

## **Ecological site AX001X02X403 Frigid Udic Moist Forest**

Last updated: 1/23/2025  
Accessed: 05/12/2025

---

### **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): 001X–Northern Pacific Coast Range, Foothills, and Valleys

This long and narrow resource area stretches along the Pacific Border Province of the Pacific Mountain System in Oregon and Washington. The area is bounded by the Olympic Mountains on the north and the Klamath Mountains on the south. Most of the area consists of hills and low mountains with gentle to steep slopes. The parent materials are composed primarily of young Tertiary sedimentary rocks with some minor volcanic rocks. Glacial till and outwash deposits are found in the northern half of the area within Washington. In the far southern portion of the area, near the Klamath Mountains, the sedimentary rocks are older and some have been metamorphosed. The average annual precipitation ranges from 60 to 200 inches, increasing with elevation.

The dominant soil orders in this MLRA are Andisols, Inceptisols, and Ultisols. Soil depth ranges from shallow to very deep. While most soils in the area are well drained and occur on foothills, mountain slopes and ridges, floodplain and depressional soils can range from well drained to very poorly drained. Soil textures are typically medial, loamy, or clayey. The dominant soils in the area have a mesic or frigid soil temperature regime and a udic soil moisture regime; however, soils with an aquic soil moisture regime or cryic soil temperature regime do occur.

### **LRU notes**

The North Pacific Coast Range land resource unit (LRU 2) of MLRA 1 is located in the northwestern corner on the Olympic Peninsula and within the Olympic National Forest in Washington State. LRU 2 is bounded on the west by MLRA 4a Sitka Spruce Belt and MLRA 2 Willamette and Puget Sound Valleys to the east. LRU 2 encircles the Olympic National Park (LRU 1). Several major rivers have headwaters in this LRU or carved valleys through the landscape depositing more recent alluvium. These include the Duckabush, Elwha, Queets, Quinault, Skokomish, Sol Duc, and Wynoochee Rivers.

### **Ecological site concept**

This ecological site is found on the western Coast Range on the Olympic Peninsula in Washington state. A temperate climate supports a variety of flora and fauna. Elevations are typically between 1,850 and 2,850 feet. The most common overstory species are Pacific silver fir (*Abies amabilis*), western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), and Douglas-fir (*Pseudotsuga menziesii*). The understory is floristically diverse as a result of more openings in the canopy cover. Common understory species may include Alaska huckleberry (*Vaccinium alaskaense*), red huckleberry (*Vaccinium parvifolium*), salmonberry (*Rubus spectabilis*), threeleaf foamflower (*Tiarella trifoliata*), deerfoot vanillaleaf (*Achlys triphylla*), queencup beadlelily (*Clintonia uniflora*), deer fern (*Blechnum spicant*), common ladyfern (*Athyrium filix-femina*), and western oakfern (*Gymnocarpium dryopteris*). The most common natural disturbance is windthrow of overstory trees, which results in patchy, small pockets of open areas. This in turn creates more canopy openings which allow more sunlight to reach the forest floor, leading to a shrubby understory. Frequent tip-ups also cause these sites to have a hummocky surface with an abundance of down woody debris.

In addition, western hemlock and Pacific silver fir are highly susceptible to rot diseases from fungi such as; *Armillaria ostoyae*, *Heterobasidion annosum*, *Phellinus weirii*, and *Echinodontium tinctorium* which may exacerbate

the extent and area of disturbance. Following root disease, Pacific silver fir is highly susceptible to fir engravers. The resulting openings in the canopy allow sunlight to reach the forest floor, benefiting the understory. Disturbance by fire is infrequent as a result of the high humidity, high elevation, and precipitation within the Pacific silver fir and western hemlock zones. The site has a fire interval of 500 years and may experience stand replacing catastrophic wildfires (US Department of Agriculture, 2012).

Associated sites

AX001X02X402	<b>Frigid Udic Forest</b> Frigid Udic Forest is typically located on steeper slopes within the same elevation range. They are well drained soils and sites lack threeleaf foamflower ( <i>Tiarella trifoliata</i> ) and common ladyfern ( <i>Athyrium filix-femina</i> ).
--------------	--

Table 1. Dominant plant species

Tree	(1) <i>Abies amabilis</i> (2) <i>Tsuga heterophylla</i>
Shrub	(1) <i>Vaccinium alaskaense</i> (2) <i>Rubus spectabilis</i>
Herbaceous	(1) <i>Tiarella trifoliata</i> (2) <i>Achlys triphylla</i>

Legacy ID

F001XB403WA

Physiographic features

This ecological site occurs across mountain slopes, proglacial lakes, and moraines.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope (2) Mountains > Proglacial lake (relict) (3) Mountains > Moraine
Flooding frequency	None
Ponding frequency	None
Elevation	1,850–2,850 ft
Slope	5–100%
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The climate has cool, moist summers and cold, wet winters. Mean annual precipitation ranges from 35 to 150 inches. Precipitation falls as snow during the winter months and there is a moderate snowpack. Average annual temperatures range from 43 to 46 degrees F. As a result of the shorter growing season resulting from higher elevations, colder temperatures, and longer durational snowpack these sites tend to be moderately productive.

Table 3. Representative climatic features

Frost-free period (characteristic range)	140-180 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	35-150 in

## Influencing water features

In general, this ecological site is not influenced by wetland or riparian water features but may be found on stream terraces or adjacent to wetland and riparian areas. This site does not experience flooding or ponding.

## Soil features

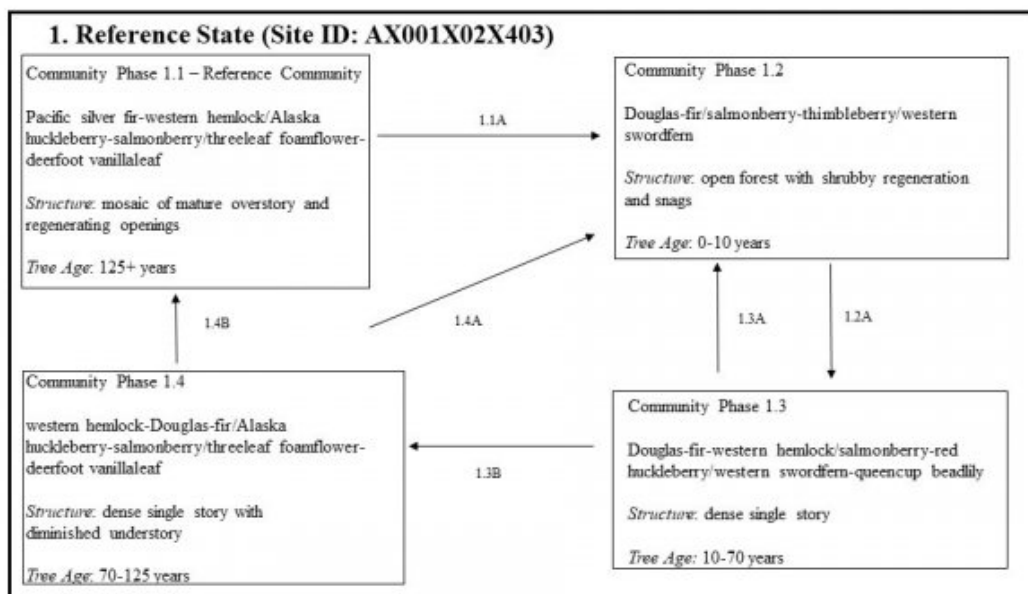
Soils that support this ecological site occur in the frigid soil temperature regime and the udic soil moisture regime. The soil is usually moist during the growing season. The abundance of soil moisture is favorable for plant growth.

**Table 4. Representative soil features**

Parent material	(1) Colluvium (2) Glaciolacustrine deposits (3) Till
Surface texture	(1) Very gravelly, extremely gravelly sandy loam (2) Fine sandy loam (3) Loam
Drainage class	Somewhat poorly drained to well drained
Depth to restrictive layer	40–60 in
Soil depth	40–60 in
Surface fragment cover ≤3"	0–47%
Surface fragment cover >3"	0–10%
Clay content (1–6in)	8–27%
Subsurface fragment volume ≤3" (1–60in)	23–40%
Subsurface fragment volume >3" (60in)	3–36%

## Ecological dynamics

### State and transition model



## State 1 Reference

### Community 1.1

#### Pacific Silver Fir, Western Hemlock, Alaska Huckleberry, Salmonberry, Threaleaf Foamflower, and Deerfoot Vanillaleaf

Pacific silver fir - western hemlock / Alaska huckleberry – salmonberry/ threaleaf foamflower – deerfoot vanillaleaf  
Structure: mosaic of mature overstory and regenerating openings Western hemlock and Pacific silver fir are the most common overstory species in the Reference Community which lacks major disturbance for at least 100 years. Both Pacific silver fir and western hemlock are considered to be very shade tolerant, and perhaps the most shade tolerant of any tree species in North America (Crawford, 1990). Douglas-fir and western redcedar will be present but there will be minimal Douglas-fir regeneration under closed canopy forests, at times, entirely absent. The dense canopy created by multiple age groups of hemlocks may block most of the sunlight from the forest floor, leading to sparse understory in some areas. Gaps in the mid-canopy and overstory allow sunlight to reach the ground are where the majority of the understory plants establish. When there is no mid-canopy, the understory tends to be more continuous. The most common natural disturbance on this site is the small gap dynamics following the death of one or two trees or windthrow. Common understory species include red huckleberry, salmonberry, Alaska huckleberry, threaleaf foamflower, deerfoot vanillaleaf, queencup beadlily, five-leaf bramble (*Rubus pedatus*), twistedstalk (*Streptopus lanceolatus*), deer fern, western oakfern, and common ladyfern.

#### Dominant plant species

- Pacific silver fir (*Abies amabilis*), tree
- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- Alaska blueberry (*Vaccinium alaskaense*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- salmonberry (*Rubus spectabilis*), shrub
- threaleaf foamflower (*Tiarella trifoliata*), other herbaceous
- sweet after death (*Achlys triphylla*), other herbaceous
- bride's bonnet (*Clintonia uniflora*), other herbaceous

- strawberryleaf raspberry (*Rubus pedatus*), other herbaceous
- twistedstalk (*Streptopus lanceolatus*), other herbaceous
- deer fern (*Blechnum spicant*), other herbaceous
- western oakfern (*Gymnocarpium dryopteris*), other herbaceous
- common ladyfern (*Athyrium filix-femina*), other herbaceous

## Community 1.2

### Douglas-fir, Salmonberry, Thimbleberry, and Western Swordfern

Douglas-fir / salmonberry – thimbleberry / western swordfern Structure: open forest with abundant regeneration and snags Community phase 1.2 is an early seral plant community that has been impacted by a stand-replacing disturbance such as a wildfire, timber management, large scale wind event, mass movement, or major insect pest or disease. Nearly all trees are absent, but some fire-resistant trees may survive in the overstory. Snags are prevalent and remain standing and decaying. Large stems may be present on the surface and serve as nurse sites. The understory is predominately early seral tree, shrub, and forb species such as red huckleberry, thimbleberry (*Rubus parviflorus*), and western swordfern (*Polystichum munitum*). Douglas-fir is relatively fire resistant and can survive moderately intense fires, due to its thick corky bark. Depending on fire severity and cambium damage, a mature Douglas-fir component may remain as a dominant overstory species, while western redcedar, Pacific silver fir, and western hemlock may be at full stand replacement post fire.

#### Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- salmonberry (*Rubus spectabilis*), shrub
- thimbleberry (*Rubus parviflorus*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous

## Community 1.3

### Douglas-fir, Western Hemlock, Salmonberry, Red Huckleberry, Western Swordfern, and Queencup Beadlily

Douglas-fir – western hemlock / salmonberry – red huckleberry / western swordfern – queencup beadlily Structure: dense single story Community phase 1.3 is an early seral forest in regeneration, possibly with scattered remnant mature trees. Species composition depends on the natural seed sources present and the intensity of disturbance. Red huckleberry and salmonberry may be abundant in the understory depending on sunlight availability.

#### Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- salmonberry (*Rubus spectabilis*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous
- bride's bonnet (*Clintonia uniflora*), other herbaceous

## Community 1.4

### Western Hemlock, Douglas-fir, Alaska Huckleberry, Salmonberry, Threeleaf Foamflower, and Deerfoot Vanillaleaf

Western hemlock – Douglas-fir / Alaska huckleberry – salmonberry / threeleaf foamflower – deerfoot vanillaleaf Structure: dense single story with diminished understory Community phase 1.4 is a forest in the competitive exclusion stage, possibly with scattered remnant mature trees. There is increasing competition among individual trees for available water and nutrients. Douglas-fir and western hemlock will dominate the overstory canopy, however species composition begins to phase out less shade tolerant species in favor of very shade tolerant species such as western hemlock and Pacific silver fir. Canopy closure is almost 100 percent leading to diminished shrub and forb layers. Some understory species better adapted to at least partial shade will begin to increase. Over time, the forest will begin to self-thin due to the elevated competition.

## **Dominant plant species**

- western hemlock (*Tsuga heterophylla*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- Pacific silver fir (*Abies amabilis*), tree
- Alaska blueberry (*Vaccinium alaskaense*), shrub
- salmonberry (*Rubus spectabilis*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- threeleaf foamflower (*Tiarella trifoliata*), other herbaceous
- sweet after death (*Achlys triphylla*), other herbaceous
- bride's bonnet (*Clintonia uniflora*), other herbaceous

## **Pathway 1.1A**

### **Community 1.1 to 1.2**

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, large scale wind event, major insect pest infestation, timber management, or large mass movement event leading to the stand initiation phase of forest development.

## **Pathway 1.2A**

### **Community 1.2 to 1.3**

This pathway represents growth over time with no further significant disturbance.

## **Pathway 1.3A**

### **Community 1.3 to 1.2**

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, large scale wind event, major insect pest or disease infestation, timber management, or large mass movement leading to the stand initiation phase of forest development.

## **Pathway 1.3B**

### **Community 1.3 to 1.4**

This pathway represents growth over time with no further significant disturbance.

## **Pathway 1.4B**

### **Community 1.4 to 1.1**

This pathway represents growth over time with no further major disturbance.

## **Pathway 1.4A**

### **Community 1.4 to 1.2**

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, large scale wind event, major insect pest or disease infestation, timber management, or large mass movement leading to the stand initiation phase of forest development.

## **Additional community tables**

### **Inventory data references**

Other Established Classifications for Ecological Site

National Vegetation Classification: G241 North Central Pacific Maritime Silver fir-Western Hemlock Rainforest and A3386 Pacific Silver Fir-Western Hemlock/Sweet After Death Forest Alliance

USDA Forest Service Plant Association of the Olympic National Forest: Pacific silver fir/Alaska

huckleberry/foamflower, Pacific silver fir/vanillaleaf-foamflower, and western hemlock/swordfern-oxalis

Washington Department of Natural Resources Ecological Systems of Washington State- North Pacific Mesic Western Hemlock-Silver fir Forest

## Other references

- Cope, Amy B. 1992. *Abies amabilis*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory.
- Crawford, P.D. 1990. *Abies amabilis*. Silvics of North America. [Online]. U.S. Department of Agriculture, Forest Service, Northeastern Area.
- Crawford, R. C., C. B. Chappell, C. C. Thompson, and F. J. Rocchio. 2009. Vegetation Classification of Mount Rainier, North Cascades, and Olympic National Parks. Natural Resource Technical Report NPS/NCCN/NRTR-2009/211. National Park Service, Fort Collins, Colorado.
- Goheen, E.M. and Willhite, E.A. 2006. Field Guide to Common Diseases and Inspect Pests of Oregon and Washington Conifers. Portland, Oregon: USDA Forest Service, Pacific Northwest Region R6-NR-FID-PR-01-06.
- Henderson, J., Peter, D., Leshner, R., Shaw, D. 1989. Forested Plant Associations of the Olympic National Forest. United States Department of Agriculture Forest Service, Pacific Northwest Region. Technical Paper R6-ECOL-TP 001-88.
- McCain, C., Diaz, N. 2002. Field Guide to the Forested Plant Associations of the Northern Oregon Coast Range. United States Department of Agriculture Forest Service, Pacific Northwest Region. Technical Paper R6-NR-Ecol-TP-03-02
- Pojar J., and MacKinnon. 1994. Plants of the Pacific Northwest Coast. Lone Pine, Vancouver, British Columbia. 528 pages.
- PRISM Climate Group, Oregon State University, <http://prism.oregonstate.edu>, visited Feb., 2015.
- Soil Survey Staff. 2014. Keys to Soil Taxonomy, 12th ed. USDA-Natural Resources Conservation Service, Washington, DC.
- Soil Survey Staff. 1999. Soil Taxonomy: A Basic System of Soil classification for Making and Interpreting Soil Surveys. 2nd ed. USDA-Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436. U.S. Department of Agriculture, Forest Service, Missoula Fire Sciences Laboratory. 2012. Information from LANDFIRE on fire regimes of wet-mesic western hemlock communities. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory (Producer). Available: [www.fs.fed.us/database/feis/fire\\_regimes/Western\\_hemlock\\_wet/all.html](http://www.fs.fed.us/database/feis/fire_regimes/Western_hemlock_wet/all.html) [ 2019, October 17].
- United States National Vegetation Classification. 2016. United States National Vegetation Classification Database, V2.0. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC. (accessed 28, November, 2016.)
- Washington Department of Natural Resources, Natural Heritage Program. 2015. Ecological Systems of Washington State. A Guide to Identification.

## Contributors

Erin Kreutz  
Erik Dahlke

## Approval

Kirt Walstad, 1/23/2025

## 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	12/03/2021
Approved by	Kirt Walstad
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:**
-