U.S. Environmental Protection Agency
Region IX

Ballona Creek Wetlands Total Maximum Daily Loads for Sediment and Invasive Exotic Vegetation

"Ballona salt pan, pickleweed and ponded rainwater"
Photograph by Jonathan Coffin

Approved by:

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26 March 2012

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Date

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List of Acronyms

Basin Plan	Water Quality Control Plan
BMP	Best management practices
BWER	Ballona Wetlands Ecological Reserve
CA IPC	California Invasive Plant Council
Caltrans	California Department of Transportation
CCC	California Coastal Commission
CDFG	California Department of Fish and Game
CFR	Code of Federal Regulations
CWA	Clean Water Act
DO	Dissolved oxygen
DPW	Department of Public Works
LA	Load allocations
LARWQCB	Los Angeles Regional Water Quality Control Board
m^3	Cubic meters
MGD	Million gallons per day
MOA	Memorandum of Agreement
MOS	Margin of safety
MS4	Municipal Separate Storm Sewer System
MSL	Mean sea level
NAVD	North American Vertical Datum
NPDES	National Pollutant Discharge Elimination System
PWA	Philip Williams and Associates
Regional Board	California Regional Water Quality Control Board, Los Angeles Region
SLC	State Lands Commission
SoCalGas	Southern California Gas Company
SWRCB	State Water Resources Control Board
TMDLs	Total Maximum Daily Loads
TSS	Total suspended solids
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WDRs	Waste discharge requirements
WLA	Wasteload allocations
WQBELs	Water quality based effluent limitations
WQSs	Water quality standards
yd^3	Cubic yards

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Executive Summary

The Ballona Creek Wetlands are diminishing and deteriorating due to the presence of legacy sediment and invasive exotic vegetation. This has severely impacted the wetland habitats and the wildlife and aquatic organisms dependent on the wetlands. Ballona Creek Wetlands is one of the TMDLs identified on the Consent Decree between USEPA and local environmental groups (Heal the Bay Inc., et al. v. Browner, et al. C 98-4825 SBA, March 22, 1999). The State or USEPA must complete TMDLs for all waterbodies identified on California‟s 1998 303(d) Impaired Waterbody List for the Los Angeles Region by March 24, 2012. These TMDLs address the sediment and exotic vegetation impairments by setting targets to restore a diverse composition of healthy wetland habitats and to eliminate the presence of invasive exotic vegetation that overwhelms the highly sensitive native habitats. These specific goals will ensure water quality standards are met in Ballona Creek Wetlands.

This TMDL covers approximately 600 acres of wetland habitat to match the area identified by the California Coastal Conservancy and California Department of Fish and Game as an ecological reserve of critical importance (the Ballona Wetlands Ecological Reserve). The Ballona Creek Wetlands are located downstream of the Ballona Creek Watershed, sandwiched between Marina del Rey and upstream urban development. This site has been physically impacted by dredge spoils, fill, creek channelization, roads, Marina del Rey, and other modifications to the hydrology of the wetlands. The Ballona Creek Wetlands is the last remaining major coastal wetland in Los Angeles County and lies along the Pacific Migratory pathway, a critical habitat for hundreds of bird species visiting from the Northern and Southern hemispheres.

The critical stressors causing impacts to the Ballona Creek Wetlands are excessive sediment on-site that has raised the mean elevation and buried critical habitat. Excess sediment has also created conditions to support highly invasive exotic vegetation that crowd out native species. Based on a highly detailed hand-drawn historical map of the extent of natural habitats in Ballona Creek Wetlands, specific target habitat acreages for intertidal, subtidal, salt pan, and vegetated marsh[1] were established to achieve a healthy functioning wetland.

Load allocations (LA) for legacy sediment were set at zero and approximately 3.1 million cubic yards of excess sediment have been identified to be removed from the sensitive habitat to restore beneficial uses. The legacy sediment must be removed; however, it can be maintained on site to be reused and support future restoration efforts. This load allocation is assigned jointly to Cooperative Parties that have a stake in the future restoration actions planned for Ballona Creek Wetlands. An existing combined wasteload allocation (WLA) of 58,354 cubic yards per year of

[1] For this TMDL, vegetated marsh refers to multiple habitat types, including salt, brackish, and freshwater marsh.

incoming sediment load is given to the County of Los Angeles and its Co-Permittees, as part of their municipal Separate Storm Sewer System permit. The WLA and LA are set at zero for invasive exotic vegetation species on the California Noxious Weed List or rated as "high" or "moderate" on the California Invasive Plant Council"s Inventory List. For exotic vegetation species rated as "low" on the CA IPC list, the WLA and LA are set at 10% cover.

1 Introduction

The U.S. Environmental Protection Agency (USEPA) Region IX is establishing Total Maximum Daily Loads (TMDLs) for the Ballona Creek Wetlands to address the following impairments: habitat alteration, reduced tidal flushing, hydromodification and exotic vegetation. The State of California identified these impairments and placed the Ballona Creek Wetlands on its Section 303(d) Impaired Waters List in 1996. USEPA concludes the critical stressors causing the above impairments are legacy sediment and invasive exotic vegetation; therefore, USEPA is establishing TMDLs for sediment and invasive exotic vegetation to address habitat alteration, reduced tidal flushing, hydromodification and exotic vegetation.

These TMDLs comply with 40 Code of Federal Regulations (CFR) 130.2 and 130.7, Section 303(d) of the Clean Water Act (CWA) and USEPA guidance for developing TMDLs in California (USEPA, 2000). Information used by USEPA to develop sediment TMDLs to address habitat alteration, exotic vegetation, hydromodification and reduced tidal flushing is summarized throughout this document. USEPA was assisted in this effort by the California Regional Water Quality Control Board, Los Angeles Region (Regional Board). Because an implementation plan is not a required element of a TMDL established by USEPA, these TMDLs do not include an implementation plan to achieve the waste load allocations (WLAs), load allocations (LAs) and water quality standards (WQSs). The Regional Board has the regulatory authority to develop Implementation Plans for TMDLs in its Water Quality Control Plan (Basin Plan).

1.1 REGULATORY BACKGROUND

Section 303(d) of the CWA requires that each State "shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality objective applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in the USEPA Region IX"s Guidance for Developing TMDLs in California (USEPA, 2000). A TMDL is defined as the "sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loads (the loading capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (CWA 303(d)(1)(C) (USEPA, 2000).

States must develop water quality management plans to implement the TMDL (40 CFR 130.6). USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If USEPA disapproves a TMDL submitted by a State, or if a State does not develop a TMDL in a timely manner, USEPA is required to establish a TMDL for that waterbody. The California Regional Water Quality Control Boards (Regional Boards) hold regulatory authority for many of the instruments used to implement the TMDLs, such as the National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

As part of its 1996 and 1998 regional water quality assessments, the LARWQCB identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWQCB, 1996, 1998). These are referred to as "listed" or "303(d) listed" waterbodies or waterbody segments. A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree approved between USEPA and several environmental groups on March 22, 1999 (Heal the Bay Inc., et al. v. Browner, et al. C 98-4825 SBA). Under the consent decree, USEPA must establish these TMDLs by March 24, 2012. For the purpose of scheduling TMDL development, the consent decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units. These TMDLs address all of the waterbody-pollutant combinations in analytical unit 65, which includes habitat alteration, exotic vegetation, hydromodification and reduced tidal flushing impairments for Ballona Creek Wetlands. USEPA is establishing these TMDLs at the request of the Regional Board, and to meet its obligations under the consent decree.

1.2 Elements of a TMDL

Guidance from USEPA (1991) identifies several elements of a TMDL. Sections 3 through 7 of this document are organized such that each section describes one of the elements, with the analysis and findings of these TMDLs for that element. Additionally, implementation and monitoring recommendations are provided in Section 8. TMDL sections are as follows:

- **Section 3: Problem Identification.** Presents the data used to add the waterbody to the 303(d) list, and summarizes existing conditions using that evidence along with any new information acquired since the listing. This element identifies portions of the waterbody that fail to support all designated beneficial uses; the criteria designed to protect those beneficial uses; and, in summary, the evidence supporting the decision to list, such as the number and severity of impact observed.
- **Section 4: Numeric Targets.** Sets numeric targets based upon the water quality standards (WQS) described in the Los Angeles Region Water Quality Control Plan (Basin Plan).

- **Section 5: Source Assessment.** Describes and identifies the potential point sources and nonpoint sources of sediment and impact to the Ballona Creek Wetlands.
- **Section 6: Linkage Analysis.** Provides an analysis of the relationship between sources and the receiving water quality impairment. The linkage analysis addresses the critical conditions, loading, and water quality parameters. Allocations are designed to protect the waterbody from conditions that exceed the applicable numeric target. The allocations are based on critical conditions to ensure protection of the waterbody under all conditions.
- **Section 7: TMDLs and Pollutant Allocations.** Identifies the quantitative load or in this case, the necessary numeric habitat proportions and tidal elevations that need to be achieved to ensure protection of the identified beneficial uses in Ballona Creek Wetlands.
- **Section 8: Implementation.** Not considered a required element of a TMDL established by USEPA; contains recommendations to the State regarding implementation and monitoring for this TMDL.

2 Wetland Characteristics

In California, the total wetland loss is estimated at 4.6 million acres, which is approximately 91% of the acreage present before European settlement; these wetland losses is directly attributable to human activities (CCC 1994). A large variety of activities have caused the dramatic loss and alterations of wetlands in California. These include agricultural use and development; residential development; commercial and industrial development; oil and gas development; roads, highways and railways, port and marina development and flood control. All of these activities have led to dredging and filling of wetlands, removal of vegetation, increased sediment discharge into wetlands, and exposure to polluted runoff.

2.1 Environmental Setting

The Ballona Creek Wetlands are located in Southern California at the western edge of the Los Angeles Metropolitan area. To the south of the wetlands are the Westchester and Playa del Rey bluffs, to the northwest is Marina Del Rey and to the north lie the towns of Vista del Mar and Culver City. The wetlands are completely surrounded by the highly urbanized metropolitan area of Los Angeles and other cities upstream (Figure 1).

The Ballona Creek Wetlands are currently located within the area identified as the Ballona Wetlands Ecological Reserve (BWER), which is located at the mouth of Ballona Creek in west Los Angeles, California (Figure 2). The Ballona Creek Wetlands encompass approximately 600 acres and is the last remaining major coastal wetland in the Santa Monica Bay. At one time over 2000 acres, the site has been impacted by fill, creek channelization, and development of roads, railways, a marina, natural gas infrastructure, housing and businesses. The Ballona Creek Wetlands are comprised of salt marsh and freshwater wetlands, coastal bluffs, dunes, and upland habitats. The site supports several state- and federally-listed species of concern. The Ballona Creek Wetlands lies along the Pacific Migratory Pathway and hosts bird species from the Northern and Southern hemispheric extremes.

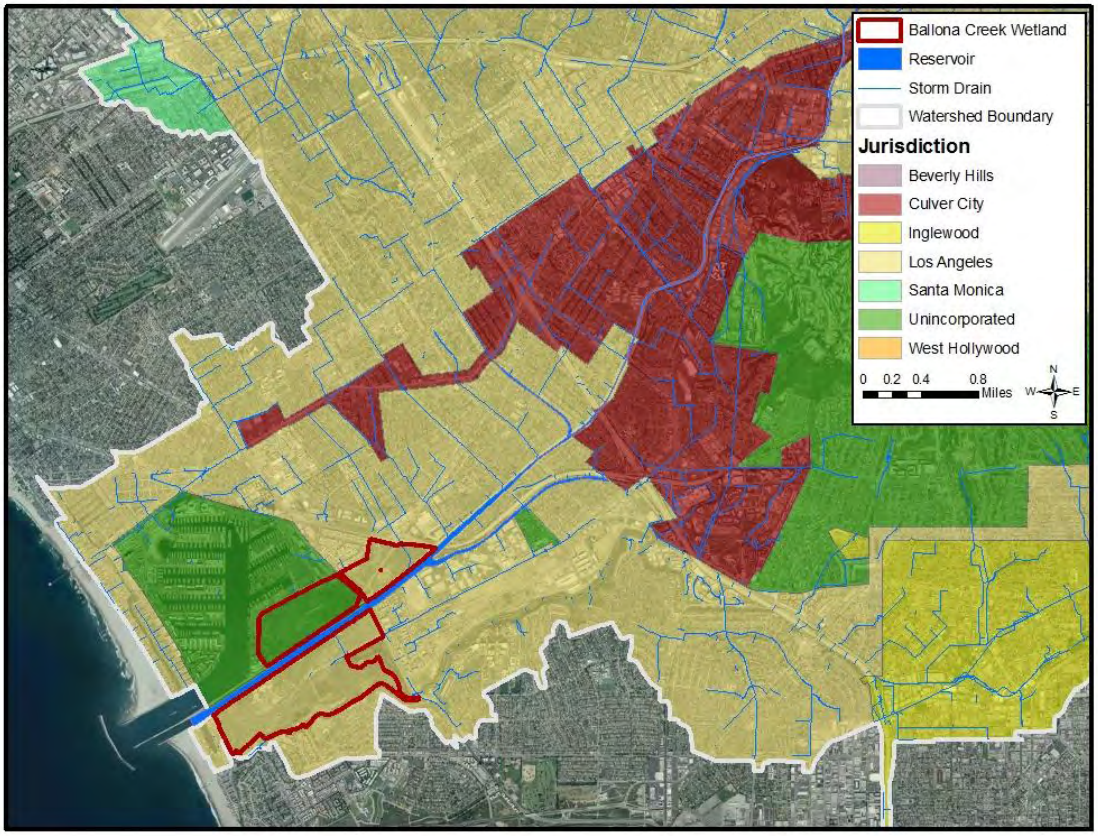

Figure 1. Map of Ballona Creek Wetlands and the major cities draining the Ballona Creek Watershed. Marina del Rey is shaded green and north of Ballona Creek Wetlands.

The Ballona Creek Wetlands, lying to the south of Marina Del Rey and Ballona Creek, currently includes tidal salt marsh receiving muted tidal flows and freshwater habitat receiving seasonal flow. It is the last remaining major coastal wetland in Los Angeles County (West, 2001). Extensively developed urban areas surrounding the wetlands, as well as many other human activities have significantly impacted the wetlands. Historically, rail and roadways have fragmented the wetlands since the 1800"s. In 1937, the US Army Corps of Engineers (USACE constructed the Ballona Creek flood control channel that diverted water from the creek straight to the Santa Monica Bay, thus severely limiting tidal flow to the salt marsh. Today, the water entering the wetlands is mainly from Ballona Creek via a single tide gate and from Marina del Rey into Fiji Ditch. Other sources of freshwater would include intermittent flows of runoff from residential areas on the southern bluffs and storm runoff from Culver Boulevard flowing through the wetland area (PWA, 2006). In 2004, the State of California took title to approximately 600-acres of the wetlands consisting of three areas (Figure 2) with Area B encompassing the main saltwater marsh. Funding for the acquisition was provided by the Wildlife Conservation Board and the State Coastal Conservancy. The property is owned by the State Lands Commission (SLC) and managed by the California Department of Fish and Game (CDFG). A third agency, the California State Coastal Conservancy, has funding for developing a plan to restore the wetlands to a more natural condition. Together, the three agencies are working with a large group of stakeholders and other agencies to develop and implement the restoration plan. The Conservancy provides funding for the planning effort and manages the work plan, budget, and schedule. As the landowner, CDFG will be the applicant for any permits needed for the restoration project and the lead agency for purposes of CEQA. Planning is being conducted within the wider framework of the Ballona Creek Watershed, incorporating adjacent and ecologically related resources. (Dorsey & Berquist 2007).

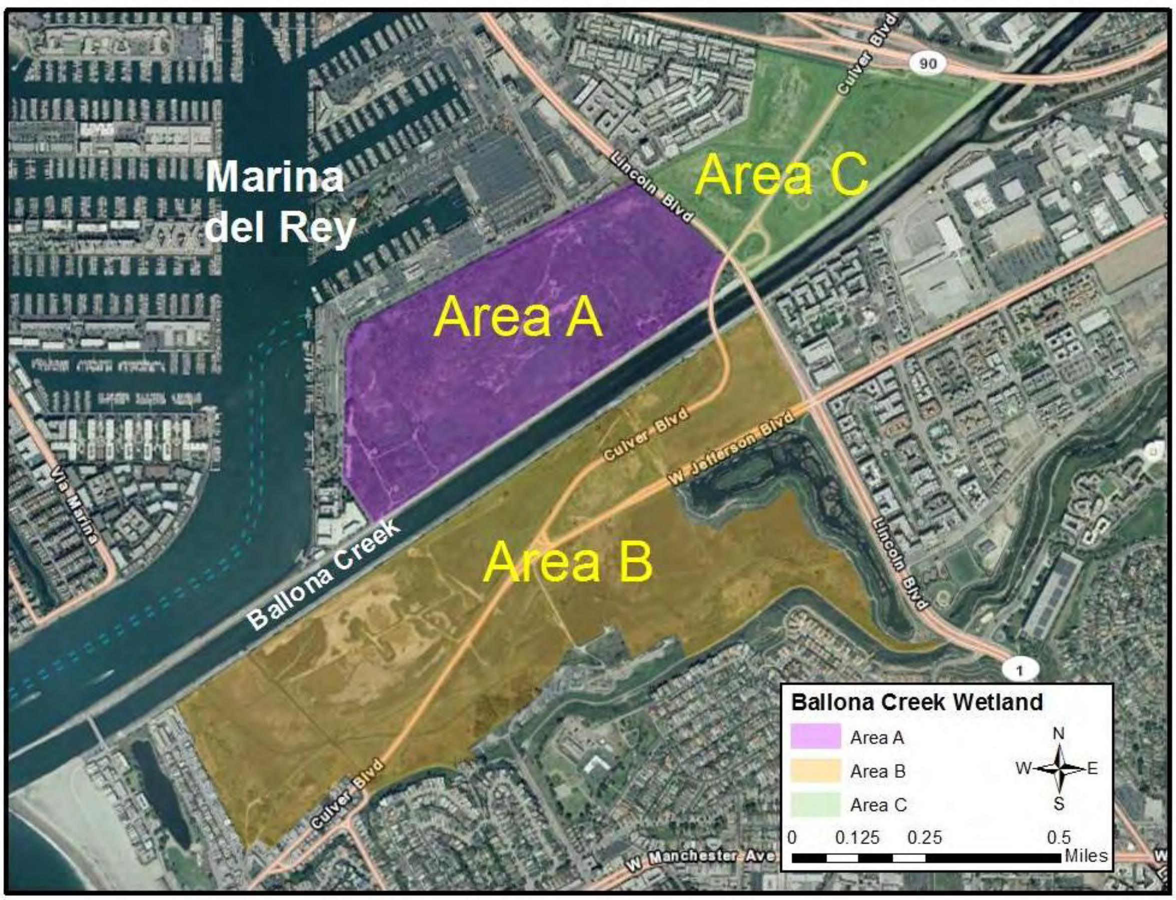

Figure 2. Map of Ballona Creek Wetlands, Ballona Creek and Marina Del Rey. Ballona Creek Wetlands is shaded in green.

2.2 WETLAND AREAS

Due to the impacts of anthropogenic activities in the past, the current delineation of Ballona Creek Wetlands is divided into three primary areas, each with distinct characteristics and history. Ballona Creek Wetlands is composed of Areas A, B, and C. CDFG has informed USEPA that it owns 523 acres and that SLC owns 60 acres in the Ballona Wetlands area (See CDFG Comment Letter , January 26, 2012). Of the 60 acres owned by SLC, 24 acres are included in Ballona Wetlands Ecological Reserve (named the Expanded Wetlands parcel), resulting in a total of 547 acres. The remaining 36 acres owned by SLC is the Freshwater Marsh mitigation site constructed for the Playa Vista Development to the east, and is not part of the Ballona Wetlands Ecological Reserve. The Expanded Wetlands parcel is under lease from SLC to CDFG and is included in the Ballona Creek Wetlands. USEPA has calculated that the area encompassed by the Ballona Wetlands Ecological Reserve is approximately 626 acres, of which an estimated 85 acres are roads, levees, parking lots and other structures, and the remaining 541 acres are open water, wetlands and uplands within Areas A, B, and C.[2] See Section 3.4 and Table 5.

2.2.1 Area A

Area A is approximately 139 acres in size and lies north of Ballona Creek, west of Lincoln Boulevard and south of Fiji Way (Figure 2). Elevations range between approximately nine and 17 feet relative to mean sea level (MSL); fill was placed on Area A during the excavations of Ballona Creek and Marina Del Rey. Area A is undeveloped with the exception of a parking area along the western boundary and a drainage channel along the northern boundary. In addition, the Southern California Gas Company (SoCalGas) currently maintains five monitoring well sites in the western end of this area (Ballona Creek Wetlands Existing Conditions Report, 2006).

2.2.2 Area B

Area B, approximately 338 acres in size, lies south of Ballona Creek and west of Lincoln Boulevard. Area B extends south to Cabora Drive, a utility access road near the base of the Playa Del Rey Bluffs (Figure 2). To the west, Area B extends into the dunes that border homes along Vista Del Mar. Elevations across Area B range between approximately two and five feet MSL in the lower flat portions, and up to 50 feet MSL below the Del Rey Bluffs. Area B contains the largest area of remnant unfilled wetlands with abandoned agricultural lands to the southwest, and the Freshwater Marsh to the northeast. The SoCalGas Company has easements for 12 well sites (1 injection/withdrawal well and 11 monitoring wells) that support access routes in Area B (Ballona Creek Wetlands Existing Conditions Report, 2006). The 24-acre Expanded Wetlands parcel owned by SLC and managed by CDFG is included in Area B.

[2] There are small differences in the total acreage calculations due to uncertainties inherent in interpreting maps at this scale, estimating boundaries between ground features, and rounding of calculated estimates.

2.2.3 Area C

Area C is to the east of A and contains baseball fields and associated minor structures with more than half of the remaining area being undeveloped. Area C is north of Ballona Creek and east of Lincoln Boulevard in the City of Los Angeles (Figure 2). The Marina Freeway forms the northeastern border of Area C. The area is approximately 64 acres in size and is traversed in an east-west direction by Culver Boulevard. Area C contains fill from the construction of the Ballona Creek flood control channel, and developments such as Marina Del Rey, the Pacific Electric Railroad, the raising of Culver Boulevard and the Marina Freeway. Elevations within Area C range from approximately 4.5 to 25 feet MSL. Area C is mostly undeveloped with the exception of the ball fields and supporting minor structures (Ballona Creek Wetlands Existing Conditions Report, 2006). SoCalGas Company has no facilities in Area C.

2.2.4 Constructed Freshwater Marsh

The Freshwater Marsh is not part of the Ballona Wetlands Ecological Reserve and sits west of Lincoln Boulevard and south of Jefferson Boulevard, adjacent to Area B in the City of Los Angeles (Figure 2). The Freshwater Marsh was constructed between 2001 and 2003. The Freshwater Marsh treats urban runoff and stormwater from the Playa Vista development (central inlet) and from Jefferson Boulevard (Jefferson inlet). It is operated and managed by the Ballona Wetlands Conservancy, a non-profit organization established for that purpose. A riparian corridor east of Lincoln Boulevard and outside of the project area connects to the southern end of the Freshwater Marsh (Ballona Creek Wetlands Existing Conditions Report, 2006). The Freshwater Marsh maintains its own treatment.

2.2.5 Ballona Creek Channel

The channel is trapezoidal, with bottom widths varying from 80 to 200 feet and depths varying from 19 to 23 feet from the top of the levee. The side slopes are lined with concrete, paving stones and riprap; the channel bottom is not armored. Culverts with flap gates allow only limited amounts of sea water into the marsh via Ballona Creek. There are two self-regulating tide gates and one flap gate that lead to Area B. Area B receives the greatest amount of tidal water, but tidal range rarely exceeds one meter. Fiji Ditch, a drainage ditch on the northern border of area A and connected by a culvert to Marina del Rey, does get tidal exchange, but only within the ditch itself; exchange does not impact the surrounding habitat areas.

2.3 PHYSICAL CHARACTERISTICS

The physical characteristics of a wetland are complex and include the geographical setting of the area, in addition to the habitat types, soil saturation, tidal flushing, freshwater inputs, salinity, tidal elevation. These are some of the most critical components that help define a wetland.

2.3.1 Habitat, Flora, Fauna

Wetlands are loosely defined as lands that are covered by shallow water or by water part of the time. They include prairie potholes, vernal pools, bogs, fens, swamps, marshes, floodplains, and shallow lakes. Some are coastal (brackish or salt) and some are inland (usually freshwater). For regulatory purposes under the Clean Water Act, the term wetlands means "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." Wetlands are often incredibly rich in wildlife, partly because of the complexity of the habitat and partly because of the abundant nutrients provided by runoff from the land.

