USDA Natural Resources Conservation Service

Ecological site R061XY042SD
Lowland

Accessed: 05/02/2024

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.

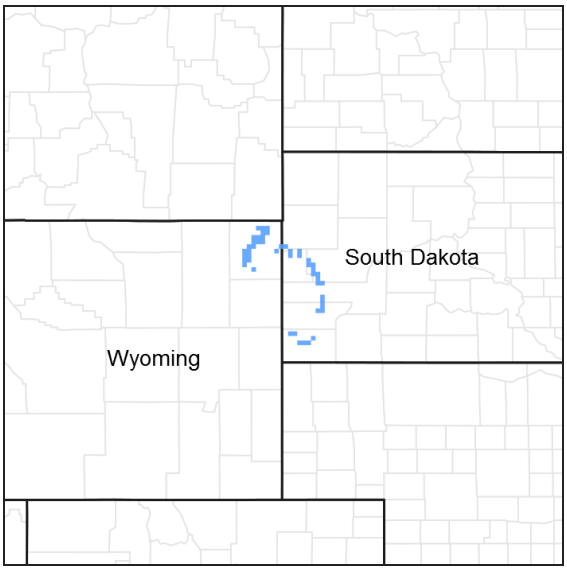


Figure 1. Mapped extent

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.

Classification relationships

Level IV Ecoregions of the Conterminous United States: 17a – Black Hills Foothills.

Associated sites

R061XN010SD	**Loamy-North (18-22" PZ)**
R061XS010SD	**Loamy-South (16-18" PZ)**
R061XY020SD	**Overflow**

Similar sites

R061XS010SD	**Loamy-South (16-18" PZ)** (R061XN010SD & R061XS010SD) – Loamy [less big bluestem; lower production]
R061XY020SD	**Overflow** (R061XY020SD) – Loamy Overflow [very few trees]
R061XN010SD	**Loamy-North (18-22" PZ)** (R061XN010SD & R061XS010SD) – Loamy [less big bluestem; lower production]

Table 1. Dominant plant species

Tree	(1) *Fraxinus pennsylvanica* (2) *Populus deltoides ssp. monilifera*
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Panicum virgatum*

Physiographic features

This site occurs on nearly level lowlands and drainageways.

Table 2. Representative physiographic features

Landforms	(1) Flood plain (2) Stream terrace
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to occasional
Ponding frequency	None
Elevation	884–1,219 m
Slope	0–3%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

The climate in this MLRA is typical of the drier portions of the Northern Great Plains where sagebrush steppes to the west yield to grassland steppes to the east. Annual precipitation ranges from 18 to 21 inches per year, with most occurring during the growing season. Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring.

The average annual temperature is about 46° F. January is the coldest month with average temperatures ranging from about 20° F (Sundance, Wyoming (WY)) to about 26° F (Fort Meade, South Dakota (SD)). July is the warmest month with temperatures averaging from about 69° F (Sundance, WY) to about 72° F (Fort Meade, SD). The range of average monthly temperatures between the coldest and warmest months is about 48° F. Hourly winds 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 and occasional storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

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

Table 3. Representative climatic features

Frost-free period (average)	140 days
Freeze-free period (average)	167 days
Precipitation total (average)	533 mm

Influencing water features

Soil features

The soils in this site are moderately well to well drained and formed in alluvium. The silt loam to fine sandy loam surface layer is 4 to 20 inches thick. The soils have a moderate to moderately slow infiltration rate. This site should show no evidence of rills, wind scoured areas or pedestalled plants. If present, water flow paths are broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers. The soil surface is stable and intact.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases where vegetative cover is not adequate. A drastic loss of the soil surface layer on this site can result in a shift in species composition and/or production.

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

Table 4. Representative soil features

Surface texture	(1) 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

This site developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or man-caused wildfire (often of light intensities), and other biotic and abiotic factors that typically influence soil/site development. Changes will occur in the plant communities due to short-term weather variations, impacts of native and/or exotic plant and animal species, and management actions. While the following plant community descriptions describe more typical transitions that will occur, severe disturbances, such as periods of well-below average precipitation, can cause significant shifts in plant communities and/or species composition.

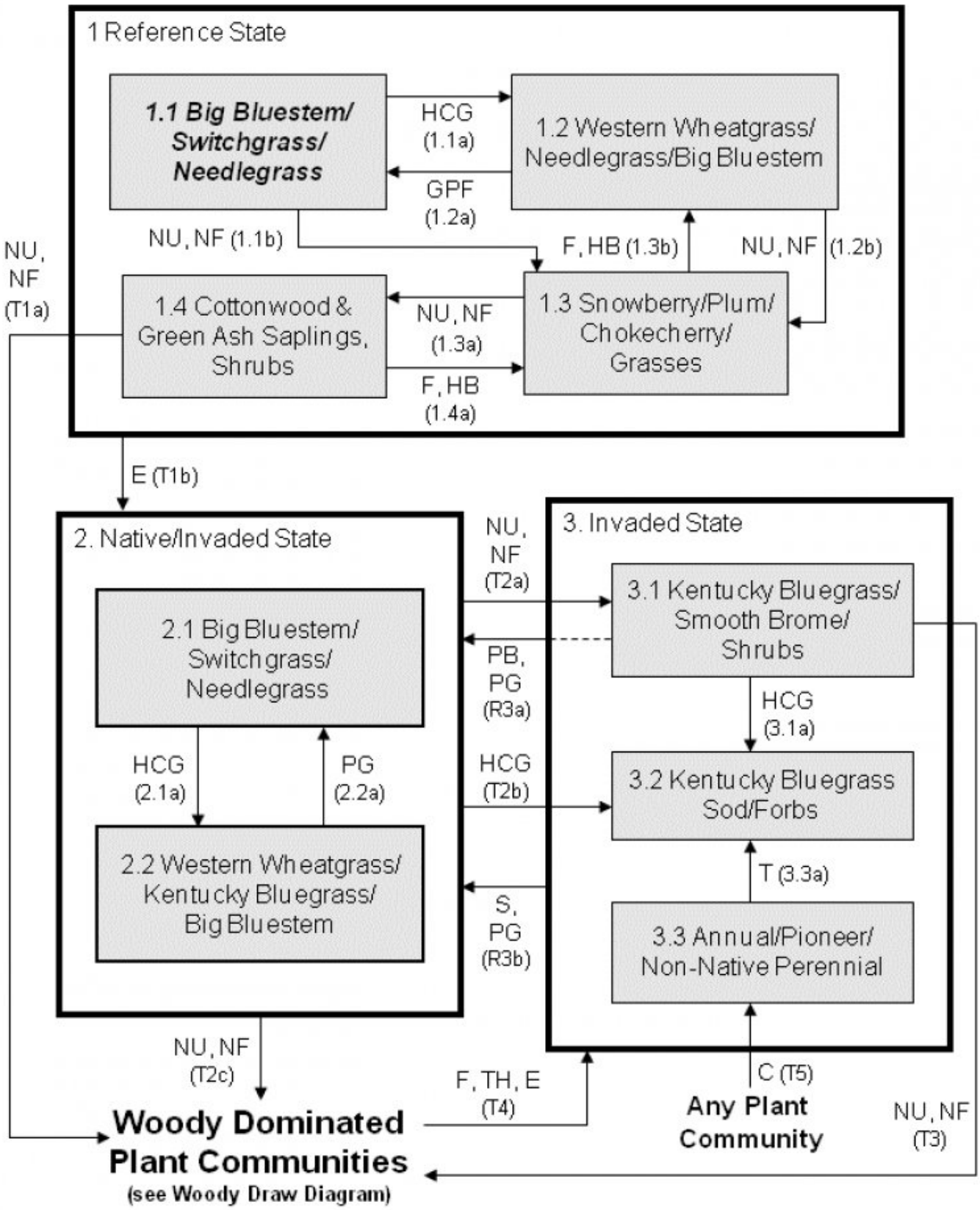
Heavy continuous grazing (moderate to heavy stocking levels for extended portions of the growing season and typically at the same time of year each year) or a combination of disturbances such as grazing and extended periods of below average precipitation causes departure from the Big Bluestem/Switchgrass/Needlegrass Plant Community Phase. Short grass and grass-like species such as sedge, blue grama, and bluegrass will increase and eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Green

needlegrass, big bluestem, switchgrass, and Indiangrass will decrease in frequency and production. Excessive defoliation can cause bluegrass and annuals to increase and dominate the site. 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 green needlegrass, western wheatgrass, bluegrass, smooth bromegrass and cheatgrass.

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

The following is a diagram that illustrates the common plant community phases that can occur on the site and the transition pathways between communities. These are the most common plant community phases based on current knowledge and experience, and changes may be made as more data is collected. Narratives following the diagram contain more detail pertaining to the ecological processes.

State and transition model



Refer to narrative for details on pathways: **C** – Cropped, abandoned; **E** – Encroachment of non-native species; **F** – Fire; **GPF** – Grazing, precipitation, and fire returned to more normal disturbance levels; **HB** – Heavy browsing; **HCG** – Heavy continuous grazing; **NU, NF** – Non-use or very light use, and no fire for extended periods; **PB** – Presribed burning; **PG** – Prescribed grazing; **S** – Seeding; **T** – Time, with or without grazing; **TH** – Timber harvest.

State 1

Reference

This state description represents the natural range of variability that dominated the dynamics of this ecological site. 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, 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/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

The plant community upon which interpretations are primarily based is the Big Bluestem/Switchgrass/Needlegrass Plant Community Phase. 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, bearded 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 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 off-site. Natural plant mortality was very low. The diversity in plant species allowed for high drought tolerance. Run-off 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	2202	2780	3239
Shrub/Vine	163	269	415
Tree	163	269	415
Forb	163	269	415
Total	**2691**	**3587**	**4484**

Figure 5. Plant community growth curve (percent production by month). SD6104, Black Hills Foot Slopes, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

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

Community 1.2
Western Wheatgrass/Needlegrass/Big Bluestem

The pathway described in 1.1a reduced the tall warm-season grass component in stature and extent while the grazing tolerant mid statured needlegrass and the short statured blue grama increased. The tall warm-season grasses did not disappear from the plant community but were reduced in vigor. Major grasses included western wheatgrass, green needlegrass, porcupine grass, and blue grama. Big bluestem, switchgrass and Indiangrass were reduced to minor components. Forbs such as western yarrow, goldenrods, and western ragweed would have increased in extent and proportions. Due to the increase in the cool-season grass component of the plant community, energy capture shifted to the early portion of the growing season. Nutrient cycling likely still functioned near optimum levels; however, hydrologic processes would have been somewhat impaired with the increase of the shorter statured, shallower rooted species.

Figure 6. Plant community growth curve (percent production by month). SD6102, Black Hills Foot Slopes, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant.

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

Community 1.3
Snowberry/Plum/Chokecherry/Grasses

Although this community phase appeared shrub dominated, grasses still constituted the majority of the production for this community phase. The vegetation was about 50 to 80 percent grasses and grass-like plants, 5 to 10 percent forbs, 15 to 30 percent shrubs, and 2 to 10 percent trees. Major grasses included western wheatgrass, green needlegrass, slender/bearded wheatgrass and Canada wildrye. Big bluestem, switchgrass and Indiangrass were minor components. Prominent forbs would have included goldenrod, cudweed sagewort, and American licorice. Shrub species would have included snowberry, plum, chokecherry, silver buffaloberry, leadplant, and rose. The increase of shading and litter fall has a cooling effect on the soil surface, and provides for favorable micro-sites for establishment of various tree species. Without a disturbance that reduces woody vegetation, these changes have a tendency to result in an increase of shrubs and trees on the site. Within this plant community phase, scattered mature trees such as American elm, boxelder and green ash would have been present but a majority of tree species would have been maintained at the seedling and sapling stage.

Figure 7. Plant community growth curve (percent production by month). SD6103, Black Hills Foot Slopes, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

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

Community 1.4
Cottonwood & Green Ash Saplings, Shrubs

This plant community phase is dominated by woody plant species. Visually, saplings of green ash and cottonwood would have been prominent but shrub species would have been the most productive component of this plant community phase. Herbaceous species would have constituted a sub-dominant component in the early stages of this phase, declining as tree canopy increased. The vegetation was about 50 to 75 percent grasses and grass-like plants, 5 to 10 percent forbs, 15 to 30 percent shrubs, and 2 to 10 percent trees. This plant community phase was nearing a threshold which would have lead to dominance by trees and a significant reduction in the herbaceous component of the site.

Pathway 1.1a
Community 1.1 to 1.2

Heavy continuous grazing which included herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or a combination of disturbances such as extended periods of below average precipitation coupled with periodic or chronic heavy grazing would have shifted this community to the 1.2 Western Wheatgrass/Needlegrass/Big Bluestem Plant Community Phase. This typically occurred in areas adjacent to water sources.

Pathway 1.1b
Community 1.1 to 1.3

Non-use (or very light use) and no fire for extended periods of time (typically for about 10 years or more) will favor a shift to cool-season species, especially deciduous shrubs and eventually trees, and lead this plant community to the 1.3 Snowberry/Plum/Chokecherry/ Grasses Plant Community Phase.

Pathway 1.2a
Community 1.2 to 1.1

Grazing, precipitation, and/or fire returned 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 Big Bluestem/Switchgrass/Needlegrass Plant Community Phase.

Pathway 1.2b
Community 1.2 to 1.3

Non-use (or very light use) and no fire for extended periods of time (typically for about 10 years or more) will favor a shift to cool-season species, especially deciduous shrubs and eventually trees, and lead this plant community to the 1.3 Snowberry/Plum/Chokecherry/ Grasses Plant Community Phase.

Pathway 1.3b
Community 1.3 to 1.2

A combination of disturbances such as fire, heavy browsing, and/or other disturbances coupled with below average precipitation will tip the competitive advantage back to the grass species and reduce the woody component, shifting this community to the 1.2 Western Wheatgrass/Needlegrass/Big Bluestem Plant Community Phase.

Pathway 1.3a
Community 1.3 to 1.4

Non-use (or very light use) and no fire for extended periods of time (typically for about 10 years or more) will favor a further shift to cool-season species, especially deciduous shrubs and especially trees at this stage, and lead this plant community to the 1.4 Cottonwood & Green Ash Saplings, Shrubs Plant Community Phase.

Pathway 1.4a
Community 1.4 to 1.3

A single, intense fire event, fire and heavy browsing, and/or other disturbances coupled with below average precipitation would have nearly eliminated tree saplings and shifted this plant community back to the 1.3 Snowberry/Plum/Chokecherry/Grasses Plant Community Phase.

State 2
Native/Invaded

This state is very similar to the reference state. The invasion of introduced cool-season sodgrasses has altered the natural range of variability for this ecological site. This state is typically dominated by tall native warm-season grasses, but invasive introduced cool-season grasses are now present in all community phases of this state. The primary disturbance mechanisms for this state include grazing by domestic livestock and infrequent fires. Timing and intensity of grazing events coupled with weather dictate the dynamics that occur within this state. The cool-season native grasses can decline and an increase in introduced sod grasses will occur. Many times, this state appears as a mosaic of community phases caused primarily by continuous season-long grazing.

Community 2.1
Big Bluestem/Switchgrass/Needlegrass

This plant community phase closely resembles plant community phase 1.1 with the addition of minor amounts of non-native species (refer to the plant composition table for a more detailed list of species that would be present in this phase). The vegetation is about 70 percent grasses and grass-like plants, 10 percent forbs, 10 percent shrubs, and 10 percent trees. Major grasses include big bluestem, switchgrass, green needlegrass, Indiangrass, and western wheatgrass. Other grasses that occurr within this community include slender wheatgrass, bearded wheatgrass, Canada wildrye, little bluestem, sideoats grama, and blue grama. Major forbs and shrubs include American licorice, sunflower, goldenrod, 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 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.

Figure 8. 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
Western Wheatgrass/Kentucky Bluegrass/Big Bluestem

This plant community phase 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 to 85 percent grasses and grass-like plants, 5 to 10 percent forbs, 5 to 10 percent shrubs, and 5 to 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 western ragweed, goldenrods and western yarrow. Chokecherry and snowberry would be the dominate shrubs. Green ash, plains cottonwood, and 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 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1552	1998	2376
Shrub/Vine	118	194	291
Tree	118	192	291
Forb	118	194	291
Total	**1906**	**2578**	**3249**

Figure 10. 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

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), or a combination of disturbances such as extended periods of below average precipitation coupled with periodic heavy grazing will shift this community to the 2.2 Western Wheatgrass/Kentucky Bluegrass/Big Bluestem Plant Community Phase.

Pathway 2.2a
Community 2.2 to 2.1

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 2.1 Big Bluestem/Switchgrass/Needlegrass Plant Community Phase.

Conservation practices

Prescribed Grazing

State 3
Invaded

This state is the result of invasion and dominance of introduced species. This state is characterized by the dominance of Kentucky bluegrass and smooth bromegrass, 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% of the plant community and native grasses represent less than 40% of the plant community composition. Once the 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/Smooth Brome/Shrubs

This plant community phase is characterized by a co-dominance of Kentucky bluegrass and smooth bromegrass. Lack of further disturbance usually results in dominance by smooth bromegrass. Some remnant native grasses such as green needlegrass and big bluestem may still be present. Grasses constitute about 70 to 85 percent of the production with forbs contributing 5 to 10 percent, shrubs 5 to 10 percent, and trees 5 to 10 percent. Dominant forbs include cudweed sagewort, goldenrod, and American licorice. Shrubs would include snowberry, plum, chokecherry and prairie rose. The opportunity for high intensity spring burns is reduced by early green up and increased moisture and humidity at the soil surface. 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. Nutrient cycling is limited by root depth of the dominate species and lack of litter to soil surface contact.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2029	2438	2701
Shrub/Vine	146	325	583
Tree	146	243	375
Forb	146	244	375
Total	**2467**	**3250**	**4034**

Figure 12. 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/Forbs

This plant community phase 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 ticklegrass 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. The opportunity for spring burns is severely 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 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	981	1255	1429
Forb	84	224	415
Shrub/Vine	84	179	308
Tree	84	135	202
Total	**1233**	**1793**	**2354**

Figure 14. 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 3.3

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 and/or early seral species. Plant diversity is low (plant richness may be high, but areas are often dominated by a few species). The ecological processes are difficult to restore because of the loss of plant diversity and overall soil disturbance. Soil erosion is potentially very high because of the bare ground and shallow rooted herbaceous plant community. Water runoff will increase and infiltration will decrease due to animal related soil compaction and loss of root mass due to low plant diversity and vigor. This plant community will require significant economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This is due to the loss of diversity (including the loss of the seed bank), within the existing plant community, and the plant communities on adjacent sites.

Pathway 3.1a
Community 3.1 to 3.2

Heavy continuous 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 to the 3.2 Kentucky Bluegrass Sod/Forbs Plant Community Phase. Smooth bromegrass will be reduced to a minor component while the shrubs will be reduced in vigor.

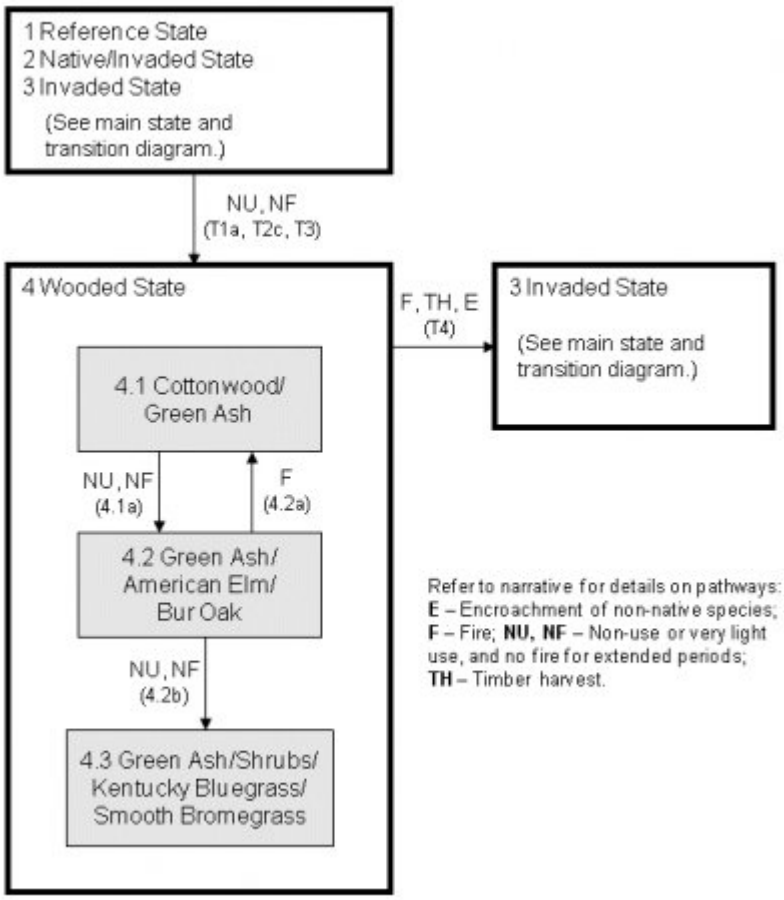
Pathway 3.3a
Community 3.3 to 3.2

Over time with or without grazing, Kentucky bluegrass will begin to establish and will continue to increase. This will likely result in an eventual dominance by Kentucky bluegrass which will lead to the 3.2 Kentucky Bluegrass Sod/Forbs Plant Community Phase.

State 4
Wooded

Historically, this state existed as small patches of trees and shrubs scattered across the site. Repeated intense disturbances (e.g., fire, fire coupled with grazing) would have reverted these smaller patches of trees to the herbaceous dominated Reference State (State 1) in pre-European times, while it will likely revert to the Invaded State (State 3) today. For simplification purposes, the pre-European transition returning from the wooded state to the reference state is not shown on the state and transition diagrams. Likewise the pre-European and modern day conditions of the Wooded State are combined within this state description. Community phases 4.1 and 4.2 would have occurred in pre-European times without the presence of non-native species; whereas, community phase 4.3 will only be present in modern times, and all three community phases will likely have some amounts of non-native species in the present day. Otherwise, the community pathways between 4.1 and 4.2 would generally apply in both pre-European and under modern day circumstances. 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 sedges and/or Kentucky bluegrass.

Community 4.1
Cottonwood/Green Ash



This plant community phase is characterized by a dominance of plains cottonwood with lesser amounts of green ash, American elm, and occasionally other tree species. Shrubs may include chokecherry, plum, snowberry, and gooseberry. An herbaceous understory of sedges, wildrye, slender and/or bearded wheatgrass and the more shade-tolerant forbs such as false Solomon's-seal, stickseed, Northern bedstraw, wood lily, and others may also be present depending upon the amount of canopy cover. The stage would be considered an early mature seral stage. Canopy has not closed and is relatively diffuse allowing for a moderate level of herbaceous and shrub production. As the trees mature and canopy cover increases herbaceous production declines and shrubs/vines associated with mature woodlands may begin to occupy the understory.

Community 4.2
Green Ash/American Elm/Bur Oak

This plant community phase is a result of a lack of disturbance for extended periods of time. Initially, tree regeneration is still taking place. Over time, the tree canopy begins to become closed or nearly so. The herbaceous understory is greatly reduced, and can at times seem almost non-existent. This would be considered a mature seral stage. In pre-European times or in areas not affected by disease, American elm would have become more dominant in the overstory. Shade tolerant trees and shrubs would make up the secondary stand or the understory of this community. Species such as bur oak increase substantially in the shaded levels of the secondary stand of this community.

Community 4.3
Green Ash/Shrubs/Kentucky Bluegrass/Smooth Bromegrass

This plant community phase is characterized by a "park like appearance" with scattered mature green ash and bur oak. Little regeneration occurs. Snowberry and scattered chokecherry are the primary shrubs. Invasive cool season sod forming grasses becomes the dominant herbaceous cover. The establishment of tree seedlings is further limited by the competitive nature of these grasses.

Pathway 4.1a

Community 4.1 to 4.2

Non-use or sporadic light use and no fire for extended periods of time (typically for 10 or more years) will cause this plant community to shift to the 4.2 Green Ash/American Elm/Bur Oak Plant Community Phase. Lack of disturbance allows for closure of the tree canopy to begin and regeneration of various tree species to occur. In pre-European times, the occurrence of this pathway would have been limited to areas randomly escaping fire, or if patches became large enough to prevent fire from carrying through the entire patch.

Pathway 4.2a
Community 4.2 to 4.1

Fire of low intensity that occurs periodically will remove some of the understory and smaller trees, and stimulates tree regeneration which leads this plant community back to the 4.1 Cottonwood/Green Ash Plant Community Phase.

Pathway 4.2b
Community 4.2 to 4.3

Non-use or sporadic light use and no fire for extended periods of time (typically for 10 or more years) will cause this plant community to shift to the 4.3 Green Ash/Shrubs/Kentucky Bluegrass/Smooth Bromebrass Plant Community Phase. Encroachment of non-native species also has detrimental impacts on the ecological processes, and results in dramatic changes in the understory.

Transition T1b
State 1 to 2

Encroachment of non-native grasses such as Kentucky bluegrass and smooth bromegrass, and disruption of natural disturbance regimes (typically as a result of fire suppression following settlement) led this state over a threshold to the Native/Invaded State (State 2). The threshold between these states was crossed when non-native species became established on the site.

Transition T5
State 1 to 3

Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 3) and more specifically to the 3.3 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

Transition T1a
State 1 to 4

Non-use (or very light use) and no fire for extended periods of time (typically for about 10 years or more) would have caused a further shift to dominance by woody species, and allowing the tree species to become mature enough to at least partially survive periodic fire. This would result in a transition over a threshold leading to the Wooded State (State 4). As trees increased in size, canopy cover increased which altered micro-climate and reduced fine fuel amounts resulting in reduced fire intensity and frequency. This would have been the primary pathway under the historic disturbance regime and would have resulted in a mosaic pattern of small wooded patches interspersed within herbaceous plant community phases.

Transition T5
State 2 to 3

Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 3) and more specifically to the 3.3 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and

expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

Transition T2b
State 2 to 3

Heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season, and at the same time of year each year) will cause a shift across a threshold leading to the 3.2 Kentucky Bluegrass Sod/Forbs Plant Community Phase within the Invaded State (State 3).

Transition T2a
State 2 to 3

Non-use and no fire for extended periods of time (typically for 10 or more years) will likely lead this state over a threshold resulting in the 3.1 Kentucky Bluegrass/Smooth Brome/Shrubs Plant Community Phase within the Invaded State (State 3).

Transition T2c
State 2 to 4

Non-use and no fire for extended periods of time (typically for 10 or more years) will likely lead this state over a threshold resulting in a shift leading to the Wooded State (State 4). Rather than patches of trees and shrubs interspersed within herbaceous dominated plant communities as they exist within the Native/Invaded State (State 2) and as they existed in the Reference State (State 1), this transition results in an expansion of the patches into an almost continuous woody dominated site.

Restoration pathway R3a
State 3 to 2

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 may lead this plant community phase over a threshold to the Native/Invaded State (State 2). Pest management (i.e., herbicide) may also be needed to suppress cool-season invasive grasses. This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable. Success depends on whether native reproductive propagules remain intact on the site.

Conservation practices

Prescribed Burning
Prescribed Grazing
Integrated Pest Management (IPM)

Restoration pathway R3b
State 3 to 2

Seeding of selected varieties of native species coupled with prescribed grazing may result in a plant community that approaches something very near the functioning of the Native/Invaded State (State 2). Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, management objectives must include the maintenance of those species, the associated reference state functions and continued treatment of the introduced grasses.

Conservation practices

Prescribed Grazing

Transition T3
State 3 to 4

Non-use and no fire for extended periods of time (typically for 10 or more years) will likely lead this state over a threshold resulting in a shift leading to the Wooded State (State 4). Rather than patches of trees and shrubs interspersed within herbaceous dominated plant communities as they exist within the Invaded State (State 3) and as they existed in the Reference State (State 1), this transition results in an expansion of the patches into an almost continuous woody dominated site.

Transition T4
State 4 to 3

Fire of high enough intensity to remove and/or kill many of the trees, or timber harvest that effectively reduces the stand to scattered over-mature individual trees will lead to a shift over a threshold to the Native/Invaded State (State 3). Encroachment of non-native cool-season grasses will have also occurred to effect this transition. Potentially, this transition could also be initiated or compounded with the introduction of various tree and/or shrub diseases or pests.

Transition T5
State 4 to 3

Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 3) and more specifically to the 3.3 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

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	**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 Bunchgrasses**			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	–
3	**Wheatgrass**			179–359	
	western wheatgrass	PASM	*Pascopyrum smithii*	179–359	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–179	–
4	**Mid Warm-Season Grasses**			72–179	
	sideoats grama	BOCU	*Bouteloua curtipendula*	36–179	–
	little bluestem	SCSC	*Schizachyrium scoparium*	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	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–179	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	36–108	–
	fowl bluegrass	POPA2	*Poa palustris*	0–108	–
7	**Grass-likes**			36–179	
	clustered field sedge	CAPR5	*Carex praegracilis*	36–179	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–108	–
Forb					
8	**Forbs**			179–359	
	Forb, native	2FN	*Forb, native*	36–179	–
	scurfpea	PSORA2	*Psoralidium*	36–108	–
	goldenrod	SOLID	*Solidago*	36–108	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	36–108	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–72	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–72	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	36–72	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–72	–
	dotted blazing star	LIPU	*Liatris punctata*	0–72	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	36–72	–
	vervain	VERBE	*Verbena*	36–72	–
	American vetch	VIAM	*Vicia americana*	36–72	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	36–72	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	36–72	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	36–72	–
	starry false lily of the valley	MAST4	*Maianthemum stellatum*	0–36	–
	beardtongue	PENST	*Penstemon*	0–36	–
	northern bedstraw	GABO2	*Galium boreale*	0–36	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–36	–
Shrub/Vine					
9	**Shrubs**			179–359	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–179	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	36–179	–
	leadplant	AMCA6	*Amorpha canescens*	36–108	–
	American plum	PRAM	*Prunus americana*	36–108	–
	chokecherry	PRVI	*Prunus virginiana*	0–108	–
	rose	ROSA5	*Rosa*	36–72	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–72	–
Tree					
10	**Trees**			179–359	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–287	–
	American elm	ULAM	*Ulmus americana*	0–287	–
	plains cottonwood	PODEM	*Populus deltoides ssp*	0–179	

	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–179	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–179	–
	Tree	2TREE	*Tree*	0–179	–

Table 10. 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	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–77	–
2	**Cool-Season Bunchgrasses**			52–258	
	green needlegrass	NAVI4	*Nassella viridula*	52–258	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–52	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–52	–
3	**Wheatgrass**			258–644	
	western wheatgrass	PASM	*Pascopyrum smithii*	258–644	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–129	–
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	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	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	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–129	–
8	**Non-Native Grasses**			258–644	
	bluegrass	POA	*Poa*	129–516	–
	smooth brome	BRIN2	*Bromus inermis*	52–387	–
	brome	BROMU	*Bromus*	0–129	–
Forb					
9	**Forbs**			129–258	
	Forb, introduced	2FI	*Forb, introduced*	26–103	–
	Forb, native	2FN	*Forb, native*	0–103	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	26–77	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	26–77	–

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

Table 11. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Bunchgrasses**			0–163	
	green needlegrass	NAVI4	*Nassella viridula*	0–163	–
2	**Wheatgrass**			0–325	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–325	–
3	**Short Warm-Season Grasses**			0–163	
	blue grama	BOGR2	*Bouteloua gracilis*	0–130	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–33	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–33	–
4	**Other Native Grasses**			0–163	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–163	–

	prairie Junegrass	KOMA	*Koeleria macrantha*	0–65	–
	fowl bluegrass	POPA2	*Poa palustris*	0–65	–
5	**Grass-likes**			33–325	
	clustered field sedge	CAPR5	*Carex praegracilis*	33–260	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–163	–
6	**Non-Native Grasses**			975–2113	
	smooth brome	BRIN2	*Bromus inermis*	488–1950	–
	bluegrass	POA	*Poa*	325–1300	–
	brome	BROMU	*Bromus*	33–325	–
Forb					
7	**Forbs**			163–325	
	Forb, introduced	2FI	*Forb, introduced*	33–260	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	33–130	–
	goldenrod	SOLID	*Solidago*	33–98	–
	Forb, native	2FN	*Forb, native*	0–98	–
	vervain	VERBE	*Verbena*	33–98	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	33–65	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	33–65	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	33–65	–
	scurfpea	PSORA2	*Psoralidium*	33–65	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–33	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–33	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–33	–
Shrub/Vine					
8	**Shrubs**			163–488	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	33–488	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–98	–
	American plum	PRAM	*Prunus americana*	0–98	–
	chokecherry	PRVI	*Prunus virginiana*	0–65	–
	rose	ROSA5	*Rosa*	0–65	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–33	–
Tree					
9	**Trees**			163–325	
	American elm	ULAM	*Ulmus americana*	0–260	–
	green ash	FRPE	*Fraxinus pennsylvanica*	0–260	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–163	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–163	–
	Tree	2TREE	*Tree*	0–163	–

Table 12. Community 3.2 plant community composition

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

1	**Cool-Season Bunchgrasses**			0–36	
	green needlegrass	NAVI4	*Nassella viridula*	0–36	–
2	**Wheatgrass**			0–90	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–90	–
3	**Short Warm-Season Grasses**			36–269	
	blue grama	BOGR2	*Bouteloua gracilis*	36–215	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–90	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–90	–
4	**Other Native Grasses**			0–90	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–72	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–36	–
	fowl bluegrass	POPA2	*Poa palustris*	0–18	–
5	**Grass-likes**			90–359	
	clustered field sedge	CAPR5	*Carex praegracilis*	90–323	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–90	–
6	**Non-Native Grasses**			448–807	
	bluegrass	POA	*Poa*	359–717	–
	smooth brome	BRIN2	*Bromus inermis*	18–215	–
	brome	BROMU	*Bromus*	0–90	–
Forb					
7	**Forbs**			90–359	
	Forb, introduced	2FI	*Forb, introduced*	18–269	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	18–90	–
	goldenrod	SOLID	*Solidago*	18–90	–
	vervain	VERBE	*Verbena*	18–90	–
	scurfpea	PSORA2	*Psoralidium*	18–72	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	18–72	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	18–72	–
	Forb, native	2FN	*Forb, native*	0–54	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–36	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–18	–
Shrub/Vine					
8	**Shrubs**			90–269	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	36–269	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–54	–
	rose	ROSA5	*Rosa*	0–36	–
Tree					
9	**Trees**			90–179	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–143	–
	American elm	ULAM	*Ulmus americana*	0–143	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–90	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–90	–

	Tree	2TREE	*Tree*	0–90	–

Animal community

Animal Community – Grazing Interpretations
The following table lists annual, suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site 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.

Big Bluestem/Wheatgrass/Needlegrass (1.1 & 2.1)
Average Annual Production (lbs./acre, air-dry): 3,200
Stocking Rate* (AUM/acre): 0.88

Western Wheatgrass/Kentucky Bluegrass/Big Bluestem (2.2)
Average Annual Production (lbs./acre, air-dry): 2,300
Stocking Rate* (AUM/acre): 0.63

Kentucky Bluegrass/Smooth Brome/Shrubs (3.1)
Average Annual Production (lbs./acre, air-dry): 2,900
Stocking Rate* (AUM/acre): 0.79

Kentucky Bluegrass Sod/Forbs (3.2)
Average Annual Production (lbs./acre, air-dry): 1,600
Stocking Rate* (AUM/acre): 0.44

Annual/Pioneer, Non-Native Perennial (3.3)
Average Annual Production (lbs./acre, air-dry): 800
Stocking Rate* (AUM/acre): 0.22

Cottonwood/Green Ash (4.1)
Average Annual Production (lbs./acre, air-dry): 3,000
Stocking Rate* (AUM/acre): 0.55

Green Ash/American Elm/Bur Oak (4.2)
Average Annual Production (lbs./acre, air-dry): 3,000
Stocking Rate* (AUM/acre): 0.25

Green Ash/Shrubs/Kentucky Bluegrass/Smooth Bromegrass (4.3)
Average Annual Production (lbs./acre, air-dry): 2,400
Stocking Rate* (AUM/acre): 0.41

* Based on 912 lbs./acre (air-dry weight) per Animal Unit Month (AUM), and on 25% harvest efficiency (refer to USDA 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 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% ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Dominance by blue grama, buffalograss, bluegrass, and/or smooth bromegrass will result in reduced infiltration and increased runoff. Areas where ground cover is less than 50% 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 variety of plants that bloom from spring until fall have an esthetic value that appeals to visitors.

Wood products

No appreciable wood products are typically present on this site.

Other products

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

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; Tate Lantz, 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.

Other references

High Plains Regional Climate Center, University of Nebraska, 830728 Chase Hall, Lincoln, NE 68583-0728. (http://www.hprcc.unl.edu/)
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Contributors

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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.

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Approved by	Stan Boltz
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 or not present.

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

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 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.