

# Ecological site R055CY040SD

## Loamy Floodplain

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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.

### MLRA notes

Major Land Resource Area (MLRA): 055C—Southern Black Glaciated Plains

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

The dominant soil order in this MLRA is Mollisols. The soils in the area dominantly have a mesic soil temperature regime, an ustic soil moisture regime, and mixed or smectitic mineralogy. They generally are very deep, well drained to very poorly drained, and clayey or loamy. This area supports natural prairie vegetation characterized by western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), needle and thread (*Hesperostipa comata*), and porcupinegrass (*Hesperostipa spartea*) with Prairie cordgrass (*Spartina pectinata*), and reed canarygrass (*Phalaris arundinacea*) as the dominant vegetation on the poorly drained soils. (USDA-NRCS, 2006).

### Classification relationships

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

USFS Subregions: North Central Glaciated Plains Section (251B); Yankton Hills and Valleys Subsection (251Bf); Western Glaciated Plains Section (332B); James River Lowland Subsection (332Bb); North Central Great Plains Section (332D); Southern Missouri Coteau Slope Subsection (332Dd); Southern Missouri Coteau Subsection (332De) - (Cleland et al., 2007)

US EPA Level IV Ecoregion: Southern Missouri Coteau (42e); Southern Missouri Coteau Slope (42f); James River Lowland (46n) - (USEPA, 2013)

### Ecological site concept

The Loamy Floodplain ecological site occurs in high floodplain areas. Soils are moderately well drained. Water flows into and over or through the site, which is subject to occasional to frequent flooding. Vegetation in the Reference State is dominated by warm season grasses including big bluestem, switchgrass, and Indiangrass. Trees may also occur, species include Plains Cottonwood and Green ash. Common shrubs include American plum and western snowberry. Non-native grasses such as smooth brome and Kentucky may invade due to shifts in disturbance regime.

### Associated sites

R055CY002SD	<b>Linear Meadow</b> These sites occur on lower floodplain area. Soils are poorly to very poorly drained with a water table within two feet of the soil surface that persists longer than the wettest part of the growing season, typically until the month of August. The central concept soil series are Arlo and Clamo, but other series are included.
R055CY003SD	<b>Subirrigated</b> These sites occur in drainageways. Soils are somewhat poorly drained with a water table within two to five feet of the soil surface that persists longer than the wettest part of the growing season, typically until the month of August. The central concept soil series is Lamo, but other series are included.

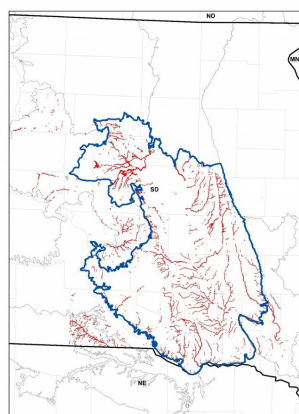
## Similar sites

R055CY020SD	<b>Loamy Overflow</b> The Loamy Overflow site occurs in upland swales. Soils are moderately well drained, which indicates water flow into and over/through the site. The Loamy Overflow site will have more green needlegrass and western wheatgrass than the Loamy Floodplain site.
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**Table 1. Dominant plant species**

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Andropogon gerardii</i> (2) <i>Sorghastrum nutans</i>

## Physiographic features



**Figure 1. Distribution Map for the Loamy Floodplain site in MLRA 55C.**

**Table 2. Representative physiographic features**

Landforms	(1) Plains > Flood plain
Flooding duration	Brief (2 to 7 days)
Flooding frequency	Rare to frequent
Elevation	1,310–1,970 ft
Slope	0–2%
Water table depth	30–80 in

## Climatic features

MLRA 55C is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's

location near the geographic center of North America. There are few natural barriers on the Northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation typically ranges from 19 to 25 inches per year. The average annual temperature is about 47°F. January is the coldest month with average temperatures ranging from about 15°F (Howard, South Dakota (SD)), to about 20°F (Wagner, SD). July is the warmest month with temperatures averaging from about 73°F (Howard, SD), to about 77°F (Wagner, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 58°F. This large annual range attests to the continental nature of this area's climate. Hourly winds are estimated to average about 12 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 11 mph during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 mph.

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

Table 3. Representative climatic features

Frost-free period (characteristic range)	123-129 days
Freeze-free period (characteristic range)	135-146 days
Precipitation total (characteristic range)	22-26 in
Frost-free period (actual range)	114-130 days
Freeze-free period (actual range)	133-151 days
Precipitation total (actual range)	21-27 in
Frost-free period (average)	125 days
Freeze-free period (average)	142 days
Precipitation total (average)	24 in

