CHAPTER 2.0
DESCRIPTION OF PROJECT ALTERNATIVES

This chapter provides a description of the Enhancement Project evaluated in Chapter 3 of this EIR. The project background, project location, and general existing environmental setting are described below, followed by a description of the proposed project alternatives, construction methods, and maintenance and adaptive management strategies that would be required with implementation of the Enhancement Project. Three alternatives are evaluated at an equal level of detail in this EIR: the Freshwater, Saltwater, and Hybrid Alternatives. A discussion of the Environmentally Superior Alternative is identified in Section 4.4, including a comparison of how the different alternatives meet the project objectives.

2.1 PROJECT LOCATION AND ENVIRONMENTAL SETTING

Buena Vista Lagoon is located in northern San Diego County and spans the boundaries of the Cities of Carlsbad and Oceanside. The lagoon encompasses approximately ~~220~~ 240 acres and is located within the Buena Vista Lagoon Ecological Reserve (Reserve) managed by CDFW. The lagoon is fed by Buena Vista Creek, which drains approximately 20 square miles of the Buena Vista Watershed into the Pacific Ocean. Figure 2-1 shows the location of the project site in a regional context, and Figure 2-2 shows the lagoon project vicinity.

2.1.1 LAGOON CHARACTERISTICS AND BACKGROUND

Buena Vista Lagoon is a freshwater lagoon, a majority of which is owned by CDFW. The remaining portions of the lagoon are owned by other public agencies and private parties (see Figure 2-3). ~~Due to the coastal wetland habitat and the number of wildlife species that use the area including and surrounding the lagoon, t~~The portion owned by CDFW is designated as a State Ecological Reserve and is managed for the protection of rare, threatened, or endangered native plants, wildlife, aquatic organisms, and specialized terrestrial or aquatic habitat types in compliance with CCR Title 14, Section 630(a) and California Fish and Game Code, Section 1580-1587. As shown in Figure 2-2, the lagoon is bisected in three locations; by I-5, Carlsbad Boulevard (South Coast Highway in the City of Oceanside), and the LOSSAN railroad tracks. These crossings create four basins: the I-5 Basin, the Coast Highway Basin, the Railroad Basin, and the Weir Basin.

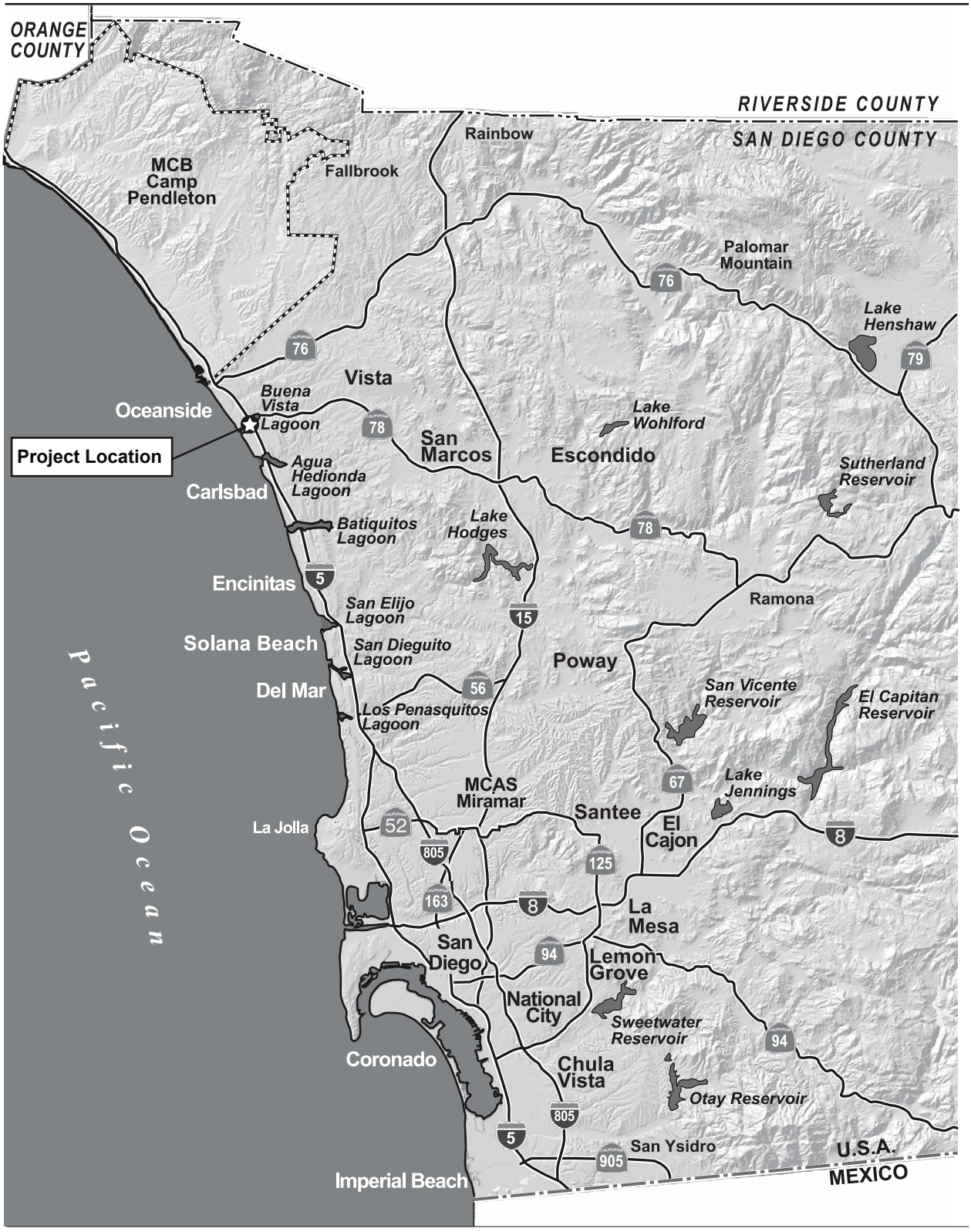
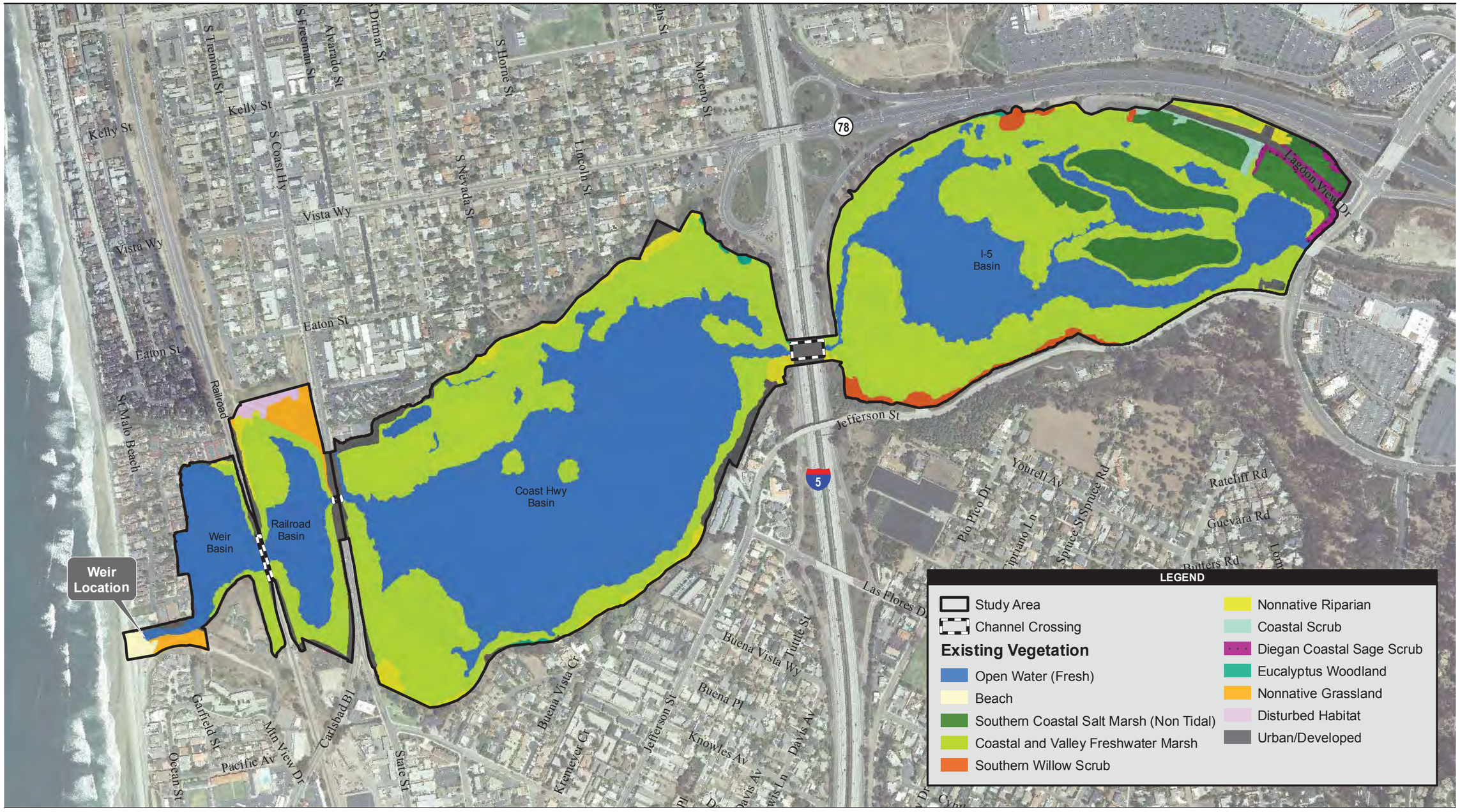


Figure 2-1
Regional Map



Source: SANDAG 2012; Sangis; Everest; AECOM 2014

600 300 0 600 Feet

Scale: 1:7,200; 1 inch = 600 feet

Figure 2-2
Project Location and Existing Habitat Distribution Map

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Source: SANDAG 2012; Sangis; Everest; AECOM 2014

600 300 0 600 Feet

Scale: 1 = 7,200; 1 inch = 600 feet

Figure 2-3
Land Ownership and Boundaries within Buena Vista Lagoon

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The lagoon is a large water feature that serves as a landmark and de facto boundary between the Cities of Oceanside and Carlsbad. Both of these suburban jurisdictions have a mix of residential and commercial development of varying densities, and substantial transportation features (highway and railroad), and are influenced by the adjacent Pacific Ocean. Generally to the west of I-5, the lagoon is surrounded by single-family and multi-family units to the north and south, most along bluffs and hillsides but some at elevations only slightly raised. Generally to the east of I-5, the northern and eastern lagoon boundaries are highway (SR 78) and commercial uses, with more open hillsides to the south and residences set back on the tops. The lagoon basins have open water in the middle and vegetation on the edges, with the most dense vegetation in the easternmost I-5 Basin (Figure 2-2).

Currently, multiple owners and agencies provide ongoing maintenance activities within and adjacent to the lagoon. CDFW has been making an effort to manage cattails within the lagoon to improve vector control, although methodologies are still being identified to provide effective removal of established cattail stands that are too dense for standard aquatic mowers (CDFW 2014a; Aquatic Environments 2014). The St. Malo HOA conducts vegetation removal and other maintenance activities in the Weir Basin. The City of Oceanside periodically removes the sandy beach berm that builds up on the beach west of the weir. Additionally, the Nature Center conducts trail maintenance on informal trails and pathways along the northwestern shore of the Coast Highway Basin.

2.1.2 Littoral Zone Nourishment Site Characteristics and Background

There are two nearby locations where materials dredged from the lagoon during enhancement activities may be placed. These materials placement sites are beaches and nearshore areas outside of the lagoon and therefore affected by marine coastal processes as opposed to lagoon hydrology. Placement of material at these sites would allow beneficial reuse of the materials, depending upon grain size, which determines suitability for beach or nearshore placement. The Oceanside materials onshore placement site is approximately 0.8 mile in length, located north of the lagoon. It consists of a typically sandy beach between Wisconsin Street and Morse Street where riprap (large boulders) has been placed to protect beach-front residential structures. The placement site is not the currently permitted site specified under the existing Oceanside Beach Fill Program. The North Carlsbad site is approximately 3,000 feet long, from immediately south of the lagoon to Oak Street. It also is a typically sandy beach backed by residences, some of which are built on bluffs overlooking the ocean. The character of each site varies by season, tide, storm damage, and periodic beach nourishment activities. Both locations have had sand previously placed directly on their shorelines from the 2001 and 2012 RBSPs. There is also a possible underwater nearshore materials placement site at Oceanside that is characterized by a sandy bottom.

2.2 ALTERNATIVES SELECTION PROCESS

Several state and local agencies and organizations have been involved in enhancement efforts within the lagoon, including the Foundation, the California Coastal Conservancy, CDFW, the Cities of Oceanside and Carlsbad, USFWS, and, since 2012, SANDAG. Additionally, several stakeholders and individuals from the communities surrounding the lagoon have provided input regarding their concerns over different aspects of the lagoon (Section 1.3.2).

In 1982, the California Coastal Conservancy began a sediment control program within the watershed to review sediment sources, plan sediment control measures, and develop a model erosion control ordinance. This effort also helped establish a Joint Powers Committee including the Cities of Carlsbad, Oceanside, and Vista to help coordinate activities within the watershed (California Coastal Conservancy 2006). The California Coastal Conservancy, the Foundation, USFWS, and the RWQCB have contributed toward the funding of several studies including the Buena Vista Lagoon Restoration Feasibility Analysis completed in 2004, supplemental technical studies conducted in 2005, and a regional habitat analysis completed in 2006 (California Coastal Conservancy 2006). Additional information on previous documents prepared is provided in Section 1.1.2.

Information from these past efforts, as well as input provided by responsible agencies and interested organizations and individuals, has been used to guide the alternatives development process. This has also led to the preparation of subsequent preliminary engineering studies to refine the range of alternatives considered to the three enhancement alternatives selected for detailed analysis in this EIR.

The project alternatives have been developed from past efforts in response to the need to improve and restore the biologic and hydrologic functions of the lagoon. Each of the alternatives evaluated within this document seeks to enhance existing lagoon functions through dredging and grading, as well as management of freshwater and saltwater inputs and outputs. The range of alternatives developed reflect differing water regimes, as well as resulting habitat distribution. Hydraulic improvements within the lagoon are also included in the alternatives, including enlarging channels to reduce flood elevations. As a result of dredging and grading activities proposed under each of the alternatives, material necessitating disposal and/or beneficial reuse would be generated. Material removed from the lagoon could include beneficial reuse of the material through placement on the beach or nearshore, or disposal at a designated EPA ocean disposal site (LA-5), dependent upon the suitability of the material (e.g., grain size). Appropriate infrastructure improvements are also included in the Enhancement Project alternatives as necessary to accommodate project actions.

2.3 ALTERNATIVES ELIMINATED FROM DETAILED REVIEW

Over the life of the project, various opportunities for enhancement of the lagoon have been considered. However, the primary focus of the Enhancement Project is to enhance the biological and hydrological functions of the lagoon to stop or reverse the decline of the lagoon's health. While benefits associated with the options may vary, the project objectives in Chapter 1 of this EIR identify the key selection criteria and remain linked to the enhancement element of the project. Table 2-1 highlights the lagoon enhancement alternatives that were considered but have been eliminated from further analysis in the EIR, as well as the rationale for elimination. As shown in Table 2-1, alternatives were eliminated from further consideration based on potential loss of sensitive habitat, frequency of maintenance activities required, impacts to views from residences surrounding the lagoon, and disposal requirements of sediment and vegetation to be removed from the lagoon.

2.4 PROJECT ALTERNATIVES CARRIED FORWARD

The Enhancement Project would address the continued degradation of Buena Vista Lagoon through enhancement of its biological and hydrological functions. A range of alternatives that meet the objectives of the Enhancement Project have been analyzed at an equal level of detail in this EIR. Each of the alternatives has a design project life of 50 years. The analysis within this document and associated stakeholder/public input obtained through the environmental review process will drive selection of the preferred alternative. All alternatives identified in this document are analyzed at an equal level of detail to facilitate identification of the preferred alternative and the ultimate selection of an alternative for implementation. The alternatives carried forward for detailed analysis in this EIR include:

- Freshwater Alternative
- Saltwater Alternative
- Hybrid Alternative – Options A and B
- No Project Alternative

As further discussed in Section 2.8.6 below, an effort has been made to proactively incorporate measures into each of the alternatives to minimize and avoid, where possible, impacts to resources. These Project Design Features (PDFs) are outlined in Table 2-10. The Enhancement Project also involves several design elements/considerations common to multiple build alternatives analyzed within this EIR, such as infrastructure improvements, that would be implemented as part of the Enhancement Project or by others. Those common project components include an elevated pedestrian boardwalk (evaluated as part of the Enhancement

Table 2-1
Comparison of Alternatives Considered and Justification for Elimination

Name of Alternative	Year Evaluated	Brief Description	Justification for Elimination
Freshwater Alternatives Considered			
Alternative 1	2008	This alternative included an 80-foot-wide weir, elimination of the existing exotic vegetation, and dredging to remove excess sediment.	This alternative was eliminated from further consideration due to impacts to endangered species and critical habitat associated with complete removal of the existing vegetation. The U.S. Army Corps of Engineers (Corps) indicated that mitigation would be required since this alternative would effectively destroy vegetated wetland to create open water.
4-Foot Deep Freshwater Alternative	2010	Open water depths of 4 feet below the water elevation maintained via dredging in the lagoon. The cut and fill were balanced by creating "islands" in each basin for upland habitat with excavated material, to eliminate the need for sediment disposal off-site.	This alternative was eliminated from further consideration due to impacts to endangered species and critical habitat associated with complete removal of the existing vegetation. The Corps indicated that mitigation would be required since this alternative would effectively destroy too large an area of vegetated wetland to create open water.
Freshwater Alternative	2010	Open water depths of 6 feet deep, but maintaining cattail habitat in existing locations (except for cattails adjacent to Coast Highway) so that impacts to vegetated wetland habitat would be minimized. In this alternative, all dredge material would be hauled off-site for beneficial use and/or disposal. The central portions of each basin would be dredged to maintain a water depth of 6 feet.	This alternative was carried forward with modifications to become the currently proposed Freshwater Alternative.
Saltwater Alternatives Considered			
Alternative 2	2008	Three scenarios were developed to explore a range of modifications to the hydraulic connections below the bridges, including the following: • Scenario 2-1: Involved restoring the hydraulic connections to design conditions by removing vegetative growth and excavating sediment. Ocean inlet would require stabilization with two jetties that would extend to the mean lower low	This alternative was eliminated from further consideration due to issues related to the proposed tidal inlet. The relatively deep tidal inlet would allow significant sedimentation from beach sand that would require extensive and frequent maintenance using hydraulic dredge equipment (or equivalent) operating in the Weir Basin, Railroad Basin, and Coast Highway Basin. The inlet location would have to be stabilized with a jetty system that would extend seaward to the

Name of Alternative	Year Evaluated	Brief Description	Justification for Elimination
		water (MLLW) contour. • Scenario 2-2: Included substantial structural modifications to the hydraulic connections to increase tidal exchange. The Railroad Basin would be deepened from -1 to -15 National Geodetic Vertical Datum (NGVD) to allow a continuous connection between the Weir Basin and Railroad Basin. The Coast Highway Basin would be doubled in width from 25 feet to 50 feet; depth would be maintained according to design. The I-5 Basin would be modified by increasing the bottom width from 24 feet to 40 feet and lowering the bottom elevation from -2.0 to -6.0 feet NGVD; the channel side slopes would be maintained according to the design condition (1.5H:1V). Finally, the ocean inlet would require stabilization with one or two jetties. • Scenario 2-3: Similar to Alternative 2-2, but with structural modifications at the Interstate 5 (I-5) bridge hydraulic connection. The channel width of the I-5 bridge hydraulic connection would be increased to 24 feet; side slopes would be maintained according to design conditions (1.5H:1V).	MLLW contour. The large tidal range of this alternative would result in fairly large areas of exposed vegetation and sediment (mudflat). The amount and frequency of maintenance that would be required for operation makes this alternative cost prohibitive and financially infeasible to implement. Additionally, the inlet area property owners raised concerns that the jetty system and mudflat created under this alternative would adversely impact views. There was also the perception among property owners that unpleasant odors would result from mudflats.
Conceptual Alternative A	April 2010	Existing vegetation would be removed throughout the lagoon and no grading modifications would be made except for the creation of tidal channels.	This alternative was eliminated from further consideration due to impacts to endangered species and critical habitat associated with complete removal of the existing vegetation. The resource agencies were concerned that, without grading modifications, not enough vegetated wetlands (coastal salt marsh) would be created to provide habitat for the endangered species impacted by removal of the existing vegetation. Additionally, the inlet area property owners raised

Name of Alternative	Year Evaluated	Brief Description	Justification for Elimination
			concerns that this alternative would create mudflats that would adversely impact open water views. There was also the perception among property owners that unpleasant odors would result from mudflats.
Conceptual Alternative C	April 2010	This alternative included modification of the lagoon grading to produce intertidal habitats. Alternative C involved a more gradual transition of the intertidal area to create low marsh, mudflat, and subtidal habitats.	The resource agencies were concerned that, without grading modifications, not enough vegetated wetlands (coastal salt marsh) would be created to provide habitat for the endangered species impacted by removal of the existing vegetation. Additionally, the inlet area property owners raised concerns that this alternative would create mudflats that would adversely impact their open water views. There was also the perception among property owners that unpleasant odors would result from mudflats.
Alternative B	April 2010	An initial saltwater target habitat distribution was developed for Alternative B.	This alternative was carried forward with modifications to become the currently proposed Saltwater Alternative.
	May 2010	Minor grading changes were made to the intertidal slope from 1:4 to 1:8 (vertical:horizontal). This grading change decreased the low marsh habitat and increased the intertidal unvegetated and open water vegetated habitat area.	
	November 2010	The saltwater habitat distribution was further modified to increase the intertidal unvegetated habitat area by decreasing the high, middle, and low marsh habitat areas.	
Saltwater Alternative	2011	The November 2010 Alternative B grading plan was used as a starting point for detailed numerical analysis of the Saltwater Alternative. This grading plan was used as input for detailed tidal hydraulics analysis to determine a more accurate saltwater habitat distribution, accounting for tidal response, tidal muting, and inlet morphology. An iterative process of modifying grading contours and repeating hydraulic modeling was repeated to achieve the desired habitat distribution. This alternative involved conversion of the Railroad Basin from coastal salt marsh to open water.	This alternative was carried forward with modifications to become the currently proposed Saltwater Alternative.
Hybrid Alternatives Considered			
Hybrid Alternative – Option A	2012	Although the concept of a hybrid alternative was discussed in the Enhancement Project feasibility study, both configurations of the Hybrid Alternative carried forward were developed during the	This alternative was carried forward with modifications to become the currently proposed Hybrid Alternative – Option A.

Name of Alternative	Year Evaluated	Brief Description	Justification for Elimination
Hybrid Alternative – Option B	2012	process of finalizing alternatives for the Environmental Impact Report. Both options are identical except that, under Option A, a channel would be constructed to connect the tidal inlet from the ocean area through the Weir Basin and into the Railroad Basin. This channel would result in a perched water level within the Weir Basin that would have a substantially muted tide range.	This alternative was carried forward with modifications to become the currently proposed Hybrid Alternative – Option B.
Vegetation Disposal Options Considered			
Craft Material	2013	This option would involve the use of vegetation removed from the lagoon for arts and crafts. For example, the reedy portion of the cattails could be used for artisans to make baskets.	This option was eliminated from further consideration because the volume of vegetation material would far exceed the local market for such material if such material would prove adequate for such use.
Mulch	2013	This option would involve use of vegetation removed from the lagoon as mulch at the flower fields located off Palomar Airport Road near I-5.	This option was eliminated from further consideration because the volume of vegetation material that would be removed from the lagoon would far exceed the amount that could be used as mulch at the flower fields.
Sediment Disposal Options Considered			
On-site Disposal		Reuse on-site in created islands or transitional areas.	This option was eliminated because sediment volumes generated by the project would be too large to construct reasonably sized transitional areas. Additionally, transitional areas constructed within the basins would further constrain hydrology of the lagoon, prohibiting the desired increase in circulation.
Topsoil		Reuse as topsoil at the flower fields located off Palomar Airport Road near I-5.	This option was eliminated from further consideration because the volume of sediment material that would be removed from the lagoon would far exceed the amount that could be used at the flower fields.

Project), proposed I-5 bridge replacement (implemented by Caltrans), and proposed North County Transit District (NCTD) LOSSAN Improvements (implemented by SANDAG), which would replace bridge structures over the lagoon and would be implemented regardless of the enhancement alternative. Some of the alternatives would also include improvements to the Carlsbad Boulevard bridge structure (evaluated as part of the Enhancement Project – Saltwater and Hybrid Alternatives) and the creation of subtidal or deep-water fish areas with trail access designed to promote fishing activities within the lagoon, as applicable. These common components are described below to reduce duplication within the document. Under all alternatives, public access to areas not under active construction would be maintained. During construction, alternative access to trails, beaches adjacent to placement sites, ocean areas not directly adjacent to the monobuoy or marine vessel and pipeline routes, and the Buena Vista Audubon Nature Center would be maintained.

2.5 COMPONENTS COMMON TO MULTIPLE ALTERNATIVES

2.5.1 BOARDWALK

An elevated pedestrian boardwalk (Boardwalk) would be incorporated into each of the enhancement alternatives and is evaluated as part of the Enhancement Project. The Nature Center is located along the northern edge of Buena Vista Lagoon, just east of Carlsbad Boulevard as it transitions to South Coast Highway in the City of Oceanside. The Nature Center offers a variety of public programs and serves as one of the primary public access points to the north shore of the lagoon. Adjacent to the Nature Center, interpretive signage provides information on species present and regulations at the lagoon. In addition, picnic tables and informal trail access are located in the area.

Maxton Brown Park is located on the south shore of the lagoon just east of Carlsbad Boulevard. The park is open to the public and provides another critical visual access point along the lagoon. Carlsbad Boulevard extends north-south across the lagoon between the Nature Center and Maxton Brown Park, and provides vehicular access across the lagoon. Bike and pedestrian access is also provided along the roadway via class 2 bike lanes, a sidewalk, and the Coastal Rail Trail Reach 1 completed in spring of 2014. Visibility into the lagoon basins from the roadway and Nature Center is limited due to the low roadway elevation and relatively high vegetation located directly adjacent to Carlsbad Boulevard. Visual access to the lagoon along Carlsbad Boulevard was previously limited to the existing bridge spanning the channel, and recent improvements to the roadway made as part of the Coastal Rail Trail Reach 1 Project provided a sidewalk and path for pedestrian viewers along the roadway, but visibility remains limited.

As part of the Enhancement Project, a Boardwalk would be constructed parallel to the roadway to further increase connectivity between the Cities of Oceanside and Carlsbad and enhance public access to the lagoon, both physically and visually. The Boardwalk would extend between the Nature Center and Maxton Brown Park, creating a continuous pedestrian-only route within open space directly adjacent to and within the lagoon, as shown in Figure 2-4. The Boardwalk would provide a separated pedestrian facility, elevated above vegetation to provide visibility to the interior of the lagoon. Six 12-foot-wide overlooks would be incorporated into the Boardwalk to accommodate benches and vista points to enhance passive recreation at the lagoon. The Boardwalk would accommodate a range of recreational activities, including fishing, walking, nature study (e.g., bird watching), education, and interpretation of the site's unique ecological habitat. Construction of the Boardwalk would complement existing and proposed trails within the Cities of Oceanside and Carlsbad.

The Boardwalk would be constructed of timber, with 42-inch wood handrails, including a mid-rail, to blend with the existing natural setting. The elevated Boardwalk would be located approximately 20 feet away from the edge of pavement along Carlsbad Boulevard, partially within the Reserve and partially within the Carlsbad Boulevard right-of-way in the City of Carlsbad. The deck would be located above the 100-year flood water surface elevation at approximately 12 feet NGVD. This would prevent flooding and enable users to view large portions of the lagoon. The structure would be accessed by three sets of stairs extending to Carlsbad Boulevard, as well as 6-foot-wide paths connecting to Maxton Brown Park and the Nature Center on either end to facilitate pedestrian flow and accessibility. Design for foundations, landings, platforms, rest areas, handrails, and the walking surface would comply with local and state codes. Renderings included in Figure 2-4 illustrate the visual character proposed for the Boardwalk.

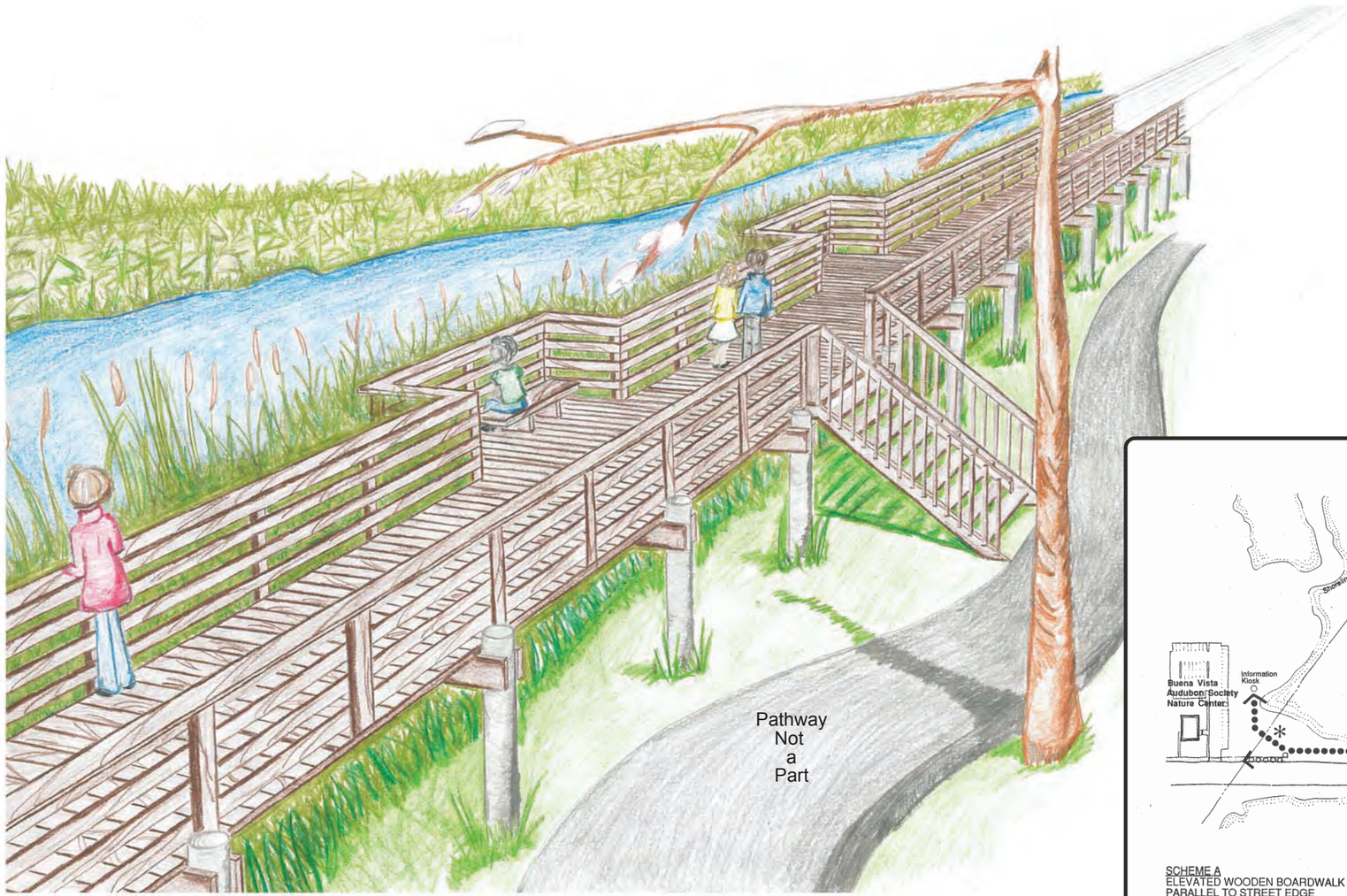
2.5.2 CARLSBAD BOULEVARD BRIDGE

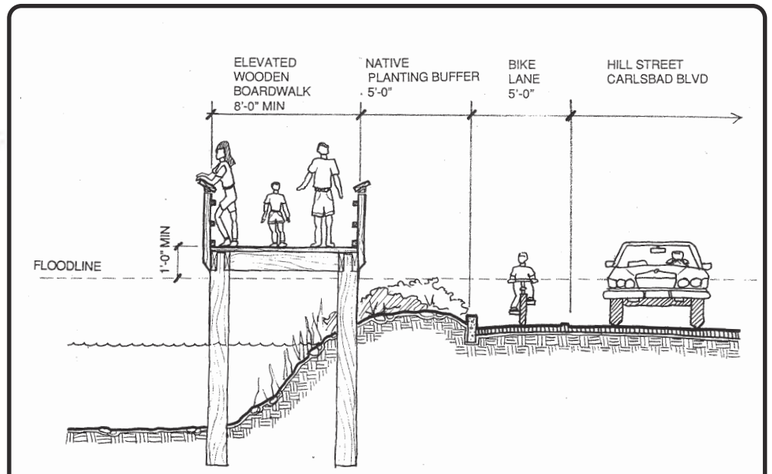
Improvements to the Carlsbad Boulevard bridge would occur under both the Saltwater and Hybrid Alternatives and is evaluated as part of the Enhancement Project. Carlsbad Boulevard currently traverses the lagoon and provides north-south access between the Cities of Carlsbad and Oceanside. A bridge spans the existing lagoon channel that connects the Coast Highway and Railroad Basins. As part of the Enhancement Project, improvements to the channel and roadway bridge structure could occur to accommodate increases in hydraulic connectivity between the two basins. The Freshwater Alternative would remove accumulated sediment and vegetation from the existing channel, but the channel under Carlsbad Boulevard and the bridge would remain as is. However, the channel would be expanded under the Saltwater and Hybrid Alternatives, and the bridge structure would be replaced at a higher elevation.

The existing structure is a 29-foot-long bridge within a 54-foot-wide cross-section. As part of the Coastal Rail Trail Reach 1 Project in 2014, the City of Carlsbad enhanced bike and pedestrian access along the lagoon and between the Cities of Carlsbad and Oceanside. The enhanced road section includes a curb and gutter; two general traffic lanes and one bike lanes in each direction; a sidewalk on the east side; and a pathway separated by a raised median on the west side for the Coastal Rail Trail (Figure 2-5).

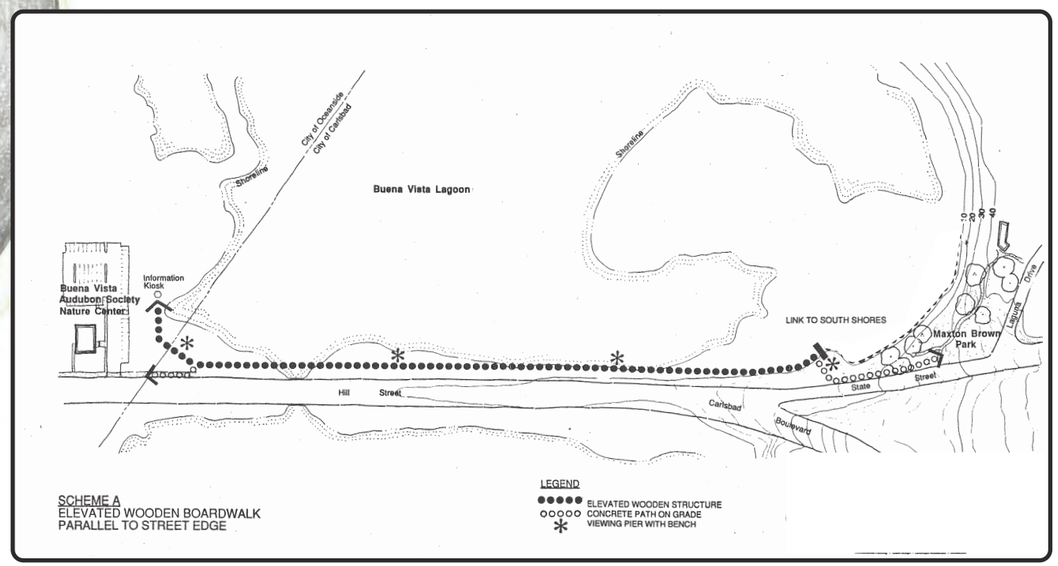
Under the Saltwater and Hybrid Alternatives, the channel extending under Carlsbad Boulevard would be expanded to 110 feet, requiring replacement of the existing bridge. The proposed bridge would remain 54 feet wide and would be constructed within the same right-of-way and horizontal alignment as the current bridge. The existing cross-section would be maintained, which reflects the City of Carlsbad ultimate roadway configuration (City of Carlsbad 2014a). Figure 2-5 illustrates the cross-section of the proposed bridge.

To accommodate flood flows under the bridge and eliminate flooding of the roadway during storm events (including a 1-foot freeboard), the roadway elevation would be raised to 14 feet NGVD from the existing 9.6-foot NGVD elevation. Approaches would be constructed in compliance with Caltrans (Section 200 Highway Design Manual) stopping sight distance requirements, resulting in reconstruction of bridge approaches extending approximately 300 feet north and south of the proposed structure, as shown in Figure 2-6. The bridge would be constructed as a two-span structure and would require the installation of pilings in the underlying channel to support the spans.





SECTION - ELEVATED BOARDWALK
ABOVE FLOODLINE



Source: Wallace Roberts &Todd 1991

Figure 2-4
Proposed Boardwalk Alignment and Concept Plan

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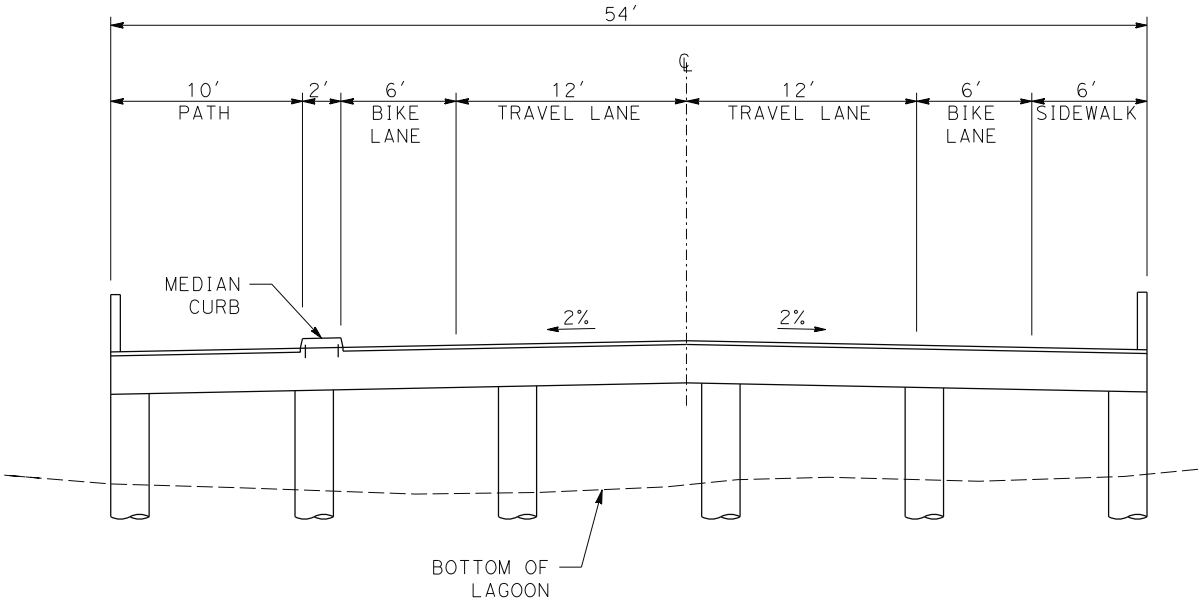
EXISTING CARLSBAD BLVD. CROSS-SECTION



TYPICAL BRIDGE SECTION

NOT TO SCALE

Figure 2-5

Carlsbad Boulevard Existing Cross-Section and Typical Bridge Section for Saltwater and Hybrid Alternatives

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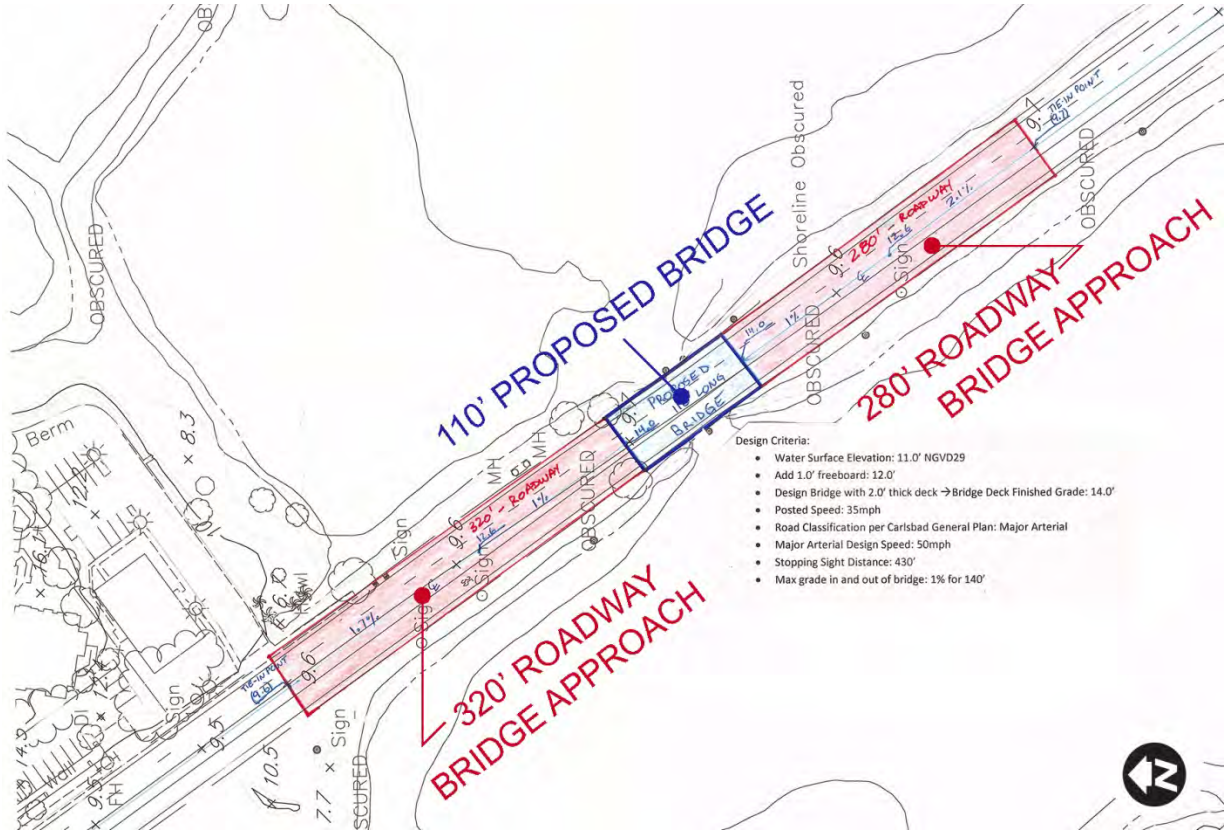


Figure 2-6. Proposed Carlsbad Boulevard Bridge Approach Footprint

2.5.3 I-5 AND NCTD LOSSAN IMPROVEMENTS

Two infrastructure improvements are planned within the lagoon by other agencies and structures associated with those improvements have been evaluated separately from the Enhancement Project. These include replacement of the I-5 bridge over the lagoon as part of the North Coast Corridor Project and construction of the I-5/SR 78 interchange proposed by Caltrans, which is currently in the planning process, as well as ~~and~~ double-tracking the railroad tracks extending through the lagoon as part of the LOSSAN project proposed by SANDAG. The Enhancement Project and these two infrastructure projects have independent utility, and each could be constructed and usable without the others. Infrastructure improvements are assumed to be implemented by the proposing agencies regardless of the Enhancement Project alternative. Design for both the I-5 and LOSSAN bridge structures is being prepared by the agency responsible for their construction. Those designs have been provided to SANDAG so correct dimensions are anticipated over proposed channels in preparation of this EIR. The Enhancement Project would construct the channels and hydraulic connections crossing under these bridges; changes to the channels themselves are evaluated within this EIR. Senate Bill 468 mandates that transportation improvements and regional habitat enhancements within the north coast corridor

occur concurrently, unless construction in phases would result in an environmentally superior alternative to concurrent construction. Coordination between projects could include consideration of phased construction, as well as consolidating construction needs such as staging, access, and parking areas. While these projects would not be constructed as part of the Enhancement Project, consistent with Senate Bill 468 (Kehoe), it is anticipated that I-5, I-5/SR 78 interchange, and railroad bridge improvements over the lagoon would occur concurrently with the Enhancement Project or would be built to accommodate any of the Enhancement Project alternatives and their respective channel connections. If the Enhancement Project does not occur (e.g., under the No Project Alternative), it is assumed these projects would still move forward concurrent with each other. These bridges are not part of the Enhancement Project and the environmental analysis for these projects, all of which are proposed, constructed, and maintained by others, is either addressed in other documents (SCH No. 2002031067/SCH No. 2004101076) or is in the planning phase (I-5/SR 78 Interchange Project). The Enhancement Project, while not evaluating construction of the LOSSAN or I-5 bridge structures, would include channel improvements under those proposed structures. With the exception of channel improvements, work associated with the Enhancement Project would remain outside existing Caltrans right-of-way along I-5 and SR 78.

2.5.4 ~~SUBTIDAL~~ DEEP-WATER FISH AREAS

Between two to three relatively deep ~~subtidal~~ areas for fish would be incorporated into each of the build alternatives, as discussed below under each of the alternatives. Fishing is an existing recreational resource in the lagoon, and maintaining a variety of water depths and substrates to encourage the continued presence of fish, either under freshwater or saltwater conditions, is important to maintaining the biological health of the lagoon fisheries.

Current freshwater fish populations are dominated by bass, and the Freshwater Alternative and freshwater (eastern) portion of the Hybrid Alternative would incorporate deeper freshwater areas, providing a better range of depths for fish habitat enhancement and providing deep water refugia; this would benefit the existing fish populations and contribute to maintaining/increasing the quality of recreational fishing opportunities. Design criteria for freshwater fishing opportunities would include creating areas with depths between 8 to 12 feet, and providing substrates for both spawning and nursery phases of the life cycle. Slopes would be created along the edge of the fishing areas with hard substrate (e.g., small pea gravel) at depths where sunlight can reach the bottom surface (e.g., 6 feet). Specific spawning habitat would be created on sides of the fishing areas least accessible for fishing (e.g., on the interior of the lagoon basin, or along the border with vegetation). Nursery habitat would include areas of submerged vegetation, which could include cattails under freshwater conditions. In the absence of such ~~subtidal~~ shelter, adaptive management strategies would include the potential creation of nursery areas with material such

as disposed pine trees, manzanita, or other woody vegetation. Fishing areas would also be located along the edge of the lagoon basins to minimize wave action that could lead to nest failure (e.g., in the northeast corner of the Railroad Basin and southwest corner of the Coast Highway Basin). The new fishing area located in the northeast corner of the Railroad Basin would be accessed via a proposed new trail. The final design of the trails would be developed in collaboration with the federal and state wildlife agencies during regulatory permitting for the Enhancement Project; however, it is likely the trail would be a low-intensity, single-track, soft-soil pathway. Parking to access the new trail would be in the Nature Center parking lot and the trail would consist of a pedestrian crosswalk across Carlsbad Boulevard from the Nature Center and continue westward to the lagoon shore via a previous pedestrian trail extending through the currently vacant lot north of the lagoon (it is anticipated that this vacant lot would be acquired as part of the Enhancement Project).

