Ecological site R006XA310OR
Juniper-Oak Clayey

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

Located at the eastern edge of the Columbia River Gorge, this unit is restricted to areas influenced by the modified maritime climate of this unique passageway through the Cascades. This setting allows for the persistence of Oregon white oak woodlands east of the Cascade crest. These woodlands often include ponderosa pine, and on sites with greater soil moisture, Douglas-fir. Botanical diversity is high, with a mixture of West Cascade and East Cascade plant species commonly co-occurring. Physiographically, this unit is characterized by dissected foothills, valleys and ridges draining Mount Hood in Oregon and Mount Adams in Washington. Geologically, the unit is characterized by late tertiary pyroclastic and volcanoclastic deposits and basalt flows. The climate of this unit is generally warm and dry with a predominately xeric soil moisture regime and mesic soil temperature regime. Historically, the drier extent of these forests have been influenced by a fire regime whereby frequent low and mixed severity fires would have favored the development of open canopied forests. Higher elevations and more westerly locations receiving more moisture within this unit would have been influenced by moderately frequent, low and mixed severity fires favoring a mosaic of forest stages with closed canopy conditions common.

Ecological site concept

This site represents a dry woodland community at the transition zone between the eastside foothills of the Oregon Cascades and the Columbia plateau. The Reference Plant Community is that of a woodland with an overstory of Oregon white oak (Quercus garryana) and western juniper (Juniperus occidentalis), as well as scattered ponderosa pine (Pinus ponderosa), and an herbaceous layer largely dominated by Idaho fescue (Festuca idahoensis) and

bluebunch wheatgrass (Pseudoroegneria spicata) with a shrub layer of antelope bitterbrush (Purshia tridentata). This site exists toward the southern-most extent of white oak within the Columbia river basin of Oregon. Sites further north within the same precipitation range, experience fewer frost-free days as a result of the climate influences of the Columbia Gorge and therefore support higher cover of white oak and lower cover of juniper. Compared to adjacent shallow, south aspect influenced sites where soil moisture availability is lower and evapotranspiration is increased, this site supports higher density of woody species. At its upper precipitation range on sites with deeper soils, this site transitions into more productive ponderosa pine - bitterbrush forests with occasional Douglas-fir.

This is a provisional ecological site and is subject to extensive review and revision before final approval. All data herein should be considered provisional and contingent upon field validation prior to use in conservation planning.

Development of this site as a range site was based on field data collection completed in 1996. It was revised and updated with information regarding ecological dynamics in 2020.

Associated sites

R006XA308OR	**Moist Scabland 14-18 PZ** Shallower soils, courser textures, JUOC uncommon

Similar sites

R006XB208OR	**Shallow Slopes 14-20 PZ** Shallower soils, courser textures
R006XA308OR	**Moist Scabland 14-18 PZ** Shallower, courser textured soils
R006XA300OR	**Loamy 14-20 PZ** Deeper soils, PIPO common

Table 1. Dominant plant species

Tree	(1) *Juniperus occidentalis* (2) *Quercus garryana*
Shrub	(1) *Purshia tridentata*
Herbaceous	(1) *Festuca idahoensis*

Physiographic features

This site occurs on gently to moderately sloping benches and side slopes of foothills. Slopes range from nearly level to 50 percent. Elevations range from 2,000 to 3,500 feet (600 to 1,050 meters). This site is found on all aspects. 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) Foothills > Bench (2) Foothills > Hillslope
Flooding frequency	None
Ponding frequency	None
Elevation	2,000–3,500 ft
Slope	0–50%
Ponding depth	0 in
Water table depth	100 in
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This site has a xeric soil moisture regime with mean annual precipitation ranging from 12 to 16 in (300 to 400 mm) most of which occurs during the months of October through June in the form of rain and snow. This climate is modified by the influence of the Columbia River Gorge which acts as a conduit for maritime air masses to move past the Cascade mountains. The soil temperature regime is mesic with a mean annual air temperature of about 48 degrees Fahrenheit (9 degrees C). Historical annual temperature extremes range from -16 to 103 degrees F (-27 to 39 degrees C). The frost-free period ranges from about 100 to 140 days. The optimum period for plant growth is March through early July. The graphs below are populated from the closest available weather station to representative site locations and are provided to indicate general climate patterns.

Table 3. Representative climatic features

Frost-free period (characteristic range)	100-140 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	12-16 in
Frost-free period (average)	120 days
Freeze-free period (average)	
Precipitation total (average)	14 in

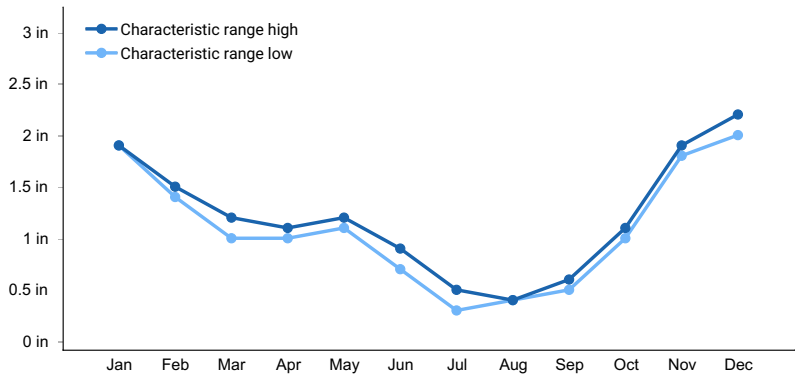


Figure 1. Monthly precipitation range

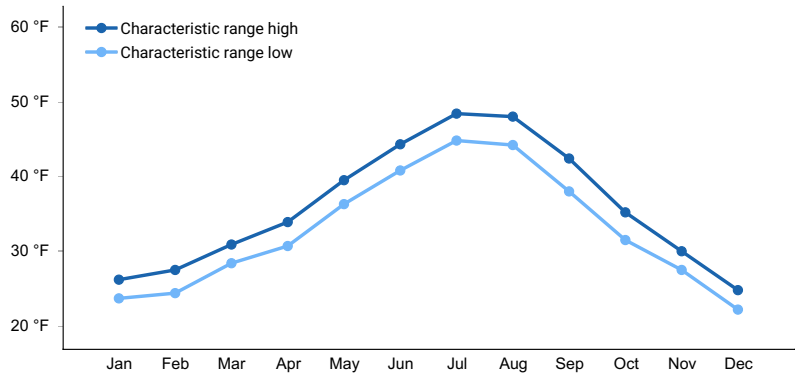


Figure 2. Monthly minimum temperature range

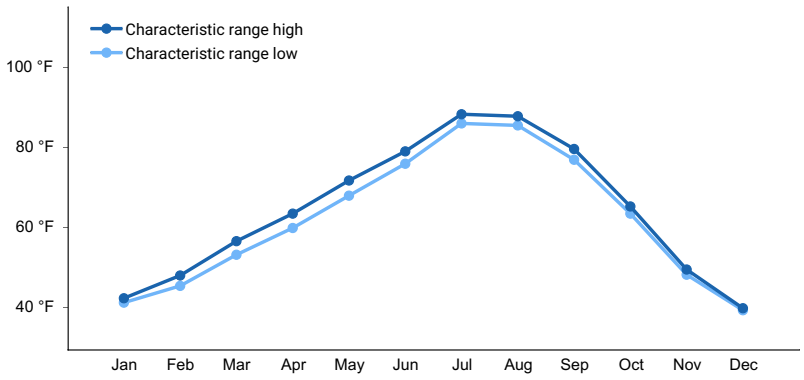


Figure 3. Monthly maximum temperature range

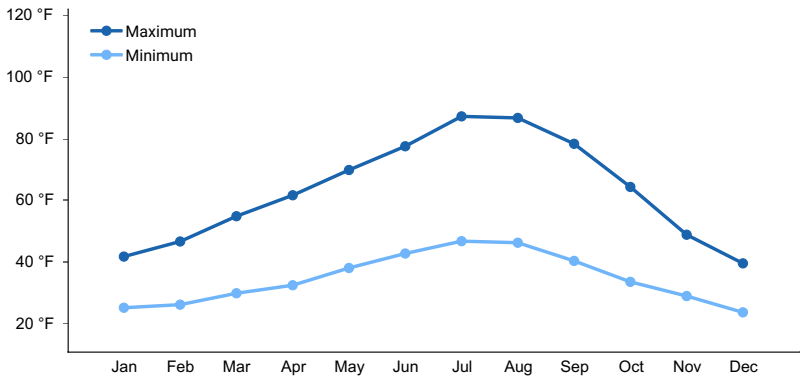


Figure 4. Monthly average minimum and maximum temperature

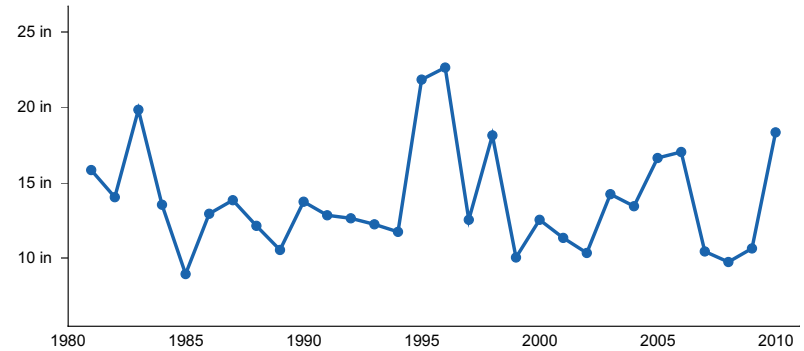


Figure 5. Annual precipitation pattern

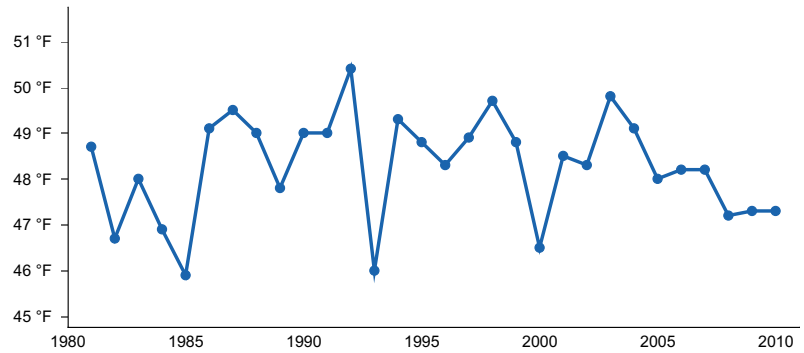


Figure 6. Annual average temperature pattern

Climate stations used

- (1) DUFUR [USC00352440], Dufur, 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, well drained and fine (clay) textured. This site may occur on shallower soils. They are generally formed in tuff. Surface textures are typically gravelly silty clay loam or gravelly clay. Permeability is slow and the available water holding capacity is typically 3 to 5 inches for the profile. The potential for wind or water erosion is moderate to high.

Table 4. Representative soil features

Parent material	(1) Colluvium–tuff (2) Residuum–tuff
Surface texture	(1) Gravelly silty clay loam (2) Gravelly clay
Family particle size	(1) Fine (2) Very-fine
Drainage class	Well drained
Permeability class	Slow
Depth to restrictive layer	20–40 in
Soil depth	20–40 in
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-40in)	3–5 in
Soil reaction (1:1 water) (0-40in)	6.6–7.3
Subsurface fragment volume <=3" (4-40in)	5–20%
Subsurface fragment volume >3" (4-40in)	5–10%

Table 5. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	10–40 in
Soil depth	10–40 in
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	3–6.7 in
Soil reaction (1:1 water) (0-40in)	6.1–8.4
Subsurface fragment volume <=3" (4-40in)	Not specified

Subsurface fragment volume >3" (4-40in)	Not specified

Ecological dynamics

The Reference Plant Community of this site is characterized by an open, savannah-like woodland dominated by white oak and western juniper. Ponderosa pine is common to a lesser extent in the overstory and pine reproduction may be sporadic in the openings. The understory composition is dominated by Idaho fescue and bluebunch wheatgrass. Canby bluegrass (*Poa secunda*, formerly Poa canbyi) is prominent in the understory. A variety of perennial forbs occur throughout the stand such as lupine (Lupinus spp.), lomatium (Lomatium spp.), balsamroot (Balsamorhiza spp.), common yarrow (*Achillea millefolium*), groundsel (Senecio spp.) and agoseris (Agoseris spp.). Bitterbrush, serviceberry (Amalanchier alnifolia), snowberry (Symphorocarpus spp.) and buckwheat (Erioganum spp.) are prominent shrubs and subshrubs on the site. Vegetative composition is approximately 60 percent grasses, 10 percent forbs, and 30 percent shrubs and trees. The southern range for this site is largely outside of the influence of the Columbia gorge climate influence and therefore has little oak, leaving juniper and pine as the principal overstory. Southerly and droughty aspects have higher proportions of bluebunch wheatgrass and less Idaho fescue.

Disturbance:

As one of the driest woodland types in Oregon, white oak – ponderosa pine communities on the eastside of the Cascades this site was historically subject to frequent, low severity fires. This maintained the open, savannah-like appearance and higher cover of herbs in the understory, both due to natural and cultural ignitions (Landfire 2007). Mixed and stand replacement fires also occurred occasionally in these stands but were rare due to limited fuels and fire tolerant canopies (Landfire 2007). Western juniper woodlands, by contrast, often had longer fire return intervals. As a transitional site between these ecological types, mean fire return intervals likely approximate those of very dry ponderosa pine – western juniper forests which range from 10 to 50 years, (Miller et al. 2019, Miller and Heyerdahl 2008, Landfire 2007). Oregon white oak is adapted to fire by resprouting from bases following topkill as well as developing thick, fire-resistant bark with maturity (Devine et al 2013). Ponderosa pine is also fire-adapted, developing increasing fire resistance with age by growing thick bark and self-thinning lower limbs (Fryer 2008). While bitterbrush may re-sprout following fire, repeated fire may reduce its cover over time (Busse and Riegel 2009). Western juniper has thin bark and is readily killed by low to moderate severity fires, yet develops increasing resistance with age (Fryer and Tirmenstein 2019). It is well documented that expansion of western juniper in the Western US is in part associated with the suppression of fire (Miller et al. 2019). All three tree species are susceptible to mortality by low intensity fires when young and if fires are frequent enough, they can remove many of the young trees, leaving only those trees that managed to survive and continue growing (Landfire 2007). With a disruption of this fire regime, the canopy becomes more closed and the understory declines in cover and production (Devine et al. 2013).

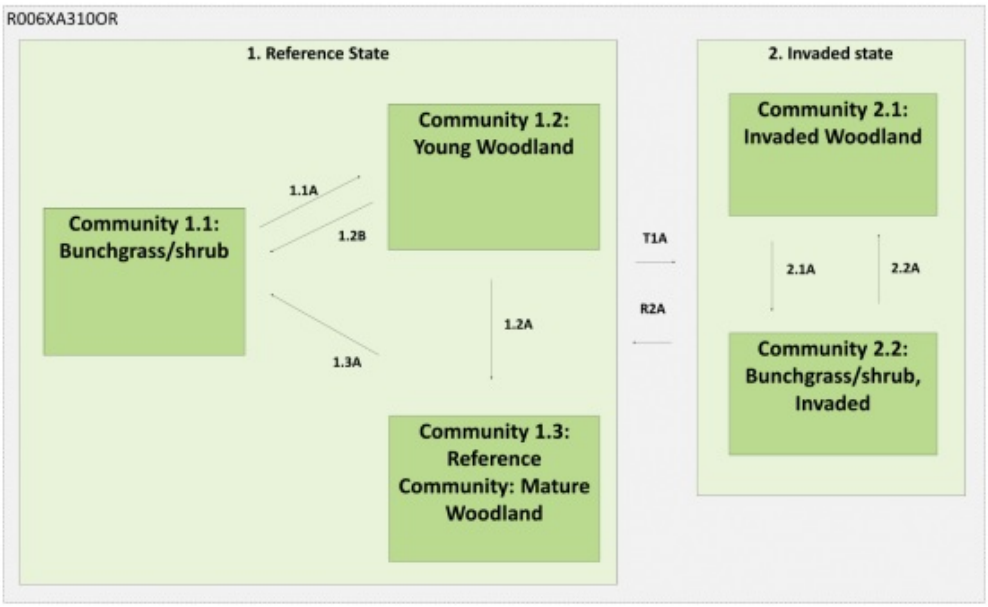
Since this site occurs toward the lower precipitation range suitable for ponderosa pine reproduction and growth, ponderosa may struggle to reestablish post fire except for during climate cycles of increased moisture. In fact, across the Western US, many dry ponderosa forests existing toward the fringe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

As warm, dry, open, woodland communities, these sites may be highly susceptible to invasive plant species introductions. This site is may be used for livestock grazing yet overgrazing may reduce Idaho fescue, bluebunch wheatgrass and bitterbrush, depending on season of use. Plants likely to increase and invade with overgrazing include cheatgrass (*Bromus tectorum*), collinsia (Collinsia spp.), cleavers bedstraw (*Galium aparine*), bulbous bluegrass (*Poa bulbosa*), Pacific fescue (*Vulpia microstachys*) and medusahead (*Taeniatherum caput-medusae*). Clayey soils of this site are also likely to promote invasions of medusahead, a highly detrimental exotic annual grass.

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 the complex interacting effects of grazing, fire and invasive species on ecosystem change and the potential alternative states and pathways emerging from these dynamics. As this site is updated in future iterations, and further research informs our understanding of these woodland types, descriptions will include more thorough treatments of

disturbance and ecological change. The reference state is largely based on Landfire biophysical settings models 0710532: Northern Rocky Mountain Ponderosa Pine Woodland and Savanna – Xeric and 0710600: East Cascades Oak-Ponderosa Pine Forest and Woodland (Landfire 2007).

State and transition model



Community Pathways

1.1A	Time without fire
1.2A	Time without fire
1.2B	High severity, stand replacing fire occurs
1.3A	High severity, stand replacing fire occurs
2.1A	High severity, stand replacing fire occurs
2.2A	Time without fire

Transitions / Restoration Pathways

T1A	Major invasion of site with invasive annual grasses
R2A	Site restoration

State 1
Historical Reference State

The Reference Plant Community is an open, mature woodland represented by Community Phase 1.3. This is the most advanced community within the historical disturbance regime for this site, yet this site occurs across the landscape as a mosaic of plant community phases characterized by variation in community structural stage (tree age, density and cover) and species composition. Historically, these woodlands would have cycled from a shrub bunchgrass young tree stand initiation phase (1.1) to a young woodland phase (1.2) to a mature woodland phase (1.3) with a disturbance regime characterized by moderately frequent, low intensity surface fires with occasional mixed or replacement severity fires (Landfire fire regime group 3). Fire suppression has likely diminished the presence of mature savannah across the landscape, instead favoring closed canopy conditions and higher densities of younger trees, especially juniper. 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
- Gambel oak (*Quercus gambelii*), tree
- antelope bitterbrush (*Purshia tridentata*), shrub
- Idaho fescue (*Festuca idahoensis*), grass

Community 1.1
Bunchgrass/shub

Site characterized by bunchgrasses, shrubs, white oak sprouting as coppice from bases and seedling ponderosa pine and western juniper. Frequent fire will maintain the community in this phase.

Community 1.2
Young Woodland

Young stand characterized by an open overstory of intermediate aged white oak with scattered ponderosa pine throughout the canopy, some intermediate aged western juniper and an understory of bunchgrasses and shrubs. Regular surface fire will maintain the community in this phase but may reduce juniper density relative to other species.

Community 1.3
Reference Community: Mature Woodland

This is the Reference Community and is characterized by an open overstory of mature, mostly multi-stemmed white oaks , scattered mature ponderosa pine, few large western juniper and an understory of bunchgrasses, shrubs and perennial grasses. Regular surface fires will maintain the community in this phase but may reduce juniper density relative to other species.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	500	625	750
Tree	125	155	190
Shrub/Vine	115	145	175
Forb	60	75	85
Total	**800**	**1000**	**1200**

Pathway 1.1A
Community 1.1 to 1.2

Time without fire

Pathway 1.2B
Community 1.2 to 1.1

High severity, stand replacing fire occurs

Pathway 1.2A
Community 1.2 to 1.3

Time without fire

Pathway 1.3A
Community 1.3 to 1.1

High severity, stand replacing fire occurs

State 2
Invaded State

Much of the perennial grasses have been lost and replaced by exotic annual grasses. This may result in an alteration of fire regimes creating feedbacks that maintain the site in this state (Archer 2001, Zouhar 2003).

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass
- medusahead (*Taeniatherum caput-medusae*), grass

Community 2.1
Invaded Woodland

Site characterized by an oak woodland that includes a significant portion of invasive annual grasses with sufficient cover to alter the fire regime and reduce understory biodiversity. Fires become more frequent and may be shifted earlier into the season.

Community 2.2
Bunchgrass/shrub, Invaded

Site characterized by invasive annual grasses, reduced bunchgrasses, shrubs, white oak sprouting as coppice from bases and seedling ponderosa pine and western juniper. Frequent fire will maintain the community in this phase.

Pathway 2.1A
Community 2.1 to 2.2

High severity, stand replacing fire occurs

Pathway 2.1B
Community 2.2 to 2.1

Time without fire

Transition T1A
State 1 to 2

Invasion of annual grasses in to the understory composition, such as cheatgrass and medusahead, reduction in native perennial bunchgrasses. Research has not identified a threshold for cover that will shift this community into an alternative state.

Restoration pathway R2A
State 2 to 1

Reduction of invasive species may be possible yet will be time and labor intensive and require significant inputs.

Additional community tables

Table 7. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Grass and grasslike plants**			310–1000	
	Idaho fescue	FEID	*Festuca idahoensis*	200–500	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	100–400	–
	California brome	BRCA5	*Bromus carinatus*	10–100	–
2	**Canby Bluegrass**			10–100	
3	**Other perennial grasses**			10–50	
	blue wildrye	ELGL	*Elymus glaucus*	0	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0	–
	Sandberg bluegrass	POSE	*Poa secunda*	0	–
	squirreltail	ELEL5	*Elymus elymoides*	0	–
Forb					
4	**Forbs**			40–80	
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	10–20	–
	yarrow	ACHIL	*Achillea*	10–20	–
	silver lupine	LUAL4	*Lupinus albifrons*	10–20	–
	Nuttall's lobelia	LONU	*Lobelia nuttallii*	10–20	–
5	**Other perennial forbs**			10–40	
	onion	ALLIU	*Allium*	0	–
	agoseris	AGOSE	*Agoseris*	0	–
	ragwort	SENEC	*Senecio*	0	–
	avens	GEUM	*Geum*	0	–
	fawnlily	ERYTH3	*Erythronium*	0	–
	vetch	VICIA	*Vicia*	0	–
	clover	TRIFO	*Trifolium*	0	–
Shrub/Vine					
6	**Shrubs**			90–250	
	antelope bitterbrush	PUTR2	*Purshia tridentata*	50–100	–
	common snowberry	SYAL	*Symphoricarpos albus*	10–50	–
	Saskatoon serviceberry	AMALS	*Amelanchier alnifolia var. semiintegrifolia*	10–50	–
	buckwheat	ERIOG	*Eriogonum*	20–50	–
Tree					
7	**Trees**			120–250	
	western juniper	JUOC	*Juniperus occidentalis*	50–100	–
	Oregon white oak	QUGA4	*Quercus garryana*	50–100	–
	ponderosa pine	PIPO	*Pinus ponderosa*	20–50	–

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:**

   _____

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):

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

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17. **Perennial plant reproductive capability:**