USDA Natural Resources Conservation Service

Ecological site R026XY022NV
STONY SLOPE 8-10 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 Stony Slope 8-10 P.Z. is found on moderate to steep slopes on hills and mountains. The elevations range from 4300 to 6600 feet. The soil is shallow to bedrock and the surface soil texture is very stony sandy loam to very cobbly/stony loam. The dominant vegetation is Wyoming sagebrush (Artemisia tridentata ssp. wyomingensis) and desert needlegrass (Achnatherum speciosum).

Associated sites

F026XY063NV	**Shallow Sandy Pediment 13-15 P.Z. JUOS/ARTRW8/ACHY-HECO26**
R026XY010NV	**LOAMY 10-12 P.Z.**
R026XY016NV	**LOAMY 8-10 P.Z.**
R026XY017NV	**LOAMY HILL 10-12 P.Z.**
R026XY050NV	**GRAVELLY CLAY 10-12 P.Z.**

Similar sites

R026XY016NV	**LOAMY 8-10 P.Z.** more productive site; occurs on gentler slopes
R026XY015NV	**SHALLOW LOAM 10-12 P.Z.** ACTH7 dominant grass
R026XY011NV	**SOUTH SLOPE 8-12 P.Z.** SADOD3 and EPVI major shrubs
R026XY029NV	**ERODED SLOPE 10-12 P.Z.** SADOD3, PUTR2, CHVI8 major shrubs; more productive site

Table 1. Dominant plant species

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

Physiographic features

This site occurs on convex sideslopes of hills and mountains. Slopes range from 4 to over 75 percent, but slope gradients of 15 to 50 percent are most typical. Elevations are 4300 to 6600 feet.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mountain
Elevation	4,300–6,600 ft
Slope	15–50%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Elevation	Not specified
Slope	4–75%

Climatic features

The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 8 to 10 inches. Mean annual air temperature is 49 to 51 degrees F. The average growing season is about 90 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)	8-10 in
Frost-free period (average)	105 days
Freeze-free period (average)	
Precipitation total (average)	9 in

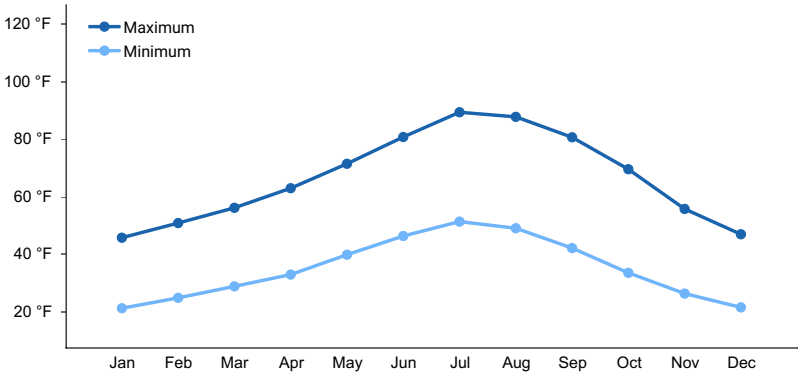

Figure 1. Monthly average minimum and maximum temperature

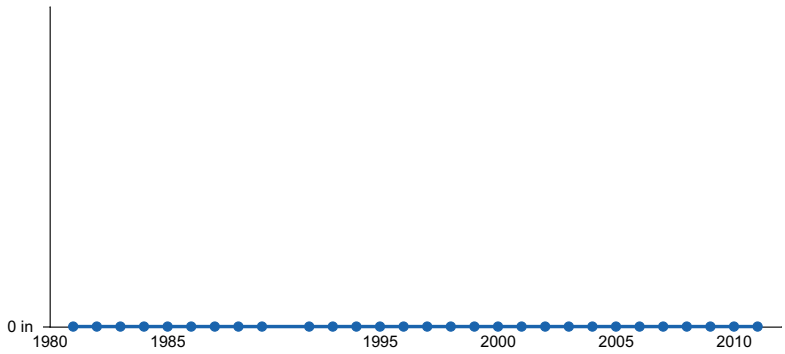

Figure 2. Annual precipitation pattern

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site are shallow to moderately deep and well drained. The available water capacity is very low to low. Boulders, stones and cobbles on the soil surface reduce growing space and plant density. The surface rock fragments provide a stabilizing affect on surface erosion conditions. Susceptibility to sheet and rill erosion is slight to moderate depending on slope. Soil series associated with this site include: Acrelane, Bombadil, Hefed, Indiano, Old Camp, Reno, Risley, Tarloc, and Xerta.

Table 5. Representative soil features

Parent material	(1) Residuum–volcanic rock (2) Colluvium–volcanic rock
Surface texture	(1) Very stony loam (2) Very cobbly loam (3) Very stony sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Slow to moderately rapid
Soil depth	10–40 in
Surface fragment cover <=3"	10–32%
Surface fragment cover >3"	2–30%
Available water capacity (0-40in)	0.9–1.6 in

Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–30%
Subsurface fragment volume >3" (Depth not specified)	10–36%

Ecological dynamics

As ecological condition declines, big sagebrush, Anderson's peachbrush and Douglas' rabbitbrush become dominant. Cheatgrass, annual forbs and utah juniper are the species most likely to invade this site.

Fire Ecology:
The fire return interval for Wyoming big sagebrush communities ranges from 10 to 70 years. Fire is the principal means of renewal for decadent stands of Wyoming big sagebrush. 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. Fires in Wyoming big sagebrush are usually not continuous, and remnant plants are the principal means of postfire reproduction. Green ephedra generally sprouts vigorously from the roots or woody root crown after fire and rapidly produces aboveground biomass from surviving meristematic tissue. Fires in spiny hopsage sites generally occur in late summer when plants are dormant, and sprouting generally does not occur until the following spring. Spiny hopsage is considered to be somewhat fire tolerant and often survives fires that kill sagebrush. Mature spiny hopsage generally sprout after being burned. Spiny hopsage is reported to be least susceptible to fire during summer dormancy. 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. Most perennial grasses have root crowns that can survive wildfire. 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.

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 7.

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 Phase 1.1: Wyoming big sagebrush and Thurber’s needlegrass dominate the site. Ephedra, Indian ricegrass and bottlebrush squirreltail (*Elymus elymoides*) are also common. Utah juniper is described in the site concept and may be present in minor amounts.

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 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 1.1b, from Phase 1.1 to 1.3: Long-term drought, time and/or herbivory favor an increase in Wyoming big sagebrush over deep-rooted perennial bunchgrasses. Combinations of these would allow the sagebrush overstory to increase and dominate the site, causing a reduction in the perennial bunchgrasses. Bottlebrush squirreltail may increase in density depending on the grazing management.

Community Phase 1.2: This community phase is characteristic of a post-disturbance, early to mid-seral community phase. 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. Ephedra, desert peach, spiny hopsage, Indian ricegrass and other perennial grasses are common. Wyoming big sagebrush is killed by fire, therefore decreasing within the burned community. Sagebrush could still be present in unburned patches.

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: Wyoming big sagebrush increases in the absence of disturbance. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from herbivory. Bottlebrush squirreltail will likely increase in the understory and may be the dominant grass on the site.

Community Phase Pathway 1.3a, 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.

Community Phase Pathway 1.3b, 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.

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, Russian thistle (Salsola iberica), medusahead, or stork's bill (Erodium spp.) dominate the understory.
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: Wyoming big sagebrush and Thurber's needlegrass dominate the site. Ephedra, Indian ricegrass and bottlebrush squirreltail are also common on this site. Utah 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 seral community phase. Thurber's needlegrass, Indian ricegrass, and other perennial bunchgrasses dominate the site. Sprouting shrubs such as rabbitbrush, ephedra, desert peach, and spiny hopsage may increase. Wyoming big sagebrush is killed by fire, therefore decreasing within the burned community. Sagebrush could still be present in unburned patches. Perennial forbs may increase or dominate after fire for several years. Thurber's needlegrass can experience high mortality from fire and may be reduced in the community for several years. Annual non-native species generally respond well after fire and maybe stable or increasing within the community. Rabbitbrush may dominate the aspect for a number of years following wildfire.

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 2.2a, 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: Wyoming big sagebrush increases and the perennial understory is reduced. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from inappropriate grazing management. Bottlebrush squirreltail will likely increase in the understory and may be the dominant grass on the site. Utah juniper may be present. Annual non-native species present.

Community Phase Pathway 2.3a, 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 2.3b, 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 2.3c, 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: 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.

Community Phase Pathway 2.4a, 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.
Community Phase Pathway 2.4b, 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.

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.
Shrub State 3.0: This state has two community phases; a Wyoming big sagebrush dominated phase and a bottlebrush squirreltail dominated phase. This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Bottlebrush squirreltail will increase with a reduction in deep-rooted perennial bunchgrass competition and become the dominant grass. Sagebrush dominates the overstory and rabbitbrush 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 bottlebrush squirreltail 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: Wyoming big sagebrush dominates the overstory. Bottlebrush squirreltail dominates the understory. Utah juniper may be present or increasing. Annual non-native species may be present. Understory may be sparse, with bare ground increasing. 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 the bottlebrush squirreltail, 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 Sandberg bluegrass to dominate the site.

Community Phase 3.2: Bottlebrush squirreltail dominates the understory; annual non-natives are present but are not dominant. Trace amounts of sagebrush may be present. Sprouting shrubs may dominate for a number of years following fire.
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 bottlebrush 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 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 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 5.0: 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, Russian thistle, medusahead, and/or stork’s bill (Erodium spp.) in the understory. Sagebrush and/or rabbitbrush may dominate the overstory.

Community Phase 4.1: Annual non-native plants dominate 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: Wyoming big sagebrush remains in the overstory with annual non-native species dominating the understory. Trace amounts of desirable bunchgrasses may be present.

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

Tree State 5.0: 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, sagebrush is decadent and dying, and cover of deep-rooted perennial bunchgrasses is decreasing. Recruitment of sagebrush cohorts is minimal. Annual non-natives may be present or increasing.

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: 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 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 or fire when bottlebrush squirreltail is dominant in the understory will transition to community phase 3.2.
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 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. 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 Wyoming 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: Wyoming big sagebrush increases and becomes dominant in the overstory. Seeded wheatgrass species dominate understory. Annual non-native species may be present in trace amounts.

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 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 nutrient redistribution, and reduces soil organic matter.

State and transition model

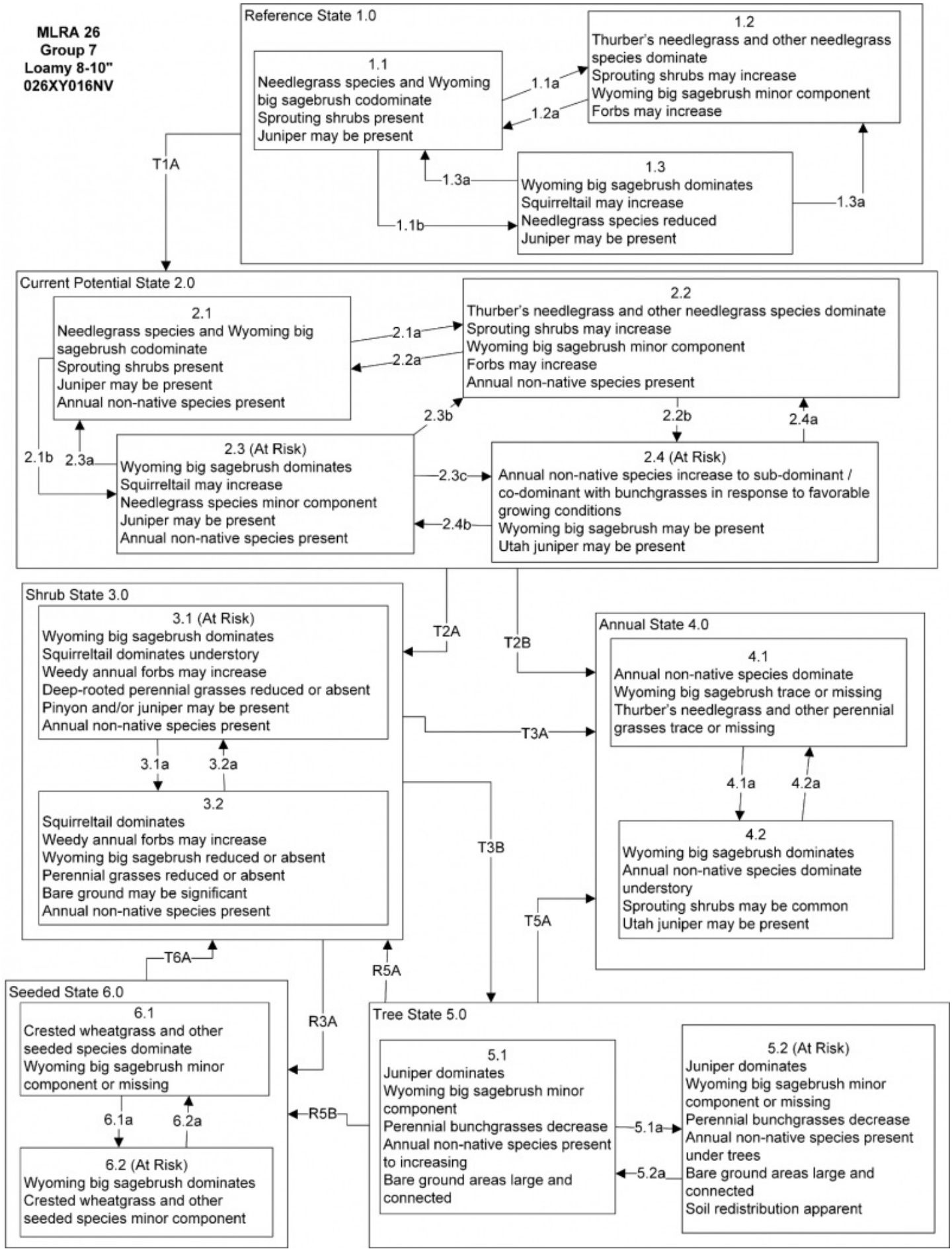

Figure 4. Group STM

MLRA 26
Group 7
Loamy 8-10"
026XY016NV
KEY

Reference State 1.0 Community Phase Pathways
1.1a: 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 and/or herbivory that allows for shrub regeneration.
1.3a: High severity fire and/or severe Aroga moth infestation significantly reduces sagebrush cover leading to early/mid-seral community.

Transition T1A: Introduction of non-native annual species.

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire and/or Aroga moth infestation creates grass/sagebrush mosaic; non-native annual species present.
2.1b: Time and lack of disturbance such as fire. Inappropriate grazing and/or drought will reduce perennial bunchgrasses.
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: Low severity fire or Aroga moth infestation creates sagebrush/grass mosaic. Brush management (aerial herbicide application), late-fall/winter grazing causing mechanical damage to sagebrush.
2.3b: High severity fire and/or severe Aroga moth infestation significantly reduces sagebrush cover leading to early mid-seral community.
2.3c: Fall and spring growing season conditions that favors the germination and production of non-native annual grasses. 2.4 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 high severity fire (to 3.2).
Transition T2B: Fire or brush management causing severe soil disturbance. Annuals like cheatgrass can become dominant under an existing shrub canopy (to 4.2).

Shrub State 3.0 Community Phase Pathways
3.1a: High severity fire; brush management with minimal soil disturbance.
3.2a: Time and lack of disturbance (may take many years).

Transition T3A: Catastrophic fire and/or treatments that disturb the existing plant community (to 4.1). Annuals like cheatgrass can become dominant under an existing shrub canopy (to 4.2).
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 to allow sagebrush to increase (pathway unlikely).
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 with no seeding from Phase 5.1.
Restoration R5B: Tree removal with minimal soil disturbance with native grasses present and seeding of wheatgrass species.

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

Transition T6A: Inappropriate grazing management favoring shrub dominance and reducing perennial bunchgrasses will lead to phase 3.1. Soil disturbing treatments and/or fire will lead to phase 3.2.

State 1
Reference Plant Community

Community 1.1
Reference Plant Community

The reference plant community is dominated by desert needlegrass and Wyoming big sagebrush. Potential vegetative composition is about 50% grasses, 5% forbs and 45% shrubs and trees. Approximate ground cover (basal and crown) is 15 to 25 percent.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	150	225	300
Shrub/Vine	135	203	270
Forb	15	22	30
Total	**300**	**450**	**600**

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**			189–248	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	180–225	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	9–23	–
2	**Secondary Perennial Grasses**			9–36	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	2–14	–
	squirreltail	ELEL5	*Elymus elymoides*	2–14	–
	basin wildrye	LECI4	*Leymus cinereus*	2–14	–
	Sandberg bluegrass	POSE	*Poa secunda*	2–14	–
Forb					
3	**Perennial**			9–36	
	milkvetch	ASTRA	*Astragalus*	2–14	–
	buckwheat	ERIOG	*Eriogonum*	2–14	–
	desertparsley	LOMAT	*Lomatium*	2–14	–
Shrub/Vine					
4	**Primary Perennial Shrubs**			41–114	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	23–68	–
	mormon tea	EPVI	*Ephedra viridis*	9–23	–
5	**Secondary Perennial Shrubs**			9–36	
	fourwing saltbush	ATCA2	*Atriplex canescens*	2–14	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	2–14	–
	desert peach	PRAN2	*Prunus andersonii*	2–14	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	2–14	–
	horsebrush	TETRA3	*Tetradymia*	2–14	–

Animal community

Livestock Interpretations:
This site has limited use for grazing by livestock due to steep slopes and high amounts of stones on the surface. Grazing managment should be keyed to desert and thurber's needlegrass. 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. 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. Spiny hopsage provides a palatable and nutritious food source for livestock, particularly during late winter through spring. Domestic sheep browse the succulent new growth of spiny hopsage in late winter and early spring.

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:
Wyoming big sagebrush is preferred browse for wild ungulates, and Wyoming big sagebrush communities are important winter ranges for big game and provide 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. Spiny hopsage provides a palatable and nutritious food source for big game animals. Spiny hopsage is used as forage to at least some extent by domestic goats, deer, pronghorn, and rabbits. Desert and thurber's needlegrass are palatable to wildlife species in the spring.

Hydrological functions

Runoff is medium to very high. Rills and water flow patterns are rare, but a few can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. 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. Gullies are none to very rare in areas of this site that occur on stable landforms. 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. Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., desert needlegrass and Thurber's 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 has some potential for hiking and upland game hunting.

Wood products

This site may be susceptible to minimal encroachment by Utah juniper

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. Some Native American peoples traditionally ground parched seeds of spiny hopsage to make pinole flour.

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. 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. Spiny hopsage has moderate potential for erosion control and low to high potential for long-term revegetation projects. It can improve forage, control wind erosion, and increase soil stability on gentle to moderate slopes. Spiny hopsage is suitable for highway plantings on dry sites in Nevada. 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.

Type locality

Location 1: Carson City County, NV	
Township/Range/Section	T16N R20E S35
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://www.plants.usda.gov).

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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)	GK Brackley
Contact for lead author	State Rangeland Management Specialist
Date	06/01/1979
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are rare. 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 subjected to summer convection storms or rapid snowmelt.

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground ± 45%; surface rock fragments ±50%; shrub canopy 15 to 20%; basal area for perennial herbaceous plants =5%.

5. **Number of gullies and erosion associated with gullies:** Gullies are none to very rare in areas of this site that occur on stable landforms.

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) 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.

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. Areas of this site occurring on soils that have a physical crust will probably have stability values less than 3. (To be field tested.)

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically thin to thick platy or massive. Soil surface colors are light and the soils are typified by an ochric epipedon. Organic carbon of the surface 2 to 3 inches is typically 1 to 1.5 percent dropping off quickly below.

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 & Thurber''s needlegrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are not typical. Platy or massive sub-surface horizons, subsoil argillic horizons or hardpans shallow to the surface are not to be interpreted as compacted layers.

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Reference Plant Community: Deep-rooted, cool season, perennial bunchgrasses >> tall shrubs (Wyoming big sagebrush). By above ground production)

Sub-dominant: Associated shrubs>shallow-rooted, cool season, perennial grasses>deep-rooted, cool season, perennial forbs=fibrous, shallow-rooted, cool season, annual and perennial 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 35% of total woody canopy; some of the mature bunchgrasses (<20%) 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 May) ± 450 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:** Cheatgrass, rabbitbrush, snakeweed, halogeton, knapweed, yellowstar thistle, Russian thistle, annual mustards, bassia and Utah juniper are all 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.
