United States Department of Agriculture
Natural Resources Conservation Service

Ecological Site Description

Site Stage: Provisional

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

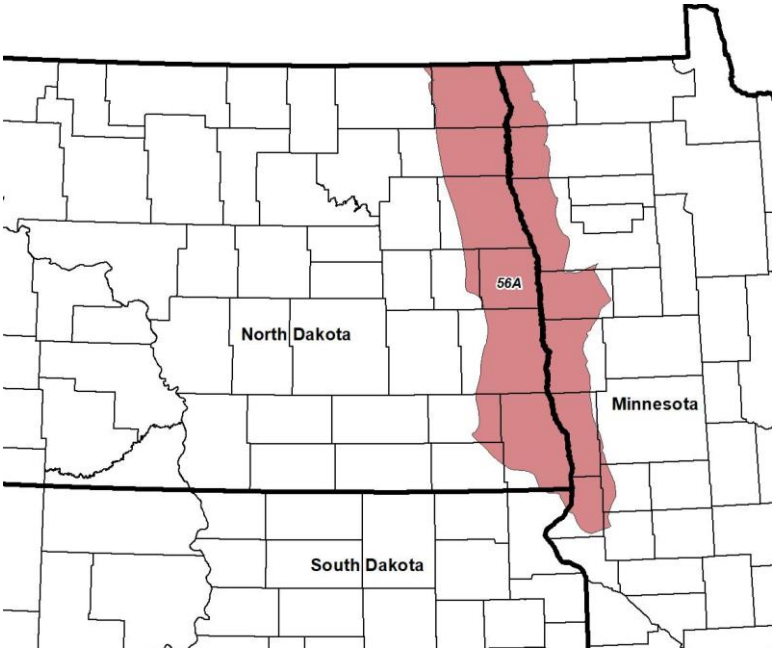
Site Name: Choppy Sands

Site Type: Rangeland

Site ID: R056AY104ND

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

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



Location of MLRA 56A within Minnesota, North Dakota, and South Dakota

The Red River Valley of the North MLRA is an expansive and agriculturally important region consisting of 10,400,000 acres and including a portion of 25 counties in eastern North Dakota and

northwestern Minnesota along with a small portion of the northeast corner (Roberts County) of South Dakota.

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

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

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

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

Ecological Site Concept

The Choppy Sands ecological site is located on moderately steep and steep sandy uplands (primarily delta plains), many of which have been reworked by wind into dunes. The soils are very deep. The thickness of the topsoil is generally less than 5 inches; but it may be as thick as 9 inches. The surface layer is typically fine sand, but loamy fine sand is included. The rest of the soil profile to depth $\geq$40 inches is typically fine sand, but sand is included. Soil on this site is excessively drained. The slopes of the dunes are highly variable; the slope range of the Choppy Sands site is typically 15 to 35 percent but slopes >35% may be included in some areas. On the landscape, this site is above the Subirrigated, Subirrigated Sands, and Wet Meadow ecological sites (all three sites occur in blowout

areas). The Sands site occurs on adjacent, less sloping (<15 percent) sandy landscapes (**see Site Development and Testing Plan**).

Physiographic Features

This site occurs on sandy uplands, primarily delta plains; many areas have been reworked by wind into dunes. Slope typically ranges from 15 to 35 percent.

Landform: Dune, Ridge

	Minimum	Maximum
Elevation (feet):	750	1475
Slope (percent):	15	35
Water Table Depth (inches):	80	>80
Flooding:		
Frequency:	None	None
Ponding:		
Frequency:	None	None
Runoff Class:	Very low	Medium
Aspect:	No influence on this site	

Climatic Features

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

Annual precipitation typically ranges from 18 to 23 inches per year. The average annual temperature is about 40°F. January is the coldest month with average temperatures ranging from about 1°F (Pembina, North Dakota (ND) to about 11°F (Wheaton, Minnesota (MN). July is the warmest month with temperatures averaging from about 68°F (Pembina, ND) to about 73°F (Wheaton, MN). The range of normal average monthly temperatures between the coldest and warmest months is about 65°F. This large annual range attests to the continental nature of this area's climate. Winds are estimated to average about 13 miles per hour annually, ranging from about 15 miles per hour during the spring to about 11 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

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

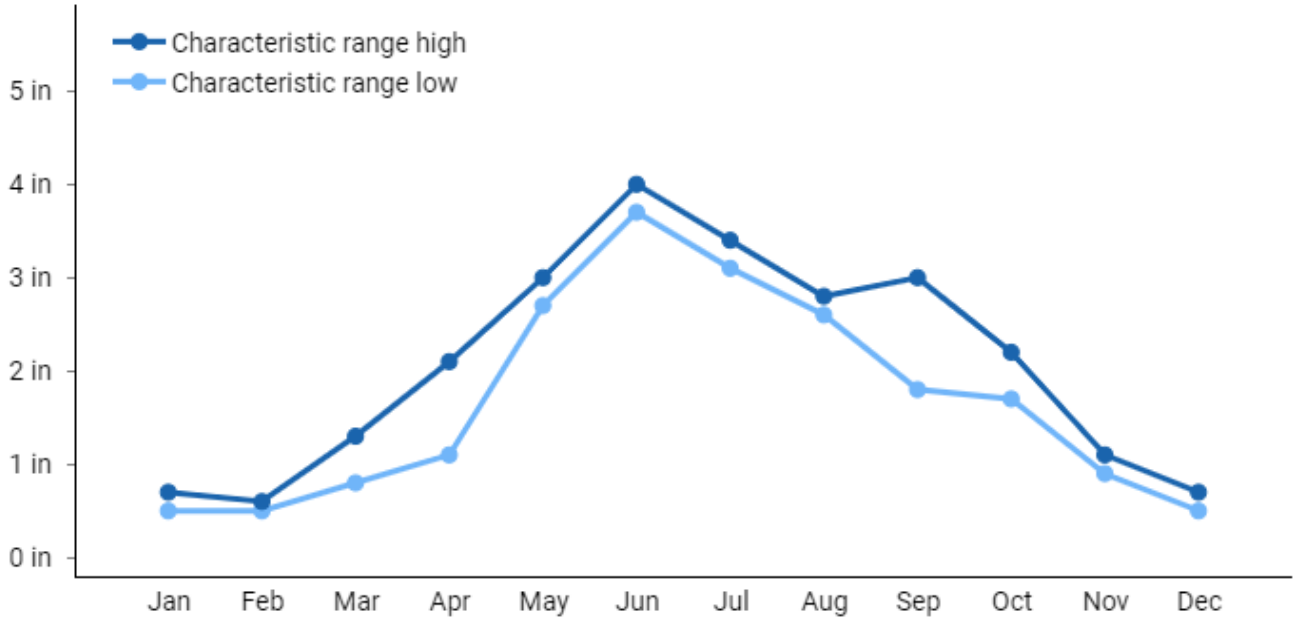
Climate normals

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

Normal monthly precipitation (in)

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

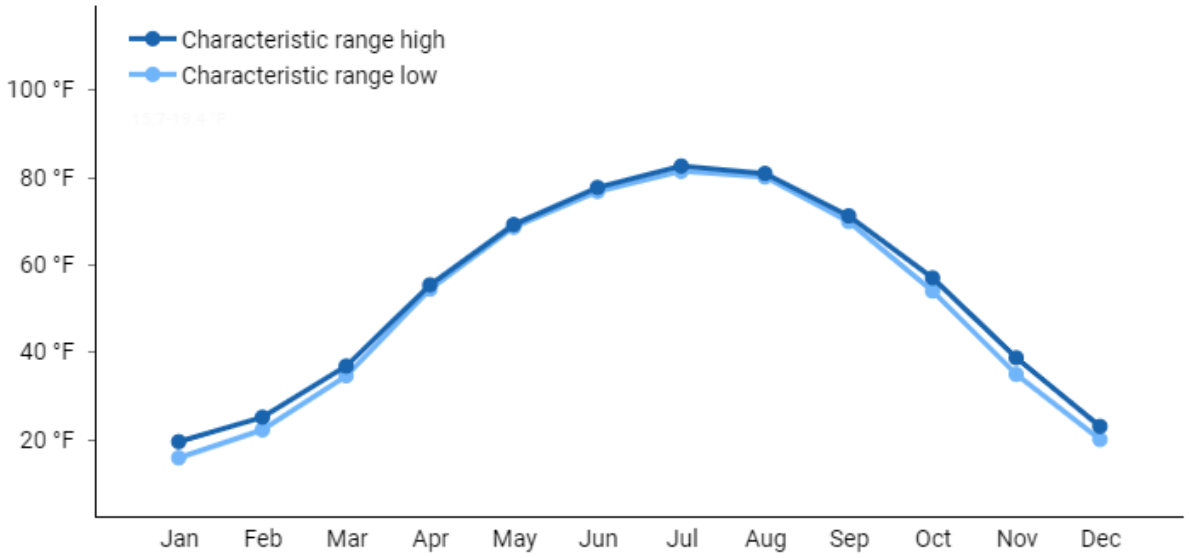
Normal Monthly Precipitation (in)



Normal monthly maximum temperature (°F)

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

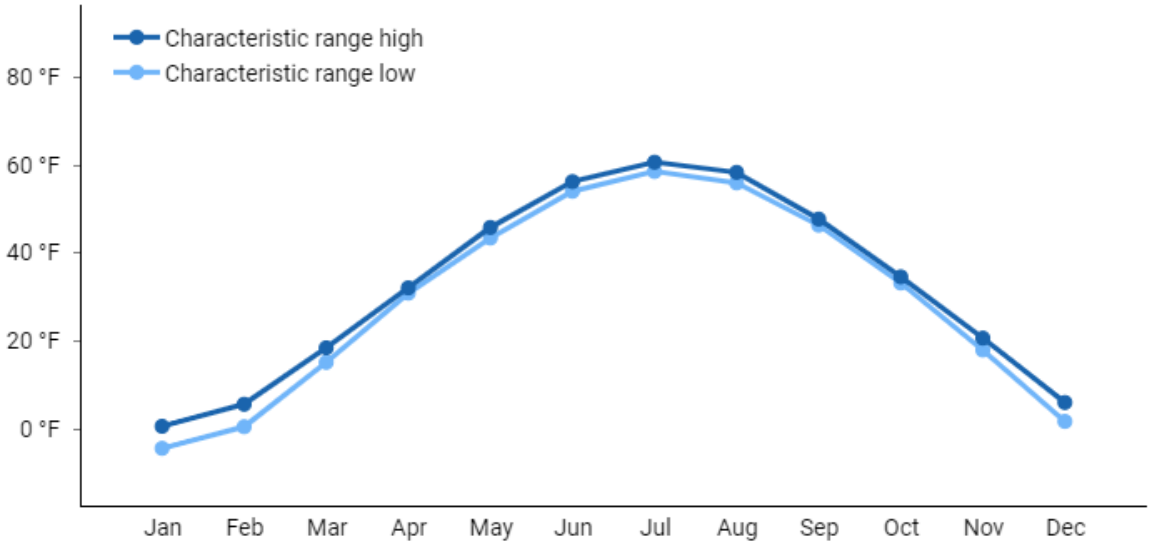
Normal Monthly Maximum Tempurature (F°)



Normal monthly minimum temperature (°F)

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

Normal Monthly Minimum Temperature (F°)



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 additional water, either as runoff from adjacent slopes or from a seasonal high-water table. Depth to the water table is deeper than 6 feet throughout the growing season. Surface infiltration and permeability through the profile are rapid. Water loss on this site occurs through percolation below the root zone and through evapotranspiration.

Representative Soil Features

Soils associated with Choppy Sands ES are in the Entisol and Mollisol orders. The Entisols are classified further as Typic Udipsamments; the Mollisols are classified further as Entic Hapludolls. These soils were developed under prairie vegetation. They formed primarily in eolian sands. These soils are very deep and excessively drained. The common features of soils in this site are the sandy textures throughout and dominant slopes exceeding 15 percent. The surface layer is typically fine sand, but loamy fine sand is included. It generally is <5 inches thick, but it may be as thick as 9 inches. Some areas may have buried A horizons. The rest of the soil profile is typically fine sand, but sand is included.

Salinity and sodicity are typically none throughout the soil profile. Soil reaction ranges from slightly acid to slightly alkaline (pH 6.1 to 7.8). Calcium carbonate content is none or very low.

Wind erosion is the greatest risk. Loss of the thin soil surface layer can result in a shift in species composition and/or production.

The major soil series correlated to the Choppy Sands site are Serden and Maddock.

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

Parent Material Kind: eolian sands
Parent Material Origin: lacustrine deposits, outwash
Surface Texture: fine sand
Surface Texture Modifier: none
Subsurface Texture Group: sand
Surface Fragments <3" (% Cover): 0
Surface Fragments ≥3" (%Cover): 0
Subsurface Fragments <3" (% Volume): 0
Subsurface Fragments ≥3" (% Volume): 0

	Minimum	Maximum
Drainage Class:	excessively	excessively
Permeability Class*:	rapid	rapid
Depth to first restrictive layer (inches):	80	>80

Electrical Conductivity (dS/m)*:	0	0
Sodium Absorption Ratio*:	0	0
Soil Reaction (1:1 Water)*:	6.1	7.8
Soil Reaction (0.1M CaCl2):	NA	NA
Available Water Capacity (inches)*:	2.5	4
Calcium Carbonate Equivalent (percent)*:	0	3

*These attributes represent from 0-40 inches.

Plant Communities

Ecological Dynamics of the Site:

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

Prior to European influence, the historical disturbance regime for MLRA 56A included frequent fires, both anthropogenic and natural in origin. Most fires, however, were anthropogenic fires set by Native Americans. Native Americans set fires in all months except perhaps January. These fires occurred in two peak periods, one from March-May with the peak in April and another from July-November with the peak occurring in October. Most of these fires were scattered and of small extent and duration. The grazing history would have involved grazing and browsing by large herbivores (such as American bison, elk, and whitetail deer). Herbivory by small mammals, insects, nematodes, and other invertebrates are also important factors influencing the production and composition of the communities. Grazing and fire interaction, particularly when coupled with drought events, influenced the dynamics discussed and displayed in the following state and transition diagram and descriptions.

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

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

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

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

Reference State is thought to have shifted temporally and spatially between three plant community phases.

Currently the primary disturbances include widespread introduction of exotic plants, concentrated livestock grazing, lack of fire, and perhaps long-term non-use 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 (such as Kentucky bluegrass, smooth brome, quackgrass, and/or crested wheatgrass) which have been particularly and consistently invasive under long-term non-use or very light grazing, and no fire. Other exotic plants (e.g., Canada thistle, leafy spurge) are also known to invade the site.

Three community phases have been identified for this state, 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 4: Invaded State should be expected (T2B). This state may also transition to State 3: Wooded State during extended periods of non-use or very light grazing, and no fire (T2A).

State 3: Wooded State. This state historically existed as small patches of trees and/or shrubs scattered across the site when precipitation, fire frequency, and other factors enabled woody species to colonize or encroach on the site. This often resulted in a mosaic of patches of woody vegetation interspersed within the grass dominated vegetation. A marked increase in non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread. Two community phases have been identified and often result from long-term non-use or very light grazing and no fire (T2A, R4B). Brush control (e.g., herbicide, mechanical, prescribed burning) may lead to State 2: Native/Invaded State (R3A). However, depending on the abundance of exotic cool-season grasses, brush control may need to be followed by a range planting to complete the restoration.

State 4: Invaded State. The threshold for this state is reached when the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, crested wheatgrass) exceed 30% of the plant community and native grasses represent less than 40% of the community. One community phase has been identified for this state.

The exotic cool-season grasses can be quite invasive and often form monotypic stands. As they increase, both forage quantity and quality of the annual production becomes increasingly restricted to late spring and early summer, even though annual production may increase. Forb diversity often

declines. Under non-use or minimal use management, mulch can increase and become a physical barrier to plant growth which alters nutrient cycling, infiltration, and soil biological activity. As such, desirable native plants become increasingly displaced.

Once the state is well established, prescribed burning and prescribed grazing techniques have been largely ineffective in suppressing or eliminating the exotic cool-season grasses, even though some short-term reductions may appear successful. However, assuming there is an adequate component of native grasses to respond to treatments, a restoration pathway to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing in conjunction with prescribed burning (R4A). This state may also transition to State 3: Wooded State during long-term non-use or very light grazing, and no fire (T4A).

State 5: Go-Back State results from the cessation of ground disturbance, often over-use with extended drought or human disturbance (e.g., off-road vehicle use, non-motorized use (hiking, biking, horseback, etc.); it consists of only one community phase. This weedy assemblage may include noxious weeds that need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, quackgrass, and/or crested wheatgrass) will likely predominate.

Initially, due to extensive bare ground and a preponderance of shallow-rooted annual plants, the potential for soil erosion is high. Plant species richness may be high, but overall diversity (i.e., equitability) is typically low, with the site dominated by a relatively small assemblage of species. Due to the lack of native perennials and other factors, restoring the site with the associated ecological processes is difficult. However, a successful range planting may result in something approaching State 2: Native/Invaded State (R5A). Following seeding, prescribed grazing, prescribed burning, haying, and the use of herbicides will generally be necessary to achieve the desired result and control weeds, some of which may be noxious weeds. A failed range planting and/or secondary succession will lead to State 4: Invaded State (R5B).

