Ecological site R025XY016OR
SHALLOW CLAYPAN 11-13 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): 025X–Owyhee High Plateau

MLRA Notes 25—Owyhee High Plateau
This area is in Nevada (56 percent), Idaho (30 percent), Oregon (12 percent), and Utah (2 percent). It makes up about 27,443 square miles. MLRA 25 is characteristically cooler and wetter than the neighboring MLRAs of the Great Basin. The western boundary is marked by a gradual transition to the lower and warmer basins of MLRA 24. The boundary to the south-southeast, with MLRA 28B, is marked by gradual changes in geology marked by an increased dominance of singleleaf pinyon and Utah juniper and a reduced presence of Idaho fescue. The boundary to the north, with MLRA 11, is a rapid transition from the lava plateau topography to the lower elevation Snake River Plain.
Physiography:
All of this area lies within the Intermontane Plateaus. The southern half is in the Great Basin section of the Basin and Range province. This part of the MLRA is characterized by isolated, uplifted fault-block mountain ranges separated by narrow, aggraded desert plains. This geologically older terrain has been dissected by numerous streams draining to the Humboldt River.
The northern half of the area lies within the Columbia Plateaus province. This part of the MLRA forms the southern boundary of the extensive Columbia Plateau basalt flows. Most of the northern half is in the Payette section, but the northeast corner is in the Snake River Plain section. Deep, narrow canyons draining into the Snake River have been incised into this broad basalt plain. Elevation ranges from 3,000 to 7,550 feet on rolling plateaus and in gently sloping basins. It is more than 9,840 feet on some steep mountains. The Humboldt River crosses the southern half of this area
Geology:
The dominant rock types in this MLRA are volcanic. They include andesite, basalt, tuff, and rhyolite. In the north and west parts of the area, Cretaceous granitic rocks are exposed among Miocene volcanic rocks in mountains. A Mesozoic igneous and metamorphic rock complex dominates the south and east parts of the area. Upper and Lower Paleozoic calcareous sediments, including oceanic deposits, are exposed with limited extent in the mountains. Alluvial fan and basin fill sediments occur in the valleys.
Climate:
The average annual precipitation in most of this area is typically 11 to 22 inches. It increases to as much as 49 inches at the higher elevations. Rainfall occurs in spring and sporadically in summer. Precipitation occurs mainly as snow in winter. The precipitation is distributed fairly evenly throughout fall, winter, and spring. The amount of precipitation is lowest from midsummer to early autumn. The average annual temperature is 33 to 51 degrees F. The freeze-free period averages 130 days and ranges from 65 to 190 days, decreasing in length with elevation. It is typically less than 70 days in the mountains.
Water:
The supply of water from precipitation and streamflow is small and unreliable, except along the Owyhee, Bruneau, and Humboldt Rivers. Streamflow depends largely on accumulated snow in the mountains. Surface water from mountain runoff is generally of excellent quality and suitable for all uses. The basin fill sediments in the narrow alluvial valleys between the mountain ranges provide some ground water for irrigation. The alluvial deposits along the large streams have the most ground water. Based on measurements of water quality in similar deposits in

adjacent areas, the basin fill deposits probably contain moderately hard water. The water is suitable for almost all uses. The carbonate rocks in this area are considered aquifers, but they are little used. Springs are common along the edges of the limestone outcrops.
Soils:
The dominant soil orders in this MLRA are Aridisols and Mollisols. The soils in the area dominantly have a mesic or frigid temperature regime and an aridic, aridic bordering on xeric, or xeric moisture regime. Soils with aquic moisture regimes are limited to drainage or spring areas, where moisture originates or runs on and through. These soils are of a very limited extent throughout the MLRA. They generally are well drained, clayey or loamy, and shallow or moderately deep. Most of the soils formed in mixed parent material. Volcanic ash and loess mantle the landscape. Surface soil textures are loam and silt loam with ashy texture modifiers in some areas. Argillic horizons occur on the more stable landforms. They are exposed nearer the soil surface on convex landforms, where ash and loess deposits are more likely to erode. Soils that formed in carbonatic parent material in areas that receive less than 12 inches of precipitation are characterized by calcic horizons throughout the profile, while soils in areas that receive more than 12 inches of precipitation do not have calcic horizons in the upper part of the profile. Soils that formed on stable landforms at the lower elevations are dominated by ochric horizons. Soils that formed at the middle and upper elevations are characterized by mollic epipedons. Soils in drainage areas at all elevations that receive moisture running on or through them are characterized by thicker mollic epipedons.
Biological Resources:
This MLRA supports shrub-grass vegetation. Lower elevations are characterized by Wyoming big sagebrush associated with bluebunch wheatgrass, western wheatgrass, and Thurber’s needlegrass. Other important plants include bluegrass, squirreltail, penstemon, phlox, milkvetch, lupine, Indian paintbrush, aster, and rabbitbrush. Black sagebrush occurs but is less extensive. Singleleaf pinyon and Utah juniper occur in limited areas. With increasing elevation and precipitation, vast areas characterized by mountain big sagebrush or low sagebrush/early sagebrush in association with Idaho fescue, bluebunch wheatgrass, needlegrasses, and bluegrass become common. Snowberry, curl-leaf mountain mahogany, ceanothus, and juniper also occur. Mountains at the highest elevations support whitebark pine, Douglas-fir, limber pine, Engelmann spruce, subalpine fir, aspen, and curl-leaf mountain mahogany.
Major wildlife species include mule deer, bighorn sheep, pronghorn, mountain lion, coyote, bobcat, badger, river otter, mink, weasel, golden eagle, red-tailed hawk, ferruginous hawk, Swainson’s hawk, northern harrier, prairie falcon, kestrel, great horned owl, short-eared owl, long-eared owl, burrowing owl, pheasant, sage grouse, chukar, gray partridge, and California quail. Reptiles and amphibians include western racer, gopher snake, western rattlesnake, side-blotched lizard, western toad, and spotted frog. Fish species include bull, red band, and rainbow trout.

Ecological site concept

This ecological site is on gently sloping foothills and broad tablelands associated with volcanic plateau landscapes. Elevations range from 4,300 to 5,500 feet (1,310 to 1,676 meters). The soils associated with this site are moderately deep to a duripan or lithic contact, and have an abrupt boundary in the top 10 inches (25cm) resulting in wet non-saturated conditions. The soil climate is frigid. The reference plant community is characterized by low sagebrush and a mix of Idaho fescue and bluebunch wheatgrass in the understory.

(wet non-saturated conditions - Schoeneberger, P.J., 2012, pg 1-15)

Associated sites

R025XY021OR	**CLAYPAN SOUTH SLOPES 11-13 PZ**
R025XY012OR	**LOAMY 11-13 PZ**
R025XY011OR	**VERY SHALLOW 8-13 PZ**
R025XY063OR	**SKELETAL CLAYPAN 11+ PZ**
R025XY032OR	**NORTH SLOPES 11-13 PZ**

Similar sites

R025XY061OR	**SHALLOW CLAYPAN 8-11 PZ** Warmer and drier (mesic, aridic); slightly lower production; species composition is dominated by bluebunch wheatgrass and Poas.
R025XY018OR	**SHALLOW CLAYPAN 13-16 PZ** Higher precip (frigid, xeric); higher production

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia arbuscula*
Herbaceous	(1) *Festuca idahoensis* (2) *Pseudoroegneria spicata subsp. spicata*

Physiographic features

This site is on plateaus and tablelands. Slopes range from 2 to 12 percent. Elevation typically varies from 4,300 to 5,000 feet (1,310 to 1,524 meters). However, site has been observed as high as 5,500 feet (1,676 meters).

Table 2. Representative physiographic features

Landforms	(1) Lava plateau > Plateau (2) Tableland
Runoff class	High to very high
Elevation	4,300–5,000 ft
Slope	2–12%
Water table depth	100 in
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Elevation	4,300–5,500 ft
Slope	Not specified
Water table depth	Not specified

Climatic features

The mean annual precipitation ranges from 11 to 13 inches (28 to 33cm), most of which occurs in the form of snow during the months of December through March. The average Mean annual precipitation of the site is typically 12 inches (30 cm). Localized convection storms occasionally occur during the summer.
The soil temperature regime is frigid with a mean annual air temperature of 46 degrees F. Temperature extremes range from 10 to 90 degrees F. The frost-free period ranges from 30-100 days, most commonly 90 days. The optimum growth period for native plants is from April through June.

*The above data is average from the DANNER and ROCKVILLE 5 N Climate stations, NASIS, and Western Regional Climate Center.

Table 4. Representative climatic features

Frost-free period (characteristic range)	30-100 days
Freeze-free period (characteristic range)	110-130 days
Precipitation total (characteristic range)	11-13 in

Frost-free period (actual range)	
Freeze-free period (actual range)	
Precipitation total (actual range)	8-18 in
Frost-free period (average)	90 days
Freeze-free period (average)	120 days
Precipitation total (average)	12 in

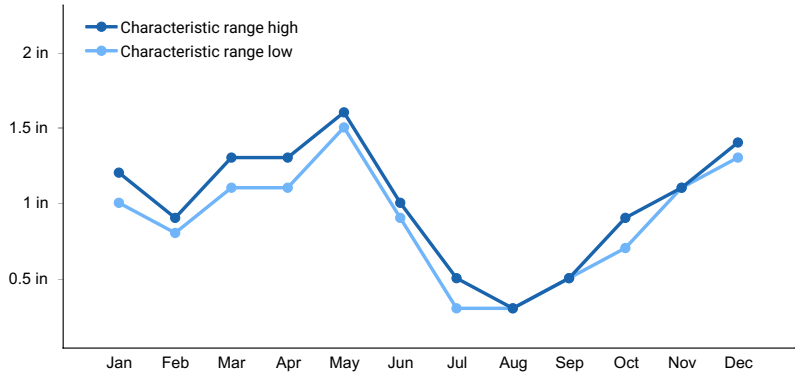


Figure 1. Monthly precipitation range

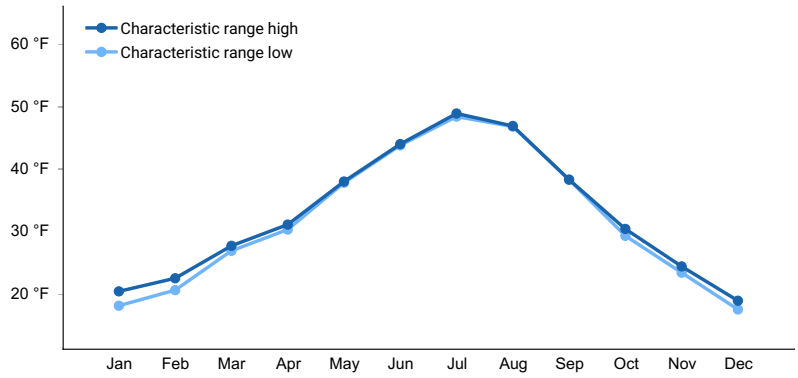


Figure 2. Monthly minimum temperature range

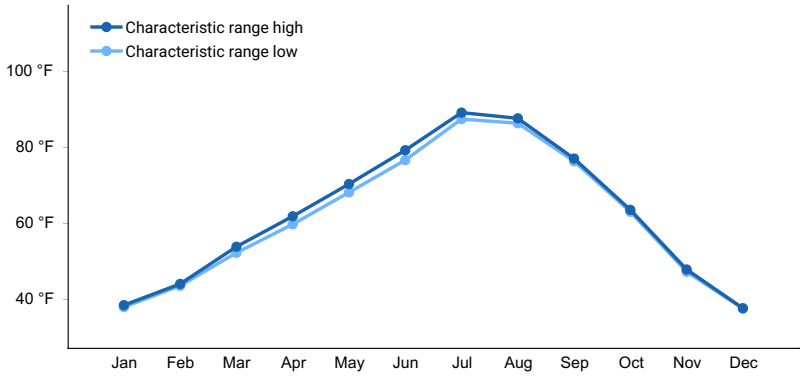


Figure 3. Monthly maximum temperature range

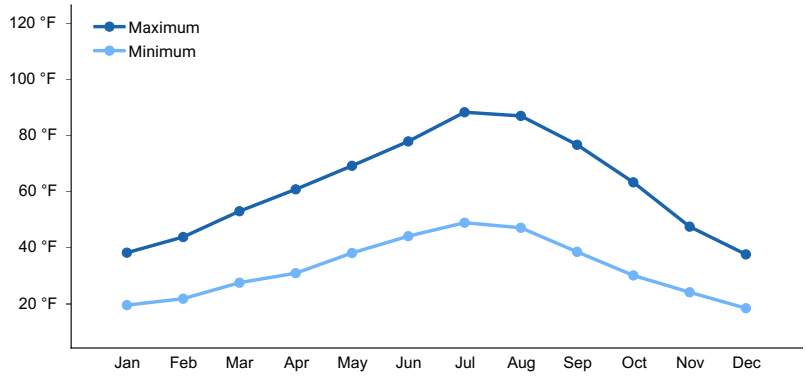


Figure 4. Monthly average minimum and maximum temperature

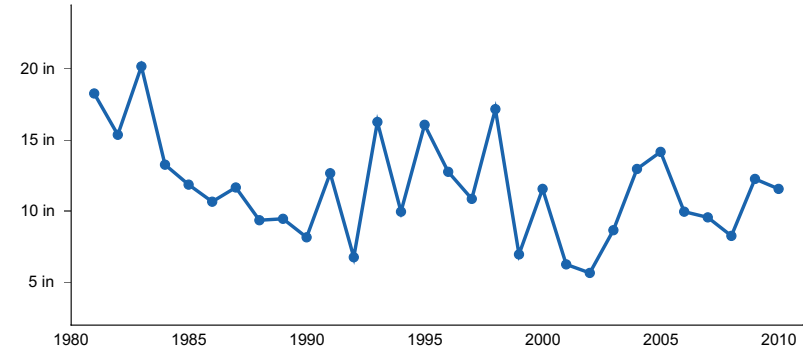


Figure 5. Annual precipitation pattern

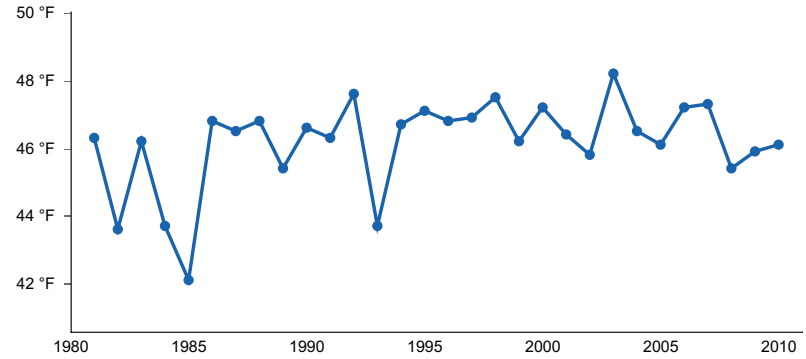


Figure 6. Annual average temperature pattern

Climate stations used

- (1) DANNER [USC00352135], Jordan Valley, OR
- (2) ROCKVILLE 5 N [USC00357277], Adrian, OR

Influencing water features

Site is not influenced by water features.
Site is not connected to a water table.

Soil features

The soils associated with this site are moderately deep over bedrock or an indurated pan. The surface layer is ashy silt loam to loam, 4 to 6 inches (10 to 15 cm) thick. The subsoil texture is typically clay to clay loam. An abrupt boundary occurs at the interface of the surface and subsoil, resulting in wet non-satiated conditions in the spring. Depth to bedrock or an indurated pan is 20 to 40 inches (50 to 100 cm). Permeability is moderate in the surface and slow in the subsoil. The available water holding capacity is about 3 to 4.5 inches (8 to 11 cm) for the profile.

The soils correlated to this site are: Drice, Pinchey, Robson and Succor.

(wet non-saturated conditions - Schoeneberger, P.J., 2012, pg 1-15)

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Residuum–volcanic rock (3) Loess–volcanic rock
Surface texture	(1) Ashy silt loam (2) Loam
Family particle size	(1) Fine
Drainage class	Well drained
Permeability class	Slow to moderate
Depth to restrictive layer	20–40 in
Soil depth	20–40 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	2–7%
Available water capacity (0-10in)	1.5–2.2 in
Soil reaction (1:1 water) (0-40in)	6.6–7.8
Subsurface fragment volume <=3" (0-40in)	0–10%
Subsurface fragment volume >3" (0-40in)	0–10%

Table 6. Representative soil features (actual values)

Drainage class	Moderately well drained to well drained
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 (0-10in)	Not specified
Soil reaction (1:1 water) (0-40in)	Not specified
Subsurface fragment volume <=3" (0-40in)	Not specified
Subsurface fragment volume >3" (0-40in)	Not specified

Ecological dynamics

The reference plant community is dominated by low sagebrush (little sagebrush) with an understory of Idaho fescue and bluebunch wheatagrass. The site has low to moderate resilience to disturbance and resistance to invasion (Stringham et al. 2015). Resilience is a system’s capacity to regain its structure, processes, and function following stressors or disturbance (e.g. drought or fire). Resistance is the capacity of the system to retain its structure, processes, and function despite stressors or disturbances (including pressure from invasive species) (Chambers 2014a). Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient

availability (Stringham et al. 2015); where greater resource availability and more favorable environmental conditions exist for plant growth and reproduction (Chambers 2014a).

This ecological site's lower effective precipitation (aridic soil moisture regime) and restrictive soil features limit site productivity resulting in more open space for establishment of invasive annual grasses. Timing of precipitation also favors invasive annual grasses that are particularly well adapted to cool wet winters and warm dry summers; beginning growth and utilizing resources prior to native species breaking dormancy. The site's cooler soil temperature regime (frigid) does increase resistance compared to warmer sites, but is not cold enough to inhibit invasive annual grasses (Chambers 2014b).

This ecological site is dominated by deep-rooted cool season, perennial bunchgrasses and long-lived shrubs (50+ years) with high root to shoot ratios. Community types with low sagebrush as the dominant shrub were found to have soil depths and thus available rooting depths of 71 to 81 centimeters in a study in northeast Nevada (Jensen 1990). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992).

Periodic drought regularly influences sagebrush ecosystems and drought duration and severity has increased throughout the 20th century in much of the Intermountain West. Major shifts away from historical precipitation patterns have the greatest potential to alter ecosystem function and productivity. Species composition and productivity can be altered by the timing of precipitation and water availability with the soil profile (Bates et al. 2006).

Low sagebrush is fairly drought tolerant but also tolerates periodic wetness during some portion of the growing season. Low sagebrush is also susceptible to the sagebrush defoliator Aroga moth. Aroga moth can partially or entirely kill individual plants or entire stands of big sagebrush (Furniss and Barr 1975), but the research is inconclusive of the damage sustained by low sagebrush populations.

The low sagebrush communities have high spatial and temporal variability in precipitation both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition. It can also increase resource pools by the decomposition of dead plant material following disturbance. The invasion of sagebrush communities by cheatgrass (*Bromus tectorum*) has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al. 2007).

The perennial bunchgrasses that are dominant on this ecological site are Idaho fescue and bluebunch wheatgrass. These species generally have shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 m of the soil profile. General differences in root depth distributions between grasses and shrubs results in resource partitioning in these shrub/grass systems.

As ecological condition declines, the sagebrush and rabbitbrush become dominant with increases of Sandberg's bluegrass, bottlebrush squirreltail and mat forming forbs in the understory. The potential invasive/noxious weeds are cheatgrass, rabbitbrush, and annual mustards.

Four possible alternative stable states have been identified for this ecological site.

Fire Ecology:
Prior to 1897, mean fire return intervals for low sagebrush communities have been estimated to be from 35 to over 100 years. Fire most often occurs during wet years with high forage production.

Low sagebrush is killed by fire and does not sprout (Tisdale and Hironaka 1984). Establishment after fire is from seed, generally blown in and not from the seed bank (Bradley et al. 1992). Fire risk is greatest following a wet, productive year when there is greater production of fine fuels (Beardall and Sylvester 1976). Fire return intervals have been estimated at 100-200 years in black sagebrush-dominated sites (Kitchen and McArthur 2007) and likely is similar in the low sagebrush ecosystem. Historically, however, fires were probably patchy due to the low productivity of these sites. Recovery time of little sagebrush following fire is variable (Young 1983). After fire, if regeneration conditions are favorable, low sagebrush recovers in 2 to 5 years; on harsh sites where cover is low to begin with and/or erosion occurs after fire, recovery may require more than 10 years (Young 1983). Slow regeneration may subsequently worsen erosion (Blaisdell et al. 1982).

The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. The initial condition of bunchgrasses within the site along with seasonality and intensity of the fire all factor into the individual species response. The growing points for most forbs and grasses are located at or below the soil surface, providing relative protection from disturbances which decrease above ground biomass, such as grazing or fire. Thus, fire mortality is more correlated to duration and intensity of heat which is related to culm density, culm-leaf morphology, size of plant and abundance of old growth (Wright 1971, Young 1983). However, season and severity of the fire and post-fire soil moisture availability will influence plant response.

Idaho fescue, the dominant grass within this community, response to fire varies with condition and size of the plant, season and severity of fire, and ecological conditions. Mature Idaho fescue plants are commonly reported to be severely damaged by fire in all seasons (Wright et al. 1979). Initial mortality may be high (in excess of 75%) on severe burns, but usually varies from 20 to 50% (Barrington et al 1988). Rapid burns have been found to leave little damage to root crowns, and new tillers are produced with onset of fall moisture (Johnson et al. 1994). However, Wright and others (1979) found the dense, fine leaves of Idaho fescue provided enough fuel to burn for hours after a fire had passed, thereby killing or seriously injuring the plant regardless of the intensity of the fire (Wright et al. 1979). Idaho fescue is commonly reported to be more sensitive to fire than the other prominent grass on this site, bluebunch wheatgrass (Conrad and Poulton 1966). However Robberecht and Defosse (1995) suggested the latter was more sensitive. They observed culm and biomass reduction with moderate fire severity in bluebunch wheatgrass, whereas a high fire severity was required for this reduction in Idaho fescue. Also, given the same fire severity treatment, post-fire culm production was initiated earlier and more rapidly in Idaho fescue (Robberecht and Defosse 1995).

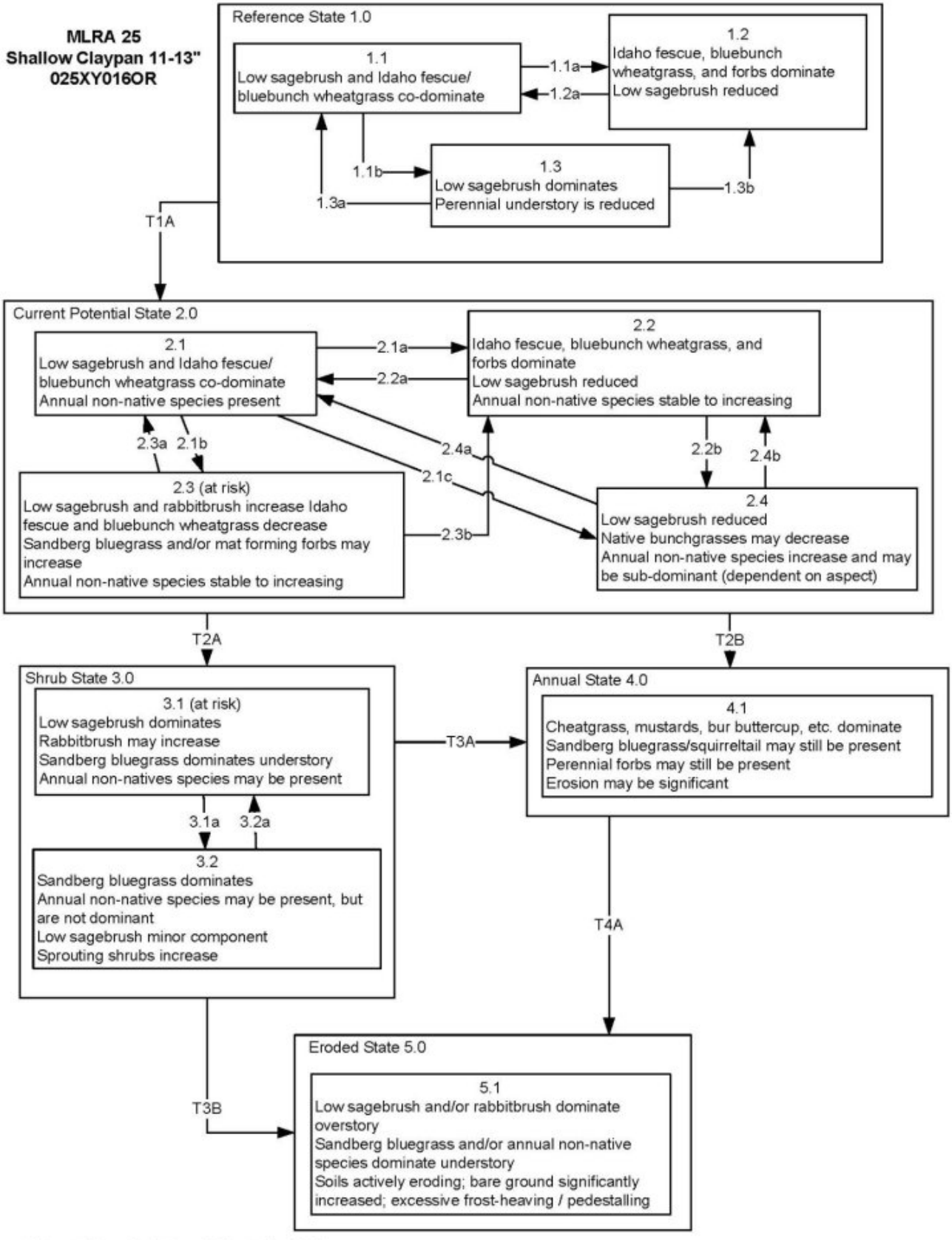
Bluebunch wheatgrass has coarse stems with little leafy material, the aboveground biomass burns rapidly and little heat is transferred downward into the crowns (Young 1983). Bluebunch wheatgrass was described as fairly tolerant of burning, other than in May in eastern Oregon (Britton et al. 1990). Uresk et al. (1976) reported burning increased vegetative and reproductive vigor of bluebunch wheatgrass, thus it experiences slight damage to fire but is more susceptible in drought years (Young 1983).

Sandberg bluegrass has been found to increase following fire, likely due to its low stature and productivity (Daubenmire 1975) and may retard reestablishment of deeper rooted bunchgrasses.

Adapted from: Stringham, T.K., P. Novak-Echenique, P. Blackburn, D. Snyder, and A. Wartgow. 2015. Final Report for USDA Ecological Site Description State-and-Transition Models by Disturbance Response Groups, Major Land Resource Area 25 Nevada. University of Nevada Reno, Nevada Agricultural Experiment Station Research Report 2015-02. p. 569

State and transition model

MLRA 25
Shallow Claypan 11-13"
025XY016OR



(Adapted from Stringham, T.K. et all., 2015)

MLRA 25
Shallow Claypan 11-13
025XY016OR

Reference State 1.0 Community Phase Pathways
1.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community, dominated by grasses and forbs.
1.1b: Time and lack of disturbance such as fire or drought. Excessive herbivory and/or long-term drought may also reduce perennial understory.
1.2a: Time and lack of disturbance allows for shrub regeneration.
1.3a: Low severity fire would create sagebrush/grass mosaic.
1.3b: High severity fire significantly reduces sagebrush cover leading to early/mid-seral community.

Transition T1A: Introduction of non-native annual species.

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs; non-native annual species present.
2.1b: Time and lack of disturbance. Inappropriate grazing management and/or long-term drought may also reduce perennial understory.
2.1c: Rainfall pattern favoring annual species production (higher than normal spring precipitation)
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
2.2b: Rainfall pattern favoring annual species production (higher than normal spring precipitation)
2.3a: Low severity fire creates sagebrush/grass mosaic, herbivory or combinations. Brush management with minimal soil disturbance reduces sagebrush
2.3b: High severity fire significantly reduces sagebrush cover leading to early mid-seral community. Brush management with minimal soil disturbance reduces sagebrush.
2.4a: Rainfall pattern favoring perennial bunchgrass production and reduced cheatgrass production (less than normal spring with higher than normal summer)
2.4b: Rainfall pattern favoring perennial bunchgrass production and reduced cheatgrass production (less than normal spring with higher than normal summer)

Transition T2A: Inappropriate grazing management (3.1), or high severity fire (3.2)
Transition T2B: Fire or brush management causing severe soil disturbance

Shrub State 3.0 Community Phase Pathways
3.1a: Low severity fire
3.2a: Time and lack of disturbance

Transition T3A: Catastrophic fire and/or treatments that disturb the existing plant community
Transition T3B: Inappropriate grazing management following fire and/or multiple fires and/or prolonged drought. Additional soil disturbing treatments (ex: failed drill seeding) could also increase erosion.

Annual State 4.0
None

Transition T4A: Inappropriate grazing management following fire and/or multiple fires and/or long-term drought. Additional soil disturbing treatments (ex: seedings that fail) could also increase erosion.

Eroded State 5.0 Community Phase Pathways
None

(Stringham, T.K. et all., 2015)

State 1
Reference State 1.0

The Reference State 1.0 is a representative of the natural range of variability under pristine conditions. The reference state has three general community phases: a shrub-grass dominant phase, a perennial grass dominant phase and a shrub dominant phase. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic drought and/or insect or disease attack.

Community 1.1
Reference Plant Community 1.1

This community is dominated by low sagebrush, Idaho fescue, and bluebunch wheatgrass. Forbs and other grasses make up smaller components.

Dominant plant species

- little sagebrush (*Artemisia arbuscula*), shrub
- Idaho fescue (*Festuca idahoensis*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata ssp. spicata*), grass

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	425	595	850
Shrub/Vine	50	70	100
Forb	25	35	50
Total	**500**	**700**	**1000**

Community 1.2
Community Phase 1.2

This community phase is characteristic of a post-disturbance, early/mid-seral community. Idaho fescue, bluebunch wheatgrass and other perennial bunchgrasses dominate. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush and other sprouting shrubs may be sprouting. Perennial forbs may be a significant component for a number of years following fire.

Community 1.3
Community Phase 1.3

Sagebrush increases in the absence of disturbance. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs and/or from herbivory.

Pathway P1.1a
Community 1.1 to 1.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring may be more severe and reduce sagebrush cover to trace amounts.

Pathway P1.1b
Community 1.1 to 1.3

Time and lack of disturbance such as fire allows for sagebrush to increase and become decadent. Long-term drought, herbivory, or combinations of these will cause a decline in perennial bunchgrasses and fine fuels leading to a reduced fire frequency and allowing sagebrush to dominate the site.

Pathway P1.2a
Community 1.2 to 1.1

Time and lack of disturbance will allow sagebrush to increase.

Pathway P1.3a
Community 1.3 to 1.1

A low severity fire, herbivory or combinations will reduce the sagebrush overstory and create a sagebrush/grass mosaic.

Pathway P1.3b
Community 1.3 to 1.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community.

State 2
Current Potential State 2.0

This state is similar to the Reference State 1.0. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. This state has the same three general community phases. These non-native species can be highly flammable, and promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These feedbacks include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the nonnatives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal.

Community 2.1
Community Phase 2.1

This community phase is similar to the Reference State Community Phase 1.1, with the presence of non-native species in trace amounts. Sagebrush, Idaho fescue, and bluebunch wheatgrass dominate the site. Forbs and other shrubs and grasses make up smaller components of this site.

Community 2.2
Community Phase 2.2

This community phase is characteristic of a post-disturbance, early to mid-seral community where annual non-native species are present. Sagebrush is present in trace amounts; perennial bunchgrasses dominate the site. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush may be sprouting or dominant in the community. Perennial forbs may be a significant component for a number of years following fire. Annual non-native species are stable or increasing within the community.

Community 2.3
Community Phase 2.3 (At Risk)

This community is at risk of crossing a threshold to another state. Sagebrush dominates the overstory and perennial bunchgrasses in the understory are reduced, either from competition with shrubs or from inappropriate grazing, or from both. Rabbitbrush may be a significant component. Sandberg bluegrass may increase and become co-dominate with deep rooted bunchgrasses. Annual non-natives species may be stable or increasing due to lack of competition with perennial bunchgrasses. This site is susceptible to further degradation from grazing, drought, and fire.

Community 2.4
Community Phase 2.4 (at risk)

This community is at risk of crossing into an annual state. Native bunchgrasses dominate; however, annual non-native species such as cheatgrass may be sub-dominant in the understory. Annual production and abundance of these annuals may increase drastically in years with heavy spring precipitation. Sagebrush is a minor component. This site is susceptible to further degradation from grazing, drought, and fire.

Pathway P2.1a
Community 2.1 to 2.2

Fire reduces the shrub overstory and allows for perennial bunchgrasses to dominate the site. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring or a change in management favoring an increase in fine fuels may be more severe and reduce sagebrush cover to trace amounts. Annual non-native species are likely to increase after fire.

Pathway P2.1b
Community 2.1 to 2.3

Time and lack of disturbance allows for sagebrush to increase and become decadent. Long-term drought reduces fine fuels and leads to a reduced fire frequency, allowing sagebrush to dominate the site. Inappropriate grazing management reduces the perennial bunchgrass understory; conversely Sandberg bluegrass may increase in the understory depending on grazing management.

Pathway P2.1c
Community 2.1 to 2.4

Higher than normal spring precipitation favors annual nonnative species such as cheatgrass. Non-native annual species will increase in production and density throughout the site. Perennial bunchgrasses may also increase in production.

Pathway P2.2a
Community 2.2 to 2.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of low sagebrush can take many years.

Pathway P2.2b
Community 2.2 to 2.4

Higher than normal spring precipitation favors annual nonnative species such as cheatgrass. Non-native annual species will increase in production and density throughout the site. Perennial bunchgrasses may also increase in production.

Pathway P2.3a
Community 2.3 to 2.1

A change in grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall or winter grazing may cause mechanical damage and subsequent death to sagebrush, facilitating an increase in the herbaceous understory. Brush treatments with minimal soil disturbance will also decrease sagebrush and release the perennial understory. A low severity fire would decrease the overstory of sagebrush and low for the understory perennial grasses to increase. Due to low fuel loads in this State, fires will likely be small creating a mosaic pattern. Annual non-native species are present and may increase in the community.

Pathway P2.3b
Community 2.3 to 2.2

Fire eliminates/reduces the overstory of sagebrush and allows for the understory perennial grasses to increase. Fires may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community. Annual non-native species respond well to fire and may increase post burn.

Pathway P2.4a
Community 2.4 to 2.1

Rainfall patterns favoring perennial bunchgrasses. Less than normal spring precipitation followed by higher than normal summer precipitation will increase perennial bunchgrass production.

Pathway P2.4b
Community 2.4 to 2.2

Rainfall patterns favoring perennial bunchgrasses. Less than normal spring precipitation followed by higher than normal summer precipitation will increase perennial bunchgrass production.

State 3
Shrub State 3.0

This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Sandberg bluegrass will increase with a reduction in deep rooted perennial bunchgrass competition and become the dominant grasses. Sagebrush dominates the overstory and rabbitbrush may be a significant component. Sagebrush cover exceeds site concept and may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. The shrub overstory and bluegrass understory dominate site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed.

Community 3.1
Community Phase 3.1 (At Risk)

Decadent sagebrush dominates the overstory. Rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Sandberg bluegrass and annual non-native species increase. Bare ground is significant.

Community 3.2
Community Phase 3.2

Bluegrass dominates the site; annual non-native species may be present but are not dominant. Trace amounts of sagebrush or rabbitbrush may be present.

Pathway P3.1a
Community 3.1 to 3.2

Fire, heavy fall grazing causing mechanical damage to shrubs, and/or brush treatments with minimal soil disturbance, will greatly reduce the overstory shrubs to trace amounts and allow for Sandberg bluegrass to dominate the site.

Pathway P3.2a
Community 3.2 to 3.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of low sagebrush can take many years.

State 4
Annual State 4.0

An abiotic threshold has been crossed and state dynamics are driven by fire and time. The herbaceous understory is dominated by annual non-native species such as cheatgrass and mustards. Resiliency has declined and further degradation from fire facilitates a cheatgrass and sprouting shrub plant community. Fire return interval has shortened due to the dominance of cheatgrass in the understory and is a driver in site dynamics.

Community 4.1
Community Phase 4.1

Annuals dominate; Sandberg bluegrass and perennial forbs may still be present in trace amounts. Surface erosion may increase with summer convection storms and would be verified through increased pedestalling of plants, rill formation or extensive water flow paths.

State 5
Eroded State 5.0

This state has one community phase. Loss of the A horizon and extreme pedestalling are identifiable features. Abiotic factors including soil redistribution and erosion, soil temperature, soil crusting and sealing are primary drivers of ecological condition within this state. Soil moisture, soil nutrients and soil organic matter distribution and cycling are severely altered due to degraded soil surface conditions. Regeneration of shrubs is not evident.

Community 5.1
Community Phase 5.1

This community phase is characterized by an increase in soil redistribution or loss of the A horizon. Low sagebrush and/or rabbitbrush dominate the overstory. Sandberg bluegrass and annual species dominate the understory. Plants are pedestalled. Dead sagebrush skeletons may be prominent. Regeneration of sagebrush and herbaceous species is not evident.

Transition T1A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass, mustards, and bur buttercup. Slow variables: Over time the annual non-native species will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Transition T2A
State 2 to 3

Trigger: To Community Phase 3.1: Inappropriate grazing will decrease or eliminate deep rooted perennial bunchgrasses, increase Sandberg bluegrass and favor shrub growth and establishment. Trigger: To Community Phase 3.2: Severe fire in community phase 2.3 will remove sagebrush overstory, decrease perennial bunchgrasses and enhance Sandberg bluegrass. Annual non-native species will increase. Slow variables: Long term decrease in deep-rooted perennial grass density. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

Transition T2B
State 2 to 4

Trigger: Fire or soil disturbing treatment would transition to Community Phase 4.1. Slow variables: Increased production and cover of non-native annual species. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes temporal and spatial nutrient capture and cycling within the community. Increased, continuous fine fuels modify the fire regime by increasing frequency, size and spatial variability of fires.

Transition T3A
State 3 to 4

Trigger: Fire and/or treatments that disturb the soil and existing plant community. Slow variables: Increased seed production (following a wet spring) and cover of annual nonnative species. Threshold: Increased, continuous fine fuels modify the fire regime by changing frequency, intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture and impact the temporal and spatial aspects of nutrient cycling and distribution.

Transition T3B
State 3 to 5

Trigger: Inappropriate grazing management causing a removal of perennial bunchgrasses and a disruption of the

soil surface would increase soil erosion. Soil disturbing treatments such as a chaining or other mechanical tree removal treatment. Slow variable: Bare ground interspaces large and connected; water flow paths long and continuous, understory is sparse, pedestalling of plants significant. Threshold: Soil redistribution and erosion is significant and linked to vegetation mortality evidenced by pedestalling and burying of herbaceous species and / or lack of recruitment in the interspaces.

Transition T4A
State 4 to 5

Trigger: Inappropriate grazing management , multiple fires, cheatgrass dieoff, a prolonged drought, summer convection storms or combinations of disturbances that reduce ground cover. Soil disturbing treatments (ex: range seedings that fail) may promote further soil erosion. Slow variables: Overall reduction in the plant community coupled with increased bare ground and soil erosion. Threshold: Soil erosion is controlling site processes. Surface may be sealed after rain events and infiltration rates are greatly reduced. Ponding may be evident. Large connected bare ground patches and evidence of long connected flow paths is common. In some landscape positions wind erosion may be more significant than water erosion.

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	**Dominant, perennial, deep rooted grasses**			280–420	
	Idaho fescue	FEID	*Festuca idahoensis*	280–420	–
2	**Sub-dominant, perennial, deep rooted grasses**			140–210	
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	140–210	–
3	**Sub-dominant, perennial, shallow rooted grasses**			7–21	
	Sandberg bluegrass	POSE	*Poa secunda*	7–21	–
4	**All other perennial grasses**			21–77	
	Cusick's bluegrass	POCU3	*Poa cusickii*	21–35	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	0–14	–
	squirreltail	ELEL5	*Elymus elymoides*	0–14	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–14	–
Forb					
5	**Dominant, perennial forbs**			21–49	
	balsamroot	BALSA	*Balsamorhiza*	7–21	–
	buckwheat	ERIOG	*Eriogonum*	7–14	–
	lupine	LUPIN	*Lupinus*	7–14	–
6	**All other perennial forbs**			7–28	
	common yarrow	ACMI2	*Achillea millefolium*	0–7	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–7	–
	fleabane	ERIGE2	*Erigeron*	0–7	–
	stoneseed	LITHO3	*Lithospermum*	0–7	–
	desertparsley	LOMAT	*Lomatium*	0–7	–
	phlox	PHLOX	*Phlox*	0–7	–
Shrub/Vine					
7	**Dominant, evergreen shrubs**			35–105	
	little sagebrush	ARAR8	*Artemisia arbuscula*	35–105	–

Animal community

This site offers food and cover for antelope, mule deer, rodents and a variety of birds. It is an important spring, summer and fall use area for antelope and mule deer.

This site is suitable for livestock grazing. Grazing management considerations include timing, intensity and duration of grazing.

Domestic sheep and, to a much lesser degree, cattle consume low sagebrush, particularly during the spring, fall, and winter (Sheehy and Winward 1981). Heavy dormant season grazing by sheep will reduce sagebrush cover and increase grass production (Laycock 1967). Severe trampling damage to supersaturated soils could occur if sites are used in early spring when there is abundant snowmelt. Trampling damage, particularly from cattle or horses, in low sagebrush habitat types is greatest when high clay content soils are wet.

Bunchgrasses, in general, best tolerate light grazing after seed formation. Britton et al. (1990) observed the effects of clipping date on basal area of 5 bunchgrasses in eastern Oregon and found grazing from August to October (after seed set) has the least impact. Heavy grazing during the growing season will reduce perennial bunchgrasses and increase sagebrush (Laycock 1967). Abusive grazing by cattle or horses will likely increase low sagebrush, rabbitbrush and some forbs such as arrowleaf balsamroot. Annual non-native weedy species such as cheatgrass and mustards, and potentially medusahead, may invade.

Idaho fescue tolerates light to moderate grazing (Ganskopp and Bedell 1980) and is moderately resistant to trampling (Cole 1987). Heavy grazing may lead to replacement of Idaho fescue with non-native species such as cheatgrass (Mueggler 1984).

Bluebunch wheatgrass is moderately grazing tolerant and is very sensitive to defoliation during the active growth period (Blaisdell and Pechanec 1949, Laycock 1967, Anderson and Scherzinger 1975, Britton et al. 1990). Herbage and flower stalk production was reduced with clipping at all times during the growing season; however, clipping was most harmful during the boot stage (Blaisdell and Pechanec 1949). Tiller production and growth of bluebunch was greatly reduced when clipping was coupled with drought (Busso and Richards 1995). Mueggler (1975) estimated that low vigor bluebunch wheatgrass may need up to 8 years rest to recover. Although an important forage species, it is not always the preferred species by livestock and wildlife.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces. Sandberg bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass or other weedy species. Excessive sheep grazing favors Sandberg bluegrass; however, where cattle are the dominant grazers, cheatgrass often dominates (Daubenmire 1970). Thus, depending on the season of use, the grazer and site conditions, either Sandberg bluegrass or cheatgrass may become the dominant understory with inappropriate grazing management.

(Adapted from Stringham, T.K. et al., 2015)

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Vale District BLM Ecological Site Inventory
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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.

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Date	05/15/2017
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None to some; moderate sheet and rill erosion hazard.

2. **Presence of water flow patterns:** Water flow patterns are none to rare. In areas subject to summer convection storms and rapid snowmelt, short (<1m) and stable flow patterns can be expected. Flow paths are not connected.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to few on this site. As clay content in soil increases slight pedestalling may occur.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 30-40% depending on amount of surface gravels.

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** None; slight wind erosion hazard.

7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) – limited movement; expected to move no more than the distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Low to moderate resistance to erosion. Aggregate stability values should be 1 to 3 on most soil textures found on this site.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface texture is typically stony ashy silty clay loam. Soil surface color is typically grayish brown (10YR 5/2) (dry). Surface structure is weak fine and medium granular structure (A--0-10 cm) and weak thin platy (AB—10-36 cm)(Drice). Soil surface is partly covered by 20 percent stones . *Draft Soil Survey-subject to change.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Typical vegetation composition is 85 percent grasses, 5 percent forbs, and 10 percent shrubs. Perennial herbaceous plants (i.e. Idaho fescue & bluebunch wheatgrass) slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are none. Weak thin platy structure or subsoil argillic horizons are not to be interpreted as compacted layers.

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: Deep-rooted, cool season, perennial bunchgrasses(Idaho fescue > bluebunch wheatgrass)

    Sub-dominant: Low sagebrush

    Other: Other perennial grasses > forbs

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Normal decadence and mortality for this site is expected to be low <2%. As composition of sagebrush increases decadence and mortality will also increase.

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Favorable – 1000 lbs/ac, Average -- 700 lbs/ac, Unfavorable – 500 lbs/ac. Spring moisture significantly affects total 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:** Potential invaders include cheatgrass, medusahead, annual mustards in response to

disturbance.

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17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years. Reduced growth and reproduction occur during extreme or extended drought conditions.
