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.

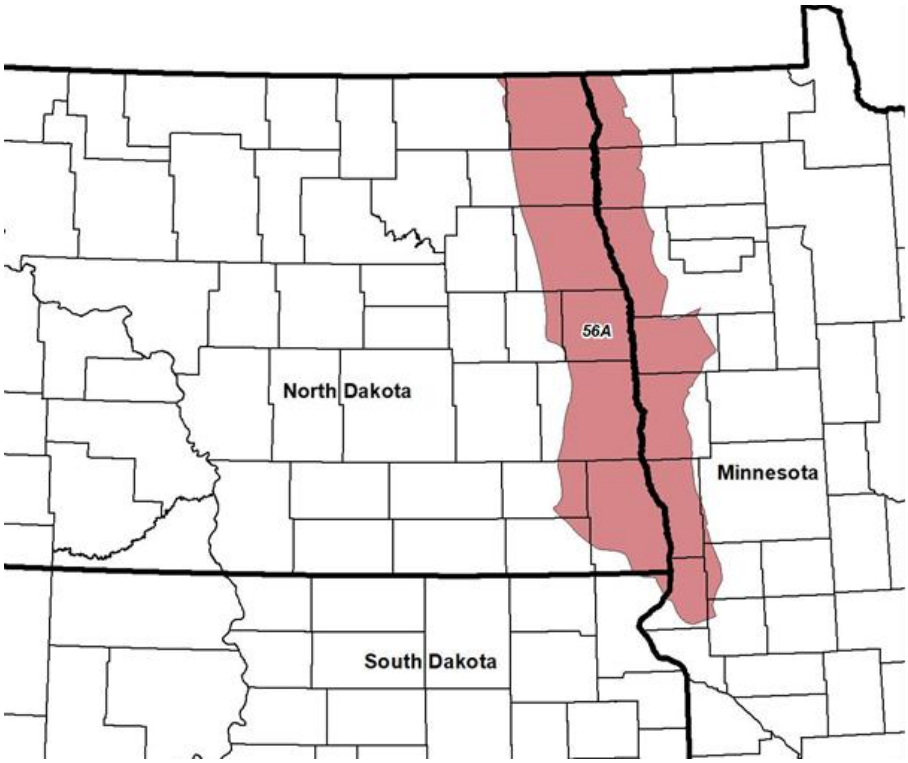
Site Name: Subirrigated Sands

Site Type: Rangeland

Site ID: R056AY096ND

Major Land Resource Area: 56A – Red River Valley of the North

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 56A within Minnesota, North Dakota, and South Dakota

The Red River Valley of the North MLRA is an expansive and agriculturally important region consisting of 10,400,000 acres and including a portion of 25 counties in eastern North Dakota and northwestern Minnesota along with a small portion of the northeast corner (Roberts County) of South Dakota.

Although MLRA 56A is currently called the Red River Valley of the North, the landscape does not fit the common understanding of "valley" as the transition out of the Valley is very gradual in most places. The extent of the MLRA corresponds to the area covered by Glacial Lake Agassiz including lacustrine sediments, beach ridges, and deltas where rivers flowed into the glacial lake. Also included are island areas of glacial till which were surrounded by the lake waters. Some of the lacustrine deposits are very deep and some have glacial till within a few feet of the surface. The glaciolacustrine materials range from clayey to sandy.

The primary river in the MLRA is the Red River of the North flowing northward into Canada where it empties into Lake Winnipeg. The river is formed by the confluence of the Bois de Sioux River (flowing from northeastern South Dakota) and the Ottertail River flowing from west-central Minnesota. Numerous tributaries in MLRA 56A contribute additional water to the Red River. In Minnesota these include the Two Rivers, Snake, Marsh, Middle, Red Lake, Wild Rice, and Buffalo. In North Dakota, the Pembina, Tongue, Park, Forest, Turtle, Goose, Elm, Rush, Maple, Sheyenne, and Wild Rice are tributaries to the Red River. There are also smaller streams and coulees along with many legal drains.

The relative flatness of much of the MLRA contributes to a flooding hazard for large areas of agricultural land in the spring months. Soil salinity, while variable, also impacts land management on many areas within the MLRA. Extensive surface and subsurface (tile) drainage systems have been constructed/installed to manage excess water and/or salinity on cropland. This extensive drainage has apparently reduced ground water recharge regionally, thus impacting seasonal water table level/fluctuation and its influence on plant communities. Soils that were poorly drained prior to wide-spread drainage may now function as somewhat poorly drained or even moderately well drained soils. For example, undrained Fargo soils are Wet Meadow ecological sites; with surface drainage they may function as Subirrigated sites; and with tile drainage, they commonly function as Clayey sites. Because of the extensive alteration of the hydrology, restoration to the natural conditions of the reference state dynamics would not be possible.

MLRA 56A is an ecotone between grassland dominated MLRAs 55A and 55B to the west and forest dominated MLRAs 56B and 102A to the east. This region is utilized mostly by farms; about 80 percent is non-irrigated cropland, but some irrigated fields exist on the beach areas. Cash-grain, bean, sugar beets, potatoes, and oil production crops are the principal enterprise on many farms, but other feed grains and hay are also grown. Currently, about 6 percent of this area is forested, mostly in areas along rivers that are difficult to access with farm equipment. Another 6 percent is grassland used for ranching and/or wildlife habitat. Grazing lands occur primarily in the Sand Hills area of the Sheyenne River delta, on beach areas, and on other areas too wet, saline, sodic, steep, or inaccessible to be productive cropland.

Ecological Site Concept

The Subirrigated Sands ecological site is primarily located on sandy delta plains, lake plains, and till-floored lake plains and on ground moraines mantled with eolian sands; a few areas also occur on outwash plains and glacial lake beaches. The soils are very deep. Surface and subsoil textures typically are loamy fine sand, fine sand, or loamy sand; these textures do not form a ribbon. Fine sandy loam or sandy loam surface textures are allowable if $\leq$10 inches thick. Some soils have loamy or clayey substratum layers deeper than 20 inches. Soil on this site is moderately well drained;

redoximorphic features are deeper than 30 inches, but within a depth of 40 inches. Slopes range from 0 to 6 percent. On the landscape, this site is below the Choppy Sands and Sands ecological sites and above the Limy Subirrigated, Subirrigated, and Wet Meadow sites.

Physiographic Features

This site typically occurs on uplands – on sandy delta plains, lake plains, and till-floored lake plains and on ground moraines mantled with eolian sands; a few areas also occur on outwash plains and glacial lake beaches. Parent materials are sandy glaciolacustrine or glaciofluvial sediments and eolian sands; in some areas each of these parent materials have an underlying parent material, either of till or of glaciolacustrine sediments containing more silt and clay. Slopes range from 0 to 6 percent.

Landform: delta plain, lake plain, till-floored lake plain, eolian mantled till plain, outwash plain

	Minimum	**Maximum**
Elevation (feet):	750	1475
Slope (percent):	0	6
Water Table Depth (inches):	36	72
Flooding:		
Frequency:	None	None
Ponding:		
Frequency:	None	None
Runoff Class:	Very low	Low
Aspect:	No influence on this site	

Climatic Features

MLRA 56A is considered to have a continental climate – cold winters and relatively hot summers, low to moderate humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation typically ranges from 18 to 23 inches per year. The average annual temperature is about 40°F. January is the coldest month with average temperatures ranging from about 1°F (Pembina, North Dakota (ND) to about 11°F (Wheaton, Minnesota (MN). July is the warmest month with temperatures averaging from about 68°F (Pembina, ND) to about 73°F (Wheaton, MN). The range of normal average monthly temperatures between the coldest and warmest months is about 65°F. This large annual range attests to the continental nature of this area's climate. Winds are estimated to average about 13 miles per hour annually, ranging from about 15 miles per hour during the spring to about 11 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 cool season plants begins in early to mid-March, slowing or ceasing in late June. Warm season plants begin growth about mid-May and continue to early or mid-September. Greening up of cool season plants may occur in September and October when adequate soil moisture is present.

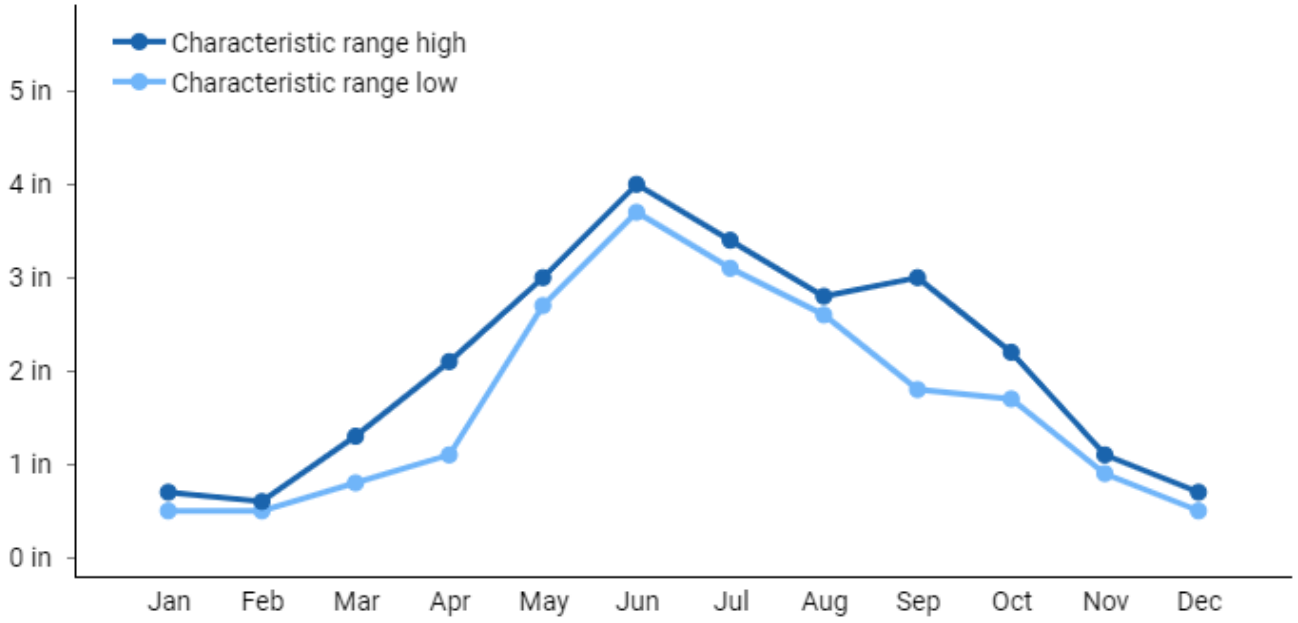
Climate normals

	Representative High	Representative Low	Actual High	Actual Low	Average
Mean annual precipitation (in):	24	21	25	20	22
Frost free period (days):	126	102	131	87	112
Freeze free period (days):	145	132	150	126	138