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

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

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

Plant Communities and Transitional Pathways

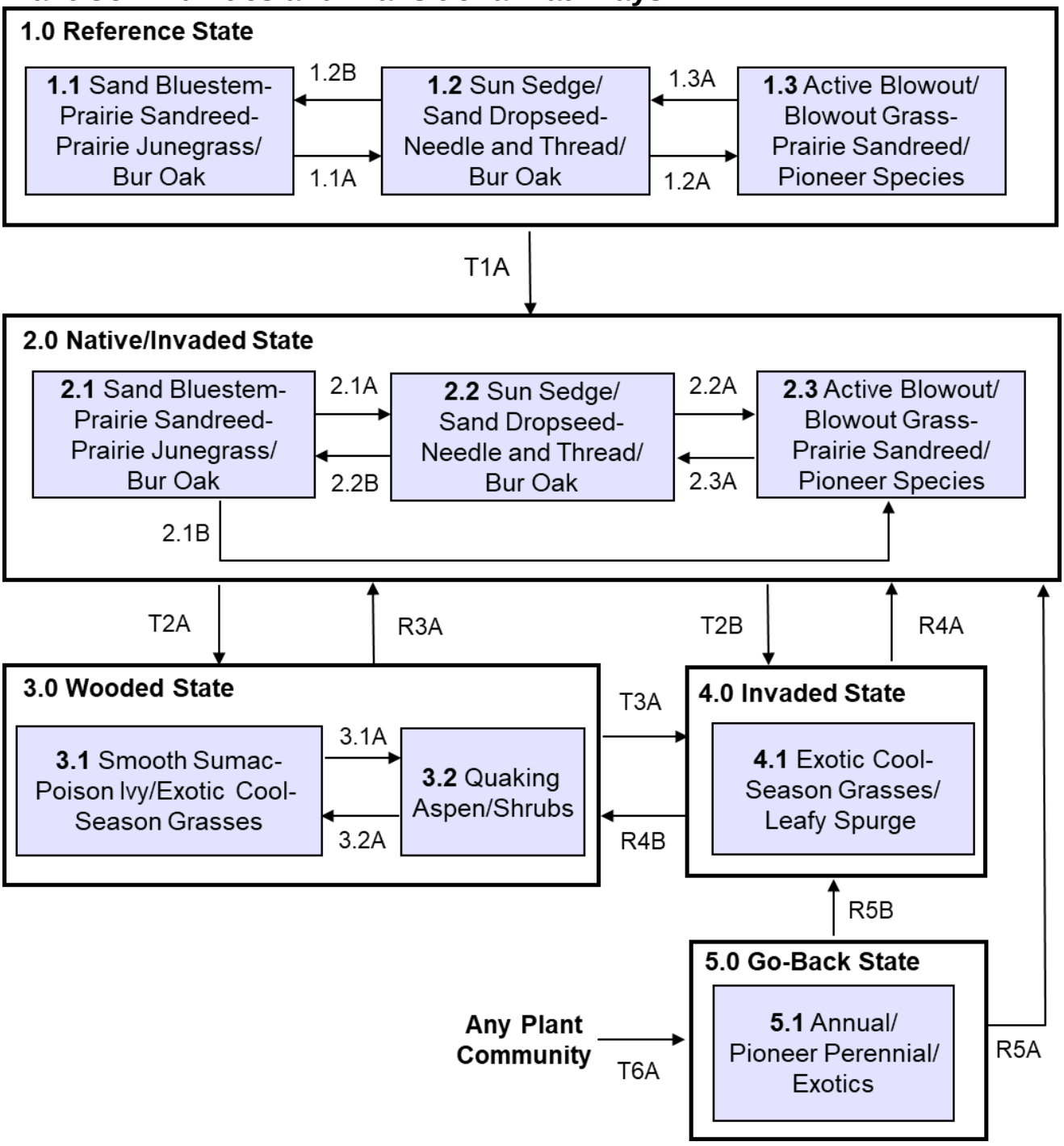


Diagram Legend - MLRA 56A Choppy Sands

T1A	Introduction of exotic plants
T2A	Long-term non-use or very light grazing and no fire
T2B	Heavy season-long grazing
T3A	Brush control (i.e. herbicide, mechanical, prescribed burning)
T4A	Long-term non-use or very light grazing and no fire
T6A	Cessation of ground disturbances
R3A	Brush control, perhaps followed by range planting
R4A	Long-term prescribed grazing and prescribed burning
R5A	Successful range planting
R5B	Failed range planting and/or secondary succession
CP 1.1 - 1.2 (1.1A)	Periods of below average precipitation
CP 1.2 - 1.3 (1.2A)	Multiyear drought, excessive disturbance
CP 1.2 - 1.1 (1.2B)	Return to average precipitation and disturbance regime
CP 1.3 - 1.2 (1.3A)	Return to average precipitation and disturbance regime
CP 2.1- 2.2 (2.1A)	Long-term heavy grazing and/or multiyear below average precipitation
(CP 2.1-2.3 (2.1B)	Excessive disturbance
CP 2.2 - 2.3 (2.2A)	Multiyear drought, excessive disturbance
CP 2.2 - 2.1 (2.2B)	Long-term prescribed grazing and prescribed burning
CP 2.3 - 2.2 (2.3A)	Return to average precipitation, long-term prescribed grazing and prescribed burning
CP 3.1 - 3.2 (3.1A)	Long-term non-use or very light grazing and no fire
CP 3.2 - 3.1 (3.2A)	Long-term prescribed burning and/or mechanical treatment

State 1: Reference State

This state represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. The primary disturbance mechanisms for this site in the reference condition included 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 three community phases.

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

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

Community Phase 1.1: Sand Bluestem-Prairie Sandreed-Prairie Junegrass/Bur Oak (*Andropogon hallii-Calamovilfa longifolia-Koeleria macrantha/Quercus macrocarpa*)

This community phase was the most dominant both temporally and spatially. Tall statured warm-season grasses (such as sand bluestem and prairie sandreed) would have been co-dominant with mid statured warm-season and cool-season grasses (such as needle and thread, porcupinegrass, and little bluestem). Other grasses and grass-like species would have included sideoats grama,

Canada wildrye, sand dropseed, prairie Junegrass, blue grama, and sun sedge. A variety of perennial forbs including prairie spiderwort, dotted blazing star, goldenrod, field sagewort, hairy false goldenaster, silky prairie clover, and sunflower were present. Shrubs included prairie sagewort, leadplant, Saskatoon serviceberry, chokecherry, smooth sumac, and prairie rose. Single stemmed bur oak trees would have been scattered across the site with oak mottes (a grove or clump of trees) occurring on some north-facing slopes. Due to a diverse assemblage of plants (both rhizomatous and bunchgrasses) and presence of plant litter, this community would have been characterized by high infiltration, little runoff, and high drought tolerance.

Annual production varied from about 1500-2700 pounds per acre with grasses and grass-likes, forbs, shrubs, and trees contributing about 80%, 10%, 7% and 3%, respectively. Both warm-season grasses and cool-season grasses were well represented in the community; as a result, production was distributed throughout the growing season. This community represents the plant community phase upon which interpretations are primarily based and is described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description.

Plant Community Composition and Group Annual Production

		1.1 Sand Bluestem-Prairie Sandreed-Prairie Junegrass/Bur Oak		
COMMON/GROUP NAME	**SYMBOL**	**Group**	**lbs./acre**	**% Comp**
GRASSES & GRASS-LIKES			*1470 - 1680*	*70 - 80*
TALL-WARM SEASON		**1**	**315 - 840**	**15 - 40**
sand bluestem	ANHA	1	315 - 420	15 - 20
prairie sandreed	CALO	1	210 - 315	10 - 15
COOL-SEASON BUNCH		**2**	**105 - 420**	**5 - 20**
needle and thread	HECO26	2	210 - 315	10 - 15
porcupinegrass	HESP11	2	21 - 63	1 - 3
Canada wildrye	ELCA4	2	21 - 42	1 - 2
MID WARM-SEASON		**3**	**210 - 420**	**10 - 20**
sideoats grama	BOCU	3	42 - 105	2 - 5
little bluestem	SCSC	3	105 - 210	5 - 10
sand dropseed	SPCR	3	21 - 105	1 - 5
SHORT WARM-SEASON		**4**	**21 - 105**	**1 - 5**
blue grama	BOGR2	4	42 - 105	2 - 5
hairy grama	BOHI2	4	0 - 63	0 - 3
OTHER NATIVE GRASSES		***5***	***21 - 105***	***1 - 5***
Scribner's rosette grass	DIOLS	5	21 - 42	1 - 2
prairie Junegrass	KOMA	5	21 - 63	1 - 3
other native perennial grasses	2GR	5	42 - 105	2 - 5
GRASS-LIKES		**6**	**105 - 210**	**5 - 10**
sun sedge	CAINH2	6	42 - 105	2 - 5
Schweinitz's flatsedge	CYSC3	6	0 - 21	0 - 1
other grass-likes	2GL	6	21 - 105	1 - 5
FORBS		***7***	***105 - 210***	***5 - 10***
field sagewort	ARCA12	7	21 - 63	1 - 3
white sagebrush	ARLU	7	21 - 63	1 - 3
prairie spiderwort	TROC	7	21 - 63	1 - 3
Cuman ragweed	AMPS	7	21 - 42	1 - 2
silky prairie clover	DAVI	7	21 - 42	1 - 2
smooth horsetail	EQLA	7	21 - 42	1 - 2
western wallflower	ERCAC	7	21 - 42	1 - 2
stiff sunflower	HEPA19	7	21 - 42	1 - 2
dotted blazing star	LIPU	7	21 - 42	1 - 2
rush skeletonweed	LYJU	7	21 - 42	1 - 2
flat-top goldentop	EUGR5	7	0 - 42	0 - 2
common sunflower	HEAN3	7	0 - 42	0 - 2
goldenrod	SOLID	7	0 - 42	0 - 2
wild onion	ALLIU	7	0 - 21	0 - 1
milkweed	ASCLE	7	0 - 21	0 - 1
thymeleaf spurge	CHSES	7	0 - 21	0 - 1
prostrate spurge	EUMA	7	0 - 21	0 - 1
false hairy goldenaster	HEVIV	7	0 - 21	0 - 1
hoary puccoon	LICA12	7	0 - 21	0 - 1
Lewis flax	LILE3	7	0 - 21	0 - 1
narrowleaf stoneseed	LIIN2	7	0 - 21	0 - 1
other native perennial forbs	2FP	7	21 - 63	1 - 3
SHRUBS		***8***	***105 - 147***	***5 - 7***
leadplant	AMCA6	8	21 - 42	1 - 2
prairie sagewort	ARFR4	8	21 - 42	1 - 2
Saskatoon serviceberry	AMAL2	8	0 - 21	0 - 1
hawthorn	CRATA	8	0 - 21	0 - 1
western sandcherry	PRPUB	8	0 - 21	0 - 1
chokecherry	PRVI	8	0 - 21	0 - 1
smooth sumac	RHGL	8	0 - 21	0 - 1
gooseberry	#N/A	8	0 - 21	0 - 1
prairie rose	ROAR3	8	0 - 21	0 - 1
American red raspberry	RUID	8	0 - 21	0 - 1
prairie willow	SAHU2	8	0 - 21	0 - 1
western snowberry	SYOC	8	0 - 21	0 - 1
poison ivy	TORA2	8	0 - 21	0 - 1
common pricklyash	ZAAM	8	0 - 21	0 - 1
other native shrubs	2SHRUB	8	0 - 21	0 - 1
TREES		***9***	***21 - 63***	***1 - 3***
quaking aspen	POTR5	9	21 - 63	1 - 3
bur oak	QUMA2	9	21 - 63	1 - 3
hackberry	CEOC	9	0 - 21	0 - 1

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	1300 -	1817	- 2335
FORBS	100 -	158	- 215
SHRUBS	100 -	126	- 150
TOTAL	1500 -	2100	- 2700

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

Community Phase Pathway 1.1A
Community Phase Pathway 1.1 to 1.2 occurred during periods of below average precipitation which may have been intensified by repeated heavy grazing, either due to proximity to water or following short term fire intervals followed by intense grazing. The competitive advantage shifted to the more grazing tolerant mid statured bunchgrasses (such as needle and thread and sand dropseed), short statured grass-likes, and warm-season short statured grasses like blue grama.

