brule and Buffalo Counties Soil survey).
• SD017 Buffalo County, SD (SD603 Brule and Buffalo Counties Soil Survey) did not use the (HwB) Houdek-Ethan-Prosper loams, 1 to 6 percent slopes (national symbol 2tlb9) (R55CY012SD ESD) as used in the adjoining SD073 Jerauld County. SD073 Jerauld County, SD (HwB) Houdek-Ethan-Prosper loams, 1 to 6 percent slopes (national symbol 2tlb9) (R55CY012SD ESD) will need to be split correlated to match SD017 Buffalo County, SD ESD.
• SD017 Buffalo County, SD (SD603 Brule and Buffalo Counties Soil Survey) did not use the (EtD) Ethan-Betts loams, 9 to 15 percent slopes (national symbol 2wkq8) (R55CY012SD ESD) as used in the adjoining SD073 Jerauld County. SD073 Jerauld County, SD (EtD) Ethan-Betts loams, 9 to 15 percent slopes (national symbol 2wkq8) (R55CY012SD ESD) will need to be split correlated to match SD017 Buffalo County, SD ESD.
• SD073 Jerauld County, SD did not use the (HgB) Highmore-Java complex, 1 to 5 percent slopes (national symbol cxxx) (R55CY012SD ESD) as used in the adjoining SD017 Buffalo County (SD603 Brule and Buffalo Counties Soil survey). SD017 Buffalo County, SD (HgB) Highmore-Java complex, 1 to 5 percent slopes (national symbol cxxx) (R55CY012SD ESD) will need to be split correlated to match SD073 Jerauld County, SD ESD.
• SD017 Buffalo County, SD (SD603 Brule and Buffalo Counties Soil Survey) did not use the (PgC) Peno-Gettys complex, 6 to 9 percent slopes (national symbol cxyh) as used in the adjoining SD073 Jerauld County.
• SD073 Jerauld County, SD did not use the (EeB) Eakin-Ethan complex, 2 to 6 percent slopes (national symbol 2xhbv) (R55CY012SD ESD) as used in the adjoining SD003 Aurora County. SD003 Aurora County, SD (EeB) Eakin-Ethan complex, 2 to 6 percent slopes (national symbol 2xhbv) (R55CY012SD ESD) will need to be split correlated to

match SD073 Jerauld County, SD ESD.
• SD015 Brule County, SD (SD603 Brule and Buffalo Counties Soil survey) did not use the (BeE) Betts-Ethan complex, 15 to 40 percent slopes (national symbol 2wkq9) (R55CY012SD ESD) as used in the adjoining SD003 Aurora County. SD003 Aurora County, SD (BeE) Betts-Ethan complex, 15 to 40 percent slopes (national symbol 2wkq9) (R55CY012SD ESD) will need to be split correlated to match SD015 Brule County, SD ESD.
• SD015 Brule County, SD (SD603 Brule and Buffalo Counties Soil survey) did not use the (EtD) Ethan-Betts complex, 15 to 40 percent slopes (national symbol 2wkq8) (R55CY012SD ESD) as used in the adjoining SD003 Aurora County. SD003 Aurora County, SD (EtD) Ethan-Betts complex, 15 to 40 percent slopes (national symbol 2wkq8) (R55CY012SD ESD) will need to be split correlated to match SD015 Brule County, SD ESD.
• SD059 Hand County, SD did not use the (WzD) Williams-Zahl-Bowbells loams, 2 to 15 percent slopes (national symbol cxmf) (R53BY012SD ESD) as used in the adjoining SD049 Faulk County. SD049 Faulk County, SD (WzD) Williams-Zahl-Bowbells loams, 2 to 15 percent slopes (national symbol cxmf) (R53BY012SD ESD) will need to be split correlated to match SD059 Hand County, SD ESD.
• SD059 Hand County, SD did not use the (VdC) Vida-Williams-Bowbells loams, 2 to 9 percent slopes (national symbol cxm0) (R53BY012SD ESD) as used in the adjoining SD049 Faulk County. SD049 Faulk County, SD (VdC) Vida-Williams-Bowbells loams, 2 to 9 percent slopes (national symbol cxm0) (R53BY012SD ESD) will need to be split correlated to match SD059 Hand County, SD ESD.
• Reference and alternative states within the state and transition model are may not be fully documented and may require additional field sampling for refinement.

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 (RMS), NRCS; Shane Deranleau, RMS, NRCS; Mitch Faulkner, RMS, NRCS; and Kelly Stout, RMS, and Bruce Kunze, Soil Scientist, NRCS.

Data Source Sample Period State County
SCS-RANGE-417 (0017046059) 10/19/1970 SD Hand
SCS-RANGE-417 (0027146059) 4/13/1971 SD Hand
SCS-RANGE-417 (0017246059) 9/20/1972 SD Hand

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Approval

Suzanne Mayne-Kinney, 1/22/2024

Acknowledgments

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This Provisional Ecological Site concept has passed both Quality Control and Quality Assurance processes. Quality Assurance was approved by David Kraft, NRCS Regional Ecologist as of 11/12/2020.

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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, Mitch Faulkner, Shane Deranleau

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Date	03/15/2011
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present.

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2. **Presence of water flow patterns:** Barely observable if present.

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3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent. Some bunchgrasses may be slightly pedestalled, but no exposed roots will be present.

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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 5 percent and pathces less than two 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 present.

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7. **Amount of litter movement (describe size and distance expected to travel):** Little to no plant litter movement. Plant litter remains in place and is not moved by erosional forces.

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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 normally a 5 to 6 rating. Typically high root content and organic matter in the soil surface. Soil surface is very resistant to erosion.

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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, and mollic (higher organic matter) colors of A-horizon down to about 3 to 6 inches. 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 grass and grass-like species 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 present.

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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: Tall, warm-season grasses = mid, warm-season grasses >

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

    Other: Wheatgrasses = forbs > short, warm-season grasses > grass-like species = shrubs

    Additional: Other native 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.

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14. **Average percent litter cover (%) and depth (in):** 70-80 percent plant litter cover, roughly 0.25 to 0.5 inches in depth. Litter cover is in contact with the soil surface.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2,400 pounds/acre (air-dry basis)

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Refer to State and local Noxious Weed List; also Kentucky bluegrass and smooth bromegrass.

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