USDA Natural Resources
Conservation Service

Ecological site R056AY097ND
Thin Claypan

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 056A–Glacial Lake Agassiz, Red River Valley

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

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.

Classification relationships

Level IV Ecoregions of the Conterminous United States: 48a Glacial Lake Agassiz Basin; 48c Saline Area; and 48d Lake Agassiz Plains.

Ecological site concept

The Thin Claypan ecological site is typically located on flats on lake plains, till-floored lake plains, delta plains, and outwash plains a few areas occur on isolated areas of glacial till surrounded by lake plain. Although these soils are very deep, a dense claypan layer severely limits the rooting depth of plants. The thickness of the surface layer is 6 inches or less. The texture of the claypan layer typically is clay, silty clay, silty clay loam, or clay loam (forms a ribbon >1.5 inches long); but it is sandy loam or loam in a few soils (forms a ribbon <1.5 inches long). The texture of the surface layer is typically silty clay loam or silty clay, but clay loam, silt loam, or sandy loam also occur (particularly where the soil surface has not been disturbed by tillage). Soil on this site is somewhat poorly drained or moderately well drained. Salt accumulations typically occur within a depth of 16 inches. Slopes range from 0 to 3 percent. On the landscape, this site is below the Clayey and Loamy ecological sites; these sites do not have root-restrictive claypan layers. The

Claypan ecological site occurs in a mosaic across the landscape on micro-highs associated with the Thin Claypan site. The surface layer of Claypan is 6 to 14 inches thick and the depth to salts is >16 inches. The Saline Lowland and Wet Meadow sites are in shallow depressions or on poorly drained flats. Due to extensive tile drainage in the MLRA, some soils that formed naturally as Saline Lowland ecological sites now function similar to Thin Claypan sites.

To see a full copy of the ecological site description with all tables and the full version 5 rangeland health worksheet. Please use the following hyperlink:(https://efotg.sc.egov.usda.gov/references/public/ND/56A_Thin_Claypan_Narrative_FINAL_Ref_FSG.pdf)

Associated sites

R056AY089ND	**Saline Lowland** This site occurs in shallow depressions. It is poorly drained and has an accumulation of salts in the surface and subsoil layer (E.C. >8 dS/m).
R056AY094ND	**Loamy** This site occurs higher on the landscape. The subsoil forms a ribbon 1-2 inches long; it is not root-restrictive. Soil salinity is none or very slight (E.C. <4 dS/m) to a depth >20 inches.
R056AY084ND	**Clayey** This site occurs somewhat higher on the landscape. The subsoil forms a ribbon >2 inches long; but it is not root-restrictive. Soil salinity is none to very slight (E.C. <4 dS/m) to a depth >20 inches.
R056AY085ND	**Claypan** This site typically occurs on micro-highs. It is 6 to 20 inches to the dense, root-restrictive claypan layer. The claypan forms a ribbon >1 inch long. It is >16 inches to accumulated salts.
R056AY102ND	**Wet Meadow** This site occurs on poorly drained flats and in depressions. The soil does not have a root-restrictive claypan layer. Soil salinity is none to slight (E.C. <8 dS/m to a depth >20 inches). Some soils are highly calcareous throughout.

Similar sites

R056AY089ND	**Saline Lowland** This site occurs in shallow depressions. It is poorly drained and has an accumulation of salts in the surface and subsoil layer (E.C. >8 dS/m).
R056AY085ND	**Claypan** This site typically occurs on micro-highs. It is 6 to 20 inches to the dense, root-restrictive claypan layer. The claypan forms a ribbon >1 inch long. It is >16 inches to accumulated salts.

Table 1. Dominant plant species

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

Physiographic features

This site typically occurs on lake plains and delta plains, but it also occurs on outwash plains and isolated areas of till plain surrounded by lake plain. It most commonly occurs in micro-lows on flats. Parent materials are glaciolacustrine sediments, deltaic deposits, glaciofluvial deposits, or till. Slopes range from 0 to 3 percent.

Table 2. Representative physiographic features

Landforms	(1) Lake plain (2) Delta plain (3) Outwash plain
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	229–450 m
Slope	0–3%
Water table depth	46–152 cm
Aspect	Aspect is not a significant factor

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.

Table 3. Representative climatic features

Frost-free period (characteristic range)	102-126 days
Freeze-free period (characteristic range)	132-145 days
Precipitation total (characteristic range)	533-610 mm
Frost-free period (actual range)	87-131 days
Freeze-free period (actual range)	126-150 days
Precipitation total (actual range)	508-635 mm
Frost-free period (average)	112 days
Freeze-free period (average)	138 days
Precipitation total (average)	559 mm