Community Phase 1.2: Sun Sedge/Sand Dropseed-Needle and Thread/Bur Oak (*Carex inops/Sporopobolus cryptandrus-Hesperostipa comata/Quercus macrocarpa*)
Grasses and grass-like species would have still dominated this phase, but the overall productivity of these species would have been reduced while forbs would have increased. Needle and thread, blue grama, sand dropseed, and sedges would have increased. Prairie sandreed and the bluestems would have decreased but still would have been present. Forb species (such as field sagewort, goldenrod, Cuman ragweed, common yarrow, and upright prairie coneflower) would have increased. Regeneration of bur oak was reduced.

The shift to the shallower rooted, short statured blue grama and sedges, coupled with an increase in bare ground, resulted in higher soil surface temperatures as compared to Community Phase 1.1. Due to soil texture, infiltration rates would have been similar to Community Phase 1.1. Annual production would have slightly reduced compared to that of Community Phase 1.1.

Community Phase Pathway 1.2A
Community Phase Pathway 1.2 to 1.3 occurred with excessive disturbances (such as multiyear drought, wildlife trailing or burrowing, or heavy grazing by wildlife due to proximity to a perennial water source) which would have significantly reduced perennial plant cover, reduced soil surface cover, and increased basal gap distance. This, coupled with the repeated disturbances, would have increased the amount of soil erosion due to wind, resulting in a blowout condition. These blowouts may have been relatively small and isolated or, depending upon the extent of the disturbance mechanism (i.e., long-term drought), covered larger areas.

Community Phase Pathway 1.2B
Community Phase Pathway 1.2 to 1.1 occurred with a return to average precipitation patterns, grazing and fire regime which allowed for the recovery of tall statured warm-season species and mid statured warm-season and cool-season bunch grasses. As the plant community recovered, basal gaps would have decreased, and plant litter would have increased.

Community Phase 1.3: Active Blowout/Blowout Grass-Prairie Sandreed/Pioneer Species (Active Blowout/*Redfieldia flexuosa-Calamovilfa longifolia*/Pioneer Species)
This plant community phase was not stable. It consisted of bare areas that were continually eroded by wind. Vegetation was spare and scattered. Patches of sand bluestem and prairie sandreed would have been scattered across the site with blowout grass and other pioneer perennial and annual species (such as mat sandbur and common sunflower) comprising the majority of the vegetation. Active wind erosion was very evident with soil deposition on the leeward side of blowouts common. Excessive soil erosion in isolated instances may have resulted in a change in ecological site depending upon depth to water table. As erosion progressed, Subirrigated Sands and/or Subirrigated ecological sites may have developed within the Choppy Sands ecological site complex.

Annual production and plant litter would have been greatly reduced as compared to Plant Community Phase 1.1, with bare ground exceeding 90 percent.

Community Phase Pathway 1.3A

Community Phase Pathway 1.3 to 1.2 occurred over several years of average or above average precipitation and a reduction or elimination of the disturbance resulting in an increase in sand bluestem, blowout grass, and pioneer annuals and perennials. This additional cover (plant litter and basal) would have altered the wind patterns at the soil surface as the pathway proceeded.

Transition T1A

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

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

State 2: Native/Invaded State

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

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

These exotic cool-season grasses have been particularly and consistently invasive under extended periods of non-use and no fire. To slow or limit the invasion of these exotic grasses, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 4: Invaded State should be expected.

Annual production of this state can be quite variable, in large part due to the amount of exotic cool-season grasses. Production, however, may be expected to be similar to that of State 1: Reference State (i.e.,1500-2700 pounds per acre).

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

Resilience management (i.e., management strategies that will sustain a state and prevent a transition). To slow or limit the invasion of these exotic grasses, it is imperative that managerial

techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective.

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

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

Community Phase 2.1: Sand Bluestem-Prairie Sandreed-Prairie Junegrass/Bur Oak (*Andropogon hallii-Calamovilfa longifolia-Koeleria macrantha/Quercus macrocarpa*)

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, and/or crested wheatgrass). However, these exotics are present in smaller amounts with the community still dominated by native grasses. Also, due to the altered fire regime, oak mottes on north-facing slopes have increased in size and canopy cover.

Annual production may be comparable to that of Community Phase 1.1 (1500-2700 pounds per acre). However, as the exotic cool-season grasses increase, peak production will shift to earlier in the growing season. This plant community phase is described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description.

Figure 1. Community Phase 2.1: Sand Bluestem-Prairie Sandreed-Prairie Junegrass/Bur Oak.

Community Pathway 2.1A
Community Phase Pathway 2.1 to 2.2. This pathway occurs with long-term heavy grazing and/or multiyear below average precipitation. Long-term heavy grazing will shift the competitive advantage away from the tall warm-season rhizomatous grasses and mid statured warm-season and cool-season grasses to more grazing tolerant short statured grasses, grass-likes, and forbs. Multiyear periods of below average precipitation will intensify the impact of the grazing and further facilitate this transition. Multiyear drought would also result in this shift, with or without the grazing pressure.

Community Phase Pathway 2.1B
Community Phase Pathway 2.1 to 2.3. Excessive disturbance, such as that related to off-road vehicle use or livestock trailing that removes plant cover, results in a direct shift to plant community phase 2.3.

Community Phase 2.2: Sun Sedge/Sand Dropseed-Needle and Thread/Bur Oak (*Carex inops/Sporopobolus cryptandrus-Hesperostipa comata/Quercus macrocarpa*)
This community phase is similar to Community Phase 1.2 but has now been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass). These exotics, however, are present in smaller amounts with the community still dominated by native grasses.

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

A shift to shallower rooted and short statured species, coupled with an increase in bare ground, results in higher soil surface temperatures compared to Community Phase 2.1. Infiltration rates would be similar, as would the timing of plant production. Annual plant production, however, is slightly reduced.

Community Phase Pathway 2.2A
Community Phase Pathway 2.2 to 2.3 occurs with multiyear drought and/or excessive disturbances (e.g., livestock trailing/loafing due to proximity to a perennial water source, off-road vehicle use) which would significantly reduce perennial plant cover, reduce soil surface cover, and increase basal gaps. This, coupled with the repeated disturbances, increases the amount of wind erosion resulting in a blowout condition.

Community Phase Pathway 2.2B
Community Phase Pathway 2.2 to 2.1 is initiated by implementation of long-term prescribed grazing and prescribed burning which includes adequate recovery periods following each grazing event and stocking levels which match the available resources. If properly implemented, this will shift the competitive advantage away from the introduced cool-season species and back to the tall statured warm-season rhizomatous grasses and mid statured warm-season and cool-season grasses. The addition of properly timed prescribed burning may expedite this shift.

Community Phase 2.3: Active Blowout/Blowout Grass-Prairie Sandreed/Pioneer Species (Active Blowout/*Redfieldia flexuosa-Calamovilfa longifolia*/Pioneer Species)

This community phase is similar to Community Phase 1.3 but has been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, and/or crested wheatgrass). However, these exotics are present in smaller amounts with the community still dominated by native grasses. Leafy spurge is also an exotic species of concern.

This plant community may be characterized by “blowouts” (i.e., active dunes and/or denuded areas caused by wind erosion). Active wind erosion is conspicuous with soil deposition on the leeward side of the “blowouts”. It is unstable and generally occupies small, isolated areas (e.g., 2 acres or less), but can increase to become more extensive. Vegetation consists of sparse and scattered patches of sand bluestem and prairie sandreed along with blowout grass and other pioneer perennial and annual species (e.g., mat sandbur). Exotic forbs such as leafy spurge may also be present.

Figure 2. Community Phase 2.3: Active Blowout/Blowout Grass-Prairie Sandreed/Pioneer Species

Community Phase Pathway 2.3A

Community Phase Pathway 2.3 to 2.2 occurs with return to average precipitation and the implementation of long-term prescribed grazing and prescribed burning which includes adequate recovery periods following each grazing event and stocking levels which match the available resources will allow the remaining vegetation to recolonize and stabilize the site. Depending on the level of grazing management, fencing, seeding, mulching, and complete deferment of the site for a couple of growing seasons may be necessary to speed the transition. Variation in seasonal precipitation may speed or delay recovery.

Transition T2A

This transition from the State 2: Native/Invaded to State 3: Wooded State generally occurs during long-term non-use or very light grazing, and no fire. Complete rest from grazing and elimination of fire

are the two major contributors to this transition. Removal of these two disturbances shifts the competitive advantage within the herbaceous component of the plant community to exotic plants, such as Kentucky bluegrass and leafy spurge. The lack of repeated fire events permits shrubs (such as smooth sumac, poison ivy, and/or chokecherry) to expand from the edges of oak mottes into the adjacent herbaceous communities. Once established, this facilitates further expansion of the tree and shrub components. As shrub and tree canopy cover increases, the potential for disturbance by fire decreases due to lack of fuel and reduction of fire behavior.

Constraints to recovery (i.e., variables or processes that preclude recovery of the former state). The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of tree seeds from adjacent sites will hamper site restoration.

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

Transition T2B

The Transition from State 2: Native/Invaded State to State 4: Invaded State occurs with heavy season-long grazing. It may also occur with other management (e.g., long-term non-use or very light grazing and no fire). Leafy spurge is a frequent invader of the site. As leafy spurge becomes established on the site, it limits use by livestock and changes the micro-climate at the soil surface which facilitates a shift from the native herbaceous species to a community dominated by introduced grass and forb species. It is speculated that the application of certain herbicides in an effort to control leafy spurge may facilitate an increase in 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.

