Ecological site R055DY010SD
Loamy

Last updated: 11/14/2024
Accessed: 12/22/2024

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 Loamy ecological site typically is located on glaciated uplands – rises on ground moraines and lake plains; on back slopes on moraines; and on side slopes of escarpments. Some areas of moraines are covered with silty loess – particularly on the east side of Glacial Lake Dakota. The site also occurs on flats on outwash plains and on terraces which are no longer impacted by frequent flooding. Generally, the soils are very deep; however, some have layers of sand and gravel or weathered shale in the substratum (>20 inches deep). The dark-colored surface soil is more than 7 inches thick. Surface textures typically are loam or silt loam; but clay loam, silty clay loam, and fine sandy loam also occur. The subsoil is loam, clay loam, silt loam, or silty clay loam (forms a ribbon 1 to 2 inches long). Soil on this site is moderately well drained or well drained. Generally, the depth to effervescence exceeds 12 inches; however, very slight effervescence is allowable where the depth to a layer of accumulated carbonate (strong

or violent effervescence) is >20 inches. Soil salinity, typically, is none to very slight in the upper 20 inches, but below that depth may increase to moderate in some soils. Slopes range from 0 to 30 percent. On the landscape, this site is below the Thin Loamy and Shallow Loamy ecological sites and above the Loamy Overflow, Limy Subirrigated, Wet Meadow, and Subirrigated sites. The Clayey ecological site occurs on similar landscape positions; the subsoil forms a ribbon >2 inches long. The transition between Loamy and Thin Loamy sites is determined by depth to accumulated carbonates. Soils with strong or violent effervescence within a depth of 8 inches are included in Thin Loamy - even where a thin, non-calcareous subsoil layer occurs above the calcic layer. This soil profile occurs most commonly where there has been cultivation at some time, but it also occurs in some soils in native grass.

Associated sites

R055DY011SD	**Clayey** This site typically occurs somewhat lower on the landscape. The subsoil layer forms a ribbon >2 inches long.
R055DY043SD	**Shallow Loamy** This site occurs on escarpments higher on the landscape. It has soft sedimentary shale bedrock within a depth of 20 inches. The soil above the shale forms a ribbon 1 to 2 inches long.
R055DY020SD	**Loamy Overflow** This site occurs on lower, concave slopes on till plains and lake plains – a run-on position; it also occurs on frequently flooded floodplain steps and low terraces. The surface and subsoil layers form a ribbon 1 to 2 inches long.
R055DY003SD	**Subirrigated** This site occurs on flats and in shallow depressions which have occasional, brief ponding early in the growing season. It has redoximorphic features at a depth of 18 to 30 inches. If present, a highly calcareous subsoil is >16 inches deep. All textures are included in this site.
R055DY006SD	**Limy Subirrigated** This site occurs 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.
R055DY012SD	**Thin Upland** This site occurs on higher, convex slopes on till plains and lake plains – a run-off landscape position. The surface and subsoil layers form a ribbon 1 to 2 inches long. It is highly calcareous (strong or violent effervescence) within a depth of 8 inches.

Similar sites

R055DY011SD	**Clayey** This site typically occurs somewhat lower on the landscape. The subsoil layer forms a ribbon >2 inches long.
R055DY009SD	**Sandy** This site occurs on till plains and lake plains that are mantled with fine sandy loam or sandy loam eolian deposits. The surface and subsoil layers from a ribbon <1 inch long.
R055DY020SD	**Loamy Overflow** This site occurs on lower, concave slopes on till plains and lake plains – a run-on position; it also occurs on frequently flooded floodplain steps and low terraces. The surface and subsoil layers form a ribbon 1 to 2 inches long.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Nassella viridula*

Physiographic features

This site typically occurs on glaciated uplands. Most commonly, it is on rises on ground moraines and lake plains; on

back slopes on moraines; and on side slopes of escarpments. It also occurs on flats on outwash plains. On ground moraines and moraines, the parent material is either fine-loamy or coarse-loamy till or fine-silty loess over till. On lake plains, the parent material is fine-silty, coarse-silty, fine-loamy or coarse-loamy glaciolacustrine sediments. On escarpments, the parent material is till or colluvium (at least 20 inches thick) over weathered shale. On outwash plains, the parent material is fine-loamy glaciofluvial deposits (at least 20 inches thick) over coarser glaciofluvial deposits. Included in this site are terraces which are no longer impacted by frequent flooding. Slopes could range from 0 to 35 percent but mostly fall within 3 to 8 percent.

Table 2. Representative physiographic features

Landforms	(1) Till plain (2) Terrace (3) Lake plain (4) Escarpment (5) Outwash plain
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	299–649 m
Slope	3–8%
Ponding depth	0 cm
Water table depth	117–183 cm
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)	559-584 mm
Frost-free period (actual range)	114-119 days
Freeze-free period (actual range)	127-134 days
Precipitation total (actual range)	559-584 mm
Frost-free period (average)	116 days
Freeze-free period (average)	131 days
Precipitation total (average)	584 mm

