Ecological site GX060B00X165
Thin Claypan 10-14

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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): 060B–Pierre Shale Plains, Northern Part

MLRA 060B, Pierre Shale Plains (Northern Part), is almost entirely in Montana (94 percent) and Wyoming (6 percent). The area makes up about 2,160,000 acres and occurs in the uplands between most of the major rivers in southeastern Montana and northeastern Wyoming. The area is within the Missouri Plateau, Unglaciated, Section of the Great Plains Province of the Interior Plains. It is an area of old plateaus and terraces that have been deeply eroded. The shale plains have long, smooth, gentle to strong slopes. Slopes along drainageways and streams are moderately steep or steep. Elevation ranges from 1,900 to 3,500 feet on uplands. Marine and continental sediments of the Cretaceous Montana Group underlie most of this MLRA. The average annual precipitation in the area is 14 inches and ranges from 11 to 17 inches. Most of the annual precipitation occurs as high-intensity, convective thunderstorms during the growing season. Precipitation in winter occurs mainly as snow, which usually is accompanied by high winds that cause much drifting. The average annual temperature is 43 to 46 degrees Fahrenheit. The freeze-free period averages 142 days and ranges from 130 to 160 days. The frost-free period averages 120 days and ranges from 110 to 135 days. The dominant soil orders in this MLRA are Alfisols, Entisols, and Vertisols. The soils in the area dominantly have a frigid soil temperature regime, an ustic soil moisture regime, and smectitic mineralogy. The soils are shallow to very deep, generally well drained, and clayey. The area supports native prairie vegetation characterized by a diversity of cool-season and warm-season grasses, sedges, forbs, and shrubs. A majority of this area is in farms or ranches and comprised of rangeland used for livestock grazing. Some small areas of nearly level to moderately sloping soils are used for winter wheat or for livestock feed crops.

Classification relationships

NRCS Soil Geography Hierarchy • Land Resource Region: Western Great Plains • Major Land Resource Area (MLRA): 060B Pierre Shale Plains, Northern Part 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: North Central Highlands (331K) and Missouri Plateau Section (331M) National Vegetation Classification Standard (Federal Geographic Data Committee, 2008) • Class: Xeromorphic Woodland, Scrub and Herb Vegetation Class (3) • Subclass: Cool Semi-Desert Scrub and Grassland Subclass (3.B) • Formation: Cool Semi-Desert Scrub and Grassland Formation (3.B.1) • Division: Cool Semi-Desert Scrub and Grassland Division (3.B.1.Ne) • Macrogroup: Artemisia tridentata - Artemisia tripartita ssp. tripartita - Purshia tridentata Steppe and Shrubland Macrogroup (3.B.1.Ne.3) • Group: Artemisia tridentata ssp. wyomingensis - Artemisia tridentata ssp. tridentata Steppe & Shrubland Group (3.B.1.Ne.3.a) EPA Ecoregions • Level 1: Great Plains (9) • Level 2: West-Central Semi-Arid Prairies (9.3) • Level 3: Northwestern Great Plains (9.3.3) • Level 4: Sagebrush Steppe (43e)

Ecological site concept

This ecological site occurs on nearly level to gently sloping uplands, terraces, and fans at elevations ranging from 1,900 to 3,500 feet. Slopes range from 0 to 15 percent but are generally less than 8 percent. This site occurs on all aspects, although aspect is not a significant factor. The distinguishing characteristic of this site is the presence of a dense, sodium-affected (natric) horizon between depths of 1 to 4 inches from the soil surface. The natric horizon exhibits columnar structure, is very hard and severely limits both root penetration and infiltration. Soil surface horizons (0 to 4 inches) are typically loam, clay loam, or silty clay loam.

