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.

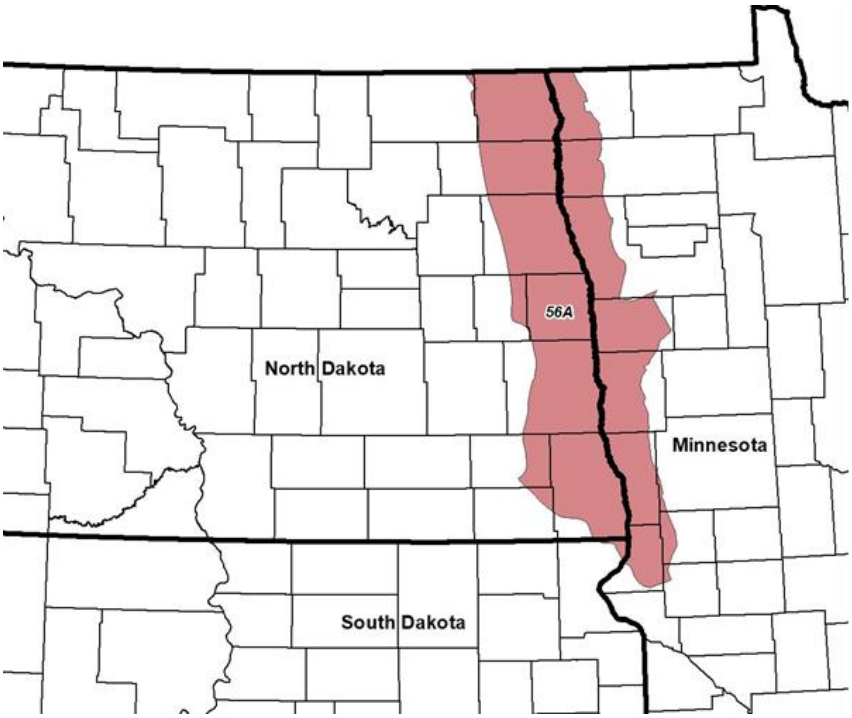
Site Name: Saline Lowland

Site Type: Rangeland

Site ID: R056AY089ND

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 Saline Lowland ecological site generally is located on flats and depressions on lake plains, till-floored lake plains, delta plains, flood plains, and isolated areas of till plain. This site also is found down-slope of the beach lines of glacial Lake Agassiz. Soil parent material in MLRA 56A is commonly stratified; contrasting textures often create episaturation and regional lateral movement of water. Discharge of laterally moving saline water can contribute significantly to the salinization of the soils.

In addition, specifically in Grand Forks County (Manvel area), artesian pressure forces water from the Dakota Sandstone aquifer toward the land surface, contributing to wide-spread soil salinity.

Typically, soil parent material for this site is very deep; however, some soils have a root-restrictive, dense, claypan subsoil. Salt accumulations are common throughout the rooting zone; soil salinity is moderate or higher (E.C. >8 dS/m). Areas within this site can become nearly barren due to the accumulation of salts at the surface. The soils in this site are poorly drained with redoximorphic features within a depth of 18 inches; some ponding or flooding can occur on soils in this site. Soil salinity is the primary factor used in identifying this site. All textures are included in the site. Slopes range from 0 to 3 percent. On the landscape, this site is below the Clayey, Loamy, Loamy Overflow, and Thin Claypan ecological sites and above the Shallow Marsh sites. The Limy Subirrigated and Wet Meadow ecological sites occur on similar landscape positions as this site; but they are non-saline to slightly saline to a depth greater than 20 inches. On deltas, the Sandy Claypan and Sodic Subirrigated sites may also be associated; they are slightly above the Saline Lowland site. **Note: Some frequently flooded soils may be included in this site. The Riparian Complex ecological site should be considered for such soils.**

The main drivers for this site are subsurface hydrology (e.g., fluctuating depth of the water table) and water chemistry (e.g., salinity/sodicity). Depth to water table can be quite variable on this site due to inter-seasonal or intra-seasonal variations in precipitation and other factors. It is a major factor influencing vegetation on the site. When the water table is near the surface, capillary action tends to bring salts upward to the soil surface. The critical period is during the summer months when evaporation rates are high. Conversely, when the water table is deeper the salts tend to be driven downward in the soil through precipitation. As a result, the changes in salinity within the rooting zone can lead to marked changes in the botanical composition of the site.

Management of the site should focus on moving water downward in the soil. Managerial techniques to move water downward (eventually below the rooting zone) should focus on maintaining soil surface cover, plant vigor, and diversity. Conversely, techniques that facilitate the movement of salts upward to the soil surface can be expected to result in a decreased production with expanding areas of bare salt-encrusted soil. A critical time for management is when the soil is drying out after a period of saturation. Overgrazing during this time may increase surface evaporation and salt accumulation.

Physiographic Features

This site typically occurs on flats and shallow depressions on lake plains, till-floored lake plains, delta plains, flood plains, and isolated areas of till plain. As the landforms vary considerably, so do the parent materials. Slopes are less than 3 percent.

Landform: flat, depression, flood plain

	Minimum	**Maximum**
Elevation (feet):	750	1475
Slope (percent):	0	3
Water Table Depth (inches):	0	42
Flooding:		
Frequency:	None	Occasional
Duration:	None	Long
Ponding:		
Depth (inches):	0	18
Frequency:	None	Occasional
Duration:	None	Long
Runoff Class:	Negligible	Medium

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.

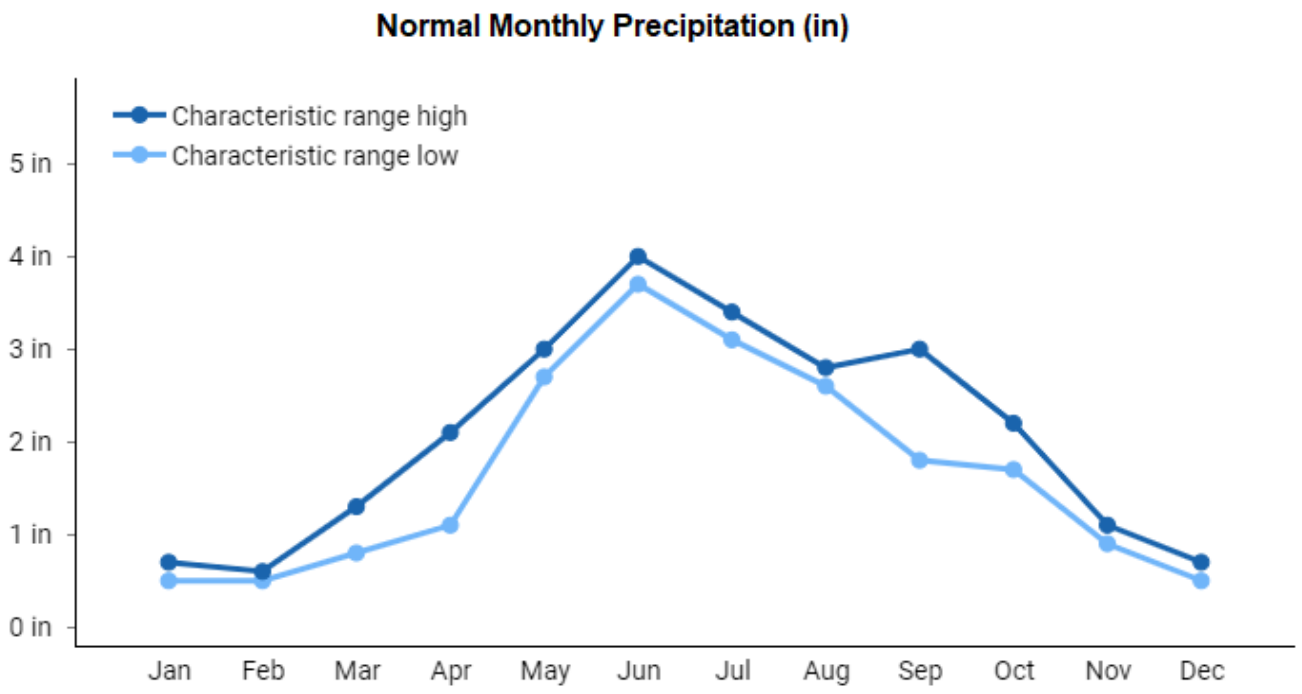
Growth of cool season plants begins in early to mid-March, slowing or ceasing in late June. Warm season plants begin growth about mid-May and continue to early or mid-September. Greening up of cool season plants may occur in September and October when adequate soil moisture is present.

Climate normals

	Representative		Actual		
	High	Low	High	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

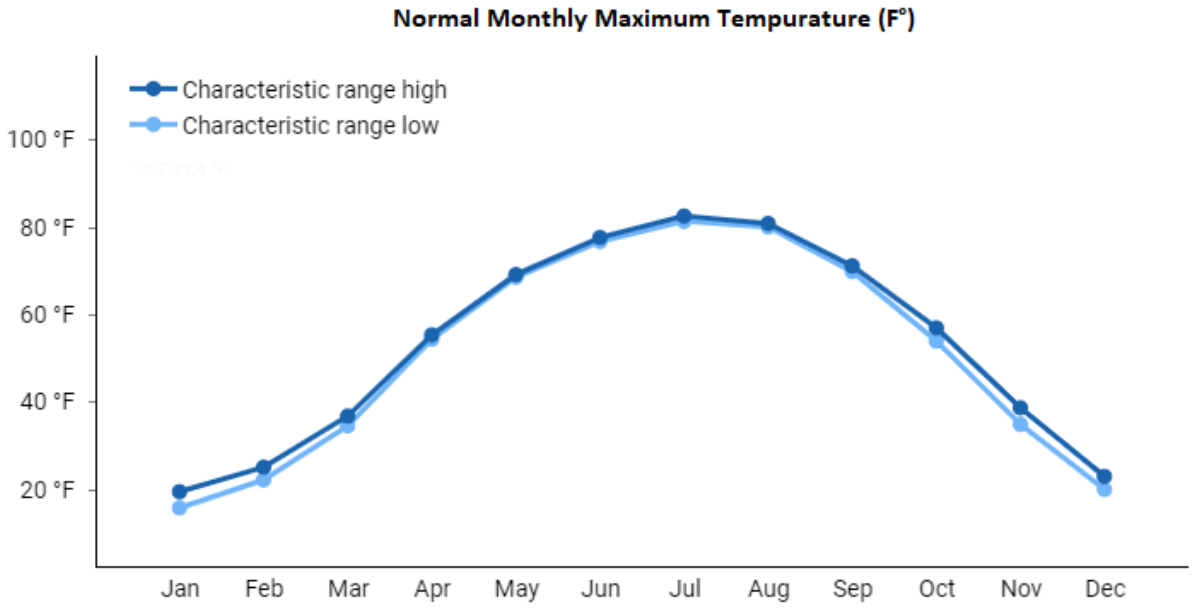
Normal monthly precipitation (in)

	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



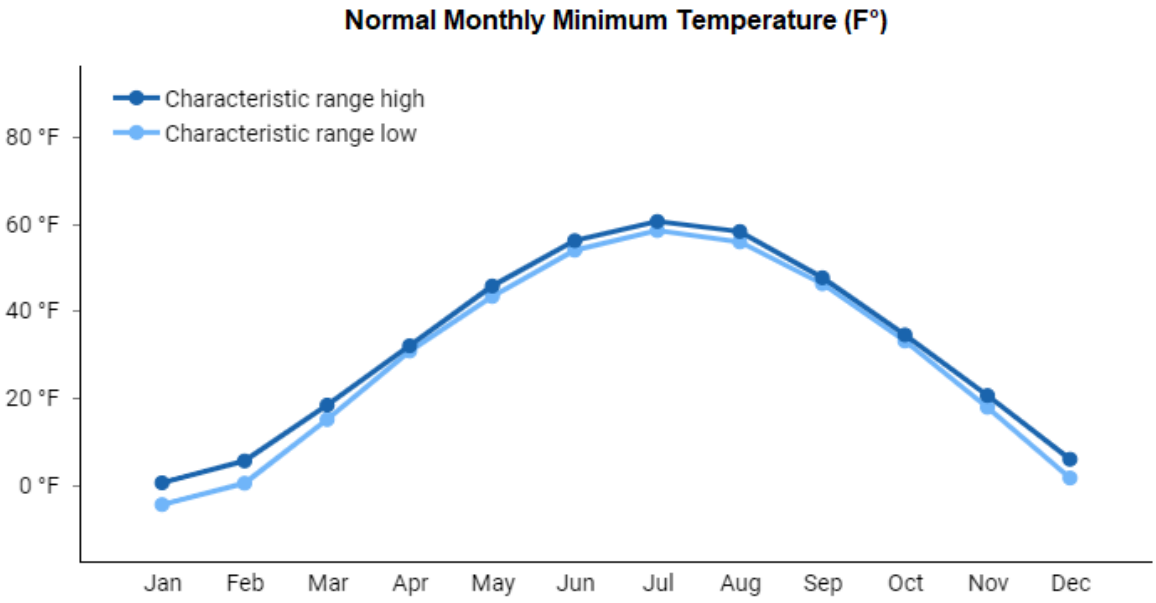
Normal monthly maximum temperature (°F)

	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

This site most commonly occurs as a discharge site with evaporation during the growing season resulting in the accumulation of salts at or near the soil surface. During the growing season, the water table is typically within a depth of 1.5 feet in the spring and within 3.5 feet in mid-summer. Some areas of this site have endosaturation (the soil is saturated with water in all layers); other areas have episaturation (perched water table above a subsoil layer with slow or very slow permeability) due to dense subsoil layers or clayey substrata. Regional lateral water movement caused by episaturation (contrasting textures in the parent materials) is common. Discharge of laterally moving saline water can contribute significantly to the salinization of the soils. In addition, specifically in Grand Forks County (Manvel area), artesian pressure forces water from the Dakota Sandstone aquifer toward the land surface, contributing to wide-spread soil salinity.

Surface infiltration ranges from very slow to moderately rapid; permeability through the profile ranges from very slow to moderately rapid. Water loss is through evapotranspiration and percolation below the root zone.

Some areas have wetland functions due to prolonged, near-surface saturation which supports salt-tolerant, hydrophytic vegetation. In other areas, under normal climatic conditions, soil saturation is not shallow enough to support hydrophytic vegetation.

Early in the growing season and after heavy rains, areas of this site on flats may pond as deep as 6 inches; this ponding is very brief or brief (<7 days). Areas in depressions typically have occasional, long ponding (7 to 30 days) in early spring. Ponding is usually <12 inches deep; however, ponding as deep as 18 inches for longer periods (>30 days) can occur. On flood plains, this site typically has rare or occasional flooding of brief to long duration but areas with frequent, very long flooding are currently included in the site (**see Site Development and Testing Plan**).

Representative Soil Features

Soils associated with Saline Lowland ES are in the Mollisol and Vertisol orders. The Mollisols are further classified as Typic Calciaquolls, Cumulic Endoaquolls, Typic Endoaquolls, Vertic Endoaquolls, and Typic Natraquolls. The Vertisols are further classified as Typic Calciaquerts, Typic Endoaquerts, and Typic Epiaquerts. These soils were developed under prairie or wetland vegetation. They formed in glaciolacustrine sediments, deltaic deposits, alluvium, or till. The soils on this site are very deep. The common feature of these soils is the presence of soluble salts within the rooting zone. Soil salinity is moderate or stronger (E.C. >8 dS/m).