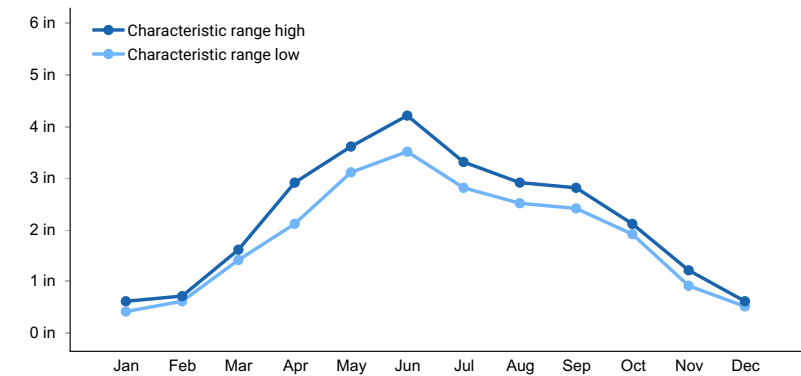


Figure 2. Monthly precipitation range

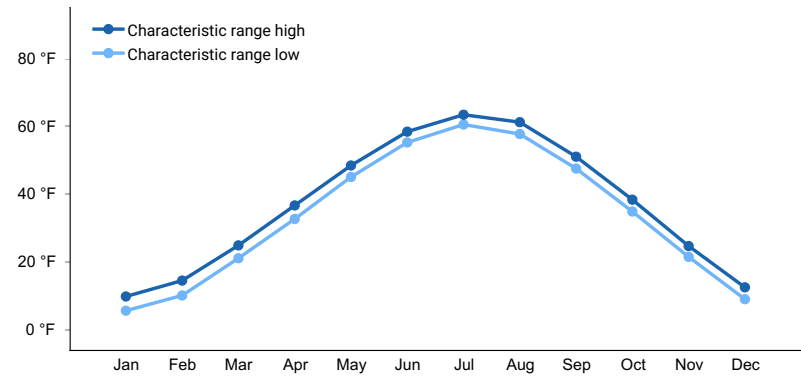
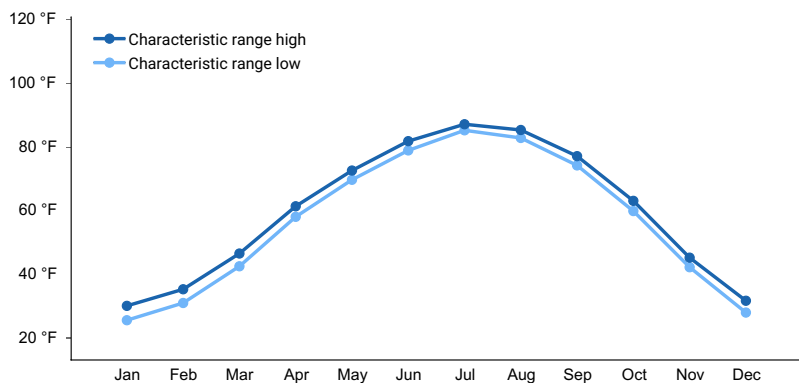
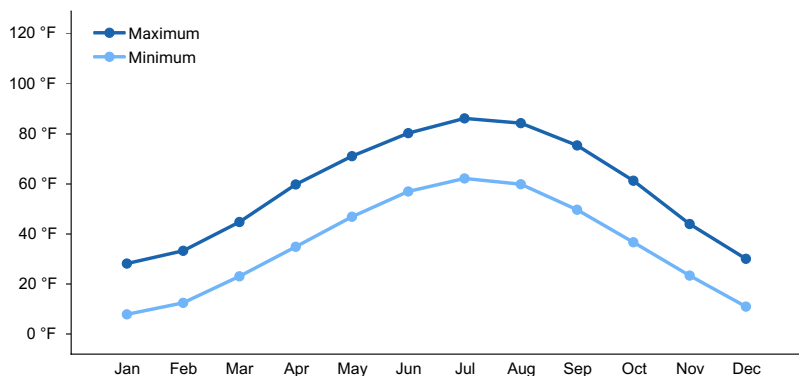


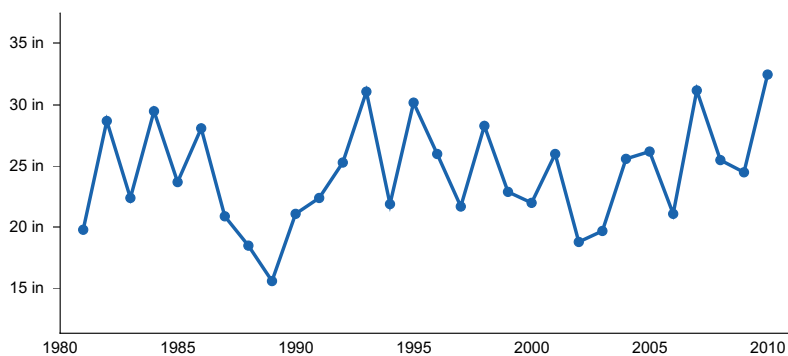
Figure 3. Monthly minimum temperature range



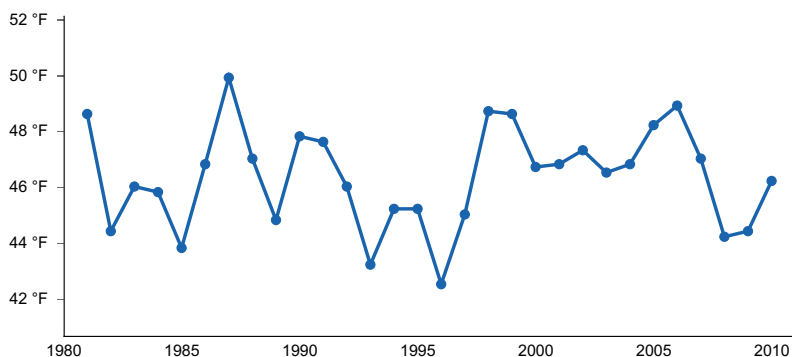
**Figure 4. Monthly maximum temperature range**



**Figure 5. Monthly average minimum and maximum temperature**



**Figure 6. Annual precipitation pattern**



**Figure 7. Annual average temperature pattern**

## Climate stations used

- (1) FAULKTON 1 NW [USC00392927], Faulkton, SD
- (2) MILLER [USC00395561], Miller, SD
- (3) REDFIELD [USC00397052], Redfield, SD

- (4) HURON RGNL AP [USW00014936], Huron, SD
- (5) DE SMET [USC00392302], De Smet, SD
- (6) HOWARD [USC00394037], Howard, SD
- (7) ALEXANDRIA [USC00390128], Alexandria, SD
- (8) MARION [USC00395228], Marion, SD
- (9) MENNO [USC00395481], Menno, SD
- (10) TYNDALL [USC00398472], Tyndall, SD
- (11) WAGNER [USC00398767], Wagner, SD
- (12) ACADEMY 2NE [USC00390043], Platte, SD

## Influencing water features

This section is under construction.

## Wetland description

This section is under construction.

## Soil features

The common soil features of soils in this site are the loam subsoil and slopes zero to two percent. The soils in this site are moderately drained and formed in alluvium. The loam surface layer is eight to 20 inches thick. The soils have a moderate infiltration rate. The central concept soil series is Bon, but others are included. The soils show no evidence of rills, wind scoured areas, or pedestalled plants. The soil surface is stable and intact. Subsurface soil layers are nonrestrictive to water movement and root penetration. These soils are not susceptible to water erosion. Flooding frequency strongly influences the soil-water-plant relationship.

**Table 4. Representative soil features**

Surface texture	(1) Loam
Family particle size	(1) Fine-loamy
Drainage class	Moderately well drained
Permeability class	Moderate
Soil depth	0–80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	0.18–0.22 in
Calcium carbonate equivalent (0-40in)	0–5%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	Not specified
Subsurface fragment volume >3" (Depth not specified)	Not specified

## Ecological dynamics

The information in this Ecological Site Description, including the state-and-transition model (STM), was developed

based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The site, which is located in the Southern Black Glaciated Plains, developed under Northern Great Plains climatic conditions and included natural influence of large herding herbivores and occasional fire. Changes will occur in the plant communities due to weather fluctuations and management actions. Under adverse impacts, a relatively rapid decline in vegetative vigor and composition can occur. Under favorable conditions the site has the potential to resemble the Reference State. Interpretations for this site are based primarily on the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase. This community phase and the Reference State have been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been considered.

This ecological site (ES) has been grazed by domestic livestock since they were introduced into the area. The removal of fire, the introduction of invasive species, and the introduction of domestic livestock and the use of fencing and reliable water sources have changed the ecological dynamics of this site. Continuous grazing without adequate recovery periods following each grazing occurrence over several years and lack of fire frequency cause this site to depart from the interpretive plant community. Trees and shrubs are a minor but consistent component in the reference state occurring as scattered individuals or patches. The establishment of plains cottonwood (*Populus deltoides*) results from severe flooding events where scouring or sediment deposition allow for seed germination and establishment. Not a frequently occurring plant community, but rather unique and dependent upon the combination of flooding, bare soils, seed dispersal, and germination. Other shrub and tree species often establish as a result of high litter levels or bare ground opportunities and the lack of fire, all of which favor woody plant establishment. Species such as green ash (*Fraxinus pennsylvanica*), and plains cottonwood initially increase. Big bluestem and switchgrass will decrease in frequency and production. Increased woody and tree species and heavy, continuous grazing causes shade-tolerant species like Kentucky bluegrass (*Poa pratensis*) to increase and eventually develop into a sod-bound condition. The significant increase in invasive cool-season grasses, specifically Kentucky bluegrass and smooth brome (*Bromus inermis*), on this site is the result of several factors including typically cold wet springs coupled with spring grazing deferment, high tolerance of grazing, shade tolerance, severe defoliation of native grasses in the growing season, and the elimination of fire from the system. Due to the spread of these species, the interpretive plant community no longer exist. Extended periods of non-use and no fire will result in a plant community of mature green ash or plains cottonwood with a shaded understory of Kentucky bluegrass creating a park-like appearance.

Mechanical removal, catastrophic fire, or inundation of woody species due to flooding with very long duration (greater than 30 days) beyond normal ponding and drying patterns will create a community dominated by big bluestem, switchgrass, and Indiangrass (*Sorghastrum nutans*), which will be invaded with lesser amounts of non-native species such as Kentucky bluegrass and smooth brome.

