USDA Natural Resources Conservation Service

Ecological site R103XY014MN
Recharge Depressions

Last updated: 10/04/2023
Accessed: 05/04/2024

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): 103X–Central Iowa and Minnesota Till Prairies

MLRA 103 is in Minnesota (56 percent) and Iowa (44 percent) and consists of approximately 18 million acres. It is in the Western Lake Section of the Central Lowland Province of the Interior Plains in an area known as the "Des Moines Lobe" of the Wisconsin-age ice sheet. The MLRA is mostly on a young, nearly level to gently rolling, glaciated till plain that has moraines and glacial lake plains in some areas. The plain is covered with glacial till, outwash, and glacial lake deposits. Recent alluvium consisting of clay, silt, sand, and gravel fill the bottoms of most of the major river valleys. Paleozoic bedrock sediments, primarily shale and limestone, underlie the glacial deposits in most of the area.

The annual precipitation increases from northwest to southeast. Most of the rainfall occurs as high-intensity, convective thunderstorms during the summer. Two-thirds or more of the precipitation falls during the freeze-free period. Snowfall is common in winter. Ground water supplies are adequate for the domestic, livestock, municipal, and industrial needs. Nearly all of this area is farmland, and about four-fifths is cropland.

Classification relationships

Major Land Resource Area (MLRA): Central Iowa and Minnesota Till Prairies (103) (USDA Handbook 296, 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Upper Minnesota River-Des Moines Lobe (251BA) and Southern Des Moines Lobe (251Be) Subsections (Cleland et al. 2007)

Ecological site concept

The Recharge Depressions ecological site is characterized by a hydrologic interaction with adjacent sloping ground which classifies this site as a recharge wetland. With natural hydrology intact, this site is frequently ponded. Soils are classified as very poorly drained and have a relatively high organic matter content in the surface and near surface horizons.

Associated sites

F103XY025MN	**Loamy Upland Forests** The Loamy Upland Forests ecological site occurs on uplands and on soils which are derived from loamy till and have a thin or moderately thick dark (mollic) surface layer. The drainage class ranges from somewhat poorly drained to well drained.
R103XY008MN	**Clayey Wet Prairies** The Clayey Wet Prairies ecological site is located on soils that are poorly drained and have surface textures of clay, silty clay, silty clay loam, and clay loam. This site does not typically flood or pond, but the water table is usually at or near the surface during spring months.

F103XY030MN	**Wet Footslope/Drainageway Forests** The Wet Footslope/Drainageway Forests ecological site is on somewhat poorly and poorly drained soils located on base slopes, head slopes, footslopes, toeslopes, and drainageways.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Typha latifolia* (2) *Bolboschoenus fluviatilis*

Physiographic features

The Recharge Depressions ecological site is extensive (>100,000 acres) in MLRA 103. This site occurs mainly in the central prairie and the Big Woods ecoregion. It is partially defined by its hydrologic relationship with the uplands that surround the depression and areas that lie below. Landscape positions include concave landforms within depressions. Even though this site can be linear in shape, the term “depression” best describes the overall landform.

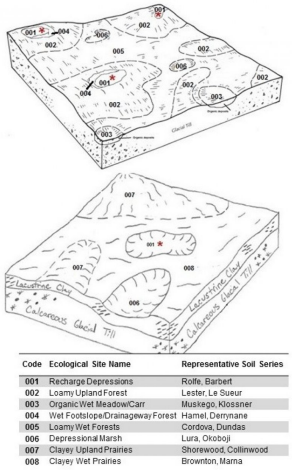


Figure 1. Block diagrams of the representative Recharge Depressions and associated ecological sites.

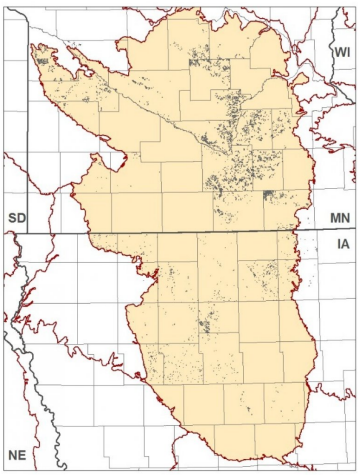


Figure 2. Distribution of the Recharge Depressions ecological site within MLRA 103. In many cases, the data set is not spatially consistent across political boundaries due to the method by which soils were mapped; e.g. due to county subsets.

