USDA Natural Resources Conservation Service

Ecological site R055CY012SD
Thin Upland

Last updated: 1/31/2024
Accessed: 05/13/2025

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): 055C–Southern Black Glaciated Plains

The Southern Black Glaciated Plains (55C) is located within the Northern Great Plains Region. It is entirely within South Dakota encompassing about 10,835 square miles (Figure 1). The elevation ranges from 1,310 to 1,970 square feet. The MLRA is on nearly level to undulating glacial till plains interrupted by steeper slopes adjacent to streams and moraines. The James River is an under-fit stream. Its valley was carved by floodwaters draining glacial Lake Dakota and is filled with glacial outwash and alluvial deposits. (USDA-NRCS, 2006).

The dominant soil order in this MLRA is Mollisols. 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 to very poorly drained, and clayey or loamy. This area supports natural prairie vegetation characterized by western wheatgrass (Pascopyrum smithii), green needlegrass (*Nassella viridula*), needle and thread (*Hesperostipa comata*), and porcupinegrass (Hesperostipa spartea) with Prairie cordgrass (Spartina pectinata), and reed canarygrass (Phalaris arundinacea) as the dominant vegetation on the poorly drained soils. (USDA-NRCS, 2006).

Classification relationships

Major Land Resource Area (MLRA): Southern Black Glaciated Plains (55C) (USDA-NRCS, 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Yankton Hills and Valleys Subsection (251Bf); Western Glaciated Plains Section (332B); James River Lowland Subsection (332Bb); 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: Southern Missouri Coteau (42e); Southern Missouri Coteau Slope (42f); James River Lowland (46n) - (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 is dominated by warm-season grasses, with a subdominant cool-season component. Warm season grasses include little bluestem and big bluestem. Cool season grasses include needlegrasses, with porcupinegrass making up the majority. Forbs include cudweed sagewort, prairie coneflower, and western yarrow. Non-native grasses such as smooth bromegrass and Kentucky bluegrass or native conifers such as eastern redcedar may invade due to shifts in disturbance regime.

Associated sites

R055CY010SD	**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 are Clarno, Hand, and Houdek, but other series are included.
R055CY011SD	**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 are Beadle and Stickney, but other series are included.
R055CY020SD	**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 Bonilla and Prosper but other series are included.

Similar sites

R055CY010SD	**Loamy** The Loamy site occurs in a backslope landscape position and does not effervesce with acid at or near the surface. The Loamy site will have less little bluestem and higher production than a Thin Upland site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Hesperostipa spartea*

Physiographic features

This site occurs on nearly level to steeply sloping uplands.

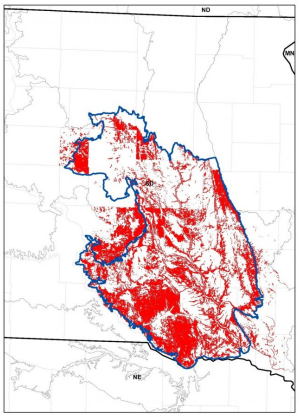

Figure 2. Distribution Map of theThin Upland Site within MLRA 55C. In many cases, data is not spatially consistent across political boundaries due to the method with which soils were mapped; e. g. county subsets.

Table 2. Representative physiographic features

Landforms	(1) Moraine (2) Plain (3) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	396–610 m
Slope	4–35%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 55C 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 19 to 25 inches per year. The average annual temperature is about 47°F. January is the coldest month with average temperatures ranging from about 15°F (Howard, South Dakota [SD]), to about 20°F (Wagner, SD). July is the warmest month with temperatures averaging from about 73°F (Howard, SD), to about 77°F (Wagner, 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. 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)	122-129 days
Freeze-free period (characteristic range)	137-150 days
Precipitation total (characteristic range)	559-660 mm

Frost-free period (actual range)	114-130 days
Freeze-free period (actual range)	133-155 days
Precipitation total (actual range)	533-686 mm
Frost-free period (average)	125 days
Freeze-free period (average)	144 days
Precipitation total (average)	610 mm

