USDA Natural Resources
Conservation Service

Ecological site R030XB189CA
Shallow Cool Hills

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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.

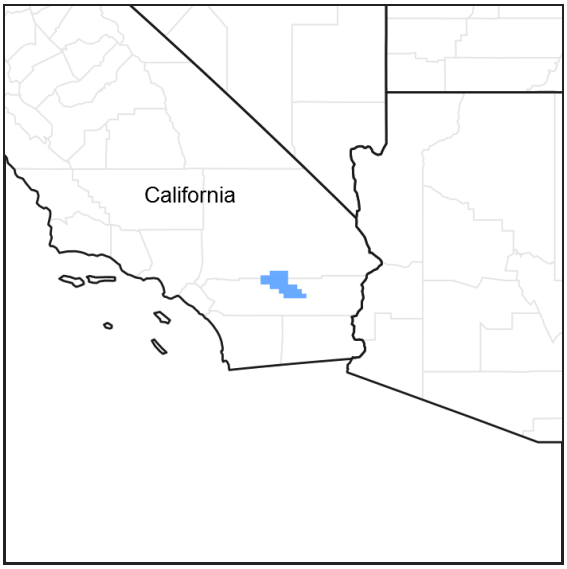

Figure 1. Mapped extent

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): 030X–Mojave Basin and Range

MLRA Description:

Major Land Resource Area (MLRA) 30, Mojave Desert, is found in southern California, southern Nevada, the extreme southwest corner of Utah and northwestern Arizona within the Basin and Range Province of the Intermontane Plateaus. The climate of the area is hot (primarily hyperthermic and thermic; however at higher elevations, generally above 5000 feet, mesic, cryic and frigid) and dry (aridic). Elevations range from below sea level to over 12,000 feet in the higher mountain areas found within the MLRA. Due to the extreme elevational range found within this MLRA, Land Resource Units (LRUs) were designated to group the MLRA into similar land units.

LRU notes

This LRU (designated by 'XB') is found across the eastern half of California, much of the mid-elevations of Nevada, the southernmost portions of western Utah, and the mid-elevations of northwestern Arizona. Elevations range from 1800 to 5000 feet and precipitation ranges from 4 to 9 inches per year, but is generally between 5-6 inches. This LRU is characterized primarily by the summer precipitation it receives, ranging from 18 – 35% but averages 25%. Summer precipitation falls between July and September in the form of rain, and winter precipitation falls starting in November and ends between February and March, also mostly in the form of rain; however it does receive between

0 and 3 inches of snow, with an average of 1 inch. The soil temperature regime is thermic and the soil moisture regime is typic-aridic. Vegetation includes creosote bush, burrobush, Nevada jointfir, ratany, Mojave yucca, Joshua tree, chollas, cactus, big galleta grass and several other warm season grasses. At the upper portions of the LRU, plant production and diversity are greater and blackbrush is a common dominant shrub.

Ecological site concept

This site occurs on steep mountain slopes with shallow soils at elevations between 3300 and 5700 feet. Soils have a cool thermic soil temperature regime. Production reference value (RV) for is 393 pounds per acre, and ranges from 170 to 690 pounds per acre depending on annual precipitation and annual species production. The site is dominated by blackbrush (*Coleogyne ramosissima*) and California juniper (*Juniperus californica*). Shallow soils and a cool thermic temperature regime increases soil moisture availability allowing blackbrush and California juniper to dominate. Blackbrush is shallow-rooted, and most competitive on shallow soils. California juniper can thrive in both shallow and deep soils.

Data ranges in the physiographic data, climate data and soil data are based on major components only (15 percent or greater). Information for associated minor components may be included in the narrative section.

This site is part of group concept R030XB151CA.

Associated sites

R030XD003CA	**Hyperthermic Steep South Slopes** Hyperthermic steep south facing slopes with brittlebush (Encelia farinosa) and creosote bush (Larrea tridentata) distinguish this site from R030XB189CA.
R030XD040CA	**Hyperthermic Steep North Slopes** Hyperthermic steep north slopes with burrobush and brittlebush distinguish this site from R030XB189CA.
R030XB140CA	**Shallow Hill 4-6" P.Z.** Side slopes of fan remnants, low hills and mountains on all exposures. Elevations are 1800 to 5000 feet. Slopes range from 4 to 75 percent, but slope gradients of 15 to 50 percent are most typical. Burrobush (Ambrosia dumosa), creosote bush (Larrea tridenta) and desert needlegrass (Achnatherum speciosum) are dominant plant species at this site. The soils at this site generally have a warm thermic soil temperature regime which distinguishes this site from R030XB189CA.
R030XB164CA	**Steep South Slopes** Steep south-facing slopes at elevations of 2300 to 3950 feet. Soils are shallow sands. The southerly aspect, hot temperatures and shallow rocky soils favor brittlebush (Encelia farinosa) which is extremely drought-deciduous and able to effectively use additional run-on moisture when it is available. A warm thermic soil temperature regime distinguishes this site from R030XB189CA.
R030XB166CA	**Dissected Pediment, Cool** Cool thermic dissected pediments with very shallow soils on slopes of 4 to 30% between the elevations of 3280 to 5180 feet. Blackbrush (Coleogyne ramosissima) and California juniper (Juniperus californica) dominate. The pediment landform distinguishes this site from R030XB189CA.
R030XB168CA	**Cool Deep Sandy Fans** This ecological site occurs on cool thermic sandy soils of fan aprons and fan remnants adjacent to mountains. Very deep soils distinguish this ecological site from R030XB189CA. Some minor components may have moderately deep soils over bedrock. Cooler temperatures and water run-off from the nearby mountains allow blackbrush (Coleogyne ramosissima)and California juniper (Juniperus californica) to dominate the site while excluding creosote bush from becoming established at this site.
R030XB170CA	**Bouldery Very Shallow To Shallow Gravelly Slopes** Cool hills and mountains with very shallow to shallow soils over bedrock. Blackbrush (Coleogyne ramosissima), singleleaf pinyon (Pinus monophylla) and Muller oak (Quercus cornelius-mulleri) are the dominant species at this site. The presence of singleleaf pinyon suggests this site is a bit cooler and moister than R030XB189CA. A high percentage of rock outcrops also distinguishes this site from R030XB189CA.

R030XB172CA	**Warm Gravelly Shallow Hills** This site is found on steep stony mountain and hill slopes with shallow to moderately deep soils. Slopes are generally greater than 40% with more than 10% surface stone cover. A warm thermic soil temperature regime allows creosote bush (Larrea tridentata) and Parish's goldeneye (Viguiera parishii) to dominate the site, distinguishing this site from R030XB189CA.
R030XB193CA	**Very Shallow To Moderately Deep Gravelly Slopes** This site occurs on warm thermic steep hill and mountain slopes with very shallow to moderately deep soils which typically have an argillic horizon within 2 to 7 cm of the soil surface. Both a warm thermic soil temperature regime and an argillic horizon distinguish this site from R030XB189CA. The site is characterized by a diverse shrub assemblage, comprised of Jojoba (Simmondsia chinensis), burrobush (Ambrosia dumosa), Parish's goldeneye (Viguiera parishii), Nevada jointfir (Ephedra nevadensis), and water jacket (Lycium andersonii), and is not strongly dominated by any one species.
R030XE200CA	**Xeric Very Deep Sandy Fan Aprons On Pediments** This site occurs on hills with 4-8% slopes. Very deep soils, lower slopes and a xeric-aridic soil moisture regime distinguish this site from R030XB189CA.
R030XB213CA	**Moderately Deep Gravelly Mountain Slopes** This site is found on very steep, very shallow to moderately deep, warm thermic hill and mountain slopes. California juniper (Juniperus californica) and Eastern Mojave buckwheat (Eriogonum fasciculatum) are the dominant species. The warm thermic temperature regime distinguishes this site from R030XB189CA.
R030XY202CA	**Very Rarely To Rarely Flooded Thermic Ephemeral Stream** This is a very rarely to rarely flooded ephemeral stream with Nevada jointfir (Ephedra nevadensis), water jacket (Lycium andersonii) and desert almond (Prunus fasciculata).
R030XE196CA	**Sandy Xeric-Intergrade Slopes** Shallow soils on steep hill and mountain slopes. A xeric-aridic soil moisture regime distinguishes this site from R030XB189CA. Muller oak (Quercus cornelius-mulleri) and singleleaf pinyon (Pinus monophylla) are the dominant species on R030XE196CA.
R030XE191CA	**Dry Sandy Mountain Slopes** This site is found on steep hill and mountain slopes. Soils are shallow to weathered bedrock. A xeric-aridic soil moisture regime distinguishes this site from R030XB189CA. Muller oak (Quercus cornelius-mulleri) and singleleaf pinyon (Pinus monophylla) are the dominant species on R030XE191CA.

Similar sites

R030XB170CA	**Bouldery Very Shallow To Shallow Gravelly Slopes** Cool hills and mountains with very shallow to shallow soils over bedrock. Blackbrush (Coleogyne ramosissima), singleleaf pinyon (Pinus monophylla) and Muller oak (Quercus cornelius-mulleri) are the dominant species at this site. The presence of singleleaf pinyon suggests this site is a bit cooler and moister than R030XB189CA. A high percentage of rock outcrops also distinguishes this site from R030XB189CA.
R030XB168CA	**Cool Deep Sandy Fans** This ecological site occurs on cool thermic sandy soils of fan aprons and fan remnants adjacent to mountains. Very deep soils distinguish this ecological site from R030XB189CA. Some minor components may have moderately deep soils over bedrock. Cooler temperatures and water run-off from the nearby mountains allow blackbrush (Coleogyne ramosissima)and California juniper (Juniperus californica) to dominate the site while excluding creosote bush from becoming established at this site.
R030XB166CA	**Dissected Pediment, Cool** Cool thermic dissected pediments with very shallow soils on slopes of 4 to 30% between the elevations of 3280 to 5180 feet. Blackbrush (Coleogyne ramosissima) and California juniper (Juniperus californica) dominate. The pediment landform distinguishes this site from R030XB189CA.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Coleogyne ramosissima* (2) *Juniperus californica*
Herbaceous	Not specified

Physiographic features

This ecological site is found on all aspects of steep hill and mountain slopes at elevations of 3360 to 5710 feet. Slopes range from 15 to 75 percent. Runoff class is medium to very high.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mountain
Flooding frequency	None
Ponding frequency	None
Elevation	3,360–5,710 ft
Slope	15–75%
Aspect	Aspect is not a significant factor

Climatic features

The climate at this site is arid, and characterized by cool, somewhat moist winters and hot, dry summers. The average annual precipitation ranges from 4 to 7 inches with most falling as rain from November to March. Mean annual air temperature ranges from 55 to 63 degrees F. June, July and August can experience average maximum temperatures of 100 degrees F while December and January can have average minimum temperatures near 20 degrees F.

Maximum and minimum monthly climate data for this ESD were generated by the Climate Summarizer (http://www.nm.nrcs.usda.gov/technical/handbooks/nrph/Climate_Summarizer.xls) using data from the following climate stations (results are weighted averages; numbers in square brackets represent relative weights):

LTHC1 Lost Horse, Joshua Tree National Park (Period of record = 1991 to 2011) [2]

44405 JOSHUA TREE, CA (Period of record = 1959 to 2011) [1]

44467 Kee Ranch, CA (Period of record = 1948 to 1979) [1]

45112 Yucca Valley, CA (Period of record = 1990 to 2011) [1]

The Lost Horse weather station is closest to this ecological site but is limited by the number of years data was collected. The Joshua Tree weather station is also nearby this ecological site but is located at approximately 2750 feet in elevation while the ecological site has an elevational range of 3200 to 5200 feet. This weather station is lacking precipitation data for the years between 1975 and 2008 and there is very little temperature data. Kee Ranch weather station contains precipitation data for all years of the period of record but has no temperature data. The Yucca Valley weather station contains temperature and precipitation data for the 20 year period of record.

Frost Free Period and Mean Annual Precipitation were determined using a variety of climate data and models. Freeze Free Period is a best guess based on available temperature data and the Frost Free Period. Due to sparse temperature data, the Frost Free Period determined using the Climate Summarizer does not agree with the models used to populate the National Soil Information System.

Table 3. Representative climatic features

Frost-free period (average)	270 days
Freeze-free period (average)	300 days
Precipitation total (average)	7 in

Influencing water features

Soil features

The soils associated with this ecological site formed in colluvium or residuum derived from granite, granitoid and/or gneiss. They are very shallow to moderately deep over fractured bedrock but are typically very shallow to shallow. Surface textures are typically gravelly loamy sand, and less commonly sandy loam and cobbly sand. Subsurface textures are generally gravelly loamy sand other than Contactmine (see below).

Gravels less than or equal to 3 inches compose between 22 to 72 percent cover with gravels greater than 3 inches in diameter with 5 to 55 percent cover with a typical range between 5 and 35 percent. Subsurface fragments (below 2 inches in depth) less than or equal to three inches in diameter range from 4 to 75 percent of the horizon volume with 4 to 25 percent being typical. Subsurface fragments greater than 3 inches in diameter range from 0 to 15 percent of the horizon volume with 0 percent being the most common.

The soil series that are correlated with this ecological site that are 15 percent or greater of any one map unit include: Desertqueen (Loamy, mixed, superactive, thermic, shallow Typic Haplargids); Pinecity (mixed, thermic, shallow Typic Torripsamments); and Contactmine (Fine-loamy, mixed, superactive, thermic Typic Haplargids). Other soil series associated with this site are 10 percent or less of any one mapunit, these include: Littlefargo (Coarse-loamy, mixed, superactive, thermic Typic Haplargids); Dalvord (Loamy-skeletal, mixed, superactive, calcareous, thermic Lithic Torriorthents); Seanna (Loamy-skeletal, mixed, superactive, calcareous, thermic, shallow Typic Torriorthents); and a higher order Typic Haplargids.

Desertqueen and Pinecity soils are very shallow to shallow to weathered, extremely weakly cemented or weakly cemented, fractured bedrock to 59 inches. The Contactmine soils are moderately deep to fractured, moderately weathered bedrock. Desertqueen soils have an argillic horizon 2 to 8 inches below the soil surface. Contactmine and Littlefargo soils have an argillic horizon 4 to 8 inches below the soil surface. Pinecity soils are sandy throughout above the weathered bedrock contact. The Seanna soils are a tax adjunct to the series, and are shallow to weathered bedrock, and loamy above the contact.

This ecological site is found in the following map units of the Joshua Tree National Park Soil Survey (CA794) listed by map unit ID; map unit; component; and component percent:

3120; Aguilareal-Rock outcrop-Angelpoint complex, 30 to 60 percent slopes; Contactmine, cool; 5%
3285; Pinecity-Contactmine-Desertqueen-Rock outcrop association, 30 to 50 percent slopes; Desertqueen; 20%: Littlefargo; 8%: Pinecity, warm, steep; 30%: Pinecity, warm; 5%
3286; Pinecity gravelly loamy sand, 30 to 60 percent slopes; Pinecity, gravelly loamy sand; 85%: Desertqueen; 6%
3291; Smithcanyon-Stubbespring-Rock outcrop complex, 15 to 50 percent slopes; Contactmine, cool; 5%: Pinecity; 2%
3293; Smithcanyon-Pinecity association, 15 to 50 percent slopes; Pinecity; 25%: Pinecity; strongly sloping; 5%: Pinecity, steep, cool; 4%
3296; Desertqueen-Pinecity complex, 15 to 50 percent slopes; Desertqueen; 45%: Desertqueen, low slope; 4%: Pinecity; 35%: Littlefargo; 2%
3325; Ironped-Rock outcrop-Hexie complex, 30 to 60 percent slopes; Desertqueen; 3%
3336; Xeric Torriorthents-Bigbernie association, 30 to 75 percent slopes; Pinecity; 2%
3340; Seanna-Grubstake-Pinecity complex, 30 to 75 percent slopes; Pinecity; 15%: Seanna, cool; 1%
4615; Desertqueen-Jumborox-Rock outcrop association, 2 to 15 percent slopes; Desertqueen, steep; 5%
4804; Rock outcrop-Ironped-Pinecity association, 30 to 60 percent slopes; Pinecity; 20%: Littlefargo; 5%
4806; Rock outcrop; Pinecity, gravelly loamy sand; 5%
4811; Rock outcrop-Pioneertown association, 30 to 60 percent slopes, dry; Dalvord, cool; 5%
3292; Smithcanyon-Pinecity-Rock outcrop association, 15 to 50 percent slopes; Pinecity; 25%: Pinecity; very steep; 2%

Table 4. Representative soil features

Parent material	(1) Colluvium–granite (2) Residuum–gneiss

Surface texture	(1) Gravelly loamy sand (2) Sandy loam (3) Sand
Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to rapid
Soil depth	2–39 in
Surface fragment cover <=3"	22–72%
Surface fragment cover >3"	5–55%
Available water capacity (0-40in)	0.2–3.6 in
Calcium carbonate equivalent (0-40in)	0–1%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	6.1–8
Subsurface fragment volume <=3" (Depth not specified)	5–75%
Subsurface fragment volume >3" (Depth not specified)	0–15%

Ecological dynamics

Abiotic Factors

The major factors affecting this ecological site are shallow, stable soils, and a cool climate. These conditions favor the growth of blackbrush (*Coleogyne ramosissima*) and California juniper (*Juniperus californica*).
Shallow soils hold water near the surface where roots are concentrated. Roots also penetrate the fractured bedrock for deeper water. Blackbrush is a shallow-rooted, very long-lived, drought-tolerant shrub. Shallow roots enable blackbrush to thrive in soils where soil moisture is restricted to shallow depths, and extreme drought-tolerance coupled with extreme longevity allow blackbrush to achieve community dominance over shorter-lived, less drought-tolerant species, provided there are long periods of time without disturbance (Pendleton and Meyer 2004).
California juniper is a long-lived evergreen shrub or small tree that is often associated with shallow soils (Sawyer et al. 2009). It achieves maximum dominance at elevations slightly higher than this ecological site, where mean annual precipitation is above 9.5 inches (Rhode 2002). Thus, while California juniper is an important species in this ecological site, it is restricted to mesic microsites receiving additional run-on, and does not achieve dominance across the site.

Disturbance Dynamics

The major disturbances affecting this ecological site are drought, invasion by non-native species, and fire.
Drought is an important shaping force in Mojave Desert plant communities (Webb et al. 2003, Hereford et al. 2006). Short-lived perennial shrubs and perennial grasses demonstrate the highest rates of mortality (Webb et al. 2003, Bowers 2005, Hereford et al. 2006, Miriti et al. 2007), and annual species remain dormant in the soil seedbank (Beatley 1969, 1974, 1976). Long-lived shrubs are more likely to exhibit branch-pruning, and or limited recruitment during drought (e.g. Hereford et al. 2006, Miriti et al. 2007), leading to reduced cover and biomass in drought-afflicted communities. Because relatively sparse cover characterizes this ecological site, further loss of cover due drought-induced mortality increases the susceptibility of this site to increased damages from erosion.

Non-native annual grasses (red brome [*Bromus rubens*], cheatgrass [*Bromus tectorum*] and Mediterranean grass

[Schismus species]) have become naturalized throughout the Mojave Desert over the past century (Rickard and Beatley 1965, D'Antonio and Vitousek 1992, Brooks 1999, Reid et al. 2006, Norton et al. 2007). Increased soil nitrogen due to air pollution has been shown to increase the productivity of exotic annual grasses across the Mojave Desert (Brooks 1999). In Joshua Tree National Park, elevated soil N is decreasing the diversity and cover of native forb species in the park, and at the same time increasing the cover of exotic annual grasses (Rao and Allen 2010).

Invasion by non-native annual grasses has increased the flammability of Mojave Desert vegetation communities by providing a continuous fine fuel layer between widely spaced shrubs (Brown and Minnich 1986, Brooks 1999, Brooks et al. 2004, Rao and Allen 2010, Rao et al. 2010). After fire, these communities appear to be more susceptible to invasion by exotic grasses, leading to a grass-fire cycle (D'Antonio and Vitousek 1992). Historically, fire would have been a very rare occurrence in this ecological site due to the lack of a continuous fine fuel layer (Minnich 2003, Webb et al. 1987), occurring only in the year immediately following heavy winter precipitation or during periods of extreme fire behavior (Brooks et al. 2007).

State and transition model

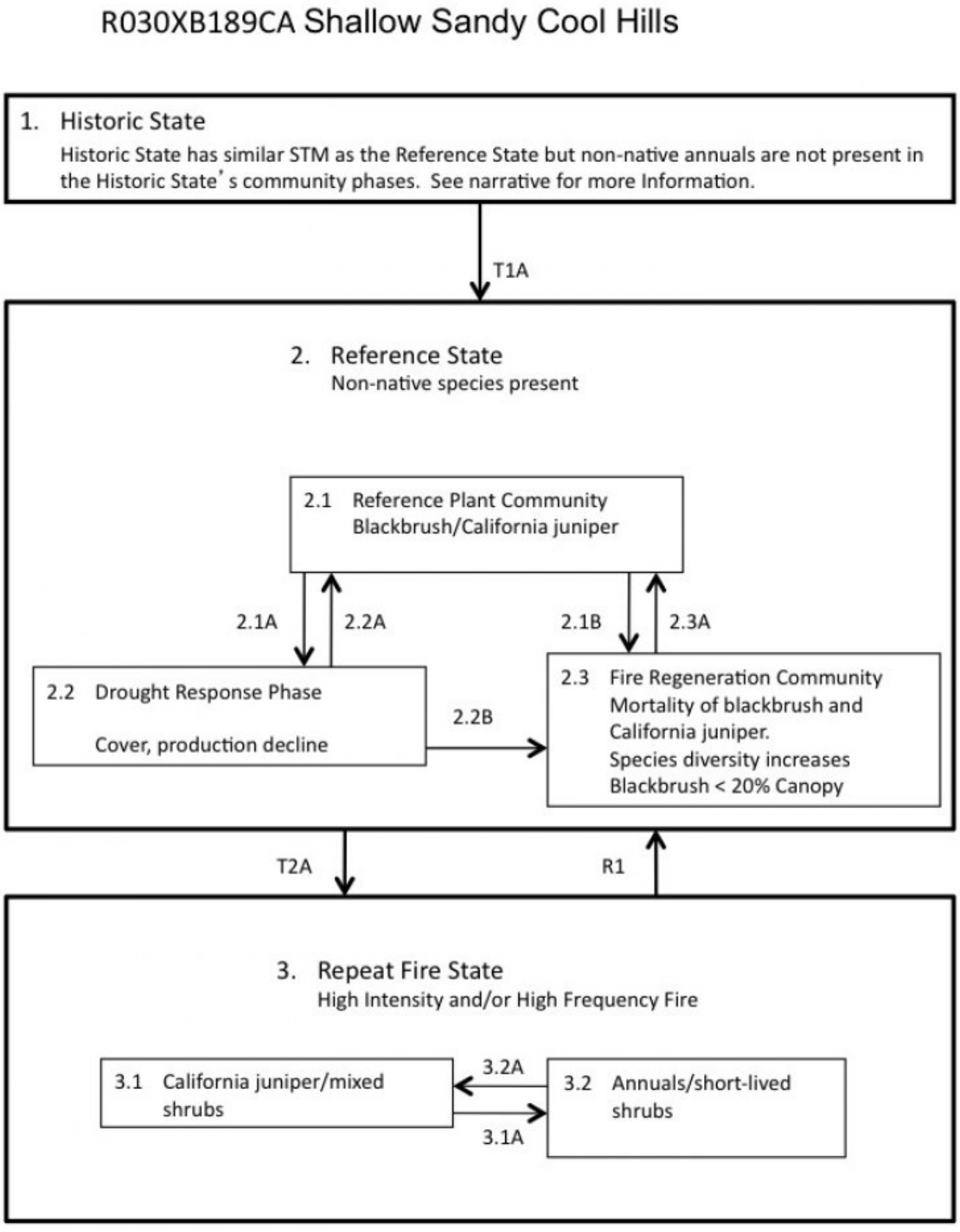

Figure 4. R030XB189CA

State 1
Historic State

This state is similar to State 2.0, but Historic State 1.0 contains only native species. If dynamics were included in this state, they would be similar to those displayed in State 2.0. The presence of non-native species in State 2.0 may increase fire frequency and intensity from that experienced in Historic State 1.0.

State 2
Reference State

The Reference State includes three community phases maintained by the current natural conditions for this ecological site.

Community 2.1
Reference Plant Community

Figure 5. R030XB189CA Community Phase 2.1

The reference plant community is dominated by blackbrush and California juniper. Shallow soils help support blackbrush and California juniper by maintaining the water supply near the surface where roots are present. Blackbrush and California juniper are more dominant in areas of fewer large surface fragments. Secondary shrubs may include: Nevada jointfir (*Ephedra nevadensis*), Eastern Mojave buckwheat (*Eriogonum fasciculatum*), green rabbitbrush (*Ericameria teretifolia*), Mojave yucca (*Yucca schidigera*) and Parry's jujube (*Ziziphus parryi*). Common forbs are bristly fiddleneck (*Amsinckia tessellata*), sowthistle desertdandelion (*Malacothrix sonchoides*), chia (*Salvia columbariae*), and desert globemallow (*Sphaeralcea ambigua*). The native desert needlegrass (*Achnatherum speciosum*) is present with low cover, and the non-native annual grass red brome (*Bromus rubens*) is generally present with fair cover. Prolonged severe drought will decrease the total canopy cover for this site (Schultz and Ostler 1995), and lead to a drought-response community phase. Years with above average precipitation produce heavy growth of native annuals and exotic grasses (Humphrey 1974; Brown and Minnich 1986), which may create a continuous fine fuel load between shrubs, which puts this community at risk for fire.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	165	350	515
Forb	0	20	65
Tree	5	18	60
Grass/Grasslike	0	5	50
Total	**170**	**393**	**690**

Table 6. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	30-45%
Grass/grasslike foliar cover	0-20%
Forb foliar cover	0-5%
Non-vascular plants	0%

Biological crusts	1-2%
Litter	5-20%
Surface fragments >0.25" and <=3"	20-30%
Surface fragments >3"	0-15%
Bedrock	0-20%
Water	0%
Bare ground	0-5%

Community 2.2
Drought Response

This community phase is characterized by a decline in cover and production due to branch-pruning of long-lived shrubs (including blackbrush, Nevada jointfir, and Mojave yucca), mortality of California juniper, and mortality of shorter-lived perennials (including Acton's brittlebush, eastern Mojave buckwheat, and desert needlegrass), and lack of emergence of annual forbs and grasses.

Community 2.3
Fire regeneration community

This community is characterized by decreases in blackbrush and California juniper, and an increase in species diversity. Blackbrush survival and regeneration following fire is rare and its documentation is limited to only a few cases of blackbrush re-sprouting (Bates 1984), seedling establishment (Ellison 1950; Lei 1999), autogenic succession following fire (Thatcher 1975) and fire islands (Minnich 2003). Fires tend to remove blackbrush and California juniper as dominants within these plant communities. Vigorous sprouting of other native shrubs at this site occurs following fire, such as Nevada jointfir (*Ephedra nevadensis*), California buckwheat (*Eriogonum fasciculatum*), desert globemallow (*Sphaeralcea ambigua*), and rabbitbrush species (Ericameria spp.). Annual grasses and forbs are likely to increase at this site following fire (Humphrey 1953; Wallace and Romney 1972; Baldwin 1979; Callison et al. 1985; West and Hassan 1985; Conrad 1987; Minnich 1995; Loik et al. 2000; Brooks and Matchett 2003; Abella et al. 2009). This community is considered an at-risk community phase. A community is at risk when annual plant cover creates a continuous fuel load between shrubs. Non-native species are limited by both water and nitrogen availability, but anthropogenic nitrogen deposition may be providing supplemental nitrogen which can increase production of both native and non-native annual species. Climate change may accelerate the change in the Reference State's fire ecology by further promoting the growth of non-native forbs and grasses (Dukes and Mooney 1999; Rao and Allen 2010). Islands of vegetation may exist which were not burned by fire may provide seed sources for colonization. These unburned islands are especially important for blackbrush re-colonization.

Pathway 2.1A
Community 2.1 to 2.2

This pathway occurs with prolonged or severe drought.

Pathway 2.1B
Community 2.1 to 2.3

This pathway occurs with fire.

Pathway 2.2A
Community 2.2 to 2.1

This pathway occurs with a return to average climatic conditions. Growth of long-lived shrubs and colonization by shorter-lived shrubs increases cover.

Pathway 2.2B
Community 2.2 to 2.3

This pathway occurs with moderate to severe fire. Although live annuals are largely absent from Community Phase 2.2, standing annual biomass in drought years immediately following a period of heavy precipitation poses a severe risk for fire. Cured native annual cover may pose a risk during the first year of drought, and non-native annual grasses pose a risk for three or more years (Minnich 2003, Brooks et al. 2007, Rao et al. 2010).

Pathway 2.3A
Community 2.3 to 2.1

With time, community phase 2.3 will develop into community phase 2.1. Shrub dominance can be expected to return within 20 years but may not resemble the pre-burn composition (Callison et al. 1985) for 100 or more years. Blackbrush may require more time than California juniper to achieve the cover and production that it once had because blackbrush establishment from seed is rare (Webb et al. 1987).

State 3
Repeat Fire

This state develops when intense and/or frequent fire removes blackbrush as a dominant species. There are two community phases maintained by an increase in fire intensity and fire frequency due to the abundance of annual species, especially invasive grasses.

Community 3.1
Juniper/mixed shrubs

This community phase develops 15 to 50 years without fire. Juniper can reestablish itself by seed after several years without fire (Wright 1972). Juniper may be able to repopulate an area as early as fifteen years, especially when islands of juniper have survived a burn. Juniper may take as long as 50 years to repopulate an area where it has been completely removed (Schmidt and Larson 1989). California juniper does not sprout from live root tissue following fire (Hanes 1971). Years with above average precipitation will produce an abundance of annual grasses, which increase the susceptibility of this site to repeat burning.

Community 3.2
Annuals/short lived shrubs

High intensity fire has removed blackbrush and juniper from the site. Annual grasses, forbs and short lived shrubs dominate the site. Post burn species composition in this ecological site is variable (Bowns and West 1976; Vamstad 2009). Canopy cover of non-native grasses and forbs, such as cheatgrass, red brome, and redstem stork's bill, may increase greater than native plants. Non-native invaders have the potential to permanently increase the fire frequency regime at these sites, maintaining this community phase (D’Antonio and Vitousek 1992; Whisenant 1990). Periodic droughts may provide native plants the opportunity to colonize the site when non-natives do not have sufficient water available to them (Brooks 2002; Bartha et al. 2003).

Pathway 3.1A
Community 3.1 to 3.2

This pathway occurs with fire.

Pathway 3.2A
Community 3.2 to 3.1

With time (15-50 years) California juniper may repopulate the site via seed sources.

Transition T1A
State 1 to 2

Non-native forbs and grasses are introduced to the Historic State. Some areas of this ecological site contain no invasive plant species but it is likely that invasion into these areas is only a matter of time. Non-native species are well adapted to the desert climate. Attempts to eradicate this species may be futile as seed sources are widespread throughout the state of California and the Southwest.

Transition 2A
State 2 to 3

This transition occurs with high intensity or frequent fire. This transition is most likely to occur when the interstitial spaces between shrubs are filled with dried annual species, especially non-native grasses.

Restoration pathway 1
State 3 to 2

Restoration of arid desert communities severely altered by repeat fire at the landscape scale is very difficult (Allen 1993), especially on steep, rugged slopes. Reducing invasion of non-native grasses that increase after fire may help promote native plant recovery, and reduce the probability of repeat burning (Fuhrmann et al. 2009, Matchett et al. 2009, Steers and Allen 2010); however, accomplishing this at a landscape scale, for a time period long enough to be effective, has not yet been accomplished. In small-scale trials, Fusilade, a grass-specific herbicide, was successful in reducing invasive grasses in burned creosote bush communities in the Colorado Desert in the initial three years after fire (Steers and Allen 2010). The long-term efficacy of such treatments on a landscape scale, and non-target effects have not yet been determined. The pre-emergent herbicide Plateau was applied in conjunction with aerial seeding of natives after fire in Zion National Park (Fuhrmann et al. 2009, Matchett et al. 2009). Initial results indicate that autumn application of Plateau after fire is most effective for reducing cheatgrass (*Bromus tectorum*), but longer-term monitoring is needed to evaluate long-term and non-target effects. In addition to controlling invasive species, active recovery of native vegetation may be attempted. Methods may include seeding of early native colonizers such as desert globemallow, burrobrush, threeawns (Aristida spp.), and desert marigold (e.g. Abella et al. 2009, Abella et al. 2012). Increased native cover may help to reduce non-native plant invasion, helps to stabilize soils, provides a source of food and cover for wildlife, and provides microsites that facilitate blackbrush establishment. However, the amount of seed required for success is often prohibitive. Large-scale planting of both early colonizers and community dominants tends to be more successful in terms of plant survival, especially if outplants receive supplemental watering during the first two years (Allen 1993). Blackbrush is difficult to cultivate due to susceptibility to fungal pathogens in the greenhouse environment.

Additional community tables

Table 7. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Tree					
1	**Trees**			5–60	
	California juniper	JUCA7	*Juniperus californica*	5–60	0–5
Shrub/Vine					
2	**Shrubs**			165–515	
	blackbrush	CORA	*Coleogyne ramosissima*	165–460	20–40
	green rabbitbrush	ERTE18	*Ericameria teretifolia*	0–25	0–1
	Eastern Mojave buckwheat	ERFA2	*Eriogonum fasciculatum*	0–15	0–10
	Nevada jointfir	EPNE	*Ephedra nevadensis*	0–15	0–5
	Mojave yucca	YUSC2	*Yucca schidigera*	0–15	0–2
	Parry's jujube	ZIPA	*Ziziphus parryi*	0–1	0–1
Forb					
3	**Native forbs**			0–65	
	Forb, annual	2FA	*Forb, annual*	0–55	0–2
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	0–10	0–2
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	0–1	0–1
	sowthistle desertdandelion	MASO	*Malacothrix sonchoides*	0–1	0–1
	chia	SACO6	*Salvia columbariae*	0–1	0–1
Grass/Grasslike					
4	**Native perennial grasses**			0–6	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–1	0–1
5	**Non-native annual grasses**			0–50	
	red brome	BRRU2	*Bromus rubens*	0–50	0–20

Table 8. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)

Animal community

Bighorn sheep and mule deer may tend to use this site in the winter to feed on blackbrush, juniper, desert needlegrass and big galleta (Sampson and Jespersen 1963; Bradley 1965; Stark 1966; Bowns and West 1976; Loope et. al 1988; Urness and Austin 1989; Seegmiller et. al 1990; Krausman et. al 1997). Small mammals, such as kangaroo rats, and birds will cache and eat blackbrush achenes and juniper berries (Barrett 1983; West 1983; Blake 1984; Mozingo 1987). A list of the many animals which may use the area is presented below.

MAMMALS:

Badgers, Skunks, Weasels
Long-tailed Weasel (Mustela frenata latirosta)

Bats
Desert Long-legged Bat (Myotis volans interior)
Northern Fringed Bat (Myotis thysanodes thysanodes)
Western Pipistrelle (Pipistrellus hesperus hesperus)
Desert Big Brown Bat (Eptesicus fuscus pallidus)
Hoary Bat (Lasiurus cinereus cinereus)
Pallid Bat (Antrozous pallidus minor)

Bears
California Black Bear (Ursus Americanus californianus)

Canids
Desert Coyote (Canis latrans mearnsi)
Common Gray Fox (Urocyon cinereoargenteus scottii)

Cats
California Mountain Lion (Felis concolor californica)
Desert Bobcat (Lynx rufus baileyi)

Ringtails
California Ringtail (Bassariscus astutus ocatvus)

Deer & Sheep
Southern Mule Deer (Blacktail) (Odocoileus hemionus fuliginatus)
Desert Bighorn Sheep (Ovis canadensis nelsoni)

Rabbits & Hares
Southern Desert Cottontail (Sylvilagus audubonii arizonae)

Rodents
Dusky Chipmunk (Tamias obscurus davisi)
Whitetail Antelope Squirrel (Ammospermophilus leucurus leucurus)
Western Mojave Ground Squirrel (Spermophilus beecheyi parvulus)
Long-tailed Pocket Mouse (Chaetodipus formosus mojavensis)
Western Chisel-toothed Kangaroo Rat (Dipodomys microps occidentalis)
Merriam's Kangaroo Rat (Dipodomys merriami merriami)
Desert Wood Rat (Neotoma lepida lepida)
Eastern Dusky-footed Wood Rat (Neotoma fuscipes simplex)
White-throated Wood Rat (Neotoma albigula venusta)
Sonoran Deer Mouse (Peromyscus maniculatus sonoriensis)
Southern California Pinyon Mouse (Peromyscus truei chlorus)
Desert Grasshopper Mouse (Onychomys torridus pulcher)

Shrews
Desert Shrew (Gray) (Notiosorex crawfordi crawfordi)

REPTILES:

Lizards
Desert Banded Gecko (Coleonyx variegatus variegatus)
Mojave Collared Lizard (Crotaphytus bicinctores)
Western Chuckwalla (Sauromalus ater obesus)
Great Basin Fence Lizard (Sceloporus biseriatus longipes)
Western Brush Lizard (Urosaurus graciosus graciosus)
Great Basin Whiptai (Aspidoscelis tigris tigris)
Western Red-tailed Skink (Eumeces gilberti rubricaudatus)
San Diego Alligator Lizard (Elgaria multicarinata webbii)
Silvery Legless Lizard (Anniella pulchra pulchra)

Snakes
Southwestern Blind Snake (Leptotyphlops humilis humilis)
Desert Rosy Boa (Lichanura trivirgata gracia)
Mojave Glossy Snake (Arizona occidentalis candida)
Desert Night Snake (Hypsiglena torquata deserticola)
California Kingsnake (Lampropeltis getula californiae)
California Striped Racer (Masticophis lateralis lateralis)

Great Basin Gopher Snake (Pituophis catenifer deserticola)
Western Long-nosed Snake (Rhinocheilus lecontei lecontei)
Smith’s Black-headed Snake (Tantilla hobartsmithi)
California Lyre Snake (Trimorphodon biscutatus vandenburghi)
Southwestern Speckled Rattlesnake (Crotalus mitchelli pyrrhus)
Red Diamond Rattlesnake (Crotalus ruber ruber)
Southern Pacifi c Rattlesnake (Crotalus helleri)

This list is not intended to be an exhaustive list of animals found in this ecological site. Many birds are likely to use this ecological site. No wildlife inventory was used to create the above list; this list is based on species' habitat preferences (National Park Service 2012).

Recreational uses

This ecological site may be used for hiking and aesthetic enjoyment.

Wood products

California juniper is a poor source of lumber because of low volume and multi-stemmed growth form. However, early ranchers used juniper for fenceposts, and it is used for fuel and as Christmas trees (Cope 1992).

Other products

California juniper was used by Native Americans for a variety of medicinal purposes, including cold remedies, cough treatment, anticonvulsive, to induce sweating, for hangovers, for hypotension, fever and as a muscle relaxant for childbirth relief. Berries were eaten fresh, and were dried for later use, when they were ground to make porridge or to make bread. The Kawaiisu used the bark as a building cover, and used the wood to make arrows and cooking utensils. (http://herb.umd.umich.edu/herb/search.pl?searchstring=Juniperus+californica)

Blackbrush was used by the Kawaiisu for treating gonorrhea, and the Havasupai used blackbrush as source of fodder when grass was not available. (http://herb.umd.umich.edu/herb/search.pl?searchstring=Coleogyne+ramosissima).

Inventory data references

Cover data for this ecological site was described using line-point intercept transects. The complete protocol for this sampling method is found in Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems, Volume 1: Quick Start.

Below are the User Pedon ID locations that were used to describe each community phase.

Community phase 2.1
12497-138-06 (Type location - duplicate number may change)
1251503836

Type locality

Location 1: San Bernardino County, CA	
Township/Range/Section	T2S R8E S15
UTM zone	N

UTM northing	3762451
UTM easting	580074
General legal description	The type locality for community phase 2.1 is located approximately 0.27 miles from the Ryan Mountain Parking area along Park Boulevard.

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Contributors

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Approval

Sarah Quistberg, 2/25/2025

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	

Date	03/10/2025
Approved by	Sarah Quistberg
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

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

Dominant:

Sub-dominant:

Other:

Additional:

---

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

---

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

---

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

---

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

---

17. **Perennial plant reproductive capability:**
