Ecological site FX053A99X071
Recharge Closed Depression (CdR)

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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-Agropyron, Stipa-Bouteloua-Agropyron, and Stipa-Bouteloua faciations (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) • Subclass: Shrub and Herb Wetland Subclass (2.C) • Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4) • Division: Eastern North American Temperate & Boreal Freshwater Marsh, Wet Meadow and Shrubland (2.C.4.Nd) • Macrogroup: Great Plains Marsh, Wet Meadow, Shrubland & Playa (2.C.4.Nd.5) • Group: Great Plains Wet Prairie, Wet Meadow & Seepage Fen (2.C.4.Nd.5.b) 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) USFWS (Cowardin et al., 1979) • Palustrine Emergent Temporarily Flooded and Palustrine Emergent Seasonally Flooded Classification of natural ponds and lakes in the Glaciated Prairie Region (Stewart and Kantrud, 1971) • Ephemeral Pond, Temporary Pond, and Seasonal Pond

Ecological site concept

Recharge Closed Depression is a somewhat extensive ecological site occurring in depressions on till plains and moraines. The distinguishing characteristics of this ecological site are that it is located in closed depression landforms, receives surface water runoff from adjacent uplands, and contains hydric soils. The ponding duration is typically temporary or seasonal, however, it is highly variable depending on catchment size and annual precipitation. Soils for this ecological site are typically very deep (more than 60 inches), poorly drained, derived from alluvium, and are typically non-saline. Characteristic vegetation is western wheatgrass (Pascopyrum smithii), fowl bluegrass (Poa palustris), and needle spikerush (Eleocharis acicularis).

Associated sites

FX053A99X062	**Swale (Se)** The Swale ecological site is in upland coulees and swales. It is typically upslope from the Recharge Closed Depression ecological site on till plains and moraines. It contributes surface water to the Recharge Closed Depression ecological site.
FX053A99X032	**Loamy (Lo)** The Loamy ecological site is in uplands surrounding the Recharge Closed Depression ecological site on till plains and moraines. It contributes surface water to the Recharge Closed Depression ecological site.
FX053A99X040	**Loamy Steep (LoStp)** The Loamy Steep ecological site is on slopes greater than 15 percent surrounding the Recharge Closed Depression ecological site on till plains and moraines. It contributes surface water to the Recharge Closed Depression ecological site.
FX053A99X705	**Discharge Closed Depression (CdD)** The Discharge Closed Depression ecological site is on landforms similar to those of the Recharge Closed Depression ecological site. It typically is in lower topographic positions and receives ground-water discharge from the Recharge Closed Depression ecological site.

Similar sites

FX053A99X084	**Slough (Sl)** The Slough ecological site is on flood plains, commonly in oxbows or channels where flooding is very frequent and a water table is shallow and persistant. Its hydroperiod is typically much longer than that of the Recharge Closed Depression ecological site. This site typically contains deep marsh vegetation.
FX053A99X060	**Overflow (Ov)** The Overflow ecological site occurs on flood plains, commonly on higher terraces that receive additional moisture from runoff and stream overflow. Vegetation is dominated by facultative upland species.
FX053A99X705	**Discharge Closed Depression (CdD)** The Discharge Closed Depression ecological site differs from the Recharge Closed Depression ecological site in that it receives a significant amount of moisture from ground-water discharge as well as surface runoff. Water and soils are typically more saline, and salt-tolerant vegetation is common.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Eleocharis acicularis*

Legacy ID

R053AY711MT

Physiographic features

The Recharge Closed Depression ecological site occurs in closed depressions on till plains. It is typically found on disintegration moraines but may also occur on ground moraines.

Table 2. Representative physiographic features

Geomorphic position, flats	(1) Dip
Landforms	(1) Till plain > Disintegration moraine > Closed depression (2) Till plain > Ground moraine > Closed depression
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	550 – 1,010 m
Slope	0 %
Ponding depth	0 – 30 cm
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) SCOBEY 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 a depressional wetland site that receives additional moisture via surface runoff. Hydrology is most similar to a recharge depressional hydrogeomorphic (HGM) model, although water rarely reaches a ground-water table because evapotranspiration greatly exceeds precipitation. Runoff from surrounding uplands enters the site and is unable to infiltrate rapidly due to the high clay content of the soils. Water ponds on the surface for a brief time, then is lost by evapotranspiration. The ponding duration is typically 4 weeks or less, but some areas may pond water for 3 to 4 months. In the latter case, there may be some subsurface flow of water into lower landscape positions or ground water. Ponding depth is typically 1 foot or less.

Wetland description

Palustrine Emergent Temporarily Flooded and Palustrine Emergent Seasonally Flooded

Soil features

Soils for this ecological site are typically very deep (more than 60 inches to bedrock), poorly drained, and derived from clayey alluvium. They are episaturated, meaning that they receive additional moisture from surface water, and have hydric features. Ponding frequency varies from occasional to frequent and duration varies from brief to long depending on catchment size and annual precipitation. They have an aquic moisture regime, which means that the soils are saturated within 40 inches (100 cm) of the mineral soil surface for some time during the year, and a frigid soil temperature regime (Soil Survey Staff, 2014).

Soil textures in the surface horizon on this site are typically loam, silt loam, clay loam, or clay; the underlying horizons are typically clay. Hydric features such as redox or gleying may be present in any horizon. In the upper 20 inches, electrical conductivity is less than 4 and the sodium absorption ratio is less than 13. Calcium carbonate equivalent is typically less than 5 percent in the upper 5 inches of soil. Soil pH classes are slightly acid to neutral in the surface horizon and neutral to strongly alkaline in the subsurface horizons. Typically, the upper 20 inches of soil does not contain coarse fragments.

Table 4. Representative soil features

Parent material	(1) Alluvium – igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Silt loam (3) Clay loam (4) Clay
Drainage class	Poorly drained
Soil depth	150 – 180 cm
Calcium carbonate equivalent (0-12.7cm)	0 – 10 %
Electrical conductivity (0-50.8cm)	Not specified
Sodium adsorption ratio (0-50.8cm)	0 – 10

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 Recharge Closed Depression provisional ecological site in MLRA 53A consists of six vegetative states: The Historic Reference state (1), the Current Potential state (2), the Invaded state (3), the Undrained Cropland state (4), the Impounded state (5) and the Drained Cropland state (6). Plant communities associated with the Recharge Closed Depression ecological site evolved under the combined influences of climate, grazing, hydrology, and fire. Extreme climatic variability results in frequent droughts, which can have great influence on the relative contribution of species cover and production (Coupland, 1958, 1961; Biondini et al., 1998).

Hydrology is a crucial dynamic on this site. The site receives water surface runoff primarily from spring snowmelt and from high intensity thunderstorms. The duration of ponding, or hydroperiod, dramatically influences the vegetation of the site. The hydroperiod varies depending by the catchment size and by annual precipitation patterns. The majority of sites in MLRA 53A contain water for only a few weeks in the spring. Larger catchment basins, above average precipitation cycles, or a combination of these factors may increase the hydroperiod to several months. Plant communities vary depending on the hydroperiod.

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 the historic fire return interval are not definitive, but in general the mixedgrass ecosystem was resilient to fire. Potential effects are generally temporary and may include reduction of litter, fluctuations in production, and changes in species composition (Vermeire et al., 2011, 2014).

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. Additionally, small mammals such as

prairie dogs (Cynomys spp.) and ground squirrels (Urocitellus spp.) influenced this plant community (Salo et al., 2004). Grasshoppers and periodic outbreaks of Rocky Mountain locusts (Melanoplus spretus) also played an important role in the ecology of these communities (Lockwood, 2004). The mixedgrass ecosystem was resilient to grazing, although localized areas could experience shifts in species composition 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 is now the principle disturbance on the landscape.

Plant communities on the Recharge Closed Depression ecological site are very complex. Much of the dynamics of this site are still under investigation and are not fully understood. Frequently, sites contain multiple plant community zones that correspond to the hydroperiod for that portion of the site. In the ephemeral communities (1.1, 2.1) the hydroperiod is only 7 to 10 days early in the spring and the site supports facultative upland species. The wheatgrass/forb plant community is the typically the only one present. Periods of above average precipitation or depressions with a moderate catchment size will transition to the temporarily ponded communities (1.2, 2.2). In this phase the hydroperiod increases to 1.5 to 4 weeks and the site begins to support more hydrophytic vegetation. There are typically two distinct vegetation zones with a wheatgrass-spikerush plant community occupying the center of the depression. The rim of the depression transitions to wheatgrass/forb plant community. The seasonally ponded communities (1.3, 2.3) occur primarily in depressions that have large catchment basins, although they can occur in moderate-sized catchment basins during periods of above average precipitation. The hydroperiod for these communities is much longer, typically 1 to 4 months, and is sufficient for a significant amount of hydrophytic vegetation to establish. The center of the depression frequently supports a spikerush-sedge plant community, this is surrounded by a wheatgrass-spikerush plant community, and a rim of wheatgrass and forbs. All plant communities are often dynamic and diversity varies from site to site. Further study is needed to fully describe all major species and plant community dynamics.

Disturbances to the Recharge Closed Depression ecological site can have significant effects on hydrology and vegetation. Disturbances that directly affect the site include, but are not limited to, excavation, draining, impoundment, conversion to cropland, and grazing. The effects of improper grazing of this site have not been documented in detail, but improper grazing is known to cause a reduction in palatable forage species and an increase in unpalatable species such as white sagebrush (Artemisia ludoviciana) and mountain rush (Juncus arcticus ssp. littoralis), also known as Baltic rush. 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 may not be providing adequate cover to prevent soil erosion over time. This may include, but is not limited to, overstocking, continuous grazing, and/or inadequate seasonal rotation moves over multiple years.

The most common disturbance on this site is most likely conversion to cropland. Smaller depressions, particularly those with ephemeral hydroperiods, are frequently farmed through with no further alteration. Seasonally ponded depressions are typically too wet to farm without artificial drainage. Typically, water is drained by ditching, then the site is converted to cropland. In these cases, the natural hydrology is severely altered and the site is unlikely to return to reference conditions without significant restoration. Another common alteration of hydrology is impoundment of water for livestock or wildlife. Impoundment increases the hydroperiod and effectively converts the site from a temporarily or seasonally ponded wetland to a semi-permanent wetland.

Most, if not all, extant examples of this site have some degree of invasion by non-native species. Non-native perennial grasses, such as Kentucky bluegrass (Poa pratensis) and smooth brome (Bromus inermis), are widespread throughout the Great Plains (Toledo et al., 2014) and sites that are ephemeral or temporarily ponded are particularly prone to invasion. Wetter, seasonally ponded sites appear to have fewer non-native species but may still be affected by more ponding-tolerant species, such as reed canarygrass (Phalaris arundinacea) and creeping meadow foxtail (Alopecurus arundinaceus). Noxious weeds such as Canada thistle (Cirsium arvense) and leafy spurge (Euphorbia esula L.) have also been documented on this site.

The state-and-transition model (STM) diagram and legend 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 vegetative 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 (%)

Table 6. Community 1.2 plant community composition

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

Table 7. Community 1.3 plant community composition

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

Table 8. Community 2.1 plant community composition

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

Table 9. Community 2.2 plant community composition

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

Table 10. Community 2.3 plant community composition

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

Table 11. Community 3.1 plant community composition

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

Table 12. Community 4.1 plant community composition

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

Table 13. Community 4.2 plant community composition

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

Table 14. Community 5.1 plant community composition

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

Table 15. Community 6.1 plant community composition

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

Inventory data references

No field plots were available for this site, but three similar sites from MLRA 53B were available as proxy references. These plots, in conjunction with a review of the scientific literature and professional experience, were used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on these plots and the sources identified in this ecological site description.

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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	04/23/2025
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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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):**

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

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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:**

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17. **Perennial plant reproductive capability:**