Associated sites

GX060B00X001	**Clayey 10-14** The Clayey ecological site occurs on similar slopes and similar landform positions, but the Clayey ecological site has soils with greater than 35 percent clay content. The Clayey ecological site has significantly higher total annual production than the Thin Claypan ecological site.
GX060B00X006	**Claypan 10-14** The Claypan ecological site occurs on similar slopes and landform positions as the Thin Claypan ecological site. The Claypan ecological site has the presence of a dense, sodium-affected (natric) horizon between depths of 4 to 8 inches from the soil surface. The Thin Claypan ecological site has the presence of a natric horizon between depths of 1 to 4 inches from the soil surface.
GX060B00X131	**Shallow Clay 10-14** The Shallow Clay ecological site occurs on slopes ranging from 0 to 70 percent, has a soil depth of 10 to 20 inches to shale, and has higher total annual production. The Shallow Clay ecological site is positioned above the Thin Claypan ecological site.
GX060B00X032	**Loamy 10-14** The Loamy ecological site occurs on similar slopes, similar landform positions, and may have similar soil surface textures as the Thin Claypan ecological site, but the Loamy ecological site does not have the presence of a natric horizon between depths of 1 to 4 inches from the soil surface. The Loamy ecological site has significantly higher total annual production than the Thin Claypan ecological site.

Similar sites

GX060B00X005	**Clayey Steep 10-14** The Clayey Steep ecological site has similar soil depths as the Thin Claypan ecological site, but occurs on slopes ranging from 15 to 45 percent and has higher total annual production. The Clayey Steep ecological site is positioned above the Thin Claypan ecological site.
GX060B00X006	**Claypan 10-14** The Claypan ecological site occurs on similar slopes and landform positions as the Thin Claypan ecological site. The Claypan ecological site has the presence of a dense, sodium-affected (natric) horizon between depths of 4 to 8 inches from the soil surface. The Thin Claypan ecological site has the presence of a natric horizon between depths of 1 to 4 inches from the soil surface.
GX060B00X131	**Shallow Clay 10-14** The Shallow Clay ecological site occurs on slopes ranging from 0 to 70 percent, has a soil depth of 10 to 20 inches to shale, and has higher total annual production. The Shallow Clay ecological site is positioned above the Thin Claypan ecological site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. wyomingensis*

Herbaceous	(1) *Pascopyrum smithii*

Legacy ID

R060BE165MT

Physiographic features

This ecological site occurs on nearly level to gently sloping uplands, terraces, and fans at elevations ranging from 1,900 to 3,500 feet. Slopes range from 0 to 15 percent but are generally less than 8 percent. This site occurs on all aspects, although aspect is not a significant factor.

Table 2. Representative physiographic features

Landforms	(1) Upland slope (2) Terrace (3) Fan
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	580 – 1,070 m
Slope	0 – 20 %
Water table depth	150 – 180 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 060B is a semi-arid region and is considered to have a continental climate characterized by cold winters, hot summers, low humidity, light rainfall, and much sunshine. The climate is the result of the MLRA's location in the geographic center of North America. Temperatures can be extreme.

The average annual temperature is 43 to 46 degrees Fahrenheit. Summer daytime temperatures are typically quite warm, generally averaging in the lower to mid-80's for July and August. Summertime temperatures will typically reach 100 degrees or more at some point during the summer and can reach 90 degrees during any month between May and September. Conversely, winter temperatures can be cold, averaging in the mid-teens to mid-20's for December and January. There will typically be several days of below zero temperatures each winter. It is not uncommon for temperatures to reach 30 to 40 degrees below zero, or even colder, most any winter.

The average annual precipitation in this area is 14 inches, and ranges from 10 to 17 inches. During an average year, 70 to 75 percent of the annual precipitation falls between April and September, which are the primary growing season months. A majority of the annual precipitation occurs as frontal storms early in the growing season during the months of May and June and high-intensity, convective thunderstorms during July and August. Some rainfall occurs during the fall.

Seasonal precipitation is often limiting for plant growth. Annual fluctuations in species composition and total production are typical depending on the amount and timing of rainfall. Precipitation during the winter occurs primarily as snow, although snowfall is generally not heavy. Snow cover is typically 1 to 3 inches. Heavy snowfall occurs infrequently, usually late in the winter or early spring. Snowfall is generally accompanied by high winds that causes drifting.

The prevailing wind direction is from the northwest. Precipitation fluctuates widely from year to year and severe drought occurs 2 out of 10 years on average. There are few natural barriers on the northern Great Plains and the winds move freely across the plains and account for rapid changes in temperature. Spring can be windy throughout the MLRA, with winds averaging over 10 mph about 15 percent of the time. Speeds of 50 mph or stronger can occasionally occur.

For local climate station information, refer to https://wrcc.dri.edu/summary/Climsmemt.html.

