United States Department of Agriculture
Natural Resources Conservation Service

Ecological Site Description

Site Stage: Provisional

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

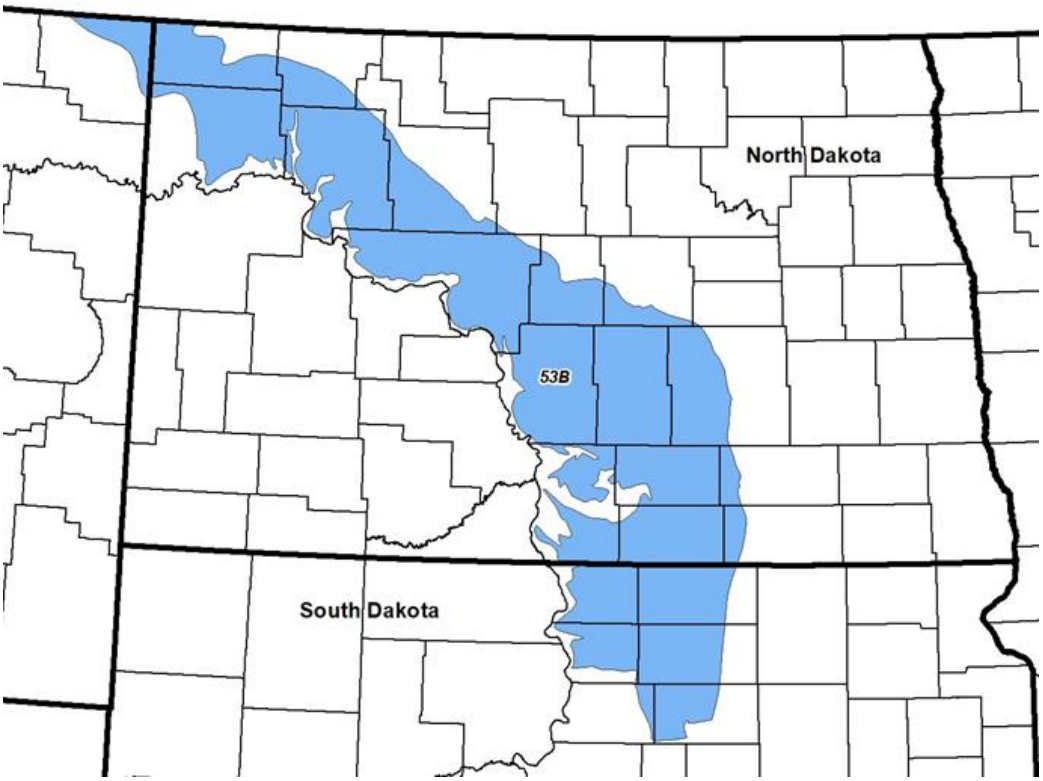
Site Name: Clayey

Site Type: Rangeland

Site ID: R053BY001ND

Major Land Resource Area: 53B – Central Dark Brown Glaciated Plains

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 53B - Central Dark Brown Glaciated Plains in North Dakota, South Dakota, and Montana

Central Dark Brown Glaciated Plains MLRA is an expansive and agriculturally important region consisting of about 12,000,000 acres. The MLRA includes all or portions of 25 counties in east-central and southeastern North Dakota, northeastern South Dakota and the extreme northeast corner of Montana.

Most of MLRA 53B is covered by till: material that was moved and redeposited by the glaciers into a long, large moraine known as the Missouri Coteau; some nearly level to rolling ground moraine areas are included. Pre-glaciated bedrock is exposed by geologic erosion on some breaks along edges of the MLRA. A few areas of shale are exposed on the southeast edge and several areas of sandstone and loamstone are exposed on the west edge (bordering MLRA 54). Glacial sediment covers the bedrock and is known as drift. Much of the moraine has a closed drainage system, but integrated drainage is also present (primarily in areas with geologic erosion).

The Missouri Coteau Region is the western edge of the glaciated land in North Dakota. It consists of nearly level to very steep glacial till plains and moraines. Many elevated ice-walled lake plains occur on the moraine. Some areas are dissected by glacial outwash channels. MLRA 53B is located within the boundaries of the Prairie Pothole Region with numerous wetlands (particularly in areas with closed drainage systems). It is part of the Northern Mixed Grass Prairie region. The Missouri River flows along (or near) the western edge of the MLRA and includes two large reservoirs, Lake Sakakawea and Lake Oahe. Numerous named and unnamed tributaries originate in MLRA 53B and outlet into the Missouri River (MLRA 54). In the northeastern part of the MLRA, integrated drainage systems contribute water to the Des Lacs River (MLRA 55A). In the southeastern part of the MLRA, integrated drainage systems contribute water to the James River system (MLRA 55B). The constructed McClusky canal begins at the west end of Audubon Lake and runs east, dissecting MLRA 53B.

This region is primarily farms and livestock ranches; about 56 percent is non-irrigated cropland. Cash-grain, bean and oil production crops are the principal enterprise on many farms, but other feed grains and hay are also grown. Canola is a major crop in the northern part of the MLRA. Common native vegetation on rangeland includes western wheatgrass, needle and thread, big bluestem, sideoats grama, green needlegrass and little bluestem.

Ecological Site Concept

The Clayey ecological site, typically, is located on linear back slopes, concave foot slopes, and flats on till plains, collapsed ice-walled lake beds, and glacial lake plains, or on side slopes and flats on sedimentary plains exposed by geologic erosion. A few sites occur on flood plain steps (rare to occasional, brief flooding). Although these soils generally are very deep or deep, sedimentary bedrock (Cr horizon) as shallow as 20 inches occurs on sedimentary plains and restricts root growth. Typically, the soils have a dark colored surface soil more than 5 inches thick; however, on flood plain steps, the soil may be light brownish-gray throughout. The surface texture is loam, silt loam, silty clay loam, clay loam, silty clay, or clay. Subsoil textures typically are clay or silty clay, although clay loam and silty clay loam textures with >35% clay are included. The subsoil forms a ribbon $\geq$2 inches long. Soil on this site is moderately well drained or well drained. Generally, calcium carbonate does not occur in the surface and upper subsoil layers; however, very slight to slight effervescence is allowable. At depths exceeding 16 inches, a layer of carbonate accumulation is common. Soil salinity, typically, is none to very slight in the upper 20 inches, but it may increase to slight within 40 inches; below that depth, it may increase to moderate in some soils. Slopes range from 0 to 25 percent. On the landscape, this site is above Loamy Overflow, Claypan, Thin Claypan, Closed Depression, and Wet Meadow ecological sites and on similar positions as Loamy sites (soils on Loamy sites form a ribbon 1 to 2 inches long). On higher landscape positions, Thin Loamy sites commonly occur on till plains and lake plains; Shallow Clayey sites occur in some areas of sedimentary plains.

Physiographic Features

This site typically occurs on nearly level to moderately steep uplands – lake plains, till plains, and sedimentary plains. It also occurs on some level to nearly level a floodplain steps. Slopes are less than 25 percent. The

parent material incudes fine-loamy or clayey till, clayey glaciolacustrine deposits, residuum weathered from shale, and alluvium.

Landform: collapsed ice-walled lakebed, lake plain, till plain, sedimentary plain, flood plain step

	Minimum	Maximum
Elevation (feet):	1280	2560
Slope (percent):	0	25
Water Table Depth (inches):	42	>80
Flooding:		
Frequency:	None	Occasional
Duration:	None	Brief
Ponding:		
Frequency:	None	None
Runoff Class:	Low	Very high
Aspect:	No influence on this site	

Climatic Features

MLRA 53B is considered to have a continental climate – cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are characteristic of the MLRA. The climate is the result of this MLRA's location in the geographic center of North America. There are few natural barriers on the northern Great Plains. The air masses move unobstructed across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 15 to 20 inches per year. The normal average annual temperature is about 41° F. January is the coldest month with average minimum temperatures ranging from about -3.0° F (Powers Lake, ND) to about 4° F (Selby, SD). July is the warmest month with average maximum temperature from about 80° F (Powers Lake, ND) to about 85° F (Selby, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 62° F. This large annual range attests to the continental nature of this MLRA's climate. Winds average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of 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
USW00094041	GARRISON	Garrison	1910.1	47.6458	-101.4394
USC00329400	WILDROSE 3NW	Wildrose	2259.8	48.6631	-103.2131
USC00328737	TIOGA 1E	Tioga	2245.1	48.3989	-102.9181
USC00327281	POWERS LAKE 1N	Powers Lake	2205.1	48.5722	-102.6467
USC00397277	ROSCOE	Roscoe	1835	45.4525	-99.3358
USC00394891	LEOLA	Leola	1580.1	45.7192	-98.9439
USC00323309	GACKLE	Gackle	1951.1	46.6275	-99.1383
USC00329455	WILTON	Wilton	2188	47.1603	-100.7892

Climate Normals

	Representative		Actual		
	High	Low	High	Low	Average
Mean annual precipitation (in):	20	15	21	15	18
Frost free period (days):	117	88	120	84	102
Freeze free period (days):	135	115	136	109	125

Normal Monthly Precipitation (in)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.5	0.5	1.1	1.6	2.9	3.5	3.2	2.3	2.0	1.6	0.7	0.6
Representative low:	0.5	0.4	0.6	0.9	2.1	2.9	2.7	1.7	1.2	1.1	0.5	0.5
Actual high:	0.6	0.6	1.3	1.9	3.0	3.6	3.6	2.3	2.1	1.7	0.8	0.7
Actual low:	0.4	0.3	0.6	0.9	2.1	2.7	2.5	1.6	1.2	1.0	0.5	0.4

Normal Monthly Minimum Temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	1.9	6.7	18.2	30.7	43.0	53.3	58.4	55.5	45.5	32.7	19.0	6.1
Representative low:	-0.9	4.0	15.9	28.5	39.6	49.4	54.3	52.2	41.1	28.8	16.1	2.8
Actual high:	2.9	7.5	18.6	31.2	43.6	53.5	58.8	56.5	46.5	33.8	19.5	6.8
Actual low:	-2.6	2.7	15.0	27.7	39.3	49.0	53.6	51.4	40.4	28.0	14.8	1.1
Average:	0.6	5.5	17.2	29.7	41.7	51.4	56.3	54.1	43.7	31.1	17.6	4.5

Normal Monthly Maximum Temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Representative low:	18.9	23.6	35.8	53.6	65.4	73.4	79.9	80.1	68.8	53.9	35.7	21.9
Actual high:	22.1	27.2	39.6	57.0	68.6	77.2	84.0	83.5	72.1	57.2	39.0	25.2
Actual low:	18.1	23.0	35.2	53.5	65.2	73.3	79.8	79.7	68.2	52.9	35.0	20.9
Average:	20.4	25.2	37.3	55.0	66.8	75.1	81.7	81.3	70.4	55.4	37.1	23.3

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

1981 N	1982 N	1983 N	1984 N	1985 N	1986 W	1987 N	1988 D	1989 D	1990 N	1991 N	1992 D	1993 W	1994 W	1995 N
16.7	20.0	15.7	16.4	15.9	20.7	15.1	11.3	13.0	16.0	18.4	14.5	25.1	21.6	18.0

1996 N	1997 D	1998 N	1999 W	2000 W	2001 N	2002 N	2003 N	2004 N	2005 N	2006 D	2007 N	2008 N	2009 W	2010 W
17.6	14.7	19.9	20.4	20.8	16.4	15.7	15.1	16.2	19.7	13.3	19.5	19.3	20.8	24.3

Influencing Water Features

No significant water features influence this site. This site typically occurs on runoff landscape positions; however, a few soils with occasional, brief flooding are included in the site. Permeability is very slow to slow. Water loss is through evapotranspiration and percolation below the root zone.

Representative Soil Features

Soils associated with the Clayey ES are in the Mollisol, Vertisol, and Entisol orders. The Mollisols are classified further as Glossic Natrustolls, Pachic Vertic Haplustolls, Pachic Argiustolls, Pachic Vertic Argiustolls, and Vertic Argiustolls. The Vertisols are classified further as Chromic Haplusterts, Typic Haplusterts, Leptic Haplusterts, and Aridic Haplusterts. The Entisols are classified further as Vertic Ustifluvents. These soils were developed under prairie vegetation. They formed in glaciolacustrine sediments, in fine-loamy or clayey till, alluvium, or in residuum weathered from shale. The soils on this site are very deep to moderately deep. They are well drained or moderately well drained – redoximorphic features, where present, are below a depth of 3 feet. 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 soil, typically, is 5 to 16 inches thick. The surface texture is loam, silt loam, silty clay loam, clay loam, silty clay, or clay.

Soil salinity, typically, is none to very slight (E.C. <4 dS/m) in the upper 20 inches and none to slight (E.C. <8 dS/m) between 20 and 40 inches; below this it may increase to moderate (E.C. 8 - <16 dS/m), particularly in Glossic Natrustolls (e.g. Aberdeen, Belfield, Niobell). Sodicity is low (SAR <5) above the clayey subsoil; however, in some soils (particularly Glossic Natrustolls) it increases to moderate in the upper part of the subsoil and SAR values may exceed 13 in the lower subsoil and substratum.

Soil reaction typically is slightly acid to slightly alkaline (pH 6.1 to 7.8) above the clayey subsoil and slightly or moderately alkaline (pH 7.4 to 8.4) in the subsoil and substratum; in layers with high SAR values, reaction may be strongly alkaline (pH 8.5 to 9.0). Calcium carbonate content, typically, is none to moderate (<10%) to a depth of 16 inches or more; below this it may increase to as much as 30 percent.

When dry, these soils crack. When the soils are wet, surface compaction can occur with heavy traffic. Sub-surface soil layers are non-restrictive to water movement and root penetration. These soils are susceptible to water and wind 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.

Major soil series correlated to the Clayey site are Alkabo, Bearpaw, Belfield, Grail, Lawther, Lohler, Magnus, Marias, Minot, Mondamin, Niobell, Regent, Wyola, Wildrose, and Zeeland. Taxadjuncts of the Aberdeen and Nutley series (low precipitation) and the Opal and Promise series (cool) are included in the site.

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

Parent Material Kind: glaciolacustrine deposits, till, alluvium, residuum
Parent Material Origin: lacustrine, till, shale
Surface texture: silt loam, loam, silty clay loam, silty clay, clay
Subsurface texture group: Clayey
Surface fragments <3" (% cover): 0-10
Surface fragments ≥3" (% cover): 0-2
Subsurface fragments <3" (% volume): 0-10
Subsurface fragments ≥3" (% volume): 0-5

	Minimum	Maximum
Drainage class:	moderately well	well
Permeability class:**	very slow	slow
Depth to first restrictive layer (inches):	20	>80
Electrical conductivity (dS/m)*:	0	4
Sodium adsorption ratio:**	0	15
Soil reaction (1:1 water):**	6.1	9.0
Soil Reaction (0.1M CaCl2):	NA	NA
Available water capacity (inches):**	5.00	10.00
Calcium carbonate equivalent (percent):**	0	30

*This attribute represents from 0 to 20 inches. Electrical Conductivity (E.C.) values are based on Saturated Paste method; the commonly used 1:1 field method will likely have E.C. values ≤2.
**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 53B included frequent fires, both anthropogenic and natural in origin. Most fires, however, were anthropogenic fires set by Native Americans. Native Americans set fires in all months except perhaps January. These fires occurred in two peak periods, one from March-May with the peak in April and another from July-November with the peak occurring in October. Most of these fires were scattered and of small extent and duration. The grazing history would have involved grazing and browsing by large herbivores (such as American bison, elk, and whitetail deer). Herbivory by small mammals, insects, nematodes, and other invertebrates are also important factors influencing the production and composition of the communities. Grazing and fire interaction, particularly when coupled with drought events, influenced the dynamics discussed and displayed in the following state and transition diagram and descriptions.

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

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

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

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

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

State 2: Native/Invaded State. Colonization of the site by exotic species results in a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition is inevitable; it often results from colonization by exotic cool-season grasses (commonly Kentucky bluegrass, smooth brome, and/or

quackgrass) which have been particularly and consistently invasive under extended periods of non-use and no fire. Other exotic plants (e.g., Canada thistle, leafy spurge) are also known to invade the site.

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

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

State 3: Invaded State. The threshold for this state is reached when both the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) exceed 30% of the plant community and native grasses represent less than 40% of the community. One community phase has been identified for this state.

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

Once the state is well established, prescribed burning and prescribed grazing techniques have been largely ineffective in suppressing or eliminating the exotic cool-season grasses, even though some short-term reductions may appear successful. However, assuming there is an adequate component of native grasses to respond to treatments, a restoration pathway to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing in conjunction with prescribed burning (R3A).

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

Initially, due to extensive bare ground and a preponderance of shallow rooted annual plants, the potential for soil erosion is high. Plant species richness may be high, but overall diversity (i.e., equitability) is typically low, with the site dominated by a relatively small assemblage of species. Due to the lack of native perennials and other factors, restoring the site with the associated ecological processes is difficult. However, a successful range planting may result in something approaching State 2: Native/Invaded State (R4A). Following planting, prescribed grazing, prescribed burning, haying, and the use of herbicides will generally be necessary to achieve the desired result and control weeds, some of which may be noxious weeds. A failed range planting and/or secondary succession will lead to State 3: Invaded State (R4B).

The following state and transition model diagram illustrates the common states, community phases, community pathways, and transition and restoration pathways that can occur on the site. These are the most common plant community phases and states based on current knowledge and experience. Changes may be made as more data are collected. Pathway narratives describing the site's ecological dynamics reference various management practices (e.g., prescribed grazing, prescribed burning, brush management, herbaceous weed

treatment) which, if properly designed and implemented, will positively influence plant community competitive interactions. The design of these management practices will be site specific and should be developed by knowledgeable individuals; based upon management goals and a resource inventory; and supported by an ongoing monitoring protocol.

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

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

Plant Communities and Transitional Pathways

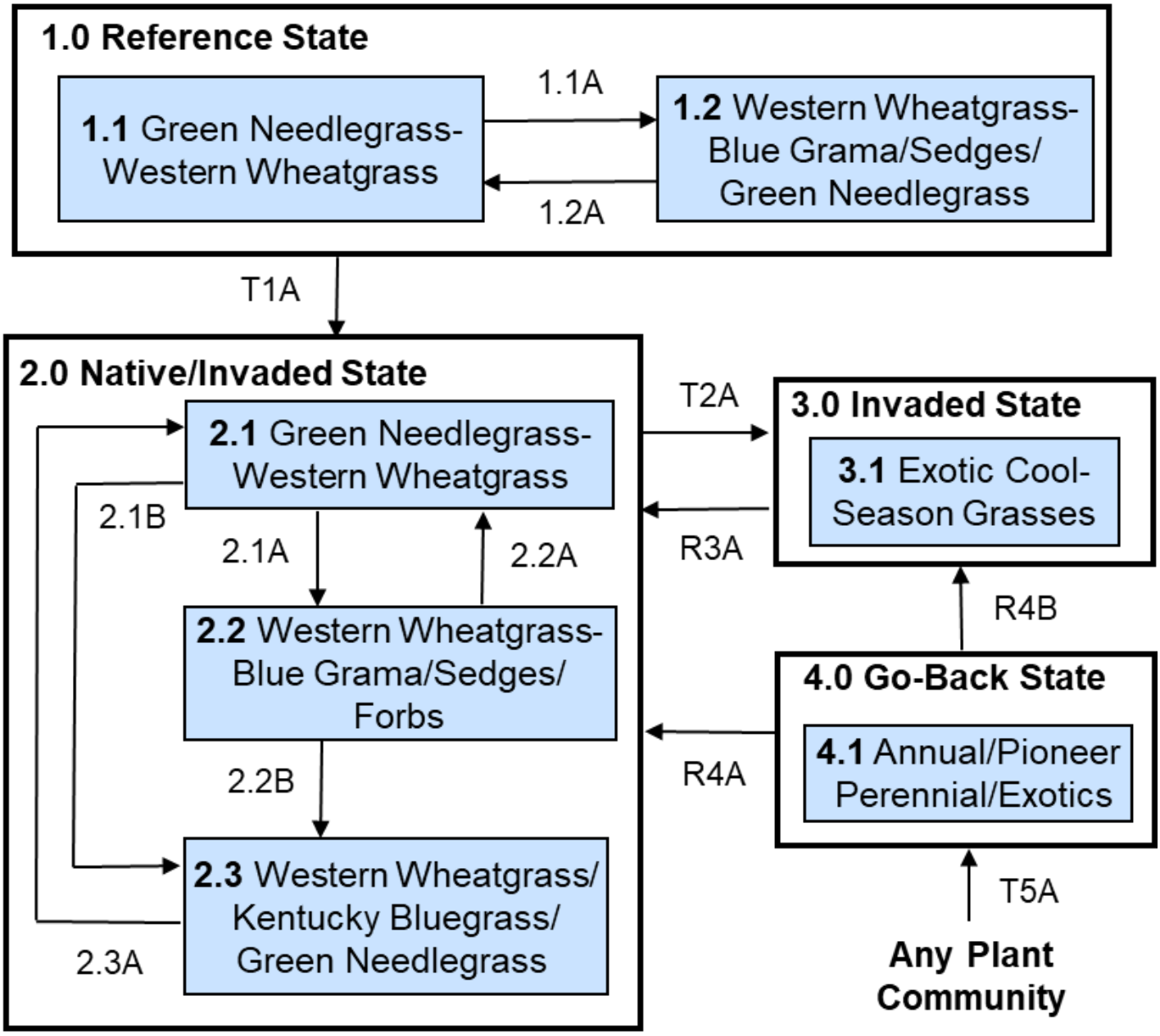

1.0 Reference State
1.1 Green Needlegrass-Western Wheatgrass
1.1A
1.2A
1.2 Western Wheatgrass-Blue Grama/Sedges/ Green Needlegrass
T1A
2.0 Native/Invaded State
2.1 Green Needlegrass-Western Wheatgrass
2.1B
2.1A
2.2A
2.2 Western Wheatgrass-Blue Grama/Sedges/ Forbs
2.2B
2.3 Western Wheatgrass/ Kentucky Bluegrass/ Green Needlegrass
2.3A
T2A
R3A
3.0 Invaded State
3.1 Exotic Cool-Season Grasses
R4B
4.0 Go-Back State
4.1 Annual/Pioneer Perennial/Exotics
R4A
T5A
Any Plant Community

Diagram Legend - MLRA 53B Clayey	
T1A	Introduction of exotic cool-season grasses
T2A	Long-term no-use or very light grazing, no fire
T5A	Cessation of annual cropping
R3A	Long-term prescribed grazing and prescribed burning
R4A	Successful range planting
R4B	Failed range planting and/or secondary succession
CP 1.1 - 1.2 (1.1A)	Multiyear drought with/without long-term heavy grazing
CP 1.2 - 1.1 (1.2A)	Return to average precipitation and long-term reduced grazing
CP 2.1 - 2.2 (2.1A)	Long-term heavy season-long grazing with or without drought
CP 2.1 - 2.3 (2.1B)	Long-term no-use or very light grazing, no fire
CP 2.2 - 2.1 (2.2A)	Return to average precipitation, long-term prescribed grazing and prescribed burning
CP 2.2 - 2.3 (2.2B)	Long-term no-use or very light grazing, no fire
CP 2.3 - 2.1 (2.3A)	Long-term prescribed grazing and prescribed burning

State 1: Reference State

This state represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. This state was composed predominately of cool-season grasses. Prior to European influence the primary disturbance mechanisms for this site in the reference condition included occasional fire and grazing by large herding ungulates. Timing of fires and grazing, coupled with weather events, dictated the dynamics that occurred within the natural range of variability. Today the primary disturbances are from a lack of fire and concentrated livestock grazing. Grasses that are desirable for livestock and wildlife can decline and a corresponding increase in less desirable grasses will occur. Exotic species did not occur in this state.

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 evolved with frequent fires and grazing/browsing by native ungulates and may be described as a cool-season dominated grassland. The main grasses included green needlegrass, western wheatgrass, porcupinegrass, needle and thread, slender wheatgrass, and bearded wheatgrass. Other associated grasses included warm-season grasses (such as sideoats grama, blue grama, and prairie dropseed). A diverse forb component was also present and included goldenrod, common yarrow, dotted blazing star, upright prairie coneflower, purple prairie clover, scarlet beeblossom, silverleaf Indian breadroot. Prairie sagewort, prairie rose, and western snowberry were among the more common shrubs.

Annual production likely ranged between 1300 to 3100 pounds per acre with graminoids, forbs, and shrubs contributing about 90%, 5% and 5% of the production, respectively. Community Phase 1.1 is considered the Reference Plant Community upon which most interpretations are 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			*1955 - 2070*	*85 - 90*
WHEATGRASS		**1**	**575 - 805**	**25 - 35**
western wheatgrass	PASM	1	575 - 805	25 - 35
thickspike wheatgrass	ELLAL	1	0 - 230	0 - 10
NEEDLEGRASS		**2**	**345 - 575**	**15 - 25**
green needlegrass	NAVI4	2	230 - 575	10 - 25
porcupinegrass	HESP11	2	0 - 115	0 - 5
needle and thread	HECOC8	5	23 - 115	1 - 5
shortbristle needle and thread	HECU9	2	0 - 345	0 - 15
MID WARM-SEASON		**3**	**115 - 230**	**5 - 10**
prairie dropseed	SPHE	3	23 - 115	1 - 5
sideoats grama	BOCU	3	23 - 115	1 - 5
plains muhly	MUCU3	3	0 - 115	0 - 5
SHORT WARM-SEASON		**4**	**115 - 230**	**5 - 10**
blue grama	BOGR2	4	115 - 230	5 - 10
buffalograss	BUDA	4	23 - 115	1 - 5
NATIVE COOL-SEASON		**5**	**23 - 230**	**1 - 10**
prairie Junegrass	KOMA	5	23 - 69	1 - 3
plains reedgrass	CAMO	5	23 - 69	1 - 3
slender wheatgrass	ELTR7	5	23 - 138	1 - 6
OTHER NATIVE GRASSES		**6**	**23 - 115**	**1 - 5**
big bluestem	ANGE	6	0 - 115	0 - 5
saltgrass	DISP	6	0 - 23	0 - 1
other perennial grasses	2GP	6	23 - 115	1 - 5
SEDGES		**6**	**23 - 115**	**1 - 5**
sedges	CAREX	6	0 - 115	0 - 5
FORBS		*7*	*46 - 115*	*2 - 5*
white sagebrush	ARLU	7	23 - 69	1 - 3
goldenrod	SOLID	7	23 - 69	1 - 3
common yarrow	ACMI2	7	23 - 46	1 - 2
leafy wild parsley	MUDI	7	23 - 46	1 - 2
scarlet beeblossom	OESU3	7	23 - 46	1 - 2
purple locoweed	OXLA3	7	23 - 46	1 - 2
Indian breadroot	PEDIO2	7	23 - 46	1 - 2
upright prairie coneflower	RACO3	7	23 - 46	1 - 2
scarlet globemallow	SPCO	7	23 - 46	1 - 2
white heath aster	SYER	7	23 - 46	1 - 2
milkvetch	ASTRA	7	0 - 46	0 - 2
gayfeather	LIATR	7	0 - 46	0 - 2
autumn onion	ALST	7	23 - 23	1 - 1
false boneset	BREU	7	23 - 23	1 - 1
wavyleaf thistle	CIUN	7	23 - 23	1 - 1
desert parsley	LOMAT	7	23 - 23	1 - 1
American vetch	VIAM	7	23 - 23	1 - 1
pussytoes	ANTEN	7	0 - 23	0 - 1
prairie clover	DALEA	7	0 - 23	0 - 1
white prairie aster	SYFA	7	0 - 23	0 - 1
other perennial forbs	2FP	7	0 - 46	0 - 2
other annual forbs	2FA	7	0 - 23	0 - 1
SHRUBS		*8*	*23 - 115*	*1 - 5*
prairie sagewort	ARFR4	8	23 - 46	1 - 2
prairie rose	ROAR3	8	23 - 46	1 - 2
western snowberry	SYOC	8	23 - 69	1 - 3
plains pricklypear	OPPO	8	0 - 23	0 - 1
other shrubs	2SHRUB	8	0 - 23	0 - 1

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	1235 -	2151 -	2860
FORBS	45 -	81 -	120
SHRUBS	20 -	69 -	120
TOTAL	1300 -	2300 -	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 multiyear drought with or without long-term and heavy grazing. This resulted in marked increases in blue grama and sedges along with a decrease in green needlegrass.

Community Phase 1.2: Western Wheatgrass-Blue Grama/Sedges/Green Needlegrass (*Pascopyrum smithii-Bouteloua gracilis/Carex* spp./*Nassella viridula*)
This community phase resulted from multiyear drought with or without long-term heavy grazing. Green needlegrass decreased while blue grama and sedges (e.g., needleleaf sedge) were markedly more abundant than in Community Phase 1.1. The forb and shrub components would also be expected to contain increases in prairie sagewort, common yarrow, and silverleaf Indian breadroot. Annual production decreased to about 700-1700 pounds per acre.

Community Phase Pathway 1.2A
Community Phase Pathway 1.2 to 1.1 occurred with the return of average precipitation and long-term reduced grazing, leading to an increase in green needlegrass and decreases in blue grama and sedges, as well as in forbs (such as prairie sagewort, common yarrow, and silverleaf Indian breadroot).

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

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

These exotic cool-season grasses have been particularly and consistently invasive under extended periods of no use and no fire. To slow or limit the invasion of these exotic grasses, it is imperative that managerial options (e.g., prescribed grazing, prescribed burning) be carefully constructed and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 3: Invaded State should be expected.

Annual production of this state can be quite variable, in large part due to the amount of exotic cool-season grasses. However, annual production may range from 1400-2600 pounds per acre.

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

Resilience management (i.e., management strategies that will sustain a state and prevent a transition). To slow or limit the invasion of these exotic grasses, it is imperative that managerial options (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective.

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

This community phase is similar to Community Phase 1.1 but has been colonized by exotic cool-season grasses (often Kentucky bluegrass or smooth brome). However, these exotic cool-season grasses 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 long-term heavy season-long grazing with or without drought which leads to a marked decrease in green needlegrass and increases in Kentucky bluegrass, blue grama, and sedges.

Community Phase Pathway 2.1B

Community Phase Pathway 2.1 to 2.3 occurs with periods of long-term no use or very light grazing, and no fire, leading to a marked increase in Kentucky bluegrass and decrease in green needlegrass.

Community Phase 2.2: Western Wheatgrass-Blue Grama/Sedges/Forbs (P*ascopyrum smithii - Bouteloua gracilis*/*Carex* spp./Forbs)

This community phase is similar to Community Phase 1.2 but has now been colonized by exotic cool-season grasses (often Kentucky bluegrass which is conspicuously present) and an increase in the forb component. Common yarrow, desert parsley, pussytoes, and curlycup gumweed are among the more common forbs.

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.

Community Phase Pathway 2.2A
Community Phase Pathway 2.2 to 2.1 occurs the return to average precipitation and implementation of long-term prescribed grazing and prescribed burning leading to decreases in blue grama, sedges, and Kentucky bluegrass with a corresponding increase in green needlegrass.

Community Phase Pathway 2.2B
Community Phase Pathway 2.2 to 2.3 occurs with long-term non-use or very light grazing, and no fire, leading to an increase in Kentucky bluegrass and decreases in blue grama and sedges. Mulch also increases and may become a physical barrier to plant growth.

Community Phase 2.3: Western Wheatgrass/Kentucky Bluegrass/Green Needlegrass (*Pascopyrum smithii/Poa pratensis/Nassella viridula*)
This community phase forms with long-term no-use or very light grazing, and no fire. It is approaching the threshold leading to a transition to State 3: Invaded State. As a result, it is an “at risk” community. If management does not include measures to control or reduce the exotic cool-season grasses (e.g., Kentucky bluegrass), the transition to State 3: Invaded State should be expected.

Community Phase Pathway 2.3A
Community Phase Pathway 2.3 to 2.1 occurs with the implementation of long-term prescribed grazing and prescribed burning. This leads to decreases in mulch and Kentucky bluegrass along with a potential increase in the native grasses.

Transition T2A
This transition from the State 2: Native/Invaded State to State 3: Invaded State generally occurs from long-term no use or very light grazing, and no fire. Exotic cool-season grasses (such as Kentucky bluegrass, smooth brome, or other exotic cool-season grasses) increase to 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. This transition may occur under other managerial conditions such as heavy season-long grazing (primarily Kentucky bluegrass).

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

State 3: Invaded State
This state is the result of invasion and dominance by the exotic cool-season grasses (commonly Kentucky bluegrass, smooth brome, and/or quackgrass). The exotic leafy spurge and Canada thistle 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, Canadian horseweed, curlycup gumweed, common yarrow, silverleaf Indian breadroot, and white sagebrush. Shrubs are often few or lacking. Once the state is well established,

prescribed burning and grazing techniques have been largely ineffective in suppressing or eliminating these species, even though some short-term reductions may appear successful.

Annual production of this state may vary widely, in part due to variations in the extent of invasion by exotic cool-season grasses. However, annual production may be in the range of 1200-3000 pounds per acre.

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

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

Community Phase 3.1 – Exotic Cool-Season Grasses

This community phase is dominated by exotic cool-season grasses (such as Kentucky bluegrass, smooth brome, and/or quackgrass), often with a much-reduced forb and shrub component. Excessive accumulation of mulch may also be present, particularly when dominated by Kentucky bluegrass. Common forbs and shrubs often include white heath aster, Canadian horseweed, curlycup gumweed, common yarrow, silverleaf Indian breadroot, and white sagebrush. Exotic forbs, such as leafy spurge and Canada thistle, 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).

State 4: Go-Back State

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

This community phase is highly variable depending on the level and duration of disturbance related to the T5A transitional pathway. In this MLRA, the most probable origin of this phase is secondary succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses, including noxious weeds (e.g., leafy spurge, Canada thistle) which may need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or quackgrass) 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 planting, prescribed grazing, prescribed burning, haying, or use of herbicides will generally be necessary to achieve the desired result and control any noxious weeds.

It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical planting 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 planting 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 planting methods, seeded species not adapted to the site, insufficient weed control, herbicide carryover, poor seed quality (purity & germination), and/or improper management.

Transition T5A

This transition from any plant community to State 4: Go-Back State. It is 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 53B landscape is characterized by nearly level to rolling till plains including kettle holes, kames, moraines, and small glacial lakes. The MLRA is located within the heart of the Prairie Pothole (Coteau) Region with temporary, seasonal, and semi-permanent wetlands throughout the MLRA. MLRA 53B has 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 prairie vegetation characterized by western wheatgrass, needle and thread, green needlegrass, and big bluestem. Little bluestem is an important species on sloping and shallow soils. Prairie cordgrass, northern reedgrass, and sedges are important species on wet soils. Western snowberry, chokecherry, plum, stiff goldenrod, blacksamson echinacea, and prairie rose are commonly interspersed throughout the area.

Complex and intermingled ecological sites create diverse grass and shrub land habitats. Ecological sites are interspersed with moderate to high densities of depressional wetlands. MLRA 53B includes headwaters to tributaries of the Missouri River, including the Big Muddy River, White Earth River, Painted Woods Creek and Apple Creek in North Dakota and Spring Creek in South Dakota. Numerous unnamed creeks and drainageways drain into the James River in North and South

Dakota which are in MLRA 55B. These habitats provide critical life-cycle components for many wildlife species including aquatic species.

Historic Communities/Conditions within MLRA 53B:

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). The high density of wetland and associated native grassland historically supported an abundance of waterfowl and other marsh dependent birds. Many species of grassland birds, small mammals, insects, reptiles, amphibians, and herds of roaming American bison, elk, and pronghorn were historically among the inhabitants adapted to this semi-arid region. Roaming herbivores, as well as several small mammal and insect species, were the primary consumers linking the grassland resources to large predators (such as the wolf and mountain lion) and smaller carnivores (such as the coyote, bobcat, red fox, and raptors). Extirpated species include free-ranging American bison, elk, black and grizzly bear, gray wolf, and peregrine falcon (breeding). Extinct from the region is the Rocky Mountain locust.

Present Communities/Conditions within MLRA 53B:

Following European influence, domestic livestock grazing, elimination of fire, energy development, and other anthropogenic factors influenced plant community composition and abundance. Approximately 34% of the native grassland in MLRA 53B remains intact but grassland continues to be converted to annual cropping systems. Annual cropping, wetland drainage, wind energy, woody encroachment, and transportation corridors are the main contributors to habitat fragmentation, which reduces habitat quality for area-sensitive species. The fragmented landscape reduced or eliminated ecological drivers (fire) and introduced exotic plant species including smooth brome, crested wheatgrass, Kentucky bluegrass, and leafy spurge which further impacted plant and animal communities. Loss of fire allowed woody species to expand onto historically grassland sites. The loss of these ecological drivers greatly influenced the remaining native plant communities and wildlife species presence, moving towards a more fragmented but diverse landscape; but in many cases a more homogeneous grassland dominated by cool-season exotic grass species develops.

The high density of wetlands provides habitat for large numbers and species of waterfowl and waterbirds. MLRA 53B is a major contributor to the annual production of waterfowl and waterbirds within the Central Flyway. Many wildlife species found in MLRA 53B are those that have adapted to annual crop production. Some wildlife species in this area are white-tailed deer, coyote, red fox, American badger, raccoon, beaver, striped skunk, American mink, white-tailed jackrabbit, Eastern turkey, sharp-tailed grouse, waterfowl, and numerous species of grassland-nesting birds and pollinating insects. Numerous fish species inhabit the lakes and creeks within the MLRA.

National wildlife refuges, waterfowl production areas, and state wildlife management areas along with North Dakota Department of Trust Lands and South Dakota State School Lands provide herbaceous and woody cover for wildlife. In addition, the United States Army Corps of Engineers, United States Fish and Wildlife Service (USFWS), and the North Dakota Game and Fish Department (NDGFD) jointly manage one large manmade reservoir, Lake Audubon (16,612 acres), for waterfowl and fish production. The USFWS manages approximately 56,000 acres in National Wildlife Refuges and 59,000 acres of Waterfowl Production Areas including 5,526 acres of wilderness area within the Lostwood National Wildlife Refuge and 4,201 acres of wilderness area within the Chase Lake National Wildlife Refuge. The NDGFD manages approximately 47,000 acres of Wildlife Management Areas (WMA) and the South Dakota Game Fish and Parks manages approximately 12,000 acres of Game Production Areas in the southern end of the MLRA.

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

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

Species of Concern within MLRA 53B:

The following is a list of species considered "species of conservation priority" in the North Dakota State Wildlife Action Plan (2015) and South Dakota State Wildlife Action Plan (2014); and species listed as "threatened, endangered, or petitioned" under the Endangered Species Act within MLRA 53B at the time this section was developed:

Invertebrates: Dakota skipper, Dakota stonefly, Iowa skipper, monarch butterfly, northern sandy tiger beetle, Ottoe skipper, regal fritillary, yellow-banded bumble bee, and western bumble bee.

Birds: American avocet, American bittern, American kestrel, American white pelican, Baird's sparrow, bald eagle, black-billed cuckoo, black tern, bobolink, burrowing owl, canvasback, chestnut-collared longspur, Dickcissel, ferruginous hawk, Franklin's gull, grasshopper sparrow, greater prairie-chicken, horned grebe, horned lark, lark bunting, LeConte's sparrow, lesser scaup, loggerhead shrike, long-billed curlew, marbled godwit, Nelson's sparrow, northern goshawk, northern harrier, northern pintail, peregrine falcon (migration), piping plover (migration), red knot (migration), sharp-tailed grouse, short-eared owl, Sprague's pipet, Swainson's hawk, trumpeter swan, upland sandpiper, western meadowlark, willet, Wilson's phalarope, whooping crane (migration), and yellow rail.

Mammals: Arctic shrew, big and little brown bats, Franklin's ground squirrel, plains pocket mouse, Richardson's ground squirrel, silver-haired bat, and swift fox (historical range).

Amphibians and Reptiles: Canadian toad, false map turtle, plains hognose snake, smooth green snake, and snapping turtle.

Fish and Mussels: Blacknose shiner, blue sucker, burbot, fathead chub, fragile papershell, northern pearl dace, northern redbelly dace, pink papershell, sicklefin chub, sturgeon chub, and yellow sandshell.

Grassland Management for Wildlife in the MLRA 53B

Management activities within State and Transition models follow various community phase pathways. These management activities will impact wildlife (both positively and negatively) but are essential for maintenance of healthy grassland ecosystems. Community phase, transitional, and restoration pathways are keys to long-term management within each State and between States. 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

management effects of grassland and woodland resources in comparison to typically short-term negative effects to the habitats of individual species.

Ecological sites occur as intermingled complexes on the landscape with gradual or sometimes abrupt transitions. Rarely do ecological sites exist in large enough acreage to manage independently for wildlife. A management regime for one ecological site may negatively impact an adjacent site (e.g., alteration of a grazing regime within a Loamy Overflow ecological site to encourage tall warm-season grass development) may encourage exotic cool-season grasses to increase or dominate adjacent ecological sites.

Life requisites and habitat deficiencies are determined for targeted species, species guilds, or by land use. Deficiencies need to be addressed along community phase, transitional, and restoration pathways as presented in specific state-and-transition models. Ecological sites should be managed and restored within the site's capabilities to provide sustainable habitat for targeted species or species guilds. Habitat fragmentation caused by the conversion to annual cropping, tree plantings, rural housing, and fragmentation due to transportation and electrical transmission corridors need to be considered when managing for target species.

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

Understanding preferred vegetative stature and sensitivity to woody encroachment is necessary to manage for the specific grassland species. Various grass heights may be used for breeding, nesting, or foraging habitat. While most species use varying heights, many have a preferred vegetative stature height. The following chart provides preferred vegetative stature heights and sensitivity to woody vegetation encroachment.

Grassland-nesting Bird Species	Preferred Vegetative Stature			Avoids woody vegetation*
	Short < 6 inches	Medium 6 - 12 inches	Tall >12 inches	
Baird's sparrow	x	x		x
Bobolink		x	x	x
Brewer's sparrow	x	x		
Burrowing owl	x			x
Chestnut-collared longspur	x	x		x
Common yellowthroat			x	
Dickcissel		x	x	
Ferruginous hawk	x	x		
Grasshopper sparrow	x	x		x
Horned lark	x			x
Killdeer	x			x
Lark bunting	x	x		
Lark sparrow	x			

Le Conte's sparrow			x	x
Long-bill curlew	x			x
Marbled godwit	x	x		x
McCown's longspur	x	x		x
Mountain plover	x			x
Nelson's sparrow			x	x
Nesting waterfowl		x	x	
Northern harrier		x	x	x
Savannah sparrow		x	x	x
Short-eared owl		x	x	x
Sprague's pipit	x	x		x
Upland sandpiper	x	x		x
Western meadowlark	x	x		
Willet	x	x		x
*Many of the listed species avoid nesting in grassland areas 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., western snowberry, prairie rose) in this MLRA.				

Clayey Wildlife Habitat Interpretation

Clayey ecological sites have no restrictions in the soil profile. This complex of ecological sites provides habitat for many edge-sensitive, grassland bird species. Clayey habitat features support nesting and foraging grassland birds but may be too dense and tall for sharp-tailed grouse leks. Associated ecological sites include Claypan, Closed Depression, Loamy Overflow, Loamy, Thin Claypan, Thin Loamy, Wet Meadow, and Shallow Clayey.

Clayey ecological sites may be found in four plant community states (1.0 Reference State, 2.0 Native/Invaded State, 3.0 Invaded State, and Go-Back). Multiple plant community phases exist within States 1 and 2. These states occur primarily in response to grazing, drought, and non-use. Secondary influences include fire and anthropogenic disturbances.

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using tools in State 1.0 and State 2.0 community phase pathways to prevent further plant community degradation along the T2A transitional pathway to Invaded State 3.0. Native, grassland associated wildlife generally benefit from a heterogeneous grassland (as found in community phases of States 1.0 and 2.0) that includes diverse grass and forb species with varying structure and density.

As plant communities degrade within State 2.0 and transition to State 3.0, cool-season exotic grasses increase while native forbs are reduced. This transition results in reduced structure, increased plant community homogeneity, and reduced insect populations which results 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. A homogenous grassland landscape does not provide quality escape or winter cover. As a result, many species may not be able to meet life requisites within State 3.0.

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 or successful native range planting.

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

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 period as well as prescribed fire. Predominance of grass species in this community favors grazers and mixed-feeders (animals selecting grasses as well as forbs and shrubs). The structural diversity provides habitat for a wide array of migratory and resident birds.

Invertebrates: Insects play a role in maintaining the forb community and provide a forage base for grassland birds, reptiles, and rodents. Ecological services, historically provided by bison, are simulated by domestic livestock. These services include putting plant material and dung in contact with mineral soil to be used by low trophic level consumers (such as invertebrate decomposers, scavengers, 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 Nuttall's violet and prairie violets being uncommon. Monarch butterfly may use flowering forbs on this site; however, few milkweed species are found on this site to support breeding and larvae development. The ecological site does not provide habitat for the northern sandy tiger beetle which prefers dry, sandy dunes and sandy areas away from water. This plant community does not provide habitat for the Ottoe Skipper preferring mid-statured grasses containing little bluestem, prairie dropseed, and side-oats grama. Bumblebees and other native bees utilize forbs for pollen and nectar and bare ground for nesting amongst bunchgrasses. Prescribed grazing with adequate recovery periods, as well as prescribed fire, to maintain Community Phase 1.1 will have long term positive effects on ground dwelling insects.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by short- to mid-grass nesting birds. Plant structure may be too dense or tall for species using short-grass habitats; however, it may be used during periods of drought or management such as rotational grazing or fire (resulting 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.

This site is associated with Wet Meadow ecological sites providing nesting opportunities for waterfowl and other water birds. Grassland birds preferring short- to mid-grass structure will use this site. In years with reduced precipitation or drought, nesting recruitment may be compromised. This plant community provides suitable areas for sharp-tailed grouse leks and nesting and brood-rearing habitat. Limited structure and diverse prey populations provide good hunting opportunity for grassland raptors. Many passerine species utilize MLRA 53B as a major migratory travel corridor.

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

Amphibians/Reptiles: This ecological site and associated plant communities provides habitat for smooth green snakes. This ecological site can provide habitat for the northern leopard frog and Great Plains toad if freshwater habitats (such as wetlands, streams, or lakes) are adjacent to the site.

Fish and Mussels: This ecological site is not directly associated with streams, rivers, or water bodies. This ecological site may receive run-on hydrology from adjacent ecological sites, and it provides hydrology to downslope ecological sites such as Wet Meadow. Management on Clayey sites, in conjunction with neighboring run-on sites, will have an indirect effect on aquatic species in streams and/or tributaries and wetlands receiving water from Clayey and adjacent sites. Optimum hydrological function and nutrient cycling limit potential for sediment yield and nutrient loading to the nearby aquatic ecosystems from Community Phase 1.1.

Community Phase 1.2 Western Wheatgrass-Blue Grama/Sedges/Green Needlegrass: This plant community phase occurred during periods of drought and heavy grazing, resulting in marked increases in blue grama and sedges along with a decrease in green needlegrass.

Invertebrates: Provides similar life requisites as Community Phase 1.1. However, white sagebrush, white heath aster, and common yarrow increase, reducing nectar and pollen availability for many pollinators. An increase in warm-season, sod-forming grasses may negatively impact ground nesting pollinator species.

Birds: Provides similar life requisites as Community Phase 1.1. However, the increase of short warm-season grasses favors grassland-nesting birds species preferring short to mid-statured vegetation. Short, warm-season grasses may be more attractive for sharp-tailed grouse lek sites.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

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

2.0 Native/Invaded State

Community Phase 2.1 Green Needlegrass-Western Wheatgrass: 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, smooth brome, 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 the Invaded State 3.0. There is no known Community Phase Pathway back to State 1.0 from State 2.0.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

Community Phase 2.2 Western Wheatgrass-Blue Grama/Sedges/Forbs:

This community occurs with long-term heavy season-long grazing (with or without drought) which leads to a marked decrease in green needlegrass and increases in blue grama and sedges. Community Phase Pathway 2.1A leads to shorter-statured warm-season grasses and a reduction in forb diversity. Dominated by shorter-stature grasses and a loss of nitrogen-fixing or leguminous native forbs, the diversity of this plant community is reduced. Prescribed grazing with adequate recovery periods along Community Phase Pathway 2.2A may regain the cool-season grass and forb diversity components in Community Phase 2.1.

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

Birds: Heavy continuous grazing or continuous season-long grazing will reduce nesting sites, forage (invertebrates), and cover. A reduced forb component may limit insect foraging opportunities. The stature is generally short, serving both short- and mid- grass nesting birds. Shortgrass-nesting birds favor this phase. Species that prefer mid-grass stature generally will be successful with normal to above normal precipitation and a change in management (implementation of a prescribed grazing system, along the 2.2A Community 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. Heavy grazing and a lack of cover for small mammals reduces hunting opportunities for grassland raptors.

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

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

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

Community Phase 2.3 Western Wheatgrass/Kentucky Bluegrass/Green Needlegrass: Periods of no use and no fire (via Community Pathway 2.2B) leads to an increase in Kentucky bluegrass and decreases in blue grama and sedges. Mulch also increases and may become a physical barrier to plant growth. Runoff and available nitrogen increase.

Invertebrates: The increase in sod-forming Kentucky bluegrass limits production of forbs and further limits nesting sites for pollinators.

Birds: Total rest will provide short- to mid-stature vegetation. Depending on the degree of Kentucky bluegrass invasion, the lack of plant diversity and stature, along with increased litter and the tendency of Kentucky bluegrass and smooth brome cover to prostrate (or “flop”), limits use by many grassland-nesting birds. This plant community provides areas suitable for sharp-tailed grouse lek site development. Non-use or lack of fire provides protective and thermal cover for small mammals and good hunting opportunities for grassland raptors.

Mammals: Multiple years of continuous season-long grazing limits suitable food, thermal, protective, and escape cover (reduction in litter) for most mammals. The increased litter from total rest from grazing combined with no fire events provides protective, thermal, and escape cover for small mammals but limited protective, thermal, or escape cover for large mammals.

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

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

3.0 Invaded State

Community Phase 3.1 Exotic Cool-Season Grasses: Prolonged periods of no use and no fire or heavy, continuous season long grazing transitions this plant community from a more native dominated state to an exotic cool season invaded state (via Transitional Pathway T2A). Characterized by a dominance (>30%) of exotic cool-season grasses, such as smooth brome and Kentucky bluegrass, native grasses represent less than 40% of the plant community. Return to State 2.0 (via Restoration Pathway R3A) through prescribed burning and high levels of grazing management requires remnant amounts of native warm- and cool-season grasses and forbs to be successful. The remnant native community needs frequent prescribed burns and high levels of grazing management targeting the exotic, cool-season grasses to improve competitiveness and increase vigor and density. Without intensive management, the remnant native plants will not increase adequately to transition back to State 2.0. Intensified management along the R3A Pathway will have significant short-term negative impacts on wildlife habitat; however, this is necessary to restore long-term native habitat functions.

Invertebrates: Exotic grasses limit use by beneficial insects provided in States 1.0 and 2.0. Heavy, continuous season-long grazing causes this plant community to be dominated by sod forming cool- and warm-season grasses creating a thick root layer which eliminates bare ground and nesting sites for native bees and other ground-nesting insects. Lack of nectar-producing plants and native grass host plants eliminates life requisites for invertebrate species of concern in MLRA 53B.

Birds: The homogeneous community phase, dominated by exotic short statured grass species, provides limited habitat and life requisites for most obligate grassland-nesting birds. Bird species that favor short-statured vegetation may use this site; however, heavy, continuous season-long grazing, along with a lack of plant diversity and stature, limits use by many grassland-nesting birds. Total rest will provide short- to mid-stature vegetation. Under no use and no fire, Kentucky bluegrass invasion causes a lack of plant diversity and stature; along with increased litter and the tendency of Kentucky bluegrass and smooth brome cover to prostrate (or “flop”), use by many grassland-nesting birds is limiting. Non-use or lack of fire provides protective and thermal cover for small mammals and good hunting opportunities for grassland raptors. Sharp-tailed grouse may use this plant community for lek sites; however, all other life requisites will need to be met on other nearby or adjacent ecological sites’ plant communities.

Mammals: Heavy, continuous season-long grazing causes this plant community to be dominated by short-statured, sod forming cool- and warm-season grasses providing limited thermal, protective, escape cover for mammals. Limited habitat is available for mammals except for ground dwelling rodent species. The increased litter from total rest from grazing combined with no fire events provides protective, thermal, and escape cover for small mammals but limited protective, thermal, or escape cover for large mammals.

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

Fish and Mussels: Provides similar life requisites as Community Phase 1.1. However, runoff increases significantly from the plant community due to thick thatch and sod forming grasses increasing yield and nutrient loading to adjacent ecological sites and waterbodies.

4.0 Go-Back State

Community Phase 4.1 Annual/Pioneer Perennial/Exotics: These plant communities are the result of severe soil disturbance (such as cropping, recreational activity, or concentrated livestock activity for a prolonged period). Following cessation of disturbances, the resulting plant community is dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals and birds, and their young. Dense weed cover can keep soils moist, increasing the presence of insects. Milkweed can be an early pioneering pollinator species and host plant for monarch butterflies. Tall stature provided by some annual weeds offers thermal cover and seeds throughout winter for deer, small mammals, and over-wintering birds. The response by wildlife species will be dependent upon plant community composition, vegetative stature, patch size, and management activities (such as prescribed grazing, burning, inter-planting, haying, or noxious weed control).

Successful restoration of native species along Transition Pathway R4A can result in a native grass and forb community in Native/Invaded State 2.0. Over time (with no management), the exotic cool-season perennial grasses (Kentucky bluegrass, smooth brome, and/or quackgrass) generally become established and dominate the community. Failed native grass planting, via Transition Pathway R4B, can result in an invaded plant community Invaded State 3.0.

Animal Community – Grazing Interpretations

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

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

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

Grazing levels are noted within the plant community narratives and pathways in reference to 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 group C with localized areas in hydrologic group D. Infiltration varies from moderately slow to very slow; runoff potential varies from low to very high for this site depending on hydrologic group, soil surface texture, slope, 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

National wildlife refuges (NWR) (56,476 acres), waterfowl production areas (WPAs) (183,465 acres), state wildlife management areas (WMAs) (59,476 acres), Department of Trust Lands/State School Lands (284,695 acres), and the United State Army Corps of Engineers (65,619 acres) provide hunting, bird watching, hiking, and other outdoor recreation opportunities. Audubon WMA, North Dakota, is the largest state managed, wildlife area covering 6,716 acres. The largest refuges managed by the United States Fish and Wildlife service are Audubon NWR (14,735 acres); Lostwood NWR (26,747 acres with 5,526 acres designated as wilderness area); Chase Lake NWR (4,385 acres, of which 4,201 acres were designated a wilderness area); and Long Lake NWR (22,300 acres). United States Bureau of Reclamation manages approximately 2,215 acres for fish and wildlife habitat. The Bureau of Land Management manages 6,042 acres in small, scattered tracts across the MLRA.

Bird watching: Prairie-dependent and migratory birds provide quality birding opportunities within this MLRA. NWRs, WPAs, and WMAs provide essential habitat for prairie-dependent bird species (such as Sprague's pipit and Baird's sparrow) along with some of the larger, showy members of the upland prairie including marbled godwit, upland sandpipes, and willet. MLRA 53B is in the heart of spring and fall bird migratory routes.

Chase Lake NWR is home to one of the largest breeding colonies of American white pelicans and has been identified by the American Bird Conservancy as one of the top 100 Globally Important Bird Areas in the United States. Lostwood NWR is designated a Globally Important Bird Area by the American Birding Conservancy and the Audubon Society. Long Lake NWR consists of a 15,000-acre saline basin that is 18 miles long and is appropriately named "Long Lake". The refuge was listed as a top 10 birding site by Wild Bird Magazine. It was also recently designated as both a Globally Important Bird Area and a Western Hemisphere Shorebird Reserve Network (WHSRN) site because of its importance as both a breeding and migratory stopover site for more than 20,000 shorebirds, annually.

Hunting/Fishing: MLRA 53B is a fall destination for thousands of waterfowl hunters. The density of prairie pothole wetlands, WPAs, state owned trust lands, and WMAs provide quality opportunities for waterfowl and upland game bird hunting. This MLRA also provides quality white-tailed deer hunting opportunities along with moose hunting opportunities.

Quality fishing (summer and winter fishing) opportunities are available in the MLRA. The North Dakota Game and Fish Department and the South Dakota Game Fish and Parks manages approximately 125 fishing lakes within the MLRA. Available species include yellow perch, walleye, northern pike, muskellunge, crappie, bluegill, and smallmouth bass. Lake Audubon is the largest fishing lake within the MLRA. A portion of Lake Audubon, within the National Wildlife refuge system, provides ice fishing access only; there is no open-water fishing on the refuge portion of Lake Audubon.

Camping: The Bureau of Reclamation manages the Brekken-Holmes Recreation Area in the Turtle Lake area. The recreation area consists of approximately 675 water surface acres, 620 land acres, and 10 miles of shoreline. The Garrison Conservancy District provides primitive camping along the chain of lakes connected by the McClusky Canal diverting water eastward into central North Dakota. Nine state parks are located within the MLRA totaling 1,340 acres. Fort Stevenson State Park is the only State Park in the MLRA that provides boating access to Lake Sakakawea. Other numerous camping (primitive and improved) sites are available in numerous city and county parks.

Hiking: The North Country Trail dissects the MLRA east to west following the 76-mile section of the McClusky Canal; in addition is has 12 miles of off-road trails through the Audubon National Wildlife Refuge, a road walk from Coleharbor to Riverdale and across Garrison Dam, and a short, off-road segment leading to the Western Terminus within Lake Sakakawea State Park. Hiking is also permitted on other state and federally owned lands. In addition, the Lostwood NWR and the Audubon NWR have 7 and 8 miles, respectively, of self-guided auto tours.

Wood Products

No appreciable wood products are found on this site.

Other Products

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

Site Development and Testing Plan

- Further investigation is recommended on the included Glossic Natrustolls (Aberdeen, Belfield, and Niobell). Sodicity (SAR values) is at higher levels than typical for other soils in the Clayey site. Soil

salinity can also exceed the typical range and be higher in the profile than other soils in the Site. Some areas of these natric soils may be more similar to Claypan ecological sites than Clayey sites.

- Further investigation is needed on site hydrology and soil chemistry where this site is in complex with Limy Subirrigated or Thin Claypan sites. The Limy Subirrigated site has a higher water table than the Clayey site. The Thin Claypan site has accumulated salts in the upper soil layers; the Glossic Natrustolls currently included in the Clayey site have a risk of increasing soil salinity and SAR values in the subsoil. Site to site interactions need further study in the following MLRA map units:
  - Hamerly-Niobell loams, 0 to 3 percent slopes (map unit 2q4w5)
  - Belfield-Rhoades complex, 0 to 2 percent slopes (2q2m2)
  - Belfield-Rhoades complex, 2 to 6 percent slopes (2q3b5)
  - Belfield-Rhoades-Grail complex, 0 to 2 percent slopes (2q3b6)
  - Rhoades-Savage complex, 0 to 6 percent slopes (2q77q)
- Future consideration should be given to a Clayey Overflow ES (particularly for Zeeland soils).
- A limited acreage of soils included in the Clayey site exceed 15 percent slopes. Opal soils, particularly, have a slope range up to 25 percent. Future investigation of the plant communities associated with these slopes should be considered.
- Further evaluation and refinement of the State-and-Transition model is needed to identify disturbance driven dynamics. Additional states and/or phases may be required to address grazing response.
- Further documentation may be needed for plant communities in all states. Plant data has been collected in previous range-site investigations, including clipping data; however, this data needs review. If geo-referenced sites meeting Tier 3 standards for either vegetative or soil data are not available, representative sites will be selected for further investigation.
- Site concepts will be refined as the above noted investigations are completed.
- The long-term goal is to complete an approved, correlated Ecological Site Description as defined by the National Ecological Site Handbook.

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	*R053BY002ND*	Moderately well and well drained soils that have a dense, root-restrictive, sodic claypan layer starting between a depth of 6 to 20 inches. This site is commonly on somewhat lower landscape positions than the Clayey site. Salt accumulations, if present, are deeper than 16 inches.
Closed Depression	*R053BY003ND*	Poorly drained soils in depressions with a surface layer <4 inches thick and a dense clayey subsoil. Ponding (typically <1 foot deep) is frequent during March through May.
Loamy Overflow	*R053BY005ND*	Moderately well and well drained soils somewhat lower on the landscape than the Clayey site. The Loamy Overflow site receives additional water as run-on from adjacent higher slopes or as stream

		overflow. The soil forms a ribbon 1 to 2 inches long.
Loamy	*R053BY011ND*	Well drained soils on similar or slightly higher landscape positions as the Clayey site. Soil forms a ribbon 1 to 2 inches long.
Thin Claypan	*R053BY013ND*	Moderately well and well drained soils that have a dense, root-restrictive, sodic claypan layer within a depth of 6 inches and salt accumulations within a depth of 16 inches. This site is commonly on lower landscape positions (typically micro-lows) than the Clayey site.
Thin Loamy	*R053BY015ND*	Well drained soils on higher, convex landscape positions on till plains and lake plains. The soil is highly calcareous with a depth of 8 inches and forms a ribbon <2 inches long.
Wet Meadow	*R053BY019ND*	Poorly drained soils in depressions on till plains. The surface layer is >6 inches and the depth to the non-sodic, clayey subsoil is >12 inches. Ponding (typically <1.5 feet deep) is frequent during March through May.
Shallow Clayey	*R054XY028ND*	Well drained soils higher on the landscape than the Clayey site in areas with sedimentary bedrock within the rooting zone. Depth to bedded shale is 10 to 20 inches.

Similar Sites

Ecological Site Name	Site ID	Narrative
Claypan	*R053BY002ND*	Moderately well and well drained soils that have a dense, root-restrictive, sodic claypan layer starting between a depth of 6 to 20 inches. This site is commonly on somewhat lower landscape positions than the Clayey site. Salt accumulations, if present, are deeper than 16 inches.
Loamy	*R053BY011ND*	Well drained soils on similar or slightly higher landscape positions as the Clayey site. Soil forms a ribbon 1 to 2 inches long.

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Inventory Data References

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

State Correlation

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

Relationship to Other Established Classifications

Level IV Ecoregions of the Conterminous United States: 42a – Missouri Coteau; 42c – Missouri Coteau Slope; 42d – Northern Missouri Coteau; 42f – Southern Missouri Coteau; 43c – River Breaks; and 46h – Northern Dark Brown Prairie.

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Site Description Approval

ND, State Range Management Specialist	Date	SD, State Range Management Specialist	Date

INTERPRETING INDICATORS OF RANGELAND HEALTH, Version 5, REFERENCE SHEET

Ecological site name: _Clayey_____ **Ecological site code: _RO53BY001ND___**
Author(s)/participant(s): _USDA-NRCS North Dakota_____
Contact for lead author: _NRCS State Rangeland Management Specialist_____
Date: _Oct 2021___ **MLRA:** ___53B_____ **LRU:** _____
Composition based on (check one): ☐ Cover ☒ Annual Production

Indicators. For each indicator, describe the potential for the site using the reference sheet checklist. Where possible, (1) use quantitative measurements; (2) include expected range of values for above- and below-average years and natural disturbance regimes for each community phase within the reference state, when appropriate; and (3) cite data sources used. Continue descriptions on separate sheet.
1. Rills: Rills are not expected on this site.
2. Water flow patterns: Water flow patterns are not visible on this site.
3. Pedestals and/or terracettes: Neither pedestals nor terracettes are expected.
4. Bare ground: Bare ground is less than 5%. 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: Structure is granular or subangular blocky parting to granular within the upper A-horizon. A-horizons for this ecological site range from 4 to 10 inches thick. Hue 10YR with colors value of 2 or 3 moist or 3 or 4 dry, and chroma 1 or 2.
10. Effects of plant community composition and distribution on infiltration: Mid- and short-statured bunchgrasses and mid- and short-statured rhizomatous grasses are dominant and subdominant. Bunchgrasses are 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 bunch grasses (5); Mid & short C3 rhizomatous grasses (2)		
Subdominant	Mid & short C4 bunch grasses (3)		
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 60 to 80% with a depth of 0.25 to 0.5 inches. Litter is in contact with soil surface.

15. Annual production: Annual air-dry production is 2300 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, quackgrass, and Eastern red cedar/juniper.

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

Site Type: Rangeland October 2024
MLRA: 53B Central Dark Brown Glaciated Plains

Functional/Structural Groups Sheet

State_____ **Office**_____ **Ecological site** Clayey **Ecol. site code** R053BY001ND

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 bunch grasses	green needlegrass, porcupinegrass, Canadian needlegrass*, needle and thread,
.	prairie Junegrass, slender wheatgrass
Mid & short C3 rhizomatous grasses	western wheatgrass, thickspike wheatgrass*, plains reedgrass
Mid & short C4 bunch grasses	prairie dropseed, plains muhly*, blue grama, buffalograss
Mid & short C4 rhizomatous grasses	sideoats grama, inland saltgrass*
Forbs	please see plant community table 1.1
Tall C4 rhizomatous grasses	big bluestem*
Shrub	prairie rose, western snowberry, plains pricklypear*, fringed sagewort
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 bunch grasses > Mid & short C3 rhizomatous 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. Absence of these species may not constitute a departure.
** See IIRH Version 5 page 70.

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

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