USDA Natural Resources Conservation Service

Ecological site R057XY007MN
Steep Upland Prairie

Last updated: 10/03/2023
Accessed: 04/27/2024

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): 057X–Northern Minnesota Gray Drift

The Northern Minnesota Gray Drift (57) is located within the Northern Lakes Forest and Forage Region. This area is entirely in north-central Minnesota and makes up about 9,785 square miles (Figure 1). The entire area is covered by Wisconsin-age glacial drift. The glacial deposits are from four major ice lobes-Des Moines, Rainy, Superior, and Wadena. The landscape developed through a series of glaciations and the subsequent retreating and wasting of the ice sheets, which resulted in a complex pattern of moraines, outwash plains, drumlins, lake plains and drainages. Lakes, ponds and marshes are common. The thickness of the glacial till ranges from 90 to 185 meters. Some areas of these deposits are overlain by outwash or lacustrine sediments. Some depressional areas have an accumulation of organic matter. The organic deposits are more than 2.5 meters thick in some areas. Elevation ranges from 300 to 500 meters across the area. (USDA-NRCS 2006)

The dominant soil orders in this MLRA are Alfisols, Entisols, and Histisols, with some Mollisols in the westernmost part of the area. The soils in the area have a frigid soil temperature regime; aquic or udic soil moisture regime, and mixed mineralogy. Their natural drainage class is related to landscape position. In general, the Alfisols formed in till on moraines, Entisols formed in outwash on moraines and outwash plains, and Histosols formed in organic material over outwash or till on moraines or outwash plains. (USDA-NRCS 2006)

Classification relationships

Major Land Resource Area (MLRA): Northern Minnesota Gray Drift (57) (USDA Handbook 296, 2006)

USFS Subregions: Northern Minnesota Drift & Lake Plain Section (212N); Chippewa Plains Subsection (212Na), Pine Moraines & Outwash Plains Subsections (212Nc), St. Louis Moraines Subsection (212Nb); Minnesota & NE Iowa Morainal Section (222M); Hardwood Hills Subsection (222Ma); Northern Superior Uplands Section (212L); Nashwauk Uplands Subsection (212Lc); Northern Minnesota & Ontario Peatlands Section (212M); Littlefork-Vermillion Uplands Subsection (212Ma) (Cleland et al. 2007).

US EPA Level IV Ecoregion: Itasca and St. Louis Moraines (50q); Chippewa Plains (50r); Nashwauk/Marcell Moraines and Uplands (50s); Alexandria Moraines and Detroit Lakes Outwash Plain (51j); McGrath Till Plain and Drumlins (51k); Wadena/Todd Drumlins and Osakis Till Plain (51l)(U.S. Environmental Protection Agency, 2013)

Ecological site concept

Steep Upland Prairie sites are limited in extent in the southern region of MLRA 57, and typically occur on moraines and with slope gradients greater than 12 percent. Soils textures can vary from medium to fine textured and are mollisols with dark organic-enriched upper horizons. Plant communities are graminoid dominated.

Associated sites

R057XY010MN	**Loamy Prairie** These sites occur on summit, shoulder and upper backslope hillslope positions on moraines and outwash plains. These sites typically exist on soils with loamy and clayey textures of loam, silt loam, silty clay loam, clay loam, sandy clay loam, very fine sandy loam, clay, silty clay and silty clay loam within a depth of 50 centimeters.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Bouteloua curtipendula*

Physiographic features

Steep Upland Prairie sites are limited in extent in the southern region of MLRA 57, and typically occur on moraines and with slope gradients greater than 12 percent.

Table 2. Representative physiographic features

Hillslope profile	(1) Backslope (2) Shoulder
Landforms	(1) Outwash plain (2) Delta plain
Runoff class	Negligible to very low
Flooding frequency	None
Ponding frequency	None
Elevation	750–1,000 ft
Slope	12–30%
Aspect	Aspect is not a significant factor

Climatic features

In general, MLRA 57 has cold winters and warm summers. About 65 percent of the annual precipitation falls as rain during the 5-month growing season (May through September), and an additional 18 percent falls as snow. The freeze-free period averages 150 days and ranges from 120 to 175 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	102-110 days
Freeze-free period (characteristic range)	128-138 days
Precipitation total (characteristic range)	27-29 in
Frost-free period (actual range)	100-112 days
Freeze-free period (actual range)	126-140 days
Precipitation total (actual range)	26-30 in
Frost-free period (average)	106 days
Freeze-free period (average)	133 days
Precipitation total (average)	28 in

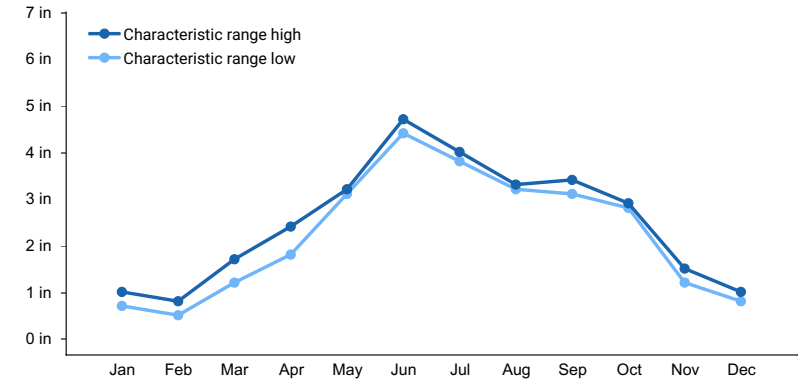


Figure 1. Monthly precipitation range

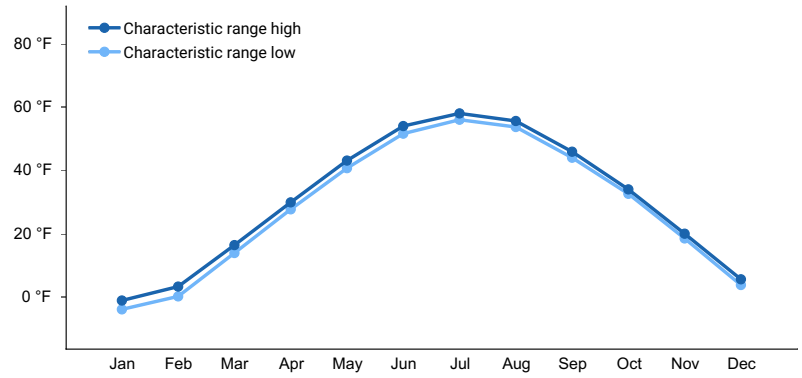


Figure 2. Monthly minimum temperature range

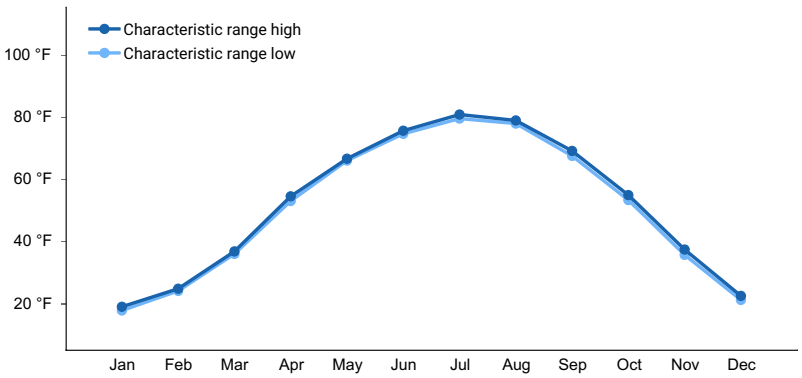


Figure 3. Monthly maximum temperature range

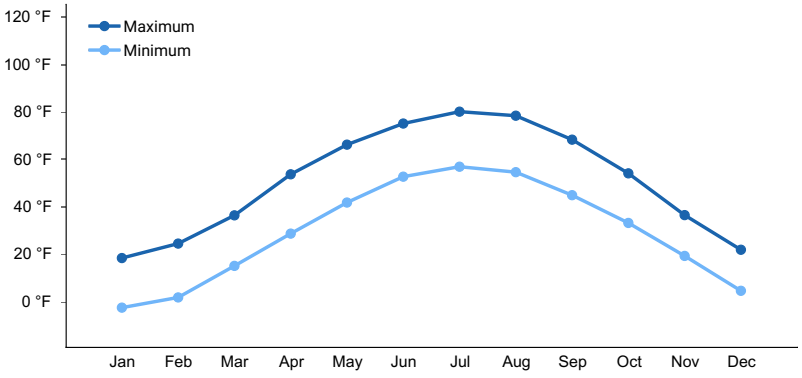


Figure 4. Monthly average minimum and maximum temperature

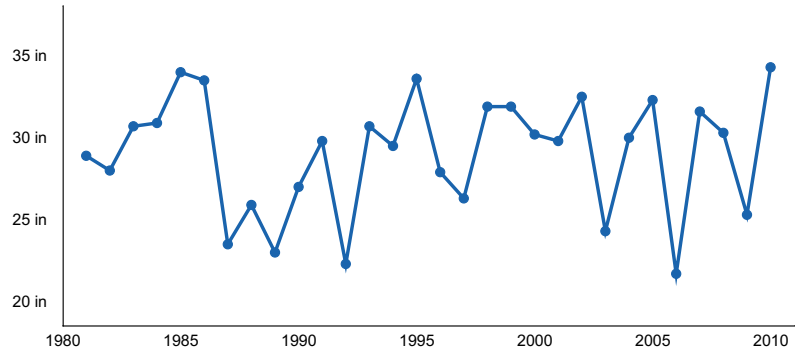


Figure 5. Annual precipitation pattern

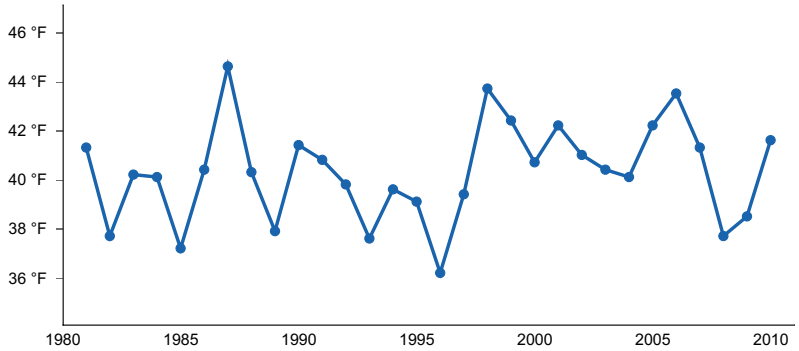


Figure 6. Annual average temperature pattern

Climate stations used

- (1) LONG PRAIRIE [USC00214861], Long Prairie, MN
- (2) ITASCA UNIV OF MINN [USC00214106], Park Rapids, MN
- (3) NEW YORK MILLS [USC00215902], New York Mills, MN

Influencing water features

Not Applicable.

Wetland description

Not Applicable.

Soil features

This site is represented by the Maddock soil series, although other series could be included as well. Soils textures can vary from medium to fine textured and are mollisols with dark organic-enriched upper horizons. These sites are typically well to somewhat excessively drained soils with depth to gray and or rust colored redoximorphic features or depth to seasonal high water-table ranges from 75 to more than 150 centimeters.