Tidal (coastal) marshes occur along coastlines and are influenced by tides and often by freshwater from runoff, rivers, or ground water. Salt marshes are the most prevalent types of tidal marshes and are characterized by salt tolerant plants such as smooth cord grass, saltgrass, and glasswort. Salt marshes have one of the highest rates of primary productivity associated with wetland ecosystems because of the inflow of nutrients and organics from surface and/or tidal water. Tidal freshwater marshes are located upstream of estuaries. Tides influence water levels but the water is fresh. The lack of salt stress allows a greater diversity of plants to thrive. Cattail, wild rice, pickelweed, and arrowhead are common and help support a large and diverse range of bird and fish species, among other wildlife (USEPA 2001).

The State-listed endangered Belding‟s savannah sparrow *(Passerculus sandwichensis beldingi)* resides in the Ballona Creek Wetlands. The Federal and State listed endangered California least tern *(Sterna antillarum browni)* breeds on nearby Venice Beach (within a fenced reserve area) and forages in the lagoons and channels of the Ballona wetlands. Other listed species that do not breed in the area but forage in the Ballona wetlands include the Federal listed threatened western snowy plover *(Charadrius alexandrinus nivosus)*, and the State listed endangered American peregrine falcon *(Falco peregrinus anatum)* (for more extensive list, see Section 3.2.1.1.2).

2.3.2 Wetland Hydrologic Processes

The Ballona Creek Wetlands are bisected by a channelized and armored portion of Ballona Creek, with limited hydrologic connection to the adjacent historic floodplains, tidal and freshwater flow; the presence of tide gates at various points along Ballona Creek allow muted tidal flows into the Wetlands. Ballona Creek Wetlands receive flows from Ballona Creek including surface runoff and groundwater inputs from the entire watershed, through a tide gate in the south levee of Ballona Creek, direct runoff from the bluffs along the southern border of the wetlands, overflow runoff from Playa Vista Development as well as parts of Jefferson and

Lincoln Boulevards. Water from the Freshwater Marsh flows through a culvert at its northern end, under Jefferson and Culver Boulevards, and out to Ballona Creek during large storm events.

2.4 HISTORICAL WETLAND CONDITION

California has lost over 90% of its wetlands, more than any other state. Birds wintering in California's wetlands have declined from 60 million to 2 million, largely because of the destruction of this habitat (Bryant 2003). Based on Shreiber‟s (1981) study, approximately 2,120 acres made up a part of the greater Ballona Wetland marsh complex at one time. Since a significant proportion of naturally functioning wetlands have been lost in California, and perhaps, even more so in southern California, it was difficult to find comparable conditions from similar coastal wetlands. Consequently, this TMDL assessed the natural conditions of a functioning wetland by considering the historical ecology and hand drawn maps of Ballona Wetlands and the Southern California wetlands. These maps provide the basis for supporting the designated uses expected from a naturally functioning coastal wetland.

The historic hydrologic condition of Ballona Wetlands was highly dynamic, as characteristic of all Southern California coastal wetlands. Ballona Wetlands were likely influenced by both freshwater and tidal flows, and maintained both open and closed connections to the ocean as a function of the annual precipitation and other watershed variables. Some evidence suggest that approximately half of the larger Ballona Wetland complex historically experienced freshwater and tidally affected saltmarsh and brackish habitats that transitioned into a more freshwater system about 1.5 miles inland (Dark et al. 2011). One of the most comprehensive and detailed source of evidence documenting the wetland condition of the Ballona Wetlands are the presence of hand drawn T-Sheet maps describing the specific habitats and hydrologic conditions in the Wetland.

2.4.1 Historical T-Sheet Maps

From 1851-1900, the US Coast Survey produced maps of coastal features at a large scale (1:10,000) which were referred to as T-sheets. They depict the distribution and abundance of different wetland habitat types along the coast of southern California prior to major coastal development by Europeans. The T-sheets were difficult to access in the past because of their accessibility via the National Archives and the lack of high-quality digital reproductions. Recently, historical ecology scientists were able to obtain high-quality digital reproductions, and interpret the original T-sheets with the aid of other historical texts and drawings to provide reliable data on historic wetland habitat types. This report, "Historical Wetlands of the Southern California Coast: An Atlas of US Coast Survey T-sheets, 1851-1889" provided a rare and invaluable source of information for evaluating the habitats of a once natural functioning wetland in Ballona (Figure 3).

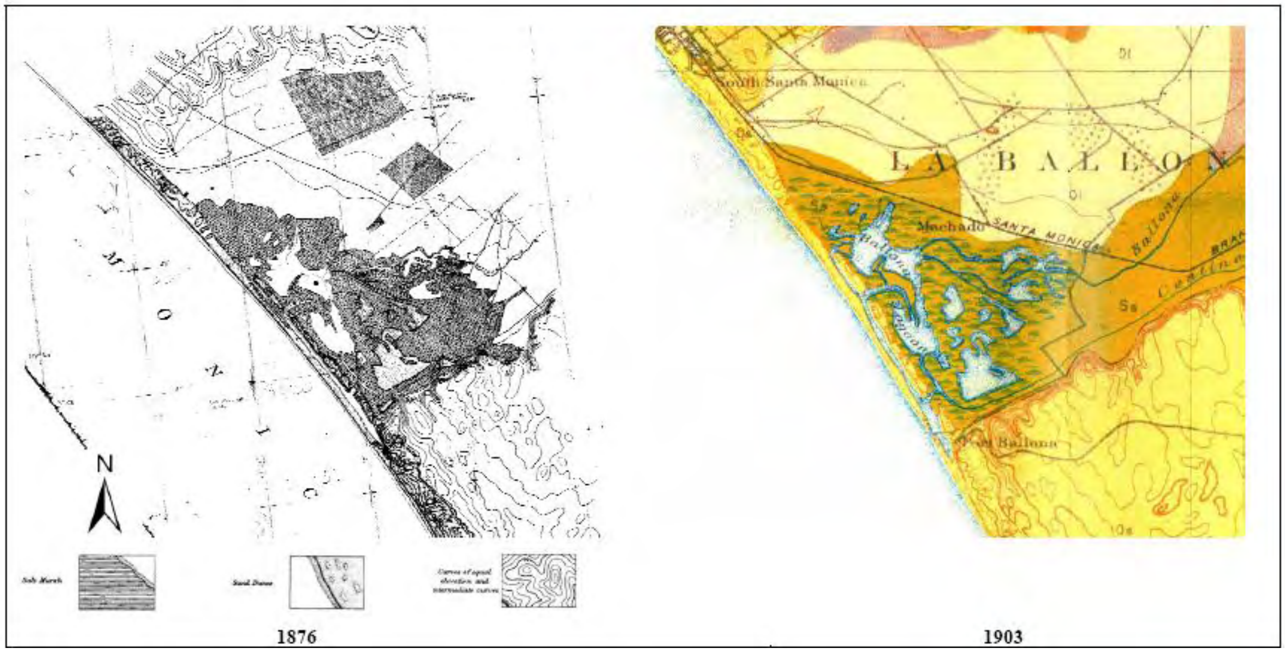

Figure 3. Map of Ballona Creek Wetlands in 1876 and 1903 (PWA, 2006). The source of maps are from the U.S. Coast Survey, 1876 "Topography from West Beach to Vicinity of Santa Monica" and USGS Quad and Soil Survey, 1903

The T-sheets demonstrate that current southern California coastal wetlands are greatly reduced in size. At the current Ballona Creek Wetlands, only about 600 acres of open space remain where a 2000+ acre wetlands complex once existed (Figure 4). The full wetlands complex included a variety of habitat types that were interdependent, i.e., ecological function depends on the presence of different habitat types and in different proportions.

Figure 4. Map of historical extent of the Ballona Creek Wetlands complex.

To achieve beneficial uses at Ballona Creek Wetlands, the historic wetlands habitat diversity should be re-established so that interdependent ecological functions are restored on the site. The T-sheet data were used to document the proportions of different habitat types that existed prior to major impacts from human activities. The analysis includes data from Ballona Creek Wetlands and other historically similar wetlands, i.e. those defined in the T-sheets atlas as tidal marsh-tidal flat dominant wetland systems. These included Ballona Creek Wetlands, Seal Beach, Bolsa Chica, Carpinteria, Newport Bay, Alamitos Bay, Tijuana Estuary and Mugu Lagoon. Data on each habitat type from each of these wetlands were pooled and an average value was calculated, to obtain average proportions of each habitat type in historical tidal marsh-tidal flat wetlands in southern California.

The use of these maps does not negate the possibility that other habitat vegetation, habitat extent and hydrologic conditions may have occurred. Instead, the T-Sheet maps provide the best available defined and quantitative information, reflecting a period in which the wetlands were functioning naturally. Consequently, it is appropriate to use this source as a point of reference.

2.5 HISTORICAL USE

During the late 1800's the wetland area was used by several hunting lodges and resorts. Rail lines were constructed through the marsh in the 1880's and roadways were built in 1900 and 1910. Oil and gas exploration and production began in the 1930's and in 1934 Ballona Creek was channelized to the ocean. The wetland acreage was greatly reduced with the construction of Marina Del Rey in the 1960's.

From the middle of the 1800's, farming began replacing cattle ranching. Urban development began in the early 1900's catering to recreational activities in the area of Venice Beach. By 1924 the area to the west and northwest had become a densely developed part of the greater metropolitan Los Angeles area. In addition, real estate developments in Venice and Playa del Rey began encroaching into the wetland region. The channelization of Ballona Creek in 1935 caused limited flow to the wetlands and lagoons, drying them up. Between 1930s to 1950s, oil derricks were built throughout the wetland areas causing them to be diked, drained or developed into artificial ponds. The development of Marina del Rey in the late 1950s removed a large portion of the remaining wetlands. As a result, the wetlands shrank to less than 200 acres, about 10 percent of the original area (Ballona Creek Task Force, 2004).

As many reports and assessments have determined, the precise extent of Ballona Creek Wetlands is complex. Until about 2004, only the undeveloped Area B (south of Ballona Creek and north of Culver Boulevard) was traditionally identified as the Ballona Creek Wetlands. The construction of tide gates between the late 1990's to early 2000 restored some tidal flushing to the central portion of Area B. In 2001, the State of California retained Area C (north of Ballona Creek and east of Lincoln Boulevard) as part of a tax settlement. Area C is composed of fill material deposited during construction of Marina del Rey. After extensive local environmental battles, a Freshwater Marsh was completed in 2008 (south of Jefferson Boulevard and west of Lincoln Boulevard), where storm water runoff from the Playa Vista development and Jefferson Drain is discharged. The State of California recently purchased 483 acres, which is planned for expanding the wetland area for restoration (Figure 5). Please see Section 2.2 for more description of the Wetland acreage and ownership.

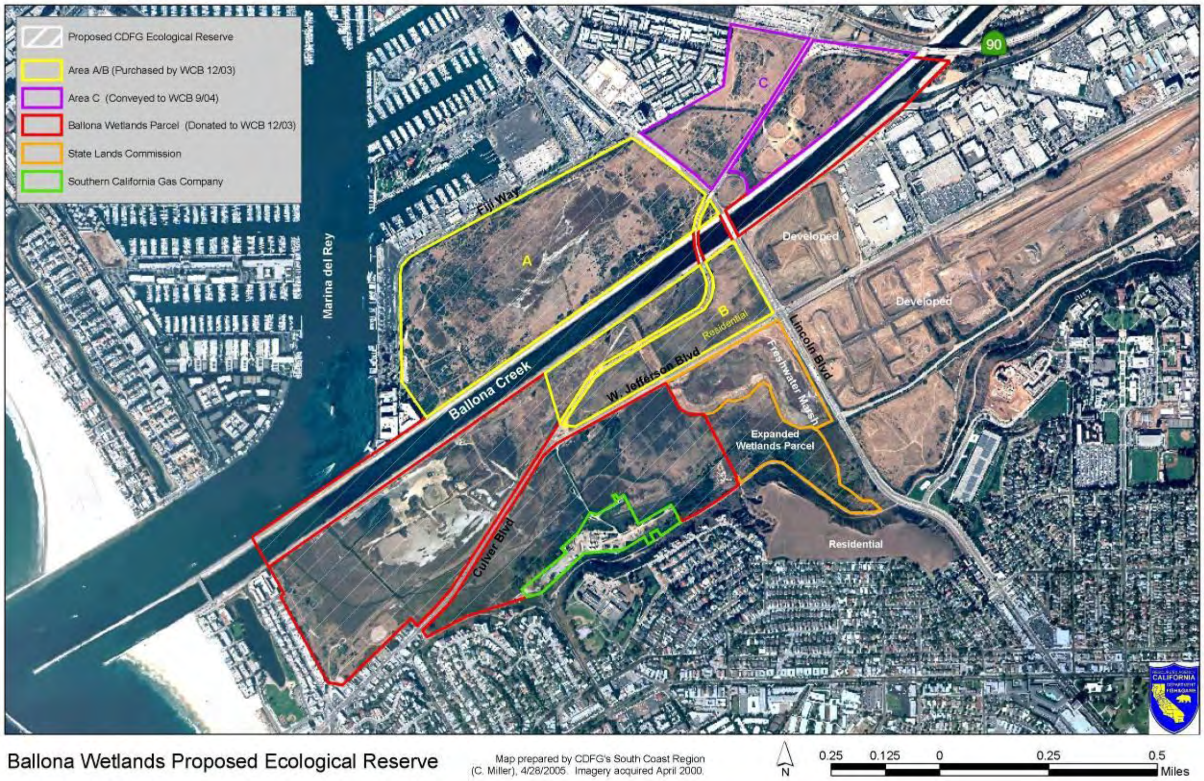

Figure 5. Map of Ballona Creek Wetlands Acquisition status (CA Department of Fish and Game).

Due to the varied modification of the wetland region, invasive exotic species have limited the extent of native vegetation. The history of development have also greatly reduced the extensive network of tidal lagoons (Figure 6), leaving only Ballona Lagoon (which provides a water connection to the Venice Canals) and Del Rey Lagoon, south of the Ballona Creek channel. Tidal flushing to both lagoons is constrained to reduce high water during flood events (Ballona Creek Task Force 2004). The report completed by the Ballona Creek Task Force (2004) further states that "the lack of tidal flushing in the lagoons and associated water bodies, and poor water quality in Marina del Rey and Ballona Creek, limits the number and diversity of fish, birds, and other creatures supported by these aquatic habitats. The discharge of stormwater and urban runoff from Ballona Creek into Santa Monica Bay reduces water quality and clarity within the nearshore areas of the bay and results in the deposition of sediment (with varying toxicity) at the mouth of the creek."

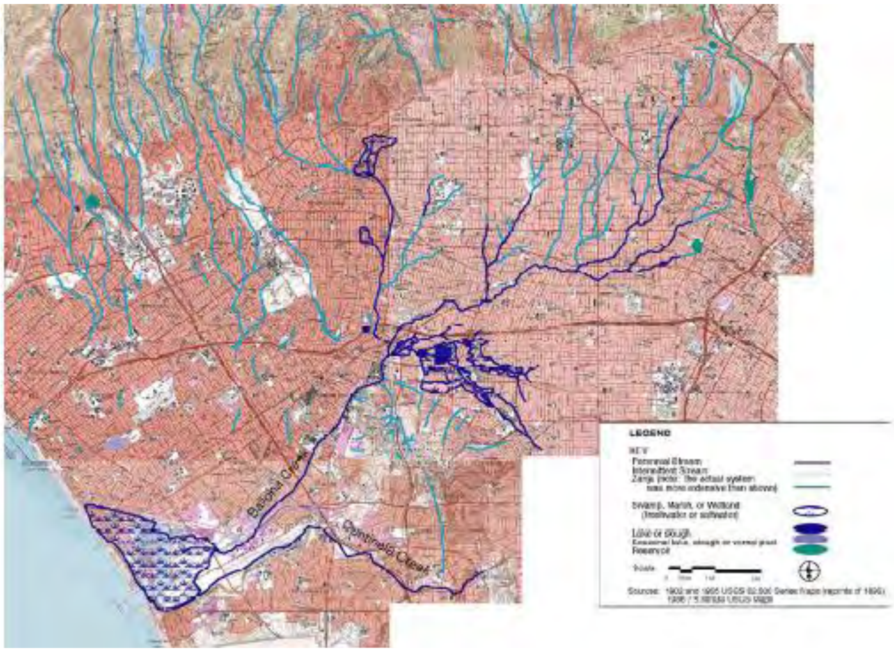

Figure 6. Historic Ballona Creek Watershed Drainage Area Overlap Map, 1896 and 1986. (Braa et al. 2001).

2.6 NATIVE AMERICAN CULTURAL RESOURCE

According to the Gabrielino Tongva tribe, portions of the Ballona Creek Wetlands are considered a State registered sacred site, known as the Saangna area (Personal Communication, Johntommy Rosas). It is USEPA‟s understanding that this State recognized tribe is currently working with the State (i.e., California State Coastal Conservancy) to address issues related to cultural resources on site.

2.7 SUMMARY OF PAST IMPACTS

Beginning about 200 years before present, human actions caused significant changes in the size and functions of coastal wetlands at Ballona. An overlapping series of anthropogenic changes to the Ballona Creek Wetlands have cumulatively had an enormous effect on the landscape and hydrology of the area (Table 1). The overall effect has been extensive burial and shifting of natural habitats and reduction of tidal influence throughout the Ballona Creek Wetlands, with the exception of muted tidal flows through a self-regulating tide gate, and a large reduction in freshwater flooding of the wetlands.

Table 1. Summary of anthropogenic activities to the Ballona Creek Wetlands since 1900. Areas A, B, C and D refer to contemporary designations within the Ballona Creek Wetlands.

Time period	Anthropogenic Activity	Impact
Early 1900s	Pacific Electric railroad tracks built on earthen berms altered tidal flows in areas A, B and C	Sediment deposition; habitat alteration; reduced tidal flushing
1918	Lincoln and Jefferson Blvds. were constructed, and flows from eastern portions of wetlands routed into culverts under Culver Blvd. in area B	Sediment movement; habitat alteration; reduced and/or restricted freshwater flows
1920s	Fill was dumped in several places to construct oil and gas drilling platforms and protect them from extreme tides, and to build berms for access roads for the platforms; SoCalGas Company Rd. in Area B especially restricts flows from the east, and platforms and access roads in Area A created depressions where water continues to pond sporadically	Sediment deposition; habitat alteration; reduced tidal flushing and/or restricted freshwater flows
1930-1958	Farming of lima beans and barley in Areas B (east of SoCalGas Company Rd.) and C resulted in filling of many natural tidal channels	Sediment deposition and transport; habitat burial
1930s	Ballona Creek was straightened and channelized in concrete levees by the USACE; culverts with flap gates allowed drainage from Area B but prevented tidal inflows (except when gates malfunctioned)	Sediment deposition; habitat alteration; reduced and/or restricted freshwater flows and tidal flushing
1950s-60s	Centinela Ditch was excavated through Area B before 1950, directing freshwater flows from east of Lincoln Blvd. along the south border of the wetlands area. In 1962, Centinela Creek was fully channelized in concrete and diverted to Ballona Creek channel at Centinela Ave., at the then-eastward extent of the remaining wetlands.	Sediment deposition and removal; reduced and/or restricted freshwater flows
1960s	The southwest portion of the extant wetlands in 1960 was dredged to create Marina Del Rey. The dredged mud was deposited on what is now Area A, and raised the land surface 12 – 15 feet above previous mean sea level.	Sediment deposition; reduced tidal flushing
1950s-present	Urbanization of surrounding land has increased volume of storm runoff, while burying and channelizing of natural streams has confined the routes of stormwater runoff into and through the wetlands to very few concrete or straightened man-made channels.	Sediment deposition, transport; habitat buried; reduced and/or restricted freshwater flows
2003	A Freshwater Marsh was constructed along Lincoln Blvd. in Area B, as a stormwater treatment wetland to mitigate impacts of development in Area D; this diverted flows from Centinela Ditch and local streets through the constructed marsh and directly to Ballona Creek channel, away from the rest of Area B.	Reduced and/or restricted freshwater flows
2003	Flap gates in the south levee of Ballona Creek channel, which allowed no tidal influence, were replaced with self-regulating tide gates, which allow a muted tidal regime in Area B.	Reduced tidal flushing

3 Problem Identification

Ballona Creek Wetlands is listed as impaired for habitat alteration, hydromodification, reduced tidal flushing, and exotic vegetation on the State‟s Section 303(d) Impaired Waters List (SWRCB, 2010).

This section reviews the listing status of the Ballona Creek Wetlands, includes a description of the applicable water quality standards for the Ballona Creek Wetlands, the causes of the water quality impairments, the biological and hydrological responses to the impairments, and summarizes the existing conditions of the Ballona Creek Wetlands.

The State has referred to and named this wetland area in their administrative documents (e.g., State‟s biannual Clean Water Act Section 303(d) List of Water Quality Limited Segments Reports and associated documents) as the "Ballona Wetlands" or "Ballona Creek Wetlands". This TMDL is established for the wetland area identified as either "Ballona Wetlands" or "Ballona Creek Wetlands". For reasons of consistency, this document will refer to the impaired wetland area as Ballona Creek Wetlands.

This TMDL defines Ballona Creek Wetlands as the area encompassing the Ballona Wetlands Ecological Reserve (BWER), rather than the entire existing and historical greater Ballona Wetlands complex. Based on available data, historical ecology, relevant studies and monitoring results for Ballona Creek Wetlands, USEPA has determined that all wetland habitats within the 626 acres of the BWER are impaired. This corresponds with the State‟s goal of returning the area identified as the Ballona Wetlands Ecological Reserve "into a thriving ecological reserve…to create a diverse, resilient, and dynamic ecosystem" that can support the intrinsic structure and function, and recovery of native species in the Wetlands[3]. Figure 7 shows a map of the Ballona Wetlands Ecological Reserve that reflects the land area owned by the State and managed by the CDFG.

[3] The State of California owns Ballona Creek Wetlands and the California Department of Fish and Game manages the Wetlands as a State ecological reserve. The California Coastal Conservancy and California State Lands Commission are partners in planning efforts to restore the Wetlands.

Figure 7. California Department of Fish and Game's delineation of the Ballona Creek Wetlands Ecological Reserve, Los Angeles County.

3.1 WATER QUALITY STANDARDS

In accordance with the Clean Water Act (CWA), TMDLs are set at levels necessary to achieve the applicable water quality standards. Under the federal CWA, water quality standards consist of designated uses, water quality criteria to protect those uses, and an antidegradation policy. California similarly defines beneficial uses, water quality objectives, and state antidegradation policy in the Basin Plans of each Regional Board. The Basin Plan describes numeric and narrative water quality objectives for beneficial uses in the Los Angeles Region (LARWQCB, 1994). This section describes the State"s water quality standards applicable to the Ballona Wetland TMDLs.

3.1.1 Beneficial Uses

The Los Angeles Region Basin Plan designates beneficial uses for water bodies in the Los Angeles Region, where the uses are recognized as existing (E), intermittent (I), or potential (P) uses. According to the Water Quality Control Plan for the Los Angeles Region (the Basin Plan)

(LARWQCB, 1994), the designated beneficial uses for Ballona Creek Wetlands include (Table 2):

EST – Estuarine Habitat. Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

MIGR – Migration of Aquatic Organisms. Uses of water that support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.

RARE - Rare, Threatened, or Endangered Species. Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

REC1 - Water Contact Recreation. Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, waterskiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

REC2 - Non-contact Water Recreation. Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

SPWN - Spawning, Reproduction and/or Early Development. Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

WET - Wetland Habitat. Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

WILD - Wildlife Habitat. Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Table 2. Beneficial use designations for Ballona Creek Wetlands, Hydrologic Sub Area 405.13 (LARWQCB 1994).

Beneficial Use	Designation
EST	Existing
MIGR	Existing[f]
RARE	Existing[e]
REC-1	Existing
REC-2	Existing
SPAWN	Existing[f]
WET	Existing
WILD	Existing

e One or more rare species utilize all ocean, bays, estuaries, and coastal wetlands for foraging and/or nesting.
f Aquatic organisms utilize all bays, estuaries, lagoons and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas which are heavily influenced by freshwater inputs.

3.1.2 Water Quality Objectives

The Los Angeles Regional Board Water Quality Control Plan states that coastal waters, such as that of Ballona Creek Wetlands, are often impacted by a variety of activities including "…dredging, increased development and loss of habitat…" (LARWQCB, 1994). The Basin Plan includes clearly defined narrative water quality objectives designed to protect the designated beneficial uses. This TMDL addresses the water quality objectives for wetland, exotic vegetation, and solid, suspended or settleable materials:

The narrative objective for **Wetlands** includes hydrology and habitat components:

Hydrology
Natural hydrologic conditions necessary to support the physical, chemical, and biological characteristics present in wetlands shall be protected to prevent significant adverse effects on:
Natural temperature, pH, dissolved oxygen, and other natural physical/chemical conditions,
Movement of aquatic fauna
Survival and reproduction of aquatic flora and fauna, and
Water levels.

Habitat
Existing habitats and associated populations of wetlands fauna and flora shall be maintained by:
Maintaining substrate characteristics necessary to support flora and fauna which would be present naturally,
Protecting food supplies for fish and wildlife,
Protecting reproductive and nursery areas, and
Protecting wildlife corridors

Exotic Vegetation
Exotic (non-native) vegetation introduced in and around stream courses is often of little value as habitat (food and cover) for aquatic-dependent biota. Exotic plants can quickly out-complete native vegetation and cause other water quality impairments. Exotic vegetation shall not be introduced around stream courses to the extent that such growth causes nuisance or adversely affects beneficial uses.

Solid, Suspended, or Settleable Materials:
"Surface waters carry various amounts of suspended settleable materials from both natural and human sources. Suspended sediments limit the passage of sunlight into waters, which in turn inhibits the growth of aquatic plants. Excessive deposition of sediments can destroy spawning habitat, blanket benthic (bottom dwelling) organisms, and abrade the gills of larval fish. *Waters shall not contain suspended or settleable materials in concentrations that cause nuisance or adversely affect beneficial uses."*

3.1.3 Ecologically Functioning Wetland

In order to meet water quality standards, Ballona Creek Wetlands must be an ecologically functioning wetland. The definition of an ecologically functioning coastal wetland is based on the designated uses defined in the State‟s Basin Plan for Ballona Creek Wetlands, studies and evaluations of other similar work on wetlands (Bedford 1999; Mitsch 1998; Streever 1999; Zedler 1999 and 2000; Ballona Creek Wetlands Restoration Plan (2006)[4]).

The beneficial uses describe the need for the wetland to support a natural range of habitats and functions, especially as related to estuarine dependent plants and animals. This section describes the characteristics of an ecologically functioning wetland that would support the hydrology, physical, chemical, and biological features critical to maintaining a healthy flora and fauna. A healthy wetland should maintain a diverse habitat that is historically associated with Ballona Creek Wetlands and other similar wetlands in the Southern California region. An ecologically functioning wetland supporting the designated beneficial uses should aim to have a diverse composition of habitats, adequate tidal inundation and maintain the substrate characteristics necessary to support flora and fauna; these should include considerations of elevation, hydroperiod and salinity. This is critical to supporting aquatic life health, including fish and benthic organisms. For Ballona Creek Wetlands to support wetland and aquatic health, it is necessary to increase the diversity and population of plant and animal species, which is directly dependent on the physical habitat structure health, and the tidal and freshwater flows.

[4] The goals for achieving an ecologically functioning coastal wetland is based on the extended evaluation and recommendations of the Ballona Creek Wetlands Restoration Scientific Advisory Committee.

The condition of wetlands and the consequences of future restoration activities are strongly reflected in hydraulic, topographic, and edaphic (soil) variables. These variables, in turn, exert a strong influence on and are modified by a variety of biological variables such as vegetation development, plant diversity and composition. The distribution of water and sediment are critical variables in determining the changes to the marsh form, function and extent (Siegel et al. 2005). The distribution, abundance, and habits of living organisms utilizing tidal marshes are linked to the spatial and temporal variations in the physical parameters of the wetlands. Both physical and ecological processes form the basis of a functioning wetland.

3.1.4 Impairment Listing

Ballona Creek Wetlands was first identified as impaired on California‟s 1996 303(d) list for not meeting beneficial uses due to poor condition of the wetland‟s "physical, chemical, and biological" characteristics, and due to the poor health of the habitat and its "flora and fauna". The Los Angeles Regional Water Quality Control Board‟s 1996 "Water Quality Assessment and Documentation" Report, identified Ballona Wetland as impaired for habitat alteration, exotic vegetation, reduced tidal flushing, and hydromodification; the report identified the following potential sources of impairment: urban runoff, natural sources, flow modification, habitat alteration, construction runoff, hydromodification, periodic stagnation, and recreation. The State continued to include Ballona Creek Wetlands on its Impaired Waterbodies 303(d) list in 1998, 2002, 2006 and 2010.

California‟s 1996 303(d) list estimated 86 acres of the Ballona Creek Wetlands as the affected size based on state and private property boundaries (Nancy Kapellas, CA State Water Resources Control Board, personal communication). The State and local stakeholders recognized the important value of these wetland habitats and over the years worked with private entities to purchase and restore more wetlands acreages. Consequently, wetland acreage increased to 289 acres in 2000 and the State Water Resources Control Board adjusted the affected size area in their 2002 State Impaired Waters 303(d) List. In 2004, the State negotiated purchase of additional wetland acres in the Ballona Creek Wetlands area with the goal of restoring a critical coastal wetland habitat in Los Angeles County and southern California (http://resources.ca.gov/ballona_wetlands/ballona_wetlands_summaries.pdf). This led to the establishment of the Ballona Wetland Ecological Reserve and approximately 626 acres slotted for wetland restoration. USEPA has determined that all wetland habitats within the 626 acres are impaired based on available data, historical ecology, relevant studies and monitoring results for Ballona Creek Wetlands. This determination matches the State‟s goals for Ballona Creek Wetlands.

The State‟s water quality objectives are narrative, but specifically require the protection of natural hydrologic conditions to support natural chemical levels (e.g., pH, Temperature, DO, etc.), movement of aquatic fauna, survival and reproduction of aquatic flora and fauna, and water levels. The condition of the habitat and the populations of wetland fauna and flora need to be sufficiently robust to maintain the necessary substrate characteristics that support a functioning wetland, protect food supplies for fish and wildlife, protect reproductive and nursery areas, and the wildlife corridors. Ballona Creek Wetlands is also listed for having excessive invasive exotic vegetation introduced in and around the waterways that have negatively impacted the beneficial uses.

The CDFG, in their report on the vegetation mapping (CDFG 2007), supported this finding and cited the Coastal Conservancy"s conclusion that the Ecological Reserve has undergone significant disturbance and fragmentation as a result of the alteration caused by human activity which include: active oil extraction on the wetlands causing changes to the landscape; channelization of Ballona Creek; construction of Marina del Rey, which converted coastal dunes and wetlands into a marina; dredge spoils from marina construction were deposited on the undeveloped portions of the Ballona wetlands, which raised the elevation of the site and altered the soil profile; construction of the Little League baseball fields; the Jefferson, Culver, Lincoln boulevard infrastructures which significantly impacted the hydrologic and habitat connectivity. The CDFG and GreenInfo Network created a vegetation map of Ballona Creek Wetlands Ecological Reserve in 2007 with the goals to assist restoration planning for the Ballona Wetland Enhancement Project. The Project goals include the restoration and enhancement of native habitats on the site and provision for public access and recreational opportunities.

Ballona Creek Wetlands are not supporting the identified beneficial uses (see Section 3.1.1). Ballona Creek Wetlands suffer from physical modification of the landscape (i.e., hydromodification) due primarily to the addition of sediment or fill over wetland space, channelization on site, and construction of roadways in and around the wetland area. These activities have caused further habitat alteration and significantly impacted tidal flushing in the wetland.

3.2 OVERVIEW OF STRESSORS & IMPAIRMENT CONDITION

This section describes the evidence and potential causes of the impairment condition. USEPA assessed the available data and information to evaluate the current condition of the Ballona Creek Wetlands. The evidence for the impairment is based on available information, data and reports available for the Ballona Creek Wetlands. These include, but are not limited to, studies and reports from California Department of Fish and Game, California Coastal Conservancy, County of Los Angeles, City of Los Angeles, Santa Monica Bay Restoration Commission, Ballona Creek Watershed Task Force, and the USACE.

3.2.1 Stressor Identification

This TMDL used USEPA‟s guidance on identifying key stressors (USEPA Stressor Identification Guidance Document 2000) to identify the impairments and the principal causes, or stressors, of the impairments. The available data and best professional judgment of the State Coastal Conservancy‟s Ballona Creek Wetlands Science Advisory Committee were considered in identifying the critical stressors in the Ballona Creek Wetlands.

This evaluation followed the steps identified in the US EPA Stressor Identification Guidance Document. The following steps were used to consider the available information for this waterbody:

1. Identify all possible impairments
2. List the candidate causes of impairments
3. Analyze the evidence for each candidate cause
4. Characterize causes
5. Identify or Apportion sources, if applicable
6. Describe management actions, if applicable

3.2.1.1 Impairment Identification

USEPA‟s evaluation of the available information and data showed critical impairments to the Wetland habitat and flow (Table 3). The sections below highlight and summarize the impairments observed in the Ballona Creek Wetlands.

Table 3. List of impairments identified for Ballona Creek Wetlands.

Loss of Wetland Habitat
Altered Habitat Composition
Loss & Modification of Species Diversity & Abundance (Exotic species increase)
Reduced tidal and freshwater flow to support habitat & aquatic life

This list of impairments was developed by following USEPA‟s Stressor Identification Approach (USEPA 2000).

3.2.1.1.1 Loss of wetland habitat and alteration of habitat composition

The proportion of the site area identified as wetlands is much smaller than observed in historical maps (i.e. 1870s USGS T-sheets, Figure 4). Comparing present day habitat maps to the historical T-sheet maps indicates that much of the Ballona wetlands have been converted from wetland to upland habitat, and or other surfaces. Vegetated wetland from the earliest historical map shows a decrease from 413 acres to -258 current acres of vegetated wetland; upland habitat area shows an increase from 19 acres to 272 current acres of upland habitat. This dramatic change from wetland habitat to upland habitat results in different species living in the current habitat. For example, species that are wetland dependent such as *Salicornia virginica, Jaumea carnosa,* or even the endangered Belding‟s Savannah Sparrow, are now restricted to a much smaller habitat area than historically in the wetland region. The large quantities of sediment placed in the Wetlands over the years have caused a shift from wetland to upland vegetation species and a corresponding change to the aquatic life inhabiting them. Although upland habitats are critical to the ecological health of a functioning wetland, upland habitats should be in reasonable proportions relative to other habitat types (e.g., salt marsh, mudflat, freshwater marsh, etc.) in a coastal wetland, such as Ballona Creek Wetlands.

3.2.1.1.2 Loss & Modification of species abundance & composition

This description of the species loss and modification is not comprehensive, but instead illustrates some of the main findings to date. The diversity of bird, plant, and mammal species compositions have decreased compared to other southern California wetlands.

Vegetation

Studies have also shown a dramatic reduction in seed bank diversity compared to other southern California wetlands. The most recent available surveys indicate low native plant species richness (i.e., the number of different species in a given area) in the Ballona Creek Wetlands, particularly in the salt marsh, seasonal wetland and upland habitats. In contrast, the upland habitats in Ballona Creek Wetlands showed higher non-native plant species richness. Species richness is an informative indicator in which to assess the sensitivity of ecosystems and their resident species. Figure 8 and Figure 9 provide an example of this observed shift in species richness for the salt marsh and non-salt marsh habitats in Ballona Creek Wetlands [Note: these figures indicate relative species richness based on representative transect areas in the Wetland]. Soil cores also indicate low species richness in the seed banks (i.e. seeds stored in shallow soils for later germination), as defined by the number of seedlings germinated per m^3 in each habitat, in Ballona Creek Wetlands relative to other southern California wetlands (Johnston et al. 2011).

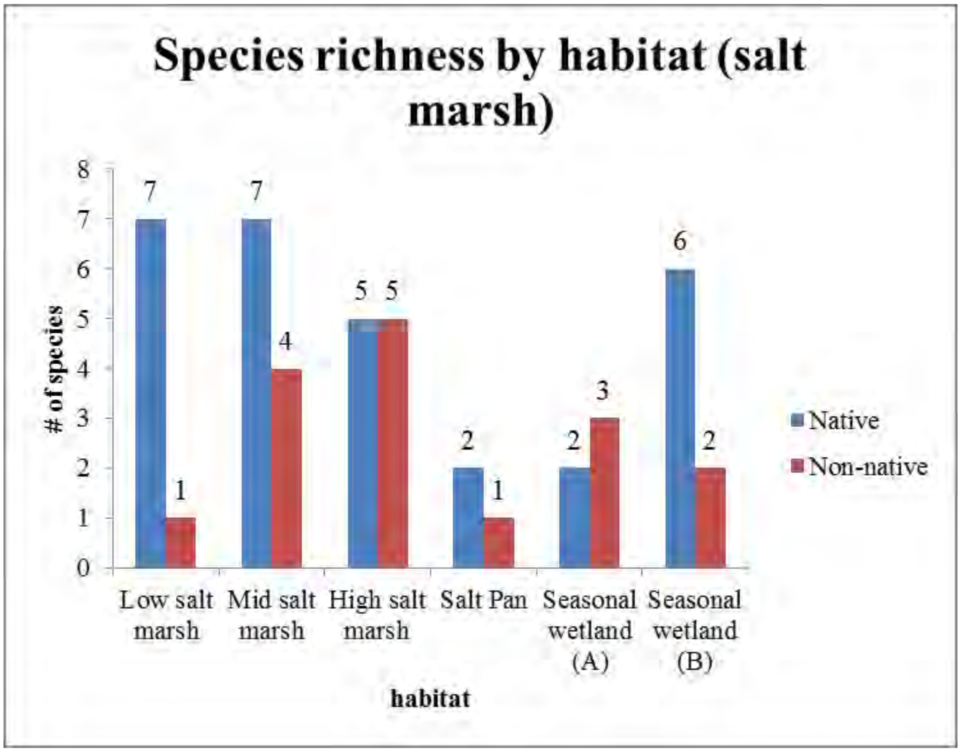

Figure 8. Plant species richness in marsh habitats on the Ballona Creek Wetlands (Johnston et al. 2011).

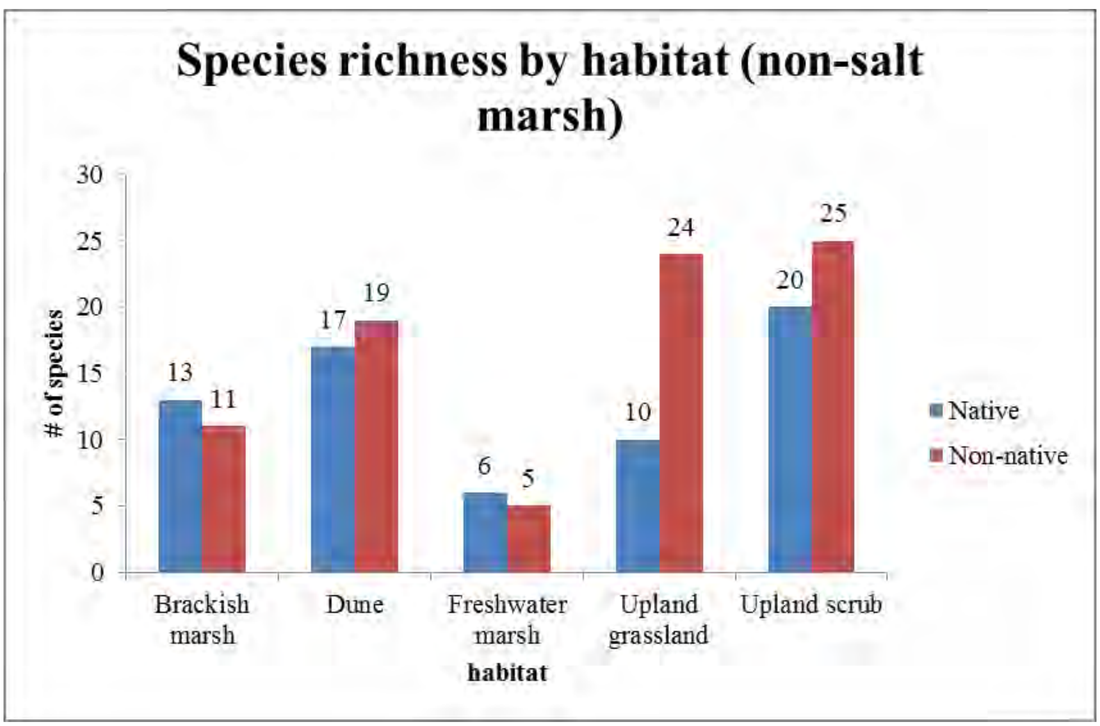

Figure 9. Plant species richness in non-salt marsh habitats on the Ballona Creek Wetlands (Johnston et al. 2011).

Data also show a decreased diversity of plants and an increased dominance of exotic plant species compared to other southern California wetlands. Plant diversity is an indicator of both species richness and abundance. Furthermore, plant species diversity and presence of non-native plant species are important measures of community structure because plants are important sources of food and shelter for many other organisms. Surveys over the last 10-20 years show a low diversity of plants and an increased dominance of exotic and invasive plant species at the Ballona Creek Wetlands compared to other southern California wetlands (Figure 10 and Figure 11). In particular, the percentage of non-native species in the non-salt marsh vegetation cover is between 40-80% of the dune, freshwater marsh and upland habitats (Figure 11) [Note: these data are based on transects surveys]. Furthermore, vegetation and habitat monitoring in the wetland have shown there is clear competition between native species, *Salicornia,* and exotic species, *Polypogon.* The greater increase of the exotic *Polypogon* in 2011, compared with 2009, was likely due to the increase in freshwater input (e.g., rainfall) for the last two years. As a result, salt tolerant species (e.g., *Salicornia*) were out-competed.

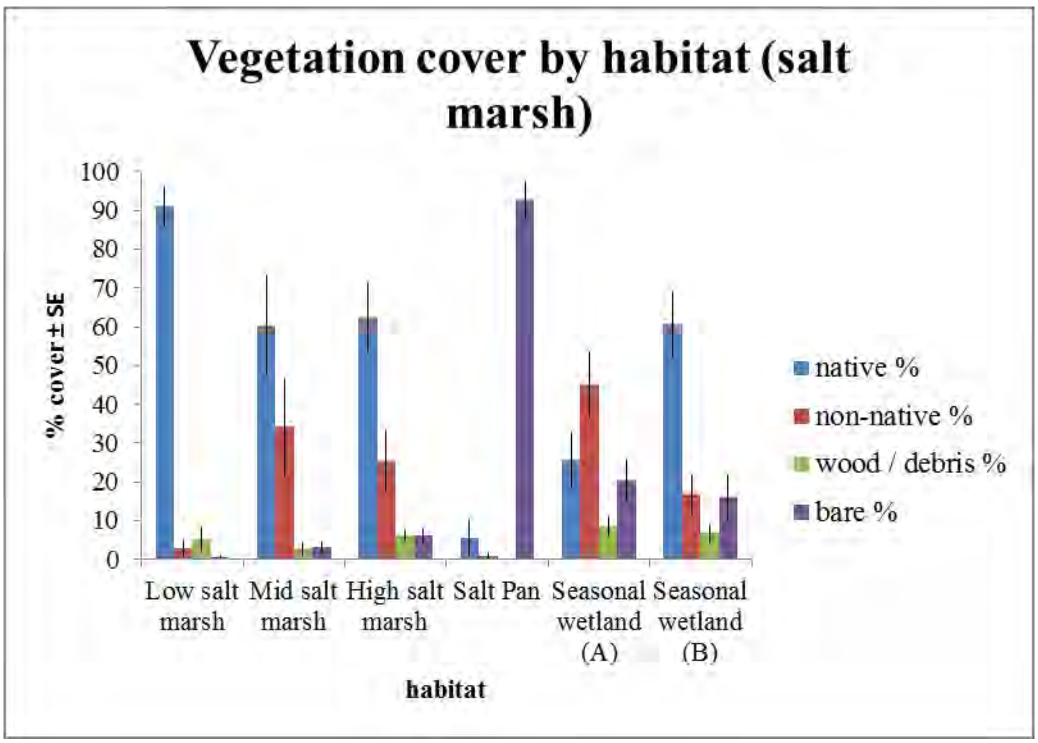

Figure 10. Vegetation cover of native and non-native species in salt marsh habitats at the Ballona Creek Wetlands (Johnston et al. 2011).

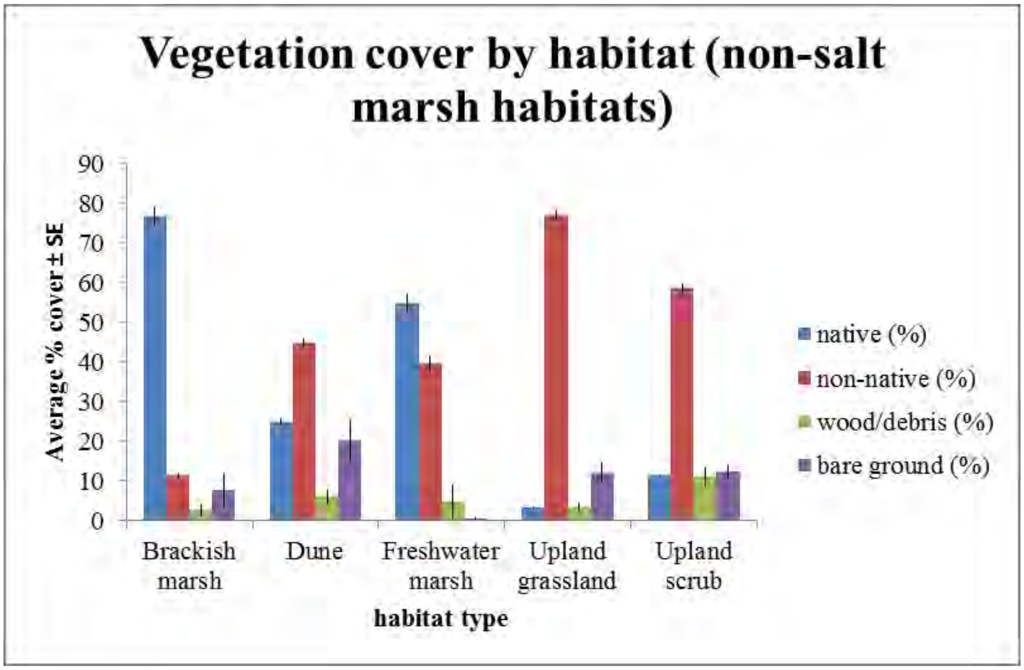

Figure 11. Vegetation cover of native and non-native species in non-salt marsh habitats at the Ballona Creek Wetlands (Johnston et al. 2011).

Invertebrates

The Ballona Creek Wetlands are an important site for coastal saltmarsh insects due to the rarity of this type of habitat in Southern California; there are few studies of invertebrates in the region, but the assumption is that the populations of native species declined along with nearly all coastal wildlife in the 20th century. (PWA 2006). The Ballona Creek Wetlands also is home to many special species of invertebrates (e.g., endangered, threatened, rare or nearly extirpated): butterflies (Wandering skipper, Monarch, El Segundo blue, Quino checkerspot), Belkin"s dune tabanid fly, Dorothy"s El Segundo dune weevil, globose dune beetle, Lange"s El Segundo dune weevil, and brackish water snail (*Tryonia imitator*). This indicates threatened or loss of viable habitat to support these species in Ballona Creek Wetlands.

Fish

Similarly, the Ballona Creek Wetland fish community has been highly impacted. At one point, when the Los Angeles River emptied into the Ballona Creek Wetlands during flood events, the fish assemblage would have included all the species know to have inhabited the River. Since the 1950"s, most of these species have been absent from the project area (Swift et al. 1993); this is primarily due to the redirection of the Los Angeles River drainage, which is maintained to the south and away from Ballona Creek since 1884 (PWA 2006). Although a few studies of the fish assemblage has been conducted to date, a detailed comparison of the historical presence of fish compared with the current fish population species has not been completed. However, due to the modification of the hydrologic regime and the loss of habitat in the Wetland, fish species richness and abundance have been affected. For instance, the federally endangered tidewater goby should occur in Area B under more natural conditions (Swift et al. 1993); as should the federally endangered steelhead trout and unarmored threespine stickleback, the federally threatened Santa Ana sucker, and two California species of concern, arroyo chub and Santa Ana speckled dace, if the Los Angeles River still emptied into the Ballona Creek Wetlands. These fish species need very unique coastal wetland habitats during each life stage (i.e., reproduction, juvenile, adult). Each of these species were found to be absent in the area, with no potential of occurrence at the site due to the lack of suitable habitat and absence of species during past surveys of the area (Psomas 2001; Psomas and Lockhart 2001).

Birds

Ballona Wetlands used to support many species of breeding birds that are less common today because of the loss or degradation of coastal wetlands in California. There are many extensive surveys of birds in the Ballona Creek Wetland region. This TMDL presents only a brief summary of those bird species that are impacted by the impairment conditions observed. Although there are a large number of migratory birds that winter in Ballona Creek Wetlands, there are also many bird species that used to inhabit year round in the Wetland. For instance, Belding‟s savannah sparrow nested in extensive pickleweed that was present before significant human disturbance.

Currently, Ballona Creek Wetlands include the following endangered species: Belding‟s savannah sparrow, California Least Tern, Peregrine Falcon; species of special concern: Elegant Tern, Burrowing Owl, Northern Harrier, White-Tailed Kite, Cooper‟s Hawk, Osprey, Loggerhead Shrike. The following special-status bird species either occur during the day or only has potential for occurring at Ballona Wetlands with restored habitat composition: black rail, light-footed clapper rail, 34 western snowy plover, California least tern, whitetailed kite, northern harrier, peregrine falcon, Cooper‟s hawk, osprey, long-eared owl (*Asio otus*), short-eared owl (*Asio flammeus*), burrowing owl, southwestern willow flycatcher (*Empidonax trailii extimus*), California gnatcatcher (*Polioptila californica californica*), Least Bell‟s vireo (*Vireo belli pusillus*), and Belding‟s savannah sparrow. This loss of available habitat for the many bird species illustrates the Wetland‟s impairment condition. For a more comprehensive discussion on bird surveys in Ballona Creek Wetlands and adjacent habitats, please refer to the Ballona Wetlands Draft Existing Conditions Report (PWA 2006).

3.2.1.1.3 Alteration of ecosystem functions

A natural coastal wetland, influenced by both tidal currents and freshwater inputs, supports multiple functions, such as flood control, trapping of sediments (maintaining natural sediment elevations), retaining or transforming nutrients, and water quality maintenance. Due to the loss of floodplain connectivity as a result of physical habitat modification and effects of channelization, the current wetland condition has reduced its ability to store floodwaters and accumulate sediments compared to its historical capacity, as depicted in the 1870s T-sheet maps (Figure 4). The concrete levees currently separate the majority of the Ballona Creek Wetlands from tidal influence and freshwater input from Ballona Creek. A muted tidal connection to several tidal channels is the only remaining direct water connection to the larger watershed. This separation of the tidal waters from the once-wetland habitats causes both a habitat shift and a change in hydrology. The effects of habitat alteration and channelization of the creek directly led to reduced and modified wetland habitat acreage and a smaller tidal prism; these physical changes in the wetland impacted the wetland"s ability to support critical ecosystem functions, which in turn impact the wildlife and aquatic life viability.

Ballona Creek Wetlands receive flow from both freshwater inputs and tidal flows. The 303(d) list specifically identifies "reduced tidal flushing" as an impairment. This listing does not suggest that the Wetland does not receive freshwater inputs, but instead, indicate that the more limiting factor, comparatively, is a significant reduction in tidal flow. Due to development, modification and loss of the wetland habitats, the Ballona Creek Channel and tide gate restrictions limit flow into the Wetlands.

3.2.1.2 Causes of Impairments

USEPA considered all potential activities or actions leading to the observed impairment, and found several key variables critical to explaining the current condition (Table 4). This section describes the causes of the impairments observed and provides the evidence for each potential cause. This section details out the evidence for the causes of the impairment and provides the association between cause and effect.

Table 4. Stressors causing the observed impairment in Ballona Creek Wetlands.

Cause (Stressor)	Result (Effect)
Excess deposition of sediment ⇨ Raises elevation above tidal influence	Converted wetland to non-functional upland; reduced native plan and seed back species diversity; increased invasive and exotic species
Levees ⇨ Prevents connection to creek with floodplain	Reduced ability to store floodwaters and accrete sediment; caused impacts to nutrient cycling, salinity gradients, and water column circulation.
Tide Gates ⇨ Prevents full tidal range within existing tidal channels	Reduced native wetland plant and seed bank diversity; a muted system, in combination with the steep slopes of the tide channels, eliminates mud flat and other low marsh habitats important for fish nursery and bird feeding functions.
Exotic plant species ⇨ Prevents native species to inhabit	Exotic plant species out-competing native plants; Creates less suitable habitat for other native species including rare, threatened and endangered species.
Bacteria, metals, trash and other pollutants flowing from Ballona Creek into Wetland	Impacts to wetland habitat, wildlife and aquatic life health, in addition to impacting public health and recreational use

This list of stressors was developed by following USEPA‟s Stressor Identification Approach (USEPA 2000).

3.2.1.2.1 Sediment

A spatial link exists between the presence of sediment that was discharged and placed into the wetland in the past and the shrinkage of wetland habitats relative to historic maps. Locations that once supported salt marsh and other intertidal wetlands habitats are now buried under excess sediment due to the increased elevations caused by deposition and retention of sediment from outside sources. Several areas contain sediment 15-20 ft higher in elevation than those of a natural salt marsh. This sediment altered the marsh, prevented the growth of wetland species, raised the elevation to an unnatural height typical for marsh systems in southern California, affected the groundwater storage, and blocked tidal and freshwater flow influence to the majority of the site. For example, when comparing current acreages to historical maps: intertidal mudflat habitat decreased 25%, freshwater wetlands decreased 61%, vegetated wetland decreased 62%, salt pan decreased over 80%, while subtidal channel area increased by 174% and upland habitat area increased over 1000%. These changes in percentage habitat area are useful in showing the overall changes in the landscape acreages over time. Upland habitats should be in reasonable proportions relative to other habitat types (e.g., salt marsh, mudflat, intertidal, etc.) in coastal Ballona Creek Wetlands.

This TMDL is only addressing those affected habitat areas within the Ballona Wetlands Ecological Reserve that are necessary to re-establish a functioning coastal marsh wetland, with consideration of the current landscape modifications upstream and adjacent to the Ballona Creek Wetlands; these critical wetland habitats include intertidal, mudflat, salt flat, subtidal, salt marsh, and seasonal fresh water habitat. This TMDL does not negate the importance of upland habitats, but instead point to the significant loss of coastal wetland habitats in the Ballona Creek Wetlands. Although many studies have pointed to the critical importance of upland habitat to wetland habitat function, few can provide a specific ratio of upland to wetland habitat required in an area to maintain wetland health. Consequently, a target acreage is not provided for upland habitat. USEPA expects the future restoration effort to include the necessary upland and transition habitats for Ballona Creek Wetlands that balance the other Numeric Target habitat acreages.

3.2.1.2.2 Levees and tide gates

The modified wetland habitats in Ballona Creek Wetlands are spatially influenced by the presence of the Ballona Creek levees. Due to the barrier formed by the levees, locations that once supported salt marsh and other intertidal wetlands habitats now support upland habitats, and are no longer influenced by tidal inflows and outflows, or by freshwater inputs from Ballona Creek. Levees create physical barriers in the Wetland, preventing tidal influence from ocean seawater and freshwater input from the watershed and Ballona Creek. These barriers block water movement through the wetlands, restrict the ability of the wetlands to act as filtration systems, block floodwater capabilities of a functioning estuarine system and prevent natural accretion of sediment to maintain habitat health. These barriers also serve to prevent the natural transition zones found within southern California estuaries (e.g. block the transition from intertidal habitats, to mudflats and low marsh).

The tide gates allow some muted tidal flushing of the existing tidal channels at Ballona Creek Wetlands (i.e. in Area B, on the south side of the Ballona Creek Wetlands), but prevent full tidal flushing. The tide gates are set to prevent tides above 1.1 m above sea level and restrict flow considerably. The resulting lack of higher tide heights in the wetlands decreases the diversity of mud flat habitats and inhibits propagation of wetland plants that require a variety of tide heights for optimal seed dispersal. The muted conditions allow for less water, less inundation, restricted water movement, prevent natural erosion and bank modification processes, and limit the lower marsh habitat acreages. They also provide a physical barrier to fish species. These restrictions, combined with a much smaller acreage of intertidal, subtidal, and mudflat habitats, reduced the value of the wetlands as a nursery habitat to ecologically and economically important fish species.

3.2.1.2.3 Exotic plant species

The presence of exotic plant species and the lack of habitat for native species are interconnected. Exotic species often out compete native species, causing a decline in the habitat value for native species utilizing those habitats. In addition to competition, exotic species can be toxic, propagate quickly, reduce and affect groundwater movement and recharge (e.g. *Arundo donax)*, modify the subground biomass and root structures, alter nutrient uptake abilities, change the three-dimensional structure and canopy structure of a habitat, and reduce the native plant species diversity. Exotic plant species dominate upland areas that were impacted by dumping of excess sediment. Exotic species do not provide appropriate habitat for numerous native animals including some rare, threatened and endangered species that were historically present at Ballona Wetlands. Exotic species can be invasive and create significant disturbance to the existing habitat as a result of vigorous growers that outcompete and eliminate native plant species.

3.2.1.2.4 Bacteria, metals, trash and other pollutants

These impairments are currently being addressed by the Regional Board adopted TMDLs for the Ballona Creek and Estuary (see adopted Regional Basin Plan Orders: Resolution No. 2007-015; Resolution No. 2006-011; Resolution No. 2005-008; Resolution No. 2004-023; and Resolution No. 2001-014).

3.2.1.2.5 Relationship between causes and responses

To illustrate the interrelationships between stressors, i.e., causes, and responses, i.e., impairments, a conceptual model of the causes and its impact on the wetlands was created (Figure 12). All the responses of impact can be tied back to habitat alteration, which are linked directly to the impact of excess sediment deposition. The conceptual model also shows the beneficial uses impacted by the causes.

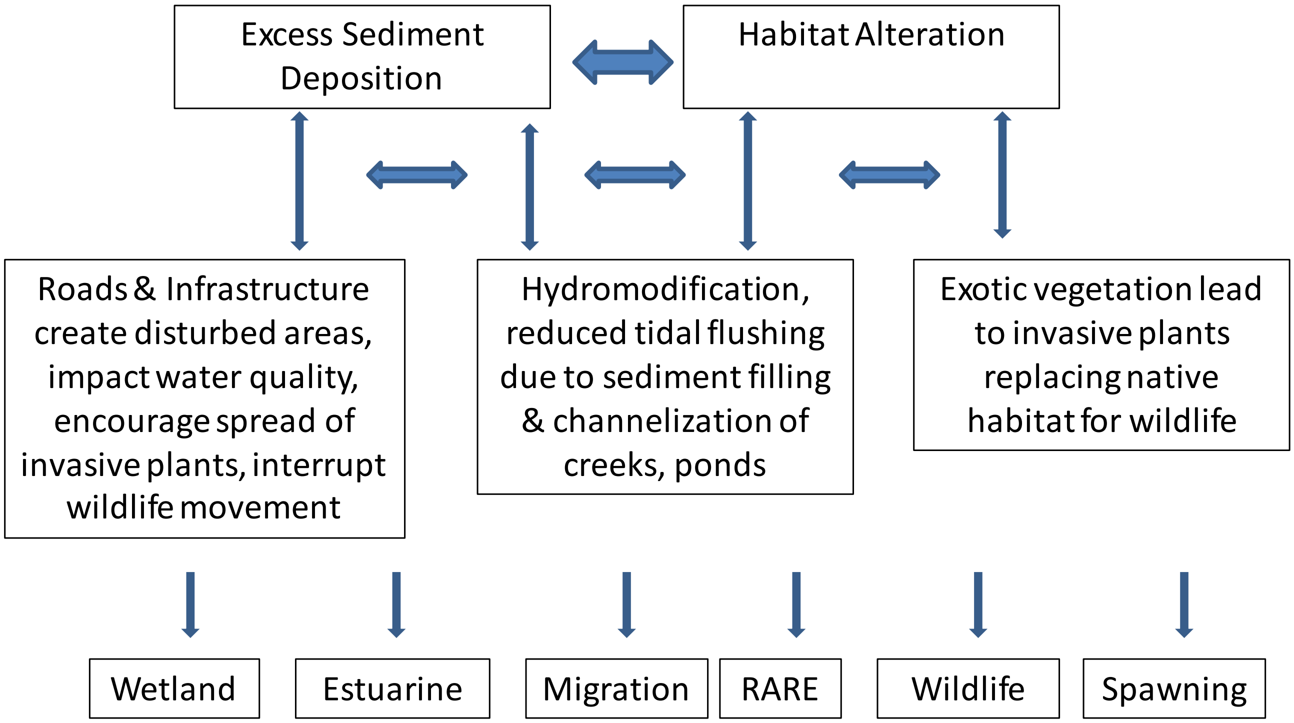

Figure 12. A conceptual model of the interrelationships between impairments and the causes of the impairments in the Ballona Creek Wetlands. The beneficial uses impacted by the activities are shown.

The straightening and armoring of Ballona Creek from its outlet to the Pacific Ocean, through the Ballona Creek Wetlands and continuing upstream, has reduced the area and quality of estuarine habitat, habitat for spawning and migration of aquatic organisms in the Ballona Creek Wetlands by altering the habitats and constraining freshwater flows to a relatively narrow and straight path, eliminating tidal channels, burying intertidal wetlands and raising the land surface above tidal elevations. As a result, estuarine vegetation is reduced or absent from areas where it previously existed, and fish and shellfish that depend on estuarine processes or habitats are reduced or absent. Similarly, waterfowl and shorebirds that depend on estuarine habitats including mudflats and wetlands vegetation, are also greatly reduced or absent. This condition reduces the ability of migrating species to move through the estuary, reduces the ability of species to spawn in the habitat conditions, and impairs the MIGR and SPWN beneficial uses.

A number of rare, threatened and endangered species have been eliminated from the Ballona Creek Wetlands through loss of habitat, habitat alteration, and reduced habitat condition through the straightening and armoring of Ballona Creek from its outlet to the Pacific Ocean, eliminating tidal channels, burying intertidal wetlands and raising the land surface above tidal elevations. Thirteen species of rare plants may have occurred in the Ballona Creek Wetlands, 12 of which are believed to have been extirpated. The Ballona Creek Wetlands does not currently support any rare, threatened or endangered fish species, but may have supported seven and has the potential to support three.

The modification to Ballona Creek, its hydrologic disconnection, and the excess addition of sediment prevent natural inundation, from Ballona Creek and ocean tides, of the floodplain and former wetland areas. The ability of the Wetlands to provide flood control is reduced because the hydraulic disconnection prevents floodwaters in Centinela and Ballona creeks and the estuary from spreading out over the floodplain and filtering into floodplain soils for storage. The ability of the Wetlands to filter and purify naturally occurring contaminants is also reduced because the hydraulic disconnection prevents movement of water through the floodplain soils where this function would normally occur.

Terrestrial ecosystems in the Ballona Creek Wetlands have been impacted by filling (burying) and by the proliferation of invasive plants and resulting lack of native plant communities. Population sizes and species diversity of birds, fish, mammals, reptiles and amphibians are impacted compared to early surveys due to lack of suitable vegetation to provide food and shelter or nesting sites (Johnston et al. 2011).

3.3 PRIMARY CAUSE OF IMPAIRMENT

In evaluating all the candidate causes considered in this TMDL, USEPA concludes that historical loading of sediment to the Ballona Wetland has resulted in impacts to natural wetland functions. The excess deposition and movement of sediment within Ballona Creek has greatly altered the natural conditions. Urbanized development of the Ballona Creek watershed and the channel straightening has modified both the sediment supply and the ability of flows to transport sediments. Additionally, channelization of the creek has cut off the banks and floodplains of the natural river. Sediments carried in flows are not stored within the banks but are rather transported to the outlet of Ballona Creek where they are deposited. The US Army Corp of Engineers (USACE) periodically dredges the mouth of Ballona Creek and the Marina del Rey entrance channel to prevent sediment build-up. Currently, the habitats are fragmented by existing roads, infrastructure and surrounding development.

The impairments for Ballona Creek Wetlands reflect the long-term input of sediment, reshaping of the Ballona Creek Channel and the construction of major and minor roadways. These are referred to as stressors rather than pollutants of concern. The applicable water quality standards for these stressors are defined in the Basin Plan"s narrative standards. The primary pollutant of concern that directly links the impacts of these multiple stressors is the legacy of anthropogenic sediment deposition and placement.

A consequence of the placed sediment, in addition to the reshaping of the Ballona Creek Channel, is the muted tidal conditions. Flap gates were installed in the late 1990"s to allow some flow between Ballona Creek and the wetland region (i.e. in Area B and on the south side of the Ballona Creek Wetlands). These were switched to self-regulating tide gates in 2003 to prevent tides greater than 1.1 m above sea level. Both types of gates led to a modified tidal regime in the Wetlands by restricting full tidal inundation and viability of diverse composition of habitat types. The tides in the Wetland are restricted, resulting in highly variable pressure, depth, temperature, salinity, and most critically, limited inundation.

Tidal inundation is the rise of tidal water overflowing onto wetland, in addition to reflecting the characteristics of frequency, duration and depth of water reaching the tidal marsh. It is a critical variable in determining the chemical, physical properties of wetland marsh soils in addition to accompanying changes in the biological community (Siegel et. al 2005) (http://www.irwm.org/files/IRWM-PhysProc-Poster_SciConf_2005-1003trc.pdf). Monitoring in Ballona Creek Wetlands has shown that inundated vegetated wetland areas have higher coverage or percent cover of native species. The relationship between species distribution and elevation dependent tidal inundation is important and cannot be excluded in our understanding of the ecological response to the intertidal conditions. Many studies have shown that variations in inundation patterns under varying tidal phases influence the physiological and biological conditions throughout the wetland (Hickney and Bruce 2010). If the wetland experienced a full natural tidal cycle, the banks would slough off, allowing physical creation of gradual slopes, and this variable tidal inundation would lead to a higher variety of habitats (i.e., mudflats, low marsh, and gradual transitions) (Personal Communication Karina Johnson, Santa Monica Bay Restoration Commission). Thus, the lack of higher tide heights in the wetlands results in lower diversity of wetland habitats and greater inhibition of optimal seed dispersal of native wetland plants species.

3.4 CURRENT HABITAT CONDITION

This section evaluates the changes to the habitat distribution and areas. The comparison between current habitat composition and historic Ballona Wetlands is based on historical ecology and mapping data and recent information evaluated (extensive summaries of data before 2006 are described in "Ballona Creek Wetlands Existing Conditions Draft Report" (PWA 2006) and summarized here as they apply to the stressors listed in Section 3.2).

The beneficial uses of the Ballona Creek Wetlands depend on the presence of a diverse composition of habitat types that are interconnected to allow for hydrologic flow and aquatic and wildlife movement. Since the impact of sediment dumping, channelizing and/or armoring of creeks and wetlands, reduced tidal and freshwater flushing, and proliferation of invasive plant species, Ballona Creek Wetlands currently have significantly reduced habitat areas, limited interconnectedness and modified habitats. The current habitat distributions are presented in Table 5; these are based on elevations within the tidal regime and plant community maps developed by the California Department of Fish and Game (Figure 13) (CDFG 2011). The dominating habitat type currently in Ballona Creek Wetlands is upland habitat. Although upland habitats are naturally important to a wetland region, it is critically important to have a balance of diverse habitats to support a functioning wetland. Currently, Ballona Creek Wetlands have limited or connected salt marsh, subtidal, and intertidal habitats, as would be expected from a Southern California coastal wetland.

Table 5. Distribution of habitat types in present-day Ballona Creek Wetlands by area and percent of total (CDFG 2007).

Habitat type	Area (acres)	% of Total Area (acres)
Subtidal channel	39	5.9
Intertidal (mudflat and channel)	19	2.9
Vegetated wetland	155	23.4
Salt pan	22	3.4
Freshwater wetland	1	4.3
Riparian	23	3.5
Upland	282	44.0
Unvegetated (roads, etc.)	85	12.6
Total	626	100.0

Figure 13. Current habitats observed in Ballona Wetland Ecological Reserve (CDFG 2007). The unvegetated area includes, but not limited, the SoCalGas Company roads, levees, other roads, and parking lots.

The total acreage currently in Ballona Creek Wetlands is 626 acres (not including the Freshwater Marsh), of which 85 acres of consist of roads, levees, Southern California Edison roads and platforms, etc. This is a significant change when compared with the greater Ballona Wetlands complex historically.

Based on the T-Sheet maps detailing the vegetation habitat types and extent, the total acreage of wetland habitats across the entire area of the historic Ballona Creek Wetlands was approximately 1762 acres of wetlands (Table 6). Other sources have estimated that the entire wetland region covered approximately 2100 acres (Schreiber 1981). Historically, the greater Ballona Wetland complex encompassed Marina del Rey, Ballona Lagoon, Del Rey Lagoon, and additional areas north of Marina del Rey. Since the State identified each waterbody separately, this TMDL only addresses the area referred to as Ballona Creek Wetlands or Ballona Wetlands; this excludes Marina del Rey, Ballona Lagoon, Del Rey Lagoon and the Freshwater Marsh.

Table 6. Distribution of habitat acreages in Historic Greater Ballona Wetlands complex (Grossinger et al. 2011).

Habitat type	Historic Greater Ballona Wetlands	
	Acres	%
Freshwater Marsh	--[1]	--[1]
Intertidal Flat	281	16
Riparian	5.3	0.3
Salt Flat	135	7.7
Subtidal Water	103	5.8
Unvegetated	0	0
Upland	0	0
Vegetated Wetland (Salt Marsh)	1238	70.3
Grand Total	1762	100

[1]The T-Sheet maps identified vegetated wetland as a unique habitat category to include primarily salt and brackish marsh habitats; however, analysis of the historical ecology of Ballona Creek Watershed suggest these habitats are dynamic and freshwater marsh may have shifted into areas identified as vegetated wetland (Dark et al. 2011). The subtidal water category includes both open and subtidal water areas. The riparian category includes channel and woody habitats.

Our review of past and current available studies focused on the significant habitat modifications due to anthropogenic activities. USEPA evaluated the habitat acreage changes in two ways: (1) a comparison between the historical, greater Ballona Wetlands complex (1762 acres) and present-day Ballona Creek Wetlands (626 acres); and (2) a comparison between historical Ballona Wetlands, bounded by the current 626 acres area and present-day Ballona Creek Wetlands (626 acres). The results showed large habitat differences for both comparisons. This is illustrated by the estimated proportion of each habitat type observed from the 1762-acre greater Ballona Wetlands complex observed historically; 626-acre are of Ballona Creek Wetlands currently; and 626-acre bounded area overlaid on top of the historical Ballona Wetlands complex (Figure 14). For instance, comparing the habitat proportions of the bounded historical Ballona Wetlands with present day Ballona Creek Wetlands, salt marsh habitat declined from 412 to 155 acres while upland-like habitat increased from 19 to 282 acres, and salt pan habitat declined from 155 to 22 acres (Table 7). Although this directly compares a historical and current Ballona Creek Wetlands with the same exact geographical location and size, it does not adequately account for the importance of evaluating a wetland as a complete dynamic region; a functional wetland region maintains a natural balance of diverse habitats and their areas; by cutting out a portion of the historical extent of Ballona Wetlands, it can be challenging to evaluate the proportional loss of specific habitat types.

Table 7. Comparison of habitat acreages between historical Ballona Creek Wetlands within current boundary and present-day Ballona Creek Wetlands by area and percent of total (CDFG 2006).

Habitat type	Historic Ballona Creek Wetlands w/current Boundary		Current Ballona Creek Wetlands	
	Acres	%	Acres	%
Freshwater Wetland	73[1]	11.1	1	0.2
Intertidal Flat	26	3.9	19	3.1
Riparian	1	0.2	24	3.8
Salt Flat	115	17.4	22	3.6
Subtidal Water	14	2.1	39	6.2
Unvegetated	0	0	85	13.5
Upland	19	2.9	282	45.1
Vegetated Wetland (Salt Marsh)	413	62.5	155	24.7
Grand Total	661[2]	100	626	100

[1] The T-Sheet maps (Grossinger et al. 2011) and historical ecology (Dark et al. 2011) of Ballona Creek Watershed were used to identify the habitats that historically existed within present-day Ballona Creek Wetlands boundary.

[2] The difference between the total acreages for Historic Ballona Creek Wetlands (661 acres) and Current Ballona Creek Wetlands (626 acres) is due to the specific way Area C is apportioned. Only a portion of Area C is identified as impaired for this TMDL and thus, only this portion is required to meet the numeric targets and allocations outlined in this TMDL.

It may be more relevant to evaluate the habitat proportions of the historically greater Ballona Wetlands complex with the habitat proportions of the current Ballona Creek Wetlands area. Historically, approximately 70% of the greater Ballona Wetlands complex was composed of vegetated marsh (i.e., salt, brackish, fresh, seasonal wetlands). Currently, vegetated marsh habitat makes up approximately 25% and upland makes up 45% of the total Ballona Creek Wetland area. These results are indicative of the current condition of Ballona Creek Wetlands, which is disconnected from adjacent waterbodies (Marina del Rey, Ballona Lagoon, Del Rey Lagoon) that used to part of a larger wetland complex. These habitat changes provide a general account of the types of natural functioning wetland habitats lost due to anthropogenic activities.

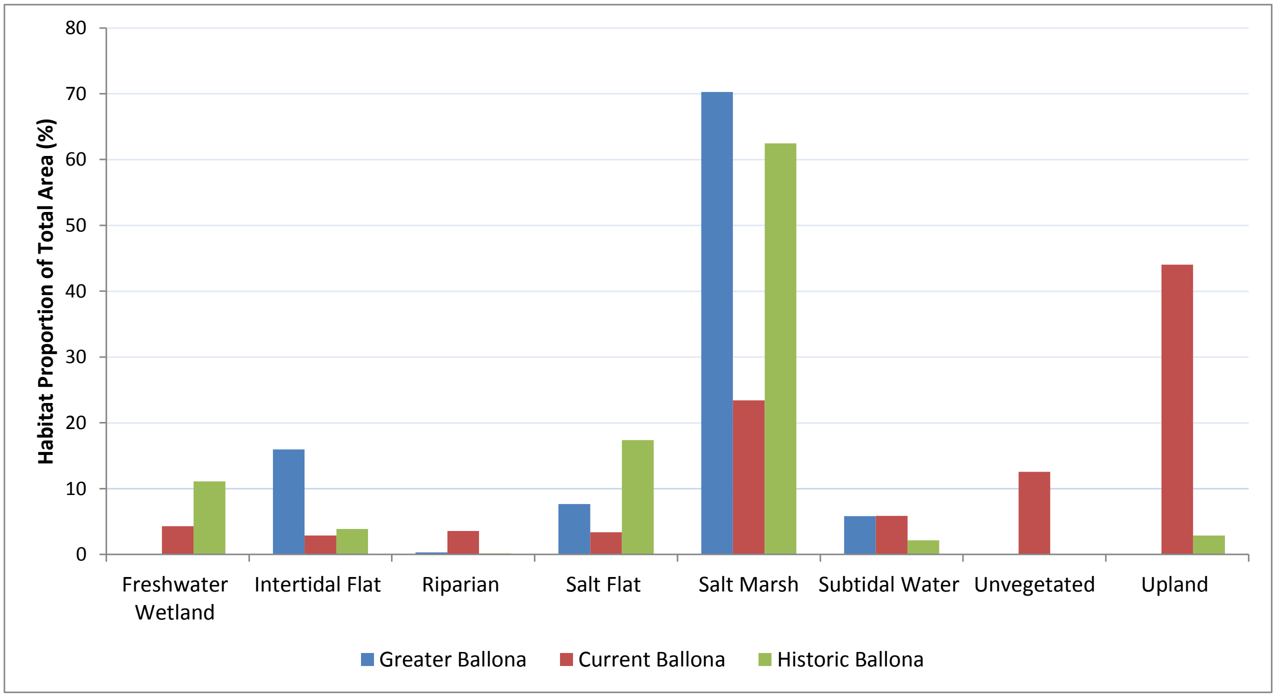

Figure 14. Habitat Proportions for the Greater Ballona Wetlands Complex (1762 acres), Current Ballona Creek Wetland area, and Historical Ballona Creek Wetlands (626 acres). Percentage of freshwater wetland, intertidal, riparian, salt flat, salt marsh, subtidal, unvegetated, and upland estimated from historical and current maps.

In general, these percentage comparisons are an indication of the impairment of overall wetland functions. The largest difference is the conversion of those diverse wetland habitats to primarily upland habitat and a marina. This represents the impact of depositing excess sediment and modifying tidal and freshwater flow in the Ballona Creek Wetlands area.

3.5 Invasive Exotic Vegetation Condition

The proliferation of exotic vegetation, especially invasive species, has altered habitats throughout the Ballona Creek Wetlands. Exotic vegetation impairs WILD and RARE beneficial uses by displacing and out-competing the native plants that birds and wildlife rely on for food and shelter.

A total of 171 species of exotic vegetation has been identified within the Ballona Creek Wetlands. Exotic vegetation is present throughout the Ballona Creek Wetlands, and often represents the dominant species in areas with limited tidal inundation or excess fill placement. Plant community mapping by the California Department of Fish and Game (CDFG) in 2007 identified 229 acres of habitat dominated by exotic species (a total of 476 acres were surveyed by the CDFG 2007). Detailed vegetation surveys conducted during 2009-2010 by the Santa Monica Restoration Commission (SMBRC) identified similar exotic species distributions as the previous

CDFG plant community mapping in 2007, and added further detail including percent cover of native and exotic vegetation by habitat type (Table 8, Figure 15, Figure 16).

Table 8. Percent cover of native and exotic vegetation at Ballona Creek Wetlands by habitat[1].

Habitat Type	% Native	% Exotic
Low Marsh	91.0 ± 5.2	2.9 ± 2.1
Mid Marsh	60.4 ± 12.9	34.2 ± 12.5
High Marsh	62.3 ± 9.1	25.5 ± 8.0
Seasonal Marsh (Area B)	60.6 ± 8.5	16.7 ± 5.0
Seasonal Marsh on Fill (Area A)	25.6 ± 7.0	45.3 ± 8.5
Freshwater Marsh	76.8 ± 2.3	39.5 ± 2.0
Brackish Marsh	55.0 ± 2.4	11.5 ± 0.4
Dune	25.0 ± 0.6	45.0 ± 1.1
Coastal Grassland	3.5 ± 0.1	77.1 ± 1.1
Coastal Scrub	11.6 ± 0.2	58.8 ± 1.1

[1]The sum of native and exotic vegetation is not equal to 100% because of the presence of bare ground.

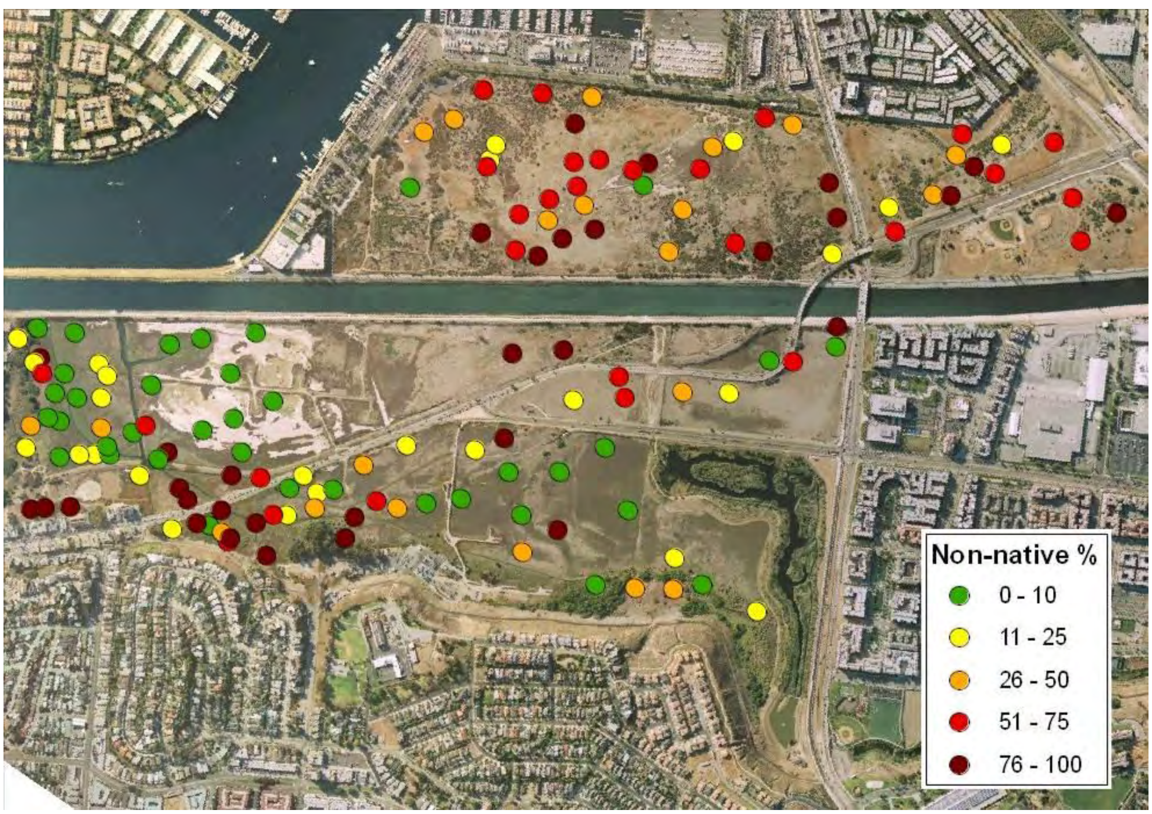

Figure 15. Average percent cover of non-native vegetation on each surveyed transect.

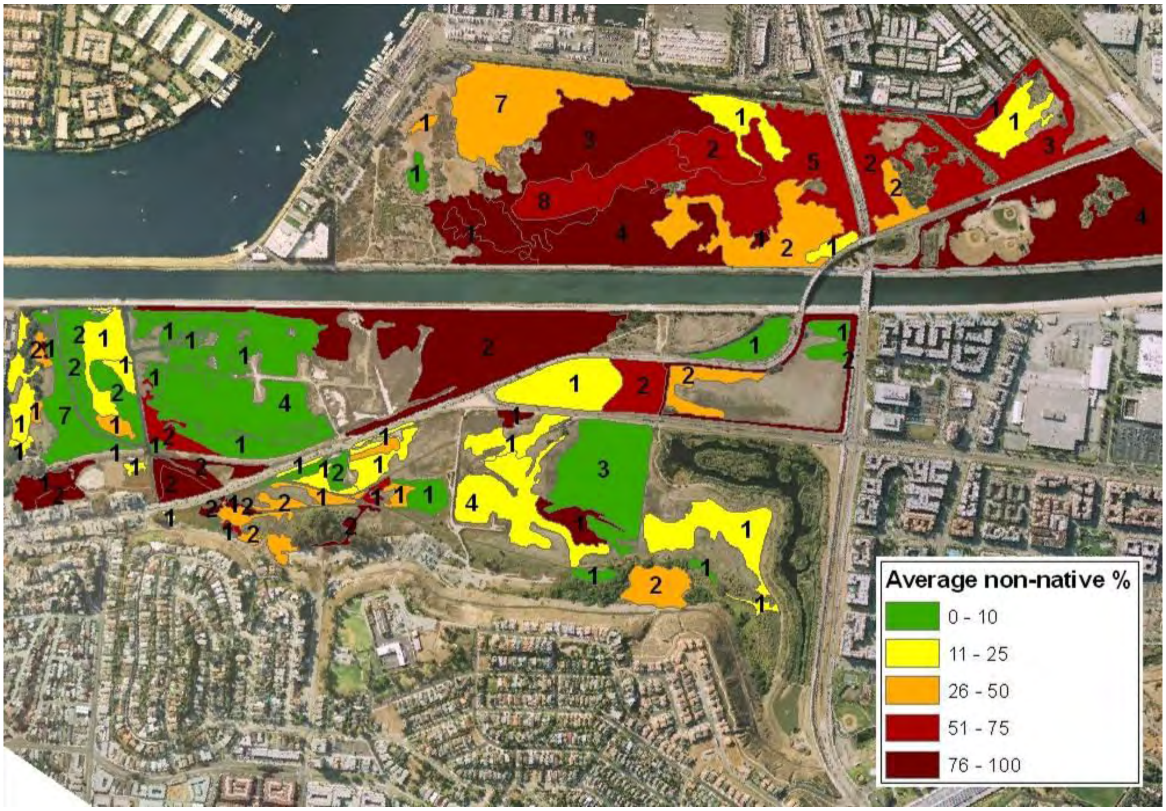

Figure 16. Cover of non-native vegetation averaged by habitat polygon. Black numbers indicate the number of transects used in calculating the average.

Exotic vegetation at the Ballona Creek Wetlands alters both the habitat composition and structure, which results in loss of plant and wildlife species. Exotic vegetation can dominate habitats limiting food support, and necessary habitat structure to support wildlife species, including mammals, birds, reptiles, amphibians and invertebrates.

3.6 SEDIMENT CONDITION

The soils of the Ballona Creek Wetlands originally derived from fluvial and marine environments (PWA 2006). The Ballona Creek Wetlands was subsequently overlain by fill dredged during the construction of Marina del Rey and excavated during flood management projects along Ballona Creek (PWA 2006). Fill materials were comprised mostly of clay, silt, silty sand, and sand and ranged in depth from zero feet in several parts of Area B to 18 feet deep in Areas A and C (Law and Crandall, Inc. 1991a, 1991b). The City of Los Angeles (1992) also provided estimates of the sediment characteristics in the area and found the sediment in the area mostly composed of fill overlying alluvial deposits, ranging from 4 to 17 feet in depth and consisting mostly of silts and clays; these were likely imported from a variety of sources, including the result of dredging Marina del Rey.

3.7 HYDROLOGIC CONDITION

Since the early 1900‟s and the large-scale modification of Ballona Creek Watershed, its tributaries, and the Wetland, the natural hydrologic functions have been significantly reduced. Approximately 40% of the watershed is covered with impervious surfaces, leading to larger and faster flow of runoff entering the creek, tributaries, and wetland area (Ballona Creek Watershed Task Force, Chapter 2, 2004). As a result, infiltration of precipitation to groundwater has been reduced along with the alteration of the natural processes of erosion and sedimentation due to the lining of the channels. Eroded sediment is transported along Ballona Creek Channel, through the wetland region and ending in the mouth of Ballona Creek, where it periodically leads to a partial closure of the boat entrance to the Marina del Rey. The construction of levees on Ballona Creek and Marina del Rey has significantly reduced the extent of tidal wetlands and tidal flushing in the estuary and adjacent lagoons (i.e., Del Rey Lagoon and Ballona Lagoon) (Ballona Creek Watershed Task Force, 2004). Imported water and extensive landscaping, along with other non-point source flows, have led to year-round flows in most channels, which were historically dry most of the year.

There are four main potential sources of hydrologic inflows to the Ballona Creek Wetlands: (1) Freshwater and marine inflows from Ballona Creek and the Santa Monica Bay to the muted tidal channels of Area B, (2) Marina del Rey inflows to the Fiji Ditch in Area A, (3) urban runoff, and (4) groundwater. Urban runoff and groundwater enter the Ballona Creek Wetlands from many sources. The influence of Ballona Creek is restricted to the muted tidal portion of the southwest corner of Area B, accessible through the eastern self-regulating tide gate. The Ballona Creek Watershed drains approximately 130 square miles of land, about 80% of which is urbanized, while the remaining 20% are composed of partially developed foothills and mountains (Figure 17; PWA 2006). The majority of the Ballona Creek drainage network has been modified into underground pipes and culverts, and open concrete channels.

Marina del Rey is the largest artificial small-craft harbor in the U.S. and accommodates more than 5,000 privately owned pleasure crafts (PWA 2006, Kearney et al. 2010). The Marina was developed in the late 1950s and early 1960s on parts of the former Ballona Creek Wetlands complex. The Marina Del Rey watershed is approximately 2.9 square miles and is highly urbanized. The Fiji Ditch in the northern portion of Area A connects to Marina del Rey through a box culvert.

Groundwater is present in all three Areas (i.e. A, B, and C) (Straw 1987). Historically, the Ballona Creek Wetlands received water through artesian upwellings (Henrickson 1991), although current conditions indicate much lower levels, with ranges in elevation depending on the specific location (Diaz, Yourman, and Associates 2010; Weston Solutions 2009).

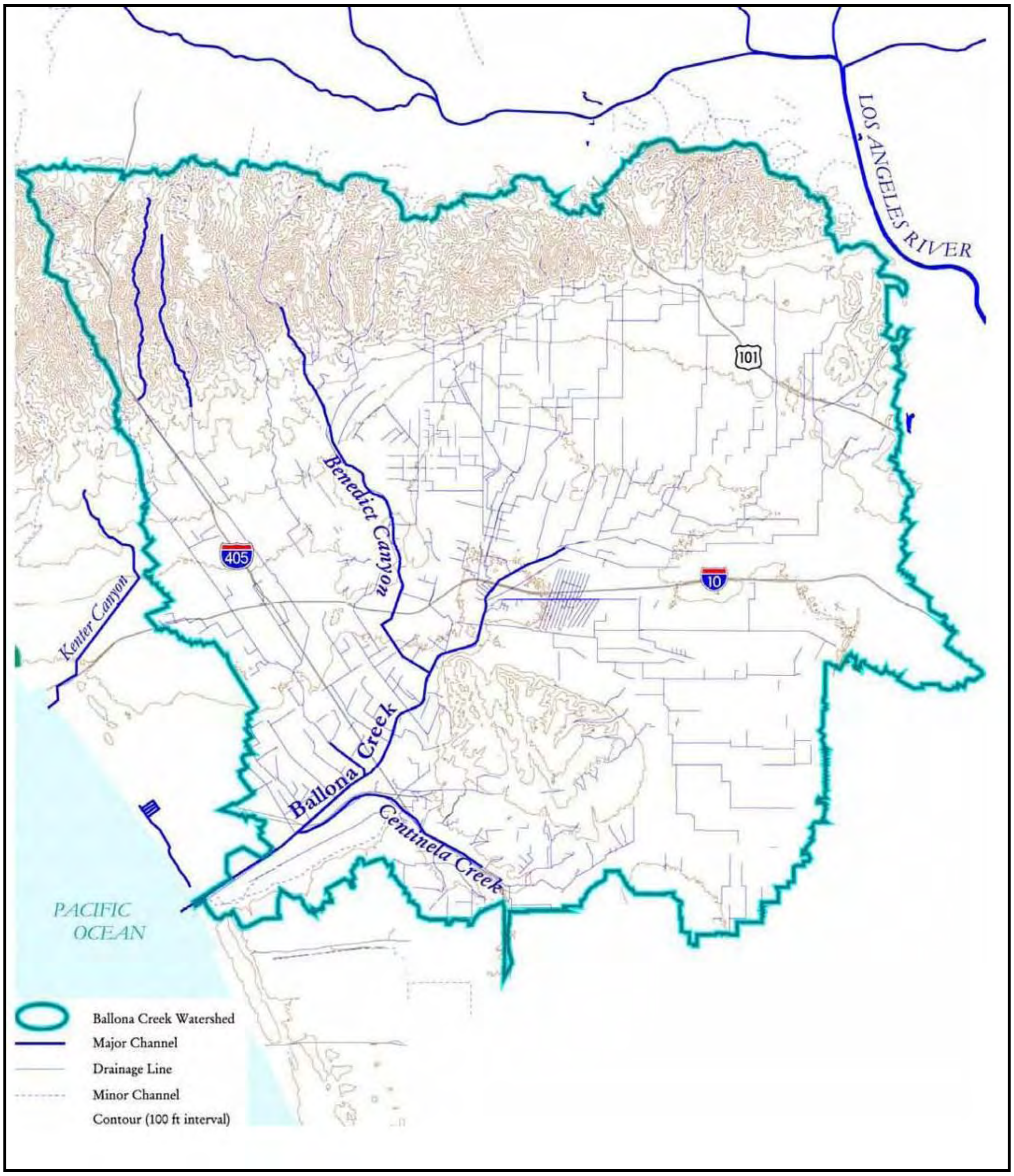

Figure 17. Ballona Creek watershed (reproduced from DPW 2004).

4 Numeric Targets

This section analyzes the linkage between the impairments and the observed conditions in the Ballona Creek Wetlands, and defines numeric targets that will achieve the water quality standards and lead to protection of the designated beneficial uses.

4.1 SELECTION OF WATER QUALITY TARGETS

These TMDLs include numeric targets based on the Basin Plan"s water quality objectives for a wetland and the designated beneficial uses referenced in Section 3.1.1 and 3.1.2. Clean Water Act 40 CFR 122.2 defines "Pollutant" (to) mean dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 USC 2011 *et seq.*)), heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water. In Ballona Creek Wetlands, deposited sediment is a pollutant that impairs that impaired the identified beneficial uses.

Following review of the available data, studies and reports for the Ballona Creek Wetlands, USEPA concurs with the State"s determination that Ballona Creek Wetlands is impaired for wetland habitat alteration, hydromodification, reduced tidal flushing, and exotic vegetation. These impairments are a direct result of past activities which added excess sediment and altered the physical transport of sediment in and out of the Ballona Creek Wetlands, and allowed for the introduction and proliferation of exotic vegetation. These historic anthropogenic inputs of sediment and effect of impervious surfaces within the watershed have caused significant habitat alteration, allowed exotic species to flourish and contributed a reduction in tidal flushing. Therefore, USEPA is addressing habitat alteration, hydromodification, reduced tidal flushing, and exotic vegetation by establishing TMDLs for sediment and invasive exotic vegetation.

The primary stressors identified by USEPA are sediment input, sediment reshaping, the tide gates, levees, and invasive exotic vegetation. TMDL development requires the determination of endpoints, or water quality targets, to address the stressors of the impaired waterbody. The TMDL targets are the conditions that support attainment of applicable water quality standards for Ballona Creek Wetlands. The translation of the State"s narrative water quality standards to numeric targets that will achieve the protection of the beneficial uses for the wetland is accomplished by setting targets for an ecologically functioning wetland that will support the designated beneficial uses. The numeric targets representative of an ecologically functioning wetland should ensure the presence of diverse habitat types in appropriate proportions and at reasonable elevations for those habitat types. In an ecologically functioning wetland, there is a direct relationship between the diverse composition of habitats in a wetland and its support of the flora and fauna. Beford (1999) concludes that wetland function is closely related to landscape, and therefore, cumulative alteration of landscapes is the greatest constraint on restoring wetlands. Thus, restoring the ecological functions lost due to the impacts from sediment should address the impairments of habitat alteration hydromodification, and reduced tidal flushing. Exotic vegetation will be addressed by minimizing the invasive exotic species.

4.2 BASIS FOR THE WETLAND REFERENCE

Estuarine wetland systems include a variety of different habitats; each contributes to a unique ecological function and is therefore necessary to restore the beneficial uses at the Ballona Creek Wetlands. Without the presence of diverse habitats, wetlands may not be capable of healthy ecological function. Some habitat types are now absent or significantly reduced from the Ballona Creek Wetlands area and need to be re-established to achieve the habitat-related beneficial uses. In addition to past activities altering habitats, existing wetland habitat conditions exacerbate the impaired condition. Specifically, habitat patchiness and connectivity decrease a region"s ability to effectively restore habitat beneficial uses. Numerous, small patches of habitat areas tend to increase edge effects that degrade habitat quality (e.g. colonization by invasive exotic plants is greater on habitat edges). Connectivity of similar habitat types allows migration of plant and animal species, which can be important to survival when local conditions change. Therefore, in restoring habitat beneficial uses at the Ballona Creek Wetlands, larger and continuous habitat areas are generally preferable to smaller discrete habitat areas, which are representative of current conditions in Ballona Creek Wetlands.

Since the majority of southern California coastal wetlands have been significantly altered or reduced, it was not possible to identify another Southern California coastal wetland as the basis for comparison. There are several coastal wetlands in Southern California currently undergoing restoration and the ecological functions identified as appropriate goals are similar to those considered in this TMDL (e.g., San Dieguito Wetland Restoration Project; Ormond Beach Wetland Restoration Project, South San Diego Bay Wetlands Restoration Project).

USEPA evaluated the available historical information for Ballona Creek Wetlands and found that the best information indicative of the characteristics of an ecologically functional Ballona Creek Wetlands is the study on the historical T-Sheet maps for California coastal areas, which show specific habitats hand drawn and observed by scientists of the US Coastal Survey (Gosselinger 2011) (see Section 2.4.1). Based on T-Sheet maps, habitat composition and proportions reflective of a once functioning Ballona Wetlands were evaluated. The habitat composition, proportion and extent of other Southern California coastal wetlands were also assessed to determine the appropriate habitat composition for Ballona Creek Wetlands. Historic habitat distributions are known and can be discussed in terms of percent areal distribution. Hand drawn maps from 1870‟s were used to identify the habitat distributions representative of a period before the large-scale anthropogenic activities began to affect the waterbody.

4.3 Basis for Numeric Targets

The T-sheet maps establish a reference point for Ballona Creek Wetlands. By establishing comparable habitat distributions observed in historically functioning Ballona Wetlands and other Southern California coastal wetlands, ecological function and beneficial uses similar to a natural ecologically functioning coastal wetland can be restored in the current Ballona Creek Wetlands. The targets for achieving habitat-related beneficial uses can be estimated by examining the historic habitat distributions at the historic 1762-acre greater Ballona Wetland complex, and at other similar tidal marsh-tidal flat dominant Southern California wetlands (referred to as "Southern California Historic"). The historic habitat distributions were then proportionally applied to the existing area of the Ballona Creek Wetlands Ecological Reserve. For example, analysis of T-sheet data from Southern California Historic and from the historic greater Ballona Wetlands provided area proportions of each habitat type (e.g., subtidal, intertidal, mudflat, vegetated/salt marsh, etc.) (Table 6; Table 9).

USEPA‟s extensive analysis and assessment of appropriate wetland habitat goals included consideration of the following factors and references:

1. Historical extent of the greater Ballona Wetlands complex and its habitat proportions;
2. Historical habitat proportions observed in eight Southern California coastal wetlands;
3. Present-day boundary of habitat area available for restoration;
4. Current landscape modifications to the Ballona Creek Wetlands region and its environs.

The historical extent of the greater Ballona Wetlands complex (based on the T-Sheet maps) included approximately 1762 acres of diverse wetland habitats and dynamic hydrologic conditions. Over the years, this wetland area has shrunk as a result of anthropogenic activities. The current property boundary of Ballona Wetlands Ecological Reserve includes roughly 626 acres; this boundary area was overlaid on top of the historical extent of Ballona Wetlands to calculate the areal extent of habitats observed within the present day boundary to show the types of habitats that existed in the same area historically (Figure 18; Table 7).

Figure 18. Historical habitat composition of Ballona Creek Wetlands within present-day boundary (modified from Grossinger et al. 2011 and Dark et al. 2011).

Since present-day Ballona Creek Wetlands is a remnant of a larger wetlands complex, this TMDL also considered and evaluated the habitat compositions and associated proportions of the historic southern California wetlands. The data calculated from the historic southern California wetlands T-Sheet mapping provide the overall habitat types and associated proportions for all of southern California. Analysis of historic T-sheet data[5] from tidal marsh-tidal flat dominated wetlands in southern California provides the percent area of each habitat type present in those wetlands.

According to CDFG‟s estimates of the different habitat types and landuses in the property boundary of the Ballona Creek Wetlands Ecological Reserve, the approximate acreage of roads, levees, parking lots, So CA Edison roads and plant facilities total 85 acres. In developing functioning wetland habitat targets to establish a healthy wetland ecosystem in the current boundary area, it was appropriate to consider the current landscape of the wetland area, which includes roads and other uses that will be minimally to moderately modified. Consequently, to account for these uncertainties in the future restoration efforts, we subtracted 85 acres from the total of 626 acres to estimate the available habitat acreage to be addressed or restored with a high level of certainty; this resulted in approximately 541 acres that can be addressed by restoration, best management practices or relevant activities.

USEPA considered multiple methods of computing target habitat percentages that evaluated both the naturally diverse reference habitat composition observed from the T-Sheet maps and the current areal limitations of the remaining Ballona Creek Wetland region. The purpose of habitat targets is to provide goals that would lead to a functioning wetland ecosystem that meets the water quality objectives identified in the State‟s basin plan and supports the multiple beneficial uses listed in Section 3. To achieve this wetland goal, the available reference information on habitat proportions was applied to the available habitat acreage in the current Ballona Creek Wetlands. By establishing a diverse habitat composition as the goal, this will ensure a healthy functioning wetland ecosystem in the Ballona Creek Wetlands.

The methods considered primarily apply a historical habitat proportion to the current available wetland acreage for restoration. These include the following:

1. Use habitat proportions from the greater historical Ballona Wetlands complex (1762 acres).
2. Use habitat proportions from the historical Ballona Wetlands bounded by current property boundary (626 acres).
3. Use habitat proportions calculated from the specific habitat means averaged across eight Southern California wetlands, which would inherently include the range of variability observed at these wetlands.

[5] Grossinger et al. 2011. Historical Wetlands of the Southern California Coast: An Atlas of US Coast Survey T-Sheets 1851-1889. Accessed online May 2011 at http://www.sfei.org/projects/SoCalTSheets. From 1851-1900, the US Coast Survey produced maps of coastal features at a large scale (1:10,000) which were referred to as T-sheets. They depict the distribution and abundance of different wetland habitat types along the coast of southern California prior to major coastal development by Europeans. The T-sheets were difficult to access in the past because they are stored in the National Archives and high-quality digital reproductions did not exist. The report referenced here obtained high-quality digital reproductions, and interprets the original T-sheets with the aid of other historical tests and drawings.

The first method referenced a larger wetland complex that would be challenging to achieve under current conditions. Although habitat proportions would be used and not the actual historical acreages, there is a large uncertainty with the assumption of a linear relationship between habitat size and habitat proportions. In addition, this approach assumes actual acreage size is independent of habitat proportions. Since wetland ecosystems are highly dynamic, in particular coastal wetlands, we expect the natural areal extent of the coastal wetland to change with tides, precipitation, and other hydrological variables. Although T-Sheet maps are useful and appropriate as a resource for providing a reference condition for a healthy functioning ecosystem in Ballona Creek Wetlands, the map for Ballona Wetlands complex is a snapshot in time and does not show the variability of the areal extent and hydrological conditions that affect the habitat compositions. The second method harbors similar uncertainties as the first method. In addition, the smaller area does not capture the large variability expected from a whole functioning wetland.

To address the natural variability expected from a dynamic coastal wetland with the best available reference data to date, we examined the habitat proportions for eight Southern California coastal wetlands and computed average percentage of total found for each habitat observed across eight Southern CA wetlands (Table 9).

Expected range of natural variability was captured by evaluating multiple wetlands. Furthermore, to increase our understanding of the variability expected from wetlands, the standard errors were calculated for the habitat means of four distinct habitats (e.g., intertidal, subtidal, vegetated (salt marsh) and salt flat) and eight Southern California coastal wetlands. To ensure confidence in the selected target habitat proportions, the 95% confidence interval was calculated (this is roughly equivalent to two standard deviations from the mean); this resulted in a range for each habitat type (Table 9). This TMDL set targets based on the lower range of the CI to provide the minimum target acreage set for each habitat (Table 10); a maximum was not set since higher wetland acreage is encouraged. USEPA believes that setting these minimum critical wetland habitat target acreages for intertidal, subtidal, salt flat and vegetated wetland will lead to a healthy and functional wetland ecosystem. Due to the modified environment surrounding Ballona Creek Wetlands today, it was appropriate to expand the vegetated wetland category to include salt, brackish, and freshwater marsh. This increased scope recognizes the naturally dynamic climatic condition (i.e., precipitation pattern) which can influence tidal and seasonal flow. The goal of the TMDL is to establish a diverse composition of wetland habitats that reflects a healthy, functioning wetland region.

Table 9. Habitat percentages based on Ballona Historic and average of 8 Southern CA wetlands' habitat proportions (Gossinger et al. 2011).

Habitat Type	Habitat Distributions	
	Average Habitat % of 8 So CA Historic Wetlands[1,2]	Average Range of 8 So CA Historic Wetlands[4] (%)
Subtidal[3]	9	4 – 11
Intertidal	20.2	16 – 25
Vegetated Wetland (Salt Marsh)[5]	67.8	64 – 72
Salt Flat	3	1– 6
TOTAL	100	NA

[1] These eight Southern California coastal wetlands include Alamitos Bay, Ballona, Bolsa Chica, Carpinteria, Mugu, Newport Beach, Seal Beach, and Tijuana.

[2] For comparative purposes, the habitat proportions estimated from the greater Ballona Wetland complex of 1762 acres are 6% subtidal; 16% intertidal channel/mudflat; 70% vegetated (salt) marsh; and 8% salt flat.

[3] The subtidal habitat includes the sum of subtidal water and open water because both categories are similar and not easily distinguishable.

[4] Range is based on calculating the 95% Confidence Interval which generated a range; this provides a 95% confidence that the applicable percentage is in this range. Percentages are rounded up for the final report.

NA Since this column shows the lower and upper range of the 95% confidence interval, the sum of the categories does not necessarily add to 100%.

[5] The T-Sheet maps identified vegetated wetland as a unique habitat category to include primarily salt and brackish marsh habitats; however, analysis of the historical ecology of Ballona Creek Watershed suggest these habitats are dynamic and freshwater marsh may have shifted into areas identified as vegetated wetland (Dark et al. 2011).

Table 10. Habitat Acreage Numeric Targets.

Habitat Type	Habitat Numeric Targets[2] (Acres)	Applicable %
Subtidal	22	4
Intertidal	87	16
Vegetated Wetland[1]	346	64
Salt Flat	5	1
TOTAL	460[3]	

[1] For this Ballona Creek Wetlands TMDL, vegetated wetland includes the following habitat types: salt marsh, brackish marsh, freshwater wetland, seasonal wetland, and low, mid, and high marsh.

[2] The specific habitat numeric targets are calculated by applying the applicable % to 541 acres available for restoration (difference between 626 total acres in Ballona Creek Wetlands and 85 acres of roads, etc.).

[3] The total amount of 460 acres does not account for upland and transitional habitats, which are expected to make up the additional habitat acres.

4.4 TIDAL ELEVATION

Tidal inundation regime is defined as the frequency, duration and depth of water reaching the plain of estuarine tidal marshes. Inundation regime exerts significant control across the marsh plain in the chemical and physical properties of marsh soils with accompanying changes in the biological community. The depth and period of tidal inundation are major influences on the types of habitats a wetland supports. Restoring the beneficial uses at the Ballona Creek Wetlands likely requires establishing inundation frequencies and times that reflect natural tide cycles and rainfall patters in the Ballona Creek Wetlands and the upstream watershed. This may occur by achieving appropriate grade elevations. Elevations associated with wetlands habitat types in southern California are known from various hydrological studies (Table 11). The areal extent of numeric targets for elevations to reduce impacts of hydromodification would be similar to the habitat areas previously described, but defined by elevations rather than plant species assemblages.

Table 11. Elevation ranges associated with wetland habitat types in Southern California tidal wetlands (based on Zedler 2001 and modified from PWA 2008).

Habitat Type	Elevation (ft NAVD)	
	Lower Range	Upper Range
Subtidal	-3.0	-0.2
Intertidal	-0.2	3.6
Low Marsh	3.6	4.6
Mid Marsh	4.6	6.3
High Marsh	6.3	7.3
Transition Zone	7.3	9.6
Upland	9.6	NA

NA – an upper range for elevation is not expected for upland habitats.

The targets for achieving habitat-related beneficial uses can be expressed in terms of elevations associated with different habitat types, and based on either the historic distributions of habitats at the historic 2000 acre wetlands, or historic southern California wetlands. The preferred distributions as percent areas of a wetland system can then be applied to the existing area of the Ballona Creek Wetlands. The T-sheet analysis used to provide the percent area of each habitat type in Ballona Historic and Southern California Historic can also provide the elevation ranges needed to achieve those habitat types (Table 12). The necessary habitat distributions would be determined by taking the lesser values of the two provided in order to obtain conservative estimates of the elevation ranges that would be needed to achieve the desired habitat types and restore ecological function and beneficial uses at the Ballona Creek Wetlands. The final habitat proportional acreages and associated elevations are the numeric targets in this TMDL (Table 12). For clarification, this TMDL is addressing those increased upland habitat areas that are undeveloped and currently located in the Ballona Wetland Ecological Reserve slated for restoration.

Table 12. Target Elevation and Habitat Acreage for Ballona Creek Wetlands.

Elevation Range (ft NAVD)	Habitat Distributions[1]	
	Applicable %	Habitat (Acres)
-3.0 to -0.2 (Subtidal)	4	22
-0.2 to 3.6 (Intertidal)	16	87
3.6 to 9.6 (Vegetated Wetland)[2]	64	346
6.3 to 9.6 (Salt Flat)	1	5
TOTAL	>85%	460

[1]Historic proportions based on average historic habitat proportions of eight Southern CA wetlands (Gossinger et al. 2011).
[2] For this Ballona Creek Wetlands TMDL, vegetated wetland includes the following habitat types: salt marsh, brackish marsh, freshwater wetland, seasonal wetland, and low, mid, and high marsh.

4.5 EXOTIC VEGETATION

Exotic vegetation impairs the habitat-related beneficial uses of the Ballona Creek Wetlands. To reverse the loss of habitat available to support the WILD, RARE, MIGR, SPWN, and WET beneficial uses at Ballona Creek Wetlands, invasive exotic vegetation should be eliminated. This TMDL is addressing invasive exotic vegetation species since these are the species most detrimental to the support of a functioning habitat and related beneficial uses. Invasive plant species have an extremely high rate of growth and reproduction in the Wetland and can lead to significant proliferation, water quality impairment, and elimination of native habitat. Furthermore, invasive species often are transported from other waterbodies or habitats, can quickly establish new populations of nuisance wetland species, and thus, contribute to non-attainment of the designated uses. To facilitate the removal of highly invasive exotic vegetation from the Ballona Creek Wetlands, this TMDL identifies invasive exotic vegetation species by referencing two California exotic plant lists.

This TMDL is setting a goal of zero or 10% extent of coverage of invasive exotic plant species for those species listed on either the California Invasive Plant Council"s (CA IPC) Invasive Plant Inventory List or the California Noxious Weed List. For those species listed on the California Noxious Weed List or rated as a “high” or “moderate” on the CA IPC List, numeric target is set at zero. For those species rated as “low” on the CA IPC List, the numeric target is set at 10% to accommodate situations in which removal of these particular species would cause more disturbances to the habitat. These numeric targets for invasive exotic vegetation are set because the presence of these species quickly results in habitat loss and impairment of beneficial uses.

5 Source Assessment

This section describes the source of the pollutant impact to Ballona Creek Wetlands.

5.1 Point Sources

Point sources, according to 40 CFR 122.3, are defined as direct discharges of a pollutant from an identifiable, confined, and discrete conveyance point into a waterbody (e.g., pipe, ditch, channel). These discharges are regulated through the federal National Pollutant Discharge Elimination System (NPDES) program, which is delegated to the state of California and implemented by the Regional Boards through the issuance of Waste Discharge Requirements (WDRs). Urban runoff is considered a point source and regulated under stormwater NPDES permits.

5.1.1 Stormwater

The Ballona Creek Watershed drains into Ballona Wetland and Estuary; the NPDES permits in the watershed includes the Municipal Separate Storm Sewer System (MS4) permit issued to the County of Los Angeles, the Statewide stormwater permit issued to the California Department of Transportation (Caltrans), the statewide Construction Activities Stormwater General Permit, and the statewide Industrial Activities Stormwater General Permit. These stormwater discharges are considered point sources because they flow into a stormwater conveyance system that ends in Ballona Creek and Ballona Creek Wetlands. The MS4 permit was last renewed in December 2001 (Regional Board Order No. 01-182) and is on a five-year renewal cycle. Currently, the MS4 permit is in its renewal stage and the Regional Board plans to issue a revised MS4 permit in May 2012 (Regional Board Hearing Workshop Item November 10, 2011).

The MS4 system collect commingled discharges from the Ballona Creek Watershed and drain into the Ballona Creek and Wetland receiving waterbodies. The MS4 permit covers multiple jurisdictions, which are responsible for discharges into Ballona Creek and Wetland. The cities of Los Angeles, Culver City, Beverly Hills, Inglewood, West Hollywood, and Santa Monica are the responsible jurisdictions and responsible agencies for the Ballona Creek Watershed. These cities are jointly responsible for complying with the existing Ballona Creek and Estuary waste load allocations in each reach and estuary draining into the wetland. Sources covered by the general construction and general industrial stormwater NPDES permits also discharge flows which reach Ballona Creek and Wetland (typically less than 1 MGD) and have direct discharges further upstream in the watershed.

5.1.2 Caltrans

The California Department of Transportation (Caltrans), a department of the State of California Business, Transportation, and Housing Agency, is responsible for operating and maintaining the state highway system within the State of California. Caltrans is regulated by a statewide storm water discharge permit covering all municipal storm water and construction activities (California State Water Resources Board Order No. 99-06-DWQ). This statewide permit authorizes storm water discharges from Caltrans properties such as the state highway system, rights-of-ways facilities, and construction activities. Caltrans has developed a Storm Water Management Program to comply with statewide NPDES stormwater permitting requirements. The permit is currently undergoing the process of being reissued and will be superseded by a new permit when the Tentative Order is adopted by the State Water Board and approved by the USEPA (State Board Order No. 2011-XX-DWQ). The discharges from Caltrans properties and facilities flow into a City or County storm drain and similar to the Ballona Creek TMDL for metals (State Water Board Resolution No. 2005-0078). However, Caltrans is responsible for the maintenance, and in some cases construction, of roads and highways in the Ballona Creek Wetland and Watershed.

5.1.3 Ballona Creek Watershed Sediment Loading

The Ballona Creek watershed covers approximately 130 square miles (340 km^2) with landuse areas dominated by urban use: 64% residential, 8% commercial, 4% industrial, and 17% open space. Ballona Creek is an 8.8 mile (14.2 Km) long waterway, whose watershed drains some of the major cities in the Los Angeles County. Ballona Creek is one of the largest drainage channels that discharges into Santa Monica Bay. The potential for sediment loading into the Wetland is associated with the flow coming down the watershed. Sediment moves from the watershed down the drainage channels or MS4 system as a result of storms, wind and land based runoff. Major storms usually take place in winter and are responsible for major movements of sediment, both transport and deposition down the watershed into Ballona Creek, Ballona Wetland towards the coastal waterbodies. These activities can lead to discharge of large quantities of sediments in runoff from rivers and flood control channels (USACE 2003).

USEPA principally considered two available estimates of Ballona Creek Watershed sediment loading to Ballona Creek and Wetlands: Inman and Jenkins (1999) and USACE (2003a, 2003b). Inman and Jenkins (1999) estimated the watershed sediment loading in Ballona Creek, based on flow and total suspended sediment data to be approximately 10,800 m^3/yr (14,126 yd^3/yr) (Inman and Jenkins reported a total mean annual sediment flux of 0.014 x 10^6 tons/yr; to calculate the comparable volumetric sediment loading, a typical sediment density of 1.3 MT/m^3 was used). One USGS gage (USGS 11103500) was used to determine sediment loading in Ballona Creek. The drainage area of the gage is 232 km^2 (draining about two-thirds of the Ballona Creek watershed) and the period of record used was 1928-1995 with only one year of break (1968-1969). The watershed is considered to be extensively developed.

According to the study, the annual net yield (mean TSS load over the drainage area) is 0.6 (ton/yr)/ha. Individual drainage areas were considered by breaking the study streams into regional provinces. These analyses illustrated that urbanized areas with extensively modified river channels had the lowest sediment loading. Therefore, the low yield in Ballona Creek is attributed to the extensive impervious cover and river channels.

The sediment fluxes recorded characterize the flux of load material measured (or assumed to occur) within the streamflow from 10 centimeters above the streambed to the surface. This suspended load includes the wash load of silt and clay sized material and some sand. Estimates of the coarser bed load material are not included in these suspended load estimates. Bed load is difficult to measure directly and is often inferred from material retained in river deltas and debris basins. In Inman and Jenkins (1999), it is assumed that rivers with drainage basins greater than 500 km^2 had 10 percent bed load relative to the total load and that for smaller streams the percentage of bed load is 15 percent or more. No direct measurements of total load transport on the rivers were presented in this study.

The other significant study considered by USEPA was published by the USACE (2003a, 2003b). According to the Draft EIR/EIS Ballona Creek Sediment Control Management Plan (USACE 2003a) and the Marina Del Rey and Ballona Creek Feasibility Study, Supplemental Analyses Appendix (USACE 2003b), the estimated amount of sediment discharged by the Ballona Creek Watershed is approximately 58,354 yd^3/yr (44,615 m^3/yr). This loading consisted of 39,760 m^3 of sand and 4,855 m^3 of silt and is based on the total sediment load accumulated at the channel mouth. In a more recent USACE report (Coastal Engineering Appendix of the 2009 Ballona Creek Ecosystem Restoration Feasibility Study), the USACE‟s 1998 Marina Del Rey Shoaling and Disposal Feasibility Study is cited and presents an average annual sand yield of Ballona Creek of 52,004 yd^3/yr (39,760 m^3/yr) (USACE 2009). According to the 1998 feasibility study, the primary sources of sediment loading are sediment yield from Ballona Creek and longshore transport (USACE 2009).

In addition to the two studies described above, several other reports were reviewed to determine whether they had pertinent, numerical loading values to characterize the current sediment load from the Ballona Creek Watershed. For instance, the results were consistent when suspended sediment sampling data from County of Los Angeles and Southern California Coastal Water Resources Project (SCCWRP) were compared to Inman and Jenkin‟s Ballona Creek sediment flux estimates. Some additional studies were identified with numerical information; however, the scale of their drainage area and/or the portion of the total sediment load presented was determined to be too small to fully represent the total loading from the entire drainage area.

Specifically, sediment transport is defined by bed load, suspended load, settleable load, and wash load, where bed load is the part of the total load that is in frequent contact with the bed during transport and suspended load describes the part of the total load that moves without frequent contact with the bed (wash load is frequently included with suspended load) (Schwartz 2005). Furthermore, sediment production is highly dynamic and dependent on the variable conditions of land use, water management, and hydrological conditions with the Ballona Creek Watershed. As such, USEPA believes the more conservative USACE sediment load estimate of 58,354 yd^3/yr, based on suspended sediment, settleable load, and bed load, is more reflective of the total load that is transported from the Ballona Creek Watershed to the Creek and Wetland. For a list of the studies and reports that USEPA used to assess the sediment loading into Ballona Creek and Wetlands, see Appendix A.

5.1.3.1 Ballona Creek Watershed Sediment Yield

Watershed modifications, including urbanization, influence downstream suspended sediment concentrations. Although, it is difficult to attribute specific changes in concentrations to specific land use changes, studies in California have demonstrated that land use composition of watersheds influence trends in downstream suspended sediment concentration. For instance, Willis and Griggs concluded that many rivers in California are experiencing lower sediment supply and decreased sediment loads for equivalent discharge events (2003). Particularly, the Los Angeles urban area was found to have the lowest sediment yield, despite having the highest rainfall, when compared to nearby areas. Inman and Jenkins‟ (1999) estimates of streamflow and sediment flux for 20 rivers in Southern California showed that Ballona Creek had the second lowest total sediment flux. Inman and Jenkins suggested that this low yield is associated with the extensive hard cover (streets and river channels) (1999). They also found that sediment flux during wet periods is approximately five times higher than during dry periods (Inman and Jenkins, 1999).

While these studies were not specific to the Ballona Creek Watershed, they did include nearby watersheds with similar land use and impervious cover characteristics; therefore, their conclusions are expected to apply to Ballona Creek. Studies in the Ballona Creek Watershed show that seven percent of the watershed is impounded by a dam; however, this does not appear to impact the overall sediment load (Willis and Griggs, 2003). Other factors in the watershed do impact the sediment load, including the extensively developed area (over 80% of the watershed is developed) and lining of the channel. The increased urban area reduces the amount of pervious cover that is subject to erosion. Urbanization also increases the velocity of flow, which would typically cause scouring in natural channels, thereby increasing the sediment load; however, the Ballona Creek is largely a lined channel so the natural bottom is not present to contribute additional sediment load. Sedimentation rates to the Ballona Creek Wetland are slow due to low sediment supply from the Ballona Creek Watershed (PWA, 2008). These estimates support the low sediment yield from Balllona Creek Watershed into the Wetlands.

5.1.4 Playa Vista Freshwater Marsh

The Playa Vista Freshwater Marsh is also a potential source of sediment loading into the wetland during high storm events when sediment is transported along with flow. The Freshwater Marsh was designed to capture all flow up to a 1-year storm flow, which represents approximately 90% of all flows. For storm events greater than the 1-year storm flow, the freshwater will spill over into Area B. (Playa Vista built a sluice gate that can be opened and lead to continuous freshwater flow to Ballona). The Freshwater Marsh diverts freshwater flows from existing and new development away from the existing Ballona Creek Wetlands salt marsh. During most runoff events, the Freshwater Marsh will discharge into Ballona Channel directly through flap-gated culverts; however, an overflow spillway is provided into the Ballona Creek Wetlands to divert major storm flows (over 1-year storm levels). The Freshwater Marsh is divided from the Ballona Creek Wetlands by a berm. Under normal conditions, storm flows greater than a 1-year storm will flow over the overflow spillway into the existing Ballona Creek Wetlands. The storm overflow drains through the East, South, and North Wetland portions of the Ballona Creek Wetlands and outlets into Ballona Channel.

USEPA does not expect the Freshwater Marsh to be a significant source of sediment loading into the wetland. However, since the Freshwater Marsh is only designed to treat 1-year storm events, storm events greater than 1-yr storm flows will lead to overflow into Ballona Creek Wetlands Area B. A load allocation (LA) for invasive exotic vegetation will be given to the Freshwater Marsh. This LA will control for invasive exotic vegetation that may be transported from the Freshwater Marsh into Ballona Creek Wetlands. Furthermore, in the Purchase Agreement Summary between the State and relevant entities, it states, “The State is not releasing Playa from any liability for the clean up of hazardous materials, if any, required under applicable law” (California Resources Agency 2003).

The Playa Vista development applied and received a 404 permit from the Army Corp of Engineers. The 404 Permit recognizes the Freshwater Wetlands System as having multiple purposes and states that those purposes are: (1) improve the quality of urban runoff entering the Ballona Creek Wetlands and Santa Monica Bay, reducing existing water quality impacts to the area and aiding in the national program for improvement of water quality from urban runoff; (2) provided ecologically-sound flood control facilities for the Playa Vista First Phase Project; and (3) provide wildlife habitat enhancement in an area where severe habitat degradation had occurred. The 404 Permit, the 401 Certification, the CCC Certification, CDP, and the HMMP established performance criteria that are designed to take into account the specific conditions of the adjacent Playa Vista First Phase Project and the Proposed Project and allow the Freshwater Wetlands System to function in its water quality, flood control, and habitat enhancement capacities (Performance Criteria). These performance Criteria are conditions and requirements of the 404 Permit, the 401 Certification, and the CCC Certification and , as such, are “regulatory standards” as that term is used in the Draft Los Angeles CEQA Thresholds Guide. The constructed Freshwater Marsh, managed by the Ballona Wetlands Conservancy, is not part of the Ballona Wetlands Ecological Reserve property. It maintains separate treatment from Ballona Creek Wetlands and is covered under the Los Angeles County MS4 Permit.

5.1.5 Sanitary Storm Drains and Sewers

There is evidence of a 20-ft wide sanitary sewer and storm drain easement to the City of Los Angeles that runs north to south through Area A and Area B west of the SoCalGas Company Road. This line was closed in 1958 and likely not causing discharge from the storm drain into portions of the Wetland (PWA 2010).

5.2 NON-POINT SOURCES

A nonpoint source is any source of water pollution that does not meet the definition of a point source, such as runoff, drainage, seepage, atmospheric deposition, and discharges to water of the US and/or State via natural overland flow or discharge. In the Ballona Wetland area, non-point sources are the primary sources of pollutant loading and impact. The largest source of impact is due to historical developmental activities that have led to a legacy of excess sediment loading in the wetland areas.

5.2.1 Historic Sources

The physical and ecological habitat of Ballona Creek Wetlands has suffered the largest impact in the last century. Hydromodifications and discharges of dredged spoils and fill have caused significant changes in the size and function of the coastal wetland in Ballona. Perhaps the largest modifications to the physical make-up of the wetland have been the construction of the Ballona Creek Flood Control channel, conversion of saltmarsh to agricultural areas in Area B, construction of Culver Boulevard through Area B, and the deposition of dredged and fill sediment on Area A during the construction of the Marina del Rey Harbor.

The construction of railroad tracks and roads has bisected the wetland and consequently, altered the natural dynamic flow behavior of both freshwater and tidal flow. In the 1900‟s, the Pacific Electric Railroad to Playa Del Rey was extended through parts of Areas A, B and C (Sanders, 2000). The impact of this was the placement of fill sediment to elevate the tracks above the tidal elevation. Since then, the railroad tracks have been removed, but the fill remains, creating upland areas within the wetland. The commercial agricultural activities from the 1930‟s up to 1985 caused the filling in of tidal channels with farming operations, and thus, excess sediment and agricultural spoils. When oil and gas production began in the 1920‟s, sediment fill was placed in the wetlands to construct and raise platforms to protect oil and gas facilities from extreme tides. This resulted in burying pockets of the habitat areas which created depressions that pond water (Straw, 2000).

The US Army Corp of Engineers constructed the Ballona Creek flood control channel in the 1930"s. During the extensive construction and channelization of the Ballona Creek, the wetland experienced significant impact due to sediment accretion, deposit of dredge spoils, and the alteration of the natural hydrology of the Creek and wetland. The straightening of Ballona Creek by the Army Corps of Engineers (USACE) in the 1930"s significantly altered the freshwater and tidal flow in Ballona Creek Wetlands. But, more important for this TMDL was the addition of sediment material (i.e., dredge spoils) from the construction of the channel, which was than "sidecast" north of the channel in a broad band approximately 300-400 feet wide. The excavation of Marina del Rey and the disposal of the dredged sediment fill from that project to the remaining wetlands north of Ballona Creek (Areas A and C) buried the marsh surface and drainage channels and raised the land 12 to 15 feet above mean sea level (MSL), above the elevation of tidal inundation (PWA 2006).These anthropogenic activities have left a legacy load of sediment in the former and existing wetland, and has eliminated and reduced the natural ecological functions of a coastal wetland.

This TMDL addresses the impact of excess sediment placed in the Wetlands during the construction activity of the Channel. The operation and maintenance of the flood control channel was subsequently transferred to the LACFCD. The LACFCD is responsible for providing regional flood protection through the maintenance and operation of the flood control facilities under its jurisdiction.

The 1998 Marina Del Rey Shoaling and Disposal Feasibility Study (cited by USACE 2009) analyzed historic shoaling rates in the Marina Del Rey entrance channel for three periods of time; July 1965 to July 1991, July 1991 to August 1997, and July 1965 to August 1997 (Note: shoaling is the buildup of sediment that forms sandbars). Based on hydrographic survey data and dredging records, the total volume of sediment input into the Wetlands from July 1965 to July 1991 was 949,973 yd^3 (USACE 2009). Additional data from USACE showed that approximately 1,557,000 cubic yds of material was removed from Marina del Rey and placed in Area A of Ballona Creek Wetlands.

The largest source of sediment to Ballona Creek Wetlands is due to anthropogenic placement of fill in Areas A, B and C. Since data associated with sediment loading from each historic anthropogenic activity (i.e., railroad construction, agriculture, Marina Del Rey excavation, etc.) do not exist and is very difficult to determine, USEPA believes that an aggregate approach is sufficient to comprehensively estimate the accretion of anthropogenic sediment in the wetland.

An assessment of the historic volume was completed by comparing the difference in sediment volume between the 1870s and 2005. These sediment volumes and areas were estimated by comparing wetland elevations in the late 1800s with the current elevations in the wetland area. Specifically, historic sediment volume was determined in GIS by calculating the volume between the existing topography (from PSOMAS 2005) and mean higher high water (5.2 ft NAVD). The mean higher high water was used as the typical historic elevation of a vegetated high marsh wetland habitat. Historically, this vegetated high marsh wetland habitat dominated the Ballona Wetlands Area according to Historic Wetlands of Southern California Coast Atlas (Grossinger et al. 2011). The estimated sediment volume is limited to the extent of historic wetlands mapped. Therefore, since the eastern portion of Area C is not mapped as historic wetland, legacy sediment placed in that area is not included (PWA 2011). The total estimated volume of legacy sediment volume placed in the Ballona Creek Wetlands between the 1870s and 2005 is 3.1 million cubic yards (2.1 million cubic yards for Area A; 700,000 cubic yards for Area B; and 300,000 cubic yards for Area C) (Table 13). These estimates are comparable with the USACE (2003a; 2003b) report stating approximately 1,557,000 cubic yards were removed from Marina del Rey and deposited in Area A, and 942,000 cubic yards of material deposited in Area C (only a portion of Area C is identified as requiring restoration to wetland habitats).

USEPA believes these are the best available estimates of the deposited sediment volume into Ballona Creek Wetlands. Although this is a common technique and provides a reasonable best estimate of the sediment accretion, USEPA recognizes there are inherent assumptions and uncertainties with these estimates. For instance, studies evaluating the accuracy of historical maps, digital renditions and aerial photographs across different years can lead to error estimates that range between 10% to 20% (Halls and Kraatz 2006; Ellis and Wang 2006). These spatial error analyses suggest these type of calculations capture 80-90% of the real geographical changes or landscape information. This is due to uncertainties and assumptions associated computing and quantifying spatial variability and accuracy of historical maps, current geographical information, and aerial photographs (i.e., true map class categories). Since Ballona Creek Wetlands are modified and surrounded by a highly urbanized watershed, the relationship between current hydrologic conditions, a changing tidal range, future storm frequency, sediment watershed supply, and expected sea level rise need to be quantified.

Consequently, USEPA believes it is critically important to conduct field verification monitoring during and after restoration planning to evaluate further the specific applicable amount of legacy sediment load to be removed from the each section of Wetland Areas A, B and C, that will result in achieving the habitat target acreages. Specifically, a detailed error analysis and field validation for Ballona Creek Wetlands should be performed to elucidate presently unknown variables, such as compaction and settlement over time, change in vegetation patterns, explicit sediment supply and loss for Areas A, B and C, and influence of other historic activities (e.g., agriculture and railroad construction). USEPA encourages a detailed monitoring study that evaluates the relationship between wetland habitat function, wetland stability, and excess sediment removal.

The legacy sediment volume is estimated as the volume of sediment placed in historic wetland areas in Areas A, B and C of the Ballona Creek Wetlands, including sediment placed across these areas and for levees, roads, and embankments. Table 13 shows the volumes and areas of legacy sediment placed in Ballona Creek Wetlands. Area A shows that the legacy sediment was placed in 139 acres, which covers 100% of the current total area; Area B shows that legacy sediment was placed on 166 acres or 50% of the total current areas; and Area C shows placement of excess sediment on 17 acres or 25% of the total current wetland area.

Table 13. Estimated volumes and areas of legacy sediment deposited in Areas A, B and C of Ballona Creek Wetlands (PWA 2011).

	Legacy sediment volume (cubic yards)	Area of legacy sediment placement (acres)	Total area (acres)	% of total area
Area A	2,100,000	139	139	100%
Area B	700,000	166	338	50%
Area C	300,000	17	64	25%
Total	**3,100,000**	**323**	**541**	**60%**

5.2.2 Southern California Gas Company

The Southern California Gas Company (SoCalGas) infrastructure includes 19 on-site wells, roads, underground gas pipelines and off-site facilities at the base of the Westchester Bluff. The presence of these infrastructure lead to some disturbance and impact to the Wetland habitat. Existing roads can lead to erosion and provide opportunities for invasive exotic vegetation to flourish if not maintained. This is further supported by the State‟s agreement with SoCalGas Company. In the Purchase Agreement Summary between the State and relevant entities, it states, “Southern California Gas Company is liable under existing law for contamination on the property, if any, associated with its wells and operations” (California Resources Agency 2003).

5.2.3 Fiji Ditch

Other current sediment loading sources potentially include Fiji Ditch. Fiji Ditch is located in the northwest edge of Area A, just below Fiji Way Road, and connects flow from the Marina del

Rey waters underneath Dock 52 and Fiji Way and along east of Fiji Way. There is another stormwater drainage ditch where flow from Marina del Rey passes underneath Lincoln Boulevard; it is not clear if this flows to Area A. After the dredging of Marina del Rey, water saturated soil was dumped into Area A, and the ditch allowed water flow between the Marina del Rey and Ballona Creek Wetlands. Fish species found in the salt marsh of Area B are also found here. According to Karina Johnston, biologist at Santa Monica Bay Restoration Commission, Round stingrays have been found in the ditch during certain tides and seasons to feed on invertebrates in the sediment. Currently, a portion of this ditch experiences tidal flow, but it is not clear how much flow, if any, passes between the Ballona Creek Wetlands and Marina del Rey.

The current tidal flow from Fiji Ditch potentially provides tidal flushing to Areas A, and is thus, beneficial to the functions of the Wetland, which currently receive little, if any, tidal flow. We conclude that the source of loading from Fiji Ditch is a minimal portion of the loading, if any exists. If flow does pass between the Marina del Rey and Ballona Creek Wetlands, this may support Wetland functions because it provides a source of tidal flow with limited suspended sediment.

6 Linkage Analysis

This section discusses how elevation and tidal inundation are linked directly to the target habitat composition and the respective proportions of habitat acres needed to achieve an ecologically functional wetland that supports the designated beneficial uses. The background discussion on the foundation of the scientific linkages between elevation and habitat represents a summary of the primary points reported in the Ballona Creek Wetlands Restoration Feasibility Report (PWA 2008).

Elevation is a major determining factor of habitat composition in wetlands. The hydrology of a given area within a wetland represents the water quality, salinity, hydroperiod and circulation patterns (Sullivan 2001). Hydrology is largely determined by the elevation, which is directly related to the frequency and duration of tidal inundation (Bockelman et al. 2002). Tidal inundation was one of the major determining factors of large scale spatial vegetation patterns in mediterranean-climate salt marshes (Pennings and Callaway 1992); the other determining factor was soil salinity, which was inversely correlated to tidal inundation. Both these factors were more important than interspecies competition in determining plant zonation.

Small variations in elevation occur across natural wetlands, creating habitat heterogeneity based on things like hummocks or depressions that drain/retain water at different rates, or soil texture and organic matter content which also affect drainage rates along with interaction with underlying soil layers (e.g. a sand or clay lens) (Sullivan 2001). This small-scale heterogeneity is important in providing the variety of microhabitats that result in diverse plant communities in wetlands; however, elevation more broadly does integrate hydrology of the site with several other factors that are important in wetland plant community function and is a good indicator of where particular plant species, i.e. habitats, will thrive (Sullivan 2001, Haltiner et al 1997, Pennings and Callaway 1992).

Elevation is also a major determining factor in benthic and fish community diversity (Williams and Desmond 2001). Several studies show that crustacean densities and fish use were lower in created marshes than in natural marshes, where the created marshes had higher elevations than the natural marshes. These differences were linked to water depth and submergence time, as well as biotic factors including competition and predation, which are controlled largely by marsh elevations (Williams and Desmond 2001).

At Ballona Creek Wetlands, habitat alteration has been mainly in the form of conversion from wetlands habitats to upland habitats or other non-wetland surfaces. In the historic salt marsh and other wetland habitats, elevations were at various levels below the highest high tide (Grossinger et al 2011). In the existing upland habitats, elevations are increased above historical and are generally above the highest high tides (PWA 2006). The conversion of varied wetlands habitats to fairly uniform uplands habitats occurred at Ballona largely as a result of two major influences: sediment accumulation resulting in increased elevations over large areas of the wetland, and channelization and bank hardening of Ballona Creek resulting in reduced tidal flushing and the lack of physical connection with the creek. As a result, the habitat diversity, ecological functions and beneficial uses at Ballona Creek Wetlands are severely impaired.

Historic T-sheet maps of Ballona and other southern California wetlands are described above (see Section 2.4.1). The T-sheets depict coastal wetlands as they existed prior to major modifications by European settlers. Various tidally influenced habitats such as salt marsh and intertidal mud flats provided beneficial uses including EST, WILD, RARE, MIGR, SPWN and WET, which are now impaired at Ballona Creek Wetlands due to the absence of those habitats.

To best characterize the linkage between sediment accretion, tidal elevation and critical importance of the diversity of habitat types, the following is included from the Ballona Wetland Feasibility Report (PWA, 2008):

The degree of tidal inundation is a major factor in influencing habitat type at Ballona and other wetlands. "The period, depth, and frequency of inundation by tidal water are dependent upon the tidal range, density of soil, degree of slope, and ground elevation." The ground elevations relate to particular habitat types as shown in Table 14 below.

Table 14. Elevation of the different habitat types (PWA 2008).

Habitat type	Lower NAVD (ft)	Upper NAVD (ft)	Lower % time tide exceeds	Upper % time tide exceeds
Subtidal	-5.0	-3.0	100	100
Intertidal channel/mudflat	-3.0	1.0	100	90
Salt pan	4.5	5.5	28	14
Low marsh	1.0	2.5	90	74
Mid marsh	2.5	3.5	74	50
High marsh	3.5	4.5	50	28
Transition zone	4.5	5.5	28	14

Shallow subtidal habitats, including channels, basins and other features, do not drain with the outgoing tides even at extreme low water. This estuarine water regime results in permanently flooded habitats and permanent open water bodies. These habitats are generally considered truly aquatic systems and are adjacent to and downslope from tidal estuarine wetlands. Intertidal channels and creeks support a complex assemblage of plants and animals in salt marshes. They also convey tidal waters with dissolved and particulate nutrients and dissolved gases and influence the species composition, distribution, and population dynamics of the channel fauna.

"Intertidal mudflats are situated low in the intertidal zone, between subtidal open water and vegetated salt marsh (low marsh), at the open water edge and along channel banks. Mudflats are inundated and exposed during most tide cycles. Mudflat habitat support invertebrate population and provides valuable foraging habitat, particularly for shorebirds.

Intertidal salt marsh ranges from low marsh, dominated by California cordgrass (Spartina foliosa), to a diverse mosaic of species that comprises the mid-marsh, to very high marsh species that transition to upland. Salt marsh vegetation changes gradually with elevation. Nearly every species has its peak occurrence at its unique elevational band and the vegetation forms a continuum rather than a set of zones. However, the presence of shrub-like succulents at the uppermost elevations and tall cordgrass at the lowest elevations helps to delineate low to high marsh.

Low salt marsh is regularly inundated by tides and is dominated by California cordgrass that forms dense monotypic stands. At its lower elevation, cordgrass intergrades with mudflat habitat;
at its upper elevation it intergrades with a mosaic of mid-marsh species. This highly productive species decomposes to form the base of the detrital food chain that supports many lower order estuarine consumers. Many of the animals of the low marsh are adapted to periods of frequent inundation.

Intermediate elevations within the salt marsh are inundated irregularly by tides but at a greater frequency than are higher elevations. As a result, the plant species that inhabit this elevation are adapted to highly saline soil conditions due to long periods of exposure. The animals of the midmarsh are abundant and diverse. Food is abundant in the form of algae and the epifaunal invertebrates and insects that feed on algae. In addition, when flooded by the tides, fish move into the marsh plain to forage on these abundant invertebrates. Several bird species such as the Beldings' savannah sparrow and light footed clapper rail also forage in this zone.

High marsh habitats are also irregularly to intermittently inundated by tidal water and generally range from saline to hypersaline conditions. The vegetation varies depending on the density of the soil (i.e. ratio of clay to sand), which often is correlated with salinity.

Salt pans form in the high marsh where drainage is poor. These higher elevation areas along the upland edge are only inundated during the highest spring tides and typically have no tidal channels. As a result, ponded areas are formed that become hypersaline as water evaporates, *thereby inhibiting vegetation establishment. These salt pans provide habitat diversity and have habitat value for foraging and refugia.*

The wetland transitional zone represents that area where the halophytic (salt-tolerant) and hydrophytic salt marsh vegetation overlaps with upland communities. Scrub-shrub plant species of the transition zone overlap with the highest of the salt marsh species. The animals at the higher elevations of the transition zone are primarily terrestrial species. The transitional zone may also include nontidal palustrine habitats both salt influenced and non-saline types. Seeps from perched water tables on deltas and the toe of slopes and along dune transitions often support a variety of palustrine emergent and scrub-shrub types. Seasonal wetlands also occur in this area, especially in low-gradient deltaic deposits and may include salt pans. Transitional zones provide refugia during extreme weather or tides, as well as foraging opportunities. These areas also support a unique set of plant species, which may only occur or coexist in the habitat conditions provided in these transition zones."

Restoring the proportional mix of wetland habitat types at Ballona Creek Wetlands will provide the connectivity needed for interdependent wetland ecosystem to function and achieve the beneficial uses that are currently impaired. The land elevations in the table above relate to specific wetland habitat types and can be achieved in proportions that are similar to average proportions in historic tidal marsh-tidal flat wetlands of the region. To achieve these elevations, accumulated sediment would have to be removed from the site or shifted from one location to another on the site. This TMDL addresses the impact of sediment accumulation due to the increased and changed elevation over large portions of the wetland. Addressing the sediment accretion will significantly reduce the impacts of hydromodification, habitat alteration and reduced tidal flushing. The process of restoring the natural habitat composition and elevations will also support native vegetation viability and prevent invasive exotic vegetation.

7 Total Maximum Daily Loads and Allocations

Federal regulations (40 CFR 130.7) require that TMDLs include load allocations (LAs) and waste load allocations (WLAs), and that the individual sources for each be identified and enumerated. The TMDL for a given pollutant and waterbody is the total amount of pollutant that can be assimilated by the receiving water while still achieving water quality standards. Once calculated, the TMDL is equal to the sum of individual WLAs for point sources, and LAs for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water. Conceptually, this definition is represented by the equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The regulations governing TMDL development provide for the expression of TMDLs as either mass per time, concentration per time or other appropriate measures (40 CFR 130.2(h)). USEPA is establishing two TMDLs for the Ballona Creek Wetlands, which is currently owned by the state of California and managed by the California Department of Fish and Game as a state ecological reserve. These TMDLs are calculated to address habitat alteration and exotic vegetation that result from the non-natural, large scale changes to the sediment inputs in the wetland as well as hydrological modifications and anthropogenic changes to the tidal flushing. As such, the TMDLs are written to attain habitat proportions and tidal elevations expected from a functioning coastal wetland that supports the following designated uses: wildlife habitat, estuarine habitat, migration of aquatic organisms, rare, threatened or endangered species, recreation, habitat for spawning and reproduction, wetland habitat.

Sediment is the identifiable pollutant in this waterbody causing habitat alteration and contributing to the spread of exotic vegetation and the negative impacts of hydromodification and reduced tidal flushing. The impact of sediment in a wetland is complex and influences many core variables/factors, such as habitat structure, geomorphology, hydrology and vegetation. Human or anthropogenic sources of sediment historically have led to significant alteration of the habitat structure, composition and acreage, in addition to excessive exotic vegetation and hydrologic modification of the tidal and freshwater flow. The pollutant targeted in this TMDL is sediment from the dredging of Marina Del Rey, sediment removal and movement due to road and levee[6] construction, and the channelization of Ballona Creek. The channelization of Ballona Creek exacerbated an already impacted problem due to the deposition of sediment from Marina

[6] Levees were identified as critical stressor in this TMDL during USEPA‟s stressor identification analyses. USEPA discusses the impact of the stressor, but does not necessarily suggest that restoration of Ballona Creek Wetlands would require the removal of the levees.

Del Rey. Deposition of these sediments from historic development, referred to hereafter as legacy sediments, have built up and altered (i.e., filled in, raised, shifted, etc.) the natural wetland area. The current sediment loading entering Ballona Creek Wetland from other parts of Ballona Creek Watershed are believed to be lower than the natural concentrations that existed before the large-scale development activities, and are likely not contributing to the impairments of the waterbody. Due to the extensive urbanization and development of Ballona Creek Watershed (80% of the watershed is developed with 40% of the watershed area covered with impervious surfaces), the watershed system is suffering from limited suspended sediment draining into the Wetland (Personal Communication Karina Johnston, October 20, 2011).

USEPA finds that the current habitat proportions, tidal elevation regime and sediment accretions are not reflective of a functioning wetland that meets the existing water quality objectives (See Section 3 for WQSs). This TMDL expresses the allocations in terms of proportion of habitat with needed tidal elevations and the amount of sediment loading that would have to be removed or reconfigured to attain water quality standards and protection of beneficial uses.

As such, this TMDL sets sediment wasteload allocations (WLAs) and load allocations (LAs) that are designed to meet the numeric targets for habitat acreage and tidal elevation and the water quality standards. See sections 7.1 and 7.2 for specific allocations. Allocations for invasive exotic vegetation are expressed as percentage of invasive exotic vegetation to be removed. Where applicable, federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available WLAs.

7.1 WASTELOAD ALLOCATIONS FOR SEDIMENT

These TMDLs establish wasteload allocations (WLAs) for sediment to address the impairments identified for the Ballona Creek Wetlands. WLAs are assigned to the Los Angeles County MS4 and their co-permittees, and Caltrans who are responsible for the loading of sediment into Ballona Creek and Wetland. The WLAs are the total allowable sediment load that can be discharged into Ballona Creek Wetlands (Table 15). This total sediment load includes both suspended sediment and sediment bed load that are transported from Ballona Creek Watershed into Ballona Creek Wetlands.

Table 15. Sediment Wasteload Allocations for Ballona Creek Wetlands.

Responsible Jurisdiction	Input	Sediment Wasteload Allocation[1] (yd^3/yr)	Existing Total Sediment Load (yd^3/yr)
Los Angeles County MS4 and co-permittees; Caltrans	Ballona Creek Watershed	58,354	58,354

[1] This is a combined WLA for all identified parties.

Since the current existing discharge of sediment load is not contributing to the listed impairments or otherwise causing a negative impact to Ballona Creek Wetlands, this TMDL establishes WLAs based on existing conditions. The allowable WLA is set at 58,354 yd^3/yr (or 44,615 m^3/yr).

The WLAs are set for the following NPDES permits:

County of Los Angeles & Co-Permittees	CAS004001
Caltrans (MS4)	CAS000003

It is also important to consider that functioning wetland systems require a constant input of sediment. Specifically, without the influx of sediment and freshwater from an upstream river, wetlands will slowly erode (essentially sediment deposition from a watershed offsets any sediment losses due to erosion). Therefore, sediment loading to the Ballona Creek Wetlands is an important part of restoring a balanced system and, at the current rates, we expect minimal adverse impact on the Wetland (note: impairments could be caused by sediment-borne contaminants associated with current loading; however, these loads are already addressed in existing TMDLs) (See Section 5.1.3).

7.2 LOAD ALLOCATIONS FOR SEDIMENT

These TMDLs establish LAs and alternative LAs for the legacy sediment placed in Ballona Creek Wetlands. The alternative LAs will supersede the LAs listed in Table 16 if the conditions described in Section 7.2.1 are met.

These LAs are set at levels that allow for restoration of the wetlands and are capable of addressing the impairments of habitat alteration, reduced tidal flushing, hydromodification and exotic vegetation. LAs are established for each of the three wetland areas within the Ballona

Creek Wetlands. If the LAs are achieved, the ongoing point and nonpoint sources of sediment loading to the Wetlands are not expected to contribute to the listed impairments.

The LAs are calculated to remove the legacy sediment deposits from the currently defined wetland areas (see Section 2.2.1, 2.2.2, and 2.2.3 for description of Areas A, B and C) in the Ballona Creek Wetlands. The removal of this excess pollutant sediment load will lead to the attainment of the beneficial uses[7].

USEPA is aware that the SLC, CDFG, California Coastal Conservancy and the Santa Monica Restoration Commission are working towards restoration of Ballona Creek Wetlands. This TMDL does not stipulate the specific actions required to achieve the LAs, but instead provides the sediment load reductions calculated to achieve water quality standards.

The following list of entities are identified as Cooperative Parties because they are either: (a) current owners or managers of portions of the Ballona Creek Wetlands, or (b) current owners or managers of facilities in proximity to the Ballona Creek Wetlands which have, or are expected to have in the future, an impact on the management of legacy sediment within the Ballona Creek Wetlands (Table 16). These are joint LAs because it is not feasible at this time to divide responsibilities for removal of the legacy sediments among the cooperative parties.

- Caltrans
- US Army Corp of Engineers
- California Department of Fish and Game
- State Lands Commission
- LA County (Flood Control District, Beaches and Harbors)
- The Southern California Gas Company

[7] Removal of legacy sediment in Ballona Creek Wetlands include removal of material offsite, transport of the "removed" material from the targeted restored habitat area to an on-site location, or storage of the "removed" material on-site for future use. Since offsite removal of sediment material can be costly and a potential source of impact at other off-site areas, USEPA encourages re-use of the "removed" sediment on-site where applicable. The term "on-site" refers to Ballona Creek Wetlands in this TMDL.

Table 16. Legacy Sediment Deposit Load Allocations for Ballona Creek Wetlands.

Cooperative Parties	Wetland Area	Legacy Sediment Load Allocation (yd^3)[2]	Legacy Sediment Deposits To Be Removed[3] (yd^3)
CDFG; USACE; Caltrans; County of Los Angeles; SoCalGas Company	A	0	2,100,000
CDFG; USACE; SLC; Caltrans; County of Los Angeles; SoCalGas Company	B	0	700,000
CDFG; USACE; Caltrans; County of Los Angeles	C[1]	0	300,000

[1] Only a portion of Area C is identified as requiring legacy sediment be removed.
[2] The load allocation is set as zero in this TMDL to indicate that additional sediment load cannot be deposited or transported, in any manner, to the Ballona Creek Wetlands; the Wetlands is significantly impaired and has no capacity to support additional sediment loading.
[3] Removal of legacy sediment in Ballona Creek Wetlands include removal of material offsite, transport of the "removed" material from the targeted restored habitat area to an on-site location, or storage of the "removed" material on-site for future use. The term "on-site" refers to Ballona Creek Wetlands in this TMDL.

7.2.1 Alternative Load Allocations

Since the attainment of the beneficial uses for the Ballona Creek Wetlands require not just the removal of legacy sediment, but the restoration of adequate wetland conditions, USEPA establishes alternative LAs, listed in Table 17 for elevation and habitat acreages. These alternative LAs supersede the sediment LAs defined in Table 16 if:

1. Cooperative parties submit a proposal to implement the alternative LAs to USEPA and the Los Angeles Regional Water Quality Control Board, which describes how the alternatives LAs will adequately address the impairments; and
2. The Executive Officer of the Regional Board approves the request and notifies USEPA of the approval.
3. USEPA does not object to the Regional Board�even determination within sixty days of receiving notice of it.

Table 17. Alternatove Sediment Deposit Load Allocations for Ballona Creek Wetlands.

Cooperative Parties	Elevation Range (ft NAVD)	Elevation & Habitat Acreage LAs (acres)[1]
CDFG; USACE; SLC; Caltrans; County of Los Angeles, The SoCalGas Company	-3.0 to -0.2 (Subtidal)	22
	-0.2 to 3.6 (Intertidal)	87
	3.6 to 9.6 (Vegetated Wetland)	346
	6.3 to 9.6 (Salt Flat)	5

[1]These habitat acreage load allocations are based on the lesser of historic elevation ranges at Ballona Creek Wetlands and similar tidal marsh-tidal flat dominant wetland systems in Southern California.

7.3 LOAD & WASTELOAD ALLOCATIONS FOR INVASIVE EXOTIC VEGETATION

The loading capacity for invasive exotic vegetation is zero for "highly" and "moderately" invasive vegetation species and 10% for other exotic vegetation linked to the California Invasive Plant Council"s Plant Inventory (CA IPC) and California Noxious Weed List. Invasive species have an extremely high rate of growth, therefore invasive exotic vegetation, biomass should be controlled to levels that will avoid reintroduction and regrowth and protect beneficial uses. This TMDL identifies those specific vegetation species on the CA IPC and the CA Noxious Weed List as ones most invasive and harmful to the wetlands. Invasive exotic vegetation species listed on the CA Noxious Weed list are given a WLA and LA of zero. Invasive exotic vegetation species rated as "high" or "moderate" on the CA IPC Inventory list is given a WLA and LA of zero. Invasive exotic vegetation species rated as "low" on the CA IPC Inventory list are given a WLA and LA of 10%. This WLA and LA is expressed as an average daily rate. This latter category allows the less invasive exotic vegetation species, that may function similarly to a native plant, to be controlled but not eradicated to avoid situations where complete eradication of certain species would cause greater disturbance to the local habitat.

The WLA for invasive exotic vegetation in the Ballona Creek Wetlands are assigned to entities identified below:

- Los Angeles County MS4 and its Co-Permittees

The LA for invasive exotic vegetation in the Ballona Creek Wetlands and the Freshwater Marsh is assigned to the entities identified below:

- Caltrans
- US Army Corp of Engineers
- California Department of Fish and Game

- CA State Lands Commission[8] (for Area B and Freshwater Marsh)
- LA County (Flood Control District, Beaches and Harbors)
- The Southern California Gas Company

7.4 DAILY LOAD EXPRESSION OF TOTAL MAXIMUM DAILY LOADS

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. These TMDLs present a maximum daily load estimated according to the guidelines provided by USEPA (2007).

For the Ballona Creek Wetlands, the primary existing sediment loading into the Wetlands is from the MS4 stormwater permittees. The allowable daily mass load of sediment into the Wetland is calculated from the annual allowable sediment load (58,354 yd^3/yr or 44,615 m^3/yr) divided by the 365 days in a year. The allowable average daily mass load of sediment from the Ballona Creek Watershed into the Wetland is 160 yd^3/day (or 122 m^3/day). The WLA of 10% allowable invasive exotic vegetation for those vegetation species rated as "low" on the CA IPC List are expressed as an average daily rate which complies with EPA guidance on "daily loads.

7.5 SEASONAL VARIATION & CRITICAL CONDITION

TMDLs are required to consider critical conditions and seasonal variation for streamflow, loading, and water quality parameters. The critical condition is the set of environmental conditions for which controls designed to protect water quality will ensure attainment of water quality standards for all other conditions. The intent of this requirement is to ensure protection of water quality in waterbodies during periods when they are most vulnerable. Ballona Creek Wetlands experiences large dynamic variations to the flow of water, and thus transport of sediment, during the year. The numeric targets and wasteload and load allocations established in this TMDL conservatively address all seasons in the Ballona Creek Wetlands. Since the WLA and LA for invasive exotic vegetation are set at zero, additional consideration of seasonal variation was not made. Although a specific critical condition was not specified for the purposes of meeting the WLA, LA and numeric targets, we note that the condition of limited tidal flows is significantly impacting the Wetland"s ability to support natural functions. Ballona Creek Wetland receives freshwater flow via Ballona Creek Channel, stormdrains, and overflows from the bluffs and the Freshwater Marsh (future investigation is warranted to determine if these freshwater flows are sufficient to support the long term sustainability of the Wetland). However, due to the restrictions established for the tide gates, the Wetland system evidently does not

[8] The California State Lands Commission is the property owner of the Freshwater Marsh and the adjacent Expanded Wetlands Parcel, and does not own any property in Areas A or C. The Freshwater Marsh is operated and maintained by the Ballona Wetlands Conservancy.

receive sufficient tidal flows to support a functioning wetland with diverse habitat (i.e., salt marsh, mudflats, etc. and associated vegetation species).

7.6 MARGIN OF SAFETY

The federal statute and regulations require that TMDLs include a margin of safety (MOS) to account for any lack of knowledge concerning the relationships between effluent limitations and water quality. The required MOS may be provided explicitly by reserving (not allocating) a portion of available pollutant loading capacity and/or implicitly by making environmentally conservative analytical assumptions in the supporting analysis. This TMDL includes an implicit margin of safety. An implicit MOS was included in the following ways:

- The TMDL used T-Sheet maps from the late 1880"s as the point of reference for determining the type of habitats expected from a functioning coastal wetland.
- The TMDL selected conservative habitat target acreages when considering the historic Southern California and Ballona wetland habitat proportions.

Although the use of GIS to calculate land areas and elevation at different points in time based on multiple map sources is a common and effective approach, USEPA recognizes there are some inherent assumptions and uncertainties associated with the calculations. For example, these estimates assumed that the GIS map layers and past aerial photographs captured all the variability of historical Ballona Wetlands. Although these are the best available information and estimates, USEPA acknowledges some inherent limitations with regards to the map"s accuracy and the available data"s representation of the full range of natural variability. Consequently, this TMDL included a conservative implicit MOS in our estimates of the legacy sediment accretion in Ballona Creek Wetlands.

7.7 FUTURE GROWTH

If any currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

8 Implementation Recommendations

This section recommends monitoring and implementation activities that will mitigate the impairments and achieve beneficial uses in the Ballona Creek Wetlands.

8.1 BALLONA WETLAND RESTORATION PROJECT

The current wetland complex known as the Ballona Creek Wetlands or the Ballona Wetlands Ecological Reserve is owned by the state of California and managed by the California Department of Fish and Game. The California State Coastal Conservancy and California State Lands Commission are partners in the planning and restoration of the wetlands. The State‟s goal is to restore the Ballona Creek Wetland into "a thriving ecological reserve" that is will restore the loss of its ecological and native species. The Ballona Wetland Restoration Project is a long-term project overseen by the Ballona Wetland Restoration Project Management Team, which includes the Coastal Conservancy, the Department of Fish and Game, the State Lands Commission and the Santa Monica Bay Restoration Commission. In addition, the Ballona Wetlands Restoration Working Group, the Ballona Wetlands Science Advisory Committee and the Agency Advisory Committee provide project review, direction and recommended project goals.

Furthermore, the USACE includes an on-going Federal Ballona Creek Ecosystem Restoration Study. In 2005, SMBRC entered into a feasibility cost-sharing agreement with the USACE in the Los Angeles District to study alternatives for restoring the Ballona Creek ecosystem, and related purposes within the Ballona Creek watershed. The purpose of the Study is to identify opportunities to restore degraded habitat and ecosystem function of the Ballona Creek Channel and the Ballona Wetlands. The project addresses degradation and loss of habitat due to decreased tidal exchange and circulation; decreased biodiversity and overall ecological health; and lack of recreational opportunities of the creek and wetlands. This feasibility study includes investigations related to ecosystem restoration, a USACE high priority mission, in addition to other beneficial uses such as recreation, and water quality which are also of interest.

Currently, the Ballona Wetland Restoration Project has identified five different restoration options, "Alternatives", to restore the Ballona Creek Wetlands with the additional goal of providing greater opportunities public access. The Restoration Project is still in the development phase and plans to identify the best Alternative that will achieve the project goals. These project goals are ecosystem restoration; habitat preservation and enhancement; maintenance of the physical and chemical processes; biodiversity; sustainability; creation of opportunities for cultural, recreational and educational use; and enhanced public access.

USEPA supports all restoration efforts and planning that would achieve the numeric targets and allocations established in this TMDL. USEPA recommends that the State Coastal Conservancy, California Department of Fish and Game, all identified relevant cooperative parties, and the Regional Board work collaboratively to achieve this TMDL. This may include multiple and varied implementation actions (i.e., permit issuance to support restoration, sediment dredging, removal of invasive exotic species, improvement of flow, etc.). For example, for invasive exotic plant species, additional control methods are needed to reduce the noxious wetland plant species growth necessary to meet the water quality standards. These may include plant harvesting and active re-introduction of native plant species more hospitable to the wetland ecosystem.

In achieving the habitat acreage and elevation numeric targets, USEPA understands it may be necessary to increase natural upland habitats in certain areas to compensate for loss of those habitats in the surrounding landscape due to urban development. Furthermore, a naturally functioning wetland may have regional habitat linkages and corridors that bridge the fragmented sites, along with transitional habitats to link upland habitats with wetlands.

8.2 Cooperative Parties

USEPA identified cooperative parties to reflect the intent of the State"s overall restoration effort and goals for the Ballona Creek Wetlands. In keeping with the Regional Board"s approach towards similar legacy TMDLs in the Los Angeles region, cooperative parties for this TMDL are identified, not as responsible parties or as dischargers, but as landowners or managers in the Ballona Creek Wetlands region. USEPA supports the State"s implementation option to establish a Memorandum of Agreement between all entities identified as having some part in supporting the goals of this TMDL. These entities may execute a MOA jointly with the Regional Board for the development of a work plan for Ballona Creek Wetlands so that allocations can be achieved in a manner that is in the best interest of both the subwatershed landowners and the public in general.

In absence of a collaborative approach (i.e., MOA established by and between cooperative parties and the Regional Board), the Regional Board can use other regulatory tools to implement this TMDL, which may include investigative and regulatory orders.

8.3 Sea Level Rise

In the State"s effort towards restoration of Ballona Creek Wetlands, State agencies must consider and accommodate for sea level rise. USEPA understands this is a critical factor in the State"s long-term planning and supports the assessment of the restoration actions in combination with the predicted sea level rise for the coasts of California. For instance, long-term impacts of sea level rise are of concern because sediment loading from Ballona Creek Watershed to the Wetlands downstream is low compared to more natural conditions, due to the highly modified impervious watershed surfaces (See Section 5.1.3.1). Ballona Creek Wetlands may become sediment limited and water inundated if the rate of vertical sediment accretion does not equal or exceed sea level rise. The risk of inundation is associated with the rate of sea level rise. To be conservative, rapid sea-level rise scenarios should be evaluated during future assessments.

At a minimum, monitoring should occur to monitor sea level rise and the change in mean higher high water. If significant changes in mean higher high water are observed near the Ballona Creek Wetlands, a study may be required to determine if the habitat acres associated with the numeric targets are still protective of the beneficial uses. It is expected that, in the short-term, sea level rise may help increase the soil salinity, creating an environment more conducive to native wetlands flora.

Based on The Pacific Institute report (2009), "The Impacts of Sea-Level Rise on the California Coast", a 55-inch sea-level rise with a 100-yr storm event along the California coast is predicted. In response, the Governor issued an Executive Order in 2008 directing state agencies to develop a climate adaptation strategy and consider multiple sea-level scenarios for years 2050 and 2100 to "assess project vulnerability and reduce expected risks, and increase resiliency to sea-level rise". Consequently, sediment re-use in Ballona Creek Wetlands is being considered by the State and other entities currently evaluating restoration options. For example, in future scenarios accounting for sea level rise, the "removed" sediment could be stored on-site for beneficial replenishment of sediment loss in Ballona Creek Wetlands. USEPA supports the State"s goal to consider sea-level rise in coastal projects.

8.4 MONITORING

USEPA supports the baseline monitoring effort currently underway in the Ballona Wetlands conducted by scientists in the Santa Monica Bay Restoration Commission. Their baseline monitoring program includes the collection of physical, chemical, biological and human use date at the Ballona Wetlands. The continued monitoring of Ballona Creek Wetlands is necessary to support the development of restoration actions to meet this TMDL, show improvement and confirm that the water quality standards and allocations, as established in this TMDL is achieved. USEPA supports continued monitoring for those biological and physical variables collected during the baseline monitoring at Ballona Creek Wetlands. This is critical to increasing our knowledge of the wetland condition.

To track the progress of future restoration activities in achieving the habitat targets, it will be critical to include, at minimum, monitoring of the wetland habitats in Ballona Creek Wetlands, which should include habitat mapping on an annual basis. For the invasive exotic vegetation in

Ballona Creek Wetlands, tracking and monitoring of the invasive species should be conducted, at minimum, on an annual basis.

USEPA used the best available information to calculate the excess sediment deposited in the three wetland areas in Ballona Creek Wetlands. However, USEPA acknowledges there are some assumptions inherent in mapping the changes over time to a specific area. Based on examples from other countries and states of similar mapping comparisons for an area at different points in time (Halls and Kraatz 2006; Ellis and Wang 2006), error estimates can range between 10-20%. USEPA believes it is critically important to conduct field verification monitoring during and after restoration planning to evaluate further the specific applicable amount of legacy sediment load to be removed from the each section of Wetland Areas A, B and C, that will result in achieving the habitat target acreages. Specifically, a detailed error analysis and field validation for Ballona Creek Wetlands should be performed to elucidate presently unknown variables, such as compaction and settlement over time, explicit sediment supply and loss, and influence of other historic activities (e.g., agriculture and railroad construction). USEPA encourages a detailed monitoring study that evaluates the relationship between wetland habitat function and excess sediment removal.

Sediment monitoring to quantify the load of sediment from the Ballona Creek Watershed will be useful to ensure the amount of sediment entering the Wetlands is adequate. Similar monitoring is ongoing to support other TMDL and MS4 permit requirements (i.e., Ballona Creek Estuary Toxics TMDL). These existing efforts should also consider the impact of sediment loading into Ballona Creek Wetlands; slight modifications or additions to these monitoring programs may be useful to ensure all sediment inputs from the watershed into the Ballona Creek Wetlands and adjacent waterbodies are characterized. This TMDL provides a WLA for sediment loading from Ballona Creek and Watershed. These sediment loading estimates are based on a 10-year average of sediment discharge from Ballona Creek collected previously; in determining monitoring for compliance purposes, it may be appropriate to evaluate the WLA based on a 10-year averaging period in order to generate data that are comparable with the initial sediment loading estimate and to capture the representative temporal variation in sediment loads. USEPA recommends that monitoring of the sediment loads in the watershed should be on an annual basis.

8.5 FUTURE STUDY

Given that ongoing sediment flux is critical to a functioning wetland, it is particularly important to understand the amount of sediment loading to the Ballona Creek Wetlands. Implementation of metals and toxics TMDLs may involve best management practices (BMP) to control sediment-associated pollutants; however, contribution of clean sediment is necessary for healthy wetlands. Therefore, it would be useful to design and conduct a study to evaluate the sediment loading rates associated with anticipated and ongoing implementation of metals and toxics TMDLs in the

Ballona Creek watershed. A calibrated watershed model that considers sediment load reductions from various BMPs could be a useful tool for such a study. In addition, such a model could be linked with the receiving water model of the Ballona Creek Wetlands area that has been used to evaluate various restoration options.

9 References

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Appendix A

References and Studies Reviewed to Investigate Current and Historic Sediment Loading Values to the Ballona Creek Wetlands

Author (Year)	Reference Title
USACE (2003a)	DRAFT EIR/EIS for the Ballona Creek Sediment Control Management Plan
USACE (2003b)	Marina Del Rey and Ballona Creek Feasibility Study, Supplemental Analyses Appendix, DRAFT
PWA (2011)	Memorandum of Legacy Sediment volume and area estimates for the Ballona Wetlands TMDL
Ballona Creek Watershed Task Force (2004)	Ballona Creek Watershed Management Plan
Inman and Jenkins (1999)	Climate Change and the episodicity of sediment flux of small California Rivers
Stein et al. (2003)	Watershed-based sources of contaminants to San Pedro Bay and Marina Del Rey: Patterns and Trends
Willis and Griggs (2003)	Reductions in Fluvial Sediment Discharge by Coastal Dams in California and Implications for Beach Sustainability
PWA (2006)	Ballona Creek Watershed Draft Existing Conditions Draft Report
USACE (2009)	Ballona Creek Ecosystem Restoration Feasibility Study, Coastal Engineering Appendix DRAFT, F3 - Without Project Coastal Engineering Analysis
PWA (2008)	Ballona Wetlands Restoration Feasibility Report
California Coastal Sediment Management Workgroup (2006)	California Coastal Sediment Master Plan Status Baseline Report 2006
California Coastal Sediment Management Workgroup (2009)	California Coastal Sediment Master Plan Status Report 2008
USACE (2002)	Lower Ballona Creek Watershed Ecosystem Restoration 905(b) Reconnaissance Report
USACE (2005)	Los Angeles District Coastal Planning Program
USGS (2007)	Sources, dispersal, and fate of fine sediment supplied to coastal California
Patsch and Griggs (2007)	Development of sand budgets for California's major littoral cells
USACE (2003)	Marina del Rey and Ballona Creek Feasibility Study, Ballona Creek Sediment Control Management Plan, Coastal Engineering Appendix (1 of 2a)

Author (Year)	Reference Title
USACE (2003)	Marina Del Rey and Ballona Creek Feasibility Study. Ballona Creek Sediment Control Management Plan. Final Draft F4 Documentation. Hydrology and Hydraulics Analyses for Sediment Basin. (2 of 2a)
USACE (2010)	Ballona Creek Ecosystem Restoration Feasibility Study, Water Quality Appendix (F3 Without Project Water Quality Analysis). July 2010.
California Coastal Conservancy (2011)	Ballona Wetlands Ecological Reserve Baseline Assessment Program 2009-2010 Final report
Los Angeles Contaminated Sediments Task Force (2003)	Literature Review of effects of resuspended sediments due to dredging operations
USACE (2010)	Ballona Creek Ecosystem Restoration Feasibility Study, Hydrology Appendix (Present Conditions/Without Project September 2010)
USACE (2010)	Ballona Creek Ecosystem Restoration Feasibility Study, Hydraulic Appendix (Present Conditions/Without Project September 2010)
California Coastal Sediment Management Workgroup (2006)	Cumulative Loss of Sand to the California Coast by Dams
City of Los Angeles (2009)	DEIR Village at Playa Vista (Volume 1, 2, and 3)
Thornton (1981)	Suspended sediment transport in surface waters of the California Current off southern California: 1977-78 floods
Dorsey and Bergquist (2007)	A Baseline study of the Ballona Outdoor Learning & Discovery (BOLD) Area
PWA & SMBRC (2010)	Memorandum of Preferred Alternatives to the California State Coastal Conservancy
California Coastal Conservancy (2002)	Impact of sand retention structures on southern and central California beaches
California Coastal Sediment Management Workgroup (2004)	Literature search and review of selected topics related to coastal processes features and issues in CA
California Coastal Sediment Management Workgroup (2010)	California beach erosion assessment survey