USDA Natural Resources
Conservation Service

Ecological site R030XY023CA
Hyperthermic Dissected Shallow Pediment

Accessed: 05/19/2024

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): 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 Description:

This Land Resource Unit (designated by ‘XD’) is found on the eastern side of California. Elevations range from 400 to 2200 feet on average, but may be found up to 3600 feet on southern exposures. Precipitation ranges from 1 to 6 inches per year, but averages between 2-4 inches. This LRU is characterized primarily by the extreme aridity, hot temperatures, hyperthermic soil temperatures and low stature of widely spaced vegetation. Temperatures can reach over 110 degrees Fahrenheit for several weeks in July and August. Summer precipitation falls between July and September, ranging from 20-33% in the form of rain, and winter precipitation falls starting in November and ends between February and March, ranging from 56-70%, also mostly in the form of rain. Vegetation is primarily small, widely-spaced, low-producing creosote bush (Larrea tridentata), burrobush (Ambrosia dumosa), and brittlebush (Encelia farinosa).

Ecological Site Concept –

This ecological site occurs on dissected pediments at elevations of 950 to 2800 feet and slopes of 2 to 30 percent. Soils are very shallow to shallow over unweathered bedrock.

Production reference value (RV) is 164 pounds per acre and ranges from 68 to 221 pounds per acre depending on annual precipitation. The site is co-dominated by Mojave indigo bush (Psorothamnus arborescens), desertsenna (Senna armata), and burrobush (Ambrosia dumosa), and a high diversity of other shrubs is typically present. Hyperthermic soil temperatures and shallow soils with a hard bedrock contact limit water availability and annual production. The dissected topography and shallow soils provide areas of localized run-off, which supports desertsenna and Mojave indigo bush, as well as a higher diversity of shrubs than is found on surrounding fan aprons.

The data in the following sections is based on all components (major and minor) that this ecological site is correlated with.

Associated sites

R030XD042CA	**Hyperthermic Shallow To Moderately Deep Fan Remnants** R030XD042CA is found on adjacent fan remnants. Vegetation is sparse and dominated by creosote bush (Larrea tridentata).

Similar sites

R030XB228CA	**Warm Shallow Pediments** R030XB228CA is found pediments with warm thermic soils. Creosote bush (Larrea tridentata) and burrobush (Ambrosia dumosa) dominate. Mojave indigobush (Psorothamnus arborescens) and desertsenna (Senna armata) are secondary species if present.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Psorothamnus arborescens* (2) *Senna armata*
Herbaceous	Not specified

Physiographic features

This ecological site occurs on dissected pediments at elevations of 950 to 2760 feet. Slopes are range from 2 to 30 percent, and the site is found on all aspects. The site experiences no flooding or ponding, runoff is medium to high.

Table 2. Representative physiographic features

Landforms	(1) Pediment
Flooding frequency	None
Ponding frequency	None
Elevation	290–841 m
Slope	2–30%
Aspect	Aspect is not a significant factor

Climatic features

The climate of this ecological site is characterized by hot temperatures, aridity, and a bimodal precipitation pattern. Precipitation falls as rain, with 30 percent falling in summer between July and October, and 65 percent falling in winter between November and March. The mean annual precipitation is 3 to 5 inches and mean annual air temperature is 68 to 73 degrees F. The frost free period is 300 to 340 days.

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 unweighted averages):

42598, Eagle Mountain, CA (Period of record = 1933 to 2011) [1]

43855, Hayfield Reservoir, CA (Period of record = 1933 to 2011) [1]

049099, Twentynine Palms, California (Period of record = 1935 to 2011) [1]

The data from multiple weather were combined to most accurately reflect the climatic conditions of this ecological site.

Table 3. Representative climatic features

Frost-free period (average)	340 days
Freeze-free period (average)	0 days
Precipitation total (average)	127 mm

Influencing water features

Soil features

The soils associated with this ecological site are very shallow to shallow over unweathered bedrock. They are well to somewhat excessively drained soils that formed in residuum from granitoid rocks. Surface textures are gravelly loamy sand or cobble with sand and loam subsurface textures. Surface gravels (< 3 mm in diameter) range from 25 to 70, and larger fragments range from 1 to 70 percent. Subsurface gravels by volume (for a depth of 0 to 20 inches) range from 20 to 35 percent and larger fragments by volume range from 0 to 70 percent. Soils are well to somewhat excessively drained with slow to rapid permeability.

The associated soil series are Impedimenta (mixed, hyperthermic Lithic Torripsamments); and Marbolite (loamy-skeletal, mixed, superactive, hyperthermic, Lithic Haplargids).

The Impedimenta soils are very shallow over unweathered bedrock. Soil textures are sandy throughout. The Marbolite soils have a cobbly soil surface, are shallow to unweathered bedrock, and have a loamy-skeletal particle size control section with an argillic horizon directly above the unweathered bedrock contact.

This ecological site is correlated with the following map units and soil components in the Joshua Tree National Park Soil Survey:

2820;Rock outcrop-Impedimenta complex, 4 to 30 percent slopes;Impedimenta;;25; Marbolite;;10
2717;Dalelake-Rock outcrop-Buzzardsprings association, 4 to 30 percent slopes;Impedimenta;;1

Table 4. Representative soil features

Parent material	(1) Residuum–granite
Surface texture	(1) Gravelly loamy sand (2) Cobbly
Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to rapid
Soil depth	3–51 cm
Surface fragment cover <=3"	25–70%
Surface fragment cover >3"	1–70%
Available water capacity (0-101.6cm)	0.51–2.03 cm
Calcium carbonate equivalent (0-101.6cm)	0–1%
Electrical conductivity (0-101.6cm)	0 mmhos/cm

Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	20–35%
Subsurface fragment volume >3" (Depth not specified)	0–70%

Ecological dynamics

Abiotic Factors

The most important abiotic factors driving this ecological site are a dissected, eroded pediment landform, very shallow to shallow soils to a hard bedrock contact, and a hyperthermic soil temperature regime. The site is co-dominated by Mojave indigobush, desertsenna and burrobush, and a high diversity of secondary shrubs and subshrubs is typically present.

Pediments are gently sloping, bedrock erosional surfaces of low relief that form at the base of receding mountain fronts. Pediment surfaces are covered by a discontinuous layer of alluvium that is typically thinner closer to the mountain front and eventually thick enough that the pediment is no longer distinct from the alluvial fan (Dohrenwend and Parsons 2009). Closer to the mountain front, erosion is active, and exposed bedrock is dissected and undulating (Dohrenwend and Parsons 2009). Different topographical positions within these dissected pediment landscapes experience different rates of overland flow and rainsplash erosion (Edinger-Marshall and Lund 1999).

The dissected pediment landscape, with contrasting and localized areas of soil erosion and deposition, and run-off and run-on, supports a diverse plant community. The majority of the landscape is characterized by shallow soils subject to active erosion, which support a sparse but diverse community of shallow-rooted woody shrubs and subshrubs. Species that are capable of sprouting after mechanical damage are more common in this ecological site; these include Mojave indigobush, desertsenna, Fremont's dalea (*Psorothamnus emoryi*), California jointfir (*Ephedra californica*), and range ratany (*Krameria erecta*). The frequency of disturbance supports the continuous presence of shorter-lived subshrubs, which in more stable landforms are eventually replaced by longer-lived dominants. Annual species are limited in this site by the lack of soil moisture, and by soil erosion, which limits seedling establishment (Guerrero-Campo et al. 2008). Interfluves transport material, receive run-on from higher positions, and are mantled by a deeper layer of alluvium, which supports deeper-rooted species like creosote bush, and species more typical of washes, such as desertsenna.

Disturbance dynamics

The major disturbances affecting this ecological site are drought, invasion by non-native species and erosion.

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 this ecological site already has sparse cover, 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). Although non-native annuals are present in this ecological site, the site is relatively resistant to invasion. The active erosion that characterizes this site limits seedling establishment annual species (Guerrero-Campo and Montserrat-Marti 2000), and shallow soils and a hot climate reduce available soil moisture, which limits biomass of annuals.

The inability of this site to support a high biomass of annuals, and overall sparse vegetation cover, makes this site

resistant to fire, which has increased in other Mojave Desert plant communities due to the continuous fine fuel layer created by non-native annuals in wet years (D'Antonio and Vitousek 1992, Brooks et al. 2004). In the very unlikely instance of ignition in this ecological site, fire is likely to be small and of low intensity so the effects are insignificant at the landscape scale.

Water erosion is the dominant process modifying and maintaining exposed pediment surfaces (Edinger-Marshall and Lund 1999, Dohrenwend and Parsons 2009), and is an important process modifying and maintaining the vegetation community. Without additional disturbance, the affects of erosion are within the natural range of variability of the reference plant community. However, with additional disturbance (anthropogenic or natural), the effects of erosion may be more severe leading to vegetation and soil loss and potentially a new community phase or state. For example, shrub cover protects the gravelly soils of this ecological site from erosion (Edinger-Marshall and Lund 1999). If shrub cover is reduced due to drought, erosion will remove more soil, which reduces the availability of safe sites for plant establishment, which further reduces shrub cover.

State and transition model

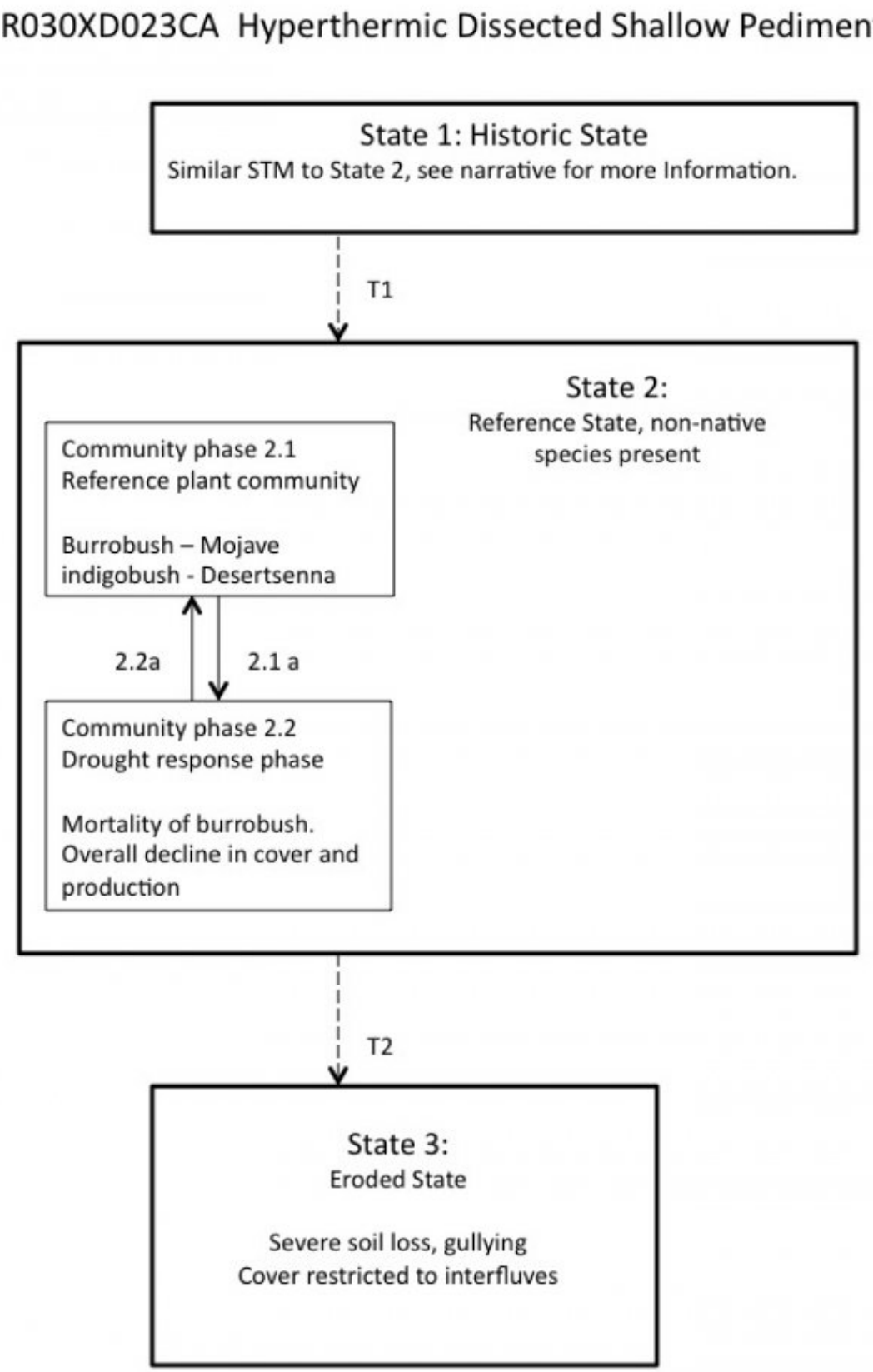

Figure 4. R030XD023CA

State 1

Historic State

State 1 represents the historic range of variability for this ecological site. This state no longer exists due to the ubiquitous naturalization of non-native species in the Mojave Desert. Periodic drought and water erosion were the natural disturbances influencing this ecological site. Data for this State does not exist, but it would have been similar to State 2, except with only native species present. See State 2 narrative for more detailed information.

State 2
Reference State

State 2 represents the current range of variability for this site. Non-native annuals, including Mediterranean grass and Asian mustard (*Brassica tournefortii*) are naturalized in this plant community. Their abundance varies with precipitation, but they are at least sparsely present (as current year's growth or present in the soil seedbank).

Community 2.1
Reference plant community

Figure 5. Community Phase 2.1

The current potential plant community is co-dominated by Mojave indigobush, desertsenna and burrobush. Secondary shrubs include Fremont's dalea, creosote bush, range ratany, white ratany (*Krameria grayi*), Parish's goldeneye (Viguira parishii), and California jointfir. Subshrubs and perennial forbs are an important component of the vegetation community, and include Mojave aster (*Xylorhiza tortifolia*), California fagonbush (Fagonia leavis), brownplumed wirelettuce (*Stephanomeria pauciflora*), and desert trumpet (*Eriogonum inflatum*). Native winter annuals are seasonally present, and common species include desert Indianwheat (*Plantago ovata*) and pincushion flower (Chaenactis fremonti). Mediterranean grass and Asian mustard are sparsely present. Asian mustard is restricted to interfluves. Biological soil crusts (BSC) are often associated with grus (granite that is crumbled, but not decomposed), which is typical of soil surfaces on this ecological site. These crusts are important for improving soil stability, infiltration, and nutrient cycling on these shallow soils (Belnap et al. 2001). Biological soil crusts form slowly, and are very sensitive to physical disturbance (such as from trampling or off-road vehicle disturbance).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	73	112	146
Forb	2	67	90
Grass/Grasslike	–	3	11
Microbiotic Crusts	1	1	1
Total	**76**	**183**	**248**

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 Mojave indigobush, creosote bush, California jointfir, range ratany, and white ratany), and mortality of shorter-lived shrubs (including burrobush, desertsenna, Parish's goldeneye) and subshrubs, and lack of emergence of annual forbs. This is an at-risk phase, as the increase in bare ground that occurs during drought increases the susceptibility of this site to erosion. Biological soil crusts are dormant during drought, and are especially susceptible to damage by mechanical disturbance when dry (Warren and Eldridge 2003). Thus, any additional disturbance threatens to transition this community phase to a phase of increased erosion, or a new state, where significant loss of ecological function has occurred.

Pathway 2.1a
Community 2.1 to 2.2

This pathway occurs with severe or prolonged drought.

Pathway 2.2a
Community 2.2 to 2.1

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

State 3
Eroded State

This state is characterized by severe soil erosion. Biological soil crusts are largely absent, gullying is pronounced, and soil surfaces have no protective surface gravels. Vegetative cover is restricted to interfluves.

Transition 1
State 1 to 2

This transition occurred with the naturalization of non-native species in this ecological site. Non-native species were introduced with settlement of the Mojave Desert region in the 1860s.

Transition 2
State 2 to 3

This transition occurs with severe or continuous anthropogenic disturbance that increases the effects of erosion.

Additional community tables

Table 6. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
1	**Native shrubs**			73–146	
	Mojave indigobush	PSAR4	*Psorothamnus arborescens*	22–45	1–5
	desertsenna	SEAR8	*Senna armata*	58–45	1–4
	burrobush	AMDU2	*Ambrosia dumosa*	17–39	2–6
	dyebush	PSEM	*Psorothamnus emoryi*	0–34	0–2
	littleleaf ratany	KRER	*Krameria erecta*	9–17	0–1
	creosote bush	LATR2	*Larrea tridentata*	2–9	2–4
	white ratany	KRGR	*Krameria grayi*	0–9	0–2
	Mojave woodyaster	XYTO2	*Xylorhiza tortifolia*	2–9	0–1
	Parish's goldeneye	VIPA14	*Viguiera parishii*	0–4	0–1
	California jointfir	EPCA2	*Ephedra californica*	0–4	0–1
	brownplume wirelettuce	STPA4	*Stephanomeria pauciflora*	0–3	0–1
	California fagonbush	FALA	*Fagonia laevis*	0–2	0–1
Forb					
2	**Native forbs**			2–90	
	desert Indianwheat	PLOV	*Plantago ovata*	0–45	0–3
	pincushion flower	CHFR	*Chaenactis fremontii*	0–22	0–1
	desert trumpet	ERIN4	*Eriogonum inflatum*	2–12	0–1
	distant phacelia	PHDI	*Phacelia distans*	0–11	0–1
	brittle spineflower	CHBR	*Chorizanthe brevicornu*	0–11	0–1
4	**Non-native annual forbs**			0–45	
	Asian mustard	BRTO	*Brassica tournefortii*	0–45	0–3
Grass/Grasslike					
3	**Non-native annual grasses**			0–11	
	common Mediterranean grass	SCBA	*Schismus barbatus*	0–11	0–1

Animal community

This ecological site is habitat for the threatened desert tortoise (Gopherus agassizii agassizii).

Recreational uses

This ecological site can be used for hiking and aesthetic enjoyment. Pediment landscapes are an unusual and interesting feature of arid environments.

Inventory data references

Community Phase 2.1:

G1-H (Type location)
G1-Q
G1-G
G1-T

Type locality

Location 1: San Bernardino County, CA	
UTM zone	N
UTM northing	3774911
UTM easting	640377
General legal description	The type location is located approximately 0.3 miles due south of Highway 62, within Joshua Tree National Park.

Other references

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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)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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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:

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17. **Perennial plant reproductive capability:**
