USDA Natural Resources
Conservation Service

Ecological site R035XA115AZ
Sandstone Upland 10-14" p.z.

Accessed: 05/11/2025

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 35.1 - the Colorado Plateau Mixed Grass Plains

Elevations range from 4800 to 6300 feet and precipitation averages 10 to 14 inches per year. Vegetation includes Stipa species, Indian ricegrass, galleta, and blue grama, fourwing saltbush, winterfat, and cliffrose. The soil temperature regime is mesic and the soil moisture regime is ustic 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	(1) *Juniperus utahensis*
Shrub	(1) *Ephedra* (2) *Purshia mexicana*
Herbaceous	(1) *Bouteloua eriopoda* (2) *Pleuraphis jamesii*

Physiographic features

This site occurs in an upland position. Slopes on rolling mesa tops are from 0 to 15%. On the rocky escarpments slopes can reach up to 30% for short distances. It neither benefits significantly from run-in moisture nor is greatly affected by excess runoff.

Table 2. Representative physiographic features

Landforms	(1) Mesa (2) Escarpment
Flooding duration	Extremely brief (0.1 to 4 hours)
Flooding frequency	None to rare
Ponding duration	Very brief (4 to 48 hours)
Elevation	4,800–6,300 ft
Slope	0–15%
Aspect	Aspect is not a significant factor

Climatic features

50-60% of moisture falls as rain Jul-Sept and is the most effective moisture for plant growth. The remaining moisture comes as snow during the winter.

Mean temperatures for the hottest month (Jul) is 72 degrees F; for the coldest month (Jan) is 32 degrees F. Extreme temperatures of 105 degrees F and -26 degrees F have been recorded. Long periods with little or no effective moisture are relatively common.

Cool season plants begin growth in early spring and mature in the early summer. Warm season plants take advantage of the summer rains and grow from July through September.

Table 3. Representative climatic features

Frost-free period (average)	160 days
Freeze-free period (average)	180 days
Precipitation total (average)	13 in

Influencing water features

This site does not benefit significantly from run-in moisture nor is it greatly affected by excess runoff.

Soil features

Soils grouped together in this site have the following characteristics: very shallow and shallow to sandstone and fractured shale bedrock. Surface horizon textures typically range from loamy sand to fine sandy loam with about 1 to 4 inches surface thickness. Subsurface horizon textures range from sandy loam to light clay loam with gravel and cobble contents less than 35% by volume. Soil reaction is mildly to strongly alkaline (pH 7.4 to 9.0) and soluble salt accumulations are low. Shallow depth to bedrock restricts the movement of both plant roots and moisture. These soils have low available moisture capacity due to shallow depth. Surfaces readily disperse and seal over during heavy rains which increases runoff, erosion and loss of moisture.

Typical taxonomic units include:

Coconino County Central (AZ631) Soil Map Units -Kopie 16, 22;
Navajo County central (AZ633) Soil Map Units-Kech 30, 31, 55, Leanto 33, 34, 56, Chedeski 45, Arches 52;
Apache County central (AZ635) Soil Map Units-Moenkopie MKB, MOD, Lithic torriorthents SA;

Yavapai County Western (AZ637) Soil Map Units-Moenkopie MsB, PwD;
Little Colorado River (AZ707) Soil Map Units-Aut 2, Tuweep 63;
Navajo Mountain (AZ711) Soil Map Units-Arches 31, Nalcase 21,22,48, 49.

Table 4. Representative soil features

Parent material	(1) Colluvium–sandstone (2) Alluvium–shale
Surface texture	(1) Loamy sand (2) Sandy loam (3) Fine sandy loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Slow to moderate
Soil depth	5–20 in
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–20%
Available water capacity (0-40in)	2.5–5 in
Calcium carbonate equivalent (0-40in)	0–4%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	7.4–9
Subsurface fragment volume >3" (Depth not specified)	0–35%

Ecological dynamics

The plant communities found on an ecological site are naturally variable. Composition and production will vary with yearly conditions, location, aspect, and the natural variability of the soils. The historical climax plant community represents the natural potential plant communities found on relict or relatively undisturbed sites. Other plant communities described here represent plant communities that are known to occur when the site is disturbed by factors such as grazing, fire, or drought.

Production data provided in this site description is standardized to air-dry weight at the end of the summer growing season. The plant communities described in this site description are based on near normal rainfall years.

NRCS uses a Similarity Index to compare existing plant communities to the plant communities described here. Similarity Index is determined by comparing the production and composition of a plant community to the production and composition of a plant community described in this site description. To determine Similarity Index, compare the production (air-dry weight) of each species to that shown in the plant community description. For each species, count no more than the maximum amount shown for the species, and for each group, count no more than the maximum shown for the group. Divide the resulting total by the total normal year production shown in the plant community description. If rainfall has been significantly above or below normal, use the total production shown for above or below normal years. If field data is not collected at the end of the summer growing season, then the field data must be corrected to the end of the year production before comparing it to the site description. The growth curve can be used as a guide for estimating production at the end of the summer growing season.

The State and Transition model shows the most common occurring plant communities likely to be encountered on this ecological site. This model may not show every possible plant community, but only those that are most

prevalent and observed through field inventory. As more data is collected and research is available, these plant communities may be revised, removed, and even added to reflect the ecological dynamics of this site.

State and transition model

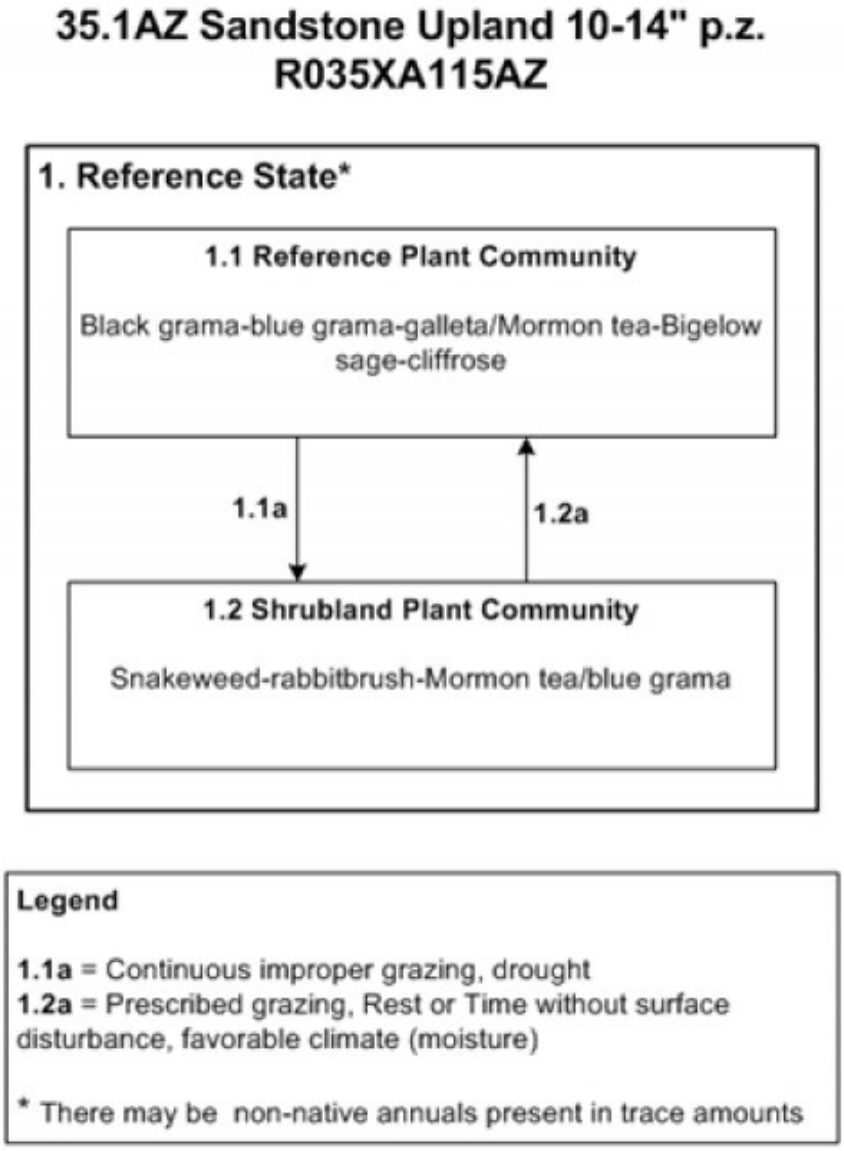

Figure 4. STM - R035XA115AZ

State 1
Reference State

The reference state and the reference plant community (Historic Climax Plant Community) has been determined by study of relict areas or areas protected from excessive disturbances. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures and historical accounts have also been used. This reference state is characterized as a native mid and short grassland with scattered shrubs and trees. The dominant herbaceous cover is warm season grasses such as black grama, blue grama and galleta. Dominant woody species is a mix of large and low growing shrubs along with scattered trees.

Community 1.1
Reference Plant Community

Figure 5. Sandstone Upland, High Precipitation Site

This plant community is made up primarily of warm season grasses with a fair percentage of cool season grasses, shrubs and scattered juniper trees. This community is comprised mostly of grasses (about 70%), followed by shrubs (about 15%), then forbs (about 5%) and trees (about 5%). With continued disturbance the plant community shifts toward a shrub/grass mix and scattered trees with a decline in favorable grasses and shrubs. In this plant community there may be trace amounts (<2% by weight) of non-native annuals present. They do not affect the sites ecological processes in these minor amounts.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	210	355	485
Shrub/Vine	55	80	110
Forb	25	40	55
Tree	10	25	50
Total	**300**	**500**	**700**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0-15%
Biological crusts	0%
Litter	5-20%
Surface fragments >0.25" and <=3"	0-20%
Surface fragments >3"	0-20%
Bedrock	5-20%
Water	0%
Bare ground	35-65%

Table 7. Soil surface cover

Tree basal cover	1-3%
Shrub/vine/liana basal cover	2-4%
Grass/grasslike basal cover	2-6%

Forb basal cover	1-3%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 8. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	0-1%	0-1%	0-1%
>0.5 <= 1	–	0-2%	0-3%	0-2%
>1 <= 2	–	0-3%	0-5%	–
>2 <= 4.5	0-1%	0-2%	0-1%	–
>4.5 <= 13	1-10%	0-1%	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Figure 7. Plant community growth curve (percent production by month). AZ3511, 35.1 10-14" p.z. all sites. Growth begins in the spring and continues through the summer, most growth occurs during the summer rainy season.
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	1	5	11	18	25	24	13	3	0	0

Figure 8. Plant community growth curve (percent production by month). AZ5102, 35.1 10-14" p.z. blue grama. Growth occurs mostly in summer and early fall during the rainy season..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	5	15	30	30	15	0	0	0

Figure 9. Plant community growth curve (percent production by month). AZ5103, 35.1 10-14" p.z. sideoats grama. Most growth occurs in summer and early fall during the rainy season..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	10	20	30	20	10	5	0	0

Community 1.2
Shrubland Plant Community

This plant community has a decrease in perennial grasses and palatible shrubs. Plants that invade or increase when this site deteriorates are blue grama, broom snakeweed, rabbitbrush, Mormon tea, various annual forbs and scattered trees.

Pathway 1.1a
Community 1.1 to 1.2

Unmanaged grazing use during the winter and spring periods will decrease the cool season grasses, which are replaced by warm season, lower forage value grasses and shrubs, drought.

Pathway 1.2a
Community 1.2 to 1.1

Prescribed grazing, Rest or time without surface disturbance, favorable climate (moisture)

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Grasses**			250–350	
	black grama	BOER4	*Bouteloua eriopoda*	75–125	–
	blue grama	BOGR2	*Bouteloua gracilis*	50–100	–
	James' galleta	PLJA	*Pleuraphis jamesii*	50–100	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	25–75	–
	bush muhly	MUPO2	*Muhlenbergia porteri*	5–25	–
2	**Cool Season Grasses**			25–100	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	25–50	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	5–25	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–20	–
	New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	0–20	–
	muttongrass	POFE	*Poa fendleriana*	0–20	–
	Fendler's threeawn	ARPUF	*Aristida purpurea var. fendleriana*	5–15	–
3	**Occasional Grasses**			5–25	
	sandhill muhly	MUPU2	*Muhlenbergia pungens*	0–10	–
	alkali sacaton	SPAI	*Sporobolus airoides*	0–10	–
	spike dropseed	SPCO4	*Sporobolus contractus*	0–10	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–10	–
	mesa dropseed	SPFL2	*Sporobolus flexuosus*	0–10	–
	Grass, annual	2GA	*Grass, annual*	0–5	–
Forb					
4	**All forbs**			25–50	
	Forb, annual	2FA	*Forb, annual*	5–15	–
	Forb, perennial	2FP	*Forb, perennial*	5–15	–
	Rocky Mountain zinnia	ZIGR	*Zinnia grandiflora*	0–10	–
	globemallow	SPHAE	*Sphaeralcea*	0–10	–
	Wright's bird's beak	COWR2	*Cordylanthus wrightii*	0–5	–
	winged buckwheat	ERAL4	*Eriogonum alatum*	0–5	–
	buckwheat	ERIOG	*Eriogonum*	0–2	–
	rosy gilia	GISI	*Gilia sinuata*	0–2	–

	Mexican woollywhite	HYME	*Hymenopappus mexicanus*	0–2	–
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–2	–
	Fendler's bladderpod	LEFE	*Lesquerella fendleri*	0–2	–
	shortstem lupine	LUBR2	*Lupinus brevicaulis*	0–2	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–2	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–2	–
	four o'clock	MIRAB	*Mirabilis*	0–2	–
	phacelia	PHACE	*Phacelia*	0–2	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–2	–
	sand verbena	ABRON	*Abronia*	0–2	–
	Fendler's sandwort	ARFE3	*Arenaria fendleri*	0–2	–
	milkvetch	ASTRA	*Astragalus*	0–2	–
	mustard	BRASS2	*Brassica*	0–2	–
	whitemargin sandmat	CHAL11	*Chamaesyce albomarginata*	0–2	–
	rose heath	CHER2	*Chaetopappa ericoides*	0–2	–
	cryptantha	CRYPT	*Cryptantha*	0–2	–
	bulbous springparsley	CYBU	*Cymopterus bulbosus*	0–2	–
	touristplant	DIWI2	*Dimorphocarpa wislizeni*	0–2	–
	small wirelettuce	STEX	*Stephanomeria exigua*	0–2	–
	annual Townsend daisy	TOAN	*Townsendia annua*	0–2	–
Shrub/Vine					
5	**Common shrubs**			25–50	
	Bigelow sage	ARBI3	*Artemisia bigelovii*	0–25	–
	jointfir	EPHED	*Ephedra*	5–25	–
	Mexican cliffrose	PUME	*Purshia mexicana*	0–25	–
	Stansbury cliffrose	PUST	*Purshia stansburiana*	0–25	–
6	**Misc. shrubs**			25–50	
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–10	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–10	–
	Greene's rabbitbrush	CHGR6	*Chrysothamnus greenei*	0–10	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–10	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–10	–
	New Mexico groundsel	PANE7	*Packera neomexicana*	0–10	–
	yucca	YUCCA	*Yucca*	0–10	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–5	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–5	–
	pricklypear	OPUNT	*Opuntia*	0–5	–
	Whipple cholla	CYWH	*Cylindropuntia whipplei*	0–5	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	0–5	–
Tree					
7	**Trees**			25–50	
	oneseed juniper	JUMO	*Juniperus monosperma*	10–40	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–25	–

Animal community

This site is suitable for grazing at any time throughout the year by cows and calves, stocker cattle, sheep and horses. The breaks portion of this site makes it a desirable winter range areea as it provides good protection from the wind.

The potential plant community provides a variety of food and cover plants for wildlife. When the vegetative comlplex of this site retrogresses, unpalatable shrubby species increase and the site becomes less valuable as a foraging area for some wildlife species. Areas where outcrops occur are important cover area for various wildlife species such as cottontail, wrens and reptiles. These outcrops are also important hunting perches for raptors.

Recreational uses

This site occurs on slopes and mesa tops and is typified by reddish outcrops of sandstone of the moenkopie formation which may exhibit strange formations as a result of erosional forces.
Winters are cold, but summers are quite warm and attractive for recreational use.
Uses include cross country travel, photography, wildlife observation, hunting, and rock collecting.

Other information

This site is an occasional feeding and resting area for golden eagles and prairie falcons. These birds may nest in inaccessible outcrops of sandstone, usually along the edges of mesas.

Type locality

Location 1: Coconino County, AZ	
General legal description	State location is by a rest stop on Interstate 40 approximately 30 miles east of Flagstaff, AZ.

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.

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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.

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Date	03/21/2006
Approved by	
Approval date	

Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** A few rills may form on the steeper slopes due to sandy loam and loam textures, moderate permeability, shallow depth, rapid runoff, and high amount of bare ground.

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2. **Presence of water flow patterns:** Water flow patterns may be common due to moderate permeability, shallow depths, rapid runoff, and high amount of bare ground. There will be more water flow patterns in the steeper areas adjacent to rock outcrop or very shallow (<10" deep) soils.

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3. **Number and height of erosional pedestals or terracettes:** Some pedestals and terracettes may form, but they should be very short.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** There may be as much as 60% bare ground on sites with low surface rock fragments. This site has a very low available water capacity (1-2 inches), so it has a very low plant cover potential except in areas where plants have access to water in sandstone bedrock cracks. Areas with more rock outcrop and surface rock fragments will have less bare soil. Drought may cause an increase in bare ground.

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

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Some areas will have small blowouts and minor depositional areas around rock outcrop and plant bases.

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7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous and fine woody litter will be transported in water flow pathways and by wind. Coarse woody litter will generally remain in place. Litter movement may be greater in areas adjacent to rock outcrop and very shallow (<10 inches deep) soils due to increased water flow over the surface.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate stability values average 4-5 under plant canopy and 3-4 in the interspaces. Soil surface texture ranges from loamy sand to fine sandy loam, but is mostly sandy loam, fine sandy loam, or loam. Many surface horizons are channery, but some have flagstones or gravels or no rock fragments at all. When well vegetated, these soils have a moderate to high reisitance to water erosion and a low to moderate resistance to wind erosion.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface structure may be single grain, platy (weak, thin to medium), or granular (weak to moderate, fine to medium). Surface thickness is generally 1-2 inches. Color is variable depending upon parent material.

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 patchy distribution of mostly grasses and scattered trees. The plants grow mostly in areas with good soil development or access to water in bedrock cracks. Canopy cover averages about 25% (5% trees, 3% shrubs, 17% grasses). Basal cover averages about 8% (1% trees, 1% shrubs, 6% grasses). Canopy and basal plant cover is reduced by an increased amount of rock fragment and bedrock ground cover. Both plant cover values decrease during a prolonged drought. This type of plant community is slightly to moderately effective at capturing and storing precipitation.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. Due to sandy loam, fine sandy loam, and loam textures in the surface horizonz, these soils may be easily compacted below 3" when wet. But they are generally protected by channers or other size rock fragments within the surface horizons. Some of the soils have a naturally platy surface structure.

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: Warm season grasses >

    Sub-dominant: cool season grasses > large shrubs > forbs

    Other: half-shrubs >= trees > succulents

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All plant functional groups are adapted to survival in all but the most severe droughts. Severe winter droughts affect the shrubs and trees the most. Severe summer droughts affect the grasses the most. Very shallow (<10" deep) soils will show the most mortality in all functional groups, except in areas where the plants have access to water in bedrock cracks.

14. **Average percent litter cover (%) and depth (in):** Mostly herbaceous litter with some woody litter. 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):** 350-400 pounds per acre (dry weight) in dry years; 400-600 pounds per acre in average years; 600-700 pounds per acre in wet years. Pounds per acre will be reduced by the amount of rock outcrop found on the site.

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:** Broom snakeweed, rabbitbrush, Mormon tea, oneseeded juniper, and Colorado pinyon are all native to the site, but they have the capacity to increase after many years of heavy grazing. Tall tumblemustard,

cheatgrass and Russian thistle are exotic plants that may invade this site.

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