USDA Natural Resources Conservation Service

Ecological site F006XB801OR
Frigid Xeric Foothills 30-40 PZ

Last updated: 9/11/2023
Accessed: 05/19/2024

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): 006X–Cascade Mountains, Eastern Slope

Stretching from northern Washington to southern Oregon, MLRA6 encompasses the mountain slopes, foothills, elevated plateaus and valleys on the eastern slopes of the Cascade mountains. This MLRA is a transitional area between the Cascade Mountains to the west and the lower lying Columbia Basalt Plateau to the east.
Situated in the rain shadow of the Cascade Crest, this MLRA receives less precipitation than portions of the cascades further west and greater precipitation than the basalt plateaus to the east. Geologically, the majority of the MLRA is dominated by Miocene volcanic rocks, while the northern portion is dominated by Pre-Cretaceous metamorphic rocks and the southern portion is blanketed with a thick mantle of ash and pumice from Mount Mazama. The soils in the MLRA dominantly have a mesic, frigid, or cryic soil temperature regime, a xeric soil moisture regime, and mixed or glassy mineralogy. They generally are moderately deep to very deep, well drained, and loamy or ashy. Biologically, the MLRA is dominated by coniferous forest, large expanses of which are dominated by ponderosa pine, Douglas-fir or lodgepole pine. Areas experiencing cooler and moister conditions include grand fir, white fir, and western larch while the highest elevations include pacific silver fir, subalpine fir and whitebark pine.
Economically, timber harvest and recreation are important land uses in these forests. Historically, many of these forests would have experienced relatively frequent, low and mixed severity fire favoring the development of mature forests dominated by ponderosa pine or Douglas-fir. In the southern pumice plateau forests, less frequent, higher severity fire was common and promoted the growth of large expanses of lodgepole pine forests.

LRU notes

This unit is characterized by ash mantled lava flows and glacial outwash plains on lower mountain slopes and foothills of the East Cascades in Oregon. Vegetation is largely dominated by forests of ponderosa pine with transitional dry mixed conifer forests where Douglas fir and grand fir are subdominant occurring in areas with greater effective precipitation.
Historically, these forests have been influenced by a fire regime whereby frequent to moderately frequent, low and mixed severity fires would have favored the development of open stands of mature ponderosa pine. The climate of this unit is cool and dry with a predominately xeric soil moisture regime and frigid soil temperature regime. Geologically, underlying lithologies are dominated by Quaternary and late Tertiary basalt and basaltic andesite as well as mixed grain sediments deposited during Pleistocene glacial retreat. Unlike the nearby pumice plateau, this unit lacks the deep pumice soils that favor lodgepole pine and discourage Douglas-fir. This unit is south of the climate influences of the Columbia gorge and therefore does not support woodlands of Oregon white oak.

Classification relationships

Forested Plant Associations of the Oregon East Cascades (Simpson 2007)
CWS533 – white fir–grand fir/golden chinquapin

Plant Associations of the Central Oregon Pumice Zone (Volland 1985)

CWC211 - Mixed conifer/snowbrush-chinkapin/brackenfern

Plant Associations of the Commercial Forest of the Warm Springs Indian Reservation (Marsh 1987)
Mixed conifer - Snowberry
Mixed conifer - Chinkapin

Landfire Biophysical Setting (Landfire 2007)
0710450 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest

Ecological site concept

This site encompasses a broad group of dry mixed conifer communities on foothills and mountain slopes of the Eastern Cascades. The visual aspect of this site is a forest canopy dominated by a variable mixture of ponderosa pine (Pinus ponderosa) and Douglas fir (Pseudotsuga menziesii), with grand fir (Abies grandis) subdominant, and understory reproduction of Douglas fir and grand fir common.
The plant community often includes shrubs such as snowbrush (Ceanothus velutinus), greenleaf manzanita (Arctostaphylos patula), golden chinkapin (Chrysolepis chrysophylla) and snowberry (Symphoricarpos spp.) and herbaceous species such as pinegrass (Calamagrostis rubescens), brakenfern (Pteridium aquilinum) and starflower (Trientalis borealis). Nearby sites at lower elevations or occupying doughtier aspects experience less effective precipitation and support a reference community dominated by ponderosa pine and Douglas fir, with little grand fir. This is in part due to less effective moisture and higher temperatures and helps to facilitate a more frequent fire rotation.
Nearby sites at higher elevations or more northerly aspects host wet adapted tree species such as western hemlock, due to cooler temperatures and greater effective precipitation. These conditions facilitate a less frequent fire rotation. Since this site occupies a transition between these forest types, this site experiences a fire regime that may be intermediate between the two forest types or host a mosaic of the two types (Landfire fire regime groups 1 and 3). As such, the plant community of this site may attain many forms both structurally and compositionally depending on disturbance history and the influences of adjacent sites on its fire regime.

This is a provisional ecological site that groups characteristics at a broad scale with little to no field verification and is subject to extensive review and revision before final approval. All data herein was developed using existing information and literature and should be considered provisional and contingent upon field validation prior to use in conservation planning.

Associated sites

F006XB800OR	**Frigid Xeric Foothills 20-30 PZ** Downslope, occupying lower elevations and slope positions with lower available moisture
F003XD805OR	**Frigid Udic Maritime Mountain Slopes 40-60 PZ** Upslope, occupying higher elevations and slope positions with greater moisture, udic soil moisture regime

Similar sites

F006XB800OR	**Frigid Xeric Foothills 20-30 PZ** Lower precipitation, shade tolerant conifers uncommon in understory
F003XD805OR	**Frigid Udic Maritime Mountain Slopes 40-60 PZ** Higher precipitation, udic soil moisture regime

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa* (2) *Pseudotsuga menziesii*
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

This site is largely found occupying middle elevations on foothills and mountain slopes of the Eastern Cascades in Oregon. Within this range the site is primarily found on benches and mountain slopes, and occasionally on stream terraces, drainageways and outwash plains. Elevations are commonly 3,000 to 4,600 feet (900 to 1,400 m) but range from 2,600 to 5,000 feet (800 to 1500 m). Slopes are most often 6 to 50 percent but can range from 0 to 70 percent. This site is found on all aspects. This site is found on all aspects. This site is not subject to ponding or flooding and no water table is present within 100 inches of the soil surface.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Bench (2) Mountains > Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	914–1,219 m
Slope	6–50%
Ponding depth	0 cm
Water table depth	254 cm
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	792–1,524 m
Slope	0–70%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

The average annual precipitation ranges from 30 to 40 inches (750 to 1,000 mm) which occurs mainly between the months of November and June, mostly in the form of snow. The average annual air temperature ranges from 41 to 45 degrees Fahrenheit (5 to 7 °C) and the frost-free period ranges from 40 to 80 days. The soil temperature regime is frigid, soil moisture regime is xeric. The graphs below are populated from the closest available weather station to representative site locations and are provided to indicate general climate patterns.

Table 4. Representative climatic features

Frost-free period (characteristic range)	40-80 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	762-1,016 mm
Frost-free period (average)	60 days
Freeze-free period (average)	
Precipitation total (average)	889 mm

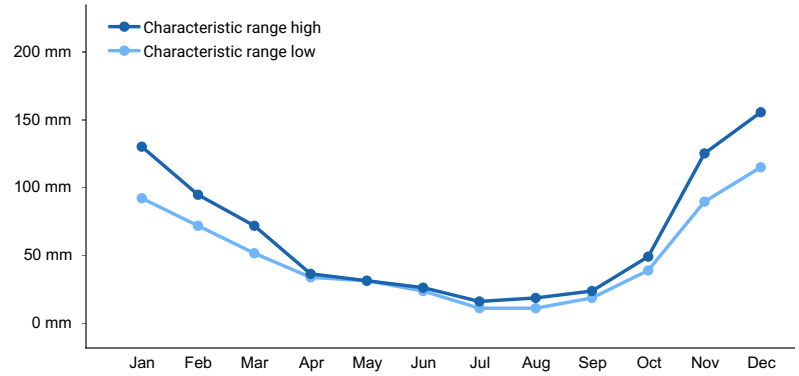


Figure 1. Monthly precipitation range

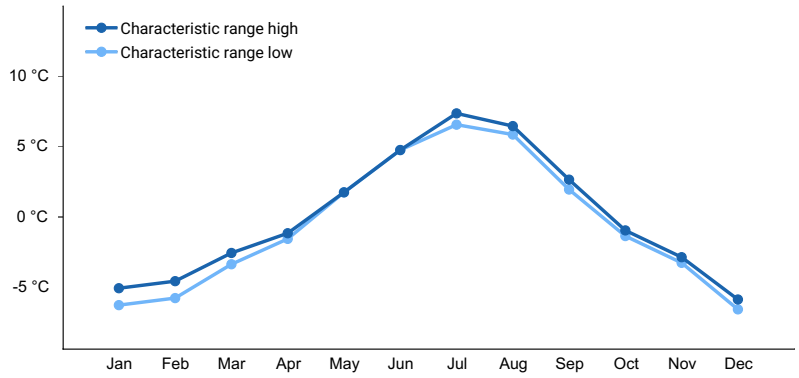


Figure 2. Monthly minimum temperature range

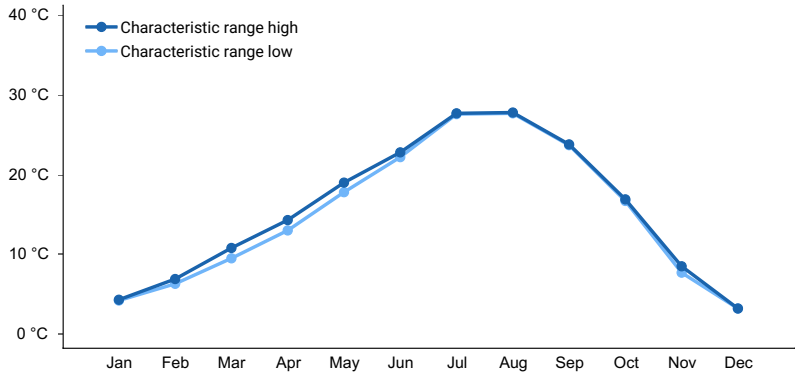


Figure 3. Monthly maximum temperature range

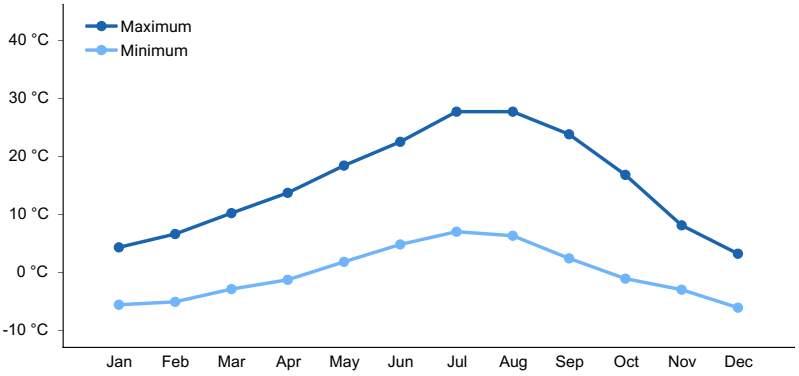


Figure 4. Monthly average minimum and maximum temperature

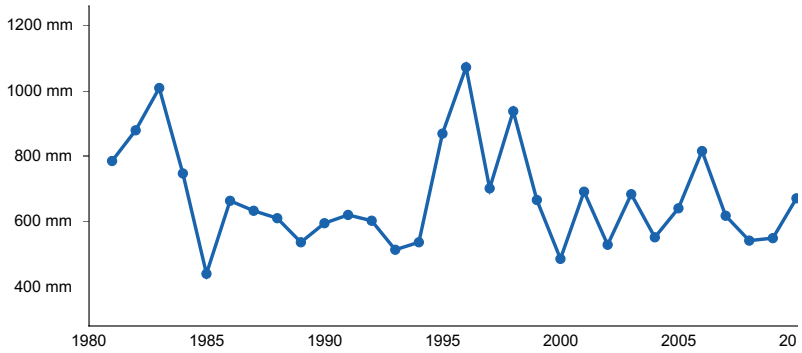


Figure 5. Annual precipitation pattern

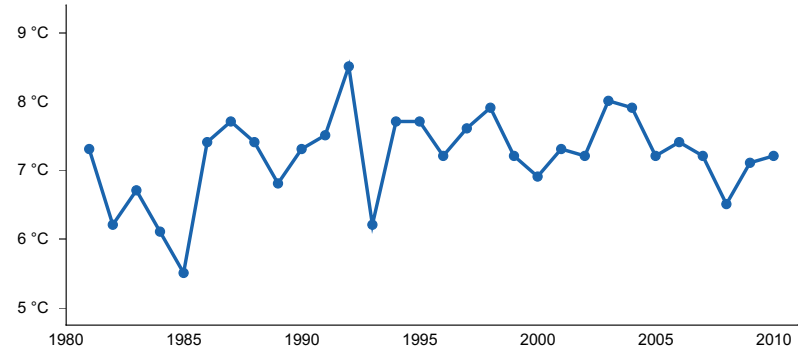


Figure 6. Annual average temperature pattern

Climate stations used

- (1) WICKIUP DAM [USC00359316], La Pine, OR
- (2) GLENWOOD #2 [USC00453184], Glenwood, WA

Influencing water features

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

Wetland description

N/A

Soil features

The soils that typify this site concept are moderately deep to very deep over lithic and paralithic bedrock. Soil parent materials are highly variable, yet all influenced by ash. These range from colluvium and residuum weathered from andesite, basalt, tuff, and sedimentary rock; to glacial outwash or mixed alluvium. Soil drainage and available water content are influenced by ash content and rock fragments throughout the profile. These are primarily well drained to somewhat excessively drained soils that often contain substantial subsurface rock fragments. Surface textures typically range from loams and sandy loams to very stony and very gravelly sandy loams.

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Colluvium–volcanic rock (3) Residuum–volcanic rock (4) Alluvium (5) Outwash

Surface texture	(1) Loam (2) Sandy loam (3) Very stony sandy loam (4) Very gravelly sandy loam
Family particle size	(1) Ashy over loamy (2) Ashy-skeletal
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid to very rapid
Depth to restrictive layer	51–203 cm
Soil depth	51–203 cm
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-101.6cm)	7.62–15.24 cm
Soil reaction (1:1 water) (0-101.6cm)	6.1–7.3
Subsurface fragment volume <=3" (10.2-152.4cm)	15–40%
Subsurface fragment volume >3" (10.2-152.4cm)	5–25%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	5.08–17.78 cm
Soil reaction (1:1 water) (0-101.6cm)	5.6–7.3
Subsurface fragment volume <=3" (10.2-152.4cm)	10–45%
Subsurface fragment volume >3" (10.2-152.4cm)	0–30%

Ecological dynamics

Reference Plant Community:

As a dry mixed conifer forest, this site is situated above the dry ponderosa pine zone and below the moist mixed conifer forests. The Reference Plant Community under the historical fire regime is characterized by a mature stand of ponderosa pine and Douglas fir, with grand fir subdominant and western larch (*Larix occidentalis*) common in some stands. Understory reproduction of shade tolerant grand fir and Douglas fir is variable. Of the true firs, grand fir is more common on this site north of the Metolius drainage, with hybrids between grand fir and white fir more common to the south (Simpson 2007). Common understory shrubs include snowbrush, manzanita, golden chinkapin and snowberry. Herbaceous cover is highly variable depending on shrub cover and canopy closure, a diverse community may be present but common members are pinegrass, brakenfern and starflower.

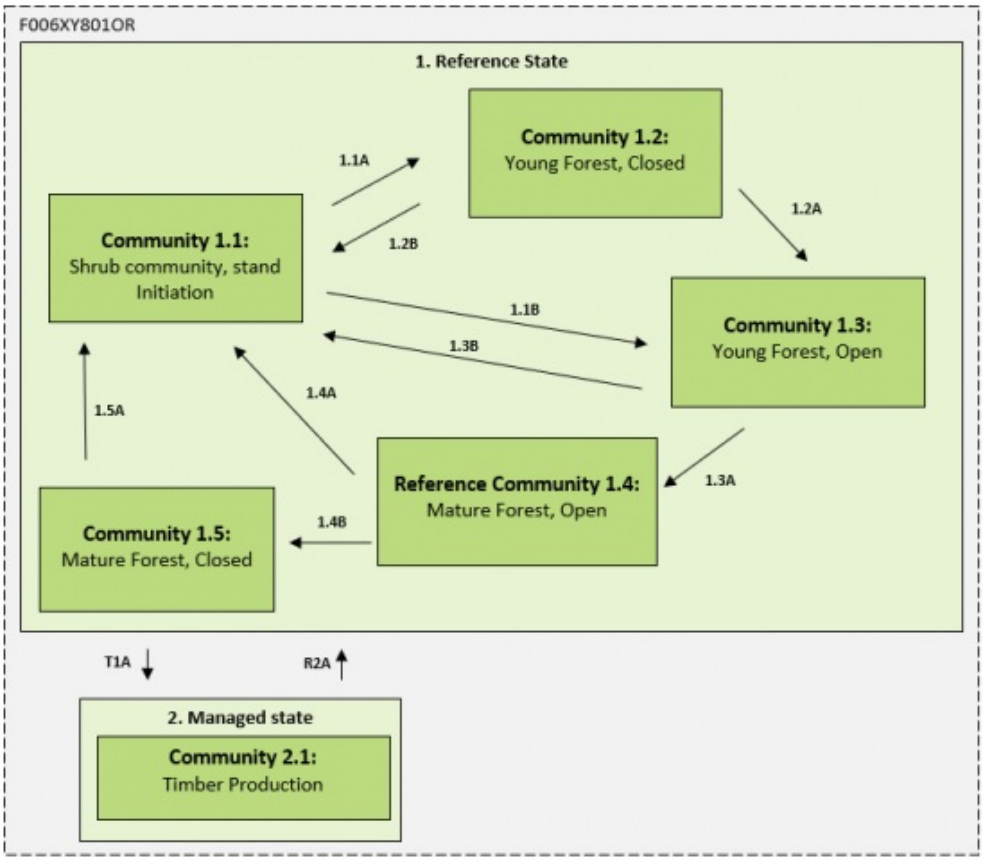
Disturbance:

This site occupies a transitional zone where information on historical fire regimes is somewhat mixed (Agee 1993, Simpson 2007). Drier, lower elevation ponderosa pine and Douglas fir dominated forests experienced regular surface fires (Landfire fire regime group 1) whereas higher elevation, wet mixed conifer forests experienced a more mixed fire regime (Landfire fire regime group 3) (Simpson 2007, Landfire 2007). As a dry mixed conifer site, the fire regime was likely somewhat mixed between these two types (fire regime groups 1 and 3) depending on attributes such as slope aspect, mean annual precipitation and forest productivity (Simpson 2007). Fire regime and disturbance history will have major implications for stand structure and composition on this site. Fire regimes approximating fire regime group 1 will favor more open canopy conditions with fire resistant ponderosa pine and to a lesser extent, Douglas fir, increasing in dominance overtime (Hessberg et al 2005). On the other hand, less frequent, more mixed fire regimes would favor the development of closed canopy conditions and the infill of shade tolerant true fir species, incense cedar and Douglas fir in the understory. Forest conditions influenced by these two fire regimes likely encourage this site to occupy a greater mosaic pattern of stands in different structural stages compared to more even aged ponderosa pine dominated forests (Simpson 2007). Manzanita, snowbrush and chinkapin will increase following fire and often form shrub fields on favorable sites following stand replacing fires. Prolonged anthropogenic fire suppression may lead to cycles of overstocking and larger, more high severity fires, yet evidence is insufficient for the characterization of this pattern as an alternative state. Evidence suggests these densely forested community phases are more common across the landscape compared to historical conditions (Hessberg et al. 2005).

This site is often highly productive and attractive for commercial timber harvesting which will have varying effects on stand structure and composition depending on harvest practices. Dense shrub cover following fire or logging may delay stand regeneration (Marsh et al 1987). Selective logging of large shade intolerant ponderosa pine trees may advance succession and favor the development of stands dominated by more shade tolerant grand fir and Douglas-fir overtime (Hessberg et al. 2005). Livestock grazing potential is limited on this site due to closed canopy conditions and high shrub cover.

The state and transition model below represents a generalized and simplified version of forest change in response to fire in this ecological site. It does not attempt to model the complex effects of forestry practices, insect outbreaks or climate change on ecosystem function or process. Emerging evidence is suggesting that climate change is leading to hotter and drier conditions in western forests that will increase fire frequency and extent and lengthen fire seasons (Halofsky et al. 2020). When combined with the interacting impacts of fire suppression, drought, and insect outbreaks, it is possible that this ecological system will experience unpredictable ecosystem shifts and additional alternative states. The current model is largely based on Landfire biophysical settings model: 0710450 Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (Landfire 2007). Despite the complexity of the fire regime of this site, currently abiotic criteria to separate this site at scales relevant to management and geographic representation is unavailable.

State and transition model



Community Pathways

1.1A	Fire cycle(s) missed
1.1B	Frequent, low severity fire regime maintained for extended duration
1.2A	Mixed severity fire occurs
1.2B	High severity, stand replacing fire occurs
1.3A	Frequent, low severity fire regime maintained for extended duration
1.3B	High severity, stand replacing fire occurs
1.4A	High severity, stand replacing fire occurs
1.4B	Fire cycle(s) missed
1.5A	High severity, stand replacing fire occurs

Transitions / Restoration Pathways

T1A	Extensive timber harvest
R2A	Forest restoration, stand replacing fire

State 1
Historical Reference State

This site occurs across the landscape as a mosaic of plant community phases characterized by variation in forest structural stage (tree age, density and cover) and plant community composition. Historically, many dry mixed conifer forests would have cycled from a shrub/tree initiation phase (1.1) to a young forest stage (1.3) to a mature forest phase (1.4) with a fire regime characterized by frequent surface and mixed fires. However, some communities would have been shaped by less frequent fire intervals and a mixed intensity fire regime and would have been characterized by a closed canopy and dense understory stocking conditions represented by Communities 1.2 and 1.5. The Reference Community within this state is that of an open mature stand represented by Community Phase 1.4. Historical evidence suggests that this community type was common across the landscape prior to selective logging and widespread fire suppression, which can alter fire regimes and lead to a greater frequency of high severity fire.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- grand fir (*Abies grandis*), tree

Community 1.1
Shrub community, stand Initiation

This community is dominated by shrubs including manzanita, snowbrush and golden chinkapin. Some trees are regenerating. These shrub fields may persist for decades yet are likely important for providing shade to young conifers, cycling nutrients and providing wildlife forage. Forest reestablishment will depend on seed sources and may require longer intervals if available sources are no longer onsite and must depend on wind or animal transport from adjacent forests. Fire with high enough severity to remove shrub cover will maintain this community. All other communities may transition to this phase after stand replacing fires.