Table 4. Representative soil features

Parent material	(1) Glaciolacustrine deposits
Surface texture	(1) Loam (2) Sandy loam (3) Loamy fine sand
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	72 in

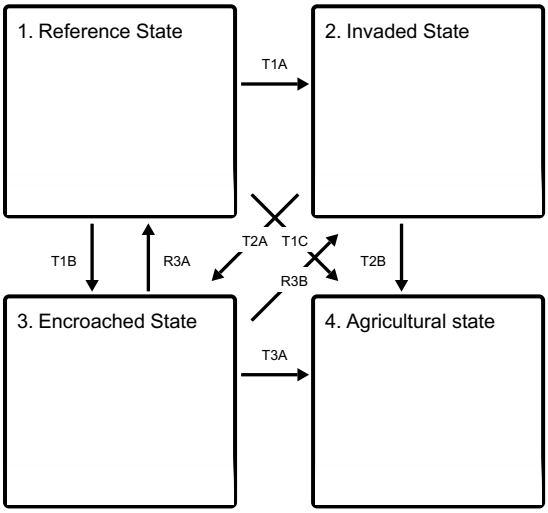
Soil depth	80 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–2%
Available water capacity (0-150in)	0–4 in
Calcium carbonate equivalent (0-100in)	0–5%
Soil reaction (1:1 water) (0-100in)	6.6–8.4
Subsurface fragment volume <=3" (0-40in)	0–5%
Subsurface fragment volume >3" (Depth not specified)	Not specified

Ecological dynamics

Plant communities typical with Steep Upland Prairies tend to be graminiod-dominated herbaceous communities of little bluestem, side-oats grama, plains muhly, and prairie dropseed. The low shrub wolfberry is commonly found along with leadplant, prairie rose and sage wormwood shrubs. Forbs important to this site are heart-leaved alexanders, alumroot, northern bedstraw, white aster-like goldenrod, prairie phlox to mention a few.

State and transition model

Ecosystem states



T1A - Heavy grazing or high levels of ground litter accumulation

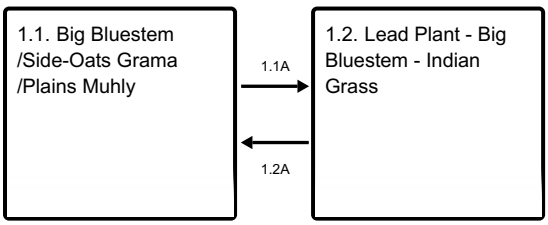
T1B - Lack of fire for more than 5 years.

T1C - Tillage or other agricultural practices.

T2A - Lack of fire for more than 5 years.

T2B - Tillage and farming practices.

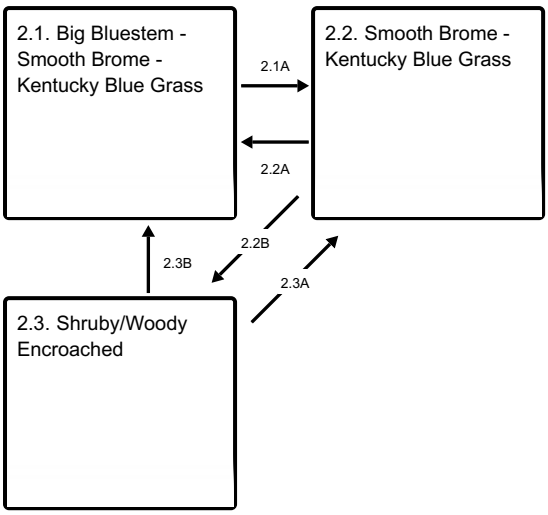
State 1 submodel, plant communities



1.1A - Lack of fire greater than five years, drought, and grazing.

1.2A - Increased fire return interval, less than 5 years.

State 2 submodel, plant communities



2.1A - Lack of disturbance, over grazing, buildup of heavy litter layer.

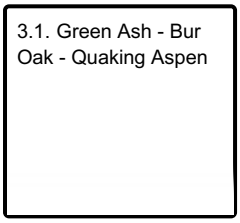
2.2A - Timed grazing and fire

2.2B - Lack of disturbance

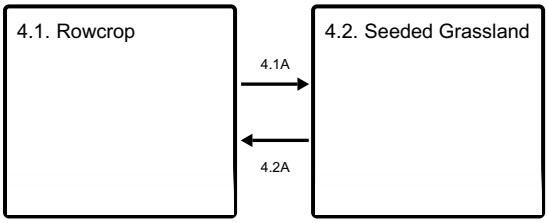
2.3B - Intensive prescribed burning

2.3A - Intensive prescribed burning

State 3 submodel, plant communities



State 4 submodel, plant communities



4.1A - Seeded grass species sowed.

4.2A - Tillage and seasonal row crop planting.

State 1
Reference State

The reference state is considered to be representative of the native range of variability under pre Euro-settlement conditions. Community phase changes in this state are primarily driven by a fire return interval less than 5 years, periodic drought cycles, and light to moderate grazing pressure. This state was co-dominated by warm and cool season grasses.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum*), grass

- porcupinegrass (*Hesperostipa spartea*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- plains muhly (*Muhlenbergia cuspidata*), grass
- leadplant (*Amorpha canescens*), other herbaceous

Community 1.1
Big Bluestem /Side-Oats Grama /Plains Muhly

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum*), grass
- porcupinegrass (*Hesperostipa spartea*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- plains muhly (*Muhlenbergia cuspidata*), grass

Community 1.2
Lead Plant - Big Bluestem - Indian Grass

Dominant plant species

- leadplant (*Amorpha canescens*), grass
- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum*), grass

Pathway 1.1A
Community 1.1 to 1.2

Lack of fire greater than five years, drought, and heavy grazing.

Pathway 1.2A
Community 1.2 to 1.1

Increased fire return interval, less than 5 years; return to more frequent grazing.

State 2
Invaded State

This state is dominated by cool season invasive grasses resulting from heavy grazing and high ground litter accumulation. Some native species are still present.

Dominant plant species

- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- big bluestem (*Andropogon gerardii*), grass

Community 2.1
Big Bluestem - Smooth Brome - Kentucky Blue Grass

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Community 2.2
Smooth Brome - Kentucky Blue Grass

This community phase is dominated by Kentucky bluegrass , smooth brome, or other introduced cool-season grasses. Big bluestem is severely reduced and is suffering in terms of vigor and reproductive capacity.

Community 2.3
Shruby/Woody Encroached

Invasive shrubs and woody species dominate this site after encroaching on prairie communities.

Dominant plant species

- western snowberry (*Symphoricarpos occidentalis*), shrub
- smooth sumac (*Rhus glabra*), shrub

Pathway 2.1A
Community 2.1 to 2.2

Lack of disturbance, over grazing, buildup of heavy litter layer.

Pathway 2.2A
Community 2.2 to 2.1

Timed grazing and fire

Pathway 2.2B
Community 2.2 to 2.3

Lack of disturbance

Pathway 2.3B
Community 2.3 to 2.1

Intensive prescribed burning

Pathway 2.3A
Community 2.3 to 2.2

Intensive prescribed burning

State 3
Encroached State

The encroached state is characterized by increased cover of native woody species due to the absence of wildfire. Ecological processes such as energy distribution, nutrient cycling, and soil moisture recharge are being controlled by trees. Herbaceous species in the understory experience reduced productivity and reproductive capacity due to shading.

Community 3.1
Green Ash - Bur Oak - Quaking Aspen

Dominant plant species

- green ash (*Fraxinus pennsylvanica*), tree
- bur oak (*Quercus macrocarpa*), tree
- quaking aspen (*Populus tremuloides*), tree

State 4
Agricultural state

Indefinite use for agriculture including tillage and crop production.

Community 4.1
Rowcrop

Planted row crops such as corn and soybean.

Community 4.2
Seeded Grassland

This community phase is characterized by the seeding of or reestablishment of long-lived, perennial grasses both native and non-native following previous cultivation or tillage. Functional groups and visual aspect of the vegetation may be similar to the reference state, however ecological function is different. Tillage and cultivation negatively impacts soil structure and organic matter leading to lower rates of infiltration and increased runoff

Pathway 4.1A
Community 4.1 to 4.2

Seeded grass species sowed.

Pathway 4.2A
Community 4.2 to 4.1

Tillage and seasonal row crop planting.

Transition T1A
State 1 to 2

Triggers: the introduction of non-native, cool-season, perennial grasses that can not be removed from the system. Slow variables: prolong periods of heavy grazing pressure reduce vigor and reproductive capacity of native species allowing non-natives to establish. This process can be exacerbated by the absence of wildfire that allows for the accumulation of litter that favors non-native, cool-season, grasses.

Transition T1B
State 1 to 3

Slow variables: Lengthened fire return intervals (greater than 5 years) allow native woody species in encroach and being to dominant the ecological processes. As canopy cover increases herbaceous perennial understory is reduced in both vigor and reproductive capacity. Heavy grazing pressure may exacerbate the impacts of woody species encroachment Thresholds: Nutrient cycling, energy capture and hydrologic function have been spatially and temporally truncated by the dominance of trees.

Transition T1C
State 1 to 4

Triggers: Lands have been cleared and cultivated. These management actions represent a discrete event that truncates energy, nutrient, water cycling dynamics reducing ecological resilience. Thresholds: Once the site is cultivated, soil properties such as structure and organic matter are permanently altered.

Transition T2A
State 2 to 3

Slow variables: Lengthened fire return intervals (greater than 5 years) allow native woody species in encroach and being to dominant the ecological processes. As canopy cover increases herbaceous perennial understory is reduced in both vigor and reproductive capacity. Heavy grazing pressure may exacerbate the impacts of woody species encroachment Thresholds: Nutrient cycling, energy capture and hydrologic function have been spatially and temporally truncated by the dominance of trees.

Transition T2B
State 2 to 4

Triggers: Lands have been cleared and cultivated. These management actions represent a discrete event that truncates energy, nutrient, water cycling dynamics reducing ecological resilience. Thresholds: Once the site is cultivated, soil properties such as structure and organic matter are permanently altered.

Restoration pathway R3A
State 3 to 1

The encroached state will not return to the reference state without significant management actions. To restore this community to reference-like conditions requires the continued use of prescribed burning (fire return interval of ~5years is required to maintain the reference state). Management may also initially require herbicide and mechanical brush control. Additional considerations include deferment from grazing and the health and vigor of remnant native grass species in the understory.

Restoration pathway R3B
State 3 to 2

Triggers: Widespread fire, or multiple fires, severe enough to kill overstory of woody species Slow variables: prolonged heavy grazing, may also be coupled with drought and the introduction of non-native species. Thresholds: hydrologic cycling, nutrient cycling, energy capture are controlled by herbaceous species

Transition T3A
State 3 to 4

Triggers: Lands have been cleared and cultivated. These management actions represent a discrete event that truncates energy, nutrient, water cycling dynamics reducing ecological resilience. Thresholds: Once the site is cultivated, soil properties such as structure and organic matter are permanently altered.

Additional community tables

Inventory data references

Information presented was derived from Minnesota Department of Natural Resources Field Guide to the Native Plant Communities of Minnesota, USDA-NRCS soil survey information, and USDA Plants Database.

Relationship to Other Established Classifications:
MN DNR Native Plant Community (MN DNR, 2003); the reference community of this Provisional Ecological Site is most similar to:
UPs13d Southern Dry Prairie (Dry Hill Prairie-southern)

Other references

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USDA, NRCS. 2018. The PLANTS Database (http://plants.usda.gov, 27 March 2018). National Plant Data Team, Greensboro, NC 27401-4901 USA.

U.S. Environmental Protection Agency. 2013. Level III and IV ecoregions of the continental United States: Corvallis, Oregon, U.S. EPA, National Health and Environmental Effects Research Laboratory, map scale 1:3,000,000, https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states.

Contributors

Ezra Hoffman, Ecological Site Specialist for North Central Region
Kade Anderson, Ecological Site Specialist for North Central Region
Stacey Clark, Former Regional Ecologist for Regions 10 & 11
Patty Burns, Soil Scientist at Bemidji Soil Survey Office

Approval

Suzanne Mayne-Kinney, 10/03/2023

Acknowledgments

MLRA 57 technical team completed in 2022.

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	04/27/2024
Approved by	Suzanne Mayne-Kinney
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):

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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:**