Climate stations used

- (1) FAULKTON 1 NW [USC00392927], Faulkton, SD
- (2) REDFIELD [USC00397052], Redfield, SD
- (3) MILLER [USC00395561], Miller, SD
- (4) HURON RGNL AP [USW00014936], Huron, SD
- (5) DE SMET [USC00392302], De Smet, SD
- (6) HOWARD [USC00394037], Howard, SD
- (7) FORESTBURG 4 NNE [USC00393029], Artesian, SD
- (8) CHAMBERLAIN MUNI AP [USW00094943], Chamberlain, SD
- (9) CHAMBERLAIN 5 S [USC00391621], Chamberlain, SD
- (10) ACADEMY 2NE [USC00390043], Platte, SD
- (11) MITCHELL MUNI AP [USW00094950], Mitchell, SD
- (12) MITCHELL [USC00395669], Mitchell, SD
- (13) ALEXANDRIA [USC00390128], Alexandria, SD
- (14) SALEM 5NE [USC00395360], Salem, SD
- (15) BRIDGEWATER [USC00391032], Bridgewater, SD
- (16) MARION [USC00395228], Marion, SD
- (17) MENNO [USC00395481], Menno, SD
- (18) ARMOUR [USC00390296], Armour, SD
- (19) TYNDALL [USC00398472], Tyndall, SD

Influencing water features

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

Soil features

The features common to soils in this site are the loam to silt loam textured surface layers and slopes of 4 to 35 percent. The soils in this site are well drained and formed in loamy till or residuum from calcareous siltstone. The surface layer is 3 to 9 inches thick. The texture of the subsurface layers ranges from loam to silty clay loam. The soils have a moderately slow to 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.

Soil series are Betts and Ethan.

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/HomePage.htm) for specific local soils information.

Table 4. Representative soil features

Surface texture	(1) Loam (2) Silt loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Slow to moderately slow
Soil depth	76–203 cm
Surface fragment cover <=3"	0–9%
Surface fragment cover >3"	0–25%
Available water capacity (0-101.6cm)	12.7–17.78 cm
Calcium carbonate equivalent (0-101.6cm)	5–45%
Electrical conductivity (0-101.6cm)	0–8 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–3
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–8%
Subsurface fragment volume >3" (Depth not specified)	0–4%

Ecological dynamics

State and Community Phases
The information in this Ecological Site Description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The site which is located in the Southern Black 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 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-Big Bluestem-Porcupinegrass 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.

This ecological site (ES) has been grazed by domestic livestock since they were 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) 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-Big Bluestem-Porcupinegrass Plant Community Phase. Blue grama will eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Green needlegrass (*Nassella viridula*), needle and thread, porcupinegrass, sideoats grama (*Bouteloua curtipendula*), big bluestem (*Andropogon gerardii*) and little bluestem (*Schizachyrium scoparium*) will decrease in frequency and production. Extended periods of non-use and/or lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as Kentucky bluegrass (*Poa pratensis*), smooth bromegrass (*Bromus inermis*), and cheatgrass (*Bromus tectorum*). Extended periods of no surface fire could result in the invasion of conifers in which eastern redcedar (*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 and community phases. The associated plant composition tables 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 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.

State and Community Phases

The information in this Ecological Site Description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

State and transition model

Thin Upland – R055CY012SD

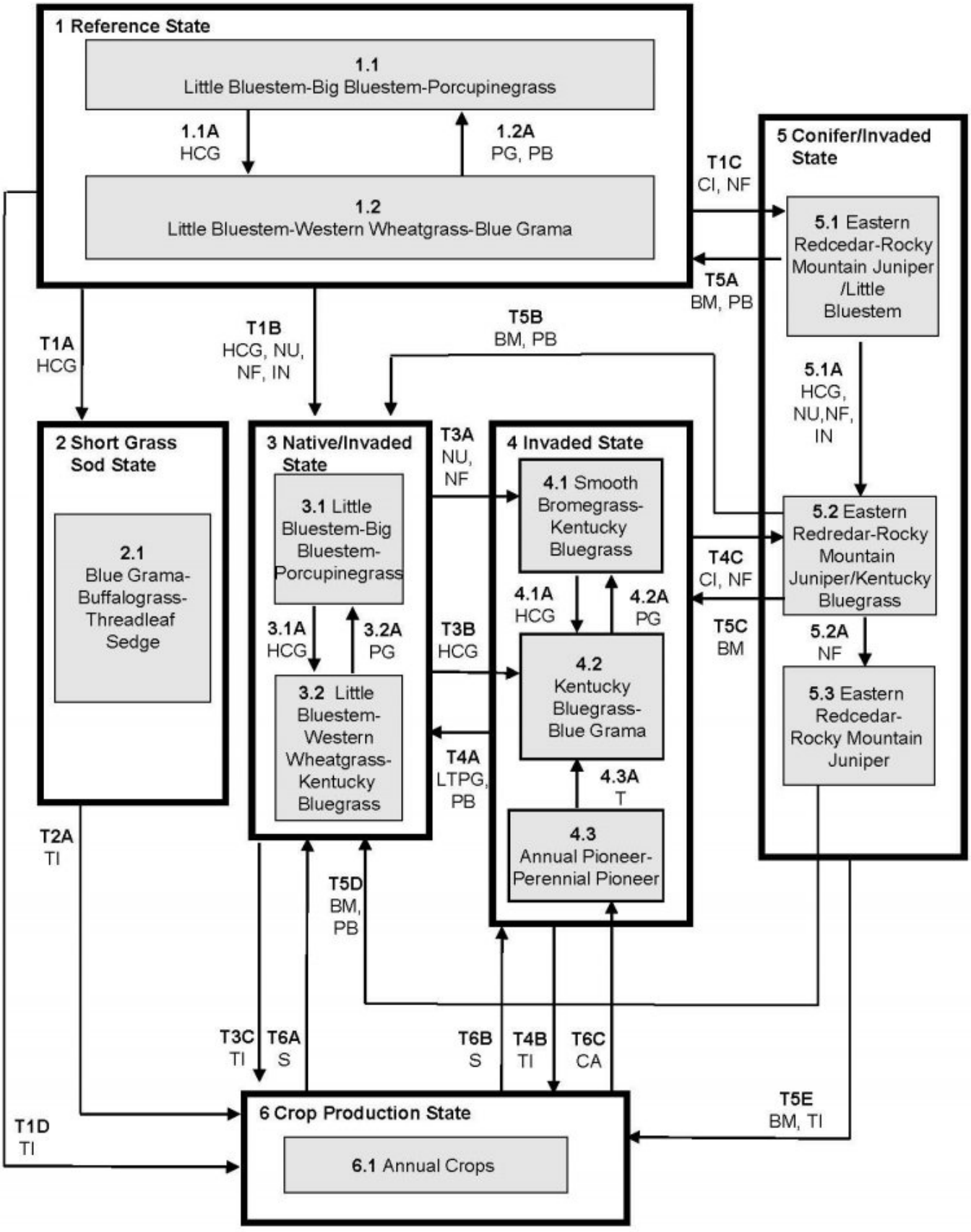

Figure 9. State-and-Transition Model for the Thin Upland Site in MLRA 55C.

Figure 10. Legend for the Thin Upland Site in MLRA 55C.

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 for the Thin Upland Site in MLRA 55C.

State 1
Reference State

The Reference 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. Prior to European settlement of North America, the primary disturbance mechanisms for this site in the Reference condition included periods of below and 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-Big Bluestem-Porcupinegrass

Interpretations are based primarily on the 1.1 Little Bluestem-Big Bluestem-Porcupinegrass Plant Community Phase (this is also considered to be the Reference community). The potential vegetation was about 82 percent grasses or grass-like plants, 10 percent forbs, and 8 percent shrubs. The community was dominated by warm-season grasses, with cool-season grasses being subdominant. The major grasses included little bluestem, big bluestem, porcupinegrass, green needlegrass, and sideoats grama. Other grass or grass-like species included prairie dropseed (*Sporobolus heterolepis*), needle and thread (*Hesperostipa comata*), western wheatgrass, plains muhly (*Muhlenbergia cuspidata*), Canada wildrye (Elymus Canadensis), prairie sandreed (*Calamovilfa longifolia*),

switchgrass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*), slender wheatgrass (*Elymus trachycaulus*), 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 tolerance to drought. This was a sustainable plant community in regards to site and soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2018	2632	3189
Forb	135	228	347
Shrub/Vine	90	167	275
Total	**2243**	**3027**	**3811**

Figure 13. Plant community growth curve (percent production by month). SD5504, Southern Black Glaciated Plains, warm-season dominant, cool-season . Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	18	24	25	15	7	1	0	0

Community 1.2
Little Bluestem-Western Wheatgrass-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, western wheatgrass, blue grama, green needlegrass, and needle and thread. Grasses of secondary importance included sideoats grama, porcupinegrass, big bluestem, and sedge (Carex). 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-Western Wheatgrass-Kentucky Bluegrass Plant Community Phase. The main difference is that this plant community phase did not have the presence of non-native invasive species such as Kentucky bluegrass and smooth bromegrass. When compared to the 1.1 Little Bluestem-Big Bluestem-Porcupinegrass Plant Community Phase, western wheatgrass, blue grama, and sedges increased. Big bluestem, porcupinegrass, green needlegrass, and sideoats grama decreased, and production of mid- 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). SD5504, Southern Black Glaciated Plains, warm-season dominant, cool-season . Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	18	24	25	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-Western Wheatgrass-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 (every 3 to 5 years), a return to normal disturbance regime levels and frequencies, or periodic light to moderate grazing (possibly including periodic rest) will convert this plant community to the 1.1 Little Bluestem-Big Bluestem-Porcupinegrass Plant Community Phase

State 2
Short-grass Sod State

Th Short-grass Sod State is the result of heavy, continuous grazing and the absence of periodic fire due to fire suppression. This state is dominated blue grama and threadleaf sedge. . 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-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 and threadleaf sedge (*Carex filifolia*). Grasses of secondary importance included needle and thread and western wheatgrass. 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-Big Bluestem-Porcupinegrass Plant Community Phase, the more grazing tolerant species such as blue 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.

Figure 15. Plant community growth curve (percent production by month). SD5504, Southern Black Glaciated Plains, warm-season dominant, cool-season . Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	18	24	25	15	7	1	0	0

State 3
Native/Invaded State

The Native/Invaded 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 species can decline and a corresponding increase in short statured grass will occur.

Community 3.1
Little Bluestem-Big Bluestem-Porcupinegrass

This plant community phase is similar to the 1.1 Little Bluestem-Big Bluestem-Porcupinegrass 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 15 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, porcupinegrass, and sideoats grama. Other grass or grass-like species include prairie dropseed, needle and thread, western wheatgrass, plains muhly, Canada wildrye, prairie sandreed, switchgrass,

Indiangrass, slender wheatgrass, 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 tolerance to drought. This is a sustainable plant community in regards to site and soil stability, watershed function, and biologic integrity.

Figure 16. Plant community growth curve (percent production by month). SD5504, Southern Black Glaciated Plains, warm-season dominant, cool-season . Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	18	24	25	15	7	1	0	0

Community 3.2
Little Bluestem-Western Wheatgrass-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 80 percent grasses and grass-like species, 15 percent forbs, and 5 percent shrubs. Dominant grasses include little bluestem, western wheatgrass, Kentucky Bluegrass, and blue grama. Grasses of secondary importance include sideoats grama, green needlegrass, needle and thread, porcupinegrass, big bluestem, buffalograss (*Bouteloua dactyloides*), smooth bromegrass, and threadleaf sedge. Forbs commonly found in this plant community include cudweed sagewort, prairie coneflower, and western yarrow. When compared to the 3.1 Little Bluestem-Big Bluestem-Porcupinegrass Plant Community Phase, western wheatgrass, blue grama, and sedges have increased. Big bluestem, porcupinegrass, green needlegrass, and sideoats 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 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1451	1853	2208
Forb	101	213	370
Shrub/Vine	17	64	112
Total	**1569**	**2130**	**2690**

Figure 18. Plant community growth curve (percent production by month). SD5503, Southern Black Glaciated Plains, cool-season/warm-season codominant.. Cool-season, warm-season codominant..

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

Pathway 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-Western Wheatgrass-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-Big Bluestem-Porcupinegrass Plant Community Phase.

Conservation practices

Prescribed Grazing

State 4
Invaded State

The Invaded 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. Grazing pressure cannot cause a reduction in sod-grass 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 non-use 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. 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.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1816	2715	3094
Shrub/Vine	62	188	359
Forb	140	235	359
Total	**2018**	**3138**	**3812**

Figure 20. Plant community growth curve (percent production by month). SD5501, Southern Black Glaciated Plains, cool-season dominant.. Cool-season dominant..

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

Community 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 eventually a thatch-mat layer may develop at the surface as well. 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.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	925	1404	1984
Forb	73	118	174
Shrub/Vine	11	47	84
Total	**1009**	**1569**	**2242**

Figure 22. Plant community growth curve (percent production by month). SD5502, Southern Black Glaciated Plains, cool-season dominant, warm-season . Cool-season dominant, warm-season subdominant..

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

Community 4.3
Annual/Pioneer, Non-Native Perennial

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

Conservation practices

Prescribed Grazing

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.

Conservation practices

Integrated Pest Management (IPM)

State 5
Conifer-Invaded State

The Conifer-Invaded Stateis 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 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 redcedar 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 redcedar trees per acre (or one tree every thirteen feet) is reduced 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 Redcedar-Rocky Mountain Juniper/Little Bluestem

This plant community evolved due to the invasion of conifers, such as eastern redcedar 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, porcupinegrass, 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 redcedar and Rocky Mountain juniper. When compared to the 1.1 Little Bluestem-Big Bluestem-Porcupinegrass Plant Community, coniferous trees have increased significantly and herbaceous component has decreased. This plant community is susceptible to the encroachment of eastern redcedar and Rocky Mountain juniper.

Community 5.2
Eastern Redcedar-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 Redcedar-Rocky Mountain Juniper/Little Bluestem Plant Community, the amount of non-native 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 eventually a thatch-mat layer may develop at the surface as well. 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 Redcedar-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 redcedar 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 Redcedar-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, heavy continuous grazing, or invasion of non-native plant species will shift this plant community to the 5.2 Eastern Redcedar-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 Redcedar-Rocky Mountain Juniper Plant Community Phase.

State 6
Crop Production State

The Crop Production 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 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-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, 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 T5
State 1 to 4

Encroachment of non-native invasive and noxious species, abandonment of cropping, or seeding of introduced or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4), and more specifically to the 4.3 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group (FSG) description for adapted species and expected production (production estimates in the FSG description may be unrealistically high due to the degraded condition of the site at this phase).

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 Redcedar-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 T5
State 2 to 4

Encroachment of non-native invasive or noxious species, abandonment of cropping, or seeding of introduced or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4), and more specifically to the 4.3 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group (FSG) description for adapted species and expected production (production estimates in the FSG description may be unrealistically high due to the degraded condition of the site at this phase).

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, T3B
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). 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), will likely lead this state over a threshold leading to the 4.2 Kentucky Bluegrass-Blue Grama Plant Community Phase within the Invaded State (State 4). Grazing repeatedly in the early growing season can expedite this shift by causing mechanical disturbance due to trampling.

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 every 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 Redcedar-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 every 3 to 5 years), and a return to normal disturbance regime levels may lead this 5.1 Eastern Redcedar-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, every 3 to 5 years), and a return to normal disturbance regime levels may lead this 5.2 Eastern Redcedar-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, every 3 to 5 years), and a return to normal disturbance regime levels may lead this 5.3 Eastern Redcedar-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).

Restoration pathway T5C
State 5 to 4

Brush management (which would include the mechanical removal of the conifers) may lead this 5.2 Eastern Redcedar-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 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 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**			605–1059	
	little bluestem	SCSC	*Schizachyrium scoparium*	303–908	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	151–454	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	91–303	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–151	–
2	**Cool-Season Bunchgrasses**			303–757	
	porcupinegrass	HESP11	*Hesperostipa spartea*	151–605	–
	green needlegrass	NAVI4	*Nassella viridula*	91–454	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	61–303	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–151	–
3	**Tall Warm-Season Grasses**			303–757	
	big bluestem	ANGE	*Andropogon gerardii*	242–757	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	30–151	–
	switchgrass	PAVI2	*Panicum virgatum*	30–151	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–151	–
4	**Wheatgrass**			151–303	
	western wheatgrass	PASM	*Pascopyrum smithii*	151–303	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–151	–
5	**Short Warm-Season Grasses**			61–151	
	blue grama	BOGR2	*Bouteloua gracilis*	61–151	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–91	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–91	–
6	**Other Native Grasses**			30–151	
	prairie Junegrass	KOMA	*Koeleria macrantha*	30–91	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–61	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–61	–
7	**Grass-likes**			61–212	
	threadleaf sedge	CAFI	*Carex filifolia*	61–212	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–61	–
Forb					
8	**Forbs**			151–303	
	Forb, native	2FN	*Forb, native*	30–91	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	30–91	–

	stiff sunflower	HEPA19	*Helianthus pauciflorus*	30–61	–
	blazing star	LIATR	*Liatris*	30–61	–
	scurfpea	PSORA2	*Psoralidium*	30–61	–
	cutleaf anemone	PUPAM	*Pulsatilla patens ssp. multifida*	0–61	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	30–61	–
	compassplant	SILA3	*Silphium laciniatum*	0–61	–
	goldenrod	SOLID	*Solidago*	30–61	–
	white heath aster	SYER	*Symphyotrichum ericoides*	30–61	–
	American vetch	VIAM	*Vicia americana*	30–61	–
	field sagewort	ARCA12	*Artemisia campestris*	0–61	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	30–61	–
	purple prairie clover	DAPU5	*Dalea purpurea*	30–61	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	30–61	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–30	–
	milkvetch	ASTRA	*Astragalus*	0–30	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–30	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–30	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–30	–
	pussytoes	ANTEN	*Antennaria*	0–30	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–30	–
Shrub/Vine					
9	**Shrubs**			91–242	
	leadplant	AMCA6	*Amorpha canescens*	30–151	–
	snowberry	SYMPH	*Symphoricarpos*	30–91	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–61	–
	rose	ROSA5	*Rosa*	30–61	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–61	–

Table 10. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid Warm-Season Grasses**			213–532	
	little bluestem	SCSC	*Schizachyrium scoparium*	106–426	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–106	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–106	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–106	–
2	**Cool-Season Bunchgrasses**			43–213	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	43–213	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–106	–
	green needlegrass	NAVI4	*Nassella viridula*	0–106	–
3	**Tall Warm-Season Grasses**			43–213	
	big bluestem	ANGE	*Andropogon gerardii*	43–213	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–64	–

	switchgrass	PAVI2	*Panicum virgatum*	0–43	–
4	**Wheatgrass**			213–426	
	western wheatgrass	PASM	*Pascopyrum smithii*	213–426	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–43	–
5	**Short Warm-Season Grasses**			106–319	
	blue grama	BOGR2	*Bouteloua gracilis*	106–319	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–106	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–106	–
6	**Other Native Grasses**			21–106	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–106	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–43	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	21–43	–
7	**Grass-likes**			106–256	
	threadleaf sedge	CAFI	*Carex filifolia*	64–256	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–106	–
8	**Non-Native Grasses**			106–383	
	Kentucky bluegrass	POPR	*Poa pratensis*	43–319	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–213	–
	brome	BROMU	*Bromus*	21–170	–
	quackgrass	ELRE4	*Elymus repens*	0–106	–
	smooth brome	BRIN2	*Bromus inermis*	0–106	–
Forb					
9	**Forbs**			106–319	
	Forb, introduced	2FI	*Forb, introduced*	21–149	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	21–106	–
	field sagewort	ARCA12	*Artemisia campestris*	0–85	–
	Forb, native	2FN	*Forb, native*	0–64	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	21–64	–
	scurfpea	PSORA2	*Psoralidium*	21–64	–
	goldenrod	SOLID	*Solidago*	21–64	–
	white heath aster	SYER	*Symphyotrichum ericoides*	21–64	–
	blazing star	LIATR	*Liatris*	0–43	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–43	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	21–43	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–21	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–21	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–21	–
	pussytoes	ANTEN	*Antennaria*	0–21	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–21	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–21	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–21	–
	American vetch	VIAM	*Vicia americana*	0–21	–

	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–21	–
Shrub/Vine					
10	**Shrubs**			21–106	
	prairie sagewort	ARFR4	*Artemisia frigida*	21–64	–
	rose	ROSA5	*Rosa*	0–43	–
	snowberry	SYMPH	*Symphoricarpos*	0–43	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–43	–
	leadplant	AMCA6	*Amorpha canescens*	0–43	–

Table 11. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid Warm-Season Grasses**			0–16	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–157	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–63	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–31	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–31	–
2	**Cool-Season Bunchgrasses**			0–157	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–157	–
3	**Tall Warm-Season Grasses**			0–157	
	big bluestem	ANGE	*Andropogon gerardii*	0–94	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–94	–
4	**Wheatgrass**			0–314	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–314	–
5	**Short Warm-Season Grasse**			0–157	
	blue grama	BOGR2	*Bouteloua gracilis*	0–157	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–31	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–31	–
6	**Other Native Grasses**			0–157	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–157	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–63	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–31	–
7	**Grass-likes**			31–157	
	threadleaf sedge	CAFI	*Carex filifolia*	31–157	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–94	–
8	**Non-Native Grasses**			628–2040	
	smooth brome	BRIN2	*Bromus inermis*	314–1726	–
	Kentucky bluegrass	POPR	*Poa pratensis*	157–942	–
	brome	BROMU	*Bromus*	63–471	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–471	–
	quackgrass	ELRE4	*Elymus repens*	0–314	–

Forb					
9	**Forbs**			157–314	
	Forb, introduced	2FI	*Forb, introduced*	31–157	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	31–126	–
	Forb, native	2FN	*Forb, native*	0–94	–
	goldenrod	SOLID	*Solidago*	31–94	–
	white heath aster	SYER	*Symphyotrichum ericoides*	31–94	–
	scurfpea	PSORA2	*Psoralidium*	31–63	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–63	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	31–63	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–63	–
	field sagewort	ARCA12	*Artemisia campestris*	0–63	–
	blazing star	LIATR	*Liatris*	0–31	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–31	–
	pussytoes	ANTEN	*Antennaria*	0–31	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–31	–
	American vetch	VIAM	*Vicia americana*	0–31	–
Shrub/Vine					
10	**Shrubs**			63–314	
	snowberry	SYMPH	*Symphoricarpos*	63–314	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–126	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–63	–
	rose	ROSA5	*Rosa*	0–63	–

Table 12. Community 4.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Bunchgrasses**			0–78	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–78	–
2	**Wheatgrass**			0–235	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–235	–
3	**Short Warm-Season Grasses**			157–392	
	blue grama	BOGR2	*Bouteloua gracilis*	157–392	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–78	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–78	–
4	**Other Native Grasses**			16–78	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–78	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–31	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	16–31	–
5	**Grass-likes**			157–392	
	threadleaf sedge	CAFI	*Carex filifolia*	157–392	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–78	–
6	**Non-Native Grasses**			235–628	
	Kentucky bluegrass	POPR	*Poa pratensis*	157–549	–
	smooth brome	BRIN2	*Bromus inermis*	0–157	–
	brome	BROMU	*Bromus*	16–157	–
	quackgrass	ELRE4	*Elymus repens*	0–157	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–78	–
Forb					
7	**Forbs**			78–157	
	Forb, introduced	2FI	*Forb, introduced*	16–78	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	16–63	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	16–47	–
	field sagewort	ARCA12	*Artemisia campestris*	0–47	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	16–47	–
	goldenrod	SOLID	*Solidago*	16–47	–
	white heath aster	SYER	*Symphyotrichum ericoides*	16–47	–
	scurfpea	PSORA2	*Psoralidium*	0–31	–
	Forb, native	2FN	*Forb, native*	0–31	–
	pussytoes	ANTEN	*Antennaria*	0–16	–
Shrub/Vine					
8	**Shrubs**			16–78	
	prairie sagewort	ARFR4	*Artemisia frigida*	16–63	–
	snowberry	SYMPH	*Symphoricarpos*	0–47	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–31	–

Animal community

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. Stocking rates are calculated using Animal-Unit-Month (AUM), which is the amount of air-dry forage required to feed a cow, with or without calf, for one month.

Bluestem/Needlegrass (1.1 & 3.1)
Average Annual Production (lbs./acre, air-dry): 2,700
Stocking Rate* (AUM/acre): 0.74

Little Bluestem/Western Wheatgrass/Kentucky Bluegrass (3.2)
Average Annual Production (lbs./acre, air-dry): 1,900
Stocking Rate* (AUM/acre): 0.52

Smooth Bromegrass/Kentucky Bluegrass (4.1)
Average Annual Production (lbs./acre, air-dry): 2,800
Stocking Rate* (AUM/acre): 0.77

Kentucky Bluegrass/Blue Grama (4.2)
Average Annual Production (lbs./acre, air-dry): 1,400
Stocking Rate* (AUM/acre): 0.38

Annual/Pioneer, Non-Native Perennial (4.3)
Average Annual Production (lbs./acre, air-dry): 800
Stocking Rate* (AUM/acre): 0.22

*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 short-grasses form a strong sod and dominate the site. Dominance by blue grama, buffalograss, bluegrass, or smooth bromegrass will result in reduced infiltration and increased runoff. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Recreational uses

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

Wood products

No appreciable wood products are typically present on this site.

Other products

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

Other information

Ecological Site Correlation Issues and Questions:

• SD059 Hand County, SD did not use the (GnA) Glenham-Java-Cavo loams, 0 to 4 percent slopes (national symbol cw4v) as used in the adjoining SD069 Hyde County, SD.
• SD059 Hand County, SD did not use the (HgB) Highmore-Java complex, 1 to 5 percent slopes (national symbol cxxx) as used in the adjoining SD603 Brule and Buffalo Counties, SD.
• SD059 Hand County, SD did not use the (HwB) Houdek-Ethan-Prosper loams, 1 to 6 percent slopes (national symbol 2tlb9) as used in the adjoining SD073 Jerauld County, SD.
• SD059 Hand County, SD did not use the (HwC) Houdek-Ethan-Prosper loams, 2 to 9 percent slopes (national symbol 2tlbb) as used in the adjoining SD073 Jerauld County, SD.
• SD059 Hand County, SD did not use the (HeC) Houdek-Ethan loams, 1 to 6 percent slopes (national symbol 2wkqk) as used in the adjoining SD005 Beadle County, SD.
• SD059 Hand County, SD did not use the (BeD) Betts stony loam, 6 to 40 percent slopes (national symbol cwy3) as used in the adjoining SD005 Beadle County, SD.
• SD059 Hand County, SD did not use the (BfD) Ethan-Betts loams, 9 to 15 percent slopes (national symbol 2wkq8) as used in the adjoining SD005 Beadle County, SD.
• SD059 Hand County, SD did not use the (HgB) Hand-Ethan-Bonilla loams, 1 to 6 percent slopes (national symbol cz3m) as used in the adjoining SD115 Spink County, SD.
• SD059 Hand County, SD did not use the (HgC) Hand-Ethan-Bonilla loams, 2 to 9 percent slopes (national symbol cz3m) as used in the adjoining SD115 Spink County, SD.
• SD059 Hand County, SD did not use the (MmB) Max-Arnegard-Zahl loams, 1 to 6 percent slopes (national symbol cxlf) as used in the adjoining SD049 Faulk County, SD.
• 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, NRCS; and Bruce Kunze, Soil Scientist, NRCS.

Data Source Sample Period State County
SCS-RANGE-417 (0787146059) 9/13/1975 SD Hand
SCS-RANGE-417 (1008546069) 9/12/1985 SD Hyde
SCS-RANGE-417 (0018546115) 10/31/1985 SD Spink
SCS-RANGE-417 (0038546073) 10/30/1985 SD Jerauld
SCS-RANGE-417 (0018646073) 10/15/1986 SD Jerauld
SCS-RANGE-417 (0018646115) 10/28/1985 SD Spink
SCS-RANGE-417 (0018746073) 10/9/1987 SD Jerauld
SCS-RANGE-417 (0018746115) 10/22/1987 SD Spink

Other references

Cleland, D.T., J.A. Freeouf, J.E. Keys, G.J. Nowacki, C. Carpenter, and W.H. McNab. 2007. Ecological Subregions: Sections and Subsections of the Coterminous United States. USDA Forest Service, General Technical Report WO-76. Washington, DC.

Gilbert, M. C., Whited, P. M., Clairain Jr, E. J., & Smith, R. D. (2006). A Regional Guidebook for Applying the

Hydrogeomorphic Approach to Assessing Wetland Functions of Prairie Potholes. Washington DC.

Samson, F. B., & Knopf, F. L. (1996). Prairie Conservation Preserving North America's Most Endagered Ecosystem. Washington D.C.: Island Press.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions. Available online. Accessed March 2018.

United States Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS). 2003. National Range and Pasture Handbook, Revision 1. Grazing Lands Technology Institute.

United States Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS). 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

USDA, NRCS. National Soil Information System, Information Technology Center, (http://soils.usda.gov/technical/nasis/)

USDA, NRCS. 2019. The PLANTS Database (http://plants.usda.gov, 13 March 2019).

U.S. Environmental Protection Agency [EPA]. 2013. Level III and Level IV Ecoregions of the Continental United States. Corvallis, OR, U.S. EPA, National Health and Environmental Effects Research Laboratory, map scale 1:3,000,000. Available at http://www.epa.gov/eco-research/level-iii-and-iv-ecoregions- continental-united-states. (Accessed 13 March 2019).

High Plains Regional Climate Center, University of Nebraska. (http://www.hprcc.unl.edu/)

USDA, NRCS. National Water and Climate Center. (http://wcc.nrcs.usda.gov)

USDA, NRCS. National Range and Pasture Handbook, September 1997

USDA, NRCS. 2001. The PLANTS Database, Version 3.1 (http://plants.usda.gov). National Plant Data Center.

Contributors

Stan Boltz

Approval

Suzanne Mayne-Kinney, 1/31/2024

Acknowledgments

Contact for Lead Authors: Natural Resources Conservation Service (USDA-NRCS), Redfield Soil Survey Office Redfield, SD; Lance Howe (Lance.Howe@usda.gov), Soil Survey Office Leader, USDA-NRCS, Redfield, SD; and Steve Winter (Steven.Winter@usda.gov), Soil Scientist, USDA-NRCS, Redfield, SD

Additional Information Acknowledgment: Jason Hermann (Jason.Hermann@usda.gov), Area Rangeland Management Specialist, USDA-NRCS, Redfield, SD.

This Provisional Ecological Site concept has passed both Quality Control and Quality Assurance processes. Officially approved for publication by David Kraft as of 11/12/2020.

derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, available online and at any USDA office, or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632- 9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

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
Contact for lead author	Stan Boltz, stanley.boltz@sd.usda.gov, 605-352-1236
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.

---

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

---

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.

---

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.

---

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

---

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

---

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.

---

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.

---

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.

---

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.

---

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.

---

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

    Additional: Other native grasses occur in other functional groups in minor amounts. Due to differing root structure and distribution, Kentucky bluegrass and smooth bromegrass do not fit into reference plant community F/S groups.

---

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.

---

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.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2,000–3,400 lbs./acre air-dry weight, average 2,700 lbs./acre air-dry weight.

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.

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