USDA Natural Resources Conservation Service

Ecological site F094CY038MI
Shallow Limestone Drift

Last updated: 10/30/2023
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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): 094C–Northern Michigan Limestone Lake Plains

This area is dominated by lake plains, some of which are till-floored plains. Drumlins, moraines, and outwash plains occur throughout the area. The terrain includes flat outwash and lake plains and steep slopes in areas of moraines. Elevation ranges from 177 to 300 m (580 to 985 ft). Local topographic relief averages 7 m and ranges up to 79 m (25 to 260 ft). The Cheboygan, Ocqueoc, and Thunder Bay Rivers are the major streams in the area. This area is covered with thin to thick glacial deposits. Bedrock is generally at shallow depths and is evident throughout the area. It consists of Devonian limestone and dolomite with interbedded shale, chert, and anhydrite stringers. Karst features are very common in the area.

About two-thirds of this MLRA is in small, privately owned holdings, and the other third consists of State forestland. The forests are used mainly for timber production and recreation. Dairy and beef operations are very important enterprises in the area. Forage and feed grain crops for dairy cattle and other livestock are the principal crops. Wheat, oats, corn, potatoes, and hay also are grown. Wilderness State Park Natural Area, Negwegon State Park, Atlanta State Forest, and Beaver Island State Wildlife Research Area are among the more notable conservation lands in the area.

Summary of existing land use:
Upland Forest (40%)

Hardwood (24%)
Conifer (14%)
Swamps and Marshes (32%)
Developed (10%)
Agricultural (8%)
Open Water (6%)

Classification relationships

According to the USFS (Bailey) system of ecoregions, the site is located mostly within 212Hj (Presque Isle Lake and Till Plains) and 212Hl (Valders Red Till and Sandy Lake Plain) subsections. According to the EPA (Omernik) system of ecoregions, the site is located in 50ab (Cheboygan Lake Plain) and eastern 50ac (Onaway Moraines) 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 Shallow Limestone Drift is uplands with shallow to limestone bedrock soils. Site is in lower elevation northern portions of the MLRA where boreal conifer species are more frequent associates. Vegetation ranges from northern hardwoods or boreal forest to open alvar barrens.

Associated sites

F094CY028MI	**Cool Loamy Till**
R094CY001MI	**Cobble Shore And Fen Complex**

Similar sites

F098XA024MI	**Limestone Drift Plains**

Table 1. Dominant plant species

Tree	(1) *Thuja occidentalis* (2) *Picea glauca*
Shrub	(1) *Juniperus horizontalis*
Herbaceous	(1) *Schizachyrium scoparium*

Physiographic features

Site occurs where Pleistocene deposits are thinner than 150 cm. Areas mostly gently sloping due to gently sloping bedrock strata.

Table 2. Representative physiographic features

Landforms	(1) Plain (2) Cuesta
Runoff class	Medium to high
Elevation	177–402 m
Water table depth	99 cm
Aspect	Aspect is not a significant factor

Climatic features

Mean annual temperatures are 6.0 to 7.1 °C (43 to 45 °F). The warmest six months average 14.6 to 15.4 °C (58 to 60 °F). Mean July temperatures range from 19.1 to 20.2 °C (66 to 68 °F). Mean January temperatures range from -

7.9 to -5.9 °C (18 to 21 °F). The maximum monthly average daily highs are 24.1 to 27.3 °C (75 to 81 °F). The minimum monthly average daily lows are -13.3 to -9.4 °C (8 to 15 °F). Mean annual precipitation ranges from 720 to 810 mm (28 to 32 in). The western one-third of the area is wetter than the eastern two-thirds. The precipitation occurs as both rain during the growing season and snow in winter. Average 0 °C (32 °F) frost-free season ranges from 100 to 161 days. Average -2 °C (28 °F) freeze-free season is 137 to 188 days. Mean annual snowfall ranges from 1.6 to 2.9 m (60 to 110 in). Mean annual extreme minimum temperatures range from -31.6 to -23 °C (-25 to -9 °F), or hardiness zones 4b to 6a.

Table 3. Representative climatic features

Frost-free period (characteristic range)	101-119 days
Freeze-free period (characteristic range)	125-155 days
Precipitation total (characteristic range)	762 mm
Frost-free period (actual range)	83-132 days
Freeze-free period (actual range)	121-173 days
Precipitation total (actual range)	737-787 mm
Frost-free period (average)	108 days
Freeze-free period (average)	143 days
Precipitation total (average)	762 mm

Climate stations used

- (1) CHEBOYGAN [USC00201492], Cheboygan, MI
- (2) PELLSTON RGNL AP [USW00014841], Pellston, MI
- (3) ONAWAY 4N [USC00206184], Onaway, MI
- (4) ROGERS CITY [USC00207094], Rogers City, MI
- (5) ALPENA CO RGNL AP [USW00094849], Alpena, MI
- (6) ALPENA WWTP [USW00014814], Alpena, MI
- (7) CROSS VILLAGE 1E [USC00201896], Harbor Springs, MI

Influencing water features

Some sites may be within 50 cm of a seasonally high water table, but most sites are well drained.

Soil features

Soils are moderately well drained to well drained shallow sands or loams over limestone bedrock. They are commonly classified Lithic Hapludolls, Lithic Eutrudepts, and Typic Epiaquolls, and commonly mapped as Hessel, Summerville, and Namur series or components. The top 50 cm has a typical pH of 7.3 and is 45% sand and 6.4% organic matter. At depth, pH ranges up to 7.7, and texture averages 50% sand and 15% clay. Depth to impeded hydraulic conductivity or root restrictive layers averages 60 cm. Depth to carbonates averages 30 cm.

Table 4. Representative soil features

Parent material	(1) Drift (2) Residuum–limestone and dolomite
Surface texture	(1) Loam (2) Sand
Drainage class	Excessively drained to somewhat poorly drained
Permeability class	Slow to moderately rapid
Depth to restrictive layer	0–150 cm
Soil depth	0–150 cm

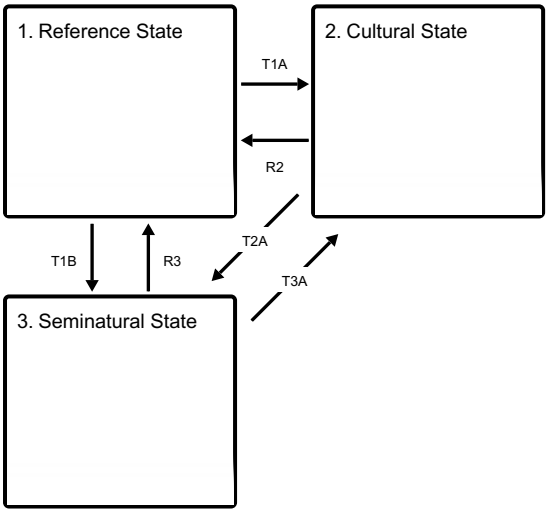
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–5%
Available water capacity (0-100.1cm)	0.99–22 cm
Soil reaction (1:1 water) (0-50cm)	6.5–8
Subsurface fragment volume <=3" (0-150.1cm)	5–35%
Subsurface fragment volume >3" (0-150.1cm)	0–15%

Ecological dynamics

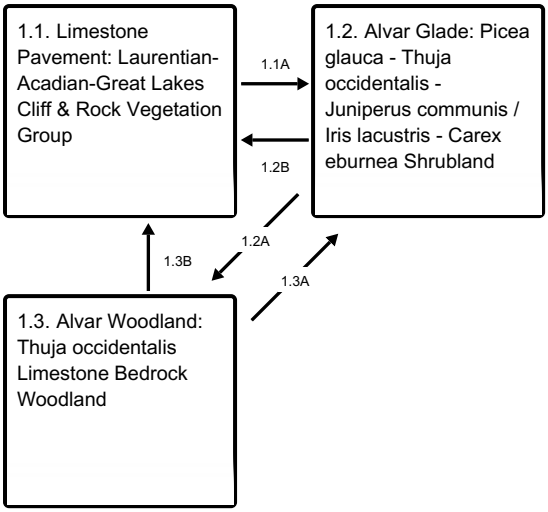
Shallow Limestone Drift tends to share the same ecological dynamics as Natureserve/Landfire system, Great Lakes Alvar. Stand replacing fires occurred every 200-850 years, with light surface fires every 1600-6500 years. Shallow soil areas tend to have higher vegetation cover than exposed bedrock glades. Prairie barrens vegetation can form where shallow mineral soil allows for a continuous vegetation coverage. Over long fire free intervals, organic matter can accumulate over the glades and support more continuous vegetation. Because the shallow organic matter dries out quickly during rain free intervals, trees are able to survive only where roots can penetrate deeper crevices in the bedrock. Fire can consume the thin layer of organic matter, setting succession back to bedrock glade conditions. Overstory species most suited to shallow rooting conditions and cool lake influenced summer temperatures of this site are whitecedar (*Thuja occidentalis*) and white spruce (*Picea glauca*). Deeper soils and warmer inland locations may trend towards sugar maple (*Acer saccharum*) and beech (*Fagus grandifolia*) dominance. The dry sunny conditions of exposed bedrock can support dwarf creeping shrubs like creeping juniper (*Juniperus horizontalis*) and kinnikinnick (*Arctostaphylos uva-ursi*). Prairie grasses like little bluestem (*Schizachyrium scoparium*) occur in the thin soil areas. Under forested conditions, the shade and organic matter accumulation may support plants with boreal affinity.

State and transition model

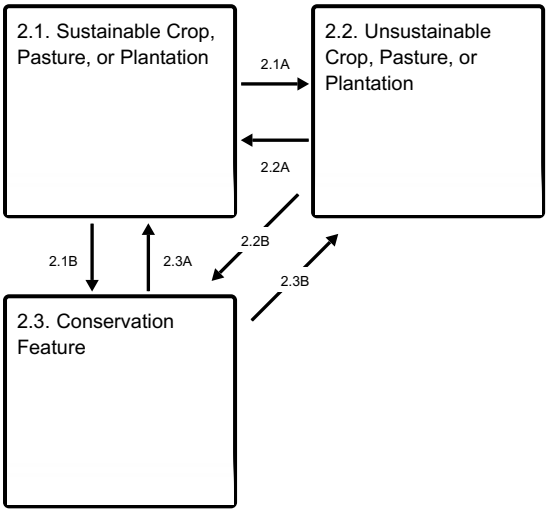
Ecosystem states



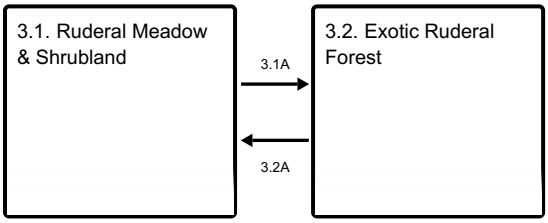
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

Dominant plant species

- arborvitae (*Thuja occidentalis*), tree
- white spruce (*Picea glauca*), tree
- creeping juniper (*Juniperus horizontalis*), shrub
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.1
Limestone Pavement: Laurentian-Acadian-Great Lakes Cliff & Rock Vegetation Group

Community 1.2
Alvar Glade: Picea glauca - Thuja occidentalis - Juniperus communis / Iris lacustris - Carex eburnea Shrubland

Community 1.3
Alvar Woodland: Thuja occidentalis Limestone Bedrock Woodland

Pathway 1.1A
Community 1.1 to 1.2

Organic soil build up over a roughly 500 year period.

Pathway 1.2B
Community 1.2 to 1.1

Intense fire burns off all organic soil during severe drought year, exposing bedrock.

Pathway 1.2A
Community 1.2 to 1.3

Succession.

Pathway 1.3B
Community 1.3 to 1.1

Intense fire burns off all organic soil during severe drought year, exposing bedrock.

Pathway 1.3A
Community 1.3 to 1.2

Medium intensity fire, killing off the overstory, but leaving soil intact.

State 2
Cultural State

Community 2.1
Sustainable Crop, Pasture, or Plantation

Community 2.2
Unsustainable Crop, Pasture, or Plantation

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

Pathway 2.3B
Community 2.3 to 2.2

Revert to unsustainable cultural practices.

State 3
Seminatural State

Community 3.1
Ruderal Meadow & Shrubland

Community 3.2
Exotic Ruderal Forest

Pathway 3.1A
Community 3.1 to 3.2

Succession.

Pathway 3.2A
Community 3.2 to 3.1

Blowdown/clearcut.

Transition T1A
State 1 to 2

Clear vegetation; cultivate domesticated species

Transition T1B
State 1 to 3

Clear vegetation, invasive species introduced

Restoration pathway R2
State 2 to 1

Remove domesticated species; restore native species.

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Upland Wildlife Habitat Management
Herbaceous Weed Control

Transition T2A
State 2 to 3

Abandoned, succession.

Restoration pathway R3
State 3 to 1

Control invasive species; restore native species

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Upland Wildlife Habitat Management
Herbaceous Weed Control

Restoration pathway T3A
State 3 to 2

Clear vegetation; cultivate domesticated species

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

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Approval

Nels Barrett, 10/30/2023

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	05/06/2024
Approved by	Nels Barrett
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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

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

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

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

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

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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:**