State 3: Wooded State

This state historically existed as small patches of trees and/or shrubs scattered across the site, particularly when close to wooded areas where trees and shrubs could have encroached onto the site vegetatively (e.g., rhizomes, root sprouts) or provided a seed source for colonization of the site. Variations in fire frequency enabled woody plant species in some areas (i.e., period of infrequent fire) to grow large enough to escape the next fire event. As trees increased in size, canopy cover increased which altered micro-climate and reduced fine fuel amounts resulting in reduced fire intensity and frequency. This would have been the primary pathway under the historic disturbance regime and would have resulted in a mosaic pattern of small, wooded patches interspersed within herbaceous plant community phases. A marked increase in non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread.

Smooth sumac or poison ivy often initially become the dominant shrubs within the herbaceous portion of the site. Remnant warm-season and cool-season grasses and forbs are still found within these shrubs but in reduced amounts due to increased shading. Kentucky bluegrass is often present but may or may not be the dominant herbaceous species. Chokecherry and Saskatoon serviceberry

thickets become more common near the edges of the bur oak mottes, as do young trees such as green ash and hackberry.

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

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

Community Phase 3.1: Smooth Sumac-Poison Ivy/Exotic Cool-Season Grasses (*Rhus glabra-Toxicodendron rydbergii*/Exotic Cool-Season Grasses)

This plant community phase represents the shift from an herbaceous dominated plant community with scattered bur oak and oak mottes to one dominated by shrubs, such as smooth sumac or poison ivy, with an herbaceous understory dominated by Kentucky bluegrass and leafy spurge. Remnant native grasses and grass-likes would include sand dropseed, needle and thread, blue grama, and sun sedge. Forbs would include Cuman ragweed, field sagewort, and white sagebrush. As the canopy cover of this shrub layer increases, the herbaceous plant community shifts from the remnant warm-season and cool-season native species to the more shade tolerant Kentucky bluegrass. Existing bur oak mottes would increase in size as shrubs - such as Saskatoon serviceberry, chokecherry, and western snowberry (usually associated with the exterior fringe of the oak motte) - expand outward into the adjacent herbaceous dominated plant community. As the shrub component increases, herbaceous production declines. This, combined with the shading effect of the shrubs, limits the effectiveness of prescribed burning as a restoration tool.

Figure 3. Community Phase 3.1: Smooth Sumac-Poison Ivy/Exotic Cool-Season Grasses

Community Phase Pathway 3.1A

Community Phase Pathway 3.1 to 3.2 results from long-term non-use or very light grazing, and no fire. The lack of disturbance, primarily fire, shifts the competitive advantage to the taller, fast growing tree species such as quaking aspen. As the quaking aspen canopy increases, shade tolerant understory species increase. Increasing canopy cover also serves to further decrease fire intensity and frequency.

Community Phase 3.2: Quaking Aspen/Shrubs (*Populus tremuloides*/Shrubs)

Once established, the quaking aspen's fast growth and clonal expansion often enables it to out-compete slower growing trees such as bur oak. Red cedar and buckthorn may invade the site. Quaking aspen may also encroach onto the site from adjacent Subirrigated Sands and Subirrigated ecological sites.

Figure 4. Community Phase 3.2: Quaking Aspen/Shrubs

Community Phase Pathway 3.2A

Community Phase Pathway 3.2 to 3.1 occurs with long-term prescribed burning and/or mechanical treatment. Long-term prescribed burning and/or mechanical treatment shifts the plant community to a more open canopy dominated by an herbaceous plant community.

Transition T3A

This transition from State 3: Wooded State to State 4: Invaded State can be accomplished with brush control. Initial use of herbicides and/or mechanical brush control to reduce smooth sumac and other

shrubs will permit adequate fine fuel loads to establish, permitting the application of prescribed fire to further control sprouting shrubs species.

Constraints to recovery (i.e., variables or processes that preclude recovery of the former state). The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of tree seeds from adjacent sites will hamper site restoration.

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

Restoration R3A

This restoration pathway from State 3: Wooded State to State 2: Native/Invaded State can be accomplished with brush control. Initial use of herbicides and/or mechanical brush control to reduce smooth sumac and other shrubs will permit adequate fine fuel loads to establish, permitting the application of prescribed fire to further control sprouting shrubs species. However, depending upon level of remnant native grasses and forbs, a range planting may also be necessary to re-establish the herbaceous plant community.

A combination of mechanical brush management, chemical treatment, and prescribed burning is necessary to remove the woody vegetation and, if necessary, to prepare the seedbed for a successful range planting. Once this is accomplished, it may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. The application of several prescribed burns may be needed at relatively short intervals in the early phases of this restoration process, in part because many of the shrubs (e.g., western snowberry) sprout profusely following one burn. After establishment of the native plant species, management objectives must include the maintenance of those species, the associated reference state functions, and continued treatment of exotic grasses. Due to the resprouting nature of woody species within MLRA 56A, repeated treatments will be necessary for a transition from this state.

Following the removal of woody species, other restoration practices (such as range planting, prescribed burning, and prescribed grazing) may be necessary to complete the restoration. The prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources. If properly implemented, this will help suppress any exotic cool-season grasses on the site.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Prescribed burning should be applied in a manner that enhances the competitive advantage of native grass and forb species over the exotic species. Prescribed burns should be applied at a frequency which mimics the natural disturbance regime or more frequently as is ecologically (e.g., available fuel load) and economically feasible. Burn prescriptions may need adjustment to: (1) account for change in fuel type (herbaceous vs. shrub vs. tree), fine fuel amount and orientation; (2) fire intensity and duration by adjusting ignition pattern (e.g.,

backing fires vs head fires); (3) account for plant phenological stages to maximize stress on woody and exotic species while favoring native species (both cool- and warm-season grasses).

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

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

State 4: Invaded State

This state is often characterized by an almost total dominance of Kentucky bluegrass and leafy spurge or perhaps other exotic cool-season grasses (e.g., quackgrass, smooth brome, crested wheatgrass) and leafy spurge. Remnant native species may still be found on the site but in only minor amounts. The exotic cool-season grasses can be quite invasive on the site and are particularly well adapted to heavy grazing. They also often form monotypic stands. As these exotic cool-season grasses increase, both forage quantity and quality become increasingly restricted to late spring and early summer due to the monotypic nature of the stand, even though annual production may increase. Native forbs generally decrease in production, abundance, diversity, and richness compared to that of State 1: Reference State. Common forbs often include white heath aster, goldenrod, common yarrow, and white sagebrush. Shrubs, such as western snowberry and rose, may show marked increases. Once the state is well established, prescribed burning and grazing techniques have been largely ineffective in suppressing or eliminating these species, even though some short-term reductions may appear successful.

Annual production of this state may vary widely, in part due to variations in the extent of invasion by exotic cool-season grasses. However, annual production may be in the range of 2300-3300 pounds per acre with the exotic cool-season grasses accounting for the bulk of the production.

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

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

Community Phase 4.1: Exotic Cool-Season Grasses/Leafy Spurge (Exotic Cool-Season Grasses/*Euphorbia esula*)

This community phase is recognized by the dominance of exotic cool-season grasses and leafy spurge. Kentucky bluegrass is often the major exotic cool-season grass; other common exotic cool-season grasses that invade the site include smooth brome, quackgrass, and crested wheatgrass. The lack of disturbance allows plant litter amounts to increase, further shifting the competitive advantage to these exotic species. Tall, mid and short statured warm-season and cool-season native species begin to decline until they are completely displaced. Research would indicate that leafy spurge alters soil microbiology in a manner which inhibits the growth of native species. This effectively reduces any potential for restoration to a native dominated plant community without very significant intervention.

Compared to State 1: Reference State, herbaceous production has declined while peak production has shifted to early spring through early summer. Plant diversity is also reduced. However, infiltration and runoff remain much the same.

Figure 5. Community Phase 4.1: Exotic Cool-Season Grasses/Leafy Spurge. Note infestation of leafy spurge.

Restoration R4A

This restoration pathway from State 4: Invaded State to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing and prescribed burning, assuming there is an adequate component of native grasses to respond to the treatments.

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

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

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

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

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

Transition T4A

This transition from State 4: Invaded State to State 3: Wooded State occurs during long-term non-use or very light grazing, and no fire. This enables shrubs, such as smooth sumac and poison ivy, to expand from the edges of bur oak mottes into the adjacent herbaceous communities. Once established, this facilitates further expansion of the tree and shrub components. As shrub and tree canopy cover increases, the potential for disturbance by fire decreases due to lack of fine fuels and reduction in fire behavior.

Constraints to recovery (i.e., variables or processes that preclude recovery of the former state). The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of tree seeds from adjacent sites will hamper site restoration.

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

State 5: Go-Back State

This state is highly variable depending on the level and duration of disturbance related to the T6A transitional pathway. In this MLRA, the most probable origin results from the cessation of ground disturbance, often over-use with extended drought or human disturbance (e.g., off-road vehicle use, non-motorized use (hiking, biking, horseback, etc.), and consists of only one community phase. This

plant community will initially include a variety of annual forbs and grasses, some of which may be noxious weeds and need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, quackgrass, and/or crested wheatgrass) will likely predominate.

Characteristics and indicators (i.e., characteristics that can be used to distinguish this state from others). Ground disturbance has destroyed the native plant community, altered soil structure and biology, and reduced soil organic matter. 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 ground disturbance will maintain the state. Control of noxious weeds will be required.

Restoration R5A

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

It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, 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 R5B

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

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Failed range plantings can result from many causes (both singularly and in combination) including drought, poor seedbed preparation, improper seeding

methods, seeded species not adapted to the site, insufficient weed control, herbicide carryover, poor seed quality (purity & germination), and/or improper management.