Normal monthly precipitation (in)

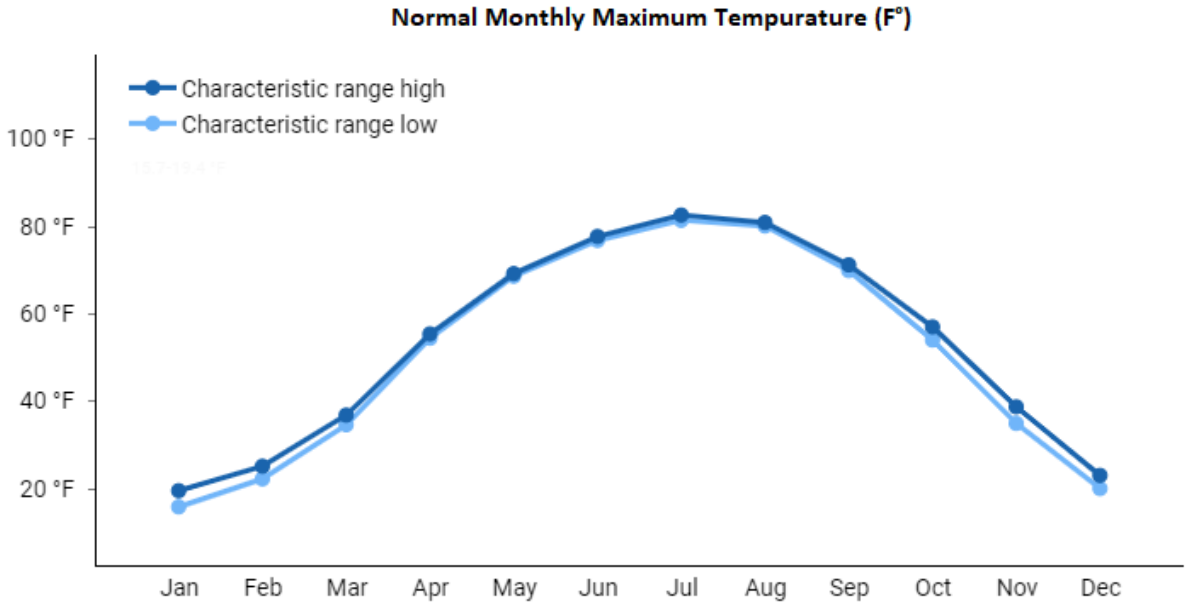
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.7	0.6	1.3	2.1	3	4	3.4	2.8	3	2.2	1.1	0.7
Representative low:	0.5	0.5	0.8	1.1	2.7	3.7	3.1	2.6	1.8	1.7	0.9	0.5
Actual high:	0.8	0.7	1.5	2.2	3.2	4.1	3.4	3	3.1	2.3	1.2	0.8
Actual low:	0.5	0.4	0.8	1	2.7	3.6	3	2.5	1.8	1.6	0.8	0.5

Normal Monthly Precipitation (in)



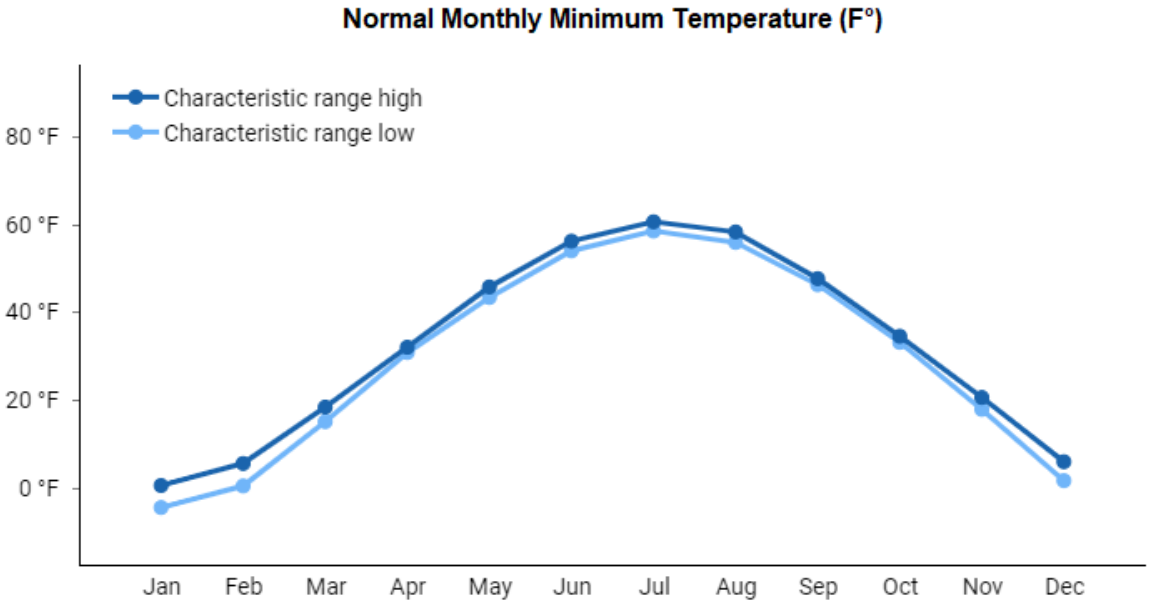
Normal monthly maximum temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	19.4	25	36.7	55.3	69.1	77.6	82.5	80.8	71.1	56.9	38.6	22.9
Representative low:	15.7	22.1	34.5	54.3	68.5	76.7	81.3	80	69.8	53.9	34.8	19.9
Actual high:	19.9	25.1	36.8	55.9	69.7	77.7	82.7	80.8	71.4	57	38.6	23.9
Actual low:	13.4	19.3	32	51.8	65.8	74.5	79.1	78.4	67.9	52.3	33.1	18.1
Average:	17	23	35.2	54.5	68.3	76.7	81.5	80.1	70.2	55.1	36.1	21.1



Normal monthly minimum temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.6	5.6	18.4	32	45.7	56.1	60.5	58.2	47.6	34.5	20.6	6
Representative low:	-4.4	0.5	15.1	30.8	43.3	53.9	58.4	55.8	46.2	33.1	17.9	1.7
Actual high:	0.6	5.7	18.9	33.3	46.1	56.2	60.7	58.4	48.4	35.6	20.7	6.3
Actual low:	-5.4	-0.5	13.9	29.7	41.9	52.4	56.6	53.8	43.8	31.5	16.9	1.2
Average:	-1.5	3.6	16.9	31.5	44.2	54.5	58.9	56.3	46.5	33.9	19.4	4.3



Climate stations used

(1) VICTOR 4 NNE [USC00398652], Rosholt, SD
(2) PARK RIVER [USC00326857], Park River, ND
(3) GRAFTON [USC00323594], Grafton, ND
(4) WHEATON [USC00218907], Wheaton, MN
(5) AGASSIZ REFUGE [USC00210050], Grygla, MN
(6) PEMBINA [USW00014924], Pembina, ND

Influencing Water Features

Under normal climatic conditions, this site receives additional water from a seasonal high-water table. The duration of the water table can be prolonged in some soils due a loamy substratum layer which perches some water in the lower root zone and contributes to lateral flow from surrounding uplands. During the growing season, water table depths typically are 3 to 5 feet during April through June; however, it can be as shallow as 2.5 feet in early spring. It commonly lowers to 4 to 6 feet during mid-summer through autumn. Surface infiltration is moderately rapid to very rapid. Permeability through the profile is rapid or very rapid in the sandy materials. In soils with a loamy or clayey layer (below a depth of 20 inches), permeability is moderate to slow in that layer; this slows percolation and can prolong subirrigation in spring and early summer. Water loss is primarily through evapotranspiration. During mid-summer, percolation below the root zone may also occur.

Due to the low relief landscape that typically surrounds this site, additional water received as runoff from adjacent uplands is not a major factor in the soil/hydrology/plant relationship.

Representative Soil Features

Most soils associated with Subirrigated Sands ES are in the Mollisol and Entisol orders. The Mollisols are classified further as Oxyaquic Hapludolls and Calcic Hapludolls. The Entisols are classified further as Aquic Udipsamments and Aquic Udorthents. These soils were developed under prairie vegetation. They formed in sandy glaciolacustrine or glaciofluvial sediments and eolian sands; in

some areas each of these parent materials have an underlying parent material, either of till or of glaciolacustrine sediments containing more silt and clay.

The common features of soils in this site are coarse textures to a depth of greater than 20 inches and a seasonal water table which is moderately high contributing additional water for transpiration. Surface and subsoil textures typically are loamy fine sand, fine sand or loamy sand; these textures do not form a ribbon. Fine sandy loam or sandy loam surface textures are allowable if ≤10 inches thick. Some soils have loamy or silty substratum layers deeper than 20 inches. The soils are moderately well drained – redoximorphic features are visible at a depth of 3 to 3.5 feet. These soils are very deep; some have a loamy or clayey substratum within a depth of 20 to 60 inches. Most soils in this site have less than 5 percent gravel, but some have as much as 15 percent in the upper 3 feet and as much as 35 percent in the lower substratum.

Soil salinity and sodicity are typically none in the sandy materials; where a loamy substratum occurs, the salinity is very slight (E.C. 2 - <4 dS/m) and sodicity is low (SAR <3). Soil reaction typically is slightly acid to slightly alkaline (pH 6.1 to 7.8) in the sandy materials; however, a few soils are moderately acid (pH 5.6 to 6.0). Also, some soils have lower subsoils which are moderately alkaline (pH 7.9 to 8.4) due to calcium carbonate accumulation. Where a loamy or clayey substratum occurs, it is slightly to moderately alkaline (pH 7.4 to 8.4). The calcium carbonate (CaCO3) content is none to low (<5%) in the upper part of the soil, but in some soils increases to as much as 30 percent at a depth greater than 2 feet.

The soil surface is stable and intact. Sub-surface soil layers are non-restrictive to water movement and root penetration. These soils are susceptible to wind erosion. Loss of the soil surface layer can result in a shift in species composition and/or production.

Major soil series correlated to the Subirrigated Sands site are Aylmer, Falsen, Foldahl, Hecla, Hilaire, Poppleton, and Towner (moderately well drained phase).

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

Permeability note: The permeability class of the Foldahl, Hilaire, and Towner soils is rapid or very rapid in the upper part and moderate to slow in the lower part. Depth to the layer of reduced permeability is 20 to 40 inches in these soils.

