Ecological site AX002X01X002
Puget Lowlands Tidal Flat

Last updated: 12/03/2024
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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.

This MLRA includes a variety of ecological sites. Many are characterized by forest vegetation, but some were maintained as prairie, savanna, or oak woodland through cultural burning prior to Euro-American settlement. In the northern part of this MLRA Puget Sound has a moderating effect on temperature, and humidity is generally higher. Douglas-fir (Pseudotsuga menziesii) is widespread throughout. Oregon white oak (Quercus garryana) is common on valley bottoms and surrounding slopes in the south. In the north its historic extent is more limited, occurring on warm aspects with exposed or droughty conditions and areas affected by rain shadowing from local ranges, particularly the Olympic Mountains. Big leaf maple (Acer macrophyllum) is common as a codominant or sub canopy tree across many sites. Pacific madrone grows in areas close to saltwater, or within drier forest sites with well-drained soils. Western hemlock (Tsuga heterophylla) and western red cedar (Thuja plicata) are common in wetter portions of the MLRA. 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 Puget Sound Trough Lowlands Land Resource Unit (LRU) 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.

Classification relationships

This community is described as Estuarine Association ED02 in:
MacKenzie, W.H. and J.R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Res. Br., B.C. Min. For., Victoria, B.C. Land Manage. Handbook. No. 52.

Ecological site concept

This ecological site occurs in nearshore low-lying areas and marine estuaries where inundation by both salt water and fresh water occurs. Tides often greatly influence this site, allowing for regular periods of inundation as marine and riverine waters interact. This site is in areas that are cooler than the rest of the immediate Puget Lowlands area because the site is exposed to prevailing winds from across marine waters. Because of these influences, this site is typically dominated by graminoids, forbs and low shrubs adapted to brackish conditions. With drainage or diking to control tidal and freshwater influences, the site can be developed for agricultural use.
Typical native plant species include Tufted Hairgrass (Deschampsia caespitosa), Meadow Barley (Hordeum brachyantherum), Red Fescue (Festuca rubra), Oregon Gumweed (Grindellia stricta), Douglas Aster (Symphyotrichum subspicatum), Fat Hen (Atriplex patula), Pacific Silverweed (Potentilla pacifica), Saltgrass (*Distichlis spicata*), Seaside Arrowgrass (Triglochin maritimum), Lyngbye's Sedge (*Carex lyngbyei*), Pickleweed (Salicornia virginica), Mountain Rush (Juncus arcticus ssp. Littoralis), Seashore Plantain (Plantago macrocarpa), and Goose Tongue (Plantago maritima).

Associated sites

AX002X01X003	**Puget Lowlands Peat Wetlands**
AX002X01X001	**Puget Lowlands Dry Forest**
AX002X01X008	**Puget Lowlands Riparian Forest**

Similar sites

R002XN713WA	**Tidal Meadow**

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Deschampsia cespitosa* (2) *Festuca rubra*

Legacy ID

R002XA002WA

Physiographic features

On tidal flats, in depressions, and along estuaries.

Table 2. Representative physiographic features

Landforms	(1) Tidal flat (2) Depression (3) Estuary
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	Very frequent
Elevation	0–3 m
Slope	0–5%
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

Mean annual air temperature: 50 to 52 degrees Fahrenheit

Table 3. Representative climatic features

Frost-free period (characteristic range)	240-300 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	508-1,524 mm

Influencing water features

Unless drained and protected, this site is influenced by daily tides and periodic saltwater intrusion or flooding. High tides can cause major flooding.

Wetland description

Saltwater marsh or estuary

Soil features

Surface textures: Gravelly sand, muck, and silt
Soil family textures: Sandy
Parent material: Herbaceous organic material and beach sand
Soil depth: More than 60 inches
Soil drainage: Very poorly drained
Available water capacity in the top 40 inches: 0.6 to 36 in/in.
pH in water: 5.1 to 6.5

Ecological dynamics

The primary dynamic factor affecting community shifts in this ecological site is the frequency, duration and depth of inundation by water, either fresh or brackish. Much of this ecological site occurs within areas that can be influenced by tidal inundation, and changes to soil surface elevation, water control structures, or water diversions all have the potential to force plant communities in this site beyond tolerance thresholds for dominant species, thereby causing community or state transitions. The degree of change in the physical factors that affect these inter tidal and water flow dynamics is widely variable from areas with dykes or diversions that completely exclude inundation, to very slight soil surface elevation changes from earthquakes and erosion or accretion of material.

Fire (both natural and human caused), and periodic or continuous soil perturbation from activity of grazing wildlife or livestock, small mammals, earthworms, root activity, freeze-thaw cycles, and harvest of bulbs and rhizomes by people are additional disturbances that influence plant community dynamics. Disturbance regimes are often affected by management actions such as fire control, mowing, livestock grazing, or vehicle access.

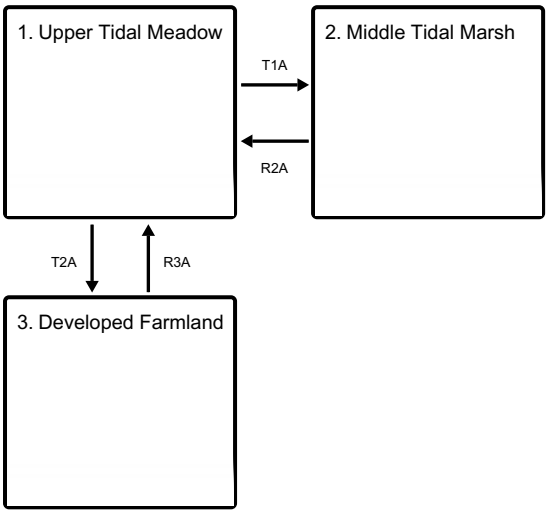
Many nonnative species will invade the site whether or not disturbance is maintained, increased, or eliminated.

Their dominance in the community will be affected by the type and intensity of disturbance. Nonnative plant communities will often establish following disturbance such as tillage, herbicide use, overgrazing, or intensive vehicle traffic that denudes the site.

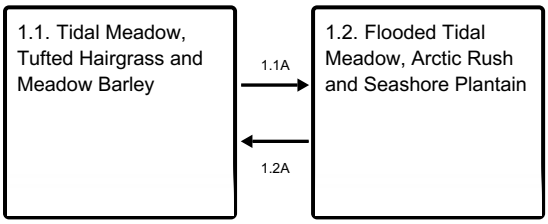
Restoration, it’s possible to reestablish native plant communities on suitable soils. Native species can be replanted and the site managed to maintain or increase the cover of these species. Inundation duration and frequency can be adjusted by removing or modifying water control features or changing the elevation of a site, thereby creating the desired flooding dynamics that match those that will support vegetation of the desired state or community phase. Once non-natives become established they will always have a presence in this ecological site because many are adapted to a wide range of soils, climates and disturbance regimes. However, the management of disturbance regimes and facilitative practices can greatly affect composition and minimize cover of non-native plants.

State and transition model

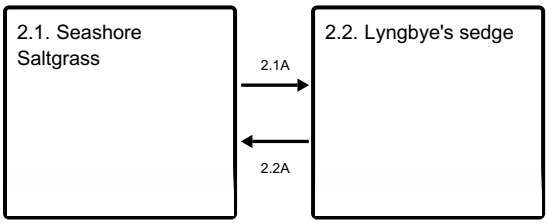
Ecosystem states



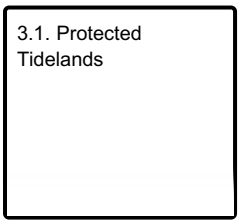
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Upper Tidal Meadow

Community 1.1
Tidal Meadow, Tufted Hairgrass and Meadow Barley

The soils that support this native plant community are typically adjacent to marine waters and affected by extreme high tides and saltwater intrusion. This plant community grows immediately adjacent to, and higher in elevation than, the Middle Tidal Marsh plant community. The Tidal Meadow, Tufted Hairgrass and Meadow Barley plant community is widespread in estuaries. It grows in the upper tidal meadow zone between the backshore shrub communities and the middle tidal marsh, typically in broad and extensive flats. It has weakly brackish conditions and irregular inundation.

Dominant plant species

- tufted hairgrass (*Deschampsia cespitosa*), grass
- meadow barley (*Hordeum brachyantherum*), grass
- red fescue (*Festuca rubra*), grass

Community 1.2
Flooded Tidal Meadow, Arctic Rush and Seashore Plantain

This Flooded Tidal Meadow, Mountain Rush and seashore Plantain plant community occurs when there are longer periods of inundation than in community 1.1.

Dominant plant species

- mountain rush (*Juncus arcticus ssp. littoralis*), grass
- seashore plantain (*Plantago macrocarpa*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents an increase in period of inundation through such processes as soil subsidence caused by earthquakes; oxidation of organic matter; or erosion.

Pathway 1.2A
Community 1.2 to 1.1

This pathway represents a reduction in period of inundation through such processes as the accretion of sediment, either from fluvial or oceanic processes.

State 2
Middle Tidal Marsh

Community 2.1
Seashore Saltgrass

This native plant community is typically adjacent to marine waters and is affected by daily high tides and saltwater intrusion. This plant community is dominated by seashore saltgrass (*Distichlis spicata*). This site has more marine saltwater intrusion and is more brackish than communities 1.1 or 1.2.

Dominant plant species

- saltgrass (*Distichlis spicata*), grass

Community 2.2
Lyngbye's sedge

This community is dominated by Lyngbye's sedge (*Carex lyngbyei*) and occurs in brackish areas that have longer periods of inundation than Community 2.1.

Dominant plant species

- Lyngbye's sedge (*Carex lyngbyei*), grass

Pathway 2.1A
Community 2.1 to 2.2

This pathway represents an increase in period of inundation through such processes as soil subsidence caused by earthquakes; oxidation of organic matter; or erosion.

Pathway 2.2A
Community 2.2 to 2.1

This pathway represents a reduction in period of inundation through such processes as the accretion of sediment, either from fluvial or oceanic processes.

State 3
Developed Farmland

Community 3.1
Protected Tidelands

This community grows in areas where dikes and artificial drainage reduce inundation and salt intrusion, allowing for development of farmland. Species occurring here are highly variable and are affected by artificial establishment efforts to promote desirable species for grazing livestock or species favored for other agricultural purposes.

Transition T1A
State 1 to 2

This transition is caused by an increase in period of inundation through such processes as soil subsidence caused by earthquakes; oxidation of organic matter; or erosion.

Transition T2A
State 1 to 3

This transition is caused by diking and artificial drainage that limits or prevents tidal and freshwater inundation.

Restoration pathway R2A
State 2 to 1

This restoration is caused by reduction in period of inundation and restoration of freshwater influence. Accretion of sediment or intentional addition of soil to raise the elevation of the site may facilitate this restoration pathway.

Restoration pathway R3A
State 3 to 1

This restoration is caused by removal of dikes and artificial drainage that restores inundation influence of fresh and salt water. After dike and drainage structure removal, elevation of the site must be high enough to prevent inundation that is overly prolonged which can result in mud flat or shallow marine water with little to no vegetation.

Additional community tables

Other references

CNPS. Accessed in 2024. A Manual of California Vegetation, Online Edition.

MacKenzie, W.H., and J.R. Moran. 2004. Wetlands of British Columbia: A guide to identification. Research Branch, British Colombia, Ministry of Forests, Victoria, B.C. Land Management Handbook No. 52.

Seliskar, Denise M., and John L. Gallagher. The ecology of tidal marshes of the Pacific Northwest coast: a community profile. The Service, 1983.

Contributors

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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	05/13/2025
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**