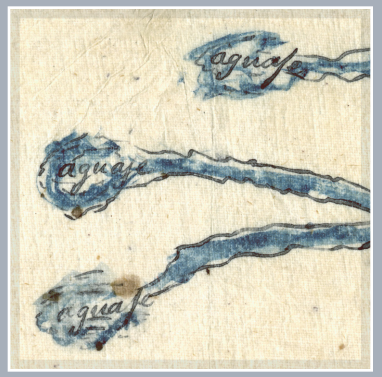
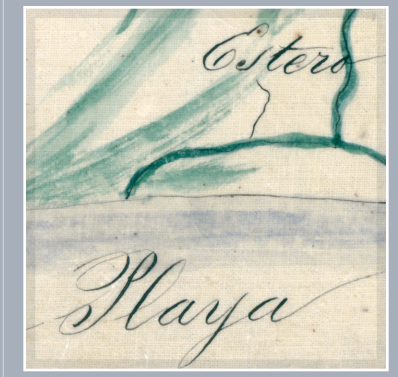
HISTORICAL ECOLOGY OF THE

Ballona Creek Watershed



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SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT · TECHNICAL REPORT #671 · 2011

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EXECUTIVE SUMMARY

Looking across the vast urbanized landscape in the Los Angeles Basin, it is almost impossible to imagine the natural landscape prior to human development. The remaining wetlands leave only a few clues about the past wetland complexes in this region. Nevertheless, the past is vital to understanding the foundation of landscape-processes, historical wetland distribution, and human impact that lend to a better understanding of sustainable restoration plans within the constraints of the contemporary landscape.

The primary goal of this project was to identify the characteristics of historical wetland habitat types and describe the historical form of major creeks in the Ballona Creek watershed. Our target time period was 1850-1890, just prior to contemporary impacts but after the migration of the Los Angeles River, which fundamentally altered the hydrology and morphology of the watershed. It is also a time period that is relatively data rich associated with information compiled around the time of statehood. We set forth to answer the following questions:

1. What was the extent (acreage) of persistent riparian, wetland, and associated floodplain habitat in the Ballona waterhshed?
2. What were the predominant types of wetlands in the watershed and what was the spatial distribution of these wetlands within the watershed?
3. What potential resources are available for stakeholders and scientists wanting to pursue further and more detailed research on this watershed?

Conclusions about historical wetland composition, extent, and distribution were based on a "weight of evidence" approach. Over 300 documents were compiled from 84 source institutions and organized through a metadata catalogue. Data sources were digitized, georeferenced, and organized by subregions within the study area. Spatially referenced datasets were overlaid and augmented by textual citations, photographs and other non-geospatial data. The concordance between multiple data sources allowed us to draw conclusions that supported inferences about historical conditions. We assigned a certainty rating for interpretation, shape/size, and location of each polygon mapped based on the number and quality of corroborating pieces of evidence. Finally, historical herbaria records and bird observations were used to provide insight into the composition of historical plant communities.

Extent and Type of Wetlands in the Ballona Watershed

The Ballona watershed supported a great diversity of wetlands during the mid-late 19th century (figure es-1). The La Cienega wetlands and the Ballona Lagoon complex accounted for the majority of wetland area in the watershed. Various freshwater ponds, vernal pools, wet meadows, freshwater marshes and numerous springs were found throughout the watershed. We mapped 174 unique wetland polygon features comprising 14,149 acres. The dominant wetland types included alkali meadow (35%), valley freshwater wet meadow (10%), valley freshwater marsh (10%), brackish to salt marsh/tidal marsh (9%), and alkali flats (8%; table es-1).

HABITAT CLASSIFICATION	UNIQUE WETLANDS	ACRES	HECTARES
ALKALI FLAT	5	1284	486
ALKALI MEADOW	21	5273	1915
BEACH	2	159	64
DUNE	8	187	76
OPEN WATER*	8	96	39
PERENNIAL FRESHWATER POND	8	110	45
SALT FLAT/TIDAL FLAT	15	423	171
SALT MARSH/TIDAL MARSH	20	1240	498
VALLEY FRESHWATER MARSH	35	1356	547
VERNAL POOL	15	260	105
WET MEADOW	24	3336	1351
WILLOW THICKET	13	425	173
TOTALS	174	14149	5470

*DOES NOT INCLUDE PACIFIC OCEAN

TABLE ES-1:
Summary of wetlands mapped on the Ballona Historical Ecology project.

We mapped 232 miles (373 km) of historical stream channels in the study area. Approximately 80% of the stream channels were intermittent (often discontinuous) washes. Across the valley floor most of the streams sank into porous soils or spread into the major wetland complexes of La Cienega and the Ballona Lagoon. This characteristic likely contributed to a significant amount of subsurface water flow and to the vast wetland complex at La Cienega. The exceptions were Ballona and Centinela Creeks, which were perennial streams lined with willow woodlands. Both streams provided freshwater input to coastal wetlands of Ballona Lagoon.

Freshwater seeps and springs were a characteristic feature of the Ballona Watershed. Although springs were present at a few locations throughout the Ballona Valley, 70% of the 45 mapped springs in the watershed were found in the Santa Monica Mountain foothills. These springs were clustered in the foothills and stopped abruptly at Franklin Canyon. This distribution could be the result of fault displacement or geologic composition. These springs played a notable role in downstream hydrology, where in several locations freshwater wetlands formed at their confluence (particularly in Rodeos de las Aguas near present day Beverly Hills). Many of these springs persist today and are unique remnant features from the historical landscape.

Data Products

In addition to this summary report, we developed several products designed to make the data compiled through this effort more readily available for exploration and use. Once collected, photographs, maps, and textual data were uploaded into an online metadata catalog. The catalog provides a means to organize and query historical documentation by spatial location, wetland descriptions, time period, and source. Bibliographic tables and information about source institutions may also be downloaded from this online database creating a secondary product for stakeholder use. This type of database creates a dynamic tool for the discovery of new information and allows for the creation of different hypothetical questions that can be explored by future researchers. The metadata catalogue, an associated geodatabase with spatially explicit data, raw data tables, and this summary report can be viewed and downloaded from **www.ballonahe.org**.

The contemporary Ballona watershed represents unique opportunities for restoration planning. The information in this report should provide a foundation for understanding the functional relationships of the various wetland complexes, lend support to the development of sustainable restoration plans, and facilitate consideration of natural landscapes into future planning for infrastructure and stormwater management.

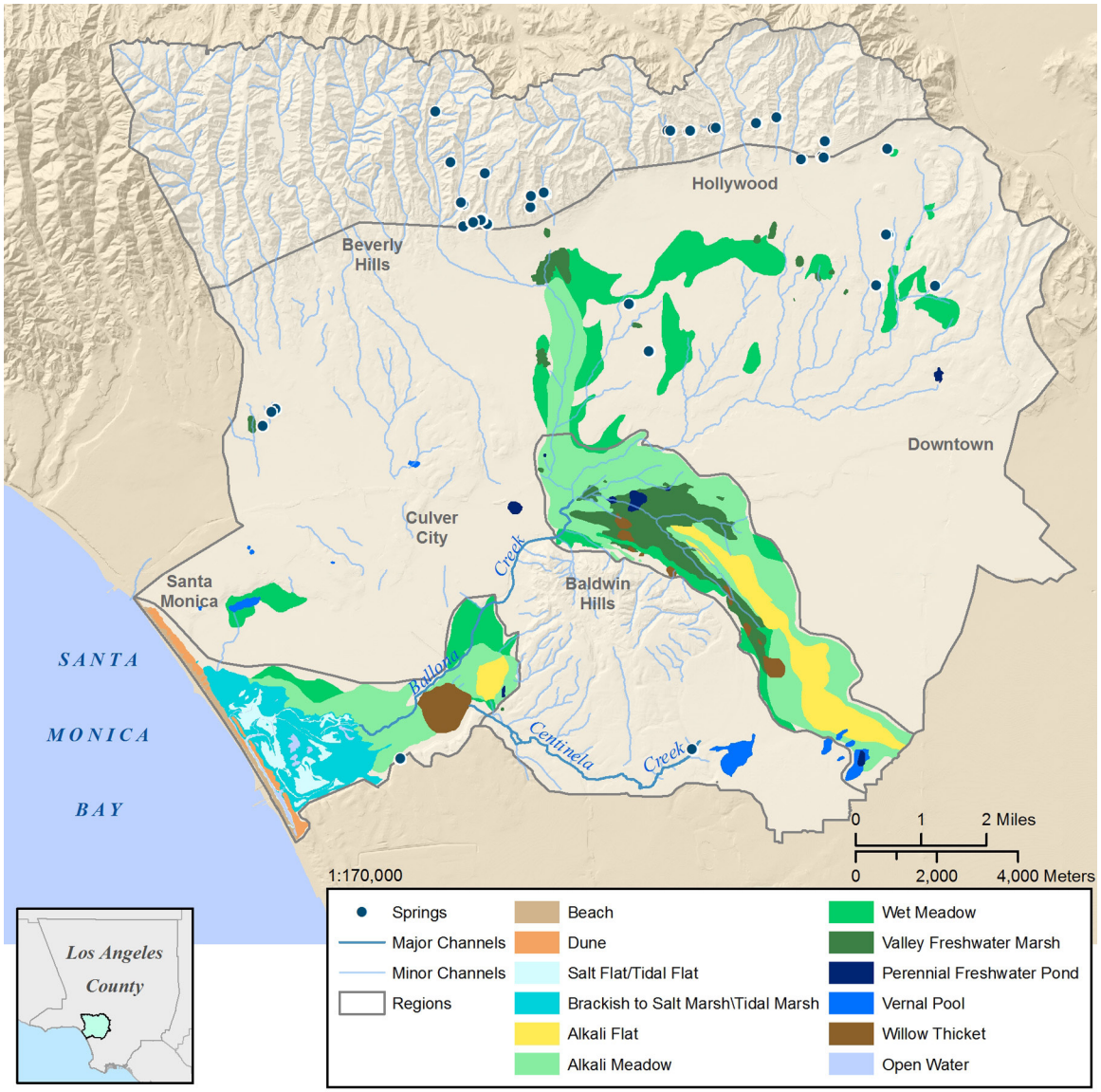

FIGURE ES-1: *Distribution of wetlands and associated features within the Ballona Watershed (1850–1890).*

INTRODUCTION

"Restoring the Ballona Creek watershed is a waste of time and money." Such commonly heard sentiments about highly urbanized watersheds used to be commonplace. Studies in California and other regions have shown that where underlying watershed processes remain intact, restoration options exist, even in highly urbanized settings (Zedler and Leach 1998, Ehrenfeld 2000). Historical ecology provides an understanding of how landscape-scale processes influence wetland extant and distribution under more natural conditions; thus it provides context for restoration planning by providing insight to natural ecosystem functions. (Kentula 1997, Kershner 1997, NRC 2001, White and Fennessy 2005, Kentula 2007).

The on-going planning efforts associated with the Ballona watershed can benefit from the insights of historical ecology. While the Ballona watershed is highly urbanized, it retains remnants of its historical natural resources mainly in the form of coastal wetlands and natural springs. Developing an understanding of potential restoration options in such landscapes depends upon a sound understanding of both contemporary conditions and historical ecological wetland functions. The historical perspective provides an understanding of the relationship between physical settings that support natural wetland functions, the driving forces behind ecosystem degradation and perhaps most importantly, the value of wetland ecosystems that remain intact (Stein et al. 2010). Our goal is to provide this unique perspective of the Ballona Watershed as a valuable tool for understanding not only the past, but for assessing present and future options for management and restoration.

Knowing the historical ecosystem processes associated with the Ballona watershed will provide insight into larger ecosystem processes that governed the greater Los Angeles/San Gabriel river basin. Previous historical ecological research on the San Gabriel River suggests that ecosystem processes were more dynamic and wetlands more diverse than previously expected (Stein et al. 2007). This sheds light on only one component of a larger interconnected system of rivers and wetland complexes, all tied together at some point in time by the Los Angeles River. This report provides information on one additional component of this system, accentuating the importance of historical research on the Los Angeles River to capture a more comprehensive understanding of inter-relatedness and unique qualities of Southern California wetland ecosystems.

PROJECT OBJECTIVES

The primary goal of this project was to identify the characteristics of historical wetland habitat types and describe the historical form of major creeks in the Ballona Creek watershed. To achieve this goal, we created a habitat map and comprehensive dataset describing the extent of creeks and diversity of habitats throughout the watershed. The target time period was prior to significant Euro-American modification (including the Spanish-Mexican ranching era) and just after the natural realignment of the Los Angeles River in 1825 from the Los Angeles Basin to the San Gabriel Valley. Specifically, we used historical ecological research to answer the following questions about the Ballona watershed:

1. What was the extent (acreage) of persistent riparian, wetland, and associated floodplain habitat in the Ballona waterhshed?
2. What were the predominant types of wetlands in the watershed and what was the spatial distribution of these wetlands within the watershed?
3. What potential resources are available for stakeholders and scientists wanting to pursue further and more detailed research on this watershed?

Data Products Available

In answering the above questions, we developed a geodatabase with spatially explicit data. This geodatabase can be used to identify the location and classification of historical habitat types. We also developed a web-portal for visualizing the historical distribution of wetlands relative to the contemporary environment, this executive summary report, and a series of tables that will provide resources to those wanting to pursue more detailed research of specific wetlands or specific time periods not examined for this project. These data sets can be viewed and downloaded from **www.ballonahe.org**. TABLE 1 provides an overview of each data set, including data format, source, and brief description.

Disclaimer

The information provided in this report should be viewed as metadata that supports a detailed understanding of how the GIS data layers for this project were created, interpreted from historical documents, and are best used. In addition, we provide a summary of the historical watershed characteristics. This report has a limited focus on interpreting these data. We did not interpret or analyze landscape change or discuss implications for management. While we documented historical habitat and creek patterns in the watershed, we did not investigate historical ecological dynamics such as how the migration of the Los Angeles River impacted hydrological dynamics of the watershed. The "Next Steps" section of this report (see page 34) provides a comprehensive overview of potential efforts that would provide a better understanding and documentation of historical processes and conditions of the Ballona Creek and adjacent watersheds.

GEOSPATIAL DATA PRODUCTS					
DATA LAYER	AVAILABLE FORMAT	REPRESENTATIONAL GEOMETRY	DATA SOURCES	CLASSIFICATION	DESCRIPTION
WETLAND LAYER	GEODATABASE, KML SHAPEFILE	POLYGON	COMPILED FROM SYNTHESIS OF ALL HISTORICAL DATA	HISTORICAL WETLAND CLASSIFICATIONS, SOURCE, CERTAINTY LEVELS	SEE METHODS SECTION OF THIS DOCUMENT FOR INFORMATION ON THE DERRIVATION OF THIS LAYER
CREEKS AND STREAMS	GEODATABASE, KML SHAPEFILE	LINE	USGS TOPOGRAPHIC MAPS, 1927 AERIAL PHOTOGRAPHY, IRRIGATION MAPS	SEASONALITY, SOURCE, CERTAINTY LEVELS	DATA LAYER REPRESENTS THE DISTRIBUTION OF HISTORICAL STREAMS IN THE STUDY AREA
GLO DATA	GEODATABASE, KML SHAPEFILE	POINT	GENERAL LAND OFFICE SURVEY DATA	ECOLOGICAL FLAGS	FIELD NOTES TRANSCRIBED INTO A GIS
SPECIFIC LOCATION DATA	GEODATABASE, KML SHAPEFILE	POINT	TEXTUAL DATA	NONE	TEXTUAL CITATIONS WITH ENOUGH INFORMATION FOR GEOREFERENCING TO A POINT LOCATION
NON-GEOSPATIAL DATA PRODUCTS					
SOURCE INSTITUTIONS VISITED	EXCEL	NA	NA	NA	LIST OF SOURCE INSTITUTIONS VISITED WITH BRIEF DESCRIPTION OF RELATED COLLECTION
CITATION LIST	EXCEL	NA	SOURCE INSTITUTIONS	ECOLOGICAL FLAG	EACH TEXTUAL CITATION WAS FLAGGED BASED ON REGIONAL LOCATION WITHIN THE WATERSHED, TYPE OF WETLAND, AND BASIC TYPE OF INFORMATION
HISTORICAL BIRD/PLANT SPECIMENS	EXCEL	NA	SOURCE INSTITUTIONS	NA	NA
BIBLIOGRAPHY	EXCEL	NA	SOURCE INSTITUTIONS	NA	LIST OF CITATIONS USED FOR THIS PROJECT

TABLE 1: *Data products created for the Ballona Historical Ecology project can be downloaded from* ***www.ballonahe.org****.*

WATERSHED BACKGROUND

Historical accounts of the Ballona watershed suggest a landscape with vast and diverse sources of water. Descriptions of groundwater fed wetlands, springs, creeks, and lagoons were abundant in the early literature (Mesmer 1904, Regan 1917). These descriptions also suggest that before most of the county's hydrology was constrained to concrete channels, the prairie-like lowlands were often flooded from seasonal rainfall contributing to a dynamic and diverse watershed (LAT 1906, Regan 1917, USEO 1939, Schiffman 2005).

Understanding the unique history of this watershed is important as it helps to identify the most appropriate target time period for this project. Prior to 1825, the Los Angeles River flowed through the Ballona watershed and into the Ballona Lagoon. However, beginning in 1825, the Los Angeles region experienced three consecutive years of heavy rains that inundated the lowland (LAT 1906, Reagan 1917). Along with years of unusually high precipitation, the residents during this period frequently mention a series of earthquakes that rocked the Los Angeles area (Regan 1917). While it may not be possible to fully determine the extent of each natural change, it was after *both* of these that the discharge of the Los Angeles River shifted south to San Pedro.

Despite the newly formed southward course of the Los Angeles River, the inland marshes of the Ballona watershed although hydrologically altered, did not dry up. In both the lowlands and the Santa Monica Mountains, fresh water springs flowed in a southwest direction and sustained much of the inland marshland of the Ballona Creek. Because our goal was to identify the historical landscape that is most representative of the contemporary hydrodynamics and it is doubtful the Los Angeles River will ever flow into the Ballona estuary again, we chose the post-Los Angeles River migration period (1850-1890) as our target time period. This was also just prior to significant changes in land use that likely had a dramatic impact on water resources in the region, such as a shift from ranching to agriculture which was quickly followed by urban development (Stein et al. 2007).

The Ballona watershed geology played a major role in shaping its ecological patterns. Major factors controlling this geologic template include the Newport-Inglewood fault, which created the Baldwin Hills and other outcrops, aeolian beach-derived sand deposits, and the Holocene history of various courses of the Los Angeles River. The eastern part of the watershed comprises well-drained soils of the Los Angeles River's broad alluvial fan (FIGURE 1). Where the coarse alluvial fan deposits diminish, giving way to finer grain soils, wetlands occurred. Wetlands formed in the trough aligned with the Baldwin Hills and faulting throughout the watershed. These geologic patterns expressed themselves in habitats found in the 19th century, such as the groundwater fed wetland complex at the base of the Baldwin Hills and the springs in the Santa Monica Mountain foothill regions.

METHODS

The following section provides a broad overview of the analytical process used to map wetlands in the study area and provides guidance the most effective use of the data relative to current restoration and management practices. Land use history was investigated as it related to wetland location, type, and extent. A detailed investigation of the history of land and water use for the Ballona watershed is, however, beyond the scope of this study.

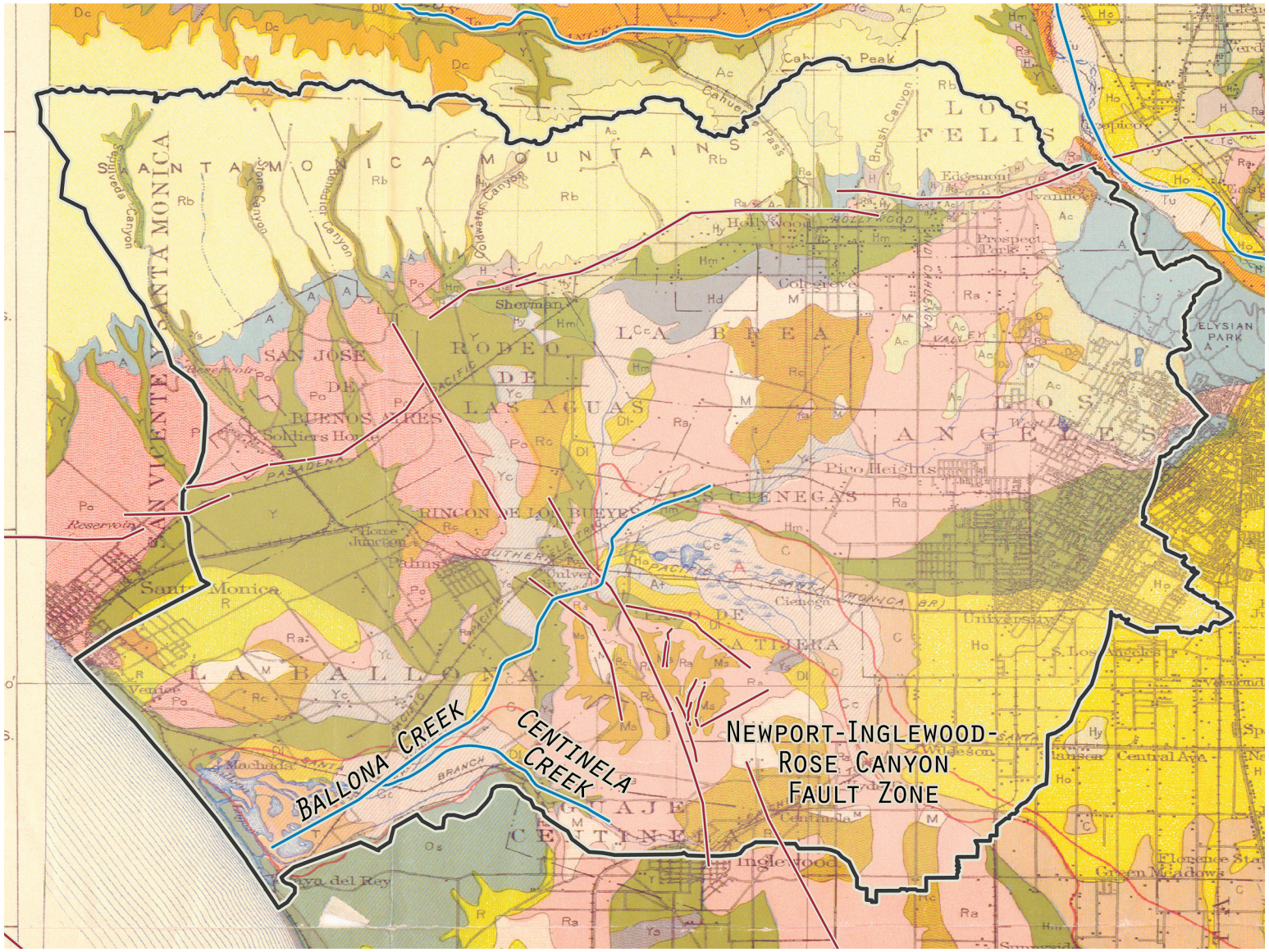

FIGURE 1:
Historical soil map (Nelson et al. 1917) demonstrating the extent of the historical Los Angeles River alluvial fan (dark yellow) within the Ballona watershed.

Our methodology can be divided into a series of phases; data collection/data compilation, synthesis/interpretation, and mapping. Each phase of the project represents a systematic and consistent process that has been developed by the San Francisco Estuary Institute (SFEI) and applied across many historical ecology projects throughout the state of California (e.g., Grossinger et al. 2006, Grossinger et. al. 2007, Stein et al. 2007, Grossinger et al. 2008, Beller et al. 2010, Beller et al. 2011). FIGURE 2 demonstrates the various phases of the project and the primary tasks completed in each phase.

Data Collection and Compilation

Mapping historical wetland features is dependent upon building a body of evidence to support habitat boundaries, classification interpretations, and

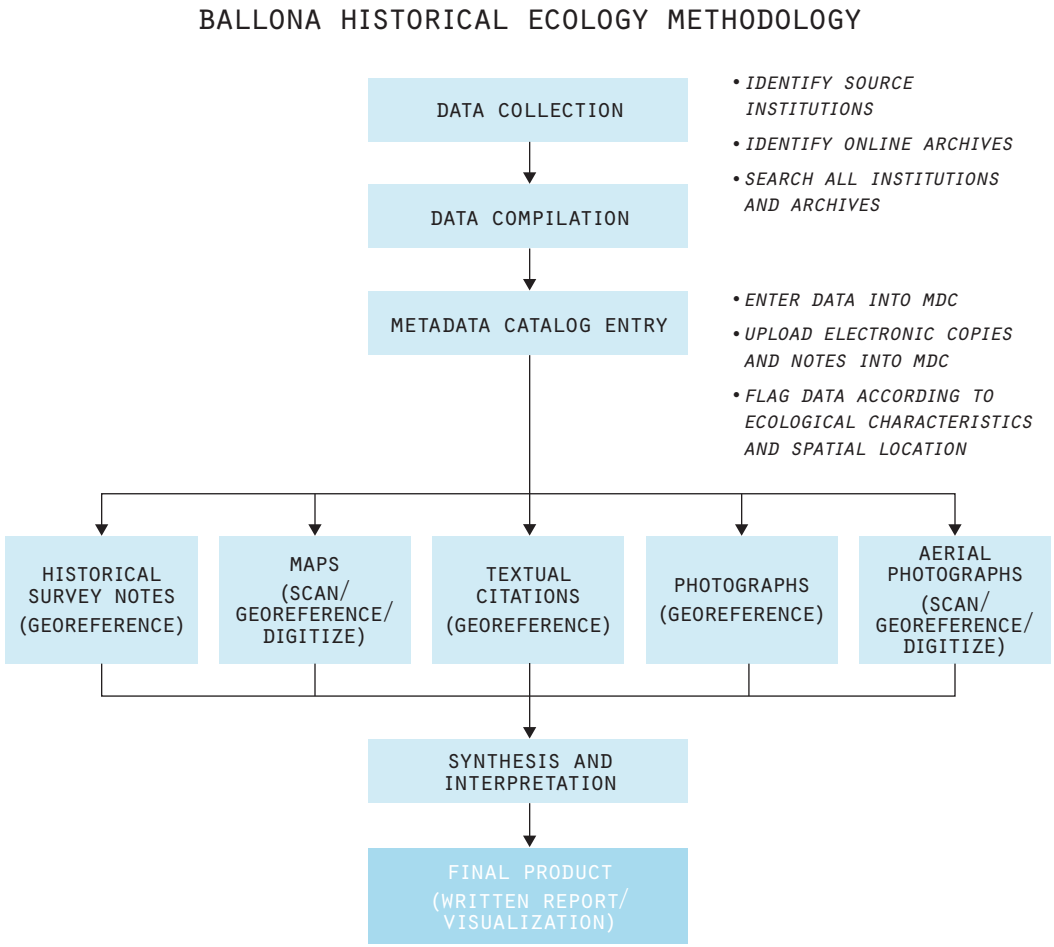

FIGURE 2: *Schematic illustration of research process for historical data acquisition and use in historical ecology. Methodology described in detail in the following sections.*

certainty of the features mapped. For this project, we visited 84 source institutions (50 physical archives and 34 online archives) throughout the state of California, although the majority of institutions are located in Southern California. These institutions included libraries, government agencies, historical societies, map archives, and other institutions housing related historical documents. One of the most notable collections investigated for this project was the Solano Reeves map collection found at the Huntington Library, which provided both early surveyor maps of Los Angeles County and field notes not attainable through other sources.

Over 300 documents were collected. The documents included written accounts, historical photographs (landscape and aerial), and historical maps. Our data collection efforts focused on 19th century sources; a few data sets from the 20th century (e.g. 1927 aerial photography, 1917 soil map) were also collected. The variety of data sets from overlapping time periods allowed for a comprehensive assessment of persistent wetland features and an in-depth interpretation of their classification. We relied on each overlapping dataset to understand the complexity of the ecological pattern and function of the landscape, and our confidence in conclusions about these features was commensurate with the supporting weight of evidence.

Written documents provided detailed insight, supplementing historical map interpretation and allowing for a more comprehensive depiction of the landscape. In some instances, textual data provided significant support for wetland features depicted on a historical map. For example, the following quote identifies the size of a depression and its associated flow regime:

> *"In the Northwest corner of the parcel secondly described in said order of partition, I found a depression cover about sixteen acres, which was filled up by the rains in winter so as to render it unfit for either cultivation or pasture."*
> ***–Solano (1893)***

This information allowed us to verify the size of the mapped feature and classify it as a vernal pool given the additional information about seasonality. Other quotes provided a general overview of the study area:

> *"In the medium part of this southwest course [Ballona Creek] it is bordered on either side by a rich plain of several thousand acres in area, and which, to some extent, it has served in irrigation for a long number of years. The lands irrigated are all within the rancho La Ballona and the waters have for many years been considered as appurtenant thereto."*
> ***–Hall (1888)***

> *"In several depressions or arroyos of the Santa Monica plain, and at the footing of that plain against the Centinela hills, as elsewhere better explained, there are a number of little water sources of the class called cienegas, and which have been referred to in this report, also as cienega springs, and sometimes as artesian springs. A belt of these sources in the ranchos La Brea, Rodeo de los Aguas, and Santa Monica, is found one to three miles out from the mountain's base, and nearly half way down the plain."*
> ***–Hall (1888)***

> *"Coldwater Canyon Creek; Ballona Creek basin; Los Angeles County; an intermittent stream, 3 or 4 miles long, draining a small area in the Santa Monica Mountains, and flowing southward and southeastward into Rodeo de las Aguas Rancho. Near the mouth of its canyon it receives streams draining from Franklin and Higgins canyons."*
> ***–Lee (1912)***

Historical photographs collected from the Los Angeles Public Library and the Huntington Library also provided insight into landscape conditions throughout the watershed. Some of the most useful photographs were those that did not have a principal focus on ecology, but depicted enough of the landscape to provide corroborating data. For example, the photograph in FIGURE 3 depicts recreational boating on Ballona Lake, which gave us insight into not only the size and extent of the dunes surrounding this feature, but also the cultural value of the physical landscape at this site.

A variety of unique historical thematic and reference maps were collected, many of which became the primary source of mapping. Some examples of these include the Hall irrigation maps (1888), a variety of soil maps (1903–1916), and diseño maps of California land grants (circa 1840). The Hall irrigation maps are two maps produced in conjunction with an irrigation report, Irrigation in California by the California State Engineer, William H. Hall in 1888. These two maps focused on water works, developments, and use within Southern California (Hall 1888). The maps provided an accurate depiction of natural hydrological features such as channels and springs (FIGURE 4).

Additionally, ecological features were accurately presented in the Hall irrigation map, allowing us to use the map as a primary source to digitize historical wetlands (FIGURE 5). Primary digitizing sources were those that we used as a primary source to create habitat boundaries (though thse boundaries may bave been further adjusted based on additional subsidiary evidence). Because of the maps' accuracy, composition, and time frame they served as a useful source, particularly in areas with large and diverse wetland complexes.

Similarly, the 1876 T-Sheet (Chase 1876; T-1432B) was another dataset that was key to the completion of this project. T-Sheets were produced between 1851 and 1900 by the United States Coast Survey. These accompanied surveys completed along the Southern California coastline (Grossinger et al, 2011). Specifically, the T-Sheet we utilized for this project included the Ballona Lagoon and immediate wetlands as surveyed in 1876. Produced at an unusually large scale (1:10,000),

FIGURE 3:
Ballona Lake located at what is now Del Rey/Ballona Lagoon (photo courtesy of the Los Angeles Public Library).

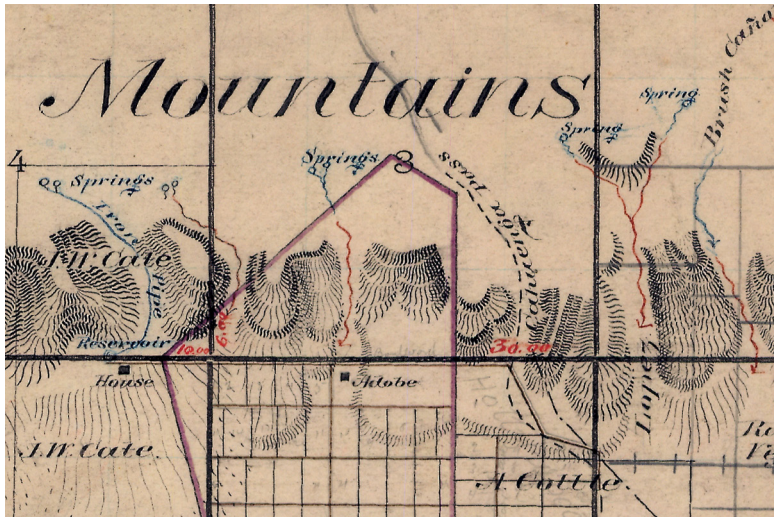

FIGURE 4:
Detail of Hall (1888) irrigation map demonstrating the location of springs in the Santa Monica Mountains.

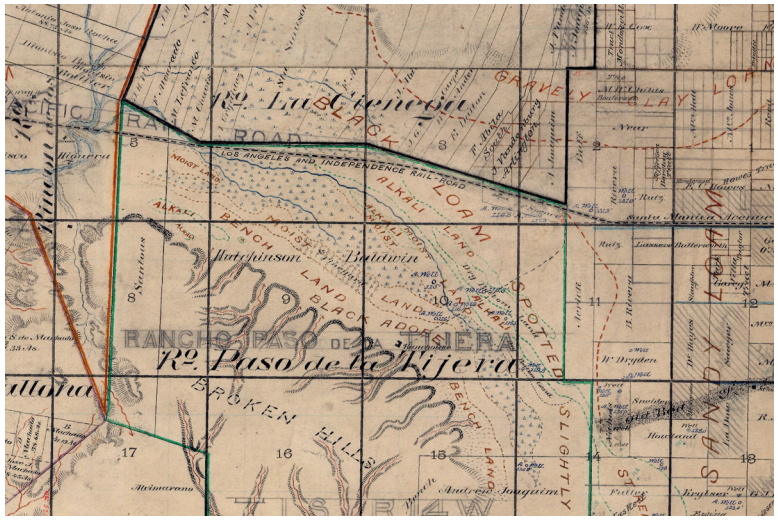

FIGURE 5:
Detail of Hall (1888) irrigation map demonstrating the level of detail in describing habitat types in the La Cienega area at the base of present day Baldwin Hills.

this map provided a level of detail not available on other data sets. It was useful for mapping fine scale features within the estuary, especially when used in conjunction with other data sources (FIGURE 6).

We also obtained detailed ecological information from the General Land Office (GLO) Public Land Survey (PLS) survey notes. Initiated in 1785, the GLO Public Land Survey was carried out by dividing the land into a grid system. Land was divided into 36 mi2 townships and further divided into square mile sections. In California, Mexican land grant boundaries were not modified, though surrounding lands were assimilated into the township-range system. Surveyors ran the boundaries of these land divisions, including those of the Mexican land grants, taking note of distances and notes on the landscape including any significant human made and natural features to establish these boundaries. The GLO survey notes provide an array of detailed historical ecological descriptions that could be spatially referenced. Notes often included information about hydrology, soil types, and vegetation. At times, survey notes were extremely detailed, providing channel morphology descriptions, physical characteristics of trees, including species, height, and diameter, and wetland descriptions (Manies 1997). In the Ballona watershed, GLO surveys were conducted from 1850 to 1895, with the most frequent survey period being around 1870.

Metadata Catalog

Once collected, photographs, maps, and textual data were uploaded into an online metadata catalog. Given the collaborative nature of this project, being able to share data dynamically was important to reduce repetition of effort, to allow for collaborative viewing of data, and to

facilitate regional synthesis and ongoing investigations. The catalog provided the means to organize and query historical documentation by spatial location, wetland descriptions, time period, and source (FIGURE 7). Upon review and entry to the catalog, each source was assigned metadata such as year, author, and keywords pertaining to the item's ecological content. The assigning of metadata within the online catalog system allowed us to query our data sources by using simple to complex parameters in an efficient manner with relative ease. For example, we were able search citations by year or by year, location, author, and citation type (i.e., map, text, or photograph). The metadata catalog also allowed for data to be uploaded to a centralized location via ftp so that team members were able to download and access the data dynamically. Bibliographic tables

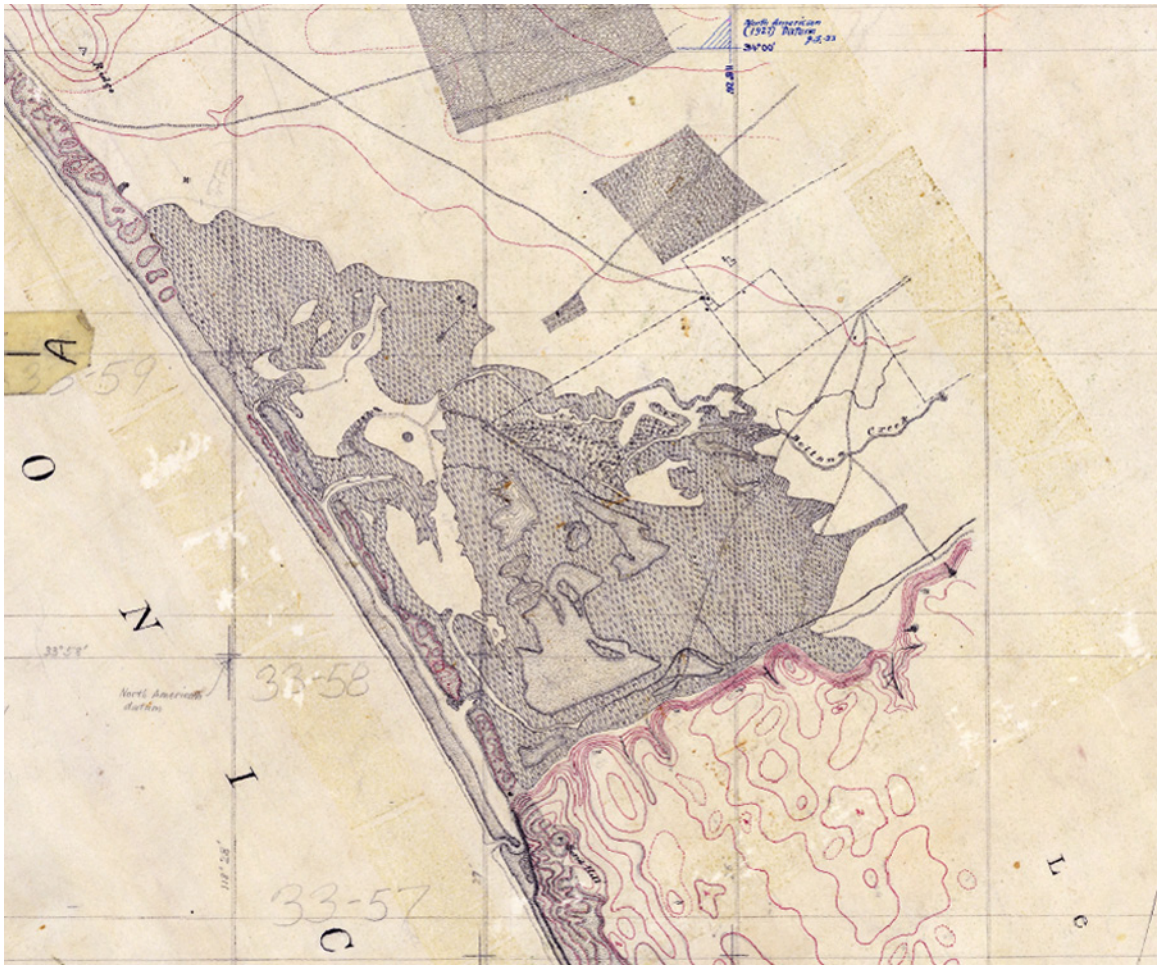

FIGURE 6:
Chase (1876) T-Sheet demonstrating the detail used to map the Ballona Lagoon.

Subset Records by Title:
Subset Records by Reference Type: All
Subset by Primary Source:
Subset by Collector:

	Reference Type	Author	Journal / Publisher	Found (Y/N)	Acquired (Y/N)	Useful (Y/N)	Original Scan Aquired (Y/N)	Title	Year	Primary Source	Call #	Secondary Source	Call #	Tertiary Source	Call #	Geographic Area	Watershed	Scale	Description	Keywords	Collector	File Path	GeoReferenced (Y/N)
Select	Text	Mesmer, L.		Yes	Yes	Yes		Soil Survey of the Los An ...	1904	Google Book Search						Los Angeles County			Soil survey for Los Angel ...	soils, hydric soils	S. Dark	Mesmer_1904_soilsurvey.pdf	
Select	Map	Unknown		Yes	Yes	Yes	Yes	Map Showing Part of the R ...	1887	LA County Department of Public Works	MR022-020					Rancho Rincon de los Buey ...			Plat map scanned by LA Co ...	sycamore, valley floor habitats	S. Dark	MR022-020.pdf	Yes
Select	Map	Mesmer, L.		Yes	Yes	Yes	Yes	Soil Map: Los Angeles She ...	1903	University of Alabama, Department of Geography						Los Angeles County		1:62,500	Great soils map, really g ...	soils, hydric soils, cienegas	S.Dark	UnivAlabama_map_Mesmer_1903.sid	Yes
Select	Text	Salvator, L.		Yes	No	Yes		Los Angeles in the Sunny ...	1929	First-person Narratives of California's Early Years	F869.L8 L94					General Study Area			Very general description ...	Springs, rivers	S. Dark	AmerMem_text_Salvator.doc	
Select	Map	Jonas, C.		Yes	Yes	Yes	Yes	Index map to county surve ...	1950	Library of Congress Map Collections	G1528.L6 R3 1950					LA Basin		1:24000	General index map for sur ...	Surveyor index	S.Dark	LiboCong_Map_1950.zip	Yes
Select	Text	Grinnell, J.		Yes	Yes	Yes		Birds of the Pacific Slop ...	1898	Archive.org	None					Los Angeles County			Birds of LA County. Usefu ...	Birds	S. Dark	GrinnellJ_Archive_1877_birds.pdf	
Select	Map	Solano, A.		Yes	Yes	Yes	Yes	Map of Those Parts of the ...	1868	LA County Department of Public Works	3204					Rancho La Ballona			Plat map scanned by LA Co ...	lagoon	S. Dark	MR003_204_laballona.pdf	Yes

FIGURE 7:
Sample of the online metadata catalog used to store, query, and flag data.

and information about source institutions may also be downloaded from this online database creating a secondary product for stakeholder use. These data products are available at **www.ballonahe.org**. This type of metadata catalog creates a living tool for the discovery of new information and allows for the creation of different questions that can be explored by future researchers.

Data Processing

Certain sources required further processing in the form of spatial reference assignments. Maps were georeferenced, GLO data was transferred to a point layer via linear referencing, and aerial photographs were orthorectified and mosaiced into a single data layer. This allowed us to assimilate a significant portion of our data sources into Geographic Information System (GIS) software for electronic mapping. Some data sources were not spatially referenced. These sources, including photographs and most textual documents, were still organized geographically via their metadata, printed, and compiled manually for use during the interpretation process. Over 150 maps were georeferenced. Textual citations with enough spatial detail were also georeferenced into a point layer. For this point layer, the associated textual description and citation were recorded in the features attribute table. Over 50 of these "specific location" points were digitized.

Mapping and Interpretation of Historical Documents

All mapping was completed using a Geographic Information System (GIS). ArcGIS 9.3 (ESRI) software was used to display, manipulate, and compare spatial data sources as well as create our final geospatial dataset. As discussed in the previous sections, data sources that could not be spatially referenced were printed and organized by very general regional spatial locations (as flagged in our metadata catalog). These data sources were reviewed as we mapped each of these regions and often provided valuable nuanced descriptions of wetlands in the study area that maps could not provide, such as details about tree species or plant composition not depicted on a map. Using GIS, data sources were organized and spatially overlayed with each other, which not only allowed us to view features across multiple datasets, but also allowed us to view change over time. Subsequently, this granted us the ability to better establish the shape, location, and identification of persistent wetland features while at the same time considering the variability (or lack thereof) in the physical and relational aspects of those features through different datasets.

The ability to compare the numerous historical data sources allowed us to build a body of evidence and assess the certainty of each persistent landscape feature mapped. Drawing upon methodological approaches used in previous studies in California, we documented each feature using multiple sources from varying years and authors to ensure accurate interpretation (Grossinger 2005, Grossinger et al. 2007). This was possible for many features, although others (notably some ponds and springs) were only documented by one source.

Usually, the most detailed and accurate datasets that fell within our target mapping period were used to map features. These sources included the Hall irrigation maps and historic topographic maps. After initial digitizing, other datasets were reviewed to determine if corroboration between them deemed it necessary to modify a given feature's properties, such as shape, location, attributes, and sometimes, identification.

Datasets that were produced within our target mapping period, 1850 to 1890, were given mapping priority. Datasets that fell outside of this range were used only as interpretation sources for already mapped features. Interpretation sources are those sources that gave us additional evidence in our interpretation but were not used as a mapping source. These datasets were not used as a mapping source because it is likely they depicted the landscape after significant modification by European settlement and could only be used as supporting evidence for persistent features found on earlier maps. Examples of these include the soil survey maps and aerial photographs. Whenever photographs or textual documents supported the interpretation of features their citation was added to the feature's attributes, specifically as an interpretation source. Seldom did photographs provide extreme corroboration, but there were times where photographs were vital. For example, a set of oblique aerial photographs taken over the Ballona Lagoon provided excellent corroborating evidence to the shape of included waterbodies (FIGURE 8).

Another important component of the mapping methodology involved transcribing and spatially referencing the GLO survey notes. A total of 1,913 survey points were produced with just over 900 points solely dedicated to describing natural features mapped by the GLO during their surveys. These data proved invaluable due to both their spatial and descriptive accuracy. GLO points were often used to confirm boundaries of habitat features. In several GLO survey notes surveyors would note when they entered or left an area of a given habitat type. Thus, it was common to find phrases such as "enter swamp" or "leave prairie" within GLO surveys. These points aided in modifing feature boundaries that were initially drawn from primary mapping sources. Ultimately, the GLO data resulted in a more refined physical shape in the wetland areas mapped and supported more detailed intepretation. These surveys were

FIGURE 8:
Oblique aerial photograph of the Ballona Lagoon taken from the current site of Loyola Marymount University (circa 1940, photo courtesy of Loyola Marymount University, Special Collections). Areas with a smooth, lighter signature in the background are either open water or unvegetated areas.

also aligned with known rain and drought cycles to better inform our interpretations.

Streams were mapped primarily from the historical aerial photographs and historical topographic maps (because of their improved spatial accuracy compared to older mapping sources). When available, other data sources were used to provide additional interpretation validation such as the Hall Irrigation Map (1888). All streams that were consistently present across the historical aerials, topographic maps, and irrigation map (Hall 1888) were digitized. However, we prioritized digitizing from the aerials because the spatial referencing was the most accurate. The topographic maps and irrigation maps were in this order of priority where the feature was no longer present on the aerials. The channel network in the watershed was not analyzed extensively due to two factors. First, preedominantly intermittent streams dominated the Ballona watershed; this likely is the result of porous soils, geology, and climatic conditions (Hall 1888). We were only able to identify two major channels that were perennial: Ballona Creek and Centinela Creek. Second, as would be expected, corroborating evidence for the remainder of the intermittent channel network was sparse.

Estimating Confidence in Mapped Polygons

Measuring and quantifying certainty is critical to the final interpretation and usefulness of historical ecology data. Following Grossinger (2005), feature attributes were developed to capture the estimated certainty of a mapped feature's interpretation, size, and location. Each feature was assigned these attributes to provide a concise assessment of how confident we are in its presence and habitat classification, and in its spatial accuracy (Grossinger and Askevold, 2005). Certainty levels were based primarily on the number, type (i.e. GLO versus historical topo) and quality (i.e. degree of detail and/or spatial accuracy) of the data sources (TABLE 2). For example, a feature such as a wet meadow may be supported by numerous and highly detailed independent data sources would be assigned a "high" value for interpretation certainty. On the other hand, a wet meadow referenced in only 1 or 2 more contemporary historical documents may

CERTAINTY LEVEL	INTERPRETATION	SIZE	LOCATION
HIGH "DEFINITE"	FEATURE DEFINITELY PRESENT BEFORE EURO-AMERICAN MODIFICATION	MAPPED FEATURE EXPECTED TO BE 90%–110% OF ACTUAL FEATURE SIZE	EXPECTED MAXIMUM HORIZONTAL DISPLACEMENT <50 METERS
MEDIUM "PROBABLE"	FEATURE PROBABLY PRESENT BEFORE EURO-AMERICAN MODIFICATION	MAPPED FEATURE EXPECTED TO BE 50%–200% OF ACTUAL FEATURE SIZE	EXPECTED MAXIMUM HORIZONTAL DISPLACEMENT <150 METERS
LOW "POSSIBLE"	FEATURE POSSIBLY PRESENT BEFORE EURO-AMERICAN MODIFICATION	MAPPED FEATURE EXPECTED TO BE 25%–400% OF ACTUAL FEATURE SIZE	EXPECTED MAXIMUM HORIZONTAL DISPLACEMENT <500 METERS

TABLE 2:
Certainty levels assigned to historical features on the Ballona Historical Ecology Project (after Grossinger et al. 2007).

receive a lower value. Confidence values were assigned not just on the number of data sources supporting the presence of a particular feature, but also on the quality and time period of the individual data source. For example, the Hall Irrigation map (1888) provided detailed information about wetlands mapped, as such, wetlands mapped from this source were given a consistently higher confidence value for interpretation than a feature found on a few coarse scale maps (such of topographic maps) that had very little detail. Estimation of certainty is critical to the scientific credibility of any study and reinforces why conclusions about historical conditions must be based on corroboration of multiple lines of independent evidence. Ultimately, land managers and other stakeholders can utilize these objective classifications of certainty to guide the decision making process by helping to determine how extensively results are applied to various land management and restoration activities.

Assessment of Historical Plant and Bird Communities

We also collected about the natural history of the study area, concentrating on plants and birds. For plants, all of the digitized herbarium records available from the state clearinghouse (Jepson Interchange) for Los Angeles County were obtained. Because these records contain many spelling errors and the locations are not reported in a standardized manner, they were sorted through (100,382 records) manually to extract those records from the Ballona watershed and to exclude exotic species, leaving 2,342 records of native species. These were updated with current nomenclature, sorted into families, and coded with the standard U.S. Fish and Wildlife Service codes for wetland indicator status. Each record was then assigned to a region within the watershed to develop species lists for each. For birds, we obtained nest and egg set records from the Western Foundation for Vertebrate Zoology for a suite of riparian indicator species: Black Phoebe, Common Yellowthroat, Black-headed Grosbeak, Least (Bell's) Vireo, Yellow Warbler, House Wren, Long-tailed Chat, Little Flycatcher, Western Wood-Pewee, Song Sparrow, Barn Swallow, and Cliff Swallow. Searches were not made for species associated with coastal wetland features. Region and nest condition notes were consolidated from these records as indicators of riparian vegetation.

RESULTS

A diversity of wetlands were mapped in the Ballona watershed during the target time period with four major types of wetlands dominating the watershed; coastal wetlands, the inland La Cienega complex (consisting of groundwater and surface water associated depressional wetlands), seeps and springs, and creeks (FIGURE 9). Particularly unique to this watershed was the continued legacy of the migration of the Los Angeles River and its effect on the nature and distribution of wetlands. During the target period of analysis, Ballona Lagoon was undergoing a transition from a wetland at the terminus of the large Los Angeles River watershed to a system associated with the smaller Ballona Creek watershed. The shift to a smaller watershed likely resulted in a reduction in the magnitude and frequency of high energy scouring flows experienced by the estuary. Historical analysis of the Ballona watershed is also complicated by the relatively early human impact beginning in the mid-19th century which escalated in pace into the early 1900s along this portion of the southern California coast.

A total of 174 unique wetland polygons were mapped comprising 14,149 acres (5,470 ha; TABLE 3). The dominant wetland types across the entire study area included alkali meadow (35%), valley freshwater marsh (10%), brackish to salt marsh/tidal marsh (9%), and alkali flats (8%). The watershed contained a wide diversity of wetlands ranging from vernal pools and alkali flats to wetland meadows and willow thickets (excluding willow-dominant riparian corridors). It is likely that our habitat map did not capture the total complexity of this landscape, due to a lack of documentation in the historical record, or inability to display using a habitat map. For example, textual citations describing features at a finer scale cannot be incorporated into a two-dimensional map, but lend depth to our understanding of habitat diversity. We hope to provide a cautioned insight into the complexity of this ecological system in the following pages.

HABITAT CLASSIFICATION	UNIQUE WETLANDS	ACRES	HECTARES
ALKALI FLAT	5	1284	486
ALKALI MEADOW	21	5273	1915
BEACH	2	159	64
DUNE	8	187	76
OPEN WATER*	8	96	39
PERENNIAL FRESHWATER POND	8	110	45
SALT FLAT/TIDAL FLAT	15	423	171
SALT MARSH/TIDAL MARSH	20	1240	498
VALLEY FRESHWATER MARSH	35	1356	547
VERNAL POOL	15	260	105
WET MEADOW	24	3336	1351
WILLOW THICKET	13	425	173
TOTALS	174	14149	5470

*DOES NOT INCLUDE PACIFIC OCEAN

TABLE 3:
Summary of wetlands mapped on the Ballona Historical Ecology project.

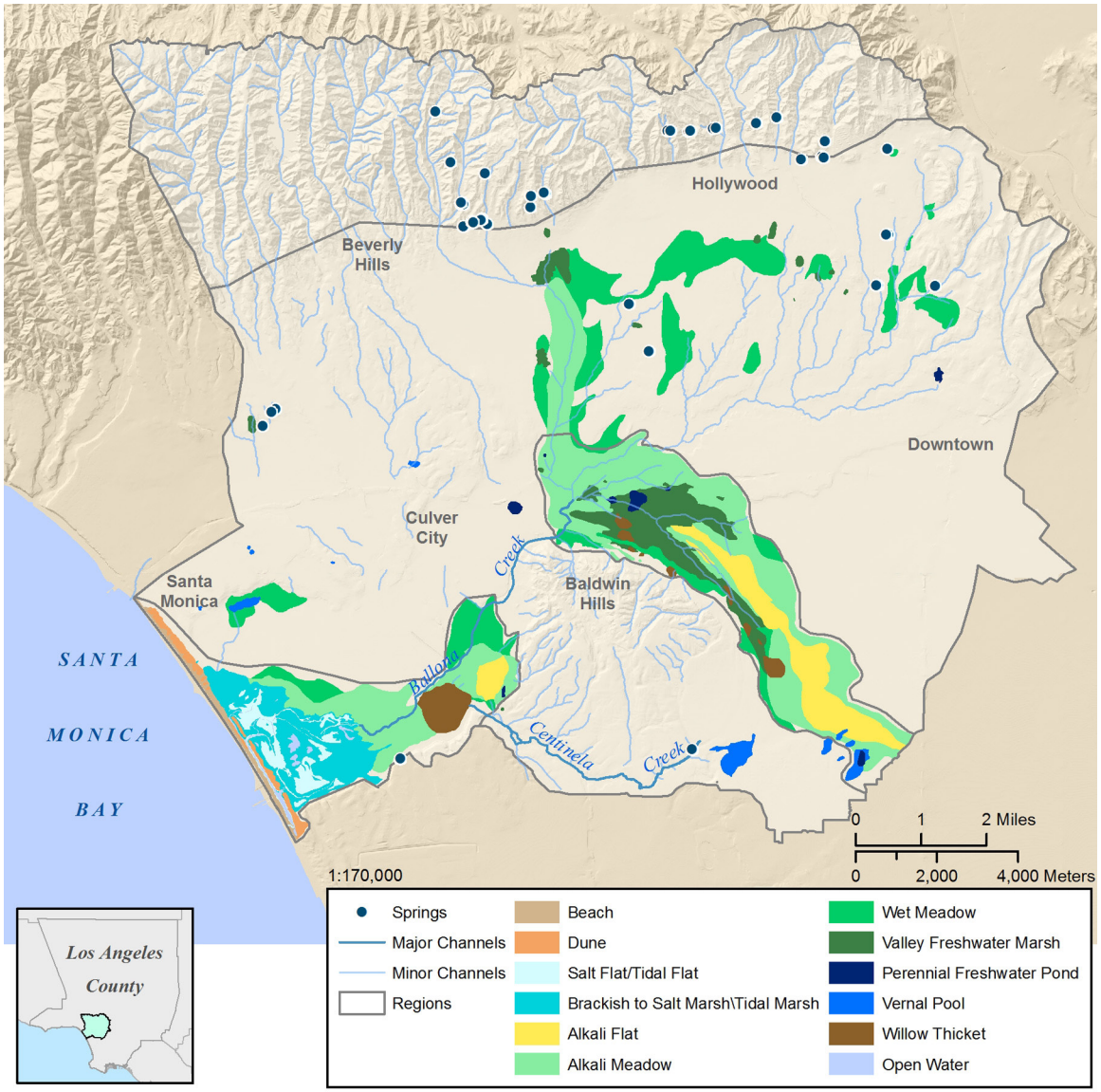

FIGURE 9: *Wetlands mapped for the Ballona Historical Ecology project.*

The historical location and extent of wetlands in the Ballona watershed was extensive compared to their contemporary distribution. Although discrete boundaries of historical wetlands can be challenging to identify in many instances, a few substantial wetland complexes were clearly evident, namely the La Cienega wetlands and the Ballona Lagoon complex. These complexes, in addition to other topographic and ecological factors, were used to organize the Ballona watershed into meaningful units of analysis. The four regions are Ballona Valley, Ballona Lagoon, Santa Monica Mountain Foothills (SAMO), and La Cienega. Key hydrologic features, Ballona and Centinela Creeks were discussed separately (FIGURE 10).

Each of these regions demonstrated a unique profile of wetland types (FIGURE 11). Two significant wetland complexes (La Cienega and Ballona Lagoon) supported the largest extent of wetland habitat in the watershed. Freshwater marsh surrounded by numerous other habitat types (primarily alkali meadows and flats) dominated a broad band of habitat making up the La Cienega complex. Brackish to salt/tidal marsh was the principal component making up the Ballona Lagoon complex, although various other habitat types were present as well. Elsewhere across the valley floor wetland habitat existed but was sparse with the exception of intermittent streams, which were in greater abundance. Various freshwater ponds, vernal pools, wet meadows, and freshwater marshes and numerous springs were found throughout the watershed.

We mapped 232 miles (373 km) of historical stream channels in the study area (FIGURE 10). One characteristic of the channels is their lack of continuity across the watershed, especially in the Ballona Valley region. With the exception of Ballona Creek, virtually every

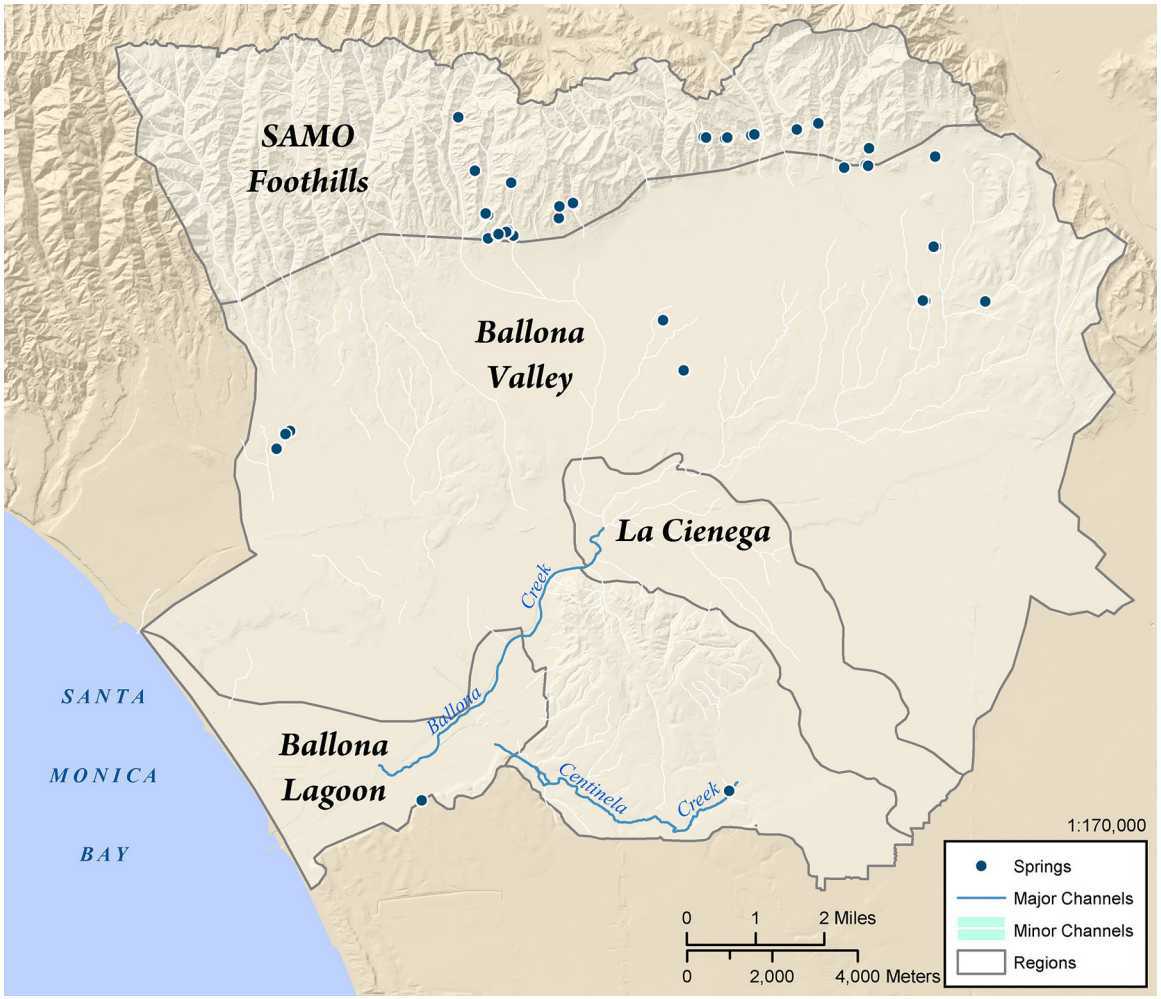

FIGURE 10: *Regions and distribution of springs mapped within the Ballona watershed.*

other channel either sank into porous soils or spread into the major wetland complexes of La Cienega and the Ballona Lagoon. While this characteristic may have contributed to a significant amount of subsurface water flow and consequently to the vast wetland complex at La Cienega, we were unable to discern if this pattern was naturally occurring or the result of land use changes (that may have lowered the water table) during our target time period.

Although springs were present at a few locations throughout the Ballona Valley, 70% of the springs in the Ballona Watershed were found in the Santa Monica Mountain foothills (primarily from Hall 1888; see FIGURE 10). These springs were clustered in the foothills and stopped abruptly at Franklin Canyon. This distribution could be the result of fault displacement or geologic composition.

In the following sections, a landscape profile of wetlands found within each of the regions identified in the study area. The landscape profile includes a review of wetland types, extent, and spatial distribution. In addition, we have included a discussion of stream characteristics within each region.

Ballona Valley

Ballona Valley was the largest region in the study area, comprising the entire valley floor (FIGURE 12). Streams from the surrounding foothill regions drained into the valley floor and in many places disappeared as they flowed across alluvial fans with porous soils. However, in some places spring fed wetlands gave way to wetland and alkali meadows, the dominant wetland types within this region.

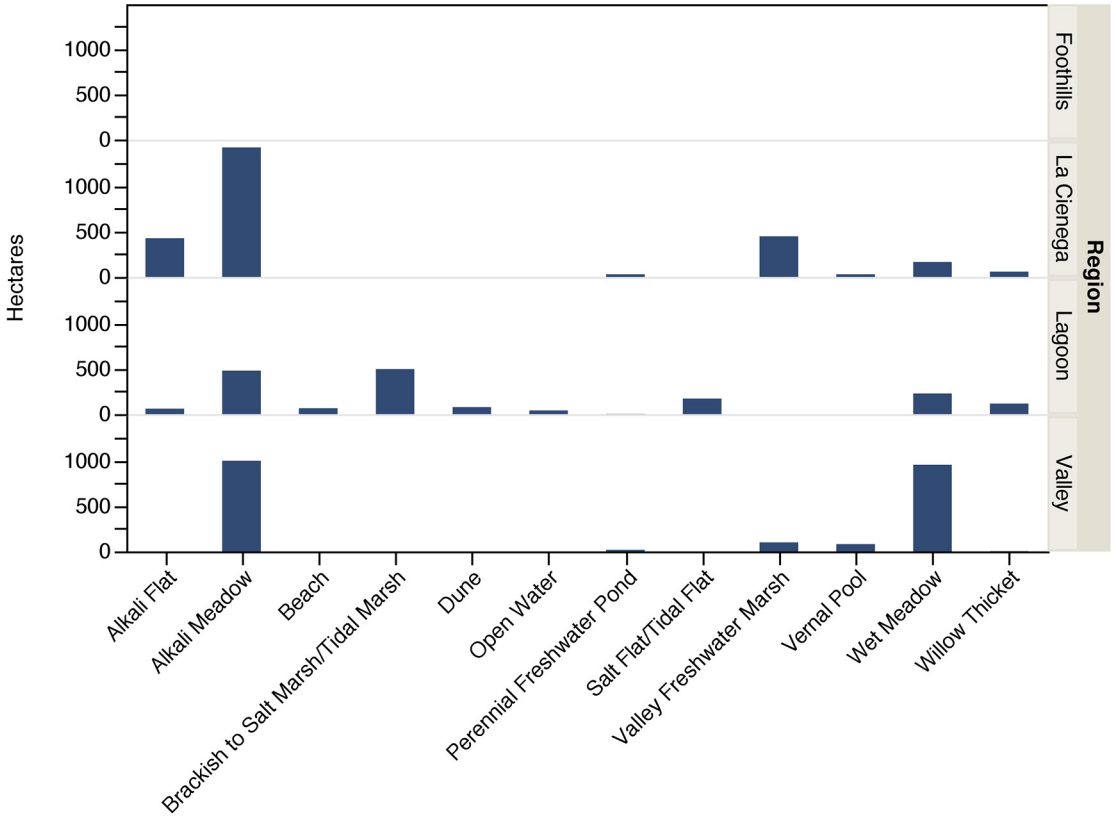

FIGURE 11: *Landscape profile for each region in the Ballona watershed.*

Wetlands

Wetland habitat, excluding streams and associated riparian areas, covered five percent (5,327 acres) of the Ballona Valley region. We mapped five different types of habitat on the valley floor: valley freshwater marsh (242 acres), wet meadow (2,370 acres), alkali meadow (2,479 acres), freshwater ponds (37 acres) and vernal pools (197 acres) (TABLE 4). With just two freshwater ponds and only one lake documented in the historical record, perennial water bodies were scarce throughout the region.

On the other hand, 12 vernal pools, and a significant vernal pool complex were present, probably comparable in flora to vernal pools described for the Los Angeles Coastal Prairie immediately to the south (Mattoni and Longcore 1997). Concentrations existed in both in the southwestern and southeastern portions of the region. One vernal pool located in the southwest portion of the Valley is noteworthy due to its size (16 acres) and an abundance of supporting historical documentation both in narrative and map form (Carson 1883, Solano 1893) (FIGURE 13). This wetland feature is also shown on a Solano Reeves (1893) map which indicates a channel connecting the depression to the Ballona Lagoon.

HABITAT CLASSIFICATION	UNIQUE WETLANDS	ACRES	HECTARES
ALKALI MEADOW	1	2479	1003
PERENNIAL FRESHWATER POND	2	37	15
VALLEY FRESHWATER MARSH	14	242	98
VERNAL POOL	12	197	79
WET MEADOW	14	2370	959
WILLOW THICKET	1	2	1
TOTALS	44	5327	2155

TABLE 4:
Habitat types mapped in the Ballona Valley region of the Ballona Watershed.

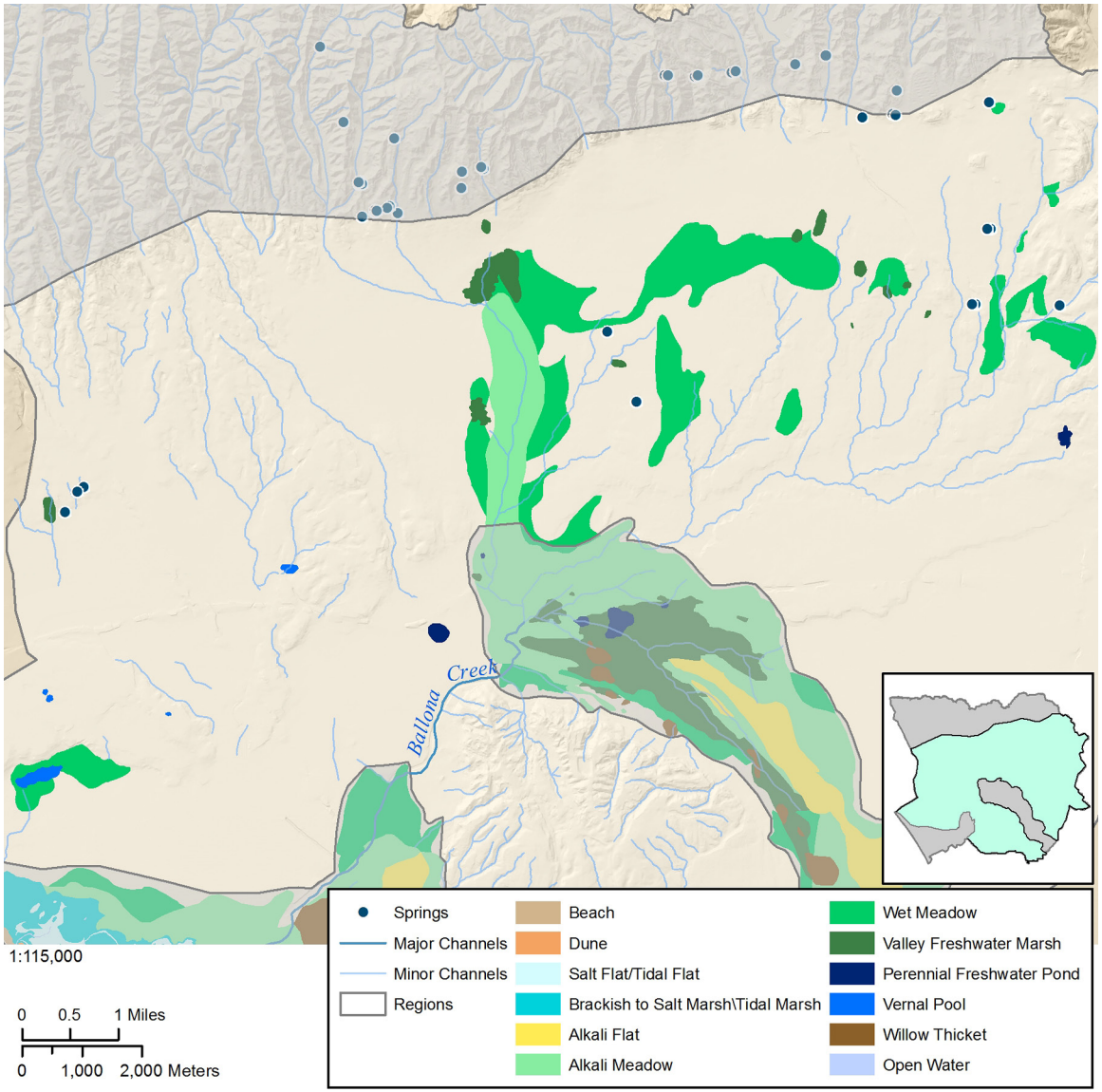

FIGURE 12: *Wetlands of the Ballona Valley region.*

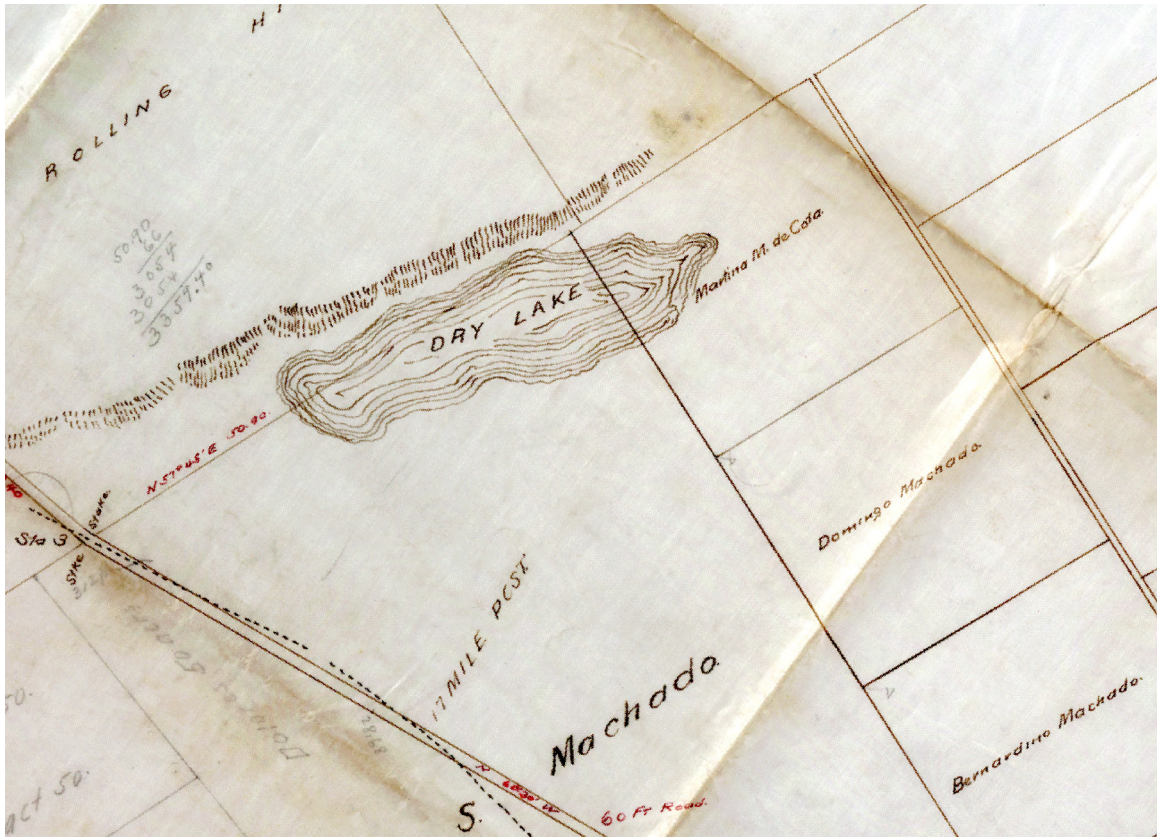

FIGURE 13:
Map (Solano 1893) showing the location of a large vernal pool adjacent to the Ballona Lagoon (Map courtesy of Huntington Library).

The central northern section of the Ballona Valley is also of special interest due to the area referred to as the "Rodeo de Las Aguas" or the "Round-up of the Waters" (Hancock 1949). In this area, streams ran down from the Santa Monica foothills and converged "each rainy season in a broad swamp or cienega" (Benedict 1934, Wilson 1959). This locale marks the northernmost extent of a band of wetland habitat that transitions into the La Cienega system to the south. Valley freshwater

FIGURE 14:
Early diseño map showing the location of a spring and fresh water marsh on Rancho de las Aguas. (Map courtesy of the Bancroft Library).

marsh transitions into wet meadow, which in turn becomes a huge swath of alkali meadow. This area is depicted in detail on historical topographic maps, the Hall irrigation maps, and a diseño of this area (FIGURE 14).

The remaining wetland habitat covering the northeastern sections of the Ballona Valley contained a few pockets of valley freshwater marsh, which, in most cases, were surrounded by wet meadow, the most prevalent habitat type in the area. As Ballona Valley's wet meadows were not clearly and frequently depicted on multiple data sources, polygons were primarily derived from the 1916 soil map offering lower levels of certainty across all categories.

Eleven springs were mapped within the Ballona Valley region. Although most of the springs were not coincident with other wetland features, they were often in close proximity. The absence of a direct physical connection between the springs and other wetlands features

may have been due to the limitations in spatial accuracy of historical data sources, rather than the true locations of the feature themselves. These springs likely played an important role in the early settlement patterns and ranching practices of this region as most settlements were typically located near reliable water sources. FIGURE 15 shows the use of one of these springs for aquaculture (notice a man standing in the background tending to the plants).

Streams

There were approximately 120 miles (193 km) of channels in the Ballona Valley region. Ballona and Centinela creeks are the only two streams consistently identified as perennial in the Ballona Watershed (Hansen 1866, CIU 1874, Hall 1888, Lee 1912, LAT 1914, Mathew 1917). These channels would have been associated with a range of facultative to obligate wetland plant species (as documented in herbaria specimens) but only our channel lines (not polygons) represent the extent of this vegetation. So although riparian and associated stream channel vegetation area is not reported separately, it would have been associated with these linear features, depending on the hydroperiod of the stream. The 1902 topographic map indicates that a few other creeks in the northeast section of Ballona Valley may be perennial, but lack of corroborating evidence limited the interpretation of these creeks' hydrology.

The only intermittent channels that continued out of the SAMO Foothills and down across the valley floor were Brown Canyon and the junction of Franklin and Coldwater Canyons (Giffin 1902, Lee 1912). The northeast section of the region also hosts a fairly continuous network of

FIGURE 15:
Photograph of a spring being used as a garden in the Ballona Valley (Photo courtesy of the Huntington Library). Note the man standing in the middle of the garden towards the back tending to the plants.

streams that are likely dependent on groundwater presence, as are the springs, valley freshwater marsh, and wet meadow habitat present in that area (FIGURE 16).

Flora and Fauna

The plant species from the Ballona Valley supported the presence of freshwater wetlands, riparian elements, and some scrub (Appendix 1). The bird species confirmed this, but with some difficulty distinguishing between the foothills and the valley from the location data provided in the historical data sets. Obligate wetland plant species included whorled

marsh pennywort (*Hydrocotyle verticillata*), water parsely (*Oenanthe samentosa*), seaside heliotrope (*Heliotropium curassavicum*), chairmaker's bulrush (*Schoenoplectus americanus*), prairie bulrush (*Scirpus maritimus*), marsh milk-vetch (*Astragalus pycnostachyus*), swollen duckweed (*Lemna gibba*), common duckweed (*Lemna minor*), floating primrose willow (*Ludwigia peploides*), curlytop knotweed (*Polygonum lapathifolium*), silver weed cinquefoil (*Potentilla anserine*), yerba mansa (*Anemopsis californica*), and seep monkeyflower (*Mimulus guttatus*) (Appendix 1).

La Cienega

Located at the base of Baldwin Hills, the La Cienega region encompassed approximately 7,012 acres and the complexity of this region was one of the most intriguing aspects of the historical landscape given the contemporary lack of wetlands in this area (FIGURE 17). The historical extent of La Cienaga was large, stretching from present day Hollywood in the north to present day Inglewood in the south; roughly 10 miles in length and up to 3 miles wide in places (Denker 1881). Of the wetlands mapped in this complex, we were highly confident in both interpretation and location certainty. We had less confidence with shape certainty, which reflects the dynamic quality of this complex. In years with high rainfall, this complex was likely large and comprised different types of wetlands (more freshwater ponds and marshes) compared to dry years which probably supported more alkali flats and meadows.

Wetlands

This wetland complex was dominated by alkali meadow (58%), alkali flat (16%), and valley freshwater marsh (16%; TABLE 5). The internal

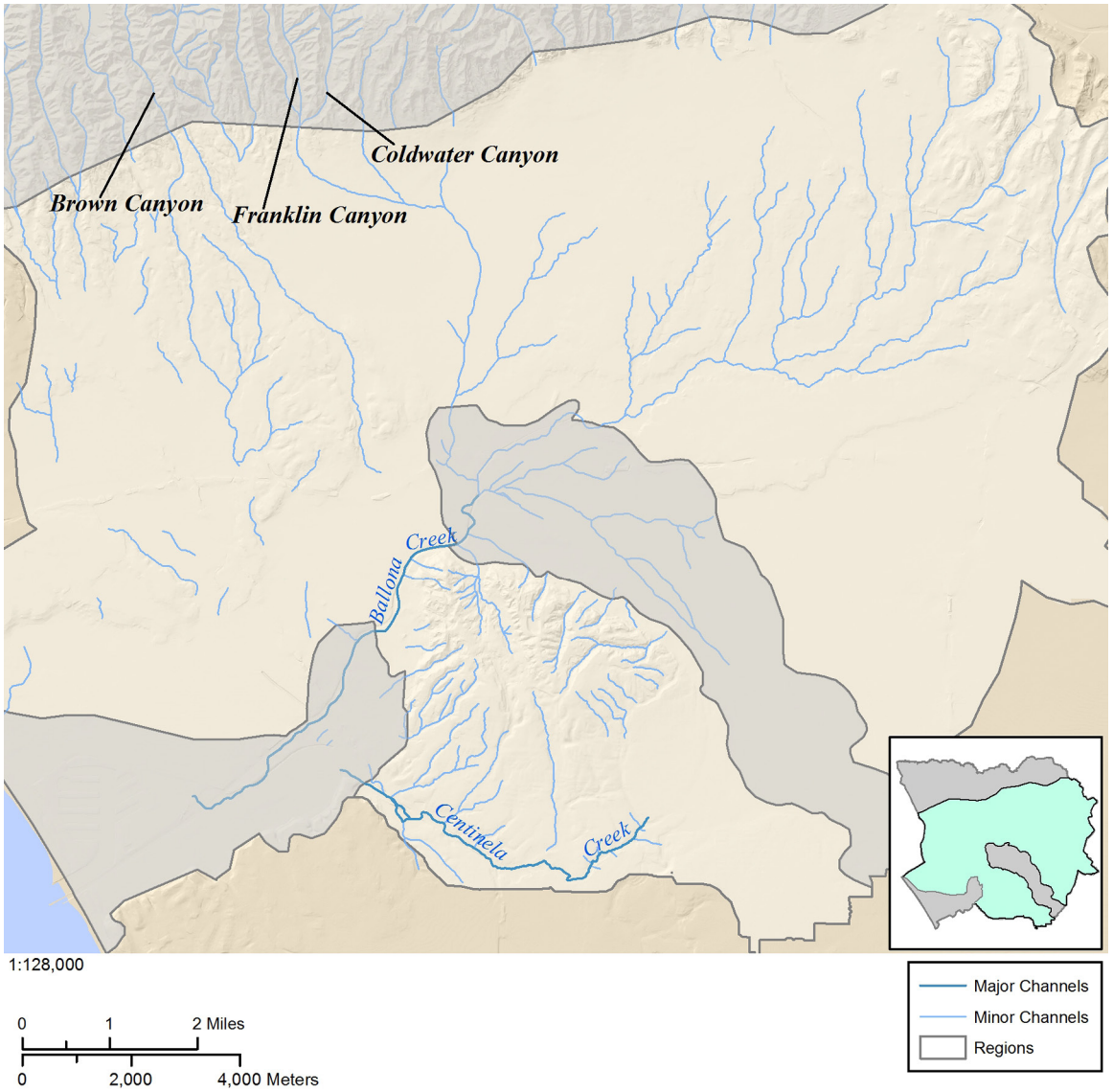

FIGURE 16: *Distribution of creeks and streams in the Ballona Valley region.*

habitat was dominated by valley freshwater marsh and alkali flat, and was surrounded by vast expanses of alkali meadow with wet meadow habitat dotting the periphery of the complex (FIGURE 18, FIGURE 19). The habitat composition also included numerous willow thickets and perennial freshwater ponds (as supported by the Solano Reeves maps). The southwest region of the system is host to a vernal pool complex as indicated by Hansen court dockets (Abila 1859) and consistent with those documented immediately to the south by Mattoni and Longcore (1997).

Streams

Approximately 18 miles (29 km) of streams and sloughs traversed the La Cienega region. We did not designate many permanent channels in this complex because data indicated that it was extremely dynamic; channels appeared to be continually changing location and even disappearing, as the greater wetland complex engulfed them during very wet seasons (Reagan 1915). An absence of any references to channel names in historical sources appears to support this theory.

HABITAT CLASSIFICATION	UNIQUE WETLANDS	ACRES	HECTARES
ALKALI FLAT	4	1137	427
ALKALI MEADOW	17	4085	1434
PERENNIAL FRESHWATER POND	5	68	28
VALLEY FRESHWATER MARSH	21	1114	449
VERNAL POOL	3	63	26
WET MEADOW	5	404	164
WILLOW THICKET	11	141	57
TOTALS	66	7012	2585

TABLE 5:
Habitat types mapped in the La Cienega region of the Ballona Watershed.

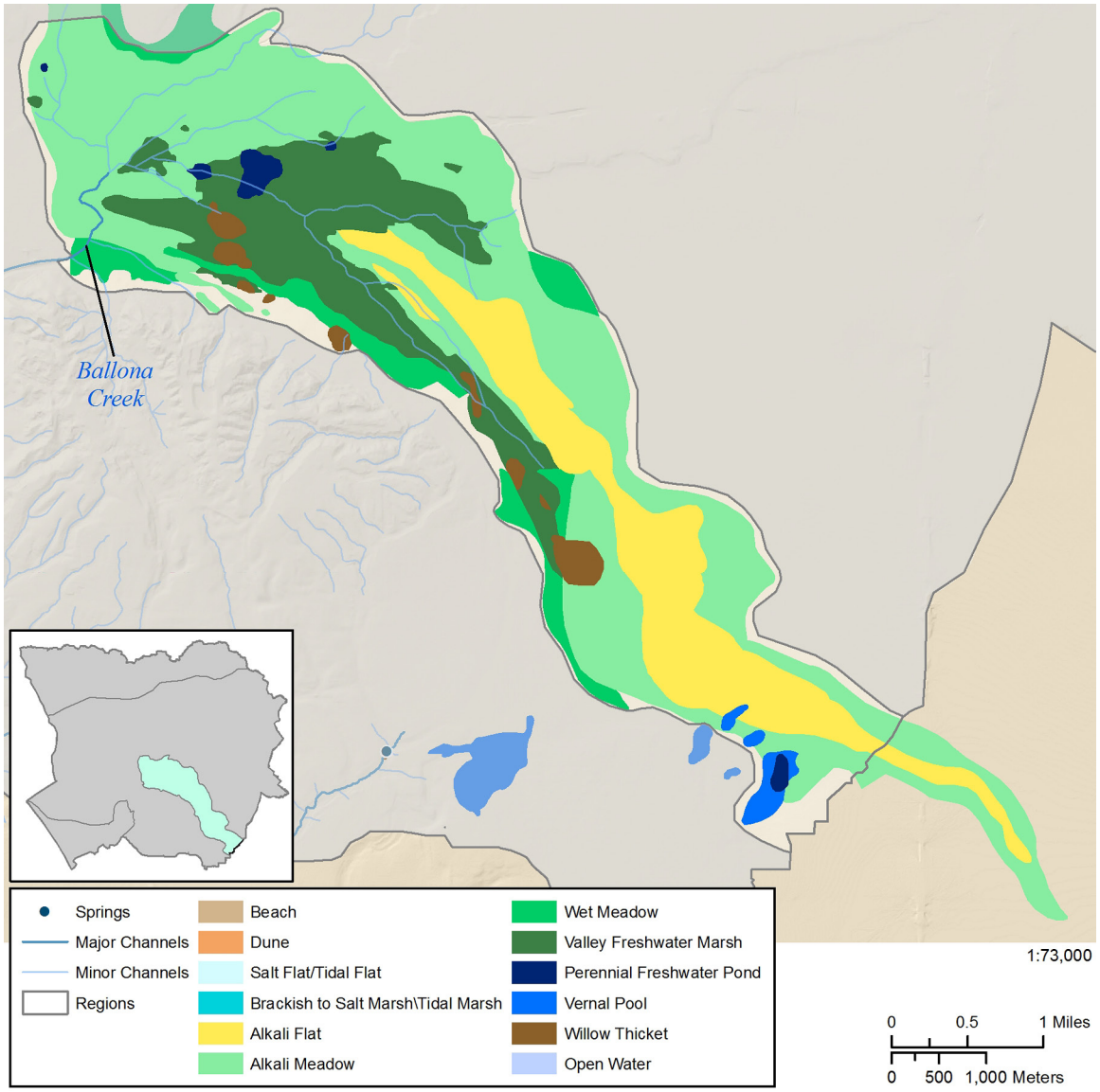

FIGURE 17: *Wetlands mapped within the La Cienega region. This complex extended beyond the watershed boundary.*

Flora and Fauna

Botanical records from La Cienega conclusively document the presence of extensive perennial and ephemeral freshwater wetlands and alkali meadows in this region (Appendix 2). Records indicated that La Cienega supported many types of sedge and rushes, and even rare species like marsh milk-vetch (Astragalus pycnostachyus var. lanosissimus; once thought extinct) and interestingly also Braunton's milk-vetch (Astragalus brauntonii). The language on the herbarium records describes the region mostly as "Cienega," but sometimes also "Cienega swamp," "Culver City marshland," and "marsh at Cienega." Bird nest records from our target species included Black Phoebe ("Under bridge across from Baldwin's sloughs") and Common Yellowthroat ("Tules, in swamp").

Ballona Lagoon

The Ballona Lagoon was a large (4,288 acres) and diverse system. The historical lagoon extended from the base of the bluffs to the south all the way to the intersection of Main St and Abbot Kinney to the north, and as far east as Overland Blvd. Historical narratives, such as Reagan (1917), provide strong support to suggest that the size of the greater wetland system was dynamic and heavily influenced by winter rains: "This area was called Ballona Swamp. In rainy winters Ballona Swamp extended over nearly all the low ground as far back as the present site of Culver City, then called "The Palms," and running over to the Inglewood Mesa, an area about ten miles square." (Chambers 1936).

This area encompassed a tremendous diversity of wetland habitat types, more so than any region within the study area (table 6). This is likely due to the juxtaposition of freshwater and brackish environments

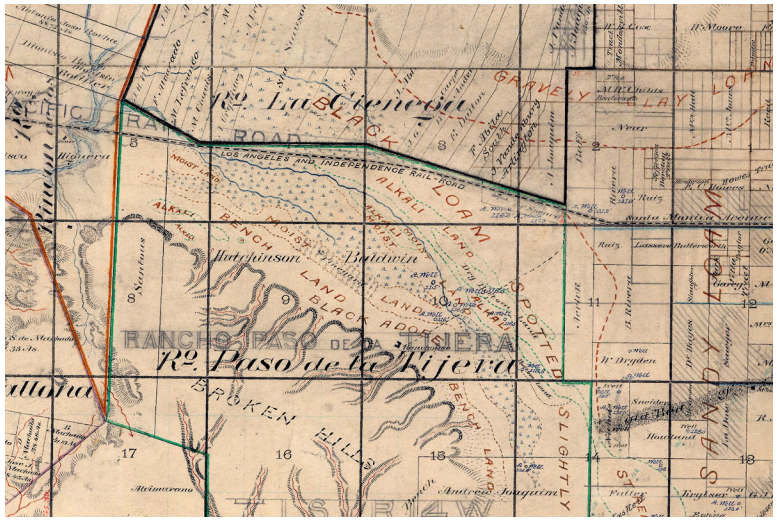

FIGURE 18: *Hall irrigation map (1888), notice the reference to alkali land. [courtesy of California State Archives].*

FIGURE 19: *Alkali lands in the La Cienega wetland complex at the base of Baldwin Hills (photo courtesy of Los Angeles Public Library, date unknown).*

and the complexity of the hydrodynamics of the system. This complexity was likely enhanced by the change in the volume of freshwater input and the assumed frequency of mouth opening associated with the re-alignment of the Los Angeles River. T-sheet analysis by Grossinger et al. (2011) focused specifically on mapping habitats as depicted by the T-sheet and did not include additional sources. As with other historical ecology studies (e.g., Beller et al. 2011), the use of additional historical data sources revealed additional information. For example, our research determined that the use of the term tidal in reference to habitat associated with the lagoon was too limiting. Our data suggests that at most times, this low energy system had only moderate or no tidal influence and was dominated by freshwater inputs from the watershed (see Jacobs et al. 2011). The textual sources indicate complete closure of the system from the ocean through substantial portions of the year, opening only during periods of significant rainfall (LAT 1887; see discussion in Jacobs et al. 2011). Consequently, we broadened our classification from tidal flat to salt flat/tidal flat and from tidal marsh to brackish to salt marsh/tidal marsh. In addition, we were able to map transitional estuarine–upland habitats not mapped on the T-sheet project such as the presence of willow groves and akali flats located at the confluence Centinela Creek and the inland extent of the estuary.

HABITAT CLASSIFICATION	UNIQUE WETLANDS	ACRES	HECTARES
ALKALI FLAT	1	147	59
ALKALI MEADOW	4	1118	481
BEACH	2	159	64
DUNE	8	187	76
OPEN WATER*	8	96	39
PERENNIAL FRESHWATER POND	1	5	2
SALT FLAT/TIDAL FLAT	15	423	171
BRACKISH TO SALT MARSH/TIDAL MARSH	18	1239	498
WET MEADOW	5	562	228
WILLOW THICKET	1	282	115
TOTALS	63	4288	1733

*DOES NOT INCLUDE PACIFIC OCEAN

TABLE 6:
Distribution of habitats associated with the Ballona Lagoon.

Wetlands

The historical mouths of both Ballona and Centinela Creeks emptied into the lagoon complex at different locations (Lee 1912); the Centinela tributary further inland into a large willow thicket, and the Ballona tributary closer to the coast into the brackish to salt/tidal marsh habitat (FIGURE 20). The 1825 migration of the Los Angeles River dramatically reduced flow into the lagoon area and the wetland distribution that developed since that time likely reflected a process of equilibration to this new flow regime. As a consequence, efforts to obtain consistent corroborating evidence for the system were difficult. The documentation that exists, aside from the USCS T-sheet (Chase 1876), often provided conflicting and broad descriptions as to the historical habitat and ecological communities in the complex. Apparent inconsistencies in the historical record may have also resulted from the dynamism inherent in coastal lagoons leading to different physical and biological conditions at different points in time. What is clear is that the system was an expansive marshy area that supported both abundant wildlife, and later on, extensive human activity such as fishing, hunting and boating (Ingersoll 1908, Adler 1969, Wittenberg 1973).

Approximately half of the aggregate Ballona Lagoon area consisted of a freshwater and tidally affected saltmarsh and brackish habitats that transitioned into a more alkaline/freshwater system about 1.5 miles (2.4 km) inland. Historical habitat of the Ballona Lagoon coastal complex consisted of substantial amounts of brackish to salt marsh/tidal marsh habitat (29%), followed by salt flat/tidal flat (10%). Open water made up less than 3 percent of the lagoon and one of the more salient features of the complex was a long but narrow strip of open water referred to by some as a "lake" at what we call today Del Rey/Ballona Lagoon (Sheridan 1887). This strip of open water periodically emptied into the ocean at the documented location of seasonal tidal access (FIGURE 22). We found no evidence that the lagoon remained perennially open, but rather the textual sources indicate that access to the ocean depended on hydraulic forces during any given year (LAT 1887, Sheridan 1887, Hansen and Jackson 1889, Solano 1893). The migration of the Los Angeles River away from the lagoon transitioned the system into a lower energy system where only on rare occasions was there enough freshwater flow from Ballona Creek to break through the buildup of sediment along the coast. As a result, gradual build up of sediment around the terminus of the previous estuary formed dunes and created this "trapped" lake-like feature. The coastal dunes, which occupied four percent of the Ballona Lagoon coastal complex, played a significant role in the formation of the lake and the limited tidal access (see Jacobs et al. 2011).

Inland areas of the Ballona Lagoon were dominated by alkali meadow, with less wet meadow. Water from Centinela Creek also flooded into this area contributing to the formation of an extensive willow thicket which covered approximately 280 acres. Diseno maps

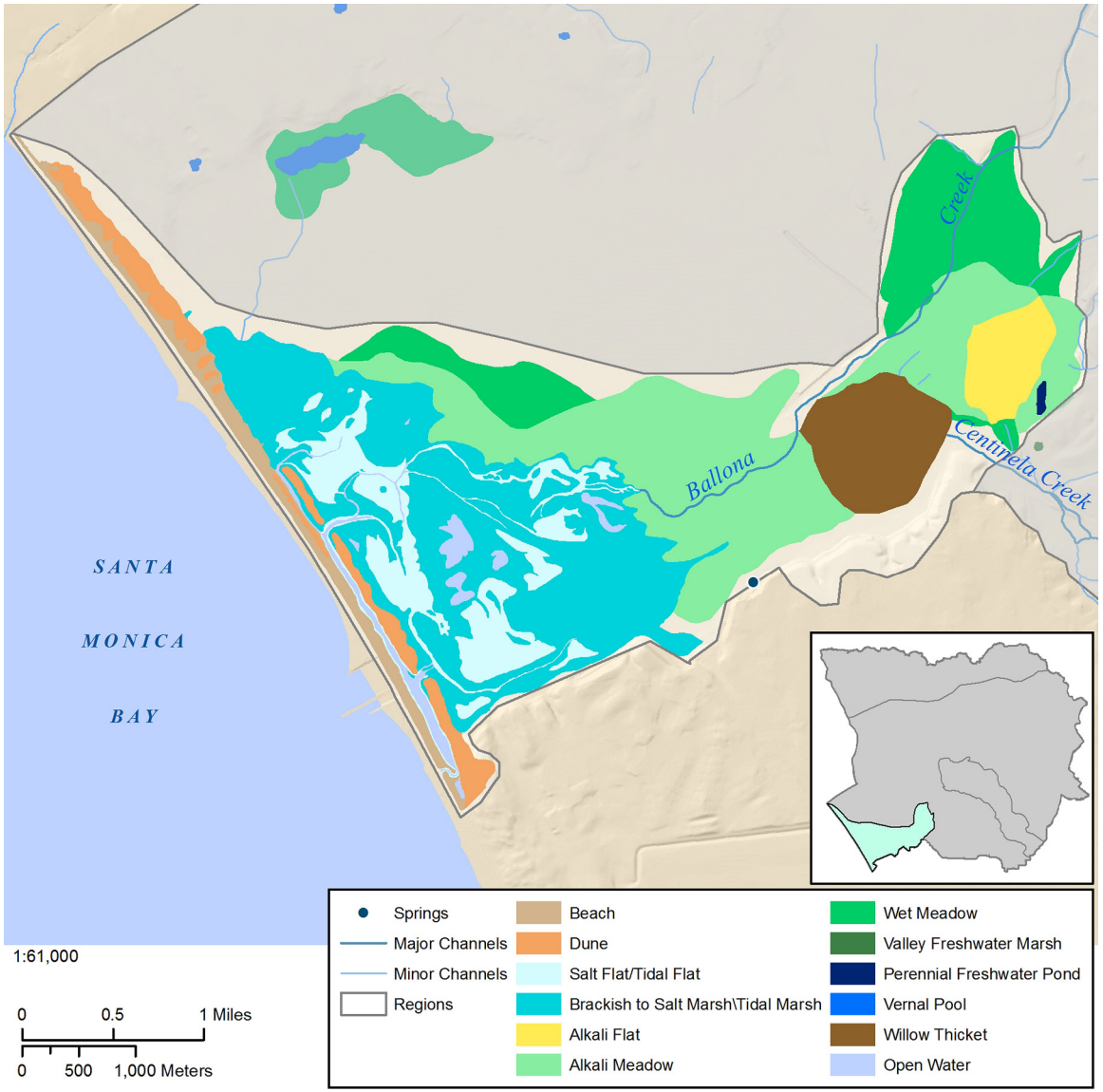

FIGURE 20: *Wetlands mapped in the Ballona Lagoon region of the Ballona Watershed.*

FIGURE 21:
Man boating on Ballona Lake (photo courtesy of Los Angeles Public Library, date unknown). Notice the dunes surrounding the lake.

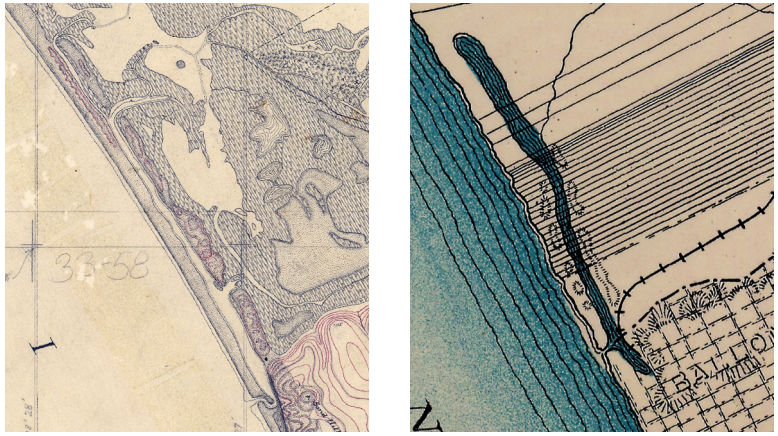

FIGURE 22:
Maps demonstrating the location of Ballona Lagoon (a) Chase T-sheet (1876) and b) Hall irrigation map (1887).

(FIGURE 23) clearly depict a large willow grove or thicket, and ancillary data sources such as the 1894 topographic map and alkali soils map support the delineation and classification of this wetland habitat. Alkali flat comprises 147 acres of the inland lagoon, and a single five-acre freshwater pond sits in a small depression on the southeastern edge of the system.

Streams and Tidal Channels

The coastal region of the Ballona Lagoon contained extensive drainage channel networks as illustrated in the USCS T-sheet (Chase 1876). These channel networks served in part to connect salt flat/tidal flat habitat, and ultimately drain into the long "lake" described previously. Ballona and Centinela creeks were the only substantial freshwater channels to enter the upper lagoon system. Ballona Creek terminated at the head of the tidal portion of the complex. Centinela Creek entered the upper lagoon region just south of Ballona Creek.

Flora

Herbarium records provide a picture of freshwater to brackish and some saltwater wetlands in this region (Appendix 3). Species of perennially open tidal wetlands (e.g., cordgrass) are not found in the older records. Rather, brackish, freshwater, and salt marsh species are represented in the records. All of the dune species are also recorded in this region as these habitats interweave with the wetlands. Of the riparian bird species we surveyed, Song Sparrows are recorded nesting in the tules at the Lagoon. The brids of the lagoon region and the changes in composition over time have been discussed previously by Cooper (2006).

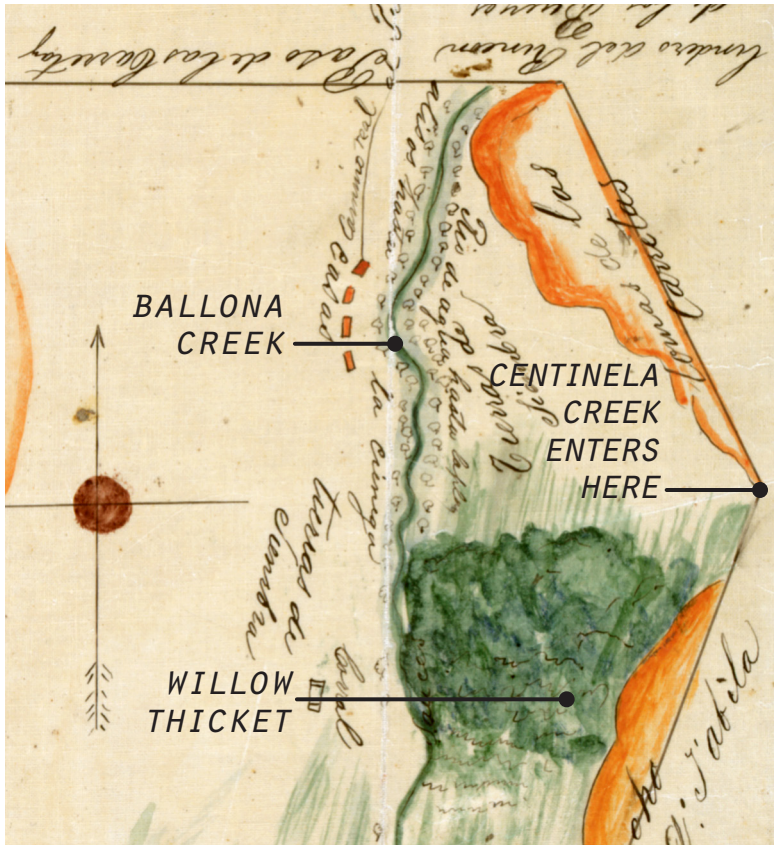

FIGURE 23: *Diseno map (circa 1860) demonstrating the location of a willow thicket at the confluence of Ballona and Centinela Creek (not shown on map). (Map courtesy of the Bancroft Library).*

Santa Monica Mountain Foothills

Located in the northern-most section of the Ballona watershed, the Santa Monica Mountain Foothills (SAMO) are composed entirely of steep canyons (FIGURE 24). This region is dominated by approximately 97 miles of intermittent channels and 29 springs. No other wetland habitat type was documented in historical sources. According to one narrative source, "In the winter time, when the rains came the gullies ran full and overflowing from the mountain. That would only last for two or three days and then it would be gone" (Eckhardt, 1966).

One notable geographic trend is the absence of springs along the western section of the foothill region. This could be the result of local trends in geomorphic composition or displacement caused by faulting. These springs played a notable role in downstream hydrology, where in several locations freshwater wetlands formed at their confluence (particularly in Rodeos de las Aguas as discussed in the Ballona Valley regional description above). Many of these springs persist today and are unique remnant features from the historical landscape (FIGURE 25).

Flora and Fauna

The flora of the foothills includes the expected chaparral and coastal sage elements, but also documents the presence and diversity of the riparian habitats associated with perennial and ephemeral streams (Appendix 4). Obligate wetland species included cutlear water-parsnip (*Berula erecta*), saltmarsh baccharis (*Baccharis douglasii*), mosquito fern (*Azolla filiculoides*), California tule (*Scirpus californicus*), basket rush (*Juncus textilis*), rigid hedge nettle (*Stachys ajugoides*), valdiva duckweed (*Lemna valdiviana*), California loosestrife (*Lythrum californicum*), willow dock

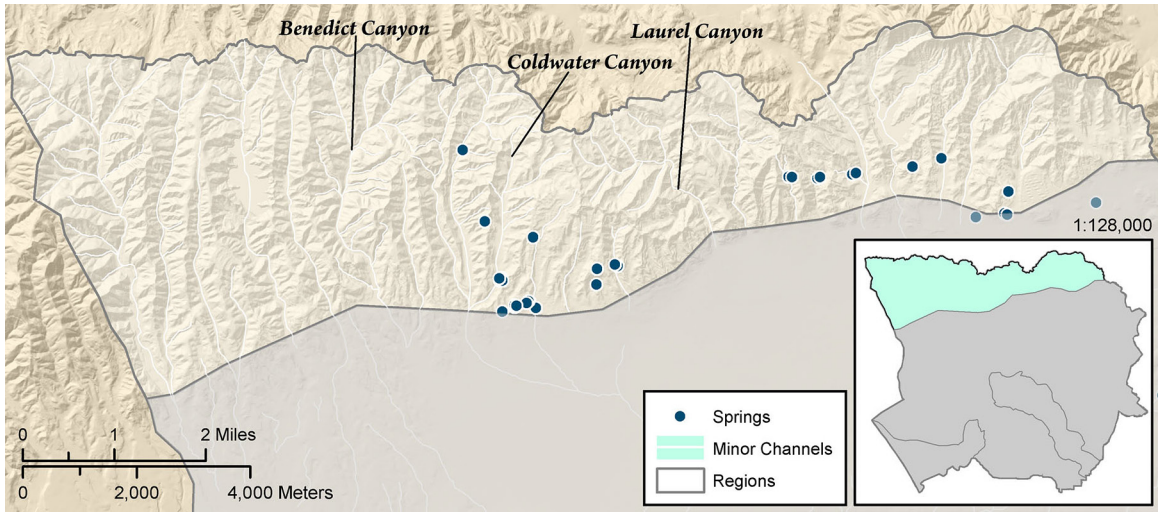

FIGURE 24:
SAMO region showing location of springs and streams.

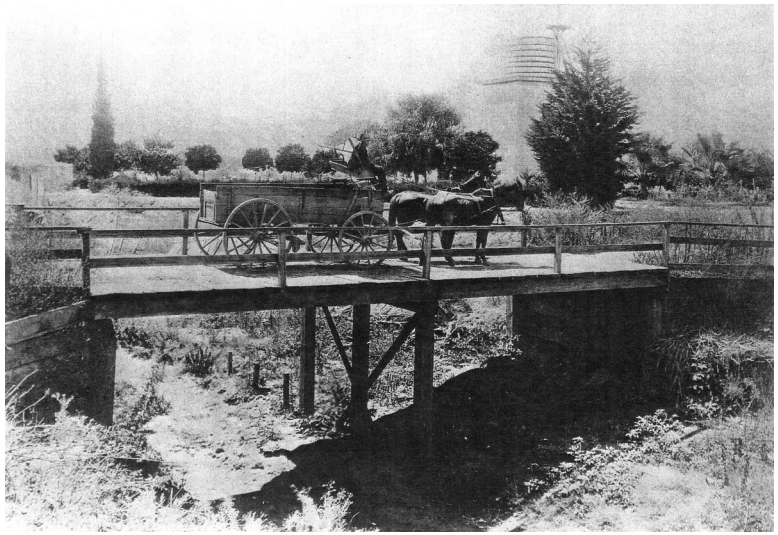

FIGURE 25:
Bridge over Franklin Canyon, 1890 (photo courtesy of the Seaver Collection at the Natural History Museum).

(*Rumex salicifolius*), sago pondweed (*Stuckenia pectinata*), and seep monkey flower (*Mimulus guttatus*). The nest and egg records showed the breeding presence of a range of riparian-associated bird species, including Black-headed Grosbeak (in willows, "grape vine," and sycamores), the now-endangerd Least Bell's Vireo (in sycamores, willows, and "elder"), Yellow Warbler (in willows), House Wren (in willows), Long-tailed Chat ("blackberry vines in willow thicket," "tangle of briars"), Little flycatcher ("thicket, near stream"), and Western Wood-Pewee (in oaks).

Ballona and Centinela Creeks

Ballona and Centinela creeks were the dominant fluvial features in the Ballona watershed. Both channels played major roles in the formation, development and usage of the surrounding landscape. Likewise, both channels were the primary streams supplying water to the Ballona Lagoon.

Ballona Creek

Although we classified Ballona Creek as a perennial channel (Hall 1888, Giffin 1902, Adler 1969), we were surprised at how relatively little other historical information was available for the most significant channel in the watershed. In retrospect, we realized that this lack of information was related to the relatively short length of the fluvial channel. Contemporary channelized Ballona Creek is a fairly long hydrologic feature, but the historical span was only 5.7 miles (9.2 km) long prior to 1900, when expansive wetlands dominated the adjacent areas. The two ends of Ballona Creek were effectively subsumed by the La Cienega and Ballona Lagoon wetland complexes and the creek provide surface hydrologic linkage between these two larger wetland complexes (FIGURE 26).

Several smaller drainages flowed into the La Cienega wetlands, but none appeared to be continguous with Ballona Creek; therefore, we interpreted the origin of Ballona Creek proper to be at the outflow of the La Cienega complex.

As indicated by textual descriptions such as the one below and various map sources, the Creek's historical terminus was the Ballona wetland complex (Solano 1868, Carson 1883 Adler 1969). The contemporary location of the channel is remarkably similar but now extends substantially farther upstream and downstream than it did historically.

> *"Out from the central springs of the upper belt - on the ranchos La Brea and Rodeo de las Aguas - Ballona creek gathers its upper perennial waters, leads them south against the base of the Centinela hills. Here, reinforced by a little stream from the east, draining the springs of the ranchos La Cienega and Paso de la Tijera, it turns west and southwest, parallel with the hill's footing, into the Ballona flats and the sea five to six miles away" (Hall 1888).*

Where Ballona Creek flowed independently from the surrounding wetlands, narrative accounts support the description of a clear flowing "stream"lined with sycamores, willows and tules, which, on occasion, inundated the surrounding lands during times of flooding (LAT 1906, Robinson 1942, Wittenberg 1973). Tributaries of Ballona Creek originated far to the north (potentially via the Los Angeles River), and throughout the La Cienega wetland complex (LAT 1906). As described by Hall in 1888.

Centinela Creek

Centinela Creek was largely a spring fed channel just over 4.5 miles (7.2

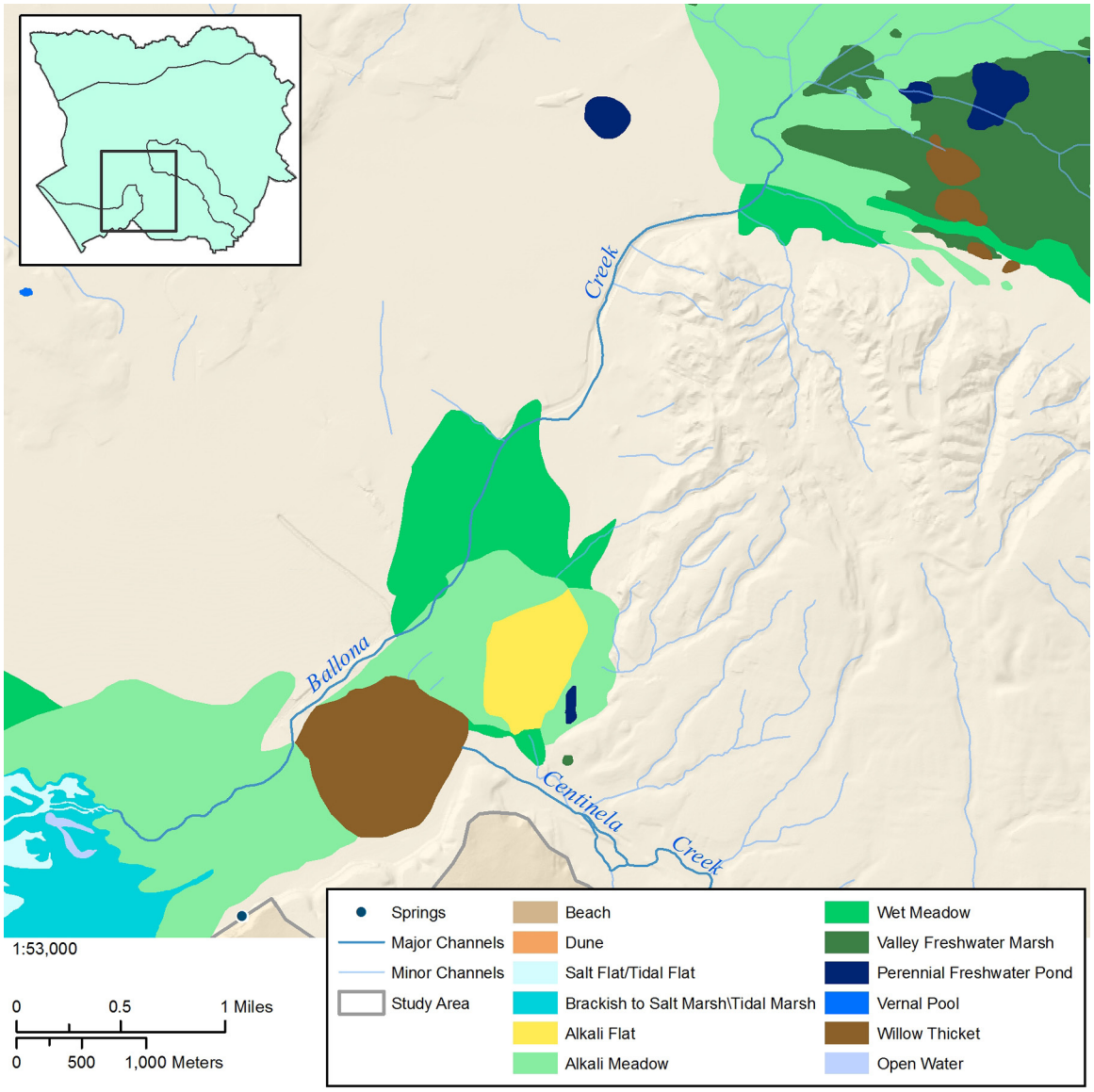

FIGURE 26: *Extent of Ballona Creek.*

km) long, originating at Centinela Springs (FIGURE 27) in the Inglewood area, and draining most of the lands in the surrounding region (Hansen 1867, CIU 1874). As with Ballona Creek, historical documentation was limited, and mainly focuses on the Centinela Springs and surrounding lands of Centinela rather than the Creek itself. Records indicate that the Creek was a perennial stream that provided consistent and ample flow for both domestic and agricultural uses (Hansen 1867, LAT 1873, CIU 1874). The surrounding lands and rich soils of Centinela produced a region ideal for agriculture (LAT 1873, CIU 1874). Several documents described the creek morphology, for example:

> *"The bottom of the Creek from the Spring to St. 16 is from 660 to 1320 feet wide, the banks, from 20 to 30 feet high and steep from station 16 North westerly the bottom widens out and the banks are less abrupt" (Hansen 1867).*

FIGURE 27: *Photograph of Centinela Springs (date unknown, photo courtesy of the Huntington Library).*

Compared to the channelized, short extent of contemporary Centinela Creek, historical Centinela Creek maintained significant sinuosity as it wound its way through the lands of Centinela. Depth and volume of the historical Creek was "over 75 miner's inches of water (3 acre feet/day)" (LAT, 1904). At its terminus, Centinela Creek emptied into the southeastern part of the Ballona Lagoon promoting the formation of a large willow thicket (Lee 1912; FIGURE 28).

Flora and Fuana

The plant records for Ballona Creek are found largely in the Lagoon category for the lower creek, frequently refered to as "Ballona Creek, near Mesmer." Other records are from the relatively short Culver City section between the marshes of the Cienega and the start of the coastal wetland complex. The flora of Centinela Creek was classified with Inglewood because insufficient records speifically identified the creek (Appendix 5). These records also show presence of vernal pools through the presence of spreading navarretia, which is found in vernal pools and alkali grasslands, and is now federally endangered. None of the riparian bird nest records were from this region.

Overall Confidence in Mapped Polygons

Estimated confidence in the historical analysis was based on three factors; interpretation of data sources, wetland location, and wetland shape. Interpretation of data sources and the shape of wetlands mapped had the highest confidence classifications (FIGURE 29). This is not

CERTAINTY	INTERPRETATION	SHAPE	LOCATION
HIGH	9	3	6
MEDIUM	91	48	75
LOW	0	49	19
TOTALS [%]	100	100	100

FIGURE 29:
Percentage of wetland area mapped in each certainty category.

surprising given the dynamic nature of wetlands in the study area. While a wetland feature may have been persistent on multiple sources it may have been much larger or smaller depending upon the amount of rainfall in any given year.

Certainty estimates based on habitat type were also analyzed. We were the most confident in our interpretation of alkali flats and valley fresh water marsh, both habitat types had certainty classifications of high for 80% of the associated polygons mapped. Salt/tidal flat had the lowest interpretation certainty given the inconsistency of the data sources for the Ballona Lagoon region with regard to tidal influence.

Habitat maps with the greatest confidence in shape and location were; alkali flats, beach, salt/tidal marsh, and salt/tidal flats. Beach, salt/tidal marsh, and salt/tidal flats were all mapped from the detailed USGS T-Sheet (Chase 1876). Given our knowledge of the detail and spatial accuracy of these maps we feel confident in the general location and shape of these features. The location and shape of vernal pools and willow thickets had the lowest confidence classification, with both receiving a classification of low in these categories for about 70% of the polygons mapped. This may reflect the dynamic nature of these habitat types. Vernal pools are heavily influenced by annual precipitation,

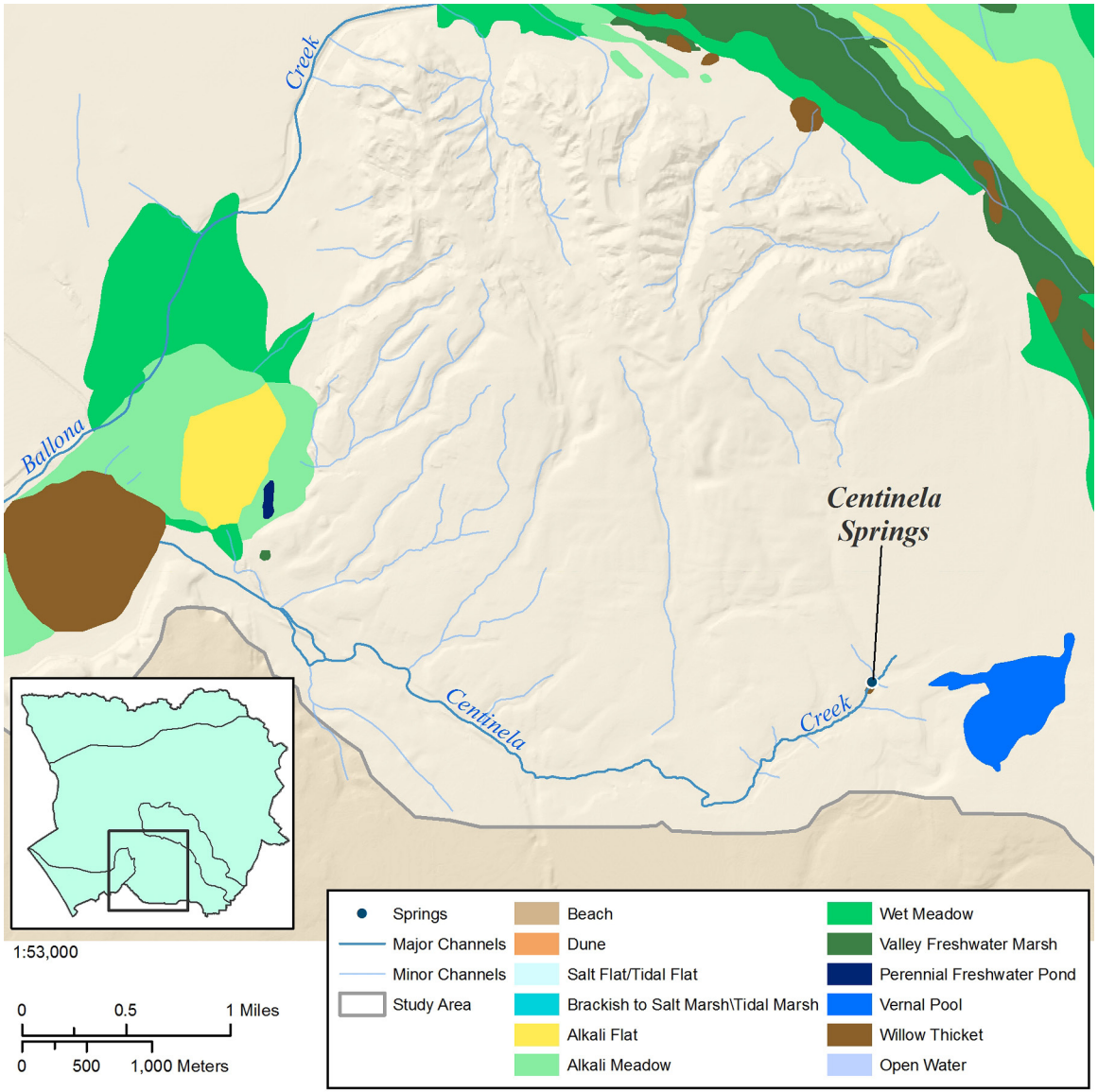

FIGURE 28: *Extent of Centinela Creek.*

therefore during dry years there were likely to be less data sources available documenting their location and shape with consistency. Willow thickets were only found on the early diseno and docket maps, but not present on any other maps from the late 19th century. It may be these thickets were so small they were not identified on more coarse scale maps. Also, it could be they were modified by humans early given their location relative to fresh water and the likely fertile soils they are found on.

SUMMARY

This research outlined above demonstrates the impressive complexity and diversity that was characteristic of southern California's wetland ecosystems. The dynamism of surface waters in combination with broad shallow aquifers supported vast expanses of alkali flats, alkali meadows, wet meadows, and salt/tidal associated wetlands. Vernal pools, freshwater ponds, and willow groves were also evident, contributing to a tremendous diversity of wetland habitats and consequently large amounts of biodiversity that were historically present within the watershed.

The question remains, how do we bridge this knowledge of the historical Ballona watershed to contemporary landscape management plans? The knowledge of reference conditions often creates considerable discussion about what should be restored, how, and where. We consider this discussion to be an extremely valuable process for restoration of wetlands within this watershed. Clearly, it is unrealistic to have the expectation that systems can be restored to their natural hydrodynamics. The vast alkali meadows of the La Cienega region cannot be realistically restored in the contemporary urbanized landscape. Application of the findings of this study is largely dependent on the extent of human modification, the confidence of historical interpretations, and the intended purpose of restoration. We do not believe the results from this study drive toward one specific endpoint, but may support numerous alternatives for a particular project. In fact, the ensuing discussions about restoration and the iterative process by which further understanding is developed are a valuable outcome from this project.

NEXT STEPS

This project provides significant insight into the historical landscape of the Ballona watershed. The development of living tools such as the metadata catalog and Ballona Historical Ecology website will hopefully encourage further historical research of wetland resources in this region. As stated at the beginning of this report, we provide a summary of the historical watershed characteristics. This report has a limited focus on the interpretation of data created. We do not interpret or analyze landscape change or discuss implications for management. Future efforts can build upon the foundation provided by this project through the exploration of key issues such as:

1. An analysis of how the ecosystem functioned over time, including factors that affected local and regional habitats. Broadening the temporal scale to include human impact would create a better understanding of the key drivers influencing changes within this unique landscape.
2. A more detailed analysis of the distribution of specific plant communities.
3. An examination of where the greatest losses occurred, both geographically and in terms of specific habitat types.
4. A linkage between our results and potential restoration options in light of current day landscape constraints.

The datasets and living tools provided on the Ballona Historical Ecology website may serve as valuable resources to initiate research in some of these areas.

A common theme running through some of the unanswered questions in this report is the lack of information about the historical ecology of the Los Angeles River. Attempts to understand the history of the Los Angeles River have been made through a variety of mediums (Gumprecht 1999, Elrick and FOLAR 2007). However, there has been little detailed work focusing on the historical wetland habitats, hydrodynamics and associated impacts of the Los Angeles River on connected systems such as the Ballona Watershed and the San Gabriel River watershed. We believe this report offers an opportunity to understand the value and need of such research, not just within the regional landscape but also to better understand the historical ecology of wetland ecosystems throughout Southern California.

In addition to furthering our understanding of the Los Angeles River, there is also a need to better connect the historical ecological research being performed throughout southern California with contemporary landscapes. For example, creating a cross-walk between contemporary and historical habitat classifications would be immensely helpful for restoration purposes. Likewise, the identification of specific sites that could be restored and the options for restoration given the historical ecology would be immensely helpful.

This project has provided a unique opportunity to collaborate across disciplines and within groups currently involved in historical ecology efforts throughout the state of California. We were able to create living tools such as the metadata catalog and the Ballona Historical Ecology website that allow for a coordinated exchange of information in both data collection efforts and visualization of the study area. These tools set a precedent for future research and lend to further development on future projects.

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Additional information on historical ecology in southern California, can be obtained from **www.csun.edu/~centergs/**. Digital products associated with this project can be obtained at **www.ballonahe.org**.

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APPENDIX 1.
PLANT SPECIES RECORDED IN THE BALLONA VALLEY REGION

Family	Species	Common Name	Wetland
Apiaceae	*Hydrocotyle verticillata*	whorled marsh pennywort	OBL
Apiaceae	*Oenanthe sarmentosa*	water parsley	OBL
Apiaceae	*Tauschia arguta*	southern umbrellawort	
Asteraceae	*Ambrosia acanthicarpa*	annual bursage	
Asteraceae	*Ambrosia psilostachya*	western ragweed	FAC
Asteraceae	*Ambrosia psilostachya var. californica*	western ragweed	FAC
Asteraceae	*Chrysothamnus nauseosus*		
Asteraceae	*Conyza canadensis*	Canada horseweed	FAC
Asteraceae	*Corethrogyne filaginifolia*	common sandaster	
Asteraceae	*Corethrogyne filaginifolia var. virgata*	common sandaster	
Asteraceae	*Deinandra fasciculata*	common tarweed	
Asteraceae	*Erigeron foliosus*	leafy fleabane	
Asteraceae	*Gnaphalium leucocephalum*	white-headed cudweed	
Asteraceae	*Gnaphalium stramineum*	Small-flowered cudweed	
Asteraceae	*Grindelia camporum*	Great Valley gumweed	
Asteraceae	*Grindelia hirsutula*	hairy gumweed	FACW
Asteraceae	*Helianthus annuus*	common sunflower	FAC
Asteraceae	*Helianthus annuus subsp. lenticularis*	common sunflower	FAC
Asteraceae	*Hemizonia australis*	Asteraceae	
Asteraceae	*Heterotheca grandiflora*	telegraphweed	
Asteraceae	*Isocoma menziesii var. vernonioides*	white-flowered goldenbush	FAC
Asteraceae	*Lasthenia californica*	California goldfields	FACW
Asteraceae	*Lasthenia glabrata subsp. coulteri*	yellowray goldfields	FACW
Asteraceae	*Layia glandulosa*	White tidy-tips	
Asteraceae	*Lepidospartum squamatum*	scalebroom	
Asteraceae	*Malacothrix saxatilis var. tenuifolia*	cliff aster	

Family	Species	Common Name	Wetland
Asteraceae	*Pseudognaphalium leucocephalum*	white headed cudweed	
Asteraceae	*Pseudognaphalium microcephalum*		
Asteraceae	*Senecio californicus*	California Butterweed	
Asteraceae	*Senecio flaccidus var. douglasii*	Douglas' shrubby ragwort	
Asteraceae	*Stephanomeria exigua subsp. coronaria*	milk aster	
Asteraceae	*Uropappus lindleyi*	silver puffs	
Asteraceae	*Xanthium spinosum*	spiny cocklebur	FAC
Boraginaceae	*Amsinckia intermedia*	Eastwood's fiddleneck	
Boraginaceae	*Cryptantha muricata*	prickly cryptantha	
Boraginaceae	*Heliotropium curassavicum var. oculatum*	seaside heliotrope	OBL
Boraginaceae	*Plagiobothrys nothofulvus*	rusty popcornflower	FAC
Brassicaceae	*Erysimum capitatum*	western wallflower	
Brassicaceae	*Lepidium oblongum*	Wayside peppergrass	
Brassicaceae	*Lepidium strictum*	prostrate pepper grass	
Cactaceae	*Opuntia oricola*	chaparral pricklypear	
Caryophyllaceae	*Silene laciniata subsp. major*	Indian pink	
Chenopodiaceae	*Atriplex serenana*	saltscale	FAC
Chenopodiaceae	*Suaeda calceoliformis*	Pursh seepweed	FACW+
Chenopodiaceae	*Suaeda moquinii*	bush seepweed	FAC
Cistaceae	*Helianthemum scoparium var. vulgare*	common sun-rose	
Convolvulaceae	*Calystegia macrostegia subsp. cyclostegia*	south coast morning-glory	
Convolvulaceae	*Cressa truxillensis*	spreading alkaliweed	FACW
Cupressaceae	*Calocedrus decurrens*	incense cedar	
Cuscutaceae	*Cuscuta campestris*	field dodder	
Cyperaceae	*Carex praegracilis*	clustered field sedge	FACW-
Cyperaceae	*Cyperus eragrostis*	tall flatsedge	FACW

Family	Species	Common Name	Wetland
Cyperaceae	*Cyperus esculentus*	Yellow nutgrass	FACW
Cyperaceae	*Schoenoplectus americanus*	chairmaker's bulrush	OBL
Cyperaceae	*Scirpus maritimus*	prairie bulrush	OBL
Euphorbiaceae	*Chamaesyce albomarginata*	rattlesnake weed	
Euphorbiaceae	*Croton californicus*	California croton	
Fabaceae	*Astragalus pycnostachyus var. lanosissimus*	marsh milk-vetch	OBL
Fabaceae	*Astragalus trichopodus var. lonchus*	Santa Barbara milk-vetch	
Fabaceae	*Lathyrus vestitus subsp. laetiflorus*	wild sweetpea	
Fabaceae	*Lotus unifoliolatus*	American bird's foot trefoil	
Fabaceae	*Lupinus excubitus var. hallii*	Hall's bush lupine	
Fabaceae	*Lupinus longifolius*	long leaf bush lupine	
Fabaceae	*Pickeringia montana*	chaparral pea	
Fabaceae	*Trifolium ciliolatum*	foothill clover	
Fabaceae	*Trifolium obtusiflorum*	creek clover	FAC
Grossulariaceae	*Ribes aureum var. gracillimum*	golden currant	FACW
Hydrophyllaceae	*Nemophila menziesii*	baby blue eyes	
Hydrophyllaceae	*Phacelia distans*	common phacelia	
Hydrophyllaceae	*Phacelia minor*	California bluebell	
Iridaceae	*Sisyrinchium bellum*	blue-eyed grass	FAC
Juncaceae	*Juncus ambiguus*	saline toad rush	FACW
Lamiaceae	*Stachys ajugoides var. rigida*	rigid hedge nettle	
Lemnaceae	*Lemna gibba*	swollen duckweed	OBL
Lemnaceae	*Lemna minor*	common duckweed	OBL
Liliaceae	*Bloomeria crocea var. crocea*	common goldenstar	
Loasaceae	*Mentzelia affinis*	yellow blazing star	
Myricaceae	*Morella californica*	Myricaceae	FAC

Family	Species	Common Name	Wetland
Nyctaginaceae	*Abronia umbellata*	purple sand verbena	
Onagraceae	*Camissonia cheiranthifolia subsp. suffruticosa*	beach evening-primrose	
Onagraceae	*Epilobium canum subsp. canum*	California fuchsia	
Onagraceae	*Ludwigia peploides subsp. peploides*	floating primrose willow	OBL
Papaveraceae	*Platystemon californicus*	cream cups	
Papaveraceae	*Romneya coulteri*	Coulter's matilija poppy	RARE
Plantaginaceae	*Plantago erecta*	California plantain	
Platanaceae	*Platanus racemosa*	western sycamore	FACW
Poaceae	*Bromus grandis*	tall brome	
Poaceae	*Elymus condensatus*	giant wild rye	FACU
Poaceae	*Elymus triticoides*	alkali rye	FAC
Poaceae	*Eragrostis pectinacea*	tufted lovegrass	FAC
Poaceae	*Eragrostis pectinacea var. pectinacea*	tufted lovegrass	FAC
Poaceae	*Leptochloa panicea ssp. brachiata*	mucronate sprangeltop	
Poaceae	*Leptochloa uninervia*	Mexican sprangletop	FACW
Poaceae	*Leymus triticoides*	beardless wildrye	FAC
Poaceae	*Nassella cernua*	nodding needlegrass	
Poaceae	*Nassella pulchra*	purple needlegrass	
Poaceae	*Phalaris lemmonii*	Lemmon's canarygrass	FACW-
Poaceae	*Phalaris minor*	littleseed canarygrass	
Polygonaceae	*Polygonum lapathifolium*	curlytop knotweed	OBL
portulacaceae	*Calandrinia ciliata*	red maids	FACU
Primulaceae	*Dodecatheon clevelandii*	padre's shootingstar	
Rosaceae	*Potentilla anserina*	silver weed cinquefoil	OBL
Rosaceae	*Potentilla glandulosa*	Common cinquefoil	FAC
Salicaceae	*Salix lasiolepis*	arroyo willow	FACW

Family	Species	Common Name	Wetland
Saururaceae	*Anemopsis californica*	yerba mansa	OBL
Scrophulariaceae	*Castilleja exserta*	purple owl's clover	
Scrophulariaceae	*Kochia scoparia*	climbing penstemon	
Scrophulariaceae	*Linaria canadensis var. texana*	rough seeded blue toad flax	
Scrophulariaceae	*Mimulus guttatus*	seep monkeyflower	OBL
solanaceae	*Datura wrightii*	Jimson weed	
Ulmaceae	*Celtis laevigata*	western hackberry	
Urticaceae	*Hesperocnide tenella*	western stinging nettle	
Verbenaceae	*Verbena lasiostachys var. lasiostachys*	Common verbena	FAC

APPENDIX 2.
FLORA OF THE LA CIENEGA REGION AS DOCUMENTED IN HERBARIUM SPECIMENS

Family	Species	Common Name	Wetland
Apiaceae	*Oenanthe sarmentosa*	water parsley	OBL
Asclepiadaceae	*Asclepias fascicularis*	narrow leaf milkweed	FAC
Asteraceae	*Ambrosia acanthicarpa*	annual bursage	
Asteraceae	*Baccharis douglasii*	saltmarsh baccharis	OBL
Asteraceae	*Helianthus nuttallii subsp. parishii*	Los Angeles sunflower	FACW
Asteraceae	*Hemizonia australis*	Asteraceae	
Asteraceae	*Isocoma menziesii var. menziesii*	white-flowered goldenbush	FAC
Asteraceae	*Pluchea odorata*	salt marsh fleabane	
Asteraceae	*Pseudognaphalium stramineum*	Small flowered cudweed	FAC
Asteraceae	*Symphyotrichum defoliatum*	San Bernardino aster	
Asteraceae	*S. lanceolatum var. hesperium [=Aster hesperius]*		
Asteraceae	*Xanthium spinosum*	spiny cocklebur	FAC
Brassicaceae	*Hutchinsia procumbens*	prostrate hutchinsia	FAC
Brassicaceae	*Nasturtium gambelii*	Gambel's yellowcress	OBL
Chenopodiaceae	*Atriplex argentea var. mohavensis*	mohave saltbush	FAC
Chenopodiaceae	*Atriplex serenana var. davidsonii*	saltscale	FAC
Chenopodiaceae	*Atriplex triangularis*	spear leaved saltbrush	
Chenopodiaceae	*Salicornia virginica*	pickleweed	OBL
Chenopodiaceae	*Suaeda moquinii*	bush seepweed	FAC
Cornaceae	*Cornus californica*	Creek Dogwood	FACW
Cornaceae	*Cornus occidentalis*	Creek Dogwood	FACW
Cyperaceae	*Carex barbarae*	Santa Barbara sedge	FACW
Cyperaceae	*Carex praegracilis*	clustered field sedge	FACW
Cyperaceae	*Carex schottii*	Schott's sedge	OBL
Cyperaceae	*Cyperus esculentus*	Yellow nutgrass	FACW
Cyperaceae	*Cyperus niger var. capitatus*	black flatsedge	FACW

Family	Species	Common Name	Wetland
Cyperaceae	*Scirpus californicus*	California tule	OBL
Euphorbiaceae	*Chamaesyce serpens*	creeping spurge	FAC
Euphorbiaceae	*Euphorbia serpens*	creeping spurge	FAC
Fabaceae	*Astragalus brauntonii*	Braunton's milk vetch	
Fabaceae	*Astragalus funereus*	black milk vetch	
Fabaceae	*Astragalus pycnostachyus var. lanosissimus*	marsh milk-vetch	OBL
Fabaceae	*Lotus purshianus var. purshianus*	Spanish clover	
Juncaceae	*Juncus mexicanus*	mexican rush	FACW
Juncaceae	*Juncus phaeocephalus*	brownhead rush	FACW
Lamiaceae	*Stachys albens*	whitestem hedgenettle	OBL
Liliaceae	*Bloomeria crocea var. crocea*	common goldenstar	
Onagraceae	*Epilobium ciliatum*	fringed willowherb	FACW
Onagraceae	*Epilobium ciliatum subsp. ciliatum*	fringed willowherb	FACW
Onagraceae	*Ludwigia peploides subsp. peploides*	floating primrose willow	OBL
Poaceae	*Setaria parviflora*	marsh bristlegrass	
Polygonaceae	*Polygonum punctatum*	Common water smartweed	OBL
Rosaceae	*Potentilla anserina var. grandis*	silver-weed cinquefoil	OBL
Rubiaceae	*Galium trifidum var. pacificum*	Pacific Bedstraw	FACW
Typhaceae	*Sparganium erectum subsp. stoloniferum*	simplestem bur-reed	OBL

APPENDIX 3.
PLANT SPECIES RECORDED AT BALLONA LAGOON FROM HERBARIUM RECORDS

Family	Species	Common Name	Wetland
Aizoaceae	*Sesuvium verrucosum*	western sea-purslane	
Alismataceae	*Sagittaria montevidensis ssp. calycina*	hooded arrowhead	OBL
Amaranthaceae	*Amaranthus blitoides*	mat amaranth	FACW
Anacardiaceae	*Malosma laurina*	laurel sumac	
Anacardiaceae	*Rhus ovata*	sugar bush	
Apiaceae	*Bowlesia incana*	hoary bowlesia	FACW
Apiaceae	*Hydrocotyle verticillata*	whorled marsh pennywort	OBL
Apiaceae	*Oenanthe sarmentosa*	water parsley	OBL
Asclepiadaceae	*Asclepias fascicularis*	narrow leaf milkweed	FAC
Asteraceae	*Amblyopappus pusillus*	dwarf coastweed	FACW
Asteraceae	*Ambrosia acanthicarpa*	annual bursage	
Asteraceae	*Ambrosia chamissonis*	Silver Beachweed	
Asteraceae	*Ambrosia chamissonis var. bipinnatisecta*	Silver Beachweed	
Asteraceae	*Ambrosia psilostachya*	western ragweed	FAC
Asteraceae	*Ambrosia psilostachya var. californica*	western ragweed	FAC
Asteraceae	*Artemisia californica*	California sagebrush	
Asteraceae	*Artemisia douglasiana*	mugwort	FACW
Asteraceae	*Artemisia dracunculus*	herbaceous sagewort	
Asteraceae	*Aster subulatus var. ligulatus*	annual water-aster	
Asteraceae	*Baccharis douglasii*	saltmarsh baccharis	OBL
Asteraceae	*Baccharis pilularis*	coyote brush	
Asteraceae	*Baccharis salicifolia*	mulefat	FACW
Asteraceae	*Bidens laevis*	bur marigold	OBL
Asteraceae	*Centromadia parryi subsp. australis*	Parry's tarweed	FAC
Asteraceae	*Chaenactis glabriuscula*	yellow pincushion	
Asteraceae	*Chaenactis glabriuscula var. glabriuscula*	yellow pincushion	

Family	Species	Common Name	Wetland
Asteraceae	*Chaenactis glabriuscula var. lanosa*	yellow pincushion	
Asteraceae	*Chaenactis glabriuscula var. orcuttiana*	yellow pincushion	
Asteraceae	*Cirsium occidentale var. occidentale*	California thistle	
Asteraceae	*Conyza canadensis*	Canada horseweed	FAC
Asteraceae	*Corethrogyne filaginifolia*	common sandaster	
Asteraceae	*Deinandra fasciculata*	common tarweed	
Asteraceae	*Ericameria ericoides*	California goldenbush	
Asteraceae	*Euthamia occidentalis*	western goldenrod	OBL
Asteraceae	*Filago californica*	California Cottonrose	
Asteraceae	*Gnaphalium bicolor*	bicolored everlasting	
Asteraceae	*Gnaphalium californicum*	California cudweed	
Asteraceae	*Gnaphalium californicum*	California everlasting	
Asteraceae	*Gnaphalium ramosissimum*	pink everlasting	
Asteraceae	*Gnaphalium stramineum*	Everlasting Cudweed	FAC
Asteraceae	*Grindelia camporum*	Great Valley gumweed	
Asteraceae	*Helianthus annuus subsp. lenticularis*	common sunflower	FAC
Asteraceae	*Hemizonia australis*	Asteraceae	
Asteraceae	*Hemizonia fasciculata*	common tarweed	
Asteraceae	*Heterotheca grandiflora*	telegraphweed	
Asteraceae	*Jaumea carnosa*	marsh jaumea	OBL
Asteraceae	*Laennecia coulteri*	Coulter's horseweed	FAC
Asteraceae	*Lasthenia californica*	California goldfields	FACW
Asteraceae	*Lasthenia coronaria*	royal goldfields	
Asteraceae	*Lasthenia glabrata subsp. coulteri*	yellowray goldfields	FACW
Asteraceae	*Lasthenia gracilis*	needle goldfields	
Asteraceae	*Layia platyglossa*	White tidy-tips	

Family	Species	Common Name	Wetland
Asteraceae	*Lessingia filaginifolia*	common sandaster	
Asteraceae	*Logfia filaginoides*	California Cottonrose	
Asteraceae	*Malacothrix saxatilis var. tenuifolia*	cliff aster	
Asteraceae	*Pluchea odorata*	salt marsh fleabane	
Asteraceae	*Pseudognaphalium biolettii*	twocolor cudweed	
Asteraceae	*Pseudognaphalium canescens ssp. beneolens*	Wright's cudweed	
Asteraceae	*Pseudognaphalium microcephalum*		
Asteraceae	*Pseudognaphalium microcephalum*	white headed cudweed	
Asteraceae	*Senecio californicus*	California Butterweed	
Asteraceae	*Stephanomeria diegensis*	San Diego milk aster	
Asteraceae	*Stephanomeria exigua subsp. coronaria*	milk aster	
Asteraceae	*Stephanomeria virgata*	Tall stephanomeria	
Asteraceae	*Symphyotrichum subulatum*	eastern annual saltmarsh aster	FACW
Asteraceae	*Xanthium spinosum*	spiny cocklebur	FAC
Asteraceae	*Xanthium strumarium*	rough cockleburr	FAC
Boraginaceae	*Amsinckia eastwoodiae*	Eastwood's fiddleneck	
Boraginaceae	*Amsinckia intermedia*	Eastwood's fiddleneck	
Boraginaceae	*Amsinckia lycopsoides*	Eastwood's fiddleneck	
Boraginaceae	*Amsinckia spectabilis*	seaside fiddleneck	FACU
Boraginaceae	*Cryptantha clevelandii*	Cleveland's cryptantha	
Boraginaceae	*Cryptantha clevelandii var. florosa*	Cleveland's cryptantha	
Boraginaceae	*Cryptantha intermedia*	Clearwater cryptantha	
Boraginaceae	*Cryptantha leiocarpa*	coast cryptantha	
Boraginaceae	*Cryptantha microstachys*	Tejon cryptantha	
Boraginaceae	*Heliotropium curassavicum*	seaside heliotrope	OBL
Boraginaceae	*Heliotropium curassavicum var. oculatum*	seaside heliotrope	OBL

Family	Species	Common Name	Wetland
Brassicaceae	*Descurainia pinnata subsp. menziesii*	western tansymustard	
Brassicaceae	*Dithyrea californica*	California shieldpod	
Brassicaceae	*Dithyrea maritima*	beach shieldpod	RARE
Brassicaceae	*Erysimum insulare subsp. suffrutescens*	suffrutescent wallflower	
Brassicaceae	*Erysimum suffrutescens*	suffrutescent wallflower	
Brassicaceae	*Guillenia lasiophylla*	California mustard	
Brassicaceae	*Lepidium lasiocarpum*	shaggyfruit pepperweed	
Brassicaceae	*Lepidium nitidum*	shining pepperweed	
Brassicaceae	*Lepidium virginicum*	wild pepper grass	FACW
Brassicaceae	*Lepidium virginicum var. pubescens*	hairy pepperweed	FACW
Brassicaceae	*Rorippa curvisiliqua*	curvepod yellowcress	OBL
Brassicaceae	*Tropidocarpum gracile*	slender tropidocarpum	
Cactaceae	*Opuntia oricola*	chaparral pricklypear	
Capparaceae	*Isomeris arborea*	Coastal bladderpod	
Caryophyllaceae	*Cardionema ramosissimum*	Sand mat	
Caryophyllaceae	*Minuartia douglasii*	Douglas' stitchwort	
Caryophyllaceae	*Polycarpon depressum*	California manyseed	
Caryophyllaceae	*Spergularia macrotheca*	sticky sandspurry	FAC
Caryophyllaceae	*Spergularia marina*	salt marsh sand spurry	OBL
Chenopodiaceae	*Atriplex argentea*	silverscale saltbush	FAC
Chenopodiaceae	*Atriplex argentea var. mohavensis*	mohave saltbush	FAC
Chenopodiaceae	*A. argentea var. mohavensis [=Atriplex expansa]*	mohave saltbush	FAC
Chenopodiaceae	*Atriplex breweri*	quailbush	FAC
Chenopodiaceae	*Atriplex californica*	California saltbush	FAC
Chenopodiaceae	*Atriplex lentiformis*	big saltbush	FAC
Chenopodiaceae	*Atriplex lentiformis subsp. breweri*	quailbush	FAC

Family	Species	Common Name	Wetland
Chenopodiaceae	*Atriplex lentiformis subsp. lentiformis*	big saltbush	FAC
Chenopodiaceae	*Atriplex lentiformis var. breweri*	quailbush	FAC
Chenopodiaceae	*Atriplex leucophylla*	beach saltbush	FAC
Chenopodiaceae	*Atriplex patula subsp. hastata*	fathen saltweed	FACW
Chenopodiaceae	*Atriplex triangularis*	spear leaved saltbrush	
Chenopodiaceae	*Atriplex truncata*	wedgescale	FAC
Chenopodiaceae	*Salicornia europaea*	slender pickleweed	OBL
Chenopodiaceae	*Salicornia subterminalis*	Parish's pickleweed	OBL
Chenopodiaceae	*Salicornia virginica*	pickleweed	OBL
Chenopodiaceae	*Suaeda calceoliformis*	Pursh seepweed	FACW
Chenopodiaceae	*Suaeda taxifolia*	woolly seablite	FACW
Chenopodiaeceae	*Chenopodium berlandieri var. sinuatum*	Berlandier's goosefoot	
Convolvulaceae	*Calystegia macrostegia subsp. intermedia*	south coast morning-glory	
Convolvulaceae	*Calystegia soldanella*	beach morning glory	
Convolvulaceae	*Cressa truxillensis*	spreading alkaliweed	FACW
Crassulaceae	*Crassula connata*	sand pygmyweed	FAC
Crassulaceae	*Crassula connata var. erectoides*	sand pygmyweed	FAC
Crassulaceae	*Dudleya lanceolata*	lanceleaf liveforever	
Cucurbitaceae	*Cucurbita foetidissima*	calabazilla	
Cucurbitaceae	*Marah macrocarpus*	southern wild-cucumber	
Cuscutaceae	*Cuscuta californica*	chaparral dodder	
Cuscutaceae	*Cuscuta campestris*	field dodder	
Cuscutaceae	*Cuscuta salina*	saltmarsh dodder	
Cyperaceae	*Carex praegracilis*	clustered field sedge	FACW
Cyperaceae	*Cyperus eragrostis*	tall flatsedge	FACW
Cyperaceae	*Cyperus esculentus*	Yellow nutgrass	FACW

Family	Species	Common Name	Wetland
Cyperaceae	*Eleocharis macrostachya*	common spikerush	OBL
Cyperaceae	*Eleocharis montevidensis*	sand spikerush	FACW
Cyperaceae	*Eleocharis montevidensis var. montevidensis*	sand spikerush	FACW
Cyperaceae	*Isolepis cernua*	annual tule	OBL
Cyperaceae	*Schoenoplectus americanus*	chairmaker's bulrush	OBL
Cyperaceae	*Scirpus [=Schoenoplectus] californicus*	California tule	OBL
Cyperaceae	*Scirpus californicus*	California tule	OBL
Cyperaceae	*Scirpus maritimus*	prairie bulrush	OBL
Equisetaceae	*Equisetum hyemale subsp. affine*	common scouring rush	FACW
Equisetaceae	*Equisetum telmateia subsp. braunii*	giant horsetail	OBL
Euphorbiaceae	*Chamaesyce albomarginata*	rattlesnake weed	
Euphorbiaceae	*Chamaesyce polycarpa var. polycarpa*	small seeded spurge	
Euphorbiaceae	*Chamaesyce serpens*	creeping spurge	FAC
Euphorbiaceae	*Croton californicus*	California croton	
Euphorbiaceae	*Croton californicus var. californicus*	California croton	
Euphorbiaceae	*Croton californicus var. tenuis*	California croton	
Euphorbiaceae	*Croton setigerus*	dove weed	
Fabaceae	*Astragalus didymocarpus var. didymocarpus*	dwarf white milk vetch	
Fabaceae	*Astragalus pycnostachyus var. lanosissimus*	marsh milk-vetch	OBL
Fabaceae	*Astragalus trichopodus var. lonchus*	Santa Barbara milk-vetch	
Fabaceae	*Hoffmannseggia glauca*	Indian rushpea	FACU
Fabaceae	*Lotus heermannii*	Heermann's lotus	
Fabaceae	*Lotus scoparius*	deerweed	
Fabaceae	*Lotus scoparius var. scoparius*	deerweed	
Fabaceae	*Lotus strigosus*	Hairy Lotus	
Fabaceae	*Lotus strigosus var. strigosus*	Hairy Lotus	

Family	Species	Common Name	Wetland
Fabaceae	*Lotus unifoliolatus*	American bird's foot trefoil	
Fabaceae	*Lupinus bicolor*	miniature lupine	
Fabaceae	*Lupinus bicolor subsp. microphyllus*	miniature lupine	
Fabaceae	*Lupinus chamissonis*	dune bush lupine	
Fabaceae	*Lupinus excubitus*	grape lupine	
Fabaceae	*Lupinus excubitus var. hallii*	Hall's bush lupine	
Fabaceae	*Lupinus longifolius*	long leaf bush lupine	
Fabaceae	*Lupinus succulentus*	succulent lupine	
Fabaceae	*Lupinus truncatus*	truncated lupine	
Fabaceae	*Trifolium willdenovii*	tomcat clover	
Frankeniaceae	*Frankenia salina*	alkali seaheath	FACW
Frankeniaceae	*Frankenia salina*	alkali seaheath	FACW
Frankeniaceae	*Fraxinus latifolia*	alkali seaheath	FACW
Grossulariaceae	*Ribes malvaceum var. viridifolium*	chaparral currant	
Hydrophyllaceae	*Nemophila menziesii*	baby blue eyes	
Hydrophyllaceae	*Phacelia distans*	common phacelia	
Hydrophyllaceae	*Phacelia douglasii*	Douglas' phacelia	
Hydrophyllaceae	*Phacelia ramosissima*	south coast branching phacelia	
Hydrophyllaceae	*Phacelia ramosissima var. austrolitoralis*	south coast branching phacelia	
Hydrophyllaceae	*Phacelia stellaris*	Brand's phacelia	
Hydrophyllaceae	*Phacelia tanacetifolia*	tansy leafed phacelia	
Juncaceae	*Juncus bufonius*	toad rush	FACW
Juncaceae	*Juncus mexicanus*	mexican rush	FACW
Juncaceae	*Juncus textilis*	basket rush	OBL
Lamiaceae	*Lycopus americanus*	American water horehound	OBL
Lamiaceae	*Salvia carduacea*	thistle sage	

Family	Species	Common Name	Wetland
Lamiaceae	*Salvia columbariae*	chia sage	
Lamiaceae	*Stachys ajugoides*	bugle hedgenettle	OBL
Lamiaceae	*Stachys ajugoides var. rigida*	rigid hedge nettle	OBL
Lamiaceae	*Stachys albens*	whitestem hedgenettle	OBL
Lemnaceae	*Lemna minuscula*	least duckweed	OBL
Lemnaceae	*Lemna valdiviana*	valdivia duckweed	OBL
Lennoaceae	*Pholisma arenarium*	Desert pholisma	
Loasaceae	*Mentzelia affinis*	yellow blazing star	
Lythraceae	*Lythrum californicum*	California loostrife	OBL
Malvaceae	*Malacothamnus fasciculatus*	chaparral mallow	
Malvaceae	*Malvella leprosa*	alkali mallow	FAC
Malvaceae	*Malvella leprosa var. hederacea*	alkali mallow	FAC
Nyctaginaceae	*Abronia maritima*	red sand verbena	
Nyctaginaceae	*Abronia umbellata*	purple sand verbena	
Nyctaginaceae	*Abronia umbellata subsp. umbellata*	purple sand verbena	
Nyctaginaceae	*Abronia villosa*	desert sand verbena	
Nyctaginaceae	*Mirabilis laevis var. crassifolia*	California four o'clock	
Oleaceae	*Fraxinus velutina var. coriacea*	velvet ash	FACW
Onagraceae	*Camissonia bistorta*	California sun cup	
Onagraceae	*Camissonia cheiranthifolia subsp. suffruticosa*	beach evening-primrose	
Onagraceae	*Camissonia lewisii*	Lewis' evening primrose	
Onagraceae	*Camissonia micrantha*	miniature suncup	
Onagraceae	*Epilobium ciliatum subsp. ciliatum*	fringed willowherb	FACW
Onagraceae	*Epilobium pygmaeum*	smooth boisduvalia	OBL
Onagraceae	*Ludwigia peploides subsp. peploides*	floating primrose willow	OBL
Onagraceae	*Oenothera elata subsp. hirsutissima*	hairy evening primrose	FACW

Family	Species	Common Name	Wetland
Papaveraceae	*Eschscholzia californica*	California poppy	
Papaveraceae	*Platystemon californicus*	cream cups	
Papaveraceae	*Stylomecon heterophylla*	wind poppy	
Plantaginaceae	*Plantago erecta*	California plantain	
Poaceae	*Agrostis viridis*	green bentgrass	
Poaceae	*Distichlis spicata*	saltgrass	FACW
Poaceae	*Elymus condensatus*	giant wild rye	FACU
Poaceae	*Elymus glaucus*	blue wildrye	FACU
Poaceae	*Elymus triticoides*	alkali rye	FAC
Poaceae	*Hordeum brachyantherum*	meadow barley	FACW
Poaceae	*Hordeum intercedens*	vernal barley	FAC
Poaceae	*Koeleria macrantha*	prairie Junegrass	
Poaceae	*Leptochloa uninervia*	Mexican sprangletop	FACW
Poaceae	*Melica imperfecta*	smallflower melicgrass	
Poaceae	*Nassella pulchra*	purple needlegrass	
Poaceae	*Phalaris minor*	littleseed canarygrass	
Poaceae	*Setaria parviflora*	marsh bristlegrass	
Polemoniaceae	*Gilia clivorum*	purplespot gilia	
Polemoniaceae	*Linanthus parviflorus*	common linanthus	
Polemoniaceae	*Navarretia prostrata*	prostrate pincushionplant	OBL
Polygonaceae	*Eriogonum fasciculatum*	California buckwheat	
Polygonaceae	*Eriogonum gracile*	slender buckwheat	
Polygonaceae	*Eriogonum gracile var. gracile*	slender buckwheat	
Polygonaceae	*Eriogonum parvifolium*	seacliff buckwheat	
Polygonaceae	*Eriogonum parvifolium var. parvifolium*	seacliff buckwheat	
Polygonaceae	*Lastarriaea coriacea*	leather spineflower	

Family	Species	Common Name	Wetland
Polygonaceae	*Mucronea californica*	California spineflower	
Polygonaceae	*Mucronea californica var. suksdorfii*	California spineflower	
Polygonaceae	*Polygonum hydropiperoides*	swamp smartweed	OBL
Polygonaceae	*Polygonum lapathifolium*	curlytop knotweed	OBL
Polygonaceae	*Pterostegia drymarioides*	woodland pterostegia	
Polygonaceae	*Rumex maritimus*	golden dock	FACW
Polygonaceae	*Rumex salicifolius*	willow dock	OBL
Portulacaceae	*Calandrinia ciliata*	red maids	FACU
Portulacaceae	*Calyptridium monandrum*	common pussypaws	
Potamogetonaceae	*Ruppia cirrhosa*	spiral ditchgrass	OBL
Potamogetonaceae	*Ruppia maritima*	widgeongrass	OBL
Ranunculaceae	*Clematis ligusticifolia*	creek clematis	FAC
Ranunculaceae	*Delphinium parryi subsp. maritimum*	seaside larkspur	
Ranunculaceae	*Delphinium parryi subsp. parryi*	San Bernardino larkspur	
Rosaceae	*Potentilla anserina ssp. pacifica*	Pacific potentilla	OBL
Rosaceae	*Potentilla anserina subsp. pacifica*	silver-weed cinquefoil	OBL
Rosaceae	*Potentilla anserina var. grandis*	silver-weed cinquefoil	OBL
Rosaceae	*Potentilla multijuga*	ballona cinquefoil	OBL
Rubiaceae	*Galium angustifolium subsp. angustifolium*	narrowleaf bedstraw	
Salicaceae	*Populus fremontii*	Fremont cottonwood	FACW
Salicaceae	*Salix exigua*	sandbar willow	OBL
Salicaceae	*Salix laevigata*	red willow	
Salicaceae	*Salix lasiolepis*	arroyo willow	FACW
Saururaceae	*Anemopsis californica*	yerba mansa	OBL
Scrophulariaceae	*Antirrhinum coulterianum*	Coulter's snapdragon	
Scrophulariaceae	*Antirrhinum nuttallianum subsp. nuttallianum*	Nuttall's snapdragon	

Family	Species	Common Name	Wetland
Scrophulariaceae	*Castilleja exserta*	purple owl's clover	
Scrophulariaceae	*Collinsia heterophylla*	purple Chinese houses	
Scrophulariaceae	*Cordylanthus maritimus subsp. maritimus*	salt marsh bird's beak	OBL
Scrophulariaceae	*Mimulus guttatus*	seep monkeyflower	OBL
Solanaceae	*Datura wrightii*	Jimson weed	
Solanaceae	*Nicotiana clevelandii*	Cleveland's tobacco	
Solanaceae	*Solanum americanum*	common nightshade	FAC
Solanaceae	*Solanum douglasii*	Douglas' nightshade	FAC
Typhaceae	*Sparganium erectum subsp. stoloniferum*	simplestem bur-reed	OBL
Typhaceae	*Typha domingensis*	narrowleaf cattail	OBL
Typhaceae	*Typha latifolia*	broadleaf cattail	OBL
Urticaceae	*Urtica dioica subsp. holosericea*	giant creek nettle	FACW
Urticaceae	*Urtica urens*	dwarf nettle	
Verbenaceae	*Phyla lanceolata*	lanceleaf fogfruit	
Verbenaceae	*Phyla lanceolata*	lanceleaf fogfruit	FACW
Verbenaceae	*Verbena lasiostachys var. lasiostachys*	Common verbena	FAC
Zosteraceae	*Phyllospadix torreyi*	Torrey's surfgrass	OBL

APPENDIX 4.
FLORA OF THE SANTA MONICA MOUNTAIN REGION AS DOCUMENTED IN HERBARIUM RECORDS

Family	Species	Common Name	Wetland
Amaranthaceae	*Amaranthus blitoides*	mat amaranth	FACW
Amaranthaceae	*Amaranthus powellii*	Powell's amaranth	
Anacardiaceae	*Malosma laurina*	laurel sumac	
Anacardiaceae	*Rhus integrifolia*	lemonade berry	
Anacardiaceae	*Rhus ovata*	sugar bush	
Anacardiaceae	*Rhus trilobata*	skunkbush sumac	NI
Anacardiaceae	*Rhus trilobata var. pilosissima*	skunkbush sumac	NI
Apiaceae	*Apiastrum angustifolium*	wild celery	
Apiaceae	*Berula erecta*	cutleaf water-parsnip	OBL
Apiaceae	*Bowlesia incana*	hoary bowlesia	FACW
Apiaceae	*Daucus pusillus*	Wild carrot	
Apiaceae	*Lomatium lucidum*	shiny biscuitroot	
Apiaceae	*Sanicula arguta*	sharp toothed snakeroot	
Apiaceae	*Sanicula bipinnata*	poison sanicle	
Apiaceae	*Sanicula crassicaulis*	Pacific blacksnakeroot	
Apiaceae	*Tauschia arguta*	southern umbrellawort	
Asteraceae	*Achillea millefolium*	common yarrow	FACU
Asteraceae	*Acourtia microcephala*	sacapellote	
Asteraceae	*Ambrosia acanthicarpa*	annual bursage	
Asteraceae	*Ambrosia chamissonis*	Silver Beachweed	
Asteraceae	*Ambrosia confertiflora*	weak leaved burweed	
Asteraceae	*Ambrosia psilostachya*	western ragweed	FAC
Asteraceae	*Ambrosia psilostachya var. californica*	western ragweed	FAC
Asteraceae	*Artemisia californica*	California sagebrush	
Asteraceae	*Artemisia douglasiana*	mugwort	FACW
Asteraceae	*Artemisia dracunculus*	herbaceous sagewort	

Family	Species	Common Name	Wetland
Asteraceae	*Baccharis douglasii*	saltmarsh baccharis	OBL
Asteraceae	*Baccharis pilularis*	coyote brush	
Asteraceae	*Baccharis salicifolia*	mulefat	FACW-
Asteraceae	*Brickellia californica*	California brickellbush	FACU
Asteraceae	*Brickellia nevinii*	Nevin's brickellia	
Asteraceae	*Centromadia parryi subsp. australis*	Parry's tarweed	FAC
Asteraceae	*Chaenactis artemisiifolia*	artemisia leaved chaenactis	
Asteraceae	*Chaenactis glabriuscula var. glabriuscula*	yellow pincushion	
Asteraceae	*Cirsium occidentale*	California thistle	
Asteraceae	*Cirsium occidentale var. californicum*	California thistle	
Asteraceae	*Cirsium occidentale var. occidentale*	California thistle	
Asteraceae	*Conyza canadensis*	Canada horseweed	FAC
Asteraceae	*Corethrogyne filaginifolia*	common sandaster	
Asteraceae	*Corethrogyne filaginifolia var. virgata*	common sandaster	
Asteraceae	*Deinandra fasciculata*	common tarweed	
Asteraceae	*Dicoria canescens*	desert dicoria	
Asteraceae	*Encelia californica*	California sunflower	
Asteraceae	*Ericameria ericoides*	California goldenbush	
Asteraceae	*Ericameria linearifolia*	narrowleaf goldenbush	
Asteraceae	*Ericameria palmeri var. pachylepis*	broad scaled Palmer's goldenbush	
Asteraceae	*Ericameria parishii*	Parish's goldenbush	
Asteraceae	*Ericameria pinifolia*	pinebush	
Asteraceae	*Erigeron foliosus*	leafy fleabane	
Asteraceae	*Erigeron foliosus var. foliosus*	leafy fleabane	
Asteraceae	*Eriophyllum confertiflorum*	golden-yarrow	
Asteraceae	*Eriophyllum confertiflorum var. confertiflorum*	golden-yarrow	

Family	Species	Common Name	Wetland
Asteraceae	*Filago californica*	California Cottonrose	
Asteraceae	*Gnaphalium bicolor*	bicolored everlasting	
Asteraceae	*Gnaphalium californicum*	California cudweed	
Asteraceae	*Gnaphalium californicum*	California everlasting	
Asteraceae	*Gnaphalium canescens subsp. microcephalum*	white everlasting	
Asteraceae	*Gnaphalium ramosissimum*	pink everlasting	
Asteraceae	*Grindelia camporum*	Great Valley gumweed	
Asteraceae	*Grindelia hirsutula*	hairy gumweed	FACW
Asteraceae	*Gutierrezia californica*	California matchweed	
Asteraceae	*Gutierrezia sarothrae*	Matchweed	
Asteraceae	*Hazardia squarrosa var. grindelioides*	saw toothed goldenbush	
Asteraceae	*Hazardia squarrosa var. squarrosa*	saw toothed goldenbush	
Asteraceae	*Hemizonia fasciculata*	common tarweed	
Asteraceae	*Heterotheca grandiflora*	telegraphweed	
Asteraceae	*Heterotheca sessiliflora ssp. fastigiata*	erect goldenaster	
Asteraceae	*Isocoma menziesii var. vernonioides*	white-flowered goldenbush	FAC
Asteraceae	*Iva hayesiana*	San Diego marsh elder	FACW
Asteraceae	*Laennecia coulteri*	Coulter's horseweed	FAC
Asteraceae	*Lasthenia californica*	California goldfields	FACW
Asteraceae	*Lasthenia gracilis*	needle goldfields	
Asteraceae	*Layia platyglossa*	White tidy-tips	
Asteraceae	*Layia platyglossa subsp. campestris*	White tidy-tips	
Asteraceae	*Lepidospartum squamatum*	scalebroom	
Asteraceae	*Lepidospartum squamatum var. squamatum*	scalebroom	
Asteraceae	*Lessingia filaginifolia*	common sandaster	
Asteraceae	*Madia gracilis*	slender tarweed	

Family	Species	Common Name	Wetland
Asteraceae	*Madia sativa*	coast tarweed	
Asteraceae	*Malacothrix saxatilis var. tenuifolia*	cliff aster	
Asteraceae	*Monolopia lanceolata*	common monolopia	
Asteraceae	*Pluchea sericea*	arroweed	FACW
Asteraceae	*Pseudognaphalium biolettii*	twocolor cudweed	
Asteraceae	*Pseudognaphalium microcephalum*		
Asteraceae	*Pseudognaphalium microcephalum*	white headed cudweed	
Asteraceae	*Pseudognaphalium ramosissimum*	pink cudweed	
Asteraceae	*Pseudognaphalium stramineum*	Small flowered cudweed	FAC
Asteraceae	*Psilocarphus tenellus*	round woolly-marbles	FAC
Asteraceae	*Rafinesquia californica*	California chicory	
Asteraceae	*Senecio californicus*	California Butterweed	
Asteraceae	*Senecio flaccidus*	Douglas' shrubby ragwort	
Asteraceae	*Senecio flaccidus var. douglasii*	Douglas' shrubby ragwort	
Asteraceae	*Solidago californica*	California goldenrod	
Asteraceae	*Solidago velutina subsp. californica*		
Asteraceae	*Stebbinsoseris heterocarpa*	grassland stebbinsoseris	
Asteraceae	*Stephanomeria cichoriacea*	chicory leaved stephanomeria	
Asteraceae	*Stephanomeria diegensis*	San Diego milk aster	
Asteraceae	*Stephanomeria exigua subsp. coronaria*	milk aster	
Asteraceae	*Stephanomeria virgata*	Tall stephanomeria	
Asteraceae	*Stephanomeria virgata subsp. virgata*	Tall stephanomeria	
Asteraceae	*Symphyotrichum defoliatum [=Aster bernardinus]*	San Bernardino aster	RARE
Asteraceae	*Symphyotrichum greatae [=Aster greatae0*	Greata's aster	RARE
Asteraceae	*Venegasia carpesioides*	canyon sunflower	
Asteraceae	*Xanthium spinosum*	spiny cocklebur	FAC

Family	Species	Common Name	Wetland
Asteraceae	*Xanthium strumarium*	rough cockleburr	FAC
Azollaceae	*Azolla filiculoides*	mosquito fern	OBL
Berberidaceae	*Berberis nevinii*	Nevin's barberry	
Boraginaceae	*Amsinckia intermedia*	Eastwood's fiddleneck	
Boraginaceae	*Amsinckia punctata*		
Boraginaceae	*Cryptantha intermedia*	Clearwater cryptantha	
Boraginaceae	*Cryptantha micromeres*	minute flowered cryptantha	
Boraginaceae	*Cryptantha microstachys*	Tejon cryptantha	
Boraginaceae	*Cryptantha muricata*	prickly cryptantha	
Boraginaceae	*Cryptantha muricata var. jonesii*	prickly cryptantha	
Boraginaceae	*Pectocarya penicillata*	sagebrush combseed	
Boraginaceae	*Pedicularis densiflora*	Indian warrior	
Boraginaceae	*Plagiobothrys collinus*	Cooper's popcornflower	
Brassicaceae	*Arabis glabra*	smooth rock cress	
Brassicaceae	*Barbarea orthoceras*	American Wintercress	FACW
Brassicaceae	*Cardamine californica*	California toothwort	UPL*
Brassicaceae	*Caulanthus heterophyllus var. pseudosimulans*	San Diego wild cabbage	
Brassicaceae	*Descurainia pinnata subsp. menziesii*	western tansymustard	
Brassicaceae	*Erysimum capitatum subsp. capitatum*	western wallflower	
Brassicaceae	*Guillenia lasiophylla*	California mustard	
Brassicaceae	*Lepidium virginicum*	wild pepper grass	FACW
Brassicaceae	*Thysanocarpus curvipes*	common fringe-pod	
Brassicaceae	*Thysanocarpus laciniatus*	common lace pod	
Brassicaceae	*Tropidocarpum gracile*	slender tropidocarpum	
Cactaceae	*Opuntia littoralis*	coast prickly pear	
Cactaceae	*Opuntia vaseyi*	Vasey's prickly pear	

Family	Species	Common Name	Wetland
Campanulaceae	*Githopsis diffusa subsp. candida*	San Gabriel bluecup	
Campanulaceae	*Triodanis biflora*	Venus looking glass	
Capparaceae	*Isomeris arborea*	Coastal bladderpod	
Caprifoliaceae	*Lonicera interrupta*	chaparral honeysuckle	
Caprifoliaceae	*Lonicera subspicata var. denudata*	southern honeysuckle	
Caprifoliaceae	*Sambucus nigra ssp. caerulea*	blue elderberry	FAC
Caprifoliaceae	*Symphoricarpos mollis*	creeping snowberry	
Caryophyllaceae	*Polycarpon depressum*	California manyseed	
Caryophyllaceae	*Silene antirrhina*	sleepy silene	
Caryophyllaceae	*Silene laciniata*	Indian pink	
Caryophyllaceae	*Silene laciniata subsp. major*	Indian pink	
Chenopodiaceae	*Atriplex serenana*	saltscale	FAC
Chenopodiaceae	*Chenopodium californicum*	soaproot	
Chenopodiaeceae	*Chenopodium berlandieri*	Berlandier's goosefoot	
Cistaceae	*Helianthemum scoparium*	common sun-rose	
Cistaceae	*Helianthemum scoparium var. scoparium*	common sun-rose	
Cistaceae	*Helianthemum scoparium var. vulgare*	common sun-rose	
Convolvulaceae	*Calystegia macrostegia*	south coast morning-glory	
Convolvulaceae	*Calystegia macrostegia subsp. cyclostegia*	south coast morning-glory	
Convolvulaceae	*Calystegia macrostegia subsp. intermedia*	south coast morning-glory	
Convolvulaceae	*Calystegia purpurata*	Pacific false bindweed	
Convolvulaceae	*Convolvulus simulans*	small flowered morning glory	RARE
Cornaceae	*Cornus occidentalis*	Creek Dogwood	FACW
Crassulaceae	*Crassula connata var. erectoides*	sand pygmyweed	FAC
Crassulaceae	*Dudleya lanceolata*	lanceleaf liveforever	
Crassulaceae	*Dudleya multicaulis*	manystem liveforever	RARE

Family	Species	Common Name	Wetland
Cucurbitaceae	*Marah macrocarpus*	southern wild-cucumber	
Cucurbitaceae	*Marah macrocarpus var. macrocarpus*	southern wild-cucumber	
Cuscutaceae	*Cuscuta californica*	chaparral dodder	
Cuscutaceae	*Cuscuta subinclusa*	canyon dodder	
Cyperaceae	*Carex triquetra*	triangular fruit sedge	
Cyperaceae	*Scirpus californicus*	California tule	OBL
Dennstaedtiaceae	*Pteridium aquilinum*	western brackenfern	FACU
Dennstaedtiaceae	*Pteridium aquilinum var. pubescens*	hairy brackenfern	FACU
Dryopteridaceae	*Athyrium filix-femina var. californicum*	Western Lady Fern	FAC
Dryopteridaceae	*Dryopteris arguta*	California wood fern	
Equisetaceae	*Equisetum hyemale subsp. affine*	common scouring rush	FACW
Equisetaceae	*Equisetum laevigatum*	smooth horsetail	FACW
Ericaceae	*Arctostaphylos glandulosa*	Eastwood manzanita	
Ericaceae	*Arctostaphylos glandulosa subsp. mollis*	Eastwood manzanita	
Euphorbiaceae	*Chamaesyce albomarginata*	rattlesnake weed	
Euphorbiaceae	*Chamaesyce melanadenia*	squaw spurge	
Euphorbiaceae	*Chamaesyce polycarpa*	small seeded spurge	
Euphorbiaceae	*Chamaesyce polycarpa var. polycarpa*	small seeded spurge	
Euphorbiaceae	*Chamaesyce serpens*	creeping spurge	FAC
Euphorbiaceae	*Chamaesyce serpyllifolia*	thyme leafed spurge	
Euphorbiaceae	*Croton californicus*	California croton	
Euphorbiaceae	*Croton setigerus*	dove weed	
Euphorbiaceae	*Euphorbia polycarpa*	small seeded spurge	
Fabaceae	*Amorpha californica*	California false indigo	
Fabaceae	*Amorpha californica var. californica*	California false indigo	
Fabaceae	*Astragalus didymocarpus var. didymocarpus*	dwarf white milk vetch	

Family	Species	Common Name	Wetland
Fabaceae	*Astragalus gambelianus*	Gambel's dwarf milk vetch	
Fabaceae	*Astragalus trichopodus var. phoxus*	Santa Barbara milk-vetch	
Fabaceae	*Cercis occidentalis*	western redbud	
Fabaceae	*Lathyrus vestitus subsp. laetiflorus*	wild sweetpea	
Fabaceae	*Lathyrus vestitus subsp. laevicarpus*	wild sweetpea	
Fabaceae	*Lathyrus vestitus subsp. vestitus*	wild sweetpea	
Fabaceae	*Lathyrus vestitus var. vestitus*	wild sweetpea	
Fabaceae	*Lotus argophyllus var. argophyllus*	southern California silver lotus	
Fabaceae	*Lotus purshianus var. purshianus*	Spanish clover	
Fabaceae	*Lotus salsuginosus*	coastal lotus	
Fabaceae	*Lotus salsuginosus var. salsuginosus*	coastal lotus	
Fabaceae	*Lotus scoparius*	deerweed	
Fabaceae	*Lotus strigosus*	Hairy Lotus	
Fabaceae	*Lotus strigosus var. strigosus*	Hairy Lotus	
Fabaceae	*Lotus wrangelianus*	Calf lotus	
Fabaceae	*Lupinus affinis*	fleshy lupine	
Fabaceae	*Lupinus bicolor*	miniature lupine	
Fabaceae	*Lupinus excubitus*	grape lupine	
Fabaceae	*Lupinus excubitus var. hallii*	Hall's bush lupine	
Fabaceae	*Lupinus formosus*	summer lupine	
Fabaceae	*Lupinus formosus var. formosus*	summer lupine	
Fabaceae	*Lupinus hirsutissimus*	stinging annual lupine	
Fabaceae	*Lupinus latifolius subsp. parishii*	broadleaf lupine	
Fabaceae	*Lupinus lepidus var. sellulus*	dwarf tidy lupine	
Fabaceae	*Lupinus longifolius*	long leaf bush lupine	
Fabaceae	*Lupinus sparsiflorus*	Coulter's lupine	

Family	Species	Common Name	Wetland
Fabaceae	*Lupinus sparsiflorus subsp. sparsiflorus*	Coulter's lupine	
Fabaceae	*Lupinus succulentus*	succulent lupine	
Fabaceae	*Lupinus truncatus*	truncated lupine	
Fabaceae	*Pickeringia montana*	chaparral pea	
Fabaceae	*Rupertia physodes*	California tea	
Fabaceae	*Trifolium albopurpureum*	Indian clover	FACU
Fabaceae	*Trifolium ciliolatum*	foothill clover	
Fabaceae	*Trifolium gracilentum*	pinpoint clover	
Fabaceae	*Vicia americana*	American vetch	FACU
Fabaceae	*Vicia americana var. americana*	American vetch	FACU
Fagaceae	*Quercus agrifolia*	coast live oak	
Fagaceae	*Quercus berberidifolia*	inland scrub oak	
Fagaceae	*Quercus dumosa*	Nuttall's scrub oak	
Fagaceae	*Quercus durata var. gabrielensis*	San Gabriel Mtns. leather oak	
Fagaceae	*Quercus wislizeni var. frutescens*	Chapparal Oak	
Fumariaceae	*Ehrendorferia ochroleuca*	yellow bleeding heart	
Gentianaceae	*Centaurium venustum*	Beautiful centaury	
Geraniaceae	*Geranium carolinianum*	Carolina geranium	
Grossulariaceae	*Ribes aureum var. gracillimum*	golden currant	FACW
Grossulariaceae	*Ribes californicum var. hesperium*	California gooseberry	
Grossulariaceae	*Ribes indecorum*	white-flowering currant	
Grossulariaceae	*Ribes malvaceum*	chaparral currant	
Grossulariaceae	*Ribes malvaceum var. viridifolium*	chaparral currant	
Grossulariaceae	*Ribes speciosum*	fuchsia flowered gooseberry	
Hydrophyllaceae	*Emmenanthe penduliflora*	whisperingbells	
Hydrophyllaceae	*Emmenanthe penduliflora var. penduliflora*	whisperingbells	

Family	Species	Common Name	Wetland
Hydrophyllaceae	*Eriodictyon trichocalyx*	hairy yerba santa	
Hydrophyllaceae	*Eucrypta chrysanthemifolia*	common eucrypta	
Hydrophyllaceae	*Eucrypta chrysanthemifolia var. chrysanthemifolia*	common eucrypta	
Hydrophyllaceae	*Nama stenocarpum*	mud fiddleleaf	FACW
Hydrophyllaceae	*Nemophila menziesii*	baby blue eyes	
Hydrophyllaceae	*Nemophila menziesii var. integrifolia*	baby blue eyes	
Hydrophyllaceae	*Phacelia cicutaria*	caterpillar phacelia	
Hydrophyllaceae	*Phacelia cicutaria var. hispida*	caterpillar phacelia	
Hydrophyllaceae	*Phacelia cicutaria var. hubbyi*	caterpillar phacelia	
Hydrophyllaceae	*Phacelia grandiflora*	giant flowerd phacelia	
Hydrophyllaceae	*Phacelia imbricata subsp. imbricata*	imbricate phacelia	
Hydrophyllaceae	*Phacelia minor*	California bluebell	
Hydrophyllaceae	*Phacelia parryi*	Parry's phacelia	
Hydrophyllaceae	*Phacelia viscida*	sticky phacelia	
Hydrophyllaceae	*Pholistoma auritum*	blue fiestaflower	
Hydrophyllaceae	*Turricula parryi*	common turricula	
Iridaceae	*Sisyrinchium bellum*	blue-eyed grass	FAC
Juglandaceae	*Juglans californica*	Southern California black walnut	FAC
Juglandaceae	*Juglans californica var. californica*	Southern California black walnut	FAC
Juncaceae	*Juncus balticus*	wire rush	FACW
Juncaceae	*Juncus textilis*	basket rush	OBL
Lamiaceae	*Salvia apiana*	white sage	
Lamiaceae	*Salvia columbariae*	chia sage	
Lamiaceae	*Salvia leucophylla*	purple sage	
Lamiaceae	*Salvia mellifera*	black sage	
Lamiaceae	*Salvia spathacea*	hummingbird sage	

Family	Species	Common Name	Wetland
Lamiaceae	*Scutellaria tuberosa*	Danny's skullcap	
Lamiaceae	*Stachys ajugoides var. rigida*	rigid hedge nettle	
Lamiaceae	*Stachys ajugoides var. rigida*	rigid hedge nettle	OBL
Lamiaceae	*Stachys bullata*	California hedgenettle	
Lamiaceae	*Trichostema lanatum*	woolly bluecurls	
Lamiaceae	*Trichostema lanceolatum*	vinegarweed	
Lauraceae	*Umbellularia californica*	California laurel	FAC
Lemnaceae	*Lemna valdiviana*	valdivia duckweed	OBL
Liliaceae	*Allium haematochiton*	redskin onion	
Liliaceae	*Allium peninsulare*	Mexicali onion	
Liliaceae	*Bloomeria crocea*	common goldenstar	
Liliaceae	*Bloomeria crocea var. crocea*	common goldenstar	
Liliaceae	*Brodiaea terrestris subsp. kernensis*	chaparral brodiaea	
Liliaceae	*Calochortus catalinae*	Catalina mariposa lily	
Liliaceae	*Calochortus clavatus var. clavatus*	club haired mariposa	
Liliaceae	*Calochortus plummerae*	Plummer's mariposa lily	
Liliaceae	*Dichelostemma capitatum*	blue dicks	
Liliaceae	*Fritillaria biflora*	chocolate lily	
Liliaceae	*Lilium humboldtii*	Humboldt's lily	
Liliaceae	*Triteleia ixioides subsp. scabra*	prettyface	FAC
Liliaceae	*Triteleia laxa*	Ithuriel's spear	
Liliaceae	*Yucca whipplei subsp. intermedia*	chaparral yucca	
Liliaceae	*Yucca whipplei var. parishii*	chaparral yucca	
Liliaceae	*Zigadenus fremontii*	Fremont's Star Lily	
Loasaceae	*Mentzelia lindleyi*	Lindley's blazing star	
Loasaceae	*Mentzelia micrantha*	chaparral blazing star	

Family	Species	Common Name	Wetland
Lythraceae	*Lythrum californicum*	California loostrife	OBL
Malvaceae	*Malacothamnus fasciculatus*	chaparral mallow	
Malvaceae	*Malacothamnus fasciculatus var. fasciculatus*	chaparral mallow	
Malvaceae	*Malvella leprosa var. hederacea*	alkali mallow	FAC
Nyctaginaceae	*Mirabilis laevis var. crassifolia*	California four o'clock	
Nyctaginaceae	*Mirabilis multiflora var. pubescens*	Colorado four o'clock	
Onagraceae	*Camissonia bistorta*	California sun cup	
Onagraceae	*Camissonia californica*	California suncup	
Onagraceae	*Camissonia hirtella*	Santa Cruz Island suncup	
Onagraceae	*Camissonia ignota*	Jurupa Hills sun cups	
Onagraceae	*Camissonia intermedia*	intermediate suncup	
Onagraceae	*Camissonia micrantha*	miniature suncup	
Onagraceae	*Camissonia robusta*	robust sun cup	
Onagraceae	*Clarkia bottae*	Botta's clarkia	
Onagraceae	*Clarkia cylindrica*	speckled clarkia	
Onagraceae	*Clarkia dudleyana*	Dudley's clarkia	
Onagraceae	*Clarkia epilobioides*	Willow Herb Clarkia	
Onagraceae	*Clarkia purpurea*	purple clarkia	
Onagraceae	*Clarkia unguiculata*	elegant clarkia	
Onagraceae	*Epilobium canum subsp. canum*	California fuchsia	
Onagraceae	*Epilobium ciliatum*	fringed willowherb	FACW
Onagraceae	*Epilobium paniculatum*	autumn willowherb	
Oxalidaceae	*Oxalis albicans subsp. californica*	California woodsorrel	
Paeoniaceae	*Paeonia californica*	California peony	
Papaveraceae	*Dendromecon rigida subsp. rigida*	bush poppy	
Papaveraceae	*Eschscholzia californica*	California poppy	

Family	Species	Common Name	Wetland
Papaveraceae	*Meconella denticulata*	smallflower fairypoppy	
Papaveraceae	*Papaver californicum*	western poppy	
Papaveraceae	*Platystemon californicus*	cream cups	
Plantaginaceae	*Plantago erecta*	California plantain	
Platanaceae	*Platanus racemosa*	western sycamore	FACW
Poaceae	*Vulpia bromoides*		
Poaceae	*Achnatherum coronatum*	giant needlegrass	
Poaceae	*Agrostis pallens*	Bent grass	
Poaceae	*Bothriochloa barbinodis*	Beard grass	
Poaceae	*Bromus arizonicus*	Arizona brome	
Poaceae	*Bromus carinatus*	California brome	
Poaceae	*Elymus condensatus*	giant wild rye	FACU
Poaceae	*Elymus glaucus*	blue wildrye	FACU
Poaceae	*Hordeum brachyantherum*	meadow barley	FACW
Poaceae	*Melica imperfecta*	smallflower melicgrass	
Poaceae	*Muhlenbergia microsperma*	littleseed muhly	
Poaceae	*Nassella lepida*	small flowered needlegrass	
Poaceae	*Poa secunda*	one sided blue grass	FACW
Poaceae	*Setaria parviflora*	marsh bristlegrass	
Poaceae	*Vulpia octoflora*	sixweeks fescue	
Polemoniaceae	*Allophyllum glutinosum*	sticky false gilia	
Polemoniaceae	*Eriastrum sapphirinum*	sapphire woollystar	
Polemoniaceae	*Eriastrum sapphirinum subsp. dasyanthum*	sapphire woollystar	
Polemoniaceae	*Gilia angelensis*	chaparral gilia	
Polemoniaceae	*Gilia cana subsp. cana*	showy gilia	
Polemoniaceae	*Gilia capitata*	blue field-gilia	

Family	Species	Common Name	Wetland
Polemoniaceae	*Gilia capitata subsp. abrotanifolia*	blue field-gilia	
Polemoniaceae	*Gilia tricolor*	Tricolor gilia	
Polemoniaceae	*Leptodactylon californicum*	prickly phlox	
Polemoniaceae	*Leptodactylon californicum ssp. californicum*	California prickly phlox	
Polemoniaceae	*Leptosiphon grandiflorus*	large flowered leptosiphon	
Polemoniaceae	*Leptosiphon liniflorus*	narrowflower flaxflower	
Polemoniaceae	*Navarretia atractyloides*	hollyleaf pincushionplant	
Polemoniaceae	*Navarretia hamata subsp. hamata*	hooked pincushionplant	
Polemoniaceae	*Saltugilia splendens*		
Polygonaceae	*Chorizanthe parryi var. fernandina*	Parry's spineflower	RARE
Polygonaceae	*Chorizanthe staticoides*	Turkish rugging	
Polygonaceae	*Eriogonum elongatum*	longstem buckwheat	
Polygonaceae	*Eriogonum elongatum var. elongatum*	longstem buckwheat	
Polygonaceae	*Eriogonum fasciculatum*	California buckwheat	
Polygonaceae	*Eriogonum fasciculatum var. fasciculatum*	California buckwheat	
Polygonaceae	*Eriogonum fasciculatum var. foliolosum*	California buckwheat	
Polygonaceae	*Eriogonum gracile*	slender buckwheat	
Polygonaceae	*Pterostegia drymarioides*	woodland pterostegia	
Polygonaceae	*Rumex salicifolius var. salicifolius*	willow dock	OBL
Polypodiaceae	*Polypodium californicum*	California polypody	
Portulacaceae	*Calandrinia breweri*	Brewer's calandrinia	
Portulacaceae	*Calandrinia ciliata*	red maids	FACU
Portulacaceae	*Claytonia perfoliata subsp. mexicana*	miner's lettuce	FAC
Portulacaceae	*Claytonia perfoliata subsp. perfoliata*	miner's lettuce	FAC
Potamogetonaceae	*Stuckenia pectinata*	sago pondweed	OBL
Primulaceae	*Dodecatheon clevelandii*	padre's shootingstar	

Family	Species	Common Name	Wetland
Primulaceae	*Dodecatheon clevelandii subsp. clevelandii*	padre's shootingstar	
Pteridaceae	*Adiantum jordanii*	California maiden-hair	FAC
Pteridaceae	*Pellaea andromedifolia*	coffee fern	
Pteridaceae	*Pellaea mucronata*	bird's foot fern	
Pteridaceae	*Pentagramma triangularis subsp. triangularis*	gold back fern	
Ranunculaceae	*Clematis ligusticifolia*	creek clematis	FAC
Ranunculaceae	*Delphinium cardinale*	scarlet larkspur	
Ranunculaceae	*Delphinium parryi subsp. parryi*	San Bernardino larkspur	
Ranunculaceae	*Delphinium patens*	spreading larkspur	
Ranunculaceae	*Delphinium patens subsp. hepaticoideum*	spreading larkspur	
Ranunculaceae	*Ranunculus californicus*	California buttercup	FAC
Rhamnaceae	*Ceanothus crassifolius*	hoary leaved ceanothus	
Rhamnaceae	*Ceanothus cuneatus*	buckbrush	
Rhamnaceae	*Ceanothus cuneatus var. cuneatus*	buckbrush	
Rhamnaceae	*Ceanothus cyaneus*	Lakeside ceanothus	RARE
Rhamnaceae	*Ceanothus megacarpus*	big pod ceanothus	
Rhamnaceae	*Ceanothus megacarpus var. megacarpus*	big pod ceanothus	
Rhamnaceae	*Ceanothus oliganthus*	hairy ceanothus	
Rhamnaceae	*Ceanothus spinosus*	greenbark ceanothus	
Rhamnaceae	*Rhamnus californica*	California coffeeberry	
Rhamnaceae	*Rhamnus crocea*	redberry buckthorn	
Rhamnaceae	*Rhamnus ilicifolia*	hollyleaf redberry	
Rosaceae	*Adenostoma fasciculatum var. fasciculatum*	chamise	
Rosaceae	*Cercocarpus betuloides*	birch-leaf mountain-mahogany	
Rosaceae	*Cercocarpus betuloides var. betuloides*	birch-leaf mountain-mahogany	
Rosaceae	*Fragaria vesca*	California strawberry	

Family	Species	Common Name	Wetland
Rosaceae	*Heteromeles arbutifolia*	Toyon	
Rosaceae	*Holodiscus discolor*	Ocean spray	FAC
Rosaceae	*Horkelia cuneata*	wedge-leaf horkelia	
Rosaceae	*Potentilla glandulosa*	Common cinquefoil	FAC
Rosaceae	*Prunus ilicifolia*	holly leaf cherry	
Rosaceae	*Prunus ilicifolia subsp. ilicifolia*	holly leaf cherry	
Rosaceae	*Rosa californica*	California wild rose	FAC
Rubiaceae	*Galium angustifolium subsp. angustifolium*	narrowleaf bedstraw	
Rubiaceae	*Galium aparine*	common bedstraw	FACU
Rubiaceae	*Galium cliftonsmithii*	Santa Barbara bedstraw	
Rubiaceae	*Galium porrigens*	Nuttall's bedstraw	
Rubiaceae	*Galium porrigens var. porrigens*	Nuttall's bedstraw	
Salicaceae	*Populus fremontii*	Fremont cottonwood	FACW
Salicaceae	*Salix lasiolepis*	arroyo willow	FACW
Saxifragaceae	*Lithophragma affine*	common woodland star	
Saxifragaceae	*Lithophragma affine subsp. mixtum*	common woodland star	
Saxifragaceae	*Saxifraga californica*	California saxifrage	
Scrophulariaceae	*Antirrhinum coulterianum*	Coulter's snapdragon	
Scrophulariaceae	*Antirrhinum kelloggii*	Kellogg's snapdragon	
Scrophulariaceae	*Antirrhinum multiflorum*	Withered Snapdragon	
Scrophulariaceae	*Antirrhinum nuttallianum*	Nuttall's snapdragon	
Scrophulariaceae	*Castilleja affinis*	Indian paintbrush	
Scrophulariaceae	*Castilleja affinis subsp. affinis*	Indian paintbrush	
Scrophulariaceae	*Castilleja applegatei subsp. martinii*	wavyleaf Indian paintbrush	
Scrophulariaceae	*Castilleja exserta*	purple owl's clover	
Scrophulariaceae	*Castilleja foliolosa*	Texas paintbrush	

Family	Species	Common Name	Wetland
Scrophulariaceae	*Collinsia heterophylla*	purple Chinese houses	
Scrophulariaceae	*Cordylanthus rigidus subsp. setigerus*	bristly bird's beak	
Scrophulariaceae	*Keckiella cordifolia*	climbing penstemon	
Scrophulariaceae	*Linaria canadensis*	blue toad flax	
Scrophulariaceae	*Mimulus aurantiacus*	sticky monkeyflower	
Scrophulariaceae	*Mimulus aurantiacus var. pubescens*	sticky monkeyflower	
Scrophulariaceae	*Mimulus aurantiacus var. puniceus*	sticky monkeyflower	
Scrophulariaceae	*Mimulus brevipes*	wide throated yellow monkeyflower	
Scrophulariaceae	*Mimulus guttatus*	seep monkeyflower	OBL
Scrophulariaceae	*Penstemon centranthifolius*	scarlet bugler	
Scrophulariaceae	*Penstemon heterophyllus*	foothill penstemon	
Scrophulariaceae	*Penstemon heterophyllus var. australis*	southern foothill penstemon	
Scrophulariaceae	*Penstemon spectabilis*	showy penstemon	
Scrophulariaceae	*Scrophularia californica*	California Bee plant	FAC
Solanaceae	*Datura wrightii*	Jimson weed	
Solanaceae	*Solanum americanum*	American black nightshade	FAC
Solanaceae	*Solanum douglasii*	Douglas' nightshade	FAC
Solanaceae	*Solanum umbelliferum*	blue witch nightshade	
Solanaceae	*Solanum xanti*	chaparral nightshade	
Solanaceae	*Solanum xanti var. intermedium*	chaparral nightshade	
Typhaceae	*Typha latifolia*	broadleaf cattail	OBL
Urticaceae	*Hesperocnide tenella*	western stinging nettle	
Urticaceae	*Parietaria hespera*	western pellitory	
Urticaceae	*Parietaria hespera var. hespera*	western pellitory	
Urticaceae	*Urtica dioica subsp. holosericea*	giant creek nettle	FACW
Verbenaceae	*Verbena lasiostachys*	Common verbena	FAC

Family	Species	Common Name	Wetland
Verbenaceae	*Verbena lasiostachys var. lasiostachys*	Common verbena	FAC
Violaceae	*Viola pedunculata*	California Golden Violet	
Vitaceae	*Vitis girdiana*	Southern california grape	

APPENDIX 5.
FLORA OF INGLEWOOD AND CENTINELA CREEK FROM HERBARIUM RECORDS

Family	Species	Common Name	Wetland
Apiaceae	*Perideridia parishii subsp. latifolia*	wide leaved Parish's yampah	FACW
Apiaceae	*Sanicula arguta*	sharp toothed snakeroot	
Asteraceae	*Artemisia californica*	California sagebrush	
Asteraceae	*Centromadia parryi subsp. australis*	Parry's tarweed	FAC
Asteraceae	*Cirsium brevistylum*	Indian thistle	
Asteraceae	*Ericameria palmeri var. pachylepis*	broad scaled Palmer's goldenbush	
Asteraceae	*Gnaphalium palustre*	western marsh cudweed	FACW
Asteraceae	*Grindelia hirsutula*	hairy gumweed	FACW
Asteraceae	*Heterotheca grandiflora*	telegraphweed	
Asteraceae	*Lasthenia glabrata subsp. coulteri*	yellowray goldfields	FACW
Asteraceae	*Psilocarphus brevissimus*	woolly marbles	OBL
Asteraceae	*Stephanomeria exigua subsp. exigua*	slender stephanomeria	
Boraginaceae	*Pectocarya linearis subsp. ferocula*	sagebrush combseed	
Brassicaceae	*Rorippa palustris subsp. occidentalis*	western bog yellow cress	OBL
Brassicaceae	*Sibara virginica*	common rock cress	FAC
Caryophyllaceae	*Spergularia macrotheca var. leucantha*	sticky sandspurry	FAC
Caryophyllaceae	*Spergularia marina*	salt marsh sand spurry	OBL
Chenopodiaceae	*Atriplex serenana var. serenana*	saltscale	FAC
Chenopodiaceae	*Chenopodium californicum*	soaproot	
Convolvulaceae	*Calystegia macrostegia subsp. intermedia*	south coast morning-glory	
Convolvulaceae	*Cressa truxillensis*	spreading alkaliweed	FACW
Convululaceae	*Calystegia macrostegia ssp. intermedia*	south coast morning glory	
Cyperaceae	*Eleocharis acicularis*	needle spikerush	OBL
Cyperaceae	*Eleocharis acicularis var. acicularis*	needle spikerush	OBL
Cyperaceae	*Eleocharis macrostachya*	common spikerush	OBL
Cyperaceae	*Scirpus californicus*	California tule	OBL

Family	Species	Common Name	Wetland
Cyperaceae	*Scirpus maritimus*	prairie bulrush	OBL
Elatinaceae	*Elatine brachysperma*	short-seed waterwort	FACW
Euphorbiaceae	*Chamaesyce albomarginata*	rattlesnake weed	
Euphorbiaceae	*Croton setigerus*	dove weed	
Fabaceae	*Astragalus tener var. titi*	alkali milk-vetch	FACW
Fabaceae	*Astragalus trichopodus var. lonchus*	Santa Barbara milk-vetch	
Fabaceae	*Lotus heermannii*	Heermann's lotus	
Fabaceae	*Lotus strigosus*	Hairy Lotus	
Fabaceae	*Lotus strigosus var. hirtellus*	Hairy Lotus	
Fabaceae	*Lotus strigosus var. strigosus*	Hairy Lotus	
Fabaceae	*Lupinus bicolor subsp. microphyllus*	miniature lupine	
Fabaceae	*Trifolium ciliolatum*	foothill clover	
Fabaceae	*Trifolium gracilentum*	pinpoint clover	
Fabaceae	*Trifolium willdenovii*	tomcat clover	
Malvaceae	*Sidalcea malviflora subsp. sparsifolia*	dwarf checkerbloom	
Onagraceae	*Camissonia lewisii*	Lewis' evening primrose	
Onagraceae	*Camissonia strigulosa*	sandysoil suncup	
Onagraceae	*Epilobium pygmaeum*	smooth boisduvalia	OBL
Plantaginaceae	*Plantago elongata*	coastal plantain	FACW
Plantaginaceae	*Plantago subnuda*	tall coastal plantain	FACW
Poaceae	*Agrostis viridis*	green bentgrass	
Poaceae	*Alopecurus carolinianus*	Carolina foxtail	FACW
Poaceae	*Bromus carinatus*	California brome	
Poaceae	*Phalaris lemmonii*	Lemmon's canarygrass	FACW
Poaceae	*Phalaris minor*	littleseed canarygrass	
Poaceae	*Poa secunda*	one sided blue grass	FACW

Family	Species	Common Name	Wetland
Polemonaceae	*Navarretia fossalis*	spreading navarretia	
Polemoniaceae	*Gilia angelensis*	chaparral gilia	
Polemoniaceae	*Linanthus dianthiflorus subsp. dianthiflorus*	fringed linanthus	
Polemoniaceae	*Navarretia prostrata*	prostrate pincushionplant	OBL
Polemoniaceae	*Saltugilia splendens ssp. spendens*		
Portulacaceae	*Calandrinia ciliata var. menziesii*	red maids	FACU
Ranunculaceae	*Ranunculus californicus*	California buttercup	FAC
Rosaceae	*Heteromeles arbutifolia*	Toyon	
Salicaceae	*Salix lasiolepis*	arroyo willow	FACW
Solanaceae	*Solanum douglasii*	Douglas' nightshade	FAC
Verbenaceae	*Verbena bracteata*	bigbract verbena	FACW
Verbenaceae	*Verbena lasiostachys var. lasiostachys*	Common verbena	FAC
Violaceae	*Viola pedunculata*	California Golden Violet	