USDA Natural Resources Conservation Service

Ecological site R022AA200CA
Alpine Scree

Accessed: 05/20/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

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): 022A–Sierra Nevada and Tehachapi Mountains

Major Land Resource Area 22A, Sierra Nevada Mountains, is located predominantly in California and a small section of western Nevada. The area lies completely within the Sierra Nevada Section of the Cascade-Sierra Mountains Province. The Sierra Nevada range is highly asymmetrical with a long, gentle western slope, and a very abrupt eastern slope. The Sierra Nevada consists of hilly to steep mountains and occasional flatter mountain valleys. Elevation ranges between 1,500 and 9,000 ft throughout most of the range, but certain peaks often exceed 12,000 ft. The highest point in the continental US occurs in this MLRA (Mount Whitney, 14,494 ft). Most of the Sierra Nevada is dominated by granitic rock of the Mesozoic age, known as the Sierra Nevada Batholith. The northern half is flanked on the west by a metamorphic belt, which consists of highly metamorphosed sedimentary and volcanic rocks of Paleozoic and Mesozoic ages. Additionally, glacial activity of the Pleistocene has played a major role in shaping Sierra Nevada features, including cirques, arêtes, and glacial deposits and moraines. Average annual precipitation ranges from 20 to 80 inches in most of the area, with increases along elevational and south-north gradients. Soil temperature regime ranges from mesic, frigid, and cryic. 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 "A" Sierran Alpine: This LRU occurs at the highest elevations of the Sierra Nevada, above treeline on upper mountain slopes, exposed ridges and mountain peaks. This LRU begins at the alpine treeline ecotone, which occurs at approximately 11,000 feet in the south and central areas and approximately 9,800 feet in the north, and

extends up to 14,494 feet (Mount Whitney). Mean annual air temperature (MAAT) ranges from 29 to 35 degrees F, mean annual precipitation (MAP) ranges from 39 to 60 inches, and the frost free season is 20 to 30 days.

Ecological site concept

This ecological site occurs above timberline on windswept ridges, shoulders and mountain peaks at elevations typically between 9,800 and 12,000 feet. Slopes range from 15 and 75 percent. Soils are derived from granitic parent material, and are shallow to moderately deep over paralithic granitic bedrock, with a sandy skeletal particle size class. Wind exposure, cold temperatures, high solar radiation, a short growing season, coarse granitic soils with low water holding capacity, and slope instability limit the vegetation community to a very sparse cover of dwarf alpine subshrubs, perennial forbs and grasses. Vegetation composition is variable, with low constancy across sites, but rosy buckwheat (*Eriogonum rosense*), Nevada podistera (*Podistera nevadensis*), granite prickly phlox (Linanthes pungens), and fewseed draba (*Draba oligosperma*) are among the more frequently occurring species.

Associated sites

F022AC001CA	**Cryic Sandy Mountain Slopes** Occurs on lower elevation slopes at or near treeline. An open whitebark pine (Pinus albicaulis) forest dominates, with very little understory vegetation.
R022AA201CA	**Sandy Shallow Alpine Mountain Slopes** Occurs on adjacent slightly lower elevation slopes with shallow soils over decomposed granite. Krummholz whitebark pine (Pinus albicaulis) characterizes the vegetation.
R022AC204CA	**Cryic, Umbric Or Andic Slopes** Occurs on lower elevation slopes with moderate to very deep, cryic skeletal soils over volcanic or granitic bedrock. The vegetation is a productive shrub-grassland dominated by mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and antelope bitterbrish (Purshia tridentata).
R022AY025NV	**MAHOGANY THICKET** Occurs on landscape positions where snow accumulates. Curl-leaf mountain mahogany (Cercocarpus ledifolius) dominates this shrubland community.

Similar sites

R022AY032NV	**ALPINE RIDGE** Occurs on similar landforms, but is found on volcanic soils in more southerly locations. Production and diversity potential are higher due to greater soil moisture holding capacity of the soil.
R022AA201CA	**Sandy Shallow Alpine Mountain Slopes** This site occurs on similar soils, but in lower or more protected topographic positions that allow for the development of krummholz whitebark pine (Pinus albicaulis) communities. The herbaceous component of these sites is very similar.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Eriogonum rosense* (2) *Podistera nevadensis*

Physiographic features

This site occurs on high wind swept mountain peaks, ridges and shoulders in relatively unstable talus slopes or scree. Slopes range from 15 to 75 percent. Elevations range from 9,000 to 12,000 feet, but are typically above 9,800 feet. Runoff class is medium to very high.

Table 2. Representative physiographic features

Landforms	(1) Mountain

Flooding frequency	None
Ponding frequency	None
Elevation	2,743–3,658 m
Slope	15–75%

Climatic features

The climate of this ecological site is characterized by cool temperatures, wet winters with most precipitation falling as snow in winters, and relatively dry summers. The mean annual precipitation ranges from 35 to 55 inches. The mean annual temperature ranges from 34 to 37 degrees F. The frost-free (>32F) season is 20 to 45 days, but is typically below 30 days. The freeze-free (>28F) season is 30 to 45 days.

There are no representative climate stations for this ecological site so maximum and minimum monthly climate data for this ESD were generated using PRISM data (PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, created 4 Feb 2004.) and the ArcGIS ESD extract tool.

Table 3. Representative climatic features

Frost-free period (average)	33 days
Freeze-free period (average)	38 days
Precipitation total (average)	1,143 mm

Influencing water features

Soil features

The soils associated with this ecological site are very shallow to moderately deep over paralithic bedrock, and formed in colluvium over residuum derived from granodiorite. They are moderately rapid to rapidly drained with somewhat excessive to excessive permeability. The soil moisture regime is typic xeric and the soil temperature regime is cryic. Surface rock fragments smaller than 3 inches in diameter range from 50 to 65 percent cover, and larger fragments range from 7 to 45 percent. Surface textures are gravel, and very gravelly loamy coarse sand. Subsurface textures are gravel, extremely gravelly coarse sand, very gravelly sand, very cobbly loamy fine sand, and very gravelly loamy coarse sand. Subsurface rock fragments smaller than 3 inches in diameter range from 21 to 41 percent by volume, and larger fragments range from 0 to 18 percent (for a depth of 0 to 40 inches). The soils correlated to this site include Freelpeak (Sandy-skeletal, mixed Typic Cryorthents), Windyridge (Sandy-skeletal, mixed, shallow Typic Cryorthents), and a minor component of Lithnip (Loamy-skeletal, isotic, nonacid Lithic Cryorthents), which are derived from volcanic parent material and are not typical for this site.

This ecological site has been correlated with the following mapunits and soil components in the Tahoe Basin soil survey area (CA693):
Area_sym ; Musym ; MUname ; Compname ; Local_phase ; Comp_pct
CA693 ; 9411 ; Freelpeak-Windyridge-Rock outcrop complex, 15 to 75 percent slopes ; Freelpeak ; ; 50
CA693 ; 9411 ; Freelpeak-Windyridge-Rock outcrop complex, 15 to 75 percent slopes ; Windyridge ; ; 25
CA693 ; 9421 ; Jobsis-Whittell-Rock outcrop complex, cool, 8 to 30 percent slopes ; Windyridge ; ; 4
CA693 ; 9461 ; Whittell-Jobsis-Rock outcrop complex, cool, 30 to 75 percent slopes ; Windyridge ; ; 4
CA693 ; 9111 ; Florand-Lostridge-Fishsnooze association, 15 to 50 percent slopes ; Lithnip ; moist ; 3
CA693 ; 7500 ; Rock outcrop, granitic ; Windyridge ; ; 2
CA693 ; 7500 ; Rock outcrop, granitic ; Freelpeak ; ; 1

Table 4. Representative soil features

Parent material	(1) Colluvium–granodiorite
Surface texture	(1) Very gravelly coarse sand
Family particle size	(1) Sandy

Drainage class	Somewhat excessively drained to excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	10–102 cm
Surface fragment cover <=3"	50–65%
Surface fragment cover >3"	7–45%
Available water capacity (0-101.6cm)	0.51–5.59 cm
Soil reaction (1:1 water) (0-101.6cm)	4.5–6
Subsurface fragment volume <=3" (Depth not specified)	21–41%
Subsurface fragment volume >3" (Depth not specified)	0–18%

Ecological dynamics

Abiotic factors
This ecological site occurs above timberline on windswept ridges, shoulders and mountain peaks between 9,000 and 12,000 feet. Soils are derived from granitic parent material, and are shallow to moderately deep over paralithic granitic bedrock, with a sandy skeletal particle size class. Wind exposure, cold temperatures, high solar radiation, a short growing season, coarse granitic soils with low water holding capacity, and slope instability limit the vegetation community to a very sparse cover of dwarf alpine subshrubs, perennial forbs and grasses. Vegetation composition is variable, with low constancy across sites, but rosy buckwheat (*Eriogonum rosense*), Nevada podistera (*Podistera nevadensis*), granite prickly phlox (Linanthes pungens), and fewseed draba (*Draba oligosperma*) are among the more frequently occurring species. Alpine ridges, especially in the Sierra Nevada with a Mediterranean climate with dry summers, are extremely xeric environments due to frequent high winds and high solar radiation (Chambers 1997, Körner 2003, Elliot and Jules 2005). Where soils are coarse with little soil development, as in much of the alpine Lake Tahoe area, drought stress is particularly acute (Smiley 1915). The vegetation that can withstand these harsh conditions is limited to low-growing, long-lived, slow-growing forb and grass species (Smiley 1915, Körner 2003, Elliot and Jules 2005). Subshrubs such as rosy buckwheat and granite prickly phlox exhibit a prostrate growth form, and forbs such as Nevada podistera and fewseed draba are cushion or mat forming, while grasses form tight tussock growth forms (Körner 2003). These adaptations trap heat, which increases photosynthetic capacity in these cold environments, and limits moisture loss due to transpiration (Körner 2003). More upright forbs, which include Pacific hulsea (*Hulsea algida*) and dwarf alpine Indian paintbrush (*Castilleja nana*) are often densely covered in hairs, which serve the same functions.

Scree and talus slopes are inherently unstable environments (e.g. Perez 2012), where plants are subject to both burial and erosion, both of which also limit production and cover on this ecological site.

Disturbance/Ecological factors
Slope erosion from recreational impacts, climatic fluctuations, including both reduced and heavy snowpack, and climate change are the primary disturbances impacting this ecological site. Although lightning strikes are common in these exposed environments, fuel loads are too low to carry a fire.

Slope instability on these rocky, loose soils means that this site is highly susceptible to erosion impacts from trails and trampling. Even light trampling can trigger significant downslope rock movement, which decreases plant production and cover (Bell and Bliss 1973). The erosion of nutrient and moisture poor soils with low propagule availability in these low cover environments may cause significant damage to sensitive, slow-growing plant communities (e.g. Chambers 1997). However, protection from trampling can reverse these impacts (Bell and Bliss 1973).

Increased snowpack shortens the already limited growing season of this ecological site, causing reduced cover and production in the plant community (e.g. Franklin 2013). Reduced snowpack and warmer temperatures increases the

growth and productivity of at least some species in this plant community. Granite prickly phlox in the eastern Sierra Nevada was shown to have higher growth rates during warmer periods (Franklin 2013), and decreased snowpack has been shown to increase plant performance in similar habitats in Europe (Klimesova et al. 2013).

Currently, these fluctuations fall within the range of variability expected for the reference plant community of this ecological site, and are not included as a separate community phase in the State-and-Transition (STM) model. However, an ongoing pattern of warming and decreased snowpack, which has been predicted under global climate change scenarios for the Sierra Nevada (e.g. Hayhoe et al. 2004, Safford et al. 2012), will likely have more significant impacts on this ecological site, shifting it into an altered state. Since these are theoretical impacts based on climate and range shift modeling, or on patterns observed in other locations, and the specific impacts on the species that occur in this site is unknown, an altered state is not included in the STM. Production and cover of this ecological site are likely to increase with warming, and species composition is likely to change. Species that occur in this site but that have a wider ecological amplitude than strictly alpine environments, such as granite prickly phlox, cushion buckwheat (*Eriogonum ovalifolium*), Shasta knotweed (*Polygonum shastense*), western needlegrass (Achnatherum occidentalis), and squirreltail (*Elymus elymoides*) are likely to increase in production and cover. Species richness may increase from species moving upslope, as has already been demonstrated in other alpine environments (e.g. Bahn and Körner 2003). However, these increases in species richness may be offset by the extirpation of species that are restricted to the alpine and have no upslope environment to move to, such as rosy buckwheat, Pacific hulsea, Nevada podistera, Tahoe draba (*Draba asterophora*), and dwarf alpine penstemon. A modeling study in the White Mountains of California predicted extinction of 10 or 14 alpine forbs modeled with a 6 degree temperature increase, with the remaining 4 shrinking to less than 1% of current range (Van de Ven et al. 2007). A 3 degree warming predicted extinction of 2 species including, and severe range restrictions of all others (Van de Ven et al. 2007). Recent California based climate models predict a 9 degree F increase in temperature by 2100, and more conservative models predict a 2 to 4 degree F increase in winter and 4 to 8 degree increase in summer (Safford et al. 2012). Models are more variable for precipitation, but recent models for the Sierra Nevada, predict similar to slightly less precipitation. Most models agree that summers will become drier, since more of the precipitation is predicted to come as rain, and snow melt-off will occur earlier in spring (Hayhoe et al. 2004, Safford et al. 2012).

Conifer invasion of formerly persistent snowfields has been documented during warm periods during the past century (Millar et al. 2004), and ongoing warming could see tree invasion in this site. Krummholz whitebark pine (*Pinus albicaulis*) communities exist at slightly lower elevations or more sheltered topographic positions to this site; milder conditions will likely lead to an expansion of these krummholz patches. Krummholz trees exhibit leader growth during warm periods (Millar et al. 2004), and would likely eventually transition to upright growth forms with continued warming. With a 2 to 6 degree warming, species such as Sierra lodgepole pine (*Pinus contorta* var. murrayana), or mountain hemlock (*Tsuga mertensiana*) may move into this ecological site. A 9 degree warming shift over the next 85 years could make conditions favorable for upper montane species to establish. Species such as Jeffrey pine (*Pinus jeffreyi*) and California red fir (*Abies magnifica*) could survive with the longer growing season and warmer temperatures for seedling germination and leader growth.

State and transition model

State-Transition Model - Ecological Site R022AA200CA
//Eriogonum rosense-Podistera nevadensis
(//rosy buckwheat-Nevada podistera)

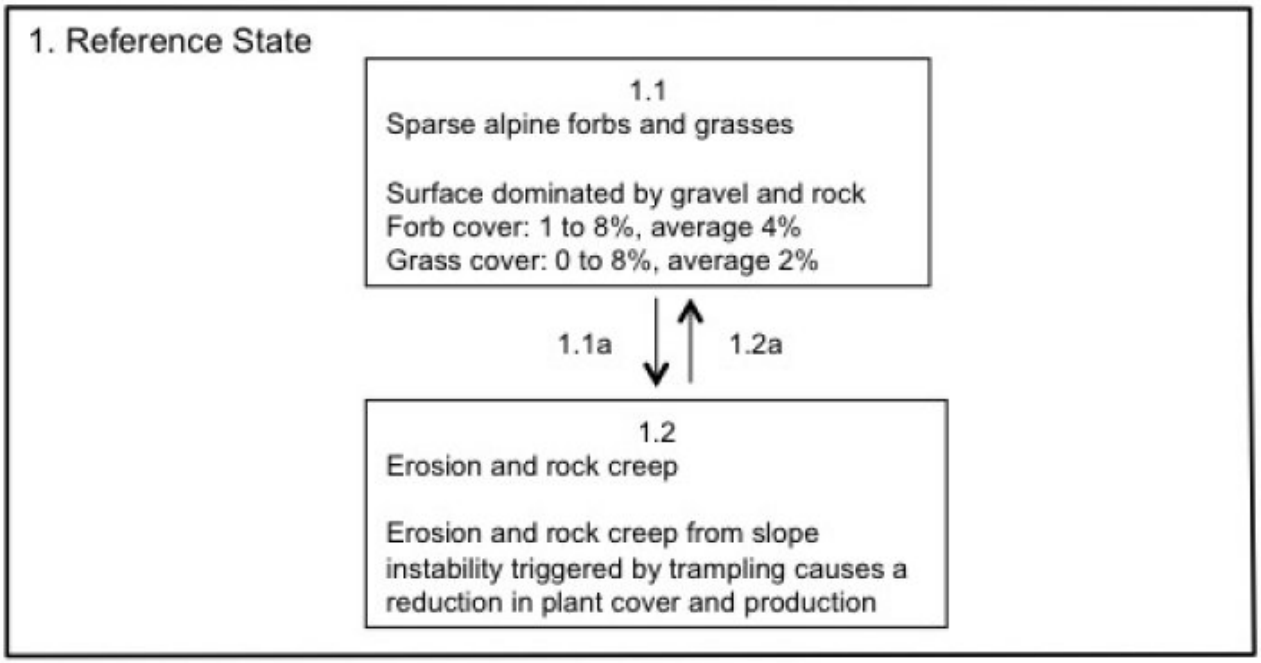

Figure 6. R022AA200CA

State 1
Reference

Community 1.1
Reference plant community

Figure 7. R022AA200CA

Figure 8. A typical clustering of dwarf alpine plants

Low cover and production of dwarf subshrubs, forbs, and grasses characterize the reference plant community. Subshrubs and forbs average four percent cover, and grasses average two percent cover. Gravels dominate the soil surface, at 45 to 90 percent cover, and larger rock fragments are also abundant, providing up to 50 percent cover. Plant cover is often congested, with multiple species growing together in an interwoven mat due to the facilitating effects of established plants (e.g. Greenlee and Calloway 1996). Species richness in this site is relatively low, with an average of seven species occurring in a given location. Species constancy is also low, with no species occurring in all locations. The subshrubs rosy buckwheat and granite prickly phlox, and the forbs Nevada podistera and fewseed draba are the most frequent species occurring on this site. Other subshrubs likely to be encountered include cushion buckwheat, Shasta knotweed, and Lobb's buckwheat (*Eriogonum lobbii*). Forbs include Pacific hulsea, dwarf alpine Indian paintbrush, Tahoe draba, brittle sandwort (*Minuartia nuttallii* ssp. gracilis), pygmy fleabane (*Erigeron pygmaeus*), pioneer rockcress (*Arabis platysperma*), southern Sierra pincushion (*Chaenactis alpigena*), dwarf phlox (*Phlox condensata*), Watson's spikemoss (*Selaginella watsonii*), and Davidson's penstemon (*Penstemon davidsonii*).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Forb	11	34	50
Grass/Grasslike	–	2	17
Total	**11**	**36**	**67**

Table 6. Ground cover

Tree foliar cover	0%

Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0-8%
Forb foliar cover	1-8%
Non-vascular plants	0%
Biological crusts	0%
Litter	0-1%
Surface fragments >0.25" and <=3"	45-90%
Surface fragments >3"	8-50%
Bedrock	0-3%
Water	0%
Bare ground	0-70%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-8%	1-8%
>0.15 <= 0.3	–	–	0-5%	0-5%
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.2
Erosion and rock creep

This community phase is characterized by rock creep and erosion. Erosion exposes plant roots and may uproot plants entirely, and results in a loss of the limited soil resource and propagule pools contained within it. Rock creep may bury plants downslope. Cover and production is reduced in this community. Because the plants occurring in this environment are tolerant of some talus shift due to the inherent instability of the talus environment, recovery can occur if this site is protected from continued trampling (Bell and Bliss 1973).

Pathway 1.1a
Community 1.1 to 1.2

Occurs with human trampling that causes erosion of the loose soils and rocks covering the surface of this ecological site.

Pathway 1.2a
Community 1.2 to 1.1

Protection from social trail networks that cause erosion in this site will allow recovery with adequate time.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Forb					
1	**Subshrubs**			6–39	
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–22	0–2
	Shasta knotweed	POSH	*Polygonum shastense*	0–22	0–2
	rosy buckwheat	ERRO	*Eriogonum rosense*	0–17	0–2
	Lobb's buckwheat	ERLO2	*Eriogonum lobbii*	0–6	0–1
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–6	0–1
2	**Perennial Forbs**			1–22	
	Nevada podistera	PONE4	*Podistera nevadensis*	0–9	0–3
	Lake Tahoe draba	DRASA2	*Draba asterophora var. asterophora*	0–6	0–2
	fewseed draba	DROL	*Draba oligosperma*	0–6	1
	pygmy fleabane	ERPY	*Erigeron pygmaeus*	0–6	0–1
	Pacific hulsea	HUAL	*Hulsea algida*	0–6	0–1
	brittle sandwort	MINUG	*Minuartia nuttallii ssp. gracilis*	0–6	0–1
	Davidson's penstemon	PEDA2	*Penstemon davidsonii*	0–6	0–1
	dwarf phlox	PHCO11	*Phlox condensata*	0–6	0–1
	pioneer rockcress	ARPL	*Arabis platysperma*	0–6	0–1
	dwarf alpine Indian paintbrush	CANA3	*Castilleja nana*	0–6	0–1
	southern Sierra pincushion	CHAL	*Chaenactis alpigena*	0–6	0–1
	Watson's spikemoss	SEWA2	*Selaginella watsonii*	0–6	0–1
Grass/Grasslike					
3	**Grasses and Grasslike**			0–17	
	bluegrass	POA	*Poa*	0–11	0–3
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–6	0–1
	sedge	CAREX	*Carex*	0–6	0–1
	squirreltail	ELEL5	*Elymus elymoides*	0–6	0–1

Animal community

Yellow bellied marmot (Marmota flaviventris) and American pika (Ochotona princeps) live in this ecological site.

Recreational uses

This is a scenic alpine area popular for hiking.

Other information

Typically designated trails are not present, and social trail networks can be found throughout the site. In areas with high recreational use, trails should be properly designed to reduce erosion and keep hikers on the designated trails. Sensitive plant species that are negatively impacted by erosion caused by trampling exist in this site.

Inventory data references

The following NRCS plots were used to describe this ecological site:

rx02h48 - Type location
rx02h45
rx02h47
sm02h48a
GWF02032
GwF02552
rx02h46
sm02h44

Type locality

Location 1: El Dorado County, CA	
UTM zone	N
UTM northing	4305371
UTM easting	249509
General legal description	The type location is approximately a quarter mile west of Freel Peak, in the Lake Tahoe Basin.

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:**

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

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

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

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

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

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

17. **Perennial plant reproductive capability:**