USDA Natural Resources Conservation Service

Ecological site R026XY046NV
GRANITIC SLOPE 12-14 P.Z.

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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): 026X–Carson Basin and Mountains

The area lies within western Nevada and eastern California, with about 69 percent being within Nevada, and 31 percent being within California. Almost all this area is in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. Isolated north-south trending mountain ranges are separated by aggraded desert plains. The mountains are uplifted fault blocks with steep side slopes. Most of the valleys are drained by three major rivers flowing east across this MLRA. A narrow strip along the western border of the area is in the Sierra Nevada Section of the Cascade-Sierra Mountains Province of the Pacific Mountain System. The Sierra Nevada Mountains are primarily a large fault block that has been uplifted with a dominant tilt to the west. This structure leaves an impressive wall of mountains directly west of this area. This helps create a rain shadow affect to MLRA 26. Parts of this eastern face, but mostly just the foothills, mark the western boundary of this area. Elevations range from about 3,806 feet (1,160 meters) on the west shore of Pyramid Lake to 11,653 feet (3,552 meters) on the summit of Mount Patterson in the Sweetwater Mountains.

Valley areas are dominantly composed of Quaternary alluvial deposits with Quaternary playa or alluvial flat deposits often occupying the lowest valley bottoms in the internally drained valleys, and river deposited alluvium being dominant in externally drained valleys. Hills and mountains are dominantly Tertiary andesitic flows, breccias, ash flow tuffs, rhyolite tuffs or granodioritic rocks. Quaternary basalt flows are present in lesser amounts, and Jurassic and Triassic limestone and shale, and Precambrian limestone and dolomite are also present in very limited amounts. Also of limited extent are glacial till deposits along the east flank of the Sierra Nevada Mountains, the result of alpine glaciation.

The average annual precipitation in this area is 5 to 36 inches (125 to 915 millimeters), increasing with elevation. Most of the rainfall occurs as high-intensity, convective storms in spring and autumn. Precipitation is mostly snow in winter. Summers are dry. The average annual temperature is 37 to 54 degrees F (3 to 12 degrees C). The freeze-free period averages 115 days and ranges from 40 to 195 days, decreasing in length with elevation.

The dominant soil orders in this MLRA are Aridisols and Mollisols. The soils in the area dominantly have a mesic soil temperature regime, an aridic or xeric soil moisture regime, and mixed or smectitic mineralogy. They generally are well drained, are clayey or loamy and commonly skeletal, and are very shallow to moderately deep.

This area supports shrub-grass vegetation characterized by big sagebrush. Low sagebrush and Lahontan sagebrush occur on some soils. Antelope bitterbrush, squirreltail, desert needlegrass, Thurber needlegrass, and Indian ricegrass are important associated plants. Green ephedra, Sandberg bluegrass, Anderson peachbrush, and several forb species also are common. Juniper-pinyon woodland is typical on mountain slopes. Jeffrey pine, lodgepole pine, white fir, and manzanita grow on the highest mountain slopes. Shadscale is the typical plant in the drier parts of the area. Sedges, rushes, and moisture-loving grasses grow on the wettest parts of the wet flood plains and terraces. Basin wildrye, alkali sacaton, saltgrass, buffaloberry, black greasewood, and rubber rabbitbrush grow on the drier sites that have a high concentration of salts.

Some of the major wildlife species in this area are mule deer, coyote, beaver, muskrat, jackrabbit, cottontail, raptors, pheasant, chukar, blue grouse, mountain quail, and mourning dove. The species of fish in the area include trout and catfish. The Lahontan cutthroat trout in the Truckee River is a threatened and endangered species.

LRU notes

The Sierra Influenced Ranges LRU is characterized by wooded great basin mountains with climatic and biotic affinities to the Sierra Nevada mountain range. The Sierra Influences Ranges LRU receives greater precipitation that the mountain ranges of central NV. Amount of precipitation varies in relation to the local strength of the Sierra NV rain shadow, characterized by pinyon and juniper trees. The White, Sweetwater, Pine Nut, Wassuk, and Virginia ranges of Nevada support varying amounts of Sierra Nevada flora, such as ponderosa pine. Elevations range from 1610 to 2420 meters and slopes range from 5 to 49 percent, with a median value of 22 percent. Frost free days (FFD) ranges from 92 to 163.

Ecological site concept

The Granitic Slope 12-14 P.Z. site is found on mountain slopes characterized by soils formed in residuum weathered from basalt. The soils are moderately deep and well drained. The dominant vegetation is mountain big sagebrush (Artemisia tridentata ssp. vaseyana), antelope bitterbrush (Purshia tridentata), and western needlegrass (Achnatherum occidentale ssp. occidentale).

Associated sites

R026XY006NV	**GRANITIC LOAM 14+ P.Z.**
R026XY008NV	**GRANITIC FAN 10-12 P.Z.**
R026XY010NV	**LOAMY 10-12 P.Z.**
R026XY026NV	**GRANITIC SLOPE 10-12 P.Z.**
R026XY085NV	**GRANITIC FAN 12-14 P.Z.**

Similar sites

R026XY006NV	**GRANITIC LOAM 14+ P.Z.** More productive site
R026XY010NV	**LOAMY 10-12 P.Z.** ACTH7 dominant grass
R026XY040NV	**GRAVELLY LOAM 14+ P.Z.** PUTR2 dominant shrub; more productive site
R026XY052NV	**SHALLOW LOAM 16+ P.Z.** LEKI2 dominant grass
R026XY084NV	**DEEP LOAMY 14+ P.Z.** ACOCO-POSE codominant grasses
R026XY005NV	**LOAMY 12-14 P.Z.** More productive site
R026XY026NV	**GRANITIC SLOPE 10-12 P.Z.** ACTH7-ACSP12 codominant grasses
R026XY100NV	**STONY SLOPE 10-12 P.Z.** ACTH7-POFE codominant grasses
R026XY082NV	**MOUNTAIN LOAM 16+ P.Z.** ACPI2-KOMA codominant grasses with ACLE9
R026XY018NV	**GRANITIC SOUTH SLOPE 10-12 P.Z.** ACTH7-ACOCO dominant grasses
R026XY079NV	**GRANITIC SOUTH SLOPE 14+ P.Z.** Soils derived from granitic parent materials

R026XY089NV	**SOUTH SLOPE 12-14 P.Z.** LEKI2-ACHNA codominant grasses
R026XY076NV	**MOUNTAIN SHOULDERS 16+ P.Z.** ACLE9 dominant grass; less productive site
R026XY053NV	**LOAMY 16+ P.Z.** BRMA4 codominant grass
R026XY048NV	**LOAMY SLOPE 12-14 P.Z.** PUTR2 codominant shrub; ACTH7 codominant grass; more productive site
R026XY008NV	**GRANITIC FAN 10-12 P.Z.** HECO26-ACHY codominant grasses

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. vaseyana* (2) *Purshia tridentata*
Herbaceous	(1) *Achnatherum thurberianum* (2) *Achnatherum occidentale ssp. occidentale*

Physiographic features

This site occurs on mountain sideslopes.. Slopes range from 15 to 50 percent. Elevations are 5400 to 7700 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope
Elevation	1,646–2,347 m
Slope	15–50%
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is subhumid with cool, dry summers and cold, wet winters. Average annual precipitation is 12 to 14 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is about 85 to 120 days.

Nevada’s climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada’s climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating.

Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from

monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).

Table 3. Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	305-356 mm
Frost-free period (average)	102 days
Freeze-free period (average)	
Precipitation total (average)	330 mm

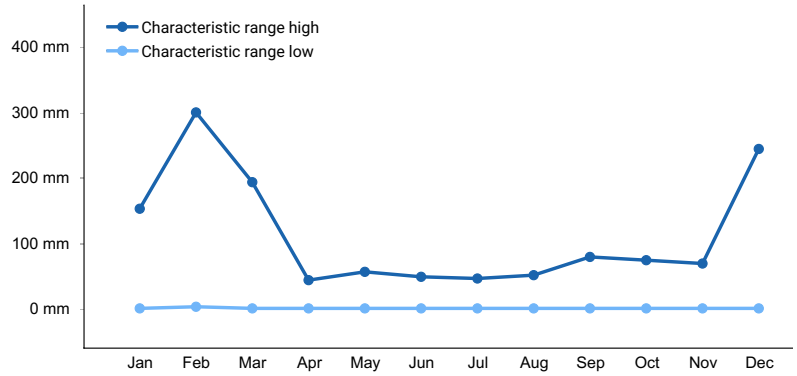


Figure 1. Monthly precipitation range

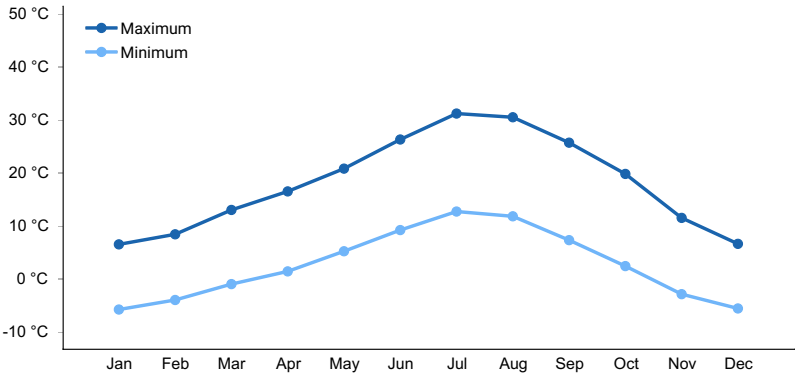


Figure 2. Monthly average minimum and maximum temperature

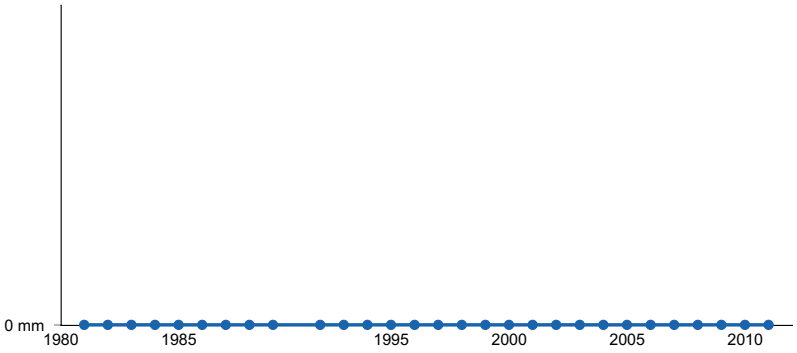


Figure 3. Annual precipitation pattern

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils are formed in residuum weathered from basalt with additions of surface volcanic ash. The soils are moderately deep and well drained. The soil profiles are modified with high volumes of rock fragments. Soil series associated with this site include Eaglerock, Pizona, Roloc, and Trid.

Table 4. Representative soil features

Parent material	(1) Volcanic ash (2) Residuum–basalt
Surface texture	(1) Very gravelly sandy loam (2) Very cobbly, ashy sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate to moderately slow
Soil depth	51–112 cm
Surface fragment cover <=3"	22–32%
Surface fragment cover >3"	3–16%
Available water capacity (0-101.6cm)	6.35–11.18 cm
Calcium carbonate equivalent (0-101.6cm)	0–1%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–1
Soil reaction (1:1 water) (0-101.6cm)	6.1–7.3
Subsurface fragment volume <=3" (Depth not specified)	20–35%
Subsurface fragment volume >3" (Depth not specified)	3–16%

Ecological dynamics

As ecological condition declines, mountain big sagebrush and Douglas' rabbitbrush become dominant. Species most likely to invade this site are annuals.

Fire Ecology:
Presettlement fire return intervals in mountain big sagebrush communities varied from 15 to 25 years. Mountain big sagebrush is highly susceptible to injury from fire. Plants are readily killed in all seasons, even light severity fires. Mountain big sagebrush plants top-killed by fire will not resprout. It is considered a weak sprouter and is often killed by summer or fall fire. Antelope bitterbrush in some areas may sprout after light-severity spring fire. Season of burning and environmental conditions impact antelope bitterbrush ability to survive fire and sprout. High fuel consumptions increase antelope bitterbrush mortality and therefore favors seedling establishment.
Thurber needlegrass is classified as moderately resistant, but depending on season of burn, phenology, and fire severity, this perennial bunchgrass is moderately to severely damaged by fire. Burning has been found to decrease the vegetation and reproductive vigor. Early season burning is more damaging to this needlegrass than late season burning.

State and Transition Model Narrative Group 12:
This is a text description of the states, phases, transitions, and community pathways possible in the State and Transition model for the MLRA 26 Disturbance Response Group 12. Site included in this DRG are: R026XY005NV,

R026XY105NV, R026XY046NV, R026XY006NV, R026XY048NV, R026XY111NV, R026XY040NV, R026XY106NV, R026XY089NV, R026XF057CA, R026XF063CA, and R026XF064CA.

The ecological sites in this DRG have low to moderate resilience to disturbance and resistance to invasion. Resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Long-term disturbance response may be influenced by small differences in landscape topography. North slopes are also more resilient than south slopes because lower soil surface temperatures operate to keep moisture content higher on northern exposures. Six possible alternative stable states have been identified for this DRG.

Reference State 1.0:
The Reference State 1.0 represents the natural range of variability of this site 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 Phase 1.1:
Needlegrasses, basin wildrye, and mountain big sagebrush dominate the site. Bitterbrush may be a significant component. Pinyon and juniper may be present.

Community Phase Pathway 1.1a, from phase 1.1 to 1.2:
Fire would decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses and perennial forbs to dominate the site. Fires would typically be small and patchy due to low fuel loads. 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.

Community Phase Pathway 1.1b, from phase 1.1 to 1.3:
Time and lack of disturbance such as fire or drought allow for an increase in mountain big sagebrush. Excessive herbivory and/or long-term drought may also reduce perennial understory.

Community Phase 1.2:
This community phase is characteristic of a post-disturbance, early- to mid-seral plant community. Needlegrasses, basin wildrye, and perennial grasses and forbs dominate. Mountain big sagebrush is a minor component. Bitterbrush may be sprouting. Forbs may increase.

Community Phase Pathway 1.2a, from phase 1.2 to 1.1:
Time and lack of disturbance allows for sagebrush to reestablish.

Community Phase 1.3:
Mountain big sagebrush increases in the absence of disturbance and becomes dominant. Bitterbrush may be a significant component. Needlegrasses and other perennial grasses are reduced. Squirreltail and/or bluegrasses may increase. Pinyon and juniper may be present.

Community Phase Pathway 1.3a, from phase 1.3 to 1.2:
Fire. A low severity fire creates a sagebrush/grass mosaic, while a high-severity fire reduces sagebrush to trace amounts.

T1A: Transition from Reference State 1.0 to Current Potential State 2.0
Trigger: This transition is caused by the introduction of non-native annual weeds, such as cheatgrass, mustard and Russian thistle (*Salsola tragus*).
Slow variables: Over time the annual non-native plants will increase within the community, decreasing organic matter inputs from deep-rooted perennial bunchgrasses. This results 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.

T1B: Transition from Reference State 1.0 to Shrub State 3.0
Trigger: Inappropriate, long-term grazing of perennial bunchgrasses during the growing season would favor shrubs and initiate transition to Community Phase 3.1.
Slow variables: Long term decrease in deep-rooted perennial grass density.
Threshold: Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and nutrient redistribution and reduces soil organic matter and soil moisture.

T1C: Transition from Reference State 1.0 to Tree State 5.0
Trigger: Time and lack of disturbance or management action allows pinyon or juniper to dominate. This may be coupled with grazing management that favors tree establishment by reducing understory herbaceous competition for site resources.
Feedbacks and ecological processes: Trees increasingly dominate use of soil water, contributing to reductions in soil water availability to grasses and shrubs. Overtime, grasses and shrubs are outcompeted. Reduced herbaceous and shrub production slows soil organic matter inputs and increases soil erodibility through loss of cover and root structure.
Slow variables: Over time the abundance and size of trees will increase.
Threshold: Trees dominate ecological processes and the number of shrub skeletons exceed number of live shrubs.

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 four general community phases. 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. Additionally, the presence of highly flammable, non-native species reduces State resilience because these species can promote fire where historically fire has been infrequent leading to positive feedbacks that further the degradation of the system.

Community Phase 2.1:
Needlegrasses, basin wildrye and mountain big sagebrush dominate the site. Bitterbrush may be a significant component. Pinyon and juniper may be present. Annual non-native species present.

Community Phase Pathway 2.1a, from phase 2.1 to 2.2:
Fire. Low severity fire creates sagebrush/grass mosaic while a high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs. Non-native annual species present.

Community Phase Pathway 2.1b, from phase 2.1 to 2.3:
Time, lack of disturbance, long-term drought, grazing management that favors shrubs or combinations of these would allow the sagebrush overstory to increase and dominate the site, causing a reduction in the perennial bunchgrasses.

Community Phase 2.2:
This community phase is characteristic of a post-disturbance, early-seral plant community. Needlegrasses and other perennial grasses and perennial forbs dominate. Mountain big sagebrush is a minor component. Bitterbrush may be sprouting. Forbs may increase. Annual non-native species are present.

Community Phase Pathway 2.2a, from phase 2.2 to 2.1:
Absence of disturbance over time allows for the sagebrush to recover. This may be combined with grazing management that favors shrubs.

Community Phase Pathway 2.2b, from Phase 2.2 to 2.4:
Higher than normal spring precipitation favors annual non-native species such as cheatgrass. Non-native annual species will increase in production and density throughout the site. Shrub removal or prescribed burning may increase invasive annuals. Perennial bunchgrasses may also increase in production.

Community Phase 2.3:

Mountain big sagebrush is dominant and the perennial understory is reduced. Bitterbrush may be a significant component. Bluegrass may increase. Pinyon and juniper may be present. Annual non-native species are present.

Community Phase Pathway 2.3a, from phase 2.3 to 2.1:
Low severity fire creates sagebrush/grass mosaic. Other disturbances/practices include brush management with minimal soil disturbance leading to a reduction in sagebrush.

Community Phase Pathway 2.3b, from phase 2.3 to 2.2:
High severity fire or brush management with minimal soil disturbance significantly reduces sagebrush and leads to early/mid-seral community.

Community Phase Pathway 2.3c, from phase 2.3 to 2.4:
Fall and spring growing season conditions that favor the germination and production of non-native annual grasses.

Community Phase 2.4:
This community is at risk of crossing to an annual state. Native bunchgrasses and forbs still comprise 50% or more of the understory annual production, however non-native annual grasses are nearly codominant. If this site originated from phase 2.3 there may be significant shrub cover as well. Annual production and abundance of these annuals may increase drastically in years with heavy spring precipitation. This site is susceptible to further degradation from grazing, drought, and fire.

Community Phase Pathway 2.4a, from phase 2.4 to 2.2:
Growing season conditions favoring perennial bunchgrass production and reduced cheatgrass production.

Community Phase Pathway 2.4b, from phase 2.4 to 2.3:
Growing season conditions favoring perennial bunchgrass production and reduced cheatgrass production.

T2A: Transition from Current Potential State 2.0 to Shrub State 3.0:
Trigger: Inappropriate, long-term grazing of perennial bunchgrasses during growing season would favor shrubs and initiate transition to Community Phase 3.1.
Slow variables: Long term declines in deep-rooted perennial grass density.
Threshold: Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and nutrient redistribution and reduces soil organic matter.

T2B: Transition from Current Potential State 2.0 to Annual State 4.0:
Trigger: Fire and/or multiple fires lead to plant community phase 4.1, inappropriate grazing management that favors shrubs in the presence of non-native annual species leads to community phase 4.2.
Slow variables: Increased production and cover of non-native annual species.
Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs truncates, spatially and temporally, nutrient capture and cycling within the community. Increased, continuous fine fuels from annual non-native plants modify the fire regime by changing intensity, size and spatial variability of fires.

T2C: Transition from Current Potential 2.0 to Tree State 5.0:
Trigger: Time and lack of disturbance or management action allows pinyon and juniper to dominate. This may be coupled with grazing management that favors tree establishment by reducing understory herbaceous competition for site resources.
Feedbacks and ecological processes: Trees increasingly dominate use of soil water, contributing to reductions in soil water availability to grasses and shrubs. Overtime, grasses and shrubs are outcompeted. Reduced herbaceous and shrub production slows soil organic matter inputs and increases soil erodibility through loss of cover and root structure.
Slow variables: Over time the abundance and size of trees will increase.
Threshold: Trees dominate ecological processes and number of shrub skeletons exceed the number of live shrubs.

Shrub State 3.0:
This state has two community phases: a mountain big sagebrush dominated phase and a squirreltail-dominated phase. This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Squirreltail will increase with a reduction in deep rooted perennial bunchgrass competition and become the dominant grass. Sagebrush and bitterbrush dominate the overstory. Sagebrush canopy cover is high

and sagebrush 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 Phase 3.1:
This site is at risk of transitioning to another state. Mountain big sagebrush, possibly decadent, dominates the overstory. Antelope bitterbrush may be a significant component. Deep-rooted perennial bunchgrasses are present in only trace amounts and may be absent from the community. Squirreltail may be dominant in the understory. Understory may be sparse, with bare ground increasing. Pinyon and/or juniper may be present as a result of encroachment from neighboring sites and lack of disturbance. Annual non-native species are present to increasing.

Community Phase Pathway 3.1a, from phase 3.1 to 3.2:
Fire reduces or eliminates the overstory of sagebrush. Non-native annual species increase with higher-than-normal spring precipitation.

Community Phase 3.2:
Squirreltail dominates the site. Needlegrasses and other perennial grasses are reduced. Mountain big sagebrush is reduced or missing. Bitterbrush may be sprouting. Annual non-native species are increasing and may be co-dominant in the understory.

Community Phase Pathway 3.2a, from phase 3.2 to 3.1:
Absence of disturbance over time would allow for sagebrush and other shrubs to recover.

T3A: Transition from Shrub State 3.0 to Annual State 4.0:
Trigger: Fire or inappropriate grazing management can eliminate the squirreltail understory and transition to community phase 4.1 or 4.2.
Slow variable: Increased seed production and cover of annual non-native species.
Threshold: Increased, continuous fine fuels modify the fire regime by changing 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 big sagebrush truncate energy capture and impact the nutrient cycling and distribution.

T3B: Transition from Shrub State 3.0 to Tree State 5.0:
Trigger: Time and lack of disturbance allows for maturation of the tree community. This may be coupled with grazing management that favors shrub and tree growth.
Slow variable: Over time, with lack of fire, the abundance and size of trees increase.
Threshold: Trees overtop mountain big sagebrush and out-compete shrubs for water and sunlight. Shrub skeletons exceed live shrubs with minimal recruitment of new cohorts. Bare ground areas are large and connected.

R3A: Restoration from Shrub State 3.0 to Seeded State 6.0:
Brush management and seeding of crested wheatgrass and/or other desired species. Presence of non-native annual species will make this restoration pathway difficult.

Annual State 4.0:
This state has two community phases, both characterized by a dominance of non-native annual grasses and forbs. Shrub cover is present in one phase, while the other is primarily annual grasses. Sagebrush and/or rabbitbrush may dominate the overstory. Annual non-native species dominate the understory. Ecological dynamics are significantly altered in this state. Annual non-native species create a highly combustible fuel bed that shortens the fire return interval. Nutrient cycling is spatially and temporally truncated as annual plants contribute significantly less to deep soil carbon. Because this is a productive site, some deep-rooted perennial grasses may remain, even in the annual state. Without management, it is unlikely these plants will be able to recruit in the presence of dominant annual grasses.

Community Phase 4.1:
Annual non-native plants such as cheatgrass dominate the site. This phase may have seeded species present if resulting from a failed seeding attempt. Needlegrasses, mountain big sagebrush, and other shrubs are only present in trace amounts and may be missing from the community.

Community Phase Pathway 4.1a, from phase 4.1 to phase 4.2:

Time and lack of disturbance allows for shrubs to reestablish. Probability of sagebrush reestablishment is extremely low.

Community Phase 4.2:
Annual non-native species, primarily cheatgrass, dominate the understory. Sprouting shrubs dominate the overstory. Perennial bunchgrasses are a minor component or missing. Seeded species may be present.

Community Phase Pathway 4.2a, from phase 4.2 to 4.1:
Fire kills non-sprouting shrubs and allows annual non-native species to dominate site.

Tree State 5.0:
This state is characterized by a dominance of pinyon and/or juniper in the overstory. It occurs where sagebrush sites exist adjacent to stands of trees. Big sagebrush and perennial bunchgrasses may still be present, but they are no longer controlling site resources. Skeletons of dead sagebrush plants are apparent. Soil moisture, soil nutrients, soil organic matter distribution and nutrient cycling have been spatially and temporally altered.

Community Phase 5.1:
Pinyon and juniper dominate. Trees are actively growing with noticeable leader growth. Mountain big sagebrush is stressed and dying. Needlegrass and other perennial grasses reduced. Annual non-native species are present under tree canopies. Bare ground interspaces are large and connected.

Community Phase Pathway 5.1a, from phase 5.1 to 5.2:
Absence of disturbance over time allows for tree cover and density to further increase and out-compete the herbaceous understory species for sunlight and water.

Community Phase 5.2:
Pinyon and/or juniper dominate the site and tree leader growth is minimal. Annual non-native species may be the dominant understory species and will typically be found under tree canopies. Trace amounts of sagebrush may be present, however dead skeletons will be more numerous than living sagebrush. Bunchgrass may or may not be present. Bare ground areas are large and connected, and soil redistribution is apparent.

Community Phase Pathway 5.2a, from phase 5.2 to 5.1:
Tree thinning treatment (typically for fuels management) removes some tree cover and may allow sagebrush to survive. Without further management this pathway is temporary.

T5A: Transition from Tree State 5.0 to Annual State 4.0:
Trigger: Catastrophic crown fire would reduce or eliminate trees to transition the site to 4.1. Tree removal when annual non-natives such as cheatgrass are present would also transition the site to state 4.0.
Slow variable: Increased seed production and cover of annual non-native species.
Threshold: Increased, continuous fine fuels modify the fire regime by changing 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 nutrient cycling and distribution.

R5A: Restoration from Tree State 5.0 to Shrub State 6.0:
Tree removal with minimum soil disturbance such as hand felling or mastication within community phase 5.1 when native grasses are still present.

R5B: Restoration from Tree State 5.0 to Seeded State 6.0:
Tree removal and seeding of desired species. Tree removal practices that minimize soil disturbance are recommended. Probability of success declines with increased presence of non-native annual species.

Seeded State 6.0:
This state has two community phases: a grass-dominated phase and a shrub dominated phase. This state is characterized by the dominance of seeded introduced wheatgrass species in the understory. Crested wheatgrass is a dominant plant in this phase. Conservation practices such as brush management and prescribed grazing should be used to maintain the perennial bunchgrasses and other desirable species.

Community Phase 6.1:

Seeded wheatgrasses and/or other seeded species dominate the community. Non-native annual species are present. Trace amounts of mountain big sagebrush may be present, especially if seeded.

Community Phase Pathway 6.1a, from phase 6.1 to 6.2:
Time and lack of disturbance allows shrubs to dominate. This process may be accelerated through inappropriate grazing management.

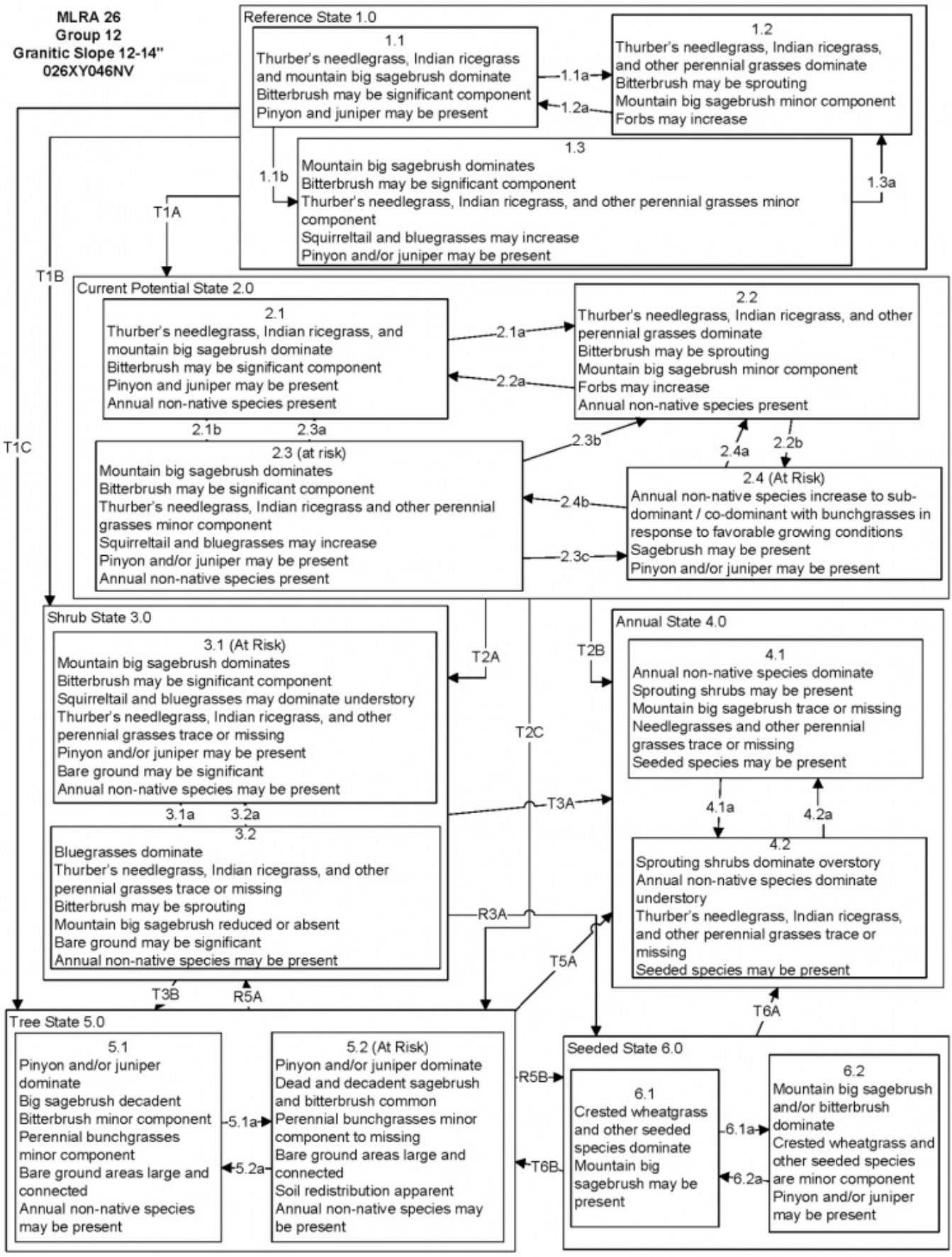
Community Phase 6.2:
Mountain big sagebrush and/or bitterbrush increases and dominates the overstory. Seeded wheatgrass species are a minor component. Annual non-native species may be present in trace amounts. Pinyon and/or juniper may be present.

Community Phase Pathway 6.2a, from phase 6.2 to 6.1:
Fire, brush management and/or Aroga moth infestation reduces sagebrush overstory and allows for seeded wheatgrasses or other seeded grasses to increase.

T6A: Transition from Seeded State 6.0 to Annual State 4.0:
Trigger: Catastrophic fire.
Slow variables: Increased production and cover of non-native annual species.
Threshold: Increased continuous fine fuels modify the fire regime by changing 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 spatially and temporally, thus impacting nutrient cycling and distribution.

T6B: Transition from Seeded State 6.0 to Tree State 5.0:
Trigger: Time and lack of disturbance or management action allows for pinyon and/or juniper to dominate. This may be coupled with grazing management that favors tree establishment by reducing understory herbaceous competition for site resources.
Slow variables: Over time, the abundance and size of trees will increase.
Threshold: Trees dominate ecological processes and number of shrub skeletons exceed number of live shrubs.

State and transition model


MLRA 26
Group 12
Granitic Slope 12-14"
026XY046NV
Reference State 1.0
1.1
Thurber's needlegrass, Indian ricegrass and mountain big sagebrush dominate
Bitterbrush may be significant component
Pinyon and juniper may be present
1.1a
1.2a
1.2
Thurber's needlegrass, Indian ricegrass, and other perennial grasses dominate
Bitterbrush may be sprouting
Mountain big sagebrush minor component
Forbs may increase
1.3
1.1b
Mountain big sagebrush dominates
Bitterbrush may be significant component
Thurber's needlegrass, Indian ricegrass, and other perennial grasses minor component
Squirreltail and bluegrasses may increase
Pinyon and/or juniper may be present
1.3a
T1A
T1B
T1C
Current Potential State 2.0
2.1
Thurber's needlegrass, Indian ricegrass, and mountain big sagebrush dominate
Bitterbrush may be significant component
Pinyon and juniper may be present
Annual non-native species present
2.1a
2.2a
2.2
Thurber's needlegrass, Indian ricegrass, and other perennial grasses dominate
Bitterbrush may be sprouting
Mountain big sagebrush minor component
Forbs may increase
Annual non-native species present
2.1b
2.3a
2.3b
2.4a
2.2b
2.3 (at risk)
Mountain big sagebrush dominates
Bitterbrush may be significant component
Thurber's needlegrass, Indian ricegrass and other perennial grasses minor component
Squirreltail and bluegrasses may increase
Pinyon and/or juniper may be present
Annual non-native species present
2.4b
2.3c
2.4 (At Risk)
Annual non-native species increase to sub-dominant / co-dominant with bunchgrasses in response to favorable growing conditions
Sagebrush may be present
Pinyon and/or juniper may be present
Shrub State 3.0
3.1 (At Risk)
Mountain big sagebrush dominates
Bitterbrush may be significant component
Squirreltail and bluegrasses may dominate understory
Thurber's needlegrass, Indian ricegrass, and other perennial grasses trace or missing
Pinyon and/or juniper may be present
Bare ground may be significant
Annual non-native species may be present
3.1a
3.2a
3.2
Bluegrasses dominate
Thurber's needlegrass, Indian ricegrass, and other perennial grasses trace or missing
Bitterbrush may be sprouting
Mountain big sagebrush reduced or absent
Bare ground may be significant
Annual non-native species may be present
T2A
T2B
T2C
T3A
R3A
T5A
T3B
R5A
Annual State 4.0
4.1
Annual non-native species dominate
Sprouting shrubs may be present
Mountain big sagebrush trace or missing
Needlegrasses and other perennial grasses trace or missing
Seeded species may be present
4.1a
4.2a
4.2
Sprouting shrubs dominate overstory
Annual non-native species dominate understory
Thurber's needlegrass, Indian ricegrass, and other perennial grasses trace or missing
Seeded species may be present
T6A
Tree State 5.0
5.1
Pinyon and/or juniper dominate
Big sagebrush decadent
Bitterbrush minor component
Perennial bunchgrasses minor component
Bare ground areas large and connected
Annual non-native species may be present
5.1a
5.2a
5.2 (At Risk)
Pinyon and/or juniper dominate
Dead and decadent sagebrush and bitterbrush common
Perennial bunchgrasses minor component to missing
Bare ground areas large and connected
Soil redistribution apparent
Annual non-native species may be present
R5B
T6B
Seeded State 6.0
6.1
Crested wheatgrass and other seeded species dominate
Mountain big sagebrush may be present
6.1a
6.2a
6.2
Mountain big sagebrush and/or bitterbrush dominate
Crested wheatgrass and other seeded species are minor component
Pinyon and/or juniper may be present

MLRA 26
Group 12
Granitic Slope 12-14"
026XY046NV
KEY

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. 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.

Transition T1A: Introduction of non-native annual species.
Transition T1B: Inappropriate grazing management favoring shrub dominance (to 3.1).
Transition T1C: Time without disturbance such as fire allows trees to become dominant. May be coupled with grazing management that favors shrub and tree dominance.

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.
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
2.2b: Shrub removal treatment or prescribed burning in the presence of annual grass species coupled with heavy spring precipitation.
2.3a: Low severity fire creates sagebrush/grass mosaic. Brush management with minimal soil disturbance reduces sagebrush.
2.3b: High severity fire or brush management with minimal soil disturbance significantly reduces sagebrush and leads to early/mid-seral community.
2.3c: Fall and spring growing season conditions that favors the germination and production of non-native annual grasses.
2.4a: Growing season conditions favoring perennial bunchgrass production and reduced cheatgrass production.
2.4b: Growing season conditions favoring perennial bunchgrass production and reduced cheatgrass production.

Transition T2A: Inappropriate grazing management (3.1), or high severity fire (3.2).
Transition T2B: Fire or brush management causing severe soil disturbance.
Transition T2C: Time without disturbance such as fire allows trees to become dominant. May be coupled with grazing management that favors shrub and tree dominance.

Shrub State 3.0 Community Phase Pathways.
3.1a: Low severity fire, non-native annual species increase with higher than normal spring precipitation.
3.2a: Time and lack of disturbance.

Transition T3A: Catastrophic fire and/or treatments that disturb the existing plant community.
Transition T3B: Time and lack of disturbance allows maturation of the tree community.

Restoration R3A: Brush management combined with seeding of desired species.

Annual State 4.0 Community Phase Pathways.
4.1a: Time and lack of disturbance. Big sagebrush is unlikely to reestablish and may take many years.
4.2a: Fire.

Tree State 5.0 Community Phase Pathways.
5.1a: Time and lack of disturbance allows for maturation of tree community.
5.2a: Tree thinning treatment (typically for fuels management).

Transition T5A: Catastrophic fire.

Restoration R5A: Tree removal allows for shrub dominance.
Restoration R5B: Tree management coupled with seeding of desired species.

Seeded State 6.0 Community Phase Pathways.
6.1a: Time and lack of disturbance.
6.2a: Fire and/or brush management.

Transition T6A: Fire and/or treatments that disturb the existing plant community, more likely from 6.2.
Transition T6B: Time and lack of disturbance allows maturation of the tree community (from 6.2).

State 1
Reference Plant Community

Community 1.1

Reference Plant Community

The reference plant community is dominated by Thurber's needlegrass and/or western needlegrass, mountain big sagebrush and antelope bitterbrush. Potential vegetative composition is about 50% grasses, 5% forbs and 45% shrubs. Approximate ground cover (basal and crown) is 25 to 35 percent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	280	392	504
Shrub/Vine	252	353	454
Forb	28	39	50
Total	**560**	**784**	**1008**

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**			267–455	
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	118–177	–
	western needlegrass	ACOCO	*Achnatherum occidentale ssp. occidentale*	118–176	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	16–63	–
	bluegrass	POA	*Poa*	16–39	–
2	**Secondary Perennial Grasses**			39–118	
		ACBL	*Achnatherum ×bloomeri*	4–24	–
	pine needlegrass	ACPI2	*Achnatherum pinetorum*	4–24	–
	squirreltail	ELEL5	*Elymus elymoides*	4–24	–
	basin wildrye	LECI4	*Leymus cinereus*	4–24	–
	rock melicgrass	MEST	*Melica stricta*	4–24	–
Forb					
3	**Perennial**			39–118	
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	4–24	–
Shrub/Vine					
4	**Primary Shrubs**			157–314	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	118–196	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	39–118	–
5	**Secondary Shrubs**			16–63	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	8–16	–
	mormon tea	EPVI	*Ephedra viridis*	8–16	–
	desert peach	PRAN2	*Prunus andersonii*	8–16	–
	desert gooseberry	RIVE	*Ribes velutinum*	8–16	–
	spineless horsebrush	TECA2	*Tetradymia canescens*	8–16	–

Animal community

Livestock Interpretations:
This site is suited for livestock grazing. Grazing management should be keyed to Thurber's and western needlegrass production. Mountain big sagebrush is eaten by domestic livestock but has long been considered to be of low palatability, and a competitor to more desirable species. Antelope bitterbrush is important browse for cattle. Cattle prefer antelope bitterbrush from mid-May through June and again in September and October. Domestic livestock and mule deer may compete for antelope bitterbrush in late summer, fall, and/or winter.

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:
Mountain big sagebrush is highly preferred and nutritious winter forage for mule deer. Antelope bitterbrush is extensively used by pronghorn antelope and mule deer. Mule deer use of antelope bitterbrush peaks in September, when antelope bitterbrush may compose 91 percent of the diet. Winter use is greatest during periods of deep snow. Antelope bitterbrush seed is a large part of the diets of rodents, especially deer mice and kangaroo rats. Thurber's and western needlegrass are other important forage species for several wildlife species.

Hydrological functions

Runoff is high to very high. Permeability is moderate to moderately slow.

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

Native peoples used big sagebrush leaves and branches for medicinal teas, and the leaves as a fumigant. Bark was woven into mats, bags and clothing.

Other information

Antelope bitterbrush has been used extensively in land reclamation. Antelope bitterbrush enhances succession by retaining soil and depositing organic material and in some habitats and with some ecotypes, by fixing nitrogen.

Type locality

Location 1: Washoe County, NV	
Township/Range/Section	T23N R19E S7
General legal description	Westside of Bedell Flat, approximately 2.5 miles NNW of Granite Peak, Sand Hills Range, Washoe County, Nevada. This site also occurs in Carson City, Douglas, Lyon, Mineral and Storey Counties, Nevada.

Other references

Fire Effects Information System (Online; http://www.fs.fed.us/database/feis/plants/).

USDA-NRCS Plants Database (Online; http://www.plants.usda.gov).

Contributors

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Approval

Kendra Moseley, 4/10/2024

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)	Patti Novak-Echenique
Contact for lead author	State Rangeland Management Specialist
Date	11/08/2011
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 none to 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 10-20% 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.)

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

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Reference Plant Community: Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., needlegrasses) 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 none. Subangular blocky structure or subsoil argillic horizons are not to be interpreted as compaction.

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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: Deep-rooted, cool season, perennial bunchgrasses > tall shrubs (big sagebrush & antelope bitterbrush)

    Sub-dominant: associated shrubs > deep-rooted, cool season, perennial forbs >> shallow-rooted, cool season, perennial grasses > 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 may be common with standing dead shrub canopy material as much as 25% 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):** Between plant interspaces and under canopy as much as 50% and litter depth is < ¼ 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) ± 700 lbs/ac; =500 lbs/ac on unfavorable and = 900 lbs/ac on exceptional years. 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: Potential invaders on this site 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. Reduced growth and reproduction occur during extended or extreme drought periods.
