USDA Natural Resources Conservation Service

Ecological site R028AY131NV
MOIST CLAYPAN 12-16 P.Z.

Accessed: 06/30/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 028A–Ancient Lake Bonneville

MLRA 28A occurs in Utah (82%), Nevada (16%), and Idaho (2%). It makes up about 36,775 square miles. A large area west and southwest of Great Salt Lake is a salty playa. This area is the farthest eastern extent of the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. They are not well dissected because of low rainfall in the MLRA. Most of the valleys are closed basins containing sinks or playa lakes. Elevation ranges from 3,950 to 6,560 ft. in the basins and from 6,560 to 11,150 ft. in the mountains. Most of this area has alluvial valley fill and playa lakebed deposits at the surface. Great Salt Lake is all that remains of glacial Lake Bonneville. A level line on some mountain slopes indicates the former extent of this glacial lake. Most of the mountains in the interior of this area consist of tilted blocks of marine sediments from Cambrian to Mississippian age. Scattered outcrops of Tertiary continental sediments and volcanic rocks are throughout the area. The average annual precipitation is 5 to 12 ins. in the valleys and is as much as 49 ins. in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39 to 53 °F. The freeze-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. The dominant soil orders in this MLRA are Aridisols, Entisols, and Mollisols. The soils in the area dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained, loamy or loamy-skeletal, and very deep.

Ecological site concept

This site occurs on concave mountain sideslopes and hills on northerly exposures. Slopes range from 15 to 50 percent, but slope gradients of 15 to 30 percent are typical. Elevations are 7800 to about 9000 feet.

Average annual precipitation is 12 to 16 inches. Moisture from intermittent convection storms provides an important source of precipitation from July through September. Mean annual air temperature is 40 to 43 degrees F. The average frost free period is about 40 to 70 days.

The soils associated with this ecological site are moderately deep and well drained. Soils are formed in the residuum and colluvium derived from welded tuff. Soils are modified with 35 to 50 percent gravels and cobbles. The soils have a mollic epipedon and an argillic horizon.

The reference state is dominated by low sagebrush, Utah serviceberry, mountain snowberry and muttongrass. Production ranges from 500 to 800 pounds per acre.

Associated sites

F028AY078NV	**POTR5-PIEN WSG:1R1907**
F028AY080NV	**ABCOC-PSMEG (White Fir-Douglas Fir)**
R028AY058NV	**STONY MAHOGANY SAVANNA**
R028AY059NV	**MAHOGANY SAVANNA**
R028AY060NV	**MAHOGANY THICKET**
R028AY062NV	**MOUNTAIN RIDGE**
R028AY066NV	**GRAVELLY LOAM 12-14 P.Z.**
R028AY126NV	**COBBLY CLAYPAN 12-14 P.Z.**

Similar sites

R028AY062NV	**MOUNTAIN RIDGE** Less productive site; PSSPS dominant grass; higher elevations
R028AY061NV	**CLAYPAN 14+ P.Z.** Less diverse shrub community; PSSPS dominant grass
R028AY094NV	**CLAYPAN 12-14 P.Z.** PSSPS dominant grass; PUTR2 common shrub
R028AY125NV	**GRAVELLY CLAYPAN 14+ P.Z.** PSSPS dominant grass; PUTR2 codominant shrub
R028AY126NV	**COBBLY CLAYPAN 12-14 P.Z.** PSSPS dominant grass; PUTR2 codominant shrub; less productive site

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia arbuscula* (2) *Amelanchier utahensis*
Herbaceous	(1) *Poa fendleriana*

Physiographic features

This site occurs on concave mountain sideslopes and hills on northerly exposures. Slopes range from 15 to 50 percent, but slope gradients of 15 to 30 percent are typical. Elevations are 7800 to about 9000 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope
Elevation	7,800–9,000 ft
Slope	15–50%
Aspect	N

Climatic features

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).

Average annual precipitation is 12 to 16 inches. Moisture from intermittent convection storms provides an important source of precipitation from July through September. Mean annual air temperature is 40 to 43 degrees F. The average frost free period is about 40 to 70 days.

Mean Annual precipitaion at PIOCHE, NEVADA Climate Station (266252) is 13.6 inches

Monthly mean precipitation is:
January 1.55; February 1.48; March 1.59;
April 1.05; May 0.96; June 0.38; July 1;
August 1.35; September 0.91; October 1.03;
November 1.01; December 1.29.

Table 3. Representative climatic features

Frost-free period (average)	0 days
Freeze-free period (average)	55 days
Precipitation total (average)	14 in

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this ecological site are moderately deep and well drained. Soils are formed in the residuum and colluvium derived from welded tuff. Soil surface textures are ashy gravelly loams. Soils are modified with 35 to 50 percent gravels and cobbles. The soils have a mollic epipedon and an argillic horizon. Soils have slow permeability and high runoff. The depth to the argillic horizon that has slow permeability mimics soils with abrupt upper textural boundaries. The soil moisture regime is xeric and the soil temperature regime is cryic. Soil series associated with this ecological site include: Oxvalley.

The representative soil series is Oxvalley, a Clayey-skeletal, smectitic Pachic Argicryolls. Diagnostic horizons include a mollic epipedon from the surface to 66 cm, an argillic horizon from 40 to 92 cm, and a lithic contact at 92 cm. Clay content in the particle control section averages 35 to 50 percent. Rock fragments range from 35 to 50 percent. Reaction is neutral to slightly alkaline. Effervescence is none. Lithology consists of welded tuff and minor amounts of quartzite.

Table 4. Representative soil features

Parent material	(1) Residuum–welded tuff (2) Colluvium–quartzite
Surface texture	(1) Gravelly loam (2) Ashy
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Slow
Soil depth	30–37 in
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	3.5–5 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)	6.7–7.7
Subsurface fragment volume <=3" (Depth not specified)	10–15%
Subsurface fragment volume >3" (Depth not specified)	25–35%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and it has a set of key characteristics that influence a site's resilience to disturbance and resistance to invasives. Key characteristics include 1) climate (precipitation, temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration, runoff), 4) soils (depth, texture, structure, organic matter), 5) plant communities (functional groups, productivity), and 6) natural disturbance regime (fire, herbivory, etc.)(Caudle 2013). Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).
The ecological site is dominated by deep-rooted cool season, perennial bunchgrasses and long-lived shrubs (50+ years) with high root to shoot ratios. The dominant shrubs usually root to the full depth of the winter-spring soil

moisture recharge, which ranges from 1.0 to over 3.0 m (Dobrowolski et al. 1990). Root length of mature sagebrush plants was measured to a depth of 2 meters in alluvial soils in Utah (Richards and Caldwell 1987). However, community types with low sagebrush as the dominant shrub were found to have soil depths and thus available rooting depths of 71 to 81 cm in a study in northeast Nevada (Jensen 1990).These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992).
Periodic drought regularly influences sagebrush ecosystems and drought duration and severity as increased throughout the 20th century in much of the Intermountain West. Major shifts away from historical precipitation patterns have the greatest potential to alter ecosystem function and productivity. Species composition and productivity can be altered by the timing of precipitation and water availability with the soil profile (Bates et al. 2006). Low sagebrush is fairly drought tolerant but also tolerates perched water tables during some portion of the growing season. Low sagebrush is also susceptible to the sagebrush defoliator, Aroga moth. Aroga moth can partially or entirely kill individual plants or entire stands of big sagebrush (Furniss and Barr 1975), but the research is inconclusive of the damage sustained by low sagebrush populations.
The Great Basin sagebrush communities have high spatial and temporal variability in precipitation both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition or can increase resource pools by the decomposition of dead plant material following disturbance. The invasion of sagebrush communities by cheatgrass has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al. 2007).
The range and density of singleleaf pinyon and Utah juniper has increased since the middle of the nineteenth century (Tausch 1999, Miller and Tausch 2000). Causes for expansion or infilling of trees into sagebrush ecosystems include wildfire suppression, historic livestock grazing, and climate change (Bunting 1994). Mean fire return intervals prior to European settlement in low sagebrush ecosystems were greater than 100 years, however frequent enough to inhibit the encroachment and expansion of singleleaf pinyon and Utah juniper into these low productive sagebrush cover types (Miller and Tausch 2000). Thus, trees were isolated to fire-safe areas such as rocky outcroppings and areas with low-productivity. An increase in crown density causes a decrease in understory perennial vegetation and an increase in bare ground. This allows for the invasion of non-native annual species such as cheatgrass. With annual species in the understory wildfire can become more frequent and increase in intensity. With frequent wildfires these plant communities can convert to annual species with a sprouting shrub and juvenile tree overstory.

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

Fire Ecology:
Fire return intervals have been estimated at 100-200 years in black sagebrush dominated sites (Kitchen and McArthur 2007) and likely is similar in the low sagebrush ecosystem; however, historically fires were probably patchy due to the low productivity of these sites. Fine fuel loads generally average 100 to 400 pounds per acre (110- 450 kg/ha) but are occasionally as high as 600 pounds per acre (680 kg/ha) in low sagebrush habitat types (Bradley et al. 1992). Recovery time of low sagebrush following fire is variable (Young 1983). After fire, if regeneration conditions are favorable, low sagebrush recovers in 2 to 5 years, however on harsh sites where cover is low to begin with and/or erosion occurs after fire, recovery may require more than 10 years (Young 1983). Slow regeneration may subsequently worsen erosion (Blaisdell et al. 1982). Low sagebrush is killed by fire and does not sprout (Young 1983). Establishment after fire is from seed, generally blown in and not from the seed bank (Bradley et al. 1992). Fire risk is greatest following a wet, productive year when there is greater production of fine fuels (Beardall and Sylvester 1976).

Fire will remove aboveground biomass from bluebunch wheatgrass but plant mortality is generally low (Robberecht and Defossé 1995) because the buds are underground (Conrad and Poulton 1966) or protected by foliage. Uresk et al. (1976) reported burning increased vegetative and reproductive vigor of bluebunch wheatgrass. Thus, bluebunch wheatgrass is considered to experience slight damage to fire but is more susceptible in drought years (Young 1983). Plant response will vary depending on season, fire severity, fire intensity and post-fire soil moisture availability.
Sandberg bluegrass, a minor component of this ecological site, has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975). Sandberg bluegrass may retard reestablishment of deeper

rooted bunchgrass.

Muttongrass is top killed by fire but will resprout after low to moderate severity fires. A study by Vose and White (1991) in an open sawtimber site, found minimal difference in overall effect of burning on mutton grass.

Singleleaf pinyon and Utah juniper are usually killed by fire, and are most vulnerable to fire when they are under four feet tall (Bradley et al. 1992). Larger trees, because they have foliage farther from the ground and thicker bark, can survive low severity fires but mortality does occur when 60% or more of the crown is scorched. With the low production of the understory vegetation, high severity fires within this plant community were not likely and rarely became crown fires (Bradley et al. 1992, Miller and Tausch 2000). Tree density on this site increases with grazing management that favors the removal of fine fuels and management focused on fire suppression. Singleleaf pinyon and Utah juniper reestablish by seed from nearby seed source or surviving seeds. Utah juniper begins to produce seed at about 30 years old (Bradley et al. 1992). Seeds establish best through the use of a nurse plant such as sagebrush and rabbitbrush (Everett and Ward 1984, Tausch and West 1988, Bradley et al. 1992).

State and transition model

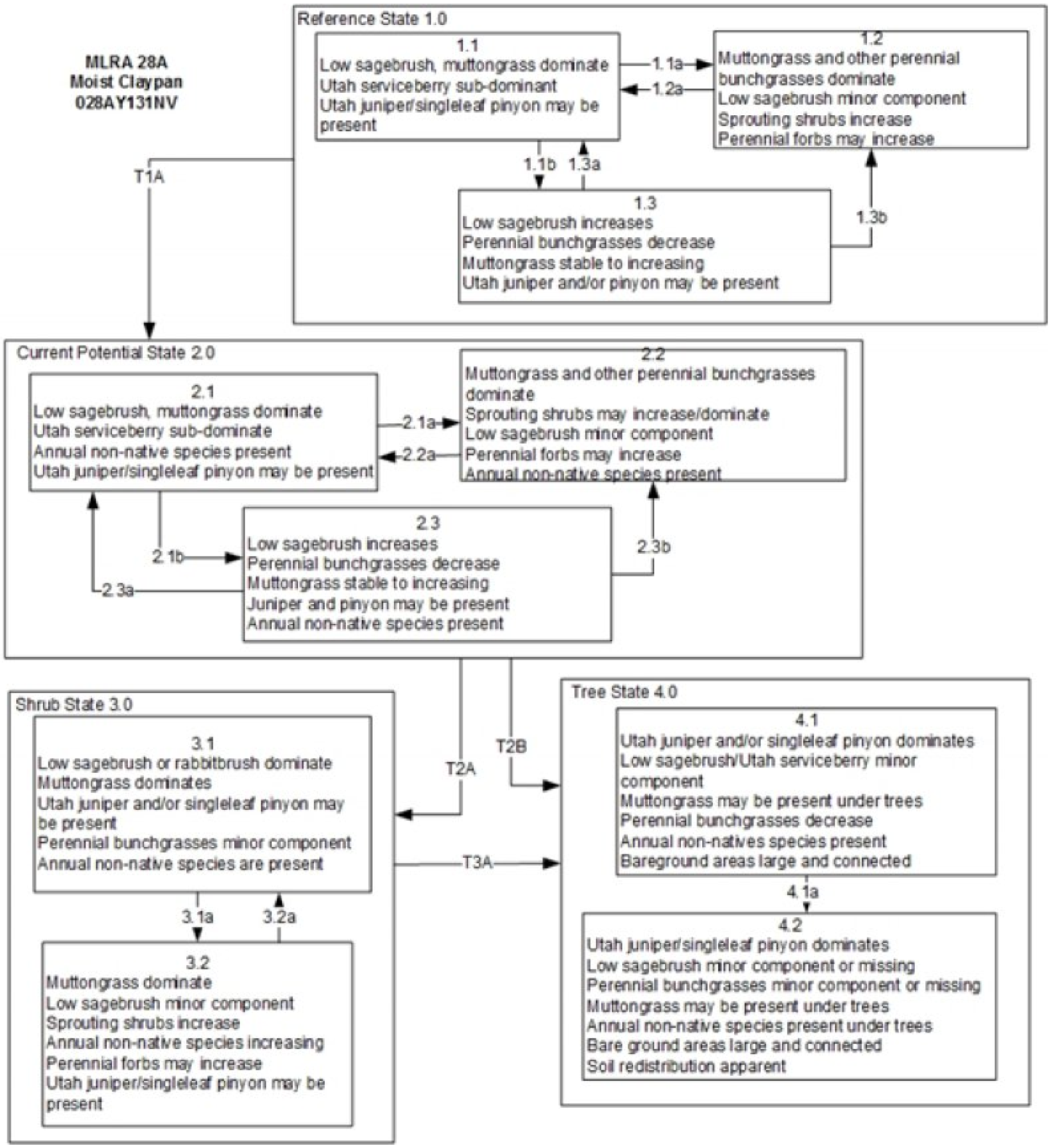

Figure 5. State and Transition Model

MLRA 28A
Moist Claypan
028AY131NV

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

Transition T1A: Introduction of non-native species such as bulbous bluegrass, cheatgrass and thistles.

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire creates grass/sagebrush mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs; non-native annual species present
2.1b: Time and lack of disturbance such as fire or drought. Inappropriate grazing management may also reduce perennial understory.
2.2a: Time and lack of disturbance allows for regeneration of sagebrush
2.3a: Low severity fire creates sagebrush/grass mosaic. Brush management with minimal soil disturbance; late-fall/winter grazing causing mechanical damage to sagebrush.
2.3b: High severity fire significantly reduces sagebrush cover leading to early mid-seral community

Transition T2A: Time and lack of disturbance may be coupled with inappropriate grazing management (3.1), fire (3.2)
Transition T2B: Time and lack of disturbance allows for maturation of tree community

Shrub State 3.0 Community Phase Pathways
3.1a: Fire, inappropriate grazing, and/or brush management with minimal soil disturbance
3.2a: Time and lack of disturbance and/or grazing management that favors shrubs. This is a slow transition, the establishment of low sagebrush can take many years.

Transition T3A: Time and lack of disturbance or management action

Tree State 4.0 Community Phase Pathways
4.1a: Time and lack of disturbance allows for maturation of tree community

Figure 6. Legend

State 1
Reference State

The Reference State 1.0 is a representative of the natural range of variability under pristine conditions. The reference state has 3 general community phases; a shrub-grass dominant phase, a perennial grass dominant phase and a shrub dominant phase. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic drought and/or insect or disease attack.

Community 1.1
Community Phase

This community is dominated by low sagebrush, bluebunch wheatgrass and muttongrass. Forbs and other grasses make up smaller components. Utah serviceberry, Utah juniper and singleleaf pinyon are described in the site concept and may or may not be present in low densities. Potential vegetative composition is about 40% grasses, 10% forbs and 50% shrubs and trees. Approximate ground cover (basal and crown) is 50 to 55 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	230	322	368
Grass/Grasslike	200	280	320
Forb	50	70	80
Tree	20	28	32
Total	**500**	**700**	**800**

Community 1.2
Community Phase

This community phase is characteristic of a post-disturbance, early/mid-seral community. Bluebunch wheatgrass and other perennial bunchgrasses dominate. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush and other sprouting shrubs may be sprouting. Perennial forbs may be a significant component for a number of years following fire.

Community 1.3
Community Phase

Sagebrush increases in the absence of disturbance. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs and/or from herbivory.

Pathway a
Community 1.1 to 1.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring may be more severe and reduce sagebrush cover to trace amounts.

Pathway b
Community 1.1 to 1.3

Time and lack of disturbance such as fire allows for sagebrush to increase and become decadent. Chronic drought, herbivory, or combinations of these will cause a decline in perennial bunchgrasses and fine fuels leading to a reduced fire frequency and allowing sagebrush to dominate the site.

Pathway a
Community 1.2 to 1.1

Time and lack of disturbance will allow sagebrush to increase.

Pathway a
Community 1.3 to 1.1

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

Pathway b
Community 1.3 to 1.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community.

State 2
Current Potential State

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

Community 2.1
Community Phase

This community phase is similar to the Reference State Community Phase 1.1, with the presence of non-native species in trace amounts. Sagebrush, bluebunch wheatgrass and muttongrass dominate the site. Forbs and other shrubs and grasses make up smaller components of this site. Utah juniper and singleleaf pinyon are described in the site concept and may or may not be present in low densities.

Community 2.2
Community Phase

This community phase is characteristic of a post-disturbance, early to mid-seral community where annual non-native species are present. Sagebrush is present in trace amounts; perennial bunchgrasses dominate the site. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush may be sprouting or dominant in the community. Perennial forbs may be a significant component for a number of years following fire. Annual non-native species are stable or increasing within the community.

Community 2.3
Community Phase (at risk)

This community is at risk of crossing a threshold to another state. Sagebrush dominates the overstory and perennial bunchgrasses in the understory are reduced, either from competition with shrubs or from inappropriate grazing, or from both. Rabbitbrush may be a significant component. Sandberg bluegrass may increase and become co-dominate with deep rooted bunchgrasses. Utah juniper and/or singleleaf pinyon may be present and without management will likely increase. Annual non-natives species may be stable or increasing due to lack of competition with perennial bunchgrasses. This site is susceptible to further degradation from grazing, drought, and fire.

Pathway a
Community 2.1 to 2.2

Fire reduces the shrub overstory and allows for perennial bunchgrasses to dominate the site. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring or a change in management favoring an increase in fine fuels may be more severe and reduce sagebrush cover to trace amounts. Annual non-native species are likely to increase after fire.

Pathway b
Community 2.1 to 2.3

Time and lack of disturbance allows for sagebrush to increase and become decadent. Chronic drought reduces fine fuels and leads to a reduced fire frequency, allowing big sagebrush to dominate the site. Inappropriate grazing management reduces the perennial bunchgrass understory; conversely Sandberg bluegrass and muttongrass may increase in the understory depending on grazing management.

Pathway a

Community 2.2 to 2.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of low sagebrush can take many years.

Pathway a
Community 2.3 to 2.1

A change in grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall or winter grazing may cause mechanical damage and subsequent death to sagebrush, facilitating an increase in the herbaceous understory. Brush treatments with minimal soil disturbance will also decrease sagebrush and release the perennial understory. A low severity fire would decrease the overstory of sagebrush and low for the understory perennial grasses to increase. Due to low fuel loads in this State, fires will likely be small creating a mosaic pattern. Annual non-native species are present and may increase in the community.

Pathway b
Community 2.3 to 2.2

Fire eliminates/reduces the overstory of sagebrush and allows for the understory perennial grasses to increase. Fires may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community. Annual non-native species respond well to fire and may increase post burn.

State 3
Shrub State

This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Sandberg bluegrass and muttongrass will increase with a reduction in deep rooted perennial bunchgrass competition and become the dominant grasses. Sagebrush dominates the overstory and rabbitbrush may be a significant component. Sagebrush cover exceeds site concept and may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. The shrub overstory and bluegrass understory dominate site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed.

Community 3.1
Community Phase

Decadent sagebrush dominates the overstory. Rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Sandberg bluegrass, muttongrass and annual non-native species increase. Bare ground is significant. Juniper and/or singleleaf pinyon may be present as a result of encroachment from neighboring sites and lack of disturbance.

Community 3.2
Community Phase

Bluegrass dominates the site; annual non-native species may be present but are not dominant. Trace amounts of sagebrush or rabbitbrush may be present.

Pathway a
Community 3.1 to 3.2

Fire, heavy fall grazing causing mechanical damage to shrubs, and/or brush treatments with minimal soil disturbance, will greatly reduce the overstory shrubs to trace amounts and allow for Sandberg bluegrass to dominate the site.

Pathway a
Community 3.2 to 3.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of low sagebrush can take many years.

State 4
Tree State

This state is characterized by a dominance of Utah juniper and/or singleleaf pinyon in the overstory. Low sagebrush and perennial bunchgrasses may still be present, but they are no longer controlling site resources. Soil moisture, soi nutrients and soil organic matter distribution and cycling have been spatially and temporally altered.

Community 4.1
Community Phase

Utah juniper and/or singleleaf pinyon dominates the overstory and site resources. Trees are actively growing with noticeable leader growth. Trace amounts of bunchgrass may be found under tree canopies with trace amounts of Sandberg bluegrass, muttongrass and forbs in the interspaces. Sagebrush is stressed and dying. Annual non-native species are present under tree canopies. Bare ground interspaces are large and connected.

Community 4.2
Community Phase

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. Sandberg bluegrass, muttongrass or mat forming forbs may be present in trace amounts. Bare ground interspaces are large and connected. Soil redistribution is evident.

Pathway a
Community 4.1 to 4.2

Time and lack of disturbance or management action allows Utah juniper and/or singleleaf pinyon to further mature and dominate site resources.

Transition A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass, mustards, and bur buttercup. Slow variables: Over time the annual non-native species 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 A
State 2 to 3

Trigger: To Community Phase 3.1: Inappropriate grazing will decrease or eliminate deep rooted perennial bunchgrasses, increase Sandberg bluegrass and muttongrass and favor shrub growth and establishment. To Community Phase 3.2: Severe fire in community phase 2.3 will remove sagebrush overstory, decrease perennial bunchgrasses and enhance Sandberg bluegrass and muttongrass. Annual non-native species will increase. Slow variables: Long term decrease in deep-rooted perennial grass density. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

Transition B
State 2 to 4

Trigger: Time and lack of disturbance or management action allows for Utah Juniper and/or singleleaf pinyon to dominate. This may be coupled with grazing management that favors tree establishment by reducing understory herbaceous competition for site resources. Feedbacks and ecological processes: Trees increasingly dominate use of soil water resulting in decreasing herbaceous and shrub production and decreasing organic matter inputs, contributing to reductions in soil water availability for grasses and shrubs and increased soil erodibility. Slow variables: Over time the abundance and size of trees will increase. Threshold: Trees dominate ecological processes and number of shrub skeletons exceed number of live shrubs.

Transition A
State 3 to 4

Trigger: Time and a lack of disturbance or management action allows for Utah Juniper and/or singleleaf pinyon to dominate site. Slow variables: Long-term increase in juniper and/or singleleaf pinyon density. Threshold: Trees dominate ecological processes and number of shrub skeletons exceed number of live shrubs.

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**			175–210	
	muttongrass	POFE	*Poa fendleriana*	175–210	–
2	**Secondary Perennial Grasses**			70–105	
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	4–21	–
	blue grama	BOGR2	*Bouteloua gracilis*	4–21	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	4–21	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	4–21	–
Forb					
3	**Perennial**			35–70	
	common yarrow	ACMI2	*Achillea millefolium*	4–14	–
	tapertip onion	ALAC4	*Allium acuminatum*	4–14	–
	milkvetch	ASTRA	*Astragalus*	4–14	–
	Indian paintbrush	CASTI2	*Castilleja*	4–14	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	4–14	–
	larkspur	DELPH	*Delphinium*	4–14	–
	fleabane	ERIGE2	*Erigeron*	4–14	–
	buckwheat	ERIOG	*Eriogonum*	4–14	–
	stoneseed	LITHO3	*Lithospermum*	4–14	–
	lupine	LUPIN	*Lupinus*	4–14	–
	beardtongue	PENST	*Penstemon*	4–14	–
	phlox	PHLOX	*Phlox*	4–14	–
4	**Annual**			1–14	
Shrub/Vine					
5	**Primary Shrubs**			315–420	
	little sagebrush	ARAR8	*Artemisia arbuscula*	175–210	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	105–140	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	35–70	–
6	**Secondary Shrubs**			14–35	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	7–14	–
	shrubby cinquefoil	DAFR6	*Dasiphora fruticosa*	7–14	–
	pricklypear	OPUNT	*Opuntia*	7–14	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	7–14	–
Tree					
7	**Evergreen**			8–28	
	Utah juniper	JUOS	*Juniperus osteosperma*	4–14	–
	singleleaf pinyon	PIMO	*Pinus monophylla*	4–14	–

Animal community

Livestock/Wildlife Grazing Interpretations:
This site is suitable for livestock grazing. Considerations for grazing management including timing, intensity and

duration of grazing. Targeted grazing could be used to decrease the density of non-natives.
Bunchgrasses, in general, best tolerate light grazing after seed formation. Britton et al. (1990) observed the effects of clipping date on basal area of five bunchgrasses in eastern Oregon, and found grazing from August to October (after seed set) has the least impact. Heavy grazing during the growing season will reduce perennial bunchgrasses and increase sagebrush. Abusive grazing by cattle or horses will likely increase low sagebrush, rabbitbrush and some forbs such as mat forming eriogonums or arrowleaf balsamroot. Annual non-native weedy species such as cheatgrass and mustards, and potentially medusahead, may invade.
Muttongrass is a highly nutritious grass that is known for fattening sheep. Like Sandbergs bluegrass, muttongrass greens up in early spring before many of the other perennial bunchgrasses, and is highly palatable to all classes of livestock as well as good forage to wildlife such as deer and elk (Dayton 1937). In a study by Currie et al. (1977) in a ponderosa pine forest deer preferred muttongrass which comprised up to 18% of their diet.

Low sagebrush is considered valuable browse in the spring, fall and winter months for wildlife. In a study by Barnett and Crawford (1994), low sagebrush-bluebunch wheatgrass community was used during the pre-laying season of sagegrouse hens, sagebrush composed 50 to 80% of the diet by dry weight. Pronghorn antelope commonly use low sagebrush ranges through the summer months (Kindschy et al. 1982) and deer make heavy use of low sagebrush community types in early spring (Urness 1965).
Domestic sheep and, to a much lesser degree, cattle consume low sagebrush, particularly during the spring, fall, and winter (Sheehy and Winward 1981). Heavy dormant season grazing by sheep will reduce sagebrush cover and increase grass production (Laycock 1967). Severe trampling damage to supersaturated soils could occur if sites are used in early spring when there is abundant snowmelt. Trampling damage is likely to be localized in nature around areas where livestock or feral horses congregate. Trampling damage, particularly from cattle or horses, in low sagebrush habitat types is greatest when high clay content soils are wet. In drier areas with more gravelly soils, no serious trampling damage occurs, even when the soils are wet (Hironaka et al. 1983). Bottlebrush squirreltail may provide forage for mule deer and pronghorn.
Pygmy rabbits, a threatened species of conservation concern throughout California, Oregon, Nevada, Idaho, Montana, Wyoming and Utah (endangered in Washington) often burrow where low sagebrush mixes with mountain big sagebrush. Low sagebrush is an important shrub for pygmy rabbits and other sagebrush obligate species (Oregon Conservation Strategy, 2006). In southwest Idaho, Oregon, Montana and Nevada, pygmy will burrow where the big sagebrush form islands within the low sagebrush matrix (Keinath and McGee 2004). Sage grouse, another threatened species of conservation concern and sagebrush obligate species, feeds almost exclusively on leaves of sagebrush. Although big sagebrush dominates the diet in most portions of the range sage grouse inhabit low sagebrush varieties will be consumed depending on availability (Connelly et al. 2000). Other bird species, such as the Columbian sharp-tailed grouse, use low sagebrush, as it provides intermediate cover (Saab and Marks. 1992).
Several reptiles and amphibians are distributed throughout the sagebrush steppe in the west in Nevada, where low sagebrush is known to grow (Bernard and Brown 1977). Studies have not determined if reptiles and amphibians prefer certain species of sage; however, researchers agree that maintaining habitat where low sagebrush and reptiles and amphibians occur is important.

Hydrological functions

Runoff is high. Permeability is slow.

Recreational uses

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

Other products

Utah serviceberry fruits were used by Native Americans and early European explorers in North America for food and medicine. Mountain snowberry is useful for establishing cover on bare sites and has done well when planted onto roadbanks.

Other information

Utah serviceberry has been used to revegetate big game winter range and for surface stabilization. It grows slowly from seed and therefore transplanting may be more successful than seeding for revegetation projects. Low sagebrush can be successfully transplanted or seeded in restoration.

Type locality

Location 1: Lincoln County, NV	
Township/Range/Section	T1N R71E S7
UTM zone	N
UTM northing	0757800
UTM easting	4206188
Latitude	37° 58′ 0″
Longitude	114° 3′ 55″
General legal description	Mahogany Mountains, Lincoln County, Nevada. Approximately 0.35 miles south of Ox Valley Spring.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	PATTI NOVAK-ECHENIQUE
Contact for lead author	State Rangeland Management Specialist
Date	04/07/2014
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are none to rare. A few may occur on steeper slopes after summer convection storms.

Rills are short (<1 m) and stable.

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2. **Presence of water flow patterns:** Water flow patterns are none to rare. A few (short <1m and not connected) can be expected in areas recently subjected to summer convection storms or rapid snowmelt.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground ± 5-20% depending on amount of surface rock fragments.

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

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

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

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 4 to 6 on most soil textures found on this site.

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

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., muttongrass]) slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are none. Subsoil argillic or massive horizons are not to be interpreted as compacted.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live**

foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):

Dominant: Reference State: low shrubs (low sagebrush) > Deep-rooted, cool season, perennial bunchgrasses

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

Other: evergreen trees, succulents

Additional: With an extended fire return interval, the shrub and tree component will increase at the expense of the herbaceous component. Singleleaf pinyon may increase and eventually dominate this site and the understory would be greatly reduced.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 20% of total woody canopy; some of the mature bunchgrasses (<10%) have dead centers.

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14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (30-40%) and litter depth is ±¼ inch.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (through mid-June) ±700 lbs/ac; Favorable years ±800 lbs/ac and unfavorable years ±500 lbs/ac.

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