WETLAND AND RIPARIAN MAPPING WITHIN THE RIVERS AND MOUNTAINS CONSERVANCY TERRITORY: A LANDSCAPE PROFILE

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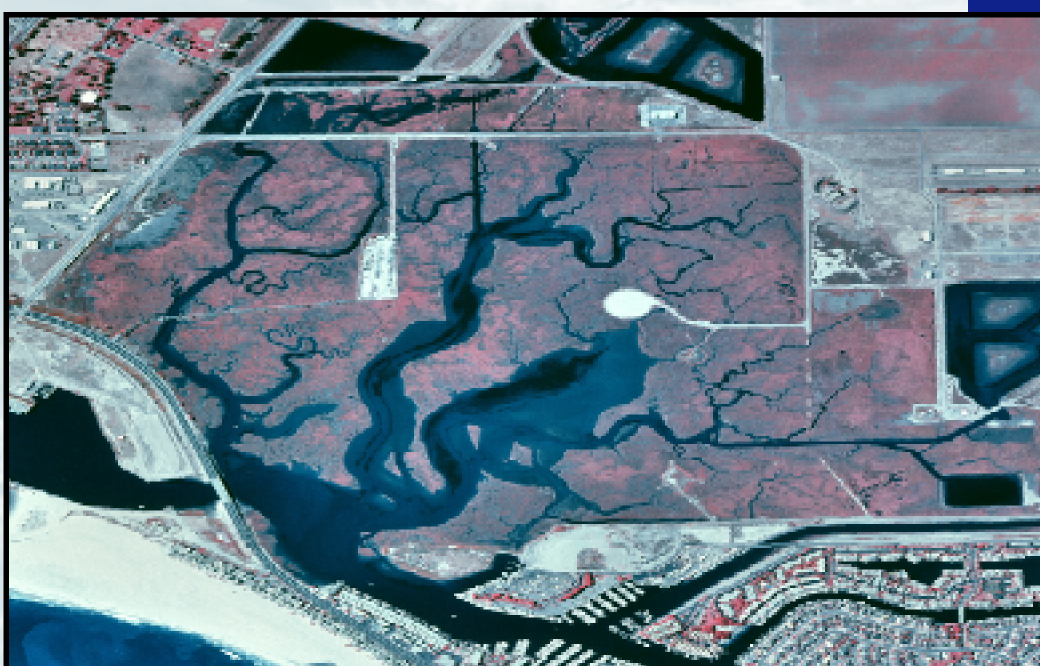

Southern California Coastal Water Research Project

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WETLAND AND RIPARIAN MAPPING WITHIN THE RIVERS AND MOUNTAINS CONSERVANCY TERRITORY: A LANDSCAPE PROFILE

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EXECUTIVE SUMMARY

The watersheds of the San Gabriel and Los Angeles Rivers cover 1513 square miles, from the San Gabriel Mountains to the North to the Pacific Ocean at Long Beach. Historically, extensive wetlands and riparian areas existed throughout the San Gabriel and Los Angeles River basin. The region within the two watersheds has been at the epicenter of urbanization in Southern California, which has significantly altered the hydrology and reduced the extent of natural habitat and biotic communities. Wetlands and riparian areas have been among the most impacted habitats.

The objective of this project is to produce a full set of wetland and riparian habitat maps within the San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy (RMC) territory. Wetland and riparian habitat were mapped in 27- 7.5" USGS quadrangle maps. This report documents the methods used for mapping and provides a brief summary or "landscape profile" of the wetland and riparian habitat mapped in the RMC territory.

A total of 53,139 acres of estuarine, lacustrine and palustrine wetlands and 16,692 acres of riparian habitat were mapped within the study area. 2355 wetland polygons representing 20% percent of the wetlands inventoried were given special modifiers indicating they were either modified or human-made. It is anticipated that these maps will provide critical data to a host of activities related to the management and restoration of watershed functions, including land use planning, conservation and restoration, expansion of wetland beneficial use protection in Regional Board basin plans and regulation of habitat and water quality impacts from development activities.

The digital maps will be available to the public for downloading at the CSUN Center for Geographic Studies website (www.csun.edu\centerforgeographicstudies) until permanently posted to the US FWS NWI Interactive Mapper Website (wetlandsfws.er.usgs.gov/wtlnds/launch.html).

1. INTRODUCTION

Background and Purpose of Project

The southern California coastal province is a distinct region that extends from Point Conception in Santa Barbara County to Punta Banda, south of Ensenada, Baja Mexico, and includes all watersheds that drain to the Pacific Ocean. The physical features, climate, and hydrology of this biogeographic province have produced an unusual set of hydrogeomorphic conditions and a diversity of plants and animals that sharply distinguish the region from any other in North America. Southern California's wetlands and riparian habitat are among the most diverse, productive and densely populated habitats on the Pacific coast (Warner and Hendrix 1985, USDOI 1994). However, the important habitats have been dramatically altered by human activities over the past 150 years. It is estimated that approximately 80–90% of California's historical wetlands had been lost by 1989, and 90–95% of Southern California's riparian ecosystem had been destroyed or severely degraded (Tiner 1984, Dahl and Johnson 1991, USDOI 1994). The fragmentation and loss of habitat has resulted in the threatened extinction of numerous wetland-dependent species. The loss of wetlands and riparian areas, known for their importance in enhancing water quality, has also contributed to the decline in the water quality in streams and estuaries in southern California. Development pressure on this area continues to be intense, with a doubling of the 1995 population expected by 2020.

The watersheds of the San Gabriel and Los Angeles Rivers cover 1513 square miles, from the San Gabriel Mountains to the North to the Pacific Ocean at Long Beach. Historically, extensive wetlands and riparian areas existed throughout the San Gabriel and Los Angeles River basin. The region within the two watersheds has been at the epicenter of urbanization in Southern California, which has significantly altered the hydrology and reduced the extent of natural habitat and biotic communities. Wetlands and riparian areas have been among the most impacted habitats. Within the Los Angeles Watershed an estimated 100 percent of the original lower riverine and tidal marsh and 98 percent of all inland freshwater marsh and ephemeral ponds have been lost (Stein et al. 2007).

Mapping of wetlands and riparian areas is the first step in a host of activities related to the management and restoration of watershed functions, including land use planning, conservation and restoration, expansion of wetland beneficial use protection in Regional Board basin plans and regulation of habitat and water quality impacts from development activities. Recent maps of wetlands and comprehensive maps of riparian habitat did not exist for the San Gabriel and Los Angeles River. These maps are key to a regional planning effort known as the "Green Visions" plan, a joint venture between the University of Southern California and the region's land conservancies, including the San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy (RMC), Santa Monica Mountains Conservancy, Coastal Conservancy, and Baldwin Hills Conservancy. The purpose of the Green Visions Plan is to provide a guide to habitat conservation, watershed health and recreational open space for the Los Angeles metropolitan region, and to design planning and decision-support tools to nurture a living green matrix for southern California. The RMC is a major participant in the Green Visions planning process and also a major source of funding for conservation and restoration projects within the San Gabriel and lower Los Angeles River watersheds. Wetland and riparian habitat maps are key to theRMC mission, which is to mission is to preserve open space and habitat in order to provide for low-impact recreation and educational uses, wildlife habitat restoration and protection, and watershed improvements within the RMC jurisdiction.

The objective of this project is to produce a full set of wetland and riparian habitat maps within the RMC territory (Figure 1-1). "Wetlands" include estuaries, lagoons, wadeable and nonwadeable streams and rivers, depressions, seeps, springs and lakes. Riparian areas include those upland transitional areas adjacent to rivers, streams, estuaries, lakes, and depressional wetlands that characteristically have a high water table and are subject influence from these adjacent water bodies. This report documents the methods used for mapping and provides a brief summary or "landscape profile" of the wetland and riparian habitat mapped in the RMC territory. The digital maps will be available to the public for downloading at the CSUN Center for Geographic Studies website (http://www.csun.edu/csbs/geographic_studies.html) and the Southern California Wetlands Website (http://www.socalwetlands.com) until permanently posted to the US FWS NWI Interactive Mapper Website (wetlandsfws.er.usgs.gov/wtlnds/launch.html).

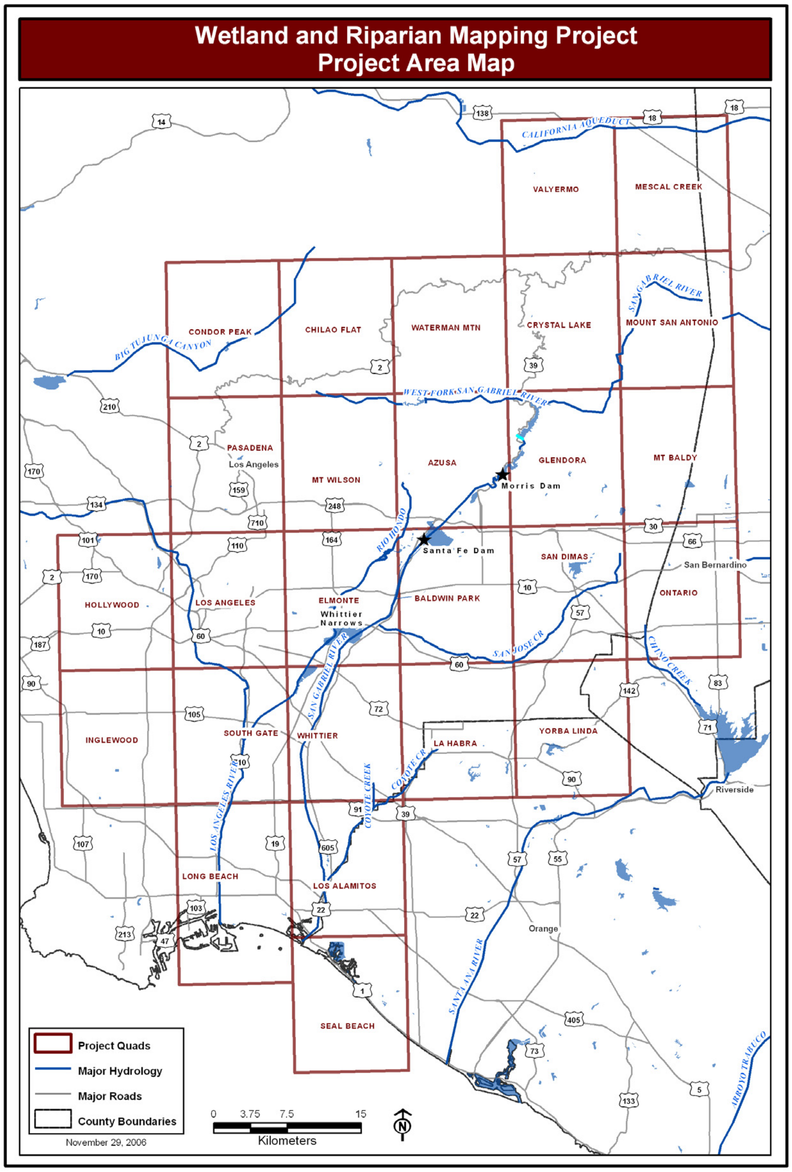


Figure 1-1. Map of quads in the RMC Territory. Note that mapping in 6 of these 27 quads was conducted by the USFWS NWI with a separate funding source.

Data Limitations and Uses

For the purposes of this project, the central objective of mapping wetlands and riparian areas is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland and riparian boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems. Wetlands or other mapped features may have changed since the date of the imagery and/or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that is found in the intertidal and subtidal zones of estuaries and nearshore coastal waters.

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands and riparian areas in a different manner than that used in this inventory (see Section 2- Methods for additional details). There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

2. METHODS

Definitions

There is no single correct definition of "wetlands" or "riparian areas." These zones lie on a continuum between terrestrial and aquatic environments, and demarcation of the boundaries often is not clear-cut. For the purpose of this project, the US Fish and Wildlife Service definition of wetlands was used:

> "Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For the purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year"(Cowardin et al. 1979).

The wetland ecosystems of southern California include five types or systems: marine, estuarine, riverine, lacustrine and palustrine wetlands (Cowardin et al. 1979). The term, riparian, has numerous definitions in the technical and policy-related literature. The lack of a consistent definition for riparian has been identified as a major problem of federal and state programs that might protect riparian areas. The National Research Council has addressed this range of definitions and synthesized one that seems fundamental to most interests. This definition has been adopted for the purposes of this project (NRC 2002):

> "Riparian Areas are transitional between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes and biota. They are areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands. They include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems. Riparian areas are adjacent to perennial, intermittent, and ephemeral streams, lakes and estuarine-marine shorelines, and other wetlands.

Overview of Methods

Wetlands were mapped for this project using established federal and state standards as defined by the National Wetlands Inventory and the California Statewide Wetlands Inventory. Riparian areas were mapped using draft riparian habitat mapping standards developed for the State of California under the consideration of the Riparian Habitat Joint Venture[1] (Collins et al. 2007). Details on the classification systems for wetlands and riparian areas are given in sections 2.3 and 2.4 respectively. The general process for mapping is detailed below.

Geodatabases, Base Imagery and Collateral Data

The process of inventorying wetlands and riparian areas was be initiated by the creation of an ArcGIS 9.0 geodatabase containing base digital aerial imagery and collateral data for the 27 U.S. Geological Survey 7.5" quadrangle maps in the study area (Table 2-1)[2]. These data were

[1] The RHJV is is a cooperative effort of 18 state and federal agencies and private organizations to restore, enhance, and protect a network of functioning riparian habitat across California to support the long-term viability of landbirds and other species. The RHJV mission is to provide leadership and guidance to promote the effective conservation and restoration of riparian habitats.
[2] Note that under a previous arrangement between the USFWS and the Coastal Conservancy, six of these quads were being mapped with different grant funding from the Coastal Conservancy (Mount San Antonio, Crystal Lake, Condor Peak, Mescal Creek,

used as a guide for identifying potential sites where target habitat may be present. Collateral data include old NWI wetland maps where available, 10-meter digital elevation models, quadrangle boundaries of the area to be mapped, land use data (SCAG. 2000), pre-existing National Hydrography Data (USGS. 2004), hydric soils data (NRCS 2005), and USGS topographic maps (1:24,000). In addition, because dirt roads may appear to be intermittent streams on color infrared aerial photography, data on roads and railroads were included as collateral data. Finally, any updated wetland features or useful collateral data were obtained from local and regional agencies willing to loan data for the project. The collateral data was compiled into one standardized geodatabase, which was used as a template for all wetland and riparian area mapping. In addition, slope and hillshade maps were created from the 10-meter digital elevation models. These maps will aid in visualizing the topographic relief of the landscape within a watershed and identify areas where riparian areas may be present. Likewise, both flow direction and water accumulation models were developed from all 10-meter digital elevation models using ArcGIS Spatial Analyst. These additional models will help to identify the course of water in a particular watershed as well as outline locations where water is like to accumulate; this information can then be used as an indicator of potential locations that could support wetland and riparian habitat. These models also help to identify first order streams that are representative of some of the unique wetlands in the southern California region.

Table 2-1. List of 7.5" USGS quadrangle maps in the RMC territory (Data for the quads funded through the RMC are reported in this document).

	NWI 100 K NAME	*Watershed*	*MAPNAME*	*Lead Agency*
1	Los Angeles SE	LA River	HOLLYWOOD	RMC
2	Long Beach NE	LA River	INGLEWOOD	RMC
3	Long Beach NE	LA River	LONG BEACH	RMC
4	Los Angeles SE	LA River	LOS ANGELES	RMC
5	Los Angeles SE	LA River	PASADENA	RMC
6	San Bernardino SW	SG River	GLENDORA	RMC
7	Santa Ana NW	SG River	LA HABRA	RMC
8	Santa Maria NE	SG River	LOS ALAMOS	RMC
9	San Bernardino SW	SG River	MT. BALDY	RMC
10	San Bernardino SW	SG River	ONTARIO	RMC
11	San Bernardino SW	SG River	SAN DIMAS	RMC
12	Long Beach NE	SG River	SEAL BEACH	RMC
13	Santa Ana NW	SG River	YORBA LINDA	RMC
14	San Bernardino SW	SG & LA River	AZUSA	RMC
15	San Bernardino SW	SG & LA River	BALDWIN PARK	RMC
16	Los Angeles SE	SG & LA River	EL MONTE	RMC
17	Long Beach NE	SG & LA River	LONG BEACH	RMC
18	Los Angeles SE	SG & LA River	MT. WILSON	RMC
19	Long Beach NE	SG & LA River	SOUTH GATE	RMC
20	Long Beach NE	SG & LA River	WHITTIER	RMC
21	San Bernardino SW	SG River	MOUNT SAN ANTONIO	USFWS/NWI
22	San Bernardino SW	SG River	CRYSTAL LAKE	USFWS/NWI
23	Los Angeles SE	LA River	CONDOR PEAK	USFWS/NWI
24	San Bernardino SW	SG River	MESCAL CREEK	USFWS/NWI
25	San Bernardino SW	SG River	VALYERMO	USFWS/NWI
26	Los Angeles SE	SG & LA River	CHILAO FLAT	USFWS/NWI
27	San Bernardino SW	SG & LA River	WATERMAN MOUNTAIN	USFWS/NWI

Valyermo and Chilao Flat, and Waterman Mountain). Note that only the data from the 21 quads created through funding from the RMC are reported here.