Parent Material Kind: glaciolacustrine deposits, glacifluvial deposits, eolian deposits
Parent Material Origin: lacustrine, outwash
Surface Texture: fine sand, loamy fine sand, loamy sand
Surface Texture Modifier: none
Subsurface Texture Group: sandy
Surface Fragments <3" (% Cover): 0-12
Surface Fragments ≥3" (%Cover): 0-3
Subsurface Fragments <3" (% Volume): 0-13
Subsurface Fragments ≥3" (% Volume): 0-3

	Minimum	Maximum
Drainage Class:	moderately well	moderately well
Permeability Class*:	rapid	very rapid
Depth to first restrictive layer (inches):	80	>80
Electrical Conductivity (dS/m)*:	0	2
Sodium Absorption Ratio:**	0	3
Soil Reaction (1:1 Water):**	5.6	8.4

Soil Reaction (0.1M CaCl2):	NA	NA
Available Water Capacity (inches):**	2.5	9
Calcium Carbonate Equivalent (percent):**	0	30

*This attribute represents from 0 to >20 inches (sandy materials). Electrical Conductivity (E.C.) values are based on Saturated Paste method; the commonly used 1:1 field method will likely have E.C. values ≤1.

**These attributes represent from 0-40 inches.

Plant Communities

Ecological Dynamics of the Site:

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

Prior to European influence, the historical disturbance regime for MLRA 56A 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, Wooded, Invaded, and Go-Back). Within each state, one or more community phases have been identified. These community phases are named based on the more dominant and visually conspicuous species; they have been determined by study of historical documents, relict areas, scientific studies, and ecological aspects of plant species and plant communities. Transitional pathways and thresholds have been determined through similar methods.

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

Reference State is thought to have shifted temporally and spatially between two Plant Community Phases.

Presently 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 plants, as well as other environmental changes, the Reference State is considered to no longer exist. Thus, the presence of exotic plants on the site precludes it from being placed in the Reference State. It must then be placed in one of the other states, commonly State 2: Native/Invaded State (T1A).

State 2: Native/Invaded State. Colonization of the site by exotic plants results in a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition was inevitable; it often resulted from colonization by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, quackgrass) which have been particularly and consistently invasive under long-term non-use or very light grazing ,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 and are similar those of 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 may decline. A decline in forb diversity can also be expected. Under non-use or minimal use management, mulch increases and may become a physical barrier to plant growth. This also changes the micro-climate near the soil surface and may alter infiltration, nutrient cycling, and biological activity near the soil surface. As a result, these factors coupled with shading cause desirable native plants to have increasing difficulty remaining viable and recruitment declines.

To slow or limit the invasion of these exotic grasses or other exotic plants, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic plants, the transition to State 3: Invaded State should be expected (T2B). This state may also transition to State 4: Invaded Wooded State during long-term non-use or very light grazing, and no fire (T2A).

State 3: Invaded State. The threshold for this state is reached when both the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, quackgrass) exceed 30% of the plant community and native grasses represent less than 40% of the community. One plant 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 (R3A) may be accomplished with the implementation of long-term prescribed grazing in conjunction with prescribed burning. This state may also transition to State 4: Invaded Wooded State with long-term non-use or very light grazing, and no fire (T3A).

State 4: Invaded Wooded State. This state historically existed as small patches of shrubs and perhaps trees scattered across the site when precipitation, fire frequency, and other factors enabled woody species to colonize or encroach on the site. This often resulted in a mosaic of patches of woody vegetation interspersed within the grass dominated vegetation. A marked increase in non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread. One community phase has been identified; it often results from long-term non-use or very light grazing, and no fire (T2A, T3A).

Brush control can lead to State 3: Invaded State (R4B). Brush control can also lead to State 2: Native/Invaded State (R4A); however, depending upon the native component, a range planting may be necessary to complete the restoration.

State 5: Go-Back State often results following cropland abandonment and consists of one plant community phase. This weedy assemblage may include noxious weeds that need control. Over time, the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, crested wheatgrass) will likely predominate.

Initially, due to extensive bare ground and a preponderance of shallow rooted annual plants, infiltration is low and 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 (R5A). Following seeding, prescribed grazing, prescribed burning, haying, and the use of herbicides will generally be necessary to achieve the desired result and control weeds, some of which may be noxious weeds. A failed range planting and/or secondary succession will lead to State 3: Invaded State (R5B).

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

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

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

Plant Communities and Transitional Pathways

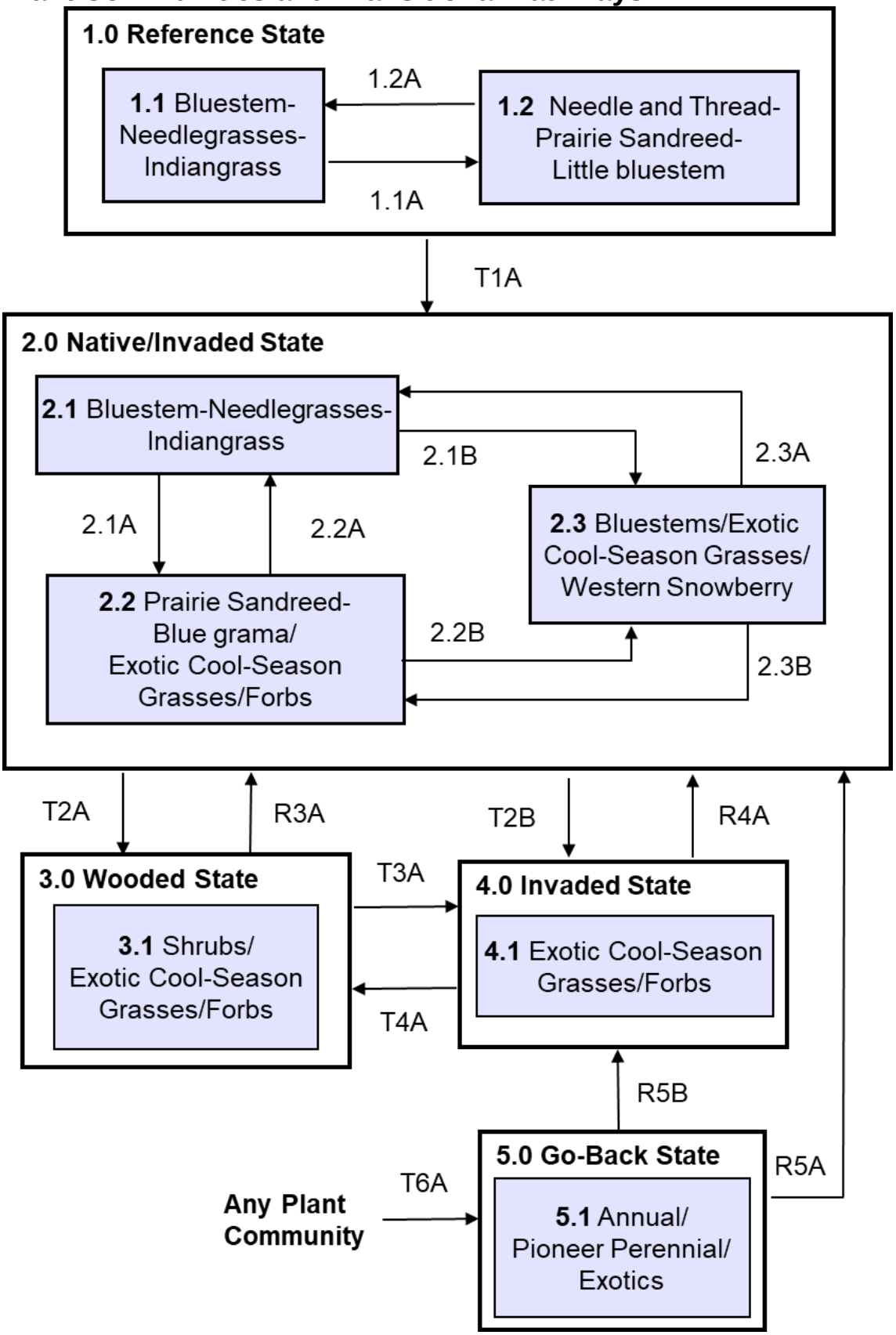


Diagram Legend - MLRA 56A Subirrigated Sands

T1A	Introduction of exotic plants
T2A	Long-term non-use or very light grazing and no fire
T2B	Long-term heavy grazing or long-term non-use and no fire
T3A	Long-term non-use or very light grazing and no fire
T6A	Cessation of annual cropping
R3A	Long-term prescribed grazing and prescribed burning
R4A	Brush control, perhaps followed by a range planting
R4B	Brush control
R5A	Successful range planting
R5B	Failed range planting and/or secondary succession
CP 1.1 - 1.2 (1.1A)	Periods of below average precipitation and increased disturbance
CP 1.2 - 1.3 (1.2A)	Return to average precipitation and disturbance regime
CP 2.1 - 2.2 (2.1A)	Heavy grazing
CP 2.1 - 2.3 (2.1B)	Long-term non-use or very light grazing and no fire
CP 2.2 - 2.1 (2.2A)	Long-term prescribed grazing and prescribed burning
CP 2.2 - 2.3 (2.2B)	Long-term non-use or very light grazing and no fire
CP 2.3 - 2.1 (2.3A)	Long-term prescribed grazing and prescribed burning
CP 2.3 - 2.2 (2.3B)	Heavy grazing

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.

This was a diverse, stable, and productive state with the high-water table supplying much of the moisture for plant growth. It was dominated by warm-season grasses (i.e., bluestem and Indiangrass) with lesser amounts of cool-season grasses (i.e., needlegrasses). During multiyear drought periods the community shifted to one of needle and thread, prairie sandreed, and little bluestem.

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 state is contingent upon a monitoring protocol to guide management.

Community Phase 1.1: Bluestems-Needlegrasses-Indiangrass (*Andropogon gerardii*, *Andropogon hallii*, *Schizachyrium scoparium-Hesperostipa* spp.-*Sorghastrum nutans*)

This community phase was the most dominant both temporally and spatially. It was dominated by tall and mid warm-season grasses (such as big bluestem, prairie sandreed, and Indiangrass) in association with mid cool-season grasses such as porcupinegrass. Other grass and grass-like

species included switchgrass, little bluestem, sideoats grama, needle and thread, blue grama, and sedge. A wide variety of native perennial forbs were present including white sagebrush, purple prairie clover, stiff goldenrod, prairie spiderwort, Maximillian sunflower, and blazing star. Common shrubs included prairie willow, prairie rose, leadplant, western snowberry, prairie sagewort, and white meadowsweet.

