USDA Natural Resources Conservation Service

# Ecological site R055DY063SD
# Shallow Gravel

Last updated: 2/23/2024
Accessed: 05/03/2024

## 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.

## MLRA notes

Major Land Resource Area (MLRA): 055D–Glacial Lake Dakota

MLRA 55D is in South Dakota (92 percent) and southeastern North Dakota (8 percent). It makes up about 3,059 square miles (7,923 square kilometers). This area,
which is part of the glacial till plain region, consists of a large, glacial lake plain that was drained by the James River, which flows southward through the area. The MLRA is dominantly farmland converted from prairie, but some areas of grassland remain. Agricultural drainage practices have impacted shallow depressions in many areas.

MLRA 55D has distinct boundaries. Till plains are on all sides. MLRA 55B borders the area largely to the north and is also between the Lake Dakota Plain and two prominent coteaus—the Missouri Coteau on the west and the Prairie Coteau on the east. To the south is MLRA 55C (Southern Black Glaciated Plains), which has a mesic soil temperature regime.

This area is in the Central Lowland province of the Interior Plains. Elevation ranges from 1,250 to 1,330 feet (380 to 405 meters), generally increasing from south to north. The area is characterized by mostly level to moderately sloping lake plains with many depressions and drainages. Much of the area has integrated drainage; drainage channels are poorly to moderately defined.

The glaciolacustrine sediments of the Lake Dakota Plain range from sandy to clayey and are commonly stratified. Some areas of the lake plain are mantled with wind-deposited materials, which are moderately coarse textured or sandy. Alluvial deposits and low terraces are common along the James River and its major tributaries but also occur in narrow and discontinuous strips along other streams.

## Classification relationships

Major Land Resource Area (MLRA): Southern Black Glaciated Plains (55D) (USDA-NRCS, 2022)

USFS Sub-region: Located mainly within unit 332Bc and 332Ba (Cleland et al., 2007).

## Ecological site concept

The Shallow Gravel ecological site is located on flats, rises and hills on outwash plains and, also, on terraces. The soils are shallow (14 to 20 inches) to sand and gravel. The dark-colored surface soil is more than 7 inches thick. The surface and subsoil layers above the gravel contact are commonly loam or sandy loam (form a ribbon <2 inches long). The gravel content of the substratum ranges from 10 to 60 percent. In some soils, this layer contains significant amounts (>25%) of shale fragments. In some soils, loamy till is within a depth of 5 feet, but this has little impact on plant available water due to thick layer of gravel and sand in the upper substratum. Soil on this site is moderately well drained to somewhat excessively drained. Slopes range from 0 to 15 percent. On the landscape, this site is below the Very Shallow ecological site and above the Limy Subirrigated and Sandy sites. The Loamy ecological site typically occurs on similar or slightly lower landscape positions. The Loamy and Sandy sites are

deeper than 20 inches to sand and gravel.

## Associated sites

| | |
|---|---|
| R055DY058SD | **Limy Subirrigated**<br>This site occurs somewhat lower on the landscape. It is highly calcareous in the upper part of the subsoil and has redoximorphic features at a depth of 18 to 30 inches. All textures are included in this site. |
| R055DY064SD | **Loamy**<br>This site typically occurs on linear slopes on till plains and lake plains on run-off landscape positions; it also occurs on high terraces which are no longer impacted by flooding. The surface and subsoil layers form a ribbon 1 to 2 inches long. |
| R055DY069SD | **Very Shallow**<br>This site occurs somewhat higher on the landscape. The gravel and sand substratum is within a depth of 14 inches. |
| R055DY062SD | **Sandy**<br>This site occurs on higher, linear slopes on lake plains and till plains mantled with moderately coarse textured eolian deposits – a run-off landscape position. The surface and subsoil layers form a ribbon <1 inch long. |

## Similar sites

| | |
|---|---|
| R055DY069SD | **Very Shallow**<br>This site occurs somewhat higher on the landscape. The gravel and sand substratum are within a depth of 14 inches. |
| R055DY061SD | **Sands**<br>This site occurs on similar landscape positions. It is sand or loamy sand (fine to coarse sands) within a depth of 10 inches and does not have a significant amount of gravel; the soil does not form a ribbon. |
| R055DY062SD | **Sandy**<br>This site typically occurs slightly lower on the landscape. The surface and subsoil layers form a ribbon <1 inch long; where a sand and gravel substratum occurs, it is deeper than 20 inches. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | Not specified |
| Shrub | Not specified |
| Herbaceous | (1) *Hesperostipa comata*<br>(2) *Nassella viridula* |

## Physiographic features

This site occurs on uplands – outwash plains and terraces. On outwash plains it is on flats, rises and hills. The parent material is glaciofluvial deposits; some areas have fine-loamy alluvium as thick as 20 inches over the gravel and sand deposits. Slopes typically range from 4 to 8 percent.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Outwash plain<br>(2) Terrace |
| Runoff class | Low to high |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 98–2,130 ft |
| Slope | 4–8% |
| Ponding depth | 0 in |

| | |
|---|---|
| Water table depth | 42–70 in |
| Aspect | Aspect is not a significant factor |

## Climatic features

The average annual precipitation of MLRA 55D is 22 to 23 inches (549 to 594 millimeters). About 75 percent of the rainfall comes from high-intensity, convective thunderstorms during the growing season. Winter precipitation is typically snow. The average annual snowfall is 25 to 50 inches (635 to 1,270 millimeters). Strong winds commonly deposit the snow unevenly across the landscape. The average annual temperature is 43 to 45 degrees F (6 to 7 degrees C). The freeze-free period averages about 135 days and ranges from 120 to 150 days.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 114-117 days |
| Freeze-free period (characteristic range) | 129-134 days |
| Precipitation total (characteristic range) | 22-23 in |
| Frost-free period (actual range) | 114-119 days |
| Freeze-free period (actual range) | 127-134 days |
| Precipitation total (actual range) | 22-23 in |
| Frost-free period (average) | 116 days |
| Freeze-free period (average) | 131 days |
| Precipitation total (average) | 23 in |

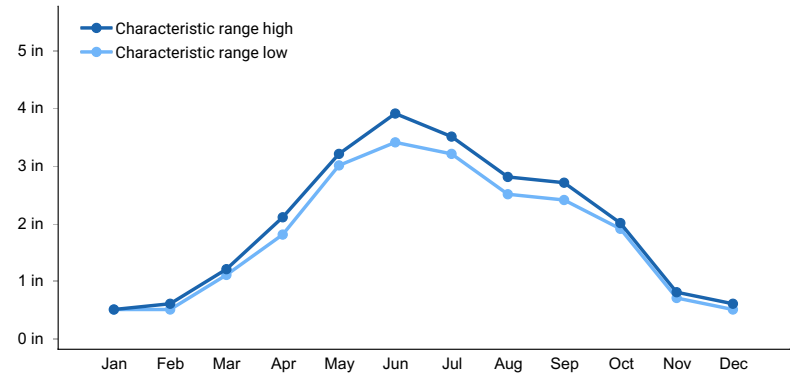



**Figure 1. Monthly precipitation range**

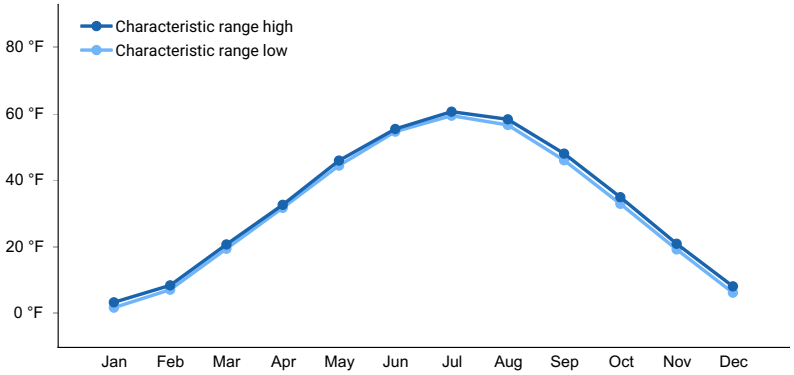



**Figure 2. Monthly minimum temperature range**

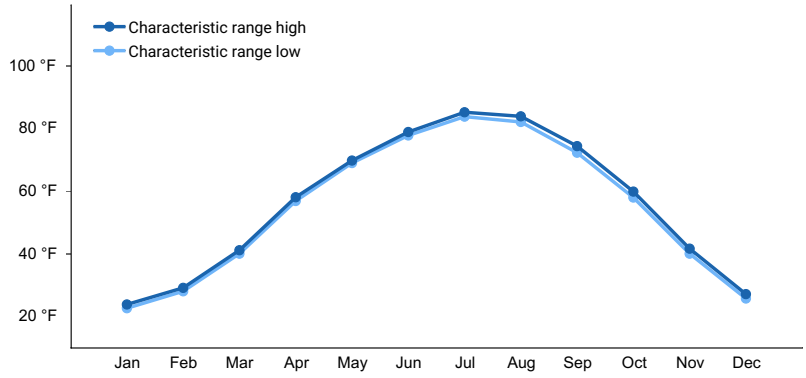



**Figure 3. Monthly maximum temperature range**

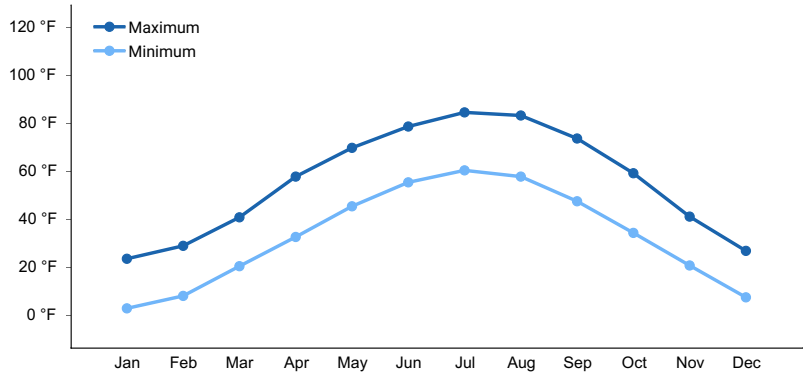



**Figure 4. Monthly average minimum and maximum temperature**

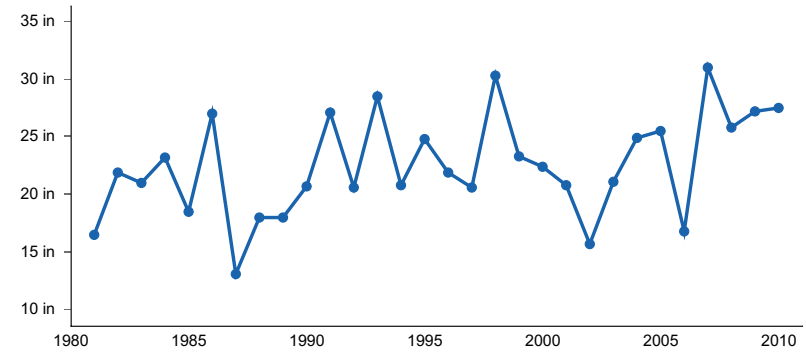



**Figure 5. Annual precipitation pattern**

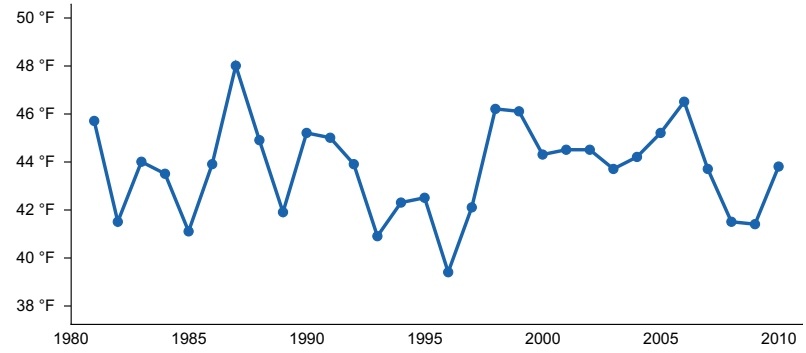



**Figure 6. Annual average temperature pattern**

## Climate stations used

- (1) BRITTON [USC00391049], Britton, SD
- (2) ANDOVER #2 [USC00390120], Andover, SD
- (3) TURTON [USC00398420], Turton, SD

- (4) CONDE [USC00391917], Conde, SD
- (5) REDFIELD [USC00397052], Redfield, SD
- (6) MELLETTE 4 W [USC00395456], Northville, SD
- (7) ABERDEEN [USW00014929], Aberdeen, SD
- (8) COLUMBIA 8 N [USC00391873], Columbia, SD

## Influencing water features

This site does not receive significant additional water, either as runoff from adjacent slopes or from a seasonal high water table. Typically, depth to the water table exceeds 4 feet during the months of May through June and exceeds 6 feet the rest of the growing season. Although the water table may be as shallow as 3.5 feet early in the growing season in a few soils in this site, the shallow depth to gravel prohibits the plants from benefiting significantly from subirrigation. Surface infiltration is moderate or moderately rapid. Saturated hydraulic conductivity is moderately high or high in the surface and subsoil layers and it is very high in the gravelly layers. Water loss is through evapotranspiration and percolation below the root zone.

## Wetland description

Not Applicable,

## Soil features

Soils associated are in the Mollisol order and are classified further as Calcic Hapludolls, Typic Hapludolls, and Oxyaquic Hapludolls. These soils were developed under prairie vegetation. They formed in glaciofluvial deposits on broad outwash plains or in alluvium over glaciofluvial deposits on terraces along drainageways through glacial till uplands.

The common feature of soils in this site is the shallow depth (14 to 20 inches) to coarse-textured layers with significant gravel content (10 to 60 percent). The abrupt change in texture and structure in these soils has the effect of a restrictive layer, even though a few roots may penetrate the gravelly layers. The soils are moderately well drained to somewhat excessively drained – redoximorphic features, where present, are deeper than 3.5 feet.

The surface and subsoil layers above the gravel contact have medium or moderately coarse textures – most commonly loam or sandy loam. The gravelly layers in some soils contain significant amounts (>25%) of shale fragments. In some soils, loamy till is within a depth of 5 feet, but this has little impact on plant available water due to thick layer of gravel and sand in the upper substratum.

This site should show little or no evidence of rills, wind-scoured areas, or pedestaled plants. If present, water flow paths are broken, irregular in appearance, or discontinuous. The soil surface is stable and intact. These soils are moderately susceptible to water and wind erosion. Loss of the soil surface layer can result in a shift in species composition and/or production.

Major soil series correlated to the Shallow Gravel site are Arvilla and Renshaw.

Access Web Soil Survey ( https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx ) for specific local soils information.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Glaciofluvial deposits<br>(2) Alluvium |
| Surface texture | (1) Loam<br>(2) Sandy loam |
| Family particle size | (1) Loamy |
| Drainage class | Somewhat excessively drained |
| Permeability class | Moderate to rapid |

| | |
|---|---|
| Depth to restrictive layer | 14–20 in |
| Soil depth | 80 in |
| Surface fragment cover <=3" | 0–14% |
| Surface fragment cover >3" | 1–5% |
| Available water capacity (0-60in) | 3–5 in |
| Calcium carbonate equivalent (0-40in) | 0–6% |
| Electrical conductivity (0-40in) | 0 mmhos/cm |
| Soil reaction (1:1 water) (0-40in) | 6.6–7.9 |
| Subsurface fragment volume <=3" (0-40in) | 4–30% |
| Subsurface fragment volume >3" (0-40in) | 0% |

## Ecological dynamics

The site developed under Northern Great Plains climatic conditions, and included natural influence of large herding herbivores and frequent fire. Changes will occur in the plant communities due to weather fluctuations and/or management actions. Under adverse impacts, a slow decline in vegetative vigor and composition will occur. Under favorable conditions the site can return to a plant community resembling the Reference State plant community phases. Interpretations for this site are based on the Reference State. The Reference State 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 considered. Community phases, community pathways, states, transitions, thresholds and restoration pathways have been determined through similar studies and experience.

The natural disturbance regime consisted of frequent fires caused both by natural and Native American ignition sources. These fires occurred during any season of the year, but were concentrated in the spring and late summer or early fall. Lightening fires occurred most frequently in July and August while fires started by Native Americans occurred in April, September and October. Large ungulate grazing was heavy and occurred often, but usually for short durations. Grazing may have been severe when occurring after a fire event. The grazing and fire interaction especially when coupled with drought events, set up the dynamics discussed and displayed in the following state and transition diagram and descriptions.

This ecological site has been grazed by domestic livestock since introduced into the area. The introduction of domestic livestock and the use of fencing and reliable water sources have radically changed the disturbance regime of this site.

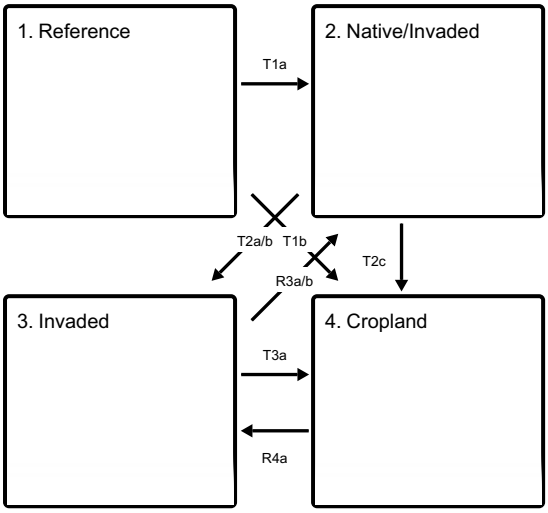
Heavy continuous grazing and/or continuous seasonal (spring) grazing, without adequate recovery periods following each grazing occurrence, coupled with the introduction of non-native invasive species causes this site to depart from the Reference State. As this site deteriorates, species such as blue grama, sand dropseed, red threeawn and sedge will increase. Grasses such as needleandthread, green needlegrass, western wheatgrass and plains muhly will decrease in frequency and production. Perennial forbs increase under poor management, and if management persists, annual forbs and shrubs will also increase as grasses decrease. This site is extremely responsive to high moisture years when additional moisture is received during the growing season. The associated coarse textured soils have low moisture holding capability, which generally limits plant growth. With additional moisture, the interpretive plant community can significantly increase its production when compared to the production of a normal year.

Following the state and transition diagram are narratives for each of the described states and community phases. These may not represent every possibility, but they are the most prevalent and repeatable states/community

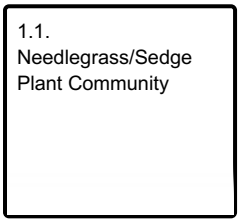
phases. The plant composition tables shown below have been developed from the best available knowledge at the time of this revision. As more data are collected, some of these community phases and/or states may be revised or removed, and new ones may be added. The main purpose for including the descriptions here is to capture the current knowledge and experience at the time of this revision.

## State and transition model

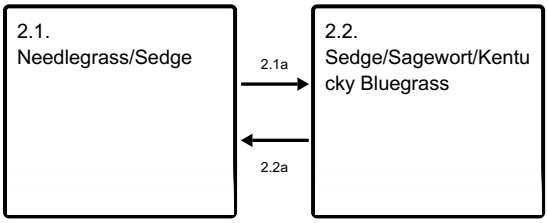
**Ecosystem states**



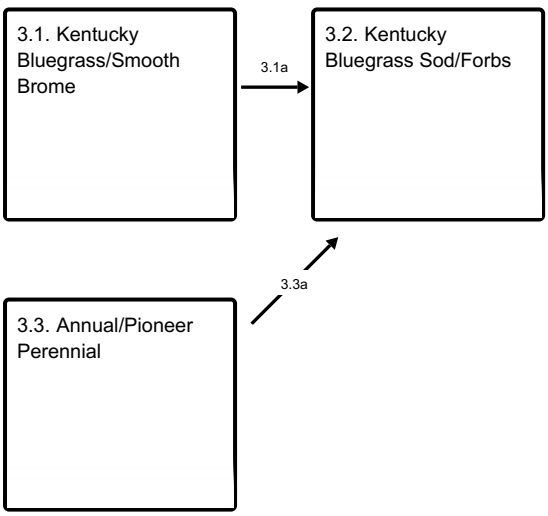

**State 1 submodel, plant communities**




**State 2 submodel, plant communities**




**State 3 submodel, plant communities**




## State 1
## Reference

This state represents the natural range of variability that dominated the dynamics of this ecological site. This state was dominated by native cool-season bunchgrasses. The primary disturbance mechanisms for this site in the reference condition include frequent fire and grazing by large herding ungulates. Timing of fires and grazing coupled with weather events dictate the dynamics that occur within the natural range of variability. Mid and tall stature grass species can decline and a corresponding increase in short stature warm-season grasses and cool-season grass-like species will occur.

