Ecological site AX002X02X004
Portland Basin 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): 002X–Willamette and Puget Sound Valleys

MLRA The Willamette and Puget Sound Valleys Major Land Resource Area (MLRA 2) is in western parts of Washington and Oregon. It occupies a forearc basin between the Coast Ranges and the Cascade Mountain volcanic arc. The northern part contains Pleistocene drift, outwash, and lacustrine and glaciomarine deposits associated with continental glaciers. The southern part contains Late Pleistocene deposits from glacial outburst floods (Missoula Floods). Climate is mild and moist, and the growing season is long. Mean annual precipitation ranges from 20 to 60 inches, received mostly in fall, winter, and spring. Summers are dry. The soil temperature regime is mesic, and the soil moisture regimes are xeric and aquic. Most sites in this MLRA can support forested vegetation, but some were maintained as prairie, savanna, or woodland through cultural burning prior to Euro-American settlement. Puget Sound has a moderating effect on temperatures, and humidity can be higher in the northern part of the MLRA. Douglas-fir (Pseudotsuga menziesii) is widespread throughout. Oregon white oak (Quercus garryana) is common on uplands in the south and on warm, exposed or droughty sites in the north. Pacific madrone grows in areas close to saltwater. Western hemlock (Tsuga heterophylla) is codominant with Douglas-fir in the north. Flood plains typically contain Brayshaw black cottonwood (Populus balsamifera ssp. trichocarpa) and red alder (Alnus rubra). Oregon ash (Fraxinus latifolia) is typical of forested wetlands in the south. Forestry, urban development, and cultivated agriculture are currently the most extensive land uses (USDA, Agriculture Handbook 296, 2022).

LRU notes

The Portland Basin and Hills Land Resource Unit (LRU B) is in southwestern Washington and northwestern Oregon. The LRU extends north to the Cowlitz River and transitions to the Willamette Valley in the south. The Columbia River Gorge limits the eastern extent, and influence of tidewater at Cathlamet identifies the northwestern extent. Elevation ranges from sea level to about 2,000 feet. Major landforms include glaciofluvial terraces along the Columbia River, as well as residual hills and foothills surrounding the basin. Minor areas of Columbia River flood plain are present in Washington and more extensively in Oregon. Residual hills are composed primarily of Quaternary-Pliocene and Tertiary volcanic and sedimentary rocks. The lower-relief basin is composed primarily of sediment from catastrophic Quaternary glacial flooding from Glacial Lake Missoula. The Columbia River splits this LRU between Oregon and Washington. In Washington, mean annual precipitation ranges from 35 to 60 inches. Most falls as rain between October and May. The frost-free period ranges from 160 to 220 days. Locations near the Columbia River Gorge experience strong winds and infrequent ice storms with little winter snow. Average daily maximum temperatures in summer at Vancouver, Washington, are 1 to 3 degrees F warmer compared to Seattle or Olympia, Washington (Agricultural Climate Information System, 2007a, 2007b). Oregon white oak and Douglas-fir are common north of the Columbia River in Washington. Western redcedar and western hemlock grow in areas of higher moisture, at higher elevations, or on protected aspects.

Ecological site concept

The soil moisture control section of this ecological site is dry for 45 to 75 consecutive days a year. Most of the annual precipitation is received from October through April, primarily as rain. Snow is rare. This ecological site is widespread on soils with variable drainage. The site represents the most common forest community in much of the southern Washington portion of MLRA 2 and is on terraces and hills. Parent material is typically colluvium or residuum with some volcanic ash. In areas of lower elevation, alluvium can contribute to soil development. This site can be compared to the Puget Lowlands Forest site in LRU A, which is similar but has lower summer temperatures and higher amounts of summer precipitation. The climate may be moister during the growing season in LRU A, leading to a shorter recovery between disturbances and lower fire frequency than in LRU B.

Associated sites

AX002X02X008	Portland Basin Riparian Forest
AX002X02X007	Portland Basin Wet Forest

Similar sites

F002XN902WA	Western hemlock - Douglas-fir/Cascade Oregongrape
F002XN906WA	Western hemlock-western redcedar/red huckleberry-salal/western swordfern
AX002X01X004	Puget Lowlands Forest

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Pseudotsuga menziesii*
Shrub	(1) *Mahonia nervosa* (2) *Gaultheria shallon*
Herbaceous	(1) *Polystichum munitum*

Legacy ID

F002XB004WA

Physiographic features

This site is on slopes of bedrock hills, glacially modified hills, and glacial terraces.

Table 2. Representative physiographic features

Flooding frequency	None to very rare
Ponding frequency	None
Elevation	60 – 150 m
Slope	10 – 30 %
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	30 – 610 m
Slope	0 – 60 %

Climatic features

Mean annual air temperature: 48 to 54 degrees Fahrenheit

Table 4 Representative climatic features

Frost-free period (characteristic range)	160-220 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	1,020-1,780 mm

Influencing water features

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

Soil features

Surface textures: Loams, silt loams, and clay loams
Soil family textures: Fine-loamy, coarse-loamy, coarse-silty, and fine-silty
Parent material: Colluvium, residuum, alluvium, and volcanic ash
Soil depth: 20 to more than 60 inches. Lithic contacts are possible restrictions.
Soil drainage: Somewhat poorly drained to somewhat excessively drained. Moderately well drained and well drained are most common.
Available water capacity in the top 40 inches: 3.5 to 14 in/in
pH in water: 4.5 to 7.3
Soil is dry in all parts from 60 to 75 consecutive days.

Ecological dynamics

Fire, wind and storm damage are important disturbance agents in this ecological site. Wind and storm damage occurs regularly in winter, causing small patches of seedbed to be exposed by uprooted trees and small earthflows, and providing release to sub-dominant species in shaded understories. Western hemlock and Douglas-fir are the dominant trees. Douglas-fir is not as shade tolerant as western hemlock (Hermann and Lavender 1990). Because of this, western hemlock often develops in sub-dominant canopy positions alongside faster growing Douglas-fir after major disturbances. The more shade tolerant conifers can also establish in the understory and persist until minor disturbances cause overstory mortality and allow narrow gaps for them to grow into (Minore 1990, Packee 1990). Douglas-fir can persist in the overstory for very long periods due to its great height, thick fire-protective bark, and longevity (800+years), but it also requires disturbances that cause greater canopy openings and exposure of mineral soil to establish in abundance (Hermann and Lavender 1990). During longer fire free intervals stand composition tends to shift in favor of highly shade tolerant western hemlock as Douglas-fir is intolerant of deep shade (Munger 1940, Hermann and Lavender 1990). In contrast to Douglas-fir, western hemlock is very successful germinating on organic matter in the understory, such as duff or rotten logs (Packee 1990). Thus, exposure of mineral soil is not a requirement for its regeneration in this site and it continues to regenerate in the understory unless it is pushed back by fire.
In the dry range of this ecological site, plant species common to the Portland Basin Dry Douglas-fir can occur, such as Pacific madrone and oceanspray (Holodiscus discolor). Western red cedar and big leaf maple are less common in this ecological site than the Puget

Lowlands Forest due to it being slightly drier. Grand fir may also be present. In some cases, bigleaf maple can come to dominate the overstory by resprouting after a disturbance, such as fire or logging, and temporarily outpace growth of conifers. It will persist for variable lengths of time depending on how quickly conifers establish and the time required for them to surpass the maple canopy. Sword fern, red huckleberry, and salal are common in the understory.

There is strong agreement in the research community that fire is a critical determinant of stand structure and composition in Pacific Northwest conifer forests (Munger 1940, Morrison and Swanson 1990, Agee 1993,). Historic fire frequency in western Oregon and Washington conifer-dominated forests is an ongoing topic of debate with recent research suggesting that assigning a long-interval (150+ year), stand-replacing fire regime to these forests (as has been the long-held view) is inaccurate, or at least over-simplified (Wendel and Zabowskl 2010, Tepley 2010, Tepley et al. 2013). In general, fire in this ecological site is likely to have occurred in the past with relatively long (50+ year) mean fire return intervals (MFRI) but with great variability in behavior and effects. While an individual point location (such as a tree or plot) may be unlikely to experience fire at quick intervals, when considered at a watershed scale, fire occurred often, burning different areas at different times (Morrison and Swanson 1990, Agee 1993, Tepley 2010). Fires also displayed varying behavior including infrequent stand-replacing events alongside lower intensity events that cause small patch or individual tree mortality and leave many surviving overstory trees, particularly Douglas-fir (Tepley et al. 2013). This variable, rotational pattern supports high structural and compositional diversity. Much of the area where this ecological site occurs has experienced little fire between the early 20th century and time of this writing (2024) due to active fire suppression, which suggests a trend toward more western hemlock and less Douglas-fir on unmanaged lands where fire is excluded (Munger 1940).

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 1.2 plant community composition

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

Table 7. Community 1.3 plant community composition

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

Table 8. Community 1.4 plant community composition

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

Table 9. Community 2.1 plant community composition

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

Table 10. Community 2.2 plant community composition

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

Table 11. Community 2.3 plant community composition

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

Table 12. Community 3.1 plant community composition

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

Table 13. Community 3.2 plant community composition

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

Table 14. Community 3.3 plant community composition

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

Inventory data references

Relationship to Other Established Classifications: This site is related to plant associations PICO-PSME/GASH, PSME-ABGR/FEOC, PSME-ABGR/HODI/POMU, PSME-ARME/GASH, PSME- ARME/HODI/LOHI, PSME/GASH-HODI, SPME/HODI-SYAL, SPME/ROGY-

HODI, and QUGA-PSME/SYAL/POMU in Chappell (2006). Chappell, C.B. 2006. Upland plant associations of the Puget Trough ecoregion, Washington. Natural Heritage Rep. 2006-01. Washington Department of Natural Resources, Natural Heritage Program, Olympia, WA. https://file.dnr.wa.gov/publications/amp_nh_upland_puget.pdf (accessed 29 January 2021).

Other references

U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. 2019. Fire Effects Information System (FEIS). https://www.feis-crs.org/feis/ (accessed 8 January 2021).Agee, J.K. 1993. Fire ecology of Pacific Northwest forests. Island Press. Covelo, CA. ISBN: 978-1559632300.
Hermann and Lavender, 1990. Pseudotsuga menziesii. In: Burns, R.M. and Honkala, B.H., 1990. Silvics of North America. Volume 1. Conifers.
Morrison, P.H., Swanson, F.J. 1990. Fire history and pattern in a Cascade Range landscape (Vol. 254). US Department of Agriculture, Forest Service, Pacific Northwest Research Station.
Minore, D. 1990. Thuja plicata. In: Burns, R.M. and Honkala, B.H., 1990. Silvics of North America. Volume 1. Conifers.
Munger, T.T., 1940. The Cycle form Douglas Fir to Hemlock. Ecology, 21(4), pp.451-459.
Packee, E.C. 1990. Tsuga heterophylla. In: Burns, R.M. and Honkala, B.H., 1990. Silvics of North America. Volume 1. Conifers.
Perry, D.A. 1994. Forest ecosystems. The Johns Hopkins University Press. Baltimore, MD. ISBN: 0-8018-4760-5.
Tepley, A.J., 2010. Age structure, developmental pathways, and fire regime characterization of Douglas-fir/western hemlock forests in the central western Cascades of Oregon. Oregon State University.
Tepley, A.J., Swanson, F.J. and Spies, T.A., 2013. Fire?mediated pathways of stand development in Douglas?fir/western hemlock forests of the Pacific Northwest, USA. Ecology, 94(8), pp.1729-1743.
Wendel, R. and Zabowskl, D., 2010. Fire history within the lower Elwha river watershed, Olympic National Park, Washington. Northwest Science, 84(1), pp.88-97.

Contributors

Erik Dahlke
Marty Chaney
Stephanie Shoemaker
Mathew Cocking

Approval

Kirt Walstad, 12/03/2024

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	08/31/2026
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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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:**