Annual production varied from about 2400-4000 pounds per acre with grasses and grass-likes, forbs, and shrubs contributing about 80%, 10% and 10%, respectively. Because both warm-season grasses and cool-season grasses and sedges are well represented in the community, production would have been distributed throughout the growing season. 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 Bluestems-Needlegrasses-Indiangrass		
COMMON/GROUP NAME	**SYMBOL**	**Group**	**lbs./acre**	**% Comp**
GRASSES & GRASS-LIKES			*2240 - 2560*	*70 - 80*
TALL WARM-SEASON GRASSES		**1**	**480 - 1120**	**15 - 35**
big bluestem	ANGE	1	160 - 480	5 - 15
sand bluestem	ANHA	1	0 - 160	0 - 5
prairie sandreed	CALO	1	160 - 480	5 - 15
switchgrass	PAVI2	1	64 - 320	2 - 10
Indiangrass	SONU2	1	64 - 320	2 - 10
prairie cordgrass	SPPE	1	0 - 64	0 - 2
COOL-SEASON BUNCH GRASSES		**2**	**160 - 640**	**5 - 20**
porcupinegrass	HESP11	2	160 - 480	5 - 15
needle and thread	HECOC8	2	32 - 160	1 - 5
slender wheatgrass	ELTR7	2	0 - 96	0 - 3
Canada wildrye	ELCA4	2	0 - 96	0 - 3
MID WARM-SEASON GRASSES		**3**	**160 - 640**	**5 - 20**
little bluestem	SCSC	3	160 - 480	5 - 15
sideoats grama	BOCU	3	64 - 320	2 - 10
sand dropseed	SPCR	3	0 - 160	0 - 5
MID COOL-SEASON GRASSES		**4**	**64 - 160**	**2 - 5**
western wheatgrass	PASM	4	0 - 160	0 - 5
SHORT WARM-SEASON GRASSES		**5**	**32 - 160**	**1 - 5**
blue grama	BOGR2	5	32 - 160	1 - 5
OTHER NATIVE GRASSES		**6**	**32 - 160**	**1 - 5**
prairie Junegrass	KOMA	6	32 - 96	1 - 3
Scribner's rosette grass	DIOLS	6	0 - 64	0 - 2
fall rosette grass	DIWI5	6	0 - 64	0 - 2
other grasses	2GRAM	6	32 - 160	1 - 5
GRASS-LIKES		**7**	**64 - 320**	**2 - 10**
Penn sedge	CAPE6	7	32 - 256	1 - 8
sun sedge	CAINH2	7	32 - 256	1 - 8
other grass-likes	2GL	7	0 - 96	0 - 3
FORBS		*8*	*160 - 320*	*5 - 10*
white sagebrush	ARLU	8	32 - 96	1 - 3
Cuman ragweed	AMPS	8	32 - 64	1 - 2
purple prairie clover	DAPU5	8	32 - 64	1 - 2
smooth horsetail	EQLA	8	32 - 64	1 - 2
flat-top goldentop	EUGR5	8	32 - 64	1 - 2
stiff goldenrod	OLRI	8	32 - 64	1 - 2
Missouri goldenrod	SOMI2	8	32 - 64	1 - 2
white heath aster	SYER	8	32 - 64	1 - 2
prairie spiderwort	TROC	8	32 - 64	1 - 2
Maximilian sunflower	HEMA2	8	0 - 64	0 - 2
field sagewort	ARCA12	8	0 - 32	0 - 1
prairie milkweed	ASSU3	8	0 - 32	0 - 1
Geyer's sandmat	CHGE2	8	0 - 32	0 - 1
Canadian horseweed	COCAC3	8	0 - 32	0 - 1
silky prairie clover	DAVI	8	0 - 32	0 - 1
blazing star	LIATR	8	0 - 32	0 - 1
narrowleaf stoneseed	LIIN2	8	0 - 32	0 - 1
lobelia	LOBEL	8	0 - 32	0 - 1
rush skeletonweed	LYJU	8	0 - 32	0 - 1
native forbs	2FN	8	32 - 96	1 - 3
SHRUBS		*9*	*160 - 320*	*5 - 10*
prairie willow	SAHU2	9	0 - 128	0 - 4
leadplant	AMCA6	9	32 - 96	1 - 3
prairie rose	ROAR3	9	32 - 96	1 - 3
white meadowsweet	SPAL2	9	32 - 96	1 - 3
western snowberry	SYOC	9	32 - 64	1 - 2
prairie sagewort	ARFR4	9	0 - 32	0 - 1
other shrubs	2SHRUB	9	0 - 96	0 - 3

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	2110 -	2720 -	3260
FORBS	145 -	240 -	370
SHRUBS	145 -	240 -	370
TOTAL	2400 -	3200 -	4000

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 Pathway 1.1 to 1.2 occurred during periods of below average precipitation and increased disturbance resulting in declines in the more grazing sensitive species (such as big bluestem, Indiangrass, and porcupinegrass) with corresponding increases in the more drought and grazing resistant species (such as needle and thread, prairie sandreed, and little bluestem).

Community Phase 1.2: Needle and Thread-Prairie Sandreed-Little Bluestem (*Hesperostipa comata-Calamovilfa longifolia-Schizachyrium scoparium*)
This community would have been characterized by more drought and grazing tolerant species compared to that of Community Phase 1.1. Prominent grasses would have included needle and thread, prairie sandreed, little bluestem, sideoats grama, and blue grama. White heath aster, field sagewort, Cuman ragweed, rigid sunflower, and prairie sagewort were among the prominent forbs and shrubs. Annual production would have declined in comparison to that of Community Phase 1.1.

Community Phase Pathway 1.2A
Community Pathway 1.2 to 1.1 would have occurred with the return to average precipitation and disturbance regime resulting in increases in the more grazing sensitive species (such as big bluestem, Indiangrass, and porcupinegrass) with corresponding declines in the more drought and grazing resistant species (such as needle and thread, prairie sandreed, and little bluestem).

Transition T1A
This transition from the State 1: Reference State to the State 2: Native/Invaded State is due to the introduction and establishment of exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, crested wheatgrass). 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, crested wheatgrass or other exotic plants 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, crested wheatgrass) 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 techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 3: Invaded State should be

expected. Annual production of this state can be quite variable, in large part due to the amount of exotic cool-season grasses. Annual production, however, may range from 2400-4000 pounds per acre.

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

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

Grazing management should be applied that enhances the competitive advantage of native grass and forb species. This may include: (1) 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: Bluestems-Needlegrass-Indiangrass (*Andropogon gerardii*, *Andropogon hallii*, *Schizachyrium scoparium-Hesperostipa* spp.-*Sorghastrum nutans*)

This community phase is similar to Community Phase 1.1 but has been colonized by exotic cool-season grasses which are now minor components of the community. The warm- and cool-season co-dominated community is maintained with grazing systems that allow for adequate recovery periods following grazing events and, potentially, the combination of grazing and prescribed burning which closely mimics the natural disturbance regime.

Annual production is similar to that of Community Phase 1.1 (2400-4000 pounds per acre) with graminoids, forbs and shrubs contributing roughly 80%, 10%, and 10% of the production, respectively.

Figure 1. Foreground - Community Phase 2.1: Bluestem-Needlegrass-Indiangrass.

Community Phase Pathway 2,1A

Community Phase Pathway 2.1 to 2.2 occurs during periods of heavy grazing or seasonal grazing without adequate recovery periods (grazing at the same season of year for extended periods during the active growing season of the dominant native grasses). This results in marked declines in the big bluestem, little bluestem, porcupinegrass, and Indiangrass, with corresponding increases in the exotic cool-season grasses (blue grama, prairie sandreed, and forbs).

Community Phase Pathway 2.1B

Community Phase Pathway 2.1 to 2.3 occurs during long-term non-use or very light grazing, and no fire. Plant litter increases and the exotic cool-season grasses (often Kentucky bluegrass) and western snowberry markedly increase.

Community Phase 2.2: Prairie Sandreed-Blue Grama/Exotic Cool-Season Grasses/Forbs (*Calamovilfa longifolia-Bouteloua gracilis*/Exotic Cool-Season Grasses/Forbs)

Heavy grazing has reduced the mid/tall less grazing tolerant species, while the shorter more grazing tolerant species have increased compared to Community Phase 2.1. Common grasses often include prairie sandreed, blue grama, needle and thread, Kentucky bluegrass, and/or other exotic cool-season grasses. The common forbs include Cuman ragweed, scouring rush, and goldenrod. Western snowberry and prairie sagewort are common shrubs.

Compared to Community Phase 2.1, litter has decreased while peak production has shifted to slightly earlier in the growing season due to declines in the later maturing warm-season grasses and corresponding increases in native and exotic cool-season grasses. Annual production is similar to that of Community Phase 2.1 (2400-4000 pounds per acre) with contributions from Kentucky bluegrass or other exotic cool-season grasses approaching 30% of the production.

This community phase is often dispersed throughout the pasture, in an overgrazed/undergrazed pattern, typically referred to as patch grazing. Some areas (overgrazed) will exhibit the impacts of heavy use, while other areas (undergrazed) will have a build-up of litter and a high amount of plant decadence. This is a typical pattern found in properly stocked pastures grazed season-long. In the undergrazed patches, litter buildup reduces plant vigor and density and native seedling recruitment declines. Due to a lack of tiller stimulation and sunlight, native bunchgrasses typically develop dead centers and native rhizomatous grasses are limited to small colonies. In the overgrazed patches, plant vigor is reduced; the competitive advantage goes towards the grazing tolerant species, such as Kentucky bluegrass.

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

Community Phase Pathway 2.2A

Community Phase Pathway 2.2 to 2.1 is initiated by implementation of long-term prescribed grazing and prescribed burning to suppress the exotic cool-season grasses and enable the native grasses, particularly the warm-season species to increase. 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 species to the native cool-season and warm-season grass species.

Community Phase Pathway 2.2B

Community Phase Pathway 2.2 to 2.3 occurs with long-term non-use or very light grazing, and no fire. This leads to increases in the exotic cool-season grasses (often Kentucky bluegrass), western snowberry, and litter with corresponding decreases in forbs and native grasses, particularly the warm-season species.

Community Phase 2.3: Bluestems/Exotic Cool-Season Grasses/Western Snowberry (*Andropogon gerardii*, *Andropogon hallii*, *Schizachyrium scoparium/Exotic Cool-Season Grasses/Symphoricarpos occidentalis)*

The removal of disturbances has allowed the exotic cool-season grasses (commonly Kentucky bluegrass) to increase to 20 to 30 percent of the annual production. Tall and mid statured warm and cool season native grasses (such as big bluestem, Indiangrass, switchgrass, little bluestem, sideoats grama, porcupinegrass, and needle and thread) constitute at least 40 percent of the annual production. Native forbs (such as Maximilian sunflower, goldenrods, white heath aster, common yarrow, Cuman ragweed, and white sagebrush) are present along with exotic forbs, such as sweet clover and black medic. Western snowberry and prairie rose are common shrubs. Smooth brome may encroach onto the site, particularly when adjacent to rights-of-way.

