Ecological site F022AC004CA
Cryic Very Gravelly Loamy Mountain 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 a 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, 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 "C" Northern Sierra Subalpine: Elevations are typically between 7,800 and 9,800 feet. The frost free period is between 30 and 90 days, MAAT is between 35 and 44 degrees, MAP is between 45 and 65 inches. Soils are typically cryic, but frigid soils may occur at lower elevations on southern aspects. Forests are dominated by whitebark pine (*Pinus albicaulis*), Sierra lodgepole pine (*Pinus contorta* spp. murrayana), mountain hemlock (*Tsuga mertensiana*) and/or California red fir (*Abies magnifica*).

Classification relationships

Forest Alliance = *Abies magnifica-Abies concolor* – Red fir-white fir forest; Association = tentatively *Abies magnifica-Abies concolor-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 is found on gentle to steep upper montane mountain slopes at elevations of approximately 7,500 to 9,000 feet, predominately along the eastern side of the Lake Tahoe Basin, where precipitation is relatively lower. Slopes are typically between 30 and 50 percent. Soils are very deep, and are derived from metamorphic parent material. Soils have a high degree of development, with argillic horizons and loam and silty clay loam subsurface textures. The vegetation is a relatively open California red fir (*Abies magnifica*) - Jeffrey pine (*Pinus jeffreyi*) forest with a dense understory of upper montane shrubs, which commonly includes roundleaf snowberry (*Symphoricarpos rotundifolius*) and wax currant (*Ribes cereum*). California red fir is a slow-growing, long-lived tree that has high frost tolerance and low drought tolerance, and reaches dominance only in cooler and moister upper elevation. Jeffrey pine is indicative of the eastern, lower precipitation environment of this site. Loamy soils support the dense understory.

Associated sites

F022AC003CA	**Frigid-Cryic Sandy Slopes** Occurs on adjacent mountain slopes with moderately deep to very deep, poorly developed, gravelly coarse sandy soils over decomposed granite. Vegetation is a red fir (Abies magnifica) - western white pine (Pinus monticola) forest with pinemat mananita (Arctostaphylos nevadensis) dominant in canopy openings.
F022AF006CA	**Loamy Frigid Metamorphic Slopes** Occurs on lower elevation slopes with very deep, fine loamy soils developed from metamorphic parent material. The forest is dominated by a dense productive Jeffrey pine (Pinus jeffreyi) and white fir (Abies magnifica) forest, and a diverse herbaceous understory is present.
F022AX101CA	**Moist Colluvial Headwater System** Occurs on adjacent headwater swales and first order streams. A complex of vegetation community types is present, and quaking aspen (Populus tremuloides) is a characteristic species.
R022AC204CA	**Cryic, Umbric Or Andic Slopes** Occurs on adjacent mountain slopes with andic soils or a thick umbric epipedon. Mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and antelope bitterbrush (Purshia tridentata) dominate with a productive herbaceous community.

Similar sites

F022AC008CA	**Cryic Volcanic Mountain Slopes** This site is found on south-facing slopes in areas receiving more precipitation. White fir (Abies concolor) is co-dominant with red fir (Abies magnifica). Greenleaf manzanita (Arctostaphylos patula) and whitethorn ceanothus (Ceanothus cordulatus) are common shrub species.
F022AC003CA	**Frigid-Cryic Sandy Slopes** This site occurs on poorly developed soils derived from granitic parent materials. Western white pine (Pinus monticola) is co-dominant with red fir (Abies magnifica) and Jeffrey pine (Pinus jeffreyi) is a minor species if present. The understory is less productive and less diverse, and is dominated by pinemat manzanita (Arctostaphylos nevadensis).
F022AF006CA	**Loamy Frigid Metamorphic Slopes** This site is found at lower elevations. White fir (Abies concolor) is co-dominant with Jeffrey pine (Pinus jeffreyi), while red fir (Abies magnifica) is a secondary species.
F022AE007CA	**Frigid, Sandy, Moraines And Hill Slopes** This site occurs on lower elevations on glacial outwash and moraines. White fir (Abies concolor) is co-dominant with Jeffrey pine (Pinus jeffreyi), and red fir (Abies magnifica) is a minor species if present.

F022AF004CA	**Frigid, Shallow To Deep, Sandy Mountain Slopes** This site occurs at on south-facing slopes at lower elevations on poorly developed sandy soils. The vegetation is dominated by an open Jeffrey pine (Pinus jeffreyi) forest while red fir (Abies magnifica) is a minor species if present. A dense shrub layer has variable composition, with greenleaf manzanita (Arctostaphylos patula) and antelope bitterbrush (Purshia tridentata) common species.
F022AF005CA	**Frigid, Deep To Very Deep, Sandy-Loamy Mountain Slopes** This site is found at lower elevations on north-facing slopes with coarse sandy soils. White fir (Abies concolor) is co-dominant with Jeffrey pine (Pinus jeffreyi) and red fir (Abies magnifica) is minor if present.

Table 1. Dominant plant species

Tree	(1) *Abies magnifica* (2) *Pinus jeffreyi*
Shrub	(1) *Symphoricarpos rotundifolius* (2) *Ribes cereum*
Herbaceous	(1) *Lupinus argenteus*

Physiographic features

This ecological site is on mountain slopes at elevations between 7,680 and 8,830 feet. Slopes may range from 9 to 50 percent, but are typically between 30 and 50 percent. It is located in the Carson Range, along the eastern side of the Lake Tahoe Basin. Runoff class is high.

Table 2. Representative physiographic features

Landforms	(1) Mountain
Flooding frequency	None
Ponding frequency	None
Elevation	7,680–8,830 ft
Slope	9–50%
Aspect	SW, W, NW

Climatic features

The average annual precipitation ranges from 31 to 37 inches, mostly in the form of snow in the winter (November through April). The average annual air temperature ranges from 38 to 42 degrees Fahrenheit. The frost-free (>32F) season is 25 to 75 days.

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)	50 days
Freeze-free period (average)	0 days
Precipitation total (average)	34 in

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 very deep and developed from colluvium over residuum weathered from metamorphic rock. These soils are well drained with very slow to slow permeability. The soil moisture regime is xeric and the soil temperature regime is cryic. Surface rock fragments smaller than 3 inches in diameter are generally absent and larger fragments average 3 percent. Surface textures are silt loam. Partially decomposed organic matter overlies the mineral horizons (Oi horizon). Subsurface textures are very gravelly loam, very gravelly clay loam, and silty clay loam. Subsurface rock fragments smaller than 3 inches in diameter average 5 percent by volume, and larger fragments average 20 percent (for a depth of 0 to 61 inches). The soils that are correlated to this ecological site are the Shakespeare soils (Loamy-skeletal, mixed, superactive Xeric Haplocryalfs).

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
9151 ; Shakespeare silt loam, 9 to 30 percent slopes ; Shakespeare ; Silt loam ; 80
9152 ; Shakespeare silt loam, 30 to 50 percent slopes, very stony ; Shakespeare ; Very stony ; 80
7111 ; Deerhill gravelly fine sandy loam, 9 to 30 percent slopes, very stony ; Shakespeare ; Silt loam ; 3
7112 ; Deerhill gravelly fine sandy loam, 30 to 50 percent slopes, very stony ; Shakespeare ; Very stony ; 3

Table 4. Representative soil features

Surface texture	(1) Silt loam

Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Very slow to slow
Soil depth	60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	3%
Available water capacity (0-40in)	3.6–5.7 in
Soil reaction (1:1 water) (0-40in)	5.1–6.5
Subsurface fragment volume <=3" (Depth not specified)	20%
Subsurface fragment volume >3" (Depth not specified)	5%

Ecological dynamics

Abiotic factors

This site is found on gentle to steep upper montane mountain slopes at elevations of approximately 7,500 to 9,000 feet, predominately along the eastern side of the Lake Tahoe Basin, where precipitation is relatively low. Soils are very deep, and are derived from metamorphic parent material. Soils have a high degree of development, with argillic horizons and loam and silty clay loam subsurface textures. The vegetation is a relatively open California red fir (*Abies magnifica*) - Jeffrey pine (*Pinus jeffreyi*) forest with a dense understory of upper montane shrubs, which commonly includes roundleaf snowberry (*Symphoricarpos rotundifolius*) and wax currant (*Ribes cereum*). California red fir is a slow-growing, long-lived tree that has high frost tolerance and low drought tolerance, and reaches dominance only in cooler and moister upper elevations. Jeffrey pine is indicative of the eastern, lower precipitation environment of this site. Loamy soils support the dense understory. At lower elevations, it intergrades into the white fir (*Abies concolor*)-Jeffrey pine (*Pinus jeffreyi*) forest communities. At the upper elevations it intergrades into the sub-alpine forest of western hemlock (*Tsuga mertensiana*), Sierra lodgepole pine (*Pinus contorta* var. murrayana), and whitebark pine (*Pinus albicaulis*) communities. It is common to find white fir and western white pine (*Pinus monticola*) in this ecological site.

Disturbance factors

Fire and fire suppression, logging, drought and pathogens are the primary disturbance factors affecting the dynamics of this ecological site. Pre-European settlement, the most successionally advanced community phase was most likely dominated by large old growth red fir and Jeffrey pine. The canopy was relatively open, allowing for a high diversity of shrubs and forbs in the understory (e.g. Beardsley et al. 1999, Murphy and Knopp 2000, Barbour et al. 2002, Taylor 2004, Stephens and Fry 2005, Binkley et al. 2007).

Historically, this community phase developed with a mixed fire severity regime, with patchy, frequent, low to medium intensity surface fires, and occasional larger high severity fires, all of which occurred primarily in the fall when fuel moisture was lowest and trees were dormant (Beaty and Taylor 2008).

Specific fire history data for this forest community site is not available, because it is a mix of the California red fir and Jeffrey pine forest. The fire frequency for California red fir forest ranges from 10 to 65 years (Cope). The average historic fire return interval for Jeffery pine forest in the eastern Lake Tahoe area was approximately 11 years (Taylor 2004), with a range from 5 to 39 years (Skinner and Chang 1996, Murphy and Knopp 2000, Stephens 2001). Red fir forest burns less frequently than Jeffrey pine due to moister environmental conditions with a shorter fire season, and differences in canopy structure that influence fire behavior (Stephens 2001).

The pre-settlement phase is rare due to either fire suppression or clear-cutting. This ecological site was almost entirely clear-cut during the 1870s to 1890s during the period known as the Comstock Era (Elliot-Fisk et al. 1996, Murphy and Knopp 2000, Barbour et al. 2002, Taylor 2004), and forests that have developed since have higher density and basal area (Taylor 2004, Stephens and Fry 2005) A long-term policy of fire suppression has impacted these second-growth forests, as well as the few contemporary stands of old-growth forest (Barbour et al. 2002, Stephens and Fry 2005). California red fir and white fir (*Abies concolor*) are more important in the understory, and understory trees provide ladder fuels, increasing the likelihood of large high severity fire.

Contemporary forests, with more crowded conditions and a higher frequency of drought (e.g.Jones et al. 2004) are more susceptible to pathogen induced mortality (Barbour et al. 2002). California red fir, white fir, and Jeffrey pine are susceptible to several pathogens that can cause extensive stand mortality if they reach epidemic levels. Epidemic levels of disease and insect outbreaks can shift the state of the forest by killing large patches of forest or scattered individual trees. These pathogens are part of the natural cycle of regulation and can push the closed forest types to a more open forest. However, fuel loads are high after insect outbreaks, and fire may be more likely.

The reference state consists of the most successionally advanced community phase (numbered 1.1) as well as other community phases, which 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

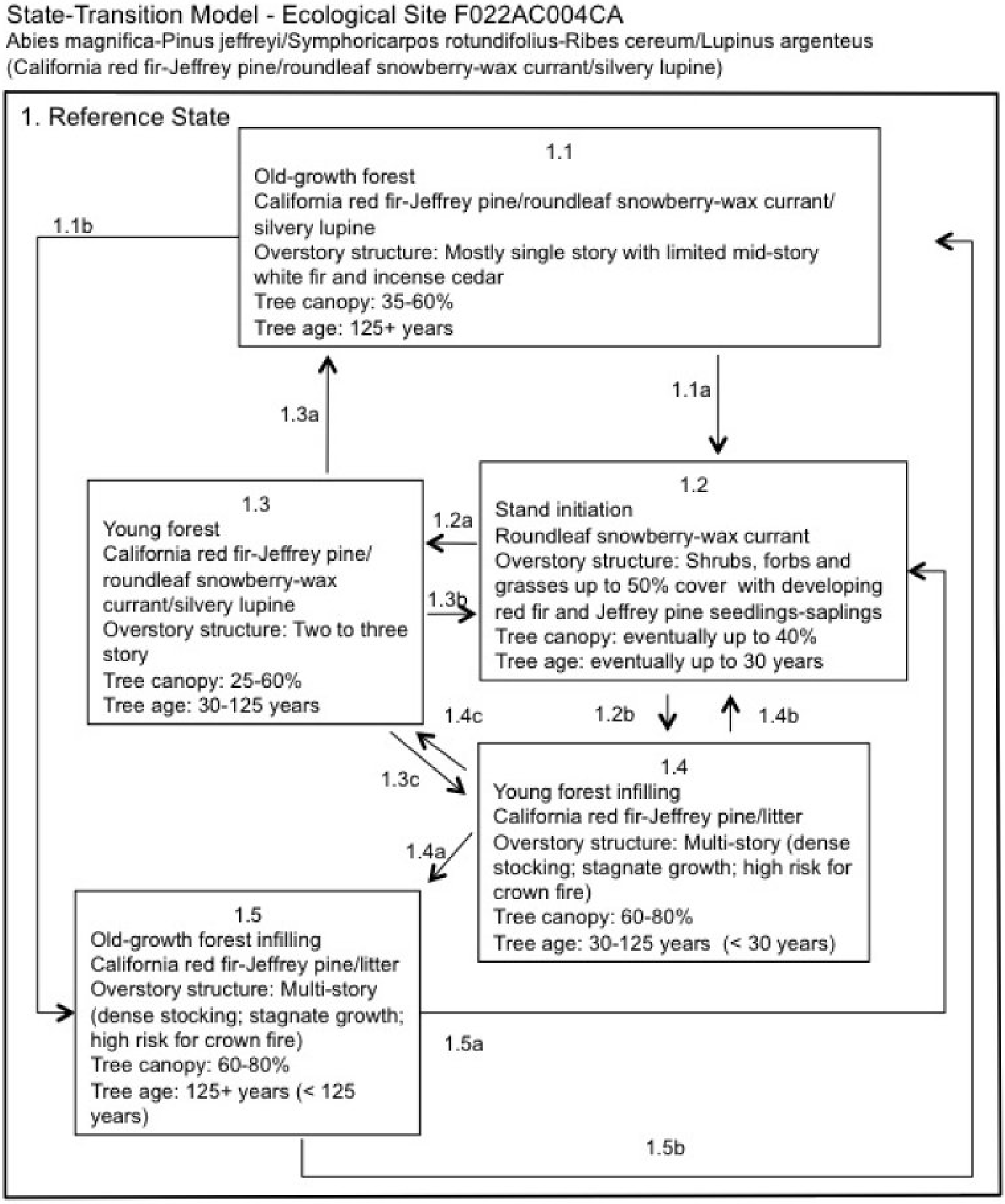

Figure 6. F022AC004CA

State 1

Reference

Community 1.1
Old-growth forest

The most successionally advanced community is a mature California red fir - Jeffrey pine forest. The canopy is open with large, widely spaced trees. Low intensity surface fires are needed to maintain the open canopy and shrubs in the understory. The age for this community phase ranges from 125 to greater than 300 years.

Forest overstory. Red fir dominates the canopy with Jeffrey pine as a co-dominant. Trees are large and widely spaced, and are commonly over 100 feet tall with diameters over 30 inches. Total canopy cover ranges from 25 to 65 percent.

Forest understory. The understory cover is high. Roundleaf snowberry (Symphoricarpos rotundifolius), wax current (Ribes cereum), mountain monardella (Monardella odoratissima), and silvery lupine (Lupinus argenteus) are commonly found.

Community 1.2
Stand initiation

This shrubland community phase thrives in the new openings created by large fires burning the forest canopy and killing the majority of overstory trees. Shrubs will begin to resprout and germinate from seed as early as the first year post-fire, gaining dominance with time. Wax currant is likely to be killed by high severity fire, but will establish from soil seed reserves that are stimulated to germinate by fire and other soil disturbance (Marshall 1995). Roundleaf snowberry is commonly one of the first species to re-colonize after fire, as it is generally only top killed and regenerates from rhizomes (McWilliams 2000). Numerous wax currant seeds are deposited in the duff and can remain viable for many years, while roundleaf snowberry probably re-establishes from offsite seed transported in from animals or water. The mixed shrub community can be perpetuated by frequent fire or other disturbances such as grazing, human intervention, or heavy foot traffic. These actions can significantly diminish establishment of trees. Silvery lupine may be a common forb. California red fir and Jeffrey pine seedlings are scattered throughout, but they may take an extended period of time to established and overgrow the shrub layer. Remnant overstory trees may be present in limited numbers.

Community 1.3
Young forest

Figure 7. Community Phase 1.3

This forest community phase develops under a natural fire regime, which can be emulated with manual thinning and prescribed fires. Low to moderate intensity fire clears the understory and removes fuels before they reach hazardous levels. Severe, high-intensity canopy fires are rare but possible.

Forest overstory. This is a young forest dominated by California red fir with Jeffrey as a pine co-dominant. The trees are clustered in groups, with wide spaces between groups. This community phase begins with 10 to 20 foot tall pole-sized trees. Once mature, trees will be up to 100 feet tall and 20 to 30 inches in diameter.

Forest understory. The understory cover is high. Roundleaf snowberry, wax currant, mountain monardella (Monardella odoratissima), and silvery lupine are commonly found.

Community 1.4
Young forest infilling

This closed California red fir-Jeffrey pine forest develops in the prolonged absence of fire. This results in increased basal area density and canopy cover, and will cause the shrubs in the understory to die out. Red fir seedlings are more shade tolerant than Jeffrey pine seedlings, which allows them to continue to reproduce in the understory. The density of red fir and Jeffrey pine increases over time, and creates competition within the forest for sunlight and water. This stress makes the trees more susceptible to death from disease and drought, which in turn increases fuel loads and the potential for a severe fire.

Forest overstory. Young red fir and Jeffrey pine dominate in the developing canopy. This community phase begins with young pole-sized trees increasing with age to mature, 100-foot-tall trees. Combined canopy cover begins at 25 percent and increases to 60 to 80 percent. Tree regeneration continues throughout this period. If the trees are not removed by fire, the stand density will continue to increase.

Forest understory. The understory is nearly barren with a low cover of roundleaf snowberry and wax currant. Grasses and forbs may be present in small numbers.

Community 1.5
Old-growth forest infilling

This community phase develops with the continued exclusion of fire, allowing tree density to increase to unhealthy levels. Competition for water and sunlight continues, and tree health and vigor deteriorate. An estimated age for this community ranges from approximately 125 to more than 200 years.

Forest overstory. Mature California red fir and Jeffrey pine dominate in the overstory with combined canopy cover ranging from 60 to 80 percent. Trees are approximately 80 to 120 feet tall with diameters ranging from 20 to 30 inches at breast height.

Forest understory. The understory is nearly barren with a low cover of roundleaf snowberry and wax currant. Grasses and forbs may be present in small numbers.

Pathway 1.1a
Community 1.1 to 1.2

The primary threat to red fir-Jeffrey pine forest is a severe canopy fire. In the event of such a fire, or a clear-cut and prescribed burn, the old growth forest would shift to community phase 1.2, which is dominated by roundleaf snowberry and-wax current.

Pathway 1.1b
Community 1.1 to 1.5

If fire is excluded from the community phase, tree density will continue to increase, shifting this community phase towards the closed California red fir-Jeffery pine community phase 1.5.

Pathway 1.2a
Community 1.2 to 1.3

The natural pathway is to the young, open California red fir-Jeffrey pine forest (community phase 1.3). This pathway is followed with a natural fire regime. Reports vary on the natural fire return interval, but this pathway assumes that surface fires were relatively frequent, ranging from 10 to 40 years. Manual thinning with prescribed burns can imitate the natural cycle and lead to the same open community phase.

Pathway 1.2b
Community 1.2 to 1.4

An alternate pathway is created when fire is excluded from the system, and leads to the closed California red fir-Jeffrey pine community phase 1.4.

Pathway 1.3a
Community 1.3 to 1.1

This is the natural pathway for this community phase, which evolved with the historic fire regime of occasional surface and moderately severe fires, or partial tree mortality from a pest outbreak. Manual thinning or prescribed burning can be implemented to replace the natural disturbances and keep this forest open. This pathway leads to community phase 1.1.

Pathway 1.3b
Community 1.3 to 1.2

In the event of a high-intensity canopy fire this community phase would quickly shift to community phase 1.2.

Pathway 1.3c
Community 1.3 to 1.4

If fire does not occur, the density of the forest increases, favoring California red fir over Jeffrey pine. White fir also increases. The increased density shifts this community phase towards the young closed California red fir-Jeffery Pine community phases 1.4.

Pathway 1.4b
Community 1.4 to 1.2

The density of ground and mid-canopy fuels create conditions for a high intensity canopy fire. A severe fire would initiate stand regeneration (community phase 1.2). Further treatments including use of fire may be needed to facilitate a more open forest community sequence to community phase 1.3 and ultimately phase 1.1.

Pathway 1.4c
Community 1.4 to 1.3

A naturally occurring 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 fire over time. Manual treatment or prescribed burns could thin out the California red fir and Jeffrey pine, as well as the fuels in the understory. This would shift this forest back to its natural state of a more open red fir-Jeffrey pine-mixed shrub forest (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 from this system, the phase increases in age and cover resulting in Community phase 1.5.

Pathway 1.5b
Community 1.5 to 1.1

A naturally occurring 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 fire over time. Manual treatment or prescribed burns could thin out the California red fir and Jeffrey pine, as well as the fuels in the understory. This would shift this forest back to its natural state of a more open red fir-Jeffrey pine-mixed shrub forest (community phase 1.1). A partial mortality disease or pest infestation could also create a shift towards community phase 1.1.

Pathway 1.5a
Community 1.5 to 1.2

A severe fire would initiate stand regeneration (community phase 1.2). Further treatments including the use of fire may be needed to facilitate a more open forest community sequence to community phase 1.3 and ultimately phase 1.1.

Additional community tables

Table 5. Community 1.3 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
California red fir	ABMA	*Abies magnifica*	Native	–	14–30	–	–
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	10–23	–	–
white fir	ABCO	*Abies concolor*	Native	–	1–3	–	–
western white pine	PIMO3	*Pinus monticola*	Native	–	0–2	–	–
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–2	–	–

Table 6. Community 1.3 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
bluegrass	POA	*Poa*	Native	–	0–2
Ross' sedge	CARO5	*Carex rossii*	Native	–	0–2
squirreltail	ELEL5	*Elymus elymoides*	Native	–	0–2
Forb/Herb					
silvery lupine	LUAR3	*Lupinus argenteus*	Native	–	2–4
Sierra stickseed	HANE	*Hackelia nervosa*	Native	–	0–2
Sierra pea	LANE3	*Lathyrus nevadensis*	Native	–	0–2
wavyleaf Indian paintbrush	CAAP4	*Castilleja applegatei*	Native	–	0–2
rockcress	ARABI2	*Arabis*	Native	–	0–2
Shrub/Subshrub					
roundleaf snowberry	SYRO	*Symphoricarpos rotundifolius*	Native	–	3–7
wax currant	RICEC2	*Ribes cereum var. cereum*	Native	–	2–4
pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	Native	–	1–3
mountain monardella	MOOD	*Monardella odoratissima*	Native	–	1–3
mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	Native	–	0–2
Tree					
California red fir	ABMA	*Abies magnifica*	Native	–	1–2
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0.5–1
white fir	ABCO	*Abies concolor*	Native	–	0–0.5

Animal community

This forest provides a crucial habitat for rodents, birds, mammals and insects. Some animals that use this area are the martin, fisher, mountain beaver, wolverine, black bear, squirrels, chickadee, pileated woodpecker, great gray owl, Williamson's sapsucker, pocket gopher, and deer (Cope 1993). Jeffrey pine seeds are eaten by birds, and the roots and young stems are eaten by small mammals (Gucker 2007).

Hydrological functions

The soil associated with this site is in Hydrologic Group B. These soils have a moderate infiltration rate when thoroughly wetted. They have a moderate rate of water transmission.

Recreational uses

This area is used for hiking and biking on trails, and backcountry skiing in winter. If the slope is appropriate it can provide scenic campsites.

Wood products

The wood of California red fir is stronger and of higher quality than other firs. The wood is used for fuel, coarse lumber, quality veneer, solid framing, plywood, printing paper, and high-quality wrapping paper, and is preferred for pulping (Cope 1993).

Jeffrey pine is a high-grade lumber important for raw material used for creating molding, mill work, cabinets, doors, and windows (Gucker 2007).

Other products

California red fir is used for Christmas trees and Jeffrey pine cones are collected for arts and crafts.

Jeffrey pine pitch was distilled for turpentine early in the century, however, the terpenes were found to contain high amounts of the explosive chemical heptane (Gucker 2007).

Other information

Site index documentation:
Schumacher (1926), Schumacher (1928) and Meyer (1961) were used to determine forest site productivity for white fir, red 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.

Trees appropriate for site index measurement typically occur in stands of community phases 1.3 and 1.4. White fir, red fir and Jeffrey pine site trees are selected according to guidance in Schumacher (1926), Schumacher (1928) and Meyer (1961), respectively. Please refer to the Tahoe Basin Soil Survey for detailed site index information by soil component.

Forest pathogen information:
In the Lake Tahoe Basin, many pathogens are found on white fir. These include: dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris), broom rust (Melamsporlla caryophyllacearum), annosus root disease (Heterobasidium annosum), trunk rot (Echinodontium tinctorium) and the fir engraver (Scotylus ventralis). The most threatening of these is the combination of the fir engraver and annosus root disease. These pathogens can kill large areas of white fir (Murphy and Knopp 2000).

The major pathogens that affect California red fir in this area include: red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae), fir broom rust (Melampsorella caryophyllacearum), annosus root rot (Heterobasidion annosum), and the fir engraver (Scolytus ventralis) (Murphy et al., 2000). Other diseases also affecting red fir are known as heart rots, which cause the centers of limbs and trunks to decay. Commonly seen heart rots include yellow cap fungus (Pholiota limonella) and Indian paint fungus (Echinodontium tinctorium). Common pests affecting red fir are: cone maggots (Earomyia spp.), several chalcids (Megastigmus spp.) and cone moths (Barbara spp. and Eucosma spp.) (Burns and Honkala 1990)

Red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae) is a parasitic plant common in the survey area. Visible symptoms include witches brooms, top kill, stem cancers, and swellings. The vegetative shoots of the dwarf mistletoe are also often present from spring to fall. Infestation of the red fir dwarf mistletoe can cause reduced growth and vigor which weakens the tree and allows other pathogens to infest the tree. The mistletoe cankers create an entry point for other diseases such as heart rots and the cytospora canker (Cytospora abietis) (Burns and Honkala 1990).

Fir broom rust (Melampsorella caryophyllacearum) causes dense witches brooms with stunted yellow needles, and can damage tree growth by reducing crown development. Tree death is less common in mature trees than in the younger regeneration trees. The infected branch sheds its needles in fall leaving a barren, dead looking branch. The alternate host for this rust is the chickweeds (Stellaria spp. and Cerastium spp.) (Hagle et al. 2003).

Annosus root rot (Heterobasidion annosum) can affect large acres of fir forest. It slowly decays the roots, the root collar and the stem butt for many years causing structural weaknesses and making the tree vulnerable to wind throw. Annosus root rot can spread from infected roots to healthy roots as well as aerially by infecting freshly cut stumps or other fresh tree wounds. Painting Borax on the freshly cut stumps restricts the entry of the fungus. In all management activities, it is important to reduce damage to the bark because the rot itself does not often kill red fir directly, but it weakens the tree and makes it easier for bark beetles (Scolytus spp), annosus root rot, or dwarf mistletoe to infect the tree (Burns and Honkala 1990).

The fir engraver (Scolytus ventralis) can cause extensive damage to a red fir forest and outbreaks can cause mortality to several acres of trees. It can reach epidemic levels when the trees are stressed due to annosus root rot, dwarf mistletoe, drought, or fire damage (Burns and Honkala 1990).

Jeffrey Pine is susceptible to several diseases and insect infestations, especially in periods of drought or when overcrowded. The most threatening of these are the western dwarf mistletoe and the Jeffrey pine bark beetle (Murphy and Knopp 2000). Other pathogens that affect Jeffrey pine in this area include: western dwarf mistletoe (Arceuthobium campylopodium), root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), Jeffrey pine bark beetle (Dedroctonus jeffreyi), Red turpentine beetle (D. valens) and pine engravers (Ips species).

Infections from western dwarf mistletoe (Arceuthobium campylopodium) cause witches brooms, reduced growth, and tree mortality. Sticky seeds are spread in fall and infest nearby trees. In years of severe drought, dwarf mistletoe has induced a 60 to 80 percent mortality of the Jeffery pine (Burns and Honkala 1990).

Jeffrey pine bark beetles (Dedroctonus jeffreyi) are native beetles that can only reproduce in Jeffrey pine. They are part of the natural cycle and help maintain a healthy forest. They generally attack older trees that have been weakened by drought, lightning, fire, or other disturbances. However, in times of severe disturbance, epidemic levels can breakout and cause extensive damage to the forest. These beetles infest the lower stem and bole of the trees usually after a pine engraver (Ips pini) infestation in the upper portion of the tree. The beetles slowly destroy the cambium, inhibiting the flow of nutrients. A sign of infestation is the change in color of the pine needles from green to yellow to reddish brown, beginning from the top and moving down the tree (Hagle et al. 2003, Smith 1971).

Table 7. 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
California red fir	*ABMA*	40	40	135	135	140	050	–	
Jeffrey pine	*PIJE*	80	80	69	69	40	600	–	
white fir	*ABCO*	35	35	57	57	70	030	–	

Inventory data references

The following NRCS plots describe this ecological site.

She02h63
She03h121

She04206 - site location
She04210

Type locality

Location 1: Douglas County, NV	
Township/Range/Section	T14N R19E S18
UTM zone	N
UTM northing	4329128
UTM easting	250265
General legal description	Take Highway 50 towards Spooner Summit then take Forest Service road 14N32 south along ridge. The plot is about 300 feet above road, south west of Duane Bliss Peak.

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Contributors

Alice Miller
Lyn Townsend
Marchel M. Munnecke
Marchel Munnecke

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:**