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

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

## State and transition model

## Loamy Floodplain – MLRA 55C (8/8/19)

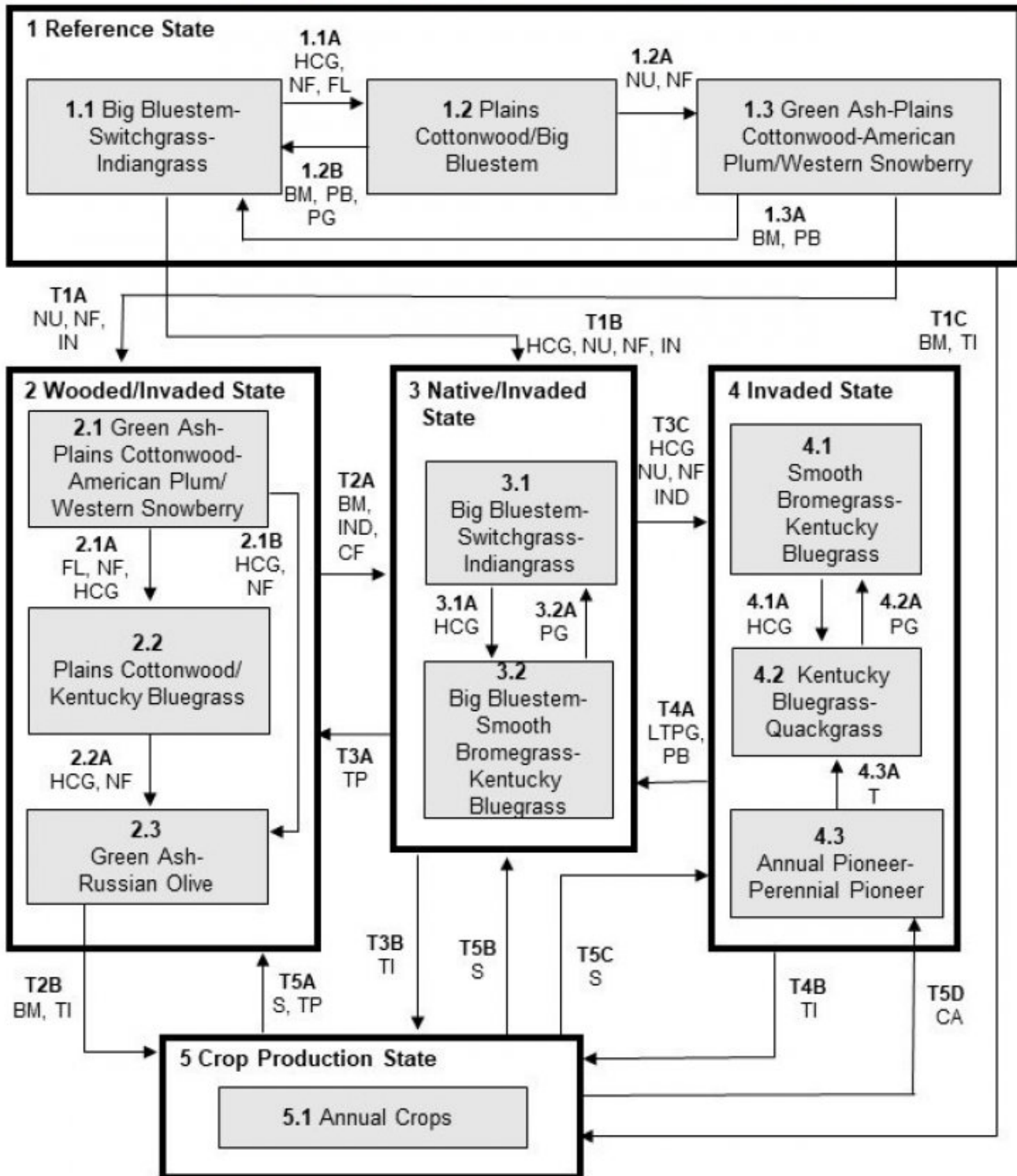


Figure 8. State-And-Transition Model.

## Loamy Floodplain – MLRA 55C (7/16/19)

### LEGEND

#### Loamy Floodplain– R055CY040SD

BM – Brush management  
CA – Cropped and abandoned  
CF – Catastrophic fire  
FL – Flooding  
HCG – Heavy continuous grazing  
IN – Invasion  
IND – Inundation  
LTPG – Long-term prescribed grazing  
NU – Non-use  
NF – No fire  
PB – Prescribed burning  
PG – Prescribed grazing  
S – Seeding  
T – Time w/wo disturbances  
TI – Tillage  
TP – Tree planting

Figure 9. Legend

Code	Process
T1A	Non-use, no fire, invasion
T1B	Heavy continuous grazing, non-use, no fire, invasion
T1C	Brush management, tillage
T2A	Brush management, inundation, catastrophic fire
T2B	Brush management, tillage
T3A	Tree planting
T3B	Tillage
T3C	Heavy continuous grazing, non-use, no fire, inundation
T4A	Long term prescribed grazing, prescribed burning
T4B	Tillage
T5A	Seeding, tree planting
T5B	Seeding
T5C	Seeding
T5D	Abandonment of cropping
1.1A	Heavy continuous grazing, no fire, Flooding
1.2A	Non-use, no fire
1.2B	Prescribed grazing with recovery periods, prescribed burning, brush management
1.3A	Brush management, prescribed burning
2.1A	Heavy continuous grazing, no fire, Flooding
2.1B	Heavy continuous grazing, no fire
2.2A	Heavy continuous grazing, no fire
3.1A	Heavy continuous grazing
3.2A	Prescribed grazing with recovery periods
4.1A	Heavy continuous grazing
4.2A	Prescribed grazing with recovery periods
4.3A	Time w/wo disturbances

Figure 10. Matrix

State 1  
Reference State

The Reference State would include Community Phases 1.1, 1.2, and small areas of 1.3. The extent of each would be dependent upon recent growing conditions. Drought and increased fire frequency would favor the herbaceous community, while periods of above normal precipitation and reduced fire frequency would have favored the shrub and woody community phase. Due to change in microclimate within the wooded patches, fire intensity would have been lessened, thereby permitting this community to escape normal fire events. Extreme fire events may have resulted in these areas being burned over and reverting to more of a herbaceous and shrub dominated plant community. Invasion of conifers such as eastern redcedar (*Juniperus virginian*) and Rocky Mountain juniper (*Juniperus scopulorum*) is possible over time on areas with reduced fire frequency. These areas typically occur in the upper reaches of the watershed.

## **Community 1.1**

### **Big Bluestem-Switchgrass-Indiangrass**

Interpretations are based primarily on the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase (this is also considered to be the reference community). It was dominated by warm-season grasses. Due to spring flooding events, warm-season species have competitive advantage. The major grasses included big bluestem, switchgrass, and Indiangrass. Other grass or grass-like species included western wheatgrass, slender wheatgrass (*Elymus trachycaulus*), Canada wildrye (*Elymus canadensis*), porcupinegrass, and sedge (*Carex*). This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. This was a sustainable plant community regarding site and soil stability, watershed function, and biologic integrity. Shrub communities were scattered throughout the site and consisted of western snowberry (*Symphoricarpos occidentalis*), American plum (*Prunus Americana*), and chokecherry (*Prunus virginiana* L.). Trees were also found scattered across the site and consisted of plains cottonwood and green ash. The diversity in plant species allowed for great tolerance of variable environmental conditions. This plant community phase is diverse, stable, and productive, and is well adapted to the Northern Great Plains. The water table supplies much of the moisture for native plants with deep root systems. Community dynamics, nutrient and water cycle, and energy flow are functioning properly. Plant litter is properly distributed with very little movement off-site and natural plant mortality is very low. The variability of both the fluctuations of the water table and reoccurring ponding allows for the diversity in plant species. This is a sustainable plant community in terms of soil stability, watershed function, and biologic integrity.

## **Community 1.2**

### **Plains Cottonwood/Big Bluestem**

This plant community will slowly develop from the adverse effects of heavy, continuous grazing, without adequate recovery periods between each grazing event during the growing season, and no surface fire. This phase would occupy those areas that escaped several fire events. Flooding that causes erosion, sediment deposit, and bare soil moves the plant community toward a plant community that includes species that responded favorably to those soil disturbances, and that could spread quickly through seed dispersal or rhizomes. The plains cottonwood component is restricted to those areas where and when the soil disturbances allow for air-dispersed cottonwood seeds to settle on bare soils and germinate within the same growing season. This may be an environment only large enough to support a single tree or a larger location (more catastrophic event) where numerous seedlings establish a colony of same-aged trees. When compared to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase, native warm-season tallgrasses have decreased. The woody species such as plains cottonwood have increased and tend to dominate this plant community.

## **Community 1.3**

### **Green Ash-Plains Cottonwood-American Plum/Western Snowberry**

This plant community will slowly develop from the side effects of non-use and no surface fire. The presence of woody species in the 1.2 Plains Cottonwood/Big Bluestem Community Phase will continue to take over the site when lack of fire and non-use are part of the management practices. Patches of this plant community phase would be found scattered across the site, most likely in slight depressions or other small areas where fire behavior is minimized due to microclimate or terrain. The green ash and plains cottonwood will grow large and begin to shade out low-growing species and close up the canopy.

## **Pathway 1.1A**

## **Community 1.1 to 1.2**

Heavy, continuous grazing and no fire, that includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites and no surface fire for extended periods of time (typically for 10 years or more, causing litter levels to become high enough to reduce native grass vigor, diversity, and density), or flooding with inundation for 30 days or less will shift this community to the 1.2 Plains Cottonwood/Big Bluestem Plant Community Phase.

### **Pathway 1.2B**

#### **Community 1.2 to 1.1**

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest, and/or prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels and frequencies, or brush management such as removing woody vegetation will shift this plant community to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase.

### **Pathway 1.2A**

#### **Community 1.2 to 1.3**

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years), causing litter levels to become high enough to reduce native grass vigor, diversity, and density, will likely lead this state over a threshold leading to the 1.3 Green Ash-Plains Cottonwood-American Plum/Western Snowberry Plant Community Phase.

### **Pathway 1.3A**

#### **Community 1.3 to 1.1**

Brush management, which would include the mechanical removal of the woody and shrub vegetation, coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels and frequencies will shift this plant community to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase.

## **State 2**

### **Wooded/Invaded State**

The Wooded/Invaded State is characterized by the increase in bare ground due to trampling caused by excessive use and by inundation for extended periods which causes a temporary shift in the plant composition and cover. Severe flooding events in which scouring or sediment deposition allow for seed germination and establishment. This allows for the invasion of woody species, which, with continued heavy grazing and no surface fire, can increase to eventual dominance. Loss or reduction of native cool- and warm-season species can negatively impacted energy flow and nutrient cycling. Small amount of shade-tolerant non-native species such as smooth brome grass and Kentucky bluegrass would be present. Infiltration will be reduced and native plant mortality will increase. As the disturbance level increases, native plant density decreases even more, giving way to annual species and invasive perennial species, a further increase woody species, and bare ground. Invasion of conifers such as eastern redcedar and Rocky Mountain juniper is possible on areas with reduced fire frequency. These areas occur typically in the upper reaches of the watershed.

## **Community 2.1**

### **Green Ash-Plains Cottonwood-American Plum/Western Snowberry**

This plant community developed with non-use and/or no surface fire for extended periods of time (typically for 10 or more years). Green ash, plains cottonwood, American plum, and western snowberry dominate the community. This plant community phase is similar to the 1.3 Green Ash-Plains Cottonwood-American Plum/Western Snowberry Plant Community Phase but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth brome grass (up to about 15 percent by air-dry weight). Native warm-season tallgrasses like big bluestem and switchgrass will be virtually eliminated from the plant community and replaced with woody vegetation and sedges. Areas of bare ground can be present throughout the site. Loss or reduction of native

grasses, grass-likes, and forbs has negatively impacted energy flow and nutrient cycling. It will take a long time to restore this plant community with improved management or the return of more normal precipitation patterns and a regular fire regime.

## **Community 2.2**

### **Plains Cottonwood/Kentucky Bluegrass**

This plant community developed with heavy, continuous grazing without adequate recovery periods between grazing events, no surface fire, and/or with a flooding event that caused erosion of the top soil and left bare soil for the plains cottonwood to establish. The dominant vegetation includes Plains Cottonwoods, Kentucky Bluegrass, and other native and non-native shade tolerant grasses, and shrubs. Grasses may include, Kentucky bluegrass, smooth brome grass, and sedges. 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, and increased shade from mature cottonwood trees shading out native species. Significant economic inputs, management, and time would be required to move this plant community toward a higher successional stage. Secondary succession is highly variable, depending upon availability and diversity of a viable reproductive source of higher successional species.

## **Community 2.3**

### **Green Ash-Russian Olive**

This plant community phase is characterized by a dense understory of grasses with an overstory of green ash and Russian olive. As mature trees die, they are replaced by Russian olive. The herbaceous understory consists of Kentucky bluegrass, smooth brome grass, and native grass species. Significant economic inputs, management, and time would be required to move this plant community toward a higher successional stage. Secondary succession is highly variable, depending upon availability and diversity of a viable reproductive source of higher successional species.

## **Pathway 2.1A**

### **Community 2.1 to 2.2**

Heavy, continuous grazing that includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below-normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites, or no surface fire for extended periods of time (typically for 10 years or more) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, and severe flooding events in which scouring or sediment deposition allow for seed germination and establishment will shift this community to the 2.2 Plains Cottonwood/Kentucky Bluegrass Plant Community Phase.

## **Pathway 2.1B**

### **Community 2.1 to 2.3**

Heavy, continuous grazing and/or no surface fire will encourage establishment of green ash and Russian olive (*Elaeagnus angustifolia*), with an understory of Kentucky bluegrass or smooth brome grass. These invasive species alter regeneration rates of native species by out-competing them for resources. Heavy, continuous grazing that includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below-normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites, and/ or no surface fire for extended periods of time (typically for 10 years or more), causing litter levels to become high enough to reduce native grass vigor, diversity, and density, will shift this community to the 2.3 Green Ash-Russian Olive Plant Community Phase.

## **Pathway 2.2A**

### **Community 2.2 to 2.3**

Heavy, continuous grazing and/or no surface fire will encourage establishment of green ash and Russian olive (*Elaeagnus angustifolia*), with an understory of Kentucky bluegrass or smooth brome grass. These invasive species alter regeneration rates of native species by out-competing them for resources. Heavy, continuous grazing that includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery

periods, or during periods of below-normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites, and/ or no surface fire for extended periods of time (typically for 10 years or more), causing litter levels to become high enough to reduce native grass vigor, diversity, and density, will shift this community to the 2.3 Green Ash-Russian Olive Plant Community Phase. 2.3 Green Ash-Russian Olive Plant Community Phase.

## **State 3**

### **Native/Invaded State**

The Native/Invaded State represents the more common range of variability that exists with higher levels of grazing management but in the absence of periodic fire due to fire suppression. This state is dominated by warm-season grasses, while cool-season grasses are subdominant. It can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. Taller warm-season species can decline and a corresponding increase in short-statured grass will occur. Invasion of conifers such as eastern redcedar and Rocky Mountain juniper is possible over time on areas with reduced fire frequency. These areas typically occur in the upper reaches of the watershed.

## **Community 3.1**

### **Big Bluestem-Switchgrass-Indiangrass**

This plant community phase is similar to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase, but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth brome grass (up to about 10 percent by air-dry weight). The potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs. This community is dominated by warm-season grasses. The major grasses include big bluestem, switchgrass, and Indiangrass. Other grass or grass-like species include porcupinegrass, green needlegrass, and slender wheatgrass. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high tolerance to drought. This is a sustainable plant community in regard to site and soil stability, watershed function, and biologic integrity.

## **Community 3.2**

### **Big Bluestem-Smooth Brome grass-Kentucky Bluegrass**

This plant community is a result of heavy, continuous grazing or from over-utilization during extended drought periods. The potential plant community is made up of approximately 75 percent grasses and grass-like species, 15 percent forbs, and 10 percent shrubs. Dominant grasses include big bluestem, smooth brome grass, and Kentucky bluegrass. Grasses of secondary importance include Indiangrass, sideoats grama, green needlegrass, tall dropseed (*Sporobolus compositus*), slender wheatgrass, and sedge. Forbs commonly found in this plant community include cudweed sagewort (*Artemisia ludoviciana*), heath aster (*Symphyotrichum ericoides*), Canada goldenrod (*Solidago canadensis*), stiff goldenrod (*Solidago rigida*), scurfpea (*Psoralea*), Indian hemp (*Apocynum cannabinum*), and western yarrow (*Achillea millefolium*). When compared to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase, big bluestem has increased, smooth brome grass and Kentucky bluegrass have invaded and become co-dominant. Production of tall warm-season grasses is reduced. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term. Most of the components of the ecological processes are functioning at optimum levels. However, the vigor and reproductive capability of the warm-season tallgrasses are reduced due to grazing pressure or a combination of stressors. A reduction of this dominant functional group allows for an increase in shorter-statured (and shallower-rooted) species. The introduction of non-native invasive species such as Kentucky bluegrass and smooth brome grass results in alterations to the soil profile. Organic matter levels tend to decrease and begin to be concentrated more in the surface layers, and the structure will begin to be modified. These changes favor the shallow-rooted species and hasten their eventual dominance if steps are not taken to reduce these species.

## **Pathway 3.1A**

### **Community 3.1 to 3.2**

Heavy, continuous grazing that includes herbivory at moderate to heavy levels at the same time of year each year

without adequate recovery periods, or during periods of below-normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites will shift this community to the 3.2 Big Bluestem-Smooth Brome-grass-Kentucky Bluegrass Plant Community Phase.

### **Pathway 3.2A**

#### **Community 3.2 to 3.1**

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing, possibly including periodic rest, will convert this plant community to the 3.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase.

## **State 4**

### **Invaded State**

The Invaded State is a result of encroachment by invasive introduced cool-season grasses. The ecological processes are not functioning, especially the biotic processes and the hydrologic functions. The introduced cool-season grasses cause reduced infiltration and increased runoff. Preliminary studies indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community, and native grasses represent less than 40 percent of the plant community composition. The opportunity for high-intensity spring burns is severely reduced by early green-up and increased moisture and humidity at the soil surface and grazing pressure cannot cause a reduction in sod-grass dominance. Production is limited to the sod-forming species. Infiltration continues to decrease and runoff increases, and energy capture into the system is restricted to early season low-producing species. Nutrient cycling is limited by root depth of the dominant species. Invasion of conifers such as eastern redcedar and Rocky Mountain juniper is possible over time on areas with reduced fire frequency. These areas typically occur in the upper reaches of the watershed.

### **Community 4.1**

#### **Smooth Brome-grass-Kentucky Bluegrass**

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

### **Community 4.2**

#### **Kentucky Bluegrass-Quackgrass**

This plant community phase is a result of heavy, continuous seasonal grazing or heavy, continuous season-long grazing. It is characterized by a dominance of Kentucky bluegrass and quackgrass (*Elymus repens*). The dominance is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate at or above the soil surface and eventually a thatch-mat layer may develop at the surface as well. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. Infiltration is greatly reduced and runoff is high. Production will be significantly reduced when compared to the interpretive plant community. The period that palatability is high is relatively short as Kentucky bluegrass matures rapidly. Energy capture is also reduced. Biological activity in the soil is likely reduced significantly in this phase.

### **Community 4.3**

#### **Annual Pioneer-Perennial Pioneer**

This plant community developed under continuous, heavy grazing or other excessive disturbances. The potential plant community is made up of approximately 40 to 80 percent grasses and grass-like species, 20 to 60 percent forbs, and 0 to 5 percent shrubs. The species present in this phase are highly variable, but often include non-native invasive and 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. This community can be renovated to improve the production capability; however, if management changes are not made, the vegetation could revert back to early seral species.

