Ecological site R015XF005CA
Steep Loamy Foothills

Accessed: 09/07/2026

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.

MLRA notes

Major Land Resource Area (MLRA): 015X–Central California Coast Range

Major Land Resource Area (MLRA) 15 (Central California Coast Range): The MLRA is an area of gently sloping to steep, low mountains. Precipitation is evenly distributed throughout fall, winter, and spring but is very low in summer. Elevation ranges from sea level to 2,650 feet (810 meters) in most of the area, but up to 4,950 feet (1,510 meters) in some of the mountains. The soils in the area dominantly have a thermic soil temperature regime, a xeric soil moisture regime, and mixed or smectitic mineralogy. Land Resource Unit (LRU) 15XF: The LRU includes Blue Ridge in the northern California Coast Ranges and steep hills east of Blue Ridge and east of the Stony Creek fault, extending north to the Klamath Mountains down to the southern portion of Napa and Yolo Counties. The LRU is formed mostly from Jurassic and Cretaceous sandstone and shale facies of the Great Valley sequence. This area includes north to south trending foothill slopes and alluvial back valleys. Soil temperature regime is mostly thermic, with some high elevation areas that are mesic, and soil moisture regime is xeric. Common vegetation includes introduced annual grasses and forbs, blue oak, chamise, ceanothus, manzanita and foothill pine. Elevations generally range from 500 to 2400 feet. Rainfall levels drop quickly from the mountains to the foothills and valley due to the rain shadow effect. Annual precipitation generally averages from 16 to 40 inches. LRU 15XF has several Environmental Protection Agency (EPA) Ecoregions; this ecological site is located in Ecoregion “6f”.

Classification relationships

This blue oak dominated site may include the following Allen-Diaz Class: 1) Blue Oak-Foothill Pine/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 (Shiflet (Ed.), 1994). This site includes the Quercus douglasii Woodland Alliance from the publication "A Manual of California Vegetation, 2nd Edition", (Sawyer et al., 2009).

Ecological site concept

This ecological site predominantly occurs on moderately deep loamy soils found on steep to very steep foothill shoulders and backslopes. Steep slopes incur more erosion as water drains rapidly from these sites. Soils are also drier due to increased water runoff from this site. Found primarily on east and northwest facing aspects, this site receives peak solar radiation during the morning and at mid-day (Kimmins, 1987), experiencing lower evapotranspiration rates than south facing slopes. The diagnostic soil horizon includes the presence of an Argillic Horizon or a zone of clay accumulation that indicate site stability. Permeability is slow, runoff high and erosion hazard is high. This ecological site is an oak savanna with an understory dominated by non-native annual grasses including wild oat (Avena fatua) or slender oat (Avena barbata), a low to moderate cover of blue oak (Quercus douglasii), and California foothill pine (Pinus sabiniana), and shrub cover of Pacific poison oak (Toxicodendron diversiloba).

Associated sites

R015XF002CA	**Clayey Foothills** The Clayey Foothills ecological site is often found in association with the Steep Loamy Foothill Ecological Site, occurring predominantly on adjacent steep backslopes and footslopes. Vegetation is Blue oak with whiteleaf manzanita in the understory, along with annual grasses and forbs. The Clayey Foothills ecological site is similar to this site but differs in that its soil texture is clayey instead of loamy, and deep cracks develop in the soil surface that extend well down into the soil profile. Steep Loamy Foothills is found at higher elevations and generally has a greater amount and diversity of shrubs than the Clayey Foothills ecological site.

R015XF004CA	**Shallow Loamy Foothills** The Shallow Loamy Foothills ecological site is found in association with this site, primarily on south and southwest facing slopes. Vegetation is Blue oak with a shrub layer of buckbrush, and an understory dominated by wild oat.

Table 1. Dominant plant species

Tree	(1) *Quercus douglasii* (2) *Pinus sabiniana*
Shrub	(1) *Toxicodendron diversilobum*
Herbaceous	(1) *Avena fatua*

Physiographic features

This ecological site predominantly occurs on moderately deep soils found on steep to very steep foothill shoulders and backslopes (See the Physiographic Diagram below). This ecological site is often found in association with another site, R015XF004CA, Shallow Loamy Foothills. This ecological site occurs predominantly at elevations of 1,000 to 2,000 feet however elevations may range from 300 to 2,000 feet. This site occurs on all aspects however the Reference Community Phase is primarily found on east to northwest facing slopes.

Slopes generally range from 30 to 60 percent however the full slope range is from 10 to 75 percent.

Figure 1. R015XF005CA - Steep Loamy Foothills

Table 2. Representative physiographic features

Landforms	(1) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	310 – 610 m
Slope	30 – 60 %
Aspect	E, W, NW

Climatic features

This ecological site has a Mediterranean climate characterized by hot summer temperatures and cool moist winters. The driest time of the year is generally in June, July, August and September. Precipitation falls primarily as rain during October through May. The northern part of the California Central Valley receives precipitation from winter storms from the Pacific Northwest. The timing, length and intensity of storms are highly variable and unpredictable.

Periodic drought may occur for months or years at a time, depending on the fluctuations of winds and ocean currents in the equatorial region of the Pacific ocean (Quinn and Keely, 2006).

The mean annual precipitation is 19 to 24 inches and the mean annual air temperature is 59 to 63 degrees Fahrenheit. The frost free period averages 224 days. The freeze free period averages 279 days.

Two climate stations were utilized due their central location within the ecological site: East Park Reservoir and Stony Gorge Reservoir. The southern extent of this site is subject to higher precipitation with increased elevation.

Table 3 Representative climatic features

Frost-free period (average)	220 days
Freeze-free period (average)	280 days
Precipitation total (average)	610 mm

- (1) STONY GORGE RSVR [USC00048587], Elk Creek, CA
- (2) EAST PARK RSVR [USC00042640], Stonyford, CA

Influencing water features

The presence of an Argillic Horizon, steep slopes, and topographic position affect the rate of infiltration and runoff from this ecological site. The slowly permeable argillic layer affects water infiltration through subsurface layers and may alter interflow to downslope positions. Steep slopes and the site’s location on shoulders and backslope positions contribute to medium to very high runoff. The concave downslope and across slope shape also favors runoff from this site. The low surface litter layer and the amount of bare ground may also contribute to increases in overland flow and soil loss.

Soil features

The soils typically associated with this ecological site are formed in residuum from Cretaceous sandstone and shale facies of the Great Valley sequence. This soil series, Contra costa (Fine, mixed, superactive, thermic Mollic Haploxeralfs), has a moderate degree of soil development, and is moderately deep to hard bedrock.

Dominant soils are loamy throughout the soil profile. Surface textures are loam and clay loam and subsurface textures are clay, clay loam, channery clay loam and very gravelly clay loam. Available water capacity tends to be low to moderate on these sites (4-5 inches). These soils are well drained. Surface gravels range from 1 to 13 percent and subsurface gravels range from 1 to 21 percent. Subsurface fragments greater than 3 inches range from 0 to 6 percent.

The soils on this ecological site have an argillic horizon, a subsurface horizon of clay accumulation from illuviation. The presence of an argillic subsurface horizon indicates that the geomorphic surface has been relatively stable and that the period of stability is long (USDA, NRCS, 1999). Permeability is slow and runoff is medium to very high.

This ecological site is correlated with the following map units and components in MLRA 15:
Contra costa - Fine, mixed, superactive, thermic Mollic Haploxeralf

Soils Map Units:

CA011; Colusa County, California:
241; Contra costa–Altamont association, 30 to 50 percent slopes; Contra costa
305; Contra costa loam, 50 to 75 percent slopes
334; Millsholm-Contra costa association 30 to 75 percent slopes; Contra costa

CA21; Glenn County, California:
CtE; Contra costa clay loam 30 to 65 percent slopes
CvE; Contra costa–Millsholm clay loams, 30 to 65 percent, Contra costa

Figure 6. Contra costa Soil

Table 4. Representative soil features

Parent material	(1) Residuum – sandstone and shale
Surface texture	(1) Loam (2) Clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Slow
Soil depth	50 – 100 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	10.16 – 12.7 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	5.6 – 7.3
Subsurface fragment volume <=3" (Depth not specified)	0 – 20 %

Subsurface fragment volume >3" (Depth not specified)	0 – 10 %

Ecological dynamics

Disturbance is defined as “any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resource pools, substrate availability, or the physical environment” (Pickett and White, 1985); a disturbance may be natural or anthropogenic in origin.

This ecological dynamics section will focus on the primary vegetation types found in this ecological site: Blue oak-California foothill pine and Blue oak Woodland. Significant areas of chamise and to a lesser extent Lower Montane Mixed Chaparral exist in the southern portion of the site. These areas are not considered part of this site, and therefore are not addressed within the ecological dynamics section

Historic Disturbances:
The interaction of several disturbance agents including fire, clearing, invasive species and drought has influenced and shaped the oak savanna environment. In the mid-1800s prior to European settlement fire frequency was approximately every 25 years (McClaran 1986). Native Americans regularly used fire to manage vegetation communities to provide food and fiber (Blackburn and Anderson 1993; McCleary 2004). The historic vegetation community likely experienced an understory fire regime (Arno, Allison-Burnell, 2002). Frequent low intensity fire likely left widely spaced overstory trees and removed smaller trees and brush (McCleary, 2004; Pavlik 1991; Mensing 1992; Stephens 1997). Following settlement before and after the gold rush, fires were more frequent, every 5 to 15 years, due to the intentional use of fire by ranchers and others to reduce brush. Shrub and oak recruitment increased in the absence of periodic fire or grazing in some environments (Purcell and Stephens, 2005).

Clearing of oaks occurred throughout the 1880’s for agriculture and livestock purposes (McCleary, 2004). Increased settlement also resulted in the loss of oaks in the support of fuels for railroads, mines and steamships. After the Second World War, there was extensive conversion of woodland to pasture, and the inventory of hardwood forest types in California has decreased with widespread conversion from residential and commercial development. Within the State of California about 1.9 million acres of hardwoods and chaparral were reported to have been cleared in rangeland improvement projects (Bolsinger, 1988). Chaining of oaks occurred during the 1960’s in an attempt to provide for more grassland production. The increase in grass production was short-lived (less than 10-20 years) following oak removal and oak representation on some landscapes was altogether eliminated. Foothill pine also suffered the same fate in some areas. Some research indicates that oak removal results in a rapid decline in soil quality, including a loss in soil organic matter and nitrogen (Dalgren et al., 2003), and that oaks help retain more water on site and enhance soil quality through nutrient cycling, organic matter deposition and reduced bulk density (O’Geen et al., 2010). Firewood cutting for fuel and residential and commercial development continue to contribute to the loss of oaks, though at a much slower rate. The lack of natural regeneration of oak has been attributed to many factors including herbivory, acorn predation, competition from annual grasses, and altered fire regimes (Fryer 2007; UC 2007; Sweitzer and Van Vuren 2002).

Drought: California grasslands experience an annual summer water deficit (Barbour and Major, 1977) as a result of the Mediterranean-influenced climate. This water deficit in combination with periodic drought can lead to changes in grassland species composition and production as a result of prolonged low water availability (Stromberg et al., 2007). The most recent drought period, now in its fourth year is unprecedented in California’s climate record (Griffin and Anchukaitis, 2014). Increased temperature and evaporation will likely have a significant effect on species composition and productivity on this site, favoring more droughty species, lowering oak seedling survival (Grünzweig et al., 2008) and lessening overall range production. Oaks are efficient water users; they are adapted to very low moisture conditions by virtue of their small leaf size, the regulation of water loss through the leaf stomata and by tapping into water below fractured rock (Baldocchi et al., 2007). Oak leaves may brown and drop prematurely during a drought year and fully recover the following year, potentially affecting the acorn crop, however, prolonged severe drought can result in mortality in oaks, especially on south facing slopes (Harper et al., 1991). Foothill pine has the ability to grow on the doughtiest sites by photosynthesizing during winter and spring and through low transpiration rates (Burns and Honkala (eds.), 1990).

Fire: Active fire suppression during the last century has allowed for the accumulation of fuels and a trend towards larger more devastating fires (McCleary 2004; Arno and Allison-Bunnell, 2002). The lack of fire on this site has resulted in significant regeneration and survival of California foothill pine, adding to ladder fuels and the increased fire risk. Foothill pine is susceptible to fire due to its thin flaky bark and heavy resin production (Howard, 1992). Blue oak can withstand low-intensity ground fires but is very susceptible to moderate to severe fire (Pavlik et al., 1992). Blue oak is considered a weak sprouter following fire, and sprouting declines with age (Burns and Honkala 1990, McDonald 1990). Pacific poison oak (Toxicodendron diversiloba), regenerates via seed dispersed by birds and sprouting from the root crown following fire. Birchleaf mountain mahogany is top killed by fire and sprouts via rhizomes or the root crown.

Harvesting: In studies examining oaks following harvest (McCleary, 2008) one third of the trees sprouted, however, subsequent sprout survival was significantly affected by browsing. In general, smaller diameter oaks (less than 12 inches in diameter) sprout more readily than larger oaks (Standiford, 2011) and sprouting is more common in moist environments than in dry sites (McCleary et al., 2002; McCreary 2004).

Grazing: Currently species composition and productivity of the annual-dominated grassland and 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). Grazing (or the lack of grazing) greatly influences residual dry matter (RDM) left on site. Sufficient litter or residue is required for good germination of grass species (Young et al, 1981). Besides weather and temperature, oak canopy may affect forage yield; in the drier areas of California with low oak cover, oak canopy enhances forage, and in higher precipitation areas with greater oak cover, production is reduced (Connor, 1996). Tree shading may help reduce thermal stress in cattle; as temperature increases so do water requirements (Hahn, 1985; George et al., 2015).

Diseases: There are many disease and insect pests found on California oaks. Some diseases of blue oak damage the heartwood of the trunk and large limbs (McDonald, 1990; Hickman et al., 2011). A white pocket rot (Inonotus dryophilus) causes rot in the heartwood of living oaks. The sulphur conk (Laetiporus sulphureus) causes a brown cubical rot also of the heartwood of living oaks. The hedgehog fungus (Hydnum erinaceum) and the artist's fungus (Ganoderma applanatum) are also capable of destroying the heartwood of living oaks. A disease of blue oak roots, the shoestring fungus rot (Armillaria mellea) gradually weakens trees at the base until they fall. A white root rot (Inonotus dryadeus) also has been reported on blue oak. The fruit tree leaf roller (Archips argyrospila) may cause significant defoliation and when combined with a multi-year drought, an increase in oak tree mortality rates (USDA, 2006). Prominent diseases of foothill pine include western gall rust (Periderium harknessii) and dwarf-mistletoe (Arceuthobium occidentale) and (A. campylopodum forma campylopodum) (Howard, 1992).

Climate: In California's Mediterranean climate evaporative demand and rainfall are out of sync with one another (Miller et al., 2012). During peak demand in the spring, water is quickly depleted from the soil profile and grasses senesce. After that period the only moisture available to woody plants is through root access to groundwater. Groundwater has been shown to be a critical link to blue oak survival over the prolonged summer drought period (Miller et al., 2010). Extended periods of drought could slow recovery by limiting photosynthesis and affect carbon intake, hindering reproductive processes, leading to a reduction in oak seedling establishment.

The influence of climate change on vegetation has been widely debated. Some climate models indicate that decreasing precipitation and increasing temperature could result in a potential shift in the blue oak type to the north and shrinking of the overall range of the species. This change in range is thought to be a potential result of increasing moisture stress with changing climate (Kueppers, et al, 2005). Although there are many other factors that influence plant communities, climate related effects include the potential for a changed fire regime and more favorable conditions for species invasions (Stromberg, et al, 2007).

State and transition model

Figure 7. R015XF005CA - Steep Loamy Foothills

Additional community tables

Table 5. Community 1.1 plant community composition

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

Table 6. Community 1.2 plant community composition

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

Table 7. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Forb					
1	**Annual Herbs**			65-81	
	springbeauty	CLAYT	*Claytonia*	11-26	1-5
	false carrot	YAMI	*Yabea microcarpa*	15-24	1-3
	knotted hedgeparsley	TONO	*Torilis nodosa*	11-19	1-2
	rose clover	TRHI4	*Trifolium hirtum*	0-12	0-1
	pincushionplant	NAVAR	*Navarretia*	6-9	1-2
5	**Perennial Herbs**			49-93	
	straightbeak buttercup	RAOR3	*Ranunculus orthorhynchus*	29-53	2-8
	Ithuriel's spear	TRLA16	*Triteleia laxa*	2-17	1-3
	onion	ALLIU	*Allium*	9-12	1-2
	bedstraw	GALIU	*Galium*	3-7	1-2

	sanicle	SANIC	*Sanicula*	2-4	1-2
Grass/Grasslike					
2	**Grasses**			482-690	
	wild oat	AVFA	*Avena fatua*	475-690	15-25
	Chinook brome	BRLA3	*Bromus laevipes*	0-119	0-6
	soft brome	BRHO2	*Bromus hordeaceus*	0-67	1-15
	small fescue	VUMI	*Vulpia microstachys*	0-67	0-6
	California melicgrass	MECA2	*Melica californica*	0-9	0-1
Shrub/Vine					
3	**Shrubs**			52-108	
	birchleaf mountain mahogany	CEMOG	*Cercocarpus montanus var. glaber*	11-59	3-8
	Pacific poison oak	TODI	*Toxicodendron diversilobum*	11-22	5-20
	scrub oak	QUBE5	*Quercus berberidifolia*	0-22	0-14
	whiteleaf manzanita	ARMA	*Arctostaphylos manzanita*	1-3	1-5
Tree					
4	**Trees**			87-370	
	blue oak	QUDO	*Quercus douglasii*	68-257	10-25
	California foothill pine	PISA2	*Pinus sabiniana*	10-118	5-10

Table 8. Community 2.1 plant community composition

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

Table 9. Community 2.2 plant community composition

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

Table 10. Community 2.3 plant community composition

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

Table 11. Community 3.1 plant community composition

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

Animal community

Oak savannas and woodlands may provide essential habitat elements for a variety of wildlife species. The blue oak-gray pine community is preferred habitat for black-tailed deer, California quail, and mourning dove and the seeds are eaten by various birds and rodents including Scrub jay, acorn woodpecker, and squirrels are major seed consumers (Howard, 1992). Due to the natural mosaic of grassland, shrubs and trees, a variety of micro-habitats are provided for wildlife. The increased shrub cover and structure provided in Plant Communities 1.2 and 1.3 provide additional habitat elements necessary for a variety of birds and animals. In one study in central California, habitat elements that included shrubs, grass and down wood were positively associated with the abundance of small mammals, and shrub cover and litter weight with abundance of birds and reptiles (Tieje, Vreeland, Siepel and Dockter, 1997). Shrubs provide thermal hiding and escape cover for many birds and mammals, including deer and rabbits (Fryer, 2006). 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 least 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 Beechey ground squirrels (Spermophilus beecheyi), Botta pocket gopher (Thomomys bottae mewa), and Audubon cottontail (Sylvilagus audubonii vallicola). 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). Other wildlife species found in oak woodland include several important game animals, such as mule deer (Odocoileus hemionus), California quail (Callipepla californica), and the "re-introduced" wild turkey (Meleagris gallopavo) contribute to California’s economy through revenues from recreational hunting (Garrison and Standiford, 1997). Birds can serve as “focal species” in that their requirements define spatial attributes, habitat characteristics and management regimes for a healthy system (Zack, 2002). Essential habitat elements include large oak trees with associated cavities and acorns, snags, shrubs, grasses and forbs, brush piles and water. Oak woodlands are important over-wintering environments for large numbers of neotropical migratory birds such as flycatchers, vireos, and warblers. Acorn woodpeckers (Melanerpes formicivoris) and western scrub jays (Aphelocoma californica) forage heavily on acorns, and oak titmice (Baeolophus inornatus), western bluebirds (Sialia Mexicana) and tree swallows (Tachycineta bicolor) nest in the cavities of oaks. The numerous diseases that affect the heartwood of oak boles and limbs create important cavities for a variety of tree dwellers. Mistletoe in oaks (Phorodendron villosum) has berries that are attractive to birds that eat and excrete the live seeds which then stick and create new plants (Perry and Elmore, 2006). Different age classes of blue oak (seedlings, sapling and young trees) are represented on these north slope ecological sites. Shade ameliorates soil temperatures for seedling establishment and the animals that utilize this site. Birds perch in the trees and contribute to shrub dispersal (Block, 1990). Forage and cover available for birds and other animals on these sites is low to moderate. Grazing and Browsing The primary limitation for livestock production on this site is lack of water sources during most of the year. 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 (George, 1993). The browse value of common oak woodland species is listed in Sampson and Jespersen (1963). Manzanita berries are utilized by a number of birds and small animals (Stuart and Sawyer, 2001). Young oak seedlings leaves are browsed by deer and cattle. 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). Deer, rodents and rabbits browses blue oak and contributes to poor survival of oak natural regeneration.

Hydrological functions

The watersheds associated with these sites are drained by intermittent streams that only flow during the wet season. In dry years these intermittent streams may not flow at all. Runoff on these soils is rapid and soil erosion hazard is high.

Recreational uses

Bird watching, hunting, camping, horseback riding, all-terrain vehicle riding, and hiking in spring are common recreational pursuits.

Wood products

Firewood cutting of blue oak, once prevalent, has decreased with increased public awareness of poor blue oak regeneration.

Other products

Native Americans have historically used and managed the blue oak woodlands for food and fiber. The gathering of native plants such as bulbs and corms, grasses and brush for food, medicine and crafts is still practiced today (Anderson, 2006). These gathering methods sustained local plant populations and promoted plant diversity.

Other information

Natural regeneration of blue oaks may be limited on some 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. McCreary (2001) provides an extensive review of oak regeneration problems and practices on California’s oak woodlands. Young oak seedlings are especially susceptible to mortality during the early years. One study indicates blue oak seedlings that reach 10 years of age are more likely to survive compared to newly germinated seedlings (Philips et al, 2007). Protection of saplings from grazing pressure utilizing tree shelters (McCreary and George, 2005) or exclosures (Philips, et al 2007) has been shown to be an effective management technique to aid survival and accelerate growth of young seedlings. Supplemental irrigation may be necessary to ensure survival on some sites. Native Grass Restoration: Native perennial grasses may occur on this ecological site in very small amounts. There is no known practice or group of practices that can successfully restore native grasses on this ecological site. Soils: The capacity of the soil to function is affected by dynamic soil properties (Tugel and Brown, 2001). “Dynamic properties include organic matter, soil structure, infiltration rate, bulk density, and water and nutrient holding capacity” (Soil Quality.Org, 2012). Soil resistance is defined as: "the capacity of a soil to continue to function without change throughout a disturbance" and soil resilience is defined as "the capacity of a soil to recover its functional and structural integrity after a disturbance" (Seybold et al. 1999). “Changes in those properties depend both on land management practices and the inherent properties of the soil” (Soil Quality.Org, 2012). These soils have some properties that have a high resistance to disturbance; for example they have a moderate volume (moderate depth) to absorb and buffer compaction (average soil depth is about 35 inches). Infiltration and water and nutrient holding capacity are enhanced by the strong structure found in the well developed soil profile.

Inventory data references

Ecological Site Inventory Plots: - 9 traverses with soil pits - 4 Line intercept transects with soil pits - 7 double sampling plots Range 417s - #14, 1981

Type locality

Location 1: Colusa County, CA	
Township/Range/Section	TT15N RR5W S11
UTM zone	N
UTM northing	551859.6
UTM easting	4335528.6
General legal description	Location approximately 1.3 miles east of Bear Valley Road.

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Contributors

Judith Welles

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)	J.Welles, R. Miebach
Contact for lead author	Chico Soil Survey Office, Chico, CA
Date	09/25/2013
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills were noted on steep slopes following heavy precipitation events. Approximate number and distance 2-4 per 100 feet.

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2. **Presence of water flow patterns:** Water flow patterns are generally short flows of 200-500 feet.

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3. **Number and height of erosional pedestals or terracettes:** Some minor pedestals or terracettes might be found on this site, though uncommon.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground ranges from 10 to 27 percent.

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5. **Number of gullies and erosion associated with gullies:** No gullies were noted.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** No wind scour or blowouts were noted.

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7. **Amount of litter movement (describe size and distance expected to travel):** Very little if any litter movement was noted. Foothill pine tree litter would be 6 to 8 inches in length by 1/10th of an inch; oak tree litter would be 3 to 4 inches in length by 2 inches wide; annual grass litter would be 4 to 6 inches in length by 1/10 inch wide; forb litter would be 1 to 2 inches in length by 1/4 to 1/2 inch wide.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soils generally have a surface layer that is heavy clay loam or light clay. Permeability is slow, runoff rapid and erosion hazard is severe.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 0 to 5 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; moderate coarse granular structure; hard, friable, sticky, plastic; many fine roots; about 12 percent coarse fragments; neutral (pH 6.9); abrupt wavy boundary. (4 to 10 inches thick). 0.5 to 3.0 percent SOM

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Annual Grasses 60% Trees 25% Annual Forbs 10% Shrubs 5% High grass cover on footslopes should prevent soil loss from rainfall impact. Backslopes would have less grass cover and more tree cover. The presence of trees and shrubs aids water infiltration and grass cover slows runoff. Trees and low to moderate shrub cover intercept rainfall slowing infiltration. Soil cover of grasses and forbs decreases runoff.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None noted.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant: Annual Grasses>

Sub-dominant: Trees>>

Other: Shrubs = Forbs

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** **Plant mortality highest in annual grasses and forbs after May through June drought conditions. Foothill pine may show up to 20 percent mortality and oak 1-2 percent mortality**

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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):** **Annual production varies. Double sampling production values were collected in a 50-80 percent of normal precipitation year. Unfavorable, normal and favorable production ranges from 400 to 1300 pounds per acre respectively.**

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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:** **Invasives such as medusahead and yellow star-thistle do not have the potential to become dominant on this site.**

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17. **Perennial plant reproductive capability:** **Minor amounts of native perennial grasses exist on the site including Chinook brome amd California Melic. Typically the native perennial grasses face strong competition from non-native grasses and forbs. Wet years with fall and winter rains tend to favor non-native grasses on well drained deep soils (Stromberg et al., 2007).**