Annual production is similar to the reference plant community (2400-4000 pounds per acre) but peak production has shifted to early spring to mid-summer due to the invasion of exotic cool-season grasses. Litter cover (extent) is similar to the reference plant community; however, the depth has increased to greater than 5 inches and is not in contact with the soil surface.

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

Community Phase Pathway 2.3A

Community Phase Pathway 2.3 to 2.1 is initiated by implementation of long-term prescribed grazing and prescribed burning. The prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources. The application of several prescribed burns may be needed at relatively short intervals in the early pathway, in part because western snowberry and some other shrubs sprout profusely following one burn. Early season prescribed burns have been successful; however, fall burning may also be an effective technique.

Community Phase Pathway 2.3B

Community Phase Pathway 2.3 to 2.2 occurs with heavy grazing. This results in decreases in the exotic cool-season grasses (often Kentucky bluegrass), western snowberry, and litter with corresponding increases in forbs and native grasses, particularly the warm-season grasses.

Transition T2A

This transition from the State 2: Native/Invaded to State 4: Invaded Wooded State generally occurs with long-term 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). The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of tree seeds from adjacent sites will hamper site restoration.

Reticence to undertake tree removal and the perception that trees may be a desirable vegetation component for wildlife habitat, carbon sequestration, aesthetics, etc. are some of the constraints to recovery. Managers wanting to manage the site for deer, livestock, or grassland nesting birds will need to consider the intensive management required to restore and maintain the site in State 2. The disturbance regime necessary to restore this site to State 2: Native/Invaded State is very labor intensive and costly; therefore, addressing woody removal earlier in the encroachment phase is the most cost-effective treatment for woody control.

Transition T2B

This transition from the State 2: Native/Invaded State to State 3: Invaded State generally occurs with long-term heavy grazing or long-term non-use and no fire. Exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, crested wheatgrass) become the dominant graminoids.

Studies indicate that a threshold may exist in this transition when both the exotic cool-season grasses exceed 30% of the plant community and native grasses represent less than 40% of the plant community composition. This transition may occur under other managerial conditions, for example 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.

Figure 2. Plant Community Phase 2.3: Bluestems/Exotic Cool-Season Grasses/Western Snowberry. Kentucky bluegrass (21% by weight) and native grasses (50% by weight) is at risk to transition (Transition T2B) to State 3.0 Invaded State

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, crested wheatgrass). Other exotic plants (e.g., leafy spurge, Canada thistle) are also known to 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 3300-5300 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

This community phase is dominated by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, crested wheatgrass). Excessive accumulation of mulch may also be present, particularly when dominated by Kentucky bluegrass. Common forbs often include goldenrod, common yarrow, asters, and Cuman ragweed. Exotic forbs, such as leafy spurge and Canada thistle, are also known to invade the site. Rose and western snowberry are common shrubs.

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 3300-5300 pounds per acre. The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of exotic cool-season grasses are typically short-lived.

Figure 3. Community Phase 3.1 – Exotic Cool-Season Grasses/Forbs – Native grasses (24% by weight) and Kentucky bluegrass (38% by weight).

Transition T3A

The transition from State 3: Invaded Site to State 4: Invaded Wooded State generally occurs with long-term non-use or very light grazing, and no fire. It frequently occurs when the site is near 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). The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of tree seeds from adjacent sites will hamper site restoration.

Constraints to recovery include the reticence to undertake tree removal and the perception that trees may be a desirable vegetation component for wildlife habitat, carbon sequestration, aesthetics, etc. Managers wanting to manage the site for deer, livestock, or grassland nesting birds will need to consider the intensive management required to restore and maintain the site in State 2. The disturbance regime necessary to restore this site to State 2: Native/Invaded State is very labor intensive and costly; therefore, addressing woody removal earlier in the encroachment phase is the most cost-effective treatment for woody control.

Restoration R3A

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

Both prescribed grazing and prescribed burning are likely necessary to successfully initiate this restoration pathway, the success of which depends upon the presence of a remnant population of native grasses in Community Phase 4.1. That remnant population, however, may not be readily apparent without close inspection. The application of several prescribed burns may be needed at relatively short intervals in the early phases of this restoration process, in part because many of the shrubs (e.g., western snowberry) sprout profusely following one burn. Early season prescribed burns have been successful; however, fall burning may also be an effective technique.

The prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources. If properly implemented, this will shift the competitive advantage from the exotic cool-season grasses to the native cool-season grasses.

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

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

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.

State 4: Invaded Wooded State

This state historically existed as small patches of shrubs and perhaps trees scattered across the site, particularly when near wooded areas where they could have encroached onto the site vegetatively (e.g., rhizomes, root sprouts) or provided a seed source for colonization of the site. Common woody species often include western snowberry, prairie rose, Wood’s rose, white meadowsweet, and willow. Trees, such as quaking aspen and green ash, may also be present. A marked increase in non-use management and active fire suppression since European influence has enabled this state 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 4.1: Shrubs/Exotic Cool-Season Grasses/Forbs

Shrubs (e.g., western snowberry, prairie rose, Wood's rose, white meadowsweet, willow) increase to become major components in this community phase. The herbaceous understory is dominated by the shade-tolerant, cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, crested wheatgrass). Common forbs include goldenrod, American licorice, Cuman ragweed, white heath aster, and common yarrow. Quaking aspen, green ash, and perhaps other trees may also be present. Remnants of native warm- and cool-season grasses are still present, but greatly reduced in extent, vigor and production.

This community phase is somewhat resistant to change. Once established, time and external resources will be needed to see any immediate recovery. The combination of both prescribed grazing and prescribed fire is the most effective in moving this plant community towards State 2: Native/Invaded State.

Restoration R4A

This restoration from State 4: Invaded Wooded State to State 2: Native/Invaded State can be accomplished with brush control, perhaps followed by a range planting. Initial use of herbicides and/or mechanical brush control to reduce the shrubs will permit adequate fine fuel loads to enable the application of prescribed burning to further control sprouting shrub species. However, depending upon level of remnant native grasses and forbs, a range planting may also be necessary to complete the restoration.

A combination of mechanical brush management, chemical treatment, and prescribed burning is necessary to remove the woody vegetation and, if necessary, to prepare the seedbed for a successful range planting. Once this is accomplished, it may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. 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. After establishment of the native plant species, management objectives must include the maintenance of those species, the associated reference state functions, and continued treatment of exotic grasses. Due to the resprouting nature of woody species within MLRA 56A, repeated treatments will be necessary for a transition from this state.

Following the removal of woody species, other restoration practices (such as range planting, prescribed burning, and prescribed grazing) may be necessary to complete the restoration. 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 help suppress any exotic cool-season grasses on the site.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). 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 fuel type (herbaceous vs. shrub vs. tree), fine fuel amount and orientation; (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 woody and exotic species while favoring native species (both cool- and warm-season grasses).

The method of brush management will be site specific 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.

A successful range planting will include proper seedbed preparation, weed control (both prior to and after the planting), selection of adapted native species representing functional/structural groups inherent to the State 1, and proper seeding technique. Management (e.g., prescribed grazing, prescribed burning) during and after establishment must be applied in a manner that maintains the competitive advantage for the seeded native species. Adding non-native species can impact the above and below ground biota. Some evidence suggests the addition of exotic legumes to the seeding mixture may favor exotic cool-season grass expansion/invasion.

Restoration R4B

This is the restoration from State 4: Invaded Wooded State to State 3: Invaded State resulting from brush control (e.g., mechanical and/or chemical, repeated prescribed burns).

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Societal norms have accepted woody invasion as positive for wildlife habitat, carbon sequestration, aesthetics, etc. Livestock managers may not understand the loss of production due to woody invasion and loss of native grass species. Wildlife managers may need to manage woody habitat for exotic wildlife species, such as ring-necked pheasant, instead of sharp-tailed grouse or other grassland nesting birds which are intolerant to woody species invasion.

State 5: 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 (Kentucky bluegrass, smooth brome, quackgrass, and/or crested wheatgrass) will likely predominate.

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 5.1: 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, leafy spurge) which may need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, quackgrass, and/or crested wheatgrass) will likely predominate.

Restoration R5A

This Restoration Pathway from State 5: Go-Back State to the State 2: Native/Invaded State can be accomplished with a successful range planting. Following seeding, prescribed grazing, prescribed burning, haying, or use of herbicides will generally be necessary to achieve the desired result and control any noxious weeds.

It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, 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 seeding technique. Management (e.g., prescribed grazing, prescribed burning) during and after establishment must be applied in a manner that maintains the competitive advantage for the seeded native species. Adding non-native species can impact the above and below ground biota. Elevated soil nitrogen levels have been shown to benefit smooth brome and Kentucky bluegrass more than some native grasses. As a result, fertilization, exotic legumes in the seeding mix, and other techniques that increase soil nitrogen may promote smooth brome and Kentucky bluegrass invasion.

The method or methods of herbaceous weed treatment will be site specific to each situation; 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 R5B

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.

Transition T6A

This transition from any plant community to State 5: 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 compaction layer, 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 56A landscape is characterized by a nearly level glacial lake plain bordered on the east and west by outwash plains, till plains, gravelly beaches, and dunes. MLRA 56A is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are common and characteristic of the MLRA. This area supports natural tall-grass prairie vegetation with bur oak, green ash, and willow growing in drainageways. This area is formed in silty and clayey lacustrine sediments from the former Glacial Lake Agassiz. Complex intermingled ecological sites create diverse grass/shrub land habitats interspersed with varying densities of linear, slope, depressional, and in-stream wetlands associated with headwater streams and tributaries to the Red River of the North. MLRA 56A is located within the boundaries of the Prairie Pothole Region and is an ecotone between the humid east and the sub-humid west regions. The primary land use is annual cropland (~80%). The Red River Valley is known for its exceptional fertility with major crops including corn, soybeans, small grains, and sugar beets.

By the mid-19th century, the majority of the Red River Valley had been converted from tall-grass prairie to annual crop production. To alleviate crop production loss from wetlands and overland flow, a system of shallow surface ditches, judicial ditches, and road ditches removes surface water in spring and during high rainfall events. The major soils are poorly drained with extensive areas of saline soils. Tile drainage systems have been or are being extensively installed throughout MLRA 56A for sub-surface field drainage to enhance annual crop production.

