USDA Natural Resources
Conservation Service

Ecological site F003XD806OR
Frigid Udic Maritime Mountain Slopes 60-90 PZ

Last updated: 1/29/2025
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.

MLRA notes

Major Land Resource Area (MLRA): 003X–Olympic and Cascade Mountains

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This area includes the west slope and parts of the east slope of the Cascades Mountains in Washington and Oregon. The Olympic Mountains in Washington State are also included. These mountains are part of a volcanic arc located at a convergent plate boundary. Volcanic rocks predominate but metamorphic and sedimentary rocks occur in the North Cascades and Olympic Mountains. Topography is generally dissected and steep, but some areas consist of constructional volcanic platforms and isolated stratovolcanoes. Elevation is usually 500 to 6000 feet but reaches to 14,410 ft at the summit of Mount Rainier. Many areas hosted alpine glaciers or ice sheets during the Pleistocene, and a few remain today.

Climate becomes cooler and moister with increasing elevation and latitude. Low elevations experience a long growing season and mild temperatures. High elevations can accumulate snowpack lasting into summer and frost may occur in any month. Average annual precipitation ranges from 60 to 180 inches in most areas. Most precipitation falls during the fall, winter, and spring during low-intensity frontal storms. Summers are relatively dry. Average annual temperature is 27 to 50 degrees F. The frost-free period is 10 to 180 days.

Classification relationships

Forested Plant Associations of the Oregon East Cascades (Simpson 2007)
Plant association group – Western Hemlock, Wet

Plant Associations of the Commercial Forest of the Warm Springs Indian Reservation (Marsh 1987)
Western Hemlock / Rhododendron macrophyllum
Western Hemlock / Vine Maple

Landfire biophysical settings model (Landfire 2007)
0711740 North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest

Ecological site concept

This site encompasses a group of forest communities encompassed by the modified maritime influenced, western hemlock (Tsuga heterophylla) zone at middle elevations on the east slope of the Oregon Cascades. In reference condition, this site supports a forest canopy dominated by western hemlock, Douglas-fir (Pseudotsuga menziesii), with noble fir (Abies procera) and understory reproduction of Douglas fir, western hemlock and grand fir common. Plant community diversity is high with many wet site indicator species present such as pacific rhododendron (Rhododendron macrophyllum), prince’s pine (Chimaphila umbellata), bigleaf huckleberry (Vaccinium membranaceum), Oregon boxwood (Paxistima myrsinites), bride’s bonnet (Clintonia uniflora), pacific trillium (Trillium ovatum) and beargrass (Xerophyllum tenax). In comparison to mixed conifer sites receiving less

precipitation, the maritime influence of this site results in a udic rather than xeric soil moisture regime with greater available moisture during the summer season. In comparison to mixed conifer sites dominated by grand fir, protected slope aspects and higher precipitation facilitate higher effective moisture conditions beneficial to western hemlock, and further prolong fire return intervals. Unlike forest sites found further west in the Oregon cascades, the maritime influence of this site is weakened by the rainshadow effect of the Cascade crest, resulting in lower mean annual precipitation and larger temperature variations in winter. In comparison to sites situated at higher elevations toward the Cascade crest, where mountain hemlock (Tsuga mertensiana) or pacific silver fir (Abies amabilis) may become important canopy dominates overtime, this site has a frigid rather than cryic soil temperature.. This condition favors the competitive dominance of western hemlock which requires warmer temperatures and shallower snowpacks in order to persist.

This is a provisional ecological site that groups characteristics at a broad scale with little to no field verification and is subject to extensive review and revision before final approval. All data herein was developed using existing information and literature and should be considered provisional and contingent upon field validation prior to use in conservation planning

Associated sites

F003XD805OR	**Frigid Udic Maritime Mountain Slopes 40-60 PZ** Occupying landforms downslope or landscape positions with lower precipitation and/or soil moisture accumulation and retention.

Similar sites

F003XD805OR	**Frigid Udic Maritime Mountain Slopes 40-60 PZ** Lower precipitation, western hemlock less common

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Pseudotsuga menziesii*
Shrub	(1) *Acer circinatum*
Herbaceous	Not specified

Physiographic features

This site is largely found occupying middle elevations on the east slope of the Cascades in Oregon. Within this range the site is primarily found on benches and slopes of mountains. Elevations are commonly 3,400 – 5,600 ft (1,050 – 1,700 m). Slopes are most often 0 – 30% but can be as steep as 65%. This site is often found on North and East aspects but can be found on all aspects. This site does not experience flooding or ponding and no water table is present within the upper two meters of soil.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope (2) Mountains > Bench
Flooding frequency	None
Ponding frequency	None
Elevation	3,400–5,600 ft
Slope	0–30%
Water table depth	100 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–65%
Water table depth	Not specified

Climatic features

The average annual precipitation ranges from 60 - 90 in (150 – 230 cm) which occurs mainly between the months of November and June, mostly in the form of rain and snow. The average annual air temperature ranges from 39 - 43° F (4 - 6 °C) and the frost-free period ranges from 40 to 90 days. The soil temperature regime is frigid, soil moisture regime is udic. This climate is influenced by maritime weather patterns emerging from the pacific coast which bring greater precipitation and higher winter temperatures. These patterns are somewhat modified by the Cascade crest, which due to orographic uplift, buffers the site from the greater maritime impacts experienced by forests in the Western Cascades. The graphs below are populated from the closest available weather station to representative site locations and are provided to indicate general climate patterns.

Table 4. Representative climatic features

Frost-free period (characteristic range)	40-90 days
Freeze-free period (characteristic range)	100-140 days
Precipitation total (characteristic range)	60-90 in
Frost-free period (average)	65 days
Freeze-free period (average)	120 days
Precipitation total (average)	75 in

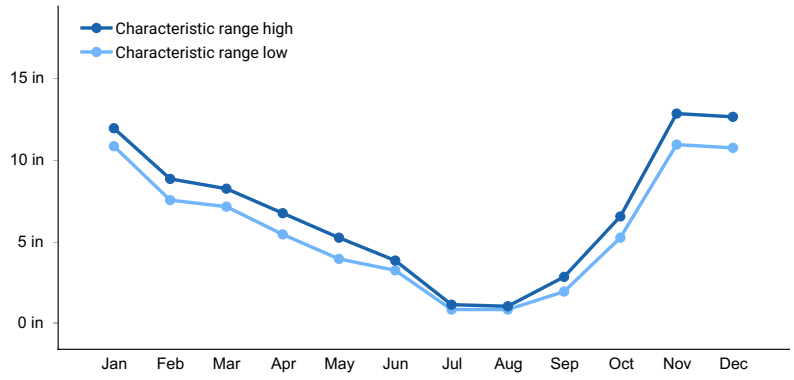


Figure 1. Monthly precipitation range

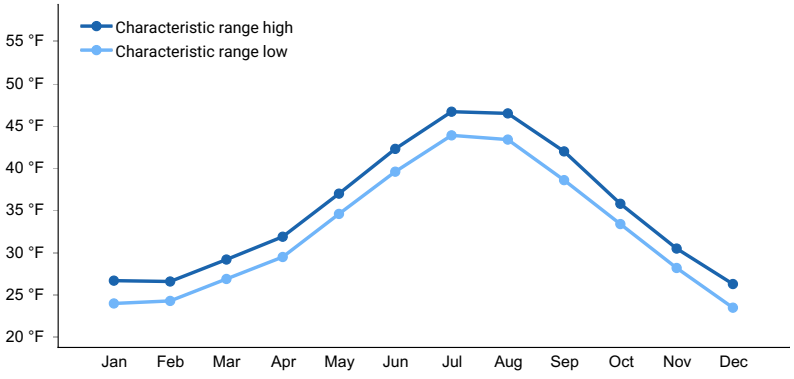


Figure 2. Monthly minimum temperature range

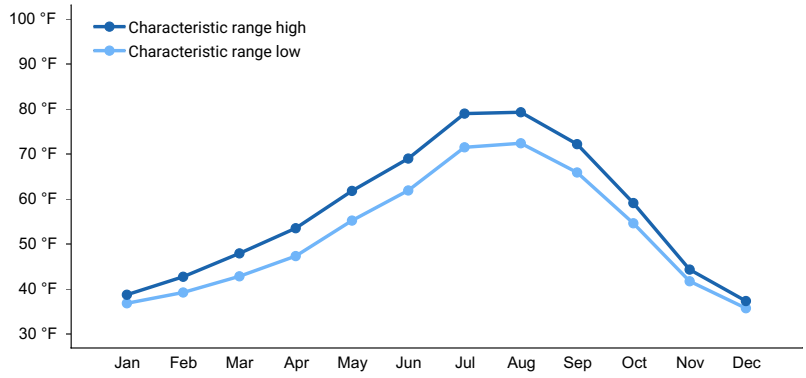


Figure 3. Monthly maximum temperature range

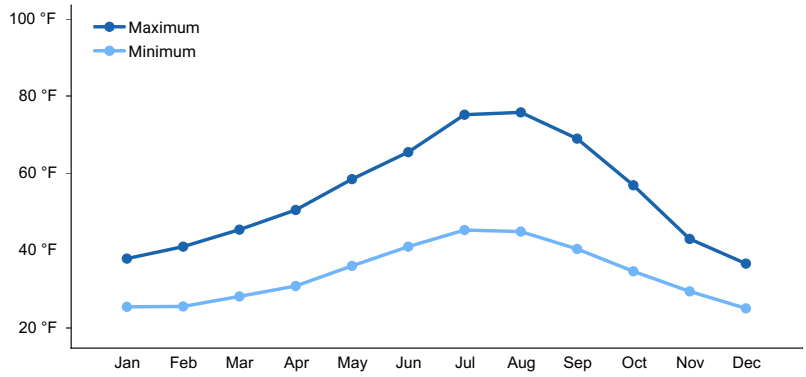


Figure 4. Monthly average minimum and maximum temperature

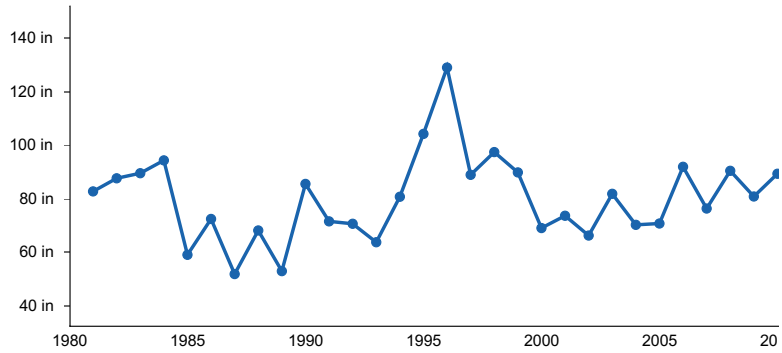


Figure 5. Annual precipitation pattern

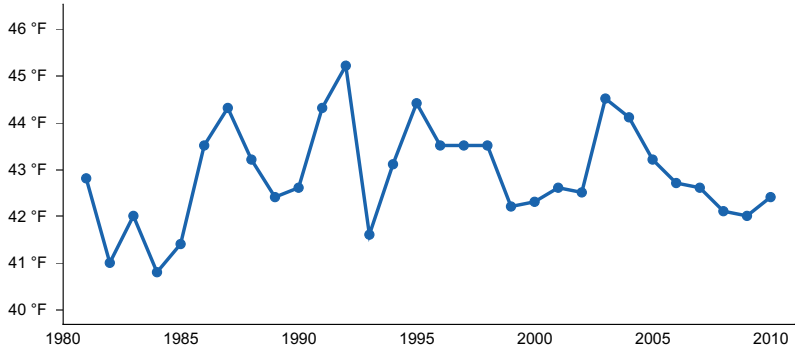


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MARION FRKS FISH HATCH [USC00355221], Willamette Natl Forest, OR
- (2) SANTIAM JUNCTION [USC00357554], Blue River, OR
- (3) GOVERNMENT CAMP [USC00353402], Government Camp, OR

Influencing water features

This site is not influenced by water from a wetland or stream.

Soil features

The soils that typify this site concept are moderately deep to very deep over paralithic bedrock. Soil parent materials are commonly colluvium and residuum weathered from andesite, either mixed or mantled with volcanic ash. Soil drainage and available water content are influenced by ash content and rock fragments throughout the profile. These are primarily somewhat excessively drained to well drained soils that often contain substantial subsurface rock fragments. Surface textures are commonly sandy loams but range to very gravelly and very cobbly or stony sandy loams.

Table 5. Representative soil features

Parent material	(1) Colluvium–andesite (2) Residuum–andesite (3) Volcanic ash–volcanic rock
Surface texture	(1) Very gravelly sandy loam (2) Very cobbly sandy loam (3) Very stony sandy loam (4) Sandy loam
Family particle size	(1) Medial-skeletal (2) Ashy-skeletal
Drainage class	Excessively drained
Permeability class	Moderate to rapid
Depth to restrictive layer	20–80 in
Soil depth	20–80 in
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-40in)	1.6–4.14 in
Soil reaction (1:1 water) (0-40in)	5.1–6
Subsurface fragment volume <=3" (4-60in)	5–45%
Subsurface fragment volume >3" (4-60in)	10–45%

Table 6. Representative soil features (actual values)

Drainage class	Well drained to excessively drained
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	Not specified
Soil reaction (1:1 water) (0-40in)	Not specified

Subsurface fragment volume <=3" (4-60in)	Not specified
Subsurface fragment volume >3" (4-60in)	Not specified

Ecological dynamics

Reference Plant community:

As a Eastern Cascades western hemlock site, this site occupies favorable aspects and moist sites adjacent to udic mixed conifer forests and below the cold silver fir forests. The reference plant community for this site is that of a diverse canopy composed of a mixture of predominately Douglas fir, and western hemlock, with noble fir common and western white pine (*Pinus monticola*), pacific silver fir, western larch (*Larix occidentalis*), and grand fir sometimes present to a lesser extent. Prevalence of pacific silver fir likely indicates moister soil conditions and succession to a silver fir dominated site overtime. Common understory shrubs may include pacific rhododendron, prince's pine, bigleaf huckleberry, Oregon boxwood, snowbrush (*Ceanothus velutinus*), and golden chinkapin (*Chrysolepis chrysophylla*). Herbaceous cover is often highly diverse, yet common members may include bride's bonnet, pacific trillium, twinflower (*Linnaea borealis*) and beargrass.

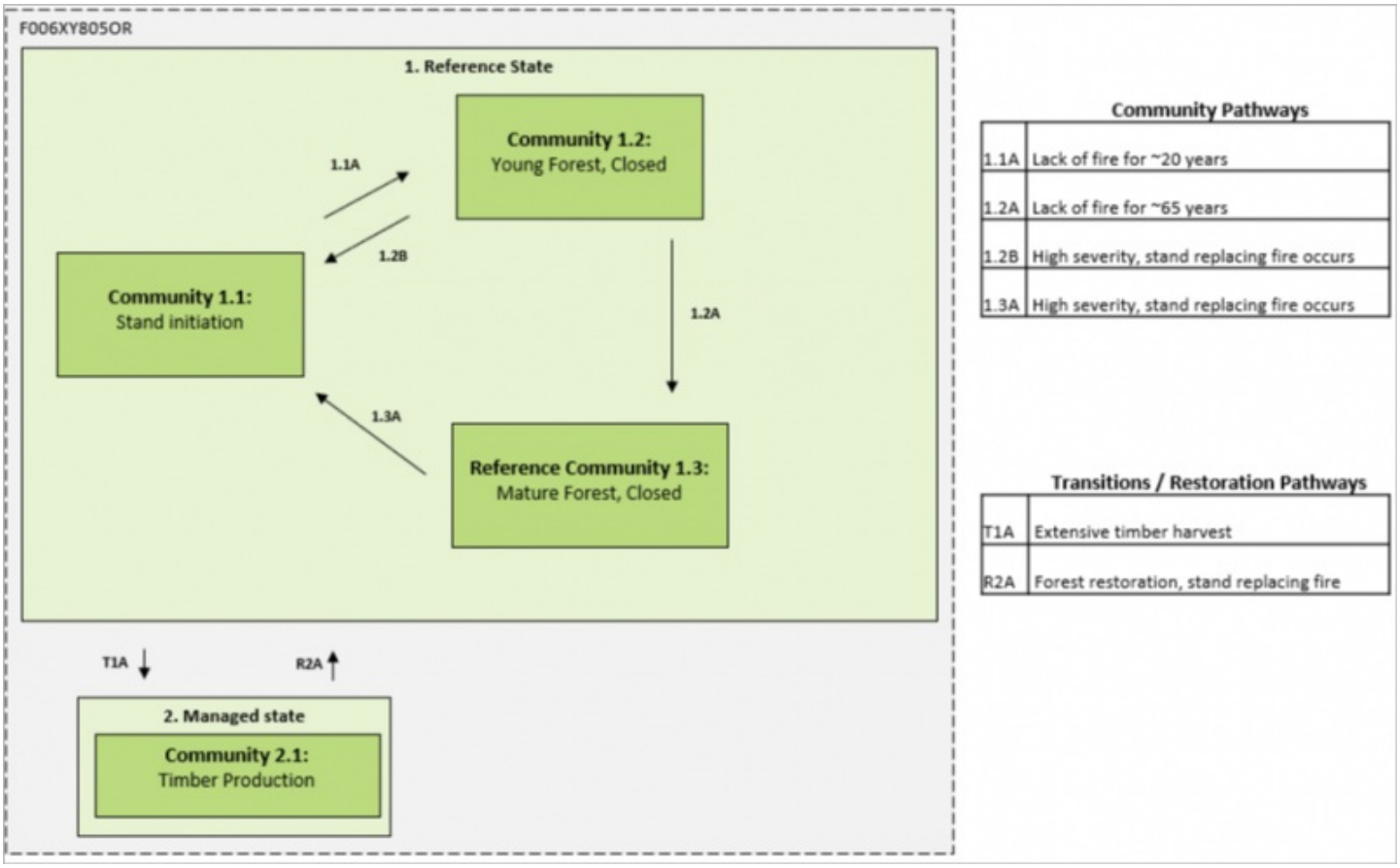
Disturbance:

Historically, Eastern Cascade western hemlock forests were likely subject to a fire regime characterized mainly by infrequent, mixed severity fire (Landfire fire regime group 3) (Simpson 2007, Landfire 2007). Variability in fire history is dependent on topographic characteristics, climate influences and species composition and will in turn influence species composition and forest structure. Longer fire intervals may favor western white pine and western larch, and less severe fires may also favor these species (Simpson 2007). Fire suppression may also reduce the proportion of Douglas-fir overtime (Agee 1993). These forest sites are also likely influenced by the fire regime of adjacent sites, whether these be the often more frequent fires of mixed conifer forests or less frequent fires of silver fir/mountain hemlock forests. These dynamics often result in a highly complex mosaic of forest structure and composition. Generally, however, the infrequent fire regime of this site combined with high precipitation, favors the development of closed canopy conditions. Following severe wildfire, these forests are often replaced with dense shrubfields that may persist for decades and may inhibit the reestablishment of tree species (Franklin and Dyrness 1973).

These sites are often of high productivity and attractive for commercial timber harvesting which will have varying effects on stand structure and composition depending on harvest practices. Dense shrub cover following fire or logging may delay stand regeneration (Marsh et al 1987). Livestock grazing potential is limited on this site due to closed canopy conditions and high shrub cover.

The state and transition model below represents a generalized and simplified version of forest change in response to fire in this ecological site. It does not attempt to model the complex effects of forestry practices or insect outbreaks on ecosystem change. It is largely based on Landfire biophysical settings model: 0711740 North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest and descriptions of disturbance dynamics for the Wet Western Hemlock series in Simpson (Landfire 207, Simpson 2007).

State and transition model



State 1
Reference

A highly productive forest community, this site occurs across the landscape as a mosaic of plant community phases characterized by variation in forest structural stage (tree age, density and cover) and plant community. This mosaic pattern is highly influenced by a mixed fire regime. As a highly productive forest community, this site will persist in closed canopy conditions represented by communities 1.2 and 1.3 most often with the mature closed forest community 1.3 representing the historical reference community. Open stand conditions on a large scale are possible following mixed severity fire but rarely persist given site productivity. On a smaller scale, avalanches and incidences of windthrow may also lead to open stand conditions. Given the likelihood that this state, even in the best condition and highest potential, will almost always include at least some component of exotic species regardless of management inputs, this may also be referred to as the “current potential state”. In this document, the term “reference state” is used synonymously with “current potential state” for the sake of simplicity. However, site productivity and diversity likely bolster resilience to invasion for this site and exotic species are not known to significantly alter plant community dynamics as of writing.

Community 1.1
Shrub Stand Initiation

This community is dominated by shrubs such as snowbrush, chinkapin and vine maple. These shrubfields may persist for decades yet are likely important for providing shade to young conifers, cycling nutrients and providing wildlife forage. Forest reestablishment will depend on seed sources and may require longer intervals if available sources are no longer onsite and must depend on wind or animal transport from adjacent forests. Fire with high enough severity to remove shrub cover will maintain this community. All other communities may transition to this phase after stand replacing fires.

Community 1.2
Young Closed Forest

This community is characterized by a closed canopy, densely stocked with young to intermediate aged Douglas fir, western white pine, western hemlock, and noble fir.

Community 1.3
Mature Closed Forest

This community is characterized by a closed canopy of mature trees. This is an uneven aged stand with mature conifers such as Douglas fir, noble fir and western hemlock. Silver fir is also likely, yet dominance is restricted to cooler sites. Western white pine and western larch may be common in stands experiencing more frequent fire.

Pathway 1.1A
Community 1.1 to 1.2

Lack of fire for ~10 - 40 years

Pathway 1.2B
Community 1.2 to 1.1

High severity, stand replacing fire occurs

Pathway 1.2A
Community 1.2 to 1.3

Lack of fire for ~80 years

Pathway 1.3A
Community 1.3 to 1.1

High severity, stand replacing fire occurs

State 2
Managed

This alternative state represents the many variations of timber harvesting that can occur in this site. This may result in a number of manipulated community types and pathways depending on strategies surrounding harvest, shrub control, weed control and replanting. Following harvest, some sites with adequate moisture and shrub seed source may be dominated by early seral shrubs. These may persist for decades yet are likely important for providing shade to young conifers, cycling nutrients and providing wildlife forage and cover.

Transition T1A
State 1 to 2

Extensive timber harvest followed by continual management for timber production that has significantly altered species compositions and resulting disturbance responses

Restoration pathway R2A
State 2 to 1

Alterations of forest tree species composition, as well as soil compaction and surface disturbances due to large machine usage may hinder passive forest reestablishment. Forest reestablishment may require shrub control and tree replanting if the desired goal is regaining a forest structure within a desired timeframe. Ecological forestry practices may promote a return to reference state. Stand replacing fire may lead to a transition to community 1.1 of the reference state if soil compaction is not severe, species composition has not been significantly altered and tree seed source is available.

Additional community tables

References

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Contributors

Andrew Neary - Concept developed for 2020 PES initiative

Approval

Kirt Walstad, 1/29/2025

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	05/10/2024
Approved by	Kirt Walstad
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:

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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:**
