USDA Natural Resources
Conservation Service

# Ecological site F094AB020MI
# Acidic Sandy Depression

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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): 094A–Northern Michigan Sandy Highlands

This area is dominated by outwash plains and moraines. The terrain can be steep on the moraines and flat in the areas of outwash. Elevation ranges from 177 to 520 m (580 to 1705 ft). Local topographic relief averages 14 m and ranges up to 188 m (45 to 615 ft). This area is covered entirely by drift. Bedrock consisting of Devonian limestone and dolomite with interbedded shale, chert, and anhydrite stringers is at various depths below the surface because of the curvature of the Michigan basin. However, bedrock exposures completely absent, as the depth of glacial drift ranges from 60 to 300 m (200-1000 ft). The Au Sable, Manistee, Au Gres, and Pine Rivers are the major streams draining this MLRA, in both the Lake Michigan and Lake Huron watersheds. The Muskegon River has its headwaters in this area.

About 70 percent of this area is forested, and about 15 percent is cropland or hayland. About one-third of the area is in small, privately owned holdings, and another one-third consists of national and State forests. The forests are used mainly for timber production and recreation. Dairy and beef operations are very important enterprises in the area. Forage and feed grains for dairy cattle and other livestock are the principal crops. Wheat, oats, corn, potatoes, and hay also are grown in the area. The Huron and Manistee National Forests, Hartwick Pines State Park, Camp Grayling (Department of Defense), Pigeon River Country State Forest are among the most notable conservation lands in the area. Reaches of the Au Sable and Pine Rivers are National Wild and Scenic Rivers.

Summary of existing land use:
Upland Forest (58%)
Hardwood (41%)
Conifer (15%)
Swamps and Marshes (14%)
Developed (11%)
Agricultural (10%)
Grassland (5%)

## Classification relationships

According to the USFS (Bailey) system of ecoregions, the site is located mostly within 212Hg (Kirtland's Warbler High Sand Plains) and 212Hh (Gladwin Silty Lake Plain) subsections. According to the EPA (Omernik) system of ecoregions, the site is located in 50ae (Mio Plateau), 50ah (Tawas Lake Plain) and eastern 50ad (Vanderbilt Moraines) level IV ecoregions. This site roughly corresponds to PArVCo, in the Kotar system. This site corresponds to the Lowland, ecological land type phase, 62, in the USFS Ecological Land Type system.

## Ecological site concept

The central concept of Acidic Sandy Depression is lowlands with a seasonal high watertable 25 to 100 cm deep (moderately well drained or somewhat poorly drained) and a soil pH of the upper 50 cm less than 5.5, and a low base saturation, including Spodosols, Ultic subgroups, and dysic great groups and families. 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 outside the heavy snowfall belt, mostly east of Houghton Lake where fire was frequent. Vegetation trending towards mesophytic forest with an acidophilic species composition.

## Associated sites

| F094AB021MI | **Wet Acidic Sandy Depression** |
| | Wet Acidic Sandy Depression has a higher water table, and is hydric. Consequently, the vegetation is wetland, such as hardwood-conifer swamp. |
| F094AB019MI | **Dry Sandy Plains** |
| | Dry Sandy Plains has a lower amount of spodic development reflecting higher productivity or has lower pH, which drives lower productivity. Vegetation tends to be more open with more jack pine and higher fire frequencies. |

## Similar sites

| F094AA007MI | **Snowy Acidic Sandy Depression** |
| | Snowy Acidic Sandy Depression has a greater amount of annual snowfall, and a lower fire frequency. Consequently, the species composition is less pine and more hemlock. |

**Table 1. Dominant plant species**

| Tree | (1) *Pinus strobus* |
| --- | --- |
| Shrub | Not specified |
| Herbaceous | (1) *Cornus canadensis* |

## Physiographic features

Site occurs on coarse textured ice contact, glacial till, outwash, and lake plain deposits. Landforms are gently sloping lower slope positions and depressions.

**Table 2. Representative physiographic features**

| Landforms | (1) Outwash plain<br>(2) Kame<br>(3) Lake plain |
|---|---|
| Runoff class | Negligible to low |
| Elevation | 177–479 m |
| Water table depth | 25–99 cm |
| Aspect | Aspect is not a significant factor |

## Climatic features

Mean annual temperatures are 5.7 to 7.6 °C (42 to 46 °F). The warmest six months average 14.3 to 16.1 °C (58 to 61 °F). Mean July temperatures range from 19.1 to 20.8 °C (66 to 69 °F). Mean January temperatures range from -8.2 to -6.0 °C (17 to 21 °F). The maximum monthly average daily highs are 25.9 to 27.7 °C (79 to 82 °F). The minimum monthly average daily lows are -13.2 to -10.7 °C (8 to 13 °F).Temperatures generally decrease with elevation and latitude. Mean annual precipitation ranges from 700 to 870 mm (28 to 34 in). Precipitation decreases from west to east. Average 0 °C (32 °F) frost-free season ranges from 73 to 144 days. Average -2 °C (28 °F) freeze-free season is 106 to 172 days. Mean annual snowfall ranges from 1.1 to 2.9 m (40 to 120 in). Snowfall decreases from northwest to southeast. Mean annual extreme minimum temperatures range from -33.3 to -23.1 °C (-28 to -10 °F), or hardiness zones 4a to 6a.

**Table 3. Representative climatic features**

| Frost-free period (characteristic range) | 76-110 days |
|---|---|
| Freeze-free period (characteristic range) | 119-143 days |
| Precipitation total (characteristic range) | 737-787 mm |
| Frost-free period (actual range) | 52-113 days |
| Freeze-free period (actual range) | 114-150 days |
| Precipitation total (actual range) | 711-838 mm |
| Frost-free period (average) | 92 days |
| Freeze-free period (average) | 133 days |
| Precipitation total (average) | 762 mm |

## Climate stations used

- (1) MIO HYDRO PLT [USC00205531], Mio, MI
- (2) WEST BRANCH 3SE [USC00208800], West Branch, MI
- (3) HOUGHTON LK ROSCOMMON AP [USW00094814], Houghton Lake, MI
- (4) EAST TAWAS [USC00202423], Tawas City, MI
- (5) VANDERBILT 11ENE [USC00208417], Vanderbilt, MI
- (6) HALE LOUD DAM [USC00203529], Glennie, MI
- (7) GRAYLING [USC00203391], Grayling, MI

## Influencing water features

Site is moderately well to somewhat poorly drained with seasonally high water table within 25-100 cm of the surface.

## Soil features

Soils are somewhat poorly drained to moderately well drained sands. They are commonly classified Oxyaquic Haplorthods, Typic Endoaquods, and Alfic Oxyaquic Haplorthods, and commonly mapped as Croswell, Au Gres, and Morganlake series or components. The top 50 cm has a typical pH of 5.4 and is 90% sand and 1.3% organic

matter. At depth, pH ranges up to 6.4, and texture averages 90% sand and 5% clay. Depth to impeded hydraulic conductivity or root restrictive layers averages >200 cm. Depth to carbonates averages >200 cm.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Outwash |
| Surface texture | (1) Sand |
| Drainage class | Somewhat poorly drained to moderately well drained |
| Permeability class | Moderately rapid to rapid |
| Soil depth | 201 cm |
| Surface fragment cover <=3" | 0–1% |
| Surface fragment cover >3" | 0% |
| Available water capacity (0-100.1cm) | 3.99–10.01 cm |
| Soil reaction (1:1 water) (0-50cm) | 3.5–5.5 |
| Subsurface fragment volume <=3" (0-150.1cm) | 0–10% |
| Subsurface fragment volume >3" (0-150.1cm) | 0–5% |

## Ecological dynamics

Acidic Sandy Depression tends to share the same ecological dynamics as Natureserve/Landfire system, Laurentian-Acadian Pine-Hemlock-Hardwood Forest. Stand replacing fires occurred every 150-600 years, with light surface fires every 30-115 years. Overstory was dominated by fire dependent, early successional pine (Pinus spp.) or oak (Quercus spp.). The moist low nutrient status of the soil tends to support Ericaceae, and species with boreal affinities like dwarf dogwood (*Cornus canadensis*). Kotar community, PArVCo (Pinus spp.-*Acer rubrum*/Vaccinium spp.-*Cornus canadensis*), understory indicator species include: *Aralia nudicaulis*, *Clintonia borealis*, *Coptis trifolia*, *Cornus canadensis*, *Eurybia macrophylla*, *Gaultheria procumbens*, Lysimachia borealis, *Maianthemum canadense*, *Medeola virginiana*, *Mitchella repens*, Osmundastrum cinnamomeum, *Pteridium aquilinum*, *Vaccinium angustifolium*, and *Viburnum lentago* (Wild Sarsaparilla, Yellow Bluebead-Lily, Goldthread, Bunchberry, Big-leaved Aster, Teaberry, Star-flower, Canada Mayflower, Indian Cucumber-root, Partridge-berry, Cinnamon Fern, Bracken Fern, Northern Lowbush Blueberry, and Nannyberry).
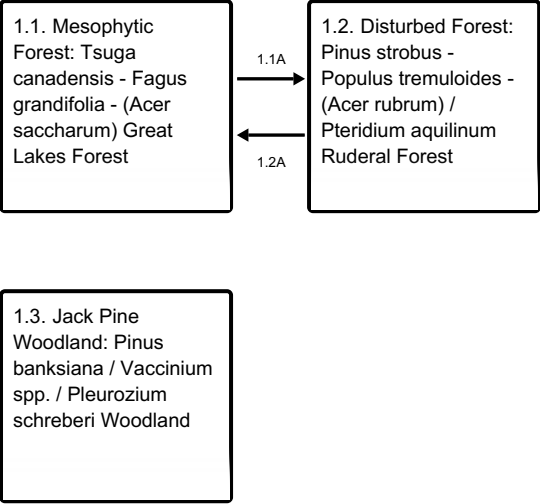
## State and transition model

**Ecosystem states**
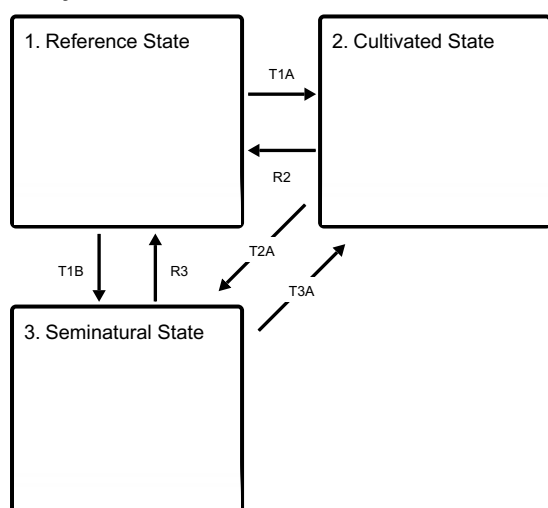


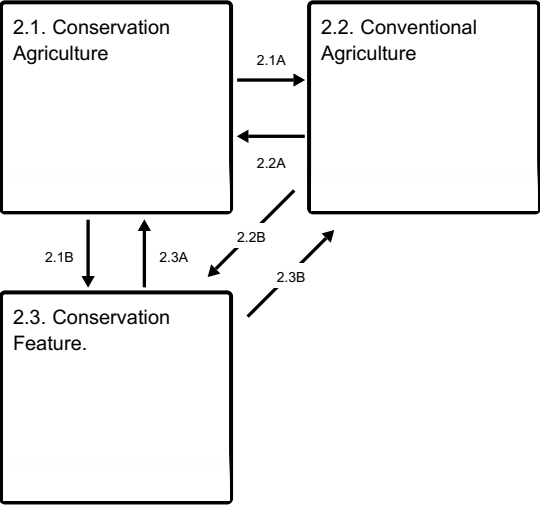**T1A** - Clear vegetation; cultivate crop species.

**T1B** - Clear vegetation, invasive species introduced.

**R2** - Remove crop species; restore native species.

**T2A** - Abandoned, succession.

**R3** - Control invasive species; restore native species.

**T3A** - Clear vegetation; cultivate crop species.
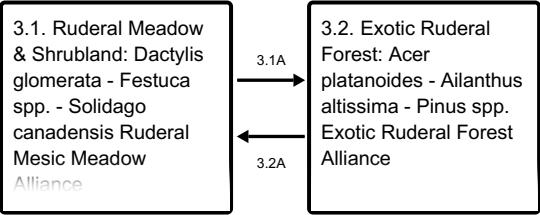
**State 1 submodel, plant communities**

| 1.1. Mesophytic Forest: Tsuga canadensis - Fagus grandifolia - (Acer saccharum) Great Lakes Forest | 1.1A → ← 1.2A | 1.2. Disturbed Forest: Pinus strobus - Populus tremuloides - (Acer rubrum) / Pteridium aquilinum Ruderal Forest |

1.3. Jack Pine Woodland: Pinus banksiana / Vaccinium spp. / Pleurozium schreberi Woodland

**1.1A** - Blowdown/clearcut/fire.

**1.2A** - Succession

**State 2 submodel, plant communities**

| 2.1. Conservation Agriculture | 2.1A → ← 2.2A | 2.2. Conventional Agriculture |

2.1B ↓  2.3A ↑   2.2B   2.3B

2.3. Conservation Feature.

**State 3 submodel, plant communities**

| 3.1. Ruderal Meadow & Shrubland: Dactylis glomerata - Festuca spp. - Solidago canadensis Ruderal Mesic Meadow Alliance | 3.1A → ← 3.2A | 3.2. Exotic Ruderal Forest: Acer platanoides - Ailanthus altissima - Pinus spp. Exotic Ruderal Forest Alliance |

# State 1
# Reference State

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

**Dominant plant species**

- eastern hemlock (*Tsuga canadensis*), tree
- American beech (*Fagus grandifolia*), tree
- sugar maple (*Acer saccharum*), tree

## Community 1.2
## Disturbed Forest: Pinus strobus - Populus tremuloides - (Acer rubrum) / Pteridium aquilinum Ruderal Forest

**Dominant plant species**

- eastern white pine (*Pinus strobus*), tree
- quaking aspen (*Populus tremuloides*), tree
- red maple (*Acer rubrum*), tree
- western brackenfern (*Pteridium aquilinum*), other herbaceous

## Community 1.3
## Jack Pine Woodland: Pinus banksiana / Vaccinium spp. / Pleurozium schreberi Woodland



Figure 8. Jack pine intermixed with black spruce.

**Dominant plant species**

- jack pine (*Pinus banksiana*), tree
- velvetleaf huckleberry (*Vaccinium myrtilloides*), shrub

## Pathway 1.1A
## Community 1.1 to 1.2

Blowdown/clearcut/fire.

**Conservation practices**

| |
|---|
| Prescribed Burning |
| Forest Stand Improvement |

## Pathway 1.2A
## Community 1.2 to 1.1

Succession

## State 2
## Cultivated State

Site can be used for Christmas tree farms or pasture, but otherwise growing season too short and soils too infertile for most food crops.

## Community 2.1
## Conservation Agriculture

## Community 2.2
## Conventional 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 crop species.

## Transition T1B
## State 1 to 3

Clear vegetation, invasive species introduced.

## Restoration pathway R2
## State 2 to 1

Remove crop 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 crop species.

## Additional community tables

**Table 5. Community 1.3 forest overstory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (M) | Canopy Cover (%) | Diameter (Cm) | Basal Area (Square M/Hectare) |
|---|---|---|---|---|---|---|---|
| **Tree** | | | | | | | |
| jack pine | PIBA2 | *Pinus banksiana* | Native | 7.2–15.6 | 45.5–54.5 | 15–30 | – |
| black spruce | PIMA | *Picea mariana* | Native | 5–10 | 3.6–9.4 | 15 | – |
| jack pine | PIBA2 | *Pinus banksiana* | Native | 6–12 | 1.9–5.1 | – | – |
| black cherry | PRSE2 | *Prunus serotina* | Native | 4–8 | 0.3–0.7 | – | – |

**Table 6. Community 1.3 forest understory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (M) | Canopy Cover (%) |
|---|---|---|---|---|---|
| **Grass/grass-like (Graminoids)** | | | | | |
| Pennsylvania sedge | CAPE6 | *Carex pensylvanica* | Native | 0.1–0.2 | 2.9–7.3 |
| **Forb/Herb** | | | | | |
| starflower | TRBO2 | *Trientalis borealis* | Native | 0–0.1 | 0.1–0.3 |
| rattlesnakeweed | HIVE | *Hieracium venosum* | Native | 0–0.1 | 0.1 |
| Canada mayflower | MACA4 | *Maianthemum canadense* | Native | 0–0.1 | 0.1 |
| narrowleaf cowwheat | MELI2 | *Melampyrum lineare* | Native | 0–0.1 | 0.1 |
| **Fern/fern ally** | | | | | |
| western brackenfern | PTAQ | *Pteridium aquilinum* | Native | 0.3–0.7 | 32.4–47.6 |
| **Shrub/Subshrub** | | | | | |
| lowbush blueberry | VAAN | *Vaccinium angustifolium* | Native | 0.2–0.5 | 8.5–22.5 |
| eastern teaberry | GAPR2 | *Gaultheria procumbens* | Native | 0.1–0.2 | 20.1–21.9 |
| velvetleaf huckleberry | VAMY | *Vaccinium myrtilloides* | Native | 0.1–0.3 | 5.2–13.8 |
| sheep laurel | KAAN | *Kalmia angustifolia* | Native | 0.2–0.5 | 3.3–7.5 |
| bristly dewberry | RUHI | *Rubus hispidus* | Native | 0.1–0.3 | 2.9–7.3 |
| sweet fern | COPE80 | *Comptonia peregrina* | Native | 0.2–0.5 | 0.1–0.3 |
| trailing arbutus | EPRE2 | *Epigaea repens* | Native | 0.1–0.3 | 0.1–0.3 |
| **Tree** | | | | | |
| black spruce | PIMA | *Picea mariana* | Native | 2.5–5 | 2.2–5.8 |
| black spruce | PIMA | *Picea mariana* | Native | 0.2–0.5 | 0.6–1.4 |
| balsam fir | ABBA | *Abies balsamea* | Native | 2.5–5 | 0.6–1.4 |
| black cherry | PRSE2 | *Prunus serotina* | Native | 0.2–0.5 | 0.1–0.3 |
| red maple | ACRU | *Acer rubrum* | Native | 0.2–0.5 | 0.1–0.3 |
| eastern white pine | PIST | *Pinus strobus* | Native | 2.5–5 | 0.1–0.2 |
| eastern white pine | PIST | *Pinus strobus* | Native | 0.2–0.5 | 0.1 |
| **Biological Crusts** | | | | | |
| greygreen reindeer lichen | CLRA60 | *Cladina rangiferina* | Native | – | 0.6–10.9 |
| **Nonvascular** | | | | | |
| dicranum moss | DIPO70 | *Dicranum polysetum* | Native | – | 32.8–37.2 |
| Schreber's big red stem moss | PLSC70 | *Pleurozium schreberi* | Native | – | 5.5–14.5 |
| polytrichum moss | POLYT5 | *Polytrichum* | Native | – | 1.4–3.6 |
| leucobryum moss | LEUCO9 | *Leucobryum* | Native | – | 0.3–0.7 |

## Inventory data references

Medium intensity field data was collected in 2024 from 2 sites representing community phase 1.3. More data are needed from other community phases to verify this provisional ecological site.

## 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, 2/25/2025

## 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 | 11/25/2024 |
| Approved by | Greg Schmidt |
| 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:**