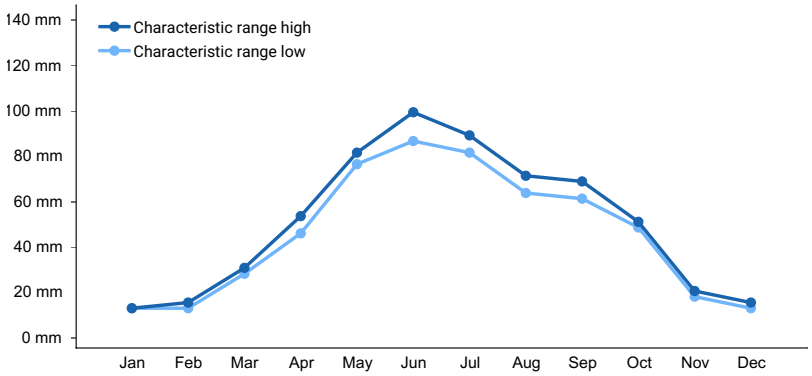


Figure 1. Monthly precipitation range

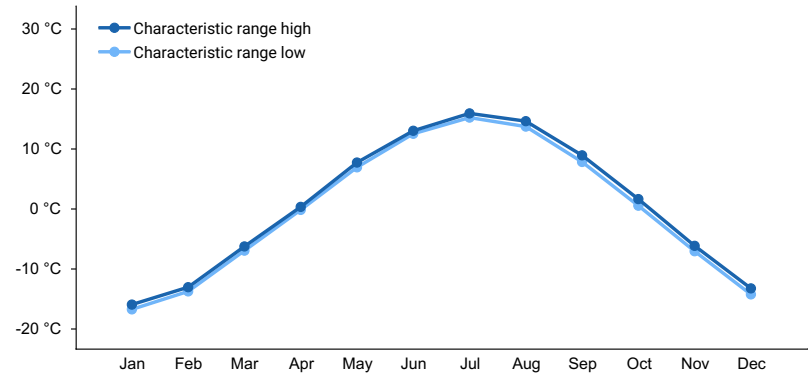


Figure 2. Monthly minimum temperature range

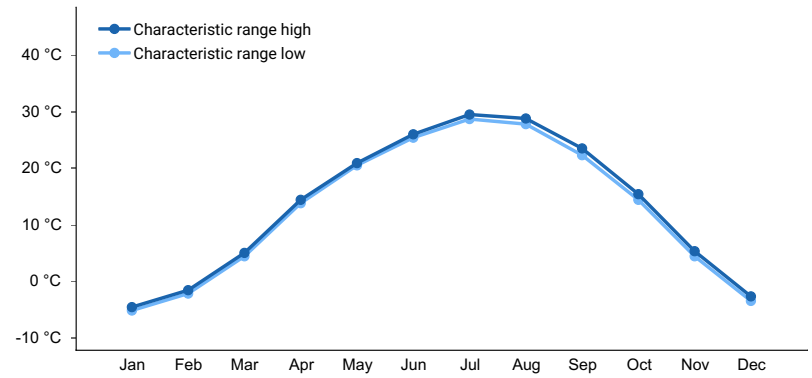


Figure 3. Monthly maximum temperature range

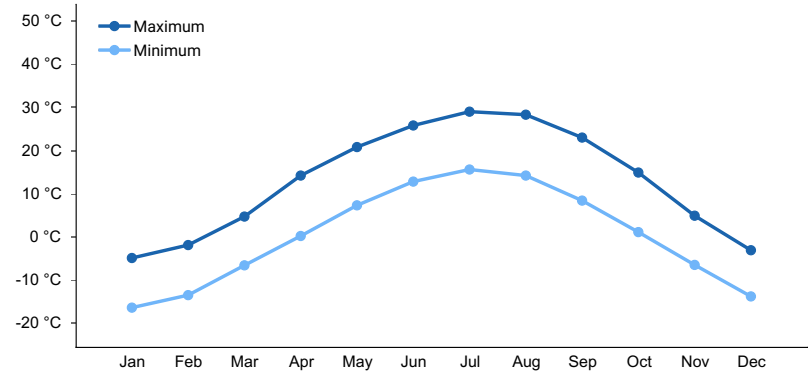


Figure 4. Monthly average minimum and maximum temperature

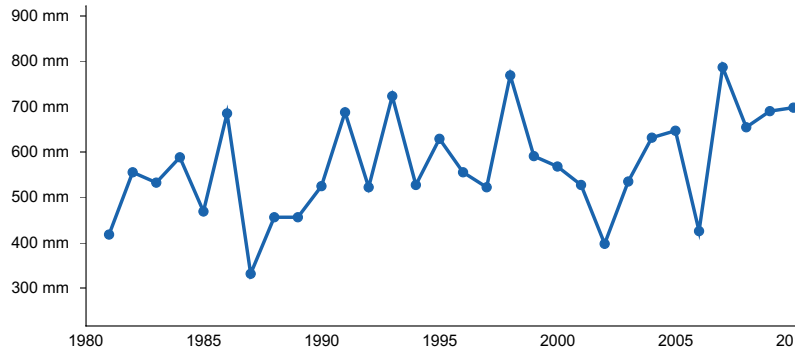


Figure 5. Annual precipitation pattern

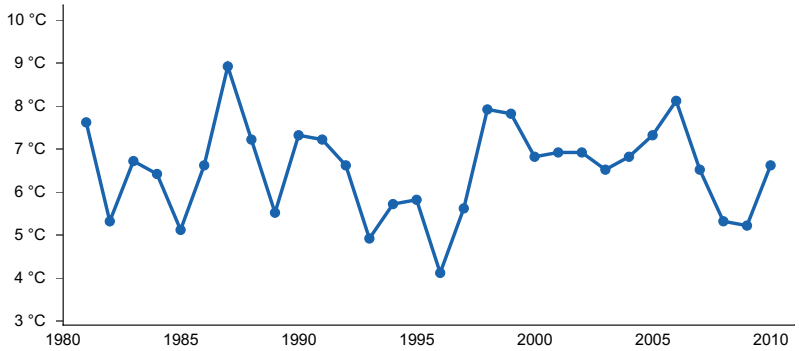


Figure 6. Annual average temperature pattern

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 additional water as runoff from adjacent slopes (it is commonly in a run-off landscape position). Neither does it receive significant additional water from a seasonal high water table. Depth to the water table exceeds 46 inches in the spring and ranges from 4 feet to more than 6 feet during the summer months. Surface infiltration is moderately slow or moderate. Saturated hydraulic conductivity throughout the profile typically is moderately high; however, in soils with contrasting substratum materials, it is very high where gravelly and moderately low where weathered shale beds occur. Water loss is through evapotranspiration and percolation below the root zone. Where this site occurs on terraces, flooding frequency is none to occasional.

Wetland description

Not Applicable

Soil features

Soils associated are in the Mollisol order. The Mollisols are classified further as Calcic Argiudolls, Pachic Argiudolls, Calcic Hapludolls, Typic Hapludolls, Pachic Hapludolls, Oxyaquic Hapludolls, Glossic Natrudolls (<35% clay), and Cumulic Hapludolls (>6% slope on uplands or on terraces). These soils were developed under prairie vegetation. The soils in this site commonly formed in till, silty loess over till, glaciolacustrine sediments, or colluvium from till or residuum. A few formed in alluvium.

The common feature of soils in this site are the medium and moderately fine textures through most of the root zone. Surface textures most commonly are loam or silt loam; but clay loam and silty clay loam are included. Also, fine sandy loam is allowable where it is <10 inches thick. Most of these soils are very deep; however, some are moderately deep (20 to 40 inches) to layers of weathered shale or sand and gravel. They are moderately well drained or well drained. Where present, redoximorphic features are deeper than 3 feet.

Some pedestaling of plants occurs, but it is not very evident on casual observation and occurs on less than 5% of the plants. Water flow paths are typically non-existent. The soil surface is stable and intact. These soils are mainly susceptible to water erosion. The hazard of water erosion increases where vegetative cover is not adequate. Loss of the soil surface layer can result in a shift in species composition and/or production.

Major soil series correlated to the Loamy site are: Aastad, Barnes, Beotia, Camtown, Darnen, Doland, Eckman, Edgeley, Estelline, Fordville, Forman, Gardena, Great Bend, Heimdal, Kranzburg, La Prairie(>6% slope), LaDelle (occasionally flooded), Overly, Poinsett, Putney, Spottswood, Svea, Vang, Vida, and Vienna.

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) Till (2) Glaciolacustrine deposits (3) Residuum
Surface texture	(1) Loam (2) Stony silt loam (3) Very stony silty clay loam (4) Bouldery clay loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Moderately slow to moderate
Depth to restrictive layer	51–203 cm
Soil depth	51–203 cm
Surface fragment cover <=3"	0–8%
Surface fragment cover >3"	0–2%
Available water capacity (0-152.4cm)	16.26–18.54 cm
Calcium carbonate equivalent (0-101.6cm)	0–26%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Soil reaction (1:1 water) (0-101.6cm)	6.5–8.5
Subsurface fragment volume <=3" (0-101.6cm)	0%
Subsurface fragment volume >3" (0-101.6cm)	1–7%

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 has the potential to resemble the reference state. Interpretations for this site are based

on the Green Needlegrass/Western Wheatgrass Plant Community Phase (1.1). The Reference State has been determined by study of rangeland relict 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. Lightning 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.

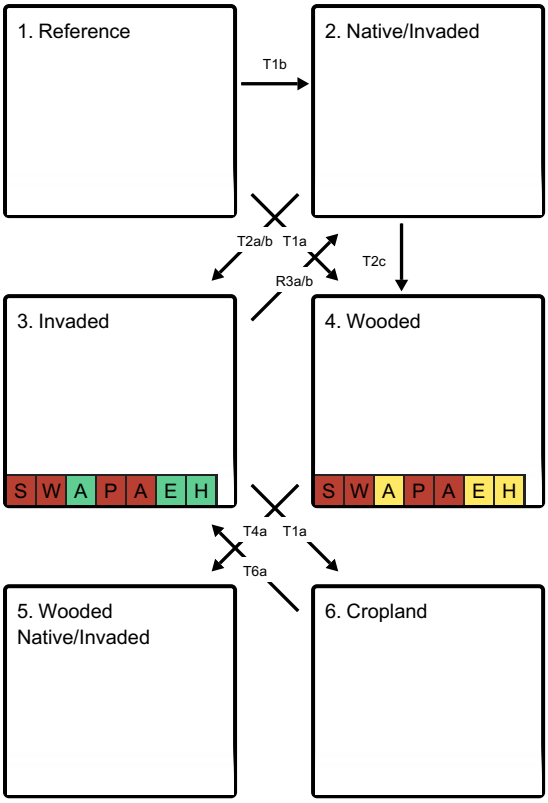
When this site is located within proximity to wooded floodplain sites, it may have transitioned to a woody (tree and shrub) dominated plant community. This situation primarily occurred along major river valleys where the floodplain sites served as a seed source for the woody plant material to expand onto adjoining sites, especially after settlement when historic fire regime was altered. This transition is represented on the state and transition diagram as transitional pathway T1a and T2c.

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, causes this site to depart from the reference plant community. Blue grama and Kentucky bluegrass, if present, will begin to increase. Western wheatgrass will increase initially and then begin to decrease. Green needlegrass will decrease in frequency and production. In time, heavy continuous grazing will likely cause upland sedges and blue grama and/or Kentucky bluegrass, if present, to dominate and pioneer perennials and annuals to increase. The resulting plant community is relatively stable and competitive advantage prevents other species from establishing. Extended periods of non-use and/or lack of fire will result in a plant community having high litter levels, which favors an increase in Kentucky bluegrass and/or smooth bromegrass. Shrubs such as western snowberry increase in this situation, especially in areas prone to snow accumulation and drift.

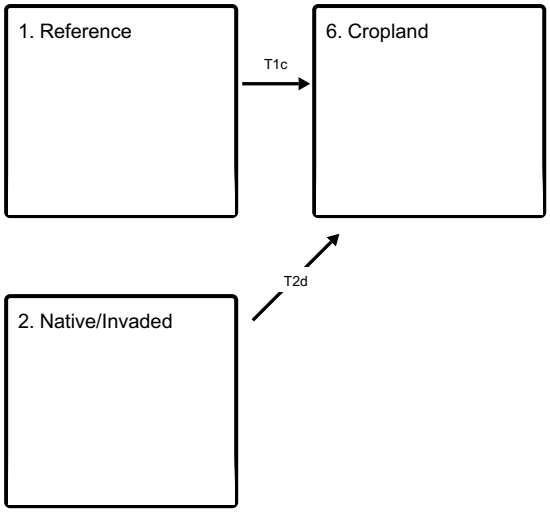
Following the state and transition diagram are narratives for each of the described states and community phases. These may not represent every possibility, but they are the most prevalent and repeatable states/community phases. The plant composition tables shown below have been developed from the best 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; 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

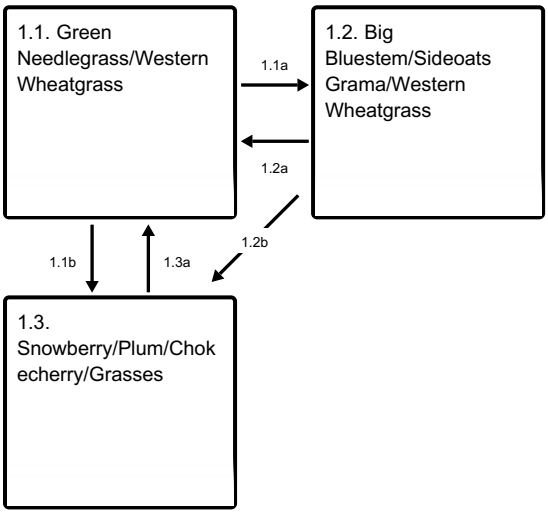
Ecosystem states



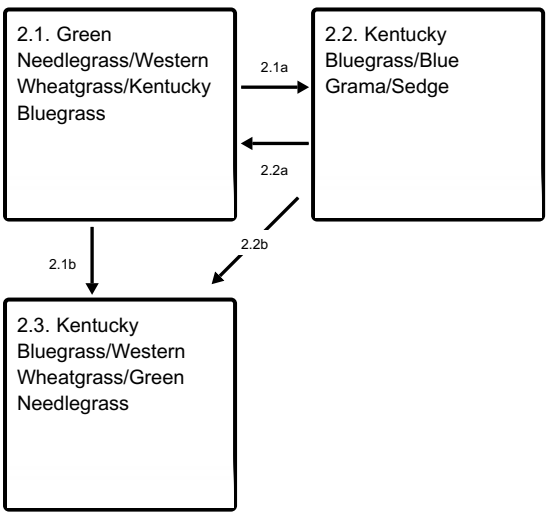
States 1, 6 and 2 (additional transitions)



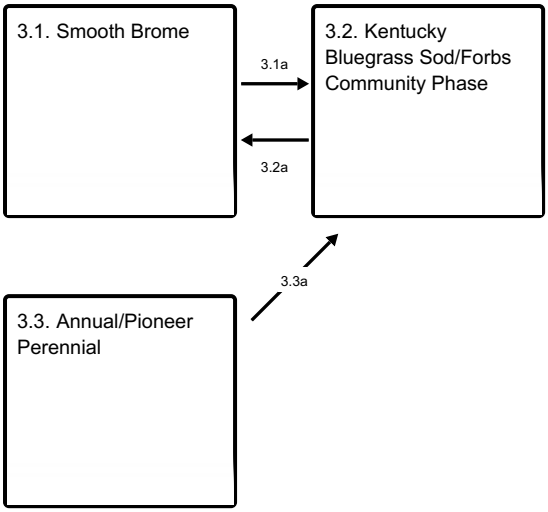
State 1 submodel, plant communities



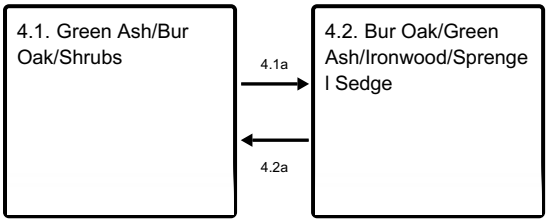
State 2 submodel, plant communities



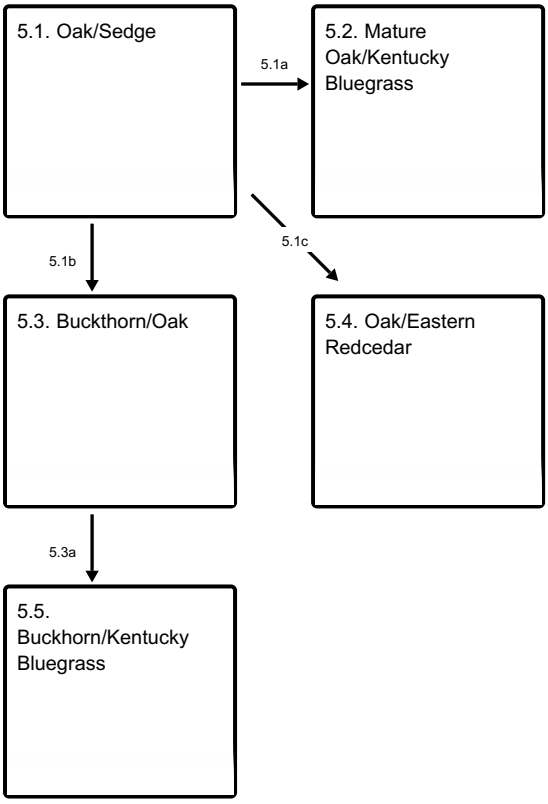
State 3 submodel, plant communities



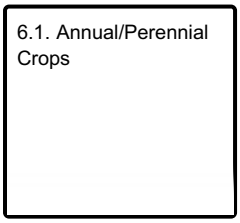
State 4 submodel, plant communities



State 5 submodel, plant communities



State 6 submodel, plant communities



State 1
Reference

This state represents the natural range of variability that dominates the dynamics of this ecological site. This state is dominated by cool season grasses. 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. Cool season species can decline and a corresponding increase in warm season grasses will occur.

Dominant plant species

- western snowberry (*Symphoricarpos occidentalis*), shrub
- chokecherry (*Prunus virginiana*), shrub
- American plum (*Prunus americana*), shrub
- green needlegrass (*Nassella viridula*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- big bluestem (*Andropogon gerardii*), grass
- sideoats grama (*Bouteloua curtipendula*), grass

Community 1.1
Green Needlegrass/Western Wheatgrass

This community phase was the most dominant both temporally and spatially. The prevailing climate and weather patterns favored the development of this community phase dominated by cool season grasses such as, green needlegrass and western wheatgrass. There are also other needlegrasses and wheatgrasses present as well as various amounts of warm season grasses such as big bluestem, blue grama and sideoats grama. A variety of leguminous and non-leguminous perennial forbs are present but only in slight amounts. This is the reference 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 with a carbon to nitrogen ratio of approximately 40:1.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1614	2809	3536
Forb	151	235	336
Shrub/Vine	28	94	163
Total	**1793**	**3138**	**4035**

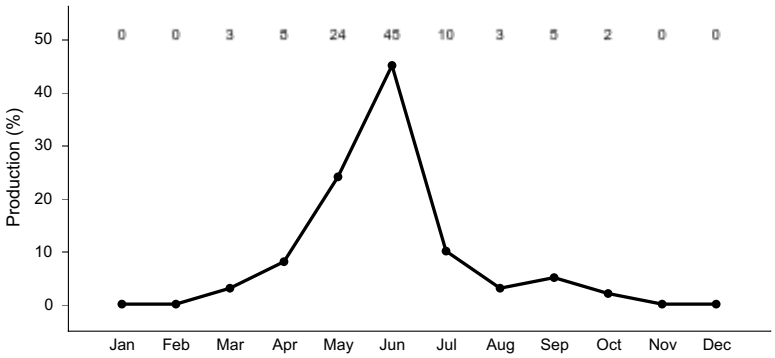


Figure 8. Plant community growth curve (percent production by month). ND5501, Central Black Glaciated Plains, cool-season dominant. Cool-season dominant..

Community 1.2
Big Bluestem/Sideoats Grama/Western Wheatgrass

When natural or management actions favor a shift from cool season dominated communities to warm season grass dominated communities this is the resulting community phase. This community phase is dominated by a combination of big bluestem, sideoats grama and western wheatgrass. Blue grama and prairie dropseed are also obvious on the site. Deep rooted summer perennial forbs are showy and evident, but are only minor components in the system.

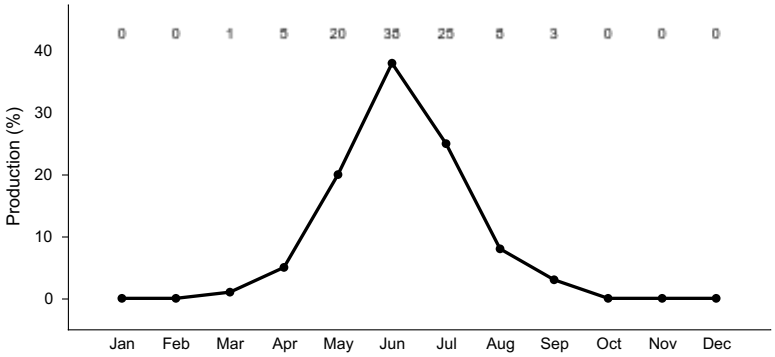


Figure 9. Plant community growth curve (percent production by month). ND5504, Central Black Glaciated Plains, warm-season dominant, cool-season sub-dominant.. Warm-season dominant, cool-season sub-dominant..

Community 1.3
Snowberry/Plum/Chokecherry/Grasses

Although this community phase appeared shrub dominated, grasses would have still constituted the majority of the production for this community phase. The western snowberry would have been spread across the site with chokecherry and plum in scattered patches. A remnant herbaceous understory was still present but may have been limited by reduced sunlight due to shrub canopy. Due to a reduced warm season component within this plant community, energy capture would have been shifted slightly to spring and early summer. Dominant functional/structural plant groups have been replaced by group(s) considered as minor components in community phase 1.1.

Pathway 1.1a
Community 1.1 to 1.2

This pathway occurs when events favor the decrease of cool season grasses and the increase of warm season grasses. Such events include early spring fires followed by severe grazing. This may have been a common occurrence in the natural range of variability. Spring and early summer drought, especially combined with early season burns or grazing could also initiate this pathway. Continuous early season burning or continuous early season grazing would also favor this pathway. Along this pathway, the dominant timing of energy capture shifts from spring and early summer to summer and early fall as the plant functional groups begin to change.

Pathway 1.1b
Community 1.1 to 1.3

This pathway was initiated by periods of above normal precipitation coupled with a reduction in fire frequency. The reduced fire frequency permitted the woody component of the plant community to expand and shift the dominance to the shrub species.

Pathway 1.2a
Community 1.2 to 1.1

The climate of the northern Great Plains favors this pathway. Time and natural and/or management events that favor a decrease in warm season grasses and an increase in cool season grasses will initiate this pathway. Summer fires and/or short duration severe summer grazing will favor this pathway. These events were common within the natural range of variability. As the plant functional groups shift from warm season to cool season, the timing of energy capture shifts to earlier in the growing season.

Pathway 1.2b
Community 1.2 to 1.3

This pathway was initiated by periods of above normal precipitation coupled with a reduction in fire frequency. The reduced fire frequency permitted the woody component of the plant community to expand and shift the dominance to the shrub species.

Pathway 1.3a
Community 1.3 to 1.1

A return to historic fire frequencies and normal, to below normal, precipitation would shift the competitive advantage back to the herbaceous component.

State 2
Native/Invaded

This state is very similar to the reference state. The invasion of introduced cool season sodgrasses has altered the natural range of variability for this ecological site. This state is still dominated by native cool season grass, 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 and duration of grazing coupled with weather events dictate the dynamics that occur within this state. The cool season native grasses can decline and an increase in introduced sod grasses will occur. Many times, this state appears as a mosaic of community phases caused primarily by continuous season long grazing.

Dominant plant species

- green needlegrass (*Nassella viridula*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- blue grama (*Bouteloua gracilis*), grass
- sedge (*Carex*), grass

Community 2.1
Green Needlegrass/Western Wheatgrass/Kentucky Bluegrass

This community phase is very similar in appearance and function to Phase 1.1 with the exception of the presence of minor amounts of non-native, cool season rhizomatous grasses such as Kentucky bluegrass and smooth bromegrass. The prevailing climate and weather patterns favor the development of this community phase dominated by the cool season grasses, green needlegrass and western wheatgrass. There are also other needlegrasses and wheatgrass present as well as small amounts of warm season grasses such as big bluestem, sideoats grama and blue grama. A variety of perennial forbs are present but only in slight amounts. Productivity is very similar to community phase 1.1 as is the timing of energy capture, infiltration rates and nutrient cycling.

Table 6. Annual production by plant type

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Total	**1793**	**3138**	**4035**

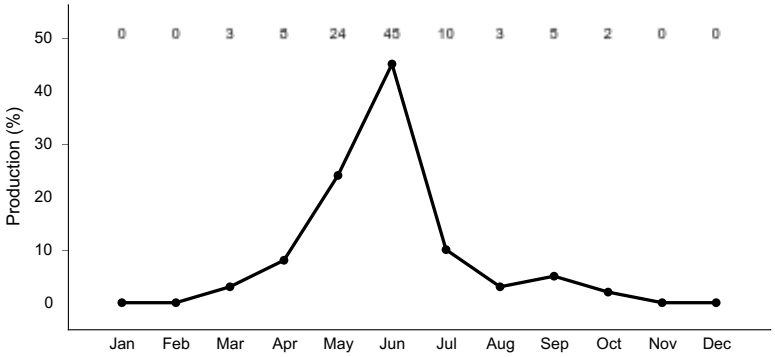

Figure 11. Plant community growth curve (percent production by month). ND5501, Central Black Glaciated Plains, cool-season dominant. Cool-season dominant..

Community 2.2
Kentucky Bluegrass/Blue Grama/Sedge

This community phase occurs when natural or management actions favor the development of a sodgrass community. It is dominated by Kentucky bluegrass, blue grama and upland sedges. Needleleaf and threadleaf sedge are the dominate sedges. Both tap rooted and fibrous rooted perennial forbs increase in this phase, but remain a minor component. Nutrient cycling declines due to a lack of deep root grasses, higher soil surface temperatures due to lack of plant cover, and lack of leguminous forbs. Water cycling also declines due to a decrease in the rooting depth of the plant community, increase in percent of bare ground, and increased soil surface temperatures.

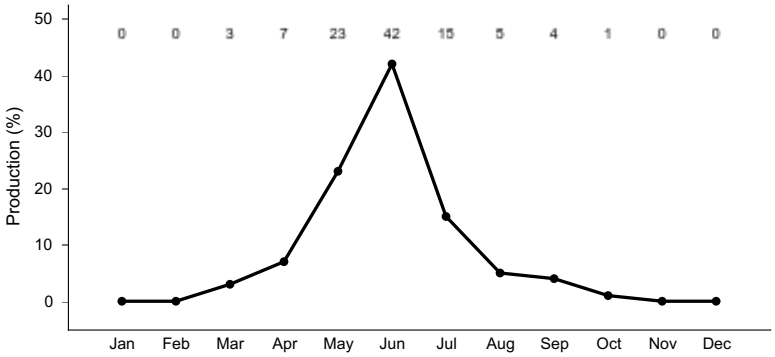

Figure 12. Plant community growth curve (percent production by month). ND5502, Central Black Glaciated Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..

Community 2.3
Kentucky Bluegrass/Western Wheatgrass/Green Needlegrass

This community phase is characterized by an increase in the introduced cool season sodgrass, Kentucky bluegrass. This community phase is the most dominant today both temporally and spatially. Kentucky bluegrass has become nearly co-dominant with the native cool season grasses western wheatgrass and green needlegrass. Warm season grasses are present but only in minor amounts. The amount and diversity of tap rooted perennial forbs decreases. Production and infiltration both decrease and this community phase is at risk of transitioning across a state threshold. With natural or management actions that decrease the composition of the cool season native bunchgrasses and increase the composition of Kentucky bluegrass, transition T2a will be initiated.

Pathway 2.1a
Community 2.1 to 2.2

Several combinations of events can occur to initiate this pathway. Severe repeated late season grazing or burning will favor the shift to sod forming grasses and sedges. Chronic heavy season-long grazing will also favor this shift. Along this pathway, the timing of energy capture shifts from spring and early summer to early spring and mid 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 leguminous forbs and minor grass components.

Pathway 2.1b
Community 2.1 to 2.3

This pathway is initiated with any action that allows the introduced Kentucky bluegrass to increase. Heavy late season or chronic season-long grazing will favor this change. Total rest from grazing and no fire events will also initiate this pathway. 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. Available nitrogen increases due to invasive legumes (black medic and sweetclover) altering the carbon to nitrogen ratio, favoring non-native, nitrogen dependent species such as Kentucky bluegrass.

Pathway 2.2a
Community 2.2 to 2.1

This pathway is characterized by natural or management actions such as time and summer drought combined with grazing timing and intensity that provides adequate recovery periods for the native cool season grasses. The climate of the northern Great Plains favors this pathway and the removal of disturbances that favor sodgrasses will initiate the pathway. The change of plant functional and structural groups will increase the annual production and shift the timing of the energy capture from early spring and mid-summer to late spring/summer. As this pathway continues, the change in composition and distribution of the plant community will increase infiltration and reduce runoff.

Pathway 2.2b
Community 2.2 to 2.3

Complete rest from grazing and no fire events will initiate this pathway. This lack of disturbance results in plant litter accumulation which alters energy capture, nutrient cycling and the micro-climate at the soil surface. These changes favor the shade tolerant species such as Kentucky bluegrass and smooth bromegrass.

State 3
Invaded

This state is the result of invasion and dominance of Kentucky bluegrass and/or smooth brome. This state is characterized by these two species 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.

Dominant plant species

- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Dominant resource concerns

- Organic matter depletion
- Aggregate instability
- Naturally available moisture use
- Plant structure and composition
- Plant pest pressure
- Wildfire hazard from biomass accumulation
- Feed and forage imbalance

Community 3.1
Smooth Brome

This community phase is dominated by a monotypic stand of smooth brome. The longer this community phase exists the more resilient it becomes. Natural or management disturbances that reduce the cover of smooth brome are very short lived due to the abundance of rhizomes of smooth brome in the soil and the lack of proagules of other species present.

Community 3.2
Kentucky Bluegrass Sod/Forbs Community Phase

This community phase is dominated by the cool season sodgrass Kentucky bluegrass. Runoff is relatively high and nutrient cycling is limited by the shallow rooting depth of these species and the lack of leguminous forbs.

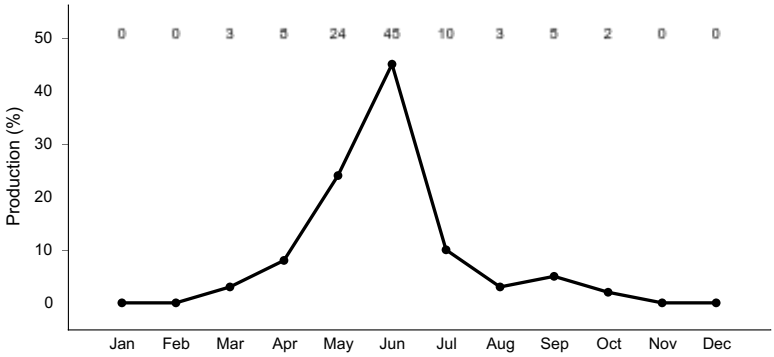

Figure 13. Plant community growth curve (percent production by month). ND5501, Central Black Glaciated Plains, cool-season dominant. Cool-season dominant..

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 T5 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. Overtime, the introduced cool-season perennial grasses will begin to establish on this site.

Pathway 3.1a
Community 3.1 to 3.2

Heavy continuous grazing will shift the plant community to the grazing tolerant Kentucky bluegrass.

Pathway 3.2a
Community 3.2 to 3.1

This pathway is initiated by continuous rest from grazing and fire. With the lack of grazing and fire to remove the litter, a thatch builds which reduces sunlight, competition from other species and favors the development of a monoculture of smooth brome. Energy inputs into the system are limited to one early growing species, and runoff increases. Nutrient cycling is severely limited to the rooting depth of the smooth brome and production declines.

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 western snowberry and remnant native grass species

State 4
Wooded

A wooded state may occupy this site when it occurs in association with river drainages and within close proximity to wooded loamy floodplain sites which serve as seed sources for the tree and shrub species. Elimination of fire as a disturbance factor and alteration of the historic grazing regimes resulted in the scattered shrub patches forming almost continuous woody dominated plant communities across the site. This state is characterized by an overstory of tall trees such as bur oak and green ash an understory of small trees and shrubs such as ironwood and chokecherry. Depending upon the amount of canopy cover, an herbaceous shade tolerant understory of sedges, smooth bromegrass, wildrye and/or Kentucky bluegrass may also be present.

Dominant plant species

- bur oak (*Quercus macrocarpa*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- chokecherry (*Prunus virginiana*), shrub
- western snowberry (*Symphoricarpos occidentalis*), shrub
- American plum (*Prunus americana*), shrub
- sedge (*Carex*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- Sprengel's sedge (*Carex sprengelii*), grass
- Virginia wildrye (*Elymus submuticus*), grass

Dominant resource concerns

- Sheet and rill erosion
- Classic gully erosion
- Plant productivity and health
- Plant structure and composition
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates

Community 4.1
Green Ash/Bur Oak/Shrubs

This plant community phase was/is characterized by a dominance of green ash and bur oak with lesser amounts of ironwood and boxelder. Shrubs include chokecherry, plum, snowberry, and gooseberry. An herbaceous understory of sedges, wildrye, and assorted forbs may also be present depending upon the amount of canopy cover. Kentucky bluegrass, smooth bromegrass and other non-native species may also be present if this plant community transitioned from State 2, Native/Invaded State. As the trees mature and canopy cover increases, herbaceous production declines and shrubs/vines associated with mature woodlands may begin to occupy the understory.

Community 4.2
Bur Oak/Green Ash/Ironwood/Sprengel Sedge

This plant community phase represented a mature to over-mature phase in which mature bur oak and green ash dominate with an understory of ironwood, gooseberry and other shade tolerant shrubs. The herbaceous component is limited to Sprengel sedge and other shade tolerant grasses/grass-likes such as Virginia wildrye. Regeneration of green ash and bur oak may have been limited by the closed canopy.

Pathway 4.1a
Community 4.1 to 4.2

As community phase 4.1 matured, the impacts of fire were reduced due to canopy cover and lack of fine fuels. This lack of disturbance resulted in further canopy development and eventually, canopy closure. Canopy closure further limited sunlight penetration, reducing herbaceous component to highly shade tolerant species and eventually, limiting tree regeneration.

Pathway 4.2a
Community 4.2 to 4.1

This pathway was initiated by drought and the associated increase in fire behavior and frequency resulting from these dryer conditions.

State 5
Wooded Native/Invaded

The introduction of non-native species and elimination of the fire as a disturbance mechanism results in a tree and shrub dominated plant community with an understory of native and non-native shade tolerant herbaceous species.

Dominant plant species

- bur oak (*Quercus macrocarpa*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- eastern redcedar (*Juniperus virginiana*), tree
- chokecherry (*Prunus virginiana*), shrub
- buckthorn (*Rhamnus*), shrub
- sedge (*Carex*), grass
- wildrye (*Elymus*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous
- riverbank grape (*Vitis riparia*), other herbaceous

Community 5.1
Oak/Sedge

This community phase is very similar in composition and function as those community phases described in State 4, Wooded State. Bur oak and green ash are the dominant trees with an understory of small trees, shrubs, and woody vines including ironwood, chokecherry, gooseberry, Virginia creeper, and riverbank grape. An herbaceous understory of sedges, wildrye, and introduced species such as Kentucky bluegrass and smooth bromegrass may also be present depending upon the amount of canopy cover. This is a relatively stable state with both tree and shrub regeneration occurring.

Community 5.2
Mature Oak/Kentucky Bluegrass

This community phase is dominated by mature bur oak trees with an understory of Kentucky bluegrass and possibly Sprengel’s sedge where the tree canopy is closed. “Park-like” best describes the appearance of this community phase. Bur oak, green ash and ironwood regeneration is very limited. Heavy grazing also limits shrub growth so the understory is relatively open. Ground cover can vary from leaf litter to herbaceous depending upon canopy cover which also makes herbaceous production highly variable.

Community 5.3
Buckthorn/Oak

This plant community phase closely resembles the Oak/Sedge community phase but with varying amounts of the invasive shrub buckthorn present. Initially, scattered buckthorn plants are relatively inconspicuous but as time progresses, buckthorn begins to dominate the understory, displacing native shrubs and limiting tree regeneration.

Community 5.4
Oak/Eastern Redcedar

This community phase is similar to the Oak/Sedge community phase except it has been invaded by eastern redcedar. Eastern redcedar is native to the state; however, it is considered an invasive on loamy sites. Historically,

periodic fire would have eliminated young eastern redcedar trees from the community before they attained a height or density to avoid a killing fire event. Without the benefit of these fires, young cedar trees can become established and spread across the site. Increasing amounts of eastern redcedar on a site can dramatically alter the historic ecological processes. The switch from a deciduous dominated community to one dominated by a coniferous species alters the functional/structural groups, changing the way energy, nutrients and water are cycled through the site.

Community 5.5
Buckhorn/Kentucky Bluegrass

This community phase represents a complete shift from the bur oak, green ash dominated community to one dominated by the invasive buckthorn and Kentucky bluegrass. The highly competitive nature of these two invasive species essentially eliminates the native species from this community. The overall stature and complexity of the community is lowered as a mid-statured shrub becomes the dominant species.

Pathway 5.1a
Community 5.1 to 5.2

Heavy, season-long grazing reduces tree and shrub regeneration and results in a more open canopy. This additional sunlight and heavy grazing pressure favors the Kentucky bluegrass resulting in a shift toward community phase 5.2, Mature Oak/Kentucky Bluegrass.

Pathway 5.1b
Community 5.1 to 5.3

This pathway is initiated when the Oak/Sedge community phase is invaded by Buckthorn. This invasion may occur with, or without the presence of livestock grazing.

Pathway 5.1c
Community 5.1 to 5.4

This pathway is initiated when the Oak/Sedge community phase is invaded by Eastern red cedar. This invasion may occur with, or without the presence of livestock grazing.

Pathway 5.3a
Community 5.3 to 5.5

As buckthorn increases and becomes a dominant understory shrub, regeneration of bur oak and green ash becomes less common and eventually, nonexistent. As older bur oak and ash trees begin to die, the lack of regeneration due to competition from the buckthorn results in a dramatic change in the appearance and stature of the plant community.

State 6
Cropland

This state is the result of annual cropping.

Community 6.1
Annual/Perennial Crops

This plant community is the result of cropping.

Transition T1b
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 cool season bunchgrasses and an increase in cool season sodgrasses. Chronic season long or heavy late season grazing facilitate this transition. Complete rest from grazing and no fire events can also lead to this transition. The threshold between states is crossed when Kentucky bluegrass becomes established on the site.

Transition T1a
State 1 to 4

This is the transition from the native herbaceous or herbaceous/shrub dominated Reference State to a state that is dominated by mature trees and shrubs. This transition occurs on those Loamy sites located along major river systems and in close proximity to frequently flooded Loamy Overflow ecological sites. These flooded sites served as a source of seed for trees and shrubs which, coupled with an alteration of the fire frequency following settlement, permitted this transition from an herbaceous dominated plant community to a woody dominated community. Increasing tree size and canopy cover altered the micro-climate and reduced fine fuel amounts, reducing fire frequency and intensity.

Transition T1c
State 1 to 6

Removal of vegetative cover and tilling for agricultural crop production.

Transition T2a/b
State 2 to 3

T2a - Several combinations of events can occur to initiate this pathway. Severe repeated late season grazing or burning will favor the shift to sod forming grasses and sedges. Chronic heavy season-long grazing will also favor this shift. Along this pathway, the timing of energy capture shifts from spring and early summer to early spring and mid-summer. The change in plant functional and structural groups and the composition and distribution of the vegetation cause 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 leguminous forbs and minor grass components. T2b - This pathway is initiated with any action that allows the introduced Kentucky bluegrass to increase. Heavy late season or chronic season-long grazing will favor this change. Total rest from grazing and no fire events will also initiate this pathway. 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. Available nitrogen increases due to invasive legumes (black medic and sweetclover) which alters the carbon to nitrogen ratio, favoring non-native, nitrogen dependent species such as Kentucky bluegrass.

Transition T2c
State 2 to 4

Removal of all disturbance from Loamy sites which are located adjacent to Loamy Overflow sites with existing trees to serve as seed sources.

Transition T2d
State 2 to 6

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 plant species, management objectives must include the maintenance of those species, the associated reference state functions, and the continued treatment of the introduced sodgrasses.

Transition T1a
State 3 to 6

Removal of vegetative cover and tilling for agricultural crop production.

Transition T4a
State 4 to 5

This transition occurs when non-native species and/or invasive native species invade the site. This may include such species as Kentucky bluegrass, smooth bromegrass, buckthorn and Eastern redcedar.

Transition T6a
State 6 to 3

This transition occurs with cessation of cropping practices being applied to cropland on this ecological site.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			314–628	
	western wheatgrass	PASM	*Pascopyrum smithii*	157–628	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	157–314	–
	slender wheatgrass	ELTRS	*Elymus trachycaulus ssp. subsecundus*	63–314	–
2	**Needlegrass**			471–942	
	green needlegrass	NAVI4	*Nassella viridula*	157–785	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	157–314	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	157–314	–
3	**Short Warm-season Grasses**			63–157	
	blue grama	BOGR2	*Bouteloua gracilis*	63–157	–
4	**Tall/Mid Warm-Season Grasses**			157–628	
	big bluestem	ANGE	*Andropogon gerardii*	157–628	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–157	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–157	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–94	–
5	**Other Native Perennials**			63–157	
	Grass, perennial	2GP	*Grass, perennial*	0–94	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	31–94	–
6	**Grass-likes**			31–157	

6	**Grass-likes**			31–157	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	31–157	–
	sedge	CAREX	*Carex*	31–157	–
Forb					
7	**Forbs**			157–314	
	Forb, native	2FN	*Forb, native*	0–157	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	31–63	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	31–63	–
	false boneset	BREU	*Brickellia eupatorioides*	31–63	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	31–63	–
	purple prairie clover	DAPU5	*Dalea purpurea*	31–63	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	31–63	–
	tall blazing star	LIAS	*Liatris aspera*	31–63	–
	dotted blazing star	LIPU	*Liatris punctata*	31–63	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	31–63	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	31–63	–
	goldenrod	SOLID	*Solidago*	0–63	–
	white heath aster	SYER	*Symphyotrichum ericoides*	31–63	–
	American vetch	VIAM	*Vicia americana*	31–63	–
	northern bedstraw	GABO2	*Galium boreale*	31–63	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–31	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–31	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–31	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–31	–
Shrub/Vine					
8	**Shrubs**			31–157	
	leadplant	AMCA6	*Amorpha canescens*	31–94	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	31–94	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–63	–
	prairie rose	ROAR3	*Rosa arkansana*	0–63	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–63	–

Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			314–628	
	western wheatgrass	PASM	*Pascopyrum smithii*	157–628	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	157–314	–
	slender wheatgrass	ELTRS	*Elymus trachycaulus ssp. subsecundus*	63–314	–
2	**Needlegrass**			471–942	
	green needlegrass	NAVI4	*Nassella viridula*	157–785	–

	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	157–314	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	157–314	–
3	**Short Warm-season Grasses**			63–157	
	blue grama	BOGR2	*Bouteloua gracilis*	63–157	–
4	**Tall/Mid Warm-Season Grasses**			157–628	
	big bluestem	ANGE	*Andropogon gerardii*	157–628	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–157	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–157	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–94	–
5	**Other Native Perennials**			63–157	
	Grass, perennial	2GP	*Grass, perennial*	0–94	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	31–94	–
6	**Grass-likes**			31–157	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	31–157	–
	sedge	CAREX	*Carex*	31–157	–
7	**Non-Native Grasses**			31–94	
	smooth brome	BRIN2	*Bromus inermis*	31–63	–
	Kentucky bluegrass	POPR	*Poa pratensis*	31–63	–
	Grass, perennial	2GP	*Grass, perennial*	0–31	–
Forb					
8	**Forbs**			157–314	
	Forb (herbaceous, not grass nor grass-like)	2FORB	*Forb (herbaceous, not grass nor grass-like)*	0–157	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	31–63	–
	northern bedstraw	GABO2	*Galium boreale*	31–63	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	31–63	–
	false boneset	BREU	*Brickellia eupatorioides*	31–63	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	31–63	–
	purple prairie clover	DAPU5	*Dalea purpurea*	31–63	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	31–63	–
	tall blazing star	LIAS	*Liatris aspera*	31–63	–
	dotted blazing star	LIPU	*Liatris punctata*	31–63	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	31–63	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	31–63	–
	goldenrod	SOLID	*Solidago*	0–63	–
	white heath aster	SYER	*Symphyotrichum ericoides*	31–63	–
	American vetch	VIAM	*Vicia americana*	31–63	–
	sweetclover	MELIL	*Melilotus*	0–31	–
	black medick	MELU	*Medicago lupulina*	0–31	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–31	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–31	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–31	–
Shrub/Vi					

Shrub/Vine					
9	**Shrubs**			31–157	
	leadplant	AMCA6	*Amorpha canescens*	31–94	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	31–94	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–63	–
	prairie rose	ROAR3	*Rosa arkansana*	0–63	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–63	–

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.

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Approval

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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	11/14/2024
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):**

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:**

17. **Perennial plant reproductive capability:**