

Ecological site R022BI218CA Thermal Seeps

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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 –

Riparian Complex: Hydrologically connected by thermal springs and seeps.

Slopes: 4 to 30 percent.

Landform: seeps on strath terrace.

Soils: Shallow to moderately deep, poorly drained soils that formed in geothermal spring alluvium from volcanic rocks. Duripan contact at 10 to 40 inches.

Temp regime: Frigid.

MAAT: 41 to 42 degrees F (6.1 to 7.3 degrees C).

MAP: 63 to 91 inches (1,600 to 2,300 mm).

Soil texture: Peaty silt loam and mucky silt loam.

Surface fragments: 0 percent surface rock fragments.

Vegetation: Several wet seep community types are present, that are dominated by graminoids and forbs.

Associated sites

F022BI110CA	Frigid Humic Loamy Gentle Slopes This is a white fir- mixed conifer forest common on the nearby hillslopes.
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F022BI120CA	Frigid Gravelly Sandy Loam Outwash-Stream Terraces This is a moist Sierra lodgepole pine- white fir forest found near the springs.
R022BI211CA	Spring Complex This site is associated with cold springs and heavy cover of thinleaf alder.

Similar sites

R022BI209CA	Loamy Seeps This thermal seep/spring site is associated with soil movement.
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Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Carex subfusca</i> (2) <i>Veratrum californicum var. californicum</i>

Physiographic features

This ecological site is found on seeps on strath terraces. It occurs between 5,660 and 6,760 feet in elevation, on 4 to 30 percent slopes.

Table 2. Representative physiographic features

Landforms	(1) Strath terrace
Flooding frequency	None
Ponding frequency	None
Elevation	5,660–6,760 ft
Slope	4–30%
Water table depth	0–7 in
Aspect	N, E, W

Climatic features

This ecological site receives most of its annual precipitation during winter months in the form of snow. The mean annual precipitation ranges from 63 to 91 inches (1,600 to 2,300 mm) and the mean annual temperature ranges from 41 to 42 degrees F (6.1 to 7.3 degrees C). The frost free (>32F) season is 70 to 90 days. The freeze free (>28F) season is 85 to 200 days.

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)	91 in

Influencing water features

This site is associated with small geothermal springs that eventually flow into larger perennial streams.

Soil features

The Typic Petraquepts soil component is associated with this site. Typic Petraquepts consists of shallow to moderately deep, poorly drained soils that formed in geothermal spring alluvium from volcanic rocks. The combined A horizons are 2 to 7 inches thick with peaty silt loam and mucky silt loam textures. The subsurface textures are ashy loam, gravelly ashy loams, or very gravelly ashy loam. Gleyed soil colors are present below the A horizons. Depth to duripan contact ranges from 10 to 40 inches.

This ecological site has been correlated with the following map units and components within the CA789 Soil Survey Area:

DMU Component percent
164 Typic Petraquepts 10

Table 4. Representative soil features

Surface texture	(1) Peaty silt loam
Family particle size	(1) Loamy
Drainage class	Poorly drained
Permeability class	Very slow
Soil depth	10–40 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	3.9–5 in
Soil reaction (1:1 water) (0-40in)	6.5–8
Subsurface fragment volume <=3" (Depth not specified)	7–30%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This ecological site is associated with geothermal springs and seeps, and the plant communities that exist due to the presence of the springs. There are multiple hot springs associated with this site. Each spring has unique physical and biological characteristics. Most have steady flow throughout the year, which develop into small stream channels called rivulets or runnels that lack the banks, beds, and floodplains of larger streams. These streams eventually flow into larger perennial streams.

The soil associated with this site has two A horizons, which combined are 7 inches deep. The textures are peaty silt loam over mucky silt loam. Gravelly ashy loams and ashy loam textures are present at lower depths. Gleyed soil colors are present under the A horizons, which indicate saturated soil conditions for prolonged periods of time. A duripan is present at depths between 10 to 40 inches. Depth to the duripan, percent slope, microtopography, spring chemistry, and proximity to the spring determine the composition of vegetation.

This ecological site is unique and diverse, but has limited distribution. A significant amount of time is required to collect additional soil, vegetation, and hydrological data to fully understand this complex ecosystem. Several springs should be selected for geothermal water analysis. Additional soil-vegetation plots should be located in distinct zones associated with these springs. A more descriptive ecological site can be developed from this additional data.

Several plant communities are associated with these hot springs. They are mostly dominated by forb and graminoid species. When springs change their course, do to build up of plant material or sediment, it alters the distribution of plant communities. If an area becomes dry for a significant amount of time, it may eventually support an upland forest community. Shrub communities are not abundant, but thinleaf alder (*Alnus incana* ssp. *tenuifolia*) can be

found along flowing channels. Data is insufficient to describe all the plant communities associated with this ecological site. The site where vegetation data was collected has a low flowing spring, and is in a concave depression. At this site there are two plant community components. One is in a wetter area and is dominated by hardstem bulrush, (*Schoenoplectus acutus*), chairmaker's bulrush (*Schoenoplectus americanus*), panicled bulrush (*Scirpus microcarpus*), field horsetail (*Equisetum arvense*), and smooth horsetail (*Equisetum laevigatum*). In slightly drier areas brown sedge (*Carex subfusca*), whitetip clover (*Trifolium variegatum*), and California false hellebore (*Veratrum californicum* var. *californicum*) are dominant, with a variety of other species.

At the source of active thermal springs there is diverse biological community. Most of these hot springs have neutral pH and low chloride concentrations. The hot springs are associated with the nearby steam vents, formed from vapor-dominated hydrothermal systems. Precipitation infiltrates over time through the rock, then vaporizes and rises to the surface (Thompson, 1985).

Hot springs have variable characteristics. Some springs form a mat of algal growth in the water and along the margins of the small stream. Hot springs ecology is a relatively new science, but studies conducted in Lassen Volcanic National Park indicate that several microbial communities are associated with specific hot spring characteristics. Microbes reside in thermal waters within specific zones of tolerance for temperature and acidity. A study in Cold Boiling Lake indicates that sulfur-metabolizing archaeans are present in the hottest zones (above 60 degrees C), with iron-oxidizing bacteria in cooler zones and photosynthetic algae and cyanobacteria in more moderate zones. Cold Boiling Lake is acidic however, so it's possible the microbial communities may differ for this site. Cyanobacteria and algae species form thin, dense green microbial mats. These mats are an ecosystem unto themselves with a diversity of organisms, each performing a specific task within the system. The cyanobacteria are on the surface of the mats and produce oxygen through photosynthesis. The oxygen filters into the lower layer where aerobic bacteria and archaea utilize it. The respiration between these organisms can deplete oxygen, creating an anoxic zone where purple sulfur bacteria reside. The purple sulfur bacteria use sulfide produced from sulfide-reducing bacteria (Wilson, et al., 2008 and Engleman, 2003).

This ecological site is a complex of communities, which are interrelated by hydrology. This is a relatively new concept for ecological sites. Additional studies are needed to describe additional plant communities and changes in plant community composition within the reference state or altered state (if there is one). A state and transition model (STM) has not been developed for this ecological site, due to lack of data and information. For information on STMs, see the following citations: Bestelmeyer et al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and transition model

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This complex ecological site needs additional vegetation, soil, and hydrologic data to identify present status, possible states, and associated plant community components.

Therefore, a state and transition model has not been developed for this site.

Figure 2. Thermal Seeps

State 1 Thermal seeps

This state is presently the only state for this ecological site and it represents the current unaltered conditions. However, disturbed areas were observed, which may represent an altered state due to diverted water flow or channel incision. There is insufficient data and knowledge at this time to determine if this area has crossed a threshold to an altered state. And if a threshold has been crossed, data is needed to determine the effect on the associated plant communities.

Community 1.1 Thermal seeps



Figure 3. Thermal Seeps



Figure 4. Altered Hydrology

Several plant communities are associated with this ecological site. Data was collected on two plant communities. The site where vegetation data was collected has a low flowing spring, and it is in a concave depression. This site was below a trail and may have some affect from water diversions presently or in the past. The flow begins to incise at the lower end of the depression. The wetter plant community is dominated by hardstem bulrush (*Schoenoplectus acutus*), chairmaker's bulrush (*Schoenoplectus americanus*), paniced bulrush (*Scirpus microcarpus*), field horsetail (*Equisetum arvense*), and smooth horsetail (*Equisetum laevigatum*). This area remains saturated through most of the year. The drier community has more diversity of species but is dominated by brown sedge (*Carex subfusca*), whitetip clover (*Trifolium variegatum*), and California false hellebore (*Veratrum californicum* var. *californicum*). Other graminoid species are bluejoint (*Calamagrostis Canadensis*), lakeshore sedge (*Carex lenticularis*), sedge (*Carex* sp.), fowl mannagras (*Glyceria striata*), meadow barley (*Hordeum brachyantherum*), mountain rush (*Juncus arcticus* ssp. *littoralis*), and Sandberg bluegrass (*Poa secunda*). Other forbs are common yarrow (*Achillea millefolium*), white marsh marigold (*Caltha leptosepala*), Douglas' thistle (*Cirsium douglasii*), fringed willowherb (*Epilobium ciliatum*), glaucous willowherb (*Epilobium glaberrimum*), scarlet fritillary (*Fritillaria recurva*), feathery false lily of the valley (*Maianthemum racemosum* ssp. *racemosum*), seep monkeyflower (*Mimulus guttatus*), Bolander's yampah (*Perideridia bolanderi*), Howell's yampah (*Perideridia howellii*), Sierra bog orchid (*Platanthera dilatata* var. *leucostachys*), slender cinquefoil (*Potentilla gracilis*), woodland buttercup (*Ranunculus uncinatus*), arrowleaf ragwort (*Senecio triangularis*), bugle hedgenettle (*Stachys ajugoides*), and American speedwell (*Veronica americana*). The channel begins to incise in the middle of the drier community, indicating disturbance and a drop in the water table. The "Altered Hydrology" photo above shows a ditch which captures spring flow. Water has been diverted away from the vegetation to the right. Data was not collected on these plant communities, but it appears to be more productive growth where water has not been diverted. Production data was not collected for this ecological site. "0" was entered in lieu of a null value for production in the table below.

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	Grass/grasslike			0	
	brown sedge	CASU6	<i>Carex subfusca</i>	0	30–60
	sedge	CAREX	<i>Carex</i>	0	10–15
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0	1–10
	chairmaker's bulrush	SCAM6	<i>Schoenoplectus americanus</i>	0	3–8
	hardstem bulrush	SCAC3	<i>Schoenoplectus acutus</i>	0	1–6
	bluejoint	CACA4	<i>Calamagrostis canadensis</i>	0	3–6
	lakeshore sedge	CALE8	<i>Carex lenticularis</i>	0	1–5
	mountain rush	JUARL	<i>Juncus arcticus ssp. littoralis</i>	0	0–3
	fowl mannagrass	GLST	<i>Glyceria striata</i>	0	0–3
	meadow barley	HOBR2	<i>Hordeum brachyantherum</i>	0	0–1
	panicled bulrush	SCMI2	<i>Scirpus microcarpus</i>	0	0–1
Forb					
1	Forbs			0	
	California false hellebore	VECAC2	<i>Veratrum californicum var. californicum</i>	0	10–25
	whitetip clover	TRVA	<i>Trifolium variegatum</i>	0	8–20
	smooth horsetail	EQLA	<i>Equisetum laevigatum</i>	0	3–8
	Howell's yampah	PEHO5	<i>Perideridia howellii</i>	0	0–5
	Douglas' thistle	CIDO2	<i>Cirsium douglasii</i>	0	1–4
	field horsetail	EQAR	<i>Equisetum arvense</i>	0	1–3
	arrowleaf ragwort	SETR	<i>Senecio triangularis</i>	0	0–2
	bugle hedgenettle	STAJ	<i>Stachys ajugoides</i>	0	0–1
	American speedwell	VEAM2	<i>Veronica americana</i>	0	0–1
	Sierra bog orchid	PLDIL	<i>Platanthera dilatata var. leucostachys</i>	0	0–1
	slender cinquefoil	POGR9	<i>Potentilla gracilis</i>	0	0–1
	woodland buttercup	RAUN	<i>Ranunculus uncinatus</i>	0	0–1
	fringed willowherb	EPCI	<i>Epilobium ciliatum</i>	0	0–1
	glaucus willowherb	EPGL	<i>Epilobium glaberrimum</i>	0	0–1
	common yarrow	ACMI2	<i>Achillea millefolium</i>	0	0–1
	white marsh marigold	CALE4	<i>Caltha leptosepala</i>	0	0–1
	scarlet fritillary	FRRE	<i>Fritillaria recurva</i>	0	0–1
	feathery false lily of the valley	MARAR	<i>Maianthemum racemosum ssp. racemosum</i>	0	0–1
	seep monkeyflower	MIGU	<i>Mimulus guttatus</i>	0	0–1
	Bolander's yampah	PEBO2	<i>Perideridia bolanderi</i>	0	0–1

Animal community

Springs provide habitat for aquatic plants and animals and a water source for terrestrial animals. Such wetlands provide a source of food and cover for birds, reptiles, amphibians, and mammals and they may be occupied by endemic vertebrates or macroinvertebrates.

Hydrological functions

This site is a source of geothermal ground water discharge.

Recreational uses

This area provides a unique experience to view the emergence and ecology of geothermal seeps and spring. Trails should be constructed carefully, so water flow is not diverted.

Inventory data references

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

789285- Type location
789285B

Type locality

Location 1: Plumas County, CA	
Township/Range/Section	T30 N R5 E S22
UTM zone	N
UTM northing	4478040
UTM easting	635584
General legal description	The type location is about 0.19 miles southeast of Drakesbad, in Lassen Volcanic National Park.

Other references

Bestelmeyer, Brandon T.; Brown, Joel R.; Havstad, Kris M.; Alexander, Robert; Chavez, George; and Herrick Jeffrey E.; 2003. Development and Use of State-and-Transition Models for Rangelands. *Journal of Range Management*, Vol. 56, No. 2 (Mar., 2003), pp. 114-126. Allen Press and Society for Range Management. Stable URL: <http://www.jstor.org/stable/4003894>

Bestelmeyer, Brandon T.; Tugel, Arlene J.; Peacock, George L. Jr.; Robinett, Daniel G.; Shaver, Pat L.; Brown, Joel R.; Herrick, Jeffrey E.; Sanchez, Homer; and Havstad, Kris M.; 2009. State-and-Transition Models for Heterogeneous Landscapes: A Strategy for Development and Application. *Rangeland Ecology and Management* 62:1–15; January 2009.

Briske, D. D., Fuhlendorf, S. D; and Smeins, F. E., 2006. A Unified Framework for Assessment and Application of Ecological Thresholds. *Rangeland Ecology and Management* 59:225–236.

Briske, D. D; Bestelmeyer B. T; Stringham, T. K., and Shaver, P. L., 2008. Recommendations for Development of Resilience-Based State-And-Transition Models. *Rangeland Ecology and Management* 61:359–367. Bestelmeyer et al. 2003,

Briske, D. D.; Fuhlendorf, S. D.; and Smeins, F. E.; 2009. State-and-Transition Models, Thresholds, and Rangeland Health: A Synthesis of Ecological Concepts and Perspectives. *Rangeland Ecology & Management*, Vol. 58, No. 1 (Jan., 2005), pp. 1-10. Allen Press and Society for Range Management. Stable URL: <http://www.jstor.org/stable/3899791>

Clyne, Michael A.; Janik, Cathy J.; and Muffler, L.J.P. Fact Sheet 101-02 “Hot Water” in Lassen Volcanic National Park— Fumaroles, Steaming Ground, and Boiling Mudpots. U.S. Geological Survey.

Engleman, Kurt, 2003. Hot Springs Ecology. Humboldt State University, online at <http://users.humboldt.edu/plsiering/LIBARATE/Kurt%20Engleman/k-ecology.htm>

Stringham, T.K., W.C. Krueger, and P.L. Shaver. 2003. State and Transition Modeling: An Ecological Process

Approach. J. Range Manage 56: 106-113.

Thompson, J. Michael, 1985. Chemistry of thermal and nonthermal springs in the vicinity of Lassen Volcanic National Park. Journal of Volcanology and Geothermal Research. Volume 25, Issues 1-2, June 1985, Pages 81-104. Copyright © 1985 Published by Elsevier B.V.

USDA, NRCS. 2007. The PLANTS Database. National Plant Data Center, Baton Rouge, LA 70874-4490 USA. Available online at: <http://plants.usda.gov>

USDA, NRCS. 2003. National Range and Pasture Handbook. Available online at: <http://www.glti.nrcs.usda.gov/technical/publications/nrph.html>

Weixelman, Dave; Weis, Sue; Linton, Fletcher; and Swartz, Heather; 2007. DRAFT: Condition Checklist for Fens in the Montane and Subalpine Zones of the Sierra Nevada and Southern Cascade Ranges, CA.

Wilson, Mark S.; Siering, Patricia L.; White, Christopher L.; Hauser, Michelle E.; and Bartles, Andrea N. (2008). Microbial diversity and dynamics in an acidic hot spring at Lassen Volcanic National Park. Environmental Microbiology, 56 (2), 292-305 (<http://www.springerlink.com/content/371xh7144562w637>)

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:
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17. **Perennial plant reproductive capability:**
-