USDA Natural Resources Conservation Service

Ecological site R028BY020NV
SODIC FLAT 5-8 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.

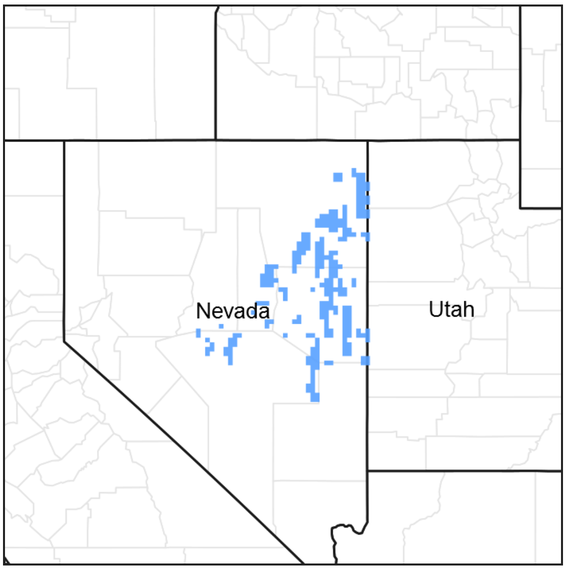

Figure 1. Mapped extent

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): 028B–Central Nevada Basin and Range

MLRA 28B occurs entirely in Nevada and comprises about 23,555 square miles (61,035 square kilometers). More than nine-tenths of this MLRA is federally owned. This area is in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level, aggraded desert basins and valleys between a series of mountain ranges trending north to south. The basins are bordered by long, gently sloping to strongly sloping alluvial fans. The mountains are uplifted fault blocks with steep sideslopes. Many of the valleys are closed basins containing sinks or playas. Elevation ranges from 4,900 to 6,550 feet (1,495 to 1,995 meters) in the valleys and basins and from 6,550 to 11,900 feet (1,995 to 3,630 meters) in the mountains.
The mountains in the southern half are dominated by andesite and basalt rocks that were formed in the Miocene and Oligocene. Paleozoic and older carbonate rocks are prominent in the mountains to the north. Scattered outcrops of older Tertiary intrusives and very young tuffaceous sediments are throughout this area. The valleys consist mostly of alluvial fill, but lake deposits are at the lowest elevations in the closed basins. The alluvial valley fill consists of cobbles, gravel, and coarse sand near the mountains in the apex of the alluvial fans. Sands, silts, and clays are on the distal ends of the fans.
The average annual precipitation ranges from 4 to 12 inches (100 to 305 millimeters) in most areas on the valley floors. Average annual precipitation in the mountains ranges from 8 to 36 inches (205 to 915 millimeters) depending on elevation. The driest period is from midsummer to midautumn. The average annual temperature is 34 to 52 degrees F (1 to 11 degrees C). The freeze-free period averages 125 days and ranges from 80 to 170 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 soil temperature regime, an aridic or xeric soil moisture regime, and mixed or carbonatic mineralogy. They generally are well drained, loamy or loamyskeletal, and shallow to very deep.
Nevada’s climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms and heavy snowfall in the higher mountains. Three basic geographical factors largely influence Nevada’s climate: continentality, latitude, and elevation. 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, as a result 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 midlatitude 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 occasional thundershowers. The eastern portion of the state receives noteworthy 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).

Ecological site concept

This site occurs on alluvial flats and lake plains. Slope gradients of less than 2 percent are typical. Elevations are 4700 to 6200 feet.
The soils associated with this site are very deep, poorly drained, and formed in mixed alluvium and lacustrine sediments. Ground water is within 76cm (approximately 30") of the surface seasonally. The upper profile is strongly salt and sodium affected due to capillary movement of dissolved salts upward from the groundwater. High salt concentrations in the surface horizon and periods of ponding reduce seed viability and germination. Soil moisture regime is aquic and the soil temperature regime is mesic.

The reference state is dominated by black greasewood and alkali sacaton. Vegetation of this site is restricted to coppice mound areas that are surrounded by nearly level, playa-like depressions that are usually barren. Production ranges from 150 to 500 pounds per acre. Potential vegetative composition is about 15 percent grasses, 5 percent forbs, and 80 percent shrubs.

Associated sites

R028BY002NV	**SALINE MEADOW** Saline Meadow: dominated by alkali sacaton
R028BY004NV	**SALINE BOTTOM** Saline bottom: more productive, dominated by basin wildrye
R028BY069NV	**SODIC FLAT 8-10 P.Z.** 028BY069NV can be found adjacent to 028BY020NV, but on slightly elevated positions that do not receive run-on moisture that results in ponding.
R028BY074NV	**SODIC TERRACE 5-8 P.Z.**

Similar sites

R028BY069NV	**SODIC FLAT 8-10 P.Z.** More productive site; vegetation not restricted to coppice mounds; ground cover (basal and crown) at least 15 percent. 028BY069NV is characterized by increased production of basin wildrye and a slightly elevated position on alluvial flats or lake plains that does not receive run-on moisture.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Sarcobatus vermiculatus*
Herbaceous	(1) *Sporobolus airoides* (2) *Distichlis spicata*

Physiographic features

This site occurs on lake plains and alluvial flats adjacent to playas. Slope gradients of less than 2 percent are most typical. Elevations range from 4700 to 6200 feet. This ecological site experiences periods of ponding resulting from run-on moisture. Minor changes in micro-topography, being slightly lower than the surrounding area, reduce production of basin wildrye.

Table 2. Representative physiographic features

Landforms	(1) Lake plain (2) Alluvial flat
Flooding frequency	None
Ponding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Ponding frequency	Rare
Elevation	4,700–6,200 ft
Slope	0–2%
Ponding depth	0 in
Water table depth	0–72 in
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers.

The average annual precipitation ranges from 5 to 8 inches. The mean annual air temperature is about 42 to 55 degrees F. The average growing season is 70 to 140 days.

Mean annual precipitation across the range in which this ES occurs is 7.83".
Monthly mean precipitation: January 0.685; February 0.61; March 0.70; April 0.845; May .97; June 0.68; July 0.50; August 0.395; September 0.50; October 0.745; November 0.60; December 0.60.
*The above data is averaged from the Beowawe and Lages WRCC climate stations.

Table 3. Representative climatic features

Frost-free period (average)	120 days
Freeze-free period (average)	160 days
Precipitation total (average)	8 in

Climate stations used

- (1) LAGES [USC00264341], Ely, NV
- (2) BEOWAWE 49S U OF N RCH [USC00260800], Eureka, NV

Influencing water features

This site is associated with the presence of ground water. Seasonally high water table is within 76cm of the soil surface at some point during the year.

Soil features

The soils associated with this site are very deep, poorly drained, and formed in alluvium derived from mixed rocks and lacustrine sediments. High water table is within 76cm (approximately 30") of the soil surface sometime between January and June. The upper profile is strongly salt and sodium affected due to capillary movement of dissolved salts upward from the groundwater.

Soil chemistry of the surface horizon reduces seed viability and germination. Soil moisture regime is aquic and the soil temperature regime is mesic. The soil series associated with this site are: Benin, Bubus, Boofuss, Dianev, Ewelac, Ixian, Ocala, Orizaba, Orupa, Sader, Sondoa, Umberland, and Vinsad.

The representative soil series is Boofuss, a clayey over loamy, smectitic over mixed, superactive, calcareous, mesic Typic Halaquepts. An ochric epipedon occurs from the soil surface to 18 cm. Soils are strongly alkaline and effervescent throughout. Lithology consists of mixed rocks and lacustrine sediments.

Table 4. Representative soil features

Surface texture	(1) Silt loam (2) Silty clay loam (3) Silty clay
Family particle size	(1) Loamy
Drainage class	Somewhat poorly drained
Permeability class	Very slow
Soil depth	72–84 in
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	5.5–7.9 in
Calcium carbonate equivalent (0-40in)	25–35%
Electrical conductivity (0-40in)	16–32 mmhos/cm
Sodium adsorption ratio (0-40in)	50–80
Soil reaction (1:1 water) (0-40in)	9–9.6
Subsurface fragment volume <=3" (Depth not specified)	2–20%
Subsurface fragment volume >3" (Depth not specified)	0%

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 et al 2013). Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).

The Great Basin shrub 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 moisture resource supporting the greatest amount of plant growth is usually the water stored in the soil profile during the winter. 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.

Black greasewood is classified as a phreatophyte (Eddleman 2002), and its distribution is well correlated with the distribution of groundwater (Mozingo 1987). Meinzer (1927) discovered that the taproots of black greasewood could penetrate from 20 to 57 feet below the surface. Romo (1984) found water tables ranging from 3.5 to 15 m under black greasewood dominated communities in Oregon. Black greasewood stands develop best where moisture is readily available, either from surface or subsurface runoff (Brown 1965). It is commonly found on floodplains that are either subject to periodic flooding, have a high water table at least part of the year, or have a water table less than 34 feet deep (Harr and Price 1972, Blauer et al. 1976, Branson et al. 1976, Blaisdell and Holmgren 1984, Eddleman 2002). Ganskopp (1986) reported that water tables within 9.8 to 11.8 inches of the surface had no effect on black greasewood in Oregon. However, a study, conducted in California, found that black greasewood did not survive six months of continuous flooding (Groeneveld and Crowley 1988, Groeneveld 1990). Black greasewood is usually a deep rooted shrub but has some shallow roots near the soil surface; the maximum rooting depth can be determined by the depth to a saturated zone (Harr and Price 1972).

Drought will initially cause a decline in bunchgrasses, but prolonged drought will eventually cause a decline in shrubs, including black greasewood. As site condition deteriorates, these sites may become a pure stand of black greasewood or a pure stand with an annual understory. Marcum and Kopec (1997) found inland saltgrass more tolerant of increased levels of salinity than alkali sacaton therefore dewatering and/or long term drought causing increased levels of salinity would create environmental conditions more favorable to inland saltgrass over alkali sacaton. Alkali sacaton is considered a facultative wet species in this region; therefore it is not drought tolerant. A lowering of the water table can occur with ground water pumping in these sites and has been identified in other MLRA’s. This may contribute to the loss of deep rooted species such as greasewood and basin wildrye and an increase in rabbitbrush, shadscale and other species with the absence of drought.
Vegetation on these sites is normally restricted to coppice mound areas that are surrounded by playa-like depressions or nearly level, usually barren interspaces. These communities often exhibit the formation of microbiotic crusts within the interspaces. These crusts influence the soils on these sites and their ability to reduce erosion and increase infiltration, they may also alter the soil structure and possibly increase soil fertility (Fletcher and Martin 1948, Williams 1993). Finer textured soils such as silts tend to support more microbiotic cover than coarse texture soils (Anderson et al. 1982). Disturbance such as hoof action from inappropriate grazing and cheatgrass invasion can reduce biotic crust integrity (Anderson et al. 1982, Ponzetti et al. 2007) and increase erosion. Annual non-native species such as Russian thistle, halogeton and cheatgrass invade these sites where competition from perennial species is decreased.

The ecological site has moderate resilience to disturbance and resistance to invasion. A primary disturbance on these ecological sites is extended drought or other disturbance leading to lowering of the seasonal water table. This facilitates an increase in shrubs and a decrease in basin wildrye. The introduction of annual weedy species, like cheatgrass, may cause an increase in fire frequency and eventually lead to an annual state or a state dominated by black greasewood and rabbitbrush. Three possible stable states have been identified for this site but an annual state has been noted in other MLRA’s.

Fire Ecology:

Fire is a rare disturbance in these plant communities likely occurring in years with above average production. Natural fire return intervals are estimated to vary between less than 35 years up to 100 years in salt desert ecosystems with basin wildrye (Paysen et al. 2000). Historically, black greasewood-saltbush communities had sparse understories and bare soil in intershrub spaces, making these communities somewhat resistant to fire (Young 1983, Paysen et al. 2000). They may burn only during high fire hazard conditions; for example, years with high precipitation can result in almost continuous fine fuels, increasing fire hazard (West 1994, Paysen et al. 2000).

Black greasewood may be killed by severe fires, but can resprout after low to moderate severity fires (Robertson 1983, West 1994). Sheeter (1969) reported that following a Nevada wildfire, black greasewood sprouts reached approximately 2.5 feet within 3 years. Grazing and other disturbance may result in increased biomass production due to sprouting and increased seed production, also leading to greater fuel loads (Sanderson and Stutz 1994). Higher production sites would have experienced fire more frequently than lower production sites.

Shadscale is intolerant of fire and can only regenerate through seed (Zielinski 1994). Increases in the fire return interval leads to increases in the shrub component of the plant community, potentially facilitating increases in bare ground, inland salt grass and invasive weeds. Lack of fire combined with excessive herbivory decreases or eliminates the herbaceous understory, favoring black greasewood and annual species. Therefore, fire can be detrimental to these communities, especially in the presence of fire tolerant, annual non-native species.

The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. The initial condition of bunchgrasses within the site along with seasonality and intensity of the fire all factor into the individual species response. For most forbs and grasses the growing points are located at or below the soil surface providing relative protection from disturbances which decrease above ground biomass, such as grazing or fire. Thus, fire mortality is more correlated to duration and intensity of heat which is related to culm density, culm-leaf morphology, size of plant and abundance of old growth (Wright 1971, Young 1983). However, season and severity of the fire will influence plant response. Plant response will vary depending on post-fire soil moisture availability.

Alkali sacaton is a native, long-lived, warm season densely tufted perennial bunchgrass ranging from 20 to 40 inches in height. It usually grows on saline soils but is not restricted to saline soils and can be found on nonsaline soils, rocky sites, open plains, valleys and bottom lands (Dayton 1931). Alkali sacaton is tolerant of, but not resistant to fire. Recovery of alkali sacaton after fire has been reported as 2 to 4 years (Bock and Bock 1978).

Basin wildrye, a minor component on this site, is relatively resistant to fire, particularly dormant season fire, as plants sprout from surviving root crowns and rhizomes (Zschaechner 1985). Miller et al. 2013 reports fall and spring burning increased total shoot and reproductive shoot densities in the first year, although live basal areas were similar between burn and unburned plants. By year two there was little difference between burned and control treatments.

State and transition model

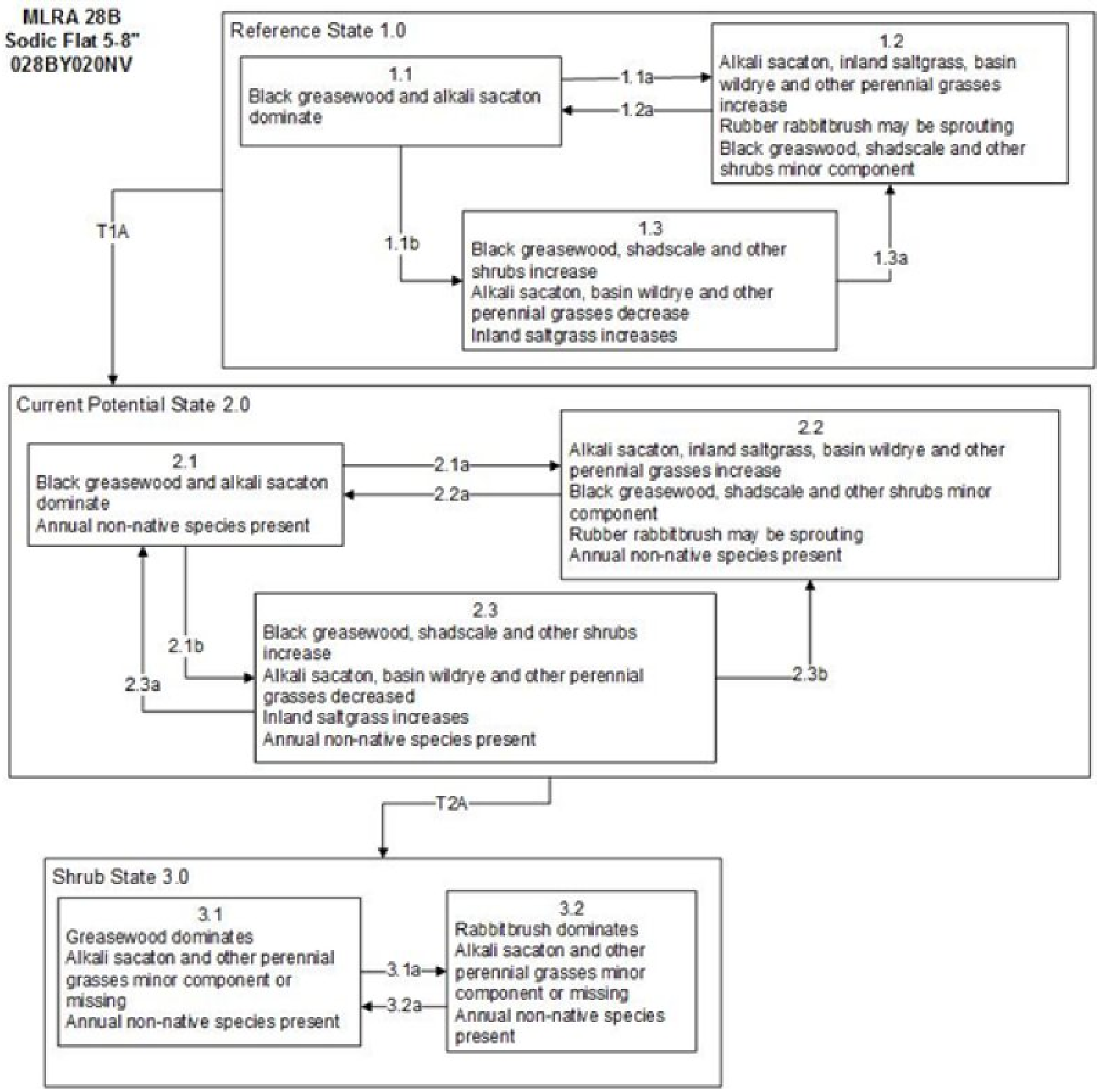

Figure 6. State and Transition Model

MLRA 28B
Sodic Flat 5-8"
028BY020NV

Reference State 1.0 Community Phase Pathways
1.1a: Low severity fire creates grass/shrub mosaic.
1.1b: Time and lack of disturbance, long-term drought, herbivory or combinations.
1.2a: Time and lack of disturbance allows for shrub regeneration.
1.3a: Fire significantly reduces shrub cover and leads to early/mid-seral community.

Transition T1A: Introduction of non-native species such as cheatgrass and halogeton.

Current Potential State 2.0 Community Phase Pathways
2.1a: Fire or brush treatments (i.e. mowing) with minimal soil disturbance.
2.1b: Time and lack of disturbance, long-term drought, inappropriate grazing management or combinations.
2.2a: Time and lack of disturbance allows for shrub regeneration, may be coupled with grazing management to increase shrubs.
2.3a: Heavy late fall/winter grazing, brush treatments and/or fire.

Transition T2A: Inappropriate grazing management would reduce the perennial understory(3.1). Severe fire, lowering of water table from groundwater pumping and/or soil disturbing brush treatments (3.2)

Shrub State 3.0 Community Phase Pathways
3.1a: Long-term drought and/or lowering of the water table due to groundwater pumping and/or severe fire.
3.2a: Release of drought and/or grazing pressure may allow for black greasewood and perennial bunchgrasses to increase

Figure 7. Legend

State 1
Reference State

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

Community 1.1
Community Phase

This community is dominated by black greasewood. Shadscale and rubber rabbitbrush are also common. The herbaceous understory is dominated by alkali sacaton. Inland saltgrass, basin wildrye and other perennial grasses and shrubs make up minor components. Vegetation on this site is normally restricted to coppice mound areas that are surrounded by playa-like depressions or nearly level, usually barren interspaces. Potential vegetative composition is about 15% grasses, 5% forbs, and 80% shrubs. Approximate ground cover (basal and crown) is 15 to 25 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	120	240	400
Grass/Grasslike	22	45	75
Forb	8	15	25
Total	**150**	**300**	**500**

Community 1.2
Community Phase

This community phase is characteristic of a post-disturbance, early-seral community phase. Basin wildrye and alkali sacaton dominate the community. Black greasewood will decrease but will likely sprout and return to pre-burn levels within a few years. Early colonizers such as rabbitbrush and shadscale may increase.

Community 1.3
Community Phase

Figure 9. Sodic Flat 5-8" (R028BY020NV) T.Stringham September 2013

Black greasewood and shadscale increase in the absence of disturbance. Decadent shrubs dominate the overstory and deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs, herbivory, drought or combinations of these.

Pathway a
Community 1.1 to 1.2

A low severity fire would decrease the overstory of black greasewood and allow for the understory perennial grasses to increase. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring facilitating an increase in fine fuels may be more severe and reduce black greasewood cover to trace amounts.

Pathway b
Community 1.1 to 1.3

Absence of disturbance over time, significant herbivory, chronic drought or combinations of these would allow the black greasewood overstory to increase and dominate the site. This will generally cause a reduction in perennial bunchgrasses; however inland saltgrass may increase in the understory depending on the timing and intensity of herbivory. Heavy spring utilization will favor an increase in black greasewood.

Pathway a
Community 1.2 to 1.1

Time and lack of disturbance will allow shrubs to increase.

Pathway a
Community 1.3 to 1.2

Fire will decrease the overstory of black greasewood and allow for the perennial bunchgrasses to dominate the site. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads.

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. This community is dominated by black greasewood. Shadscale and rubber rabbitbrush are also common. The herbaceous understory is dominated by alkali sacaton, inland saltgrass, basin wildrye and other perennial grasses are also common. Non-native annual species such as halogeton, Russian thistle and cheatgrass are present.

Community 2.2
Community Phase

This community phase is characteristic of a post-disturbance, early-seral community where annual non-native species are present. Perennial bunchgrasses such as alkali sacaton, inland saltgrass and basin wildrye dominate the site. Depending on fire severity patches of intact shrubs may remain. Black greasewood and rabbitbrush may be sprouting. Annual non-native species are stable to increasing in the community.

Community 2.3
Community Phase

Figure 10. Sodic Flat 5-8" (R028BY020NV) T.Stringham April 2013

Black greasewood 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. Annual non-native species are stable or increasing. This community is at risk of crossing a threshold to State 3.0 (grazing or fire).

Pathway a
Community 2.1 to 2.2

A low severity fire would decrease the overstory of black greasewood and allow for the understory perennial grasses to increase. 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 black greasewood cover to trace amounts. Brush treatments with minimal soil disturbance may also reduce black greasewood and allow for perennial bunchgrasses to increase. Annual non-native species are likely to increase after fire.

Pathway b
Community 2.1 to 2.3

Absence of disturbance over time, chronic drought, inappropriate grazing management or combinations of these would allow the black greasewood overstory to increase and dominate the site. Inappropriate grazing management reduces the perennial bunchgrass understory; conversely inland saltgrass may increase in the understory.

Pathway a
Community 2.2 to 2.1

Absence of disturbance over time and/or grazing management that favors the establishment and growth of black greasewood allows the shrub component to recover.

Pathway a
Community 2.3 to 2.1

Grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall/winter grazing may cause mechanical damage to black greasewood promoting the perennial bunchgrass understory. Brush treatments with minimal soil disturbance will also decrease black greasewood and release the perennial understory. Annual non-native species are present and may increase in the community. A low severity fire would decrease the overstory of black greasewood (it said sagebrush) and allow for the understory perennial grasses to increase.

Pathway b
Community 2.3 to 2.2

Fire would reduce shrubs in the overstory and allow for the perennial bunchgrasses in the understory to increase.

State 3
Shrub State

This state has two community phases, one that is characterized by a dominance of a black greasewood overstory and the other with a rabbitbrush overstory. This site has crossed a biotic and abiotic threshold and site processes are being controlled by shrubs. Bare ground has increased and pedestalling of grasses may be excessive.

Community 3.1
Community Phase

Figure 11. Sodic Flat 5-8" (R028BY020NV) T.Stringham June 2012

Black greasewood dominates the overstory. Rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses such as alkali sacaton have significantly declined. Annual non-native species increase. Bare ground is significant.

Community 3.2
Community Phase

Rabbitbrush dominates the site. Perennial bunchgrasses may be present but will be a minor component. Annual non-native species are present and may be increasing in the understory.

Pathway a
Community 3.1 to 3.2

Drought and/or lowering of water table by groundwater pumping would reduce black greasewood and allow for rabbitbrush and other shrubs on the site to dominate. Severe fire would also reduce black greasewood overstory and allow for an increase rabbitbrush.

Pathway a
Community 3.2 to 3.1

Release from drought and/or grazing pressure may allow for black greasewood, basin wildrye and other perennial bunchgrasses to increase.

Transition A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass, mustards, halogeton, and Russian thistle. 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 cattle/horse grazing will decrease or eliminate deep rooted perennial bunchgrasses and favor shrub growth and establishment. To Community Phase 3.2: Severe fire will reduce and/or eliminate black greasewood overstory and decrease perennial bunchgrasses. Soil disturbing brush treatments will reduce black greasewood and possibly increase non-native annual species. Lowering of the water table due to groundwater pumping will also decrease black greasewood and allow for rabbitbrush and other shrubs to increase. Slow variables: Long term decrease in deep-rooted perennial bunchgrasses density and/or black greasewood. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter. Loss of long-lived, black greasewood changes the temporal and depending on the replacement shrub, the spatial distribution of nutrient cycling.

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**			27–69	
	alkali sacaton	SPAI	*Sporobolus airoides*	15–30	–
	saltgrass	DISP	*Distichlis spicata*	6–24	–
	basin wildrye	LECI4	*Leymus cinereus*	6–15	–
2	**Secondary Perennial Grasses**			6–24	
	squirreltail	ELEL5	*Elymus elymoides*	2–6	–
	western wheatgrass	PASM	*Pascopyrum smithii*	2–6	–
Forb					
3	**Perennial**			6–15	
	basin wildrye	LECI4	*Leymus cinereus*	6–15	–
	thelypody	THELY	*Thelypodium*	2–6	–
Shrub/Vine					
4	**Primary Shrubs**			192–255	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	180–225	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	6–15	–
	rubber rabbitbrush	ERNAN5	*Ericameria nauseosa ssp. nauseosa var. nauseosa*	6–15	–
5	**Secondary Shrubs**			15–30	
	green molly	BAAM4	*Bassia americana*	2–9	–
	bud sagebrush	PIDE4	*Picrothamnus desertorum*	2–9	–
	seepweed	SUAED	*Suaeda*	2–9	–
	horsebrush	TETRA3	*Tetradymia*	2–9	–
	squirreltail	ELEL5	*Elymus elymoides*	2–6	–

Animal community

Livestock Interpretations:
This site is has limited value for livestock grazing due to low forage production. Grazing should be keyed to perennial grass and palatable shrub production. Alkali sacaton is a valuable forage species in arid and semiarid regions. Plants are tolerant to moderate grazing and can produce abundant herbage utilized by livestock. Livestock generally avoid saltgrass due to its coarse foliage. Saltgrass's value as forage depends primarily on the relative availability of other grasses of higher nutritional value and palatability. It can be an especially important late summer grass in arid environments after other forage grasses have deceased. Saltgrass is rated fair to good as forage species only because it stays green after most other grasses dry. The early growth and abundant production of basin wildrye make it a valuable source of forage for livestock. It is important forage for cattle and is readily grazed by cattle and horses in early spring and fall. Though coarse-textured during the winter, basin wildrye may be utilized more frequently by livestock and wildlife when snow has covered low shrubs and other grasses. Black greasewood is an important winter browse plant for domestic sheep and cattle. Black greasewood receives light to moderate use by domestic sheep and cattle during spring and summer months. Black greasewood contains soluble sodium and potassium oxalates that may cause poisoning and death in domestic sheep and cattle if large amounts are consumed in a short time. Shadscale is a valuable browse species, providing a source of palatable, nutritious forage for a wide variety of livestock. Shadscale provides good browse for domestic sheep. Shadscale leaves and seeds are an important component of domestic sheep and cattle winter diets. In general, livestock forage only lightly on this species during the summer, but winter use can be heavy in some locations. Fall use is variable, but flowers are often used by livestock. A few leaves and the more tender stems may also be used.

Stocking rates vary over time depending upon season of use, climate variations, site, and previous and current management goals. A safe starting stocking rate is an estimated stocking rate that is fine tuned by the client by adaptive management through the year and from year to year.

Wildlife Interpretations:
Black greasewood is an important winter browse plant for big game animals. It also receives light to moderate use by mule deer and pronghorn during spring and summer months.
Alkali sacaton is a valuable forage species in arid and semiarid regions. Plants are tolerant to moderate grazing and can produce abundant herbage utilized by wildlife. The communities where alkali sacaton is common support an abundance of mule deer, pronghorn, carnivores, small mammals, birds, amphibians, and reptiles.
Saltgrass provides cover for a variety of bird species, small mammals, and arthropods and is on occasion used as forage for several big game wildlife species. Basin wildrye provides winter forage for mule deer, though use is often low compared to other native grasses. Basin wildrye provides summer forage for black-tailed jackrabbits. Because basin wildrye remains green throughout early summer, it remains available for small mammal forage for longer time than other grasses.

Livestock/ Wildlife Grazing Interpretations:
Black greasewood is typically not considered an important browse species for wildlife and livestock. However, in a study by Smith et al. (1992), utilization of new growth on greasewood shrubs by cattle was 77 percent in summer, and greasewood was found to have the highest amounts of crude protein when compared to perennial and annual grasses. Black greasewood plants have been found to contain high amounts of sodium and potassium oxalates which are toxic to livestock and caution should be taken when grazing these communities. These shrubs can be used lightly in the spring as long as there is a substantial amount of other preferable forage available (Benson et al. 2011). Black greasewood also provides good cover for wildlife species (Benson et al. 2011).

Shadscale is a valuable browse species for a wide variety of wildlife and livestock (Blaisdell and Holmgren 1984). The spinescent growth habit of shadscale lends to its browsing tolerance with no more than 15 to 20% utilization by sheep being reported (Blaisdell and Holmgren 1984) and significantly less utilization by cattle. Increased presence of shadscale within grazed versus ungrazed areas is generally a result of the decreased competition from more heavily browsed associates (Cibils et al. 1998). Reduced competition from more palatable species in heavily grazed areas may increase shadscale germination and establishment. Chambers and Norton (1993) found shadscale establishment higher under spring than winter browsing as well as heavy compared to light browsing ($p<0.01$). During years of below average precipitation, shadscale has been found very susceptible to grazing pressure regardless of season (Chambers and Norton 1993).

Alkali sacaton has been found to be sensitive to early growing season defoliation whereas late growing season and/or dormant season use allowed recovery of depleted stands (Hickey and Springfield 1966). Shadscale, squirreltail, and saltgrass will eventually decline with continued inappropriate grazing. Thus, inadequate rest and recovery from defoliation can cause a decrease in basin wildrye and an increase in rabbitbrush and black greasewood, along with inland saltgrass and non-native weeds (Young et al. 1976, Roundy 1985).

Spring defoliation of basin wildrye and/or consistent, heavy grazing during the growing season has been found to significantly reduce basin wildrye production and density (Krall et al. 1971). Basin wildrye is valuable forage for livestock (Ganskopp et al. 2007) and wildlife, but is intolerant of heavy, repeated, or spring grazing (Krall et al. 1971). Basin wildrye is used often as a winter feed for livestock and wildlife; not only providing roughage above the snow but also cover in the early spring months (Majerus 1992).

Hydrological functions

Potential for sheet and rill erosion is slight to moderate. Water flow patterns are rare to common dependent on location relative to major inflow areas. Water flow patterns are typically short, ending in depressional areas where water ponds. Moderately fine to fine surface textures and physical crusts result in limited infiltration rates. Concentrations of surface salts and sodium result in chemical crusts which also impede precipitation infiltration. In areas with cover (although typically sparse) of deep-rooted perennial herbaceous bunchgrasses (basin wildrye) and/or rhizomatous grasses (salt grass) slow runoff and increase infiltration.

Recreational uses

Aesthetic value is derived from the diverse floral and faunal composition. This site offers rewarding opportunities to photographers and for nature study. This site has potential for upland and big game hunting.

Other products

Black greasewood is useful in landscaping. The leaves, seeds, and stems of black greasewood are edible. Alkali sacaton is used by Native Americans for basketry and weaving. Saltgrass was used as a food source by Native Americans. Basin wildrye was used as bedding for various Native American ceremonies, providing a cool place for dancers to stand.

Other information

Black greasewood is useful for stabilizing soil on wind-blown areas. It successfully revegetates and is commonly found on eroded areas and sites too saline for most plant species. Alkali sacaton is one of the most commonly used species for seeding and stabilizing disturbed lands. Due to its salt tolerance, it was recommended for native grass seeding on subirrigated saline sites in mixtures with western wheatgrass and switchgrass. Given its extensive system of rhizomes and roots which form a dense sod, inland saltgrass is considered an outstanding species for controlling wind and water erosion. 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.

Type locality

Location 1: White Pine County, NV	
Township/Range/Section	T21 N R58 E S24
General legal description	About 1 mile southeast of Dry Lake Well, Long Valley, White Pine County, Nevada. This site also occurs in Churchill, Elko, and Eureka counties, Nevada.

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Contributors

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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)	GK BRACKLEY/P.NOVAK-ECHENIQUE
Contact for lead author	State Rangeland Management Specialist
Date	06/20/2006
Approved by	P.Novak-Echenique
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Typically there are no rills as this site is essentially level.

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2. **Presence of water flow patterns:** Water flow patterns are rare to common dependent on location relative to major inflow areas. Water flow patterns are typically long (10-20 ft), ending in depressional areas where water ponds.

3. **Number and height of erosional pedestals or terracettes:** Plants may have small pedestals where they are adjacent to water flow patterns. Terracettes should not be present. Vegetation occurs mainly on small coppice dunes.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground ~50-70%

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** Wind scouring or blowouts are not evident. Small depositional mounds occur at shrub bases.

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values will range from 5 to 6 under shrub canopies and 1 to 3 in the interspaces.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Structure of soil surface will be thin platy or subangular blocky. Soil surface colors are light grays and soils are typified by an ochric epipedon. Soil surface textures are silt loams, silty clay loams or fine sandy loams. Organic carbon is typically less than 1 percent.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** In areas with cover (although typically sparse) of deep-rooted perennial herbaceous bunchgrasses (basin wildrye) and/or rhizomatous grasses (salt grass) runoff is slowed. Moderately fine to fine surface textures and physical crusts result in limited infiltration rates. Concentrations of surface salts and sodium result in chemical crusts which also impede precipitation infiltration.

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. Prismatic or massive subsoil structure is normal for this site and is not to be interpreted as compaction.

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: tall salt-desert shrubs >

Sub-dominant: Warm season bunchgrasses > warm season rhizamotous grasses > deep-rooted, cool season, perennial bunch grasses > deep-rooted, cool season, perennial forbs > shallow-rooted, cool season, perennial bunchgrasses

Other: microbiotic crusts

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 35% of total woody canopy.

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14. **Average percent litter cover (%) and depth (in):** Between plant interspaces 10-15% and depth of litter 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 June) ±300 lbs/ac; Winter moisture significantly affects total production. Favorable years ±500 lbs/ac and unfavorable years ±150 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 annual mustards, Russian thistle, halogeton, and cheatgrass.

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