Community 1.2

Young Forest, Closed

This community is characterized by a closed canopy, densely stocked with young to intermediate aged ponderosa pine, Douglas fir, western larch and grand fir. The understory is dominated by shrubs with little herbaceous cover due to lack of light.

Community 1.3
Young Forest, Open

This community has an open overstory of uneven aged ponderosa pine and Douglas fir with some western larch. Grand fir present in the sub-canopy. The herbaceous cover is increased with greater light availability, yet is patchy and discontinuous. This stand has a low probability of stand replacing fire.

Community 1.4
Reference plant community: Mature Forest, Open

This community is characterized by an open canopy of mature trees. This is an uneven aged stand with a mixture of ponderosa pine and Douglas fir dominating the overstory with subdominant grand fir and some western larch. Frequent, low severity fires maintain this community.

Community 1.5
Mature Forest, Closed

This community is characterized by a closed canopy of mature trees. This is an uneven aged stand with large ponderosa pine, grand fir, Douglas fir and some western larch in the overstory. Tree species density is high and herbaceous cover is low. This community has a high vulnerability to stand replacing fire.

Pathway 1.1A
Community 1.1 to 1.2

Fire cycle(s) missed

Pathway 1.1B
Community 1.1 to 1.3

Frequent low severity fire regime maintained for an extended duration

Pathway 1.2B
Community 1.2 to 1.1

High severity, stand replacing fire occurs

Pathway 1.2A
Community 1.2 to 1.3

Mixed severity fire occurs

Pathway 1.3B
Community 1.3 to 1.1

High severity, stand replacing fire occurs

Pathway 1.3A
Community 1.3 to 1.4

Frequent low severity fire regime maintained for an extended duration

Pathway 1.4A
Community 1.4 to 1.1

High severity, stand replacing fire occurs

Pathway 1.4B
Community 1.4 to 1.5

Fire cycle(s) missed

Pathway 1.5A
Community 1.5 to 1.1

High severity, stand replacing fire occurs

State 2
Managed state

This alternative state represents the many variations of timber harvesting that can occur on this site. This may result in a number of manipulated community types and pathways depending on strategies surrounding harvest, shrub control, weed control and replanting. Following harvest, some sites with adequate moisture and shrub seed source may be dominated by early seral shrubs. These may persist for decades yet are likely important for providing shade to young conifers, cycling nutrients and providing wildlife forage and cover. Selective removal of large ponderosa pine may advance succession and favor maturation of shade tolerant trees such as grand fir, Douglas fir, and incense cedar.

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree

Transition T1A
State 1 to 2

Extensive timber harvest followed by continual management for timber production that has significantly altered species compositions and resulting disturbance responses.

Restoration pathway R2A
State 2 to 1

Ecological forestry practices may promote a return to Reference State. Forest reestablishment may require shrub control and tree replanting if the desired goal is regaining a forest structure within a desired timeframe. Stand replacing fire may lead to a transition to Community 1.1 of the Reference State if soil compaction is not severe, species composition has not been significantly altered and tree seed source is available.

Context dependence. Alterations of forest tree species composition, as well as soil compaction and surface disturbances due to large machine usage may hinder passive forest reestablishment.

Additional community tables

Inventory data references

Information presented here has been derived from NRCS data. Field observations from range trained personnel were also used. Other sources used as references include USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, and USDA NRCS Soil Surveys from various counties.

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Contributors

Andrew Neary - Original PES site concept

Approval

Kirt Walstad, 9/11/2023

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	05/19/2024
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:**

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):**

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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:**
