USDA Natural Resources Conservation Service

Ecological site R025XY046NV
FRACTURED STONY LOAM 14+ P.Z.

Last updated: 4/25/2024
Accessed: 06/30/2024

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): 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 site occurs on crests, shoulders and backslopes of foothills and mountains on all aspects. This site is often associated with areas of rock outcrop and rubbleland. Slope gradients of 4 to 50 percent are typical. Elevations range from 6,000 to 8,800 feet.

The soils correlated with this site are well drained and less than 20 inches deep to bedrock. Bedrock material is highly fractured and has greater than 50 percent cobbles and stones throughout. The available water capacity is very low. However, fractures in the bedrock fill with soil providing additional moisture to plant roots able to penetrate the crevices.

The reference plant community is dominated by Utah and/or western serviceberry, Idaho fescue and bluebunch wheatgrass. Antelope bitterbrush, snowberry and mountain big sagebrush are other important shrub species associated with this site. Tree-like stands of serviceberry dominate the aspect.

Associated sites

R025XY004NV	**LOAMY SLOPE 16+ P.Z.**
R025XY005NV	**WET MEADOW**
R025XY006NV	**DRY MEADOW**
R025XY012NV	**LOAMY SLOPE 12-16 P.Z.**
R025XY017NV	**CLAYPAN 12-16 P.Z.**

R025XY056NV	**LOAMY 14-16 P.Z.**

Similar sites

R025XY004NV	**LOAMY SLOPE 16+ P.Z.** LOAMY SLOPE 16+ P.Z. typically has a deeper soil profile. Dominant species are JUOS/ARTRV

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Amelanchier*
Herbaceous	(1) *Festuca idahoensis* (2) *Pseudoroegneria spicata*

Physiographic features

This site occurs on crests, shoulders and backslopes of foothills and mountains on all aspects. This site is often associated with areas of rock outcrop and rubbleland. Slope gradients of 4 to 50 percent are typical. Elevations are 6000 to 8800 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Hill
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	1,829–2,682 m
Slope	4–50%
Water table depth	183 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers.
The average annual precipitation ranges from 10 to 12 inches. Mean annual air temperature is typically <45 degrees F.

Mean annual precipitation across the range in which this ES occurs is 18.58".

Monthly mean precipitation: January 1.65”; February 1.68”; March 1.98”; April 2.43”; May 2.41”; June 1.62”; July 0.61”; August 0.63”; September 0.84”; October 1.41”; November 1.51”; December 1.79”.

*The above data is averaged from the Jarbridge 4N and Lamoille PH WRCC climate stations.

Table 3. Representative climatic features

Frost-free period (average)	64 days
Freeze-free period (average)	100 days
Precipitation total (average)	406 mm

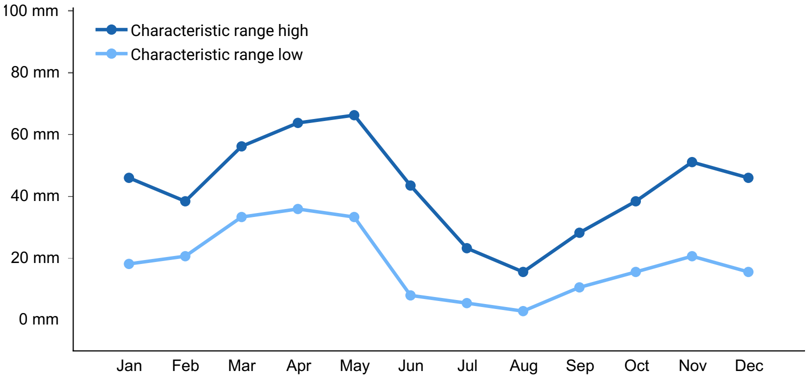

Figure 1. Monthly precipitation range

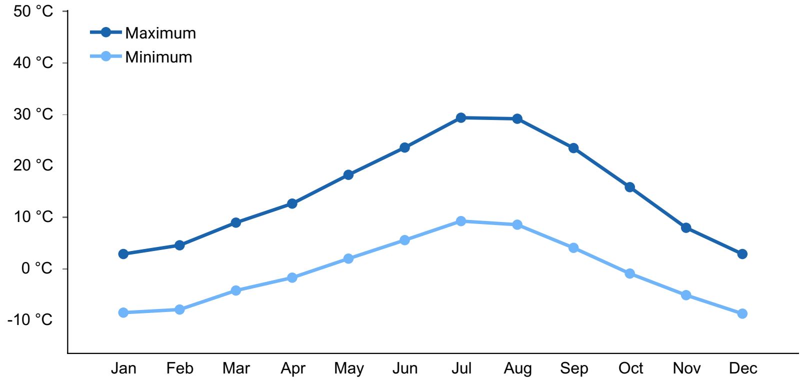

Figure 2. Monthly average minimum and maximum temperature

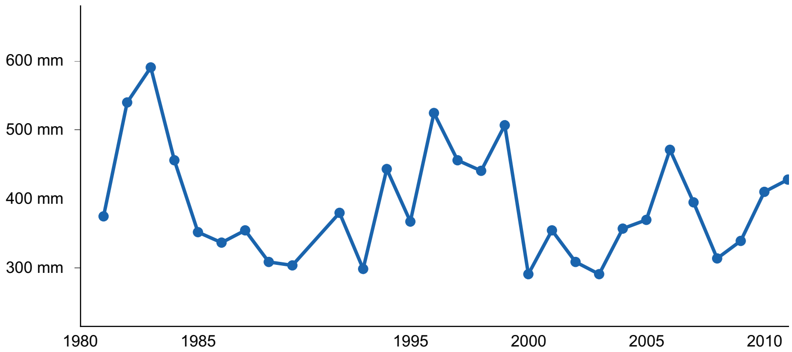

Figure 3. Annual precipitation pattern

Climate stations used

- (1) JARBIDGE 7 N [USC00264039], Jackpot, NV
- (2) LAMOILLE YOST [USC00264394], Spring Creek, NV

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site are well drained and less than 20 inches deep to bedrock. Bedrock material is highly fractured and the soil has greater than 50 percent cobbles and stones throughout. The available water capacity is very low. However, fractures in the bedrock fill with soil providing additional moisture to plant roots able to penetrate the crevices. These soils have a high percentage of gravels, cobbles, rocks or stones on the soil surface. Rock fragments on the soil surface provide a stabilizing affect on surface erosion conditions.

The soil series correlated with this site include Amene, Lerrow variant, Netti and Pernty.

A representative soil series is Pernty, a loamy-skeletal, mixed, superactive, frigid Aridic Lithic Argixeroll. This soil is shallow and well drained and was formed in residuum and colluivium derived from volcanic or metamorphic rocks. Reaction is neutral or slightly alkaline. Diagnostic horizons include a mollic epipedon that occurs from the soil surface to 8 inches and an argillic horizon that occurs from 3 to 14 inches. Clay content in the particle-size control section averages 25 to 35 percent. Rock fragments average 35 to 50 percent, mainly gravel or cobbles. Lithology of fragments is volcanic rocks such as rhyolite or metamorphic rocks such as chert.

Table 4. Representative soil features

Parent material	(1) Residuum (2) Colluvium
Surface texture	(1) Very gravelly silt loam (2) Very gravelly loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Very slow to moderate
Depth to restrictive layer	36–183 cm
Soil depth	36–183 cm
Surface fragment cover <=3"	25–40%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	3.05–12.95 cm
Calcium carbonate equivalent (0-101.6cm)	1–60%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	6.1–9
Subsurface fragment volume <=3" (Depth not specified)	21–65%
Subsurface fragment volume >3" (Depth not specified)	0–30%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and has a set of key characteristics that influence a site’s resilience to disturbance and resistance to invasives. Key characteristics include 1) climate (precipitation and temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration and runoff), 4) soils (depth, texture, structure, and organic matter), 5) plant communities (functional groups and productivity), and 6) natural disturbance regime (fire, herbivory, etc.) (Caudle et al. 2013). Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and
regeneration (Chambers et al. 2013).

The site is dominated by deep-rooted cool season, perennial bunchgrasses and long-lived shrubs (50+ years) with high root to shoot ratios. The dominant shrubs usually root to the full depth of the winter-spring soil moisture recharge, which ranges from 1.0 to over 3.0 meters (Dobrowolski et al. 1990). Root length of mature sagebrush plants was measured to a depth of 2 meters in alluvial soils in Utah (Richards and Caldwell 1987). Tap roots of antelope bitterbrush have been documented from 4.5 to 5.4 meters in length (McConnell 1961). 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 within the soil profile (Bates et al. 2006).

Mountain big sagebrush and antelope bitterbrush are generally long-lived; therefore it is unnecessary for new individuals to recruit every year for perpetuation of the stand. Simultaneous low, continuous recruitment and infrequent large recruitment events are the foundation of population maintenance (Noy-Meir 1973). Survival of the seedlings is dependent upon adequate moisture conditions.

Native insect outbreaks are also important drivers of ecosystem dynamics in sagebrush communities. Climate is generally believed to influence the timing of insect outbreaks especially with regard to Aroga moth (Aroga websteri), a sagebrush defoliator. Aroga moth infestations have occurred in the Great Basin in the 1960s, early 1970s, and have been ongoing in Nevada since 2004 (Bentz et al 2008). Thousands of acres of big sagebrush have been impacted, with partial to complete die-off observed in both individual plants and entire stands (Furniss and Barr 1975).

The Great Basin 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 via 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 co-dominant with the shrubs include Idaho fescue and bluebunch wheatgrass. These species generally have somewhat 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. The root systems of short lived perennial grasses such as Sandberg bluegrass and mountain brome penetrate only the upper 40cm of the soil, whereas longer lived perennial bunchgrasses can reach depths up to 160 cm (Spence 1937). General differences in root depth distributions between grasses and shrubs results in resource partitioning in these shrub/grass systems.

South-facing slopes will generally express a higher abundance of bluebunch wheatgrass, while north-facing slopes will contain more Idaho fescue. Production will be higher on sites with deeper soils. Overgrazing by livestock and horses will cause a decrease in deep-rooted perennial bunchgrasses, mainly Idaho fescue and bluebunch wheatgrass. As grass cover declines, the potential for invasion by annual non-native species (such as cheatgrass), singleleaf pinyon (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*) will increase. Continued inappropriate grazing management may result in an increase in Sandberg bluegrass (*Poa secunda*), balsamroot, lupine, sagebrush, and rabbitbrush (*Chrysothamnus viscidiflorus*).
As ecological condition declines, the density of serviceberry increases with bottlebrush squirreltail, bluegrasses and forbs such as wyethia and balsamroot becoming dominant in the understory. Cheatgrass will readily invade this site.

This ecological site has low to high resilience to disturbance and resistance to invasion. Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Two possible stable states have been identified for this site.

Fire Ecology:
Fire return intervals in Utah serviceberry communities range from 2.7 to 25 years. Aboveground parts of Utah serviceberry may be killed or consumed under fire conditions with sufficient flame lengths. Utah serviceberry may be slightly harmed by fire, depending on moisture conditions, but is generally considered to be fire tolerant. Utah serviceberry sprouts from the root crown following fire. Soil moisture is important to aid sprouting.

Mountain big sagebrush is killed by fire (Neuenschwander 1980, Blaisdell et al. 1982), and does not resprout (Blaisdell 1953). Post-fire regeneration occurs from seed and will vary depending on site characteristics, seed source, and fire characteristics. Mountain big sagebrush seedlings can grow rapidly and may reach reproductive maturity within 3 to 5 years (Bunting et al. 1987). Mountain big sagebrush may return to pre-burn density and cover within 15-20 years following fire, but establishment after severe fires may proceed more slowly and can take up to 50 years (Bunting et al. 1987, Ziegenhagen 2003, Miller and Heyerdahl 2008, Ziegenhagen and Miller 2009). The introduction of annual weedy species such as cheatgrass may cause an increase in fire frequency and eventually lead to an annual dominated community. Conversely, without fire, sagebrush will increase and the potential for encroachment by pinyon and juniper also increases. Without fire or changes in management, pinyon and juniper will dominate the site and mountain big sagebrush will be severely reduced. The herbaceous understory will also be reduced; Idaho fescue may remain underneath trees on north facing slopes. The potential for soil erosion increases as the woodland matures and the understory plant community cover declines. Catastrophic wildfire in these tree-controlled sites may lead to an annual weed dominated site.

Antelope bitterbrush is moderately fire tolerant (McConnell and Smith 1977). It regenerates by seed and resprouting (Blaisdell and Mueggler 1956, McArthur et al. 1982), however sprouting ability is highly variable and has been attributed to genetics, plant age, phenology, soil moisture and texture, and fire severity (Blaisdell and Mueggler 1956, Blaisdell et al. 1982, Clark et al. 1982, Cook et al. 1994). Bitterbrush sprouts from a region on the stem approximately 1.5 inches above and below the soil surface; the plant rarely sprouts if the root crown is killed by fire (Blaisdell and Mueggler 1956). Low intensity fires may allow for bitterbrush to sprout; however, community response also depends on soil moisture levels at time of fire (Murray 1983). Lower soil moisture allows more charring of the stem below ground level (Blaisdell and Mueggler 1956), thus sprouting will usually be more successful after a spring fire than after a fire in summer or fall (Murray 1983, Busse et al. 2000, Kerns et al. 2006). If cheatgrass is present, bitterbrush seedling success is much lower. The factor that most limits establishment of bitterbrush seedlings is competition for water resources with cheatgrass, an invasive species (Clements and Young 2002).

Depending on fire severity, rabbitbrush, Utah serviceberry (*Amelanchier utahensis*) and mountain snowberry (*Symphoricarpos orbiculatus*) may increase after fire. Mountain snowberry is also top-killed by fire, but resprouts after fire from rhizomes (Leege and Hickey 1971, Noste and Bushey 1987). Snowberry has been noted to regenerate well and exceed pre-burn biomass in the third season after a fire (Merrill et al. 1982). Douglas' rabbitbrush is top-killed by fire, but sprouts vigorously after fire (Kuntz 1982, Akinsoji 1988). As cheatgrass increases, fire frequencies also increase to between 0.23 and 0.43 times a year; at this rate, even sprouting rabbitbrush will not survive (Whisenant 1990).

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, coupled with seasonality and intensity of the fire factor into individual species' responses. For most forbs and grasses, the growing points 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).

Idaho fescue's 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). Robberecht and Defosse (1995) suggested the latter was more sensitive, however. 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. 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, therefore 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, bluebunch wheatgrass is considered to experience slight damage to fire but is more susceptible in drought years (Young 1983). Most authors classify the plant as undamaged by fire (Kuntz 1982).

Basin wildrye is relatively resistant to fire, particularly dormant season fire, as plants sprout from surviving root crowns and rhizomes (Zschaechner 1985). Miller et al. (2013) reported increased total shoot and reproductive shoot densities in the first year following fire; by year two, however, there was little difference between burned and control treatments.

State and transition model

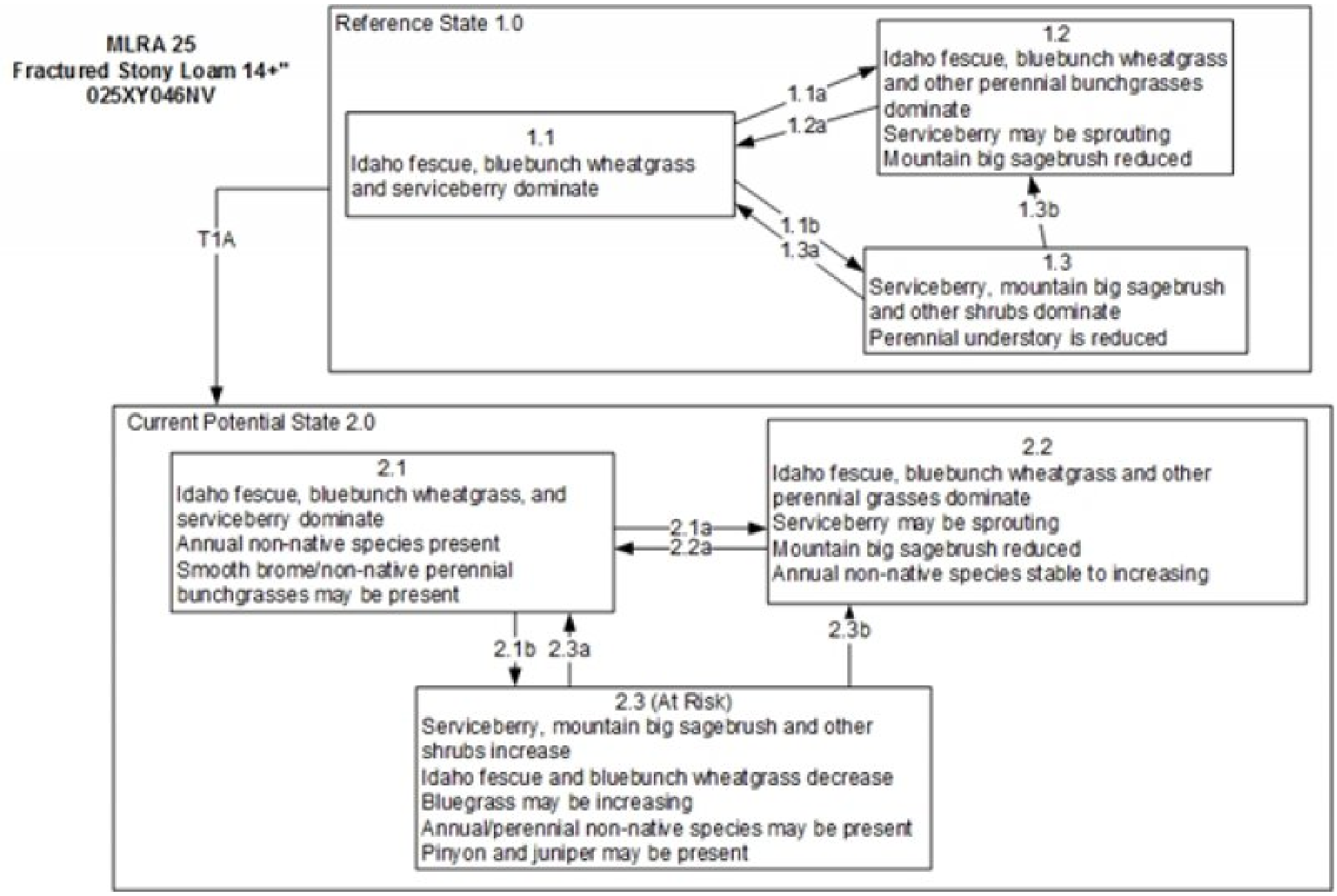

Figure 5. T. Stringham July 2015

MLRA 25
Fractured Stony Loam 14+"
R025XY046NV

Reference State 1.0 Community 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 may also reduce perennial understory.
1.2a: Time and lack of disturbance allows for shrub regeneration.
1.3a: Low severity fire, and/or herbivory, 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 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 such as fire or drought. Inappropriate grazing management may also reduce perennial understory.
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
2.3a: Low severity fire and/or grazing management creates sagebrush/grass mosaic.
2.3b: High severity fire significantly reduces sagebrush cover leading to early mid-seral community.
2.3c: Inappropriate grazing management coupled with fire
2.4a: Time and lack of disturbance and a change in grazing management to facilitate perennial bunchgrass production.

Figure 6. T. Stringham July 2015

State 1
Reference State

The Reference State 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
Serviceberry/perennial bunchgrasses

The reference plant community is dominated by Utah and/or western serviceberry, Idaho fescue and bluebunch wheatgrass. Antelope bitterbrush, snowberry and mountain big sagebrush are other important shrub species associated with this site. Tree-like stands of serviceberry dominate the aspect. Potential vegetative composition is about 30 percent grasses, 10 percent forbs and 60 percent shrubs. Approximate ground cover (basal and crown) is 40 to 55 percent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	605	874	1211
Grass/Grasslike	303	437	605
Forb	101	146	202
Total	**1009**	**1457**	**2018**

Community 1.2
Perennial bunchgrasses

This community phase is characteristic of a post-disturbance, early seral community phase. Idaho fescue, bluebunch wheatgrass and other perennial grasses dominate. Douglas rabbitbrush, mountain snowberry and Utah serviceberry may be resprouting. Big sagebrush is killed by fire, therefore decreasing within the burned community. Depending on fire severity or intensity of Aroga moth infestations, patches of intact sagebrush may remain. Perennial forbs may increase post-fire but will likely return to pre-burn levels within a few years.

Community 1.3
Shrubs

Mountain big 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. Sandberg bluegrass and/or squirreltail will likely increase in the understory and may be the dominant grass on the site.

Pathway 1.1a
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 or a change in management may be more severe and reduce sagebrush cover to trace amounts. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs.

Pathway 1.1b
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 allowing big sagebrush to dominate the site.

Pathway 1.2a
Community 1.2 to 1.1

Time and lack of disturbance will allow the mountain big sagebrush to recover/increase.

Pathway 1.3a
Community 1.3 to 1.1

A low severity fire, Aroga moth or combinations will reduce the sagebrush overstory and create a sagebrush/grass mosaic with sagebrush and perennial bunchgrasses codominant.

Pathway 1.3b
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 will typically be low severity due to low fine fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce sagebrush cover to trace amounts. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs.

State 2
Current Potential State

This state is similar to the Reference State 1.0 with three similar community phases. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant within this State. These non-natives can be highly flammable, and can promote fire where historically fire had been infrequent. 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. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate and adaptations for seed dispersal.

Community 2.1
Perennial bunchgrasses/serviceberry

This community phase is similar to the Reference State Community Phase 1.1, with the presence of non-native species in trace amounts. The plant community is dominated by Idaho fescue, bluebunch wheatgrass and basin wildrye. Serviceberry is the dominant shrub with mountain big sagebrush also common on this site. Smooth brome or other perennial non-native bunchgrasses may be present. Cheatgrass is the most likely species to invade.

Community 2.2
Perennial bunch grasses

This community phase is characteristic of a post-disturbance, early seral community phase where non-native species are present. Idaho fescue, bluebunch wheatgrass and other perennial grasses dominate. Douglas rabbitbrush, mountain snowberry and Utah serviceberry may be resprouting. Depending on fire severity or intensity of Aroga moth infestations, patches of intact sagebrush may remain. Perennial forbs may increase post-fire but will likely return to pre-burn levels within a few years. Annual non-native species are stable or increasing within the community.

Community 2.3
Shrubs dominate (at risk)

Mountain big sagebrush, serviceberry and bitterbrush increase, Idaho fescue and bluebunch wheatgrass decrease. Sandberg bluegrass may be increasing. Smooth brome and other non-native species are stable to increasing. Juniper and pinyon may be present as a result of encroachment from neighboring sites, and lack of disturbance.

Pathway 2.1a
Community 2.1 to 2.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be small and patchy due to low fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce sagebrush cover to trace amounts. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs.

Pathway 2.1b
Community 2.1 to 2.3

Time and lack of disturbance allows for sagebrush to increase and become decadent. Chronic drought will reduce fine fuels and lead to a reduced fire frequency allowing big sagebrush to dominate the site. Inappropriate grazing management will reduce the perennial bunchgrass understory; conversely Sandberg bluegrass may increase in the understory depending on grazing management. Excessive sheep grazing favors Sandberg bluegrass; however, where cattle are the dominant grazers, cheatgrass often increases.

Pathway 2.2a
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 big sagebrush may take many years.

Pathway 2.3a
Community 2.3 to 2.1

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

Pathway 2.3b
Community 2.3 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. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs. Annual non-native species are likely to increase after fire.

Transition T1A
State 1 to 2

Trigger: Introduction of annual non-native species. Slow variable: Over time the annual non-native plants will increase within the community decreasing organic matter inputs from deep-rooted perennial bunchgrasses resulting in reductions in soil water availability for perennial bunchgrasses. 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.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			102–291	
	Idaho fescue	FEID	*Festuca idahoensis*	73–146	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	29–146	–

2	**Secondary Perennial Grasses**			73–291	
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	8–73	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	8–73	–
	mountain brome	BRMA4	*Bromus marginatus*	8–73	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	8–73	–
	melicgrass	MELIC	*Melica*	8–73	–
	bluegrass	POA	*Poa*	8–73	–
	basin wildrye	LECI4	*Leymus cinereus*	8–63	–
Forb					
3	**Perennial**			73–219	
	milkvetch	ASTRA	*Astragalus*	8–44	–
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	8–44	–
	buckwheat	ERIOG	*Eriogonum*	8–44	–
	western stoneseed	LIRU4	*Lithospermum ruderale*	8–44	–
	desertparsley	LOMAT	*Lomatium*	8–44	–
	lupine	LUPIN	*Lupinus*	8–44	–
	phacelia	PHACE	*Phacelia*	8–44	–
	mule-ears	WYAM	*Wyethia amplexicaulis*	8–44	–
	melicgrass	MELIC	*Melica*	10–41	–
Shrub/Vine					
4	**Primary Shrubs**			670–1035	
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	291–364	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	291–364	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	29–117	–
	snowberry	SYMPH	*Symphoricarpos*	29–117	–
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	29–73	–
	mule-ears	WYAM	*Wyethia amplexicaulis*	9–28	–
	desertbroom	BASA2	*Baccharis sarothroides*	10–28	–
	desertparsley	LOMAT	*Lomatium*	9–28	–
	lupine	LUPIN	*Lupinus*	9–27	–
	phacelia	PHACE	*Phacelia*	9–27	–
	buckwheat	ERIOG	*Eriogonum*	9–27	–
	western stoneseed	LIRU4	*Lithospermum ruderale*	9–27	–
	milkvetch	ASTRA	*Astragalus*	9–27	–
5	**Secondary Shrubs**			29–73	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	8–29	–
	chokecherry	PRVI	*Prunus virginiana*	8–29	–

Animal community

Livestock Interpretations:
This site is suited for livestock grazing. Considerations for grazing management include timing, intensity and duration of grazing.

Overgrazing leads to an increase in sagebrush and a decline in understory plants like bluebunch wheatgrass and Idaho fescue. Squirreltail or Sandberg bluegrass will increase temporarily with further degradation. Invasion of annual weedy forbs and cheatgrass could occur with further grazing degradation, leading to a decline in squirreltail and bluegrass and an increase in bare ground. A combination of overgrazing and prolonged drought leads to soil erosion, increased bare ground, and a loss in plant production. Wildlife in sites with cheatgrass present could transition to cheatgrass-dominated communities, and without management, cheatgrass and annual forbs are likely to dominate.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces, leading to increased fire frequency and potentially an annual plant community. Sandberg bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass. 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.

Long-term disturbance response may be influenced by small differences in landscape topography. Concave areas hold a little more moisture and may retain deep-rooted perennial grasses whereas convex areas are slightly less resilient and may have more Sandberg bluegrass present.

Serviceberry branches and leaves are consumed by both domestic livestock and wildlife, particularly in late winter and early spring. Serviceberry can tolerate moderate to heaving browsing when adequate precipitation is received.

Antelope bitterbrush is an important shrub species to domestic livestock (Wood 1995). Antelope bitterbrush is most commonly found on soils which provide minimal restriction to deep root penetration such as coarse textured soil, or finer textured soil with high stone content (Driscoll 1964, Clements and Young 2002). Grazing tolerance of antelope bitterbrush is dependent on site conditions (Garrison 1953).

Idaho fescue provides important forage for many types of domestic livestock. The foliage cures well and is preferred by livestock in the late fall and winter. 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.

Basin wildrye is valuable forage for livestock (Ganskopp et al. 2007) and wildlife, but is intolerant of heavy, repeated, or spring grazing (Krall et al. 1971). Basin wildrye is used often as a winter feed as it not only provides roughage above the snow but provides cover in the early spring months as well (Majerus 1992).

Stocking rates vary over time depending upon season of use, climate variations, site, and previous and current management goals. A safe starting stocking rate is an estimated stocking rate that is fine-tuned by the client by adaptive management through the year and from year to year.

Wildlife Interpretations:
Sheehy and Winward (1981) studied preferences of mule deer and sheep in a controlled experiment: several different varieties of sagebrush (basin big sagebrush, black sagebrush, Bolander silver sagebrush, foothill big sagebrush, low sagebrush, mountain big sagebrush, Wyoming big sagebrush) were brought into a pen and the animals' preferences were measured. Deer showed the most preference for low sagebrush, mountain and foothill sagebrush, and Bolander silver sagebrush and least preference for black sagebrush. Sheep showed highest preference for low sagebrush, medium preference for black sagebrush, and least preference for Wyoming and basin big sagebrush. In a study by Personius et al (1987), mountain big sagebrush was the most preferred taxon by mule deer. Fecal samples from ungulates in Montana showed that bighorn sheep, mule deer, and elk all consumed

mountain big sagebrush in small amounts in winter, while cattle had no sign of sagebrush use. This same study found that juniper (mostly Juniperus horizontalis) constituted half of the diet of mule deer and approximately 1/6 of the late winter diets of elk and bighorn sheep (Kasworm et al. 1984).

Idaho fescue is an important source of forage for pronghorn and deer in ranges of northern Nevada.

Serviceberry berries provide excellent forage for small animals and birds. Birds also utilize the shrub for nesting and cover.

Bitterbrush is critical browse for mule deer, as well as domestic livestock, antelope, and elk (Wood 1995).

Recreational uses

Aesthetic value is derived from the diverse floral and faunal composition and the colorful flowering of wild flowers and shrubs during the spring and early summer. This site offers rewarding opportunities to photographers and for nature study. This site is used for camping and hiking and has potential for upland and big game hunting.

Other products

Utah serviceberry fruits were used by Native Americans and early European explorers in North America for food and medicine.

Other information

Utah serviceberry has been used to revegetate big game winter range and for surface stabilization. It grows slowly from seed and therefore transplanting may be more successful than seeding for revegetation projects.

Inventory data references

Soils and Physiographic features were gathered from NASIS.

Type locality

Location 1: Elko County, NV	
Township/Range/Section	T41N R62E S15
General legal description	Snake Mountains above Tabor Creek, Elko County, Nevada

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Contributors

RK
TK Stringham
P Novak-Echenique

Approval

Kendra Moseley, 4/25/2024

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)	P NOVAK-ECHENIQUE
Contact for lead author	State Rangeland Management Specialist
Date	07/12/2012
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are typically non-existent.

2. **Presence of water flow patterns:** Water flow patterns are typically non-existent. Water flow patterns may rarely be observed on steeper slopes in areas recently subjected to summer convection storms or rapid spring snowmelt.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants should not be considered a "normal" condition.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 15-20% depending on amount of surface rock fragments

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

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

7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) expected to move 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):** Soil stability values should be 3 to 6 on most soil textures found on this site. (To be field tested.)

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically fine granular. Soil surface colors are dark grayish browns and soils are typified by a mollic epipedon. Organic matter of the surface 2 to 4 inches is typically 1.25 to 3 percent dropping off quickly below. Organic matter content can be more or less depending on micro-topography.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial**

distribution on infiltration and runoff: Perennial herbaceous plants (especially deep-rooted bunchgrasses [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.

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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):** Compacted layers are not typical. Platy or massive sub-surface horizons or subsoil argillic horizons are not to be interpreted as compacted.

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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: tall deciduous shrubs

    Sub-dominant: deep-rooted, cool season, perennial bunchgrasses >deep-rooted, cool season, perennial forbs> shallow-rooted, cool season perennial bunchgrasses > fibrous, shallow-rooted, cool season, perennial and annual forbs

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 35% of total woody canopy; some of the mature bunchgrasses (<10%) have dead centers.

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14. **Average percent litter cover (%) and depth (in):** Reference Plant Community: Under shrubs and between plant interspaces (50+%) and litter depth is ±½ inch.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (through mid-June) ± 1000 lbs/ac; Spring moisture significantly affects total 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:** Invaders include cheatgrass, annual mustards, and knapweeds.

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17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years

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