Table 3 Representative climatic features

Frost-free period (characteristic range)	110-140 days
Freeze-free period (characteristic range)	130-160 days
Precipitation total (characteristic range)	250-360 mm
Frost-free period (actual range)	
Freeze-free period (actual range)	
Precipitation total (actual range)	250-430 mm
Frost-free period (average)	120 days
Freeze-free period (average)	140 days
Precipitation total (average)	360 mm

- (1) INGOMAR 14 NE [USC00244386], Ingomar, MT
- (2) RIDGEWAY 1 S [USC00247034], Hammond, MT
- (3) ALBION 1 N [USC00240088], Alzada, MT
- (4) BAKER MUNI AP [USW00094055], Baker, MT

Influencing water features

This upland ecological site is not influenced by a water table or run in from adjacent sites. Due to the semi-arid climate in which it occurs, the water budget is normally contained within the soil pedon. Soil moisture is recharged by spring rains, but it rarely exceeds field capacity in the upper 40 inches before being depleted by evapotranspiration. During intense precipitation events, precipitation rates frequently exceed infiltration rates and the site delivers moisture to downslope sites through surface runoff. Moisture loss through evapotranspiration exceeds precipitation for a majority of the growing season. Soil moisture is the primary limiting factor for vegetative production on this ecological site.

Wetland description

Not applicable

Soil features

Soils for this ecological site are typically moderately deep to very deep (greater than 20 inches to bedrock), well drained, and derived from alluvium. A root restrictive layer referred to as a natric horizon occurs between 1 and 4 inches below the soil surface. The natric horizon exhibits distinctive columnar structure and is dense, root-limiting, and affected by sodium salts. Surface horizon textures are typically loam but may range anywhere from loam to clay. The underlying horizons typically and have loam, clay loam or clay textures but may range from sandy loam to clay, depending on the parent material. Figure 5 shows a typical soil profile for this ecological site.

Table 4. Representative soil features

Parent material	(1) Alluvium – shale
Surface texture	(1) Loam (2) Clay loam (3) Silty clay loam
Drainage class	Well drained
Permeability class	Very slow
Depth to restrictive layer	0 – 10 cm
Soil depth	150 – 180 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-152.4cm)	5.08 – 5.59 cm
Calcium carbonate equivalent (35.6-152.4cm)	10 – 20 %
Electrical conductivity (55.9-152.4cm)	10 – 20 mmhos/cm
Sodium adsorption ratio (10.2-152.4cm)	10 – 30

Soil reaction (1:1 water) (0-152.4cm)	6.6 – 10
Subsurface fragment volume <=3" (0-152.4cm)	10 – 30 %
Subsurface fragment volume >3" (0-152.4cm)	0 – 20 %

Ecological dynamics

The Reference state is the plant community in which interpretations are primarily based and is used as a reference in order to understand the original potential of the site. The Reference state evolved under the combined influences of climatic conditions, periodic fire activity, grazing by large herbivores, and impacts from small mammals and insects. Changes may occur to the Reference state due to management actions such as improper grazing management, climatic conditions such as drought, and natural events such as multiple fires in close succession. The Reference state is dominated by a diversity of tall and medium height, cool-season and warm-season grasses which are tightly intermixed and well distributed over the site. Various forbs, half-shrubs, and shrubs are common on this site. The Reference state is not necessarily the management goal, as other vegetative states may be considered desired plant communities as long as critical resource concerns are met.

In addition to the Reference state, other plant communities can occur on this site and are usually the result of historic management practices. Long term overgrazing on this ecological site results in a decrease of tallgrasses, mid-grasses, and more palatable forbs and in an increase of shortgrasses, sedges, and less palatable forbs. Half-shrubs and shrubs increase in the absence of prescribed fire and wildfire. More frequent fire intervals decreases the shrub component resulting in a site dominated by herbaceous species. There are various transitional stages which may occur on this ecological site.

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 1.4 plant community composition

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

Table 9. Community 2.1 plant community composition

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

Table 10. Community 2.2 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 5.1 plant community composition

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

Table 14. Community 5.2 plant community composition

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

Inventory data references

Specific field data was not obtained for this provisional ecological site description. Existing field data was used in conjunction with a review of scientific literature and professional experience to approximate the plant communities, states, and transitions. All community phases are considered provisional based on the sources identified in this ecological site description.

Other references

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Approval

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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	08/12/2024
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:**

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

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

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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):**

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

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

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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):**

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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:

    Sub-dominant:

    Other:

    Additional:

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

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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:**
