# United States Department of Agriculture
# Natural Resources Conservation Service

## Ecological Site Description

**Site Stage: Provisional**

**Provisional:** an ESD at the provisional status represents the lowest tier of documentation that is releasable to the public. It contains a grouping of soil units that respond similarly to ecological processes. The ESD contains 1) enough information to distinguish it from similar and associated ecological sites and 2) a draft state and transition model capturing the ecological processes and vegetative states and community phases as they are currently conceptualized. The provisional ESD has undergone both quality control and quality assurance protocols. It is expected that the provisional ESD will continue refinement towards an approved status.

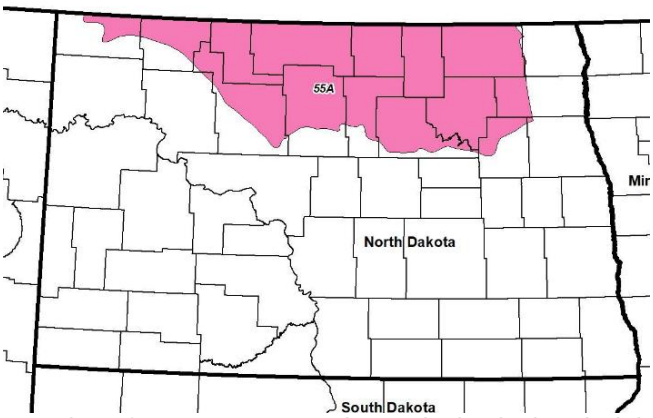
**Site Name**: Very Shallow

**Site Type:** Rangeland

**Site ID: R055AY053ND**

**Major Land Resource Area:** 55A – Northern Black Glaciated Plains

For more information on MLRAs, refer to the following web site:
https://www.nrcs.usda.gov/resources/data-and-reports/major-land-resource-area-mlra



Location of MLRA 55A - Northern Black Glaciated Plains within North Dakota

The Northern Black Glaciated Plains MLRA is an expansive and agriculturally important region consisting of 8,200,000 acres and including all or a portion of 16 counties in north-central and northeast North Dakota.

Nearly all MLRA 55A is covered by till: material that was moved and redeposited by the glaciers. Pre-glaciated bedrock (shale) is exposed in some of the deeper valleys and at the edges of some hills; but what covers the bedrock is glacial sediment, known as drift. These areas have the Late Wisconsin age till plain integrated drainage system in contrast to the closed drainage of much of the till plain and moraines. The Drift Prairie Region consists of nearly level to gently rolling glacial till plains dissected by glacial outwash channels. Five rivers flow through parts of the MLRA. The Souris (also known as Mouse) River meanders across the Canadian border through Renville and Ward counties; it then

loops east through McHenry County and north through Bottineau County returning to Canada. The Des Lacs River flows southward from Canada through Burke, southwest Renville, and Ward counties where it joins the Souris River. Along the eastern edge of the MLRA the Pembina River, Park River, and Forest River flow eastward to join the Red River. Some soils along these rivers have weathered shale beds in the substratum.

This region is utilized mostly by farms and ranches; about 80 percent is cropland that is dry-farmed. Cash-grain, bean and oil production crops are the principal enterprise on many farms, but other feed grains and hay are also grown. The vegetation on the steeper slopes and thinner (or sandy) soils is still native rangeland. About 3 percent of this area is forested. The most extensive areas of forest are in the Turtle Mountains, Pembina Gorge, White Horse Hill, and on the moraines in proximity to Devils Lake.

## Ecological Site Concept

The Very Shallow ecological site is located on uplands – primarily on outwash plains and on terraces and moraines dissected by rivers, streams and drainageways; it also occurs on high beach ridges along some lake shores. The soils are very shallow (<14 inches) to layers high in coarse sand and gravel (15 to 60 percent gravel). In some soils this layer contains significant amounts (>25%) of shale fragments. The thin surface layer is typically sandy loam, gravelly sandy loam, or loamy coarse sand; but gravelly loam and coarse sandy loam also occur. Where the soils have been cultivated, the surface layer may be very gravelly. Soil on this site is excessively drained. Slopes range from 0 to 45 percent. On the landscape, this site is above the Shallow Gravel, Loamy, and Subirrigated ecological sites. On moraines, the Thin Loamy site occurs on similar landscape positions; it is highly calcareous with loamy or silty textures to a depth of 40 inches or more.

## Physiographic Features

This site occurs on uplands – on glacial outwash plains, on terraces, on dissected moraines, and on high beach ridges along lake shores. It is on upper back slopes, shoulder slope and summits. Parent materials are gravelly glaciofluvial or beach deposits. Slopes range from 0 to 45 percent.

Landform: outwash plain, moraine, beach ridge

| | **Minimum** | **Maximum** |
|---|---|---|
| **Elevation (feet):** | 950 | 2525 |
| **Slope (percent):** | 0 | 45 |
| **Water Table Depth (inches):** | 80 | >80 |
| **Flooding:** | | |
| **Frequency:** | None | None |
| **Ponding:** | | |
| **Frequency:** | None | None |
| **Runoff Class:** | Negligible | Medium |
| **Aspect:** | No influence on this site | |

## Climatic Features

MLRA 55A is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are common and characteristic of the MLRA. The continental climate is the result of the location of this MLRA in the geographic center of North America. There are few natural barriers on the northern Great Plains, so air masses move unobstructed across the plains and account for rapid changes in temperature.

The average annual precipitation is 17 to 19 inches (432 to 483 millimeters). The normal average annual temperature is 36º to 41º F (2º to 5º C). January is the coldest month with an average low temperature of about ⁻ 3º F (⁻19º C). July is the warmest month with an average high temperature of about 80º F (27º C).

About 75 percent of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. Winter precipitation is typically snow. The annual snowfall is 25 to 50 inches (635 to 1,270 millimeters). The frost-free period averages 101 days and ranges from 108 days to 92 days. The freeze-free period averages 124 days and ranges from 128 to 119 days.

Growth of native cool-season plants begins in mid-April and continues to mid-July. Native warm-season plants begin growth in late May and continue to the end of August. Greening up of cool-season plants can occur in September and October when adequate soil moisture is present.

Long-term climate data is lacking for Turtle Mountain; however, annual precipitation for the International Peace Garden averaged 27.7 inches (704 millimeters) from 1967-1970 while that for Boissevain, Manitoba averaged 17.1 inches (434 millimeters). Turtle Mountain likely has greater precipitation, cooler temperatures, and less evapotranspiration than the adjacent plains.

**Climate Station(s) 1981-2010**

| Station | Name | Location | Elevation | Lat | Long |
|---|---|---|---|---|---|
| USC00323963 | HANSBORO 4 NNE | Hansboro | 1540 | 48.9989 | -99.3464 |
| USC00324958 | LANGDON EXP FARM | Langdon | 1615.2 | 48.7622 | -98.3447 |
| USC00328913 | UPHAM 3 N | Upham | 1424.9 | 48.6147 | -100.7264 |
| USC00328990 | VELVA 3NE | Velva | 1535.1 | 48.0797 | -100.875 |
| USC00329333 | WESTHOPE | Westhope | 1502 | 48.9097 | -101.0192 |
| USW00024013 | MINOT INTL AP | Minot | 1665 | 48.2553 | -101.2733 |
| USC00322304 | DRAKE 9 NE | Drake | 1529.9 | 48.0475 | -100.31 |
| USC00322525 | EDMORE 1NW | Edmore | 1535.1 | 48.4267 | -98.47 |
| USC00325993 | MINOT EXP STN | Minot | 1769 | 48.1803 | -101.2964 |
| USC00326025 | MOHALL | Mohall | 1641.1 | 48.7603 | -101.5089 |
| USC00327704 | RUGBY | Rugby | 1549.9 | 48.3542 | -99.9925 |
| USC00328792 | TOWNER 2 NE | Towner | 1480 | 48.3706 | -100.3908 |
| USC00329445 | WILLOW CITY | Willow City | 1473.1 | 48.6061 | -100.2911 |
| USW00014912 | DEVILS LAKE KDLR | Devils Lake | 1463.9 | 48.1069 | -98.8681 |
| USC00320941 | BOTTINEAU | Bottineau | 1619.1 | 48.8217 | -100.4525 |
| USC00323686 | GRANVILLE | Granville | 1509.8 | 48.2675 | -100.8439 |
| USC00325078 | LEEDS | Leeds | 1529.9 | 48.2881 | -99.4317 |
| USC00327664 | ROLLA 1NE | Rolla | 1833 | 48.8811 | -99.5861 |
| USC00321871 | CROSBY | Crosby | 1952.1 | 48.9075 | -103.2944 |
| USC00320961 | BOWBELLS | Bowbells | 1961 | 48.7994 | -102.2464 |

## Climate Normals

| | Representative | | Actual | | |
|---|---|---|---|---|---|
| | High | Low | High | Low | Average |
| Mean annual precipitation (in): | 19 | 17 | 20 | 17 | 18 |
| Frost free period (days): | 109 | 92 | 112 | 88 | 101 |
| Freeze free period (days): | 128 | 119 | 132 | 116 | 124 |

### Normal Monthly Precipitation (in)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Representative high: | 0.6 | 0.5 | 0.8 | 1.2 | 2.6 | 3.6 | 3.1 | 2.5 | 1.8 | 1.5 | 1.0 | 0.7 |
| Representative low: | 0.5 | 0.4 | 0.7 | 1.0 | 2.4 | 3.3 | 2.7 | 2.0 | 1.4 | 1.2 | 0.7 | 0.5 |
| Actual high: | 0.6 | 0.5 | 1.0 | 1.3 | 2.7 | 3.9 | 3.4 | 2.6 | 1.8 | 1.6 | 1.1 | 0.7 |
| Actual low: | 0.4 | 0.4 | 0.7 | 0.9 | 2.2 | 3.2 | 2.5 | 1.9 | 1.4 | 1.2 | 0.6 | 0.5 |

### Normal monthly minimum temperature (°F)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Representative high: | 0.1 | 4.0 | 17.1 | 30.3 | 42.0 | 52.2 | 56.6 | 54.3 | 44.0 | 31.7 | 17.7 | 3.9 |
| Representative low: | -4.9 | 0.2 | 13.3 | 27.3 | 39.4 | 49.6 | 54.0 | 51.8 | 41.4 | 28.9 | 14.6 | -0.1 |
| Actual high: | 1.8 | 7.9 | 19.2 | 31.8 | 43.6 | 53.3 | 58.0 | 55.8 | 46.0 | 33.9 | 18.6 | 6.4 |
| Actual low: | -6.2 | -1.6 | 11.8 | 26.2 | 38.1 | 48.7 | 53.2 | 51.0 | 40.8 | 27.9 | 14.1 | -0.6 |
| Average: | -2.6 | 2.3 | 14.9 | 28.8 | 40.6 | 50.7 | 55.3 | 53.1 | 42.8 | 30.2 | 16.0 | 2.0 |

### Normal monthly maximum temperature (°F)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Representative high: | 18.9 | 24.1 | 35.7 | 55.3 | 67.6 | 76.0 | 81.7 | 81.2 | 70.3 | 55.5 | 35.9 | 21.6 |
| Representative low: | 15.9 | 21.1 | 33.5 | 53.1 | 65.6 | 74.2 | 79.8 | 79.3 | 68.1 | 53.1 | 34.4 | 19.4 |
| Actual high: | 20.9 | 25.7 | 37.7 | 56.6 | 68.3 | 76.8 | 82.3 | 82.1 | 71.1 | 56.4 | 37.9 | 24.0 |
| Actual low: | 13.2 | 18.7 | 30.4 | 49.6 | 63.5 | 72.0 | 76.6 | 76.5 | 66.4 | 51.0 | 32.2 | 17.1 |
| Average: | 17.4 | 22.5 | 34.5 | 53.9 | 66.4 | 74.8 | 80.4 | 80.2 | 69.1 | 54.2 | 35.1 | 20.7 |

**30 Year Annual Rainfall (inches):** D-Dry; N-Normal; W-Wet

| 1981 D | 1982 W | 1983 D | 1984 D | 1985 N | 1986 N | 1987 N | 1988 D | 1989 D | 1990 D | 1991 W | 1992 D | 1993 W | 1994 W | 1995 N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15.5 | 22.9 | 16.1 | 16.2 | 18.5 | 18.8 | 17.4 | 11.6 | 13.5 | 16.5 | 22.7 | 11.5 | 21.7 | 22.1 | 17.9 |

| 1996 W | 1997 D | 1998 W | 1999 W | 2000 W | 2001 D | 2002 N | 2003 D | 2004 W | 2005 W | 2006 D | 2007 D | 2008 W | 2009 N | 2010 W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19.6 | 16.2 | 22.8 | 21.9 | 22.9 | 16.3 | 17.0 | 15.0 | 20.8 | 22.7 | 13.4 | 16.8 | 21.5 | 18.4 | 26.7 |

## Influencing Water Features

This site does not receive additional water as runoff from adjacent slopes; it is on a run-off landscape position. Neither does it receive additional water from a seasonal high-water table. Depth to the water table is deeper than 6 feet throughout the growing season. Infiltration is moderately rapid to very rapid. Permeability below the surface layer is rapid or very rapid. Water loss is through percolation below the root zone and evapotranspiration.

## Representative Soil Features

Soils associated with Very Shallow ES are in the Mollisol and Entisol orders. The Mollisols are classified further as Entic Hapludolls. The Entisols are classified further as Typic Udorthents. These soils were developed under prairie vegetation. They formed in glaciofluvial deposits or beach deposits.

The common feature of soils in this site is the very shallow depth (<14 inches) to layers high in coarse sand and gravel (15 to 60 percent gravel). In some soils this layer contains significant amounts (>25%) of shale fragments. Due to the high amounts of gravel, these soils are very droughty and have limited plant production. The soils are excessively drained. The thin surface layer is typically sandy loam, gravelly sandy loam, or loamy coarse sand; but gravelly loam and coarse sandy loam also occur. Where the soils have been cultivated, the surface layer may be very gravelly.

Salinity and sodicity are none. Soil reaction is neutral to moderately alkaline. Calcium carbonate content is none to low (CaCO3 <5%) in the surface soil and low to moderately high below. Some soils have layers of calcium carbonate accumulation in the upper part of the gravelly layers (typically as coatings on undersides of rock fragments).

This site should show 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 very unstable but intact. Sub-surface soil layers are restrictive to root penetration. These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 15 percent. Very low available water capacity caused by the shallow rooting depth strongly influences the soil/water/pant relationship. Loss of the soil surface layer can result in a shift in species composition and/or production.

Major soil series correlated to the Very Shallow site are Coe, Sioux, and Wamduska.

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

**Parent Material Kind**: glaciofluvial deposits, beach sands
**Parent Material Origin:** outwash, till
**Surface Texture:** sandy loam, loamy coarse sand, loam, coarse sandy loam
**Surface Texture Modifier:** gravelly, very gravelly
**Subsurface Texture Group:** sandy
**Surface Fragments <3" (% Cover):** 3-40
**Surface Fragments ≥3" (%Cover):** 0-30
**Subsurface Fragments <3" (% Volume):** 15-60
**Subsurface Fragments ≥3" (% Volume):** 0-10

| | Minimum | Maximum |
|---|---|---|
| **Drainage Class:** | excessively | excessively |
| **Permeability Class*:** | rapid | very rapid |
| **Depth to first restrictive layer (inches):** | 2 | 14 |
| **Electrical Conductivity (dS/m)*:** | 0 | 0 |
| **Sodium Absorption Ratio*:** | 0 | 0 |
| **Soil Reaction (1:1 Water)*:** | 6.6 | 8.4 |
| **Soil Reaction (0.1M CaCl2):** | NA | NA |
| **Available Water Capacity (inches)*:** | 1.0 | 2.5 |
| **Calcium Carbonate Equivalent (percent)*:** | 0 | 20 |

*These attributes represent from 0-40 inches.

## Plant Communities

**Ecological Dynamics of the Site:**
This ecological site description is based on nonequilibrium ecology and resilience theory and utilizes a State-and-Transition Model (STM) diagram to organize and communicate information about ecosystem change as a basis for management. The ecological dynamics characterized by the STM diagram reflect how changes in ecological drivers, feedback mechanisms, and controlling variables can maintain or induce changes in plant community composition (phases and/or states). The application of various management actions, combined with weather variables, impact the ecological processes which influence the competitive interactions, thereby maintaining or altering plant community structure.

Prior to European influence, the historical disturbance regime for MLRA 55A included frequent fires, both anthropogenic and natural in origin. Most fires, however, were anthropogenic fires set by Native Americans. Native Americans set fires in all months except perhaps January. These fires occurred in

two peak periods, one from March-May with the peak in April and another from July-November with the peak occurring in October. Most of these fires were scattered and of small extent and duration. The grazing history would have involved grazing and browsing by large herbivores (such as American bison, elk, and whitetail deer). Herbivory by small mammals, insects, nematodes, and other invertebrates are also important factors influencing the production and composition of the communities. Grazing and fire interaction, particularly when coupled with drought events, influenced the dynamics discussed and displayed in the following state and transition diagram and descriptions.

Following European influence, this ecological site generally has had a history of grazing by domestic livestock, particularly cattle, which along with other related activities (e.g., fencing, water development, fire suppression) has changed the disturbance regime of the site. Changes will occur in the plant communities due to these and other factors.

Weather fluctuations coupled with managerial factors may lead to changes in the plant communities and may, under adverse impacts, result in a slow decline in vegetative vigor and composition. However, under favorable conditions the botanical composition may resemble that prior to European influence.

Four vegetative states have been identified for the site (Reference, Native/Invaded, Invaded, and Go-Back). Within each state, one or more community phases have been identified. These community phases are named based on the more dominant and visually conspicuous species; they have been determined by study of historical documents, relict areas, scientific studies, and ecological aspects of plant species and plant communities. Transitional pathways and thresholds have been determined through similar methods.

**State 1: Reference State** represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. Dynamics of the state were largely determined by variations in climate and weather (e.g., drought), as well as that of fire (e.g., timing, frequency) and grazing by native herbivores (e.g., frequency, intensity, selectivity). Due to those variations, the Reference State is thought to have shifted temporally and spatially between two plant community phases.

Currently the primary disturbances include widespread introduction of exotic plants, concentrated livestock grazing, lack of fire, and perhaps long-term non-use and no fire. Because of these changes, particularly the widespread occurrence of exotic plants, as well as other environmental changes, the Reference State is considered to no longer exist. Thus, the presence of exotic plants on the site precludes it from being placed in the Reference State. It must then be placed in one of the other states, commonly State 2: Native/Invaded State (T1A).

**State 2: Native/Invaded State.** Colonization of the site by exotic plants results in a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition was inevitable; it often resulted from colonization by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, crested wheatgrass) which have been particularly and consistently invasive under long-term non-use and no fire. Other exotic plants (e.g., leafy spurge) are also known to invade the site.

Three community phases have been identified for this state; they are similar to the community phases in the Reference State but have now been invaded by exotic cool-season grasses. These exotic cool-season grasses can be expected to increase. As that increase occurs, plants more desirable to wildlife and livestock decline. A decline in forb diversity can also be expected. Under non-use or minimal use management, mulch increases and may become a physical barrier to plant growth. This also changes the micro-climate near the soil surface and may alter infiltration, nutrient cycling, and

biological activity near the soil surface. As a result, these factors coupled with shading cause desirable native plants to have increasing difficulty remaining viable and recruitment declines.

To slow or limit the invasion of these exotic grasses or other exotic plants, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic plants, the transition to State 3: Invaded State should be expected (T2A).

**State 3: Invaded State.** The threshold for this state is reached when both the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, crested wheatgrass) exceed 30% of the plant community and native grasses represent less than 40% of the community. One community phase has been identified for this state.

The exotic cool-season grasses can be quite invasive and often form monotypic stands. As they increase, both forage quantity and quality of the annual production becomes increasingly restricted to late spring and early summer, even though annual production may increase. Forb diversity often declines. Under non-use or minimal use management, mulch can increase and become a physical barrier to plant growth which alters nutrient cycling, infiltration, and soil biological activity. As such, desirable native plants become increasingly displaced.

Once the state is well established, prescribed burning and prescribed grazing techniques have been largely ineffective in suppressing or eliminating the exotic cool-season grasses, even though some short-term reductions may appear successful. However, assuming there is an adequate component of native grasses to respond to treatments, a restoration pathway to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing in conjunction with prescribed burning (R3A).

**State 4: Go-Back State** often results following cropland abandonment and consists of one plant community phase. This weedy assemblage may include noxious weeds that need control. Over time, the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, crested wheatgrass) will likely predominate.

Initially, due to extensive bare ground and a preponderance of shallow rooted annual plants the potential for soil erosion is high. Plant species richness may be high, but overall diversity (i.e., equitability) is typically low, with the site dominated by a relatively small assemblage of species. Due to the lack of native perennials and other factors, restoring the site with the associated ecological processes is difficult. However, a successful range planting may result in something approaching State 2: Native/Invaded State (R4A). Following seeding, prescribed grazing, prescribed burning, haying, and the use of herbicides will generally be necessary to achieve the desired result and control weeds, some of which may be noxious weeds. A failed range planting and/or secondary succession will lead to State 4: Invaded State (R4B).

The following state and transition model diagram illustrates the common states, community phases, community pathways, and transition and restoration pathways that can occur on the site. These are the most common plant community phases and states based on current knowledge and experience; changes may be made as more data are collected. Pathway narratives describing the site's ecological dynamics reference various management practices (e.g., prescribed grazing, prescribed fire, brush management, herbaceous weed treatment) which, if properly designed and implemented, will positively influence plant community competitive interactions. The design of these management practices will be site specific and should be developed by knowledgeable individuals; based upon management goals and a resource inventory; and supported by an ongoing monitoring protocol.

When the management goal is to maintain an existing plant community phase or restore to another phase within the same state, modification of existing management to ensure native species have the competitive advantage may be required. To restore a previous state, the application of two or more management practices in an ongoing manner will be required. Whether using prescribed grazing, prescribed burning, or a combination of both with or without additional practices (e.g., brush management), the timing and method of application needs to favor the native species over the exotic species. Adjustments to account for variations in annual growing conditions and implementing an ongoing monitoring protocol to track changes and adjust management inputs to ensure desired outcome will be necessary.

The plant community phase composition table(s) has been developed from the best available knowledge including research, historical records, clipping studies, and inventory records. As more data are collected, plant community species composition and production information may be revised.

## Plant Communities and Transitional Pathways

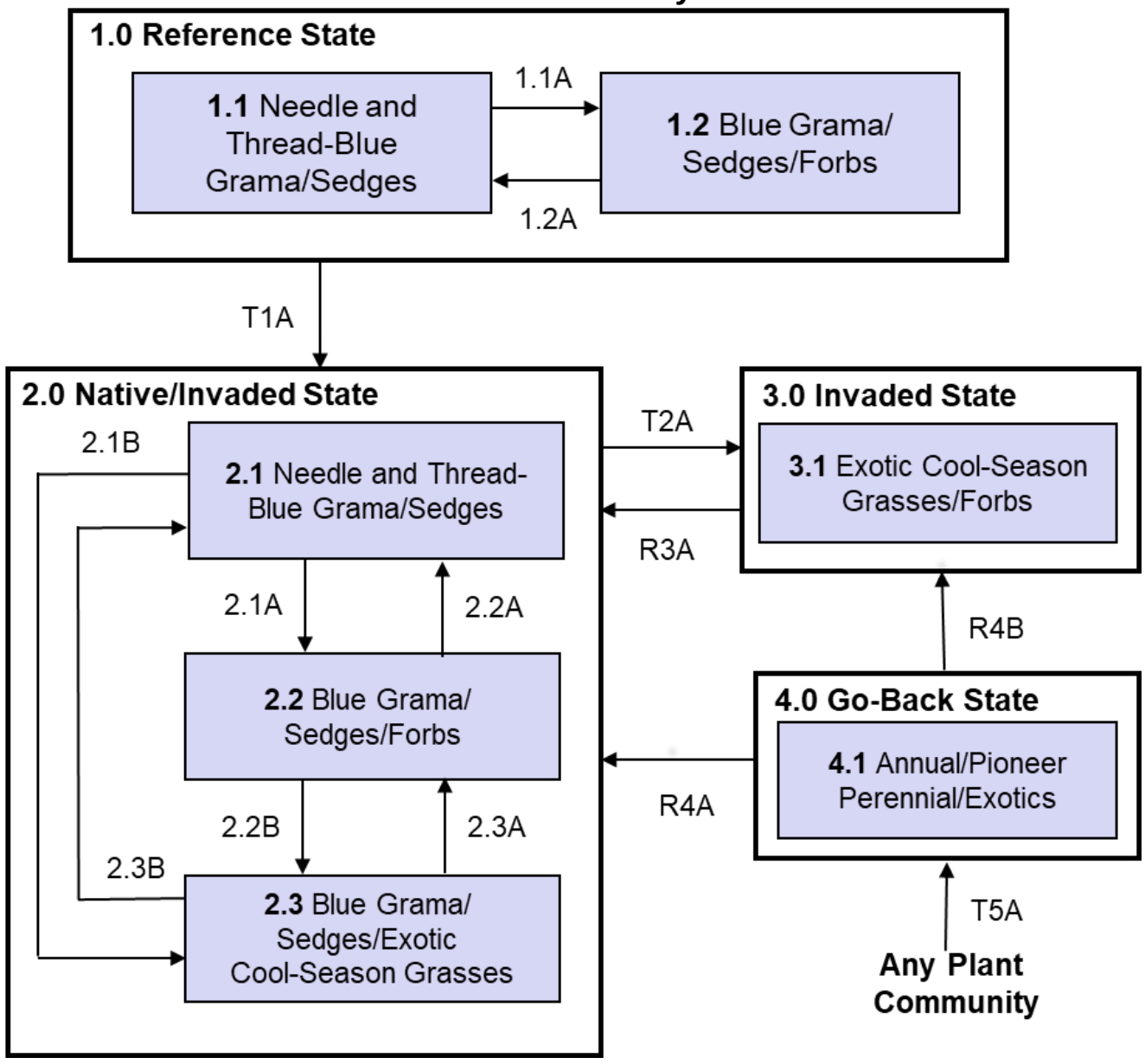


**Diagram Legend-MLRA 55A Very Shallow**

| | |
|---|---|
| T1A | Introduction of exotic cool-season grasses |
| T2A | Long-term non-use, or very light grazing, no fire |
| T5A | Cessation of annual cropping |
| R3A | Long-term prescribed grazing and prescribed burning |
| R4A | Successful range planting |
| R4B | Failed range planting and/or secondary succession |
| CP 1.1 - 1.2 (1.1A) | Multiyear drought with or without heavy grazing |
| CP 1.2 - 1.1 (1.2A) | Return to average precipitation with light to moderate grazing |
| CP 2.1 - 2.2 (2.1A) | Multiyear drought with or without heavy grazing |
| CP 2.1 - 2.3 (2.1B) | Long-term non-use, or very light grazing, no fire |
| CP 2.2 - 2.1 (2.2A) | Long-term prescribed grazing and prescribed burning and return to average precipitation |
| CP 2.2 - 2.3 (2.2B) | Long-term non-use, or very light grazing, no fire |
| CP 2.3 - 2.2 (2.3A) | Long-term prescribed grazing and prescribed burning |
| CP 2.3 - 2.1 (2.3B) | Long-term prescribed grazing with prescribed burning |

## State 1: Reference State

This state represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. The primary disturbance mechanisms for this site in the reference condition included frequent fire and grazing by large herding ungulates. Timing of fires and grazing, coupled with weather events, dictated the dynamics that occur within the natural range of variability. These factors likely caused the site to shift both spatially and temporally between two community phases - a warm/cool season, mid statured bunchgrass phase and a short statured warm-season grass and sedge phase.

Today the primary disturbance is from a lack of fire and concentrated livestock grazing. Grasses that are desirable for livestock and wildlife can decline and a corresponding increase in less desirable grasses will occur.

**Characteristics and indicators** (i.e., characteristics that can be used to distinguish this state from others). Because of changes in disturbances and other environmental factors (particularly the widespread occurrence of exotic species), the Reference State is considered to no longer exist.

**Resilience management** (i.e., management strategies that will sustain a state and prevent a transition). If intact, the reference state should probably be managed with current disturbance regimes which has permitted the site to remain in reference condition, as well as maintaining the quality and integrity of associated ecological sites. Maintenance of the reference condition is contingent upon a monitoring protocol to guide management.

### Plant Community Phase 1.1: Needle and Thread-Blue Grama/Sedges (*Hesperostipa comata-Bouteloua gracilis*/Carex spp.)

This community phase was the most dominant both temporally and spatially. Cool-season grasses and grass-like species dominated this plant community with warm-season grasses being subdominant. The major grasses and sedges included needle and thread, blue grama, western wheatgrass, and threadleaf sedge. Other grasses occurring on the site included Fendler threeawn, plains muhly, slender wheatgrass, sand dropseed, and prairie Junegrass. Dotted blazing star, hairy false goldenaster, blacksamson echinacea, and prairie clover were among the more common forbs. Common shrubs include prairie sagewort and rose.

Annual production likely varied from about 900-2000 pounds per acre with grasses and grass-likes, forbs, and shrubs contributing about 85%, 10% and 5%, respectively. This community represents the plant community phase upon which interpretations are primarily based and is described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description.

# Plant Community Composition and Group Annual Production

| | | 1.1 Needle and Thread-Blue Grama/Sedges | | |
|---|---|---|---|---|
| **COMMON/GROUP NAME** | **SYMBOL** | **Group** | **lbs./acre** | **% Comp** |
| ***GRASSES & GRASS-LIKES*** | | | *1050 - 1275* | *70 - 85* |
| ***COOL-SEASON GRASSES*** | | **1** | **450 - 825** | **30 - 55** |
| needle and thread | HECO26 | 1 | 75 - 525 | 5 - 35 |
| western wheatgrass | PASM | 1 | 75 - 150 | 5 - 10 |
| slender wheatgrass | ELTR7 | 1 | 150 - 225 | 10 - 15 |
| ***WARM-SEASON GRASSES*** | | **2** | **225 - 375** | **15 - 25** |
| blue grama | BOGR2 | 2 | 75 - 150 | 5 - 10 |
| plains muhly | MUCU3 | 2 | 15 - 75 | 1 - 5 |
| Fendler threeawn | ARPUL | 2 | 15 - 75 | 1 - 5 |
| sand dropseed | SPCR | 2 | 15 - 75 | 1 - 5 |
| ***OTHER NATIVE GRASSES*** | | **3** | **75 - 150** | **5 - 10** |
| prairie Junegrass | KOMA | 3 | 15 - 75 | 1 - 5 |
| other perennial grasses | 2GP | 3 | 0 - 75 | 0 - 5 |
| ***GRASS-LIKES*** | | **4** | **15 - 150** | **1 - 10** |
| threadleaf sedge | CAFI | 4 | 30 - 150 | 2 - 10 |
| other grass-likes | 2GL | 4 | 0 - 75 | 0 - 5 |
| ***FORBS*** | | *5* | *75 - 150* | *5 - 10* |
| blazing star | LIATR | 5 | 15 - 120 | 1 - 8 |
| hairy false goldenaster | HEVI4 | 5 | 15 - 60 | 1 - 4 |
| silverleaf Indian breadroot | PEAR6 | 5 | 0 - 60 | 0 - 4 |
| pussytoes | ANTEN | 5 | 15 - 45 | 1 - 3 |
| upright prairie coneflower | RACO3 | 5 | 15 - 45 | 1 - 3 |
| velvety goldenrod | SOMO | 5 | 15 - 45 | 1 - 3 |
| field sagewort | ARCA12 | 5 | 15 - 30 | 1 - 2 |
| blacksamson echinacea | ECAN2 | 5 | 15 - 30 | 1 - 2 |
| lacy tansyaster | MAPI | 5 | 15 - 30 | 1 - 2 |
| spiny phlox | PHHO | 5 | 15 - 30 | 1 - 2 |
| white heath aster | SYER | 5 | 15 - 30 | 1 - 2 |
| common yarrow | ACMI2 | 5 | 0 - 15 | 0 - 1 |
| onion | ALLIU | 5 | 0 - 15 | 0 - 1 |
| plains milkvetch | ASGI5 | 5 | 0 - 15 | 0 - 1 |
| prairie clover | DALEA | 5 | 0 - 15 | 0 - 1 |
| scarlet beeblosom | GACO5 | 5 | 0 - 15 | 0 - 1 |
| rush skeletonplant | LYJU | 5 | 0 - 15 | 0 - 1 |
| cutleaf anemone | PUPAM | 5 | 0 - 15 | 0 - 1 |
| other native forbs | 2FORB | 5 | 15 - 75 | 1 - 5 |
| ***SHRUBS*** | | *6* | *30 - 75* | *2 - 5* |
| prairie sagewort | ARFR4 | 6 | 15 - 60 | 1 - 4 |
| rose | ROSA5 | 6 | 15 - 30 | 1 - 2 |
| other shrubs | 2SHRUB | 6 | 0 - 45 | 0 - 3 |

| **Annual Production lbs./acre** | LOW | RV | HIGH |
|---|---|---|---|
| ***GRASSES & GRASS-LIKES*** | 765 - | 1275 - | 1700 |
| ***FORBS*** | 90 - | 150 - | 200 |
| ***SHRUBS*** | 45 - | 75 - | 100 |
| **TOTAL** | 900 - | 1500 - | 2000 |

This list of plants and their relative proportions are based on near normal years. Fluctuations in species composition and relative production may change from year to year dependent upon precipitation or other climatic factors. RV = Representative Value.

### Community Phase Pathway 1.1A
Community Phase Pathway 1.1 to 1.2 occurred during long-term drought with or without heavy grazing. This resulted in marked increases in blue grama and sedges with a corresponding decrease in needle and thread.

### Plant Community Phase 1.2: Blue Grama/Sedges/Forbs (*Bouteloua gracilis*/*Carex* spp./Forbs)
This plant community resulted from long-term drought with or without heavy grazing. It had a decreased annual production and an increase in forbs compared to Community Phase 1.1. Blue grama, threadleaf sedge, and forbs have increased markedly with a corresponding decline in needle and thread. Other grasses typically included western wheatgrass and prairie Junegrass. The more conspicuous forbs included field sagewort, silverleaf Indian breadroot, white heath aster, common yarrow, and blazing star. Prairie sagewort was generally the predominant shrub.

### Community Phase Pathway 1.2A
Community Phase Pathway 1.2 to 1.1 occurred with return to average precipitation with light to moderate grazing. This led to a marked increase in needle and thread along with corresponding declines in blue grama, sedges, and forbs.

### Transition T1A
This is the transition from the State 1: Reference State to the State 2: Native/Invaded State due to the introduction and establishment of exotic cool-season grasses (commonly Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass). This transition was inevitable and corresponded to a decline in native warm-season and cool-season grasses; it may have been exacerbated by chronic season-long or heavy late season grazing. Complete rest from grazing and suppression of fire could also have hastened this transition. The threshold between states was crossed when Kentucky bluegrass, smooth brome, crested wheatgrass, quackgrass, or other exotic cool-season grasses became established on the site.

**Constraints to recovery** (i.e., variables or processes that preclude recovery of the former state). Current knowledge and technology will not facilitate a successful restoration to Reference State.

### State 2: Native/Invaded State
This State is similar to the State 1: Reference State but has now been colonized by the exotic cool-season grasses (often Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass). These exotic grasses are present in small amounts; although the state is still dominated by native grasses, an increase in the exotic cool-season grasses can be expected.

These exotic cool-season grasses can be quite invasive on the site and are particularly well adapted to heavy grazing. They also often form monotypic stands. As these exotic cool-season grasses increase, both forage quantity and quality become increasingly restricted to late spring and early summer due to the monotypic nature of the stand, even though annual production may increase. Native forbs generally decrease in production, abundance, diversity, and richness compared to that of State 1: Reference State.

These exotic cool-season grasses have been particularly and consistently invasive under extended periods of non-use and no fire. To slow or limit the invasion of these exotic grasses, it is imperative that managerial techniques (e.g. prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to

control or reduce these exotic cool-season grasses, the transition to State 3: Invaded State should be expected.

Annual production of this state can be quite variable, in large part due to the amount of exotic cool-season grasses. Production, however, may be expected to be within the range between that of State 1: Reference State Community Phase 1.1 (900-2000 pounds per acre) and State 3: Invaded State (1450-2750 pounds per acre).

**Characteristics and indicators** (i.e., characteristics that can be used to distinguish this state from others). The presence of trace amounts of exotic cool-season grasses indicates a transition from State 1 to State 2. The presence of exotic biennial or perennial leguminous forbs (i.e., sweet clover, black medic) may not, on their own, indicate a transition from State 1 to State 2 but may facilitate that transition.

**Resilience management** (i.e., management strategies that will sustain a state and prevent a transition). To slow or limit the invasion of these exotic grasses, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective.

Grazing management should be applied that enhances the competitive advantage of native grass and forb species. This may include: (1) early spring grazing when exotic cool-season grasses are actively growing and native cool-season grasses are dormant; (2) applying proper deferment periods allowing native grasses to recover and maintain or improve vigor; (3) adjusting overall grazing intensity to reduce excessive plant litter (above that needed for rangeland health indicator #14 – see Rangeland Health Reference Worksheet); (4) incorporating early heavy spring utilization which focuses grazing pressure on exotic cool-season grasses and reduces plant litter, provided that livestock are moved when grazing selection shifts from exotic cool-season grasses to native grasses.

Prescribed burning should be applied in a manner that maintains or enhances the competitive advantage of native grass and forb species. Prescribed burns should be applied as needed to adequately reduce/remove excessive plant litter and maintain the competitive advantage for native species. Timing of prescribed burns (spring vs. summer vs. fall) should be adjusted to account for differences in annual growing conditions and applied during windows of opportunity to best shift the competitive advantage to the native species.

### Plant Community Phase 2.1: Needle and Thread-Blue Grama/Sedges (*Hesperostipa comata-Bouteloua gracilis*/Carex spp.)

This community phase is similar to Community Phase 1.1 but has been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, quackgrass). However, these exotics are present in smaller amounts with the community still dominated by native grasses.

### Community Phase Pathway 2.1A

Community Phase Pathway 2.1 to 2.2 occurs with multiyear drought with or without heavy grazing. This results in marked increases in blue grama, sedges, and forbs with a corresponding decrease in needle and thread.

### Community Phase Pathway 2.1B

Community Phase Pathway 2.1 to 2.3 occurs during long-term non-use or very light grazing, and no fire. This results in the buildup of excessive mulch and a marked increase in the exotic cool-season grasses along with a corresponding decline in native grasses, particularly the warm-season species.

### Plant Community Phase 2.2: Blue Grama/Sedges/Forbs (*Bouteloua gracilis*/*Carex* spp./Forbs)

This community phase is similar to Community Phase 1.2 but has now been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, quackgrass). These exotics, however, are present in smaller amounts with the community still dominated by native grasses.

This community phase is often dispersed throughout a pasture in an overgrazed/undergrazed pattern, typically referred to as patch grazing. Some overgrazed areas will exhibit the impacts of heavy use, while the ungrazed areas will have a build-up of litter and increased plant decadence. This is a typical pattern found in properly stocked pastures grazed season-long. As a result, Kentucky bluegrass tends to increase more in the undergrazed areas while the more grazing tolerant short-statured species, such as blue grama and sedges, increase in the heavily grazed areas. If present, Kentucky bluegrass may increase under heavy grazing.

### Community Phase Pathway 2.2A

Community Phase Pathway 2.2 to 2.1 occurs with return to average precipitation with the implementation of long-term prescribed burning and prescribed grazing. This results in a noticeable increase in needle and thread along with corresponding declines in blue grama, sedges, and forbs.

### Community Phase Pathway 2.2B

Community Phase Pathway 2.2 to 2.3 occurs with long-term non-use or very light grazing, and no fire. This results in the buildup of excessive mulch and a marked increase in the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, quackgrass) along with a corresponding decline in native grasses, particularly the warm-season species.

### Plant Community Phase 2.3: Blue Grama/Sedges/Exotic Cool-Season Grasses (*Bouteloua gracilis*/*Carex* spp./Exotic Cool-Season Grasses)

This community phase occurs with long-term non-use or very light grazing, and no fire. This results in a buildup of excessive mulch and a marked increase in the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, quackgrass) with a corresponding decline in native grasses, particularly the warm-season species. Common forbs include white heath aster, goldenrod, and white sagebrush. Wild rose, broom snakeweed, and prairie sagewort are typically the more common shrubs.

This community phase is approaching the threshold leading to a transition to State 3: Invaded State. As a result, it is an “at risk” community. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 3: Invaded State should be expected.

### Community Phase Pathway 2.3A

Community Phase Pathway 2.3 to 2.2 occurs with the implementation of long-term prescribed grazing and prescribed burning which results in noticeable decreases in the exotic cool-season grasses along with corresponding increases in the native grasses.

### Community Phase Pathway 2.3B

Community Phase Pathway 2.3 to 2.1 occurs with the implementation of long-term prescribed grazing and prescribed burning which results in noticeable decreases in the exotic cool-season grasses along with noticeable increases in needle and thread and other native grasses. This pathway is similar to Community Phase Pathway but differs in the amount of needle and thread in Community Phase 2.3.

## Transition T2A

This transition from State 2: Native/Invaded State to State 3: Invaded State is due to the establishment of exotic cool-season grasses (typically Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass). This transition typically results from long-term non-use or very light grazing, with no fire, but it can also occur under other management. Studies indicate a threshold may exist in this transition when both exotic cool-season grasses exceed 30% of the plant community and native grasses represent less than 40% of the plant community composition.

**Constraints to recovery** (i.e., variables or processes that preclude recovery of the former state). Variations in growing conditions (e.g., cool, wet spring) will influence effects of various management activities on exotic cool-season grass populations.

## State 3: Invaded State

This state is the result of invasion and dominance by the exotic cool-season grasses (often Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass). These exotic cool-season grasses can be quite invasive on the site and are particularly well adapted to heavy grazing. They also often form monotypic stands; as a result, plant diversity is often markedly reduced and peak production is restricted to late spring/early summer. Native forbs generally decrease in production, abundance, diversity, and richness compared to that of State 1: Reference State and may include white heath aster, goldenrod, common yarrow, and white sagebrush. Shrubs, such as rose, may show marked increases. Once the state is well established, prescribed burning and grazing techniques have been largely ineffective in suppressing or eliminating the exotic cool-season grasses, even though some short-term reductions may appear successful.

Annual production can vary considerably, in part due to variations in the extent of invasion by exotic cool-season grasses. However, estimated annual production may range from 1450-2750 pounds per acre with the exotic cool-season grasses accounting for over 50% of the annual production.

**Characteristics and indicators** (i.e., characteristics that can be used to distinguish this state from others). This site is characterized by exotic cool-season grasses constituting greater than 30 percent of the annual production and native grasses constituting less than 40 percent of the annual production.

**Resilience management** (i.e., management strategies that will sustain a state and prevent a transition). Light or moderately stocked continuous, season-long grazing or a prescribed grazing system which incorporates adequate deferment periods between grazing events and proper stocking rate levels will maintain this State. Application of herbaceous weed treatment, occasional prescribed burning and/or brush management may be needed to manage noxious weeds and increasing shrub (e.g., western snowberry) populations.

## Community Phase 3.1: Exotic Cool-Season Grasses/Forbs

This community phase is generally dominated by exotic cool-season grasses (commonly Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass). Plant diversity is much reduced, and an excessive accumulation of mulch may also be present (particularly when dominated by Kentucky bluegrass). Common forbs and shrubs often include common yarrow, silverleaf Indian breadroot, white heath aster, prairie sagewort, and rose.

The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of Kentucky bluegrass or smooth brome are typically short-lived.

## Restoration R3A

This restoration pathway from State 3: Invaded State to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing and prescribed burning, assuming there is an adequate component of native grasses to respond to the treatments.

Both prescribed grazing and prescribed burning are likely necessary to successfully initiate this restoration pathway, the success of which depends upon the presence of a remnant population of native grasses in Community Phase 3.1. That remnant population, however, may not be readily apparent without close inspection. The application of several prescribed burns may be needed at relatively short intervals in the early phases of this restoration process, in part because many of the shrubs (e.g., western snowberry) sprout profusely following one burn. Early season prescribed burns have been successful; however, fall burning may also be an effective technique.

The prescribed grazing should include 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 exotic cool-season grasses to the native cool-season grasses.

**Context dependence** (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Grazing management should be applied in a manner that enhances/maximizes the competitive advantage of native grass and forb species over the exotic species. This may include the use of prescribed grazing to reduce excessive plant litter accumulations above that needed for rangeland health indicator #14 (see Rangeland Health Reference Worksheet). Increasing livestock densities may facilitate the reduction in plant litter provided length and timing of grazing periods are adjusted to favor native species.

Grazing prescriptions designed to address exotic grass invasion and favor native species may involve earlier, short, intense grazing periods with proper deferment to improve native species health and vigor. Fall (e.g., September, October) prescribed burning followed by an intensive, early spring graze period with adequate deferment for native grass recovery may shift the competitive advantage to the native species which facilitates the restoration to State 2: Native/Invaded.

Prescribed burning should be applied in a manner that enhances the competitive advantage of native grass and forb species over the exotic species. Prescribed burns should be applied at a frequency which mimics the natural disturbance regime, or more frequently as is ecologically (e.g., available fuel load) and economically feasible. Burn prescriptions may need adjustment to: (1) account for change in fine fuel orientation (e.g., “flopped” Kentucky bluegrass); (2) fire intensity and duration by adjusting ignition pattern (e.g., backing fires vs head fires); (3) account for plant phenological stages to maximize stress on exotic species while favoring native species (both cool- and warm-season grasses).

## State 4: Go-Back State

This state is highly variable depending on the level and duration of disturbance related to the T5A transitional pathway. In this MLRA, the most probable origin of this state is plant succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses, some of which may be noxious weeds and need control. Common forb and shrub associates include common dandelion, goldenrod, common yarrow, and wild rose. Over time, however, the site will naturally transition to State 3: Invaded State which is generally dominated by the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, quackgrass).

**Characteristics and indicators** (i.e., characteristics that can be used to distinguish this state from others). Tillage has destroyed the native plant community, altered soil structure and biology, reduced

soil organic matter, and resulted in the formation of a tillage induced compacted layer which is restrictive to root growth. Removal of perennial grasses and forbs results in decreased infiltration and increased runoff.

**Resilience management** (i.e., management strategies that will sustain a state and prevent a transition). Continued tillage will maintain the state. Control of noxious weeds will be required.

### Community Phase 4.1: Annual/Pioneer Perennial/Exotics

This community phase is highly variable depending upon the level and duration of disturbance related to the T5A 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 site will naturally transition to State 3: Invaded State which is generally dominated by the exotic cool-season grasses (often Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass). Noxious weeds may also be present which will necessitate control measures.

### Restoration R4A

This Restoration Pathway from State 4: Go-Back State to State 2: Native/Invaded State can be accomplished with a successful range planting. Following seeding, prescribed grazing, prescribed burning, haying, or use of herbicides will generally be necessary to achieve the desired result and control any noxious weeds.

It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, management objectives must include the maintenance of those species, the associated reference state functions, and continued treatment of exotic grasses.

The prescribed grazing should include 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 exotic cool-season grasses to the native cool-season grasses.

**Context dependence** (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). A successful range planting will include proper seedbed preparation, weed control (both prior to and after the planting), selection of adapted native species representing functional/structural groups inherent to the State 1, and proper seeding technique. Management (e.g., prescribed grazing, prescribed burning) during and after establishment must be applied in a manner that maintains the competitive advantage for the seeded native species. Adding non-native species can impact the above and below ground biota. Elevated soil nitrogen levels have been shown to benefit smooth brome and Kentucky bluegrass more than some native grasses. As a result, fertilization, exotic legumes in the seeding mix, and other techniques that increase soil nitrogen may promote smooth brome and Kentucky bluegrass invasion.

The method or methods of herbaceous weed treatment will be site specific to each situation; but generally, the goal would be to apply the pesticide, mechanical control, or biological control (either singularly or in combination) in a manner that shifts the competitive advantage from the targeted species to the native grasses and forbs. The control method(s) should be as specific to the targeted species as possible to minimize impacts to non-target species.

### Restoration R4B

This Restoration Pathway from State 4: Go-Back State to State 3: Invaded State results from a failed range planting and/or secondary succession.

**Context dependence** (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Failed range plantings can result from many causes (both singularly and in combination) including drought, poor seedbed preparation, improper seeding methods, seeded species not adapted to the site, insufficient weed control, herbicide carryover, poor seed quality (purity & germination), and/or improper management.

### Transition T5A

This transition from any plant community to State 4: Go-Back State. It is commonly associated with the cessation of cropping without the benefit of range planting, resulting in a "go-back" situation. Soil conditions can be quite variable on the site, in part due to variations in the management/cropping history (e.g., development of a tillage induced compacted layer (plow pan), erosion, fertility, and/or herbicide/pesticide carryover). Thus, soil conditions should be assessed when considering restoration techniques.

## Ecological Site Interpretations

### Animal Community – Wildlife Interpretations

Landscape

The MLRA 55A landscape is characterized by mostly nearly level to gently rolling till plains with some steep slopes adjacent to streams. The MLRA includes areas of kettle holes, kames, and ground moraines. MLRA 55A is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are common and characteristic of the MLRA. This area supports mid- to tall-grass prairie vegetation with quaking aspen, bur oak, green ash, and willow species growing on the higher elevations in Turtle Mountain, on moraines in proximity of Devils Lake, Pembina River Escarpment and Gorge, and various drainageways throughout the MLRA. Numerous depressional wetlands are ringed with quaking aspen. Complex intermingled ecological sites create diverse grass/shrub land habitats interspersed with varying densities of linear, slope, depressional, and in-stream wetlands associated with headwater streams and tributaries of the Souris and Pembina Rivers. MLRA 55A is located entirely within North Dakota and within the boundaries of the Prairie Pothole Region. The primary land use is cropland. Glacial Lake Souris and the Devils Lake Basin are known for exceptional fertility with major crops including corn, canola, soybeans, and small grains. Together, these two areas make up 73% of the MLRA (Glacial Lake Souris 5500 $mi^2$, 43%; and the Devils Lake Basin 3810 $mi^2$, 30%).

Turtle Mountain (1000 $mi^2$ of which 405 $mi^2$ are found in North Dakota), in the north-central part of the MLRA on the Canadian border, is approximately 1,950 to 2,541 feet (595 to 775 meters) in elevation, rising approximately 600 to 800 feet (150 meters) above the adjacent till plain. Home to an extensive forest of quaking aspen, bur oak, green ash, and willows, it has an understory of beaked hazel with associates of chokecherry, Saskatchewan serviceberry, downy arrowwood, and rose. Turtle Mountain comprises the largest area of quaking aspen forest in North Dakota.

The Pembina Escarpment extends from the Canadian border southeast to Walhalla where the Pembina River enters the floor of the Red River Valley in MLRA 56A. Mainly found on steep slopes along the Pembina River, the Pembina Gorge is in a rugged and sheltered setting with bur oak, green ash, cottonwood, and American elm. Encompassing approximately 12,500 acres, the Pembina Gorge is one of the largest uninterrupted blocks of woodlands in North Dakota. This segment of the Pembina River is the longest segment of unaltered river valley in the North Dakota.

Two major Hydrologic Unit Areas make up this MLRA. 56% of the MLRA drains into the Souris River while 44% drains into the Red River (via the Pembina River) or into Devils Lake (out-letting to Sheyenne River via a pump, pipeline, canal system). The North Dakota portion of the Souris River watershed is in this MLRA. The Souris River basin drains nearly 23,600 square miles and has a long history of flooding.

By the mid-19th century, over 75% of the MLRA had been converted from mid- to tall-grass prairie or woodland to annual crop production. To alleviate crop production loss from wetlands and overland flow, a system of shallow surface ditches, judicial ditches, and road ditches removes surface water in spring and during high rainfall events. Tile drainage systems have been or are being installed extensively throughout MLRA 55A for sub-surface field drainage to enhance annual crop production.

Historic Communities/Conditions within MLRA 55A:

The northern tall- and mixed-grass prairie along with the quaking aspen forest were disturbance-driven ecosystems with fire, herbivory, and climate functions as the primary ecological drivers (either singly or often in combination). American bison roamed MLRA 55A wintering along the Souris River and migrating through MLRA 55A into MLRAs 56A and 55B. Many species of grassland birds, small mammals, insects, reptiles, amphibians, elk, moose, pronghorn, and large herds of American bison were historically among the inhabitants adapted to this region. Roaming herbivores, as well as several small mammal and insect species, were the primary consumers linking the grassland resources to large predators (such as the wolf, American black bear, grizzly bear) and smaller carnivores (such as the coyote, bobcat, red fox, and raptors). Extirpated species include free-ranging American bison and gray wolf (breeding). Extinct is the Rocky Mountain locust.

Present Communities/Conditions within MLRA 55A:

This area supports natural prairie vegetation characterized by western wheatgrass, green needlegrass, needle and thread, and blue grama. Little bluestem is an important species on the more sloping and shallower soils. Prairie cordgrass, northern reedgrass, big bluestem, and wheat sedge are important species on soils with higher water tables. Western snowberry, leadplant, and prairie rose are commonly interspersed throughout the area. Native forests occur in Turtle Mountain, Pembina Gorge, moraines near Devils Lake, woody draws, scattered tracts along the Souris River, and in the sand dunes in west central region of the MLRA.

Over 75% of MLRA 55A has been converted to annual crop production. European influence has impacted remaining grassland, forestland, and shrubland by domestic livestock grazing, elimination of fire, tree harvest, removal of surface and subsurface hydrology via artificial drainage, and other anthropogenic factors influencing plant community composition and abundance.

Hydrological manipulation is extensive throughout the MLRA. Extensive wetland and subsurface tile drainage have taken place. Ephemeral and intermittent streams and the Souris River have been straightened - removing sinuosity, creating isolated oxbows, and converting riparian zones to annual crop production. These anthropogenic impacts have reduced flood water detention and retention on the landscape. The results have been increasing storm water runoff sediment and nutrient loading impacting the Souris and Des Lacs Rivers and their tributaries along with Devils Lake and other lakes within the MLRA. The installation of instream structures has reduced aquatic species movement within the MLRA. Two large dams in Saskatchewan, Canada (Rafferty on the Souris River and Alameda on Moose Mountain Creek, a major tributary to the Souris River) were built, in part, to reduce flood peaks on the Souris River. In addition, three USFWS National Wildlife Refuges were created by building two low-head dams on the Souris River and one on the Des Lacs River in North Dakota. Numerous low-head dams are located on the Souris and Des Lacs Rivers in North Dakota.

The Eaton Irrigation Project low-head dam, located in the vicinity of Towner, North Dakota, provides flood irrigation to approximately 6,700 acres of hayland and pastureland.

The loss of the American bison and fire, as primary ecological drivers, greatly influenced the character of the remaining native plant communities and the associated wildlife moving towards a less diverse and more homogeneous landscape. Annual cropping is the main factor contributing to habitat fragmentation, reducing habitat quality for area-sensitive species. These influences fragmented the landscape, reduced or eliminated ecological drivers (fire), and introduced exotic species including smooth brome, Kentucky bluegrass, and leafy spurge which further impacted plant and animal communities.

Included in this MLRA are over 121,000 acres of National Wildlife Refuges and over 77,000 acres of waterfowl production areas owned and managed by the United States Fish and Wildlife Service. White Horse Hill National Game Preserve is a 1,674-acre national wildlife refuge sitting on the south shores of Devils Lake, about 10 miles south of the city of Devils Lake. Numerous state-owned parks, state wildlife management areas, North Dakota Forest Service and Department of Trust Lands are found in the MLRA. Wakopa Wildlife Management Area is the largest WMA covering approximately 6,739 acres.

Some characteristic wildlife species in this area are:

Birds: Common loon, common goldeye, bufflehead, ruffed grouse, broad-winged hawk, alder flycatcher, mourning warbler, mallard, blue-winged teal, red-tailed hawk, American kestrel, killdeer, eastern and western kingbird, American crow, common yellowthroat, clay-colored sparrow, vesper sparrow, red-necked grebe, Savannah sparrow, downy and hairy woodpeckers, black-capped chickadee, white-breasted nuthatch, and brown-headed cowbird.

Mammals: Northern short-tailed shrew, water shrew, beaver, muskrat, mink, long-tailed weasel, American martin, fisher, white-tailed jackrabbit, snowshoe hare, Franklin's ground squirrel, thirteen-lined ground squirrel, northern pocket gopher, plains pocket gopher, western harvest mouse deer mouse, meadow vole, meadow jumping mouse, western jumping mouse, coyote, red fox, racoon, American badger, striped skunk, white-tailed deer, elk, moose, and woodchuck, red squirrel, porcupine, and northern flying squirrel.

Reptiles/Amphibians: American toad, Great Plains toad, northern leopard frog, chorus frog, tiger salamander, plains garter snake, smooth green snake, wood frog, and common garter snake.

Presence of wildlife species is often determined by ecological site characteristics including grass and forb species, tree and shrub species, hydrology, aspect, and other associated ecological sites. The home ranges of a majority species are usually larger than one ecological site or are dependent on more than one ecological site for annual life requisites. Ecological sites offer different habitat elements as the annual life requisites change. Habitat improvement and creation must be conducted within the mobility limits of a known population for the species.

Insects play an important role providing ecological services for plant community development. Insects that are scavengers or aid in decomposition provide the food chain baseline sustaining the carnivorous insects feeding upon them. Many insects provide the ecological services necessary for pollination, keeping plant communities healthy and productive. Insects provide a protein food source for numerous species including grassland-nesting birds, woodpeckers, and woodland edge and interior species, and their young. Extensive use of insecticides for specialty crops (such as soybeans, corn, and other crops) has greatly reduced insects within this MLRA.

Species of Concern within MLRA 55A:

The following is a list of species considered "species of conservation priority" in the North Dakota State Wildlife Action Plan (2015) and "species listed as threatened, endangered, or petitioned" under the Endangered Species Act within MLRA 55A at the time this section was developed:

Invertebrates: Dakota skipper, monarch butterfly, and regal fritillary. Within the MLRA, the United States Fish and Wildlife Service lists 5 areas (in Rolette and McHenry Counties) as critical habitat for the Dakota skipper.

Birds: American avocet, American bittern, American kestrel, American white pelican, Baird's sparrow, bald eagle, black tern, black-billed cuckoo, bobolink, canvasback, chestnut-collared longspur, ferruginous hawk, Franklin's gull, grasshopper sparrow, horned grebe, LeConte's sparrow, lesser scaup, loggerhead shrike, marbled godwit, Nelson's sparrow, northern harrier, northern pintail, piping plover, sharp-tailed grouse, short-eared owl, Sprague's pipit, Swainson's hawk, upland sandpiper, western meadowlark, whooping crane, willet, Wilson's phalarope, and yellow rail.

Mammals: American martin, Arctic shrew, big brown bat, gray fox, little brown bat, northern long-eared bat, plains pocket mouse, pygmy shrew, Richardson's ground squirrel, river otter, and Townsend's big-eared bat.

Amphibians/Reptiles: Canadian toad, common snapping turtle, plains hog-nosed snake, and smooth green snake.

Fish: Finescale dace, hornyhead chub, largescale stoneroller, logperch, northern pearl dace, and trout-perch.

Mussels: Black sandshell, creek heelsplitter, creeper, mapleleaf, and pink heelsplitter.

Grassland and Woodland Management for Wildlife in the MLRA 55A

Management activities within the community phase pathways impact wildlife but are essential for maintenance of healthy grassland ecosystems. Community phase, transitional, and restoration pathways are keys to long-term management within each State and between States. Timing, intensity, and frequency of these inputs can have dramatic positive or negative effects on local wildlife species. Ranchers and other land managers must always consider the long-term beneficial management effects of grassland and woodland resources in comparison to typically short-term negative effects to the habitats of individual species.

Ecological sites occur as intermingled complexes on the landscape with gradual or sometimes abrupt transitions. Rarely do ecological sites exist in large enough acreage to manage independently for wildlife. Conversion to annual cropping and fragmentation due to transportation and electrical transmission corridors and to rural housing are main causes of fragmentation. This MLRA supports ecological sites that are dominated by woody vegetation and can be located adjacent to ecological sites that support tall- to mid-statured grasses (Thin Loamy/Shallow Loamy) or are adjacent to ecological sites that support wetland vegetation (Shallow Marsh and Wet Meadow).

Management of these ecological site complexes challenges managers to properly manage the entire landscape. A management strategy for one ecological site may negatively impact an adjacent site. For example, grazing Upland Hardwood Forest or Loamy Savannah ecological sites along with herbaceous dominated Loamy Overflow ecological sites may degrade one site by under-use, favoring woody vegetation or increasing exotic cool-season grasses.

Life requisites and habitat deficiencies are determined for targeted species. Deficiencies need to be addressed along community phase, transitional, and restoration pathways as presented in specific state-and-transition models. Ecological sites should be managed and restored within the site's capabilities to provide sustainable habitat for targeted species or species guilds. Managers also need to consider vegetative associations provided by adjacent/intermingled ecological sites for species with home ranges or life requisites that may not be provided by one ecological site. Understanding specific grassland species' sensitivity to woody encroachment and preferred vegetative structure enables managers to determine which grassland-nesting bird species will avoid grassland habitats adjacent to Upland Hardwood Forest or Loamy Savannah ecological sites or woody dominated, Plant Community Phase 5, Loamy ecological site.

Many passerine species utilize MLRA 55A as a major migratory travel corridor. Grassland species sensitive to woody associations during nesting and brooding may utilize the woodier fragmented sites, such as the Wooded State 5.0 in the Loamy ecological site, during migration.

Grassland-nesting birds use various grass heights for breeding, nesting, foraging, or winter habitat. While most species use varying heights, many have a preferred vegetative stature height or sensitivity to woody vegetation. Understanding the sensitivity of grassland species to woody vegetation and preferred vegetative structure enables managers to determine which grassland-nesting bird species avoid grassland habitats adjacent to Upland Hardwood Forest or Loamy Savannah ecological sites. The following chart provides sensitivity to woody vegetation and preferred vegetative stature heights.

| Grassland-nesting Bird Species | Preferred Vegetative Stature | | | Avoids woody vegetation* |
|---|---|---|---|---|
| | Short < 6 inches | Medium 6 - 12 inches | Tall >12 inches | |
| Baird's sparrow | x | x | | x |
| Bobolink | | x | x | x |
| Brewer's sparrow | x | x | | |
| Burrowing owl | x | | | x |
| Chestnut-collared longspur | x | x | | x |
| Common yellowthroat | | | x | |
| Dickcissel | | x | x | |
| Ferruginous hawk | x | x | | |
| Grasshopper sparrow | x | x | | x |
| Horned lark | x | | | x |
| Killdeer | x | | | x |
| Lark bunting | x | x | | |
| Lark sparrow | x | | | |
| Le Conte's sparrow | | | x | x |
| Long-bill curlew | x | | | x |
| Marbled godwit | x | x | | x |
| McCown's longspur | x | x | | x |
| Mountain plover | x | | | x |
| Nelson's sparrow | | | x | x |

| | | | | |
|---|---|---|---|---|
| Nesting waterfowl | | x | x | |
| Northern harrier | | x | x | x |
| Savannah sparrow | | x | x | x |
| Short-eared owl | | x | x | x |
| Sprague's pipit | x | x | | x |
| Upland sandpiper | x | x | | x |
| Western meadowlark | x | x | | |
| Willet | x | x | | x |
| *Many of the listed species avoid nesting in grassland areas with large amounts of woody vegetation within a grassland or avoid nesting near woody vegetation in adjacent habitats. Although these species avoid areas with woody vegetation, most can tolerate a small amount of woody vegetation within areas dominated by grassland habitat, including short-statured shrubs (e.g., western snowberry) in this MLRA. | | | | |

Very Shallow Wildlife Habitat Interpretation:

Very Shallow ecological sites are excessively drained and have coarse sand and/or gravel within 14 inches of the surface. These sites are usually found on slopes ranging from 0 to 45 percent. Needlegrasses are the dominant mid cool-season grass. Associated ecological sites include Shallow Gravel, Loamy, Thin Loamy, and Subirrigated. This site, generally, is not associated with riparian, wetland, or water features; however, a few areas do occur on high beach ridges near lakes.

Due to the high amounts of gravel and coarse sand, these soils are very droughty and have limited plant production. Very Shallow habitat features and components commonly support grassland-nesting birds that prefer short-statured vegetation and bare ground. Insects rely on associated forbs and grasses for survival. Insect populations provide food sources for birds and their young. Very Shallow ecological sites provide forage for small and large herbivores.

Very Shallow ecological sites may be found in four plant community states (1.0 Reference State, 2.0 Native/Invaded State, 3.0 Invaded State, and 4.0 Go-Back State) within a local landscape. Multiple plant community phases exist within States 2.0 and 3.0. Today, these States occur primarily in response to drought, fire, grazing, non-use, and other anthropogenic disturbances.

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using tools in State 1.0 and State 2.0 Community Phase Pathways to prevent further plant community degradation along the T2A Transitional Pathway to State 3.0. Native wildlife generally benefits from the heterogeneous grasslands found in Community Phases 1.1 and 2.1 that include grass and forb species of varying stature and density. As plant communities degrade within State 2.0, Kentucky bluegrass increases while native forbs are reduced. When Kentucky bluegrass exceeds 30%, the site transitions to 3.0 Invaded State. This transition results in reduced stature and increased plant community homogeneity. When adjacent and/or intermingled ecological sites undergo the same transition, the result can be an expansive, homogenous landscape.

Success along Restoration Pathway R3A from State 3.0 to State 2.0 is very difficult and is dependent upon presence of a remnant native grass population. This concept also applies to wildlife, as the target species must either be present on adjacent State 1.0 or State 2.0 plant communities or on other ecological sites within the mobility limits of the species. Species with limited mobility, such as Dakota skippers, must exist near the plant community to utilize restored sites. Mobile species, such as grassland-nesting birds, can easily locate isolated, restored plant communities.

Plant Community Phases 3.1 show dramatic increased homogeneity of exotic cool-season grasses and further reduction in native forbs. Reduced forb diversity limits insect populations, negatively affecting foraging opportunities for grassland-nesting birds. Increased exotic grass litter or dense sod can limit access to bare ground by nesting insects and can limit mobility by small chicks. A homogenous grassland landscape does not provide quality escape or winter cover. As a result, many species are not able to meet life requisites, especially non-migratory species.

Management along community phase, transition, or restoration pathways should focus upon attainable changes. Short- and long-term monetary costs must be evaluated against short- and long-term ecological services in creating and maintaining habitat of enough quality to support a sustainable population density.

## 1.0 Reference State

Community Phase 1.1 Needle and Thread-Blue Grama/Sedges**:** This plant community offers vegetative cover for wildlife; every effort should be made to maintain this ecological site within this community phase. Even though production is limited due to droughty soil conditions, these phases retain high functionality through continued maintenance including prescribed grazing (with adequate recovery period), as well as prescribed fire. Prescribed fire frequency maintains a grass-dominated plant community providing habitat for bird species reliant on a diverse plant community (structure and native composition). Predominance of grass species in these communities favors grazers and mixed-feeders (animals selecting grasses as well as forbs and shrubs). The structural diversity provides habitat for a migratory and resident birds that prefer short, open density plant structure. Plant structure within Plant Community Phase 2.1 is very similar to 1.1 except for the invasion of minor amounts of cool-season exotic grasses, mainly Kentucky bluegrass.

Invertebrates: Insects play a role in maintaining the forb community and provide a forage base for grassland birds, reptiles, and rodents. Ecological services, historically provided by bison, are simulated by domestic livestock. These services include putting plant material and dung in contact with mineral soil to be used by lower trophic level consumers (such as invertebrate decomposers, scavengers, shredders, predators, herbivores, dung beetles, and fungal-feeders).

Lack of host plants, such as little bluestem, limits use by Dakota skippers. Violet species are not common on this site, not supporting the needed habitat for the regal fritillary. Monarch butterfly may use flowering forbs; however, few milkweed species are found on these sites to support caterpillar food. Bumblebees and other native bees utilize forbs as a nectar source; bare ground and nesting sites are available due to the dominance of bunch grasses.

Birds: This plant community provides nesting, foraging, and escape habitats favored by short-grass nesting birds. These plant communities can provide suitable areas for sharp-tailed grouse lek sites; however, coarse soils and steep slopes may reduce suitability. This

site is not preferred nesting, brood-rearing, and loafing habitat. This site provides limited hunting opportunities for grassland raptors.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores. Short- to mid-statured vegetation provides limited food and thermal, protective, and escape cover for small herbivores, but no thermal, protective, or escape cover for large ungulates.

Amphibians and Reptiles: This ecological site is not typically found near Wet Meadow or Shallow Marsh ecological sites; therefore, it does not provide habitat for the northern leopard frog and Canadian toad. This site does not provide habitat for the northern prairie skink and plains hog-nosed snake.

Fish and Mussels: This ecological site is not typically located adjacent to streams, rivers, or water bodies. This ecological site does not receive run-on hydrology from adjacent ecological sites and provide limited hydrology to adjacent down-slope ecological sites, such as Shallow Gravel and Loamy. Management on Very Shallow sites, in conjunction with neighboring run-on sites, will have an indirect effect on aquatic species in streams and/or tributaries receiving water from adjacent sites. Optimum hydrological function and nutrient cycling limit potential for sediment yield and nutrient loading to the adjacent aquatic ecosystems from Community Phase 1.1.

Community Phase 1.2 Blue Grama/Sedges/Forbs: Long-term drought, with or without heavy long-term grazing, (via Community Phase Pathway 1.1A) causes an evident increase in short grasses and sedges and a corresponding decrease in mid-grass species. The reduction in bunch grasses and the increase in warm season-grasses and sedges decrease bare ground and create a shorter statured plant community. Forb diversity is somewhat reduced; but forbs (such as field sagewort, silverleaf Indian breadroot, white heath aster, common yarrow, and blazing star) provide nectar and pollen. Prairie sagewort becomes the principal shrub. Return to normal precipitation and reduced grazing pressure with adequate recovery periods (via Community Phase Pathway 1.2A) will shift the competitive edge back to a green needlegrass dominated plant community.

Invertebrates: Provides similar life requisites as Community Phase 1.1. Wind-pollinated prairie sagewort provides nesting sites for native bees and larval food butterfly species. Forb species may produce fewer flowers reducing overall pollen and nectar sources during periods of long-term drought.

Birds: A shift to shorter statured grasses provides nesting, foraging, and escape habitats favored by short-statured grassland nesting birds. This plant community provides suitable areas for sharp-tailed grouse lek sites, dependent upon slope steepness. This site provides hunting opportunities for grassland raptors.

Mammals: Provides similar life requisites as Community Phase 1.1; however, the increase in short-statured, sod-forming warm season grasses sedges reduces plant diversity and thermal, escape, and protective cover for small mammals. Foliage and stems of prairie sagewort provide browse for jackrabbits, cottontails, ground squirrels, and various mice species.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: The increase in sod-forming grasses and sedges will increase run-off and provide increased hydrology to adjacent down-slope ecological sites, such as Shallow Gravel and Loamy.

**2.0 Native/Invaded State**

Community Phase 2.1 Needle and Thread-Blue Grama/Sedges: This plant community develops through Transition Pathway T1A due to changes in management and the presence of exotic, cool-season grasses. Lack of fire or heavy season-long grazing can facilitate this transition. The threshold between States 1.0 and 2.0 is crossed when Kentucky bluegrass, smooth brome, or other exotic species become established. This plant community phase has a very similar appearance and function to the Reference State of Community 1.1, except it has a minor amount of exotic cool-season grasses and forbs. This phase functions at a high level for native wildlife; therefore, managers should consider the State 2.0 community phase pathways to avoid transitioning to the 3.0 Invaded State. There is no known Community Phase Pathway back to 1.0 Reference State from 2.0 Native/Invaded State.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1.

Community Phase 2.2 Blue Grama/Sedges/Forbs: Long-term drought, with or without heavy long-term grazing, and invasion of cool-season grasses (generally Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass), via Community Phase Pathway 2.1A, causes an evident increase in short grasses and sedges and a corresponding decrease in mid-grass species. The reduction in bunch grasses and the increases in warm season-grasses, sedges, and cool-season exotic grasses decrease bare ground and create a shorter statured plant community. Prairie sagewort becomes the principal shrub. Return to normal precipitation and reduced grazing pressure with adequate recovery periods (via Community Phase Pathway 2.2A) will shift the competitive edge back to a green needlegrass and western wheatgrass dominated plant community.

Invertebrates: Provides similar life requisites as Community Phase 1.2. Long-term drought may limit flower amount and timing.

Birds: Provides similar life requisites as Community Phase 1.2. In addition, the mosaic of overgrazed/undergrazed pattern provides both mid- and short-statured grasses which provide nesting, foraging, and escape habitats favored by short- to mid-statured grassland nesting birds.

Mammals: Provides similar life requisites as Community Phase 1.2. However, dependent upon the amount of overgrazed vs. undergrazed area, vegetative stature in the undergrazed areas could limit thermal and escape cover for mammals, especially small mammals.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.2.

Community Phase 2.3 Blue Grama/Sedges/Exotic Cool-Season Grasses: Extended periods of non-use or very light grazing, and no fire, results in a blue grama/sedge plant community with a marked increase in cool-season exotic grasses (mainly Kentucky bluegrass). Forb diversity is reduced with white heath aster, goldenrod and white sagebrush being the common forbs. Wild rose, prairie sagewort, and broom snakeweed become the principal shrubs. The amount of bare ground decreases as sod-forming cool- and warm-season grasses and sedges, along with exotic cool-season grasses, increase. Long-term prescribed grazing with adequate recovery periods will shift the competitive edge back to mid-statured warm-season bunch grasses via Community Pathway 2.3A or 2.3B.

Invertebrates: Pollen and nectar sources become limited as this site becomes dominated by white heath aster, goldenrod, and white sagebrush. Early-season pollen is provided by white sagebrush, while white heath aster and goldenrod provide late-season pollen sources. Warm-season sod-forming grasses and sedges, along with Kentucky bluegrass, limit nesting sites for ground nesting bees.

Birds: This homogenous landscape provides limited structural diversity or insect production for grassland nesting birds. Grassland nesting birds preferring increased plant litter and short-statured vegetation will benefit, but long-term continued rest (via Transition Pathway T2A) reduces nesting habitat for most species. This plant community provides suitable areas for sharp-tailed grouse lek sites dependent upon degree of slope on the landscape. This site provides hunting opportunities for grassland raptors.

Mammals: Large herbivores' life requisites will not be met in this plant community. Short-statured vegetation provides suitable food, thermal, protective, and escape cover for small ground dwelling mammals and rodents.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.2.

**3.0 Invaded State**

Community Phase 3.1 Exotic Cool-Season Grasses/Forbs: The elimination of fire and grazing (via Transitional Pathway T2A) allows Kentucky bluegrass to dominate this site. Native grasses may still be present but with reduced vigor and numbers not allowing for recovery without prescribed grazing and burning (via Restoration Pathway R3A). Overall plant diversity is reduced.

Invertebrates: This plant community is dominated by cool season sod-forming grasses and increased plant litter limits bare ground for ground nesting bee species. Forbs and shrubs are limited to common yarrow, silverleaf Indian breadroot, white heath aster, prairie sagewort, and prairie rose. Forbs and shrubs will provide limited early- and late-season pollen and nectar. Overall, pollinator plant diversity is low, limiting season-long nectar and pollen production.

Birds: This homogenous landscape provides limited structural diversity or insect production for grassland nesting birds. Grassland nesting birds preferring increased plant litter will benefit, but long-term continued rest reduces nesting habitat for most species.

Mammals: High litter amounts provide food and thermal, protective, and escape cover for small herbivores. Large herbivores' life requisites will not be met in this plant community.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.2.

**4.0 Go-Back State**

Community Phase 4.1 Annual/Pioneer Perennial/Exotics: These plant communities are the result of severe soil disturbance (such as cropping, recreational activity, or concentrated livestock activity for a prolonged period). Following cessation of disturbances, the resulting plant community is dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable dependent upon duration of disturbance. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals and birds, and their young. Tall stature provided by some annual weeds offers thermal cover and seeds throughout winter for deer, small mammals, and over-wintering birds. The response by wildlife species will be dependent upon plant community composition, vegetative stature, patch size, and management activities (such as prescribed grazing, burning, inter-seeding, haying, or noxious weed control).

Successful restoration of native species along Transition Pathway R4A can result in a native grass and forb community in State 2.0. Over time, with no management, the exotic cool-season perennial grasses (Kentucky bluegrass, smooth brome, and/or quackgrass) generally become established and dominate the community. Failed native grass seeding, via Transition Pathway R4B, can result in an invaded plant community Invaded State 3.0.

## Animal Community – Grazing Interpretations

This site is well adapted to managed grazing by domestic livestock. The predominance of herbaceous plants across all plant community phases best lends these sites to grazing by cattle, but other domestic grazers with differing diet preferences may also be a consideration depending upon management objectives. Often, the current plant community does not entirely match any particular plant community (as described in the ecological site description). Because of this, a resource inventory is necessary to document plant composition and production. Proper interpretation of this inventory data will permit the establishment of a safe, initial stocking rate for the type and class of animals and level of grazing management. More accurate stocking rate estimates should eventually be calculated using actual stocking rate information and monitoring data.

NRCS defines prescribed grazing as "managing the harvest of vegetation with grazing and/or browsing animals with the intent to achieve specific ecological, economic, and management objectives". As used in this site description, the term 'prescribed grazing' is intended to include multiple grazing management systems (e.g., rotational grazing, twice-over grazing, conservation grazing, targeted grazing, etc.) provided that, whatever management system is implemented, it meets the intent of prescribed grazing definition.

The basic grazing prescription addresses balancing forage demand (quality and quantity) with available forage, varying grazing and deferment periods from year-to-year, matching recovery/deferment periods to growing conditions when pastures are grazed more than once in a growing season, implementation of a contingency (e.g., drought) plan, and a monitoring plan. When the management goal is to facilitate change from one plant community phase or state to another, then

the prescription needs to be designed to shift the competitive advantage to favor the native grass and forb species.

Grazing levels are noted within the plant community narratives and pathways in reference to grazing management. "Degree of utilization" is defined as the proportion of the current year's forage production that is consumed and/or destroyed by grazing animals (may refer to a single plant species or a portion or all the vegetation). "Grazing utilization" is classified as slight, moderate, full, close, and severe (see the following table for description of each grazing use category). The following utilization levels are also described in the Ranchers Guide to Grassland Management IV. Utilization levels are determined by using the landscape appearance method as outlined in the Interagency Technical Reference "Utilization Studies and Residual Measurements" 1734-3.

| Utilization Level | % | Use Description |
|---|---|---|
| Slight (Light) | 0-20 | Appears practically undisturbed when viewed obliquely. Only choice areas and forage utilized. |
| Moderate | 20-40 | Almost all of accessable range shows grazing. Little or no use of poor forage. Little evidence of trailing to grazing. |
| Full | 40-60 | All fully accessable areas are grazed. The major sites have key forage species properly utilized (about half taken, half left). Points of concentration with overuse limited to 5 to 10 percent of accessible area. |
| Close (Heavy) | 60-80 | All accessible range plainly shows use and major sections closely cropped. Livestock forced to use less desirable forage, considering seasonal preference. |
| Severe | > 80 | Key forage species completely used. Low-value forages are dominant. |

## Hydrology Functions

Available water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group A. Infiltration varies from moderately rapid to very rapid; runoff potential varies from negligible to medium depending upon surface texture, slope percent, slope shape, and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An exception would be where short grasses form a strong sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

## Recreational Uses

Hunting and Bird Watching: Over 113,000 acres of National Wildlife Refuges and over 77,000 acres of Waterfowl Production Areas owned and managed by the United States Fish and Wildlife Service are available for public hunting and bird watching. In addition, over 22,000 acres of North Dakota Wildlife Management Areas (WMAs), approximately 8,000 acres of North Dakota Forest Service, and thousands of acres of Department of Trust Lands are scattered throughout the central and western portions of the MLRA; these areas are available for hunting and bird watching. MLRA 55A provides a unique ruffed grouse hunting opportunity in North Dakota on wildlife management areas managed by the North Dakota Game and Fish Department and forest service lands managed by North Dakota Forest Service within the Turtle Mountain.

Camping: Three state parks are located within the MLRA including Lake Metigoshe State Park (Turtle Mt.), Grahams Island State Park (Devils Lake), and the newly designated Pembina Gorge State Park (formerly Pembina Gorge Recreation Area). These Parks provide hiking, biking, birding, canoeing, and wildlife viewing opportunities. Many local parks and private parks provide modern and primitive camping opportunities. The approximately 8,000 acres of North Dakota Forest Service provides primitive camping (no electric or water hookups) as well as fishing and canoeing access at various lakes. These forests and lakes provide access to swimming beaches, picnicking, and an extensive trail system open to hiking, mountain biking, horseback riding, snowmobiling, and cross-country skiing (not groomed). Limited primitive camping is also available on North Dakota Game and Fish Department Wildlife Management Areas.

Hiking/Biking/Horseback Riding: Hiking is permitted on most state and federally owned lands. Developed hiking and biking trails can be found on North Dakota Forest Service lands (18.6 miles), Upper Souris NWR (4.25 miles), Des Lacs NWR (8.5 miles), J. Clark NWR (3.3 miles), White Horse Hill National Game Preserve (3.6 miles), Lake Metigoshe State Park (16 miles), and Grahams Island State Park (2.1 miles; 3 miles cross country skiing). In addition, extensive biking and walking trails are found in local county and city parks. The Turtle Mountain State Recreation Area (ND Forest Service) is located six miles northwest of Bottineau. This recreation area has over 12 miles of trails open to hiking, biking, snowshoeing, horseback riding, and OHV's.

The Pembina Gorge State Park encompasses over 2,800 acres of public land in the Pembina River Gorge. Steep valley cliffs towering over small, isolated prairies and pocketed wetlands surrounded by the largest continuous, undisturbed forest in North Dakota provide opportunities for canoeing, kayaking, hiking, biking, horseback riding, hunting, wildlife observing, birding, and downhill and cross-country skiing. Thirty miles of trails provide snowmobiling, mountain biking, and off-highway vehicles (OHV) opportunities.

Canoeing/Kayaking: Designated canoe and kayaking trails are available within the MLRA. J. Clark Sayler NWR has 12.75 miles of designated trails on the Souris River and Pembina Gorge State Park has 14.25 miles on the Pembina River. The Pembina Gorge State Park offers kayak rentals along

with kayak transportation. Lake Metigoshe State Park offers canoe and kayak rentals along with standup paddleboards, pontoons, cross country skis, snowshoes, etc.

Downhill Skiing: Downhill skiing is available at Bottineau Winter Park within Turtle Mountain and Frost Fire Park at the Pembina Gorge. Full-service rental shops are available along with alpine trails ranging from beginner to expert. Conveyor lifts on the beginner hills to chairlifts are available for skiers.

International Peace Garden: The only peace garden located on the United States/Canada border, the International Peace Garden is a 2,339-acre botanical garden commemorating peace between the United States and Canada along the world's longest unfortified border. It blooms with more than 155,000 flowers and showcases the Peace Chapel, Peace Towers, and Floral Clock. The North American Game Wardens Museum if also located within the boundaries of the International Peace Garden.

## Wood Products

No appreciable wood products are present on the site.

## Other Products

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

## Site Development and Testing Plan

- Further investigation is needed where areas of this site occur on beach ridges. These areas are periodically inundated for extended periods. When the progressive soil surveys were completed, these soils were not inundated; currently many of them are inundated and have been for many consecutive years. A major component in this site affected by recent inundation is Wamduska. The MLRA map units needing investigation is:
    - Wamduska-Mauvais complex, 0 to 9 percent slopes (map unit 2q555)
    - Wamduska sandy loam, 9 to 45 percent slopes (map unit 2q5dn)
- Further investigation is needed in areas of bedded shale to determine if a Very Shallow minor component should be added to data map units with Kloten soil as a major component. A few, brief, pedon descriptions and field notes in Soil Survey Office files indicate shale beds may occur within a depth of 10 inches in steep areas. If a Very Shallow component is added, the physiographic and soil features narratives in the ESD will need to be revised accordingly. MLRA map units to investigate are:
    - Edgeley-Kloten-Buse loams, 9 to 35 percent slopes (map unit 2q5d3)
    - Kloten-Walsh-Edgeley loams, 6 to 35 percent slopes (map unit 2q5d8)
    - Olga-Kloten complex, 9 to 75 percent slopes (map unit 2q5d7)
- Further evaluation and refinement of the State-and-Transition model is needed to identify disturbance driven dynamics. Additional states and/or phases may be required to address grazing response.
- Further documentation may be needed for plant communities in all states. Plant data has been collected in previous range-site investigations, including clipping data; however, this data needs review. If geo-referenced sites meeting Tier 3 standards for either vegetative or soil data are not available, representative sites will be selected for further investigation.
- Site concepts will be refined as the above noted investigations are completed.
- The long-term goal is to complete an approved, correlated Ecological Site Description as defined by the National Ecological Site Handbook.

- NASIS revisions needed:
    - One component of Wabek is currently linked to 53A Very Shallow (Legacy); it should be relinked to 55A or 53B Very Shallow.

This ESD is the best available knowledge. The site concept and species composition table have been used in the field and tested for more than five years. It is expected that as additional information becomes available revisions may be required.

# Supporting Information

## Associated Sites

| Ecological Site Name | Site ID | Narrative |
|---|---|---|
| Shallow Gravel | R055AY046ND | This site occurs lower on the landscape. The depth to sand and gravel is 14 to 20 inches. |
| Loamy | R055AY047ND | This site typically occurs somewhat lower on the landscape. It either does not have a sand and gravel layer or it is deeper than 20 inches to that layer. The surface and subsoil layers form a ribbon 1 to 2 inches long. |
| Thin Loamy | R055AY052ND | This site occurs on shoulder slopes of moraines. The soil does not have a sand and gravel layer. 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. |
| Subirrigated | R055AY048ND | This site occurs lower on the landscape on beach ridges. It has redoximorphic features at a depth of 18 to 30 inches. Where a highly calcareous subsoil layer occurs, it is at a depth >16 inches. All textures are included in this site. |

## Similar Sites

| Ecological Site Name | Site ID | Narrative |
|---|---|---|
| Shallow Gravel | R055AY046ND | This site occurs lower on the landscape. The depth to sand and gravel is 14 to 20 inches. |

## Acknowledgements

## Developers

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## 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.

## State Correlation

This site has been correlated with North Dakota.

## Relationship to Other Established Classifications

Level IV Ecoregions of the Conterminous United States: 46a – Pembina Escarpment; 46b – Turtle Mountains; 46c – Glacial Lake Basins; 46d – Glacial Lake Deltas; 46f – End Moraine Complex; 46g – Northern Black Prairie; 46i – Drift Plains; and 46j – Glacial Outwash.

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## Site Description Approval

ND, State Range Management Specialist Date

**INTERPRETING INDICATORS OF RANGELAND HEALTH, Version 5, REFERENCE SHEET**

**Ecological site name: _Very Shallow__ Ecological site code: _RO55AY053ND_____**
**Author(s)/participant(s):** _USDA-NRCS North Dakota_____
**Contact for lead author:** __NRCS State Rangeland Management Specialist__
**Date:** _Dec. 2021__ **MLRA:** __55A_____ **LRU:** _____
**Composition based on (check one)**: ☐ Cover ☒ Annual Production

| |
|---|
| **Indicators.** For each indicator, describe the potential for the site using the reference sheet checklist. Where possible, (1) use quantitative measurements; (2) include expected range of values for above- and below-average years and natural disturbance regimes for each community phase within the reference state, when appropriate; and (3) cite data sources used. Continue descriptions on separate sheet. |
| **1. Rills:** Rills are not expected on this site when slopes are less than 15%. On slopes greater than 15%, scattered, short (12 to 20 inches), and disconnected rills may be visible. |
| **2. Water flow patterns:** On slopes less than 15%, water flow patterns may be present but are infrequent and difficult to find. On slopes greater than 15%, water flow patterns are more pronounced, frequent, short (10 feet or less), disconnected and irregular in appearance. |
| **3. Pedestals and/or terracettes:** Neither pedestals nor terracettes are expected when slopes are less than 15%. Some pedestalling and terracettes may be evident when slopes exceed 15%. |
| **4. Bare ground:** Bare ground ranges from 20 to 35%. Bare ground patches consist of randomly scattered patches no greater than 10 inches in diameter and not connected. Animal activity (burrows and ant mounds) may occasionally result in isolated bare patches of up to 24 inches in diameter. |
| **5. Gullies:** Active gullies are not expected on this site. If present, gully channel(s) are fully vegetated with no active erosion visible. |
| **6. Wind-scoured and/or depositional areas:** No wind-scoured or depositional areas expected on this site. |
| **7. Litter movement:** Plant litter movement not expected on this site when slopes are less than 15%. When slopes exceed 15%, some short movement (12 to 24 inches) of small/fine class of litter (forb and grass leaves) may be present. |
| **8. Soil surface resistance to erosion:** Stability class anticipated to average 5 or greater. |
| **9. Soil surface loss and degradation:** Use soil series description for depth, color, and structure of A-horizon. |
| **10. Effects of plant community composition and distribution on infiltration:** Mid- and short-statured bunch grasses are dominant and well distributed across the site. Mid- and short-statured rhizomatous grasses, forbs, grass-likes, and shrub are subdominant. |
| **11. Compaction layer:** No compaction layers occur naturally on this site. |
| **12. Functional/structural groups:** Due to differences in phenology, root morphology, soil biology relationships, and nutrient cycling Kentucky bluegrass, smooth brome, and crested wheatgrass are included in a new Functional/structural group, mid- and short-statured early cool-season grasses (MSeC3), **not expected for this site**. |

| Dominance Category[1] | Relative dominance of F/S groups for community phases in the *Reference State*<br>*Minimum expected number of species for dominant and subdominant groups is included in parentheses.* | | |
|---|---|---|---|
| | **Dominance based on[1]: Annual Production _X_ or Foliar Cover __** | | |
| | **Phase 1.1_** | **Phase 1. __** | **Phase 1. __** |
| **Dominant** | Mid & short C3 bunch grasses (3) | | |
| **Subdominant** | Mid & short C4 bunch grasses (3); Mid & short C3 rhizomatous grasses (1); Forbs (10); Grass-likes (1) | | |
| **Minor** | Shrub | | |
| **Trace** | | | |

[1]Biological soil crust dominance is determined based on cover, rather than production. If biological soil crusts are an expected dominant or subdominant group, the number of expected life forms (e.g., lichen, moss) is listed, rather than number of individual species.

**13. Dead or dying plants or plant parts:** Dead or dying plants/plant parts occur rarely on this site. Some dead centers may be observed on warm-season bunchgrasses after one to several years of below normal precipitation.

**14. Litter cover and depth:** Plant litter cover is 15 to 30% with a depth of 0.1 to 0.25 inches. Litter is in contact with soil surface.

**15. Annual production:** Annual air-dry production is 1500 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 900 to 2000 lbs./ac, respectively.

**16. Invasive plants:** State and local noxious species, Kentucky bluegrass, smooth bromegrass, crested wheatgrass, Eastern red cedar/juniper.

**17. Vigor with an emphasis on reproductive capability of perennial plants:** Noninvasive species in all functional/structural groups are vigorous and capable of reproducing annually under normal weather conditions.

# Functional/Structural Groups Sheet

**State** ND **Office** _____ **Ecological site** Very Shallow **Ecol. site code** RO55AY053ND

**Observers** _____ **Date** _____

Evaluation site ID and/or name: _____
Dominance in ESD based on: Foliar Cover Annual Production Biomass

| Species list of functional/structural groups in the **Reference State** | |
|---|---|
| Functional/Structural Group | Species List |
| Mid & short C3 bunch grasses | needle and thread, slender wheatgrass, prairie Junegrass |
| Mid & short C4 bunch grasses | blue grama, plains muhly, Fendler threeawn, sand dropseed |
| Mid & short C3 rhizomatous grasses | western wheatgrass |
| Forbs | please see plant community table 1.1 |
| Grass-likes | threadleaf sedge |
| Shrub | prairie sagewort, rose |
| . | |
| . | |
| . | |
| . | |
| Biological soil crust[1] | |

**Reference State** - Relative dominance of functional/structural groups for each community phase

***Relative dominance annotations:*** *Use the following annotations in the narrow columns to describe the relative dominance of the listed functional/structural groups: = "equal"; > "greater than"; >> "much greater than"*

| Phase | Dominant ** | >> > = | Subdominant ** | >> > = | Minor ** | >> > = | Trace ** |
|---|---|---|---|---|---|---|---|
| 1.1 | Mid & short C3 bunch grasses | >> | Mid & short C4 bunch grasses >> Mid & short C3 rhizomatous grasses = Forbs = Grass-likes | > | Shrub | . | |
| | | . | | . | | . | |
| | | . | | . | | . | |

* Indicates species that may or may not be present on the site. Absence of these species may not constitute a departure.
** See IIRH Version 5 page 70.

Circle the community phase that most closely matches the evaluation area. *Revise functional/structural groups relative dominance for the community phase circled to represent changes in dominance given the time since disturbance(s) (see page 1 of site evaluation sheet).

| Species list of functional/structural groups in the **Evaluation Area** | |
|---|---|
| Functional/Structural Group | Species List |
| Mid & short C3 bunch grasses | |
| Mid & short C4 bunch grasses | |
| Mid & short C3 rhizomatous grasses | |
| Forbs | |
| Grass-likes | |
| Shrub | |
| | |
| | |
| Groups not expected: | |
| Mid & short early C3 grasses | |
| | |
| Biological soil crust[1] | |

**Evaluation Area** - Relative dominance of functional/structural groups

| Dominant ** | >> > = | Subdominant ** | >> > = | Minor ** | >> > = | Trace ** |
|---|---|---|---|---|---|---|
| | | | | | | |

**Biological soil crust** [1] - dominance is evaluated solely on cover, not composition by weight

** See IIRH Version 5 page 70.

Notes: