# Ecological site R010XA027OR Juniper Pumice Flat 8-10 PZ

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## General information

**Provisional**. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

## MLRA notes

Major Land Resource Area (MLRA): 010X–Central Rocky and Blue Mountain Foothills

This MLRA is characterized by gently rolling to steep hills, plateaus, and low mountains at the foothills of the Blue Mountains in Oregon and the Central Rocky Mountains in Idaho. The geology of this area is highly varied and ranges from Holocene volcanics to Cretaceous sedimentary rocks. Mollisols are the dominant soil order and the soil climate is typified by mesic or frigid soil temperature regimes, and xeric or aridic soil moisture regimes. Elevation ranges from 1,300 to 6,600 feet (395 to 2,010 meters), increasing from west to east. The climate is characterized by dry summers and snow dominated winters with precipitation averaging 8 to 16 inches (205 to 405 millimeters) and increasing from west to east. These factors support plant communities with shrub-grass associations with considerable acreage of sagebrush grassland. Big sagebrush, bluebunch wheatgrass, and Idaho fescue are the dominant species. Stiff sagebrush, low sagebrush, and Sandberg bluegrass are often dominant on sites with shallow restrictive layers. Western juniper is one of the few common tree species and since European settlement has greatly expanded its extent in Oregon. Nearly half of the MLRA is federally owned and managed by the Bureau of Land Management. Most of the area is used for livestock grazing with areas accessible by irrigation often used for irrigated agriculture.

## Ecological site concept

This ecological site occurs on nearly level basalt lava plains overlain by eolian pumice sands. Elevations range from 2,300 to 4,300 feet (700 to 1,300 meters) and slopes range from 0 to 10 percent but is typically less 3 percent. The soils associated with this site are moderately deep to deep to bedrock. The soil climate is mesic (soil temperature regime) and aridic (soil moisture regime). The reference plant community is characterized by an open stand of old growth western juniper, which are over 150 years old and express old growth morphological and structural characteristics. In the understory, Idaho fescue dominates under tree canopies. Interspaces between trees are dominated by mountain and basin big sagebrush and needle and thread grass, with minor components of Indian ricegrass, western needlegrass and Thurber’s needlegrass.

## Associated sites

| | |
|---|---|
| R010XA022OR | **Juniper Lava Blisters 8-10 PZ**<br><br>Occurs in complex with this site on pressure ridges of lava flows. Pumice sand mantle is shallow to bedrock and commonly mixed with rock outcrop. |

## Similar sites

| | |
|---|---|
| R010XA009OR | **Juniper Shrubby Pumice Flat 10-12 PZ**<br><br>Higher precipitation and production. Understory dominated by mountain big sagebrush, bitterbrush, and Idaho fescue |

| | |
|---|---|
| R010XA021OR | **Juniper Shallow Pumice Hills 10-12 PZ**<br><br>Higher precipitation and frigid soil temperature regime. Understory dominated by mountain big sagebrush and Idaho fescue. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Juniperus occidentalis* |
| Shrub | (1) *Artemisia tridentata ssp. tridentata*<br>(2) *Artemisia tridentata ssp. vaseyana* |
| Herbaceous | (1) *Hesperostipa comata*<br>(2) *Festuca idahoensis* |

## Physiographic features

This site occurs on nearly level basalt lava plains. Slopes range from 0 to 10 percent, but are generally less than 3 percent. Elevations range from 2,300 to 4,300 feet.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Lava plain > Lava plateau |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 700 – 1,310 m |
| Slope | 0 – 10 % |
| Aspect | Aspect is not a significant factor |

## Climatic features

The annual precipitation ranges from 8 to 10 inches which occurs mainly between the months of November and June, mostly in the form of rain and snow. The average annual air temperature is 48 degrees F. with extreme temperatures ranging from -10 to 105 degrees F. The frost free period is 40 to 90 days. The optimum period for plant growth is from late March through June.

**Table 3 Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 50 days |
| Freeze-free period (characteristic range) | 110 days |

| | |
|---|---|
| Precipitation total (characteristic range) | 230 mm |
| Frost-free period (actual range) | 50 days |
| Freeze-free period (actual range) | 110 days |
| Precipitation total (actual range) | 230 mm |
| Frost-free period (average) | 50 days |
| Freeze-free period (average) | 110 days |
| Precipitation total (average) | 230 mm |

- (1) REDMOND ROBERTS FLD [USW00024230], Redmond, OR

### Influencing water features

This site is not associated with riparian or wetland features.

### Soil features

The soils of this site are moderately deep or deep to basalt bedrock. They are formed from eolian deposited pumice ash, primarily derived from Mt. Mazama. They are typically well drained and have an ashy sandy loam texture throughout the profile. Permeability is moderately rapid to rapid and the available water holding capacity is 3 to 7 inches for the profile. The potential for wind erosion is high. Soil temperature regime is mesic. Soil moisture regime is aridic.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Volcanic ash<br>(2) Residuum – basalt |
| Surface texture | (1) Ashy sandy loam<br>(2) Ashy loamy sand |
| Family particle size | (1) Coarse-loamy<br>(2) Ashy<br>(3) Fine-loamy |
| Drainage class | Well drained to somewhat excessively drained |

| | |
|---|---|
| Permeability class | Moderately rapid to rapid |
| Soil depth | 50 – 150 cm |
| Surface fragment cover <=3" | 0 – 10 % |
| Surface fragment cover >3" | 0 – 10 % |
| Available water capacity (0-101.6cm) | 7.62 – 17.78 cm |
| Calcium carbonate equivalent (0-101.6cm) | Not specified |
| Electrical conductivity (0-101.6cm) | Not specified |
| Sodium adsorption ratio (0-101.6cm) | Not specified |
| Soil reaction (1:1 water) (0-101.6cm) | 6.6 – 7.8 |
| Subsurface fragment volume <=3" (0-152.4cm) | 0 – 10 % |
| Subsurface fragment volume >3" (0-152.4cm) | 0 – 10 % |

## Ecological dynamics

This site occurs on nearly level lava plains overlain by eolian pumice sands and supports a juniper woodland plant community. These woodlands are characterized by an open stand of old growth western juniper, which are over 150 years old and express old growth morphological and structural characteristics. In the understory, Idaho fescue dominates under tree canopies. Interspaces between trees are dominated by mountain and basin big sagebrush and needle and thread grass, with minor components of Indian ricegrass, western needlegrass and Thurber’s needlegrass.

Woodland ecological sites existing on these eolian-volcanic sands collectively represent the most extensive old growth western juniper woodlands within the range of the species (Waichler et al. 2001). Trees in this region have been aged at over 1,600 years old and standing snags have been dated back to 100 BC. When compared to younger trees, old growth trees have a more rounded canopy shape with limited leader growth, deep vertical furrows in their bark, rot pockets, cavities, abundant arboreal lichen cover, and changing branch structure, including large basal branches. These woodlands have evolved over centuries and are relatively stable, resulting in the accumulation of dead wood in the form of snags, dead branches in live trees, logs, and weathered stumps (Miller et al., 2019, pg 57). It also predominately stays aloft throughout the decay process, deteriorating more through abiotic weathering than biotic decomposition; greatly limiting contributions to soil organic matter and nitrogen pools (Waichler et al. 2001).

Western juniper is highly susceptible to fire, so old growth juniper woodlands are often isolated in fire resistant locations such as "rock outcrops, knolls, ridges, and/or soils that are shallow, coarse, rocky, and often high in clay or sand" (Miller et al., 2019, pg 57). This site occurs on basalt lava plains overlain with moderately deep to deep pumice ash, primarily derived from Mt. Mazama. While soils on this site are deeper and have fewer coarse fragments than is typical of other old growth juniper sites, the soils on this site are geologically young; less than 7,000 years old, and primarily coarse pumice sands. Limited pedogenic development of these sandy soils in a low precipitation environment (8-10 inches annually) limits resources and results in a plant community that expresses large gaps between individual plants and limits overall understory production. Distance between trees and a discontinuous understory breaks up fine fuels and limits ladder fuels, typically containing fire events to one or several trees thereby creating the conditions for old growth woodlands to develop. This site is also in complex with shallow soils and rock outcrop. This close proximity to other fire resistant sites further limits fire spread. Stand replacement fires and mixed-severity fires were historically rare (return intervals measured in centuries) (Miller et al., 2005, pg 21; Miller et al., 2019, pg112); meaning climatic conditions, such as severe drought, are the primary influence on tree mortality and establishment and understory dynamics.

In addition to influencing fire behavior, soil characteristics on this site drive species composition and production in the understory. While soil textures are coarse, the soil particles themselves are porous and can hold water in addition to the capillary water of the profile. Some of this water is plant available, greatly increasing the available water capacity (AWC) of the soil compared to non-pumice soils with similar textures. (Anderson et al., 1998, pg 89). These pumice soils also have high albedo. The light color on the surface absorbs less sunlight and thus keeps the soil cooler than soils with darker A horizons. The porous nature of these soils also makes them very insulating, moderating subsurface temperatures, and keeping them cooler longer into the growing season. These unique characteristics result in a diverse species composition in the understory community that is typically more common on cooler, wetter, higher production sites. Spatial distribution of these understory species is further influenced by the size of the pumice sands. Redistribution of the pumice ash by wind resulted in varying surface textures across the site. The coarser sands favor the needelgrasses, while the finer sands favor other species like Idaho fescue and bluebunch wheatgrass.

Paleobotany and Climate:
Western juniper first arrived in its current geographical range in Central Oregon between 4,800 to 6,600 years ago, during the mid Holocene era. Cool and moist conditions 4,000 to 3,000 years ago favored tree growth, cone production and seedling establishment, resulting in rapid expansion; Western juniper reached its prehistoric maximum across most of its present-day range during this period. A subsequent warm period 2,500 to 3,000 years ago caused severe droughts, major fires, and regional declines in western juniper stands. With the onset of the Little Ice Age conditions again became cooler and wetter and pollen records indicate juniper again began to gradually increase to its current range. (Miller et al., 2019, pg 102, 103). Under a natural disturbance regime, climate is the primary driver of juniper distribution and persistence, particularly in juniper woodlands. It directly influences seed production, seedling establishment, and plant mortality while also influencing other disturbances such as fire, competition, insects, and disease. (Miller et al., 2019, pg 123)

Cool, moist conditions favor juniper expansion, while severe or extended drought and warmer conditions cause tree stress and mortality (Miller et al., 2019, pg 102). Some mortality is the direct result of drought stress, while some trees succumb to secondary disturbances due to reduced vigor. Old trees are susceptible to heart-rots, which target the heartwood of the trunk and large limbs. Heart-rots rarely kill the tree but can structurally weaken them. Stressed trees are also more susceptible to mistletoe infestations and insects. In spite of vulnerabilities, western juniper is very resistant to many pressures. Overall, tree mortality in old growth juniper woodlands is typically low (Miller et al., 2019, pg 42 to 48); estimated at less than one percent per century (Miller et al., 2019, pg 111).

Western Juniper Woodland Infill:
While old growth juniper woodlands are relatively stable, they are not static. They have historically experienced cycles of infill and mortality in response to climatic conditions. With the end of the Little Ice Age in the 1850s, evidence suggests these woodlands were slowly expanding and infilling. Rate of infill throughout the Great Basin greatly accelerated in the late 1800s, peaking in the early 1900s. Infill rates slowed with the onset of widespread severe droughts starting in the 1920s. This acceleration coincides with a significant rise in settlement throughout the Intermountain West and is attributed to a combination of factors including climate, grazing, altered fire regimes, and increased $CO_2$ levels (Miller et al., 2019, pg 83, 104).

Woodland infill, precipitated by the end of the Little Ice Age, coincided with a time of rapid settlement and introduction of livestock grazing in the Great Basin, altering understory dynamics and fire behavior. Wetter periods, as were experienced during this timeframe, typically result in the accumulation of fine fuels (Miller et al., 2019, pg 83). In addition to effects increased understory vegetation has on fire cycles, paleobotany literature suggests competition with herbaceous vegetation may limit tree seedling establishment and/or result in thinning. This indicates a robust understory can provide some competition to juniper establishment, limiting infill (Miller et al., 2019, pg 112). Large numbers of domestic livestock grazing during this period prevented fine fuel accumulation and areas of heavy grazing would have resulted in understory plant stress. Without fire or competition, young juniper trees were able to rapidly establish.

Carbon dioxide ($CO_2$) levels have also increased since the end of the Little Ice Age. Increased $CO_2$ can increase water use efficiency in conifers relative to herbaceous species, resulting in faster tree growth and denser canopies (Miller et al., 2019, pg 119). As climate conditions became warmer and drier in the early 1900s, expansion and infill slowed but still exceeded historic rates under similar conditions. This suggests CO2 concentrations and reduced competition from perennial grasses could be playing a significant role in current woodland expansion (Miller et al., 2019, pg 121 and 123). These factors have resulted in altered stand structure in many persistent woodlands.

Infill trees compete with understory vegetation for water and other resources. Shrubs decline as trees increase in dominance, with sagebrush being highly sensitive to tree competition. Idaho fescue will persist longer as infill progresses, in part due to their superior shade tolerance relative to other species but will also eventually be removed from the site. (Miller et al., 2019, pg 52; Miller et al., 2000) Herbaceous species are more resistant to tree competition, but also decline with increased tree dominance. Microclimate conditions under old growth trees shelter Idaho fescue, so interspace species are the first to decline. Understory decline is accelerated when plants are stressed by other disturbances such as drought, heavy grazing, or recreational use (Miller et al., 2019, pg 48 to 55).

Non-Native Species:
With increased native plant understory stress and mortality, there is greater opportunity for establishment of non-native species and native increasers. This site is susceptible to cheatgrass (Bromus tectorum), an invasive annual grass, and introduced annual forbs like pale madwort (Alyssum alyssoides). Medusahead (Taeniatherum caput-medusae) and North Africa grass (Ventenata dubia) are not a concern on this site, as they typically do not establish in these coarse textured pumaceous soils. With repeated disturbance, sprouting shrubs (e.g. rabbitbrush species) and forbs (e.g. granite prickly phlox, Linanthus pungens and tansymustard, Descurainia sp.) also increase and fill open spaces in the understory.

Over time, this can create fuel continuity that is atypical of old growth woodlands, making this site more prone to fire. Fires become more frequent and widespread. Higher tree densities from juniper infill also creates ladder fuels, making old trees more susceptible to fire, leading to more stand-replacing fires. (Miller et al., 2019, pg 115). Recurring fires favor re-establishment of annual and sprouting species over native perennial grasses and shrubs, thereby perpetuating the fire cycle.

Resilience Management:
Within the natural range of variability under a normal distribution regime this site is resistant to disturbance, but has low resilience when disturbance occurs. Physiographic characteristics including proximity to rock outcrops and adjacent shallow soils as well as low fine fuel loads and minimal ladder fuels make this site very fire resistant. The site is also capable of withstanding extended drought with limited plant mortality. Disturbances outside of shifts in climate are not common resulting in a very stable site.

When disturbance occurs outside the normal range of variability the plant community shifts quickly and is very susceptible to invasion by non-native annual species. This low resilience is a result of the site's limited resources (arid soil moisture regime and sandy soils) and warmer climate (mesic soil temperature regime).

## State and transition model

## Additional community tables

**Table 5. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Grasses and Grasslikes** | | | 504-841 | |
| | needle and thread | HECO26 | *Hesperostipa comata* | 269-381 | – |
| | Idaho fescue | FEID | *Festuca idahoensis* | 95-168 | – |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 22-56 | – |
| | western needlegrass | ACOC3 | *Achnatherum occidentale* | 22-56 | – |
| | Thurber's needlegrass | ACTH7 | *Achnatherum thurberianum* | 22-56 | – |
| | thickspike wheatgrass | ELLA3 | *Elymus lanceolatus* | 17-34 | – |
| | prairie Junegrass | KOMA | *Koeleria macrantha* | 17-28 | – |
| | Ross' sedge | CARO5 | *Carex rossii* | 17-28 | – |
| | squirreltail | ELEL5 | *Elymus elymoides* | 11-17 | – |
| | bluebunch wheatgrass | PSSPS | *Pseudoroegneria spicata ssp. spicata* | 11-17 | – |
| **Forb** | | | | | |
| 2 | **Perennial Forbs** | | | 34-56 | |
| | common yarrow | ACMI2 | *Achillea millefolium* | 0-11 | – |
| | pussytoes | ANTEN | *Antennaria* | 0-11 | – |
| | larkspur | DELPH | *Delphinium* | 0-11 | – |

| | | | | | |
|---|---|---|---|---|---|
| | fleabane | ERIGE2 | *Erigeron* | 0-11 | – |
| | buckwheat | ERIOG | *Eriogonum* | 0-11 | – |
| | common starlily | LEMO4 | *Leucocrinum montanum* | 0-11 | – |
| | lupine | LUPIN | *Lupinus* | 0-11 | – |
| | granite prickly phlox | LIPU11 | *Linanthus pungens* | 0-11 | – |
| | phacelia | PHACE | *Phacelia* | 0-11 | – |
| | spiny phlox | PHHO | *Phlox hoodii* | 0-11 | – |
| **Shrub/Vine** | | | | | |
| 3 | **Dominant Shrubs** | | | 62-95 | |
| | basin big sagebrush | ARTRT | *Artemisia tridentata ssp. tridentata* | 11-84 | – |
| | mountain big sagebrush | ARTRV | *Artemisia tridentata ssp. vaseyana* | 11-84 | – |
| 4 | **Other Shrubs** | | | 17-28 | |
| | yellow rabbitbrush | CHVI8 | *Chrysothamnus viscidiflorus* | 0-11 | – |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 0-11 | – |
| | spiny hopsage | GRSP | *Grayia spinosa* | 0-11 | – |
| | spineless horsebrush | TECA2 | *Tetradymia canescens* | 0-11 | – |
| | desert gooseberry | RIVE | *Ribes velutinum* | 0-11 | – |
| **Tree** | | | | | |
| 5 | **Evergreen Tree** | | | 56-101 | |
| | western juniper | JUOC | *Juniperus occidentalis* | 56-101 | – |

**Table 6. Community 1.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 7. Community 2.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 8. Community 2.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 9. Community 3.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 10. Community 3.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 11. Community 4.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 12. Community 4.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 13. Community 4.3 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

## Animal community

The unique morphological structure of old growth western juniper trees including hollows and cavities provide habitat for cavity nesting birds. A study in Central Oregon found cavity nesting birds were 2.7 times more abundant in old growth juniper woodlands than post settlement stands (Waichler et al. 2001).

## Hydrological functions

The soils of this site have high infiltration rates and low runoff potential.

## Wood products

Firewood and fence posts.

## Inventory data references

Prineville District BLM Ecological Site Inventory NASIS component and pedon data Range Site Descriptions Field knowledge of range-trained personnel

## Other references


Anderson, E. J., M. M. Borman, and W. C. Krueger. 1998. The Ecological Provinces of Oregon: a Treatise on the Basic Ecological Geography of the State., Oregon Agricultural Experiment Station. Special Report 990. (Oregon State University: Corvallis.)

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Miller, Richard F.; Chambers, Jeanne C.; Evers, Louisa; Williams, C. Jason; Snyder, Keirith A.; Roundy, Bruce A.; Pierson, Fred B. 2019. The ecology, history, ecohydrology, and management of pinyon and juniper woodlands in the Great Basin and Northern Colorado Plateau of the western United States. Gen. Tech. Rep. RMRS-GTR-403. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 284 p.

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## Approval

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Dr. Richard Miller, Professor Emeritus Oregon State University - Thank you for reviewing this ecological site and providing valuable feedback.


## 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) | Jeff Repp and Bruce Franssen. |

| | |
|---|---|
| Contact for lead author | State Rangeland Management Specialist for NRCS - Oregon |
| Date | 04/24/2003 |
| Approved by | |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

### Indicators

1. **Number and extent of rills: None**

2. **Presence of water flow patterns: None**

3. **Number and height of erosional pedestals or terracettes: None**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground): 20-30%**

5. **Number of gullies and erosion associated with gullies: None**

6. **Extent of wind scoured, blowouts and/or depositional areas: None to some**

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values): Slightly to moderately resistant to erosion: aggregate stability = 2-5**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** **single grain to moderate very fine granular structure, dry color value 4-5, 7-12 inches thick; low organic matter content (1-2%).**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** **Significant ground cover (60-70%) and moderate slopes (0-10%) effectively limit rainfall impact and overland flow**

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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):** **None**

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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: Perennial, deep-rooted bunch-grasses**

    **Sub-dominant: Evergreen shrubs**

    **Other: Evergreen trees = perennial forbs > other shrubs**

    **Additional:**

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

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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):** **Favorable: 1000, Normal: 800, Unfavorable: 600 lbs/acre/year at high RSI**

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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:** **Cheatgrass and Medusahead invade sites that have lost deep rooted perennial grass functional groups**

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17. **Perennial plant reproductive capability:** **All species should be capable of reproducing annually**

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