

Ecological site F003XC309WA

Mountain Slopes Parkland and Forest whitebark pine

Last updated: 1/29/2025
Accessed: 05/10/2025

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 Glaciated Western Cascades land resource unit is located in southwestern Washington primarily along the western slope of the Cascade Range. It is bounded by the Snoqualmie Pass area to the north and the Columbia River to the south. To the west is the Puget Sound Trough (MLRA 2) and to the east is the drier eastern slope of the Cascade Range (MLRA 6).

The major rivers originating in the LRU are the Puyallup and Nisqually Rivers which drain to Puget Sound and the Cowlitz and Lewis Rivers which drain west to the Columbia.

Some of the lithology in the LRU is the result of numerous accretions from tectonic subduction of the Pacific plate along the margin of the North American plate creating combinations of metamorphized sedimentary or oceanic rock and intrusive volcanic plutons. The Cascades in this area have a long history of volcanic activity starting about 55 million years ago. Eruptions have created a complex sequence of low-silica and silica-rich depositions that have been eroded and buried repeatedly (Washington Geological Survey). Mount Rainier, Mount Adams, and Mount Saint Helens are volcanoes and the most notable peaks; Mount Saint Helens continues to vent after the 1980 eruption. Alpine glaciers still remain active at the highest elevations. The area was not influenced by continental glaciation, however Pleistocene alpine glaciation modified much of the dissected terrain and contributed glacial sediment to the complex combination of lithologies and volcanism.

Soils are mainly Spodosols and Andisols.

Vegetation is primarily dense forest with some parkland in subalpine and alpine areas. Douglas-fir (*Pseudotsuga menziesii*) and western hemlock (*Tsuga heterophylla*) are the dominate tree species found at lower elevations;

western redcedar (*Thuja plicata*) is quite common. 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.

Ecological site concept

This ecological site is defined as the highest extent of closed canopy forest of whitebark pine (*Pinus albicaulis*) to the highest elevations of this site, parkland where trees grow only in clumps. Tree clumps reside at the interface between treeline and the alpine life zone. This ecological site resides on mountain slopes at elevations spanning 3,900 to 7,000 feet on slopes of 30 to 90 percent. *Pinus albicaulis* dominated areas range lower (3,900 to 6,800 feet) and are found on moderate slopes (25 to 50 percent), while the parkland type of tree clumps ranges higher in elevation (5,200 to 7,000 feet) and occurs on steeper slopes (60 to 90 percent). The climate is cold (average frost-free days is 45 to 80, average annual precipitation is 55 to 80 inches and the mean average annual temperature is 38 to 41 degrees Fahrenheit). The soils are primarily Andisols (Inceptisols and Spodosols potentially also support this site). Soils have andic soil properties and skeletal textures. Parent material is residuum or colluvium from igneous rock mixed with volcanic ash and most have lithic contacts. These soils are in the cryic soil temperature and udic soil moisture regimes. High wind, deep and persistent snowpacks, and a short growing season create a harsh climate that allows whitebark pine (*Pinus albicaulis*) to be the dominant tree species in this closed or open canopy forest. The open canopy configuration is due to insect, disease and mixed severity fire. At the highest elevations' conditions relegate tree species to only clumps within an alpine meadow. In the understory, cold adapted species include broadleaf arnica (*Arnica latifolia*), western moss heather (*Cassiope mertensiana*), pink mountainheath (*Phyllodoce empetrifomis*), jacob's-ladder (*Polemonium pulcherrimum*), pinegrass (*Calamagrostis rubescens*), common juniper (*Juniperus communis*), whortleberry (*Vaccinium myrtillus*), grouse whortleberry (*Vaccinium scopulorum*), Hitchcock's smooth woodrush (*Luzula hitchcockii*). Dominant tree species include whitebark pine, mountain hemlock, and subalpine larch (*Larix lyalli*), though subalpine fir and Engelmann spruce may grow in the center of the tree clumps. In general, mountain hemlock may grow on the wetter, more moist western side of the Cascades; whitebark pine is found in the in drier areas and subalpine larch in areas with more severe wind. The understory species are adapted to site conditions and vary from drier areas with eight-petal mountain avens (*Dryas octopetala*), pinegrass (*Calamagrostis rubescens*), common juniper (*Juniperus communis*), Greenleaf fescue (*Festuca viridis*) to moister areas with western moss heather (*Cassiope mertensiana*), partridgefoot (*Luetkea pectinata*), grouse whortleberry (*Vaccinium scopulorum*), broadleaf arnica (*Arnica latifolia*), jacob's-ladder (*Polemonium pulcherrimum*), pink mountainheath (*Phyllodoce empetrifomis*), black alpine sedge (*Carex nigricans*), alpine hairgrass (*Vahlodea atropurpurea*), and Hitchcock's smooth woodrush (*Luzula hitchcockii*). The site conditions are the main limiting factor to tree growth, though rare stand replacing fire can occur at intervals of 200 to 400 years, based on the LANDFIRE models for *Pinus albicaulis*. Numerous lightening strikes can occur on this site, particularly on ridges, but the lack of continuous tree canopy and low fuels preclude fire spread and severity.

Associated sites

F003XC306WA	High Glacial Valley Floors Forest subalpine fir
F003XC308WA	High Cirques Forest mountain hemlock

Similar sites

F003XA309WA	High Glacial Trough Valleys Parkland - mountain hemlock-subalpine larch-whitebark pine
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Table 1. Dominant plant species

Tree	(1) <i>Tsuga mertensiana</i> (2) <i>Pinus albicaulis</i>
Shrub	(1) <i>Vaccinium scoparium</i>
Herbaceous	(1) <i>Luzula glabrata</i> var. <i>hitchcockii</i>

Physiographic features

This ecological site is defined as the highest extent of tree species. It resides at the interface between treeline and

the alpine life zone. This ecological site resides on mountain slopes at elevations spanning 3,900 to 7,000 feet on slopes of 30 to 90 percent.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope
Elevation	4,000–6,600 ft
Slope	30–55%
Aspect	W, NW, N, S, SW

Climatic features

The climate is cold. The mean average annual temperature is 38 to 41 degrees Fahrenheit. High wind, a deep and persistent snowpack, and a short growing season create a harsh climate.

Table 3. Representative climatic features

Frost-free period (characteristic range)	45-80 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	55-80 in

Influencing water features

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

Soil features

The soils are primarily Andisols (Inceptisols and Spodosols potentially also support this site). Soils have andic soil properties and skeletal textures. Parent material is residuum or colluvium from igneous rock mixed with volcanic ash and most have lithic contacts. Andic soil properties occur from the surface to a depth of 44 inches. These soils are in the cryic soil temperature and udic soil moisture regimes.

Table 4. Representative soil features

Parent material	(1) Volcanic ash (2) Colluvium (3) Residuum
Surface texture	(1) Ashy sandy loam (2) Ashy loam
Family particle size	(1) Ashy-skeletal (2) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	8–60 in
Soil depth	8–60 in
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–25%
Available water capacity (Depth not specified)	1.6–5.5 in
Calcium carbonate equivalent (Depth not specified)	0%

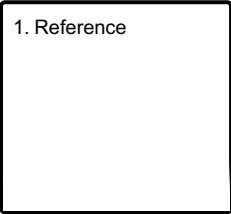
Soil reaction (1:1 water) (Depth not specified)	5.1–7.3
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Ecological dynamics

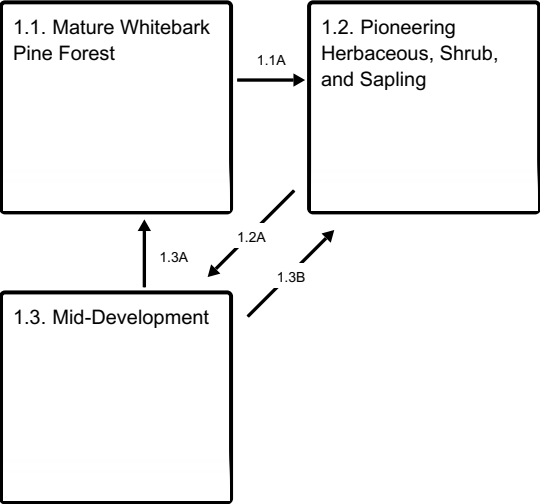
This ecological site is defined by harsh site conditions that allow whitebark pine to be dominant, the canopy configuration can be closed or open or at the highest elevations of this ecological site trees to grow in clumps within an alpine meadow glade with heath shrub species and other shrubs. The main disturbance within the parkland tree clumps and meadow, is burrowing by rodents such as hoary marmots (*Marmota caligata*) or black bear (*Ursus americanus*) scavenging by digging and very rare stand replacing fire. Fire spread and severity would be limited due to lack of continuous tree canopy at the highest elevations and generally low fuels. The climatic site conditions are the main limiting factor to tree growth, though rare stand replacing fire can occur at intervals between 200 to 400 years (mixed severity fires can occur at intervals between 80 to 120 years), based on the LANDFIRE models for whitebark pine (*Pinus albicaulis*). Numerous lightning strikes can occur on this site, particularly on ridges, but the lack of continuous tree canopy and low fuels preclude fire spread and severity. This site is bounded at higher elevations by the Alpine PES which lacks all tree species, and by the High cirques Forest - Mountain Hemlock PES below.

State and transition model

Ecosystem states



State 1 submodel, plant communities



State 1
Reference

Community 1.1
Mature Whitebark Pine Forest

This phase has an overstory dominated by multi-aged whitebark pine growing in an open to closed canopy configuration. At the highest elevations of this ecological site, trees grow in clumps due to the harsh site conditions of wind and cold, and include mountain hemlock, whitebark pine, Subalpine larch and sometimes subalpine fir and Engelmann spruce in the protected center of the clump. Typical understory includes broadleaf arnica, western moss heather, pink mountainheath, jacob's ladder, pinegrass, common juniper, whortleberry, dwarf bilberry, Hitchcock's smooth woodrush. This community can have an open canopy structure due to insect and/or disease damage that occurs on a mean interval of 200 years, and a mixed severity fire regime of on an interval of 80-120 years and

replacement severity fire every 200 -400 years. Tree ages at this phase are multi-aged, with seedlings and saplings present, but at the oldest are 100 to 200 years old and large (average diameter at breast height of over thirty inches). At the highest elevations of this site, site conditions are harsh and preclude closed canopy tree growth, rather trees grow in small clumps.

Community 1.2

Pioneering Herbaceous, Shrub, and Sapling

Immediately post-fire, on-site and windblown tree seeds establish, shrub and herbaceous plants resprout and pioneering herbaceous plants establish on mineral soil interspaces. This is a short duration community phase, approximately three years. This is replaced by the shrub community. This plant community contains a high diversity of shrubs including *Vaccinium scopulorum*, *Juniperus communis*, western moss heather, pink mountainheath, whortleberry, dwarf bilberry. Seedlings mature to saplings of the species: whitebark pine, mountain hemlock, subalpine larch but also Grand fir and subalpine fir, Engelmann spruce that are all low cover. Tree ages are seedlings to twenty years old in this phase. Fire occurs as replacement severity about every 400 yrs.

Community 1.3

Mid-Development

This phase is dominated by either an open or closed stand of young whitebark pine or at the highest elevations of this ecological site, tree clumps with mountain hemlock and subalpine larch trees that are pole sized. Configuration is either closed or an open canopy due to windthrow, insects and disease.

Pathway 1.1A

Community 1.1 to 1.2

Rare, stand-replacement fire that kills a 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 1.3A

Community 1.3 to 1.1

With time, the tree pole sized trees mature to the reference community.

Pathway 1.3B

Community 1.3 to 1.2

Rare, stand-replacement fire that kills a 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

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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:**
