USDA Natural Resources Conservation Service

Ecological site F018XI208CA
Deep Low Rolling Hills and Terraces

Last updated: 4/24/2024
Accessed: 05/05/2024

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

This LRU (designated XI) is located on moderate to steep hills in the Sierra Nevada Foothills east of Sacramento, Stockton, and Modesto, CA. Various geologies occur in this region: metavolcanics, granodiorite, slate, marble, argillite, schist and quartzite, as well as ultramafic bands to a limited and localized extent. It includes mesa formations from volcanic flows, where vernal pool habitats occur. Soil temperature regime is thermic and soil moisture regime is xeric. Elevation ranges between 300 and 3400 feet above sea level. Precipitation ranges from 14 to 42 inches annually. Most precipitation falls between the months of November and March in the form of rain. Dominant vegetation includes annual grasslands, blue oak (Quercus douglasii), interior live oak (Quercus wislizeni), chamise (Adenostoma fasciculatum), buckbrush (Ceanothus cuneatus), and foothill pine (Pinus sabiniana).

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), M261Fb, the Lower Foothills Metamorphic Belt 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 6b, Northern Sierran Foothills, Ecoregion 6c, Comanche Terraces.

Ecological site concept

This site is characterized by shallow to deep alluvial soils occurring on toeslope and footslope positions on undulating to rolling hillslopes and on ancient stream terraces. Slopes typically range from 1 to 23% with elevation ranging from 200 to 1300 feet. Precipitation typically ranges from 17 to 22 inches per year.

Deep soils and high soil moisture content from the water receiving landscape positions allows for greater production, both woody and herbaceous than the landscape positions where water is more readily lost. Mokelumne and Hicksville soil components are often correlated with this ecological site. Mokelumne soils are moderately deep soils on dissected terraces, hills, sideslopes of terrace remnants and in swales. They are classified as fine, kaolinitic, thermic Typic Haploxerults. Hicksville soils are deep to very deep, moderately well drained soils occurring on low stream terraces and alluvial flats along the eastern edge of the San Joaquin Valley. They are fine-loamy, mixed superactive, thermic Mollic Haploxeralfs.

The vegetation community consists of open blue oak (Quercus douglasii) and interior live oak (Quercus wislizeni) and scattered shrubs such as manzanita (Arctostaphylos spp.), California buckeye (Aesculus californica) and poison oak (Toxicodendron diversilobum). The open structure allow for high production of bromes (Bromus spp.), fillaree (Erodium spp.) and other forbs and grasses. However, production data still needs to be collected on this ecological site.

Table 1. Dominant plant species

Tree	(1) *Quercus douglasii* (2) *Quercus wislizeni*
Shrub	(1) *Toxicodendron diversilobum* (2) *Arctostaphylos*
Herbaceous	(1) *Bromus* (2) *Avena*

Physiographic features

This site occurs on toeslope and footslope positions with slopes typically ranging from 1 to 23%. Elevation generally ranges from 200 to 1300.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope (2) Toeslope
Geomorphic position, terraces	(1) Tread
Landforms	(1) Foothills > Hill (2) Foothills > Stream terrace
Runoff class	Medium
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	61–396 m
Slope	1–23%
Water table depth	25–152 cm
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	37–762 m
Slope	0–30%

Water table depth	Not specified

Climatic features

This ecological site is characterized by hot, dry summers and cool, wet winters, a typical Mediterranean climate. Mean annual precipitation ranges from 18 to 28 inches and usually falls from October to May. Mean annual temperature is 60 to 63 degrees F with 212 to 306 frost free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	212-306 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	457-711 mm
Frost-free period (actual range)	210-350 days
Freeze-free period (actual range)	365 days
Precipitation total (actual range)	406-762 mm
Frost-free period (average)	264 days
Freeze-free period (average)	365 days
Precipitation total (average)	584 mm

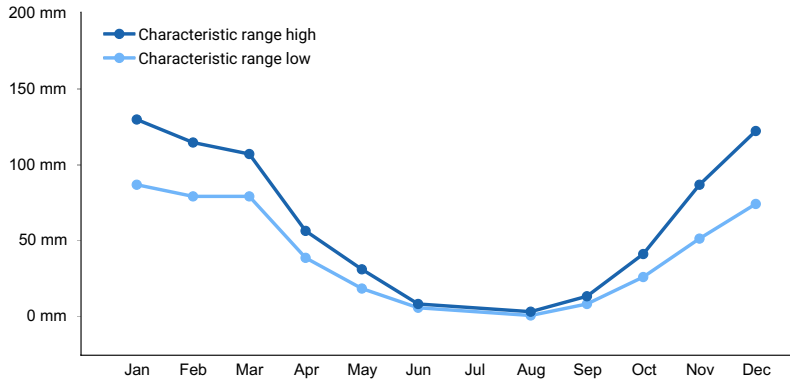


Figure 1. Monthly precipitation range

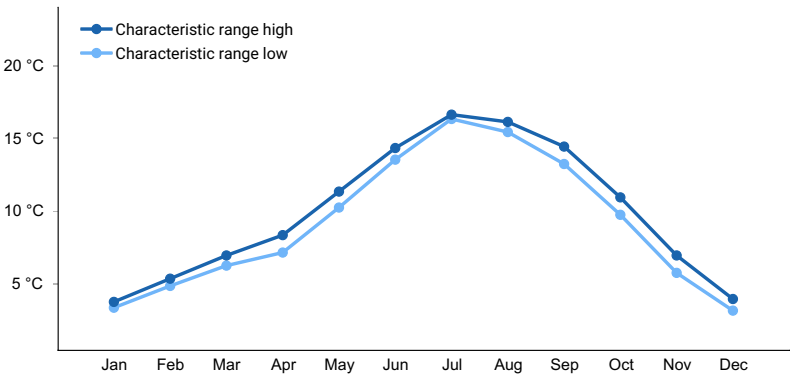


Figure 2. Monthly minimum temperature range

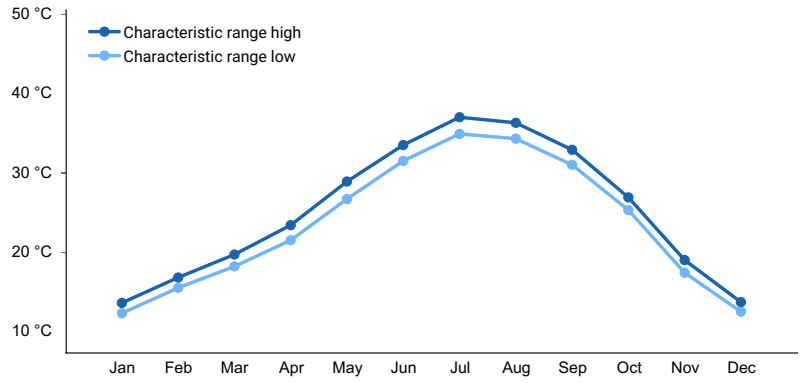


Figure 3. Monthly maximum temperature range

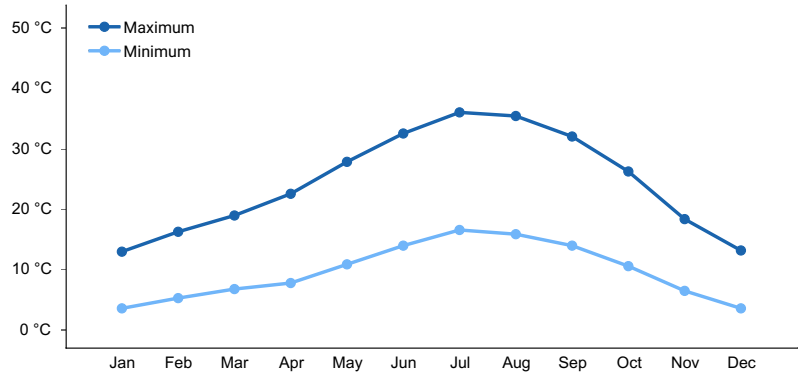


Figure 4. Monthly average minimum and maximum temperature

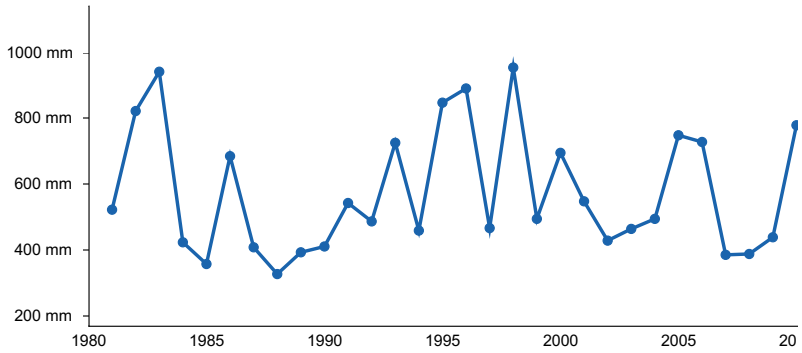


Figure 5. Annual precipitation pattern

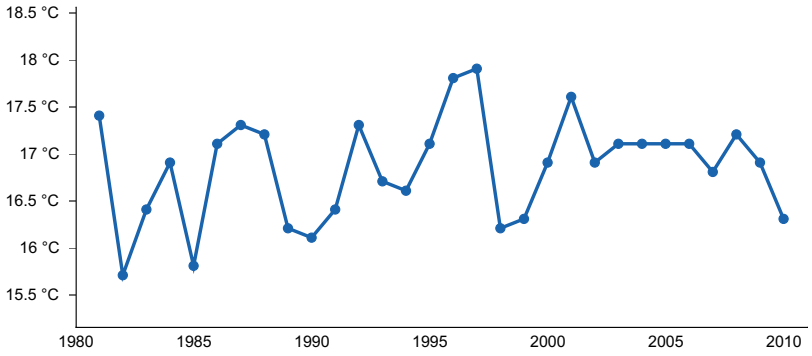


Figure 6. Annual average temperature pattern

Climate stations used

- (1) FRIANT GOVERNMENT CAMP [USC00043261], Friant, CA
- (2) CAMP PARDEE [USC00041428], Valley Springs, CA
- (3) OROVILLE [USC00046521], Oroville, CA

Influencing water features

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

Wetland description

N/A

Soil features

The soils in this ecological site occur on stream and alluvial terraces and fans, and toeslopes of hills. They vary in depth from moderately to very deep, and the particle size control section ranges from fine-loamy to fine with surface textures including sandy loam, gravelly sandy loam and loam. The restrictive feature (when it occurs) tends to be incoherent densic material that can occur within the profile between 19 and 52 inches. Gravels (< 3 inch diameter) occupy between 1 and 5% of the soil surface and larger fragments (= 3 inch diameter) cover between 0 and 1% of the surface. Within the profile gravels range from between 6 to 28% and larger fragments from between 1 to 8% by volume. The soils in this ecological site are moderately well to well drained and the permeability class ranges from very slow to moderately slow. Available Water Capacity (AWC) ranges from 3.1 to 6.4 inches. The soil pH in the top 10 inches of the profile ranges from 5 to 6.4, and throughout the rest of the profile ranges from 3.8 to 7.

Two soils that commonly occur on this ecological site are the Mokelumne and Hicksville series. Mokelumne soils are fine, kaolinitic, thermic Typic Haploxerults and found on dissected terraces, hills, sideslopes of terrace remnants and in swales. Hicksville soils are classified as fine-loamy, mixed, superactive, thermic Mollic Haploxeralfs and are found on low stream terraces and alluvial flats along drainageways of terraces and hills.

Table 5. Representative soil features

Parent material	(1) Alluvium–sedimentary rock (2) Colluvium–fanglomerate (3) Alluvium–igneous rock
Surface texture	(1) Loam (2) Gravelly loam (3) Sandy loam
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to moderately slow
Depth to restrictive layer	43–145 cm
Soil depth	43–145 cm
Surface fragment cover <=3"	1–5%
Surface fragment cover >3"	0–1%
Available water capacity (0-101.6cm)	7.87–16.26 cm
Soil reaction (1:1 water) (0-25.4cm)	5–6.4
Subsurface fragment volume <=3" (0-152.4cm)	6–28%
Subsurface fragment volume >3" (0-152.4cm)	1–8%

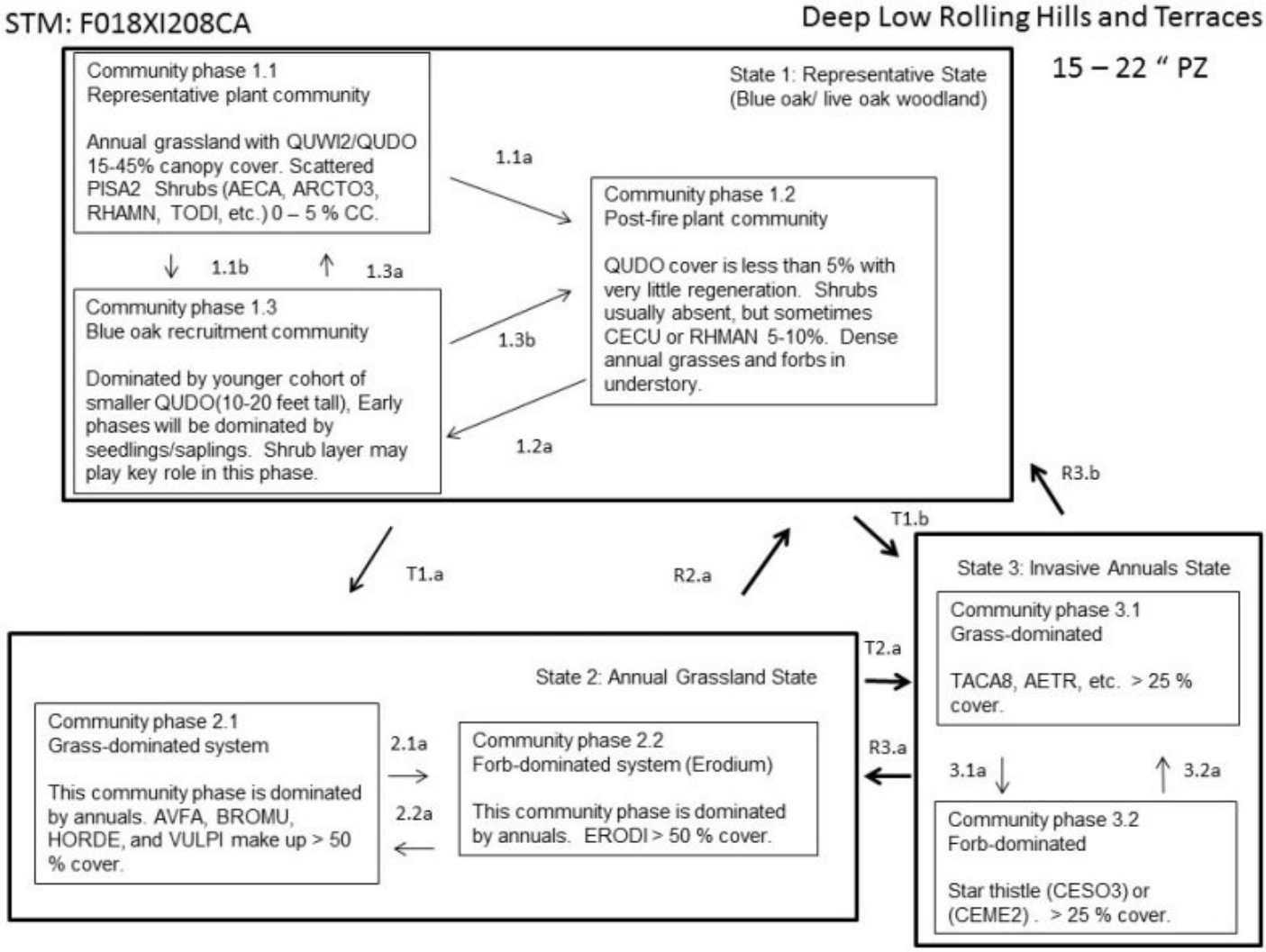
Table 6. Representative soil features (actual values)

Drainage class	Moderately well drained to well drained
Permeability class	Very slow to moderate
Depth to restrictive layer	25–155 cm

Soil depth	25–155 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–15%
Available water capacity (0-101.6cm)	2.79–21.59 cm
Soil reaction (1:1 water) (0-25.4cm)	4.5–7.3
Subsurface fragment volume <=3" (0-152.4cm)	0–46%
Subsurface fragment volume >3" (0-152.4cm)	0–27%

Ecological dynamics

State and transition model



Community pathways and Transitions

T1.a This transition occurs after mechanical clearing that results in loss of oak and acorn source. Grazing management also can be used to create/maintain an annual dominated state.

T1.b This transition occurs when invasive grasses or forbs become established.

1.1a This community pathway occurs when a high severity fire removes most of the woody vegetation. Some oaks remain on or near the site. Alternatively, brushing or tree clearing may cause this community pathway.

1.1b This uncommon community pathway occurs when favorable conditions such as abundant moisture and/or seeds (acorns) etc. cause oak regeneration. Low intensity fire or clearing can also result in a resprouting of oaks.

1.2a This community pathway occurs shortly after CP 1.1a, resulting in profuse sprouting of oak trees, some of which escape herbivory and establish into sapling stage.

1.3a This community pathway occurs with normal time and growth.

1.3b This community pathway occurs with intense brushing/tree clearing which results in significant decrease of woody vegetation.

T2.a This transition occurs after invasive plants posing extreme economic/environmental issues become established.

R2.a This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful.

2.1a This community pathway occurs as forbs become more dominant, often following low winter precipitation and reduced litter layers.

2.2a This community pathway occurs as grasses become more dominant, often in response to higher litter levels.

R3.a. This restoration pathway occurs with integrated weed management. May require mowing, herbicides, and/or biological control.

R3.b This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful. This also may require integrated weed management to reduce the seedling's competition from annual invasive species.

3.1a This community pathway occurs as invasive forb species become dominant.

3.2a This community pathway occurs as invasive grass species become dominant.

State 1
Representative State (Blue oak/ live oak woodland)

Community 1.1
Representative plant community

Annual grassland with QUWI2/QUDO 15-45% canopy cover. Scattered PISA2 Shrubs (AECA, ARCTO3, RHAMN, TODI, etc.) 0 – 5 % CC.

Community 1.2
Post-fire plant community

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

Community 1.3
Blue oak recruitment community

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

Pathway 1.1a
Community 1.1 to 1.2

Representative plant community

Post-fire plant community

This community pathway occurs when a high severity fire removes most of the woody vegetation. Some oaks remain on or near the site. Alternatively, brushing or tree clearing may cause this community pathway.

Pathway 1.1b
Community 1.1 to 1.3

Representative plant community

Blue oak recruitment community

This uncommon community pathway occurs when favorable conditions such as abundant moisture and/or seeds (acorns) etc. cause oak regeneration. Low intensity fire or clearing can also result in a resprouting of oaks.

Pathway 1.2a
Community 1.2 to 1.3

Post-fire plant community

Blue oak recruitment community

This community pathway occurs shortly after CP 1.1a, resulting in profuse sprouting of oak trees, some of which escape herbivory and establish into sapling stage.

Pathway 1.3a
Community 1.3 to 1.1

Blue oak recruitment community

Representative plant community

This community pathway occurs with normal time and growth.

Pathway 1.3b
Community 1.3 to 1.2

Blue oak recruitment community

Post-fire plant community

This community pathway occurs with intense brushing/tree clearing which results in significant decrease of woody vegetation.

State 2
Annual Grassland State

Community 2.1
Grass-dominated system

This community phase is dominated by annuals. AVFA, BROMU, HORDE, and VULPI make up > 50 % cover.

Community 2.2
Forb-dominated system (Erodium)

This community phase is dominated by annuals. ERODI > 50 % cover.

Pathway 2.1a
Community 2.1 to 2.2

Grass-dominated system

Forb-dominated system (Erodium)

This community pathway occurs as forbs become more dominant, often following low winter precipitation and reduced litter layers.

Pathway 2.2a
Community 2.2 to 2.1

Forb-dominated system (Erodium)

Grass-dominated system

This community pathway occurs as grasses become more dominant, often in response to higher litter levels.

State 3
Invasive Annuals State

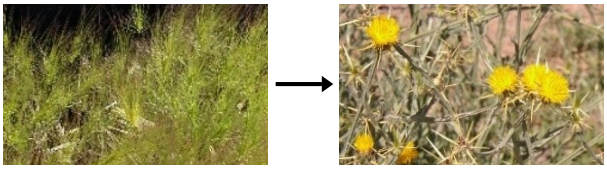
Community 3.1
Grass-dominated

TACA8, AETR, etc. > 25 % cover.

Community 3.2
Forb-dominated

Star thistle (CESO3) or (CEME2) . > 25 % cover.

Pathway 3.1a
Community 3.1 to 3.2



Grass-dominated | Forb-dominated

This community pathway occurs as invasive forb species become dominant.

Pathway 3.2a
Community 3.2 to 3.1

Forb-dominated | Grass-dominated

This community pathway occurs as invasive grass species become dominant.

Transition T1.a
State 1 to 2

This transition occurs after mechanical clearing that results in loss of oak and acorn source. Grazing management also can be used to create/maintain an annual dominated state.

Transition T1.b
State 1 to 3

This transition occurs when invasive grasses or forbs become established.

Restoration pathway R2.a
State 2 to 1

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

Transition T2.a
State 2 to 3

This transition occurs after invasive plants posing extreme economic/environmental issues become established.

Restoration pathway R3.b
State 3 to 1

This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful. This also may require integrated weed management to reduce the seedling's competition from annual invasive species

Restoration pathway R3.a
State 3 to 2

This restoration pathway occurs with integrated weed management. May require mowing, herbicides, and/or biological control.

Additional community tables

Inventory data references

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

References

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Contributors

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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	05/05/2024
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):**

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

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

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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:**