**Dominant plant species**

- needle and thread (*Hesperostipa comata*), grass
- green needlegrass (*Nassella viridula*), grass
- threadleaf sedge (*Carex filifolia*), grass
- porcupinegrass (*Hesperostipa spartea*), grass

## Community 1.1
## Needlegrass/Sedge Plant Community

This community phase was the most dominant both temporally and spatially. The prevailing climate and weather patterns favor the development of this community phase dominated by mid and tall cool-season bunchgrass such as needleandthread and green needlegrass. Other grass and grass-likes species occurring include threadleaf sedge, porcupine grass, plains muhly, blue grama, western wheatgrass, little bluestem, prairie dropseed, prairie junegrass, sand dropseed and red threeawn. The vegetation consists of about 85 to 95 percent grass and grass-like species, 2 to 10 percent forbs, and 2 to 5 percent shrubs. A variety of leguminous and non-leguminous perennial forbs are present in minor amounts. This is the interpretive plant community phase and is described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description. This is a naturally nitrogen deficient plant community.

**Table 5. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 1030 | 1720 | 2205 |
| Forb | 35 | 114 | 195 |
| Shrub/Vine | 35 | 67 | 100 |
| **Total** | **1100** | **1901** | **2500** |

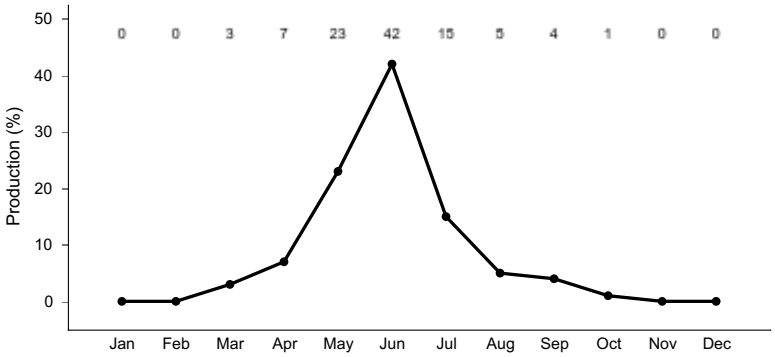



**Figure 8. Plant community growth curve (percent production by month). ND5502, Central Black Glaciated Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..**

## 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 still has a strong component of cool-season bunchgrass species, but invasive introduced cool-season sodgrasses 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 of fires and grazing coupled with weather events dictate the dynamics that occur within this state. The cool season native grass 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.

**Dominant plant species**

- prairie sagewort (*Artemisia frigida*), shrub
- western snowberry (*Symphoricarpos occidentalis*), shrub
- needle and thread (*Hesperostipa comata*), grass
- green needlegrass (*Nassella viridula*), grass
- threadleaf sedge (*Carex filifolia*), grass
- porcupinegrass (*Hesperostipa spartea*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- goldenrod (*Solidago*), other herbaceous
- prairie clover (*Dalea*), other herbaceous
- field sagewort (*Artemisia campestris*), other herbaceous

## Community 2.1
## Needlegrass/Sedge

This community phase most closely resembles the Reference State in appearance and ecological functions (e.g., hydrologic, biotic and soil/site stability). The cool-season dominated community is maintained with grazing systems that allow for adequate recovery periods following grazing events, and potentially the combination of grazing and prescribed burning which closely mimics the natural disturbance regime. This community phase closely resembles the Reference State community phase 1.1 (see narrative for 1.1 Needlegrass/Sedge). The basic difference between this community phase and 1.1 of the Reference State is the presence of minor amounts of introduced cool-season grasses and forbs. This is likely a naturally nitrogen deficient plant community, but perhaps less so than the Reference State. A change in the nutrient cycle on this ecological site possibly due to the introduction of non-native species may be a causative factor leading to the eventual dominance of cool-season introduced grasses in the Invaded State.

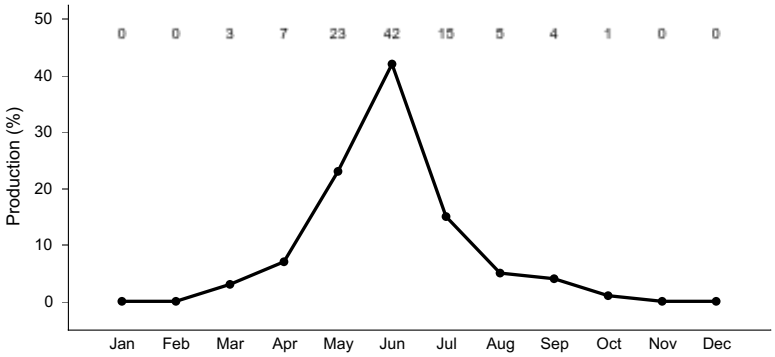



**Figure 9. Plant community growth curve (percent production by month). ND5502, Central Black Glaciated Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..**

## Community 2.2
## Sedge/Sagewort/Kentucky Bluegrass

Grazing pressure reduces the mid/tall, less grazing tolerant species, while the shorter more grazing tolerant species increase. Litter amounts are reduced, and energy capture shifts to slightly earlier in the growing season due to a decline in the later maturing native grass component and an increase in the earlier maturing grass-likes and non-native grasses. Kentucky bluegrass increases and may approach dominance in this community. Vegetation consists of about 80 to 90 percent grass and grass-like species, 5 to 15 percent forbs, and 2 to 5 percent shrubs. Sedge, cudweed sagewort, green sagewort, and fringed sagewort are the dominant species in the early stages of this community phase. Significant grass species include Kentucky bluegrass, needleandthread, red threeawn and sand

dropseed. Other grasses present include blue grama, western wheatgrass, green needlegrass, and prairie junegrass. The common forbs include cudweed sagewort, goldenrod, green sagewort, western salsify, heath aster, and scurfpea. Western snowberry, fringed sagewort, and rose are the principal shrubs. This community phase is often dispersed throughout the pasture, in an overgrazed/undergrazed pattern, typically referred to as patch grazing. Some areas (overgrazed) will exhibit the impacts of heavy use, while other areas (undergrazed) will have a build-up of litter and a high amount of plant decadence. This is a typical pattern found in properly stocked pastures grazed season-long. In the undergrazed patches, litter buildup reduces plant vigor and density, and native seedling recruitment declines. Due to a lack of tiller stimulation and sunlight, native bunchgrasses typically develop dead centers and native rhizomatous grasses are limited to small colonies. In the overgrazed patches, plant vigor is reduced and the competitive advantage goes towards the grazing tolerant short statured species such as Kentucky bluegrass and sedge. This community phase is approaching the threshold which would readily lead to the Invaded State. If management is significantly altered, this community phase can still be reverted back to the Needlegrass/Sedge community. Grazing management that allows for adequate recovery periods will tend to restore the ecological functions of this site. Fire can play a role in reducing the introduced cool-season species. The combination of grazing and fire may be the most effective in moving this community phase towards a community resembling the Reference State. Soil erosion is low. Infiltration is reduced, while runoff is increased compared to the Reference State.

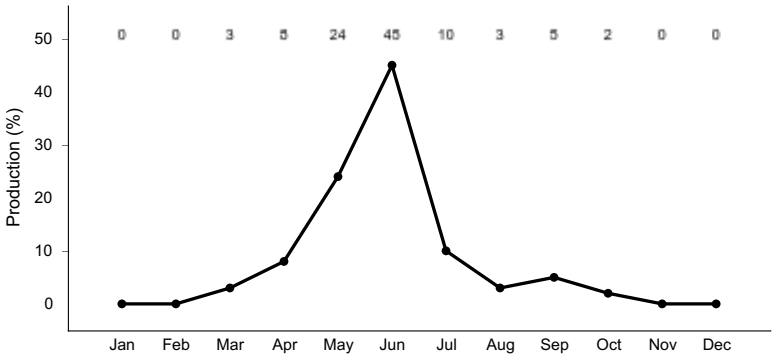



**Figure 10. Plant community growth curve (percent production by month). ND5501, Central Black Glaciated Plains, cool-season dominant. Cool-season dominant..**

### Pathway 2.1a
### Community 2.1 to 2.2

This community pathway is triggered by a change in the natural disturbance regime, most often caused by either heavy, continuous season-long grazing or continuous seasonal grazing without adequate recovery periods (grazing at the same season of year for extended periods during the active growing season of the dominant native grasses). Along this pathway, the timing of energy capture shifts from early to mid summer to spring and early summer. The change in plant functional and structural groups and the composition and distribution of the vegetation causes a decrease in production and an increase in runoff with a corresponding decrease in infiltration. Nutrient cycling is restricted as the rooting depth of the vegetation decreases with the change in functional and structural groups. Plant community diversity is reduced with a loss of some native forbs and minor grasses.

### Pathway 2.2a
### Community 2.2 to 2.1

This community pathway is initiated by implementation of prescribed grazing management which includes adequate recovery periods following each grazing event, and stocking levels which match the available resources. If properly implemented, this will shift the competitive advantage from the introduced cool-season species to the native cool-season bunchgrasses. The addition of prescribed burning may expedite this shift.

## State 3
## Invaded

This state is the result of invasion and dominance of introduced cool-season sodgrasses. This state is characterized by the dominance of Kentucky bluegrass and/or smooth brome and an increasing thatch layer that effectively blocks introduction of other plants into the system. Once the state is well established, even drastic events such as high

intensity fires driven by high fuel loads of litter and thatch will not result in more than a very short term reduction of these two species. These events may reduce the dominance of the sodgrasses, but due to the large amount of rhizomes in the soil there is no opportunity for the native species to establish and dominate before the sodgrasses rebound and again dominate the system. This state also includes the Annual, Pioneer Perennial community phase which is highly variable depending on the disturbance which causes this transition (T4). Over time, the Annual, Pioneer Perennial community phase will likely become dominated by introduced cool-season grasses, and shift to the Kentucky Bluegrass community phase (3.2).

**Dominant plant species**

- prairie sagewort (*Artemisia frigida*), shrub
- western snowberry (*Symphoricarpos occidentalis*), shrub
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- goldenrod (*Solidago*), other herbaceous

## Community 3.1
## Kentucky Bluegrass/Smooth Brome

This community phase is dominated by the cool-season sodgrasses including Kentucky bluegrass and smooth brome. Remnants of native cool- and warm-season grasses are still present, but greatly reduced. Vegetation consists of about 85 to 95 percent grass and grass-like species, 2 to 5 percent forbs, and 2 to 5 percent shrubs. Dominant grasses include Kentucky bluegrass and smooth brome. Significant forbs include cudweed sagewort, goldenrod, western yarrow, and green sagewort. Shrubs are essentially limited to fringed sagewort and western snowberry. Infiltration is reduced and runoff is increased when compared to the Reference State. Nutrient cycling is limited by the rooting depth of these species, the lack of leguminous forbs, and the alteration of the soil biotic community. Energy capture into the system is restricted to a short window provided by the early season species.

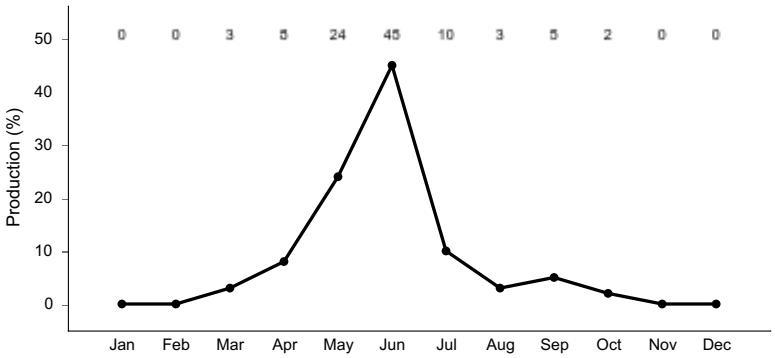



**Figure 11. Plant community growth curve (percent production by month). ND5501, Central Black Glaciated Plains, cool-season dominant. Cool-season dominant..**

## Community 3.2
## Kentucky Bluegrass Sod/Forbs

This community phase is dominated by Kentucky bluegrass with lesser amounts of sedge, and forbs such as cudweed sagewort, green sagewort, western yarrow, rush skeletonweed, and goldenrod. Fringed sagewort is also prevalent. Vegetation consists of about 75 to 90 percent grass and grass-likes species, 5 to 15 percent forbs, and 5 to 10 percent shrubs. The longer this community phase exists the more resilient it becomes. Natural or management disturbances that reduce the cover of Kentucky bluegrass are very short lived due to the abundance of rhizomes of Kentucky bluegrass in the soil and the lack of propagules of other species present. Production is limited to the sod forming species. Energy capture into this system is limited to one early growing species. Runoff increases and is the highest of any plant community phase on this ecological site. Nutrient cycling is severely limited to the rooting depth of the Kentucky bluegrass and production is limited.

## Community 3.3

### Annual/Pioneer Perennial

The Annual, Pioneer Perennial community phase is highly variable depending on the level and duration of disturbance related to the T4 transitional pathway. In this MLRA, the most probable origin of this phase is secondary succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses. Over time, the introduced cool-season perennial grasses will begin to establish on this site.

### Pathway 3.1a
### Community 3.1 to 3.2

This pathway is initiated by heavy continuous season-long grazing. The heavy continuous grazing favors those plants which can tolerate repeated defoliation (Kentucky bluegrass and sedges). Smooth brome will decrease with heavy use due to its elevated growth point. Grazing pressure will reduce litter cover resulting in elevated soil surface temperatures increasing evaporation rates and reducing biological activity.

### Pathway 3.3a
### Community 3.3 to 3.2

With grazing and time, the grazing tolerant Kentucky bluegrass will continue to increase leading to community phase 3.2. In the absence of grazing, this pathway will lead to a community phase resembling 3.1 with the primary difference being the lack of remnant native grass species.

## State 4
## Cropland

This state is the result of annual cropping.

### Transition T1a
### State 1 to 2

This is the transition from the native cool-season grass dominated Reference State to a state that has been invaded by introduced cool-season grass species. When propagules of Kentucky bluegrass are present, this transition occurs as natural and/or management actions favor a decline in the composition of native cool-season bunchgrasses grasses and an increase in cool-season sodgrasses. This transition is compounded by a change in the historic grazing and fire regime where native herbivores would follow periodic fires with grazing. This historic grazing/fire sequence has largely been replaced chronic season-long or heavy late season grazing. Complete rest from grazing and suppression of fire can also lead to this transition. The threshold between states is crossed when Kentucky bluegrass, smooth brome, and other introduced species become established on the site. These species typically are part of functional/structural groups that were not present in the Reference State.

### Transition T1b
### State 1 to 4

Removal of vegetative cover and tilling for agricultural crop production.

### Transition T2a/b
### State 2 to 3

T2a - Complete rest from grazing and elimination of fire are the two major contributors to this transition, especially when smooth brome is present. The opportunity for high intensity spring burns is severely reduced by early green-up and increased moisture and humidity at the soil surface. Plant litter accumulation tends to favor the more shade tolerant introduced grass species. The nutrient cycle is also impaired; 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; 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 sodgrass 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. T2b - Heavy. continuous season-long grazing is the primary driver of this transition. The very grazing tolerant species have the competitive advantage during this transition. The opportunity for high intensity spring burns (which can serve to reduce the introduced cool-season species) is severely reduced by early green-up and the lack of fuel. The nutrient cycle is impaired due to a shift from perennial native legumes to introduced biennial legumes and the lack of available carbon for soil biota due to accumulation in the surface layer root mat. These two factors result in reduced soil biological activity. Studies indicate that soil biological activity is altered; 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 sodgrass 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.

### Transition T2c
### State 2 to 4

Removal of vegetative cover and tilling for agricultural crop production.

### Restoration pathway R3a/b
### State 3 to 2

R3a - This restoration pathway may be initiated with the combination of prescribed burning followed by high levels of prescribed grazing management. The success of this restoration pathway depends on the presence of a remnant population of native grasses in community phase 3.1. This remnant population may not be readily apparent without close inspection. The application of prescribed burning may be needed at relatively short intervals in the early phases of this restoration process. Some previous efforts have shown promise with early season prescribed burning; however, fall burning may also be effective under certain circumstances. Both prescribed grazing and prescribed burning are necessary to successfully initiate this restoration pathway. R3b - It may be possible using selected plant materials and agronomic practices to approach 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 grasses, management objectives must include the maintenance of those species, the associated reference state functions, and the continued treatment of the introduced sodgrasses.

### Transition T3a
### State 3 to 4

Removal of vegetative cover and tilling for agricultural crop production.

### Transition R4a
### State 4 to 3

This transition occurs with cessation of cropping practices.

## Additional community tables

**Table 6. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Needlegrass** | | | 190–855 | |
| | needle and thread | HECOC8 | *Hesperostipa comata ssp. comata* | 380–665 | – |
| | green needlegrass | NAVI4 | *Nassella viridula* | 38–190 | – |
| | porcupinegrass | HESP11 | *Hesperostipa spartea* | 0–95 | – |
| 2 | **Warm-season Grasses** | | | 38–285 | |
| | blue grama | BOGR2 | *Bouteloua gracilis* | 19–95 | – |

| | | | | | |
|---|---|---|---|---|---|
| | plains muhly | MUCU3 | *Muhlenbergia cuspidata* | 19–95 | – |
| | little bluestem | SCSC | *Schizachyrium scoparium* | 0–57 | – |
| | Fendler threeawn | ARPUL | *Aristida purpurea var. longiseta* | 19–57 | – |
| | prairie dropseed | SPHE | *Sporobolus heterolepis* | 0–57 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 0–38 | – |
| 3 | **Other Native Grasses** | | | 38–190 | |
| | western wheatgrass | PASM | *Pascopyrum smithii* | 19–95 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 0–57 | – |
| | prairie Junegrass | KOMA | *Koeleria macrantha* | 19–38 | – |
| 4 | **Grass-likes** | | | 95–285 | |
| | threadleaf sedge | CAFI | *Carex filifolia* | 38–190 | – |
| | Grass-like (not a true grass) | 2GL | *Grass-like (not a true grass)* | 38–152 | – |
| **Forb** | | | | | |
| 5 | **Forbs** | | | 38–190 | |
| | goldenrod | SOLID | *Solidago* | 19–57 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 19–57 | – |
| | prairie clover | DALEA | *Dalea* | 19–57 | – |
| | blacksamson echinacea | ECAN2 | *Echinacea angustifolia* | 19–38 | – |
| | field sagewort | ARCA12 | *Artemisia campestris* | 19–38 | – |
| | white sagebrush | ARLU | *Artemisia ludoviciana* | 19–38 | – |
| | western yarrow | ACMIO | *Achillea millefolium var. occidentalis* | 19–38 | – |
| | scarlet beeblossom | GACO5 | *Gaura coccinea* | 19–38 | – |
| | blazing star | LIATR | *Liatris* | 19–38 | – |
| | lacy tansyaster | MAPI | *Machaeranthera pinnatifida* | 19–38 | – |
| | scurfpea | PSORA2 | *Psoralidium* | 19–38 | – |
| | Forb, annual | 2FA | *Forb, annual* | 0–38 | – |
| | upright prairie coneflower | RACO3 | *Ratibida columnifera* | 19–38 | – |
| | scarlet globemallow | SPCO | *Sphaeralcea coccinea* | 19–38 | – |
| | white heath aster | SYER | *Symphyotrichum ericoides* | 19–38 | – |
| | cutleaf anemone | PUPAM | *Pulsatilla patens ssp. multifida* | 0–19 | – |
| | spiny phlox | PHHO | *Phlox hoodii* | 0–19 | – |
| | rush skeletonplant | LYJU | *Lygodesmia juncea* | 0–19 | – |
| | onion | ALLIU | *Allium* | 0–19 | – |
| | pussytoes | ANTEN | *Antennaria* | 0–19 | – |
| | milkvetch | ASTRA | *Astragalus* | 0–19 | – |
| | blanketflower | GAAR | *Gaillardia aristata* | 0–19 | – |
| **Shrub/Vine** | | | | | |
| 6 | **Shrubs** | | | 38–95 | |
| | leadplant | AMCA6 | *Amorpha canescens* | 19–57 | – |
| | prairie sagewort | ARFR4 | *Artemisia frigida* | 19–57 | – |
| | rose | ROSA5 | *Rosa* | 19–57 | – |
| | western snowberry | SYOC | *Symphoricarpos occidentalis* | 0–19 | – |
| | spinystar | ESVIV | *Escobaria vivipara var. vivipara* | 0–19 | – |

| | | | | | |
|---|---|---|---|---|---|
| | spinystar | ECVIV | *Escobaria vivipara var. vivipara* | 0–19 | – |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 0–19 | – |

## Inventory data references

Information presented here has been derived from NRCS and other federal/state agency clipping and inventory data. Also, field knowledge of range-trained personnel was used. All descriptions were peer reviewed and/or field-tested by various private, state and federal agency specialists. Those involved in developing this site description include: Stan Boltz, NRCS Range Management Specialist; David Dewald, NRCS State Biologist; Jody Forman, NRCS Range Management Specialist; Jeff Printz, NRCS State Range Management Specialist; Kevin Sedivec, Extension Rangeland Management Specialist; Shawn Dekeyser, North Dakota State University; Rob Self, The Nature Conservancy and Lee Voigt, NRCS Range Management Specialist.

MLRA 55D was split from MLRA 55B in 2022. Many of the site concepts for this MLRA are borrowed from neighboring MLRA 55B pending further vegetation and soils validation.

## Other references

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## Approval

Suzanne Mayne-Kinney, 2/23/2024

## 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 | 05/03/2024 |
| Approved by | Suzanne Mayne-Kinney |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

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

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

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):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth ( in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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

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17. **Perennial plant reproductive capability:**

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