

Ecological site F003XB305WA

Low Mountain Slopes Moist Forest western hemlock

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

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.

LRU notes

The Olympic Mountains land resource unit is composed of the mid to upper elevation areas on the Olympic Peninsula in northwest Washington. It occurs primarily on the eastern side of the peninsula above the warmer, lower Olympic foothills of MLRA 2.

Large amounts of rain and snow contribute to a very moist environment and a considerable stream and river network. Major rivers that have headwaters in the LRU include the Elwha, Wynoochee, and Skokomish Rivers.

Lithology is primarily oceanic sedimentary rock stacked in an accretionary wedge and coastal basalt that has been metamorphosed and vertically uplifted into a large horseshoe shape called the Crescent Formation (Washington Geological Survey). This collection of rock has been metamorphosed in many cases. These geologic materials were heavily modified by Pleistocene alpine glaciation. Contemporary glaciers which receive copious amounts of yearly snowfall continue to sculpt the dissected valleys with runoff.

Soils are primarily Spodosols, Inceptisols, and unique Andisols developed from non-volcanic materials.

The LRU has a strong rainshadow effect and areas on the northeastern side of the peninsula are considerably drier than near-Pacific western slopes. Vegetation is primarily dense forest. At lower elevations, western hemlock (*Tsuga heterophylla*) is the dominant tree species; western redcedar (*Thuja plicata*) is quite common in moist areas and Douglas-fir (*Pseudotsuga menziesii*) is common in drier areas. Pacific silver fir (*Abies amabilis*) and mountain hemlock (*Tsuga mertensiana*) are the primary tree species in the higher elevations; subalpine fir (*Abies lasiocarpa*) and Alaska cedar (*Callitropsis nootkatensis*) can be widespread as well.

Classification relationships

USFS Plant Association: Western hemlock/Alaska huckleberry/salal, Olympic

Ecological site concept

This ecological site resides on mountain slopes at elevations spanning 2,900 to 4,100 feet on steep slopes averaging 60 to 95 percent primarily in the rainshadow area of the Olympic Mountains. The climate is warm and moist (frost free days average 130 to 155, mean annual precipitation is 65 to 95 inches, and mean annual air temperatures average 40 to 44 degrees Fahrenheit). The soils are Andisols with medial-skeletal soil textures or Inceptisols with loamy-skeletal textures. Andic soil properties are derived from the extreme weathering environment and higher amounts of organic matter in the soil; volcanic ash influence is minimal. Parent material is sedimentary rock or marine deposits derived from basalt. The soil temperature regime is cryic and the moisture regime straddles udic and xeric. Lithic contacts occur in some soils. The reference community has an overstory of western hemlock (*Tsuga heterophylla*) with western redcedar (*Thuja plicata*) with an understory dominated by shrubs usually Pacific rhododendron (*Rhododendron macrophyllum*), Alaska blueberry (*Vaccinium alaskaense*), vine maple (*Acer circinatum*), rusty menziesia (*Menziesia ferruginea*), deer fern (*Blechnum spicant*), western swordfern (*Polystichum munitum*), red huckleberry (*Vaccinium parvifolium*), salal (*Gaultheria shallon*). Seral tree species exist throughout the early and mid-development community phases and include Douglas fir (*Pseudotsuga menziesii*), Pacific silver fir (*Abies amabilis*), Cascade buckthorn (*Frangula purshiana*), Pacific yew (*Taxus brevifolia*) and in moister areas and red alder (*Alnus rubra*). Fire is the main disturbance factor and occurs on rotational intervals of 500 years and is stand replacing in severity in the Olympic Mountains. In the Pacific Northwest in general, western hemlock (*Tsuga heterophylla*) forests have fire return intervals of 150 to 400 years. LANDFIRE models state an average fire return interval of 500 years (300 to 800 years range) based on the 0710390 North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest B classification. Small patch disturbances include diseases Laminated (*Armillaria*, *Annosum*) root rots, heart, butt rot, and brown cubical rot, and hemlock dwarf mistletoe. Insect damage can also occur, particularly from the Douglas fir beetle.

Associated sites

F003XB307WA	High Mountain Slopes Forest Pacific silver fir
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Similar sites

F003XA305WA	Low Glacial Trough Valleys Moist Forest western hemlock
F003XC305WA	Low Mountain Slopes Moist Forest western hemlock

Table 1. Dominant plant species

Tree	(1) <i>Tsuga heterophylla</i>
Shrub	(1) <i>Rhododendron macrophyllum</i> (2) <i>Vaccinium alaskaense</i>
Herbaceous	(1) <i>Gaultheria shallon</i>

Physiographic features

This ecological site resides on mountain slopes in the mountains, at elevations spanning 2,900 to 4,100 feet on slopes averaging 60-95 percent.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	2,900–4,100 ft

Slope	60–95%
Aspect	W, NW, N, S, SW

Climatic features

The climate is warm and moist (frost free days average 130 to 155, mean annual precipitation is 65 to 95 inches and mean annual air temperatures average 40 to 44 degrees Fahrenheit).

Table 3. Representative climatic features

Frost-free period (characteristic range)	130-155 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	65-95 in

Influencing water features

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

Soil features

The soils are Andisols with medial-skeletal soil textures or Inceptisols with loamy-skeletal textures. Andic soil properties are derived from the extreme weathering environment and higher amounts of organic matter in the soil; volcanic ash influence is minimal. Parent material is sedimentary rock or marine deposits derived from basalt. The soil temperature regime is cryic and the moisture regime straddles udic and xeric. Lithic contacts occur in some soils.

Table 4. Representative soil features

Parent material	(1) Marine deposits–sedimentary rock (2) Basalt
Surface texture	(1) Extremely gravelly sandy loam
Family particle size	(1) Medial-skeletal (2) Loamy-skeletal
Drainage class	Well drained
Permeability class	Rapid
Depth to restrictive layer	10–60 in
Soil depth	10–60 in
Surface fragment cover ≤3"	40–50%
Surface fragment cover >3"	3–10%
Available water capacity (0-40in)	0.5–2.6 in
Calcium carbonate equivalent (Depth not specified)	0%
Soil reaction (1:1 water) (Depth not specified)	5.1–6.5

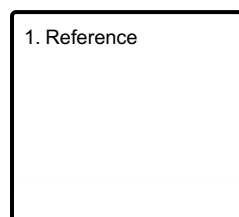
Ecological dynamics

Fire is the main disturbance factor and occurs on rotational intervals of 500 years and is stand replacing in severity in the Olympic Mountains. In the Pacific Northwest in general, western hemlock forests have fire return intervals of 150 to 400 years. LANDFIRE models state an average fire return interval of 500 years (300 to 800 years range) based on the 0710390 North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest B classification.

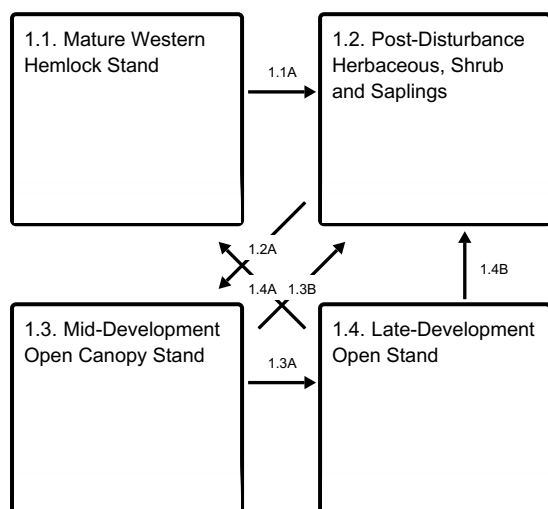
Small patch disturbances include diseases such as Laminated (*Armillaria*, *Annosum*) root rots, heart, butt rot, and brown cubical rot and hemlock dwarf mistletoe. Insect damage, particularly from the Douglas fir beetle, can also occur.

State and transition model

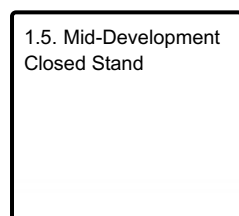
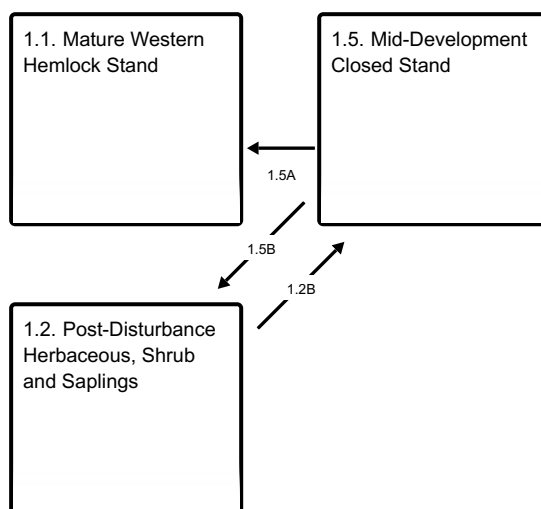
Ecosystem states



State 1 submodel, plant communities



Communities 1, 5 and 2 (additional pathways)



State 1 Reference

Community 1.1 Mature Western Hemlock Stand

This phase has an overstory dominated by Western hemlock, though Western redcedar and Douglas fir are also common in lower cover. These trees are mature with average ages of 150 to 200 years and large (average diameter at breast height is 20 to 30 inches). There are numerous tree canopies present and the lower tree canopies have all of these species. An understory is comprised of tall shrubs, and cool, moist adapted herbaceous species: Pacific rhododendron, Alaska blueberry, salal, Cascade barberry, vine maple, twinflower, redwood sorrel, red huckleberry. Initially, the understory may be dominated by red alder, but there may be die-back of this species that leads to a more open understory canopy.

Dominant plant species

- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- vine maple (*Acer circinatum*), shrub

- salal (*Gaultheria shallon*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- Alaska blueberry (*Vaccinium alaskaense*), shrub
- red alder (*Alnus rubra*), shrub
- Pacific rhododendron (*Rhododendron macrophyllum*), shrub
- twinflower (*Linnaea borealis*), other herbaceous
- redwood-sorrel (*Oxalis oregana*), other herbaceous

Community 1.2

Post-Disturbance Herbaceous, Shrub and Saplings

Immediately post-fire, on-site and windblown tree seeds including Western hemlock, Western redcedar and Douglas fir and less Grand fir, lodgepole pine and western white pine establish shrub and herbaceous plants resprout and pioneering herbaceous plants such as fireweed (*Chameria angustifolia*) and western brackenfern (*Pteridium aquilinum*) establish on mineral soil interspaces. Deciduous trees species can also occur and include quaking aspen, paper birch and black cottonwood. This is a short duration community phase that lasts approximately three years. This is followed by the shrub dominated community with high diversity that can include: Pacific rhododendron, Alaska blueberry, salal, Cascade barberry, vine maple, red huckleberry, snowbush ceanothus and potentially red alder. Throughout this phase, trees grow from seedlings to twenty year old saplings.

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- snowbrush ceanothus (*Ceanothus velutinus*), shrub
- Pacific rhododendron (*Rhododendron macrophyllum*), shrub
- Alaska blueberry (*Vaccinium alaskaense*), shrub
- salal (*Gaultheria shallon*), shrub

Community 1.3

Mid-Development Open Canopy Stand

This phase is dominated by a mix of Douglas fir, western hemlock, western redcedar and some deciduous trees that are pole-sized and are in an open canopy due to windthrow, insects, disease and red alder die-back. Trees are moderately large (average diameter at breast height is less than twenty inches) and average 20 to 100 years old. Shrubs can be present, and thick in the open canopy areas and include Pacific rhododendron, Alaska blueberry, salal, Cascade barberry, vine maple, red huckleberry, snowbush ceanothus and potentially red alder.

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree

Community 1.4

Late-Development Open Stand

This phase is dominated by a mix of Douglas fir, western hemlock, western redcedar and some deciduous trees that are pole-sized and are in an open canopy due to windthrow, insects, disease and red alder die-back. Trees are large (average diameter at breast height is more than twenty inches) and average 100 to 150 years old. Shrubs can be present and particularly thick in the open canopy areas and include Pacific rhododendron, Alaska blueberry, salal, Cascade barberry, vine maple, red huckleberry, snowbush ceanothus and potentially red alder.

Dominant plant species

- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree

- Pacific rhododendron (*Rhododendron macrophyllum*), shrub
- Cascade barberry (*Mahonia nervosa*), shrub
- Alaska blueberry (*Vaccinium alaskaense*), shrub
- salal (*Gaultheria shallon*), shrub
- thinleaf huckleberry (*Vaccinium membranaceum*), shrub

Community 1.5

Mid-Development Closed Stand

This phase is dominated by a mix of Douglas fir, western hemlock, western redcedar and some deciduous trees that are pole-sized and are in an closed canopy. Trees are moderately large (average diameter at breast height is less than twenty inches) and average 20 to 100 years old. The understory is generally depauperate as the closed canopy precludes much sunlight reaching the forest floor. Shrubs can be present and include Pacific rhododendron, Alaska blueberry, salal, Cascade barberry, vine maple, red huckleberry, snowbush ceanothus and potentially red alder.

Pathway 1.1A

Community 1.1 to 1.2

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

Pathway 1.2A

Community 1.2 to 1.3

With time, the tree seedlings and small saplings go to the mid-development community and due to the occurrence of mixed severity fire the canopy is in an open configuration.

Pathway 1.2B

Community 1.2 to 1.5

With time, the tree seedlings and small saplings go to the mid-development community and due to the occurrence of mixed severity fire the canopy is in an closed canopy configuration.

Pathway 1.3B

Community 1.3 to 1.2

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

Pathway 1.3A

Community 1.3 to 1.4

With time, the pole-sized trees develop to large mature trees in the late development phase.

Pathway 1.4A

Community 1.4 to 1.1

With time, the large mature trees develop into the closed configuration of the reference phase without the occurrence of mixed severity fire.

Pathway 1.4B

Community 1.4 to 1.2

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

Pathway 1.5A

Community 1.5 to 1.1

With time, the large mature trees develop into the closed configuration of the reference phase without the occurrence of mixed severity fire.

Pathway 1.5B

Community 1.5 to 1.2

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

Additional community tables

Other references

Scientific Literature:

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Contributors

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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	05/09/2024
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:**
-