USDA Natural Resources Conservation Service

Ecological site F089XY020WI
Loamy Uplands

Last updated: 9/27/2023
Accessed: 11/04/2024

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): 089X–Wisconsin Central Sands

The Wisconsin Central Sands (MLRA 89) corresponds closely to Central Sand Plains Ecological Landscape published by the Wisconsin Department of Natural Resources (WDNR, 2015). Much of the following brief overview of this MLRA is borrowed from that publication.

The Wisconsin Central Sands MLRA is entirely in Wisconsin. The total land area is 2,187,100 acres (3,420 square miles, 8858 square kilometers). It is bordered to the east by Johnstown-Hancock end moraines, which were pushed to their extent by the west side of the Green Bay Lobe (Clayton & Attig, 1999). It is bordered to the southwest by highly eroded, unglaciated valleys and ridges. The dominant feature of this MLRA is the remarkably flat, sandy plain, composed of lacustrine deposits and outwash sand, that was once the main basin of Glacial Lake Wisconsin. It also features extensive pine and oak barrens and wetland complexes.

Glacial Lake Wisconsin was fed primarily by glacial meltwater from the north and east. The lake deposited silt overlain by tens of meters of sand (Clayton & Attig, 1989). The silty layers are closer to the surface in some areas, where they impede drainage and contribute to the formation of extensive wetland complexes. It is believed that Glacial Lake Wisconsin drained within several days after a breach in the ice dam that supported it. The catastrophic flood that followed flowed to the south and carved the scattered buttes and mesas protruding from the sandy plain in the southern portion of this MLRA. Before vegetation established after glacial recession, strong winds formed aeolian sand dunes that now support xeric pine and oak stands within the Wisconsin Central Sands.

The surface of the northwestern portion is mostly undulating. The sandy surface sediment was mostly deposited by meltwater during the Wisconsin glaciation. Gentle hills are a result of underlying bedrock topography. Valleys and floodplains are formed by stream action. The underlying bedrock controls the water table elevation and contributes to the formation of numerous wetlands.

Historically, the Wisconsin Central Sands were dominated by large wetland complexes, sand prairies, and oak forests, savannas, and barrens. Some pine and hemlock forests were found in the northwest portion. The Wisconsin Central Sands was subject to frequent fires, leading to today’s need for prescribed burns to maintain a representation of fire-dependent plant communities.

Classification relationships

Major Land Resource Area (MLRA): Wisconsin Central Sands (89)

USFS Subregions: Central Wisconsin Sand Plain (222Ra), Lincoln Formation Till Plain - Mixed Hardwoods (212Qb), Central Wisconsin Moraines and Outwash (222Kb), and Neillsville Sandstone Plateau (222Rb)

Relationship to Established Framework and Classification Systems:
Habitat Types of N. & S. Wisconsin (Kotar, 2002 & 1996): The sites of this ES keyed out to three habitat types:

Acer-Tilia-Fraxinus/Circaea (ATiFrCi); *Acer saccharum*/Viburnum, Vaccinium variant (AVb-V); Pinus/Vaccinium-Gaultheria (PVG)

Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest, Eastern Cool Temperate Row Crop, and Eastern Cool Temperate Close Grown Crop.

WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Northern Mesic Forest and Northern Dry-Mesic Forest communities.

Ecological site concept

The Loamy Uplands ecological site is found on stream terraces, lake terraces, upland plains, and ridges of MLRA 89. These sites are found mostly on the eastern and northern borders of the MLRA, where the Central Sands meets the loamy materials of glacial till from terminal moraines (east) and loess plains (north). These sites are characterized by very deep, well drained soils formed primarily loamy alluvium, but include other loamy materials. Some sites have silty alluvium, loamy drift, loamy till, ort sandy alluvium over clayey lacustrine deposits. Precipitation and runoff from adjacent uplands are the primary water sources, but groundwater discharge may be a significant contribution. Soils range from strongly acid to moderately alkaline.

Historically these sites supported a range of plant community types from savannas, oak openings, to mixed oak forests (Finley 1976). However, soil characteristics and understory flora suggest that shade-tolerant mesic hardwoods are also well suited to these sites and are currently rare, or absent, only because historic fires greatly reduced the seed source of these fire-sensitive species.

Loamy Uplands differs from other sites based on its deep loamy deposits and well drained soils. The deep deposits set this site apart from Loamy Bedrock Uplands. Other well drained sites have sandy textures. Loamy textures tend to have higher pH and available water capacity than sand. The well-drained soil sets this site apart from other loamy sites.

Associated sites

F089XY011WI	**Moist Sandy Outwash Uplands** Moist Sandy Outwash Uplands consist of deep sandy deposits derived from a mixture of outwash, alluvium, and lacustrine sources. They are somewhat poorly drained and are subject to neither flooding nor ponding. The sandy deposits of certain Poorly Drained Outwash
F089XY014WI	**Moist Loamy Uplands** Moist Loamy Uplands consist of deep loamy alluvium over sandy alluvium or clayey lacustrine deposits. They are somewhat poorly drained and are subject to neither flooding nor ponding. These sites are primarily found in the northwestern portion of the Wisconsin Central Sands MLRA. They occur lower in the drainage sequence and are wetter than Loamy Uplands.
F089XY004WI	**Loamy Floodplains** Loamy Floodplains are found exclusively on floodplains in loamy alluvium underlain by sandy alluvium. Soils are somewhat poorly to poorly drained and are subject to flooding. These sites occur primarily along tributaries to the Yellow River in central Wood County and along the Lemonweir River. They may be adjacent to Loamy Uplands.

Similar sites

F089XY019WI	**Loamy Bedrock Uplands** Loamy Bedrock Uplands sites form in loamy alluvium or loess overlain by interbedded sandstone and shale. Bedrock contact occurs within 39 inches (99 cm) of the surface. Soils are moderately well or well drained. These sites are primarily found in the northern portion of the Wisconsin Central Sands MLRA which was covered in loamy glacial deposits prior to the most recent glacial advance and where depth of bedrock is shallow. They occur in similar landscape positions and share both drainage class and particle size with Loamy Uplands but have bedrock contact within two meters of the soil surface.

F089XY017WI	**Sandy Outwash Uplands** Sandy Outwash Uplands primarily consist of deep sandy outwash deposits. Soils are somewhat excessively to excessively drained and are primarily found east of the Yellow River. They are found in similar landscape positions and share their drainage class with Loamy Uplands but have coarser particle sizes.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Tilia americana*
Shrub	(1) *Acer rubrum* (2) *Amelanchier*
Herbaceous	(1) *Circaea*

Physiographic features

These sites formed on stream terraces, lake terraces, and outwash plains. Slopes range from 0 to 15 percent. Sites are on summit, shoulder, backslope, and toeslope positions. Elevation ranges from 689 to 1214 feet (210 to 370) meters above sea level. These sites are not subject to ponding or flooding. Sites have an apparent seasonally high water table (endosaturation) at depths between 24 to 80+ inches (61 and 200+ cm). The water table can drop to greater than 80 inches (200 cm) during dry conditions. Surface runoff ranges from negligible to high.

Table 2. Representative physiographic features

Landforms	(1) Stream terrace (2) Plain (3) Ridge
Runoff class	Negligible to high
Flooding frequency	None
Ponding frequency	None
Elevation	689–1,214 ft
Slope	0–15%
Water table depth	24–80 in
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The continental climate of the Wisconsin Central Sands is typical of the southern half of the state – cold winters and warm summers. Precipitation is well-distributed throughout the year with a slight peak in the summer months. Snowfall covers the ground from late fall to early spring. The soil moisture regime of MLRA 89 is udic (humid climate). The soil temperature regime is mostly frigid, with a small portion of mesic in the southern tip. Neither precipitation nor temperature vary greatly across this MLRA. More so than latitude, local topography seems to be an important predictor of growing season length, with fewer growing degree days in lower-lying areas.

This site is represented by five NOAA weather stations – Hancock Experimental Farm, Friendship, Hatfield, Mauston, and Stevens Point, recorded 1981 to 2010. None of these stations are located on the site itself.

The average annual precipitation for this ecological site is 33 inches. The average annual snowfall is 47 inches. The annual average maximum and minimum temperatures are 55°F and 34°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	98-125 days
Freeze-free period (characteristic range)	121-146 days

Precipitation total (characteristic range)	33-34 in
Frost-free period (actual range)	79-125 days
Freeze-free period (actual range)	101-149 days
Precipitation total (actual range)	33-34 in
Frost-free period (average)	110 days
Freeze-free period (average)	132 days
Precipitation total (average)	33 in

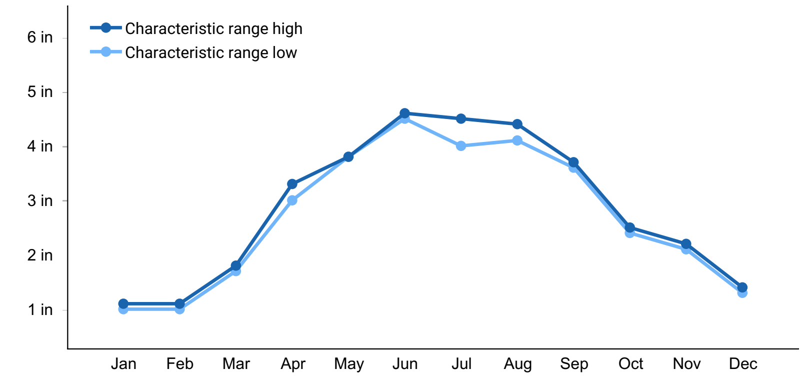


Figure 1. Monthly precipitation range

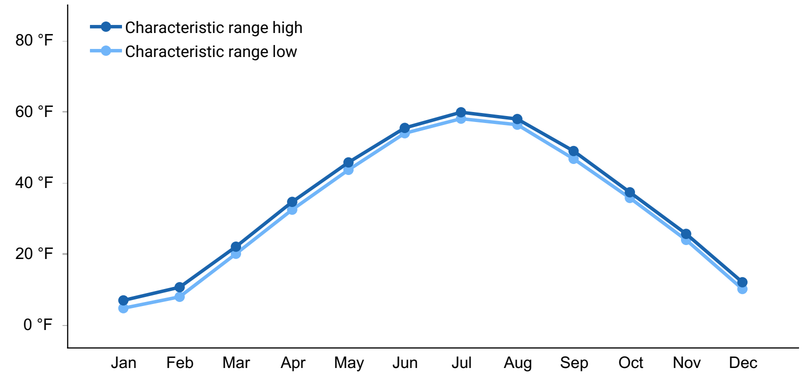


Figure 2. Monthly minimum temperature range

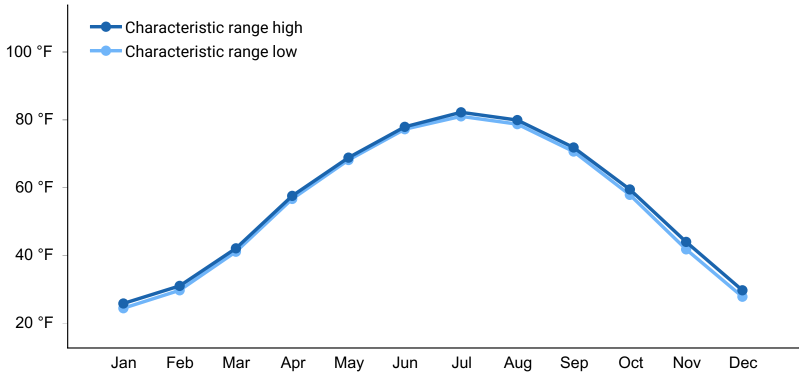


Figure 3. Monthly maximum temperature range

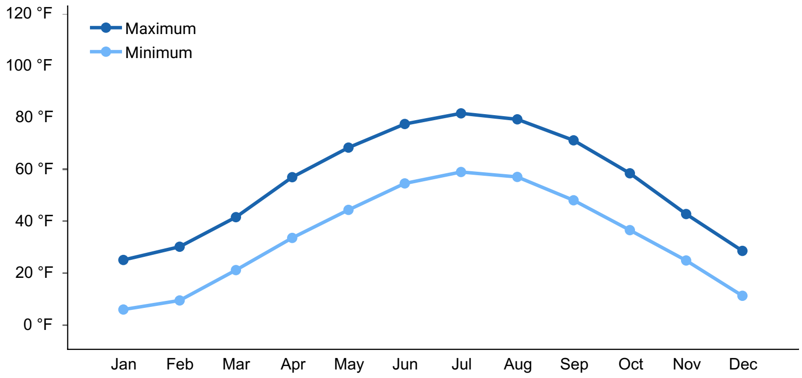


Figure 4. Monthly average minimum and maximum temperature

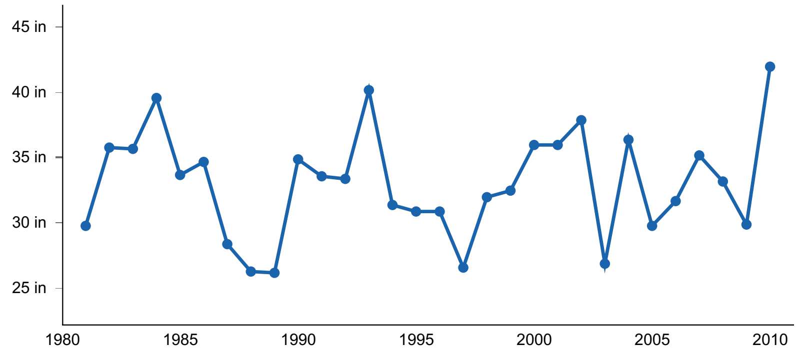


Figure 5. Annual precipitation pattern

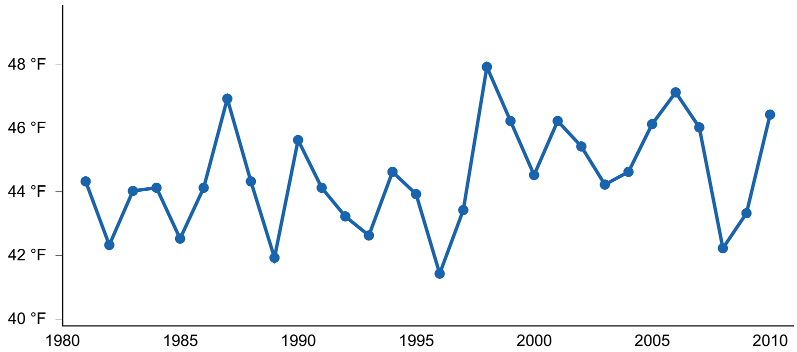


Figure 6. Annual average temperature pattern

Climate stations used

- (1) FRIENDSHIP [USC00472973], Adams, WI
- (2) HATFIELD [USC00473471], Merrillan, WI
- (3) MAUSTON 1 SE [USC00475178], Mauston, WI
- (4) STEVENS POINT [USC00478171], Stevens Point, WI
- (5) HANCOCK EXP FARM [USC00473405], Hancock, WI

Influencing water features

Water is received primarily from precipitation, runoff from adjacent uplands, and groundwater discharge. Water leaves the site primarily through runoff, evapotranspiration, and groundwater recharge. Permeability of these sites is moderately rapid or rapid in the sandy mantle, but slow to impermeable in the finer substratum. Hydrologic group is A, B, or C.

Soil features

These sites are represented by the Delton, Dunnville, Pearl, and Richford soil series. Delton and Richford series are classified as Arenic Hapludalfs; Dunnville is a Typic Hapludalf; and Pearl is an Arenic Oxyaquic Hapludalf.

These sites formed primarily in sandy materials. Some sites have underlying clayey lacustrine deposits, and other sites are formed in loamy alluvium overlying sandy outwash. Soils are very deep and range from moderately well to somewhat excessively drained. They do not meet hydric soil requirements.

Surface textures of these sites are primarily sand, loamy sand, or sandy loam. Subsurface textures include sand, loamy sand, sandy loam, loam, and silty clay. Soil pH ranges from Strongly acid to moderately alkaline with values of 5.1 to 7.9. Surface fragments are absent. Subsurface fragments less than 3 inches can be present up to 25 percent volume, and fragments greater than 3 inches can be present up to 5 percent. Carbonates are absent on most sties, but may be present up to 18 percent beginning at 35.8 inches (91 cm).

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Outwash (3) Lacustrine deposits
Surface texture	(1) Sand (2) Loamy sand (3) Sandy loam
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Very slow to moderate
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	4.91–6.96 in
Calcium carbonate equivalent (Depth not specified)	0–18%
Soil reaction (1:1 water) (Depth not specified)	5.1–7.9
Subsurface fragment volume <=3" (Depth not specified)	0–25%
Subsurface fragment volume >3" (Depth not specified)	0–5%

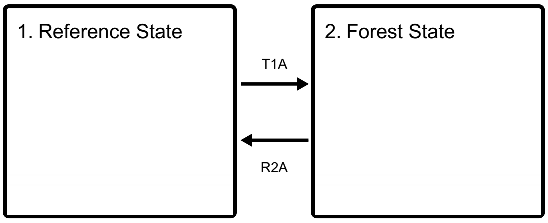
Ecological dynamics

Historically, the nature of plant communities on this ecological site, as in MLRA 89 in general, was strongly influenced by fire regimes. Different frequency and intensity of fires shaped different plant communities which, in turn, affected subsequent fire behavior. Studies show that fire frequency of one to ten years maintained tall grass prairie, which otherwise was invaded by trees and shrubs (Abrams, 1992; Dickermann and Cleland, 2002). During prolonged fire-free periods a variety of hardwood trees species could have become established, but only oaks possess adequate fire resisting properties that enabled them to survive subsequent fires. Perhaps the principal advantage of all oak species to thrive in the face of repeated grass fires is initial vigorous root growth, rather than shoot growth, that allows subsequent repeated re-sprouting of fire-killed shoots. With time enough oak stems accumulate on a site to form a savanna and eventually even a mixed oak forest. With maturity, oak trees develop a thick bark that protects the inner tissue from fire damage. White oak is somewhat of an exception in this regard, as its bark is not as insulating as that of the other native species, but, in turn, it has an advantage of greater shade-tolerance, enabling it to regenerate under moderately dense forest canopy.

With total exclusion of fire, or silvicultural intervention, oak forests on this Ecological Site begin to succeed toward more shade-tolerant species, most frequently red maple, but where seed sources are available, also white ash (*Fraxinus americana*), basswood (Tilia Americana), ironwood (*Ostrya virginiana*) and ultimately sugar maple (*Acer saccharum*).

State and transition model

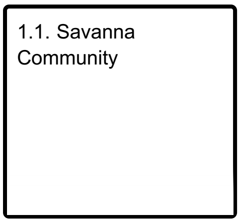
Ecosystem states



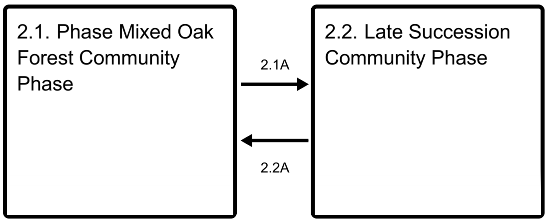
T1A - High frequency of fires

R2A - Savanna restoration techniques using fire

State 1 submodel, plant communities



State 2 submodel, plant communities



2.1A - Long periods without fire; natural succession

2.2A - Moderate intensity fire or silvicultural techniques favoring oaks

State 1
Reference State

The reference state is a savanna. Savanna plant community is primarily a historic plant formation that was maintained in pre-European settlement time by wild fires and Native-American activities. Today, such communities exist only where special ecological restoration actions are being applied.

Dominant plant species

- northern pin oak (*Quercus ellipsoidalis*), tree
- black oak (*Quercus velutina*), tree
- bur oak (*Quercus macrocarpa*), tree
- serviceberry (*Amelanchier*), shrub
- serviceberry (*Amelanchier*), other herbaceous

Community 1.1
Savanna Community

This community is an oak savanna dominated by northern pin oak, black oak, and/or bur oak. A variety of native shrubs, grasses, and forbs occur.

Dominant plant species

- northern pin oak (*Quercus ellipsoidalis*), tree
- black oak (*Quercus velutina*), tree

- bur oak (*Quercus macrocarpa*), tree
- serviceberry (*Amelanchier*), shrub

State 2
Forest State

Almost a century of active fire suppression allowed oak savannas and “scrub oak” communities to develop into closed canopy forests. Based on the degree of successional development two community phases can be characterize.

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- serviceberry (*Amelanchier*), shrub
- enchanter's nightshade (*Circaea*), other herbaceous

Community 2.1
Phase Mixed Oak Forest Community Phase

We are designating this community as a reference phase community because it appears to be closest in species composition to pre-European settlement, fire-dependent communities. Principal species typically are white and red oak (*Quercus alba*, *Q. rubra*) with occasional admixtures of box elder (*Acer negundo*), black cherry (*Prunus serotina*) or shagbark hickory (*Carya ovata*). Where current communities, no doubt, differ from the pre-settlment ones is in that they often contain saplings or young trees of more shade-tolerant specie, most often red maple (*Acer rubrum*), but sometimes also basswood (*Tilia americana*) and sugar maple (*Acer saccharum*).

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- serviceberry (*Amelanchier*), other herbaceous
- enchanter's nightshade (*Circaea*), other herbaceous

Community 2.2
Late Succession Community Phase

The structure and species composition of these communities varies greatly reflecting primarily the length of time since fire disturbance and availability of seed sources of specific species. Many stands are still dominated by oak species, mostly white and red oaks, in the oldest age classes, but have strong representation of more shade-tolerant species in younger age classes, including saplings and seedlings. Almost universally present is red maple, while white ash, basswood and sugar maple occur sporadically. Some stands have been in this stage of development long enough to tip the species mixture in the dominant canopy in favor of the shade-tolerant species.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- basswood (*Tilia*), tree
- red maple (*Acer rubrum*), tree
- serviceberry (*Amelanchier*), shrub
- enchanter's nightshade (*Circaea*), other herbaceous

Pathway 2.1A
Community 2.1 to 2.2

Long periods without fire disturbance allow natural succession toward more shade-tolerant species to progress. This process is most strongly dependent on availability of seed sources. Specimens of fire-sensitive species are found scattered on the landscape positions where wetlands and water bodies prevented the spread of fires and thus provided localized refugia for fire-sensitive species.

Pathway 2.2A
Community 2.2 to 2.1

A return to oak dominated community by natural means seldom occurs under current fire suppression conditions. However, selective harvesting, favoring oaks, and often the use of prescribed fires, maintain oak-dominated communities. Currently, this practice is heavily favored due to high market value of oaks.

Transition T1A
State 1 to 2

Fire frequency of one to ten years stimulates sprouting of small fire-killed oak stems and eliminates competition by other vegetation and especially the encroachment of other woody species.

Restoration pathway R2A
State 2 to 1

Oak savannas, oak openings and grasslands are of concern to natural resource managers and conservationists. In special locations, various mechanical techniques and prescribed fire are applied to recreate and maintain a representation of these fire-dependent communities on the landscape.

Additional community tables

Inventory data references

Plot and other supporting inventory data for site identification and community phases is located on a NRCS North Central Region shared and one drive folder. University Wisconsin-Stevens Point described soils, took photographs, and inventoried vegetation data at community phases within the reference state. The data sources include WI ESD Plot Data Collection Form - Tier 2, Releve Method, NASIS pedon description, NRCS SOI 036, photographs, and Kotar Habitat Types.

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Approval

Suzanne Mayne-Kinney, 9/27/2023

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	09/27/2023
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):

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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:**