The soils in this site are poorly drained with redoximorphic features within a depth of 18 inches. Soil salinity is the primary factor used in identifying this site; all textures are included. Therefore, soil physical properties associated with texture vary widely. Some poorly drained soils in this site also have a sodic claypan which restricts rooting depth.

Sodicity ranges from low to very high (SAR 2 to 25). Soil reaction is neutral to strongly alkaline (pH 6.6 to 9.0). Calcium carbonate content ranges from none to high ($CaCO_3$ $\leq$45%).

Areas within this site can become nearly barren due to the accumulation of salts at the surface. The soil surface is stable and intact. Sub-surface soil layers can be restrictive to water movement and root penetration. Salt accumulation strongly influences the soil/water/plant relationship.

Major soil series correlated to the Saline Lowland site are Arveson, Augsburg, Borup, Colvin, Fargo, Hegne, Lamoure, Ludden, Manfred, Ojata, Playmoor, Ryan, Thiefriver, Vallers, and Winger.

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

Parent Material Kind: glaciolacustrine, deltaic deposits, alluvium, glacial till
Parent Material Origin: lacustrine, till
Surface Texture: loam, clay loam, silt loam, silty clay loam, silty clay, clay, very fine sandy loam, fine sandy loam, loamy fine sand
Surface Texture Modifier: none
Subsurface Texture Group: loamy, silty, clayey, sandy
Surface Fragments <3" (% Cover): 6
Surface Fragments $\geq$3" (%Cover): 1
Subsurface Fragments <3" (% Volume): 0-15

Subsurface Fragments ≥3" (% Volume): 0-6

	Minimum	Maximum
Drainage Class:	poorly	poorly
Permeability Class:**	very slow	moderately rapid
Depth to first restrictive layer (inches):	5	>80
Electrical Conductivity (dS/m)*:	8	>16
Sodium Absorption Ratio:**	1	25
Soil Reaction (1:1 Water):**	6.6	9.0
Soil Reaction (0.1M CaCl2):	NA	NA
Available Water Capacity (inches):**	0.5	8.0
Calcium Carbonate Equivalent (percent):**	0	45

*This attribute represents from 0 to 20 inches. Electrical Conductivity (E.C.) values are based on Saturated Paste method; the commonly used 1:1 field method will have E.C. values >4.
**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.

Soils on this site are poorly drained with an accumulation of salts within the rooting zone (often at the soil surface) which is the primary factor influencing the vegetation of the site. Vegetation of the site is largely halophytic; due to variations in the depth and concentration of salts, the vegetation can be quite variable with some areas nearly barren due to the accumulation of salts at the surface.

Depth to water table can be quite variable on this site due to inter-seasonal or intra-seasonal variations in precipitation and other factors; it is a major factor influencing vegetation on the site. When the water table is near the surface, capillary action tends to bring salts upward to the soil surface. Conversely, when the water table is deeper the salts tend to be driven downward in the soil through precipitation. As a result, the changes in salinity within the rooting zone can lead to marked changes in the botanical composition of the site.

Management of the site should focus on increasing vegetative cover. Managerial success will be largely dictated by the movement of salts in the soil. Techniques that move the salts downward, eventually below the rooting zone, can be expected to increase production and reduce bare salt-encrusted soil. Conversely, techniques that facilitate the movement of salts upward to the soil surface can be expected to result in a decreased production with expanding areas of bare salt-encrusted soil. A critical time for careful management is when the soil is drying out after a period of saturation. Overgrazing during this time may increase surface evaporation and salt accumulation.

Drainage/Hydrological Manipulation: Hydrological manipulation (e.g., surface or tile drainage, pumping, surface water diversion, etc.) modifies this ecological site. For more detailed information on drainage/hydrological manipulation of the site, see the "Hydrology Functions" section of this document.

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 is also an important factor 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.

At times, particularly during times of soil saturation with little standing water, these sites may be susceptible to pugging damage (or hummocking) of the soil by livestock walking on the site. Pugging is a form of soil compaction due to livestock which damages the soil structure. It can seal the soil surface which reduces infiltration and exacerbates waterlogging of the topsoil. The micro-topography created by pugging generally supports plants of more well drained conditions and is often associated with an increase in weedy species. This can lead to a significant reduction in herbage production and utilization.

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

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

State 1: Reference State represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. Dynamics of the state were largely determined by variations in climate and weather (e.g., drought), as well as that of fire (e.g., timing, frequency) and grazing by native herbivores (e.g., frequency, intensity, selectivity). Due to those variations the Reference State is thought to have shifted temporally and spatially between three Plant Community Phases. Presently the primary disturbances are due to the widespread introduction of exotic plants, concentrated livestock grazing, lack of fire, and perhaps long-term non-use or very light grazing, and no fire. Because of these and other environmental changes, particularly the widespread occurrence of exotic plants, 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 will cause a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition was inevitable; it often resulted from colonization by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) which have been particularly and consistently invasive under extended periods of

non-use or very light grazing, and no fire. Other exotic plants (e.g., Canada thistle, field sowthistle, curly dock) are also known to invade the site.

Three community phases have been identified for this state; they are similar to the community phases in the Reference State but have now been invaded by exotic cool-season grasses. These exotic cool-season grasses can be expected to increase. As that increase occurs, a decline in forb diversity can be expected. Under non-use or minimal use management, mulch increases and may become a physical barrier to plant growth. This also changes the micro-climate near the soil surface and may alter infiltration, nutrient cycling, and biological activity near the soil surface. As a result, these factors, combined with shading, cause desirable native plants to have increasing difficulty remaining viable and recruitment declines.

To slow or limit the invasion of these exotic grasses or other exotic plants, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic plants, the transition to State 3: Invaded State should be expected (T2A). The threshold to this transition is reached when both the exotic cool-season grasses exceed 30% of the plant community and native grasses represent less than 40% of the community.

State 3: Invaded State. The threshold for this state is reached when both the exotic cool-season grasses 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 may be accomplished with the implementation of long-term prescribed grazing in conjunction with prescribed burning (R3A).

State 4: Go-Back State often results following cropland abandonment and consists of only one plant community phase. This weedy assemblage may include noxious weeds that need control. Over time, quackgrass, Kentucky bluegrass, foxtail barley, and/or smooth brome 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 (R4A). Following planting, prescribed grazing, prescribed burning, haying, and the use of herbicides will generally be necessary to achieve the desired result and control weeds, some of which may be noxious weeds. A failed range planting and/or secondary succession will lead to State 3: Invaded State (R4B).