The Saltwater Alternative and saltwater (western) portion of the Hybrid Alternative would incorporate deeper areas designed to encourage saltwater fish presence in the lagoon. Anticipated salinity levels associated with these alternatives would exceed the upper tolerance range of freshwater fish species currently present in the lagoon, including largemouth bass and bluegill. However, conversion to a saltwater system would encourage saltwater fish species to enter and use the lagoon during various life history stages. It is anticipated that the lagoon could provide fertile rearing habitat, and possibly spawning habitat, for a variety of saltwater fish species including members of the Atherinidae (silversides), Engraulidae (anchovies), Gobiidae (gobies), Embiotocidae (surfperch), and Clupeidae (herring, sardine) families. Conversion to a saltwater system would also encourage saltwater species popular among recreational anglers to enter and use the lagoon. These species could include spotted sand bass (*Paralabrax maculatofasciatus*, family Serranidae), barred sand bass (*Paralabrax nebulifer*, family Serranidae), kelp bass (*Paralabrax clathratus*, family Serranidae), and California halibut (*Paralichthys californicus*, family Paralichthyidae). Based on information from other local lagoons, including Agua Hedionda and Batiquitos lagoons, that have similar inlet conditions and saltwater systems, it is anticipated that saltwater fish species targeted by recreational anglers would use the lagoon in sufficient numbers and size classes to provide viable recreational angling opportunities (discussed further in Section 3.1 Land Use and Recreation). Additionally, species assemblages, population structure, and richness are likely to change through time as a result of temporal changes to saltwater habitat complexity and composition (e.g., development of ~~kelp and~~ eelgrass beds) and primary production. Therefore, it is expected that marine fish species would provide a similar recreational fishing opportunity to what currently exists and also be biologically important to the lagoon (discussed further in Section 3.5 Biological Resources).

2.6 ALTERNATIVES CHARACTERISTICS

Three build alternatives have been identified for analysis in this EIR. They represent a range of alternatives based on water regime within the lagoon, and include the Freshwater, Saltwater, and Hybrid Alternatives. This section provides a comparative look at the different components of each alternative using the baseline of existing conditions, as well as a more detailed discussion of each of the different alternatives. Table 2-2 provides a summary of the habitat distribution under existing conditions and for the proposed enhancement alternatives. Table 2-3 provides a summary of existing hydraulic connections (i.e., infrastructure and channel dimensions) and those proposed for each of the enhancement alternatives. Improvements to structures extending over the lagoon proposed by others, as noted above, would be built to accommodate the channels proposed as part of the Enhancement Project. Work associated with the Enhancement Project would occur outside these existing rights-of-way, with the exception of activities needed to improve the channels under structures. Table 2-4 provides a summary of the materials removal and periodic maintenance requirements for each of the proposed enhancement alternatives.

These tables summarize the alternatives proposed as part of the Enhancement Project. More detail regarding the habitat distribution, infrastructure, and materials removal associated with each of the specific alternatives is included in Sections 2.6.1 through 2.6.4 below. A detailed discussion of how construction and maintenance activities would occur is included in Section 2.8 Construction Methods, Schedule, and Design Features.

2.6.1 FRESHWATER ALTERNATIVE

Under the Freshwater Alternative, the hydrologic regime of the lagoon would remain a freshwater system influenced primarily by freshwater entering the lagoon from the upstream watershed in the eastern portion of the system and along the boundary of the lagoon. Primary loss of water in the lagoon occurs via evapotranspiration and seepage, and large inflows occur during storm events, when water overtops the weir and beach berm. Outflow from the lagoon also occurs when the beach berm is periodically lowered by the City of Oceanside or during high flood events, allowing lagoon water to breach the berm.

Habitats supported under this alternative would remain primarily freshwater marsh and open freshwater habitat, and would be similar to those supported under existing conditions. Enhancement activities would focus on removal of vegetation encroaching into open water areas and decreasing vegetation density. Dredging would be used to minimize the potential for vegetation to expand back into open water areas and to remove nutrient-rich sediments from the lagoon.

Table 2-2
Existing and Proposed Habitat Distribution (Acreages)

Habitat Type	Existing Condition	Freshwater Alternative	Saltwater Alternative	Hybrid Alternative (Options A and B)
Beach	0.6	1.3	0.8	0.8/0.8
Coastal and Valley Freshwater Marsh	96.2	24.7	--	10.2/10.2
Coastal Scrub	0.6	0.6	0.5	0.7/0.7
Deep Open Water	--	4.5	4.0	5.0/5.0
Diegan Coastal Sage Scrub	<0.1	0.6	0.8	0.8/0.8
Diegan Coastal Sage Scrub: Baccharis-Dominated	1.3	1.6	1.3	1.3/1.3
Disturbed Habitat	0.7	--	--	--
Eucalyptus Woodland	0.5	--	--	--
Freshwater Habitat Transition Zone	--	9.2	--	--
Mudflat	--	--	20.0	4.7/4.9
Nonnative Grassland	2.4	--	--	--
Nonnative Riparian	4.2	--	--	--
Open Water	106.8	133.4	51.0	99.3/98.6
Proposed Cattail Maintenance Area	--	32.9	--	30.5/30.5
Riparian Enhancement	--	4.5	6.6	4.6/4.6
Southern Coastal Salt Marsh (Non Tidal)	14.8	14.8	23.2	17.9/17.9
Southern Coastal Salt Marsh High	--	--	55.0	26.5/26.5
Southern Coastal Salt Marsh Low	--	--	33.2	6.3/6.5
Southern Coastal Salt Marsh Mid	--	--	35.4	20.3/20.6
Southern Willow Scrub	2.0	2.2	--	2.2/2.2
Urban/Developed	8.7	8	6.5	7.3/7.3
Totals	**238.3**	**238.3**	**238.3**	**238.3/238.3**

[1] Totals may not add due to rounding and slight differences in project study area.

Table 2-3
Hydraulic Connection Summary

Infrastructure	Hydraulic Connection			
	I-5 Bridge[2]	Carlsbad Boulevard Bridge	Railroad Bridge[2]	Weir/Inlet
Existing Conditions				
Weir Top Width (feet)	N/A	N/A	N/A	50 weir
Weir Invert Elevation (feet NGVD)	N/A	N/A	N/A	+5.6
Channel Bottom Width (feet)	36	29	200	N/A
Channel Invert Elevation (feet NGVD)	+2.0	-3.0	+3.0	N/A
Channel Side Slope (horizontal/vertical)	1.5/1	Vertical	4.5/1 (N Side) 18/1 (S Side)	N/A
Freshwater Alternative				
Weir Top Width (feet)	N/A	N/A	N/A	80 weir
Weir Invert Elevation (feet NGVD)	N/A	N/A	N/A	+5.6
Channel Bottom Width (feet)	36	29	90[1]	N/A
Channel Invert Elevation (feet NGVD)	+2.0	-3.0	-2.5	N/A
Channel Side Slope (horizontal/vertical)	1.5/1	Vertical	8.5/1 (N Side) 11.5/1 (S Side)	N/A
Saltwater Alternative				
Channel Bottom Width (feet)	160	110	90[1]	100 inlet top width
Channel Invert Elevation (feet NGVD)	-2.5	-2.5	-2.5	-2.0
Channel Side Slope (horizontal/vertical)	2/1	Vertical	8.5/1 (N Side) 11.5/1 (S Side)	2/1
Hybrid Alternative				
Channel Bottom Width (feet)	36	110	90[1]	100 inlet top width
Channel/Spillway Invert Elevation (feet NGVD)	+2.0/+5.6	-2.5	-2.5	-2.0
Channel Side Slope (horizontal/vertical)	1.5/1	Vertical	8.5/1 (N Side) 11.5/1 (S Side)	2/1

N/A = not applicable; NGVD = National Geodetic Vertical Datum
Notes:
[1] The channel at the railroad bridge would be deepened from existing conditions; the channel bottom would be narrower than existing conditions, while the width at +3 feet NGVD would remain 200 feet.
[2] Bridges extending over the lagoon would be constructed by others and have been evaluated separately. Channels within the lagoon would be constructed as part of the Enhancement Project to identified dimensions.

Table 2-4
Materials Removal and Maintenance Requirements

	Freshwater Alternative		Saltwater Alternative		Hybrid Alternative	
	Vegetation	**Sediment**	**Vegetation**	**Sediment**	**Vegetation**	**Sediment**
Initial Volume Removed During Construction (cy)	129,000	562,000	211,000	781,000	148,500	833,000
I-5 Basin	29,500	188,000	92,000	320,500	29,500	188,000
Coast Highway Basin	89,500	290,500	103,500	293,000	103,500	488,000
Railroad Basin	9,500	62,500	14,000	101,000	14,000	95,000
Weir Basin	500	21,000	1,500	67,000	1,500	62,000
Maintenance Type/Amount/Location	1.0 acre of cattail removed from I-5 and Coast Highway Basin maintenance areas	N/A[1]	N/A	27,000 Inlet/Weir Basin/Railroad Basin	0.9 acre of cattail removed from I-5 Basin maintenance area	27,000 Option A: Inlet/Railroad Basin/Coast Highway Basin Option B: Inlet/Weir Basin/Railroad Basin
Inlet Maintenance Frequency/Duration	Every 1-2 years for 1 week, outside of bird nesting season	N/A	N/A	Inlet/Weir Basin every 12–20 months for 2-4 weeks	Every 1-2 years for 1 week, outside of bird nesting season	Option A: Inlet/Railroad Basin every 12–20 months for 2-4 weeks Option B: Inlet/Weir Basin every 12–18 months for 2-4 weeks.
Maintenance Construction Approach/Material Disposal	Water-based vegetation mower or land-based equipment near lagoon edge; trucked to ~~landfill~~green waste facility	N/A	NA	Backhoes, front loaders, scrapers, and dump trucks with placement at North Carlsbad Beach south of inlet	Water-based vegetation mower or land-based equipment near lagoon edge; trucked to ~~landfill~~green waste facility	Backhoes, front loaders, scrapers, and dump trucks with placement at North Carlsbad Beach south of inlet.

cy = cubic yards; N/A = not applicable

[1] The variable and difficult to predict nature of sediment patterns and storm events, which would have a large impact on sedimentation under the Freshwater Alternative, makes calculations of further maintenance needs highly speculative. Therefore, although maintenance is anticipated to be required approximately every 25 years, the Enhancement Project does not assume additional sediment removal as part of this alternative.

Under this alternative, two deep areas, approximately 9 feet deep, would be dredged to function as fishing areas within the lagoon. These new fishing areas would supplement the existing location in the southeastern portion of the I-5 Basin just downstream from Jefferson Street. One fishing area would be located within the southwest portion of the Coast Highway Basin and would be accessed from Maxton Brown Park or the Boardwalk. The other fishing area would be located in the northern part of the Railroad Basin off Coast Highway and would be accessed via the proposed trail described under Section 2.5.

Habitat Distribution

The range of habitats within the lagoon under the Freshwater Alternative would remain similar to the existing habitats (Table 2-2), but the proportion of vegetation to open water and distribution would shift, as illustrated in Figure 2-7. Encroaching freshwater marsh, primarily cattails, would be removed and open water areas dredged to remove historic sediment accumulation and nutrient load and to minimize future vegetation encroachment into open water areas. The three existing islands of coastal salt marsh located in the I-5 Basin would be preserved under the Freshwater Alternative, along with the deep, open water area located just downstream from the Jefferson Street bridge, which acts as a sediment trap for fluvial runoff into the lagoon.

Under the Freshwater Alternative, much of the existing freshwater marsh would be left in place to maintain habitat for some of the rare, threatened, and endangered species, such as the light-footed Ridgway's rail *(Rallus obsoletus levipes)* (formerly light-footed clapper rail; Chesser et al. 2014) and Clark's marsh wren (*Cistothorus palustris clarkae*). Vegetation removal would occur adjacent to roadways/railways to minimize the risk of special-status species moving onto roadways/railways, thereby reducing the likelihood of injury or death to these species. Vegetation would also be removed from central portions of basins to enhance localized circulation and allow better access for vector control efforts. Freshwater marsh left intact would be managed in specific areas with large patch size to minimize vectors in the future. Specific vector management strategies are discussed further in Section 2.9.

Channel and Infrastructure Improvements

Under the Freshwater Alternative, the existing 50-foot weir at the ocean outlet would be replaced with a wider, 80-foot weir to improve flood performance (Table 2-3). The new weir structure would have the same elevation as the existing weir of +5.6 feet NGVD. The new weir would be built in the same location as the existing weir and would be constructed of concrete and/or wood. Similar to existing conditions, the weir would continue to retain freshwater in the lagoon by

limiting discharges to the ocean only when the lagoon water level exceeds the weir elevation and the beach berm is not higher than that elevation.

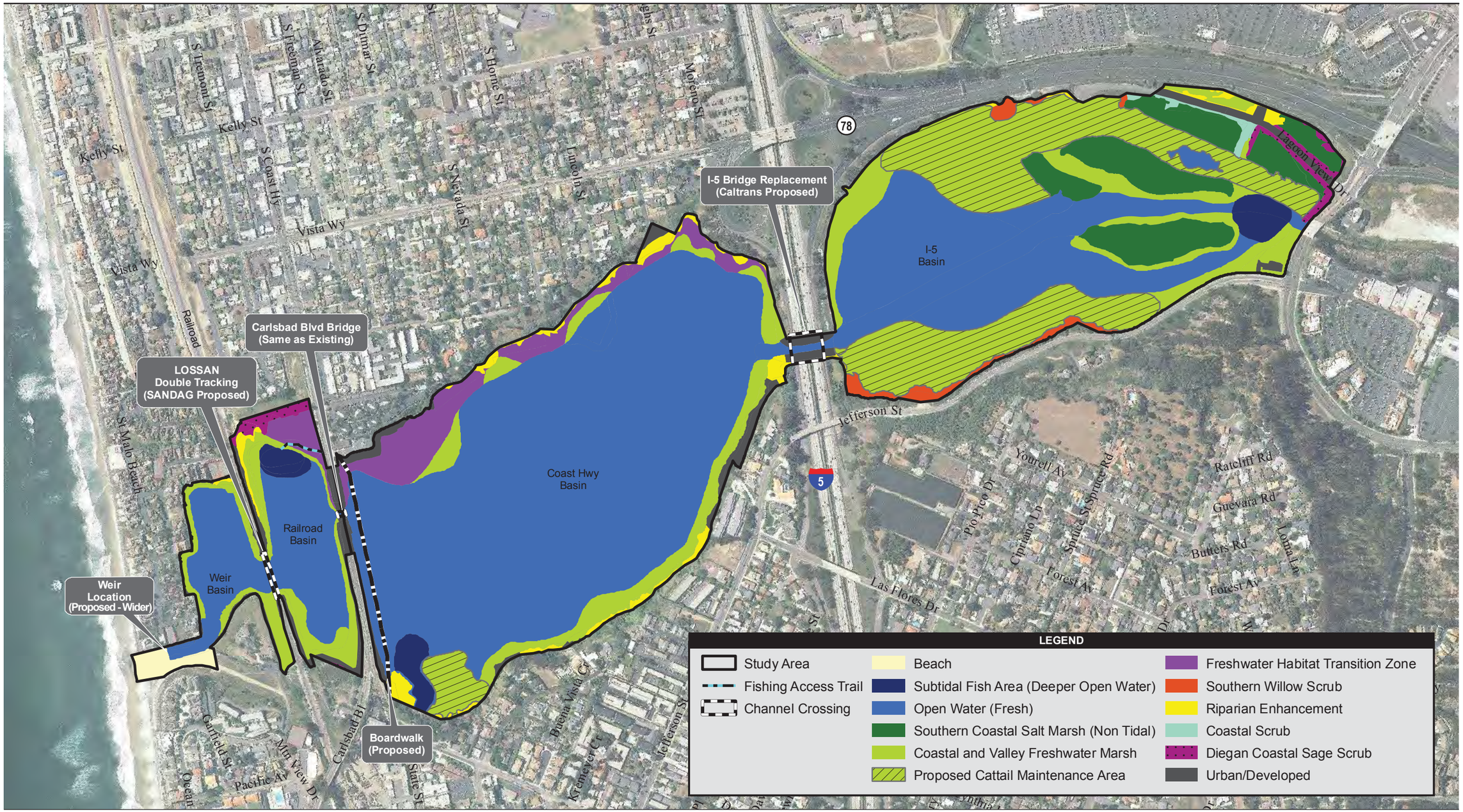
Under the Freshwater Alternative, the railroad bridge would be improved as part of the LOSSAN corridor improvements and the I-5 bridge would be replaced as part of the North Coast Corridor Project (Table 2-3). The channel extending under I-5 would remain at the existing dimensions. The bridge spanning the channel would be constructed by Caltrans to allow future widening of the channel under the bridge. However, no channel widening would be done as a part of this project. The Carlsbad Boulevard bridge would remain in place since no additional expansion of the underlying channel would be required as part of the Freshwater Alternative. Accumulated sediment and vegetation would be removed to return the channel to the original design dimensions; no additional protection would be placed within the channel at this crossing.

Materials Removal and Periodic Maintenance

~~Although m~~Much of the existing vegetation around the perimeter of the lagoon basins would remain in place under the Freshwater Alternative ~~would remain in place~~, with varying widths across the lagoon. A~~a~~pproximately 129,000 cubic yards (cy) of vegetation (e.g., cattails) would be removed, primarily from the interior of the lagoon, and hauled off-site for disposal in ~~a landfill~~a green waste facility, as identified in Table 2-4.

Under this alternative, portions of the lagoon would be dredged to provide water depths that would preclude cattail growth and expansion. Depending on the characteristics of the dredged material, it would be used beneficially as a source of beach material or disposed of as waste on-site or off-site. Approximately 562,000 cy of sediment would be removed from the lagoon to achieve the proposed habitat distribution shown in Figure 2-7. The final grade elevations are based on a 4-foot minimum water depth designed to preclude the growth of cattails.

The project design life of the Enhancement Project is 50 years, during which periodic maintenance and monitoring and adaptive management (discussed in Section 2.9) would be implemented. However, the variable and difficult to predict nature of sediment patterns and storm events, which would have a large impact on sedimentation under the Freshwater Alternative, makes calculations of further maintenance needs highly speculative. Therefore, although sediment-related maintenance is anticipated to be required approximately every 25 years due to fluvial sediment accumulating in the lagoon from upstream sedimentation, the Enhancement Project does not assume additional sediment removal as part of this alternative. Periodic maintenance of the Freshwater Alternative would instead be focused on management of remaining cattail and freshwater marsh areas. It is anticipated that, as part of the adaptive



Source: SANDAG 2012; Sangis; Everest; AECOM 2014

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Scale: 1:7,200; 1 inch = 600 feet

Figure 2-7

Proposed Freshwater Alternative Habitat Distribution

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management strategy to maintain cattails yet allow effective vector control, vegetation thinning through the establishment or maintenance of channels through dense cattail areas would be conducted. It is anticipated that such thinning would occur approximately every 1 to 2 years, during daylight hours and outside of the breeding season (PDF-11). Cattail maintenance is discussed further in Section 2.9. Intermittent breaching of the beach berm along the coast would continue similar to existing conditions.

2.6.2 SALTWATER ALTERNATIVE

Under the Saltwater Alternative, the hydrologic regime of the lagoon would be changed from the existing freshwater system to a saltwater system influenced primarily by saltwater entering the lagoon from an open tidal inlet during flood tides, as well as freshwater entering the lagoon from upstream and along the boundary of the lagoon. Water exiting the lagoon under the Saltwater Alternative would primarily occur during ebb tides (outgoing tides), with evapotranspiration and seepage providing additional output.

Habitat Distribution

As this alternative would result in a conversion of the hydrologic regime of the lagoon, the habitat would also be converted from that of a freshwater system to that of a saltwater system. Existing vegetation within the construction disturbance limits would be removed and hauled off-site for disposal in ~~a landfill~~a green waste facility. Areas of freshwater vegetation outside the construction disturbance limits would be allowed to transition naturally. These areas would be monitored and adaptively managed, as described in Section 2.9, to facilitate transition to salt marsh habitat over time.

The range of habitats within the lagoon would be substantially modified under this alternative, as summarized in Table 2-2. Existing freshwater marsh and open water areas would be replaced with coastal salt marsh and open saline water areas. The Saltwater Alternative would feature a subtidal, open water channel running from the ocean (tidal inlet) to approximately halfway through the I-5 Basin. On either side of the channel, the ground would be graded to provide intertidal mudflat and a mix of coastal salt marsh habitats (low, mid, and high salt marsh) within each of the four basins. This distribution of habitats would provide habitat for some of the rare, threatened, and endangered species that currently use the lagoon, as well as support additional species that do not use the lagoon under existing conditions. Similar to the Freshwater Alternative, the three existing islands located in the I-5 Basin would be preserved, along with the sediment trap (deep, open water area) located just downstream from the Jefferson Street bridge (this trap would also function as a subtidal fish area).

Planting would be conducted, as necessary, to supplement the natural processes-driven recruitment that is expected to occur after project completion and subsequent exposure to ocean water via tidal exchange.

The habitat distribution for the Saltwater Alternative is shown in Figure 2-8.

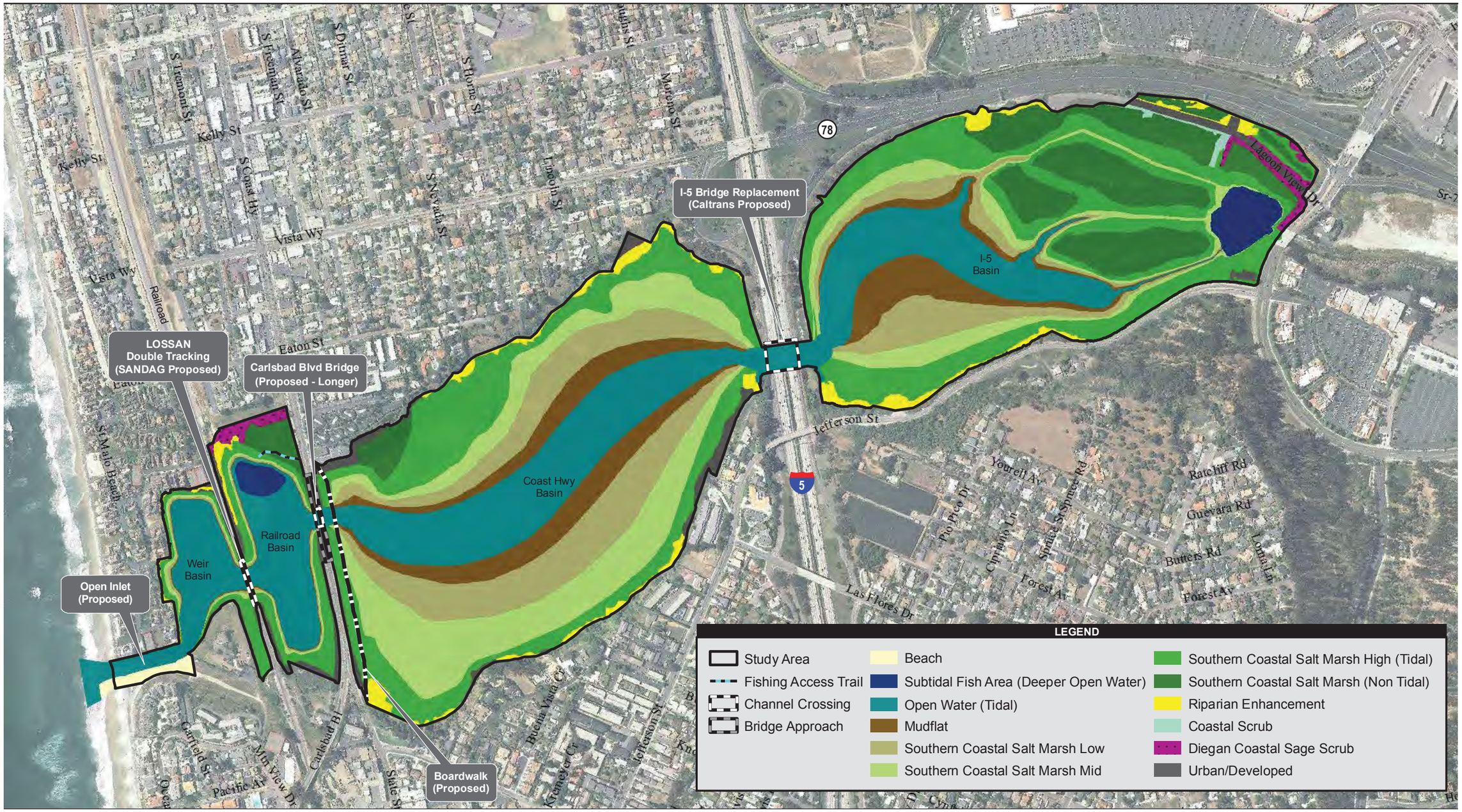
Channel and Infrastructure Improvements

Under this alternative, the existing 50-foot weir at the ocean outlet would be removed and replaced with an open tidal inlet to provide tidal exchange while improving flood performance. The tidal inlet would have a maximum width of 100 feet at an elevation of +4.0 feet NGVD and an initial bottom (invert) elevation at -2.0 feet NGVD. The inlet would be confined on the northern side by the existing stone revetment running along the St. Malo complex, although improvements may be required depending on the integrity of the existing revetment. On the southern side, the inlet would be confined by the construction of a stabilized channel running from inside the Weir Basin seaward to the shoreline position established by the St. Malo revetment to the north. Although still in the design phase, it is anticipated that the structural toe (bottom) of the channel structure would be between -5 feet NGVD to -10 feet NGVD and the crest (top) would extend no higher than +6.0 feet NGVD. The channel would likely be constructed of stone.

