USDA Natural Resources
Conservation Service

Ecological site F096XA014MI
Snowy Mucky Depression

Last updated: 9/11/2024
Accessed: 05/10/2025

General information

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

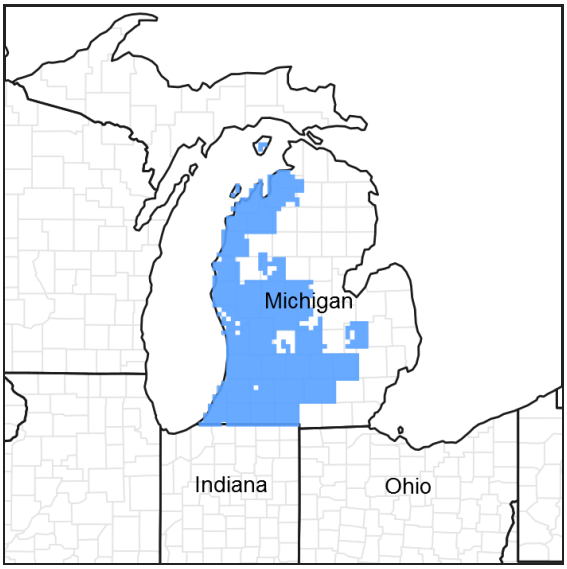


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 096X–Northwestern Michigan Fruit Belt

This area is dominated by outwash plains and moraines. Lake plains, till plains, drumlins, and sand dunes are found locally across the area. The terrain is steep on stream carved moraines, ice contact ridges, and sand dunes, and flat on outwash plains and lake plains. Elevation ranges from 177 to 369 m (580 to 1210 ft). Local topographic relief averages 11 m (35 ft) in the south to 20 m (65 ft) in the north and ranges up to a maximum of 158 m (520 ft) at Empire Bluff (Sleeping Bear Dunes). Much of the area rises sharply from the lakeshore to the adjoining hilltops. The Manistee River is the longest river in this area. Its trout fishery is maintained by constant inflow of cool ground water from the porous sand dominated landscape. The Pine and Pere Marquette Rivers also occur in this MLRA. Surficial topography are formed of glacial deposits except for local areas with dune building near Lake Michigan. Most of the bedrock surface is at or below the elevation of Lake Michigan, and is exposed in only in limited extents near Charlevoix. The bedrock, all Paleozoic in age, is the Traverse Group and the Dundee Limestone. These Silurian-Devonian rocks are mostly limestone and dolomite with some interbedded shale, chert, and anhydrite stringers. The drumlin belts in the northern portion of the area is the most affected by the limestone nearer to the surface in terms of carbonates in the till.

About two-thirds of this area is in small, privately owned holdings, and one-third consists mostly of State forests. The forests are used mainly for timber production and recreation. The growth of orchard crops and other crops and dairy and beef operations are important enterprises in the area. Forage and feed grains for dairy and other livestock

are the principal crops. Asparagus, wheat, oats, corn, and hay are commonly grown in the area. Orchard products include sweet and tart cherries, apples, plums, and peaches. The Manistee National Forest and Sleeping Bear Dunes National Lakeshore are among the more notable conservation lands in the area. Nordhouse Dunes Wilderness Area is within the Manistee National Forest. Sections of the Pere Marquette, Pine, and Manistee Rivers, and Bear Creek have been designated as National Wild and Scenic Rivers.

Summary of existing land use:
Upland Forest (47%)
Hardwood (38%)
Conifer (7%)
Developed (16%)
Swamps and Marshes (12%)
Agricultural (10%)
Open Water (8%)
Grassland (6%)

Classification relationships

According to the USFS (Bailey) system of ecoregions, the site is located mostly within 212Hd (Grand Traverse Ground Moraine) and 212Hf (Grand Traverse Drumlin Fields) subsections. According to the EPA (Omernik) system of ecoregions, the site is located in 51m (Manistee-Leelanau Shore) and 51n (Platte River Outwash) level IV ecoregions. This site is outside the environmental range of the Kotar system. This site corresponds to the Organic Wetland, ecological land type phase, 82, in the USFS Ecological Land Type system.

Ecological site concept

The central concept of Snowy Mucky Depression is lowlands on hydric organic or marl soils with a pH greater than 4.5 (euic histosols). Site is in the heavy annual snowfall belt, mostly north of Manistee River, where fire was rare. Area with a more northern flora than sites further south. Vegetation ranging from rich conifer swamp to fen.

Associated sites

F096XA013MI	**Snowy Wet Floodplain**

Similar sites

F096XB027MI	**Mucky Depression**

Table 1. Dominant plant species

Tree	(1) *Thuja occidentalis* (2) *Fraxinus nigra*
Shrub	Not specified
Herbaceous	(1) *Cystopteris bulbifera* (2) *Caltha palustris*

Physiographic features

Site found in depressions and lower slope positions of various glacial landforms, especially if coarse textured, allowing for groundwater movement.

Table 2. Representative physiographic features

Landforms	(1) Depression
Runoff class	Negligible to low
Elevation	581–1,198 ft

Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

Mean annual temperatures are 7.1 to 8.0 °C (45 to 46 °F). The warmest six months average 15.3 to 16.2 °C (60 to 61 °F). Mean July temperatures range from 19.8 to 20.7 °C (68 to 69 °F). Mean January temperatures range from -6.7 to -4.2 °C (20 to 24 °F). The maximum monthly average daily highs are 24.2 to 27.4 °C (76 to 81 °F). The minimum monthly average daily lows are -10.8 to -7.2 °C (13 to 19 °F). Mean annual precipitation ranges from 780 to 880 mm (31 to 35 in). Prevailing winds pick up moisture from the Great Lakes in the form of lake effect rain and snow showers during fall and winter seasons, and in the form of fog during spring and summer. Thunderstorm intensity is reduced by temperature inversions over the lake during the spring and early summer when lake water is cools the air flowing over it. Average 0 °C (32 °F) frost-free season ranges from 108 to 161 days. Average -2 °C (28 °F) freeze-free season is 141 to 194 days increasing in length from north to south and decreasing in length from the lakeshore inward. Mean annual snowfall ranges from 2.1 to 3.4 m (60 to 130 in). Mean annual extreme minimum temperatures range from -29 to -18.9 °C (-20 to -2 °F), or hardiness zones 4b to 6b.

Table 3. Representative climatic features

Frost-free period (characteristic range)	111-141 days
Freeze-free period (characteristic range)	144-207 days
Precipitation total (characteristic range)	32-35 in
Frost-free period (actual range)	110-148 days
Freeze-free period (actual range)	141-208 days
Precipitation total (actual range)	31-35 in
Frost-free period (average)	129 days
Freeze-free period (average)	174 days
Precipitation total (average)	33 in

Climate stations used

- (1) NORTHPORT 2W [USC00206007], Northport, MI
- (2) TRAVERSE CITY CHERRY CPTL AP [USW00014850], Traverse City, MI
- (3) CHARLEVOIX [USC00201468], Charlevoix, MI
- (4) MAPLE CITY 1E [USC00205097], Cedar, MI
- (5) PETOSKEY [USC00206507], Petoskey, MI
- (6) FRANKFORT 2NE [USC00202984], Frankfort, MI
- (7) NW MICHIGAN RSCH FM [USC00206012], Suttons Bay, MI

Influencing water features

Site has a stable source of minerotrophic groundwater flowing through it at less than 25 cm in depth.

Soil features

Soils are very poorly drained circumneutral mucks to calcareous marl. They are commonly classified Terric Borosaprists, Typic Haplosaprists, and Terric Haplosaprists, and commonly mapped as Adrian, Houghton, and Tawas series or components. The top 50 cm has a typical pH of 6.4 and is 5% sand and 54.1% organic matter. At depth, pH ranges up to 7.1, and texture averages 30% sand and 10% clay. Depth to impeded hydraulic conductivity or root restrictive layers averages >200 cm. Depth to carbonates averages 200 cm.

Table 4. Representative soil features

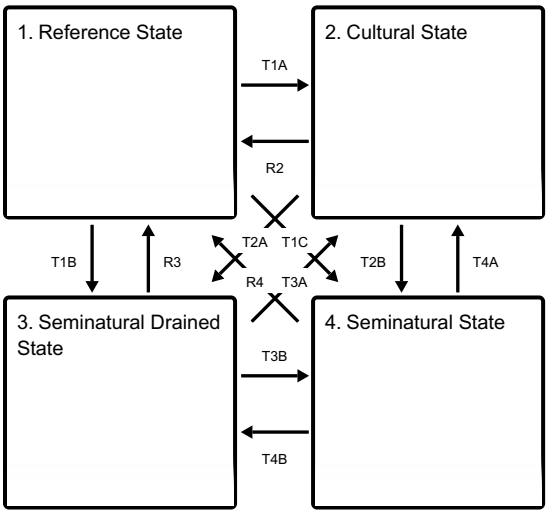
Parent material	(1) Organic material
Surface texture	(1) Muck (2) Marl
Drainage class	Very poorly drained
Permeability class	Moderately slow to moderately rapid
Soil depth	79 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-39.4in)	13.78–21.65 in
Soil reaction (1:1 water) (0-19.7in)	5.5–8
Subsurface fragment volume <=3" (0-59.1in)	0%
Subsurface fragment volume >3" (0-59.1in)	0%

Ecological dynamics

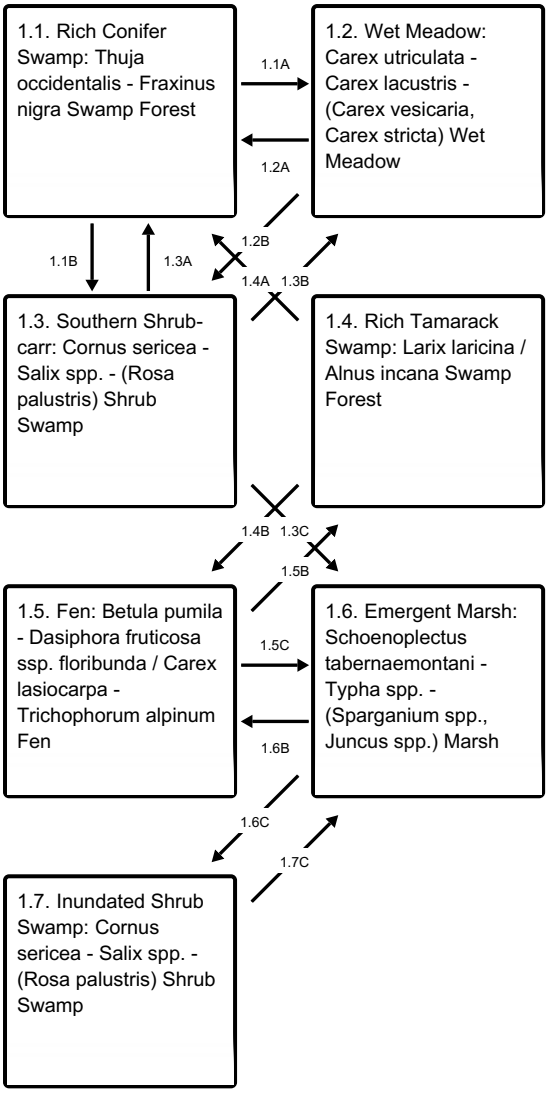
Snowy Mucky Depression tends to share the same ecological dynamics as Natureserve/Landfire system, Laurentian-Acadian Alkaline Conifer-Hardwood Swamp or Laurentian-Acadian Alkaline Fen. Stand replacing fires occurred every 500-2000 years, while light surface fires were very rare. Overstory was dominated by species like whitecedar (*Thuja occidentalis*) and black ash (*Fraxinus nigra*), which thrive in soils saturated with minerotrophic groundwater. The minerotrophic groundwater seeping into the mucks supports an understory of marsh marigold (*Caltha palustris*) and skunk cabbage (*Symplocarpus foetidus*). Sloping mucks may support carpets of bladder fern (*Cystopteris bulbifera*).

State and transition model

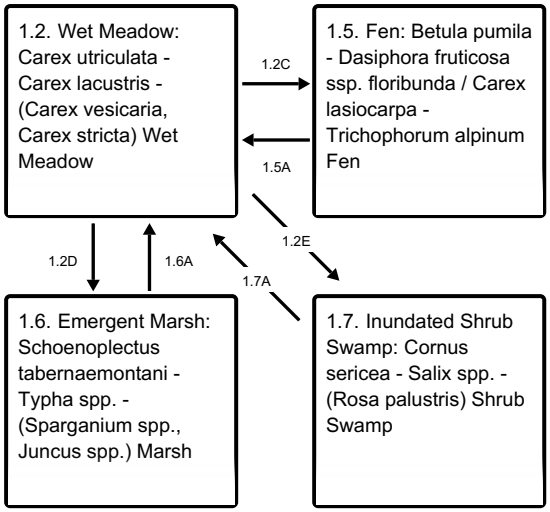
Ecosystem states



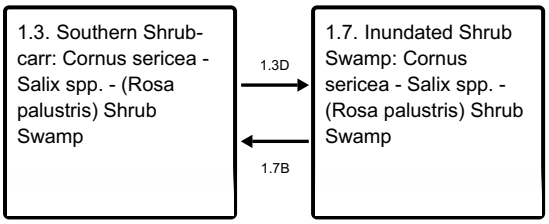
State 1 submodel, plant communities



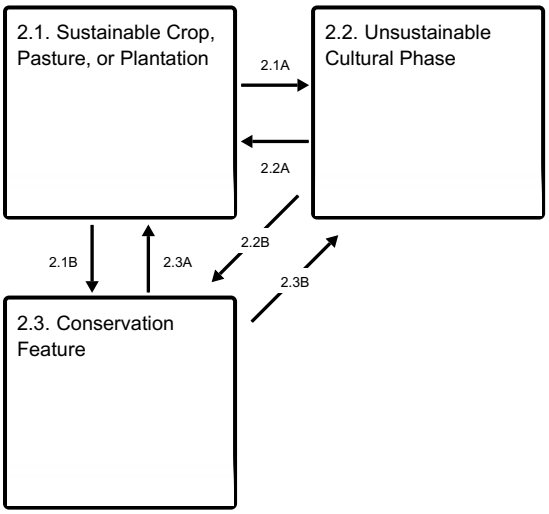
Communities 2, 5, 6 and 7 (additional pathways)



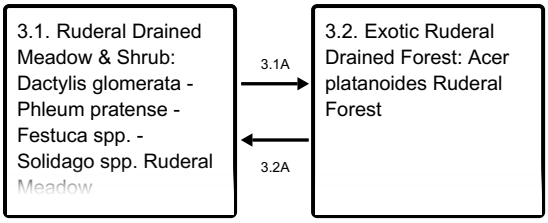
Communities 3 and 7 (additional pathways)



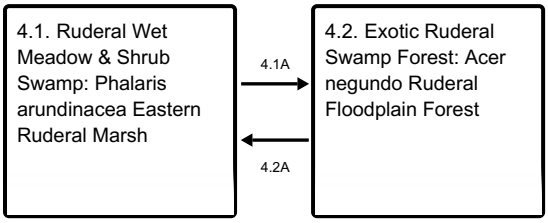
State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities



State 1
Reference State

Dominant plant species

- arborvitae (*Thuja occidentalis*), tree
- black ash (*Fraxinus nigra*), tree
- bulblet bladderfern (*Cystopteris bulbifera*), other herbaceous
- yellow marsh marigold (*Caltha palustris*), other herbaceous

Community 1.1
Rich Conifer Swamp: Thuja occidentalis - Fraxinus nigra Swamp Forest

Community 1.2
Wet Meadow: Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta) Wet Meadow

Community 1.3
Southern Shrub-carr: Cornus sericea - Salix spp. - (Rosa palustris) Shrub Swamp

Community 1.4
Rich Tamarack Swamp: Larix laricina / Alnus incana Swamp Forest

Community 1.5
Fen: Betula pumila - Dasiphora fruticosa ssp. floribunda / Carex lasiocarpa - Trichophorum alpinum Fen

Community 1.6
Emergent Marsh: Schoenoplectus tabernaemontani - Typha spp. - (Sparganium spp., Juncus spp.) Marsh

Community 1.7
Inundated Shrub Swamp: Cornus sericea - Salix spp. - (Rosa palustris) Shrub Swamp

Pathway 1.1A
Community 1.1 to 1.2

Temporary prolonged inundation/Fire.

Conservation practices

Prescribed Burning

Pathway 1.1B
Community 1.1 to 1.3

Clearcut/Blowdown/Fire.

Conservation practices

Prescribed Burning
Early Successional Habitat Development/Management
Forest Stand Improvement

Pathway 1.2A
Community 1.2 to 1.1

Succession.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.2B
Community 1.2 to 1.3

Succession.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.2C
Community 1.2 to 1.5

Increase peat or marl thickness, decrease nitrogen or phosphorus availability.

Pathway 1.2D
Community 1.2 to 1.6

Permanent inundation.

Pathway 1.2E
Community 1.2 to 1.7

Permanent inundation.

Pathway 1.3A
Community 1.3 to 1.1

Succession.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.3B
Community 1.3 to 1.2

Temporary prolonged inundation/Fire.

Conservation practices

Prescribed Burning

Pathway 1.3C
Community 1.3 to 1.6

Permanent inundation.

Pathway 1.3D
Community 1.3 to 1.7

Permanent inundation.

Pathway 1.4A
Community 1.4 to 1.1

Succession.

Pathway 1.4B
Community 1.4 to 1.5

Clearcut/Blowdown/Fire.

Conservation practices

Prescribed Burning
Early Successional Habitat Development/Management
Forest Stand Improvement

Pathway 1.5A
Community 1.5 to 1.2

Decrease peat or marl thickness, increase nitrogen or phosphorus availability.

Pathway 1.5B
Community 1.5 to 1.4

Succession.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.5C

Community 1.5 to 1.6

Permanent inundation.

Pathway 1.6A
Community 1.6 to 1.2

Drop water table.

Pathway 1.6B
Community 1.6 to 1.5

Drop water table.

Pathway 1.6C
Community 1.6 to 1.7

Temporary drop water table; shrub establishment.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.7A
Community 1.7 to 1.2

Drop water table, fire.

Conservation practices

Prescribed Burning

Pathway 1.7B
Community 1.7 to 1.3

Drop water table.

Pathway 1.7C
Community 1.7 to 1.6

Temporary drought and fire; shrub mortality.

Conservation practices

Brush Management
Prescribed Burning

State 2
Cultural State

Community 2.1
Sustainable Crop, Pasture, or Plantation

Community 2.2
Unsustainable Cultural Phase

Community 2.3
Conservation Feature

Can be a grassed waterway, conservation reserve, a small patch pollinator garden, or other land taken out of its primary cultural production to mitigate or reduce impacts of adjacent land use, and is not by itself a permanent restoration of a complete native biological community and associated ecosystem services.

Pathway 2.1A
Community 2.1 to 2.2

Revert to unsustainable cultural practices.

Pathway 2.1B
Community 2.1 to 2.3

Establish conservation feature.

Conservation practices

Conservation Cover
Grassed Waterway

Pathway 2.2A
Community 2.2 to 2.1

Implement sustainable cultural practices.

Conservation practices

Conservation Crop Rotation
Cover Crop
Nutrient Management
Integrated Pest Management (IPM)

Pathway 2.2B
Community 2.2 to 2.3

Establish conservation feature.

Conservation practices

Conservation Cover
Grassed Waterway

Pathway 2.3A
Community 2.3 to 2.1

Implement sustainable cultural practices.

Conservation practices

Conservation Crop Rotation
Cover Crop
Nutrient Management

Integrated Pest Management (IPM)

Pathway 2.3B
Community 2.3 to 2.2

Revert to unsustainable cultural practices.

State 3
Seminatural Drained State

Community 3.1
Ruderal Drained Meadow & Shrub: Dactylis glomerata - Phleum pratense - Festuca spp. - Solidago spp. Ruderal Meadow

Community 3.2
Exotic Ruderal Drained Forest: Acer platanoides Ruderal Forest

Pathway 3.1A
Community 3.1 to 3.2

Succession

Pathway 3.2A
Community 3.2 to 3.1

Blowdown/clearcut.

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

State 4
Seminatural State

Community 4.1
Ruderal Wet Meadow & Shrub Swamp: Phalaris arundinacea Eastern Ruderal Marsh

Community 4.2
Exotic Ruderal Swamp Forest: Acer negundo Ruderal Floodplain Forest

Pathway 4.1A
Community 4.1 to 4.2

Succession.

Pathway 4.2A
Community 4.2 to 4.1

Blowdown/clearcut.

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

Transition T1A
State 1 to 2

Drain; clear vegetation; cultivate domesticated species.

Transition T1B
State 1 to 3

Drain; clear vegetation, invasive species introduced.

Transition T1C
State 1 to 4

Clear vegetation, invasive species introduced.

Restoration pathway R2
State 2 to 1

Restore hydrology; remove domesticated species; restore native species.

Conservation practices

Brush Management
Restoration and Management of Rare and Declining Habitats
Wetland Wildlife Habitat Management
Wetland Restoration
Herbaceous Weed Control

Transition T2A
State 2 to 3

Abandon, succession.

Transition T2B
State 2 to 4

Restore hydrology; abandon; succession.

Conservation practices

Wetland Restoration

Restoration pathway R3
State 3 to 1

Restore hydrology; control invasive species; restore native species

Conservation practices

Brush Management
Restoration and Management of Rare and Declining Habitats
Wetland Wildlife Habitat Management
Wetland Restoration

Herbaceous Weed Control

Transition T3A
State 3 to 2

Clear vegetation; cultivate domesticated species.

Transition T3B
State 3 to 4

Restore hydrology.

Conservation practices

Wetland Restoration

Restoration pathway R4
State 4 to 1

Control invasive species; restore native species.

Conservation practices

Brush Management
Restoration and Management of Rare and Declining Habitats
Wetland Wildlife Habitat Management
Herbaceous Weed Control

Transition T4A
State 4 to 2

Drain; clear vegetation; cultivate domesticated species.

Transition T4B
State 4 to 3

Drain.

Additional community tables

Other references

A PROVISIONAL ECOLOGICAL SITE is a conceptual grouping of soil map unit components within a major land resource area (MLRA) based on the similarities in response to management. A provisional ecological site is a first approximation based on a cursory literature review, personal experience, and limited field reconnaissance. As more adequate literature review, expert opinion, and intensive plot data are collected, the site concept is subject to shifting, broadening, narrowing, subdivision, or re-aggregation in definition. Likewise, the community dynamics will be more elaborate in content, and may also change in structure, upon reaching approved status.

Future work, as described in a project plan, to validate the information in this provisional ecological site description is needed. This will include field activities to collect low and medium intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the project plan are to be conducted by the Ecological Site Technical Team.

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Contributors

Gregory J. Schmidt

Approval

Greg Schmidt, 9/11/2024

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The following individuals made substantive comments regarding the development of the Provisional Ecological Sites: Randy Swaty, The Nature Conservancy; Trevor Hobbs, USFS; Richard A. Corner, USFS; Andy Henriksen, NRCS; Dan Zay, NRCS.

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	05/10/2025
Approved by	Greg Schmidt
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):**

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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:**