The east and west side of the Red River Valley formed in a complex pattern of sandy beach material, stratified inter-beach material, lacustrine silts, and lake washed glacial till. The soils vary from excessively drained on ridges to very poorly drained organic basins. Surface ditches serve to drain some of the area, although much of the area lacks adequate drainage for maximum crop production. Calcareous fens and saline seeps can occur at the base of beach ridges and result in rare plant communities. Native vegetation was mixed- and tall-grass prairie with scattered woodland and brush.

Historic Communities/Conditions within MLRA 56A:

The northern tall- and 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). Frequent and expansive flooding along the Red River and its tributaries provided abundant opportunities for Native Americans to harvest wild rice. American bison roamed MLRA 56A wintering along the Red River and migrating west into MLRA 55A and 55B for parts of the season. Many species of grassland birds, small mammals, insects, reptiles, amphibians,

and large herds of roaming American bison, elk, and pronghorn were historically among the inhabitants adapted to this region. Roaming herbivores, as well as several small mammal and insect species, were the primary consumers linking the grassland resources to large predators (such as the wolf and American black bear) and smaller carnivores (such as the coyote, bobcat, red fox, and raptors). Extirpated species include free-ranging American bison and gray wolf (breeding). Extinct from the region is the Rocky Mountain locust.

Present Communities/Conditions within MLRA 56A:

MLRA 56A has the most conversion to cropland of any MLRA within Region F-Northern Great Plains. European influence has impacted remaining grassland and shrubland by domestic livestock grazing, elimination of fire, removal of surface and subsurface hydrology via artificial drainage, and other anthropogenic factors influencing plant community composition and abundance.

Extensive drainage has taken place. Streams have been straightened (removing sinuosity) and riparian zones have been converted to annual crop production. These anthropogenic impacts have reduced flood water detention and retention on the landscape, increasing storm water runoff, sediment, and nutrient loading to the Red River and its tributaries. The installation of instream structures has reduced aquatic species movement within the MLRA.

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

Included in this MLRA are approximately 70,000 acres of the United States Forest Service, Sheyenne National Grassland (southern portion of MLRA) with an additional 65,000 acres of intermingled privately owned land of sandy soils providing a large tract of intact tall grass prairie within the MLRA. United Fish and Wildlife Service refuges and waterfowl production areas, along with and state wildlife management areas cover approximately 67,000 acres within the MLRA. Two of three largest cities in North Dakota are located within the MLRA.

USDA conservation programs have seeded thousands of cropland acres in riparian zones to native herbaceous vegetation. Natural succession is replacing the planted native herbaceous vegetation to native woody vegetation re-establishing native wooded riparian areas on previously cropland. Most of the plantings have been along the Red River and its tributaries in the northern portions of the MLRA within the United States. These areas are privately owned and protected from annual agricultural production with perpetual conservation easements.

Some characteristic wildlife species in this area are:

Birds: Mallard, blue-winged teal, red-tailed hawk, American kestrel, ring-necked pheasant, western meadowlark, killdeer, eastern and western kingbird, American crow, common yellowthroat, downy and hairy woodpecker, clay-colored sparrow, vesper sparrow, Savannah sparrow, and brown-headed cowbird.

Mammals: Northern short-tailed shrew, white-tailed jackrabbit, snowshoe hare, Franklin's ground squirrel, thirteen-lined ground squirrel, northern pocket gopher, plains pocket gopher,

western harvest mouse, deer mouse, meadow vole, meadow jumping mouse, western jumping mouse, coyote, red fox, raccoon, American badger, striped skunk, white-tailed deer, North American beaver, and moose.

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

Presence of wildlife species is often determined by ecological site characteristics including grass and forb species, hydrology, aspect, and other associated ecological sites. The home ranges of most species are usually 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. Extensive use of insecticides for specialty crops (such as potatoes, sugar beets, and other crops) has greatly reduced insects within this MLRA.

Species of Concern within MLRA 56A:

The following is a list of species considered “species of conservation priority” in the North Dakota State Wildlife Action Plan (2015); “species of greatest conservation need” in the Minnesota State Wildlife Action Plan, Conservation Focus Areas, Target Species (2015) and the South Dakota State Wildlife Action Plan (2014); and “species listed as threatened, endangered, or petitioned” under the Endangered Species Act within MLRA 56A at the time this section was developed:

Invertebrates: Arogos skipper, Assiniboia skipper, Dakota skipper, dusted skipper, Leonard’s skipper, monarch butterfly, Poweshiek skippering, red-tailed leafhopper, regal fritillary, and Uhler’s Arctic.

Birds: American kestrel, American bittern, bobolink, American white pelican, bald eagle, black-billed cuckoo, chestnut-collared longspur, Dickcissel, grasshopper sparrow, greater prairie-chicken, Henslow’s sparrow, LeConte’s sparrow, loggerhead shrike, marbled godwit, Nelson’s sparrow, northern harrier, northern pintail, red-headed woodpecker, sharp-tailed grouse, short-eared owl, Swainson’s hawk, upland sandpiper, western meadowlark, willet, Wilson’s phalarope, and yellow rail.

Mammals: Arctic shrew, big brown bat, eastern spotted skunk, gray fox, little brown bat, northern grasshopper mouse, plains pocket mouse, prairie vole, pygmy shrew, Richardson’s ground squirrel, and river otter.

Amphibians/Reptiles: Canadian toad, common snapping turtle, northern prairie skink, and plains hognose snake.

Fish: Blacknose shiner, blue sucker, burbot, chestnut lamprey, finescale dace, hornyhead chub, largescale stoneroller, logperch, northern pearl dace, northern redbelly dace, pearl dace, shortnose gar, sickle-fin chub, sliver chub, silver lamprey, trout-perch, and yellow bullhead.

Mussels: Black sandshell, creek heelsplitter, creeper, mapleleaf, pink heelsplitter, pink papershell, threeridge, and Wabash pigtoe.

Grassland Management for Wildlife in MLRA 56A:

Management activities within the community phase pathways have both short and long term positive and negative impacts on wildlife. Community phase, transitional, and restoration pathways are keys to long-term management within each State and between States. Significant inputs must occur to cross the threshold between States (e.g., State 3.0 to 2.0) requiring substantial economic inputs and management (grazing intensity, reseeding, prescribed fire, woody vegetation removal, etc.). Timing, intensity, and frequency of these inputs can have dramatic positive or negative effects on vegetative structure impacting local wildlife species' habitats. Ranchers and other land managers must always consider the long-term beneficial effects of management on the habitat in comparison to potential short-term negative effects to 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. Ecological sites supporting a dominance of herbaceous vegetation (Wet Meadow, Subirrigated Sands) can be located adjacent to ecological sites that support trees (Choppy Sands and Loamy Overflow).

Management of these complex ecological sites can provide a heterogeneous or a homogenous landscape. Grassland bird use reduces as the plant community transitions to a homogenous state or increases in woody vegetation. Managers need to recognize ecological sites and the complexes they occur in to properly manage the landscape. A management regime for one ecological site may negatively impact an adjacent site (e.g., alteration of a grazing regime within a Choppy Sands ecological site to encourage understory growth may encourage exotic cool-season grasses to increase or dominate an adjacent ecological site).

Life requisites and habitat deficiencies are determined for targeted species. Deficiencies need to be addressed along community phase, transitional, and restoration pathways as presented in specific state-and-transition models. Ecological sites should be managed and restored within the site's capabilities to provide sustainable habitat. Managers also must consider habitat provided by adjacent/intermingled ecological sites for species with home ranges or life requisites that cannot be provided by one ecological site.

With populations of many grassland-nesting birds in decline, it is important to maintain these ecological sites in a 1.0 Reference State 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 with large amounts of woody vegetation within a grassland or avoid nesting near woody vegetation in adjacent habitats. Although these species avoid areas with woody vegetation, most can tolerate a small amount of woody vegetation within areas dominated by grassland habitat, including short-statured shrubs (e.g., western snowberry) in this MLRA.

Subirrigated Sands Wildlife Habitat Interpretation:

Subirrigated Sands ecological sites are moderately well drained, coarse textured soils usually found on sandy delta plains, lake plains, and till-floored lake plains and on ground moraines mantled with eolian sands; a few areas also occur on outwash plains and glacial lake beaches. This site has a seasonally high-water table during months April, May, June

influencing vegetation production. The soils are highly susceptible to wind erosion but are well suited for tall warm-season grasses, as well as mid-statured cool-season grasses and forbs. Associated ecological sites include Limy Subirrigated, Sands, Subirrigated, Choppy Sands, and Wet Meadow. This complex of ecological sites provides habitat for many edge-sensitive grassland bird species preferring medium- to tall-statured vegetation.

Subirrigated sands habitat features and components commonly support grassland-nesting birds, notably sharp-tailed grouse and greater prairie chicken nesting sites. Insects rely on associated forbs and grasses for survival and serve as food sources for birds and their young and as forage for small and large herbivores.

Subirrigated sands ecological sites may be found in five plant community states (1.0 Reference State, 2.0 Native/Invaded State, and 3.0 Invaded State, 4.0 Invaded Wooded State, and 5.0 Go-Back State) within a local landscape. Today, these states occur primarily in response to drought, fire, grazing, non-use (lack of management), and other anthropogenic disturbances.

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using tools in State 1.0 and State 2.0 Community Phase Pathways to prevent further plant community degradation along Transitional Pathway T2B to State 3.0 and Transitional Pathway T2A to State 4.0. Native wildlife generally benefits from the heterogeneous grasslands found in States 1.0 and 2.0 that include diverse grass and forb species of varying stature and density. As plant communities degrade within State 2.0, Kentucky bluegrass and woody vegetation increases, while native forbs are reduced.

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

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

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

1.0 Reference State

Community Phase 1.1 Bluestems-Needlegrasses-Indiangrass: This plant community offers quality vegetative cover for wildlife; 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. Prescribed fire maintains a grass-dominated plant community providing habitat for bird species sensitive to woody vegetation. 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 bison, are simulated by domestic livestock. These services include putting plant material and dung in contact with mineral soil to be used by lower trophic level consumers (such as invertebrate decomposers, scavengers, shredders, predators, herbivores, dung beetles, and fungal-feeders).

This site supports Dakota skippers preferred host plants, such as little and big bluestem, but does not support preferred forb species. Arogos skippers may use this site since it contains host plants, such as big bluestem and little bluestem, and can nectar on forb species found on the site. Regal fritillary will not use this site since violet species are absent for larval food. Monarch butterfly may use flowering forbs on this site, with smooth milkweed available for caterpillar food. Bumblebees and other native bees utilize forbs as a nectar source. Five to ten percent of the site is bare ground, providing nesting sites for ground nesting bee species.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by mid- to tallgrass-nesting birds. Prescribed fire maintains a grass-dominated plant community providing habitat for bird species sensitive to woody vegetation. This plant community does not provide suitable areas for sharp-tailed grouse or greater prairie chicken lek sites, unless grazed; but it does provide nesting habitat, brood-rearing, escape, and winter cover. This site provides good hunting opportunities for grassland raptors.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores. Tall- to mid-statured vegetation provides quality food, thermal, protective, and escape cover for small and large herbivores.

Amphibians and Reptiles: Ecological site provides high quality food, foraging and dispersal habitat for the northern leopard frog and Canadian toad since this site is frequently found adjacent to Wet Meadow ecological sites. Herbaceous vegetation may be too dense or tall for the plains hog-nosed snake and northern prairie skink, decreasing sunlight penetration needed for temperature regulation.

Fish and Mussels: This ecological site is not typically adjacent to streams, rivers, or water bodies. This site receives limited run-on hydrology from adjacent ecological sites (Sands) and provides hydrology (mainly subsurface) to Limy Subirrigated, Subirrigated, and Wet Meadow ecological Sites. Management on Subirrigated Sands sites, in conjunction with neighboring run-on sites, will have an indirect effect on aquatic species in streams and/or tributaries receiving water from Subirrigated Sands and adjacent sites. Optimum hydrological function and nutrient cycling limit potential for sediment yield and nutrient loading to the adjacent aquatic ecosystems from Community Phase 1.1.

Community Phase 1.2 Needle and Thread-Prairie Sandreed-Little Bluestem: This plant community phase occurs after a spring burn followed by intense grazing. An increase in forbs favors pollinator insects providing an increase food source for grassland nesting birds. Indiangrass slightly decreases while forbs increase significantly.

Invertebrates: Provides similar life requisites as Community Phase 1.1. However, an increase in forbs provides increased pollen and nectar sources for insects and increased bare ground for ground-nesting insects.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

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

2.0 Native/Invaded State

Community Phase 2.1 Bluestems-Needlegrasses-Indiangrass: This plant community develops through Transition Pathway T1A due to changes in management and the presence of exotic, cool-season grasses. The threshold between States 1.0 and 2.0 is crossed when exotic cool-season grasses, such as Kentucky bluegrass, become established. This plant community phase has a very similar appearance and function to the Plant Community 1.1, except that 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 management within the State 2.0 Community Phase Pathways to avoid transitioning to State 3.0.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

Community Phase 2.2 Prairie Sandreed-Blue Grama/Exotic Grasses/Forbs: Heavy grazing (along Community Phase Pathway 2.1A) reduces tall, warm-season grasses. The reduction of vigor of warm-season grasses allows for the increase in Kentucky bluegrass, decrease in some native forbs, and an increase in western snowberry. This plant community can also occur from Community Phase 2.3 (via Community Phase Pathway 2.3B) by use of prescribed grazing with adequate recovery periods. However, the shrub component in 2.3 will persist unless prescribed fire or mechanical treatment is initiated.

Invertebrates: Increased grazing pressure reduces litter amount while increasing grazing-tolerant exotic species, such as Kentucky bluegrass. Kentucky bluegrass can increase to as much as 30 percent of the community by weight causing a reduction of native forbs and bare ground favoring ground nesting insects. Forb abundance still provides for season-long pollen and nectar source for insects, while the addition of western snowberry provides a quality late spring pollen and nectar source.

Birds: Depending on the abundance of Kentucky bluegrass and blue grama, the shift to short- to mid-statured vegetation favors grassland nesting birds preferring short to medium vegetative stature. The presence and density of western snowberry may negatively impact grassland-nesting bird species intolerant to woody vegetation while the loss of little bluestem limits nesting opportunities for greater prairie chicken.

Mammals: The shift to shorter statured grasses reduces habitat for large ungulates such as elk. However, the increase in western snowberry provides white-tailed deer browse and habitat.

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 Bluestems/Exotic Cool-Season Grasses/Western Snowberry: Removal of disturbances such as grazing and fire (via Community Phase Pathway 2.1B or 2.2B) allows for the increase in shade-tolerant Kentucky bluegrass and accumulation of litter. Kentucky bluegrass approaches the 30 percent level. Western snowberry increases, thus increasing shade and decreasing native warm-season grasses. Every effort should be made by managers to avoid reaching the 30 percent Kentucky bluegrass threshold or transitioning to aspen as found in Invaded State 3.0 by implementing a prescribed grazing system and introducing prescribed fire.

Invertebrates: Increase in Kentucky bluegrass and western snowberry reduces native forbs diversity and moves the pollen availability window to late spring dominated by western snowberry. Introduced forbs (such as yellow and white sweet clover and black medic) increase, providing mid- to late-season pollen and nectar sources.

Birds: Provides similar life requisites as Community Phase 1.1. However, as this community phase approaches the 30 percent Kentucky bluegrass threshold, grassland nesting bird species that favor mid-grass statured vegetation increase. Depending on the density of western snowberry, grassland nesting bird species intolerant to woody vegetation will decrease.

Mammals: The reduction of tall- to mid-statured vegetation reduces thermal, protective, and escape cover for small and large herbivores. However, dependent upon the increase of western snowberry the reduction of thermal, protective, and escape cover may be mitigated.
Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

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: Heavy grazing shifts the competitive edge to Kentucky bluegrass via Transitional Pathway T2B. Introduced forbs increase, while native forbs decrease in diversity and extent. Removal of all disturbance increases litter and cools the soil surface giving the competitive edge to cool-season exotic species shifting this plant community to 3.1, increasing shrubs. Non-use will also result in extensive areas of Kentucky bluegrass litter accumulation and have the effect of residual cover going prostrate or “laying down”. Management along Restoration Pathway R3A will require intensive prescribed grazing and prescribed fire over a long period to bring forb and grass diversity back to this plant community phase. Remnant native species are required to move this plant community back to State 2.0.

Invertebrates: Heavy grazing without adequate recovery periods will result in little, if any, residual cover. Native and non-native forbs provide season-long pollen and nectar sources; however, diversity and extent may be reduced by heavy continuous season-long grazing.

Heavy grazing will reduce litter amounts and provide some bare ground for ground nesting insects. This plant community will not provide reliable nectar or pollen sources for any butterfly species of greatest conservation need.

Birds: Heavy grazing without adequate recovery periods will result in little, if any, residual cover favoring short-grass bird species. A continuous over-grazing management scenario favors Kentucky bluegrass and other non-native, cool-season exotic grazing tolerant grasses. Lack of pollinator forb species limits invertebrate use. This plant community does not provide suitable areas for sharp-tailed grouse or greater prairie chicken lek sites, or for brood or escape cover. Continuous season-long grazing reduces cover, providing little hunting opportunity for grassland raptors.

Mammals: Lacking residual cover under the over-grazing management scenario, this short-statured community provides limited food, thermal, protective, and escape cover 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.

4.0 Invaded Wooded State

Community Phase 4.1 Shrubs/Exotic Cool-Season Grasses/Forbs: Complete rest from grazing and the elimination of fire (via Transitional Pathway T2A) allow for western snowberry, roses, willows and other shrubs to dominate the site. Shade-tolerant Kentucky bluegrass dominates the understory exceeding 30 percent by weight while native grasses are less than 40 percent with reduced vigor and diversity. Recovery back to State 2.0 requires high levels of grazing management along with repeated prescribed burns via Restoration Pathway R4A.

Invertebrates: The invasion of woody vegetation reduces or eliminates habitat for all species of concern within MLRA 56A. Season-long pollen and nectar availability becomes limited on this site. Early season pollen and nectar is provided by willow, western snowberry and rose species but mid-to late season pollen and nectar is limited to absent. Overall, pollinator plant diversity is low, limiting season-long nectar and pollen production.

Birds: Grassland nesting birds sensitive to woody vegetation encroachment will discontinue use of this community phase; bird species preferring woodland edge may begin to use this site, especially where willow species dominate. This site will provide winter food (buds) and cover for sharp-tailed grouse but will not provide any habitat needs for greater prairie chicken.

Mammals: Aspen will provide increased year-round cover for white-tailed deer and elk. Mammals, such as porcupines, that prefer woody habitat will use this site.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1. However, sod-forming Kentucky bluegrass and aspen may become too dense for northern prairie skink and plains hognose snake.

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

5.0 Go-Back State

Community Phase 5.1 Annual/Pioneer Perennial/Exotics: This plant community is the result of severe soil disturbance (such as cropping, recreational activity, or concentrated livestock activity for a prolonged period). Following cessation of disturbances, the resulting plant community is dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals and birds, and their young. Dense weed cover can keep soils moist, increasing the presence of insects. Milkweed can be an early pioneering pollinator species and host plant for monarch butterflies. Tall stature provided by some annual weeds offers thermal cover and seeds throughout winter for deer, small mammals, and over-wintering birds. The response by wildlife species will be dependent upon plant community composition, vegetative stature, patch size, and management activities (such as prescribed grazing, burning, inter-seeding, haying, or noxious weed control).

Successful restoration of native species along Transition Pathway R5A can result in a native grass and forb community in Native/Invaded State 2.0. Over time (with no management), the exotic cool-season perennial grasses (Kentucky bluegrass, smooth brome, and/or quackgrass) generally become established and dominate the community. Failed range planting, via Transition Pathway R5B, can result in an invaded plant community Invaded State 3.0

Animal Community – Grazing Interpretations

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

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

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

Grazing levels are noted within the plant community narratives and pathways in reference to grazing prescribed grazing management. “Degree of utilization” is defined as the proportion of the current year’s production that is consumed and/or destroyed by grazing animals (may refer to a single plant

species or a portion or all the vegetation). "Grazing utilization" is classified as slight, moderate, full, close, and severe (see the following table for description of each grazing use category). The following utilization levels are also described in the Ranchers Guide to Grassland Management IV. Utilization levels are determined by using the landscape appearance method as outlined in the Interagency Technical Reference "Utilization Studies and Residual Measurements" 1734-3.

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

Hydrology Functions

Water is the principal factor limiting herbage production on this site as the water table drops after the early growing season. The site is dominated by soils in hydrologic groups A and B, but also includes a few soils in group C. Infiltration varies from moderately rapid to rapid; runoff potential is very low or low for this site depending on 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 shortgrasses 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).

Tile drainage is common where soils in this site occur in complex with wetter soils (Limy Subirrigated, Subirrigated, and Wet Meadow ecological sites). Depending on the depth to tile, this hydrological manipulation can modify the ecological site. If the water table is effectively lowered (beyond 40 inches throughout the growing season) the site conditions would better fit the Sands ecological site. A field investigation may be needed to determine the appropriate ecological site and proceed accordingly.

Without restoring hydrologic function (which may include range planting), managers need to reference state and transition model of the Sands site. Hydrology will need to be fully restored in the associated Wet Meadow ecological sites for this site to properly function. It is recommended that managers review that State and Transition Model prior to wetland restoration.

