USDA Natural Resources
Conservation Service

Ecological site F018XA201CA
Deep Thermic Hillslopes

Last updated: 4/24/2024
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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 018X–Sierra Nevada Foothills

Major Land Resource Area (MLRA) 18, Sierra Nevada Foothills is located entirely in California and runs north to south adjacent to and down-slope of the west side of the Sierra Nevada Mountains (MLRA 22A). MLRA 18 includes rolling to steep dissected hills and low mountains, with several very steep river valleys. Climate is distinctively Mediterranean (xeric soil moisture regime) with hot, dry summers, and relatively cool, wet winters. Most of the precipitation comes as rain; average annual precipitation ranges from 15 to 55 inches in most of the area (precipitation generally increases with elevation and from south to north). Soil temperature regime is thermic; mean annual air temperature generally ranges between 52 and 64 degrees F. Geology is rather complex in this region; there were several volcanic flow and ashfall events, as well as tectonic uplift, during the past 25 million years that contributed to the current landscape.

LRU notes

The Tuscan Flows LRU is the northernmost Land Resource Unit in MLRA 18. It occurs down slope of and is geologically related to the southern Cascades; however, its inclusion in MLRA 18 stems from the ecosystem’s close resemblance to other Sierra Nevada Foothill systems. This LRU is situated on a low elevation volcanic plateau at the northeast end of the Sacramento Valley. The geology includes, but is not limited to late Pliocene and Quartenary basalt, andesite and andesitic lahars (mudflows). Several cinder cones dot the landscape and active fluvial processes are occurring in the larger canyons. Elevation ranges between 250 and 2000 feet above sea level on the main plateau, but can range as high as 3000 feet on the highest hills. Precipitation is among the highest in MLRA 18,

ranging from 30 to 55 inches annually. Mean annual air temperature ranges between 56 and 62 F. Frost free days (generally exhibiting an inverse relationship with elevation) range from 184 to 282 days.

Classification relationships

CLASSIFICATION RELATIONSHIPS
This site is located within M261F, the Sierra Nevada Foothills Section, (McNab et al., 2007) of the National Hierarchical Framework of Ecological Units (Cleland et al., 1997), M261Fa, the Tuscan Flows Subsection.

Level III and Level IV ecoregions systems (Omernik, 1987, and EPA, 2011) are: Level III, Central California Foothills and Coastal Mountains and Level IV, Ecoregion 6a, Tuscan Flows.

Ecological site concept

The Deep Thermic Hillslopes Ecological Site occurs on moderately deep to very deep soils formed in colluvium from basalt and volcanic mudflow breccias. These sites generally occur in concave positions on lower sideslopes and canyon walls. The precipitation range for this site is generally between 29 to 53 inches per year. The soil temperature regime is thermic. Elevation ranges from 400 feet to 1840 feet. Slope gradient ranges from 5 to 60%.

The landscape position on lower slopes results in deep, colluvial soils, commonly with skeletal textures. Deep soils and concave water-gathering positions support open woodlands which provide habitat important for wildlife species needing cover for nesting, forage, and protection. Common soil series correlated to this ecological site include Chinacamp (loamy-skeletal, mixed, superactive, thermic Haplic Palexeralfs), and Coalcanyon (loamy-skeletal, parasesquic, thermic Pachic Ultic Argixerolls). Chinacamp soils are very deep and formed in colluvium from volcanic mudflow breccia. Coalcanyon soils are very deep and formed in colluvium from basalt.

Vegetation includes open oak woodland (Quercus douglasii) with scattered foothill pines (Pinus sabiniana), occasional ponderosa pine (Pinus ponderosa) and dense to scattered whiteleaf manzanita (Arctostaphylos viscida). Poison oak (Toxicodendron diversilobum) is often dense. Forbs and annual grasses generally exceed 50% canopy cover.

Associated sites

R018XA103CA	**Shallow Thermic Volcanic Ridges** This site commonly occurs nearby.

Similar sites

F018XA202CA	**Deep Mesic Mountain Slopes & Summits** Site relationships being developed.

Table 1. Dominant plant species

Tree	(1) *Quercus douglasii* (2) *Pinus sabiniana*
Shrub	(1) *Arctostaphylos viscida* (2) *Toxicodendron diversilobum*
Herbaceous	Not specified

Physiographic features

The Deep Thermic Hillslopes Ecological Site is on backslope and footslope positions of hills. Slopes range from 5 to 60 percent. Elevations range from 400 to 1850 feet.

Table 2. Representative physiographic features

Hillslope profile	(1) Backslope (2) Footslope
Slope shape up-down	(1) Concave
Landforms	(1) Foothills > Hillslope (2) Foothills > Canyon (3) Foothills > Plateau (4) Foothills > Ridge
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	400–1,850 ft
Slope	5–60%
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Very low to high
Flooding frequency	None
Ponding frequency	None
Elevation	165–2,600 ft

Slope	0–100%

Climatic features

The climate associated with this ecological site is Mediterranean, and characterized by hot, dry summers and cool, wet winters. Mean annual precipitation ranges from 29 to 53 inches and usually falls from October to May. Mean annual temperature is 59 to 62 degrees F with 220 to 260 frost-free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	220-260 days
Freeze-free period (characteristic range)	262-365 days
Precipitation total (characteristic range)	29-53 in
Frost-free period (actual range)	161-260 days
Freeze-free period (actual range)	248-365 days
Precipitation total (actual range)	27-57 in
Frost-free period (average)	240 days
Freeze-free period (average)	312 days
Precipitation total (average)	41 in

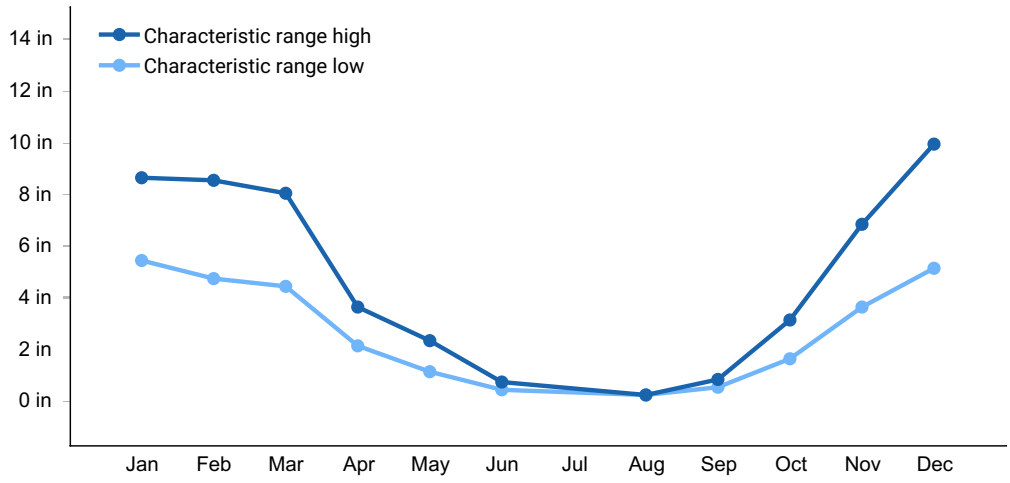


Figure 1. Monthly precipitation range

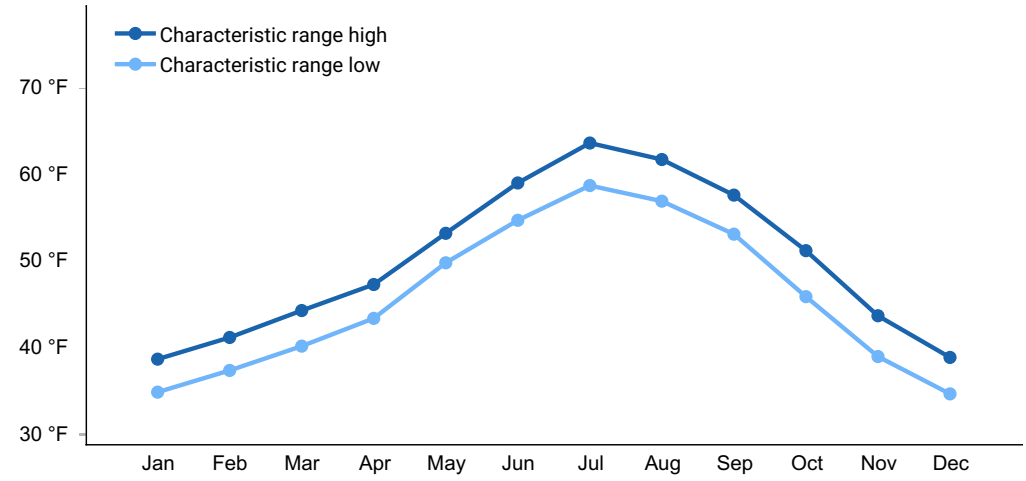


Figure 2. Monthly minimum temperature range

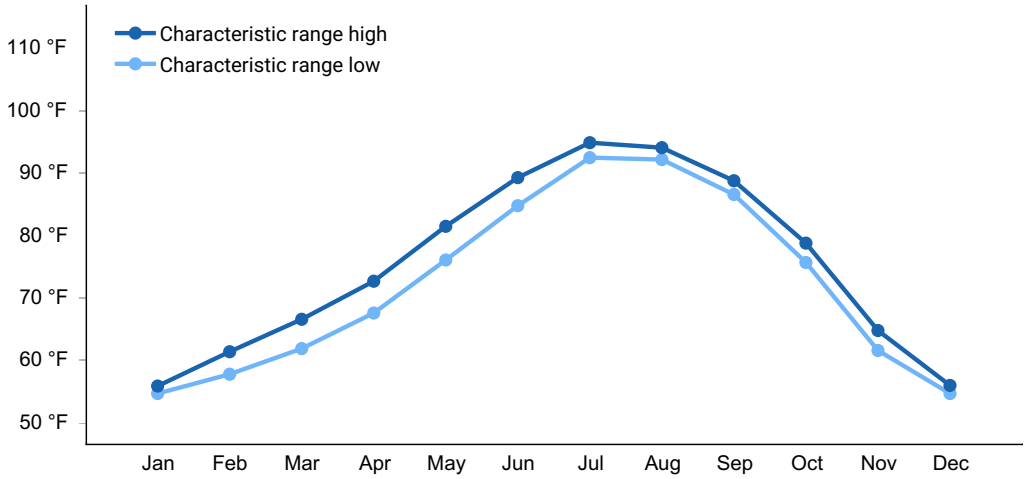


Figure 3. Monthly maximum temperature range

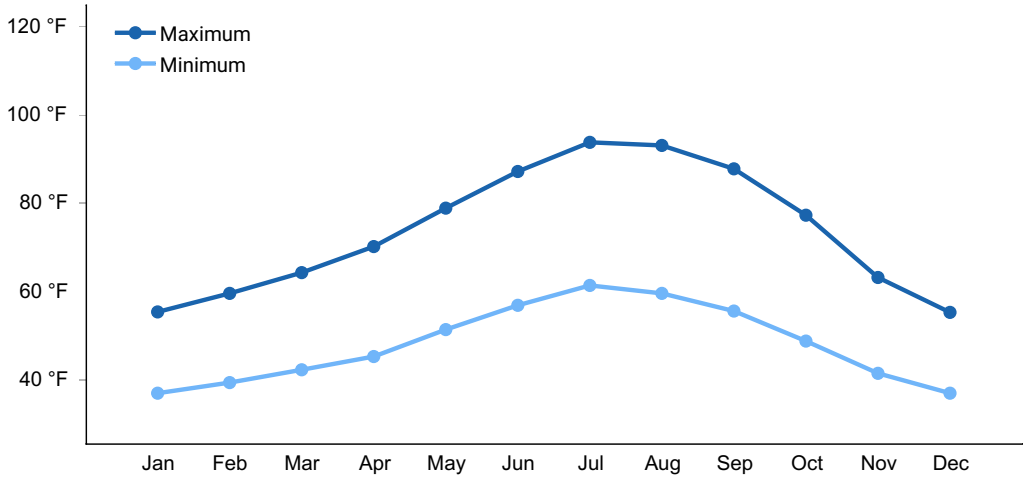


Figure 4. Monthly average minimum and maximum temperature

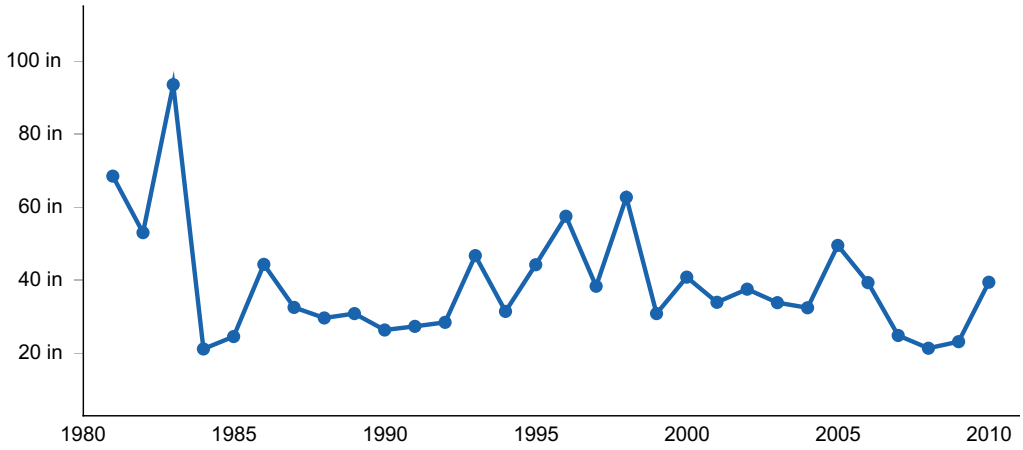


Figure 5. Annual precipitation pattern

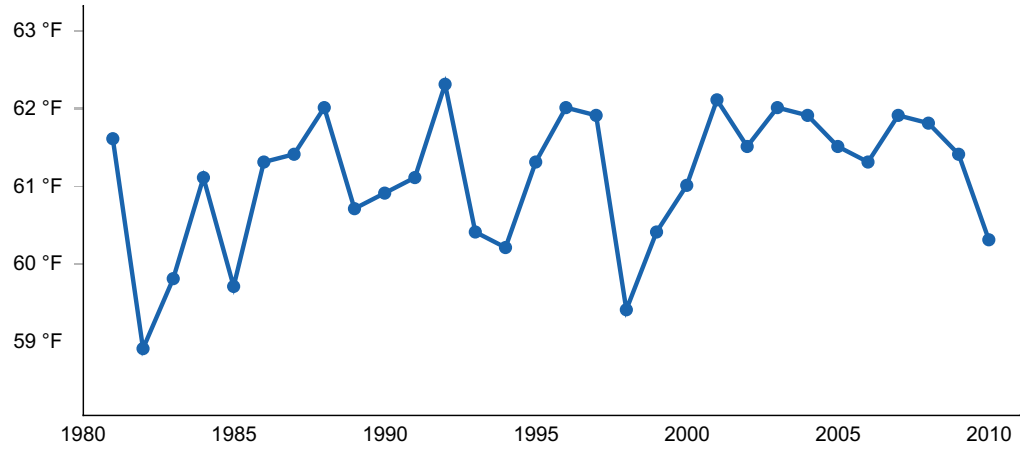


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CHICO UNIV FARM [USC00041715], Chico, CA
- (2) DOBBINS 1 S [USC00042456], Dobbins, CA
- (3) PARADISE [USC00046685], Chico, CA
- (4) OROVILLE [USC00046521], Oroville, CA

Influencing water features

Due to the topographic position, this site does not have water features.

Wetland description

N/A

Soil features

The soils associated with this ecological site are formed from colluvium and residuum from basalt, conglomerate, and/or metamorphic rock. The typical depth is very deep, but soils

range from as shallow as 25 inches to over 60 inches due to the variable thickness of colluvial materials on the side slopes of volcanic ridges. The bedrock, when present in the profile, is restrictive. The particle-size control sections are loamy-skeletal or fine-loamy, and surface textures include gravelly loam, very gravelly loam and very cobbly loam. Gravels (< 3 inch diameter) range from 10 to 25% throughout the profile and larger fragments (≥ 3 inch diameter) range from 0 to 45%. Gravels on the soil surface range from 0 to 15% and larger fragments range from 0 to 35% cover. The soils are well drained or moderately well drained. Permeability is moderately slow to moderately rapid. Available Water Storage (AWS) in the profile ranges from 2.6 to 5.9 inches. Surface pH ranges from 6.1 to 7.2 and subsurface pH range from 6.2 to 7.3. Common soil series correlated to this ecological site include Chinacamp (loamy-skeletal, mixed, superactive, thermic Haplic Palexeralfs), and Coalcanyon (loamy-skeletal, parasesquic, thermic Pachic Ultic Argixerolls).

Table 5. Representative soil features

Parent material	(1) Colluvium–basalt (2) Colluvium–volcanic rock (3) Residuum–volcanic rock (4) Residuum–metamorphic rock
Surface texture	(1) Gravelly loam (2) Loam (3) Very gravelly loam (4) Very cobbly loam
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	25–65 in
Soil depth	25–65 in
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–35%
Available water capacity (0-40in)	2.6–5.9 in
Soil reaction (1:1 water) (0-10in)	6.1–7.2
Subsurface fragment volume <=3" (0-60in)	10–25%
Subsurface fragment volume >3" (0-60in)	0–45%

Table 6. Representative soil features (actual values)

Drainage class	Somewhat poorly drained to well drained

Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	20–90 in
Soil depth	20–90 in
Surface fragment cover <=3"	0–60%
Surface fragment cover >3"	0–100%
Available water capacity (0-40in)	0.5–8.4 in
Soil reaction (1:1 water) (0-10in)	4.7–8.4
Subsurface fragment volume <=3" (0-60in)	5–70%
Subsurface fragment volume >3" (0-60in)	0–100%

Ecological dynamics

State and transition model

Community pathways and Transitions continued

T1.a This transition occurs after decades of little to no disturbance agents, resulting in a build up of fuels and higher density of live vegetation (especially shrubs). A high severity, stand replacing fire then results in a system dominated by shrubs and other fire-adapted plant species, upon revegetating. Shrubs adapted to this system sprout and seed at a much higher rate than the tree component, leading to chaparral dominated systems.

T1.b This transition occurs after tree removal and repeated brush management.

1.1a Time without fire or other disturbances (including management practices).

1.1b This community pathway occurs with mechanical clearing that removes both shrubs and trees. Some oaks remain on the site.

1.2a This community pathway occurs over time without major disturbances.

1.2b This community pathway occurs after a stand replacing fire, or mechanical treatment of some of the young trees/shrubs.

1.3a This community pathway occurs with time and regeneration of oaks, often following low to moderately intense fire and favorable conditions permitting saplings/seedlings to become established.

1.4a This community pathway occurs after mortality of older trees/shrubs create canopy gaps, leading to a slightly more open woodland.

1.4b This community pathway occurs with a moderate/high severity fire killing most of the trees/shrubs. Alternatively, intensive brush management can produce similar results.

T2.a This transition occurs when continual brush management has successfully removed all shrubs and their seed bank from the site for long enough that annual herbaceous species begin to take competitive advantage of the site resources, creating a threshold to a new state where annuals dominate all ecological functions on the site

R2.a This restoration pathway This transition is possible only thru significant inputs of time and labor, including conducting multiple years of brush management, chemical treatments to reduce shrub establishment, followed by planting of oak and foothill pine trees. The shrub management will likely need to continue for several years after tree planting as well, to ensure the success of the trees.

2.1a This community pathway occurs following a high severity fire.

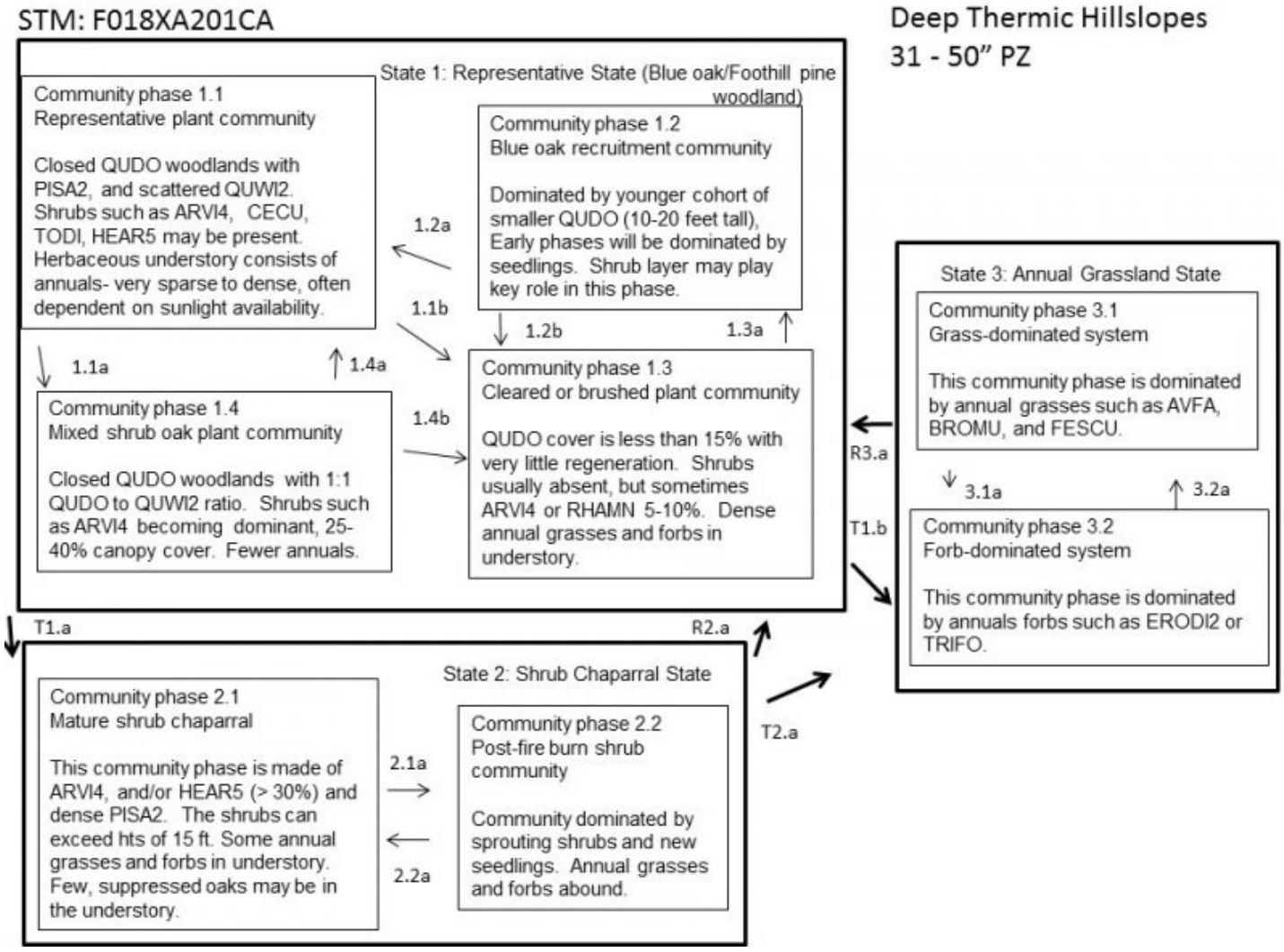
2.2a This community pathway occurs over time without major disturbances.

Community pathways and Transitions

R3.a This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful.

3.1a This community pathway occurs as forbs become dominant, often following lower winter precipitation and reduced litter cover.

3.2a This community pathway occurs as grasses become dominant, often in response to greater litter levels.



State 1
Representative State (Blue oak/Foothill pine woodland)

Dominant plant species

- California foothill pine (*Pinus sabiniana*), tree
- blue oak (*Quercus douglasii*), tree
- sticky whiteleaf manzanita (*Arctostaphylos viscida*), shrub
- Pacific poison oak (*Toxicodendron diversilobum*), shrub

Community 1.1
Representative plant community

Closed QUDO woodlands with PISA2, and scattered QUWI2. Shrubs such as ARVI4, CECU, TODI, HEAR5 may be present. Herbaceous understory consists of annuals- very sparse to dense, often dependent on sunlight availability.

Dominant plant species

- blue oak (*Quercus douglasii*), tree
- California foothill pine (*Pinus sabiniana*), tree
- interior live oak (*Quercus wislizeni*), tree
- buckbrush (*Ceanothus cuneatus*), shrub
- sticky whiteleaf manzanita (*Arctostaphylos viscida*), shrub
- toyon (*Heteromeles arbutifolia*), shrub
- Pacific poison oak (*Toxicodendron diversilobum*), shrub

Community 1.2
Blue oak recruitment community

Dominated by younger cohort of smaller QUDO (10-20 feet tall), Early phases will be dominated by seedlings. Shrub layer may play key role in this phase.

Dominant plant species

- blue oak (*Quercus douglasii*), tree

Community 1.3
Cleared or brushed plant community

QUDO cover is less than 15% with very little regeneration. Shrubs usually absent, but sometimes ARVI4 or RHAMN 5-10%. Dense annual grasses and forbs in understory.

Dominant plant species

- blue oak (*Quercus douglasii*), tree
- sticky whiteleaf manzanita (*Arctostaphylos viscida*), shrub
- buckthorn (*Rhamnus*), shrub
- wild oat (*Avena fatua*), grass
- soft brome (*Bromus hordeaceus*), grass

Community 1.4
Mixed shrub oak plant community

Closed QUDO woodlands with 1:1 QUDO to QUWI2 ratio. Shrubs such as ARVI4 becoming dominant, 25-40% canopy cover. Fewer annuals.

Dominant plant species

- blue oak (*Quercus douglasii*), tree
- interior live oak (*Quercus wislizeni*), tree
- sticky whiteleaf manzanita (*Arctostaphylos viscida*), shrub

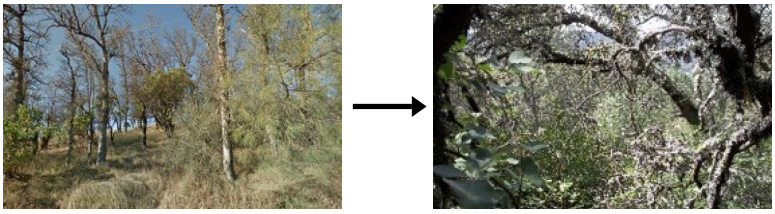
Pathway 1.1b
Community 1.1 to 1.3

Representative plant community

Cleared or brushed plant community

1.1b This community pathway occurs with mechanical clearing that removes both shrubs and trees. Some oaks remain on the site.

Pathway 1.1a
Community 1.1 to 1.4



Representative plant community

Mixed shrub oak plant community

1.1a Time without fire or other disturbances (including management practices).

Pathway 1.2a
Community 1.2 to 1.1

Blue oak recruitment community

Representative plant community

1.2a This community pathway occurs over time without major disturbances.

Pathway 1.2b
Community 1.2 to 1.3

Blue oak recruitment community

Cleared or brushed plant community

1.2b This community pathway occurs after a stand replacing fire, or mechanical treatment of some of the young trees/shrubs.

Pathway 1.3a
Community 1.3 to 1.2

Cleared or brushed plant community

Blue oak recruitment community

1.3a This community pathway occurs with time and regeneration of oaks, often following low to moderately intense fire and favorable conditions permitting saplings/seedlings to become established.

Pathway 1.4a
Community 1.4 to 1.1

Mixed shrub oak plant community

Representative plant community

1.4a This community pathway occurs after mortality of older trees/shrubs create canopy gaps, leading to a slightly more open woodland.

Pathway 1.4b
Community 1.4 to 1.3

Mixed shrub oak plant community

Cleared or brushed plant community

1.4b This community pathway occurs with a moderate/high severity fire killing most of the trees/shrubs. Alternatively, intensive brush management can produce similar results.

State 2
Shrub Chaparral State

Community 2.1
Mature shrub community

This community phase is made of ARVI4, and/or HEAR5 (> 30%) and dense PISA2. The shrubs can exceed hts of 15 ft. Some annual grasses and forbs in understory. Few,

suppressed oaks may be in the understory.

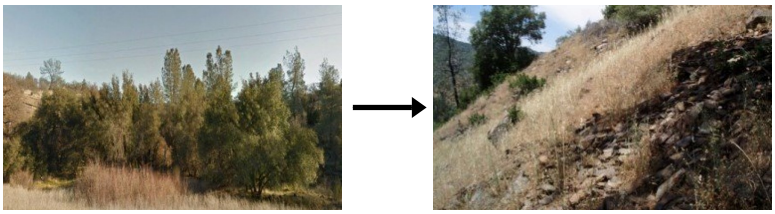
Dominant plant species

- California foothill pine (*Pinus sabiniana*), tree
- sticky whiteleaf manzanita (*Arctostaphylos viscida*), shrub
- toyon (*Heteromeles arbutifolia*), shrub

Community 2.2
Post-fire community

Community dominated by sprouting shrubs and new seedlings. Annual grasses and forbs abound.

Pathway 2.1a
Community 2.1 to 2.2



Mature shrub community **Post-fire community**

2.1a This community pathway occurs following a high severity fire.

Pathway 2.2a
Community 2.2 to 2.1

Post-fire community

Mature shrub community

2.2a This community pathway occurs over time without major disturbances.

State 3
Annual Grassland State

Community 3.1
Grass-dominated plant community

This community phase is dominated by annual grasses such as AVFA, BROMU, and FESCU.

Dominant plant species

- wild oat (*Avena fatua*), grass
- brome (*Bromus*), grass
- fescue (*Festuca*), grass

Community 3.2
Forb-dominated plant community

This community phase is dominated by annuals forbs such as ERODI2 or TRIFO.

Pathway 3.1a
Community 3.1 to 3.2

Grass-dominated plant community

Forb-dominated plant community

3.1a This community pathway occurs as forbs become dominant, often following lower winter precipitation and reduced litter cover.

Pathway 3.2a
Community 3.2 to 3.1

Forb-dominated plant community

Grass-dominated plant community

3.2a This community pathway occurs as grasses become dominant, often in response to greater litter levels.

Transition T1.a
State 1 to 2

T1.a This transition occurs after decades of little to no disturbance agents, resulting in a build up of fuels and higher density of live vegetation (especially shrubs). A high severity, stand replacing fire then results in a system dominated by shrubs and other fire-adapted plant species, upon re-vegetating. Shrubs adapted to this system sprout and seed at a much higher rate than the tree component, leading to chaparral dominated systems.

Transition T1.b
State 1 to 3

T1.b This transition occurs after tree removal and repeated brush management.

Restoration pathway R2.a
State 2 to 1

R2.a This restoration pathway is possible only through significant inputs of time and labor, including conducting multiple years of brush management, chemical treatments to reduce shrub establishment, followed by planting of oak and foothill pine trees. The shrub management will likely need to continue for several years after tree planting as well, to ensure the success of the trees.

Transition T2.a
State 2 to 3

T2.a This transition occurs when continual brush management has successfully removed all shrubs and their seed bank from the site for long enough that annual herbaceous species begin to take competitive advantage of the site resources, creating a threshold to a new state where annuals dominate all ecological functions on the site

Restoration pathway R3.a
State 3 to 1

R3.a This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful.

Additional community tables

Inventory data references

Inventory data to be collected using future projects based on priorities.

References

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Other references

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Contributors

Nathan Roe
Andrew Conlin

Approval

Kendra Moseley, 4/24/2024

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	05/21/2025
Approved by	Kendra Moseley
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):**

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5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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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):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and 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):**

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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:

    Sub-dominant:

    Other:

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**