

Ecological site FX053A99X700

Choppy Sandhills (CS)

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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.

MLRA notes

Major Land Resource Area (MLRA): 053A–Northern Dark Brown Glaciated Plains

The Northern Dark Brown Glaciated Plains, MLRA 53A, is a large, agriculturally and ecologically significant area. It consists of approximately 6.1 million acres and stretches 140 miles from east to west and 120 miles from north to south, encompassing portions of 8 counties in northeastern Montana and northwestern North Dakota. This region represents part of the southern edge of the Laurentide Ice Sheet during maximum glaciation. It is one of the driest and westernmost areas within the vast network of glacially derived prairie pothole landforms of the Northern Great Plains and falls roughly between the Missouri Coteau to the east and the Brown Glaciated Plains to the west. Elevation ranges from 1,800 feet (550 meters) to 3,300 feet (1,005 meters). Soils are primarily Mollisols, but Inceptisols and Entisols are also common. Till from continental glaciation is the predominant parent material, but alluvium and bedrock are also common. Till deposits are typically less than 50 feet thick (Soller, 2001). Underlying the till is sedimentary bedrock largely consisting of Cretaceous shale, sandstone, and mudstone (Vuke et al., 2007). The bedrock is commonly exposed on hillslopes, particularly along drainageways. Significant alluvial deposits occur in glacial outwash channels and along major drainages, including portions of the Missouri, Poplar, and Big Muddy Rivers. Large eolian deposits of sand occur in the vicinity of the ancestral Missouri River channel east of Medicine Lake (Fullerton et al., 2004). The northwestern portion of the MLRA contains a large unglaciated area containing paleoterraces and large deposits of sand and gravel known as the Flaxville gravel. Much of this MLRA was glaciated towards the end of the Wisconsin age, and the maximum glacial extent occurred approximately 20,000 years ago (Fullerton and Colton, 1986; Fullerton et al., 2004). Subsequent erosion from major stream and river systems has created numerous drainageways throughout much of the MLRA. The result is a geologically young landscape that is predominantly a dissected till plain interspersed with alluvial deposits and dominated by soils in the Mollisol and Inceptisol orders. Much of this area is typic ustic, making these soils very productive and generally well suited to production agriculture. Dryland farming is the predominant land use, and approximately 50 percent of the land area is used for cultivated crops. Winter, spring, and durum varieties of wheat are the major crops, with over 48 million bushels produced annually (USDA-NASS, 2017). Areas of rangeland typically are on steep hillslopes along drainages. The rangeland is mostly native mixed-grass prairie similar to the *Stipa-Agroropyron*, *Stipa-Bouteloua-Agroropyron*, and *Stipa-Bouteloua* faciatiions (Coupland, 1950, 1961). Cool-season grasses dominate and include rhizomatous wheatgrasses, needle and thread, western porcupine grass, and green needlegrass. Woody species are generally rare; however, many of the steeper drainages support stands of trees and shrubs such as green ash and chokecherry. Seasonally ponded, prairie pothole wetlands may occur throughout the MLRA, but the greatest concentrations are in the east and northeast where receding glaciers stagnated and formed disintegration moraines with hummocky topography and numerous areas of poorly drained soils.

Classification relationships

NRCS Soil Geography Hierarchy • Land Resource Region: Northern Great Plains • Major Land Resource Area (MLRA): 053A Northern Dark Brown Glaciated Plains National Hierarchical Framework of Ecological Units (Cleland et al., 1997; McNab et al., 2007) • Domain: Dry • Division: Temperate Steppe • Province: Great Plains-Palouse Dry Steppe Province 331 • Section: Glaciated Northern Grasslands Section 331L • Subsection: Glaciated Northern Grasslands Subsection 331La • Landtype association/Landtype phase: N/A National Vegetation Classification Standard (Federal Geographic Data Committee, 2008) • Class: Mesomorphic Shrub and Herb Vegetation Class (2) o Subclass: Temperate and Boreal Grassland and Shrubland Subclass (2.B) ? Formation: Temperate Grassland and Shrubland Formation (2.B.2) • Division: Central North American Grassland and Shrubland Division (2.B.2.Nb) o Macrogroup: *Andropogon hallii* - *Calamovilfa longifolia* - *Artemisia filifolia* Great Plains Sand Grassland & Shrubland Macrogroup ? Group: *Andropogon hallii* - *Calamovilfa longifolia* - *Hesperostipa comata* Sand Grassland Group • Alliance: *Andropogon hallii* Sand Prairie Alliance • Alliance: *Calamovilfa longifolia* Sand Prairie Alliance o Macrogroup: *Hesperostipa comata* - *Pascopyrum smithii* - *Festuca hallii* Grassland Macrogroup (2.B.2.Nb.2) ? Group: *Pascopyrum smithii* - *Hesperostipa comata* - *Schizachyrium scoparium* Mixedgrass Prairie Group (2.B.2.Nb.2.c) • Alliance: *Prunus virginiana* - *Symphoricarpos occidentalis* - *Amelanchier alnifolia* Great Plains Shrubland Alliance EPA Ecoregions • Level 1: Great Plains (9) • Level 2: West-Central Semi-Arid Prairies (9.3) • Level 3: Northwestern Glaciated Plains (42) • Level 4: Glaciated Dark Brown Prairie (42i) Glaciated Northern Grasslands (42j)

Ecological site concept

This provisional ecological site is limited to areas of wind-deposited sediments in MLRA 53A. Choppy Sandhills is an ecological site of limited extent occurring in areas of wind-transported sands, known as eolian sands. This site is characterized by an undulating, dynamic landscape of dunes or dune fields. Soils typically contain more than 70 percent sand and have little or no development. Characteristic vegetation is Indian ricegrass (*Achnatherum hymenoides*), lemon scurfpea (*Psoralidium lanceolatum*), various bunchgrasses, chokecherry (*Prunus virginiana*), and western snowberry (*Symphoricarpos occidentalis*).

Associated sites

FX053A99X110	<p>Sandy (Sy)</p> <p>This site occurs on alluvial deposits adjacent to the Choppy Sandhills ecological site. It is generally on outwash fans, alluvial fans, or terraces whereas the Choppy Sandhills ecological site is on eolian sands.</p>
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Similar sites

FX053A99X110	<p>Sandy (Sy)</p> <p>This site differs from the Choppy Sandhills ecological site in that it is not derived from eolian sands and its soils typically contains less than 70 percent sand.</p>
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Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	<p>(1) <i>Calamovilfa longifolia</i></p> <p>(2) <i>Sporobolus cryptandrus</i></p>

Legacy ID

R053AY700MT

Physiographic features

The Choppy Sandhills ecological site occurs in areas of eolian sand dunes. Sand dunes, predominantly parabolic forms, are common landforms on the Northern Great Plains. Most areas of these dunes are stable, although small areas of active dunes occur (Muhs and Wolfe, 1999). This ecological site occurs on dunes, interdunes, and sand plains in dune fields. Slopes are highly variable and range from 0 to 60 percent.

Figure 1. General distribution of the Choppy Sandhills ecological site by map unit extent.

Figure 2. Diagram of physiographic features.

Table 2. Representative physiographic features

Landforms	<p>(1) Dune field > Dune</p> <p>(2) Dune field > Interdune</p> <p>(3) Sand plain</p>
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Flooding frequency	None
Ponding frequency	None
Elevation	550 – 1,010 m
Slope	0 – 60 %
Aspect	Aspect is not a significant factor

Climatic features

The Northern Dark Brown Glaciated Plains is a semi-arid region with a temperate continental climate that is characterized by frigid winters and warm to hot summers (Coupland, 1958; Richardson and Hanson, 1977; Heidel et al., 2000). The majority of precipitation occurs as steady, soaking, frontal system rains in late spring to early summer. Summer rainfall comes mainly from convection thunderstorms that typically deliver scattered amounts of rain in intense bursts. These storms may be accompanied by damaging winds and large-diameter hail and result in flash flooding along low-order streams. Approximately 80 percent of the annual precipitation occurs during the growing season. June is the wettest month, followed by July and May (Richardson and Hanson, 1977; Heidel et al., 2000). Average annual precipitation ranges from 11 inches (280 mm) near Richey, Montana, to 15 inches (380 mm) in the Little Muddy drainage near Williston, North Dakota, but precipitation varies greatly from year to year. On average, severe drought and very wet years occur with the same frequency, which is 1 out of 10 years (Coupland, 1958; Heidel et al., 2000). Extreme climatic variations, especially droughts, have the greatest influence on species cover and production (Coupland, 1958, 1961; Biondini et al., 1998). The frost-free period for this ecological site ranges from 90 to 130 days, and the freeze-free period ranges from 115 to 155 days.

Table 3 Representative climatic features

Frost-free period (characteristic range)	90-130 days
Freeze-free period (characteristic range)	120-160 days
Precipitation total (characteristic range)	280-380 mm
Frost-free period (average)	110 days
Freeze-free period (average)	140 days
Precipitation total (average)	330 mm

- (1) BREDETTE [USC00241088], Poplar, MT
- (2) CULBERTSON [USC00242122], Culbertson, MT
- (3) OPHEIM 10 N [USC00246236], Opheim, MT
- (4) OPHEIM 12 SSE [USC00246238], Opheim, MT
- (5) PLENTYWOOD [USC00246586], Plentywood, MT
- (6) SCOBNEY 4 NW [USC00247425], Scobey, MT
- (7) SIDNEY [USC00247560], Sidney, MT
- (8) VIDA 6 NE [USC00248569], Vida, MT
- (9) WILLISTON SLOULIN INTL AP [USW00094014], Williston, ND

Influencing water features

This is an upland ecological site with soils that have a very high sand content, a low water-holding capacity, and high infiltration rates. Water is able to flow freely through the soil profile to lower areas on the landscape, but typically this does not create a water table. Some portions of this site are considered important recharge areas for local aquifers. These aquifers are too deep to directly influence the ecological site, but they are important water sources for irrigation and livestock water. Moisture loss exceeds precipitation for the majority of the growing season, and soil moisture is the primary limiting factor for plant production on this ecological site.

Soil features

The soil series that best represents the central concept of this ecological site is Blanchard. This soil is in the Ustipsamments great group and is characterized by a surface horizon that lacks enough organic matter to have a mollic epipedon and by textures of loamy fine sand or coarser in all layers. It is derived from eolian sand parent material, has mixed mineralogy, and has a sand content of 90 to 100 percent. The soil moisture regime for all soils in this ecological site concept is typic ustic, which means that the soils are moist in some or all parts for either 180 cumulative days or 90 consecutive days during the growing season but are dry in some or all parts for over 90 cumulative days. These soils have a frigid soil temperature regime (Soil Survey Staff, 2014).

Surface horizon textures on this site are typically sand or loamy sand and contain 90 to 100 sand. The underlying horizons typically contain 95 to 100 percent sand and have coarse sand, sand, or fine sand textures. Organic matter content in the surface horizon typically ranges from 0.5 to 1.5 percent, and moist colors vary from dark brown (10YR 3/2) to grayish brown (10YR 5/2). Calcium carbonate equivalent ranges from 0 to 5 percent in the surface horizon and 0 to 15 percent in the underlying horizons. Soil pH classes are neutral to slightly alkaline in the surface horizon and neutral to strongly alkaline in the subsurface horizons. The soil depth class for this site is typically deep or very deep (more than 40 inches to bedrock). Content of coarse fragments in the upper 20 inches of soil is less than 35 percent and typically less than 5 percent.

Table 4. Representative soil features

Parent material	(1) Eolian sands
Surface texture	(1) Sand (2) Loamy sand
Family particle size	(1) Sandy
Drainage class	Excessively drained
Soil depth	100 – 180 cm
Available water capacity (0-101.6cm)	7.11 – 10.16 cm
Calcium carbonate equivalent (0-12.7cm)	0 – 10 %
Electrical conductivity (0-50.8cm)	Not specified

Sodium adsorption ratio (0-50.8cm)	0 – 10
Soil reaction (1:1 water) (0-101.6cm)	6.6 – 10
Subsurface fragment volume <=3" (0-50.8cm)	0 – 30 %
Subsurface fragment volume >3" (0-50.8cm)	0 – 30 %

Ecological dynamics

The information in this ecological site description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The Choppy Sandhills provisional ecological site in MLRA 53A consists of four states: the Historic Reference state (1), the Current Potential state (2), the Destabilized state (3), and the Invaded state (4). This ecological site occurs in an eolian, sand dune ecosystem and thus is influenced heavily by dune evolution and dune morphology. Dunes in the Great Plains typically have a parabolic morphology; the dunes are crescent shaped with a steep face (known as the slip face) on the downwind side, a deflation depression on the upwind side, and two wings extending upwind on either end. Because dune evolution is largely driven by climatic factors, this ecological site is inherently sensitive to small shifts in climate (Muhs and Wolfe, 1999; Wolfe and Lemmen, 1999). Drought reduces vegetative cover and can result in localized blowouts, particularly on windward slopes. Severe drought may trigger widespread dune activity at a local or even regional scale, whereas moister climatic cycles result in revegetation and stabilization of dunes (Wolfe et al., 2001). Evidence suggests that periods of widespread dune activity occurred in the 1800s, whereas much of the area has been restabilizing in the 20th century, likely due to climatic variations (Wolfe et al., 2001).

Plant communities are diverse and typically vary depending on dune morphology and the degree of site stability (Heidel et al., 2000; Coenen and Bentz, 2003). Areas of active blowouts will be colonized by pioneering species such as Indian ricegrass, prairie sandreed (*Calamovilfa longifolia*), and lemon scurfpea. When these areas begin to stabilize, bunchgrasses such as sand bluestem (*Andropogon hallii*) and needle and thread (*Hesperostipa comata*) will begin to colonize the site. Shrubs will establish on the most stable sites, but species will depend on the position on the dune and available soil moisture.

The historic ecosystem experienced periodic lightning-caused fires, with estimated fire return intervals of 6 to 25 years (Bragg, 1995). Historically, Native Americans also set periodic fires. The majority of lightning-caused fires occurred in July and August, whereas Native Americans typically set fires during spring and fall to correspond with the movement of bison (Higgins, 1986). The precise effects of fire on this ecological site are not well known. Plant communities associated this ecological site are generally resilient to fire, but it is largely unknown how fire affects the stability of the site. Further study is need to assess the role of fire on this ecological site.

Native grazers also shaped these plant communities. American bison (*Bison bison*) were the dominant historic grazer, but pronghorn (*Antilocapra americana*), elk (*Cervus canadensis*), and deer (*Odocoileus* spp.) were also common. Grasshoppers and periodic outbreaks of Rocky Mountain locusts (*Melanoplus spretus*) also played an important role in the ecology of these communities (Lockwood, 2004). In general, this ecological site was resilient to light grazing, but localized areas may have experienced destabilization due to heavy grazing.

Following European settlement, fire was largely eliminated, domestic livestock replaced native ungulates as the primary grazers, and non-native species were introduced to the ecosystem. Aside from drought, livestock grazing and mechanized disturbances, such as vehicle traffic, are now the principle disturbances on the landscape.

Improper grazing of this site can result in a reduction in vegetation cover and increased wind erosion in localized areas. Improper grazing practices include any practices that do not allow sufficient opportunity for plants to physiologically recover from a grazing event or multiple grazing events within a given year and/or that do not provide adequate cover to prevent soil erosion over time. These practices may

include, but are not limited to, overstocking, continuous grazing, and/or inadequate seasonal rotation moves over multiple years. Mechanical disturbances, such as heavy vehicle traffic or excavations, may also cause localized blowouts. Further degradation of the site due to improper grazing can result in a destabilized state, where stable vegetation is unable to persist and active soil movement becomes widespread.

Most, if not all, extant examples of this site have some degree of invasion by non-native species. Non-native grasses such as crested wheatgrass (*Agropyron cristatum*) are the most common invasive species. Seeding introduced grasses, particularly crested wheatgrass, was a common practice in eroded and abandoned agricultural areas after the droughts of the 1930s. Crested wheatgrass can invade relatively undisturbed grasslands, reducing cover and production of native cool-season midgrasses (Heidinga and Wilson, 2002; Henderson and Naeth, 2005). In most cases native ecological function is relatively intact, but in some cases non-native grasses will displace native species and dominate the ecological functions of the site.

Due to the undulating topography, a very low water-holding capacity, and the extreme sensitivity to disturbance, this ecological site is generally not suitable for cropland. In general, this site has not been converted to cropland and has remained in native vegetation.

The state-and-transition model (STM) suggests possible pathways that plant communities on this site may follow as a result of a given set of ecological processes and management. The site may also support states not displayed in the STM diagram. Landowners and land managers should seek guidance from local professionals before prescribing a particular management or treatment scenario. Plant community responses vary across this MLRA due to variability in weather, soils, and aspect. The reference community phase may not necessarily be the management goal. The lists of plant species and species composition values are provisional and are not intended to cover the full range of conditions, species, and responses for the site. Species composition by dry weight is provided when available and is considered provisional based on the sources identified in the narratives associated with each community phase.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 7. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 8. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 10. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 11. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 12. Community 2.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 13. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 14. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 15. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Inventory data references

Data for this provisional ecological site was obtained from three low-intensity plots. These plots were used in conjunction with a review of the scientific literature and professional experience to approximate the plant communities for the Contemporary Reference State (2). Information for remaining states was obtained from professional experience and a review of the scientific literature. All community phases are considered provisional based on these plots and the sources identified in this ecological site description.

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Contributors

Scott Brady
Stuart Veith

Approval

Kirt Walstad, 4/21/2025

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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)	
Contact for lead author	
Date	04/21/2025
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. Number and extent of rills:

2. Presence of water flow patterns:

3. Number and height of erosional pedestals or terracettes:

4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):

5. Number of gullies and erosion associated with gullies:

6. Extent of wind scoured, blowouts and/or depositional areas:

7. Amount of litter movement (describe size and distance expected to travel):

8. Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):

9. Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):

10. Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:

11. Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):

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:

Sub-dominant:

Other:

Additional:

13. Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):

14. Average percent litter cover (%) and depth (in):

15. Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):

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:

17. Perennial plant reproductive capability:
