

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: Loamy Overflow

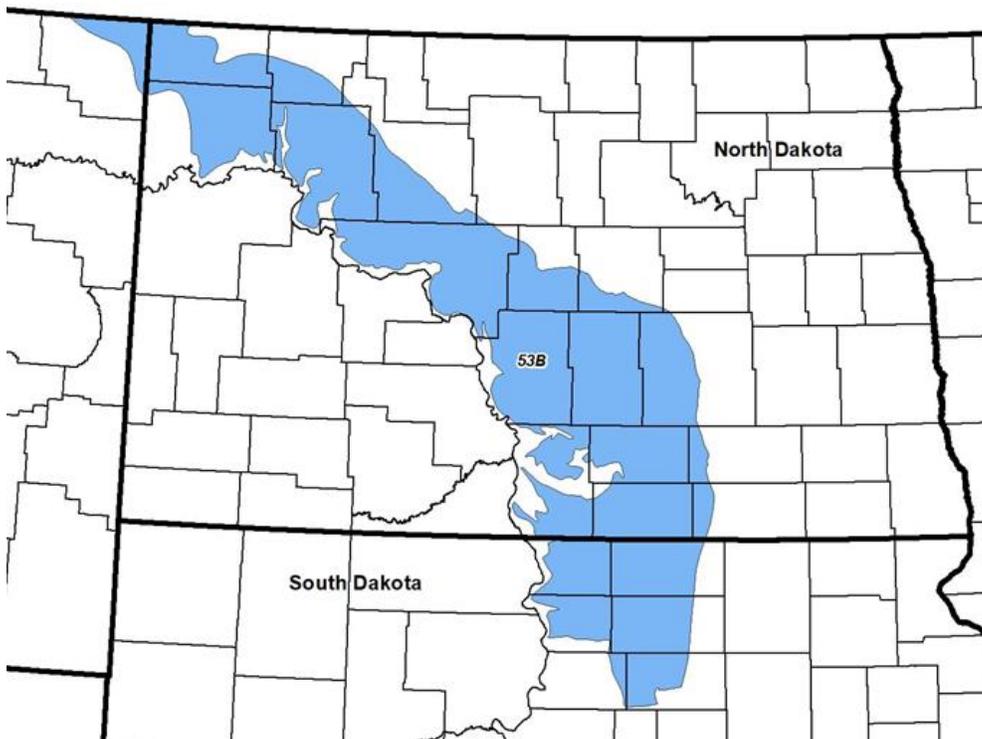
Site Type: Rangeland

Site ID: R053BY005ND

Major Land Resource Area: 53B – Central Dark Brown 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 53B - Central Dark Brown Glaciated Plains in North Dakota, South Dakota, and Montana

Central Dark Brown Glaciated Plains MLRA is an expansive and agriculturally important region consisting of about 12,000,000 acres. The MLRA includes all or portions of 25 counties in east-central and southeastern North Dakota, northeastern South Dakota and the extreme northeast corner of Montana.

Most of MLRA 53B is covered by till: material that was moved and redeposited by the glaciers into a long, large moraine known as the Missouri Coteau; some nearly level to rolling ground moraine areas are included. Pre-glaciated bedrock is exposed by geologic erosion on some breaks along edges of the MLRA. A few areas of shale are exposed on the southeast edge and several areas of sandstone and loamstone are exposed on the west edge (bordering MLRA 54). Glacial sediment covers the bedrock and is known as drift. Much of the moraine has a closed drainage system, but integrated drainage is also present (primarily in areas with geologic erosion).

The Missouri Coteau Region is the western edge of the glaciated land in North Dakota. It consists of nearly level to very steep glacial till plains and moraines. Many elevated ice-walled lake plains occur on the moraine. Some areas are dissected by glacial outwash channels. MLRA 53B is located within the boundaries of the Prairie Pothole Region with numerous wetlands (particularly in areas with closed drainage systems). It is part of the Northern Mixed Grass Prairie region. The Missouri River flows along (or near) the western edge of the MLRA and includes two large reservoirs, Lake Sakakawea and Lake Oahe. Numerous named and unnamed tributaries originate in MLRA 53B and outlet into the Missouri River (MLRA 54). In the northeastern part of the MLRA, integrated drainage systems contribute water to the Des Lacs River (MLRA 55A). In the southeastern part of the MLRA, integrated drainage systems contribute water to the James River system (MLRA 55B). The constructed McClusky canal begins at the west end of Audubon Lake and runs east, dissecting MLRA 53B.

This region is primarily farms and livestock ranches; about 56 percent is non-irrigated cropland. Cash-grain, bean and oil production crops are the principal enterprise on many farms, but other feed grains and hay are also grown. Canola is a major crop in the northern part of the MLRA. Common native vegetation on rangeland includes western wheatgrass, needle and thread, big bluestem, sideoats grama, green needlegrass and little bluestem.

Ecological Site Concept

The Loamy Overflow ecological site is located on swales, foot slopes, and base slopes of uplands – till plains and moraines, lake plains, and sedimentary plains exposed by geologic erosion. Some of the till plains and moraines have a cap of silty loess; some areas of sedimentary plains have a thin cap of glacial till. Areas on low terraces of streams and drainageways are currently included in the site (see **Site Development and Testing Plan**). The soils are very deep. The dark-colored surface soil is generally more than 16 inches thick. Surface and subsoil textures are typically loam, silt loam, or silty clay loam but clay loam or fine sandy loam also occur; the soil forms a ribbon 1 to 2 inches long. Soil on this site is moderately well drained or well drained. The site receives additional water as run-on from surrounding slopes (or from frequent stream flooding). Generally, calcium carbonate does not occur in the surface and upper subsoil layers. However, very slight to slight effervescence is allowable in these layers; where present, the carbonates were mixed with soil materials transported and deposited by runoff from calcareous upland sites. At depths exceeding 16 inches, a layer of carbonate accumulation is common. Slopes range from 0 to 6 percent (see note in Site Development and Testing Plan regarding slopes >6 percent). On the landscape, this site is below the Loamy, Thin Loamy, and Clayey ecological sites and above the Limy Subirrigated, Wet Meadow, Shallow Marsh, and Saline Lowland sites. The Claypan ecological site is on similar landscape positions as Loamy Overflow; it has a dense, sodic claypan layer starting between a depth of 6 to 20 inches.

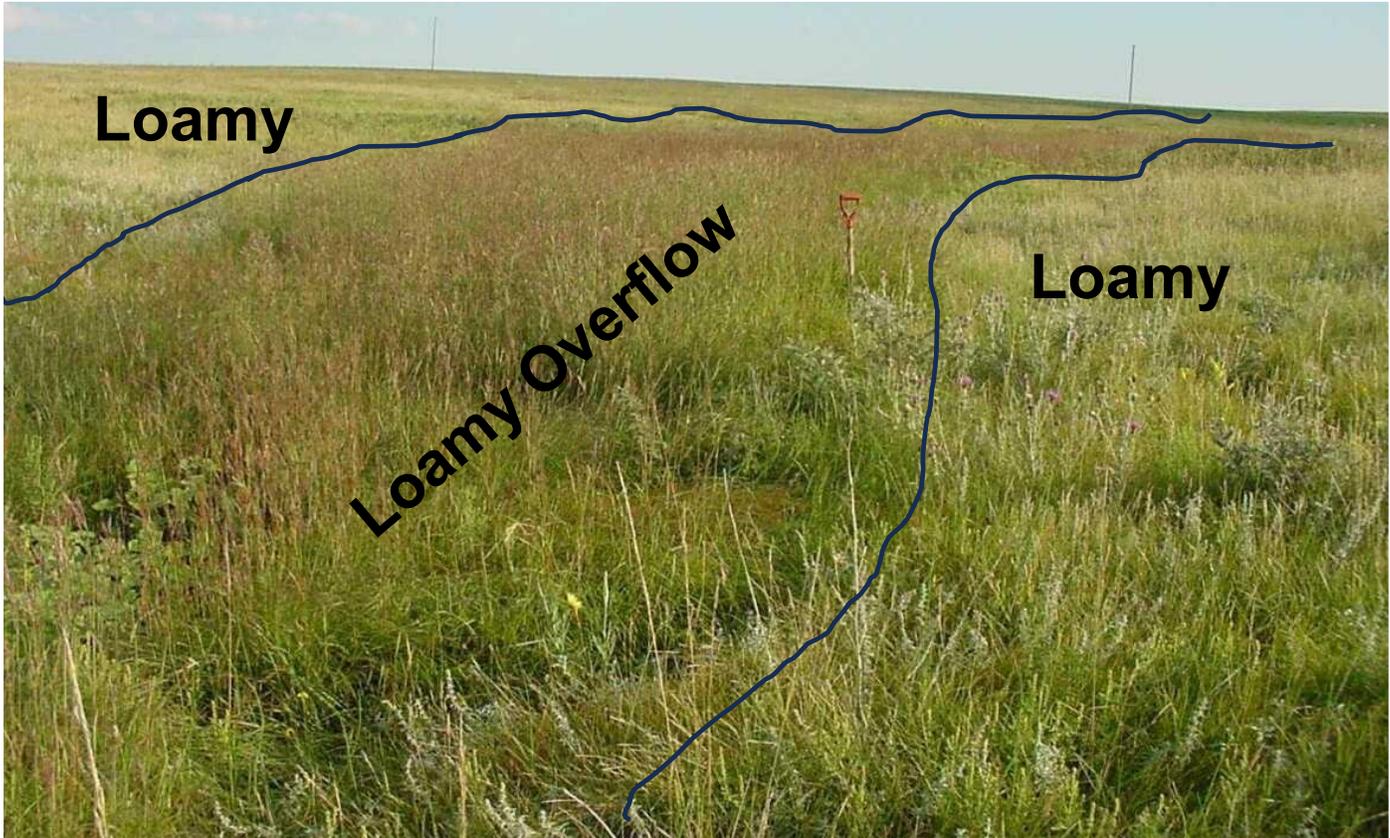


Figure 1. Loamy Overflow ecological site – linear/concave landscape, receiving runoff from adjacent uplands

Physiographic Features

This site occurs on areas that receive additional water as runoff from adjacent slopes or as overflow of intermittent streams. It typically occurs in swales, on foot slopes, and on base slopes of uplands – till plains and moraines, glacial lake plains, and sedimentary plains; areas on low terraces of streams are currently included (see **Site Development and Testing Plan**). On till plains and moraines, the parent material is either fine-loamy or coarse-loamy till or colluvium from till. On lake plains the parent material is either fine-silty, coarse-silty, or coarse-loamy glaciolacustrine sediments. Some areas have a mantle of silty loess deposits over the till. On sedimentary plains, the parent material is loamy or silty alluvium from weathered residuum. On terraces, the parent material is loamy or silty alluvium. Slopes range from 0 to 6 percent.

Landform: till plain, lake plain, sedimentary plain, terrace

	<u>Minimum</u>	<u>Maximum</u>
Elevation (feet):	1280	2560
Slope (percent):	0	6
Water Table Depth (inches):	42	>80
Flooding:		
Frequency:	None	Frequent
Duration:	None	Long
Ponding:		
Frequency:	None	None
Runoff Class:	Negligible	Medium
Aspect:	No influence on this site	

Climatic Features

MLRA 53B is considered to have a continental climate – cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are characteristic of the MLRA. The climate is the result of this MLRA’s location in the geographic center of North America. There are few natural barriers on the northern Great Plains. The air masses move unobstructed across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 15 to 20 inches per year. The normal average annual temperature is about 41° F. January is the coldest month with average temperatures ranging from about 4° F (Powers Lake, ND) to about 10° F (Pollock, SD). July is the warmest month with temperatures averaging from about 67° F (Powers Lake, ND) to about 72° F (Pollock, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 62° F. This large annual range attests to the continental nature of this MLRA's climate. Winds average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of native cool-season plants begins in late March and continues to early to mid-July. Native warm-season plants begin growth in mid-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.

Climate station(s) 1981-2010

Climate Station(s) 1981-2010

Station	Name	Location	Elevation	Lat	Long
USW00094041	GARRISON	Garrison	1910.1	47.6458	-101.4394
USC00329400	WILDROSE 3NW	Wildrose	2259.8	48.6631	-103.2131
USC00328737	TIOGA 1E	Tioga	2245.1	48.3989	-102.9181
USC00327281	POWERS LAKE 1N	Powers Lake	2205.1	48.5722	-102.6467
USC00397277	ROSCOE	Roscoe	1835	45.4525	-99.3358
USC00394891	LEOLA	Leola	1580.1	45.7192	-98.9439
USC00323309	GACKLE	Gackle	1951.1	46.6275	-99.1383
USC00329455	WILTON	Wilton	2188	47.1603	-100.7892

Climate Normals

	Representative		Actual		Average
	High	Low	High	Low	
Mean annual precipitation (in):	20	15	21	15	18
Frost free period (days):	117	88	120	84	102
Freeze free period (days):	135	115	136	109	125

Normal Monthly Precipitation (in)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.5	0.5	1.1	1.6	2.9	3.5	3.2	2.3	2.0	1.6	0.7	0.6
Representative low:	0.5	0.4	0.6	0.9	2.1	2.9	2.7	1.7	1.2	1.1	0.5	0.5
Actual high:	0.6	0.6	1.3	1.9	3.0	3.6	3.6	2.3	2.1	1.7	0.8	0.7
Actual low:	0.4	0.3	0.6	0.9	2.1	2.7	2.5	1.6	1.2	1.0	0.5	0.4

Normal Monthly Minimum Temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	1.9	6.7	18.2	30.7	43.0	53.3	58.4	55.5	45.5	32.7	19.0	6.1
Representative low:	-0.9	4.0	15.9	28.5	39.6	49.4	54.3	52.2	41.1	28.8	16.1	2.8
Actual high:	2.9	7.5	18.6	31.2	43.6	53.5	58.8	56.5	46.5	33.8	19.5	6.8
Actual low:	-2.6	2.7	15.0	27.7	39.3	49.0	53.6	51.4	40.4	28.0	14.8	1.1
Average:	0.6	5.5	17.2	29.7	41.7	51.4	56.3	54.1	43.7	31.1	17.6	4.5

Normal Monthly Maximum Temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Representative low:	18.9	23.6	35.8	53.6	65.4	73.4	79.9	80.1	68.8	53.9	35.7	21.9
Actual high:	22.1	27.2	39.6	57.0	68.6	77.2	84.0	83.5	72.1	57.2	39.0	25.2
Actual low:	18.1	23.0	35.2	53.5	65.2	73.3	79.8	79.7	68.2	52.9	35.0	20.9
Average:	20.4	25.2	37.3	55.0	66.8	75.1	81.7	81.3	70.4	55.4	37.1	23.3

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

1981 N	1982 N	1983 N	1984 N	1985 N	1986 W	1987 N	1988 D	1989 D	1990 N	1991 N	1992 D	1993 W	1994 W	1995 N
16.7	20.0	15.7	16.4	15.9	20.7	15.1	11.3	13.0	16.0	18.4	14.5	25.1	21.6	18.0
1996 N	1997 D	1998 N	1999 W	2000 W	2001 N	2002 N	2003 N	2004 N	2005 N	2006 D	2007 N	2008 N	2009 W	2010 W
17.6	14.7	19.9	20.4	20.8	16.4	15.7	15.1	16.2	19.7	13.3	19.5	19.3	20.8	24.3

Influencing Water Features

This site receives significant additional water as overflow from rivers, streams, and intermittent drainageways or as run-on from adjacent slopes. Most of the additional water flows across the site during the months of April through June or after heavy summer thunderstorms. Some soils in this site have a seasonal high-water table shallower than 3.5 feet very early in the growing season; but this is not a major influence on the soil/water/plant relationship throughout the growing season. Depth to the water table typically is more than 4 feet during most of the growing season. Surface infiltration and permeability, typically, range from moderately slow to moderately rapid; however, in the substratum of some soils, permeability may be slow. Water loss is through evapotranspiration and percolation below the root zone.

Representative Soil Features

Soils associated with Loamy Overflow ES are in the Mollisol and Entisol orders. The Mollisols are classified further as Cumulic Haplustolls, Pachic Haplustolls, and Pachic Argiustolls. The Entisols are classified further as Pachic Ustarents (these soils are specific to reclaimed areas e.g., coal mines). These soils were developed under prairie vegetation. Typically, they formed in till, colluvium from till, silty loess over till, glaciolacustrine sediments, local alluvium from residuum, or stream alluvium.

The common feature of soils in this site are the moderately fine to moderately coarse textures (soil forms a ribbon less than 2 inches long) to a depth of more than 40 inches and the run-on or frequently flooded landscape position. The soils are very deep. They are well drained or moderately well drained – redoximorphic features, where present, are deeper than 3.5 feet. Surface and subsoil textures are typically

loam, silt loam, or silty clay loam but clay loam or fine sandy loam also occur; textures may be stratified in some soils.

Soil salinity is none to very slight (E.C. <4 dS/m) to a depth of more than 4 feet; below this, it may increase to moderate (E.C. 8 - <16 dS/m) in some soils. Sodicity is none or low to a depth of more than 30 inches. In a few reclaimed soils, SAR can exceed 15 below a depth of 40 inches. Soil reaction is typically slightly acid to slightly alkaline (pH 6.1 to 7.8) in the surface layer and upper part of the subsoil. A layer of calcium carbonate accumulation commonly occurs in the lower subsoil. Where present, it is below a depth of 16 inches and typically is deeper than 20 inches. Calcium carbonate content above that layer is none or low. In the layer of accumulation, it can be as high as 30 percent. Soil reaction in layers with carbonate accumulation is slightly alkaline to moderately alkaline (pH 7.4 to 8.4).

This site should show slight to no evidence of rills, wind-scoured areas, or pedestaled plants. Water flow paths are broken, irregular in appearance or discontinuous. The soil surface is stable and intact. These soils are mainly susceptible to water erosion. The hazard of water erosion increases where vegetative cover is not adequate. Loss of the soil surface layer can result in a shift in species composition and/or production.

Major soil series correlated to the Loamy Overflow site are Arnegard, Bowbells, Dovecreek, Grassna, Makoti, Mandan, Mobridge, Roseglen, Straw, and Wilton. Also, ustic taxadjuncts of the Darnen, Emrick, and Gardena series (established for the udic moisture regime) and a frigid taxadjunct of the Mobridge series (established for the mesic temperature regime) are included in this site.

Access Web Soil Survey for specific local soils information (follow link below).

https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm?TARGET_APP=Web_Soil_Survey_application_4ryckf1mh1xmw5tgbyzhxf5s

Parent Material Kind: glacial till, glaciolacustrine deposits, loess, alluvium, colluvium

Parent Material Origin: till, lacustrine, residuum

Surface Texture: loam, silt loam, silty clay loam

Surface Texture Modifier: none

Subsurface texture group: Loamy

Surface fragments <3" (%cover): 0-8

Surface fragments ≤3" (%cover): 0-4

Subsurface fragments >3" (% volume): 0-10

Subsurface fragments ≥3" (%volume): 0-4

	<u>Minimum</u>	<u>Maximum</u>
Drainage Class:	moderately well	well
Permeability Class*:	moderately slow	moderately rapid
Depth to first restrictive layer (inches):	80	>80
Electrical Conductivity (dS/m)*:	0	4
Sodium Absorption Ratio*:	0	5
Soil Reaction (1:1 Water)*:	6.1	8.4
Soil Reaction (0.1M CaCl₂):	NA	NA
Available Water Capacity (inches):	6	12
Calcium Carbonate Equivalent (percent)*:	0	30

*This attribute represents from 0-40 inches. Electrical Conductivity (E.C.) values are based on Saturated Paste method; the commonly used 1:1 field method will likely have E.C. values ≤2.

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 53B 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.

Five vegetative states have been identified for the site (Reference, Native/Invaded, Invaded, Invaded Wooded, 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 species, 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 species, as well as other environmental changes, the Reference State is considered to no longer exist. Thus, the presence of exotic species 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 species 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) which have been particularly and consistently invasive under extended periods of non-use and no fire. Other exotic plants (e.g., Canada thistle, 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 combined 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 options (e.g., prescribed grazing, prescribed burning) be carefully constructed 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). This state may also transition to State 5: Invaded Wooded State during extended periods of no use or very light grazing and no fire (T2B).

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) 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). This state may also transition to State 5: Invaded Wooded State during extended periods of non-use or very light grazing, and no fire (T3A).

State 4: Go-Back State often results from cropland abandonment and consists of only one 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) 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 planting, 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).

State 5: Invaded Wooded State. Historically, individual (or small patches of) shrubs and/or trees were scattered across the site. However, a marked increase in fire suppression, climate change, increase in non-use or light use, and other factors have enabled these patches to expand and become more widespread. Encroachment of both native and exotic woody species (e.g., Rocky Mountain juniper, Russian olive, Siberian elm, western snowberry, silverberry, ponderosa. pine, eastern red cedar, etc.) are examples of woody vegetation increasing in extent and impinging on the ecological integrity of the grassland biome. Windbreaks and other tree plantings can contain problematic and invasive species (such as eastern redcedar, Rocky Mountain juniper, ponderosa pine, Russian olive, etc.) which can contaminate surrounding grasslands. This results in increased long-term costs to maintain or restore this ecological site in native grasses and forbs.

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 burning, 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

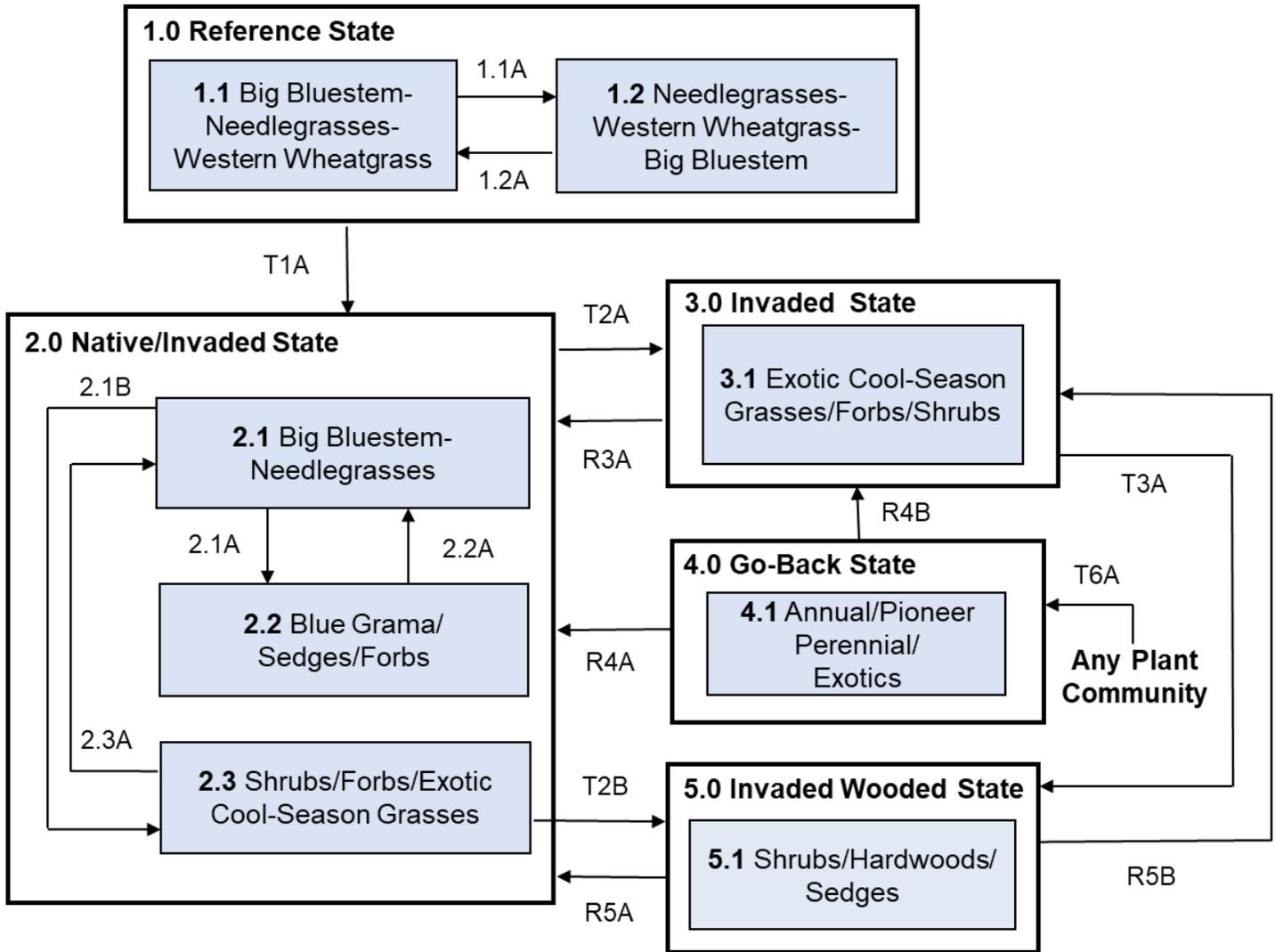


Diagram Legend - MLRA 53B Loamy Overflow

T1A	Introduction of exotic cool-season grasses
T1B	Extended period of non-use or very light grazing, no fire
T2A	Extended period of non-use or very light grazing, no fire
T2B	Extended period of non-use or very light grazing, no fire
T3A	Extended period of non-use or very light grazing, no fire
T6A	Cessation of annual cropping
R3A	Long-term prescribed grazing and prescribed burning
R4A	Successful range planting
R4B	Failed range planting and/or secondary succession
R5A	Prescribed burning and/or chemical/mechanical brush management
R5B	Prescribed burning and/or chemical/mechanical brush management
CP 1.1 - 1.2 (1.1A)	Below average precipitation and/or increased fire frequency, with or without heavy grazing
CP 1.2 - 1.1 (1.2A)	Return to average precipitation and fire frequency with or without reduced grazing
CP 2.1 - 2.2 (2.1A)	Heavy season-long grazing with or without drought
CP 2.1 - 2.3 (2.1B)	Extended period of non-use or very light grazing, no fire
CP 2.2 - 2.1 (2.2A)	Long-term prescribed grazing and prescribed burning, return to average precipitation
CP 2.3 - 2.1 (2.3A)	Long-term prescribed grazing and 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 occurred within the natural range of variability. These factors likely caused the community to shift both spatially and temporally between two community phases. Both warm-season grasses and cool-season grasses were well represented in the community. As a result, production was distributed throughout the growing season.

Characteristics and indicators (i.e., characteristics and indicators 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.

Community Phase 1.1: Big Bluestem-Needlegrasses-Western Wheatgrass (*Andropogon gerardii*-*Hesperostipa* spp., *Nassella viridula*-*Pascopyrum smithii*)

This community phase was historically the most dominant both temporally and spatially. Cool-season grass and grass-like species dominated this plant community with warm-season grasses being subdominant. The major cool-season grasses included green needlegrass, porcupinegrass, western wheatgrass, slender wheatgrass, and bearded wheatgrass. Big bluestem and switchgrass were the major warm-season grasses. Other grasses and sedges included sideoats grama, little bluestem, needle and thread, and Pennsylvania sedge. White sagebrush, downy gentian, common yarrow, Indianhemp, sunflower, and goldenrod were among

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Loamy Overflow
R053BY005ND

the more common forbs. Common trees and shrubs often included western snowberry, Saskatoon serviceberry, hawthorn, chokecherry, and green ash.

Annual production likely varied from about 2800-4300 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 Big Bluestem-Needlegrasses-Western Wheatgrass			
COMMON/GROUP NAME	SYMBOL	Group	lbs./acre	% Comp	
GRASSES & GRASS-LIKES			2625 - 2975	75 - 85	
TALL WARM-SEASON		1	875 - 1225	25 - 35	
big bluestem	ANGE	1	700 - 1050	20 - 30	
switchgrass	PAVI2	1	175 - 350	5 - 10	
Indiangrass	SONU2	1	35 - 70	1 - 2	
NEEDLEGRASS		2	350 - 525	10 - 15	
green needlegrass	NAVI4	2	70 - 350	2 - 10	
porcupinegrass	HESP11	2	70 - 350	2 - 10	
WHEATGRASS		3	175 - 875	5 - 25	
western wheatgrass	PASM	3	175 - 350	5 - 10	
slender wheatgrass	ELTR7	3	35 - 350	1 - 10	
bearded wheatgrass	ELCA11	3	35 - 350	1 - 10	
MID WARM-SEASON		4	70 - 350	2 - 10	
sideoats grama	BOCU	4	35 - 175	1 - 5	
little bluestem	SCSC	4	35 - 175	1 - 5	
OTHER NATIVE GRASSES		5	175 - 350	5 - 10	
blue grama	BOGR2	5	35 - 70	1 - 2	
marsh muhly	MURA	5	35 - 70	1 - 2	
Canada wildrye	ELCA4	5	35 - 70	1 - 2	
dropseed	SPORO	5	35 - 70	1 - 2	
needle and thread	HECOC8	5	35 - 140	1 - 4	
other perennial grasses	2GP	5	35 - 105	1 - 3	
GRASS-LIKES		6	70 - 175	2 - 5	
Pennsylvania sedge	CAPE6	6	70 - 175	2 - 5	
shortbeak sedge	CABR10	6	35 - 70	1 - 2	
other grass-likes	2GL	6	35 - 105	1 - 3	
FORBS		7	175 - 350	5 - 10	
white sagebrush	ARLU	7	35 - 105	1 - 3	
downy gentian	GEPU5	7	35 - 105	1 - 3	
common yarrow	ACMI2	7	35 - 70	1 - 2	
Indianhemp	APCA	7	35 - 70	1 - 2	
purple prairie clover	DAPU5	7	35 - 70	1 - 2	
fleabane	ERIGE2	7	35 - 70	1 - 2	
American licorice	GLLE3	7	35 - 70	1 - 2	
Maximilian sunflower	HEMA2	7	35 - 70	1 - 2	
goldenrod	SOLID	7	35 - 70	1 - 2	
white heath aster	SYER	7	35 - 70	1 - 2	
American vetch	VIAM	7	35 - 70	1 - 2	
meadow anemone	ANCA8	7	0 - 35	0 - 1	
Flodman's thistle	CIFL	7	0 - 35	0 - 1	
northern bedstraw	GABO2	7	0 - 35	0 - 1	
silverleaf Indian breadroot	PEAR6	7	0 - 35	0 - 1	
meadow zizia	ZIAP	7	0 - 35	0 - 1	
other perennial forbs	2FP	7	0 - 70	0 - 2	
SHRUBS		8	35 - 175	1 - 5	
western snowberry	SYOC	8	70 - 175	2 - 5	
Saskatoon serviceberry	AMAL2	8	35 - 70	1 - 2	
thorn apple	CRATA	8	35 - 70	1 - 2	
American plum	PRAM	8	35 - 70	1 - 2	
chokecherry	PRVI	8	35 - 70	1 - 2	
golden currant	RIAU	8	35 - 70	1 - 2	
prairie rose	ROAR3	8	35 - 70	1 - 2	
leadplant	AMCA6	8	0 - 70	0 - 2	
other shrubs	2SHRUB	8	0 - 105	0 - 3	
TREES		9	0 - 35	0 - 1	
green ash	FRPE	9	0 - 35	0 - 1	
boxelder	ACNE2	9	0 - 35	0 - 1	
common hackberry	CEOC	9	0 - 35	0 - 1	
American elm	ULAM	9	0 - 35	0 - 1	
other trees	2TREE	9	0 - 35	0 - 1	
Annual Production lbs./acre			LOW	RV	HIGH
GRASSES & GRASS-LIKES			2600	3115	3705
FORBS			170	263	375
SHRUBS			30	105	180
TREES			0	18	40
TOTAL			2800	3500	4300

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 periods of below average precipitation and/or fire frequency with or without heavy grazing. This resulted in a decrease in big bluestem and corresponding increases in the needlegrasses and western wheatgrass.

Community Phase 1.2: Needlegrasses-Western Wheatgrass-Big Bluestem (*Hesperostipa* spp., *Nassella viridula*-*Pascopyrum smithii*-*Andropogon gerardii*)

This community phase occurred during periods of below average precipitation and/or fire frequency with or without heavy grazing leading to a decrease in big bluestem and corresponding increases in the needlegrasses and western wheatgrass. Other more drought resistant species, such as blue grama, would have increased in comparison to Community Phase 1.1. Annual production would have declined compared to that of Community Phase 1.1.

Community Phase Pathway 1.2A

Community Phase Pathway 1.2 to 1 occurred with the return to average precipitation and fire frequency with or without reduced grazing pressure, resulting in an increase in big bluestem and corresponding decreases in the needlegrasses and western wheatgrass.

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 (e.g., Kentucky bluegrass, smooth brome, 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 the transition. The threshold between states was crossed when Kentucky bluegrass, smooth brome, quackgrass, or other exotic species 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 State 1: Reference State but has now been colonized by the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) which are now present in small amounts. Although the state is still dominated by native grasses, an increase in these 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 options (e.g., prescribed grazing, prescribed burning) be carefully constructed 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. Annual production, however, may range from 1800-3200 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 options (e.g., prescribed grazing, prescribed burning) be carefully constructed 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) 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.

Community Phase 2.1: Big Bluestem-Needlegrasses (*Andropogon gerardii*-*Hesperostipa* spp., *Nassella viridula*)

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, quackgrass). However, these exotics are present in smaller amounts with the community still dominated by native grasses.

Annual production may be comparable to that of Community Phase 1.1 (2800-4300 pounds per acre). However, as the exotic cool-season grasses increase, peak production will shift to earlier in the growing season.



Figure 2. Community Phase 2.1: Big Bluestem-Needlegrasses



Figure 3. Community Phase 2.1: Big Bluestem-Needlegrasses - Big Bluestem remains under short-term heavy grazing, active head cutting healing under prescribed grazing.

Community Phase Pathway 2.1A

Community Phase Pathway 2.1 to 2.2 occurs with heavy season-long grazing, with or without drought. Season-long grazing and drought need to be sufficient in intensity and duration to result in marked decreases in big bluestem and needlegrasses and corresponding increases in blue grama and sedges.

Community Phase Pathway 2.1B

Community Phase Pathway 2.1 to 2.3 occurs during extended periods of non-use or very light grazing, and no fire. This results in marked increases in shrubs and forbs with corresponding decreases in big bluestem and needlegrasses.

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

This community phase results from heavy season-long grazing with or without drought. There has been marked increases in blue grama, sedges, and forbs with corresponding decreases in big bluestem and needlegrasses compared to Community Phase 2.1.

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 long-term prescribed grazing and prescribed burning, and the return to average precipitation resulting in marked increases in big bluestem and needlegrasses with corresponding decreases in blue grama and sedges.

Community Phase 2.3: Shrubs/Forbs/Exotic Cool-Season Grasses

This community phase occurs with extended periods of non-use or very light grazing, and no fire. It may be characterized by the predominance of shrubs, often western snowberry, with an understory of forbs and exotic cool-season grasses. This community 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.



Figure 4. Community Phase 2.3: Shrubs/Forbs/Exotic Cool-Season Grasses

Community Phase Pathway 2.3A

Community Phase Pathway 2.3 to 2.1 occurs with the implementation of long-term prescribed grazing and prescribed burning that is detrimental to the shrubs and exotic grasses while conversely beneficial to big bluestem and the needlegrasses.

Transition T2A

This transition from the State 2: Native/Invaded State to State 3: Invaded State often occurs during extended periods of non-use or very light grazing, and no fire. Exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) become the dominant graminoids.

Studies indicate that a threshold may exist in this transition when both Kentucky bluegrass exceeds 30% of the plant community and native grasses represent less than 40% of the plant community composition. Similar thresholds may exist for smooth brome and quackgrass. This transition may occur under other managerial conditions such as heavy season-long grazing (primarily Kentucky bluegrass).

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.

Transition T2B

This transition from the State 2: Native/Invaded to State 5: Invaded Wooded State generally occurs during extended periods of non-use or very light grazing, and no fire. It frequently occurs when the site is in close proximity to wooded areas where the woodland vegetation may encroach vegetatively upon the site and/or serve as a seed source for these species to colonize the site. It has also become more frequent following European settlement when the historic fire regime was markedly reduced.

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 (e.g., Kentucky bluegrass, smooth brome, quackgrass). Canada thistle, leafy spurge, and other exotic plants may also invade the site. The 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. Common forbs often include white heath aster, goldenrod, common yarrow, and white sagebrush. Shrubs, such as western snowberry and rose, may show marked increases. Once the state is well established, prescribed burning and grazing techniques have been largely ineffective in suppressing or eliminating these species, even though some short-term reductions may appear successful.

Annual production of this state may vary widely, in part due to variations in the extent of invasion by exotic cool-season grasses. However, annual production may be in the range of 2200-3400 pounds per acre.

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/Shrubs

This community phase is dominated by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass), often with a much-reduced forb and shrub component. Excessive accumulation of mulch may also be present, particularly when dominated by Kentucky bluegrass. Common forbs and shrubs often include white heath aster, silverleaf Indian breadroot, goldenrod, western snowberry, chokecherry, prairie rose, and leadplant. The exotic forbs, such as Canada thistle and leafy spurge, may also invade the site.

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.



Figure 5. Community Phase 3.1 – Exotic Cool-Season Grasses/Forbs/Shrubs

Transition T3A

This transition from the State 3: Invaded to State 5: Invaded Wooded State occurs during extended periods of non-use or very light grazing, and no fire, causing a shift from dominance by exotic cool-season grass to dominance by woody vegetation.

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.

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.

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, facilitating 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).

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.

State 4: Go-Back State

This state is highly variable depending on the level and duration of disturbance related to the T6A 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. Over time, the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) will likely predominate.

Common forb and shrub associates include northern bedstraw, common dandelion, Canada goldenrod, common yarrow, Canada thistle, western snowberry, and wild rose. If the site is adjacent to woodlands, sprouts and seeds from the woodland species may begin to encroach and colonize the site.

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 on the level and duration of disturbance related to the T6A 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, including noxious weeds (e.g., Canada thistle) which may need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or quackgrass) will likely predominate.

Restoration R4A

This Restoration Pathway from State 4: Go-Back State to the State 2: Native/Invaded State can be accomplished with a successful range planting. Following planting, 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 planting methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources; management objectives must include the maintenance of those species, the associated reference state functions, and continued treatment of exotic 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 planting 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

A failed range planting and/or secondary succession will lead to State 3: Invaded State.

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.

State 5: Invaded Wooded State

Historically small patches of shrubs, perhaps in association with trees, were scattered across the site. Non-use and fire suppression since European influence has enabled woody species to expand and become more widespread.

Characteristics and indicators (i.e., characteristics and indicators that can be used to distinguish this state from others). The dominance of woody species (by cover and production) distinguishes this state from other herbaceously dominated states.

Resilience management (i.e., management strategies that will sustain a state and prevent a transition). This state is resistant to change in the long-term absence of fire. Restoration efforts would require the use of prescribed fire, mechanical treatment, and prescribed grazing. Considerable time and effort will be required to restore to other States.

Community Phase 5.1: Shrubs/Hardwoods/Sedges (Shrubs/Hardwoods/*Carex* spp.)

In many situations this community phase is dominated by western snowberry. Chokecherry, Saskatoon serviceberry, leadplant, and/or wild rose may also be present. Kentucky bluegrass and/or smooth brome are generally the main grasses with a forb component which often includes white heath aster, silverleaf Indian breadroot, goldenrods, and sunflowers. Mature stands may contain green ash, American elm, boxelder, hawthorn and/or American plum.



Figure 6. Community Phase 5.1: Shrubs/Hardwoods/Sedges

Restoration R5A

This restoration pathway from State 5: Invaded Wooded State to State 2: Native/Invaded State can occur with prescribed burning and/or chemical/mechanical brush management. However, depending upon the abundance of exotic cool-season grasses, the brush management may need to be followed by a successful range planting to complete the restoration. Prescribed burning generally will require repeated treatments because many of the shrubs (e.g., western snowberry, chokecherry) sprout profusely following burning.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of shrub tree seeds from adjacent sites and resprouting of existing shrubs will hamper site restoration. Intensive management is required to restore and maintain the site in State 3: Invaded State.

Restoration R5B

This restoration pathway from State 5: Invaded Wooded State to State 3: Invaded State can occur with prescribed burning and/or chemical/mechanical brush management when the grasses on the site are dominated by exotic cool-season species. It may also occur when brush management is followed by a failed range planting.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of shrub tree seeds from adjacent sites and resprouting of existing shrubs will hamper site restoration. Intensive management is required to restore and maintain the site in State 3: Invaded State.

Transition T6A

This transition from any plant community to State 4: Go-Back State. It is most 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 53B landscape is characterized by nearly level to rolling till plains including kettle holes, kames, moraines, and small glacial lakes. The MLRA is located within the heart of the Prairie Pothole (Coteau) Region with temporary, seasonal, and semi-permanent wetlands throughout the MLRA. MLRA 53B has 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 natural prairie vegetation characterized by western wheatgrass, needle and thread, green needlegrass, and big bluestem. Little bluestem is an important species on sloping and shallow soils. Prairie cordgrass, northern reedgrass, and sedges are important species on wet soils. Western snowberry, chokecherry, plum, stiff goldenrod, blacksamson echinacea, and prairie rose are commonly interspersed throughout the area.

Complex and intermingled ecological sites create diverse grass and shrub land habitats. Ecological sites are interspersed with moderate to high densities of depressional wetlands. MLRA 53B includes headwaters to tributaries of the Missouri River, including the Big Muddy River, White Earth River, Painted Woods Creek and Apple Creek in North Dakota and Spring Creek in South Dakota. Numerous unnamed creeks and drainageways drain into the James River in North and South Dakota which are in MLRA 55B. These habitats provide critical life-cycle components for many wildlife species including aquatic species.

Historic Communities/Conditions within MLRA 53B:

The northern mixed-grass prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary ecological drivers (either singly or often in combination). The high density of wetland and associated native grassland historically supported an abundance of waterfowl and other marsh dependent birds. Many species of grassland birds, small mammals, insects, reptiles, amphibians, and herds of roaming American bison, elk, and pronghorn were historically among the inhabitants adapted to this semi-arid 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 and mountain lion) and smaller carnivores (such as the coyote, bobcat, red fox, and raptors). Extirpated species include free-ranging American bison, elk, black and grizzly bear, gray wolf, and peregrine falcon (breeding). Extinct from the region is the Rocky Mountain locust.

Present Communities/Conditions within MLRA 53B:

Following European influence, domestic livestock grazing, elimination of fire, energy development, and other anthropogenic factors influenced plant community composition and abundance. Approximately 34% of the native grassland in MLRA 53B remains intact but grassland continues to be converted to annual cropping systems. Annual cropping, wetland drainage, wind energy, woody encroachment, and transportation corridors are the main contributors to habitat fragmentation, which reduces habitat quality for area-sensitive species. The fragmented landscape reduced or eliminated ecological drivers (fire) and introduced exotic plant species including smooth brome, crested wheatgrass, Kentucky bluegrass, and leafy spurge - further impacting plant and animal communities. Loss of fire allowed woody species to expand onto historically grassland sites. The loss of these ecological drivers greatly influenced the remaining native plant communities and wildlife species presence, moving towards a more fragmented but diverse landscape; but in many cases a more homogeneous grassland dominated by cool-season exotic grass species develops.

The high density of wetlands provides habitat for large numbers and species of waterfowl and waterbirds. MLRA 53B is a major contributor to the annual production of waterfowl and waterbirds within the Central Flyway. Many wildlife species found in MLRA 53B are those that have adapted to annual crop production. Some wildlife species in this area are white-tailed deer, coyote, red fox, American badger, raccoon, beaver, striped skunk, American mink, white-tailed jackrabbit, Eastern turkey, sharp-tailed grouse, waterfowl, and numerous species of grassland-nesting birds and pollinating insects. Numerous fish species inhabit the lakes and creeks within the MLRA.

National wildlife refuges, waterfowl production areas, and state wildlife management areas along with North Dakota Department of Trust Lands and South Dakota State School Lands provide herbaceous and woody cover for wildlife. In addition, the United States Army Corps of Engineers, United States Fish and Wildlife Service (USFWS), and the North Dakota Game and Fish Department (NDGFD) jointly manage one large manmade reservoir, Lake Audubon (16,612 acres), for waterfowl and fish production. The USFWS manages approximately 56,000 acres in National Wildlife Refuges and 59,000 acres of Waterfowl Production Areas including 5,526 acres of wilderness area within the Lostwood National Wildlife Refuge and 4,201 acres of wilderness area within the Chase Lake National Wildlife Refuge. The NDGFD manages approximately 47,000 acres of Wildlife Management Areas (WMA) and the South Dakota Game Fish and Parks manages approximately 12,000 acres of Game Production Areas in the southern end of the MLRA.

Wildlife species presence is often determined by site characteristics including grass and forb species, hydrology, aspect, and other associated ecological sites. Home ranges of most species are larger than one ecological site or are dependent upon 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 and their young.

Species of Concern within MLRA 53B:

The following is a list of species considered “species of conservation priority” in the North Dakota State Wildlife Action Plan (2015) and South Dakota State Wildlife Action Plan (2014); and species listed as “threatened, endangered, or petitioned” under the Endangered Species Act within MLRA 53B at the time this section was developed:

Invertebrates: Dakota skipper, Dakota stonefly, Iowa skipper, monarch butterfly, northern sandy tiger beetle, Ottoe skipper, regal fritillary, yellow-banded bumble bee, and western bumble bee.

Birds: American avocet, American bittern, American kestrel, American white pelican, Baird’s sparrow, bald eagle, black-billed cuckoo, black tern, bobolink, burrowing owl, canvasback, chestnut-collared longspur, Dickcissel, ferruginous hawk, Franklin’s gull, grasshopper sparrow, greater prairie-chicken, horned grebe, horned lark, lark bunting, LeConte’s sparrow, lesser scaup, loggerhead shrike, long-billed curlew, marbled godwit, Nelson’s sparrow, northern goshawk, northern harrier, northern pintail, peregrine falcon (migration), piping plover (migration), red knot (migration), sharp-tailed grouse, short-eared owl, Sprague’s pipet, Swainson’s hawk, trumpeter swan, upland sandpiper, western meadowlark, willet, Wilson’s phalarope, whooping crane (migration), and yellow rail.

Mammals: Arctic shrew, big and little brown bats, Franklin’s ground squirrel, plains pocket mouse, Richardson’s ground squirrel, silver-haired bat, and swift fox (historical range).

Amphibians and Reptiles: Canadian toad, false map turtle, plains hognose snake, smooth green snake, and snapping turtle.

Fish and Mussels: Blacknose shiner, blue sucker, burbot, fathead chub, fragile papershell, northern pearl dace, northern redbelly dace, pink papershell, sicklefin chub, sturgeon chub, and yellow sandshell.

Grassland Management for Wildlife in the MLRA 53B

Management activities within State and Transition models follow various community phase pathways. These management activities will impact wildlife, both positive and negative, 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. A management regime for one ecological site may negatively impact an adjacent site (e.g., alteration of a grazing regime within a Loamy Overflow ecological site to encourage tall warm-season grass development) may encourage exotic cool-season grasses to increase or dominate adjacent ecological sites.

Life requisites and habitat deficiencies are determined for targeted species, species guilds, or by land use. 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. Habitat fragmentation caused by the conversion to annual cropping, tree plantings, rural housing, and fragmentation due to transportation and electrical transmission corridors need to be considered when managing for target species.

With populations of many grassland-nesting birds in decline, it is important to maintain these ecological sites in a 1.0 Reference State (if found) or the 2.0 Native/Invaded State. Plant communities optimal for a guild of grassland species serve as a population source where the birth rate exceeds mortality. Species may use marginal plant communities; however, these sites may function as a population sink where mortality exceeds the birth rate.

Understanding preferred vegetative stature and sensitivity to woody encroachment is necessary to manage for the specific grassland species. Various grass heights may be used for breeding, nesting, or foraging habitat. While most species use varying heights, many have a preferred vegetative stature height. The following chart provides preferred vegetative stature heights and sensitivity to woody vegetation encroachment.

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 when 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, prairie rose) in this MLRA.				

Loamy Overflow Wildlife Habitat Interpretation:

Loamy Overflow ecological sites have no restrictions in the soil profile. This complex of ecological sites provides habitat for many edge-sensitive, grassland bird species. Commonly found on terraces and concave landscapes, Loamy Overflow habitat features support nesting and foraging grassland birds; but vegetation may be too dense and tall for sharp-tailed grouse leks. Associated ecological sites include Clayey, Claypan, Limy Subirrigated, Loamy, Thin Loamy, Wet Meadow, Shallow Marsh, and Saline Lowland.

Loamy Overflow ecological sites may be found in five plant community states (1.0 Reference State, 2.0 Native/Invaded State, 3.0 Invaded Grass State, 4.0 Go-Back State, and 5.0 Invaded Wooded State). Multiple plant community phases exist within States 1.0 and 2.0. These states occur primarily in response to grazing, drought, and non-use. Secondary influences include fire and 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 either the Transitional Pathway T1A to the Native/Invaded Grass State 2.0 or T2B to Invaded Wooded State 5.0. Conversion to a woody state along transitional pathway T2B, or T3A generally benefit wildlife species that can tolerate or require woody habitat within plant community State 5.0.

As plant communities degrade within State 2.0 warm-season grasses, particularly short-statured and cool-season exotic grasses, increase while native forbs are reduced. This transition results in reduced structure, increased plant community homogeneity, and reduced insect populations resulting in a reduction of breeding, nesting, foraging, or winter habitat for grassland birds. When adjacent/intermingled ecological sites undergo the same transition, the result can be an expansive, homogenous landscape. Success along restoration pathways R3A, R4A, and R5B to State 2.0 is very difficult and is dependent upon presence of remnant native grass populations, successful native range planting, and/or successful woody vegetation removal.

Invaded Wooded State 5.0 provides habitat features and components supporting woodland edge and interior birds and other wildlife species dependent upon trees and shrubs to meet their life requisites. Grassland-nesting birds that commonly avoid woody vegetation will not have their habitat needs met and may even avoid adjacent ecological sites dominated by grassland vegetation. A reduction in nesting success by grassland nesting birds on adjacent herbaceous sites is likely due to increase in avian predation. These forested sites provide quality loafing, escape, and winter cover for small and large herbivores and quality year-round habitat for American martin, snowshoe hare, elk, moose, and white-tailed deer. These sites provide seasonal habitat for many migratory passerines and year-

round habitat for ruffed grouse and quality winter cover for eastern screech owl, great horned owl, wild turkey, and non-migrating passerine birds such as black-capped chickadee and white-breasted nuthatch.

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.

1.0 Reference State

Community Phase 1.1 Big Bluestem-Needlegrasses-Western Wheatgrass: This plant community offers quality wildlife habitat; every effort should be made to maintain this ecological site within this community phase. This phase retains high functionality through continued maintenance including prescribed grazing with adequate recovery period as well as prescribed fire. Predominance of grass species in this community favors grazers and mixed feeders (animals selecting grasses as well as forbs and shrubs). The structural diversity provides habitat for a wide array of migratory and resident birds.

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 American bison, are simulated by domestic livestock. These services include putting plant material and dung in contact with mineral soil to be used by low trophic level consumers (such as invertebrate decomposers, scavengers, shredders, predators, herbivores, dung beetles and fungal feeders).

Dakota skippers may use this site since host plants (such as woody lily, big bluestem, little bluestem, and prairie dropseed) can be found on this site. Regal fritillary habitat is limited due to Nuttall's violet and prairie violets being uncommon. Monarch butterfly may use flowering forbs on this site; however, few milkweed species are found on this site to support breeding and larvae development. Bumblebees and other native bees utilize forbs for nectar and pollen and bare ground for nesting amongst bunchgrasses. Prescribed grazing with adequate recovery periods, as well as prescribed fire, to maintain the 1.1 phase, will have long term positive effects on ground dwelling insects.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by mid-to tall-grass nesting birds. Plant structure may be too dense or tall for species using short-grass habitats. The low scattered shrubs present in the plant community phase should not impact woody vegetation sensitive bird species.

Grassland birds preferring mid to tall-grass structure will use this site. In years with reduced precipitation or drought, nesting recruitment may be compromised. This plant community provides suitable areas for sharp-tailed grouse nesting and brood-rearing habitat but may be too tall for lek sites. Limited structure and diverse prey populations provide good hunting opportunity for grassland raptors. Many passerine species utilize MLRA 53B as a major migratory travel corridor. Grassland species sensitive to woody associations during nesting and brooding may utilize the woodier fragmented sites.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores. Moderate to tall stature provides suitable food, thermal, protective, and escape cover for small and large herbivores.

Amphibians/Reptiles: This ecological site and associated plant communities provides habitat for smooth green snakes. This ecological site can provide habitat for the northern leopard frog and Great Plains toad if freshwater habitats (such as wetlands, streams, or lakes) are adjacent or near the site.

Fish and Mussels: This ecological site can be near or adjacent to wetlands, streams, rivers, or water bodies. Loamy Overflow sites receive run-on hydrology from up-slope ecological sites, such as Loamy and Thin Loamy ecological sites, and then out-let into receiving waters. Management on these interconnected sites can have direct effects on aquatic species.

Community Phase 1.2 Needlegrasses-Western Wheatgrass-Big Bluestem: Below normal precipitation or increased fire frequency, with or without heavy grazing, favors an increase in cool-season grasses and in decrease in warm-season grasses.

Invertebrates: Provides similar life requisites as Community Phase 1.1 since the forb component remains similar.

Birds: Provides similar life requisites as Community Phase 1.1. However, the increase of shorter cool-season grasses favors grassland-nesting bird species preferring short- to mid-statured vegetation. Winter cover for resident bird species, such as sharp-tailed grouse, is somewhat compromised due to the increase in cool-season grasses.

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.

2.0 Native/Invaded State

Community Phase 2.1 Big Bluestem-Needlegrasses: This plant community results from the introduction and establishment of exotic cool-season grasses (commonly Kentucky bluegrass, smooth brome, and/or quackgrass). It is exacerbated by long-term, season-long grazing as well as long-term non-use and no fire events (via Transitional Pathway T1A). The threshold between the states is crossed when exotic grasses, such as Kentucky bluegrass and smooth brome, become established on the site. 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 cool-season exotic grasses and forbs. This phase functions at a high level for native wildlife; therefore, managers should consider the 2.0 community phase pathways to avoid transitioning to the Invaded State 3.0. There is no known Community Phase Pathway back to State 1.0 from State 2.0.

Invertebrates: Provides similar life requisites as Community Phase 1.1. Increase in sod-forming Kentucky bluegrass reduces bare ground availability for ground nesting bees. Although forb diversity is maintained, the amounts are reduced - limiting nectar and pollen availability.

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.

Community Phase 2.2 Blue Grama/Sedges/Forbs: Heavy season-long grazing, with or without drought, along Community Phase Pathway 2.1A leads to shorter-statured grasses. Dominated by shorter-stature grasses and a loss of nitrogen-fixing or leguminous native forbs, the diversity of this plant community is reduced. Prescribed grazing with adequate recovery periods along Community Phase Pathway 2.2A is an efficient, effective method to regain the cool-season grass and forb diversity components in Community Phase 2.1.

Invertebrates: The reduction of native forbs and increase in sod-forming grasses limit foraging and nesting sites for all pollinators. Continuous, heavy season-long grazing or heavy seasonal grazing may reduce ground-nesting site availability. Homogeneity of forb species may limit season-long nectar availability. Late season pollen and nectar are available from white heath aster and velvety goldenrod.

Birds: Heavy season-long grazing or severe late-season grazing will reduce nesting sites, forage (invertebrates), and cover. A reduced forb component may limit foraging opportunities. The stature is generally short, serving both mid- and short-grass nesting birds. Shortgrass-nesting birds favor this phase. Species that prefer mid-grass stature generally will be successful with normal to above normal precipitation and a change in management along the 2.2A Community Phase Pathway. In years with reduced precipitation or heavy grazing during the nesting season, use by mid-grass nesting species may be compromised. Located in a concave landscape position, this plant community does not provide suitable areas for sharp-tailed grouse lek site development with limited nesting, brood, and winter cover. Limited stature and diverse prey populations provide good hunting opportunities for grassland raptors.

Mammals: Suitable food, thermal, protective, and escape cover (reduction in litter) for most mammals become limited. The loss of diversity of grasses and forbs reduces nutrition levels for small and large herbivores.

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 2.3 Shrubs/Forbs/Exotic Cool-Season Grasses: Extended periods of non-use or very light season-long grazing, and no fire, enables native shrubs to become dominant. Kentucky bluegrass, smooth brome, and/or quackgrass may be found alone or as a mosaic across the site. Shrubs are dominated by shorter statured shrubs, but Saskatoon serviceberry, chokecherry, and silver buffaloberry may be found in this plant community phase. Continued extended periods of non-use or very light season-long grazing with no fire enables native trees to dominate the site, via Transitional Phase T2B, moving this state to 5.0. While implementation of prescribed grazing or prescribed burning, via Community Phase pathway 2.3A, may result in a reduction of the shrub component moving this plant community back to Community Phase 2.1.

Invertebrates: The invasion of woody vegetation and reduction or entire loss of bluestems reduces or eliminates habitats for all invertebrate species of concern within MLRA 53B. Season-long pollen and nectar availability becomes limited on this site. The woody shrub component will provide an early- to mid-season bloom period. Forbs are present as in other states; however, shading limits distribution across the site. Overall pollinator plant diversity is good, providing season-long nectar and pollen production.

Birds: Grassland nesting birds sensitive to woody vegetation encroachment may discontinue use of this community phase depending on the density of western snowberry, Saskatoon serviceberry,

chokecherry, and silver buffaloberry. Tall shrub density will also have a negative impact on grassland nesting birds not tolerant to woody species. Woody vegetation typically does not reach enough density or height to provide habitat for bird species favoring woodland edge. Brown-headed cowbird use will increase with an increase in the woody cover component of this ecological site. Increases in the woody component will provide winter cover for pheasant and sharp-tailed grouse.

Mammals: Increases in woody habitat provides winter and escape cover, birthing sites, browse, etc. for white-tailed deer and moose. Small mammal cover is excellent.

Amphibians and Reptiles: This site no longer provides life requisites for the northern prairie skink and plains hog-nosed snake due to the dominance of western snowberry and other shrubs.

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

3.0 Invaded State

Community Phase 3.1 Exotic Cool-Season Grasses/Forbs/Shrubs: Community Phase Pathway T2A is characterized by non-use and elimination of fire when exotic cool-season grasses are present as in Community Phase 2.0. This plant community phase is characterized by a dominance (>30%) of exotic cool-season grasses such as smooth brome; native grasses represent less than 40% of the plant community. Restoration Pathway R3A, through prescribed burning and high levels of grazing management, requires remnant amounts of native warm- and cool-season and forbs to be successful. The remnant native community needs frequent prescribed burns and high levels of grazing management targeting the exotic cool-season grasses to improve competitiveness and increase vigor and density. Without intensive management, the remnant native plants will not increase adequately to transition back to State 2.0. Managers need to evaluate impacts to wildlife while implementing these management practices. Intensified management along the R3A Pathway will have significant short-term negative impacts on wildlife habitat; however, this is necessary to restore long-term native habitat functions.

Invertebrates: Exotic grasses limit use by beneficial insects provided in States 1.0 and 2.0. However, western snowberry and prairie rose may provide early season pollen and nectar sources. Although forbs are a minor component in this community, they still offer mid- to late-season pollen and nectar opportunities. Increased litter and lack of grazing leads to limited contact between plant material and mineral soil resulting in a cooler micro-climate, which is unfavorable to most insects. Lack of bare soil limits ground-nesting sites for native bees and other ground-nesting insects.

Birds: The homogeneous community phase, dominated by exotic plant species, provides limited habitat and life requisites for most obligate grassland-nesting birds. Lack of plant diversity and stature, along with increased litter and the tendency of Kentucky bluegrass and smooth brome to lay down, limits use by many grassland-nesting birds. Sharp-tailed grouse may use this plant community for lek sites and nesting cover; western snowberry may provide winter cover, dependent upon density.

Mammals: Litter accumulation and exotic grass cover favors thermal, protective, and escape cover for small rodents.

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

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

4.0 Go-Back State

Community Phase 4.1 Annual/Pioneer Perennial/Exotics: Following cropland abandonment, these plant communities are dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals, birds, and their young. Dense weed cover can keep soils moist, increasing insect presence. Tall stature provided by some weeds, such as marsh elder and ragweed, offer 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 along Transition Pathway R4A can result in a native grass and forb community in State 2.0. Implementation of prescribed burning and/or chemical/mechanical brush management followed by a failed range planting, via Transition Pathway R4A, can result in an invaded plant community Invaded State 3.0.

5.0 Invaded Wooded State

Loamy Overflow ecological sites supported small patches trees and shrubs. Today, this invaded wooded state usually exists as a linear woody feature on a concave landscape commonly referred to as 'woody draws'. The wooded state occurs when the Loamy Overflow ecological site is located near a seed source for woody vegetation such as a wooded Loamy ecological site or near a wooded riparian corridor. The removal of all disturbance through Transition Pathways T2B, or T3A are the major contributors to this community phase crossing the threshold from an herbaceous plant community to a community dominated by hardwoods and shrubs. The composition of this woody plant community will be dependent upon shading (tree canopy density), management (grazing), and the amount of invasive grass and shrub species.

Successful restoration along Transition Pathway R5A can result in a native grass and forb community in State 2.0. Implementation of prescribed burning and/or chemical/mechanical brush management followed by a failed range planting, via Transition Pathway R5B, can result in an invaded plant community (Invaded State 3.0).

Wooded State 5.1 Shrubs/Hardwoods/Sedges: Wooded draws are an important vegetative type used by many large herbivorous mammals. Multi-level canopy, high edge-to-area ratio, and prevalence of preferred forage provides high quality wildlife habitat. Within MLRA 53B, woody draws (such as those in Wooded State 5.1) provide important travel corridors, security cover, foraging, loafing, and parturition (birthing) areas.

Invertebrates: Early season flowering shrubs provide pollen and nectar. However, pollinating insects will need adjacent herbaceous- and forb-dominated ecological sites for mid- to late-season pollen sources. Lower trophic-level consumers (such as invertebrate decomposers, scavengers, shredders, predators, herbivores, dung beetles and fungal-feeders) will use woody plant material, leaves, and limited number of grasses in contact with mineral soil. The woody component of this site is not conducive to use by the Dakota skipper, monarch butterfly, and regal fritillary. Woody plant material is available for wood-nesting bees. These wind-protected, moist plant communities provide favorable habitat for flying insects (flies, mosquitoes, moths, etc.). Favorable climatic conditions can lead to large hatches of insects.

Birds: This site no longer provides habitat for grassland-nesting bird species due to the dominance of woody vegetation. Bird species that use and benefit from woodland edge (such as wild turkey, black-billed cuckoo, black-capped chickadee, gray catbird, and Swainson's hawk) may be found in this community phase. These sites provide nesting habitat for many migratory passerines and quality winter cover for sharp-tailed grouse, eastern screech owl, great horned owl, wild turkey, and non-migrating passerine birds, such as black-capped chickadee and white-breasted nuthatch. Berry producing shrubs provide late summer, fall, and winter forage for many bird species. Wildlife use increases as the depth of snow increases during the winter, thereby becoming critical to the sustainment of winter resident bird populations. The presence of woody plant species may increase mammalian and avian predation and increase brood parasitism by brown-headed cowbirds on adjacent grassland ecological sites.

Mammals: Dead and mature trees provide cavities and loose bark for big brown bat, northern long-eared bat, and Townsend's big-eared bat. Small herbivores that can use or tolerate woodland edge, such as American porcupine and cotton-tail rabbit, will benefit from this plant community phase. Shrubs and trees provide security and thermal cover used by white-tailed deer for foraging, loafing, and rearing young-of-the-year. Multi-layer shrub/tree communities provide concealment protection from predators during parturition. Plant species provide highly nutritious forage during peak lactation, one of the most energy demanding time periods of the year for female ungulates. Winter white-tailed deer diets are dominated by chokecherry, western snowberry, Saskatoon serviceberry, rose, and various species of gooseberry. When located near streams or other permanent water, these sites may be used by North American beaver as a woody material source.

Amphibians and Reptiles: This Wooded State does not provide habitat for species of conservation priority.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1; however, the wooded state can occur within drainageways that are in close proximity to receiving water bodies. The bare soil found under the tree and shrub canopy may reduce infiltration and nutrient cycling. Run-off, sediment yield, and nutrient load increase from the site negatively impacting receiving water bodies.

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 years 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 accessible range shows grazing. Little or no use of poor forage. Little evidence of trailing to grazing.
Full	40-60	All fully accessible 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

Water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic group B, but includes some soils in group C. Infiltration varies from moderately slow to moderately rapid; runoff potential varies from negligible to medium depending upon hydrologic group, surface texture, slope percent, 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 dense 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

National wildlife refuges (NWR) (56,476 acres), waterfowl production areas (WPAs) (183,465 acres), state wildlife management areas (WMAs) (59,476 acres), Department of Trust Lands/State School Lands (284,695 acres), and the United State Army Corps of Engineers (65,619 acres) provide hunting, bird watching, hiking, and other outdoor recreation opportunities. Audubon WMA, North Dakota, is the largest state managed, wildlife area covering 6,716 acres. The largest refuges managed by the United States Fish and Wildlife service are Audubon NWR (14,735 acres); Lostwood NWR (26,747 acres with 5,526 acres designated as wilderness area); Chase Lake NWR (4,385 acres, of which 4,201 acres were designated a wilderness area); and Long Lake NWR (22,300 acres). United States Bureau of Reclamation manages approximately 2,215 acres for fish and wildlife habitat. The Bureau of Land Management manages 6,042 acres in small, scattered tracts across the MLRA.

Bird watching: Prairie-dependent and migratory birds provide quality birding opportunities within this MLRA. NWRs, WPAs, and WMAs provide essential habitat for prairie-dependent bird species (such as Sprague's pipit and Baird's sparrow) along with some of the larger, showy members of the upland prairie including marbled godwit, upland sandpipes, and willet. MLRA 53B is in the heart of spring and fall bird migratory routes.

Chase Lake NWR is home to one of the largest breeding colonies of American white pelicans and has been identified by the American Bird Conservancy as one of the top 100 Globally Important Bird Areas in the United States. Lostwood NWR is designated a Globally Important Bird Area by the American Birding Conservancy and the Audubon Society. Long Lake NWR consists of a 15,000-acre saline basin that is 18 miles long and is appropriately named "Long Lake". The refuge was listed as a top 10 birding site by Wild Bird Magazine. It was also recently designated as both a Globally Important Bird Area and a Western Hemisphere Shorebird Reserve Network (WHSRN) site because of its importance as both a breeding and migratory stopover site for more than 20,000 shorebirds, annually.

Hunting/Fishing: MLRA 53B is a fall destination for thousands of waterfowl hunters. The density of prairie pothole wetlands, WPAs, state owned trust lands, and WMAs provide quality opportunities for waterfowl and upland game bird hunting. This MLRA also provides quality white-tailed deer hunting opportunities along with moose hunting opportunities.

Quality fishing (summer and winter fishing) opportunities are available in the MLRA. The North Dakota Game and Fish Department and the South Dakota Game Fish and Parks manages approximately 125 fishing lakes within the MLRA. Available species include yellow perch, walleye, northern pike, muskellunge, crappie, bluegill, and small mouth bass. Lake Audubon is the largest fishing lake within the MLRA. A portion of Lake Audubon, within the National Wildlife refuge system, provides ice fishing access only; there is no open-water fishing on the refuge portion of Lake Audubon.

Camping: The Bureau of Reclamation manages the Brekken-Holmes Recreation Area in the Turtle Lake area. The recreation area consists of approximately 675 water surface acres, 620 land acres, and 10 miles of shoreline. The Garrison Conservancy District provides primitive camping along the chain of lakes connected by the McClusky Canal diverting water eastward into central North Dakota. Nine state parks are located within the MLRA totaling 1,340 acres. Fort Stevenson State Park is the only State Park in the MLRA that provides boating access to Lake Sakakawea. Other numerous camping (primitive and improved) sites are available in numerous city and county parks.

Hiking: The North Country Trail dissects the MLRA east to west following the 76-mile section of the McClusky Canal; in addition it has 12 miles of off-road trails through the Audubon National Wildlife Refuge, a road walk from Coleharbor to Riverdale and across Garrison Dam, and a short, off-road segment leading to the Western

Terminus within Lake Sakakawea State Park. Hiking is also permitted on other state and federally owned lands. In addition, the Lostwood NWR and the Audubon NWR have 7 and 8 miles, respectively, of self-guided auto tours.

Wood Products

No appreciable wood products are found on this site.

Other Products

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

Site Development and Testing Plan

- The slope range for this site is currently 0 to 6 percent. In several areas of the associated Loamy ecological site, plant communities similar to Loamy Overflow have been observed on slopes exceeding 6 percent. These areas generally are a minor component, but some may make up more than 15 percent of the spatial extent of a map unit. Further investigation and documentation of the vegetation of these areas is recommended.
- Further evaluation is recommended on soils in areas of reclaimed coal mines that meet the slope percent and slope criteria for the Loamy Overflow ecological site. Determining CaCO₃ content should be part of any investigations. Since these soils are reclaimed, range plantings should be periodically revisited to see what species establish and respond to management.
- This site currently includes soils on terraces and flood plain steps. A unique, provisional ecological site (Loamy Floodplain) had been proposed to separate these areas from Loamy Overflow soils which occur in upland swales but has not been developed. Some of the terraces may have the frequency and duration of flooding to be best represented by a Riparian Complex ESD; other terraces may be better represented by a Loamy Terrace site similar to the one used in MLRA 54. The major soil of interest in MLRA 53B is Straw. These soils, map units, and flooding frequency/duration need further review to determine the appropriate ESD and MLRA soil survey projects to be pursued to resolve the issue in a consistent manner.
- 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 to determine which sampling sites occur in upland swales and which sampling sites occur on floodplains. The data also needs review to determine if geo-referenced sites meeting Tier 3 standards for either vegetative or soil data are available; if not, representative sites will be selected for further investigation.
- Further evaluation and refinement of the State-and-Transition model may be needed to identify disturbance driven dynamics. Additional states and/or phases may be required to address grazing response.
- 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:
 - The criteria for separating Loamy ES and Loamy Overflow ES have not been consistently applied. Components of the following soil series need review and some relinking: Arnegard, Bowbells, Emrick, Grassna, Makoti, Mandan, Roseglen, and Wilton.
 - Some Parshall components need to be relinked from Sandy to Loamy Overflow.

- Occasionally flooded and frequently flooded components of Straw soils need to be reviewed. Occasionally flooded components should be relinked to 54 Loamy Terrace; frequently flooded components should probably be Riparian Complex ES.

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
Clayey	R053BY001ND	This site occurs higher on the landscape; it does not receive additional water as run-on. The subsoil forms a ribbon ≥ 2 inches long.
Claypan	R053BY002ND	This site typically occurs on similar landscape positions. It has a dense, root-restrictive, sodic subsoil starting between a depth of 6 to 20 inches.
Limy Subirrigated	R053BY004ND	This site occurs somewhat lower on the landscape. It is highly calcareous in the upper part of the subsoil and has redoximorphic features at a depth of 18 to 30 inches. All textures are included in this site.
Loamy	R053BY011ND	This site typically occurs on linear slopes on higher, run-off landscape positions; it also occurs on terraces which are no longer impacted by frequent flooding. The soils are very deep to moderately deep. The surface and subsoil layers form a ribbon 1 to 2 inches long.
Thin Loamy	R053BY015ND	This site typically occurs on convex slopes on higher, run-off landscape positions. 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.
Wet Meadow	R053BY019ND	This site occurs in depressions and flats on uplands. It is poorly drained - a seasonal high-water table is typically within a depth of 1.5 feet during the months of April through June; in depressions, it is frequently ponded (typically ≤ 1.5 feet) in April and May. It typically has redoximorphic features within a depth of 18 inches. Some soils are highly calcareous. E.C. is < 8 dS/m in the surface and subsoil layers. All textures are included in this site.
Shallow Marsh	R053BY025ND	This site occurs in very poorly drained depressions. It is frequently ponded (typically > 2 feet) into mid-summer or longer.
Saline Lowland	R053BY006ND	This site occurs floodplains and flats. It is poorly or somewhat poorly drained. The soil has salt accumulations (E.C. > 8 dSm) within a depth of 16 inches.

Similar Sites

Ecological Site Name	Site ID	Narrative
Loamy	R053BY011ND	This site typically occurs on linear slopes on higher, run-off landscape positions; it also occurs on terraces which are no longer impacted by frequent flooding. The soils are very deep to moderately deep. The surface and subsoil layers form a ribbon 1 to 2 inches long.
Subirrigated	R053BY012ND	This site occurs on concave areas of flats and in shallow depressions with occasional, brief ponding. It has redoximorphic features at a depth of 18 to 30 inches. All textures are included in this site.

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 and South Dakota.

Relationship to Other Established Classifications

Level IV Ecoregions of the Conterminous United States: 42a – Missouri Coteau; 42b – Collapsed Glacial Outwash; 42c – Missouri Coteau Slope; 42d – Northern Missouri Coteau; 42f – Southern Missouri Coteau; 43c – River Breaks; and 46h – Northern Dark Brown Prairie.

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Site Type: Rangeland
MLRA: 53B – Central Dark Brown Glaciated Plains

Loamy Overflow
R053BY005ND

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Site Description Approval

ND, State Range Management Specialist

Date

SD, State Range Management Specialist

Date

INTERPRETING INDICATORS OF RANGELAND HEALTH, Version 5, REFERENCE SHEET

Ecological site name: Loamy Overflow Ecological site code: RO53BY005ND
 Author(s)/participant(s): USDA-NRCS North Dakota
 Contact for lead author: NRCS State Rangeland Management Specialist
 Date: Oct. 2021 MLRA: 53B LRU: _____
 Composition based on (check one): Cover Annual Production

<p>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.</p>
<p>1. Rills: Rills are not expected on this site.</p>
<p>2. Water flow patterns: Water flow patterns are not visible with canopies >6" in height, and may become visible following drought, fire, or heavy grazing yielding short (<2" in length and width) discontinuous patterns.</p>
<p>3. Pedestals and/or terracettes: Neither pedestals nor terracettes are expected.</p>
<p>4. Bare ground: Bare ground is less than 5%. Bare ground patches should be small (less than 2 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.</p>
<p>5. Gullies: Active gullies are not present. If present, relic gully channel(s) are fully vegetated with no active erosion visible.</p>
<p>6. Wind-scoured and/or depositional areas: No wind-scoured or depositional areas expected on this site.</p>
<p>7. Litter movement: Plant litter movement not expected on this site.</p>
<p>8. Soil surface resistance to erosion: Stability class averages 5 or greater.</p>
<p>9. Soil surface loss and degradation: Structure is granular or prismatic within the upper A-horizon. A-horizons for this ecological site range from 6 to 16 inches thick. Hue 10YR with value of 3 or less moist or 4 or less dry, and chroma 2 or less moist.</p>
<p>10. Effects of plant community composition and distribution on infiltration: Deep rooted native tall-statured rhizomatous grasses and mid- and short-statured bunch grasses are dominant, mid- and short-statured rhizomatous grasses, forbs, and shrubs are subdominant and all functional/structural groups are well distributed across the site.</p>
<p>11. Compaction layer: No compaction layers. Plant roots show no signs of restrictive or limited growth.</p>
<p>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.</p>

Dominance Category ¹	Relative dominance of F/S groups for community phases in the <i>Reference State</i> <i>Minimum expected number of species for dominant and subdominant groups is included in parentheses.</i>		
	Dominance based on ¹ : Annual Production <u> X </u> or Foliar Cover <u> </u>		
	Phase 1.1_	Phase 1. __	Phase 1. __
Dominant	Tall C4 rhizomatous grasses (3); Mid & short C3 bunch grasses (6)		
Subdominant	Mid & short C3 rhizomatous grasses (1); Forbs (11); Shrub (7)		
Minor	Mid & short C4 bunch grasses; Mid & short C4 rhizomatous grasses; Grass-likes; Trees		
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: Rare to not occurring on this site.			
14. Litter cover and depth: Plant litter cover is 60 to 80% with a depth of 0.25 to 0.75 inches. Litter is in contact with soil surface.			
15. Annual production: Annual air-dry production is 3500 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 2800 lbs./ac to 4300 lbs./ac, respectively.			
16. Invasive plants: State and local noxious species, smooth brome grass, Kentucky bluegrass, crested wheatgrass, quackgrass, Eastern red cedar/juniper, Russian olive and Siberian elm.			
17. Vigor with an emphasis on reproductive capability of perennial plants: Noninvasive plants in all functional/structural groups should be vigorous and capable of reproducing annually under normal weather conditions.			

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
Tall C4 rhizomatous grasses	
Mid & short C3 bunch grasses	
Mid & short C3 rhizomatous grasses	
Forbs	
Shrub	
Mid & short C4 bunch grasses	
Mid & short rhizomatous grasses	
Grass-likes	
Trees	
<u>Groups not expected:</u>	
Mid and short early C3 grasses	
Biological soil crust ¹	

Evaluation Area - Relative dominance of functional/structural groups

Dominant	>>	Subdominant	>>	Minor	>>	Trace
	>		>		>	
	=		=		=	

Biological soil crust¹ - dominance is evaluated solely on cover, not composition by weight