USDA Natural Resources Conservation Service

Ecological site R096XY002MI
Great Lakes Marsh

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.

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 (52%)
Hardwood (38%)
Conifer (11%)
Agricultural (15%)
Swamps and Marshes (13%)
Developed (13%)

Classification relationships

According to the USFS (Bailey) system of ecoregions, the site is located mostly within 212Ha (Oceana Sandy Lake Plains and Dunes), 212Hb (Manistee Sandy Outwash Plain), 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 50ag (Newaygo Barrens) and northern 56d (Michigan Lake Plain) level IV ecoregions. This site concept is outside the range of the USFS Ecological Land Type classification and the Kotar system.

Ecological site concept

The central concept of Great Lakes Marsh is marshes located at river mouths and shallow bays of the Great Lakes, subject to storm surge and annual and decadal fluctuation in water levels.

Associated sites

R096XY001MI	**Coastal Dune Complex**
F096XB026MI	**Wet Floodplain**

Similar sites

F096XB026MI	**Wet Floodplain**
R097XA024MI	**Great Lakes Marsh**

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schoenoplectus acutus* (2) *Eleocharis palustris*

Physiographic features

Site is formed of fine deposits at river mouths.

Table 2. Representative physiographic features

Landforms	(1) Estuary
Runoff class	Negligible to low
Flooding duration	Very brief (4 to 48 hours) to very long (more than 30 days)
Flooding frequency	Occasional to very frequent
Elevation	571–584 ft
Water table depth	0–10 in
Aspect	Aspect is not a significant factor

Climatic features

Mean annual temperatures are 7.1 to 8.5 °C (45 to 47 °F). The warmest six months average 15.5 to 16.5 °C (60 to 62 °F). Mean July temperatures range from 20.0 to 21.1 °C (68 to 70 °F). Mean January temperatures range from -6.7 to -3.9 °C (20 to 25 °F). The maximum monthly average daily highs are 25.5 to 28.1 °C (78 to 83 °F). The minimum monthly average daily lows are -11.2 to -7.3 °C (12 to 19 °F). Mean annual precipitation ranges from 850 to 920 mm (33 to 36 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 1.6 to 2.5 m (60 to 100 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)	110-132 days

Freeze-free period (characteristic range)	134-173 days
Precipitation total (characteristic range)	32-34 in
Frost-free period (actual range)	94-146 days
Freeze-free period (actual range)	122-199 days
Precipitation total (actual range)	32-35 in
Frost-free period (average)	120 days
Freeze-free period (average)	157 days
Precipitation total (average)	33 in

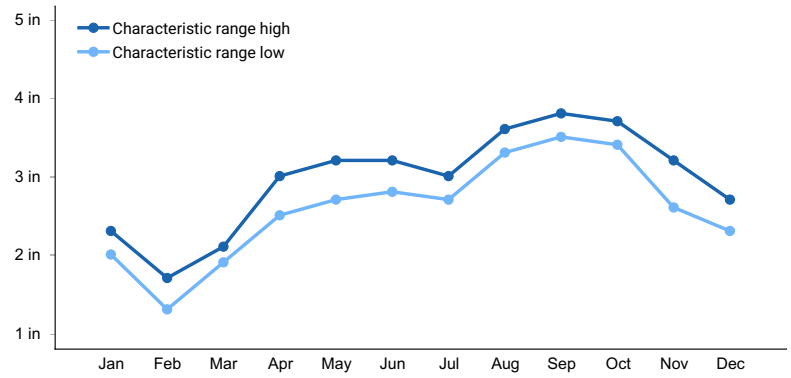


Figure 1. Monthly precipitation range

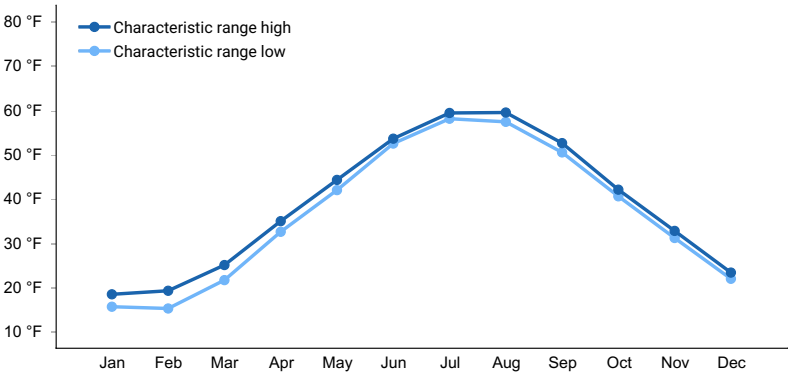


Figure 2. Monthly minimum temperature range

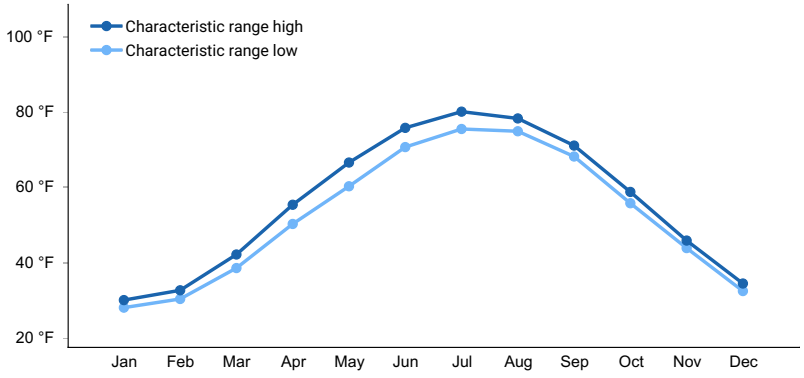


Figure 3. Monthly maximum temperature range

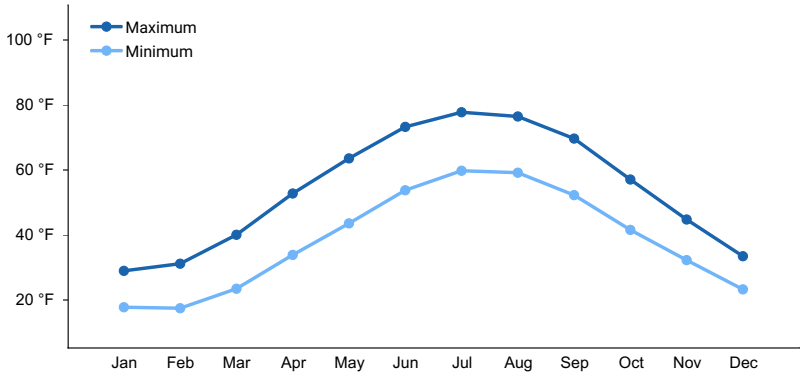


Figure 4. Monthly average minimum and maximum temperature

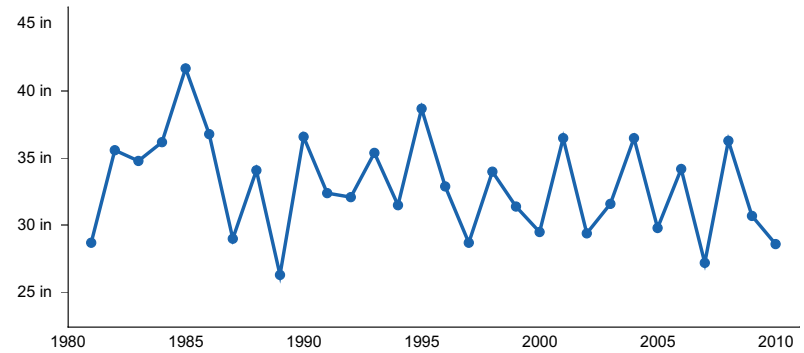


Figure 5. Annual precipitation pattern

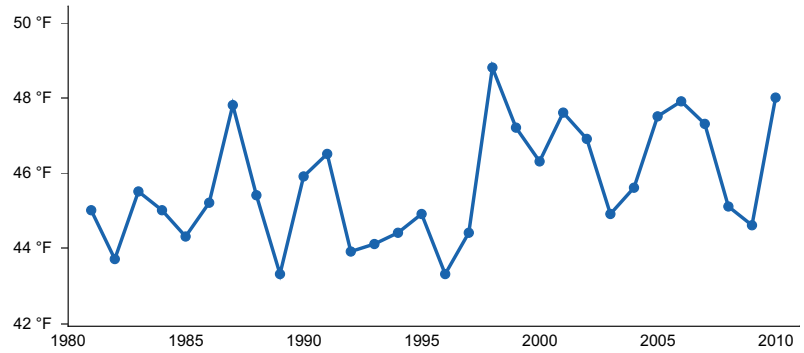


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MONTAGUE 4 NW [USC00205567], Montague, MI
- (2) CHARLEVOIX [USC00201468], Charlevoix, MI
- (3) FRANKFORT 2NE [USC00202984], Frankfort, MI
- (4) NORTHPORT 2W [USC00206007], Northport, MI
- (5) PETOSKEY [USC00206507], Petoskey, MI
- (6) MANISTEE 3SE [USC00205065], Manistee, MI
- (7) TRAVERSE CITY CHERRY CPTL AP [USW00014850], Traverse City, MI

Influencing water features

Surface waters of the Great Lakes and local rivers have the greatest influence on this site. See ecological dynamics for details on water level variability.

Soil features

Soils are very poorly drained sands or muck. They are potentially classified as Frassiwassents or Frassiwassists, and commonly mapped as Water components.

Table 4. Representative soil features

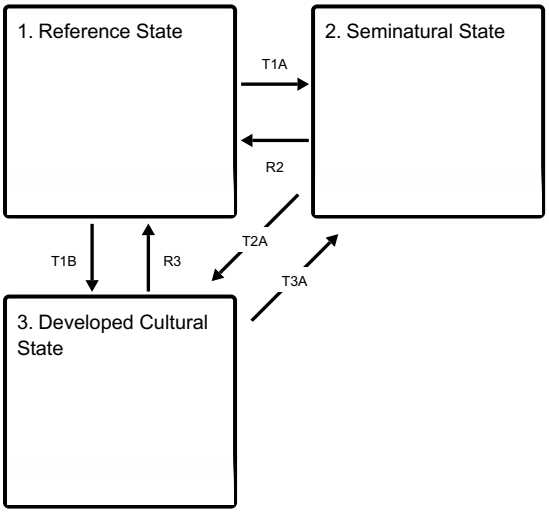
Parent material	(1) Alluvium (2) Lacustrine deposits
Surface texture	(1) Sand (2) Silt (3) Muck
Drainage class	Subaqueous to poorly drained
Permeability class	Slow to moderately rapid
Soil depth	79 in
Surface fragment cover <=3"	0–1%
Surface fragment cover >3"	0–1%
Available water capacity (0-39.4in)	1.97–21.65 in
Soil reaction (1:1 water) (0-19.7in)	5.5–7
Subsurface fragment volume <=3" (0-59.1in)	0–5%
Subsurface fragment volume >3" (0-59.1in)	0–1%

Ecological dynamics

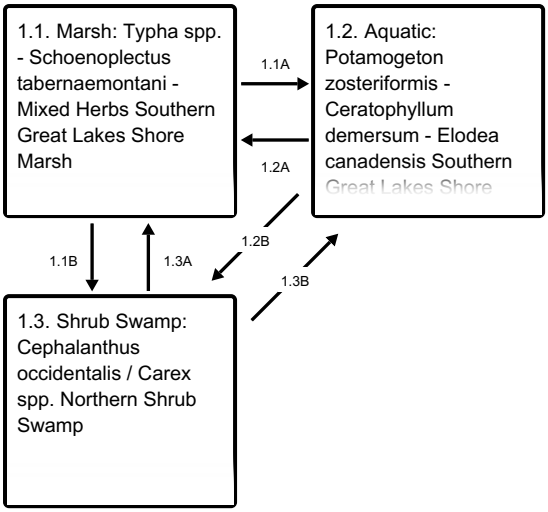
Great Lakes Marsh tends to share the same ecological dynamics as Natureserve/Landfire system, Great Lakes Freshwater Estuary or Delta or Northern Great Lakes Coastal Marsh. Site is subject to prolonged periods of deep inundation, rendering fire a rare event. Astronomical tides are insignificant (about 2 cm daily), but atmospheric disturbances (i.e. storm surge) may raise or lower water levels by 0.25-0.5 m. After a storm passes, water levels recover gradually after oscillating (seiches) with a period of 5-9 hours depending on direction of the original disturbance relative the axis of the lake. Water levels rise and fall on annual cycles of about a 30 cm, peaking in summer. Average water levels vary more than 1 m over periods of 20 years or more due to trends in basin wide precipitation and evaporation. Maximum range within the last century has been about 2 m. Species of sedges (Cyperaceae) and rushes (Juncaceae) and cattails (Typhaceae) dominate the emergent marshes.

State and transition model

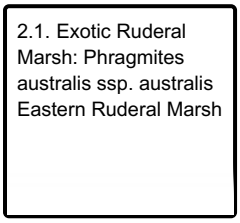
Ecosystem states



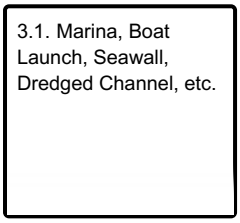
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

Dominant plant species

- hardstem bulrush (*Schoenoplectus acutus*), grass
- common spikerush (*Eleocharis palustris*), grass

Community 1.1
Marsh: Typha spp. - Schoenoplectus tabernaemontani - Mixed Herbs Southern Great Lakes Shore Marsh

Community 1.2
Aquatic: Potamogeton zosteriformis - Ceratophyllum demersum - Elodea canadensis Southern Great Lakes Shore Aquatic Vegetation

Community 1.3
Shrub Swamp: Cephalanthus occidentalis / Carex spp. Northern Shrub Swamp

Pathway 1.1A
Community 1.1 to 1.2

Lake level rises; emergent herbaceous plant mortality.

Pathway 1.1B
Community 1.1 to 1.3

Lake level drop; shrubs established.

Pathway 1.2A
Community 1.2 to 1.1

Lake level drop; emergents established.

Pathway 1.2B
Community 1.2 to 1.3

Lake level drop; shrubs established.

Pathway 1.3A
Community 1.3 to 1.1

Lake level rise; shrub mortality; emergent herbaceous established.

Pathway 1.3B
Community 1.3 to 1.2

Lake level rises; shrub mortality.

State 2
Seminatural State

Community 2.1
Exotic Ruderal Marsh: Phragmites australis ssp. australis Eastern Ruderal Marsh

State 3
Developed Cultural State

Community 3.1
Marina, Boat Launch, Seawall, Dredged Channel, etc.

Transition T1A
State 1 to 2

Filling or dredging.

Transition T1B
State 1 to 3

Invasive species established.

Restoration pathway R2
State 2 to 1

Conservation practices

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

Transition T2A
State 2 to 3

Abandoned; invasive species established.

Restoration pathway R3
State 3 to 1

Remove invasive species; reestablish native plants.

Conservation practices

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

Transition T3A
State 3 to 2

Filling or dredging.

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.

Albert, D. A. et al., 1995. Vegetation circa 1800 of Michigan. Michigan's native landscape as interpreted from the General Land Office Surveys 1816-1856 (digital map), Lansing: Michigan Natural Features Inventory.

Baker, M.E. and Barnes, B.V., 1998. Landscape ecosystem diversity of river floodplains in northwestern Lower Michigan, USA. Canadian Journal of Forest Research, 28(9), pp.1405-1418.

Barnes, B. V. and Wagner, W. H., 2004. Michigan trees: a guide to the trees of the Great Lakes region. Ann Arbor (Michigan): University of Michigan Press.

Burger, T. L. and Kotar, J., 2003. A Guide to Forest Communities and Habitat Types of Michigan. Madison, Wisconsin: Department of Forest Ecology and Management, University of Wisconsin.

Cleland, D. T. et al., 1994. Field guide: Ecological classification and inventory system of the Huron-Manistee National Forests, s.l.: USDA Forest Service, North Central Forest Experiment Station.

Eichenlaub, V.L., 1979. Weather and climate of the Great Lakes region. University of Notre Dame Press, Indiana.

335 pages.

GHCN, 2016. Global Historical Climatology Network Monthly Versions 2 and 3 (temperature and precipitation data). NOAA. https://www.ncdc.noaa.gov/ghcnm/

Kost, M. A. et al., 2010. Natural Communities of Michigan: Classification and Description, Lansing, MI: Michigan Natural Features Inventory.

Landfire, 2017. Landfire Biophysical Settings Review Site. Accessed May, 2017 http://www.landfirereview.org/descriptions.html.

National Ocean Service, 2017. Tides and Currents (historic water level data for US coastal waters). https://tidesandcurrents.noaa.gov/stations.html?type=Water+Levels

NDBC, 2017. National Data Buoy Center (wave height and period data for US coastal waters). NOAA. http://www.ndbc.noaa.gov/

PRISM Climate Group. 2013. Gridded 30 Year Normals, 1981-2010. Oregon State University, http://prism.oregonstate.edu

U.S. Department of the Interior, Geological Survey, 2011. LANDFIRE: LANDFIRE 1.1.0 Existing Vegetation Type layer. http://landfire.cr.usgs.gov/viewer/

USFS, Witness Tree data for northern Lower Michigan.

Contributors

Gregory J. Schmidt

Approval

Greg Schmidt, 9/11/2024

Acknowledgments

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:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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

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

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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

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

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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):**

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:**

17. **Perennial plant reproductive capability:**