Under the Saltwater Alternative, the railroad bridge would be improved as part of the LOSSAN corridor improvements and the I-5 bridge would be replaced as part of the I-5 North Coast Corridor Project. The channel extending under I-5 would be expanded to 160 feet as a component of the Enhancement Project, and the bridge would be constructed by Caltrans to span the larger channel. Slope protection for this structure would be designed and placed as part of the Caltrans improvements along I-5. The channel extending under Carlsbad Boulevard and the bridge spanning the channel would be expanded to 110 feet and replaced as part of the Saltwater Alternative. The expanded channel may require slope protection to prevent scour of the bridge abutments and embankments. It is anticipated that stone revetment would extend up to 300 feet from the channel to the north and south on both the eastern and western sides of the embankment.

Materials Removal and Periodic Maintenance

Under the Saltwater Alternative, large portions of the lagoon would be dredged to provide ground elevations suitable to support tidal wetlands. Approximately 211,000 cy of vegetation (e.g., cattails) would be removed from the lagoon, as described in Table 2-4.



Source: SANDAG 2012; Sangis; Everest; AECOM 2014

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Scale: 1:7,200; 1 inch = 600 feet

Figure 2-8
Proposed Saltwater Alternative Habitat Distribution

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Approximately 781,000 cy of sediment would be removed from the lagoon to achieve the proposed habitat distribution for the Saltwater Alternative, as shown in Figure 2-8. The final grade elevations are based on the inundation frequency range associated with each coastal salt marsh habitat type. Depending on the characteristics of the dredged material, it would be used beneficially as a source of beach material or disposed of as waste on-site or off-site.

The project design life of the Enhancement Project is 50 years, during which periodic maintenance and monitoring and adaptive management (discussed in Section 2.9) would be implemented. Periodic maintenance of the Saltwater Alternative would involve sediment removal during inlet maintenance. Up to 27,000 cy of material would be removed from the inlet using land-based equipment, and placed on the north end of the North Carlsbad Beach placement site. Sand would be spread on the beach using bulldozers. It is anticipated that inlet maintenance could take between 2 to 4 weeks to complete, and could occur every 12 to 20 months. Analysis of historic bathymetric data suggests that, under the Saltwater Alternative, most fine-grained fluvial sediment would pass through the lagoon to the ocean. Therefore, fluvial sedimentation maintenance is not anticipated to be required under the Saltwater Alternative (Everest 2015a).

2.6.3 HYBRID ALTERNATIVE

Under the Hybrid Alternative, the hydrologic regime of the lagoon would be changed from the existing freshwater system to a hybrid system influenced by both saltwater and freshwater, with a saltwater system created west of I-5 and a freshwater system maintained east of I-5. The hydrologic system west of I-5 would be influenced primarily by saltwater entering the system from an open tidal inlet during flood tides, as well as freshwater entering the lagoon just downstream from I-5 and along the boundary of the lagoon. Under the Hybrid Alternative, water would exit the lagoon primarily during ebb tides with evapotranspiration and seepage providing additional output. The hydrologic system east of I-5 would be controlled primarily by freshwater entering the system from upstream and along the boundary of the lagoon, and outputs via evapotranspiration and seepage, or overflow at the weir to be located under I-5.

There are two options under the Hybrid Alternative (Options A and B) differentiated by work within the Weir Basin and the future maintenance requirement. Under Hybrid Alternative, Option A, a channel would be constructed to connect the tidal inlet from the ocean area through the Weir Basin and into the Railroad Basin (Figure 3.9-15). Hybrid Alternative, Option B would achieve tidal exchange in the same manner as the Saltwater Alternative with an open tidal inlet connecting the ocean to the Weir Basin. The channel constructed under Hybrid Alternative, Option A would result in a perched water level within the Weir Basin that would have a substantially muted tide range compared to Hybrid Alternative, Option B. The elevation of the

top of the channel guide is +2.3 ft. NGVD; therefore, tide elevations greater than this height (anticipated to occur approximately 13 percent of the time) would result in the exchange of water within the Weir Basin. During lower tides, the channel guide would preclude draining of the Weir Basin. In addition, this feature would allow littoral sediment (sand) to bypass the Weir Basin and enter the Railroad Basin where some of the sediment would settle to the bottom.

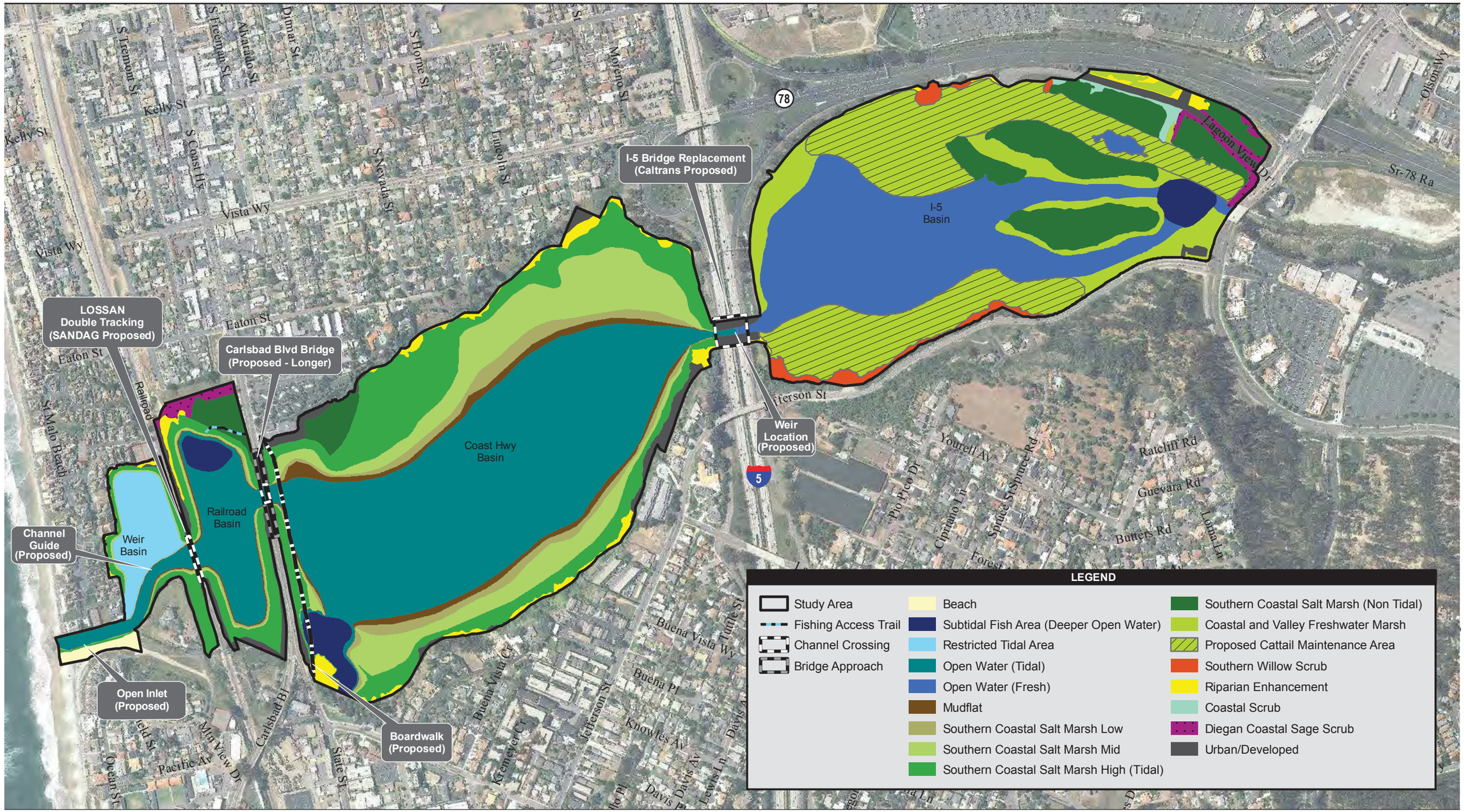
Habitat Distribution

The range of habitats within the lagoon under the Hybrid Alternative would be substantially modified, with the existing freshwater marsh and open water areas replaced with open freshwater marsh and fringing habitats east of I-5, and coastal salt marsh and open saline water areas west of I-5 (see Table 2-2). The Hybrid Alternative would feature a subtidal, open water channel running from the ocean (tidal inlet) through the Coast Highway Basin. On either side of the channel, the ground would be graded to provide intertidal mudflat and a mix of coastal salt marsh habitats (low, mid, and high salt marsh) within the Railroad and Coast Highway Basins. This mix of habitats would provide habitat for some of the rare, threatened, and endangered species that currently use the lagoon as well as support additional species that do not use the lagoon under existing conditions. Existing freshwater vegetation within the construction disturbance limits in areas identified as transitioning to saltwater conditions (e.g., west of I-5) would be removed and hauled off-site for disposal in a green waste facility~~landfill~~. Freshwater vegetation outside the construction disturbance limits within this area would be allowed to transition naturally. These areas would be monitored and adaptively managed, as described in Section 2.9, to facilitate transition to salt marsh habitat over time. As with the Freshwater and Saltwater Alternatives, the three existing coastal salt marsh islands located in the I-5 Basin would be preserved, along with the sediment trap (deep, open water area) located just downstream from the Jefferson Street bridge (which would be designed to function as a fishing area).

Planting would be conducted, as necessary, to supplement the natural processes-driven recruitment that is expected to occur in the area west of I-5 after project completion and subsequent exposure to ocean water via tidal exchange. The habitat distributions for the Hybrid Alternative, Option A and Hybrid Alternative, Option B are shown in Figures 2-9 and 2-10, respectively.

Channel and Infrastructure Improvements

Similar to the Saltwater Alternative, the existing 50-foot weir at the ocean outlet would be removed under this alternative and replaced with an open tidal inlet to provide tidal exchange to



Source: ; AECOM; Everest 2014

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Scale: 1:7,200; 1 inch = 600 feet

Figure 2-9

Proposed Hybrid Alternative Option A Habitat Distribution

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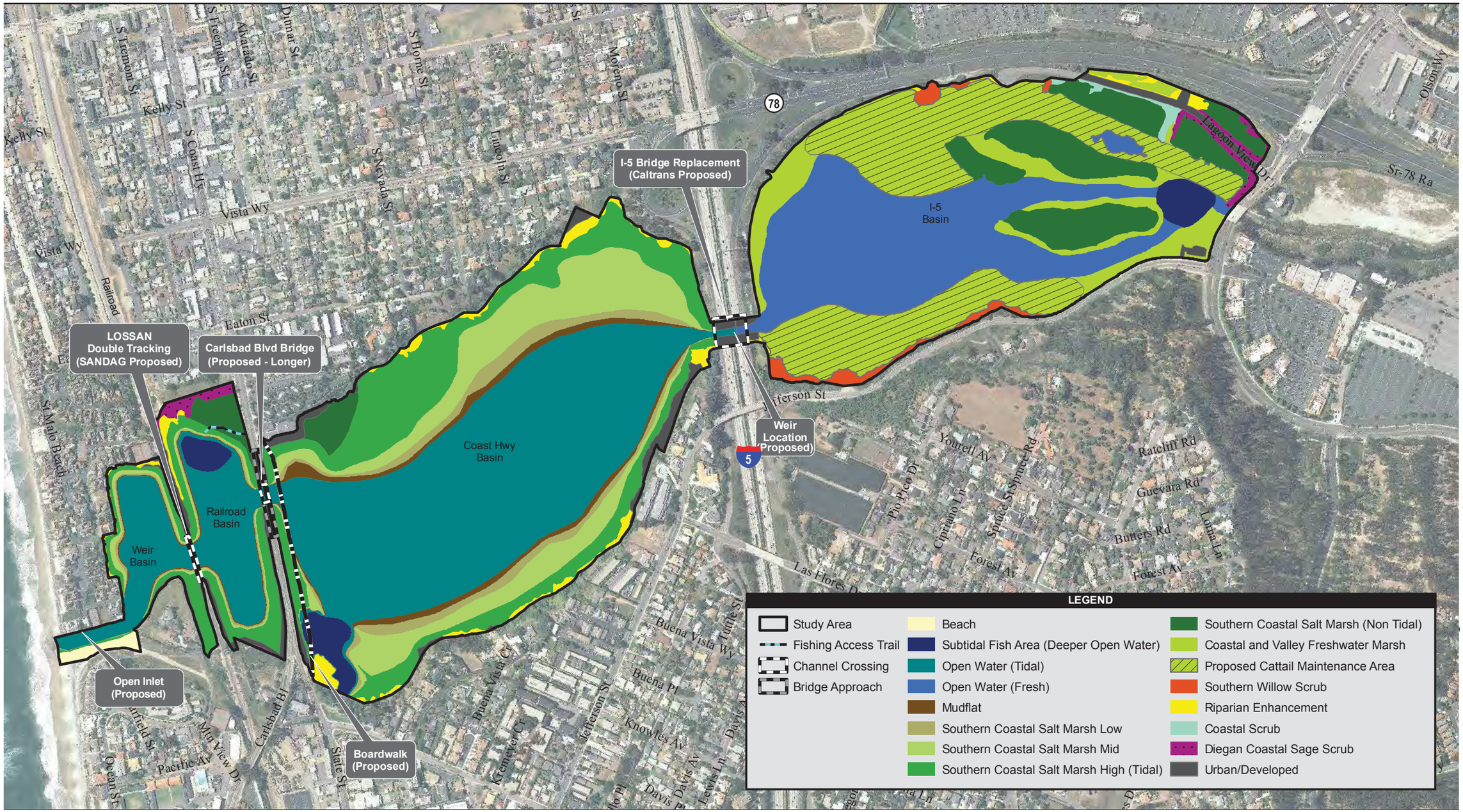

Source: ; AECOM; Everest 2014

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Scale: 1:7,200; 1 inch = 600 feet

Figure 2-10
Proposed Hybrid Alternative Option B Habitat Distribution

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the portion of the lagoon west of I-5 while also improving flood performance. The tidal inlet would have a maximum width of 100 feet at an elevation of +4.0 feet NGVD and an initial bottom (invert) elevation of -2.0 feet NGVD. The inlet would be confined on the northern side by the existing stone revetment running along the St. Malo complex, although improvements may be required depending on the integrity of the existing revetment. On the southern side, the inlet would be confined by the construction of a channel structure running from inside the Weir Basin seaward to the shoreline position established by the St. Malo revetment to the north. Although still in the design phase, it is anticipated that the structural toe (bottom) of the channel would be between -5 feet NGVD to -10 feet NGVD and the crest (top) would extend no higher than +6.0 feet NGVD. The channel structure would likely be constructed of stone.

Under the Hybrid Alternative (both options), the railroad bridge would be improved as part of the LOSSAN corridor improvements and the I-5 bridge would be replaced as part of the I-5 North Coast Corridor Project. The channel extending under I-5 would remain at the existing width, and the bridge spanning it would be constructed by Caltrans to allow widening of the channel in the future as needed but the channel would not be widened as part of the Enhancement Project. Additionally, the Hybrid Alternative would include construction of a new water control structure (weir) at the I-5 bridge to maintain a freshwater hydrologic regime in the portion of the lagoon east of I-5. The new weir at this location would have the same invert elevation as the existing weir in the Weir Basin (+5.6 feet NGVD) and the same top width as the existing channel under the I-5 bridge (36 feet). The new structure at the I-5 bridge would be constructed of concrete, stone, and/or wood. Maintenance access to this structure would be provided via the I-5 roadway embankment to the south and north. Additionally, as described above, the channel guide constructed under Hybrid Alternative, Option A would result in a perched water level within the Weir Basin. This channel guide would be constructed of rock with an armor layer. Figure 2-11 shows a conceptual image of the location of channel guide under Hybrid Alternative, Option A.

The channel extending under Carlsbad Boulevard and the bridge spanning the channel would be expanded to 110 feet and replaced as part of the Hybrid Alternative under both options. The expanded channel may require slope protection to prevent scour of the bridge abutments and embankments. It is anticipated that stone revetment would extend up to 300 feet from the channel to the north and south on both the eastern and western sides of the embankment.

Materials Removal and Periodic Maintenance

Under the Hybrid Alternative, a portion of the I-5 Basin would be dredged to provide water depths that would preclude cattail growth and expansion. The portion of the lagoon west of I-5 would be dredged to provide ground elevations suitable for tidal wetlands. Approximately

148,500 cy of vegetation (e.g., cattails) would be removed from the lagoon, as identified in Table 2-4.

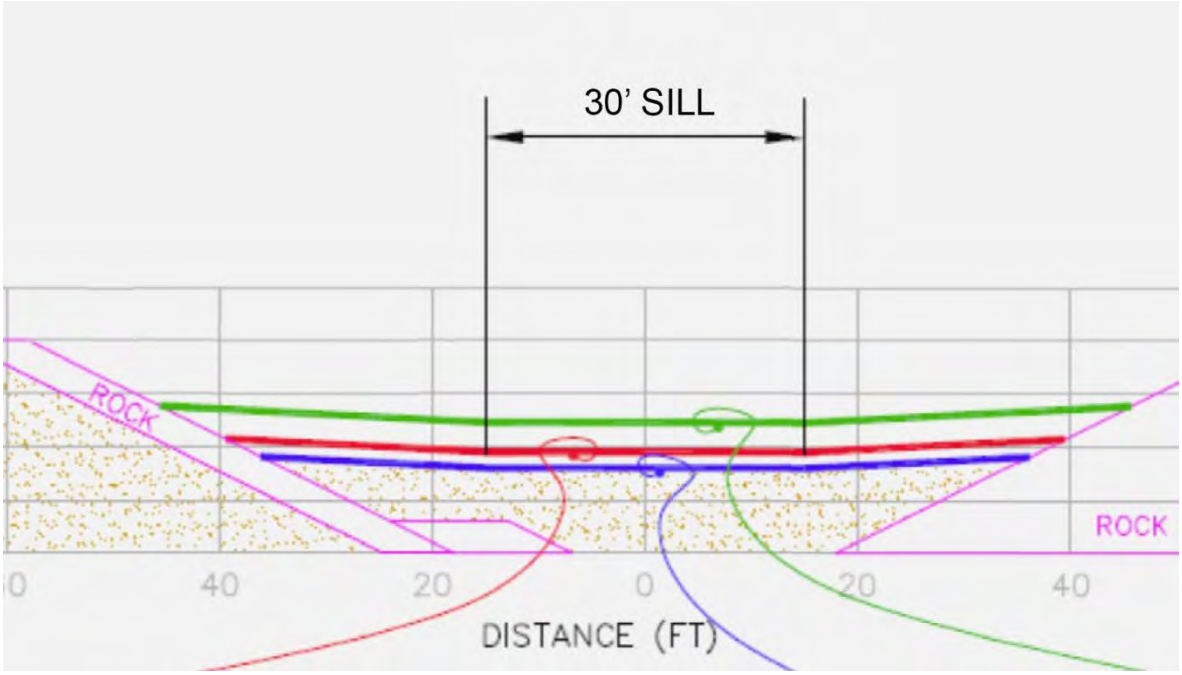


Figure 2-11. Proposed Hybrid Alternative, Option A Channel Guide

Approximately 833,000 cy of sediment would be removed from the lagoon to achieve the proposed habitat distribution for the Hybrid Alternative, as shown in Figures 2-9 and 2-10. The final grade elevations are based on the inundation frequency range associated with each coastal salt marsh habitat type. Depending on the characteristics of the dredged material, it would be used beneficially as a source of beach or nearshore material or disposed of as waste on-site or off-site.

The project design life of the Enhancement Project is 50 years, during which periodic maintenance and monitoring and adaptive management (discussed in Section 2.9) would be implemented. Periodic maintenance of the Hybrid Alternative would include both sediment removal during inlet maintenance and management of remaining cattail and freshwater marsh areas in the I-5 Basin. Up to 27,000 cy of material would be removed from the inlet using land-based equipment, and placed on the north end of the North Carlsbad Beach placement site. Sand would be spread on the beach using bulldozers. It is anticipated that inlet maintenance could take between 2 to 4 weeks to complete, and could occur every 12 to 20 months. Within the I-5 Basin, areas of freshwater marsh would remain after enhancement. It is anticipated that, as part of the adaptive management strategy to maintain cattails yet allow effective vector control, vegetation thinning through the establishment or maintenance of channels through dense cattail areas would

be conducted. Thinning would occur approximately every 1 to 2 years; cattail maintenance is discussed further in Section 2.9.

2.6.4 NO PROJECT ALTERNATIVE

According to the CEQA Guidelines Section 15126.6(e)(3)(b), the No Project Alternative is defined as the "circumstance under which the proposed project does not proceed." The impacts of the No Project Alternative shall be analyzed "by projecting what would reasonably be expected to occur in the foreseeable future if the project were not approved, based on the current plans and consistent with available infrastructure and community services." The purpose of describing and analyzing the No Project Alternative is "to allow decision makers to compare the impacts of approving the proposed project with the impacts of not approving the proposed project." Under the No Project Alternative, the proposed enhancement of the lagoon would not be completed at the project site. The existing weir would remain in place. No removal of sediment or vegetation would occur, and no maintenance regime would be implemented to enhance the biological, water quality, and hydrological functions of the lagoon. Additionally, improvements such as the Boardwalk would not be constructed as part of the No Project, although the Boardwalk could be implemented as an independent project. Replacement and expansion of the Carlsbad Boulevard bridge would not occur under the No Project Alternative. However, as the I-5 improvements (e.g., bridge replacement and I-5/SR 78 interchange) and LOSSAN improvements have independent utility and are not a part of the Enhancement Project, it is assumed that these projects would be constructed under the No Project Alternative.

It is anticipated that the biological, water quality, and hydrological functions of the lagoon would continue to degrade under the No Project Alternative as the lagoon continues to experience sedimentation and expansion of vegetation. As vegetation expands into currently open water areas of the lagoon, it is anticipated that water circulation will further decrease, leading to additional water quality issues within the lagoon. Flooding under storm conditions would also increase as open water and channels continue to fill in with sediment and vegetation. Species that currently utilize the open water areas would be restricted to smaller areas as vegetation expands into the lagoon basins, while the biological value of the freshwater marsh vegetation would continue to decrease as it becomes more monotypical, density increases, and access to nearby open water decreases. Vector concerns due to lack of water circulation, which increases breeding potential for vectors, and the density of vegetation in the lagoon, which decreases treatment effectiveness, would continue to increase under the No Project Alternative.

