USDA Natural Resources
Conservation Service

Ecological site F094CY031MI
Cool Rich Sandy Drift

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

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): 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 roughly corresponds to PArVVb, in the Kotar system. This site corresponds to the Mesic Ice Contact Sand Hills, ecological land type phases 30-33, in the USFS Ecological Land Type system.

Ecological site concept

The central concept of Cool Rich Sandy Drift is uplands with a seasonal high watertable greater than 100 cm in depth (excessively drained to moderately well drained) and a dark brown spodic (Bhs) horizon present in soil profile. Site occurs on sandy drift (outwash, ice contact, or lake plains) where soil textures are sand or loamy sand (upper 50 cm >70% sand). Site is in lower elevation northern portions of the MLRA where boreal conifer species are more frequent associates. Vegetation trending towards mesophytic forest with a poor herb understory and a low fire frequency.

Associated sites

F094CY032MI	**Cool Acidic Sandy Depression**

Similar sites

F094AB018MI	**Rich Sandy Drift**

Table 1. Dominant plant species

Tree	(1) *Fagus grandifolia* (2) *Tsuga canadensis*
Shrub	Not specified
Herbaceous	(1) *Maianthemum canadense*

Physiographic features

Site occurs on coarse textured ice contact, glacial till, outwash, and lake plain deposits. Landforms are gently to steeply sloping.

Table 2. Representative physiographic features

Landforms	(1) Kame (2) Outwash plain (3) Lake plain
Runoff class	Negligible to low
Elevation	581–1,319 ft
Water table depth	39 in
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)	30 in
Frost-free period (actual range)	83-132 days
Freeze-free period (actual range)	121-173 days
Precipitation total (actual range)	29-31 in
Frost-free period (average)	108 days
Freeze-free period (average)	143 days
Precipitation total (average)	30 in

Climate stations used

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

Influencing water features

Lower slope positions and finer substrates may have a seasonal high water table 100-200 cm in depth. Well drained upper slope positions are 200 cm or more from the water table.

Soil features

Soils are well drained to excessively well drained sands. They are commonly classified Entic Haplorthods, Alfic Haplorthods, and Entic Hapludolls, and commonly mapped as Rubicon, East Lake, and Alpena series or components. The top 50 cm has a typical pH of 6.1 and is 85% sand and 1.1% organic matter. At depth, pH ranges up to 6.9, and texture averages 90% sand and 5% clay. Depth to impeded hydraulic conductivity or root restrictive layers averages >200 cm. Depth to carbonates averages 170 cm.

Table 4. Representative soil features

Parent material	(1) Outwash
Surface texture	(1) Sand
Drainage class	Excessively drained to well drained
Permeability class	Moderately rapid to rapid
Soil depth	79 in

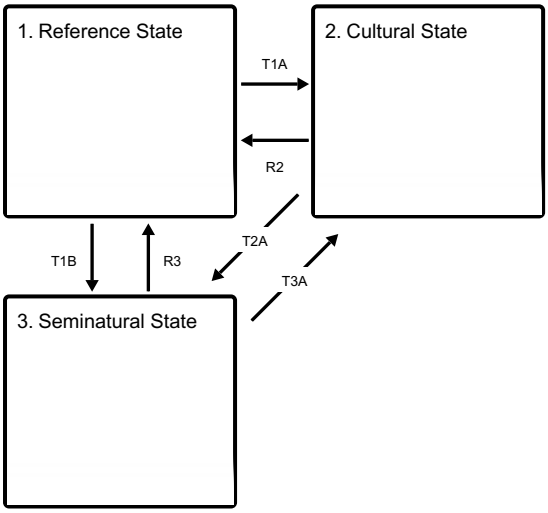
Surface fragment cover <=3"	0–1%
Surface fragment cover >3"	0%
Available water capacity (0-39.4in)	1.57–3.94 in
Soil reaction (1:1 water) (0-19.7in)	6.5–7.5
Subsurface fragment volume <=3" (0-59.1in)	0–10%
Subsurface fragment volume >3" (0-59.1in)	0–5%

Ecological dynamics

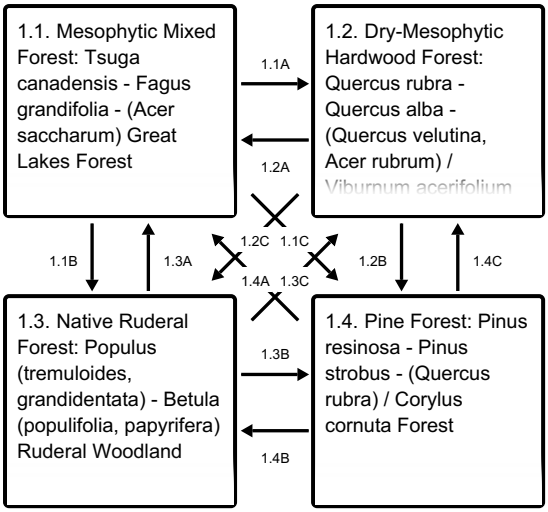
Cool Rich Sandy Drift tends to share the same ecological dynamics as Natureserve/Landfire system, Boreal White Spruce-Fir-Hardwood Forest or Laurentian-Acadian Northern Hardwoods Forest. Stand replacing fires occurred every 1650-6500 years, while light surface fires were very rare. Overstory was dominated by late successional beech (*Fagus grandifolia*) and hemlock (*Tsuga canadensis*). Understory is composed of shade-tolerant, acid-tolerant forbs such as Canada mayflower (*Maianthemum canadense*). Kotar community, PArVVb (*Pinus strobus-Acer rubrum*/Vaccinium spp.-*Viburnum acerifolium*), understory indicator species include: *Acer saccharum*, *Aralia nudicaulis*, *Eurybia macrophylla*, *Galium triflorum*, *Gaultheria procumbens*, *Hamamelis virginiana*, *Lonicera canadensis*, Lysimachia borealis, *Maianthemum canadense*, *Mitchella repens*, Polygaloides paucifolia, *Polygonatum pubescens*, *Pteridium aquilinum*, *Trillium grandiflorum*, *Vaccinium angustifolium*, and *Viburnum acerifolium* (Sugar Maple, Wild Sarsaparilla, Big-leaved Aster, Fragrant Bedstraw, Teaberry, Witch-hazel, Canadian Fly Honeysuckle, Star-flower, Canada Mayflower, Partridge-berry, Fringed Polygala, Downy Solomon's-seal, Bracken Fern, Great White Trillium, Northern Lowbush Blueberry, and Maple-leaved Viburnum).

State and transition model

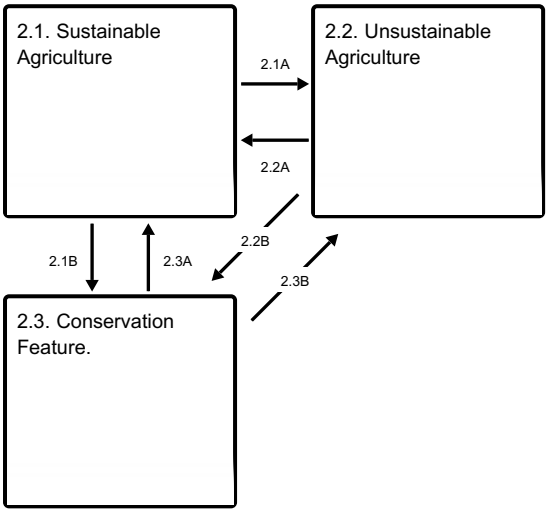
Ecosystem states



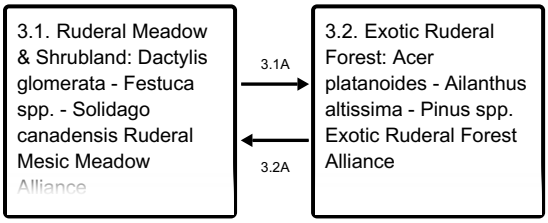
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

Dominant plant species

- American beech (*Fagus grandifolia*), tree
- eastern hemlock (*Tsuga canadensis*), tree
- Canada mayflower (*Maianthemum canadense*), other herbaceous

Community 1.1
Mesophytic Mixed Forest: Tsuga canadensis - Fagus grandifolia - (Acer saccharum) Great Lakes Forest

Community 1.2
Dry-Mesophytic Hardwood Forest: Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium Forest

Community 1.3
Native Ruderal Forest: Populus (tremuloides, grandidentata) - Betula (populifolia, papyrifera) Ruderal Woodland

Community 1.4
Pine Forest: Pinus resinosa - Pinus strobus - (Quercus rubra) / Corylus cornuta Forest

Pathway 1.1A
Community 1.1 to 1.2

Blowdown/clearcut followed by fire a few years after, destroying conifer regeneration, deferentially favoring oak regeneration.

Conservation practices

Prescribed Burning
Forest Stand Improvement

Pathway 1.1B
Community 1.1 to 1.3

Blowdown/clearcut

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

Pathway 1.1C
Community 1.1 to 1.4

Crown fire, or blowdown/clearcut with fire in close succession.

Conservation practices

Prescribed Burning
Forest Stand Improvement

Pathway 1.2A
Community 1.2 to 1.1

Succession

Pathway 1.2C
Community 1.2 to 1.3

Blowdown/clearcut

Pathway 1.2B
Community 1.2 to 1.4

Crown fire, or blowdown/clearcut with fire in close succession.

Conservation practices

Prescribed Burning

Forest stand improvement for habitat and soil quality

Pathway 1.3A
Community 1.3 to 1.1

Succession

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.3C
Community 1.3 to 1.2

Succession if fire consumed any subsequent pine regeneration.

Pathway 1.3B
Community 1.3 to 1.4

Light fire removes the leaf litter, allowing for pine seedlings to establish followed by succession.

Pathway 1.4A
Community 1.4 to 1.1

Succession.

Pathway 1.4C
Community 1.4 to 1.2

Blowdown/clearcut followed by fire a few years after, destroying conifer regeneration, deferentially favoring oak regeneration.

Pathway 1.4B
Community 1.4 to 1.3

Blowdown, clearcut, or crown fire, with establishment of clonal tree species.

State 2
Cultural State

Community 2.1
Sustainable Agriculture

Community 2.2
Unsustainable Agriculture

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

Apply unsustainable farming techniques.

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

Apply sustainable farming techniques.

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

Revert to sustainable agriculture.

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 agriculture.

State 3
Seminatural State

Community 3.1
Ruderal Meadow & Shrubland: Dactylis glomerata - Festuca spp. - Solidago canadensis Ruderal Mesic Meadow Alliance

Community 3.2
Exotic Ruderal Forest: Acer platanoides - Ailanthus altissima - Pinus spp. Exotic Ruderal Forest Alliance

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

Transition 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

Gregory J. Schmidt

Approval

Greg Schmidt, 9/11/2024

Acknowledgments

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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	10/30/2023
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:**

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:**