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

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

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

Plant Communities and Transitional Pathways

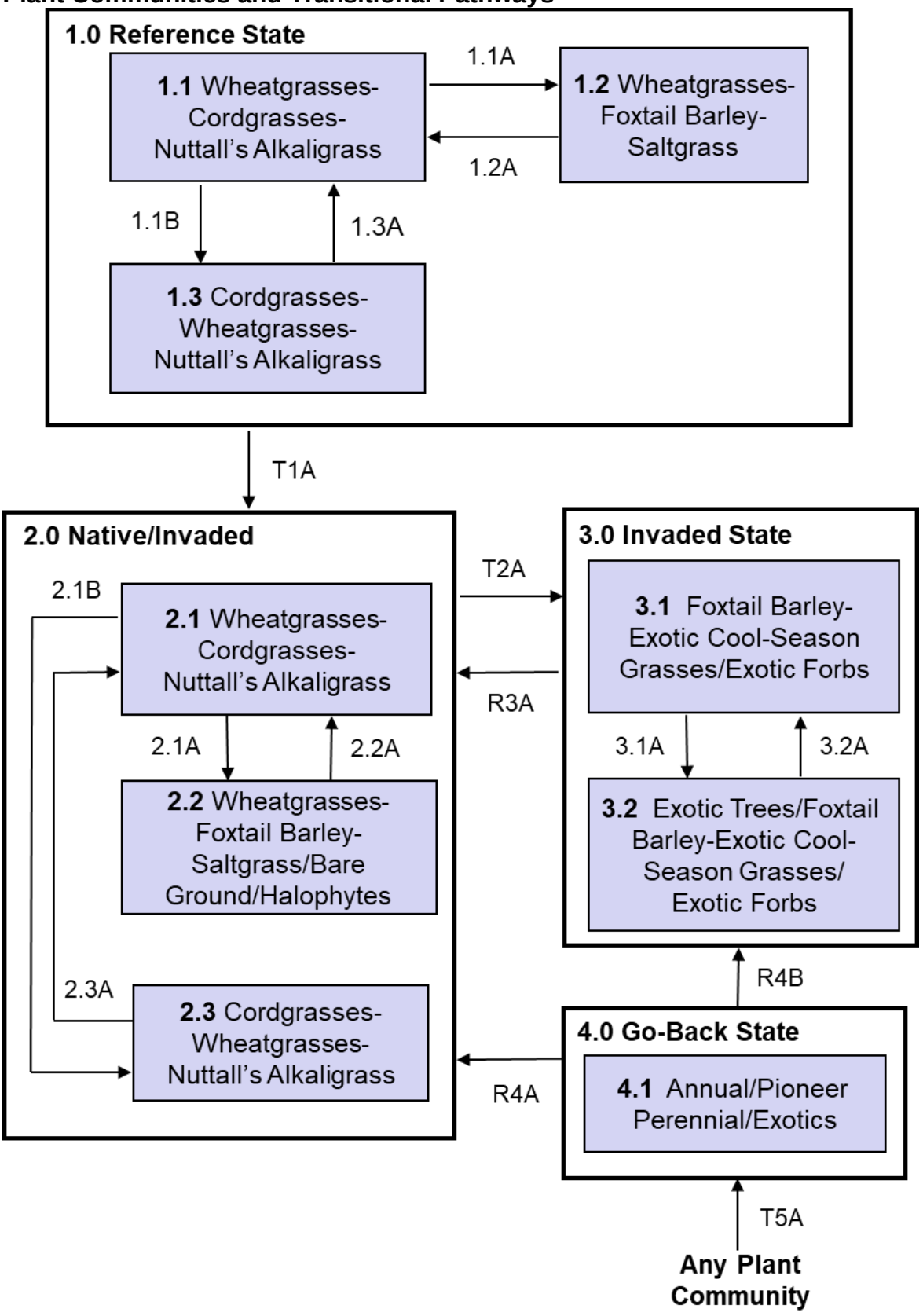


Diagram Legend - MLRA 56A Saline Lowland

T1A	Introduction of exotic cool-season grasses
T2A	Long-term non-use or very light grazing, no fire
T5A	Cessation of annual cropping
R3A	Long-term prescribed grazing and prescribed burning
R4A	Successful range planting
R4B	Failed range planting and/or secondary succession
CP 1.1 - 1.2 (1.1A)	Multiyear drought with or without heavy long-term grazing
CP 1.1 - 1.3 (1.1B)	Above average precipitation
CP 1.2 - 1.1 (1.2A)	Return to average precipitation, light to moderate grazing
CP 1.3 - 1.1 (1.3A)	Return to average precipitation, light to moderate grazing
CP 2.1 - 2.2 (2.1A)	Multiyear drought with or without heavy long-term grazing
CP 2.1 - 2.3 (2.1B)	Above average precipitation
CP 2.2 - 2.1 (2.2A)	Return to average precipitation, long-term prescribed grazing and prescribed burning
CP 2.3 - 2.1 (2.3A)	Return to average precipitation, long-term prescribed grazing and prescribed burning
CP 3.1 - 3.2 (3.1A)	Long-term non-use or very light grazing, no fire
CP 3.2 - 3.1 (3.2A)	Long-term prescribed burning and/or mechanical treatment

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 occasional 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 may have caused the community to shift both spatially and temporally between three community phases.

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

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

Community Phase 1.1: Wheatgrasses-Cordgrasses-Nuttall's Alkaligrass (*Pascopyrum smithii, Elymus trachycaulus-Spartina pectinata, Spartina gracilis-Puccinellia nuttalliana*)

This community phase was the most dominant both temporally and spatially and supported a mixture of cool-season and warm-season grasses. Major grasses included western wheatgrass, slender wheatgrass, prairie cordgrass, alkali cordgrass, and Nuttall's alkaligrass. Other grasses likely included saltgrass, scratchgrass, mat muhly, and foxtail barley. Salt-tolerant forbs (such as redwool plantain, silver cinquefoil, curlycup gumweed, and Pursh seepweed) were among the common associates.

Annual production may have varied from about 3100-5100 pounds per acre with grasses and grass-likes and forbs contributing about 90% and 10%, respectively. Because both warm-season grasses and cool-season grasses were well represented in the community, production was 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 Wheatgrasses-Cordgrasses-Nuttall's Alkaligrass		
COMMON/GROUP NAME	**SYMBOL**	**Group**	**lbs./acre**	**% Comp**
GRASSES & GRASS-LIKES			*2870 - 3690*	*70 - 90*
WHEATGRASSES		**1**	**820 - 1435**	**20 - 35**
slender wheatgrass	ELTR7	1	205 - 615	5 - 15
western wheatgrass	PASM	1	820 - 1640	20 - 40
CORDGRASS		**2**	**615 - 1435**	**15 - 35**
prairie cordgrass	SPPE	2	205 - 820	5 - 20
alkali cordgrass	SPGR	2	205 - 820	5 - 20
COOL-SEASON GRASSES		**3**	**82 - 410**	**2 - 10**
Nuttall's alkaligrass	PUNU2	3	82 - 410	2 - 10
plains bluegrass	POAR3	3	82 - 410	2 - 10
foxtail barley	HOJU	3	82 - 205	2 - 5
other perennial grasses	2GP	3	41 - 205	1 - 5
WARM-SEASON GRASSES		**4**	**0 - 410**	**0 - 10**
saltgrass	DISTI	4	41 - 205	1 - 5
scratchgrass	MUAS	4	0 - 205	0 - 5
mat muhly	MURI	4	0 - 205	0 - 5
OTHER NATIVE GRASSES		**5**	**0 - 205**	**0 - 5**
plains bluegrass	POAR3	5	0 - 205	0 - 5
green needlegrass	NAVI4	5	0 - 205	0 - 5
other perennial grasses	2GP	5	0 - 205	0 - 5
GRASS-LIKES		**6**	**0 - 205**	**0 - 5**
sedge	CAREX	6	0 - 205	0 - 5
mountain rush	JUARL	6	0 - 205	0 - 5
other grass-likes	2GL	6	0 - 205	0 - 5
FORBS		*7*	*205 - 410*	*5 - 10*
redwool plantain	PLER	7	41 - 123	1 - 3
silver cinquefoil	POAR8	7	41 - 123	1 - 3
curlycup gumweed	GRSQ	7	41 - 82	1 - 2
povertyweed	IVAX	7	41 - 82	1 - 2
giant sumpweed	IVXA	7	41 - 82	1 - 2
seepweed	SUAED	7	41 - 82	1 - 2
Pursh seepweed	SUCA2	7	41 - 82	1 - 2
white prairie aster	SYFA	7	41 - 82	1 - 2
seaside arrowgrass	TRMA20	7	41 - 82	1 - 2
silverscale saltbush	ATAR2	7	0 - 82	0 - 2
Cuman ragweed	AMPS	7	0 - 41	0 - 1
western dock	RUAQ	7	0 - 41	0 - 1
red swampfire	SARU	7	0 - 41	0 - 1
native forbs	2FN	7	41 - 82	1 - 2

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	2790 -	3690	- 4590
FORBS	310 -	410	- 510
TOTAL	3100 -	4100	- 5100

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

Community Phase Pathway 1.1A
Community Phase Pathway 1.1 to 1.2 occurred with multiyear drought with or without heavy, long-term grazing. This resulted in increased salts on and near the soil surface, leading to marked increases in foxtail barley and saltgrass with corresponding decreases in the cordgrasses and Nuttall's alkaligrass.

Community Phase Pathway 1.1B
Community Phase Pathway 1.1 to 1.3 occurred with above average precipitation. This resulted in a downward movement of salts in the soil and a marked increase in the cordgrasses.

Community Phase 1.2: Wheatgrasses-Foxtail Barley-Saltgrass (*Pascopyrum smithii, Elymus trachycaulus-Hordeum jubatum-Distichlis spicata*)
This community developed with multiyear drought with or without heavy, long-term grazing. As a result, salt concentrations on and near the soil surface increased. Compared to Community Phase 1.1, saltgrass and foxtail barley have markedly increased with corresponding decreases in the wheatgrasses, cordgrasses, and Nuttall's alkaligrass. Increased salt accumulation within the rooting zone also increased the extent of bare, salt encrusted areas, often with associated forbs (such as red swampfire and Pursh seepweed). Annual production may have varied widely, in part due to variations in the extent of bare, salt encrusted areas.

Community Phase Pathway 1.2A
Community Phase Pathway 1.2 to 1.1 occurred with the return to average precipitation and light to moderate grazing. This resulted in a downward movement of salts in the soil and marked increases in the cordgrasses and Nuttall's alkaligrass with corresponding decreases in foxtail barley and saltgrass.

Community Phase 1.3: Cordgrasses-Wheatgrasses-Nuttall's Alkaligrass (*Spartina pectinata, Spartina gracilis-Pascopyrum smithii, Elymus trachycaulus-Puccinellia nuttalliana*)
This plant community occurred during times of above average precipitation with or without heavy long-term grazing. As a result, salts at and near the soil surface were driven further downward. Plant composition was similar to that of Community Phase 1.1 with some notable changes. The cordgrasses increased while the wheatgrasses decreased. The forb component would have been similar to that of Community Phase 1.1. Production would be expected to have increased compared to that of Community Phase 1.1.

Community Phase Pathway 1.3A
Community Phase Pathway 1.3 to 1.1 occurred with the return to average precipitation with light to moderate grazing. This resulted in marked increases in western wheatgrass and slender wheatgrass.

Transition T1A
This is the transition from the State 1: Reference State to the State 2: Native/Invaded State due to the introduction and establishment of exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, and/or quackgrass). This transition was inevitable and corresponded to a decline in native warm-season and cool-season grasses; it was exacerbated by chronic season-long or heavy late season grazing. Complete rest from grazing and fire suppression may have also hastened this transition. The threshold between states was crossed when Kentucky bluegrass, smooth brome, quackgrass, 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 (commonly Kentucky bluegrass, smooth brome, and/or quackgrass) which are now present in small amounts. Although the state is still dominated by native grasses, an increase in these exotic cool-season grasses can be expected.

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

These exotic cool-season grasses have been particularly and consistently invasive under extended periods of non-use and no fire. To slow or limit the invasion of these exotic grasses, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning, other) 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 and the extent of bare ground. However, annual production may range from 2100-3400 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: Wheatgrasses-Cordgrasses-Nuttall's Alkaligrass (*Pascopyrum smithii, Elymus trachycaulus-Spartina pectinata, Spartina gracilis-Puccinellia nuttalliana*)

This plant community is similar to Community Phase 1.1 but has now been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, quackgrass, smooth brome). However, these exotics are present in smaller amounts with the community still dominated by native grasses. Exotic forbs (e.g., field sowthistle, curly dock, common plantain, lambsquarters) may also be present.

Community Phase Pathway 2.1A

Community Phase Pathway 2.1 to 2.2. occurs with multiyear drought with or without heavy, long-term grazing. This results in salt accumulation on and near the soil surface, leading to marked increases in foxtail barley and saltgrass with corresponding decreases in prairie cordgrass, alkali cordgrass, and Nuttall's alkaligrass.

Community Phase Pathway 2.1B

Community Phase Pathway 2.1 to 2.3 occurs with above average precipitation. Salts become less concentrated allowing for an increase in cordgrasses.

Community Phase 2.2: Wheatgrasses-Foxtail Barley-Saltgrass (*Pascopyrum smithii, Elymus trachycaulus-Hordeum jubatum-Distichlis spicata*)

This community phase is similar to Community Phase 1.2 but now supports minor amounts of exotic cool-season grasses (e.g., quackgrass, Kentucky bluegrass, smooth brome). Increased salt accumulation on and near the soil surface results in an increase in bare, salt-encrusted soil with associated forbs (such as red swampfire and Pursh seepweed). Exotic forbs (such as field sowthistle, curly dock, common plantain, and lambsquarters) may also be present. Annual production may vary widely, in part due to variations in the extent of bare, salt-encrusted areas.

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

Community Phase Pathway 2.2A

Community Phase Pathway 2.2 to 2.1 occurs with the return to average precipitation with the implementation of long-term prescribed grazing and prescribed burning. This results in a downward movement of salts in the soil and marked increases in the cordgrasses and Nuttall's alkaligrass with corresponding decreases in foxtail barley and saltgrass.

Community Phase 2.3: Cordgrasses-Wheatgrasses-Nuttall's Alkaligrass (*Spartina pectinata, Spartina gracilis-Pascopyrum smithii, Elymus trachycaulus-Puccinellia nuttalliana*)

This plant community occurred during times of above average precipitation with or without heavy long-term grazing. As a result, salts near the soil surface were driven further downward. Plant composition was similar to that of Community Phase 2.1, but with a marked increase in the exotic cool-season grasses and forbs along with an increase in cordgrass and a decrease in wheatgrass. Exotic plants in this community phase include quackgrass, Kentucky bluegrass, and/or smooth brome. Native forbs may include forbs (such as silverleaf cinquefoil, western dock, redwool plantain, seaside arrowgrass, red swampfire, and Pursh seepweed). Field sowthistle is often a common exotic forb in

this community phase. Production would be expected to have increased compared to that of Community Phase 2.1.

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

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 occurs with the return to average precipitation with the implementation of long-term prescribed grazing and prescribed burning. This results in marked increases in western wheatgrass and slender wheatgrass.

Transition T2A
This Transition from the State 2: Native/Invaded State to State 3: Invaded State generally occurs with long-term non-use or very light grazing, and no fire. Exotic cool-season grasses (e.g., quackgrass, Kentucky bluegrass smooth brome) 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.

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

State 3: Invaded State
This state is the result of invasion and dominance by the exotic cool-season grasses. Quackgrass is often the dominant exotic grass. However, due to variation in soil salinity and other factors, it may occur alone or in combination with Kentucky bluegrass and/or smooth brome. 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.

Exotic forbs (e.g., field sowthistle, Canada thistle, curly dock, lambsquarters) are often present, as are native forbs (e.g., curlycup gumweed, redwool plantain). Exotic trees (e.g., Russian olive, Siberian elm) are also known to invade the site.

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. Annual production of this state may vary widely, in part due to variations in the extent of invasion by exotic cool-season grasses, as well as the extent of salt

encrusted bare ground. However, annual production may be in the range of 3400-6200 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: Foxtail Barley-Exotic Cool-Season Grass/Exotic Forbs (*Hordeum jubatum*-Exotic Cool-Season Grass/Exotic Forbs)

Foxtail barley is conspicuously abundant, often with quackgrass as the dominant exotic cool-season grass. Due to variation in salinity and other factors, a combination of Kentucky bluegrass and/or smooth brome may also be present. Other associated graminoids often include saltgrass, cordgrasses, sedges, and mountain rush. Exotic forbs (e.g., field sowthistle, Canada thistle, curly dock, lambsquarters) are often present as are native forbs (e.g., curlycup gumweed, redwool plantain). Exotic trees (e.g., Russian olive) are also known to invade the site.

Community Phase Pathway 3.1A

Community Phase Pathway 3.1 to 3.2 occurs with long-term non-use or very light grazing and no fire, resulting in a marked increase in Russian olive or perhaps other exotic trees (e.g., Siberian elm) depending upon salinity, local seed sources, and other factors.

Community Phase 3.2: Exotic Trees/Foxtail Barley-Exotic Cool-Season Grass/Exotic Forbs (Exotic Trees/*Hordeum jubatum*-Exotic Cool-Season Grass/Exotic Forbs)

This community phase is similar to that of Community Phase 3.1 but has been invaded by exotic trees, commonly Russian olive. Other exotic trees such as Siberian elm may also invade, depending upon salinity, local seed sources, and other factors.

Community Phase Pathway 3.2A

Community Phase Pathway 3.2 to 3.1 occurs with long-term prescribed burning and/or mechanical treatment to remove the exotic trees, commonly Russian olive, although other exotic trees (e.g., Siberian elm) may also invade the site depending upon salinity, local seed sources, and other factors.

Elimination of Russian olive from the site will likely require repeated treatments because it is a known ‘sprouter’ and depending upon tree maturity, seeds may be present in the seed bank. In addition to prescribed burning and mechanical treatment, chemical stump treatment and close monitoring/treatment of sprouts may be necessary to complete the pathway.

Restoration R3A

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

Both prescribed grazing and prescribed burning are likely necessary to successfully initiate this restoration pathway, the success of which depends upon the presence of a remnant population of native grasses in Community Phase 3.1. That remnant population, however, may not be readily apparent without close inspection. The application of several prescribed burns may be needed at relatively short intervals in the early phases of this restoration process. 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).

State 4: Go-Back State

This state is highly variable depending on the level and duration of disturbance related to the T5A transitional pathway. In this MLRA, the most probable origin of this state is plant succession following cropland abandonment. The site will often consist of areas of vegetation and areas of bare ground where salt has accumulated at the soil surface in concentrations that preclude vegetative growth. Vegetation is patchy and variable but often initially consists of a mixture of foxtail barley, burningbush (aka. kochia), and red swampfire. Other plants which may be present include quackgrass, Kentucky bluegrass, smooth brome, field sowthistle, curly dock, and curlycup gumweed.

Over time, however, the site will become dominated by the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) often in association exotic forbs (e.g., field sowthistle, burningbush).

Characteristics and indicators (i.e., characteristics that can be used to distinguish this state from others). Tillage has destroyed the native plant community, altered soil structure and biology, reduced soil organic matter, and resulted in the formation of a tillage induced compacted layer which is

restrictive to root growth. Removal of perennial grasses and forbs results in decreased infiltration and increased runoff.

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

Community Phase 4.1: Annual/Pioneer Perennial/Exotics

This community phase is highly variable depending on the level and duration of disturbance related to the T5A transitional pathway. In this MLRA, the most probable origin of this phase is secondary succession following cropland abandonment. It can also result from heavy season-long grazing. This plant community will initially include a variety of annual forbs, such as burningbush (aka. kochia) and red swampfire, along with native and exotic grasses including foxtail barley, quackgrass, Kentucky bluegrass, and/or smooth brome. The exotic grasses can be expected to increase over time.

Restoration R4A

This restoration pathway from State 4: Go-back State to State 2: Native/Invaded State results from a successful range planting. Following planting, prescribed grazing, prescribed burning, haying, or use of herbicides will generally be necessary to achieve the desired result and control any noxious weeds.

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

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

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

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

Restoration R4B

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

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

Transition T5A

This is the Transition from any plant community to State 4: Go-Back State. It is most commonly associated with the cessation of cropping without the benefit of range planting, resulting in a "go-back" situation. Soil conditions can be quite variable on the site, in part due to variations in the management/cropping history (e.g., development of a tillage induced compaction, 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.

Saline Lowland Wildlife Habitat Interpretation:

Saline Lowland ecological sites are poorly drained; soluble salts are present within the rooting zone and significantly impact the plant community. The surface can become nearly barren due to the presence of salts. In some soils, subsurface soil layers may be restrictive to water movement and root penetration. Associated ecological sites commonly include Limy Subirrigated, Clayey, Loamy Overflow, Loamy, Thin Claypan, Shallow Marsh, Wet Meadow, Sandy Claypan, and Sodic Subirrigated (only found on sandy delta plains). This complex of ecological sites provides habitat for many edge-sensitive, grassland bird species preferring medium- to tall-statured vegetation.

Saline Lowland habitat features and components commonly support grassland-nesting birds that prefer short- to medium-stature vegetation. Only in Plant Community Phases 1.1, 1.3, 2.1 and 2.3 does tall-statured vegetation, such as prairie cordgrass, occur in any abundance to provide needed habitat for grassland nesting birds that prefer tall-statured vegetation. Low diversity and density of forb species provide limited pollen and nectar resources for pollinating insects. In turn, invertebrate production is low, providing limited protein resources for grassland-nesting birds. Saline Lowland ecological sites provide forage for small and large herbivores.

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

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using Community Phase Pathways in State 1.0 to prevent further plant community degradation along the T1A Transitional Pathway to State 2.0. Native wildlife generally benefits from the heterogeneous grasslands found in State 1.0 that include grass and forb species of varying stature and density. As plant communities degrade and transition to State 2.0, foxtail barley increases while native forbs are reduced.

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

1.0 Reference State

Community Phase 1.1 Wheatgrasses-Cordgrasses-Nuttall's Alkaligrass: This plant community offers 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 burning. Prescribed burning frequency maintains a grass-dominated plant community providing habitat for bird species sensitive to woody vegetation. Predominance of grass species in this plant 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 including aquatic 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).

Dependent upon salinity levels, Saline Lowland ecological sites provide habitat for a diverse suite of aquatic invertebrates providing an important trophic link between macrophytes and vertebrates that depend upon them as food. Rapid warming during spring snowmelt allows the invertebrate population to flourish. The vegetative structure provided by shallow vegetated wetlands increase the abundance of aquatic invertebrates compared to less vegetated sites.

Dakota skippers do not prefer this site due to salinity and wetness along with limited host plants, such as little bluestem and prairie dropseed. Regal fritillary habitat is limited due to salinity and wetness and uncommon Nuttall's and prairie violets. Monarch butterflies may use flowering forbs on this site; however, no milkweed species are found on this site to support caterpillar food. Bumblebees and other native bees utilize forbs as a nectar source. Although bare ground is common, wetness and salinity will limit nesting.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by mid- to tallgrass-nesting birds. Dependent upon ponded water levels, this plant community may provide habitat for species preferring wetter (hydric) habitats (such as Nelson's sparrow, northern harrier, sedge wren, yellow rail, Wilson's phalarope, Wilson's snipe, etc.). This site provides waterfowl pair bonding sites, early season invertebrate food sources, and early season shorebird habitat. The rapid warming during spring snowmelt provides water birds an abundant invertebrate protein source for egg laying. Prescribed burning 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 lek sites or nesting habitat. However, it does provide winter cover, escape habitat, and brood-rearing habitat (depending on water levels). This site provides good hunting opportunities for grassland raptors, especially northern harrier.

Mammals: Limited diversity of grasses and forbs provide reduced nutrition levels for small and large herbivores. This plant community provides foraging opportunities for raccoon, skunks, coyotes, and other mammals that use wetlands and wetland edges for food resources. This site has less diversity and overall shorter plant stature compared to associated sites (such as Wet Meadow, Shallow Marsh, Limy Subirrigated, and Loamy Overflow). Mid- to tall-statured vegetation provides suitable food, thermal, protective, and escape cover for small herbivores.

Amphibians and Reptiles: Due to potential high salinity levels and wetness, these ecological sites do not provide suitable habitat for northern prairie skink and plains hog-nosed snake. Brief early spring ponded water may provide foraging habitat for the northern leopard frog and Canadian toad, dependent upon salinity levels. Water may not be deep enough to provide breeding or hibernation habitat.

Fish and Mussels: These ecological sites can be located adjacent to streams, rivers, or water bodies. These sites receive run-on hydrology from adjacent ecological sites and provide hydrology to Wet Meadow or Shallow Marsh ecological sites. Management on Saline Lowland sites, in conjunction with neighboring run-on sites, can have a direct effect

on aquatic species in streams and/or tributaries receiving water from Saline Lowland 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 Wheatgrasses-Foxtail Barley-Saltgrass: Multiyear drought (with or without heavy grazing) with lack of recovery periods gives foxtail barley and other salt tolerant grasses a competitive edge. This plant community is adapted to increased salinity and is relatively stable. Every effort should be made to manage this plant community via Community Pathway 1.2A (light to moderate grazing with adequate recovery periods) to move back to Plant Community Phase 1.1. Improper management such as heavy continuous season-long grazing will transition this plant community to State 2.0 with increased abundance of foxtail barley, saltgrass, and bare ground. Structural diversity and density reduce habitat for a wide array of migratory and resident birds.

Invertebrates: Heavy grazing with lack of recovery periods further reduces density and diversity of pollinating forb species. Multiyear drought along with increased salinity reduces aquatic invertebrates.

Birds: Heavy grazing with lack of recovery periods gives foxtail barley, saltgrass, and other salt tolerant grasses a competitive edge reducing density and stature of grasses. Loss of prairie cordgrass favors grassland nesting birds bird species that use short- to mid-statured vegetation. Depending on water depth, this plant community will be attractive to various shorebirds.

Mammals: This site is no longer favored by large herbivores and provides limited life requisites for small herbivores.

Amphibians and Reptiles: Multiyear drought, coupled with increased salinity levels, provides limited to no habitat for amphibians and reptiles.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1; however, increased bare ground will yield additional sediment to nearby water bodies.

Community Phase 1.3 Cordgrasses-Wheatgrasses-Nuttall's Alkaligrass: Above average precipitation, via plant community Pathway 1.1B, moves this plant community phase to one a taller statured vegetation characterized by an increase in cordgrass.

Invertebrates: This plant community provides similar life requisites as Plant Community Phase 1.1. Increase precipitation favors aquatic invertebrates with a reduction in pollinator species.

Birds: Above average precipitation provides for taller statured vegetation, mainly prairie cordgrass, with a reduction in western wheatgrass favoring grassland-nesting birds that prefer mid- to tall-statured vegetation. Increase in precipitation may increase ponding/saturation levels favoring water dependent nesting birds, such as sedge wren and yellow rail.

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 Wheatgrasses-Cordgrasses-Nuttall's Alkaligrass: The introduction of cool-season exotic grasses exacerbated by heavy grazing, along Transition Pathway T1A, results in a plant community that functions similarly to 1.1. Bare ground has increased salinity with micro-lows having the highest salt concentrations.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

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

Community Phase 2.2 Wheatgrasses-Foxtail Barley-Saltgrass/Bare Ground/Halophytes: These plant communities are the result of multiyear drought with or without heavy, long-term grazing. Increased bare ground and an increase in halophytes tolerant to saline soils reduces vegetation structure for wildlife in general.

Invertebrates: Forb species have been dramatically reduced limiting pollinator species in this plant community phase. Multiyear drought eliminates aquatic invertebrates.

Birds: Dependent on the amount of bare ground, this site may provide vegetative structure for grassland birds that favor short- to mid-statured vegetation.

Mammals: Short-statured vegetation couple with bare ground reduces cover for large and small mammals.

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

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

Community Phase 2.3 Cordgrasses-Wheatgrasses-Nuttall's Alkaligrass: Above average precipitation, via Plant Community Pathway 2.1B, causes a marked increase in taller- statured vegetation indicative of prairie cordgrass.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

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

3.0 Invaded State

Community Phase 3.1 Foxtail Barley-Exotic Cool-Season Grass/Exotic Forbs: Invaded State generally occurs with heavy season-long grazing or extended periods of no use (via Transition Pathway T2A). Dependent upon the salinity level, foxtail barley along with exotic cool-season grasses (such as quackgrass, Kentucky bluegrass and/or, perhaps, smooth brome) become the dominant graminoids. Grazing tolerant foxtail barley begins to dominate the site. Grazing tolerant rush and spikerush species increase along with bare ground. Use by wildlife will be dependent upon vegetation response to the degree of salinity and management.

Invertebrates: This plant community has an overall low diversity of forbs; however, Canada thistle and field sowthistle provide mid- to late-season pollen. Bare ground increases but few ground nesting species, if any, within MLRA 56A use saline soils for nesting sites. This shift to drier soil conditions reduces or eliminates aquatic invertebrates.

Birds: Increase in short- to mid-statured vegetation favors grassland nesting birds that prefer this statured vegetation. Invertebrate food sources are reduced and with heavy season-long grazing. In addition, as these sites dry during periods of prolonged below normal precipitation, bare ground increases which reduces grassland-nesting bird habitat.

Mammals: A shift to short-grass species and increased salinity reduces habitat for large mammals; it may still provide vegetative cover for small mammals depending on amount of bare soil. Thermal, escape, and winter cover is no longer provided for larger ungulates.

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 3.2 Exotic Trees/Foxtail Barley-Exotic Cool-Season Grasses/Exotic Forbs: Continued long-term non-use or very light grazing, and no fire allows for the introduction of exotic trees such as Russian olive. Russian olive's salinity tolerance allows this species to be invasive in saline soils under long-term non-use, especially lack of fire.

Invertebrates: Provides similar life requisites as Community Phase 3.1.

Birds: The degree of Russian olive invasion impacts grassland nesting birds for species that avoid woody species. Increased use by brown-headed cowbirds could be an additional impact to grassland nesting birds.

Mammals: Provides similar life requisites as Community Phase 3.1.

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

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

4.0 Go-Back State

Community Phase 4.1 Annual/Pioneer Perennial/Exotics: Following cropland abandonment or other disturbance, these plant communities are dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals, birds, and their young. Dense weed cover can keep soils moist, increasing insect

presence. Tall stature provided by some weeds, such as marsh elder and ragweed, offer thermal cover and seeds throughout winter for deer, small mammals, and over-wintering birds. The response by wildlife species will be dependent upon plant community composition, vegetative stature, patch size, and management activities (such as prescribed grazing, burning, inter-seeding, haying, or noxious weed control).

Successful restoration along Transition Pathway R4A can result in a native grass and forb community in State 2.0. Implementation of prescribed burning and/or chemical/mechanical brush management followed by a failed range planting, via Transition Pathway R4B, can result in an invaded plant community Invaded State 3.0.

Animal Community – Grazing Interpretations

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

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

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

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

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

Hydrology Functions

Available water is the principal factor limiting forage production on this site. Soil salinity significantly reduces the availability of water (hinders osmosis) to plants growing on the site.

Under unaltered hydrologic conditions, this site is dominated by soils in hydrologic groups B and C, but incudes some soils in group D. Where the natural hydrology has been altered, the soils are predominantly in hydrologic groups B/D and C/D with some soils in group A/D (depending upon soil texture). Infiltration varies from very slow to moderately rapid. Runoff potential varies from negligible to medium depending on soil hydrologic group, surface texture, and ground cover.

Hydrological manipulation (surface or tile drainage, pumping, surface water diversion, etc.) modifies this ecological site. Under natural conditions, this ecological site includes a wide range of soil textures; after hydrologic manipulation, soil texture often becomes a more significant factor in vegetative response. If the degree of manipulation allows soil texture to influence the plant community or if altered soil properties (i.e., salinization or the addition of fill material) results in vegetation change, a transition to a completely different ecological site may have occurred. The transition to an altogether different ecological site will depend upon severity of altered hydrology, soil properties, and corresponding vegetation. Due to the many variables (e.g., hydrology, success and type of drainage, etc.), impacts to the ecological site will be site-specific. As a result, each situation will require field investigation to determine what, if any, change in ecological site designation is necessary and proceed accordingly.

Without restoring hydrologic function (which may include range seeding), managers need to reference state and transition models within those sites. Hydrology will need to be fully restored in Wet Meadow and Shallow Marsh ecological sites for these sites to properly function. It is recommended that managers review the appropriate State and Transition Models 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 in the MLRA. 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

- Further investigation is needed on areas of this site associated with flood plains. Lamoure and Ludden soils occur on flood plains of streams and rivers. The impact of occasional or frequent flooding on these areas needs evaluation; areas with frequent, very long flooding should probably be included in a Riparian Complex ESD.
- Further investigation is recommended on sodic, claypan soils (e.g., Manfred, Ryan) included in this site as compared to other soils in the site.
- Further investigation is needed on the wide range of soil textures and associated properties and their relationship to hydrology/plant dynamics.
- 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.
- NASIS revisions needed:
    - During the recently completed Ecological Site Description update, saline phases of Aeric Calciaquolls were reassigned from Saline Lowland to the Salinized State of Limy Subirrigated. Numerous components of Antler, Bearden, Elmville, Gilby, Glyndon, Hamerly, Ulen, Wheatville, and Wyndmere need to be relinked in NASIS, as well as 3 components of Moritz.
    - During the recently completed Ecological Site Description update, the Sodic Subirrigated ecological site was developed; all Stirum components need to be relinked from Saline Lowland to Sodic Subirrigated.
    - Two major components of Endoaquolls, moderately saline occur in a borrow area map unit. If these are disturbed soils, they should probably be relinked from Saline Lowland to Non-site.

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 somewhat poorly drained landscape positions. The soils are highly calcareous within a depth of 16 inches. Redoximorphic features occur at a depth between 18 and 30 inches. Salinity, typically, is none to slight (E.C. <8 dS/m); however, a Salinized State is recognized. All textures are included in this site.
Clayey	R056AY084ND	This site occurs higher on the landscape. The soil is typically non-saline, but slight salinity is allowable. The subsoil forms a ribbon ≥2 inches thick. It is >30 inches to redoximorphic features.
Loamy Overflow	R056AY088ND	This site occurs on flood plains and upland swales. The surface and subsoil layers form a ribbon 1 to 2 inches long. It is non-saline and is >30 inches to redoximorphic features.
Loamy	R056AY094ND	This site occurs higher on the landscape. The soil is typically non-saline, but slight salinity is allowable. The subsoil forms a ribbon 1 to 2 inches thick. It is >30 inches to redoximorphic features.
Thin Claypan	R056AY097ND	This site typically occurs somewhat higher on the landscape. It has a dense, claypan layer within a depth of 6 inches. The depth to redoximorphic features is >18 inches.
Shallow Marsh	R056AY101ND	This site occurs in deep depressions which have frequent ponding through most of the growing season. It is very poorly drained. All textures are included in this site.
Wet Meadow	R056AY102ND	This site occurs on similar landscape positions. Salinity is none to slight (E.C. <8 dS/m) in the surface and subsoil layers. It is poorly drained; it typically has redoximorphic features within a depth of 18 inches. Some soils are highly calcareous. All textures are included in this site.
Sandy Claypan	R056AY103ND	This site occurs on sandy lake plains and is slightly higher on the landscape than Saline Lowland. It has a claypan layer starting at a depth between 6 to 20 inches; salinity is none to slight to a depth >16 inches.
Sodic Subirrigated	RO56AY104ND	This poorly drained site occurs on sandy lake plains. It has a claypan layer starting within a depth of 13 inches. Vegetation can be severely impacted by high soil pH/SAR on this site, although soil salinity is none to slight (E.C. <8 dS/m) to a depth >16 inches.

Similar Sites

Ecological Site Name	Site ID	Narrative
Limy Subirrigated	R056AY087ND	This site occurs on somewhat poorly drained landscape positions. The soils are highly calcareous within a depth of 16 inches. Redoximorphic features occur at a depth between 18 and 30 inches.

		Salinity, typically, is none to slight (E.C. <8 dS/m); however, a Salinized State is recognized. All textures are included in this site.
Thin Claypan	R056AY097ND	This site typically occurs somewhat higher on the landscape. It has a dense, claypan layer within a depth of 6 inches. The depth to redoximorphic features is >18 inches.
Wet Meadow	R056AY102ND	This site occurs on similar landscape positions. Salinity is none to slight (E.C. <8 dS/m) in the surface and subsoil layers. It is poorly drained; it typically has redoximorphic features within a depth of 18 inches. Some soils are highly calcareous. All textures are included in this site.
Sodic Subirrigated	RO56AY104ND	This poorly drained site occurs on sandy lake plains. It has a claypan layer starting within a depth of 13 inches. Vegetation can be severely impacted by high soil pH/SAR on this site, although soil salinity is none to slight (E.C. <8 dS/m) to a depth >16 inches.

Acknowledgements

Developers

ND NRCS: David Dewald, Jonathan Fettig, Alan Gulsvig, Mark Hayek, Chuck Lura, Jeff Printz, Steve Sieler, and Hal Weiser

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; 48c Saline Area; and 48d Lake Agassiz Plains.

Stream Type: DA6 (Rosgen System) on riparian systems.

Wetland Description:	**System**	**Subsystem**	**Class**	**Sub-class**	**Water Regime**
Cowardin, et. al., 1979	Palustrine	N/A	Emergent	Persistent	Temporary/Saturated

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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: _Saline Lowland_ Ecological site code: _RO56AY089ND_____
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 is less than 5% occurring as small (less than 2 inches in diameter), scattered, disconnected patches. Slickspots of varying size can occur in complex with this site and will be mostly bare ground with sparse, salt-tolerant vegetation.
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.
8. Soil surface resistance to erosion: Stability class expected to average 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: Mid- and short-statured rhizomatous grasses, tall-statured rhizomatous grasses, and mid- and short-statured bunch grasses are dominant and well distributed across the site. Forbs are subdominant.
11. Compaction layer: No compaction layers occur naturally on this site. Naturally occurring platy soil surface structure may be observable.
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	Mid & short C3 rhizomatous grasses (1); Tall C4 rhizomatous grasses (2); Mid & short C3 bunch grasses (3)		
Subdominant	Mid & short C4 rhizomatous grasses (1); Forbs (9)		
Minor	Grass-likes		
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 45 to 65% with a depth of 0.75 to 1.5 inches. Litter is in contact with the soil surface.

15. Annual production: Annual air-dry production is 4100 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 3100 lbs./ac to 5100 lbs./ac, respectively.

16. Invasive plants: State and local noxious species, Kentucky bluegrass, smooth bromegrass, crested wheatgrass, quackgrass, 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.

October 2024

Functional/Structural Groups Sheet

State ND **Office** _____ **Ecological site** Saline Lowland **Ecol. site code** RO56AY089ND

Observers _____ **Date** _____

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

Species list of functional/structural groups in the **Reference State**	
Functional/Structural Group	Species List
Mid & short C3 rhizomatous grasses	western wheatgrass, plains bluegrass*
Tall C4 rhizomatous grasses	prairie cordgrass, alkali cordgrass
Mid & short C3 bunch grasses	slender wheatgrass, Nuttall's alkaligrass, foxtail barley, green needlegrass*
Mid & short C4 rhizomatous grasses	saltgrass, scratchgrass*, mat muhly*
Forbs	please see plant community table 1.1
Grass-likes	sedge*, mountain rush*
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.	
Biological soil crust[1]	

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

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

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

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

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

Species list of functional/structural groups in the **Evaluation Area**	
Functional/Structural Group	Species List
Mid & short C3 rhizomatous grasses	
Tall C4 rhizomatous grasses	
Mid & short C3 bunch grasses	
Mid & short C4 rhizomatous grasses	
Forbs	
Grass-likes	
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: