USDA Natural Resources Conservation Service

Ecological site R061XY042SD
Lowland

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General information

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

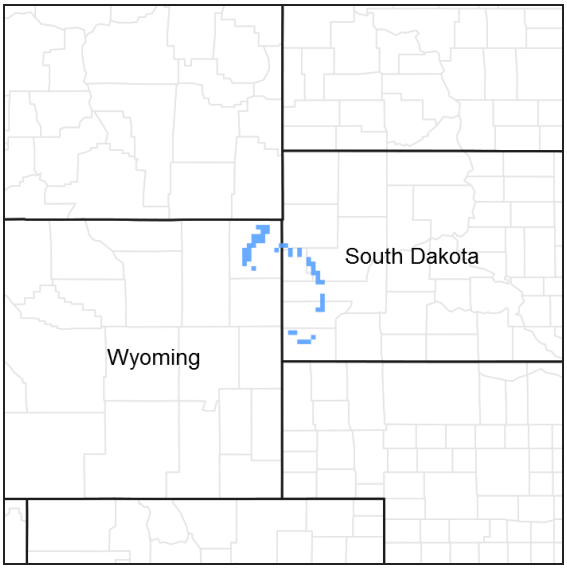

Figure 1. Mapped extent

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

MLRA notes

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

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

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

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

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

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

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

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

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

LRU notes

For development of ecological sites, MLRA 61 is divided into three precipitation zones (PZ).

The northern area (18–22” PZ) extends from just south of Rapid City, South Dakota, north to the Wyoming border.

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

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

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

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

Classification relationships

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

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

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

Ecological site concept

The Lowland ecological site is found throughout MLRA 61. It is located on Strahler Stream Orders 2 or greater. This site is a run-in site and receive additional moisture through occasional overflow during flooding and high-water events, and to a minor extent, runoff from adjacent sites. The slopes range from 0 to 3 percent. The soil surface layer is 4 to 20 inches in depth with a texture range of silt loam to fine sandy loam. The soils in this site are formed

in stratified alluvium. This site occurs on low stream terraces and most vegetation has access to the water table. Typically, this site is positioned between the loamy terrace (upslope) and the overflow (downslope) ecological sites.

The vegetation in the Reference State (1.0) is a mix of grasses and grass-likes, forbs, shrubs and trees. Major grasses include big bluestem, switchgrass, green needlegrass, Indiangrass, and western wheatgrass. Forbs are common and very diverse. Patches of western snowberry, American plum, chokecherry, silver sage, and willow are almost always present. Green ash, boxelder, cottonwood, and in some locations bur oak, will occur as scattered individuals to larger patches. This site is susceptible to encroachment of ponderosa pine from the surrounding uplands and breaks and from the invasion of Russian olive. When disturbed, this site is very susceptible to invasion of non-native cool-season grasses, Canada thistle, hound's tongue, and other weedy forbs.

Associated sites

R061XN010SD	**Loamy-North (18-22" PZ)** The Loamy 18-22" PZ ecological is found on upland landscapes above the Lowland ecological site.
R061XS010SD	**Loamy-South (16-18" PZ)** The Loamy 16-18" PZ ecological is found on upland landscapes above the Lowland ecological site.
R061XY020SD	**Overflow** The Overflow ecological site is found adjacent to the Lowland ecological site in flood plains and creek channels.
R061XY022SD	**Loamy Terrace** The Loamy Terrace ecological site is found on the terrace above the Lowland ecological site in flood plains and creek channels.
R061XW112WY	**Loamy-West (16-20" PZ)** The Loamy 16-20" PZ ecological site is found on upland landscapes above the Lowland ecological site.

Similar sites

R061XY022SD	**Loamy Terrace** The Loamy Terrace ecological site will have fewer trees than the Lowland ecological site. If trees exist, they will be mature trees and with little or no regeneration.
R061XW112WY	**Loamy-West (16-20" PZ)** The Loamy 16-20' PZ ecological site will have fewer tall warm-season grasses; shrubs; and lower vegetative production than the Lowland ecological site.
R061XS010SD	**Loamy-South (16-18" PZ)** The Loamy 16-18' PZ ecological site will have fewer tall warm-season grasses; shrubs; and lower vegetative production than the Lowland ecological site.
R061XY020SD	**Overflow** The Overflow ecological site will have fewer trees than the Lowland ecological site.
R061XN010SD	**Loamy-North (18-22" PZ)** The Loamy 18-22" PZ ecological site will have fewer tall warm-season grasses; shrubs; and lower vegetative production than the Lowland ecological site.

Table 1. Dominant plant species

Tree	(1) *Fraxinus pennsylvanica*
Shrub	(1) *Symphoricarpos occidentalis*
Herbaceous	(1) *Andropogon gerardii* (2) *Panicum virgatum*

Physiographic features

The Lowland ecological site occurs on nearly level drainageways, low stream terraces, and floodplains.

Table 2. Representative physiographic features

Landforms	(1) Valley > Flood plain (2) Valley > Stream terrace
Runoff class	Negligible to medium
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to occasional
Ponding frequency	None
Elevation	884–1,524 m
Slope	0–3%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

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

The average annual temperature is about 47 °F. January and December are the coldest months with average temperatures ranging from about 23 °F (NNW of Edgemont, SD) to about 26 °F (Fort Meade, SD). July is the warmest month with average temperatures ranging from about 69 °F (Fort Meade, WY) to about 73 °F (Hot Springs, SD). The range of average monthly temperatures between the coldest and warmest months is about 47 °F. Wind speeds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime winds. Occasionally, storms bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and continue to early or mid-September. Cool-season plants may green-up in September and October if adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	96-117 days
Freeze-free period (characteristic range)	120-143 days
Precipitation total (characteristic range)	457-533 mm
Frost-free period (actual range)	80-124 days
Freeze-free period (actual range)	115-157 days
Precipitation total (actual range)	406-559 mm
Frost-free period (average)	107 days
Freeze-free period (average)	133 days
Precipitation total (average)	483 mm

Climate stations used

- (1) BEAR RIDGE [USC00390554], Spearfish, SD
- (2) EDGEMONT [USC00392557], Edgemont, SD

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

Influencing water features

The Lowland ecological site will be associated with riparian areas and possible wetland features.

Stream Type: B6, C6
(Rosgen System)

Wetland description

Not Applicable.

Soil features

The common features of soils in this site are 4 to 20 inches thick silt loam to fine sandy loam surface layer. Sub-surface textures are fine sandy loam to loam. Slopes ranging from about 0 to 4 percent. The soils in this site are well drained and formed in stratified alluvium. They have a moderate to moderately slow infiltration rate. This site is on a low stream terrace and is occasionally flooded. Most vegetation has access to the water table.

This site typically should show slight to no evidence of rills, wind-scoured areas or pedestalled plants. If present, water flow paths are broken, irregular in appearance or discontinuous. The soil surface is stable and intact. Sub-surface soil layers are nonrestrictive to water movement and root penetration.

Major Soils correlated to the Lowland ecological site include, Pathfinder, Sodawells, and St. Onge. These soils will typically have an occasionally flooded Local Phase, and a Flooding rating of occasionally to rare.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 10 percent. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and production.

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

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Silt loam (2) Fine sandy loam (3) Loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Moderately slow to moderate
Soil depth	203 cm
Surface fragment cover <=3"	0–10%

Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	12.7–20.32 cm
Calcium carbonate equivalent (0-101.6cm)	0–20%
Electrical conductivity (0-101.6cm)	0–8 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–4
Soil reaction (1:1 water) (0-101.6cm)	5.1–9
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

The Lowland ecological site developed under Northern Great Plains climatic conditions; light to severe grazing by bison and other large herbivores; sporadic, natural or human-caused wildfire (often of light intensities); and other biotic and abiotic factors that typically influence soil and site development. Changes occur in the plant communities due to short-term weather variations, effects of native and exotic plant and animal species, and management actions. Although the following plant community descriptions are typical of the transitions between communities, severe disturbances, such as periods of well below average precipitation and the introduction of non-native cool-season grasses, and non-native deciduous trees, can cause significant shifts in plant communities and species composition.

Continuous season-long grazing (during the typical growing season of May through October); or excessive haying; or no use and no fire and the invasion of non-native cool-season grasses causes departure from the Big Bluestem-Switchgrass-Needlegrass/Scattered Shrubs/Scattered Trees Plant Community (1.1). Kentucky bluegrass, smooth brome, or timothy will increase and eventually develop into a sod. Trees and shrubs will persist across the site but without occasional flooding recruitment will not likely to occur.

Flooding, no fire, and long-term prescribed grazing which includes extended periods of rest can transition the primarily herbaceous Reference Plant Community (1.1) to the woody dominated Wooded Overstory State (4.0).

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

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

State and transition model

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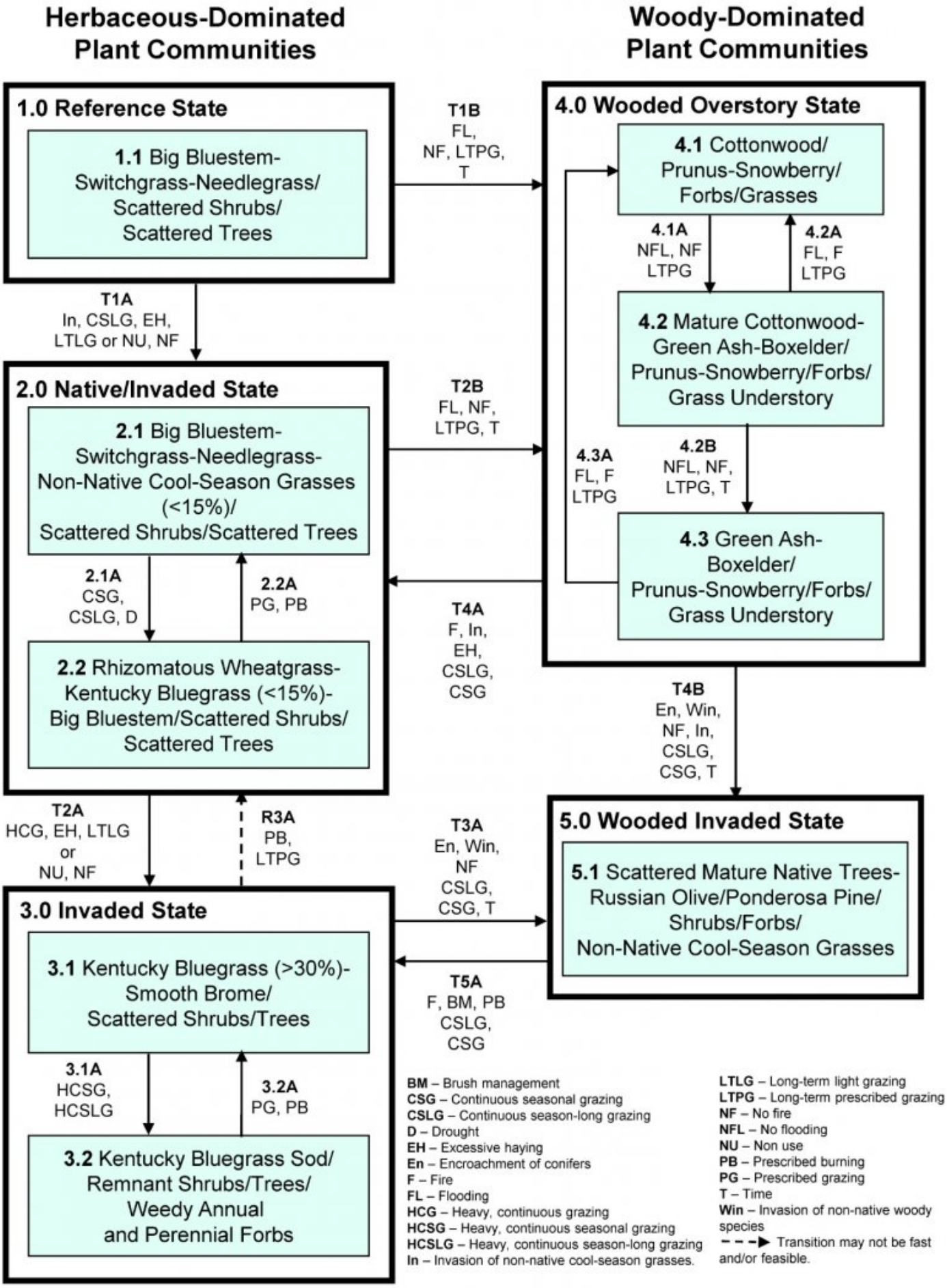

Diagram Legend: Lowland - R061XY042SD

T1A	1.0 to 2.0	Continuous season-long grazing; excessive haying; invasion and establishment of non-native, cool-season grasses; long-term light grazing; or extended periods of non-use and no fire.
T1B	1.0 to 4.0	Flooding; no fire; long-term prescribed grazing with proper stocking, change in season of use, and deferment to provides time for establishment of tree seedling.
T2A	2.0 to 3.0	Heavy, continuous grazing; excessive haying; or long-term light grazing will cause this transition. Extended periods of non-use and no fire can also cause this transition.
T2B	2.0 to 4.0	Flooding; no fire; followed by long-term prescribed grazing with proper stocking, change in season of use, and deferment to provide time for establishment of tree seedling.
T3A	3.0 to 5.0	Encroachment of conifer trees; invasion of non-native woody species; no fire; continuous season-long grazing; or continuous seasonal grazing; and time.
T4A	4.0 to 2.0	Fire; invasion of non-native, cool-season grasses; excessive haying; continuous season-long grazing; or continuous seasonal grazing.
T4B	4.0 to 5.0	Encroachment of conifer trees; invasion of non-native woody species; invasion of non-native, cool-season grasses; no fire; continuous season-long grazing; or continuous seasonal grazing; and time.
T5A	5.0 to 3.0	Fire; prescribed burning; and/or mechanical or chemical brush management; continuous season-long grazing; or continuous seasonal grazing.

R3A	3.0 to 2.0	Long-term prescribed grazing with proper stocking rates, change in season of use, and adequate time for plant recovery; prescribed burning followed by long-term prescribed grazing. This transition may not be fast or feasible.

2.1A	2.1 to 2.2	Continuous seasonal grazing; continuous season-long grazing; heavy grazing in combination with drought.
2.2A	2.2 to 2.1	Prescribed grazing with proper stocking, change in season of use, and adequate time for plant recovery; prescribed burning followed by prescribed grazing.
3.1A	3.1 to 3.2	Heavy, continuous seasonal grazing; heavy, continuous season-long grazing.
3.2A	3.2 to 3.1	Prescribed grazing with proper stocking, change in season of use, and adequate time for plant recovery; prescribed burning followed by prescribed grazing.
4.1A	4.1 to 4.2	No flooding; no fire; long-term prescribed grazing that included proper stocking, change in season of use, and deferment which provides opportunity for woody regeneration; and time.
4.2A	4.2 to 4.1	Flooding; or fire; long-term prescribed grazing with proper stocking, change in season of use, and deferment which provides opportunity for woody regeneration.
4.2B	4.2 to 4.3	No flooding; no fire; long-term prescribed grazing that included proper stocking, change in season of use; and time.
4.3A	4.3 to 4.1	Flooding; fire; long-term prescribed grazing that with proper stocking, change in season of use, and deferment which provides opportunity for woody regeneration.

State 1
Reference State

The Reference State represents what is believed to show the natural range of variability that dominated the dynamics of the ecological site prior to European settlement. Historically, this state ranged from a tall, warm-season grass dominated site to one dominated by deciduous shrubs, saplings, and trees depending upon disturbance regime. The primary disturbance mechanisms for this site in the reference condition included periodic fire and grazing by large herding ungulates. Timing of fires and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Dominance during the herbaceous phases of this state shifted between warm-season and cool-season grasses. Although slight shifts may have occurred in timing of energy capture, hydrologic function, and nutrient cycling between plant community phases within the Reference State (1.0), overall the ecological processes were functioning at near optimum levels. High basal density and deep root systems resulted in low runoff rates and high infiltration rates. Areas of trees and shrubs existed within this state due to irregularity of burn patterns. Areas which escaped fire may have permitted trees and shrubs to become established. These areas may have served as a seed source for further expansion of the woody dominated plant communities as the fire frequency was altered after settlement.

Community 1.1
Big Bluestem-Switchgrass-Needlegrass/Scattered Shrubs/Scattered Trees

Interpretations are based primarily on the Big Bluestem-Switchgrass-Needlegrass/Scattered Shrubs/Scattered Trees Plant Community. This is also considered to be the Reference Plant Community (1.1). This community evolved with grazing by large herbivores and occasional prairie fire. The vegetation was about 70 percent grasses and grass-like plants, 10 percent forbs, 10 percent shrubs, and 10 percent trees. Major grasses included big bluestem, switchgrass, green needlegrass, Indiangrass, and western wheatgrass. Other grasses that occurred within this community included slender wheatgrass, thickspike wheatgrass, Canada wildrye, little bluestem, sideoats grama, and blue grama. Major forbs and shrubs included American licorice, sunflower, goldenrod, and western snowberry. Green ash, American elm, bur oak, and other native tree species occurred as scattered individuals to larger patches. This plant community was well adapted to the Northern Great Plains climatic conditions. Individual species varied greatly in production depending on growing conditions (timing and amount of precipitation and temperature). Community dynamics, nutrient cycle, water cycle, and energy flow were properly functioning. Due to the diversity of warm- and cool-season species within this plant community phase, energy capture was spread more evenly throughout the growing season compared to other plant community phases within this state. Plant litter was properly distributed in contact with the soil surface and with very little movement offsite. Natural plant mortality was very low. The diversity in plant species allowed for high drought tolerance. Runoff from adjacent sites and moderate or high available water capacity provided a favorable soil-water-plant relationship.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2169	2780	3307
Shrub/Vine	174	269	392
Tree	174	269	392
Forb	174	269	392
Total	**2691**	**3587**	**4483**

Figure 9. Plant community growth curve (percent production by month). SD6104, Black Hills Foot Slopes, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

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

State 2
Native/Invaded State

The Native/Invaded State (2.0) 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. The invasion of non-native cool-season grasses has also altered the natural range of variability for this ecological site. Currently this state is dominated by tall native warm-season grasses, but invasive introduced cool-season grasses are now present in all community phases of this state. 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. Many times, this state appears as a mosaic of community phases caused primarily by continuous season-long grazing. Native cool- and warm-season species can decline and a corresponding increase in non-native cool-season grasses will occur. Non-native cool-season grasses will typically make up less than 15 percent of total annual production. Preliminary studies tend to indicate that when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition a threshold has been crossed to an Invaded State (5.0). These invaded plant communities that are dominated by Kentucky bluegrass will have significantly less cover and diversity of native grasses and forb species (Toledo, D. et al., 2014).

Community 2.1
Big Bluestem-Switchgrass-Needlegrass-Non-Native Cool-Season Grasses (<15%)/Scattered Shrubs/Scattered Trees

This plant community phase is similar to the Big Bluestem-Switchgrass-Needlegrass/Scattered Shrub /Scattered Trees Plant Community (1.1) but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass. smooth brome, and possibly timothy (up to about 15 percent by air-dry weight). The potential vegetation is about 70 percent grasses or grass-like plants, 10 percent forbs, 10 percent shrubs, and 10 percent mature trees. The community is dominated by warm-season grasses. Major grasses include big bluestem, switchgrass, green needlegrass, Indiangrass, and western wheatgrass. Other grasses that occur within this community include slender wheatgrass, thickspike wheatgrass, Canada wildrye, little bluestem, sideoats grama, and blue grama. Major forbs and shrubs include American licorice, sunflower, goldenrod, chokecherry, and western snowberry. Green ash, American elm, bur oak, and other native tree species occur as scattered individuals to larger patches. Ecological processes are functioning at levels near what would be expected for the Reference State (1.0) although nutrient cycling may be somewhat altered due to changes in disturbance regimes (lack of fire, frequency and intensity of grazing events) and energy capture may be shifted slightly to more late spring, early summer. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regard to soil and site stability, watershed function, and biologic integrity.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1978	2606	3166
Forb	163	252	364
Shrub/Vine	163	252	364
Tree	163	252	364
Total	**2467**	**3362**	**4258**

Figure 11. Plant community growth curve (percent production by month). SD6104, Black Hills Foot Slopes, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

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

Community 2.2
Rhizomatous Wheatgrass-Kentucky Bluegrass (<15%)-Big Bluestem/Scattered Shrubs/Scattered Trees

This plant community is characterized by a shift to mid-cool-season rhizomatous grasses with minor amounts of tall warm-season and mid-cool-season bunchgrasses. The vegetation is about 70 percent grasses and grass-like plants, 10 percent forbs, 10 percent shrubs, and 10 percent trees. Dominant grasses would include western wheatgrass and Kentucky bluegrass with minor amounts of needlegrasses, big bluestem, and switchgrass. Major forbs would include Cumin ragweed (western ragweed), goldenrods, and western yarrow. Chokecherry and snowberry would be the dominate shrubs. Green ash, plains cottonwood, and possibly bur oak will be present in most areas. Energy capture by this plant community phase has shifted from late spring and summer to early spring

through early summer.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1536	1998	2410
Shrub/Vine	123	193	280
Tree	123	193	280
Forb	123	194	280
Total	**1905**	**2578**	**3250**

Figure 13. Plant community growth curve (percent production by month). SD6102, Black Hills Foot Slopes, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant.

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

Pathway 2.1A
Community 2.1 to 2.2

Continuous seasonal grazing which includes grazing at moderate to heavy stocking levels at the same time of year each year; or continuous season-long grazing; will shift this community (2.1) to the Rhizomatous Wheatgrass-Kentucky Bluegrass (<15%)/Shrubs/Scattered Trees Plant Community (2.2).

Pathway 2.2A
Community 2.2 to 2.1

Prescribed grazing (proper stocking levels, alternating season of use, and providing adequate recovery periods); possibly prescribed burning in combination with prescribed grazing; will convert this plant community (2.2) to the Big Bluestem-Switchgrass-Needlegrass-Rhizomatous-Non-Native Cool-Season Grass (<15%)/Shrubs/Scattered Trees Plant Community (2.1).

Conservation practices

Prescribed Burning
Prescribed Grazing

State 3
Invaded State

This Invaded State (3.0) is the result of invasion and dominance of introduced species. The Invaded State is characterized by the dominance of Kentucky bluegrass and smooth brome, and an increasing thatch layer that effectively blocks introduction of other plants into the system. Plant litter accumulation tends to favor the more shade-tolerant, introduced grass species. The nutrient cycle is also impaired, and the result is typically a higher level of nitrogen, which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns, thereby shifting competitive advantage to shade-tolerant introduced grass species. Studies indicate that soil biological activity is altered, and this shift apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the invasive grass dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent and native grasses represent less than 40 percent of the plant community composition. Plant communities dominated by Kentucky bluegrass have significantly less cover and diversity of native grasses and forb species (Toledo, D., et al., 2014). Once this state is well established, even drastic events such as high intensity fires driven by high fuel loads of litter and thatch may not result in more than a very short-term reduction of Kentucky bluegrass. These events can reduce the dominance of Kentucky bluegrass, but due to the large amount of rhizomes in the soil, there is little opportunity for the native species to establish and

dominate before Kentucky bluegrass rebounds and again dominates the system.

Community 3.1
Kentucky Bluegrass (>30%)-Smooth Brome/Scattered Shrubs/Scattered Trees

This plant community phase is a result of heavy, continuous grazing, excessive haying, or extended periods of non-use and no fire. It is characterized by a dominance of Kentucky bluegrass and smooth brome. 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 through non-use. Vegetative production can be variable in this plant community. The period that forage palatability is high is relatively short, as these cool-season species mature rapidly. Grasses constitute about 70 percent of the production with forbs contributing 10 percent, shrubs 10 percent, and trees 10 percent. Dominant forbs include white sagebrush (cudweed sagewort), goldenrod, and American licorice. Shrubs would include snowberry, plum, chokecherry, and prairie rose. Grazing pressure alone cannot induce a reduction in sodgrass dominance. Production is limited to the sod forming species. Infiltration continues to decrease, and runoff increases. Energy capture into the system is restricted to early season low producing species. The opportunity for high intensity spring burns is reduced by early green-up and increased moisture and humidity at the soil surface. Nutrient cycling is greatly reduced, and native plants have great difficulty becoming established.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1995	2438	2802
Shrub/Vine	157	325	504
Tree	157	244	364
Forb	157	243	364
Total	**2466**	**3250**	**4034**

Figure 15. Plant community growth curve (percent production by month). SD6101, Black Hills Foot Slopes, cool-season dominant. Cool-season dominant.

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

Community 3.2
Kentucky Bluegrass Sod/Remnant Shrubs/Trees/Weedy Annuals and Perennial Forbs

This plant community is characterized by a dense Kentucky bluegrass sod. Kentucky bluegrass is the dominant grass species with minor amounts of other grasses such as western wheatgrass and needlegrass, as well as, grass-likes still represented. Forb species would include curly-cup gumweed, western yarrow, and stiff goldenrod. Shrubs are very limited but may include snowberry. This plant community is resistant to change, and if disturbed, it is resilient. Bluegrass will increase under grazing pressure. Cool, moist climatic conditions will also tend to increase bluegrass production. The opportunity for spring burns can be limited due to lack of fine fuel and early green up. Production is reduced due to lack of plant vigor. Infiltration is greatly reduced due to the dense sod while energy capture is shifted to early spring through early summer.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	981	1255	1496
Forb	84	224	392
Shrub/Vine	84	179	280
Tree	84	135	185
Total	**1233**	**1793**	**2353**

Figure 17. Plant community growth curve (percent production by month). SD6101, Black Hills Foot Slopes, cool-season dominant. Cool-season dominant.

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

Pathway 3.1A
Community 3.1 to 3.2

Heavy, continuous seasonal grazing (stocking levels well above carrying capacity for extended portions of the growing season, and at the same time of year each year) or heavy, continuous season-long grazing will convert this plant community (3.1) to the Kentucky Bluegrass Sod/Remnant Shrubs/Trees/Weedy Annual and Perennial Forbs Plant Community (3.2).

Pathway 3.2A
Community 3.2 to 3.1

Prescribed burning followed by prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing, possibly including periodic rest, may convert this plant community (3.2) to the Kentucky Bluegrass-Smooth Brome/Scattered Shrubs/Trees Plant Community (3.1).

Conservation practices

Prescribed Burning
Prescribed Grazing

State 4
Wooded Overstory State

Historically, this state existed as small patches of trees and shrubs scattered across the site. Repeated intense disturbances (e.g., fire coupled with grazing) would have reverted these smaller patches of trees to the herbaceous dominated Reference State (1.0). In pre-European times, periodic low intensity fires typically would have maintained these small, wooded patches in a tree dominated state. Alterations to the historic fire and grazing disturbance regimes have resulted in these scattered tree/shrub patches forming almost continuous woody dominated plant communities across the site. This state is characterized by an overstory of tall trees, an understory of shrubs, and depending upon the amount of canopy cover, an herbaceous understory of grasses, sedges, and forbs. The dynamics of the Wooded Overstory State (4.0) are largely due to flooding and the natural successional changes, starting with cottonwood and shrub establishment, and eventually the development of a green ash and boxelder plant community. The successional process can restart following another flooding event. Water control structures which limit flooding, livestock grazing, heavy wildlife browse, fire, the introduction of non-native, cool-season grasses, and encroachment of juniper can alter the dynamics of this site, resulting in old remnant stands of trees with little, if any regeneration.

Community 4.1
Cottonwood/Prunus-Snowberry/Forbs/Grasses

This plant community typically develops after a flooding event. Flooding reduces herbaceous competition through scouring and silt deposition at the soil surface, which provides a site for regeneration and establishment of cottonwood and shrubs. Long-term rest periods during the growing season will be required to allow cottonwood seedlings to reach a height which is out of reach of livestock. Late winter and early spring grazing will also need to be closely monitored to prevent grazing of cottonwood seedlings during early spring leaf development. Restricted grazing during late-summer and fall grazing when browsing is common is also necessary for this plant community to establish. Plains cottonwood develop quickly into a robust tree so grazing deferment may only be required for 3 to 4 years. Trees will range from seedlings to saplings, and the herbaceous understory will still be productive as a result of the filtered canopy of the deciduous trees. Understory shrubs, primarily plum, chokecherry, and snowberry will likely establish. However, other species, including silver buffaloberry, silver sagebrush, big sagebrush, and

currants can occur and make up a significance percentage of the shrub layer.

Community 4.2
Mature Cottonwood-Green Ash-Boxelder/Prunus-Snowberry/Forbs/Grass Understory

This plant community develops over time with prescribed grazing and no flooding or fire. Mature cottonwood trees and woody shrubs provide a suitable microclimate for establishment of other deciduous trees. Green ash and boxelder are typically the first trees to establish, but other species such as hackberry and possibly bur oak will establish as well. Regeneration of woody species will normally be evident (i.e., seedlings and saplings should be present). The herbaceous plant community will remain relatively productive but will be reduced somewhat from the Reference Plant Community (1.1). This is due mainly to the competition from the woody shrub understory.

Community 4.3
Green Ash-Boxelder/Prunus-Snowberry/Forbs/Grass Understory

This plant community develops over time, with prescribed grazing and no flooding. Mature cottonwood trees will likely remain in lesser numbers, but the dominant trees will normally consist of green ash and boxelder. At times there will be a mix of all three species; however, some areas will be dominated by one or two of these species. Woody shrubs will remain in the understory, but typically in lesser amounts than in the previous two plant communities. While somewhat reduced, the herbaceous understory will remain relatively productive. The trees will mostly be in the mature stage, but regeneration will normally be evident (i.e., seedlings and saplings should be present).

Pathway 4.1A
Community 4.1 to 4.2

No flooding and long-term prescribed grazing that manages the herbaceous understory, but is not detrimental to woody regeneration, will allow this plant community (4.1) to develop into the Mature Cottonwood-Immature Green Ash-Boxelder/Prunus-Snowberry/Forbs/Grass Understory Plant Community (4.2). Existing saplings must be large enough to avoid damage by livestock and wildlife for this pathway to occur.

Conservation practices

Prescribed Grazing

Pathway 4.2A
Community 4.2 to 4.1

Flooding, and possibly fire, which opens-up the herbaceous understory and allows for woody regeneration, followed by long-term prescribed grazing that manages for woody regeneration and establishment will shift this plant community (4.2) back to the Cottonwood/Prunus-Snowberry/Forbs/Grasses Plant Community (4.1).

Conservation practices

Prescribed Grazing

Pathway 4.2B
Community 4.2 to 4.3

No flooding, no fire, and long-term prescribed grazing that manages the herbaceous understory but is not detrimental to woody regeneration, and time will transition this plant community (4.2) to the Green Ash-Boxelder/Prunus-Snowberry/Forbs/Grass Understory Plant Community (4.3).

Conservation practices

Prescribed Grazing

Pathway 4.3A
Community 4.3 to 4.1

Flooding, and possibly fire, which opens up the herbaceous understory and allows for woody regeneration, followed by long-term prescribed grazing that manages for woody regeneration and establishment will shift this plant community (4.3) back to the Cottonwood/Prunus-Snowberry/Forbs/Grasses Plant Community (4.1).

Conservation practices

Prescribed Grazing

State 5
Wooded Invaded State

The Woody Invaded State develops as a result of continuous season-long grazing, or continuous seasonal grazing and no fire combined with the invasion and establishment of Russian olive, saltcedar, or conifer trees. With time, the cottonwood, boxelder, and ash trees that survive become mature, with little or no regeneration. This is due mainly to grazing of seedlings and saplings. Wildlife browse can also contribute to the loss of native tree and shrub regeneration. Grazing that limits regeneration also results in a reduction of the desirable native herbaceous species, often resulting in a dominance of species such as bluegrass and smooth brome, and forbs such as western ragweed, Canada thistle, burdock, and hound's tongue.

Community 5.1
Scattered Mature Native Trees-Russian Olive/Ponderosa Pine/Shrubs/Forbs/Non-Native Cool-Season Grasses

This plant community developed due to the lack of natural occurring flooding events, native woody regeneration, and continuous season-long grazing without adequate recovery periods. Older mature trees remain, including cottonwood, boxelder, and green ash. The trees are scattered, and the site may have a "park-like" appearance with few trees and reduced understory. If grazed during the winter, the increased durations of livestock loitering can result in manure accumulations and soil compaction which will reduce the vigor of the native understory plant community. Kentucky bluegrass and smooth brome continue to persist as dominant grass species at reduced production rates. The presence of non-desirable forb species such as Canada thistle, burdock, and hound's tongue can be prolific and difficult to control. When invaded by Russian olive and/or saltcedar these species will increase dramatically over time and will eventually dominate the site.

Transition T1A
State 1 to 2

Continuous season-long grazing; excessive haying; long-term light grazing; or no use and no fire; and the invasion of non-native cool-season grasses will transition the Reference State (1.0) to the Native/Invaded State (2.0).

Transition T1B
State 1 to 4

Flooding, which opens the herbaceous understory and allows for woody establishment; no fire; long-term prescribed grazing to promote tree survival; and an extended period of time will transition the Reference State (1.0) to the Wooded Overstory State (4.0).

Conservation practices

Prescribed Grazing

Transition T2A
State 2 to 3

Continuous heavy grazing; excessive haying; or long-term light grazing will result in an increase in non-native cool-

season grasses and cause a transition from the Native/Invaded State (2.0) to the Invaded State (3.0). Extended periods of non-use and no fire, and heavy litter build-up will favor non-natives cool-season grasses transition this state to the Invaded State (3.0).

Transition T2B
State 2 to 4

Flooding, which opens the herbaceous understory and allows for woody establishment; no fire; long-term prescribed grazing to promote tree survival; and an extended period of time will transition the Native/Invaded State (2.0) to the Wooded Overstory State (4.0).

Conservation practices

Prescribed Grazing

Restoration pathway R3A
State 3 to 2

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems intended to treat specific species dominance, or periodic light to moderate stocking levels, possibly including periodic rest) may lead the Invaded State (3.0) over a threshold to the Native/Invaded State (2.0). Prescribed burning may also be needed to suppress cool-season invasive grasses. This will likely take a long period of time, possibly up to ten years or more, and recovery may not be attainable. Success depends upon whether native reproductive propagules remain intact on the site.

Conservation practices

Prescribed Burning
Prescribed Grazing

Transition T3A
State 3 to 5

Encroachment of juniper trees from upland sites, or invasion of non-native deciduous trees; no fire for extended periods of time; continuous season-long grazing, or continuous seasonal grazing, and time; will cause a transition from the Invaded State (3.0) to the Wooded Invaded State (5.0). Canopy cover increases as trees increase in size, which alters microclimate and reduces fine fuel amounts, resulting in reduced fire intensity and frequency.

Transition T4A
State 4 to 2

Fire; invasion of non-native, cool-season grasses; excessive haying; continuous season-long grazing or continuous seasonal grazing resulting in little woody regeneration; and time; will transition the Wooded Overstory State (4.0) to the Native/Invaded State (2.0).

Transition T4B
State 4 to 5

Encroachment of juniper from upland sites, and/or invasion of non-native deciduous trees, coupled with no fire and continuous season-long grazing or continuous seasonal grazing will transition the Wooded Overstory State (4.0) to the Wooded Invaded State (5.0).

Transition T5A
State 5 to 3

Fire, brush management to remove Russian olive; continuous season-long grazing; or continuous seasonal grazing will transition the Wooded Invaded State (5.0) to the Invaded State (3.0).

Conservation practices

Brush Management

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			897–1793	
	big bluestem	ANGE	*Andropogon gerardii*	717–1435	–
	switchgrass	PAVI2	*Panicum virgatum*	179–897	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–359	–
2	**Cool-Season Bunchgrass**			179–717	
	green needlegrass	NAVI4	*Nassella viridula*	179–717	–
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	0–179	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–179	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–179	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–179	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–179	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–72	–
3	**Rhizomatous Wheatgrass**			179–359	
	western wheatgrass	PASM	*Pascopyrum smithii*	179–359	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–179	–
4	**Mid- Warm-Season Grasses**			72–179	
	little bluestem	SCSC	*Schizachyrium scoparium*	36–179	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	36–179	–
5	**Short Warm-Season Grasses**			36–179	
	blue grama	BOGR2	*Bouteloua gracilis*	36–179	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–108	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–72	–
6	**Other Native Grasses**			36–179	
	Grass, perennial	2GP	*Grass, perennial*	0–179	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	36–108	–
	fowl bluegrass	POPA2	*Poa palustris*	0–108	–
7	**Grass-likes**			36–179	
	Sprengel's sedge	CASP7	*Carex sprengelii*	36–179	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–108	–
	clustered field sedge	CAPR5	*Carex praegracilis*	36–108	–
8	**Non-Native Cool-Season Grasses**			–	
Forb					
9	**Forbs**			179–359	

	Forb, native	2FN	*Forb, native*	36–179	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	36–108	–
	goldenrod	SOLID	*Solidago*	36–108	–
	scurfpea	PSORA2	*Psoralidium*	36–108	–
	vervain	VERBE	*Verbena*	36–72	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–72	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	36–72	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	36–72	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	36–72	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–72	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–72	–
	dotted blazing star	LIPU	*Liatris punctata*	0–72	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	36–72	–
	American vetch	VIAM	*Vicia americana*	36–72	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	36–72	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–72	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–36	–
	starry false lily of the valley	MAST4	*Maianthemum stellatum*	0–36	–
	northern bedstraw	GABO2	*Galium boreale*	0–36	–
	beardtongue	PENST	*Penstemon*	0–36	–
Shrub/Vine					
10	**Shrubs**			179–359	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	36–179	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–179	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–108	–
	American plum	PRAM	*Prunus americana*	36–108	–
	chokecherry	PRVI	*Prunus virginiana*	36–108	–
	leadplant	AMCA6	*Amorpha canescens*	0–108	–
	rose	ROSA5	*Rosa*	36–72	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–72	–
	hawthorn	CRATA	*Crataegus*	0–36	–
Tree					
11	**Trees**			179–359	
	American elm	ULAM	*Ulmus americana*	0–287	–
	green ash	FRPE	*Fraxinus pennsylvanica*	0–287	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–179	–
	Tree	2TREE	*Tree*	0–179	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–179	–
	boxelder	ACNE2	*Acer negundo*	0–129	–

Table 11. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					

Grass/Grasslike					
1	**Tall Warm-Season Grasses**			673–1345	
	big bluestem	ANGE	*Andropogon gerardii*	504–1345	–
	switchgrass	PAVI2	*Panicum virgatum*	0–504	–
2	**Cool-Season Bunchgrass**			168–673	
	green needlegrass	NAVI4	*Nassella viridula*	168–673	–
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	0–168	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–168	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–168	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–168	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–168	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–67	–
3	**Rhizomatous Wheatgrass**			168–336	
	western wheatgrass	PASM	*Pascopyrum smithii*	168–336	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–168	–
4	**Mid- Warm-Season Grasses**			67–168	
	little bluestem	SCSC	*Schizachyrium scoparium*	34–168	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	34–168	–
5	**Short Warm-Season Grasses**			34–168	
	blue grama	BOGR2	*Bouteloua gracilis*	34–168	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–101	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–67	–
6	**Other Native Grasses**			34–168	
	Grass, perennial	2GP	*Grass, perennial*	0–168	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	34–101	–
	fowl bluegrass	POPA2	*Poa palustris*	0–101	–
7	**Grass-Likes**			34–168	
	Sprengel's sedge	CASP7	*Carex sprengelii*	34–168	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–101	–
	clustered field sedge	CAPR5	*Carex praegracilis*	34–101	–
8	**Non-Native Cool-Season Grasses**			168–504	
	Kentucky bluegrass	POPR	*Poa pratensis*	67–336	–
	smooth brome	BRIN2	*Bromus inermis*	0–336	–
	timothy	PHPR3	*Phleum pratense*	0–168	–
	cheatgrass	BRTE	*Bromus tectorum*	0–67	–
	field brome	BRAR5	*Bromus arvensis*	0–67	–
Forb					
9	**Forbs**			168–336	
	Forb, native	2FN	*Forb, native*	34–168	–
	Forb, introduced	2FI	*Forb, introduced*	34–168	–
	scurfpea	PSORA2	*Psoralidium*	34–101	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	34–101	–

	goldenrod	SOLID	*Solidago*	34–101	–
	dotted blazing star	LIPU	*Liatris punctata*	0–67	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	34–67	–
	American vetch	VIAM	*Vicia americana*	34–67	–
	vervain	VERBE	*Verbena*	34–67	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–67	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	34–67	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	34–67	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	34–67	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–67	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–67	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	34–67	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–67	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–34	–
	northern bedstraw	GABO2	*Galium boreale*	0–34	–
	beardtongue	PENST	*Penstemon*	0–34	–
	starry false lily of the valley	MAST4	*Maianthemum stellatum*	0–34	–
Shrub/Vine					
10	**Shrubs**			168–336	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–168	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	34–168	–
	American plum	PRAM	*Prunus americana*	34–101	–
	chokecherry	PRVI	*Prunus virginiana*	34–101	–
	leadplant	AMCA6	*Amorpha canescens*	0–101	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–101	–
	rose	ROSA5	*Rosa*	34–67	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–67	–
	hawthorn	CRATA	*Crataegus*	0–34	–
Tree					
11	**Trees**			168–336	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–269	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–168	–
	Tree	2TREE	*Tree*	0–168	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–168	–
	boxelder	ACNE2	*Acer negundo*	0–129	–
	American elm	ULAM	*Ulmus americana*	0–52	–

Table 12. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			129–387	
	big bluestem	ANGE	*Andropogon gerardii*	52–387	–

	switchgrass	PAVI2	*Panicum virgatum*	0–77	–
2	**Cool-Season Bunchgrass**			52–258	
	green needlegrass	NAVI4	*Nassella viridula*	52–258	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–129	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–52	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–52	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–52	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–52	–
3	**Rhizomatous Wheatgrass**			258–644	
	western wheatgrass	PASM	*Pascopyrum smithii*	258–644	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–52	–
4	**Mid- Warm-Season Grasses**			0–129	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–129	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–77	–
5	**Short Warm-Season Grasses**			52–258	
	blue grama	BOGR2	*Bouteloua gracilis*	52–258	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–129	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–77	–
6	**Other Native Grasses**			26–129	
	Grass, perennial	2GP	*Grass, perennial*	0–129	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	26–77	–
	fowl bluegrass	POPA2	*Poa palustris*	0–52	–
7	**Grass-likes**			52–258	
	clustered field sedge	CAPR5	*Carex praegracilis*	52–258	–
	Sprengel's sedge	CASP7	*Carex sprengelii*	26–258	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–129	–
8	**Non-Native Cool-Season Grasses**			258–644	
	smooth brome	BRIN2	*Bromus inermis*	52–387	–
	timothy	PHPR3	*Phleum pratense*	0–258	–
	Kentucky bluegrass	POPR	*Poa pratensis*	129–258	–
	cheatgrass	BRTE	*Bromus tectorum*	0–129	–
	field brome	BRAR5	*Bromus arvensis*	0–129	–
Forb					
9	**Forbs**			129–258	
	Forb, native	2FN	*Forb, native*	0–103	–
	Forb, introduced	2FI	*Forb, introduced*	26–103	–
	vervain	VERBE	*Verbena*	26–77	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	26–77	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	26–77	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	26–77	–
	goldenrod	SOLID	*Solidago*	26–77	–

	American licorice	GLLE3	*Glycyrrhiza lepidota*	26–52	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–52	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–52	–
	scurfpea	PSORA2	*Psoralidium*	26–52	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–52	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–26	–
	American vetch	VIAM	*Vicia americana*	0–26	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–26	–
	dotted blazing star	LIPU	*Liatris punctata*	0–26	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–26	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	–	–
Shrub/Vine					
10	**Shrubs**			129–258	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	26–180	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–129	–
	silver sagebrush	ARCA13	*Artemisia cana*	26–77	–
	rose	ROSA5	*Rosa*	26–52	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–52	–
	American plum	PRAM	*Prunus americana*	26–52	–
	chokecherry	PRVI	*Prunus virginiana*	26–52	–
	leadplant	AMCA6	*Amorpha canescens*	0–26	–
	hawthorn	CRATA	*Crataegus*	0–26	–
Tree					
11	**Trees**			129–258	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–206	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–129	–
	Tree	2TREE	*Tree*	0–129	–
	boxelder	ACNE2	*Acer negundo*	0–129	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–129	–
	American elm	ULAM	*Ulmus americana*	0–52	–

Table 13. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			33–163	
	big bluestem	ANGE	*Andropogon gerardii*	33–163	–
2	**Cool-Season Bunchgrass**			33–163	
	green needlegrass	NAVI4	*Nassella viridula*	33–163	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	33–65	–
3	**Rhizomatous Wheatgrass**			33–325	
	western wheatgrass	PASM	*Pascopyrum smithii*	33–325	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	33–325	–
4	**Mid- Warm-Season Grasses**			33–163	

	little bluestem	SCSC	*Schizachyrium scoparium*	33–163	–
5	**Short Warm-Season Grasses**			0–163	
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–455	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–130	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–33	–
6	**Other Native Grasses**			0–163	
	Grass, perennial	2GP	*Grass, perennial*	0–163	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–65	–
	fowl bluegrass	POPA2	*Poa palustris*	0–65	–
7	**Grass-Likes**			33–325	
	clustered field sedge	CAPR5	*Carex praegracilis*	33–325	–
	Sprengel's sedge	CASP7	*Carex sprengelii*	0–260	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–163	–
8	**Non-Native Cool-Season Grasses**			975–2113	
	smooth brome	BRIN2	*Bromus inermis*	488–1950	–
	Kentucky bluegrass	POPR	*Poa pratensis*	325–1300	–
	timothy	PHPR3	*Phleum pratense*	163–813	–
	cheatgrass	BRTE	*Bromus tectorum*	33–325	–
	field brome	BRAR5	*Bromus arvensis*	0–163	–
Forb					
9	**Forbs**			163–325	
	Forb, introduced	2FI	*Forb, introduced*	33–260	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	33–130	–
	vervain	VERBE	*Verbena*	33–98	–
	goldenrod	SOLID	*Solidago*	33–98	–
	Forb, native	2FN	*Forb, native*	0–98	–
	scurfpea	PSORA2	*Psoralidium*	33–65	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	33–65	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	33–65	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	33–65	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–33	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–33	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–33	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–33	–
Shrub/Vine					
10	**Shrubs**			163–488	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	33–488	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–98	–
	silver sagebrush	ARCA13	*Artemisia cana*	33–98	–
	American plum	PRAM	*Prunus americana*	0–65	–
	chokecherry	PRVI	*Prunus virginiana*	0–65	–
	rose	ROSA5	*Rosa*	0–65	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–33	–

	silver buffaloberry	SHAR	*Shepherdia argentea*	0–33	–
Tree					
11	**Trees**			163–325	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–260	–
	boxelder	ACNE2	*Acer negundo*	0–163	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–163	–
	Tree	2TREE	*Tree*	0–163	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–163	–
	American elm	ULAM	*Ulmus americana*	0–65	–

Table 14. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			0–90	
	big bluestem	ANGE	*Andropogon gerardii*	0–90	–
2	**Cool-Season Bunchgrass**			18–39	
	green needlegrass	NAVI4	*Nassella viridula*	1–36	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	1–36	–
3	**Rhizomatous Wheatgrass**			18–90	
	western wheatgrass	PASM	*Pascopyrum smithii*	1–90	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	1–90	–
4	**Mid- Warm-Season Grasses**			0–90	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–90	–
5	**Short Warm-season Grasses**			36–269	
	blue grama	BOGR2	*Bouteloua gracilis*	2–215	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–90	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–90	–
6	**Other Native Grasses**			0–90	
	Grass, perennial	2GP	*Grass, perennial*	0–72	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–36	–
	fowl bluegrass	POPA2	*Poa palustris*	0–18	–
7	**Grass-Likes**			90–359	
	clustered field sedge	CAPR5	*Carex praegracilis*	6–323	–
	Sprengel's sedge	CASP7	*Carex sprengelii*	0–143	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–90	–
8	**Non-Native Cool-Season Grasses**			448–1166	
	Kentucky bluegrass	POPR	*Poa pratensis*	22–717	–
	smooth brome	BRIN2	*Bromus inermis*	1–269	–
	timothy	PHPR3	*Phleum pratense*	6–179	–
	cheatgrass	BRTE	*Bromus tectorum*	0–90	–
	field brome	BRAR5	*Bromus arvensis*	0–90	–
Forb					
9	**Forbs**			90–359	

9	**Forbs**			90–359	
	Forb, introduced	2FI	*Forb, introduced*	1–269	–
	vervain	VERBE	*Verbena*	1–90	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	1–90	–
	goldenrod	SOLID	*Solidago*	1–90	–
	scurfpea	PSORA2	*Psoralidium*	1–72	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	1–72	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	1–72	–
	Forb, native	2FN	*Forb, native*	0–54	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–36	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–18	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–18	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–18	–
Shrub/Vine					
10	**Shrubs**			90–269	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	2–269	–
	silver sagebrush	ARCA13	*Artemisia cana*	1–90	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–54	–
	rose	ROSA5	*Rosa*	0–36	–
Tree					
11	**Trees**			90–179	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–143	–
	boxelder	ACNE2	*Acer negundo*	0–90	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–90	–
	Tree	2TREE	*Tree*	0–90	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–90	–
	American elm	ULAM	*Ulmus americana*	0–36	–

Animal community

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

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

habitats. Human development reduced habitat quality for area-sensitive species.

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

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

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

Grazing Interpretations:
The following list suggests annual, initial stocking rates for average growing conditions. These estimates are conservative and should be used only as guidelines in the initial stages of conservation planning. Commonly, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Therefore, a resource inventory is necessary to document plant composition and production. More accurate estimates of carrying capacity should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. In consultation with the land manager, a more intensive grazing management program that results in improved harvest efficiencies and increased carrying capacity may be developed.

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

Plant Community: Big Bluestem-Switchgrass-Needlegrass/Scattered Shrubs/Scattered Trees (1.1)
Average Production (lb/acre, air-dry): 3,200
Stocking Rate (AUM/acre): 0.88

Plant Community: Big Bluestem-Switchgrass-Needlegrass-Non-Native Cool-Season Grasses (<15%)/Scattered Shrubs/Scattered Trees (2.1)
Average Production (lb/acre, air-dry): 3,000
Stocking Rate (AUM/acre): 0.82

*Plant Community: Rhizomatous Wheatgrass-Kentucky Bluegrass (<15%)-Big Bluestem/Scattered Shrubs/Scattered Trees (2.2)
Average Production (lb/acre, air-dry): 2,300*
Stocking Rate (AUM/acre): 0.63*

Plant Community: Kentucky Bluegrass (>30%)-Smooth Brome/Scattered Shrubs/Trees (3.1)
Average Production (lb/acre, air-dry): 2,900*
Stocking Rate (AUM/acre): 0.79*

Plant Community: Kentucky Bluegrass Sod/Remnant Shrubs/Trees/Weedy Annuals and Perennial Forbs (3.2)
Average Production (lb/acre, air-dry): 1,600*
Stocking Rate (AUM/acre): 0.44*

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

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

Total onsite annual production may contain vegetation deemed undesirable or untargeted by the grazing animal. Therefore, AUM values may need to be reduced to reflect only preferred or desirable forage species.

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

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic groups B. Infiltration and runoff potential for this site varies from moderate to high depending on soil hydrologic group, slope, and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Dominance by blue grama, buffalograss, bluegrass, or smooth brome will result in reduced infiltration and increased runoff. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff. Refer to the USDA-NRCS National Engineering Handbook, Part 630, for hydrologic soil groups, runoff quantities, and hydrologic curves.

Recreational uses

This site provides opportunities for hiking, hunting upland game species, bird watching, and photography. The wide variety of plants that bloom from spring until fall have aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are typically present on this site.

Other products

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

Other information

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

This ESD is an updated “Previously Approved” ESD that represented a first-generation tier of documentation that, prior to the release of the 2014 National Ecological Site Handbook (NESH), met all requirements as an “Approved” ESD as laid out in the 1997 National Range and Pasture Handbook (NRPH). The document fully described the reference state and community phase in the state-and-transition model. All other alternative states are at least described in narrative form. The “Previously Approved” ESD has been field-tested for a minimum of 5 years and is a proven functional document for conservation planning. The “Previously Approved” ESD may not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but continued refinement toward an “Approved” status is expected.

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

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: Stan Boltz, Range Management Specialist, NRCS; Cynthia Englebert, Range Management Specialist, Forest Service; George Gamblin, Range Management Specialist, NRCS; Ryan Murray, Range Management Specialist, NRCS; Cheryl Nielsen, Range Management Specialist, NRCS; L. Michael Stirling, Range Management Specialist, NRCS; Jim Westerman, Soil Scientist, NRCS.

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Approval

Suzanne Mayne-Kinney, 7/17/2024

Acknowledgments

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

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

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

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Stan Boltz
Contact for lead author	Stan Boltz, stanley.boltz@sd.usda.gov, 605-352-1236
Date	09/30/2009
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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2. **Presence of water flow patterns:** Barely observable or not present.

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3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground less than 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.

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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.

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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 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 or parting to granular, and mollic (higher organic matter) colors of A-horizon down to about 6 to 14 inches deep. If conditions are other than this, refer to map unit component descriptions for component on which the site occurs.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** 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: Tall, warm-season grasses >>

    Sub-dominant: Tall and mid, cool-season bunchgrasses > trees >

    Other: Mid, cool-season rhizomatous grasses = forbs = shrubs > mid, warm-season grasses = short, warm-season grasses = grass-like species

    Additional: Other native grasses occur in other functional groups in minor amounts.

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):** 80-90 percent plant litter cover, roughly 0.5 to 1 inch 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):** Total annual production ranges from 2,400 to 4,000 pounds/acre, with the reference value being 3,200 pounds/acre (air-dry basis).

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