2.7 MATERIALS DISPOSAL/REUSE

Vegetation and soil removal from the lagoon are the major construction activities associated with the Enhancement Project. Depending on the alternative, implementation of the Enhancement Project would involve the removal and subsequent disposal of approximately 128,600 cy to 211,100 cy of vegetation (mostly cattails). In addition, the Enhancement Project would require the net excavation (cut) of approximately 562,000 cy to 833,000 cy of sediment from the four basins.

2.7.1 VEGETATION

The Enhancement Project would involve the removal and disposal of a substantial volume of vegetation. Approximately 129,000 cy of vegetation would be removed from the four basins under the Freshwater Alternative; 211,000 cy of vegetation under the Saltwater Alternative; and 148,500 cy of vegetation under the Hybrid Alternative. Construction equipment would be used to remove vegetation, which would be disposed of at the closest facility that accepts green waste (e.g., Sycamore Landfill).

The distribution of the vegetation removal between the four basins for each alternative is presented in Table 2-5.

Table 2-5
Volume of Vegetation to Be Removed by Basin under Each Alternative

Alternative	Volume of Vegetation to Be Removed (cy) by Basin				Total
	Weir	Railroad	Coast Highway	I-5	
Freshwater	500	9,500	89,500	29,500	**129,000**
Saltwater	1,500	14,000	103,500	92,000	**211,000**
Hybrid	1,500	14,000	103,500	29,500	**148,500**

cy = cubic yards

2.7.2 SEDIMENT

Construction of the Enhancement Project would require the net excavation of approximately 562,000 cy of sediment from the four basins under the Freshwater Alternative; 781,000 cy of sediment under the Saltwater Alternative; and 833,000 cy of sediment under the Hybrid Alternative (both options). The distribution of earthwork between the four basins for each alternative is presented in Table 2-6.

Table 2-6
Earthwork Volume by Basin under Each Alternative

Alternative	Earthwork Volume (cy) by Basin				Total
	Weir	Railroad	Coast Highway	I-5	
Freshwater	21,000	62,500	290,500	188,000	**562,000**
Saltwater	67,000	101,000	292,500	320,500	**781,000**
Hybrid	61,500	95,500	488,000	188,000	**833,000**

cy = cubic yards

Possible disposal options have been identified based on preliminary sediment characterization data regarding the content of sand in lagoon sediments. Sediment disposal and reuse options are outlined based on typical suitability requirements for reuse within the littoral zone (i.e., on the beach or in the nearshore). Sediment with a sand content higher than 80 percent would be suitable for beneficial use as beach placement, and sediment with a sand content between 70 percent and 80 percent would be suitable for beneficial use as nearshore placement. It is assumed that sediment with less than 70 percent sand content would not be suitable for placement within the littoral zone and would require disposal at an offshore disposal or in-lagoon disposal site.

Based on previous material characterization studies (Everest and Battelle 2003; SAIC 2008a), the sand contents for each basin at different depths were estimated and are summarized in Table 2-7. As shown in Table 2-7, most of the material from the two downstream basins (i.e., the Weir and Railroad Basins) is suitable to be placed on the beach or in the nearshore. In the Coast Highway Basin, sediment below 4 feet is suitable to be placed on the beach or in the nearshore. None of the sediment within the I-5 Basin would be suitable for beach or nearshore placement. It should be noted that the previous sediment characterization studies were based on composite samples of a few locations so further soil characterization investigations during future phases of the project would provide more precise soil characterization estimates.

Because the sediment characterization is preliminary and it is possible that different volumes of material could be identified as project implementation occurs, a range of sediment reuse/disposal options have been analyzed as part of the Enhancement Project. Potential littoral cell reuse is proposed as one of these options. Volumes analyzed for placement at these sites total more than the anticipated disposal needs of the project in order to provide flexibility in the event additional suitable material is identified during construction.

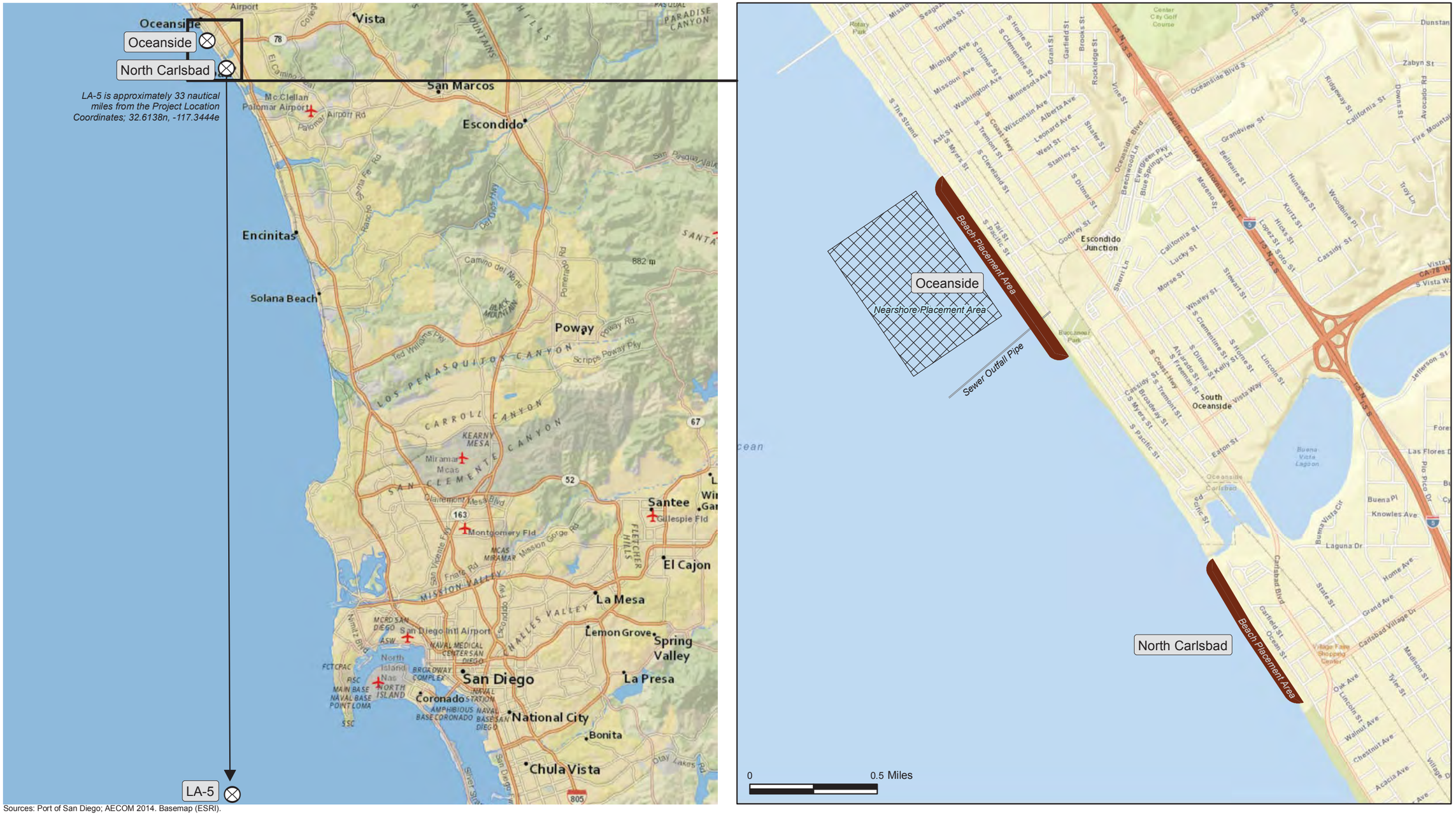
As previously discussed, specific locations have been carried forward for potential materials disposal/reuse based on historic project site boundaries, including the 2012 RBSP implemented by SANDAG and the Navy Homeporting Project. The latest SANDAG RBSP included two nearby beach locations – Oceanside and North Carlsbad. These sites, due to their proximity to

Table 2-7
Estimated Sand Content Percentage by Basin

Depth (feet)	Weir Basin	Railroad Basin	Coast Highway Basin	I-5 Basin
	Estimated Sand Content (%) for 2-foot Lifts			
0 - 1	74	65	37	12
1 - 2				
2 - 3	82	80	62	23
3 - 4				
4 - 5	78	88	81	34
5 - 6				
6 - 7	96	84	80	35
7 - 8				
8 - 9	98	84	78	44
9 - 10				
10 - 11	99	84	77	53
11 - 12				
12 - 13	99	84	77	53
13 - 14				
14 - 15	99	84	77	53
15 - 16				
16 - 17	99	84	77	53
17 - 18				
18 - 19	99	84	77	53
19 - 20				

Yellow denotes sand content >80% – suitable for reuse; beach placement
Blue denotes sand content between 70%–80% - suitable for reuse; nearshore placement
Grey denotes sand content <70% – not suitable for reuse; disposal required

the project site and their previously use for materials placement (based on previously permitted past projects), are determined as suitable for materials placement for the Enhancement Project. A matrix describing each of the materials disposal/reuse scenarios and maximum capacity per site is provided in Table 2-8 and shown in Figures 2-12 through 2-14. Under each of the alternatives, a combination of different strategies could be implemented based on sediment characteristics. Specific volumes anticipated for placement are included in Table 2-8 for reference, but the analysis in this EIR is based on placement of the total sand capacity at each site. The scenarios described and analyzed in this EIR therefore represent a "worst-case" scenario and reflect a maximum volume that could be placed at each location. The total capacity at the receiver site exceeds the amount of material needed to be disposed/reused for the construction of the Enhancement Project. Thus, only a portion of these disposal/reuse sites, or a portion of the volume (and footprints) identified may actually be used for materials placement under each alternative. Based on preliminary sediment characterization information, sediment generated as



Sources: Port of San Diego; AECOM 2014. Basemap (ESRI).

Figure 2-12
Potential Offsite Materials Placement Sites

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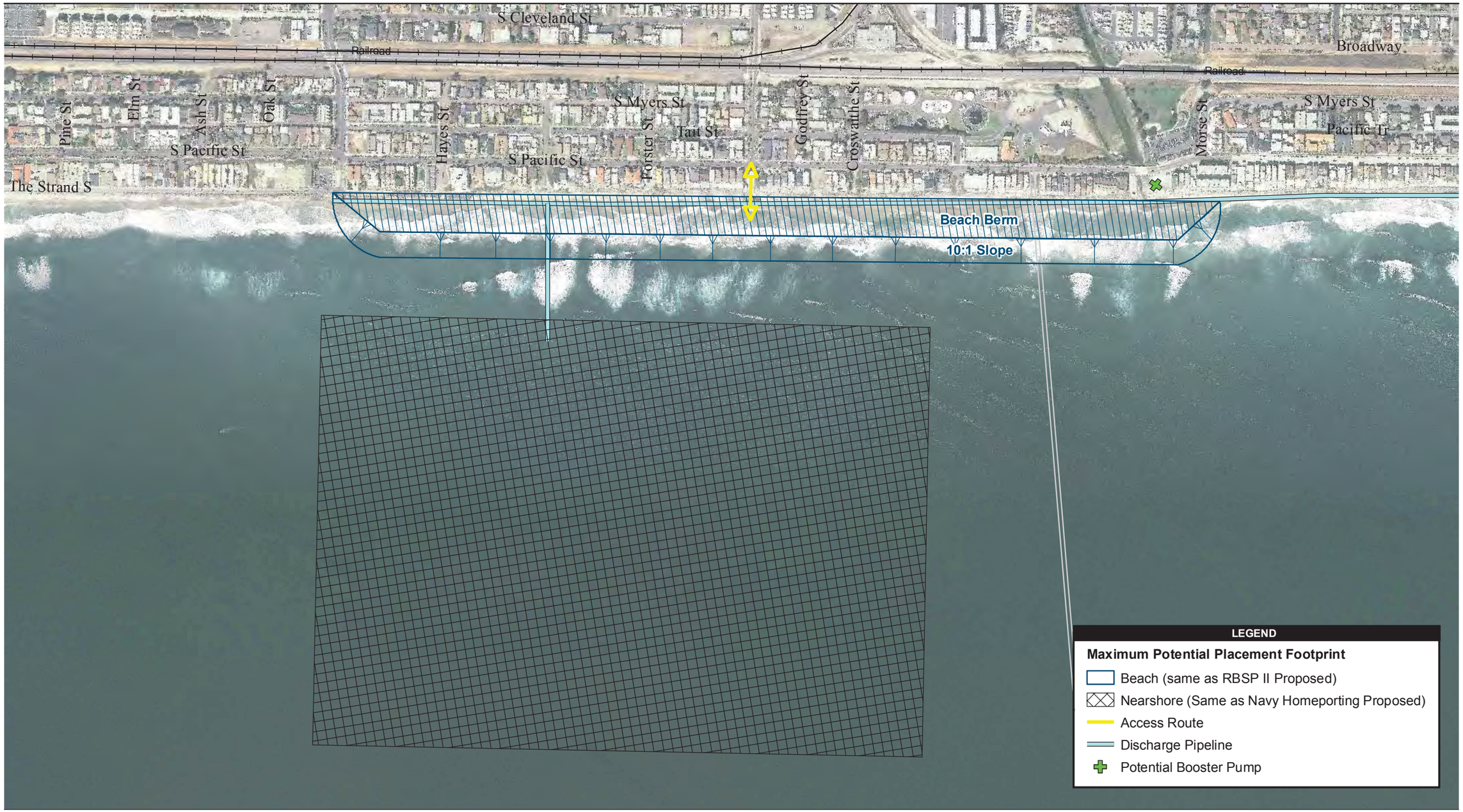

Source: SanGIS 2014; SANDAG 2012; MoffattNichol 2009

500 250 0 500 Feet

Scale: 1 = 6,000; 1 inch = 500 feet

Figure 2-13
Oceanside Placement Sites

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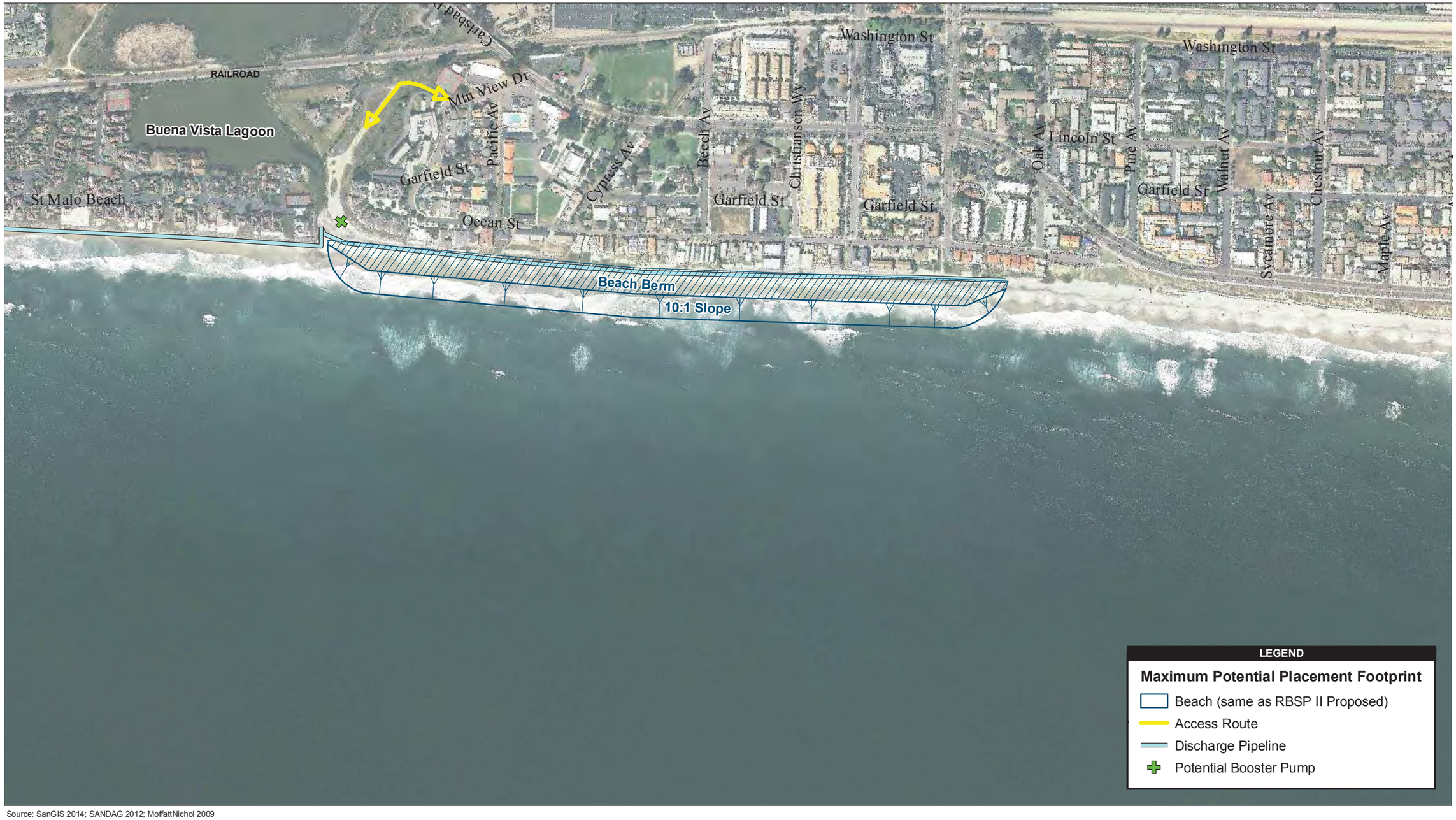

Source: SanGIS 2014; SANDAG 2012; MoffattNichol 2009

500 250 0 500 Feet

Scale: 1 = 6,000; 1 inch = 500 feet

Figure 2-14
North Carlsbad Placement Site

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part of the initial construction effort is anticipated to be placed within the Oceanside beach or nearshore sites. No placement at Carlsbad is currently anticipated, although the site could provide additional capacity if suitable material is identified prior to construction. This site would be used for placement of material excavated during periodic inlet maintenance of the Saltwater and Hybrid Alternatives. The analysis in this EIR therefore includes evaluation of potential impacts associated with placement of material at the North Carlsbad site only for purposes of full disclosure in case unexpected suitable material is available. The likely scenario is construction placement in Oceanside (nearshore and onshore) and only routine post-project maintenance at North Carlsbad.

As outlined in Table 2-8, two different construction approaches could be used for implementation of the Enhancement Project. One method, identified under Approach 1, would dredge materials in areas designated for grading to lower elevations and dispose of those dredged materials on nearby beaches, the nearshore, or offshore based on their characteristics (e.g., proportion of sand and grain size). Approach 2 would construct an overdredge pit to provide capacity for on-site disposal of fine-grained material and generate material that could be reused within the littoral zone, on the beach or in the nearshore. The overdredge pit would be located in an area of the lagoon that contains high proportions of sand at depth, which would be placed on the beach and nearshore sites as the pit is excavated. That pit would then be backfilled with finer-grained materials that would otherwise need to be disposed of at LA-5. The pit would be capped with sand and topped with native marsh sediments. As a result, finer-grained materials would be encapsulated on-site and no off-site disposal would be required under Approach 2. Construction of the overdredge pit and placement of beach and nearshore materials are described in more detail in Section 2.8. Approach 1 assumes an overdredge pit would not be built within Buena Vista Lagoon, and no on-site retention of fine-grained material would occur. Under Approach 1, any fine-grained material would be disposed of at LA-5, and less material would be generated that could be reused on the beach or in the nearshore, as identified in Table 2-8. Analyses within Chapter 3 accounts for transport of material to LA-5. Approval of LA-5 as a marine disposal site was completed as part of EPA designation (including environmental analysis under NEPA), and it is currently used as a disposal area for material.

Inlet maintenance required under the Saltwater and Hybrid Alternatives would also result in materials requiring disposal, but material removed from the inlet is anticipated to be sandy and disposed of on the adjacent beach at North Carlsbad. This material placement would occur annually but is not added into the totals in Table 2-8, which focuses on the one-time beneficial use and disposal needs associated with initial project implementation. Materials placement associated with annual inlet maintenance would be substantially less than the total capacity of the Carlsbad beach site (27,000 cy compared to 225,000 cy capacity) and would be placed within the footprint analyzed as part of the proposed initial placement. Analysis in Chapter 3 accounts for

placement during annual maintenance in the materials disposal/reuse discussion. Where relevant, specific reference to annual placement is made. To provide full public disclosure and maximum flexibility during construction, both disposal/reuse scenarios are evaluated in this EIR. To facilitate identification of potential impacts associated with placement of material due to sediment disposal/reuse, materials disposal/reuse scenarios are evaluated independently throughout the document.

Table 2-8
Materials Disposal and Reuse Scenarios

Construction Approach	Capacity Based on Historical Projects (see notes)	Alternative		
		Freshwater	Saltwater	Hybrid
		Disposal Need: 562,000 cy	Disposal Need: 781,000 cy	Disposal Need: 833,000 cy
Approach 1 – Without an Overdredge Pit				
Beach				
Oceanside	420,000	49,000	110,000	129,500
North Carlsbad	225,000	0	0	0
Nearshore				
Oceanside	2,460,000	30,000	49,000	51,000
LA-5	N/A	483,000	622,000	652,500
Approach 2 – With an Overdredge Pit				
Beach				
Oceanside	420,000	175,000	232,500	255,000
North Carlsbad	225,000	0	0	0
Nearshore				
Oceanside	2,460,000	387,000	548,500	578,000
LA-5	N/A	0	0	0

cy = cubic yards; N/A = not applicable

Notes:

1. Materials placement quantities exceed amount to be disposed of, or reused, to allow flexibility at individual placement sites. The North Carlsbad site is not anticipated to be used as part of the initial construction placement but could provide additional capacity in the event more suitable material is identified during construction. In addition, the North Carlsbad site is proposed to be used for placement of material removed during periodic inlet maintenance required as part of the Saltwater and Hybrid Alternatives.
2. Onshore beach sand placement sites are consistent with the 2012 RBSP (SCH No. 2010051063). Refer to Figures 2-11, 2-12, and 2-13 for the proposed sand placement sites. While 2012 RBSP sites are proposed for use, the Enhancement Project would obtain permits for placement, since the 2012 RBSP was a one-time project implemented in 2012.
3. The nearshore placement site is consistent with the Oceanside nearshore beach replenishment site H identified in the Final Environmental Impact Statement for the Development of Facilities in San Diego/Coronado to Support the Homeporting of One NIMITZ Class Aircraft Carrier (Navy Homeporting EIS). The Enhancement Project would obtain permits for placement, since the Navy Homeporting was a one-time project.
4. Sand Compatibility and Opportunistic Use Programs (SCOUP) sites are not included as an option for materials placement in this EIR because the existing SCOUPs assume construction methods and other conditions that are not consistent with the Enhancement Project (e.g., daytime construction only).
5. LA-5 is an existing EPA-designated ocean disposal site located approximately 10 nautical miles offshore, southwest of San Diego Bay. This site can be used for the disposal of dredged material from federal projects. The project must establish that the dredged material would not exceed the capacity of the site and confirm that the material is in compliance with the EPA and Corps criteria and regulations prior to approval to dispose of material by EPA and the Corps (EPA 1987). Preliminary testing of materials indicates that the material would be suitable for disposal at LA-5, but authorization would be required prior to construction.

2.8 CONSTRUCTION METHODS, SCHEDULE, AND DESIGN FEATURES

This section describes the methods and equipment that would likely be used for construction of the proposed enhancement alternatives, along with information regarding the construction schedule and design features. Project construction would primarily involve removing vegetation and lowering existing ground elevations in the four basins to create the various habitat distributions for each of the enhancement alternatives, as shown in Figures 2-7 through 2-10. The construction methods for the Enhancement Project were developed based on project requirements and site constraints, as well as experience with similar previous projects. Standard construction practices would be utilized for the project and are described in this section as well. The construction impact area for the Freshwater Alternative, Saltwater Alternative, and Hybrid Alternative would vary, as shown in Figures 2-15 through 2-17, respectively.

The timing and phasing of the various construction activities are important considerations in project planning. In general, the first step in the sequence of construction work would be to mobilize equipment to the project site, develop access to the construction areas, and prepare staging areas. The staging areas would be cleared, grubbed, and surfaced, as needed, to support construction equipment and materials. Vegetation removal would be completed next, moving from one basin to another, with work starting at the I-5 Basin and moving downstream until reaching the Weir Basin. After vegetation removal, dredging work would be undertaken, starting in the Coast Highway Basin and moving to the I-5 Basin, with the Railroad and Weir Basins completed last. The weir/inlet work would be conducted next, and the lagoon would be opened (under Saltwater Alternative and Hybrid Alternative only) once this work is complete, leaving the lagoon mouth closed during construction. Planting of the vegetated areas would begin after the earthwork is complete and final elevations have been verified in the field but prior to opening of the lagoon to tidal exchange (as appropriate). After planting is completed, the demobilization of all construction equipment and materials would commence. Demobilization would include the restoration of staging and access areas to agreed-upon post-construction conditions (e.g., pre-construction conditions). The construction methodology and phasing ultimately used would be determined by the contractor selected for construction with due consideration to the requirements specified in permits, agreements, and approval documents. If the selected contractor chooses a construction methodology substantially different than what is presented herein, additional environmental review would be conducted as required under CEQA and the State CEQA Guidelines.

It is expected that the contractor would generally follow time restrictions for construction operation set by the Cities of Carlsbad and Oceanside. Based on these restrictions, it is anticipated that construction would start at 7 a.m. and end at 6 p.m., Monday through Friday, although these time constraints may vary. The exception to this is dredging and sand placement operations, which could continue up to 24 hours a day/7 days a week due to issues associated

with starting and stopping these activities (e.g., sand settlement in pipelines that then require resuspension, adding to the potential for pipeline clogs).

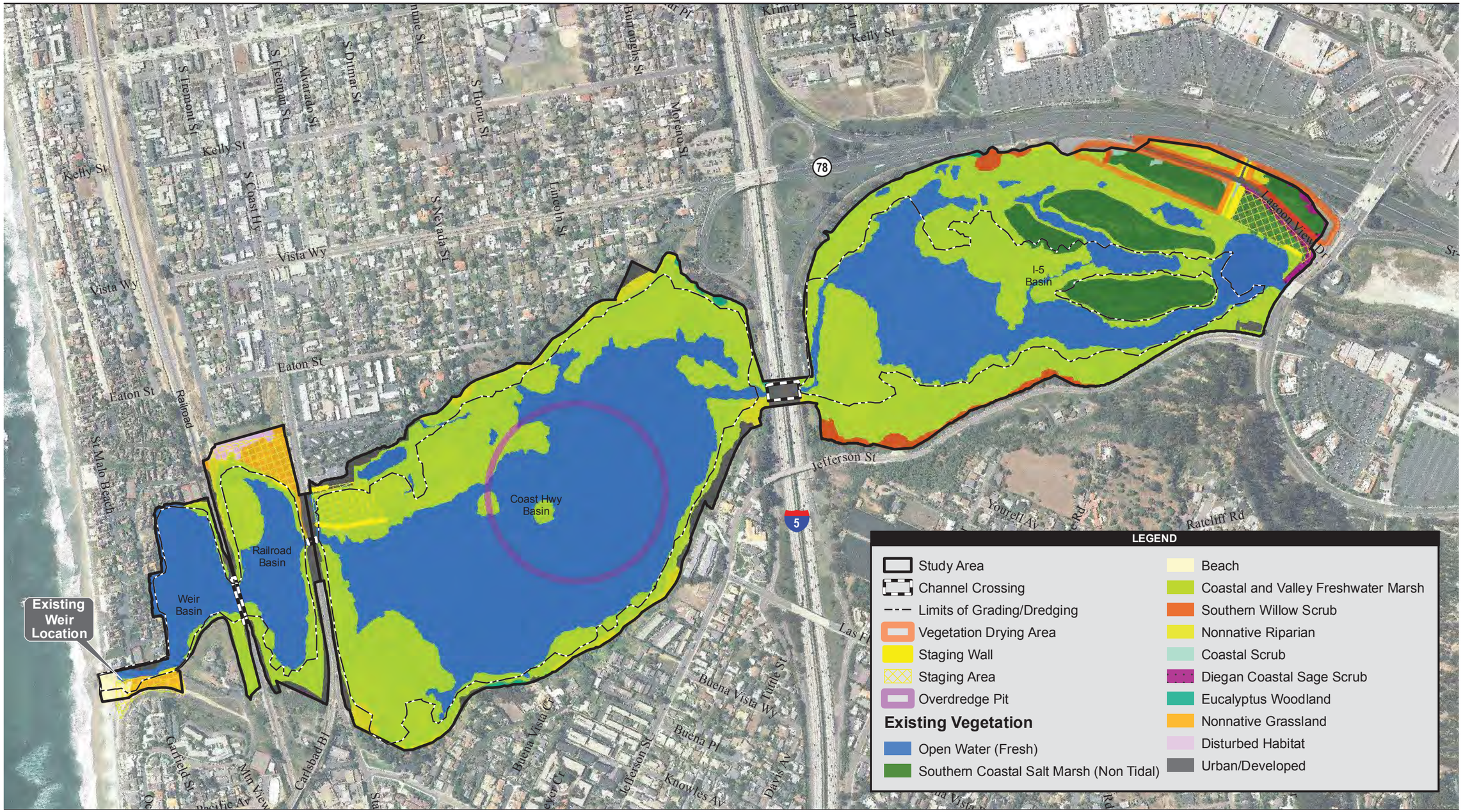
Mobilization of construction equipment and material is expected to take 1 to 2 months to complete. It is estimated that the vegetation removal operation would take 2 to 3 months to complete. Given the nature of this work, vegetation removal could be disruptive to wildlife and would occur between October 1 and February 14, outside the nesting season (February 15 through September 30). Dredging within the lagoon is anticipated to take 12 to 24 months to complete. The dredging operation would be limited in area to the immediate vicinity of the dredge and sediment discharge locations (beach, nearshore, offshore, and within the lagoon). Restricting all construction to outside of the nesting season would substantially increase the construction schedule and would double the time needed to restore the lagoon. Therefore, given the limited area and nature of this work, it is expected that the dredging operation would take place throughout the year with no shutdown during the nesting season. Construction of the Boardwalk and replacement of the Carlsbad Boulevard bridge (depending on alternative) would occur concurrent with dredging operations. Demobilization of construction equipment and material is expected to take 1 to 2 months to complete. It is estimated that the entire construction program would take 15 to 30 months to complete.

2.8.1 GENERAL CONSTRUCTION FEATURES

Construction in a lagoon environment is challenging and can be complex. Several methods are typically required to coordinate working with dredges over water and earthmoving equipment over land. Often a combination of approaches is utilized, particularly in a large site such as Buena Vista Lagoon.

Generally, construction would consist of:

1. Removal of vegetation (primarily cattails) and drying for off-site transport and disposal.
2. Dredging and grading within the lagoon to raise or lower elevations to create a diverse mix of habitats.
3. Disposal of sediments excavated from the lagoon to different locations, as identified for materials disposal/reuse, including nearshore areas, nearby beaches, and/or on-site placement. One construction approach would allow for construction of an overdredge pit within the lagoon to provide on-site disposal of fine material. This approach would also generate material that could be beneficially reused in the littoral system.
4. Infrastructure improvements and protection, as necessary, including replacement of the Carlsbad Boulevard bridge (under the Saltwater and Hybrid Alternatives only).



Source: SANDAG 2012; Sangis 2014; AECOM; Everest 2014

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Scale: 1:7,200; 1 inch = 600 feet

Figure 2-15
Freshwater Alternative Construction Impact Area

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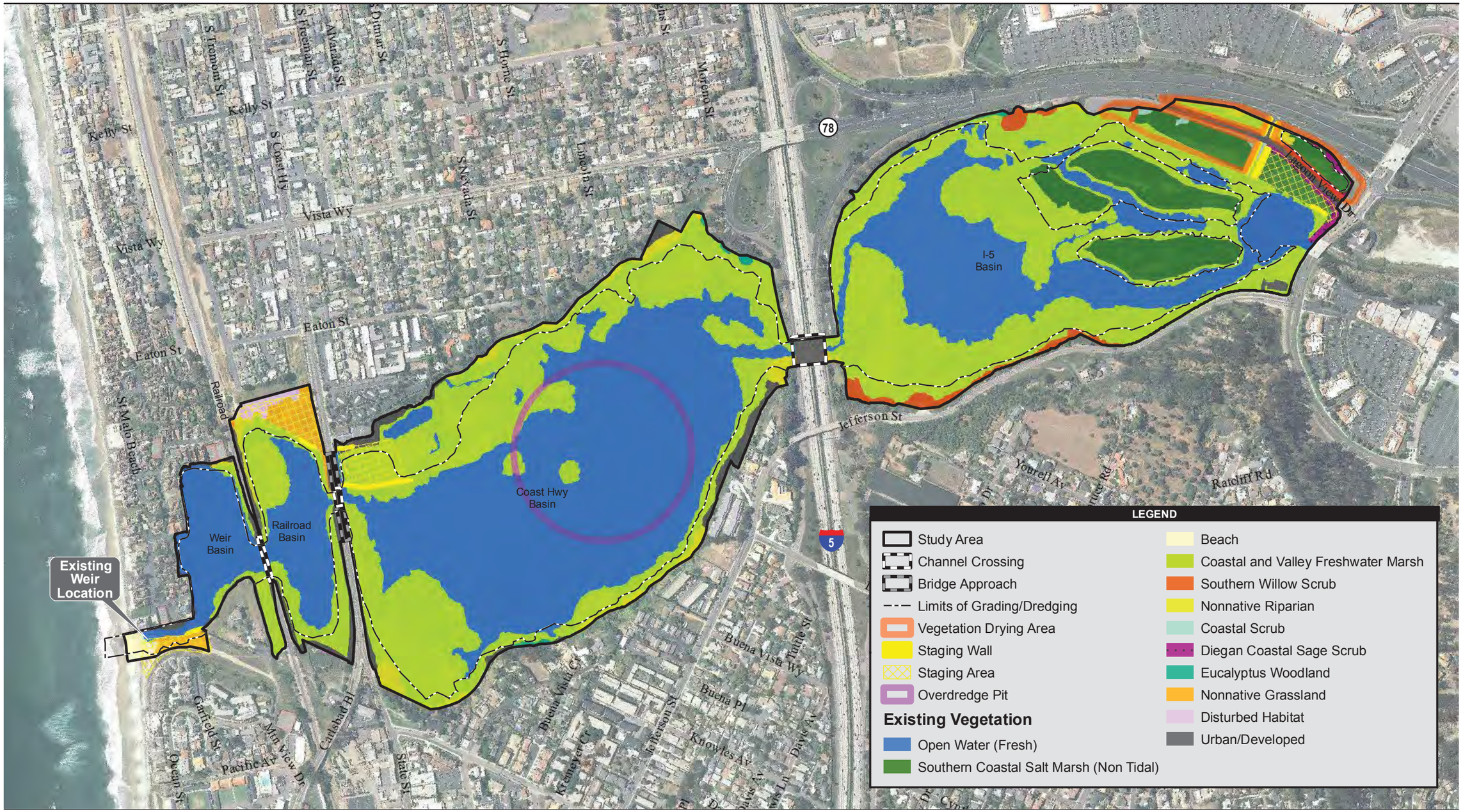

Source: Sangis 2014; SANDAG 2012; AECOM 2014; Everest 2014

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Scale: 1:7,200; 1 inch = 600 feet

Figure 2-16
Saltwater Alternative Construction Impact Area

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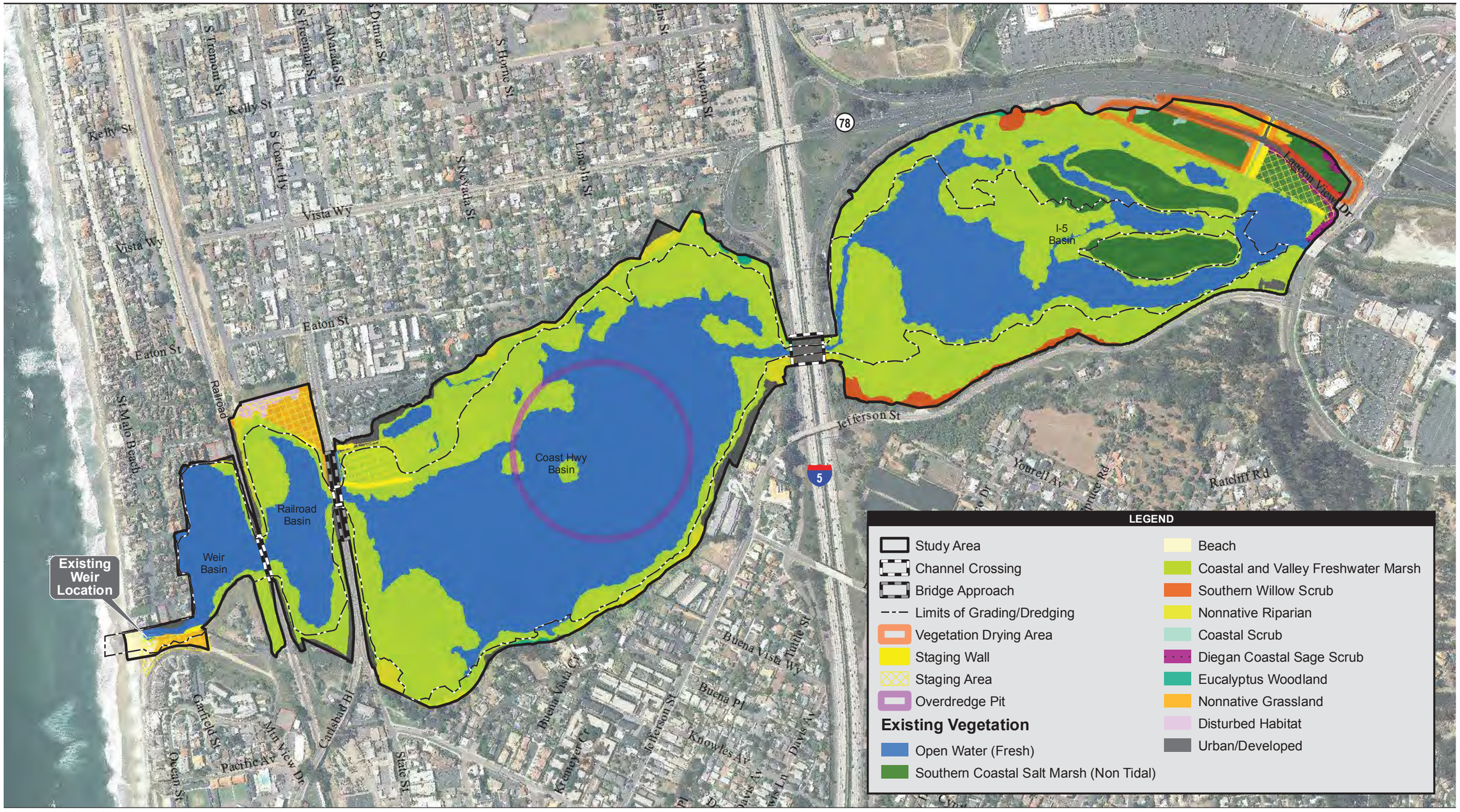

Source: SANDAG 2012; AECOM; Everest 2013

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Scale: 1:7,200; 1 inch = 600 feet

Figure 2-17

Hybrid Alternatives A & B Construction Impact Area

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5. Revegetation of graded areas within the lagoon to facilitate recovery of habitat.
6. Periodic maintenance of inlet sedimentation (under the Saltwater and Hybrid Alternatives only) and vegetation (e.g., vector management areas).
7. Monitoring and adaptive management activities to maintain ecological functions of lagoon.

This section reflects the preliminary construction phasing and approach anticipated for the project for the purposes of disclosure under CEQA. Impacts associated with the approach discussed in this section of the EIR are evaluated under each resource area in Chapter 3. Prior to construction, a detailed construction phasing plan would be developed for the chosen alternative.

Throughout construction, standard construction practices would be followed by the contractor. These practices have been established to maintain public and contractor safety and enforce equipment operational requirements during project construction. Some of the standard construction practices incorporated into the Enhancement Project are listed below in Table 2-9.

Table 2-9
Standard Construction Practices

• Implement a public information program to assist nearby residents in understanding the purpose of the project and disseminate pertinent project information, including a project website with current construction schedule.
• Coordinate with applicable agencies regarding construction and maintenance schedules and worksite traffic control plans including, but not limited to, Oceanside Fire Department, Oceanside Police Department, Carlsbad Fire Department, and Carlsbad Police Department.
• Coordinate with the utility service provider for relocating and/or avoiding utilities infrastructure.
• Notify residents at least 1 week in advance of nighttime construction work within 100 feet of residences; restrict construction work to no longer than 3 consecutive nights within 100 feet of a specific residence where sleep disturbance may occur.
• Have Resident Engineer or designee on-site during construction to confirm compliance with permit conditions and construction specifications.
• Prior to initiating construction, identify sensitive “no construction zones” and fence or flag those areas. Limit construction equipment and vehicles to within these limits of disturbance.
• Restrict access to active construction areas to maintain public safety (e.g., portions of trails, beaches within placement sites, and ocean adjacent to monobuoy and/or pipelines).
• Clearly mark pipelines used during materials transport to the nearshore site, including both floating and submerged, as “navigational hazards.”
• Site staging areas and access roads at existing access points and previously disturbed areas, where feasible.
• During off working hours, secure heavy equipment and vehicles in staging area.
• Conduct equipment fueling and maintenance at designated staging and fueling areas away from publicly accessible areas.
• Maintain equipment and vehicle engines in good condition and properly tuned per manufacturers’ specifications. Idling time for construction equipment will be minimized, as appropriate.
• Maintain one lane of circulation on public roadways and access to neighboring commercial establishments during project construction. Restore roadway capacity upon completion of the new Carlsbad Boulevard bridge.
• Ensure temporary speed limit reduction for the traffic detour approaches and exits conforms to safe highway design speeds.

• Have a flag person present to coordinate north-south traffic during those limited times that only a single lane is open across the Carlsbad Boulevard bridge.
• Prior to opening areas of beach with placed materials, spread the materials and check for potential hazards (e.g., foreign objects in the sand).
• Post signs advising the public of the presence of steep sand slopes (e.g., scarps) should they develop on beaches where sand is placed.
• Require heavy equipment operators to be trained in appropriate responses to accidental fires.
• Provide fire suppression equipment on board land- and aquatic-based vehicles and at the worksite.
• Provide emergency communication equipment for site personnel.
• As part of permanent erosion control, protect lagoon channel cross sections with erosion control products (i.e., riprap) and vegetated material to stabilize soils and foster natural recruitment from restoration planting, thus managing erosion during higher-velocity storm flows and preventing damage.

2.8.2 CONSTRUCTION EQUIPMENT MOBILIZATION AND DEMOBILIZATION

Vegetation removal would be conducted with land-based and/or water-based construction equipment while excavation/dredging activities would be conducted primarily with water-based equipment, such as a dredge. Land-based equipment, such as backhoes and excavators, would work from the shore to remove vegetation, both the stalks and root mass. Excavation of sediment within the lagoon would be conducted using a moderate-sized cutterhead dredge (e.g., 18-inch to 24-inch). Pipelines to transport dredge sediment would also be brought to the site. Construction equipment would be brought to the project site by land using trucks that would access the site via I-5, Vista Way, Jefferson Street, and Carlsbad Boulevard/Coast Highway. Large equipment would be transported during off-peak traffic to minimize traffic congestion. Some large equipment, such as a dredge, would likely be brought to the project site in several pieces for subsequent on-site assembly.

Following completion of construction activities, equipment would be demobilized. Demobilization of equipment would use the same routes as mobilization. Staging areas, access routes, and other disturbed areas would be decompacted, revegetated, and restored to pre-construction conditions or as specified in the construction documents. Any temporary equipment, structures, or utilities (e.g., water and power) installed at the project site would be removed at the completion of construction.

2.8.3 CONSTRUCTION ACCESS, HAUL ROUTES, AND STAGING AREAS

Construction Access

Access to the site varies with each basin and is shown in Figure 2-18. The Weir Basin is accessible from the south via Mountain View Drive in Carlsbad. The Railroad Basin is accessible on the north via Coast Highway in Oceanside and on the south via Carlsbad Boulevard in Carlsbad. The Coast Highway Basin would likely be accessed via the Nature Center located on

Source: SanGIS 2009; Landiscorp 2010; Everest 2009

600 300 0 600 Feet

Scale: 1 = 7,200; 1 inch = 600 feet

Figure 2-18
Proposed Construction Access, Haul Routes, and Staging Areas

Path: P:\2013\60288954_BVLEP_EIR\06GIS\6.3_Layout\Reports\EIR\Access_and_Staging.mxd, Paul_Moreno, 6/30/2015, 2:25:07 PM

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the east side of Coast Highway. The I-5 Basin would be accessed from Jefferson Street via Lagoon View Drive, which is located off Jefferson Street along the far eastern boundary of the project site. For material transport, access routes would be established and maintained for public safety and environmental pollution control.

Vegetation removed from the lagoon would be transported to a disposal facility via surface streets, SR 78, and I-5. The haul route used for this activity would be different for each basin. For the Weir Basin, trucks would use Mountain View Drive, Carlsbad Boulevard, and Carlsbad Village Drive to access I-5 through Carlsbad. For the Railroad Basin, trucks would access I-5 via Carlsbad Boulevard and Carlsbad Village Drive in Carlsbad and/or Coast Highway and Vista Way in Oceanside. For the Coast Highway Basin, trucks would access I-5 via Laguna Drive and Jefferson Street in Carlsbad and/or Coast Highway and Vista Way in Oceanside. For the I-5 Basin, trucks would use Jefferson Street to access I-5 directly in Carlsbad or Jefferson Street to SR 78. The construction access, haul routes, and staging areas are shown in Figure 2-18.

Staging Areas

Existing areas suitable for staging are limited within the project site; therefore, temporary staging areas would be established for construction equipment, including areas in each basin that allow water access for a dredge. Staging for construction activities in the Weir Basin would be located in the dirt area near the ocean outlet of the lagoon, with access from Mountain View Drive in Carlsbad. The open space area located on the northern shore of the lagoon in the Railroad Basin would be used for staging of construction activities in the Railroad Basin. As there are limited options for construction staging in the Coast Highway Basin, a staging area would need to be created through the temporary placement of fill that would be removed after construction. This staging area would be located adjacent to the lagoon and next to the Nature Center. Staging for construction equipment and activities in the I-5 Basin would occur along the northeast boundary of the I-5 Basin, with access from Jefferson Street via Lagoon View Drive.

2.8.4 HABITAT ENHANCEMENT

Vegetation Removal

Removal of vegetation would be required as one of the initial steps during construction of any of the proposed alternatives. Land-based (e.g., backhoes) and/or water-based (e.g., Marsh Master Amphibian Cutter shown in Figure 2-19) construction equipment would be used to remove vegetation by accessing the lagoon from the shoreline with land-based equipment and/or the water side with water-based equipment.

Figure 2-19. Amphibian Construction Equipment

Vegetation material, consisting of stalk and root mass, would be removed and loaded onto dump trucks (typically with capacity of 12 cy) for disposal at the closest facility that accepts green waste (e.g., Sycamore Landfill). Vegetation would initially be cut and moved to the staging area specific to each basin. At staging areas with sufficient room (e.g., Coast Highway Basin and I-5 Basin), vegetation would be dried in designated vegetation drying areas (Figure 2-18) for 1 to 3 days prior to transport. Wet vegetation would be laid on the ground and/or picked up with slotted/holed picks/scoops to facilitate draining and/or drying of the vegetation and associated root mass. After draining and/or drying, the vegetation would be loaded onto dump trucks for subsequent transport to the green waste facility. At the smaller staging areas (e.g., Weir Basin and Railroad Basin), the vegetation would likely be loaded directly onto dump trucks for subsequent transport to the green waste facility.

Dredging and Sediment Disposal/Reuse

After vegetation removal from the lagoon, sediment removal would occur, primarily using water-based equipment such as dredges. Limited soil removal using land-based equipment could occur in areas directly adjacent to the lagoon edge where disturbed, compacted areas provide access to the lagoon basins. Sediment would be dredged using a hydraulic cutterhead dredge from specific designated areas within each of the lagoon basins. Dredged materials would be directed via pipeline to the appropriate receiver beach or designated nearshore area for placement, an interior overdredge pit, or an offshore disposal site (if no overdredge pit is created), depending on the construction approach and quality of material.

Two options for the beneficial use and/or disposal of dredged sediment have been identified, as described in Section 2.7 and shown in Table 2-10. The first approach would involve hydraulic dredging with beach nourishment and offshore placement. The second approach would involve hydraulic dredging with beach nourishment and lagoon placement (via the creation of an

overdredge pit). These two options are described below and represent the range of possible methods that would likely be considered by a contractor, given the site conditions and quantity of material.

Table 2-10
Earthwork Quantities by Disposal Options

Export	Freshwater Alternative (cubic yards)		Saltwater Alternative (cubic yards)		Hybrid Alternative (cubic yards)	
	Approach 1	Approach 2	Approach 1	Approach 2	Approach 1	Approach 2
Beach (Oceanside and/or North Carlsbad)	49,000	175,000	110,000	232,500	129,500	255,000
Nearshore (Oceanside)	30,000	387,000	49,000	548,500	51,000	578,000
LA-5	483,000	0	622,000	0	652,500	0
Total Export	562,000	562,000	781,000	781,000	833,000	833,000

Approach 1 – Hydraulic Dredging with Beach/Nearshore and Offshore Placement

Under this option, a hydraulic cutterhead dredge would dredge and transport the sediment within the four basins. Sediment suitable (>80 percent sand) for beneficial use as beach placement would be dredged and transported via pipeline to the placement site on each beach, where it would be spread along the beach using conventional construction equipment such as bulldozers, scrapers, dump trucks, and graders. The distance from the project site to the Oceanside or North Carlsbad receiver sites is approximately 2.5 miles. To transport material to the site, up to two booster pumps would be required along the pipeline at approximately 1-mile intervals. Possible booster pump locations include just south of the existing weir and an area adjacent to Loma Alta Creek, as shown in Figures 2-13 and 2-14.

Sand would be discharged from the pipeline at the placement site in a slurry of water and sediment. To minimize impacts to nearshore water quality, a shore parallel berm called a training dike would be constructed to form a settling basin where the slurry would be discharged (PDF-6). The material would be worked upcoast and downcoast from this settling basin. Sediment marginally suitable (70 percent to 80 percent sand) for beneficial use would be dredged and transported via pipeline to the nearshore area (Oceanside only), where it would be discharged in water ranging in depth from approximately -20 feet NGVD29 to -30 feet NGVD29. Material discharged into the nearshore would be released close to the sea bottom to minimize surface turbidity.

Sediment unsuitable for beneficial use (<70 percent sand) would be dredged and transported to a barge offshore via a pipeline system that connects the excavation site to the barge. Excess water contained in the dredged material in the barge would be decanted and transported back to the excavation site via pipeline for reuse in the dredging operation and to minimize water quality

impacts. An offshore mooring would be located at a temporary monobuoy offshore to provide a relatively stable hook-up location for a barge. Once the barge has reached an acceptable load, it would be towed to the Los Angeles Ocean Dredged Material Disposal Site (LA-5), located off the coast of San Diego approximately 6 miles from Point Loma. This site is shown in Figure 2-12 and is designated for the disposal of sediment dredged from waters of the U.S. that is unsuitable for beneficial use yet is deemed clean enough to not cause significant harm to aquatic organisms. Once the barge reaches LA-5, the sediment would be discharged within the disposal site.

Approach 2 – Hydraulic Dredging with Beach/Nearshore and Lagoon Placement

Under this option, a hydraulic cutterhead dredge would dredge and transport the sediment within the four basins. Sediment suitable for beneficial use (>80 percent sand) would be dredged and transported to the beach where it would be spread along the beach using conventional construction equipment such as bulldozers, scrapers, dump trucks, and graders. As discussed in Approach 1, the two potential beach placement sites would be Oceanside and North Carlsbad; the nearshore site in Oceanside would also be used. To minimize impacts to nearshore water quality, a training dike would be constructed to form a settling basin where the dredged sediment would be discharged (PDF-6). The sediment would be worked upcoast and downcoast from this settling basin. Sediment marginally suitable for beneficial use (70 percent to 80 percent sand) as beach nourishment would be dredged and transported via pipeline to the nearshore area (Oceanside only) where it would be discharged in water ranging in depth from approximately -20 feet NGVD29 to -30 feet NGVD29. Material discharged into the nearshore would be released close to the sea bottom to minimize surface turbidity.

Sediment unsuitable for beneficial use (<70 percent) would be placed in a pit within the lagoon created by overdredging (dredging deeper than required to create the final grade elevations). The Coast Highway Basin would be overdredged to create an “overdredge pit” measuring approximately 22 to 32 feet deep that can accommodate fine-grained surface sediment from the Railroad Basin and Coast Highway Basin, and all sediment dredged from the I-5 Basin. The fine-grained surface sediment in the Coast Highway Basin would be dredged and pumped to the area adjacent to the overdredge pit in the Coast Highway Basin for temporary stockpiling. The deeper sandy sediments in the Coast Highway Basin would be dredged and pumped for placement directly on Oceanside or North Carlsbad beaches or in the nearshore area off Oceanside, as described above. This operation would continue in the Coast Highway Basin until a pit of sufficient volume is created to contain all the fine-grained sediment that is found above the proposed grade. The fine-grained sediment would then be pumped into the pit. After the fine-grained sediment in the Railroad Basin is moved to the overdredge pit in the Coast Highway Basin, the sandy sediment from the Railroad Basin would be pumped to the beach for beach nourishment directly on the beach or in the nearshore area. Under Approach 2, the volumes of

earthwork due to overexcavation and backfill for each basin range from approximately 574,000 cy to 690,000 cy. This additional earthwork would not be required under Approach 1 since no excavation is required for an overdredge pit. This approach would maximize material available from the project that could be beneficially reused in the littoral zone, including on area beaches and in the nearshore. Under Approach 2, no disposal of sediment at LA-5 would be required, reducing need for transportation to LA-5.

2.8.5 CHANNEL/INFRASTRUCTURE IMPROVEMENTS

All Alternatives

Boardwalk

The Boardwalk would be installed over approximately 6 to 9 months and would include the installation of 95 to 100 pairs of timber pilings. The Boardwalk alignment would extend approximately 1,500 linear feet between the existing Nature Center and Maxton Brown Park. Pilings would be located 16 feet on center, and would be long enough to extend at least 4 feet into stable ground past lagoon silts. As a result, timber piles are anticipated to be at least 24 feet long and would be installed with a pile driver or screw anchor using equipment located along the shoulder of Carlsbad Boulevard. Wood used for construction would be treated with nontoxic products to resist insect attack, biological decay, ultraviolet light exposure, stress from wetting and drying, and moisture. Equipment would not extend into the traffic lanes and would not require closure along the roadway, although a K-rail barrier may be temporarily established to maintain vehicle and worker safety.

Freshwater Alternative

Weir Replacement

Construction of the new weir structure is anticipated to require approximately 1 to 2 months. The first step would be to construct a temporary, sheetpile cofferdam around the work area, approximately 15 feet on each side of the weir. Once the cofferdam is in place, the work area would be dewatered using pumps and hoses with the water pumped back into the lagoon. The site would be kept dry during weir construction by continuous pumping. Once the work area is dewatered, the existing weir would be demolished and the material would be hauled off-site via dump truck for disposal at a landfill. The work area would then be cleared of vegetation and loose surface material, which would also be hauled off-site via dump truck for disposal at a green waste facility. The demolition would be conducted primarily with backhoes, although some hand labor may be needed in isolated areas. After demolition and clearing, the new weir site would be excavated to the final bottom elevation of the new weir structure. A gravel bedding layer would

be placed on the bottom and then timber would be used to construct the formwork for the concrete work. Steel rebar would be brought in next and the reinforcement structure would be laid out within the formwork. Upon completion of the formwork and steel reinforcement, concrete would be brought in and pumped into place with final working via hand labor. Once the concrete has cured and the weir structure is complete then the work area would be backfilled to final project elevations on either side of the weir. The temporary cofferdam would then be removed and the rest of the work area would be finished to final grade and condition. Construction of the new weir could be conducted at any time of the year. The construction contractor would determine when storm conditions are likely to occur and would implement measures, complying with existing regulations, to ensure that the temporary cofferdam would not result in adverse flooding.

Saltwater Alternative

Tidal Inlet Construction

Construction of the tidal inlet is anticipated to require approximately 3 to 5 months. The first step would be to isolate the work area from fluvial water influence on the east side and ocean water influence on the west side. A temporary, sheetpile cofferdam would be placed on the landward side and an earthen dike would be constructed on the western side using on-site soil. Once the cofferdam and temporary dike are in place, the work area would be dewatered using pumps and hoses with the water pumped back into the lagoon. The water levels within the work area would be kept low during construction by continuous pumping. Once the work area water level is acceptable, the existing weir would be demolished and the material would be hauled off-site via dump truck for disposal at a landfill. The work area would then be cleared of vegetation and loose surface material, which would also be hauled off-site via dump truck for disposal at a green waste facility. The demolition would be conducted primarily with backhoes, although some hand labor may be needed in isolated areas. After demolition and clearing, excavation would be conducted at the existing rock levee and revetment locations to achieve final bottom elevation. Filter fabric would be placed along the bottom and then a bedding layer of quarry run would be placed on top of the filter fabric. An underlayer of rock would be placed on top of the bedding layer and then the armor layer would be placed on top of the underlayer. The rock would be hauled via dump truck to the site with backhoes and front loaders would be used to place the rock. With the rock structures complete, the inlet channel would be excavated to achieve final design elevations. The temporary cofferdam would be removed and the rest of the work area would be finished to final grade and condition, including the small beach area located directly to the south of the channel guide. Finally, the earthen dike would be removed and the channel excavated to final grade, thereby allowing tidal exchange between the ocean and lagoon.

The tidal inlet work would also include the construction of a rock revetment extending into the Weir Basin along the southern side and northern side wrapping around the eastern boundary of the St. Malo complex. This structure would tie into the stabilized channel structure on the south side and the existing St. Malo revetment on the north side. The first step would be to conduct excavation with backhoes to achieve final ground elevation. Filter fabric would be placed along the ground, as needed, and then a bedding layer of quarry run would be placed on top of the filter fabric. An underlayer of rock would be placed on top of the bedding layer and then the armor layer would be placed on top of the underlayer. The rock would be hauled via dump truck to the site with backhoes and front loaders would be used to place the rock. This work would likely be conducted in wet conditions so no dewatering is anticipated for this component of work.

Carlsbad Boulevard Bridge

Replacement of the Carlsbad Boulevard bridge is anticipated to require approximately 6 to 9 months and would be phased. It is anticipated that, for the majority of time, one lane in each direction would remain open to vehicular and bicycle traffic. As described in Table 2-9, Standard Construction Practices, a flag person would be present during construction to coordinate north-south traffic during those limited times that only a single lane is open. During the first phase of construction, anticipated to last approximately 4 months, half of the bridge would be demolished, and bridge abutment supports and piers drilled/driven at both ends of the structure and in the middle of the channel for half of the proposed bridge. Bridge support abutments and piers would extend to stable formations. Design recommendations from the SANDAG Sea Level Rise Study (SANDAG 2013) and CCC Sea-Level Rise Policy Guidance (CCC 2015) will be incorporated into pile foundation and abutment protection engineering for bridgework (PDF-1). In addition, the replacement bridge structure along Carlsbad Boulevard will possess deep pile foundations and well-protected abutments as engineered per appropriate regulatory safety requirements. Structures will be designed in accordance with applicable local and state engineering and design standards (PDF-2). The piers would be constructed using construction equipment positioned on the closed portion of the roadway after demolition. Girders would then be placed and prepped for the bridge deck placement.

The bridge deck would be poured, striped, and opened to traffic. During construction of the bridge deck in phase 1, reinforcing would be set for the second phase of the bridge deck to be joined to the phase 1 section of the bridge deck. The second phase of bridge construction would be anticipated to last another 4 to 5 months. Traffic would be detoured to the newly constructed portion of the bridge while the other half of the existing bridge was demolished, piles and bridge abutment supports driven/drilled, and the bridge deck constructed in a fashion similar to phase 1. Following construction, the roadway would be completely reopened to two-way traffic, as well as bike and pedestrian uses.

Bridge construction would result in the export of approximately 200 cy of concrete and 750 cy of asphalt from demolition of the existing bridge and adjacent roadway. Approximately 1,200 cy of fill import would be required, as well as two to three bridge supports. Additionally, approximately 3,000 cy of concrete, asphalt, and aggregate base for construction of the new bridge structure and approaches would be brought to the site via Vista Way and Coast Highway.

The expanded channel crossing under the expanded bridge structure may require slope protection to prevent scour of the bridge abutments and embankments. It is anticipated that stone revetment would extend up to 300 feet from the channel to the north and south on both the eastern and western sides of the embankment. The sequence of work for the slope protection would be to first excavate the site to achieve the final ground elevation and then install filter fabric along the ground where needed. An underlayer of quarry run would be placed on top of the quarry run followed by an underlayer and armor layer.

I-5 Channel Widening

The channel under I-5 would likely be constructed after the pile/pier and abutment components of the bridge project are complete. Backhoes would be used to excavate the area under the bridge to achieve the final design elevations (channel depth and side slopes). It is anticipated that slope protection would consist of a rock revetment under the bridge on both the north embankment and south embankment wrapping around to provide protection to the embankments extending 350 feet to the north and south on both sides (east and west) of the embankment. The sequence of work for the slope protection would be to first excavate the site to achieve the final ground elevation and then install filter fabric along the ground where needed. An underlayer of quarry run would be placed on top of the quarry run followed by an underlayer and armor layer. It is anticipated that this work would be done primarily in the dry with dewatering provided by Caltrans as part of the I-5 North Coast Corridor Project.

Hybrid Alternative

Tidal Inlet Creation

Similar to the Saltwater Alternative, a tidal inlet would be created as part of the Hybrid Alternative. One option of the Hybrid Alternative would also include creation of a channel guide through the Weir Basin, as discussed below. Construction of the tidal inlet is anticipated to require approximately 3 to 5 months. The first step would be to isolate the work area from fluvial water influence on the east side and ocean water influence on the west side. A temporary, sheetpile cofferdam would be placed on the landward side and an earthen dike would be

constructed on the western side using on-site soil. Once the cofferdam and temporary dike are in place, the work area would be dewatered using pumps and hoses with the water pumped back into the lagoon. The water levels within the work area would be kept low during construction by continuous pumping. Once the work area water level is acceptable, the existing weir would be demolished and the material would be hauled off-site via dump truck for disposal at a landfill. The work area would then be cleared of vegetation and loose surface material, which would also be hauled off-site via dump truck for disposal at a ~~landfill~~green waste facility. The demolition would be conducted primarily with backhoes, although some hand labor may be needed in isolated areas. After demolition and clearing, excavation would be conducted at the channel guide (rock levee) and revetment locations to achieve final bottom elevation. Filter fabric would be placed along the bottom and then a bedding layer of quarry run would be placed on top of the filter fabric. An underlayer of rock would be placed on top of the bedding layer and then the armor layer would be placed on top of the underlayer. The rock would be hauled via dump truck to the site with backhoes and front loaders would be used to place the rock. With the rock structures complete, the inlet channel would be excavated to achieve final design elevations. The temporary cofferdam would be removed and the rest of the work area would be finished to final grade and condition, including the small beach area located directly south of the channel guide. Finally, the earthen dike would be removed and the channel excavated to final grade, thereby allowing tidal exchange between the ocean and lagoon.

For Hybrid Alternative, Option A, the tidal inlet work would also include the construction of a rock revetment extending into the Weir Basin along the southern side and a dike running along the northern side through the Weir Basin to form a channel running directly from the ocean to the Railroad Basin. The revetment would tie into the channel guide on the south side while the dike would tie into the existing St. Malo revetment on the north side. The first step would be to conduct excavation with backhoes to achieve final ground elevations. Suitable fill material would be brought in to create the dike running through the Weir Basin. Once the dike is complete then slope protection would be constructed on the channel side (south side) of the dike and along the south side of the Weir Basin. Filter fabric would be placed on the cut slope, as needed, and then a bedding layer of quarry run would be placed on top of the filter fabric. An underlayer of rock would be placed on top of the bedding layer and then the armor layer would be placed on top of the underlayer. The rock would be hauled via dump truck to the site with backhoes and front loaders would be used to place the rock. This work would likely be conducted in wet conditions so no dewatering is anticipated for this component of work. This work is expected to take between 3 to 4 months to complete. This additional channel guide would not be included as part of the Hybrid Alternative, Option B.

Carlsbad Boulevard Bridge

Similar to the Saltwater Alternative, replacement of the Carlsbad Boulevard bridge is anticipated to require approximately 6 to 9 months and would be phased. It is anticipated that, for the majority of time, one lane in each direction would remain open to vehicular and bicycle traffic., As described in Table 2-9, Standard Construction Practices, a flag person would be present during construction to coordinate north-south traffic during those limited times that only a single lane is open. During the first phase of construction, anticipated to last approximately 4 months, half of the bridge would be demolished, and bridge abutment supports and piers drilled/driven at both ends of the structure and in the middle of the channel for half of the proposed bridge. Bridge support abutments and piers would extend to stable formations. Design recommendations from the SANDAG Sea Level Rise Study (SANDAG 2013) and CCC Sea-Level Rise Policy Guidance (CCC 2015) will be incorporated into pile foundation and abutment protection engineering for bridgework (PDF-1). In addition, the replacement bridge structure along Carlsbad Boulevard will possess deep pile foundations and well-protected abutments as engineered per appropriate regulatory safety requirements. Structures will be designed in accordance with applicable local and state engineering and design standards (PDF-2). The piers would be constructed using construction equipment positioned on the closed portion of the roadway after demolition. Girders would then be placed and prepped for the bridge deck placement.

The bridge deck would be poured, striped, and opened to traffic. During construction of the bridge deck in phase 1, reinforcing would be set for the second phase of the bridge deck to be joined to the phase 1 section of the bridge deck. The second phase of bridge construction is anticipated to last another 4 to 5 months. Traffic would be detoured to the newly constructed portion of the bridge while the other half of the existing bridge was demolished, piles and bridge abutment supports driven/drilled, and the bridge deck constructed in a fashion similar to in phase 1. Following construction, the roadway would be completely reopened to two-way traffic, as well as bike and pedestrian uses.

Bridge construction would result in the export of approximately 200 cy of concrete and 750 cy of asphalt from demolition of the existing bridge and adjacent roadway. Approximately 1,200 cy of fill import would be required, as well as two to three bridge supports. Additionally, approximately 3,000 cy of concrete, asphalt, and aggregate base for construction of the new bridge structure and approaches would be brought to the site via Vista Way and Coast Highway.

The expanded channel crossing under the expanded bridge structure may require slope protection to prevent scour of the bridge abutments and embankments. Design recommendations from the SANDAG Governments Sea Level Rise Study (SANDAG 2013) and CCC Sea-Level Rise

Policy Guidance (CCC 2015) will be incorporated into pile foundation and abutment protection engineering for bridgework (PDF-1). In addition, the replacement bridge structure along Carlsbad Boulevard will possess deep pile foundations and well-protected abutments as engineered per appropriate regulatory safety requirements. Structures will be designed in accordance with applicable local and state engineering and design standards (PDF-2). It is anticipated that stone revetment would extend up to 300 feet from the channel to the north and south on both the eastern and western sides of the embankment. The sequence of work for the slope protection would be to first excavate the site to achieve the final ground elevation and then install filter fabric along the ground where needed. An underlayer of quarry run would be placed on top of the quarry run followed by an underlayer and armor layer.

Weir Construction At I-5

Construction of the new weir structure under I-5 is anticipated to require approximately 2 to 3 months. The first step would be to construct a temporary, sheetpile cofferdam around the work area, approximately 15 feet on each side of the weir. Once the cofferdam is in place, the work area would be dewatered using pumps and hoses with the water pumped back into the lagoon. The site would be kept dry during weir construction by continuous pumping. The work area would then be cleared of vegetation and loose surface material, which would also be hauled off-site via dump truck for disposal at a ~~landfill~~green waste facility. The clearing and removal would be conducted primarily with backhoes, although some hand labor may be needed in isolated areas. After clearing, the new weir site would be excavated to the final bottom elevation of the new weir structure. A gravel bedding layer would be placed on the bottom and timber would then be brought in to the site. The timber would be used to construct the concrete formwork. Steel rebar would be brought in next and the reinforcement structure would be laid out within the formwork. Upon completion of the formwork and steel reinforcement, concrete would be brought in and pumped into place with final working via hand labor. Once the concrete has cured and the weir structure is complete then the work area would be backfilled to final project elevations on either side of the weir. The temporary cofferdam would then be removed and the rest of the work area would be finished to final grade and condition.

2.8.6 Design Features

The Enhancement Project is designed to enhance the lagoon system as a whole. Due to the nature of the project, an effort has been made to proactively incorporate measures into each of the alternatives to minimize and avoid, where possible, impacts to resources. These “project design features” represent a commitment by the project proponent to construct the project in an environmentally sensitive way. Some project design features are incorporated to avoid or minimize a potential significant impact proactively through design, but others are additional

measures that support the overall enhancement objectives of the project without being tied to a specific potential impact. Many features also represent regulatory or code requirements that the project would need to comply with to be approved by various agencies and/or implemented legally. These features are committed to by the project applicant and would be implemented by the contractor or other parties before, during, and after construction. Inclusion of these project design features is considered in the determination of CEQA impact significance in Chapter 3. These features are summarized in Table 2-11 and include the purpose, timing, and responsibility for implementation of each project design feature.

2.9 MONITORING, MAINTENANCE, AND ADAPTIVE MANAGEMENT

Implementation of the Enhancement Project would require a comprehensive monitoring program to ensure compliance with regulatory requirements, track project success, and identify adaptive management strategies for use in the future. The detailed monitoring program would be developed after selection of a project alternative for implementation; this section discusses the anticipated framework and approach for that more detailed monitoring program. The monitoring program would likely have three components with different goals, as described below

1. Construction monitoring: to minimize and avoid impacts associated with construction
2. Enhancement monitoring: to track enhancement success immediately following construction (5 to 10 years)
3. Adaptive management: to monitor the overall health of the lagoon and maintain the lagoon into the future, for a minimum of the 50-year project life.

All three program components are described in general below. The final details would be determined upon selection of an alternative and identification of permit conditions with the resource agencies. Items such as exact monitoring locations and frequencies would depend on the alternative to be implemented and would be detailed as part of the permitting process.

Table 2-11
Project Design Features

PDF #	Design Features	Purpose	Timing	Implementation Responsibility
CARLSBAD BOULEVARD BRIDGE DESIGN FEATURES – Saltwater and Hybrid Alternatives Only				
PDF-1	Design recommendations from the San Diego Association of Governments (SANDAG) Sea Level Rise Study (SANDAG 2013) and California Coastal Commission Sea-Level Rise Policy Guidance (CCC 2015) will be incorporated into pile foundation and abutment protection engineering for bridgework.	Ensure bridge structural integrity.	Pre-construction	Project engineer
PDF-2	The replacement bridge structure along Carlsbad Boulevard will possess deep pile foundations and well-protected abutments as engineered per appropriate regulatory safety requirements. Structures will be designed in accordance with applicable local and state engineering and design standards.	Ensure bridge structural integrity and meet engineering requirements.	Pre-construction	Project engineer
PDF-3	The Carlsbad Boulevard alignment and bridge approach will conform to California Department of Transportation (Caltrans) standards for sight distance and vertical clearance.	Ensure motorist safety and meet engineering requirements.	Pre-construction	Project engineer
PDF-4	Channel and infrastructure improvements would be reviewed by SANDAG, the City of Carlsbad, and the City of Oceanside, as appropriate, prior to approval of project grading plans. Review by agencies with regulatory authority over specific structures in the lagoon (e.g. SANDAG for railroad structure protection, Caltrans for I-5 structure protection, cities of Carlsbad and Oceanside for Carlsbad Boulevard bridge replacement and pier protection) would focus on code requirements for structural and seismic safety for infrastructure improvements, and adequacy of revetment/pier protection for structures within channels.	Engineering review.	Pre-construction	SANDAG, City of Carlsbad, City of Oceanside
PDF-5	Create a temporary bicycle path on the outside lane of the open lane along Carlsbad Boulevard during bridge construction to allow continued access between the Cities of Oceanside and Carlsbad.	Bicycle access during construction.	During bridge reconstruction	Construction contractor
MATERIAL PLACEMENT ACTIVITIES				
PDF-6	Construct longitudinal training dikes at all receiver sites.	Reduce nearshore turbidity.	During beach-building	Construction contractor
PDF-7	Sand placement to avoid blocking line-of-sight at permanent lifeguard towers.	Public safety during construction.	During beach-building activities	Construction contractor, in coordination with local lifeguards

PDF #	Design Features	Purpose	Timing	Implementation Responsibility
PDF-8	Coordinate the schedule at individual materials placement sites to the extent possible to avoid major holidays and special events.	Minimize recreational conflicts.	During beach-building activities	SANDAG and construction contractor
PDF-9	Contain fill material during sand placement near storm drain outlets.	Continue proper drainage.	During beach-building activities	Construction contractor, in coordination with City Engineer
PDF-10	For disposal at LA-5, during transfer of the material at the monobuoy, excess water would be decanted from the barge and returned via pipe back to the lagoon to minimize ocean turbidity.	Minimize ocean turbidity.	During material disposal	Construction contractor
LAGOON ENHANCEMENT ACTIVITIES				
PDF-11	Conduct cattail maintenance during daylight hours and outside the bird nesting season (February 1 through September 15).	Avoid impacts to breeding birds and sensitive species.	During cattail maintenance	SANDAG

2.9.1 CONSTRUCTION MONITORING PROGRAM

The construction monitoring program for the Enhancement Project would be designed to minimize and avoid impacts to resources that could occur during construction activities. The program would address potential impacts associated with both construction within the lagoon as well as materials disposal/reuse. The project is an enhancement project and, as such, has been designed to be proactive in incorporating measures to reduce or avoid impacts to resources where possible. A number of PDFs have been incorporated as part of the Enhancement Project to avoid or minimize impacts, as identified in Table 2-11.

Mitigation measures have also been identified under specific resources to reduce potential significant impacts, as identified throughout Chapter 3. Additional measures could be identified as conditions associated with permits that would be issued by regulatory agencies prior to project initiation. Compliance with these permit conditions would also be integral to construction monitoring. The monitoring program for construction would be composed of these different measures.

In general, the anticipated construction monitoring program can be divided into two distinct phases:

1. Pre-construction (initiated approximately 1 year prior to construction)
2. During construction (up to approximately 30 months)

Construction monitoring would focus on ensuring compliance with project features and measures, particularly with respect to biological resources, water quality, and cultural resources. A monitoring program composed of project design features, mitigation measures, and additional permit conditions will be completed as final design progresses and permitting occurs.

A summary of the known measures that have been identified to date is shown in Table 2-12 by construction monitoring phase. Detailed measures are identified throughout this document, either in Table 2-11 or under specific resource discussions.

Table 2-12
Summary of Construction Monitoring Elements and Timing Requirements

Monitoring Element	EIR Analysis Section	Monitoring Phase	
		Pre-Construction	During Construction
Water Quality (Turbidity)	3.4		X
Biological Site Constraints	3.5	X	X
Threatened and Endangered Species	3.5	X	X
Grunion	3.5	X	X
Cultural Resources	3.7	X	X

The proposed materials placement sites have been identified based on previously authorized projects to minimize potential effects to sensitive resources (2001 and 2012 RBSPs, Navy Homeporting Project). Since those projects did not identify or result in significant environmental impacts, long-term monitoring is not anticipated at those sites, although specific resource agency conditions will be identified as part of the permitting process. Because pre-construction monitoring is designed to minimize construction impacts rather than establish a baseline for long-term enhancement monitoring, it is different from the lagoon enhancement component, which is addressed separately below.

2.9.2 LAGOON ENHANCEMENT MONITORING PROGRAM

Lagoon enhancement monitoring would occur during and immediately following construction for a period of 5 to 10 years. Once the initial post-construction monitoring phase is complete and success criteria have been met, the program would transition to adaptive management, where the site would be maintained in perpetuity. For the lagoon enhancement monitoring program, a comprehensive construction and monitoring plan would be prepared once the final alternative is selected. Regardless of the alternative, the plan would include requirements for planting plans, weed abatement, and remedial measures, as well as established annual success criteria.

Monitoring for the lagoon enhancement component of the Enhancement Project would be primarily focused on the lagoon itself and would include pre- and post-construction monitoring. Pre- and post-construction monitoring would be designed to focus on establishing a pre-construction baseline for lagoon conditions and sensitive species, then monitoring and confirming project success criteria are met over the longer term (5 to 10 years). Post-construction monitoring can also be tied to adaptive management actions to facilitate project success. While the main components of the pre- and post-construction monitoring program have been identified, a detailed program would be identified after the preferred alternative has been selected, and during final engineering of the project. This program would also incorporate permitting

conditions identified after the Final EIR has been certified, but prior to the initiation of construction.

Pre-construction monitoring for the Enhancement Project would focus on establishing a baseline for assessing the success of enhancement efforts. Each of the pre-construction surveys conducted for the lagoon enhancement itself would have a post-construction component as well. The potential effects of enhancement on sensitive bird species is one of the most important aspects of the project. Monitoring bird species would include species-specific surveys and monitoring of the avian assemblage as a whole within the lagoon. Types of surveys anticipated as part of the monitoring program are identified in Table 2-13, but this program may be altered or augmented based on permit and agency consultation through the permitting process.

Post-construction monitoring of the Enhancement Project would be focused on the lagoon enhancement component and designed to document achievement of project goals and objectives, including habitat improvements for plants and wildlife, success of revegetation efforts, and use of the site by sensitive species. This analysis would also be used to inform potential future adaptive management decisions and actions. Post-construction monitoring would document as-built conditions and provide comparison with pre-construction baseline conditions immediately after construction. Intensive short-term monitoring of enhancement success is anticipated to continue annually for a minimum period of 5 years after construction. It is more likely the short-term monitoring period would be developed based on 10 years of ecological performance standards; however, if success is achieved prior to 10 years, the site can transition to the less intensive, long-term monitoring and management phase that would adapt to ecological conditions in perpetuity.

Because the Enhancement Project is identified as one potential mitigation opportunities for the I-5 North Coast Corridor Project, the Resource Enhancement and Mitigation Program (REMP) would be consulted in the development of performance standards for the monitoring plan, which would also include the establishment of an endowment fund prior to implementation of the project. As stated in the REMP, performance standards to measure and monitor the success of the restoration efforts would occur pursuant to future permitting processes and in discussions with the REMP working group. Performance standards would be designed with the intent to provide resource and regulatory agencies with a high level of confidence that, once performance standards are achieved, the restored habitat is providing the desired ecological functions and will be self-sustainable under a long-term management program. The following are examples of performance standards that would be developed and quantified with measurable criteria:

Table 2-13
Anticipated Biological Survey Framework

Type of Survey	Purpose
Benthic Macroinvertebrates	Evaluate the health and functioning of the enhanced lagoon, due to importance in estuarine food webs. Benthic invertebrates can affect, and be affected by, physical processes, such as erosion, sedimentation, and nutrient cycling. Monitoring would include sampling of both epifauna and infauna and would occur during the summer, concurrently with the fish sampling protocols described below.
Fish	Post-construction monitoring for fish in deep and shallow subtidal and open water areas, as well as channels, would begin immediately following construction. Fish density surveys would be conducted annually between June 1 and July 31, while species richness surveys would be conducted between June 1 and October 31. Surveys would take place twice within one month at a number of locations within the lagoon. Surveys would be designed to provide information on the effectiveness of deep-water fish areas and colonization of saltwater species (Saltwater and Hybrid Alternatives). Fish surveys would also focus on presence of species critical for vector control, such as mosquito and killifish, in newly mowed channels through cattail areas.
General Avian Use of the Enhanced Lagoon	Monitoring of use of the lagoon by water-dependent birds, including shorebirds, waterfowl, gulls, terns, and others, is anticipated to be conducted monthly during the 5- to 10-year post-construction monitoring period to assist in determining whether the project has met its goals and objectives for improving habitats for bird species.
Light-Footed Ridgway's Rail	Ridgway's rail is a year-round resident of the lagoon and may utilize many of the habitat types (existing or established with the Enhancement Project) within the lagoon (low, brackish, and freshwater marsh for nesting, in addition to mid- and high-marsh and mudflat for foraging), and the project would affect each of these to different extents. Surveys for this species would inform continued habitat availability for Ridgway's rail within the enhanced lagoon. Although it is possible these species may be incidentally detected during general avian use surveys, annual focused surveys by permitted biologists for this species at appropriate times of the year when they are most vocal would provide the most accurate information regarding presence in the lagoon.
Belding's Savannah Sparrow	Belding's savannah sparrow may utilize pickleweed marsh in the I-5 Basin and forage at the beach in the western portion of the lagoon. Post-construction surveys (Saltwater and Hybrid Alternatives) would be designed to provide information on the presence of this species. Although it is possible these species may be incidentally detected during general avian use surveys, focused surveys by permitted biologists for these species at appropriate times of the year when they are most vocal – between March 1 and May 31 - would provide the most accurate information regarding presence in the lagoon.
Habitat/Species Coverage	The development of transitioning or planted areas, i.e., salt marsh and transition habitats, as well as sensitive species being tracked, would be monitored post-construction for 5 years to document the success of the Enhancement Project's planting plan and inform adaptive management actions.

- Topography. The wetland/and or aquatic habitat will not undergo major topographic degradation (such as excessive erosion or sedimentation) and will maintain percentage of the specified final wetland acreage amount.

- Water Quality. Water quality variables (to be specified) will be similar to reference wetlands or aquatic habitat.

- Tidal Prism. The designed tidal prism will be maintained and show continued tidal exchange.

- Habitat Areas. The area of different habitats will not substantially deviate from the planned habitats, and each habitat area will achieve a percentage of the expected species diversity and an expected cover.

- Biological Communities. Community composition and the total densities and number of species of fish, macroinvertebrates and birds will achieve specified levels.

- Reproductive Success. Certain plant species will have demonstrated reproduction at least once in three years.

- Food Chain Support. The food chain support provided to birds will achieve determined success criteria as determined by feeding activity of the birds.

- Exotics. The important functions of the wetland will not be impaired by exotic species as determined by cover percentages.

2.9.3 Adaptive Management and Maintenance

The Enhancement Plan would include both the anticipated maintenance regime and an adaptive management plan that would be implemented through at least the 50-year design life of the Enhancement Project. The maintenance plan would identify those areas of the lagoon that are anticipated to require periodic maintenance, such as inlet maintenance, cattail maintenance, or less frequent channel maintenance in other areas of the lagoon. The adaptive management plan would identify remedial measures that may be implemented if success criteria put in place as part of the project or permit conditions are not met or if conditions change during long-term monitoring and need to be addressed. Some of these actions may include, but are not limited to, refinement of cattail maintenance for effective vector control, facilitation of transitioning habitat, experimental planting of certain areas with bulrush or salt marsh species, additional dredging, replanting of salt marsh and transitional habitats, ~~and~~ amendment of soils, and relocation of fish

that could be extirpated during the transition to a saltwater regime. Long-term monitoring would be an integral part of an adaptive management program established to guide maintenance strategies into the future. Development of the detailed adaptive management program would occur after selection of the preferred alternative and during the final engineering phase of the project, prior to the initiation of construction. Detailed plans would be developed as part of consultation with permitting and resource agencies during the permitting approval process; however, it is anticipated that the long-term management plan would be a living document and would be updated regularly, as necessary.

General Components

General components associated with the adaptive management strategy are described below. Those referencing inlet maintenance would only be applicable if the Saltwater Alternative or Hybrid Alternative was selected for implementation.

1. **Replacement Planting**. Planted material that fails to become established would be replaced with similar plant species. Replacement vegetation would be installed between October 1 and March 31, to the extent possible. Areas with cattail may also be experimentally planted with bulrush, which provides better protection against vector breeding. Once established, bulrush also is a more stable habitat type in freshwater marsh.
2. **Weed Abatement**. Weedy species would be removed from the enhancement site frequently so they do not compete with the establishment of native plantings. This effort could also extend into areas adjacent to the project disturbance limits if the project is responsible for the expansion of invasive species into undisturbed areas.
3. **Trail Maintenance and Trash Removal.** Fishing access trail maintenance would occur periodically to maintain a clear and safe pathway. Trash would be removed from the fishing access trail and other enhancement project areas and disposed of in an acceptable manner, e.g., trash bins or landfill.
4. **Bank Protection Repair.** Should severe storms or other events result in damage to bridge and channel armor, repairs may be completed.
5. **Biological Monitoring and Maintenance of Habitat Quality.** Regular biological monitoring would be conducted to ensure that the wetlands meet biological goals. These activities would include:
    - habitat protection and posting of No Trespassing signs,

- enforcement of regulations associated with the enhancement of the wetlands and protection of listed species,
- control of nonnative invasive plant species by mechanical and chemical means as appropriate, and
- control of feral/exotic animal species using trapping and barriers as appropriate.

6. **Nesting Areas/Breeding.** A comprehensive program of inspection and maintenance of sensitive species breeding and nesting areas would be included as part of the biological monitoring program. Nesting area management would require regular control of excessive, especially weedy vegetation, and of predators in the surrounding urban environment.

7. **Threatened and Endangered Species.** Species-specific monitoring and management objectives would be established in conjunction with the resource agencies for threatened and endangered resident species. Measures may include ongoing surveys, habitat improvements, predator control, or other activities for the benefit of the species.

8. **Inlet Maintenance.** In addition to potential closure of the inlet by sediment transported during an extreme storm event, the regular flood and ebb currents moving through the inlet would build a flood shoal in the interior of the inlet. These sediment deposits in the flood shoal can change the habitat distribution within the wetlands by reducing the tidal range and/or by raising the elevations. As part of the adaptive management program, criteria establishing thresholds for initiating inlet maintenance would be developed.

9. **Channel Maintenance.** While maintenance of the inlet itself is anticipated to occur as frequently as every year, depending on the alternative, vegetation encroachment or sediment accumulation could occur in portions of lagoon channels over time. Maintenance of focused areas within lagoon channels is anticipated approximately every 10 years but would be tied to specific thresholds for initiating maintenance activities, which could involve vegetation removal and hauling from the site, or sediment removal through dredging small areas of the lagoon. Sediment accumulation under the Freshwater Alternative is difficult to predict, and maintenance is anticipated to be required approximately every 25 years. Therefore, these activities are not included in the maintenance analysis in this EIR."

Vector Management

Vector control, primarily focused on reducing mosquito populations, would be a key element of the adaptive management plan under all three enhancement alternatives. The conditions that tend to favor mosquitoes are stagnant, fresh or brackish water with minimal circulation, narrow

channels or a limited circulation system, and dense vegetation (particularly cattails). Critical management strategies to control vector populations in water bodies focus on breaking the larval life cycle before they mature and become adult mosquitoes. Strategies focus on increasing water circulation (particularly at a localized level) and wave action, varying water levels, decreasing vegetation such as cattails or replacing vegetation with more appropriate vegetation (e.g., bulrush), decreasing nutrients and reducing water temperatures, and providing improved access for natural predators of larval and adult mosquitoes (aquatic and airborne) to potential breeding areas. Aerial larvicide treatments can also become more effective if channels are extended through dense vegetation that may otherwise prevent the treatment from reaching the water surface.

Vector management in the form of aerial biological control larvicide applications would continue to be performed as needed by the County of San Diego Department of Health Services, Vector Control Program. The product currently used for aerial application is a combination of *Bacillus thuringiensis israelensis (Bti)* and *Bacillus sphaericus (Bs).* This product is appropriate for use in the sensitive lagoon habitat because it only affects mosquito and midge larvae, and not most other marsh invertebrates that are important to the food web and for other ecological functions. It is considered harmless to humans, fish, and other wildlife. Applications typically occur every 3 to 4 weeks during the general mosquito breeding season of April through October (County of San Diego 2014a).

Initial Management Strategy

Improved vector control would be included under all three enhancement alternatives. Specified cattail management areas that were generally determined based on stands of cattails that extended more than 150 feet from an open water area. In these areas, cattails would be managed to reduce the suitability of the habitat for vectors, while minimizing impacts to species that may use these habitats, such as Ridgway's rail. Management would involve mowing channels within the cattail stands to allow for swaths of open water throughout the vegetated area. Interspersed channels throughout the marsh vegetation would reduce the production of adult mosquitos by the following:

- allowing for increased predation of mosquito larvae by natural predators such as killifish and native minnows that would have better access to forage within the vegetation;
- increasing the effectiveness of aerial treatments (e.g. *Bti* larvicide) by allowing the larvicide to reach the water surface where it is most effective, rather than being caught in the vegetation canopy and on debris;

- increasing localized water circulation and wind wave action into dense cattail patches, which creates poor vector breeding conditions (e.g., wind waves drown mosquito larvae that rely on breathing tubes at the water surface); and
- improving tidal exchange and volumetric turnover to reduce the formation of persistent algal mats on which adult mosquitos lay eggs.

Two approaches may be used to create these channels:

1. Channels may initially be dredged of vegetation and then maintained by an aquatic mower to preclude encroachment of freshwater marsh vegetation.
2. Channels may instead be cut as shown in Figure 2-20 to a minimum depth of 4 feet below the water surface (or as deep as bottom depth allows). No sediment removal would occur under this approach and channels may shift in location to gradually remove areas of dense cattails that have accumulated a thatch layer.

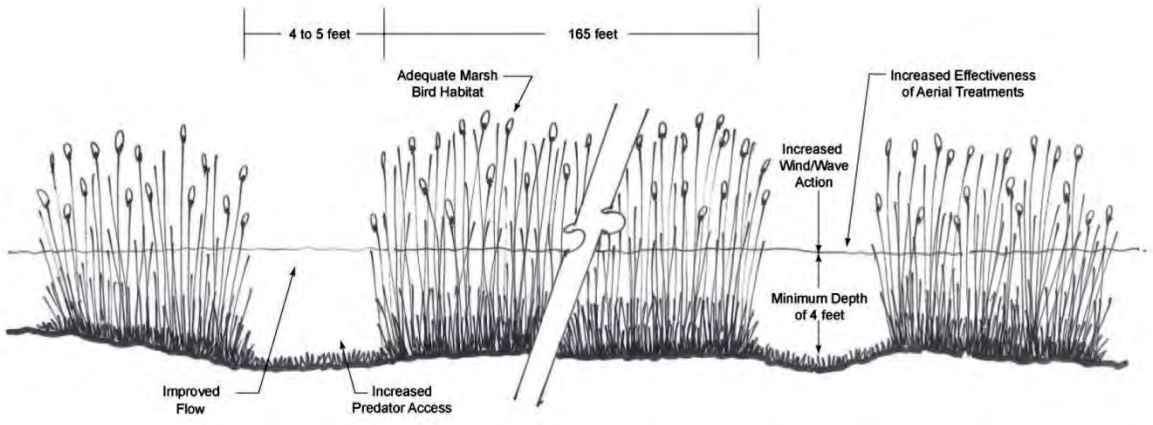

Figure 2-20. Vector Management

Channels would have a minimum width of 4 to 5 feet (dependent on machinery cutting width) and would be cut approximately every 165 feet (50 meters) apart. It is anticipated that up to 1 acre of cattails would be removed through these maintenance activities (1.0 acre under the Freshwater Alternative, and 0.9 acre under the Hybrid Alternatives) and it would require up to a week to complete each maintenance event. This cattail management activity would occur during daylight hours outside of the bird nesting season (PDF-11) and would be done in conjunction with a biological monitor to flush resident birds (e.g., Ridgway's rail) that may be present. Dependent on regrowth, cattail management would be performed approximately once a year,

possibly on a rotating schedule, or as necessary to prevent large, unbroken masses of dense cattail from forming.

Monitoring

Once the initial management strategy was implemented, ongoing monitoring efforts would be put in place to determine if the increased areas of open water through the channelized cattail management areas effectively reduce vector populations. Monitoring may include coordination with the County of San Diego Vector Control Program for the comparison of historic mosquito trap counts with current counts once management measures have been implemented. Monitoring may also include inspection for predatory fish species, such as mosquito fish or killifish within the lagoon and mowed channels.

Adaptive Management

Once the effectiveness of the initial cattail management strategy can be assessed, additional or modified vector control strategies may be implemented. Those specific strategies cannot be determined at this time but would be identified as needed based on future vector conditions. However, some future potential adaptive strategies are discussed in generalities below.

- Where brackish and freshwater marsh vegetation grows, promote replacement of cattail dominated habitat and incorporate a mixture of tule habitat (e.g., bulrush). Tule habitat provides for more open and conducive underwater passage for predatory fish as well as better conditions for effective aerial treatment applications. Tule would also preclude the regrowth of cattails in that area. Tule habitat is appropriate for the marsh bird species that currently use the cattail habitat.
- Reduce sediment accretion in channels created within marsh vegetation to encourage the passing through of nutrients (e.g., reduce and isolate sediment sources directly entering marsh areas).
- Implement a pilot program of dredging the channels through the cattail stands in place of mowing the vegetation. Dredging the channel bottoms to more than 4 feet below water surface levels would preclude the regrowth of cattail vegetation within those channels and eliminate the need for continual mowing of the vegetation.
- Mow or dredge additional main channels wider than the proposed 4- to 5-foot-wide channels. These main channels would serve to create more area of open water surface and provide better flow and access to the proposed smaller feeder channels. Design of these

channels would occur in conjunction with the resource agencies to ensure biological function for threatened and endangered species would not be compromised.

Under the Freshwater Alternative, develop a program to actively breech the weir and beach berm on a scheduled basis to flush water and the accumulated nutrients and bio mass/debris that encourage vector breeding. This could be accomplished through operational control features on the weir that would allow for elevational control.

Habitat Transition Areas

As a result of implementation of the Saltwater Alternative or Hybrid Alternative (west of I-5), saltwater would inundate freshwater marsh habitat. Much of the current freshwater marsh habitat would be actively transitioned through grading and dredging to salt marsh habitat. Areas outside the direct grading/dredging footprint that currently have freshwater marsh habitat (e.g., cattails), would be left in place to provide an interim habitat for Ridgway's rail and allowed to transition naturally over time (transition time would likely be dependent on resulting salinity levels). Cattails are anticipated to die off and be replaced with salt marsh habitat as soil salinities reach 25 percent (Beare 1987). As a result of the introduction of salt water, soil salinities will begin to increase, and remaining freshwater marsh areas would be anticipated to naturally transition to salt marsh habitat over time. The monitoring final details would be determined upon selection of an alternative and identification of permit conditions with the resource agencies. Items such as exact monitoring locations and frequencies would depend on the alternative to be implemented and would be detailed as part of the permitting process.

It is anticipated that passive adaptive management strategies would include a series of monitoring efforts as the habitat transitions naturally with time to determine if more active strategies are necessary for success. Monitoring would include the observation of cattail die-off rates in saltwater-influenced areas. Dead vegetation would be monitored to determine if it is accumulating or being flushed through the lagoon system. Invasive species would be closely monitored as transitional areas may be more prone to invasion by nonnative species.

Active adaptive management strategies would facilitate transition to saltwater habitats and would be determined based on the results of the habitat monitoring. While these specific strategies cannot be fully determined at this time, they could include:

- removal of dead vegetation if it were to accumulate and create a biomass layer (hindering habitat growth and increasing vector breeding areas),

- supplemental planting of salt marsh habitats, and
- removal of invasive species and treatments to limit the possibility of invasion.