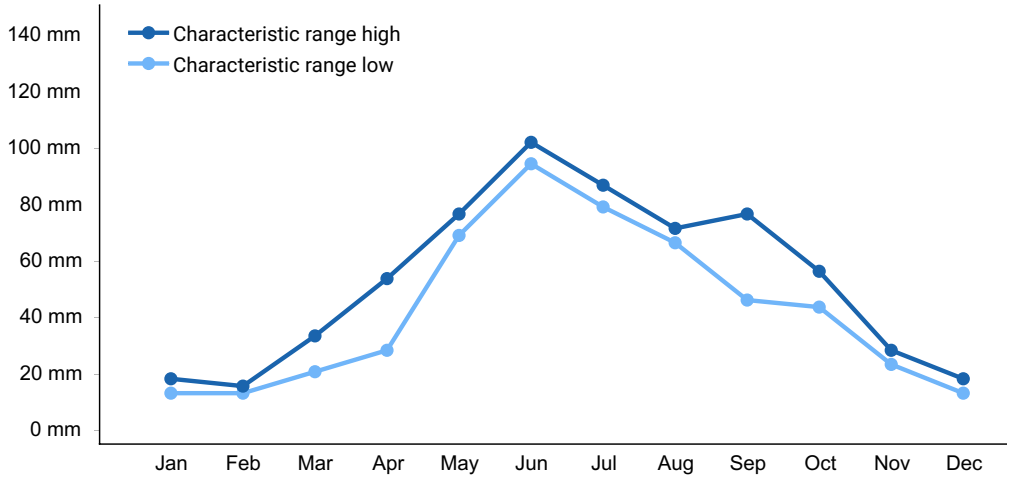

Figure 1. Monthly precipitation range

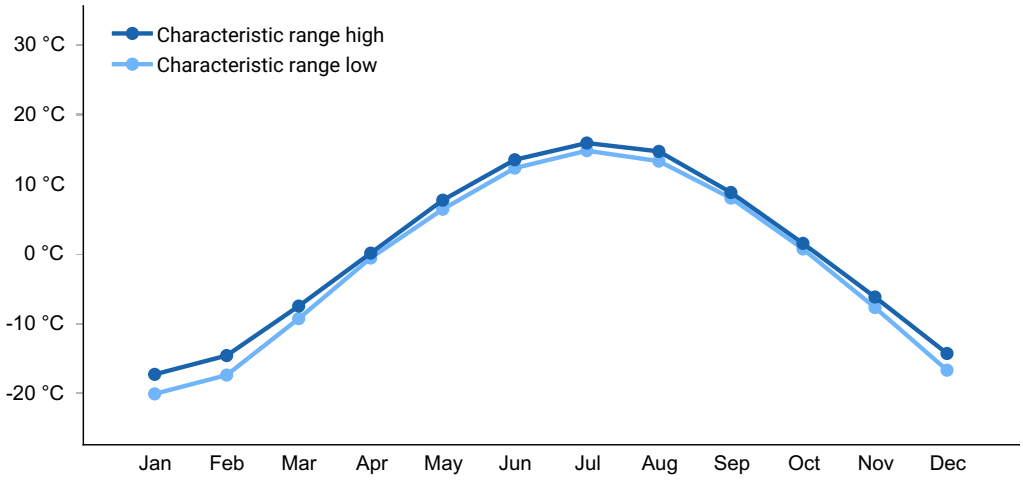

Figure 2. Monthly minimum temperature range

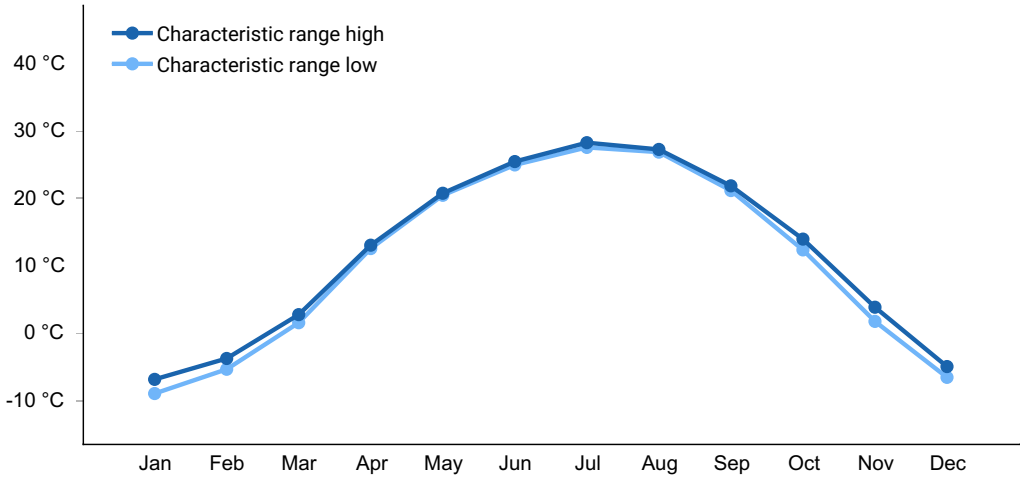

Figure 3. Monthly maximum temperature range

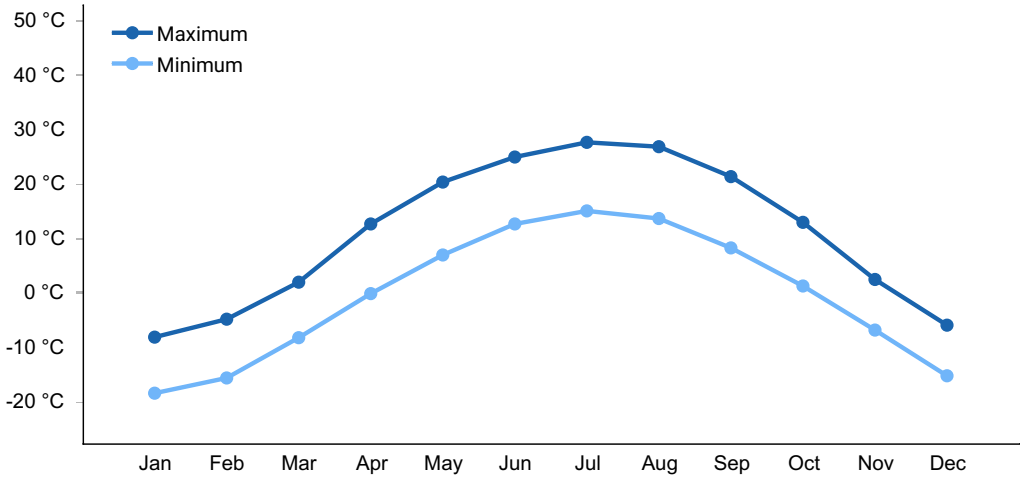

Figure 4. Monthly average minimum and maximum temperature

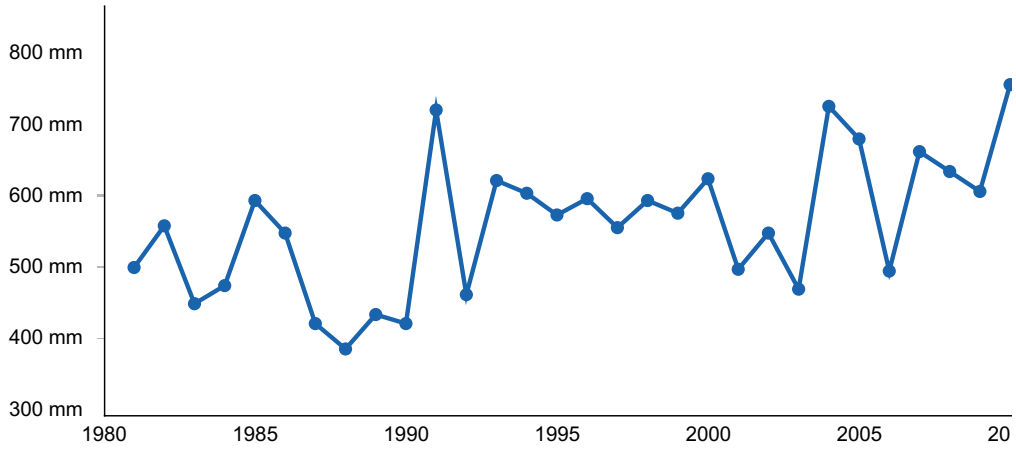

Figure 5. Annual precipitation pattern

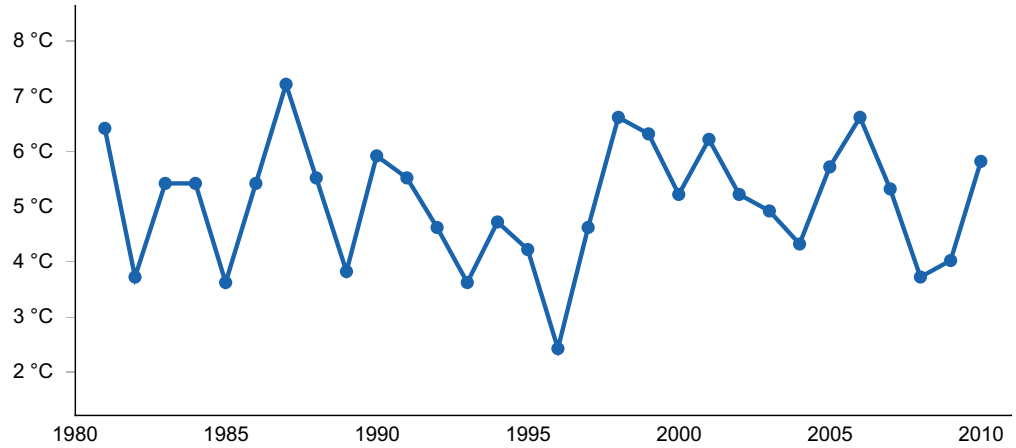

Figure 6. Annual average temperature pattern

Climate stations used

- (1) 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 does not receive significant additional water, either as runoff from adjacent slopes or from a seasonal high-water table. Although the seasonal water table can be as shallow as 18 inches early in the growing season, the root-restrictive claypan layer and soil salinity prohibit the plants from benefiting from subirrigation. Depth to the water table typically exceeds 2.5 feet during April through June and more than 3.5 feet during the remainder of the year. Surface infiltration and the permeability in the claypan layer are slow to very slow. Water loss is primarily through evapotranspiration.

Soil features

Soils associated with Thin Claypan ES are typically in the Mollisol order; they are classified further as Leptic Natrudolls. These soils were developed under prairie vegetation. They formed in glaciolacustrine sediments, deltaic deposits, glaciofluvial deposits, or isolated areas of till. Typically, the soils are moderately well drained or somewhat poorly drained.

The common features of soils in this site are the shallow depth (typically less than 6 inches) to a dense, root-restrictive, claypan layer and salt accumulations within a depth of 16 inches (typically near the surface). Although these soils are very deep to moderately deep, the claypan severely limits the rooting depth of plants and the salts limit plant-available water. The texture of the surface layer is typically silty clay loam or silty clay, but clay loam, silt loam, or sandy loam also occur (particularly where the soil surface has not been disturbed by tillage). The dense claypan typically is clay, silty clay, silty clay loam, or clay loam (forms a ribbon >1.5 inches long); but it is sandy loam or loam in a few soils (forms a ribbon <1.5 inches long).

Soil salinity is typically moderate (E.C. 8 - <16 dS/m) or strong (E.C. >16 dS/m) within a depth of 16 inches, but some soils have slight salinity to that depth. Sodicity is low to moderate (SAR 2-8) in the surface layer; in the claypan layer, it is typically moderately high or high (SAR >10). Soil reaction is slightly acid to moderately alkaline (pH 6.1 to 8.4) above the claypan and slightly alkaline to strongly alkaline (pH 7.4 to 9.0) in the claypan. Calcium carbonate ($CaCO_3$) content is none to low in the surface layer and typically low to moderate in the upper part of the claypan; in the lower part of the claypan there is commonly an accumulation of calcium carbonate (as much as 25 percent).

Wet surface compaction can occur with heavy traffic. Crypto-biotic crusts may be present. These soils are mainly susceptible to water erosion. Loss of the soil surface layer can result in a shift in species composition and/or production.

Major soil series correlated to the Thin Claypan site are Exline, Ferney, and Lemert.

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

Table 4. Representative soil features

Parent material	(1) Glaciolacustrine deposits (2) Glaciofluvial deposits (3) Till (4) Outwash (5) Lacustrine deposits

Surface texture	(1) Silty clay loam (2) Silty clay (3) Sandy loam
Family particle size	(1) Clayey
Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Very slow to slow
Depth to restrictive layer	0–15 cm
Soil depth	102–203 cm
Surface fragment cover <=3"	0–4%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	3.81–10.16 cm
Calcium carbonate equivalent (0-101.6cm)	0–25%
Electrical conductivity (0-40.6cm)	4–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	5–25
Soil reaction (1:1 water) (0-101.6cm)	6.1–9
Subsurface fragment volume <=3" (0-101.6cm)	0–8%
Subsurface fragment volume >3" (0-101.6cm)	0–2%

Ecological dynamics

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

Prior to European influence, the historical disturbance regime for MLRA 56A included frequent fires, both anthropogenic and natural in origin. Most fires, however, were anthropogenic fires set by Native Americans. Native Americans set fires in all months

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

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

Weather fluctuations, coupled with managerial factors, may lead to changes in the plant communities and, under adverse impacts, may result in a slow decline in vegetative vigor and composition. However, under favorable conditions the botanical composition may resemble that prior to European influence. Also, extensive tile drainage significantly alters subsurface hydrology (lowering the depth to the seasonal water table); areas which, under natural hydrologic conditions, functioned as Saline Lowland may now function similarly to the Thin Claypan ecological site (for example, the Ryan soil series).

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

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

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

State 2: Native/Invaded State. Colonization of the site by exotic plants results in a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition was inevitable; it often resulted from colonization by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) 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, leafy spurge) are also known to invade the site.

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

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

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 (R3A) may be accomplished with the implementation of long-term prescribed grazing in conjunction with prescribed burning.

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

brome, quackgrass) 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.

