USDA Natural Resources Conservation Service

Ecological site F022AE007CA
Frigid, Sandy, Moraines And Hill Slopes

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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 has s 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 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. Additionally, glacial activity of the Pleistocene has played a major role in shaping Sierra Nevada features, including cirques, aretes, 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. The soil temperature regime ranges from mesic, frigid, and cryic.

LRU "E" Northern Sierran Upper Montane: This LRU occurs at the mid elevations of the Sierra Nevada, from the Sonora Pass area to the higher mountains in the vicinity of Quincy. Elevations are typically between 5,500 feet to 8,500 feet, with the lower elevations typically on southern aspects, and the higher elevations on northern aspects. The frost-free season is 60 to 125 days, MAAT ranges from 40 to 50 F, and MAP ranges from 35 to 85 inches. The soil temperature regime is mostly frigid, with some cryic soil temperatures at the upper elevations and northern aspects. Soil moisture regimes are mostly xeric, but may be udic where snow persists through spring.

Classification relationships

Smith, Sydney. 1994. Ecological Guide to Eastside Pine Associations. USDA Forest Service, Pacific Southwest Region. R5-ECOL-TP-004.This site is similar to the YP-ABCO/SYMO-WYMO series.

Forest Alliance = *Abies concolor* – White fir forest; Association = tentatively *Abies concolor*/Symphoricarpos and *Abies concolor-Calocedrus decurrens-Pinus jeffreyi*. (Sawyer, John O., Keeler-Wolf, Todd, and Evens, Julie M. 2009. A Manual of California Vegetation. 2nd ed. California Native Plant Society Press. Sacramento, California.)

Ecological site concept

This site occurs on gentle to steep sloping moraines at elevations of typically between 6,000 and 6,700 feet. Slopes are typically between 15 and 50 percent. Soils are deep to very deep, have skeletal textures, and are derived from colluvium and till from mixed parent materials. The vegetation is a widespread white fir (*Abies concolor*) - Jeffrey pine (*Pinus jeffreyi*) forest that can become very dense and overstocked. Huckleberry oak (*Quercus vacciniifolia*) and whitethorn ceanothus (*Ceanothus cordulatus*) may be abundant in the shrub layer.

Associated sites

F022AC005CA	**Cryic Sheltered, Moist Sandy Mountain Slopes** Occurs on adjacent cryic north-facing slopes with deep sandy soils. A mixed subalpine forest is present, with Sierra lodgepole pine (Pinus contorta var. murrayana), mountain hemlock (Tsuga mertensiana), red fir (Abies magnifica) and western white pine (Pinus monticola) all present.
F022AC006CA	**Moderately Deep Cryic Sandy Till** Occurs on adjacent south-facing cryic mountain slopes with moderately deep loamy-skeletal soils. The vegetation is an open lodgepole pine (Pinus contorta var. murrayana) forest with red fir (Abies magnifica) and western white pine (Pinus monticola).
F022AE025CA	**Loamy Moist Outwash** This site occurs on adjacent valley bottoms on outwash adn on old river and lake terraces with very deep, gently sloping soils formed in alluvium. The vegetation is a mixed conifer forest of white fir (Abies concolor), Jeffery pine (Pinus jeffreyi) and sugar pine (Pinus lambertiana). The understory is diverse, and Utah serviceberry (Amelanchier utahensis) and thimbleberry (Rubus parviflorus) are common shrub species.
F022AF001CA	**Frigid Sandy Outwash Plain Gentle Slopes** Occurs on adjacent undulating outwash soils that are deep to a duripan. The depth to the duripan is variable due to undulating topography, which creates a mosaic of saturated and very droughty soils. The vegetation is a patchy Sierra lodgepole pine (Pinus contorta var. murrayana) forest, with western juniper (Juniperus grandis) scattered in shallower dry areas.
F022AF002CA	**Frigid, Sandy, Or Loamy Outwash** Occurs on adjacent gently sloping outwash, moraines and outwash fans with moderately deep to very deep soils of mixed origin. Vegetation is an open Jeffrey pine (Pinus jeffreyi) forest.
F022AF003CA	**Frigid, Loamy, Fragipan, Outwash** Occurs on adjacent very deep soils from outwash and alluvium from mixed sources. Soils have a weak fragipan at 12 to 65 inches, and no duripan. The vegetation is dense Sierra lodegepole pine (Pinus contorta var. murrayana) forest with sparse grasses in the understory.
F022AF004CA	**Frigid, Shallow To Deep, Sandy Mountain Slopes** Occurs on adjacent slopes with south-facing aspects and sandy soils. An open Jeffrey pine (Pinus jeffreyi) forest dominates and shrub density may be high, with greenleaf manzanita (Arctostaphylos patula) and antelope bitterbrush (Purshia tridentata) the most common shrub species.
F022AF005CA	**Frigid, Deep To Very Deep, Sandy-Loamy Mountain Slopes** Occurs on adjacent north-facing slopes with very deep soils. Jeffrey pine (Pinus jeffreyi) and white fir (Abies concolor) co-dominate.

R022AE202CA	**Granitic Pocket** Occurs on adjacent slopes with a high percentage of rock outcrop and shallow, sandy soils that occur in pockets among bedrock ledges. The vegetation is sparse western juniper (Juniperus grandis)-Jeffrey pine (Pinus jeffreyi)-Sierra lodgepole pine (Pinus contorta var. murrayana) with a sedge-forb community in soil pockets and a huckleberry oak (Quercus vaccinifolia) dominated shrub community among talus.
R022AE213CA	**Steep Rubbly Slope** Occurs on adjacent very steep, rubbly slopes with deep soils. The vegetation is a dense shrubland dominated by huckleberry oak (Quercus vaccinifolia) and greenleaf manzanita (Arctostaphylos patula).
R022AX105CA	**Steep Mountain Drainageways** Occurs on steep mountain drainageways with very deep, frigid, sandy, aquic, alluvial soils, along Rosgen B or A type channels. A complex of community types is present. Aspen (Populus tremuloides), Lemmon's willow (Salix lemmonii) and thinleaf alder (Alnus incana spp. tenuifolia) are characteristic species.
R022AX107CA	**Frigid C Channel System** This riparian complex occurs along C-B type channels with gravelly to cobbly channel substrates and 2 - 3 percent slopes. The vegetation is characterized by willow (Salix ssp.) - aspen (Populus tremuloides) - cottonwood (Populus balsamifera) communities.

Similar sites

F022AF002CA	**Frigid, Sandy, Or Loamy Outwash** This site occurs in the "F" LRU, which is characterized by lower precipitation. Jeffrey pine (Pinus jeffreyi) is strongly dominant, and the site is less favorable for white fir (Abies concolor).
F022AE025CA	**Loamy Moist Outwash** This site occurs on very deep, gently sloping soils formed in alluvium. Soil textures are fine-loamy. Soils have higher moisture availability, and the understory is more diverse and productive.

Table 1. Dominant plant species

Tree	(1) *Abies concolor* (2) *Pinus jeffreyi*
Shrub	(1) *Quercus vacciniifolia* (2) *Ceanothus cordulatus*
Herbaceous	(1) *Senecio integerrimus*

Physiographic features

This ecological site is on moraines on slopes ranging from 0 to 70, but typically between 15 and 50 percent. Elevations may range from 6,240 feet to 7,900 feet, but are typically below 7,600 feet. It is found on all aspects, primarily along the west and south to south-west shore of Lake Tahoe. Runoff class is negligible to medium.

Table 2. Representative physiographic features

Landforms	(1) Moraine
Flooding frequency	None
Ponding frequency	None
Elevation	1,902–2,408 m
Slope	0–70%
Ponding depth	0 cm
Water table depth	0 cm

Climatic features

The average annual precipitation ranges from 23 to 65 inches, mostly in the form of snow in the winter months (November through April). The average annual air temperature ranges from 39 to 46 degrees Fahrenheit. The frost-free (>32F) season is 40 to 90 days, and the freeze-free (>28F) season is 60 to 110 days.

Table 3. Representative climatic features

Frost-free period (average)	65 days
Freeze-free period (average)	115 days
Precipitation total (average)	1,422 mm

Influencing water features

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

Soil features

The soils associated with this ecological site are deep to very deep, and formed in till or colluvium over till from granodiorite or mixed sources. They are well to somewhat excessively drained with slow to rapid permeability. The soil moisture regime is typic xeric and the soil temperature regime is frigid. Surface rock fragments smaller than 3 inches in diameter range from 0 to 51 percent, and larger fragments range from 0 to 45 percent. Surface textures include extremely gravelly and gravelly loamy coarse sand, extremely gravelly and gravelly sandy loam, and gravelly coarse sandy loam. A layer of partially and moderately decomposed litter (Oi horizon) may overlay the mineral subsurface horizons. Subsurface textures include extremely gravelly, gravelly and extremely stony loamy coarse sand, extremely cobbly, extremely gravelly, very gravelly and gravelly coarse sandy loam, and extremely gravelly sandy loam. Subsurface rock fragments smaller than 3 inches in diameter range from 10 to 72 percent by volume, and larger fragments range from 0 to 50 percent (for a depth of 0 to 73 inches). The soils correlated to this site include Meeks (Sandy-skeletal, mixed, frigid Humic Dystroxerepts), Tallac (Loamy-skeletal, mixed, superactive, frigid Humic Dystroxerepts), Burnlake (Loamy-skeletal, mixed, superactive, frigid Humic Dystroxerepts), and Roadcat (Sandy-skeletal, mixed, frigid Typic Haploxerepts). Meeks soils are deep to very deep over weakly cemented glacial till and formed from material weathered from glacial till and outwash. Tallac soils are deep to very deep and formed in material weathered from glacial deposits. Burnlake soils are very deep and formed in till derived from mixed rocks. Roadcat soils are very deep and formed in till derived mainly from granitic rock.

This ecological site has been correlated with the following mapunits and soil components in the Tahoe Basin soil survey area (CA693):

Musym ; MUname ; Compname ; Local_phase ; Comp_pct
7522 ; Tallac gravelly coarse sandy loam, 15 to 30 percent slopes, very stony ; Tallac ; very stony ; 85; ; Meeks ; extremely bouldery ; 10
7523 ; Tallac gravelly coarse sandy loam, 30 to 70 percent slopes, very stony ; Tallac ; very stony ; 85; ; Meeks ; extremely bouldery ; 10
7481 ; Meeks gravelly loamy coarse sand, 0 to 5 percent slopes, stony ; Meeks ; stony ; 85
7483 ; Meeks gravelly loamy coarse sand, 0 to 5 percent slopes, very stony ; Meeks ; very stony ; 85
7526 ; Tallac gravelly coarse sandy loam, moderately well drained, 2 to 9 percent slopes, rubbly ; Tallac ; rubbly ; 85; Tallac ; very stony ; 4
7482 ; Meeks gravelly loamy coarse sand, 5 to 15 percent slopes, stony ; Meeks ; stony ; 80
7484 ; Meeks gravelly loamy coarse sand, 5 to 15 percent slopes, extremely bouldery ; Meeks ; extremely bouldery ; 80; Meeks ; rubbly ; 5; ; Burnlake ; ; 5
7485 ; Meeks gravelly loamy coarse sand, 15 to 30 percent slopes, extremenly bouldery ; Meeks ; extremely bouldery ; 80; Meeks ; rubbly ; 5; ; Burnlake ; ; 5
7486 ; Meeks gravelly loamy coarse sand, 30 to 70 percent slopes, extremely bouldery; Meeks ; extremely bouldery ; 80; Meeks ; rubbly ; 5; ; Burnlake ; ; 5
7487 ; Meeks gravelly loamy coarse sand, 5 to 15 percent slopes, rubbly ; Meeks ; rubbly ; 80; Burnlake ; ; 5; Roadcat ; ; 3
7488 ; Meeks gravelly loamy coarse sand, 15 to 30 percent slopes, rubbly ; Meeks ; rubbly ; 80; Burnlake ; ; 5; Roadcat ; ; 3
7489 ; Meeks gravelly loamy coarse sand, 30 to 70 percent slopes, rubbly ; Meeks ; rubbly ; 80; Burnlake ; ; 5; Roadcat ; ; 3
7521 ; Tallac gravelly coarse sandy loam, 5 to 15 percent slopes, very stony ; Tallac ; very stony ; 75; Tallac ; rubbly

; 10; ; Meeks ; extremely bouldery ; 5
7401 ; Burnlake-Roadcat association, 4 to 30 percent slopes ; Burnlake ; ; 60; Roadcat ; ; 25
7431 ; Celio loamy coarse sand, 0 to 5 percent slopes ; Meeks ; stony ; 7
7524 ; Tallac gravelly coarse sandy loam, moderately well drained, 0 to 5 percent slopes ; Meeks ; very stony ; 5
7525 ; Tallac gravelly coarse sandy loam, moderately well drained, 5 to 9 percent slopes ; Meeks ; extremely bouldery ; 5
7501 ; Rock Outcrop-Rockbound complex, 5 to 30 percent slopes ; Meeks ; rubbly ; 5
7425 ; Cassenai cobbly loamy coarse sand, moist, 5 to 15 percent slopes, very bouldery ; Meeks ; extremely bouldery ; 5; Tallac ; very stony ; 5
7426 ; Cassenai cobbly loamy coarse sand, moist, 15 to 30 percent slopes, very bouldery ; ; Tallac ; very stony ; 5; Meeks ; extremely bouldery ; 4
7427 ; Cassenai cobbly loamy coarse sand, moist, 30 to 50 percent slopes, very bouldery
7428 ; Cassenai cobbly loamy coarse sand, moist, 50 to 70 percent slopes, very bouldery ; Meeks ; extremely bouldery ; 5; ;Tallac ; very stony ; 2
9101 ; Callat very gravelly coarse sandy loam, 9 to 30 percent slopes, very stony ; Meeks ; extremely bouldery ; 5; ; Tallac ; very stony ; 5
9102 ; Callat very gravelly coarse sandy loam, 30 to 50 percent slopes, very stony ; Meeks ; extremely bouldery ; 5; ; Tallac ; very stony ; 5
7491 ; Oneidas coarse sandy loam, 0 to 5 percent slopes ; Meeks ; stony ; 3
7492 ; Oneidas coarse sandy loam, 5 to 15 percent slopes ; Meeks ; stony ; 3
7484 ; Meeks gravelly loamy coarse sand, 5 to 15 percent slopes, extremely bouldery ; Tallac ; very stony ; 3; Roadcat ; ; 2
7485 ; Meeks gravelly loamy coarse sand, 15 to 30 percent slopes, extremenly bouldery ; Tallac ; very stony ; 3; Roadcat ; ; 2
7486 ; Meeks gravelly loamy coarse sand, 30 to 70 percent slopes, extremely bouldery ; Tallac ; very stony ; 3; Roadcat ; ; 2
7511 ; Shalgran-Rock outcrop complex, 30 to 75 percent slopes ; Burnlake ; ; 2
7142 ; Inville gravelly coarse sandy loam, 9 to 15 percent slopes, stony ; Meeks ; extremely bouldery ; 2
7143 ; Inville gravelly coarse sandy loam, 15 to 30 percent slopes, stony ; Meeks ; extremely bouldery ; 2

Table 4. Representative soil features

Parent material	(1) Till–granodiorite
Surface texture	(1) Gravelly loamy coarse sand (2) Gravelly sandy loam (3) Extremely gravelly loamy coarse sand
Family particle size	(1) Sandy
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Slow to rapid
Soil depth	99 cm
Surface fragment cover <=3"	0–51%
Surface fragment cover >3"	0–45%
Available water capacity (0-101.6cm)	4.06–13.21 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0

Soil reaction (1:1 water) (0-101.6cm)	5.6–7.3
Subsurface fragment volume <=3" (Depth not specified)	10–72%
Subsurface fragment volume >3" (Depth not specified)	0–50%

Ecological dynamics

Abiotic factors
This site occurs on gentle to steep sloping moraines at elevations of approximately 5,700 to 8,700 feet. Soils are deep to very deep, have skeletal textures, and are derived from glacial till or colluviums over till from mixed parent materials. The vegetation is a widespread white fir (*Abies concolor*) - Jeffrey pine (*Pinus jeffreyi*) forest that can become very dense and overstocked. Huckleberry oak (*Quercus vacciniifolia*) and whitethorn ceanothus (*Ceanothus cordulatus*) may be abundant in the shrub layer.

Ecological/Disturbance factors
The reference community was most likely composed of large, old-growth white fir and Jeffrey pine with intermixed incense cedar (*Calocedrus decurrens*). Canopy cover ranged from 40 to 80 percent with several tree layers in the mid-canopy, and patches of shrubs in the understory.

White fir is a large long-lived tree in this area. It commonly reaches heights of 120 to 140 feet and can live for 300 to 400 years. It produces single needles1.2 to 2.8 inches long that are distributed along the young branches. Because the female seed cones open and fall apart while still attached to the tree, cones are not often seen on the forest floor. White fir tends to develop a shallow root system that can graft to other white fir roots and spread root rots (Zouhar 2001). Jeffrey pine is also a relatively large and long-lived tree, attaining heights of 200 feet and living for 400 to 500 years or more. It produces 3 to 8 inch needles in bundles of three. The female seed cones range in size from 4.7 to 12 inches long. Jeffrey pine produces a deep taproot and extensive lateral roots (Gucker 2007) that are intolerant of wet conditions.

This site was almost entirely clear-cut in the 1870s and 1890s during the period known as the Comstock Era (Murphy and Knopp 2000) which greatly influenced the ecological dynamics of this area. Historically, this site developed with frequent low to moderate intensity fires with occasional stand-replacing fires. Fires were historically frequent, with fire return intervals with a median of 8 to 12 years and a range of 3 to 40 years (4 to 9 years for white fir-sugar pine and 14 to 24 years for white-fir-Jeffrey pine) and low to moderate intensity (Bekker and Taylor 2001). More frequent fires would tend to favor Jeffrey pine, while fires that are more sporadic in timing and intensity will favor white fir (Skinner and Chang 1996, Murphy and Knopp 2000).

Along with fire, tree pathogens and insect infestations can kill large areas of forest. An epidemic-level outbreak can cause a major shift of plant communities in the forest by killing either patches of whole forest or just scattered trees. The pathogens are a natural cycle of regulation and can push the closed forest types to a more open forest. Fuel loads are high after pathogen outbreaks and subsequent fires would burn hotter and longer.

Jeffrey Pine is susceptible to several diseases and insect infestations especially in periods of drought or when overcrowded. The most threatening of these are dwarf mistletoe (*Arceuthobium abietinum* f. sp. Concoloris) and Jeffrey pine bark beetle (Dendroctonus jeffreyi) (Murphy and Knopp 2000). Other pathogens that affect Jeffrey pine in this area include root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), red turpentine beetle (Dendroctonus valens) and pine engraver beetle (Ips species).

Pathogens and insects infestations can also affect white fir. The most threatening of these is the combination of the fir engraver beetle (Scotylus ventralis) and annosus root disease (Heterobasidium annosum), which can kill large areas of white fir (Murphy and Knopp 2000). Other pathogens that affect white fir include dwarf mistletoe (*Arceuthobium abietinum* f. sp. concoloris), broom rust (Melamsporlla caryophyllacearum) and trunk rot (Echinodontium tinctorium).

The reference state consists of the most successionally advanced community phase (numbered 1.1) as well as other community phases that result from natural and human disturbances. Community phase 1.1 is deemed the phase representative of the most successionally advanced pre-European plant/animal community including periodic natural surface fires that influenced its composition and production. Because this phase is determined from the oldest modern day remnant forests and/or historic literature, some speculation is necessarily involved in describing it.

All tabular data listed for a specific community phase within this ecological site description represent a summary of one or more field data collection plots taken in communities within the community phase. Although such data are valuable in understanding the phase (kinds and amounts of ground and surface materials, canopy characteristics, community phase overstory and understory species, production and composition, and growth), it typically does not represent the absolute range of characteristics nor an exhaustive listing of species for all the dynamic communities within each specific community phase.

State and transition model

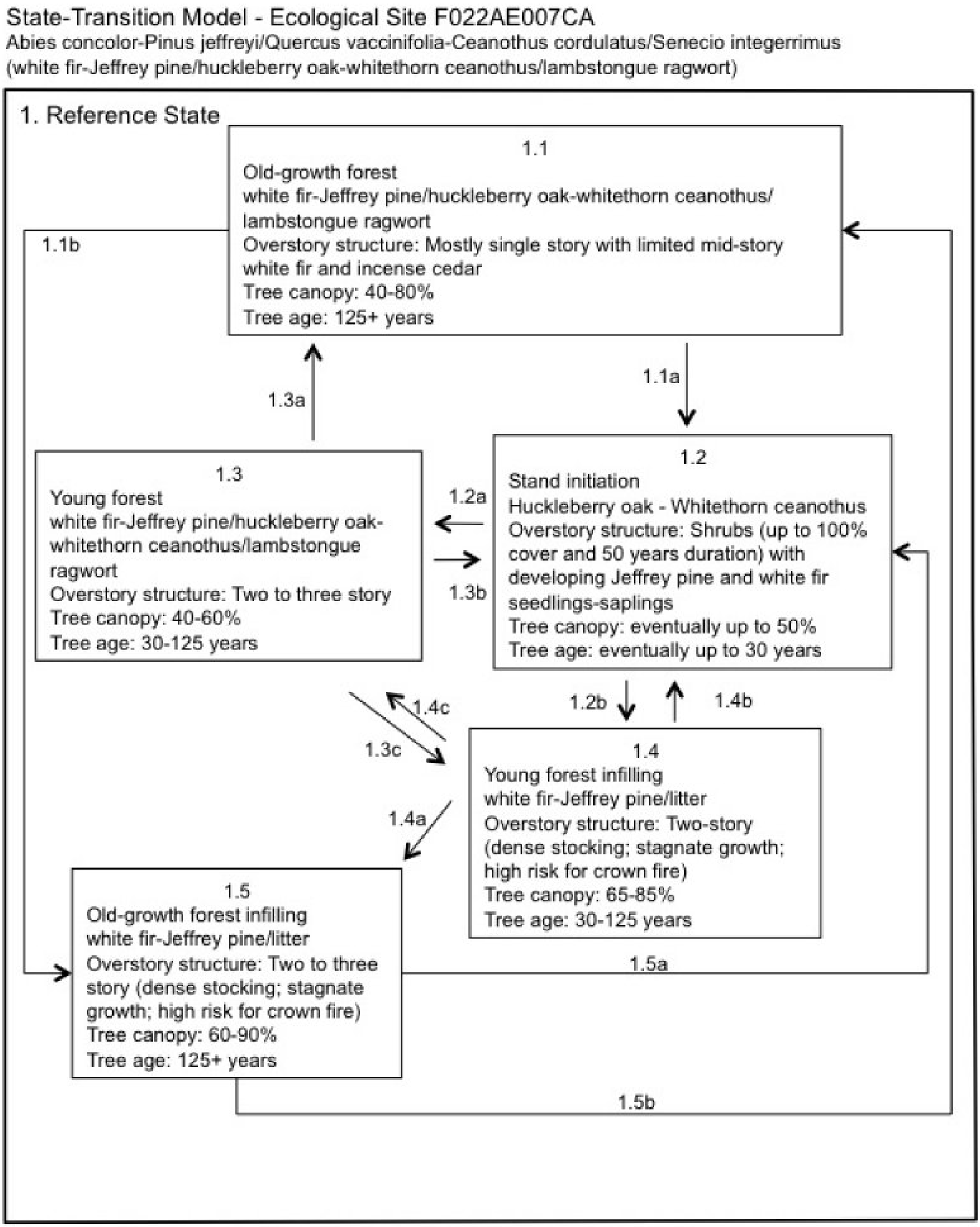

Figure 6. F022AE007CA

State 1
Reference

Community 1.1
Old-growth forest

This community phase represents the most successionally advanced community for this ecological site and is largely absent. It can be characterized by an open, old-growth forest of white fir and Jeffrey pine with a multi-tiered forest beneath. Ages exceeded 125 years. White fir may reach maximal ages of 300-400 years. Jeffrey pine often lives to maximal ages of 400 or 500 years and is somewhat less likely to succumb to stress from drought and pests. Incense cedar was a common associate but of limited extent. Common shrubs likely included huckleberry oak, whitethorn ceanothus, greenleaf manzanita (*Arctostaphylos patula*), prostrate ceanothus (*Ceanothus prostratus*), creeping snowberry (*Symphoricarpos mollis*), gooseberry (Ribes spp.), and bush chinquapin (Chysolepis sempervirens). Low to moderate intensity fires with a return interval of 3 to 40 years likely controlled overall stocking/cover of overstory trees by periodically killing some of the thin-barked seedlings, saplings and pole-sized trees (particularly white fir and incense cedar). Overall cover of understory species was also influenced by periodic fires because of species equilibration with shade of the overstory canopy.

Community 1.2
Stand initiation

Figure 7. Whitethorn ceanothus 3 years after wildfire.

This shrubland community thrives in the new openings created by large crown fires that kill the majority of overstory trees. Huckleberry oak is a fire-adapted species that is highly flammable and vigorously resprouts from the root crown after fire (Howard 1992, Nagal and Taylor 2005, Odion et al. 2009). Whitethorn ceanothus will resprout following light to moderate severity fire, and after severe intensity fire regenerates from heat activated seed that may survive in the soil for more than 200 years (Nagal and Taylor 2005, Reeves 2006). Greenleaf manzanita vigorously resprouts from underground lignotubers, and regerates from heat scarified seeds that may survive in the soil for more than 400 years (Nagal and Taylor 2005, Hauser 2007). With rapid regeneration from root sprouts, and recruitment from on site seed stores, this shrubland can resemble preburn coverage in 7 to 9 years (Risser and Fry 1988). The size and the intensity of a burn may influence the shrub expression. Shrubs have been associated with large burn size, whereas trees were not able to establish across the landscape (Royce and Barbour, 2001). Shrubs can prevail in areas prone to frequent fire, such as ridges and wind tunnels. Greenleaf manzanita is a strong competitor for water. It continues to deplete water after conifer species have gone dormant for the drought season. This competition for water and sunlight between the shrubs and conifer seedlings can delay the establishment of a forest (Royce and Barbour 2001). The shrub community may persist for 50 years or more. The surviving overstory trees are a valuable source of seed for tree regeneration. Seeds are dispersed downwind at approximately twice the height of the source tree, possibly farther under windy conditions. Jeffrey pine seed is also cached by squirrels and chipmunks, which aid in dispersing the seed. Studies have shown that Jeffrey pine seed germination and seedling survival is greater for cached seeds that have been buried in soil rather than for windblown seeds deposited on the surface.

Forest overstory. Canopy cover of remnant overstory trees surviving the causal disturbance may be up to 10 percent.

Forest understory. Shrubs varies in composition and cover as they dominate the area several years after disturbance. Tree regeneration typically is slow to infill in openings in shrub cover.

Community 1.3
Young forest

Figure 8. Community Phase 1.3

This is the most common community phase in the Lake Tahoe Basin. The community phase consists of white fir-Jeffrey pine stands with two to three layers, 40 to 60 percent canopy cover, and tree ages ranging from 30 to 125 years. It developed under natural succession with recurring low to moderate surface fires affecting overstory species canopy and composition as well as the amount of understory. Many of the communities in this phase are managed forests, with manual thinning and prescribed burns used to remove white fir and allow for more predominance of Jeffrey pine. The removal of some of the understory creates a somewhat more open forest with less competition between trees.

Forest overstory. This forest community phase is dominated by an even-aged stand of white fir and Jeffrey pine. The trees range from 30 to 125 years old. Canopy cover ranges from 40 to 60 percent, with an average of 50 percent cover. Incense cedar is common in the canopy and the understory with low cover.

Forest understory. The understory cover and diversity increases as the overstory canopy decreases. Average shrub cover is 15 to 45 percent, and huckleberry oak (Quercus vaccinifolia), whitethorn ceanothus (Ceanothus cordulatus), prostrate ceanothus (Ceanothus prostratus), and greenleaf manzanita (Arctostaphylos patula) are common species. Forb cover is low, averaging 3 percent. lambstongue ragwort (Senecio integerrimus and Brewer's fleabane (Erigeron breweri) are the most frequently present species, but a range of other forbs may be present at a given site. Grass cover is low, at less than 1 percent.

Table 5. Soil surface cover

Tree basal cover	2.0-3.5%
Shrub/vine/liana basal cover	1.0-1.5%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	34-74%
Surface fragments >0.25" and <=3"	1-10%
Surface fragments >3"	1-30%
Bedrock	0%
Water	0%
Bare ground	1-5%

Table 6. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	1-5%
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	1-10%
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	1-10%
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	1-20%
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	1-5%
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	
Tree snag count** (hard***)	

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

**** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.**

***** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.**

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0-1%	0-15%	0-1%	0-3%
>0.15 <= 0.3	0-2%	0-15%	0-1%	0-5%
>0.3 <= 0.6	0-4%	5-45%	0-1%	0-3%
>0.6 <= 1.4	0-4%	5-45%	–	–
>1.4 <= 4	0-4%	0-10%	–	–
>4 <= 12	0-15%	–	–	–
>12 <= 24	10-40%	–	–	–
>24 <= 37	40-55%	–	–	–
>37	0-15%	–	–	–

Community 1.4
Young forest infilling

This community phase begins with pole-sized white fir and Jeffrey pine, which eventually mature reaching 100 feet or taller. The age range for the phase is 30 to 125 years with a second story of trees developing beneath with ages down to 15 years. Canopy cover increases to 65 to 85 percent. White fir continues to reproduce and grow better in the understory than Jeffrey pine, so with time this forest will become dominated by white fir. This community phase is defined by a dense canopy and high basal area. The trees are often overcrowded and competition for water and nutrients increases stress, making this phase susceptible to death from pests and drought. Wildfire, if and when it occurs, will be severe due to the deep accumulation of litter, standing dead and down trees, and dense multi-layered structure of the forest. Decimation of the majority of trees can be expected. Forest understory is very sparse to absent.

Forest overstory. Young white fir and Jeffrey pine are mixed in the developing canopy. Combined canopy cover begins at 25 percent and increases to 65 to 85 percent. Tree regeneration continues throughout this phase, and if not removed by fire, overall stand density will increase. White fir continues to reproduce and grow better in the understory than Jeffrey pine, so with time this forest will become dominated by white fir.

Forest understory. The understory is densely shaded and covered with woody debris, which inhibits most vegetative growth other than white fir seedlings.

Community 1.5

Old-growth forest infilling

Figure 9. Community Phase 1.5

This community is defined by a dense canopy and high basal area of older white fir (125+ years in age). Canopy cover ranges from 60 to 90 percent including lower tree canopy stories. The trees are often overcrowded and stressed due to competition for water and nutrients, which makes this phase susceptible to death from pests and drought. Wildfire, if and when it occurs, will be severe due to the deep accumulation of litter, the standing dead and down trees, and dense multi-layered structure of the forest. Decimation of the majority of trees can be expected. Forest understory is very sparse to absent.

Forest overstory. White Fir dominates this forest with a dense canopy and multiple tree layers. Jeffrey pine is a common associate while incense cedar are occasionally present but with low cover.

Forest understory. The understory is very sparse to absent and typically only white seedlings are present.

Pathway 1.1a
Community 1.1 to 1.2

In the event of a severe canopy fire or a clear-cut and prescribed burn, the reference community phase would quickly transition to the stand initiation phase, 1.2.

Pathway 1.1b
Community 1.1 to 1.5

If low to moderate periodic fires are excluded from this community phase, tree density will continue to increase, favoring high stocking of shade-tolerant species (white fir and incense cedar) in lower and eventually mid-level canopy layers (phase 1.5).

Pathway 1.2a
Community 1.2 to 1.3


Stand initiation


Young forest

Time and growth of Jeffrey pine and white fir (tree age approximately 30 years) advances to a somewhat more closed-canopy, larger diameter forest (community phase 1.3) that may have two to three developing overstory canopy layers. A natural low to moderate intensity fire regime is assumed (return interval of about 4 to 12 years) which influences infill of additional species such as shade-tolerant white fir and possibly incense cedar. In the absence of recurring low to moderate intensity fires, manual thinning with prescribed burns can progress the forest to community phase 1.3.

Pathway 1.2b
Community 1.2 to 1.4

If low to moderate periodic fires are excluded from this community phase, tree density will continue to increase favoring high stocking of shade-tolerant species (white fir and some incense cedar) in lower and eventually mid-level canopy layers (phase 1.4).

Pathway 1.3a
Community 1.3 to 1.1

Time and growth of forests in this community phase allow development towards the reference community phase 1.1, as long as a natural low to moderate surface fire regime occurs. Partial tree mortality from pest outbreaks is another disturbance moving stands towards conditions of community phase 1.1. With control or suppression of fire and pests, manual thinning or prescribed burning can be implemented to emulate natural disturbances.

Pathway 1.3b
Community 1.3 to 1.2


Young forest


Stand initiation

In the event of a crown fire which decimates the majority of overstory trees or patch cutting, this community moves quickly to community phase 1.2.

Pathway 1.3c
Community 1.3 to 1.4

If low to moderate periodic fires are excluded, and other thinning management does not occur, tree density will continue to increase, favoring high stocking of shade-tolerant species (white fir and some incense cedar) in lower and eventually mid-level canopy layers (moving towards community phase 1.4).

Pathway 1.4b
Community 1.4 to 1.2

Should a wildfire occur, the density of ground and mid-canopy fuels create potential conditions for a high intensity canopy fire. A severe fire would move this phase quickly to community phase 1.2.

Pathway 1.4c
Community 1.4 to 1.3

The natural event of a moderate or surface fire in this forest is unlikely due to the high fuel loading. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest if it had developed with fire over time. Manual treatment to thin out the white fir and fuels in the understory including the use of prescribed burns could be implemented to shift this forest to community phase 1.3. A partial mortality disease or pest infestation could also create a shift towards community phase 1.3.

Pathway 1.4a
Community 1.4 to 1.5

If fire continues to be excluded this community phase progresses to an older community phase, 1.5.

Pathway 1.5b
Community 1.5 to 1.1

The natural event of a moderate or surface fire in this forest is unlikely due to the high fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest if it had developed with recurring surface fires. Manual treatment to thin out the understory trees and fuels including prescribed burns could be implemented to shift this forest to the reference community phase 1.1. A partial mortality disease or pest infestation of white fir could also create a shift towards community phase 1.1.

Pathway 1.5a
Community 1.5 to 1.2


Old-growth forest infilling


Stand initiation

Should a wildfire occur, the potential for a severe crown fire is likely with decimation of the majority of trees. Such a fire would move this phase quickly to community phase 1.2.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)

Table 9. Community 1.2 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–8	–	–
white fir	ABCO	*Abies concolor*	Native	–	0–2	–	–

Table 10. Community 1.2 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Forb/Herb					
milk kelloggia	KEGA	*Kelloggia galioides*	Native	–	2–10
Shrub/Subshrub					
whitethorn ceanothus	CECO	*Ceanothus cordulatus*	Native	–	20–60
greenleaf manzanita	ARPA6	*Arctostaphylos patula*	Native	–	10–50
huckleberry oak	QUVA	*Quercus vacciniifolia*	Native	–	10–30
creeping snowberry	SYMO	*Symphoricarpos mollis*	Native	–	5–15
Tree					
white fir	ABCO	*Abies concolor*	Native	0.2–1.4	3–7
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	0.2–1.4	3–7

Table 11. Community 1.3 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
white fir	ABCO	*Abies concolor*	Native	–	15–40	–	–
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	15–25	–	–
incense cedar	CADE27	*Calocedrus decurrens*	Native	–	0–10	–	–
sugar pine	PILA	*Pinus lambertiana*	Native	–	0–2	–	–

Table 12. Community 1.3 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Forb/Herb					
Brewer's fleabane	ERBR4	*Erigeron breweri*	Native	–	0–1
lambstongue ragwort	SEIN2	*Senecio integerrimus*	Native	–	0–1
Shrub/Subshrub					
huckleberry oak	QUVA	*Quercus vacciniifolia*	Native	–	1–40
prostrate ceanothus	CEPR	*Ceanothus prostratus*	Native	–	0–10
whitethorn ceanothus	CECO	*Ceanothus cordulatus*	Native	–	1–5
greenleaf manzanita	ARPA6	*Arctostaphylos patula*	Native	–	0–3
creeping snowberry	SYMO	*Symphoricarpos mollis*	Native	–	1–3
gooseberry currant	RIMO2	*Ribes montigenum*	Native	–	0–1
Utah serviceberry	AMUT	*Amelanchier utahensis*	Native	–	0–1
wax currant	RICEC2	*Ribes cereum var. cereum*	Native	–	0–1
Sierra gooseberry	RIROR	*Ribes roezlii var. roezlii*	Native	–	0–1
bush chinquapin	CHSE11	*Chrysolepis sempervirens*	Native	–	0–1
Tree					
white fir	ABCO	*Abies concolor*	Native	–	1–2
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	1–2
incense cedar	CADE27	*Calocedrus decurrens*	Native	–	0–1
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–1

Table 13. Community 1.5 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
white fir	ABCO	*Abies concolor*	Native	–	55–77	–	–
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	5–10	–	–
California red fir	ABMA	*Abies magnifica*	Native	–	0–1	–	–
incense cedar	CADE27	*Calocedrus decurrens*	Native	–	0–1	–	–
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–1	–	–

Table 14. Community 1.5 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
needlegrass	ACHNA	*Achnatherum*	Native	–	0–2
squirreltail	ELEL5	*Elymus elymoides*	Native	–	0–2
Forb/Herb					
milk kelloggia	KEGA	*Kelloggia galioides*	Native	–	0–2
Tree					
white fir	ABCO	*Abies concolor*	Native	–	0–2

Animal community

This forest provides food and shelter for squirrel, deer, bear, and many species of birds. The Jeffrey pine seeds are eaten by birds, and the roots and young stems are eaten by small mammals. The standing dead and downed trees provide habitat for nesting birds and shelter for cavity dwellers (Gucker 2007).

Hydrological functions

The hydrology of this site is characterized by heavy snowmelt in the spring, with very little precipitation in the summer months.

Recreational uses

This ecological site is found in gently sloping areas near Lake Tahoe. It is often developed, but also provides suitable camping and picnicking areas. Trails for walking, biking and cross-country skiing trails are found along the lake and throughout the developed areas.

Wood products

Jeffrey pine and white fir provide many different timber products (e.g. lumber, veneer, composite board, fuelwood, biomass). Prescribed thinnings and individual tree selection harvests would increase the health of forests, reduce heavy fuel loads (if ignited, could cause catastrophic wildfire), and maintain the natural dominance of Jeffrey pine.

For dense mixed stands of Jeffrey pine and white fir, landowners and managers are cautioned when patch-cutting and disturbing the ground. Such actions may cause a dense growth/regrowth of whitethorn ceanothus and associated shrubs which could dominate the site for decades and retard tree regeneration. Light disturbance removal of trees having mistletoe, root rot or drought/insect damage could be a successful strategy to improve forest health, maintain the visual aspect of the forest, and avoid dense infill of shrubs. Remaining trees should have sufficient space to stimulate increased crown development (follow NRCS and CalFire spacing guidelines). Slash reduction using off-site removal or mastication, for example, would be needed to reduce at-risk fuel loads. Small patch-cut harvests could create some openings for Jeffrey pine regeneration. Subsequent to thinnings and patch cuts, periodic prescribed burning could emulate pre-Euporean disturbance which historically favored Jeffrey pine.

Site index and CMAI (culmination of mean annual increment) listed above in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively.

Other products

The Jeffrey pine cones are suitable for arts and craft stores, and the thin layer of pine needles could be a source of litter and duff for environmental restoration projects.

Other information

Forest Site Productivity:

Schumacher (1926) and Meyer (1961) were used to determine forest site productivity for white fir and Jeffrey pine respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phases 1.3 and 1.4. They are selected according to guidance listed in the site index publications. Please refer to the Tahoe Basin Soil Survey for detailed site index information by soil component.

Table 15. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
Jeffrey pine	*PIJE*	80	110	69	122	40	600	–	
white fir	*ABCO*	49	50	88	91	70	030	–	

Inventory data references

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

jac03069 - Type location
tcc03068
tmf03001

Type locality

Location 1: El Dorado County, CA	
UTM zone	N
UTM northing	4307048
UTM easting	752206
General legal description	Take Fallen Leaf Lake road to the gate. The plot is along the gravel road just past Lily Lake.

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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:

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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:**

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17. **Perennial plant reproductive capability:**
