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: Clayey

Site Type: Rangeland

Site ID: R058CY072ND

Major Land Resource Area (MLRA): 58C Northern Rolling Plains, Northeastern Part
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 58C - Northern Rolling Plains, Northeastern Part in North Dakota and Montana

MLRA 58C covers 2,320 square miles and encompasses approximately 1.8 million acres. MLRA 58C spans two states, with 96 percent located in North Dakota and the remaining 4 percent is in Montana. The MLRA 58C landscape is characterized by steeply sloping dissected badlands along the Little Missouri River and its tributaries. Primary land uses are of rangeland for grazing and wildlife habitat. Microclimates inherent in badlands landscapes influence both variety and abundance of vegetation in MLRA 58C. South- and west-facing exposures are dry, hot, and sparsely vegetated. More humid and cooler north- and east-facing exposures are favorable for abundant forage and woody vegetation.

MLRA 58C is known as the Little Missouri Badlands, which formed when the Little Missouri River was diverted along a shorter, steeper course by Pleistocene glaciers. Due to the resulting increased gradient after its eastward diversion by the glaciers, the Little Missouri River began rapidly downcutting into the soft, calcareous sedimentary shale, siltstone, and sandstone of the Fort Union and Hell Creek geological formations. This rapid downcutting eroded and carved the badlands of the MLRA. This cycle of erosion and deposition continues today.

Most of the soils in MLRA 58C developed from residuum weathered in place. As a result of constant erosion and deposition, the majority of soils in MLRA 58C are Entisols and Inceptisols. Mollisols formed on the high, stable drainageway divides and plateaus above the steeper, dissected hillslopes and fans that define the Little Missouri Badlands. Elevation ranges from 1,835 feet (560 meters) to 3,400 feet (1,036 meters). The Little Missouri River flows through the entire length of MLRA 58C and empties into Lake Sakakawea that was formed by the Garrison Dam on the Missouri River.

Ecological Site Concept

The Clayey ecological site in MLRA 58C occurs on stable backslopes, erosional foot slopes, and toe slopes of upland landforms. Soils on this site are moderately deep to very deep, fine-textured soils with greater than 18 percent clay in the surface horizon and greater than 35 percent clay in the subsoil (forms a ribbon >2 inches long). Soils on the Clayey ecological site formed in calcareous residuum and in alluvium derived from residuum. Thickness of the soil surface horizon ranges from 3 to 15 inches. Slopes range from 0 to 35 percent. On the landscape, Shallow Loamy ecological sites occur higher and Loamy Overflow occurs lower. Claypan and Loamy sites occur on similar landscape positions. The Claypan site has a dense, sodic, root-restrictive subsoil. Soils on the Loamy site form a ribbon 1 to 2 inches long.

Physiographic Features

The Clayey ecological site is located on stable backslopes, erosional foot slopes, and toe slopes on level to steep landforms on upland sedimentary plains. Slope ranges from 0 to 35 percent.

Landform: sedimentary plain

	Minimum	**Maximum**
Elevation (feet):	1835	3400
Slope (percent):	0	35
Water Table Depth (inches):	42	>80
Flooding:		
Frequency:	None	None
Ponding:		
Frequency:	None	None
Runoff Class:	Low	Very high
Aspect:	No influence on this site	

Climatic Features

MLRA 58C 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 the location of this MLRA 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 17 inches per year. The normal average annual temperature is about 41° F. January is the coldest month with an average temperature of about 17° F. July is the warmest month with an average temperature of about 70° F. The range of normal average monthly temperatures between the coldest and warmest months is 53° F. This large temperature range attests to the continental nature of the MLRA 58C 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 to 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 in September and October when adequate soil moisture is present.

Climate Station(s) 1981 - 2010

Station	Name	Location	Elevation	Lat	Long
USC00328812	TROTTERS 3 SSE	Beach	2419.9	47.2842	-103.9006
USC00329246	WATFORD CITY 14S	Grassy Butte	2026.9	47.6	-103.2597
USW00094080	MEDORA 7 E	Fairfield	2771	46.8947	-103.3769
USC00320209	AMIDON	Amidon	2910.1	46.4819	-103.3222
USC00241518	CARLYLE 13 NW	Wibaux	3140.1	46.7447	-104.3080

Climate Normals

	Representative		Actual		
	High	Low	High	Low	Average
Mean annual precipitation (in):	16	15	16	14	15
Frost free period (days):	100	91	102	84	95
Freeze free period (days):	123	119	123	116	121

Normal monthly precipitation (in)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.4	0.4	0.8	1.4	2.4	3.0	2.3	1.6	1.4	1.4	0.6	0.5
Representative low:	0.4	0.3	0.7	1.1	2.3	2.8	2.1	1.4	1.4	1.3	0.5	0.4
Actual high:	0.5	0.4	0.9	1.6	2.4	3.0	2.3	1.7	1.5	1.4	0.7	0.6
Actual low:	0.3	0.3	0.6	1.0	2.2	2.6	2.0	1.3	1.4	1.1	0.5	0.4

Normal monthly minimum temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	8.2	11.8	21.2	31.9	42.3	51.9	57.7	55.9	45.6	33.7	21.1	9.3
Representative low:	5.8	10.4	20.2	31.0	41.3	50.5	56.6	55.0	44.5	32.3	19.7	7.6
Actual high:	9.9	13.4	21.7	32.0	42.8	52.0	58.3	56.3	45.7	33.9	22.2	11.3
Actual low:	3.8	9.3	19.9	30.9	41.2	50.5	56.4	55.0	44.4	32.3	19.1	6.3
Average:	6.9	11.1	20.7	31.4	41.8	51.1	57.1	55.5	44.9	33.0	20.4	8.6

Normal monthly maximum temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	27.7	32.0	43.3	57.5	67.6	77.1	85.8	85.6	73.8	58.9	41.2	29.1
Representative low:	26.0	31.1	41.3	55.1	65.0	74.3	82.6	82.8	70.7	56.1	40.2	27.5
Actual high:	28.7	33.6	43.5	58.0	68.4	77.5	85.9	85.7	74.1	59.1	42.3	30.4
Actual low:	25.5	31.1	41.3	54.4	64.2	73.3	82.1	82.3	70.3	55.9	39.9	27.5
Average:	27.1	31.8	42.4	56.4	66.5	75.7	84.3	84.2	72.2	57.3	40.8	28.6

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

1981 D	1982W	1983 D	1984 D	1985 N	1986 W	1987 D	1988 D	1989 N	1990 D	1991 W	1992 D	1993 W	1994 N	1995 N
12.6	22.8	12.3	12.0	15.7	20.7	13.8	8.3	15.1	11.1	18.3	13.5	19.5	15.2	15.9

1996 W	1997 N	1998 W	1999 W	2000 N	2001 N	2002 D	2003 N	2004 D	2005 W	2006 N	2007 D	2008 N	2009 W	2010 W
16.9	14.1	18.5	13.5	15.1	15.4	12.7	14.3	12.2	20.7	15.1	13.9	14.8	16.4	22.1

Influencing Water Features

No significant water features influence this site. A seasonal water table is typically than 4 feet throughout the growing season; however, in a few soils it may be as shallow as 3.5 feet early in the spring. Surface infiltration range from slow to moderately slow. Permeability through the profile ranges from very slow to moderately slow. Water loss is through evapotranspiration and percolation below the root zone.

Salinization Risk – Removal of perennial vegetation (e.g., annual cropping), above this ecological site (recharge area), may result in increased water moving down through the soil profile. The potential salinization of the site can occur in any of the vegetative states; however, it is most prevalent in the State 4.0 Go-Back. This downward water movement leaches salts over time creating shallow saline groundwater immediately above a less permeable layer. Due to gravity, water moves downward through the soil profile then laterally through a porous layer, such as a coal or sand/gravel seam transporting salts to the discharge area. Below the porous layer, is a less permeable layer such as soft sedimentary bedrock. Where shallow saline groundwater occurs, salts often concentrate at or near the soil surface through capillary rise (discharge area). In capillary rise, water moves from where the soil is saturated, or nearly so, to drier soil against the force of gravity. Evaporation at the soil surface dries the soil and “pulls” water by capillary flow from the wet soil zone. Because only pure water evaporates, salts are left behind.

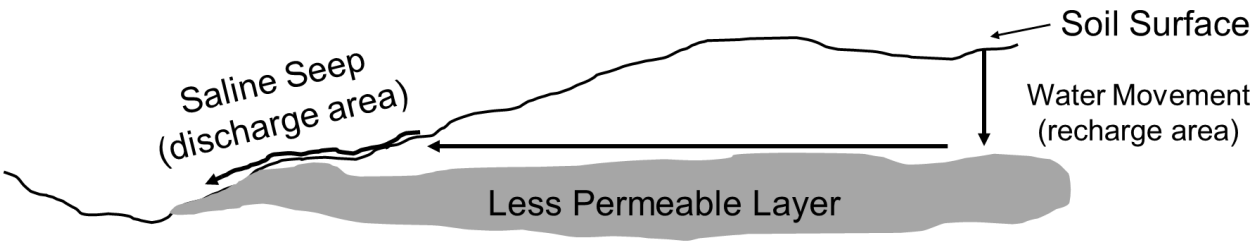

Figure 1. Increased salinity levels will make establishment of grasses and forbs more difficult. Treatment of the recharge area is a requirement to reclaim these soils from salinization. Some salinized soils can be excessively wet making establishment of saline tolerant vegetation difficult.

Representative Soil Features

Soils associated with the Clayey ES are in the Mollisol and Vertisol orders. The Mollisols are classified further as Aridic Argiustolls, Torrertic Argiustolls, and Aridic Natrustolls. The Vertisols are classified further as Aridic Haplusterts, Leptic Haplusterts, and Leptic Udic Haplusterts. These soils were developed under prairie vegetation. They formed in calcareous clayey residuum (typically soft sedimentary shale or siltstone) or clayey alluvium derived from residuum. The soils on this site are moderately deep to very deep. They are well drained or moderately well drained.

The common feature of soils in this site is a fine-textured subsoil (forms a ribbon >2 inches long), but it is not so dense as to be root-restrictive. The subsoil is clay, silty clay, clay loam, or silty clay loam (if clay loam or silty clay loam, clay content exceeds 35%). The surface layer is 3 to 15 inches thick. The surface texture is predominantly silty clay loam, but may also be silt loam, silty clay, clay, or clay loam.

Soil reaction typically is neutral to moderately alkaline (pH 6.6 to 8.4) in the surface layer; however, it ranges from moderately acid (pH 5.6) to strongly alkaline (pH 9.0). The subsoil and substratum layers are neutral to strong alkaline (pH 6.6 to 9.0). Calcium carbonate content, typically, is none to low (<5%) in surface layer; below this it may increase to as much as 15 percent.

When dry, these soils can crack; when wet, surface compaction can occur with heavy traffic. The soil surface is stable and intact. Sub-surface soil layers are non-restrictive to water movement and root penetration.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 5 percent. Loss of the soil surface layer can result in a shift in species composition and/or production.

The major soil series which characterize the Clayey ecological site in MLRA 58C are Abor, Ethridge, and Tanna. Also included is a taxadjunct to the Belfield series.

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

Parent Material Kind: residuum, slope alluvium
Parent Material Origin: residuum
Surface Texture: silty clay loam, silty clay, clay, silt loam, clay loam
Surface Texture Modifier: none
Subsurface Texture Group: Clayey
Surface Fragments <3" (% Cover): 0
Surface Fragments ≥3" (%Cover): 0
Subsurface Fragments <3" (% Volume): 0-5
Subsurface Fragments ≥3" (% Volume): 0-5

	Minimum	Maximum
Drainage Class:	moderately well	well
Permeability Class:**	very slow	moderately slow
Depth to first restrictive layer (inches):	20	>80
Electrical Conductivity (dS/m)*:	0	8
Sodium Absorption Ratio*:	0	12
Soil Reaction (1:1 Water):**	5.6	9.0
Soil Reaction (0.1M CaCl2):	NA	NA
Available Water Capacity (inches):**	4.50	8.50
Calcium Carbonate Equivalent (percent):**	0	15

*These attributes represent from 0 to 16 inches. Electrical Conductivity (E.C.) values are based on Saturated Paste method; the commonly used 1:1 field method will likely have E.C. values ≤4.
**These attributes represent from 0 to 40 inches or the first restrictive layer.

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 58C 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, pronghorn, mule deer, and whitetail deer). Herbivory by small mammals, insects, nematodes, and other invertebrates are also important factors influencing the production and composition of the communities. Grazing and fire interaction, particularly when coupled with drought events, influenced the dynamics discussed and displayed in the following state and transition diagram and descriptions.

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

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

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

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

Currently the primary disturbances include widespread introduction of exotic 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, with or without long-term occupation by prairie dogs, 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 (such as Kentucky bluegrass, smooth brome, crested wheatgrass, Canada bluegrass, and/or annual bromes) which have been particularly and consistently invasive under extended periods of no use and no fire. Other exotics, such as Canada thistle and leafy spurge, are also known to invade the site.

Three community phases have been identified for this state; they are similar to those of the Reference State but have now been invaded by exotic cool-season grasses. These exotic cool-season grasses can be expected to increase. As that increase occurs, plants more desirable to wildlife and livestock may decline. A decline in forb diversity can also be expected. Under non-use or minimal use management, mulch increases and may become a physical barrier to plant growth. It 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). Extended periods of no fire lead to State 5: Invaded Conifer State (T2B). Managers need to understand when the plant community is at or near these parameters; all data available needs to be evaluated to determine needed management actions.

State 3: Invaded State. The threshold for this state is reached when both the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, Canada bluegrass, annual bromes) exceed 30% of the plant community and native grasses represent less than 40% of the community. Managers need to understand when the plant community is at or near these parameters; all data available needs to be evaluated to determine needed management actions. One community phase has been identified for this state.

The exotic cool-season grasses can be quite invasive and often form monotypic stands. As they increase, both forage quantity and quality of the annual production becomes increasingly restricted to late spring and early summer, even though annual production may increase. Forb diversity often declines. Under non-use or minimal use management, mulch can increase and become a physical barrier to plant growth which alters nutrient cycling, infiltration, and soil biological activity. As such, desirable native plants become increasingly displaced.

Once the state is well established, prescribed burning and prescribed grazing techniques have been largely ineffective in suppressing or eliminating the exotic cool-season grasses, even though some short-term reductions may appear successful. However, assuming there is an adequate component of native grasses to

respond to treatments, a restoration pathway to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing in conjunction with prescribed burning (R3A). Extended periods of no fire leads to State 5: Invaded Conifer State (T3A).

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

State 5: Invaded Conifer State. This state historically existed as small patches of fire-tolerant trees and shrubs when precipitation, fire frequency, and other factors enabled woody species to colonize or encroach on the site. This often resulted in a mosaic of small, scattered patches of woody vegetation interspersed within the grass dominated vegetation.

A marked decrease in fire frequency and increased fire suppression since European influence has enabled this state to expand and become more widespread. This is particularly important to the fire-intolerant juniper species' ability to expand and exploit and dominate grasslands. Where a conifer seed source is available, woody encroachment processes begin to dominate as fire intervals increase or fire is eliminated from the site. As depicted in the following diagram, conifer seeds disperse into an intact grassland State 1.0 or 2.0, beginning the process of woody encroachment. Extended fire intervals allow conifer to establish allowing for a transition to an Invaded Conifer State.

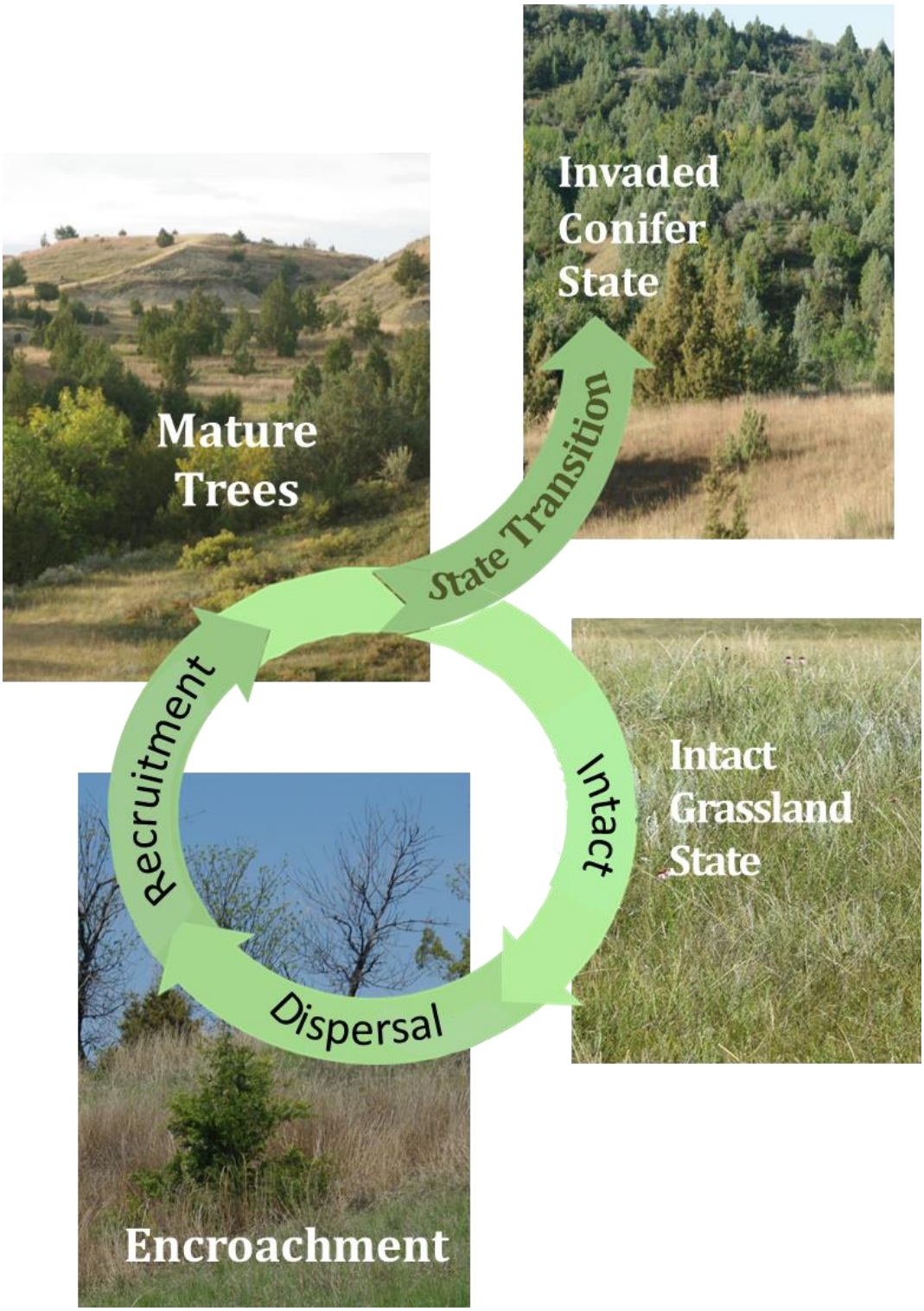

Figure 1. Stages of Woody Encroachment - Adapted from: Reducing Woody Encroachment in Grasslands – A Guide for Understanding Risk and Vulnerability; Oklahoma Cooperative Extension Service

This conifer invaded community phase often results from extended periods of no fire (T2B, T3A). Brush control (e.g., prescribed burning, and/or chemical/mechanical brush management) may lead to State 2: Native/Invaded State (R5A) or perhaps 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

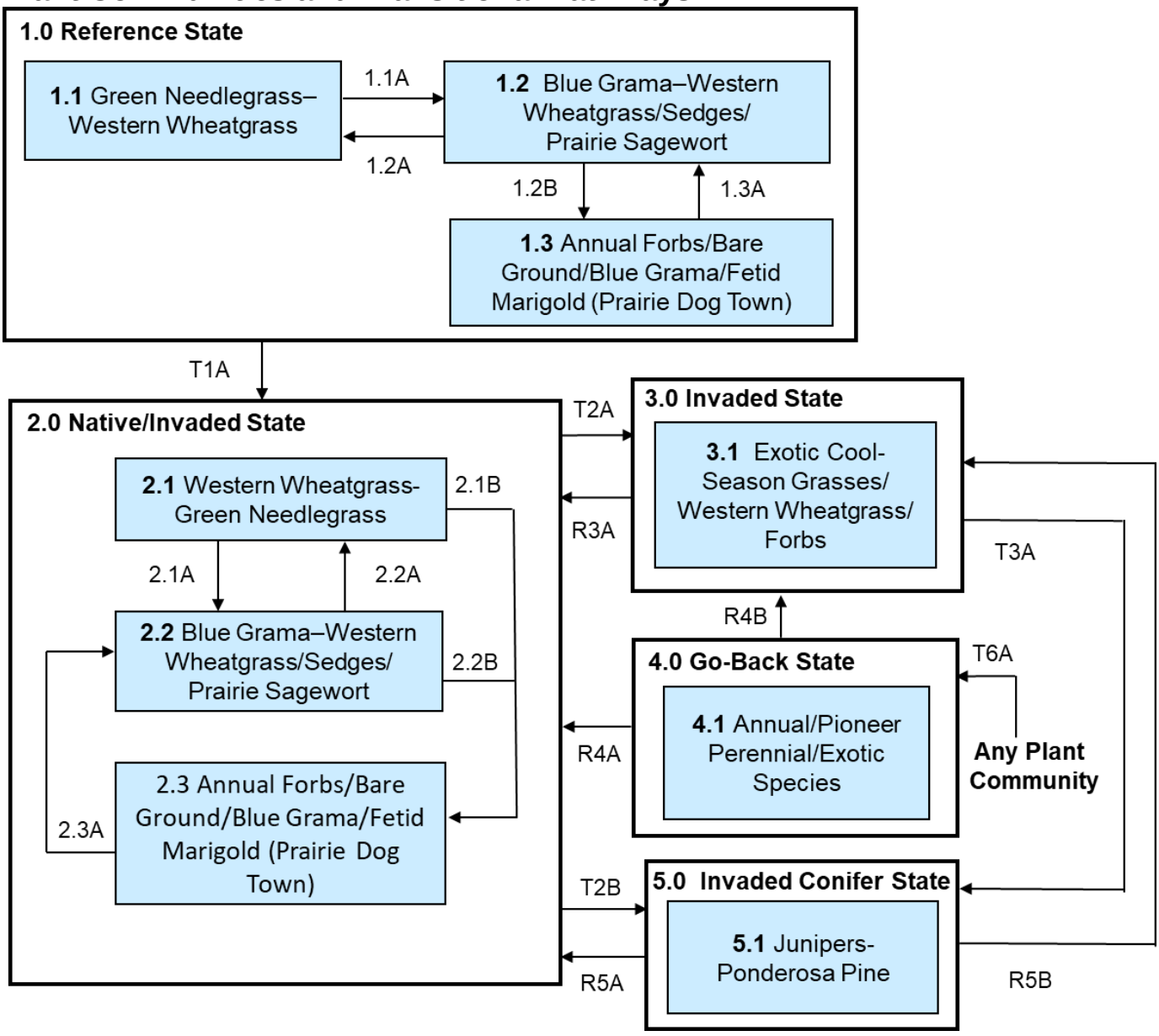

Diagram Legend - MLRA 58C Clayey	
T1A	Introduction of exotic cool-season grasses
T2A	Extended periods of non-use or very light grazing, no fire
T2B	Extended periods of no fire
T3A	Extended periods of no fire
T6A	Cessation of annual cropping
R3A	Long term prescribed grazing and prescribed burning
R4A	Successful range planting with prescribed grazing and prescribed burning
R4B	Failed range planting and/or secondary succession
R5A	Prescribed burning and/or chemical/mechanical brush management
R5B	Prescribed burning and/or chemical/mechanical brush management
CP 1.1 - 1.2 (1.1A)	Long-term drought with/without heavy, long-term grazing
CP 1.2 - 1.1 (1.2A)	Return to average growing conditions and reduced grazing pressure
CP 1.2 - 1.3 (1.2B)	Long-term occupation by prairie dogs
CP 1.3 - 1.2 (1.3A)	Prairie dog abandonment
CP 2.1 - 2.2 (2.1A)	Heavy season-long grazing with or without drought
CP 2.1 - 2.3 (2.1B)	Long-term occupation by prairie dogs
CP 2.2 - 2.1 (2.2A)	Long term prescribed grazing and prescribed burning
CP 2.2 - 2.3 (2.2B)	Long-term occupation by prairie dogs
CP 2.3 - 2.2 (2.3A)	Removal/abandonment of prairie dogs

State 1: Reference State

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

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

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

Community Phase 1.1: Green Needlegrass-Western Wheatgrass (*Nassella viridula-Pascopyrum smithii*)

This community phase was historically the most dominant both temporally and spatially. Cool-season grass and grass-like species dominated this plant community with warm-season grasses being subdominant. The major graminoids included green needlegrass and western wheatgrass with associates of thickspike wheatgrass, needle and thread, blue grama, porcupinegrass, buffalograss, prairie Junegrass, and upland sedges. Common forbs included scurfpea, purple locoweed, scarlet globemallow, white sagewort, and common yarrow. Common shrubs included silver sagebrush, prairie rose, leadplant, winterfat, and prairie sagewort.

Annual production likely varied from about 1300-3100 pounds per acre with grasses and grass-likes, forbs, and shrubs contributing about 90%, 7% and 3%, respectively. This community represents the plant community phase upon which interpretations are primarily based and is described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description.

Plant Community Composition and Group Annual Production

		1.1 Green Needlegrass-Western Wheatgrass		
COMMON/GROUP NAME	**SYMBOL**	**Group**	**lbs./acre**	**% Comp**
GRASSES & GRASS-LIKES			*1890 - 1995*	*90 - 95*
WHEATGRASS		**1**	**525 - 840**	**25 - 40**
western wheatgrass	PASM	1	525 - 840	25 - 40
thickspike wheatgrass	ELLAL	1	0 - 210	0 - 10
NEEDLEGRASS		**2**	**420 - 630**	**20 - 30**
green needlegrass	NAVI4	2	315 - 525	15 - 25
porcupinegrass	HESP11	2	0 - 63	0 - 3
SHORT WARM-SEASON		**3**	**105 - 210**	**5 - 10**
blue grama	BOGR2	3	105 - 210	5 - 10
buffalograss	BUDA	3	21 - 105	1 - 5
NATIVE COOL-SEASON		**4**	**21 - 126**	**1 - 6**
needle and thread	HECOC8	4	21 - 105	1 - 5
prairie Junegrass	KOMA	4	21 - 63	1 - 3
plains reedgrass	CAMO	4	21 - 63	1 - 3
slender wheatgrass	ELTRT	4	21 - 63	1 - 3
Sandberg bluegrass	POSE	4	21 - 42	1 - 2
sedge	CAREX	4	21 - 42	1 - 2
OTHER NATIVE GRASSES		**5**	**21 - 126**	**1 - 6**
big bluestem	ANGE	5	0 - 105	0 - 5
sideoats grama	BOCU	5	0 - 105	0 - 5
plains muhly	MUCU3	5	0 - 42	0 - 2
saltgrass	DISP	5	0 - 21	0 - 1
other perennial grasses	2GP	5	21 - 105	1 - 5
FORBS		*6*	*42 - 147*	*2 - 7*
common yarrow	ACMI2	6	21 - 42	1 - 2
tarragon	ARDR4	6	21 - 42	1 - 2
white sagebrush	ARLUA	6	21 - 42	1 - 2
scarlet beeblossom	GACO5	6	21 - 42	1 - 2
blazing star	LIATR	6	21 - 42	1 - 2
leafy wildparsley	MUDI	6	21 - 42	1 - 2
purple locoweed	OXLA3	6	21 - 42	1 - 2
scurfpea	PSORA2	6	21 - 42	1 - 2
upright prairie coneflower	RACO3	6	21 - 42	1 - 2
goldenrod	SOLID	6	21 - 42	1 - 2
scarlet globemallow	SPCO	6	21 - 42	1 - 2
white heath aster	SYER	6	21 - 42	1 - 2
goldenpea	THRH	6	21 - 42	1 - 2
autumn onion	ALST	6	0 - 21	0 - 1
pussytoes	ANTEN	6	0 - 21	0 - 1
false boneset	BREU	6	0 - 21	0 - 1
wavyleaf thistle	CIUN	6	0 - 21	0 - 1
larkspur	DELPH	6	0 - 21	0 - 1
blacksamson echinacea	ECAN2	6	0 - 21	0 - 1
old man's whiskers	GETR	6	0 - 21	0 - 1
desertparsley	LOMAT	6	0 - 21	0 - 1
rush skeletonplant	LYJU	6	0 - 21	0 - 1
spiny phlox	PHHO	6	0 - 21	0 - 1
white prairie aster	SYFA	6	0 - 21	0 - 1
American vetch	VIAM	6	0 - 21	0 - 1
other perennial forbs	2FP	6	0 - 42	0 - 2
other annual forbs	2FA	6	0 - 21	0 - 1
SHRUBS		*7*	*21 - 63*	*1 - 3*
prairie sagewort	ARFR4	7	21 - 42	1 - 2
prairie rose	ROAR3	7	21 - 42	1 - 2
western snowberry	SYOC	7	21 - 42	1 - 2
silver sagebrush	ARCA13	7	0 - 21	0 - 1
winterfat	KRLA2	7	0 - 21	0 - 1
plains pricklypear	OPPO	7	0 - 21	0 - 1
other shrubs	2SHRUB	7	0 - 21	0 - 1

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	1240 -	1964	- 2885
FORBS	40 -	95	- 150
SHRUBS	20 -	42	- 65
TOTAL	1300 -	2100	- 3100

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 long-term drought with/without heavy, long-term grazing. This resulted in marked increases in blue grama, sedges, and prairie sagewort with a corresponding decrease in green needlegrass.

Community Phase 1.2: Blue Grama-Western Wheatgrass/Sedges/Prairie Sagewort (*Bouteloua gracilis-Pascopyrum smithii*/*Carex* spp./*Artemisia frigida*)
Community Phase 1.2 occurred during long-term drought with/without heavy, long-term grazing. Green needlegrass and other plants less tolerant to drought and grazing decreased while the more drought/grazing tolerant species (such as blue grama, sedges, and prairie sagewort) increased. Annual production would have decreased compared to that of Community Phase 1.1.

Community Phase Pathway 1.2A
Community Phase Pathway 1.2 to 1.1 occurred with the return to average growing conditions and reduced grazing pressure resulting in a marked increase in green needlegrass and corresponding decreases in blue grama, sedges and prairie sagewort.

Community Phase Pathway 1.2B
Community Phase Pathway 1.2 to 1.3 occurred with long-term occupation by prairie dogs. This resulted in an abundance of annual forbs (e.g., fetid marigold, wooly plantain) and bare ground. Some perennial native species would have remained but were greatly reduced in vigor.

Community Phase 1.3: Annual Forbs/Bare Ground/Blue Grama/Fetid Marigold (Prairie Dog Town): (Annual Forbs/Bare Ground/*Bouteloua gracilis*/*Dyssodia papposa*) (Prairie Dog Town)
This community phase formed during periods of long-term occupation by prairie dogs. It was characterized by the abundance of annual forbs (e.g., fetid marigold, wooly plantain) and bare ground. Some perennial native species remained but were greatly reduced in vigor.

Community Phase Pathway 1.3A
Community Phase Pathway 1.3 to 1.2 occurred with prairie dog abandonment, resulting in marked decreases in annual forbs and bare ground with corresponding increases in native grasses, sedges, forbs, and shrubs.

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 (typically Kentucky bluegrass, smooth brome, crested wheatgrass, Canada bluegrass, and/or annual bromes). 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 exotic cool-season grasses 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, crested wheatgrass, Canada bluegrass, and/or annual bromes) 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 no 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.

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 grazing when exotic cool-season grasses are actively growing and native cool-season grasses are dormant; (2) applying proper deferment periods allowing native grasses to recover and maintain or improve vigor; (3) adjusting overall grazing intensity to reduce excessive plant litter (above that needed for rangeland health indicator #14 – see Rangeland Health Reference Worksheet); (4) incorporating early heavy spring utilization which focuses grazing pressure on exotic cool-season grasses and reduces plant litter, provided that livestock are moved when grazing selection shifts from exotic cool-season grasses to native grasses.

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

Community Phase 2.1: Western Wheatgrass-Green Needlegrass (*Pascopyrum smithii-Nassella viridula*)

This Community Phase is similar to Community Phase 1.1 but has been colonized by exotic cool-season grasses. However, the abundance/conspicuousness of western wheatgrass has generally increased relative to that of green needlegrass due to heavy grazing history. The exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass, Canada bluegrass, annual bromes), however, are present in smaller amounts with the community still dominated by native grasses.

Annual production may be comparable to that of Community Phase 1.1 (1300-3100 pounds per acre). However, as the exotic cool-season grasses increase, peak production will shift to earlier in the growing season.

Community Phase Pathway 2.1A
Community Phase Pathway 2.1 to 2.2 occurs with heavy continuous grazing with or without drought. This results in marked increases in blue grama, sedges, and prairie sagewort with a corresponding decrease in green needlegrass.

Community Phase Pathway 2.1B
Community Phase Pathway 2.1 to 2.3 occurs with the long-term occupation by prairie dogs. This results in an abundance of annual forbs (e.g., fetid marigold, wooly plantain) and bare ground. Some perennial native species remain but are greatly reduced in vigor and may not be readily visible.

Community Phase 2.2: Blue Grama-Western Wheatgrass/Sedges/Prairie Sagewort (*Bouteloua gracilis-Pascopyrum smithii*/*Carex* spp./*Artemisia frigida*)
This Community Phase is similar to Community Phase 1.2 but has now been colonized by exotic cool-season grasses (often Kentucky bluegrass, smooth brome, crested wheatgrass, Canada bluegrass, and/or annual bromes). These exotics, however, are present in smaller amounts with the community still dominated by native grasses. The shrub component is largely prairie sagewort and often includes prairie rose and western snowberry.

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

Increasing amounts of exotic cool-season grasses, particularly Kentucky bluegrass, can make this an “at risk” community even though its presence may not be obvious. If management does not include measures to control or reduce Kentucky bluegrass, the transition to State 3: Invaded State should be expected.

Community Phase Pathway 2.2A
Community Phase Pathway 2.2 to 2.1 occurs with long-term prescribed grazing and prescribed burning. This results in marked increases in western wheatgrass and green needlegrass and corresponding decreases in blue grama, sedges, and prairie sagewort.

Community Phase Pathway 2.2B
Community Phase Pathway 2.2 to 2.3 occurs with the long-term occupation by prairie dogs. This results in an abundance of annual forbs (e.g., fetid marigold, wooly plantain) and bare ground. Some perennial native species remain but are greatly reduced in vigor and may not be readily visible.

Community Phase 2.3: Annual Forbs/Bare Ground/Blue Grama/Fetid Marigold: (Annual Forbs/Bare Ground/*Bouteloua gracilis*/*Dyssodia papposa*) (Prairie Dog Town)
This community phase forms during periods of long-term occupation by prairie dogs. It is characterized by the abundance of annual forbs (e.g., fetid marigold, wooly plantain) and bare ground. Some perennial native species remain but are greatly reduced in vigor and may not be readily visible.

Community Phase Pathway 2.3A
Community Phase Pathway 2.3 to 2.2 occurs with the removal/abandonment of prairie dogs resulting in marked decreases in annual forbs and bare ground with corresponding increases in blue grama and other native grasses, sedges, forbs, and shrubs.

Transition T2A

This transition from the State 2: Native/Invaded State to State 3: Invaded State generally occurs with extended periods of no use or very light grazing, and no fire. Exotic cool-season grasses (such as Kentucky bluegrass, smooth brome, Canada bluegrass, and/or annual bromes) become the dominant graminoids.

Studies indicate that a threshold may exist in this transition when both Kentucky bluegrass exceeds 30% of the plant community and native grasses represent less than 40% of the plant community composition. Similar thresholds may exist for other exotic cool-season grasses.

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

Transition T2B

This transition from State 2: Native/Invaded State to State 5: Invaded Conifer State generally occurs over extended periods of no fire. A marked decrease in fire frequency and increased fire suppression since European influence has been particularly important to the fire-intolerant juniper species' ability to expand and exploit and dominate grasslands.

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

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

State 3: Invaded State

This state is the result of invasion and dominance by the exotic cool-season grasses (commonly Kentucky bluegrass, smooth brome, crested wheatgrass, Canada bluegrass, and/or annual bromes). The exotic forbs (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, rose, and silver sagebrush), however, 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.

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

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

Community Phase 3.1: Exotic Cool-Season Grasses/Western Wheatgrass/Forbs (Exotic Cool-Season Grasses/*Pascopyrum smithii*/Forbs)

This community phase is dominated by exotic cool-season grasses (such as Kentucky bluegrass, smooth brome, crested wheatgrass, Canada bluegrass, and/or annual bromes), often with a conspicuous forb component. Excessive accumulation of mulch may also be present, particularly when dominated by Kentucky bluegrass. Common forb and shrub species often include scarlet globe mallow, white sagebrush, and white heath aster. Exotic forbs, such as leafy spurge, may also invade the site. 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.

Restoration R3A

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

Both prescribed grazing and prescribed burning are likely necessary to successfully initiate this restoration pathway, the success of which depends upon the presence of a remnant population of native grasses in Community Phase 3.1. That remnant population, however, may not be readily apparent without close inspection. The application of several prescribed burns may be needed at relatively short intervals in the early phases of this restoration process, in part because many of the shrubs (e.g., western snowberry) sprout profusely following one burn. Early season prescribed burns have been successful; however, fall burning may also be an effective technique.

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

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

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

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

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

Transition T3A

This transition from State 3: Invaded State to State 5: Invaded Conifer State occurs over extended periods of no fire. A marked decrease in fire frequency and increased fire suppression since European influence has been particularly important to the fire-intolerant juniper species' ability to expand and exploit and dominate grasslands.

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

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

State 4: 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 4.1: Annual/Pioneer Perennial/Exotic Species

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, crested wheatgrass, Canada bluegrass, and/or annual bromes) will likely predominate.

Restoration R4A

This Restoration Pathway from State 4: Go-Back State to the State 2: Native/Invaded State can be accomplished with a successful range planting. Following 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 R4B

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

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

State 5: Invaded Conifer State

This state historically existed as small patches of fire-tolerant trees and shrubs when precipitation, fire frequency, and other factors enabled woody species to colonize or encroach on the site. This often resulted in a mosaic of small, scattered patches of woody vegetation interspersed within the grass dominated vegetation. A marked decrease in fire frequency and increased fire suppression since European influence has enabled this state to expand and become more widespread. This is particularly important to the fire-intolerant juniper species' ability to expand and exploit and dominate grasslands.

One community phase has been identified and often results from extended periods of no fire and close proximity to a seed source (T2B, T3A). Brush control (e.g., prescribed burning, and/or chemical/mechanical brush management) may lead to State 2: Native/Invaded State (R5A) or perhaps State 3: Invaded State (R5B).

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

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

Community Phase 5.1: Junipers-Ponderosa Pine (*Juniperus* spp.-*Pinus ponderosa*)

This community phase results from extended periods of no fire and typically consists of stands of juniper (e.g., common juniper, Rocky Mountain juniper, and creeping juniper) and/or ponderosa pine. Shrubs (such as silver sagebrush, prairie rose, western snowberry, and winterfat) may also be present. Associated grasses can be quite variable depending on variations in shading and other factors, but often includes exotic cool-season grasses (e.g., crested wheatgrass, Kentucky bluegrass, Canada bluegrass, and/or annual bromes) and a few forbs.

Restoration R5A

This restoration pathway from State 5: Invaded Conifer State to State 2: Native/Invaded State can occur with prescribed burning and/or chemical/mechanical brush management, assuming exotic cool-season grasses do not dominate the understory. If exotic cool-season grasses dominate the understory, brush management will lead to State 3: Invaded State via R5B.

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.

Restoration R5B

This restoration pathway from State 5: Invaded Conifer State to State 3: Invaded State can occur with prescribed burning and/or chemical/mechanical brush management, assuming exotic cool-season grasses dominate the understory. If native grasses dominate the understory, brush management will lead to State 2: Native/Invaded State via R5A.

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 3.

Transition T6A

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

Ecological Site Interpretations

Animal Community – Wildlife Interpretations

Landscape

The MLRA 58C landscape is characterized by moderately dissected rolling plains with areas of local badlands, buttes, and isolated hills. MLRA 58C 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- and shrubland 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 58C:

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 Audubon bighorn sheep, roaming bison, elk, and pronghorn were historically among the inhabitants adapted to this semi-arid region. Bighorn sheep have been re-introduced. 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 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, Canada lynx, common raven, 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 58C:

Following European influence, domestic livestock grazing, elimination of fire, energy development, and other anthropogenic factors influenced plant community composition and abundance. Transportation corridors, energy development, and Rocky Mountain juniper and ponderosa pine encroachment 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 plant species including, smooth brome, crested wheatgrass, Kentucky bluegrass, and leafy spurge further impacting 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, lacking diverse species composition and stature.

Extensive fragmentation by annual cropping has not occurred within the MLRA. Limited fragmentation from annual cropping or tame hay production has occurred within the Little Missouri River flood plain and the higher, flat plateaus. Fragmentation east and west of MLRA 58C has funneled many species into this area in search of expansive grasslands.

Some wildlife species in this area are: mule deer, white-tailed deer, elk, bighorn sheep, pronghorn, mountain lion, 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 wild turkey, golden eagle, ferruginous hawks, sharp-tailed grouse, greater sage-grouse, black-billed magpie, and numerous species of grassland-nesting birds and pollinating

insects. The highest diversity of bats in North Dakota also occurs in this MLRA, where eleven species have been documented.

Presence of wildlife species is often determined by ecological site characteristics including grass and forb species, hydrology, aspect, and other associated ecological sites. Home ranges for most 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 the MLRA:

Mountain Lions: Mountain lions were relatively common in the Badlands but disappeared from the state by the early 20th Century. Sightings resumed in the 1950's and have subsequently increased since that time. The species has recently taken up permanent residency within the region. Mountain lions occur in of the Little Missouri Badlands and woody habitat in MLRA 58C. Rugged terrain and forest provide excellent stalking cover to hunt large mammals and other prey. Mountain lions make use of caves for escape and loafing cover.

Bighorn sheep: Bighorn sheep make use of the rugged terrain, rocky outcrops, and high plateaus of MLRA 58C along the Little Missouri River. North Dakota bighorn sheep populations are almost exclusively within MLRA 58C. Bighorn sheep were once extirpated from North Dakota but were successfully reintroduced in the mid-twentieth century. They now occur in several distinct populations within MLRA 58C. Rocky Mountain juniper encroachment degrades the limited habitat for bighorn sheep. Managers should consider bighorn sheep association with domestic sheep, since transfer of pneumonia and other diseases is known to occur.

Golden eagle: The badlands within MLRA 58C are key areas for Golden eagle nesting. Adjacent grasslands, shrublands, and black-tailed prairie dog towns are used for hunting.

Bats: MLRA 58C provides life requisites for several bat species, in part due to presence of riparian forest, wooded draws, caves, and rocky outcrops. Hibernacula of six bat species have been found in MRLA 58C; however, additional work is needed to further understand utilization of hibernacula by bats during the winter months in North Dakota.

Short-horned lizard and sagebrush lizard: This MLRA provides preferred habitat for these two species. The short-horned lizard prefers semi-arid, shortgrass prairie in rough terrain, and is uncommon to locally abundant in MLRA 58C. The rare sagebrush lizard prefers sagebrush and rocky areas provided by this MLRA and adjacent MLRA 58D.

Greater sage-grouse and Brewer's sparrow: The extreme southwest extension of MLRA 58C have ecological sites capable of producing sufficient big sage canopy cover to provide greater sage-grouse life requisites. MLRA 58C and 58D are the only MLRAs in North Dakota that support Wyoming big sage brush (big sage) production. Research data indicates greater sage-grouse prefer big sagebrush canopy cover for nesting at ≥8% with an average height of around 16 inches. The species prefers winter cover canopy that averages 15% with an average height of around 8 inches. Soil site potential,

management, climate, and other factors all play a role in the amount, if any, of big sagebrush on an ecological site. Changes in big sage canopy cover occur slowly (30-50 years) unless the site is impacted by fire or cultivation. Big sage recovery after a burn can take 30 to 100 years. Greater sage-grouse and Brewer's sparrow habitat and populations are reduced or eliminated when big sagebrush canopy is reduced to less than 8% for greater sage-grouse and 10% cover for Brewer's sparrow. As conifer encroachment increases, greater sage-grouse lekking activity decreases. Once conifer encroachment exceeds 4% canopy cover, no leks remain.

Species of Concern within the MLRA:

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 species listed as "threatened, endangered, or petitioned" under the Endangered Species Act within MLRA 58C at the time this section was developed:

Invertebrates: Dakota skipper, monarch butterfly, regal fritillary, yellow-banded bumble bee, and western bumble bee.

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

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

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

Fish and Mussels: Blue sucker, burbot, Flathead chub, northern redbelly dace, sickle-fin chub, pearl dace, shortnose gar, 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, supporting a dominance of herbaceous vegetation (Loamy/Limy Residual), 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 need to recognize ecological sites and the complexes they occur in to properly manage the landscape. A management regime for one ecological site may negatively impact an adjacent site (e.g., alteration of a grazing regime within a Flat Bottom Wooded Draw ecological site to encourage understory growth may encourage exotic, cool-season grasses to increase or dominate an adjacent ecological site).

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

With populations of many grassland-nesting birds in decline, it is important to maintain these ecological sites in a 1.0 Reference State or the 2.0 Native/Invaded. 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 when 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, prairie rose, etc.) in this MLRA.				

Clayey Wildlife Habitat Interpretation:

Clayey ecological sites are located on fans, foot slopes, or swales and terraced in lake plains and sedimentary plains. Associated ecological sites include Claypan, Loamy Overflow, Loamy, and Shallow Loamy. This complex of ecological sites provides habitat for many edge-sensitive grassland bird species. Clayey ecological sites support nesting and foraging grassland birds, as well as shorter grasses preferred by sharp-tailed grouse for lek sites.

Clayey 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 Go-Back State, and 5.0 Invaded Conifer State). Multiple plant community phases exist within States 1.0 and 2.0. These states occur primarily in response to grazing, drought, and non-use. Secondary influences include black-tailed prairie dogs, fire, and anthropogenic disturbances. Ecological services, historically provided by bison, are simulated by domestic livestock.

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using tools in State 1.0 and State 2.0 Community Phase Pathways to prevent further plant community degradation along either the T1A Transitional Pathway to Native/Invaded State 2.0 or T2A Transitional Pathway to Invaded State 3.0 thresholds. Native wildlife generally benefits from a heterogeneous grassland, in stature and plant composition, found States 1.0, 2.0 and 5.0 that include diverse grass and forb species with varying stature and density. As plant communities degrade within State 2.0, warm-season grasses (particularly short-statured grasses) increase while native forbs are reduced. This transition results in reduced stature, increased plant community homogeneity and reduced insect populations resulting in a reduction of breeding, nesting,

foraging, or winter habitat for grassland birds. When adjacent/intermingled ecological sites undergo the same transition, the result can be an expansive, homogenous landscape.

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 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 phases within the State 3.0 show dramatic increased homogeneity of exotic cool-season grasses and further reduction in native forbs. However, western snowberry can become dominant shrub at this site, impacting bird species-sensitive invasion by woody vegetation. Reduced forb diversity limits insect populations, negatively affecting grassland-nesting bird foraging opportunities. Increased exotic-grass litter can limit access to bare ground by nesting insects and can limit mobility by small chicks. A homogenous grassland landscape does not provide quality escape or winter cover. As a result, many species are not able to meet life requisites on communities in the 3.0 State.

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

1.0 Reference State

Community Phase 1.1 Green Needlegrass-Western Wheatgrass: 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 periods, 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 do not prefer this site due to limited host plants, such as little bluestem and prairie dropseed. Regal fritillary habitat is limited due to the rarity of Nuttall's violet and prairie violets. Monarch butterfly may use flowering forbs on this site; however, few milkweed species are found on this site to support breeding and larvae development. Bumblebees and other native bees utilize some forbs as a nectar source and bare ground for nesting sites in 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 short- to midgrass-nesting birds. Plant stature may be too dense or tall for burrowing owl and McCown's longspur; however, it may be used during periods of drought or management (such as rotational grazing or fire) that results in defoliation along Community Phase Pathway 1.1A. The low, scattered shrubs present in the plant community phase should not impact woody vegetation-sensitive bird species.

Grassland birds that prefer midgrass stature may 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 and lek, nesting, and brood-rearing habitat. Limited stature and diverse prey populations provide good hunting opportunities for grassland raptors.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores including voles, mice, rodents, jackrabbits, pronghorn, and white-tailed and mule deer. Short- to moderate-statured vegetation provides suitable food and thermal, protective, and escape cover for small herbivores such as the hispid pocket mouse.

Amphibians/Reptiles: This ecological site and associated plant communities provides habitat for smooth green snakes. This ecological site can provide habitat for the northern leopard frog and Great Plains toad if freshwater habitats (such as stock water ponds) are located in or adjacent to the site. Silver sagebrush provides habitat to support sagebrush lizard; however, due to the lack of rocky and/or sandy soils, neither the sagebrush lizard nor short-horned lizard may use this ecological site. This ecological site provides limited habitat for the plains hog-nosed snake (prefer sandy soils) and plains spadefoot (prefer gravelly or sandy soils).

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

Community Phase 1.2 Blue Grama-Western Wheatgrass/Sedges/Prairie Sagewort: Blue grama and western wheatgrass will dominate after continuous long-term heavy grazing or over utilization during extended drought periods. Forb density and diversity is slightly changed from Community Phase 1.1.

Invertebrates: Provides similar life requisites as Community Phase 1.1; however, continuous long-term heavy grazing may negatively impact ground-nesting sites for bumble bees, other native bees, and other ground-nesting insects due to increased soil compaction.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by short- to mid-grass nesting birds. A shift to shorter plant stature along Community Phase Pathway 1.1A benefits McCown's longspur, chestnut-collared longspur, horned lark, and burrowing owl. Species that prefer a 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 lek. Moderate cover and diverse prey populations provide good hunting opportunities for grassland raptors.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

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

Community Phase 1.3 Annual Forbs/Bare Ground/Blue Grama/Fetid Marigold (Prairie Dog Town): This plant community phase is characterized by grazing-tolerant species and annual forbs. Continued heavy grazing or prairie dog occupation, will shift the plant community to increased annual forbs and grazing tolerant perennial grasses. Perennial forbs stature and abundance are being replaced by short-statured annual forbs. Bare ground increases, litter amounts, and infiltration rates decline while soil surface

temperatures increase. This short-statured plant community is resilient, retaining sufficient grazing-sensitive native species to return to 1.2 Community Phases (via Community Phase Pathway 1.3A).

Invertebrates: A switch to annual forbs from perennial forbs may not have a significant impact to invertebrates but may reduce season-long nectar producing plants for pollinators. Season-long nectar sources may be found on adjacent plant communities or ecological sites for mobile species. Increased bare ground and prairie dog burrow sites provide increased nesting sites for bumble bees and other ground-nesting insects.

Birds: This very short-statured phase, driven by continued over grazing or 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 stature limits use by many bird species.

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 and bison, use prairie dog towns for foraging and loafing.

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

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

2.0 Native/Invaded State

The main ecological driver for the native/invaded state is the invasion of exotic cool-season grasses. Historic grazing by native herbivories and fire has been replaced by chronic season-long or heavy late season grazing.

Community Phase 2.1 Western Wheatgrass-Green Needlegrass: This plant community develops through Transition Pathway T1A, due to changes in management and the presence of exotic, cool-season grasses. The threshold between states 1.0 and 2.0 is crossed when Kentucky bluegrass, crested wheatgrass, smooth brome grass or other exotic species become established. This plant community phase has a very similar appearance and function to the Reference State of Community 1.1, except it has a minor amount of cool-season exotic grasses and forbs. 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/Reptiles: Provides similar life requisites as Community Phase 1.1.

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

Community Phase 2.2 Blue Grama-Western Wheatgrass/Sedges/Prairie Sagewort: Continuous, long-term heavy grazing or periodic heavy grazing (with or without drought) along Community Phase Pathway 2.1A

leads to shorter-statured grasses, such as blue grama and sedges. Dominated by shorter-stature grasses 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 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: Both tap-rooted and fibrous-rooted perennial forbs increase but remain a minor component providing similar life requisites as Plant Community Phase 1.1. Continuous, long-term heavy season-long grazing or periodic heavy seasonal grazing may reduce ground-nesting site availability.

Birds: Continuous, long-term heavy season-long grazing or periodic heavy seasonal grazing may 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. Short-grass-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, use by mid-grass nesting species may be compromised. This plant community provides areas suitable for sharp-tailed grouse lek site development. Limited stature and diverse prey populations provide good hunting opportunities for grassland raptors.

Mammals: Suitable food, thermal, protective, and escape cover (reduction in litter) for most mammals become limited.

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

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

Community Phase 2.3 Annual Forbs/Bare Ground/Blue Grama/Fetid Marigold (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 Pathways 2.1B and 2.2B. Black-tailed prairie dogs provide primary ecological services to transition to and maintain Plant Community Phase 2.3. Utilizing one or more tools in Community Phase Pathway 2.3A (e.g., removal of black-tailed prairie dogs, control of exotic perennial forbs, implementation of prescribed grazing) can move this community back to Phase 2.2, but this may require significant management and economic inputs.

Invertebrates: The loss of native forb diversity limits use by all pollinators. However, invasive forbs may provide limited seasonal use dependent on 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, attracting dung beetles and other insects as a food source.

Birds: Burrowing owl and McCown's longspur rely on the stature and composition that 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 dog, this plant community provides little habitat for mid-sized or small herbivores. Nonetheless, black-tailed prairie dog towns provide important habitat for many mammal species, including small rodents. Grazers, such as pronghorn and bison, use prairie dog towns for foraging and loafing.

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

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

3.0 Invaded State

Community Phase 3.1 Exotic Cool-Season Grasses/Western Wheatgrass/Forbs: Community Phase Pathway T2A is characterized by complete rest (10 or more years) from 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, crested wheatgrass, and smooth brome). Restoration Pathway R3A requires remnant amounts of native warm and cool-season grasses and forbs. The remnant native community requires frequent prescribed burns and high levels of grazing management targeting the exotic cool-season grasses to improve competitiveness and increase vigor and density. This plant community is very resistant to changes and without intensive management, the remnant native plants may 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.

Invertebrates: Complete rest (10 or more years) from grazing and elimination of fire, reduces or eliminates forbs, limiting use by beneficial insects found 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: This homogeneous community phase, dominated by exotic plant species, provides limited habitat and life requisites for most obligate grassland-nesting birds. Lack of stature and plant diversity, along with increased litter and the tendency of Kentucky bluegrass and smooth brome to lay down, 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 plant community; however, brood and 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. This phase provides limited foraging habitat for pronghorn and deer. Litter accumulation 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/Reptiles: Provides similar life requisites as Community Phase 1.1.

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

4.0 Go-Back State

Community Phase 4.1 Annual/Pioneer Perennial/Exotic Species: 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 insect presence. 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 Transition Pathway R4A results in a native grass and forb community in State 2.0. Failed restoration to native species through Restoration Pathway R4A results in Invaded State 3.0. Wildlife species response may be dependent upon plant community composition, vegetative stature, patch size, and management activities (such as prescribed grazing, burning, interseeding, haying, or noxious weed control).

5.0 Invaded Conifer State

Community Phase 5.1 Junipers-Ponderosa Pine: Resulting from Transitional Pathway (extended periods of no fire) T2B or T3A, this plant community phase forms when the site is in close proximity to Rocky Mountain juniper or ponderosa pine. Rocky Mountain juniper, other juniper species, and/or ponderosa pine may invade and eventually dominate the site. This phase is dependent upon seed dispersal by birds and mammals from nearby sites. A dense stand of conifers leads to a detritus layer of juniper needles-leaves, shade, shallow root system, interception of precipitation with a possible soil chemistry change (decrease in pH), reduces or eliminates an herbaceous or forb understory. A stand replacing fire is required to move this plant community to State 2.0 Native/Invaded State or 3.0 Invaded State.

Invertebrates: Conifers and pine are wind-pollinated, not providing nectar sources for pollinating insects. Flowering shrubs, such as chokecherry and buffaloberry, are outcompeted by Rocky Mountain juniper and ponderosa pine. Dependent upon the degree of dominance by Rocky Mountain juniper or ponderosa pine, pollinating insects may only be supported by this phase if flowering shrubs or forbs remain within or on the edge of the plant community. In addition, the loss of a forb component limits insect populations.

Birds: Juniper and pine occur along a continuum. Light infestation may continue to support some grassland and open-area species tolerant of woody invasion (e.g., lark sparrow, vesper sparrow). Bird species which are intolerant of woody vegetation are eliminated. Species associated with woodlands and woodland edges will increase. The presence of woody plant species may increase predation by mammals and avian predators and brood parasitism by brown-headed cowbirds. Nearly all grassland-nesting bird species are negatively affected by Community Phase 5.1.

Mammals: Bat species found in MLRA 58C use Community Phase 5.1 for roost sites if mature trees are available. Nearby community phases supporting insects provide foraging opportunities. This phase can provide significant thermal, escape, and loafing habitat for elk and deer. However, a high density of Rocky Mountain juniper can limit access and use by large ungulates.

Amphibians/Reptiles: Dense stands of juniper may reduce or eliminate life for amphibians and reptiles.

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

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

Water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic groups C with localized areas in hydrologic group D. Infiltration varies from moderately slow to slow and runoff potential varies from medium to very high for this site depending on soil surface texture and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An exception would be where short grasses form a dense sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and increase 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 National Grasslands in North Dakota (525,211 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 30,895 acres in North Dakota and Montana with the same recreational opportunities as the USFS lands. North Dakota and Montana Department of Trust Lands (80,220 acres) provide hunting, bird watching, hiking, and other outdoor recreation opportunities. North Dakota Wildlife Management Areas (3,447 acres) of land managed by the states for wildlife habitat in MLRA 58C.

MLRA 58C is home to the North and South Units of Theodore Roosevelt National Park. The Park encompasses approximately 70,000 acres and welcomes approximately 900,000 visitors annually. 29,920 acres of the park is designated Wilderness Area. The south unit of the park has a 48-mile scenic drive while

the north unit has a 28-mile scenic drive. The Badlands and associated ecological sites provide the main scenery attraction.

Bird watching: Public and private grasslands within MLRA 58C 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 including marbled godwits, upland sandpipers, and willets. The abundance of publicly owned lands (such as Theodore Roosevelt National Park, USFS, North Dakota Department of Trust Lands, BLM, etc.) provide excellent birding opportunities. MLRA 58C is in the Central Flyway.

Hunting/Fishing: MLRA 58C is a fall destination for upland game bird hunters, especially sharp-tailed grouse. This MLRA also provides excellent white-tailed deer, mule deer, pronghorn, elk, coyote, and mountain lion hunting opportunities along with the only bighorn sheep hunting units in the North Dakota. The North Dakota Game and Fish Department manages three man-made fishing lakes within the MLRA. Available species include rainbow and brown trout, bluegill, and largemouth and smallmouth bass.

Camping: Many camping opportunities exist in the MLRA. Modern and primitive camping is available at the Theodore Roosevelt National Park, Sully's Creek State Park, Little Missouri State Park, Buffalo Gap Campground, BLM land, and the Dakota Prairie National Grasslands. The Sully's Creek and Little Missouri State Parks are designated horse parks.

Hiking/Biking: Over 150 miles of the May-Daah-Hey Trail provide some of the best single-track trails in the world for biking, hiking, or horseback riding. The International Mountain Biking Association (IMBA) has designated the hiking, biking and horseback riding trail as EPIC - meaning it's one of the top mountain biking trails in the United States. The trail has nine fenced campgrounds, each accessible by gravel surfaced roads; they include camping spurs, potable water, hitching rails, picnic tables, fire rings, and accessible toilets. They are spaced about every 20 miles along the trail. The North and South Units of the Theodore Roosevelt National Park provide 38.9 and 49.6 miles, respectively, of hiking trails for walkers, bikers, or horseback riders. The Little Missouri State Park has 45 miles of trails that run through the North Dakota Badlands.

Canoeing: Traversing 274 miles through MLRA 58C, the Little Missouri River provides early spring canoeing and kayaking. The Little Missouri River is the only designated State Scenic River in the MLRA. The river passes through Sully Creek State Park, the Little Missouri National Grassland, and Theodore Roosevelt National Park.

Wood Products

No appreciable wood products are present on the site.

Other Products

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

Site Development and Testing Plan

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

Supporting Information

Associated Sites

Ecological Site Name	Site ID	Narrative
Claypan	R058CY073ND	The Claypan ecological site is adjacent to and, in places, in complex with the Clayey ecological site. The Claypan site has well or moderately well drained, moderately deep to very deep soils on the same upland landforms as the Clayey site, but lateral subsurface water movement and sodium in the soil have formed a dense claypan layer in these soils. The depth to the claypan is between 6 and 20 inches with visible salts and gypsum crystals below 16 inches. This site has lower production than the Clayey ecological site.
Loamy Overflow	R058CY074ND	The Loamy Overflow ecological site developed in run-on positions, such as swales and drainageways, that accumulate sediments eroded from the surrounding landforms and receive additional moisture from runoff. When associated with Clayey ecological sites, soils on Loamy Overflow sites are typically fine textured and will make a ribbon longer than 2 inches before breaking. Soils on the Loamy Overflow site are moderately well drained, very deep soils with a dark A horizon that is typically 16 inches or more thick. Carbonates, if present, are deeper in the soil profile than on the Clayey site.
Loamy	R058CY080ND	The Loamy ecological sites are often adjacent to Clayey ecological sites on upland landforms. Loamy ecological sites have well-drained, moderately deep to very deep, medium-textured soils that will form a ribbon 1 to 2 inches long.
Shallow Loamy	R058CY086ND	Due to limited acres in MLRA 58C, the Shallow Clayey ecological site was combined with the Shallow Loamy ecological site. This site is up-slope from Clayey sites and the soils have soft sedimentary bedrock at a depth of 10 to 20 inches; this soft bedrock affects root growth. When associated with the Clayey site, soils on Shallow Loamy sites may be fine-textured or medium-textured, depending on the sedimentary parent material from which they formed. If fine textured, the soils will make a ribbon >2 inches long. If medium textured, the soils will make a ribbon 1 to 2 inches long. This site has less production than the Clayey site.

Similar Sites

Ecological Site Name	Site ID	Narrative
Claypan	R058CY073ND	The Claypan ecological site is adjacent to and, in places, in complex with the Clayey ecological site. The Claypan site has well or moderately well drained, moderately deep to very deep soils on the same upland landforms as the Clayey site, but lateral subsurface water movement and sodium in the soil have formed a dense claypan layer in these soils. The depth to the claypan is between 6 and 20 inches with visible salts and gypsum crystals below 16 inches. This site has lower production than the Clayey ecological site.
Loamy	R058CY080ND	The Loamy ecological sites are often adjacent to Clayey ecological sites on upland landforms. Loamy ecological sites have well-drained, moderately deep to very deep, medium-textured soils that will form a ribbon 1 to 2 inches long.

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Developers
ND NRCS: David Dewald, Alan Gulsvig, Mark Hayek, Jeanne Heilig, John Kempenich, Chuck Lura, Jeff Printz, and Steve Sieler.

Inventory Data References
Information presented here has been derived from NRCS clipping and other 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 and Montana.

Relationship to Other Established Classifications
Level IV Ecoregions of the Conterminous United States: 43b – Little Missouri Badlands

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Site Description Approval

_____ _____
ND, State Rangeland Management Specialist Date

INTERPRETING INDICATORS OF RANGELAND HEALTH, Version 5, REFERENCE SHEET

Ecological site name: ___Clayey_____ Ecological site code: ___RO58CY072ND_____
Author(s)/participant(s): _J. Fettig, J. Printz_____
Contact for lead author: _NRCS State Rangeland Management Specialist_____
Date: _April 2023_____ **MLRA:** ___58C_____ **LRU:** _____
Composition based on (check one): ☐ Cover ☒ Annual Production
Metadata storage location: _____

Indicators. For each indicator, describe the potential for the site using the reference sheet checklist. Where possible, (1) use quantitative measurements; (2) include expected range of values for above- and below-average years and natural disturbance regimes for each community phase within the reference state, when appropriate; and (3) cite data sources used. Continue descriptions on separate sheet.
1. Rills: Rills are not expected on this site.
2. Water flow patterns: Water flow patterns are not visible on this site on slopes less than 5%. On slopes greater than 5%, water flow patterns may be visible but uncommon, short, and disconnected.
3. Pedestals and/or terracettes: Neither pedestals nor terracettes are expected.
4. Bare ground: Bare ground ranges from 5 to 15%. Bare ground patches should be small (less than 2 inches in diameter) and not connected. Animal activity (burrows and ant mounds) may occasionally result in isolated bare patches of up to 24 inches in diameter.
5. Gullies: Active gullies are not expected on this site. If present, gully channel(s) are fully vegetated with no active erosion visible.
6. Wind-scoured and/or depositional areas: No wind-scoured or depositional areas expected on this site.
7. Litter movement: Plant litter movement is not expected on this site.
8. Soil surface resistance to erosion: Stability class averages 5 or greater.
9. Soil surface loss and degradation: Use soil series description for depth, color, and structure of A-horizon.
10. Effects of plant community composition and distribution on infiltration: Mid- and short-statured bunch grasses are dominant/subdominant and well distributed across the site.
11. Compaction layer: No compaction layers occur naturally on this site.
12. Functional/structural groups: Due to differences in phenology, root morphology, soil biology relationships, and nutrient cycling Kentucky bluegrass, smooth brome, and crested wheatgrass are included in a new Functional/structural group, mid- and short-statured early cool-season grasses (MSeC3), **not expected for this site**.

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

	Dominance based on[1]: Annual Production _X_ or Foliar Cover __		
	Phase 1.1_	**Phase 1. __**	**Phase 1. __**
Dominant	**Mid & short C3 rhizomatous grasses (2); Mid & short C3 bunch grasses (5)**		
Subdominant	**Mid & short C4 bunch grasses (1)**		
Minor	**Mid & short C4 rhizomatous grasses; Forbs; Tall C4 rhizomatous grasses; Shrub; Grass-likes**		
Trace			

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

13. Dead or dying plants or plant parts: Dead or dying plants/plant parts are not expected on this site.

14. Litter cover and depth: Plant litter cover is 40 to 60% with a depth of 0.25 to 0.5 inches. Litter is in contact with the soil surface.

15. Annual production: Annual air-dry production is 2100 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 1300 lbs./ac to 3100 lbs./ac, respectively.

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

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

Functional/Structural Groups Sheet

State ND **Office** _____ **Ecological site** Clayey **Ecol. site code** RO58CY072ND

Observers _____ **Date** _____

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

Species list of functional/structural groups in the **Reference State**	
Functional/Structural Group	Species List
Mid & short C3 rhizomatous grasse	western wheatgrass, thickspike wheatgrass*, plains reedgrass
Mid & short C3 bunch grasses	green needlegrass, porcupinegrass*, needle and thread, prairie Junegrass, slender wheatgrass
.	Sandberg bluegrass
Mid & short C4 bunch grasses	blue grama, plains muhly*
Mid & short C4 rhizomatous grasse	sideoats grama*, buffalograss, saltgrass*
Forbs	please see plant community table
Tall C4 rhizomatous grasses	big bluestem*
Shrub	prairie sagewort, prairie rose, western snowberry, silver sagebrush*, winterfat*, plains pricklypear*
Grass-likes	sedge
.	
Biological soil crust[1]	

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

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

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

*indicates species that may or may not be present on the site
** See IIRH Version 5 page 70.

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

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

Evaluation Area - Relative dominance of functional/structural groups						
Dominant **	>> > =	Subdominant **	>> > =	Minor **	>> > =	Trace **

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

** See IIRH Version 5 page 70.

Notes: