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Report and GIS layers are available on SFEI’s website, at www.sfei.org/HEEastContraCosta.

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Front cover: Views of East Contra Costa County through time. Top: View from Fox Ridge west towards Mount Diablo, 2010; Middle: Kellogg Creek, ca. 1920 "In NW 3/4 sec. 3, 25, 2E, on road slope from hill looking N. along Kellogg Creek"; Bottom: Detail from USGS 1916 (Byron Hot Springs quad).


Title page: View of Kellogg Creek watershed, looking south toward Brushy Peak, ca. 1920. Near present-day Los Vaqueros Reservoir on section 21 (SE quarter) Township 1 South, Range 2 East.

Courtesy of the California Historical Society.
This map reconstructs characteristics of East Contra Costa County prior to significant Euro-American modification (mid-1800s). Some upland features are more reflective of 1930s conditions. Present-day road and city locations are provided for context.

Also mapped but not visible at this scale due to their relatively small size are the following wetland features: perennial freshwater ponds, perennial alkali ponds, seasonal lakes, and seep wetlands. Valley freshwater marshes may also be difficult to see. For these features, see the larger scale maps in the Map Section.
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This project built on work completed by others in this region, including the Contra Costa County Watershed Atlas and extensive work completed by the East Contra Costa County Habitat Conservation Plan Association and Jones & Stokes to create the Habitat Conservation Plan/Natural Community Conservation Plan. In addition, we drew upon a series of reports by the Natural Heritage Institute covering Marsh Creek, Dutch Slough, and Mt. Diablo Creek. We thank Sean Micallef for sending a copy of his thesis, and Sheila Barry and Cyndy Shafer for contributing additional reference materials. Seth Adams, Steve Edwards, and Pete Englehart contributed information on the cultural and ecological history of the region.

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CHAPTER 1
INTRODUCTION

Standing on the summit of Mount Diablo, that cone-like pinnacle...a panoramic view is obtained that, however gifted, no artist’s brush could paint or pen faithfully portray. It is simply a wonderful and interesting picture of valley ‘cradled in the hills,’ of farms, orchards, hamlets, towns, cities – long stretches of watercourses, silvery in the sunlight – great bays and far-reaching inlets, with sail and steam craft crawling on their surface like flies on a gigantic mirror – vast areas of plains – the islands of the great delta of the Sacramento and San Joaquin rivers; and beyond, dim in the distance, the Sierras lift their lofty and luminous summits, snow-crested, into the imperial blue of unclouded skies.

—R.G. DeAN IN HULANSKI 1917

East Contra Costa County is a complex and ecologically important region. It is topographically diverse, ranging in elevation from Mount Diablo at 3,849 feet to the tidelands of the Sacramento-San Joaquin Delta which lie at or below sea level. The region is also climatically diverse: while the western edge receives some marine influence, the east lacks this moderating force and can become hot and dry – rainfall varies from 13 to 23 inches per year (Jones & Stokes 2006). Finally, the region has a complex geology as a result of the uplift that created Mount Diablo. These factors combine to create highly variable soils and a wide range of land cover types (fig. 1.1). Historically, a patchwork of chaparral, savanna, grassland, and woodland covered the hills; intermittent and ephemeral streams drained into wet meadows in the north; a swath of dense interior dune scrub covered 2,800 acres in the northeast; and alkali wetland complexes spread towards tidal marsh in the southeast.

Although substantial portions of East Contra Costa County remain relatively undeveloped, extensive landscape change has occurred over the past 200 years. Many habitats have been lost or altered, particularly in the more intensively developed lower elevations. Many questions exist about the pre-modification distribution of habitats, the processes that controlled their formation and maintenance, and the changes that have resulted from historical land use. The study of historical ecology can address these information gaps, providing a critical foundation for successful environmental planning (NRC 1992, Montgomery 2008). Through comparison to contemporary conditions, historical ecological research can identify new conservation strategies that could not have been recognized without historical information (e.g., Grossinger et al. 2007, Walter and Merritts 2008).
Historical ecology seeks to describe historical landscape patterns to improve understanding and management of the contemporary landscape. The goal of this report is to document landscape features as they existed, on average, during the first decades of Euro-American settlement, and to help translate this information into useful tools for present-day land managers, scientists, and residents. To do this, we synthesized an array of records documenting the landscapes of East Contra Costa County prior to significant Euro-American modification. This report and the associated geo-database provide a spatially comprehensive dataset documenting the distribution, and abundance of the historical native habitats of East Contra Costa County. The approximate time period for our historical habitat map is the mid-1800s, although portions of the map (including the uplands) are more representative of 1930s conditions. The mid-1800s is the earliest date with enough historical evidence to support our mapping process. We did not attempt to exhaustively document land use history or record all changes that have occurred since European contact. Rather, the focus is on describing ecological and landscape-level patterns across the region.

**DESIGNING RESILIENT LANDSCAPES:**
**HISTORICAL ECOLOGY, RESTORATION, AND CLIMATE CHANGE**

Restoration goals should be informed by knowledge of landscape conditions before modern development. Historical ecology research improves our understanding of the habitats we seek to restore, including the physical and cultural processes that governed their former distribution. Studying the landscape under earlier, less impacted conditions facilitates a landscape perspective that addresses questions fundamental to the restoration planning process: What habitats were supported where, and why? Where have certain habitats persisted? How have landscape patterns and process changed over time? Most importantly, how do we choose appropriate restoration and management targets?

Historical ecology has particular relevance to these questions in the context of global climate change. As we anticipate a more variable climate in the future, we can learn from the ways in which dynamic historical ecosystems were able to respond and adapt to extreme conditions in the past. The harsh semi-arid conditions of East Contra Costa County supported plant communities adapted to low rainfall and high temperatures, including alkali communities and the Oakley sand dune scrub. Embracing and understanding these communities may help us design more resilient, well-adapted suites of plant species in the future.

Historical ecology is an essential component of restoration design, but it is not an answer in and of itself. It is a tool for scientists and managers seeking to understand and recover from the dramatic landscape changes of the past 250 years. When integrated with contemporary data and future projections, historical information helps identify restoration opportunities and develop realistic management strategies. Often these would not be recognized without a historical perspective. Though controls on habitat distribution such as land use and climate may change, others, such as topography and geology, remain relatively stable (fig. 1.2). Historical ecology helps us understand which characteristics supported native species of concern and how these can be recovered or enhanced. Understanding the landscape patterns and processes of the recent past can help us establish functional, resilient systems that improve the ecological health of the region.

The recently adopted East Contra Costa County Habitat Conservation Plan/ Natural Community Conservation Plan (HCP/NCCP; here referred to as the HCP) and other local environmental planning efforts have recognized the need for a better understanding of the historical ecology of the area to inform the protection, restoration, and enhancement of local natural resources. Accordingly, this historical analysis has been developed to inform strategies for habitat restoration and conservation, acquisition priorities, natural flood protection, parkland management, and other environmental management activities. An important goal of many restoration projects is to reestablish site conditions that existed historically in order to enhance ecosystem function and habitat for local endangered and threatened species. The HCP also calls for improved management in many upland communities. This report is intended to help inform the design and implementation of these and other restoration and enhancement projects. This information is also made publicly available as a tool for future research and an information resource for other local and regional planning efforts. The report and accompanying GIS data can be downloaded from www.sfei.org/HEEastContraCosta.

Today East Contra Costa County is home to over 250,000 people. Brentwood grew 120% between 2000 and 2010, and the region as a whole added over 50,000 residents (U. S. Census Bureau 2010). However, many undeveloped and protected spaces remain. Urban development covered 19% of the HCP area in 2006, with agriculture (primarily croplands) covering an additional 22% (Jones & Stokes 2006). Alkalai, dryland, and wetland habitats (including reservoirs and non-native woodlands) covered 57% of the study area.

This study focuses on the 174,018 acre area covered by the HCP, plus adjacent tidal marshlands (fig. 1.3). Throughout this report, we refer to the study area as East Contra Costa County, or ECCC. The ECCC study area covers approximately one-third of Contra Costa County (187,230 acres). On the south side, the boundary follows the county line with Alameda County. The southwest boundary follows the watershed divide that separates the Alameda Creek watershed (draining to the Bay) from creeks to the east that drain to the Delta. The city limits of Clayton and Concord form the western and northwestern boundaries. The northern boundary follows the county line with Solano County. The eastern boundary extends beyond that of the HCP to incorporate the tidal habitats of the Sacramento-San Joaquin River. The eastern boundary follows that of the HCP inventory area except for an extension to the east beyond the town of Discovery Bay.

We begin the report with a general discussion of research methods and an overview of historical land use in the region to provide context for our findings. We then review and analyze our results for each of three broad habitat classes: streams and riparian habitats, wetland habitats, and dryland habitats. For each habitat class we present methods, results, and discussion of key findings. At the end of each chapter is a boxed text including a summary of findings and management implications for the chapter. Appendices discuss additional methods in greater detail.
Figure 1.3. Study area and geographic locator map. The study area is in light green in the inset above and outlined in orange on the map at right. The contemporary stream network is shown on top of the aerial imagery. (Imagery USDA 2005, courtesy of NAIP)
East Contra Costa County has alternately charmed and dismayed visitors for centuries. Explorers and travelers from Europe and the eastern United States had difficulty appreciating the American West, and found the vastness of the landscape and the relatively dry climate unsettling (Hyde 1993, Stegner 2002). Their expectations, combined with the seasonal and regional variability of the region resulted in a range of somewhat contradictory descriptions.

In particular, the plains north and east of Mount Diablo often evoked uneasy responses from early visitors and settlers, who were struck by the barren and dry landscape. Prospectors passing Pittsburg en route to the gold mines in the Sierra foothills were dismissive of the northern shoreline, and one gold seeker from Ireland noted “this is a wretched looking town... built on very low swampy ground, up to this I may say that the land along the banks is not of much value being of a barren nature” (Kerr 1850). William Brewer, the chief botanist for the California Geological Survey (fig. 1.4), lamented in October of 1861 that there were “no trees to cheer the eye, no water in the many canyons and ravines...found no water for self or mule, except some alkaline springs which neither mule nor I could drink” (1974).

However, over time residents came to describe even these plains in more favorable terms, noting the oaks, wildflower displays, and agricultural productivity: “The country is beautified by live oaks... It is a charming drive through this brushy, varied tract to Brentwood, especially when spring has spread the ground with a carpet of many colors, white, crimson, purple and yellow, in large continuous patches” (Contra Costa Gazette 1887).

Although the East Contra Costa plains were largely cleared for agriculture, farm and ranch houses were usually situated by clumps of remaining trees, or by ornamental trees that were planted to supplement or replace the native oaks (Smith and Elliot 1879). Remnants of the savanna after agricultural clearing can be seen in historical aerial photos and contemporary imagery, as in figure 1.5, showing an area by Point of Timber Road west of Discovery Bay.

Views across the county from Mount Diablo were also often described in glowing terms. Josiah Whitney, Chief of the California Geological Survey, was particularly impressed:

The view from the summit is magnificent... around the base of the mountain you behold, in all the elegance of their graceful outline and the beauty of their light and shadow, the admirably rounded foothills, gradually diminishing in prominence until they merge with the delightful valleys through whose groves of wide-spreading oaks and sycamores the eye involuntarily traces out the meandering courses of the sparkling waters, that, after having dashed down their rugged mountain channels, appear to delight to linger amid the scenes of beauty with which they are surrounded. (Contra Costa County 1887)

Early settlers learned to appreciate the unique nature of the area, and to understand to the seasonal variability of rainfall. In May of 1862 – the spring of a year with record rainfall, and six months after the quote above – Brewer’s perspective had changed:

Everything has ‘greened up’ marvelously, and this region, so brown, dry, dusty, and parched when we visited it last fall, is now green and lovely, as only California can be in the spring. Flowers in the greatest profusion and richest colors adorn hills and valleys and the scattered trees are of the livestilest and richest green. (Brewer 1974)

The xeric nature of East Contra Costa continues to challenge our conceptions of how a system ‘should’ work. By carefully uncovering the story of the ecological past we can hopefully learn to adapt more fully to this varied and rich region.

Differing Perspectives on East Contra Costa County


Figure 1.5. Trees on the former oak savanna near Discovery Bay. (Top: USDA 1939, courtesy of CCC and Earth Sciences & Map Library, UC Berkeley. Bottom: USDA 2005, courtesy of NAIP)
I cannot say that I understand this diseño, it has no scale on it and nothing to show how much land it is intended to contain.

— WILLIAM W. SMITH 1855, FIRST ALCADÉ OF NEW YORK OF THE PACIFIC, CONTRA COSTA RESIDENT SINCE 1849, SPEAKING OF LOS MEÑANOS Diseño, MADE CA. 1839

To reconstruct the past landscape of East Contra Costa County, we collected hundreds of historical textual and graphic records, and synthesized these with useful contemporary datasets such as soils, topography, hydrology, and vegetation. This section describes the general methods used throughout the study. Additional description of methods specific to each habitat type is provided in the landscape analysis chapters.

DATA COLLECTION

A substantial variety and quantity of historical data are needed for an accurate assessment of the historical landscape (Grossinger 2005). With this in mind, we assembled a diverse range of records spanning more than two centuries. We then compiled these data into a map of historical landscape patterns as we believe they existed around 1850.

Assembled materials included textual data (e.g., Spanish explorers’ accounts, Mexican land grant case court testimonies, Public Land Survey records, early travelogues, and Contra Costa County histories and reports), maps (e.g., Mexican land grant maps, early city and county maps and surveys, USDA soil surveys, and US Geological Survey maps; fig. 2.1, 2.2), and paintings and photography (both ground-based and aerial). We used a customized Endnote database to catalogue these historical data sources and produce bibliographies.

To acquire these sources, we visited local historical archives (e.g., Contra Costa County Historical Society, East Contra Costa Historical Society and Museum, Pittsburg Historical Society), county offices (e.g., Contra Costa County Public Works Department, Contra Costa County Recorder’s Office), and regional archives (e.g., California Historical Society, The Bancroft Library at UC Berkeley, Bureau of Land Management). We also reviewed material available online and conducted searches of over twenty electronic sites and databases, including the Online Archive of California, California Natural Diversity Database, the Library of Congress Online Catalog, and others. Early aerial photographs covering the study area were acquired and scanned through a partnership with the Earth Sciences & Map Library at the University of California, Berkeley.

Figure 2.1. U.S. Geological Survey (USGS). Top row: (A) detail from a Meganos land grant map by A.W. Von Schmidt in 1861; (B) a surveying compass which was used by early surveyors to measure direction; and (C) a portion of a USGS map near Antioch. (D) Surveyors in the field ca. 1925 working with an alidade and a plane table. The alidade was used to sight an object and draw a line or angle on the plane table during the construction of a topographic map. (A: Los Meganos land grant map, courtesy The Bancroft Library, UC Berkeley; B: courtesy U.S. Geological Survey; C: USGS 1918 (Collinsville); D: USGS ca. 1925, courtesy U.S. Geological Survey)
Figure 2.2. Rancho de Los Meganos, J. E. Whitcher, 1853(a). This map depicting the extent of John Marsh's land grant claim is remarkably informative. Natural landmarks depicted include stream channels, springs, alkali flats, tidal marsh, and areas of oak savanna. While many land grant maps are not to scale and show only the general relationship between features rather than precise locations, this map is highly accurate. Whitcher, an experienced surveyor, added township, range, and section lines, which allow for accurate depictions within each section of the map. The map is shown georeferenced in the inset at right but the map below is as Whitcher oriented it with the San Joaquin River and Marsh's Landing as the primary points of entry. The original map measures approximately 34 inches wide by 28 inches high. For each numbered point below, an illustration with additional map sources is shown in the boxed text on the opposite page. (Courtesy of The Bancroft Library, UC Berkeley)
We collected two additional specialized and highly detailed sources. Public Land Survey (PLS) data produced by the General Land Office (GLO) cover the entire study area in a one mile grid, excluding land grants. The GLO survey came to Contra Costa County in 1851 and provides detailed point information on stream crossings and vegetation (see box text on p.11 and further discussion in Chapter 6, p.75). Additional vegetation information came from a dataset produced under Alfred Wieslander in the 1930s, which we were able to acquire as vectorized polygons from Jim Thorne of the Information Center for the Environment (ICE) at the University of California, Davis.

We reviewed an estimated 6,000 historical documents (maps, photographs, and written materials) and acquired full or partial copies of over 2,000. This variety of documents from different eras allowed us to use independent sources to intercalibrate or triangulate landscape features (Grossinger et al. 2007). While we reviewed a large amount of information for this study, the local historical record is voluminous. Additional information will likely be discovered in future years that can contribute further refinement of our understanding of the local landscape.

**INTERPRETATION OF HISTORICAL DOCUMENTS**

Accurate interpretation of documents produced during different eras, within differing social contexts, and by different authors, surveyors, or artists can be challenging (Harley 1989, Askevold 2005, Grossinger and Askevold 2005). To address these concerns, we used a number of independently-produced documents, covering a range of eras, to assess the accuracy of each individual document and to promote accurate interpretation of landscape characteristics. This approach, which requires document redundancy, provides the only independent verification of the accuracy of original documents and of our interpretation of them, given the unavoidable absence of replicate samples and predetermined methods (Grossinger 2005, Grossinger and Askevold 2005; see box at right).

We examined historical data for evidence of landscape characteristics prior to significant Euro-American modification. Despite inter-annual and decadal-scale variability, climatic characteristics during the period for which historical data were obtained (1770s-1940s) were relatively stable (Dettinger et al. 1998). Land use was much more variable during this time, so we focused on differentiating natural and anthropogenic features. We were careful to map only features that were not the result of agriculture or other 19th century land use or extreme climatic periods. Quantitative and textual descriptions of climatic conditions (floods, droughts, and rainfall) and land use regimes (native management, grazing, dry-farmed agriculture, and irrigated agriculture) were recorded and compiled. We attempted to document features using multiple sources across the focal time period to assure persistence and accurate interpretation. For example, GLO survey data describing a pond approximately 30 meters wide was supported by a depiction of a lake on...

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**COMPARISON OF DIFFERENT MAP SOURCES**

1. This section of Marsh Creek, at the confluence with Briones Creek, was the site of John Marsh's homestead. The 1853 map depicts Marsh's house, garden, and fence on the edge of Marsh Creek. It also shows a band of trees along Marsh Creek and scattered trees in the surrounding valley. The same pattern is indicated in this 1861 map by Von Schmidt, which shows trees around Marsh's Stone House, completed in 1856. The red dots link the same position on the two images. (See p. 81 for more on this oak savanna.)

2. John Marsh's ranch was called Los Meganos (“the sand dunes”), in reference to the sandy soil formation that covered the northern portion of the land grant. Dunes, drawn in 1853 as a speckled pattern, are depicted in the 1918 U.S. Geological Survey quadrangle (Collinsville) as hills of sand up to 120 feet high. Part of this area, just to the east of present-day Antioch, is protected by the U.S. Fish and Wildlife Service as a refuge. (See pp. 90-92 for more details.)

3. A large salt pond surrounded by scrubby vegetation was drawn on the southeastern edge of the land grant boundary. In a 1939 aerial photograph, the same feature—the complex of alkali springs and flats at Byron Hot Springs—is clearly seen from the air. (See p. 54 for a larger comparison of these two images.) In all comparisons, Whitcher 1853a courtesy of The Bancroft Library, UC Berkeley.

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continued on page 10
HISTORICAL DATA FOR CONTRA COSTA COUNTY

For this project, we collected a wide variety of historical material, including early journals, diaries, and newspaper accounts that describe the ecology of the area; historical maps, surveys, and aerial photos that show where early features were located; and historical landscape photographs, drawings, and paintings that help us understand the historical wetland, dryland, and riparian habitats. Because these sources were produced for a variety of reasons in previous eras, we need to understand who made the maps and for what purpose so that we can evaluate and use the data appropriately.

To do this, we also collected information about the surveyors, the agencies they worked for, technical constraints such as scale or mapping methods, and the timing of the document in relation to landscape change. Shown below are examples and brief descriptions of some of the primary sources used in the study. Most of the maps and historical aerial photographs below were placed in physical space and tied to geographical coordinates (georeferenced) in a geographic information system (GIS), as was narrative data that could be accurately located. Examples elsewhere in the report show how multiple sources are used to calibrate our assessment of the historical environment.

Mexican land grant sketches (1840s-1850s). As the Mission system disintegrated, influential Mexican citizens submitted claims to the government for land grants. A diseño—rough sketch of the property—was included with each claim, and showed distinctive features of the land, such as creeks, wetlands, and woods—often with watercolors, handwritten annotation, and varying systems of symbols and styles. They are some of the earliest maps available of the California landscape. Despite their valuable information, they have been rarely used for environmental research. The detail on the right of Los Vaqueros diseño, ca. 1840(b), shows a pond or spring (Ojo de Agua) adjacent to Kellogg Creek in the foothills. (courtesy of The Bancroft Library, UC Berkeley)

General Land Office Public Land Surveys (1851-1875). The U.S. Public Land Survey imposed a series of straight lines on the land, dividing property into 6-mile-square townships. Each township was further subdivided into 36 one-mile sections, each section containing 640 acres. Surveyors methodically surveyed section lines with a measuring devise called a Gunter’s chain, noting up to four bearing trees at each mile and half mile point, and recording the species and diameter of each tree. They often described natural features such as creek crossings, pools of water, rock formations, and scattered trees. (courtesy of the BLM)

In this plat, surveyor Sherman Day noted in June of 1853, “The line on this mile passes over a mountain some 1000 or 1200 feet above the valleys below: yellowish, gray sandstone dipping to NE, scattered timber on the sides. Live oak, white oak, buckeye, sycamore, mansanita [sic] bushes, and chamisal.”

Textual accounts (1772-2011). Written accounts can provide a wealth of detailed information. Spanish expeditions were chronicled in substantial detail, and represent the earliest Euro-American descriptions of the California landscape. Testimony in land grant cases included interviews with local residents and contained details about natural boundaries and features. Surveyors often kept detailed notes about what they mapped. Newspaper accounts add details about early land use history, and major events such as floods or fires that affect the landscape. (Courtesy of the Library of Congress)

Land grant confirmation maps (1850s-1880s). After the U.S. took control of California in 1848, land grantees were forced to prove the legitimacy of their claims. The claimants had to pay for confirmation surveys performed by civil engineers, under the direction of the U.S. Surveyor General. While the diseño was a freehand drawing produced without survey equipment or specialized expertise, confirmation maps were filled with a table of angles and distances in chains. This map of the Rancho Los Medanos was made by J.T. Stratton in 1863(a). While it shows little detail of natural features, it accurately locates the nascent town of Antioch. (courtesy of the BLM)

U.S. Coast and Geodetic Survey maps (1866-1887). The U.S. Coast Survey was established in 1807 by Thomas Jefferson to create navigation maps. The large-scale map shown at the right, published in 1887, shows detailed patterns of tidal marsh, sloughs, and tidal ponds just east of present-day Pittsburg. The area is characterized by long tidal ponds reaching inland beyond the tidal marsh, providing a transitional ecotone between tidal marsh and upland grasses. The dark shaded areas on the shore and surrounding nearby Browns Island are depictions of new sediment washed down-river from hydraulic gold mining. These maps are also referred to as topographic sheets (T-sheets). (Davidson 1887, courtesy of NOAA)

An 1899 story titled “Building a Railroad Through a Swamp”, in the San Francisco Morning Call, describes building “an enormous levee” 12 miles long across the tidal land from Brentwood to Stockton before the tracks were laid for the Sante Fe Railroad.
City and county surveys (1870s-1930s). This 1871 county-wide map by Britton and Rey was compiled from the California State Geological Survey, a short-lived but highly regarded state agency that preceded the U.S. Geological Survey. This detail from the map covers the area from Clayton Valley to Mount Diablo, and shows topography, creeks, springs, early roads and trails, township and range section lines, property owners, and some of the Black Diamond coal mines. Large-scale road surveys can also be useful, as they describe features such as creeks or flooded areas. (Courtesy of Contra Costa County Public Works Department)

USDA soil surveys (1933-1977). The first U.S. Department of Agriculture soil survey was published in 1899. Early soil surveys were developed to describe the agricultural viability of the soils, but the descriptions can also provide evidence of native vegetation and hydrologic conditions. For example, the Olcott loam soils (Ol) shown on the 1933 soil map to the right by Lawlor Ravine are described as “hard and baked when dry”, and “boggy following heavy rains” (Carpenter and Cosby 1939), indicating potential areas of seasonal wetland. These data were used in conjunction with remnant traces on the historical aerial photography to classify wet meadow habitat in this area.

U.S. Geological Survey topographic maps (1896-1970s). The USGS was established in 1879, and until 1900 the largest scale map the agency produced was 1:62,500 (approximately 1 mile to the inch). Shortly after 1900, the USGS started producing maps at twice the scale (1:31,680) for areas of interest. The northern and eastern portions of the study area are covered by these more detailed topographic base maps, with contour intervals of five feet. The area shown here, from the Honker Bay quadrangle (1918), shows detail in the tidal marsh and shoreline along the Suisun Bay.

Historical aerial photography (1939). An ambitious Depression-era program to ensure crop stabilization and soil conservation practices resulted in extensive vertical aerial photography for agricultural areas of the country. The images for Contra Costa were taken in 1939 and provide continuous coverage across the project area. While relatively late, the photos nevertheless reveal patterns of historical creeks, alkali wetlands, and woodland, savanna, chaparral, and grassland. Even where agriculture has replaced the natural landscape, trace evidence of natural features often remains, as shown in this image near Byron Hot Springs. (USDA 1939, courtesy of Contra Costa County and Earth Sciences & Map Library, UC Berkeley)

Landscape photography (late 1800s-present). Historical photographs represent a diverse category of historical data that can provide invaluable information not available elsewhere. Research to establish photograph location and land use history makes information gathered from photographs more readily applicable. This early 1930s photograph, part of the Wieslander Vegetation Type mapping documentation, shows the endangered Mount Diablo manzanita (Arctostaphylos andersonii auriculata) on a rocky slope just south of Somersville. Coulter (Pinus coulteri) and gray pine (Pinus sabiniana) can also be seen in the photograph. (courtesy of the Marian Koshland Bioscience and Natural Resources Library, University of California, Berkeley)

Wieslander Vegetation Type Maps (1930s). Maps of California vegetation were developed by Alfred Wieslander for the USDA Forest Service in the 1930s. The maps were created in the field by crews who drew polygons representing vegetation directly on 15-minute USGS quadrangles. They mapped vegetation composition, including the dominant plant species but also less dominant species. We developed a method to adjust the original polygons to historical aerial imagery, thus improving the spatial data while retaining the complexity. Additional detail about this process can be found in the Drylands chapter. This detail from the original quadrangles shows an area near Curry Canyon. (courtesy of ICE, UC Davis)
a Contra Costa County map and more precisely located using both a modern map showing topography and historical aerial imagery showing remnant traces. For the lowlands, we attempted to map features as they would have existed in the mid-1800s, or before large-scale Euro-American modification, which was as early as our data would support. For the upland portion of the study, we relied heavily on 1930s Wieslander vegetation mapping, supported by 1939 aerials, which we believe to be largely representative of earlier conditions. A discussion of how this adjusted Wieslander data represents historical conditions can be found in the Dryland Habitats chapter.

**MAPPING METHODOLOGY**

A geographic information system (GIS) was used to collect, catalog, analyze, and display the spatial components of our data. The relational database component of the GIS allows for storing many attributes about each feature, making a GIS ideal for these tasks. We were able to step through time by assembling maps and narrative information from different time periods, which allowed us to both assess the different data sources and better understand change.

In the following text we describe how we integrated historical sources into the GIS and then synthesized these sources to produce our habitat map and analyses. We used ArcGIS 9.3.1 (Esri) software.

1) **Collection of Historical Spatial Data.**

During data collection, we evaluated sources for their potential usefulness in the GIS. Historical maps, aerial photography, narrative accounts describing a location, and surveyor point data are all potential GIS data.

2) **Addition of Historical Data to the GIS.**

We added sources that were suitable for use in the GIS by georeferencing raster maps or by digitizing narrative or survey data. This allowed us to compare historical data to each other and to contemporary aerial photography and maps.

We developed a continuous historical aerial photomosaic for the study area based upon the earliest available imagery (approximately 230 images, USDA 1939) using the Leica Photogrammetry Suite module of ERDAS Imagine 9.2. Images were orthorectified and mosaicked together to provide county-wide continuous coverage. The photomosaic was particularly useful for identifying wetlands, upland habitats, and former creek alignments within the pre-urban, agricultural setting. Although taken after many significant landscape changes had occurred, these photographs show traces of earlier landscape features that have since been lost. The consistency, accuracy, and high level of detail make these an invaluable source in analysis.

Accurate historical maps with pertinent land cover information were georeferenced to contemporary orthorectified aerial imagery (USDA 2005), using ArcGIS 9.3.1 (Esri). We developed a GIS database for the Public Land Survey data of the General Land Office, based upon a database and data entry form originally developed by the Forests Landscape Ecology Lab at the University of Wisconsin-Madison. The use of these data is discussed further in Chapter 6. Additionally, the GIS was also used to locate and hold textual information gathered from surveyor notes, early explorers’ journals, travelers’ accounts, and newspaper articles.

3) **Synthesis into a Composite Map**

We synthesized selected georeferenced historical data into a GIS to create a picture of historical habitat distribution and abundance. Certainty levels were assigned to each feature based upon qualitative or quantitative assessment. Our confidence in a feature’s interpretation, size, and location was assigned on a relative scale based upon the number and quality of sources and our experience with the particular interpretation, following the standards in Grossinger et al. 2007 (table 2.1, fig. 2.3).

Reliable historical evidence was found for mapping 15 historical habitat or land cover types. These are shown in table 2.2 along with corresponding contemporary wetland and vegetation classes. To record the variations in source data and confidence level associated with different features, we used a set of attributes to record both historical sources and estimated certainty levels. The application of attributes on a feature-by-feature basis allows users to assess the accuracy of different map elements and identify the original data, serving as a catalog of information sources (Grossinger 2005).

**Analysis and Comparison to Present-Day Conditions**

The recently completed work for the HCP served as our modern comparison data. The HCP identified 25 different land cover types, including wetland, alkali, agriculture, oak savanna, chaparral, and urban. We were able to use this data to track change from historical conditions, and also in some cases as a starting point for our mapping of historical cover.

In our analysis of ECCC we divided the region into geomorphic units based upon those developed by Jones & Stokes (2006) for the HCP (fig. 2.4). The plains region, or plains, includes lands below 200 feet. The foothills fall between 200-900 feet. The montane region includes lands above 900 feet. These divisions in elevation correspond to differences in topography as well as social history and land use. We found that these topographically-based units enabled us to summarize regional differences in stream characteristics, vegetation patterns, and human modifications.

**Figure 2.3. Interpretation certainty level for the historical habitat map.** Green areas have been assigned a high certainty level; yellow are categorized as having medium certainty level, and orange have been assigned a low certainty level.

**Table 2.1 Certainty level standards** (after Grossinger et al. 2007).

<table>
<thead>
<tr>
<th>Certainty Level</th>
<th>Interpretation</th>
<th>Size</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>High/&quot;Definite&quot;</td>
<td>Feature definitely present before Euro-American modification</td>
<td>Mapped feature expected to be 90%-110% of actual feature size</td>
<td>Expected maximum horizontal displacement less than 50 meters (150 ft)</td>
</tr>
<tr>
<td>Medium/&quot;Probable&quot;</td>
<td>Feature probably present before Euro-American modification</td>
<td>Mapped feature expected to be 50%-200% of actual feature size</td>
<td>Expected maximum horizontal displacement less than 150 meters (500 ft)</td>
</tr>
<tr>
<td>Low/&quot;Possible&quot;</td>
<td>Feature possibly present before Euro-American modification</td>
<td>Mapped feature expected to be 25%-400% of actual feature size</td>
<td>Expected maximum horizontal displacement less than 500 meters (1600 ft)</td>
</tr>
</tbody>
</table>
Contra Costa County’s earliest existing maps used natural features such as hills, ponds, stream courses, tidal marsh edges, and clusters of trees to indicate land grant boundaries and depict significant landmarks. When California became a state in 1850, the General Land Office (GLO) was charged with developing public land surveys on public domain land, allowing the federal government to more easily distribute property to settlers moving west. GLO surveyors were mandated by the federal Land Ordinance of 1785 to map land using a rectangular township and range system (Carstensen [1976]1985). Surveyors divided land into six-mile square townships with 36 one-mile square sections, parallel to an east-west baseline and a north-south principal meridian, creating a grid of imaginary lines over the state.

The method of surveying was called “chaining the land,” because surveyors used a device called a Gunter’s chain to measure distances. A Gunter’s chain was a steel or iron chain 66 feet long, consisting of 100 links, each 7.92 inches long (Uzes 1977). The chain, a compass, and a transit to measure angles (shown above) were used to methodically walk the section lines of every square mile, except those lands that were designated as land grants.

One of the earliest sources of systematic landscape descriptions in East Contra Costa is from the General Land Office (GLO) public land surveys, which started in the county in 1851.

Until 1910, the public land surveys were carried out by deputy surveyors who contracted with the federal government, and the survey teams were paid between $2 and $8 a mile. Deputy surveyors often held additional jobs or owned a farm or ranch of their own (Clement [1958]1985). Some were significant figures in regional surveying and engineering. Surveyors were instructed to record information about the land they were passing through, including the nature of the soil, minerals, trees and timber, tidal lands, creeks, springs, and alkaline ponds. Some surveyors used their experience and later became land agents, or purchased large tracts of land themselves. An understanding of the individual surveyor helped us to interpret the GLO data, as some surveyors were highly observant, and created detailed and descriptive field notes, while others recorded more limited inventories (Johnson 1976).

Following are descriptions of some early surveyors who mapped East Contra Costa.

**LEANDER RANSOM** (1800-1874) came to California in 1851 with Samuel King, the U.S. Surveyor General, and was charged with establishing an “initial point” for the primary principal meridian and baseline for California’s GLO survey (fig. 2.5). In July, 1851, Ransom and his survey crew traveled with pack animals loaded with survey equipment to the top of Mount Diablo, but found the terrain so rugged that they needed to create a series of offset lines below the peak to establish the initial point (White 1991). Ransom later served as Chief Clerk in the California Surveyor’s General office in San Francisco (Pettley [2000]).

**SHERMAN DAY** (1806-1884) was Surveyor General of California, a state senator, and superintendent of the New Almaden Quicksilver Mines. Day developed many of the General Land Office Public Land Survey data used in this report. Sherman Island in the San Joaquin Delta and Mount Day in the Sierra Nevada were both named after Day. To the right, Day is pictured with survey equipment in front of an Almaden Mine tunnel in a 1880s photograph by Carleton E. Watkins.

**E.H. DYER** (1822-1906) surveyed East Contra Costa for the GLO between 1861 and 1869. Dyer was born in Maine, and joined his brother in California in 1857. He later saw an economic opportunity in sugar beets and established the first successful mill in California. He owned several lots along Alameda Creek near Alvarado (present-day Union City).
TECHNICAL ADVICE AND REVIEW

We recruited advice and review from experts in a number of different fields, including ecology, geomorphology, geology, archaeology, and landscape history. Members of the Technical Advisory and Review Committee provided comments on the draft report; several advisors also provided guidance and review on specific topics during the course of the project.

Members of the Contra Costa Watershed Forum, the Friends of Marsh Creek Watershed, and Contra Costa County staff provided comment and advice through local presentations and project meetings.

Both the historical habitat map and the orthorectified historical aerial mosaic are available to the public. The habitat map and report can be downloaded at www.sfei.org/HEEastContraCosta.

Table 2.2. Habitat crosswalk. Crosswalk between historical land cover types used in this report and contemporary classification systems, including the HCP landcover types. The MCV types listed represent a sampling of the contemporary habitat types that could crosswalk with the historical types – the list is not exhaustive.

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Wetland Classification and Water Regime (Cowardin 1979)</th>
<th>Vegetation Classification (NDDB: Holland 1994; MCVII/CNDDB: Sawyer et al. 2009)</th>
<th>HCP/NCCP (Jones &amp; Stokes 2006)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal Marsh</td>
<td>Estuarine intertidal persistent emergent wetland. Regularly flooded, permanently saturated.</td>
<td>Coastal brackish marsh (NDDB), Coastal and Valley Freshwater Marsh (NDDB), American/ Hardstem/California bulrush marsh (MCVII)</td>
<td></td>
</tr>
<tr>
<td>Wet Meadow</td>
<td>Palustrine emergent wetland. Temporarily flooded, seasonally to permanently saturated.</td>
<td>Native grassland (NDDB), Valley wetland grassland (NDDB), Creeping reed grass turf (MCVII)</td>
<td>Seasonal Wetland, Grassland</td>
</tr>
<tr>
<td>Valley Freshwater Marsh</td>
<td>Palustrine persistent emergent freshwater/saline wetland. Temporarily to permanently flooded, permanently saturated.</td>
<td>Coastal and valley freshwater marsh (NDDB), California bulrush marsh (MCVII), Cattail marshes (MCVII)</td>
<td>Permanent Wetland</td>
</tr>
<tr>
<td>Perennial Freshwater Pond</td>
<td>Permanently flooded.</td>
<td></td>
<td>Pond</td>
</tr>
<tr>
<td>Alkali Meadow</td>
<td>Palustrine emergent saline wetland. Temporarily flooded, seasonally to permanently saturated.</td>
<td>Alkali meadow (NDDB), Alkali wetland - salt grass playas and sinks (MCVII), Salt grass flats (MCVII), Creeping reed grass turf (MCVII), Alkali heath marsh (MCVII)</td>
<td>Alkali Grassland, Alkali Wetland</td>
</tr>
<tr>
<td>Alkali (Valley) Sink Scrub</td>
<td>Palustrine emergent saline wetland. Temporarily flooded, seasonally to permanently saturated.</td>
<td>Valley sink scrub (NDDB), Iodine bush scrub (MCVII)</td>
<td>Alkali Grassland, Alkali Wetland</td>
</tr>
<tr>
<td>Alkali Flat</td>
<td>Seasonally flooded, temporarily to seasonally saturated.</td>
<td>Alkali playa (NDDB), Alkali weed-salt grass playas and sinks (MCVII), Salt grass flats (MCVII)</td>
<td>Alkali Wetland</td>
</tr>
<tr>
<td>Alkali Marsh</td>
<td>Palustrine persistent emergent freshwater/saline wetland. Temporarily to permanently flooded, permanently saturated.</td>
<td>Cismontane alkali marsh (NDDB)</td>
<td>Alkali Wetland</td>
</tr>
<tr>
<td>Perennial Alkali Pond</td>
<td>Permanently flooded.</td>
<td></td>
<td>Pond</td>
</tr>
<tr>
<td>Grassland</td>
<td>Native grassland (NDDB), Purple needle grass grassland (MCVII), Curly blue grass grassland (MCVII)</td>
<td>Grassland (Native Grassland)</td>
<td></td>
</tr>
<tr>
<td>Oak Savannah</td>
<td>Valley oak woodland (NDDB), Blue oak woodland (MCVII), Valley oak woodland (MCVII)</td>
<td>Oak Savannah</td>
<td></td>
</tr>
<tr>
<td>Woodland</td>
<td>Valley oak woodland (NDDB), Blue oak woodland (MCVII), Valley oak woodland (MCVII)</td>
<td>Oak Woodland, Mixed Evergreen Forest</td>
<td></td>
</tr>
<tr>
<td>Chaparral</td>
<td>Coastal sage chaparral scrub (Holland), Chamise chaparral (MCVII), Scrub oak-chamise chaparral (MCVII)</td>
<td>Chaparral and Scrub</td>
<td></td>
</tr>
<tr>
<td>Interior Dune Scrub</td>
<td>Interior stabilized dune (NDDB), Scrub oak chaparral (NDDB), Live oak chaparral (MCVII)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior Dune (vegetation undefined)</td>
<td>Interior stabilized dune (NDDB), Scrub oak chaparral (NDDB), Live oak chaparral (MCVII), Live oak woodland (MCVII)</td>
<td>Oak Savannah, Grassland</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 3
LAND USE AND CLIMATE HISTORY

Farther than the eye can reach to the eastward and southward, extending from Bay Point to Byron, lie the eighty thousand acres of wheat field, level almost as the floor, from which come the great quantities of grain shipped annually from Antioch.

—CONTRA COSTA COUNTY 1887

LAND USE

This section reconstructs general patterns of land use in East Contra Costa County (ECCC) over the past 200 years (fig. 3.1). Understanding major prehistorical and historical land use trends is essential to understanding native habitat patterns. In this section, we give a brief overview of major land use trends.

First Human Settlement

The story of the indigenous people of East Contra Costa County is told in large part through the vast record of the human experience of colonization – as detailed by the colonizers themselves. The tribes of the area had no written language prior to the arrival of the Spanish in 1769, so Spanish writings provide our first narrative glimpse of the region’s people. There is also a robust physical record of human life in the region which lies in archaeological contexts – and the living descendants of the tribal people have memories, records, and family histories that detail the indigenous experience in ECCC. What we now know of the immediate, post-colonial story of these people – which captures the most recent, prehistoric arrangement of human civilizations in the region – comes primarily from the work of one individual, Dr. Randall Milliken. Together with local tribal and professional colleagues, Dr. Milliken has spent much of the last 30 years building on past work of Harrington, Merriam, Bennyhoff, and others to piece together the human experiences of colonization in the Bay Area (see Milliken et al. 2009).

Another perspective on pre-colonial life in ECCC can be derived from an examination of subsistence lifeways and patterns of natural resource management practiced by local tribes. Indian fire management, large-scale harvest and manipulation of terrestrial and aquatic floral and faunal resources had, at times, profound influences on the function and resilience of ecosystems throughout the region.

Archaeological records of human presence in ECCC stretch back thousands of years. Archaeologists have found traces of human activity dating to nearly 10,000 years ago near the Los Vaqueros Reservoir (Ziesing et al. 1997), and to at least 6,000 years ago near Marsh Creek (Rosenthal et al. 2006). A later site at Los
Vaqueros Reservoir revealed traces of residences including hearths and hunting tools dating to between 3,000 and 1,500 years ago (Ziesing et al. 1997). Dr. Milliken estimates that population density in the Bay Area at the time of contact ranged from two to six people per square mile, high for a nonagricultural society (Milliken 1995). The largest Bay Area village recorded by early explorers was within Contra Costa near Carquinez Strait, and contained an estimated 400 people (Anza 1776 in Brown 1998:59-63, Milliken 1995).

At the time of Spanish contact in 1772, ECCC was home to several small tribes representing the Delta Yokuts, Ohlone/Costanoan, and Bay Miwok language groups (Bennhoff 1977, Milliken 1995). Table 3.1 provides a basic overview of the geographic, linguistic (e.g., Bay Miwok), and tribal (e.g., Chupcan) associations in ECCC. All of these groups shared similar world views, political organizations, and hunting and gathering material cultures, but each also had a unique language, a unique history, and a special relationship with a specific portion of what is now ECCC (fig. 3.2).

Native people in California did not practice agriculture as it is typically described; however they did modify the landscape in a variety of important ways (Lewis 1985; Stewart et al. 2002; Anderson 2005, Martinez 2010 in prep). Tribal groups managed lands under their influence with practices such as seed beating, scrub and grassland burning, harvest of grasses, and use of digging sticks to turn the soil (see Anderson 2005). Products harvested by Native groups included acorns, grasses and forbs, intertidal and nearshore marine products, and tule to construct rafts and innumerable other products (Kroeber [1925] 1976). Archaeological research reveals that a high diversity of shellfish, large and small mammals, birds, and small fishes were eaten by native people living near Marsh Creek in the middle Holocene (Rosenthal et al. 2006). Native groups also hunted game such as deer, pronghorn antelope, and elk, which appeared to be abundant in ECCC at the time of Spanish contact (Anza 1772 in Brown 1998, Font and Bolton 1933).

Of particular interest to land managers as well as tribes today is the historical use of fire by local tribes to maintain and enhance resilience of local ecosystems. Native groups used fire to control the distribution of chaparral, maintain grassland cover and forage for wildlife, control pathogens, improve access to acorns, and aid in hunting rabbits and other small game (Kroeber [1925] 1976, Keeley 2002, Stewart et al. 2002, Anderson 2005). While indigenous fire use specifically in ECCC is not well documented, observations by early explorers, and subsequent observations of changes in terrestrial vegetation in response to fire suppression indicate that ECCC was managed with fire much as other, similarly populated areas.

Recent quantitative studies of fire ecology and fire behavior (e.g., Stephens and Fry 2005, Everett et al. 2007) have concluded that local tribes were the source of a high majority of all fire ignitions in many coastal regions prior to colonization. Historical incidents of lightening cannot explain the frequency of historic fires in these areas as recorded by fire scarred tree records and other proxies. Over the millennia, shifting patterns of managed burns created a rich mosaic of habitats, likely increased edge area, and created more resilient ecosystems (Martinez 2010 in prep; see Dryland Habitats, chapter six). However, quantitative models of the impact, distribution, and frequency of managed fires at a localized scale are only starting to receive funding for study (e.g., Johnson et al. 2010). Concurrently, new and existing technologies are being brought to bear to answer growing questions about how Native fire management may inform contemporary management of terrestrial vegetation management, ecological restoration, and conservation of threatened species.

Table 3.1. Geographic, linguistic, and tribal associations in East Contra Costa County.

<table>
<thead>
<tr>
<th>Geographic Region</th>
<th>Tribe/Linguistic group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pittsburg</td>
<td>Chupcan Bay Miwok</td>
</tr>
<tr>
<td>Antioch</td>
<td>Julpun Bay Miwok</td>
</tr>
<tr>
<td>Brentwood</td>
<td>Jalaken Delta Yokuts</td>
</tr>
<tr>
<td>Byron</td>
<td>Tamcan Delta Yokuts</td>
</tr>
<tr>
<td>Mount Diablo/Briones Valley</td>
<td>Yokon Bay Miwok</td>
</tr>
<tr>
<td>Morgan Territory</td>
<td>Souyen Ohlone</td>
</tr>
<tr>
<td>Brushy Creek</td>
<td>Saasam Ohlone</td>
</tr>
</tbody>
</table>

Figure 3.2. Sacred sites. East Contra Costa County contained important spiritual sites for native peoples, which were featured in local legends. Pictured here are (A) Mount Diablo, (B) Byron Hot Springs with Clift Court forebay, (C) Brushy Peak (in Alameda County, but important to ECCC tribes), and (D) Vasco Caves. (Top left image by Scott Hein, www.heinphoto.com; all other images by Abigail Fateman, Contra Costa County)
Spanish Contact (1772-1835)

The first Spanish exploration of ECCC took place in 1772, in an expedition led by Don Pedro Fages. The explorers moved east through northern Contra Costa and turned around just beyond Pittsburg (Crespi and Bolton 1927, Cook 1957). In 1776 a second expedition, led by Juan Bautista de Anza, continued further east along this route and were turned back at the edge of the extensive Delta marshes (Bolton et al. 1930, Cook 1957).

After missions San Francisco de Asís (Dolores) and San José were founded in 1776 and 1797, the Spanish presence began to more directly impact the native population (Milliken 1995). Based on mission baptism records, researchers believe that missionization of native tribes generally moved outward from the missions, reaching more distant tribes after those closest to the mission had already been converted or had moved off of the land. In 1805 and 1806, mission records list baptisms of Volvon, who lived in the uplands near Mount Diablo and along Marsh Creek (Milliken 1995), and by 1806 this group had essentially been removed from ECCC (Praetzellis et al. 1991). The reach of the missions continued eastward until by 1812 ECCC was almost entirely uninhabited (Milliken 1986 in Praetzellis et al. 1991).

Throughout the mission period, ECCC indigenous peoples moved from mission to mission and mission to rancho/pueblo. They also intermarried, sometimes with traditional allies, yet often far outside their cultural kin – even outside the Native community. New, mission-based identities evolved, often reflecting a blending of cultural expressions, though many families retained ties to their historic lands. The missions were secularized in 1835-1836, and their landholdings were gradually broken up. With the collapse of the Mission system, the much reduced Native populations were denied the land that had been promised them and were left to either work for Spanish landowners or move to uninhabited lands further east (Milliken 1997b, Ziesing et al. 1997). Many returned to their original villages, but some may have settled regions that were historically occupied by other tribes (Davis et al. 1997). Children were often relegated to legalized slavery, moved en masse to boarding schools, and prevented from speaking their languages and practicing their cultures. Today, the descendants of these indigenous groups are represented through one or more organized tribal governments (Milliken et al. 2009).

Rancho Period (1835-1848)

After the dissolution of the missions, the Mexican government granted land to private individuals for stock-raising and agriculture. In 1835, the first ECCC land grant deeded Los Meganos to Jose Noriega (fig. 3.3), who in turn passed the grant...
to American John Marsh. Additional land grants were made in 1839 (Los Medanos) and 1844 (Los Vaqueros). The land grants, and especially the arrival of John Marsh, signaled the beginning of Euro-American habitation in ECCC. Prior to Marsh’s arrival, Mexican families in the region had avoided living in inland areas because they were subject to raids by native peoples or attack by grizzly bear (Miranda 1880, Milliken 1997b). Marsh chose to live in the region to ranch cattle and began encouraging other settlers to join him. Native people (likely Jupunes and/or Volvons) who had returned to the area from Mission San José lived along Marsh Creek and helped to work Marsh’s land (Milliken 1997b).

Until this time, European impact on the land had been relatively limited. Mission San José may have used portions of ECCC for grazing cattle during the early 1800s, but these cattle grazed primarily in the Livermore Valley and only occasionally reached north to Contra Costa near Los Vaqueros or up San Ramon Valley to Clayton (Bowman 1947). As the settlers population increased, their impact on the natural environment became more pronounced, although there was little cultivation through the rancho period.

These early ranchers allowed cattle to run freely over their land, and unclaimed public land was used for communal grazing (Alviso 1853, Welch 1880). The grazing may have helped spread non-native grasses, as well as limiting opportunities for forest regeneration (Sweeck and Bernhardt 1993). By some accounts, ECCC was overgrazed by the 1850s, to the point that ranchers slaughtered wild horses to relieve grazing pressure on the grasslands (Parcell 1940). Landowner Ignacio Sibrian (1881) described conditions in the 1850s:

Q. Did not the cattle of the whole neighborhood graze upon and feed upon the rancho before it was fenced by Perez?

A. The hills was public, everybody’s cattle, mine, Pacheco’s and everybody’s cattle run on the ranch….Until 1862, everybody’s cattle run there, they did not use to go and brand them, they were not worth branding.

**Early American Settlement and Agriculture (1848-1930s)**

After California became part of the United States in 1848, settlement intensified and plots became smaller. To retain their lands under the American government, owners of the Los Vaqueros, Los Medanos, and Los Meganos grants had to prove their claims, a process that produced land case testimony and associated confirmation maps. Although all three land grants were ultimately approved, owners of the Los Vaqueros, Los Medanos, and Los Meganos grants had to prove their claims, a process that produced land case testimony and associated confirmation maps. Although all three land grants were ultimately approved, they were divided into smaller holdings through this process, opening the way for more settlers.

The new settlers became squatters within land grants, or claimed the land remaining outside of land grant boundaries (Pacheco 1861). They raised sheep and cattle, as the Mexican landowners had done, but these cattle were primarily for dairy and beef rather than for hides (fig. 3.4). The arrival of new American settlers accelerated a movement towards grain, which lent itself more readily to small plots and required less investment than cattle.

Over the second half of the 19th century, ECCC transitioned from primarily ranchland to grain production. The first crop of grain was planted by John Marsh in 1839 (Lyman 1931); by 1892 the California Department of Agriculture stated that “nearly half of this [Contra Costa County] is cultivated, the remainder being grazing and waste land.” As much of California, the flood of 1862 followed by the drought in 1863 and 1864 killed large numbers of cattle and helped to speed the transition to grain cultivation (History of Contra Costa County 1882, Purcell 1940). The rise of grain was marked by increased use of fences, and in 1872 a law was finally passed which shifted the responsibility for constructing fences to protect crops from livestock to ranchers rather than farmers (Praetzellis et al. 1997). Even the heavily grazed Los Vaqueros land grant had been converted to dry-farmed grain by 1880 (Ziesing et al. 1997; fig. 3.5).

Wheat was the most dominant cultivated crop in Contra Costa at this time (Smith and Elliott 1879), although dry-farmed alfalfa for cattle was widely grown in the eastern portion of the county (Taylor 1912a). Many early accounts boasted that alfalfa could grow without irrigation because of the high groundwater level in the east near the San Joaquin River (Douglas 1908, Contra Costa County Gazette 1912). Alfalfa could also tolerate low levels of alkalinity: “alfalfa will grow in soil containing an appreciable accumulation [of alkali] if the salts are below the feeding zone of the plant roots during the seedling stage” (Carpenter and Cosby 1939). Farmers dry-farmed alfalfa well into the 20th century.

Grain farming also extended up the foothills, as “the hills dividing these valleys are no less valuable or productive than the valleys” (Contra Costa County 1887, Adams pers. comm.). The *Antioch Ledger* reported on this transformation in 1872 (b):

> Five years ago the plains between Antioch and Ray Point to the westward, and to Banta’s [near Tracy] to the east and south, presented to the eye one vast area of grazing land. Flocks and herds roamed at large…Today nearly every acre of the entire scope of country between the points named is sown to wheat.

As more settlers began to move into the area, they also harvested wood. Settlers cleared trees for use as fuel or fence posts (Gehringer n.d., History of Contra Costa County 1882, Byron Times 1908a, b; Carpenter and Cosby 1939; Homan 2001). Ranchers also thinned small, easily cleared trees in the upland woodlands to improve grazing for their cattle (Engelhart pers. comm.). However, trees were not appropriate for lumber: narrative accounts described trees “of little practical value” (History of Contra Costa County 1882), or bemoaned that among the “shrubby white oaks, there was not one tall enough to make a rail-cut” (Bidwell [1842] 1937).
It is a very finely located piece of land, devoted mostly to wheat, but has a fine young orchard of most varieties of fruits. A mountain stream, called Kellogg Creek, passes on the south side of the farm, and its waters are used when necessary for irrigating purposes. There are on the farm at least twenty-five of those grand old oak trees, whose boughs gracefully sweep down and reach the ground. These oaks have a great resemblance to the weeping willow or elm of the East. The fields look like an old park, as the trees are low branched, wide-spreading, gnarled; they are magnificent in size; many of them must be hundreds of years old; they are disposed about the plain in most lovely groups, masses or single ones.

—Smith and Elliott 1879, "Canadian" (Volney) Farm - Accompanying illustration at right

Figure 3.5. “Residence of A.T. and Volney Taylor. Point of Timber, Contra Costa Co.” The early agricultural landscape of East Contra Costa County combined grain farming and orchards with planted and remnant native trees. Note the double peaks of Mount Diablo in the background. (See also accompanying text at left; Smith and Elliott 1879)
Industrial Development and Mining (1853 - present)

In 1853 Antioch opened a wharf, the furthest inland wharf in the region, and the beginning of ECCC’s industrial development. Throughout the late 19th century and early 20th century, factories developed along the San Joaquin River that produced lumber, paper, pottery, and glass. Mining operations extracted coal, silica, cinnabar, silver, gold, and even petroleum from the foothills (see Davis and Vernon 1951). Tule gathered near Antioch was shipped to San Francisco to construct products such as mattresses, upholstery, and paper (Antioch Ledger 1872a, Pacific Rural Press 1875, Benyo 1972). By 1877 the Central Pacific had run a railroad through Contra Costa, linking it with the rest of the region.

The first and most intensively mined substance was coal, with production beginning in the 1860s and continuing until 1902 (Davis and Goldman 1958). A series of 12 coal mines were developed in the foothills north of Mount Diablo, the largest of which was Black Diamond Mine. At the mines’ production peak in 1874, they produced over 480 million pounds of coal per year, and employed 1,000 miners, spurring a wave of settlement in ECCC foothill towns such as Nortonville and Somersville (fig. 3.6, 3.7). The first railroad in ECCC was built to ship coal to the wharves, and was completed by the mid-1860s. Mining declined in the late 1870s due to decreasing profits and competition from superior imported coal, and by the 1880s mines were beginning to close. Some miners left for newly developing mines in what is now Washington State, while others remained as settlers in Contra Costa.

Early industry impacted local hydrology and ecology in many ways. Silica mining in the Antioch dunes reduced their height from an original 65-115 feet down to 50-80 feet by 1957 (Davis and Goldman 1958, Howard and Arnold 1980). Clay kilns in Antioch were fired with oak wood harvested from the savanna in Clayton Valley (Gehringer n.d.). Gravel to build local roads was mined from Marsh Creek (Hohlmayer 1996, fig. 3.8). Mining for coal and other minerals disturbed hillsides and displaced soil and vegetation, contributing to erosion and stream incision. Mining tended to concentrate in the relatively untouched foothill and montane regions, which had been less impacted by agriculture than the plains. Mining also led to a rapid increase in population, as immigrants moved to the mines and then spread across central and eastern Contra Costa.

Mines also produced debris and contaminants. The plaintiff in an 1881 court case complained that “screeings, ashes, and other substances” were washed down Kirker Creek from Black Diamond Mine and decreased the value of the downstream property (Robinson v. Black Diamond Coal Company 1881). A mercury mine operated intensively from 1875-1877 and intermittently thereafter has continued to leach mercury into the Marsh Creek watershed (Davis and Vernon 1951, Cain et al. 2004, Jones & Stokes 2006), and is still visible at the intersection of Marsh Creek Road and Morgan Territory Road.

The tule factory near Antioch is now in active operation. One shipment of prepared tule has been already forwarded to San Francisco, and the proprietors are desirous of contracting for the cutting and delivery at the factory of a sufficient quantity of tule to supply the winter trade.

---PACIFIC RURAL PRESS NOVEMBER 6, 1875

Figure 3.6. Coal mining. A) Coal mining at Nortonville. The Black Diamond Mine waste rock deposits are visible at bottom left. B) Somersville townsite - mining debris is still visible in the waste rock pile at center of this image. (A: Unknown ca. 1870, courtesy of the Pittsburg Historical Society; B: Unknown 1924, courtesy of East Bay Regional Park District)

Figure 3.7. Coal mining sites. The mining towns of Nortonville, Somersville, Stewartsville, and West Harley are shown here with the railroads that connected them to the Sacramento-San Joaquin River.

---JOHN CLAYTON 1865

Another part [sic] of it is used for depositing coal for shipping. Some of New York and some of Antioch. At these places they ship the coal from the natural ground without any warehouses [sic] and it frequently lies there from eight to ten days accumulating to two or three hundred tons of coal which if the tides was to wet it the salt would destroy the value of the coal.

---JOHN CLAYTON 1865
One of the most promising mineral locations in Contra Costa is the quicksilver mine near the eastern base of the main summit of Mount Diablo. This mine has been known to the Indians from time immemorial. A very aged Indian, who has given up the roving habits of his race, and "located" in the vicinity of this mine, says that from the time of his boyhood all the Indians in that region have been in the habit of resorting to that place for obtaining the red paint (sulphate of mercury) with which they were accustomed to bedaub themselves on all occasions of great festivity or when preparing for battle.

—Unknown 1865, quicksilver at Mount Diablo
Irrigated Crops (1860s-present)

ECCC has limited surface water resources and low rainfall, so at an early date farmers began to irrigate with surface water from the San Joaquin River and with groundwater (fig. 3.9). To access groundwater, artesian wells were bored near the coal mines as early as 1860 (Daily Alta California 1860), and by 1877 this had grown so that “one sees a large number of wind mills” near Antioch (Antioch Ledger 1877). Irrigation initiatives organized to draw water from the San Joaquin or dig to reach groundwater. By the early 20th century, farmers began to form irrigation districts.

Irrigation allowed farmers to shift from grains to higher value crops such as fruits and vegetables. By the end of the 19th century, grain production had peaked and begun to decline as irrigation allowed orchards to spread through the dry eastern portion of the county. Readily available pesticides and increased access to markets through the growing railway system allowed farmers to more profitably transition to fruits and vegetables (Hulanski 1917; fig. 3.10). The decline of grain was hastened by competition from the Midwest and instability in the grain market. This conversion to orchards and vegetables was recorded by historians:

Here within the past 20 years has been a complete transformation from the region of grain and hay raising to an orchard and vegetable district, where an almost limitless variety of high quality fruits and vegetables grow. (Purcell 1940)

In time, the overdraft of groundwater and excessive diversions of water from the Sacramento-San Joaquin Delta led to salt-water intrusion to the local aquifers. Eventually in the 1940s the Contra Costa Canal, part of the Central Valley Project, was constructed to bring water from the Delta to Contra Costa County bringing relief to farmers (Rowland 1967). This canal draws water from the San Joaquin River near both Knightsen (Rock Slough) and Discovery Bay (Old River).
Mount Diablo in 1931, and in 1971 the East Bay Regional Parks District expanded into East Contra Costa, making its first acquisition in 1973 at Black Diamond Mines (Adams pers. comm.). The implementation of the County Urban Limit Line and the recent completion of the ECCC HCP/NCCP have helped to continue the trend towards an expansion of protected lands.

Although cattle, grain, irrigated crops, and urbanization reached East Contra Costa in successive waves, none has succeeded in entirely replacing the previous industry (fig. 3.12, 3.13). The 1939 soil survey describes how these land use types have worked together over the past century:

The present-day agriculture consists of the production of fruits, nuts, and vegetables on the flatter valley plains; the production of grain, hay, and forage on the foothills; and the grazing of cattle and sheep over the pasture lands of the valleys and the steeper uncultivated hill and mountain lands. (Carpenter and Cosby 1939)

Grazing continues to be a significant form of land use today on parklands and other open spaces within the study area, and has reclaimed some of the marginal land that had been converted to grain crops (Carpenter and Cosby 1939, East Contra Costa Soil Conservation District et al. 1959, Jones & Stokes 2006, Cain and Walking 2006).

Urban Development, Water Management, and Protection

Toward the end of the 20th century, the growing Bay Area began to expand into ECCC, concentrated in the towns surrounding Highway 4. In the 1990s the population in the region grew by 43%, and Brentwood became the fastest growing city in the U.S., reaching 152% growth in one year (Jones & Stokes 2006). With this urban growth, agriculture has declined to 18% percent of total area - and now occupies an area roughly equal to the area covered by "urban" – as mapped by the HCP (Jones & Stokes 2006).

This growth represents a transformation in land use and infrastructure for urbanized areas (fig. 3.11). Along with (and to support) growing urbanization, the past century has seen many modifications to the ECCC water system for irrigation, ranching, urban water supply, and flood control. Many creeks have been channelized for flood control (see chapter four) and a number of reservoirs and stock ponds have been created for flood control and water storage. Major reservoirs include the Antioch Municipal Reservoir (1926), Marsh Creek Reservoir (1963), Contra Loma Reservoir (1965), and Los Vaqueros Reservoir (1998). The partial completion of the Contra Costa Canal in 1940 brought additional water to the county and relieved pressure on groundwater supplies in Antioch and Pittsburg (Rowland 1967).

Another trend through the 20th century has been towards increasing land protection. The newly created Mount Diablo State Park protected the upper slopes of Mount Diablo in 1911, and in 1971 the East Bay Regional Parks District expanded into East Contra Costa, making its first acquisition in 1973 at Black Diamond Mines (Adams pers. comm.). The implementation of the County Urban Limit Line and the recent completion of the ECCC HCP/NCCP have helped to continue the trend towards an expansion of protected lands.

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Today the landscapes of ECCC record a variety of human uses, from rangeland, dryland farming, windmills, and golf courses to armored creek banks and rural residential development. The urban developments of Antioch, Pittsburg, Brentwood, Byron, and Oakley cover much of the plains area beyond the rolling upland hills. (Images by Scott Hein, www.heinphoto.com)

This timeline shows important events and land use trends in ECCC over the past 250 years. We divided the timeline into five land management eras, which are matched with four agricultural phases, shown conceptually at the bottom of the diagram. We also included conceptual curves representing major resource extraction efforts. Both the agricultural and resource extraction curves are not shown to scale, and are based on a qualitative understanding of trends in the historical record rather than acreages of land or quantities of a particular resource that were extracted. Population data are from the U.S. Census Bureau. (ECCC total population is based on a sum of all ECCC towns, including some not shown.)
CLIMATE HISTORY

Climate and weather patterns in ECCC, as elsewhere, are driven by a combination of regional physiographic characteristics, local topography and land use, the interaction of maritime and continental air masses, and global climate patterns (3.14). Over long time scales, climate causes shifts in habitat distribution and abundance. Short-term climatic variation influences native habitat patterns indirectly by affecting land use, as droughts can instigate greater reliance on groundwater, new irrigation practices, or the failure and abandonment of a crop, extreme winter floods can catalyze the construction of improved flood protection channels or alter riparian habitat (fig. 3.15). Short-term climatic variation also can have a direct effect on plant diversity and cover (Bartolome et al. 2004). Historical landscapes and land use change should be interpreted within the context of climate history.

ECCC has a Mediterranean climate, characterized by high inter- and intra-annual variability. Virtually all precipitation occurs between the months of October and April. In the higher elevations, precipitation can occasionally come as snow which lasts for two to three days (USDA 1977). Location and topography are important determinants of East Contra Costa’s climate patterns (USDA 1977). The region is affected by the San Francisco Bay Area’s maritime climate, resulting in moderated temperatures and bringing winds through the Golden Gate in the summer. Mount Diablo is defined as the boundary between the cool climate type of the coast and the hot climate type of the Central Valley (Bowerman 1944). Precipitation varies substantially across the region, which reflects elevation and proximity to the coast (USDA 1977). The presence of Mount Diablo creates a rain shadow effect, resulting in approximately 10 inches more precipitation at the mountain’s summit than in the lowlands.

Consistent records at established stations within Eastern Contra Costa only date back to the 1920s (though some data does exist as shown in fig. 3.16). Therefore, we used regression methods to estimate precipitation at two stations (Antioch 1E, WRCC and Mount Diablo Junction, WRCC) from long-term records from Livermore (dating back to 1872) and San Francisco (dating back to 1850). ECCC stations were well correlated with the Livermore precipitation ($R^2 > 0.87$). According to these estimates, the average annual precipitation on Mount Diablo is 24 inches, with a range from 9 (in 1976) to 47 (in 1862) inches (see fig. 3.14). In Antioch, average annual precipitation is only 13 inches, with a range from 4 (in 1976) to 29 (in 1983) inches.

Figure 3.14. ECCC rainfall. (left) This graph depicts annual precipitation and the 30-year running average (the average of the preceding and succeeding 15 years) for the Mount Diablo Junction station (in green) and the Antioch station (purple). Data prior to 1952 for Mount Diablo and prior to 1926 and after 1975 (for Antioch) were estimated using regression from Livermore and San Francisco records ($R^2 = 0.91$; WRCC, Golden Gate Weather Services). The Mount Diablo Junction station receives less rainfall than the summit. Year indicated on the graph refers to the water year (July to June), so the year 1850 represents rainfall from July 1849 to June 1850.

Figure 3.15. Marsh Creek flooding. (below) This picture shows flooding in the very northeast corner of ECCC, at the edge of the historical tidal marsh and looking east across the Delta. This area would have been part of the natural overflow zone of Marsh Creek. (Image courtesy of Contra Costa County)
Figure 3.16. State weather data. This state-compiled rain and snow data for the 1880s was collected to better understand "the water supply and demand features of irrigation questions, and the flood problems, in the great valleys of the State" (Hall 1886b). Shown at right are precipitation levels for three rain stations in East Contra Costa County.
Local historical information, such as written accounts of explorers, surveyors, and residents, provides corroborating evidence and offers information concerning climatic events that occurred prior to standardized meteorological data collection. Accounts of floods and droughts reveal years of above or below average rainfall that were particularly damaging and may therefore have had substantial effects on the landscape (fig. 3.17). The combination of precipitation records, longer-term climatic analyses, and historical accounts allows for the reconstruction of the historical climatic context. Cartographic and narrative evidence of ponds or wetlands were considered in relation to the timing of wet and dry years.

Numerous accounts and local histories of East Contra Costa recount the critical flood and drought years, and are summarized here. The winter of 1841 and 1842 had, by one account “three times as much rain this winter as they ever knew in one season before” (Bidwell [1842]1937). Just prior to that, in the summer of 1841, settlers visiting John Marsh were told that “there had been no rain for eighteen months” (Lyman 1931). In the early historical period, decades marked by floods include 1750-70, and 1810-20 (Sullivan 1982 in Malamud-Roam et al. 2007). Other significant flood years were 1849-50, 1852-3, 1861-2, 1866-7, 1867-8, 1871-2, 1889-90, 1894-5, 1910-1, 1907, and 1913-4 (Purcell 1940, Rowland 1967, Leighton 2001).

Drought years appear at a roughly decadal scale, the severity of which varies significantly. In 1776, Pedro Font made note of a particularly dry year, which facilitated travel across the marshes near San Juan Bautista (Font and Bolton 1933). Relevant to the early settlement period, Benyo (1972) reports that “the year 1851 was very dry, all vegetation was blighted.” Other droughts occurred in 1862-5, 1870-1, 1876-7, 1883, and 1898-9 (California Dept. of Agriculture 1892, Purcell 1940, Rowland 1967).

The 1860s was a significant decade in terms of climate events and is of particular interest given the number of important datasets (e.g., General Land Office surveys, early travelers journals) from this period. Of relevance to land use change, one county history states, "The flood year of 1862 was succeeded by three dry years, the most disastrous drought on record in the history of California…From this period dates the beginnings of irrigation on a large scale.” (Purcell 1940).

Figure 3.17. Crossing wet and dry. The railroad crossing at Knightsen, depicted in 1939 (top left) and 1952 (top right), shows the effect of different rainfall events. (The intersection of the railroad and county road is marked with a red circle in both photographs.) The year that the historical aerials were taken, 1939, was a dry year, with precipitation in Antioch less than half of average. This contrasts with widespread flooding in 1952. The bottom image shows detail of flooding near Marsh Creek - note the people rowing down the street. Major flooding was controlled when the Marsh Creek flood control channel was constructed in the 1960s, although localized runoff can still result in minor flooding. (Top left: USDA 1939, courtesy of Contra Costa County and Map & Sciences Library, UC Berkeley; Top right: Contra Costa County Flood Control 1952, courtesy of Contra Costa County; Bottom: courtesy of Contra Costa County)