USDA Natural Resources
Conservation Service

# Ecological site F026XY044NV
# Shallow Sandy 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

MLRA 26 is in western Nevada and eastern California; approximately 69 percent is in Nevada, and 31 percent in California. The area is predominantly 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. The valleys are drained by three major rivers flowing east across MLRA 26; the Truckee, Carson and Walker rivers. A narrow strip along the western border of MLRA 26 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. The structure creates an impressive wall of mountains directly west of the area creating a rain shadow affect to MLRA 26. Parts of the eastern face; the foothills, mark the western boundary of the area. Elevations range from near 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.

In MLRA 26, the valleys are composed dominantly of Quaternary alluvial deposits. Quaternary playa or alluvial flat deposits typically occupy the lowest valley bottoms in the internally drained valleys. Tertiary andesitic flows, breccias, ash flow tuffs, rhyolite tuffs or granodioritic rocks dominate the hills and mountains. Quaternary basalt flows are present in lesser amounts. Jurassic and Triassic limestone and shale, and Precambrian limestone and dolomite are also present in very limited amounts. Glacial till deposits, of limited extent are along the east flank of the Sierra Nevada Mountains; the result of alpine glaciation.

The average annual precipitation in MLRA 26 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 MLRA 26 are Aridisols and Mollisols. The soils in the area typically have a mesic soil temperature regime, an aridic or xeric soil moisture regime, and mixed or smectitic mineralogy. The soils are generally well drained, clayey or loamy and are commonly skeletal. The soils depths are typically very shallow to moderately deep.

This area supports shrub-grass vegetation characterized by big sagebrush. Low sagebrush and Lahontan sagebrush are on some soils. Antelope bitterbrush, squirreltail, desert needlegrass, Thurber needlegrass, and Indian ricegrass are important associated plants. Green ephedra, Sandberg bluegrass, desert peach, and several forb species are also 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.

Wildlife species in the area are mule deer, coyote, beaver, muskrat, jackrabbit, cottontail, raptors, pheasant, chukar, blue grouse, mountain quail, and mourning dove, amongst other species. 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 and climatic and biotic affinities to the Sierra Nevada Mountain range. The Sierra Influenced Ranges LRU receives greater precipitation than the mountain ranges of central Nevada.

Amount of precipitation varies in relation to the local strength of the Sierra Nevada 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, like 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.

## Classification relationships

PIMO WSG:1R0601

## Ecological site concept

The Shallow Sandy Slope 10-12 P.Z. occurs on mid- to upper mountain side slopes on all aspects except at lower elevations. Slopes are typically 15 to 50 percent. The soils are shallow to very deep and well drained. Soils have 35 to over 50 percent gravels, cobbles, or stones, by volume, distributed throughout the soil profile. The dominant plants are mountain big sagebrush (*Artemisia tridentata* ssp. vaseyana), antelope bitterbrush (*Purshia tridentata*), muttongrass (*Poa fendleriana*), and Thurber's needlegrass (*Achnatherum thurberianum*).

## Associated sites

| | |
|---|---|
| F026XY069NV | **Shallow Clayey Summit 11-14 P.Z. PIMO/ARTRV/POA-KOMA** |
| R026XY040NV | **GRAVELLY LOAM 14+ P.Z.** |
| R026XY048NV | **LOAMY SLOPE 12-14 P.Z.** |
| R026XY078NV | **CLAYPAN 12-14 P.Z.** |
| F026XY104NV | **Shallow Coarse Sandy Slopes 16+ P.Z. PIMO WSG:1R1** |

## Similar sites

| | |
|---|---|
| F026XY069NV | **Shallow Clayey Summit 11-14 P.Z. PIMO/ARTRV/POA-KOMA**<br>Lower site index |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Pinus monophylla* |
| Shrub | (1) *Artemisia tridentata ssp. vaseyana*<br>(2) *Purshia tridentata* |
| Herbaceous | (1) *Poa fendleriana*<br>(2) *Achnatherum thurberianum* |

## Physiographic features

This site occurs on mid- to upper mountain side slopes on all aspects. At the lower end of its range, the site is restricted to northerly aspects. Slopes are typically 15 to 50 percent but range from 15 to over 75 percent. Elevations are 4920 to 8000 feet.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Mountain slope<br>(2) Mountain |
| Runoff class | Medium to very high |
| Elevation | 4,920–8,000 ft |
| Slope | 15–50% |
| Aspect | Aspect is not a significant factor |

## Climatic features

The climate associated with this site is subhumid with cool, dry summers and cold, wet winters. Average annual precipitation is about 10 to 12 inches. Mean annual air temperature is 42 to 46 degrees F. The average growing season is 65 to 90 days.

Nevada's climate is predominantly arid, and has large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and significant variations with elevation. Three basic geographical factors largely influence Nevada's climate (1) continentality, (2) latitude, and (3) elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada is 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. As a result, the lowlands of Nevada are largely deserts 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. The terrain responds quickly to changes in solar heating.

Nevada is within the mid-latitude belt of prevailing westerly winds that 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, is a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 4 days |
| Freeze-free period (characteristic range) | 39 days |
| Precipitation total (characteristic range) | 9 in |
| Frost-free period (actual range) | 4 days |
| Freeze-free period (actual range) | 39 days |
| Precipitation total (actual range) | 9 in |
| Frost-free period (average) | 4 days |
| Freeze-free period (average) | 39 days |
| Precipitation total (average) | 9 in |

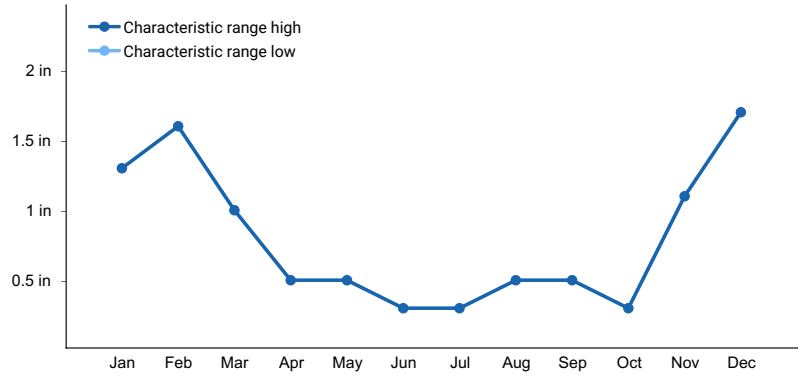



**Figure 1. Monthly precipitation range**

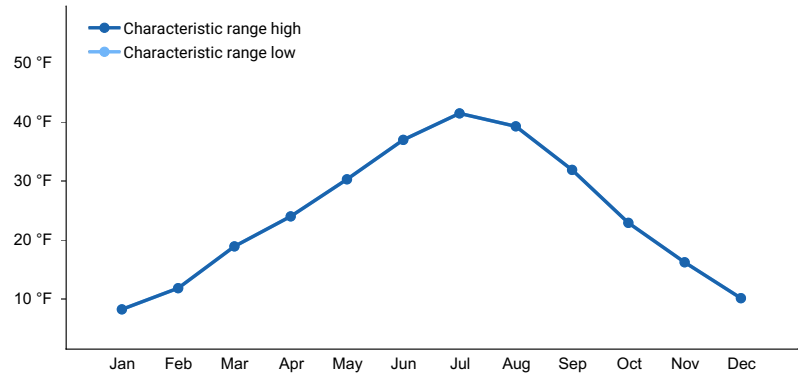



**Figure 2. Monthly minimum temperature range**

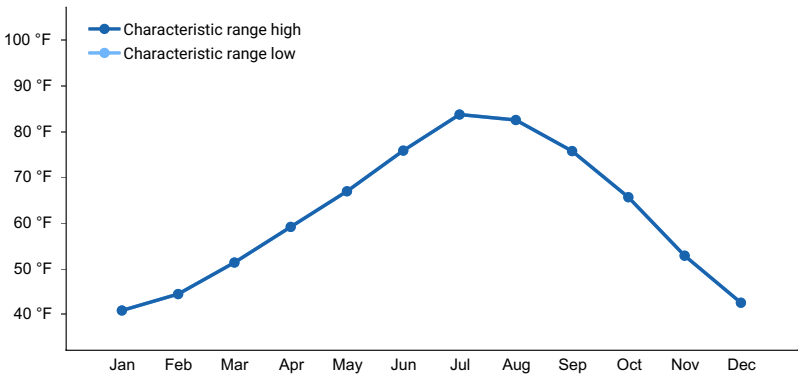



**Figure 3. Monthly maximum temperature range**

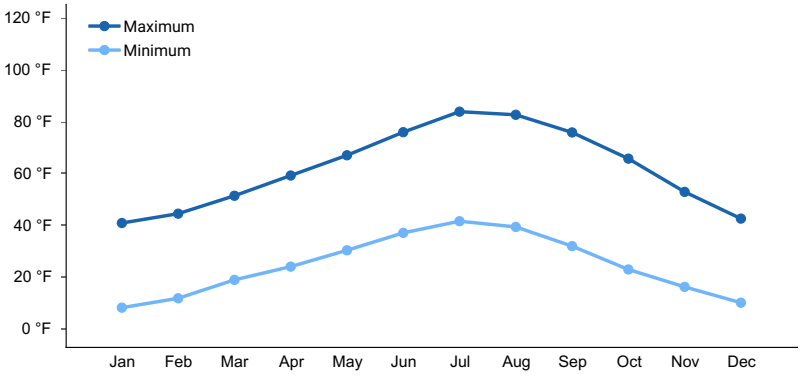



**Figure 4. Monthly average minimum and maximum temperature**

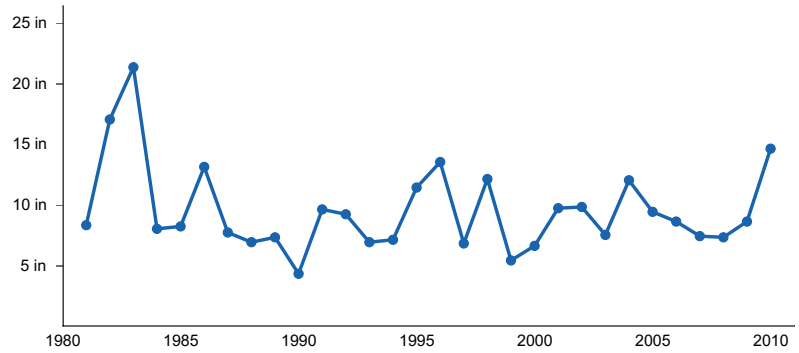



**Figure 5. Annual precipitation pattern**

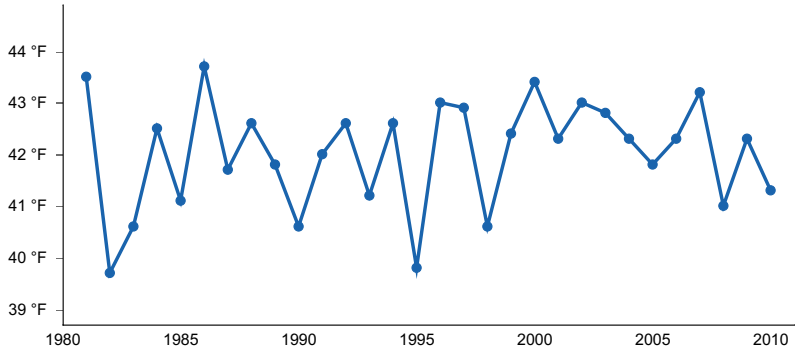



**Figure 6. Annual average temperature pattern**

## Climate stations used

- (1) BRIDGEPORT [USC00041072], Bridgeport, CA

## Influencing water features

No influencing water features are associated with this site.

## Soil features

The soils are shallow to very deep and well drained. Soils have 35 to greater than 50 percent gravels, cobbles, or stones, by volume distributed throughout the soil profile. Available water capacity is very low to low. Trees and shrubs extend their roots into fractures in the bedrock allowing them to utilize deep moisture. Rock fragments on the soil surface provide a stabilizing effect on surface erosion conditions. Runoff is high to very high and the potential for sheet and rill erosion is moderate to high depending on slope and amount of rock fragments on the soil surface. The soil series associated with this site include: Beartracker, Cagle, Crispy, Dotsolot, Duco, Erastra, Hardnut, Nall, Ocashe, Pimogran, Pinenut, and Searles.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Colluvium–andesite<br>(2) Residuum–andesite<br>(3) Colluvium–tuff breccia<br>(4) Residuum–tuff breccia<br>(5) Volcanic ash |
| Surface texture | (1) Very gravelly, ashy sandy loam<br>(2) Very gravelly sandy loam<br>(3) Very stony sandy loam |
| Family particle size | (1) Loamy |
| Drainage class | Well drained |
| Permeability class | Slow |

| | |
|---|---|
| Depth to restrictive layer | 7–20 in |
| Soil depth | 7–20 in |
| Surface fragment cover <=3" | 15–59% |
| Surface fragment cover >3" | 0–20% |
| Available water capacity (0-40in) | 0.5–2.5 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) | 20–69% |
| Subsurface fragment volume >3" (Depth not specified) | 0–13% |

## Ecological dynamics

Description of MLRA 26 DRG 19:

Disturbance Response Group (DRG) 19 consists of six ecological sites; F026XY060NV, F026XY044NV, F026XY061NV, F026XY069NV, F026XY104NV, F026XY071NV. This group receives 10 to 14 inches of precipitation each year. Elevations range from 5,000 to 9,000 while slopes range from 15 to 75 percent. The soils are typically shallow to moderately deep and well drained and the water holding capacity is low to moderate. The soils are generally skeletal with 35 to 50 percent gravels, cobbles, or stones, by volume, distributed throughout the soil profile. This group is dominated by *Pinus monophylla* (singleleaf pinyon) with *Artemisia tridentata* ssp. vaseyana (mountain big sagebrush) as the primary understory shrub. *Juniperus osteosperma* (Utah juniper) and *Cercocarpus ledifolius* (curl-leaf mountain mahogany) are minor components. Other subdominant shrubs in the group include *Artemisia tridentata* ssp. wyomingensis (Wyoming big sagebrush) and *Purshia tridentata* (antelope bitterbrush). The dominant understory grass is *Achnatherum thurberianum* (Thurber's needlegrass) or *Achnatherum speciosum* (desert needlegrass). Other grasses in the group include *Poa fendleriana* (muttongrass) and *Koeleria macrantha* (prairie junegrass). Under medium canopy cover (20-30 percent), understory production ranges from 200 to 450 pounds per acre in a normal year.

Potential Resilience Differences with other Ecological Sites:

PIMO WSG: 1R0601 (F026XY044NV):
This site is very similar to the modal site but with antelope bitterbrush as the subdominant shrub instead of Wyoming sagebrush. The dominant grass on this site is muttongrass, and Thurber's needlegrass is subdominant. It occurs on mid- to upper mountain side slopes in a slightly higher elevation range of 6,000 to 9,000 feet. This site also receives more precipitation with 12 to 16 inches annually and is more productive than the modal site with 450 lbs/ac of forage produced in a normal year under medium canopy (26-35 percent). This site is sometimes found with up to 15 percent Utah juniper or curl-leaf mountain mahogany canopy.

Major Successional Stages of Forest Development:

HERBACEOUS: The dominant vegetation is grasses and forbs under full sunlight. This stage is experienced after a major disturbance such as wildfire. Skeleton forest (dead trees) remaining after fire or other disturbances have little or no effect on the composition and production of the herbaceous vegetation.

SHRUB-HERBACEOUS: Herbaceous vegetation and woody shrubs dominate the site. Various amounts of tree

seedlings (less than 20 inches in height) may be present up to the point where they are obviously a component of the vegetal structure.

SAPLING: In the absence of disturbance, the tree seedlings develop into saplings (20 inches to 4½ feet in height) with a canopy cover generally of about 15 percent. Vegetation consists of grasses, forbs and shrubs in association with tree saplings.

IMMATURE FOREST: Singleleaf pinyon greater than 4½ feet in height form a major constituent of the visual aspect and vegetal structure of the plant community. The upper crown of dominant and codominant trees is cone- or pyramidal-shaped. Seedlings and saplings of singleleaf pinyon are prevalent in the understory. Understory vegetation is moderately influenced by a tree overstory canopy of about 15 to 25 percent.

MATURE FOREST: The visual aspect and vegetal structure are dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Tree canopy cover ranges from 25 to 35 percent. This stage of woodland development is assumed to be representative of this site in a pristine environment.

OVER-MATURE FOREST: In the absence of wildfire or other naturally occurring disturbances, the tree canopy on this site can become very dense. Dominant and codominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns of most trees are typically irregularly flat-topped or rounded. Understory vegetation is sparse to absent due to tree competition. Tree canopy cover is commonly greater than 50 percent.

The pinyon forest is generally a climax vegetation type throughout its range, reaching climax about 300 years after disturbance, with an ongoing trend toward increased tree density and canopy cover and a decline in understory species over time. Singleleaf pinyon seedling establishment is episodic. Population age structure is affected by drought, differentially reducing seedling and sapling recruitment more than other age classes. The ecotones between singleleaf pinyon forests and adjacent shrublands and grasslands provide favorable microhabitats for singleleaf pinyon seedling establishment. The ecotones are active zones for seed dispersal; nurse plants are available, and singleleaf pinyon seedlings are only affected by competition from grass and other herbaceous vegetation for a couple of years.

Several natural and anthropogenic processes can lead to changes in the spatial distribution of pinyon forests over time. These include (1) tree seedling establishment during favorable climatic periods, (2) tree mortality (especially seedlings and saplings) during periods of drought, (3) expansion of trees into adjacent grassland in response to overgrazing and/or fire suppression, and (4) removal of trees by humans, fire, or other disturbance episodes. Specific successional pathways after disturbance in singleleaf pinyon stands are dependent on several variables such as (a) plant species present at the time of disturbance and (b) their individual responses to disturbance, (c) past management, (d) type and size of disturbance, (e) available seed sources in the soil or adjacent areas, and (f) site and climatic conditions throughout the successional process.

Fire Ecology:
On high-productivity sites where sufficient fine fuels existed, singleleaf pinyon communities burn every 15 to 20 years, and on less productive sites with patchy fuels, fire return intervals may have been in the range of 50 to 100 years or longer. Thin bark and lack of self pruning make singleleaf pinyon very susceptible to intense fire. Mature singleleaf pinyon can survive low-severity surface fires but is killed by more severe fires. Most tree seedlings are killed by fire, but cached seeds may survive. Mountain big sagebrush is highly susceptible to injury from fire. Plants are readily killed in all seasons, even light severity fires. Mountain big sagebrush plants top-killed by fire will not resprout. Antelope bitterbrush is very susceptible to fire kill. It is considered a weak sprouter and is often killed by summer or fall fire.
Antelope bitterbrush in some areas may sprout after light-severity spring fire. Season of burning and environmental conditions impact antelope bitterbrush ability to survive fire and sprout. High fuel consumptions increase antelope bitterbrush mortality and therefore favors seedling establishment. Thurber needlegrass is classified as moderately resistant to fire, however, depending on season of burn, phenology, and fire severity, this perennial bunchgrass is moderately to severely damaged. Burning has been found to decrease the vegetation and reproductive vigor. Early season burning is more damaging to this needlegrass than late season burning.

State and Transition Model Narrative for Group 19:

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 19.

Reference State 1.0:

The Reference State 1.0 is representative of the natural range of variability under pristine conditions. This Reference State has four general community phases: an old-growth woodland phase, a shrub-herbaceous phase, an immature tree phase, and an infilled tree 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 long-term drought, and/or insect or disease attack. Fires are typically small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all/most of the following community phases within this state.

Community Phase 1.1:
This phase is characterized by widely dispersed old-growth singleleaf pinyon trees with an understory of mountain big sagebrush and perennial bunchgrasses. The visual aspect is dominated by singleleaf pinyon with 15 percent or greater canopy cover (USDA 1997). Utah juniper might be present. Trees have reached maximal or near maximal heights for the site and many tree crowns might be flat- or round- topped. Thurber's needlegrass and bluegrasses are the most prevalent grasses in the understory. Mountain big sagebrush is the primary understory shrub. Forbs such as arrowleaf balsamroot (*Balsamorhiza sagittata*) and tapertip hawksbeard (*Crepis acuminata*) are minor components. Utah juniper might be present.

Community Phase Pathway 1.1a, from Phase 1.1 to 1.2:
A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component. This allows for the perennial bunchgrasses to dominate the site.

Community Phase Pathway 1.1b, from Phase 1.1 to 1.4:
Time without disturbance such as fire, long-term drought, or disease will allow for the gradual infilling of singleleaf pinyon.

Community Phase 1.2:
This community phase is characterized by a post-fire shrub and herbaceous community. Thurber's needlegrass, bluegrasses, and other perennial grasses dominate. Thurber's needlegrass can experience high mortality from fire and might be reduced in the community for several years. Forbs might increase post-fire but will likely return to pre-burn levels within a few years. Singleleaf pinyon seedlings up to 4 feet in height might be present. Mountain big sagebrush might be present in unburned patches. Burned tree skeletons might be present; however, these have little or no effect on the understory vegetation.

Community Phase Pathway 1.2a, from Phase 1.2 to 1.3:
Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory might also reduce perennial grass understory.

Community Phase 1.3
This community phase is characterized as an immature woodland with singleleaf pinyon trees averaging over 4.5 feet in height. Pinyon canopy cover is 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedling and saplings, as well as perennial bunchgrasses and sagebrush.

Community Phase Pathway 1.3a, from Phase 1.3 to 1.2:
Fire reduces or eliminates tree canopy, allowing perennial grasses to dominate the site.

Community Phase Pathway 1.3b, from Phase 1.3 to 1.1:
Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of singleleaf pinyon. Excessive herbivory might also reduce perennial grass understory.

Community Phase 1.4 (at-risk):

This phase is dominated by singleleaf pinyon. The stand exhibits mixed age classes and canopy cover exceeds 30 percent. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat- forming forbs might increase. Utah juniper might be present. This community is at risk of crossing a threshold. Without proper management this phase will transition to the infilled woodland state 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

Community Phase Pathway 1.4a, from Phase 1.4 to 1.1:
Low intensity fire, insect infestation, or disease kills individual trees within the stand reducing canopy cover to less than 35 percent. Over time young trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass community increases in density and vigor.

Community Phase Pathway 1.4b, from Phase 1.4 to 1.2:
A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component which will allow for the perennial bunchgrasses to dominate the site.

T1A: Transition from Reference State 1.0 to Current Potential State 2.0:
Trigger: Introduction of non-native annual species.
Slow variables: Over time the annual non-native plants will increase within the community.
Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

T1B: Transition from Reference State 1.0 to Infilled Tree State 3.0:
Trigger: Time and a lack of disturbance allow trees to dominate site resources; might be coupled with inappropriate grazing management that favors shrub and tree dominance.
Slow variables: Over time the abundance and size of trees will increase.
Threshold: Singleleaf pinyon canopy cover is greater than 50 percent. Little understory vegetation remains due to competition with trees for site resources.

Current Potential State 2.0:

This state is similar to the Reference State 1.0, with four general community phases: an old-growth woodland phase, a shrub-herbaceous phase, an immature tree phase, and an infilled tree phase. Ecological function has not changed; however the resiliency of the state has been reduced by the presence of non-native species. These non-natives, particularly cheatgrass, can be highly flammable and promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state.
These 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. Fires within this community with the small amount of non- native annual species present are likely still small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all or most of the following community phases within this state.

Community Phase 2.1:
This phase is characterized by widely dispersed old-growth singleleaf pinyon trees with an understory of mountain big sagebrush and perennial bunchgrasses. The visual aspect is dominated by singleleaf pinyon with 15 percent or greater canopy cover (USDA 1997). Utah juniper might be present. Trees have reached maximal or near maximal heights for the site and many tree crowns might be flat- or round- topped. Thurber's needlegrass and bluegrasses are the most prevalent grasses in the understory. Mountain big sagebrush is the primary understory shrub. Forbs such as arrowleaf balsamroot and tapertip hawksbeard are minor components. Utah juniper might be present.

Community Phase Pathway 2.1a, from Phase 2.1 to 2.2:
A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component. This allows for the perennial bunchgrasses to dominate the site.

Community Phase Pathway 2.1b, from Phase 2.1 to 2.4:
Time without disturbance such as fire, long-term drought, or disease will allow for the gradual infilling of singleleaf

pinyon.

Community Phase 2.2:
This community phase is characterized by a post-fire shrub and herbaceous community. Thurber's needlegrass, bluegrass, and other perennial grasses dominate. Forbs might increase post-fire but will likely return to pre-burn levels within a few years. Pinyon seedlings up to 4.5 feet in height might be present. Mountain big sagebrush might be present in unburned patches. Burned tree skeletons might be present; however, these have little or no effect on the understory vegetation. Annual non-native species generally respond well after fire and might be stable or increasing within the community.

Community Phase Pathway 2.2a, from Phase 2.2 to 2.3:
This community phase pathway is a result of time without disturbance such as fire, long-term drought, or disease which allows for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory might also reduce perennial grass understory.

Community Phase 2.3:
This community phase is characterized by an immature woodland, with singleleaf pinyon trees averaging over 4.5 feet in height. Tree canopy cover is between 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedling and saplings, as well as perennial bunchgrasses and shrubs. Annual non-native species are present.

Community Phase Pathway 2.3a, from Phase 2.3 to 2.2:
Fire reduces or eliminates tree canopy, allowing perennial grasses to dominate the site.

Community Phase Pathway 2.3b, from Phase 2.3 to 2.1:
Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of singleleaf pinyon. Excessive herbivory might also reduce the perennial grass understory.

Community Phase 2.4 (at-risk):
This phase is dominated by singleleaf pinyon and Utah juniper might be present. The stand exhibits mixed age classes and canopy cover exceeds 30 percent. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat-forming forbs might increase. Annual non-native species are present primarily under tree canopies. Utah juniper might be present. This community is at risk of crossing a threshold, without proper management this phase will transition to the Infilled Tree State 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

Community Phase Pathway 2.4a, from Phase 2.4 to 2.1:
Low intensity fire, insect infestation, or disease kills individual trees within the stand, reducing canopy cover to less than 35 percent. Over time young trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass community increases in density and vigor. Annual non-natives present in trace amounts.

Community Phase Pathway 2.4b, from Phase 2.4 to 2.2:
A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component which will allow for the perennial bunchgrasses to dominate the site. Annual non-native grasses typically respond positively to fire and might increase in the post-fire community.

T2A: Transition from Current Potential State 2.0 to Infilled Tree State 3.0:
Trigger: Time and a lack of disturbance allow trees to dominate site resources; might also be coupled with inappropriate grazing management that favors shrub and tree dominance.
Slow variables: Over time the abundance and size of trees will increase.
Threshold: Pinyon canopy cover is greater than 30 percent. Little understory vegetation remains due to competition with trees for site resources.

T2B: Transition from Current Potential State 2.0 to Annual State 4.0:
Trigger: Catastrophic crown fire facilitates the establishment of non-native, annual weeds.
Slow variables: Increase in tree crown cover, loss of perennial understory and an increase in annual non-native species.

Threshold: Cheatgrass or other non-native annuals dominate understory. Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and nutrient redistribution and reduces soil organic matter. Increased canopy cover of trees allows severe stand- replacing fire. The increased seed bank of non-native, annual species responds positively to post-fire conditions facilitating the transition to an Annual State.

Infilled Tree State 3.0:

This state has two community phases characterized by the dominance of singleleaf pinyon in the overstory. This state is identifiable by greater than 50 percent cover of singleleaf pinyon and a mixed age class. Older trees are at maximal height and upper crowns might be flat-topped or rounded. Younger trees are typically cone- or pyramidal-shaped. Understory vegetation is sparse due to increasing shade and competition from trees.

Community Phase 3.1:
Singleleaf pinyon dominates the aspect. Understory vegetation is thinning. Perennial bunchgrasses are sparse and mountain big sagebrush skeletons are as common as live shrubs due to tree competition for soil water, overstory shading, and duff accumulation. Tree canopy cover is greater than 50 percent. Utah juniper might be present. Annual non-native species are present or co-dominate in the understory. Bare ground areas are prevalent and soil redistribution is evident. This community phase is typically described as a Phase II woodland (Miller et al. 2008).

Community Phase Pathway 3.1a, from Phase 3.1 to 3.2:
Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of singleleaf pinyon. Infilling by younger trees continues.

Community Phase 3.2:
Singleleaf pinyon dominates the aspect and Utah juniper might be present. Tree canopy cover exceeds 50 percent. Utah juniper might be present. Understory vegetation is sparse to absent. Perennial bunchgrasses, if present, exist in the dripline or under the canopy of trees. Mountain sagebrush skeletons are common or the sagebrush has been extinct long enough that only scattered limbs remain. Mat-forming forbs or Sandberg’s bluegrass might dominate interspaces. Annual non-native species are present and are typically found under the trees. Bare ground areas are large and interconnected. Soil redistribution might be extensive. This community phase is typically described as a Phase III woodland (Miller et al. 2008).

T3A Transition from Infilled Tree State 3.0 to Annual State 4.0:
Trigger: Catastrophic fire reduces the tree overstory and allows for the annual non-native species in the understory to dominate the site. Soil disturbing treatments such as slash and burn might also reduce tree canopy and allow for non-native annual species to increase.

Slow variables: Over time, cover and production of annual non-native species increases.
Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes temporal and spatial nutrient capture and cycling within the community. Increased, continuous fine fuels modify the fire regime by increasing frequency, size, and spatial variability of fires.

R3A Restoration from Infilled Tree State 3.0 to Current Potential State 2.0:
Manual or mechanical thinning of trees coupled with seeding. Probability of success is highest from community phase 3.1.

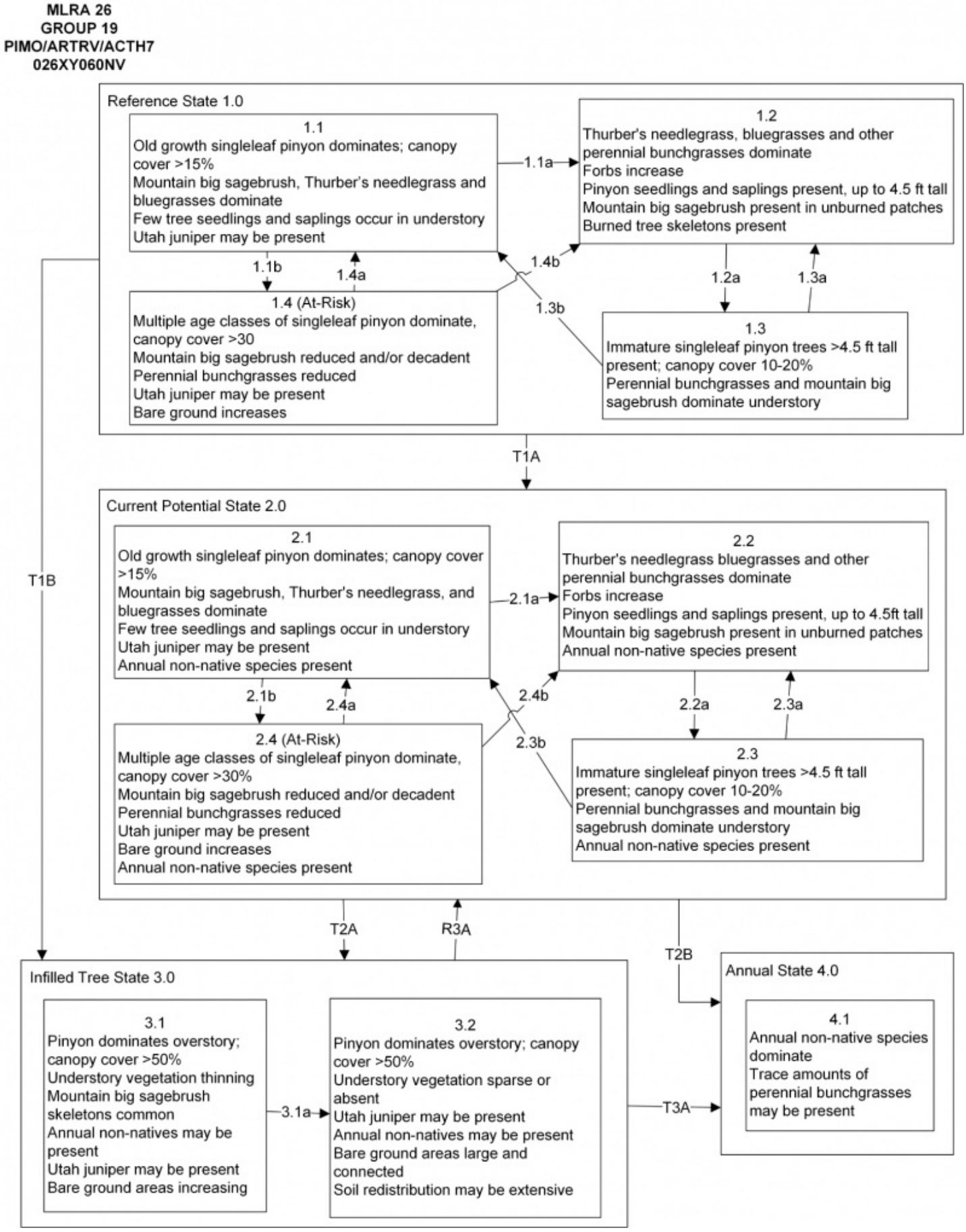
Annual State 4.0:

This community is characterized by the dominance of annual non-native species such as cheatgrass and tansy mustard in the understory. Rabbitbrush or other sprouting shrubs might dominate the overstory. Annual non-native species dominate the understory. Ecological dynamics are significantly altered in this state. Annual non-native species create a highly combustible fuel bed that shortens the fire return interval. Nutrient cycling is spatially and temporally truncated as annual plants contribute significantly less to deep soil carbon. This state was not seen in MLRA 26 during field work for this project, however it is possible given increased fire activity in these sites and their proximity to known annual states of sagebrush ecological sites. We refer the reader to the report for Disturbance Response Group 21 for MLRA 28A and 28B.

Community Phase 4.1:

Cheatgrass, mustards and other non-native annual species dominate the site. Trace amounts of perennial bunchgrasses might be present. Sprouting shrubs might increase. Burned tree skeletons present.

## State and transition model



**MLRA 26**
**GROUP 19**
**PIMO/ARTRV/ACTH7**
**026XY060NV**
**KEY**

Reference State 1.0 Community Pathways
1.1a: High severity crown fire reduces or eliminates tree cover.
1.1b: Time and lack of disturbance such as fire, disease, or drought allows younger trees to infill.
1.2a: Time and lack of disturbance such as fire or drought. Excessive herbivory may also reduce perennial grass understory.
1.3a: Fire.
1.3b: Time and lack of disturbance such as fire or drought. Excessive herbivory may also reduce perennial grass understory.
1.4a: Low severity fire, insect infestation, or disease removes individual trees and reduces total tree cover.
1.4b: High severity crown fire reduces or eliminates tree cover.

Transition T1A: Introduction of non-native annual species.
Transition T1B: Time and a lack of disturbance allows for trees to dominate site resources; may be coupled with inappropriate grazing management that favors shrub and tree dominance.

Current Potential State 1.0 Community Pathways
2.1a: High severity crown fire reduces or eliminates tree cover.
2.1b: Time and lack of disturbance such as fire, disease, or drought allows younger trees to infill.
2.2a: Time and lack of disturbance such as fire or drought. Excessive herbivory or inappropriate grazing may also reduce perennial grass understory.
2.3a: Fire.
2.3b: Time and lack of disturbance such as fire or drought. Excessive herbivory or inappropriate grazing may also reduce perennial grass understory.
2.4a: Low severity fire, insect infestation, or disease removes individual trees and reduces total tree cover.
2.4b: High severity crown fire reduces or eliminates tree cover.

Transition T2A: Time and a lack of disturbance allows for trees to dominate site resources; may be coupled with inappropriate grazing management that favors shrub and tree dominance.
Transition T2B: Catastrophic fire.

Infilled Tree State 3.0 Community Pathways
3.1a: Time and lack of disturbance such as fire, disease, or drought allows younger trees to infill.

Transition T3A: Catastrophic fire.

Restoration Pathway R3A: Thinning of trees coupled with seeding. Success unlikely from phase 3.2.

Annual State 4.0 Community Pathways
None.

## State 1
## Reference State

The Reference State 1.0 is representative of the natural range of variability under pristine conditions. This Reference State has four general community phases: an old-growth woodland phase, a shrub-herbaceous phase, an immature tree phase, and an infilled tree 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 long-term drought, and/or insect or disease attack. Fires are typically small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all/most of the following community phases within this state.

## Community 1.1
## Reference Plant Community

The reference plant community is dominated by singleleaf pinyon. Muttongrass and Thurber's needlegrass are the most prevalent understory grasses. Tapertip hawksbeard, arrowleaf balsamroot, lupine, and rockcress are common understory forbs. Mountain big sagebrush and antelope bitterbrush are the principal understory shrubs. Overstory tree canopy composition is about 85 to 100 percent singleleaf pinyon with less than 15 percent curl-leaf mountainmahogany and Utah juniper mixing in the overstory canopy.

**Forest overstory.** MATURE FOREST: The visual aspect and vegetal structure are dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Tree canopy cover ranges from 25 to 35 percent. This stage of forest development is assumed to be representative of this site in a pristine environment.

**Forest understory.** Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (25 to 35 percent). Average understory production ranges from 300 to 600 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

**Table 5. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 150 | 225 | 300 |
| Shrub/Vine | 105 | 158 | 210 |
| Tree | 30 | 45 | 60 |
| Forb | 15 | 22 | 30 |
| **Total** | **300** | **450** | **600** |

## Community 1.2

This community phase is characterized by a post-fire shrub and herbaceous community. Thurber's needlegrass, bluegrasses, and other perennial grasses dominate. Thurber's needlegrass can experience high mortality from fire and might be reduced in the community for several years. Forbs might increase post-fire but will likely return to pre-burn levels within a few years. Singleleaf pinyon seedlings up to 4 feet in height might be present. Mountain big sagebrush might be present in unburned patches. Burned tree skeletons might be present; however, these have little or no effect on the understory vegetation.

## Community 1.3

This community phase is characterized as an immature woodland with singleleaf pinyon trees averaging over 4.5 feet in height. Pinyon canopy cover is 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedling and saplings, as well as perennial bunchgrasses and sagebrush.

## Community 1.4
## (at-risk)

This phase is dominated by singleleaf pinyon. The stand exhibits mixed age classes and canopy cover exceeds 30 percent. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat- forming forbs might increase. Utah juniper might be present. This community is at risk of crossing a threshold. Without proper management this phase will transition to the infilled woodland state 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

## Pathway 1.1a
## Community 1.1 to 1.2

A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component. This allows for the perennial bunchgrasses to dominate the site.

### Pathway 1.1b
### Community 1.1 to 1.4

This pathway is a result of time without disturbance such as fire, long-term drought, or disease which allows for the gradual infilling of singleleaf pinyon.

### Pathway 1.2a
### Community 1.2 to 1.3

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory might also reduce perennial grass understory.

### Pathway 1.3b
### Community 1.3 to 1.1

This pathway is a result of time without disturbance such as fire, long-term drought, or disease which allows for the gradual maturation of singleleaf pinyon. Excessive herbivory might also reduce perennial grass understory.

### Pathway 1.3a
### Community 1.3 to 1.2

Fire reduces or eliminates tree canopy, allowing perennial grasses to dominate the site.

### Pathway 1.4a
### Community 1.4 to 1.1

Low intensity fire, insect infestation, or disease kills individual trees within the stand reducing canopy cover to less than 35 percent. Over time young trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass community increases in density and vigor.

### Pathway 1.4b
### Community 1.4 to 1.2

A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component which will allow for the perennial bunchgrasses to dominate the site.

## State 2
## Current Potential

This state is similar to the Reference State 1.0, with four general community phases: an old-growth woodland phase, a shrub-herbaceous phase, an immature tree phase, and an infilled tree phase. Ecological function has not changed; however the resiliency of the state has been reduced by the presence of non-native species. These non-natives, particularly cheatgrass, can be highly flammable and promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These 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. Fires within this community with the small amount of non- native annual species present are likely still small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all or most of the following community phases within this state.

### Community 2.1

This phase is characterized by widely dispersed old-growth singleleaf pinyon trees with an understory of mountain big sagebrush and perennial bunchgrasses. The visual aspect is dominated by singleleaf pinyon with 15 percent or greater canopy cover (USDA 1997). Utah juniper might be present. Trees have reached maximal or near maximal heights for the site and many tree crowns might be flat- or round- topped. Thurber's needlegrass and bluegrasses are the most prevalent grasses in the understory. Mountain big sagebrush is the primary understory shrub. Forbs such as arrowleaf balsamroot and tapertip hawksbeard are minor components. Utah juniper might be present.

### Community 2.2

This community phase is characterized by a post-fire shrub and herbaceous community. Thurber's needlegrass, bluegrass, and other perennial grasses dominate. Forbs might increase post-fire but will likely return to pre-burn levels within a few years. Pinyon seedlings up to 4.5 feet in height might be present. Mountain big sagebrush might be present in unburned patches. Burned tree skeletons might be present; however, these have little or no effect on the understory vegetation. Annual non-native species generally respond well after fire and might be stable or increasing within the community.

### Community 2.3

This community phase is characterized by an immature woodland, with singleleaf pinyon trees averaging over 4.5 feet in height. Tree canopy cover is between 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedling and saplings, as well as perennial bunchgrasses and shrubs. Annual non-native species are present.

### Community 2.4 (at-risk)

This phase is dominated by singleleaf pinyon and Utah juniper might be present. The stand exhibits mixed age classes and canopy cover exceeds 30 percent. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat-forming forbs might increase. Annual non-native species are present primarily under tree canopies. Utah juniper might be present. This community is at risk of crossing a threshold, without proper management this phase will transition to the Infilled Tree State 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

### Pathway 2.1a Community 2.1 to 2.2

A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component. This allows for the perennial bunchgrasses to dominate the site.

### Pathway 2.1b Community 2.1 to 2.4

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual infilling of singleleaf pinyon.

### Pathway 2.2a Community 2.2 to 2.3

This community phase pathway is a result of time without disturbance such as fire, long-term drought, or disease which allows for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory might also reduce perennial grass understory.

### Pathway 2.3b Community 2.3 to 2.1

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of singleleaf pinyon. Excessive

### Pathway 2.3a
### Community 2.3 to 2.2

Fire reduces or eliminates tree canopy, allowing perennial grasses to dominate the site.

### Pathway 2.4a
### Community 2.4 to 2.1

Low intensity fire, insect infestation, or disease kills individual trees within the stand, reducing canopy cover to less than 35 percent. Over time young trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass community increases in density and vigor. Annual non-natives present in trace amounts.

### Pathway 2.4b
### Community 2.4 to 2.2

A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component which will allow for the perennial bunchgrasses to dominate the site. Annual non-native grasses typically respond positively to fire and might increase in the post-fire community.

## State 3
## Infilled Tree

This state has two community phases characterized by the dominance of singleleaf pinyon in the overstory. This state is identifiable by greater than 50 percent cover of singleleaf pinyon and a mixed age class. Older trees are at maximal height and upper crowns might be flat-topped or rounded. Younger trees are typically cone- or pyramidal-shaped. Understory vegetation is sparse due to increasing shade and competition from trees.

### Community 3.1

Singleleaf pinyon dominates the aspect. Understory vegetation is thinning. Perennial bunchgrasses are sparse and mountain big sagebrush skeletons are as common as live shrubs due to tree competition for soil water, overstory shading, and duff accumulation. Tree canopy cover is greater than 50 percent. Utah juniper might be present. Annual non-native species are present or co-dominate in the understory. Bare ground areas are prevalent and soil redistribution is evident. This community phase is typically described as a Phase II woodland (Miller et al. 2008).

### Community 3.2

Singleleaf pinyon dominates the aspect and Utah juniper might be present. Tree canopy cover exceeds 50 percent. Utah juniper might be present. Understory vegetation is sparse to absent. Perennial bunchgrasses, if present, exist in the dripline or under the canopy of trees. Mountain sagebrush skeletons are common or the sagebrush has been extinct long enough that only scattered limbs remain. Mat-forming forbs or Sandberg’s bluegrass might dominate interspaces. Annual non-native species are present and are typically found under the trees. Bare ground areas are large and interconnected. Soil redistribution might be extensive. This community phase is typically described as a Phase III woodland (Miller et al. 2008).

### Pathway 3.1a
### Community 3.1 to 3.2

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of singleleaf pinyon. Infilling by younger trees continues.

## State 4
## Annual State

This community is characterized by the dominance of annual non-native species such as cheatgrass and tansy

mustard in the understory. Rabbitbrush or other sprouting shrubs might dominate the overstory. Annual non-native species dominate the understory. Ecological dynamics are significantly altered in this state. Annual non-native species create a highly combustible fuel bed that shortens the fire return interval. Nutrient cycling is spatially and temporally truncated as annual plants contribute significantly less to deep soil carbon. This state was not seen in MLRA 26 during field work for this project, however it is possible given increased fire activity in these sites and their proximity to known annual states of sagebrush ecological sites. We refer the reader to the report for Disturbance Response Group 21 for MLRA 28A and 28B.

### Community 4.1

Cheatgrass, mustards and other non-native annual species dominate the site. Trace amounts of perennial bunchgrasses might be present. Sprouting shrubs might increase. Burned tree skeletons present.

### Transition T1A
### State 1 to 2

Trigger: Introduction of non-native annual species. Slow variables: Over time the annual non-native plants will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

### Transition T1B
### State 1 to 3

Trigger: Time and a lack of disturbance allow trees to dominate site resources; might be coupled with inappropriate grazing management that favors shrub and tree dominance. Slow variables: Over time the abundance and size of trees will increase. Threshold: Singleleaf pinyon canopy cover is greater than 50 percent. Little understory vegetation remains due to competition with trees for site resources.

### Transition T2A
### State 2 to 3

Trigger: Time and a lack of disturbance allow trees to dominate site resources; might also be coupled with inappropriate grazing management that favors shrub and tree dominance. Slow variables: Over time the abundance and size of trees will increase. Threshold: Pinyon canopy cover is greater than 30 percent. Little understory vegetation remains due to competition with trees for site resources.

### Transition T2B
### State 2 to 4

Trigger: Catastrophic crown fire facilitates the establishment of non-native, annual weeds. Slow variables: Increase in tree crown cover, loss of perennial understory and an increase in annual non-native species. Threshold: Cheatgrass or other non-native annuals dominate understory. Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and nutrient redistribution, and reduces soil organic matter. Increased canopy cover of trees allows severe stand- replacing fire. The increased seed bank of non-native, annual species responds positively to post-fire conditions facilitating the transition to an Annual State.

### Restoration pathway R3A
### State 3 to 2

Manual or mechanical thinning of trees coupled with seeding. Probability of success is highest from community phase 3.1.

### Transition T3A
### State 3 to 4

Trigger: Catastrophic fire reduces the tree overstory and allows for the annual non-native species in the understory

to dominate the site. Soil disturbing treatments such as slash and burn might also reduce tree canopy and allow for non-native annual species to increase. Slow variables: Over time, cover and production of annual non-native species increases. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes temporal and spatial nutrient capture and cycling within the community. Increased, continuous fine fuels modify the fire regime by increasing frequency, size, and spatial variability of fires.

## Additional community tables

**Table 6. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Primary Perennial Grasses** | | | 134–296 | |
| | muttongrass | POFE | *Poa fendleriana* | 45–108 | – |
| | Thurber's needlegrass | ACTH7 | *Achnatherum thurberianum* | 45–108 | – |
| | basin wildrye | LECI4 | *Leymus cinereus* | 22–40 | – |
| | western needlegrass | ACOCO | *Achnatherum occidentale ssp. occidentale* | 22–40 | – |
| 2 | **Secondary Perennial Grasses** | | | 4–22 | |
| | Sandberg bluegrass | POSE | *Poa secunda* | 4–22 | – |
| **Forb** | | | | | |
| 3 | **Perennial** | | | 8–44 | |
| | arrowleaf balsamroot | BASA3 | *Balsamorhiza sagittata* | 4–22 | – |
| | tapertip hawksbeard | CRAC2 | *Crepis acuminata* | 4–22 | – |
| **Shrub/Vine** | | | | | |
| 4 | **Primary Shrubs** | | | 66–120 | |
| | mountain big sagebrush | ARTRV | *Artemisia tridentata ssp. vaseyana* | 22–40 | – |
| | mormon tea | EPVI | *Ephedra viridis* | 22–40 | – |
| | antelope bitterbrush | PUTR2 | *Purshia tridentata* | 22–40 | – |
| 5 | **Secondary Shrubs** | | | 12–66 | |
| | Utah serviceberry | AMUT | *Amelanchier utahensis* | 4–22 | – |
| | currant | RIBES | *Ribes* | 4–22 | – |
| | snowberry | SYMPH | *Symphoricarpos* | 4–22 | – |
| **Tree** | | | | | |
| 6 | **Deciduous** | | | 4–22 | |
| | curl-leaf mountain mahogany | CELE3 | *Cercocarpus ledifolius* | 4–22 | – |
| 7 | **Evergreen** | | | 24–44 | |
| | singleleaf pinyon | PIMO | *Pinus monophylla* | 22–40 | – |
| | Utah juniper | JUOS | *Juniperus osteosperma* | 2–4 | – |

**Table 7. Community 1.1 forest overstory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) | Diameter (In) | Basal Area (Square Ft/Acre) |
|---|---|---|---|---|---|---|---|
| **Tree** | | | | | | | |
| singleleaf pinyon | PIMO | *Pinus monophylla* | Native | – | 85–100 | – | – |
| Utah juniper | JUOS | *Juniperus osteosperma* | Native | – | 0–15 | – | – |
| curl-leaf mountain mahogany | CELE3 | *Cercocarpus ledifolius* | Native | – | 0–15 | – | – |

## Animal community

Livestock Interpretations:
This site is suited to cattle and sheep grazing where terrain permits. Grazing management should be keyed to muttongrass and Thurber’s needlegrass production. These grasses are highly nutritious and remain palatable throughout the grazing season. New plants of these grasses are established entirely from seed and grazing practices should allow for ample seed production and seedling establishment. Many areas are not used because of steep slopes or lack of adequate water. Harvesting trees under a sound management program for fuelwood, posts or other wood products can open the tree canopy to allow increased production of understory species desirable for grazing.

Initial stocking rates vary with such factors as kind and class of grazing animal, season of use and fluctuations in climate. The most reliable basis for developing initial stocking rates are actual use records for individual sites (a determination of the degree to which the sites have been grazed and an evaluation of trend in site condition). For a given grazing unit, selection of initial stocking rates is a planning decision. This decision should be made after careful consideration of (a) total resources available, (b) evaluation of alternatives for use, and (c) treatment and establishment of objectives by the decisionmaker.

The forage value rating is not an ecological evaluation of the understory. The range condition rating for rangeland however is a forage value rating. The forage value rating is a utilitarian rating of the existing understory plants for use by specific kinds of grazing animals. The amount and nature of the understory vegetation in a forestland is highly responsive to the amount and duration of shade provided by the overstory canopy. Significant changes in kinds and abundance of plants occur as the canopy changes, often regardless of grazing use.

Wildlife Interpretations:
Pinyon forests provide shelter and forage for numerous species of wildlife; some of which may be obligate to these woodlands such as pinyon mice and woodrats. These forests have value as habitat for several large mammals such as mule deer, pronghorn, bighorn sheep, wild horses, mountain lions, and bears. Gray foxes, bobcats, coyotes, weasels, skunks, badgers, and ringtails search for prey here. Black bears use this site in the fall while foraging on pinyon pine nuts. Feral horses will use this site in the late spring, summer and fall. Many species of birds and reptiles find food and shelter here. Pinyon forests are important wintering areas for Clark's nutcrackers. The quantity and variety of species using the pinyon forest changes with succession.

## Hydrological functions

In a representative stand with a sparse canopy cover, the hydrologic cover condition of this site is fair. The average runoff curve is 80 for group C soils.

## Recreational uses

The trees on this site provide a welcome break in an otherwise open landscape. Steep slopes and stony surfaces inhibit many forms of recreation. It has potential for hiking, cross-country skiing, camping, and for big game as well as upland game hunting.

## Wood products

Singleleaf pinyon trees serve as a food source, as well as providing medicinal, cultural, and spiritual values for

Native Americans. Pinyon wood is rather soft, brittle, heavy with pitch, and yellowish brown in color. Singleleaf pinyon has played an important role as a source of fuelwood and mine props. It has been a source of wood for charcoal used in ore smelting. It still has a promising potential for charcoal production. Other important uses for this tree are for Christmas trees and as a source of nuts for wildlife and human food. Thousands of pounds of nuts are gathered each year and sold throughout the United States. Diseases of singleleaf pinyon include infestations of dwarf mistletoe (a parasite), and blister rust. The mountain pine beetle attacks singleleaf pinyon.

PRODUCTIVE CAPACITY

Moderate quality site for tree production.
Site index ranges from approximately 65 to 90 (Howell,1940).

Productivity Class: 1.0
CMAI*: 6.7 to 12.3 ft3/ac/yr;
0.5 to 0.90 m3/ha/yr.
*CMAI: is the culmination of mean annual increment highest average growth rate of the stand in the units specified.

Fuelwood Production: 12 to 15 cords per acre for stands averaging 5 inches in diameter at 1 foot height. Approximately, 289,000 gross British Thermal Units (BTUs) exist per cubic foot of singleleaf pinyon wood exist. Firewood is commonly measured by cord, or a stacked unit equivalent to 128 cubic feet. Solid wood volume in a cord varies but assuming an average of 75 cubic feet of solid wood per cord, nearly 21 million BTUs of heat value exist in a cord of singleleaf pinyon wood.

Christmas trees: 15 to 25 trees per acre in stands of medium canopy.

Pinyon Nuts: Annual production varies greatly, but mature woodland stage can yield over 200 pounds per acre in favorable years.
MANAGEMENT GUIDES AND INTERPRETATIONS

1) LIMITATIONS AND CONSIDERATIONS
a) Potential for sheet and rill erosion is moderate to severe depending on slope.
b) Severe equipment limitations due to steep slopes and on sites having extreme surface stoniness.
c) Proper spacing is the key to a well-managed, multiple use and multi-product.

2) ESSENTIAL REQUIREMENTS
a) Adequately protect from wildfire.
b) Protect soils from accelerated erosion.
c) Apply proper grazing management.

3) SILVICULTURAL PRACTICES
a) Harvest cut selectively or in small patches size dependent upon site conditions) to enhance forage production.
i) Thinning and improvement cutting - Removal of poorly formed, diseased and low vigor trees for fuelwood.
ii) Harvest cutting - Selectively harvest surplus trees to achieve desired spacing. Save large, healthy, full-crowned singleleaf pinyon trees for nut producers. Do not select only "high grade" trees during harvest.
iii) Slash Disposal - broadcasting slash improves reestablishment of native understory herbaceous species and establishment of seeded grasses and forbs after tree harvest.
iv) Spacing Guide - D+10
b) Prescription burning program to maintain desired canopy cover and manage site reproduction.
c) Mechanical tree removal (i.e. chaining) is typically not recommended on this site due to steep slopes.
d) Pest control - Porcupines can cause extensive damage and populations should be controlled.
e) Fire hazard - Fire typically is not a problem in well-managed, mature stands.

## Other products

The pitch of singleleaf pinyon is used by Native Americans as an adhesive, caulking material, and a paint binder. It may also be used medicinally and chewed like gum. Pinyon seeds are a valuable food source for humans, and a

valuable commercial crop. Native Americans use big sagebrush leaves and branches for medicinal teas, and the leaves as a fumigant. Bark is woven into mats, bags and clothing. Basin wildrye is used as bedding for various Native American ceremonies, providing a cool place for dancers to stand.

## Other information

Curl-leaf mountain mahogany might be planted to help stabilize soil in disturbed areas such as roadcuts and mine spoils. 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. 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. Basin wildrye is useful in mine reclamation, fire rehabilitation and stabilizing disturbed areas. Its usefulness in range seeding, however, may be limited by initially weak stand establishment.

**Table 8. Representative site productivity**

| Common Name | Symbol | Site Index Low | Site Index High | CMAI Low | CMAI High | Age Of CMAI | Site Index Curve Code | Site Index Curve Basis | Citation |
|---|---|---|---|---|---|---|---|---|---|
| singleleaf pinyon | *PIMO* | 35 | 90 | 7 | 12 | – | – | – | |
| singleleaf pinyon | *PIMO* | 65 | 90 | 7 | 12 | – | – | – | |

## Inventory data references

NASIS data for soil survey areas CA686, CA729, CA732, NV625, NV628, NV629, NV772, NV773, NV774, and NV799.

## Type locality

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

## References


. Fire Effects Information System. http://www.fs.fed.us/database/feis/.

Stringham, T.K., D. Snyder, P. Novak-Echenique, K. O'Neill, A. Lyons, and M. Johns. 2021. Great Basin Ecological Site Development Project: State-and-Transition Models for Major Land Resource Area 26, Nevada and Portions of California..


## Other references


Howell, J. 1940. Pinyon and juniper: a preliminary study of volume, growth, and yield. Regional Bulletin 71. Albuquerque, NM.

Jordan, M. 1974. An Inventory of Two Selected Woodland Sites in the Pine Nut Hills of Western Nevada. Master's Thesis, UN-Reno.

Skelly, J. and J. Christopherson. Pinyon Pine -Management Guidelines for Common Pests. University of Nevada Reno Cooperative Extension, Nevada Division of Forestry.

USDA-NRCS.1998. National Forestry Manual - Part 537. Washington, D.C.

USDA, NRCS. 2021. The PLANTS Database (http://plants.sc.egov.usda.gov, 05/05/2021). National Plant Data

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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) | |
| Contact for lead author | |
| Date | 05/05/2024 |
| Approved by | Kendra Moseley |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**