Baseline imagery for the project will be obtained from the United States Geological Survey. This imagery will consist of 1-m resolution color infrared digital orthophoto quads (DOQ's). The digital orthophoto quadrangle (DOQ) is the standard product for the initial national orthoimagery coverage and is cast on the Universal Tranverse Mercator projection from black and white or color-infra red photographs. The process of orthorectification removes most of the feature displacements and scale variations caused by terrain relief and sensor geometry. The result combines the image characteristics of a photograph with the geometric qualities of a map.

The National Digital Orthophoto Program (NDOP) led the effort to complete national orthoimagery coverage based on photographs from the National Aerial Photography Program (NAPP). The NAPP and the NDOP are consortia of Federal agencies, principally the USGS, Natural Resources Conservation Service, Farm Service Agency, U.S. Forest Service, Bureau of Land Management, Federal Emergency Management Agency, and Environmental Protection Agency, committed to providing national photographic and orthoimagery coverage by combining funding resources and creating partnerships to coordinate requirements and costs with States, other government agencies, and the private sector. For this project, we obtained DOQ's from the year 2000 or later (Figure 2-1). In some instance, where color-infra red DOQ's are not available, local agencies were contacted for alternative sources of imagery. True color othoimagery (1 ft resolution) taken in 2002 was obtained from the Los Angeles and San Gabriel Watershed Council for some portions of the study area. In addition, true color orthoimagery (1 ft resolution) taken in 2005 from NAPP was used (Figure 2-2). Finally, we also purchased true color orthoimagery from Air Photo USA. This imagery had a resolution of 6 inches and provided our most updated and accurate imagery in places where color-infra red imagery was not available (see metadata for details on which imagery was used for each quadrat).

Figure 2-1. Example of color-infrared imagery (of Devils Gate Dam) used to map wetlands in the RMC Territory.

Figure 2-2. Example of true color imagery (of Whittier Narrows) used to delineate wetlands in the RMC Territory.

Mapping Drainage Networks

Any comprehensive effort to map existing or potential riparian areas must begin with a complete map of all the lakeshores, estuarine shorelines, perennial channels, ephemeral and intermittent channels, and artificial drainage channels that together comprise the drainage network. It can be assumed that every part of the boundary of the network supports some amount of riparian area. If the map of the drainage network is incomplete, then the map of the riparian areas must also be incomplete.

The most common set of data for depicting the drainage network of any watersheds in the Unites States consists of the “blue lines” of rivers and streams and shorelines from the 1:24000 scale topographic quadrangles produced by the U.S. Geological Survey (USGS). The blue lines comprise part of the standard 1:24000 Digital Line Graph (DLG) dataset commonly available to the public. It has long been known, however, that the blue lines do not represent the complete drainage network for any watershed. This is especially true with regard to mapping riparian areas, since they can attend artificial drainage channels as well as natural ephemeral and intermittent streams that are seldom included in the DLG.

A variety of computer-based methods exist to construct maps of drainage networks based on Digital Elevation Models (DEMs), also known as Digital Terrain Models (DTMs). A DEM or DTM is a simple, regularly spaced grid of elevation points. The size of the spaces (i.e., the size of the square cells of the grid) dictates the resolution of the DEM. Cell size is also termed node distance, which is the shortest distance between the intersections of the grid lines. As node distance increases, DEM resolution decreases. Large-node DEMs can only be used to produce relatively coarse, generalized topographic maps. DEMs can also be used to generate maps of land slope, which can help determine the limits of valley bottoms and flood plains as potential riparian areas, and to adjust models of riparian buffer width to account for the effects of slope on runoff and tree fall. The USGS 30-m node and 10-m node DEMs are commonly available in

California. Of these two DEMs, the higher-resolution 10-m node is much superior for generating drainage networks. The USGS 10-m node was used for generating drainage networks for this project. Once this drainage network was established, the drainage lines were adjusted to fit the imagery (which was created at a higher spatial resolution), buffered by 2.5 meters, and classified according to the Cowardin Classification system for wetlands.

Mapping of Wetlands and Riparian Areas

Once the stream drainage network was generated, all wetland and riparian areas were mapped as polygons or, in the case of first order streams, captured with a 2.5 meter buffer around lines that followed the stream meander. Interpretation of aerial photographs followed NWI protocol for photo interpretation (USFWS. 1995). For all sites mapped, wetland and riparian areas were mapped primarily based on spectral signature from aerial photography and/or collateral data. Detail on the methodologies and classification of wetlands and riparian areas are given in Sections 2.3 and 2.4.

Stakeholder Review and Map Quality Assurance

Upon completion of mapping for each region, all maps produced went through a watershed stakeholder review process designed to identify any inaccuracies and increase stakeholder buy-in and confidence in the final product. This stakeholder review was coordinated through the Los Angeles County Task Force of the Southern California Wetland Recovery Project. The Task Force, co-chaired by a County Supervisor and environmental leader, provides a countywide forum for public, private, and non-profit wetlands and watershed stakeholders. Participants work collaboratively to identify critical wetland resources, help implement feasible projects, and promote wetlands education and information gathering. County Task Force participant rosters and meetings will serve as an excellent venue for map review and vetting. WRP Watershed coordinator for the Los Angeles region facilitated project staff in setting up stakeholder review meetings. All final maps went through a quality assurance quality control process by NWI staff and will be posted to the WRP website for public distribution. The WRP website will require the user to register their name and affiliation in order to download maps.

Finally, a summary of the extent and distribution of wetlands and riparian areas by habitat type will be compiled (a.k.a landscape profile). The results of an inventory are displayed with histograms or tables showing amount of wetland and riparian habitat acreage by categories of interest. These categories can include political boundaries, by watershed, and/or by wetland and riparian habitat type (e.g. subtidal, mudflat, marsh). This landscape profile and source data can be used to establish a baseline with which future assessments of net change in acreage can be assessed.

Metadata associated with the final wetland and riparian maps were formatted in accordance with the Federal Geographic Data Committee (FGDC). The FGDC format is a standardized format for reporting metadata associated with geospatial data. These metadata include information about the scale, accuracy, publication date, and imagery used for wetland and riparian delineation. For more detailed information on wetland metadata attribution, NWI provides a review of this standardized template on their website at www.fws.gov/nwi/metadata.htm.

Mapping and Classification of Wetlands

Identification and mapping of wetlands of the San Gabriel and lower Los Angeles River was done through heads up digitizing of color infrared aerial photography at a 1:24,000 scale taken in the region in 2003 (USGS 2003.). Classification of wetland habitats was done according to the guidelines found in the USFWS's Method for "Classification of Wetlands and Deepwater Habitats" (Cowardin et al. 1975). The Cowardin classification of wetlands is a hierarchical classification process with systems (Marine, Estuarine, Riverine, Lacustrine and Palustrine), subsystems (includes deepwater habitats), and more detailed classes, subclasses and dominance types (See Table 2-2). Field reconnaissance was conducted prior to and after photointerpretation in order to accuracy identify wetland habitat and associated landscape features in these watersheds. Collateral data including old NWI wetland maps where available, land use data (SCAG. 2000), pre-existing Nathional Hydrography Data (USGS. 2004), hydric soils data (Los Angeles County Department of Public Works), historical topographic maps (CSUN) and USGS topographic maps (1:24,000) were used to ensure accurate mapping of wetland habitats. Because dirt roads may resemble first order streams on aerial photography, data on roads and railroads were also included as collateral data.

Table 2-2. Definitions of the Cowardin wetland systems (Cowardin et al. 1979).

System	Definition
Marine	The Marine system consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the water regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 ‰ with little or no dilution except outside the mouths of estuaries.
Estuarine	The Estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation.
Riverine	The Riverine system includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean derived salts in excess of 0.5 ‰. A channel is "an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water" (Langbein and Iseri 1960 5)
Lacustrine	The Lacustrine system includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 areal coverage; and (3) total area exceeds 8 ha (20 acres).
Palustrine	The Palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ‰. It also includes wetlands lacking such vegetation, but with all of the following characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 m at low water; and (4) salinity due to ocean-derived salts less than 0.5 ‰.

In addition to using DTM's to identify a drainage network that included first order streams, we also used two additional methods to identify wetlands. We used color-infra red stereopairs and a stereoscope to view the landscape in 3-D space. In many instances, delineation of wetlands depends on being able to interpret suttle changes in topography not evident on either slope maps or topographic maps. Viewing the landscape in 3-D space allows for delineation of these suttle topographic changes and is particularly useful for mapping depressional wetlands and delineating riparian ares from wetlands. In addition to stereopairs, we used an extension to ArcGIS called ArcScene. ArcScene allows for 3D viewing of imagery on-screen (Figure 2-3). This 3-D rendering could be rotated and viewed at any angle the mapper would like. This allowed for us to get a more accurate depiction of the topography of the landscape relative wetlands and improved our mapping accuracy.

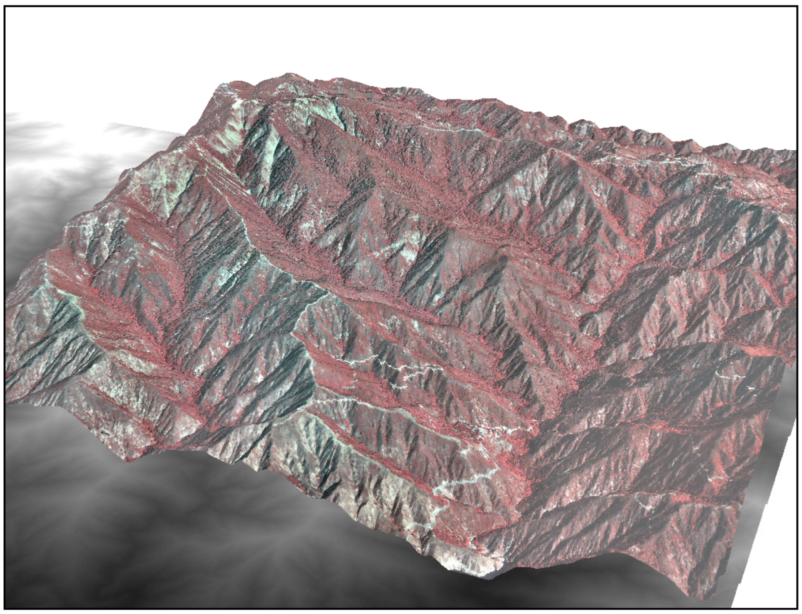


Figure 2-3. Example of 3-D rending of imagery using ArcScene in ArcGIS 9.0.

In addition to the standard classification developed by Cowardin et al. (1979), an additional set of hydrogeomorphic (HGM) modifiers were added to the maps that described the landscape position and local geomorphic context of the wetland and riparian habitat, based on the intial concept proposed by Brinson (1993) and modified by Sutula et al. (2004). The HGM modifiers build upon the Cowardin classification system and provide more specificity about landscape setting and likely hydrogeomorphic function of wetlands in California (Table 2-3). HGM classifications are applied after the Cowardin classifications are applied via an automated process. This process involves delineating the major geomorphic features of the landscape with a GIS. Then overlaying this layer onto the classified NWI wetlands. Once this layer is overlaid, then classification is performed by translating the NWI classification and it's geomorphic location into the HGM classifications. Final review of the maps was then made to insure depressional wetland features are correctly classified. The geomorphic layer for the study area will also be provided as end product of this project.

Table 2-3. Hydrogeomorphic (HGM) Modifiers for California Wetlands (Sutula et al. 2004).

HGM Category	*Level I (Landscape Geomorphic Context)*	*Level I Modifier*
Fluvial (F)	Coastal Terrace (1) Topographic Plain (2) Alluvial Fan (3) Canyon (4) Valley (5) Montane (6) Foothill (7) Delta (8)	Slope > 4% (a) Slope 2% to 4% (b) Slope < 2% (c) Artificial (d)
Depressions (D)	Coastal Terrace (1) Topographic Plain (2) Alluvial Fan (3) Canyon (4) Valley (5) Montane (6) Foothill (7) Drainage Divide (9) Dunes (0)	Volcanic (a) Aeolian (b) Tectonic (c) Colluvial (d) Glacial (e) Artificial (f)
Seeps and Springs (S)	Coastal Terrace (1) Topographic Plain (2) Alluvial Fan (3) Canyon (4) Valley (5) Montane (6) Foothill (7) Drainage Divide (9) Dunes (0)	Slopes (a) Flats (b) Pools (c)
Lake & Reservoir Shores and Beds (L)	Coastal Terrace (1) Topographic Plain (2) Alluvial Fan (3) Canyon (4) Valley (5) Montane (6) Foothill (7)	Volcanic (a) Glacial (b) Structural (c) Colluvial (d) Artificial (e)
Tidal (T)	Embayment (1) Lagoon (2) Channel Reach (3) Channel Mouth (4) Coves (5) Artificial (6) Exposed Shoreline/ Headland (7)	High-Gradient Estuarine (parallel drainage systems) (a) Low-Gradient Estuarine (vegetated flats with dendritic drainage systems) (b) Marine (c)

Riparian Mapping

The riparian mapping protocol is based on a method developed and currently piloted by the San Francisco Estuary Institute for the RHJV (Collins et al. 2007, see Appendix I). This method is currently undergoing agency review and is expected to be finalized and adopted by the Resources Agency for riparian mapping under the Statewide Wetlands Inventory. The RHJV method consists of three steps, including: 1) Mapping drainage networks, 2) mapping of riparian vegetation, and 3) classification of vegetation in riparian polygons using USFWS NWI classification of riparian habitats (USFWS 1997).

Riparian areas in the San Gabriel and lower Los Angeles River watersheds were mapped using the draft Riparian Habitat Joint Venture methodology (Collins et al. 2007, Appendix I), which is a modification of the USFWS/NWI method for mapping riparian habitat in the arid southwestern United States (USFWS 1997).

Riparian areas were delineated in areas in which either: 1) the spectral signature of riparian vegetation was distinct (Figure 2-4a), 2) the slope map (derived from a 10 meter digital elevation model) suggested a consistent drainage pattern (Figure 2-4b), or 3) vegetation within a buffered distance from the channel had 30% or greater vegetative cover (Figure 2-4c). When mapping riparian areas and wetlands, some uncertainty can emerge about their differences. Both occupy the transition between dry and wet environments. Therefore, in the latter approach different default buffer widths were applied to the drainage network depending on the dominant plant species, where dominance was based on the absolute cover of the overstory. Based on the vegetation maps and a look-up table of species-specific tree heights we initially experimented with various buffer widths. Because vegetation maps were largely inaccurate within the study area, we adopted a method of buffering wetlands dominated by scrub shrub by 10 meters and forested areas by 20 meters. These buffer widths appeared to consistently capture riparian areas where spectral signature was present, therefore we used these as the buffer width for locations where spectral signature was not present but there was 30% or greater cover from vegetation.

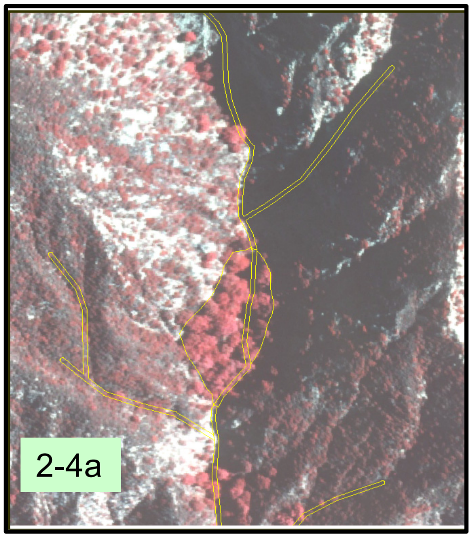
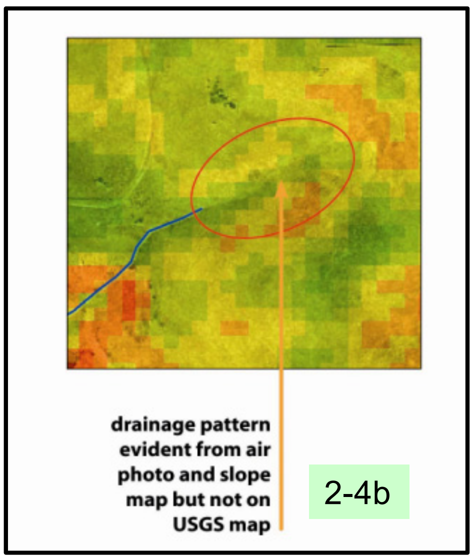


Illustration of how riparian habitat is mapped, e.g. via a) an obvious riparian spectral signature, b) mapping of an obvious drainage pattern mapped as riparian and c) where no obvious spectral signature is apparent, but slope is dominated by scrub shrub vegetation (10 meter buffer applied).



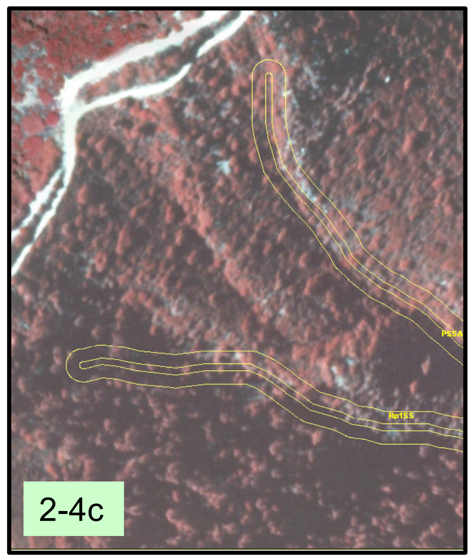


Figure 2-4(a-c). Illustration of various means by which riparian habitat is photo-interpretted.

The minimum mapping unit (MMU) for forested areas was three adjacent trees or about 0.02 ha. For shrub and non-vegetated riparian areas, the MMU was about 0.2 ha. These MMUs allowed the mapping of point bars, beaches, and other unvegetated natural features along waterbodies as parts of the riparian areas. The default riparian widths were only applied when they yielded broader riparian areas than indicated by the indicative vegetation, or when such vegetation was not evident. Riparian areas that were confined by steep terrain or land use were similarly represented by maps based on the default buffer widths or based on indicative vegetation. But areas that were not confined were not well represented by the default buffers. The reason for defaulting to the buffer widths when they were larger is that the visible vegetation was not always mature (i.e., it had not reached its maximum height or the SPTH value, and field visits revealed that the riparian-upland boundary is a fuzzy ecotone that tends to extend further into the terrestrial environment than could be discerned in the image.

Polygons of riparian vegetation were then attributed with the appropriate classification, using the USFWS NWI classification of riparian habitat in the arid southwestern United States (USFWS

1997). Aerial photographers are the primary source for riparian classification. Field reviews, soil surveys, and topographic maps are used a collateral data. The riparian mapping system is hierarchical, open ended, and uses the System, Subsystem, and class classifications. Subclass and dominance types are also sometimes included in the classification system when the riparian mappers are highly trained at interpreting specific plant species from aerial photography. These categories were not used for this project in order to maintain accuracy of classifications and to maintain consistency with other NWI mapping efforts in southern California. The System, Subsystem, and class are defined as follows:

·System is a single unit category – riparian vegetation (Rp)
·Subsystem defines two categories reflecting the water source for the riparian area – lotic (1) and lentic (2)
·Class describes the dominant nonhydrophytic life form of riparian vegetation. For these conventions, classes are: Forested (FO) woody vegetation usually > 6 m. in height; scrub/shrub (SS) woody vegetation usually less than 6 m. in eight; and emergent (EM) erect, rooted vegetation with herbaceous stems.

For instance, Rp1FO is interpreted as:

System:	Rp	Riparian
Subsystem	1	Lotic
Class	FO	Forested

3. SUMMARY OF WETLAND AND RIPARIAN HABITATS WITHIN THE RMC TERRITORY

Landscape Profile of Wetlands within the RMC Territory

A total of twenty-seven 7.5” USGS quadrangle mapsin the RMC study areas were inventoried for wetlands and riparian. Figure 3-1 shows a landscape view of the wetlands and riparian areas mapped in this project. There were a total of 195 unique wetland classifications in the study area and 13,836 wetland polygons inventoried. Table 3-1 shows the percentage of area under each system of classification for all wetlands in our study area by acreage. Approximately 28,925 acres of marine wetlands were mapped (note that this figure includes subtidal and deepwater habitat). In addition, 4,347 stream miles were mapped (including first order streams). The Palustrine wetland classification represented the greatest amount of wetlands, followed by Riverine systems.

Table 3-1. Summary of estuarine, lacustrine, palustrine and riverine wetlands mapped within the study area. Marine wetlands and deepwater habitat are not accounted here and are reported separately above.

System	Number of Unique Polygons	Area (Acres)	Percent of Wetlands
Estuarine	159	4,404	15%
Lacustrine	131	2,775	10%
Palustrine	6,771	10,131	35%
Riverine	6,775	11,654	40%
Total	13,836	28,964	100%

Over 2,700 wetland polygons representing 20% percent of the wetlands inventoried were given special modifiers indicating they were either modified or human-made. These included areas that were diked, composed of artificial substrate, or excavated. We used these special modifiers as conclusive evidence of human modification or creation (Cowardin et al. 1979).

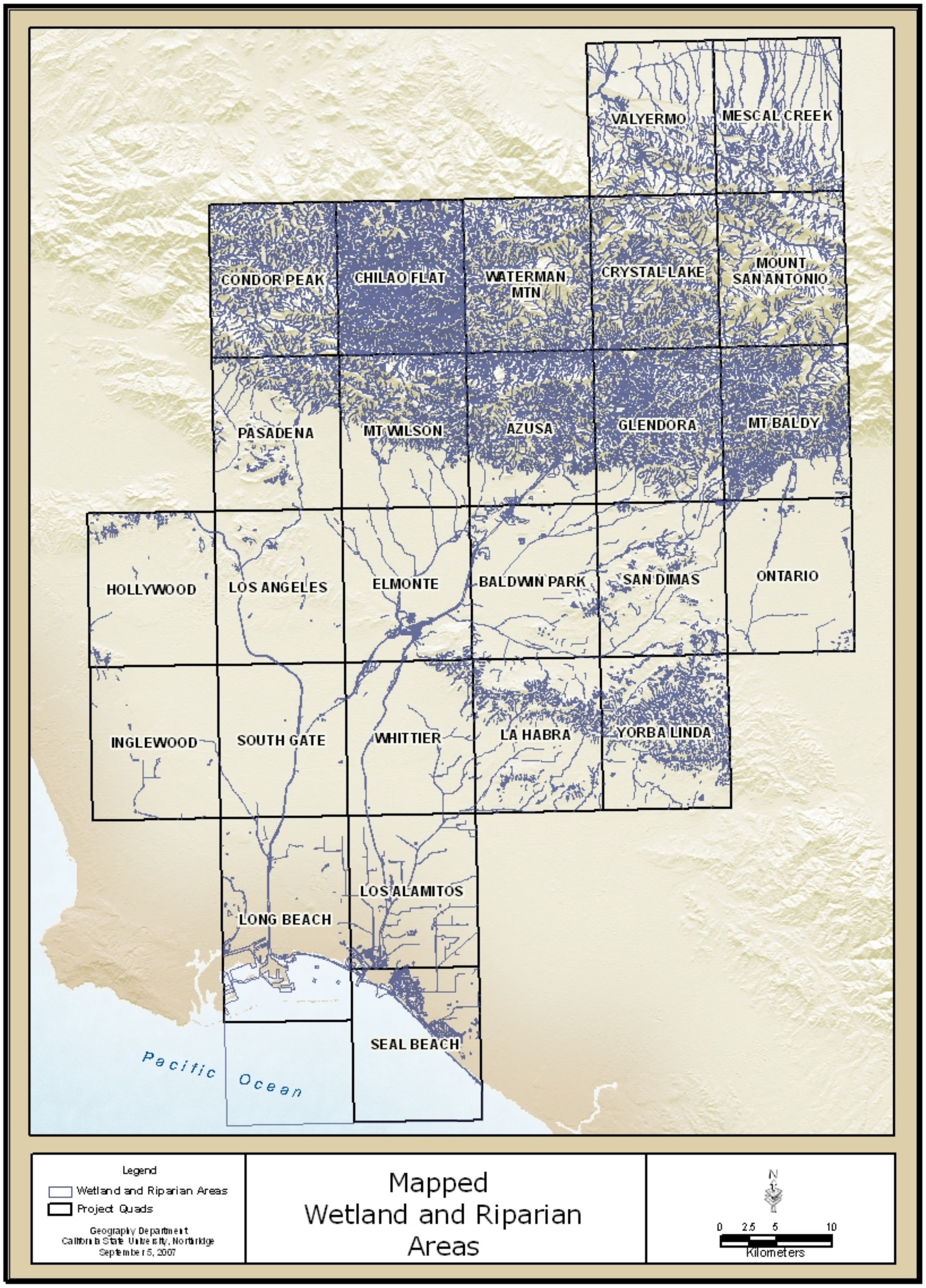


Figure 3-1. Figure showing landscape view of mapped wetlands and riparian habitat in the RMC territory.

The diversity of wetlands may seem surprising as southern California if often viewed as having a paucity of wetlands (Ferren et al. 1996). However, the San Gabriel Valley and mountain areas actually represent a wide range of potential wetland types and historically supported significant wetland areas (Stein et al., 2007). Almost all of the wetlands on the valley floor show signs of anthropogenic impact. Wetlands that have been modified have lost much of their natural functionality and should be assessed for potential restoration.

Similar to wetland areas, riparian areas have not been mapped under a single effort within the study area. This project has provided a unique opportunity to identify riparian areas. A total of 37,772 acres of riparian area was mapped across the study area (Table 3-2). Mapping these riparian areas with the RJHV method allowed us to capture the unique nature of riparian areas in semi-arid southern California. As such, we feel this methodology captured significantly more riparian area than previous mapping efforts, which rely uniquely on the spectral signature of vegetation.

