Ecological site R006XB002OR
Frigid Xeric Lava Plains 12-16 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, MLRA 6 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)
CPS111 – Ponderosa/bitterbrush sage/fescue
CPS141 - Pinus ponderosa/Artemisia tridentate
CPG135 - Pinus ponderosa/*Festuca idahoensis*

Plant Associations of the Fremont National Forest (Hopkins 1979)
CPS111 – Ponderosa/bitterbrush sage/fescue

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

Landfire Biophysical Setting (Landfire 2007)
0710532 - Northern Rocky Mountain Ponderosa Pine Woodland and Savanna - Xeric

Ecological site concept

This site represents a transitional, dry ponderosa pine (Pinus ponderosa) – western juniper (Juniperus occidentalis) forest at the footslopes and lava plains of the East Cascades of Oregon. The Reference Plant Community is that of a mixed canopy of ponderosa pine and western juniper with a shrub layer of bitterbrush (Purshia tridentata) and big sagebrush (Artemesia tridentata) and an herbaceous layer dominated by cool-season perennial grasses. Occupying a transitional ecotone between ponderosa pine forests and dry juniper woodlands, this site exhibits plant community characteristics of each. This site is found upon lava plains with shallow to moderately deep, coarsely textured, volcanic soils, and is distinguished from nearby stands with higher ponderosa productivity by having shallower soils and receiving less precipitation. As a very dry site with low productivity, this site also likely had a historical fire regime characterized by less frequent fires than other dry ponderosa pine sites, due to low fuel loads and continuity.

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

F006XY708OR	**Frigid Xeric Foothills 12-20 PZ** Deeper soils, higher precip range, higher cover ponderosa pine, scarcity of western juniper

Similar sites

F006XY708OR	**Frigid Xeric Foothills 12-20 PZ** Deeper soils, higher precip range, higher cover ponderosa pine, scarcity of western juniper

Table 1. Dominant plant species

Tree	(1) *Juniperus occidentalis* (2) *Pinus ponderosa*
Shrub	(1) *Purshia tridentata* (2) *Artemisia tridentata ssp. vaseyana*
Herbaceous	(1) *Festuca idahoensis* (2) *Pseudoroegneria spicata*

Physiographic features

This site typically occurs on gentle north aspects, and in flat or rolling positions on lava plains between juniper woodlands and ponderosa pine forests. Within these landscapes, this site is often found in interspaces between lava blisters. Slopes are commonly 2 to 15 percent but range from nearly level to 35 percent. Elevations are most commonly 3,750 to 4,250 feet (1,150 to 1,300 meters) but can range from 2,750 to 6,000 feet (850 to 1,850 m). This site is not subject to ponding or flooding and no water table is present within the upper 100 inches of soil.

Table 2. Representative physiographic features

Landforms	(1) Lava plain > Hillslope (2) Lava plateau > Depression

Flooding frequency	None
Ponding frequency	None
Elevation	3,500–5,000 ft
Slope	2–15%
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	2,750–6,000 ft
Slope	0–35%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

The annual precipitation ranges from 12 to 16 in (300 to 400 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 45 degrees Fahrenheit (7° C), ranging from 41 to 46 degrees Fahrenheit (5 to 8° C) with extreme temperatures ranging from -26 to 104 degrees Fahrenheit (-32 to 40°C). The frost-free period is 60 to 90 days. The optimum period for plant growth is from April through June. 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)	60-90 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	12-16 in
Frost-free period (average)	75 days
Freeze-free period (average)	
Precipitation total (average)	14 in

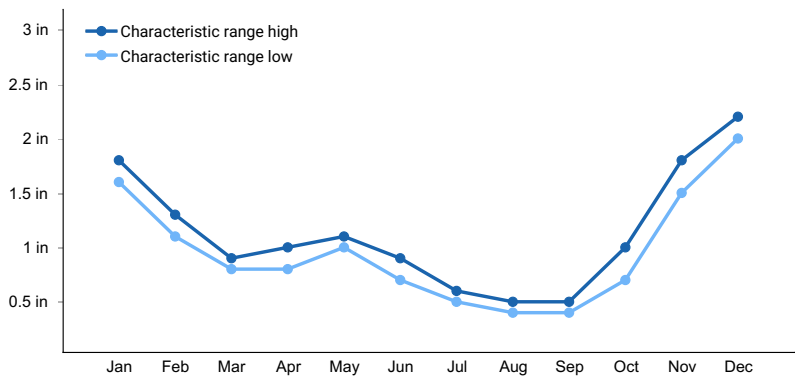


Figure 1. Monthly precipitation range

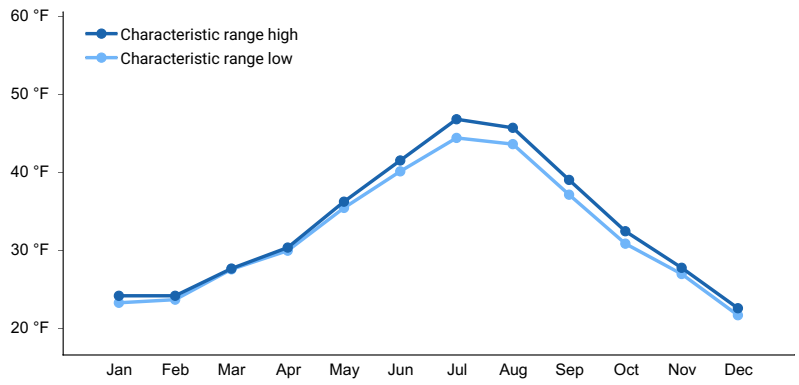


Figure 2. Monthly minimum temperature range

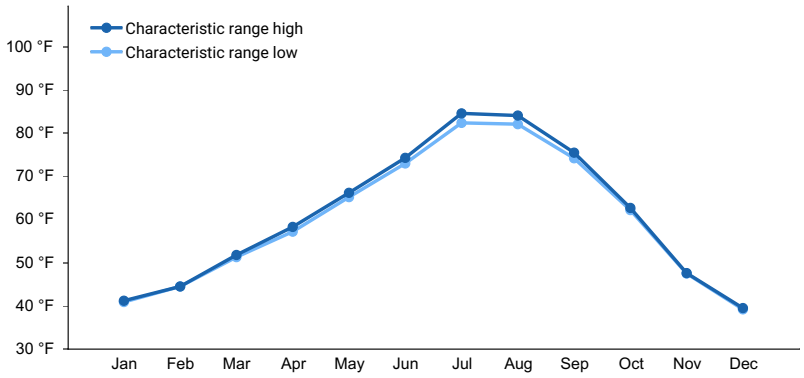


Figure 3. Monthly maximum temperature range

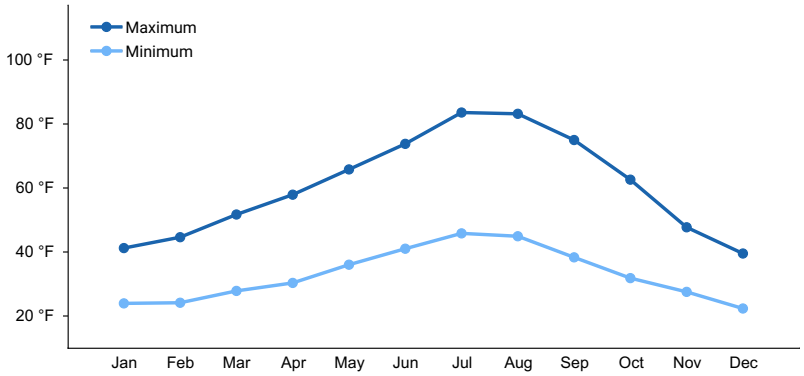


Figure 4. Monthly average minimum and maximum temperature

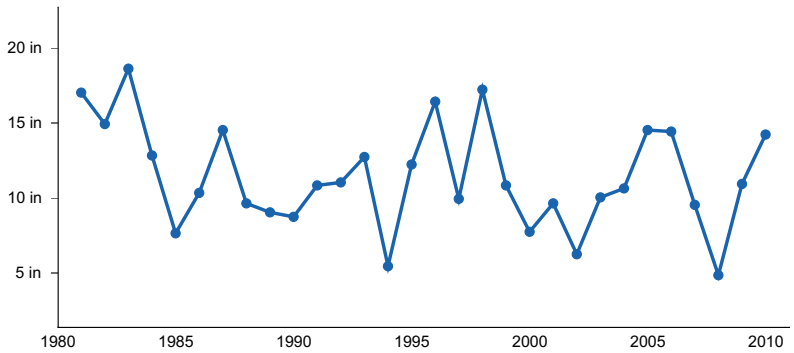


Figure 5. Annual precipitation pattern

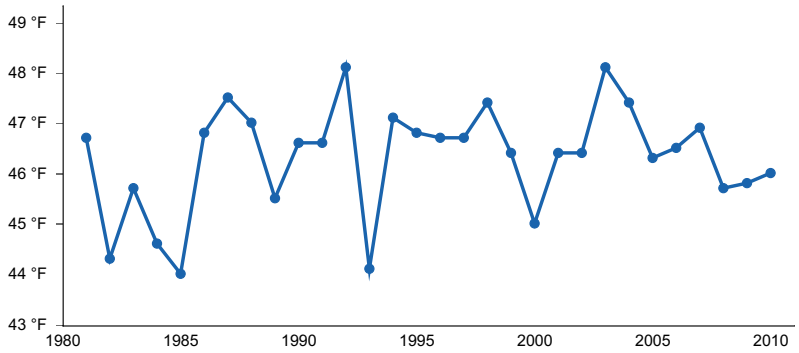


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SISTERS [USC00357857], Sisters, OR
- (2) BEND [USC00350694], Bend, OR

Influencing water features

This site is not influenced by water from adjacent wetlands or streams.

Wetland description

N/A

Soil features

The soils that typify this site concept are shallow to moderately deep, well to excessively drained and coarse textured. These soils are primarily formed in volcanic ash and colluvium, have loamy sand to sandy loam surface textures and occur over basalt and tuff. They often have substantial gravels, cobbles and stones on the surface and within the upper soil horizon which can reduce the water holding capacity of the soil. Permeability is moderately rapid and the available water holding capacity (AWC) is 3.0 to 6.0 inches for the profile. The potential for wind erosion is high and for water erosion is low. Soils of this site are largely classified as frigid vitrixerands (cool, dry soils formed in volcanic parent materials).

Representative soil associated with this site:

Fremkle, 0 – 15% slopes

Table 5. Representative soil features

Parent material	(1) Ash flow–volcanic rock (2) Colluvium–volcanic rock
Surface texture	(1) Sandy loam (2) Very cobbly sandy loam (3) Gravelly loamy sand
Family particle size	(1) Ashy (2) Ashy-skeletal
Drainage class	Well drained to excessively drained
Permeability class	Moderately rapid
Depth to restrictive layer	10–40 in
Soil depth	10–40 in
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%

Available water capacity (0-40in)	1.5–2.6 in
Soil reaction (1:1 water) (0-40in)	6.6–8
Subsurface fragment volume <=3" (4-60in)	5–15%
Subsurface fragment volume >3" (4-60in)	0–25%

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 (0-40in)	1.4–3 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 western juniper and ponderosa pine, with an understory dominated by bitterbrush, big sagebrush and cool season perennial grasses. Wax currant (*Ribes cereum*) may also be common in the shrub layer. The herbaceous layer includes an abundance of Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Pseudoroegneria spicata*), as well as lesser amounts of bottlebrush squirreltail (*Elymus elymoides*), rosy pussytoes (*Antennaria rosea*), and common yarrow (*Achillea millefolium*). Vegetative composition in this state is approximately 55 to 60 percent grasses, 3 percent forbs, and 20 percent shrubs and trees.

Potential plant communities will differ across the range of this site due to naturally occurring variability in soil, aspect and climate. An increase in stoniness results in an increase in drought tolerant species such as juniper, sagebrush, Sandberg bluegrass (*Poa secunda*), and bluebunch wheatgrass. Bluebunch wheatgrass increases on south exposures, Idaho fescue on more northerly aspects and Sandberg bluegrass on shallower soils. Bitterbrush is scarce where soils are saturated during the spring. Western juniper increases on shallow, well drained soils and at the lower end of the precipitation range. Ponderosa pine increases as precipitation approaches 14 inches or more.

Disturbance:

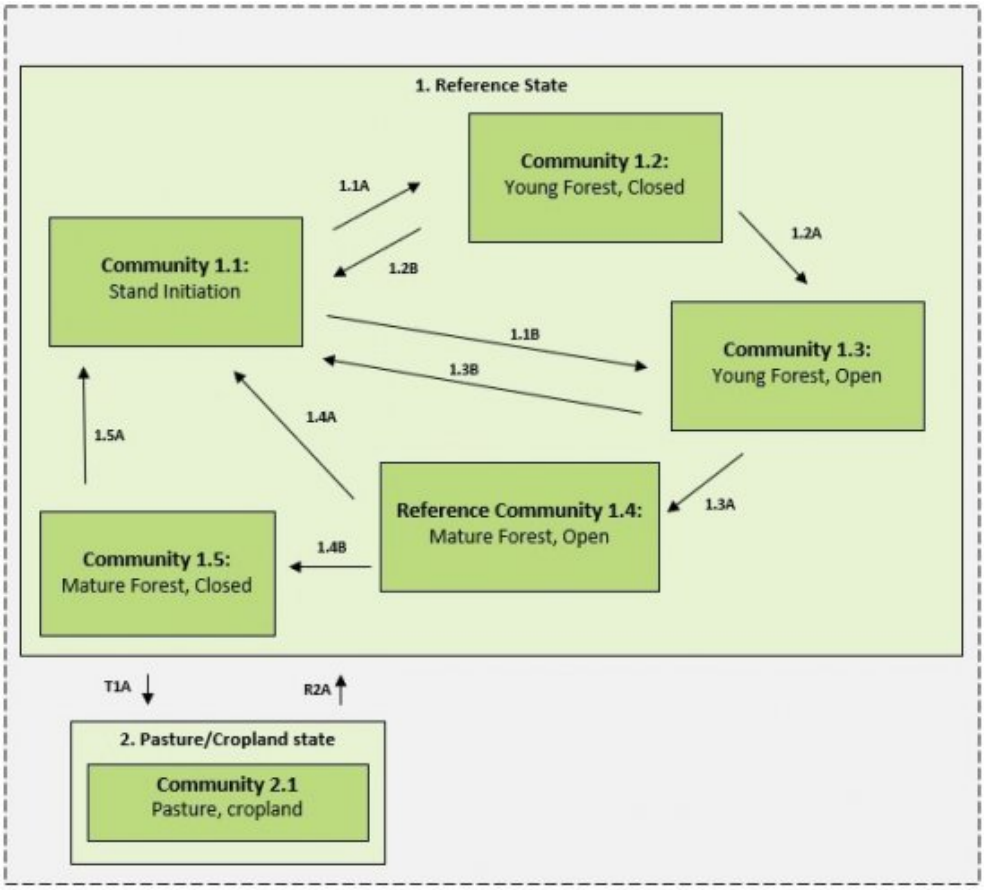
Dry ponderosa pine forests were often maintained by frequent, low severity surface fire, whereas juniper woodlands often had longer fire return intervals. As a transitional site between these ecological types, mean fire return interval estimates range between 10 to 50 years, somewhat longer than adjacent ponderosa pine forests with higher productivity and shorter than that of bordering western juniper forests and sagebrush steppe with lower productivity (Miller et al. 2019, Miller and Heyerdahl 2008, Landfire 2007). Historically, low severity fire would have decreased juniper, sagebrush and mature bitterbrush, while favoring high herbaceous cover and mature ponderosa pine development with open stand conditions. With longer time between fire, increased stocking of juniper and

ponderosa pine and 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. Since this site occurs toward the lower precipitation range suitable for ponderosa pine reproduction and growth, ponderosa pine may struggle to reestablish post fire except for during climate cycles of increased moisture. In fact, across the Western US, many dry ponderosa pine forests existing toward the fringe of their climate suitability may be transitioning into grass shrub communities due to warming and drying growing season conditions (Davis et al. 2018). Ponderosa pine recovery following stand replacing fire will also be dependent on seed sources on site or in nearby forests.

Pine beetle outbreaks are another important disturbance agent in this system helping thin overstocked, closed canopy conditions (Ritchie et al 2005). Livestock grazing is a common land use of this site. Overgrazing may reduce Idaho fescue and Ross' sedge (*Carex rossii*), while allowing Thurber's needlegrass (Achnatherum thurberanium), bottlebrush squirreltail and rabbitbrush (Ericameria and Chrysothamnus sp.) cover to increase. Invasive annual grass may also occur on this site, with coarse textured soils likely favoring cheatgrass (*Bromus tectorum*) over medusahead (*Taeniatherum caput-medusae*) or ventenata (*Ventenata dubia*). Low forest productivity of these sites often makes them impractical for commercial timber harvest, however, given the favorable climate of this site, areas with suitable soils may also be converted to agricultural use.

The state and transition model below represents a generalized and simplified version of plant community change in response to major disturbance types in this ecological site. It does not attempt to model all of the complex interacting effects of grazing, fire and invasive species on ecosystem change and the potential restoration pathways emerging from these dynamics. 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, these impacts may include the possibility of regeneration failure following wildfire disturbance (Halofsky et al. 2020). As this site is updated in future iterations, and further research informs our understanding of East Cascades oak woodlands, descriptions will include more thorough treatments of disturbance and ecological change. The Reference State is largely based on Landfire biophysical settings model 710532 (Landfire 2007).

State and transition model



Community Pathways

1.1A	Fire cycle(s) missed
1.1B	Historical disturbance regime sustained for extended duration
1.2A	Mountain pine beetle outbreak, mixed severity fire
1.2B	High severity, stand replacing fire occurs
1.3A	Frequent, low severity fire regime sustained 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	Site conversion to agricultural lands
R2A	Soil preparation, extensive plantings with seedling ponderosa

State 1
Historical Reference State

A dry forested community, 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 and insect disturbance regimes. The Reference Community within this state is an open, mature, savanna-like ponderosa pine stand represented by Community Phase 1.4. Historical evidence suggests that this community type was much more common 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

- western juniper (*Juniperus occidentalis*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- antelope bitterbrush (*Purshia tridentata*), shrub
- Idaho fescue (*Festuca idahoensis*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass

Community 1.1
Stand Initiation

Shrub and grass dominated community, ponderosa pine and western juniper 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.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	345	485	625
Tree	75	105	130
Shrub/Vine	70	95	125
Forb	10	15	20
Total	**500**	**700**	**900**

Community 1.2
Young forest, closed canopy

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

Community 1.3
Young Forest, open canopy

Open overstory of uneven aged ponderosa pine. Western juniper and ponderosa pine regenerating in understory. Shrub and bunchgrass cover increased.

Community 1.4
Reference Plant Community: Mature, Open Canopy

This is the Reference Community. Mature, open canopy. Uneven aged stand with mostly mature ponderosa pine trees. Shrub and bunchgrass cover similar to Community Phase 1.3. Western juniper cover low. Frequent, low intensity fires maintain this community, lack of fire will increase understory infill and vulnerability to severe fire. Soil moisture and depth will limit size of mature ponderosa pine.

Community 1.5
Mature Forest, closed canopy

Mature ponderosa pine stand. Uneven aged stand with dense understory stocking of ponderosa pine and western juniper in openings. Herbaceous cover decreased.

Pathway 1.1A
Community 1.1 to 1.2

Fire cycle missed, fire suppressed

Pathway 1.1B
Community 1.1 to 1.4

Historical disturbance regime maintained for 100 years or more

Pathway 1.2B
Community 1.2 to 1.1

High severity, stand replacing fire

Pathway 1.2A
Community 1.2 to 1.3

Mountain pine beetle outbreak, low to mixed severity fire

Pathway 1.3B
Community 1.3 to 1.1

High severity, stand replacing fire

Pathway 1.3A
Community 1.3 to 1.4

Historical fire regime maintained

Pathway 1.4A
Community 1.4 to 1.1

High severity, stand replacing fire

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
Developed state

Site converted to pasture, cropland.

Dominant plant species

- orchardgrass (*Dactylis glomerata*), grass

Transition T1A
State 1 to 2

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

Restoration pathway R2A
State 2 to 1

Intensive restoration practices will involve significant inputs and will likely be challenging. These may involve soil preparation, planting, seeding, weed control and protection from drought may be required to restore forest conditions.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Grass and grasslike plants**			425–575	
	Idaho fescue	FEID	*Festuca idahoensis*	315–350	–
	Ross' sedge	CARO5	*Carex rossii*	35–70	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	35–70	–
	Sandberg bluegrass	POSE	*Poa secunda*	35–70	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	5–15	–
2	**Big Bluegrass**			0	
2	**Other perennial grasses**			5–15	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0	–
Forb					
3	**Other perennial forbs**			5–20	
	lupine	LUPIN	*Lupinus*	0	–
	pussytoes	ANTEN	*Antennaria*	0	–
	phlox	PHLOX	*Phlox*	0	–
	buckwheat	ERIOG	*Eriogonum*	0	–
	beardtongue	PENST	*Penstemon*	0	–
	yarrow	ACHIL	*Achillea*	0	–
	flax	LINUM	*Linum*	0	–
Shrub/Vine					
4	**Shrubs**			55–145	
	antelope bitterbrush	PUTR2	*Purshia tridentata*	35–105	–
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	15–30	–
	wax currant	RICE	*Ribes cereum*	5–15	–
Tree					
5	**Trees**			40–175	
	western juniper	JUOC	*Juniperus occidentalis*	35–105	–
	ponderosa pine	PIPO	*Pinus ponderosa*	5–70	–

Animal community

Mule deer, Pinyon Jay, Coyotes

Inventory data references

The plant data contained in this document is derived from analysis of inventories, clipping studies, and ecological interpretation from field evaluations.

Type locality

Location 1: Deschutes County, OR	
General legal description	2-3 Miles SW of Plainview road

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Contributors

Gene Hickman
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:**

_____

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:**

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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:**