USDA Natural Resources Conservation Service

Ecological site AX002X01X007
Puget Lowlands Wet Hemlock 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

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

This ecological site may occur in both LRU A and B within MLRA 002. The Puget Sound Trough Lowlands Land Resource Unit (LRU A) is bounded to the north by the Frasier River Valley at the international border with Canada and extends south to the Cowlitz River. To the west lie Puget Sound and the Strait of Juan De Fuca; to the east lie the foothills of the Cascade Range. The LRU is affected by the proximity of climate-moderating saltwater. Modest annual swings in temperature, winters that seldom experience freezing temperatures, adequate rainfall, and warm, dry summers support small-scale agriculture and forestry. This climate also supports the largest population and highest population density in the Northwest. Aside from isolated areas affected by local rain shadows and marine-influenced fog, the climate is consistent throughout the Puget Lowlands.

The LRU represents the furthest southern extent of repeated advances of continental glaciers in western Washington. Glacial drift is the predominant parent material. The LRU also includes intermittent areas of glacially modified, resistant bedrock and several alluvial systems. Volcanic ash is present but intermittent. Soil moisture varies considerably over short distances. This variability creates a mosaic of small plant communities. Soil drainage can be restricted by dense glaciomarine sediments or till. This restriction can create widespread areas of seasonal

high water tables and ponding. In places, soils that developed in deep, unconsolidated, coarse-textured sandy drift or in bedrock- restricted colluvium have low available water capacity. South-facing areas near shorelines and minor outwash plains are typically some of the drier areas in the LRU. Precipitation increases with elevation and distance from Puget Sound.

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

This ecological site consists of forested wetlands in depressions and drainageways at elevations generally less than 500 feet. Areas of the site are affected by a seasonal high water table. The site is strongly influenced by physiography and hydrology, which provide rare and unique habitats in Puget Sound. The climate has warm, moist summers and cool, wet winters. Precipitation falls mostly as rain. Snow is rare. Soils that support this ecological site are in the mesic soil temperature regime and aquic soil moisture regime. Most areas of this site can be subject to residual ponding in addition to extended periods of water at the surface. These anaerobic conditions lead to a slowed rate of organic decomposition. The seasonal high water table and ponding dynamics may be altered by artificial drainage of the site or adjacent areas. A thin organic horizon consisting of decomposing twigs, needles, and litter is on the surface. This horizon helps to protect the soils from wind and water erosion. Fire in this ecological site historically occurred at relatively longer return intervals (100 or more years) similar to other hemlock, western red cedar and Douglas-fir ecological sites of the Pacific Northwest (Agee 1993).
The most common overstory species are western hemlock (Tsuga heterophylla), western redcedar (Thuja plicata), Douglas-fir (Pseudotsuga menziesii), Cascara buckthorn (Frangula purshiana), bigleaf maple (Acer macrophyllum), and red alder (Alnus rubra). Black cottonwood (Populus trichocarpa) may also occur, especially in the wettest portions of this ecological site and in the Puget Trough LRU to the north. As a result of soil saturation during much of the year, conifers may be restricted to nurse logs or higher microsites and they commonly are short and stunted (Roccio and Crawford, 2015).
Shrubs may be sparse or entirely absent in some areas. Shrubs may include salmonberry (Rubus spectabilis), devilsclub (Oplopanax horridus), vine maple (Acer circinatum), red huckleberry (Vaccinium parvifolium), thimbleberry (Rubus parviflorus) and salal (Gaultheria shallon). The herb layer commonly is dominantly American skunkcabbage (Lysichiton Americanus), threeleaf foamflower (Tiarella trifoliata), small enchanter’s nightshade (Circaea alpina), ladyfern (Athyrium filix-femina), deer fern (Blechnum spicant), and slough sedge (Carex obnupta).

Associated sites

AX002X01X002	**Puget Lowlands Tidal Flat**
AX002X01X003	**Puget Lowlands Peat Wetlands**
AX002X01X008	**Puget Lowlands Riparian Forest**

Similar sites

F002XN904WA	**Sitka spruce - red alder/salmonberry/field horsetail**

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Alnus rubra*
Shrub	(1) *Rubus spectabilis*
Herbaceous	(1) *Lysichiton americanus*

Legacy ID

F002XA007WA

Physiographic features

Table 2. Representative physiographic features

Landforms	(1) Depression (2) Drainageway
Flooding frequency	None to rare
Ponding duration	Very long (more than 30 days)
Ponding frequency	None to frequent
Elevation	0–152 m
Slope	0–5%
Ponding depth	0–51 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding duration	Not specified
Ponding frequency	Not specified
Elevation	0–457 m
Slope	0–15%
Ponding depth	Not specified

Climatic features

Mean annual air temperature: 48 to 52 degrees Fahrenheit

Table 4. Representative climatic features

Frost-free period (characteristic range)	160-240 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	508-1,778 mm

Influencing water features

Wetland description

National vegetation classification: G853 Tsuga heterophylla – Alnus rubra / Lysichiton Americanus Swamp Forest Group

Soil features

Surface textures: Silt loams, loams, and silty clay loams
Soil family textures: Coarse-loamy, fine-loamy, fine, loamy-skeletal, and sandy-skeletal
Parent material: Glacial drift, including outwash or till, alluvium
Soil depth: 20 to more than 60 inches. Densic contacts are possible restrictions.
Soil drainage: Very poorly, poorly, and somewhat poorly
Available water capacity in the top 40 inches: 5 to 20 in/in
pH in water: 4.5 to 6.5

Ecological dynamics

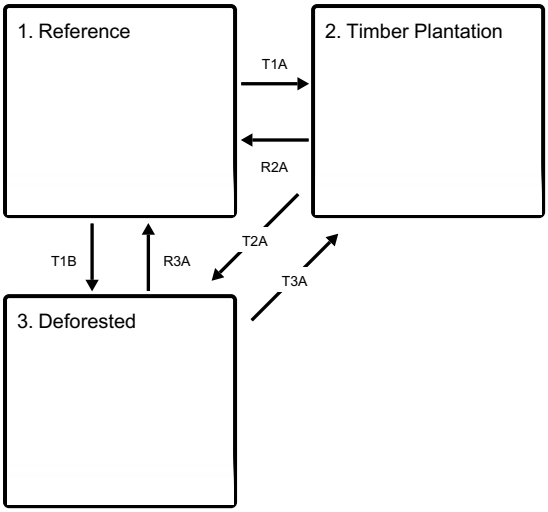
The most common natural disturbance is ponding. The volume and longevity of the ponding determines the effect on the dynamics of the forest. The site is vulnerable to windthrow following large coastal storms. Trees in this site are particularly susceptible to windthrow due to the shallow rooting depth in response to the seasonal high water table and long periods of ponding that extend into the growing season. Fallen trees that have exposed root systems and large woody debris are common. The fallen trees result in more canopy openings. The openings promote high cover of shorter-lived broadleaved species such as alder, cottonwood, and maple that thrive in these wet, disturbed zones. These deciduous species also allow more sunlight to reach the forest floor, which leads to a shrubby understory. Disturbances in adjacent areas may alter the hydrology and increase the susceptibility to infestation by invasive species.

Fire was also an important recurring disturbance in this ecological site. Historic ignitions would have been possible from both lightning and intentional use by tribal peoples. Because this site is relatively wet, periods dry enough to facilitate fire spread are relatively infrequent and therefore, fire historically occurred at relatively longer return intervals (100 or more years) similar to other hemlock, western red cedar and Douglas-fir ecological sites of the Pacific Northwest (Agee 1993). Fire events create openings similar to windthrow and can also burn as large areas of high severity, depending on weather conditions at the time of fire. After fire, regenerating plant communities include a mix of conifer and broadleaved seedlings among a thick layer of re-sprouting shrubs. Due to fire suppression and loss of tribal burning, fires have not occurred in much of this ecological site in the past 100 to 150 years.

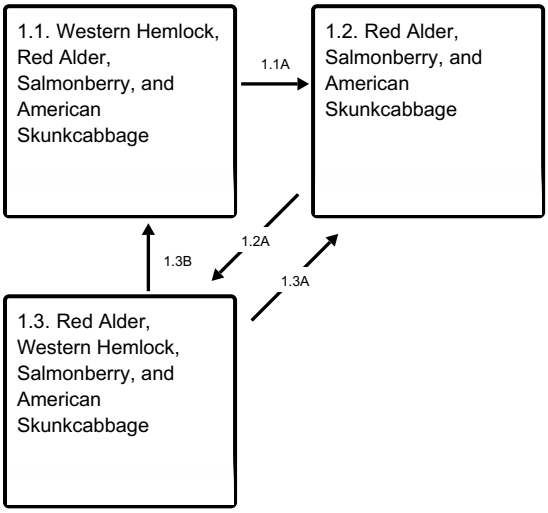
The site can be managed for timber, although its hydrology and very high water table limit the quality and productivity of conifers relative to other forested ecological sites in the region. Conversely, alder does very well in this ecological site and is at times highly valued. Timber management consists of a stand-replacement harvest system with a relatively short rotation of 40 to 70 years. After harvests, woody residue is treated and desired conifer species are intentionally replanted forming very uniform, dense young stands of trees. Alder regenerates readily in openings at extremely high density and is usually not replanted.

State and transition model

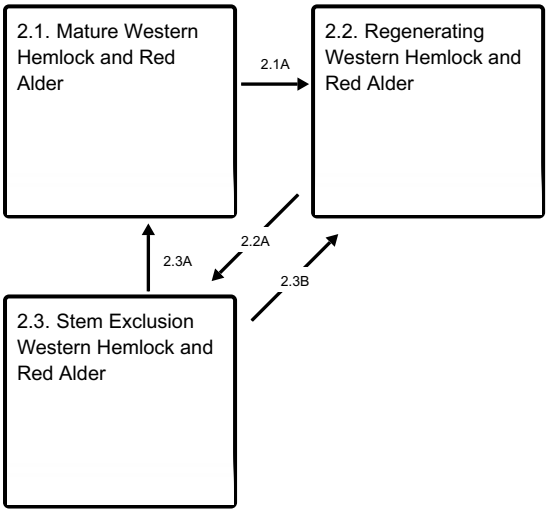
Ecosystem states



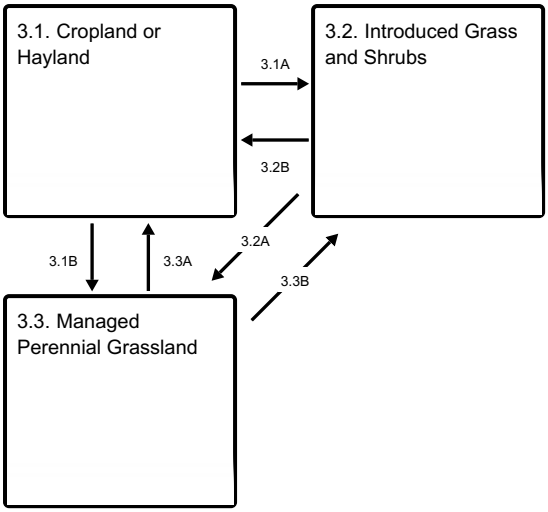
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference

Wet Hemlock and Red Alder Forest

Community 1.1
Western Hemlock, Red Alder, Salmonberry, and American Skunkcabbage

Structure is a mosaic of mature overstory and regenerating openings. Community 1.1 represents an absence of major disturbance from windthrow, fire or ponding for at least 80 years. This absence allows the pioneering species to form a mature canopy. Western hemlock and red alder are the dominant overstory species. Western redcedar and Douglas-fir may be present, but they are limited to drier microsites, such as nurse logs and mounds. Shrubs commonly are restricted to nurse logs, stumps, and higher microsites. Understory species include salmonberry, devilsclub, salal, American skunkcabbage, red huckleberry, thimbleberry, swordfern (*Polystichum munitum*), deer fern, and sedges (Carex spp.). Common disturbances include small gap dynamics (1/2-acre openings or smaller) following windstorms and excessive ponding.

Dominant plant species

- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- red alder (*Alnus rubra*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- salmonberry (*Rubus spectabilis*), shrub
- devilsclub (*Oplopanax horridus*), shrub
- salal (*Gaultheria shallon*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- vine maple (*Acer circinatum*), shrub
- American skunkcabbage (*Lysichiton americanus*), other herbaceous
- western swordfern (*Polystichum munitum*), other herbaceous
- common ladyfern (*Athyrium filix-femina*), other herbaceous
- deer fern (*Blechnum spicant*), other herbaceous
- sedge (*Carex*), other herbaceous

Community 1.2
Red Alder, Salmonberry, and American Skunkcabbage

Structure is tree, shrub, forb, and sedge establishment. This community consists of forest that is undergoing regeneration or stand initiation immediately following excessive ponding or windthrow, or fire. Scattered remnant

mature trees and shrubs are in some areas, and large woody debris is abundant. Loss of the overstory and the fallen trees may impact hydrology by resulting in more frequent, longer periods of ponding. Successful regeneration is dependent on the local seed source, an adequate seedbed, and sufficient light and water. Rapid recolonization is limited to plants that are well adapted to saturated soil conditions much of the year. Red alder is the primary tree and establishes quickly in areas that have an open canopy. Salmonberry, thimbleberry, American skunkcabbage, and sedges begin to reestablish during this phase.

Dominant plant species

- red alder (*Alnus rubra*), tree
- salmonberry (*Rubus spectabilis*), shrub
- thimbleberry (*Rubus parviflorus*), shrub
- American skunkcabbage (*Lysichiton americanus*), other herbaceous
- sedge (*Carex*), other herbaceous

Community 1.3
Red Alder, Western Hemlock, Salmonberry, and American Skunkcabbage

Structure is single story with dense understory. This community consists of early seral forest in regeneration. Scattered remnant mature trees are present in some areas. Western hemlock regenerate on hummocks and mounds and begin to establish a canopy. Shrubs are sparse, but species such as salmonberry, devilsclub, and red huckleberry become established on fallen trees and in higher microsites. Understory species include deer fern, American skunkcabbage, and sedges.

Dominant plant species

- red alder (*Alnus rubra*), tree
- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- salmonberry (*Rubus spectabilis*), shrub
- devilsclub (*Oplopanax horridus*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- thimbleberry (*Rubus parviflorus*), shrub
- American skunkcabbage (*Lysichiton americanus*), other herbaceous
- deer fern (*Blechnum spicant*), other herbaceous
- common ladyfern (*Athyrium filix-femina*), other herbaceous
- sedge (*Carex*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents wind and storm damage or mortality from fire. Excessive ponding that results in a shallow rooting zone makes larger trees susceptible to windthrow, which may create patches of fallen trees. During rare dry years, fire may burn sporadically through a stand, causing patches of mortality and other areas may be left

unburned. Very extreme windstorms or fires during very unusually dry periods may be stand-replacing.

Pathway 1.2A
Community 1.2 to 1.3

This pathway represents growth over time with no further major disturbance.

Pathway 1.3B
Community 1.3 to 1.1

Red Alder, Western Hemlock, Salmonberry, and American Skunkcabbage

Western Hemlock, Red Alder, Salmonberry, and American Skunkcabbage

This pathway represents growth over time with no further major disturbance.

Pathway 1.3A
Community 1.3 to 1.2

This pathway represents wind and storm damage or mortality from fire. Excessive ponding that results in a shallow rooting zone makes larger trees susceptible to windthrow, which may create patches of fallen trees. During rare dry years, fire may burn sporadically through a stand, causing patches of mortality and other areas may be left unburned. Very extreme windstorms or fires during very unusually dry periods may be stand-replacing.

State 2
Timber Plantation

Community 2.1
Mature Western Hemlock and Red Alder

Structure: Single story forest of even-aged trees This community is the management-controlled climax condition for this ecological site. The overstory is even-aged and exclusively or near exclusively hemlock with some codominant red alder. Trees are usually less than 100 years old. Western red cedar may be included in planting or occur naturally from adjacent seed sources depending on management objectives. Hardwoods such as maple and black cottonwood are typically less abundant but may also occur. The understory may be somewhat sparse to relatively well-vegetated with a mix of shrubs and herbaceous species, especially salmon berry, thimbleberry, skunk cabbage, and sedges. Large snags are few or absent.

Dominant plant species

- western hemlock (*Tsuga heterophylla*), tree
- red alder (*Alnus rubra*), tree
- salmonberry (*Rubus spectabilis*), shrub

Community 2.2
Regenerating Western Hemlock and Red Alder

This community consists of regenerating western hemlock and red alder forest over a large area that has been opened by timber harvest. The site may be intentionally planted or in some cases allowed to naturally regenerate as both western hemlock and red alder are relatively aggressive and capable of regenerating without assistance. Red alder often regenerates naturally at very high densities, resulting in a dense, young forest. Shrubs and mixed herbaceous species typically occupy space between planted saplings. These may include salmon berry, thimbleberry, salal, and red huckleberry. Introduced Himalayan blackberry (*Rubus armeniacus*) may present, usually at the expense of native shrubs or planted trees. Snags are very few or absent. Downed woody debris may

be abundant or limited depending on thoroughness of its reduction during the prior timber harvest.

Dominant plant species

- red alder (*Alnus rubra*), tree
- western hemlock (*Tsuga heterophylla*), tree
- salmonberry (*Rubus spectabilis*), shrub
- thimbleberry (*Rubus parviflorus*), shrub

Community 2.3
Stem Exclusion Western Hemlock and Red Alder

Structure is single story forest of even-aged trees. This community is the interim point between regeneration and the mature state. Composition is often still dominated by red alder, but western hemlock is also abundant in the overstory. The stand remains very dense. Western red cedar and Douglas-fir may be present at a lower frequency by natural regeneration or as part of the post-harvest reforestation effort. A pre-commercial thin may be applied at or shortly before this phase to reduce inter-tree competition and maintain high growth rates. The understory is dominated by a mix of shrubs such as salmonberry and thimbleberry. Big leaf maple and black cottonwood may occur sporadically. Snags are very few or absent. Downed woody debris may be abundant or limited depending on thoroughness of its reduction during the prior timber harvest.

Dominant plant species

- red alder (*Alnus rubra*), tree
- western hemlock (*Tsuga heterophylla*), tree
- salmonberry (*Rubus spectabilis*), shrub
- thimbleberry (*Rubus parviflorus*), shrub

Pathway 2.1A
Community 2.1 to 2.2

This pathway represents even-aged harvest of a mature stand followed by site preparation. Tree planting may or may not be performed depending on composition objectives and confidence in natural regeneration. This pathway may also result from a stand-replacing fire followed by a salvage harvest. Removal of woody material to limit fire hazard and facilitate operability of equipment is usually performed prior to planting.

Pathway 2.2A
Community 2.2 to 2.3

This pathway represents growth of an even-aged stand alongside active weed controls to limit competition with undesired species. Thinning of saplings and pruning may or may not occur, depending on stand density or fire hazard concerns. Disturbances, such as fire, pests, and disease, are discouraged and controlled if possible.

Pathway 2.3A
Community 2.3 to 2.1

This pathway represents growth of an even-aged stand that is maturing and dominates the overstory. Light thinning may or may not occur, depending on stand density or fire hazard concerns. Disturbances, such as fire, pests, and disease, are discouraged and controlled if possible.

Pathway 2.3B
Community 2.3 to 2.2

This pathway results from a stand-replacing fire or a major pest or disease event that kills all or nearly all trees, followed by replanting or natural regeneration. Salvage harvesting may occur if there is sufficient commercially viable material in the stand. Site preparation and removal of woody material is usually performed prior to planting.

State 3

Deforested

Community 3.1
Cropland or Hayland

Structure is annual or perennial non-native species monoculture. This community phase consists of a range of crops, including annually planted species, short-lived perennial species, and more permanent perennial crops. Hay and grasses and legumes for silage are included in this community.

Community 3.2
Introduced Grass and Shrubs

Structure is annual or perennial herbaceous or shrubby species. Community 3.2 is characterized by low-level or more intermittent management activity such as occasional or light grazing or sporadic mowing. This plant community is dominated by introduced weedy species and the less frequent disturbance supports a shrubbier character with thickets of regenerating broadleaved trees. The site is grazed, mowed or burned often enough to prevent re-establishment of forest. Dominant shrubs are typically invasive rhizomatous species that form thickets such as Himalayan blackberry (*Rubus armeniacus*). Some tougher native shrub species such as California blackberry (*Rubus ursinus*) and salmonberry may be interspersed. Areas where ponding or brief inundation occurs commonly support non-native rhizomatous grasses. Between shrub thickets introduced pasture species such as tall fescue (*Schedonorus arundinaceus*), orchardgrass (*Dactylis glomerata*), and common velvet grass (*Holcus lanatus*) are dominant. Alder and black cottonwood are regularly present in seedling thickets or as individual small seedlings.

Dominant plant species

- red alder (*Alnus rubra*), tree
- Himalayan blackberry (*Rubus armeniacus*), shrub
- salmonberry (*Rubus spectabilis*), shrub
- California blackberry (*Rubus ursinus*), shrub
- tall fescue (*Schedonorus arundinaceus*), grass
- orchardgrass (*Dactylis glomerata*), grass
- common velvetgrass (*Holcus lanatus*), grass

Community 3.3
Managed Perennial Grassland

Structure is perennial herbaceous species. This community is an introduced grassland that receives regular grazing or mowing disturbance and may include soil amendments such as fertilizers or lime. Weeds are aggressively controlled and desired herbaceous species are reseeded as necessary. Grazing, mowing and other weed control actions prevent the phase from transitioning to a forested state. This plant community is typically dominated by introduced perennial pasture species that are seeded after clearing or invade the site from nearby areas. Common species include tall fescue (*Schedonorus arundinaceus*), orchardgrass (*Dactylis glomerata*), velvet grass (*Holcus lanatus*), and red fescue (*Festuca rubra*).

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- orchardgrass (*Dactylis glomerata*), grass
- common velvetgrass (*Holcus lanatus*), grass
- red fescue (*Festuca rubra*), grass

Pathway 3.1A
Community 3.1 to 3.2

In the absence of agronomic and livestock management activities, seeds from surrounding weedy plant communities are transported to the site by wind, animals, or vehicle traffic, and the adapted species become established. Management activities include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; planting desirable herbaceous species; and implementing grazing management plans.

Pathway 3.1B
Community 3.1 to 3.3

This pathway occurs by intentional establishment of a perennial grass-dominated plant community. Often, the site will be prepped for seeding and desired pasture species artificially sown. In some cases, simply discontinuing crop production activities may allow the site to transition to grass, provided emergence of woody shrubs or trees is actively controlled with mowing, fire, or chemical treatment. Consistent grazing is essential to the maintenance of this community and to prevent establishment of woody shrubs. Other maintenance practices, such as targeted mowing, prescribed fire, chemical treatment, or other mechanical treatment are utilized as needed.

Pathway 3.2B
Community 3.2 to 3.1

This pathway represents agronomic activities. Examples include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; and planting desirable crop species.

Pathway 3.2A
Community 3.2 to 3.3

This pathway represents agronomic and livestock management activities. Examples include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; planting desirable herbaceous species; and implementing grazing management plans.

Pathway 3.3A
Community 3.3 to 3.1

This pathway represents agronomic activities. Examples include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; and planting desirable crop species.

Pathway 3.3B
Community 3.3 to 3.2

In the absence of agronomic and livestock management activities, seeds from surrounding weedy plant communities are transported to the area by wind, floodwater, animals, or vehicle traffic, and the adapted species become established. Management activities include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; planting desirable herbaceous species; and implementing grazing management plans.

Transition T1A
State 1 to 2

This transition represents a shift to a timber plantation management system. This transition is typically initiated by clear cut of old forest in the reference state but can be initiated after a large stand-replacing fire in the reference state. Management actions include even-aged harvests and replanting of desired species.

Transition T1B
State 1 to 3

This transition is caused by an intentional clearing of land or a stand replacing fire in state 1, followed by intense, frequent disturbance such as grazing, mowing, crop production, or frequent fire to prevent trees from re-establishing. This transition can be initiated from any community phase in state 1. Disruption of the hydrologic regime by ditching and draining the site may or may not occur.

Transition R2A

State 2 to 1

This restoration occurs by artificial or natural re-establishment over time of species resembling overstory and understory diversity typical of the reference state. This transition can be initiated from any community phase in state 2. Allowing the site to naturally regenerate to shrubs and forest is usually all that is needed. In some cases, treatment of invasive species such as Himalayan blackberry may improve the rate of restoration.

Transition T2A
State 2 to 3

This transition is caused by an intentional clearing of land or a stand replacing fire in state 2, followed by intense, frequent disturbance such as grazing, mowing, crop production, or frequent fire to prevent trees from re-establishing. This transition can be initiated from any community phase in state 2. Disruption of the hydrologic regime by ditching and draining the site may or may not occur.

Restoration pathway R3A
State 3 to 1

This restoration occurs by restoration of hydrologic function and regime, and artificial or natural re-establishment over time of species resembling overstory and understory diversity typical of the reference state. Intentional planting, site preparation, and control of competing invasive weeds will accelerate this transition. This transition can be initiated from any community phase in State 3. Removal of disturbance to allow the site to naturally regenerate to shrubs and forest is often the only action that is needed.

Restoration pathway T3A
State 3 to 2

This transition occurs with a change in land management from a cleared non-forest state to a forest plantation. The site is typically treated mechanically or with fire to prep the seed bed before planting or to promote natural regeneration. This transition can be initiated from any community phase in state 3.

Additional community tables

Inventory data references

Relationship to Other Established Classifications:

Washington Department of Natural Resources, Ecological Systems of Washington State: North Pacific Hardwood-Conifer Swamp

Other references

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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	12/22/2024
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:**

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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:**
