Ecological Site Description

# UNITED STATES DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

## ECOLOGICAL SITE DESCRIPTION

## ECOLOGICAL SITE CHARACTERISTICS

**Site Type:** Rangeland

**Site Name:** Gravelly Loam Foothills

*Quercus douglasii - Quercus wislizeni* / *Ceanothus cuneatus - Arctostaphylos viscida* / *Bromus - Avena fatua*
(blue oak - interior live oak / buckbrush - sticky whiteleaf manzanita / brome - wild oat)

**Site ID:** R018XI001CA

**Major Land Resource Area:** 018 - Sierra Nevada Foothills

## Physiographic Features

This ecological site extends from Shasta County to Mariposa County, covering more than 550,000 acres of gently sloping to steep foothills of the Sierra Nevada foothills. Intermittent streams drain these sites following adequate rainfall. South facing slopes tend to dry sooner than north facing slopes.

| | | Minimum | Maximum |
|---|---|---|---|
| Land Form: | (1) Hill | | |
| Elevation (feet): | | 120 | 3500 |
| Slope (percent): | | 3 | 75 |
| Water Table Depth (inches): | | | |
| Flooding: | | | |
| Frequency: | | | |
| Duration: | | None | None |
| Ponding: | | | |
| Depth (inches): | | | |
| Frequency: | | | |
| Duration: | | None | None |
| Runoff Class: | | Medium | High |
| Aspect: | | No Influence on this site | |

## Climatic Features

The average annual precipitation increases with elevation and ranges from 15 to 50 inches. Most moisture falls as rain from October – May and is produced by winter storms that move into California from the Pacific Ocean in an easterly or southeasterly direction. Mean temperatures range from 45 F in December & January to 76 F in July. Freezing temperatures may occur in winter and summer temperatures can exceed 100 F.

Monthly precipitation and temperature averages are 1971-2000 means from the PRISM Group, Oregon Climate Service, Oregon State University, Corvallis, Oregon (Daly 2006). Frost free period obtained from map unit descriptions (Soil Data Mart). Mean monthly precipitation is reported in the Maximum precipitation row.

| | Minimum | Maximum |
|---|---|---|
| Frost-free period (days): | 175 | 270 |
| Freeze-free period (days): | 0 | 0 |
| Mean annual precipitation (inches): | 15.0 | 50.0 |

Monthly precipitation (inches) and temperature (°F):

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precip. Min. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Precip. Max. | 6.3 | 5.15 | 5.2 | 2.6 | 0.8 | 0.25 | 0.25 | 0.25 | 0.75 | 2.1 | 5.35 | 5.25 |
| Temp. Min. | 36.0 | 39.0 | 42.0 | 45.0 | 50.0 | 56.0 | 60.0 | 58.0 | 55.0 | 48.0 | 40.0 | 36.0 |
| Temp. Max. | 55.0 | 59.0 | 63.0 | 69.0 | 78.0 | 87.0 | 93.0 | 92.0 | 87.0 | 77.0 | 63.0 | 55.0 |

Climate Stations:

## Influencing Water Features

Intermittent streams feeding into permanent higher order streams drain these sites. Small springs are common.

Wetland Description: System Subsystem Class

## Representative Soil Features

This site is characterized by loam soils weathered from amphibolite schist (Auburn loam), basic igneous and metamorphic rocks (Sobrante), meta-andesite (Argonaut), basic metavolcanic rock (Timbuctoo), volcanic breccia (Supan), hard andesitic breccia, schist and metamorphosed volcanic rocks (Exchequer), or consolidated or cemented sediments from volcanic rocks (Inks). The depth to bedrock is 4 to 40 inches. These soils are generally well drained except in occasional depressions. Available water holding capacity ranges very low to low at 2.2 inches to moderate at 8.6 inches. Elevation ranges from 120 to 3500 feet. In some places parent rock occur as surface outcrops.

CA115 102, 103, 104 Auburn-Argonaut complex
CA115 106-109 Auburn loams
CA115 110-116 Auburn-Sobrante complex CA115 117-120 Auburn-Sobrante-Rock Outcrop complex
CA115 121, 122 Auburn-Timbuctoo-Argonaut complex
CA115 235-237 Sobrante gravelly loam
CA115 238 Sobrante-Rock Outcrop complex
CA115 239-241 Sobrante-Timbuctoo complex
CA007 111yu Argonaut-Auburn complex

CA007 114yu Auburn-Sobrante complex, gravelly;
CA007 119yu Auburn-Sobrante-Rock Outcrop
CA089 AnB, AnD, ArD, AsD2, AtE2, AuF2 Auburn loam; Auburn very stony loam; Auburn clay loam, eroded; Auburn very stony clay loam, eroded
CA057 102 Argonaut-Auburn complex
CA057 108, AvD Auburn loam
CA057 110, 111, 112, 115 Auburn-Sobrante complex
CA057 120 Auburn-Sobrante-Rock Outcrop complex
CA057 ArC Argonaut gravelly loam
CA057 AsD Argonaut-Rock Outcrop complex
CA057 AwC Auburn-Argonaut complex
CA057 AxD, AxE Auburn-Rock Outcrop complex
CA057 RpD Rock Outcrop-Auburn complex
CA057 SoC, SoD Sobrante loam
CA057 SrD, SrE Sobrante-Rock Outcrop complex
CA061 114 Auburn silt loam
CA061 115 Auburn-Argonaut complex
CA061 116 Auburn-Argonaut-Rock Outcrop complex
CA061 117 Auburn-Rock Outcrop complex
CA061 118 Auburn-Sobrante silt loams
CA061 119, 120, 121 Auburn-Sobrante-Rock Outcrop complex
CA061 191 Sobrante silt loam
CA017 AkC Argonaut gravelly loam;
CA017 AlD Argonaut extremely stony loam;;
CA017 AmD Argonaut very rocky loam
CA017 AnB Argonaut clay loam;
CA017 AoB Argonaut loam, seeped variant
CA017 AwD Auburn silt loam
CA017 AxD, AxE E Auburn very rocky silt loam
CA017 AyF Auburn extremely rocky silt loam
CA017 AzE Auburn cobbly clay loam, heavy subsoil variant
CA017 SuC, SuD, SwD Sobrante silt loam, Sobrante very rocky silt loam
CA005 AnD, AoD Argonaut gravelly loam, Argonaut very rocky loam
CA005 ApD, ArC, ArD, AtE, Auburn silt loam; moderately deep;;
CA005 AsB2, AsD, AsE, AtD Auburn very rocky silt loam;
CA005 AuD, AuF, AvE, Auburn extremely rocky silt loam
CA005 AwC Auburn-Argonaut silt loam
CA005 AxD Auburn-Argonaut very rocky silt loams
CA005 EhD, ExD, ExE Exchequer and Auburn loams, Exchequer and Auburn very rocky loams
CA005 IdC Inks loam, deep variant
CA005 SxD, SyD, SyE Supan cobbly loam; Supan very cobbly loam, moderately deep
CA005 108 Argonaut-Auburn-Urban land complex
CA005 109 Auburn silt loam
CA005 110 Auburn-Argonaut-Rock Outcrop complex
CA099 AuB, AuD Auburn clay loam
CA099 ErD, ExB, ExD Exchequer and Auburn rocky soils, Exchequer and Auburn soils
XXX AkFma Auburn stony loam
CA047 ArB Auburn rocky silt loam
CA047 EaD Exchequer and Auburn rocky silt loam
CA043 AhD, AhE2, AkF2, AmG3, AnE, AnG2 Auburn loam; Auburn loam, eroded; Auburn stony loam; Auburn rocky loam, severely eroded; Auburn very rocky loam
CA067 107, 108, 109, 110 Argonaut-Auburn complex 3 to 8 percent slope; Argonaut-Auburn-urbanland complex; Auburn silt loam 2 to 30 percent slope; Auburn-Argonaut rock outcrop complex 8 to 30 percent slope.

Predominant Parent Materials:
Kind: Residuum
Origin: Schist

Surface Texture: (1) Very gravelly Loam

Subsurface Texture Group:

| | Minimum | Maximum |
|---|---|---|
| Surface Fragments <=3" (% Cover): | | |
| Surface Fragments > 3" (% Cover): | | |
| Subsurface Fragments <=3" (% Volume): | | |
| Subsurface Fragments > 3" (% Volume): | | |

Drainage Class: Well drained

Permeability Class: Moderate

| | Minimum | Maximum |
|---|---|---|
| Depth (inches): | 10 | 28 |
| Electrical Conductivity (mmhos/cm): | | |
| Sodium Absorption Ratio: | | |
| Calcium Carbonate Equivalent (percent): | 0 | 0 |
| Soil Reaction (1:1 Water): | | |
| Soil Reaction (0.01M CaCl2): | | |
| Available Water Capacity (inches): | 2.7 | 2.7 |

## Plant Communities

### Ecological Dynamics of the Site

Before European settlement, the natural plant community for this ecological site ranged from a blue oak (Quercus douglasii) savanna with little or no shrub layer to a woodland with blue oak, interior live oak (Q. wislenzii) and foothill pine (Pinus sabiniana) in the tree layer and wedgeleaf ceanothus (Ceanothus cuneatus), and poison oak (Toxicodendron diversilobum) dominating the shrub layer. The understory of this site was dominated by native annual and perennial grasses and forbs. On this site, the savanna or woodland is frequently intermixed in a mosaic with open grasslands. The reference state for this ecological site is similar to its pre-European state; however, density of shrubs and foothill pine may be different due to fire suppression and annual grasses and forbs that now dominate the understory.

The reference state for this ecological site ranges from a blue oak savanna at lower elevations to a blue oak-interior live oak-foothill pine woodland with a shrub layer that is dominated by ceanothus and poison oak and an understory dominated by annual grasses and forbs. Annual grass patches (non woody) are interspersed in a mosaic with the savanna and woodland patches. Other woody species that can be found throughout this ecological site include coffeeberry (Rhamnus californica and R. tomentella) and manzanita (Arctostaphylos spp). Understory species and grassland patches are frequently dominated by soft chess brome (Bromus hordeaceus), ripgut brome (Bromus diandrus), wild oats (Avena fatua), and annual ryegrass (Lolium multiflorum).

Competition between the species that germinate or resprout following fire or other disturbances, mediated by weather and soil moisture conditions, greatly influence the vegetation states present in the oak-woodlands. On some soils, geological substrates, and aspects; tree, shrub and grass patches are all possible vegetations states. Shallow soils, coarse and rocky soils and southern aspects sometimes limit vegetation to shrub dominated states. Frequent fire tends to result in vegetation states dominated by an oak-annual grass community. Protection from fire and grazing results in a gradual increase in shrubs and foothill pine (Pinus sabiniana) contributing to increased fuel loads. As the shrub canopy reaches into the tree canopy the potential for crown fires increases. Protection from browsing reduces hedging allowing the oak canopy to reach the ground layer

increasing the chances for ground fires to become crown fires. Crown fires can top-kill oak trees. While interior live oak (Q. wislenzii) will resprout vigorously, blue oak may not resprout in some locations resulting in a post fire interior live oak dominated site. Grazing and browsing may slow the recovery of woody plants following fire (Johnson and Fitzhugh 1990).

Blue oak, interior live oak and foothill pine are widely distributed along the Sierra Nevada foothills (MLRA 18). Blue oak and interior live oak trees are long-lived species that evolved under low severity understory fires that naturally occur at intervals of about 25 years (McClaran 1986). Many mature blue oaks range from 100 to 200 years old but some blue oaks have been aged at more than 400 years (McClaran 1986). Blue oak is adapted to fire by sprouting from the root crown but blue oak resprouting declines with age (Burns and Honkala 1990). Blue oak is a vigorous sprouter in some locations and not in others. Fire top-kills blue oak seedlings and saplings. Trunks and crowns of interior live oak are extremely sensitive to fire. However, it is a strong resprouting species that will usually survive even when the above ground vegetation is consumed by fire. Young trees are vulnerable to fire. Trunks of mature trees may receive minor damage from cool grass fires but are severely damaged by hotter fires. Frequent burning may kill interior live oaks. Protection from fire has decreased fire frequency allowing shrubs to extend into the oak canopy providing ladder fuels for fire. Resprouts are also vulnerable to grazing/browsing by wildlife and domestic livestock for the first few years after fire.

The shrub layer is a mixture of species that resprout from the roots and crown or are stimulated to germinate by fire, with ceanothus and manzanita being the most dominant and prolific seed producers. These long-lived seeds accumulate in the soil and litter until they are stimulated to germinate by the heat of a fire. Frequent burning can remove these species from the site creating an oak savanna. Poison oak (Toxicodendron diversilobum) and coffeeberry also occur in this habitat and can be top-killed by fire, resprouting from the root crown following a fire.

The historic herbaceous understory layer of this ecological site is unknown, having been replaced by annual grasses and forbs of European origin during the European settlement of California (Burcham 1957, Bartolome 1987, Baker 1989). The tree and shrub layers remain intact and fire is a normal component of these plant communities that were maintained by the Native American population to provide food and fiber (Blackburn and Anderson 1993). Prior to European settlement fire frequency was approximately every 25 years (McClaran 1986). Fires were more frequent (5 to 15 years) following settlement before and after the gold rush (Pavlik 1991, Mensing 1992, Stephens 1997). The intentional use of fire by ranchers and others to reduce brush from 1850 to the 1950s contributed to this frequent fire interval. While prescribed burning continues today, foothill subdivision, urbanization and air quality concerns have reduced the use of fire as a management tool. Today fire frequency is more likely to be on the order of 25 to 50 years. Prescribed burning, mechanical and chemical brush control have been used to remove the shrub and tree layers but have been used infrequently used since the beginning of the 21st century (Murphy and Crampton 1964, Murphy and Berry 1973).

Species composition and productivity of the annual dominated understory grasses and forbs vary greatly within and between years and is greatly influenced by the timing and amount of precipitation and the amount of residual dry matter (George et al. 2001a). Grass dominated years occur when rainfall is well-distributed or greater than normal. Filaree years occur in low rainfall years or when residual dry matter (Bartolome et al. 2002) is low. Drought, heavy grazing and fire result in filaree dominated understory. Following a fire filaree may dominate the site for up to three years (Parsons and Stohlgren 1989, McDougald et al 1991). Medusahead (Taeniatherum caput-medusa), goatgrass (Aegilops triuncialis) and yellow starthistle (Centaurea solstitialis) invasions are common on this site because of it’s higher clay content and higher precipitation than more southern sites in this MLRA. . Some experts have suggested that medusahead and other invasive species may gradually adapt to new sites (Rice et al 2006).

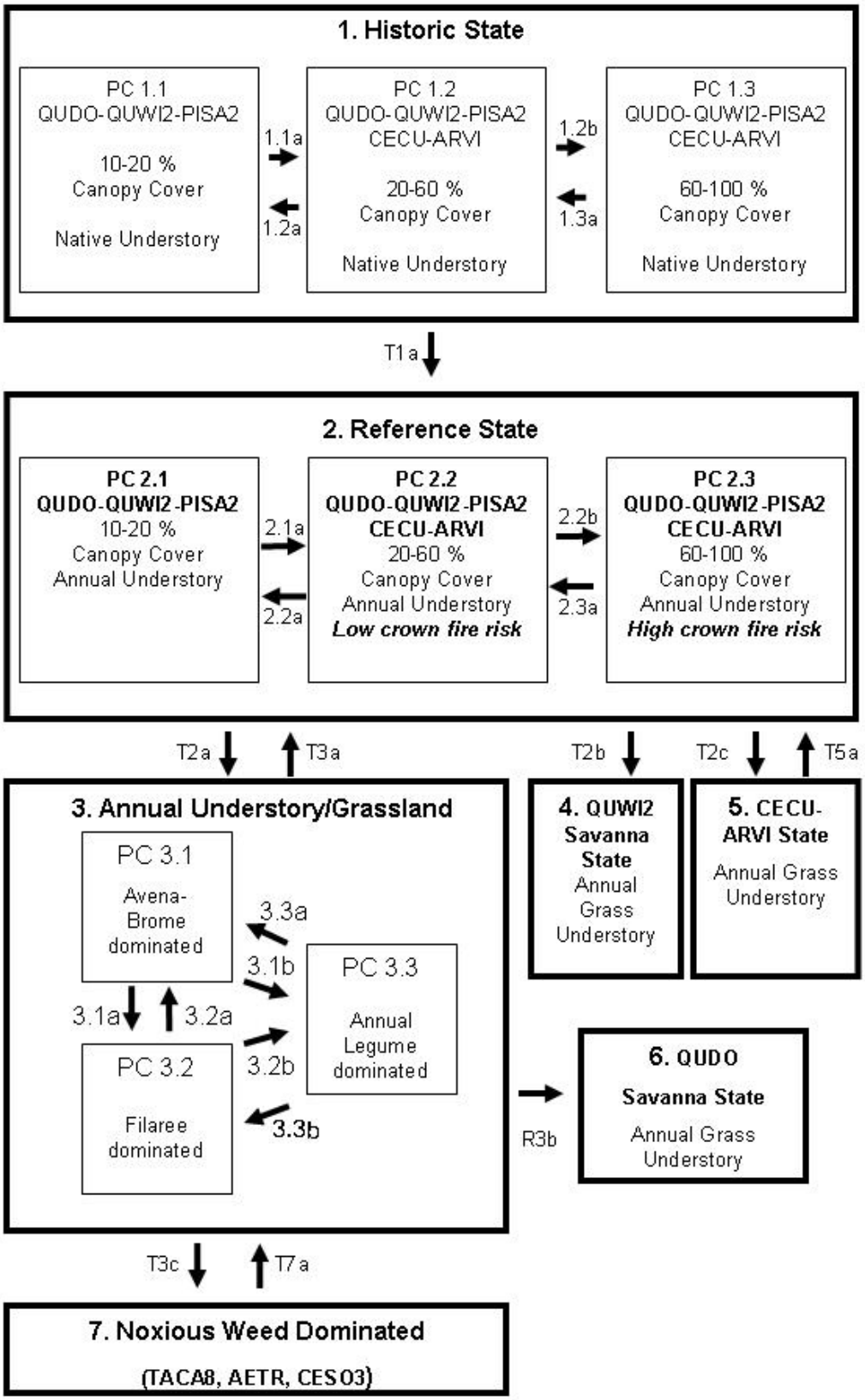
Oak Woodland Plant Community

The oak woodlands of California are a multi-layered mosaic of trees, shrubs and grass patches. In some locations these mosaics have been correlated with geological substrate (Cole 1980) and soil characteristics (Harrison et al. 1971). However, other researches have found each of these vegetation types on most soil depths,

slopes, aspects and all geological substrates suggesting that disturbance (fire) and/or biological factors (competition, grazing and browsing) are important determinants of the patchy distribution of these vegetation types (Wells 1962, Callaway and Davis 1991) at a scale smaller than an ecological site or even a soil mapping unit. Given this mosaic of multi-layered vegetation types there is wide amplitude in expected species composition and amounts on the same soil series or association within an ecological site. Therefore, these sites were delineated more on the basis of soil characteristics and long-term understory production than on species composition.

The tree layer is dominated by blue oak (Quercus douglasii), and may include interior live oak (Q. wislizenii) and foothill pine (Pinus sabiniana). The shrub layer, when present, may include poison oak (Toxicodendron diversilobum), wedgeleaf ceanothus (Ceanothus cuneatus), manzanita (Arctostaphylos spp.) and coffeeberry (Rhamnus californica or R.. tomentella). At the lower elevations this site tends to be an oak savanna. With increasing elevation and slope the interior live oak and shrub component increases.

The understory is dominated by annual grasses and forbs of European origin. Ripgut brome is often more prevalent in the oak understory on this site than in the open grassland patches. Patches on shallow soils are often dominated by filaree or other low growing forbs. Deep soils with higher water holding capacity are often dominated by wild oats and other tall annual grasses. As germination, seedling establishment and plant growth progress during the growing season, species composition changes depending primarily on the timing and amount of precipitation and temperature (George et al. 2001a). Consequently, understory and open grassland species composition varies seasonally and annually. Unlike many perennial dominated grasslands, kinds and amounts (weight or cover) of herbaceous species are not stable and annually predictable. Therefore, exact percentages by weight or ground cover are not reported as is done in more stable perennial dominated ecosystems. Instead several species are listed, several of which can be expected to dominate the composition in some years and be present in most years.




Gravelly Loam Foothill State and Transition Model

**State 1: Historic State**

State 1: This is the assumed historic state consisting of long-lived tree and shrub species similar to those in State 2. State 1 assumes that native annual and perennial grasses and forbs were common in the understory of the tree and shrub layer of these former oak-woodland ecosystems but there is no record of the species composition. As in State 2 a continuum of plant communities (PC 1.1, 1.2, and 1.3) resulted from increasing canopy cover following fire. In State 1, fire was more frequent and was not suppressed as is commonly the case in State 2. Under a more frequent fire regime, this community may never have reached the higher canopy covers that occur in State 2. Additionally, foothill pine was probably less prevalent in State 1.

T1.1a (PC 1.1 to PC1.2): Under natural fire frequencies shrub and tree canopy cover increases toward State PC 1.2 following fire.

T1.2a (PC 1.2 to PC 1.1): Natural fire frequencies estimated to be 25 years maintains an oak savanna with few shrubs and a herbaceous understory.

T1.2b (PC 1.2 to PC 1.3): Prolonged periods without fire result in increased shrub and tree canopy cover to the point where the savanna is classified as woodland. Increasing ladder fuels increase the chances of a high intensity crown fire. Under a 25 year fire interval this state may not have been reached in the pre-European plant community.

T1.3a (PC 1.3 to PC 1.1 or 1.2): Burning woodlands with dense shrub and tree layers results in removal of most shrub and understory tree canopy. In extreme cases this transition could return from PC 1.3 to PC 1.1.

T1a (State 1 to State 2): Invasion by exotic annual species, yearlong continuous grazing, drought, fire suppression and cultivation reduced or destroyed the native perennial grass and forb component of the assumed climax plant community (Burcham 1957, Bartolome 1987, Baker 1989). Apparently this is an irreversible transition in a time frame relevant to management. Restoration of native perennial herbaceous vegetation is a recurring management objective that has been largely unsuccessful. Researchers, managers and citizens groups have been unsuccessful at reversing the loss of native perennial grasses. Competition from invasive annuals and long dry summers apparently are insurmountable. Annual grasses and forbs are more competitive for soil moisture than native perennials reducing oak seedling survival (Gordon et al. 1989, Corbin and D'Antonio 2004).

**State 2: Reference State - Plant Communities 2.1, 2.2 and 2.3**

State 2: This reference state is characterized by a continuum of plant communities that can be sparse in canopy cover to dense canopy cover depending on the frequency of fire. Fire suppression has resulted in longer intervals between fires resulting in fewer ground fires and more intense crown fires. Natural fires in State 1 would have been ignited by lightening, whereas anthropogenic fires were ignited most commonly by Native Americans. Fire in State 2 is often man-caused, but can be started by lightening as well, however the timing and frequency of the fire has probably changed from State 1 to State 2.

Plant community 2.1 (PC 2.1) is a savanna community (Allen Class: Blue Oak-Interior Live Oak/Grass) of 10 to 20 percent canopy cover of blue oak and interior live oak with an annual grass dominated understory and few or no shrubs. Blue oaks are fire-resistant and evolved under low-severity grassland fires. Interior live oak is sensitive to fire but resprouts vigorously following most fires. Foothill pine is sensitive to moderate or intense fires but its overall cover is increasing throughout the site more than likely due to fire suppression. Ceanothus species and many manzanitas have seeds that require fire to germinate; therefore these species may dominate immediately following a fire.

Plant community 2.2 (PC 2.2) ranges from 20 – 60 percent canopy cover resulting from an increase in manzanita, ceanothus and other shrubs, foothill pine and increased oak canopy (Allen Class: Blue Oak-Foothill Pine/Whiteleaf Manzanita/Grass or Blue Oak-Foothill Pine/Wedgeleaf Ceanothus/Grass). Mountain mahogany may also increase at upper elevations.

Plant community 2.3 (PC 2.3) is a woodland community (Allen Class: Blue Oak-Foothill Pine/Whiteleaf Manzanita/Grass or Blue Oak-Foothill Pine/Wedgeleaf Ceanothus/Grass) resulting from continued increases in canopy cover (60 – 100 %) due to infrequent fire. Fire hazard is usually high in this plant community because of the high fuel loads that can lead to high crown fire risk. The understory of these plant communities is generally dominated by annual grasses and forbs of Eurasian origin. Understory productivity decreases as canopy cover increases above 50%. The understory species composition and dynamics in this state is similar to that for State 3 with ripgut brome and foxtail barley often prevalent under the oak canopy and soft chess brome and filaree more common in the open patches.

2.1a (PC 2.1 to PC 2.2): Under natural fire frequencies shrub and tree canopy cover increases toward PC 2.2 following fire.

2.2a (PC 2.2 to PC 2.1): Natural fire frequencies estimated to be 25 years maintains an oak savanna with a few shrubs and an herbaceous understory. More frequent burning can result in a savanna free of shrubs and understory trees. Application of mechanical and/or chemical brush control practices can result in a similar transition.

2.2b (PC 2.2 to PC 2.3): Prolonged periods without fire result in increased shrub and tree canopy cover to the point where the savanna is classified as woodland. Increasing ladder fuels increase the chances of a high intensity crown fire.

2.3a (PC 2.3 to PC 2.1 or 2.2): Burning woodlands with dense shrub layers results in removal of most shrub and understory tree canopy. In extreme cases this transition could return from PC 2.3 to PC 2.1. Implementation of mechanical or chemical brush control practices can result in a similar transition.

T2a (State 2 to State 3 - Type conversion from woodland to grassland): Use of mechanical and chemical tree and shrub control and prescribed burning remove all trees and shrubs resulting in a conversion from woodland to annual grassland. In some cases this transition may be irreversible without artificial regeneration of native woody species, especially if frequent fires and grazing suppress seedlings of woody species. Seeding and fertilization often accompanied tree and shrub control. At low canopy covers fire or natural mortality could remove woody species and conditions for resprouting and/or acorn germination and seedling establishment may be unfavorable.

T2b (State 2 to State 4): Intense fire, wood cutting or vegetation management kills blue oaks and they do not resprout due to old age (Burns and Honkala 1990) or site conditions (DeLasaux and Pillsbury 1987, Haggerty 1991). Interior live oaks are top killed but resprout vigorously. With fire protection shrubs gradually increase producing a state similar to State 2 but without blue oak.

T2c (State 2 to 5): Intense fire kills all trees and they do not regenerate (Haggerty 1991). Manzanita, and/or ceanothus reestablish from seed and poison oak and coffeeberry resprout producing patches of shrubs mixed with open grassland.

State 2: Reference State - Plant Communities 2.1, 2.2 and 2.3 Plant Species Composition:

Grass/Grasslike

| Group | Group Name | Common Name | Scientific Name | Annual Production in Pounds Per Acre Low | High |
|---|---|---|---|---|---|
| 8 - Non-native annual cool-season grass | | | | 0 | 0 |
| | | wild oat | *Avena fatua* | 0 | 0 |
| | | purple false brome | *Brachypodium distachyon* | 0 | 0 |
| | | ripgut grass | *Bromus diandrus* | 0 | 0 |
| | | soft brome | *Bromus hordeaceus* | 0 | 0 |
| | | big quakinggrass | *Briza maxima* | 0 | 0 |
| | | | *Bromus madritensis (Syn)* | 0 | 0 |
| | | | *Bromus madritensis ssp. rubens (Syn)* | 0 | 0 |
| | | bristly dogstail grass | *Cynosurus echinatus* | 0 | 0 |
| | | barley | *Hordeum* | 0 | 0 |
| | | | *Lolium multiflorum (Syn)* | 0 | 0 |

Forb

| Group | Group Name | Common Name | Scientific Name | Annual Production in Pounds Per Acre Low | High |
|---|---|---|---|---|---|
| 14 - Non-native annual forb | | | | 0 | 0 |
| | | stork's bill | *Erodium* | 0 | 0 |
| | | spreading hedgeparsley | *Torilis arvensis* | 0 | 0 |
| | | rose clover | *Trifolium hirtum* | 0 | 0 |

Shrub/Vine

| Group | Group Name | Common Name | Scientific Name | Annual Production in Pounds Per Acre Low | High |
|---|---|---|---|---|---|
| 17 - Native shrub | | | | 0 | 0 |

| | | | | |
|---|---|---|---|---|
| | sticky whiteleaf manzanita | *Arctostaphylos viscida* | 0 | 0 |
| | buckbrush | *Ceanothus cuneatus* | 0 | 0 |
| | | *Rhamnus californica (Syn)* | 0 | 0 |
| | Pacific poison oak | *Toxicodendron diversilobum* | 0 | 0 |

Tree

| Group | Group Name | Common Name | Scientific Name | Annual Production in Pounds Per Acre Low | High |
|---|---|---|---|---|---|
| 23 | Native coniferous tree | | | 0 | 0 |
| | | California foothill pine | *Pinus sabiniana* | 0 | 0 |
| 24 | Native deciduous tree | | | 0 | 0 |
| | | blue oak | *Quercus douglasii* | 0 | 0 |
| 25 | Native non-deciduous tree | | | 0 | 0 |
| | | interior live oak | *Quercus wislizeni* | 0 | 0 |

## Annual Production by Plant Type:

| Plant Type | Annual Production (lbs/AC) Low | Representative Value | High |
|---|---|---|---|
| Forb | 200 | 400 | 600 |
| Grass/Grasslike | 800 | 1600 | 2400 |
| Total: | 1000 | 2000 | 3000 |

## Structure and Cover:

Ground Cover (%)

| Vegetative Cover | | | | | | Non-Vegetative Cover | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Grass/ Grasslike | Forb | Shrub/ Vine | Tree | Non-Vascular Plants | Biological Crust | Litter | Surface Fragments > 1/4 & <= 3" | Surface Fragments > 3" | Bedrock | Water | Bare Ground |
| 80 to 100 | 0 to 20 | | | | | 0 to 100 | | | | | 0 to 20 |

Structure of Canopy Cover (%)

| | Grasses/Grasslike | Forbs | Shrubs/Vines | Trees |
|---|---|---|---|---|
| <=0.5 feet | | | | |
| > 0.5 - < 1 feet | 80 to 100 | 0 to 20 | | |
| < 1 - >= 2 feet | | | | |
| > 2 - < 4.5 feet | | | | |
| < 4.5 - >= 13 feet | | | 0 to 50 | |
| > 13 - < 40 feet | | | | 0 to 100 |

Plant Growth Curve:
Growth Curve Number: CA1501
Growth Curve Name: Annual rangeland (Normal Production Year)
Growth Curve Description: Growth curve for a normal (average) production year resulting from the production year starting in November and extending into early May. Growth curve is for oak-woodlands and associated annual grasslands.

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10 | 25 | 40 | 5 | 0 | 0 | 0 | 0 | 0 | 10 | 10 |

Plant Growth Curve:
Growth Curve Number: CA1502
Growth Curve Name: Annual rangeland (Favorable Production Year)
Growth Curve Description: Growth curve for a favorable production year resulting from the production year starting in October and extending through May. Growth curve is for oak-woodlands and associated annual grasslands.

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10 | 20 | 30 | 25 | 0 | 0 | 0 | 0 | 5 | 5 | 5 |

Plant Growth Curve:
Growth Curve Number: CA1503
Growth Curve Name: Annual rangeland (Unfavorable Production Year)
Growth Curve Description: Growth curve for an unfavorable production year resulting from the production year starting in October and exgtending through May. Growth curve is for oak-woodlands and associated annual grasslands.

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 15 | 70 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 |

**State 3: Annual Grassland**

State 3: Annual grassland with species composition fluctuating in response to weather, grazing, fire and fertility. Plant community 3.1 (PC 3.1) is dominated by wild oats (Avena spp), soft brome (Bromus hordeaceus) and ripgut brome (B. diandrus). Plant community 3.2 (PC 3.2) is dominated by filaree (Erodium spp) or other decumbent species. Plant community 3.3 (PC 3.3) is an annual grassland containing seeded annual legumes such as subterranean clover (Trifolium subterraneum) and rose clover (T. hirtum). Soil quality, especially fertility, declines following tree removal.

3.1a (PC 3.1 to PC 3.2): Filaree increases in response to low litter levels. Litter levels reduced by poor growing conditions, fire or heavy grazing. Long periods of inadequate rainfall within the growing season reduce grasses.

3.2a (PC 3.2 to PC 3.1): Annual grasses increase in filaree patches. Light to moderate grazing increases litter. Mulching effect of litter favors annual grass seedlings. Annual grasses shade filaree and other forb seedlings. Nitrogen fertilization favors increase in grasses.

3.1b (PC 3.1 to 3.3): Sulfur and/or phosphorus fertilization are required to maintain productive subterranean clover stands. Rose clover increases and spreads without fertilization. Close grazing helps to maintain legume composition.

3.2b (PC 3.2 to 3.3): Sulfur and/or phosphorus fertilization are required to maintain productive subterranean clover stands. Rose clover increases and spreads without fertilization. Close grazing helps to maintain legume composition
3.3a (PC 3.3 to PC 3.1): Grasses increase with improved soil fertility and light grazing

3.3b (PC 3.3 to PC 3.2): With loss of fertility and close grazing annual legumes are replaced by filaree.

T3a (State 3 to State 2): Recovery from grassland conversions may take decades or may be irreversible depending on the intensity and type of brush control practices. Repeated fires and grazing help to maintain the grassland. Blue oaks and other woody plants may colonize adjacent open grasslands but seedlings are seldom found more than 30 m from existing tree canopy.

R3b (State 3 to State 6): Planting, weed control and protection of blue oak seedlings from animal damage can successfully restore blue oaks (McCreary 2001).

T3c (State 3 to State 7): Invasion of grassland by medusahead, barbed goatgrass and/or yellow starthistle.

State 3: Annual Grassland Plant Species Composition:

Grass/Grasslike

| Group | Group Name | Common Name | Scientific Name | Annual Production in Pounds Per Acre Low | High |
|---|---|---|---|---|---|
| 8 - Non-native cool season annual grass | | | | 0 | 0 |
| | | wild oat | *Avena fatua* | 0 | 0 |
| | | purple false brome | *Brachypodium distachyon* | 0 | 0 |
| | | ripgut grass | *Bromus diandrus* | 0 | 0 |
| | | soft brome | *Bromus hordeaceus* | 0 | 0 |
| | | big quakinggrass | *Briza maxima* | 0 | 0 |
| | | | *Bromus madritensis (Syn)* | 0 | 0 |
| | | | *Bromus madritensis ssp. rubens (Syn)* | 0 | 0 |
| | | bristly dogstail grass | *Cynosurus echinatus* | 0 | 0 |
| | | barley | *Hordeum* | 0 | 0 |
| | | | *Lolium multiflorum (Syn)* | 0 | 0 |

Forb

| Group | Group Name | Common Name | Scientific Name | Annual Production in Pounds Per Acre Low | High |
|---|---|---|---|---|---|
| 14 - Non-native annual forb | | | | 0 | 0 |
| | | stork's bill | *Erodium* | 0 | 0 |
| | | spreading hedgeparsley | *Torilis arvensis* | 0 | 0 |
| | | rose clover | *Trifolium hirtum* | 0 | 0 |

Annual Production by Plant Type:

| Plant Type | Annual Production (lbs/AC) Low | Representative Value | High |
|---|---|---|---|
| Forb | 200 | 400 | 600 |
| Grass/Grasslike | 800 | 1600 | 2400 |
| Total: | 1000 | 2000 | 3000 |

Structure and Cover:

Ground Cover (%)

| Vegetative Cover | | | | | | Non-Vegetative Cover | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Grass/ Grasslike | Forb | Shrub/ Vine | Tree | Non-Vascular Plants | Biological Crust | Litter | Surface Fragments > 1/4 & <= 3" | Surface Fragments > 3" | Bedrock | Water | Bare Ground |
| 80 to 100 | 0 to 20 | | | | | 0 to 100 | | | | | 0 to 20 |

Plant Growth Curve:
Growth Curve Number: CA1501
Growth Curve Name: Annual rangeland (Normal Production Year)
Growth Curve Description: Growth curve for a normal (average) production year resulting from the production

year starting in November and extending into early May. Growth curve is for oak-woodlands and associated annual grasslands.

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10 | 25 | 40 | 5 | 0 | 0 | 0 | 0 | 0 | 10 | 10 |

Plant Growth Curve:
Growth Curve Number: CA1502
Growth Curve Name: Annual rangeland (Favorable Production Year)
Growth Curve Description: Growth curve for a favorable production year resulting from the production year starting in October and extending through May. Growth curve is for oak-woodlands and associated annual grasslands.

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10 | 20 | 30 | 25 | 0 | 0 | 0 | 0 | 5 | 5 | 5 |

Plant Growth Curve:
Growth Curve Number: CA1503
Growth Curve Name: Annual rangeland (Unfavorable Production Year)
Growth Curve Description: Growth curve for an unfavorable production year resulting from the production year starting in October and exgtending through May. Growth curve is for oak-woodlands and associated annual grasslands.

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 15 | 70 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 |

**State 4: Interior live oak savanna**

State 4: Live oak savanna. Live Oak dominated savanna. Allen Class: Live Oak/Grass

**State 5: Ceanothus & Manazanita**

State 5: Ceanothus and/or manzanita chaparral.

T5a (State 5 to 2): On deeper soils with better moisture holding capacity interior live oak and/or blue oak regenerate from acorns that germinate under canopy of shrubs (Callaway and D'Antonio 1991, Muick 1997). This is a slow successional process.

**State 6: Blue oak savanna**

State 6: Artificially revegetated blue oak woodland with an annual grass understory. This state is similar to State 2 without interior live oak and shrubs. Interior live oak and shrubs may naturally reestablish over a period of several decades. Allen Class: Blue Oak/Grass or Blue Oak-Understory Blue Oak/Grass.

**State 7: Noxious Weed Dominated**

State 7. Woodland type converted to a grassland is invaded and potentially dominated by medusahead, goatgrass or yellow star thistle. On this site medusahead domination of grasslands is common. Goatgrass is increasing and appears to be able to invade medusahead dominated sites. Yellow starthistle may increase if not controlled.

T7a. Burning, herbicide application, and grazing management can reduce the population of these noxious

weeds.

## Ecological Site Interpretations

Animal Community:
Wildlife

Of the 632 terrestrial vertebrates (amphibians, reptiles, birds, and mammals) native to California, over 300 species use oak woodlands for food, cover and reproduction, including at lest 120 species of mammals, 147 species of birds and approximately 60 species of amphibians and reptiles (Tietje et al. 2005). Common species on this site include California quail (Callipepla californicus), Beechey ground squirrels (Spermophilus beecheyi), Botta pocket gopher (Thomomys bottae mewa), Audubon cottontail (Sylvilagus audubonii vallicola), and deer (Odocoileus spp). The rich rodent and lagomorph population is an important food source for common predators including: bobcat (Lynx rufus californicus), coyote (Canis latrans) and the Pacific rattlesnake (Crotalus viridis oreganus). The value of this site for food or cover changes seasonally with the vegetation. In habitat planning each plant community and each species needs must be considered individually and collectively.

Deer, rodents and rabbits browses blue oak contributing to poor regeneration. Acorns are eaten by at least a dozen species of songbirds, several upland game birds, rodents, black-tailed deer, feral and domestic pig, and all other classes of livestock (Adams et al. 1992, Duncan and Clawson 1980, Sampson and Jespersen 1963). Acorns are a critical food source for deer, which migrate from high-elevation dry summer ranges to blue oak woodland for fall and winter forage (Burns and Honkala 1990). Studies in the central Sierra Nevada foothills showed that blue oak woodland is utilized by 92 species of birds, 60 of which nest there (Block and Morrison 1990). The California Wildlife Habitat Database (Mayer and Laudenslayer 1988), maintained by California Department of Fish and Game, can provide extensive information on wildlife species that may occur in the habitat type on this site.

Grazing and Browsing

The plant communities on this site are suitable for grazing by all classes of livestock at any season. However, forage quality declines below the nutritional needs of many kinds and classes of livestock during the 6 to 8 month dry season. Matching the nutrient demands of livestock with the nutrients supplied by range forage is a balancing act for a considerable portion of each year(George et al. 2001b). The quality of range forage varies with plant species, season, location, and range improvement practices. Range forage is optimal for livestock growth and production for only a short period of the year. Early in the growing season, forage may be of high nutrient content, but high water content in the forage may result in rapid passage through the rumen and incomplete nutrient extraction. The browse value of common oak woodland species can be found in Sampson and Jespersen 1963.

Plant Preference by Animal Kind:

Hydrology Functions:
The watersheds associated with these sites are predominantly drained by intermittent streams that only flow during the wet season. These intermittent streams feed into higher order permanent streams. It takes several inches of rainfall to saturate the watershed and cause intermittent streams to flow. In dry years these intermittent streams may not flow at all. Most of this site is steep resulting in moderate to rapid runoff.

The soils on this ecological site are present at the University of California Sierra Foothill Research and Extension Center northeast of Marysville, California. Water balance studies at this research station have found that average annual rainfall, runoff, and estimated evapo-transpiration for a 17 year period were 28, 14, and 15 inches respectively (Lewis et al. 2000). Potential soil water storage between bedrock and the top of the clay-rich

subsoil (Bt Horizon) was 2 inches. Studies have estimated that the threshold of water yield response to oak harvesting is greater than 14% of a watershed area for these oak-woodland soils.

Oak trees are an important component of the ecosystem that serves a valuable role in retention of nutrients which in turn contributes to long-term ecosystem sustainability. Nutrient cycling studies have shown that oak trees create islands of enhanced fertility through organic matter incorporation and nutrient cycling. Compared to adjacent grasslands, soils beneath the oak canopy have a lower bulk density, higher pH, and greater concentrations of organic carbon, nitrogen, total and available P, and exchangeable Ca, Mg, and K, especially in the upper soil horizons (Dahlgren et al. 1997). Removal of oak trees results in loss of soil fertility over a 10 to 20 year period (Kay 1987, Dahlgren & Singer 1994).

Recreational Uses:
Bird watching, hunting, camping, horseback riding, all terrain vehicle riding, and hiking in spring and near developed reservoirs are common recreational pursuits

Wood Products:
Firewood cutting of blue oak, once prevalent, has decreased with increased public awareness of poor blue oak regeneration. Cutting of interior live oak for fire wood is common.

Other Products:
Native Americans have historically used and managed the blue oak woodlands for food and fiber. This ecological site is in the heart of California's historic Mother Lode. Mining for gold has occurred in the past. Remnants of historic mining activity can be found on this ecological site including abandon mines.

Other Information:
Oak Restoration:

Natural regeneration of blue oaks may be limited because they are weak resprouters on some dry sites and because of a number of factors that limit seed germination, seedling establishment and survival to the tree stage. Competition for soil moisture from the understory annual plants, acorn and seedling damage by rodents, livestock grazing and changed fire regimes are important factors that can reduce blue oak regeneration. Interior live oak regeneration is generally not a problem because it is a strong resprouter. McCreary (2001) provides an extensive review of oak regeneration problems and practices on California's oak woodlands.

Native Grass Restoration:

Needlegrass (Nasella pulcra) and other native perennial grasses occur naturally on this site but most attemts to restore naïve perennial grasses fail due to the competition from dominant annual grasses and forbs. California scientists have tried to restore native grasses for more than 50 years but have not found any dependable native grass restoration practices that can be recommended. Therefore native grass restoration should not be a management goal on this site.

Annual Legumes and Annual Grasses:

Improved forage production and quality can be achieved by seeding annual legumes (rose clover and subterranean clover and annual grasses such as annual ryegrass. Annual legume production is improve by the application of sulfur and phosphorus fertilizers.

Poisonous/Non-native Plants

Poisonous Plants:
There are several poisonous plants on this ecological site. Pyrrolizidine alkaloids in fiddleneck (Amsinkia spp.) can cause liver damage in livestock. Yellow starthistle (Centaurea solstitialis) is poisonous to horses. Acorns and oak leaves taken in excess may be toxic. Milkweed (Asclepias fasicularis), Klamath weed (Hypericum perforatum), and common grounsel (Senecio vulgaris) are known to be present on this ecological site. Livestock poisoning is often a result of hungry animals being concentrated on toxic plants.

Several poisonous plants may be present on this ecological site although cattle losses to poisonous plants are rare. Livestock poisoning is often a result of hungry animals being concentrated on toxic plants. Pyrrolizidine alkaloids in fiddleneck (Amsinkia spp.) can cause liver damage in livestock. Several milkweeds (Asclepias spp) may be found on this ecological site including Mexican whorled milkweed. Milkweeds contain several glucosidic substances called cardenolides that are toxic to range livestock. Klamath weed (Hypericum perforatum) may occur on this site. Larkspur (Delphiium spp.)may be present and contains several alkaloids. Cattle consume larkspur most often after plants begin flowering. Acorns and oak leaves are toxic in large quantities and may be consumed in excess if leaves are knocked from the trees by wind or hail or if animals are extremely hungry.

Invasive Species:

The understory vegetation on this site is dominated by non-native annuals that invaded during the colonization of California. The species composition of the pre-colonization community is unknown. This site has been subject to invasions by medusahead (Taeniatherum caput-medusa), barbed goatgrass (Aegilops triuncialis) and yellow starthistle (Centaurea solstitialis).

## Supporting Information

Associated Sites:

| Site Name | Site ID | Site Narrative |
|---|---|---|

Similar Sites:

| Site Name | Site ID | Site Narrative |
|---|---|---|
| GRAVELLY LOAM FOOTHILLS (BLUE OAK) | R018XD063CA | |
| SHALLOW GRAVELLY LOAM FOOTHILLS | R018XD069CA | |
| SHALLOW LOAM FOOTHILLS | R018XD071CA | |

State Correlation:
This site has been correlated with the following states:
CA

Inventory Data References:
Auburnplacerjail38.9359764 121.1140739
LFBLM1 40.5008000 122.5241500
WEFVaira1 38.4130556 120.9577778
WEFVaira2 38.4125833 120.9525278
DFSFF1-44-3-3 39.2509833 121.3131667
DFSFH-8-7-8 39.2361667 121.3156667
MBSFF1-44-3-2 39.2473500 121.3032100
MBSFH-8-7-9 39.2359333 121.3155000
MCSFH-8-7-10 39.2357333 121.3140833
DFSFJAJ-4-2 39.2218200 121.3000200
DFSFJAJ-4-4 39.2219100 121.3023400
DFSFSH1-21-7-7 39.2374000 121.2928000
MBSFSH1-21-7-5 39.2373333 121.2930667
MBSFSH1-31-5-1 39.2352333 121.2840000
MBSFSH1-31-5-3 39.2342833 121.2828667

MCSFJAJ-4-1 39.2217300 121.3010400
MCSFJAJ-4-5 39.2224900 121.3043900
MCSFSH1-21-7-6 39.2375500 121.2932500
MCSFSH1-31-5-2 39.2334967 121.2839833
MCSFSH1-31-5-4 39.2342833 121.2840000
MCSFSH1-31-6-2 39.2350667 121.2840000
MBSFSC-5-6-7 39.2474667 121.3192333
MCSFJAJ-4-3 39.2221900 121.3025600
MCSFSC-5-6-6 39.2474667 121.3188000
MGSFSC14UU-2-3 39.2691500 121.2691500
MGSFSC14UU-2-4 39.2669830 121.3044670
MGSFSC14UU-2-5 39.2675330 121.3032670
Argonautwildturkey 39.2051521 121.2752727
BFebmud1 38.3124011 120.7891771
MBSFSC-10-3-1 39.2511300 121.3114000
DFSFSH1-31-6-3 39.2350500 121.2833833
Johnson-Cool 38.8583333 120.9675278
MBSFSH1-21-6-1 39.2365833 121.2840667
MBSFSH1-31-6-5 39.2337500 121.2811500
MCSFSH1-31-6-4 39.2346500 121.2825167
MlPINEFLAT6 38.7297778 122.7649389
Sobranteoest 38.9919136 121.1045037
MBSFC1-S-7-1 39.2534333 121.2793167
MBSFC1-S-7-3 39.2550333 121.2808833
MCSFC1-S-7-2 39.2541833 121.2801667
MCSFC1-S-7-4 39.2550000 121.2796833
DFSFF1-41-3-5 39.2435200 121.3109900
DFSFSC14UU-2-2
MBSFF1-13-3-6 39.2369500 121.2963400
MBSFF1-13-3-7 39.2370500 121.2963500
MBSFF1-41-3-4 39.2428700 121.3112400
MBSFKOCH-5-7 39.2952833 121.2905833
MBSFKOCH-5-9 39.2964833 121.2899667
MBSFL-1-3-8 39.2753600 121.3125600
MBSFL-1-3-9 39.2744500 121.3132600
MBSFL-1-5-5 39.2759167 121.3121833
MBSFSC-10-7-11 39.2516667 121.2833333
MCSFKO-5-10 39.2952500 121.2919833
MCSFKO-5-8 39.2951667 121.2907500
MCSFL-1-5-6 39.2754000 121.3123000
MCSFSC-10-7-12 39.2519667 121.3117667

Type Locality:

Relationship to Other Established Classifications:
This blue oak dominated site may include the following Allen-Diaz Classes: 1) Blue Oak-Interior Live Oak/Grass, 2) Blue Oak/Grass, 3) Blue Oak-Understory Blue Oak/Grass, 4) Blue Oak-Foothill Pine/Wedgeleaf Ceanothus/Grass, or 5) Blue Oak-Foothill Pine/Whiteleaf Manzanita/Grass (Allen Diaz et al. 1989). This site includes Blue Oak Woodland (BOW) and Blue Oak-Foothill Pine (BOP) of the California Wildlife Habitat Relationships System. The Society for Range Management Cover Type for this site is Blue Oak Woodland.

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Site Description Approval:

| Author | Date | Approval | Date |
|---|---|---|---|
| Melvin George, Dustin Flavel, Bill Frost, Mike Connor, Martin Beaton, Roger Ingram, and Larry Forero | 5/25/2004 | Kendra Moseley | 10/3/2007 |

# Reference Sheet

**Author(s)/participant(s):**

**Contact for lead author:**

**Date:** **MLRA:** 018X **Ecological Site:** Gravelly Loam Foothills R018XI001CA This *must* be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

**Composition (indicators 10 and 12) based on:** Annual Production, Foliar Cover, Biomass

**Indicators.** For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community and natural disturbance regimes within the reference state, when appropriate and (3) cite data. Continue descriptions on separate sheet.

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, standing dead, 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 and strength of structure, and A-horizon color and thickness):**
10. **Effect on plant community 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 weight using symbols: >>, >, = to indicate much greater than, greater than, and equal to) with dominants and sub-dominants and "others" on separate lines:**
    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 ( inches):**
15. **Expected annual production (this is TOTAL above-ground production, not just forage 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 indicator, we are describing what in NOT expected in the reference state for the ecological site:**

**17. Perennial plant reproductive capability:**