DOCKETED

Docket Number:	07-AFC-06C
Project Title:	Carlsbad Energy Center - Compliance
TN #:	204375-4
Document Title:	CalTrans FHWA I-5 Widening North Coast Corridor FEIS/FEIR Part 3 (4 of 8)
Description:	N/A
Filer:	Patty Paul
Organization:	Locke Lord LLP
Submitter Role:	Applicant Representative
Submission Date:	4/24/2015 4:16:55 PM
Docketed Date:	4/24/2015

Memorandum of Agreement and 2007 Cultural Resources Treatment Plan are no longer required for this undertaking.

In a letter addressed to FHWA dated July 1, 2013, Caltrans notified FHWA of the APE revisions, requested FHWA's review and concurrent on the draft FOE for the project, and requested FHWA to consult with SHPO regarding the project's effects on historic properties within the APE (*Figure 5-5.8*). FHWA concurred with the FOE and initiated consultation with SHPO in a letter dated July 12, 2013 that requested concurrence on the FOE and notified SHPO of the APE revisions and Section 4(f) *de minimis* determination (*Figure 5-5.9*). On September 11, 2013 SHPO concurred with the finding of no adverse effect without standard conditions (see *Figure 5-5.10*).

Following all of the steps identified above, as well as project refinement efforts following circulation of the Draft EIR/EIS, no adverse effects to known eligible resources are currently anticipated to result from project implementation.

Archaeological Sites

All or portions of the following sites are presumed eligible for the NRHP/CRHR, with those contributing portions protected by ESAs.

- CA-SDI-209 was recorded in 1998 as a shell scatter (*Chione*, *Argopecten*, and *Donax*) with some stone artifacts; a 2008 survey found shell in a dirt road cut-bank. Extended Phase 1 archaeological testing completed for the proposed project and examination of historic aerial imagery/topographical mapping indicate that the lowland areas of the site appear to have been re-deposited during road construction. Although some pockets of intact deposits may exist in the originally recorded site knoll top area, substantial erosion has occurred and topsoil sediments appear to be absent.

- CA-SDI-603 was recorded in 1929 as a large site with midden, shell, charcoal, lithics, and ceramics. Excavations occurred from 1958 to 1961 and included the recovery of a human burial. The majority of the site area to the west is now developed and highway construction in the 1960s impacted those portions recorded within the right-of-way. Testing within the right-of-way/APE was performed in 2002. The remnant site portion in the right-of-way appears to be eligible for the NRHP/CRHR under Criterion D because of its research potential to contribute significant information concerning chronology and the organization of coastal exploitation during the early Holocene (6000 to 8000 years before present [B.P.]) period, and patterns of paleo-environmental change associated with Batiquitos Lagoon.

- CA-SDI-607 was originally recorded in 1959 as a concentration of shell in the cut bank for La Costa Avenue. The site has been identified with SDM-W-105 (recorded by Malcolm J. Rogers in the 1920s or 1930s), reported as a midden as deep as 48 ft. Testing in 1987 recovered marine shell (mostly *Chione* and *Argopecten*) and one lithic flake, and determined that the site had been largely destroyed by impacts from the construction of La Costa Avenue in 1966. During a 2009 survey for the proposed project, some shell (*Chione*, *Argopecten*, *Protothaca*, and *Chama*) was noted, possibly in fill rather than *in situ* contexts.

- CA-SDI-628 was initially recorded in 1929. The site consists of a large *Chione* shell midden, with some stone artifacts. Portions of the site were tested in 1994 and 2002. Despite severe impacts to the majority of the site through development and 1960s highway construction, the remaining site area within the right-of-way/APE appears to be eligible for the NRHP/CRHR under Criterion D because of its research potential to contribute significant information concerning chronology and the organization of coastal exploitation during the Holocene period, and patterns of paleo-environmental change associated with Batiquitos Lagoon.

- CA-SDI-762 was recorded in 1961 as an eroded shell midden, with a metate. Studies conducted in 1981 and 1982 distinguished eight loci within the site, consisting of light shell scatters, midden, occasional lithic artifacts, fire-affected rock, and brownware sherds. Further subsurface testing conducted in 1983 at five of the loci encountered some marine shell, a few pieces of flaked lithic debitage, and fire-affected rock. The 1983 investigators concluded that the relatively low yield, level of disturbance, and lack of variability at the five loci lessens their significance considerably and did not recommend further work at the site. During the project-related 2009 survey, a shell scatter was noted on a site knoll-top, among substantial amounts of modern refuse.

- CA-SDI-6849 was originally recorded in 1979, and was noted to consist of lithic and shell scatters, fire-affected rock, and midden deposits. Project-related survey in 2010 observed most identified site elements, including *Chione*, *Argopecten*, and *Ostreidae* shell, although groundstone implements and midden deposits were not relocated. The site boundary was extended to the west within the project area based on identification of additional artifacts during the 2010 survey.

- CA-SDI-10965 was initially recorded in 1929. It is a long-term habitation site dating to the early Holocene, as shown by extensive shell (*Chione* with *Argopecten* and an unidentified gastropod), anthropogenic soils, and artifactual material. Adjacent private property has been graded. Portions of the site were excavated in 1983 to 1984, 1988, and 2002. Portions within the APE (a light shell scatter only, with little depth and no artifacts) are clearly peripheral to the main site area outside the APE. Within the APE, the deposits retain very poor integrity, and Caltrans recommended that the portion to be impacted does not contribute to the significance of this site.

- CA-SDI-12670 was initially recorded in 1929. Testing in 2002 identified a remnant portion of the once large shell midden dating from the beginning of the middle Holocene period (ca. 4500 to 6000 years B.P.). Although large portions of the site have been severely impacted by development to the west and highway construction to the east, a small portion retains integrity and is eligible for the NRHP/CRHR under Criterion D. This relates to its research potential to contribute important information concerning chronology; the organization of human coastal exploitation during the middle Holocene period; and the patterns of paleo-environmental (climate and vegetation) and change associated with Batiquitos Lagoon.

- CA-SDI-16637 was recorded in 2002 as a sparse artifact (ground stone and a hammerstone/core) and shell (*Chione* sp.) scatter. Artifacts appear to be eroding out of a steep embankment that borders the site to the south.

- CA-SDI-16638H was recorded in 2003 and represents the remains of a house and related features that were used in the 1950s.

- CA-SDI-16639 was recorded in 2003. It consists of a hearth feature and a small number of lithic artifacts and pieces of *Chione* shell. A portion of the site was tested in 2006, and appears to be a diffuse surface scatter of shell, with some lithics, that appears to be redeposited by erosion.

- CA-SDI-17672 was recorded in 2005 as a moderately dense scatter of marine shell and flaked lithics. A portion of the site was tested, and revealed a highly disturbed diffuse scatter of shell from a secondary deposit.

- CA-SDI-17907H is the historic Buena Vista Cemetery. The inhumations were removed in the 1960s when I-5 was originally built. Subsequently, the land was developed (cut and filled), and a restaurant is now situated there.

- CA-SDI-17960 was recorded in 2006 as one modified cobble and three lithic flakes. The site area has been impacted over the years by agricultural practices and currently is within a commercial strawberry field. Ground visibility was severely hampered by the strawberry operation.

- CA-SDI-18917 was recorded in 2008 and consists mainly of sparsely scattered surface fragments of *Chione*, *Argopecten*, and *Donax* shell and an intact midden deposit. Extended Phase 1 archaeological subsurface testing conducted in 2009 for the proposed project recovered a pottery sherd, fire-cracked rocks, and lithics from a small midden deposit. Only one of eight testing locations encountered an intact subsurface deposit.

The following prehistoric archaeological site is now outside the project APE and would no longer be impacted by the undertaking due to project redesign.

- CA-SDI-17928 was initially recorded in 2006 as a deposit of marine shell, which was reported to have also contained flaked lithics and ground stone. Testing in 2006 identified a substantial cultural deposit. The site is eligible for the NRHP/CRHR under Criterion D for its research potential, related to the potential to shed light on the chronology of changing subsistence strategies during the Middle and Early Holocene.

The remaining sites inside the APE—CA-SDI-4553, CA-SDI-6831, CA-SDI-6882, CA-SDI-7296, CA-SDI-12120, CA-SDI-12121, CA-SDI-13484, CA-SDI-15678, CA-SDI-15679, CA-SDI-15680, and CA-SDI-17673—were deemed not eligible for the NRHP/CRHR for various reasons, including: lack of cultural remains, no further research potential, no identified Native American concerns, and/or highly disturbed or displaced deposits. These conclusions are based on the results of archaeological investigations and Native American consultations.

Built Environment Resources (Over 50 Years Old)

One built environment resource is eligible for listing in both the NRHP/ CRHR:

- 767 Orpheus Avenue is a 1936 residence in Encinitas built in the English Arts and Crafts style with a detached garage. It meets NRHP/CRHR eligibility Criterion C, at the local level of significance, as a distinctive example of its style and period and one of the most architecturally distinguished residences in the City of Encinitas. Contributing features to this designation include the house, garage, and a row of palm trees at the west end of the property's front yard.

The following two built environment resource are now outside the project APE and would no longer be impacted by the undertaking due to project redesign:

- 510-514 La Costa Avenue is a 1920s agricultural property in Leucadia that meets the criteria for listing in the NRHP/CRHR under Criterion A at the local level of significance, for its association with floriculture in the Encinitas, Leucadia, and Carlsbad areas in the early to mid-20th century. It is an intact, representative example of an increasingly rare property type, as suburban growth consumes much of the former agricultural land in the coastal communities of northern San Diego County.

- 636 Leucadia Boulevard was built in 1932; it is a Spanish Eclectic style residence that exhibits an unusually high degree of craftsmanship and detailing. It meets NRHP/CRHR Criterion C, at the local level of significance, as a distinctive example of its style and period and one of the most architecturally distinguished residences in the City of Encinitas. The boundary of the NRHP/CRHR property coincides with the current parcel boundary.

Seventy-three other built environment resources were evaluated for their potential NRHP/CRHR eligibility; they were deemed to be not eligible because they lacked associations with important people or events, lacked architectural merit, did not represent the work of a master builder or architect, and did not have the ability to convey important information in history or architectural history.

All highway bridges within the APE were previously determined not significant in accordance with Caltrans Statewide 1987 historic bridge inventory, which was reconfirmed with the 2006 update.

3.8.3 Environmental Consequences

Effects to cultural resources would apply equally to all the build alternatives. Project effects to historic properties/historical resources are determined to assess if the proposed undertaking would adversely affect the qualities that make each eligible for the NRHP/CRHR. An historic property could either be not affected, not adversely affected, or adversely affected, depending on the resource type and the nature of project impacts to that resource. Not affecting an historic property means the project is avoiding the resource completely. Not adversely affecting means the project might be impacting the resource in some way, but that the impact is not so severe as to diminish the qualities that make the resource significant. Adversely affecting a resource means the project is severely impacting all or some of the characteristics that make that resource significant, usually as a consequence of destruction, demolition, or relocation. A list of Native American Heritage Commission (NAHC) and Native American consultation and coordination is provided in *Table 5.4* of this EIR/EIS.

Build Alternatives

Archaeological Sites
Known and eligible or potentially eligible archaeological sites along I-5 (CA-SDI-603, CA-SDI-628, CA-SDI-10965, CA-SDI-16637, CA-SDI-16638H, CA-SDI-16639, CA-SDI-17960, CA-SDI-17672, CA-SDI-17907H, CA-SDI-12670, and CA-SDI-17928), as well as sites known from proposed biological mitigation parcels (CA-SDI-209, CA-SDI-607, CA-SDI-762, CA-SDI-6849, and CA-SDI-18917), would not be adversely affected because they would be protected from impact, in accordance with PA Stipulation VIII.C.3. This stipulation enables Caltrans to establish an ESA to protect the sites from project-related impacts. Caltrans can make a determination of eligibility without testing in accordance with Stipulation VIII.C.3.

Built Environment Resources
None of the three built environment resources determined eligible for the NRHP/CRHP would be adversely affected by the undertaking. Both 510-514 La Costa Avenue and 636 Leucadia Boulevard are located outside the APE and would not be affected. At 767 Orpheus Avenue, small right-of-way sliver takes at the perimeter of the property would be required to construct the project and/or build a soundwall. The evaluation of the property results in determining which elements within the property boundary contribute to the significance. This might include various buildings, landscaping, walls, pools, and other features. The sliver takes required for this project would require some vegetation/landscaping and outbuildings at the east end of the parcel. It would not affect any of the qualities that make the property eligible, as no contributing buildings, landscaping, or other contributing features would be impacted. This type of effect is called a No Adverse Effect, because the qualities that make the resource eligible would not be adversely affected.

For Section 4(f) purposes, 767 Orpheus Avenue would require a Section 4(f) finding, which for the purposes of this undertaking is proposed as *de minimis*. The use is proposed as *de minimis* under 4(f) because the small sliver takes to the properties would not result in an adverse effect or diminish the qualities or character-defining features that qualify this resource for the NRHP/CRHR. On July 12, 2013, FHWA notified SHPO that a Section 4(f) *de minimis* determination was made for this historic property (see *Figure 5-5.9* in *Chapter 5* of this Final EIR/EIS).

No Build Alternative

Archaeological Sites
The No Build alternative would not result in any impacts to prehistoric archaeological sites.

Built Environment Resources
The No Build alternative would not result in any impacts to built environment resources.

3.8.4 Avoidance, Minimization, and/or Mitigation Measures

Build Alternatives
Caltrans would avoid all adverse effects to known eligible cultural resources within the project's APE. Adverse effects to the NRHP/CRHR-eligible historic built environment property at

767 Orpheus Avenue that were identified in the Draft EIR/EIS would be avoided due to project design changes. Due to project refinement since 2010, avoidance of known eligible archaeological resources within the APE is also possible.

As noted in this Final EIR/EIS *Executive Summary* and *Section 3.15, Noise*, several soundwalls for secondary consideration have been identified. If, following project approval, these walls become "reasonable" to construct (as described in *Section 3.15*), a conformity analysis would be completed to ensure that the footprints and environmental effects associated with these soundwalls fall within the existing analysis. If the soundwall is not adequately covered under existing analysis, new evaluation would occur under both CEQA and NEPA.

Archaeological Sites

Continuous efforts to avoid cultural resources were implemented by utilizing all practical design techniques. Many archaeological sites that initially were within the project's APE were avoided through project redesign. At the time of Draft EIR/EIS circulation in 2010, two archaeological sites deemed eligible for the NRHP/CRHR, CA-SDI-12670 and CA-SDI-17928, were anticipated to be adversely affected due to soundwall construction. Based on ongoing design and identification of those soundwalls as not being feasible, those impacts are no longer anticipated. Project refinement resulted in avoidance of these sensitive resources.

Caltrans would undertake efforts to avoid causing impacts to archaeological sites. Prior to construction, a Cultural Resources Treatment Plan would be developed. This plan would include an Archaeological Monitoring Area (AMA) Action Plan and an ESA Action Plan. Combined, these plans would delineate AMA and ESA locations where a "qualified" archaeological monitor and a Native American monitor would be present during construction, identify the individuals involved, and their roles and responsibilities.

AMA and ESAs would be depicted on the design/construction plans. A letter would be sent to the Resident Engineer's file, along with a copy of the AMA and ESA Action Plan. The archaeologist and Native American monitor would be present at the preconstruction meeting.

The archaeologist and Native American monitor would work with Caltrans Construction Liaison to accurately delineate the boundaries of those sites requiring the establishment of ESAs. Fencing would be placed around ESA sites, as appropriate. ESA sites would be avoided by all construction activity.

The construction contract also would contain language related to unanticipated discoveries should they be made during construction, including diverting activities away from such finds until an archaeologist could assess their nature and significance. If unanticipated discoveries occur, Section 106 consultation with the SHPO would be reopened, if appropriate. If cultural materials are discovered during construction, all earth-moving activity within and around the immediate discovery area would be diverted until a qualified archaeologist can assess the nature and significance of the find.

If unanticipated human remains are discovered, State Health and Safety Code Section 7050.5 states that further disturbances and activities would cease in any area or nearby area suspected to overlie remains, and the County Coroner would be contacted. Pursuant to PRC Section 5097.98, if the remains are thought to be Native American, the Coroner would notify the NAHC, who would then notify the Most Likely Descendant (MLD). At the same time, the person who discovered the remains would contact the District 11 Chief of the Environmental Resources Branch so that they could work with the MLD on the respectful treatment and disposition of the remains. Further provisions of PRC 5097.98 would be followed, as applicable.

No Build Alternative

Archaeological Sites

Avoidance, minimization, and/or mitigation measures would not be required under the No Build alternative.

Built Environment Resources

Avoidance, minimization, and/or mitigation measures would not be required under the No Build alternative.

PHYSICAL ENVIRONMENT

3.9 Hydrology/Drainage (and Floodplains)

The 8+4 Buffer alternative has been refined since the Draft EIR/EIS was publically circulated in 2010. This alternative was presented as the locally preferred alternative (LPA) in the August 2012 Supplemental Draft EIR/EIS, and has now been identified as the Preferred Alternative. The refined 8+4 Buffer alternative has the least amount of impact of any build alternative and also meets purpose and need.

3.9.1 Regulatory Setting

EO 11988 (Floodplain Management) directs all federal agencies to refrain from conducting, supporting, or allowing actions in floodplains unless it is the only practicable alternative. The FHWA requirements for compliance are outlined in 23 CFR 650 Subpart A.

In order to comply, the following must be analyzed:

- The practicability of alternatives to any longitudinal encroachments
- Risks of the action
- Impacts on natural and beneficial floodplain values
- Support of incompatible floodplain development
- Measures to minimize floodplain impacts and to preserve/restore any beneficial floodplain values impacted by the project

The base floodplain is defined as "the area subject to flooding by the flood or tide having a one percent chance of being exceeded in any given year." An encroachment is defined as "an action within the limits of the base floodplain."

3.9.2 Affected Environment

Location Hydraulic Studies (Hydrology and Floodplain Analysis)

This section in based primarily upon the February 2008 and February 2009 Location Hydraulic Studies, which are incorporated by reference. The lagoon bridge optimization studies are addressed below. These studies present the results of the Hydrologic Engineering Centers River Analysis System (HEC-RAS) modeling for the floodplains identified below.

The lagoons, creeks, and rivers crossed or potentially affected by the *I-5 NCC Project* were modeled to determine the potential impacts created by the proposed improvements of I-5 from Sorrento Valley to Oceanside in San Diego County. The proposed improvements would widen I-5 from an 8-lane (4 mixed flow lanes in each direction) to a 12-lane (4 mixed flow lanes and 2 Managed Lanes in each direction) or 14-lane facility (5 mixed flow lanes and 2 Managed Lanes in each direction). Location Hydraulic Studies have been performed for the following water bodies, the majority of which are designated as Federal Emergency Management Agency (FEMA) floodways or floodplains:

- Soledad Canyon Creek – FEMA Zone AE Floodway
- Los Peñasquitos Creek – FEMA Zone AE Floodway
- Carmel Creek – FEMA Zone AE Floodway
- San Dieguito River – FEMA Zone A Floodplain
- San Elijo Lagoon – FEMA Zone A Floodplain
- Cottonwood Creek – No FEMA Floodplain
- Batiquitos Lagoon – FEMA Zone A Floodplain
- Encinas Creek – No FEMA Floodplain
- Agua Hedionda Lagoon – FEMA Zone A Floodplain
- Buena Vista Lagoon – FEMA Zone A Floodplain
- Loma Alta Creek – FEMA Zone AE Floodway
- San Luis Rey River – FEMA Zone A99 Floodplain

Soledad Canyon Creek

The 100-year flood boundary is shown on the FEMA Floodway Boundary and Floodway Map, panels 1338 and 1389, effective date June 19, 1997. The 100-year peak discharges used for the study described herein were obtained from the FEMA Flood Insurance Study, San Diego County, California, Volume 1 of 7, revised July 2, 2002. The floodplain in relation to the project is depicted in *Figure 3-9.1*.

The project area is located in Sorrento Valley in the City of San Diego, and is approximately 3 mi upstream of the mouth of Los Peñasquitos Lagoon at the Pacific Ocean. Soledad Canyon Creek, located within the Los Peñasquitos Watershed, covers a watershed area of 100 square mi. Soledad Canyon Creek is fed by Carroll Canyon Creek, which originates southeast of the Miramar Reservoir in the neighborhood of Scripps Miramar Ranch in the City of San Diego, and discharges into the Pacific Ocean via Los Peñasquitos Lagoon.

Soledad Canyon Creek has been channelized through Sorrento Valley in a concrete lined trapezoidal channel for approximately 0.5 mi. Downstream, the creek joins with the Los Peñasquitos Creek and flows in a natural channel until it reaches Los Peñasquitos Lagoon. The lagoon contains extensive mudflats, saltpan, salt marsh, and one relic sand dune, with shallow water channels and broad tidal pans.

The watershed is drained by Carmel Creek, Los Peñasquitos Creek, Carroll Canyon Creek, and Soledad Canyon Creek. The creeks accumulate storm water runoff from residential and commercial development, but typically exhibit low flow during the summer. The watershed is highly urbanized with a population of approximately 400,000 residents.

The existing floodplain was analyzed using the HEC-RAS v.3.1.3 and aerial topography. The area of analysis ranges from approximately 4000-ft upstream to 1100-ft downstream of the I-5 crossing. In this region, the flow is 6,700 cubic ft per second (cfs) from Carroll Canyon Creek into the upstream boundary of Soledad Canyon Creek, and is joined with the flows from Los Peñasquitos creek after the I-5 crossing for a total 100-year flow of 19,500 cfs. During the 100-year storm event the majority of the floodwaters would flow down the canyon's center through the middle of the Sorrento Valley Business Park, with velocities ranging from 5.5 ft per second (ft/s) to 14.8 ft/s. The structures located in the creek's overbanks would be inundated by 2 ft to 9 ft of water.

Los Peñasquitos Creek

The 100-year flood boundary is shown on the FEMA Floodway Boundary and Floodway Map, panels 1338 and 1389, effective date June 19, 1997. The floodplain in relation to the project is depicted on *Figure 3-9.2*.

The project area located in the City of San Diego just north of Sorrento Valley Road/Roselle Street includes the Los Peñasquitos Creek located within the Los Peñasquitos watershed basin. The 170-square mi hydrologic unit includes the Cities of San Diego, Poway, Del Mar and unincorporated regions of San Diego County. The major basins within the Los Peñasquitos Lagoon watershed are Carroll (Soledad) Canyon, Los Peñasquitos Canyon, and Carmel Valley. These basins flow in a westerly direction towards the Pacific Ocean. These watersheds drain a highly urbanized region located almost entirely west of I-15 in coastal San Diego County. Elevations within the watershed range from mean sea level to 2900 ft above mean sea level (AMSL) in the upper watershed. Collectively and individually, the basins support a variety of water supply, economic, recreational, and habitat-related beneficial uses. Los Peñasquitos water bodies are especially sensitive to the effects of pollutants due to restricted or intermittent tidal flushing.

The Los Peñasquitos Creek watershed encompasses a land area of approximately 67 square mi including portions of the Cities of San Diego, Poway, and Del Mar. The watershed is highly urbanized with a population of approximately 400,000 residents. Los Peñasquitos Creek contains extensive mudflats, saltpan, salt marsh, and one relic sand dune, with shallow water channels and broad tidal pans. The creek was historically intermittent; however, due to development within the upper watershed, the creek now supports year-round flow. Los Peñasquitos Creek is concrete-lined along two stretches in its lower reach. Urban runoff from storm drains contributes inflows during winter storms as well as runoff from local landscaping.

The I-5 HOV/Managed Lanes freeway-to-freeway connector would span the entire Los Peñasquitos Creek floodplain, therefore no studies were required.

Carmel Creek

The 100-year flood boundary is shown on the FEMA Floodway Boundary and Floodway Map, panel 1336, effective date June 19, 1997. The 100-year peak discharges used for the study described herein were obtained from the FEMA Flood Insurance Study, San Diego County, California, Volume 1 of 7, revised July 2, 2002. The floodplain in relation to the project is depicted on *Figure 3-9.3*.

The project area located in the City of San Diego just south of Carmel Valley Road includes Carmel Creek, located within the Los Peñasquitos Lagoon watershed basin, and covers a watershed area of 170 square mi. The watershed includes the Cities of San Diego, Poway, and Del Mar, and unincorporated regions of San Diego County. The major basins within the Los Peñasquitos Lagoon watershed are Carroll (Soledad) Canyon, Los Peñasquitos Canyon, and Carmel Valley. These basins flow in a westerly direction towards the Pacific Ocean. Elevations within the watershed range from 2900 ft AMSL in the upper watershed to mean sea level.

The creek within the 15.7-square-mi Carmel Valley sub-basin flows through the valley in a westward direction from its headwaters on Black Mountain to the Los Peñasquitos marsh area. The creek was historically an ephemeral drainage; however, due to development within the upper watershed, the creek now supports year-round flow. Carmel Creek is slightly incised within its upper reaches. Material eroded from the Carmel Creek network is deposited downstream in gradients as the drainage approaches the lagoon. Runoff from Carmel Creek enters the Los Peñasquitos Lagoon within the northeastern corner.

The existing floodplain was analyzed using HEC-RAS v.3.1.3 and aerial topography. The Carmel Creek model begins upstream of the El Camino Real Bridge crossing. After the crossing, the creek opens up into a heavily vegetated plain over 700-ft wide and 1400-ft long. Several cross sections were defined in the open plain between El Camino Real and I-5 to accurately depict the back water effects that would occur due to the triple box culvert located at Sorrento Valley Road. The creek narrows as it passes beneath the I-5 bridges and becomes completely constricted as it passes through the 40-ft wide Sorrento Valley Road triple box culvert.

Immediately west of I-5, the Sorrento Valley Road triple box culvert was modeled using the HEC-RAS culvert option to represent existing conditions. For proposed conditions, the existing culvert was removed and replaced with a bridge. The proposed Sorrento Valley Road/Roselle Street Bridge replaces the triple box culvert with a 440-ft long pedestrian bridge with 13 pier rows in the floodplain.

The final bridge of interest was the Carmel Creek Truck Connector. Since the bottom soffit of this bridge would be built far above any anticipated 100-year flood levels, only the piers of the bridge would cause any effect on the floodplain. Approximately 1050 ft west of the connector bridge, the model terminates, as Carmel Creek ties into Los Peñasquitos Lagoon.

San Dieguito River

The 100-year flood boundary is shown on the FEMA Floodway Boundary and Floodway Map, panels 1307 and 1326, effective date June 19, 1997. The 100-year peak discharges used for the study described herein were obtained from the FEMA Flood Insurance Study, San Diego County, California, Volume 1 of 7, revised July 2, 2002. The floodplain in relation to the project is depicted on *Figure 3-9.4*.

The project area located in the City of Del Mar in the west-central region of San Diego County includes the San Dieguito River basin and occupies an area of approximately 346 square mi, including portions of the Cities of Del Mar, Escondido, Poway, San Diego, and Solana Beach, and unincorporated areas of San Diego County. Starting from Santa Ysabel, the watershed expands northwest to San Pasqual, southwest to Ramona, and west to the Cities of Del Mar and Solana Beach with three primary major water bodies: San Dieguito River, San Dieguito Lagoon, and Lake Hodges. Approximately 88 percent of the total drainage area is controlled by the Lake Hodges Dam. The watershed extends through a diverse array of habitats from its eastern headwaters in the Volcan Mountains to its outlet at the Pacific Ocean. There are several important natural areas within the watershed that sustain a number of threatened and endangered species. Among these are the 55-mi long, 125-square mi San Dieguito River Park; the 150-acre San Dieguito River; and water storage reservoirs including Lake Hodges, Lake Sutherland, and Lake Poway.

The existing floodplain was analyzed using HEC-RAS v.3.1.3 and aerial topography. The area of analysis ranges from 6500-ft upstream to 1500-ft downstream of the I-5 bridge. In this region, 42,800 cfs of water passes through the opening beneath the interstate bridge from a 5000-ft-wide floodplain. During a 100-year storm event, a broad slow moving river would flow through the floodplain with the I-5 bridge serving as the only major constriction. Downstream of the I-5 bridge, the floodplain opens up to the north and floods the Del Mar Fairgrounds. Within the floodplain study limits, the floodplain bottom elevations range from 9 ft to -4 ft using the North American Vertical Datum of 1988 (NAVD 88).

San Elijo Lagoon

The 100-year flood boundary is shown on the FEMA Floodway Boundary and Floodway Map, panels 1044 and 1063, effective date June 19, 1997. The 100-year peak discharges used for the study described herein were obtained from the FEMA Flood Insurance Study, San Diego County, California, Volume 1 of 7, revised July 2, 2002. The floodplain in relation to the project is depicted on *Figure 3-9.5*.

The project area is located in a coastal wetland between the Cities of Encinitas and Solana Beach, and is approximately 20-mi north of the City of San Diego. The existing watershed of the San Elijo Lagoon encompasses 77 square mi and is fed by two main water sources, Escondido Creek and San Elijo Creek, also known as Orilla Creek. It has been determined that these creeks generate a 100-year discharge of 23,255 cfs. In the late 1870s, San Elijo Lagoon was a low-lying marshy plain. Fresh and salt water exchanges took place regularly, which enabled a stable wetland environment capable of supporting unique plant and animal life. In more recent years, numerous manmade structures have substantially decreased the amount of tidal flow exchange in the lagoon. Dikes, railroads, and highways have all been built within the wetlands, and have altered the environmental characteristics and capabilities of the lagoon to the point where it can no longer support consistent tidal exchanges.

The existing floodplain was analyzed using HEC-RAS v.3.1.3 and aerial topography. The area of analysis ranges from where San Elijo and Escondido Creeks join to the Pacific Ocean. The two creeks meet in a wide portion of the lagoon with narrow, shallow channels during normal flow. In a 100-year storm event, the top width of the flow would range from 0.25-mi to 0.5-mi wide until it is channeled underneath the existing I-5 bridge. Moving westward toward the ocean, the lagoon flow would then expand into a large basin. The majority of the storm flow would pass under the NCTD Railroad and South Coast Highway bridges, whereas higher flood waters would stay under the bridges, yet overtop the berm to the south. Finally, the water would discharge into the ocean. Along its path to the ocean, the 100-year storm flow would frequently flood Manchester Avenue, including the undercrossing at I-5.

Cottonwood Creek

Cottonwood Creek is not presently within a FEMA floodplain and has been highly channelized and undergrounded east of I-5 throughout the City of Encinitas. The expected 100-year storm runoff inundation area (i.e., floodplain) upstream of the entrance to the I-5 drainage crossing has been estimated and its relation to the project is depicted on *Figure 3-9.6*.

The project area is located in the City of Encinitas and is approximately 3800-ft upstream of the creek mouth at the Pacific Ocean. The Cottonwood Creek watershed is located within the Carlsbad Watershed and covers an area of 3.4 square mi. The creek drains the western slopes of the ridge running parallel to and west of El Camino Real and the Encinitas Creek drainage. Cottonwood Creek discharges into the Pacific Ocean via a storm drain at Moonlight State Beach. The elevation within the watershed ranges from 400 ft AMSL to sea level.

The area of analysis ranges from approximately 200-ft upstream to 900-ft downstream of the I-5 crossing. In this region, Cottonwood Creek would experience a peak flow of 1,670 cfs during the 100-year storm event. The culvert system crossing beneath I-5 changes shape twice after crossing under I-5 before it outfalls into a natural channel section of the creek. The cross culvert begins as a 10-ft concrete arch culvert for 713 ft, then transitions to a 6-ft x 8-ft double box culvert for 544 ft, and finally transitions again to a 7-ft x 4-ft triple box culvert for 116 ft before it ends downstream at a triple box headwall. A peak flow analysis determined the headwater elevation upstream of the cross culvert to be 91.8 ft.

Bentley CulvertMaster v3.1 was used to analyze the culvert hydraulics and determine the headwater elevation upstream of I-5. The culvert system was determined to be operating under inlet control and therefore was analyzed as a 1373-ft long, 10-ft concrete arch culvert. The changes in the shape of the culvert system would have little effect on the computed headwater since the system operates under inlet control. In addition to CulvertMaster, Bentley StormCAD v5.6 was used to analyze the culvert system crossing beneath I-5. The three sections of the culvert system were modeled to study the transitions between and the characteristics of each section as they affect each other.

Batiquitos Lagoon

The 100-year flood boundary is shown on the FEMA Floodway Boundary and Floodway Map, panels 1033 and 1034, effective date June 19, 1997. The 100-year peak discharges used for the study described herein were obtained from the FEMA Flood Insurance Study, San Diego County, California, Volume 1 of 7, revised July 2, 2002. The floodplain in relation to the project is depicted on *Figure 3-9.7*.

The project area is located in a coastal wetland between the Cities of Carlsbad and Encinitas, includes Batiquitos Lagoon, and is located within the Carlsbad Watershed. The primary tributaries to the watershed are San Marcos Creek and Encinitas Creek. San Marcos Creek originates on the western slopes of the Merriam Mountains in west central San Diego County and discharges into the Pacific Ocean via Batiquitos Lagoon. Encinitas Creek originates in the hills southwest of Questhaven Road and parallels El Camino Real before its confluence with San Marcos Creek at the southeastern corner of Batiquitos Lagoon.

The existing floodplain was analyzed using HEC-RAS v.3.1.3 and aerial topography. The area of analysis ranges from approximately 5500-ft upstream to 3800-ft downstream of the I-5 crossing. The upstream portion of the study reach was initiated at the convergence between the San Marcos Creek and Encinitas Creek. Within the study limits, the I-5 bridge serves as a major constriction point. Once past the I-5 bridge, the lagoon opens up to approximately 1000 ft. Other major constrictions occur downstream at the railroad tracks and the Carlsbad Boulevard Bridges. The model terminates at the Pacific Ocean.

Encinas Creek

Currently there is no 100-year FEMA Floodway Boundary and Floodway Map for Encinas Creek. The estimated 100-year storm runoff inundation area upstream of the entrance to the I-5 drainage crossing has been determined and is depicted on *Figure 3-9.8*.

The project area is located in the City of Carlsbad, south of the Palomar Airport Road Interchange in Las Encinas Canyon, includes the Encinas Creek watershed, and is within the Carlsbad Watershed that covers 4.1 square mi. It is the only drainage basin within the watershed that does not empty into a lagoon before entering the Pacific Ocean. Encinas Creek begins behind an industrial park on the eastern edge of the basin. From there the creek parallels Palomar Airport Road to the south for three mi. It then crosses Paseo Del Norte and under I-5 before entering a concrete lined channel. Prior to emptying into the Pacific Ocean, the creek enters a natural basin located between South Carlsbad Boulevard (Coast Highway 101) and the NCTD rail line.

There is little disturbance to the creek's floodplain boundary at the project site.

The existing floodplain was analyzed using HEC-RAS v.3.1.3 and the project topography. The area of analysis ranges from approximately 364-ft upstream to 144-ft downstream of the current I-5 crossing. The peak flow for Encinas Creek at the I-5 crossing would be approximately 1,880 cfs during the 100-year storm event according to 1989 study titled, Hydrologic/Hydraulic Analysis for the Encinas Creek Channel between Paseo del Norte and Interstate Hwy 5, by Cooper Engineering and Associates. The culvert crossing beneath I-5 is a 10-ft x 5-ft triple box culvert that empties into a concrete lined channel west of the freeway.

Agua Hedionda Lagoon

The 100-year flood boundary for Agua Hedionda Lagoon is shown on the FEMA Floodway Boundary and Floodway Map, panels 764 and 768, effective date June 19, 1997. The 100-year peak discharges used for the study described herein were obtained from the FEMA Flood Insurance Study, San Diego County, California, Volume 1 of 7, revised July 2, 2002. The floodplain in relation to the project is depicted on *Figure 3-9.9.*

The project area is located in a coastal wetland in the City of Carlsbad and is approximately 35 mi north of the City of San Diego. Agua Hedionda Lagoon is located within the Carlsbad Watershed, which covers a watershed area of 210 square mi. Agua Hedionda Creek originates on the southwestern slopes of the San Marcos Mountains, in west-central San Diego County, and discharges into the Pacific Ocean via Agua Hedionda Lagoon.

Agua Hedionda Lagoon is unique among San Diego County lagoons, in that recreational and commercial uses are permitted; yet the lagoon is a healthy tidal body with large wetlands supporting several endangered species. The majority of the lagoon is owned and maintained by Encina Power, owners of a 900-MW power plant located on the outer segment of the lagoon. The entire 400-ac lagoon, created in 1954, was completely re-dredged in 1998 to an average depth of 8 to 11 ft, increasing tidal flushing. An extensive eelgrass planting program was initiated after the dredging, resulting in additional marine nursery areas.

Three aquaculture facilities enjoy the tidal health of the lagoon. These include a white seabass research facility jointly managed by Hubbs/Seaworld, the California Department of Fish and Wildlife (CDFW; previously California Department of Fish and Game) and a commercial mussel growing facility. In 2000, CDFW acquired 186 ac of wetland located at the eastern end of the lagoon for an Ecological Reserve. The Agua Hedionda Lagoon Foundation opened a 3800-square ft Nature Center in 2001, with educational displays and foot access planned for the wetlands and lagoon.

The watershed is drained by Agua Hedionda and Macario Creeks and is a component of the Carlsbad Hydrologic Unit. The creeks accumulate storm water runoff from continuing residential and commercial development, but typically exhibit low flow during the summer. The lagoon and wetland form a major element of Carlsbad's Habitat Management Program and are connected by corridors to other elements of the program. The wetlands and surrounding slopes of CSS provide habitat for sensitive species, including the California gnatcatcher, least Bell's vireo, and light-footed clapper rail.

The existing floodplain was analyzed using HEC-RAS v.3.1.3 and aerial topography. The area of analysis ranges from approximately 3450-ft upstream to 3350-ft downstream of the I-5 crossing. In this region, 9,850 cfs passes from a 2000-ft wide channel through the opening beneath the existing interstate bridge. During a 100-year storm event, a broad, slow moving river would form in the lagoon's easterly basin and funnel through the bridge. From there it would expand into the middle lagoon before the flow would again be constricted under the railroad crossing. The flow would open up into Agua Hedionda's outer lagoon before the final constriction under Carlsbad Boulevard. Once past Carlsbad Boulevard, Agua Hedionda Lagoon would discharge into the Pacific Ocean.

Buena Vista Lagoon

The 100-year flood boundary for Buena Vista Lagoon is shown on the FEMA Floodway Boundary and Floodway Map, panels 761 and 762, effective date June 19, 1997. The 100-year peak discharges used for the study described herein were obtained from the FEMA Flood Insurance Study, San Diego County, California, Volume 1 of 7, revised July 2, 2002. The floodplain in relation to the project is depicted on *Figure 3-9.10*.

The project area is located in a coastal wetland between the Cities of Carlsbad and Oceanside, and is approximately 37 mi north of the City of San Diego. Buena Vista Lagoon is located within the Carlsbad Watershed, which covers an area of 210 square mi. The watershed extends from Lake Wolhford to the Pacific Ocean. Seasonal flows in Buena Vista Creek are typical of most coastal drainages in San Diego County, although artesian springs provide some surface flow even during the summer dry season. During wet winter weather or flood events, surface flow increases significantly. Natural surface flows are currently augmented by urban and agricultural runoff.

Buena Vista Lagoon was originally an intermittent tidal system, although a weir was constructed in 1940 across the mouth of the lagoon to eliminate tidal flow. The result was that Buena Vista Lagoon now functions as a freshwater lake with a fringing freshwater marsh.

Most of the recreational uses are focused along the lower portions of Buena Vista Creek and around Buena Vista Lagoon, which is heavily used as a bird watching location. The Buena Vista Audubon Society operates a Nature Center at the western end of the lagoon. Some of the largest areas of freshwater marsh habitat in San Diego County are present around Buena Vista Lagoon. Sedimentation could pose a long-term threat to the freshwater marsh and open water mosaic that currently exist at the lagoon.

The existing floodplain was analyzed using HEC-RAS v.3.1.3 and aerial topography. The area of analysis ranges from approximately 3300-ft upstream to 4600-ft downstream of the I-5 crossing. During a 100-year storm event, 8,500 cfs would flow from a 1500-ft-wide channel through the opening beneath the I-5 bridge. Channel bottom elevations range from below 7 ft to 7 ft using the NAVD 88. Within the study limits, the I-5 bridge serves as a major constriction point. Once past the I-5 bridge, the lagoon opens up to approximately 2000 ft. Other major constrictions occur downstream at the Carlsbad Boulevard and railroad bridges. The model terminates at the Pacific Ocean.

Loma Alta Creek

The 100-year flood boundary for Loma Alta Creek is shown on the FEMA Floodway Boundary and Floodway Map, panel 753, effective date January 19, 2001, and panel 761, effective date June 19, 1997. The 100-year peak discharges used for the study described herein were obtained from the FEMA Flood Insurance Study, San Diego County, California, Volume 1 of 7, revised July 2, 2002. The floodplain in relation to the project is depicted on *Figure 3-9.11.*

The project area is located in the City of Oceanside, in the northwestern region of San Diego County, and includes the Loma Alta Creek Watershed. The Loma Alta Creek Watershed is located within the Carlsbad Watershed and includes an area of 9.8 square mi. Loma Alta Creek forms the western portion of the northern border of the Carlsbad Hydrologic Unit. The watershed extends inland approximately 7.3 mi and is almost completely contained within the City of Oceanside. Three tributaries drain into Loma Alta Creek with Garrison Creek being the largest of the three.

Land uses within the watershed are predominantly residential and urban development. Much of the length of Loma Alta Creek has been channelized in the past to prevent private property flood damage. Flood prevention is a top priority of the City of Oceanside within the lower sections of the watershed. I-5 spans the entire width of the watershed near the coast and Oceanside Boulevard, which parallels the drainage of Loma Alta Creek.

The existing floodplain was analyzed using HEC-RAS v.3.1.3 and aerial topography. The area of analysis ranges from approximately 2400-ft upstream to 3500-ft downstream of the I-5 crossing. The upstream portion of the study reach was initiated where the floodplain widens. In this part of the floodplain, the main creek flows through a concrete channel while the rest flows through a commercial district. Downstream of I-5, the floodplain is within Cavalier Mobile Estates between two concrete channels. The study concludes where the concrete channels converge to one channel to show the combined back water effects near I-5. FEMA water surface elevations were known and used as the boundary conditions.

San Luis Rey River

The 100-year flood boundary for the San Luis Rey River is shown on the FEMA Floodway Boundary and Floodway Map, panels 734 and 753, effective date January 19, 2001. The 100-year peak discharges used for the study described herein were obtained from the FEMA Flood Insurance Study, San Diego County, California, Volume 1 of 7, revised July 2, 2002. The floodplain in relation to the project is depicted on *Figure 3-9.12.*

The project area is located on the northern border of the City of Oceanside, in the northwestern region of San Diego County, and includes the San Luis Rey River Watershed. The San Luis Rey River Watershed encompasses 558 square mi, and is the largest drainage basin in the San Diego region. The watershed is bounded by the Monserate Mountains to the north, the Cleveland National Forest and Camp Pendleton to the northwest, and Escondido, San Diego, and other cities to the south. The basin is roughly 50-mi long by 16-mi wide and is divided into two hydrologic units by Henshaw Dam, which controls 36 percent of the watershed.

Unlike most major rivers in southern California, the San Luis Rey River has undergone relatively little channelization. The only segment of the River that has been channelized is within the City of Oceanside. However, the cumulative impacts of various land use practices in the basin appear to be degrading the river's environmental value. Operations such as sand mining have contributed an increasing rate of bed erosion in the central reaches of the River.

The existing floodplain was analyzed using HEC-RAS v.3.1.3 and aerial topography. The area of analysis ranged from 3200-ft upstream to 2500-ft downstream of the I-5 and San Luis Rey River. In this region, constrictions occur as the flow passes under I-5, North Coast Highway, the railroad, and Pacific Street. The channel top widths range from 425 ft to 685 ft. Within the project limits, the channel bottom elevations range from 2.2 ft to 6.7 ft (NAVD 88). West of Pacific Street, the San Luis Rey River opens and outlets into the Pacific Ocean. A corrugated metal pipe arch under Pacific Street serves as the last major constriction in the San Luis Rey River downstream of I-5. Pacific Street was rebuilt approximately 500 ft east of its present location. This opened up the mouth of the San Luis Rey River and eliminated the prior major backflow effects. The Pacific Street Bridge was assumed as existing for the effective model.

Lagoon Bridge Optimization Studies

In addition to the hydrology and floodplain analyses described above, the following detailed studies were conducted and circulated as part of the Supplemental Draft EIR/EIS regarding the hydrology of the six coastal lagoons and related waterways within or adjacent to the project corridor.

- I-5 Lagoons Marine Resource Investigation, June 2006
- San Elijo Lagoon Bridge Optimization Study, April 2012
- Batiquitos Lagoon Bridge Optimization Study, April 2012
- I-5 Bridge Study at Buena Vista Lagoon, May 2012
- Hydrodynamic Approach to Wetland Restoration by Optimization of Bridge Waterways, October 2010

These studies included input from lagoon scientists, such as representatives from the Scripps Institute of Oceanography, to determine the most appropriate ("optimal") bridge and channel dimensions to reduce "tidal muting" (i.e., restrictions to fresh/salt water exchange from man-made features such as levees or bridge supports) and address associated effects related to sea level rise and water quality. This new information was detailed in the August 2012 Supplemental Draft EIR/EIS, with pertinent information outlined below and in *Section 3.9.3, Environmental Consequences*, as well as in *Tables 3.17.5* through *3.17.10* in *Section 3.17, Natural Communities*.

As noted above under the discussion of Location Hydraulic Studies, a number of additional potential constraints to tidal exchange are present along downstream reaches of several of the coastal lagoons, including crossing structures associated with Coast Highway, rail lines, and local roadways. While these facilities are not directly related to the *I-5 NCC Project*, the associated effects to tidal exchange (and flooding) are important considerations in the evaluation and design of I-5 crossing structures. Specifically, it is imperative that the design of all applicable lagoon bridges be coordinated to maximize tidal exchange and overall lagoon system function. That is, no individual lagoon bridge design would produce optimal results if one or more of the other crossing structures continue to result in ongoing tidal and/or flood flow restrictions. A summary of existing conditions and related concerns in the six coastal lagoons is provided below.

Los Peñasquitos Lagoon

As indicated above, I-5 does not cross the lagoon proper, although it does cross waters flowing into the lagoon in three locations: Carmel Creek at the north end of the lagoon, and at Los Peñasquitos and Soledad Canyon Creeks southeast of the lagoon. Due to the distance from the ocean inlet, none of the I-5 crossings is affected by ocean tidal activity in the lagoon.

Four major north-south transportation facilities cross Los Peñasquitos Lagoon west of I-5; the Coast Highway (one crossing) and rail lines (three crossings). These facilities result in existing downstream constraints as previously described. The Coast Highway Bridge (immediately east of the beach at Torrey Pines) was replaced in 2005 to reduce fill and maintain tidal influence to the extent feasible. The new bridge has a design life of 75 years and there are no plans to change it in the foreseeable future. The railroad crossing includes three single-track railroad bridges, which cross both the main channel and a side channel on fill. The California Coastal Commission (CCC) recently approved the replacement of these older wood trestle railroad bridges with in-line concrete bridge structures under federal consistency certification (CC-059-09). Alternative proposals are under consideration for the potential future double tracking of these railroad bridges across the lagoon; including a potential realignment that would remove the rail from the lagoon by tunneling under Del Mar Heights Road and siting it along I-5. Because design and technical studies are scheduled for a future (2041 to 2050) phase, it is unknown at this time which alignment or structures ultimately would be built by the railroad. If feasible, however, removal of some or all of the railroad fill would likely enhance both tidal and flood flow conditions between the lagoon and the ocean.

The existing I-5 crossings at Los Peñasquitos Creek and Soledad Canyon Creek can accommodate 100-year flows, while the existing I-5 Bridge over Carmel Creek and the Sorrento Valley Road Culverts through Carmel Creek (which would be replaced by a bike/pedestrian bridge, as described below in *Section 3.9.3*) currently cannot accommodate a 100-year flood event.

San Dieguito Lagoon

Several north-south transportation facilities cross the San Dieguito River Valley and lagoon system, resulting in constriction points on flood flows and sediment transport. From west to east, these facilities include the Coast Highway, railroad bridge, Jimmy Durante Boulevard Bridge, and the I-5 bridge. The LOSSAN project plans to double-track and replace the railroad bridge across San Dieguito Lagoon in the 2021 to 2030 time period. Plans currently are preliminary, however, and detailed technical information for the proposed crossing is under development. Coast Highway and Jimmy Durante Boulevard are not proposed for any expansion and/or reconstruction at this time. These two downstream facilities would continue to result in constraints on tidal range within the lagoon.

Approximately 140 ft of the existing 650-ft I-5 bridge span is located over the flowing river channel bottom, with the depth of the main channel at -4.0 ft National Geodetic Vertical Datum of 1929 (NGVD; a datum system used to measure elevation [altitude] above and below mean sea level [MSL]). The remainder of the bridge span is located outside the active channel and is open to flood flows. An approximately 400-ft wide open area occurs south of the channel and beneath the bridge, with the north bank of the San Dieguito River channel and the southern abutment of the San Dieguito Bridge armored with riprap.

A large San Dieguito Lagoon restoration project, the Southern California Edison (SCE) San Onofre Nuclear Generating Station (SONGS) project, is underway. SONGS restoration began in 2006, and in addition to habitat restoration, this project opened the lagoon inlet and will continue to dredge the inlet to keep it open permanently. The SONGS restoration project was modeled and planned to accommodate the existing I-5 bridge span and channel dimensions. An important component of the restoration involved keeping flows within the channel at a level sufficient to transport sand to the beach in Del Mar (with the SONGS project required to maintain a condition of no decrease in downstream sand transport). The SONGS restoration project also is expected to increase the tidal “prism” (the difference between tide-related high and low water levels) of the lagoon by up to 13 percent. The associated identification of maximum tidal range is the difference between the lowest and highest observed water level. Specifically, the greater the tidal range, the lower the effects of tidal muting within the lagoon system. More complete drainage associated with greater variation in water levels also improves tidal exchange, resulting in improved water quality as indicated by higher dissolved oxygen and reduced areas of nutrient concentrations.

Agua Hedionda Lagoon

Agua Hedionda Lagoon is a relatively deep, open water system with three basins (west, central, and east), located in the City of Carlsbad. Three transportation facilities cross Agua Hedionda Lagoon and control associated water flow. Specifically, the lagoon inlet flows under the Coast Highway Bridge and is stabilized by fixed jetty structures that maintain the inlet in an open condition. The next crossing upstream is the railroad crossing, with construction ongoing for double tracking in this location (Federal Consistency Certification CC-075-09). The approved LOSSAN double tracking project will result in a second rail bridge that is 213 ft long and 22 ft wide, supported on four columns based on 4-ft concrete pilings. I-5 is the easternmost crossing of the lagoon, and is located upstream of the railroad bridge. The existing I-5 bridge at Agua Hedionda Lagoon is 191 ft long, and 157.5 ft wide, with four rows of 32 1-ft diameter columns. Riprap protection at the I-5 crossing occurs throughout the channel and abutment slopes.

The Encina Power Plant and the planned Poseidon Desalination Plant are located adjacent to the west lagoon basin. The intake of the power plant, located in the west basin, has been determined to have an “iron lung effect” on the lagoon (i.e., it artificially forces water flow from east to west), resulting in the effective draining of the eastern basin. The Encina Power Plant also regularly dredges the lagoon every two years to maintain a clear inlet to the ocean. The Poseidon Desalination Plant plans to continue similar maintenance dredging and will use the lagoon water intake for their operations (Coastal Development Permit E-06-013).

San Elijo Lagoon

San Elijo Lagoon is located in the City of Solana Beach and contains three basins divided by existing transportation facility crossings. Furthest west is the ocean inlet that flows under Coast Highway and through a narrow sinuous channel into the western basin. The channel then flows under the railroad crossing into the central basin. The main channel flows primarily along the northern edge of the central basin, and then under the I-5 bridge into the eastern basin. The existing I-5 bridge is 340 ft long and 157.5 ft wide and consists of separated north- and southbound lanes. The existing channel bottom is 130 ft wide, with a channel depth of -6.0 ft NGVD and 1:1 (horizontal to vertical) grade slopes supported by riprap.

Concurrent with the *I-5 NCC Project*, and given constraints presented by surrounding existing/current development, the San Elijo Lagoon Restoration Project (SELRP) is in the planning stage, with the objective of restoring the lagoon's hydrologic/hydraulic functions and habitat values to the extent feasible. Four options are under consideration for the SELRP, including: (1) No Project, which would be limited to maintenance dredging only; (2) Alternative 1A, which limits physical changes in the lagoon predominantly to enlarging and redirecting the main feeder channel; (3) Alternative 1B, which involves more substantial changes such as creating a subtidal basin in the central basin and expanding the eastern basin, while preserving the existing inlet; and (4) Alternative 2A, which would entail creating a new tidal inlet and subtidal basin in the western/central basins, as well as substantially enlarging the eastern basin channel.

Batiquitos Lagoon

Batiquitos Lagoon includes approximately 600 acres within a watershed that includes San Marcos and Encinitas Creeks, and is located at the very southern extent of the City of Carlsbad. As noted above under the discussion of Location Hydraulic Studies, three transportation corridors cross Batiquitos Lagoon from west to east, and form the boundaries of three basins (west, central, and east). The Coast Highway (with separated north- and southbound lanes) crosses over new inlet jetties and comprises the western edge of the west basin, with the railroad bridge separating the west and central basins. The I-5 bridge is the easternmost lagoon crossing, and separates the central and east basins. The east basin is the largest of the three, and is located east of I-5. These three crossings and the development around the lagoon are constraints to the lagoon's hydraulic flows and potential expansion, respectively.

The existing I-5 facility is divided into north and southbound bridges, each of which is approximately 68 ft wide (with a 19.2-ft gap in between) and approximately 219 ft long. Current channel design features include a bottom width of 66 ft with 4:1 grade slopes to the edges of the abutment (with approximately 106 ft between abutments), a shoaled depth of -5.3 ft NGVD,[1] and a 2:1 grade slope at the abutments covered with riprap.

A large-scale restoration project was completed by the Los Angeles Port District in Batiquitos Lagoon in 1997. As part of this effort, a new inlet was constructed concurrent with a new Coast Highway Bridge, and the inlet was stabilized with jetties. The lagoon was also dredged and riprap was placed at a depth of -7.0 ft NGVD throughout the entire I-5 channel. Additional dredging occurs periodically to maintain tidal flows.

Currently, floodwaters backup in the east basin behind the I-5 bridge, with a smaller backup noted in the central basin, and the largest backup occurring in the west basin between the inlet and the railroad bridge. Tidal velocity during the dry season varies with lagoon conditions and dredging status (i.e., whether it is dredged or shoaled). Regular maintenance (dredging) of the lagoon mouth is required to remove accumulated sediment, primarily in the west and central basins. Tidal velocity at I-5 currently is 4.3 ft/s at flood tide and 3.9 ft/s at the ebb tide.

[1] The existing channel is lined with riprap at -7.0 feet, but has filled with sediment to a current depth of -5.3 feet at the channel bottom.

Buena Vista Lagoon

Buena Vista Lagoon is the northernmost lagoon in the corridor, bordered by the City of Carlsbad on the south and the City of Oceanside on the north. The lagoon is segmented into four basins by four hydraulic connections that include channels under the LOSSAN rail and I-5 bridges, culverts under Coast Highway, and a weir and natural sand "berm" between the lagoon and the ocean. The four basins are named from west to east according to their associated downstream hydraulic connections; Weir Basin, Railroad Basin, Coast Highway Basin, and I-5 Basin. The three north-south transportation facilities between the basins constrain water flow within the lagoon. The existing channel at the railroad bridge is 17 ft wide at the channel bottom and 280 ft wide at the surface, with a maximum depth of -2.5 ft NGVD. Side slopes under the railroad bridge vary from 2:1 on the north abutment to 7:1 on the south abutment, with the bottom of the railroad bridge at an elevation of 11.1 ft NGVD. The Coast Highway culverts support the bottom of the road at an elevation of 8.2 ft NGVD, with the existing culvert channel varying from 25 to 29 ft wide and -6 to -3 ft deep (NGVD). The existing I-5 Bridge over Buena Vista Lagoon is approximately 102 ft long and 184 ft wide, with an associated channel bottom width of 24 ft. The channel exhibits depths of -2 ft NGVD, and 99 ft at the maximum water surface elevation.

Buena Vista Lagoon has developed into a primarily freshwater system, due to the presence of the sand berm that is naturally deposited along the beach and acts as a physical barrier to fresh and salt water interaction. The elevation (NGVD) of this berm is variable with conditions including tidal and wave action. The berm is regularly lowered by the City of Oceanside to prevent flooding of the Coast Highway, however, which allows water in the lagoon to discharge into (and mix with) the ocean. This process lowers the water elevation in the lagoon until it reaches the invert level (5.6 ft NGVD) of the existing weir structure at the mouth of the lagoon, which then controls the minimum water surface of the lagoon (i.e., it prevents discharge from the lagoon below 5.6 ft NGVD). The sand berm is then restored through natural deposition, which again restricts fresh and salt water interaction, raises the water level in the lagoon, and submerges the weir. A feasibility study and some restoration concepts were completed several years ago as part of a regional planning effort that focused on restoration of Buena Vista Lagoon. Those studies identified several options for a Buena Vista Lagoon restoration plan, including a saltwater alternative restoring tidal flow to the entire lagoon, a modified saltwater alternative, and two freshwater alternatives.

3.9.3 Environmental Consequences

There are no floodplain encroachments parallel to the direction of water flow, also called longitudinal encroachments, associated with the proposed improvements to the 12 described water crossings included in the *I-5 NCC Project* area. Floodplain effects were identified in the Draft EIR/EIS. *Table 3.9.1*, located at the back of this section, details these conservative numbers. No substantial impacts were identified. Since circulation of the Draft EIR/EIS, design refinement has continued, as addressed throughout this Final EIR/EIS. The effects of the project on floodplains have been clarified as a result of design refinement. FEMA mapping reflecting the most recent hydrologic conditions due to the project would be completed prior to construction.

As previously described, two of the six existing lagoon bridges (i.e., crossing Carmel Creek at Los Peñasquitos and San Dieguito Lagoons) are relatively new and are not proposed for replacement under the *I-5 NCC Project*. The remaining four lagoon bridges (San Elijo, Batiquitos, Agua Hedionda, and Buena Vista) would be replaced due to the age of the existing structures and the increased widths required for the project. Three of these four bridge designs (San Elijo, Batiquitos, and Buena Vista) also incorporate longer bridge spans than those described in the Draft EIR/EIS, based on the described Lagoon Bridge Optimization Studies. The associated conclusions support the findings in the Draft EIR/EIS, and have also resulted in refinement of the proposed project design to incorporate optimal bridge and channel dimensions if the project is approved. Specifically, the described analyses concluded that: (1) the two existing bridges crossing Carmel Creek at Los Peñasquitos and San Dieguito Lagoons are relatively new, and transportation improvements proposed under the *I-5 NCC Project* would not require bridge replacement; (2) the remaining four bridge crossings at San Elijo, Batiquitos, Agua Hedionda, and Buena Vista Lagoons would require replacement as part of the project; (3) the proposed new bridge at Agua Hedionda Lagoon would not vary from that described in the Draft EIR/EIS, as no substantial benefits would be derived from altered bridge/channel dimensions; and (4) proposed bridge and channel configurations at San Elijo, Batiquitos, and Buena Vista Lagoons have been modified from those described in the Draft EIR/EIS to reflect the optimal designs that would improve tidal exchange and fluvial flows, and enhance the overall health and function of the lagoon systems.

A summary of proposed improvements under the build and No Build alternatives is provided below, followed by analyses of related potential effects associated with floodplain encroachment and hydrology/hydraulics for all six lagoons and related waterways within the project corridor. It should be noted that wherever it is proposed to implement suspended bike/pedestrian bridges hanging below I-5 bridges, the bike/pedestrian facilities would be closed in case of flooding. The suspended pedestrian bridges were not included in the floodplain studies. If the floodwaters reach the pedestrian bridges and they do not fail, they can act as debris "catchers" and could raise the water surface elevation higher than the studies indicate.

Build Alternatives

The build alternatives are similar and combined here for analysis of hydrology and floodplains, as well as assessment of the described Lagoon Bridge Optimization Studies. The Draft EIR/EIS analyzed all the alternatives for floodplains to an equal level as presented on *Table 3.9.1.* Caltrans and FHWA assessed that there would only be minor differences between the floodplain impacts for all build alternatives. Therefore, because there would be no substantial difference among build alternatives, only the refined 8+4 Buffer alternative (Preferred Alternative) was modeled, with the impacts presented on *Table 3.9.2*.

Soledad Canyon Creek

The improvements proposed for the I-5 HOV/Managed Lanes Connector through the I-5 / 805 merge may include six rows of two piers per row within the floodplain of Soledad Canyon Creek. The connector itself would be 863 ft long and built well above the water surface elevation of the 100-year storm.

Table 3.9.2: 100-Year Floodplain Impacts for the 8+4 Buffer (Preferred Alternative)

Evaluation Criteria	Measured Parameter	No Build	8+4 Buffer (Preferred Alternative)			
Total Project Impacts to FEMA 100-year floodplains	Acres	none	**31.9**			
Specific Project Impacts to FEMA 100-year floodplains			Bridge Widening	Roadway Widening	Fill Slopes	Bridge Columns
	Acres	none	**6.9**	**7.3**	**17.6**	**0.1**
Individual Floodplain Impacts						
Soledad Canyon Creek	Acres	none	0.86	0	0.08	n/a
Los Peñasquitos Creek	Acres	none	0.21	0	0	n/a
Carmel Creek	Acres	none	0.25	0.30	0.14	n/a
San Dieguito River	Acres	none	1.15	1.36	3.21	0.03
San Elijo Lagoon	Acres	none	1.51	0.02	5.27	0.01
Cottonwood Creek	Acres	none	n/a	0	0	n/a
Batiquitos Lagoon	Acres	none	0.77	2.56	3.30	0.01
Encinas Creek	Acres	none	n/a	0	0.25	n/a
Agua Hedionda Lagoon	Acres	none	0.49	1.39	2.62	0.01
Buena Vista Lagoon	Acres	none	0.51	1.09	2.24	0.01
Loma Alta Creek	Acres	none	0.48	0.55	0.45	0.01
San Luis Rey River	Acres	none	0.69	0	0.05	0.06

The 8+4 Buffer alternative was identified as the LPA in July of 2011 and is the least impactive per the Draft EIR/EIS. Therefore, floodplain impacts were only calculated for the refined 8+4 Buffer (Preferred Alternative).

Los Peñasquitos Creek

The proposed I-5 HOV/Managed Lanes freeway-to-freeway connector spans the Los Peñasquitos Creek floodplain. The proposed bridge would be 3609 ft long and built above the existing I-5 median and high above the 100-year floodplain of Los Peñasquitos Creek and Soledad Canyon Creek (including 100-year flood levels that incorporate a conservatively "high" projected sea level rise of 4.5 ft in year 2100,[2] based on interim guidance released by the Coastal Ocean Climate Action Team [CO-CAT] in March 2011 as well as Caltrans). The two proposed bridge bents would be located on either side of the Los Peñasquitos Creek floodplain boundary.

Carmel Creek

The proposed improvements require that the existing 421-ft long Carmel Creek I-5 bridge be widened to the west. The existing Sorrento Valley Road Culvert is also proposed to be replaced with a 443-ft long pedestrian bridge, with the bridge deck to be elevated above the 100-year flood level (including consideration of a 4.5-ft sea level rise). This proposed pedestrian bridge would relieve the existing constriction of the creek at the existing Sorrento Valley Road Culvert, as well as the related floodplain issues at the I-5 bridge.

San Dieguito River

The improvements proposed for the 650-ft long I-5 bridge would include widening by approximately 40 ft on each side of the existing structure for a total proposed width of 258 ft.

San Elijo Lagoon

The proposed replacement of the I-5 Bridge over San Elijo Lagoon would entail widening the bridge to correspond to the Manchester Avenue on- and off-ramps. Specifically, the new slight arch span bridge would require a width of between 303 and 388 ft to accommodate the proposed construction area. This bridge would also be lengthened to 560 ft. A 261-ft channel bottom width is also proposed, pursuant to the optimization analysis from the lagoon bridge optimization studies. The existing I-5 structure consists of two bridges spaced 21.5 ft apart.

Cottonwood Creek

The area of flood water inundation at the inlet to the culvert conveying Cottonwood Creek under I-5 is located between the existing northbound off-ramp to Encinitas Boulevard and the right-of-way fence. The majority of the proposed widening would occur between I-5 and this ramp. The ramp would be widened approximately 5 ft to the east and would include a retaining wall along the eastern shoulder. This retaining wall would allow the widening to occur while eliminating the need to place fill material into the floodwater inundation area, therefore not impacting the area of ponding.

Batiquitos Lagoon

The new I-5 bridge configuration would be similar to the existing bridge (i.e., two bridge structures with a gap separating the north- and southbound lanes). Replacing the existing I-5 bridge would entail widening the bridge structure on each side, with the gap between the two bridges to remain. The proposed bridge would be 282 ft long. The channel bottom would be 183.5 ft wide, with a depth of -7 ft NGVD. The new channel would be a trapezoid with a level

[2] Following completion of the lagoon bridge optimization studies, the State of California provided a policy on sea level rise that assumes a maximum rise of 3.1 ft in 2100, making the I-5 NCC Project 2012 analyses conservative for this issue.

bottom between the abutments. The dimensions of the bottom would result in the same overall cross section as the optimized bridge with the same modeled dimensions at -1.0 foot elevation (NGVD). The existing riprap within the channel bottom would be removed, while the channel slopes would be armored with riprap due to the higher anticipated tidal velocities and fluvial flows. Riprap would not extend onto the channel bottom or bridge columns.

Encinas Creek

The proposed improvements would require the freeway to be widened approximately 50-ft on both sides of the freeway at the Encinas Creek crossing. The upstream end of the triple box culvert would need to be extended to accommodate this widening. The related placement of fill into the storm water inundation area at the inlet would move the culvert's headwater ponding area upstream accordingly. This would result in a slight increase in the water surface elevation upstream of the inlet.

Agua Hedionda Lagoon

Replacement for the I-5 bridge would retain the existing bridge length of 191 ft, with the bridge width to be increased from 158 to 269 ft to accommodate additional lanes.

Buena Vista Lagoon

The replacement I-5 bridge would be lengthened from the existing 102.4 ft to 197 ft. The proposed bridge would also be widened approximately 63 ft on each side to a total width of 310 ft.

Loma Alta Creek

The existing I-5 structure spans Loma Alta Creek. The Loma Alta Creek Bridge is 139 ft long. This bridge would be replaced with a bridge of equal length.

San Luis Rey River

The proposed improvements to the I-5 bridge over the San Luis Rey River would require that the bridge be widened. The existing I-5 structure consists of two bridges spaced 24 ft apart. Widening would occur in the median (approximately 30 ft) and to the east of the east bridge (approximately 35 ft). Both the left bridge (57-0713L) and right bridge (57-0713R) contain five rows of columns with supporting pier walls. To accommodate the widening, the pier walls would be extended to the east. The existing I-5 bridge would be widened minimally to the west due to its close proximity to the Coast Highway Bridge, located approximately eight ft downstream.

No Build

Implementation of the No Build alternative would not result in any changes to the existing floodplain and hydrology. Impacts to the beneficial uses from changing the number of piers and lengthening of the bridge would not occur.

Impacts on Natural and Beneficial Floodplain Boundaries

Soledad Canyon Creek

Within Soledad Canyon Creek, the I-5 HOV/Managed Lanes Connector would cause a negligible 0.04-ft increase to water surface elevations upstream. No significant increase to the area of the flood boundary would occur and no increase in flooding would result from the construction of this bridge.

Los Peñasquitos Creek

For Los Peñasquitos Creek, the I-5 HOV/Managed Lanes freeway-to-freeway connector bridge would entirely span the floodplain, and therefore would not affect the associated floodplain boundary or the water surface elevations.

Carmel Creek

The proposed improvements to Sorrento Valley Road/Roselle Street and the additional columns required to widen the I-5 bridge would not cause an increase to the flood boundary or related water surface elevations. The replacement of the Sorrento Valley Road Culvert would remove an existing constriction point in Carmel Creek and lower the base floodplain by approximately 4.4 ft upstream of the proposed Sorrento Valley Pedestrian Bridge.

San Dieguito River

There is widening of the I-5 bridge within the San Dieguito River. Upstream and downstream of I-5, the San Dieguito River is completely flat with large areas of ponding and stagnant flows. The 100-year storm event would produce a slow moving river with a water surface profile dropping roughly 1 ft every 5000 ft. Because of these pond-like conditions, the bridge widening would uniformly raise the floodplain upstream by a small amount (0.3 ft) and would taper down slowly upstream. The entire floodplain study reach is located in a FEMA Zone A floodplain, and ties into a Zone AE floodplain 2000 ft downstream. Because the rise is so slight and the proposed floodplain lies primarily within the established FEMA floodplain, impacts to the existing floodplain are considered negligible.

San Elijo Lagoon

The proposed I-5 bridge would be replaced with a longer and wider bridge. If no lengthening occurred, the widening alone would increase the upstream water surface elevation by 0.3 ft. Since the San Elijo Lagoon is a fairly flat waterway, the rise to the water surface elevation remains fairly uniform upstream of the bridge. In effect, the lagoon's flat bottom lacks the change in elevation to achieve higher flow velocities, and thus produces an extremely level water surface profile until the flow passes the South Coast Highway. With the lengthening, effects on upstream water surface elevations are anticipated to be less.

Cottonwood Creek

The proposed improvements to the I-5 near the pipe arch culvert, where the Cottonwood Creek flows, would not impact the floodplain and therefore, would not cause an increase to the flood boundary.

Batiquitos Lagoon

The proposed improvements to the I-5 bridge would not cause an increase to the flood boundary or associated water surface elevations. The replacement of the Batiquitos Lagoon Bridge would reduce an existing constriction point in the lagoon and lower the base floodplain by approximately 0.7 ft upstream of the I-5 bridge. While the associated channel widening would result in slightly higher water levels in the central basin (west of the I-5 bridge), no infrastructure would be affected and the associated impacts would be minimal.

Encinas Creek

The placement of additional fill into the existing ponding area (floodplain boundary) would increase water surface elevations at the new extended inlet location 0.22 ft. This increase would perpetuate proportionally upstream for 288 ft, at which point the water surface elevations would be unaffected by the proposed freeway widening. Because the banks of the ponding area between I-5 and Paseo del Norte are so steep, this small rise in water surface elevation would cause a negligible effect on the existing floodplain boundary.

Agua Hedionda Lagoon

Within the Agua Hedionda Lagoon, the proposed I-5 bridge replacement would cause a negligible 0.1-ft increase to water surface elevations upstream. There would be no significant increase to the area of the flood boundary and no increase in flooding from the construction of this bridge.

Buena Vista Lagoon

The proposed improvements to the I-5 bridge would not cause an increase to the flood boundary or the water surface elevation. Replacement of the Buena Vista Creek Bridge would widen the existing constriction point in the lagoon and lower the base floodplain by approximately 0.4-ft upstream of the I-5 bridge.

Loma Alta Creek

Within the Loma Alta Creek floodplain, the replacement of the I-5 bridges would not cause a significant increase to the area of the flood boundary or the water surface elevation. The water surface elevation upstream of the proposed replacedI-5 bridges would increase by 0.04 ft.

San Luis Rey River

Proposed improvements to the I-5 bridge would not cause a significant increase to the area of the flood boundary or the water surface elevation. The widening of the San Luis Rey River Bridge would increase the floodplain by approximately 0.03 ft upstream of the I-5 bridge.

Risks of the Action

None of the proposed bridge improvements create longitudinal encroachments to the following floodplains. The most current bridge planning studies were used to create the hydraulic models for each water body. Hydraulic losses through the bridges were computed by various methods provided in the HEC-RAS models. Four methods of computing losses through a bridge are available, including the Energy Equation and the Momentum Equation. The modeler is allowed to select any or all of the methods for the computation and the program will use the method that computes the greatest energy loss through the bridge. Based on the ongoing nature of the project design process, most or all of the associated HEC-RAS models may require updating during the final design phase of the project. FEMA mapping would be completed prior to construction.

Soledad Canyon Creek

The HEC-RAS model for this project was developed from the advance planning study (APS) for the I-5 HOV/Managed Lanes freeway-to-freeway connector that would span the Soledad Canyon Creek floodplain, and it was determined that there would not be a significant increase in the water surface elevation. Therefore, the proposed improvements do not have any major risks associated with their implementation.

Los Peñasquitos Creek
The I-5 HOV/Managed Lanes freeway-to-freeway connector bridge over Los Peñasquitos Creek would be designed to span the entire floodplain; therefore, the proposed improvements would not have any major risks associated with their implementation.

Carmel Creek
The HEC-RAS model for this project was developed from the I-5 Carmel Creek Bridge APS, November 2004. No APS was available for the Sorrento Valley Road/Roselle Street Bridge, a single span bridge with no columns within the floodplain was assumed for the modeling. The floodplain model would require updating during the design phase. Based on the impacts to the Carmel Creek floodplain boundary, it was determined that there would be a decrease in the water surface elevation. Therefore, the proposed improvements do not have any major flooding risks associated with their implementation.

San Dieguito River
The HEC-RAS model for this project was developed from the I-5 San Dieguito River Bridge APS, October 2004. Within the San Dieguito River, the widened I-5 bridge would cause a decrease to flood water elevations upstream. The original floodplain model used the “bridge replacement” column layout and thus resulted in a “decrease to flood water elevations upstream.” With the current plan to widen the existing bridge with the same (existing) column layout extended upstream, the flood water elevations would slightly increase rather than decrease upstream, assuming no widening or dredging of the channel is planned. Since the 100-year flood would still be contained within the floodplain boundaries, there would be no increased risk to life or property associated with the proposed improvements. The floodplain model would require updating during the design phase.

San Elijo Lagoon
The HEC-RAS model for this project was developed from the optimal length alternative for the I-5 bridge, to reduce the existing flooding of Manchester Avenue. However, the only APS available was for the widening alternative of the Manchester Avenue UC, dated January 2005. The floodplain model would require updating during the design phase to reflect the currently proposed bridge length and width, previously described, and developed based on coordination with the County of San Diego, the San Elijo Lagoon Conservancy, and CDFW.

Within San Elijo Lagoon, the replacement I-5 bridge would cause a decrease to flood water elevations upstream. The impacts to the floodplain would not be considered a significant or longitudinal encroachment, and there would be no increased risk to life or property associated with the proposed improvements. No additional roadways beyond existing flooding conditions would flood upstream from the proposed I-5 bridge. Therefore, no transportation routes would be interrupted or terminated beyond existing conditions.

Cottonwood Creek
Cottonwood Creek flows beneath I-5 within a 10-ft pipe arch culvert, and the proposed improvements to the I-5 corridor would have no effect on the flood level anticipated during the 100-year storm. According to the Floodplain Studies, analysis of the culvert system revealed that the storm water elevation upstream of I-5 would reach 91.84 ft during the peak of the 100-year storm. The flood waters would be contained within the basin located in the southeastern quadrant of the I-5 / Encinitas Boulevard Interchange and would not damage life

or property beyond levels which currently exist. There is no existing regulatory floodplain, as the creek has not been included in the standard FEMA floodplain documents.

Batiquitos Lagoon

The HEC-RAS model for this project was developed from the I-5 Bridge Across Batiquitos Lagoon APS, September 2004. Within Batiquitos Lagoon, the replacement I-5 bridge would cause a decrease to flood water elevations upstream. While the associated channel widening would result in slightly higher water levels in the central basin as previously noted (i.e., west of the I-5 bridge), no infrastructure would be affected and the impacts to the floodplain would not be considered significant. Since the 100-year flood would still be contained within the floodplain boundaries, there would be no increased risk to life or property associated with the proposed improvements. No additional roadways would flood upstream from the proposed I-5 bridge replacement. Therefore, no transportation routes would be interrupted or terminated beyond existing conditions. The floodplain model would require updating during the design phase.

Encinas Creek

The HEC-RAS model for this creek was developed and based on available existing and proposed topographical information. The analysis of the culvert system shows that there would be minimal impact to the existing flood boundary and minimal increase to the water surface elevation within the study area. The structures adjacent to the creek would not be flooded since they are located considerably above and outside of the calculated 100-year floodplain boundary. A floodplain boundary definition has been developed using the HEC-RAS model, although there is no regulatory (FEMA) floodplain on record for this creek. Because the changes in the floodplain boundary have been minimized, there are no beneficial values harmed by the proposed action.

Agua Hedionda Lagoon

The HEC-RAS model for this project was developed from the I-5 Agua Hedionda Creek Bridge APS, September 2004. Within Agua Hedionda Lagoon, the replacement I-5 bridge would cause a negligible rise to flood water elevations upstream. The impacts to the floodplain would not be considered significant. Since the 100-year flood would still be contained within the floodplain boundaries, there would be no increased risk to life or property associated with the proposed improvements. No additional roadways would flood upstream from the proposed I-5 bridge replacement. Therefore, no transportation routes would be interrupted or terminated beyond existing conditions. The floodplain model would require updating during the design phase.

Buena Vista Lagoon

The HEC-RAS model for this project was developed from the I-5 Buena Vista Creek Bridge APS, November 2004. Within Buena Vista Lagoon, the replacement I-5 bridge would cause a negligible rise to the flood water elevations upstream. The impacts to the floodplain would not be considered significant. Since the 100-year flood would still be contained within the floodplain boundaries, there would be no increased risk to life or property associated with the proposed improvements. No additional roadways would flood upstream from the proposed I-5 bridge replacement. Therefore, no transportation routes would be interrupted or terminated beyond existing conditions. This assessment assumes implementation of future restoration in the lagoon, however, as described below under the discussion of *Hydrologic/Hydraulic Impacts on Lagoons and Related Waterways*. To avoid downstream flood increases if restoration does not occur prior to I-5 bridge construction, fill may be left within the extended bridge footprint until the restoration is underway. The floodplain model would require updating during the design phase.

Loma Alta Creek

The HEC-RAS model for this project was developed from the I-5 Loma Alta Creek Bridge APS, November 2004, and the Oceanside Blvd Bridge APS, November 2004. Within the Loma Alta Creek floodplain, the widening to the I-5 bridges modeled for the Draft EIR/EIS was projected to cause a slight increase to flood water elevations upstream. The Draft EIR/EIS concluded that impacts to the floodplain would not be considered significant and there would be no increased risk to life or property associated with the proposed improvements. No additional roadways beyond the existing conditions would flood upstream from the proposed I-5 bridge widening. Therefore, no transportation routes would be interrupted or terminated beyond existing conditions. Subsequent to circulation of the Draft EIR/EIS, the project has been revised to propose replacing the Loma Alta Creek Bridge; therefore, changes to the floodplain would not be greater than previously anticipated. The floodplain model would require updating during the design phase.

San Luis Rey River

The HEC-RAS model for this project was developed from the I-5 San Luis Rey River Bridge APS, July 2005. The I-5 bridge widening would occur entirely above the 100-year floodplain and only requires the pier walls to be extended into the 100-year floodplain, thus minimal impacts would occur below the 100-year floodplain elevation. As proven in the hydraulic analysis, the extension of the pier walls would not prevent the San Luis Rey River from conveying the 100-year storm within the existing limits both upstream and downstream of the proposed widening. Since the I-5 pier wall extension would cause only a very minimal change on the floodplain, the natural and beneficial Floodplain Values of the San Luis Rey River would not be harmed by the proposed freeway widening.

Floodplain Encroachment

The proposed bridges would result in minor floodplain encroachment and would not result in incompatible floodplain development. Since the 100-year flood would still be contained within the existing floodplain boundaries at each location, there would be no increased risk to life or property associated with the proposed improvements. No additional roadways would flood upstream from the proposed I-5 bridges. Therefore, no transportation routes would be interrupted or terminated beyond existing conditions. No new access and no direct access to the affected floodplains would be provided by the proposed build alternatives. Access to the facility would be controlled, and the freeway would cross any rivers on structures above the base floodplain elevations.

Hydrologic/Hydraulic Impacts on Lagoons and Related Waterways

As previously described, bridges at San Elijo, Batiquitos, and Buena Vista Lagoons were identified as potentially posing more substantial constrictions (e.g., relative to tidal circulation and flood flow) and exhibiting a potential for optimization, with additional technical studies undertaken to identify how the replacement bridges could be designed to optimize tidal and fluvial flows Potential hydrologic and hydraulic effects at these and the other three coastal lagoons, as well as related waterways, are outlined below.

Los Peñasquitos Lagoon

Minimal changes are proposed to the I-5 bridges in the vicinity of Los Peñasquitos Lagoon, as the majority of widening required for HOV/Managed Lanes was completed in the 1990s and early 2000s as part of the I-5 / I-805 / SR-56 interchange projects. Specifically, the proposed I-5 Bridge over Carmel Creek would be limited to minor widening on the western side of the bridge, Los Peñasquitos and Soledad Canyon Creeks would be crossed by an HOV/Managed Lanes flyover bridge added to I-5 at the I-5 / I-805 merge, and the old Sorrento Valley Road culvert crossing of Carmel Creek would be replaced with a bike/pedestrian bridge.

As previously noted, the existing I-5 Bridge over Carmel Creek and the Sorrento Valley Road culverts associated with Carmel Creek currently cannot accommodate a 100-year flood event. Following completion of I-5 widening across Carmel Creek and replacement of the culverts under Sorrento Valley Road with a bike/pedestrian bridge, the main lanes of I-5 would continue to have a flood flow deficiency of approximately 0.7 ft of "freeboard" at the Carmel Creek I-5 bridge crossing (with freeboard defined as the area between the height of the flood flow and the bottom of the bridge, or soffit). A deficiency of 0.7 ft of freeboard would not result in flooding all lanes of the freeway at this crossing even if all of the conservative assumptions in the FEMA model occurred. Rather, this 0.7 ft freeboard deficiency represents a temporary build up of water east of I-5, with freeway access anticipated to be maintained. Removal of the culverts under Sorrento Valley Road and construction of the elevated bike/pedestrian bridge would improve existing conditions and accommodate 100-year flood flows, while also removing some of the existing flow constraint responsible for the current freeboard deficiencies at the Carmel Creek I-5 Bridge crossing. The new bike/pedestrian bridge would be expected to have a freeboard of 3.2 ft during a 100-year flood event.

Currently, tidal flow does not reach the I-5 Bridge over Carmel Creek. If future sea level rise allows for tidal flows to extend upstream to the bridge, it would be minimal and Caltrans could implement adaptation strategies to ensure continued access across Carmel Creek during a 100-year flood event. These strategies could include removing additional sediment from under the bridge, replacing the bridge, and/or other feasible design strategies available at that time.

Based on the height of the proposed flyover bridge at Soledad Canyon and Los Peñasquitos Creeks, freeboard would be anticipated to range from 28.5 to 35.1 ft during a 100-year flood. Assuming a reduction in projected freeboard for a 100-year flood event, combined with a conservatively projected 4.5-foot sea level rise, the remaining freeboard would still be 24 to 30.6 ft. While some of the columns supporting the bridge over Soledad Canyon Creek would be in the floodplain, they would not be in the creek channel itself. The potential impacts associated with the exacerbating effects of sea level rise on channel erosion, storm surge and flooding would be further minimized through the existing location and design of the bridge support structures, and their distance from the ocean, which reduces concern regarding impacts due to wave action, tidal inundation and/or flooding.

In summary, the existing I-5 bridges are upstream of effects associated with existing tidal circulation, erosion, and scour. Although 100-year surface flows are constricted for the Carmel Creek Bridge as noted, the existing bridge length functions during normal conditions and periods for which "back up" could occur under 100-year storm events, combined with high sea level rise, are considered to be of short duration and can be accommodated. Accordingly, the existing design is functional and the bridges are appropriate lengths for Los Peñasquitos Lagoon.

San Dieguito Lagoon

The *I-5 NCC Project* proposes to maintain the existing auxiliary lanes across the lagoon and widen the existing San Dieguito Lagoon Bridge to accommodate the proposed freeway expansion, rather than replace the bridge. Specifically, the bridge width would be expanded, while the length would remain at the current 650 ft.

A new bike/pedestrian path is proposed on the western freeway slopes across San Dieguito Lagoon. This would cross the lagoon in an area where no crossing currently exists, and would be suspended from the existing I-5 bridge where it actually crosses the lagoon (refer to *Figure 2-2.7*).

The proposed I-5 bridge widening would not constrict the SONGS-improved tidal prism, as the existing bridge span was modeled for the restoration and widening the structure would not change its effect on tidal flow. Existing downstream structures at Jimmy Durante Boulevard and Coast Highway, however, would continue to constrain the channel and the tidal flow east to the I-5 bridge and beyond. Modifications to the proposed I-5 bridge would not achieve additional tidal enhancement as a result of these downstream constraints. The proposed I-5 bridge complies with the previously described SONGS condition regarding sedimentation, in that it would not result in a decrease in downstream sediment transport.

The 100-year flood event for the proposed I-5 Bridge over San Dieguito River was modeled pursuant to FEMA requirements. Specifically, FEMA requires a worst-case scenario analysis, with the 100-year flood combined with the highest spring tides and storm wave run-up occurring within a channel that is not scoured. Based on this analysis, the proposed bridge would have only 0.7 ft of freeboard at its lowest bridge elevation (refer to *Table 3.17.6* of this Final EIR/EIS). Additional focused hydraulic studies were conducted as part of the Phase 2 lagoon studies, incorporating the SONGS restoration project and a restoration project at location W19, and assuming channel scour (Chang 2011). This more "real world" model predicted 6 ft of freeboard being maintained during 100-year flood flows for the proposed bridge. Combining that more realistic freeboard assumption of six ft with a conservative estimate of area available to pass a 100-year flood occurring during a projected sea level rise scenario (conservatively, 4.5 ft by year 2100) would result in adequate freeboard of 1.5 ft being available. The potential for sea level rise to exacerbate the effects of tidal flows and associated channel erosion, storm surge, and flooding on the I-5 bridge support structures would be minimized due to location and design of these support structures. That is, they are not expected to be subject to wave action, tidal inundation, or flooding due to the distance from the ocean and available flood-flow freeboard.

Modeling conducted to date for the proposed widened I-5 bridge and upstream mitigation (San Dieguito Lagoon W19 Restoration Project Feasibility Study 2011) did not identify any associated increase in flow velocity under the bridge. Accordingly, armoring the south bank is not anticipated to be necessary. Review of the bridge found that scour of the bridge footings could potentially occur to a maximum depth of -5.2 ft NGVD during a 100-year flood. This is well above the footings required for the bridge and would not damage the structure. The bridge is presently built to allow for scour around the columns, and therefore, armoring would only be placed along the abutments by the freeway slopes.

In summary, the existing distance between the I-5 bridge and the San Dieguito River/Lagoon opening to the ocean, combined with the existing length of the I-5 bridge structure (and associated accommodation of flood flows, wildlife movement, etc.) support the conclusion that the current I-5 crossing is an appropriate length. Specifically, any increase in bridge length would result in only minimal benefits relative to the associated additional cost. Project improvements would therefore not require any new or expanded shoreline protection and would not adversely affect the implementation and success of the ongoing SCE SONGS restoration project.

Agua Hedionda Lagoon

The proposed bridge would retain the 191-ft length, but would be widened to accommodate auxiliary lanes in both directions. Fewer support columns would be used, resulting in less obstruction in the channel, and therefore, lower potential to slow flow through the bridge. The proposed bridge would have a channel bottom width of 76 ft, equal to the existing bridge cross section, with 2:1 channel slopes (refer to *Table 3.17.9* in *Section 3.17)*.

Tidal circulation in the east basin of Agua Hedionda (including the maximum area of tidal inundation) was examined during studies comparing a number of bridge options (refer to *Table 3.17.9* in *Section 3.17*). The bridge studies also included an assessment of alternative I-5 channel and bridge designs utilizing flow fence technology (armoring features that funnel water for more hydraulic efficiency). Due to agency comments and concerns about the feasibility and local application of the technology, however, flow fence concepts are no longer under consideration.

Additional Design Considerations for Lagoon Crossing Alternatives

Hydraulic studies of tidal and fluvial flows through the I-5 Bridge at Agua Hedionda Lagoon were completed for the proposed design and several bridge alternative options (Phase 2 studies; UCSD et al. 2010). *Table 3.17.9* in *Section 3.17* contains alternative options specifics and cost differentials. The bridge options were proposed to optimize water exchange on either side of I-5 and increase tidal inundation in the wetlands east of the freeway. Each alternative was developed to reduce tidal muting east of I-5 and enhance wetland habitat and water quality. Three alternative options were proposed for Agua Hedionda: the double length bridge span alternative, the Chang channel bridge alternative, and the fill removal alternative.

The double length bridge span proposes a doubled channel bottom width of 152 ft, crossed by a bridge 267 ft long and 267 ft wide. This bridge would cost $6.6 million more than the proposed I-5 bridge. The Chang channel bridge proposes a wider bottom channel (128 ft in width) with steeper sides at a 1:1 grade supported by concrete. This bridge would cost $5.8 million more than the proposed I-5 bridge.

As previously described for San Dieguito Lagoon, the maximum tidal range is the difference between the lowest and highest observed water levels, with a higher range representing reduced tidal muting effects (and vice versa). Accordingly, a higher tidal range and corresponding lower muting would also indicate more complete drainage of the east basin during low tide. These conditions would improve tidal flushing, resulting in improved water quality as indicated by higher dissolved oxygen and reduced areas of nutrient concentrations. Tidal and fluvial modeling of the proposed bridge structure at I-5 and alternate bridge configurations showed minimal change to tidal muting and related effects, as summarized in *Table 3.17.9* of *Section 3.17*. Specifically, if the power plant were to discontinue operations, and the desalination plant were to either not be implemented or discontinue operations in the future, the I-5 crossing would not provide the primary constriction point in the lagoon.

Based on the noted analyses of tidal circulation, the proposed I-5 bridge design would result in an additional 1.1 ac of tidal inundation over the existing condition. The double length bridge span would result in 2.3 ac of additional intertidal area and loss of a corresponding amount of subtidal habitat, both in the east basin. The noted 2.3 ac would represent an increase of 1.2 ac over the proposed project, corresponding with 1.2 ac of additional inundated area. The Chang Channel bridge would result in 1.3 ac of additional inundated area (0.2 ac more than the proposed project) with a corresponding decrease of intertidal habitat in the east basin.

Although there would be some decrease in the maximum flood currents due to a wider and deeper channel with this project design, future currents would still exceed the minimum velocities required to mobilize beach sand (0.6 ft/s). Although flood currents through the bridge structures would be sufficient to mobilize sand, slower moving eddies in the basins would not be fast enough to transport fine sand and sediment, and localized shoaling (sand deposits) would result.

Based on the previously described "iron lung effect" from the power plant, a longer I-5 bridge would not appreciably increase water quality, decrease tidal muting, or result in increased wetland habitat. In addition, alternative bridge designs were shown to have a negligible effect on fluvial sedimentation and sediment transport within the system and shoreline sand supply.

Based on the FEMA 100-year flood calculations, the bridge would have at least 6.4 ft of freeboard at the Agua Hedionda Lagoon crossing, assuming a high spring tide and storm wave run-up. According to the hydraulic and scour studies by Chang for the Phase 2 studies (UCSD et al. 2010), the proposed bridge would not change flood elevations, and 100-year flood events would continue to be contained within the existing floodplain boundary. That is, the tidal cycle would not change the height of the 100-year flood at I-5 due to the higher water surface elevations during the flood, as well as the distance of I-5 from the ocean. The previously described conservatively projected sea level rise of 4.5 ft by 2100 would correspondingly increase the 100-year flood elevation at I-5; however, at least 1.9 ft of freeboard would remain at the new I-5 bridge under this scenario.

In summary, the lack of substantial difference in benefits provided by the I-5 lagoon crossing alternatives discussed above in this section, together with the substantial increases in costs associated with those alternatives, supports identification of the proposed project as the appropriate bridge. Specifically, due to the fixed inlet and railroad bridge cross sections, an increase in the I-5 cross section would provide little ecological benefit to the lagoon for the associated cost. The results of the Phase 2 studies (UCSD et al. 2010), as summarized above and in *Table 3.17.9* of *Section 3.17*, indicate that a longer bridge or deeper channel would not appreciably change tidal muting, erosion and scour, floodplain effects, or water quality in the lagoon. Although a crossing alternative with a longer bridge, and a channel that is twice as wide as the existing crossing of 152 ft, would result in fewer impacts to waters of the U.S./State (approximately 0.7 ac less) from roadbed fill, the potential benefits do not correlate with the additional bridge costs of $6.6 million.

San Elijo Lagoon

Construction of the new, slight arch span, 603.1-ft long bridge would entail a variable width to accommodate the widening required for the on- and off-ramps to Manchester Avenue, with a 261-ft wide channel bottom also proposed.

In addition to the pedestrian path on the southern abutment and along the eastern fill slopes (similar to existing conditions), a proposed bike/pedestrian path connection would be provided on the western side of I-5 from Lomas Santa Fe to Manchester Avenue on a secondary bridge suspended from the I-5 structure (refer to *Figure 2-2.7*).

Concurrent with the *I-5 NCC Project*, the SELRP is in the planning stage, with the objective of restoring the lagoon's functions and habitat values to the extent feasible, given the constraints presented by surrounding existing/current development. Four options are under consideration for the SELRP, each of which was evaluated in an optimization technical study completed for the lagoon (San Elijo Lagoon Bridge Optimization Study 2012), are discussed below:

- No Project Alternative proposes no grading within the lagoon except for maintenance dredging of the inlet channel.

- Alternative 1A would result in minimal physical changes to the lagoon, with the exception of enlarging the main feeder channel throughout and redirecting its course just west of I-5. This design option could be implemented with a 370-ft long bridge costing $26.8 million, which is considered the baseline bridge cost.

- Alternative 1B would result in a more substantial change to the existing lagoon to create a greater diversity of habitats while maintaining the existing lagoon inlet. A new subtidal basin off the main channel would be created in the central basin. The channel in the eastern basin would be significantly enlarged to promote more tidal exchange east of I-5. This design option could be implemented with a 603.1-ft long bridge, which would cost $16.1 million more to implement than baseline bridge costs.

- Alternative 2A would result in changes to the existing lagoon to create a greater diversity of habitats than presently exists. Seawater would enter the lagoon via a new tidal inlet located south of the existing inlet and a new subtidal basin would be created just landward of the new inlet in the western and central basins. The channel in the eastern basin would be significantly enlarged to promote more tidal exchange east of I-5 (identical to Alternative 1B). This design option, which could be implemented with a 603.1-ft-long bridge, also would cost $16.1 million more to implement than baseline bridge costs.

The Draft EIR/EIS for the *I-5 NCC Project* stated that regardless of the I-5 build alternative selected, if the project is approved, ultimate bridge dimensions would include the channel dimensions for the lagoon restoration option selected for the SELRP. At the time the Draft EIR/EIS was released for public review, however, the bridge length over the channel was not confirmed, and impacts were therefore based on widening the freeway while maintaining the existing bridge length. The currently proposed I-5 bridge in this area has undergone further design, including design to accommodate the 261-ft optimized channel width identified for restoration Alternatives 1B and 2A.

Should the No Project or Alternative 1A be implemented from the SELRP, it is important to note that the existing channel dimension beneath the I-5 bridge would be the optimized channel. This conclusion in the optimization technical study is based on the fact that the existing lagoon inlet and the associated channel between Coast Highway and the railroad bridge represent the primary constrictions for tidal and flood flows, and these features would not be modified for the No Project or Alternative 1A. Accordingly, increasing the I-5 bridge channel dimension would not effectively improve tidal or flood flow conditions for these alternatives. The existing I-5 bridge channel also helps to reduce flooding on Manchester Avenue in the central basin, by attenuating peak flows in the east basin (which results in higher flood levels in the east basin, but little or no flooding in the central basin). Therefore, if the I-5 existing bridge channel were widened under the No Project or Alternative 1A scenarios, substantial flooding along Manchester Avenue would occur in both the east and central basins.

Tidal and fluvial hydraulic modeling also analyzed a range of channel widths under each bridge structure crossing the lagoon to identify which would provide the optimum feasible tidal and fluvial flows. These analyses are presented in the San Elijo Lagoon Bridge Optimization Study (2012). The selection of optimum channel widths was based on a sensitivity analysis conducted for each bridge crossing under typical dry weather tidal fluctuations and extreme storm conditions (100-year storm and 100-year plus a conservative projection of sea level rise combined water levels). Tidal range was used as the primary indicator for benefits to the wetland ecosystem, and extreme flood elevations were modeled to evaluate the potential for flooding of Manchester Avenue. Using these indicators, optimal bridge lengths were identified; i.e., lengths at which tidal range and flood conveyance were most favorable, and further increase in bridge length would bring only minimal benefit. *Table 3.9.3* presents the optimum channel widths for each bridge under each SELRP alternative.

Table 3.9.3: Summary of San Elijo Lagoon Optimized Channel Dimensions for Each SELRP Alternative (in feet)

Alternative	Hwy 101 Bridge		Railroad Bridge		I-5 Bridge	
	Bottom Width	Channel Invert (NGVD)	Bottom Width	Channel Invert (NGVD)	Bottom Width	Channel Invert (NGVD)
No Project	105	-4	161	-5.5	130	-6
1A	115	-4	161	-5.5	130	-6
1B	130	-4	161	-5.5	261	-6
2A	200	-6.5	590	-15.0	261	-6.5

Upon completion of the optimization technical study, the I-5 bridge was designed to accommodate the optimal 261-ft channel bottom associated with SELRP lagoon restoration Alternatives 1B and 2A, as well as other features under consideration such as bike/pedestrian paths and wildlife crossings.

The tidal and fluvial benefits of the proposed structures would be dependent on the SELRP restoration alternative selected. For the No Project and Alternatives 1A and 1B, the tidal and fluvial flows would be primarily dependent on the existing inlet and associated sinuous channel in the west basin that regulates the flows into and out of the lagoon (i.e., the previously described channel between the Coast Highway and railroad bridges). The maximum tidal ranges at I-5 with the optimized I-5 channel dimensions specified in the table above would be between 5.06 and 5.43 ft for No Project and Alternative 1A. The maximum tidal ranges at I-5 with the 261-ft channel under I-5 would be 4.66 and 8.06 ft for Alternatives 1B and 2A, respectively (refer to *Table 3.17.7* in *Section 3.17).* The tidal range would be lower for

Alternative 1B because the larger volume of water accommodated following dredging would not be able to fully drain from the lagoon before the next high tide. Residence time is the average time a particle resides in a hydraulic system; it provides a useful measure of the rate at which waters in the hydraulic system are renewed. Accordingly, residence time provides a means for assessing the water quality of the hydraulic system. Specifically, a shorter residence time means that sediment passes through the lagoon more quickly; indicating better circulation, more water exchange, less sediment deposition, and therefore better water quality within the lagoon. The No Project lagoon design would not provide enough volume of tidal waters east of I-5, so no residence time was determined. Alternative 1A would result in a 12.7-day residence time in the east basin, while Alternatives 1B and 2A show a much quicker turn over, with 7.5 and 4.5 days of residence time, respectively (refer to *Table 3.17.7* in *Section 3.17*).

As noted, fluvial flows during storm events are also an important consideration for optimization analyses, with several portions of Manchester Avenue bordering the north side of the lagoon currently within the 100-year floodplain. With the No Project or Alternatives 1A and 1B, flows would be constrained through the existing inlet, and the related downstream channel between the Coast Highway and railroad bridges would continue to be constrained. Conversely, the lengthened I-5 bridge with an optimized channel bottom width of 261 ft for Alternative 1B would result in the majority of Manchester Avenue being removed from the floodplain (with the exception of small areas in the east and central basins). As indicated in the study, however, further expansion of the I-5 channel width to 392 ft under the Alternative 1B scenario would not result in a demonstrable difference in the flooded area. Alternative 2A is the only scenario that would remove all of Manchester Avenue from the 100-year floodplain, by combining the optimized 261-ft wide channel bottom width with a slightly deeper channel invert than Alternative 1B, and by creating a new lagoon inlet and associated railroad bridge.

Sediment transport within the lagoon is related to the flow velocity of water therein. During dry periods, flow velocity and sediment movement are dependent on tidal flows, while during storms, sedimentation is related to flood velocities. As anticipated, the results demonstrating effective sediment transport vary depending on the alternative. Tidal flow velocities would be lower at I-5 with the No Project Alternative, due to minimal tidal volume. Tidal flow velocities for Alternatives 1A and 1B at I-5 would only be slightly higher than for the No Project Alternative, although the greater volume of water movement and optimized channel at the inlet and railroad crossing under these scenarios would allow the channels to scour and reduce deposition, thereby maintaining the channel cross sections for a longer period. Flow velocities and the ability to carry sediment would be highest at I-5 for Alternative 2A, due to the increased volume and the new inlet and railroad bridges.

During peak storm flows, modeling indicated that sediment would be carried through the main channels to the mouth of the lagoon for all alternatives. Flow velocities would decrease more quickly away from the channels in Alternatives 1A and the No Project, however, due to a smaller volume of water and narrower channels.

A conservative projection of sea level rise of 4.5 ft in year 2100 also was modeled with the 100-year flood storm condition to determine flow velocities and amount of freeboard available to pass flows at each of the bridges. For all alternatives, the 100-year flood height would increase by approximately 2 ft. The velocities were shown to actually decrease because the channels would be deeper, thereby providing for a greater cross section to accommodate the flow. The Coast Highway Bridge would have the least amount of available freeboard, with only approximately 0.4 to 0.8 ft assuming the noted sea level rise. The railroad bridge in its current location would have over 6 ft of freeboard, while the new railroad bridge location under SELRP Alternative 2A would have approximately 7.9 ft of freeboard. The I-5 bridge would have between 19.5 and 21.1 ft of freeboard depending on the SELRP restoration alternative selected, and therefore would accommodate the described sea level rise.

In summary, the optimized I-5 bridge would extend 603.1 ft over San Elijo Lagoon and would encompass a channel bottom width of 261 ft. The proposed bridge length is slightly longer than recommended as a result of the Bridge Length Optimization Study and is included here as an enhancement component. Along with implementation of the other features of SELRP Alternatives 1B or 2A, this optimized I-5 bridge would result in increased tidal range and fluvial flow characteristics, with associated benefits for lagoon habitats, residence time, water quality, and flood control, at a cost of $42.9 million.

Batiquitos Lagoon

The I-5 Bridge over Batiquitos Lagoon is proposed to be 282 ft long, broken into separate north- and southbound bridges with a 19.2-ft gap between them (refer to *Table 3.17.8* in *Section 3.17*). The channel bottom would be 183.5 ft wide, with a depth of -7 ft NGVD. The new channel would be a trapezoid with a level bottom between the abutments, with these dimensions resulting in the same overall cross section as the optimized bridge with the same modeled dimensions at -1.0 ft elevation (NGVD). The existing riprap within the channel bottom would be removed.

Additional Design Considerations for Lagoon Crossing Alternatives

Two studies have been completed to look at different design options for construction of the I-5 bridge. The Phase 2 Hydrodynamic Study was completed by Jenkins, Chang, and WRA (UCSD et al. 2010). This study identified four bridge options, two of which were considered acceptable by the resource agencies. The double wide channel would increase the channel under the I-5 bridge from 106 ft to 212 ft[3] while retaining existing shoaled depth (-5.3 ft) and 2:1 side slopes supported by riprap. This bridge option would cost $7.13 million more than a $13.4 million baseline I-5 bridge measuring 246 ft in length. The Chang Channel would allow a deeper and wider channel by using steeper slopes. Specifically, this option would deepen the channel to -7.0 ft, and increase the side slope grades to 1:1 (also supported by riprap), which would result in a channel bottom that is 180 ft wide and -7.0 ft deep. Armoring of the channel bottom or bridge columns is not proposed for either option. Both options would increase tidal range in the eastern basin and reduce flow velocities under the I-5 bridge (refer to *Table 3.17.8* in *Section 3.17*). This bridge option would cost $1.26 million more than a baseline I-5 bridge measuring 246 ft in length.

Optimization Analysis

The resource agencies requested additional study of the lagoon to determine potential system-wide improvements that could be realized by looking at a wider cross section of I-5 bridge channel dimensions, and also at optimizing the railroad bridge and channel design features. The resulting optimization technical study (the Batiquitos Lagoon Bridge Optimization Study 2012) indicated a wider/deeper channel would be needed similar to the Chang Channel,

[3] Phase 2 studies modeled the channel as a trapezoid with a flat bottom width of 106 ft and a depth of -5.3 ft. The subsequent optimization study model was based on the as-built channel with a 66-ft-wide bottom sloping up at 4:1 (131 ft at -1.0 ft) to meet the 2:1 slope.

but with side slopes of 2:1. Final optimized channel dimensions were determined to include a 134-ft wide channel bottom at -7.0 ft deep, with 2:1 slopes armored with riprap (refer to *Table 3.17.8* in *Section 3.17* and the optimization technical study). Riprap would not extend onto the channel bottom. The proposed channel incorporates the described 134-ft wide channel that would transition (as a 4:1 slope channel) into a 183.5-ft channel of similar to slightly larger cross section. Additional widening of the channel beyond those specifications would result in only 0.25 in of tidal range for another 40 ft of channel width. The fluvial flows would also be optimized at the I-5 bridge, although the limitations of the coastal inlet would cause 100-year floodwater to back up upstream of the inlet. Although the 100-year flood fluvial flows remain slightly elevated upstream of each bridge, no infrastructure would be impacted and additional channel widening provides minimal change. The studies showed that the railroad bridge would also benefit from a wider and deeper channel. The railroad channel would be optimized with an increase in the channel bottom width from 162 to 202 ft, and an increase in the channel depth from -6.35 to -7.0 ft.

Since both the railroad and I-5 bridges are proposed for replacement as part of the LOSSAN double tracking effort and *I-5 NCC Project,* the optimization technical study provided modeling for optimizing tidal and fluvial flows through both of these bridges. Because the Pacific Coast Highway 101 Bridge and inlet were recently installed and designed for inlet stability utilizing a previously modeled flow regime, changes to the inlet were not modeled as part of the project optimization technical study.

The combination of the wider railroad and I-5 bridges would result in maximum tidal ranges of 7.35 ft in the eastern basin and 7.4 ft in the central basin (refer to *Table 3.17.8* in *Section 3.17*). The ocean has a maximum tidal range of 8.37 ft in this area; however, the gauge at the eastern end of the ocean inlet (west of the railroad and I-5 bridges) mutes the tide to 7.51 ft under existing conditions. Therefore, minimal muting (0.16 to 0.11 ft) is attributable to the railroad and I-5 bridges. The increase of tidal range would result in additional intertidal habitat in the east basin. The increased channel dimensions would also decrease flow velocities under the bridges, resulting in reduced scour under the I-5 and railroad bridges.

Fluvial flows associated with the 100-year flood were modeled for both the existing and the optimized channel dimensions. As noted, floodwaters currently backup in all three Batiquitos Lagoon basins. By increasing the channel dimensions of both the I-5 and the railroad bridges, there would be a lower water level in the east basin, but a higher level in the central basin. All proposed bridge dimensions would pass the 100-year flood with at least 6.6 ft of freeboard.

For the optimized I-5 bridge in the dredged condition (i.e., sediment removal at the central basin, as well as the I-5, railroad, and inlet channels), tidal velocity would decrease from 4.3 to 2.4 ft/s at flood tide, and from 3.9 to 2.3 ft/s at ebb tide. By comparison, these velocities would only change to 2.2 ft/s at flood tide and 2.0 ft/s at ebb tide under the shoaled optimized condition; which was modeled with the pre-dredged bathymetry in 2008. The reduced velocities for the optimized condition would allow for reduced scour under the bridge, while still transporting sand and sediments to the inlet. Inlet velocities would remain similar to existing conditions due to the fixed nature of the recently modified inlet.

Sediment transport under extreme flood velocities also would be decreased with the optimized channels under the bridges, resulting in less scour and erosion along the channels. The velocity in the optimized channel would reduce the time for the flood flows to travel through the east basin from 0.7 hour to 0.6 hour, thereby reducing the time for sediment to settle. Accordingly, the sediment transport capacity under the optimized bridge would be slightly improved compared to existing conditions.

The overall residence time in Batiquitos Lagoon is less than one week, indicating that circulation in the lagoon is good. With the optimized channel improvements, the residence time in the eastern basin would be reduced from 5.8 days to 5.4 days.

- A conservative projection of sea level rise of 4.5 ft in the year 2100 would result in the 100-year flood surface water levels increasing by approximately 2 ft at both the railroad and I-5 bridges. The water surface elevation would increase by approximately 0.1 ft with the optimized versus the existing channel. Both the railroad and I-5 bridges would be expected to pass the 100-year flood flows with sea level rise as noted. Assuming the replacement railroad bridge has a similar soffit height to the existing bridge, it would have a freeboard of at least 7.0 ft. The optimized I-5 bridge would have a slightly lower soffit than the existing I-5 bridge, but would have a projected freeboard of approximately 4.8 ft during the 100-year flood with sea level rise. The only bridge that would not pass the projected 100-year flood with sea level rise is the East Coast Highway Bridge, which is slightly lower than the West Coast Highway Bridge, and would have a projected freeboard deficit of 0.1 ft. As noted, above, however, the projected sea level rise of 4.5 ft is conservative and the most recent State policy reflects a projected sea level rise of 3.1 ft. With a sea level rise projection that is 1.4 ft less than the value used in the models for this EIR/EIS, there would be no freeboard deficit for the East Coast Highway Bridge.

In summary, the proposed bridge (at a cost of $3.85 million over baseline costs) would provide optimal function without over engineering (i.e., project modeling as part of Phase 2 studies showed that additional length would provide only minimal benefit relative to the associated cost). The proposed bridge length is recommended as a result of the Batiquitos Lagoon Bridge Length Optimization Study and is included here as an enhancement component. The proposed bridge cross section would have a flat-trapezoid when built; therefore, the channel dimensions would be different from those modeled. The proposed channel dimensions would be 183.5 ft wide at the bottom with 2:1 slopes on the abutments. The channel width at -1 ft NGVD remains 200 ft, which is the same cross section modeled at this elevation. The resulting cross section of the designed bridge is similar to, but slightly larger, than modeled. The trapezoid design would be a more hydrologically efficient design (Moffat & Nichol 2012: personal communication). Based on the above discussion, the optimized I-5 bridge would result in increased tidal range of 0.7 ft in the east basin and 0.5 ft in the central basin. The increased tidal range would result in increased salt marsh and other intertidal habitats, with less subtidal habitats. The increased area would enhance flushing and reduce residence time, thereby increasing water quality within the lagoon. Additional widening of the channel (requiring a longer bridge) beyond proposed specifications would result in only 0.25 inch of tidal range improvement for another 40 ft of channel width.

Buena Vista Lagoon

The current enhanced I-5 Bridge over Buena Vista Lagoon is proposed to be 197 ft long, with the channel bottom estimated at 105 ft wide and -6.0 ft NGVD (refer to *Table 3.17.10* in *Section 3.17*). The cost of this enhanced bridge is $14.6 million, while the cost of the I-5 bridge proposed in the Draft EIR/EIS was $7.6 million.

Additional Design Considerations for Lagoon Crossing Alternatives

The Draft EIR/EIS originally proposed to replace the I-5 bridge with bridge dimensions to be specified in, and required by, the Buena Vista Lagoon restoration plan that was under preparation. A number of Buena Vista Lagoon restoration plan alternatives were developed under the direction of several federal and State agencies, including the California State Coastal Conservancy (SCC), U.S. Fish and Wildlife Service, and CDFW. Due to issues with the private ownership of the lagoon mouth, however, Buena Vista Lagoon restoration plan activities were suspended. The resource agencies have asked that Caltrans model four potential Buena Vista Lagoon restoration plan alternatives to determine an optimal bridge length for I-5 that would not limit potential future Buena Vista Lagoon restoration plan activities. This modeling was completed as part of the I-5 Bridge Study at Buena Vista Lagoon (2012). These four alternatives were selected because the proposed grading and outlet/inlet configurations represent a reasonable range of potential restoration conditions for the Buena Vista Lagoon plan. Analysis of the alternatives provided ranges of dimensions for potential hydraulic connections, which would in turn affect the design of the bridge structure. The four alternatives represent options for retention of the lagoon as a primarily freshwater resource and returning it to a saltwater regime, and include:

- Saltwater Alternative 2-1
- Saltwater Alternative SW2-A
- Freshwater Alternative 1
- Freshwater Alternative FW-A

Saltwater Alternative 2-1 represents the Buena Vista Lagoon restoration plan configuration of a salt water hydrologic regime originally developed for the Buena Vista Lagoon restoration project in 2008. This alternative would achieve Buena Vista Lagoon restoration plan objectives primarily through elimination of the existing exotic vegetation, dredging to remove excess sediment, and establishment of continuous tidal exchange. Specifically, under this alternative the existing weir would be replaced with a tidal inlet, and it is assumed that the previously described sand berm would be regularly maintained (lowered) to provide continuous tidal exchange between the lagoon and ocean. The tidal inlet would require stabilization with two jetties that would extend to the Mean Lower Low Water (MLLW) contour. The bottom elevation of the Railroad and Weir Basins would be dredged to between -12 and -15 ft NGVD to provide a sediment trap for sand entering the lagoon from the ocean. Prominent features of this alternative were described in the 2008 Hydraulic Study Report (Everest 2008).

Saltwater Alternative SW2-A is the most recent salt water Buena Vista Lagoon restoration plan alternative developed for the lagoon. In this alternative, a channel would trend along the center of the I-5 and Coast Highway Basins at -3.3 ft NGVD, with the two banks of the channel being graded to a slope not to exceed 8:1. Downstream of the railroad bridge, the channel would widen and form a basin with a uniform depth of -3.3 ft NGVD. The tidal inlet channel would be constructed with an initial bottom elevation of -2.0 ft NGVD, but no jetties would be constructed to stabilize the inlet channel. Prominent features of this alternative were described in the 2011 technical memo (Everest 2011a).

Freshwater Alternative 1 represents retention of the freshwater hydrologic regime analyzed as part of the Buena Vista Lagoon Restoration Project Feasibility Study in 2004. This alternative would achieve Buena Vista Lagoon restoration plan objectives primarily through elimination of the existing exotic vegetation and dredging to remove excess sediment. The existing ocean outlet weir would be replaced with an 80-ft wide weir, consistent with a weir widening project proposed by the City of Oceanside. The invert elevation of the weir would be kept at the existing weir invert elevation, which is 5.6 ft NGVD. The bottom elevation of the Railroad and Weir Basins would be dredged to between -12 and -15 ft NGVD. Prominent features of this alternative were described in the 2008 fluvial hydraulics report (Everest 2008).

Freshwater Alternative FW-A is the most recent freshwater alternative developed for the lagoon. The central portions of each basin would be dredged to maintain a water depth of about 6 ft (bottom elevation of about 0 ft NGVD) to minimize the future encroachment of reeds (cattails) throughout the lagoon. This alternative includes similar assumptions regarding the existing weir and sand berm as noted above for Saltwater Alternative 2-1.

Optimization Analysis

The fluvial hydraulic analysis studied the impact of a 100-year return period storm along Buena Vista Creek. To evaluate impacts due to storms of lesser magnitudes, five other flood events (2-year, 5-year, 10-year, 25-year, and 50-year) were included in the analysis of one of the salt water alternatives. The flood impact of storms coupled with high tides was assessed by applying the peak of the storm hydrograph, timed to match a tide elevation of mean higher high water (MHHW). In addition to evaluating impacts due to storms under current water levels, the storm impact coupled with high tides in Year 2100 was analyzed with a higher water level to evaluate the impact of a conservative projection of sea level rise.

In the initial model run for each alternative, the hydraulic connections beneath the bridges were modeled using as-built dimensions. In subsequent simulations, the dimensions of the hydraulic connections were modified until the simulation results indicated that the storm flow through these hydraulic connections would be unimpeded. This process was conducted for fluvial flow coupled with both the current tide level and Year 2100 tide level with sea level rise (refer to the optimization technical study).

Multiple scenarios were modeled for each alternative that either increased the channel width, depth, or a combination of width and depth to determine the optimal configuration of all three bridge crossings over the lagoon. The fluvial flows were modeled as the controlling factors of the channel dimensions. The optimized channel configurations were defined as the dimensions where the surface water levels were very similar between basins, showing little or no flow constriction.

The results of the optimization technical study found that the railroad bridge was sufficiently wide, and that the channel only required dredging from -2.5 to -6 ft NGVD (*Table 3.9.4*). The Coast Highway crossing, however, would require a wider and deeper channel, as well as potential elevation of the road itself to accommodate the flow under the road, particularly if the conservative projection of sea level rise occurs.

Table 3.9.4: Lagoon Restoration Design Guidelines for Bridge Dimensions

Bridge	Parameters	As-Built	Salt Water Alts	Fresh Water Alts	Design Guideline
Railroad	Invert Elevation (ft, NGVD)	-2.5	*-4*	*-4*	*-6***
	Bottom Width @ Invert (ft)	17	17	17	17
	Channel Width @ MWE (ft)	280	280	280	280
	Soffit Elevation (ft, NGVD)	11.1	*	*	*
	Max Water Elevation (ft, NGVD)	--	*10.1*	*14.1*	*15*
Coast Hwy	Invert Elevation (ft, NGVD)	-6/-3	*-6*	*-6*	*-6*
	Bottom/Top Width (ft)	25/29	*110*	*110*	*110*
	Soffit Elevation (ft, NGVD)	8.2	*	*	*
	Max Water Elevation(ft, NGVD)	--	*10.3*	*14.3*	*15*
I-5	Invert Elevation (ft, NGVD)	-2	*-6*	*-6*	*-6*
	Bottom Width @ Invert (ft)	24	*105*	*105*	*105*
	Width (ft) @ Existing Soffit	99	*180*	*180*	*180*
	Channel width @ MWE (ft)		*147*	*157*	*160*
	Existing Soffit Elevation (ft, NGVD)	23.1			
	Max Water Elevation (ft, NGVD)	--	*10.4*	*14.4*	*15*

Italics = different from as-built**.**
* Proposed soffit elevation should be max water elevation + value (such as freeboard) based on design criteria
**Two ft added to the desired invert elevation for fluvial flows to accommodate the near full tide range.

The optimized I-5 bridge improvements over Buena Vista Lagoon would deepen the channel from -2 to -6 ft NGVD, and increase the bottom width of the channel from the existing 24 ft to 105 ft (refer to *Table 3.9.4* and *Table 3.17.10*). The top width of the channel would be 160 ft at the maximum water surface elevation of 15 ft.

The optimized channel cross sections would be adequate to accommodate flows assuming the conservative projection of sea level rise (4.5 ft) in Year 2100 with the following exceptions: (1) the soffit elevation of Coast Highway would be too low to pass the flow; and (2) the soffit elevation of the railroad would be too low for freshwater alternative FW-A under current conditions, and too low for all Buena Vista Lagoon plan restoration alternatives with future sea level rise. The railroad soffit elevation would have to be raised from 11.1 to 13.6 ft plus freeboard to accommodate the 100-year flood and sea level rise for all alternatives (refer to *Table 3.17.10* in *Section 3.17*).

Residence times were modeled for the saltwater alternatives with the optimized crossings. Alternative SW-A performed better than Alternative A-1 in the I-5 Basin with a maximum residence of 6 days versus 26 days.

In summary, based on the above discussion, a bridge length of 197 ft at a cost of $14.6 million has been identified as optimal; i.e., the length at which tidal range and flood conveyance would be most favorable, and further increase in bridge length would bring only minimal benefit. This is approximately double the $7.6 million cost of simply replacing the existing length bridge with a greater width. The proposed bridge length is recommended as a result of the Bridge Length Optimization Study and is included here as an enhancement component. Specifically, bridge optimization would increase flow through the lagoon and improve water quality. These optimized channel configurations would support a range of Buena Vista Lagoon restoration plan alternatives. The I-5 and railroad bridge improvements anticipated as part of the current project and LOSSAN double-tracking would support the Buena Vista Lagoon restoration plan alternatives. Localized downstream flooding in the Coast Highway Basin could occur, however, if the Coast Highway crossing is not changed during I-5 crossing optimization.[4]

3.9.4 Avoidance, Minimization, and/or Mitigation Measures

Build Alternatives

The proposed project has been designed to avoid and/or minimize impacts where possible, by taking the reduced amounts of right-of-way and limiting the grading footprint to minimize impacts to existing structures while still meeting project objectives. Specifically, the structures over Los Peñasquitos Creek were designed to entirely span the floodplain, the replacement of the Sorrento Valley Road Culvert would remove an existing constriction point in Carmel Creek and lower the base floodplain, and the replacement of the Batiquitos Lagoon Bridge would reduce an existing constriction point in the lagoon and lower the base floodplain. In addition, standard engineering practices would be used, where feasible, to facilitate drainage. Minimization measures for floodplain impacts include:

- Limiting the area affected by construction with utilization of barriers or fences to protect sensitive areas
- Employing best management practices (BMPs) to control erosion and runoff
- Designating ESAs to demarcate and protect floodplain habitats

No Build

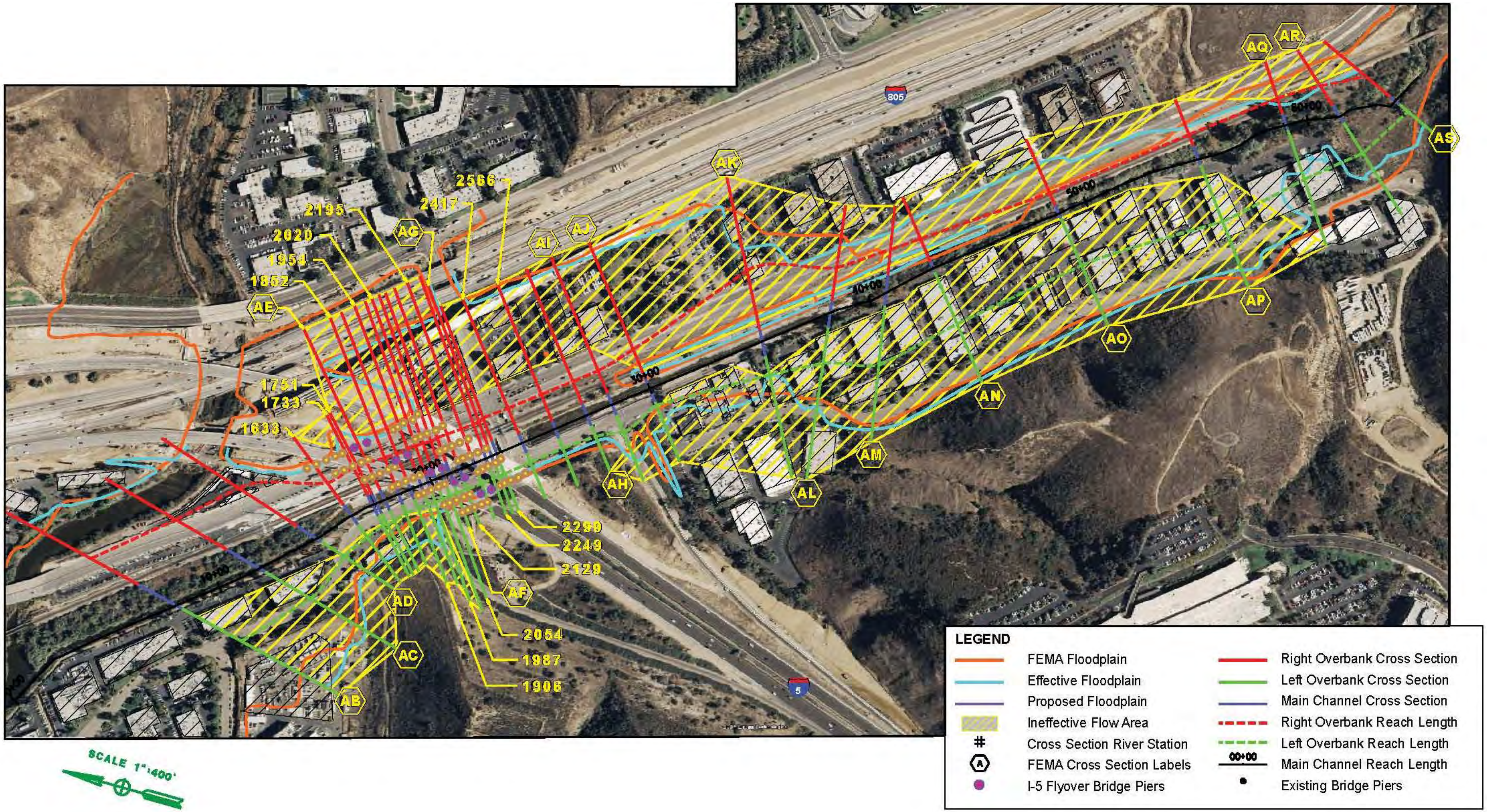
Implementation of the No Build alternative would not result in changes to the floodplain patterns, natural and beneficial floodplain values.

[4] The resource agencies may identify replacement of the Coast Highway crossing as part of the resource enhancement plan for mitigating the *I-5 NCC Project*. The benefit of the bridge lengthening will not be fully evident until a restoration project is identified and implemented in Buena Vista Lagoon.

Table 3.9.1: 100-Year Floodplain Impacts Comparison

Evaluation Criteria	Measured Parameter	No Build	10+4 Barrier				10+4 Buffer				8+4 Barrier				8+4 Buffer			
Total Project Impacts to FEMA 100-year floodplains	Acres	none	**34.6**				**29.1**				**31.2**				**25.2**			
Specific Project Impacts to FEMA 100-year floodplains			Bridge Widening	Roadway Widening	Fill Slopes	Bridge Columns	Bridge Widening	Roadway Widening	Fill Slopes	Bridge Columns	Bridge Widening	Roadway Widening	Fill Slopes	Bridge Columns	Bridge Widening	Roadway Widening	Fill Slopes	Bridge Columns
	Acres	none	**7.7**	**11.9**	**14.8**	**0.2**	**5.8**	**11.7**	**11.4**	**0.2**	**7.4**	**11.3**	**12.3**	**0.2**	**6.2**	**8.7**	**10.1**	**0.2**
Individual Floodplain Impacts																		
Soledad Canyon Creek	Acres	none	0.86	0	0.08	0.02	SAME WIDENING & IMPACTS FOR ALL ALTERNATIVES				SAME WIDENING & IMPACTS FOR ALL ALTERNATIVES				SAME WIDENING & IMPACTS FOR ALL ALTERNATIVES			
Los Peñasquitos Creek	Acres	none	0.21	0	0	0												
Carmel Creek	Acres	none	0.25	0.30	0.14	0.01												
San Dieguito River	Acres	none	1.60	2.85	4.69	0.04	1.01	2.50	3.31	0.03	1.44	2.52	3.42	0.04	1.15	1.36	3.21	0.03
San Elijo Lagoon	Acres	none	1.93	4.42	3.12	0.01	1.14	4.97	1.37	0.01	1.79	4.36	1.65	0.01	1.26	4.44	0.74	0.01
Cottonwood Creek	Acres	none	n/a	0	0	n/a	n/a	0	0	n/a	n/a	0	0	n/a	n/a	0	0	n/a
Batiquitos Lagoon	Acres	none	0.55	1.33	3.28	0.01	0.34	1.31	3.12	0.01	0.57	1.42	3.29	0.01	0.42	0.52	3.08	0.01
Encinas Creek	Acres	none	n/a	0.18	0.24	n/a	n/a	0.12	0.21	n/a	n/a	0.12	0.18	n/a	n/a	0	0.26	n/a
Agua Hedionda Lagoon	Acres	none	0.93	1.51	1.78	0.01	0.63	1.19	1.59	0.01	0.88	1.29	2.04	0.01	0.65	0.81	1.09	0.01
Buena Vista Lagoon	Acres	none	0.22	0.72	1.01	0.01	0.21	0.72	1.08	0.01	0.22	0.72	1.01	0.01	0.21	0.72	1.01	0.01
Loma Alta Creek	Acres	none	0.48	0.55	0.45	0.01	SAME WIDENING & IMPACTS FOR ALL ALTERNATIVES				SAME WIDENING & IMPACTS FOR ALL ALTERNATIVES				SAME WIDENING & IMPACTS FOR ALL ALTERNATIVES			
San Luis Rey River	Acres	none	0.69	0	0.05	0.06												

The 100-year floodplain impact acreage identified in the table is a measure of the four impacts identified that fall within the 100-year floodplain shape files that reside in Caltrans District 11 G:\gisdata\fema\shape directory.
These measured impacts include the four proposed widening alternatives and DAR identified to date.
"Bridge Widening" is the additional bridge deck area above the floodplain limits. (Shading impact)
"Roadway Widening" is the additional roadway area within the floodplain limits. (Footprint impact)
"Fill Slopes" are the additional roadway hinge and fill slope area within the floodplain limits. (Footprint impact)
"Bridge Columns" are the additional bridge column (cross-sectional) area within the floodplain limits. (Waterway impact)
These 100-year floodplain impact quantities are not a measure of the estimated change in the inundation boundary of the 100-year floodplain resulting from the change of character of the freeway corridor. They are merely the measure of the physical encroachment within the existing defined floodplain boundary without regard to the change of the boundary, if perceptible, that results from the impacts themselves.
This table provides a comparative analysis of the effects of the project build alternatives on floodplains as described in the Draft EIR/EIS. After refinement of design, including incorporation of construction footprints, phasing considerations, and quantification of alternative footprints, the areas of floodplain impacts for each of the build alternatives would be larger than shown on this table from the Draft EIR/EIS. The Preferred Alternative would remain the smallest of the build alternatives, however, and would have the least amount of impacts. See *Table 3.9.2* for impacts associated with the refined 8+4 Buffer alternative (Preferred Alternative).

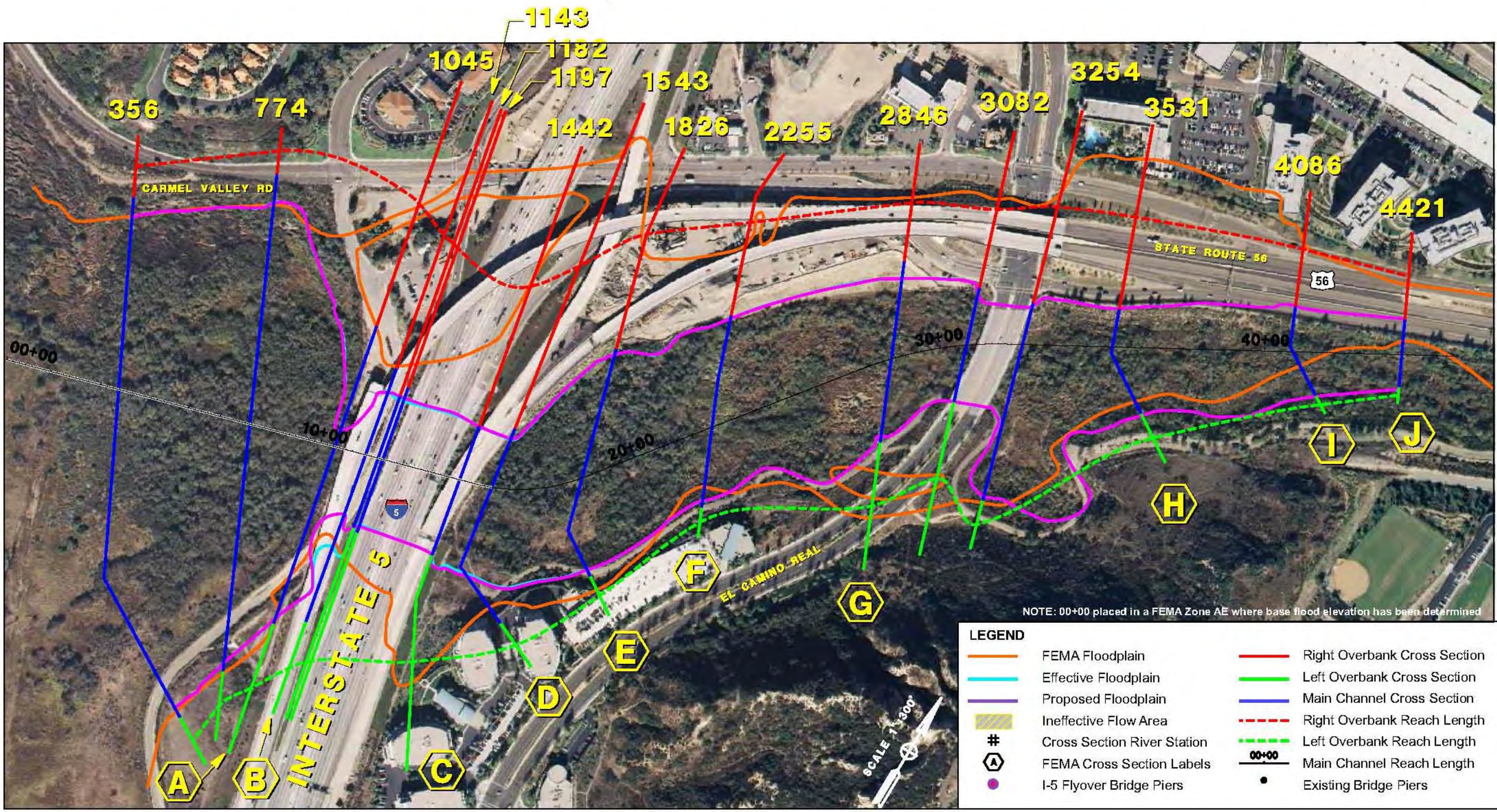


Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.1: Soledad Canyon Creek Floodplain within the Project Area

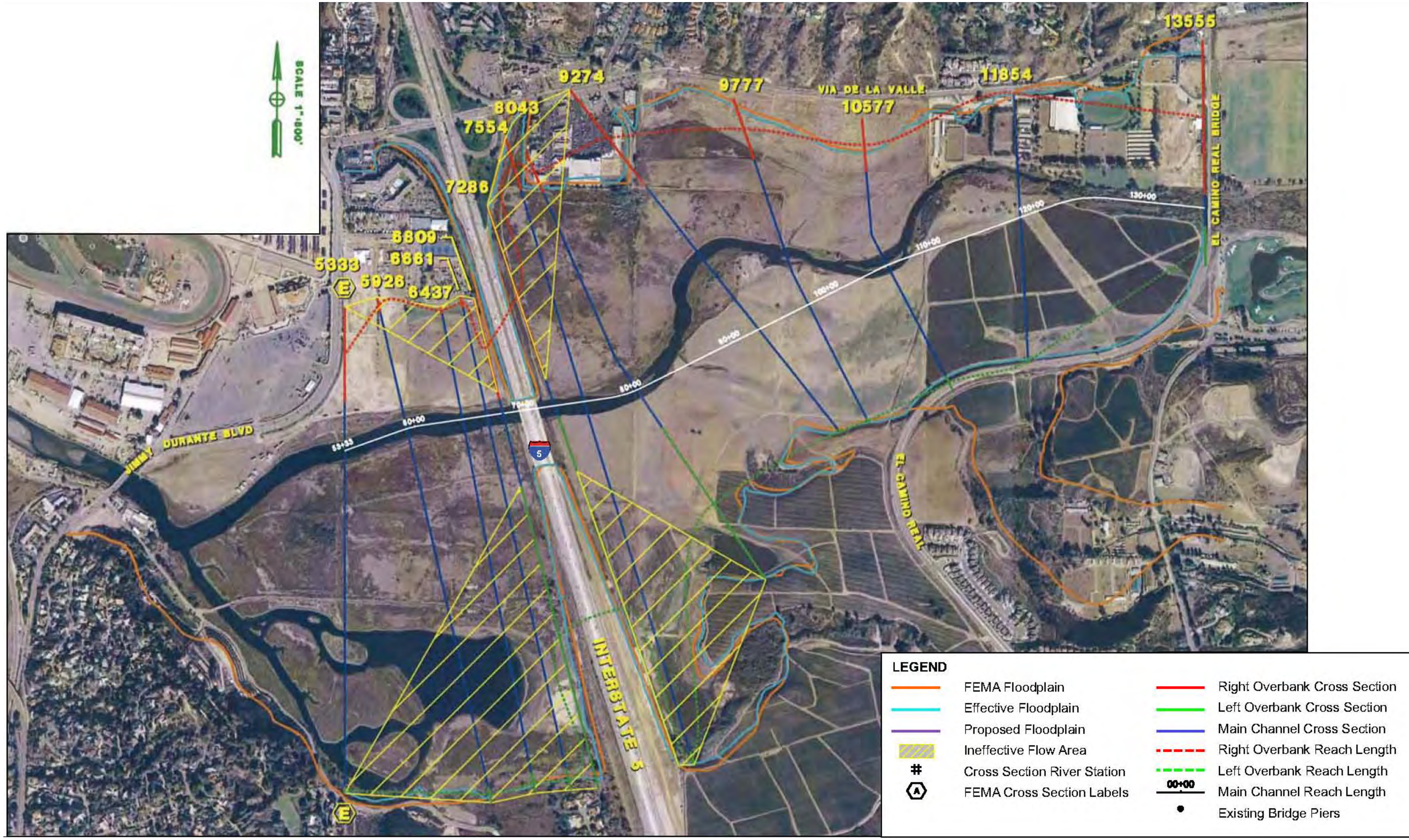
Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.2: Los Peñasquitos Creek Floodplain within the Project Area



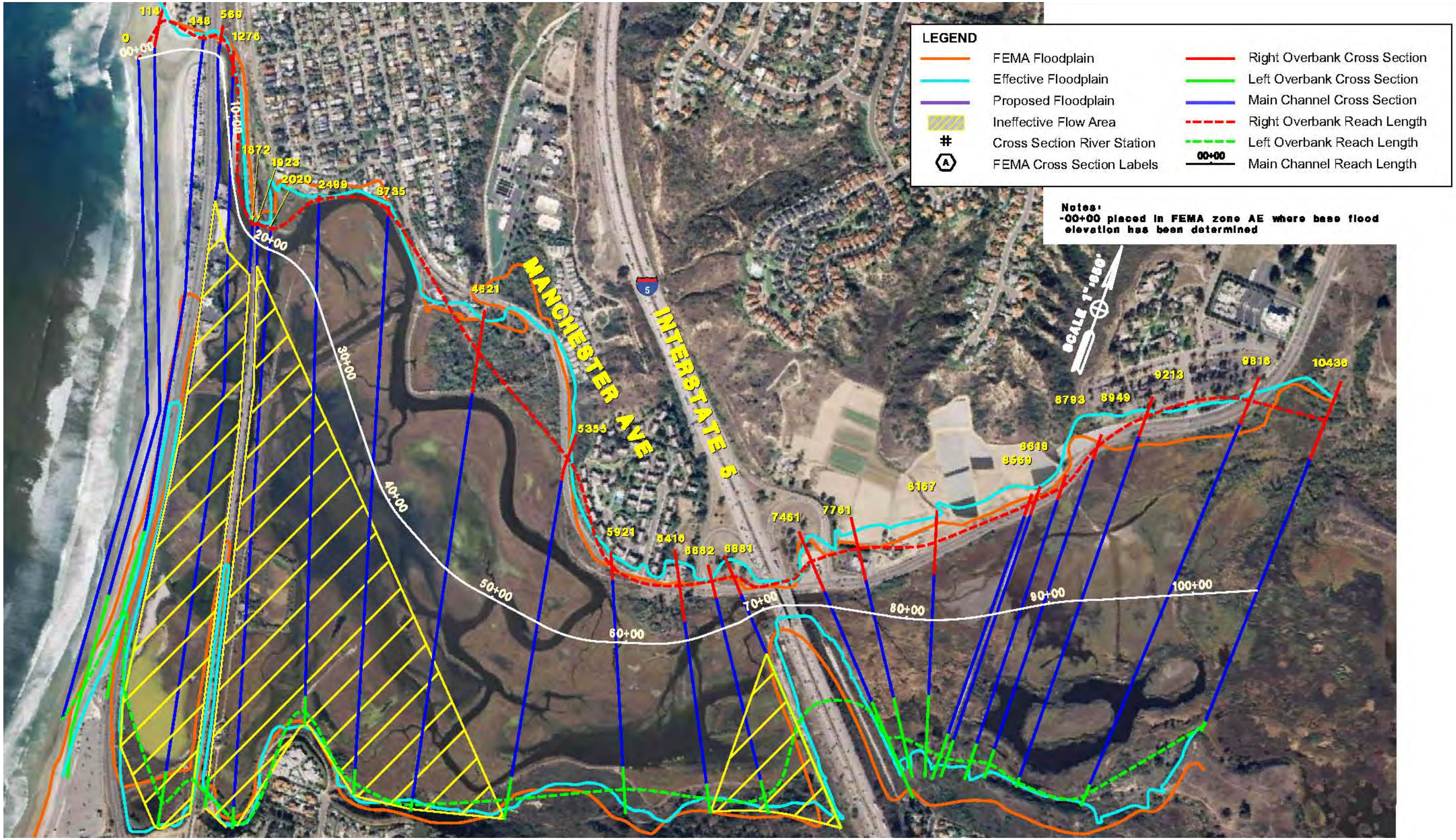
Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.3: Carmel Valley Creek Floodplain within the Project Area



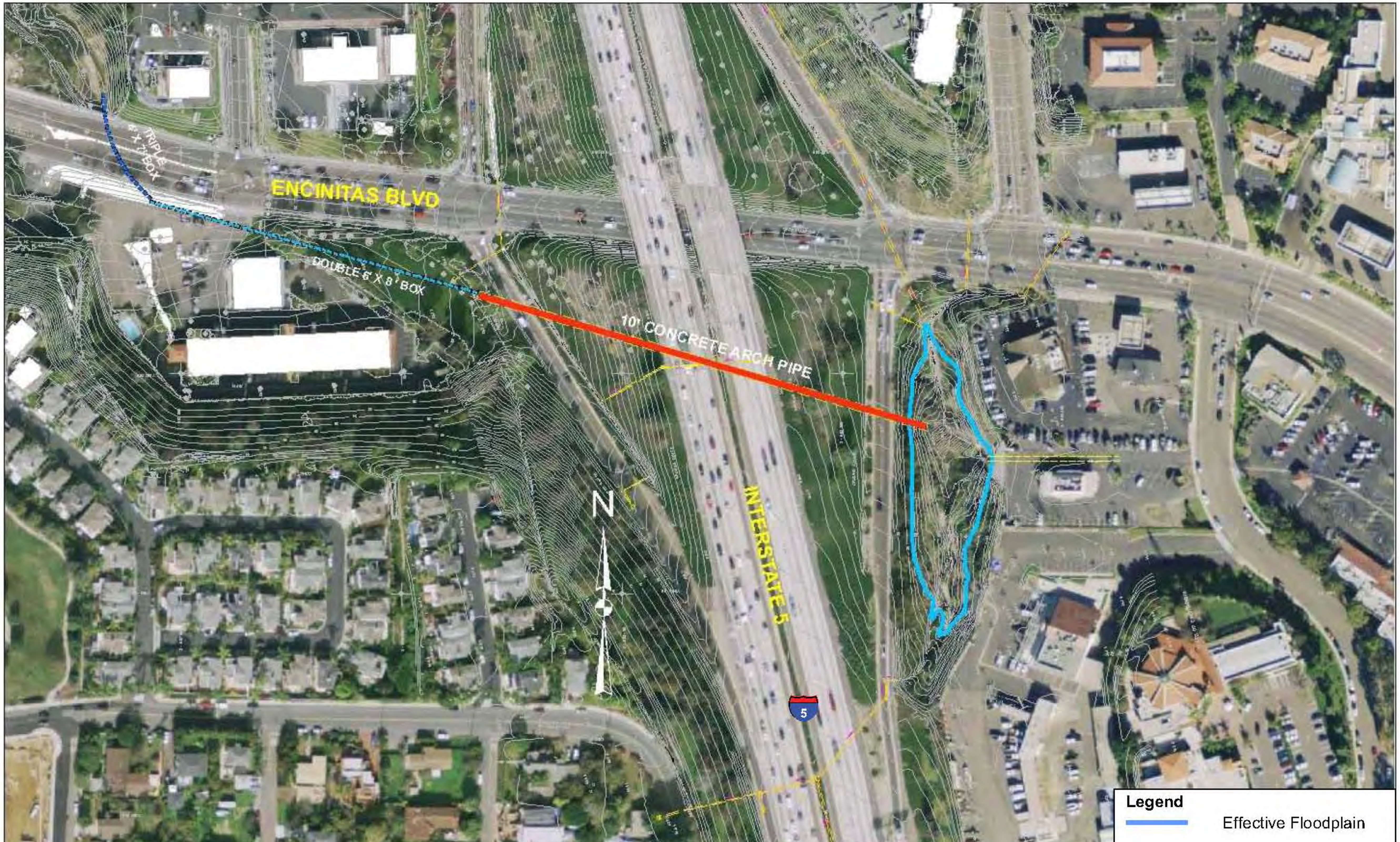
Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.4: San Dieguito River Floodplain within the Project Area



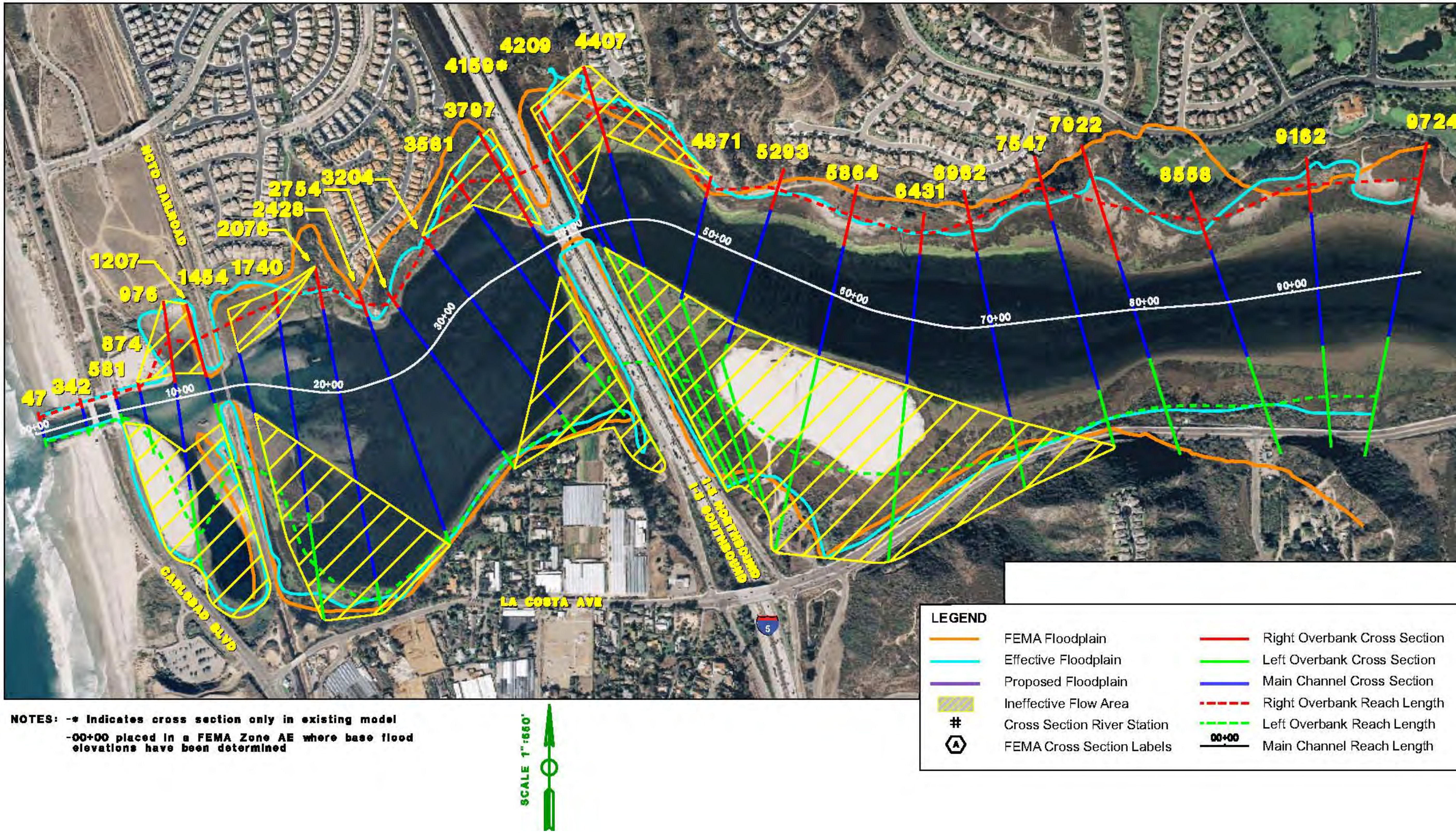
Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.5: San Elijo Lagoon Floodplain within the Project Area



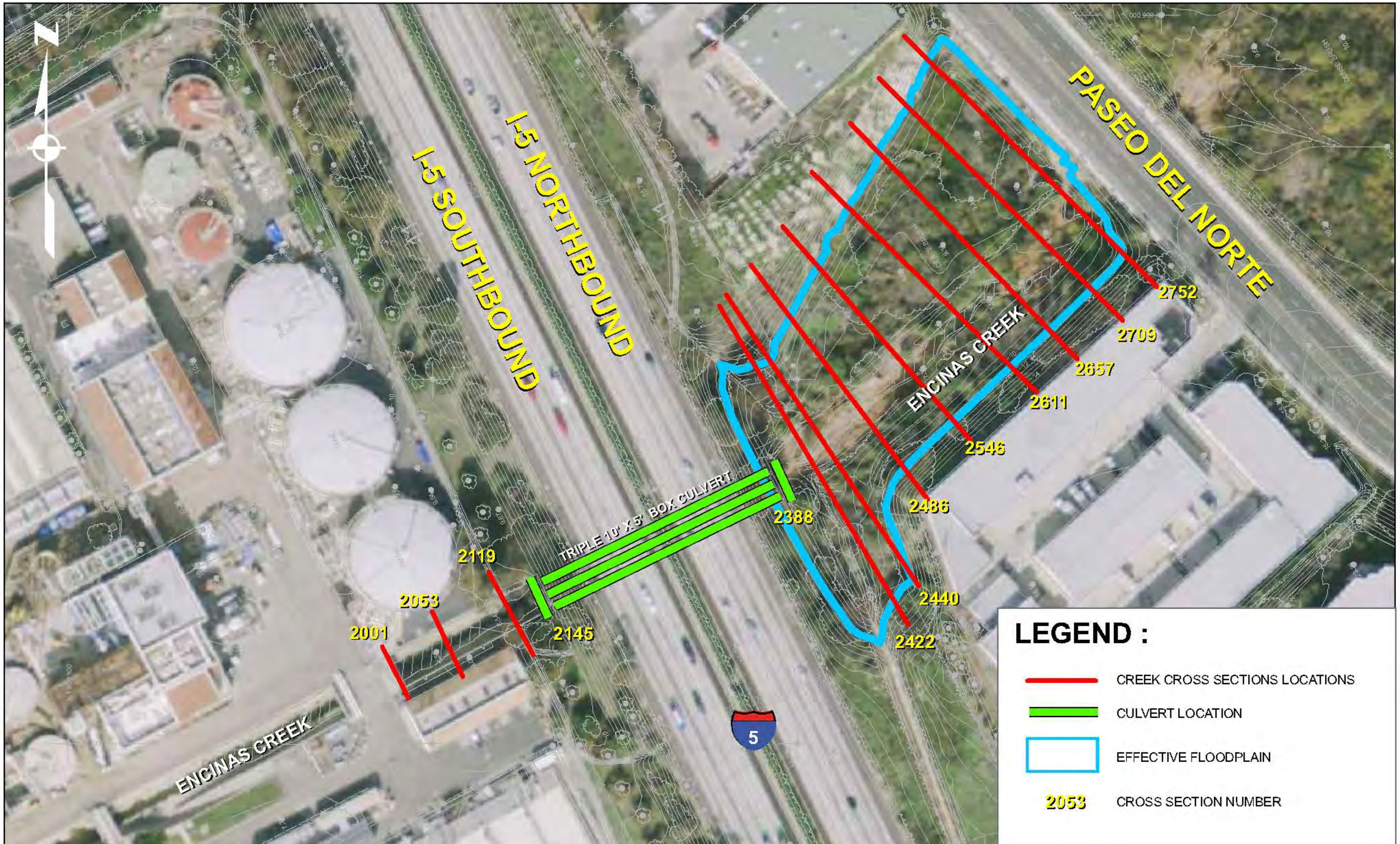
Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.6: Cottonwood Creek Floodplain within the Project Area



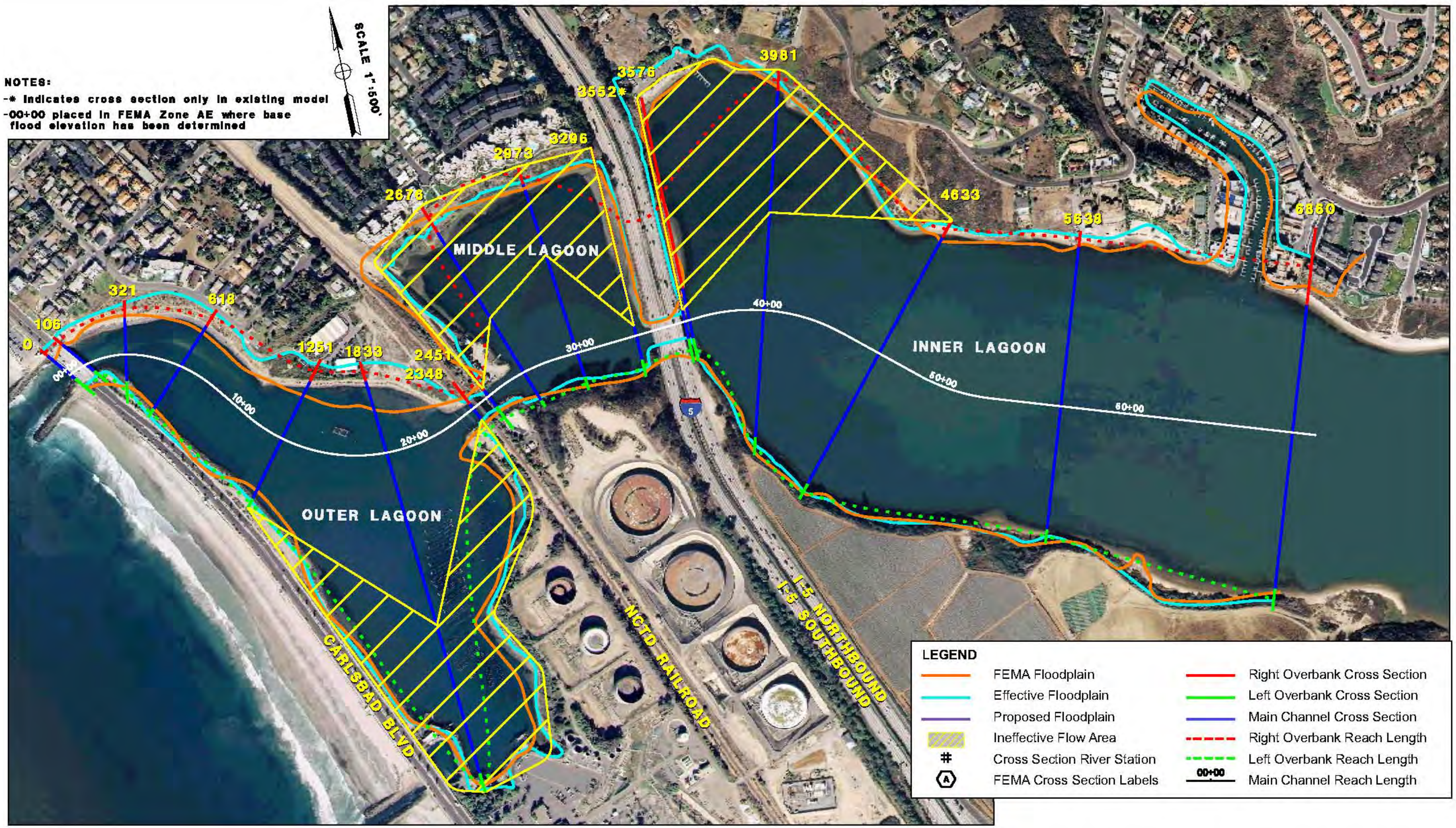
Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.7: Batiquitos Lagoon Floodplain within the Project Area



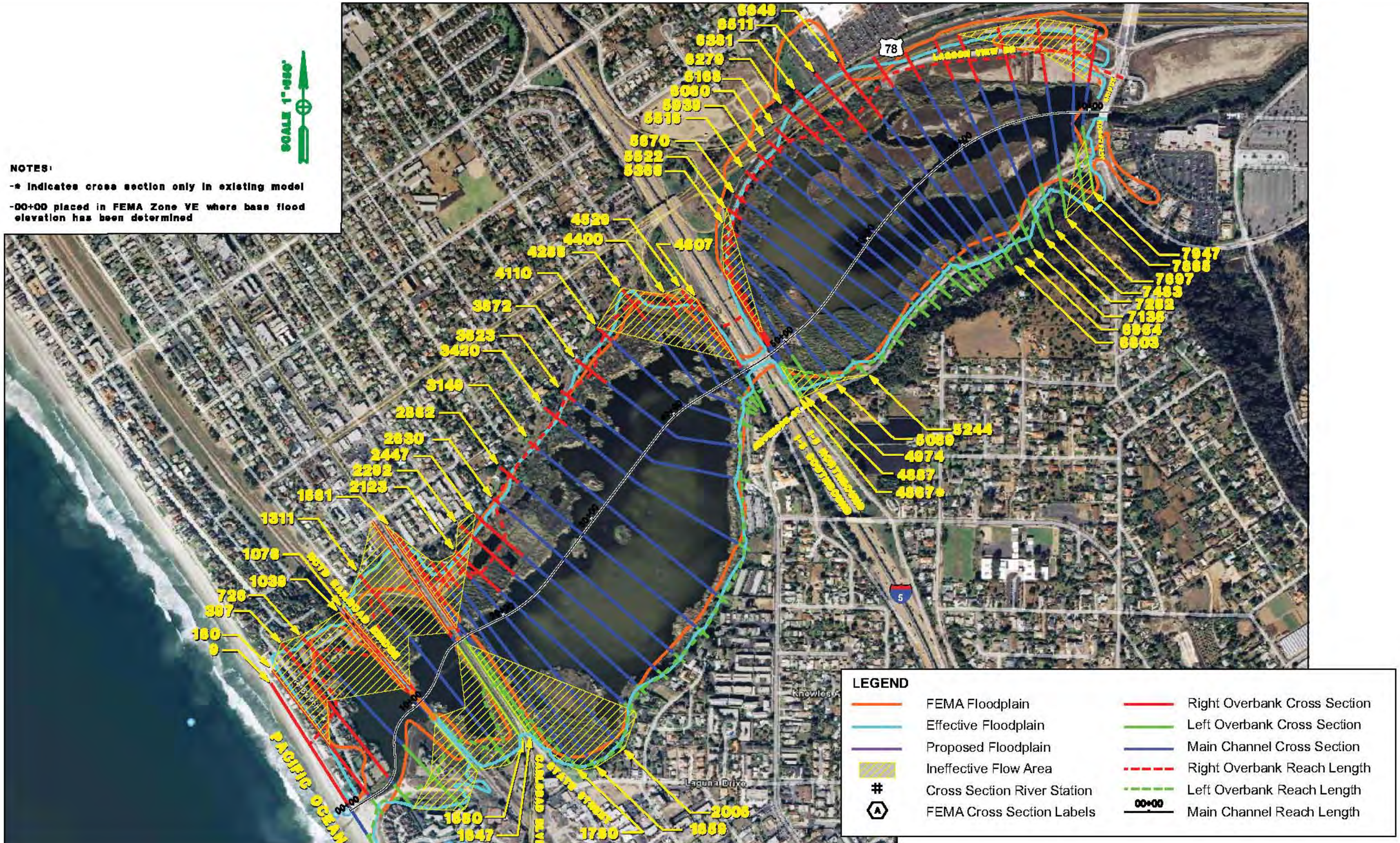
Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.8: Encinas Creek Floodplain within the Project Area



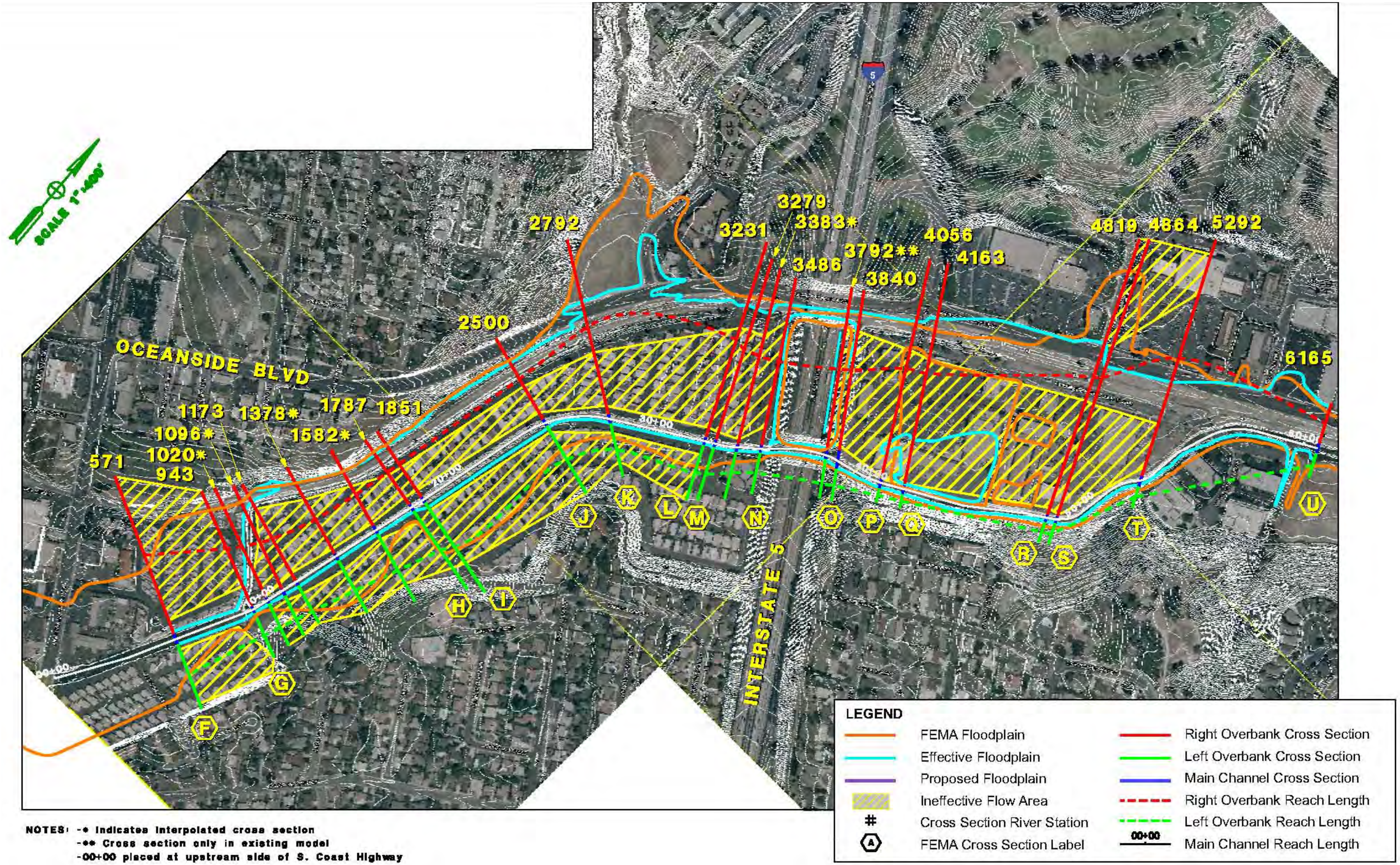
Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.9: Agua Hedionda Lagoon Floodplain within the Project Area



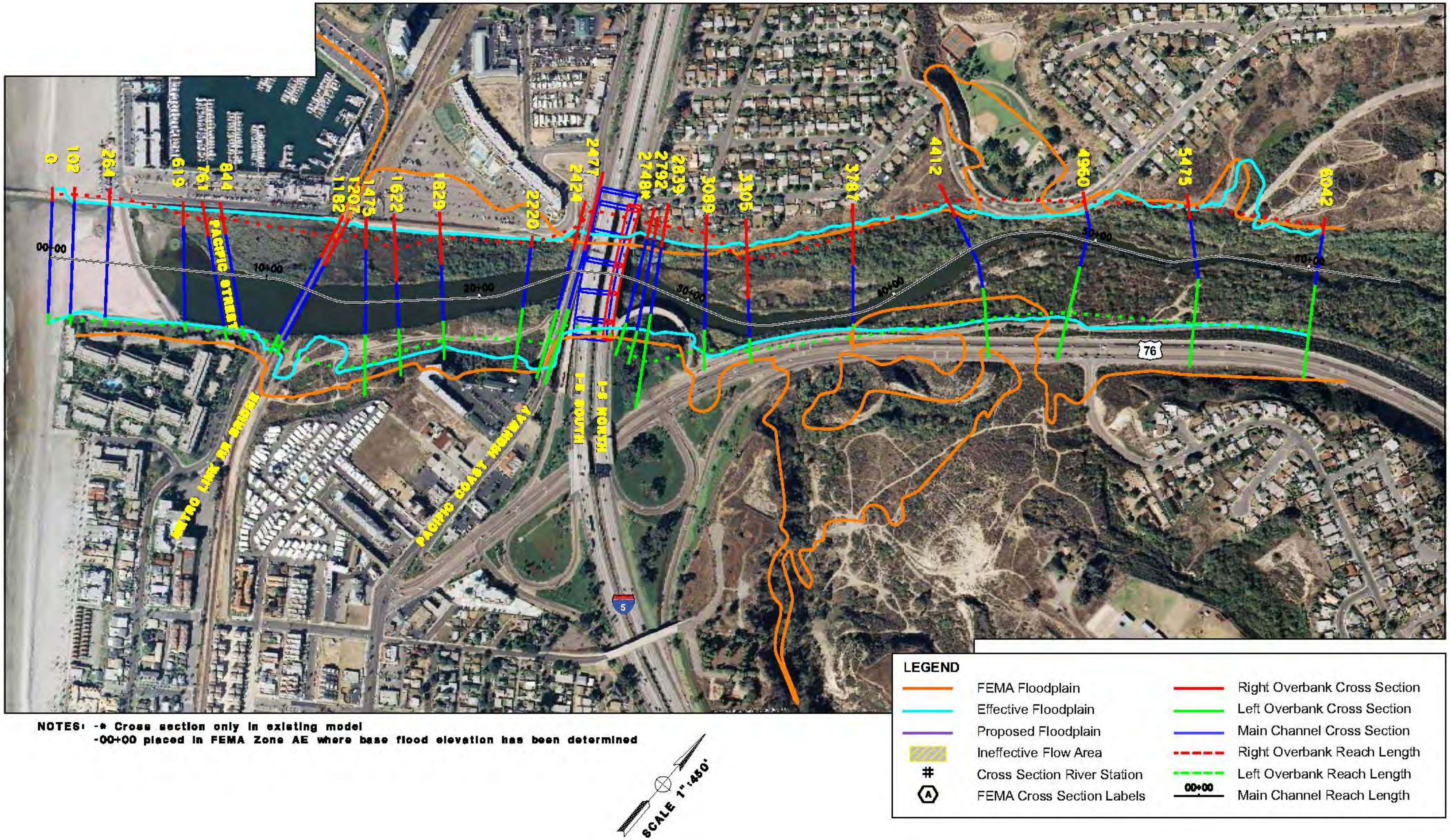
Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.10: Buena Vista Lagoon Floodplain within the Project Area



Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.11: Loma Alta Creek Floodplain within the Project Area



Source: Interstate 5 North Coast Floodplain Studies, Books 1, 2, and 3, February 2008 and February 2009

Figure 3-9.12: San Luis Rey River Floodplain within the Project Area

3.10 Water Quality and Storm Water Runoff

The 8+4 Buffer alternative has been refined since the Draft EIR/EIS was publically circulated in 2010. This alternative was presented as the locally preferred alternative (LPA) in the August 2012 Supplemental Draft EIR/EIS, and has now been identified as the Preferred Alternative. The refined 8+4 Buffer alternative has the least amount of impact of any build alternative and also meets purpose and need.

The information presented in this section is based on the July 2009 Water Quality Report (WQR) prepared for the project. A Technical Memorandum (August 2013) was prepared to update regulatory permits and storm water information related to the LPA.

3.10.1 Regulatory Setting

Federal Requirements: Clean Water Act

In 1972 Congress amended the Federal Water Pollution Control Act, making the addition of pollutants to the waters of the United States (U.S.), from any point source unlawful unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. Known today as the Clean Water Act (CWA), Congress has amended it several times. In the 1987 amendments, Congress directed dischargers of storm water from municipal and industrial/construction point sources to comply with the NPDES permit scheme. Important CWA sections are:

- Sections 303 and 304 require states to promulgate water quality standards, criteria, and guidelines.

- Section 401 requires an applicant for a federal license or permit to conduct any activity, which may result in a discharge to waters of the U.S., to obtain certification from the State that the discharge will comply with other provisions of the act. This is most frequently required in tandem with a Section 404 permit request (see below).

- Section 402 establishes the NPDES, a permitting system for the discharges (except for dredge or fill material) of any pollutant into waters of the U.S. Regional Water Quality Control Boards (RWQCBs) administer this permitting program in California. Section 402(p) requires permits for discharges of storm water from industrial/construction and municipal separate storm sewer systems (MS4s).

- Section 404 establishes a permit program for the discharge of dredge or fill material into waters of the U.S. This permit program is administered by the U.S. Army Corps of Engineers (USACE).

The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

USACE issues two types of 404 permits: Standard and General permits. There are two types of General permits: Regional permits and Nationwide permits. Regional permits are issued for a general category of activities when they are similar in nature and cause minimal environmental effect. Nationwide permits are issued to authorize a variety of minor project activities with no more than minimal effects.

There are two types of Standard permits: Individual permits and Letters of Permission. Ordinarily, projects that do not meet the criteria for a Nationwide Permit may be permitted under one of USACE's Standard permits. For Standard permits, the USACE decision to approve is based on compliance with U.S. Environmental Protection Agency (USEPA) Section 404 (b)(1) Guidelines (USEPA CFR 40 Part 230), and whether permit approval is in the public interest. The Section 404(b)(1) Guidelines (Guidelines) were developed by the USEPA in conjunction with USACE, and allow the discharge of dredged or fill material into the aquatic system (waters of the U.S.) only if there is no practicable alternative which would have less adverse effects. The Guidelines state that USACE may not issue a permit if there is a Least Environmentally Damaging Practicable Alternative (LEDPA), to the proposed discharge that would have lesser effects on Waters of the U.S., and not have any other significant adverse environmental consequences. According to the Guidelines, documentation is needed that a sequence of avoidance, minimization, and compensation measures has been followed, in that order. The Guidelines also restrict permitting activities that violate water quality or toxic effluent standards, jeopardize the continued existence of listed species, violate marine sanctuary protections, or cause "significant degradation" to waters of the U.S. In addition, every permit from the USACE, even if not subject to the Section 404(b)(1) Guidelines, must meet general requirements. See 33 CFR 320.4. A discussion of the LEDPA determination is included in Section *3.18, Wetlands and Other Waters*.

State Requirements: Porter-Cologne Water Quality Control Act

California's Porter-Cologne Act, enacted in 1969, provides the legal basis for water quality regulation within California. This Act requires a "Report of Waste Discharge" for any discharge of waste (liquid, solid, or gaseous) to land or surface waters that may impair beneficial uses for surface and/or groundwater of the State. It predates the CWA and regulates discharges to waters of the State. Waters of the State include more than just waters of the U.S., like groundwater and surface waters not considered waters of the U.S. Additionally, it prohibits discharges of "waste" as defined and this definition is broader than the CWA definition of "pollutant". Discharges under the Porter-Cologne Act are permitted by Waste Discharge Requirements (WDRs) and may be required even when the discharge is already permitted or exempt under the CWA.

The State Water Resources Control Board (SWRCB) and RWQCBs are responsible for establishing the water quality standards (objectives and beneficial uses) required by the CWA, and for regulating discharges to ensure compliance with the water quality standards. Details regarding water quality standards in a project area are contained in the applicable RWQCB Basin Plan (Basin Plan). In California, Regional Boards designate beneficial uses for all water body segments in their jurisdictions, and then set criteria necessary to protect these uses. Consequently, the water quality standards developed for particular water segments are based on the designated uses and vary depending on such uses. In addition, the SWRCB identifies waters failing to meet standards for specific pollutants, which are then State-listed in accordance with CWA Section 303(d). If a State determines that waters are impaired for one or more constituents and the standards cannot be met through point source or non-point source controls (NPDES permits or WDRs), the CWA requires the establishment of Total Maximum Daily Loads (TMDLs). TMDLs specify allowable pollutant loads from all sources (point, non-point, and natural) for a given watershed.

State Water Resources Control Board and Regional Water Quality Control Boards

The SWRCB administers water rights, sets water pollution control policy, issues water board orders on matters of Statewide application, and oversees water quality functions throughout the State by approving Basin Plans, TMDLs, and NPDES permits. RWCQBs are responsible for protecting beneficial uses of water resources within their regional jurisdiction using planning, permitting, and enforcement authorities to meet this responsibility.

National Pollutant Discharge Elimination System (NPDES) Program

Municipal Separate Storm Sewer Systems (MS4)

Section 402(p) of the CWA requires the issuance of NPDES permits for five categories of storm water discharges, including Municipal Separate Storm Sewer Systems (MS4s). The USEPA defines an MS4 as "any conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, human-made channels, and storm drains) owned or operated by a state, city, town, country, or other public body having jurisdiction over storm water, that are designed or used for collecting or conveying storm water." The SWRCB has identified Caltrans as an owner/operator of an MS4 pursuant to federal regulations.

Caltrans MS4 Program

The SWRCB adopted the Caltrans Statewide NPDES Permit (Order No. 99-06-DWQ) on July 15, 1999. This permit covers all Caltrans rights-of-way, properties, facilities, and activities in the State. NPDES permits establish a five-year permitting time frame. NPDES permit requirements remain active until a new permit has been adopted.

On September 19, 2012, the State Water Board adopted a Statewide permit (Order No. 2012-0011-DWQ) which regulates all storm water and certain non-storm water discharges from Caltrans' MS4. This includes all State highways, rights-of-way, facilities, and construction activities. This Order supersedes Order No. 99-06-DWQ upon its effective date of July 1, 2013.

In compliance with the permit, Caltrans developed the Statewide Storm Water Management Plan (SWMP) to address storm water pollution controls related to highway planning, design, construction, and maintenance activities throughout California. The SWMP describes the minimum procedures and practices Caltrans uses to reduce pollutants in storm water and non-storm water discharges. It outlines procedures and responsibilities for protecting water quality, including the selection and implementation of BMPs. The proposed project would be programmed to follow the guidelines and procedures outlined in the 2003 SWMP to address storm water runoff or any subsequently approved version of the SWMP. The SWMP is under revision to comply with the new requirements of the latest NPDES Permit.

Construction General Permit

Construction General Permit (Order No. 2009-009-DWQ), adopted on September 2, 2009, became effective on July 1, 2010. The permit regulates storm water discharges from construction sites that result in a disturbed soil area (DSA) of 1 ac or greater and/or are part of a common plan of development. By law, all storm water discharges associated with construction activity where clearing, grading, and excavation results in soil disturbance of at least 1 ac must comply with the provisions of the Construction General Permit. Construction activity that results in soil disturbances of less than 1 ac is subject to this Construction General Permit if there is potential for significant water quality impairment resulting from the activity as determined by the

RWQCB. Operators of regulated construction sites are required to develop storm water pollution prevention plans; to implement sediment, erosion, and pollution prevention control measures; and to obtain coverage under the Construction General Permit.

The 2009 Construction General Permit separates projects into Risk Levels 1 – 3. Risk levels are determined during the planning and design phases, and are based on potential erosion and transport to receiving waters. Requirements apply according to the Risk Level determined. For example, a Risk Level 3 (highest risk) project would require compulsory storm water runoff pH and turbidity monitoring, as well as pre- and post-construction aquatic biological assessments during specified seasonal windows. For all projects subject to the permit, applicants are required to develop and implement an effective Storm Water Pollution Prevention Plan (SWPPP).

Section 401 Permitting

Under Section 401 of the CWA, any project requiring a federal license or permit that may result in a discharge to a water of the U.S. must obtain a 401 Certification, which certifies that the project will be in compliance with State water quality standards. The most common federal permits triggering 401 Certification are CWA Section 404 permits issued by USACE. The 401 permit certifications are obtained from the appropriate RWQCB, dependent on the project location, and are required before USACE issues a 404 permit.

In some cases the RWQCB may have specific concerns with discharges associated with a project. As a result, the RWQCB may issue a set of requirements known as WDRs under the State Water Code (Porter-Cologne Act) that define activities, such as the inclusion of specific features, effluent limitations, monitoring, and plan submittals, that are to be implemented for protecting or benefiting water quality. WDRs can be issued to address both permanent and temporary discharges of a project.

3.10.2 Affected Environment

The water quality analysis is based on the July 2009 WQR, a separate technical study prepared for this project. A Technical Memorandum was prepared in August 2013 to supplement the 2009 WQR.

The project area parallels the coastline throughout much of San Diego County, and is entirely within the coastal region of the San Diego Basin. The project corridor traverses surface streams and floodplains, along with lagoons, mesas, small canyons, and arroyos in a series of through-cuts and fill embankments (*Figure 3-10.1*). The climate in this coastal plain is characterized as generally mild and typically has warm, dry summers, and cool, wet winters. The average mean temperature in the coastal region ranges from a high of 71 degrees Fahrenheit (ºF) to a low of 56ºF (SANDAG Geographic Information Systems [GIS] 2005). The annual precipitation along the project corridor averages from 12 to 13 in. The vast majority of rainfall occurs between November and March, with most of the annual precipitation falling during a relatively small number of storms. Rainfall patterns are subject to extreme variations from year to year with periodic long-term wet and dry cycles.

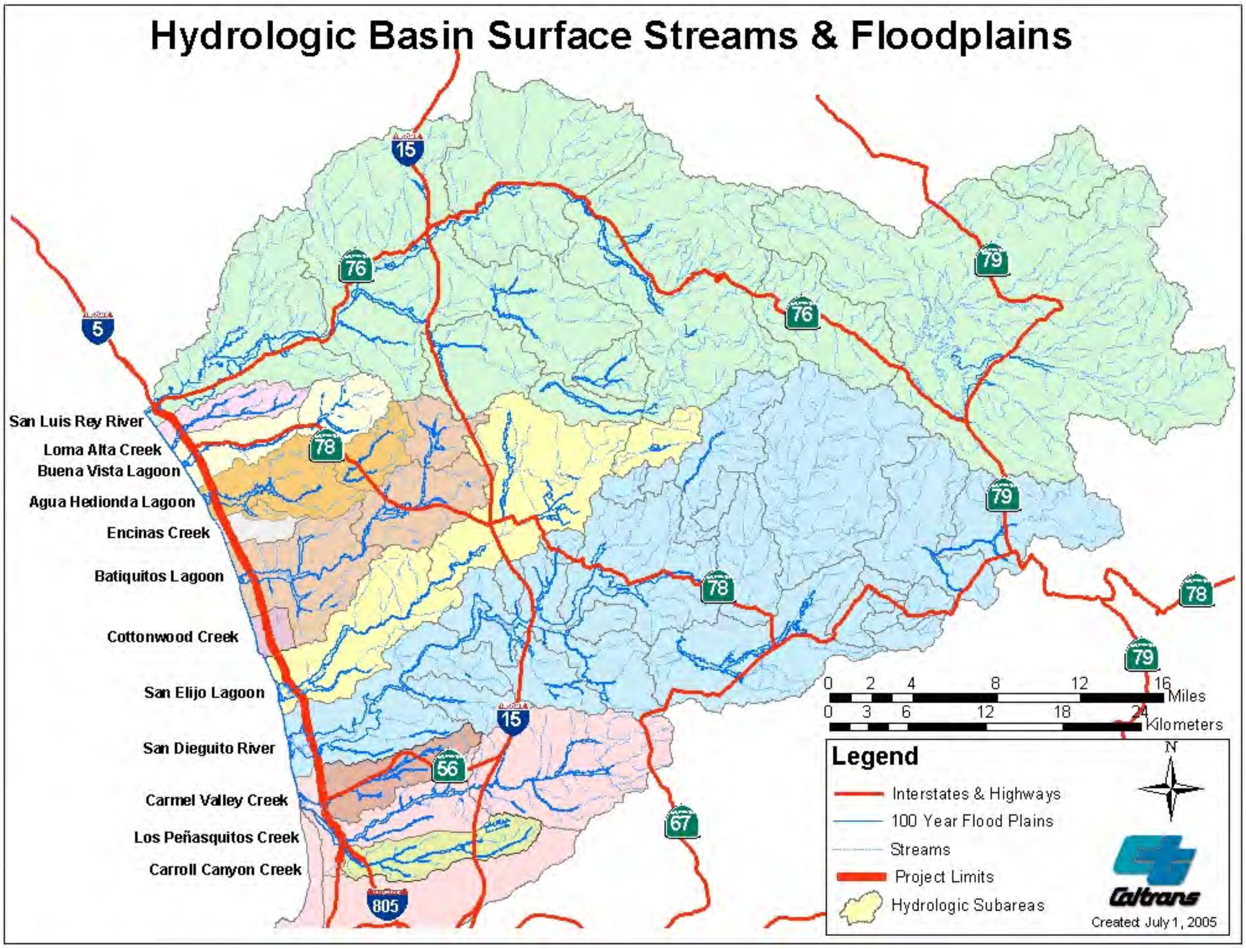


Figure 3-10.1: Surface Streams and Floodplains within the Project Limits

3.10.2.1 Hydrologic Units

The project limits cross 5 of the 11 hydrologic units (HUs) within the San Diego RWQCB Basin, including the Santa Margarita, San Luis Rey, Carlsbad, San Dieguito, and Los Peñasquitos HUs (*Figure 3-10.2*). The San Diego RWQCB Region encompasses most of San Diego County, as well as portions of southwestern Riverside County and southwestern Orange County. The region is divided into 11 major HUs, 54 hydrologic areas (HAs), and 147 hydrologic subareas (HSAs). HUs typically encompass the entire watershed of one or more streams; HAs are major tributaries and/or major groundwater basins within the HU; and HSAs are major subdivisions of the HAs and include both water bearing and non-water bearing formations (San Diego Basin Plan 1994).

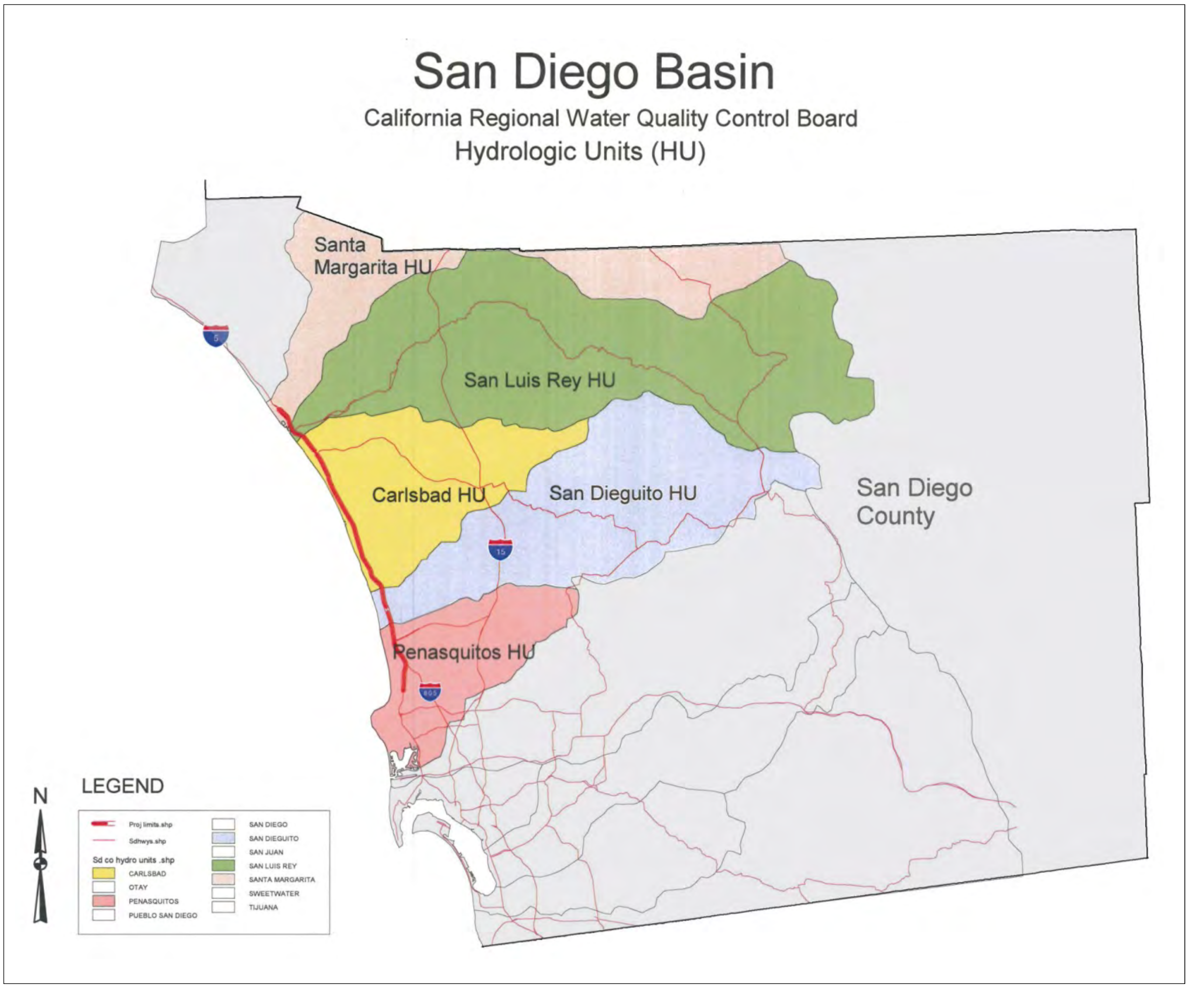


Figure 3-10.2: Hydrologic Units within the I-5 NCC Project

Santa Margarita (902.00)

The Santa Margarita River watershed encompasses approximately 750 square mi in northern San Diego and southwestern Riverside counties. The watershed contains a variety of nearly intact habitats; including chaparral-covered hillsides, riparian woodlands, and coastal marshes. Of the total watershed area, approximately 27 percent is within San Diego County. The Santa Margarita River is formed near the City of Temecula in Riverside County at the confluence of the Temecula and Murrieta Creek systems. Once formed, the majority of the Santa Margarita River main stem flows within San Diego County through unincorporated areas, the community of Fallbrook, and the Marine Corps Base Camp Pendleton.

San Luis Rey Hydrologic Unit (903.00)

The San Luis Rey is the second largest of the HUs within the project limits at approximately 562 square mi, and is one of the least developed. It is expected to increase in the amount of developed land from approximately 16 percent of the total basin currently to 23 percent by 2015. The entire basin is drained by the San Luis Rey River and crosses under I-5 north of the SR-76 Interchange. The Lake Henshaw Reservoir intercepts approximately 37 percent of the uppermost basin watershed and has a storage capacity of over 51,000 ac-ft.

Carlsbad Hydrologic Unit (904.00)

The Carlsbad HU includes approximately 212 square mi and is expected to continue developing from the current level of 56 percent of the watershed to an estimated 70 percent by the year 2015. This HU is comprised of seven sub-basins that cross under I-5. These sub-basins include San Elijo Lagoon (Escondido Creek), Cottonwood Creek, Batiquitos Lagoon (San Marcos Creek), Encinas Creek, Agua Hedionda Lagoon (Agua Hedionda Creek), Buena Vista Lagoon (Buena Vista Creek), and Loma Alta Creek. The freeway bisects four lagoons in this HU; San Elijo Lagoon south of Manchester Avenue, Batiquitos Lagoon north of La Costa Avenue, Agua Hedionda south of Tamarack Avenue, and Buena Vista Lagoon south of the I-5 / SR-78 Interchange. All four of the lagoon crossings, as well as Loma Alta Creek, are bridge structures. Cottonwood Creek crosses under the freeway in a 10-ft concrete arch culvert south of Encinitas Boulevard, and Encinas Creek crosses the corridor in a 10-ft x 5-ft concrete triple box culvert south of Palomar Airport Road.

San Dieguito Hydrologic Unit (905.00)

The entire 346 square mi that comprise the San Dieguito HU drain into the San Dieguito River, which crosses under the I-5 bridge south of Via de la Valle. This HU is expected to increase in developed area from the current level of approximately 26 percent to 38 percent by 2015.

Los Peñasquitos Hydrologic Unit (906.00)

The *I-5 NCC Project* begins near the middle of the Los Peñasquitos HU and crosses Carroll Canyon Creek just south of the I-5 / I-805 Interchange, Los Peñasquitos Creek at the I-5 / I-805 Interchange, and Carmel Valley Creek near the I-5 / SR-56 Interchange. All of these I-5 crossings are bridge structures, although Carmel Valley Creek currently drains through a 12-ft x 10-ft concrete triple box culvert under Sorrento Valley Road immediately downstream of the bridge. Approximately 89 of the 162 square mi that make up the Los Peñasquitos HU drain through the project limits. The developed area in this HU is expected to increase from the current estimate of 58 percent to 66 percent of the total watershed by the year 2015.

3.10.2.2 Existing Water Quality

To evaluate existing water quality, Caltrans has conducted runoff monitoring and characterization studies from various transportation facilities throughout the State of California. This monitoring has various objectives, including ensuring compliance with NPDES permit requirements, producing scientifically credible runoff data from various Caltrans facilities, and providing information that can assist in developing effective storm water management strategies. The following Monitoring and Characterization Studies to analyze the pollutants coming off Caltrans facilities and operations are listed below:

- First Flush Phenomenon Characterization Report, August 2005
- Monitoring & Research Program Annual Data Summary Report, February 2008
- 2002-2003 Annual Data Summary Report, August 2003
- Discharge Characterization Study Report, November 2003
- A Review of Contaminants and Toxicity Associated with Particles in Stormwater Runoff, 2003
- Caltrans Construction Site Runoff Characterization Study, September 2002

These studies, which can be found at http://www.dot.ca.gov/hq/env/stormwater/special/newsetup/index.htm#monitoring, indicate that water quality can be influenced by various factors such as:

- Traffic volume – The higher the traffic volume, the higher the pollutant concentration.
- Total event rainfall – As total event rainfall increases, pollutant concentration decreases.
- Seasonal cumulative rainfall – As cumulative rainfall increases, pollutant concentration decreases.
- Maximum rainfall intensity – The larger the drainage area, the lower the pollutant concentration.
- Antecedent dry periods – The longer the dry period, the higher the pollutant concentration.
- Drainage Areas – The larger the drainage area, pollutants for highways decrease.
- Impervious Fraction of Drainage Area – The weakest and most non-consistent effect showed that an increase in impervious areas tends to increase the concentration of some pollutants and decrease the concentration of others.

3.10.2.3 Beneficial Uses

As defined in the Basin Plan, "Beneficial Uses" are the uses of water necessary for the survival or well-being of man, plants, and wildlife. These uses promote the tangible and intangible economic, social, and environmental goals of mankind. There are three types of water bodies in the study area: inland surface waters, coastal waters, and ground waters.

According to the Basin Plan, to establish existing beneficial uses, one would have to demonstrate that fishing, swimming, or other uses have actually occurred since November 28, 1975, or that the water quality and quantity is suitable to allow the uses to be attained.

The "Potential" designation is established for a variety of reasons, including: (1) plans that are proposed to put the water to a future use; (2) potential exists to put the water to a future use; (3) the public desires to put the water to future use; (4) the water is potentially suitable for municipal or domestic water supply under the terms of the *Sources of Drinking Water* Policy (State Board Resolution No. 88-63); and (5) the Regional Board has designated a beneficial use as a regional water quality goal.

In addition, some water bodies have been exempted by the Regional Board from the municipal use designation under the terms and conditions of State Board Resolution No. 88-63, Sources of Drinking Water Policy.

Table 3.10.1 defines the existing and potential beneficial uses as outlined in the Basin Plan for water bodies within the project limits.

Table 3.10.1: Beneficial Use Definitions

Beneficial Use Definitions		
MUN	Municipal and Domestic Supply	Includes uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
AGR	Agricultural Supply	Includes uses of water for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
PROC	Industrial Process	Includes uses of water for industrial activities that depend primarily on water quality.
IND	Industrial Services Supply	Includes uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.
GWR	Ground Water Recharge	Includes uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.
FRSH	Freshwater Replenishment	Includes uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).
NAV	Navigation	Includes uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.
POW	Hydropower Generation	Includes uses of water for hydropower generation.
REC1	Contact Recreation	Includes 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, water-skiing, skin and SCUBA diving, surfing, white water activities, fishing, or use of natural hot springs.
REC2	Non-Contact Recreation	Includes the 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, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
COMM	Commercial and Sport Fishing	Includes the uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.
AQUA	Aquaculture	Includes the uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.
WARM	Warm Freshwater Habitat	Includes uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.
COLD	Cold Freshwater Habitat	Includes uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.
SAL	Inland Saline Water Habitat	Includes uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.
EST	Estuarine Habitat	Includes 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).

Table 3.10.1 (cont.): Beneficial Use Definitions

Beneficial Use Definitions		
MAR	Marine Habitat	Includes uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).
WILD	Wildlife Habitat	Includes 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.
BIOL	Preservation of Biological Habitats of Special Significance	Includes uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.
RARE	Rare, Threatened and Endangered Species	Includes 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.
SPWN	Spawning, Reproduction, and/or Early Development	Includes uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish. This use is applicable only for the protection of anadromous fish.
SHELL	Shellfish Harvesting	Includes uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters and mussels) for human consumption, commercial, or sport purposes.

The existing and potential beneficial uses for the water bodies within the project limits are included in *Tables 3.10.2, 3.10.3,* and *3.10.4.* These tables list the beneficial uses for inland surface waters, coastal waters, and ground waters respectively.

Table 3.10.2: Beneficial Uses for Inland Surface Waters

Water Body Name	Hydrologic Subarea	MUN	AGR	IND	PROC	GWR	FRSH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
Carmel Valley	906.10	*	+	+					x	+		+		+		
Soledad Canyon Creek	906.10	*	+	+					x	+		+	+	+		
Carroll Canyon	906.10	*	+	+					x	+		+	+	+	+	
Los Peñasquitos Creek	906.10	*	+	+					x	+	+	+		+		
San Dieguito River	905.11	*	x	x					+	+		+	+	+		+
Canyon del Las Encinitas	904.40	*							x	+		+		+		
Loma Alta Creek	904.10	*							x	+		+		+		
San Luis Rey River	903.11	*	+	+				+	+			+		+	+	

* Excepted from Municipal
\+ Existing Beneficial Use
X Potential Beneficial Use

Table 3.10.3: Beneficial Uses for Coastal Surface Waters

Water Body Name	Hydrologic Subarea	IND	NAV	REC1	REC2	COMM	BIOL	EST	WILD	RARE	MAR	AQUA	MIGR	SPWN	WARM	SHELL
Los Peñasquitos Lagoon	906.10			+	+		+	+	+	+	+		+	+		+
San Dieguito Lagoon	905.11			+	+		+	+	+	+	+		+	+		
Batiquitos Lagoon	904.51			+	+		+	+	+	+	+		+	+		
San Elijo Lagoon	904.61			+	+		+	+	+	+	+		+	+		
Agua Hedionda Lagoon	904.31	+		+	+	+	+	+	+	+	+	+	+	+		+
Buena Vista Lagoon	904.21			+	+		+	x	+	+	+				+	
Loma Alta Slough	904.10			+	+			+	+	+	+					
Mouth of San Luis Rey River	903.11			+	+				+	+	+		+			
Oceanside Harbor	NA	+	+	+	+	+			+	+	+		+	+		+

* Excepted from Municipal
\+ Existing Beneficial Use
x Potential Beneficial Use
NA Not applicable

Table 3.10.4: Beneficial Uses for Ground Waters

Water Body Name	Hydrologic Unit	MUN	AGR	IND	PROC	GWR	FRSH	GWR
Encinas Creek	904.40	*						
Lower San Luis[1]	903.10	+	+	+				

* Excepted from Municipal
\+ Existing Beneficial Use
x Potential Beneficial Use
[1] These beneficial uses do not apply westerly of the right-of-way of I-5 and this area is excepted from the sources of drinking water policy.

3.10.2.4 Section 303(d) of the Clean Water Act and Caltrans Targeted Design Constituents

The CWA requires states to identify and make a list of surface water bodies that do not meet water quality standards, also referred to as "water quality limited segments," even after discharges of wastes from point sources have been treated by the minimum required levels of pollution control technology. States are required to compile these water bodies into a list, referred to as the "Clean Water Act Section 303(d) List of Water Quality Limited Segments."

The Caltrans runoff characterization studies identify pollutants that are discharging with a load or a concentration that commonly exceeds allowable standards, and which are considered treatable by Caltrans-approved “treatment” BMPs. These pollutants are referred to as Targeted Design Constituents (TDCs), and include sediment, metals (total and dissolved zinc, lead and copper), nitrogen, phosphorus, and general metals. *Table 3.10.5* identifies the 303(d) receiving water bodies within the project limits and the associated TDCs.

Table 3.10.5: Project Area CWA Section 303(d) List of Water Quality Limited Segments and TDCs

Hydrologic Area	Water Body Name	HA/ HSA	Size	Pollutant	Caltrans TDC
Peñasquitos	Soledad Canyon	906.10	2 mi	Selenium, Sediment Toxicity	NA
	Los Peñasquitos Creek	906.10	12 mi	Total Dissolved Solids, Selenium, Toxicity, Total Nitrogen as N, Fecal Coliform, Enterococcus	Sediment, Nitrogen
	Los Peñasquitos Lagoon	906.10	469 ac	Sedimentation/Siltation	Sediment
	Rose Creek	906.4	13 mi	Selenium, Toxicity	NA
San Dieguito	San Dieguito River	905.11	19 mi	Total Dissolved Solids, Toxicity, Nitrogen, Fecal Coliform, Enterococcus, Phosphorus	Sediment, Nitrogen Phosphorus
Carlsbad	Loma Alta Creek	904.10	8 mi	Selenium, Toxicity	NA
	Buena Vista Creek	904.210	11 mi	Selenium, Sediment Toxicity	NA
	Buena Vista Lagoon	904.21	202 ac	Indicator Bacteria, Nutrients, Sedimentation/Siltation	Sediment, Nutrients (N and P)
	Agua Hedionda Creek	904.31	7 mi	Total Dissolved Solids, Selenium, Toxicity, Total Nitrogen as N, Fecal Coliform, Enterococcus, Phosphorus, Manganese	Sediment, Nitrogen Phosphorus
	Cottonwood Creek	904.51	2 mi	Sediment Toxicity, Selenium, DDT	NA
	Encinitas Creek	904.51	3 mi	Toxicity, Selenium	NA
	San Marcos Creek	904.51	19 mi	Selenium, Sediment Toxicity, Phosphorus, DDE	Phosphorus
	San Elijo Lagoon	904.61	566 ac	Sedimentation/Siltation, Indicator Bacteria, Eutrophic	Sediment
	Escondido Creek	904.62	26 mi	Total Dissolved Solids, Selenium, Toxicity, Total Nitrogen as N, Fecal Coliform, Enterococcus, DDT Phosphate, Sulfates, Manganese	Sediment, Nitrogen Phosphorus
San Luis Rey	San Luis Rey River, Lower (west of I-15)	903.11	19 mi	Chloride, Fecal Coliform, Phosphorus, Total Dissolved Solids, Total Nitrogen as N, Toxicity, Enterococcus	Phosphorus, Nitrogen
	Pacific Ocean Shoreline, at San Luis Rey River mouth		0 mi	Enterococcus, Total Coliform	NA
Santa Margarita	Oceanside Harbor	902.11	52 ac	Copper	Copper

Source: http://www.waterboards.ca.gov/sandiego/water_issues/programs/303d_list/index.shtml

NA = Not Applicable (Not determined to be a constituent found within Caltrans' storm water runoff monitoring program)

3.10.2.5 Total Maximum Daily Loads

Section 303(d) of the Federal Clean Water Act requires states to develop TMDLs for 303(d) listed water bodies and establish the TMDL process to guide application of State standards to individual water bodies/watersheds. According to the San Diego RWQCB website "A TMDL is a quantitative assessment of water quality problems, contributing sources, and load reductions or control actions needed to restore and protect bodies of water. The TMDL approach does not replace existing water pollution control programs. It provides a framework for evaluating pollution control efforts and for coordination between federal, State, and local efforts to meet water quality standards."

Within the project limits, Caltrans is a stakeholder in the TMDLs for Impaired Lagoons, Adjacent Beaches, and Agua Hedionda Creek (Investigation Order R9-2006-0076). Caltrans partnered with the other stakeholders to conduct monitoring for the listed water bodies and currently Caltrans is working with the stakeholders, USEPA, and the San Diego RWQCB to develop TMDLs for Los Peñasquitos Lagoon. *Table 3.10.6* lists the water bodies addressed in this order and the responsible stakeholders. Only the water bodies within the project limits and listed in this TMDL are included.

Table 3.10.6: List of Water Bodies Addressed in TMDLs and Responsible Stakeholders

Water Body	HSA	Responsible Stakeholders	
		Municipalities and Military Facilities	**Counties, State Agencies, and other Facilities**
Santa Margarita Lagoon	902.11	Camp Pendleton	San Diego County
		Fallbrook Naval Weapons Station	Riverside County Flood Control and Water Conservation District
		Murrieta	Caltrans
		Temecula	
Loma Alta Slough and Ocean shoreline	904.10	Oceanside	San Diego County
		Vista	Caltrans
Buena Vista Lagoon and Ocean Shoreline	904.20	Carlsbad	San Diego County
		Oceanside	Caltrans
		Vista	
Agua Hedionda Lagoon and lower Agua Hedionda Creek	904.31	Carlsbad	San Diego County
		Oceanside	Caltrans
		San Marcos	
		Vista	
San Elijo Lagoon and Ocean Shoreline	904.61	Encinitas	San Diego County
		Escondido	Caltrans
		Solana Beach	City of Escondido Hale Avenue Resource Recovery Facility
		San Marcos	
Los Peñasquitos Lagoon	906.10	Del Mar	
		Poway	San Diego County
		San Diego	Caltrans

http://www.waterboards.ca.gov/sandiego/water_issues/programs/tmdls/lagoons_aguahediondacreek.shtml

3.10.2.6 Navigable Waterways

There are six waterways in the project area designated as "navigable" by the United States Coast Guard and the USACE under the Rivers and Harbors Appropriation Act of 1899. No individual Coast Guard permits would be needed for San Diego River, Los Peñasquitos Lagoon and River, San Dieguito Lagoon, San Elijo Lagoon, Batiquitos Lagoon, and Agua Hedionda Lagoon because these waterways are not navigated by anything larger than small motorboats; however, San Elijo Lagoon, San Dieguito Lagoon, Buena Vista Lagoon, and Batiquitos Lagoon are under consideration for permitting by the USACE. Permits may be required for work conducted at crossings of these waterways, although current conditions restrict vessel use in these waterways. These restrictions range from none to small vessels, such as, canoes and kayaks. Following is a brief description of the existing conditions regarding current use and navigability.

San Luis Rey River

The San Luis Rey River is located on the northern border of the City of Oceanside in the northwestern region of San Diego County. The headwaters are to the east in the Cleveland National Forest, near Palomar Mountain. Unlike most major rivers in southern California, the San Luis Rey River has undergone relatively little channelization. The only channelized segment of the river is located within the City of Oceanside. The San Luis Rey River Park Master Plan does not include vessel use, and there is currently little or no use of the river by any type of vessel.

The San Luis Rey River has had a beach berm for over 60 years, and has been breached by wave action and flood flows. There is a railroad bridge crossing the river to the west of the existing I-5 bridge. A jetty was built along the northern edge of the San Luis Rey River, which extends out into the Pacific Ocean. It was built when Oceanside Harbor was constructed in the 1960s. Pacific Street was built on the sand berm in the 1980s, with a culvert for the river outlet across the river. Pacific Street Bridge realigned the road and placed it on a bridge to allow for less road maintenance and more water flow from the San Luis Rey River to the ocean. The I-5 Bridge over the San Luis Rey River is approximately 0.5 mi from the ocean. The Coast Highway Bridge is immediately west of the I-5 bridge. The San Luis Rey River has not had a stable mouth to the ocean during recorded history, and there is currently little or no use of the river by any type of vessel. Immediately upstream of the I-5 bridge, vegetation is overgrown and the river is not navigable, with the possible exception of small craft such as kayaks or canoes.

Agua Hedionda Lagoon

Agua Hedionda Lagoon is located in the City of Carlsbad, and is approximately 35 mi north of the City of San Diego. Agua Hedionda Lagoon is a healthy, tidal body, with large wetlands supporting several endangered species located in the Carlsbad Creek Watershed. Currently, there are three structures crossing the lagoon between the coast line and the project area: the Carlsbad Boulevard Bridge, a railroad bridge, and the existing I-5 bridge.

The majority of the lagoon is owned and maintained by Cabrillo Power I LLC, owners of a 900-megawatt power plant located on the outer segment of the lagoon (i.e., the Encina Power Plant). Approximately 60 years ago, three lagoon basins were built in between the structures to provide retention basins for the cooling water required for operation of the Encina Power Plant. The entire 400-ac lagoon, created in 1954, was completely re-dredged in 1998 to an average depth of 8 to 11 ft, which promoted increased tidal flushing. An extensive eelgrass planting program was initiated after the dredging, resulting in additional marine nursery areas.

The western basin, bound by Pacific Coast Highway to the west and the railroad bridge to the east, provides cooling water to the power plant and additional uses, including a commercial shellfish farm, aquaculture, and a marine fish hatchery. Small power boats are used by the shellfish farm, and the lagoon is dredged as needed to keep the mouth open. The middle basin is between the railroad bridge and the I-5 bridge. The YMCA runs a summer camp in this area and uses kayaks for recreational activities. The eastern basin extends east of I-5 for approximately 1 mi before the vegetation forms dense habitat along the narrow channel of Agua Hedionda Creek. There is a small boat marina in the eastern basin, and Agua Hedionda Lagoon accommodates active use such as boating, water skiing, wake boarding, personal watercraft use, sailing, windsurfing, and fishing.

Even though there are small recreational vessels allowed in the basins, boats, canoes, and kayaks do not travel upstream, or under the bridges, due to historic hydrologic siltation, lack of open water due to aquatic plant species, and other human activity in the area.

San Elijo Lagoon

San Elijo Lagoon is a large shallow body with a main channel that is confined to the northern side of the lagoon. The mouth of the lagoon frequently closes due to sand infiltration, and there is a hardpan sill that prevents deep dredging of the mouth. The Pacific Coast Highway Bridge over San Elijo Lagoon is less than 200 ft from the Pacific Ocean. This bridge over the narrow channel also has a low clearance. The main channel then winds to the southeast, until it turns east and flows under a railroad bridge approximately 300 ft from the Pacific Coast Highway Bridge. The main channel then meanders along the northern edge of the lagoon until it flows under I-5 approximately 0.85 mi from the Pacific Ocean. Only small watercraft such as kayaks and canoes could navigate this lagoon. The mouth frequently closes and the channel is narrow and shallow at low tide. In addition, there is no place to launch a motorized vessel within this lagoon. The majority of the lagoon is an ecological reserve. In general, the lagoon is not open to any human water use.

San Dieguito Lagoon

San Dieguito Lagoon has a main channel and a number of large open water areas. The mouth of the lagoon is subject to closure by sand accumulation, and dredging is often required to open the mouth. Camino Del Mar crosses San Dieguito Lagoon approximately 350 ft from the Pacific Ocean. There is a railroad trestle approximately 750 ft farther upstream from the Pacific Coast Highway crossing. A third crossing of the main channel is located approximately 0.5 mi from the mouth of the lagoon. The I-5 bridge is approximately 1.3 mi from the mouth of the lagoon. Only small watercraft, such as kayaks and canoes, could navigate on the lagoon channel, although the only vessels observed within the lagoon are platforms used for sampling fish and invertebrates related to the large restoration project that began in 2007. Upstream of I-5, the San Dieguito River passes under a fifth bridge, El Camino Real.

Buena Vista Lagoon

Buena Vista Lagoon has a tidal weir located at its mouth that has been in place since 1948. A new concrete weir and reinforced channel were built in 1972 at the mouth, which restrict access from the Pacific Ocean by watercraft. Buena Vista Lagoon is primarily a freshwater lagoon. Carlsbad Boulevard crosses the lagoon approximately 500 ft east of the tidal weir, and the railroad crosses the lagoon less than 500 ft from the Carlsbad Boulevard Bridge. The I-5 bridge is over 0.8 mi from the tidal weir. The lagoon is a reserve and no vessels are allowed, except those used for scientific monitoring. Only kayaks and canoes could navigate the lagoon due to thick vegetation, low bridges, and shallow water in some areas.

Batiquitos Lagoon

Batiquitos Lagoon is the outlet for San Marcos and Encinitas Creeks. Prior to the 1990s, the mouth of the lagoon was unstable and closed intermittently by wave and sand action. A large restoration project was undertaken in the 1990s to restore tidal flushing and marine resources in the lagoon, as part of the mitigation for a Port of Los Angeles project. The restoration project constructed a new tidal inlet and bridge over Carlsbad Boulevard that is approximately 400 ft from the Pacific Ocean. A second railroad bridge crosses the lagoon over 700 ft farther east of the Carlsbad Boulevard Bridge. Several nesting islands for endangered birds were also constructed during those efforts, and the lagoon is an Ecological Reserve. The only authorized motorized vessels within the lagoon are dredges that remove sediment from the lagoon and small craft for scientific monitoring. Only small personal watercraft or small motorized boats can navigate through the noted bridges.

3.10.3 Environmental Consequences

The project has the potential to impact water quality during the construction phase, as well as during its operation. BMPs would be evaluated and implemented to address these impacts during the planning and design, construction, and operational phases.

Potential sources of pollutants from construction activities could be generated from construction materials and activities. Examples of pollutants generated from construction materials include vehicle fluids, asphaltic emulsions from paving activities, joint and curing compounds, concrete curing compounds, solvents and thinners, paint, sandblasting material, landscaping materials, treated lumber, portland cement concrete rubble, and general litter. Examples of construction activities that have the potential to contribute pollutants include clearing and grubbing, grading operations, soil import operations, sandblasting, landscaping, and utility excavation.

During operation, potential sources of pollutants found in highway runoff include sediment from natural erosion; nutrients (nitrogen and phosphorus) from tree leaves or other vegetation debris, mineralized organic matter in soil, fertilizer runoff, nitrite from automobile exhausts, atmospheric deposition, emulsifiers, and surfactants; pesticides; and metals (dissolved and particulate) from combustion products of fossil fuels, wearing of brake pads, and corrosion.

Table 3.10.7 lists the HAs and HSAs that would be potentially impacted by the proposed *I-5 NCC Project*. Each of the HAs and HSAs is compared to the area of existing Caltrans right-of-way within the *I-5 NCC Project* limits. The maximum Caltrans waterway or tributary area to any of the noted hydrologic designations is less than two percent.

Table 3.10.7: Existing I-5 Contribution to the Watershed within the Project Limits

Watershed	Hydrologic Area/Sub Area Name	HA/HSA Number	HA/HSA (Acres)	Existing I-5 Tributary Area* (Acres)	Existing I-5 Contribution to HA/HSA (%)
Peñasquitos	Miramar HA	906.40	25924	288	1.10
	Miramar Reservoir HA	906.10	32,594.8	332	1.02
San Dieguito	Rancho Santa Fe HSA	905.11	22,610.5	221	0.98
Carlsbad	San Elijo HSA	904.61	20,721.5	181	0.88
	Batiquitos HSA	904.51	17,819.4	330	1.85
	Encinas HA	904.40	2,991.4	47	1.56
	Los Monos HSA	904.31	11,904.4	95	0.8
	El Salto HSA	904.21	7,476.4	134	1.79
	Loma Alta HA	904.10	5,199.6	40	0.78
San Luis Rey	Mission HSA	903.11	29,930	114	0.38
Santa Margarita	Lower Ysidora HSA	902.11	6710	38	0.57

* Source: sangis/landuse/right_of_way.shp

Build Alternatives

The build alternatives would retrofit I-5 with "treatment" BMPs to the Maximum Extent Practicable (MEP). This would require analyzing the entirety of the I-5 North Coast Corridor from a water quality perspective in relation to the impaired receiving water bodies. This process would provide for a more comprehensive approach to analyze the hydrology of the entire project area for "treatment" BMP implementation, consequently assisting Caltrans in meeting the TMDL requirements to be set by the San Diego RWQCB in the near future. *Table 3.10.8* shows the difference of additional pavement areas between each of the build alternatives. The 10+4 Barrier alternative has the highest percentage of additional impervious area, followed by the 8+4 Barrier alternative; whereas the 8+4 Buffer alternative has the lowest percentage of additional impervious area, followed by the 10+4 Buffer alternative. Implementation of the refined 8+4 Buffer alternative (Preferred Alternative) would result in a total of 112 percent of equivalent new impervious areas being treated. Currently seven percent of existing impervious areas is being treated. The Preferred Alternative would result in a total of 27 percent of total impervious areas (existing and new) being treated.

To address potential short-term impacts of each of the build alternatives, all DSAs would be stabilized before the completion of construction with permanent landscaping and/or permanent erosion control.

Table 3.10.8: Comparison of Existing and Proposed Pavement Areas between the Build Alternatives

Alternatives	Existing Impervious Area (Acres)	Proposed Additional Impervious Area (Acres)	Total Impervious Areas (Acres)	Percentage of Additional Impervious Areas (%)
8+4 Barrier	669	266	935	40
8+4 Buffer	669	214	884	32
10+4 Barrier	669	262	931	39
10+4 Buffer	669	307	976	46

No negative impacts to the six designated "navigable" waterways are predicted with construction of the proposed project, with existing planned uses to be maintained. At some locations, navigability may be improved due to project design raising the existing structures above current elevations. This could result in better access in the respective waterways for existing and planned uses to continue.

No Build Alternative

This alternative would not construct the proposed *I-5 NCC Project*, but it would construct multiple projects along the I-5 corridor to address traffic congestion issues at various locations. Similar to the build alternatives, implementation of individual projects under this alternative would require implementing BMPs to address potential pollutants during the construction and operation of those projects.

The amount of disturbed soil area during construction for each project under this alternative has not been determined for comparison to the build alternatives, since some of the proposed projects are in the early planning stages and such information is not available at this time. Nevertheless, "treatment" BMPs would only be incorporated within those projects' construction limits. "Treatment" BMPs, which are discussed in more detail in *Section 3.10.4, Avoidance, Minimization, and/or Mitigation Measures*, are permanent measures to improve storm water quality during the operation of the highway after the completion of construction.

There would be a water quality improvement with the build alternative(s) over the No Build alternative because of the opportunity to implement "treatment" BMPs throughout the *I-5 NCC Project* limits. These BMPs would "treat" water to remove targeted design constituents from existing impervious areas (including pollutants generated by future traffic volumes). This treatment would not occur under No Build conditions.

3.10.4 Avoidance, Minimization, and/or Mitigation Measures

Please see *Section 3.18, Wetlands and Other Waters*, for a discussion of Section 404 of the CWA. This establishes a regulatory program that provides that discharge of dredged or fill material cannot be permitted if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. The Section 404 permit program is run by the USACE with oversight by the USEPA.

BMPs would be implemented to address potential water quality impacts during the planning and design, construction, and operational (maintenance) stages. The Statewide SWMP describes how Caltrans would comply with the provisions of the NPDES Permit (Order 99-06-DWQ). The SWMP describes the program that Caltrans would implement to reduce the discharge of pollutants to the storm water drainage systems that serve the highway and highway-related properties, facilities, and activities. The SWMP divides the BMPs into separate categories from the planning and design phase to the operational (maintenance) phase.

Short-term potential impacts to water quality during the construction phase are prevented/minimized through the use of construction site BMPs, while the long-term potential impacts during the facility operation and maintenance are prevented/minimized through the use of design pollution prevention (DPP) BMPs, "treatment" BMPs, and maintenance BMPs (*Table 3.10.9*).

Every Caltrans project is required to complete a Storm Water Data Report (SWDR), which summarizes the storm water decisions made by the Project Development Team. These decisions take into consideration grading, environmental constraints, utility issues, and any other conflicts that might arise when designing a project. The SWDR documentation includes various checklists to help project engineers determine feasibility of BMPs and any potential conflicts related to their implementation. The SWDR is initiated at the beginning of the project and is updated as the project progresses through design. The final SWDR not only documents the decisions made throughout the phases of the project but also includes exhibits showing tributary drainage areas, percentages of "treatment," water quality impairments and types of design pollution prevention, construction, and maintenance BMPs that will be incorporated into the project.

Table 3.10.9: BMP Categories and Descriptions

BMP Category	Description	Responsible Division for BMP Implementation
Category IA	Maintenance BMPs: litter pickup, toxics control, street sweeping, etc.	Division of Maintenance
Category IB	Design pollution prevention BMPs: permanent soil stabilization systems, etc.	Division of Design
Category II	Construction site BMPs: temporary runoff control	Division of Construction
Category III	"Treatment" BMPs: permanent "treatment" devices and facilities	Divisions of Design, Construction, and Maintenance

Source: Statewide SWMP, Table 3-1, May 2003

Maintenance BMPs (Category IA)

Caltrans maintenance performs various activities on different facilities throughout the State to ensure safe and usable conditions for the public. Most of these activities are performed by small crews with minimal soil disturbance.

The objective of implementing maintenance BMPs is to provide preventative measures to ensure that maintenance activities are conducted in a manner that reduces the amount of pollutants discharged to surface waters via Caltrans storm water drainage systems. Maintenance BMPs would be ongoing for the life of the facility, and are required to be conducted in accordance with the Caltrans Storm Water Quality Handbook, Maintenance Staff Guide (Guide). The Guide provides detailed instructions on how to apply the approved storm water maintenance BMPs to maintain facility operations and highway activities.

Additionally, Appendix C of this Guide includes specific maintenance requirements for all approved treatment BMPs. Each BMP has approximately seven pages of general description, a schematic of the treatment BMPs, and tables with preventive and regular maintenance needed.

Design Pollution Prevention BMPs (Category IB)

DPP BMPs are standard technology-based, non-"treatment" controls selected to reduce pollutant discharges to the MEP. DPP BMPs have the following design objectives: prevent downstream erosion, stabilize disturbed soil areas, and maximize vegetated surfaces consistent with Caltrans policies.

Without the implementation of DPP BMPs, the project may have an effect on downstream channel stability through changes in the rate and volume of runoff, the sediment load due to changes in the land surface, and other hydraulic changes from stream encroachments, crossings, or realignment. The peak flow rate, runoff velocities, and erosive characteristics of the soils in the area would be assessed with regard to downstream watercourses to determine potential impacts.

Table 3.10.10 lists Caltrans-approved DPP BMPs for project-specific consideration Statewide. The selection of the specific BMPs is an iterative process that begins at the planning stages and is refined during the design phase. Since Caltrans is committed to prevent or minimize impacts to water quality, the project would preserve the existing vegetation outside the work areas, stabilize slopes with vegetative cover, and keep the total paved area to a practical minimum. Other DPP BMPs would be implemented as appropriate for the project.

Table 3.10.10: Design Pollution Prevention BMPs (MEP Based), Category IB

Consideration of Downstream Effects Related to Potentially Increased Flow
Preservation of Existing Vegetation
Concentrated Flow Conveyance Systems
Ditches, Berms, Dikes, and Swales
Overside Drains
Flared Culvert End Sections
Outlet Protection/Velocity Dissipation Devices
Slope/Surface Protection Systems
Vegetated Surfaces
Hard Surfaces

Source: Statewide SWMP, Table 4-1, May 2003

Low Impact Development (LID)

Caltrans encourages the use of LID features, which can mutually serve as both DPP BMPs and “treatment” BMPs. Due to limited right-of-way and the linear nature of the typical Caltrans project, the design must ensure that any design features do not create a safety hazard for the public or maintenance forces. LID uses site design and storm water management to maintain the site’s pre-project runoff rates and volumes by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source.

Features that function as LID measures include, but are not limited to:

- Surface vegetation, such as biofiltration swales and strips
- Soil amendments, such as compost and surface roughening
- Subsurface storage, such as dry-wells, infiltration trenches, or swales underlain with permeable soil layers
- Small detention areas, such as cisterns, traps, and check dams
- Pervious materials, such as paving stone and porous concrete, when used in lieu of impervious materials at locations outside the highway prism
- Disconnected drainage that relies upon overland flow rather than pipe networks to convey runoff to discharge locations
- Contour Grading, or grading that follows natural flow paths and terrain with an emphasis upon slope rounding and gradual elevation changes.

This project would review and propose LID features throughout the project footprint. Final selection would be made during final design once drainage, grading, and other design features are determined and used as a basis for feasibility and siting locations.

Hydromodification

Under its recently adopted statewide permit (Order 2012-0011-DWQ effective date of July 1, 2013), Caltrans is required to conduct a risk-based approach to ensure the project would not cause a decrease in lateral (bank) and vertical (channel bed) stability in receiving stream channels. Caltrans would assess pre-project channel stability and implement mitigation measures that are appropriate to protect structures and minimize stream channel bank and bed erosion.

A Project Approval/Environmental Document (PA/ED) level SWDR is being prepared for this project and is in the process of being finalized for the initial phase of design. The work done to date includes delineation of impervious surface tributary drainage areas and preliminary siting and selection of potential "treatment" BMPs. Discussion of LID, hydromodification and other BMPs would be included in this phase's SWDR and would be finalized as the project design progresses.

The hydromodification requirements specified in the Caltrans Permit were subject to extensive discussion with SWRCB staff as a part of the development of the Statewide Caltrans NPDES Permit. Caltrans has unique right-of-way and safety constraints that differentiate their infrastructure from that of a traditional MS4. The Caltrans Hydromodification Management Plan (HMP) was developed specifically to accommodate the unique aspects of highway infrastructure without compromising environmental protection. The mitigation measures are also those that Caltrans maintenance forces are able to maintain, and are consistent with the design guidance, federal design requirements, and Caltrans *Maintenance Staff Guide*.

The SWRCB adopted hydromodification control standards in the Caltrans Permit based on the best available technical information and FHWA guidance specifically tailored to control runoff with highway facility projects. Although the SWRCB was aware of other hydromodification standards, including the standards set forth in the San Diego HMP, it did not adopt those identical standards in the Caltrans Permit because the San Diego HMP standards are tailored to control runoff from traditional development projects, rather than highway facilities.

Broadly, the objectives of the San Diego HMP and the objectives of the adopted Caltrans Permit are consistent: to ensure that post-project receiving water stream stability is not adversely impacted by impervious surface developed as a result of new projects. The technical approach taken to meet this objective differs because anticipated project characteristics differ, but overall each of the two hydromodification control standards represent a state-of-the-art analysis and program for stream stability for the targeted type of development.

The requirements in the new Caltrans Order are based on assessment methods developed by the FHWA. The analysis method and mitigation requirements specified in the Order for hydromodification were developed specifically considering the unique impacts and design requirements for highway projects. The SWRCB is aware of the role that bed material plays in channel stability in developing the Caltrans Permit. The hydromodification analysis and mitigation methods specified in the Caltrans Permit were specifically developed for highway infrastructure, which has specific design safety constraints and drainage design standards, in order to maintain natural flow patterns and stream hydraulic characteristics.

The design standards for Caltrans facilities must be consistent with Caltrans and FHWA standards to ensure safety, maintenance, and operation. The standards in the recently adopted Caltrans Permit represent the most current approach to hydromodification mitigation for highway infrastructure throughout the State, and will be equally as protective of receiving water streambed stability as the program specified in the San Diego HMP. Consistent with Section 2.d.3 of the Caltrans Permit, the design of highway facilities can include flow control at discharge points as well as engineered energy dissipation and cross culvert designs specifically to ensure the maintenance and transport of bed material in the local streams.

The Caltrans Permit requires a risk-based approach to assessment of lateral and vertical stability of the receiving water bodies using the Publications FHWA-HIF-12-004 and FHWA-HRT-05-072 for an initial (Level 1) assessment. The assessment includes a review of 13 channel stability indicators including: (1) watershed and flood plain activity and characteristics, (2) flow habit, (3) channel pattern, (4) entrenchment and channel confinement, (5) bed material, (6) bar development, (7) obstructions, (8) bank soil texture and coherence, (9) average bank slope angle, (10) vegetative or engineered bank protection, (11) bank cutting, (12) mass wasting or bank failure, and (13) upstream distance from meander impact point and alignment. The overall ratings from the Level 1 analysis determine if further numeric analysis is required or the channel is not at risk from the project improvements. However, all projects disturbing more than 5,000 square feet, regardless of the outcome of the Level 1 assessment, are required to implement Design Pollution Prevention Best Management Practices.

Projects that show a potential hydromodification impact following completion of a Level 1 analysis proceed progressively to Level 2 or Level 3 analysis, which include state-of-the-art hydraulic and sediment transport numerical modeling. The Caltrans Permit ultimately requires the project to be redesigned if potential hydromodification impacts cannot be mitigated by other means.

Regardless of the determination of HMP susceptibility in the receiving channel, Caltrans projects implement LID efforts to maintain or restore pre-project hydrology, as well as provide overall water quality improvement of discharges. The LID measures include: (1) minimizing impervious surface area and using pervious material for hardened surfaces outside of the roadway prism, (2) grading slopes to blend with the natural terrain and decreasing the need for dikes, promoting sheet flow to vegetated areas that can provide water quality benefits and promote infiltration, (3) maintaining existing vegetation areas, and (4) designing permanent drainage facilities that mimic the existing drainage pattern of the area. The Caltrans LID practices reduce, or in some cases can eliminate, hydromodification impacts from highway facilities.

Construction BMPs (Category II)

It would be necessary to use a combination of erosion and sediment control BMPs to address both storm water and non-storm water discharges during construction of any of the four build alternatives. Caltrans would implement various construction site BMPs, as appropriate, to reduce the potential for short-term impacts. These temporary control practices are consistent with the BMPs and control practices required under the Construction General Permit, and are intended to achieve compliance with the requirements of that permit. The selected BMPs are directed at reducing pollutants in storm water discharges and eliminating non-storm water discharges. The BMPs to be implemented would cover the following categories (*Table 3.10.11*). More information on the various types of BMPs covered under each one of these categories is found in Caltrans Construction Site BMPs Manual.

Table 3.10.11: Construction BMP Categories

Category
Temporary Soil Stabilization
Temporary Sediment Control
Wind Erosion Control
Tracking Control
Non-Storm Water Management
Waste Management and Materials Pollution Control

"Treatment" BMPs (Category III)

"Treatment" BMPs must be considered for the proposed project, as required under the SWMP, to prevent or minimize the long-term potential impacts from Caltrans facilities or activities. The approved "treatment" BMPs listed in *Table 3.10.12* are considered to be technically and fiscally feasible for all of the build alternatives. Caltrans research and monitoring has found these BMPs to be constructible, maintainable, and effective at removing pollutants to the MEP.

Table 3.10.12 Approved "Treatment" BMPs (Category III)

"Treatment" BMPs	
Biofiltration Systems	Multi-Chambered "Treatment" Train
Infiltration Devices	Wet Basin
Detention Devices	Traction Sand Traps
Dry Weather Flow Diversions	Media Filters
Gross Solid Removal Devices	

Source: Project Planning & Design Guide Manual, May 2007

A preliminary review of the project area has been completed and potential locations and types of "treatment" BMPs have been assessed for feasibility (based on such factors as climate, water volume, soil conditions, physical limitations, other environmental considerations, etc.). Preliminary locations of the "treatment" BMPs are shown on the Project Features Maps (*Figures 2-3.3, Sheets 1* through *67*). As previously noted, the Preferred Alternative would "treat" 112 percent of equivalent new impervious surfaces. When the proposed project proceeds to the design phase, the locations of these "treatment" BMPs would be further evaluated to determine feasibility in relation to right-of-way limitations, environmental constraints or hydraulic capacity. In areas where "treatment" BMPs have been identified, but cannot be incorporated due to above-mentioned reasons, the equivalent minimum would be identified and implemented. In addition, vegetation would be maximized and every effort would be made to ensure the successful establishment of landscaping and erosion control throughout the project limits. The project would also consider any future "treatment" BMPs that might be approved by Caltrans from the ongoing research and monitoring program.

The District Erosion Control Specialist, in coordination with the project Biologist and Landscape Architect, would determine the appropriate planting/seeding mix to ensure that proposed vegetation is consistent with existing vegetation within the corridor, as well as any specific requirements by local entities.

Existing "Treatment" BMPs within the I-5 NCC Project Area

Litigation between Caltrans and the Natural Resources Defense Council, Bay Keepers, and USEPA resulted in a requirement that Caltrans develop a BMP Retrofit Pilot Program in Districts 7 (Los Angeles County) and 11 (San Diego/Imperial Counties) (BMP Retrofit Pilot Program Final Report). Moreover, subsequent to the Statewide Permit adoption (Order 99-06-DWQ), and as described in SWMP Section 4.4.1 and the Caltrans Project Planning and Design Guide, Caltrans conducts an assessment whenever new construction or reconstruction is taking place, which is documented in the SWDR. *Table 3.10.13* provides a list of the "treatment" BMPs that have been constructed within District 11 on the I-5 corridor, as either part of the BMP Retrofit Pilot Program or ongoing construction projects.

Table 3.10.13: Existing "Treatment" BMPs within the *I-5 NCC Project* Area

Watershed	Location Description	BMP type	Total Tributary Area (Treated Acres)
Peñasquitos	N Roselle St, 5/805 I-5/SR-56	Biofiltration Swales Detention Basin	7.7
San Dieguito	N of Del Mar Heights Lomas Santa Fe	Biofiltration Swales and Detention Basin Biofiltration Swales	24
Carlsbad	Lomas Santa Fe I-5 at Manchester Avenue I-5/La Costa I-5 and Palomar Airport Road	Biofiltration Swales Detention Basin Wet Basin Biofiltration Swale	15

Source: BMP Retrofit Program Final Report (CTSW-RT-01-050) and project files (EAs 0301U4, 06510,2358U4)
*Park and Ride "treatment" numbers not included in table.

Minimization measures would be implemented during construction at crossings over six designated "navigable" waterways. Minimization measures at waterways can typically include, but are not limited, to: flagging the perimeter of the proposed impact area to restrict access; training all contractors and construction personnel on sensitive resources, such as navigable vessel use; scheduling construction outside of breeding season(s) or conducting pre-construction surveys for presence/absence of sensitive species; restricting equipment, material storage, and staging to disturbed areas; designing the project to avoid/reduce storm water impacts where feasible, or otherwise control sediment with silt fencing, gravel bags, hay bales, and fiber rolls; control fugitive dust; restrict changing oil and/or refueling to designated areas; construct velocity dissipation structures at drainage outlets; direct all lighting to the construction area during night time construction; and temporarily divert water around the work area by use of sandbags, gravel dams, or cofferdams.

3.11 Geology/Soils/Seismicity/Topography

The 8+4 Buffer alternative has been refined since the Draft EIR/EIS was publically circulated in 2010. This alternative was presented as the locally preferred alternative (LPA) in the August 2012 Supplemental Draft EIR/EIS, and has now been identified as the Preferred Alternative. The refined 8+4 Buffer alternative has the least amount of impact of any build alternative and also meets purpose and need.

3.11.1 Regulatory Setting

For geologic and topographic features, the key federal law is the Historic Sites Act of 1935, which establishes a national registry of natural landmarks and protects "outstanding examples of major geological features." Topographic and geologic features are also protected under CEQA.

This section also discusses geology, soils, and seismic concerns as they relate to public safety and project design. Earthquakes are prime considerations in the design and retrofit of structures. The Caltrans Office of Earthquake Engineering is responsible for assessing the seismic hazard for Caltrans projects. Structures are designed using Caltrans' Seismic Design Criteria (SDC). The SDC provide the minimum seismic requirements for highway bridges designed in California. A bridge's category and classification determine its seismic performance level and which methods are used for estimating the seismic demands and structural capabilities. For more information, please see Caltrans' Division of Engineering Services, Office of Earthquake Engineering, SDC.

3.11.2 Affected Environment

The Caltrans Office of Geotechnical Design South 2 prepared a Preliminary Geotechnical Report for the *I-5 NCC Project* (October 2005). This report presents the results of the preliminary geotechnical review, which consisted of archival research of pre-existing data, field reconnaissance, and preliminary analysis and recommendations.

Information contained in the following sections was derived from the Preliminary Geotechnical Report, and this report can be referenced for further details.

Existing Topography

In the project limits, I-5 runs roughly parallel to the coast within a few miles. The landforms traversed are comprised of a series of uplifted and incised wave cut terraces (mesas) that parallel the existing coastline. East-west trending river valleys and arroyos dissect these terraces and convey drainage via ephemeral streams and perennial rivers and streams west to the ocean. Terrace elevations are typically 328 ft or less while stream and lagoon elevations are at or slightly above sea level. The lagoons and rivers crossed by I-5 represent broad topographic lows that occur at semi regular intervals along the freeway corridor. These topographic lows are subject to tidal flow and episodic flooding arising from hinterland storm runoff.

I-5 traverses lagoons, mesas, small canyons, and arroyos in a series of through-cuts and fill embankments. Natural slopes along the corridor exhibit a maximum slope inclination of about 1:3 (vertical to horizontal). These slopes are typically vegetated by native scrub with some intrusion from exotic species. Steeper slopes in the area are sparsely vegetated or unvegetated, and display a "badlands" type weathering surface, indicating that they are experiencing excessive erosion. Seeps, springs, and streams occur at the toe of some slopes and within some cut slope faces.

Existing cut slopes are typically inclined at 1:2 and are up to 150ft high. The cut slopes primarily expose Torrey Sandstone of Eocene age and are stable. They are vegetated with indigenous and exotic plants. Cut slopes typically include a brow ditch around the upper perimeter and a wide drainage bench midway up the slope. The bench feeds numerous down-drains that collect runoff and pipe it to the paved roadway below. Some cut slopes along the corridor are relatively free of vegetation and display a "badlands" type surface indicating erosional instability. Other slopes in more indurated (consolidated) sandstone have a smooth appearance and remain relatively free of vegetation even after several decades.

Existing fill slopes vary in thickness along the travel way. Fill slope angles are typically 1:2 (vertical/horizontal) or flatter, although there are a few locations where fill slope angles are steeper. Several large embankments rest on relatively young, soft lagoonal deposits. Material used in the embankments was generated in cuts notched through the adjoining mesas. Embankment material, therefore, is similar in composition to material forming cut slopes. Archived logs of test borings reveal that the sandy embankment fills are generally medium dense and presumably compacted to Caltrans standards. Fill slopes are generally well vegetated with native scrub and exotic species.

Site Geology

Throughout the project limits, I-5 traverses terrain comprised of three predominate and repetitive geologic features: (1) through cuts in relatively young marine terrace, sandstone, and shale formations; (2) artificial fills; and (3) unconsolidated lagoonal alluvium.

Formational Units

The natural and cut slopes along the project alignment are primarily composed of Torrey Sandstone and the Delmar Formation. The Torrey Sandstone, part of the La Jolla Group, is light in color and is most often associated with massive and thick bedding of medium- to coarse-grained sandstone. Torrey Sandstone deposits are porous and permeable, and therefore, susceptible to erosion. The Delmar Formation, also part of the La Jolla Group, is considered to be poorly bedded and indurated. It consists of sandy clay stone interbedded with medium to coarse-grained gray sandstone, and steep unprotected slopes are susceptible to erosion. Both of the described units are generally capable of supporting large stable cut slopes at a 1:2 inclination and may support much steeper temporary excavations. The borrow soil derived from these units is generally well suited for use as engineered embankment fill.

Artificial Fill

Four major lagoons are spanned by freeway embankment fill ranging in height from 13 to 80 ft. Strut fills are incorporated at lagoons for additional stabilization. Numerous smaller fills exist elsewhere along the alignment. Exploratory borings show the embankment fills to have the general composition of medium dense silty sand, consistent with locally derived borrow. The roadway fills have slopes inclined at 1:2 that are performing well. Large areas of embankment settlement have been previously determined to be the result of settlement of the underlying alluvium.

Lagoonal Alluvium

The lagoon sediments are composed of weak, poorly consolidated, sand, silt, clay, and gravel, with more consolidated soil at depth. Within the project limits, lagoon alluvium exceeds 100 ft in depth. These relatively weak soils may be subject to consolidation settlement and bearing capacity failure upon the application of additional overburden that would result from freeway improvements. During early freeway construction, embankment fills were placed gradually to avoid failing the weak alluvium, and on the order of six to nine ft of settlement of the finished embankment were recorded. The overlying fills have acted to densify and strengthen the alluvial soils, although it remains necessary to analyze and mitigate the consequences of additional loads.

Subsurface Soil Conditions

Characterization of the subsurface conditions along the I-5 corridor is based on the results of site observations, local knowledge, and archived subsurface information derived from previous geotechnical investigations within the project limits.

The subsurface conditions along I-5 corridor consist of a succession of relatively competent near horizontal sedimentary strata at cut locations; weak, poorly consolidated alluvial deposits at the lagoons; and sandy engineered embankment fill, which is underlain by sedimentary formation or alluvial deposits.

Groundwater

Seeps, springs, ephemeral streams, and perched water have been identified within the project limits. These phenomena often occur at the toe of slopes and embankments, at the contact between permeable sandstone and impermeable shale, within cut slope faces, at grade, and within canyons crossed or traversed by I-5.

Seismicity

Ground shaking due to nearby and distant earthquakes should be anticipated during the life of the facilities. Major fault expressions near the I-5 corridor include the San Andreas, San Jacinto, Elsinore, and Rose Canyon fault zones. Additionally, a complex system of northwest trending faults situated offshore from San Diego, which include the Coronado Banks and San Diego Trough faults, are potential seismic sources that may cause minimal to moderate shaking within the site. The closest active major fault to the site is the Newport Inglewood-Rose Canyon East Fault, which runs offshore in a northwest trend at a distance of about four mi west of the I-5 corridor.

Existing Utilities

Numerous buried and overhead utilities are present in the project area. These include, but are not limited to, buried culverts, sewer lines, buried and overhead electric, buried gas, and buried and overhead telecommunications facilities. See *Section 3.5, Utilities and Emergency Services,* for more information.

Existing Human-Made, and Natural Features of Engineering and Construction Significance

The proposed I-5 project traverses many different human-made and natural features. The most significant are the four lagoon crossings, which contain deep compressible soils; a condition that can be adverse to the construction and behavior of structures and large embankment fills.

3.11.3 Environmental Consequences

Existing and Potential Hazards

Cuts and Excavation

Cuts and excavations, both temporary and permanent, would be utilized to gain the additional roadway width necessary to accommodate the *I-5 NCC Project*.

Caltrans standards require that the stability of permanent cut slopes be evaluated to determine the appropriate safety factor for the proposed slope angle. Slope stability is a function of slope geometry, soil or rock strength parameters, geologic structure, saturation and pore water pressure, and external loading. Additionally, slope faces are subject to surficial stability and erosion. Caltrans criteria for slope stability on newly designed, non-existing permanent slopes dictate that slopes meet minimum safety factors for both static and seismic cases. For more information on Caltrans criteria for slope stability, please refer to the Preliminary Geotechnical Report. Slopes inclined at 1:2 meet the slope stability requirements for permanent slopes, although slightly steeper slopes up to 1:1.75 may be appropriate where favorable soil conditions exist and relatively small slope heights of 16 ft or less are proposed. It should be noted that slopes steeper than 1:2 are difficult to landscape and maintain.

Embankment Stability

Most of the proposed improvements associated with the four build alternatives would be accomplished by gaining additional roadway width through the placement of embankment fill. These fills would be keyed into the existing embankment fill, with the majority of soil needed to construct fills anticipated to be derived from cuts in nearby formational strata. These strata yield soils well suited for roadway embankments.

Embankment stability, as with cut slopes, is a function of slope geometry, soil strength parameters, structure, saturation and pore water pressure, and external loading. Additionally, however, embankment stability also is a function of the stability of the underlying soil in response to additional fill. Adverse conditions, such as weak (e.g., lagoonal or alluvial) foundation soils may compromise embankment stability. Caltrans criteria for slope stability of newly designed permanent embankments dictate that slopes meet minimum safety and seismic factors. For more information on Caltrans criteria for slope stability, please refer to the Preliminary Geotechnical Report.

Construction of embankments would cause settlement where the foundation soils are compressible. Since the majority of the foundation soil in the project area is formational, little settlement would occur in conjunction with most fill placement. Placement of embankments over lagoon and alluvial soils would, however, result in substantial settlement. The amount of settlement depends on the height and width of the additional embankment, and on the depth and compressibility of the foundation soil. The existing embankment fills have acted to consolidate and strengthen the underlying soft soils, thereby reducing the anticipated settlement from additional loading. Embankment settlement from the proposed loads, however, may have a minor impact on existing freeway lanes.

Surface Water

Within the project limits, several small drainages and culverts convey minor year-round flows. These flows are attributable to urban runoff and/or perched groundwater seepage. Many of the existing drainage features would require rerouting, upgrading, and/or extending to accommodate a wider freeway facility.

Groundwater Seepage

The occurrence of groundwater in slopes can substantially influence slope stability. One such seepage location is on the east cut slope of northbound I-5 in Encinitas, between the Manchester Avenue on-ramp and the Birmingham Drive off-ramp. Rainwater infiltration and the irrigation of the residential complex at the top of the slope contribute to groundwater seepage at this location throughout the year.

Groundwater depths in areas adjacent to coastal lagoons are anticipated to be shallow, with groundwater having been encountered at or slightly above mean sea level. Excavations at and below lagoon surface elevations would be prone to inundation from groundwater infiltration. Saturated soils would predispose excavations in poorly consolidated deposits located at or below the water table to collapse.

Subsurface Soil Conditions

The geologic formations within the project limits, as well as the fill material derived from cuts in those formations, generally provide good subgrade for roadways and retaining walls. The soft lagoonal deposits, however, may be subject to settlement and bearing capacity failure due to the placement of additional surcharge.

Shrink-swell behavior may be associated with some of the clay beds within local sedimentary deposits. These materials shrink and swell in response to changing soil moisture. This type of behavior could adversely affect the structural section, predispose slope faces to erosion, and compromise slope stability.

Seismic Hazards

The proximity of the project area to the Newport Inglewood-Rose Canyon Fault Zone establishes the potential for the area to be impacted by a major seismic event. The Newport Inglewood-Rose Canyon Fault Zone displaces Holocene sediment and, therefore, is considered active. In general, seismic activity in the study area could include strong ground motion, liquefaction, seismically induced settlement, and embankment spreading.

Ground surface rupture due to active faulting is considered unlikely within the project limits due to absence of known active fault traces crossing the I-5 within the proposed project. The potential for cracking of the surface as a result of nearby or distant events is also considered unlikely.

A major seismic event could cause lateral spreading, cracking, and slumping of both existing and proposed embankments. Embankments and facilities build over loose, sandy, saturated foundation soil (i.e., river beds and lagoons) may also be subject to the effects of liquefaction.

Liquefaction involves a sudden loss in strength of a saturated, predominantly sandy soil caused by a cyclic loading such as an earthquake. This results in a temporary transformation of the soil into a fluid mass. Typically, liquefaction occurs in areas where groundwater is less than about 50 ft from the surface, and where the soils consist predominantly of poorly consolidated fine sands, silty sands, and non-plastic silts. Seismically induced liquefaction could cause embankment settlement and structural failure. Areas that would mostly be affected by seismically induced liquefaction are the embankment fills and structures at the lagoon and river crossings.

Embankment failures are a result of excessive settlement and damage to pavement structural sections. Currently, strut fills support existing fill embankments at the lagoons. These strut fills act to restrain the embankment from potential slumping or spreading. Additionally, the strut fills, up to 30-ft high, have helped to densify the native soils beneath, thereby lowering the liquefaction potential.

Impacts to Utilities

Numerous buried and overhead utilities are present in the project area. Existing utilities conflicting with proposed construction activities would require protection or relocation during construction. The location of all utilities would be verified prior to subsurface investigation or construction.

Construction-related impacts

- Wall construction features, such as temporary back cuts or soil nail lengths may impact existing facilities and right-of-way requirements.

- Large, near vertical earth retaining systems that may be located above soft lagoon and river alluvium would likely necessitate ground improvements for the foundation soil. Such improvements could generate a larger impact footprint, increase project costs, and result in excessive construction delays.

3.11.4 Avoidance, Minimization, and/or Mitigation Measures

Design Considerations

- For preliminary design purposes, soils at all the lagoons and river valleys would be assumed to be predisposed to liquefaction.

- The use of large retaining structures to accommodate embankment widening over the lagoons should be avoided.

Surface and Subsurface Drainage

- Drainage for proposed improvements would be constructed in accordance with the Caltrans Highway Design Manual.

- Impacts to water quality would be minimized by directing surface runoff away from the top of slopes, and also by not allowing runoff to discharge over the top of slopes.

- Surface water would be conveyed off site by appropriate erosion-reducing devices.

- Where groundwater is present, subsurface drainage devices would be installed, if applicable.

Minimization of Embankment Settlement

- Settlement waiting periods would be employed at all soft soil locations before establishment of the final grade.

Construction Monitoring and Instrumentation

- Caltrans personnel would be present during project construction to observe all cuts, foundation subgrade, and embankment subgrade to assure that all appropriate provisions are enforced. If unanticipated subsurface conditions are encountered, a geotechnical representative would be notified to make additional recommendations to the Resident Engineer, who in turn would direct the contractor. Instrumentation for measuring settlement or slope distress, and periodic surveying for ground movement, would be included during construction in areas where the potential for ground movement or failure exists.

- Grading and roadway work would be performed in accordance with Caltrans Standard Plans and Specifications.

- To avoid surface erosion, which may supply an unacceptable sediment load to the watershed, temporary slopes would be protected throughout the wet season.

- Concentrated flows would not be allowed on slopes.

- Appropriate construction scheduling, soil tackifiers, geosynthetic mats, and plastic sheeting are some of the techniques that may be used to avert excessive slope erosion.

3.12 Paleontology

The 8+4 Buffer alternative has been refined since the Draft EIR/EIS was publically circulated in 2010. This alternative was presented as the locally preferred alternative (LPA) in the August 2012 Supplemental Draft EIR/EIS, and has now been identified as the Preferred Alternative. The refined 8+4 Buffer alternative has the least amount of impact of any build alternative and also meets purpose and need.

3.12.1 Regulatory Setting

Paleontology is the study of life in past geologic time based on fossil plants and animals. A number of federal statutes specifically address paleontological resources, their treatment, and funding for mitigation as a part of federally authorized projects. 16 United States Code (USC) 431 and 433 prohibit appropriating, excavating, injuring, or destroying any object of antiquity situated on federal land without the permission of the Secretary of the Department of Government having jurisdiction over the land. 23 USC 305 authorizes funds to be appropriated and used for archaeological and paleontological salvage as necessary by the highway department of any state, in compliance with 16 USC 431 and 433 above. 16 USC Section 470aaa prohibits the excavation, removal, or damage of any paleontological resources located on federal land. 23 Code of Federal Regulations (CFR) 1.9(a) states that the use of federal funds must be in conformity with federal and State law.

Under California law, paleontological resources are protected by CEQA. The California Coastal Act Section 30244, Archaeological or Paleontological Resources, states: “Where development would adversely impact archaeological or paleontological resources as identified by the State Historic Preservation Officer, reasonable mitigation measures shall be required.” Paleontological resources would be addressed in the coastal zone permit (see *Table 3.1.1* of this EIR/EIS).

3.12.2 Affected Environment

A paleontology study, entitled Paleontological Resource Assessment, I-5 NCC Project, Caltrans District 11, San Diego County, California, was conducted and identified the presence of geologic formations with the potential to contain important fossil remains within the project footprint. The oldest rocks date from the Eocene Epoch and include the Delmar Formation, Torrey Sandstone, Ardath Shale, Scripps Formation, and Santiago Formation, as well as a previously unmapped formation from the Oligocene Epoch. In the northern portion of the project area, the Eocene strata are overlain by Miocene-age strata of the San Onofre Breccia, and San Mateo Formation. Both the Miocene and Eocene strata are overlain by much younger Pleistocene-age deposits of the Bay Point Formation or Lindavista Formation. These formations are known to contain important land mammal and marine invertebrate fossil assemblages, and may produce important microfossil specimens.

The Delmar Formation is late-early to early-middle Eocene in age, approximately 49 to 50 million years old (Ma), has produced important remains of terrestrial vertebrate fossils, and is assigned a high paleontological resource sensitivity. Fossils from the Delmar Formation consist of well- to poorly preserved remains of estuarine invertebrates (e.g., clams, oysters, and snails) and vertebrates (e.g., sharks, rays, and fishes). An extremely important locality at Swami's Point in Encinitas has yielded well-preserved skull remains of aquatic reptiles (e.g., crocodiles) and terrestrial mammals (e.g., tillodonts and early rhinoceros). The Delmar Formation crops out from Sorrento Valley in the south to at least Batiquitos Lagoon in the north, and from the coast inland to La Costa and Rancho Santa Fe. The best exposures of the Delmar Formation occur in the sea cliffs from Torrey Pines State Reserve to Encinitas.

The Torrey Sandstone is considered to be early-middle Eocene in age, approximately 48 to 49 Ma, and is known to produce important remains of fossil plants and marine invertebrates. Invertebrate fossils known from the Torrey Sandstone primarily consist of nearshore marine taxa (e.g., clams, oysters, snails, and barnacles). Vertebrate fossil remains are rare and include teeth of crocodiles, sharks, and rays. The Torrey Sandstone occurs from Sorrento Valley in the south to Batiquitos Lagoon in the north, and from the coast inland to La Jolla Valley and Olivenhain.

The Ardath Shale was deposited at outer shelf depths on an ancient sea floor during the early-middle Eocene, about 47 to 48 Ma. This formation has yielded diverse and well-preserved assemblages of marine microfossils, macroinvertebrates, and vertebrates (e.g., sharks, rays, and bony fish). The Ardath Shale crops out from La Jolla, Pacific Beach, and Clairemont in the south, to Carmel Valley in the north.

The Scripps Formation is entirely of marine origin (continental shelf) and was deposited during the early-middle Eocene, approximately 46 to 47 Ma. It is considered to be potentially fossiliferous almost everywhere it occurs. Most of the fossils known from this formation consist of marine organisms including clams, snails, crabs, sharks, rays, and bony fishes. Fossil reptiles (e.g., crocodiles and turtles), land mammals (e.g., uintathere, brontothere, rhinoceros, and artiodactyl), and well-preserved specimens of fossil wood, however, have also been recovered from the Scripps Formation. The Scripps Formation crops out from Presidio Park in the south, north to Del Mar, and from Clairemont east to La Jolla Valley.

The Santiago Formation boundary occurs in the general area of Olivenhain and Cardiff-by-the-Sea, and broadly correlates with almost the entire middle Eocene stratigraphic sequence at San Diego (Pomerado Conglomerate to Ardath Shale), approximately 40 to 49 Ma. There are generally three recognized members of the Santiago Formation in the Encinitas-Carlsbad area, referred to as the “A,” “B,” and “C” members.

> Member “C” crops out from south of Batiquitos Lagoon north at least to the San Luis Rey River, and has produced abundant vertebrate fossils from several districts including Carlsbad, Oceanside, and Camp Pendleton Marine Corps Base. Fossils collected from this upper unit include well-preserved remains of turtles, snakes, lizards, crocodiles, birds, and mammals (e.g., opossums, insectivores, primates, rodents, brontotheres, tapirs, protoreodonts, and other early artiodactyls). The mammal assemblages are especially important because of their great faunal diversity and excellent specimen preservation. These fossils, together with contemporaneous mammal fossils from the Poway Group, make the Eocene deposits of San Diego County among the most important in North America. Also recovered from Member “C” deposits are remains of various types of marine organisms including calcareous nannoplankton and mollusks.

Member “B” crops out in Encinitas in the south, and extends north to at least the San Luis Rey River. Member "B" gradationally overlies the Torrey Sandstone near Encinitas, and is unconformably overlain by Member “C” wherever the contact between the two is observed. Member “B” has produced well-preserved vertebrate fossils from several localities in Carlsbad and Oceanside, including opossums, insectivores, primates, rodents, brontothere, rhinoceros, and uintathere. Also recovered from Member “B” deposits are various types of marine and estuarine mollusks.

Member “A” crops out sparingly south of SR-78 in the Cerro de la Calavera area, and is also present on the south side of the San Luis Rey River near Guajome Lake. Member “A” has yet to produce any fossils, but the discovery of any diagnostic fossils in this rock unit would be of great importance in resolving the age and stratigraphic significance of the Santiago Formation.

An unmapped formation of Oligocene age was discovered in the exposed sedimentary rocks of the Santiago Formation. A small number of terrestrial mammal fossils has been discovered within these sedimentary deposits. These fossils suggest that the associated strata are younger than previously believed, and were deposited during the Oligocene Epoch (approximately 23 to 34 Ma). The discovery of fossil bone at numerous localities within these strata suggests that this unit is much more fossiliferous than previously believed. This unit is assigned a high paleontological resource sensitivity because of its potential to produce well-preserved remains of fossil vertebrates, as well as the potential to yield previously unknown information about the natural history of this part of San Diego County.

The San Onofre Breccia is an alluvial fan and nearshore marine rock unit of middle Miocene age, approximately 14 to16 Ma. Poorly preserved remains of nearshore marine foraminifers and bivalve mollusks have been reported from the San Onofre Breccia. Remains of fossil mammals have also been recovered from this formation, although these fossils have not been adequately studied and remain unidentified. The San Onofre Breccia in San Diego County crops out from Oceanside, north through the coastal portion of the Camp Pendleton Marine Corps Base. The formation is well-exposed in the valleys of the San Luis Rey and Santa Margarita rivers.

The San Mateo Formation is of late Pliocene to late Miocene in age (approximately 4 to 7 Ma). This formation has produced very important and locally abundant remains of many kinds of fossil marine vertebrates, including rays, sharks, bony fishes, sea birds, dolphins, sperm whales, baleen whales, sea cows, fur seals, walrus, and sea otters. In addition, terrestrial mammal remains (e.g., horse, camel, llama, and peccary) have been recovered from these deposits. The most productive vertebrate fossil localities occur in the Lawrence Canyon area of north Oceanside. Exposures of the San Mateo Formation on Camp Pendleton have also produced diverse assemblages of marine invertebrates (e.g., clams, scallops, snails, and sea urchins). The San Mateo Formation crops out from the San Luis Rey River Valley in Oceanside, north through Camp Pendleton Marine Corps Base to San Mateo Point near San Clemente.

The Lindavista Formation represents a marine and/or non-marine terrace deposit of early Pleistocene age (approximately 0.5 to 1.5 Ma). Fossil localities are rare in the Lindavista Formation and have only been recorded from a few areas (e.g., Tierrasanta and Mira Mesa). Fossils collected from these sites consist of nearshore marine invertebrates including clams, scallops, snails, barnacles, and sand dollars, as well as sparse remains of sharks and baleen whales. The Lindavista Formation occurs over a large area from the International Border north to San Clemente.

The Bay Point Formation is actually an all-inclusive stratigraphic unit for all coastal Pleistocene sedimentary deposits younger than the Lindavista Formation. The marine deposits of the Bay Point Formation have produced large and diverse assemblages of marine invertebrate fossils such as mollusks, crustaceans, and echinoderms, as well as sparse remains of marine vertebrates including sharks, rays, and bony fish. The non-marine alluvial deposits of the Bay Point Formation have produced locally concentrated fossil remains of terrestrial mammals such as ground sloths, dire wolves, tapirs, horses, deer, camels, mastodons, and mammoths. The Bay Point Formation occurs along the coast from the International Border to San Clemente.

3.12.3 Environmental Consequences

Direct impacts to paleontological resources would occur when earthwork activities, such as mass grading operations or cuts, extend into geological deposits containing fossils. The four build alternatives would disturb similar areas along the I-5 corridor. Since, the types, depths, and locations of various construction activities are not known at this time and unearthing paleontological resources within the project study area would be anticipated, the four build alternatives are considered to have similar effects on paleontological resource sensitivity.

3.12.4 Avoidance, Minimization, and/or Mitigation Measures

Paleontological mitigation would be carried out primarily during the project construction phase. The mitigation program would consist of monitoring, fossil salvage, macrofossil and microfossil analysis, fossil preparation, report preparation, and curation.

Monitoring

- A qualified principal paleontologist (M.S. or Ph.D. in paleontology or geology familiar with paleontological procedures and techniques) would be retained to be present at pre-grading meetings to consult with grading and excavation contractors.

- A paleontological monitor, under the direction of the qualified principal paleontologist, would be on site to inspect cuts for fossils at all times during original grading involving sensitive geologic formations.

Macrofossil / Microfossil Analysis

- When fossils are discovered, the paleontologist (or paleontological monitor) would recover them. Construction work in these areas would be halted or diverted to allow recovery of fossil remains in a timely manner.

- Fossil remains collected during the monitoring and salvage portion of the mitigation program would be prepared, sorted, and cataloged.

Report Preparation

- Paleontological Mitigation Monitoring Plan (PMMP) – Once the grading plan is finalized, the types, depth, and locations of the construction activities would be analyzed to finalize the PMMP prepared by a qualified principal paleontologist.

- Paleontological Mitigation Monitoring Report (PMMR) – A PMMR would be prepared by a qualified principal paleontologist. The PMMR would document the results of the mitigation program, and include construction monitoring, fossil salvage, laboratory preparation of salvaged specimens, curation of prepared specimens, and storage of curated specimens.

Curation

- Although all fossils collected remain the property of the State, the collection must be properly curated at an approved facility (preferably local to the project location) and preserved for future researchers. A complete set of field notes, geologic maps, stratigraphic sections, and a copy of the final report should be curated with the fossils.

3.13 Hazardous Waste / Materials

The 8+4 Buffer alternative has been refined since the Draft EIR/EIS was publically circulated in 2010. This alternative was presented as the locally preferred alternative (LPA) in the August 2012 Supplemental Draft EIR/EIS, and has now been identified as the Preferred Alternative. The refined 8+4 Buffer alternative has the least amount of impact of any build alternative and also meets purpose and need.

3.13.1 Regulatory Setting

Hazardous materials including hazardous substances and wastes are regulated by many State and federal laws. Statutes govern the generation, treatment, storage, and disposal of hazardous materials, substances, and waste, and also the investigation and mitigation of waste releases, air and water quality, human health and land use.

The primary federal laws regulating hazardous wastes/materials are the Resource Conservation and Recovery Act of 1976 (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). The purpose of CERCLA, often referred to as Superfund, is to identify and clean up abandoned contaminated sites so that public health and welfare are not compromised. RCRA provides for "cradle to grave" regulation of hazardous waste generated by operating entities. Other federal laws include:

- Community Environmental Response Facilitation Act (CERFA) of 1992
- Clean Water Act
- Clean Air Act
- Safe Drinking Water Act
- Occupational Safety and Health Act (OSHA)
- Atomic Energy Act
- Toxic Substances Control Act (TSCA)
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

In addition to the acts listed above, EO 12088, Federal Compliance with Pollution Control, mandates that necessary actions be taken to prevent and control environmental pollution when federal activities or federal facilities are involved.

California regulates hazardous materials, waste, and substances under the authority of the California Health and Safety Code and is also authorized by the federal government to implement RCRA in the state. California law also addresses specific handling, storage, transportation, disposal, treatment, reduction, cleanup, and emergency planning of hazardous waste. The Porter-Cologne Water Quality Control Act also restricts disposal of wastes and requires clean up of wastes that are below hazardous waste concentrations but could impact ground and surface water quality. California regulations that address waste management and prevention and clean up of contamination include Title 22 Division 4.5 Environmental Health Standards for the Management of Hazardous Waste, Title 23 Waters, and Title 27 Environmental Protection.

Worker and public health and safety are key issues when addressing hazardous materials that may affect human health and the environment. Proper management and disposal of hazardous material is vital if it is encountered, disturbed during, or generated during project construction.

3.13.2 Affected Environment

The following reports were prepared for the proposed *I-5 NCC Project* and incorporated by reference:

- Site Investigation Report, Lead Investigation on the Route 5, from Via de la Valle to Leucadia Boulevard, San Diego, Solana Beach, and Encinitas, California, KP: R57.9/R68.7; PM: R36.0/R42.7, June 22, 2001
- Aerial Deposited Lead Investigation, Contract No. 43A0012, Task Order No. 11-07830K-VW, Route 5 Between Leucadia Boulevard and Brooks Street, San Diego County California. PM 42.7/R51.2. KP R68.7/82.4. PSI, June 28, 2001
- Limited Phase II Environmental Site Assessment Interstate 5 Expansion, Del Mar Heights Road to Birmingham Drive, San Diego California, November 15, 2005
- Phase II Environmental Site Assessment Interstate 5 Expansion, Birmingham Drive to Vandegrift Boulevard, San Diego County, California, October 31, 2006
- Aerially-Deposited Lead Survey – Interstate 5 and Genesee Avenue, San Diego, California, January 9, 2009

These reports provide an evaluation of the potential hazardous waste/material concerns within the project study area. Specific methodology used for these analyses includes:

- An evaluation of study area history through review of available reports and historic maps/aerial photographs
- Field reconnaissance to document the potential occurrence of, and contamination by, hazardous waste/materials within the study area
- Review of regulatory agency files and databases regarding the use, storage, unauthorized release, and remediation of hazardous materials within the study area and vicinity
- Subsurface evaluation, where needed
- The portion of Interstate 5 from Del Mar Heights Road to Genesee Avenue has been widened and ADL has been previously mitigated under other projects

The study area for the noted analyses was determined by reviewing databases for potential hazardous material site locations within a 0.5-mi radius of the project corridor. This study area, as with most of San Diego County, was historically rural with an agricultural base. Transportation uses began in the North Coast Corridor in the early 1900s, although several agricultural and nursery uses still exist. Urban uses have also developed, including service stations located at intersections, landfills, and facilities with potential to contain asbestos and lead, such as I-5 bridges.

In particular, there is a gasoline station on the east side and agricultural uses northeast of Manchester Avenue, with associated petroleum hydrocarbon impacts to soil and groundwater. The agricultural areas also have non-hazardous concentrations of pesticides in the soil. Gasoline stations are present at Birmingham Drive, on the east and west sides of the freeway. Between Birmingham Drive and Palomar Airport Road there are nurseries with non-hazardous