

Ecological site R016XA002CA Freshwater, Stratified, Fluventic

Accessed: 04/26/2024

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.



Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 016X–California Delta

16 – California Delta

Most of this area is in the California Trough Section of the Pacific Border Province of the Pacific Mountain System. A small part at the west edge of the area is in the California Coast Ranges Section of the same province and division. This MLRA was originally the conjoined flood plain along the Sacramento and San Joaquin Rivers. As sediment from these rivers built up in San Pablo Bay, a delta formed, creating many streams that divide this nearly level area into “islands.” Strong levees and drainage systems are needed to protect the islands from flooding. Elevation of the islands ranges from below sea level to slightly above sea level. This area is underlain by interbedded marine, estuarine, and fine-grained non-marine sediments transported to the delta by the Sacramento and San Joaquin Rivers as they flowed into San Pablo Bay. As the sediments built up, a delta formed and freshwater mixed with brackish water in marshes and on flood plains. As the marsh vegetation became covered with new sediments, the organic matter content in the soils built up to very high levels. When drained and exposed to the air, these peaty soils oxidize and shrink and then subside.

Classification relationships

Using the December 2010 draft EPA ecoregion level IV: 7j, Delta polygon mostly closely overlaps with MLRA 16.

MLRA 16 mostly aligns with the USFS (1997) ecological subsection 262AI, Great Valley, Delta.

Ecological site concept

This site is a complex patchwork of freshwater water-obligate, facultative wet and facultative plant communities that are primarily adapted to fluctuating water tables influenced primarily by flood events. This patchwork includes riparian vegetation dominated by woody scrub or shrubs with few to no tall trees; mature riparian forest usually associated with a dense understory and mixed canopy, including sycamore, oaks, willows, and other trees; and palustrine forested wetland that is intermittently flooded, and seasonally saturated.

It is found in along natural levees, some floodplains and occasionally adjacent to slough channels on slopes ranging from 0 to 2% primarily with soils that are characterized by thermic entisols with stratified primarily fluventic sediments, ranging from coarse- to fine-textured, derived from alluvial and eolian sediments. Drainage ranges from very poorly to somewhat poorly drained and salinity is limited and should not have any influence on the vegetation response or dynamics of the site.

Associated sites

R016XA001CA	<p>Tidally-Influenced, Freshwater</p> <p>016XA001 is the dominant ecological site within the LRU and is primarily organic soils with historically emergent wetland vegetation.</p>
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Table 1. Dominant plant species

Tree	(1) <i>Populus fremontii</i> (2) <i>Quercus lobata</i>
Shrub	(1) <i>Salix</i> (2) <i>Rubus vitifolius</i>
Herbaceous	Not specified

Physiographic features

This ecological site occurs predominantly on natural levees but may also exist on historic natural splays and abandoned oxbow areas. The ecological site cuts across the profile of the natural levee with the steepest slopes on the outside of eroding levee faces and the most gentle slopes normally occurring at the summit of the levee with a gradual slope to the inboard landscape. Where point bars occur along such levees, these will be most subject to flood disturbance of the vegetation which results in typically single-aged cohorts of trees on this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Natural levee
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	Rare to frequent
Elevation	0–15 ft
Slope	1–20%
Aspect	Aspect is not a significant factor

Climatic features

Precipitation is typically 100% in rain and lowest elevation extents of the ecological site are augmented by surface and subsurface water.

Table 3. Representative climatic features

Frost-free period (average)	287 days
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Freeze-free period (average)	347 days
Precipitation total (average)	19 in

Climate stations used

- (1) SACRAMENTO EXECUTIVE AP [USW00023232], Sacramento, CA

Influencing water features

Soil features

The soils associated with this ecological site are very deep and poorly or somewhat poorly drained soils developed from mixed alluvium on floodplains, floodplain splays and natural levees.

Surface textures are typically sandy loam, fine sandy loam, loam and silt loam. Subsurface textures are stratified and vary from sand, loamy sand, fine sandy loam, loam, silt loam and silty clay loam. Some areas have buried horizons with similar textures with mucky modifiers. Electrical conductivity of the soil (EC) is less than 2 dS/m throughout.

These soils are poorly or somewhat poorly drained with slow to moderate permeability. The high water table is root limiting for crops. Levees, drainage ditches and pumping of the water table alter the drainage of these soils. Typically the water table is regulated to a depth of 4 to 5 feet below the soil surface. The soil moisture regime is xeric bordering on aquic and the soil temperature regime is thermic.

The soils that are correlated to this ecological site are the Columbia, Sailboat, Sailboat variant, (Coarse-loamy, mixed, superactive, nonacid, thermic Aquic Xerofluvents), Lang (Mixed, thermic, Typic Psamaquents), Laugenour (Coarse-loamy, mixed, superactive, calcareous, thermic Aeric Fluvaquents) and Valpac (Fine-loamy, mixed, superactive, thermic Fluvaquentic Haploxerolls).

Note: When the Columbia soil was mapped in this area, it classified as an Aquic Xerofluvents, Columbia is currently classified as an Oxyaquic Xerofluvents.

This ecological site has been correlated with the following mapunits and soil components in MLRA 16:

CA067; Sacramento County Area, California

116; Columbia sandy loam, partially drained, 0 to 2 percent slopes; Columbia; 85
 122; Columbia fine sandy loam, partially drained, 0 to 2 percent slopes; Columbia; 85
 123; Columbia silt loam, drained, 2 to 5 percent slopes; Columbia; 85
 167; Lang fine sandy loam, drained, 0 to 2 percent slopes; Lang; 85
 169; Laugenour loam, partially drained, 0 to 2 percent slopes; Laugenour; 85
 206; Sailboat silt loam, partially drained, 0 to 2 percent slopes; Sailboat; 85
 209; Sailboat-Urban land complex, partially drained, 0 to 2 percent slopes; Sailboat; 50
 210; Sailboat variant silty clay loam, partially drained, 0 to 2 percent slopes; Sailboat variant; 85
 230; Valpac loam, partially drained, 0 to 2 percent slopes; Valpac; loam, partially drained; 85
 232; Valpac variant sandy loam, partially drained, 0 to 2 percent slopes; Valpac variant; 85

CA077; San Joaquin County Area, California

130; Columbia fine sandy loam, drained, 0 to 2 percent slopes; Columbia; 85
 234; Sailboat silt loam, drained, 0 to 2 percent slopes; Sailboat; 85
 235; Sailboat silt loam, drained, 0 to 2 percent slopes, occasionally flooded; Sailboat; 85

CA095; Solano County Area, California:

Cm; Columbia fine sandy loam; Columbia; 85

Table 4. Representative soil features

Surface texture	(1) Sandy loam (2) Silt loam (3) Loam
Family particle size	(1) Loamy
Drainage class	Poorly drained to somewhat poorly drained
Permeability class	Slow to moderate
Soil depth	60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	4-8 in
Soil reaction (1:1 water) (0-40in)	6.1-8.4
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

Community Dynamics Section

This ecological site is best described as complex riparian forest and historically would include frequently disturbed, infrequently disturbed and rarely disturbed positions along higher elevation natural levees occurring within the MLRA. Lower elevation natural levees of this ecological site in the southern extents would be subject to the most frequent widespread flooding for this ecological site and historically subject to frequent disturbance. The higher elevation natural levees of this ecological site would be considered infrequently disturbed while the lower slopes of such levees would be frequently flooded and infrequently disturbed. Abandoned oxbow forests would have included an element of both the infrequently and rarely disturbed aspects of this ecological site. Soils correlated to this ecological site account for just 8% of the MRLA soils described and about 9% of the soils at the LRU scale.

Comparatively coarse riverine sediment deposits along these natural levees and the elevation of these levees set this ecological site apart from contiguous ecological sites. While other soils within the LRU include some coarse sediment, the ecological processes of those ecological sites are underpinned by high water tables and/or regular inundation which tends to be substantially less influential on the distribution of community phases of this ecological site. Narrow low elevation natural levees (CA016XA001) were extensive within the San Joaquin portion of the MLRA but occurrence of long lived upland species such as walnut and oak was presumably rare while dominance by single aged stands of cottonwood and willow were more typical where those species could compete with tules.

Riparian vegetation structure in the Delta today shifts along elevation and salinity gradients, linked to the fluvial-tidal gradient. Historically, large trees such as sycamore and oaks were dominant species on large (high) natural levees along river reaches in the Delta. In contrast, central Delta tidal channels had lower levees and were dominated by tule and other emergent wetland species. The broad natural levees along the Sacramento River were elevated above tide level and were infrequently overflowed by floods. They contained more coarse inorganic sediment deposited by river floods than the island peat, creating relatively wide zones of oak dominated forest often greater than half a mile in some locations and characterized by a dense understory. Several early maps document the presence of scrub along reaches where large trees are depicted upstream (more fluvially dominated with larger natural levees) and tule marsh is depicted downstream (more tidally influenced with low natural levees).

Most of this ecological site has been substantially altered from its pre-gold mining era conditions. This is largely due to changes in hydrology which has fragmented the ecological site in terms of spatial continuity and natural flood disturbance dynamics.

Historical accounts of the extent of this ecological site indicates it was best associated with the Sacramento and Feather river delta complex rather than that of the San Joaquin portion of the Delta (SFEI, 2012). This is likely due to the significantly less frequent peak discharges of the San Joaquin watersheds and lower elevation of the natural levees which were likely subjected to more frequent inundation as indicated by the broad distribution of histosol soils within the southern Delta (ecological site 016XA001). Through the primary influence of riverine hydrology and to a lesser degree tidal hydrology, the soils of this ecological site represent the tide-impeding natural levees of the northern Delta as well the plant communities most likely to be excluded by high water table influences within the LRU.

Stand-replacing events on this ecological site are less frequent than on lower elevations of the landscape due to the lower frequency of high volume flood events. Very large events carrying substantial sediment and coarse wrack (woody debris rafts) were more likely to displace and/or uproot all but the most firmly-rooted of individual trees within the affected zones. Such very large events might have been localized or during the highest impact flooding nearly across the entire extent of the site. Under historic conditions this would likely mean that the lower extents of the ecological site would be more frequently subject to disturbance and likely occupied by short-lived willow (*Salix*) and alder (*Alnus*) species whereas the highest elevations of this ecological site would likely be populated by longer-lived sycamore (*Plantanus*), cottonwood (*Populus*) and occasional valley oak (*Quercus lobata*) in a mixed riparian forest (2007, Vaghtia and Grecko).

Hypothetically, under the current hydrology, the tops of the remnant natural levees are likely subject to lower intensity flows than historically experienced while lower along these features, disturbance to vegetation from flooding is likely less frequent as moderated by flood control and water development projects. If the natural levees were intact, this altered hydrology would likely increase the dominance of more drought-tolerant species such as Northern California walnut (*Juglans hindisii*), black walnut *Juglans nigra* and oak (*Quercus*) species while reducing recruitment of disturbance dependent species such as cottonwood, sycamore, alder and box-maple (*Acer negundo*).

Given that most of the ecological site has been heavily modified and fragmented, similar natural levees and backwaters in MRLA 17 such as at the Cosumnes River Preserve and Caswell Memorial State Park (Stanislaus River) may provide stronger contemporary analogs of historic vegetation conditions than can be observed on this ecological site today. Several tributaries to the San Joaquin give rise to similar natural levee riparian forest types as found in MLRA 16 and described for this ecological site. However, sediment depletion near the bottom of these steeper, smaller watersheds reduce the preponderance of natural levees in the San Joaquin system as it arrives in MLRA 16.

This ecological site is typically not in agricultural production but more frequently has been used as borrow areas for augmenting low elevation natural levees and/or developed for various infrastructure purposes. A few areas not substantially directly converted are isolated behind levees and are unlikely to be subjected to natural flood disturbance thereby dramatically reducing the ability of flood disturbance-obligate vegetation to compete with more typical upland vegetation.

State and transition model

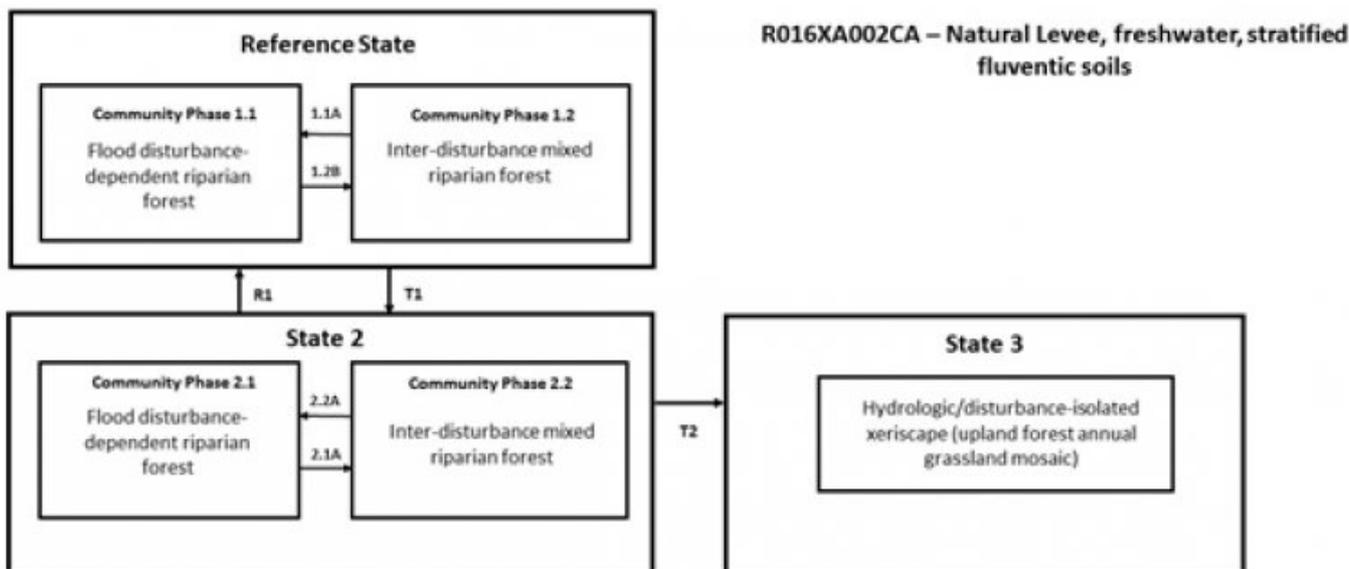


Figure 6. STM016XA002

State 1 Reference State

The species composition of the two community phases of the reference state are poorly documented in relation to the site and are better understood at the scale of riverine fluvial dynamics as a diverse mosaic of riparian forest vegetation types. This reference state consists two community phases, 1.1 which represents a recently disturbed, inundated and/or deposited soil dominated by pioneering upland and facultative wetland vegetation, and community phase 1.2 representing a less recently disturbed complex of tree species. Not surprisingly, this vegetation of community phase 1.2 represents the continuous accumulation of organic material in the soil from onsite vegetation contributions leading to the histosol classification of the representative soils. While most of the LRU has been subjected to significant hydrologic alteration, echoes of these two community phases remain observable in areas which were deemed too economically difficult to reclaim for agricultural purposes or where such efforts to reclaim the land failed and the preexisting hydrology exerted itself.

Community 1.1 Flood disturbance-dependent riparian forest

Immediate flood zone community phase. Alder, willow, cottonwood and other fast growing disturbance-dependent facultative wetland species dominate in typically even-aged cohorts.

Forest overstory. Alder and cottonwood overstory cover is limited by frequent disturbance while understory composition of these species often excludes other species following disturbance by flooding.

Forest understory. Alder, cottonwood, Salix sp.

Community 1.2 Inter-disturbance mixed riparian forest

Disturbance-delayed community phase/mixed riparian forest. Cottonwood, sycamore, elderberry, wild rose, and blackberry dominate in mixed-age stands. Valley oak and Northern California walnut likely occur at the highest elevation of this ecological site in their highest densities.

Forest overstory. Cottonwood, sycamore, California walnut, and valley oak dominate.

Forest understory. Elderberry, wild rose and blackberry dominate. Milkweeds, coyote brush and poison oak likely also present.

Pathway 1.2A

Community 1.1 to 1.2

Prolonged periods between flood events lead to declining dominance of short-lived flood disturbance-dependent species and increases diversity of upland shrubs and long-lived trees.

Pathway 1.1A

Community 1.2 to 1.1

Periodic flooding removes all but the deepest rooted trees and results in even-aged cohorts of flood disturbance-dependent species.

State 2

Hydrologically Modified, Disturbance-Poor Forest Complex

This state represents conditions consistent with altered flood frequency, timing and intensity and is the representative state. Less frequent flood pulses and lower elevation of flood levels have disrupted historic patterns of vegetation and their diversity. Novel species such as *Arundo donax* opportunistically occur within the lowest elevations of the ecological site, occasionally to the exclusion of native vegetation and *Juglans* sp. significantly increasing in extent and density across the drier portions of the ecological site (P. Kirk in Vaghti and Grecko). The shift in the disturbance regime and the elevation of flood waters has resulted in the reduced width of nearly exclusive cottonwood stands which typically occupied the elevations between recently disturbed low elevation and upper elevation mixed riparian forest; the latter community type becoming more extensive than historically present where the historic floodplain has remained intact. The potential of full restoration of this ecological site is greatly reduced due to major direct alteration to the soils of the site and the proximity to economically important infrastructure which almost certainly would be directly affected as this ecological site occurs at the highest elevations of the MLRA. Hypothetically, there is potential to restore limited extents of the ecological site through the strategic restoration of hydrology as part of a comprehensive solution for addressing hydrology across the MRLA. Operationally, vegetation enhancement is socially and economically more viable considering total long term costs.

Community 2.1

Flood disturbance-dependent riparian forest

Willow and cottonwood are clearly dominant species while giant reed (*Arundo*) is recognized as a problem in some areas contiguous to this ecological site and the LRU primarily along levees.

Forest overstory. Cottonwood and alder may occasionally reach mature heights.

Forest understory. Willow, alder and cottonwood dominate in mostly uniform single-aged cohorts.

Community 2.2

Inter-disturbance mixed riparian forest

Walnut species and oak species codominant in this community phase with some sycamore present. Cottonwood may be present in the ecotone between disturbance-isolated portions of the ecological site but is largely a minor species in this community phase. Understory species includes black berry, elderberry, wild rose and other shrubs.

Forest overstory. California walnut, and valley oak dominate.

Forest understory. Wild rose and blackberry dominate.

Pathway 2.1A

Community 2.1 to 2.2

Prolonged periods between flood events lead to declining dominance of short-lived flood disturbance-dependent species and increases diversity of upland shrubs and long-lived trees.

Pathway 2.2A

Community 2.2 to 2.1

Periodic flooding removes all but the deepest rooted trees and results in even-aged cohorts of flood disturbance-dependent species.

State 3

Hydrologically Isolated, Disturbance-Poor Woodland Mosaic

This state represents the highest degree of alteration of the ecological site primarily through direct alteration of the ecological site and nearly complete hydrologic isolation. Retrieval of natural levee soils for construction of additional levees, transportation infrastructure and general isolation from flood disturbance have resulted in a discontinuous oak woodland with a largely Mediterranean annual grass understory. While hypothetically restoration may be possible, politically and economically vegetation enhancement in the form of ongoing invasive species control and cyclical direct plantings of oak species may be the only way to retain the hallmark species of the historic conditions.

Transition T1

State 1 to 2

Natural flood regime is altered somewhat extending the period between peak flood events and dramatically reducing the frequency and elevation of what would be natural moderate flood events.

Restoration pathway R1

State 2 to 1

Removal of barriers to natural hydrology and flood disturbance.

Transition T2

State 2 to 3

Elimination of flood disturbance of the ecological site through permanent isolation from river hydrology.

Additional community tables

Other references

Galloway, D., Jones, D. and Ingebristen, S.E., 2013. Land Subsidence in the United States. USGS Circular 1182.

Sands, A. 1977. Riparian Forests in California: Their Ecology and Conservation. Institute of Ecology, UC Davis and Davis Audubon Society, Pub. No. 15.

Vaghti, M.G., and Greco, S.E. 2007. "Riparian Vegetation of the Great Valley" in Terrestrial Vegetation of California, 3rd Edition, Barbour, Keeler-Woof & Shoenherr Eds., University of California Press.

Whipple, A, Grossinger, RM, Rankin, D, Stanford, B, Askevold, RA. 2012. Sacramento-San Joaquin Delta Historical Ecology Investigation: Exploring Pattern and Process. San Francisco Estuary Institute, 672: 408 pp.

Contributors

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Acknowledgments

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

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

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

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

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

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

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

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

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

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

Dominant:

Sub-dominant:

Other:

Additional:

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:**