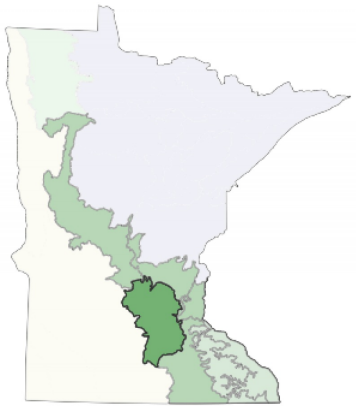


Figure 3. The Big Woods region of Minnesota shown in dark green (Minnesota Department of Natural Resources).

Table 2. Representative physiographic features

Landforms	(1) Lateral moraine (2) End moraine (3) Ground moraine (4) Lake plain (5) Outwash plain
Runoff class	Negligible to low
Ponding duration	Very brief (4 to 48 hours) to long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	689–1,837 ft
Slope	0–1%
Water table depth	0–36 in
Aspect	Aspect is not a significant factor

Climatic features

The soil temperature regime of MLRA 103 is classified as “mesic” (i.e., mean annual soil temperature between 46 and 59°F). The average freeze-free period of this site is 157 days, while the frost-free period is 134 days. Average mean annual precipitation is 33 inches, which includes rainfall plus the water equivalent from snowfall. Cold air drainage from above and the fact that wet soils are generally colder than dry soils make this site colder than adjacent, upslope areas. As a result, snow and frost remain longer in the spring, thus resulting in shorter growing seasons than the adjacent uplands.

Table 3. Representative climatic features

Frost-free period (characteristic range)	130-136 days
Freeze-free period (characteristic range)	152-163 days
Precipitation total (characteristic range)	32-35 in
Frost-free period (actual range)	129-142 days
Freeze-free period (actual range)	148-163 days
Precipitation total (actual range)	29-38 in
Frost-free period (average)	134 days
Freeze-free period (average)	157 days
Precipitation total (average)	33 in

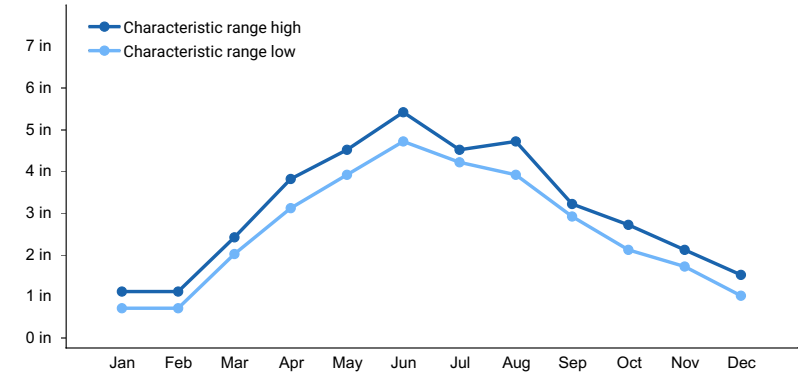


Figure 4. Monthly precipitation range

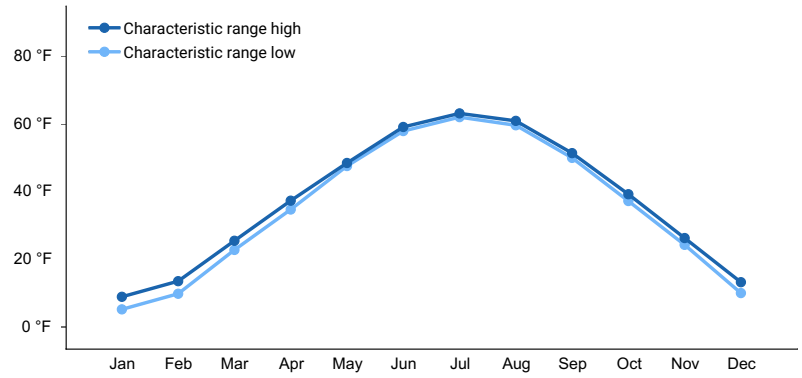


Figure 5. Monthly minimum temperature range

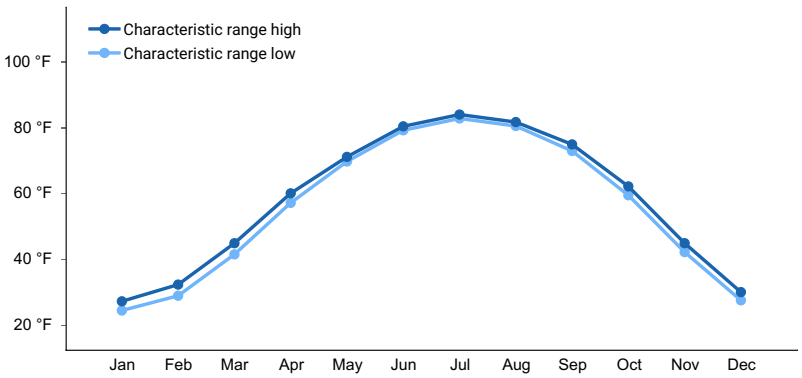


Figure 6. Monthly maximum temperature range

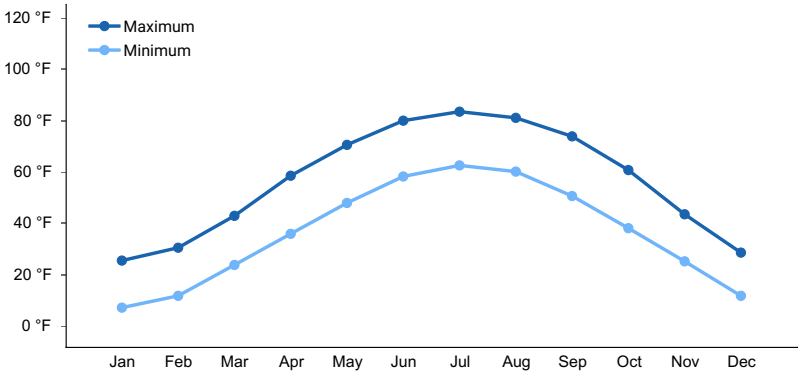


Figure 7. Monthly average minimum and maximum temperature

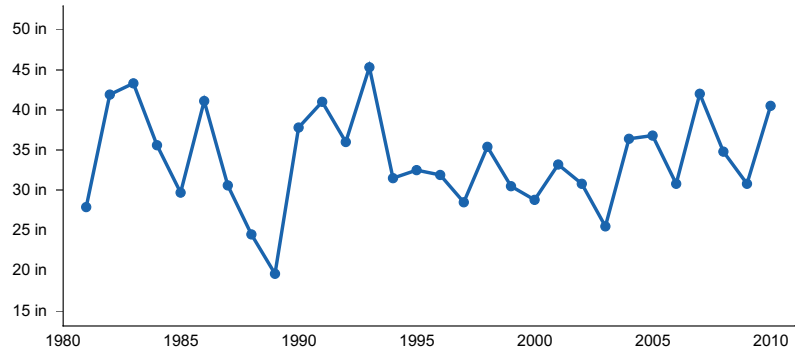


Figure 8. Annual precipitation pattern

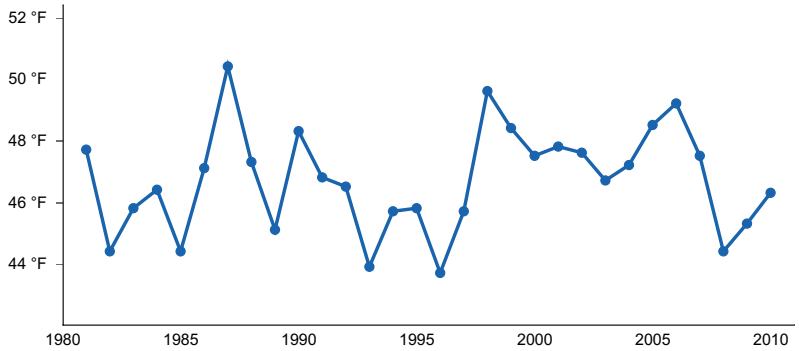


Figure 9. Annual average temperature pattern

Climate stations used

- (1) SPIRIT LAKE [USC00137859], Spirit Lake, IA
- (2) WASECA EXP STN [USC00218692], Waseca, MN
- (3) BRITT [USC00130923], Britt, IA
- (4) BOONE [USC00130807], Boone, IA
- (5) HUMBOLDT 3 W [USC00133985], Humboldt, IA
- (6) SAC CITY [USC00137312], Sac City, IA

Influencing water features

Recharge Depressions mainly receive water from precipitation but can also receive smaller amounts through runoff. With natural hydrology intact, they contribute the water they receive to the regional groundwater table. During the spring these soils are ponded. Soils are classified as endosaturated. The water table is typically above the soil surface during the spring months and may drop to as low as three feet later in the growing season during dry periods. In the hydrogeomorphic (HGM) classification system, this site is considered a part of a recharge complex, sitting relatively high in the landscape and providing recharge to the adjacent, lower ecological sites (USDA-NRCS, 2008; Gilbert et al., 2006). This site has a Saturated Cowardin Hydrologic classification of Palustrine, Scrub-Shrub Wetland, Seasonally Flooded. and has a United States Army Corps of Engineers Wetland Plant Community of C; Hardwood Swamps, Shrub-Carrs and Alder Thickets (Mineral Soils).

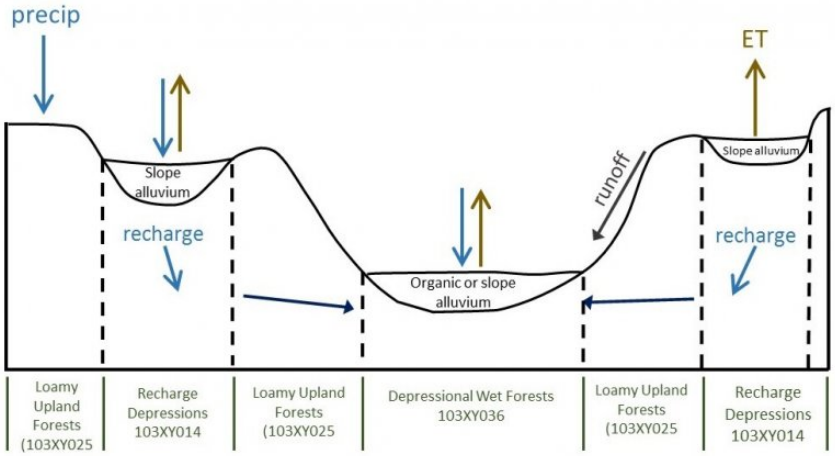


Figure 10. Representation of hydrological factors in a typical area of the Recharge Depressions and associated ecological sites on the Des Moines Lobe (MLRA 103).

Soil features

The soil series associated with this ecological site are Ames, Barbert, and Rolfe. The soils are relatively rich in organic matter and were developed under hydrophytic vegetation with ponded conditions. These mineral soils tend to lack the thin histic cap or mucky textures that other very poorly drained soils can have due to extreme drying and wetting cycles. Soil drainage class is very poorly drained. The surface texture is variable at silt loam, silty clay loam, clay loam, or loam. The subsurface textural group is classified primarily as fine (greater than 35 percent clay), but also includes coarser textural families with depth.

The soils on this site were formed under saturated conditions that produced anaerobic conditions during much of the year. The anaerobic conditions inhibit decomposition of the organic matter which enriches the surface horizons. Dry periods inhibit the accumulation of undecomposed histic materials. Since this site formed in ponded or intermittently ponded conditions in low areas, a certain amount of sediment tended to wash into the depressions. In some scenarios, these soils formed in lacustrine environments and so tend to be finer in some places than others, hence the variety in surface textures.

The majority of the soils in this group are Typic Argialbolls which have mollic epipedons 10-24 inches thick. The variety of subsurface textures affect plant growth less than in other, upslope ecological sites due to this site's high soil saturation. The high water table and recharge nature of this site are factors that overrides or carries more importance than other soil properties (like texture) in terms of plant community composition.

Table 4. Representative soil features

Parent material	(1) Slope alluvium (2) Till
Surface texture	(1) Silt loam (2) Silty clay loam (3) Clay loam (4) Loam
Drainage class	Very poorly drained
Permeability class	Very slow to moderately rapid
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	9–12 in

Calcium carbonate equivalent (0-40in)	0–30%
Soil reaction (1:1 water) (0-40in)	5.1–8.4
Subsurface fragment volume <=3" (0-40in)	0–10%
Subsurface fragment volume >3" (0-40in)	0–1%

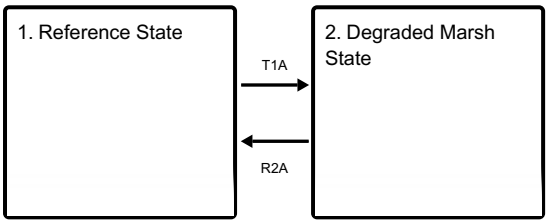
Ecological dynamics

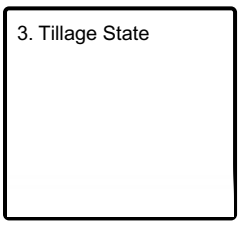
The Recharge Depressions ecological site has three states: the Reference State, the Degraded Marsh State, and the Tillage State. The Reference State describes a hydrophytic plant community with natural hydrology and no human disturbance triggers such as cattle grazing or invasive vegetation. State 2 is a Degraded Marsh State in which human disturbances have modified the plant community composition and structure. Grazing, invasive species, and hydrological modifications are common triggers to State 2. State 3 is the Tillage State which covers intensive agricultural production.

Historically, drought, fire, and grazing were the primary natural disturbances to this site. Currently, the dominant land use is corn and soybean production. Areas not in row crop agriculture most often exist as degraded marshes.

State and transition model

Ecosystem states

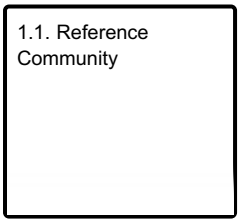




T1A - Plant community altered by cattle grazing and invasive plant species

R2A - Management inputs to restore site

State 1 submodel, plant communities



State 2 submodel, plant communities

2.1. Degraded Marsh Community

State 3 submodel, plant communities

3.1. Tillage Community

State 1
Reference State

The Recharge Depressions ecological site is characterized by a native, wet-tolerant, plant community that was historically influenced by drought, fire, and grazing. Plant community composition varies depending upon moisture and depth of ponding. Common shallow marsh species include broadleaf cattail and river bulrush. Water knotweed is common on mud flats. High-quality reference sites are now uncommon in MLRA 103. Due to current wetland protection regulations, it is unlikely that remaining areas will be transitioned to agricultural production.

Dominant plant species

- broadleaf cattail (*Typha latifolia*), grass
- river bulrush (*Bolboschoenus fluviatilis*), grass
- water knotweed (*Polygonum amphibium*), other herbaceous

Community 1.1
Reference Community

This site is characterized by frequent ponding, very poorly drained soils, natural hydrology, and native, hydrophytic vegetation. The composition and structure of the plant community will depend on the depth and length of ponding. Shallow marsh species include broadleaf cattail and river bulrush. During dry periods, water knotweed is common on mud flats.

Dominant plant species

- river bulrush (*Bolboschoenus fluviatilis*), grass
- broadleaf cattail (*Typha latifolia*), grass
- water knotweed (*Polygonum amphibium*), other herbaceous

State 2
Degraded Marsh State

The Degraded Marsh State is characterized by hydrologic alterations, non-native plants species, and long-term fire suppression which allows for an increase woody plant species. Common species in this state include common reed, narrowleaf cattail, hybrid cattail, reed canarygrass, and various shrubs and tree saplings. Plant community composition will be influenced by the duration and depth of ponding. Some sites in this state may be conservation easements. Areas not in a conservation program are assumed to be jurisdictional wetlands, making it very unlikely they will be transitioned to agriculture due to various wetland programs and laws, including the Swampbuster provision of the Food Security Act of 1985 (P.L. 99-198, as amended by P.L. 115-25) and the Minnesota Wetland Conservation Act (WCA) of 1991 (M.R. 8420.0100, as amended in 2009).

Dominant plant species

- common reed (*Phragmites australis*), grass
- hybrid cattail (*Typha ×glauca*), grass
- narrowleaf cattail (*Typha angustifolia*), grass
- reed canarygrass (*Phalaris arundinacea*), grass

Community 2.1
Degraded Marsh Community

The Degraded Marsh Community is characterized by non-native invasive plants and an increase in woody species. Cattle grazing or other human disturbances may be impacting these sites. A variety of invasive woody plants and grasses are common. Species include common reed, hybrid cattail, narrowleaf cattail, reed canarygrass, and various woody plants. Plant community composition will be influenced by the duration and depth of ponding.

Dominant plant species

- common reed (*Phragmites australis*), grass
- hybrid cattail (*Typha ×glauca*), grass
- narrowleaf cattail (*Typha angustifolia*), grass
- reed canarygrass (*Phalaris arundinacea*), grass

State 3
Tillage State

Tillage and altered hydrology are the primary mechanisms for transitioning to agriculture production. Soil tillage affects dynamic soil properties such as bulk density, structure, organic carbon content, and saturated hydraulic conductivity. Hydrological modifications (tiling and ditching) may be installed to improve drainage, so natural hydrology is also altered. Most areas currently in this state were transition to agriculture prior to current wetland protection legislation and will likely remain as such for the foreseeable future. Conservation practices can mitigate the impacts of traditional agricultural practices on soil health. Conservation tillage minimizes soil disturbance and can improve soil structure and overall soil health. Corn or soybean plantings and a cover crop rotation can build soil structure, improve infiltration rates, reduce runoff and erosion, and protect water quality. Some areas within this ecological site have been seeded to grass or have reverted to a scrubby woodland. However, this is a small percentage of acres within the MLRA, so these communities are not currently included in this state and transition model.

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine max*), other herbaceous

Community 3.1
Tillage Community

This plant community typically consists of intensively produced, traditional row crops. Tillage, tiling/ditching, and intentional plant establishment (planting crops) are the primary triggers for this community. The most common crops are corn and soybeans on an annual rotation. A few areas are reseeded to grass, but this is a minor use.

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine max*), other herbaceous

Transition T1A
State 1 to 2

Disturbances such invasive species and grazing will alter the State 1 plant community composition and structure.

Restoration pathway R2A

State 2 to 1

Restoration activities include control of invasive plant species, establishment of desired native species, and protection of the site from disturbances such as cattle grazing. Complete restoration is only possible if the natural hydrology still exists.

Additional community tables

Inventory data references

No field plots were available for this site. 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 ecological site description.

Other references

Cleland, D.T., J.A. Freeouf, J.E. Keys, G.J. Nowacki, C. Carpenter, and W.H. McNab. 2007. Ecological Subregions: Sections and Subsections of the Conterminous United States. USDA Forest Service, General Technical Report WO-76. Washington, DC.

Gilbert, M.C., P.M. Whited, E.J. Clairain, Jr., and D.R. Smith. 2006. A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Prairie Potholes. ERDC/EL TR-06-5, U.S. Army Corps of Engineers, Vicksburg, MS.

Gleason, R. A., N. H. Euliss Jr., D. E. Hubbard, and W. G. Duffy. 2004. Invertebrate Egg Banks of Restored, Natural, and Drained Wetlands in the Prairie Pothole Region of the United States. Wetlands 24:3, 562-572.

H.R. 2100 – 99th Congress: Food Security Act of 1985, Pub. L. No. 99-198, Stat 1504, Sec. 1221-1223.

Minnesota Rules, part 8420.0100, subpart 1, item A-D (2009).

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USDA-NRCS. 2008. Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the Natural Resources Conservation Service. Technical Note No. 190–8–76. Washington D.C.

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Approval

Suzanne Mayne-Kinney, 10/04/2023

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	05/04/2024
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:

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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:**