Recreational Uses

Hunting and Bird Watching: The United States Fish and Wildlife Service manages approximately 4,000 acres of National Wildlife Refuges for hiking and bird watching and approximately 24,000 acres of Waterfowl Production Areas for public hunting, hiking, and bird watching. States within MLRA 56A manage approximately 39,000 acres of wildlife management areas for multiple use including hunting, fishing, hiking, birdwatching, berry picking, and other non-motorized uses. Of the 39,000 acres, approximately 21,400 are in Minnesota with approximately 16,000 acres in North Dakota and approximately 1,700 acres in South Dakota.

In North Dakota, the United States Forest Service manages 70,000 acres on the Sheyenne National Grassland for multiple uses including camping, hunting, photography, backpacking birdwatching, biking, horseback riding, and other non-motorized recreation. The Sheyenne National Grassland is also managed for livestock grazing. The Choppy Sands and Sands ecological sites dominate the Grassland. It is the only National Grassland in the tallgrass prairie region of the United States. The grassland provides habitat for greater prairie chicken as well as several other sensitive species, such as the Dakota skipper and regal fritillary. It also contains one of largest populations of the western prairie fringed orchid which is listed as a threatened species by the U.S. Fish and Wildlife Service.

Fishing: Approximately 20 lakes are managed for public fishing MLRA 56A. Most of these lakes offer boat docks and ramps. These lakes contain various sport fish including walleye, northern pike, yellow perch, crappie, and bluegill. The Red River runs from south to north through the center of the MLRA. The Red River is best known for channel catfish but also has walleye, sauger, northern pike, and smallmouth bass. The Red River is 550 miles long from its source in the southern end of the MLRA near Breckenridge, Minnesota to Lake Winnipeg in Manitoba, Canada. Between North Dakota and Minnesota, there are 32 public access points along the Red River with 18 having boat ramps.

Camping: Four state parks or recreation areas provide of modern and primitive camping facilities. Minnesota hosts the Buffalo River State Park and Red River State Park. North Dakota hosts the Icelandic State Park and Turtle River State Park. These Parks provide hiking, biking, birding, canoeing, and wildlife viewing opportunities. Many local parks and private parks provide modern and primitive camping opportunities. Limited primitive camping is also available on North Dakota Game and Fish Department Wildlife Management Areas.

Hiking/Biking/Horseback Riding: Hiking is permitted on most state and federally owned lands. Developed hiking and biking trails can be found the four state parks. The Grand Forks Greenway has over 22 miles of trails while municipalities along the Red River have extensive walking and hiking trails. A 30-mile segment of the North Country National Scenic Trail leads hikers through the Sheyenne National Grassland's unique landforms and plant communities. This trail has three trailheads along its route; it is a graveled, marked trail. The entire North Country National Scenic Trail stretches from Crown Point, New York to Lake Sakakawea near Garrison, North Dakota.

Canoeing/Kayaking: The Red River has six designated canoe/kayaking trails. Public access, with limited rentals, is available at these segments. Sheyenne River Water Trail has a segment within the MLRA Sheyenne National Grasslands. Canoe/kayak rentals are available at Icelandic State Park.

Wood Products

No appreciable wood products are present on the site.

Other Products

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

Site Development and Testing Plan

- Review of water table depths for Hecla and Radium components is needed. Currently, it is populated in NASIS with a range of 76 to 152 cm and an RV of 114 cm. This range overlaps ESD criteria for Subirrigated Sands and Sands. MLRAs 55A and 55B have linked Hecla to Subirrigated Sands while MLRA 56A has linked Hecla to Sands. It is not known if the populated water table depths reflect natural hydrology or hydrology affected by drainage. If affected by drainage, components should be relinked to Subirrigated Sands.
- 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.
- Further documentation may be needed for plant communities in all states. Plant data has been collected in previous range-site investigations, including clipping data; however, this data needs review. If geo-referenced sites meeting Tier 3 standards for either vegetative or soil data are not available, representative sites will be selected for further investigation.
- Site concepts will be refined as the above noted investigations are completed.
- The long-term goal is to complete an approved, correlated Ecological Site Description as defined by the National Ecological Site Handbook.

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
Limy Subirrigated	R056AY087ND	This site occurs on flats that are slightly lower on the landscape. The soil is highly calcareous in the upper part of the subsoil (within a depth of 16 inches); redoximorphic features at a depth of 18 to 30 inches. All textures are included in this site.
Sands	R056AY090ND	This site occurs higher on the landscape. It is sand or loamy sand (fine to coarse sands) within a depth of 10 inches; the subsoil soil does not form a ribbon. Redoximorphic features, where present, are deeper than 40 inches.
Subirrigated	R056AY095ND	This site occurs in swales and blow-outs. Redoximorphic features at a depth of 18 to 30 inches. All textures are included in this site.
Choppy Sands	R056AY104ND	This site occurs on dunes with slopes >15 percent. The surface and subsoil layers do not form a ribbon.
Wet Meadow	R056AY102ND	This site occurs on similar landscape positions. The soil does not have a claypan layer. E.C. is <8 dS/m. All textures are included in this site.

Similar Sites

Ecological Site Name	Site ID	Narrative
Sands	R056AY090ND	This site occurs higher on the landscape. It is sand or loamy sand (fine to coarse sands) within a depth of 10 inches; the subsoil soil does not form a ribbon. Redoximorphic features, where present, are deeper than 40 inches.
Subirrigated	R056AY095ND	This site occurs in swales and blow-outs. It has redoximorphic features at a depth of 18 to 30 inches. All textures are included in this site.

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Developers

ND NRCS: Keith Anderson, Fred Aziz, Stan Boltz, David Dewald, Jonathan Fettig, Alan Gulsvig, Mark Hayek, Chuck Lura, Jeff Printz, Steve Sieler, Lee Voigt, and Hal Weiser.

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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 Minnesota, North Dakota, and South Dakota.

Relationship to Other Established Classifications

Level IV Ecoregions of the Conterminous United States: 48a Glacial Lake Agassiz Basin; 48b Beach Ridges and Sand Deltas; and 48d Lake Agassiz Plains.

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Site Description Approval

ND, State Range Management Specialist	Date	MN, State Range Management Specialist	Date
SD, State Range Management Specialist	Date		

INTERPRETING INDICATORS OF RANGELAND HEALTH, Version 5, REFERENCE SHEET

Ecological site name: _Subirrigated Sands___ Ecological site code: _RO56AY096ND___
Author(s)/participant(s): _USDA-NRCS North Dakota_____
Contact for lead author: _NRCS State Rangeland Management Specialist_____
Date: _Dec. 2021____ **MLRA:** __56_____ **LRU:** _____
Composition based on (check one): ☐ Cover ☒ Annual Production

Indicators. For each indicator, describe the potential for the site using the reference sheet checklist. Where possible, (1) use quantitative measurements; (2) include expected range of values for above- and below-average years and natural disturbance regimes for each community phase within the reference state, when appropriate; and (3) cite data sources used. Continue descriptions on separate sheet.
1. Rills: Rills are not expected on this site.
2. Water flow patterns: Water flow patterns are not visible.
3. Pedestals and/or terracettes: Neither pedestals nor terracettes are expected.
4. Bare ground: Bare ground ranges from 5 to 10% occurring in small patches (less than 3 inches in diameter) and disconnected. Animal activity (burrows and ant mound) may occasionally result in isolated bare patches of up to 24 inches in diameter.
5. Gullies: Active gullies are not expected on this site.
6. Wind-scoured and/or depositional areas: No wind-scoured or depositional areas expected on this site.
7. Litter movement: Plant litter movement not expected on this site.
8. Soil surface resistance to erosion: Stability class averages 5 or greater.
9. Soil surface loss and degradation: Use soil series description for depth, color, and structure of A-horizon.
10. Effects of plant community composition and distribution on infiltration: Tall-statured rhizomatous grasses and mid- and short-statured bunch grasses are dominant and well distributed across the site. Mid- and short-statured rhizomatous grasses, forbs, grass-likes, and shrubs are subdominant.
11. Compaction layer: No compaction layers occur naturally on this site.
12. Functional/structural groups: Due to differences in phenology, root morphology, soil biology relationships, and nutrient cycling Kentucky bluegrass, smooth brome, and crested wheatgrass are included in a new Functional/structural group, mid- and short-statured early cool-season grasses (MSeC3), **not expected for this site**.

Dominance Category[1]	**Relative dominance of F/S groups for community phases in the *Reference State*** *Minimum expected number of species for dominant and subdominant groups is included in parentheses.*

	Dominance based on[1]: Annual Production _X_ or Foliar Cover __		
	Phase 1.1_	**Phase 1. __**	**Phase 1. __**
Dominant	**Tall C4 rhizomatous grasses (5); Mid & short C4 bunch grasses (2); Mid & short C3 bunch grasses (3)**		
Subdominant	**Mid & short C4 rhizomatous grasses (1); Forbs (9); Grass-likes (2); Shrub (4)**		
Minor	**Mid & short C3 rhizomatous grasses**		
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 70 to 80% with a depth of less than 0.25 inches. Litter is in contact with the soil surface.

15. Annual production: Annual air-dry production is 3200 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 2400 lbs./ac to 4000 lbs./ac, respectively.

16. Invasive plants: State and local noxious species, Kentucky bluegrass, smooth bromegrass, crested wheatgrass, quackgrass, Eastern red cedar/juniper, Siberian elm, and Russian olive.

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

Functional/Structural Groups Sheet

State ND **Office** _____ **Ecological site** Subirrigated Sands **Ecol. site code** RO56AY096ND

Observers _____ **Date** _____

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

Species list of functional/structural groups in the **Reference State**	
Functional/Structural Group	Species List
Tall C4 rhizomatous grasses	big bluestem, sand bluestem, prairie sandreed, switchgrass, Indiangrass, prairie cordgrass*
Mid & short C4 bunch grasses	little bluestem, sand dropseed*, blue grama, Scribner panicum*, Wilcox panicum*
Mid & short C3 bunch grasses	porcupinegrass, needle and thread, slender wheatgrass*, Canada wildrye*, prairie Junegrass
Mid & short C4 rhizomatous grasses	sideoats grama
Forbs	please see plant community table 1.1
Grass-likes	Penn sedge, sun sedge
Shrub	fringed sagewort*, leadplant, prairie rose, prairie willow*, western snowberry, white meadowsweet
Mid & short C3 rhizomatous grasses	western wheatgrass*
.	
.	
Biological soil crust[1]	

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

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

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

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

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

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

Evaluation Area - Relative dominance of functional/structural groups

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

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

** See IIRH Version 5 page 70.

Notes: