USDA Natural Resources
Conservation Service

Ecological site R035XB201AZ
Mudstone/Sandstone Hills 6-10" p.z.

Accessed: 05/21/2025

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.

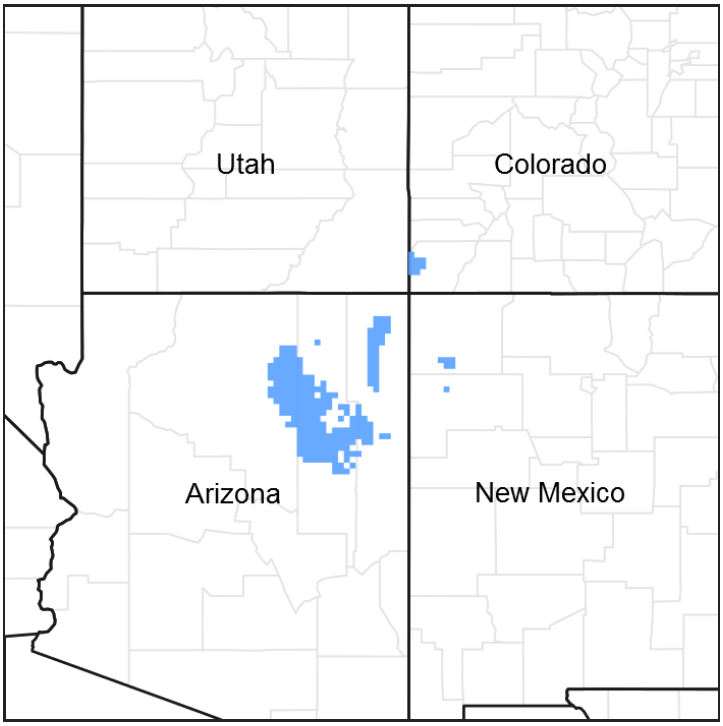

Figure 1. Mapped extent

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): 035X–Colorado Plateau

This ecological site occurs in Common Resource Area 35.2 - the Colorado Plateau Shrub – Grasslands

Elevations range from 3800-5800 feet and precipitation averages 6 to 10 inches per year. Vegetation includes shadscale, fourwing saltbush, Mormon tea, blackbrush, Indian ricegrass, galleta, blue grama, and black grama. The soil temperature regime is mesic and the soil moisture regime is typic aridic. This unit occurs within the Colorado Plateau Physiographic Province and is characterized by a sequence of flat to gently dipping sedimentary rocks eroded into plateaus, valleys and deep canyons. Sedimentary rock classes dominate the plateau with volcanic fields occurring for the most part near its margin.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia bigelovii* (2) *Ephedra torreyana*
Herbaceous	(1) *Pleuraphis jamesii* (2) *Achnatherum hymenoides*

Physiographic features

This ecological site occurs on bedrock controlled hillsides and mesa escarpments with slopes ranging from 15 to 60 percent. The site can include small areas that have less slope with pockets of deeper soils. It has excessive drainage and significant runoff.

Table 2. Representative physiographic features

Landforms	(1) Escarpment (2) Hill (3) Mesa
Flooding frequency	None
Ponding frequency	None
Elevation	3,800–5,800 ft
Slope	15–60%
Ponding depth	0 in
Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

The 35.2 Colorado Plateau Cold Desert Shrub - Grassland common resource area has a very dry and windy climate that is hot in the summer and cold in the winter. The annual precipitation averages between 6 and 10 inches. The soil moisture regime is typic aridic

and the soil temperature regime is mesic. A slight majority of the precipitation arrives during the late fall, winter, and early spring. This winter season moisture originates in the Pacific Ocean and arrives as rain, or sometimes snow, during widespread frontal storms of generally low intensity. The majority of the snow (average range of 1 to 17 inches) falls from December through February, but rarely lasts more than a few days. A seasonal drought occurs from late May through early July. Summer rains occur from July through September during brief intense local thunderstorms. The rain is sporadic in intensity and location. The moisture originates from the Gulf of Mexico in the early summer and the Gulf of California in the late summer/early fall. Windy conditions are common year round, but the winds are strongest and most frequent during the spring.

Table 3. Representative climatic features

Frost-free period (average)	181 days
Freeze-free period (average)	207 days
Precipitation total (average)	10 in

Influencing water features

The soil moisture on this site is from precipitation. Bedrock can concentrate the available moisture in deeper soil pockets, increasing productivity on those areas on the site.

Soil features

The soils on this ecological site are mostly very shallow to shallow (<20")over mudstone and sandstone bedrock. The site can include small areas with pockets of deeper soils on side slopes. Surface textures range from sandy loam to very cobbly loam. Subsurface textures range from sand to sandy clay loam. The soils are formed primarily as residuum and alluvium from a mix of mudstone and sandstone parent matrial. Available water capacity is from very low to high depending on depth.

Correlated Soil Survey Map Units include:

Navajo County Central Part (AZ633) Soil Map Units 10-Torriorthents, Calciorthids; 22-Torriorthents, Gypsiorthids; 66-Torriorthents, Calciorthids;

Hopi Area, Parts of Coconino and Navajo Counties (AZ714) Soil Map Units 2-Torriorthents, 39-Typic torriorthents;

Little Colorado River Area (AZ707)- Soil Map Units 50-Moenkopie and 58-Somorent.

Chinle Area (AZ713) Soil Map Units 13-Lithic Torriorthents, 45-Shinume.

Fort Defiance Area, Parts of Apache and Navajo Counties, Arizona, and McKinley and San Juan Counties, New Mexico (AZ715) Soil Map Units 6-Claysprings Family, 39-Torriorthents and Haplogypsids, 112-Somorent family, 121-Torriorthents and Typic Haplocalcids, 124-Typic Torriorthents

Shiprock (AZ717) Soil Map Unit 508-Shalet

Table 4. Representative soil features

Parent material	(1) Residuum–sandstone and shale (2) Alluvium–mudstone
Surface texture	(1) Very cobbly fine sandy loam (2) Loam (3) Sandy loam
Family particle size	(1) Loamy
Drainage class	Somewhat excessively drained to excessively drained
Permeability class	Slow to moderately rapid
Soil depth	10–20 in
Surface fragment cover <=3"	2–40%
Surface fragment cover >3"	0–25%
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Soil reaction (1:1 water) (0-40in)	7.9–9
Subsurface fragment volume <=3" (Depth not specified)	5–55%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

An ecological site is not a precise assemblage of species for which the proportions are the same from place to place or from year to year. In all plant communities, variability is apparent in productivity and occurrence of individual species. Spatial boundaries of the communities; however, can be recognized by characteristic patterns of species composition, association, and community structure. The historic climax plant community for this ecological site has been described by sampling relict or relatively undisturbed sites and/or reviewing historic records. The historic climax plant community is the plant community that evolved over time with the soil forming process and long term changes in

climatic conditions of the area. It is the plant community that was best adapted to the unique combination of environmental factors associated with the site.

Natural disturbances, such as drought, fire, grazing of native fauna, and insects, are inherent in the development and maintenance of these plant communities. The effects of these disturbances are part of the range of characteristics of the ecological site. Fluctuations in plant community structure and function caused by the effects of natural disturbances help establish the boundaries and characteristics of an ecological site. They are accounted for as part of the range of characteristics of the ecological site. Recognizable plant community phases are identified in the reference state of the ecological site. Some sites may have a small range of variation, while others have a large range. Some plant community phases may exist for long periods of time, while others may only occur for a couple of years after a disturbance.

Deterioration of the plant community, hydrology, or soil site stability on an ecological site can result in crossing a threshold or potentially irreversible boundary to another state, or equilibrium. This can occur as a result of the loss of soil surface through erosion, the loss of the stability of the site due to disturbances that cause active erosion on the site, increases in the amounts and/or patterns or runoff from rainstorms, changes in availability of surface and subsurface water, significant changes in plant structural and functional types, or the introduction of non-native species. When these thresholds are crossed, the potential of the ecological site to return to the historic climax plant community can be lost, or restoration will require significant inputs . There may be multiple states possible for an ecological site, determined by the type and or severity of disturbance.

The known states and transition pathways for this ecological site are described in the state and transition model. Within each state, there may be one or more known plant community phases. These community phases describe the different plant community that can be recognized and mapped across this ecological site. The state and transition model is intended to help land users recognize the current plant community on the ecological site, and the management options for improving the plant community to the desired plant community.

Plant production information in this site description is standardized to the annual production on an air-dry weight basis in near normal rainfall years.

State and transition model

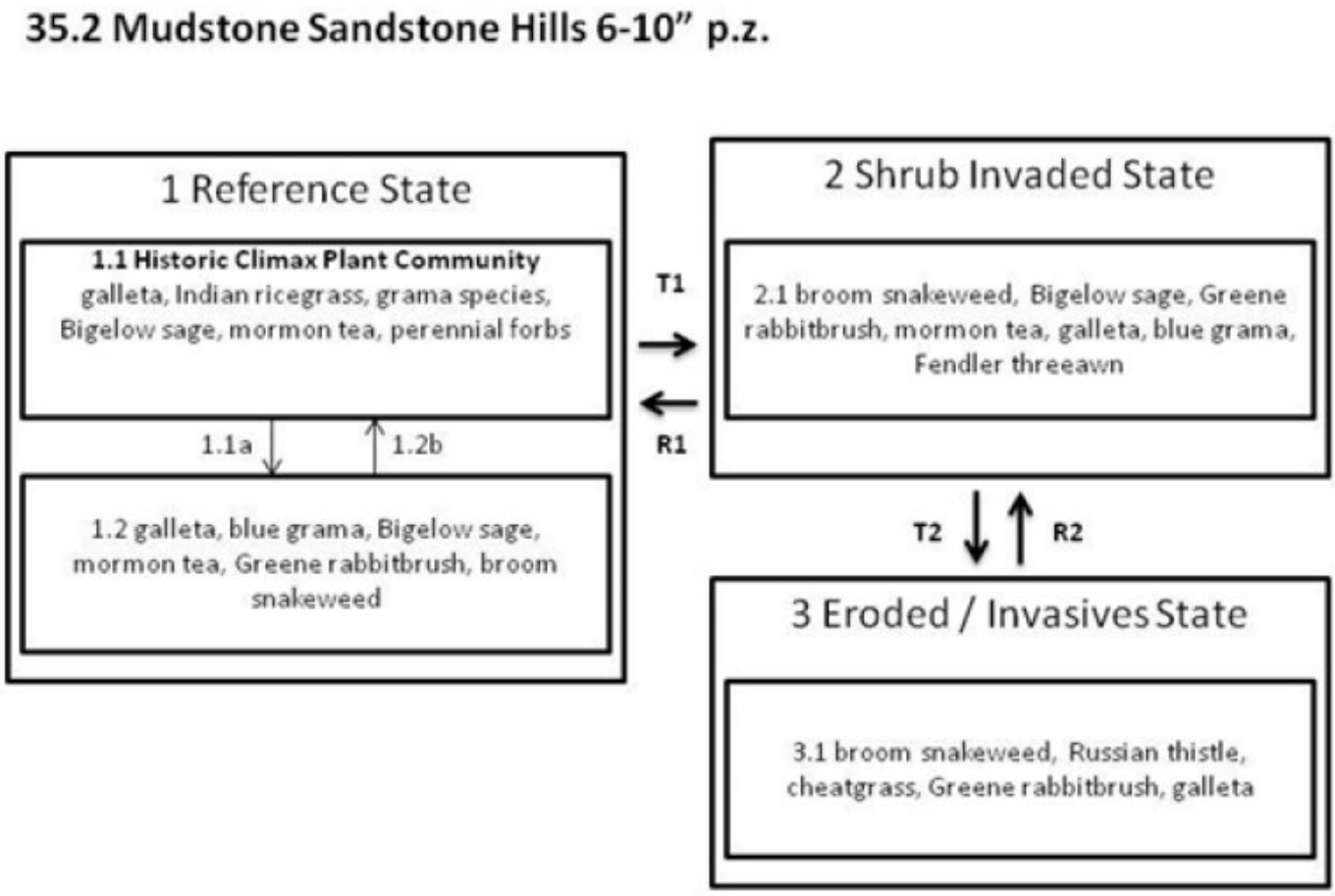

Figure 4. 35.2 Mundstone Sandstone Hills S&T

State 1
Reference State

The reference state which includes the Historic Climax Plant Community has been determined by study of relict areas or areas protected from excessive disturbances. Trends in plant communities going from unmanaged grazed areas to managed grazed areas, seasonal use pastures and historical accounts have also been used. This reference state is characterized by mix of grasses and shrubs dominated by galleta, Indian ricegrass, Bigelow sagebrush and Torrey Mormon tea.

Community 1.1
Historic Climax Plant Community

The Historic Climax Plant Community is a grassland dominated by warm season bunch grasses (galleta, sideoats grama, blue grama and black grama) mixed with cool season grasses (Indian ricegrass, needle and thread, squirreltail) and shrubs (Bigelow sage, Mormon tea). Plants that will increase with disturbance are galleta, Fendler threeawn, snakeweed and annual buckwheats. Minor amounts of non-native annual grasses and forbs may be present.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	90	175	250
Shrub/Vine	90	160	225
Forb	5	25	40
Total	**185**	**360**	**515**

Table 6. Ground cover

Tree foliar cover	0-1%
Shrub/vine/liana foliar cover	5-15%
Grass/grasslike foliar cover	5-10%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	2-40%
Surface fragments >3"	0-25%
Bedrock	0%
Water	0%
Bare ground	20-40%

Figure 6. Plant community growth curve (percent production by month). AZ3521, 35.2 6-10" p.z. all sites. Growth begins in the spring and continues through the summer. Most growth in this CRA occurs in the spring using stored winter moisture..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	1	9	20	27	14	10	11	5	3	0	0

Figure 7. Plant community growth curve (percent production by month). AZ5202, Indian ricegrass, 35.2 6-10" p.z.. Growth begins in spring, most growth occurs in May, goes dormant during summer heat..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	10	15	40	20	0	0	10	5	0	0

Community 1.2
Grasses with Mixed Shrubs

Perennial grasses decrease, especially cool and warm season bunchgrasses. Shrubs such as fourwing saltbush, Greene rabbitbrush, Mormon tea and broom snakeweed increase. Changes in vegetative structure leads to some increased erosion on steepest slopes.

Pathway 1.1a
Community 1.1 to 1.2

Unmanaged grazing, drought

Pathway 1.2b
Community 1.2 to 1.1

Managed grazing, favorable precipitation

State 2
Shrub Invaded State

This state is characterized by an invasion of native shrubs with an understory of scattered grasses. Shrubs like Mormon tea, rabbitbrush, snakeweed, Bigelow sage and shadscale have increased to dominate the plant community. There is a significant increase in rills and water flow patterns with a reduction of herbaceous canopy cover.

Community 2.1
Half Shrubs - Grasses

2.1 Shrubs become dominant on the site, with increases in composite shrubs such as broom snakeweed and Greene rabbitbrush. Bunchgrasses are mostly absent, stoloniferous grasses persist. Grazing in cooler season has significantly reduced cool season grasses. There is an increase of bare ground with a decline of herbaceous ground cover. This allows for invasive of annuals and higher runoff rates.

State 3
Eroded/ Invasives State

This state is characterized by a shrubland with an increase of annual forbs and grasses, both native and non-native. Small patches of native perennial grasses may occur.

Community 3.1
Native / Non-Native

The majority of production on this site is from native and non-native annual grasses and forbs, including Russian thistle and cheatgrass. Shrubs present include broom snakeweed, Greene's rabbitbrush and Mormon tea. Small patches of galleta may persist. There is a significant increase in water erosion.

Transition T1
State 1 to 2

Unmanaged grazing, drought

Restoration pathway R1
State 2 to 1

Manged grazing, woody species control, favorable climate.

Transition T2
State 2 to 3

Loss of perennial grasses and shrubs, reduced soil site stability and hyrologic function, invasion of non-native annuals.

Restoration pathway R2
State 3 to 2

Invasive Weed Control, woody species control, erosion control, Range seeding, managed grazing, favorable climate.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant grasses**			80–150	
	James' galleta	PLJA	*Pleuraphis jamesii*	55–75	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	35–55	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	35–55	–
2	**Misc. grasses**			75–125	

	black grama	BOER4	*Bouteloua eriopoda*	5–20	–
	blue grama	BOGR2	*Bouteloua gracilis*	5–20	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	5–20	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	5–20	–
	New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	0–10	–
	bush muhly	MUPO2	*Muhlenbergia porteri*	0–10	–
	sandhill muhly	MUPU2	*Muhlenbergia pungens*	0–10	–
	alkali sacaton	SPAI	*Sporobolus airoides*	0–10	–
	Grass-like, perennial	2GLP	*Grass-like, perennial*	0–10	–
	Fendler's threeawn	ARPUF	*Aristida purpurea var. fendleriana*	0–10	–
Forb					
3	**All forbs**			5–40	
	Forb, perennial	2FP	*Forb, perennial*	0–20	–
	Forb, annual	2FA	*Forb, annual*	0–10	–
	Eastwood's sandwort	AREA	*Arenaria eastwoodiae*	0–5	–
	James' cryptantha	CRCIJ	*Cryptantha cinerea var. jamesii*	0–5	–
	bladderpod	LESQU	*Lesquerella*	0–5	–
	desert princesplume	STPI	*Stanleya pinnata*	0–5	–
	western tansymustard	DEPI	*Descurainia pinnata*	0–2	–
	nodding buckwheat	ERCE2	*Eriogonum cernuum*	0–2	–
	flatcrown buckwheat	ERDE6	*Eriogonum deflexum*	0–2	–
Shrub/Vine					
4	**Dominant shrubs**			70–120	
	Bigelow sage	ARBI3	*Artemisia bigelovii*	50–75	–
	Torrey's jointfir	EPTO	*Ephedra torreyana*	20–35	–
	Cutler's jointfir	EPCU	*Ephedra cutleri*	5–10	–
5	**Other shrubs**			20–115	
	Shrub (> 5m)	2SHRUB	*Shrub (> 5m)*	5–20	

	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	5–20	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–20	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	0–20	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–20	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–20	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–10	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–10	–
	rubber rabbitbrush	ERNAB2	*Ericameria nauseosa ssp. nauseosa var. bigelovii*	0–10	–
	Greene's rabbitbrush	CHGR6	*Chrysothamnus greenei*	0–10	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–10	–

Animal community

Suitability for grazing by livestock and big game animals is only fair because of steep slopes and distribution problems. This could cause heavy use in limited access areas. It is important for small birds for feed, cover and nesting.

Recreational uses

The landscape is an excellent contrast to surrounding sites and provides opportunities for hiking, hunting, rock hounding and photography.

Type locality

Location 1: Navajo County, AZ	
Township/Range/Section	T26N R15E S4
General legal description	Tovar Mesa area of Hopi Reservation Sec 4, T26N, R15E, and Sec 25, T25N, R16E.
Location 2: Navajo County, AZ	
General legal description	Holbrook AZ, area south of HWY 40 and North of Painted Desert Medical clinic.

Other references

Updates and revisions for this ESD were conducted as part of a 2007-2012 Interagency Technical Assistance Agreement between the Bureau of Indian Affairs–Navajo Region and the NRCS-Arizona.

Contributors

AZ NRCS Staff
Karlynn Huling
Ken Gishi
Kenneth Gishi
Larry D. Ellicott

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)	Dean Schlichting, Ken Gishi
Contact for lead author	State Rangeland Management Specialist, NRCS-Arizona State Office, Phoenix, AZ
Date	11/10/2008
Approved by	Byron Lambeth
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** A few rills occur throughout site (1-10% cover) at infrequent intervals, mostly in exposed areas. Rills may be 8 or more feet in length and are likely to form below adjacent exposed bedrock or areas where surface rock fragments are less than 15%. The number of rills and extent will increase on slopes greater than 35%, or sites with a decrease of herbaceous cover and/or immediately following high intensity storm events.

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2. **Presence of water flow patterns:** The occurrence of water flow patterns is frequent (5-10%

cover) and occur throughout the site interspersed throughout the larger rock fragments. These water flow patterns are typically less than 6 feet long. As slope increase (>15%) water flow pattern occurrence and length increases. A temporary increase in water flow patterns in also expected following high intensity storm events.

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3. **Number and height of erosional pedestals or terracettes:** Some slight pedestalling (1-2" inch) can occur at the base of plants and rocks as a result of natural wind and water erosion in the reference state; however, terracettes are uncommon and occur only in flow paths. On steeper slopes (>35%), pedestalling and terracettes can be at moderate amounts with no exposed roots.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 20 to 40% bare ground depending on rock and gravel cover. Bare areas are moderate in size, but are rarely connected.

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5. **Number of gullies and erosion associated with gullies:** Gullies can occur in deeper soil with less rock cover with occasional headcuts on steeper slopes. There are numerous large drainages on this site that are stable; lined with bedrock and intermittent vegetation.

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

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7. **Amount of litter movement (describe size and distance expected to travel):** Most herbaceous and fine woody litter will be transported and concentration by wind and water in flow pathways and around obstructions, while a very small percentage stays in place. Coarse woody litter (>1/4" diameter) and duff will accumulate under shrub canopies.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have an average soil stability rating of 4 throughout the site. Surface texture varies from sandy loam to gravelly/cobbly clay loam.

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

and thickness): Soil surface varies from 2 to 4 inches. Structure is generally weak thin platy. Color is reddish brown (2.5YR 5/4). The A horizon will show minimal difference in structure and depth between interspaces and under plant canopies.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** This site is characterized by a relatively even distribution of mostly perennial grasses and low shrubs across the landscape. Canopy and basal cover are dominated by warm season grasses and evergreen shrubs. Both plant cover values (especially basal) decrease during a prolonged summer drought. This type of plant community along with surface rock cover and slopes are somewhat effective at capturing and storing precipitation.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. These soils are not easily compacted due to cover of rock fragments and the volume of rock fragments in the subsurface horizons of the profile.

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

    Dominant: Evergreen shrubs (25-35%)> Warm season colonizing grasses (15-20%) = Cool season bunch grasses (15-20%)

    Sub-dominant: Deciduous shrubs (5-15%)> Warm season bunch grasses (5-10%), forbs (5-10%)

    Other: Cacti (0-3%).

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** In a normal year up to 10 to 15% of grasses and shrubs die off. During and after drought years there can be from 10 to 25% die off of shrubs and grasses. Severe winter droughts affect shrubs, and cool season grasses the most. Severe summer droughts affect the warm season grasses the most.

14. **Average percent litter cover (%) and depth (in):** Within plant interspaces litter ranges from 0 to 10 % cover with no real depth, while under some shrub canopies it ranges from 20 to 40% cover with depths from 1/8 to 1/2 inches thick. Litter amounts increase during the first few years of drought, then decrease in later years.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Average annual production on this site is expected to be 300 to 400 lbs/ac. in a year of average annual precipitation.

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:** Non-native species that can invade and establish on this site are cheatgrass and Russian thistle. Native species such as James' galleta, broom snakeweed, rabbitbrush and Mormon tea are native to the site but can increase with disturbance.

17. **Perennial plant reproductive capability:** All plants native to this site are adapted to the climate and are capable of producing seeds, stolons and rhizomes except during the most severe droughts.