Ecological site F003XN943WA
Southern Washington Cascades Frigid Coniferous Forest

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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 on the warm, moist, lower slopes in the Carbon, Ohanapecosh, and Nisqually Valleys of Mount Rainier National Park. Elevation is 1,600 to 4,600 feet, depending on aspect. This site is on debris aprons, mountain slopes, valley walls, and ridges. It is on north- and east-facing slopes at the lower elevations and on south- and west-facing slopes at the higher elevations. The soils that support this ecological site are in the frigid soil temperature regime and the udic soil moisture regime. They are well drained and are shallow over bedrock to very deep. Soil moisture is not a limiting factor to forest growth on these soils because of the abundance of precipitation and the inherent water-holding properties of soils influenced by volcanic ash. The most common overstory species are western hemlock (Tsuga heterophylla) and Douglas-fir (Pseudotsuga menziesii). Western redcedar (Thuja plicata), red alder (Alnus rubra), and Pacific yew (Taxus brevifolia) may be minor components in the overstory. Regeneration is limited by the canopy cover; it commonly is limited to the gaps in the canopy where sunlight is most available. The most common disturbance on this site is patchy, small pockets of windthrown overstory trees, which commonly occur in conjunction with root-, butt- or stem-rot. Western hemlock is highly susceptible to rot diseases such as Armillaria ostoyae, Heterobasidion annosum, Phellinus weirii, and Echinodontium tinctorium (Tesky, 1992). The historic fire regime for western hemlock consists of low frequency (150 to 300 years or more), moderate- or high-intensity, stand-replacing wildfires.

Associated sites

F003XN947WA	**Southern Washington Cascades Low Cryic Coniferous Forest** Ecological site F003XN947WA, Low Cryic Coniferous Forest is located at higher elevations from F003XN943WA. Vegetation indicators for F003XN947WA include Pacific silver fir, noble fir, and black mountain huckleberry.

Similar sites

F003XN941WA	**Southern Washington Cascades Wet Frigid Coniferous Forest** Ecological site F003XN943WA, Southern Washington Cascades Frigid Coniferous Forest, is similar to site F003XN941WA, Southern Washington Cascades Wet Frigid Coniferous Forest. Ecological site F003XN941WA is in areas that have a higher water table and susceptible to ponding. The vegetation indicators for site F003XN941WA include more wet-adapted species such as western redcedar and American skunkcabbage.
F003XN942WA	**Southern Washington Cascades Moist Frigid Coniferous Forest** Ecological site F003XN943WA, Southern Washington Cascades Frigid Coniferous Forest, is similar to F003XN942WA, Southern Washington Cascades Moist Frigid Coniferous Forest. Site F003XN942WA has a high seasonal water table starting at a depth of 10-20 inches from the soil surface at some point during the growing season.

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Pseudotsuga menziesii*
Shrub	(1) *Gaultheria shallon* (2) *Mahonia nervosa*
Herbaceous	Not specified

Physiographic features

This ecological site is on debris aprons, mountain slopes, glacial-valley walls, and ridges. It is at the lower elevations in the Carbon, Ohanapecosh, and Nisqually Valleys of Mount Rainier National Park. This site may be on all slopes, but it commonly is on slopes of 10 to 65 percent.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Mountain slope (3) Glacial-valley wall
Flooding frequency	None
Ponding frequency	None
Elevation	490 – 1,420 m
Slope	0 – 100 %
Water table depth	100 – 200 cm

Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

Most of the annual precipitation is received in October through April. The mean annual precipitation is 70 to 83 inches, and the mean annual air temperature is 41 to 45 degrees F. Generally, the summers are warm and dry and the winters are cool and wet.

Table 3 Representative climatic features

Frost-free period (characteristic range)	90-130 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	1,780-2,110 mm

Influencing water features

This ecological site is not influenced by wetland or riparian water features, but it may be on stream terraces or adjacent to wetland and riparian areas. The site is not subject to flooding or ponding.

Soil features

Applicable soils: Kautz, Goldenlakes, Ingraham

Applicable soil map units: 6110, 6120, 6125, 7100, 7110, 7120, 7125

The soils that support this ecological site are in the frigid soil temperature regime and the udic soil moisture regime. They are well drained. The Kautz soils are deep or very deep, the Goldenlakes soils are moderately deep, and the Ingraham soils are shallow. Soil moisture is not a limiting factor for forest growth because of the abundance of precipitation and the inherent water-holding properties of soils influenced by volcanic ash. The soils commonly have a mantle of volcanic ash over colluvium or residuum derived from andesite. The shallow Ingraham soils consist of volcanic ash over andesite. The mantle of volcanic ash is characterized by low bulk density, high available water-holding capacity, gravel-sized pumice pararock fragments, and sandy loam and loamy sand. 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 the soils exhibit an albic and a spodic diagnostic horizon. A thin organic horizon consisting of decomposing twigs, needles, and litter is on the soil surface. This horizon helps to protect the soils from wind and water erosion.

Table 4. Representative soil features

Parent material	(1) Colluvium – andesite (2) Volcanic ash – andesite
Surface texture	(1) Ashy sandy loam (2) Paragravelly, ashy sandy loam (3) Paragravelly, ashy loamy sand
Drainage class	Well drained
Soil depth	30 – 150 cm

Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	0 – 10 %
Available water capacity (Depth not specified)	6.35 – 17.78 cm
Soil reaction (1:1 water) (Depth not specified)	3.5 – 10
Subsurface fragment volume <=3" (Depth not specified)	10 – 50 %
Subsurface fragment volume >3" (Depth not specified)	0 – 20 %

Ecological dynamics

This ecological site is on the warm, moist, lower slopes of Mount Rainier. Elevation ranges to 4,600 feet, depending on aspect. The site is on north- and east-facing slopes at the lower elevations and on south- and west-facing slopes at the higher elevations. Western hemlock (Tsuga heterophylla) and Douglas-fir (Pseudotsuga menziesii) are the most common overstory species. Western redcedar (Thuja plicata) is a minor component in the overstory. Red alder (Alnus rubra) and Pacific yew (Taxus brevifolia) may be present.

The more open the forest canopy, the more dense and diverse the understory. Cascade Oregon grape (Mahonia nervosa), vine maple (Acer circinatum), red huckleberry (Vaccinium parvifolium), salal (Gaultheria shallon), baldhip rose (Rosa gymnocarpa), little prince's pine (Chimaphila menziesii), and prince's pine (Chimaphila umbellata) are the main shrub species in areas where the overstory canopy is open. Western rattlesnake plantain (Goodyera oblongifolia), deerfoot vanillaleaf (Achlys triphylla), twinflower (Linnaea borealis), pioneer violet (Viola glabella), and western swordfern (Polystichum munitum) are common forbs. The understory species included in the Canopy Cover Summary Table had at least a 40 percent rate of constancy in the 20 inventory plots.

The most common disturbance is the patchy, small pockets of windthrown overstory trees, which commonly occurs in conjunction with root-, butt- or stem-rot. Western hemlock is highly susceptible to rot diseases such as Armillaria ostoyae, Heterobasidion annosum, Phellinus weirii, and Echinodontium tinctorium (Tesky, 1992). The resulting openings in the canopy allow sunlight to reach the forest floor, which benefits the understory. The historic fire regime consists of low frequency (150 to 300 years or more), moderate- to high-intensity fires. The fires are stand-replacing although individual trees or patches of trees survive, providing a seed source for re-establishment.

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							
red alder	ALRU2	*Alnus rubra*	Native	–	–	–	–
Douglas-fir	PSME	*Pseudotsuga menziesii*	Native	–	–	–	–

Pacific yew	TABR2	*Taxus brevifolia*	Native	–	–	–	–
western redcedar	THPL	*Thuja plicata*	Native	–	–	–	–
western hemlock	TSHE	*Tsuga heterophylla*	Native	–	–	–	–

Table 7. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (m)	Canopy Cover (%)
Forb/Herb					
sweet after death	ACTR	*Achlys triphylla*	Native	0.6-7.3	1-25
twinflower	LIBO3	*Linnaea borealis*	Native	0.3-1.8	1-15
pioneer violet	VIGL	*Viola glabella*	Native	0.3-1.8	1-10
western rattlesnake plantain	GOOB2	*Goodyera oblongifolia*	Native	0.3-3.7	1-5
Fern/fern ally					
western swordfern	POMU	*Polystichum munitum*	Native	1.2-14.6	1-45
Shrub/Subshrub					
salal	GASH	*Gaultheria shallon*	Native	0.6-11	1-80
vine maple	ACCI	*Acer circinatum*	Native	0.3-109.7	1-40
Cascade barberry	MANE2	*Mahonia nervosa*	Native	0.3-7.3	1-35
red huckleberry	VAPA	*Vaccinium parvifolium*	Native	0.6-18.3	1-20
dwarf rose	ROGY	*Rosa gymnocarpa*	Native	0.3-11	1-10
pipsissewa	CHUM	*Chimaphila umbellata*	Native	0.3-2.4	1-5
little prince's pine	CHME	*Chimaphila menziesii*	Native	0.3-1.8	1-5

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

Old-growth western hemlock and Douglas-fir forests are primary habitat for the endangered northern spotted owl. Old growth forests provide nesting and forage habitat, and less mature forests provide key dispersal habitat. This ecological site also provides habitat for a wide variety of migratory songbirds. Woodpeckers and cavity-nesting birds thrive in the dead or dying trees. Douglas-fir has low palatability for elk and deer, but it provides important forage when preferred species are low in abundance (Campbell, 1974). Douglas-fir seeds are highly palatable to small mammals, and they provide an important food source for mice, voles, shrews, and chipmunks (Hemstrom, 1987).

Recreational uses

This area of Mount Rainier National Park is accessible for hiking, camping, bike riding, photography, and sightseeing.

Wood products

The ecological site has moderate accessibility, and it supports a productive forest suitable for commercial forest products. Douglas-fir provides valuable wood commonly used as building material and some high-value poles. Western hemlock is a valuable source of wood fiber, and it is suitable for use as building products, pilings, poles, and railway ties.

Other information

Pathogens This ecological site is prone to rotting diseases. Annosus, armillaria, and laminated root rots can infest western hemlock and Douglas-fir forests. Echinodotium tinctorium (Indian paint fungus) can cause heart rot in true firs and hemlocks. Root rot and heart rot can result in mortality of individual trees, widespread mortality of several acres, and windthrow. Annosus root disease (Heterobasidion annosum) can affect nearly all conifer species in the Pacific Northwest. It is a slow-growing pathogen, but it can cause severe root and butt decay in stands. It commonly affects stands in conjunction with armillaria and laminated root rots and precedes infestations of bark beetle. Signs and symptoms of annosus commonly are difficult to differentiate from those of armillaria. Obvious signs include circular pockets of windthrown trees and canopy dieback. A distinctive fruiting body, called a conk, is in hollow stumps affected by annosus. Other identifying features include a reddish stain, decay, and a spongy texture in the heartwood and roots (Goheen, 2006). Regeneration of conifers may be unsuccessful for several decades, until the soil is void of fungal inoculum. Application of borax on freshly cut tree stumps (within 24 hours) may reduce the spread in managed stands. Armillaria root disease (Armillaria ostoyae) affects conifer species and shrubs in the Pacific Northwest. It can affect several acres and cause widespread mortality of trees. Western larch, cedar, ponderosa pine, western white pine, and lodgepole pine are susceptible to armillaria, but they commonly are more tolerant of the disease in mixed conifer stands. The disease is most devastating in young regenerating stands (less than 30 years old), and it can delay the maturation and succession of these stands. Armillaria produces a distinct white mycelial fan between the wood and bark. Rhizomorphs, or brown shoestrings of fungal mycelia, are common under the bark and roots of trees (Goheen, 2006). High resin flow and excessive sapping are also common. Hemlock and Douglas-fir forests in the Cascade Mountains of Washington and Oregon are susceptible to laminated root rot (Phellinus weirii), which causes moderate disturbances and results in openings in the forests. The fungus can cause severe root rot and butt decay, resulting in stunted growth and mortality. Western hemlock, Pacific silver fir, subalpine fir, and noble fir may be affected by laminated root rot, but these species rarely are killed by the disease. Signs and symptoms of laminated root rot include pockets of dead and fallen trees that are broken at or near ground level. Decay is identified by brown to reddish-brown speckled stains in the sapwood and by separations in the wood along the growth rings. Regeneration of highly susceptible species typically is unsuccessful in areas infected by the fungus (Goheen, 2006). Indian paint fungus (Echinodontium tinctorium) affects true firs and hemlocks. It is common in the mixed conifer forests in Washington. The decay commonly is in the mid-trunk of an infected tree and occurs as a distinctive hoof-shaped conk. Breakage of trees is common. This disease can affect 25 to 50 percent of hemlocks and true firs in old-growth stands. Management is limited to plantings of alternative conifer species (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
western hemlock	*TSHE*	95	140	222	314	60	–	–	
Douglas-fir	*PSME*	100	120	136	175	90	–	–	

Inventory data references

Other Established Classifications National vegetation classification: G240—North Pacific Maritime Douglas-fir Western Hemlock Forest group U.S. Department of Agriculture, Forest Service, plant association: • TSHE/POMU-GASH • TSHE/POMU-BENE • TSHE/GASH-BENE • TSHE/GASH • TSHE/ACCI-BENE • TSHE/BENE • TSHE/BENE-CHME U.S. Department of the Interior, National Park Service, plant association: • PSEMEN-TSUHET/GAUSHA/POLMUN • PSEMEN-TSUHET/MAHNER/POLMUN • PSEMEN-TSUHET/GAUSHA-MAHNER • PSEMEN-TSUHET/GAUSHA-VACPAR • PSEMEN-TSUHET/MAHNER • PSEMEN-TSUHET/ACHTRI

Type locality

Location 1: Lewis County, WA	
Township/Range/Section	T15N R10E S33
Latitude	46° 44′ 27″
Longitude	121° 34′ 5″

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Contributors

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Approval

Kirt Walstad, 1/30/2025

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:

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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:**