State and transition model

Plant Communities and Transitional Pathways

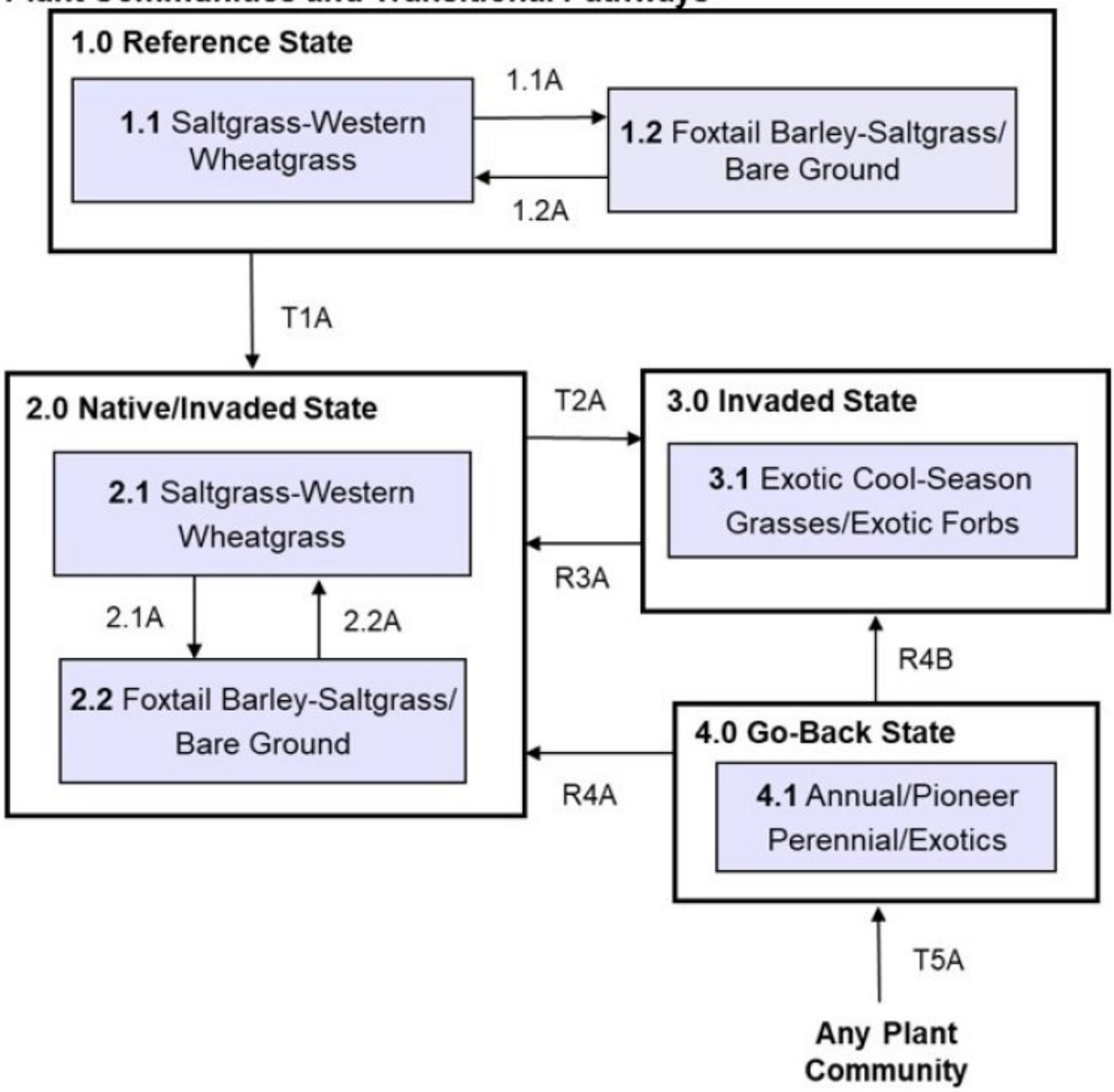

Diagram Legend - MLRA 56A Thin Claypan

T1A	Invasion by exotic cool-season grasses
T2A	Heavy grazing or long-term non-use or very light grazing and 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)	Heavy grazing with or without drought
CP 1.2 - 1.1 (1.2A)	Reduced grazing, return to average precipitation
CP 2.1 - 2.2 (2.1A)	Heavy grazing with or without drought
CP 2.2 - 2.1 (2.2A)	Long-term prescribed grazing and prescribed burning, return to average precipitation

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 mechanism for this site in the reference condition included frequent fire and grazing by large herding ungulates. Timing of fires and grazing, coupled with weather events, dictated the dynamics that occurred within the natural range of variability. These factors likely caused the community to shift both spatially and temporally between two community phases.

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 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 1.1
Saltgrass-Western Wheatgrass (Distichlis spicata-Pascopyrum smithii)

This community phase was historically the most dominant both temporally and spatially. Major graminoids included saltgrass, western wheatgrass, blue grama, and sedges (e.g., needleleaf, Pennsylvania). Associated grasses include slender wheatgrass, prairie Junegrass, and Nuttall's alkaligrass. Common yarrow, white sagebrush, curlycup gumweed, white heath aster, and woolly plantain are among the more common forbs. Common shrubs include prairie sagewort and broom snakeweed. Annual production would have varied from about 1100-2100 pounds per acre with grasses and grass- likes, forbs, and shrubs contributing about 85%, 10% and 5%, respectively. This community represents the plant community phase upon which interpretations are primarily based and is described in the "Plant Community Composition and Group Annual Production" portion of this ecological site description.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1048	1334	2001
Forb	123	157	235
Shrub/Vine	62	78	118
Total	**1233**	**1569**	**2354**

Community 1.2
Foxtail Barley-Saltgrass/Bare Ground (Hordeum jubatum-Distichlis spicata/Bare Ground)

This community phase resulted from heavy season-long grazing with or without drought. It may be characterized by the conspicuous abundance of foxtail barley and increased extent of salt encrusted bare ground. Pursh seepweed, red swampfire, curlycup gumweed, and field pussytoes may increase noticeably.

Pathway 1.1A
Community 1.1 to 1.2

Community Phase Pathway 1.1 to 1.2 occurred with heavy grazing with or without drought. This resulted in marked increases in foxtail barley and bare ground with a corresponding decrease in western wheatgrass.

Pathway 1.2A
Community 1.2 to 1.1

Community Phase pathway 1.2 to 1.1 occurred with reduced grazing and return to average precipitation, resulting in an increase in western wheatgrass and corresponding decreases in foxtail barley and bare ground.

State 2
Native/Invaded State

This state is similar to State 1: Reference State but has now been colonized by the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) which are now present in small amounts. Although the state is still dominated by native grasses, an increase in these exotic cool- season grasses can be expected. These exotic cool-season grasses can be quite invasive on the site and are particularly well adapted to heavy grazing. They also often form monotypic stands. As these exotic cool-season grasses increase, both forage quantity and quality become increasingly restricted to late spring and early summer due to the monotypic nature of the stand, even though annual production may increase. Native forbs generally decrease in production, abundance, diversity, and richness compared to that of State 1: Reference State. These exotic cool-season grasses have been particularly and consistently invasive under long-term non-use or very light grazing, and no fire. To slow or limit the invasion of these exotic grasses, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 3: Invaded State should be expected. Annual production of this state can be quite variable, in large part due to the amount of exotic cool- season grasses, as well as variations in rooting depth and other factors. However, annual production may be similar

to that of the Reference State (1100-2100 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 2.1
Saltgrass-Western Wheatgrass (Distichlis spicata-Pascopyrum smithii)

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

Community 2.2
Foxtail Barley-Saltgrass/Bare Ground (Hordeum jubatum-Distichlis spicata/Bare Ground)

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

Pathway 2.1A
Community 2.1 to 2.2

This Community Phase Pathway 2.1 to 2.2 occurs with heavy grazing with or without drought. This results in marked increases in foxtail barley and bare ground with a corresponding decrease in western wheatgrass.

Pathway 2.2A
Community 2.2 to 2.1

Community Phase pathway 2.2 to 2.1 occurs with the implementation of long-term prescribed grazing and prescribed burning and return to average precipitation, resulting in an increase in western wheatgrass and corresponding decreases in foxtail barley and bare ground.

State 3
Invaded State

This state is the result of invasion and dominance by the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass). 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. Common forbs often include common yarrow, wooly plantain, white sagebrush, field pussytoes, and curlycup gumweed. Shrubs may be largely absent or include prairie sagewort, broom snakeweed, or rose. Exotic forbs, however, are often conspicuous components of this state and include field sowthistle, dandelion, common plantain, and curly dock. Once the state is well established, prescribed burning and prescribed grazing techniques have been largely ineffective in suppressing or eliminating these species, even though some short-term reductions may appear successful. Annual production of this state can be quite variable, in large part due to the amount of exotic cool- season grasses as well as variations in rooting depth and other factors. However, annual production may be similar to that of the Reference State (1100-

2100 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 3.1
Exotic Cool-Season Grasses/Exotic Forbs

This community phase is dominated by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass), often with a much-reduced forb and shrub component. However, forbs often include common yarrow, wooly plantain, white sagebrush, field pussytoes, and curlycup gumweed. Common exotic forbs typically include field sowthistle, dandelion, common plantain, and curly dock. The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of the exotic cool-season grasses are typically short-lived.

State 4
Go-Back State

This state is highly variable depending on the level and duration of disturbance related to the T5A transitional pathway. In this MLRA, the most probable origin of this state is plant succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses, some of which may be noxious weeds and need control. Over time, however, the site will likely become dominated by exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or quackgrass).

Characteristics and indicators. (i.e., characteristics that can be used to distinguish this state from others). Tillage has destroyed the native plant community, altered soil structure and biology, reduced soil organic matter, and resulted in the formation of a tillage induced compacted layer which is restrictive to root growth. Removal of perennial grasses and forbs results in decreased infiltration and increased runoff.

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

Community 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. This plant community will initially include a variety of annual forbs and grasses, including noxious weeds (e.g., Canada thistle) which may need control.

State 5
Any Plant Community

Transition T1A
State 1 to 2

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, often 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 may have been exacerbated by chronic season-long or heavy late season grazing. Complete rest from grazing and suppression of fire could also have hastened this transition. The threshold between states was crossed when Kentucky bluegrass, smooth brome, 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.

Transition T2A
State 2 to 3

This transition from the State 2: Native/Invaded State to State 3: Invaded State generally occurs with heavy grazing or long-term non-use or very light grazing and no fire. Exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) become the dominant graminoids. Studies indicate that a threshold may exist in this transition when both the exotic cool-season grasses exceed 30% of the plant community and native grasses represent less than 40% of the plant community composition. This transition may occur under other managerial conditions including heavy season-long grazing (primarily Kentucky bluegrass).

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

Restoration pathway R3A
State 3 to 2

This restoration pathway from State 3: Invaded State to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing and prescribed burning, assuming there is an adequate component of native grasses to respond to the treatments. Both prescribed grazing and prescribed burning are likely necessary to successfully initiate this restoration pathway, the success of which depends upon the presence of a remnant population of native grasses in Community Phase 3.1. That remnant population, however, may not be readily apparent without close inspection. The application of several prescribed burns may be needed at relatively short intervals in the early phases of this restoration process, in part because some of the shrubs may sprout following one burn. Early season prescribed burns have been successful; however, fall burning may also be an effective technique. The prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources. If properly implemented, this will shift the competitive advantage from the exotic cool-season grasses to the native cool-season grasses.

Context dependence. (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Grazing management should be applied in a manner that enhances/maximizes the competitive advantage of native grass and forb species over the exotic species. This may include the use of prescribed grazing to reduce excessive plant litter accumulations above that needed for rangeland health indicator #14 (see Rangeland Health Reference Worksheet). Increasing livestock densities may facilitate the reduction in plant litter provided length and timing of grazing periods are adjusted to favor native species. Grazing prescriptions designed to address exotic grass invasion and favor native species may involve earlier, short, intense grazing periods with proper deferment to improve native species health and vigor. Fall (e.g., September, October) prescribed burning followed by an intensive, early spring graze period with adequate deferment for native grass recovery may shift the competitive advantage to the native species, facilitating the restoration to State 2: Native/Invaded. Prescribed burning should be applied in a manner that enhances the competitive advantage of native grass and forb species over the exotic species. Prescribed burns should be applied at a frequency which mimics the natural disturbance regime, or more frequently as is ecologically (e.g., available fuel load) and economically feasible. Burn prescriptions may need adjustment to: (1) account for change in fine fuel orientation (e.g., “flopped” Kentucky bluegrass); (2) fire intensity and duration by adjusting ignition pattern (e.g., backing fires vs head fires); (3) account for plant phenological stages to maximize stress on exotic species while favoring native species (both cool- and warm-season grasses).

Restoration pathway R4A
State 4 to 2

This Restoration Pathway from State 4: Go-Back State to the State 2: Native/Invaded State can be accomplished with a successful range planting. Following planting,

prescribed grazing, prescribed burning, haying, or use of herbicides will generally be necessary to achieve the desired result and control any noxious weeds. It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources; management objectives must include the maintenance of those species, the associated reference state functions, and continued treatment of exotic grasses.

Context dependence. (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). A successful range planting will include proper seedbed preparation, weed control (both prior to and after the planting), selection of adapted native species representing functional/structural groups inherent to the State 1, and proper seeding technique. Management (e.g., prescribed grazing, prescribed burning) during and after establishment must be applied in a manner that maintains the competitive advantage for the seeded native species. Adding non-native species can impact the above and below ground biota. Elevated soil nitrogen levels have been shown to benefit smooth brome and Kentucky bluegrass more than some native grasses. As a result, fertilization, exotic legumes in the seeding mix, and other techniques that increase soil nitrogen may promote smooth brome and Kentucky bluegrass invasion. The method or methods of herbaceous weed treatment will be site specific to each situation but, generally, the goal would be to apply the pesticide, mechanical control, or biological control (either singularly or in combination) in a manner that shifts the competitive advantage from the targeted species to the native grasses and forbs. The control method(s) should be as specific to the targeted species as possible to minimize impacts to non-target species.

Restoration pathway R4B
State 4 to 3

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

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

Transition T5A
State 5 to 4

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

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			471–785	
	western wheatgrass	PASM	*Pascopyrum smithii*	471–706	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–78	–
2	**Short Warms-Season Grasses**			235–549	
	blue grama	BOGR2	*Bouteloua gracilis*	157–314	–
	buffalograss	BODA2	*Bouteloua dactyloides*	16–78	–
	western wheatgrass	PASM	*Pascopyrum smithii*	16–78	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–31	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–31	–
3	**Cool-Season Bunchgrasses**			16–78	
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	16–78	–
	needle and thread	HECO26	*Hesperostipa comata*	0–47	–
4	**Other Native Grasses**			16–78	
	prairie Junegrass	KOMA	*Koeleria macrantha*	16–78	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–78	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–16	–
5	**Grass-Likes**			16–78	
	needleleaf sedge	CADU6	*Carex duriuscula*	16–78	–
	Pennsylvania sedge	CAPE6	*Carex pensylvanica*	0–31	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–31	–
Forb					

6	**Forbs**			78–157	
	Forb (herbaceous, not grass nor grass-like)	2FORB	*Forb (herbaceous, not grass nor grass-like)*	16–78	–
	common yarrow	ACMI2	*Achillea millefolium*	16–47	–
	woolly plantain	PLPA2	*Plantago patagonica*	16–47	–
	textile onion	ALTE	*Allium textile*	16–31	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	16–31	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	16–31	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	16–31	–
	white heath aster	SYER	*Symphyotrichum ericoides*	16–31	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–31	–
	field pussytoes	ANNE	*Antennaria neglecta*	0–16	–
	field sagewort	ARCA12	*Artemisia campestris*	0–16	–
	foothill bladderpod	LELU	*Lesquerella ludoviciana*	0–16	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–16	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–16	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–16	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–16	–
Shrub/Vine					
7	**Shrubs**			16–78	
	prairie sagewort	ARFR4	*Artemisia frigida*	16–47	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–31	–
	prairie rose	ROAR3	*Rosa arkansana*	0–31	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–31	–

Animal community

Animal Community – Wildlife Interpretations

Landscape

The MLRA 56 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 56 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 MLRA 56. 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 56 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 56 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 56:

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 56 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, 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 56:

MLRA 56 has the most conversion to cropland of any MLRA within Region F-Northern Great Plains. The MLRA land uses include agriculture (annual crop production, 81%), grassland/shrubland (7.3%), forestland (5.5%), wetland (4.7%), and 1.6 % in other land uses such as transportation corridors and urban areas. 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 further impacting 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 the 64,769 acres of the United States Forest Service, Sheyenne National Grassland (southern portion of MLRA); 37,000 acres of the United States Fish and Wildlife Service, Glacial Ridge National Wildlife Refuge (northeastern portion of MLRA); other wildlife refuges and waterfowl production areas; and numerous state parks and wildlife management areas. 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, 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 56:

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 56 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 56:

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, range planting, prescribed burning, 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 declines 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. Once a plant community degrades to State 2.0 Invaded State, no restoration pathway exists to return to State 1.0. 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.

To see the chart please follow the hyperlink. (https://efotg.sc.egov.usda.gov/references/public/ND/56A_Thin_Claypan_Narrative_FINAL_Ref_FSG.pdf)

Thin Claypan Wildlife Habitat Interpretation:

Thin Claypan ecological sites are identified by the presence of a dense claypan within 6 inches of the soil surface and salt accumulations with a depth of 16 inches making the site very droughty. In addition, the depth to claypan will cause a mosaic of non-vegetated (slick spots) with vegetated areas within the ecological site creating a mosaic of short- and mixed-grass habitat components that commonly support grassland nesting birds. This mosaic of slick spots and vegetated areas occurs in all States. In addition, Thin Claypan sites can occur in a complex with Claypan ecological sites. These sites may provide brood rearing habitat for sharp-tailed grouse. Due to limited diversity of forb species, protein sources for young chicks may be limited. These sites do not lend themselves well as lekking, nesting or winter cover.

Thin Claypan habitat features and components commonly support grassland nesting birds. Other associated ecological sites include Clayey, Claypan, Loamy, Saline Lowland, and Wet Meadow. This complex of ecological sites provides habitat for many edge-sensitive, grassland bird species.

Thin Claypan 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. Within each of these states, bare ground (as described in Community Phase 1.2 and 2.2) occurs in patches of varying size scattered across the ecological site. Multiple

plant community phases exist within State 2. Today, these states occur primarily in response to grazing and drought.

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage, using tools in the community phase pathways in States 1.0 and 2.0, to prevent further plant community degradation along either the T1A Transitional Pathway to the Native/Invaded State 2.0 or the T2A Transitional Pathway to the Invaded State 3.0. Native wildlife generally benefits from grasslands that are heterogeneous in species composition and stature found in States 1.0 and 2.0 that include diverse grass and forb species with varying stature and density. With heavy season-long grazing or extended periods of drought within State 2.0, warm-season grasses (particularly short-statured grasses), bare ground, and exotic grasses increase while native forbs are reduced. This transition results in reduced stature and increased plant community homogeneity. When adjacent and/or intermingled ecological sites undergo the same transition, the result can be an expansive, homogenous landscape.

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

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

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

1.0 Reference State

Community Phase 1.1: Saltgrass-Western Wheatgrass: This plant community offers good wildlife habitat, and every effort should be made to maintain this ecological site within this community phase. Overall plant diversity is low, and the forb component is inherently limited on this ecological site. Within the limits of this ecological site, this phase retains high functionality through continued maintenance including prescribed grazing with adequate recovery period, as well as prescribed burning. Predominance of grass species in this community favors grazers and mixed-feeders (animals selecting grasses as well as

forbs and shrubs). The structural diversity provides habitat for migratory and resident bird species that prefer short structure and bare ground.

Invertebrates: Insects play a role in maintaining the forb community and provide a forage base for grassland birds, reptiles, and rodents. Ecological services, historically provided by bison, are mirrored 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 shredders, predators, herbivores, dung beetles, and fungal-feeders.

Dakota skippers do not prefer this site due to limited host plants, such as little bluestem and prairie dropseed. Regal fritillary habitat is limited due to short stature of this plant community and Nuttall's and prairie violets are uncommon. Monarch butterflies may use flowering forbs on this site; however, few milkweed species are found on this site to support caterpillar food. Bumblebees and other native bees utilize forbs as a nectar source and bare ground for nesting amongst bunchgrasses. Prescribed grazing with adequate recovery periods (as well as prescribed burning) to maintain the Community Phase 1.1A will have long term positive effects on ground dwelling insects.

Birds: This plant community provides nesting, foraging, and escape habitats favored by short- to mid-grass nesting birds that can also tolerate areas of bare ground. Plant structure is generally short for bird species using short-grass habitats; however, during periods of above normal precipitation this community phase may provide habitat for bird species preferring mid-statured vegetation. The low scattered shrubs that may be present in this plant community phase should not impact woody vegetation sensitive bird species. This plant community provides suitable areas for sharp-tailed grouse leks but limited nesting and brood-rearing habitat. Limited structure and diverse prey populations provide good hunting opportunity for grassland raptors. Many passerine species utilize MLRA 56 as a major migratory travel corridor.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores including voles, mice, rodents, jackrabbits, and white-tailed deer. Short- to moderate- stature provides suitable food, thermal, protective, and escape cover for small herbivores such as ground squirrels.

Amphibians/Reptiles: This ecological site and associated plant communities provides habitat for smooth green snakes. This ecological site does not usually provide habitat for the northern leopard frog and Great Plains toad since it is not located adjacent to or near freshwater habitat such as wetlands, streams, or lakes.

Fish and Mussels: This ecological site is not directly associated with streams, rivers, or water bodies. It receives run-on hydrology from adjacent ecological sites and may provide hydrology to other ecological sites lower on the landscape. Management on Thin Claypan sites, in conjunction with nearby run-on sites, can have an indirect effect on aquatic species in streams and/or tributaries receiving water from Thin Claypan and nearby sites. Optimum hydrological function and nutrient cycling limit potential for sediment yield and

nutrient loading to any nearby aquatic ecosystems from Community Phase 1.1.

Community Phase 1.2 Foxtail Barley-Saltgrass/*Bare Ground*: A marked increase in foxtail barley with a corresponding decrease in western wheatgrass occurs after heavy season-long grazing (with or without drought). Prairie sagewort increases while forbs may decrease in flower production due to heavy grazing and drought.

Invertebrates: Provides similar life requisites as Community Phase 1.1; however, heavy, season-long grazing may negatively impact ground-nesting sites due increased soil compaction. A reduction in forbs, reduced floral production due to heavy season-long grazing and drought, along with increase in wind-pollinated prairie sagewort reduces overall pollen and nectar production.

Birds: This plant community provides nesting, foraging, and escape habitats favored by short- to mid-grass nesting birds. A shift to shorter herbaceous plant statures and a short shrub component along Community Phase Pathway 1.1A begins to benefit species preferring short-statured vegetation. Species that prefer midgrass statures will be generally successful with normal to above normal precipitation and a change in management along the 1.2A Community Phase Pathway. In years with reduced precipitation continued heavy season-long grazing, nesting recruitment may be compromised even for short-grass nesting species. This plant community provides areas suitable for sharp-tailed grouse lek sites. Limited cover and a reduction of diverse prey populations limits hunting opportunities for grassland raptors.

Mammals: Provides similar life requisites as Community Phase 1.1; however, heavy season-long grazing reduces protective and thermal cover for small mammals.

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

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

2.0 Native/Invaded State

Community Phase 2.1 Saltgrass-Western Wheatgrass: This plant community develops through Transition pathway T1A due to changes in management (by long-term season-long grazing as well as long-term non-use and no fire events) and the presence of exotic, cool-season grasses. The threshold between states 1.0 and 2.0 is crossed when Kentucky bluegrass, smooth brome grass, or other exotic species become established. This plant community phase has a very similar appearance and function to the Reference State of Community 1.1, except it has a minor amount of cool-season exotic grasses and forbs. Managers should consider the 2.0 community phase pathways to avoid transitioning to State 3.0.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

Community Phase 2.2 Foxtail Barley-Saltgrass/*Bare Ground*: Continuous, season-long grazing along Community Phase Pathway 2.1A leads to shorter-statured grasses, such as blue grama. Prescribed grazing with adequate recovery periods along Community Phase Pathway 2.2A is an efficient, effective method to regain the cool-season grass and forb diversity components in Community Phase 2.1.

Invertebrates: Provides similar life requisites as Community Phase 1.2.

Birds: Provides similar life requisites as Community Phase 1.2.

Mammals: Provides similar life requisites as Community Phase 1.2.

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

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

3.0 Invaded State

Community Phase 3.1 Exotic Grasses/Exotic Forbs: Community phase pathway T2A is characterized by non-use (10 or more years) or low intensity (less than 20% utilization) grazing and elimination of fire. This plant community phase can also be the result of heavy season-long grazing. This plant community phase is characterized by a dominance (>30%) of exotic cool-season grasses such as Kentucky bluegrass, smooth brome grass, quackgrass. However, due to the low productivity of this site, native grasses such as western wheatgrass and blue grama are still present. Restoration pathway R3A requires remnant amounts of native warm- (i.e. blue grama) and cool-season grasses (i.e. western wheatgrass) and forbs. These remnant populations can only be expressed through frequent prescribed burns and high levels of prescribed grazing management targeting the exotic cool-season grasses. Intensified management along the R3A pathway will have significant short-term negative impacts on wildlife habitat; however, this is necessary to restore long-term habitat functions.

