Ecological site F003XN951WA
Southern Washington Cascades High Cryic Coniferous Forest

Last updated: 2/03/2025
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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.

MLRA notes

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

Steep mountains and narrow to broad, gently sloping valleys characterize this MLRA. A triple junction of two oceanic plates and one continental plate is directly offshore from Puget Sound. Subduction of the oceanic plates under the westerly and northwesterly moving continental plate contributes to volcanic activity in the Cascade Mountains. Movement among these plates has resulted in major earthquakes and the formation of large stratovolcanoes. The Cascade Mountains consist primarily of volcanic crystalline rock and some associated metasedimentary rock. The mean annual precipitation is dominantly 60 to 100 inches, but it is 30 to 60 inches on the east side of the Cascade Mountains. The soil orders in this MLRA are dominantly Andisols, Spodosols, and Inceptisols and minor areas of Entisols and Histosols. The soils are dominantly in the frigid or cryic temperature regime and the udic moisture regime. The soils generally are shallow to very deep, well drained, ashy to medial, and loamy or sandy. They are on mountain slopes and ridges.

Ecological site concept

This ecological site is in cold, moist areas at high elevations (3,200 to 6,500 feet, or treeline) in Mount Rainier National Park. Elevation and climate are key components in the succession of the forest dynamics. The cold winters, deep snowpack, and mild summers impact the rate of growth and time to maturity. The fog and heavy cloud cover may provide necessary moisture in summer for areas along the timberline (Crawford, 2009). The soils that support this ecological site are in the high cryic soil temperature regime and the udic soil moisture regime. They are moderately well drained or well drained. They are shallow to bedrock to very deep. Soil moisture is not a limiting factor to forest growth because of the abundance of precipitation and the inherent water-holding properties of soils influenced by volcanic ash. Slope and aspect are not defining features of the site. The most common overstory species are mountain hemlock (Tsuga mertensiana) and subalpine fir (Abies lasiocarpa). Other common species include Pacific silver fir (Abies amabilis), noble fir (Abies procera), Alaska cedar (Callitropsis nootkatensis), and Engelmann spruce (Picea engelmannii). Disturbance factors include forest pathogens, such as root rot, and high-intensity, low-frequency fires that are stand replacing. The frequency of fire is relatively low because of the extended periods of snowpack at the higher elevations.

Associated sites

F003XN950WA	**Southern Washington Cascades Moist High Cryic Coniferous Forest** Ecological site F003XN951WA, Southern Washington Cascades High Cryic Coniferous Forest, is located within the same elevation as site F003XN950WA, Southern Washington Cascades Moist High Cryic Coniferous Forest. The dominant differentiating features are the depth to the water table and soil drainage class. The soils associated with site F003XN950WA have a higher water table during part of the growing season and are somewhat poorly drained. The vegetation on this site, such as Alaska cedar, Cascade azalea, and Sitka mountain ash, is suited to wetter environments. The soils associated with site F003XN951WA are moderately well drained or well drained soils. The vegetation on this site, such as subalpine fir and mountain heather, is more suited to drier conditions.

F003XN949WA	**Southern Washington Cascades High Cryic Riparian Forest** Ecological Site F003XN949WA, Southern Washington Cascades High Cryic Riparian Forest is located within the same elevation as site F003XN951WA, Southern Washington Cascades High Cryic Coniferous Forest. The sites are differentiated by disturbance regime and soil drainage. Ecological Site F003XN949WA is subject to flooding and vegetation is often less mature than site F003XN951WA. Vegetation within the riparian corridor is dominated by Alaska cedar, Sitka alder, and willows.

Similar sites

F003XN950WA	**Southern Washington Cascades Moist High Cryic Coniferous Forest** Ecological site F003XN951WA, Southern Washington Cascades High Cryic Coniferous Forest, is located within the same elevation as site F003XN950WA, Southern Washington Cascades Moist High Cryic Coniferous Forest. The dominant differentiating features are the depth to the water table and soil drainage class. The soils associated with site F003XN950WA have a higher water table during part of the growing season and are somewhat poorly drained. The vegetation on this site, such as Alaska cedar, Cascade azalea, and Sitka mountain ash, is suited to wetter environments. The soils associated with site F003XN951WA are moderately well drained or well drained soils. The vegetation on this site, such as subalpine fir and mountain heather, is more suited to drier conditions.

Table 1. Dominant plant species

Tree	(1) *Tsuga mertensiana* (2) *Abies lasiocarpa*
Shrub	(1) *Menziesia ferruginea*
Herbaceous	(1) *Xerophyllum tenax*

Physiographic features

This ecological site is on debris aprons of mountains slopes, glacial-valley walls, and ridges at the upper montane elevations (3,200 to 6,500 feet). The site is on all aspects and slopes, but it is dominantly on slopes of 15 to 65 percent. The site covers 24 percent of Mount Rainier National Park.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope (2) Mountains > Ridge (3) Mountains > Glacial-valley wall

Climatic features

Most of the annual precipitation is received in October through April. The mean annual precipitation is 49 to 155 inches, and the mean annual air temperature is 30 to 45 degrees F. Generally, the summers are cool and dry summers and the winters are cold and wet.

Table 3 Representative climatic features

Frost-free period (characteristic range)	30-60 days

Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	1,250-3,940 mm

Influencing water features

Generally, this ecological site is not influenced by wetland or riparian water features. It is not subject to flooding or ponding. The Unicornpeak soils have a seasonal high water table at a depth of 19 to 40 inches some time during the growing season. The water table typically rises in spring and recedes in fall.

Soil features

Applicable soils: Tipsoo, Unicornpeak, Owyhigh, Ipsut, Glacierisland, Sheepskull, Sluiskin

Applicable soil map units in Mount Rainier National Park: 8201, 8203, 8210, 8211, 8220, 8225, 8230, 8250, 8251, 8252, 8255, 8256, 8257, 9200, 9201, 9210, 9220, 9225, 9252, 9253, 9254, 9258, 9259, 9993, 9994

The Tipsoo, Unicornpeak, Owyhigh, and Ipsut soils are in the more stable landscape positions, and they formed in volcanic ash and colluvium derived from andesite. The Glacierisland, Sheepskull, and Sluiskin soils are on young, active geomorphic surfaces, and they formed in till, colluvium, and lahar deposits. The Tipsoo, Unicornpeak, and Glacierisland soils are deep or very deep, the Owyhigh and Sheepskull soils are moderately deep, and the Ipsut and Sluiskin soils are shallow.
The soils in the more stable positions have a mantle of volcanic ash (primarily Mount St. Helens P and Y tephra) over colluvium derived from andesite. The Tipsoo, Unicornpeak, Owyhigh, and Ipsut soils consist of volcanic ash mixed with colluvium over andesite. The mantle of volcanic ash has low bulk density and high available water holding capacity. It is sandy loam or loamy sand and has gravel-sized pumice parafragments. The subsoil, where present, consists of colluvium derived from andesite. It is sandy loam and has andesite fragments. Podsolization is the dominant pedogenic process in the soils. All of these soils have an albic horizon and a spodic horizon.
The soils in younger, more active positions formed in till and lahar deposits. These soils are on moraines and lahars, generally in large glacial valleys at the base of the mountains. The Glacierisland, Sheepskull, and Sluiskin soils consist of till and lahar deposits over andesite. Podsolization is not evident in the soils because of the relatively young age in terms of soil formation. The soils have volcanic ash in the profile and have andic soil properties. They are coarse textured, have low cation-exchange capacity, and have more than 35 percent rock fragments throughout.

Table 4. Representative soil features

Parent material	(1) Volcanic ash – andesite (2) Colluvium – andesite (3) Till – andesite (4) Lahar deposits – andesite
Surface texture	(1) Ashy sandy loam (2) Very gravelly, ashy loamy sand (3) Paragravelly, ashy sandy loam
Drainage class	Well drained to moderately well drained
Soil depth	30 – 150 cm
Surface fragment cover <=3"	0 – 30 %

Surface fragment cover >3"	0 – 30 %
Available water capacity (Depth not specified)	2.79 – 24.89 cm
Soil reaction (1:1 water) (Depth not specified)	4.5 – 5.8
Subsurface fragment volume <=3" (Depth not specified)	10 – 50 %
Subsurface fragment volume >3" (Depth not specified)	0 – 30 %

Ecological dynamics

This ecological site is in cold, moist areas at high elevations (3,200 feet to 6,500 feet). The cold winters, deep snowpack, and mild summers impact the rates of growth and time to maturity. Fog and heavy cloud cover may provide necessary moisture in summer to areas along the timberline (Crawford, 2009).

The most common overstory species are mountain hemlock (Tsuga mertensiana) and subalpine fir (Abies lasiocarpa). Other common species include Pacific silver fir (Abies amabilis), noble fir (Abies procera), Alaska cedar (Callitropsis nootkatensis), and Engelmann spruce (Picea engelmannii).

Common understory shrubs include rusty menziesia (Menziesia ferruginea), black mountain huckleberry (Vaccinium membranaceum), Sitka mountain ash (Sorbus sitchensis var. sitchensis), and Cascade azalea (Rhododendron albiflorum). Common forbs include common beargrass (Xerophyllum tenax), Sitka valerian (Valeriana sitchensis), sidebells wintergreen (Orthilia secunda), smooth woodrush (Luzula glabrata), dwarf bramble (Rubus lasiococcus), and five-leaved bramble (Rubus pedatus). Regeneration commonly is limited by heavy snowpack at the higher elevations. Mature trees are on mounds in areas where the snow melts earlier than in other areas (Scientia Silvica, 1997).

Disturbances include forest pathogens, such as root rot, and high-intensity, low-frequency fires that are stand replacing. Mountain hemlock and Pacific silver fir are susceptible to laminated root rot (Phellinus weirii), which will result in patches of mortality. Subalpine fir is less susceptible, and Alaska cedar and whitebark pine (Pinus albicaulis) are tolerant. This fungus can alter the composition of the forest.

Because of the extended periods of snowpack at the higher elevation, the frequency of fire is relatively low. The fire regime for mountain hemlock and subalpine fir is 400 to 800 years. The wildfires commonly are stand replacing because of the dense forest canopy and the low, non-self-pruning branches of the trees (Tesky, 1992). Western white pine (Pinus monticola) commonly occurs as an early succession species after a stand-replacing fire.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 6. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height M	Canopy Cover (%)	Diameter Cm	Basal Area (square M/hectare)
Tree							
mountain hemlock	TSME	*Tsuga mertensiana*	Native	–	–	–	–

subalpine fir	ABLA	*Abies lasiocarpa*	Native	–	–	–	–
Pacific silver fir	ABAM	*Abies amabilis*	Native	–	–	–	–
Alaska cedar	CANO9	*Callitropsis nootkatensis*	Native	–	–	–	–
noble fir	ABPR	*Abies procera*	Native	–	–	–	–

Table 7. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (m)	Canopy Cover (%)
Forb/Herb					
Sitka valerian	VASI	*Valeriana sitchensis*	Native	0-11	0-50
common beargrass	XETE	*Xerophyllum tenax*	Native	0-11	0-40
strawberryleaf raspberry	RUPE	*Rubus pedatus*	Native	0-1.8	0-30
arctic lupine	LUAR2	*Lupinus arcticus*	Native	0-7.3	0-30
white avalanche-lily	ERMO8	*Erythronium montanum*	Native	0-7.3	0-20
Shrub/Subshrub					
thinleaf huckleberry	VAME	*Vaccinium membranaceum*	Native	0-14.6	0-55
sidebells wintergreen	ORSE	*Orthilia secunda*	Native	0-3.7	0-40
Cascade azalea	RHAL2	*Rhododendron albiflorum*	Native	0-21.9	0-35
rusty menziesia	MEFE	*Menziesia ferruginea*	Native	0-18.3	0-30
pink mountainheath	PHEM	*Phyllodoce empetriformis*	Native	0-5.5	0-20
western mountain ash	SOSI2	*Sorbus sitchensis*	Native	0-11	0-10

Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 10. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 11. Community 1.5 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 12. Community 1.6 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Animal community

Migratory birds nest throughout Mount Rainier National Park in summer. Mammals such as elk, deer, and black bear forage at the higher elevations during peak periods in summer. Mountain goats, pika, and marmots maintain habitat in the high alpine and subalpine communities.

Recreational uses

The alpine environment of this site provides hiking opportunities when free of snow in June through September.

Other information

Pathogen Information Mountain hemlock forests of the Washington and Oregon Cascade Mountains are highly susceptible to laminated root rot (Phellinus weirii), which results in moderate disturbances and openings in the forest. The fungus can cause severe root rot and butt decay that stunt the growth of trees and cause mortality. Pacific silver fir, subalpine fir, and noble fir may be affected by laminated root rot, but they rarely are killed by the disease. Signs and symptoms of root rot include pockets of dead and fallen trees that are broken

at or near ground level. The decay is identified by brown to reddish brown speckled staining in the sapwood and wood that separates along the growth rings. Regeneration of highly susceptible species in infected areas typically is unsuccessful (Goheen, 2006). White pine blister rust (Cronartium ribicola) affects the early seral white pine forest, and it may result in mortality of young trees. This disease commonly increases the rates of succession and transition by girdling infected trees. It affects five-needled pines. It commonly precedes an attack by mountain pine beetles in areas where large stands of western white pine are stressed or dying. This fungus requires an alternate currant (Ribes spp.) host to complete its lifecycle. An identifier of blister rust commonly is swellings on branches, which exude sap in spring. Cankers and pustules that have yellow-orange blisters (aeciospores) by midsummer develop on branches and boles of trees. Management may include removal of the currant (Ribes spp.), pruning affected branches, and planting genetically improved stock (Goheen, 2006).

Table 13. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
mountain hemlock	*TSME*	71	116	80	172	55	–	–	
subalpine fir	*ABLA*	40	57	28	47	125	–	–	

Inventory data references

Other Established Classifications National vegetation classification: North Pacific Mountain Hemlock-Silver Fir Forest and Tree Island Group U.S. Department of Agriculture, Forest Service, plant association: •TSME/VAME-VASI •TSME/VAME-XETE U.S. Department of the Interior, National Park Service, plant association: •TSUMER-ABILAS/VACDEL-PHYEMP •PHYEMP-VACDEL-(CASMER)

Type locality

Location 1: Pierce County, WA	
Township/Range/Section	T16N R10E S22
Latitude	46° 51′56″
Longitude	121° 31′53″

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Contributors

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Approval

Kirt Walstad, 2/03/2025

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	
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):**

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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:**
