USDA Natural Resources
Conservation Service

Ecological site R026XY018NV
GRANITIC SOUTH SLOPE 10-12 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 South Slope 10-12 P.Z. site is found on steep slopes of hills and mountains. The elevations are between 4,700 and 6,500 feet. The soils are shallow to broken bedrock and the surface soil textures are cobbly sand and gravelly coarse sand. The dominant vegetation is bitterbrush (Purshia tridentata), Wyoming sagebrush (Artemisia tridentata ssp. wyomingensis), and desert needlegrass (Achnatherum speciousum).

Associated sites

R026XY026NV	**GRANITIC SLOPE 10-12 P.Z.**
R026XY046NV	**GRANITIC SLOPE 12-14 P.Z.**

Similar sites

R026XY029NV	**ERODED SLOPE 10-12 P.Z.** Less productive site
R026XY026NV	**GRANITIC SLOPE 10-12 P.Z.** ACTH7 dominant grass
R026XY011NV	**SOUTH SLOPE 8-12 P.Z.** SADOC2 important shrub; soils not of volcanic origin
R026XY048NV	**LOAMY SLOPE 12-14 P.Z.** ACTH7 (and/or ACOCO) dominant grass; soils not of granitic origin
R026XY022NV	**STONY SLOPE 8-10 P.Z.** less productive site; soils derived from volcanic rock
R026XY008NV	**GRANITIC FAN 10-12 P.Z.** ARVA2 codominant shrub; HECOC8-ACHY codominant grasses; more productive site
R026XY015NV	**SHALLOW LOAM 10-12 P.Z.** ACTH7 dominant grass; soils not of granitic origin

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Purshia tridentata* (2) *Artemisia tridentata ssp. wyomingensis*
Herbaceous	(1) *Achnatherum speciosum*

Physiographic features

This site occurs on foothills and lower mountains. Although this site may be found on all aspects, it is most common on southerly-facing sideslopes. Slopes range from 4 to 75 percent, but slope gradients of 30 to 50 percent are most typical. Elevations are 4700 to 6500 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Hill
Elevation	4,700–6,500 ft
Slope	30–50%
Aspect	SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Elevation	Not specified
Slope	4–75%

Climatic features

The climate associated with this site is arid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 10 to 12 inches. Mean annual air temperature is 44 to 59 degrees F. The average growing season is about 60 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 4. Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	10-12 in
Frost-free period (average)	90 days
Freeze-free period (average)	
Precipitation total (average)	11 in

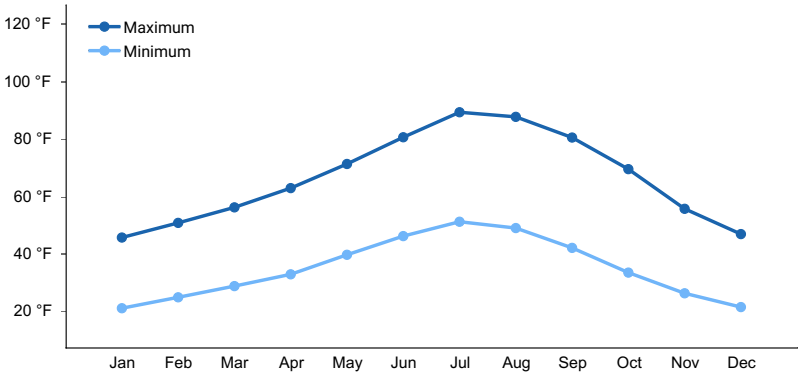


Figure 1. Monthly average minimum and maximum temperature

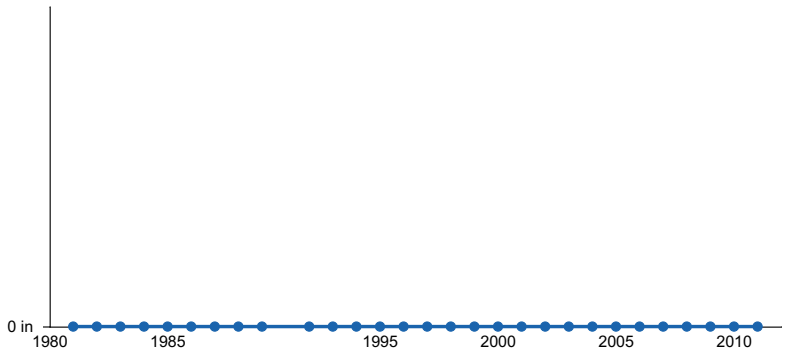


Figure 2. Annual precipitation pattern

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site are shallow to weathered granitic bedrock. These soils are well drained to somewhat excessively drained and available water capacity is very low. A shallow rooting depth and excessive drainage are the most limiting factors in the development of this site. The soil series associated with this site include: Berit, Glenbrook, and Shoken.

Table 5. Representative soil features

Parent material	(1) Residuum–granite
Surface texture	(1) Gravelly coarse sand (2) Cobbly sand
Family particle size	(1) Sandy
Drainage class	Somewhat excessively drained
Permeability class	Moderately slow to rapid
Soil depth	10–20 in
Surface fragment cover <=3"	15–17%
Surface fragment cover >3"	2–13%
Available water capacity (0-40in)	0.7–1 in
Calcium carbonate equivalent (0-40in)	0%

Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.1–7.3
Subsurface fragment volume <=3" (Depth not specified)	16–17%
Subsurface fragment volume >3" (Depth not specified)	3–8%

Ecological dynamics

Where management results in abusive livestock use, Wyoming big sagebrush, Douglas' rabbitbrush and Anderson's peachbrush increase. Filaree and cheatgrass are the species most likely to invade this site.

Fire Ecology:
Presettlement fire return intervals for antelope bitterbrush communities range from 15 to 25 years. Season of burning and environmental conditions impact antelope bitterbrush ability to survive fire and sprout. 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. High fuel consumptions increase antelope bitterbrush mortality and therefore favors seedling establishment. Wyoming big sagebrush establishes after fire from a seedbank; from seed produced by remnant plants that escaped fire; and from plants adjacent to the burn that seed in. Green ephedra generally sprouts vigorously from the roots or woody root crown after fire and rapidly produces aboveground biomass from surviving meristematic tissue. Perennial needlegrasses tend to be among the least fire resistant bunchgrass due to the densely tufted stems. Desert needlegrass has persistent dead leaf bases, which make it susceptible to burning. Fire removes the accumulation; a rapid, cool fire will not burn deep into the root crown. Thurber’s 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.

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

Community Phase1.1: Thurber’s needlegrass is codominant with big sagebrush. Sagebrush may be a mix of Wyoming big sagebrush, basin big sagebrush, and mountain big sagebrush. Pinyon and/or juniper may be present.

Community PhasePathway1.1a, from Phase 1.1 to 1.2: Low severity fire creates a sagebrush/grass mosaic. High severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs. In reference condition, fires would typically be small and patchy due to low fuel loads. 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.

Community Phase Pathway 1.1b, from Phase 1.1 to 1.3: Time and lack of disturbance such as fire or drought allows shrubs to become dominant and may reduce grass production. Excessive herbivory and/or long-term drought may also reduce the perennial understory.

Community Phase 1.2: This community phase is characteristic of a post-disturbance, early to mid-seral community. Bitterbrush, ephedra, and spiny hopsage may be sprouting and may become the dominant shrubs in this phase. Big sagebrush is killed by fire and is reduced within the burned community but may be present in unburned patches. Thurber’s needlegrass can experience high mortality from fire and may be reduced in the community for several

years. With low fire severity, Thurber's needlegrass may dominate the site post-fire.

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

Community Phase 1.3: Big sagebrush increases in the absence of disturbance. Thurber's needlegrass and other perennial grasses reduced. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from herbivory. Bluegrass (Poa) species will likely increase in the understory and may be the dominant grass on the site. Pinyon and/or juniper may be present but constitute less than 2% of production on the site.

Community Phase Pathway 1.3a, from Phase 1.3 to 1.2: Fire would decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires would 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.

Community Phase Pathway 1.3b, from Phase 1.3 to 1.1: Aroga moth infestation and/or release from growing season herbivory may reduce sagebrush dominance and allow recovery of the perennial bunchgrass understory.

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, mustards 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 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.

Current Potential State 2.0: This state is similar to the Reference State 1.0. Ecological function has not changed; however the resiliency of the state has been reduced by the presence of invasive weeds. This state has the same three general community phases. 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: Thurber's needlegrass is codominant with big sagebrush. Sagebrush may be a mix of Wyoming big sagebrush, basin big sagebrush, and mountain big sagebrush. Pinyon and/or juniper may be present. Non-native annual species are present in minor amounts.

Community Phase Pathway 2.1a, from Phase 2.1 to 2.2: Fire would decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires would 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. Annual non-native species generally respond well after fire and may be stable or increasing within the community.

Community Phase Pathway 2.1b, from Phase 2.1 to 2.3: Time, 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. However, Sandberg bluegrass and/or squirreltail may increase in the understory depending on the grazing management. Heavy spring grazing will favor an increase in sagebrush. Annual non-native species may be stable or increasing within the understory.

Community Phase 2.2: This community phase is characteristic of a post-disturbance, early to mid-seral community. Bitterbrush, ephedra, and spiny hopsage may be sprouting and may become the dominant shrubs in this phase. Big sagebrush is killed by fire and is reduced within the burned community but may be present in unburned patches.

Thurber’s needlegrass can experience high mortality from fire and may be reduced in the community for several years. With low fire severity, Thurber’s needlegrass may dominate the site post-fire. Annual non-native species generally respond well after fire and may be stable or increasing within the community.

Community Phase Pathway 2.2a, from Phase 2.2 to 2.1: Absence of disturbance over time allows for the sagebrush to recover 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. Perennial bunchgrasses may also increase in production.

Community Phase 2.3(At Risk): Big sagebrush increases in the absence of disturbance. Thurber’s needlegrass and other perennial grasses reduced. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from herbivory. Bluegrass (Poa) species will likely increase in the understory and may be the dominant grass on the site. Pinyon and/or juniper may be increasing. Annual non-native species are present. This phase may be at risk of transitioning to the Shrub State 3.0 or the Tree State 5.0.

Community Phase Pathway 2.3a, from Phase 2.3 to 2.2: Fire would decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires would 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.

Community Phase Pathway 2.3b, from Phase 2.3 to 2.1: Low severity fire or Aroga moth infestation creates sagebrush/grass mosaic. Other disturbances/practices include brush management with minimal soil disturbance; late-fall/winter grazing causing mechanical damage to sagebrush.

Community Phase Pathway 2.3c, from Phase 2.3 to 2.4: Fall, winter, and spring precipitation and temperatures mediate the ability for annual grasses and perennial grasses to germinate and/or survive. Higher than normal spring precipitation creates high annual production of annual grasses (Bradley et al. 2016). Non-native annual species increase in production and density throughout the site. Perennial bunchgrasses may also increase in production.

Community Phase 2.4 (At Risk): This community is at risk of crossing into an annual state. Native bunchgrasses dominate; however, annual non-native species such as cheatgrass may be sub or co-dominant in the understory. Annual production and abundance of these annuals may increase drastically in years with heavy spring precipitation. Seeded species may be present. Sagebrush may be present if coming from phase 2.3. This site is susceptible to further degradation from grazing, drought, and fire. Pinyon and/or juniper may be present.

Community Phase Pathway 2.4a, from phase 2.4 to 2.3: Rainfall patterns favoring perennial bunchgrasses. Less than normal spring precipitation followed by higher than normal summer precipitation will increase perennial bunchgrass production.

Community Phase Pathway 2.4b, from phase 2.4 to 2.2: Fall, winter, and spring precipitation and temperatures mediate the ability for annual grasses and perennial grasses to germinate and/or survive. Depending on temperatures and precipitation in winter and spring, annual grass production may be reduced in favor of perennial bunchgrasses.

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. Fire would cause a transition to Community Phase 3.2.Slow variables: Long term decrease in deep-rooted perennial grass density resulting in a decrease in organic matter inputs and subsequent soil water decline. Threshold: Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and redistribution and reduces soil organic matter.

T2B: Transition from Current Potential State 2.0 to Annual State 4.0: Trigger: Fire or a failed range seeding leads 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: Cheatgrass or other non-native annuals dominate understory.

T2C: Transition from Current Potential State 2.0 to Tree State 5.0: Trigger: Lack of fire allows for trees to dominate site; may be coupled with inappropriate grazing management that reduces fine fuels. Slow variables: Increased establishment and cover of juniper/pinyon trees, reduction in organic matter inputs. Threshold: Trees overtop Wyoming big sagebrush and out-compete shrubs for water and sunlight. Shrub skeletons exceed live shrubs with minimal recruitment of new cohorts.

Shrub State 3.0: This state has two community phases; a big sagebrush dominated phase and a sprouting shrub dominated phase. This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Sandberg bluegrass will increase with a reduction in deep rooted perennial bunchgrass competition and become the dominant grass. Sagebrush dominates the overstory and sprouting shrubs may be a significant component. 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 Sandberg 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(At Risk): Big sagebrush dominates overstory. Thurber’s needlegrass and other perennial grasses are reduced, with bluegrass species dominant in the understory. Pinyon and juniper may be present. Annual non-native species may be present. Bare ground may be significant. Seeded species may be present. Pinyon and/or juniper may be present or increasing.

Community Phase Pathway 3.1a, from Phase 3.1 to 3.2: Fire would decrease or eliminate the overstory of sagebrush. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to bluegrasses, forbs and sprouting shrubs. Heavy fall grazing causing mechanical damage to shrubs, and/or brush treatments with minimal soil disturbance, would greatly reduce the overstory shrubs and allow for bluegrasses to dominate the site.

Community Phase 3.2(At Risk): Bluegrass species dominate the understory. Sprouting shrubs may be present. Perennial grasses trace or missing. Annual non-native species dominate understory. Bare ground may be significant. Seeded species may be present.

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 Sandberg bluegrass 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 sagebrush truncate energy capture and impact the nutrient cycling and distribution.

T3B: Transition from Shrub State 3.0 to Tree State 5.0: Trigger: Lack of fire allows for trees to dominate site; may be coupled with inappropriate grazing management that reduces fine fuels. Slow variables: Increased establishment and cover of juniper/pinyon trees, reduction in organic matter inputs. Threshold: Trees overtop Wyoming big sagebrush and out-compete shrubs for water and sunlight. Shrub skeletons exceed live shrubs with minimal recruitment of new cohorts.

R3A: Restoration from Shrub State 3.0 to Seeded State 6.0: Brush management, herbicide, and seeding of crested wheatgrass (*Agropyron cristatum*) and/or other desired species.

Annual State 4.0: This state has two community phases; one dominated by annual non-native species and the other is a shrub dominated state. This state is characterized by the dominance of annual non-native species such as cheatgrass in the understory. Sagebrush and/or sprouting shrubs may dominate the overstory.

Community Phase 4.1: Annual non-native plants such as cheatgrass dominate the site. Perennial plants are a minor component or missing from the site. This phase may have seeded species present if resulting from a failed seeding

attempt.

Community Phase Pathway 4.1a, from Phase 4.1 to 4.2: Time and lack of disturbance allows for shrubs to reestablish. Sprouting shrubs such as ephedra, desert peach and rabbitbrush will be the first to reappear after fire. Probability of sagebrush establishment is extremely low.

Community Phase 4.2: Annual non-native species dominate understory. Sagebrush or sprouting shrubs dominate the overstory. Perennial bunchgrasses are a minor component. This phase may have seeded species present if resulting from a failed seeding attempt.

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

R4A: Restoration from Annual State 4.0 to Seeded State 6.0: Application of herbicide and seeding of desired species. Probability of success is best immediately following fire.

Tree State5.0: This state has two community phases that are characterized by the dominance of Utah juniper and/or singleleaf pinyon in the overstory. Wyoming big sagebrush and perennial bunchgrasses may still be present, but they are no longer controlling site resources. Soil moisture, soil nutrients, soil organic matter distribution and nutrient cycling have been spatially and temporally altered.

Community Phase 5.1: Utah juniper and/or singleleaf pinyon dominate overstory. Big sagebrush is subdominant and may be decadent. Thurber’s needlegrass and other perennial grasses are reduced. Annual non-native may be present. Bare ground areas 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.

Community Phase 5.2 (At Risk): Utah juniper and/or singleleaf pinyon dominates the site and tree leader growth is minimal; annual non-native species may be the dominant understory species and will typically be found under the tree canopies. Trace amounts of sagebrush may be present, however dead shrub skeletons will be more numerous than living sagebrush. Bunchgrasses may or may not be present. Bottlebrush squirreltail or mat forming forbs may be present in trace amounts. Bare ground interspaces are large and connected. Soil redistribution is evident.

Community Phase Pathway 5.2a, from phase 5.2 to 5.1: Manual or mechanical thinning of trees allows understory regrowth due to less competition for resources. This treatment is typically done for fuel management.

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 3.0: Tree removal with no seeding. Treatments done in phase 5.1 will be more successful. Tree removal practices that minimize soil disturbance are recommended. Probability of success declines with increased presence of nonnative annual species.

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 nonnative annual species.

Seeded State 6.0: This state has three community phases; a grass-dominated phase, and grass-shrub dominated phase, and a shrub dominated phase. This state is characterized by the dominance of seeded introduced wheatgrass species in the understory. Forage kochia (*Bassia prostrata*) and other desired seeded species including Wyoming big sagebrush, native and non-native forbs may be present.

Community Phase 6.1: Seeded wheatgrass and/or other seeded species dominate the community. Non-native

annual species are present. Trace amounts of 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 allow shrubs to increase. Pathway may be coupled with inappropriate grazing management.

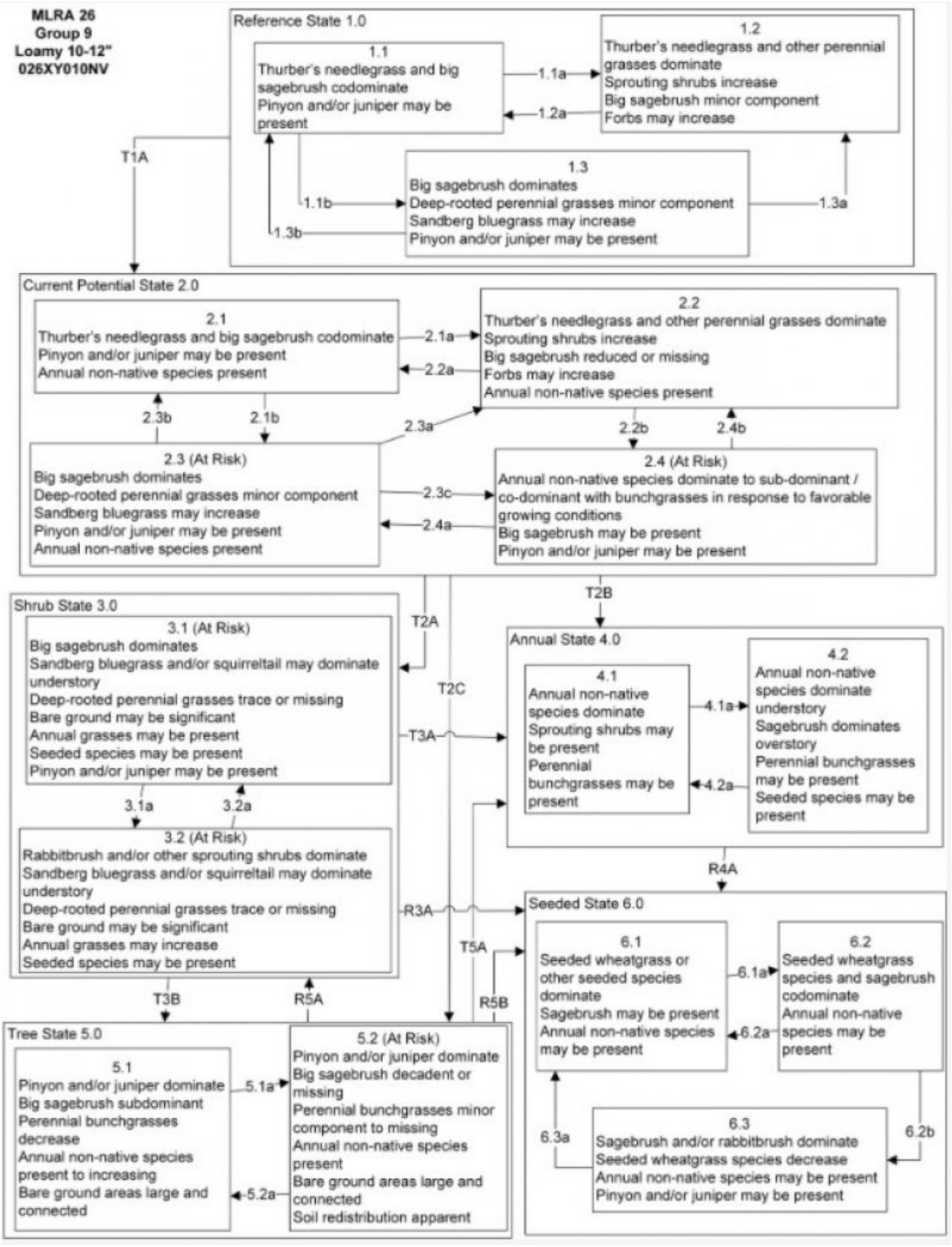
Community Phase 6.2: Big sagebrush increases and may be codominant with seeded wheatgrass species. Annual non-native species may be present in trace amounts.
Community Phase Pathway 6.2a, from Phase 6.2 to 6.1: Fire and/or brush management allows seeded grasses to return to dominance.

Community Phase Pathway 6.2b, from Phase 6.2 to 6.3: Inappropriate grazing reduces bunchgrasses and increases density of sagebrush. This is usually a slow transition.

Community Phase 6.3: Sagebrush and/or sprouting shrubs dominate. Seeded wheatgrass species decrease. Annual non-native species may be present. Pinyon and /or juniper may be present.

Community Phase Pathway 6.3a, from Phase 6.3to 6.1: Fire or brush management with minimal soil disturbance.

State and transition model


MLRA 26
Group 9
Loamy 10-12"
026XY010NV
Reference State 1.0
1.1
Thurber's needlegrass and big sagebrush codominate
Pinyon and/or juniper may be present
1.1a
1.2a
1.2
Thurber's needlegrass and other perennial grasses dominate
Sprouting shrubs increase
Big sagebrush minor component
Forbs may increase
T1A
1.1b
1.3b
1.3
Big sagebrush dominates
Deep-rooted perennial grasses minor component
Sandberg bluegrass may increase
Pinyon and/or juniper may be present
1.3a
Current Potential State 2.0
2.1
Thurber's needlegrass and big sagebrush codominate
Pinyon and/or juniper may be present
Annual non-native species present
2.1a
2.2a
2.2
Thurber's needlegrass and other perennial grasses dominate
Sprouting shrubs increase
Big sagebrush reduced or missing
Forbs may increase
Annual non-native species present
2.3b
2.1b
2.3a
2.2b
2.4b
2.3 (At Risk)
Big sagebrush dominates
Deep-rooted perennial grasses minor component
Sandberg bluegrass may increase
Pinyon and/or juniper may be present
Annual non-native species present
2.3c
2.4a
2.4 (At Risk)
Annual non-native species dominate to sub-dominant / co-dominant with bunchgrasses in response to favorable growing conditions
Big sagebrush may be present
Pinyon and/or juniper may be present
T2B
Shrub State 3.0
3.1 (At Risk)
Big sagebrush dominates
Sandberg bluegrass and/or squirreltail may dominate understory
Deep-rooted perennial grasses trace or missing
Bare ground may be significant
Annual grasses may be present
Seeded species may be present
Pinyon and/or juniper may be present
T2A
T2C
T3A
3.1a
3.2a
3.2 (At Risk)
Rabbitbrush and/or other sprouting shrubs dominate
Sandberg bluegrass and/or squirreltail may dominate understory
Deep-rooted perennial grasses trace or missing
Bare ground may be significant
Annual grasses may increase
Seeded species may be present
R3A
Annual State 4.0
4.1
Annual non-native species dominate
Sprouting shrubs may be present
Perennial bunchgrasses may be present
4.1a
4.2a
4.2
Annual non-native species dominate understory
Sagebrush dominates overstory
Perennial bunchgrasses may be present
Seeded species may be present
R4A
Seeded State 6.0
T5A
6.1
Seeded wheatgrass or other seeded species dominate
Sagebrush may be present
Annual non-native species may be present
6.1a
6.2a
6.2
Seeded wheatgrass species and sagebrush codominate
Annual non-native species may be present
6.3a
6.3
Sagebrush and/or rabbitbrush dominate
Seeded wheatgrass species decrease
Annual non-native species may be present
Pinyon and/or juniper may be present
6.2b
T3B
R5A
R5B
Tree State 5.0
5.1
Pinyon and/or juniper dominate
Big sagebrush subdominant
Perennial bunchgrasses decrease
Annual non-native species present to increasing
Bare ground areas large and connected
5.1a
5.2a
5.2 (At Risk)
Pinyon and/or juniper dominate
Big sagebrush decadent or missing
Perennial bunchgrasses minor component to missing
Annual non-native species present
Bare ground areas large and connected
Soil redistribution apparent

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

Transition T1A: Introduction of non-native annual species.

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs; non-native annual species present.
2.1b: Time and lack of disturbance. Inappropriate grazing management and/or long-term drought may also reduce perennial understory.
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
2.2b: Fall and spring growing conditions that favors the germination and production of non-native, annual grasses. Pathway typically occurs 3 to 5 years post-fire and 2.4 may be a transitory plant community.
2.3a: High severity fire significantly reduces sagebrush cover leading to early or mid-seral community. Brush management with minimal soil disturbance reduces sagebrush.
2.3b: Low severity fire creates sagebrush/grass mosaic. Brush management with minimal soil disturbance reduces sagebrush.
2.3c: Fall and spring growing season conditions that favors the germination and production of non-native annual grasses. 2.4 may be a transitory plant community.
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 (to 3.1), or fire, if coming from phase 2.3 or 2.4 (to 3.2).
Transition T2B: Severe fire and/or multiple fires, or brush management causing severe soil disturbance.
Transition T2C: Time and lack of fire allows pinyon and/or juniper to establish and dominate site resources; may be coupled with inappropriate grazing management that reduces perennial grass density and increases tree establishment.

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 or multiple fires, and/or treatments that disturb the existing plant community (to 4.1). Transition to 4.2 caused by continued inappropriate grazing management in the presence of annual grasses.
Transition T3B: Time and lack of fire allows pinyon and/or juniper to establish and dominate site resources; may be coupled with inappropriate grazing management that reduces perennial grass density and increases tree establishment.

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.

Restoration R4A: Application of herbicide and seeding of desired species (probability of success best immediately following 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 (to 4.1).

Restoration R5A: Tree removal with no seeding from Phase 5.1.
Restoration R5B: Tree management coupled with seeding of desired species.

Seeded State 6.0 Community Phase Pathways
6.1a: Time and lack of disturbance, coupled with repeated spring grazing allows shrubs to regenerate.
6.2a: Fire and/or brush management allows seeded grasses to return to dominance.
6.2b: Inappropriate grazing management reduces bunchgrasses and increases density of sagebrush; usually a slow transition.
6.3a: Fire or brush treatment with minimal soil disturbance.

State 1
Reference Plant Community

Community 1.1
Reference Plant Community

The reference plant community is dominated by desert needlegrass, antelope bitterbrush, Wyoming big sagebrush,

and green ephedra. Potential vegetative composition is about 50% grasses, 5% forbs and 45% shrubs. Approximate ground cover (basal and crown) is 20 to 25 percent.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	200	300	400
Shrub/Vine	180	270	360
Forb	20	30	40
Total	**400**	**600**	**800**

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			210–300	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	180–240	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	30–60	–
2	**Secondary Perennial Grasses**			12–60	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	3–12	–
	squirreltail	ELEL5	*Elymus elymoides*	3–12	–
Forb					
3	**Perennial**			30–60	
	antelope bitterbrush	PUTR2	*Purshia tridentata*	90–120	–
	spineless horsebrush	TECA2	*Tetradymia canescens*	3–18	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	3–18	–
	desert peach	PRAN2	*Prunus andersonii*	3–18	–
	buckwheat	ERIOG	*Eriogonum*	3–18	–
	lupine	LUPIN	*Lupinus*	3–18	–
	phlox	PHLOX	*Phlox*	3–18	–
Shrub/Vine					
4	**Primary Shrubs**			162–288	
	antelope bitterbrush	PUTR2	*Purshia tridentata*	90–120	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	60–120	–
	mormon tea	EPVI	*Ephedra viridis*	12–48	–
5	**Secondary Shrubs**			12–48	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	6–12	–
	spiny hopsage	GRSP	*Grayia spinosa*	6–12	–
	desert peach	PRAN2	*Prunus andersonii*	6–12	–
	spineless horsebrush	TECA2	*Tetradymia canescens*	6–12	–

Animal community

Livestock Interpretations:
This site use limited for grazing by domestic livestock due to steep slopes. Attentive grazing management is

required due to steep slopes and erosive soil surface condition. Grazing management should be keyed to desert needlegrass production. Needlegrass species begin growth early in the year and remain green throughout a relatively long growing season. This pattern of development enables animals to use needlegrass when many other grasses are unavailable. Cattle prefer needlegrass in early spring before fruits have developed as it becomes less palatable when mature. Needlegrasses are grazed in the fall only if the fruits are softened by rain.
Antelope bitterbrush is important browse for cattle. Young desert needlegrass is palatable to all classes of livestock. Mature herbage is moderately grazed by horses and cattle, but rarely grazed by sheep. Thurber’s needlegrass species begin growth early in the year and remain green throughout a relatively long growing season. This pattern of development enables animals to use Thurber’s needlegrass when many other grasses are unavailable. Cattle prefer Thurber’s needlegrass in early spring before fruits have developed as it becomes less palatable when mature. Thurber’s needlegrasses are grazed in the fall only if the fruits are softened by rain. 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. Livestock browse Wyoming big sagebrush, but may use it only lightly when palatable herbaceous species are available. Green ephedra is heavily browsed by livestock on winter range but only moderately or lightly browsed during other seasons.

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:
This site has high potential for wildlife habitat. It receives its greatest use as a wintering area for mule deer, due to its proximity to summer range areas and migrating routes. During the entire year this site will receive use by upland game, primarily valley quail, cottontail and pigmy rabbits. This site also provides habitat, at least for a part of the year, for various songbirds, raptors, coyotes, black-tailed jackrabbits and other rodents. Antelope bitterbrush is extensively used by mule deer. Mule deer use of antelope bitterbrush peaks in September, when antelope bitterbrush may compose 91% 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. Wyoming big sagebrush is preferred browse for wild ungulates, and Wyoming big sagebrush communities are important winter ranges for big game. Wyoming big sagebrush communities are critical habitat for birds. Sagebrush-grassland communities provide critical sage-grouse breeding and nesting habitats. Open Wyoming sagebrush communities are preferred nesting habitat. Meadows surrounded by sagebrush may be used as feeding and strutting grounds. Sagebrush is a crucial component of their diet year-round, and sage-grouse select sagebrush almost exclusively for cover. Leks are often located on low sagebrush sites, grassy openings, dry meadows, ridgetops, and disturbed sites. Sage-grouse prefer mountain big sagebrush and Wyoming big sagebrush communities to basin big sagebrush communities. Green ephedra is an important browse species for big game animals. Green ephedra is heavily used by wildlife on winter ranges. Young desert needlegrass is palatable to many species of wildlife. Desert needlegrass produces considerable basal foliage and is good forage while young. Desert bighorn sheep graze desert needlegrass. Thurber needlegrass is valuable forage for wildlife.

Hydrological functions

Runoff is low to very high. Permeability is moderately slow to rapid. A few rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. Water flow patterns are rare but can be expected in areas recently subjected to summer convection storms or rapid snowmelt, usually on steeper slopes. 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. There are no gullies. Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., desert needlegrass]) slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

Recreational uses

This site generally occurs overlooking broad expanses of the low-lands and provides scenic viewpoints of those and surrounding landscapes. Recreational uses include deer, gamebird, and wildlife hunting as well as wildflower photography.

Other products

Native Americans made tea from big sagebrush leaves. They used the tea as a tonic, an antiseptic, for treating colds, diarrhea, and sore eyes and as a rinse to ward off ticks. Big sagebrush seeds were eaten raw or made into meal.

Other information

Wyoming big sagebrush is used for stabilizing slopes and gullies and for restoring degraded wildlife habitat, rangelands, mine spoils and other disturbed sites. It is particularly recommended on dry upland sites where other shrubs are difficult to establish.
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.
Desert needlegrass seeds are easily germinated and have potential for commercial use. Desert needlegrass may be used for groundcover in areas of light disturbance, but it is susceptible to excessive trampling. Green ephedra is listed as a successful shrub for restoring western rangeland communities and can be used to rehabilitate disturbed lands. It also has value for reducing soil erosion on both clay and sandy soils. Green ephedra establishes readily through direct seeding, transplants, and stem cuttings.

Type locality

Location 1: Carson City County, NV	
General legal description	This site also occurs in Douglas, Lyon, Mineral, Storey and Washoe counties, Nevada.

Other references

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

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

Contributors

DK/FR

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)	GK BRACKLEY
Contact for lead author	State Rangeland Management Specialist
Date	02/21/2007
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** A few rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt.

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2. **Presence of water flow patterns:** Water flow patterns are rare but can be expected in areas recently subjected to summer convection storms or rapid snowmelt, usually on steeper slopes.

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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.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground ± 40%; surface rock fragments less than 15%; shrub canopy 20 to 25%; foliar cover of perennial herbaceous plants ± 40%.

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

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

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7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) is expected to move the distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during catastrophic events.

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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 4 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 to thick platy, subangular blocky or granular. Soil surface colors are dark and the soils are typified by a relatively thin mollic epipedon. Organic carbon of the surface 2 to 4 inches is typically 1.25 to 2.5 percent, dropping off quickly below. 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:** Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., desert needlegrass]) 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 shallow to the surface 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: Reference Plant Community: Deep-rooted, cool season, perennial bunchgrasses >> tall shrubs (antelope bitterbrush & big sagebrush). (By above ground production)

    Sub-dominant: Deep-rooted, cool season, perennial forbs = associated shrubs > shallow-rooted, cool season, perennial bunchgrasses = fibrous, shallow-rooted, cool season, perennial and annual forbs. (By above ground production)

    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 are common and standing dead shrub canopy material may be as much as 15% of total woody canopy; some of the mature bunchgrasses (<15%) have dead centers.

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14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (± 10%) 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) ± 600 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:** Anderson"s peachbrush is an increaser on this site. Cheatgrass, rabbitbrush, snakeweed, Russian thistle, annual mustards, knapweeds, Utah juniper, and singleleaf pinyon are invaders on this site.

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