Invertebrates: Exotic grasses limit use by beneficial insects provided in States 1.0 and 2.0. Heavy, continuous season-long grazing causes this plant community to be dominated by

sod forming, cool season exotic grasses creating a thick root layer which increases compaction and eliminates bare ground and nesting sites for native bees and other ground-nesting insects. Lack of grazing and/or fire increases litter leading to limited contact between plant material and mineral soil resulting in a cooler micro-climate, which is unfavorable to most insects. Both management scenarios lead to a lack of nectar-producing plants and reduce forb diversity, limiting life requisites for invertebrate species of concern in MLRA 56. Shrubs common to this site are wind- or self-pollinating, limiting use by pollinating insects.

Birds: The homogeneous community phase, dominated by exotic short statured grass species, provides limited habitat and life requisites for most obligate grassland-nesting birds. Bird species that favor short-statured vegetation may use this site; however, heavy, continuous season-long grazing along with a lack of plant diversity and stature limits use by many grassland-nesting birds. Lack of grazing and/or fire decreases plant diversity and stature and increases litter; and the tendency of Kentucky bluegrass and smooth bromegrass to lay down limits use by many grassland-nesting birds. Sharp-tailed grouse may use this plant community for lek sites; however, all other life requisites will need to be met on other nearby or adjacent ecological sites plant communities. The shrub component in this plant community will not reach density or height to be detrimental to grass-land nesting birds that are intolerant to woody vegetation.

Mammals: Heavy, continuous season-long grazing causes this plant community to be dominated by short-statured grasses which provides limited thermal, protective, escape cover for mammals. Limited habitat is available for mammals except for ground dwelling rodent species. Lack of grazing and/or fire decreases plant diversity and stature and increases litter; and the tendency of Kentucky bluegrass and smooth bromegrass to lay down favors thermal, protective, and escape cover for small mammals/rodents.

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

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1. However, runoff increases significantly from the plant community due to thick thatch and sod forming grasses - increasing yield and nutrient loading to ecological sites lower on the landscape and any nearby waterbodies.

4.0 Go-Back State

Community Phase 4.1 Annual/Pioneer Perennial/Exotics: This plant community is the result of severe soil disturbance such as cropping, recreational activity, or concentrated livestock activity for a prolonged time period. Following cessation of disturbances, the resulting plant community is dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals and birds and their young.

Successful restoration along transition pathway R4A results in a plant community dominated by native grass and forb species in State 2.0. Failed restoration to native species through restoration pathway R4B results in Invaded State 3.0. Wildlife species response 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).

Animal Community – Grazing Interpretations

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

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

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

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

Utilization Level % Use Description

Slight (Light) 0-20 Appears practically undisturbed when viewed obliquely. Only choice areas and forage utilized.

Moderate 20-40
Almost all of accessible range shows grazing. Little or no use of poor forage. Little evidence of trailing to grazing.

Full 40-60 All fully accessible areas are grazed. The major sites have key forage species properly utilized (about half taken, half left). Points of concentration with overuse limited to 5 to 10 percent of accessible area.

Close (Heavy) 60-80 All accessible range plainly shows use and major sections closely cropped. Livestock forced to use less desirable forage, considering seasonal preference.

Severe > 80 Key forage species completely used. Low-value forages are dominant.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group D. Infiltration ranges from moderately slow to very slow; runoff potential for this site varies from low to high depending on surface texture, slope percent, and ground cover. The dense claypan layer slows water movement through the soil profile. In many cases, areas with greater than 75% ground cover have the greatest potential for higher infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Dominance by blue grama, bluegrass, and/or smooth bromegrass will result in reduced infiltration and increased runoff. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Recreational uses

Hunting and Bird Watching: 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 chickens as well as several other sensitive species, such as the Dakota skipper and regal fritillary. It also contains one of largest populations of the western prairie fringed orchid which is listed as a threatened species by the U.S. Fish and Wildlife Service.

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

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

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

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

Wood products

No appreciable wood products are present on the site.

Other products

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

Other information

• 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.

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.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	USDA-NRCS North Dakota
Contact for lead author	NRCS State Rangeland Management Specialist

Date	12/01/2021
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are not expected on this site.

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2. **Presence of water flow patterns:** Water flow patterns are not visible.

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3. **Number and height of erosional pedestals or terracettes:** Neither pedestals nor terracettes are expected on this site.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground ranges from 10 to 35%. Bare ground patches should be small (4 to 8 inches in diameter) and disconnected. Animal activity (burrows and ant mounds) may occasionally result in isolated bare patches of up to 24 inches in diameter.

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5. **Number of gullies and erosion associated with gullies:** Active gullies are not expected on this site.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** No wind-scoured or depositional areas expected on this site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Fine/small class of plant litter associated with slick spots may be moved 4 to 8 inches following rain events. Small accumulations of plant litter may be visible.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class averages 3 or greater. Lower averages expected on the “slickspots” or plant interspaces while higher averages expected under plant canopy.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Use soil series description for depth, color, and structure of A-horizon.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Mid- and short-statured rhizomatous grasses are dominant and well distributed across the site. Mid- and short-statured bunch grasses and Forbs are subdominant.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer would be expected except for the naturally occurring pan within 6 inches of the soil surface.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Phase 1.1 -
    Mid & short C3 rhizomatous grasses (1)

    Sub-dominant: Phase 1.1 -
    Mid & short C4 bunch grasses (1); Mid & short C3 bunch grasses (2); Mid & short C4 rhizomatous grasses (2); Forbs (7)

    Other: Minor - Phase 1.1 -
    Grass-likes; Shrub

    Additional: 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.

To see a full version 5 rangeland health worksheet with functional/structural group tables. Please use the following hyperlink:(https://efotg.sc.egov.usda.gov/references/public/ND/56A_Thin_Claypan_Narrative_FIN)

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Rare to not occurring on this site.

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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is 35 to 65% with a depth of 0.1 to 0.25 inches. Litter is in contact with soil surface.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual air-dry production is 1400 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 1100 lbs./ac to 2100 lbs./ac, respectively.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** State and local noxious species, Kentucky bluegrass, smooth bromegrass, crested wheatgrass, and Eastern red cedar/juniper.

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17. **Perennial plant reproductive capability:** Noninvasive species in all functional/structural groups are vigorous and capable of reproducing annually under normal weather conditions.
