

Ecological site R028AY330UT

Upland Sand (Black Greasewood, Indian Ricegrass)

Last updated: 6/12/2025

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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.

MLRA notes

Major Land Resource Area (MLRA): 028A–Ancient Lake Bonneville

MLRA 28A occurs in Utah (82 percent), Nevada (16 percent), and Idaho (2 percent). It encompasses approximately 36,775 square miles (95,246 square kilometers). A large area west and southwest of Great Salt Lake is a salty playa. This area is the farthest eastern extent of the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. Most of the valleys are closed basins containing sinks or playa lakes. Elevation ranges from 3,950 to 6,560 feet (1,204 to 2000 meters) in the basins and from 6,560 to 11,150 feet (1996 to 3398 meters) in the mountains. Much of the MLRA has alluvial valley fill and playa lakebed deposits at the surface from pluvial Lake Bonneville, which dominated this MLRA 13,000 years ago. A level line of remnant lake terraces on some mountain slopes indicates the former extent of this glacial lake. The Great Salt Lake is what remains of the pluvial lake. Mountains in the interior of this MLRA consist of tilted blocks of marine sediments from Cambrian to Mississippian age with scattered outcrops of Tertiary continental sediments and volcanic rocks. The average annual precipitation is 5 to 12 inches (13 to 30 cm) in the valleys and ranges up to 49 inches (124 cm) in the mountains. Most of the rainfall in the southern LRU occurs as high-intensity, convective thunderstorms during the growing season (April through September). The driest period is from midsummer to early autumn in the northern LRU. Precipitation in winter typically occurs as snow. The average annual temperature is 39 to 53 °F (4 to 12 °C). The freeze-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with increasing elevation. The dominant soil orders in this MLRA are Aridisols, Entisols, and Mollisols. Soils are dominantly in the mesic or frigid soil temperature regime, aridic or xeric soil moisture regime, and mixed mineralogy. The soils are generally well drained, loamy or loamy-skeletal, and very deep.

LRU notes

The Basin and Range North LRU exhibits dry summer with stronger xeric patterns than the Basin and Range South LRU. Ranges in the north LRU are about 50 percent Paleozoic sedimentary/metasedimentary (limestone/quartzite dominant) and about 10 percent Tertiary volcanics. The basin floors are between 4,200 and 5,100 feet (1,280 to 1,554 meters) in elevation. Pinyon and juniper sites have a greater percentage of Utah juniper (*Juniperus osteosperma*) in the plant community than pinyon pine (*Pinus edulis* or *monophylla*). The Basin and Range North have few semidesert ecological sites with Utah juniper. Cool season grasses, such as bluebunch wheatgrass (*Pseudoroegneria spicata*), are dominant in the plant community, while warm season grasses are largely absent or a small component of the plant community.

Ecological site concept

The Upland Sand (Black Greasewood, Indian Ricegrass) site is located on lake terraces and alluvial fans on gentle to moderate slopes (0 to 10 percent) between 4,300 and 5,200 feet (1,311 to 1,585 meters). It can also occur on sandy and oolitic dunes. The soil is sandy and deep. The soil was formed in lacustrine deposits, alluvium and/or eolian deposits derived from sandstone and quartzite. The precipitation ranges from 15 to 24 inches (381 to 610 mm). Black greasewood (*Sarcobatus vermiculatus*), Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), and shadscale (*Atriplex confertifolia*) dominate the shrub layer. Indian ricegrass (*Achnatherum hymenoides*), bottlebrush squirreltail (*Elymus elymoides*), and saltgrass (*Distichlis spicata*) dominate the herbaceous layer.

Associated sites

R028AY131UT	Desert Salty Silt (Pickleweed) This site is located on the old lake bed of Lake Bonneville and the Great Salt Lake. This site has a high concentration of salts which influence the plant community.
R028AY332UT	Upland Alkali Loam (Wyoming Big Sagebrush) This site does not occur on dunes.
R028AY001UT	Alkali Bottom (Alkali Sacaton) This site will be in a lower landscape position and dominated by alkali sacaton
R028AY004UT	Alkali Flat (Black Greasewood) This site will be in a lower landscape position.
R028AY024UT	Wet Saline Meadow (Saltgrass) This site will have a water table within 10 inches of the soil surface and support water tolerant species.
R028AY025UT	Lakeshore Marsh This site is located adjacent to waterbodies and will have standing water much of the year.

Similar sites

R028AY128UT	Desert Oolitic Dunes (Black Greasewood) This site is similar in landscape position as the Goggin soil, but it occurs on the western shores of the Great Salt Lake and has less precipitation. The soil is dominated by oolites.
R028AY332UT	Upland Alkali Loam (Wyoming Big Sagebrush) This site is dominated by Wyoming sagebrush.

Table 1. Dominant plant species

Tree	(1) <i>Sarcobatus vermiculatus</i> (2) <i>Artemisia tridentata ssp. wyomingensis</i>
Shrub	Not specified
Herbaceous	(1) <i>Achnatherum hymenoides</i>

Physiographic features

The Upland Sand (Black Greasewood, Indian Ricegrass) site is located on lake terraces and alluvial fans on gentle to moderate slopes (0 to 10 percent) between 4,300 and 5,200 feet (1,311 to 1,585 meters). It can also occur on sandy and oolitic dunes. Slopes can also range

up to 50 percent. Flooding does not occur on this site.

Table 2. Representative physiographic features

Landforms	(1) Lake terrace (2) Alluvial fan (3) Dune
Flooding frequency	None
Ponding frequency	None
Elevation	1,310 – 1,590 m
Slope	0 – 10 %
Aspect	Aspect is not a significant factor

Climatic features

The climate is dry subhumid, it is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 15 to 24 inches. April and May are typically the wettest months with July and August being the driest. The most reliable sources of moisture for plant growth are the snow that accumulates over the winter and spring rains that, in combination, wet the sites soil throughout the spring and early summer months. Summer thunderstorms are intermittent and sporadic in nature and thus are not reliable sources of moisture to support vegetative growth on this site. The mean annual air temperature is 51 degrees.

Table 3 Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	380-610 mm
Frost-free period (average)	190 days
Freeze-free period (average)	230 days
Precipitation total (average)	480 mm

Influencing water features

There are no influencing water features.

Soil features

Characteristic soils are very deep and well drained. The soil moisture and temperature regimes are xeric and mesic respectively. These soils formed in eolian, alluvium and lacustrine deposits derived mainly from sandstone, limestone and quartzite parent material. The Goggin Series derived from oolites. The dry surface color is typically a dark grayish brown. Soil textures are mainly loamy coarse sands, loamy fine sands, and fine sands. They are slightly saline (0 to 2 mmhos/cm) and slightly to moderately alkaline. Available water capacity is 2 to 4 inches. This site has been used in the following soil surveys and has been correlated to the following components:

Soil Survey Area: Soil Components (Map units in parentheses)

Cache Valley Area (UT603): Layton (Lh); Preston (PtC)

Weber/Davis Area (UT607): Francis (FcB, FcC, FcD, FcE2, FcF2, FKG2, KFR2, KFF2, KFG2); Goggin (AS); Layton (LcB, LcC, LcD, LdB); Preston (PxB, PxE, PyB)

Tooele County Area (UT611): Wasatch (50)

Salt Lake Area (UT612): Goggin (LE); Wasatch (WgD, WgE)

Millard County Area - Eastern Part (UT618): Preston (76, 102)

Utah County Area - Central Part (UT621): Layton (HNG, LeD, LfC, LmA, LnB); Preston (PuD)

Typical Profile (Preston):

A – 0-6 inches; fine sand; dark grayish brown, noncalcareous; slightly alkaline.

AC – 6-15 inches; fine sand; dark yellowish brown; noncalcareous; slightly alkaline.

C1 – 15-26 inches; fine sand; yellowish brown; noncalcareous; slightly alkaline.

C2 - 26-64 inches; fine sand; yellowish brown; noncalcareous; slightly alkaline.

Table 4. Representative soil features

Parent material	(1) Lacustrine deposits (2) Alluvium (3) Eolian deposits
Surface texture	(1) Loamy coarse sand (2) Loamy fine sand (3) Fine sand
Family particle size	(1) Sandy
Drainage class	Well drained to excessively drained
Permeability class	Moderately rapid to rapid
Surface fragment cover <=3"	0 – 10 %
Available water capacity (0-101.6cm)	5.08 – 8.89 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified

Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	0 – 10
Soil reaction (1:1 water) (0-101.6cm)	6.1 – 8.4
Subsurface fragment volume <=3" (Depth not specified)	0 – 10 %

Ecological dynamics

The Upland Sand (Black Greasewood, Indian Ricegrass) site developed under the natural ecological conditions found in the Great Salt Lake Area of the Basin and Range Province, and includes the natural influences of native herbivore grazing and browsing, and climate. Vegetation is characterized by a shrub layer dominated by black greasewood with Wyoming big sagebrush and shadscale commonly occurring. Indian ricegrass, bottlebrush squirreltail and sand verbena are common herbaceous species. On average years, plant growth begins about April 1 and ends around October 30.

This ecological site has been grazed by domestic livestock since they were first introduced into the area around 1860. This livestock introduction, including the use of fencing, and the development of reliable water sources, has influenced the disturbance regime historically associated with this ecological site.

With the exception of the Goggin soil series, most of this site has now been converted to other land uses. In rural areas, most of this site is now irrigated or dryland cropland. Major crops include alfalfa, barley, and wheat. In more urban areas, most of this site has been converted into urbanland with much of it now in homes and businesses and at Hill Air force Base.

The Goggin soils are found in a belt adjacent to the Great Salt Lake shoreline and are mostly still rangeland. These soils are dominantly made up of oolites, which is rock consisting of small round grains, usually of calcium carbonate, cemented together. Through the blowing action from the adjacent lakeshore, the soils are now a mixture of oolites, sand, silt, clay, and crystalline salt.

Where this site is still rangeland, improperly managed livestock grazing (continuous season long grazing, heavy stocking rates, repeated early spring grazing, etc.) can cause this site to depart from its reference plant community. Indian ricegrass and bottlebrush squirreltail will often decrease while Wyoming big sagebrush, rubber rabbitbrush, and black greasewood increase. During periods of continuous winter grazing by sheep, black greasewood will also decrease.

Fire will kill Wyoming big sagebrush allowing rubber rabbitbrush and black greasewood to increase. Cheatgrass, Halogeton, ragweed, and Russian thistle are likely to invade as the site deteriorates.

As vegetative communities respond to changes in management or natural influences that move them from one state to another, a return to previous states may not be possible. The amount of energy needed to affect these vegetative shifts depends on present biotic and abiotic features and the desired results.

The following state and transition model diagram depicts some of the most commonly occurring plant communities found on this ecological site. These communities may not represent every possibility, but they are the most prevalent and repeatable. As more data are collected, some of these plant communities may be revised or removed, and new ones may be added. This model was developed using range data collected for publication of the Box Elder County, Eastern Part, Soil Survey and the recent Eastern Shores update. Both ocular and measured data was collected and utilized. Range data collected by the NRCS since 1983 was also used.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	Grasses			56-112	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	45-67	–
	saltgrass	DISP	<i>Distichlis spicata</i>	22-34	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	22-34	–
	foxtail barley	HOJU	<i>Hordeum jubatum</i>	11-22	–
	scratchgrass	MUAS	<i>Muhlenbergia asperifolia</i>	11-22	–
	weeping alkaligrass	PUDI	<i>Puccinellia distans</i>	11-22	–
	Nuttall's alkaligrass	PUNU2	<i>Puccinellia nuttalliana</i>	11-22	–
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	11-22	–
Forb					
2	Forb			45-67	
	bigbract verbena	VEBR	<i>Verbena bracteata</i>	34-45	–
	hoary tansyaster	MACA2	<i>Machaeranthera canescens</i>	22-34	–
	Mojave seablite	SUMO	<i>Suaeda moquinii</i>	11-22	–
	low goosefoot	CHCH	<i>Chenopodium chenopodioides</i>	11-22	–
	ribseed sandmat	CHGL13	<i>Chamaesyce glyptosperma</i>	11-22	–
	povertyweed	IVAX	<i>Iva axillaris</i>	11-22	–
Shrub/Vine					
3	Dominant Shrubs			280-336	
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	135-157	–
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	45-67	–
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	22-45	–
4	Secondary Shrubs			34-67	
	iodinebush	ALOC2	<i>Allenrolfea occidentalis</i>	6-11	–
	sickle saltbush	ATFA	<i>Atriplex falcata</i>	6-11	–
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	6-11	–
	Nevada jointfir	EPNE	<i>Ephedra nevadensis</i>	6-11	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	6-11	–

Table 6. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	Grasses			84-168	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	56-168	–
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	45-67	–
	saltgrass	DISP	<i>Distichlis spicata</i>	22-34	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	22-34	–
	foxtail barley	HOJU	<i>Hordeum jubatum</i>	11-22	–
	scratchgrass	MUAS	<i>Muhlenbergia asperifolia</i>	11-22	–
	weeping alkaligrass	PUDI	<i>Puccinellia distans</i>	11-22	–
	Nuttall's alkaligrass	PUNU2	<i>Puccinellia nuttalliana</i>	11-22	–
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	11-22	–

Forb					
2	Forbs			67-112	
	bigbract verbena	VEBR	<i>Verbena bracteata</i>	45-90	–
	hoary tansyaster	MACA2	<i>Machaeranthera canescens</i>	22-34	–
	Russian thistle	SAKA	<i>Salsola kali</i>	11-22	–
	tall tumbled mustard	SIAL2	<i>Sisymbrium altissimum</i>	11-22	–
	Mojave seablite	SUMO	<i>Suaeda moquinii</i>	11-22	–
	field pennycress	THAR5	<i>Thlaspi arvense</i>	11-22	–
	desert madwort	ALDE	<i>Alyssum desertorum</i>	11-22	–
	annual ragweed	AMAR2	<i>Ambrosia artemisiifolia</i>	11-22	–
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	11-22	–
	lambquarters	CHAL7	<i>Chenopodium album</i>	11-22	–
	low goosefoot	CHCH	<i>Chenopodium chenopodioides</i>	11-22	–
	ribseed sandmat	CHGL13	<i>Chamaesyce glyptosperma</i>	11-22	–
	herb sophia	DESO2	<i>Descurainia sophia</i>	11-22	–
	curlycup gumweed	GRSQ	<i>Grindelia squarrosa</i>	11-22	–
	common sunflower	HEAN3	<i>Helianthus annuus</i>	11-22	–
	povertyweed	IVAX	<i>Iva axillaris</i>	11-22	–
	prickly lettuce	LASE	<i>Lactuca serriola</i>	11-22	–
	clasping pepperweed	LEPE2	<i>Lepidium perfoliatum</i>	11-22	–
Shrub/Vine					
3	Dominant Shrubs			280-336	
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	135-157	–
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	45-67	–
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	22-45	–
4	Secondary Shrubs			34-67	
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	11-22	–
	iodinebush	ALOC2	<i>Allenrolfea occidentalis</i>	6-11	–
	sickle saltbush	ATFA	<i>Atriplex falcata</i>	6-11	–
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	6-11	–
	Nevada jointfir	EPNE	<i>Ephedra nevadensis</i>	6-11	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	6-11	–

Table 7. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 8. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Animal community

--Threatened and Endangered Species-- This section will be populated as more information becomes available. --Wildlife Interpretation-- The Upland Sand (Black Greasewood, Indian Ricegrass) ecological site, in its Reference State, produced significant amounts of nutritious forage that was utilized by native herbivores including deer and antelope who lived here along their associated predators. Although much of this site is presently different from the Reference State, it is still very important as wildlife habitat. Other wildlife commonly observed using this site include rabbit, coyote, badger, fox, and various waterfowl species. In many locations, the Upland Sand (Black Greasewood, Indian Ricegrass) ecological site and its associated wetland ecological sites provide critical habitat for migrating birds from both the Pacific and Central Flyways of North America. These areas contain abundant food for birds. The following statistics were provided by the Bear River Migratory Bird Refuge where much of the Upland Sand (Black Greasewood, Indian Ricegrass) ecological site is located: 1. Breeding colonies of white-faced ibis contain as many as 18,000 birds. 2. Up to 10,000 American avocets breed at the

Refuge annually. 3. One of North America's three largest American white pelican breeding colonies, containing in excess of 50,000 birds, is found on Gunnison Island in Great Salt Lake. 4. Northern Utah marshes host up to 60 percent of the continental breeding population of cinnamon teal. 5. The Great Salt Lake boasts the largest fall staging concentration of Wilson's phalaropes in the world, at approximately 500,000 birds. Red-necked phalaropes number nearly 100,000. 6. The Great Salt Lake area hosts greater than 50 percent of the continental breeding population of snowy plovers. 7. The Great Salt Lake area hosts 26 percent of the global population of marbled godwits during migration. 8. Bear River Refuge may attract over 65,000 black-necked stilts in the fall, more than anywhere else in the country. --Grazing Interpretations-- The Upland Sand (Black Greasewood, Indian Ricegrass) site provides fair spring, fall, and winter grazing conditions for domestic livestock due to its remoteness and its limited supply of nutritious forage. The plant herbaceous plant community is primarily grasses and forbs, with the majority of canopy cover being attributed to Indian ricegrass, saltgrass and sand verben. Improper livestock grazing can cause Indian ricegrass decrease while saltgrass, sand verben annual forbs, black greasewood, Wyoming big sage and rabbitbrush to increase. When this site is stressed, cheatgrass, Russian thistle and halogeton are likely invade.

Hydrological functions

The soils are generally in Hydrological Soil Group A. On these sites runoff potential is low and infiltration rates are high, depending on slope and ground cover/health (National Engineering Handbook). Hydrological groups are used in equations that estimate runoff from rainfall. These estimates are needed for solving hydrologic problems that arise in planning watershed-protection and flood-prevention projects and for designing structures for the use, control and disposal of water. In areas similar to the Reference State where ground cover is adequate infiltration is greater and runoff potential is lower. In areas where ground cover is less than 50 percent, infiltration is reduced and runoff potential is increased. Heavy use by domestic livestock affects hydrology in two ways. Heavy grazing can alter the hydrology by decreasing plant cover and increasing bare ground. Fire can also affect hydrology, but its impact is variable. Fire intensity, fuel type, soil, climate, and topography can each have different influences. Fires can increase areas of bare ground and hydrophobic layers that reduce infiltration and increase runoff. (National Range and Pasture Handbook, 2003)

Recreational uses

Recreation activities include aesthetic value and good opportunities for hiking, horseback riding, hunting, and off-road vehicle use. Due to the high erosion potential after a surface disturbance, care should be taken when planning recreational activities. Camp sites are usually limited due to lack of sheltering trees or rock outcrop.

Wood products

None.

Other information

--Poisonous/Toxic Plant Species-- The toxic plants include broom snakeweed and Russian thistle. Broom snakeweed contains steroids, terpenoids, saponins, and flavones that can cause abortions or reproductive failure in sheep and cattle, however cattle are most susceptible. These toxins are most abundant during active growth and leafing stage. Cattle and sheep will typically only graze broom snakeweed when other forage is unavailable and generally in winter when toxicity levels are at their lowest (Knight and Walter, 2001). Russian thistle can cause nitrate and to a lesser extent oxalate poisoning, which affects all classes of livestock. The buildup of nitrates in these plants is highly dependent upon environmental factors, such as after a rain storm during a drought, cool/cloudy days, and soils high in nitrogen and low in sulfur and phosphorus, all which cause increased nitrate accumulation. Nitrate collects in the stems and can persist throughout the growing season. Clinical signs of nitrate poisoning include drowsiness, weakness, muscular tremors, increased heart and respiratory rates, staggering gait, and death. Conversely, oxalate poisoning causes kidney failure; clinical signs include muscle tremors, tetany, weakness, and depression. Poisoning generally occurs when livestock consume and are not accustomed to grazing oxalate-containing plants. Animals with prior exposure to oxalates have increased numbers of oxalate-degrading rumen microflora and thus are able to degrade the toxin before clinical poisoning can occur. (Knight and Walter, 2001) --Invasive Plant Communities-- Generally, as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, over grazing, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses will invade the site. Of particular concern in semi-arid environments are cheatgrass, Russian thistle, kochia, Halogeton, and annual mustards. The presence of these species depends on soil properties and moisture availability; however, these invaders are highly adaptive and can flourish in many locations. Once established, complete removal is difficult but suppression may possible. Cheatgrass and Russian thistle are common invaders to this site, especially in lower areas that concentrate nutrients and moisture. In some cases cheatgrass has been able to establish into an intact perennial grass and shrub community, but disturbed communities are more susceptible to invasion and domination. If growing conditions are conducive to invaders and the disturbance is not removed, these plants can create dense monocultures that can alter the nutrient cycling, erosion rates, and the fire regime of the area. Fire Ecology The ability for an ecological site to carry fire depends primarily on the present fuel load and plant moisture content. Fire was a typical disturbance in the historic climax plant community for this ecological site. The natural fire return interval is 30 to 100 years, where fires typically occur in the fall. When the site is degraded by the presence of invasive plants, the fire return interval may be shortened due to increased flashy fuels. The shortened fire return interval in the presence of invasive annual species is often sufficient to suppress the native plant community.

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Contributors

V. Keith Wadman, Brock Benson

Approval

Kendra Moseley, 6/12/2025

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)	V. Keith Wadman (NRCS ret.), Shane A. Green (NRCS)
Contact for lead author	shane.green@ut.usda.gov
Date	06/22/2011
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** No rills present. Very minor rill development may be evident in the reference community following significant storm or snow melt events. Any rill development will be short (<6') and widely spaced (5' – 7'). Evidence of rills on dune slopes will decrease quickly following major weather events due to the affects of wind on this sites sandy soils.

2. **Presence of water flow patterns:** Slight evidence of water flow may be evident in the reference community immediately following significant weather events. Flow patterns affect <3% of the site. High soil intake rates and excessive drainage limit water movement on soil surfaces. Any flow patterns present are normally <10 feet long, follow natural contours, and are typically spaced 10 to 15 feet apart.

3. **Number and height of erosional pedestals or terracettes:** None. Pedestaling and terracette development is prevented from developing because of the nature of the soils associated with this site. Some depositional mounding around perennial vegetation is normal.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground ranges from 40% - 60% in the reference community.

5. **Number of gullies and erosion associated with gullies:** Very rare. Some gully channels are a normal component of desert environments. Gullies associated with this site are normally conveying runoff from higher elevation ecological sites. They will typically have unstable sides and bottoms as they travel through this sites sandy soils.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Moderate evidence of wind generated soil movement is normal in reference state on this site. There is typically a mix of unstable dunes mixed with mostly stable ones that are healing. Evidence of wind generated blowouts may also be present; any blowouts present are being stabilized with perennial vegetation. Depositional mounding around perennial grass clumps is normal. Moderate coppice mounding under Black greasewood canopies is also normal.

7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place within or under plant canopies. Some movement of fine material (< ¼") may move (2' – 4') in the direction of prevailing winds or down slope if being transported by water. Some accumulation is observed behind obstructions. Larger woody litter (> ½") is mostly found under or near shrubs.

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 a soil stability rating of 1 to 3. Surface textures are typically coarse loamy sands containing a few rock fragments. Where surface soil structure is lost, soil stability ratings may decrease to 1 to 2 in the remaining soil.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** This description is based on the modal soil, Goggin Sand, 1 to 6% slopes. Soil surface is approximately 3 inches deep and structure is very weak to loose, single grain. The A-horizon color is 10YR 5/2. Soils have an Ochric epipedon that extends 3 inches into the soil profile.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Healthy perennial grasses and shrubs in the reference community provides for the best infiltration and least runoff from storm events and snow melt. Soil movement is common even in healthy communities, and is characteristic of the site.
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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. Soils are deep to very deep.
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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: Sprouting shrubs (e.g. Black greasewood and rubber rabbitbrush) 50 – 75%, >> cool season grasses (e.g. Indian ricegrass and Bottlebrush squirreltail) 5 – 15%.

Sub-dominant: Perennial Forbs: (e.g. Sand verbena, hoary aster) 15 - 20%,>> Non-sprouting shrubs (e.g. Shadscale and Wyoming big sagebrush), 15 – 20%, > other grasses (e.g. Alkali sacaton, saltgrass) 1 – 5%.

Other: Others: Shrubs (e.g. Spiny hopsage and Nevada jointfir 1-5%)

Additional: Moss and lichen communities, where present, will normally be found only under plant canopies while cyanobacteria may be found throughout the site. Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference state. Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**
During years with average to above-average precipitation, there should be very little recent mortality or decadence apparent in either the shrubs or grasses. There may be partial (<30%) mortality of individual bunchgrasses and other shrubs during severe drought.
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14. **Average percent litter cover (%) and depth (in):** Litter cover ranges from 10 to 15% with a spike when shrubs drop their leaves. Depth is typically about 1/4 inch.
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**
400 - 500 pounds on an average year.
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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Cheatgrass, Russian thistle, Redstem storksbill, annual mustards and Halogeton are likely to invade this site.
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17. **Perennial plant reproductive capability:** All perennial plant species have the ability to reproduce in most years except drought years.
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