Transition T6A

This transition from any plant community to State 5: Go-Back State. It is commonly associated with the cessation of ground disturbance, often over-use with extended drought or human disturbance (e.g., off-road vehicle use, non-motorized use (hiking, biking, horseback, etc.) without the benefit of a 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 history (e.g., erosion, fertility, and/or herbicide/pesticide carryover). Thus, soil conditions should be assessed when considering restoration techniques.

Ecological Site Interpretations

Animal Community – Wildlife Interpretations

Landscape

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

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

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

Historic Communities/Conditions within MLRA 56A:

The northern tall- and mixed-grass prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary ecological drivers - either singly or often in

combination. Frequent and expansive flooding along the Red River and its tributaries provided abundant opportunities for Native Americans to harvest wild rice. American bison roamed MLRA 56A wintering along the Red River and migrating west into MLRA 55A and 55B for parts of the season. Many species of grassland birds, small mammals, insects, reptiles, amphibians, and large herds of roaming American bison, elk, and pronghorn were historically among the inhabitants adapted to this region. Roaming herbivores, as well as several small mammal and insect species, were the primary consumers linking the grassland resources to large predators (such as the wolf and American black bear) and smaller carnivores (such as the coyote, bobcat, red fox, and raptors). Extirpated species include free-ranging American bison and gray wolf (breeding). Extinct from the region is the Rocky Mountain locust.

Present Communities/Conditions within MLRA 56A:

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

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

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

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

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

Some characteristic wildlife species in this area are:

Birds: Mallard, blue-winged teal, red-tailed hawk, American kestrel, ring-necked pheasant, western meadowlark, killdeer, eastern and western kingbird, American crow, common

yellowthroat, downy and hairy woodpecker, clay-colored sparrow, vesper sparrow, Savannah sparrow, and brown-headed cowbird.

Mammals: Northern short-tailed shrew, white-tailed jackrabbit, snowshoe hare, Franklin's ground squirrel, thirteen-lined ground squirrel, northern pocket gopher, plains pocket gopher, western harvest mouse, deer mouse, meadow vole, meadow jumping mouse, western jumping mouse, coyote, red fox, raccoon, American badger, striped skunk, white-tailed deer, North American beaver, and moose.

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

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

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

Species of Concern within MLRA 56A:

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

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

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

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

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

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

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

Grassland Management for Wildlife in MLRA 56A:

Management activities within the community phase pathways have both short and long term positive and negative impacts on wildlife. Community phase, transitional, and restoration pathways are keys to long-term management within each State and between States. Significant inputs must occur to cross the threshold between States (e.g., State 3.0 to 2.0) requiring substantial economic inputs and management (grazing intensity, reseeding, prescribed fire, woody vegetation removal, etc.). Timing, intensity, and frequency of these inputs can have dramatic positive or negative effects on vegetative structure impacting local wildlife species' habitats. Ranchers and other land managers must always consider the long-term beneficial effects of management on the habitat in comparison to potential short-term negative effects to individual species.

Ecological sites occur as intermingled complexes on the landscape with gradual or sometimes abrupt transitions. Rarely do ecological sites exist in large enough acreage to manage independently. Ecological sites supporting a dominance of herbaceous vegetation (Wet Meadow, Subirrigated Sands) can be located adjacent to ecological sites that support trees (Choppy Sands and Loamy Overflow).

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

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

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

Understanding preferred vegetative stature and sensitivity to woody encroachment is necessary to manage for the specific grassland species. Various grass heights may be used for breeding,

nesting, or foraging habitat. While most species use varying heights, many have a preferred vegetative stature height. The following chart provides preferred vegetative stature heights and sensitivity to woody vegetation encroachment.

Grassland-nesting Bird Species	Preferred Vegetative Stature			Avoids woody vegetation*
	Short < 6 inches	Medium 6 - 12 inches	Tall >12 inches	
Baird's sparrow	x	x		x
Bobolink		x	x	x
Brewer's sparrow	x	x		
Burrowing owl	x			x
Chestnut-collared longspur	x	x		x
Common yellowthroat			x	
Dickcissel		x	x	
Ferruginous hawk	x	x		
Grasshopper sparrow	x	x		x
Horned lark	x			x
Killdeer	x			x
Lark bunting	x	x		
Lark sparrow	x			
Le Conte's sparrow			x	x
Long-bill curlew	x			x
Marbled godwit	x	x		x
McCown's longspur	x	x		x
Mountain plover	x			x
Nelson's sparrow			x	x
Nesting waterfowl		x	x	
Northern harrier		x	x	x
Savannah sparrow		x	x	x
Short-eared owl		x	x	x
Sprague's pipit	x	x		x
Upland sandpiper	x	x		x
Western meadowlark	x	x		
Willet	x	x		x

*Many of the listed species avoid nesting in grassland areas with large amounts of woody vegetation within a grassland or avoid nesting near woody vegetation in adjacent habitats. Although these species avoid areas with woody vegetation, most can tolerate a small amount of woody vegetation within areas dominated by grassland habitat, including short-statured shrubs (e.g., western snowberry) in this MLRA.

Choppy Sands Wildlife Habitat Interpretation:

Choppy Sands ecological sites are located on hummocks and dunes with slope greater than 15 percent. They are found on various landforms including wind-worked deltas and outwash plains. No significant water table or surface run-on influences vegetation production on this site. Associated ecological sites include Sands, Subirrigated Sands, Subirrigated, and Wet Meadow. The tree component within Choppy Sands ecological site tends to fragment ecological site complexes that otherwise provide habitat for many edge-sensitive grassland bird species preferring medium- to tall-statured vegetation with little to no woody vegetation.

Dependent upon the density of bur oak, smooth sumac, and other trees and shrubs, Choppy Sands habitat features and components can support grassland-nesting birds that are tolerant to woody vegetation. Grassland nesting birds that commonly avoid woody vegetation will not have their habitat needs met when woody vegetation density exceeds their tolerance level. Insects rely on associated forbs and grasses for survival and serve as food sources for birds and their young, and forage for small and large herbivores. Although little bluestem and sideoats grama can occur, the site is too dry for Poweshiek skipperling and Dakota skipper larvae to survive. In addition, preferred nectar forbs do not occur on this ecological site. Milkweeds are available for meeting monarch butterfly habitat needs.

Choppy Sands ecological sites may be found in five plant community states (1.0 Reference State, 2.0 Native/Invaded State, 3.0 Wooded State, and 4.0 Invaded State, 5.0 Go-Back State) within a local landscape. Multiple plant community phases exist within State 1.0, 2.0, and 3.0. Today, these states occur primarily in response to precipitation (extended periods of above average precipitation or drought), fire, grazing, non-use. and other anthropogenic disturbances.

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using tools in State 1.0 and State 2.0 Community Phase Pathways to prevent further plant community degradation along the T2A Transitional Pathway to State 3.0 or T2B Transitional Pathway to State 4.0. Native wildlife generally benefits from the heterogeneous grasslands found in States 1.0, 2.0 and 3.0. 1.1, 1.2, 2.1, 2.2, 3.1, and 3.2. Plant communities within State 2.0 are dependent upon long term changes in precipitation with impacts compounded by grazing intensity and frequency.

Success along Restoration Pathway R4A from State 4.0 to State 2.0 is very difficult; it is dependent upon presence of a remnant native grass population and degree of management treatments applied. Managers must realize there is no restoration pathway back to State 1.0 and once the plant community reaches State 4.0, the restoration back to State 2.0 via Restoration Pathway R4A is difficult, requiring active management and monitoring over extended periods of time, and may not be achieved. Once established, this Community Phase 4.1 becomes very stable with only minor amounts of native species.

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 other ecological sites within the mobility limits of the species. Species with limited mobility, such as Dakota skippers, must exist near the plant community to utilize restored sites. Mobile species, such as grassland-nesting birds, can easily locate isolated, restored plant communities.

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 Sand Bluestem-Prairie Sandreed-Prairie Junegrass/Bur Oak:
This plant community offers quality vegetative cover for wildlife; every effort should be made, when found, to maintain this ecological site within this community phase. This phase retains high functionality through continued maintenance including prescribed grazing with adequate recovery period, as well as prescribed fire. Fire frequency maintains a grass-dominated plant community providing habitat for bird species sensitive to woody vegetation. Predominance of grass species in this community favors grazers and mixed-feeders (animals selecting grasses as well as forbs and shrubs). The structural diversity provides habitat for a wide array of migratory and resident birds.

Invertebrates: Insects play a role in maintaining the forb community and provide a forage base for grassland birds, reptiles, and rodents. Ecological services, historically provided by bison, are simulated by domestic livestock. These services include putting plant material and dung in contact with mineral soil to be used by lower trophic level consumers (such as invertebrate decomposers, scavengers, shredders, predators, herbivores, dung beetles, and fungal-feeders). The limited occurrence of bur oak and other tree and shrub species should not impact pollinator species.

No violet species are found on this site limiting use by Regal fritillary. Monarch butterfly may use flowering forbs on this site; milkweed species are found on this site to support caterpillar food. Bumblebees and other native bees utilize forbs as a nectar source with ample nesting site available due to the abundance of bare ground.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by mid- to tallgrass-nesting birds. Depending on density of oak trees and other trees and shrubs, grassland bird species tolerant to woody vegetation will use this site. Fire frequency maintains a grass-dominated plant community providing habitat for bird species sensitive to woody vegetation. In years with reduced precipitation or drought, nesting recruitment may be compromised. This plant community does not provide suitable areas for sharp-tailed grouse or greater prairie chicken lek sites. The oak mottes provide habitat for bluebirds, scarlet tanagers, vireos, oven bird, and cuckoos. This site provides good hunting opportunities for grassland raptors.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores including voles, mice, jackrabbits, white-tailed deer, and elk. Tall- to mid-statured vegetation provides suitable food, thermal, protective, and escape cover for small and large herbivores. Intermingled bur oak mottes and aspen clumps provide escape, thermal, winter and parturition cover for large ungulates. During periods of extremely wet conditions, North American beaver use aspen and other trees on this site.

Amphibians and Reptiles: This ecological site provides foraging opportunities for the northern leopard frog, tree frog, and Canadian toad since this site frequently can be found adjacent to Wet Meadow ecological sites. Northern prairie skinks and plains hog-nosed snakes will use this site since it provides sands habitat and open areas favored by these species.

Fish and Mussels: This ecological site is not typically adjacent to streams, rivers, or water bodies. This site typically does not receive run-on hydrology from adjacent ecological sites but may provide hydrology to Sands, Subirrigated Sands, or Subirrigated ecological sites. Management on Choppy Sands sites, in conjunction with neighboring run-on sites, will have an indirect effect on aquatic species in streams and/or tributaries receiving water from

Choppy Sands and adjacent sites. Optimum hydrological function and nutrient cycling limit potential for sediment yield and nutrient loading to the adjacent aquatic ecosystems from Community Phase 1.1.

Community Phase 1.2 Sun Sedge/Sand Dropseed-Needle and Thread/Bur Oak: This plant community phase occurs during periods of multiyear drought or due to disturbances (such as animal trailing or burrowing, or heavy grazing close to a water source) that reduces perennial plant cover and soil surface cover. Repeated disturbances increase wind erosion resulting in a blowout condition. This plant community has transformed from a mid- to tall-grass (Community Phase 1.1) to a mid- to short-statured herbaceous community with reduced regeneration of bur oak trees.

Invertebrates: Provides similar life requisites as Community Phase 1.1. However, forb species have increased in number and diversity providing increased pollen and nectar sources and increased bare ground for ground-nesting insects.

Birds: The reduction of tall- and mid- statured grasses to mid- to short-statured grasses favors grassland nesting birds that prefer short to medium vegetative stature. The reduction in regeneration of bur oak favors grassland nesting birds that avoid woody vegetation.

Mammals: Thermal, escape, and loafing cover has been significantly reduced compared to Community Phase 1.1.

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

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

Community Phase 1.3 Active Blowout/Blowout Grass-Prairie Sandreed/Pioneer Species: This plant phase is a result of a Community Phase Pathway 1.2A with a combination of multiyear drought and excess disturbance (such as trailing, burrowing, or heavy grazing). This unstable plant community has large areas of bare soil subjected to extreme wind erosion. Pioneering perennial and annual vegetation dominate the site.

Invertebrates: Bare soil, active wind erosion, and a lack of forb species limits use of this site by pollinating species.

Birds: Bare soil, active wind erosion, and a lack of forb species limits use by pollinating species.

Mammals: Bare soil, active wind erosion, and a lack of forb species limits use by many mammals. This plant community phase my provide limited browse for large mammals and limited forage for small mammals.

Amphibians and Reptiles: As this site dries out with active wind erosion, use by northern leopard frog, tree frog, and Canadian toad becomes very limited. Northern prairie skinks may still use this site.

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

2.0 Native/Invaded State

Community Phase 2.1 Sand Bluestem-Prairie Sandreed-Prairie Junegrass/Bur Oak: This plant community develops through Transition Pathway T1A due to changes in management and the presence of non-native species, such as Kentucky bluegrass and smooth brome. This plant community phase has a very similar appearance and function to Plant Community 1.1. Except for the increase of exotic cool-season grass species, this phase functions at a high level for native wildlife. However, due to a reduction in fire frequency, oak mottes and quaking aspen clumps increase in size and canopy cover. A wide array of forbs still provides nectar and pollen sources for pollinating species. Managers should consider management within the State 2.0 Community Phase Pathways to avoid transitioning to State 3.0. There is no known Community Phase Pathway back to State 1.0.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1. However, an increase in the coverage of oak mottes and quaking aspen clumps, due to lack of fire, decreases habitat for grassland-nesting birds not tolerant to woody vegetation. Bird species that use and benefit from increased woodland edge habitat will increase (such as bluebirds, scarlet tanagers, vireos, oven bird, and cuckoos).

Mammals: Provides similar life requisites as Community Phase 1.1.

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

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

Community Phase 2.2 Sun Sedge/Sand Dropseed-Needle and Thread/Bur Oak: Season-long grazing, via Community Phase Pathway 2.1A, shifts the competitive advantages to grazing tolerant short-statured grasses, grass-likes, and forbs. Prolonged periods of below normal precipitation further facilitate the transition. Soil temperatures increase with shallower rooted, short-statured blue grama and sedges combined with an increase in bare ground and an increase in the number and diversity of forbs.

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 life requisites as Community Phase 1.1.

Community Phase 2.3 Active Blowout/Blowout Grass-Prairie Sandreed/Pioneer Species: This plant phase is a result of a Community Phase Pathway 2.2A with a combination of multiyear drought and excess disturbance (such as livestock trailing/loafing, off-road vehicle use, or heavy grazing). This unstable plant community has large areas of bare soil (>95%) subjected to wind erosion. Pioneering perennial and annual vegetation dominate the site.

Invertebrates: Provides similar life requisites as Community Phase 1.3.

Birds: Provides similar life requisites as Community Phase 1.3.

Mammals: Provides similar life requisites as Community Phase 1.3.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.3.

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

State 3.0 Wooded State

Community Phase 3.1 Smooth Sumac-Poison Ivy/Exotic Cool-Season Grasses: The elimination of fire and complete rest from grazing, via Transitional Pathway T2A, allows for the invasion of Kentucky bluegrass. The lack of repeated fire events allows smooth sumac and poison ivy to expand out from the bur oak mottes into adjacent herbaceous vegetation dominated communities. Restoration to State 2.0, via Restoration Pathway R3A, requires a combination of mechanical and herbicide application coupled with repeated prescribed burns. Reseeding of native vegetation may be necessary dependent upon the amounts of native species in the site to re-establish the native plant community.

Invertebrates: The invasion of woody vegetation reduces habitat for pollinator insects within MLRA 56A. Season-long pollen and nectar availability becomes limited on this site. However, woody species (such as Saskatoon serviceberry, chokecherry and western snowberry) provide early- to mid- season pollen sources for native and honeybees. Overall, pollinator plant diversity is low, limiting season-long nectar and pollen production.

Birds: The invasion of smooth sumac and other shrubs may cause grassland nesting birds sensitive to woody vegetation encroachment to discontinue use of this community phase. Bird species preferring woodland edge may begin to use this site.

Mammals: Shrubs will provide increased year-round cover for large mammals, such as white-tailed deer. Mammals, such as porcupines, preferring woody habitat will use this site. During periods of extremely wet conditions, North American beaver use quaking aspen and other trees on this site.

Amphibians and Reptiles: The invasion of woody vegetation significantly reduces habit for Canadian toad, northern prairie skink, and plains hognose snake.

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

Community Phase 3.2 Quaking Aspen/Shrubs: Continued lack of fire will shift the competitive edge to taller, faster growing trees such as quaking aspen. The aspen canopy cover shifts the understory to shade-tolerant species suppressing bur oak and allowing green ash and American basswood to establish.

Invertebrates: Quaking aspen and American basswood provide excellent sources of pollen from early- to mid-season. Mid- to late-season pollen sources will be scarce on this site. Overall, pollinator plant diversity is low, limiting season-long nectar and pollen production. Lower trophic-level consumers (such as invertebrate decomposers, scavengers, shredders, predators, herbivores, dung beetles, and fungal-feeders) will use woody plant material, leaves, and limited amounts of grasses in contact with the mineral soil. The woody component of this site is not conducive to use by the Dakota skipper, regal fritillary, or monarch butterfly. Woody plant material is available for wood-nesting bees.

Birds: This site does not provide habitat requisites for grassland-nesting bird species due to its woody vegetation dominance. Bird species that use and benefit from woodland edge habitat (such as red-headed woodpecker, black-capped chickadee, gray catbird, American crow, and American goldfinch, American kestrel, American redstart, black-billed cuckoos, blacked-capped chickadee, blue jay, brown-headed cowbird, brown thrasher, eastern bluebird, eastern and western kingbird, eastern screech-owl, great horned owl, house wren, black-billed magpie, mourning dove, northern flicker, oven bird, red-eyed vireos, red-headed woodpecker, pileated, downy and hairy woodpeckers, red-tailed hawk, scarlet tanager, sharp-shinned hawk, wild turkey, and yellow warbler) may use this plant community. This plant community provides spring food (catkins), winter food (buds), and thermal cover for sharp-tailed grouse. Wildlife use increases as the depth of snow increases during the winter, thereby becoming critical to the sustainment of winter resident bird populations. The presence of woody plant species may increase mammalian and avian predation and increase brood parasitism by brown-headed cowbirds on adjacent grassland ecological sites.

Mammals: Trees and shrubs will provide increased year-round cover for large mammals, such as white-tailed deer and elk. Mammals (such as American porcupine, cottontail rabbit, etc.) preferring woody habitat will use this site. During extreme wet periods, North American beaver will use aspen.

Amphibians and Reptiles: The invasion of woody vegetation diminishes habitat for Canadian toad, northern prairie skink, and plains hognose snake.

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

4.0 Invaded State

Community Phase 4.1 Exotic Cool-Season Grasses/Leafy Spurge: Long term non-use, no fire or heavy season-long grazing gives the competitive edge to exotic grasses and/or leafy spurge via Community Phase Pathway T2B. The invasion of leafy spurge into this plant community phase changes the micro-climate of the site, shifting the plant community to a dominance of exotic cool-season grasses and forbs.

Invertebrates: Amount and availability of pollen is limited to leafy spurge or long-term overgrazing. Competition and alteration of soil microbiology caused by leafy spurge, coupled with the extensive herbicide use, eliminates all other pollinator species. Leafy spurge use by pollinating insects is limited to honeybees and only during the early- to mid- bloom period. This plant community will not provide life requisites for Dakota skippers, regal fritillary, or monarch butterflies or season-long pollen for other pollinating insects.

Birds: Grassland nesting birds will generally be negatively impacted by leafy spurge and Kentucky bluegrass. Some species, such as western meadowlark and bobolink, are not significantly impacted and use leafy spurge for nesting, while Savanah and grasshopper sparrows successfully nest and fledge young from leafy spurge dominated plant communities. Long-term overgrazing creates shorter structure limiting use to grassland-nesting favoring short-statured vegetation.

Mammals: The shift from tall herbaceous cover and/or woody vegetation dominated cover as found in States 1.0, 2.0, or 3.0 to Kentucky bluegrass and leafy spurge limits its use for foraging and thermal, protective, and escape cover for large herbivores. Litter accumulation favors thermal, protective, and escape cover for small rodents. If caused by long-term

overgrazing, loss of litter and plant stature reduces or eliminates thermal, protective, and escape cover for most mammals.

Amphibians and Reptiles: Increased litter from Kentucky bluegrass and increased cover from leafy spurge and Kentucky bluegrass increase shading and reduces soil temperatures. Habitat for plains hog-nose snake and northern prairie skink is reduced or eliminated.

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

State 5 Go-Back State

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

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

Animal Community – Grazing Interpretations

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

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

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

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

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

Hydrology Functions

Available water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic group A. Infiltration is rapid; runoff potential varies from very low to medium depending upon slope percent and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. 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 approximately 70,000 acres on the Sheyenne National Grassland for multiple uses including camping, hunting, photography, backpacking birdwatching, biking, horseback riding, and other non-motorized recreation. The Sheyenne National Grassland is also managed for livestock grazing. The Choppy Sands and Sands ecological sites dominate the Grassland. It is the only National Grassland in the tallgrass prairie region of the United States. The grassland provides habitat for greater prairie chicken, as well as several other sensitive species (such as the Dakota skipper and regal fritillary). It also contains one of largest populations of the western prairie fringed orchid which is listed as a threatened species by the U.S. Fish and Wildlife Service.

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

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

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

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

Wood Products

No appreciable wood products are present on the site.

Other Products

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

Site Development and Testing Plan

- Investigation is needed on the slope break of 15% between Sands and Choppy Sands. It is currently thought that the plant community and production on stable landscapes (not dunes) with slopes >15% is similar to that of dune areas. There is also uncertainty about the plant community and productivity of Serden soils (dunes) with slope <15% as compared to other soils in the Sands ecological site. The plant communities and production levels need more documentation to verify the current slope break.
- Further documentation may be needed for plant communities in all states. Plant data has been collected in previous range-site investigations, including clipping data; however, this data needs review. If geo-referenced sites meeting Tier 3 standards for either vegetative or soil data are not available, representative sites will be selected for further investigation.
- Site concepts will be refined as the above noted investigations are completed.
- The long-term goal is to complete an approved, correlated Ecological Site Description as defined by the National Ecological Site Handbook.
- NASIS revisions needed:
    - Currently, the only Choppy Sands component (Serden) in MLRA 56A is linked to 56B Choppy Sands. However, more than 90% of the acres occur in North Dakota; this component should be relinked to 56A Choppy Sands.

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

Supporting Information

Associated Sites

Ecological Site Name	Site ID	Narrative
Sands	R056AY090ND	This site occurs on less sloping areas (<15% slope) of sand plains and dunes. It is sand or loamy sand (fine to coarse sands) within a depth of 10 inches. The subsoil does not form a ribbon.
Subirrigated	R056AY095ND	This site occurs in swales and blow-outs. It has redoximorphic features at a depth of 18 to 30 inches.
Subirrigated Sands	R056AY096ND	This site occurs lower on the landscape – on flats. It has redoximorphic features at a depth of 30 to 40 inches. The subsoil does not form a ribbon.
Wet Meadow	R056AY102ND	This poorly drained site is in the bottom of some blowouts. A seasonal high-water table is typically within a depth of 1.5 feet during the months of April through June; it may pond due to frozen ground in early spring. It has redoximorphic features within a depth of 18 inches. On this landscape, the site is non-saline.

Similar Sites

Ecological Site Name	Site ID	Narrative
Sands	R056AY090ND	This site occurs on less sloping areas (<15% slope) of sand plains and dunes. It is sand or loamy sand (fine to coarse sands) within a depth of 10 inches. The subsoil does not form a ribbon.

Acknowledgements

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Developers

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

Inventory Data References

Information presented here has been derived from NRCS and other federal/state agency clipping and inventory data. Also, field knowledge of range-trained personnel was used. All descriptions were peer reviewed and/or field-tested by various private, state, and federal agency specialists.

State Correlation

This site has been correlated with Minnesota, North Dakota, and South Dakota.

Relationship to Other Established Classifications

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

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Site Description Approval

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

SD, State Range Management Specialist	Date

INTERPRETING INDICATORS OF RANGELAND HEALTH, Version 5, REFERENCE SHEET

Ecological site name: _Choppy Sands__ Ecological site code: __RO56AY104ND_____
Author(s)/participant(s): _USDA-NRCS North Dakota_____
Contact for lead author: _NRCS State Rangeland Management Specialist ____
Date: _Dec. 2021____ **MLRA:** __56_____ **LRU:** _____
Composition based on (check one): ☐ Cover ☒ Annual Production

Indicators. For each indicator, describe the potential for the site using the reference sheet checklist. Where possible, (1) use quantitative measurements; (2) include expected range of values for above- and below-average years and natural disturbance regimes for each community phase within the reference state, when appropriate; and (3) cite data sources used. Continue descriptions on separate sheet.
1. Rills: Rills are not expected on this site when slopes are less than 25%. When slopes exceed 25%, scattered, short (6 to 8 inches) rills, associated with water flow patterns, may be visible following heavy rainfall events.
2. Water flow patterns: Water flow patterns are not visible when slopes are less than 25%. When slopes exceed 25%, short (3 to 5 feet), scattered water flow patterns may be observed but they and disconnected. Some soil and litter movement are associated with the water flow patterns.
3. Pedestals and/or terracettes: Neither pedestals nor terracettes are expected when slopes are less than 25%. When slopes exceed 25%, some pedestalling of bunchgrasses and small terracettes may be observable, but plant roots will not be exposed.
4. Bare ground: Bare ground ranges from 10 to 15%. Bare ground patches are small (6 inches or less in diameter), randomly scattered, and disconnected. Animal activity (burrows and ant mounds) may occasionally result in isolated bare patches of up to 24 inches in diameter.
5. Gullies: Active gullies are not expected on this site.
6. Wind-scoured and/or depositional areas: Not expected in Plant Community Phase 1.1.
7. Litter movement: Short movement (12 to 24 inches) of fine/small classes of litter would be expected associated with water flow patterns
8. Soil surface resistance to erosion: Stability class averages 4 or greater.
9. Soil surface loss and degradation: Use soil series description for depth, color, and structure of A horizon.
10. Effects of plant community composition and distribution on infiltration: Tall-statured rhizomatous grasses and mid- and short-statured bunch grasses are dominant and well distributed across the site. Forbs, grass-likes, and shrubs are subdominant.
11. Compaction layer: No compaction layers occur naturally on this site. Buried A horizon may sometimes be visible but does not constitute a compaction layer.
12. Functional/structural groups: Due to differences in phenology, root morphology, soil biology relationships, and nutrient cycling Kentucky bluegrass, smooth brome, and crested wheatgrass are included in a new Functional/structural group, mid- and short-statured early cool-season grasses (MSeC3), **not expected for this site**.

Dominance Category[1]	Relative dominance of F/S groups for community phases in the *Reference State* *Minimum expected number of species for dominant and subdominant groups is included in parentheses.*		
	Dominance based on[1]: Annual Production _X_ or Foliar Cover __		
	Phase 1.1_	**Phase 1. __**	**Phase 1. __**
Dominant	**Tall C4 rhizomatous grasses (2); Mid & short C4 bunch grasses (4); Mid & short C3 bunch grasses (4)**		
Subdominant	**Forbs (10); Grass-likes (1); Shrub (14)**		
Minor	**Mid & short C4 rhizomatous grass; Trees**		
Trace			

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

13. Dead or dying plants or plant parts: Not expected.

14. Litter cover and depth: Plant litter cover is 60 to 70% with a depth of 0.25 to 0.5 inch. Litter is in contact with soil surface.

15. Annual production: Annual air-dry production is 2100 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 1500 to 2700 lbs./ac, respectively.

16. Invasive plants: State and local noxious weeds, Kentucky bluegrass, smooth brome, Eastern red cedar/juniper

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

October 2024

Functional/Structural Groups Sheet

State ND **Office** _____ **Ecological site** Choppy Sands **Ecol. site code** RO56AY104ND

Observers _____ **Date** _____

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

Species list of functional/structural groups in the **Reference State**	
Functional/Structural Group	Species List
Tall C4 rhizomatous grasses	sand bluestem, prairie sandreed
Mid & short C4 bunch grasses	little bluestem, sand dropseed, blue grama, hairy grama*, Scribner's panicum
Mid & short C3 bunch grasses	needle and thread, porcupinegrass, Canada wildrye, prairie Junegrass
Forbs	please see plant community table 1.1
Grass-likes	sun sedge, Schweintz's flatsedge*
Shrub	please see plant community table 1.1
Mid & short C4 rhizomatous grasses	sideoats grama
Trees	bur oak, hackberry*, quaking aspen
.	
.	
Biological soil crust[1]	

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

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

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

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

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

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

Evaluation Area - Relative dominance of functional/structural groups

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

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

** See IIRH Version 5 page 70.

Notes: