Ecological site F006XY708OR
Frigid Xeric Foothills 12-20 PZ

Last updated: 9/11/2023
Accessed: 10/12/2024

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 sub dominant 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 coarse pumice fragments that dominate the soil profile and cooler temperatures that favor lodgepole pine. 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)
CPS211 – Ponderosa Pine/Bitterbrush/Fescue

Plant Associations of the Fremont National Forest (Hopkins 1979)
CPS211 – Ponderosa Pine/Bitterbrush/Fescue

Plant Associations of the Central Oregon Pumice Zone (Volland 1985)
CPS211 – Ponderosa Pine/Bitterbrush/Fescue
CPS111 – Ponderosa Pine/Bitterbrush-Sagebrush/Fescue
CPS216 – Ponderosa Pine/Bitterbrush/Bunchgrass

Landfire Biophysical Setting (Landfire 2007)
0710531 - Northern Rocky Mountain Ponderosa Pine Woodland and Savanna

Ecological site concept

This site represents one of the most commonly occurring ponderosa pine (Pinus ponderosa) sites in the foothills of the Eastern Cascades of Oregon. The ubiquitous presence of bitterbrush (Purshia tridentata) and Idaho fescue (Festuca idahoensis) in the understory largely defines this site biotically. Abiotically, this site is distinguished from other forest sites by its low precipitation (12 to 20 inches), Frigid temperature regime (vs cryic for most adjacent forest types), and fire regime characterized by relatively frequent surface fires. At its lower elevations, where temperatures are warmer and precipitation is lower, this site transitions into shrublands dominated by big sagebrush (Artemesia tridentata), woodlands dominated by western juniper (Juniperus occidentalis) and mixed forests dominated by ponderosa pine and juniper. At its upper elevations, with increasing precipitation and decreasing temperatures, this site transitions into forests dominated by ponderosa pine and Greenleaf manzanita (Arctostaphylos patula) or ponderosa pine and lodgepole pine (Pinus contorta). Fire was historically a critical element of the disturbance regime of this site, acting to thin crowded understories and allow fire resistant ponderosa stands to attain an open, savanna-like appearance.

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

R006XB002OR	**Frigid Xeric Lava Plains 12-16 PZ** Shallower soils, lower precip range, lower productivity of ponderosa pine, western juniper common
F006XB800OR	**Frigid Xeric Foothills 20-30 PZ** Typically upslope of this site

Similar sites

R006XB002OR	**Frigid Xeric Lava Plains 12-16 PZ** Shallower soils, lower precip range, lower productivity of ponderosa pine, western juniper common
F006XB800OR	**Frigid Xeric Foothills 20-30 PZ** Higher precipitation, greenleaf manzanita common
F006XY712OR	**Cryic Xeric Pumice Uplands 18-25 PZ** Occurring in the pumice plateau LRU, cryic soil temperature regime

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa*
Shrub	(1) *Purshia tridentata*
Herbaceous	(1) *Festuca idahoensis*

Physiographic features

This site occurs on lava plains and foothills at the base of the Eastern Cascades in Oregon. Across these landscapes the site is found on diversity of landforms including ash flows, lava flows, hillslopes and glacial outwash plains. Slopes are commonly nearly level to 15 percent but can be as steep as 50 percent. Elevations are most

commonly 4,250 to 4,750 feet (1,300 to 1,450 meters) but may range from 2,250 to 6,000 feet (700 to 1,850 meters). This site can be found on all aspects but often is found on gentle north slopes toward its driest, lower elevations. 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) Lava plain > Ash flow (2) Lava plain > Lava flow (3) Lava plain > Outwash plain (4) Foothills > Hillside or mountainside
Flooding frequency	None
Ponding frequency	None
Elevation	4,250–4,750 ft
Slope	0–15%
Ponding depth	0 in
Water table depth	100 in
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	2,250–6,000 ft
Slope	0–50%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

The average annual precipitation ranges from 12 to 20 in (300 to 500 mm) which occurs mainly between the months of November and June, mostly in the form of rain and snow. The average annual air temperature is 43 degrees Fahrenheit (6°C) but ranges from 41 to 45 degrees Fahrenheit (5 to 7°C) and the frost-free period ranges from 50 to 80 days. The optimum period for plant growth is from April through June. 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)	50-80 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	12-20 in
Frost-free period (average)	65 days
Freeze-free period (average)	
Precipitation total (average)	16 in

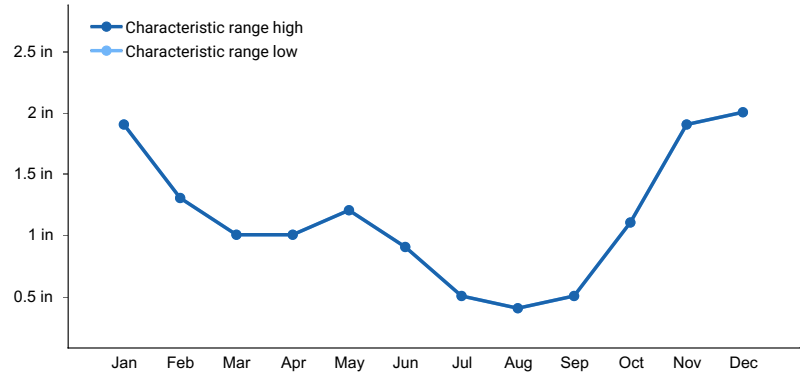


Figure 1. Monthly precipitation range

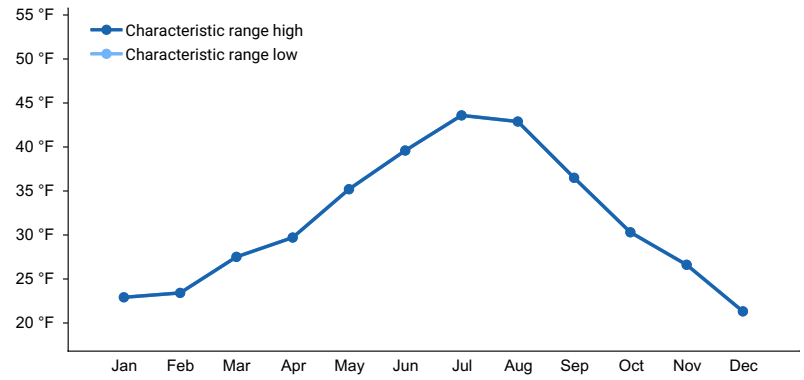


Figure 2. Monthly minimum temperature range

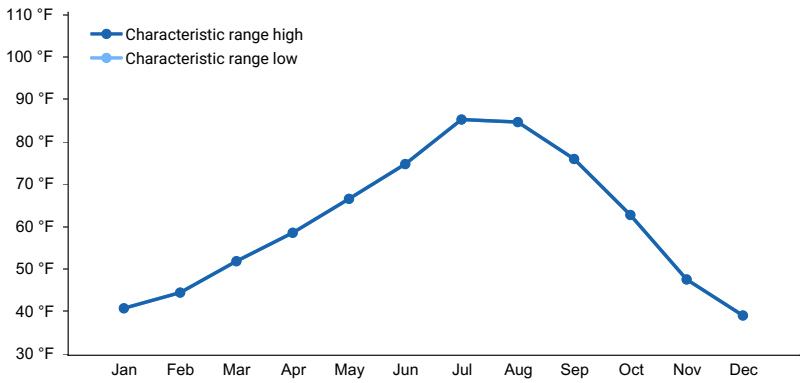


Figure 3. Monthly maximum temperature range

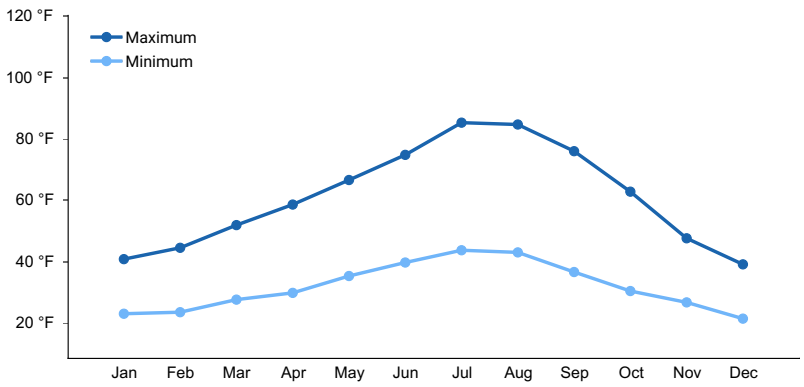


Figure 4. Monthly average minimum and maximum temperature

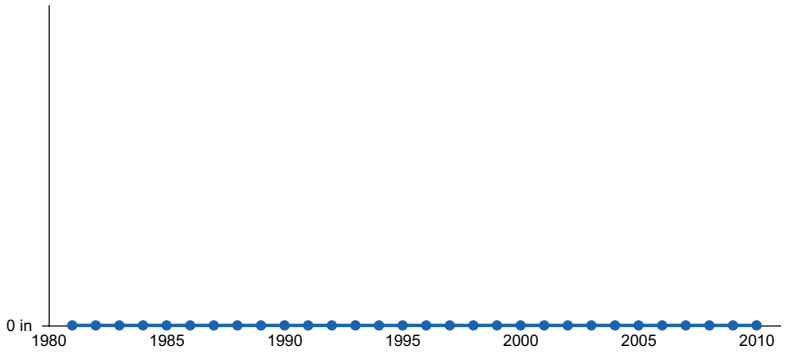


Figure 5. Annual precipitation pattern

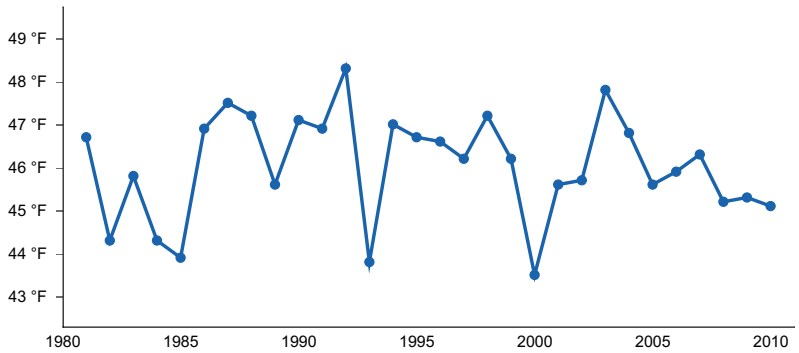


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SISTERS [USC00357857], Sisters, OR

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 fractured basalt and lava flows. These are primarily well drained, volcanic soils formed in recent deep ash and pumice deposits. Surface soil textures are commonly loamy sands and sandy loams but the site can be found on finer textured loams as well. These soils sometimes contain substantial gravels and cobbles in the upper surface layer, with areas of recent volcanic pumice deposits often containing a significant amount of gravels throughout the horizon. The soil temperature regime is frigid, soil moisture regime is xeric. Permeability is moderate to rapid and the available waterholding capacity (AWC) is 2.0 to 6.0 inches for the profile. Soils of this site are largely classified as frigid Vitrixerands (cool, dry soils formed in volcanic parent materials).

Representative soils commonly associated with this site include:

Wanoga sandy loam, 0 – 15 percent slopes
Lundgren sandy loam, 0 – 3 percent slopes

Table 5. Representative soil features

Parent material	(1) Colluvium–basalt (2) Volcanic ash (3) Pumice
Surface texture	(1) Ashy sandy loam (2) Gravelly sandy loam (3) Ashy loamy fine sand (4) Ashy loamy sand
Family particle size	(1) Ashy (2) Ashy-skeletal (3) Ashy over loamy-skeletal
Drainage class	Well drained
Permeability class	Moderate to rapid
Depth to restrictive layer	20–60 in
Soil depth	20–60 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–25%
Available water capacity (0-40in)	2.7–6.5 in
Soil reaction (1:1 water) (0-40in)	6.1–7.3
Subsurface fragment volume <=3" (4-60in)	0–60%
Subsurface fragment volume >3" (4-60in)	0–20%

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 (0-40in)	2–8.1 in
Soil reaction (1:1 water) (0-40in)	Not specified
Subsurface fragment volume <=3" (4-60in)	Not specified
Subsurface fragment volume >3" (4-60in)	Not specified

Ecological dynamics

Reference Plant community:

The reference native plant community under the natural disturbance regime, is characterized by an open stand of mature ponderosa pine, with an understory strongly dominated by bitterbrush and Idaho fescue. Mountain big sagebrush (Artemisia tridentate ssp. vaseyana) may be co-dominant with bitterbrush toward the lower end of the precipitation range. The herbaceous layer is characterized by the ubiquitous presence of Idaho fescue with other

grasses such as bluebunch wheatgrass (Pseudoregnaria spicata) common on drier sites and bottlebrush squirreltail (*Elymus elymoides*) common in disturbed areas. Forbs do not make up a substantial component of the groundcover, but some such as strawberry (Fragaria spp.) and lupine (Lupinus spp.), are common. Overall, plant diversity is quite low in these sites given the dominance of a few, highly competitive species. Lodgepole pine and juniper may be present in small amounts and may increase in some areas following disturbance. Shallower, stony soils and droughty south slopes often support a higher cover of juniper, whereas, deeper north slopes often support higher cover and productivity of ponderosa. Plant community canopy cover typically ranges from 10 to 45 percent trees, 10 to 20 percent shrubs, 15 to 30 percent grasses and 0 to 5 percent forbs.

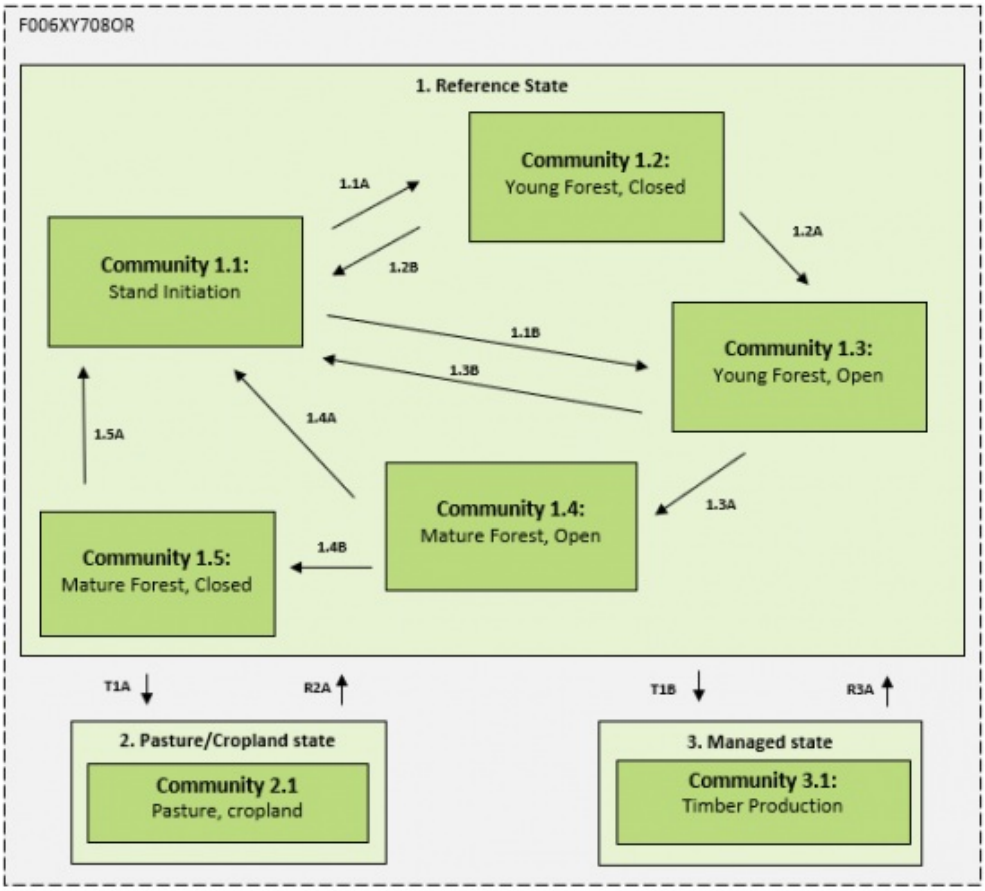
Disturbance:

Ponderosa pine forests were historically subject to frequent surface fires ignited by lightning strikes and Native American cultural burning. These low intensity fires would have decreased the density of young pine and reduced shrub understories, both of which can act as ladder fuels to ignite crown fires and lead to stand replacing events. Overtime, these events, as well as mixed severity fires, would have favored the development of mature, even-aged ponderosa pine stands with open canopies (Landfire 2007). Fire resistant ponderosa is well adapted to these conditions, developing increasing fire resistance with age by growing thick bark and self-thinning lower limbs (Fryer 2008). While sagebrush must rely on seed to return after fire, bitterbrush can re-sprout following low intensity fires. Comparatively, perennial grasses are better suited to frequent fires and may increase with shorter mean fire return interval (MFRI) while shrub cover may decline. With longer time between fire, increased development of understory fuels such as shrubs and young ponderosa, along with the development of a closed canopy, can promote an increased frequency of stand replacing fires and insect outbreaks. This condition characterizes much of the historically open canopy, dry ponderosa forests due to a history of selective logging and fire suppression (Ritchie et al 2005). Prolonged anthropogenic fire suppression may lead to cycles of overstocking and high severity fires, yet evidence is insufficient for the characterization of this pattern as an alternative state. Bark beetles are especially destructive in ponderosa forests and drought conditions may render stands more vulnerable to these outbreaks. Ponderosa recovery following stand replacing fire will be dependent on seed sources on site or in nearby forests as well as favorable growing season moisture and temperature conditions.

Historically, low elevation ponderosa forests were harvested extensively for timber products (Ritchie et al. 2005). Livestock grazing was historically a common land use of this site due to the favorability of open forest conditions and herbaceous productivity. Overgrazing may reduce Idaho fescue leading to an increase in bottlebrush squirreltail and rabbitbrush (Ericameria and Chrysothamnus sp.). Exotic annual grass invasion may also occur on this site with overuse, with coarse textured soils and cool conditions likely favoring cheatgrass (*Bromus tectorum*) over medusahead (*Taeniatherum caput-medusae*) or ventenata (*Ventenata dubia*). Stands with higher productivity may be used for commercial timber harvesting which will have varying effects on stand structure and composition depending on harvest type.

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. For warm and dry sites, this may include the possibility of regeneration failure following wildfire disturbance (Halofsky et al. 2020). The reference state of the current model is largely based on Landfire biophysical settings model 710531 (Landfire 2007).

State and transition model



Community Pathways

1.1A	Fire cycle(s) missed
1.1B	Historical disturbance regime maintained for 150+ years
1.2A	Mixed severity fire occurs
1.2B	High severity, stand replacing fire occurs
1.3A	Historical fire regime maintained for 100+ years
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	Site conversion to agricultural lands
R2A	Soil preparation, extensive plantings with seedling ponderosa
T1B	Extensive timber harvest
R3A	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. Pathways between these phases are defined by historic fire regimes, or management practices that mimic these historic fire regimes. Historically, many dry pine forests would have cycled from a shrub bunchgrass 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. Fire exclusion can lead to closed canopy and dense understory stocking conditions represented by Communities 1.2 and 1.5 which can be more vulnerable to stand replacing fires. The Reference Community within this state is that of an open, mature, savanna like ponderosa pine 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. Given the likelihood that this state, even in the best condition and highest potential, will almost always include at least some component of exotic species regardless of management inputs, this may also be referred to as the “current potential state”. In this document, the term “reference state” is used synonymously with “current potential state” for the sake of simplicity.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- antelope bitterbrush (*Purshia tridentata*), shrub
- Idaho fescue (*Festuca idahoensis*), grass

Community 1.1
Stand Initiation

Shrub and grass dominated community, ponderosa seedlings and saplings regenerating. Frequent, severe fire will maintain this community. All other communities may transition to this phase after stand replacing fires. Tree regeneration will depend on local seed sources and climate cycles and may follow grass and shrub establishment.

Community 1.2
Young Forest, Closed

Closed canopy, densely stocked with young to intermediate aged ponderosa pine. Shrub and bunchgrass decreasing. Competition for limited soil moisture and light will result in declining tree densities overtime.

Community 1.3
Young Forest, Open

Open overstory of uneven aged ponderosa pine with understory regeneration. Shrub and bunchgrass cover increased.

Community 1.4
Reference plant community: Mature forest, Open

This is the reference community. Mature, open canopy. Uneven aged stand with mostly mature ponderosa pine trees. Shrub and bunchgrass cover patchy in understory, dominated by bitterbrush and Idaho fescue. Frequent, low severity fires maintain this community, lack of fire will increase understory infill and vulnerability to severe fire.

Table 7. Ground cover

Tree foliar cover	0-10%
Shrub/vine/liana foliar cover	10-30%
Grass/grasslike foliar cover	20-50%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-10%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0-1%
Bedrock	0%
Water	0%
Bare ground	10-20%

Table 8. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	0-3%
>0.5 <= 1	–	–	0-3%	0-1%
>1 <= 2	–	10-20%	5-10%	–
>2 <= 4.5	–	10-20%	10-30%	–
>4.5 <= 13	–	–	–	–
>13 <= 40	0-5%	–	–	–
>40 <= 80	10-40%	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 1.5
Mature forest, Closed

Mature closed canopy stand. Uneven aged stand with dense understory stocking of ponderosa pine and juniper. Herbaceous cover decreased.

Pathway 1.1A
Community 1.1 to 1.2

Fire cycle(s) missed

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

Historical fire regime maintained for 100+ years

Pathway 1.4B
Community 1.4 to 1.1

High severity, stand replacing fire occurs

Pathway 1.4A
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
Developed state

Site with favorable soils may be converted to pasture or cropland.

Dominant plant species

- orchardgrass (*Dactylis glomerata*), grass

State 3
Managed state

In this state the stand is used for timber harvesting. This may result in a number of manipulated community types and pathways depending on strategies surrounding harvest, weed control and replanting. Shelter-wood production

systems are often favored due to the detrimental effects of drought and heat on ponderosa pine regeneration. Broadcast burning of bitterbrush may help increase ponderosa pine reestablishment. Clear cuts may favor lodgepole pine encroachment in areas where lodgepole pine is present. Cheatgrass will likely increase following timber harvest on sites where it was previously present.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree

Transition T1A
State 1 to 2

Site conversion to agricultural lands.

Transition T1B
State 1 to 3

Extensive timber harvest followed by management prioritizing timber production.

Restoration pathway R2A
State 2 to 1

Intensive restoration practices involving soil preparation, planting, seeding and protection from drought may be required to restore forest conditions.

Restoration pathway R3A
State 3 to 1

Ecological forestry practices may promote a return to Reference State. Stand replacing fire may return to Community 1.1 of the reference state if soil compaction is not severe and seed source is available.

Context dependence. Soil compaction due to large machine use may hinder 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 - 2020/2021 PES update of draft site

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	10/12/2024
Approved by	Kirt Walstad
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):**

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:**