Table 3-2. Statistics for riparian areas mapped within the study area.

Type of Riparian Area	Acres
Lentic (associated with standing water)	23
Lotic (associated with flowing water or riverine systems)	37,749
Total	37,773

San Gabriel River Watershed Statistics

The statistics cited above include the entire study across all 27 7.5" USGS quads. This section will provide an overview of statistics specific to the San Gabriel River Watershed (Figure 3-2). The compilation of data by watershed will for stakeholders active in the region to identify specific wetland characteristics of the area for future comparison to other watersheds within the Southern California Region. Likewise, the compiled statistics can be used to make better informed management and conservation decisions.

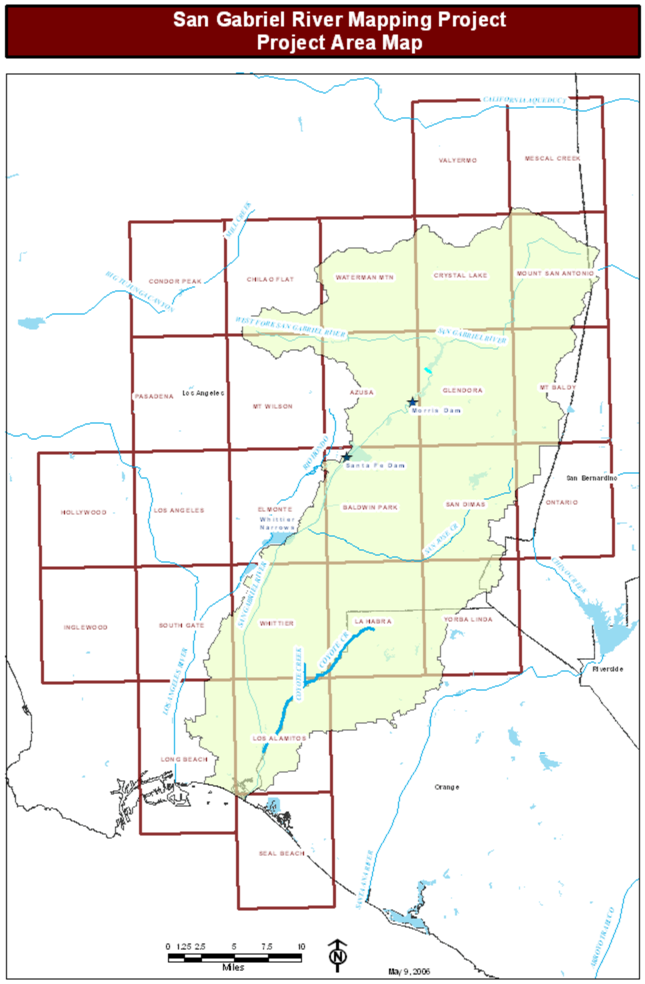


Figure 3-2. Map of the San Gabriel River Watershed.

Within the San Gabriel River Watershed there was a total 13,332 acres of wetlands mapped (Figure 3-3). The watershed is dominated by riverine and palustrine wetlands reflecting the influence of fluvial systems within the area (Figure 3-3). It should also be noted that palustrine wetlands, while dominated by vegetation, can still be represented as fluvial systems when confined to a channel. This characteristic of palustrine systems is captured in our hydrogeomorphic summary in the following section.

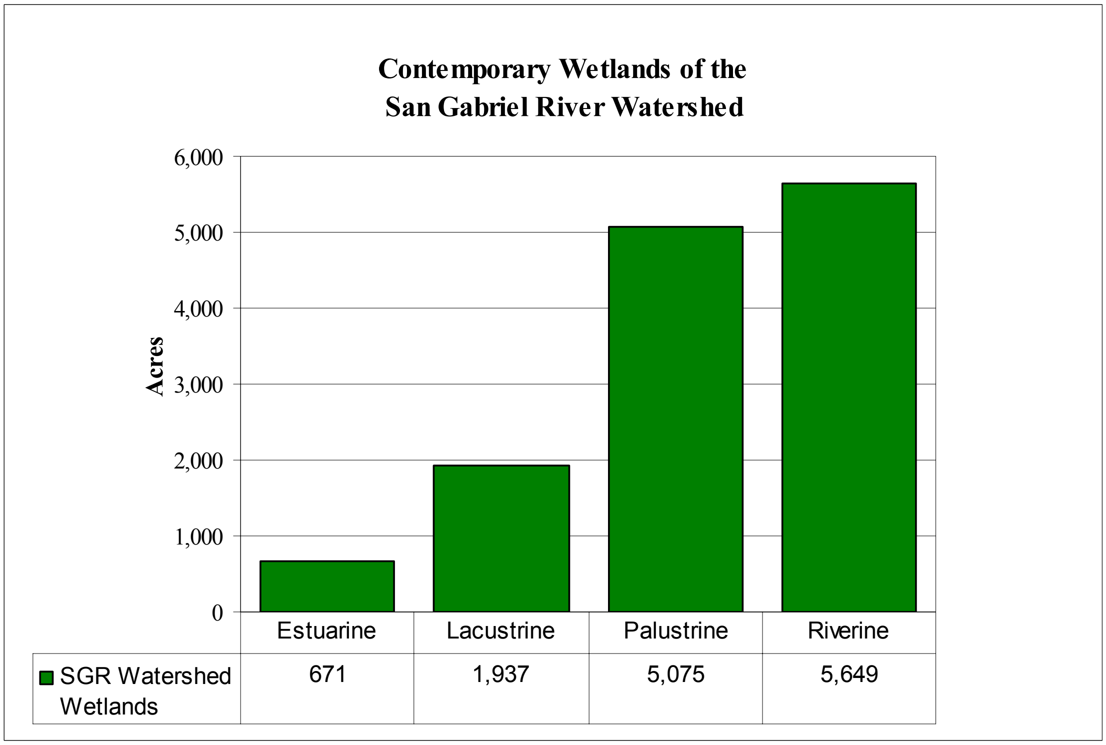


Figure 3-3. Summary statistics for the San Gabriel River Watershed by Cowardin system classification.

A summary of wetlands within the San Gabriel River Watershed by the hydrodgeomorphic category allows for an assessment of the functionality of wetlands within the region. Figure 3-4 provides this summary and demonstrates the dominance of fluvial systems when compared to the Cowardin classification system. The combined classification of wetlands by both Cowardin and Hydrogemorphic classifications allows for identification of wetlands based on not only vegetative characteristics and water regime, but also by wetland functionality and geomorphic context.

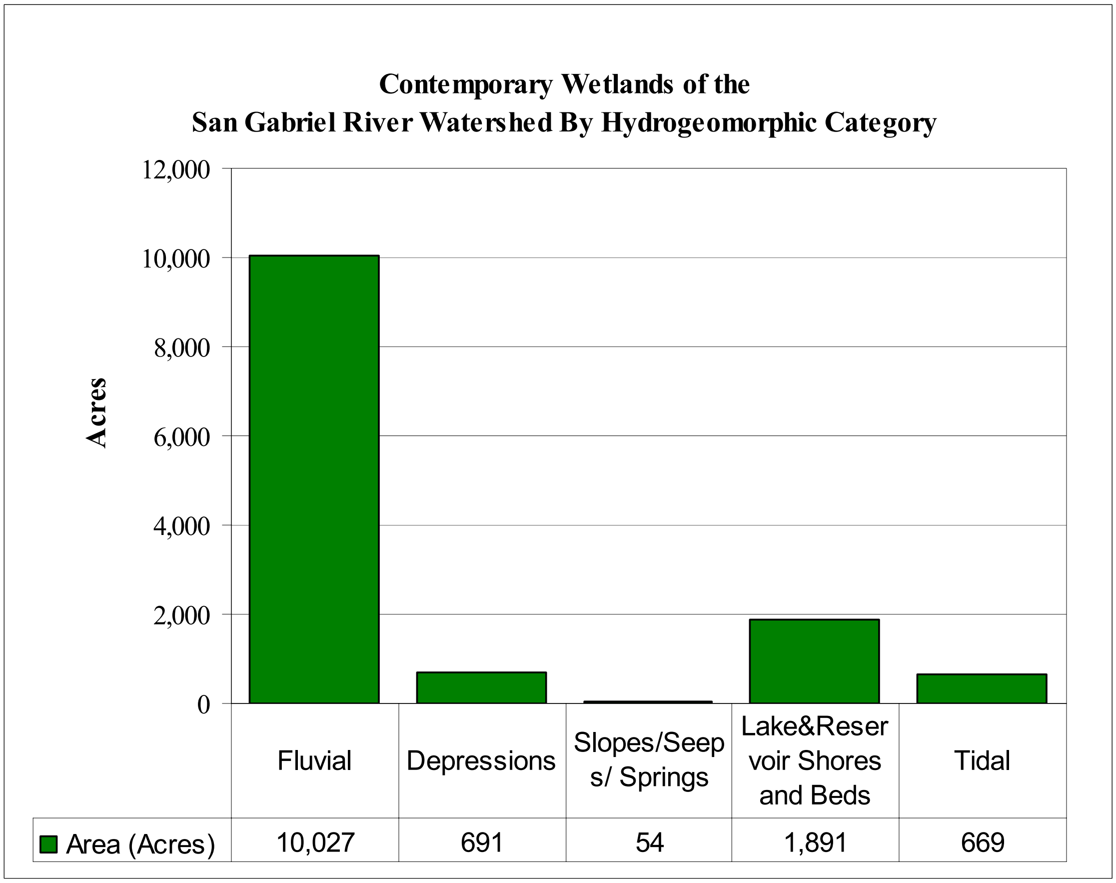


Figure 3-4. Summary statistics of wetlands within the San Gabriel River Watershed by Hydrogemorphic Category.

Figure 3-4 also demonstrates that lakes and depressional wetlands are also present on the landscape and represent roughly 20% of all wetlands within the watershed. Slope, seep, and spring wetlands are among the rarest wetlands within the watershed representing only 1% of the total wetland area. These wetlands are associated with unique hydrological formations and therefore it is not surprising that they are rare within the study area. However, these wetlands often support unique and rare vegetation making them of special concern for conservation (Dahl and Johnson 1991).

Wetlands within the watershed were also summarized by subwatershed. This may be important in identifying unique aspects of specific regions within the watershed allowing for targeted conservation efforts within these subregions. Figure 3-5 illustrates the various subwatersheds for which data was summarized.

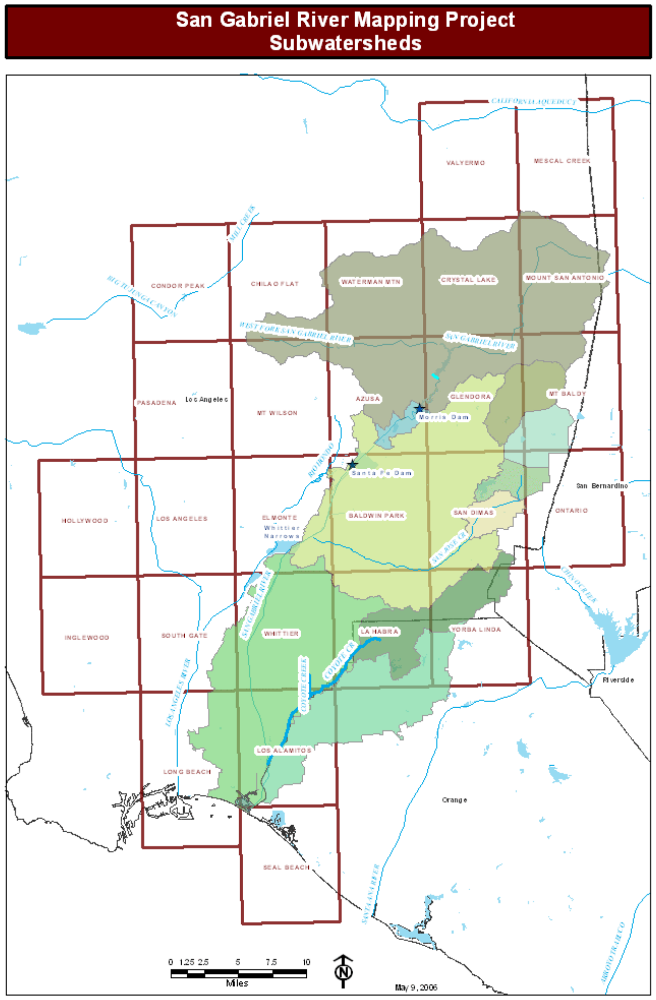


Figure 3-5. Subwatersheds within the San Gabriel River Watershed.

The Upper Canyon and Upper San Gabriel subwatersheds contributed the most to riverine and palustrine wetlands which represented the largest wetland categories under the Cowardin classification system. The Alamitos Bay subwatershed contained the majority of estuarine wetlands, while the Lower San Gabriel subwatershed contained the greatest diversity of wetlands with in each of the Cowardin systems represented in the area (Table 3-3).

Table 3-3. Summary of the wetlands within the subwatersheds of the San Gabriel River.

Region	Palustrine	Estuarine	Lacustrine	Riverine
Alamitos Bay	-	352	-	-
Anaheim	167	74	-	463
Foothill	284	-	37	162
La Habra	392	-	-	89
Live Oak	171	-	52	120
Lower Canyon	148	-	311	249
Lower San Gabriel	459	245	83	780
Pomona	39	-	208	18
San Jose	21	-	-	115
Upper Canyon	2,125	-	777	2,544
Upper San Gabriel	1,269	-	469	1,110

Data for the San Gabriel River Watershed were also summarized by congressional district. The congressional districts have only a portion of their area in the watershed (Figure 3-6) so the values here only reflect how much wetland area from the San Gabriel River Watershed are in the district, not the entire amount of wetlands in each district. This type of information may be critical for targeting politicians with regard to conservation policies within the watershed.

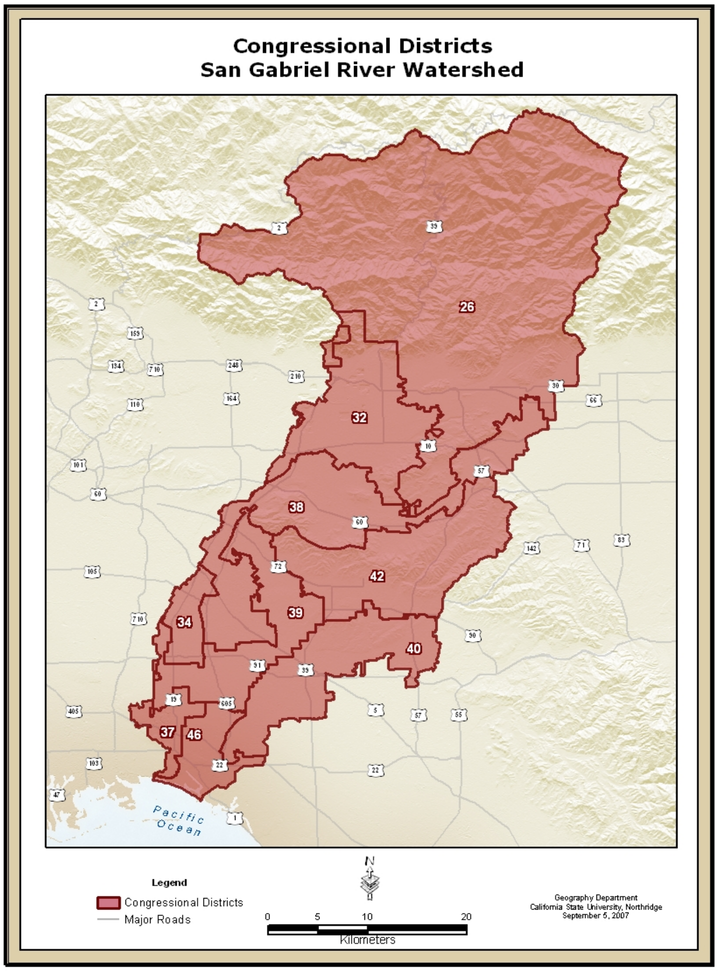


Figure 3-6. Partial Congressional Districts within the San Gabriel River Watershed.

Within the watershed, roughly 49% of the wetlands are contained in Congressional District 26 (Figure 3-7). Congressional District 32 contained the next largest amount of wetland area with 14% of the watersheds wetlands present.

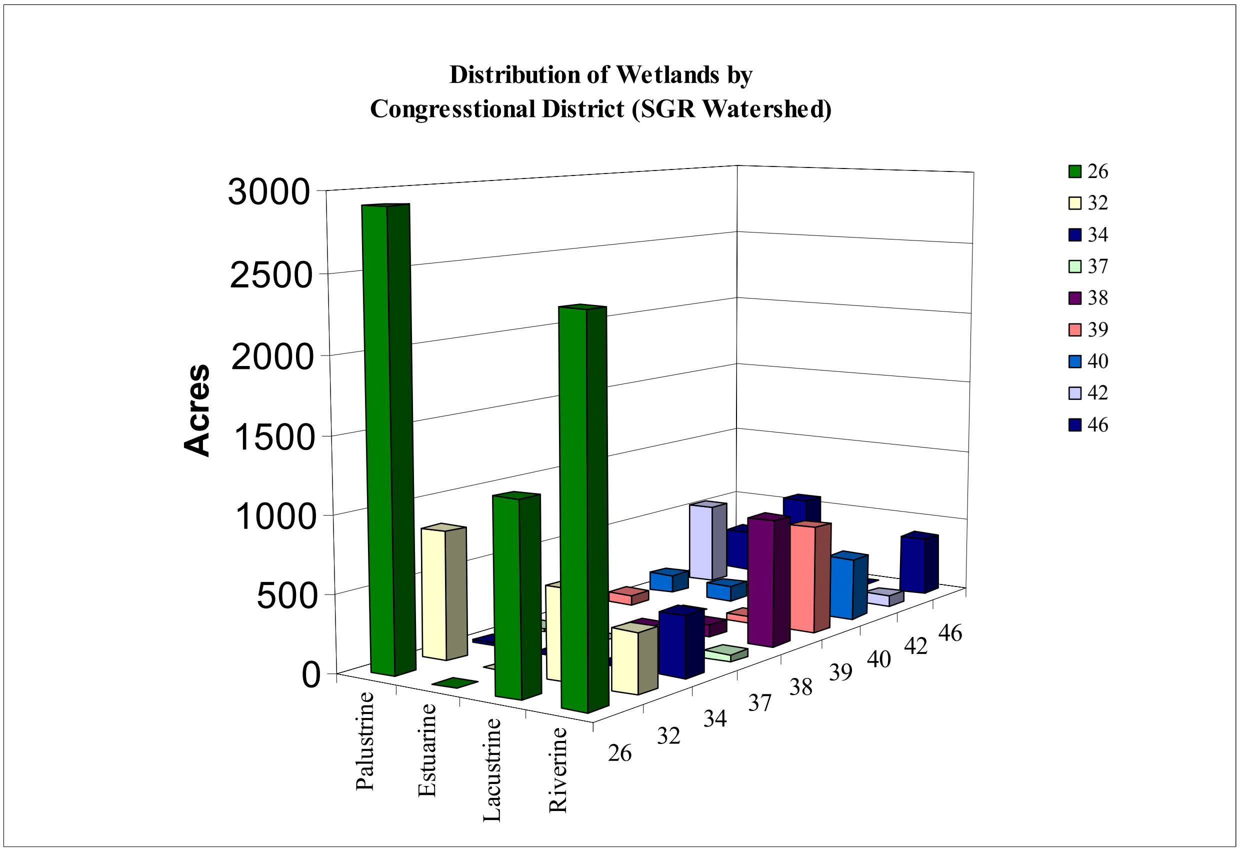


Figure 3-7. Distribution of wetlands within the San Gabriel River watershed by Congressional District.

A variety of other potential summaries of wetlands within this watershed can be obtained from the wetland and riparian maps for this watershed. For futher information, please contact Dr. Shawna Dark (shawna.dark@csun.edu).

4. DIVERSITY OF WETLANDS AND RIPARIAN AREAS WITHIN THE RMC TERRITORY – A VISUAL TOUR

Southern California's wetlands and riparian habitat are among the most diverse, productive and densely populated habitats on the Pacific coast (Warner and Hendrix 1985, USDOI 1994). The physical features, climate, and hydrology of this biogeographic province have produced an unusual set of hydrogeomorphic conditions and a diversity of plants and animals that sharply distinguish the region from any other in North America. This sample of this diversity was evident within the geographic scope of this mapping effort. The range observed spanned not only over various classes of wetlands and riparian habitats but also along an anthropogenic disturbance gradient. Thus wetlands and riparian habitat were observed in conditions ranging from pristine to heavily degraded.

The purpose of this section is to present a visual tour of the diversity of wetland and riparian habitats and their geomorphic context observed in the RMC territory.

Streams and Rivers

Southern California coastal rivers and streams vary considerably along environmental, spatial, temporal gradients, and disturbance. Their geomorphic context and hydrology produce a natural range of stream gradient and freshwater flow. First order (e.g. headwater) streams in particular, which represent approximately 80% of the drainage network, are often either emphemeral or intermittent drainages. Streams and rivers within the study area varied from a more natural setting such as along the Eaton Canyon Wash to riverine systems that are highly modified by humans such as lower the San Gabriel River. This section provides a review of the variety of streams and rivers throughout the study area.

The Eaton Canyon Wash, while impacted by humans, still provides and example of the dynamic riverine systems that dominated the historical landscape in the San Gabriel Valley (Figure 4-1). The large, dry stream bed filled with large rocks, bounlders and larger sediment represent the large exchange of material from the mountain areas to the coastal environment during periods of heavy rain. During winter months, the above canyon fills with water and during years of high rainfall floods entirely. However, the system is consistently dry during the summer giving the false appearance of a system only occasionally flooded.

Figure 4-1. Eaton Canyon Wash.

Figure 4-2 shows the East Fork of the San Gabriel River. This is also a highly modified system in terms of water regime (with a dam above dictating the annual flow of water). However, the lack of concrete channels gives the river a somewhat natural appearance. The lack of a concrete channel will allow for some recharge of groundwater. However, the majority of this type of recharge occurs on the valley floor.

Figure 4-2. East Fork of the San Gabriel River below Morris Reservoir.

While the northern regions of the San Gabriel River give the appearance of a more natural system, the lower San Gabriel River provides and excellent example of the human modified riverine system in southern California. Figure 4-3 illustrates the concrete sides of the channel and in some places the presence of a concrete bottom along the river as well.

Figure 4-3. Flooded channel of the lower San Gabriel River.

Figures 4-4 through 4-6 show examples of other stream and river reaches in the San Gabriel River watershed.

Figure 4-4. Vegetated channel along the San Gabriel River.

Figure 4-5. First order, vegetated channel (classified as Palustrine scrub shrub).

Figure 4-6. Example of a high gradient perennial stream (Leotine Falls in Upper Rubio Canyon).

Palustrine Wetlands

The category of “palustrine wetlands” encompass a large variety of freshwater wetlands including: freshwater ponds, wet meadows, vernal pools, emergent marshes, and slope/seep wetlands. Several examples of many of these palustrine wetland types were found within the RMC territory. These included perennial wetland pond such as the one located behind Devils Gate Dam (Figure 4-7), emergent freshwater marsh that is the result of type conversion from estuarine marsh (Figure 4-8), and slope/seep wetlands (Figure 4-9).

Figure 4-7. Perennial wetland pond located behind Devils Gate Dam at Hahamango Watershed Park.

Figure 4-8. Freshwater emergent marsh created by restricting tidal flows to historically estuarine system.

Figure 4-9. Seep wetland above Millard Canyon.

Estuarine Wetlands

Coastal wetlands and riparian ecosystems provide critical needs for rare and endangered species and are essential wintering, breeding, feeding and migrating sites. Estuarine wetlands occur over a broad range of physiographic settings including at the mouths of rivers, creeks and canyons, coastal lagoons, embayments, structural basins and at the base of dunes (Figure 4-10 and 4-11).

Figure 4-10. Bolsa Chica Estuary.

Figure 4-11. Seal Beach National Wildlife Refuge in color-infra red imagery.

Lacustrine Wetlands

Lacustrine wetlands include those associated with natural lakes as well as reservoirs. Figures 4-12 through 4-14 illustrate examples of these systems found in the RMC territory.

Figure 4-12. Legg Lake at the Whittier Narrows Recreation Area.

Figure 4-13. Recreational lake behind Santa Fe Dam.

Figure 4-14. Bouton Lake at the Lakewood Golf Course. This lake is also a remenant wetland.

5. SUMMARY

Wetlands and riparian areas were mapped in the 27- 7.5" USGS quadrangle maps found in the RMC territory. This report documents the methods used for mapping and provides a brief summary or "landscape profile" of the wetland and riparian habitat mapped in the RMC territory. A total of 53,139 acres of estuarine, lacustrine and palustrine wetlands and 16,692 acres of riparian habitat were mapped within the study area. 2355 wetland polygons representing 20% percent of the wetlands inventoried were given special modifiers indicating they were either modified or human-made.

It is anticipated that these maps will provide critical data to a host of activities related to the management and restoration of watershed functions, including land use planning, conservation and restoration, expansion of wetland beneficial use protection in Regional Board basin plans and regulation of habitat and water quality impacts from development activities.

The digital maps will be available to the public for downloading at the CSUN Center for Geographic Studies website (www.csun.edu\centerforgeographicstudies) until permanently posted to the US FWS NWI Interactive Mapper Website (wetlandsfws.er.usgs.gov/wtlnds/launch.html).

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APPENDIX 1: COMPARISON OF METHODS TO MAP CALIFORNIA RIPARIAN AREAS A FINAL REPORT

ftp://ftp.sccwrp.org/pub/download/PDFs/519_appendix1.pdf