USDA Natural Resources
Conservation Service

Ecological site R053BY014ND
Choppy Sands

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General information

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

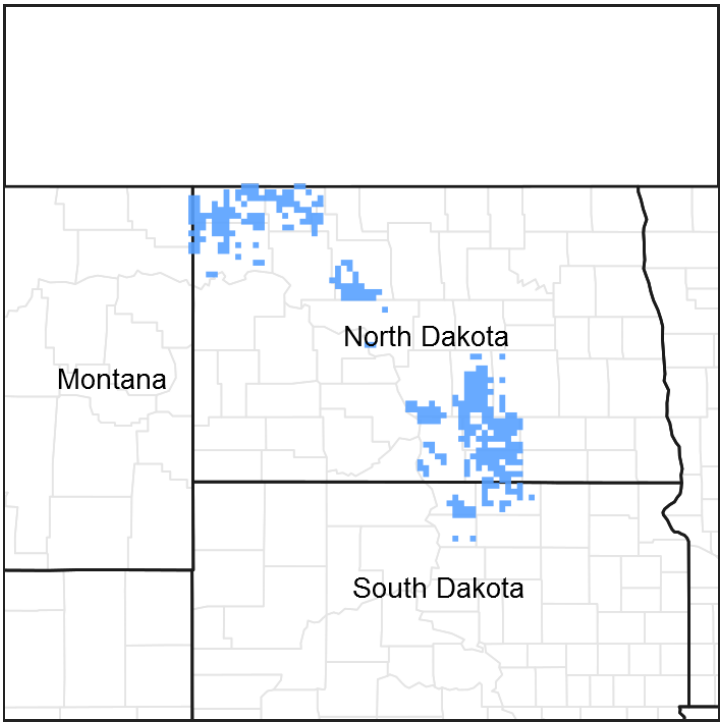

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 053B–Central Dark Brown Glaciated Plains

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.

Classification relationships

Level IV Ecoregions of the Conterminous United States: 46c - Glacial Lake Basins; 46d - Glacial Lake Deltas; 46e - Tewaukon Dead ice Moraine; 46f - End Moraine Complex; 46i - Drift Plains; and 46j - Glacial Outwash.

Ecological site concept

The Choppy Sands ecological site is located on sand plains and glacial moraines capped with eolian sand, and on weathered sandy residuum exposed by geologic erosion (along the western edge of the MLRA); typically, the landform has been wind-worked into dunes. The soils are very deep. The thickness of the topsoil is generally <5 inches; but it may be

as thick as 9 inches. The surface layer is loamy fine sand or fine sand. The rest of the soil profile to depth >40 inches is typically fine sand. Soil on this site is excessively drained. The slopes of the dunes are highly variable; the slope range of the Choppy Sands site is typically 15 to 35 percent but slopes >35% may be included in some areas. On the landscape, this site is above the Subirrigated and Wet Meadow ecological sites (both sites occur in blow-out areas) and, in areas of residuum, below the Shallow Sandy site. The Sands site occurs on adjacent, less sloping (<15 percent) sandy landscapes (see Site Development and Testing Plan). In areas of MLRA 54 linked to this ecological site, Limy Sands may also be an associated site.

To see a full copy of the ecological site description with all tables and the full version 5 rangeland health worksheet. Please use the following hyperlink:

https://efotg.sc.egov.usda.gov/references/public/ND/53B_Choppy_Sands_Narrative_FINAL_Ref_FSG.pdf

Associated sites

R053BY007ND	**Sands** This site occurs on less sloping areas (<15% slope) of sand plains and dunes. It is sand or loamy sand (fine to coarse sands) within a depth of 10 inches. The subsoil does not form a ribbon.
R053BY012ND	**Subirrigated** This site occurs in swales and blow-outs. It has redoximorphic features at a depth of 18 to 30 inches.
R053BY019ND	**Wet Meadow** This site is in the bottom of some blowouts. It is poorly drained - a seasonal high-water table is typically within a depth of 1.5 feet during the months of April through June; it may pond due to frozen ground in early spring. It has redoximorphic features within a depth of 18 inches. On this landscape, the site is non-saline.
R053BY027ND	**Shallow Sandy** This site occurs on hillslopes on sandy residuum exposed by geologic erosion. The soil has sandstone within a depth of 20 inches.
R054XY045ND	**Limy Sands** This site only occurs in areas of MLRA 54 linked to this site. The soil is calcareous within a depth of 12 inches and depth to sandstone is 20 to 40 inches.

Similar sites

R053BY007ND	**Sands** This site occurs on less sloping areas (<15% slope) of sand plains and dunes. It is sand or loamy sand (fine to coarse sands) within a depth of 10 inches. The subsoil does not form a ribbon.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon hallii* (2) *Calamovilfa longifolia*

Physiographic features

This site occurs on sand plains and glacial moraines capped with eolian sand, and on sandy residuum exposed by geologic erosion; typically, the landform has been wind-worked into dunes. Slope ranges from 15 to >35 percent.

Landform: Dune, Hillslope

Table 2. Representative physiographic features

Landforms	(1) Dune (2) Hillslope
Runoff class	Very low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	1,280–2,560 ft
Slope	15–35%
Water table depth	80 in
Aspect	Aspect is not a significant factor

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.

Table 3. Representative climatic features

Frost-free period (characteristic range)	88-117 days
Freeze-free period (characteristic range)	115-135 days
Precipitation total (characteristic range)	15-20 in
Frost-free period (actual range)	84-120 days
Freeze-free period (actual range)	109-136 days
Precipitation total (actual range)	15-21 in
Frost-free period (average)	102 days
Freeze-free period (average)	125 days
Precipitation total (average)	18 in

Climate stations used

- (1) POWERS LAKE 1N [USC00327281], Powers Lake, ND
- (2) ROSCOE [USC00397277], Roscoe, SD
- (3) LEOLA [USC00394891], Leola, SD
- (4) GACKLE [USC00323309], Gackle, ND
- (5) WILTON [USC00329455], Wilton, ND
- (6) TIOGA 1E [USC00328737], Tioga, ND
- (7) GARRISON [USW00094041], Garrison, ND
- (8) WILDROSE 3NW [USC00329400], Wildrose, ND

Influencing water features

This site does not receive additional water, either as runoff from adjacent slopes or from a seasonal high-water table. Depth to the water table is deeper than 6 feet throughout the growing season. Surface infiltration and permeability through the profile are rapid. Water loss on this site occurs through percolation below the root zone and through

evapotranspiration.

Soil features

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

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

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

The major soil series correlated to the Choppy Sands site are Seroco and Telfer.

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

Parent Material Kind: eolian sands, weathered residuum
Parent Material Origin: lacustrine, outwash, sandstone

Table 4. Representative soil features

Parent material	(1) Eolian sands (2) Residuum (3) Outwash (4) Lacustrine deposits (5) Sandstone
Surface texture	(1) Fine sand (2) Loamy fine sand
Family particle size	(1) Sandy
Drainage class	Excessively drained
Permeability class	Rapid
Soil depth	80 in
Surface fragment cover <=3"	0%

Surface fragment cover >3"	0%
Available water capacity (0-40in)	2.5–4 in
Calcium carbonate equivalent (0-40in)	0–5%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.1–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–4%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

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

Prior to European influence, the historical disturbance regime for MLRA 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 Invaded Wooded). Within each state, one or more community phases have been identified. These community phases are named based on the more dominant and visually conspicuous species; they have been determined by study of historical documents, relict areas, scientific studies, and ecological aspects of plant species and plant communities. Transitional pathways and thresholds have been determined through similar methods.

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

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

State 2: Native/Invaded State. Colonization of the site by exotic plants results in a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition was inevitable; it often resulted from colonization by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass) 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 invaded by exotic cool-season grasses. These exotic cool-season grasses can be expected to increase. As that increase occurs, plants more desirable to wildlife and livestock may decline. A decline in forb diversity can also be expected. Under long-term non-use or minimal use management, mulch increases and may become a physical barrier to plant growth. This also changes the micro-climate near the soil surface and may alter infiltration, nutrient

cycling, and biological activity near the soil surface. As a result, these factors coupled with shading cause desirable native plants to have increasing difficulty remaining viable and recruitment declines.

To slow or limit the invasion of these exotic grasses or other exotic plants, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic plants, the transition to State 3: Invaded State should be expected (T2A). This state may also transition to State 4: Invaded Wooded State during long-term non-use or very light grazing, and no fire (T2B).

State 3: Invaded State. The threshold for this state is reached when both the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass) 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 long-term 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). This state may also transition to State 4: Invaded Wooded State during long-term non-use or very light grazing, and no fire (T3A).

State 4: Invaded Wooded State. Historically, individual or small patches of shrubs and/or trees were scattered across the site. However, a marked increase in fire suppression, climate change, increase in long- term non-use, and other factors enabled woody species to colonize, form patches (resistant to fire), and begin to encroach on the site. These changes have enabled these patches to expand and become more widespread. Encroachment of both native and exotic woody species (e.g., Rocky Mountain juniper, Russian olive, Siberian elm, western snowberry, silverberry, ponderosa pine, eastern red cedar, quaking aspen) are examples of woody vegetation increasing in extent and impinging on the ecological integrity of the grassland biome. Windbreaks and other tree plantings can contain problematic and invasive species (such as eastern redcedar, Rocky Mountain juniper, ponderosa pine, Russian olive), which can contaminate surrounding grasslands. This results in increased long-term costs to maintain or restore this ecological

site in native grasses and forbs.

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

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

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

State and transition model

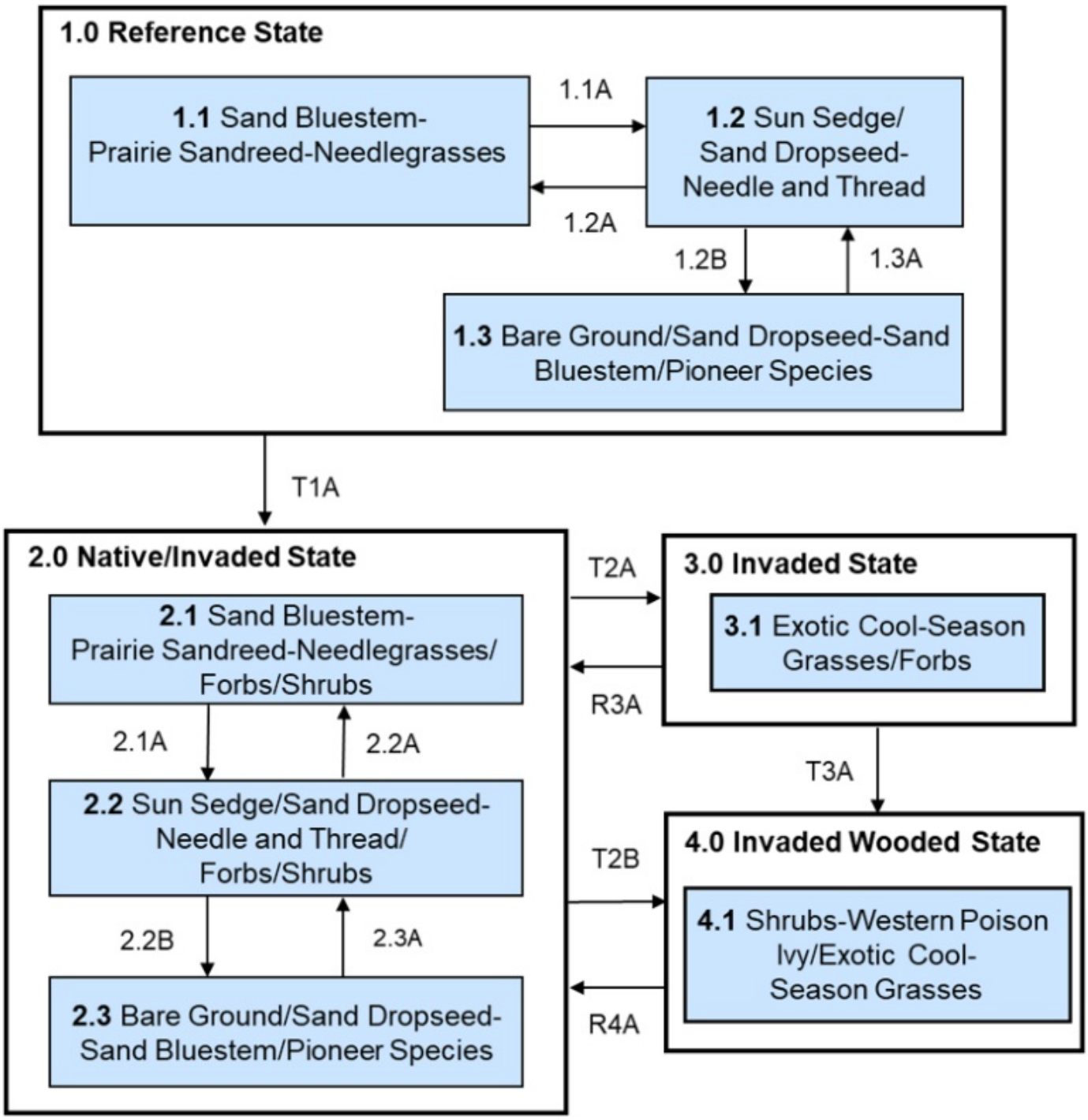
1.0 Reference State
1.1 Sand Bluestem-Prairie Sandreed-Needlegrasses
1.1A
1.2A
1.2 Sun Sedge/Sand Dropseed-Needle and Thread
1.2B
1.3A
1.3 Bare Ground/Sand Dropseed-Sand Bluestem/Pioneer Species
T1A
2.0 Native/Invaded State
2.1 Sand Bluestem-Prairie Sandreed-Needlegrasses/Forbs/Shrubs
2.1A
2.2A
2.2 Sun Sedge/Sand Dropseed-Needle and Thread/Forbs/Shrubs
2.2B
2.3A
2.3 Bare Ground/Sand Dropseed-Sand Bluestem/Pioneer Species
T2A
R3A
3.0 Invaded State
3.1 Exotic Cool-Season Grasses/Forbs
T3A
T2B
R4A
4.0 Invaded Wooded State
4.1 Shrubs-Western Poison Ivy/Exotic Cool-Season Grasses

Diagram Legend-MLRA 55B Choppy Sands	
T1A	Introduction of exotic cool-season grasses
T2A	Long-term moderate to heavy grazing
T2B	Long-term non-use or very light grazing, no fire
T3A	Long-term non-use, or very light grazing, no fire
R3A	Long-term prescribed grazing and prescribed burning
R4A	Long-term prescribed grazing with prescribed buring
CP 1.1 - 1.2 (1.1A)	Multiyear drought, with or without heavy grazing
CP 1.2 - 1.1 (1.2A)	Return to average precipitation with light to moderate grazing
CP 1.2 - 1.3 (1.2B)	Multiyear drought with or without heavy grazing
CP 1.3 - 1.2 (1.3A)	Return to average precipitation with light to moderate grazing
CP 2.1 - 2.2 (2.1A)	Multiyear drought, with or without heavy grazing
CP 2.2 - 2.1 (2.2A)	Return to average precipitation with long-term prescribed grazing and prescribed burning
CP 2.2 - 2.3 (2.2B)	Multiyear drought with or without heavy grazing
CP 2.3 - 2.2 (2.3A)	Return to average precipitation with prescribed grazing and prescribed burning

Figure 8. Eastern red cedar and Russian olive invasion on native rangeland in a formerly treeless grassland biome in MLRA 53B. Eastern red cedar and Russian olive seed sources likely translocated by birds from planted shelterbelts.

State 1
Reference State

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

Today the primary disturbance is from a lack of fire and concentrated livestock grazing. Grasses that were desirable for livestock and wildlife may have declined along with a corresponding increase in the less desirable grasses.

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 1.1
Sand Bluestem-Prairie Sandreed-Needlegrasses (Andropogon halli-Calamovilfa longifolia-Hesperostipa spp.)

This community phase was the most dominant both temporally and spatially. The prevailing climate and weather patterns favored the development of this community phase. Tall statured warm-season grasses, such as sand bluestem and prairie sandreed, would have been co-dominant with mid statured warm-season and cool-season grasses (e.g., needle and thread, porcupinegrass, little bluestem). Other grasses and grass-like species would have included sideoats grama, Canada wildrye, sand dropseed, prairie Junegrass, blue grama, and sun sedge. A variety of perennial forbs including prairie spiderwort, dotted blazing star, goldenrod, field sagewort, hairy false goldenaster, silky prairie clover, and sunflower were also present. Common shrubs included leadplant, soapweed yucca, prairie sagewort, and rose. Annual production would have ranged from roughly 1300-2500 pounds per acre with grasses and grass-likes, forbs, and shrubs contributing about 80%, 10% and 10%, respectively. Both warm-season and cool-season grasses were well represented in the community. As a result, production would have been distributed throughout the growing season. This community represents the plant community phase upon which interpretations are primarily based and is described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1120	1568	1970
Forb	90	143	215
Shrub/Vine	90	143	215
Tree	0	48	100
Total	**1300**	**1902**	**2500**

Figure 10. Plant community growth curve (percent production by month). ND5304, Missouri Coteau, warm-season dominant, cool-season sub-dominant.. Warm-season dominant, cool-season sub-dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	1	5	20	38	25	8	3	0	0	0

Community 1.2
Sun Sedge/Sand Dropseed-Needle and Thread (Carex inops/Sporobolus cryptandrus-Hesperostipa comata)

Grasses and grass-like species would have still dominated this phase, but the overall productivity of these species would have decreased compared to Community Phase 1.1. Forb diversity and production would have increased. Needle and thread, blue grama, sand dropseed, and sedges would have increased, while prairie sandreed and the bluestems would have decreased. Forb species (such as field sagewort, goldenrod, Cuman ragweed, common yarrow, and upright prairie coneflower) would have increased. Annual plant production may have decreased slightly.

Community 1.3
Bare Ground/Sand Dropseed-Sand Bluestem/Pioneer Species (Bare Ground/Sporobolus cryptandrus-Andropogon hallii/Pioneer Species)

This plant community may be characterized by “blowouts” (i.e., active dunes and/or denuded areas caused by wind erosion). Active wind erosion would have been very evident with soil deposition on the leeward side of the “blowouts”. This phase was unstable and generally occupied small, isolated areas (e.g., 2 acres or less). Vegetation would have been sparse and scattered with sand dropseed along with scattered patches of sand bluestem and prairie sandreed. Pioneer perennial and annual species, such as mat sandbur and common sunflower, comprised the majority of the vegetation. Depending upon depth to the water table, excessive soil erosion in isolated instances may have resulted in a change in ecological site designation. As erosion progressed and depth to seasonal water table decreased, Subirrigated Sands and/or Subirrigated ecological sites may have developed within the Choppy Sands ecological site complex. Bare ground would have exceeded 90 percent, with annual production and plant litter greatly reduced

compared to Community Phase 1.1.

Pathway 1.1A
Community 1.1 to 1.2

Community Phase Pathway 1.1 to 1.2 occurred with multiyear drought with or without heavy grazing. This resulted in marked increases in sun sedge and sand dropseed with corresponding decreases in sand bluestem and prairie sandreed.

Pathway 1.2A
Community 1.2 to 1.1

Community Phase Pathway 1.2 to 1.1 occurred with the return to average precipitation with light to moderate grazing which resulted in marked increases in sand bluestem and prairie sandreed along with corresponding decreases in sun sedge and sand dropseed. Tall statured warm-season species and mid statured warm- season and cool-season bunch grasses would also have increased.

Pathway 1.2B
Community 1.2 to 1.3

Community Phase Pathway 1.2 to 1.3 occurred during multiyear drought with or without heavy grazing, leading to excessive disturbances. Increased wind erosion was sufficient to form “blowouts” (i.e., active dunes and/or denuded areas caused by wind erosion). These “blowouts” may have been relatively small and isolated or, depending upon the extent of the disturbance, much more extensive (i.e., long-term drought). This would have resulted in decreases in sun sedge and needle and thread along with a corresponding increase in bare ground. Sand dropseed, sand bluestem, and pioneer species characterized the vegetation on the site

Pathway 1.3A
Community 1.3 to 1.2

Community Phase Pathway 1.3 to 1.2 would have occurred with the return to average precipitation with light to moderate grazing. This would have resulted in increases in sun sedge, sand dropseed, and needle and thread along with corresponding decreases in bare ground, sand dropseed, sand bluestem, and pioneer species. This increase in plant cover reduced erosion and stabilized “blowouts”, leading to the reestablishment of Community Phase 1.2.

State 2
Native/Invaded State

This state is similar to State 1: Reference State but has now been colonized by the exotic

cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass) which are now present in small amounts. Other exotic plants (e.g., Canada thistle, leafy spurge) may also invade the site. Although the state is still dominated by native grasses, an increase in these exotic cool-season grasses can be expected. Scattered small stands of shrubs including chokecherry, western snowberry, western poison ivy, and other woody species are often interspersed among the grass dominated communities on 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. These exotic cool-season grasses have been particularly and consistently invasive under extended periods of long-term non-use or very light grazing, and no fire. To slow or limit the invasion of these exotic grasses, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 3: Invaded State should be expected. Annual production of this state can be quite variable, in large part due to the amount of exotic cool-season grasses. However, as the exotic cool-season grasses increase, peak production will shift to earlier in the growing season.

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

Resilience management. (i.e., management strategies that will sustain a state and prevent a transition). To slow or limit the invasion of these exotic grasses, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. Grazing management should be applied that enhances the competitive advantage of native grass and forb species. This may include: (1) grazing when exotic cool-season grasses are actively growing and native cool- season grasses are dormant; (2) applying proper deferment periods allowing native grasses to recover and maintain or improve vigor; (3) adjusting overall grazing intensity to reduce excessive plant litter (above that needed for rangeland health indicator #14 – see Rangeland Health Reference Worksheet); (4) incorporating early heavy spring utilization which focuses grazing pressure on exotic cool-season grasses and reduces plant litter provided that livestock are moved when grazing selection shifts from exotic cool-season grasses to native grasses. Prescribed burning should be applied in a manner that maintains or enhances the competitive advantage of native grass and forb species. Prescribed burns should be applied as needed to adequately reduce/remove excessive plant litter and maintain the competitive advantage for native species. Timing of prescribed burns (spring vs. summer vs. fall) should be

adjusted to account for differences in annual growing conditions and applied during windows of opportunity to best shift the competitive advantage to the native species.

Community 2.1
Sand Bluestem-Prairie Sandreed-Needlegrasses/Forbs/Shrubs (Andropogon halli-Calamovilfa longifolia-Hesperostipa spp./Forbs/Shrubs)

This community phase resembles Community Phase 1.1 but has now been invaded by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass). These exotic grasses, however, are present in smaller amounts with the community still dominated by native grasses. Forbs and shrubs are also often conspicuous components of the community and include field sagewort, Cumin ragweed, sunflower, hairy false goldenaster, goldenrod, prairie sagewort, and rose. This community is maintained with grazing systems that allow for adequate recovery periods following grazing events, perhaps in combination with prescribed burning which closely mimics the natural disturbance regime. Annual production may be comparable to that of Community Phase 1.1 (1300-2500 pounds per acre). However, as the exotic cool-season grasses increase, peak production will shift to earlier in the growing season.

Community 2.2
Sun Sedge/Sand Dropseed-Needle and Thread/Forbs/Shrubs (Carex inops/Sporobolus cryptandrus-Hesperostipa comata/Forbs/Shrubs)

This community phase is similar to Community Phase 1.2 but has been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass). However, these exotics are present in smaller amounts with the community still dominated by native grasses. Although native grasses and grass-like species still dominate this phase, their overall productivity has declined while forb diversity and production has increased compared to Community Phase 2.1. Prairie sandreed, sand bluestem, sideoats grama, little bluestem, and porcupinegrass have decreased. Short statured grasses (such as blue grama and sedges), as well as sand dropseed and the exotic cool-season grasses, have increased. Forbs and shrubs are often conspicuous components of the community and include field sagewort, Cumin ragweed, sunflower, hairy false goldenaster, goldenrod, prairie sagewort, and rose. Exotic forbs, such as leafy spurge, may also be present. 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. The shift to the shallower rooted and short-statured blue grama and sedges, coupled with an increase in bare ground, results in increased soil surface temperatures. Infiltration rates would be similar, as would

the timing of plant production. Annual plant production, however, is slightly reduced. This community phase is also approaching the threshold leading to a transition to State 3: Invaded State. As a result, it is an “at risk” community. If management does not include measures to control or reduce these exotic cool-season grasses (or leafy spurge), the transition to State 4: Invaded State should be expected.

Community 2.3
Bare Ground/Sand Dropseed-Sand Bluestem/Pioneer Species (Bare Ground/Sporobolus cryptandrus-Andropogon hallii/Pioneer Species)

This community phase is similar to Community Phase 1.3 but has been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass). Other exotic plants (e.g., Canada thistle, leafy spurge) may also invade the site. However, these exotics are present in smaller amounts with the community still dominated by native grasses. This plant community may be characterized by “blowouts” (i.e., active dunes and/or denuded areas caused by wind erosion). Active wind erosion is very evident with soil deposition on the leeward side of the “blowouts”. It is unstable and generally occupies small, isolated areas (e.g., 2 acres or less), but can increase to become more extensive. Vegetation consists of sparse and scattered patches of sand bluestem and prairie sandreed along with sand dropseed and other pioneer perennial and annual species (e.g., mat sandbur).

Pathway 2.1A
Community 2.1 to 2.2

Community Phase Pathway 2.1 to 2.2 occurs with multiyear drought with or without heavy grazing. This results in marked increases in sun sedge and sand dropseed with corresponding decreases in sand bluestem and prairie sandreed.

Pathway 2.2A
Community 2.2 to 2.1

Community Phase Pathway 2.2 to 2.1 occurs with the return to average precipitation with long-term prescribed grazing and prescribed burning. This results in marked increases in sand bluestem and prairie sandreed along with corresponding decreases in sun sedge and sand dropseed. Tall statured warm-season species and mid statured warm-season and cool-season bunch grasses also increase. Both prescribed grazing and prescribed burning are likely necessary to successfully complete the pathway. 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 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 to native grasses and forbs

Pathway 2.2B
Community 2.2 to 2.3

Community Phase Pathway 2.2 to 2.3 occurs during multiyear drought with or without heavy grazing. Excessive disturbances (such as that associated with off-road vehicle use, wildlife trailing or burrowing, or heavy grazing by wildlife due to proximity to a perennial water source) may also be factors. Increased wind erosion is sufficient to form “blowouts” (i.e., active dunes and/or denuded areas caused by wind erosion). These “blowouts” may be relatively small and isolated or, depending upon the extent of the disturbance, much more extensive (i.e., long-term drought). This leads to decreases in sun sedge and needle and thread along with a corresponding increase in bare ground. Sand dropseed, sand bluestem, and pioneer species characterized the vegetation on the site.

Pathway 2.3A
Community 2.3 to 2.2

Community Phase Pathway 2.3 to 2.2 occurs with the return to average precipitation with long-term prescribed grazing and perhaps prescribed burning. This results in increases of sun sedge, needle and thread, forbs, and shrubs along with corresponding decreases in bare ground, sand bluestem, and pioneer species. The increase in plant cover reduces erosion and stabilizes “blowouts”, leading to the reestablishment of Community Phase 2.2. Prescribed grazing and perhaps prescribed burning may be necessary to successfully complete the pathway. 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 to native grasses and forbs.

State 3
Invaded State

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

prescribed burning and grazing techniques have been largely ineffective in suppressing or eliminating these species, even though some short-term reductions may appear successful. Annual production of this state may vary widely, in part due to variations in the extent of invasion by exotic cool-season grasses. However, as the exotic cool-season grasses increase, peak production will shift to earlier in the growing season.

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

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

Community 3.1
Exotic Cool-Season Grasses/Forbs

This community phase is dominated by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass). Other exotic plants (e.g., Canada thistle, leafy spurge) may also be present. Common forb and shrub species often include Cuman ragweed, white sagebrush, silverleaf Indian breadroot, horsetail, leadplant, and prairie rose. The longer these community phases exist, the more resilient they become. Natural or management disturbances that reduce the cover of Kentucky bluegrass or smooth brome are typically short-lived.

State 4
Invaded Wooded State

Long-term non-use or very light grazing, and no fire, leads to patches of shrubs and perhaps trees. Common shrubs may include chokecherry, western poison ivy, Woods' rose, western snowberry, Saskatoon serviceberry, creeping juniper, and white meadowsweet. Trees (e.g., hawthorn, green ash, bur oak) may also be present. The herbaceous understory is often composed largely of Kentucky bluegrass and, perhaps, leafy spurge. Initially the native grasses and grass-likes (such as sand dropseed, needle and thread, blue grama and sun sedge) are prominent along with forbs (e.g., Cuman ragweed, field sagewort, white sagebrush). However, as the canopy cover of woody vegetation increases, the herbaceous component shifts to the more shade-tolerant Kentucky bluegrass. A marked increase in long-term non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread.

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

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

Community 4.1
Shrubs-Western Poison Ivy/Exotic Cool-Season Grasses (Shrubs-Toxicodendron rydbergii/Exotic Cool-Season Grasses)

These patches of shrubs and, perhaps, trees may form during long-term non-use or very light grazing, and no fire. Common shrubs often include chokecherry, western poison ivy, Woods' rose, western snowberry, Saskatoon serviceberry, creeping juniper, and/or white meadowsweet. Trees (e.g., hawthorn, green ash, bur oak, bur oak) may also be present. The herbaceous understory is often composed largely of Kentucky bluegrass and (perhaps) leafy spurge. Initially the native grasses and grass-likes (such as sand dropseed, needle and thread, blue grama and sun sedge) are prominent along with forbs (e.g., Cuman ragweed, field sagewort, white sagebrush). However, as the canopy cover of woody vegetation increases, the herbaceous component shifts to the more shade-tolerant Kentucky bluegrass. A marked increase in long-term non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread.

Transition T1A
State 1 to 2

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

Transition T2A
State 2 to 3

This transition from the State 2: Native/Invaded State to State 3: Invaded State generally occurs during long- term moderate to heavy grazing. Exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass) become the dominant graminoids. Studies indicate that a threshold may exist in this transition when exotic cool-season grasses exceed 30% of the plant community and native grasses represent less than 40% of the plant community composition. This transition may occur under other managerial conditions, for example 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.

Transition T2B
State 2 to 4

This transition from State 2: Native/Invaded State to State 4: Invaded Wooded State occurs over long-term non-use or very light grazing, and no fire. A marked increase in long-term non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread.

Constraints to recovery. (i.e., variables or processes that preclude recovery of the former state). The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of tree seeds from adjacent sites will hamper site restoration. Reticence to undertake tree removal and the perception that trees may be a desirable vegetation component for wildlife habitat, carbon sequestration, aesthetics, etc. are some of the constraints to recovery. Managers wanting to manage the site for deer, livestock, or grassland nesting birds will need to consider the intensive management required to restore and maintain the site in State 2. The disturbance regime necessary to restore this site to State 2: Native/Invaded State is very labor intensive and costly; therefore, addressing woody removal earlier in the encroachment phase is the most cost-effective treatment for woody control.

Restoration pathway R3A
State 3 to 2

This restoration pathway from State 3: Invaded State to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing and prescribed burning, assuming there is an adequate component of native grasses to respond to the treatments. Both prescribed grazing and prescribed burning are likely necessary to successfully initiate this restoration pathway, the success of which depends upon the presence of a remnant population of native grasses in Community Phase 3.1. That remnant population, however, may not be readily apparent without close inspection.

The application of several prescribed burns may be needed at relatively short intervals in the early phases of this restoration process, in part because many of the shrubs (e.g., western snowberry) sprout following one burn. Early season prescribed burns have been successful; however, fall burning may also be an effective technique. The prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources. If properly implemented, this will shift the competitive advantage from the exotic cool-season grasses to the native cool-season grasses.

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

Transition T3A
State 3 to 4

This transition from State 3: Invaded State to State 4: Invaded Wooded State occurs over long-term non-use or very light grazing, and no fire. A marked increase in long-term non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread.

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

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

Restoration pathway R4A
State 4 to 2

This restoration pathway from the State 4: Invaded Wooded State to State 2: Native/Invaded State may be accomplished with long-term prescribed grazing and prescribed burning (perhaps in combination with mechanical treatment). Depending upon the abundance of exotic cool-season grasses, a subsequent range planting may be necessary to complete the restoration.

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

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			285–665	
	sand bluestem	ANHA	*Andropogon hallii*	190–380	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	95–285	–
3	**Cool-Season Bunchgrasses**			95–380	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	95–255	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–57	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–38	–
4	**Mid Warm-Season Grasses**			95–380	
	sideoats grama	BOCU	*Bouteloua curtipendula*	38–190	–
	little bluestem	SCSC	*Schizachyrium scoparium*	38–190	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	19–95	–
6	**Grass-Likes**			95–285	
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	57–190	–
	sedge	CAREX	*Carex*	19–95	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–57	–
	Schweinitz's flatsedge	CYSC3	*Cyperus schweinitzii*	0–19	–
5	**Short Warm-Season Grasses**			19–95	
	blue grama	BOGR2	*Bouteloua gracilis*	19–98	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–57	–
6	**Other Native Grasses**			19–95	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–95	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	19–57	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–38	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–38	–
Forb					
7	**Forbs**			95–190	

7	**Forbs**			95–190	
	common sunflower	HEAN3	*Helianthus annuus*	0–	19–
	longbract spiderwort	TRBR	*Tradescantia bracteata*	19–	38–
	white sagebrush	ARLUA	*Artemisia ludoviciana ssp. albula*	19–	38–
	flat-top goldentop	EUGR5	*Euthamia graminifolia*	0–	19–
	blazing star	LIATR	*Liatris*	19–	38–
	goldenrod	SOLID	*Solidago*	19–	38–
	field sagewort	ARCA12	*Artemisia campestris*	19–	38–
	hairy false goldenaster	HEVIV	*Heterotheca villosa var. villosa*	19–	38–
	hoary puccoon	LICA12	*Lithospermum canescens*	19–	38–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–	19–
	Lewis flax	LILE3	*Linum lewisii*	0–	19–
	milkweed	ASCLE	*Asclepias*	0–	19–
	narrowleaf stoneseed	LIIN2	*Lithospermum incisum*	19–	38–
	beardtongue	PENST	*Penstemon*	19–	38–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–	19–
	scurfpea	PSORA2	*Psoralidium*	19–	38–
	silky prairie clover	DAVI	*Dalea villosa*	19–	38–
	spotted sandmat	CHMA15	*Chamaesyce maculata*	0–	19–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	19–	38–
	thymeleaf sandmat	CHSES	*Chamaesyce serpyllifolia ssp. serpyllifolia*	0–	19–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	19–	38–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	19–	38–
	onion	ALLIU	*Allium*	0–	19–
	Forb, native	2FN	*Forb, native*	19–	57–
Shrub/Vine					
8	**Shrubs**			95–190	
	leadplant	AMCA6	*Amorpha canescens*	19–95	–
	rose	ROSA5	*Rosa*	19–57	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–38	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–38	–

	chokecherry	PRVI	*Prunus virginiana*	0–38	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–19	–
	currant	RIBES	*Ribes*	0–19	–
	hawthorn	CRATA	*Crataegus*	0–19	–
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	0–19	–
	pricklyash	ZANTH	*Zanthoxylum*	0–19	–
	blackberry	RUBUS	*Rubus*	0–19	–
	snowberry	SYMPH	*Symphoricarpos*	0–19	–
	sumac	RHUS	*Rhus*	0–19	–
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	0–19	–
Tree					
9	**Trees**			0–95	
	bur oak	QUMA2	*Quercus macrocarpa*	0–95	–
	quaking aspen	POTR5	*Populus tremuloides*	0–95	–
	Tree	2TREE	*Tree*	0–57	–

Table 7. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)

Animal community

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.

To see the chart, please use the following hyperlink:
https://efotg.sc.egov.usda.gov/references/public/ND/53B_Choppy_Sands_Narrative_FINAL_Ref_FSG.pdf

Choppy Sands Wildlife Habitat Interpretation:

Choppy Sands ecological sites are located on hummocks, dunes, and ridges with slopes predominantly greater than 15 percent. They are found on sandy uplands – sand plains, outwash plains, and sand-mantled moraines – which, typically, have been reworked by wind into dunes. The soils are excessively drained with no significant water table or surface run-on influencing vegetation production on this site. Associated ecological sites include Sands, Subirrigated, and Wet Meadow which are very commonly intermingled with the Choppy Sands site. In areas of MLRA 54 linked to this ecological site, Limy Sands may also be an associated site. Choppy Sands ecological sites tend to provide habitat for many edge-sensitive, grassland bird species preferring medium- to tall-statured vegetation. Insects rely on associated forbs and grasses for survival and serve as food sources for birds and their young and as forage for small and large herbivores.

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

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using tools in State 1.0 and State 2.0 Community Phase Pathways to prevent further plant community degradation along the T2A Transitional Pathway to State 3.0. Native wildlife species dependent upon grassland cover generally benefit from the heterogeneous grasslands found in States 1.0 and 2.0. Plant communities within State 2.0 depend upon long-term changes in precipitation and are compounded by grazing intensity and frequency.

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 and degree of management treatments applied. Managers must realize there is no restoration pathway back to State 1.0 and, once the plant community reaches States 3.0, it is very difficult to transition back to State 2.0. Management along community phase, transition, or restoration pathways should focus upon attainable changes. Short- and long-term monetary costs must be evaluated against short- and long-term ecological services in creating and maintaining habitat of sufficient quality to support a sustainable population density.

1.0 Reference State

Community Phase 1.1: Sand Bluestem-Prairie Sandreed-Needlegrasses: This plant community offers quality vegetative cover for wildlife; every effort should be made, when found, to maintain this ecological site within this community phase. This phase retains high functionality through continued maintenance including prescribed grazing (with adequate recovery period), as well as prescribed fire. Fire frequency maintains a grass-dominated plant community providing habitat for bird species sensitive to woody vegetation. Predominance of grass species in this community favors grazers and mixed-feeders (animals selecting grasses as well as forbs and shrubs). The structural diversity provides habitat for a wide array of migratory and resident grassland birds.

Invertebrates: Insects play a role in maintaining the forb community and provide a forage base for grassland birds, reptiles, and rodents. Ecological services, historically provided by bison, are simulated by domestic livestock. These services include putting plant material and dung in contact with mineral soil to be used by lower trophic level consumers (such as invertebrate decomposers, scavengers, shredders, predators, herbivores, dung beetles, and fungal-feeders).

No violet species are found on this site, limiting use by Regal fritillary. Monarch butterfly may use flowering forbs on this site; however, limited milkweed species and numbers are found on this site to support caterpillar food. Bumblebees and other native bees utilize forbs as a nectar source. Bare ground is abundant for ground nesting bees. Although little bluestem and sideoats grama can occur, Choppy Sands are too dry for Dakota skipper larvae.

Prescribed grazing with adequate recovery periods (as well as prescribed fire) to maintain the Community Phase 1.1A will have long-term positive effects on ground dwelling insects.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by mid- to tallgrass-nesting birds. Fire frequency maintains a grass-dominated plant community providing habitat for bird species sensitive to woody vegetation. In years with reduced precipitation or drought, nesting recruitment may be compromised. This plant community does not provide suitable areas for sharp-tailed grouse lek sites but does provide quality nesting, brood-rearing, and escape habitat. This site provides good hunting

opportunities for grassland raptors.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores. Tall- to mid-statured vegetation provides suitable food, thermal, protective, and escape cover for small and large herbivores.

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

Fish and Mussels: This ecological site is not typically adjacent to streams, rivers, or water bodies. This site typically does not receive run-on hydrology from adjacent ecological sites. The site typically contributes hydrology through sub-surface flows to sites lower on the landscape including Subirrigated and Wet Meadow ecological sites. Management on Choppy Sands sites, in conjunction with neighboring sites, will have an indirect effect on aquatic species in streams and/or tributaries receiving water from Choppy Sands and adjacent sites. Optimum hydrological function and nutrient cycling limit potential for sediment yield and nutrient loading to nearby aquatic ecosystems from Community Phase 1.1.

Community Phase 1.2: Sun Sedge/Sand Dropseed-Needle and Thread: This plant community phase occurs during periods of below average precipitation with or without heavy grazing. This results in marked increases in sun sedge and sand dropseed with a corresponding decrease in sand bluestem. This plant community has transformed from a mid- to tall-grass (Community Phase 1.1) to a mid- to short-statured herbaceous community.

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

Birds: Provides similar life requisites as Community Phase 1.1. The reduction of tall- and mid- statured grasses to mid- to short-statured grasses favors grassland nesting birds that prefer short- to medium-vegetative stature.

Mammals: Provides similar life requisites as Community Phase 1.1. A shift to short- to mid-statured grasses reduces habitat for large ungulates.

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

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

Community Phase 1.3: *Bare Ground*/Sand Dropseed-Sand Bluestem/Pioneer Species: This plant phase is a result of a Community Phase Pathway 1.2B with a combination of

extended periods of drought and excess disturbance (such as trailing, burrowing, or heavy grazing). Extended periods drought and repeated disturbances increase wind erosion resulting in a blowout condition. This unstable plant community has large areas of bare soil subjected to extreme wind erosion. Pioneering perennial and annual vegetation dominate the site.

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

Birds: Bare soil, active wind erosion, and a lack of herbaceous cover limits this site use by most bird species.

Mammals: Bare soil, active wind erosion, and a lack of herbaceous cover limits this site use by many mammal species. This plant community phase does not provide any habitat for large mammals and limited habitat for small mammals.

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

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

2.0 Native/Invaded State

Community Phase 2.1: Sand Bluestem-Prairie Sandreed-Needlegrasses/Forbs/Shrubs: This plant community develops through Transition Pathway T1A with periods of above and below average precipitation, grazing by domestic livestock, and rare to infrequent fire. Exotic cool-season grasses, such as Kentucky bluegrass and smooth brome, have established. This plant community phase has a very similar appearance and function to the Plant Community 1.1. Except for the increase of exotic cool-season grass species, this phase functions at a high level for native wildlife. However, due to a reduction in fire frequency, oak mottes increase in size and canopy cover. A wide array of forbs still provides nectar and pollen sources for pollinating species. Managers should consider management within the State 2.0 Community Phase Pathways to avoid transitioning to State 3.0. There is no known Community Phase Pathway back to State 1.0.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

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

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

Community Phase 2.2: Sun Sedge/Sand Dropseed-Needle and Thread/Forbs/Shrubs: Below average precipitation with or without drought, via Community Phase Pathway 2.1A, shifts the competitive advantages to grazing tolerant short-statured grasses, grass-likes, and forbs. Soil temperatures increase with shallower rooted, short-statured blue grama and sedges combined with an increase in bare ground. Forbs show an increase in number and diversity.

Invertebrates: Provides similar life requisites as Community Phase 1.2.

Birds: Provides similar life requisites as Community Phase 1.2.

Mammals: Provides similar life requisites as Community Phase 1.2.

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

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

Community Phase 2.3: *Bare Ground*/Sand Dropseed-Sand Bluestem/Pioneer Species: This plant phase is a result of Community Phase Pathway 2.2B with a combination of prolonged drought and excess disturbance (such as livestock trailing/loafing, off-road vehicle uses, and/or heavy grazing). This unstable plant community has large areas of bare soil (greater than 95%) subjected to wind erosion. Pioneering perennial and annual vegetation dominate the site.

Invertebrates: Provides similar life requisites as Community Phase 1.3.

Birds: Provides similar life requisites as Community Phase 1.3.

Mammals: Provides similar life requisites as Community Phase 1.3.

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

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

3.0 Invaded State

Community Phase 3.1: Exotic Cool-Season Grasses/Forbs: Extended periods of moderate to heavy grazing is the main management scenario (via Transition Pathway T2A) from Native/Invaded State 2.0 to Invaded State 3.0. These conditions often lead to the invasion by exotic cool-season grasses (such as Kentucky bluegrass, smooth brome, and/or quackgrass). This community phase is also frequently invaded by leafy spurge, often in combination with Kentucky bluegrass.

Invertebrates: The invasion of Kentucky bluegrass, other exotic cool-season grasses,

and/or leafy spurge reduces nectar and pollen sources for all pollinating species of concern within MLRA 53B. Season-long pollen and nectar availability becomes limited on this site. The woody shrub component (prairie rose and leadplant) will provide an early- to mid- season bloom period. Overall pollinator plant diversity is low, limiting season-long nectar and pollen production.

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

Mammals: The shift from tall herbaceous vegetation dominated cover, as found in States 1.0 and 2.0, to Kentucky bluegrass and leafy spurge limits its use for foraging and thermal, protective, and escape cover for large herbivores. Extended periods of overgrazing causes loss of litter and plant stature reduces or eliminates thermal, protective, and escape cover for most mammals.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1; however, excessive grazing will negatively impact the plains hog-nosed snake.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1. Due to low productivity of this site, the increase in exotic cool-season grasses (such as Kentucky bluegrass) does not create a duff layer significant enough to increase runoff or increased nutrient loading to adjacent ecological sites and waterbodies.

Animal Community – Grazing Interpretations

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

NRCS defines prescribed grazing as “managing the harvest of vegetation with grazing and/or browsing animals with the intent to achieve specific ecological, economic, and management objectives”. As used in this site description, the term ‘prescribed grazing’ is intended to include multiple grazing management systems (e.g., rotational grazing, twice-

over grazing, conservation grazing, targeted grazing, etc.) provided that, whatever management system is implemented, it meets the intent of prescribed grazing definition.

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

Grazing levels are noted within the plant community narratives and pathways in reference to grazing/prescribed 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 accessible range shows grazing. Little or no use of poor forage. Little evidence of trailing to grazing.

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

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

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

Hydrological functions

Water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic group A. Infiltration is rapid; runoff potential varies from very low to medium depending on slope percent, surface texture, and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National

Engineering Handbook for runoff quantities and hydrologic curves).

Recreational uses

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

There are no significant wood products found on this site.

Other products

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

Other information

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

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.

Inventory data references

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

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Contributors

Jeff Printz/Stan Boltz
Kevin Sedivec, Extension Rangeland Management Specialist; Darrell Vanderbusch, NRCS Resource Soil Scientist; and Lee Voigt, NRCS Range Management Specialist.
Stan Boltz, NRCS Range Management Specialist; Michael D. Brand, State Land Dept., Director Surface Management; David Dewald, NRCS State Biologist; Paul Drayton, NRCS District Conservationist;
Jody Forman, NRCS Range Management Specialist; Dennis Froemke, NRCS Range Management Specialist; Jeff Printz, NRCS State Range Management Specialist; Josh Saunders, NRCS Range Management Specialist;
ND NRCS: David Dewald, Jonathan Fettig, Hal Weiser, Alan Gulsvig, Mark Hayek, Chuck Lura, Jeff Printz, Steve Sieler, and Hal Weiser.

Approval

Suzanne Mayne-Kinney, 3/31/2025

Rangeland health reference sheet

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

Author(s)/participant(s)	USDA-NRCS North Dakota
Contact for lead author	NRCS State Rangeland Management Specialist
Date	10/31/2021
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

than 25%. When slopes exceed 25%, scattered water flow patterns may be observed but they are short (3 to 5 feet) and disconnected. No visible soil erosion is associated with these water flow patterns.

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3. **Number and height of erosional pedestals or terracettes:** Neither pedestals nor terracettes are expected when slopes are less than 25%. When slopes exceed 25%, some pedestalling of bunchgrasses may be observable, but plant roots will not be exposed.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground ranges from 15 to 20%. Bare ground patches are small (6 inches or less in diameter), randomly scattered, and disconnected. Animal activity (burrows and ant mounds) may occasionally result in isolated bare patches of up to 24 inches in diameter.

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

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Active blowouts should not be present. A few scattered, small (less than a few feet across) wind-scoured areas with associated depositional areas may be present, often associated with increased animal activity, may present. These wind-scoured areas may increase in size following prolonged drought but will not be present during several years of above normal precipitation.

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7. **Amount of litter movement (describe size and distance expected to travel):** Plant litter movement is not expected on slopes less than 25%. Slight movement (less than 15 inches) of small/fine sized litter may be observable on slopes greater than 25%.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class averages 4 or greater in both plant interspace and under plant canopy.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Structure is single grain or weak fine granular within the upper A-horizon. A-horizons for this ecological site range from 2 to 4 inches thick. Hue 10YR with color values of 3 or 4 moist or 4 or 5 dry, and chroma of 2 or 3.

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

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layers occur naturally on this site. Buried A horizon(s) may be visible in soil profile but are not considered compaction layers.

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

    Dominant: Phase 1.1
    Tall C4 rhizomatous grasses (2); Mid & short C3 bunch grasses (4)

    Sub-dominant: Phase 1.1
    Mid & short C4 bunch grasses (3); Forbs (13); Grass-likes (2)

    Other: Minor - Phase 1.1
    Mid & short C3 rhizomatous grasses; Shrub

    Additional: Due to differences in phenology, root morphology, soil biology relationships, and nutrient cycling Kentucky bluegrass, smooth brome, and crested wheatgrass are included in a new Functional/structural group, mid- and short-statured early cool-season grasses (MSeC3), not expected for this site.

    To see a full version 5 rangeland health worksheet with functional/structural group tables. Please use the following hyperlink:

    https://efotg.sc.egov.usda.gov/references/public/ND/53B_Choppy_Sands_Narrative_Fl

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Rare to not occurring on this site. Some dead or dying plant parts may be observed on warm-season bunchgrasses following multi-year drought.

14. **Average percent litter cover (%) and depth (in):** Plant litter cover is 40 to 60% with a depth of 0.1 to 0.25 inches. Litter is in contact with soil surface.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual air-dry production is 1700 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 1100 lbs./ac to 2300 lbs./ac, respectively.

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

17. **Perennial plant reproductive capability:** Noninvasive species in all functional/structural groups are vigorous and capable of reproducing annually under normal weather conditions. Some reduction in plant vigor and reproductive capability may be noted during and immediately following a multi-year drought.