USDA Natural Resources Conservation Service

Ecological site R022BI201CA
Bedded Tephra Deposits

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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.

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): 022B–Southern Cascade Mountains

Site Concept –
Slopes: Range from 2 to 50 percent.
Landform: Tephra covered lava flow.
Soils: Shallow to very deep, formed in tephra or scoria from Cinder Cone.
Temp regime: frigid.
MAAT: 43 to 44 degrees F (6.1 to 6.6 degrees C).
MAP: 31 to 35 inches (787 to 889 mm).
Soil texture: gravelly ashy coarse sand or ashy loamy sand.
Surface fragments: 65 to 95 percent gravel.
Vegetation: Very sparse cover of sulphur-flowered buckwheat (*Eriogonum polyanthum*), marumleaf buckwheat (*Eriogonum marifolium*), and naked buckwheat (*Eriogonum nudum*) and a few other species.

Associated sites

F022BI100CA	**Low Precip Frigid Sandy Tephra Gentle Slopes** This is a Jeffrey pine forest that surrounds the Painted Dunes.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Eriogonum marifolium* (2) *Eriogonum polyanthum*
Herbaceous	Not specified

Physiographic features

This ecological site is associated with the Painted Dunes, which developed from lava flows and tephra deposits from the eruption of Cinder Cone around 1650 (Clynne et al, 2000). Although this area is commonly called Painted Dunes, a more appropriate term for this area is knolls on lava flows. It is situated between 6,155 feet and 6,532 feet in elevation. Slopes are generally between 5 to 30 percent, with absolute ranges between 2 to 50 percent.

Table 2. Representative physiographic features

Landforms	(1) Lava flow
Flooding frequency	None
Ponding frequency	None
Elevation	1,876–1,991 m
Slope	2–50%
Aspect	Aspect is not a significant factor

Climatic features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 31 to 35 inches (787 to 889 mm). The mean annual temperature ranges from 43 to 44 degrees F (6.1 to 6.6 degrees C). The frost free (>32 degrees F) season is 70 to 90 days, and the freeze free (>28 degrees F) season is 90 to 200 days (MZL).

There are no representative climate stations for this site.

Table 3. Representative climatic features

Frost-free period (average)	90 days
Freeze-free period (average)	200 days
Precipitation total (average)	889 mm

Influencing water features

This site is not influenced by wetland or riparian water features.

Soil features

The soil components associated with the Painted Dunes are Typic Xerorthents-welded and Typic Xerorthent-tephra. The Typic Xerorthents-welded soils are shallow and well drained with a welded layer between 10 to 20 inches. The Typic Xerorthents-tephra soils are very deep and excessively drained. Both soils formed in tephra or scoria from Cinder Cone. The surface textures are gravelly ashy coarse sand or ashy loamy sand, with very gravelly coarse sand or ashy sand subsurface textures. The Typic Xerorthents-welded are basically barren of vegetation, most likely because of the welded layer and a tendency for the surface to create a platy crust.

This ecological site is associated with the following major soil components within the Lassen Volcanic National Park Soil Survey Area (CA789):

Map Unit Component/ Comp %
202 Typic Xerorthents-tephra /85
202 Typic Xerorthents-welded /10

Table 4. Representative soil features

Family particle size	(1) Sandy
Drainage class	Excessively drained
Permeability class	Rapid
Soil depth	25 cm
Surface fragment cover <=3"	65–95%
Surface fragment cover >3"	0–7%
Available water capacity (0-101.6cm)	0.25–7.11 cm
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	18–90%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

This ecological site is located in the north-east corner of Lassen National Volcanic Park, near Butte Lake. Called the Painted Dunes, it gets its name from the mosaic of black, tan, and red soils that appear on the landscape. The generally recognized theory that explains the different soil colors goes back to the sixteenth or seventeeth century when Cinder Cone erupted. Ash fell on the lava flow while it was still hot, creating the brightly oxidized colors. These black, tan, and red soils have slightly different expression of species but collectively make up one plant community. Most vegetation is growing on the tan soil and where slopes meet the darker black troughs. The most common species include western needlegrass (*Achnatherum occidentale*), sulphur-flowered buckwheat (*Eriogonum polyanthum*), marumleaf buckwheat (*Eriogonum marifolium*), and naked buckwheat (*Eriogonum nudum*). The red soils located at the top of the knolls are basically void of vegetation.

This ecological site consists of relatively stable knolls sparsely vegetated with a minute buckwheat plant community and scattered trees. The community maintains a reasonably steady state since, short of an eruption of Cinder Cone, which is unlikely, there is very little disturbance that can affect it. The area surrounding this ecological site was covered by the tephra deposits from Cinder Cone, and has developed Jeffrey pine forests of different successional stages. This area is developing much slower, possibly due a distant conifer seed source, or inherent soil characteristics such as the bedded tephra layers. Soil development and organic matter accumulation is proceeding at such a slow rate that it may take several centuries for this site to be suitable for a Jeffrey pine forest to develop.

The initial colonization of plants on newly exposed parent material initiates a wide range of processes. Nitrogen fixation is commonly one of the first processes initiated by pioneering plant species and microorganisms. This process converts atmospheric nitrogen gas into ammonia ($NH4+$) through chemical and biological reactions. The resulting ammonia is converted to nitrate ($NO3-$) by microorganisms through a process called nitrification. Plants assimilate inorganic nitrogen in the form ammonia and nitrate. As plants continue to establish on the new substrate, they absorb $CO2$ from the atmosphere and convert it to plant carbon through the process of photosynthesis. The carbon is sequestered in either above-ground or below-ground biomass, or as soil carbon. Soil organisms are responsible for the decomposition of plant material. When soil organisms die and decompose, nutrients are processed back into the soil. Plant material and dead soil organisms provide the bulk of organic matter in soil. The process of $CO2$ production and the accumulation of organic matter begin to transform freshly exposed parent material by providing nutrients and creating better water availability for plants and microorganisms, affecting pH and weathering minerals. Over time, as these organisms eat, grow and move through the soil, they transform it into a more vibrant biologic substrate. Most of these processes are concentrated in the upper portion of the soil.

The living and dead material of plants stabilize the soil surface by physically buffering raindrop impact and impeding surface runoff. Within the soil, plants, animals and microbes bind the soil together as aggregates with roots, hyphae, fecal pellets and decomposed organic matter. The micro-structure formed by the combined processes of buffering and binding increases soil stability, porosity, water infiltration and water holding capacity (NRCS, 2009).

Trees and burrowing animal activity produce larger pores and mix soil at a greater scale. Ants and gophers transport soil material by depositing subsoil on the surface as they build tunnels and nests. Dead tree roots produce macropores that often accumulate surface material and incorporate organic matter deeper down in the profile (NRCS, 2009).

The soils here are bedded with coarse and fine, sands and gravels. The roots are dense in the fine layers of the profile. These layers may be affecting the biological processes discussed above.

State and transition model

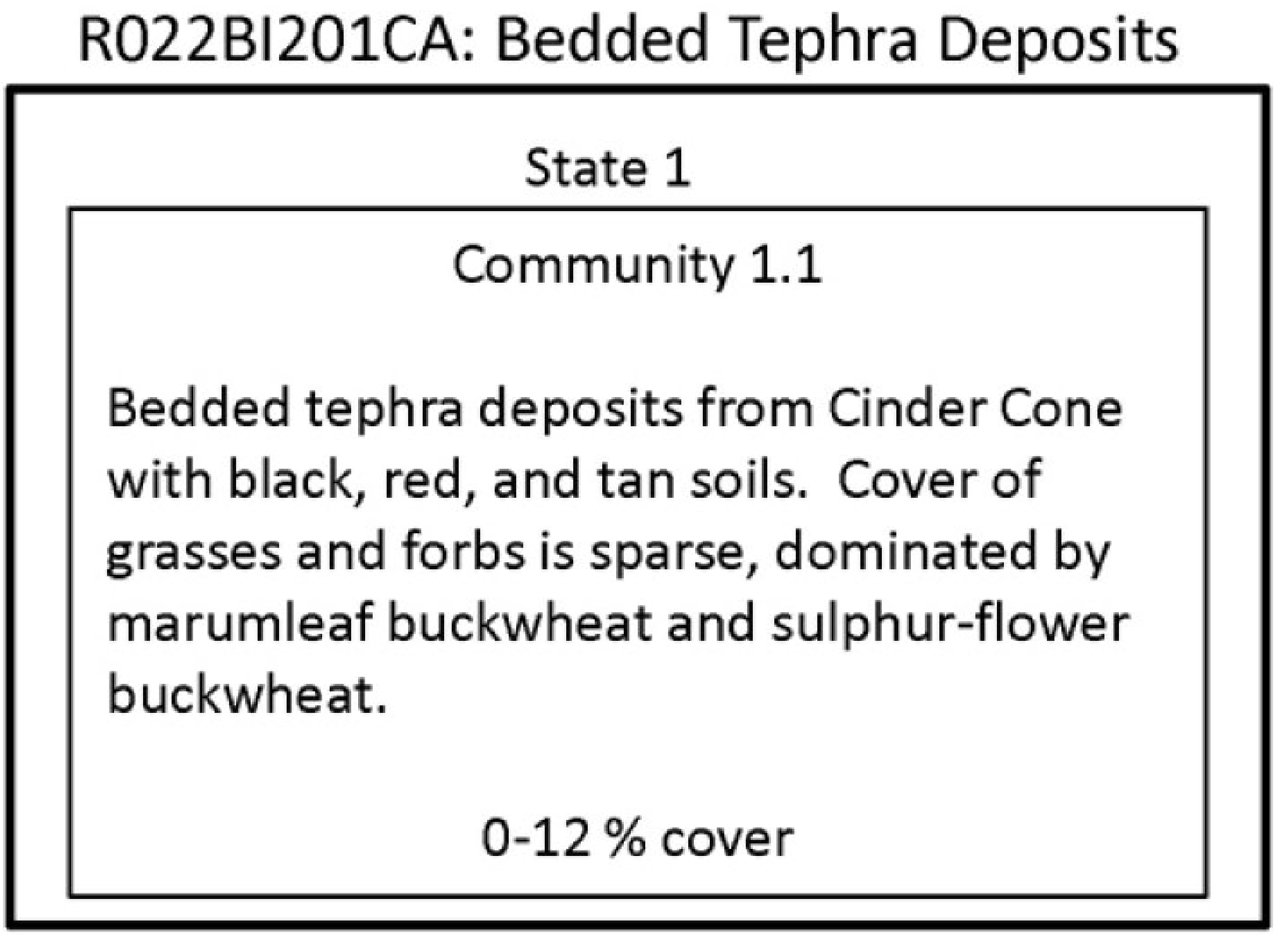

Figure 3. Bedded Tephra Deposits

State 1
Bedded Tephra Deposits

Community 1.1
Scattered forbs and grasses

Figure 4. Bedded tephra deposits ecological site

Plant community 1.1 represents a very slowly developing pioneer plant community. Under the present conditions this plant community can exist for an extended period of time. This landscape is almost barren with a few low lying subshrubs, forbs, and grasses. Although not visible from a distance, there is 0-6% total canopy cover of western needlegrass (*Achnatherum occidentale*), sulphur-flower buckwheat (*Eriogonum polyanthum*), marumleaf buckwheat (*Eriogonum marifolium*), naked buckwheat (*Eriogonum nudum*), Douglas' dustymaiden (*Chaenactis douglasii*), silverleaf phacelia (Phacelia hastate), and Lemmon's rockcress (*Arabis lemmonii*). There is less than 5 percent canopy cover from Jeffrey pine (*Pinus jeffreyi*), western white pine (*Pinus monticola*), and Sierra lodgepole pine (*Pinus contorta* var. murrayana). Trees may be 5 to 30 feet tall. The most common vegetation growing here are various species of buckwheat (Eriogonum spp.). Eriogonums are one of the most widespread genera of plants in North America. They are found in a variety of environmental conditions, including the dry sandy soil found here (Reveal, 1973). Eriogonum species can facilitate succession by accumulating seeds and providing more favorable conditions for germination and establishment of other species (Day and Wright, 1989). Litter and organic matter accumulate in the prostrate canopy of buckwheat plants, which may increase the nutrient levels of the soil (Day and Wright, 1989). There are few disturbances or ecological processes that would drive the current plant community into a new state or phase. It has been found that disturbance by animal burrowing can enhance plant growth and biodiversity (Vilies et al., 2008) in areas similar to this. A fire on this site is extremely unlikely due to the lack of fuels. Studies have shown Eriogonum species to be tolerant of stressful nutrient and water situations, making it an ideal plant for this ecological site. Eriogonum seedlings are able to withstand the coarse textured and nutrient deficient soil found in this area. Eriogonum species have lower osmotic potentials, greater fine root biomass and lower reductions in growth under drought conditions (Chapin and Bliss, 1989) than other species growing in similar environments. Jeffrey pine (*Pinus jeffreyi*) is frequently considered to be tolerant of early-seral conditions (Gucker, 2007). Jeffrey pine generally only persists to the late-seral stages on extremely harsh sites, like this ecological site, due to its shade intolerance. Although Jeffrey pine commonly grows on rocky and infertile soils, the extreme lack of resources limits its productivity. Sierra lodgepole pine (*Pinus contorta* var. murrayana) is a pioneer species that is tolerant of xeric and infertile soil. Total canopy cover will remain low for both of these species for a hundred years or more. It is not uncommon for environments like this to lack late successional species over long periods of time (Gomez-Romero et al., 2006).

Forest overstory. blank

Forest understory. blank

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Forb	–	13	21
Tree	–	3	7
Grass/Grasslike	–	3	6
Total	**–**	**19**	**34**

Table 6. Soil surface cover

Tree basal cover	0-2%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-3%
Non-vascular plants	0-1%
Biological crusts	0%
Litter	0-1%
Surface fragments >0.25" and <=3"	90-95%
Surface fragments >3"	0-3%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-4%	0-3%
>0.15 <= 0.3	–	–	–	0-3%
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	0-2%	–	–	–
>4 <= 12	0-3%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
1	**native trees**			0–7	
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0–2	0–1
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–2	0–1
	western white pine	PIMO3	*Pinus monticola*	0–2	0–1
Forb					
2	**native forbs**			0–21	
	sulphur-flower buckwheat	ERPO16	*Eriogonum polyanthum*	0–6	0–2
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–6	0–2
	Lemmon's rockcress	ARLE	*Arabis lemmonii*	0–3	0–1
	Douglas' dustymaiden	CHDO	*Chaenactis douglasii*	0–2	0–1
	naked buckwheat	ERNU3	*Eriogonum nudum*	0–2	0–1
	silverleaf phacelia	PHHA	*Phacelia hastata*	0–2	0–1
Grass/Grasslike					
3	**native grass**			0–6	
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–3	0–1

Animal community

This site has very little vegetation cover. Grazing opportunities are extremely limited and there is minimal protection or shelter available. Very few animals use this site on regular basis.

Recreational uses

Due to the sensitivity of the landscape there are limited recreation opportunities. Hiking is allowed, but it is restricted to designated trails to prevent leaving tracks that remain visible for many years. This area provides many photographic opportunities.

Inventory data references

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

789190
789191
789233
789234

Other references

Chapin, David M. and L.C. Bliss. Seedling growth, Physiology, and Survivorship in a subalpine, Volcanic Environment. Ecology. 70(5).1989.

Clynne, Michael A., Duane E. Champion, Deborah A. Trimble, James W. Hendley II, and Peter H. Stauffer. 2000. How old is “Cinder Cone”? - Solving a mystery in Lassen Volcanic National Park, California. USGS Fact Sheet - 023-00. 2000. [Available online: www.nps.gov/lavo]

Day, T.A. and R.G. Wright. 1989. Positive plant spatial associated with Eriogonum ovalifolium in primary succession on cinder cones: seed-trapping nurse plants. Vegetation 80: 37-45, 1989. [Available online: www.springerlink.com/content]

Gomez-Romero, M., Lindig-Cisneros, R., and Galindo-Vallejo S. Effect of tephra depth on vegetation development in areas affected by volcanism. Plant Ecology. 183(2). 2006.

Gucker, Corey L. 2007. *Pinus jeffreyi*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, August 21].

NRCS, 2010. Soil Survey of Lassen Volcanic National Park, United States Department of Agriculture, Natural Resources Conservation Service, 2009.

Viles, H.A., L.A. Naylor, N.E.A. Carter, and D. Chaput. 2008. Biogeomorphical disturbance regimes: progress in linking ecological and geomorphical systems. Earth Surf. Process. Landforms 33: 1419-1435(2008). [Available online: www.interscience.wiley.com]

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:**

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

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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):**

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

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

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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):**

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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:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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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:

17. **Perennial plant reproductive capability:**