#### **Pathway 4.1A**

##### **Community 4.1 to 4.2**

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

#### **Pathway 4.2A**

##### **Community 4.2 to 4.1**

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

#### **Pathway 4.3A**

##### **Community 4.3 to 4.2**

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

### **State 5**

#### **Crop Production State**

The Crop Production State is characterized by the production of annual crops using a variety of tillage and cropping systems along with management practices. Cropping on this site is enabled during years with drier than normal precipitation or with artificial drainage (surface or subsurface).

#### **Community 5.1**

##### **Annual Crops**

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

#### **Transition T1A**

##### **State 1 to 2**

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, or invasion of non-native plant species will likely take this 1.3 Green Ash-Plains Cottonwood-American Plum/Western Snowberry Plant Community Phase within the Reference State (State 1) over a threshold leading the Wooded/Invaded State (State 2).

## **Transition T1B**

### **State 1 to 3**

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, heavy, continuous grazing, or invasion of non-native plant species will likely lead this 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase within the Reference State (State 1) over a threshold, resulting in the Native/Invaded State (State 3).

## **Transition T1C**

### **State 1 to 5**

Brush management such as removing woody vegetation and tillage will cause a shift over a threshold, leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

## **Transition T2A**

### **State 2 to 3**

Brush management such as removing woody vegetation, catastrophic fire that burns with high intensity to kill a majority of the trees in the canopy, or inundation due to flooding with very long duration (greater than 30 days) beyond normal ponding and drying patterns will cause a shift over a threshold leading to the Native/Invaded State (State 3).

## **Transition T2B**

### **State 2 to 5**

Brush management such as removing woody vegetation and tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

## **Restoration pathway T3A**

### **State 3 to 2**

Tree planting will likely lead this state over a threshold leading to the Wooded/Invaded State (State 2). This will take significant resources and years of monitoring and management.

## **Transition T3C**

### **State 3 to 4**

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, 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 inundation due to flooding with very long duration (greater than 30 days) beyond normal ponding and drying patterns will likely lead this state over a threshold leading to the Invaded State (State 4).

## **Transition T3B**

### **State 3 to 5**

Tillage will cause a shift over a threshold, leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

## **Restoration pathway T4A**

### **State 4 to 3**

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

## **Transition T4B**

### **State 4 to 5**

Tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

## **Restoration pathway T5A**

### **State 5 to 2**

Seeding combined with tree planting may lead this Crop Production State (State 5) over a threshold leading to the Wooded/Invaded State (State 2). This will take significant resources and years of monitoring and management.

## **Restoration pathway T5B**

### **State 5 to 3**

Seeding may lead this Crop Production State (State 5) over a threshold leading to the Native/Invaded State (State 3).

## **Restoration pathway T5C, T5D**

### **State 5 to 4**

Seeding may lead this Crop Production State (State 5) over a threshold to the Invaded State (State 4). Cropping followed by abandonment may lead this plant community phase over a threshold to the Invaded State (State 4) and, more specifically, to the 4.3 Annual Pioneer-Perennial Pioneer Plant Community Phase.

## **Additional community tables**

### **Other information**

Ecological Site Correlation Issues and Questions:

- NOTE: In Gregory County (SD053) the (Bb) Bon loam, 0 to 2 percent slopes, rarely flooded (national symbol 2wkpm) was included in a MLRA map unit that covered more than one MLRA. This map unit is located in MLRA 66 and should be split correlated in future projects.
- NOTE: In Gregory County (SD053) the (Bc) Bon loam, channeled, 0 to 2 percent slopes, frequently flooded (national symbol 2wkpn) was included in a MLRA map unit that covered more than one MLRA. This map unit is located in MLRA 66 and should be split correlated in future projects.
- Reference and alternative states within the state-and-transition model are not be fully documented and may require additional field sampling for refinement.

## **Inventory data references**

There is no NRCS clipping data and other inventory currently available for this site. Information presented here has been derived using field observations from range-trained personnel. Those involved in developing this site include Jason Hermann, Area Rangeland Management Specialist, USDA-NRCS, Redfield, SD.

Data Source Sample Period State County  
NONE

## **Other references**

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## **Approval**

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

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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)	
Contact for lead author	
Date	02/01/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

### 1. Number and extent of rills:

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### 2. Presence of water flow patterns:

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### 3. Number and height of erosional pedestals or terracettes:

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

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5. **Number of gullies and erosion associated with gullies:**
- 
6. **Extent of wind scoured, blowouts and/or depositional areas:**
- 
7. **Amount of litter movement (describe size and distance expected to travel):**
- 
8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**
- 
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**
- 
10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**
- 
11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**
- 
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:
- Sub-dominant:
- Other:
- Additional:
- 
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**
- 
14. **Average percent litter cover (%) and depth ( in):**
- 
15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**
- 
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:

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17. Perennial plant reproductive capability:

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