United States Department of Agriculture
Natural Resources Conservation Service

Ecological Site Description

Site Stage: Provisional

Provisional: an ecological site description (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.

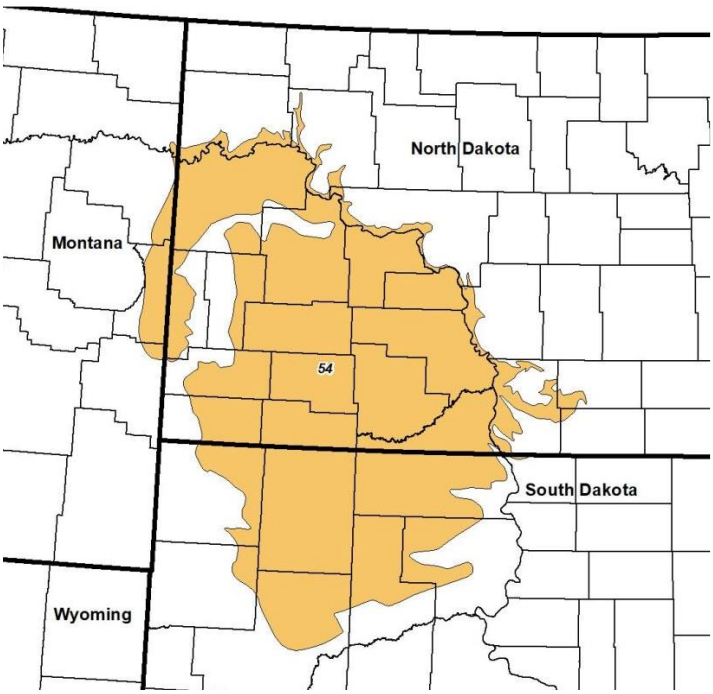
Site Name: Shallow Sandy

Site Type: Rangeland

Site ID: R054XY043ND

Major Land Resource Area (MLRA): 054-Rolling Soft Shale Plain

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 54 - Rolling Soft Shale Plain in North Dakota, South Dakota, and Montana

MLRA 54 covers 29,280 square miles and encompasses approximately 18.7 million acres. MLRA 54 spans three states with 64 percent of it in North Dakota, 33 percent in South Dakota, and 3 percent in Montana. Most of MLRA 54 is underlain by soft, calcareous shale, siltstone, and sandstone of the Tertiary Fort Union Group and the Cretaceous Fox Hills and Hell Creek Formations. Most of the soils in MLRA 54 developed from residuum weathered in place including colluvial and alluvial deposits from residuum. Along the eastern and northern edges of the MLRA where MLRA 54 transitions into the glaciated Missouri plateau, remnants of glacial till parent materials remain on the high areas of the landscape. The MLRA 54 landscape is characterized by moderately dissected rolling plains with areas of local badlands, hills, and isolated buttes. Elevation is 1,650 feet (505 meters) on the eastern side of the MLRA with a gradual rise to 3,600 feet (1,100 meters) on the western side. The Missouri River runs along the north and east side of MLRA 54. Most of the Standing Rock Indian Reservation, the northwest third of the Cheyenne River Indian Reservation, and the Grand River National Grasslands are in the southern part of the MLRA.

Ecological Site Concept

The Shallow Sandy ecological site is located on hillslopes and ridges on sedimentary plains. The soils are shallow (10 to 20 inches) to soft sedimentary sandstone which affects root growth. The texture above the sandstone is loamy fine sand or fine sandy loam. The soil either does not from a ribbon or forms a ribbon <1 inch long. Soil on this site is well drained or somewhat excessively drained. Slopes range from 3 to 70 percent. On the landscape, this site is above the Limy Sands, Sands, Sandy, and Badland ecological sites. It is below the Thin Loamy site in areas capped with till or loess. In some steep and very steep areas, the Very Shallow site is on similar or slightly higher landscape positions; it is less than 10 inches to sedimentary bedrock. A few areas of Rock Outcrop may also occur in these areas.

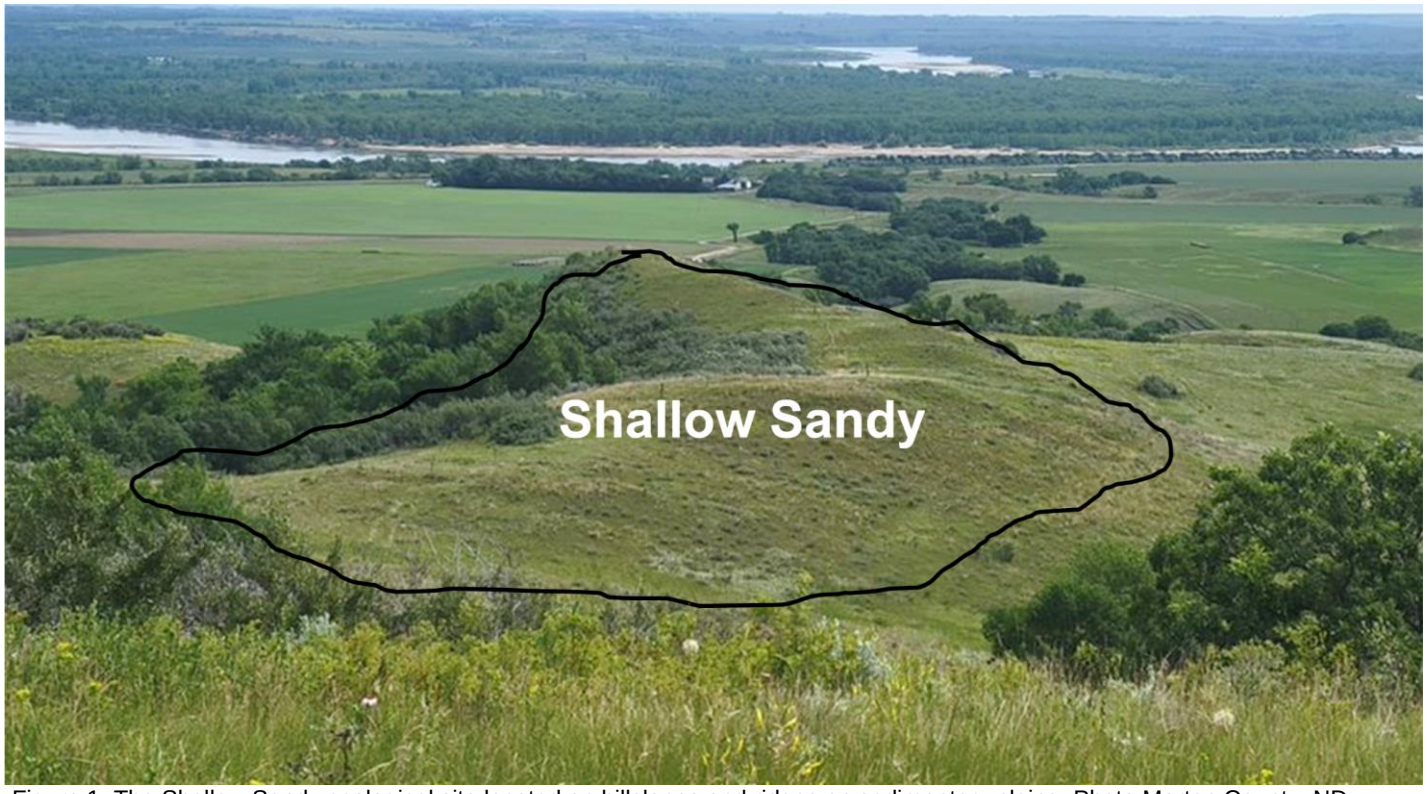


Figure 1: The Shallow Sandy ecological site located on hillslopes and ridges on sedimentary plains. Photo Morton County, ND.

Physiographic Features

This site occurs on hillslopes and ridges on sedimentary plains (some areas are capped with thin deposits of remnant glacial till or with silty loess). The parent material is weathered residuum (sandstone). Slopes range from 3 to 70 percent.

Landform: sedimentary plain

	Minimum	Maximum
Elevation (feet):	1650	3600
Slope (percent):	3	70
Water Table Depth (inches):	80	>80
Flooding:		
Frequency:	None	None
Ponding:		
Frequency:	None	None
Runoff Class:	Low	High
Aspect:	No influence on this site	

Climatic Features

MLRA 54 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. The continental climate is the result of this MLRA's location in the geographic center of North America. There are few natural barriers on the northern Great Plains, so air masses move unobstructed across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 14 to 18 inches per year. The normal average annual temperature is about 42° F. January is the coldest month with average temperatures ranging from about 13° F (Beach, ND) to about 16° F (Bison, SD). July is the warmest month with temperatures averaging from about 69° F (Beach, ND) to about 72° F (Timber Lake, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 57° F. This large temperature range attests to the continental nature of MLRA 54's climate. Wind speeds average about 11 miles per hour, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime wind speeds are generally stronger than nighttime wind speeds, and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of native cool-season plants begins in late March and continues through early to mid-July. Native warm-season plants begin growth in mid-May and continue to the end of August. Greening up of cool-season plants can occur again in September and October when adequate soil moisture is present.

Climate Station(s) 1981 - 2010

Sation	Name	Location	Elevation	Lat	Long
USC00323207	FT YATES 4 SW	Fort Yates	1674.9	46.05	-100.6667
USC00392429	DUPREE	Dupree	2375.0	45.0481	-101.5992
USC00324178	HETTINGER	Hettinger	2680.1	45.9925	-102.6442
USC00329233	WATFORD CITY	Watford City	2169.9	47.8039	-103.2892
USC00325479	MANDAN EXP STN	Mandan	1750.0	46.8128	-100.9097
USC00395048	LUDLOW 3 SSE	Ludlow	2990.2	45.785	-103.3719
USC00324102	HEBRON	Hebron	2167.0	46.9028	-102.0478

Climate Normals

	Representative		Actual		
	High	Low	High	Low	Average
Mean annual precipitation (in):	18	15	18	15	16
Frost free period (days):	111	95	114	91	101
Freeze free period (days):	127	118	129	116	123

Normal Monthly Precipitation (in)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.4	0.4	1.0	1.7	2.8	3.3	2.7	1.7	1.5	1.4	0.7	0.4
Representative low:	0.3	0.3	0.6	1.0	2.5	3.0	2.2	1.4	1.1	1.2	0.5	0.3
Actual high:	0.5	0.5	1.1	1.9	3.0	3.4	3.1	2.1	1.5	1.5	0.7	0.5
Actual low:	0.2	0.3	0.6	0.9	2.3	2.9	2.1	1.3	1.0	1.1	0.4	0.2

Normal Monthly Minimum Temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	8.3	12.0	20.5	31.0	42.7	52.3	57.8	55.5	44.9	32.8	20.1	9.3
Representative low:	2.1	7.3	17.1	28.7	40.2	49.7	55.1	52.8	41.8	30.0	18.1	6.2
Actual high:	9.2	12.8	21.3	31.9	43.3	52.7	58.7	56.8	46.3	34.0	21.0	10.3
Actual low:	2.0	6.7	17.0	28.4	39.6	49.7	55.0	52.4	41.6	29.5	17.4	5.8
Average:	4.7	9.1	18.8	29.9	41.3	50.9	56.6	54.4	43.5	31.5	19.0	7.5

Normal Monthly Maximum Temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	29.1	33.2	43.2	58.3	69.1	78.5	86.6	85.6	73.9	59.8	42.2	30.1
Representative low:	23.5	28.9	39.6	55.1	66.4	75.2	83.2	82.6	71.2	56.6	39.3	26.4
Actual high:	29.8	33.5	43.7	59.1	70.1	79.8	87.3	86.7	75.5	60.6	42.4	30.6
Actual low:	23.1	28.2	39.3	55.0	65.8	74.9	82.8	82.1	70.5	56.4	38.8	25.9
Average:	26.3	30.9	41.4	56.6	67.6	76.6	84.6	84.1	72.5	57.9	40.6	28.3

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

1981 N	1982 W	1983 D	1984 N	1985 D	1986 N	1987 D	1988 D	1989 D	1990 D	1991 N	1992 N	1993 W	1994 N	1995 W
15.1	26.3	12.7	16.1	14	18.9	14.7	10.6	14.8	11.2	15.4	15.3	19.9	17.4	21.5

1996 W	1997 D	1998 W	1999 N	2000 N	2001 N	2002 D	2003 D	2004 D	2005 B	2006 N	2007 N	2008 N	2009 N	2010 W
19.5	14.2	21.5	16.9	17.9	15.9	10.2	14.4	13.8	17.3	11.5	17.1	18.4	16.8	22.5

Influencing Water Features

This site does not receive additional water as runoff from adjacent slopes; it is on a run-off landscape position. Neither does it receive significant additional water from a seasonal high-water table. Depth to the water table typically exceeds 6 feet throughout the growing season. Surface infiltration is moderately rapid or rapid. Permeability above the sandstone is rapid or very rapid. Water loss is through evapotranspiration and percolation below the root zone.

Representative Soil Features

Soils associated with Shallow Sandy ES are in the Entisols order and are classified further as Typic Ustorthents and Typic Ustipsamments. These soils formed in weathered residuum (sandstone). They are well drained to somewhat excessively drained. The common features of soils in this site are a coarse or moderately coarse texture (either does not form a ribbon or forms a ribbon <1 inch long) and a shallow depth (10 to 20 inches) to sandstone which affects root growth. The texture above the sandstone is loamy fine sand or fine sandy loam.

Above the sandstone, soil salinity is none or very slight (E.C. <2 dS/m); sodicity is typically none. Soil reaction is neutral to moderately alkaline (pH 6.6 to 8.4) in most soils and calcium carbonate content ranges from 0 to 30 percent.

There is a risk of rills and eventually gullies if vegetative cover is not adequate. The sandstone bedrock is limiting to water movement and root penetration. These soils are mainly susceptible to wind erosion and, to a lesser degree, water erosion. The hazard of erosion increases where vegetative cover is not adequate; the hazard of water erosion increases where the slope is greater than 15 percent. Low available water capacity and, in some soils, high accumulations of lime strongly influence the soil-water-plant relationship. Loss of the soil surface layer can result in a shift in species composition and/or production.

The major soil series correlated to the Shallow Sandy site are Cohagen and Flasher.

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

Parent Material Kind: residuum
Parent Material Origin: sandstone
Surface Texture: fine sandy loam, loamy fine sand
Surface Texture Modifier: none, very stony
Subsurface Texture Group: Sandy
Surface Fragments <3" (% Cover): 0-3
Surface Fragments ≥3" (%Cover): 0-3
Subsurface Fragments <3" (% Volume): 0-13
Subsurface Fragments ≥3" (% Volume): 0-3

	Minimum	Maximum
Drainage Class:	well	somewhat excessively
Permeability Class*:	moderately rapid	rapid
Depth to first restrictive layer (inches):	10	20
Electrical Conductivity (dS/m)*:	0	2
Sodium Absorption Ratio*:	0	1
Soil Reaction (1:1 Water)*:	6.6	8.4
Soil Reaction (0.1M CaCl2):	NA	NA
Available Water Capacity (inches)*:	<1.0	3.0
Calcium Carbonate Equivalent (percent)*:	0	30

* These attributes represent from 0 to the first restrictive layer. Electrical Conductivity (E.C.) values are based on Saturated Paste method; the commonly used 1:1 field method will likely have E.C. values ≤1.

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 54 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 deer). Herbivory by small mammals, insects, nematodes, and other invertebrates are also important factors influencing the production and composition of the communities. Grazing and fire interaction, particularly when coupled with drought events, influenced the dynamics discussed and displayed in the following state and transition diagram and descriptions.

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

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

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

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

Currently the primary disturbances include widespread introduction of exotic species, concentrated livestock grazing, lack of fire, and perhaps long-term non-use and no fire. Because of these changes, particularly the widespread occurrence of exotic species, as well as other environmental changes, the Reference State is considered to no longer exist. Thus, the presence of exotic species on the site precludes it from being placed in the Reference State. It must then be placed in one of the other states, commonly State 2: Native/Invaded State (T1A).

State 2: Native/Invaded State. Colonization of the site by exotic species results in a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition was probably inevitable; it often resulted from colonization by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, and/or crested wheatgrass) which have been particularly and consistently invasive under extended periods of no use and no fire. Other exotic plants (e.g., Canada thistle, leafy spurge) are also known to invade the site.

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

result, these factors coupled with shading cause desirable native plants to have increasing difficulty remaining viable and recruitment declines.

To slow or limit the invasion of these exotic grasses or other exotic plants, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic plants, the transition to State 3: Invaded State should be expected (T2A). This state may also transition to State 4: Invaded Wooded State during periods of long-term lack of fire (T2B).

State 3: Invaded State. The threshold for this state is reached when both the exotic cool-season grasses (often Kentucky bluegrass, smooth brome, and/or 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 long-term prescribed grazing and prescribed burning with possible reseeding (R3A). This state may also transition to State 4: Invaded Wooded State resulting from long-term lack of fire (T3A).

State 4: Invaded Wooded State. A marked increase in non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread. One community phase has been identified and often results from extended periods of no fire (T2B, T3A). Brush management and/or long-term prescribed burning and prescribed grazing may lead to State 2: Native/Invaded State (R4A) or State 3: Invaded State (R4B) depending on the abundance of exotic grasses. A range planting may be necessary to complete the restoration to State 2: Native/Invaded State.

State 5: Go-Back State. This state often results following cropland abandonment or concentrated livestock activity for a prolonged period. This weedy assemblage may include noxious weeds that need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, 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 3: Invaded State (R5B).

The following state and transition model diagram illustrates the common states, community phases, community pathways, and transition and restoration pathways that can occur on the site. These are the most common

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

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

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

Plant Communities and Transitional Pathways

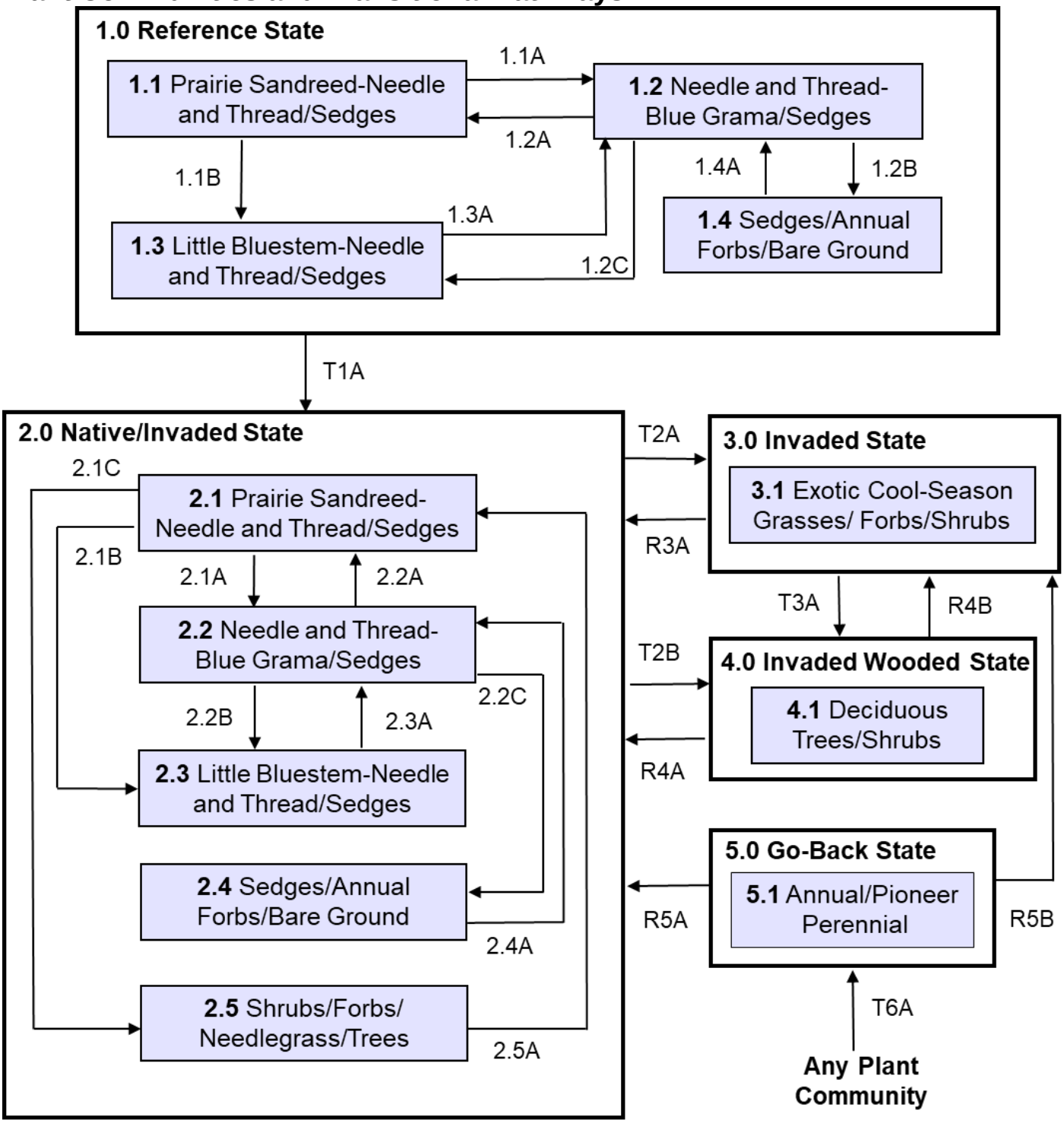


Diagram Legend - MLRA 54 Shallow Sandy	
T1A	Introduction of exotic cool-season grasses
T2A	Extended periods of non-use or very light grazing, no fire
T2B	Long-term lack of fire
T3A	Long-term lack of fire
T5A	Cessation of annual cropping
R3A	Long-term prescribed grazing and prescribed burning with possible range planting
R4A	Brush management and/or long-term prescribed burning and prescribed grazing
R4B	Brush management and/or long-term prescribed burning and prescribed grazing
R5A	Successful range planting
R5B	Failed range planting and/or secondary succession
CP 1.1 - 1.2 (1.1A)	Multiyear drought with/without heavy, long-term grazing
CP 1.1 - 1.3 (1.1B)	Soil movement as a result of rotational sliding or deposition
CP 1.2 - 1.1 (1.2A)	Return to average precipitation and reduced grazing
CP 1.2 - 1.4 (1.2B)	Long-term occupation by prairie dogs
CP 1.2 - 1.3 (1.2C)	Soil movement as a result of rotational sliding or deposition, return to average precipitation
CP 1.3 - 1.2 (1.3A)	Multiyear drought
CP 1.4 - 1.2 (1.4A)	Prairie dog abandonment
CP 2.1 - 2.2 (2.1A)	Heavy continuous grazing with or without drought
CP 2.1 - 2.3 (2.1B)	Soil movement as a result of rotational sliding or deposition, return to average precipitation
CP 2.1 - 2.5 (2.1C)	Extended periods of non-use or very light grazing, no fire
CP 2.2 - 2.1 (2.2A)	Long-term prescribed grazing and prescribed burning and return to average precipitation
CP 2.2 - 2.3 (2.2B)	Soil movement as a result of rotational sliding or deposition
CP 2.2 - 2.4 (2.2C)	Long-term occupation by prairie dogs
CP 2.3 - 2.2 (2.3A)	Multiyear drought
CP 2.4 - 2.2 (2.4A)	Removal/abandonment of prairie dogs
CP 2.5 - 2.1 (2.5A)	Long-term prescribed grazing and prescribed burning

State 1: Reference State

This state represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. The primary disturbance mechanisms for this site in the reference condition included frequent fire and grazing by large herding ungulates. Timing of fires and grazing, coupled with weather events, dictated the dynamics that occurred within the natural range of variability. These factors likely caused the community to shift both spatially and temporally between four community phases.

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

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

Community Phase 1.1: Prairie Sandreed-Needle and Thread/Sedges (*Calamovilfa longifolia-Hesperostipa comata/Carex* spp.)

This community phase was historically the most dominant both temporally and spatially. Warm-season grasses dominated this plant community. The major grasses included prairie sandreed, little bluestem, needle and thread, blue grama, and plains muhly. Other grasses included sand bluestem, porcupinegrass, sideoats grama, and western wheatgrass. Common forbs and shrubs included prairie clover, common yarrow, tarragon, blacksamson echinacea, stiff sunflower, blazing star, winterfat, prairie sagewort, broom snakeweed, and rose. Lesser spikemoss may also have been present.

Annual production likely varied from about 900-1900 pounds per acre with grasses and grass-like species, forbs and shrubs contributing about 85%, 10% and 5%, respectively. Both warm-season grasses and cool-season graminoids 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 Praire Sandreed-Needle and Thread/ Sedges		
COMMON/GROUP NAME	**SYMBOL**	**Group**	**lbs./acre**	**% Comp**
GRASSES & GRASS-LIKES			*1120 - 1190*	*80 - 85*
TALL WARM-SEASON		**1**	**280 - 420**	**20 - 30**
prairie sandreed	CALO	1	210 - 350	15 - 25
sand bluestem	ANHA	1	14 - 70	1 - 5
MID WARM-SEASON		**2**	**70 - 350**	**5 - 25**
little bluestem	SCSC	2	70 - 210	5 - 15
plains muhly	MUCU3	2	70 - 140	5 - 10
NEEDLEGRASSES		**3**	**70 - 140**	**5 - 10**
needle and thread	HECOC8	3	70 - 154	5 - 11
green needlegrass	NAVI4	3	14 - 28	1 - 2
porcupinegrass	HESP11	3	28 - 56	2 - 4
GRAMA		**4**	**70 - 140**	**5 - 10**
blue grama	BOGR2	4	42 - 98	3 - 7
sideoats grama	BOCU	4	28 - 56	2 - 4
OTHER NATIVE GRASSES		**5**	**70 - 140**	**5 - 10**
plains reedgrass	CAMO	5	0 - 14	0 - 1
prairie Junegrass	KOMA	5	14 - 28	1 - 2
Fendler threeawn	ARPUL	5	14 - 28	1 - 2
sand dropseed	SPCR	5	14 - 28	1 - 2
Scribner's rosette grass	DIOLS	5	14 - 14	1 - 1
western wheatgrass	PASM	5	28 - 56	2 - 4
other native grasses	2GL	5	14 - 28	1 - 2
GRASS-LIKES		**6**	**70 - 210**	**5 - 15**
threadleaf sedge	CAFI	6	42 - 140	3 - 10
sun sedge	CAINH2	6	28 - 70	2 - 5
Pennsylvania sedge	CAPE6	6	14 - 14	1 - 1
other grass-likes	2GL	6	0 - 42	0 - 3
FORBS		***7***	*70 - 140*	*5 - 10*
prairie clover	DALEA	7	28 - 42	2 - 3
common yarrow	ACMI2	7	14 - 28	1 - 2
tarragon	ARDR4	7	14 - 28	1 - 2
blacksamson echinacea	ECAN2	7	14 - 28	1 - 2
stiff sunflower	HEPA19	7	14 - 28	1 - 2
blazing star	LIATR	7	14 - 28	1 - 2
purple locoweed	OXLA3	7	14 - 28	1 - 2
goldenrod	SOLID	7	14 - 28	1 - 2
plains milkvetch	ASGI5	7	0 - 14	0 - 1
onion	ALLIU	7	0 - 14	0 - 1
pussytoes	ANTEN	7	0 - 14	0 - 1
white sagebrush	ARLU	7	0 - 14	0 - 1
groundplum milkvetch	ASCR2	7	0 - 14	0 - 1
wavyleaf thistle	CIUN	7	0 - 14	0 - 1
western wallflower	ERCAC	7	0 - 14	0 - 1
blanketflower	GAAR	7	0 - 14	0 - 1
hairy false goldenaster	HEVIB	7	0 - 14	0 - 1
rush skeletonplant	LYJU	7	0 - 14	0 - 1
lacy tansyaster	MAPIP4	7	0 - 14	0 - 1
penstemon	PENST	7	0 - 14	0 - 1
spiny phlox	PHHO	7	0 - 14	0 - 1
cinquefoil	POTEN	7	0 - 14	0 - 1
Indian breadroot	PEDIO2	7	0 - 14	0 - 1
American pasqueflower	PUPA5	7	0 - 14	0 - 1
upright prairie coneflower	RACO3	7	0 - 14	0 - 1
scarlet globemallow	SPCO	7	0 - 14	0 - 1
spiderwort	TRADE	7	0 - 14	0 - 1
American vetch	VIAM	7	0 - 14	0 - 1
other perennial forbs	2FP	7	0 - 14	0 - 1
SHRUBS		*8*	*28 - 70*	*2 - 5*
winterfat	KRLA2	8	28 - 42	2 - 3
prairie sagewort	ARFR4	8	14 - 28	1 - 2
broom snakeweed	GUSA2	8	14 - 28	1 - 2
rose	ROSA5	8	14 - 28	1 - 2
silver sagebrush	ARCA13	8	0 - 14	0 - 1
creeping juniper	JUHO2	8	0 - 14	0 - 1
pricklypear	OPUNT	8	0 - 14	0 - 1
skunkbush sumac	RHTR	8	0 - 14	0 - 1
soapweed yucca	YUGL	8	0 - 14	0 - 1
other shrubs	2SHRUB	8	0 - 14	0 - 1
CRYPTOGAMS		*9*	*0 - 14*	*0 - 1*
little spikemoss	SEDE2	9	0 - 14	0 - 1

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	810 -	1239	- 1665
FORBS	65 -	105	- 145
SHRUBS	25 -	49	- 75
CRYPTOGAMS	0 -	7	- 15
TOTAL	900 -	1400	- 1900

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 multiyear drought with or without heavy long-term grazing which resulted in a decrease of prairie sandreed with a corresponding increase in blue grama.

Community Phase Pathway 1.1B
Community Phase Pathway 1.1 to 1.3 was initiated with soil movement associated with the formation of "steps" (minor slumping on slopes of 9 to 25 percent), major slumping on slopes >25 percent, or soil erosion/deposition events. These events increased amounts of calcium carbonate at the soil surface which favors an increase in little bluestem. Soil disturbances such as those described may occur after multiyear drought when followed by average to above average precipitation events and are more common, but not limited to, northern facing slopes. As the steps or slump(s) widen, they unite with other steps or slumps and become deeper as erosion extends up the slope (Whitman et.al. 1943).

Community Phase 1.2: Needle and Thread-Blue Grama/Sedges (*Hesperostipa comata-Bouteloua gracilis/Carex* spp.)
This community phase resulted from multiyear drought with or without long-term heavy grazing. Needlegrasses, little bluestem and sedges were the dominant species. Other grasses and grass-like species included Fendler threeawn, sand dropseed, western wheatgrass, and prairie Junegrass. Forbs (such as Cuman ragweed, Indian breadroot, white sagebrush, and scarlet globemallow) may also have been present. This plant community could have occurred throughout the pasture, on spot-grazed areas and around water sources where season-long grazing patterns occur.

Evidence from the years 1932-1941 indicates multiyear drought results in major shifts in species composition. Blue grama, needle and thread, western wheatgrass, prairie Junegrass, and needleleaf sedge are reduced in density and abundance during one or two seasons of severe drought. Of the major species, only threadleaf sedge maintained approximately the same area. Blue grama and western wheatgrass were the most severely affected and required three to four years to fully recover. Little bluestem, prairie sandreed, and plains muhly were seriously reduced during the two drought years and did not fully recover from the drought effects. Sandberg's bluegrass increased remarkably during the drought years but decreased during post-drought years due to competition from threadleaf sedge, needle and thread, prairie Junegrass, and needleleaf sedge which recovered to pre-drought levels. The height of all species was reduced (Whitman et.al. 1943).

Community Phase Pathway 1.2A
Community Phase Pathway 1.2 to 1.1 occurred with the return to average precipitation and reduced grazing which resulted in an increase prairie sandreed and a corresponding decrease in blue grama.

Community Phase Pathway 1.2B
Community Phase Pathway 1.2 to 1.4 occurred with long-term occupation by prairie dogs shifting the community to one largely composed of grazing tolerant sedges and annual forbs.

Community Phase Pathway 1.2C
Community Phase Pathway 1.2 to 1.3 was initiated with soil movement associated with the formation of "steps" (minor slumping on slopes of 9 to 25 percent), major slumping on slopes >25 percent, or soil erosion/deposition events. These events increased amounts of calcium carbonate at the soil surface which favors an increase in little bluestem. Soil disturbances, such as those described, may occur after multiyear drought when followed by average to above average precipitation events and are more common (but not limited to) northern facing slopes. As the steps or slump(s) widen, they unite with other steps or slumps and become deeper as erosion extends up the slope (Whitman et.al. 1943).

Community Phase 1.3: Little Bluestem-Needle and Thread/Sedges (*Schizachyrium scoparium-Hesperostipa comata/Carex* spp.)

This community phase was initiated with soil movement associated with the formation of "steps" that increased calcium carbonate at the soil surface which favors little bluestem. Soil disturbances, such as those described, may occur after multiyear drought when followed by average to above average precipitation and are more common on (but not limited to) northern facing slopes. As the steps or slump(s) widen, they unite with other steps or slumps and become deeper as erosion extends up the slope (Whitman et.al. 1943).

This community phase was dominated by little bluestem with lesser amounts of needle and thread, western wheatgrass, sedges, and forbs. Once little bluestem becomes dominant, it is difficult for other grasses to displace it because of its dense, tall growth, assuming soil moisture is adequate. Moisture conditions below the step were more favorable than on the general slope because snow tended to accumulate there; runoff was retarded. As the step widened, united with other steps, and became deeper as erosion extended up the slope, the area of little bluestem enlarged until it occupied most of the hillside.

Once established, the cover of little bluestem usually protected the slopes from excessive runoff and erosion. The little bluestem type is of great ecological importance because it stabilizes areas subject to heavy runoff and erosion, holds drifting snow, and hastens soil development due to the numerous roots to 3.5 feet in depth and large volume of herbage. In places, little bluestem appears to be rather short-lived and to be succeeded on more moderate slopes by blue grama, western wheatgrass, needlegrasses, and sedges. These areas tend to become dominated by little bluestem until a severe drought reduces its competitive advantage (Whitman et.al. 1943). See Community Phase Pathway 1.3A.

Community Phase Pathway 1.3A

Community Phase Pathway 1.3 to 1.2 resulted from multiyear drought, leading to a marked decrease in little bluestem and a corresponding increase in blue grama.

Community Phase 1.4: Sedges/Annual Forbs/Bare Ground (*Carex* spp./Annual Forbs/Bare Ground) (Prairie Dog Town)

This community phase formed during periods of long-term occupation by prairie dogs. It was characterized by the abundance of sedges, annual forbs (e.g., knotweed, fetid marigold, woolly plantain) and bare ground. Some perennial native species remained but were greatly reduced in vigor and may not have been readily visible.

Community Phase Pathway 1.4A

Community Phase Pathway 1.4 to 1.2 occurred with the prairie dog abandonment (e.g., plague). This led to an increase in the more grazing/drought intolerant perennial plants and reduction in bare ground.

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 (commonly Kentucky bluegrass, smooth brome, and/or crested wheatgrass). This transition was probably 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 bromegrass, 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, 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 3: Invaded State should be expected.

Annual production of this state can be quite variable, in large part due to the amount of exotic cool-season grasses. However, as the exotic cool-season grasses increase, peak production will shift to earlier in the growing season.

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) early spring 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 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.

Plant Community Phase 2.1: Prairie Sandreed-Needle and Thread/Sedges (*Calamovilfa longifolia-Hesperostipa comata/Carex* spp.)

This community phase is similar to Community Phase 1.1. It may be maintained with grazing systems that allow for adequate recovery periods following grazing events and, potentially, the combination of prescribed grazing

and prescribed burning, which closely mimics the natural disturbance regime. Decreased fire frequency results in an increase in the shrub component.

Community Phase Pathway 2.1A
Community Phase Pathway 2.1 to 2.2 occurs with heavy continuous grazing with or without drought leading to an increase in the more disturbance tolerant plants.

Community Phase Pathway 2.1B
Community Phase Pathway 2.1 to 2.3 is initiated with soil movement associated with rotational sliding or deposition which forms “steps” (minor slides on slopes of 9 to 25 percent, major slides on slopes >25 percent, or soil erosion/deposition events). These events increase the amount of calcium carbonate at the soil surface which favors little bluestem. These soil disturbances may occur after multiyear drought when followed by average to above average precipitation events and are more common, but not limited to, northern facing slopes. As the steps or slump(s) widen, they unite with other steps or slides and become deeper as erosion extends up the slope (Whitman et.al. 1943).

This pathway may also result from other ground-disturbing events such as livestock trails, abandoned roads, and pipelines. The plant community is altered by the physical disturbance and movement of calcium carbonates, resulting in an increase in little bluestem.

Community Phase Pathway 2.1C
Community Phase Pathway 2.1 to 2.5 occurs during extended periods of non-use or very light grazing, and no fire. This results in marked increases in shrubs, forbs, needlegrasses, and trees with a corresponding decrease in prairie sandreed.

Plant Community Phase 2.2: Needle and Thread-Blue Grama/Sedges (*Hesperostipa comata-Bouteloua gracilis/Carex* spp,)
This plant community phase is characterized by disturbance tolerant grass and forb species. Needlegrasses decrease in vigor and amount with corresponding increases in blue grama and sedges compared to Community Phase 2.1.

Community Phase Pathway 2.2A
Community Phase Pathway 2.2 to 2.1 occurs with the return to average precipitation and implementation of long-term prescribed grazing 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 from the exotic cool-season species to the native cool-season and warm-season grasses. The addition of prescribed burning may expedite this shift.

Community Phase Pathway 2.2B
Community Phase Pathway 2.2 to 2.3 is initiated with soil movement associated with rotational sliding or deposition which forms “steps” (minor slides on slopes of 9 to 25 percent, major slides on slopes >25 percent, or soil erosion/deposition events). These events increase the amount of calcium carbonate at the soil surface which favors little bluestem. These soil disturbances may occur after multiyear drought when followed by average to above average precipitation events and are more common on (but not limited to) northern facing slopes. As the steps or slump(s) widen, they unite with other steps or slides and become deeper as erosion extends up the slope (Whitman et al. 1943).

This pathway may also result from other ground-disturbing events (e.g., livestock trails, abandoned roads, pipelines). The plant community is altered by the physical disturbance and movement of calcium carbonates, resulting in an increase in little bluestem.

Community Phase Pathway 2.2C
Community Phase Pathway 2.2 to 2.4 occurs with long-term occupation by prairie dogs shifting the community to one largely composed of grazing tolerant sedges and annual forbs with increased areas of bare ground.

Plant Community Phase 2.3: Little Bluestem-Needle and Thread/Sedges (*Schizachyrium scoparium-Hesperostipa comata/Carex* spp.)
This plant community phase is characterized by an increase in little bluestem resulting from soil disturbance such as rotational sliding (aka soil slumping/steps), soil erosion, soil deposition, pipelines, abandoned roads, and livestock trailing. Soil disturbance, coupled with high calcium carbonates, gives the competitive advantage to little bluestem as it tends to act as an invader on disturbed areas. Livestock typically avoid little bluestem; the lack of grazing preference may act as a driver to further favor this plants abundance once it becomes established. The deep-rooted nature of little bluestem stabilizes soil on slopes and can act as a snow trap allowing the site to collect additional moisture during spring runoff.


Figure 2: Plant Community Phase 2.3: Little Bluestem-Needle and Thread/Sedges

Community Phase Pathway 2.3A
Community Phase Pathway 2.3 to 2.2 occurs with multiyear drought which causes little bluestem to decrease along with corresponding increases in blue grama and other more drought tolerant species.

Community Phase 2.4: Sedges/Annual Forbs/Bare Ground (*Carex* spp./Annual Forbs/Bare Ground) (Prairie Dog Town)
This community phase forms during periods of long-term occupation by prairie dogs. It is characterized by the abundance of sedges, annual forbs (e.g., knotweed, fetid marigold, woolly plantain) and bare ground. Some perennial native species remain but are greatly reduced in vigor and may not be readily visible.

Figure 3: Community Phase 2.4: Sedges/Annual Forbs/Bare Ground with active wind erosion.

Community Phase Pathway 2.4A

Community Phase Pathway 2.4 to 2.2 is initiated with the abandonment or removal of prairie dogs. This leads to a decrease in grazing and drought tolerant plants and a corresponding increase in the more grazing and drought intolerant plants.

Community Phase 2.5: Shrubs/Forbs/Needlegrasses/Trees (Shrubs/Forbs/*Hesperostipa* spp., *Nassella viridula*/Trees)

This community phase forms during extended periods of non-use or very light grazing, and no fire. It may be characterized by a conspicuous shrub component, forbs, needlegrasses, and perhaps green ash trees. Leadplant, chokecherry, Saskatoon serviceberry, and soapweed yucca are common shrubs. Common forbs include white heath aster, goldenrod, common yarrow, and white sagebrush. Green ash trees are also often present.

Community Phase Pathway 2.5A

Community Phase Pathway 2.5 to 2.1 may occur with the implementation of long-term prescribed grazing and prescribed burning, leading to a marked decrease in shrubs (and trees) and corresponding increases in prairie sandreed and other native grasses.

Transition T2A

This transition from State 2: Native/Invaded State to State 3: Invaded State often occurs during extended periods of non-use or very light grazing, and no fire. Complete rest or low intensity (<20% utilization) grazing and elimination of fire are the two major contributors to this transition, especially when exotic cool-season grasses are present. Preliminary studies indicate this threshold may exist when both the exotic cool-season grasses exceed 30 percent of the plant community, and native grasses represent less than 40 percent of the plant community composition.

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

Transition T2B

This transition from State 2: Native/Invaded State to State 4: Invaded Wooded State results from long-term lack of fire. This leads to the site becoming dominated by green ash trees in association with shrubs (such as leadplant, chokecherry, Saskatoon serviceberry, and/or soapweed yucca).

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 3: Invaded State

This state is the result of invasion and dominance by the exotic cool-season grasses (commonly Kentucky bluegrass, smooth brome, and/or crested wheatgrass). Other exotic plants (e.g., leafy spurge) may also invade the site. These exotic cool-season grasses can be quite invasive on the site and are particularly well adapted to heavy grazing. They also often form monotypic stands. As these exotic cool-season grasses increase, both forage quantity and quality become increasingly restricted to late spring and early summer due to the monotypic nature of the stand, even though annual production may increase. Native forbs generally decrease in production, abundance, diversity, and richness compared to that of State 1: Reference State. Common forbs often include white heath aster, goldenrod, common yarrow, and white sagebrush. Shrubs (such as western snowberry, creeping juniper, 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, as the exotic cool-season grasses increase, peak production will shift to earlier in the growing season.

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.

Plant Community Phase 3.1: Exotic Cool-Season Grasses/Forbs/Shrubs

This plant community phase is characterized by dominance of exotic cool-season grasses with remnant amounts (<5%) of native warm-season grasses (e.g., prairie sandreed, Fendler threeawn, plains muhly), cool-season grasses (e.g., needlegrasses, western wheatgrass, prairie Junegrass), and forbs (e.g., white

sagebrush, silverleaf Indian breadroot, and blacksamson echinacea). Common shrubs include western snowberry, creeping juniper, and rose.

The opportunity for high intensity spring burns is severely reduced by early green-up and increased moisture and humidity at the soil surface; grazing pressure cannot cause a reduction in exotic grass dominance. Annual production is largely limited to the exotic species. The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of Kentucky bluegrass or smooth brome are typically short-lived.

Figure 4: Plant Community Phase 3.1: Exotic Cool-Season Grasses/Forbs/Shrubs

Restoration R3A

This restoration from State 3: Invaded State to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing and prescribed burning. Depending upon the abundance of exotic cool-season grass, a successful range planting may be necessary to complete the restoration.

The success of this restoration pathway depends on the presence of a remnant population of native grasses in Community Phase 3.1. This remnant population may not be readily apparent without close inspection. The application of prescribed burning may be necessary at relatively short intervals in the early phases of this restoration process. Some previous efforts have shown promise with early season prescribed burning; however, summer or fall burning may also be effective under certain circumstances. Prescribed grazing and burning in conjunction with a subsequent successful range planting may be necessary to successfully complete this restoration pathway.

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 T3A

This Transition from State 3: Invaded State to State 4: Invaded Wooded State results from long-term lack of fire. This leads to the site becoming dominated by green ash trees in association with shrubs (such as leadplant, chokecherry, Saskatoon serviceberry, creeping juniper, and/or soapweed yucca).

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 4: Invaded Wooded State

This state is characterized by woody vegetation, particularly on north facing slopes. It often consists of green ash trees in association with shrubs. Common shrubs may include leadplant, chokecherry, Saskatoon serviceberry, and soapweed yucca. Common juniper, or perhaps eastern red cedar may also be present. Depending upon tree density, an herbaceous understory of grasses and forbs can be minimal to non-existent.

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 burning, prescribed grazing, and perhaps mechanical treatment. Considerable time and effort will be required to restore to other States.

Plant Community Phase 4.1: Deciduous Trees/Shrubs

This community phase particularly present on north facing slopes and may be characterized by green ash trees in association with shrubs (such as leadplant, chokecherry, Saskatoon serviceberry, and/or soapweed yucca). Common juniper or, perhaps, eastern red cedar may also be present. An herbaceous understory of grasses and forbs may be minimal to non-existent, depending upon the density of woody vegetation and canopy cover.

Figure 5: Plant Community Phase 4.1: Deciduous Trees/Shrubs

Restoration R4A

This restoration from State 4: Invaded Woody State to State 2: Native/Invaded State may be accomplished with brush management and/or long-term prescribed burning and prescribed grazing. The fire-tolerant (sprouting) shrub species will initially increase but will eventually decrease if the necessary fire frequency is maintained or brush management is applied. As shrub component decreases, the remnant herbaceous component will increase. The amount of native versus exotic herbaceous component remaining will determine whether this pathway leads to the State 2: Native/Invaded State or State 3: Invaded State. In this case, the amounts of native species present results in a shift to State 2: Native/Invaded State. This may also occur if range planting is implemented successfully to re-establish a native plant community.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Ladder fuel and/or fuel loading are required for successfully controlling ponderosa pine (crown vs. ground fire). Continued recruitment of seeds (juniper and pine) from adjacent sites will hamper site restoration. Intensive management is required to restore and maintain the site in State 2: Native/Invaded State.

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

Grazing prescriptions designed to address exotic grass invasion and favor native species may involve earlier, short, intense grazing periods with proper deferment to improve native species health and vigor. Fall (e.g.,

September, October) prescribed burning followed by an intensive, early spring graze period with adequate deferment for native grass recovery may shift the competitive advantage to the native species, facilitating the restoration to State 2: Native/Invaded.

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

Restoration R4B

This restoration from State 4: Invaded Woody State to State 3: Invaded State may be accomplished with brush management and/or long-term prescribed burning and prescribed grazing. The fire-tolerant (sprouting) shrub species will initially increase but will eventually decrease if the necessary fire frequency is maintained or brush management is applied. As shrub component decreases, the remnant herbaceous component will increase. The amount of native versus exotic herbaceous component remaining will determine whether this pathway leads to State 2: Native/Invaded State or State 3: Invaded State. In this case, the amounts of exotic species present results in a shift to State 3: Invaded State. This may also occur if range planting is used in an attempt to re-establish a native plant community but, due to various factors (i.e., drought), the planting fails, and exotic species increase and dominate.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Ladder fuel and/or fuel loading are required for successfully controlling ponderosa pine (crown vs. ground fire). Continued recruitment of seeds (juniper and pine) from adjacent sites will hamper site restoration. Intensive management is required to restore and maintain the site in State 2: Native/Invaded State.

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

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

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

State 5: Go-Back State

This state is highly variable depending on the level and duration of disturbance related to the T6A transitional pathway. In this MLRA, the most probable origin of this state is plant succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses, some of which may be noxious weeds and need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or crested wheatgrass) will likely predominate.

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

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

Community Phase 5.1: Annual/Pioneer Perennial /Exotics

This community phase is highly variable depending on the level and duration of disturbance related to the T6A transitional pathway. In this MLRA, the most probable origin of this phase is secondary succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses, including noxious weeds (e.g., Canada thistle) which may need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or crested wheatgrass) will likely predominate.

Restoration R5A

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

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

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

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

Restoration Pathway R5B
A failed range planting and/or secondary succession will lead to State 3: Invaded State.

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

Transition T6A
This transition from any plant community to State 5: Go-Back State. It is most commonly associated with the cessation of cropping without the benefit of range planting, resulting in a “go-back” situation. Soil conditions can be quite variable on the site, in part due to variations in the management/cropping history (e.g., development of a tillage induced compacted layer (plow pan), erosion, fertility, herbicide/pesticide carryover). Thus, soil conditions should be assessed when considering restoration techniques.

Ecological Site Interpretations
Animal Community – Wildlife Interpretations

Landscape

The MLRA 54 landscape is characterized by moderately dissected rolling plains with areas of local badlands, buttes, and isolated hills. MLRA 54 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 mixed-grass prairie vegetation with prairie rose, leadplant, and patches of western snowberry interspersed throughout the area. Green ash, chokecherry, and buffaloberry occur in draws and narrow valleys creating woody riparian corridors. Complex intermingled ecological sites create diverse grass/shrub land habitats interspersed with varying densities linear, slope, depressional, and in-stream wetlands associated with headwater streams and tributaries to the Missouri River. These habitats provide critical life-cycle components for many wildlife species.

Historic Communities/Conditions within MLRA:

The northern mixed-grass prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary ecological drivers, either singly or often in combination. 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 semi-arid region. Roaming herbivores, as well as several small mammal and insect species, were the primary consumers linking the grassland resources to large predators (such as the wolf, mountain lion, and grizzly bear) and smaller carnivores (such as the coyote, bobcat, red fox, and raptors). The black-tailed prairie dog was once abundant and provided ecological services by manipulating the plant and soil community, thus providing habitat for the black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, swift fox, small mammals, and amphibians and reptiles. Extirpated species include free-ranging American bison, grizzly bear, gray wolf, black-footed ferret, mountain plover, and peregrine falcon (breeding). Extinct from the region is the Rocky Mountain locust.

Present Communities/Conditions within MLRA:

Following European influence, domestic livestock grazing, elimination of fire, energy development, and other anthropogenic factors influenced plant community composition and abundance. Agriculture, transportation corridors, and energy development are the main factors 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, crested wheatgrass, Kentucky bluegrass, and leafy spurge. This further impacted plant and animal communities. The loss of the bison, black-tailed prairie dogs, and fire as primary ecological drivers greatly influenced the character of the remaining native plant communities and the associated wildlife, moving towards a less diverse and more homogeneous landscape.

Included in this MLRA are the isolated Killdeer Mountains (limestone capped residual butte) containing bur oak, quaking aspen, green ash, paper birch, and American elm. Except for floodplain forests within the MLRA, the Killdeer Mountains contain the largest deciduous forest in southwestern North Dakota.

Some wildlife species in this area are deer (white-tailed and mule), elk, pronghorn, moose, coyote, red fox, bobcat, prairie rattlesnake, American badger, raccoon, North American porcupine, beaver, striped skunk, American mink, white-tailed jackrabbit, black-tailed prairie dog, Eastern and Merriam's turkey, golden eagle, ferruginous hawks, sharp-tailed grouse, black-billed magpie, and numerous species of grassland-nesting birds and pollinating insects.

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 a majority species are larger than one ecological site or are dependent on more than one ecological site for annual life requisites. Ecological sites offer different habitat elements as the annual life requisites change. Habitat improvement and creation must be conducted within the mobility limits of a known population for the species.

Insects play an important role providing ecological services for plant community development. Insects that are scavengers or aid in decomposition provide the food chain baseline sustaining the carnivorous insects feeding upon them. Many insects provide the ecological services necessary for pollination, keeping plant communities healthy and productive. Insects provide a protein food source for numerous species including grassland-nesting birds and their young.

Species unique to MLRA:

Bald eagle: Bald Eagles prefer large rivers, lakes, reservoirs, or wetlands that are bordered by mature stands of trees or a single large tree. Bald eagles use the Missouri River system, including Lakes Sakakawea and Oahe, and associated tributaries. Mature trees, including cottonwoods, provide nesting sites adjacent to aquatic and upland foraging sites.

Dakota skipper: The extreme northern portion of this MLRA provides limited Dakota skipper habitat. Dakota skipper habitat within MLRA 54 is considered Type B habitat. Type B habitat is described as rolling native-prairie terrain over gravelly glacial moraine deposits dominated by bluestems and needlegrasses with the likely presence of bluebell bellflower, wood lily, blacksamson echinacea, upright prairie coneflower, and blanketflower. The United States Fish and Wildlife Service lists two critical habitat units within the MLRA in McKenzie County, North Dakota.

Golden eagle: The Lake Sakakawea breaks, bluffs, and rock outcroppings within the northwest portion of the MLRA are key areas for golden eagle nesting. Grasslands, shrublands, and black-tailed prairie dog towns are used for foraging.

Black-footed ferret: Black-footed ferrets have been reintroduced as an experimental population in the southern portion of the MLRA located on the Cheyenne Sioux Indian Reservation. Since reintroduction between 1991 and 1996, black-footed ferrets have been documented on the Standing Rock Sioux Indian Reservation approximately 20 miles north of the reintroduction site. Black-footed ferrets rely exclusively on prairie dog towns for shelter, breeding, and food sources (prairie dogs and other species within the town).

Least tern (Interior): Least terns are found on the Missouri River system in MLRA 54. Sparsely vegetated sandbars within the free-flowing portions of the Missouri River or shorelines of Lake Oahe and Sakakawea are used for nesting and foraging.

Species of Concern within the MLRA:

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 Montana State Wildlife Action Plan (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 54 at the time this section was developed:

Invertebrates: Dakota skipper, little white tiger beetle, monarch butterfly, Ottoe skipper, regal fritillary, yellow-banded bumble bee, and western bumble bee.

Birds: American Kestrel, Baird's sparrow, bald eagle, black-billed cuckoo, black tern, bobolink, Brewer's sparrow, burrowing owl, chestnut-collared longspur, ferruginous hawk, golden eagle, grasshopper sparrow, greater sage-grouse, lark bunting, loggerhead shrike, least tern, long-billed curlew, marbled godwit, McCown's longspur, mountain plover, northern goshawk, northern harrier, northern pintail, peregrine falcon (migration), piping plover, prairie falcon, red knot (migration), red-headed woodpecker, sharp-tailed grouse, short-eared owl, Sprague's pipit, Swainson's hawk, trumpeter swan, upland sandpiper, western meadowlark, willet, Wilson's phalarope, and whooping crane (migration).

Mammals: Big and little brown bats, long-eared bat, long-legged bat, northern long-eared bat, Townsend's big-eared bat, western small-footed bat, black-footed ferret, black-tailed prairie dog, dwarf shrew, gray wolf, hispid pocket mouse, Merriam's shrew, northwestern moose, sagebrush vole, silver-haired bat, and swift fox.

Amphibians/Reptiles: Common snapping turtle, Great Plains toad, false map turtle, greater short-horned lizard, milk snake, northern leopard frog, plains hognose snake, plains spadefoot, smooth green snake, and smooth softshell and spiny softshell turtle.

Fish and Mussels: Blue sucker, burbot, flathead chub, fragile papershell, northern redbelly dace, paddlefish, pallid sturgeon, pearl dace, pink papershell, shortnose gar, sickle-fin chub, sturgeon chub, and sauger.

Grassland Management for Wildlife in the MLRA

Management activities within the community phase pathways impact 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 (mechanical, reseeding, prescribed fire, woody vegetation removal, grazing intensity, etc.). Timing, intensity, and frequency of these inputs can have dramatic positive or negative effects on local wildlife species. Ranchers and other land managers must always consider the long-term beneficial effects of management on the habitat in comparison to potential short-term negative effects to individuals.

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 that support a dominance of herbaceous vegetation (Loamy/Clayey) can be located adjacent to ecological sites that support medium to tall shrubs (Loamy Overflow). Conversely, ecological sites that are dominated by short- to mid-statured grasses (Claypan) can be adjacent to sites with bare soil only supporting minor amounts of short grasses and forbs (Thin Claypan).

Management of these complex ecological sites can provide a heterogeneous or a homogenous landscape. Grassland bird use declines as the plant community transitions to a homogenous state. Managers should 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; for example, alteration of a grazing regime within a Loamy Overflow 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 must 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 should 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 (rarely found intact) or the 2.0 Native/Invaded. 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, foraging, or winter 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., sagebrush, western snowberry) in this MLRA.				

Shallow Sandy Wildlife Habitat Interpretation:

Shallow Sandy ecological sites are droughty sites identified by the presence of moderately coarse or coarse soil textures (fine sandy loamy or sandier) and a shallow depth (10 to 20 inches) to weathered bedrock or hard sandstone bedrock. Shallow Sandy sites support drought-tolerant species but are still productive compared to Sandy sites due to the increase in tall warm-season grasses like prairie sandreed. Shallow Sandy sites support diverse stands of tall- mid- and short warm- and cool-season grasses. Associated ecological sites include Sands, Sandy, Very Shallow, Thin Loamy, Limy Sands, Steep-Sided Wooded Draw, and Badland. This complex of ecological sites provides habitat for many edge-sensitive grassland bird species.

Shallow Sandy habitat features and components commonly support grassland-nesting birds, notably sharp-tailed grouse nesting, brood cover, and possibly lekking sites (depending upon its plant community state). Insects rely on associated forbs and grasses for survival, serve as food sources for birds and their young, and as forage for small and large herbivores.

Shallow Sandy ecological sites may be found in five plant community states (1.0 Reference State, 2.0 Native/Invaded State, 3.0 Invaded State, 4.0 Invaded Wooded State, and 5.0 Go-Back State) within a local landscape. Multiple plant community phases exist within States 1.0 and 2.0. Today, these states occur primarily in response to grazing and drought. Secondary influences include anthropogenic disturbances, black-tailed prairie dogs, and fire.

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using tools in the community phase pathways of State 1.0 and State 2.0 to prevent further plant community degradation along the T1A Transitional Pathways to Native/Invaded State 2.0. Native wildlife generally benefits from the heterogeneous grasslands, in stature and plant composition, found in States 1.0 and 2.0 which include diverse grass and forb species with varying stature and density. As plant communities degrade and transition to States 3.0 and 4.0, short warm-season grasses, exotic grasses, and creeping juniper increase while native grasses and forbs are reduced. This transition results in reduced stature or an increase in woody vegetation.

Success along Restoration Pathway R3A from State 3.0 to State 2.0 is very difficult and is dependent upon presence of a remnant native grass population. This concept also applies to wildlife, as the target species must either be present on adjacent State 1.0 or State 2.0 plant communities or on ecological sites within the species' mobility limits. 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 more easily locate and utilize isolated, restored plant communities.

Plant community phase in the State 3.0 shows increased homogeneity of exotic cool-season grasses with a further reduction in native forbs. Reduced forb diversity limits insect populations, negatively affecting foraging opportunities for grassland-nesting birds. A homogenous grassland landscape does not provide quality escape or winter cover. As a result, many species are not able to meet life requisites within State 3.0. Increased exotic-grass litter can limit access to bare ground by nesting insects.

Management along community phase, transition, or restoration pathways should focus on 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 Prairie Sandreed-Needle and Thread/Sedges: This plant community offers quality wildlife habitat; every effort should be made to maintain this ecological site within this community phase. This phase retains high functionality through continued maintenance, including prescribed grazing with adequate recovery period as well as prescribed fire. Predominance of grass species in this community favors grazers and mixed-feeders (animals selecting grasses as well as forbs and shrubs). The structural diversity provides habitat for a wide array of migratory and resident birds.

Invertebrates: Insects play a role in maintaining the forb community and provide a forage base for grassland birds, reptiles, and rodents. These services include putting plant material and dung in contact

with mineral soil to be used by low trophic level consumers (such as invertebrate shredders, predators, herbivores, dung beetles and fungal-feeders).

Dakota skippers may prefer this site when host plants, such as little bluestem, are present. Regal fritillary habitat is limited due to Nuttall's violet and prairie violets being uncommon. Monarch butterfly may use flowering forbs on this site; however, few milkweed species are found on this site to support breeding. Bumblebees and other native bees utilize forbs and bare ground for nesting amongst bunchgrasses. Prescribed grazing with adequate recovery periods (as well as prescribed fire) to maintain the 1.1 Phase has little effect on nests of ground-dwelling insects.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by mid- to tall-grass nesting birds. Several species of grassland birds which prefer mid- to tall-grass stature will use this site. In years with reduced precipitation or drought, nesting recruitment may be compromised. This plant community provides suitable areas for sharp-tailed grouse nesting and brood-rearing habitat. Diverse prey populations provide good hunting opportunities for grassland raptors. Silver sagebrush is incidental to the site and will not provide the necessary life requisites for the Brewer’s sparrow.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores including voles, mice, rodents, jackrabbits, pronghorn, and deer (white-tailed and mule). Short- to moderate-statured grasses provide suitable food, thermal, protective, and escape cover for small herbivores. The composition of mid- to tallgrasses may limit use by the hispid pocket mouse.

Amphibians and Reptiles: This ecological site and associated plant communities provide habitat for smooth green snakes. This ecological site can provide habitat for the northern leopard frog and Great Plains toad dependent on distance to wetland or Riparian Complex ecological sites. Plains spadefoot prefer sandy soils found on this site and plant community and may utilize this site if small ephemeral ponds are available for breeding. Sandy soils provide burrowing sites for short-horned lizards; however, vegetation within this plant community may be too tall and dense for the short-horned lizard.

Fish and Mussels: This ecological site is not directly associated with streams, rivers, or water bodies. Associated ecological sites can receive run-on hydrology from Sallow Sandy sites. Management on these interconnected sites will have limited, secondary effects on aquatic species.

Community Phase 1.2 Needle and Thread–Blue Grama/Sedges: Multiyear drought, with or without heavy continuous grazing and/or annual continuous early spring seasonal grazing, increases the percentage of short cool-season and short warm-season grasses and sedges in this plant community. This plant community becomes dominated by shorter grasses, changing the stature of plant community from mid- to tall plant species to mid- to short-grass species.

Invertebrates: Provides similar life requisites as Community Phase 1.1; however, heavy, continuous grazing or early spring seasonal grazing may negatively impact ground-nesting sites for bumblebees, other native bees, and other ground-nesting insects due to reduction of forbs and timing of forb flowering.

Birds: This plant community provides nesting, foraging, and escape habitats favored by short- to mid-grass nesting birds. A shift to shorter herbaceous plant stature along Community Phase Pathway 1.1A begins to benefit McCown’s longspur, chestnut-collared longspur, horned lark, and burrowing owl. Species preferring midgrass stature will be generally successful with normal to above normal precipitation and a change in management along the 1.2A Community Phase Pathway. In years with reduced precipitation or heavy grazing, nesting recruitment may be compromised for midgrass nesting species. This plant community provides areas suitable for sharp-tailed grouse leks. Limited cover and diverse prey populations provide good hunting opportunity for grassland raptors.

Mammals: Shorter statured grasses reduce thermal, shelter, and escape cover for larger ungulates.

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

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

Community Phase 1.3 Little Bluestem-Needle and Thread/Sedges: Physical soil surface movement associated with the formation of "steps" (minor slumping) through water erosion and deposition in community phase pathway 1.1B or 1.2C cause increased calcium carbonates at the surface, giving little bluestem a competitive advantage. This plant community occurs in a mosaic with community phase 1.1 or 1.2 creating a patchwork landscape. Little bluestem dependent species, such as Dakota skipper, can utilize this habitat.

Invertebrates: Provides similar life requisites as Community Phase 1.1; however, the increase in the host plant little bluestem has the potential for increased use by the Dakota skipper.

Birds: Dominated by bunch grasses with short statured sedges, this plant community provides nesting cover for grassland nesting birds that prefer mid- to short- statured nesting cover.

Mammals: Provides similar life requisites as Community Phase 1.2.

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

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

Community Phase 1.4 Sedges/Annual Forbs/Bare Ground (Prairie Dog Town): This plant community phase is characterized by grazing tolerant sedges, annual forbs, and a higher percentage of bare ground due to the increase in annul forbs. Continued heavy grazing, long-term prairie dog occupation, or a combination of these disturbances will cause a shift to increased annual forbs with a reduction in perennial grasses. Perennial forbs' stature and abundance are being replaced by short-statured annual forbs. Bare ground increases and litter amounts and infiltration rates decline; soil surface temperatures increase. Scruffy in appearance, this plant community is resilient, retaining sufficient grazing sensitive native species to return to 1.2 community phase via community phase pathway 1.4A.

Invertebrates: A switch to annual forbs from perennial forbs may have a significant impact to invertebrates, due to the loss of season-long nectar producing plants for pollinators. Annual forbs' bloom periods are dependent upon climatic conditions, especially precipitation events, and may not provide season-long nectar production. Season-long nectar sources may be found on adjacent plant communities or ecological sites for mobile species. Increased bare ground provides increased nesting sites for bumblebees and other ground nesting insects.

Birds: This short-structured phase, driven by short-term prairie dog occupation, is favored by burrowing owls, chestnut-collared longspur, and McCown's longspur. Prairie dog towns provide abundant prey populations for grassland raptors. The lack of grass and forb structure limits use by many bird species. Managing this phase along community phase pathway 1.4A can be an economical and successful method to restore habitat for many grassland nesting birds.

Mammals: Suitable food, thermal, shelter, and escape cover (reduction in litter) for most mammals becomes limited. The loss of diversity of grasses and forbs reduces nutrition levels for small and large herbivores including rodents, white-tailed jackrabbits, and deer. Grazers, such as pronghorn, use prairie

dog towns for foraging and loafing. Managing this phase along community phase pathway 1.4A can be an economical and successful method to restore habitat.

Amphibians/Reptiles: Prairie dog towns provide habitat for both amphibians and reptiles. Tiger salamanders, prairie rattlesnakes, plains hog-nosed snake, and other snake species will use the burrow systems of prairie dogs for shelter and denning.

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

2.0 Native Invaded State

Community Phase 2.1 Prairie Sandreed-Needle and Thread/Sedges: This plant community develops through Transition Pathway T1A due to changes in management (chronic season-long or heavy late season grazing or complete rest) and the presence of exotic, cool-season grasses. The threshold between States 1.0 and 2.0 is crossed when Kentucky bluegrass, crested wheatgrass, or other exotic species become established. This plant community phase has a very similar appearance and function to the Reference State of Community 1.1, except it has a minor amount of cool-season exotic grasses and forbs. This phase functions at a high level for native wildlife; therefore, managers should consider the 2.0 Community Phase Pathways to avoid transitioning to State 3.0.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

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

Community Phase 2.2 Needle and Thread-Blue Grama/Sedges: Continuous, heavy season-long grazing or heavy seasonal grazing (with or without drought) along Community Phase Pathway 2.1A, leads to shorter-statured grasses (such as needle and thread and blue grama) and sedges. Dominated by shorter-statured grasses and sedges and a loss of nitrogen-fixing or leguminous native forbs, the diversity of this plant community is reduced. Both tap-rooted and fibrous-rooted perennial forbs increase in this phase but remain a minor component. Prescribed grazing (with adequate recovery periods) and return to average precipitation along Community Phase Pathway 2.2A is an efficient, effective method to regain the cool-season grass and forb diversity components in Community Phase 2.1.

Invertebrates: The reduction of native forbs and increase in sod-forming grasses limit foraging and nesting sites for all pollinators. Continuous, heavy season-long grazing or heavy seasonal grazing may reduce ground-nesting site availability. Homogeneity of forb species may limit season-long nectar availability.

Birds: Continuous, heavy season-long grazing or heavy seasonal grazing will reduce nesting sites, forage (invertebrates), and cover. A reduced forb component may limit foraging opportunities. Stature is generally short, serving both mid- and shortgrass-nesting birds. Shortgrass-nesting birds favor this phase. Species preferring midgrass stature will be generally successful with normal to above normal precipitation and a change in management along the 2.2A Community Phase Pathway. In years with reduced precipitation or heavy grazing during the nesting season, nesting recruitment may be compromised for species that prefer midgrass nesting. This plant community provides areas suitable for sharp-tailed

grouse lek site development. Limited stature and diverse prey populations provide good hunting opportunity for grassland raptors.

Mammals: Suitable food, thermal, protective, and escape cover (reduction in litter) for most mammals becomes limited. The loss of diversity of grasses and forbs reduces nutrition levels for small and large herbivores including voles, mice, rodents, jack rabbits, pronghorn, and deer.

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

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

Community Phase 2.3 Little Bluestem-Needle and Thread/Sedges: Physical soil surface movement associated with the formation of “steps” (minor slumping) through water erosion and deposition in community phase pathway 1.1B cause increased calcium carbonates at the surface, providing little bluestem a competitive advantage. This plant community occurs in a mosaic with Community Phase 1.1 creating a patchwork landscape. Little bluestem dependent species, such as Dakota skipper, can utilize this habitat.

Insects: 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 2.2.

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

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

Community Phase 2.4 Sedges/Annual Forbs/Bare Ground (Prairie Dog Town): This plant community is a result of ecological services provided by long-term black-tailed prairie dog occupation coupled with the introduction of exotic cool-season grasses and annual forbs along Community Phase Pathway 2.2C. Removal of black-tailed prairie dogs via Community Phase Pathway 2.4A can move this community back to Phase 2.2, but this may require significant management and economic inputs. Black-tailed prairie dogs provide primary ecological services to transition to and maintain Plant Community Phase 2.4.

Invertebrates: The loss of native forb diversity limits use by all pollinators. However, annual, and invasive forbs will provide limited seasonal use, dependent upon bloom period. Bare ground, burrows, and short plant stature provide nest sites for bumblebees and other ground-nesting insects. Burrowing owls place dung around their burrow entrance to attract dung beetles and other insects as a food source.

Birds: Burrowing owl and McCown’s longspur rely on the stature and composition this plant community provides. Presence of black-tailed prairie dogs provided diverse prey populations for grassland raptors, including burrowing owls, prairie falcons, and ferruginous hawks. Burrowing owls nest in abandoned prairie dog burrows.

Mammals: Suitable food, thermal, protective, and escape cover (reduction in litter) for most mammals becomes limited. The loss of grass and forb diversity reduces nutrition levels for small and large herbivores including voles, mice, rodents, white-tailed jackrabbits, cottontail rabbits, and deer. Except for black-tailed prairie dogs, this plant community provides little habitat for mid- or small herbivores.

Nonetheless, black-tailed prairie dog towns provide important habitat for many mammal species, including small rodents. Grazers, such as pronghorn, use prairie dog towns for foraging and loafing.

Amphibians and Reptiles: Prairie dog towns provide habitat for both amphibians and reptiles. Tiger salamanders, prairie rattlesnakes, plains hog-nosed snake, and other snake species will use the burrow systems of prairie dogs for shelter and denning.

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

Community Phase 2.5 Shrubs/Forbs/Needlegrasses/Trees: Extended periods of non-use or very light grazing, and no fire, allows shrubs and forbs to dominate this plant community. This plant community phase is characterized by a conspicuous shrub component, forbs, needlegrasses, and perhaps green ash trees. Leadplant, chokecherry, Saskatoon serviceberry, and soapweed yucca are common shrubs. Common forbs include white heath aster, goldenrod, common yarrow, and white sagebrush. Green ash trees are also often present.

Invertebrates: Forbs and shrubs provide early- to mid-season pollen and nectar for use by all pollinators. Sufficient bare ground provides nest sites for bumblebees and other ground-nesting insects.

Birds: Dependent upon the dentistry of shrubs and possible trees, grassland nesting birds intolerant of woody species my not use this site.

Mammals: Suitable food, thermal, protective, and escape cover are available for small and large mammals,

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

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

3.0 Invaded State

Community Phase 3.1 Exotic Cool-Season Grasses/Forbs/Shrubs: Community Phase Pathway T2A is characterized by complete rest or low intensity (<20% utilization) grazing and elimination of fire when exotic cool-season grasses are present, as in Community Phase 2.0. This plant community phase is characterized by a dominance (>30%) of exotic cool-season grasses, such as Kentucky bluegrass and crested wheatgrass. Restoration Pathway R3A requires remnant amounts of native grasses (i.e., prairie sandreed, blue grama, needlegrasses, little bluestem) and forbs (e.g., white sagebrush, silverleaf Indian breadroot, and upright prairie coneflower) with frequent prescribed burns and high levels of grazing management targeting the exotic cool-season grasses to improve competitiveness and increase vigor and density. Without intensive management, the remnant native plants will not increase adequately to transition back to State 2.0. Intensified management along the R3A Pathway will have significant short-term negative impacts on wildlife habitat; however, this is necessary to restore long-term native habitat functions. Long-term lack of fire will help this Plant Community Phase transition to 4.1.

Insects: Exotic grasses result from non-use or low intensity (<20% utilization) grazing and limit use by beneficial insects provided in States 1.0 and 2.0. Increased litter and lack of grazing leads to limited contact between plant material and mineral soil resulting in a cooler micro-climate, which is unfavorable to most insects. Lack of bare soil limits ground-nesting sites for native bees and other ground-nesting insects. The lack of nectar-producing plants limits forage opportunities for bumblebees, regal fritillary, monarch butterfly, and other pollinating species.

Birds: The homogeneous community phase, dominated by exotic plant species, provides limited habitat and life requisites for most obligate grassland-nesting birds. Lack of plant diversity and stature, along with increased litter, limits use by many grassland-nesting birds. Litter accumulations reduce use by chestnut-collared and McCown's longspurs. Burrowing owls may use the site if sufficient burrows of black-tailed prairie dogs or other burrowing mammals exist. Sharp-tailed grouse leks can be found on this exotic cool-season plant-dominated community; however, winter cover must be provided by adjacent ecological sites or plant communities.

Mammals: Black-tailed prairie dog expansion is possible in this plant community phase except where creeping juniper or soapweed yucca are dominant. This community phase provides foraging habitat for pronghorn and deer. Litter accumulation and shrub cover favors thermal, protective, and escape cover for small rodents. However, reduced availability of native grass seed may reduce food availability for species such as the hispid pocket mouse.

Amphibians and Reptiles: Provides similar secondary resources benefits as Community Phase 1.1.

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

4.0 Invaded Wooded State

Community Phase 4.1 Creeping Juniper/Shrubs: Transitional Pathway T2B is characterized long-term lack of fire allowing creeping juniper to dominate. Domination by creeping juniper causes a reduction in forbs, as well as warm- and cool-season native and exotic grasses. Prescribed burning along Restoration Pathway R4A or R4B requires remnant amounts of native warm-season grasses (e.g., blue grama), cool-season grasses (e.g., needlegrasses, western wheatgrass, and prairie Junegrass), and forbs (e.g., silverleaf Indian breadroot, and upright prairie coneflower) to move this plant community to 2.0 or 3.0 States. These remnant populations can only be expressed through frequent prescribed burns and high levels of prescribed grazing management targeting the exotic cool-season grasses. Intensified management along the R4A Pathway will have significant short-term negative impacts on wildlife habitat; however, this is necessary to restore long-term native habitat functions.

Invertebrates: Creeping juniper limits use by beneficial insects provided in States 1.0 and 2.0. Creeping juniper does not provide a pollen or nectar source and limits establishment of other flowering forbs or shrubs. The lack of nectar-producing plants limits forage opportunities for bumblebees, regal fritillary, monarch butterfly, and other pollinating species.

Birds: Long-term very light grazing and lack of fire (via Transitional PathwaysT2B and T3A) transitions this ecological site from a grassland dominated site to a creeping juniper dominated ecological site limiting use by grassland-nesting birds. In most cases the transition to creeping juniper occurs on adjoining ecological sites prone to the same T2B and T3A pathways as this Shallow Sandy ecological site. Juniper berries provide a food source for many bird species including sharptailed grouse.

Mammals: Creeping juniper limited use for larger ungulates but may be used by small mammals for escape and thermal cover.

Amphibians/Reptiles: Community Phase 4.1 will not support most of the amphibians and reptiles expected to be present in State 1.0, 2.0 and 3.0.

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

5.0 Go-Back State

Community Phase 5.1 Annual/Pioneer Perennial/Exotics: These plant communities are the result of severe soil disturbance (such as cropping, recreational activity, or concentrated livestock activity for a prolonged period). Following cessation of disturbances, the resulting plant community is dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals and birds, and their young. Dense weed cover can keep soils moist, increasing the presence of insects. Tall stature provided by some weeds, such as marsh elder and ragweed, offer thermal cover and seeds throughout winter.

Successful restoration of native species along Restoration Pathway R5A results in a native grass and forb community in State 2.0, Native/Invaded. Failed restoration to native species through Restoration Pathway R5B results in Invaded State 3.0. Wildlife species response will be dependent upon plant community composition, vegetative stature, patch size, and management activities (such as prescribed grazing, burning, interseeding, haying, or noxious weed control).

Animal Community – Grazing Interpretations

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

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

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

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

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

Hydrology Functions

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

Recreational Uses

The largest acreage of public land available for recreation in the MLRA is owned and managed by the United States Forest Service (USFS) within the Little Missouri, Grand River, and Cedar River National Grasslands in South Dakota and the Little Missouri National Grasslands in North Dakota (687,398 acres). These areas are available for hunting, fishing, hiking, camping, horse and bike riding, nature viewing, etc. In addition, the Bureau of Land Management (BLM) manages (40,264 acres) in North and South Dakota with the same recreational opportunities as the USFS lands.

The United States Army Corps of Engineers (USAE) owns 496,162 acres of land and water located on and adjacent to Lake Sakakawea and Lake Oahe. The North Dakota and South Dakota Game and Fish Departments manage the fisheries resources. These two Missouri River reservoirs provide excellent fishing

and water recreation opportunities. In addition, the United States Fish and Wildlife Service (USFWS) manages a national fish hatchery below Garrison Dam.

The USFWS manages 36,858 acres in the National Wildlife Refuge system while the North Dakota and South Dakota wildlife management agencies manage 72,218 acres as wildlife or game management areas. The North Dakota, South Dakota, and Montana Department of Trust Lands manage 486,482 acres. These areas provide hunting, bird watching, hiking, and other outdoor recreation opportunities. North Dakota Wildlife Management Areas along the shoreline of Lake Sakakawea and the Missouri River account for 60,000 acres of the approximately 72,218 acres of land managed by the states for wildlife habitat in MLRA 54. Located in the northern portion of the MLRA, the Killdeer Mountain WMA is the largest tract of state-owned land managed for wildlife habitat at approximately 7,000 acres.

The largest refuge managed by the United States Fish and Wildlife service is Lake Ilo National Wildlife Refuge totaling approximately 4,000 acres. United States Bureau of Reclamation manages approximately 11,000 acres at Lake Tschida and 8,460 acres at Bowman-Haley Lake for fish and wildlife habitat. The National Park Service manages the Knife River Indian Village National Historic Site; the North Dakota Historical Society manages the Double Ditch Indian Village site.

Bird watching: Public and private grasslands within MLRA 54 provide essential habitat for prairie-dependent bird species such as Sprague's pipits, western meadowlark, and Baird's sparrow along with some of the larger, showy members of the upland prairie include marbled godwits, upland sandpipers, willets, and sharp-tailed grouse. Publicly owned lands provide excellent birding opportunities. MLRA 54 is in the Central Flyway.

Hunting/Fishing: MLRA 54 is a fall destination for thousands of pheasant and upland game bird hunters. This MLRA also provides excellent deer (white-tailed and mule), pronghorn, and coyote hunting opportunities. Lake Sakakawea, Lake Oahe, Lake Tschida, and the Missouri River provide excellent year-round fishing opportunities. The North Dakota Game and Fish Department and South Dakota Game, Fish and Parks manage approximately 40 fishing lakes within the MLRA. Available species include yellow perch, walleye, northern pike, muskellunge, crappie, bluegill, rainbow trout, and smallmouth bass. Chinook salmon are stocked in Lake Sakakawea.

Camping: Numerous state operated campgrounds are located along the shores of Lake Sakakawea, Lake Oahe, Missouri River, and Shadehill Reservoir. Primitive camping is allowed on Grand River and Cedar River National Grasslands in South Dakota and the Little Missouri National Grasslands in North Dakota. Other numerous camping (primitive and improved) sites are available in numerous city and county parks.

Hiking/Biking/Horseback Riding: Hiking is permitted on most state and federally owned lands. Developed hiking and biking trails can be found on Harmon Lake (13.1 miles), Roughrider Trail (Morton County, 16.5 miles), Missouri River State Natural Area (5 miles), Ft. Abraham Lincoln State Park (8 miles), Cross Ranch State Park (14 miles), Grand River National Grasslands (7 miles), Lake Sakakawea State Park (5 miles), and Lewis & Clark State Park (5 miles). In addition, extensive biking and walking trails are found in local county and city parks. Ft. Abraham Lincoln State Park has 6 miles of horseback trails.

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

This ESD is the best available current 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	*R054XY025ND*	This site occurs lower on the landscape. It is >20 inches to sandstone bedrock. The soil does not form a ribbon and is not highly calcareous.
Sandy	*R054XY026ND*	This site occurs lower on the landscape. It is >20 inches to sandstone bedrock. The soil forms a ribbon <1 inch long.
Very Shallow	*R054XY035ND*	This site occurs on similar landscape positions as Shallow Sandy ecological sites. The depth to sandstone bedrock is less than 10 inches.
Thin Loamy	*R054XY038ND*	This site occurs higher on the landscape on till-capped sedimentary plains. It is deeper than 20 inches to soft sedimentary siltstone. The soil forms a ribbon 1 to 2 inches long.
Limy Sands	*R054XY045ND*	This site is somewhat lower on the landscape than Shallow Sandy ecological sites. It is >20 inches to sandstone bedrock. The soil does not form a ribbon and is highly calcareous within a depth of 12 inches.
Badland	*R058CY103ND*	This site is on the very steep, sparsely vegetated escarpments. The Badlands ecological site is characterized by exposed, soft, sedimentary bedrock that is actively and constantly eroding.

Similar Sites

Ecological Site Name	Site ID	Narrative
Shallow Loamy	*R054XY030ND*	This site is on similar landscape positions as the Shallow Sandy ecological site. The soil above the soft bedrock forms a ribbon >1 inch long. The soils have soft, sedimentary siltstone or mudstone at a depth of 10 to 20 inches. This bedrock affects root growth.
Very Shallow	*R054XY035ND*	This site occurs on similar landscape positions as Shallow Sandy ecological sites. The depth to sandstone bedrock is less than 10 inches.
Limy Sands	*R054XY045ND*	This site is somewhat lower on the landscape than Shallow Sandy ecological sites. It is >20 inches to sandstone bedrock. The soil does not form a ribbon and is highly calcareous within a depth of 12 inches.

Acknowledgements

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Developers

ND NRCS: David Dewald, Jonathan Fettig, Jody Forman, Mike Gerbig, Alan Gulsvig, Mark Hayek, Jeanne Heilig, John Kempenich, Chuck Lura, Jeff Printz, Steve Sieler, and Hal Weiser.

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Inventory Data References

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

State Correlation

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

Relationship to Other Established Classifications

Level IV Ecoregions of the Conterminous United States: 43a – Missouri Plateau; 43c – River Breaks; 43j – Moreau Prairie.

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Site Description Approval

ND, State Rangeland Management Specialist	Date	SD, State Rangeland Management Specialist	Date
MT, State Rangeland Management Specialist	Date		

15INTERPRETING INDICATORS OF RANGELAND HEALTH, Version 5, REFERENCE SHEET

Ecological site name: _Shallow Sandy__ Ecological site code: _RO54XY043ND___
Author(s)/participant(s): M. Hayek, J. Printz, S. Boltz, R. Kilian, D. Froemke, M. Rasmusson
Contact for lead author: _NRCS State Rangeland Management Specialist__
Date: _Nov. 2021__ **MLRA:** ___54_____ **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: Due to wide slope range associated with this site, the number and extent of rills will vary from none on sites with slopes less than 15% to common but short, shallow, and discontinuous on sites with slopes greater than 15%.
2. Water flow patterns: Due to the wide slope range associated with this site, water flow patterns will vary from barely observable, broken and irregular in appearance on slopes <15% to continuous on slopes >15%.
3. Pedestals and/or terracettes: Not evident on sites with slopes 15%. Erosional pedestals and terracettes will be observable but uncommon on sites with slopes > 15%.
4. Bare ground: Bare ground ranges from 25 to 40%. Bare ground patches should be small (less than 6 inches in diameter) and not connected. Animal activity (burrows and ant mounds) may occasionally result in isolated patches of up to 24 inches in diameter.
5. Gullies: Gullies not expected on this site.
6. Wind-scoured and/or depositional areas: No wind-scoured or depositional areas expected on this site.
7. Litter movement: No litter movement expected on sites with less than 15% slope. Short (less than 24 inches) movement of fine, small class litter may be observable on slopes of greater than 15%.
8. Soil surface resistance to erosion: Stability class anticipated to average 5 or greater.
9. Soil surface loss and degradation: Structure is subangular blocky or granular within the upper A-horizon. A-horizons for this ecological site range from 2 to 6 inches thick. Hue 2.5Y or 10YR with value of 4 or less moist or 4 to 6 dry, and chroma 3 or less moist.
10. Effects of plant community composition and distribution on infiltration: Tall rhizomatous grasses and mid- and short-statured bunchgrasses are dominant and grass-likes, are subdominant.
11. Compaction layer: No compaction layers occur naturally on this site except for the naturally occurring rooting restriction occurring at 10 to 20 inches below the soil surface.
12. Functional/structural groups: Due to differences in phenology, root morphology, soil biology relationships, and nutrient cycling Kentucky bluegrass, smooth brome, and crested wheatgrass are included in a new Functional/structural group, mid- and short-statured early cool-season grasses (MSeC3), **not expected for this site**.

Dominance Category[1]	Relative dominance of F/S groups for community phases in the *Reference State* *Minimum expected number of species for dominant and subdominant groups is included in parentheses.*		
	Dominance based on[1]: Annual Production _X_ or Foliar Cover __		
	Phase 1.1_	Phase 1. __	Phase 1. __
Dominant	Mid & short C4 bunch grasses (5); Tall C4 rhizomatous grasses (2)		
Subdominant	Mid & short C3 bunch grasses (5); Grass-likes (3)		
Minor	Forbs; Mid & short C3 rhizomatous grasses; Shrub; Mid & short C4 rhizomatous grasses		
Trace	Evergreen forbs		

[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: Some (less than 10%) dead or dying plants or plant parts may be observed on this site.

14. Litter cover and depth: Plant litter cover is 15 5o 35% with a depth of 0.1 to 0.25 inches. Litter is in contact with soil surface.

15. Annual production: Annual air-dry production is 1400 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 900 lbs./ac to 1900 lbs./ac respectively.

16. Invasive plants: State and local noxious species, Kentucky bluegrass, smooth bromegrass, crested wheatgrass, creeping juniper, and Rocky Mountain juniper/cedar.

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. Bunchgrasses should exhibit good vigor with basal diameters of 3 to 6 inches.

Site Type: Rangeland
MLRA: 54-Rolling Soft Shale Plain

October 2024

Functional/Structural Groups Sheet

State_____ **Office**_____ **Ecological site** Shallow Sandy **Ecol. site code** R054XY043ND

Observers_____ **Date**_____

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

Species list of functional/structural groups in the **Reference State**	
Functional/Structural Group	Species List
Mid & short C4 bunch grasses.	little bluestem, plains muhly, blue grama, red threeawn, sand dropseed
Tall C4 rhizomatous grasses.	prairie sandreed, sand bluestem
Mid & short C3 bunch grasses	needleandthread, porcupine grass, green needlegrass, prairie junegrass, Scribner panicum
Grass-likes	threadleaf sedge, sun sedge, Penn sedge
Forbs	Please see plant community table 1.1
Mid & short C3 rhizomatous grasses	western wheatgrass, plains reedgrass*
Shrub	Please see plant community table 1.1
Mid & short C4 rhizomatous grasses	sideoats grama
Evergreen forbs	lesser spikemoss/clubmoss*
.	
Biological soil crust[1]	

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

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

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

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

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

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