112th Congress, 2d Session – – – – – – – – – – – – House Document 112–143

SAN CLEMENTE SHORELINE FEASIBILITY STUDY, ORANGE COUNTY, CA

COMMUNICATION

FROM

THE ASSISTANT SECRETARY OF THE ARMY, CIVIL WORKS, THE DEPARTMENT OF DEFENSE

TRANSMITTING

THE FINAL REPORT FOR THE SAN CLEMENTE SHORELINE FEASIBILITY STUDY

SEPTEMBER 19, 2012.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

SEP - 6 2012

Honorable John Boehner
Speaker of the House
of Representatives
U.S. Capitol Building, Room H-232
Washington, D.C. 20515-0001

Dear Mr. Speaker:

In response to the Energy and Water Development Appropriations Act of 2000, PL 106-60, adopted on September 29, 1999, the Secretary of the Army recommends authorization of a plan to reduce coastal storm damages for the San Clemente Shoreline in Orange County, California. The proposal is described in the report of the Chief of Engineers dated April 15, 2012. The views of the State of California, the Department of the Interior, The National Oceanographic and Atmospheric Administration, and the Environmental Protection Agency are set forth in the enclosed communications.

The recommended plan will reduce coastal storm damages by constructing a beach fill/berm along the San Clemente shoreline. The proposed project includes construction of a 50-foot-wide beach nourishment project along a 3,412-foot-long stretch of shoreline using 251,000 cubic yards of compatible sediment, with renourishment on the average of every 6 years over a 50-year period of Federal participation. The design berm will be constructed to an elevation of 17 feet Mean Lower Low Water (MLLW) with foreshore slope of 8H:1V (at equilibrium). Material for the beach fill will be dredged from a borrow site identified off the coast of San Diego County. The recommended plan also includes post-construction monitoring over the period of Federal participation to ensure project performance and adjust renourishment plans as needed. Monitoring of the environmental resources will be required for each construction event.

Based on October 2011 price levels, the estimated first cost of initial construction is $11,300,000. There will be 8 renourishments scheduled over the project lifetime, with a total cost estimated at $86,800,000. The total project cost which includes initial construction, monitoring, and periodic nourishment is estimated to be $98,100,000. Based on a 4 percent discount rate and a 50-year period of analysis, average annual costs are estimated at $2,180,000 while average annual coastal storm damage reduction (CSDR) and recreation benefits are estimated at $3,160,000. Of the total annual benefits, $1,422,000 is attributed to CSDR and $1,738,000 is attributed to recreation. The benefit-to-cost ratio (BCR) based on total annual benefits is approximately 1.4. Total project net benefits are estimated at $978,000. The recommended plan is the national economic development (NED) plan and is estimated to reduce average annual storm damages by 98%. The recommended plan is the environmentally preferred plan. The project is expected to have minimal impacts to environmental resources. A comprehensive monitoring and mitigation plan has been incorporated in the project in the event that impacts to habitat result.

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The City of San Clemente is the non-Federal cost-sharing sponsor for all features. Cost sharing is applied in accordance with the provisions of Section 103 of the Water Resources Development Act (WRDA) of 1986, as amended by Section 215 of WRDA 1999. The Federal share of the total first cost of initial construction would be about $7,350,000 (65 percent) and the non-Federal share would be about $3,960,000 (35 percent). The cost of lands, easements, rights-of-way, relocations, and dredged or excavated material disposal sites (LERRD) is estimated at $11,000, all of which is eligible for LERRD credit. Based on WRDA 1996, as amended, subject to the availability of funds and conditions of public ownership and use of the shore, the Federal and non-Federal share of the renourishment costs is 50 percent, resulting in a total renourishment cost of about $43,400,000 each. The City of San Clemente is legally capable of fulfilling the requirements for being the non-Federal sponsor.

The Office of Management and Budget advises that there is no objection to the submission of the report to the Congress. However, OMB also advises that as a matter of Federal investment policy, flood risk management projects must have enough flood risk management and related benefits to justify its construction on its own, independent of any recreation benefits. Therefore, OMB advises that should the Congress authorize this project for construction, it would need to compete with other proposed investments for funding in future budgets. A copy of its letter is enclosed. I am providing a copy of this transmittal and the OMB letter dated August 31, 2012, to the House Committee on Transportation and Infrastructure Subcommittee on Water Resources and Environment and the House Committee on Appropriations Subcommittee on Energy and Water Development. I am providing an identical letter to the President of the Senate.

Very truly yours,

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

Enclosures

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Enclosures
1. Report of the Chief of Engineers, April 15, 2012
2. OMB Clearance Letter, August 31, 2012
3. Record of Decision, September 6, 2012
4. State of California letter to USACE, October 12, 2011
5. DOI letter to USACE, October 4, 2011
6. NOAA letter to USACE, September 30, 2011
7. EPA letter to USACE, September 27, 2011
8. HQUSACE response to DOI, March 21, 2012
9. HQUSACE response to NOAA, March 23, 2012
10. USACE response to EPA, March 14, 2012
11. San Clemente Shoreline, Orange County, California, Final Feasibility Report and Environmental Impact Statement, July 2011

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

CEMP-SPD (1105-2-10a) APR 15 2012

SUBJECT: San Clemente Shoreline, Orange County, California

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on coastal storm damage reduction along the Pacific Ocean shoreline in San Clemente, California. It is accompanied by the report of the Los Angeles District Engineer and the South Pacific Division Engineer. These reports are in partial response to the authority contained in Section 208 of the Flood Control Act of 1965 (Title II of P.L. 89-298), which provides for studies to determine the advisability of protection work against storm and tidal waves along the coasts of Washington, Oregon, and California. The Energy and Water Development Appropriations Act of 2000, P.L. 106-60, appropriated the funds for a reconnaissance study to investigate shoreline protection alternatives for San Clemente Shoreline, California. Preconstruction engineering and design activities for this project will be continued under the authority provided by the resolutions cited above.

2. The reporting officers recommend authorization for a plan to reduce coastal storm damages by constructing a beach fill/berm along the San Clemente shoreline. The recommended plan for coastal storm damage reduction includes construction of a 50-foot-wide beach nourishment project along a 3,412-foot-long stretch of shoreline using 251,000 cubic yards of compatible sediment, with renourishment on the average of every 6 years over a 50-year period of Federal participation, for a total of eight additional nourishments. The design berm will be constructed to an elevation of 17 feet MLLW with foreshore slope of 8H:1V (at equilibrium). Material for the beach fill will be dredged from a borrow site identified off the coast of San Diego County. Physical monitoring of the performance of the project will be required annually throughout the 50-year period of Federal participation. The recommended plan would provide coastal storm damage reduction throughout the project reach and would maintain the existing recreational beach. Monitoring of the environmental resources will be required for each construction event. The project is expected to have minimal impacts to environmental resources. A comprehensive monitoring and mitigation plan has been incorporated in the project in the event that impacts to habitat result. The recommended plan is the national economic development (NED) plan for coastal storm damage reduction.

3. The City of San Clemente is the non-Federal cost-sharing sponsor for all features. Based on October 2011 price levels, the estimated total nourishment cost of the plan is $98,100,000, which includes the project first cost of initial construction of $11,300,000 and a total of 8 periodic renourishments at a total cost of $86,800,000. Periodic renourishments are planned at 6-year

[1] This report contains the proposed recommendation of the Chief of Engineers. The recommendation is subject to change to reflect Washington level review and comments from Federal and State agencies.

intervals. In accordance with the cost share provisions in Section 103 of the Water Resources Development Act (WRDA) of 1986, as amended (33 U.S.C. 2213), the Federal and non-Federal shares are as follows:

a. The Federal share of the project first cost would be $7,350,000 and the non-Federal share would be $3,960,000, which equates to 65 percent Federal and 35 percent non-Federal. The cost of lands, easements, rights-of-way, relocations, and dredged or excavated material disposal areas (LERRD) is estimated at $11,000, all of which is eligible for LERRD credit.

b. The Federal share of the total renourishment cost would be $43,400,000 and the non-Federal share would be $43,400,000, which equates to 50 percent Federal and 50 percent non-Federal.

c. The total nourishment cost includes $4,460,000 for environmental monitoring, and $8,550,000 for physical monitoring over the life of the project.

d. The City of San Clemente would be responsible for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the project after construction. The project is not currently estimated to result in a significant incremental increase over the sponsor's existing beach maintenance activities and costs.

4. Based on a 4-percent discount rate and a 50-year period of analysis, the total equivalent average annual costs of the project are estimated to be $2,180,000, including monitoring. All project costs are allocated to the authorized purpose of coastal storm damage reduction. The selected plan would reduce average annual coastal storm damages by about 97 percent and would leave average annual damages estimated at $36,900. The equivalent average annual benefits, which include recreational benefits, are estimated to be $3,160,000, with net average annual benefits of $978,000. The benefit-cost ratio is approximately 1.4 to 1.

5. The goals and objectives included in the Campaign Plan of the U.S. Army Corps of Engineers have been fully integrated into the San Clemente Shoreline study process. The project includes an annual project monitoring program to reevaluate and adjust the periodic renourishment actions. The study was conducted using a watershed perspective to examine sediment supply changes within the San Juan Creek Watershed. A statistical, risk based model was used to formulate and evaluate the project. The project is intended to address erosion and prevent damages to structures and contents; it is not intended to, nor will it, reduce the risk to loss of life during major storm events. The study report fully describes risks associated with residual coastal storm damages and risks that will not be reduced. These residual risks have been communicated to the City of San Clemente.

6. Along the shoreline of San Clemente, a lack of sediment supply to the shoreline has resulted in chronic, mild, and long-term erosion. Without a coastal storm damage reduction project public properties and structures will continue to be susceptible to damages caused by erosion (including land loss and undermining of structures), inundation (structures), and wave attack (structures, railroad). The project area includes the LOSSAN (Los Angeles to San Diego)

railroad corridor which is a vital link for passenger and freight service and has been designated as a Strategic Rail Corridor by the Department of Defense. As the protective beach lessens over time and is eventually lost, it is expected that storm waves will act directly upon the railroad ballast, significantly threatening the operation of the LOSSAN railroad line. The narrowing beaches are also expected to subject ancillary beachfront public facilities to storm wave-induced damages, and further reduce recreational space on an already space-limited beach. The recommended plan was formulated to maximize coastal storm damage reduction, address potential environmental affects, and minimize cost.

7. In accordance with the Corps Engineering Circular (EC 1165-2-211) on sea level change, the study performed a sensitivity analysis to investigate the economic effects that different rates of accelerated sea level rise could have on the recommended plan. The plan was formulated using a historical or low rate of sea level rise, and the sensitivity analysis used additional accelerated rates, which includes what the EC defines as medium and high rates. The sensitivity analysis indicates that at higher rates of sea level rise, renourishment intervals increase and the reduction of storm damages decreases, but the plans are still justified.

8. In accordance with the Corps Engineering Circular (EC 1165-2-209) on review of decision documents, all technical, engineering and scientific work underwent an open, dynamic and vigorous review process to ensure technical quality. This included an Agency Technical Review (ATR), an Independent External Peer Review (IEPR) (Type I), and a Corps Headquarters policy and legal review. All concerns of the ATR have been addressed and incorporated into the final report. The IEPR was completed by Battelle Memorial Institute. A total of 24 comments were documented. The IEPR comments identified significant concerns in areas of the plan formulation and engineering assumptions that are needed to support the decision-making process and plan selection. This resulted in expanded narratives throughout the report to support the decision-making process and justify the recommended plan. A safety assurance review (Type II IEPR) will be conducted during the design phase of the project. All comments from the above referenced reviews have been addressed and incorporated into the final documents. Overall the reviews resulted in improvements to the technical quality of the report.

9. Washington level review indicates that the project recommended by the reporting officers is technically sound, environmentally and socially acceptable, and economically justified. The plan complies with all essential elements of the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Land related resources implementation studies and complies with other administrative and legislative policies and guidelines. Also the views of interested parties, including Federal, State and local agencies have been considered.

10. I concur in the findings, conclusions, and recommendations of the reporting officers. Accordingly, I recommend that the plan to reduce coastal storm damages for the San Clemente, California shoreline be authorized in accordance with the reporting officers' recommended plan at an estimated project first cost of $11,300,000 with such modifications as in the discretion of the Chief of Engineers may be advisable. My recommendation is subject to cost sharing, financing, and other applicable requirements of Federal and State laws and policies, including Section 103 of WRDA 1986, as amended by Section 215 of WRDA 1999. The non-Federal

sponsor would provide the non-Federal cost share and all LERRD. Further the non-Federal sponsor would be responsible for all OMRR&R. This recommendation is subject to the non-Federal sponsor agreeing to comply with all applicable Federal laws and policies.

a. Provide a minimum of at least 35 percent of initial project costs assigned to coastal storm damage reduction, plus 50 percent of initial project costs assigned to reducing damages to undeveloped public lands, plus 50 percent of initial project costs assigned to recreation, plus 100 percent of initial project costs assigned to reducing damages to undeveloped private lands and other private shores that do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to reducing damages to undeveloped private lands and other private shores that do not provide public benefits and as further specified below:

(1) Provide 25 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project.

(2) Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs.

(3) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the project.

(4) Provide, during construction, any additional amounts as are necessary to make the total contribution equal to 35 percent of initial project costs assigned to coastal storm damage reduction, plus 50 percent of initial project costs assigned to reducing damages to undeveloped public lands, plus 50 percent of initial project costs assigned to recreation, plus 100 percent of initial project costs assigned to reducing damages to undeveloped private lands and other private shores that do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to reducing damages to undeveloped private lands and other private shores that do not provide public benefits.

b. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government.

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal Sponsor

of responsibility to meet the non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance.

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project related betterments, except for damages due to the fault or negligence of the United States or its contractors.

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20.

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal Sponsor with prior specific written direction, in which case the non-Federal Sponsor shall perform such investigations in accordance with such written direction.

g. Assume, as between the Federal Government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project.

h. Agree, as between the Federal Government and the Non-Federal Sponsor, that the non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA.

i. If applicable, comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

j. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of floodplain management plans; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c))."

k. Comply with section 402 of the WRDA of 1986, as amended (33 U.S.C. 701b-12), which requires the non-Federal interest to participate in and comply with applicable Federal floodplain management and flood insurance programs, prepare a floodplain management plan within one year after the date of signing a Project Partnership Agreement (PPA), and implement the plan no later than one year after project construction is complete.

l. Provide the non-Federal share of that portion of the costs of data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement.

m. Participate in and comply with applicable Federal floodplain management and flood insurance programs.

n. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

o. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the project.

p. Not less than once each year, inform affected interests of the extent of protection afforded by the project.

q. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project.

r. For so long as the project remains authorized, the non-Federal Sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based;

s. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the Federal Government;

u. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

11. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any significant modifications and will be afforded an opportunity to comment further.

MERDITH W. B. TEMPLE
Major General, U.S. Army
Acting Commander

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

August 31, 2012

The Honorable Jo-Ellen Darcy
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Washington, DC 20310-0108

Dear Ms. Darcy:

As required by Executive Order 12322, the Office of Management and Budget completed its review of your recommendation for the San Clemente Shoreline, San Clemente, California, and coastal storm damage reduction project.

The feasibility report relies on the use of recreation benefits to justify the project. Based on an analysis of costs and benefits, the Corps estimates that the benefit-cost ratio for the project is 1.4 at a discount rate of 4 percent, with the benefit-cost ratio for coastal storm damage reduction alone being 0.65 and recreation at 0.75. As a matter of Federal investment policy, a Federal flood damage reduction project must have enough flood damage reduction and related benefits to justify its construction on its own, independent of any recreation benefits.

The Office of Management and Budget does not object to you submitting the San Clemente report to Congress. However, when you do so, please advise the Congress of the Administration's position cited above and that should the Congress authorize this project for construction, it would need to compete with other proposed investments for funding in future budgets.

Sincerely,

Sally Ericsson
Program Associate Director
Natural Resources, Energy, and Science

RECORD OF DECISION

SAN CLEMENTE SHORELINE, ORANGE COUNTY, CALIFORNIA

The Final Feasibility Report and the Final Environmental Impact Statement (FR/FEIS) for the San Clemente Shoreline, Orange County, California, dated February 2012, address coastal storm damage reduction opportunities in San Clemente, California. Based on the FR/FEIS, the reviews of other federal, state and local agencies, input from the public, and the review by my staff, I find that the plan recommended by the Chief of Engineers is technically feasible, economically justified, in accordance with environmental statutes and in the public interest. Thus, I approve the San Clemente Shoreline Project for construction.

The FR/FEIS documents the evaluation of both structural and non-structural alternatives to reduce coastal storm damages in the San Clemente, California area. The recommended plan consists of construction of a 50-foot wide protective beach berm which would be renourished to maintain the protection on the average of every 6 years over the 50-year period of federal participation. The beach berm would extend along about 3,400 feet of shoreline and would have a crest elevation of +17 feet above Mean Lower Low Water. The initial construction would use approximately 251,000 cubic yards of sand. The beach berm would slope toward and into the surf at a ratio of about 8 feet horizontal for every 1 foot vertical (at equilibrium). Material for the beach fill would be dredged from a borrow site off of the coast of San Diego County. Monitoring of the beach profile would be undertaken annually. The recommended plan is the National Economic Development (NED) plan. No compensatory mitigation is included as part of the initial construction; however, additional monitoring of the potential area of impact would be conducted.

Significant impacts to biological resources (i.e., surfgrass) and recreation (i.e., surfing) were not predicted to occur, in large part because of the small construction footprint and the limited schedule necessary for both the initial project implementation, as well as future renourishments. As part of the recommended plan, the Chief of Engineers included consideration of future mitigation measures if monitoring results demonstrate that impacts have not been avoided or minimized. A monitoring plan has been prepared to address potential mitigation, if necessary.

In addition to a "no action" plan, six structural alternatives and one non-structural alternative for coastal storm damage reduction were identified and discussed in the FR/FEIS. The structural alternatives included beach fill, revetments, sheet pile seawalls, breakwaters, offshore reefs and groins. The non-structural alternative that was considered was managed retreat. The no action plan and beach fill alternatives were advanced for final evaluation and are fully described in the FR/FEIS, which is incorporated here by reference. Beach berm widths ranging from 0 to 197 feet were analyzed. The 50-foot plan was identified as the NED plan. The recommended plan is the 50-foot plan, which is also the environmentally preferrable alternative and the plan

preferred by the local sponsor. All practicable means to avoid or minimize adverse environmental effects have been incorporated into the recommended plan.

The Draft Feasibility Report and Draft Environmental Impact Statement were circulated for public review for 45 days beginning on August 6, 2010. A public meeting was held August 19, 2010. All comments submitted were responded to in the FEIS.

Technical and economic criteria used in the formulation of alternative plans were those specified in the Water Resource Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies*. All applicable laws, executive orders, regulations and guidelines were considered in the evaluation of alternatives and the selection of the recommended plan. Based on review of these evaluations, I find that the overall benefits gained with construction of the recommended project serve the public interest and outweigh any adverse effects. This Record of Decision completes the National Environmental Policy Act process.

SEP - 6 2012
Date

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

STATE OF CALIFORNIA
Governor's Office of Planning and Research
State Clearinghouse and Planning Unit

Edmund G. Brown Jr.
Governor

Ken Alex
Director

October 12, 2011

Thomas W. Keeney
U.S. Army Corps of Engineers - SPL
P.O Box 532711
Los Angeles, CA 92053-2325

Subject: San Clemente Shoreline Feasibility Study
SCH#: 2010084002

Dear Thomas W. Keeney:

The State Clearinghouse submitted the above named Final Document to selected state agencies for review. The review period closed on September 28, 2011, and no state agencies submitted comments by that date. This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act.

Please call the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process. If you have a question about the above-named project, please refer to the ten-digit State Clearinghouse number when contacting this office.

Sincerely,

Scott Morgan
Director, State Clearinghouse

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

TAKE PRIDE IN AMERICA

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Mr. Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works
Headquarters
U.S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

RE: Thirty–Day Review of Chief of Engineers Proposed Report, on the San Clemente Shoreline Protection Project, Orange County, CA

Dear Mr. Brown:

The U. S. Department of the Interior (Department) has reviewed the U. S. Army Corps of Engineers (Corps), Chief of Engineers Proposed Report on the San Clemente Shoreline Protection Project, Orange County, CA.

In July 2011, the Department's U.S. Fish and Wildlife Service (FWS) developed a Coordination Act Report (CAR) for the project, pursuant to the Fish and Wildlife Coordination Act. It appears that the recommendations in the CAR were not incorporated into the current project description provided by the Corps; notably our suggestions to modify the project to a 10-meter (m) [33-foot (ft)] beach width to help minimize potential impacts to surfgrass and reef and mitigation risks/costs due to the uncertainty regarding surfgrass restoration. We are enclosing the July 2011 CAR for your consideration and inclusion within your report.

Thank you for the opportunity to provide comments. If you have any questions regarding our comments or need additional information, please contact Mr. Jon Avery, FWS, Federal Projects Coordinator, at 760-431-9440 or email Jon_Avery@fws.gov.

Sincerely,

Willie R. Taylor
Director, Office of Environmental Policy and Compliance

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

SEP 30 2011

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works
U.S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, Virginia 22315-3860

Dear Mr. Brown:

The National Oceanic and Atmospheric Administration (NOAA) has reviewed the U.S. Army Corps of Engineers' (Corps) Final Joint Environmental Impact Statement/Environmental Impact Report (FEIS) San Clemente Shoreline Protection Project. The enclosed comments include an evaluation of the Corps' response to the issues raised by NOAA's National Marine Fisheries Service's (NMFS) during development of the FEIS regarding effects of the project on the marine environment. These evaluations are based on NOAA's special expertise and responsibility to protect essential fish habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act and conserve wildlife resources under the Fish and Wildlife Coordination Act. NMFS previously provided comments on the Draft Environmental Impact Statement on September 20, 2010. The comments included EFH conservation recommendations and recommendations pursuant to our Fish and Wildlife Coordination Act (FWCA) responsibilities. The San Clemente Shoreline Project sets a precedent for how Corps Civil Works may plan and implement similar projects for which sensitive nearshore habitats may be impacted. NMFS discusses their concerns in greater detail in the enclosed comments and provides recommendations that should be addressed prior to a record of decision.

Thank you for consideration of NMFS comments and recommendations. If you have any questions, please contact Bryant Chesney, NMFS Southern California Habitat Coordinator, at (562) 980-4037 or Bryant.Chesney@noaa.gov.

Sincerely,

Paul N. Doremus, Ph.D.
NOAA NEPA Coordinator

Enclosure

cc: Colonel R. Mark Toy

NOAA's National Marine Fisheries Service (NMFS) has reviewed the U.S. Army Corps of Engineers' (Corps) Final Joint Environmental Impact Statement/Environmental Impact Report (FEIS). NMFS offers the following comments pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), National Environmental Policy Act (NEPA), and Fish and Wildlife Coordination Act (FWCA).

Consultation History

NMFS has provided informal technical input via a number of interagency meetings and email correspondence dating back to 2007. NMFS formally provided comments on the Draft Environmental Impact Assessment (DEIS) pursuant to MSA, NEPA, FWCA, the Endangered Species Act, and the Marine Mammal Protection Act on September 20, 2010. Within these comments, NMFS provided essential fish habitat (EFH) Conservation Recommendations pursuant to our MSA responsibilities and FWCA recommendations.

Proposed Project

The following project description is found on page ES-2 of the FEIS.

> *Two scales of the Beach Fill Alternative were analyzed; they both consist of dredging material from offshore Oceanside, then hauling and placing it at San Clemente Beach. The proposed Project is a 50 foot (15 m) resultant beach width. Beach fill would be 3,412 ft (1,040 m) long with a +17 ft (+5.2 m) crest elevation. The dredge volume is estimated to be approximately 251,130 cubic yards (192,000 m324). Dredge material gradation is 6 to 12 percent of fines, 5 to 8 percent of gravel/cobbles, and the rest is sand. Material classification assumed is 10 percent fines, 83 percent sand and 7 percent gravel. Construction is anticipated to begin in 2012 but may begin as soon as 2010.*

Summary of Concerns on the FEIS

The San Clemente Shoreline Project sets a precedent for how Corps Civil Works may plan and implement similar projects for which sensitive nearshore habitats may be impacted. NMFS has a number of concerns regarding the proposed project and the FEIS. They are summarized in bullet form below. These concerns are described in greater detail in the text that follows.

- The FEIS and Final Feasibility Report do not explicitly address comments provided by an Independent External Peer Review.
- The Corps' response is inconsistent with key aspects of our EFH Conservation Recommendations. In some cases, justification for the inconsistent responses is absent, unclear, and/or not supported by adequate scientific justification.
- The Corps incorrectly states that NMFS has no authority to provide comments pursuant to the FWCA.
- The FEIS contains various mischaracterizations of NMFS involvement and opinions expressed during the agency coordination process.

Precedent of Corps Civil Works Beach Nourishment Projects Near Sensitive Resources

NMFS believes this project sets a precedent for how Corps Civil Works intends to approach beach nourishment projects for which sensitive habitats exist immediately offshore. The Corps is also in the planning stages of a similar project at Encinitas -Solana Beach. This area is within San Diego County and very similar to San Clemente with high coastal bluffs, little or no sandy beach, and a rock platform. This project is substantially larger – over 1,200,000 cubic yards of sediment over approximately 2.9 miles of shoreline with extensive reef habitat immediately offshore.

Based upon comments given during the agency coordination process, our response to the DEIS, and our current response to the FEIS, NMFS does not believe the Corps has fully addressed NMFS' concerns regarding monitoring, impact determination, and mitigation for sensitive nearshore resources. Thus, NMFS hopes that resolution of concerns expressed for the San Clemente Shoreline Project will facilitate a more efficient and environmentally benign project in Encinitas-Solana Beach.

Disclosure of Pertinent NEPA Information

NMFS recently became aware of a document titled 'A Final Independent External Peer Review Report: San Clemente Storm Damage and Shoreline Protection Feasibility Study' and was dated July 23, 2010. NMFS obtained the document from the following Corps website: http://www.usace.army.mil/CECW/PlanningCOP/Documents/peer/san_clemente.pdf. The NMFS notes the absence of this review in Section 12.0 References of the FEIS. Given the findings of the independent review, NMFS finds it highly problematic that this review was not discussed in the DEIS or the FEIS.

Below is the summary of the panelist comments:

Plan Formulation: Several aspects of the plan formulation component of the San Clemente Feasibility Study lack the details necessary to fully understand the decision-making process. In particular, more details are needed on the following: the screening process for management measures, the population and properties potentially impacted by the project, and the public involvement process.

Economics: Overall, the economics portions of the report are well written, and do not include any serious issues. However, one minor concern is the lack of documentation supporting the use of an uncertified beach damage model. In addition, while the economics appendix demonstrates a clear understanding that recreational benefits are treated as incidental, the Feasibility Report's Sections 4.5 and 4.6 suggest, in contrast, that recreation was a primary planning objective.

Engineering: There are several significant engineering assumptions and analyses that affect plan formulation results which are not substantiated or well justified. There also are several parameters included in the integrated engineering-economic model that are not well supported by data, assumptions, and analyses. Further, these parameters inherently have a high degree of uncertainty that is not quantified and included in plan formulation. Additional data and analyses

to substantiate the assumptions, and consideration of the uncertainties must be incorporated into the plan formulation analyses.

Environmental: The environmental review of the project was generally clear and thorough; however, the discussion on the significance of impacts on two habitats (surfgrass and kelp beds) that are of primary concern when selecting beach width alternatives were inconsistent and not substantiated. While uncertainties exist as to the likely impact on these communities due to sand burial, the document does not provide an adequate approach to determining the significance on these communities and the species they support nor a clear adaptive management program to deal with the uncertainty.

Below is a table that lists the 24 Final Panel Comment statements by level of significance.

Table 3. Overview of 24 Final Panel Comments Identified by San Clemente Feasibility Study IEPR Panel

	Significance – High
1	The assumption that the existing beach is erosional is not supported by the data and analyses used to develop representative Future without Project conditions
2	The sediment budget discussion needs to be updated and refined to include reach-specific information.
3	Railroad Reach Conversion Criterion assumptions and values are not substantiated or consistent.
4	There are significant uncertainties associated with the selected value of the Minimum Beach Criterion that are not considered in the project alternatives evaluation and plan formulation analyses.
5	The use of the San Diego Association of Governments (SANDAG) project to predict the performance of the San Clemente project has not been justified.
6	The values used to represent expected storm-induced cross-shore sand transport and beach change have not been verified to site-specific conditions.
7	Details on sediment compatibility and relationship of depth to closure need to be added to the equilibrium beach profile, toe of fill, and rock coverage analyses.
8	The volume-to-area relationship used to derive beach fill volume and expected fill performance is not supported and additional details are needed on specific beach profile characteristics and beach fill design parameters.
	Significance – Medium
9	The significance of the loss of surfgrass and kelp bed communities should be defined.
10	The description of each planning reach should include information on the reach's economic, environmental, socio-demographic, and engineering characteristics, and the rationale for the elimination of specific reaches needs to be better described.
11	Based on the information provided, it was not evident that a sufficient level of public involvement took place.

12	Cost effectiveness and not cost should be used for screening the measures.
13	More thorough documentation and analysis is needed on management measures to justify the selection of the alternative.
14	More detailed examination of the impacts of future sea level rise on the project is warranted.
15	Impacts of the project to the local community are not described in detail sufficient to provide a clear and accurate representation of the current conditions in the study area.
16	The cost analysis assumptions are reasonable; however, the mobilization/demobilization costs and the estimate of contingencies should be revised to reflect equipment availability, travel times, and production capacity.
17	It is not clear whether Borrow Area 2A can satisfy the project's 50-year needs.
18	Since the coastal storm damage model does not appear to have been certified, then the model itself and particularly the key random variables need to be described in considerably more detail, and evidence of model certification should be provided.
19	It is not clear how the effects of loose rock and cobble in the San Clemente beach profile affect beach dynamics and expected project performance.
20	Some elements of project monitoring are missing and an adaptive management plan needs to be developed.
21	The effects of borrow area sediment quality variation on water quality, project constructability, and project performance could be different than those discussed in the report.
	Significance – Low
22	The calibration of railroad damage functions is not clear.
23	There are omissions in the Environmental Impact Statement's section on Biological Resources (including unclear figures, missing information on surfgrass fauna, and incomplete discussions on shorebirds and sea turtles) that need to be addressed.
24	Recreational benefits must be treated as incidental benefits of the project.

Given that the Feasibility Study provides the foundation for the Corps' NEPA documentation, NMFS recommends that the Corps explain how they addressed the comments provided by this independent review.

It is possible that the Corps made reference to this document on page 5-55.

> *No ATR or IEPR comments raised this* [mitigation approach] *as a concern, and uncertainty persists as to whether there will be any impacts at all to rocky reef and surfgrass vegetation from the recommended alternative.*

The meaning of the IEPR acronym was not listed in Section 11.0 Glossary, Acronyms, and Abbreviations. NMFS used the Acrobat 'Find' tool in Volumes I and II of the FEIS, the San Clemente Shoreline Feasibility Study Final Report, and the Technical Appendices to the Final Report, but was unable to locate another instance of its use. Thus, NMFS was not able to determine the exact meaning of the acronym, but, superficially, the acronym matches **I**ndependent **E**xternal **P**eer **R**eview. If the use of the acronym 'IEPR' was referring to the peer review, then this statement is misleading. As summarized above, the panelists found that 'while uncertainties exist as to the likely impact on these communities [surfgrass and kelp beds] due to sand burial, the document does not provide an adequate approach to determining the significance on these communities and the species they support nor a clear adaptive management program to deal with the uncertainty.'

Statutory Response to EFH Conservation Recommendations

The Corps' response to our EFH Conservation Recommendations reads as follows:

> *The monitoring and mitigation plan in Appendix B has been revised to include mitigation for loss of surfgrass and reef habitat. If surfgrass mitigation fails, a contingency plan has been developed to plant kelp on an offshore reef.*

The Corps' final response must include a description of measures to be required to avoid, mitigate, or offset the adverse impacts of the activity. If the Corps' response is inconsistent with our EFH conservation recommendations, the Corps must provide an explanation of the reasons for not implementing those recommendations. The reasons must include the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

The Corps response to the EFH Conservation Recommendations pointed to Appendix B. However, Appendix B did not provide an adequate response to all of our EFH Conservation Recommendations. Below NMFS identifies those EFH Conservation Recommendations that were not adequately addressed.

Conservation Recommendation 1: Given the high ecological values associated with surfgrass and rocky reef habitat, NMFS believes unavoidable reductions in quantity and/or quality of these habitats should be addressed via compensatory mitigation. The Corps and project sponsor should develop a contingency mitigation plan in consultation with NMFS and other interested agencies prior to the record of decision for the proposed project.

The contingency mitigation plan should be based upon a reasonable estimate of potential impacts to rocky reef and surfgrass habitat. This estimate should be developed and agreed upon by Corps, NMFS, and other interested agencies prior to the record of decision for the proposed project. This estimate may then be used as the basis for determining the approximate cost of implementing a mitigation project and should be incorporated into the benefit to cost ratio of the proposed project. In addition, the estimated cost can serve as the basis for providing financial assurances that will ensure a high level of confidence that the compensatory mitigation project will be completed if impacts are observed.

The Corps developed a contingency mitigation plan, which is described in Appendix B. However, the estimate of potential impacts to rocky reef and surfgrass habitat was not agreed upon by NMFS and other interested agencies. NMFS believes the Corps estimate is not well supported and outlines some of the problematic issues below.

Impact Uncertainty

The basis for the Corps estimate of impacts is uncertain. Appendix B states the following regarding estimated impacts:

Impacts to rocky reef and surfgrass are expected to be none to very minor, but currently are unknown.

Potential project impacts to these resources were based on modeling that indicates that sand movement may extend to the offshore/outer edge of the reef; however, sand at the offshore/outer edge of the reef would be thin and not significant. Potential burial of the inshore edge of T-Street reef is uncertain; however, in a reasonable worst case scenario, approximately 20 percent of the inshore edge of the T-Street reef area (about 1 acre) may be buried.

On page 5-57, the following is stated:

The estimate that approximately 20 percent of the reef or 1 acre would experience significant burial was determined by superimposing the sand distribution cross section predicted by Corps coastal engineers on the offshore bathymetry and by delineating the reef as well as the surfgrass locations measured in the field by Chambers Group.

The FEIS acknowledges the uncertainty of their impact predictions and the associated modeling. On page 93 of the Coastal Engineering Appendix (Appendix), the following is stated:

Conclusions drawn from the SANDAG Oceanside Beach monitoring suggests that the San Clemente fill will have burial impacts in the cross-shore direction, but there are no known cross-shore sediment transport models which have been demonstrated to accurately predict the distribution of material across the existing profile.

Further, on page 94 of the Appendix, the following is stated:

The depth of burial is greatest at the shoreline, and is expected to range up to 6m (19ft) thick. The depth of burial at the seaward toe of the fill footprint is expected to range between 0.3-1.0m (1-3ft)...

...The tentatively recommended plan is expected to create burial impacts to rocky bottom habitats.

Thus, according to the Appendix, burial at the outer edge will range between 0.3-1.0 meter (m) (1-3 feet (ft)). Whereas, in Appendix B, it is stated that burial on the outer edges would be thin and insignificant. NMFS does not believe 1-3ft burial is insignificant. NMFS notes that short term burial at depths of 0.8 feet exhibited a statistically significant decline in shoot count within a laboratory setting (Craig et al, 2008). Furthermore, the FEIS indicates that some portions of surfgrass habitat within the equilibrium footprint already exhibit some burial. Thus, the additive impact associated with this beach fill project may exacerbate existing conditions for surfgrass habitat.

Limited Characterization of Nearshore Habitats for Impact Assessment Purposes

In addition to the uncertainty of potential impacts, NMFS does not believe the sensitive resources within the impact area have been adequately characterized for impact assessment purposes. NMFS indicated in our comments to the DEIS that the survey information that was provided does not delineate areal extent of rocky reef and surfgrass within the impact area. No quantification of area and/or coverage was provided for the scattered boulders and surfgrass habitat. In response to NMFS comments regarding the action area, the Corps states the following:

> *The Corps' marine ecology contractor conducted several dives along 25 transects, as noted in the FEIS/R. These field data were more than reconnaissance level field investigations. The data clearly and unequivocally captures the distribution extent of rocky reef, single boulders, and the extent of surfgrass distribution.*

Further, on page 5-51, the following is stated:

> *Above all, the surveys provided the information needed to assess potential impacts, and the basis needed for discussion and evaluation of project alternatives, along with potential monitoring and mitigation.*

NMFS does not believe the information provided justifies this assertion. First, the above statements are inconsistent with the following statement made in their comment response:

> *There currently is no available data that depicts or illustrates the rocky reef or surfgrass of the entire locale.*

Second, a detailed description of the surveys was not provided. Thus, there is little to judge the confidence of the surveys that were conducted. Third, the only spatially explicit information obtained from these surveys is depicted in Figure 4-10. For example, the T-street reef is delineated on Figure 4-10. However, the Corps later states on page B-4 that a survey was not conducted to delineate the T-street reef. Instead, only the general area of T-street reef was mapped. Furthermore, single boulders were not identified and surfgrass is represented by individual points on Figure 4-10. Fourth, the dive transect surveys are inadequate to fully characterize the offshore habitat within the impact area. Although 25 dive transects were surveyed in total, only 21 transects were surveyed in the impact area. The 21 transects are immediately offshore of the approximately 3,412 foot long project area. Ideal visibility conditions may reach 30 feet in the impact area, though NMFS expects that typical visibility in this area is likely much less. Regardless, assuming optimal conditions, a diver could cover 37% of the project area. A more likely estimate of visibility in the project area would be 10 ft, which would allow 12% of the impact area to be visually estimated. At equilibrium, the Corps indicates that the fill footprint is approximately 132.0 acres. Thus, under optimum conditions 84 acres of the impact site was not characterized by diver transects. Under the more likely visibility scenario, 116 acres was not characterized by diver transects.

Thus, NMFS maintains our assertion that the survey information provided by their marine ecology contractor does not delineate areal extent of rocky reef and surfgrass within the impact

area. Hence, the information provided does not provide an accurate characterization of offshore habitats for impact assessment purposes.

Upon closer inspection of the Coastal Engineering Appendix, NMFS notes Figure 2-6 in the Appendix, which depicts the surficial geologic features in the project vicinity. Although the survey coverage is not entirely comprehensive, there appears to be a considerable amount of area where rock outcroppings cover more than 50 percent of the seabed within the impact footprint. Unfortunately, this geophysical survey is not overlaid with other mapped features in Figure 4-10 of the FEIS.

Additional information relevant to the characterization of nearshore habitat may be found on page 35 of the Coastal Engineering Appendix. Geologic mapping indicated that the areas from San Juan Creek to San Mateo creek are essentially hard exposed bedrock throughout the regime. Mapping indicated the offshore regime is primarily hard bottom covered in some places by shallow pockets or a thin veneer of sediment. The sediment sources described in Section 2.5.2 are indicative of a region that does not naturally have an abundance of sediment supplied to the beaches.

Corps Ability to Predict and Effectively Compensate for Impacts to Seagrass

The Corps has not demonstrated strong predictive abilities for impacts to seagrass for recent Corps projects. In addition, the Corps has not consistently provided adequate seagrass surveys in a timely manner and has not consistently met its environmental commitments for seagrass mitigation. The following are examples.

For the Morro Bay Harbor Six-Year Maintenance Dredging Program, the Corps concluded that the proposed dredging would not have a significant impact on eelgrass. In response to NMFS' EFH Conservation Recommendations, the Corps committed to pre-construction and post-construction surveys for dredging activities within the Morro and Navy Federal channels. In addition, they indicated that the surveys and any necessary mitigation would be conducted in accordance with the Southern California Mitigation Policy (SCEMP). The Corps conducted maintenance dredging in Morro Bay during 2009 and 2010. However, the original pre-construction eelgrass survey for the 2009/2010 dredging cycle was inadequate and significantly underestimated the distribution of eelgrass in the dredge footprint. In particular, the survey failed to capture an approximately 1 acre eelgrass bed that was directly in the dredge footprint. Unfortunately, due to contractual limitations, the Corps indicated they could not implement another pre-construction survey without significant delays that would significantly increase dredging costs. Given that the project was funded by the American Recovery and Reinvestment Act, NMFS compromised with the Corps and agreed upon an assumed impact of 1 acre based upon expected impacts within the dredge footprint, for which the Corps agreed to provide compensation. The dredging ultimately resulted in additional impacts beyond the dredge footprint - likely due to slope failures. However, the extent of the additional impacts is difficult to predict because 1) the original pre-construction survey was inadequate and 2) the Corps did not provide a timely post-construction survey of the affected areas. In fact, NMFS has yet to receive a post-construction survey from this dredging cycle that shows the affected eelgrass areas in the vicinity of the Morro Channel.

There were also issues associated with the Corps' San Diego River Mission Bay Jetty and Revetment Repair and Maintenance Dredging Project in San Diego County. NMFS expressed the importance of protecting eelgrass habitat within the project site in accordance with the SCEMP in our EFH letter dated July 29, 2009, and throughout the project planning process in general. The Corps also recognized the importance of this valuable resource and committed to protecting it while implementing the project. For instance, in section 3.2.2 of the Final Supplemental Environmental Assessment (FSEA), the NEPA document for this project, the Corps specified the measures that would be taken to avoid impacting eelgrass and then stated, "If necessary, mitigation will be coordinated with the US National Marine Fisheries Service (NMFS) and carried out in accordance with NMFS's Southern California Eelgrass Mitigation Policy". Under section 4.1.7 of the FSEA, the Corps also noted that any impacts to eelgrass would be mitigated "...in accordance with current policies and practices". In addition, the cover letter accompanying the "Pre-Dredge Eelgrass and Caulerpa Surveys for the 2010 Mission Bay Harbor Maintenance Dredging Project" appropriately reiterated the Corps' obligation to mitigate for eelgrass impacts in accordance with SCEMP. Thus the need to protect, and mitigate for any impacts to, eelgrass habitat during construction activities was adequately addressed by both the Corps and NMFS prior to project initiation. However, the Corps has yet to fully comply with these obligations. Implementation of the project resulted in the loss of approximately 0.8 acres of eelgrass habitat, as documented in the "Post-Dredge Eelgrass Survey for the 2010 Mission Bay Harbor Maintenance Dredging Project". According to SCEMP, the mitigation for these impacts should have begun within 135 days of initiating in-water construction, which occurred in October, 2010. Therefore, even if the mitigation was postponed until the next active growth phase to increase the likelihood of success, this mitigation project should have been started on or around March 1, 2011. Unfortunately, the mitigation transplant has not yet begun, nor has a mitigation plan been released by the Corps. Under section 8 of SCEMP, for projects that do not begin within the 135 day time frame, an additional seven percent for each month of delay shall be applied to the original mitigation area. This is consistent with a widely held concept that temporal losses should result in additional mitigation. However, when we reminded the Corps of this obligation, their response was that they would be unable to comply with the mitigation delay provision of SCEMP. Because NMFS does not believe an effective NEPA process and/or EFH consultation can be conducted if the Corps can not be relied upon to meet their environmental obligations, we relayed these concerns in a letter on July 22, 2011. The Corps has yet to respond to this letter.

In addition, a Corps maintenance dredging project in Lower Newport Bay also impacted eelgrass habitat. Specifically, a 2003 dredging event impacted shallow water and eelgrass habitat in Lower Newport Bay offshore of the east end of Balboa Island. Approximately 0.88 acres of eelgrass habitat was impacted with a mitigation requirement of 1.06 acres. However, mitigation measures to offset these losses have not been successfully implemented.

Summary and Recommendation for Estimated Impacts

Given the uncertainty of the modeling used to predict impacts, the limited characterization of existing offshore habitats, and the Corps' recent history in predicting and mitigating impacts to seagrass habitat, NMFS does not believe the Corps' proposed impact estimate is appropriate.

Instead, NMFS believes a more conservative estimate is appropriate. NMFS is using the following factors in determining a more conservative estimate: 1) a comprehensive survey has yet to be conducted, 2) the T-street reef structure is roughly estimated at 5 acres, 3) the scattered reefs and boulders have not been well characterized with no reliable acreage estimate, 4) the T-street reef structure is within the equilibrium footprint in which cross-shore sand movement is expected to occur, 5) the DEIS indicates that some portions of surfgrass habitat within the equilibrium footprint already exhibit some burial. Without additional information and justification, NMFS recommends that the Corps assume at least 5 acres of surfgrass/reef impacts to help ensure that adequate funds are budgeted for potential mitigation costs. This recommendation is also consistent with a recommendation provided by the U.S. Fish and Wildlife Service (USFWS) in their Final Coordination Act Report. This estimate should be adopted within the record of decision.

Conservation Recommendation 1c: The Corps and/or the project partner should coordinate with NMFS and other interested agencies to determine an appropriate mitigation ratio for impacts to surfgrass and rocky reef habitat.

Appendix B does not specifically respond to this recommendation, but indicates that reef habitat mitigation shall be constructed at an equivalent functional value of shallow and deep water reef proportional to the area of impacted surfgrass and reef.

Section 5.4.5.2 discusses the Corps' mitigation approach in greater detail.

> *The Corps does not use ratios, but instead a scientific-based approach through the use of functional habitat evaluation assessment. A basic FA was used in the BPJ approach and a more robust FA will be accomplished in PED during the monitoring of the project site and the reference site.*

In contrast to this statement, Corps Regulatory routinely uses ratios for mitigation purposes. The use of mitigation ratios is discussed in the 2008 Final Rule for Compensatory Mitigation for Losses of Aquatic Resources (Final Rule). However, at an interagency meeting on January 31, 2011, the Corps Civil Works indicated that the Final Rule does not apply to their projects. In response, NMFS specifically requested that Corps Civil Works share their policy. The Corps was unable to respond to this request at the meeting, but did cite Engineering Regulation 1105-2-100 in the FEIS.

Also, in contrast to this statement, is a 2007 memorandum from the Corps regarding the Encinitas and Solana Beach Shoreline Protection project – a project similar in nature to the San Clemente Shoreline Protection project. This memorandum specifically indicates that mitigation for impacts to reef shall be in the form of artificial reefs constructed within the reach suffering losses on a 1:1 ratio.

Moreover, the Corps implies the use of a 1:1 ratio on page 5-58:

The Project has a mitigation budget that accommodates 1 acre of impacts to surfgrass plus 1 acre of impacts to reef, for a total potential impact to 2 acres of resources as a worst-case scenario.

NMFS also notes that the best professional judgment (BPJ) referenced above from the FEIS did not incorporate opinions expressed by NMFS, USFWS, California Department of Fish and Game, Environmental Protection Agency, and California Coastal Commission. Instead it relied upon the Corps' contractors.

Regardless, NMFS agrees with the Corps that the use of ratios should be based upon sound science and, to the extent possible, a functional based approach. In response to Corps concerns that there was no scientifically-based approach to developing ratios, NMFS recommended that the Corps consider the use of a mitigation ratio calculator as a defensible means of identifying an appropriate ratio (King and Price 2004). In addition, we shared scientific rationale for why a 1:1 approach is not defensible. In summary, NMFS believes a 1:1 ratio is inappropriate because: 1) surfgrass is a difficult to replace resource, 2) uncertainty of success, and 3) temporal lag in mitigation. NMFS notes that our rationale is consistent with the Final Rule. Specifically, the Final Rule suggests that higher mitigation ratios should be required where necessary to account for the method of compensatory mitigation, the likelihood of success, differences between the functions lost at the impact site and the functions expected to be produced by the compensatory mitigation project, temporal losses of aquatic resource functions, the difficulty of restoring or establishing the desired aquatic resource type and functions, and/or the distance between the affected aquatic resource and the compensation site. The best available science suggests surfgrass exhibits late successional traits, recovers very slowly from disturbance, and requires facilitation from algae before settling - all factors suggesting that this is a difficult to replace resource. Furthermore, if impacts are identified, a significant time lag will occur between the impact and mitigation. This will result in a temporal loss of function beyond that which would be expected from a difficult to replace species.

Summary and Recommendation for Mitigation Approach

In light of the Corps assertion that they do not use mitigation ratios, NMFS has revised our recommendation. The Corps and/or the project partner should coordinate with NMFS and other interested agencies to develop an appropriate functional assessment for impacts to surfgrass and rocky reef habitat. The final functional assessment used for determining appropriate mitigation to biological resources should receive written concurrence from NMFS prior to project implementation. This recommendation should be included as a mitigation measure in the record of decision.

Conservation Recommendation 2: A scientifically defensible monitoring plan should be developed prior to a record of decision on the proposed project.

The purpose of the monitoring plan is to detect environmental impacts associated with the proposed project and serve as the basis for determining whether compensatory mitigation is appropriate. Results from the monitoring plan will inform the development of a final mitigation plan, which will be based upon the approach described in the contingency

mitigation plan. The monitoring plan should be described in greater detail than the program currently described in Appendix B. The sampling design and statistical analyses should be clearly described and should be based upon fundamental principles of statistical inference. This monitoring plan should be reviewed and approved by the Corps, NMFS, and other interested resource agencies prior to a record of decision. In addition, to ensure adequate scientific rigor, consideration should be given to involving an independent review by recognized, biostatistical experts.

A general approach to the monitoring plan is outlined in Appendix B. The Corps indicates that the final monitoring plan will be prepared during the pre-construction engineering design (PED) phase. NMFS had recommended that this plan be developed prior to the record of decision. Given the limited characterization of nearshore resources for impact assessment purposes, NMFS is amenable to the finalization of the monitoring plan during the PED phase.

NMFS previously expressed concern that the presumption that nourishment projects are ecologically benign may be based upon an incomplete and flawed body of science (Peterson and Bishop, 2005). NMFS recommended that, if previous monitoring results in Southern California are to be used as support for conclusions that impacts to biological resources are minor and/or insignificant, a more rigorous examination of their sampling design, statistical analyses, and conclusions are necessary. The Corps did not adequately respond to this recommendation in light of the flawed science identified in Peterson and Bishop (2005). Instead, they summarized conclusions from previous monitoring events for other nourishment projects without conducting an adequate examination of their sampling design, statistical analyses, and conclusions. The Corps then concluded that the weight of evidence would suggest no impacts would occur at San Clemente.

Summary and Recommendation for Monitoring Plan

NMFS maintains that the sampling design and statistical analyses of the final monitoring plan be clearly described and should be based upon fundamental principles of statistical inference. In addition, the final monitoring plan should avoid the problems identified in Peterson and Bishop (2005). The final monitoring plan used for determining impacts to biological resources should receive written concurrence from NMFS prior to project implementation. This recommendation should be included as a mitigation measure in the record of decision.

Fish and Wildlife Coordination Act Comments

16 U.S.C. 662 (a) states that whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license, such department or agency first shall consult with the United States Fish and Wildlife Service, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular State wherein the impoundment, diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing loss of and damage to such resources as well as

providing for the development and improvement thereof in connection with such water-resource development.

Reorganization Plan No. 4 of 1970 transferred all functions vested by law in the Bureau of Commercial Fisheries of the Department of the Interior or in its head, together with all functions vested by law in the Secretary of the Interior or the Department of the Interior which are administered through that Bureau or are primarily related to the Bureau to the Secretary of Commerce. NOAA NMFS is the primary agency within the Department of Commerce responsible for FWCA coordination.

The Corps states that the FWCA is an action that is taken between the USFWS and the Corps, not NMFS. The Corps' statement is inaccurate. As stated above, NMFS does have the authority to provide comments and recommendations through the FWCA. In fact, the Corps acknowledges NMFS' FWCA role on one of their websites (http://el.erdc.usace.army.mil/emrrp/emris/emrishelp5/fish_and_wildlife_coordination_act_legal_matters.htm). Below is an excerpt from the above referenced Corps website:

> *16 U.S.C. 662(a) provides that whenever the waters of any stream or other body of water are proposed to be impounded, diverted, the channel deepened or otherwise controlled or modified, the Corps shall consult with the U.S. Fish and Wildlife Service (FWS), the National Marine Fisheries Service (NMFS) as appropriate, and the agency administering the wildlife resources of the state. The consultation shall consider conservation of wildlife resources with the view of preventing loss of and damages to such resources as well as providing for development and improvement in connection with such water resources development.*

Mischaracterization of NMFS Comments and Involvement in the Review Process

A number of statements were made in the FEIS and in response to comments that mischaracterize NMFS comments and our involvement in the review process. Below, NMFS provides additional context and some examples of this mischaracterization.

In the Corps response to comments, they repeatedly emphasized their two year coordination with the resource agencies. NMFS notes that this coordination was not particularly effective or organized. Examples include the following: short notification for agency meetings, all interested agencies were not invited despite NMFS encouragement to do so, meeting times were delayed, meeting dates abruptly canceled, and clear and substantive information was often not provided at the meetings. Furthermore, much of the comments that were given to the Corps were superficially addressed. After submission of comments on the DEIS, an interagency meeting was held on January 31, 2011, to address the range of concerns expressed by various agencies. Despite acknowledgment of the Corps internal deadlines and commitment to continue discussions regarding the monitoring, mitigation, and reporting plan, the Corps did not follow up with NMFS. NMFS reached out to the Corps via email on February 25, 2011, but received no reply. NMFS believes many of the problems identified in the FEIS are attributable to the Corps' coordination approach.

On page 5-58, the following is stated:

> *Because resource agency recommendations for mitigation were only clarified in their response to the DEIS, development and certification of a habitat model to assess surfgrass impacts was not previously contemplated.*

This is an inaccurate statement. NMFS had provided a variety of input regarding surfgrass impact concerns during agency meetings, via email, and telephone discussions with Corps staff. These discussions culminated in a detailed email that was provided on August 5, 2010, which outlined many of NMFS concerns regarding the Corps proposed mitigation approach. For reference, the email chain is attached to this letter. Comments provided on the DEIS were generally consistent with the email comments.

Page 5-58 indicated that NMFS proposed a 5:1 mitigation ratio. This is incorrect. NMFS did not specifically identify a 5:1 ratio. Rather, NMFS questioned the appropriateness of estimating a 2 acre impact when 1) a comprehensive survey has yet to be conducted, 2) the T-street reef structure is roughly estimated at 5 acres, 3) the scattered reefs and boulders have not been well characterized with no reliable acreage estimate, 4) the T-street reef structure is within the equilibrium footprint in which cross-shore sand movement is expected to occur, 5) the DEIS indicates that some portions of surfgrass habitat within the equilibrium footprint already exhibit some burial. Thus, without additional information and justification, NMFS believed a 5 acre impact was a more appropriate worst case scenario.

On page 5-50, the Corps implies that NMFS was not forthcoming during the two year coordination process when we recommended the use of the San Diego Nearshore Program data at the January 31, 2011, meeting. NMFS recommended its use to provide additional information for the Corps NEPA document, not as a means of serving as a baseline dataset for determining impacts. NMFS would like to remind the Corps that the Nearshore Program was a cooperative effort involving their agency.

Closing Summary and Recommendations

NMFS believes protection of existing infrastructure and maintaining recreational opportunities associated with beach usage are important ecosystem services. However, repeated beach fill projects may have an environmental cost to various natural resources. These costs should be incorporated into the analysis to ensure the benefit to cost ratio is not skewed. Unfortunately, the views expressed by NMFS regarding potential impacts, mitigation, and monitoring have not been fully considered in the FEIS. Therefore, NMFS is concerned that the Corps may have underestimated the potential environmental costs of the project. Based on January 2011 price levels, the estimated initial construction cost of the plan is $11,100,000, for which the Federal share is approximately $7,220,000 and the non-Federal share is approximately $3,890,000. Total periodic nourishment costs are estimated to be $84,900,000 (January 2011 price level) over the 50-year period following initiation of construction, for which the Federal share is approximately $42,450,000 and the non-Federal share is approximately $42,450,000. Given the concerns expressed on this project, NMFS believes the Corps should re-evaluate their cost estimates to

ensure the project still achieves a positive benefit/cost ratio prior to further planning and implementation of a 50 year project costing $96,000,000.

Below is a summary of NMFS recommendations that should be addressed prior to a record of decision:

- The Corps should explicitly discuss how they addressed the comments provided by the Independent External Peer Review.

- The Corps should assume a minimum 5 acre impact to surfgrass/reef to help ensure that adequate funds are budgeted for potential mitigation costs. This recommendation is also consistent with a recommendation provided by the USFWS in their Final Coordination Act Report. This estimate should be adopted within the record of decision.

- The sampling design and statistical analyses of the final monitoring plan should be clearly described and should be based upon fundamental principles of statistical inference. In addition, the final monitoring plan should avoid the problems identified in Peterson and Bishop (2005). The final monitoring plan used for determining impacts to biological resources should receive written concurrence from NMFS prior to project implementation. This recommendation should be included as a mitigation measure in the record of decision.

- The Corps should coordinate with NMFS and other interested agencies to develop an appropriate functional assessment for impacts to surfgrass and rocky reef habitat. The final functional assessment used for determining appropriate mitigation to biological resources should receive written concurrence from NMFS prior to project implementation. This recommendation should be included as a mitigation measure in the record of decision.

- The Corps should include a monitoring and enforcement program for each mitigation measure identified in the record of decision. NMFS also recommends that the Corps inform commenting agencies on the progress of mitigation measures they have proposed and make the monitoring results available to the public.

Enclosure(s):

Literature Cited

NMFS August 05, 2010, email discussing surfgrass mitigation with additional literature cited

Literature Cited

Craig, C., S. Wylie-Echeverria, E. Carrington, and D. Shafer. 2008. Short-term sediment burial effects on the seagrass *Phyllospadix scouleri*. ERDC TN-EMRRP-EI-03.

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NMFS August 05, 2010, email discussing surfgrass mitigation with additional literature cited

From: Bryant Chesney [Bryant.Chesney@noaa.gov]
Sent: Thursday, August 05, 2010 3:44 PM
To: 'Smith, Lawrence J SPL'; 'Bob Hoffman'; 'Clifford, Jodi L SPL'; 'Keeney, Thomas W SPL'
Cc: 'Lawrence Honma'
Subject: RE: Surf Grass Mitigation

NMFS appreciates Corps collaboration on this important topic and believe we are coming closer to agreement on how to address surfgrass impacts. However, there are various aspects of your proposal for which NMFS has concerns. We summarize them below.

According to Subpart E Section 230.43 of the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (404(b)(1) Guidelines), vegetated shallows are considered special aquatic sites (SAS). SAS are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region. This status provides special consideration when evaluating actions involving dredged or fill material pursuant to Section 404 of the Clean Water Act. Vegetated shallows are defined as permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation. NMFS believes surfgrass should be considered a SAS and receive special consideration when evaluating actions involving discharge of dredged or fill material.

Moreover, surfgrass is designated as a habitat area of particular concern (HAPC) for various federally managed fish species under the Pacific Groundfish Fishery Management Plans, as well as essential fish habitat (EFH) for various species within the Coastal Pelagics and Highly Migratory Species Fishery Management Plans. Surfgrasses (*Phyllospadix* spp.) are considered to be among the most productive seagrass systems on the planet (Ramírez-García et al. 1998). Galst and Anderson (2008) indicate that surfgrass beds serve as an important habitat for nearshore fishes, and the loss of surfgrass from disturbance has negative consequences for recruitment success. Surfgrass also serves as an important nursery habitat for a variety of invertebrates, such as California spiny lobster (Engle 1979, as cited in MPLA Initiative 2009), and as habitat for algae (Stewart and Myers 1980, as cited in MLPA Initiative 2009). Shaw (1986) suggests that the importance of surfgrass as a nursery for juvenile lobsters in southern California is clearly apparent and the disturbance or destruction of this habitat could seriously decrease lobster abundance. Surfgrass is also important foraging habitat for the endangered green turtle, *Chelonia mydas* on the Pacific side of the Baja Peninsula (Lopez-Mendilaharsu et al 2005). Although utilization of nearshore habitats in southern California is less understood, sub-populations of the endangered green turtle are known to utilize San Diego Bay and the Long Beach area for foraging. If surfgrass serves a similar function in southern California, then adverse effects to surfgrass habitat may have a negative impact on habitat used by this listed species.

Surfgrasses are likely to be impacted by beach nourishment and shoreline protection projects that place sand either directly or indirectly onto surf grass beds (Craig et al 2008). The Corps has acknowledged this in meetings, email correspondence, and draft environmental planning documents. As described in the 404(b)(1) Guidelines, the discharge of dredged or fill material may reduce the value of vegetated shallows as nesting, spawning, nursery, cover, and forage areas, as well as their value in protecting shorelines from erosion and wave actions. In addition, the primary productivity of the system would be reduced if impacts were to occur. Surfgrasses exhibit late successional traits, recover very slowly from disturbance, require facilitation from algae before settling, and are strong competitors (Turner 1985). Removal of surfgrass from a rocky reef community has profound impacts to community structure (Turner 1985). Thus, surfgrass habitat is largely determined by patterns of disturbance. Repeated beach nourishment efforts likely will increase this rate of disturbance to these systems. Slow recovery times suggest that disturbances to these communities may be ecologically significant.

Given the high ecological values associated with surfgrass, NMFS believes unavoidable impacts to surfgrass should be addressed via compensatory mitigation and should comply with the 2008 mitigation rule. According to the rule, compensatory mitigation is defined as the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved. The rule suggests that compensation for unavoidable impacts to difficult to replace (DTR) resources (e.g. bogs, fens, springs, streams, etc.) should be provided through in-kind rehabilitation, enhancement or preservation. Given the slow recovery time and the difficulties associated with restoring this habitat, NMFS believes that surfgrass should be considered a DTR resource. Therefore, NMFS believes the Corps and/or the project partner should include in-kind surfgrass restoration or establishment as part of the mitigation plan. Therefore, NMFS does not concur with the Corps assertion that it not be considered "mitigation" in the technical sense of the term, nor do we concur that the NEPA/CEQA documents should refer to this as an unavoidable, unmitigable loss.

Although NMFS recognizes that surfgrass restoration techniques are not well established, recent successes have emerged. For example, Bull et al (2004) have demonstrated that surfgrass transplants that used sprigs survived and grew reasonably well, and regrowth of rhizomes that were cut to obtain sprigs for transplanting was rapid. They argued that the patterns of growth and survival of transplants and of recovery of donor plots, combined with the amount of effort involved, revealed that the largest gain in rhizome coverage per unit of effort occurred when sprigs were used. Moreover sprigs suitable for transplanting required relatively little effort to prepare and were abundant at study sites (Bull 2002), suggesting that collection of sprigs for transplanting would not have a large impact on existing surfgrass beds. Based upon this, Bull et al (2004) concluded that sprigs may be the most acceptable form for use in restoration.

Alternatively, MMS (1999) found that restoration of surfgrass beds using seeds and seedlings may be feasible. Sufficient numbers of seeds can easily be collected from most populations during most years to supply most restoration needs. Seeds readily germinate in the laboratory, or can be stored for several months and germinated when needed. Laboratory cultivation of large numbers of small seedlings for use in restoration is relatively simple and does not require any sophisticated equipment or facilities. Mortality rates are relatively high, though, so future efforts should reduce the likely sources of mortality to increase the efficacy of this technique. Holbrook et al. (2002) tested the use of seedlings in the field and attached seedlings to nylon rope to mimic natural conditions and achieved a survival comparable to that of control groups. The use of either sprigs or seedling transplants would minimize impacts to donor beds.

NMFS recognizes that transplant success is much higher for subtidal then for intertidal conditions. However, NMFS does not believe restoration efforts in the intertidal should be summarily dismissed within the mitigation plan, as implied in the Corps proposal. NMFS would be amenable to a smaller percentage of the mitigation addressing intertidal surfgrass habitat, but believes some good-faith effort should be applied to restore similar resources that may be lost due to the proposed projects.

The Corps has proposed a 1:1 ratio for surfgrass transplants and rocky reef impacts. The final mitigation rule suggests that higher mitigation ratios should be required where necessary to account for the method of compensatory mitigation, the likelihood of success, differences between the functions lost at the impact site and the functions expected to be produced by the compensatory mitigation project, temporal losses of aquatic resource functions, the difficulty of restoring or establishing the desired aquatic resource type and functions, and/or the distance between the affected aquatic resource and the compensation site. Given the difficulties associated with mitigating for surfgrass and the time lag in recovery, a higher ratio is likely appropriate. NMFS recommends that the Corps consider the guidance provided by the final rule and provide a more detailed rationale for determination of the mitigation ratio. NMFS also offers to provide technical assistance to the Corps in developing an appropriate mitigation ratio.

The mitigation plan should also contain performance standards that will be used to assess whether the project is achieving its objectives. These performance standards should be based on attributes that are objective, verifiable, and can be measured with a reasonable amount of effort. Thus, we do not believe it

appropriate to not include success criteria, as the Corps has proposed. NMFS recommends that the Corps work with NMFS and other appropriate agencies to develop appropriate performance standards. That said, NMFS recognizes the potential for in-kind mitigation failure. The potential for failure, however, does not justify a mitigation plan with no success criteria. Instead, NMFS believes a contingency out-of-kind mitigation approach should be developed as a back-up in case surfgrass mitigation techniques prove unsuccessful. Out-of-kind mitigation should strive to offset similar ecological functions and values that may be lost due to surfgrass impacts. Functions of high importance to NMFS include: primary productivity, fishery and invertebrate habitat, and wave energy reduction. NMFS believes eelgrass and/or kelp may be appropriate surrogates for out-of-kind mitigation.

The rule further states that there should be sufficient financial assurances to ensure a high level of confidence that the compensatory mitigation project will be completed in accordance with its performance standards. The Corps indicates they would like to place a cap on surf grass mitigation costs. NMFS is unsure how placing a cap on the mitigation costs would provide sufficient financial assurances. Perhaps a more appropriate alternative approach is to place a cap on surfgrass transplant techniques based upon cost estimates provided by both typical mitigation practitioners, such as Corps has preliminarily done via inquiries with SAIC and Merkel, and other researchers with more experience with surfgrass restoration. If success criteria are not met, the Corps and/or project partner would then move to the contingency plan for which reasonable cost estimates could also be provided. Assuming the total cost estimates of surfgrass mitigation and the out-of-kind contingency plan have appropriate justification and provide sufficient financial assurances, then NMFS would believe this total estimate could be used as an appropriate dollar amount in the Corps cost-benefit analysis. Placing a funding cap that is not well justified could skew the cost-benefit analysis and should be avoided.

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From: Smith, Lawrence J SPL [mailto:Lawrence.J.Smith@usace.army.mil]
Sent: Friday, July 23, 2010 3:10 PM
To: Bob Hoffman; Bryant Chesney; Clifford, Jodi L SPL; Keeney, Thomas W SPL
Cc: Lawrence Honma
Subject: Surf Grass Mitigation

Recent discussion have taken place between the Corps and NMFS on the issue of surf grass losses and mitigation in southern California. I'd like to take this opportunity to present our understanding of the resolution reached during recent conversations. The point is to avoid any confusion and to ensure that we are in agreement on the details prior to moving forward, first with San Clemente and then with Encinitas/Solana Beach.

The first step, as with other impact categories, is to avoid surf grass impacts to the maximum extent practicable. The second step is to minimize unavoidable impacts. The third step is to mitigate remaining impacts. The concept of mitigation, as it applies to surf grass, follows. There are currently no proven methods of transplanting surf grass. However, there are some experimental methods that show promise. Our approach is to develop the experimental methods building towards a proven transplant method. There are several key assumptions in moving in this direction. First, transplant success is much higher for subtidal then for intertidal conditions. Initial projects therefore will focus on subtidal transplants only. This is particularly true for the first two projects where we anticipate creating artificial, subtidal reef habitat as mitigation for lost reef habitat thus creating new subtidal surf grass habitat. A portion of the reef would have to be built shallow enough to accommodate surf grass. Subtidal transplants are also safer then intertidal. Transplant area will be determined by actual impact as determined by monitoring. Post-construction monitoring of the surf grass in and adjacent to project sites will determine the actual area of surf grass lost as a result of each project. Transplant area will be on a 1:1 ratio, reef transplant ratio is

also on a 1:1 ratio for monitored reef losses. Post mitigation monitoring will be performed to track performance and to identify areas where the transplant method could be modified to improve success. We are proposing two years of post-mitigation monitoring. We are not including any success criteria nor are we including any additional transplant efforts at a given site. This is a one and done proposal for each project. Follow-on projects will incorporate lessons learned incorporating method modifications as we move towards an improved methodology.

Transplanting sprigs or plants require a donor bed for plant material. Studies have shown that surf grass is sensitive to losses from harvesting plants for transplant purposes. I'm not sure how to incorporate this concern. We could harvest plant material from that portion of the bed where potential impacts are expected. However, this would require maintaining that material alive ex-situ for one to two years post construction when mitigation would be constructed. Additionally, it could become a self-fulfilling prophesy where we weaken a bed that is then impacted partially as a result of the project and partially as a result of harvesting effects. An alternative approach would be to spread these impacts over a very large area focusing on harvesting plants from the interior of the bed and avoiding harvesting from edges. It appears that edge harvesting has more of an impact on the existing bed then does interior harvesting. A recommendation on this issue would be appreciated.

One additional measure that the Corps would like to propose is a cap on surf grass mitigation costs. This would be done separately for each project and would be based on predicted impacts. This would enable the Corps to incorporate a not to exceed cost into its calculations of total project costs for comparison to project benefits. This would greatly assist us in our planning and project authorization efforts. Initially the cap would be estimated based on known costs for eelgrass restoration multiplied by a factor of three to account for the more difficult conditions expected from open coastal restoration for surf grass as opposed to in-bay restoration encountered for eelgrass restoration. After conferring with both SAIC and Merkel & Associates, we propose that an initial cost of $180K per acre be used for a surf grass restoration cap. This is based on a cost of $60K per acre for recent eelgrass restoration efforts. Our methods for surf grass impact assessment tend to err on the conservative side and to overestimate impacts. This cap should then allow for mitigation at a 1:1 ratio should actual costs exceed the $180K per acre figure. This cap cost does not include the cost of monitoring.

This is a proposal for experimental transplants. As such, we have included no success criteria. This is not "mitigation" in the technical sense of the term. We cannot guarantee that impacts to surf grass will be "mitigated". Therefore, NEPA/CEQA documents will continue to refer to this as an unavoidable, unmitigable loss. We anticipate some success, so it will not be a total loss.

Please let me know if you have any questions with the above. We would also appreciate written concurrence from the NMFS.

Larry Smith
(213) 452-3846

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

September 27, 2011

Thomas Keeney
Ecologist/Biological Sciences Manager
U.S. Army Corps of Engineers
915 Wilshire Boulevard, 14th Floor
Los Angeles, California 90017

Subject: Final Environmental Impact Statement for San Clemente Shoreline Protection Project, Orange County California. (CEQ# 20110285)

Dear Mr. Keeney:

The U.S. Environmental Protection Agency (EPA) has reviewed the Final Environmental Impact Statement (FEIS) for San Clemente Shoreline Protection Project, Orange County California. Our review is provided pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA Implementing Regulations (40 CFR 1500-1508), and Section 309 of the Clean Air Act. Our comments were also prepared in accordance with the provisions of the Federal Guidelines promulgated at 40 CFR 230 under Section 404(b)(1) of the Clean Water Act (CWA).

EPA reviewed the Draft Environmental Impact Statement (DEIS) for San Clemente Shoreline Protection Project (Project) and provided comments to the U.S. Army Corps of Engineers, (Corps), on September 20, 2010. We rated the document EC-2, Environmental Concerns – Insufficient Information based on potential impacts to waters of the United States (WUS), quality of beach nourishment materials, biological resources, climate change and air quality. Based on our review of the FEIS, some of our concerns regarding the significant environmental impacts identified in our comments on the DEIS remain unresolved.

EPA continues to have concerns regarding the use of sediment analysis results for the proposed Oceanside borrow pit that are 5-6 years old. We continue to recommend additional confirmatory testing data no more than 3 years old to ensure accurate sediment characterization is performed before the signing of the ROD. Results of the sediment testing should include a description of how many cores and if the core sampling reached the anticipated dredging depth. Should the testing determine that contaminants exceed acceptable levels; the Corps should consider other sources of beach nourishment materials.

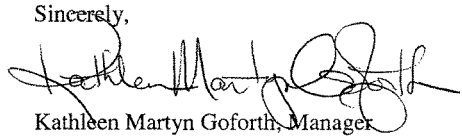
The FEIS indicates that the shoreline is "essentially in balance between erosion and accretion" [p. 4-35]. Furthermore, the document acknowledges that the shoreline will likely change as a result of projected sea level rise, ("present best estimates regarding sea level rise within southern

California vary between 0.1 and 0.2 ft (0.03 to 0.06 m) in a time span of 25 years"[p.4-27]). Given projected sea level rise, the shoreline should be monitored for any changes that may occur. Based on the combined impacts of the sediment placement and projected sea level rise, we recommend the Corps consider a shorter time period e.g. 25 years for the project. Due to the potential adverse impacts to biological resources resulting from the placement of the large volumes of sediment, we also recommend monitoring and assessment of impacts to species of concern and their habitat in the project area. We encourage the Corps to include in the ROD the results of a current comprehensive biological survey of the San Clemente shoreline. Without such baseline data, it would be difficult, if not impossible, to accurately evaluate or mitigate the environmental impacts of the proposed action.

It is unclear whether the off-shore emissions associated with the proposed action have been included in the general conformity applicability analysis for this project. The ROD should ensure that the direct and indirect emissions from both the construction and the operational phases of the project, including the off-shore emissions within three miles of the coast, conform to the approved State Implementation Plan and do not cause or contribute to violations of the NAAQS.

We appreciate the opportunity to review this FEIS. If you have any questions, please contact me at (415) 972-3521, or contact James Munson, the lead reviewer for this project. James can be reached at (415) 972-3800 or munson.james@epa.gov.

Sincerely,



Kathleen Martyn Goforth, Manager
Environmental Review Office

Cc:
Bryant Chesney, NOAA
David Zoutendyk, USFWS
Loni Adams, CDFG
U.S. Army Corps of Engineers, Headquarters.

DEPARTMENT OF THE ARMY
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441 G STREET, NW
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REPLY TO
ATTENTION OF

Planning and Policy Division

MAR 2 1 2012

Willie R. Taylor
Director, Office of Environmental Policy and Compliance
United States Department of the Interior
Office of the Secretary
Washington, D.C. 20240

Dear Mr. Taylor:

Thank you for your letter dated October 4, 2011, on the Final Environmental Impact Statement (FEIS) on the San Clemente Shoreline Protection Project, Orange County, California. We appreciate your staff's willingness to identify issues of concern and offer the following information in response to your letter.

The recommendations provided in the Final Fish and Wildlife Coordination Act Report (Final FWCA Report) provided in fulfillment of a Scope of Work between the U.S. Fish and Wildlife Service and the U.S. Army corps of Engineers on the San Clemente Shoreline Protection Project were fully considered in development of the proposed project.

Federal and Federally-assisted water and related planning activities attempt to achieve increases in National Economic Development (NED), while preserving environmental resources consistent with established laws and policies. NED plan selection calls for the alternative with the greatest amount of net NED benefits, based on storm damage reduction benefits only, to be designated as the NED plan. The alternative with the greatest net NED benefits is Alternative 2 – 15-meter beach fill. The 10-meter beach fill alternative expresses lower net annual storm damage reduction benefits. The 10-meter plan also requires a higher annual cost. Neither the 10-meter beach fill alternative nor the 15-meter alternative is expected to result in the net loss of habitat value of sensitive rocky intertidal habitat, and or in long-term net loss in habitat value of surfgrass beds. Therefore, the 15-meter plan produces the highest net benefits to the nation while causing the least potential impacts and is the plan recommended for construction.

It is the policy of the U.S. Army Corps of Engineers Civil Works program to demonstrate that damages to all significant ecological resources, both terrestrial and aquatic, have been avoided and minimized to the extent practicable, and that any remaining unavoidable damages to non-negligible resources have been compensated to the extent incrementally justified, as described in Engineer Regulation (ER) 1105-2-100, paragraph C-3(d) (3)(1) and consistent with Section 2036(a) of the Water Resources Development Act of 2007 (WRDA 07) – Mitigation for Fish and Wildlife and Wetlands Losses. ER 1105-2-100, paragraph C-3(e) requires the use of a habitat-based methodology to describe and evaluate the impacts of the alternative plans, and to identify the mitigation need of the with-project condition as measured against the future without project.

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Based on current analysis, no direct impacts to sensitive habitats would occur from the placement of sand on the beach. Using a conservative coastal engineering model, following initial placement on the beach, a portion of the sand may move upcoast, downcoast, and offshore depending on the magnitude, direction, and period of waves. The available evidence suggests that the proposed project will not result in the net loss of habitat value of sensitive rocky intertidal habitat, and or in long-term net loss in habitat value of surfgrass beds. The Corps acknowledges that the coastal engineering model has uncertainties due to multiple variables within the natural environment. Impacts to rocky reef and surfgrass are expected to be none to very minor.

As identified in Appendix B of the FEIS, the monitoring and mitigation reporting plan includes monitoring of rocky reef/surfgrass habitat in the San Clemente Pier area for a minimum of two years pre-construction and two years post construction; a preliminary mitigation implementation plan and a preliminary mitigation monitoring plan, which would be triggered if mitigation is determined to be necessary. Once authorized, the project will move into the Preconstruction, Engineering and Design (PED) Phase. The monitoring plan may be revised during that phase. The monitoring and analytical methods used will be adequate to identify and accurately measure impacts from the beach nourishment effort. If a more comprehensive biological survey of the project area is required to accomplish the above, it will be accomplished during this phase. The purpose of conducting this survey during PED is so that the information will be current at a time relevant to project construction. The monitoring and mitigation reporting plan will also ensure that appropriate mitigation sites are available to address potential impacts and that the success criteria and analytical methods used are adequate to demonstrate a difference between impact/mitigation sites and control sites. If mitigation is determined to be required, it will be accomplished at an equivalent functional value to the impacted area.

To continue to work cooperatively throughout the final project planning and construction phases, the Corps will provide, prior to commencement of construction, a copy of the final PED phase surveys and the monitoring plans to Fish and Wildlife Service and other agencies for review. The Corps will carefully consider all comments by Fish and Wildlife Service and will make all reasonable efforts to ensure that the concerns expressed are resolved prior to each construction phase. The PED surveys and monitoring plans include the final biological (reef/surfgrass) mitigation and monitoring plan including all surveys conducted in preparation of that plan; the surfing monitoring plan; the turbidity monitoring plan; the stormwater pollution prevention plan and the oil spill prevention and response plan.

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We trust that the above information sufficiently addresses your concerns. If you would like to discuss these issues further, please contact Ms. Andrea Walker, HQUSACE, at (202)-761-0316.

Sincerely,

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

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DEPARTMENT OF THE ARMY
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REPLY TO
ATTENTION OF

Planning and Policy Division

MAR 2 3 2012

Paul N. Doremus, Ph.D.
NOAA NEPA Coordinator
United States Department of Commerce
National Oceanic and Atmospheric Administration
Silver Spring, Maryland, 20910

Dear Mr. Doremus:

Thank you for your letter dated September 30, 2011, on the Final Environmental Impact Statement (FEIS) for San Clemente Shoreline Protection Project, Orange County, California. We appreciate your staff's willingness to identify issues of concern and offer the following information in response to your letter.

Procedures governing independent external peer review (IEPR) are currently documented in Engineer Circular (EC) 1165-2-209 and the results of IEPR are considered in the development of the FEIS and the Final Feasibility Report. Regardless of whether or not the views expressed in the IEPR Review Report are adopted, a written response to the report, detailing any actions undertaken or to be undertaken in response to the report, and the reasons those actions are believed to satisfy the key concerns stated in the review report (if applicable) is prepared. HQUSACE determines the appropriate command level for issuing the formal USACE response to the IEPR Review Report. When the USACE response is issued, the final IEPR Review Report, USACE response, and all other materials related to the review are posted on this organization's website and included in the applicable decision document. For the San Clemente Shoreline project, HQUSACE will summarize the IEPR Review Report in the Chief of Engineers Report and provide full USACE responses to each concern raised by the IEPR panel. This documentation will become a critical part of the review record and will be addressed in recommendations made by the Chief of Engineers.

It is the policy of the U.S. Army Corps of Engineers Civil Works program to demonstrate that damages to all significant ecological resources, both terrestrial and aquatic, have been avoided and minimized to the extent practicable, and that any remaining unavoidable damages to non-negligible resources have been compensated to the extent incrementally justified, as described in Engineer Regulation (ER) 1105-2-100, paragraph C-3(d) (3)(1) and consistent with Section 2036(a) of the Water Resources Development Act of 2007 (WRDA 07) – Mitigation for Fish and Wildlife and Wetlands Losses. ER 1105-2-100, paragraph C-3(e) requires the use of a habitat-based methodology to describe and evaluate the impacts of the alternative plans, and to identify the mitigation need of the with-project condition as measured against the future without project.

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The Corps uses a model approval/certification process for its planning models that is described in Engineer Circular (EC) 1105-2-412. For this study, the study team developed a combined coastal and economic model that evaluates wave and erosion damages in a risk-based environment. Adequate technical reviews have been accomplished and the model meets the criteria described in the Circular. A Type I IEPR that included application of the model to the study was conducted and the panel had no objection to its application.

Based on this conservative coastal engineering model, no direct impacts to sensitive habitats would occur from the placement of sand on the beach. Following initial placement on the beach, a portion of the sand may move upcoast, downcoast, and offshore depending on the magnitude, direction, and period of waves. The available evidence suggests that the proposed project will not result in the net loss of habitat value of sensitive rocky intertidal habitat, and or in long-term net loss in habitat value of surfgrass beds. The Corps acknowledges that the coastal engineering model has uncertainties due to multiple variables within the natural environment. Impacts to rocky reef and surfgrass are expected to be none to very minor, but currently are unknown. Therefore, reasonable worst-case scenario of one acre of reef burial was used to estimate contingency costs for mitigation.

As identified in Appendix B of the FEIS, the monitoring and mitigation reporting plan includes monitoring of rocky reef/surfgrass habitat in the San Clemente Pier area for a minimum of two years pre-construction and two years post-construction; a preliminary mitigation implementation plan and a preliminary mitigation monitoring plan, which would be triggered if mitigation is determined to be necessary. Once authorized, the project will move into the Preconstruction, Engineering and Design (PED) Phase. The monitoring plan may be revised during that phase. The monitoring and analytical methods used will be adequate to identify and accurately measure impacts from the beach nourishment effort. If a more comprehensive biological survey of the project area is required to accomplish the above, it will be accomplished during this phase. The purpose of conducting this survey during PED is so that the information will be current at a time relevant to project construction. The final monitoring and mitigation reporting plan will also ensure that appropriate mitigation sites are available to address potential impacts and that the success criteria and analytical methods used are adequate to demonstrate a difference between impact/mitigation sites and control sites. If mitigation is determined to be required, it will be accomplished at an equivalent functional value to the impacted area.

To continue to work cooperatively throughout the final project planning and construction phases, the Corps will provide, prior to commencement of construction, a copy of the final PED phase surveys and the monitoring plans to National Marine Fisheries Service (NMFS) and other agencies for review. The Corps will carefully consider all comments by NMFS and will make all reasonable efforts to ensure that the concerns expressed are resolved prior to each construction phase. The PED surveys and monitoring plans include the final biological (reef/surfgrass) mitigation and monitoring plan including all surveys conducted in preparation of

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that plan; the surfing monitoring plan; the turbidity monitoring plan; the stormwater pollution prevention plan and the oil spill prevention and response plan.

We trust that the above information sufficiently addresses your concerns. If you would like to discuss these issues further, please contact Ms. Andrea Walker, HQUSACE, at (202)-761-0316.

Sincerely,

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

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DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

March 14, 2012

REPLY TO
ATTENTION OF

Ms. Kathleen Martyn Goforth, Manager
Environmental Review Office
United States Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, California 94105

Dear Ms. Goforth:

Thank you for your letter dated September 27, 2011 on the Final Environmental Impact Statement (FEIS) for San Clemente Shoreline Protection Project, Orange County, California. We appreciate your staff's willingness to identify issues of concern and offer the following information in response to your letter.

In your letter, EPA recommends additional confirmatory testing of the proposed Oceanside borrow site, which is no more than three years old, to ensure accurate sediment characterization is performed before signing a Record of Decision (ROD). A geotechnical investigation, including physical and bulk sediment chemistry testing of the Oceanside borrow site, was conducted to identify areas with beach compatible material. This testing is sufficient for a planning level of analysis. Once authorized, the project will move into the Preconstruction, Engineering and Design (PED) Phase. During that phase, an underwater remote sensing survey of the borrow site and a more detailed geotechnical investigation will be conducted. The purpose of conducting this analysis during PED is to confirm information developed during the planning phase at a time closer to construction.

Given the projected sea level rise, the EPA also recommends the shoreline be monitored for any changes that may occur. Annual physical monitoring of the shoreline at the project site will consist of direct surveys of beach, bathymetric measurements, surf quality observations, and video photogrammetric methods. The purpose of this monitoring is to optimize timing and detailed design of the periodic nourishment to be implemented. This annual monitoring is in addition to pre- and post-construction monitoring of the biological resources.

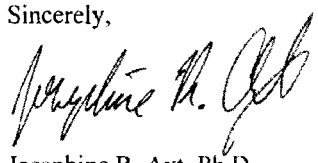
Based on the combination of sediment placement and projected sea level rise, EPA also recommends the Corps consider a shorter time period (e.g., 25 years) for the project. The 50-year period of analysis is a standard time reference, which allows comparison of project benefits and costs across Corps projects. For the San Clemente Shoreline Protection Project, economic analysis shows that, even with the high sea level rise scenario, the recommended plan retained a benefit cost ratio greater than 1 at the end of the 50-year analysis period. A 50-year period of analysis is appropriate. The proposed plan includes monitoring throughout the period of analysis which will allow the periodic renourishment to be managed adaptively in response to changing conditions.

The final monitoring and mitigation reporting plan in the FEIS includes monitoring of offshore potential impact areas for a minimum of two years pre-construction and two years post construction. The monitoring and analytical methods used will be adequate to identify and accurately measure impacts from the beach nourishment effort. The details of these plans will be revised during PED in conference with knowledgeable, experienced, and qualified marine ecologists. If a more comprehensive biological survey of the project area is required to accomplish the above, it will be accomplished during this phase. As stated above, the purpose of conducting this survey during PED is so that the information will be current at a time relevant to project construction.

EPA further recommends that the ROD should ensure that direct and indirect emissions from both construction and operation phases of the project, including off-shore emissions within three miles of the coast, conform to the approved State Implementation Plan and do not cause or contribute to violations of the National Ambient Air Quality Standards (NAAQS). Off-shore emissions associated with the proposed action have been included in the general conformity applicability analysis for this project. As contained in Section 2.4.1.14 and Appendix C of the FEIS, emissions analysis shows that emissions associated with the proposed action would not exceed General Conformity *de minimus* levels and, therefore, that the proposed action will conform.

We trust that the above information sufficiently addresses your concerns. If you would like to discuss these issues further, please contact me at (213) 452-3783 or Ms. Jodi Clifford, Chief, Environmental Resources Branch at 213-452-3840.

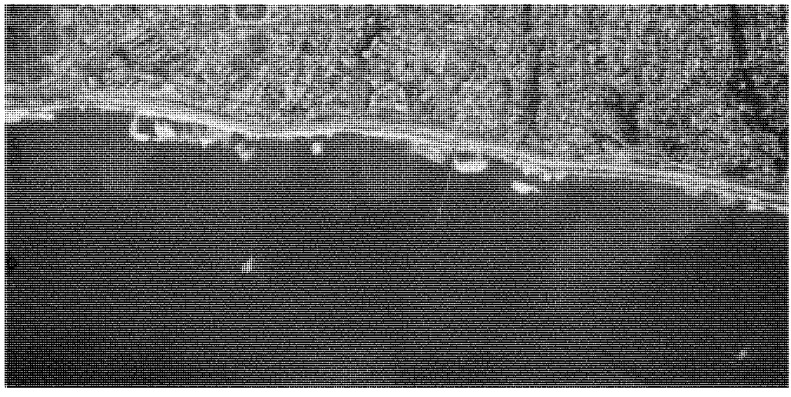
Sincerely,



Josephine R. Axt, Ph.D
Chief, Planning Division

San Clemente Shoreline Feasibility Study
Orange County, California

Final Report



U.S. Army Corps of Engineers
Los Angeles District

JULY 2011

REVISED: FEBRUARY 2012

ADDENDUM
San Clemente Shoreline Feasibility Study
Orange County, California

Final Feasibility Report and EIS
February 2012

1 PURPOSE

The purpose of this Addendum is to document changes to the project costs as presented in the Final Feasibility Report of July 2011, based on revision of the final project costs to reflect an increase in the physical monitoring costs and the current interest rate (Fiscal Year 2012) of 4 percent. The Cost Engineering Directory of Expertise (Cost-DX) certified the cost estimate in February 2011 at the October 2011 price level. The July 2011 report presented cost levels in January 2011 price levels, which were a part of the certified cost estimate. The Cost-DX has reviewed the updated cost estimate, with the above mentioned revision, and have stated that the changes are justified.

2 PHYSICAL MONITORING

Based on the condition, shown below, imposed by the California Coastal Commission's Coastal Consistency Determination and accepted by the Corps, the cost of the physical monitoring of the project during the 50-year period of analysis was increased from $856,000 to $950,000 for each nourishment cycle (approximately a 6-year period). This resulted in an overall increase to the total project cost of $2,100,000 (October 2011 price level). It should be noted that the majority of the physical monitoring costs were originally anticipated, however, the level of detail requested by the Coastal Commission exceeded initial estimates.

Condition #4:

*4. **Surfing Monitoring Details.** The Corps will revise its Surfing Monitoring Plan (Exhibit 15) to include and implement the following features:*

(a) adequate baseline data collection, including, if feasible, a full year of pre-construction monitoring to determine the baseline condition (conditions at the project area and, as appropriate, at control sites).

(b) identification of locations to be monitored, the length of the pre-project monitoring, and interest groups to be involved in establishing the monitoring effort to identify surfing or surf quality changes that might be attributable to the nourishment project, including identifying criteria for a determination of what constitutes a significant alteration or impact. Another location within the region might also be chosen to act as a control site to help determine if there are changes within the region to surfing conditions that could be attributable to other factors other than project implementation.

(c) supplementing the "wave observation" component of the surf monitoring with observations about the surfing activities, including a usage scale of surfers in the water, both morning and mid-day, and describing the average and maximum ride lengths.

(d) given that video recordings are included, if observer counts are too difficult for one observer, video may be used to augment observer counts.

(e) when collecting user data, the analysis should be disaggregated into weekday and weekend data.

(f) for mid-day observations on days when surfers are kept out of the water by lifeguards, these should be recorded as restricted use days (not zero use days).

(g) establishing mechanisms for informing the local community about the project, and encouraging public comments on surfing quality (or other recreational concerns), including but not limited to: (i) a web site, (ii) pre-construction notifications to the public; and (iii) signs.

To continue to work cooperatively throughout the final project planning and construction phases, the Corps will provide, prior to commencement of construction, a copy of the final monitoring plan, to the Commission's Executive Director, for his review. The Corps will carefully consider all comments by the Commission's Executive Director and will make all reasonable efforts to ensure that the concerns expressed are resolved prior to each construction phase.

3 BENEFITS UPDATE

The benefits of the project were recalculated using the FY12 discount rate of 4-percent. This resulted in an increase of net annual benefits from $901,000 to $978,000. There was not a change to the benefit to cost ratio.

4 UPDATED COST TABLES

The following table is an update of Table 6-4, displaying the costs of the plan at October 2011 price levels.

Federal and Non-Federal Initial Costs of the Recommended Plan
October 2011 Price Levels

		Non-Federal		Federal	
	Total Cost	%	Cost	%	Cost
Cash	$11,300,000		$3,950,000		$7,350,000
Real Estate (LERRDs)	$11,000		$11,000		
Cost Share: First Costs	$11,300,000	35	$3,960,000	65	$7,350,000
Cost Share: Continuing Construction	$86,800,000	50	$43,400,000	50	$43,400,000

The following table is an update of Table 6-5, displaying the fully funded cost estimate for the plan.

Federal and Non-Federal Cost Apportionment for the Total Project
Fully Funded Cost Estimate

Item	Total Project Cost	Non-Federal Cost	Federal Cost
Initial Construction			
Cash	$11,300,000	$3,950,000	$7,350,000
Non-Federal LERRD's	$11,000	$11,000	
Total Initial Cost	$11,300,000	$3,960,000	$7,350,000
Total Continuing Construction Cost (not discounted)	$150,000,000	$75,000,000	$75,000,000
Total Project Cost	$161,000,000	$78,900,000	$82,100,000
Percentage Share		49	51

5 UPDATED RECOMMENDATIONS

The information contained in this Addendum presents changes to the cost estimate and benefit calculation to reflect FY2012 price levels. These are the only changes to my original recommendation that was presented in the report dated July 2011. These recommendations still reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be further modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

R. Mark Toy, P.E.
Colonel, US Army
Commander and District Engineer

SAN CLEMENTE SHORELINE FEASIBILITY STUDY
FINAL REPORT

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Real Estate

EXECUTIVE SUMMARY

Introduction

The San Clemente Shoreline Feasibility Study area is located along the Pacific Ocean coastline in the City of San Clemente, Orange County, California. San Clemente is the southernmost city in Orange County and is bounded by the Camp Pendleton Marine Base and San Onofre State Beach Park to the south; and to the north, by the communities of Capistrano Shores and Dana Point. The original total study area encompasses the City of San Clemente and extends from San Mateo Point, located at the southern boundary of the City, to Dana Point Harbor for a total distance of approximately 12.1 kilometers (7.5 miles).

Running along the entire length of the San Clemente shoreline is a portion of the LOSSAN (Los Angeles to San Diego) railroad corridor, which is owned by the Orange County Transportation Authority (OCTA). This commuter rail corridor is among the busiest in the country and separates the beach from the bluff. The study area is divided into ten reaches based on locations of developments and the condition of the revetment that runs along various stretches of the railroad tracks. After analysis of each section it was determined that only reach 6 of the original ten reaches has the potential for a justified project based on economic analysis. Reach 6 extends from Paseo de Cristobal to Linda Lane in the City and contains beaches ranging from 0 to 39 m (0 to 128 ft) in width measured from the project baseline (seaward rail of the railroad) to the beach berm. Reach 6 contains both the San Clemente Pier and the "T-Street Reef" and its beaches are backed by park facilities, railroad tracks, and high coastal bluffs. No protective revetment is present in Reach 6 and, in general, the majority of significant structures running along the beach are included in Reach 6.

The "T-Street" region of the shoreline is a notoriously popular surfing site located immediately south of the San Clemente Pier, and directly offshore of the T-Street overpass. The T-Street surf break is due to a permanent, hard bottom reef that rises above the seabed. As stated above, both the "T-Street Reef" and the Pier lie within the boundaries of Reach 6. It has become apparent through the study and through interaction with local conservation agencies (i.e. Surfrider), that the unique surfing characteristics in this area could be altered by modification to or burial of the reef. As a result, mitigation of impacts to the reef has become the largest constraint in the plan formulation process for this study. Other constraints include environmental effects including kelp, seagrass, and shallow water rocky habitat.

The purpose of this study is to identify the most technically feasible and economically beneficial "recommended plan" for reducing damages from storm-induced wave attack which are expected to increase, in the future, as a result of chronic, long-term shoreline erosion. Of great risk is the LOSSAN rail line, which runs close to the shoreline in much of the study area and in some areas is protected only with unimproved ballast and therefore vulnerable to storm-induced damages. The reconnaissance phase of this study was initiated on March 28, 2000 under the authority of Section 208 of the Flood Control Act of 1965. This phase of the study resulted in the finding that there was a Federal interest in continuing into the feasibility phase. The City of San Clemente, the non-Federal sponsor, and the U.S. Army Corps of Engineers (Corps) initiated the feasibility phase in September 2001. The feasibility phase study was cost-shared equally between the Corps and the sponsor.

Without-Project Conditions and Damages

Prior to urban development in the 1990's, the beaches within the study area remained relatively stable because of a balanced sediment supply delivered from the San Juan Creek to the Oceanside littoral cell. However, documented historical beach widths above the Mean Sea Level (MSL) line between T Street and Mariposa Point were as narrow as 25 m (82 ft) in the winter months during this time period (USACE-SPL, 1991). As a consequence, storm damages occurred in the past (e.g. 1964, 1983, 1988 and 1993), as the protective buffer beach width was narrow, particularly in the winter season.

Since the 1990's, the project area has experienced chronic, mild, long-term erosion. Shoreline retreat is a result of the decrease of fluvial sand supply resulting from the concreting of creeks and rivers, upstream dams, and urban development. Continued future shoreline retreat is expected to result in storm waves breaking directly upon the railroad ballast, which significantly threatens the operation of the rail corridor. Continued future shoreline retreat also will subject public facilities to storm wave-induced damages. These facilities, maintained by the City of San Clemente, include the Marine Safety Building, public restroom facilities located on the beach, lifeguard stations, parking areas, and paving near the Pier.

If no action is taken, public properties and structures are expected to be susceptible to damages caused by erosion (including land loss and undermining of structures), inundation (structures), and wave attack (structures, railroad).

Railroad Damages

The LOSSAN railroad line, separating the active coastline from the coastal bluff and adjacent backshore development, has experienced railway traffic service delays as a result of the narrowing shorelines. These delays occur when storm wave run-up exceeds the elevation of The Southern California Regional Railroad Authority (SCRRA) protective revetments or the crest of the railroad ballast in the without-revetment segments. Two service disruption incidents of approximately 24 hours occurred in the 1960's and 1970's (McGinley, 2003) at Mariposa Point (north of the Pier) and at a location south of the Pier, respectively.

In response, the SCRRA and OCTA have constructed un-engineered riprap revetment in areas where the railroad ballast and tracks are vulnerable to storm wave-induced damages, costing the SCRRA an average of between $200,000 and $300,000 over every three-year period. Over the past ten years, storm wave attack in the study area has restricted train services periodically and during the 1998 El Nino, the protective revetment structure sustained severe damage that significantly slowed train speeds.

Coastal Storm Damages

Public beach facilities located in Reach 6 have experienced damages from storms, as the existing beach has historically acted as a buffer against storm wave attack but has been narrowed. These facilities include the Marine Safety Building, public restroom facilities located on the back beach, lifeguard stations, parking areas, and paving near the Pier. The 1983 El Nino storm season resulted in an estimated damage of $3,277,000 to public beach facilities in the study area.

If no action is taken, the City of San Clemente's properties and structures will be susceptible to future damages caused by erosion (including loss of land and of properties), inundation, and

wave attack. The majority of the National Economic Development (NED) damages/costs are related to LOSSAN railroad protection/construction and O&M costs. On an annual basis, the LOSSAN costs are $1,280,000 and the annualized value of all damage is $1,424,000. Throughout the San Clemente Study Area, the beach will continue to narrow under the without-project conditions, leading to a decline in recreational value as well.

Plan Formulation Process and Alternatives Considered

A broad set of project alternatives was initially considered:

1. No Action Alternative ("Do-Nothing");
2. Managed Retreat;
3. Beach Nourishment;
4. Revetment;
5. Seawall;
6. Groin;
7. Visible Offshore Breakwater; and,
8. Submerged Reef.

After reviewing the possible alternatives, only beach nourishment was identified as being suitable. All other alternatives were dropped from further consideration because of cost, ecosystem impacts, or lack of support from the local sponsor. The table below provides the levels of acceptability of the management measures on a qualitative scale. As can be seen in the table, only beach fill is both economically feasible and potentially environmentally acceptable. Detailed discussion of the screening of these alternatives is provided in Section 4.6.

Management Measure	Meets Purpose and Need	Technically Feasible	Economically Feasible	Environmentally Acceptable	Acceptable to Public
Beach fill	Yes	Yes	Yes	Yes	Maybe
Managed Retreat	Maybe	Yes	No	No	Maybe
Revetment	Maybe	Yes	Maybe	No	No
Seawall	No	Yes	Yes	No	No
Groin	Yes	Maybe	No	No	No
Visible Offshore Breakwater	Maybe	Yes	No	No	No
Submerged Reef	Maybe	No	No	Maybe	Maybe

The final recommended beach nourishment plan was developed by considering the storm damage reduction and recreational potential of various beach fill configuration alternatives and optimization of the average annual benefits they would yield. Beach widths ranging from 0 to 60 m (0 to 197 ft) were analyzed, with 15 m (50 ft) being designated as the NED Alternative, the alternative that would yield maximum benefits to the nation.

The following table summarizes the NED Plan costs and unlimited benefits. Initial Construction Cost consists of IDC, PED, S&A, and Environmental Monitoring Costs in addition to Initial Sand

and Initial Mob/Demob Costs as shown below. Annual Costs are the Total Cost-Shared Life-Cycle Costs of the project in Average Annual Value terms and the B/C unlimited ratio contains an unlimited amount of recreational benefits whereas the limit for recreational benefits used to calculate the limited B/C Ratio is 50% of the total benefits (i.e. 50% storm damage reduction benefits and 50% recreational). The results presented below are in January 2011 price levels and are based on a risk-based cost analysis (presented in detail in the Cost Engineering Appendix) and contain a 36% contingency.

Description :	NED Alternative 2
Initial Sand Cost	$5,250,000
Initial Mob/Demob	$2,890,000
Initial Construction Cost	$11,100,000
Annual Costs	$2,140,000
Annual Net NED Benefits (unlimited)	$901,000
B/C Ratio (SDR Benefits only)	0.7
B/C Ratio (unlimited)	1.4
B/C Ratio (limited)	1.3

The design berm elevation for the study is +5.2 m MLLW (+17 ft), which matches the natural berm of adjacent healthy beaches established by numerous surveys over the years (based on historical surveys). The design foreshore slope is established at 8H:1V and the construction foreshore slope is 13H:1V.

The recommended plan will require approximately 192,000 m^3 (251,000 CY) of beach compatible sand, placed by hopper dredge. The sand will be taken from a designated borrow site at Oceanside, CA and hauled 30 km (18.6 miles) to San Clemente. Roughly 1,040 m (3,412 ft) of shoreline would be nourished under this plan. The southern limit of the proposed beach fill is located immediately south of the T-Street overpass and the northern limit immediately north of the Marine Safety Headquarters, which lies in Reach 6. A taper would continue an additional 100 m (330 feet) to the north and south to merge with the existing shoreline.

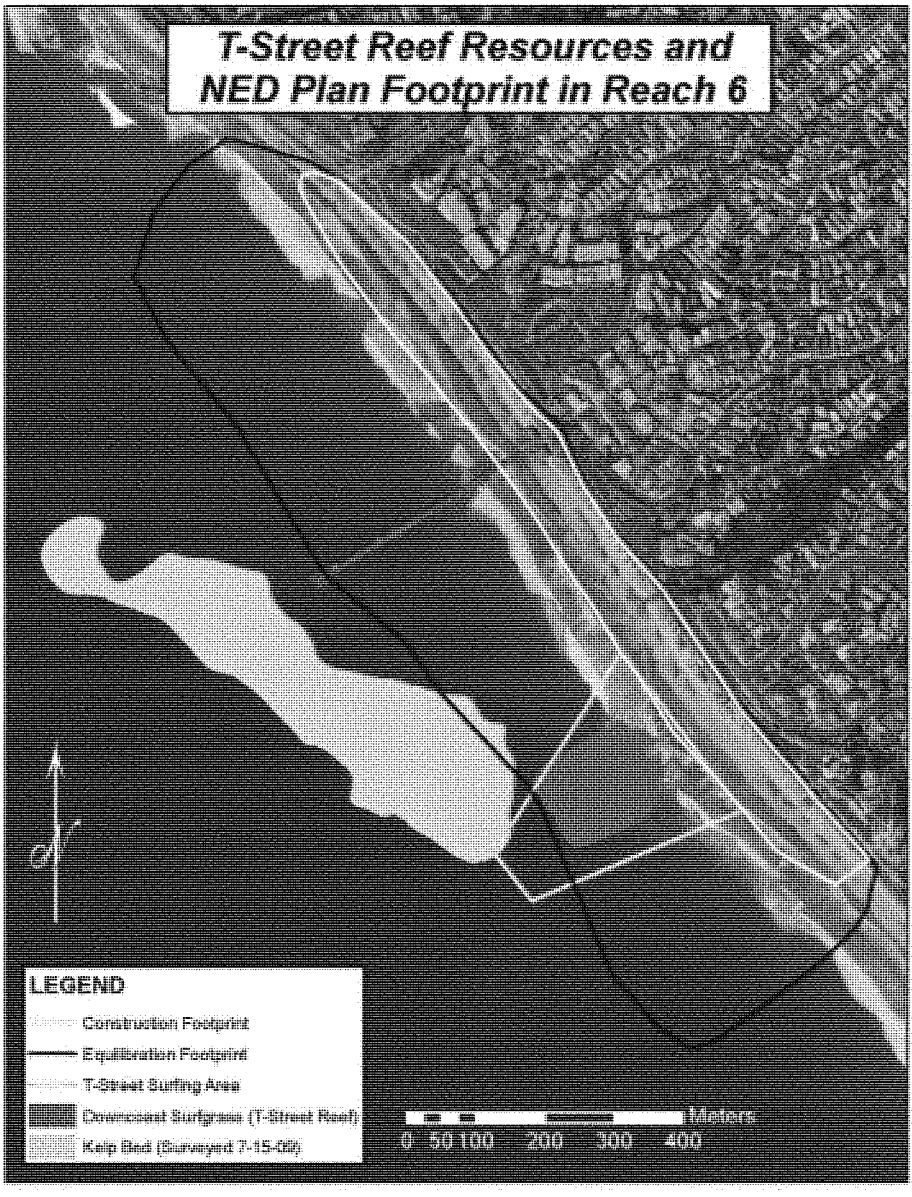
The effects of the recommended plan on the existing surfing characteristics of the study area are not quantifiable but are not expected to be large. While the potential for negative impacts on surfing exist, the equilibration footprint of the recommended plan is not expected to encroach greatly on the reef nor modify the wave-refracting qualities of the reef. In addition, it is estimated that no more than roughly 15% of the reef (all on the landward side) would potentially be impacted or buried by the NED Plan, thus potential impacts on surfgrass and rocky reef resources are expected to be minimal. Re-nourishment would be performed every 6 years. The figure below shows the reef and associated resources in relation to the equilibration footprint of the 15-m NED Plan which spans the extent of Reach 6.

USACE policy requires that a range of possible sea level rise scenarios. Over the 50 year time period between 2012 and 2061, the relative sea level rise in San Clemente, using historic data,

is expected to be 0.12 m (0.4 ft) and, using the high scenario, is predicted to be 0.7 m (2.3 ft). The recommended plan is formulated on the basis of continuous monitoring of beach fill erosion and renourishment. This monitoring should identify any rapid change in sea level. A higher future sea-level rise increases the potential for storm damages. A comparison of the number of fills required over the 50-year period of analysis shows 9 fills, including initial placement, needed for the historic sea level rise and 10 needed for the high sea level rise curve. These results indicate that the recommended plan is functional in a range of sea level rise scenarios with monitoring, and unlikely to carry a significant degree of risk related to sea level rise.

Sufficient parking and public access is provided to the project area. Of the current demand for parking spaces of almost 1100, there are almost that same number of spaces available within a 5-minute walk to the beach and even more spaces available if the distance is extended to 0.8 km (0.5 mi). There are 4 access points to the beach within the project area and one just north of the project area.

As stated, the average annual cost of the plan is $2,140,000. Initial construction will be cost-shared 65% Federal and 35% Non-Federal and continuing construction (i.e. each renourishment and monitoring) will be cost-shared 50%-50%. Based on January 2011 price levels, the estimated total first cost of the plan is $11,100,000. Continuing construction will consist of 8 renourishments with a total continuing construction cost estimated to be $84,900,000 over the 50-year period. The sum of the first cost and periodic nourishments is estimated to be $96,000,000. The City of San Clemente has expressed their interest in providing the Non-Federal matching funds to implement and construct the recommended plan.


T-Street Reef Resources and
NED Plan Footprint in Reach 6
LEGEND
Construction Footprint
Equilibration Footprint
T-Street Surfing Area
Downcoast Surfgrass (T-Street Reef)
Kelp Bed (Surveyed 7-15-09)
Meters
0 50 100 200 300 400

1 INTRODUCTION

1.1 Study Authority

This report was prepared as a response to the study authority in Section 208 of the Flood Control Act of 1965 (Title II of Public Law 89-298), which reads:

"The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the localities specifically named in this section. ... Coasts of Washington, Oregon, and California to determine advisability of protection work against storm and tidal waves."

Funding was initially appropriated by the Energy and Water Development Appropriations Act of 2000, Public Law 106-60, for the reconnaissance study, as recommended in House Report 106-253, page 27:

"The Committee recommendation includes funds for the Corps of Engineers to conduct a reconnaissance study investigating shoreline protection alternatives for San Clemente, California."

The reconnaissance phase of the study was initiated on March 28, 2000. This phase of the study resulted in the finding that there was a Federal interest in continuing the study into the feasibility phase. The City of San Clemente as the non-Federal sponsor and the U.S. Army Corps of Engineers (Corps) initiated the feasibility phase of the study in September 2001. The feasibility phase study cost was shared equally between the Corps and the sponsor. This report presents the preliminary results of both phases of study.

1.2 Study Purpose and Scope

The purpose of this Feasibility Study is to:

1) Describe existing and future without-project conditions along the coast of the City of San Clemente in Orange County, CA and identify problems and opportunities to reduce storm damages, improve public safety, increase recreation opportunities, and protect the environment.

2) Formulate and evaluate an array of alternatives and recommend the one that most effectively addresses these problems and complies with local, state, and Federal laws and regulations. Four accounts, National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE), are used to evaluate the plans.

1.3 Planning Process and Report Organization

This report includes the alternatives analysis, which develops options that focus on the reduction of storm damages. The alternatives are evaluated, and preliminary recommendations are made. This feasibility study was conducted in accordance with current Corps of Engineers regulations and policies including, but not limited to the Principles and Guidelines for Water Resources and ER 1105-2-100, Planning Guidance notebook (22 April 2000), Guidance for

Conducting Civil Works Planning Studies, (Dec 1990). The six steps in plan formulation, which are expanded in the aforementioned documents, are listed below and discussed further in Chapter 6, Plan Formulation.

1) Identify Problems and Opportunities
2) Inventory and Forecast Conditions
3) Formulate Alternative Plans
4) Evaluate Alternative Plans
5) Compare Alternative Plans
6) Select a Recommended Plan

1.4 Study Participation, Public Involvement and Coordination

The non-Federal sponsor of this study is the City of San Clemente whose representatives have taken an active role in support of this study. Numerous local, state, and federal agencies were also involved in the study effort, and these are listed below. This Feasibility Study is funded with 50% Federal and 50% non-Federal funds.

A major consideration for the City of San Clemente and the Corps of Engineers in formulating and selecting a recommended plan is consideration of the acceptability of the plan to public interests. The study included several public involvement activities to allow for public interests to provide input, and their views and comments on the study area, conditions, problems, and needs, alternative plans, and the selected recommended plan. The public involvement activities and views and comments received are presented in Chapter 7 of this report as well as the Coordination Chapter of the EIS/EIR.

The Cooperating/Consulting Public Agencies and Institutions that participated in the San Clemente Shoreline Feasibility Study include:

Federal Agencies
- U.S. Coast Guard
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. National Marine Fisheries Service

State Agencies
- California Coastal Commission
- California Department of Fish and Game
- California Department of Boating and Waterways
- California Regional Water Quality Control Board
- Office of Historic Preservation

Local Agencies
- City of San Clemente
- South Coast Air Quality Management District
- Southern California Regional Railroad Authority (SCRRA)
- Orange County Transportation Authority (OCTA)
- Metrolink

1.5 Prior Studies, Reports and Existing Water Projects

There are no existing Federal Shore Protection Projects in the Study area. The following reports are being reviewed as directed in the study authorization:

1. *State of the Coast Report, San Diego Region, River Sediment Discharge Study Report*, Corps of Engineers, 1988. This report presents the findings of a study estimating the sediment delivery to the coast from streams and watersheds draining to the California Coast in the San Diego Region, which extended north to the Dana Point headlands. It concludes that 90% of the average annual yields of sands came from major rivers and the other 10% yielded from coastal streams.

2. *State of the Coast Report, Coast of California Storm and Tidal Wave Study, San Diego Region, Littoral Zone Sediments Report*, Corps of Engineers, 1988. This report presents the findings from the collection, analysis, and interpretation of sedimentologic data from the littoral zone. From the findings, littoral segments along the southern California coast and the most likely transport direction within each of these littoral segments are defined.

3. *State of the Coast Report, San Diego Region, Historic Wave and Sea Level Data Report*, Corps of Engineers, 1988. This report presents statistically analyzed historic wave data and recent wave hindcasts for Southern Hemisphere swells and tropical storms that have impacted the San Diego region. The tide regime, historic and predicted extremes of sea level, and a chronology of extreme storm events are also presented.

4. *State of the Coast Report, Coast of California Storm and Tidal Wave Study, San Diego Region, Main Report*, Corps of Engineers, 1991. This report suggests that the condition of the beaches in the future will be governed by cycles of accretion and erosion similar to those of the past 50 years, but with accelerated trends toward erosion because of the reduction in fluvial delivery due to impediment by dams and river mining, the influence of Oceanside Harbor interrupting alongshore sediment transport, and the increasing rate of sea level rise.

5. *Wave Information Studies of US Coastlines, Southern California Hindcast Wave Information*, Corps of Engineers, 1992. This report presents hindcast wave information from 1956 to1975 for the region south of Point Conception to the Mexican border. The sources of wave energy and local effects that control the wave climate included in this report consists of northern Pacific swell, east Pacific wind fields and associated waves, localized effects such as sheltering and diffraction by islands, and meso-scale meteorological systems such as land-sea breezes.

6. *Strategic Rail Corridor Network (STRACNET) and Defense Connector Lines*, Military Traffic Command, Transportation Agency, 1998. This study updates the designation of the Strategic Rail Corridor Network (STRACNET) and its associated connector lines to verify that the rails meet defense readiness requirements for maintenance condition, clearance, and gross weight capability. STRACNET maintains a rail line running parallel to the coastline throughout the City of San Clemente.

7. *Oceanographic Design Conditions for the Repair of the San Clemente Pier*, Moffatt & Nichol Engineers, 1983. This report documents oceanographic data from the 1982-1983 winter storms, which destroyed approximately 134 meters (440 feet) of the San Clemente Pier. Design suggestions from this data and previous storm data are proposed for the repair of the Pier.

8. *Beach Width and Profile Surveys,* City of San Clemente, 2000 & 2002. Results of beach width measurements taken by the City at 16 locations in 1958, 1981 and 1999 are presented. Also, results of benthic elevations along the Pier from 1981 to the present are

provided. The data indicates that there has been a significant increase in the loss of sand along the City's coastal stretch.

9. *Draft Mitigated Negative Declaration, Marblehead Coastal Beach Replenishment Project,* City of San Clemente, 2000. This CEQA document describes a private beach nourishment project along the San Clemente shoreline.

2 STUDY AREA

2.1 Location and Description

The San Clemente Shoreline Feasibility Study area, as presented in **Figure 2-1**, is located along the Pacific Ocean coastline in the City of San Clemente, Orange County, California. San Clemente is the southernmost city in Orange County and is bounded by the Camp Pendleton Marine Base and San Onofre State Beach Park to the south; and to the north, by the communities of Capistrano Shores and Dana Point. The total study area encompasses the City of San Clemente and extends from San Mateo Point, located at the southern boundary of the City, to Dana Point Harbor for a total distance of approximately 12 kilometers (7.5 miles).

The City of San Clemente's shoreline has narrow sandy beaches, on the order of 0 to 40 meters (0 to 130 feet) from baseline to berm, and is backed by high coastal bluffs and pockets of coastal development and infrastructure. The gently to moderately sloping sandy beaches grade into a foreshore consisting of gravel and cobble at the water line in several locations. Running along the entire length of the study area is a major railroad corridor linking the coastal communities of southern California to the greater Los Angeles and San Diego metropolitan areas. The Southern California Regional Railroad Authority (SCRRA), a public associated agency, operates this corridor, which is one of the busiest in the nation. The railroad is constructed on conventional elevated crush rock ballast and is a prominent feature within the study area and effectively separates the beach area from the coastal bluffs. Historically, riprap has been placed along the seaward side of the corridor to protect the rail line from storm wave attack. The existing railroad revetment provides varying levels of protection depending on the rock size and conditions of the riprap for both the rail line and development and infrastructure improvements landward of it.

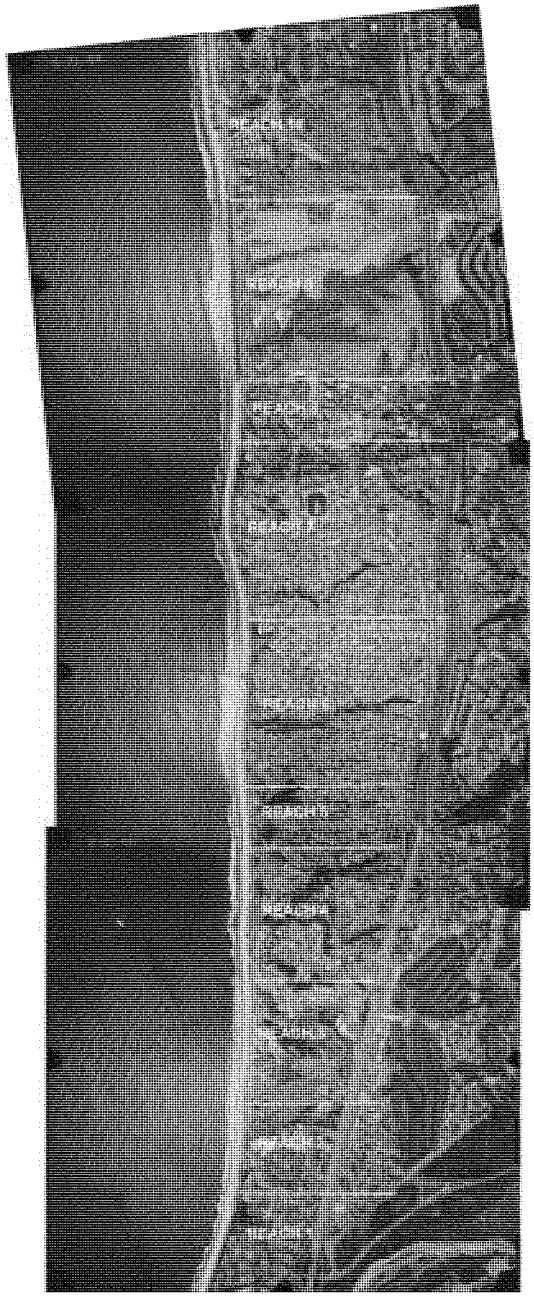


Figure 2-1 Study Area Reach

2.1.1 Reach Boundaries

To better analyze the interaction between the coastal bluffs, the railroad corridor and the shoreline morphology, the entire study area was divided into ten reaches (as shown in **Figure 2-1**). The primary consideration for project reach delineation was the varying methods of construction employed by SCRRA to protect the railroad. Armoring varies from conventional rock ballast construction to improved armor stone protection. A secondary consideration for the distinction between reaches was based on differences in topography, coastal development and beach conditions.

The 10 reach boundaries, as described in **Table 2-1**, are defined in meters northward from San Mateo Point (Station 0+000) and shoreline features located within each reach are described. Since the railroad is assumed to be a constant feature throughout the 50 year period of analysis, the railroad tracks provided a convenient feature to define a horizontal alignment. Boundaries for reaches 1 through 8 were based on whether an engineered revetment or railroad ballast exists along the railroad tracks. The reaches that have a revetment to protect the railroad are sub-divided into cells with a length of 50 meters (164 feet). Reaches 9 and 10 are located north of the city limits of San Clemente.

Table 2-1 Reach Boundaries

Reach	Range		Approximate Length m, (ft)
	From	To	
1	San Mateo Point	Palmeras	969 (3,180)
2	Palmeras	3800 Block, Vista Blanca	680 (2,230)
3	3800 Block, Vista Blanca	Calafia	600 (1970)
4	Calafia	Primavera	732 (2,400)
5	Primavera	Cristobal	413 (1,350)
6	Cristobal	Linda Lane	1,040 (3,410)
7	Linda Lane	1200 Block, Buena Vista	1,081 (3,550)
8	1200 Block, Buena Vista	Pico	347 (1,140)
9	Pico	San Andreas	1,101 (3,610)
10	San Andreas	Dana Point Harbor	5,000 (16,400)

Reach 1 (**Figure 2-2**) extends from San Mateo Point at Station 0+146 to Station 1+115, a distance of 969 meters (1,380 ft). This reach is the southern portion of San Clemente State Beach. Beach width, which is defined as that portion of the beach between the foreshore berm contour and a backshore baseline, is zero at the southern boundary and gradually increases to 41 m (135 ft) wide. For this study, the baseline is the seaward rail of the railroad. A revetment protects the seaward slope of the railroad and has a slope of 1H:1V, with a crest elevation of approximately +7 m (23 ft). There are no structures seaward of the railroad, however, some residential structures exist immediately landward of the railroad.

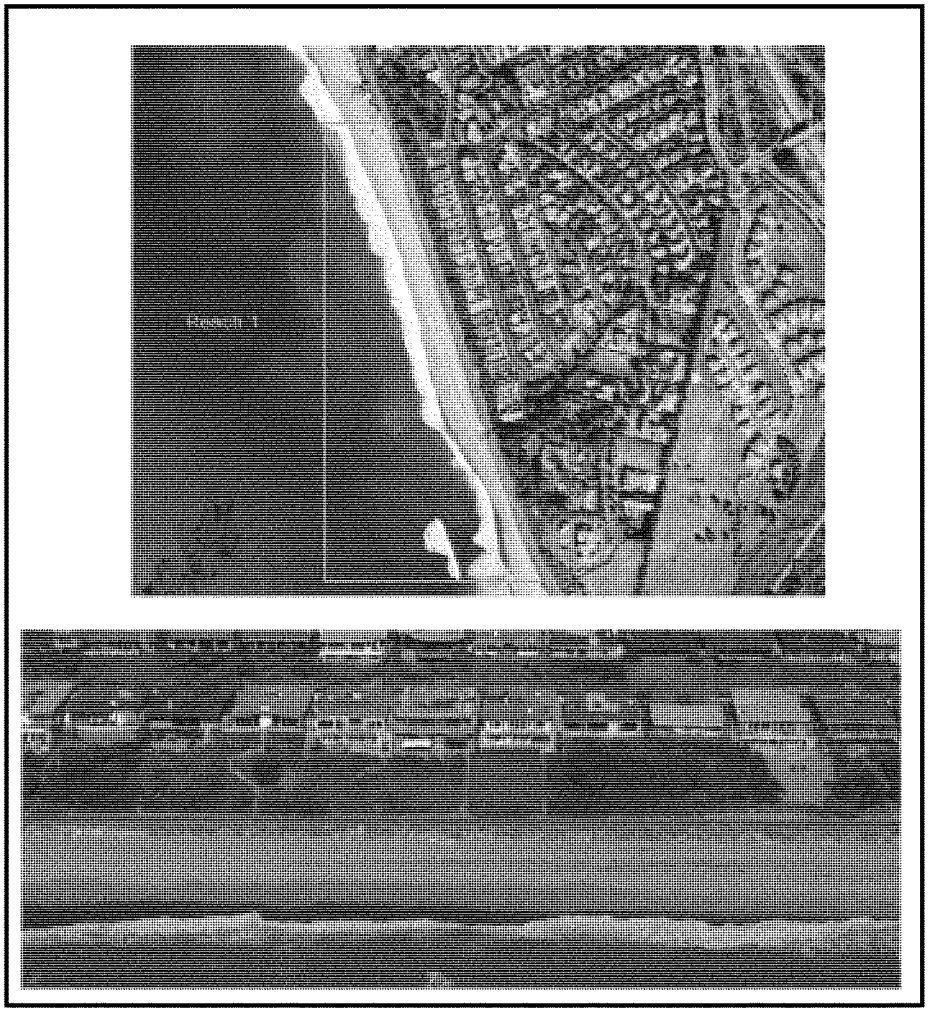


Figure 2-2 Reach 1

Reach 2 (**Figure 2-3**) extends from Avenida de las Palmeras (Station 1+115) to the 3800 block of Vista Blanca (Station 1+795), a distance of 680 meters (2,230 ft). This reach includes San Clemente State Beach and can be characterized as having a narrow to a moderate sized beach that is backed by the railroad corridor located at the base of high coastal bluffs. Beach width is approximately 40 m (130 ft) wide at the southern boundary and gradually decreases to 9 m (30 ft) wide. The railroad seaward slope is not protected by a revetment, but does contain conventional ballast construction, which has a slope of 1H:1V, and a crest elevation of approximately +6.4-7.6 m (21-25 ft). There are no structures seaward of the railroad; the underpass for San Clemente State Beach is included within this reach.

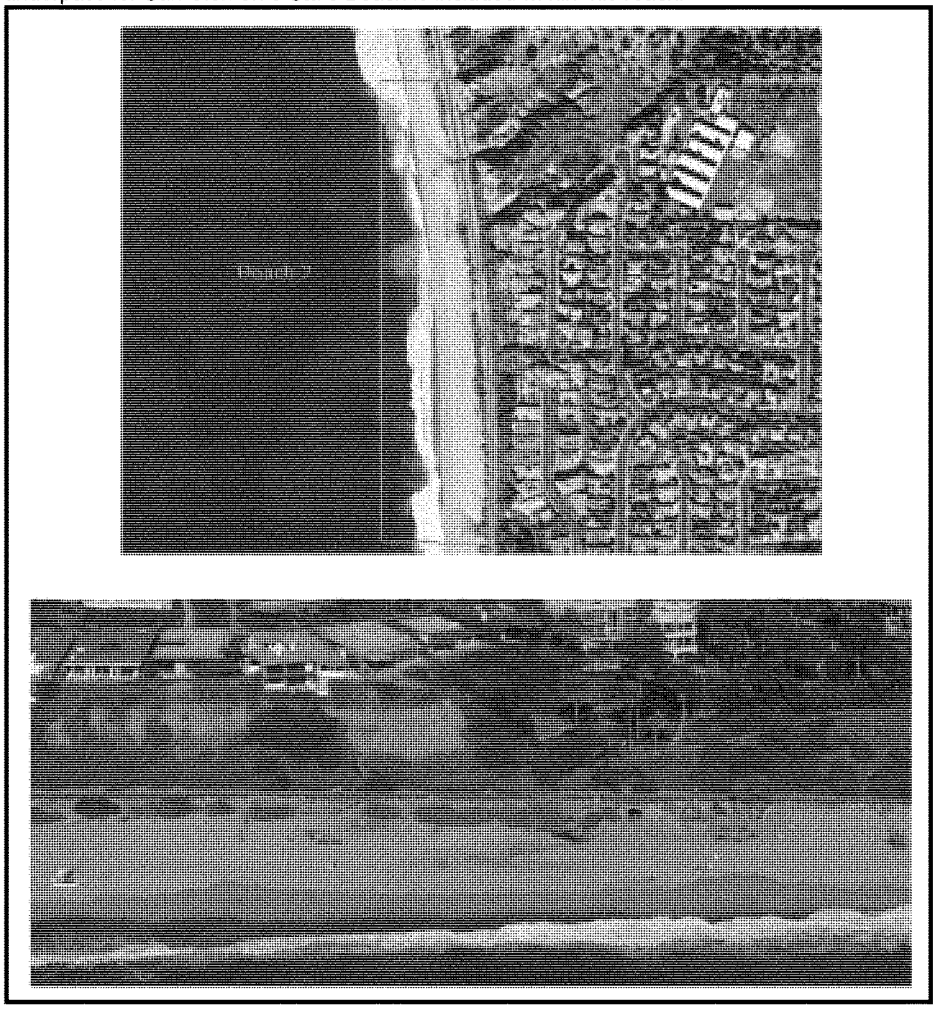


Figure 2-3 Reach 2

Reach 3 (**Figure2-4**) extends from the 3800 Block of Vista Blanca (Sta 1+795) to Avenida Calafia (Sta 2+395), a distance of 600 meters (1,970 ft). This reach encompasses San Clemente State Beach and Calafia Beach Park. The beach width is approximately 9 m (30 ft) wide at the southern boundary and quickly becomes zero throughout the remainder of the reach. There is a revetment protecting the railroad seaward slope, with a slope of 1H:1V, and a crest elevation of approximately +7 m (23 ft). There are no structures seaward of the railroad and Calafia Beach Park is on the landward side of the railroad.

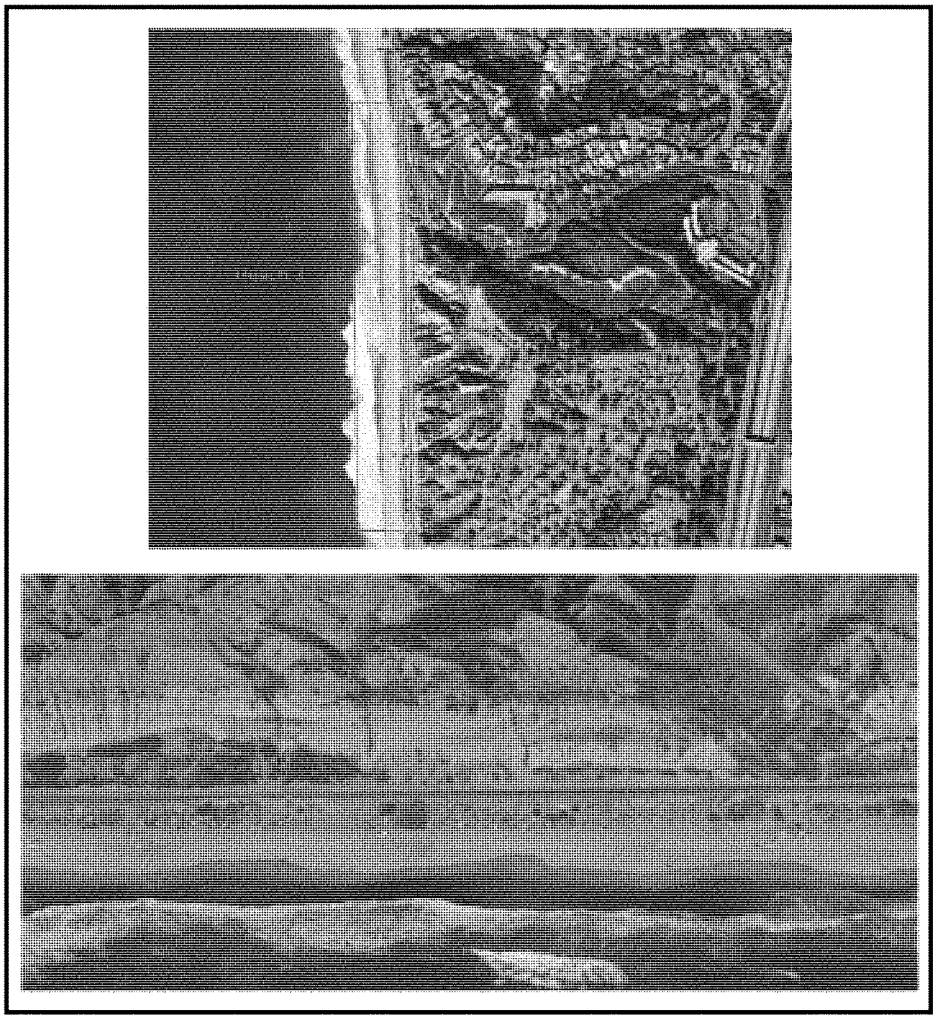


Figure 2-4 Reach 3

Reach 4 (**Figure 2-5**) extends from Sta 2+395 at Avenida Calafia to Sta 3+127 at Calle Primavera, a distance of 732 meters (2,400 ft). This reach encompasses San Clemente State Beach on the southern portion and the City of San Clemente on the northern portion. Beach width is approximately 30 m (98 ft) wide at the southern boundary, transitions to 60 m (196 ft) wide in the middle, and transitions to 10 m (33 ft) wide at the northern boundary. The railroad seaward slope is not protected by a revetment, but does contain conventional ballast construction, which has a slope of 1H:1V, and a crest elevation of approximately +6.3 m (21 ft). There are no structures seaward of the railroad, however, some residential structures exist immediately landward of the railroad.

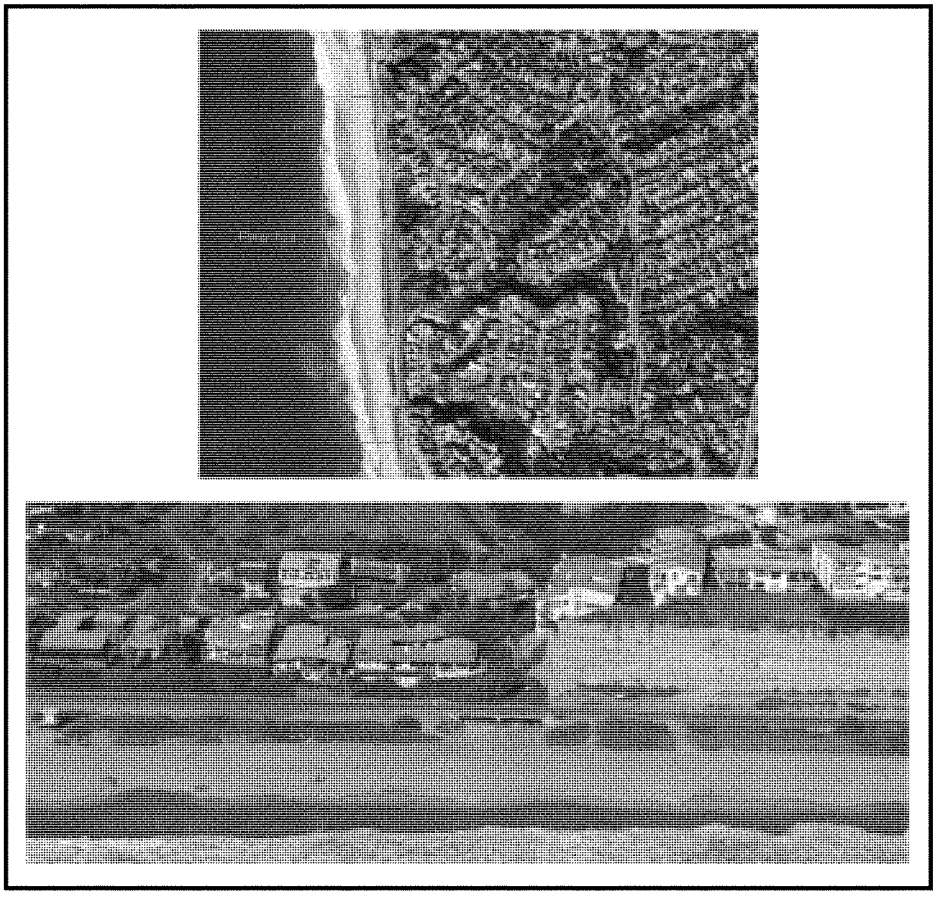


Figure 2-5 Reach 4

Reach 5 (**Figure 2-6**) extends from Sta 3+127 at Calle Primavera to Sta 3+540 at Paseo de Cristobal, a distance of 413 meters (1,355 ft). Beach width is 0 m wide throughout the reach. There is a revetment protecting the railroad seaward slope, which has a slope of 1H:1V, and a crest elevation of approximately +6.5 m (21 ft). There are no structures seaward of the railroad; some residential structures exist immediately landward of the railroad.

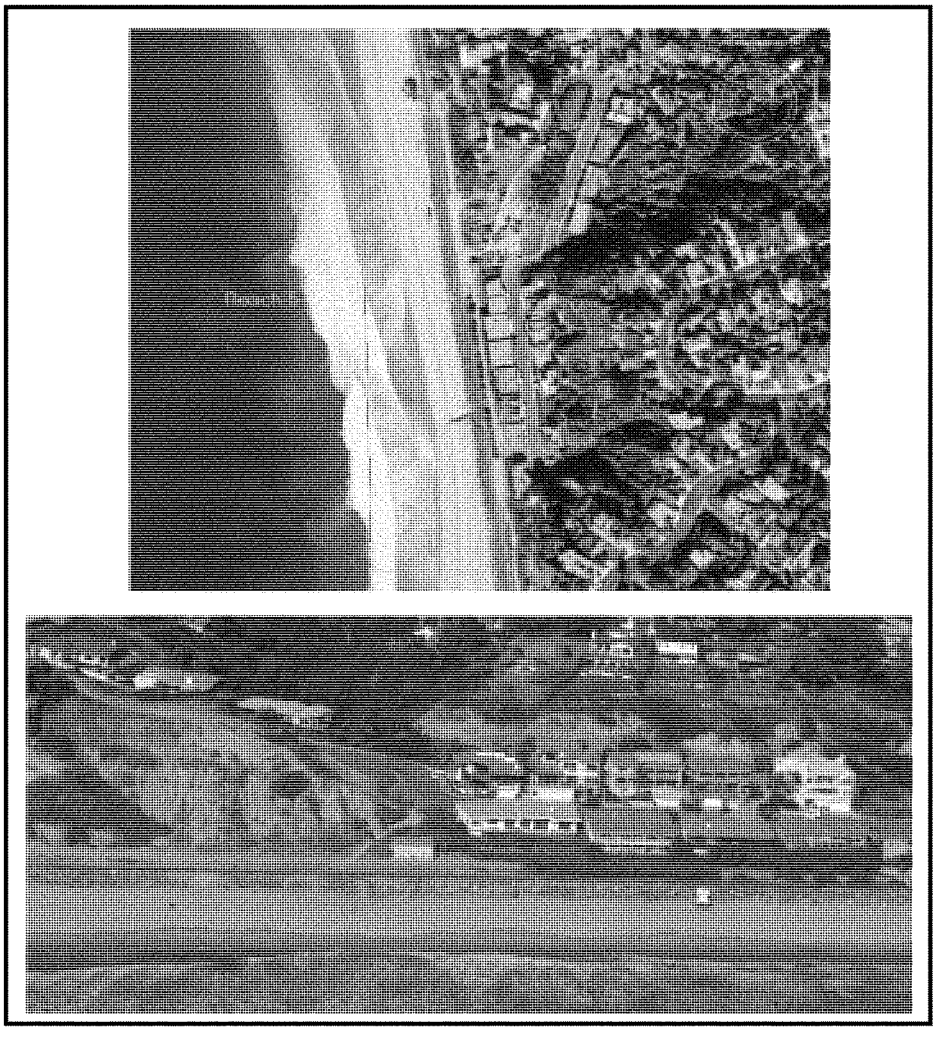


Figure 2-6 Reach 5

Reach 6 (**Figure 2-7**) extends from Sta 3+540 at Paseo de Cristobal to Sta 4+580 at Linda Lane, a distance of 1,040 meters (3,412 ft). Beach width meanders from 0 m wide to 23 m (75 ft) to 0 m to 39 m (128 ft) and back to 0 m along the reach. The beaches are backed by park facilities, railroad tracks, and high coastal bluffs. This reach includes the majority of the significant structures along the beach. This reach does not have an existing revetment to protect the railroad tracks, but does include the conventional ballast.

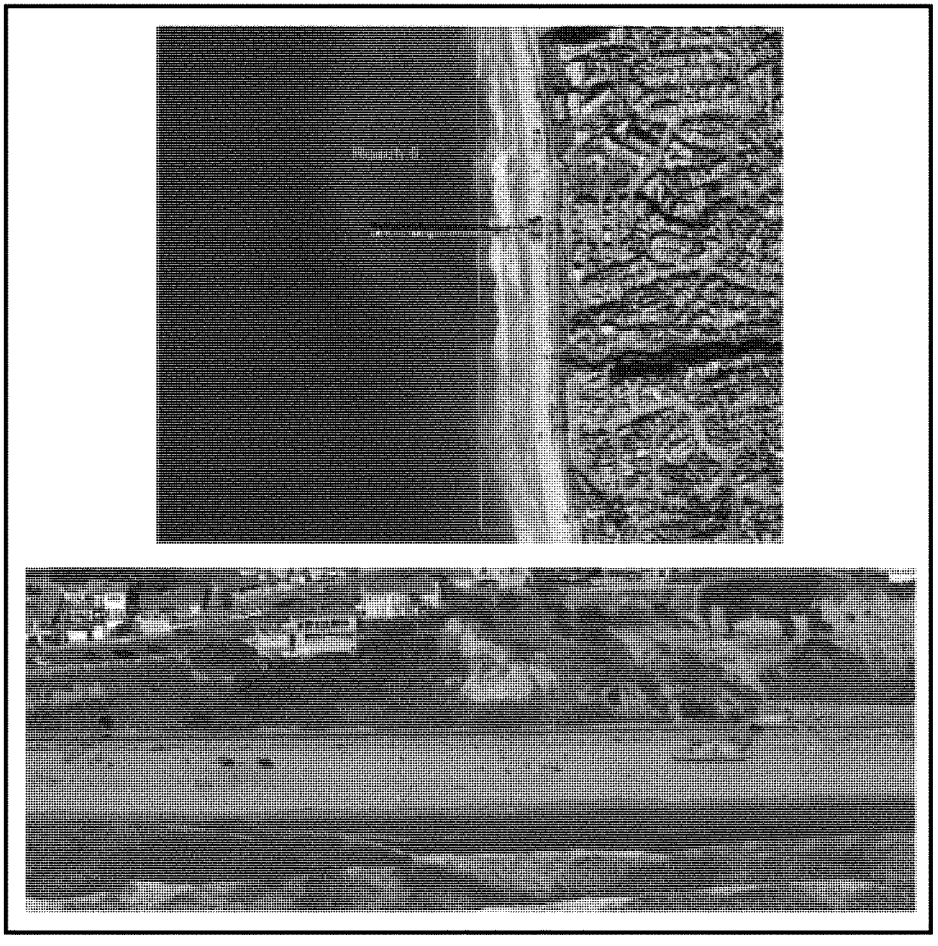


Figure 2-7 Reach 6

Reach 7 (**Figure 2-8**) extends from Sta 4+580 at Linda Lane to Sta 5+661 at the 1200 block of Buena Vista, a distance of 1,081 meters (3,550 ft). This reach contains "Mariposa Point," which lies at the center of the reach and approximately 300 meters (985 ft) northwest of the San Clemente Municipal Pier. There is a revetment protecting the railroad seaward slope, which has a slope of 1H:1V, and a crest elevation of approximately +6.9 m (23 ft). The railroad track elevation is approximately +6.5 m (21 ft). Although coastal development and infrastructure exist atop the coastal bluffs, no structures exist either seaward or landward of the railroad corridor along the back beach zone. However, a pedestrian and railroad access dirt path is evident immediately adjacent to the tracks on the landward side throughout much of the reach.

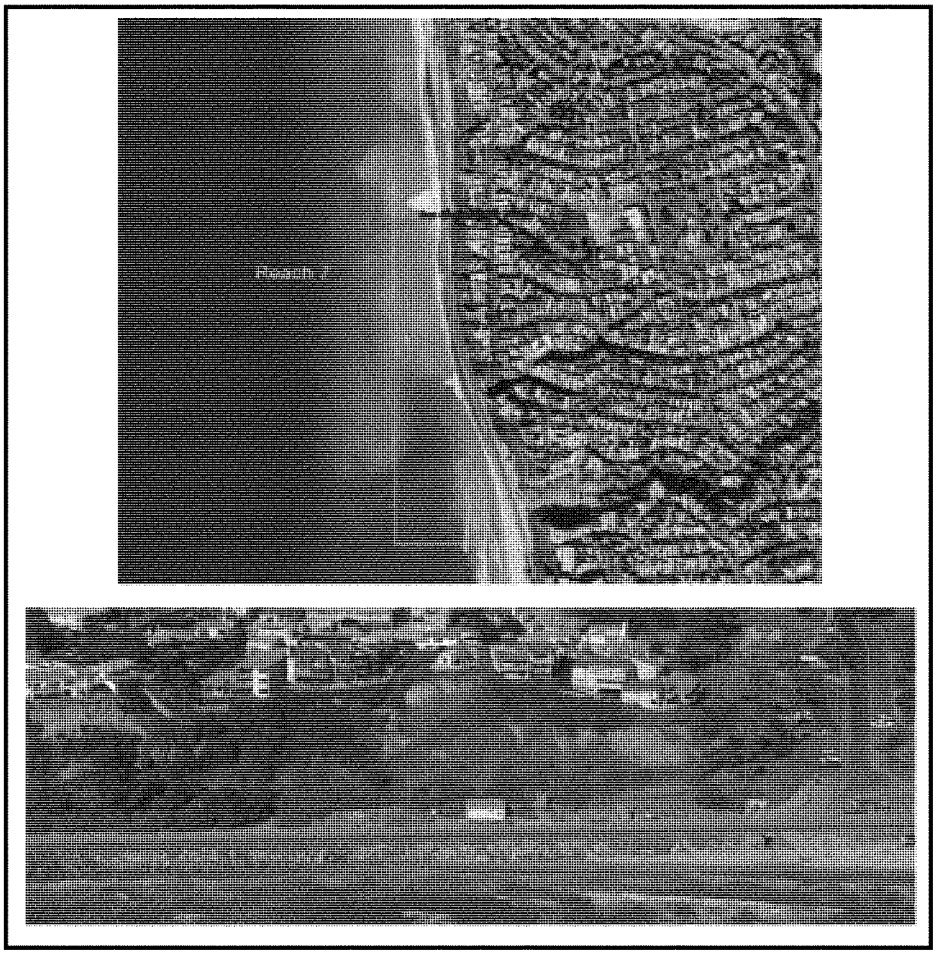


Figure 2-8 Reach 7

Reach 8 (**Figure 2-9**) extends from Sta 5+661 at the 1200 Block, Buena Vista to Sta 6+008 at Avenida Pico, a distance of 347 meters (1,140 feet). This reach represents the area known as North Beach, located just south of Capistrano Shores, and varies in width from 40 m (130 ft) wide at the southern boundary to 0 m at the northern boundary. The railroad seaward slope is not protected by a revetment, but does contain conventional ballast construction, which has a slope of 1H:1V, and a crest elevation of approximately +6.9 m (23 ft). The railroad track elevation is approximately +6.3 m (21 ft). The concession and restroom facility for the north beach is located within this reach.

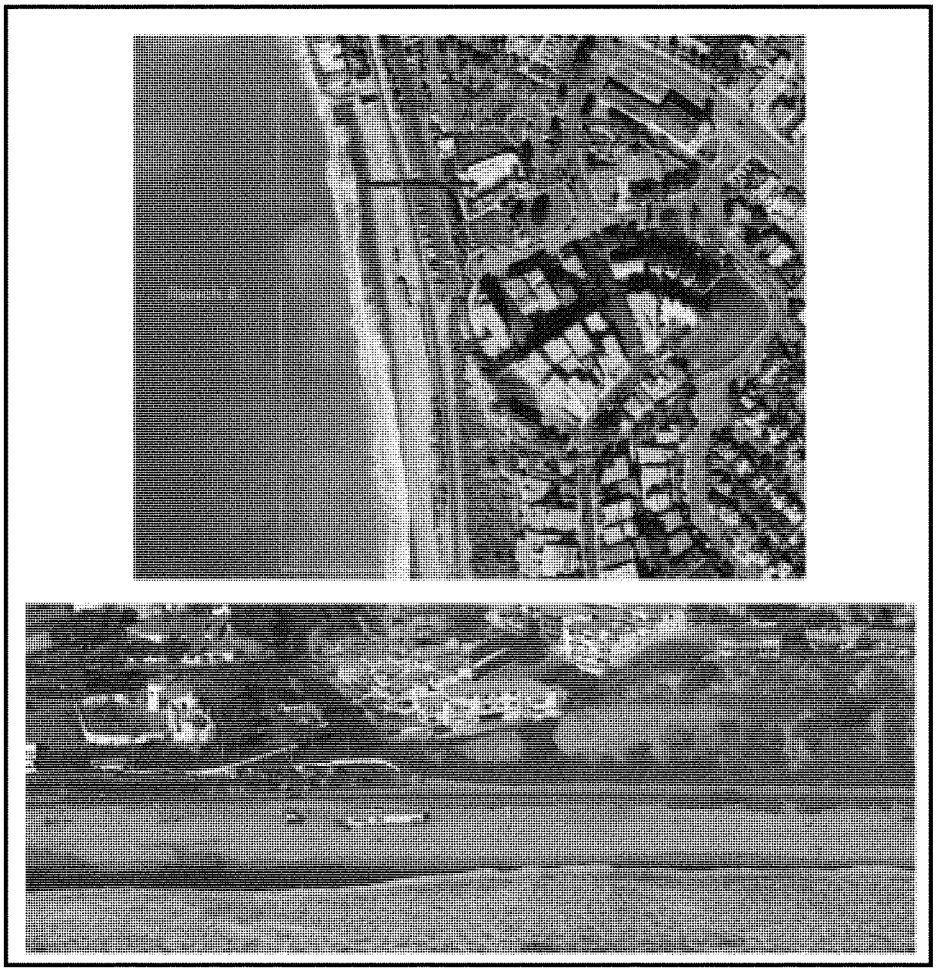


Figure 2-9 Reach 8

Reach 9 (**Figure 2-10**) extends from Sta 6+008 at Avenida Pico to Sta 7+109 at Via San Andreas, a distance of 1,101 meters (3,610 ft). This reach is known as "Capistrano Shores", private community of manufactured housing constructed in the 1950's. A timber seawall that is fronted by a rubble mound rock revetment protects the reach. The armor stone is estimated to be 2-5 tons, has a slope of 1H:1V, and a crest elevation of approximately +6.0 m (20 ft). General condition of the revetment is not uniform and appears to be fair/poor along the entire length. The beach width within this coastal zone may be considered to be primarily non-existent. The railroad is located substantially landward of the revetment and as such is no longer considered the project landward boundary. There are no structures seaward of the revetment.

Figure 2-10 Reach 9

Reach 10 (**Figure 2-11**) extends from Sta 7+109 at Via San Andreas to Dana Point Harbor, a distance of approximately 5,000 meters (3.1 miles). This reach is located immediately south of Dana Point Harbor and primarily encompasses residential coastal development along Camino Capistrano, public recreational vehicle camping and parking facilities, and Doheny State Beach and Park. The beach within this reach may be characterized as ranging between narrow to moderate in width and is backed by the aforementioned development, the railroad corridor, Pacific Coast Highway, and the coastal bluffs, respectively.

Figure 2-11 Reach 10

Reach Selection Criteria

Preliminary plan formulation and model development included the entire study area. During preliminary plan formulation it became evident that the majority of National Economic Development (NED) benefits would be derived from protection of the railroad line. Reaches 1, 3, 5, 7, and 10 were eliminated from further study due to the existence of an engineered revetment built to protect the railroad and Reach 9 was eliminated due to the engineered revetment constructed to protect the coastal property that sits landward of the railroad throughout the reach. Damages due to storms and existing erosion are not expected to greatly impact the railroad in these reaches.

The railroad in reaches 2, 4, 6 and 8 are currently protected by conventional ballast construction. Reaches 2 and 4 have beach widths greater, on average, than the other unprotected reaches. In addition, these two reaches also lack ocean-side development, further minimizing the potential for storm damage reduction benefits. Reach 8 is also unprotected by a revetment, however, the length of the reach, which was determined by the presence of engineered revetments to the north and south (Reaches 7 and 9), is too small for a justifiable project. Since the reach is so small (1/3 the size of Reach 6), initial model predictions indicate that a seawall should already be constructed prior to the start of our period of analysis.

Furthermore, the end losses (erosion) of a beach nourishment project would be too great for economic justification.

Reach 6, with the presence of public structures landward of the railroad, narrow beach widths, and presence of only conventional ballast for railroad protection, is the only reach carried forward for further alternatives analysis.

Reach 6

Coastal residential development, parks and public facilities, infrastructure and beach recreation are the most abundant within this reach. Some of these structures include the San Clemente Municipal Pier and underpass access, Marine Safety Building, public restrooms, picnic facilities and the T-Street overpass (see **Figures 2-12 and 2-13**).

The San Clemente Municipal Pier is located in the northern half of the reach and was originally constructed around 1928. In its current state, the Pier is approximately 390 meters (1,280 feet) long and has a typical deck width of about 6.4 meters (21 feet) and a deck elevation ranging from +7.2 meters (24 ft), MLLW near the Pier head to +8.3 meters (27 ft), MLLW at the seaward end. A restaurant occupies the base portion of the Pier with three smaller structures; including a snack shop, watchtower, and restroom located further seaward. The landward portion of the Pier has timber piles, caps and decking while the seaward 134 meters (440 ft) of the Pier has been reconstructed with steel members as this portion of the Pier was destroyed by large swells on March 1-2, 1983 from an intense storm moving eastward from the central Pacific Ocean. This storm, which caused in excess of $2,100,000 in damage to the Pier, was one of a series of severe storms occurring during the winter of 1982-1983 causing extensive damages and warranting a major disaster declaration in many areas of the State of California. Development along the sloped bluffs adjacent to the Pier is founded on an ancient landslide.

The Marine Safety Building is located on the beach approximately 183 meters (600 feet) north of the Pier. The building, which is an approximate 465 square meters (5,000 square feet) single story timber frame structure, has been under increased risk due to wave attack. An extensive amount of sand that at one time provided a buffer between the waves and the building has since eroded away to the point where the piles that support the most seaward portion of the building are exposed. As a result, an emergency sheet pile wall has been placed in front of the building to help protect the foundation from wave attack.

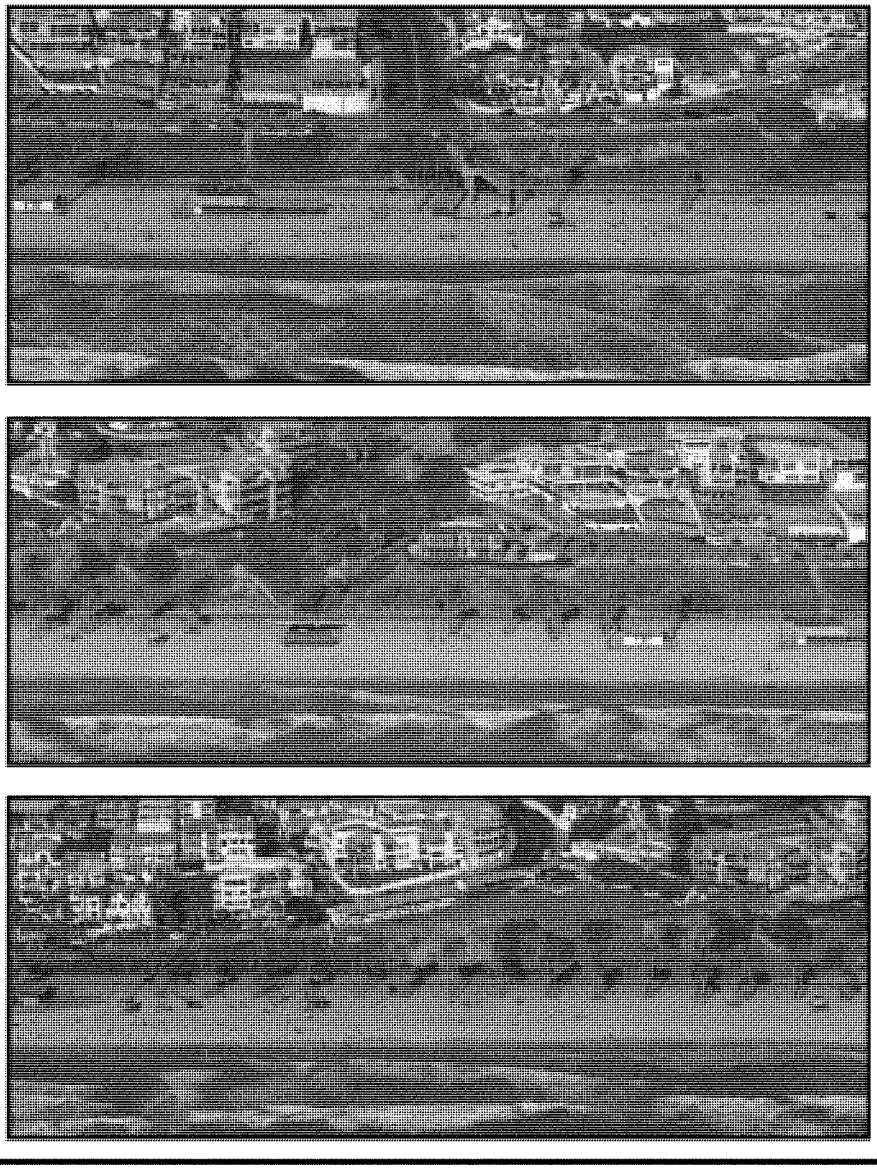


Figure 2-12 Reach 6 Oblique Photos

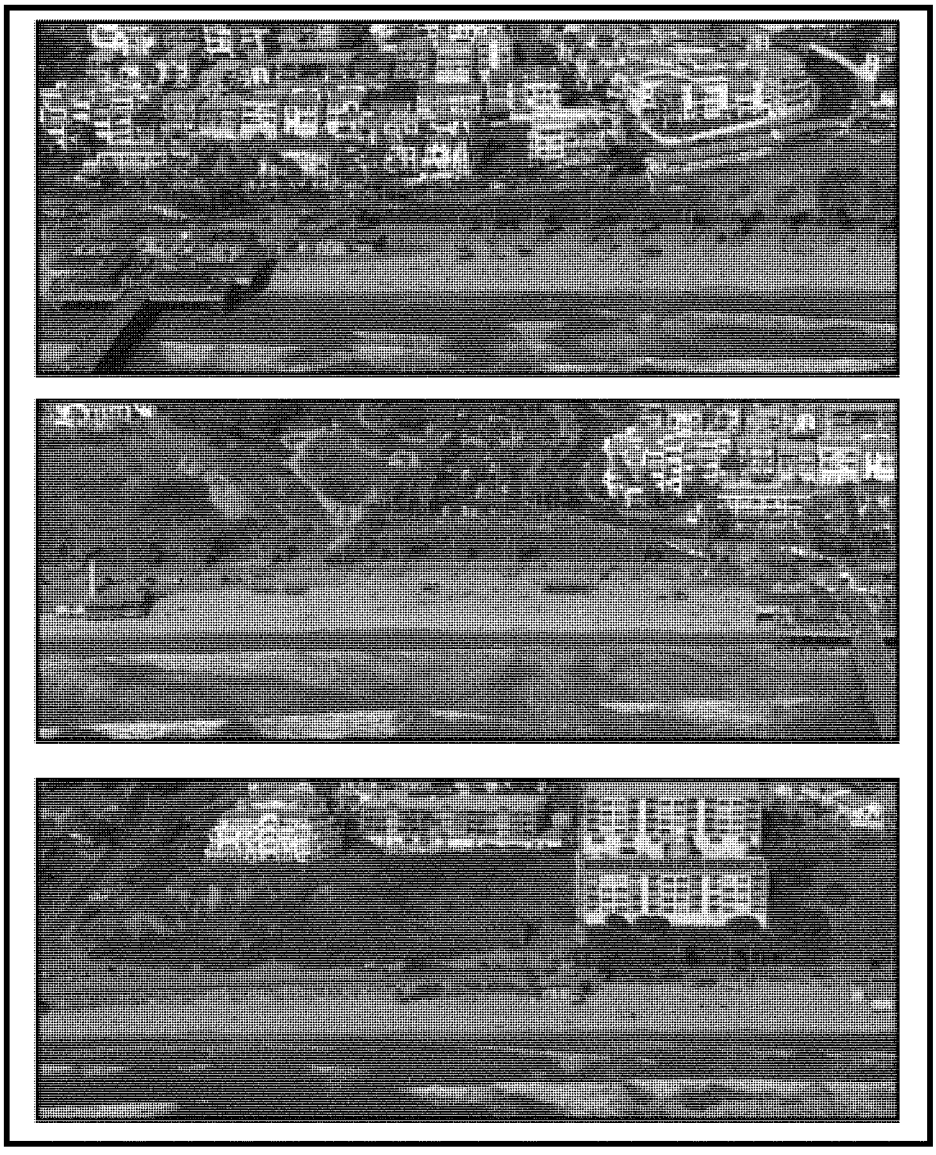


Figure 2-13 Reach 6 Oblique Photos (continued)

2.2 Physical Characteristics

2.2.1 Topography

Terrestrial topographic data were obtained from March 2002 aerial LIDAR surveys conducted as a part of this study. LIDAR (LIght Detection And Ranging) is a state-of-the-art survey system that allows high-speed collection of topographic data. The system employs a helicopter-mounted range-finding laser that is coupled with a highly accurate GPS positioning system to collect precise GPS measurements, platform altitude, laser ranges, and imagery data. Topographic information was collected at horizontal point spacing on the order of 0.1 meter (0.3 ft) that allowed detailed information to be collected of the beach, revetment, railroad, and ground elevations adjacent to structures throughout the study area. In addition, detailed mapping in the damage/flood areas provided existing beach contours, beach widths, berm elevations, foreshore slopes, and the back beach horizontal position of coastal structures. The results of the March 2002 LIDAR survey and topographic mapping investigation are presented in Appendix D of the EIS/EIR.

2.2.2 Bathymetry

The bathymetry within the San Clemente project study area is presented in Appendix D of the EIS/EIR. The water depths in the survey area range from 3 meters (10 ft) near the beach to 23 meters (75 ft) offshore. The seafloor slope direction is southwest or normal to the beach. The seafloor gradient averages 0.9 percent but varies locally. The inshore gradient between the 3 to 6-meter (10-20 ft) water depths is approximately 5 percent in the San Clemente State Beach area and decreases in a northwestward fashion as one travels from San Mateo Point to Dana Point Harbor. Several bedrock spurs extend out from shore; the largest one is the seaward extension of San Mateo Point, which may rise several meters above the intervening swales. The San Mateo Rocks northwest of San Mateo Point are isolated and may be remnant spurs. Bedrock outcrops the seafloor in places between the shore and about the 15-meter (50 ft) isobath. Where outcrops occur, the seafloor is uneven from the resistant bedrock mounds. Some of the larger outcrops rise as much as 6 meters (20 ft) above the surrounding seabed. The gradients along some of these outcrop slopes can be as high as 33 percent (18°). A smooth seafloor with an even slope forms the topography seaward of the outcrops. This smooth texture is a result of unconsolidated recent sediment deposition.

Side scan sonar data of the area, performed in May 2002, clearly show areas where bedrock is exposed. In several locations, survey data could not be acquired, as the kelp was too thick to navigate through. It is well established that bedrock is necessary for kelp growth. The bedrock exposures are mapped as either areas where exposures comprise greater than 50 percent of the seabed or zones where scattered rocks cover 10 – 50 percent of the area. Unconsolidated superficial sediment predominates in the scattered rock zones. The sub-bottom profile data reveal an immeasurably thin superficial veneer overlies the bedrock. This thin sand lens likely changes seasonally as beach sands migrate in a cross-shore direction.

2.3 Geologic Characteristics

The San Clemente area comprises a part of the western flank of the Peninsular Range Geologic Province of southern California and includes areas of the western foothills of the Santa Ana Mountains and the southeastern flank of the San Joaquin Hills. The Peninsular Range extends from the Palos Verdes Peninsula in the north to the tip of Baja California in the south. The bedrock exposure in the area is comprised of marine sedimentary and volcanic rocks of

Miocene, Pliocene and Pleistocene age. The bedrock formations both onshore and offshore consist of the San Mateo Formation, an arkosic sandstone of Pleistocene age, the Capistrano Formation, a series of silty shales, mudstones, siltstones and coarse sandstones of late Miocene and early Pliocene age and the San Onofre Breccia which is a series of volcanic breccias, ash flows and tuffs derived from large landslides during volcanic eruptions interbeded with layers of fine-grained volcanic ash deposited into fresh or salt water and is of Miocene age.

2.3.1 Onshore Geology

As result of marine erosion within the San Clemente Shoreline Feasibility study area, a broad wave-cut terrace has formed extending back from the coastline and lying several meters above sea level. This relatively flat surface is cut mainly in rocks of the Capistrano Formation of late Miocene and early Pliocene age and is mantled with poorly consolidated non-marine alluvial cover of Holocene and Pleistocene age and marine terrace deposits of Upper Pleistocene age. The non-marine cover consists of poorly bedded fine-grained sediments. The marine terrace deposits consist of poorly consolidated sands, sandstones and conglomerates. The beach, which begins at the foot of the wave-cut terrace, is composed of fine to medium grained sands and silty sands. Because of various seasonal cycles of sand deposition and erosion and the lack of adequate natural beach renourishment cycles in the area, the beach varies in width from roughly 0 to 60 meters (0 to 200 feet).

2.3.2 Offshore Geology

The area offshore of San Clemente is a part of the Capistrano Bight, located at the eastern edge of the Gulf of Santa Catalina. This area is described as that part of the California coast known as the "Continental Borderland", as there is no real continental shelf in this part of the coast. The area from Dana Point Harbor in Orange County downcoast to La Jolla in San Diego County is further defined as the "Oceanside Littoral Cell". The City of San Clemente's shoreline is located in the extreme upper portion of this Littoral Cell.

The detailed local offshore site geology and bedrock location identification was determined by a seismic survey plus 10 vibracore test holes drilled and sampled at random locations offshore of the City of San Clemente. The seismic survey was accomplished during the summer of 2002 and the vibracore sampling was accomplished from December 2002 through January 2003. The bathymetric survey indicates that the ocean bottom slopes gradually seaward for a distance of about 1,500 meters (0.93 miles) from elevation 0 meter, MLLW at the shoreline to an elevation deeper than -32.8 meters (-100 feet), MLLW. The accompanying geophysical surveys further indicated that the ocean floor is a bedrock surface covered with a thin veneer of littoral sediments that vary in thickness from approximately 0 to 0.32 meters (1-foot) or more, out to a distance of about 1,500 meters (4,920 ft) from the shoreline.

2.4 Seismicity

The geologic structure of the San Clemente study area region is the result of faulting and folding in the current tectonic regime, which began approximately 5 million years ago when the Gulf of California began to open in association with renewed movement on the San Andreas fault system (Fisher and Mills, 1991). The tectonic forces are also evident in the localized folding and faulting of the Eocene-age sediments. Some of the faults locally control the contact between formations.

The study area is located within the moderately active seismic region of Southern California that is subject to significant hazards from moderate to large earthquakes. There are several northwest to southeast trending faults in both the onshore and the offshore areas east and west of San Clemente. The Whittier-Elsinore, Agua Caliente, San Jacinto and the San Andreas Fault zones are located approximately 32 kilometers (20 miles), 43 kilometers (27 miles), 64 kilometers (40 miles) and 100 kilometers (62 miles) northeast of San Clemente, respectively. The Newport-Inglewood-Rose Canyon Fault lies approximately 8 kilometers (5 miles) offshore of the beach. The Palos Verdes Fault zone parallels the Pacific Coast offshore from the San Pedro – Long Beach area to La Jolla and lies about 29 kilometers (18 miles) from the coastline. The San Clemente Island Fault zone lies approximately 88 kilometers (55 miles) offshore and is parallel to the Newport-Inglewood-Rose Canyon Fault zone. These three faults trend parallel to the onshore faults. The Cristianitos Fault, which is the closest fault to the project area, trends northwest to southeast and passes through the mountain ranges behind the San Clemente area and then trends down the San Mateo Creek and goes offshore to parallel the coastline near San Onofre in a southerly direction past Oceanside. The fault is located approximately 2 to 8 kilometers (1 to 5 miles) offshore of the beach within San Clemente. Ground shaking resulting from an earthquake can impact the San Clemente study area.

There have been several landslides mapped in the hills and mountains that form the eastern boundary of the San Clemente project study area. These are shown on a geologic map accompanying "Natural Slope Stability as Related to Geology, San Clemente Area, Orange and San Diego Counties, California, Special Report 98" (Blanc and Cleveland, 1968) published by the California Division of Mines and Geology. The geologic map indicates that there are seven small areas of the bluff behind the beach extending from the San Clemente Pier to San Mateo Point, which contain landslide deposits. However, since none of these slides extend into the beach zone, they are not considered to be a potential problem for future beach nourishment efforts.

2.5 Climate

2.5.1 General Climatic Conditions

The local climate is dominated by the strength and position of the semi-permanent high-pressure center over the Pacific Ocean near Hawaii. This high-pressure center results in cool summers, mild winters, and infrequent rainfall. It also drives the cool daytime breezes resulting in comfortable humidity levels and an abundance of sunshine. Based on data obtained from the South Coast Air Quality Management District (SCAQMD) coastal Orange County temperatures average 61°F with an average summer temperature ranging from 68 to 70°F and an average winter temperature ranging from 51 to 53°F. Rainfall averages about 0.3 meter (12 inches) per year in the coastal zones. In contrast to a very steady pattern of temperature, rainfall is both seasonally and annually highly variable, with most rain accumulations occurring from November through April. **Table 2-2** summarizes the monthly temperature and precipitation statistics as measured in Laguna Beach (approximately 20 kilometers (12.4 miles) north of San Clemente) between 1928 and 2003.

Table 2-2 Monthly Climatic Summary at Laguna Beach, California (1928 to 2003)

Month	Ave. Max. Temperature in °F	Ave. Min. Temperature in °F	Ave. Total Precipitation m (in)
January	65.0	43.0	6.35 (2.50)
February	66.0	44.1	6.99 (2.75)
March	66.9	45.6	5.33 (2.10)
April	68.9	48.4	2.46 (0.97)
May	70.6	52.9	0.66 (0.26)
June	72.8	55.9	0.28 (0.11)
July	76.3	59.2	0.05 (0.02)
August	77.9	59.6	0.18 (0.07)
September	77.4	58.2	0.66 (0.26)
October	74.5	53.7	1.09 (0.43)
November	70.4	47.5	3.25 (1.28)
December	66.1	43.4	4.90 (1.93)

Source: Western Regional Climate Center (Station No. 044647)

Onshore winds across the south coastal region are from a westerly and southwesterly direction during the day while easterly and northeasterly breezes predominate at night. Wind speed tends to be somewhat greater during the dry summer months than during the rainy winter season. In January, light-to-moderate winds average 6 to 10 mph and blow from the northeast to the south-southwest more than three-quarters of the time. This flow is reversed during the day and the wind predominantly originates from the southwest at an average of 5 to 8 mph. Light winds averaging 3 to 6 mph originate from the east or southeast at night during July. This trend reverses during the day when winds predominate from the southwest, averaging 10 to 15 mph during the afternoon. In addition, extensive surface high-pressure systems over the Great Basin, combined with other meteorological conditions, can result in very strong, down slope "Santa Ana" winds during, especially, the winter and fall months. These winds may continue for a few days before "typical" circulation patterns recur.

2.5.2 El Nino Southern Oscillation Events (ENSO)

Southern Oscillation El Nino (ENSO) events are global-scale climatic variations with a duration lasting for approximately 2 to 7 years. They represent an oscillatory exchange of atmospheric mass as manifest by a decrease in sea surface pressure in the eastern tropical Pacific Ocean, a decrease in the easterly trade winds, and an increase in sea level on the west coast of North and South America (USACE-SPL, 1986). The interaction between the atmospheric and oceanic environment during these events drive climatic changes that can result in significant modifications of wave climate along the world's coasts.

The severe winter seasons of 1982-1983 and 1997-1998, which produced some of the most severe storms to ever impact the Encinitas and Solana Beach coast, located approximately 56 km (35 miles) south of San Clemente, were the result of intense ENSO events. The atmospheric disturbance associated with these two events caused abnormally warm water temperatures, an actual reversal of the easterly trade winds, and increased the monthly mean sea levels by as much as 0.13 meters (0.42 feet) in the 1982-1983 season and 0.16 meters (0.52 feet) in the 1997-1998 season at La Jolla, San Diego (Flick, 1998).

An analysis of California tides, storm surges, and mean sea level during the El Nino winters of 1982-1983 and 1997-1998 was performed by Flick (1998). Comparisons of two gage stations at Los Angeles Harbor and La Jolla, show that the data are virtually interchangeable, after taking

into account the respective tidal datum relationships. This assessment implies that the spatial difference of the ENSO effects between the two stations is insignificant. Since San Clemente is situated between the two locations, the ENSO effects observed at La Jolla or at Encinitas and Solana Beaches are applicable to the study area.

2.6 Coastal Processes

2.6.1 Water Levels, Tides and Sea Level Rise

Water levels within the surf zone consist of four primary factors within southern California: 1) astronomical tides, 2) storm surge and wave set-up, 3) short-term climatic variations related to ENSO events, and 4) global long-term rise in sea level.

Tides

Tides along the southern California coastline are of the mixed semi-diurnal type. Typically, a lunar day (approximately 25 hours) consists of two high and two low tides, each of different magnitudes. A lower low tide normally follows the higher high tide by approximately seven to eight hours while the time to return to the next higher high tide (through higher low and lower high water levels) is usually approximately 17 hours. Annual tidal peaks typically occur during the summer and winter seasons. The increased tidal elevations during the winter season can exacerbate the coastal impacts of winter storms.

Since tides in California have a spatial scale on the order of hundreds of kilometers, the prevailing tidal characteristics measured in La Jolla may be considered representative of the tidal elevations within the project area. The National Oceanic and Atmospheric Administration (NOAA) has established tidal datums for the La Jolla tidal station in San Diego County, approximately 81 kilometers (50 miles) southeast of the San Clemente Pier, based on 19 years of collected measurements from the 1960 through 1978 tidal epoch. The tidal characteristics at the La Jolla tidal station, referenced to the Mean Lower Low Water (MLLW) vertical datum are presented in **Table 2-3**. The highest recorded sea level at the La Jolla gage located at the terminus of the Scripps Pier was 2.38 meters (7.81 feet), MLLW measured on August 8, 1993.

In addition, it is worthy to note that the National Ocean Service (NOS) recently updated the La Jolla primary tide gage in order to re-compute the Mean Lower Low Water (MLLW) vertical datums for the 19-year tidal epoch extending from 1983 through 2001.

Table 2-3 Tidal Characteristics at Scripps Pier in La Jolla, California

Datum Plane	Elevation, meters (feet), MLLW
Highest observed water level (Aug. 8, 1993)	+2.38 (+7.81)
Mean Higher High Water (MHHW)	+1.64 (+5.39)
Mean High Water (MHW)	1.41 (+4.63)
Mean Tide Level (MTL)	0.85 (+2.78)
Mean Sea Level (MSL)	0.85 (+2.78)
National Geodetic Datum – 1929 (NGVD)	0.78 (+2.56)
Mean Low Water (MLW)	0.28 (+0.92)
Mean Lower Low Water (MLLW)	0.00 (0.00)
Lowest observed water level (Dec. 17, 1933)	-0.79 (-2.60)

Source: National Ocean Service (NOS), 2003

Storm Surge and Wave Setup

Storm surge is the super-elevation of the tidal level at the coast due to wind stresses and atmospheric pressure fluctuations acting upon the sea surface. Wind and atmospheric fluctuations associated with strong storms in southern California typically produce 0.3-0.6 meters (1-2 feet) storm surges (CCSTWS-SD, 1991). Due to a narrow continental shelf and the absence of tropical storms and/or hurricanes, storm surge heights on the California coast are small compared to those on the east and Gulf coasts where extreme surge heights of 1-3 meters (3-10 feet) are more typical and a peak 8 meters (25 feet) was documented during Hurricane Camille in 1969.

The winter storm of January 17 and 18, 1988 produced the all time record low barometric pressure for southern California. The still water level measured at the Los Angeles Harbor gage during this event was approximately 0.2 meters (0.7 feet) above the predicted astronomical tide elevation (National Ocean Service, 1988). West coast storm surges typically have time scales of 1-3 days, with longer surge episodes possible due to bunching of successive storm events.

Climatic Variation Related to ENSO Events

A positive departure in the annual mean sea level elevations occurs during strong El Nino episodes. As mentioned previously, these meteorological anomalies are characterized by low atmospheric pressures and persistent onshore winds. A review of recorded tide data indicates that six episodes (1914, 1930-1931, 1941, 1957-1959, 1982-1983, and 1997-1998) have occurred since 1905. Further analysis suggests that these events have an average return period of 14 years. During these past ENSO events, water levels have increased above the astronomical tides by about 6-centimeters (2.4-inches) with the effects lasting for 2 to 3 years (Flick, 1998).

An ENSO event also increases the probability that more severe winter storms will be experienced and the likelihood that storm waves could be coincident with times of higher water level. The highest recorded water level in the study area was measured on January 27, 1983. That episode included an estimated 0.24 meters (0.8 feet) of combined storm surge and seasonal sea level rise associated with the climatic variation of the El Nino event.

Sea Level Rise

Although the exact magnitude of the future sea level rise is unknown, the future level will depend on the extent of thermal expansion of the ocean water and the amount of melt water from receding continental glaciers and polar ice sheets. The proportion of rise associated with each of these contributions will depend largely upon the magnitude and pattern of global warming, resultant precipitation, glacial response and dynamics, time scale of oceanic mixing, and the stability of the west Antarctic ice sheet (U.S. Army Corps of Engineers, 1991). The U.S. Army Corps of Engineers considers potential relative sea level change in every feasibility study undertaken within the coastal zone. Corps of Engineers policy guidelines for sea level rise is defined in the Engineer Circular titled, "Water Resource Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs" dated July 1, 2009.

Historic regional sea level trends based on yearly mean sea level records are published by the National Ocean Service (NOS) (National Ocean Service, 2001). Monthly mean sea level variations are analyzed for 117 stations of the NOS National Water Level Observation Network having between 25 and 146 years of data. Monthly MSL data are used to obtain the average

seasonal cycle, the residual time series, and the autoregressive coefficient of the residual with accurate estimates of standard errors. Historic trends in San Diego County, California indicate a positive sea level rise of +2.45 millimeters (0.1 inch) per year based on water level measurements during the period 1950 to 1999. If past trends were to be projected into the future in San Diego County, a sea level rise of 0.10 m/yr (0.32 ft/yr) would be expected over the next 50 years.

The long-term consequences of global warming and sea level rise may be the occurrence of more severe ENSO events, more frequent coastal storms, and increased incidents of shoreline erosion and coastal flooding. In addition, an increased sea level will encroach further landward on milder sloping beaches causing an "apparent" shoreline recession.

Relative sea level rise is considered to have direct impacts on the 50-year future without-project and future with-project conditions. Relative sea level rise can be significant for long-term beach erosion rates. As the relative water level rises, a landward migration of the shoreline can be expected assuming the profile shape does not change and the longshore sediment transport is in equilibrium (i.e., no erosion or deposition).

2.6.2 Waves

Wave climatology information is available for the offshore area of San Clemente in the form of direct measurements as part of the Coastal Data Information Program (CDIP). The CDIP shallow-water gage (Station ID 052) most applicable to San Clemente is located approximately 300 m (985 ft) offshore of the San Clemente Pier in 10.2 meters (33 ft) of water. The gage is a directional wave height recorder with a 178-month record during the period 1983 to 1998 that includes wave height, period and direction. Buoy data consist of a total of four observations per day or every six hours. The height and direction data records are intermittent in that reporting of the data was only available for approximately 141 of the 178 months with one long gap occurring during the period of July 1988 to July 1991, which accounted for the majority of the missing records.

Wave Heights

The annual maximum wave heights for each year are presented in **Table 2-4**. As is evident from the illustration, the most commonly occurring significant wave height is in the range of 0.80 to 1.00 meter (2.7-3.3 ft) with no measured significant wave heights exceeding 4.0 meters (13.1 ft), as the maximum significant wave height was 3.63 meters (12 ft) measured January 18, 1988.

Since it is widely recognized that the most severe wave climate occurs during the winter season, it was important to develop the wave climatology based strictly on the winter wave population defined as December through March.

Table 2-4 Annual Maximum Wave Heights, 1983 – 1998

Year	Month/ Day	Significant Wave Height, (H_s), m (ft)
1983	December 10	3.10 (10.2)
1984	April 1	1.85 (6.1)
1985	November 29	2.18 (7.2)
1986	February 16	3.56 (11.7)
1987	March 16	2.24 (7.4)
1988	January 18	3.63 (11.9)
1991	November 15	2.06 (6.8)
1992	January 30	2.32 (7.6)
1993	February 18	2.66 (8.7)
1994	February 7	2.00 (6.6)
1995	January 5	3.22 (10.6)
1996	October 26	2.24 (7.4)
1997	December 6	2.31 (7.6)
1998	January 30	2.99 (9.8)

Wave Periods

The dominant wave periods are in the range between 12 and 14 seconds, with a smaller secondary peak between 6 and 8 seconds. The two peaks in the distribution demonstrate the dual sea/ swell nature of the wave climate. Shorter period waves are typically associated with local sea conditions; while longer period waves are associated with offshore swell conditions traveling over greater distances.

Wave Directions

Approximately 91 percent of the waves propagating into the nearshore zone from approximately 300 meters (984 ft) offshore of the San Clemente Pier approach from the relatively narrow 20-degree band between the 220° and 240° azimuths, and all other approach directions are minor or negligible. There is a small fraction of waves (0.7 percent) approaching from between 160° and 220°, which are directions considered to be from tropical depressions or southern hemisphere origins. There is a predominate westerly wave direction that envelops both local seas and extratropical swells. It is important to note that shoreline normal within the San Clemente project study area is approximately 235° and that shoaling and refraction effects are included in the wave buoy data at the point of observation, approximately 10 meters (33 ft) of water depth.

2.6.3 Currents

The offshore currents, including the California Current, the California Undercurrent, the Davidson Current, and the Southern California Countercurrent (also known as the Southern California Eddy), consist of major large-scale coastal currents, constituting the mean seasonal oceanic circulation with induced tidal and event specific fluctuations on a temporal scale of 3 to 10 days (Hickey, 1979).

The California Current

The California Current is the equatorward flow of water off the coast and is characterized as a wide, sluggish body of water that has relatively low levels of temperature and salinity. Peak

currents with a mean speed of approximately 12.5 to 25 centimeters (5-10 inches) per second occur in summer following several months of persistent northwesterly winds (Schwartzlose and Reid, 1972).

The California Undercurrent

The California Undercurrent is a subsurface northward flow that occurs below the main pycnocline and seaward of the continental shelf. The mean speeds are low, on the order of 5 to 10 centimeters (2-4 inches) per second (Schwartzlose and Reid, 1972).

The Davidson Current

The Davidson Current is a northward flowing nearshore current that is associated with winter wind patterns north of Point Conception. The current, which has average velocities between 15 and 30 centimeters (6-12 inches) per second, is typically found off the California coast from mid-November to mid-February, when southerly winds occur along the coast (Schwartzlose and Reid, 1972).

The Southern California Countercurrent

The Southern California Countercurrent is the inshore part of a large semi-permanent eddy rotating cyclonically in the Southern California Bight south of Point Conception. Maximum velocities during the winter months have been observed to be as high as 35 to 40 centimeters (14-16 inches) per second (Maloney and Chan, 1974).

Alongshore currents are those nearshore currents that travel parallel to the shoreline extending throughout, and slightly seaward of, the surf zone. The alongshore currents in the coastal zone are driven primarily by waves impinging on the shoreline at oblique angles. The rate of alongshore sediment transport varies in proportion to the characteristics of the regional wave climate and the directional predominance. The surf zone alongshore currents within the project area can attain maximum velocities of approximately 1 meter (3.3 ft) per second. Typically, summer swell conditions produce northerly drifting currents, while large winter storm events from the west and northwest produce southerly alongshore currents. Overall within the project study area, the general magnitude and persistence of the northerly winter storms generally results in a net southerly littoral drift; however, reversals are common during the summer months.

Cross-shore currents exist throughout the study area, particularly at times of increased wave activity. These currents tend to concentrate at creek mouths and shore perpendicular structures, but can occur anywhere along the shoreline in the form of rip currents and return flows of complex circulation. To date, no information is available that quantifies the velocities of these currents within the project area; however, studies have shown that the velocity of rip currents, in general, can exceed 2 meters (6.6 ft) per second (Dean and Dalrymple, 1999).

2.7 Littoral Processes

The San Clemente project study area resides within the Oceanside Littoral Cell, which extends for approximately 86 kilometers (53 miles) from Dana Point in Orange County to Point La Jolla in San Diego County. The shoreline within this littoral cell displays a wide variety of coastal features including cliffs, headlands, beaches composed of sand and/ or cobbles, rivers, creeks, tidal lagoons and marshes, submarine canyons, man-made shore and bluff protection devices

of various kinds, and major harbor structures. The cell is divided into three sub-cells based on natural physiographic units: (1) Dana Point to San Mateo Point, (2) San Mateo Point to Carlsbad Submarine Canyon, and (3) Carlsbad Submarine Canyon to Point La Jolla. The City of San Clemente is located in the northernmost sub-cell (Dana Point to San Mateo Point).

2.7.1 Sediment Sources

Numerous rivers and small streams discharge sediment into the Oceanside Littoral Cell. San Juan Creek and San Mateo Creek are considered major river systems for the influx of sediment into the north sub-cell. Extracts from a listing compiled from the results of various studies (CCSTWS) are presented in **Table 2-5** and provides a range of estimates of the sediment loads carried by fluvial systems of this littoral sub-cell. This table illustrates the relatively small amount of sediment input from San Juan Creek.

San Juan Creek is 7.4 km (4.6 mi) northwest on the updrift[1] side of San Clemente Pier. Dana Point is the southern updrift boundary headland for the Oceanside littoral cell where it is presumed no appreciable sediment is entering the cell. Therefore, San Juan Creek represents the only major source of sediment input to the immediate project area. San Mateo Creek, although physically closer, is in the downdrift direction and is not believed to be a major contributor of sediments to the project area.

The San Juan Creek discharge averages 20,383 m^3/yr (26,702 yd^3/yr). This quantity is small given the fact that some of the discharged river material is likely lost offshore as fines and some is lost/trapped updrift prior to reaching the San Clemente project area.

It is noted that river flows and the resultant sediment delivery to beaches is episodic due to the semi-arid nature of the climate and watersheds/rivers deliver sediment only during rainy/wet years. Thus, sediment to beaches tends to be delivered in large "pulses", where a large quantity is delivered to the beach in one year followed by several years of low or no sediment delivery.

Table 2-5 Sediment Discharge from Rivers and Streams

Previous Studies	River / Stream Discharge Rate m^3/yr (yd^3/yr)		
	San Juan	San Clemente	San Mateo
Drainage Area (hect / mi^2)	45,455 (175.5)	5,154 (19.9)	34,188 (132)
Moffatt&Nichol 1977	12,980 (17,000)	10,946 (14,340)	1,702 (2,240)
CCSTWS 84-4 (1984)			24,427 (32,000)
Simons/Li 1985	6,107 (8,000)		12,213 (16,000)
CCSTWS 88-3 (Simons/Li 1988)	15,603 (20,440)	786 (1,030)	3,729 (4,885)
CCSTWS 90-2 (Moffatt&Nichol 1990)	27,480 (36,000)		6,412 (8,400)
USACE-SPL 1999	36,749 (52,071)		

[1] Directional convention for this study is: "updrift" and "upcoast" refers to northerly and/or westerly direction; and "downdrift" and "downcoast" refers to the southerly and/or easterly direction.

2.7.2 Long Term Shoreline Change

Shoreline change has been calculated based on the "dry" beach width which is defined as that portion of the beach between the foreshore berm contour and the backshore. The shoreline change rate has been applied uniformly to all reaches. The design shoreline change rate in quantitative detail is discussed in Appendix D of the EIS/EIR.

Historical Shoreline Change

Shoreline changes within the Oceanside Littoral Cell were investigated during the CCSTWS-SD (1991) using historical maps, nautical charts, aerial photos, and the results of ground and bathymetric survey efforts. The results of these extensive efforts are shown in **Table 2-6**.

Table 2-6 Long Term Shoreline Change Rates in San Clemente Area

	MHHW Shoreline Change Rate m/yr (ft/yr)			Max Seasonal MHHW Movement m (ft)	
Location	1940-1960	1960-1980	1980-1989	Summer	Winter
SC 1623	-0.06 (-0.20)	-0.21 (-0.70)	2.16 (7.10)	7.7 (25.4)	-7.9 (-26)
SC 1660	0.00 (0.00)	0.18 (0.60)	-0.61 (-2.00)	5.2 (17)	-10.4 (-34)
SC 1680	0.76 (2.50)	-0.12 (-0.40)	0.43 (1.40)	13.9 (45.5)	-17.5 (-57.4)
SC 1720	0.00 (0.00)	0.00 (0.00)	1.46 (4.80)	9.2 (30)	-8.2 (-27)
DB 1805	-0.58 (-1.90)	2.47 (8.10)	-3.75 (-12.30)	7.6 (25)	-13.9 (-45.6)
DB 1850	-0.18 (-0.60)	2.84 (9.30)		0.8 (2.7)	-21.4 (-70.2)
DB 1895	0.76 (2.50)	-0.12 (-0.40)	-0.15 (-0.50)	7.5 (24.6)	-9.6 (-31.4)
DB 1900	0.00 (0.00)	-0.58 (-1.90)	-3.05 (-10.00)	18.2 (59.8)	-27.9 (-91.4)

This table exemplifies the alongshore variation of the shoreline change within the immediate vicinity of the San Clemente study area, which extends between SC 1623 (State Beach) and SC 1720 (Shorecliffs). There are contradictory trends observed in the data as the data sets are out of phase with adjacent locations; meaning that a transect which is erosional and/or accretional is adjacent to a transect which is accretional and/or erosional over the same time period.

The mean values during the 1940-1960 and 1960-1980 periods are similar in magnitude; however, the mean values during the 1980-1989 period are remarkably higher. Detailed inspection of the data indicates a shoreline that continuously fluctuates between erosional, balanced, or accretional. During the period 1940-1960, the shoreline indicated essentially zero change with a +0.76 m/yr (2.5 ft/yr) change in the vicinity of SC 1680. During the period 1960-1980, the shoreline vacillated in the alongshore direction between positive and negative. The shoreline change was approximately equal between positive and negative ranging from -0.21 m/yr (-0.69 ft/yr) and +0.18 m/yr (0.60 ft/yr). During the period 1980-1989, the shoreline was predominantly positive with accretion rates ranging from +0.43 m/yr (1.4 ft/yr) to +2.16 m/yr (7.1 ft/yr); an erosion value of -0.61 m/yr (-2.0 ft/yr) was recorded at SC 1660.

Beach Width Monitoring

The City of San Clemente initiated a beach monitoring program as part of the non-Federal in-kind contributions for this study (Coastal Frontiers, 2002). The general objective of the

monitoring program was to document changes in the condition of the shoreline between Dana Point Harbor and San Mateo Point; thereby, providing a basis for evaluating the impacts of natural events and anthropogenic operations. The program includes semi-annual full cross-shore profile surveys at 11 representative sites and bi-monthly beach width measurements at 9 of the 11 profile sites. The full cross-shore profiles were obtained by contract whereas the City of San Clemente lifeguards obtained the bi-monthly beach width measurements.

A description of the transect locations is given in **Table 2-7**. The 11 profile locations include 6 historical locations originally established by the CCSTWS-SD (1991), and 5 locations established specifically for the beach monitoring program in support of this study.

Table 2-7 San Clemente Area Beach Profile Transects

Site #	Transect Designation	Location	Origin
1	DB-1850	N. Doheny State Beach	CCSTWS
2	DB-1805	N. Doheny State Beach	CCSTWS
3	SC-1720	Shorecliffs	CCSTWS
4	SC-1705	Capistrano Trailer Court	Est. Oct. 2001
5	SC-1700	North Beach	Est. Oct. 2001
6	SC-1695	Dije Court	Est. Oct. 2001
7	SC-1680	Linda Lane	CCSTWS
8	SC-1660	T-Street	CCSTWS
9	SC-1645	Lost Winds	Est. Oct. 2001
10	SC1623	San Clemente State Beach	CCSTWS
11	SC-1605	Cottons Point	Est. Oct. 2001

Recent Shoreline Change Rate

The shoreline change rate can be determined from the aggregate of measured data collected in support of the CCSTWS-SD (1991) and the City of San Clemente's sponsored beach width monitoring program. This data set is comprised of a compilation of measurements obtained from the 1980's to the present day.

It is noted that this beach width data set is expressed relative to the Mean Sea Level (MSL) contour as opposed to the berm definition that has been adopted for this study. The beach widths are the distance between a fixed point on the backshore and the approximate location of the MSL contour, which is a commonly accepted definition for this level of analysis. The MSL beach width incorporates a portion of the "wet" beach (e.g. the foreshore between the MSL contour and the berm), whereas the berm beach width definition incorporates only the "dry" portion of the beach. Thus the MSL beach widths will be inherently greater than the berm beach widths. Based on a typical beach slope within the study area of 8H:1V, a berm elevation of +6.2 m (20.3 ft), and a MSL contour elevation of +1.64 m (5.4 ft), the estimated horizontal beach width attributable to this contour elevation difference is approximately 35 meters (114 feet). As a result, the MSL indicates a positive beach width where the beach has been previously defined in many reaches as having zero width (see Section 2.1).

Based on the assumption that the accretion/erosion trend for the berm width would coincide with the trend for the MSL line, the linear regression for each data set representing the trend of the

dry berm is developed. The slope of the lines represents the mean shoreline trend for each respective data set. The summary of the recent long-term shoreline change rates is presented in **Table 2-8**. The shoreline change data are considered together to obtain representative values for the entire study area. The mean shoreline change rate is –0.20 m/yr (-0.7 ft/yr), the maximum erosion rate is –0.61 m/yr (-2.0 ft/yr) and the maximum accretion rate is +0.38 m/yr (+1.24 ft/yr).

Table 2-8 Summary of Recent Long Term Shoreline Change Rates

Location	Erosion Rate, m/yr (ft/yr)
SC 1720, Shorecliffs	+0.38 (+1.24)
SC 1680, Linda Lane	-0.24 (-0.79)
SC 1660, T – Street	-0.61 (-2.00)
SC 1623, State Beach	-0.33 (-1.09)

There are contradictory trends observed in the data as the Shorecliffs data set is out of phase with the other three. The three data sets around the Pier are consistent in trend and phase. The data sets indicate consistent erosion and accretion trends at the same time; however, the mean values are similar in magnitude. The data set at Shorecliffs is nearly opposite in behavior. The beach is erosional and/or accretional when the others are accretional and/or erosional.

2.7.3 Short-Term Storm Induced Beach Change

Short-term shoreline erosion data have been collected within the U.S. Army Corps of Engineers, Los Angeles District as part of the Orange County Beach Erosion Control Project (Surfside-Sunset). This data set represents a collection of linear beach widths collected at 26 locations over a period of 33 years and is used in the present analysis to estimate shoreline response under storm conditions for the San Clemente project study area.

The data set collected at 26 locations represents various beach and shoreline conditions. The measured shoreline response data was correlated to ten known significant storms to estimate the degree of short-term storm-induced erosion under various intensities of storm events. However, the aforementioned study area is morphologically very different from the San Clemente study area. The northern Orange County area primarily consists of wide sandy beaches and a full sand profile. This is compared to the San Clemente study area that has been shown to be primarily a hard bottom area with a thin lens of sand along the shoreline. Thus the San Clemente area has inherently less beach width to exchange in the cross-shore direction due to storm induced impacts. Therefore, the raw data collected from northern Orange County was modified to more realistically reflect the expected San Clemente shoreline response.

2.7.4 Cross-Shore Profiles

Cross-shore profiles are compiled from the LIDAR topographic data and bathymetric measured data for all reaches and are shown in Appendix D of the EIS/EIR. Profiles from Reach 6 in the vicinity of the San Clemente Pier and Reach 7 in the vicinity of Mariposa Point may be considered to be representative of a non-armored and armored shoreline, respectively, throughout the study area. Only the portion of the profile from the bluff to the waterline is shown

in order to better illustrate the detail of the foreshore and backshore regions. The profile centerline is established at the seaward rail of the SCRRA railroad. The Pier area beach profile indicates a typical berm elevation of +5.2 meters (+17 feet), a typical foreshore slope of 8H:1V to 10H:1V, an offshore slope of 110H:1V, and a railroad elevation at approximately +6.4 meters (+21 feet), MLLW. The Mariposa Point area profile indicates a mean revetment crest elevation at +6.9 meters (+23 feet), MLLW, typical revetment slope of 1H:1V, toe elevation at approximately 0.0 meters, MLLW, an offshore slope of 110H:1V, and a railroad elevation at approximately +6.4 meters (+21 feet), MLLW.

2.7.5 Foreshore Slopes

Foreshore slope data was obtained by the City of San Clemente lifeguards, who obtained direct measurements of the foreshore slope as part of the aforementioned beach width monitoring program. Approximately 21 measurements were obtained 2 to 3 times each month for 12 month duration during the period of November 2001 to November 2002 at nine selected locations throughout the study area. The slope was measured in degrees from horizontal and converted to the slope cotangent. Assuming that the year of data collection adequately represents the future annual project period, this data set may be considered to represent the typical annual variation of foreshore slope values across the study area.

2.7.6 Profile Sediment Thickness

Data collected for the Sand Thickness Survey Report (USACE-SPL, 1988) allows estimation of the available sediment supply and consequently any potential limits to erosion. The work performed in this study consisted of jet probing activities along various profiles to determine the available sediment thickness. Three profiles in the San Clemente area were jet probed including SC-1623 (San Clemente State Beach), SC-1660 (T-Street) and SC-1720 (Capistrano Shores). The survey results indicate that the sediment thickness is relatively thin throughout the project nearshore area in depths from – 3 to –9 meters (-10 to -30 ft), MLLW and; conversely, that the associated hard bedrock substrate is relatively high relative to the shoreline position. The results of this analysis are presented in T**able 2-9**.

In addition, the measurement results identified cobbles, boulders, and other hard substrate at various depths along the profile. The observations include "some pebbles scattered on beach surface and some boulders visible at backshore" and "offshore sand-stone outcrops with local bottom relief of 1 ft". This information is consistent with 2002 geologic information collected during geophysical studies conducted as part of this study, and reported in Appendix E of the EIS/EIR. However, as the data was collected over 20 years ago, it is presented as evidence of past conditions and should not be considered indicative of current conditions.

Table 2-9 Summary of Profile Sediment Thickness

Range Line	No.	Range	Elevation (MLLW)	Sand Thickness	Bedrock Elevation (m, MLLW)
SC-1623	1	21.1 m (69.3 ft)	4.1 m (13.5 ft)	3.1 m (10.1ft)	+1.0 (3.3 ft)
SC-1623	2	34.6 m (113.5 ft)	3.4 m (11.1 ft)	3.2 m (10.5ft)	+0.2 (0.7 ft)
SC-1623	3	51.7 m (169.6 ft)	2.1 m (6.9 ft)	2.4 m (7.7 ft)	-0.3 (-1.0 ft)
SC-1623	4	194.2 m (636.8 ft)	-3.5 m (-11.4 ft)	0.1 m (0.4 ft)	-3.6 (-11.8 ft)
SC-1623	5	266.1 m (872.8 ft)	-6.0 m (-19.6 ft)	0.3 m (0.9 ft)	-6.3 (-20.7 ft)
SC-1623	6	504.2 m (1653.8 ft)	-9.3 m (-30.5 ft)	0.6 m (1.8 ft)	-9.9 (-32.5 ft)
SC-1660	1	11.5 m (37.6 ft)	5.0 m (16.3 ft)	4.5 m (14.8ft)	+0.5 (1.6 ft)
SC-1660	2	23.5 m (77.2 ft)	3.1 m (10.2 ft)	3.4 m (11.2ft)	-0.3 (-1.0 ft)
SC-1660	3	42.9 m (140.6 ft)	1.5 m (4.8 ft)	2.1 m (6.9 ft)	-0.6 (-2.0 ft)
SC-1660	4	232.8 m (763.5 ft)	-3.1 m (-10.1 ft)	0.1 m (0.4 ft)	-3.2 (-10.5 ft)
SC-1660	5	462.4 m (1516.5 ft)	-6.5 m (-21.3 ft)	0.7 m (2.2 ft)	-7.2 (-23.6 ft)
SC-1660	6	673.6 m (2209.5 ft)	-9.0 m (-29.6 ft)	2.7 m (8.8 ft)	-11.7 (-38.4 ft)
SC-1720	1	10.9 m (35.9 ft)	4.7 m (15.4 ft)	4.5 m (14.9ft)	+0.2 (0.7 ft)
SC-1720	2	24.8 m (81.4 ft)	2.7 m (8.7 ft)	2.9 m (9.6 ft)	-0.2 (-0.7 ft)
SC-1720	3	46.5 m (152.6 ft)	0.6 m (1.9 ft)	1.0 m (3.3 ft)	-0.4 (-1.3 ft)
SC-1720	4	165.2 m (541.9 ft)	-2.5 m (-8.1 ft)	0.0 m (0.0 ft)	-2.5 (-8.2 ft)
SC-1720	5	494.8 m (1622.9 ft)	-6.7 m (-21.9 ft)	0.2 m (0.5 ft)	-6.9 (-22.6 ft)
SC-1720	6	879.5 m (2884.9 ft)	-8.6 m (-28.3 ft)	0.2 m (0.7 ft)	-8.8 (-28.9 ft)

2.7.7 Sediment Budget

A sediment budget for without-project conditions has been developed based on the CCSTWS-SD (1991). Development of the sediment budget involves defining the sediment sources, sinks, losses; transport modes; erosion and accretion rates; and balancing the resultant budget. Some additional information was obtained during this study to enhance the previously developed sediment estimates. Compilation of the sediment budget specific to San Clemente is described hereinafter and is further described in the CCSTWS-SD (USACE-SPL, 1991).

The analysis of the budget of sediment for this cell has been carried out for three time periods: (1) the period from 1900 – 1938, (2) a mild, uniform weather period from 1960 – 1978, and (3) a period of more variable wave climate covered by the CCSTWS-SD studies from 1983 – 1990. The 1900 – 1938 "natural" budget permits an uncluttered look at the cell as it predates construction of dams and Oceanside Harbor, although it necessarily draws on some findings from later studies. The mild, uniform period from 1960-1978 was selected to evaluate the effects of Oceanside Harbor at a time when the wave climate was consistent from year to year and less variable than the present wave climate. The last period of more variable wave climate extending from 1983 – 1990 emphasizes the change in wave climate from one that gave a

consistent, strong southerly littoral transport to one that yields a more variable transport with a net northerly component in some years. The resultant sediment budget for the three time periods is shown in **Table 2-10**.

Table 2-10 Sediment Budget for Dana Point Subcell (Dana Point to San Mateo Point)

	1900-1938		1960-1978		1983-1990	
	Input (m^3/yr)	Output (m^3/yr)	Input (m^3/yr)	Output (m^3/yr)	Input (m^3/yr)	Output (m^3/yr)
Q_l	0	130,000	0	130,000	0	35,000
Q_n	0	15,000	0	15,000	0	5,000
$Q_{b,o}$	130,000	45,000	90,000	45,000	45,000	0
Q_a	0	0	90,000	0	0	0
$Q_{r,s}$	65,000	0	45,000	0	0	0
Total	**+195,000**	**-190,000**	**+225,000**	**-190,000**	**+45,000**	**-40,000**
Net Sand Vol Change (m^3/yr)	+5,000		+35,000		+5,000	
Shoreline Change (m/yr)	+0.03		+0.18		+0.03	

Source: USACE-SPL, 1991

Notes:

Q = total sand transport rate into or out of cell

a = artificial nourishment, bypassing, dredging, etc

b = blufflands erosion; includes seacliffs, gullies, coastal terrace, slumps, etc as distinct from rivers

l = longshore transport of sand in and near the surfzone

n = nearshore transport along the coast, outside the surfzone

o = onshore/offshore transport at the base of the shorerise

r = river yield to the coast

s = lost to submarine canyons

The resultant sediment budget indicates the shoreline is essentially in balance between erosion and accretion. The budget is considered to be in balance when the shoreline change rate, computed from the volume flux is less than 0.03 m/yr (0.1 ft/yr). The shoreline indicates a balance in the "natural" time period and the most recent variable wave climate time period. The net volume flux indicates the budget is very slightly accretional during the uniform wave climate period.

2.7.8 Summary

The shoreline morphology of the San Clemente area can be summarized as a lack of sediment supply is creating a chronic, mild, long-term erosional condition. As the beach continues to erode over time, chronic, mild, long-term erosion is expected to exacerbate existing storm wave related structure damages and create future additional damages to the railroad.

The sediment budget as described is applicable to the northern sub-cell of the Oceanside Littoral Cell. The northern littoral sub-cell is approximately 13 km (8 mi) long from Dana Point to San Mateo Point. Located within this sub-cell is the project area which is approximately 1,040 m (3,400 ft) long. The geologic conditions within the littoral sub-cell indicate that the entire area is exposed bedrock throughout the regime. Mapping indicates the offshore area is primarily hard bottom covered in some places by shallow pockets or a thin veneer of sediment. Raised

rock reefs are common. The beach is a relatively narrow ribbon of sand trapped against the coastal bluffs; the small amount of sediment within the littoral system is worked by waves to the upper limit of the profile.

The sediment budget, developed by the CCSTWS, is applicable over the 13 km (8 mi) reach. Due to the lack of available data, the sediment budget, as developed, does not allow detailed volumetric budget estimates on a smaller spatial scale. Specifically, the lack of spatially refined data does not allow a detailed volumetric analysis of the project area. The sediment budget for the sub-cell has been determined to be +5,000 cubic meters per year, with a corresponding +0.03 m/yr shoreline change rate. The positive sign (+) suggests that the shoreline is accretional. However, this volume flux rate is very small and is within the error associated with the analysis. Thus, this sediment budget (and shoreline change rate) could have easily been positive or negative. The budget is considered to be in balance when the shoreline change rate, computed from the volume flux, is less than 0.03 m/yr (0.1 ft/yr). It is further noted that 5,000 cubic meters spread over 13 km (8 mi) of shoreline is virtually undetectable.

The littoral sub-cell is dominated by sediment inputs from San Juan Creek at the northern boundary. San Juan Creek presents the single largest source of sediment within the entire sub-cell. Thus, the greatest change rates, both for sediment budget and shoreline change, will be measured in the immediate vicinity of the creek mouth. It is entirely probable, and likely, that other areas of the sub-cell farther removed from San Juan Creek will exhibit a sediment volume flux both negative (erosion) and positive (accretion). In other words, other areas of the littoral sub-cell can be either erosional or accretional, yet their signal will be masked by what is occurring in the vicinity of San Juan Creek.

The measured shoreline change rate at the project area in San Clemente has been determined to be –0.10 m/yr (-0.33 ft/yr). This value represents a shoreline that is marginally erosive, at best. This shoreline change rate is determined by an aggregation of historic and recent profile survey data. The data, when viewed in aggregate, indicates that since the 1980's the shoreline has been in a mildly erosive condition. The marginally erosive shoreline change rate is consistent with all of the prevailing geophysical information. It is believed that over decadal time scales, the shoreline has changed from a largely static condition to a mildly erosive condition due to anthropogenic influences and sediment trapping in the watershed due to urban development.

2.8 Environmental Resources

2.8.1 Biological Resources

The predominant intertidal habitat along San Clemente's shoreline is sandy beach, although some rocky outcrops that extend from mid-beach to the low intertidal are present at Mariposa Point (Reach 7), north of San Clemente Pier, as shown in **Figure 2-14**. Beyond the surf zone, the seafloor is a mosaic of sand and low-to-high relief patch reef. Some pinnacles of the reef are visible in the nearshore zone at low tide while two prominent offshore pinnacles break the surface offshore of Mariposa Point and south of the San Clemente Pier. Other reef habitats are located south of the Pier offshore of T-Street that extend west, and then north around the end of the San Clemente Pier, and secondly, offshore San Mateo Point (Reach 1). Sensitive biological resources are found within a broad band of the region between San Clemente and Oceanside that have a potential to be affected by beach stabilization and/ or protection projects. However, there are a few species that may use the nearshore zone for foraging, namely, the California

least tern (*Sterna antillarum browni*) and the California brown pelican (*Pelecanus occidentalis occidentalis*)

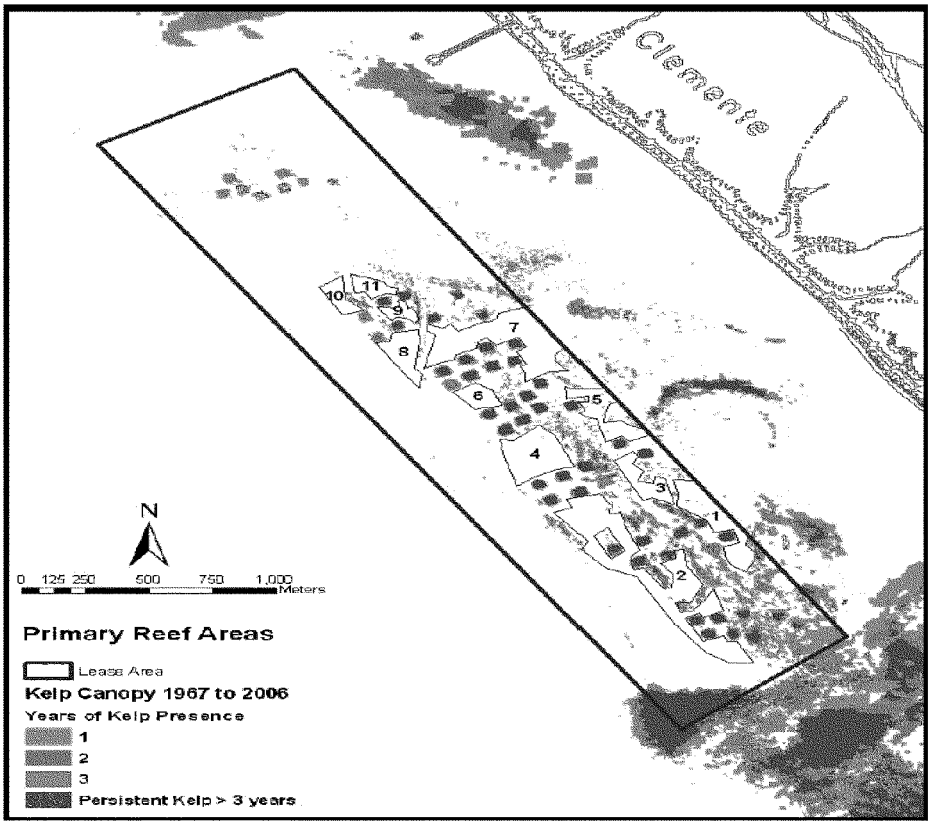


Figure 2-14 Marine Shoreline and Offshore Habitats

2.8.2 Marine Habitats

Three types of vegetated habitats, nearshore kelp and macroalgae, surfgrass beds, and offshore kelp beds, are present in the intertidal to subtidal habitats off San Clemente. Although the predominant intertidal habitat along San Clemente's shoreline is sandy beach, an area of rocky intertidal is present at Mariposa Point (Reach 7) approximately 975 meters (3,200 feet) north of the San Clemente Pier. Boulders and rocky outcroppings in this area support a variety of algal species. In the high intertidal, boulders support filamentous green algae (*Enteromorpha* spp.). The mid to low intertidal algae composition is dominated by encrusting red algae (*Lithophyllum* spp., *Lithothamnion* spp.), encrusting brown algae (*Pseudolithoderma* spp.), and coralline algae (*Corallina* spp.). Filamentous red algae, consisting of several species, and

green algae (*Enteromorpha* spp. and *Ulva* spp.) also occur in these zones. Larger brown algae species colonize the base of the intertidal reef throughout the area, including palm kelp (*Eisenia aborea*) and feather boa kelp (*Egregia menziesii*). Surfgrass (*Phyllospadix* spp.) is present in the low intertidal beginning approximately 91 meters (300 feet) offshore of the sandy beach. Surfgrass is present throughout the low intertidal platform of Mariposa Point. Other offshore rocks are found approximately 1,950 meters (6,400 feet) (Reach 4) south of the San Clemente Pier.

The shallow subtidal zone for much of the project area is a mixture of sand and boulder, with occasional outcrops of exposed shale bedrock. The subtidal areas between North Beach and Mariposa Point and offshore of Linda Lane, Mariposa Point, and T Street support filamentous red algae, coralline algae, crustose coralline algae, feather boa kelp, palm kelp, and surfgrass. Historically, offshore kelp beds, dominated by giant kelp with an understory of feather boa kelp and palm kelp, have been prevalent along this section of coastline, but within the last several years, the canopy has experienced a sharp decline (Coastal Resources Management, 2000). During surveys in June 2000, Coastal Resources Management (CRM) found low density kelp beds with little or no surface canopy approximately 610 meters (2,000 feet) off of Mariposa Point and 1,219 meters (4,000 feet) from North Beach at depths between –7 and –8.5 meters (-23 and –28 feet) MLLW. Another bed was observed 198 meters (650 feet) off of San Clemente Pier (T Street) at a depth of 4.9 meters (16 feet) in October 1999. This patch was not observed during the June 2000 survey (CRM, 2000). Much of the kelp observed in June 2000 was ragged and covered with fouling ectoprocts (*Bryozoa*); however, newly settled recruit plants were also present (CRM, 2000). In the proposed project area (Reach 6) the impact to the resources has been minimized with the footprint of the project. As monitoring occurs after construction phase any further adjustments to placement of sand can be evaluated.

Soft Bottom Communities

Common benthic invertebrates observed on southern California sandy beaches between the low and high tide marks include sand crabs (*Emerita analoga*), beach hoppers (*Orchestoidea* spp.), burrowing polychaete worms, amphipods, isopods, and clams.

The offshore benthos in the shallow subtidal are expected to be similar to species that are common to north San Diego County located approximately 40 kilometers (25 miles) from the project area. Subtidal invertebrates commonly observed in San Diego County that are likely to be found in the project area include tube-dwelling polychaete worms (e.g. *Diopatra* spp., *Loimia medusa*, *Pista pacifica*), sand dollar (*Dendraster excentricus*), crabs (*Heterocrypta occidentalis*, *Portunis xantusii*, *Randallia ornata*), hermit crabs (*Pagurus* spp., *Pagurites* spp.), marine snails (*Nassarius fossatus*, *Olivella biplicata*, *Polinices* spp.), clams (*Ensis* spp.), armored sea star (*Astropecten armatus*), tube anemones (*Harenactis attenuata*, *Zaolutus actius*), sea pens (*Stylatula elongata*), and sea pansies (*Renilla kollikeri*) (MEC, 2002; Thompson et al, 1993).

The number of species and density of bottom dwelling macroinvertebrates is expected to be low in the area of potential offshore borrow sites, which will most likely be within the inner shelf zone. Infaunal abundance and diversity is generally low in the inner shelf compared to the middle and outer shelf because the inner shelf zone is regularly disrupted by wave activity and oceanic swell (SANDAG, 2000). Polychaete worms and/ or small, mobile crustaceans typically dominate the inner to middle shelf infaunal communities of the SCB (SANDAG, 2000).
Fish species that occur within the study area are expected to be similar to those found in San Diego County. Fish commonly found over sandy subtidal habitat (less than 9 meters or 30 feet) off of San Diego County beaches include California halibut (*Paralichthys californicus*), speckled

sanddabs (*Citharichthys stigmaeus*), barred surfperch (*Amphistichus argenteus*), white croaker (*Genyonemus lineatus*), bat ray (*Myliobatus californica*), and shovelnose guitarfish (*Rhinobatos productus*) (MEC 2002, SANDAG 2000). Northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), Pacific bonito (*Sarda chiliensis*), and topsmelt (*Atherops affinis*) are commonly encountered in the water column just beyond the surfzone (MEC, 2002; SANDAG, 2000). Flatfish, including speckled sanddab, horneyhead turbot (*Pleuronichthys verticalis*), and fantail sole (*Xystreurys liolepis*), are more common at deeper inner shelf depths ranging from –10 to –24 meters (-30 to –80 feet) MLLW (MEC, 2002).

The sandy intertidal is also used by a nearshore fish, the California grunion (*Leuresthes tenuis*) which lays its eggs in the high intertidal zone between March and August. During the grunion spawning season, eggs and developing embryos are buried in the sand to incubate between the highest tides of each month, at the full and new moon (Martin 2006). The eggs incubate a few inches deep in the sand and hatch approximately 10 days later during the next series of high tides (Chambers Group 2002). Grunion are known to spawn on the beach in the vicinity of San Clemente Pier (K. Martin, Pepperdine University, pers. comm., 2007).

Hard Substrate Communities

The area at Mariposa Point consists of sensitive rocky intertidal habitat, which supports a relatively diverse invertebrate community on individual boulders as well as on the surfaces of the low-lying platform reefs (CRM, 2000). The high intertidal or splash zone is characterized by barnacles (*Cthamalus* spp.), limpets (*Lottia* spp., *Collisella* spp.), and periwinkle snails (*Littorina* spp.) (MEC, 2002). The California mussel (*Mytilus californianus*), aggregating anemone (*Anthopleura elegantissima*), giant green anemome (*A. xanthogrammica*), chitons (*Mopalia muscosa* and *Nuttallina californica*), barnacles (*Balanus* spp.), hermit crabs, and snails (*Acanthina* spp.) are commonly observed throughout the middle and low intertidal zones (CRM, 2000; MEC, 2002). Although not common, the reef-building sandcastle tube worm (*Phragmatopoma californica*) was also found around the base of several boulders in the middle intertidal zone (CRM, 2000). The low intertidal zone and the adjoining subtidal rocky habitat, including the apex of the offshore reefs, support a diverse assemblage of invertebrate species. Typical reef organisms observed during the June 2000 survey conducted by CRM included mussels (*Mytilus californianus* and *M. edulis*) gorgonians (*Muricea californica* and *M. fructicosa*), keyhole limpet (*Megathura crenulata*), purple and red sea urchin (*Strongylocentrotus purpuratus* and *S. franciscanus*), California sea cucumber (*Parastichopus californicus*), Kellet's whelk (*Kelletia kelletii*), and sea stars (*Pisaster brevispinus* and *P. giganteus*). Other species expected to occur include the California sea hare (*Aplysia californica*), as well as various crabs and marine snails (MEC, 2002).

Up to ten species of fish utilize the low to minus tidal zones of rocky intertidal habitats in the SCB (MEC, 2002). Wooly sculpin (*Clinocottus analis*) is one of the more commonly encountered fish species in tidepools, but juvenile opaleye (*Girella nigricans*), rockpool blenny (*Hypsoblennius gilberti*), spotted kelpfish (*Gibbonsia elegans*), and California clingfish (*Gobiesox rhessodon*) may also be present (Cross and Allen, 1993).

The June 2000 survey also identified spotted sand bass (*Paralabrax maculofasciatus*), kelp bass (*P. clathratus*), senorita (*Oxyjulius californicus*), bat ray, and black surfperch (*Embiotoca jacksoni*). Other fish that are commonly associated with nearshore reef habitats with developed stands of perennial vegetation above one meter (3 feet) in height may also be present within the project area, including barred sand bass (*P. nebulifer*); shiner, walleye, and dwarf surfperches (*Embiotocidae*); California sheephead (*Semicossyphus pulcher*); garibaldi (*Hypsypops*

rubicundus); jack mackerel (*Trachurus symmetricus*); giant kelpfish (*Heterostichus rostratus*); painted greenling (*Oxylebius pictus*); and halfmoon (*Medialuna californiensis*) (MEC, 2002; Thomson et al., 1993). The dominant fish species in the offshore kelp beds, approximately 650 meters (2,000 feet) offshore of Mariposa Point (Washrock Reef) and 1,220 meters (4,000 feet) from North Beach at depths between –7 to –8.5 meters (-23 to –28 feet) MLLW, are expected to be surfperch (*Embiotocidae*); rockfish (*Sebastes* spp.); and wrasses (*Labridae*) (e.g. sheephead, senorita, and rock wrasse (*Halichoeres semicinctus*)).

Birds

A diverse variety of resident and migratory seabirds and shorebirds are commonly observed along southern California beaches and offshore waters. Seabirds such as pelicans, terns, and cormorants forage for fish in the Nearshore Ocean. Sandy upper tidal beaches are utilized by gulls and shorebirds as roosts. Gulls feed on fish and invertebrates, particularly near the edge of the kelp canopy. Shorebirds probe for invertebrates in the damp sands of the middle and low intertidal zones, and some species also forage for small fish and invertebrates in the rocky intertidal. Kelp and surfgrass that have washed ashore harbor invertebrates and, thus provide good foraging areas for gulls and shorebirds.

The seabirds that are most commonly observed along the beaches and ocean waters offshore of Orange and San Diego Counties include Heerman's gull (*Larus heermanni*), ringed-billed gull (*L. delawarensis*), western gull (*L. occidentalis*), California brown pelican (*Pelecanus occidentalis californicus*), surf scoter (*Melinita perspicillata*), terns (*Sterna* spp.), grebes (*Podicipedidae* spp.), double-crested (*Phalacrocorax auritus*), Brandt's (*P. pencillatus*), and pelagic (*P. pelagicus*) cormorant (Chambers Group, 2002; MEC, 2002). Commonly observed shorebirds include black turnstone (*Arenaria melanocephala*), marbled godwit (*Limosa fedoa*), sanderling (*Calidris alba*), whimbrel (*Numenius phaeopus*), willet (*Catoptrophorus semipalmatus*), dunlin (*Calidris alpina*), western sandpiper (*Calidris mauri*), and least sandpiper (*Calidris minutilla*) (Chambers Group, 2002; McConnaughey and Mcconnaughey, 1988; MEC, 2002).

Marine Mammals (Non-Endangered)

The marine mammals that occur in the Southern California Bight have been described in detail in previous studies and environmental documents (e.g., Bonnell et al. 1981, 1983; Bonnell and Dailey 1993; Dohl et al. 1981, 1983; ADL 1984; Barlow 1995; Barlow et al. 1995, 1997; Barlow and Gerrodette 1996; Koski et al. 1998; DeLong and Melin 2000; Stewart and Yochem 2000). Although as many as 36 species of marine mammals inhabit or visit the Southern California Bight, including 6 species of pinnipeds (seals and sea lions), 29 species of cetaceans (whales, porpoises, and dolphins), and the sea otter, only about 4 species are expected to occur in the nearshore waters of the San Clemente study area on a regular basis, and are described below. Other species may also occur in the study area on an irregular basis.

Sea lions

The California sea lion (*Zalophus californianus*) ranges from British Columbia to Mexico. The current U.S. population size is estimated at 237,000-244,000 animals (Carretta et al. 2007). In the Southern California Bight, California sea lions currently breed on four islands: San Miguel, San Nicolas, Santa Barbara, and San Clemente.

Harbor seals

Harbor seals (*Phoca vitulina*) range from Mexico to the Aleutians. The North Pacific population is centered in Alaska (Hoover, 1988), and about 34,233 harbor seals are found in California (Carretta et al. 2007). Peak harbor seal populations on land occur during the species' spring breeding and pupping season and early summer molt. Harbor seals forage relatively close to shore and occasionally "haul out" onto land at various times of the day for an indefinite period of time (Seaworld 2002).

Gray Whale

The California gray whale (*Eschrichtius robustus*) population migrates through southern California waters twice a year on its way between Mexican breeding lagoons and feeding grounds in the Bering Sea. The southbound migration through the Southern California Bight begins in December and lasts through February; the northbound migration is more prolonged, lasting from February through May with a peak in March (Bonnell and Dailey 1993). Gray whales are generally absent from southern California waters from August through November. Migrating gray whales generally travel along the nearshore shallow continental shelf within 2 mi (3 km) of the shoreline over most of the route (Graham 1989). This proximity to shore makes gray whales vulnerable to numerous threats by human activities, including industrial activities, oil exploration and extraction, shipping traffic, pollution, and whale-watching tourism (Crane 1992).

Bottlenose Dolphin

Coastal bottlenose dolphins (*Tursiops truncatus*), the population most likely to occur in the study area, generally are found within approximately 1-2 km (1 mile) of shore, primarily from Point Conception south into Mexican waters. The coastal population appears to form small resident groups that range along the coastline, especially off Orange and San Diego counties (Weller and Defran 1989). The coastal population is estimated at about 323 animals (Carretta et al. 2007).

2.8.3 Threatened and Endangered Species

In Section 7(c) of the FESA, as amended, requires that a federal agency request from the appropriate authority a list of threatened and/or endangered species present in an area of a proposed major federal action.

Because of a lack of natural terrestrial habitat within the project footprint, sensitive terrestrial plants and animals would not be expected to occur in the project area. The EIS lists sensitive species with the potential to occur on the beach in the project area or offshore in the vicinity of the borrow sites and/or the beach fill site. Potential impacts to these species are addressed in Section 4.4.3 of the joint EIS/EIR.

2.8.4 Water Quality

Water quality is typically characterized by salinity, pH, temperature, clarity, and dissolved oxygen (DO). **Table 2-11** characterizes the overall water quality parameters for the project site.

Table 2-11 Water Quality Characteristics

Parameter	Range
Salinity (ppt)	22 to 34
Surface Temperature (F)	57.2 to 67.1
PH	7.4 to 7.6
Clarity (feet)	13 to 15
D.O. (mg/L)	6.5 to 10

- Water temperatures range from approximately 14°C (winter minimum) to 22°C (summer maximum). During the summer, surface water temperatures are up to 10°C warmer than those in deeper waters.
- Near shore salinity is generally uniform, from approximately 33 to 34 ppt. Seasonally, the near-surface salinity can decrease near the Prima Deshecha & Segunda Deshecha Watershed following storm-related discharges of freshwater and/ or (historically) intermittent discharges of sewage into the river.
- Dissolved oxygen concentrations typically lie between approximately 6.5 and 10 milligrams per liter (mg/L), but may drop below approximately 5 mg/L at depths of 60 meters.

Light transmittance (indicating water clarity) has been measured at approximately 4 to 4.5 meters (13 to 15 feet). Some reduction was associated with storm activity, particularly in shallower, near shore waters. Both light and nutrients are needed to support photosynthesis by attached and planktonic plants.

Nutrient concentrations are expected to be similar to that elsewhere in the Southern California Bight: Nitrates at approximately 5 to 200 nanomoles per liter; phosphates at approximately 100 to 500 nanomoles per liter; and ammonium at approximately 300 nanomoles per liter. Discharges from the Prima Deshecha & Segunda Deshecha likely represent an important seasonal source of nutrients to nearshore waters. Upwelling events also contribute nutrients to surface waters.

Several storm drains have outlets onto beaches within the study area and its vicinity. The City of San Clemente and the County of Orange have been required to monitor bacterial levels at storm drain outlets and in the adjacent surfzone since January 2003 as part of the Coastal Storm Drain Outfall Monitoring (CSDM) Program (County of Orange et al. 2003). For the CSDM Program, monitoring was conducted on both the discharge from the storm drain and the surfzone 23 meters (25 yds) up-coast and 23 meters (25 yds) down-coast of the storm drain to ocean interface. Grab samples were collected weekly for the analysis of total coliform, fecal coliform, and Enterococcus bacteria. An estimate of the flow rate from the storm drain was made and the temperatures of the storm drain discharge and the surf zone down-coast were measured (County of Orange et al. 2006).

During the monitoring period of July 2005 through June 2006, bacteria levels at nine out of ten monitoring stations within the study area or within two miles of its boundaries met California Ocean Plan standards in 90 percent or more results. The tenth monitoring station, located at Poche Beach approximately two miles north of the study area, exceeded Ocean Plan standards in 10-40 percent of results during the monitoring period (County of Orange et al. 2006). Poche Beach is at the outlet of the Prima Deshecha Flood Control Channel.

2.8.5 Sediment Quality

The sampled materials were generally fine-grained sands with local silty intervals and minor amounts of shell fragments. Significant gravel/cobble beds and lenses were encountered throughout the area, but the thicknesses generally averaged 0.65 meters (2 feet) or less. Shell and shell fragments were encountered throughout the area. Appendix E of the EIS/EIR lists the cross sections through the borrow area and presents results of the geotechnical explorations conducted at the borrow sites. In order to determine the compatibility of dredged material with the receiving beach, gradation analysis of the onshore and offshore beach profiles is required. The average median grain size diameter (D_{50}) of the proposed borrow is relatively consistent, varying from 0.21 to 0.23 mm, which is slightly coarser than the average D_{50} of 0.17 mm for the entire San Clemente shoreline project.

Chemical testing of the proposed borrow area offshore Oceanside has been done by the San Diego Association of Governments (SANDAG, 2000) and the USACE (2003). The analytical results are summarized and compared to the Sediment Quality Guidelines (SQGs) in the EIS document. The Sediment Quality Guidelines (SQGs) are based on Puget Sound Dredged Disposal Analysis (PSSDA) and NOAA guidelines. The PSSDA screening level (SL) identifies the concentration below which sediment is expected to have no unacceptable adverse effects. The higher value is the maximum level (ML) above which effects are likely. The NOAA published effects-based sediment quality values for evaluating the potential for constituents in sediment to cause adverse biological effects are referred to as Effects Range-Low (ER-L) and Effects Range-Median (ER-M). Sediment samples in which all chemical concentrations are below ER-L values are not expected to be toxic. Generally, effects may occasionally be expected when chemical concentrations occur between ER-L and ER-M values. The probability of toxicity is expected to increase with the number and level of exceedances above the ER-M. These values are not accepted standards or criteria, but rather provide effects-based guidelines. Since SQGs have not been developed for southern California, these are used as an initial, informal evaluation to determine the need for further Tier II or Tier III testing.

The total organic carbon concentration was 0.08 percent in the SANDAG samples and 0.15 percent in the USACE samples. Contaminant concentrations of metals, pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), phthalates, and phenols were non-detectible to low and well below all the thresholds in the SQGs for both sample sets. No dichlorodiphenyltrichloroethane (DDT) or chlorinated pesticides were detected in the samples. The bulk chemistry data indicated that chemicals detected within the sediments at the proposed borrow site are at very low levels and do not exceed the SQGs. Therefore, based on the geotechnical information and that of the borrow source, the borrow site sediments are considered suitable for placement at the receiving beach at San Clemente.

2.8.6 Ambient Noise and Air Quality

Dominant noise sources include waves, beach recreation activities, and vehicle noise on adjacent roads. The sound of wave action will vary with factors including wave height, period, frequency, angle of attack, season, and wind conditions. Background noise levels are generally low, due to the limited traffic and residential nature of the area. Two major sources of noise exist in the San Clemente Beach region: rotorcraft air operation training at Camp Pendleton, south of the southernmost region of the San Clemente project study area, occurring periodically throughout the year; and temporary construction activities. Noise levels occasionally impair normal conversation.

The most important climatic and meteorological characteristics influencing air quality in the study area are persistent temperature inversions, predominance of onshore winds in Orange County, mountain ridge and valley topography, and prevalent sunlight. Air quality is evaluated by measuring ambient concentrations of pollutants that are known to have deleterious effects. The degree of air quality degradation is then compared to ambient air quality standards (AAQS). Annual ambient air quality monitoring has been conducted at two locations (El Toro and Costa Mesa) approximately 20 miles north of the project area between 1992 and 1997. Detailed monitoring results can be found in the EIS/EIR. The high frequency of southwest to northwest sea breezes usually occur during the daytime for most of the year and transports air pollutants away from the coast toward the interior regions in the afternoon hours. As a result, air quality conditions along the coast, such as Newport Bay, are typically better than the conditions presented for the interior Costa Mesa and El Toro Monitoring Stations.

In addition to criteria pollutants, other regulated pollutants include toxic air contaminants (TACs), which are suspected or known to cause cancer, genetic mutations, birth defects, or other serious illnesses in exposed people. (The TACs are not regulated by the NAAQS or CAAQS, but are addressed by the National Emission Standards for Hazardous Air Pollutants [NESHAPs] and Title III of the 1990 Clean Air Act Amendments). Generally, TACs behave in the atmosphere in the same way as inert pollutants. The level of emissions at the source determines the concentrations of both inert and toxic pollutants. Thus, impacts from toxic pollutant emissions tend to be site specific and their intensity is subject to constantly changing meteorological conditions. The worst meteorological conditions that affect short-term impacts (low wind speed, highly stable air mass, and constant wind direction) occur relatively infrequently.

2.8.7 Cultural Resources

Named after one of the offshore southern Channel Islands, San Clemente Island, the city was founded by a former mayor of Seattle, Ole Hanson, in 1925 (Brock 1985). San Clemente was among the first master planned communities built from totally open land in the United States. Before erecting a single structure on the rolling coastal hills, Ole Hanson laid out an expansive plan based on the Spanish Colonial architectural style including restaurants, a clubhouse, residences, public parks, a public pool, a fishing pier, and even equestrian trails. Hanson's residential community, promoted as "The Spanish Village," featured wide, meandering streets that conformed to the contours of the hills, houses situated to provide an ocean view, and mandatory white stucco exteriors and red tile roofs for every building. San Clemente was incorporated in 1928, and grew rapidly until the Depression, when development halted. The growth rate picked up again during the 1950s, and was later boosted by construction of the San Diego Freeway.

Today, the Spanish Village by the Sea is more heterogeneous than Hanson had envisioned, but historic homeowners and current planning and development all reflect increasing esteem for his red-roofed, white-walled Spanish architecture dream. Historic homeowners must abide by city codes that protect the aesthetic spirit and style of early San Clemente.

A records and literature search was completed at the South Central Coastal Information Center at California State University, Fullerton to determine if prehistoric or historic sites had been previously recorded within the project area. While no sites have been recorded within the project area, three shell middens and an isolate have been recorded adjacent to the project's eastern boundary (T**able 2-12**). In addition, the Historic Resources Inventory (HRI), which includes the National Register (NR), California Register, State Historic Landmarks, Points of

Historic Interest and all properties evaluated for the NR, identified two properties located in the project vicinity: Casa Romantica (located in Reach 6, added to the NR in 1991; No. 91001900) and San Clemente Beach Club (located in Reach 9, added to the NR in 1981; No. 81000164).

No recorded archaeological sites or historic properties have been recorded within the project area.

Table 2-12 Summary of Recorded Archaeological Sites

Site No.	Description	Source & Date
CA-Ora-101	Shell Midden	Smethe 1954
CA-Ora-102	Shell Midden, village site, manos	Waldeck 1948
CA-Ora-103	Shell Midden, hammerstone, manos	Waldeck 1948
30-100074	Basalt dentidular flake (Isolate)	Maxon 1996

The project area has been extensively disturbed by urban development. The above listed archaeological and historical sites will not be impacted by the proposed project. Because the southern California coast is rich with cultural history, discovery of buried sites is always a possibility. If cultural resources are located, the Corps must be notified immediately.

2.8.8 Aesthetics

The views to the west of the entire project site are of the Pacific Ocean. Nearly the entire project site is lined with palm trees beachside of the railroad tracks. At the northern portion of the project site, the project site is viewable from adjacent beach areas, residential areas located atop the bluffs adjacent to the beach, visitors at Linda Lane Park, and the Pier. At the center of the project site, the project site is viewable from the Pier, from commercial businesses, located both on the Pier and east of the railroad tracks, residences, and visitors at Parque del Mar and Linda Lane Park. At the southern end of the project site, the project site is viewable from adjacent beach areas, the parking meters at West Paseo de Cristobal, pedestrians on the overpass, residential areas located atop the bluffs adjacent to the beach, and the Pier. In addition, the entire project site is visible to nearshore and offshore recreational users, as well as to passengers on passing trains.

The California Coastal Act includes the protection of the scenic and visual qualities of coastal areas, including the protection of views to and along the ocean, minimization of the alteration of natural landforms, and necessary actions to restore and enhance visual quality in visually degraded areas. The project is consistent with Policy 10.2.5 of the City of San Clemente General Plan Natural and Historic/Cultural Resources Element, which promotes development of programs "that will preserve and maintain the physical features of the coastal zone including bluffs, canyons, and beaches."

2.8.9 Environmental Regulations

As discussed in the EIS Volume I, **Table 2-13** below lists both the Federal and State environmental regulations that apply to the recommended alternative and study area that will be observed.

Table 2-13 Federal and State Environmental Regulations

Title of Regulation or Public Law	US CODE
FEDERAL ENVIRONMENTAL REGULATIONS	
National Environmental Policy Act of 1969 (Public Law 91-190) as amended	*42 USC 4321 et seq.*
ER-200-2-2, 33 CFR 230, March 1988	*33 CFR 230*
2.8.10 Coastal Zone Management Act of 1972 and California Coastal Act of 1976	*16 USC 1451 et seq.*
Clean Water Act of 1977 (Public Law 95-217)	*42 USC 7401 et seq.*
Rivers and Harbors Act of 1899	*33 USC 401-413*
Fish and Wildlife Coordination Act of 1958 (Public Law 85-624, 16 USC 661-666©)	*16 USC 661*
Federal Endangered Species Act of 1973	*16 USC 1531*
Magnuson-Stevens Fishery Management and Conservation Act, as amended 1996 (Public Law 104-267)	*16 USC 1801*
Marine Mammal Protection Act of 1972	*16 USC 1361*
Migratory Bird Treaty Act, as amended (16 USC 703-711)	*16 USC 703-711*
Executive Order 11990	
Executive Order 11991	
National Historic Preservation Act of 1966, as amended (16 USC 479)	*16 USC 470*
Clean Air Act of 1972	*42 USC 7401 et seq.*
Executive Order 12088	
Executive Order 12898	
Executive Order 13045	
Federal Water Project Recreation Act (Public Law 89-72), July 9, 1965	*16 USC 4601*
STATE ENVIRONMENTAL REGULATIONS	
California Environmental Quality Act (Public Resources Code, Sections 21000-29 21177)	
California Coastal Act of 1976, as amended	
Porter-Cologne Water Quality Control Act of 1966 (California Water Code §§13000-13999.10)	
California State Lands Commission (Sections 6216 and 6303)	
California Endangered Species Act (California Fish and Game Code Sections 2050-2116)	
LOCAL ENVIRONMENTAL REGULATIONS	
South Coast Air Quality Management Plan (AQMP); South Coast Air Quality Management District (SCAQMD) and Southern California Association of Governments (SCAG)	

2.9 Economic Conditions

2.9.1 Historic Development

The City of San Clemente, founded by Ole Hanson, consisted of 8 km^2 (3 mi^2) between the state highway and the ocean, located 106 km (66 miles) from both Los Angeles and San Diego. Despite much skepticism from realtors and other developers, Hanson moved forward and laid out his planned community using airplane photographs, and in December 1925, he began selling lots. Over a six month period, 1,200 lots were sold, and by November 1926 the building program was calling for completing 16 buildings every week. As part of his development program, Hanson deeded to the residents of the village, 915 meters (3,000 ft) of beach, the Community Clubhouse, beach Club, Fishing Pier, and golf course. In three and a half years, San Clemente had grown to the point where it was generally conceded to be the wealthiest city per capita in America. In 1928, the City of San Clemente was incorporated and received title to the water system, the beach club, the Pier, 915 meters (3,000 ft) of beach, 27 km (17 miles) of riding trails, the community center, the school and parks for $1.

2.9.2 Socio-economic Profile

Population

The majority of Californians live in Southern California. The California Department of Finance (CDOF) estimates the population of Orange County at 3,121,251 as of January 1, 2008, with the City of San Clemente having a population of 67,892 (Economics Appendix). Orange County's population accounts for 8.2% of the State's 38 million inhabitants. San Clemente is comprised of 46 km^2 (18 square miles).

Using the U.S. Bureau of Economic Analysis projection data for the State of California, the state is expected to experience a population increase of more than 28% by 2025, a considerably faster rate of growth than the United States (23%).

The City of San Clemente has experienced rapid growth since 2000. According to CDOF statistics, the City of San Clemente has grown from 49,936 residents in April of 2000 to its current figure of 67,892, an increase of 36.0%. The median age of the population of San Clemente is 38 years. The median age in Orange County is 31, and the median age for California is 33.6. Orange County has a population of 281,782 of people over the age of 65, which is 9.9% of the population.

Using 2000 Census reports, the population of the city of San Clemente is 87.9% white. Minority populations include: Asian (2.6%), American Indian and Alaskan Native (0.6%), African American (0.8%), Native Hawaiian (0.18%); and other (5.1%). Approximately 15.9% of the population is of Hispanic or Latino heritage. There are 19,395 households and the average household size is 2.56 persons.

Employment

Figure 2-15 and **Table 2-14** indicate the predominant sectors of employment for residents of the study area, according to the U.S. Census Bureau's *Profile of Selected Economic Characteristics (2000)*. Important employment sectors include: management and professional services, production and transportation occupations, service occupations, and construction and maintenance.

In 2002 the value of agricultural production was $344.3 million. That ranks the county 19th in the state of California. Leading agricultural commodities include nursery stock and cut flowers, strawberries, tomatoes, peppers, and avocados.

In Orange County, the unemployment rate in March 2009 was 8.5%, up from 4.5% in March 2008. The city of San Clemente has a rate of 6.9%, which is much lower than the rates in both the county and the state (11.2%).

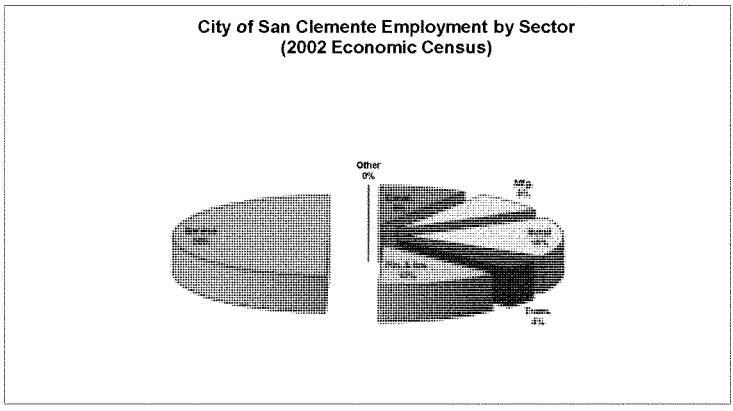


Figure 2-15 San Clemente Employment

Table 2-14 Employment by Industry (2007)

Industry	San Clemente	Orange County	California
Farming & Mining	14	5,525	326,033
Construction	2,752	111,018	1,304,774
Manufacturing	2,430	205,584	1,770,742
Wholesale & Retail	4,933	220,229	2,466,785
Transportation & Warehousing	1,214	50,199	766,388
Finance & Insurance	3,859	183,676	1,745,598
Service	14,970	680,228	8,184,668
Total	30,172	1,456,459	16,564,988

Income

Table 2-15 summarizes pertinent information regarding income and effective buying power of households in the study area. Among the most common occupations are: sales and office occupations, 28.5%; management, professional, and related occupations, 43.8%; production, transportation, and material moving occupations, 4.6%; service occupations, 15.2%; and construction, extraction, and maintenance occupations, 7.9%. Approximately, 75% of the people employed were private wage and salary workers. In 2001, 10% of people were below the poverty line. Twelve percent of related children under 18 were below the poverty level, compared with 13% of people 65 years old and over. According to the, *2005-2007 American Community Survey,* the median income of households in Orange County was $82,842 in 2007 dollars with mean household income at $109,987; 82% of the households received earnings and 17% received retirement income other than Social Security, and 25% of the households received Social Security. The average income from Social Security was $16,133. As shown in Table 2-14, the per capita income and median household income, in the study area are substantially higher than figures for the county and state.

Table 2-15 Household Income (2007)

	San Clemente	Orange County	California
Households	22,971	972,040	12,140,888
Less than $15,000	1,524	71,483	1,314,868
$15,000 - $24,999	1,561	68,436	1,184,362
$25,000 - $34,999	1,700	76,620	1,163,795
$35,000 - $49,999	2,156	115,896	1,595,293
$50,000 - $74,999	3,536	173,926	2,187,062
$75,000 or more	12,494	465,679	4,695,508
Median Household Income	**$82,842**	**$71,601**	**$58,361**
Per Capita Income	**$43,031**	**$32,890**	**$28,049**

2.9.3 Land Use

San Clemente is comprised of 46 km^2 (18 square miles). The beach characteristics for each reach are described in Section 2-1. Beach facilities are primarily located in reaches 6 and 7, provide basic services, and enhance the recreation experience for users at San Clemente Beach. **Table 2-16** shows the square footage and depreciated replacement value of public buildings that are vulnerable to wave attack and erosion of the shoreline. The building costs for the structures along the shoreline are significantly higher than inland, due to costs of protection (sheet pile and caissons) and the building materials needed for an ocean environment. Also, the building costs were inflated due to high costs providing utility services to the building. The estimates of depreciate replacement values for structures were based on Marshall & Swift and the Cost Engineering Appendix.

Table 2-16 Depreciation Replacement Values of Facilities on Public Beach

Facility	Area m^2 (ft^2)	Base Replacement Value	Depreciated Structure	Depreciated Contents
Marine Headquarters	527 (5,675)	$2,605,000	$1,953,800	$722,900
North Beach Concession & Restroom	89 (960)	$443,400	$332,500	$123,000
Linda Lane Restroom	61 (660)	$285,700	$142,900	$0
Picnic Shelter #1	46.5 (500)	$27,900	$20,900	$0
Concession South Pier	74 (800)	$246,100	$184,600	$68,300
Pier Restroom	61 (660)	$298,300	$223,700	$0
Picnic Shelter #2	46.5 (500)	$27,900	$20,900	$0
Restroom @ T-Street Beach	93 (1,000)	$392,900	$294,700	$0
Concession @ T-Street Beach	44.6 (480)	$231,200	$173,400	$64,200
Restroom south T-Street	44.6 (480)	$392,900	$196,500	$0
Total	**1,087 (11,715)**	**$4,951,300**	**$3,543,900**	**$978,400**

2.9.4 Transportation

In 2008, there were over 2,500,000 vehicles registered in Orange County. The county has over 2,700 km (1,700 miles) of streets, roads, and highways. Major interstate highways servicing the county and study area include Interstate 5 (north to south) and Pacific Coast Highway both running north and south. There are other freeways connecting cities notably I-405 (north and south); 91, and 73 running east and west.

Roughly parallel to the coastline, the North/South arterial freeway, Interstate 5, is less than 1.2 km (0.75 mi) inland from the beach and serves San Clemente with five freeway exits. The Pacific Coast Highway, runs north from San Clemente, providing local access and scenic travel along the coast. Six major airports are within 120 km (75 miles) of San Clemente. The closest, John Wayne Airport in Santa Anna, is 45 km (28 miles) away, and is served by American, Delta, Southwest, United, and other domestic carriers.

San Clemente's railway stop is at the foot of Avenida Del Mar, directly opposite the Municipal Pier. Amtrack's Pacific Surfliner train stops in San Clemente several times a day as it travels between San Luis Obispo and San Diego. Orange County has a Metrolink train system that provides commuters with access to Los Angeles, Riverside, San Bernardino, Ventura, and North San Diego counties. The seven-year old commuter train operates a total of 126 daily trains running over 416 miles of track.

While the majority of visitors to San Clemente's beaches travel by car, more than 10% of overnight guests fly to the area, and a significant number of local visitors walk to the beach or come by train. **Table 2-17** lists the principle modes of travel by frequency for all visitors who

participated in the survey, based on beach surveys (Office of Management and Budget approved) taken in 2002.

Table 2-17 The Method of Travel to San Clemente's Beaches

Mode of Transport	Frequency (%)
Car	71%
Airplane	13%
Walk	8%
Train	5%
Other/NA	3%

2.9.5 Railroad Corridor

The LOSSAN corridor (Los Angeles to San Diego) is the only railroad link between San Diego and the rest of the United States for passenger and freight railroads to operate, including military operations. This corridor is a major transportation link for passenger traffic, second only to the Washington DC to Boston corridor in terms of Amtrak train density and ridership.

History of the Railroad

In 1882 the Atchison, Topeka, and Santa Fe Railway Company (ATSF) constructed the rail line connecting San Diego to San Bernardino, but this line was abandoned after two severe flood episodes that damaged the route. The ATSF constructed the LOSSAN corrider in 1888. The railroad line connected the cities of Fullerton and San Diego.

During the 1980's ATSF, Caltrans, Amtrak and Los Angeles, Orange and San Diego counties shared the cost ($79 million) of the LOSSAN Rail Corridor Rehabilitation project. The project included replacement of the 50-year old jointed rail with new, heavier continuous-weld-rail; new wood railroad ties; installation or replacement of some power switches; and surfacing. In addition, since the 1980's the railroad and government agencies have spent $852 million in improving the infrastructure along the LOSSAN corridor.

The ATSF maintained and operated the LOSSAN corridor until 1993 when it was sold to the Orange County Transportation Authority (OCTA). The purchase by OCTA was funded by bond proceeds, the passage of propositions 108 and 116 in 1990, and by the proceeds from local transportation sales tax measures. Conditions of the purchase from the ATSF included the obligation to continue operation of ATSF and Amtrak trains, and the protection of utilities within the right of way. OCTA has assigned the maintenance of the line and operation of commuter trains to the Southern California Regional Rail Authority (SCRRA). This maintenance activity includes track and tie inspection and the periodic repairs. Also, there is on-going vegetation control and debris removal along the right-of-way, as well as periodic replacement of rip rap to protect the track bed from wave action.

Existing Operations

In 1996 the ATSF merged into a new corporation, the Burlington Northern and Santa Fe Railway (BNSF). Currently, this line connects with other railroad lines in San Diego. Also, this line connects to the Tijuana and Tecate areas of Baja California Norte (Mexico).

When Amtrak took over passenger service in 1971, only three daily "San Diegan" passenger train round trips were being operated. Eighteen San Diegan trains currently operate daily along this route, nine in each direction.

In 1992 Metrolink commuter rail service began on six local corridors centering in Los Angeles and Orange Counties. Metrolink operates 19 trains per day on the Orange County route. An average of 377 passengers board at the Oceanside and San Clemente stations daily (June 2000).

The Amtrak's Pacific Surfliner provides service to the San Clemente station. The Surfliner provides service from San Diego to San Luis Obispo. The service carried more than 1.7 million passengers in FY 2002. The Pacific Surfliner Corridor serves Southern California's key coastal population centers and connects two of the most congested regions in the country – Los Angeles and San Diego.

The BNSF operates, on average, 4 daily trains. Trains operating during the day average 4,800 tons, which is approximately 60-65 trains cars in length. Trains operating at night are typically auto trains (the trains are approximately 1980 m (6,500 ft) in length). During periods of peak freight activity, BNSF may run 6 trains a day on this segment of the LOSSAN corridor. In addition to general freight, the line handles fuel gas, bulk chemical shipments to the Port of San Diego (principally potash), feed grain, automobile, lumber, and transportation, construction, and military equipment. Also, this line serves the Camp Pendleton Marine Corps Base, the Miramar Naval Air Station, the Southern California's San Onofre nuclear plant, and the San Diego Unified Port District.

Future of the Railroad

For the year 2020 SCRRA forecasts 58 trains carrying 17,760 passengers per weekday and Amtrak forecasts 32 trains carrying 5,760,000 annual passengers (averages 15,781 per day but actually peaks on Friday, Saturday, and Sunday).

Freight service is also expected to grow in the future. Projections by San Diego Association of Government show variable projections indicating freight cargo movements along the LOSSAN corridor increasing 20 to 50 percent by the year 2022. The estimates could increase larger depending on industry growth along the United States-Mexico border related to the effectiveness of NAFTA and the success of the maquiladoras and associated industries.

High Speed Rail Plan

According to the U.S. Department of Transportation's 2009 Record of Decision, a dedicated high speed transit (HST) corridor with separate tracks for HST and conventional rail service is impracticable in the severely constrained LOSSAN corridor. Constructing an HST would create operational conflicts with existing, conventional passenger and freight rail in the corridor, and significant environmental impacts in the narrow LOSSAN right-of-way which traverses sensitive natural areas along the southern California coast. The Federal Railroad Administration selected a corridor from Los Angeles to Ontario and then along the I-15 to San Diego for the dedicated statewide HST system. Conventional rail was therefore determined to be the only practicable rail technology within the LOSSAN corridor south of Irvine.

2.9.6 Beaches in San Clemente

San Clemente's beaches are sandy and relatively narrow. Except for a pedestrian overpass at the end of Avenue Esplanade and a tunnel under the tracks at the north end of Plaza la Playa, visitors must cross the railroad tracks to visit the beach. There are three jurisdictions responsible for maintaining the recreation use of the study area beaches including: San Clemente State Beach, San Clemente's City Beach including North Beach, and a private beach adjacent to the Shorecliff Mobile Home Park. The State Beach extends for 2.4 km (1.5 miles) north from San Mateo Point to Avenida Calafia. The City Beach is a little more than 4 km (2.5 miles) long, from Avenida Calafia up to Avenida Pico, at the Ole Hanson Beach Club. The private beach is approximately 1.2 km (0.75 miles) in length from Avenida Pico to Camino Capistrano.

Amenities at the State Beach are relatively sparse, but include restrooms, outdoor showers, camping, picnic areas, a snack bar, and parking. The southern part of San Clemente's City Beach (at T street and south) is similar to North Beach in terms of amenity levels. It attracts locals, including surfers. North Beach, mainly frequented by locals, provides significantly fewer amenities than the main City beach area, though it does offer lifeguard services, rest rooms and a few other minor facilities.

Walk-in access to both the City Beach and the State Beach is free. To park, both local and non-local visitors pay a fee of $5.00/vehicle for day use at the State Beach, and an estimated 30% of drivers visiting the City Beach use metered parking at the rate of $1.00/hour. Campers at the State Beach staying in one of the 160 campsites pay $12/day, which includes parking and access to the beach.

2.9.7 San Clemente Municipal Pier and Pedestrian Beach Trail

San Clemente's Municipal Pier dominates the central area of the City Beach (Reach 6). It offers fishing, restaurants, and some other shops. Restrooms and a food concession are located near the base of the Pier. Additional shops and restaurants, metered parking and a grassy picnic area with picnic tables are available within a two minute walk from the Pier. Restrooms, beach showers, water fountains, picnic tables, fire-pits, and a volleyball court are also available at various other sites along the beach. Surfing and boogie-board equipment is available for rental nearby. Amenities at the State Beach are sparser, but include restrooms, outdoor showers, camping, picnic areas, a snack bar, and parking.

The San Clemente Pedestrian Beach Trail is a multi-use pedestrian beach trail (**Figure 2-16**) that has recently been completed at a cost of $11.8 million. The 4 km (2.5 mile) trail spans from North Beach to Calafia, and is located at the base of coastal bluffs and the beach within the right of way of the existing rail corridor. The trail consists of a 1.5 – 3 meter-wide (5 to 10 ft) at-grade multi-use path, approximately 260 meter (850 ft) long, 2.4 meter (8 ft) wide elevated walkway at Mariposa Point, three short bridges to cross drainage channels at Trafalgar, Riviera and Montalvo, improvements to existing El Portal, Montalvo and Mariposa for pedestrian under rail crossings and pedestrian at grade crossings at Dije, El Portal, Corto Lane, "T" Street South and Lost Winds for beach access. This new pedestrian trail addresses existing safety and adequacy issues with existing opportunities for public access to and along the coast in San Clemente. Overall safety will improve for pedestrians who cross the train tracks to access the beach in south San Clemente. The San Clemente Pedestrian Beach Trail will also serve to form a significant link in the statewide Coastal Trail, making more of the beach accessible to the public by creating a coordinated access system of regional and statewide significance.

Construction of the trail on the oceanside of the railroad tracks will subject the trail to erosion and wave damage.

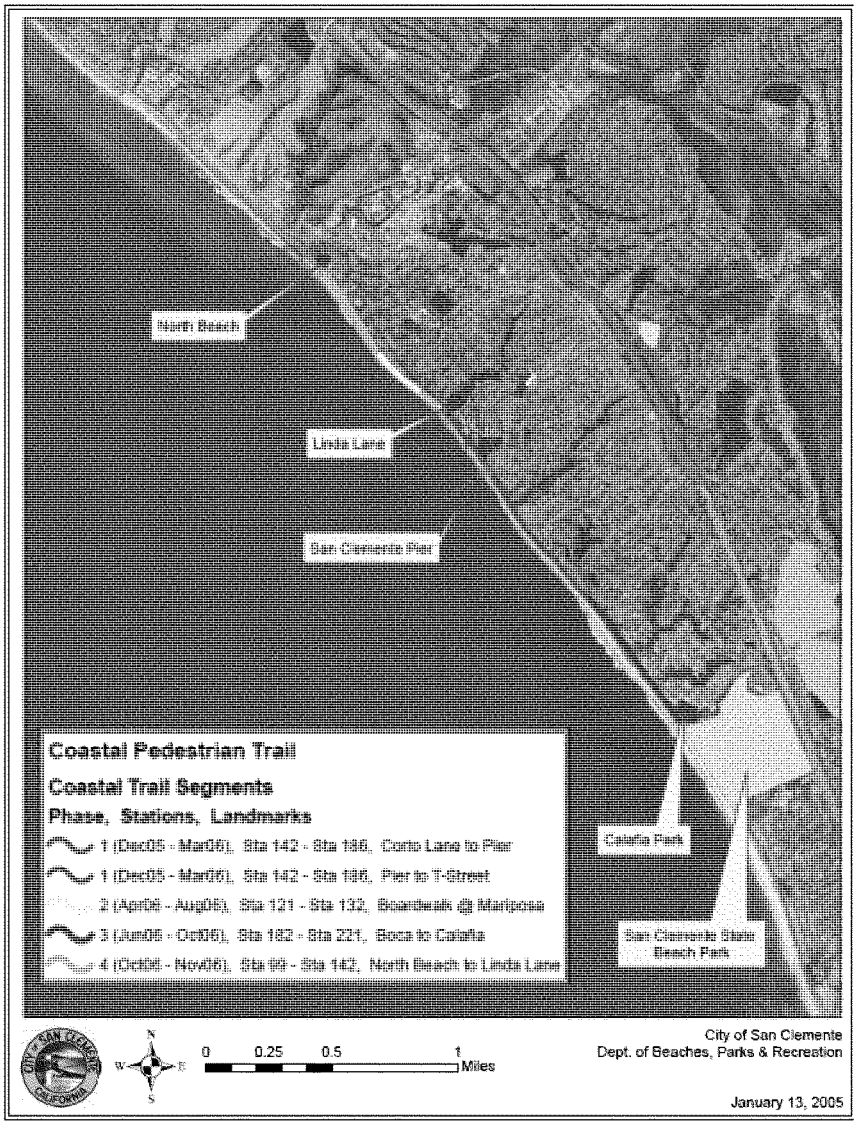


Figure 2-16 San Clemente Beach Trail

2.9.8 Recreational Activity

San Clemente is one of the most popular recreational areas for surfing. The City is the headquarters of the Surfrider Foundation, claiming 29 chapters nationwide and a membership of 25,000. There are eleven thriving surf shops and over a dozen major surf industry manufacturers, five of the world's most prestigious surf publications, as well as five surf schools and camps in the City. The San Onofre Surf Club is the oldest and largest in the world. San Clemente surfers have won championships in every competitive circuit and nearly every category in the United States. The popularity of surfing is related to some of the most outstanding wave conditions on a consistent basis, which include the areas from the "204" and the Pier, to T-Street, Riveria and State Park. In addition, the back area is heavily used for sun bathing, picnicking, swimming and beach-related sports.

The City of San Clemente beaches and Pier provide a major focal point for the community and community activities. In addition to its usual popularity for recreation use, it provides the venue for two of the City's highly popular annual weekend events including the Ocean Festival and the Sea Fest. These yearly events attract tens of thousands of visitors to the area providing numerous family activities, cook-offs, and arts and craft shows.

2.9.9 Attendance

Figure 2-17 and **Table 2-18** show annual attendance at San Clemente's beaches in terms of beach days. From 2000 through 2006, visitations at San Clemente's City and State beaches averaged 2.22 million, with the City beach accounting for 89% of all visits. During this period, overall beach attendance in San Clemente grew, on average, by 3.9% per year. State beach attendance showed no discernable growth between 2000 and 2006. We note that the relatively large variations in attendance at the State Beach since 1998 have been accompanied by opposite variations in attendance at the City Beach. One explanation is that a significant portion of these variations may be the result of attendance shifting from one beach to the other.

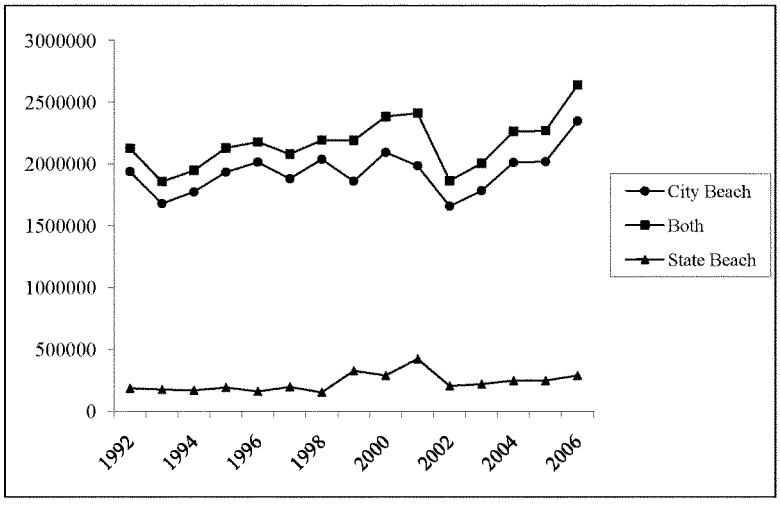


Figure 2-17 San Clemente Beach Attendance

Table 2-18 Beach Attendance for Both City and State Beaches

Year	Attendance
1960	233,000
1970	2,057,000
1980	1,480,000
1990	2,068,000
1991	1,835,000
1992	1,940,000
1993	1,614,000
1994	1,776,000
1995	1,935,000
1996	2,016,000
1997	1,812,000
1998	2,039,000
1999	1,626,000
2000	2,096,000
2001	1,987,000
2002	1,865,000
2003	2,006,000
2004	2,264,000
2005	2,670,000
2006	2,639,000

2.9.10 Future Beach Use

Over the past ten years, attendance at San Clemente's beaches has grown by roughly 2.7% a year, while the rate of population growth in Orange County has been 1.5%. Although the rate of growth in beach attendance has exceeded that of population, it is assumed for this study that the future rate of growth of beach attendance will mirror that of population growth. **Table 2-19** summarizes our estimates of population growth for Orange County and the corresponding increase in attendance. Population estimates to 2050 are taken from the State of California's Department of Finance's Demography Department estimate for 2007.

Table 2-19 Projected Beach Attendance

Year	Orange County Population	Avg Yearly % Growth Rate	Total Beach Attendance
2000	2,863,834		2,095,650
2010	3,227,836	1.20%	2,768,827
2020	3,520,265	0.87%	3,019,668
2030	3,705,322	0.51%	3,178,423
2040	3,849,650	0.38%	3,302,244
2050	3,987,625	0.35%	3,420,614

3 STATEMENT OF PROBLEMS AND NEEDS

3.1 Statement of the Problem

Prior to the 1990's, the beaches within the study area were marginally-stable as sufficient sediment was supplied from San Juan Creek to the Oceanside littoral cell. This was prior to upland urban development that deprived the sand supply causing the system to become "sand starved". Since the 1990's, the beaches in the study area have experienced gradual erosion due to the decrease of fluvial sand supply resulting from the damming and concreting of creeks and rivers, and urban development. As a result, the beaches provide minimal protection against storm-induced damages to the railroad and public facilities. The documented historical beach width above the Mean Sea Level (MSL) line between T Street and Mariposa Point was as narrow as 25 meters (82 ft) in the winter months (USACE-SPL, 1991). As a consequence, storm damages occurred in the past (e.g. 1964, 1983, 1988 and 1993), as the protective buffer beach width was narrow, particularly in the winter season.

The narrowing of the beaches along the shoreline has subjected the public facilities to wave-induced damages. These facilities include the Marine Safety Building, public restrooms, lifeguard stations, parking areas, and concession stands. Information from the Economics Appendix is given in **Table 3-1** and shows the historical damages to public facilities along the shoreline. The meteorological conditions of El Nino occurred in the years 1983, 1988, and 1998. The majority of repairs in the years of 1983 and 1988 were due to damages to the San Clemente Pier. The City spent $2,109,000 in Pier repairs in 1983 and $2,305,000 in 1988. Also, repair costs for a revetment in the community of Capistrano Shores totaled $288,000. In addition, the City is spending $5,000 per year to use a tractor to reduce the steepness of the shoreline.

PROBLEM STATEMENT: Along the shoreline of San Clemente, a lack of sediment supply to the shoreline has resulted in chronic, mild, long-term erosion. The LOSSAN railroad corridor is a vital link for passenger and freight service and has been designated as a Strategic Rail Corridor by the Department of Defense. As the protective beach lessens over time and is eventually lost, it is expected that storm waves will act directly upon the railroad ballast, significantly threatening the operation of the LOSSAN railroad line. The narrowing beaches are also expected to subject ancillary beachfront public facilities to storm wave-induced damages, and further reduce recreational space on an already space-limited beach.

Table 3-1 Historical Damages Recreational Facilities (October 2010 price level)

Year	Reason for Expenditure	Amount	Comments
1983	Facility Protection/Storm Damage Repair	$3,277,000	El Nino Storms
1988	Facility Protection/Storm Damage Repair	$3,120,000	El Nino Storms
1994	Storm Damage	$21,600	
1995	Storm Damage Repairs	$7,200	General Repairs
1996	Storm Damage Repairs	$16,500	General Repairs
1997	Facility Protection/Storm Damage Repair	$54,000	Repair of Marine Safety Sheet Pile
1998	Storm Damage Repairs	$376,000	General Repairs
1999	Storm Damage Repairs	$52,000	General Repairs
2000	Storm Damage Repairs	$14,400	General Repairs
2001	Storm Damage Repairs	$63,000	General Repairs
2003	Facility Protection	$202,000	Repair of Marine Safety Sheet Pile

3.1.1 Impacts to Railroad Service

The LOSSAN railroad line is constructed on conventional elevated crushed rock ballast along the base of the entire study area's coastal bluff. The railroad line is a prominent feature that completely separates the active coastline from the coastal bluff and adjacent backshore development. The LOSSAN railroad line is a vital transportation link for passenger and freight service. In addition, the Department of Defense has designated this right-of-way as a Strategic Rail Corridor with great significance to National defense. Railway traffic service delays occur when storm wave run ups exceed the elevation of SCRRA protective revetments or the crest of the railroad ballast in the segments without a revetment.

As documented by the SCRRA, railway traffic service delays have occurred when waves overtopped the structures during severe storms in the past. Two service disruption incidents of approximately 24 hours occurred in the 1960's at Mariposa Point (north of the Pier) and in the 1970's (McGinley, 2003) at a location south of the Pier. The failure was due to wave backwash upon overtopping the railroad ballast that eroded the embankment.

Due to chronic beach erosion in recent years that resulted in storm wave attack directly against the railroad corridor, the SCRRA and OCTA have constructed un-engineered riprap revetment segment by segment in the San Clemente area where the railroad ballast and tracks are vulnerable to storm wave-induced damages. The revetment placement practice consists of 1) delivering rocks to the roadbed via railroad cars; 2) positioning the rocks into a uniform row alongside the roadbed with a safe distance from the tracks by tracker excavators and rubber tired end loaders; and 3) side-dumping the sloped embankment. The front-face slope of the revetment ranges between 1:1 and 1.5:1 (horizontal: vertical) downward to the beach. The

crest of the revetment structure is approximately one meter above the railroad ballast to reduce wave overtopping. The riprap placement is primarily confined within the 6 to 9 meters (20-30 ft) west of the centerline of the railroad tracks.

The SCRRA has been side-dumping riprap stones in a random but controlled manner along the most critical segment between North Beach and the Marine Safety Building to mitigate wave-induced impacts on the railroad tracks. The maintenance practice of adding additional stones to the existing under-designed revetment has cost the SCRRA an average of $300,000 over every three-year period. The cumulative impact of stone placement over the years has been a curtailment of lateral beach access. Over the past ten years, storm wave attack in the study area has restricted train services periodically. During the 1998 El Nino, the protective revetment structure sustained severe damage that slowed down the train movement to ensure safe passage in the San Clemente area.

With the continuous shoreline retreat as anticipated, the potential of direct damage to the railroad ballast and tracks becomes highly probable, as the frequency of storm waves directly impinging upon the railroad ballast increases. The significance of transportation impacts, if the tracks are damaged by storm waves, would be similar to the prolonged service disruption resulting from the 1993 major mudslide in San Clemente. The railroad service was interrupted for 5 days during which more congestion occurred on Interstate 5, due to additional passenger vehicles and trucks. Furthermore, there exists no other economical means to deliver some commodities, such as liquefied natural gas, to the location across the border (e.g. Tijuana) for the essential use. Businesses receiving freight service incur higher costs to transport goods (e.g. grain, lumber, etc) that cannot be shipped by rail.

The cost to protect the tracks with additional side-dumped riprap stones will increase accordingly. Furthermore, crews will frequently be dispatched during high tide and storm conditions to visually inspect for track damage that can cause derailments. Thus, continued beach erosion along the San Clemente shoreline will lead to further disruption of rail service.

SCCRA is in the process of modifying the existing maintenance practices in response to evolving California Coastal Commission policies. In order to avoid and minimize any possible service disruption, it may become necessary or mandatory for the SCRRA to construct an "*engineered*" seawall. A conceptual seawall design and cost estimate was prepared by the City of San Clemente (Moffatt & Nichol, 2007).

In May 2003, the California Coastal Commission (CCC) proposed changes to the current maintenance plan. The CCC has significant concerns regarding the impacts of the current maintenance plan in regards to natural sand supply and recreational resources. In order for the SCRRA to get a permanent permit for the existing revetment, the SCRRA must convince the CCC that the revised maintenance plan addresses these impacts. Currently, Metrolink is committed to maintaining existing revetment areas based on the terms provided in the California Coastal Commission Consistency Certification dated May 23, 2003 (CC-033-03). The Certification identifies a "limit line" defined as the line where the rock meets the sand. This limit line establishes the revetment slope of 1H:1V. Metrolink has committed to not construct or place additional riprap to flatten the slope of the existing revetment seaward of this line. To ensure the slope of the existing revetment remains unchanged, Metrolink intends to maintain this revetment through the strategic placement or "keying in" of rock. The permit for the maintenance plan pertains to the sections of the railroad that are protected by a revetment. Reach 6, our project area, does not have a revetment currently in place, therefore, the option of "keying in" of rock is not considered. Another alternative for this reach is described below.

Recent discussions among the local stakeholders have indicated that the construction of a seawall is the likely alternative as it provides adequate protection to the rail corridor, minimizes impacts to the remaining beach, and provides safer public access by allowing for organized crossings. Through these discussions with the railroad and the City and the examination of the physical data, a significant concern of the protective effectiveness of the beach develops around a 3 meters (10 ft) width dimension. Under "average" long-term erosion conditions as stated in Appendix D of the EIS/EIR (mean historic erosion rate = 0.1 m/yr (0.33 ft/yr)), a 3 meter (10 ft) beach width would require 30 years before being completely eroded away– leaving only the small railroad shoulder buffer between the tracks and ocean. However, if storm induced erosion is entered into the equation, the potential for damage increases dramatically. There is a 1% chance that storm induced erosion will be 8 m (26 ft), which means that a 3 meter (10 ft) beach would erode completely during a 1% event, potentially endangering the railroad.

The process for implementing protective measures beyond those covered by the California Coastal Commission's Certification would be time consuming – several years at the minimum. It is economically unreasonable that railway parties would wait until an imminent danger existed, given the strategic nature of the LOSSAN corridor. Additionally, the City Manager of the City of San Clemente has declared the City support for the construction of a seawall, and to successfully navigate the current regulatory process to protect the rail corridor along the San Clemente shoreline, OCTA and Metrolink would tend to pursue the construction of seawalls, with various funding partners, in lieu of revetments as the need arises. For these reasons, the study has adopted a 8 meter (26 ft) beach width criterion for the point at which the SCRRA would construct a seawall to protect the railroad. This 8-meter (26-ft) criterion has been adopted in that it coincides with the 1% chance of storm erosion potential and conforms to the typical FEMA goal of urban flood protection for insurance removal.

The long-term comprehensive solution of seawall construction is dependent upon shoreline placement entering the 8 meter (26 ft) zone. Within a given reach, the model's triggering mechanism for seawall construction requires between 300 and 500 meters (984 to 1640 ft) of shoreline to be within the 8 meter (26 ft) criterion. However, this seawall construction does not eliminate the potential for storm induced damage prior to its construction. Emergency storm related damages to the existing revetment as well as the areas protected only by the ballast (such as Reach 6) will remain a possibility until the long-term seawall solution is in place. It is probable that an emergency repair may be applied to the damaged cell prior to the comprehensive upgrade or construction of a newly designed seawall during a severe storm event.

Therefore, the railroad is assumed to be permanent and always exist throughout the period of analysis, acting as a protective structure and fixing the position of the shoreline. As such, the railroad is considered the landward boundary and no storm damages are considered landward of the railroad.

3.1.2 Recreational Impacts

The San Clemente Beaches are a major popular recreation venue for the region as is evident by the overcrowded attendance during peak use days. The continuing erosion of the beaches will further reduce the already limited recreational spaces on the beaches. As a consequence, the beach goers will eventually seek alternative beaches for recreational activity on other adjacent beaches in Orange County.

Furthermore, continued damages to the public facilities resulting from the shoreline retreat may require their relocation to the landward side (east) of the railroad tracks. This will require pedestrians to continually cross the tracks to use the restrooms and results in a public safety concern since many will cross the railroad tracks in an unsafe manner. Additionally, the loss of sand within the active nearshore profile has exposed underlying hard substrate and man-made structures. These man-made structures consist primarily of protective measures constructed to protect the base of the Marine Safety Building and the public restrooms. A public safety issue is created because the exposed substrate and protective structures, in many cases, remain underwater and hidden from sight posing a number of potential dangers to unwary recreational swimmers. Thus, continued shoreline erosion will be detrimental to the beach recreation, resultant tourism, and economic benefits in San Clemente that has an annual tourist visitation of some two million people, approximately 60% non-residents.

3.1.3 Public Facility Damages

Public beach facilities located in Reach 6 include the Marine Safety Building, public restroom facilities located on the back beach, lifeguard stations, parking areas, and paving near the Pier. The beach facilities provide basic services and enhance the recreational experience for users at the City's beaches and have experienced storm damage in the past, as historically the beach width that acts as a buffer against storm wave attack has been narrow to moderate. The 1983 El Nino storm season has resulted in an estimated damage of $3,277,000 to coastal dwellings located landward of the railroad track and public beach facilities in the San Clemente area.

As the beach buffer that provides storm protection is further narrowed, frequent storm damages are expected to occur. Recently, an emergent sheet pile had to be installed seaward of the building to prevent the undermining of the Marine Safety Building. A similar condition that required the installation of an emergency sheet pile also occurred at a restroom located in Reach 6. In order to quantify the amount of erosion that the beach may experience in the future, a coastal storm damage model was developed.

3.2 Risk and Uncertainty Model

The model developed for the San Clemente Shoreline Study uses the principles of Risk & Uncertainty (R/U) in compliance with U.S. Army Corps of Engineers policy that requires all new federally funded coastal studies to incorporate the principles of R/U. The principal controlling guidance of the analysis comes from the U. S. Army Corps of Engineer's *"Planning Guidance Notebook"* – ER 1105-2-100, with specific guidance from Appendix D – Economic and Social Considerations and EM 1110-2-1100 – *"Planning and Design Process."* Additional guidance on the risk-based analyses has been obtained from EM 1110-2-1619, dated 1 August 1996, *"Engineering and Design - Risk-based Analysis for Flood Damage Reduction Studies."* The application of R/U in this study not only covers traditional elements of damages and coastal processes, but also covers construction costs.

3.2.1 Risk and Uncertainty Analysis

At the time of the initiation of this study there was not a Corps of Engineers standard model for R/U analysis for coastal zone storm damage reduction studies. A nationwide model for coastal zone R/U analysis is currently under development by the Corps of Engineers, however, the model completion schedule did not allow for utilization for this study. Fifty-eight models were evaluated for implementation under this study and included the Generalized Risk and Uncertainty Coastal model (GRANDUC) developed by the Wilmington District and the Risk

Storm Damage Model developed by the Jacksonville District. These R/U models, which were developed independently at different times by the respective districts, were evaluated extensively. Due to a variety of engineering considerations, technical, programming language, and other reasons, each model was not selected for use for this study. An interim model was developed that is uniquely applicable to the physics and storm conditions that are experienced within the Los Angeles District. This model utilizes many of the concepts and to a large degree is consistent with the certified nationwide model (Beach-fx).

The model used in the present study is an integrated coastal engineering – economics analytical framework for evaluating the physical performance and economic costs of shore protection projects, particularly, beach nourishment along sandy shores. The model has been implemented as an event based Monte Carlo life cycle simulation tool that is run on desktop computers. This model initiates with coastal engineering data and input, performs a series of engineering and economic computations, and concludes with economic outputs. The model inputs consist of probability distributions for various coastal engineering parameters. The model outputs consist of histograms of individual damage categories. The model does not compute annual net benefits and/or benefit/cost ratios.

The principles of Monte Carlo Simulation are used as the numerical integration technique. The proprietary computer program @RISK (Palisade, 2002) was used to run the R/U analysis. @RISK is an add-in to a standard industry spreadsheet package that provides the necessary tools for executing a Monte Carlo Simulation.

This model incorporates R/U by utilizing probability distributions for variables and design parameters where appropriate. It is recognized that the "true" values of the design variables and parameters are frequently not known with certainty and can take a range of values. However, the likelihood of a parameter taking on a particular value by a probability distribution can be described. The probability distribution may be described by its own parameters such as mean, standard deviation, shape, and scale. In some cases, the probability distribution for a parameter may be well established in the engineering literature, or in other cases a best-fit distribution of the measured data may be applied.

Procedurally, the without project damage assessment was conducted by employing a life-cycle approach. As outlined in EM 1110-2-1100, the life cycle approach deals with multiple realizations of possible evolution of the project with time during the span of its design life. The suite of life cycle realizations is constructed with consideration of the probabilities of key variables. The life cycle approach appears better suited to most coastal engineering applications. Variation with time is an essential ingredient in most coastal projects, and it is directly incorporated into the life cycle approach. Time variation of resistance and functional performance, constraints imposed by construction season and mobilization, even some economic and environmental factors, can be conveniently and flexibly introduced into the life cycle approach. This approach leads to a unified analysis of technical performance and many economic factors which are critical to project success.

The life-cycle model randomly samples various input probability distributions, calculates various coastal engineering parameters, and quantifies the individual damage mechanisms. The life cycle embodies sequences of storms (including provisions for multiple storms of varying intensity during each year of the life cycle), erosion and post-storm recovery during each event, partial and complete property damage during each event (depending on water level, waves, extent of storm erosion, and type of building construction), cumulative property damage due to a succession of storms, optional repair or rebuilding after a suitable time lag (with conformance to

any stricter building codes in effect), and periodic renourishment of the beach when needed and feasible during the life cycle. The model transitions to various economic calculations, and quantifies the damages due to the individual damage mechanisms. Typically, a key result from this analysis is the renourishment required during each life cycle, which can be converted to an economic present-worth dollar value. The expected cost and economic risks associated with maintaining the beach can then be realistically assessed by combining information from many different life cycle simulations. Specific considerations of the model include:

Seasonality

This model is a single season model; seasonality of the wave climate is not considered. It is generally accepted that the most damaging storms in southern California occur during the winter months. Although it is recognized that very large wave events can and do occur during the summer season, the winter extra tropical storms tend to cause the majority of the property losses.

Single Storm

This model is a single storm event model; multiple storms are not considered. It is recognized that several "storms" occur every winter season. In fact, it is generally accepted that storm "clusters" are responsible for some of the most damaging storm years in southern California. This was clearly observed in the 1982-1983 storm season when a series of six independent storm systems caused widespread coastal damages in southern California

A single annualized storm is believed to fairly represent the majority of the shoreline change and economic losses. It is well established that shoreline changes and the resultant economic damages tend to be cumulative throughout the storm season. However, there is little or no data that allows the full and quantitative delineation of the shoreline changes and economic damages attributed to individual storms in a cluster of successive storms. Shoreline change monitoring and measurement efforts typically are conducted on a time basis that is not in direct response to storm damages. In general it is typical that detailed descriptions of economic damages are recorded and compiled well after the storm season has ended. Therefore, there is no reliable method to individually distribute and compartmentalize the combined shoreline changes and economic damages that do occur to a sequence of storms. Each of the iterations of the Monte Carlo simulation randomly selects a storm event where the significant wave height equal or exceeds the mean annual significant wave height. Based on the annual maximum wave heights for the measured data record, the mean annual significant wave height is 2.60 m (8.5 ft). This value is consistent with conventional coastal engineering practice for expected annual maximums within the Los Angeles District.

Reach Subdivision – Cells

The study area was initially divided into 10 reaches of various lengths based upon the presence or absence of armor stone protection along the railroad. In order to provide a finer subdivision for detailed analysis of model performance and interpretation of the results, Reaches 1-9 were further subdivided into 50-meter (164 ft) segments.

Independent Sediment Transport Processes

It is convenient to separate nearshore sediment movement into two components, longshore sediment transport and cross-shore sediment transport. These two transport mechanisms were

assumed to be separate and independent in this study. This separation is not always valid in a strict sense because it is implicitly based on the assumption of plane and parallel profile contours. The time scale associated with storm-induced beach erosion is on the order of 1-3 days and depends on the level and duration of the wave and tide characteristics, whereas the time scale of beach adjustment is several months to years. Independence of cross-shore and longshore sediment transport relieves the responsibility of rigorously describing the joint morphological processes that occur. Independence of cross-shore and longshore sediment transport processes results in substantial improvement in numerical computational efficiency.

Numerical Simulation Concepts

The model employed in the present study is a spreadsheet-based model in which the Monte Carlo simulation is conducted by a spreadsheet add-in package. Use of the spreadsheet allowed each year of the economic life-cycle to be represented by one column of the spreadsheet. Thus, the spreadsheet nature of the model eliminated the numerical requirement to iterate for each life-cycle year. Each iteration represents a new simulation that results in substantial numerical computational efficiency. A single annualized storm event provides substantial numerical simplicity over the numerical complexity inherent in a time-dependent simulation. A single storm each year of the life-cycle relieves the responsibility of rigorously describing the coastal and morphological processes that occur during a time dependent sequence of storms. This results in substantial improvement in numerical computational efficiency. Simulation outputs were monitored for numerical convergence to evaluate the stability of output distributions during a simulation. A convergence criterion of 1.5% was established for convergence statistics for each output distribution. Model execution is continued until all pertinent economic outputs achieve the convergence criterion. Model convergence was typically achieved in less than 1000 simulations.

Railroad Reach Conversion Criteria

As discussed in Section 3.2, Metrolink is committed to maintaining existing revetment areas based on the terms provided in the California Coastal Commission Consistency Certification dated May 23, 2003 (CC-033-03). At a certain point in time, SCRRA will be forced to construct a seawall to protect the railroad rather than continuing to maintain the existing revetment and ballast in areas without a revetment (such as Reach 6). The point at which the SCRRA would construct a seawall is called the railroad reach conversion criteria. This criteria is comprised of two parts: a minimum beach criterion and a seawall conversion criterion. The minimum beach and seawall conversion criteria work jointly together and estimate when an unimproved (ballast) railroad reach will be improved by construction of an engineered seawall. The minimum beach criterion developed by coastal engineering is fixed at 8 m (26 ft) and is derived from the estimation of the 1% chance of for storm induced erosion. The seawall conversion criterion used in the present study is a uniform distribution ranging from 29% - 48% (6-10 cells); the criterion is randomly selected during the Monte Carlo simulation.

It is expected that the SCRRA will not have the funds immediately available to construct a capital improvement project. SCRRA is expected to navigate a budget process where funds are authorized and appropriated before plans and specifications and construction occur. This results in an inherent delay between the capital improvement decision and the actual implementation (construction) of a project. The seawall conversion criterion attempts to model this behavior. The seawall conversion criterion is a time-delay criterion and has the effect of accelerating or delaying the decision-making process for implementation of a capital improvement project. The seawall conversion criterion ranges between 0-100 percent. Since, it is likely that SCRRA

cannot invest in a capital improvement project immediately, i.e. 0%. It is expected the SCRRA will not wait until the entire existing beach is completely eroded, i.e. 100%. The 29% - 48% is an estimate for seawall conversion that encompasses these considerations. Currently 24% of the cells in Reach 6 have beach widths less than 8 m (26 ft).

During the Monte Carlo life-cycle simulation the model tracks the protective beach width in each cell of unimproved reach which currently are Reaches 2, 4, 6, and 8. Reach 6 is the only one under consideration for this study analysis. When the protective beach width is equal or less than 8 m (26 ft) the model flags this cell. The percentage of flagged cells is computed by the running total number of flagged cells in the reach compared to the total number of cells in the reach. When the flagged percentage equals or exceeds the randomly selected seawall conversion criterion, the model assumes that a seawall is constructed in the reach.

LOSSAN Service Delay

Railway traffic service delays result when severe wave run-up and overtopping exceeds the elevation of SCRRA protective revetments sufficient to interrupt service. There is no generally accepted guidance or methodology formulated to define the overtopping criteria necessary to interrupt railway service. Therefore, rail traffic service delay was directly related to revetment failure. If run-up and overtopping conditions are severe enough to cause revetment failure, then the railway traffic would logically be interrupted while the revetment and railway is repaired. Criteria have been established to compute railway traffic service delay that combines run-up elevation and a probability of occurrence. Run-up elevation must equal or exceed the revetment elevation. Since the actual rail line is constructed at or below the revetment crest elevation, overtopping of the revetment crest will logically result in overtopping of the railroad. When overtopping exceeds the revetment crest elevation, thereafter there is a 50-50 probability that this overtopping condition will result in revetment failure. The rail traffic service delay criteria are calibrated based on the total number of delays experienced during a simulation. Based on the damage description provided by the SCRRA, there were two service delays in the 1960's and 1970's. It is estimated that this time period extends to the 1950's if not earlier, which is approximately 50 years. Thus, on average the model should predict approximately 1-2 service delays in each 50-year simulation.

Revetment failure and the subsequent railway traffic service delay are treated equally and independently for each reach and each cell. Revetment failure is allowed only if the entire reach has not been converted to a seawall. A seawall is considered to permanently protect the railroad and no failure is allowed. The rail traffic service delay costs are divided into separate components consisting of costs to repair the railroad and losses to service interruption. Due to the nature of the model, it is possible that multiple railroad cells are damaged at the same time, but only one service delay is counted. Information provided by the SCRRA indicates that a 50 meter (164 ft) long railroad cell could be repaired on the order of hours after incipient damage; therefore multiple cell segments failing at the same time will not have a substantial multiplying effect to the service delay.

Structure Damages

All public buildings are located in Reach 6 of the study area, with the exception of one facility in Reach 8. These buildings provide basic services that enhance the recreation experience for users at San Clemente Beach. Building costs for these structures are significantly higher than inland, due to costs of protection (sheet pile and caissons) and the building materials necessary for an ocean environment. Estimates of depreciated replacement value for the structures are

based on data from Marshall & Swift and construction information provided by the City. Content values are based on information provided by the City. The replacement cost of the Pier was excluded from the analysis since the Pier is not susceptible to damage from the erosion of the shoreline.

The San Clemente Pedestrian Beach Trail, shown in **Figure 3-1**, is a multi-use pedestrian beach trail that has been recently completed at a cost of $11.8 million. The 4 km (2.5 mi) trail spans from North Beach to Calafia. It is located at the base of coastal bluffs and the beach within the right of way of the existing rail corridor. The trail consists of a 1.5 to 3 meter-wide (5-10 ft) at-grade multi-use path, approximately 260 meter (850 ft) long, 2.4 meter (8 ft) wide elevated walkway "at pitch point" at Mariposa Point, three short bridges to cross drainage channels at Trafalgar, Riviera and Montalvo, improvements to existing El Portal, Montalvo and Mariposa for pedestrian under rail crossings and pedestrian at grade crossings at Dije, El Portal, Corto Lane, "T" Street South and Lost Winds for beach access. The trail is constructed of natural materials, including stabilized decomposed granite, class II base and filter fabric. Barriers consisting of landscaping, rocks and fences are installed between the rail and trail. This new pedestrian trail addresses existing safety and adequacy issues with existing opportunities for public access to and along the coast in San Clemente. Overall safety has improved for pedestrians who cross the train tracks to access the beach in south San Clemente. The San Clemente Pedestrian Beach Trail also serves to form a significant link in the statewide Coastal Trail, making more of the beach accessible to the public by creating a coordinated access system of regional and statewide significance. In Reach 6, the trail is on the shore of the railroad tracks and will be subject to erosion and wave damage.

The model considers the trail as dry land that is eroded by long-term erosion or storm induced erosion. When this land is eroded, the associated portion of the trail is considered lost. The costs of the rock roadway portion of the trail are accumulated. The major trail damages are the future costs incurred for relocation and replacement of the trail to the landward side of the railroad.

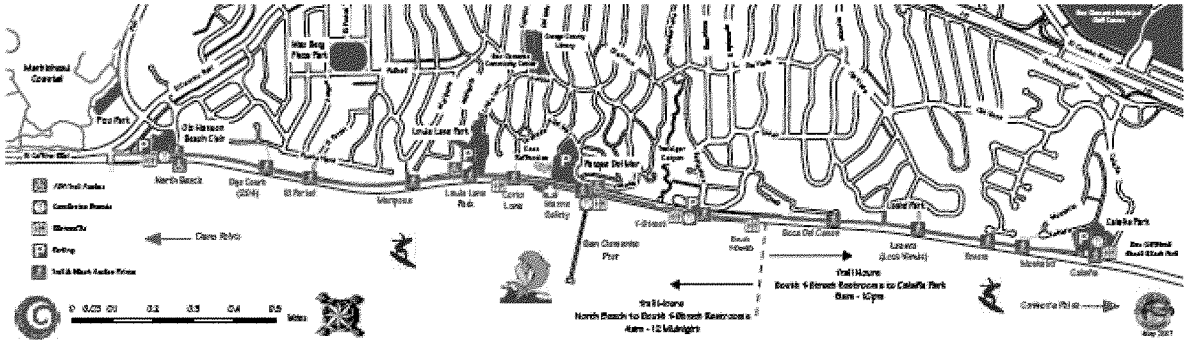


Figure 3-1 San Clemente Beach Trail

Recreational Beach

Long-term erosion and the landward advancing shoreline reduce the beach surface area available for recreation. The model simulation randomly selects a long-term erosion value and computes the dry beach area (aggregate of cell length x width) each year throughout the 50-year life-cycle. A time series plot of a 50-year life-cycle indicates a continually declining amount of dry beach area. A full description of the recreation analysis is found in the Economics Appendix.

3.2.2 Without Project Model Results

The R/U model (**Table 3-2**) for San Clemente was run for 1000 simulations under the without project conditions. Each simulation generates an individual forecast of annual erosions and storms for the 50-year period of analysis. Some of the key inputs to the model are as follows:

1. Long-term annual erosion: Defined in the model as a triangular distribution of Risktriang (-0.46 m, -0.21 m, 0.37 m) (-1.5 ft, -0.7 ft, 1.2 ft) with a mean annual value of -0.1 m (-0.33 ft). Storm erosion, wave height, sea level rise, and run-up (see Appendix D of the EIS/EIR).
2. Seawall construction trigger mechanism: Seawall construction is implemented if the number of beach cell having beach widths less than 8 m (26 ft) exceeds the random criterion of RiskDuniform ({6, 7, 8, 9, 10}) – 6 to 10 cells corresponding to 300 to 500 meters or between 28.6 to 47.6 percent of the entire reach. The justification for the range of values used for the seawall conversion criteria of 6-10 cells was based more on a qualitative rather than a quantitative analysis. This range of cells corresponds with a range of widths of 300 to 500 meters (984 to 1,640 feet). It was determined that this range was logical because a narrower criteria would show that the seawall would be built within the next couple of years, but the expected timeline to construct a seawall is expected to be four or five years. Therefore, narrower criteria did not seem reasonable to describe the expected response by SCRRA. A larger range for the criteria is expected to cause portions of the rail road track to become too vulnerable to future storm events. Further, it was felt that by applying a range rather than a single number of cells for the criterion addressed the issue of uncertainty.
3. Depreciated structural values based on City construction data and Marshall & Swift without uncertainty (Table 5 Economics Appendix) with first floor elevations (FFE) based on field survey data. FFE is generally at beach level, a zero elevation, with the notable exception of the marine headquarter building at 1 foot above beach level.
4. San Clemente Pedestrian Beach Trail – a Reach 6 DRV of between $2.8 and $3.24 million.
5. The Houma structure & content and District's wave force functions are employed.[2]
6. Transportation damages as outlined by Table 12 of the Economics Appendix.
7. The LOSSAN construction and O&M costs shown in Table 13 of the Economics Appendix.
8. The recreation value as indicated by Table 27 of the Economics Appendix.

[2] These functions are displayed in Attachment A.

9 Interest During Construction (IDC) is calculated using a mid-term full expenditure pattern approach. With a short construction timeframe of 3 to 6 months for any alternative IDC is not a major cost component.

Table 3-2 Without Project Model Results – Reach 6
FY11 Prices & Discount Rate

	Minimum	Maximum	Mean	5% Probability Value	95% Probability Value
Seawall Construction Year	2009	2058	2021	2011	2036
# of RR Breaches	0	4	0.014	0	0
Damages & Costs:					
RR Construction & O&M Costs - Average Annual (AA)	$220,136	$2,342,507	$1,275,274	$329,605	$1,996,263
Trail Damage - AA	$0	$132,781	$81,821	$0	$121,808
Structure & Content Damage - AA	$3,179	$123,382	$62,923	$26,362	$93,915
RR Delay Costs - AA	$0	$0	$0	$0	$0
Total Damages - AA	$288,514	$2,555,729	$1,420,018	$392,701	$2,181,170
Recreation:					
Reach 6 AA of Recreation	$9,666,171	$11,539,598	$10,667,923	$10,157,058	$11,196,251
AA UDV Reach 6	4.67	5.85	5.24	4.94	5.56
Weekend Sqft - Summer	30	30	30	30	30

The model predicts Reach 6 beach erosion will require the construction of the seawall in 2021, on average. There is a 5% chance that seawall construction will be required before 2011 and a 5% chance that the construction will occur after 2036. Breaching of the LOSSAN corridor appears unlikely – 0.014 times on average during the study period; and as a result delay times are $0. The model also indicates that the summertime weekend beach use will be at maximum capacity (30 ft^2 per user) throughout the study period.

The majority of NED damages/costs are related to LOSSAN construction and O&M costs. This result is as expected with erosion requiring the construction of the seawall. The mean average annual cost to LOSSAN is $1,275,274. The mean annualized value of all damage is $1,420,018.

The model predicts maximum capacity at summertime weekend use; however, the average UDV value (annual value/total annual users) of $5.24 corresponds to an average allotment of 65 ft^2 per user. The mean annualized value of recreation in Reach 6 is $10,667,923.

4 PLAN FORMULATION

4.1 Planning Process, Planning Opportunities, and Alternative Formulation.

Plan Formulation can be broken down into a six step process:

1. Identify Problems and Needs
2. Inventory and Forecast Conditions
3. Formulate Alternative Plans
4. Evaluate Alternative Plans
5. Compare Alternative Plans
6. Select a Recommended Plan

This process is a structured approach to problem solving which provides a rational framework for sound decision making. The six-step process is used for all planning studies conducted by the Corps of Engineers. The planning process is iterative by nature, with a given study performing the steps multiple times until a decision is reached. The steps give a sense of order to the planning process, but the process really is focused on balance and not rigid at all. For any given study, a number of iterations are usually required. Iterations can start with any step. Each step is performed at least once, but not necessarily in the listed order. Evaluation of environmental conditions and effects of alternative actions follows a parallel process considers a broad range of alternatives, narrows that range to a set of alternatives considered in detail, and then compares the environmental effects of each alternative considered in detail.

The sections below first provide an introduction to plan formulation objectives, constraints, and preliminary alternatives and measures considered. These measures are then screened and developed into project alternatives for full analysis. A recommended plan is finally identified which best meets the stated objectives and constraints.

4.2 National Objective

Federal and Federally-assisted water and related planning activities attempt to achieve increases in National Economic Development (NED), while preserving environmental resources consistent with established laws and policies. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. The NED objective is differentiated from Regional Economic Development (RED) benefits, which only apply to a given region, often at the expense of another region in the U.S. NED benefits accrue nationally for a net gain in Gross Domestic Product. They represent return on the investment of Federal funds, and are a useful tool in comparing the efficiency and effectiveness of alternative projects on a nationwide basis. Plans are formulated to take advantage of opportunities in ways that contribute to the NED objective. In accordance with ER 1105-2-100, it is Corps policy to provide Federal assistance in the prevention or reduction of damages caused by wind and tidal generated waves and currents along the Nation's shoreline.

The standard period of analysis is based on a 50 year functional project life. Damages (which may be financial costs or actual structural/infrastructure damages) and lost opportunities (recreational, etc.) are projected for the future without project and for the future with an array of different alternatives. The benefits of each alternative are expressed in dollar amounts of damages prevented and opportunities preserved or created.

4.3 Public Opinion

A number of public concerns have been identified during the course of the study. Input was received through coordination with the sponsor, coordination with other agencies and through a public workshop held in January 2002. A discussion of public involvement is included in Chapter 8, Public Involvement, Review and Consultation. The public concerns that are related to the establishment of planning objectives, planning constraints, and establishment of evaluation criteria are:

- Desire to reduce the potential for storm damages to the LOSSAN Rail Corridor rail facilities and rail line operations, located along the beaches of the City of San Clemente;
- Desire to reduce the potential for storm damages to public beach facilities;
- Desire to restore the recreation beach area along the Pacific Coast of the City of San Clemente;
- Desire to preserve the near shore ecosystem that supports commercial lobster, fisherman, and snorkeling activities;
- Desire to preserve and enhance opportunities for surfing along the San Clemente coast;
- Desire to maintain the aesthetic characteristics of the coastal area of the City of San Clemente;
- Desire to improve public access and safety to the recreation beach areas of the City of San Clemente.

4.4 Planning Objectives and Criteria

4.4.1 Objectives

Based on the analysis of the identified problems and opportunities and the existing conditions of the study area, planning objectives were identified to direct formulation and evaluation of alternative plans.

These objectives are:

- Reduce the potential for storm damages to facilities located along the coast of the City of San Clemente including recreation beach facilities and the LOSSAN Rail Corridor.

- Restore and maintain recreation use along the Pacific Coast of the City of San Clemente.

Alternatives are formulated to maximize storm damage reduction and minimize cost. To be recommended, their benefits must exceed their costs by NED criteria (see Economics Appendix). Improvements to safety and recreational opportunities resulting from any alternative are considered incidental to the main objective of reducing storm damages. All alternatives must undergo both National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) review processes. The purpose of the Environmental Impact Statement (EIS) is to identify and present information about any potentially significant environmental effects of the alternatives and the recommended plan.

4.4.2 Criteria

Plans are then compared using four formulation criteria suggested by the U.S. Water Resources Council. These criteria are;

- Completeness - Completeness is a determination of whether or not the plan includes all elements necessary to achieve the objectives of the plan. It is an indication of the degree that the outputs of the plan are dependent upon the action of others.
- Effectiveness – All of the plans in the final array provide some contribution to the planning objectives. Effectiveness is defined as a measure of the extent to which a plan achieves its objectives.
- Efficiency – All of the plans in the final array provide net benefits. Efficiency is a measure of the cost effectiveness of the plan expressed in net benefits.
- Acceptability – All of the plans in the final array must be in accordance with Federal law and policy. The comparison of acceptability is defined as acceptance of the plan to the local sponsor and the concerned public.

4.5 Planning Constraints and Considerations

Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. The constraints identified include those public concerns that if violated by an alternative plan would result in the plan not being acceptable to most public interests. It also includes those aspects of the study area generally regulated by government agencies that if adversely impacted would result in the plan being unacceptable. In general, the planning process needs to consider measures to avoid or mitigate any significant adverse impacts associated with the planning constraints. The planning constraints identified in this study should follow the general guidelines listed below.

Engineering and Physical Constraints: The recommended plan presented should be complete and sound, and in sufficient detail to allow development of engineering plans and specifications.

Economic Constraints: Any potential project that is in the Federal interest must display feasibility by satisfying benefit-cost (B/C) criteria. Generally, this ratio must be greater than one to allow Federal participation in continued study and any project proposal. For Environmental Restoration projects, an incremental analysis must be performed to compare cost effectiveness of the alternatives.

Financial Constraints: The sponsoring agency is required to show their ability and willingness to fund their share of any recommended project as required by the Principals and Guidelines.

Environmental Resource and Agency Constraints: Applicable environmental requirements must be met for a feasibility level study. Environmental acceptability must be ascertained; adverse impacts should be avoided if possible or minimized, if avoidance is not possible. An Environmental Impact Statement (EIS) is included with this Report.

Local Constraints (Public Acceptability): The alternative options and plans should be acceptable to the local residents, agencies, organization, and the non-Federal sponsor(s), as well as the interested State and Federal agencies. Unacceptable measures include any visible offshore structure and any structure that significantly impedes beach access, such as rock revetments.

The planning constraints and considerations for this study are the following:

- Impacts to the nearshore ecosystem that supports commercial lobster, fishing industries, and snorkeling activities;
- Impacts on the opportunities for surfing along the Pacific Coast of the City of San Clemente;
- Impacts to any critical habitat that supports Federal or State threatened and endangered species;
- Impacts on water quality characteristics along the coast and near shore areas of the City of San Clemente;
- Impacts on cultural and historic features located in the Study area;
- Impacts on air quality conditions within the study area.

4.6 Preliminary Plan Formulation – Conceptual Alternative Measures Considered

4.6.1 Methodology

The next step in the formulation process is to develop viable alternative plans. The process in developing the viable plans involves several iterations of developing and screening alternative management measures and plans. Plan formulation begins with the largest possible selection of alternatives, and screens them down through finer and finer analysis and comparison. A preliminary screening of the plans narrows the field by eliminating those plans that prove unacceptable or infeasible at a closer look. Measures passing this screening are developed and screened further until a final array of measures is selected. Any implementable combination of these measures may be considered a separate alternative. Each final alternative receives full Feasibility level development, analysis, and comparison.

4.6.2 Preliminary Measures

Alternatives to address the reduction of potential storm damages are developed considering different scopes of plans by varying levels of protection such as protecting only against frequent minor storm events as compared to protecting against the less frequent major storm events. Consideration is also given to protecting certain reaches of the study area as compared to several reaches or the entire study area. For the planning objective involving restoration of beach area for recreation use, consideration is also given to different levels of restoration involving very wide beaches that may only be needed on the highest peak use days, as compared to narrower beaches that are needed for the more frequent peak use days. Alternatives for this objective are also looked at by study reach, where some reaches may have minimal use for recreation. Screening of these alternatives will consider much of the evaluation criteria stated above including economic costs and benefits, environmental impacts, and significant impacts to the planning constraints. Mitigation measures to avoid or minimize these impacts will be incorporated into the alternative plans as necessary. This development and screening process will lead to an identifying set of final alternative plans that will be examined in detail using the system of accounts and tradeoff analysis such that decisions can be made on the best plans from NED, EQ, OSE and RED standpoints and a locally preferred standpoint. From these plans, a plan will be selected for recommendation to Congress for authorization.

Available methods to eliminate or reduce coastal storm damages and shoreline erosion include seawalls and revetments, beach nourishment-with or without groins, and offshore breakwaters. Seawalls and revetments are placed parallel to the shoreline as a last line of defense to protect

adjacent land areas from direct wave attack, flooding and erosion. As such, they often provide the most reliable form of shoreline protection; however, they do nothing to increase beach width, and can impede public access to the beach. Beach Nourishment is highly effective at protecting the coastline as long as the beach is maintained. Groins are cross-shore retention structures that act as a barrier to alongshore sediment transport. The amount of sand trapped by the structure depends on the permeability, height, and length of the structure. Offshore breakwaters are effective at retaining sand, but are expensive and require a healthy source of littoral sand to perform their sand trapping function

The following sections briefly discuss each of the measures mentioned above, and indicate whether the measure was screened out or carried forward for further analysis in subsequent sections of the report.

An alternative measure is a feature or activity at a site, which address one or more of the planning objectives. A wide variety of measures were considered, some of which were found to be infeasible due to technical, economic, or environmental constraints. Each measure was assessed and a determination made regarding whether it should be retained in the formulation of alternative plans.

4.6.3 Future without Project

The Corps is required to consider the option of "No Action" or Future without Project as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). The Future without Project scenario assumes that no project would be implemented by the Federal Government to achieve the planning objectives. The No Action Plan forms the basis for comparing the costs and benefits of different alternatives, and is described previously in this report and in the Economics appendix. Since this plan is required by NEPA to be included among the candidate plans in the final array of alternatives, it is described in more detail in the final alternative plans of this chapter. For the purposes of the initial screening, the Future without Project is based on the SCRRA's maintenance plan, as described in Section 3.2, to the potential damage to the railroad ballast and tracks, but without any measures implemented by the City of San Clemente for the continued erosion and recreation beaches along the entire coast of San Clemente.

4.6.4 Future with Project - Non Structural Measures

Alternative plans can be broken into structural and non-structural categories. Non-structural alternatives include revising management or maintenance practices, or acquiring real estate. Anything that achieves the project objectives without a hard structure is considered a non-structural alternative. For this study, non-structural measures identified include Managed Retreat, and Best Management Practices.

Managed Retreat

Managed Retreat is a term commonly used to describe a policy that restricts or opposes efforts to control long term retreat of the shoreline. It has been used to describe policies ranging from complete removal of all shore protection structures to simply not allowing new structures to be built.

Reducing Potential Storm Damage

Managed retreat of coastal development would include relocation of the railroad and beach facilities. At this time, most of the public beach facilities are located along the backshore in Reach 6. Continued erosion and storm wave attack will likely eliminate any beach area available for recreation use and accordingly the facilities may no longer be needed or minimal facilities such as restrooms being relocated to the landward side of the railroad. The relocation of the railroad is extremely costly and any decision for such relocation is beyond the scope and intent of this study. In this regard it is noted that as part of the no action plan, it is expected that the railroad will continue to upgrade the existing revetment in Reaches 1, 3 5, 7, 9, and 10 and to construct new seawalls in Reaches 2, 4, 6, and 8 (where no revetments are present) to avoid storm damage to its facilities and its operations. Accordingly managed retreat will be considered only to the extent that it may be included as part of the no action plan or without project condition.

Restoration of Beach Area for Recreation

Managed retreat of recreation uses include the continued erosion of the recreation beach area, it is expected that beach use for most recreation activities will be eliminated. Eventually the beach area will be completely lost with the backshore area being fixed by revetment or seawalls placed by the railroad. Some activities such as surfing will likely continue although the quality of the experience would be reduced causing a reduction in the number of visitors. Again, this managed retreat is likely to occur to some degree and will be further defined under the no action plan or without project condition.

Best Management Practices

Sub aerial processes both weaken the underlying bluff structure and contribute to runoff erosion on the surface of the bluff face. Along the study area shoreline, the rate of bluff top retreat caused by runoff is extremely low when compared to the rate caused by wave attack. The local sponsors have already implemented a regime of codes and ordinances to enforce Best Management Practices to reduce groundwater seepage and sub aerial erosion, therefore this will occur both with and without a Federal Project, and does not play a role in plan selection or NED analysis.

4.6.5 Future With Project - Structural Measures

Beach Replenishment

Beach replenishment involves placement of compatible sand from a borrow area outside of the littoral zone to effectively widen the beach. The increased sand buffer distance accommodates short-term sediment losses so that storm waves and run up dissipate over the wider fill profile. Long-term losses and erosion are addressed through periodic renourishment of the fill.

Design Methodology

The beach fill design parameters were determined by considering various combinations of beach-fill widths and different replenishment cycles. Each option has one combination of an initial beach width and a repetitive duration for the subsequent renourishment cycles. The optimal option is the one that yields the maximum net benefit. The Los Angeles District coastal engineering and economics sections developed the model for simulating shoreline change so

that a prediction of shoreline morphology over multiple years as waves redistribute sand after it is placed mechanically on the beach could be evaluated. The optimization consisted of finding the beach width and renourishment period that maximized the net benefits while avoiding known sensitive near shore habitat. Beach Nourishment is carried forward into the NED analysis. The concept design is schematically illustrated in **Figure 4-1.**

Beach replenishment can occur using offshore or onshore borrow sites. In general, in the study area, offshore sources have historically been used for several reasons, discussed below.

Offshore Borrow Sites

Prior offshore studies of the area conducted by the Corps of Engineers have identified potential sources of sand suitable for an offshore borrow site. The approximate location of these sites is given in **Figure 4-2**.

Two areas were selected for investigation: offshore of the beach at the City of San Clemente in Orange County, California (Borrow Area #1), and offshore of Oceanside, San Diego County, California (Borrow Area #2). They were located by previous investigations off of Oceanside by the San Diego Association of Governments (SANDAG) (1999) and USACE (1993). Sampled materials encountered off of San Clemente (Borrow Area No.1) were generally a thin layer of unconsolidated silty, very fine-grained sands and sandy silts underlain by sandy siltstone bedrock. These sediments do not represent suitable beach replenishment materials. The second area investigated, "Borrow Area #2", is located offshore of Oceanside Beach, and is situated between the mouths of the San Luis Rey and Santa Margarita Rivers, and is approximately 37 km (23 miles) from the project site. Sampled materials encountered off of Oceanside were generally fine-medium grained sands with local silty intervals and minor amounts of shell fragments. The preponderance of the sampled material within Borrow Area No.2 was beach-compatible. The samples taken in the 1999 SANDAG Study at Sites SO-8 and SO-9, as described on page 4-17 of the EIS, fall within the physical boundaries of Borrow Area No. 2.

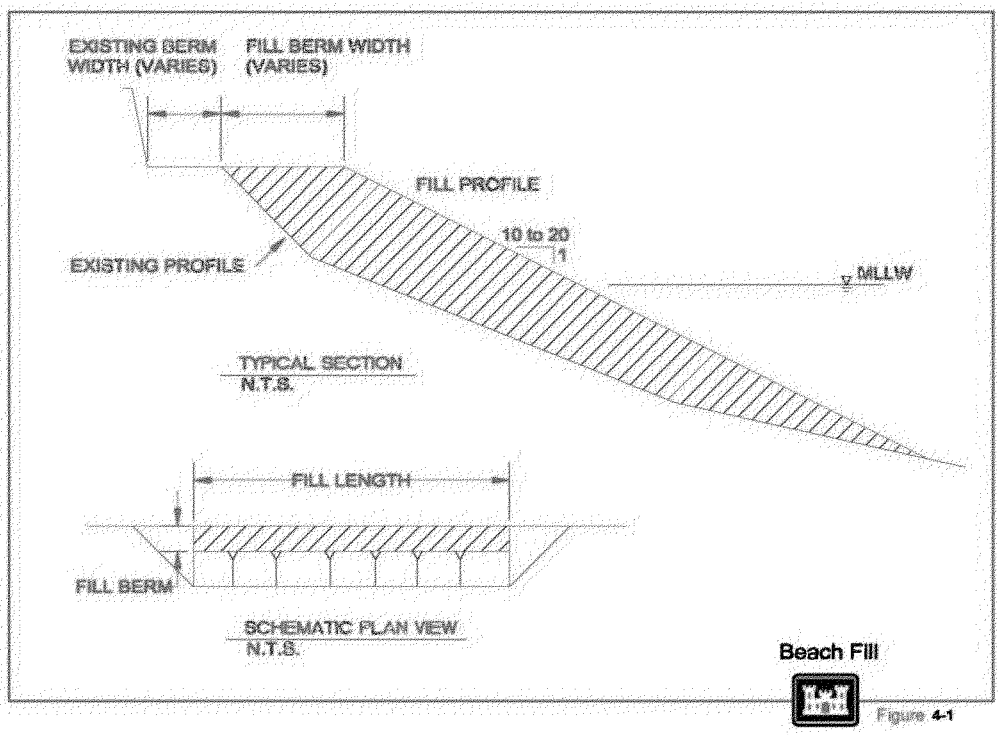


Figure 4-1 Typical Beach Nourishment Design (Beach Fill)

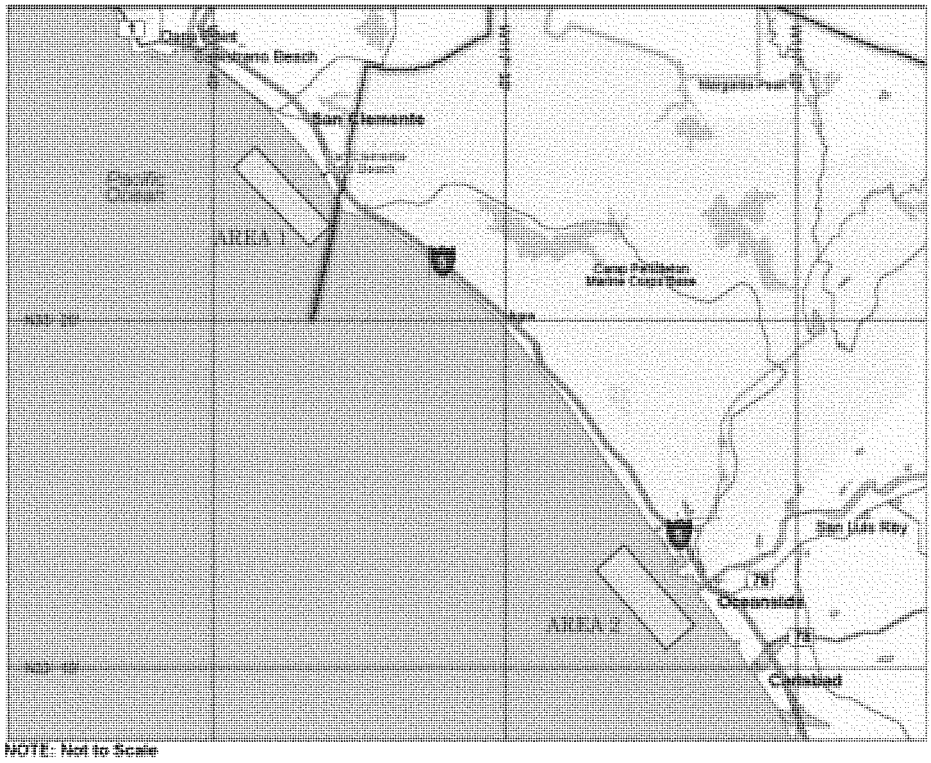


Figure 4-2 Regional Offshore Borrow Sites

Sand Retention

The effectiveness and design of sand retention structures has been studied and documented extensively in Coastal Engineering literature over the last 30 or 40 years. Innumerable empirical relationships have been developed in the laboratory and the field to try to predict the equilibrium shoreline created by a structure of given dimensions at a given location for various conditions. The most recent and relevant of these studies is the SANDAG "*Regional Beach Sand Retention Strategy*" of Oct., 2001, prepared by Moffatt & Nichol Engineers.

The sand retention structures discussed below are only considered in conjunction with a beach replenishment component; because there is little net sand transport in the littoral cell, so the structure would likely trap very little sand without artificial nourishment. The three main classes of sand retention structures and reasons for their inclusion or exclusion from the final analysis are presented in the following sections.

Visible Breakwaters

Breakwaters are concrete or rock walls built roughly parallel to the shore just beyond the breaker zone to absorb wave energy by stopping transmission or breaking the wave before it hits the beach. They can be permeable or solid, depending on the desired amount of wave energy absorption vs. reflection. Preliminary cost estimates were developed by SANDAG for a 50 year life, 305 meter (1,000 foot) long breakwater, with enough beach replenishment to create a 69,000 m^2 (17 acre) beach in the lee of the breakwater (SANDAG). The $33 million cost included 840,000 m^3 (1.1 million cy) of sand initially and an additional 474,000 m^3 (620,000) cy on a 10 year nourishment cycle. Visible breakwaters were considered, however they were screened out of the final analysis for several reasons:

- Extremely high cost,
- Impact on down coast littoral transport,
- Impact on surfing,
- Impact on aesthetics,
- Lack of support from the resource agencies, specifically the CA Coastal Commission, which is the agency that upholds the Coastal Zone Management Act within California.
- Potential impacts to Essential Fish Habitat
- Public safety issues, and;
- Lack of support from the local sponsor and local community.

- The concept design plan view is schematically illustrated in **Figure 4-3.**

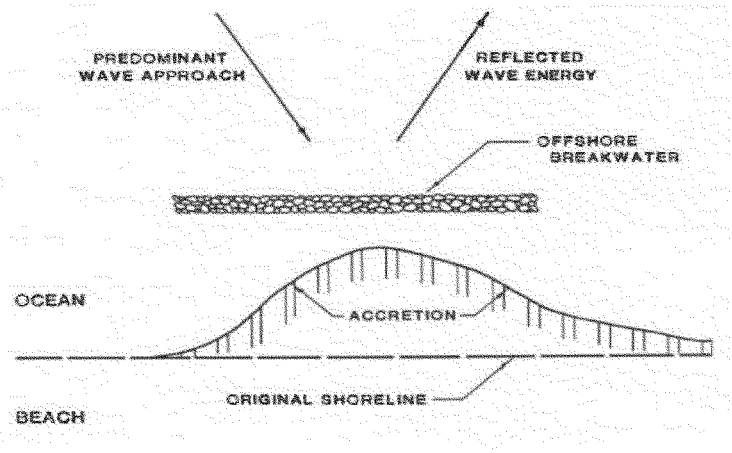


Figure 4-3 Typical Detached Breakwater

Submerged Breakwater/Artificial Reef

Submerged artificial reef type designs come in many forms, but can be roughly broken into "soft" and "hard" designs.

In the soft designs, nearshore sand berms are constructed of dredged sand placed parallel to the beach in shallow water. The "soft" breakwater reduces incident wave height, and gradual onshore migration of the sediment can contribute to renourishment of the adjacent shoreline, provided the berm itself is stable enough to withstand the wave environment. However, this type of design is generally not suited for the type of wave environment in the study area because the relatively small grain sizes of available sand would not be stable when subjected to the wave induced bottom currents. Therefore, soft submerged berms were not carried into the final analysis.

In addition to "soft" submerged breakwaters, "hard" submerged breakwaters, which include "artificial reefs", were considered. These structures reduce wave energy through breaking and dissipation. They are generally not as effective as surface piercing breakwaters at retaining sand, but do not generally have the adverse effects on surfing conditions that surface visible structures do, and can even enhance surfing conditions if designed for dual purpose. Although much theoretical research has been conducted, real world data on the performance of artificial reefs as sand retention structures is only now becoming available, because few have been built. In addition, most of those were either in Florida or Australia, where conditions differ greatly from the Southern California coastline. Pratte's Reef was constructed off El Segundo, California out of large geotube sand bags, but was ultimately too small and too far offshore to have any noticeable impact on the shoreline (M&N, SANDAG, Oct 2000). However, extremely high costs, coupled with extremely high uncertainty, severe local opposition to any system of offshore structures on the scale required, and the lack of support from the local sponsors have resulted in this measure being precluded from further consideration.

Groins

Along-shore sand retention structures, such as groins and jetties, are constructed perpendicular to the shore to form fillets that can slow beach erosion by trapping littoral sediment. Most of the littoral drift occurs inshore of the normal breaker line under prevailing wave conditions (about the 2 to 3 meter (7-10 ft) depth contours on the Pacific coast). Hence, extension of sand retention structures beyond about MLLW is generally uneconomical (USACE, 1984).

The shore perpendicular structures are generally utilized to preserve a minimum berm width and slow erosion rates so that renourishment volumes can be lower and episodes less frequent. Groins are often used if their cost is less than the cost savings gained from this reduction in nourishment volume, however, in this case the life cycle costs of constructing groins are likely to exceed any savings in cost of renourishment. The amount of sand trapped by the structure depends on the permeability, height, and length of the structure and the amount of sand in the littoral system. As material accumulates on the updrift side of the structure, supply to the downdrift side is reduced. This results in local beach accretion on the updrift side of the structure and erosion for some distance downdrift. After the beach near the structure adjusts to an "equilibrium" stage in accordance with the wave conditions, all littoral drift will pass the structure either directly over it or divert around the seaward end of the structure. Because of the potential adverse effects on downdrift beaches, groins and similar structures should be used only after careful consideration of the factors involved.

Groins were considered, but this measure would have the potential for the following reasons:

- Impact on down coast littoral transport;
- Lack of support from the resource agencies, specifically the CA Coastal Commission, which is the agency that upholds the Coastal Zone Management Act within California.
- Potential impacts to EFH due to lost habitat area occupied by construction footprints and/or turbidity impacts
- Impacts to lateral beach access
- Life cycle costs of constructing groins are likely to exceed any savings in cost of renourishment
- Lack of support from the local sponsor and local community, and
- Impact on aesthetics.

The concept design is illustrated in **Figure 4-4.**

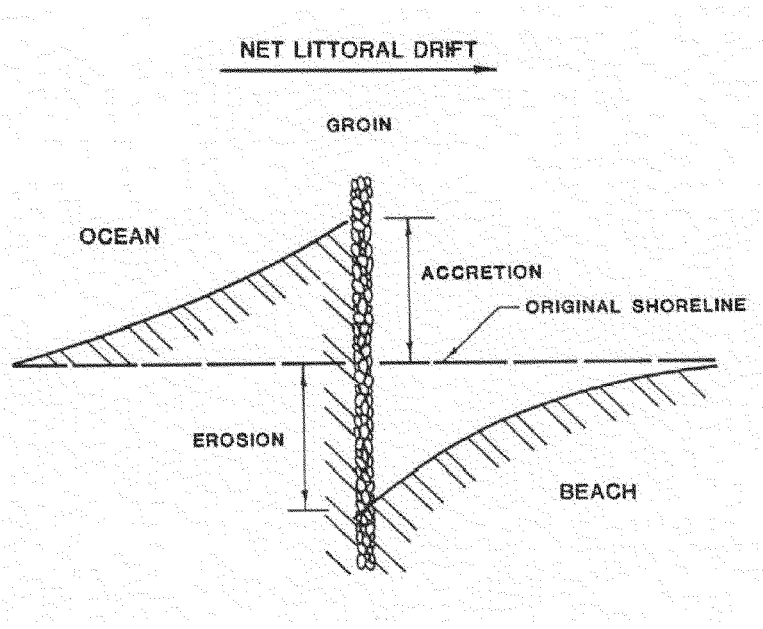


Figure 4-4 Typical Groin

Seawalls

A seawall can be considered for remedying coastal flooding and shoreline erosion, particularly at a low-lying and narrow beach. A seawall with a relatively small footprint terminates the shoreline retreat at the seawall location. However, it requires relatively high crest elevations to prevent the high waves rushing up along the vertical face from overtopping. Continued erosion of the shoreline and construction of seawalls, without beach nourishment, will lead to the absence of a beach of any width. This condition could drastically reduce the possibility for the presence of favorable surfing conditions, by changing the nearshore beach profile. Seawalls were considered, however they were screened out of the final analysis for several reasons:

- Extremely high cost (initial construction approximately $31M),
- Impact on down coast littoral transport,
- Lack of support from the resource agencies, specifically the CA Coastal Commission, which is the agency that upholds the Coastal Zone Management Act within California.
- Public safety issues,
- Lack of support from the local sponsor and local community,
- Impact on surfing, and;
- Impact on aesthetics.

A conceptual design is schematically illustrated in **Figure 4-5.** Note that although titled "San Clemente Seawall Section," Figure 4-5 is only a conceptual example and does not represent a constructed or designed seawall at San Clemente as neither currently exist. The seawall was assumed to be steel reinforced concrete structure founded on bedrock. This type of structure is not common in the southern California shoreline area.

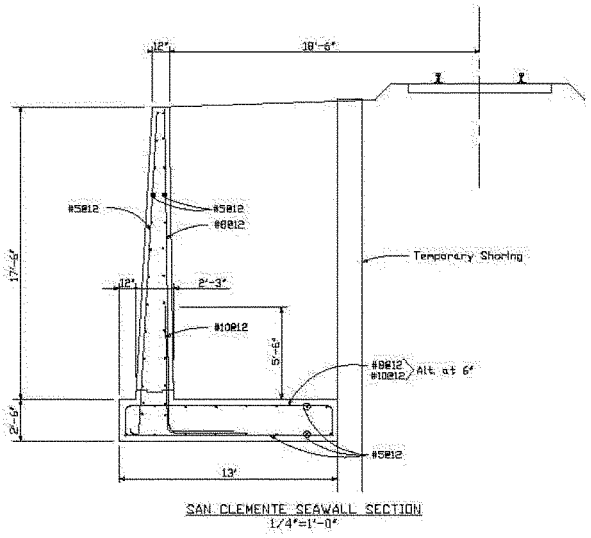


Figure 4-5 Schematic of Typical Seawall Design

Revetments

Revetments are structures made of placed quarry stone designed to protect the bluff toe from erosion by wave action. They are typically built of 2,700 to 4,500 kg (3 to 5 ton) stone over a layer of smaller stone over a layer of fill. Revetments are generally effective if maintained, but encroach significantly onto the beach and in most cases into the surf zone. Continued erosion of the shoreline and construction of engineered revetments, without beach nourishment, will lead to the absence of a beach of any width. This condition could drastically reduce the possibility for the presence of favorable surfing conditions, by changing the nearshore beach profile. Revetments were considered, however they were screened out of the final analysis for several reasons:

- Impact on down coast littoral transport,
- Lack of support from the resource agencies, specifically the CA Coastal Commission, which is the agency that upholds the Coastal Zone Management Act within California.
- Public safety issues,
- Public access impacts to pedestrians to gain access from the landside as well as lateral access along the beach,
- Lack of support from the local sponsor and local community,
- Potential impacts to EFH due to lost habitat area occupied by construction footprints and/or turbidity impacts,
- Impact on surfing,
- Impact on recreation by reducing the amount of usable beach space, and;
- Impact on aesthetics.

The conceptual design is schematically illustrated in **Figure 4-6.**

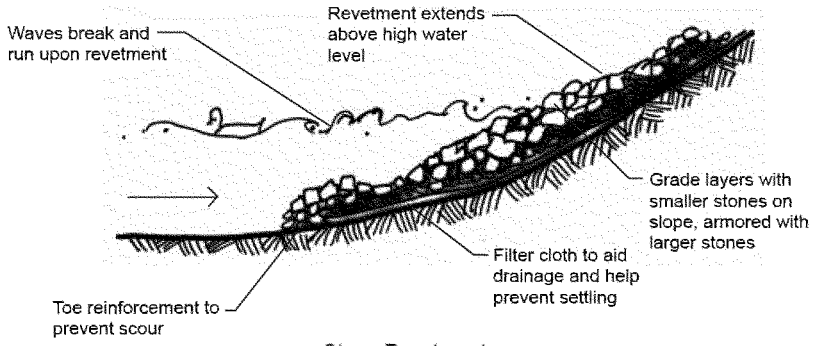


Figure 4-6 Schematic of Typical Revetment

4.6.6 Summary of Alternatives

The management measures that become the alternative plans also must follow the following guidelines. After reviewing the possible alternatives that were considered for the project only the beach fill alternatives were carried forward into the final array. Although all of the screening criteria were deemed important, the primary screening criteria included potential permanent and temporary impacts on Essential Fish Habitat, inconsistencies with the Coastal Zone Management Act, and project costs. Construction footprints for either breakwaters or groins would potentially have a permanent impact on Essential Fish Habitat. Consistency with the Coastal Zone Management Act was a criteria for eliminating breakwaters, groins and revetments. The high cost of implementing the remaining alternatives, compared to beach nourishment, would not maximize NED benefits and achieve the Planning Objectives.

Technical Feasibility - The recommended plan presented should be complete and sound, and in sufficient detail to allow development of engineering plans and specifications.

Economic Feasibility - Any potential project that is in the Federal interest must display feasibility by satisfying benefit-cost (B/C) criteria. Generally, this ratio must be greater than one to allow Federal participation in continued study and any project proposal. In addition, the sponsoring agency is required to show their ability and willingness to fund their share of any recommended project as required by the Principles and Guidelines.

Environmental Impacts - Applicable environmental requirements must be met for a feasibility level study. Environmental acceptability must be ascertained; and adverse impacts should be avoided if possible or minimized if avoidance is not possible. The screening of alternatives based on environmental acceptability limitations are done with respect to Federal environmental statutes. Federal examples of these include the Coastal Zone Management Act (CZMA) and the Fish and Wildlife Coordination Act (FWCA). The California Coastal Commission currently interprets the CZMA in such a way that favors almost any type of shore protection over rock revetments and/or seawalls, especially in areas where there is a lot of public beach use and recreation. A revetment of this size would have very little chance of obtaining a Coastal Consistency Determination.

Public Acceptability - The alternative options and plans should be acceptable to the local residents, agencies, organization, and the non-Federal sponsor(s), as well as the interested State and Federal agencies. The local sponsor has indicated that they are severely constrained by public opinion and cannot support any recommendation that meets with severe public opposition. Unacceptable plans include any visible offshore structure and any structure that significantly impedes beach access, such as rock revetments. Local, well organized and well funded citizens groups have expressed strong opposition to revetments both in public meetings and in litigation. Any proposed project including revetment would encounter severe opposition from these groups.

Table 4-1 compares the management measures to the evaluation criteria.

Table 4-1 Comparison of Evaluation Criteria

Management Measure	Meets Purpose and Need	Technically Feasible	Economically Feasible	Environmentally Acceptable	Acceptable to Public
Beach fill	Yes	Yes	Yes	Yes	Maybe
Managed Retreat	Maybe	Yes	No	No	Maybe
Revetment	Maybe	Yes	Maybe	No	No
Seawall	No	Yes	Yes	No	No
Groin	Yes	Maybe	No	No	No
Visible Offshore Breakwater	Maybe	Yes	No	No	No
Submerged Reef	Maybe	No	No	Maybe	Maybe

4.7 Final Alternatives Analysis

The study team identified a beach fill as the only viable protection alternative given the environmental and institutional constraints of the study area. The economic optimization procedure is based on selection of beach fill alternatives which produces the NED plan. The NED plan is developed by considering the recreational potential and storm damage reduction of various beach fill configuration alternatives and optimization based on the average annual benefits and the benefit/cost ratio. The only optimization parameter presented is the dimension of the sacrificial beach width of the cross-sectional design profile. Base beach width alternatives, beyond the current conditions of the beach, were considered in this study, however, the residual with project damages are minimal with the existing beach, so the benefits of maintaining a wider beach are marginal. The storm damage reduction benefits, in this study, are derived from maintaining the existing beach conditions by constructing a sacrificial beach. The twelve alternatives evaluated consist of sacrificial beach widths (m) = {10, 15, 20, 25, 30, 35, 40, 45, 50, 60}. For reference, example schematic of a typical beach fill {15 meter (50 foot) width} is presented in Figure **4-7**, and will be discussed further in this Chapter.

Sacrificial Beach Width

The sacrificial beach width is the amount of beach added to the base beach width. The sacrificial beach width is allowed to erode to the base beach width, after which the sacrificial beach width is replaced. The sacrificial beach width represents a time-varying amount of storm damage reduction protection and a time-varying amount of recreation benefits.

Nourishment Interval

The sacrificial beach width represents a period of time between successive nourishments. The sacrificial beach width divided by the mean long term erosion rate will yield an approximate value for the nourishment interval. For example, a 20 m (66 ft) sacrificial beach width divided by 4.0 m/yr (13 ft/yr) long term erosion rate approximately equals a 5 year periodic nourishment interval. During the Monte Carlo simulation the sacrificial beach width will last varying lengths of time reflecting the random nature of the erosion processes, but the final output can be

expressed in a mean number of years between successive fills. Therefore, optimization of the sacrificial beach width will yield the periodic nourishment interval.

Alongshore Length

Approximately 1,040 m (3,412 ft) of shoreline within the City of San Clemente are recommended for nourishment. The area is approximately centered about the Pier; the south limit of the proposed beach fill is located immediately south of the T-Street overpass while the north limit is located immediately north of the Marine Safety Headquarters. A taper continues an additional 100 m (330 feet) to the north and south to merge with the existing shoreline. No benefits from the tapering effects are counted. For the extreme sea level rise case, a taper continues an additional 150 m (490 feet) to the north and south to merge with the existing shoreline.

Berm (Beach) Width

The design berm width is a direct result of the model optimization, which is more fully explained in Appendix D of the EIS/EIR. The initial fill profile is expected to evolve thru an adjustment process known as equilibration. Natural foreshore processes will re-distribute a portion of the original fill volume throughout the profile. The overfill material is added to the design quantity to account for the equilibration process.

Berm (Beach) Crest Elevation

Current design guidance recommends the elevation of the design berm should generally correspond to the natural berm crest elevation. If the design berm is lower than the natural berm, a ridge will form along the crest, which when overtopped by high water will produce flooding and ponding on the berm. A design berm higher than the natural berm will produce a beach face slope steeper than the natural beach and may result in formation of scarps that interfere with recreational use and other environmental uses. Scarp formation indicates a higher transport (erosion) rate than a berm at the natural elevation, which is an inefficient use of beach fill material.

The design berm elevation for the existing sea level rise condition is established at +5.2 meters MLLW (+17 ft). This elevation matches the natural berm of adjacent healthy beaches which have been established by numerous surveys over the years. Historical beach profiles measured over the years indicate natural, stable berm elevations are approximately +5.2 meters MLLW (+17 ft). The berm crest elevation is the same for both the existing sea level rise case and the extreme sea level rise case.

The design berm elevation for the extreme sea level rise condition is expected to be +5.9 meters MLLW (+19.4 ft). This elevation is the sum of the existing beach berm elevation and the extreme sea level rise. There is no known methodology to predict the future beach berm crest elevation in response to extreme sea level rise. The extreme sea level rise assumption results in an increase of the mean long term erosion rate by 0.7 m/yr (2.3 ft/yr). The beach berm elevation tends to be the natural upper limit of run-up. It is assumed that the beach will respond by increasing the berm elevation an amount exactly equal to sea level rise to preserve its natural run-up characteristics.

Foreshore Slope

The design foreshore slope is established at 8H:1V. The foreshore slope is the same for both the existing sea level rise case and the extreme sea level rise case. This slope matches the natural foreshore slope of adjacent beaches which have been established by numerous surveys and measurements over the years. Direct measurements obtained by the City of San Clemente indicate natural, stable foreshore slopes range between 4-18H:1V, with 8H:1V as the most common value. This slope has been shown to be a stable mean value between the seasonal variations.

The construction foreshore slope is established at 10H:1V. Los Angeles District beach fill construction experience with standard earthmoving equipment indicates that slightly flatter foreshore slopes are easier to construct. The post-construction foreshore is expected to evolve thru an adjustment process known as equilibration. Natural foreshore processes will re-distribute a portion of the original fill volume throughout the profile.

Quantity

Engineering practice in southern California indicates volume/area relationships are the most reliable predictor for fill quantities. The horizontal area of the beach fill planform is computed and multiplied by a volume/area factor. It is usual and customary in southern California that this volume/area relationship ranges between 4.1-12.3 m^3/ m^2 (0.5-1.5 yd^3/ft^2). The low range of 4.1 m^3/ m^2 (0.5 yd^3/ft^2) has been shown to result in rapid erosion of the fill. The range of 8.2-12.3 m^3/ m^2 (1.0-1.5 yd^3/ft^2) typically yields more realistic estimates of sediment requirement per surface area. The value of 12.3 m^3/ m^2 (1.5 yd^3/ft^2) is used in the present study. It is expected that this quantity will have the greatest in-place stability.

4.7.1 With Project Alternatives Analysis

The without project model was adapted to simultaneously analyze both with and without project conditions with each alternative being compared to the same conditions of the without project analysis. Comparisons between with and without project were accomplished through a fixed seeded storm application. Under this constraint, the model processed the without and alternatives conditions under the exact same storm sequence. The results for without project and the alternatives were then matched paired through @RISK to compare how an alternative compares to the without project condition under the same storm sequence.

The with project conditions starts with a beach fill and is subject to the same storm as the without project condition. Damages are then computed from the storm induced erosion – erosion amounts being identical to the without project condition – but the beach starting points being offset by the fill amount. After recreation and damages are calculated, the beach is allowed to erode to the next year's starting position.

At the start of the next year, the model examines if any beach fill remains. If there is beach fill remaining the model calculates damages as previously described. If the entire beach fill has been eroded, the model requires a renourishment to the original program size. The model processes go on for the 50 years of the period of analysis and comparing the Net Present Value (NPV) streams of with and without for each iteration. The number of iterations was set at 1000. Thus, the model compares 1000 50-year forecasts to develop its distributions. This process was utilized for all alternatives.

4.7.2 With Project Model Assumptions

In addition to the without project assumptions previously discussed in Sections 3.2 and 4.7.3, the with-project model includes:

- Long-term beach fill erosion rate (ft/yr) defined as Risktriang (-15.2m, -5.5m, 9.1m) (-50 ft, -18.1 ft, 30 ft)
- An expected cost of sand at $15.36 per cubic yard
- An expected cost of mobilization/demobilization of $2,124,200.
- Initial project Pre-Construction Engineering and Design (PED) of 10% of construction cost with renourishment PED costs of $250,000
- Supervision and Administration (S&A) costs at 6.5% of construction cost
- Environmental mitigation costs of $360,000 at construction and replenishment
- Environmental offshore construction cost of $2,300,000 for fills in excess of 15 meters
- Interest During Construction cost based on a mid-term full expenditure pattern approach
- Dredge capacity of 127,000 m^3 (166,200 yd^3) per month (based on recent performance statistics of the Portland District's Hopper Dredge "Yaquina")
- A renourishment program based on an as needed approach
- No Seawall Construction occurs

4.7.3 Project Alternatives

The with-project alternatives consist of 11 alternative fill profiles starting at 10 meters (33 ft) and increasing by 5 meters (16 ft) to a maximum of 60 meters (197 ft), in addition to the Without Project condition:

The R/U model for San Clemente was simultaneously run with all alternatives to ensure that all comparisons of alternatives were conducted under the exact same conditions. Each alternative was evaluated for 1000 simulations of 50-yr projections. A brief model explanation is below:

- If the entire beach fill has been eroded, the model requires a renourishment to the original program size. For example, if the original with-project condition was a 20 meter (66 foot) beach fill program – the model monitors the remaining fill and when the fill reaches 0, the model renourishes the beach with 20 meters (66 ft) of fill. Given the random nature of long-term beach fill erosion, the model does not operate under a fixed interval of renourishment; but, is instead a fill-as-needed approach. As a result it is possible that the model would produce higher costs for a smaller (i.e. narrower) required beach fill width because of the need for more frequent renourishment events. More frequent renourishment cycles results in a greater number of events throughout the 50-year period of analysis, adding to the total cost of the project, which includes mob/demob as well as contracting, engineeirng and monitoring costs for each cycle. Examples of this are shown in **Tables 4-2** and **4-5**, where a 10-m (33 ft) beach width requires a greater Total Life Cycle (NPV) cost than a 15-m (50 ft) beach width.

The results of the model are presented in the series of tables below.

4.7.4 NED Benefits – Alternatives Comparison

ER 1165-2-130 restricts incidental recreation benefits to an equal amount of coastal storm damage reduction benefits when the project's storm damage reduction benefits on their own do

not justify the project. All of the alternatives analyzed do not possess a B/C ratio greater than 1 on coastal storm damage reduction benefits alone. Therefore, each alternative has a restricted recreational benefit equal to the amount of coastal storm damage reduction benefits for the alternative. NED plan selection calls for the alternative with the greatest amount of net NED benefits, based on storm damage reduction benefits only, to be designated as the NED plan. The alternative with the greatest net NED benefits is Alternative 2 – 15 meter beach fill. The net annual NED benefits for Alternative 2 are -$41,581. Taking into account the recreation benefits, Alternative 2 has a B/C ratio of 1.88, on a restricted basis (**Table 4-2**).

Identification of Alternative 2 as the NED Plan can be seen in **Table 4-2** below, where Alternatives 1 and 3 (10 meter and 20 meter beach fills, respectively) both express lower net annual storm damage reduction benefits. The 10 meter plan also requires a higher annual cost than the 15 meter plan due to the need for more frequent re-nourishments (roughly 11 re-nourishments needed as opposed to 8 over the project lifetime). The 20 meter plan and all plans wider require a higher annual cost due to much higher sand costs. The 15 meter plan displays the highest B/C ratio based on storm damage reduction benefits and recreation combined and the greatest net NED benefits based on storm damage reduction benefits.

Table 4-2 – Analysis of Alternatives

FY11 Prices and Discount Rate

BASE SEA LEVEL RISE CONDITION												
	W/O	10m	15m	20m	25m	30m	35m	40m	45m	50m	55m	60m
Project Total Damages - Average Annual	$1,420,018	$43,148	$35,540	$31,466	$28,614	$26,668	$24,713	$23,475	$21,791	$21,097	$20,328	$19,912
RR Construction & O&M Costs	$1,275,274	$15,629	$13,127	$11,545	$10,523	$9,798	$9,315	$8,911	$8,582	$8,354	$8,124	$7,994
Trail Damage	$81,821	$6,704	$6,400	$6,212	$6,085	$5,996	$5,934	$5,894	$5,847	$5,816	$5,787	$5,769
Structure & Content Damage	$62,923	$20,815	$16,014	$13,707	$12,007	$10,874	$9,464	$8,679	$7,362	$6,927	$6,417	$6,150
RR Delay Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Residual Damages	$1,420,018	$43,148	$35,540	$31,466	$28,614	$26,668	$24,713	$23,475	$21,791	$21,097	$20,328	$19,912
Damage Reduction	$0	$1,376,870	$1,384,478	$1,388,552	$1,391,403	$1,393,350	$1,395,305	$1,396,543	$1,398,227	$1,398,921	$1,399,690	$1,400,105
Incidental Recreation:												
W/O Project Reach 6	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923
With Project Reach 6	$10,667,923	$12,066,458	$12,328,344	$12,599,809	$12,890,901	$13,179,733	$13,429,489	$13,630,218	$13,814,365	$13,971,137	$14,103,567	$14,223,486
Incidental Recreation Improvement	$0	$1,398,535	$1,660,421	$1,931,886	$2,222,978	$2,511,810	$2,761,566	$2,962,295	$3,146,442	$3,303,214	$3,435,644	$3,555,563
Average UDV Reach 6	$5.24	$6.17	$6.30	$6.43	$6.57	$6.71	$6.84	$6.94	$7.03	$7.11	$7.18	$7.24
Weekend Sqft - Summer	30.00	39.09	44.79	50.59	56.28	62.26	68.27	74.10	80.23	86.48	92.70	99.31
Project Costs:												
Initial Fill Only												
Sand Cost	*$0*	*$2,576,985*	*$3,865,478*	*$5,153,971*	*$6,442,463*	*$7,730,956*	*$9,019,449*	*$10,307,941*	*$11,596,434*	*$12,884,926*	*$14,173,419*	*$15,461,912*
Mob/Demob	*$0*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*
IDC	*$0*	*$14,008*	*$26,805*	*$43,483*	*$64,057*	*$88,543*	*$116,954*	*$149,306*	*$185,615*	*$225,894*	*$270,160*	*$318,428*
Total Cost Initial Fill (including PED, SA, & Environmental)	*$0*	*$6,002,700*	*$7,516,590*	*$11,334,362*	*$12,856,030*	*$14,381,610*	*$15,911,115*	*$17,444,561*	*$18,981,964*	*$20,523,337*	*$22,068,697*	*$23,618,059*
Average # of Fills Project Lifetime	0	11.83	9.11	7.49	6.40	5.61	5.00	4.53	4.15	3.82	3.55	3.33
Annual Costs	$0	$1,482,807	$1,469,767	$1,590,821	$1,618,043	$1,647,458	$1,681,676	$1,718,396	$1,760,583	$1,798,508	$1,840,874	$1,885,742
Storm Damage Reduction (SDR) Benefits	$0	$1,376,870	$1,384,478	$1,388,552	$1,391,403	$1,393,350	$1,395,305	$1,396,543	$1,398,227	$1,398,921	$1,399,690	$1,400,105
Net Annual SDR Benefits	$0	-$105,937	-$85,289	-$202,269	-$226,639	-$254,108	-$286,370	-$321,856	-$362,356	-$399,588	-$441,184	-$485,637
Incidental Recreation Benefits - (Limited ER 1165-2-130)	$0	$1,376,870	$1,384,478	$1,388,552	$1,391,403	$1,393,350	$1,395,305	$1,396,543	$1,398,227	$1,398,921	$1,399,690	$1,400,105
Total SDR & Recreation Benefits - Limited	$0	$2,753,740	$2,768,955	$2,777,103	$2,782,807	$2,786,700	$2,790,610	$2,793,087	$2,796,454	$2,797,841	$2,799,380	$2,800,210
B/C Ratio - SDR only		0.93	0.94	0.87	0.86	0.85	0.83	0.81	0.79	0.78	0.76	0.74
B/C Ratio - SDR & Recreation (Limited)		1.86	1.88	1.75	1.72	1.69	1.66	1.63	1.58	1.56	1.52	1.48
Annual Net NED Benefits (Limited)		$1,270,933	$1,299,188	$1,186,282	$1,164,764	$1,139,242	$1,108,935	$1,074,087	$1,035,871	$999,333	$958,506	$914,468
Recreation Benefits - ER 1105-2-100, Appendix E, Section IV, E-24.c. Incidental Recreation Benefits - Unlimited		$1,398,535	$1,660,421	$1,931,886	$2,222,978	$2,511,810	$2,761,566	$2,962,295	$3,146,442	$3,303,214	$3,435,644	$3,555,563
Total SDR & Recreation Benefits - Unlimited		$2,775,405	$3,044,898	$3,320,437	$3,614,381	$3,905,161	$4,156,871	$4,358,838	$4,544,669	$4,702,134	$4,835,335	$4,955,668
Annual Net NED Benefits - Unlimited		$1,292,598	$1,575,130	$1,729,617	$1,996,338	$2,257,703	$2,475,196	$2,640,439	$2,784,086	$2,903,626	$2,994,460	$3,069,926
B/C Ratio - SDR & Recreation - Unlimited		1.87	2.07	2.09	2.23	2.37	2.47	2.54	2.58	2.61	2.63	2.63

4.8 The NED Plan – Alternative 2

Table 4-2 presents the model's output data for the analysis of Alternative 2. Alternative 2 would extend the beach 15 meters, from the location of the existing edge of the berm at the +5.2 m elevation, at a first cost of $7,516,590 for the initial beach fill. Expected costs for the initial fill would be: $3,865,478 for sand; $2,124,896 for mob/demob; $26,805 for IDC; and $1,499,411 for PED, S&A, and environmental mitigation. Over the 50-yr period of analysis the project would require approximately 8 additional renourishments beyond initial construction on average with a range of fills between 5 and 15. The initial fill, and 7 of the 8 renourishments, will require approximately 192,000 m^3 (251,000 CY) of beach compatible sand. The last renourishment event will require 64,000 m^3 (84,000 CY), requiring less sand so that the project life is not extended by the 50 year period of analysis. The total life-cycle cost of the alternative is $1,469,767 on an annual basis.

Alternative 2 would reduce coastal storm damage on an average annual basis from $1,420,018 to $35,540 – a 99.0% reduction. The major reduction in damages is the avoided cost savings from railroad (principally, seawall) construction. The beach fill program eliminates the need for seawall construction. The Without Project railroad construction and O&M costs (**Table 4-3**) fall from $1,275,274 to $13,127 under Alternative 2. Structure and content damages under Alternative 2 are reduced by 74% and damages to the trail system fall 92%.

Table 4-3 Alternative 2 Damage Reductions (Average Annual)
FY11 Price Levels

Category	W/O Project	Alternative 2	Reduction	% Reduction
RR Construction & O&M Costs	$1,275,274	$13,127	$1,262,147	99.0%
Trail Damage	$81,821	$6,400	$75,421	92.2%
Structure & Content Damage	$62,923	$16,014	$46,909	74.5%
RR Delay Costs	$0	$0	$ 0	00.0%
Total Damages	$1,420,018	$35,540	$1,384,478	97.5%

Alternative 2 has a large impact on recreation. The most notable impact is the effect on summertime weekend user space. Under the Without Project condition, summertime weekend space falls to 30 ft^2 throughout the period of analysis. Under Alternative 2, summertime weekend user space increases to 44.8 ft^2, on average. Although this space is well below the ideal use allotment of 100 ft^2, the beach is no longer congested and will be able to service future demand growth. Alternative 2 increases the overall annual use value of the beach from $5.24 to $6.30 per user. Total recreation value on an average annual basis increases from $10,667,923 to $12,328,344 – a $1,660,421 increase.

ER 1105-2-100, Appendix E, Section IV, E-24.c. states:

> *"Shore protection projects are formulated to provide hurricane and storm damage reduction. Recreation is incidental. The Corps participates only in those projects formulated exclusively for hurricane and storm damage reduction, and justified (BCR ≥ 1.0) based solely on damage reduction benefits, or a combination of damage reduction benefits plus (at most) a like amount of incidental recreation benefits. In other words, recreation benefits useable to establish Corps*

participation may not be more than fifty percent of the total benefits required for justification, which in turn means they may not exceed an amount equal to fifty percent of costs. If the criterion for participation is met, then all recreation benefits are included in the BCR."

Table 4-2 indicates that on a restricted basis Alternative 2 exceeds a B/C ratio of 1 and meets the criterion for participation. Therefore, under the above section all recreation benefits are to be included in the BCR for Alternative 2. The total unlimited NED benefits for Alternative 2 are shown in **Table 4-4**.

Table 4-4 Alternative 2 NED Net Benefits & B/C Ratio
FY11 Price Levels and Discount Rate

Category	W/O Project	Alternative 2	Benefits/Costs
Structural Damages - Annual			
RR Construction & O&M Costs	$1,275,274	$13,127	$1,262,147
Trail Damage	$81,821	$6,400	$75,421
Structure & Content Damage	$62,923	$16,014	$46,909
RR Delay Costs	$0	$0	$ 0
Total Damage/Reduction	$1,420,018	$35,541	$1,384,477
Recreation – Annual			
Total Recreation Value	$10,667,923	$12,328,344	$1,660,421
Total Annual Benefits			$3,044,898
Annual Costs			$1,429,767
Annual Net Benefits (unlimited)			$1,575,131
B/C Ratio (unlimited)			2.07

4.8.1 Risk & Uncertainty of the NED Plan

Further justification for the NED Plan can be seen through a Risk & Uncertainty (R/U) Analysis (detailed in the Economics Appendix) of implementing the plan based on comparison of without and with project damages. As stated in the Economics Appendix, the average annual value of the without project damages is $1,420,018 and that of the NED Plan is $35,541, producing a total damage reduction of $1,384,477.

Comparison of without and with project damages show that the with project damages are only a fraction (less than 5%) of the without project damages, thus strongly verifying economic justification for implementation of the NED Plan. The with project damages are primarily comprised of damages to structures and minor costs associated with repairs and maintenance of protection for the railroad tracks. With project residual damages are minimal because erosion of the placed fill will be monitored and future renourishment will be implemented as required,

thus negating the need for construction of a seawall or other structures rather than renourishing with beach compatible sand.

4.8.2 The NED Plan – Sea-Level Change Sensitivity Analysis

USACE issued the Engineer Circular titled, "Water Resource Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs" on July 1, 2009. The circular provides USACE guidance for incorporating the potential direct and indirect physical effects of projected future sea level change in the engineering, planning, design, and management of USACE projects. The guidance states that potential sea level change must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence. USACE requires a multiple scenario approach to address uncertainty and help develop better risk-informed alternatives. Planning studies and engineering designs should consider alternatives that are developed and assessed for the entire range of possible future rates of sea level change. The alternatives should be evaluated using "low", "intermediate", and "high" rates of future sea level change for both "with" and "without" project conditions. The historic rate of sea level change should be used as the "low" rate. The "intermediate" rate of local mean sea level change should be estimated using the modified Curve I from the National Research Council (NRC) 1987 report titled "Responding to Changes in Sea Level: Engineering Implications". The "high" rate of local sea level change should be estimated using the modified Curve III from the 1987 NRC report. This "high" rate exceeds the upper bounds of IPCC estimates from both 2001 and 2007 to accommodate for the potential rapid loss of ice from Antarctica and Greenland. The sensitivity of alternative plans and designs to the rates of future local mean sea level change should be determined. Design or operations and maintenance measures should be identified to minimize adverse consequences while maximizing beneficial effects. For each alternative sensitive to sea level change, potential timing and cost consequences should be evaluated during the plan formulation process.

Historic trends at San Diego, California indicate a positive sea level rise of +2.45 mm/yr based on water level measurements during the period 1950-1999. If past trends are projected into the future at San Diego, a sea level rise of 0.12 m (0.4 ft) would be expected during the 50 year period of economic analysis. The NRC Curve III estimates sea level rise, during the 50 year economic period of analysis, to be 0.70 m (2.3 ft).

Relative sea level rise has project impacts from two primary considerations: 1) long-term beach erosion, and 2) increased wave run-up and overtopping. The effects of sea level rise are addressed in Appendix D of the EIS/EIR.

The NED Plan is formulated on the basis of continuous monitoring of beach fill erosion and renourishment. This monitoring would be expected to identify any rapid change in sea level through an unanticipated change in renourishment requirements. Although sea level change should be identified through the frequency of renourishment, the NED Plan still requires an assessment of how sensitive its performance is to sea level change.

To examine the NED Plan under sea level change a sensitivity analysis was performed , based on the NRC Curve III, assuming a maximum sea-level rise of 0.70 meters over 50-years, as a point of reference the base case assumes a sea-level rise of 0.12 meters. This sea level change was incorporated into the model along with an adjustment to the construction cost of the seawall and simulated over the array of alternatives.

The results of the sensitivity analysis are shown in **Table 4-5**. As expected, a higher future sea-level rise increases the potential for storm damages. Storm damages increase under the without project condition from the base case's $1.42 million to $1.76 million for the maximum sea-level rise case on an average annual basis. Approximately 80% of the increase in damages is related to the seawall. Under maximum sea-level rise construction of the seawall occurs six years sooner (2015 vs. 2021) and at a higher construction cost. The maximum sea-level rise and mid-range conditions do not produce a change in NED Plan identification of Alternative 2. On a performance basis, the base case NED Plan reduces annual storm damages by about 98%, Alt 2 for the mid-range sea-level by 97%, and the maximum sea-level rise condition by 96% with Alt 2.

In addition to its performance level under sea-level rise conditions, the base case NED Plan of 15 meters requires less than one additional fill on average over the 50-year project life - 9.11 fills versus 9.49 for the mid-range and 9.66 for maximum. These results indicate that the base case NED Plan of a beach fill project of 15 meters is manageable with monitoring and unlikely to carry a significant degree of risk.

Table 4-5 – Sea-Level Rise Sensitivity – Maximum

FY11 Price Levels & Discount Rate

	MAXIMUM SEA LEVEL RISE CONDITION										
	W/O	10m	15m	20m	25m	30m	35m	40m	45m	50m	55m	60m
Project Total Damages - Average Annual	$1,764,479	$88,023	$70,655	$59,659	$52,558	$47,407	$43,096	$39,644	$37,050	$34,721	$33,899	$31,901
RR Construction & O&M Costs	$1,548,017	$24,129	$19,347	$16,768	$14,890	$13,57	$12,575	$11,712	$11,004	$10,499	$10,124	$9,725
Trail Damage	$93,756	$8,040	$7,449	$7,130	$6,861	$6,711	$6,586	$6,478	$6,392	$6,329	$6,279	$6,232
Structure & Content Damage	$122,706	$55,854	$43,859	$35,761	$30,787	$27,125	$23,935	$21,454	$19,654	$17,893	$17,496	$15,945
RR Delay Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Residual Damages	$1,764,479	$88,023	$70,655	$59,659	$52,558	$47,407	$43,096	$39,644	$37,050	$34,721	$33,899	$31,901
Damage Reduction	$0	$1,676,456	$1,693,824	$1,704,820	$1,711,92	$1,717,07	$1,721,382	$1,724,834	$1,727,428	$1,729,757	$1,730,580	$1,732,57
Incidental Recreation:												
W/O Project Reach 6	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,57
With Project Reach 6	$9,868,571	$11,957,05	$12,265,743	$12,553,597	$12,861,17	$13,158,16	$13,418,683	$13,629,867	$13,803,937	$13,968,19	$14,107,858	$14,227,080
Incidental Recreation Improvement	$0	$2,088,481	$2,397,172	$2,685,026	$2,992,604	$3,289,595	$3,550,112	$3,761,296	$3,935,366	$4,099,621	$4,239,088	$4,358,509
Average UDV Reach 6	$4.75	$6.08	$6.25	$6.40	$6.55	$6.69	$6.83	$6.94	$7.02	$7.11	$7.18	$7.24
Weekend Sqft - Summer	30.00	38.12	44.00	49.99	55.96	61.97	68.09	74.11	79.92	86.26	92.78	99.10
Project Costs:												
Initial Fill Only												
Sand Cost	*$0*	*$2,576,985*	*$3,865,478*	*$5,153,971*	*$6,442,463*	*$7,730,956*	*$9,019,449*	*$10,307,941*	*$11,596,434*	*$12,884,926*	*$14,173,419*	*$15,461,912*
Mob/Demob	*$0*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*
IDC	*$0*	*$14,008*	*$26,805*	*$43,483*	*$64,057*	*$88,543*	*$116,954*	*$149,306*	*$185,615*	*$226,894*	*$270,160*	*$318,428*
Total Cost Initial Fill (including PED, SA, & Environmental)	*$0*	*$6,002,700*	*$7,516,590*	*$11,334,362*	*$12,856,030*	*$14,361,610*	*$15,911,115*	*$17,444,561*	*$18,981,964*	*$20,523,337*	*$22,068,697*	*$23,618,059*
Average # of Fills Project Lifetime	0	12.85	9.66	7.87	6.68	5.84	5.22	4.72	4.28	3.96	3.68	3.43
Annual Costs	$0	$1,575,028	$1,539,981	$1,655,446	$1,674,77	$1,702,088	$1,735,340	$1,772,492	$1,803,478	$1,844,585	$1,887,256	$1,928,336
Storm Damage Reduction (SDR) Benefits	$0	$1,676,456	$1,693,824	$1,704,820	$1,711,92	$1,717,07	$1,721,382	$1,724,834	$1,727,428	$1,729,757	$1,730,580	$1,732,57
Net Annual SDR Benefits	$0	$101,428	$153,843	$49,374	$37,150	$14,983	-$13,957	-$47,657	-$76,050	-$114,828	-$156,676	-$195,821
Incidental Recreation Benefits - (Limited ER 1165-2-130)	$0	$1,676,456	$1,693,824	$1,704,820	$1,711,92	$1,717,07	$1,721,382	$1,724,834	$1,727,428	$1,729,757	$1,730,580	$1,732,57
Total SDR & Recreation Benefits - Limited	$0	$3,352,912	$3,387,647	$3,409,640	$3,423,841	$3,434,142	$3,442,765	$3,449,669	$3,454,856	$3,459,515	$3,461,160	$3,465,154
B/C Ratio - SDR only		1.06	1.10	1.03	1.02	1.01	0.99	0.97	0.96	0.94	0.92	0.90
B/C Ratio - SDR & Recreation (Limited)		2.13	2.20	2.06	2.04	2.02	1.98	1.95	1.92	1.88	1.83	1.80
Annual Net NED Benefits (Limited)		$1,777,884	$1,847,666	$1,754,194	$1,749,070	$1,732,054	$1,707,425	$1,677,177	$1,651,378	$1,614,929	$1,573,904	$1,536,758
Recreation Benefits - ER 1105-2-100, Appendix E, Section IV, E-24.c. Incidental Recreation Benefits - Unlimited		$2,088,481	$2,397,172	$2,685,026	$2,992,604	$3,289,595	$3,550,112	$3,761,296	$3,935,366	$4,099,621	$4,239,088	$4,358,509
Total SDR & Recreation Benefits - Unlimited		$3,764,937	$4,090,996	$4,389,846	$4,704,524	$5,006,666	$5,271,494	$5,486,131	$5,662,794	$5,829,378	$5,969,668	$6,091,086
Annual Net NED Benefits - Unlimited		$2,189,909	$2,551,014	$2,734,400	$3,029,753	$3,304,578	$3,536,155	$3,713,639	$3,859,316	$3,984,793	$4,082,413	$4,162,688
B/C Ratio - SDR & Recreation - Unlimited		2.39	2.66	2.65	2.81	2.94	3.04	3.10	3.14	3.16	3.16	3.16

4.8.3 The NED Plan Components

Table **4-6** highlights the NED Plan Components.

Table 4-6 – NED Plan Components

Alongshore Length (meters)	1,040
Berm Width (meters)	15
Berm Crest Elevation (meters, MLLW)	+5.2
Foreshore Slope at Equilibrium	8H:1V
Renourishment Interval	6 years
Volume, m^3 (yd^3)	192,000 (251,000)

4.9 The Four Accounts

The Planning Principles and Guidelines (P&Gs) which replaced the 1972 "Principles and Standards," directs the studies of major water projects by Federal water resources development agencies. A stated purpose of the P&Gs is to ensure that the formulation and evaluation of water resource studies are done properly and consistently by federal agencies. The federal objective in project planning is to contribute to national economic development (NED) while protecting the environment. NED contributions are increases in the net values of national goods and services outputs, both marketed and non-marketed. A plan, consistent with federal objectives and which maximizes NED benefits, is the "NED plan."

In addition to NED, the P&Gs includes three other accounts: regional economic development (RED), environmental quality (EQ), and other social effects (OSE). Collectively, the four accounts are required to include all significant effects of a plan on the human environment. The RED account includes the regional incidence of NED effects, income transfers, and employment effects. The EQ account shows the non-quantifiable effects of a plan on ecological, cultural, and aesthetic attributes of significant natural and cultural resources. The OSE account displays the effects of a plan on urban and community settings and on life, health, and safety.

The P&Gs require only that the NED account be developed for the selection of a plan. However, information on the other three accounts, which may bear significantly on selection of a plan, should be included in the alternative assessment.

4.9.1 Regional Economic Development (RED) Account

The RED account shows the effects of plan alternatives on the distribution of regional economic activity in the area where the plan will have significant income and employment effects. All or most of the NED benefits for a plan will accrue to the region. Effects outside the study region are categorized as "rest of the United States" impacts. The effects on regional income are the sum of 1) the NED income benefits and 2) transfers from outside the region. Income transfers comprise income from implementation outlays, transfers of economic activities, and indirect and induced effects. Indirect effects are those that result from the changed outputs of goods and services in industries which help meet changes in final products and export demands. Induced effects result from changes in consumer expenditures stimulated by changes in personal income. The effects of a plan on regional employment parallel those on regional income.

Typically, employment impacts of a plan are developed for individual industries at some level of aggregation in order to discern the distributional impacts on business sectors.

Relation of the RED Account to Other Accounts

RED impacts include, principally, changes in income and employment. However, the nuances of each of those categories may easily overlap with other accounts defined within the P&Gs. As indicated above, NED impacts are also RED impacts if they occur within the region of interest. However, the NED account is to reflect all effects on the national economy and excludes indirect and induced effects because they represent inter-regional transfers of regional economic activity. Conversely, indirect and induced impacts are shown in the RED account, and differences between it and the NED accounts are therefore accounted for as transfers from or to the rest of the nation.

The RED account may also overlap with the OSE account. The OSE account includes urban and community impacts, in particular those on income, population and employment distribution, fiscal conditions, and displacement of people and businesses and farms. A flood event may have social impacts through reduced property values, contaminated drinking water, and greater exposure to biological toxins. All may have regional impacts as typically defined by the RED account, but many may not be quantifiable and thus be included in the OSE account. Others which are measurable may fit into the OSE account and concurrently be an RED impact. For example, people in flooded areas may be unable to live in their homes or commute to work. The inability to live in their homes is an OSE impact, while the inability to commute to work is also an OSE impact, but with RED implications. In the latter case, the outputs of industries will decline if employees are unable to reach their places of employment.

Study Area RED Analysis

Notwithstanding its location of an Orange County shorefront community, the San Clemente beach area provides an important public recreational resource to a growing minority and low-income population. Although the 2005 - 2007 American Community Survey by the Census Bureau reports median family income in San Clemente at $103,500, the percent of families below the poverty line has increased 34.8% since the 2000 Census. Poverty has risen from 4.6% to 6.2% for families within San Clemente. On an individual basis 8.4% of San Clemente's population of 60,355 is below the poverty line. In addition to the increase in poverty, the population of San Clemente has become more diverse. Minority population has risen from the 2000 Census level of 12.1% to 17.5% of the population.

The public beaches of San Clemente provide not only a recreational resource to the community but also a jobs and income resource. Tourism to the beaches stimulates the local economy. To measure the economic impacts of tourism the MGM2 model, an update of the NPS Money Generation Model as originally developed at Michigan State University, and more specifically the MGM2 Short form version was utilized to measure the differences in economic impacts between the without project and NED project conditions.

MGM2 Model

MGM2 estimates both the direct effects and secondary effects of visitor spending. Although economic impact analysis can be quite complex, the basic components and calculations are summarized in the following simple equation: Economic impacts = Number of Visitors * Average spending per visitor * Economic multipliers

There are three primary inputs to the Money Generation Model: Visits, Average spending Multipliers. These inputs typically come from different sources. Visits are derived from attendance use figures or an estimate of the change in visits due to some management decision to be evaluated. Spending averages are typically estimated in surveys of visitors. Multipliers are usually derived from input-output models of the region's economy (RIMS II, IMPLAN, etc.). The model includes some suggested spending averages that may be edited or replaced with local data to represent a given set of visitors. MGM2 offers several sets of multipliers that users may choose from to capture the economy in the region around the site. For the analysis of San Clemente the default MGM settings of large metro area, high spending, and multipliers were employed. The documentation of the MGM2 model describes the economic impact concepts and is described in the Economics Appendix.

Regional Economic Modeling

Many of the RED effects considered in this report are quantified using regional economic models that are based on the principles of input-output (I-O) analysis. I-O analysis represents a means of measuring the flow of commodities and services among industries, institutions, and final consumers within an economy (or study area). I-O models capture all monetary market transactions in an economy, accounting for inter-industry linkages and availability of regionally-produced goods and services. The resulting mathematical formulae allow I-O models to simulate or predict the economic impacts of a change in one or several economic activities on an entire economy.

I-O analysis usees three main metrics to measure economic impacts – industry output, value added, and employment. Industry output refers to the value of goods and services produced in a region. Value added consists of four components – employee compensation, proprietor income, other property income, and indirect business tax. Labor income represents the sum of employee compensation and proprietor income. Lastly, employment is measured by the number of full- and part time jobs. For the purposes of this study, the focus is on value added, which represents regional income, and employment, which is consistent with the guidance on RED analysis presented in the P&Gs.

The primary input variable for I-O analysis is the dollar change in purchases of products or services for final use, the "final demand." Final demand changes drive I-O models. Industries respond to meet demands directly or indirectly by supplying goods and services to industries responding directly to final demand changes. The primary output variables are predicted changes in direct, indirect, and induced economic output, employment, and income for the affected industries within a study area. Direct economic effects refer to the response of a given industry (i.e., changes in output, income, and employment) based on final demand for that industry. Indirect effects refer to changes in output, income, and employment resulting from the iterations of industries purchasing from other industries caused by the direct economic effects. Induced economic effects refer to changes in output, income, and employment caused by the expenditures associated with new household income generated by direct and indirect economic effects.

The measurement of direct, indirect, and induced linkages within a regional economy is based on the concept of a multiplier. A multiplier is a single number that quantifies the total economic effect resulting from direct effects. For example, an output multiplier of 1.7 for the "widget" production sector indicates that every $100,000 of widgets produced (the direct output of this industry) supports a total of $170,000 in business sales throughout the economy (total output of

all industries), including the initial $100,000 in widget output. Several types of multipliers are produced by an I-O model, including output, employment, and income multipliers.

For this study, IMPLAN (IMpact Analysis for PLANning) is used to estimate regional economic effects of the proposed storm damage reduction improvement for San Clemente. IMPLAN is a computer-driven system of software and data commonly used to perform economic impact analysis. It was originally developed by the USDA Forest Service (USFS) to assist in land and resource management planning and has been in use since 1979. It is a widely used for economic analyses by clients in federal, state and local governments, universities, as well as the private sector. The system is now maintained and marketed by the Minnesota IMPLAN Group, Inc. (MIG), which updates the data annually, using information collected at the national, state, county, and local level.

IMPLAN is a "non-survey" or secondary I-O system, as it does not require primary, survey-based data, which is often difficult and expensive to obtain. National technical relationships among industries form the basis for the model, but are adjustable to account for unique regional conditions. Information on regional economic activity is also incorporated into the model. Changes can be made to data elements to account for regional conditions when better information, such as from primary surveys, is available.

The 2004 IMPLAN dataset was used in the analysis, and no adjustments were made to the regional data or economic model. All input values into IMPLAN were aligned to 2008 dollars employing the 2004 I/O modeling database. The RED analysis is based on a single-county model of Orange County where all impacts will occur.

Orange County Impact Area

Expenditures for this analysis occur solely within Orange County. Project implementation would support a number of federal employees, primarily Corps staff, to provide construction management and oversight services. Expenditures on construction goods, materials, and equipment that are made within the region would generate additional economic benefits as spending ripples through the local economy via inter-industry linkages. Further, labor income earned by both construction and federal workers would be re-spent, in part, in the local economy, generating additional economic activity. The regional multipliers for Orange County by industrial sector are shown in **Table 4-7**.

Table 4-7 Orange County Regional Multipliers

Multiplier	Other New Construction	Federal Non-Defense
Direct/Indirect	1.3069	1.0000
Induced	0.4889	0.6737
Total	**1.7957**	**1.6737**

As shown in **Table 4-8**, the Project is expected to generate a total of $5.6 million in output, which includes the direct value (or cost) of the Project ($3.2 million). Total value added generated by the Project in the region is estimated at $3.47 million over the construction period. Lastly, the project would generate a number of jobs both directly and in response to the Project's demands for goods and services (i.e., indirect effects) and spending attributed to direct and indirect labor earnings (i.e., induced effects). Approximate 25 private and public jobs

directly supported by the Project, an additional 20 annual jobs would be generated in the region, for a total of about 45 jobs in Orange County.

Table 4-8 Regional Economic Benefits – Orange County

Impact	Output	Value Added	Employment
Direct	$3,190,000	$2,012,000	25.1
Indirect	$850,000	$486,000	6.7
Induced	$1,594,000	$974,000	12.9
Total	$5,633,000	$3,472,000	44.8

4.9.2 Other Social Effects (OSE) Account

The Other Social Effects (OSE) account describes the potential effects of the proposed project alternatives in areas that are not dealt with explicitly in the NED and RED accounts presented above. ER 1105-2-409 states, "Any alternative plan may be selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse in the four Principles and Guidelines evaluation accounts," of which the OSE is one. The Principles and Guidelines state that the OSE, when included in U.S. Army Corps of Engineers documents, should "display plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others."

This particular OSE describes the potential effects of NED Plan construction. The OSE account explores the following categories of effects from the implementation of the NED plan:

- Displacement/impacts to population
- Public health and safety
- Displacement/impacts to minorities and special interest groups
- Displacement/impacts to businesses
- Displacement/impacts to agriculture
- Displacement/impacts to recreational areas
- Community growth
- Community cohesion

For the analysis of the region of influence (ROI) for direct social effects is defined as the City of San Clemente. This ROI area definition extends beyond the potential construction impact area and was chosen based on the assumption that all substantial direct social effects, if any, associated with a project of this type would be confined to this area.

Displacement/Impacts to Population

The project is expected is to be constructed during the off-season of beach activity. Its location is a non-populated public beach; however, residential and commercial locations are nearby. The direct effects of construction is not likely to result in any displacement or impacts to population beyond the health and safety concerns outlined below. Indirect construction effects are also anticipated to be minimal. It is generally assumed that the workers needed for construction would not come from the local labor pool - dredging crews of the ship coming from the ship's home port. Thus, construction-related employment is not likely to increase the population to any significant degree within the ROI.

Public Health and Safety

The analysis of effects to public health and safety includes environmental effects related to human safety, noise, air quality, and the possible effects to the populace in regard to access to emergency services.

Typically after nourishment, the foreshore slope of a beach face is steepened and extended into deeper water, creating reflected waves which can pose a potential public safety threat to swimmers and waders. In its natural, pre-nourishment condition, a beach will typically attenuate incoming waves through run-up on the naturally occurring beach slope. During the beach fill construction period and the equilibration process, it is possible that incoming waves may be reflected from the unnaturally steeper beach face. These reflected waves can compound the higher energy wave climate due to the aforementioned deeper water. Reflection can create a situation of "in and out" waves, comprised of normal waves propagating toward the shoreline colliding with the reflected waves heading out to sea. This condition of wave-reflecting, combined with a suddenly deeper drop-off at the more seaward beach face, has the potential to create hazardous swimming conditions to the recreating public. Whereas the recreating public may have become accustomed to a mild wave condition at a naturally occurring beach, it is suddenly confronted with a higher energy wave climate.

In addition, experience in some locations nationwide indicates an increase in lifeguard rescue missions immediately after a beach fill construction project. It is noted that the probability of these impacts occurring is neither guaranteed nor quantifiable, and when occurring are typically transient impacts until full profile equilibration is achieved.

Reflected waves can also potentially pose a safety issue to surfers. Reflected waves propagating seaward can pass through normal incoming waves with no effect, or can meet incoming waves and create a condition known as destructive interference. The outbound and inbound waves meet and the resulting transfer of energy can cause the waves to pitch up in a chaotic sea state, posing a potential safety risk to surfers.

Construction is likely to produce some adverse effects in regard to noise level, air quality, and near off-shore water quality levels in the construction area. Adverse noise, water and air quality effects will be most prevalent in the spaces directly surrounding the project's features. Where these areas are close to residential areas and other sensitive land uses, direct construction-related effects to health and safety are expected. Sand placement will be accompanied by some temporary increase in noise level, increased turbulence in the near off-shore waters and some limited air quality decreases. Additionally, the project will not be relocating or displacing any emergency or health-related public services. Therefore, there are no likely construction-related direct effects to health and safety, in regard to access to emergency services.

All effects associated with noise, air quality, and water are generally localized to the areas outlined above, and construction-related indirect effects to health and safety, in regard to an increase in these dangers, are unlikely.

Increased levels of construction within the project area raise the possibility of emergency services experiencing increased activity responding to work-related injuries. Given standard construction health and safety practices, however, it is unlikely that any incremental increase in emergency services demand would be significant. Thus, there are no likely construction-related indirect effects to health and safety, in regard to access to emergency services.

Displacement/Impacts to Minorities and Special Interest Groups

As discussed above, displacements or relocations related to the construction efforts surrounding the project are unlikely. The construction footprint being on a public beach and the small workforce required for construction indicated an unlikelihood for impacts.

Displacement/Impacts to Businesses

Displacement or relocations to beach businesses are expected to be temporary and minimal. Construction will impact a limited number of beach concession businesses for a short period of time during the off-season. These impacts are considered insignificant. Given the small labor force and unaffected traffic flows the indirect impacts to businesses outside of the construction area are expected to be insignificant as well.

Displacement/Impacts to Agriculture

There are no agricultural activities in the area and no impacts are anticipated.

Displacement/Impacts to Recreational Areas

Construction will take place on a public beach during the off-season. The project will cause temporary impacts along the beach as beach fill proceeds along the beachfront. The active beach fill area will be unusable for a short period of time as sand settles and dries and adjacent areas will suffer from an increase in water turbulence. These impacts will move along the beach as the beach fill program progresses. Beach use activities will be impacted in the immediate area of current fill activity, but given the off-season construction timeframe and the overall length of the beach a significant impact is not anticipated.

Community Growth

Generally, a project is expected to promote growth if it contributes substantially to the population or economics of the area. The NED Plan is not expected to significantly contribute economically to the area during the construction phase in a direct and indirect manner. Additionally, neither plan is expected to contribute to any rise in area population, directly or indirectly, during the construction. Finally, each municipality or county controls growth in their respective areas through land use and growth policies. Other, more powerful economic considerations also directly influence area growth. Thus, plan construction is not expected to affect community growth, either directly or indirectly, during the construction.

Project Impacts and Connectivity of the Community

Connectivity is generally defined as the degree to which residents feel a sense of belonging to their neighborhood or municipality. Other important measurements include the level of commitment residents feel to the community and the level of attachment residents have to certain neighbors, groups, or institutions. Generally, these levels are higher as a result of continued association over time. Major impacts to community cohesion are generally caused by displacements to important community businesses, centers of community interactions (churches, community centers, recreation areas) or large tracts of residences. Impacts can also occur through a project separating or dividing individual communities. Finally, visual impacts can affect the quality of adjacent communities, which can sometimes affect connectivity depending on the severity of the impact.

As discussed above, construction is not expected to displace any residences, businesses, or important community areas. Some temporary recreational impacts will be experienced and potentially people may choose to travel to unaffected recreational points if construction-related disturbances are particularly annoying. However, while a small direct effect in respect to impacts to recreational areas, this minor drop in attendance is not expected to affect community connectivity directly to any significant degree. Thus, the NED Plan is not expected to directly affect connectivity during construction.

4.9.3 Environmental Quality (EQ) Account

The Environmental Quality (EQ) Account is another means of evaluating the alternatives. The EQ Account is intended to display long-term effects that the alternatives may have on significant environmental resources. Significant environmental resources are defined by the Water Resources Council as those components of the ecological, cultural and aesthetic environments, which, if affected by an alternative, could have a material bearing on the decision-making process.

The NED Plan is not expected to have great impacts on the significant environmental resources in the study area. The most significant environmental resources in the study area are the T-Street Reef, surfgrass, kelp, and lobsters. The effects of the NED Plan on the Reef and its supported resources will be minimal as the fill will only encroach on its nearshore portions and is not expected to equilibrate onto the offshore portions of the Reef or cause significant burial of the Reef. The NED Plan would have minimal effects on the surfgrass in the region as partial burial of the surfgrass in the inshore portion of the reef would likely result. The inshore portions of the Reef will experience a sand accumulation ranging from very minimal (i.e. 0%) to minimal (roughly 35%). The NED Plan is not expected to have any effect on the diverse kelp species present in the study area as its equilibrium footprint is not expected to reach or cover their habitat areas. Finally, due to the equilibration and cross-shore transport processes from the beach fill, some of the lobster habitat areas in the shallow subtidal may be negatively affected by being covered with sand. However these effects would likely be minimal as lobster habitat areas are periodically covered and uncovered by sand naturally. The beach fill from this alternative would have only minimal effects on the large kelp and reef area near the end of San Clemente Pier and other rocky habitat farther than about 150 meters (500 ft) from shore and would not degrade that habitat for lobsters.

4.10 Value Engineering Activities

ER 11-1-321 Appendix F, Section F.1, subsection 2(d) provides an example of the requirements needed for the capability of an in-house value engineering (VE) team based on an Annual VE Guidance Plan for USACE use. This section states that the "VE team must have an adequate amount of training and appropriate and sufficient experience" in the essential disciplines needed on projects, including "Architectural, Civil, Structural, Electrical, Mechanical Engineers, Cost Engineers, Environmental Scientists and other specialty consultants." The Project Delivery Team (PDT) members contributing on the San Clemente Shoreline Feasibility Study had an adequate amount of experience and training to cover this requirement.

During the feasibility phase of the study, alternatives were developed by plan formulation, coastal engineering, economics, environmental studies, cost engineering, and geotechnical engineering team members whose combined experience resulted in a sufficient level of VE analysis. The alternatives developed during the plan formulation phase of the study should be

considered the result of significant planning, engineering, environmental, and economic analysis yielding highly cost-effective options for reducing shoreline damages in San Clemente, CA.

Specific examples of VE activities completed during the study include selection of borrow site, the screening of alternatives, study area refinement, and cost engineering estimation. As discussed in the Appendix E of the EIS/EIR, the borrow site offshore Oceanside, San Diego County, was chosen based on sediment compatibility with the receiving beach as well as quantity of material available. This borrow site was identified by the USACE Geotechnical Branch in 2003 as suitable for use in this study based on the aforementioned criteria. Incorporation of this criteria in borrow site selection provided a means to meet sediment compatibility requirements for a dredge-nourishment operation, thus minimizing future study costs. It should also be noted that beach compatible sand is the only construction material that is reasonable and environmentally acceptable to use for beach nourishment, therefore, material selection was not a factor considered for VE activities.

During the screening of alternatives, several structural alternatives were eliminated due to costs that would not be in the federal interest (discussed in Section 4.6.6). Among these alternatives were breakwaters and groins. Breakwaters and groins were both eliminated during initial screening of alternatives as they would demand extremely high costs, potential environmental impacts and severe public opposition. Initial screening of these alternatives ensured that only highly-cost effective and acceptable alternatives, specifically beach nourishment, were carried into the feasibility phase for further analysis.

In addition to the screening of alternatives, the refinement of the study area (Section 2.1 "Reach Selection Criteria") contributed to the VE efforts within the plan formulation phase of the study as several reaches were excluded from further analysis due to lack of potential NED benefits. For example, Reaches 2, 4, and 8 were eliminated from further study because their average beach width ranges from 15 to 19 meters (50 - 63 feet) wide, and the lack of ocean side development suggests NED benefits in these reaches would be primarily recreational. This realization allowed further time and analysis be spent on Reach 6, an unprotected 1,040 meter (3,412 foot) stretch of beach that would likely yield the greatest NED benefits and potential for project justification later in the feasibility study.

Finally, the cost estimation performed in the study provided the most accurate estimate of what the project would actually cost based on the methods of calculation. The software program used, The Cost Engineering Dredge Estimating Program (CEDEP), employs the best available methods for cost estimation on a USACE project. CEDEP meets the requirements for preparing estimates in lieu of using the Micro-Computer Aided Cost Engineering System (MCACES) software program.

4.11 The Environmentally Preferred Alternative

The National Economic Development (NED) Plan account identifies beneficial and adverse effects on the nation's economy. Beneficial effects are increases in the economic value of the national output of goods and services from a plan. Adverse effects are the opportunity cost and resources used in implementing a plan. The "NED Plan" is the plan that maximizes the economic benefits to the nation. An array of beach nourishment alternatives ranging from 10 m (33 ft) to 60 m (198 ft) widths were analyzed to determine the plan with the maximum NED benefits. The 15 m (50 ft) Beach Width Alternative has been identified as the NED plan.

The Environmentally Preferred Alternative is the alternative that has the least negative impact on environmental resources in the study area. The 15 m (50 ft) Beach Width Alternative, in addition to being the NED Plan, is identified as the Environmentally Preferred Alternative.

4.11.1 Alternatives Evaluation to Determine the Environmentally Preferred Plan

During the course of evaluating each of the alternatives, it was discovered that there is a potential for environmental impacts to varying degrees with the various alternatives. While the 15 meter plan has been identified as the National Economic Development (NED) Plan, the planning process requires that the recommended plan meets both the prescribed criteria as well as not violating the constraints identified for this study.

During the analysis of the alternatives, the estimated equilibrated profile at the T-Street Reef was used to determine the potential impacts each alternative would have to both the surfgrass as well as surfing. The estimation for toe of fill and resultant rock coverage was based on the profile translation method. The profile translation method was deemed better able to represent potential habitat burial impacts over a rigorous volumetric analysis.

In southern California typical depth of closure ranges between 8-15 m (26-50 ft) water depth. This range is applicable for beaches that have a full sand shoreface and are able to exchange sand cross-shore unrestricted. Recent repetitive profile surveys conducted at T Street indicate that the depth of closure is -4.9 m (-16 ft). This corresponds to the middle portion of the offshore reef. The repetitive surveys suggest that all sand material on the beach is trapped between the foreshore and the offshore reef. Seaward of the reef is bedrock and the repetitive profiles indicate no changes.

The toe of fill in the present analysis was placed at 8 m (26 ft) depth. This toe of fill depth was chosen to represent possible extreme cross-shore transport mechanisms (i.e. severe storm). The toe of fill delineation was not volumetrically balanced with the fill volume. The profile translation method results in a very conservative estimate which translates to a conservative estimate of bottom coverage and possible habitat impacts. This decision was deliberate reasoning that a conservatively large estimate (as opposed to an aggressively small estimate) was appropriate to highlight the potential impacts to bottom habitat. This analysis is presented below.

Alternative 2 – 15 meters

Surfing: The equilibration footprint of a 15 m beach fill (shown in **Figure 4-7**) is less likely to significantly modify the refractive abilities of the most seaward extent of the reef. This alternative could potentially have impacts to the surf zone region between shoreline and the take off zone. The surfing experience might consist of a normal take-off after which leads to a (shorter) "close-out" as the wave encounters the straightened bathymetric contours.

Surfgrass: Partial burial of the surfgrass in the inshore portion of the reef would likely result. The equilibrium cross-section profile of the 15 m beach width alternative suggests that the inshore portions of T-Street reef will experience a sand accumulation of about 0.5 m (1.7 ft). Surfgrass in this area grows on 0.3 to 0.6 m (1 to 2 ft) boulders and has average blade lengths of 0.6 to 1 m (2 to 3 ft). Therefore, the equilibrium footprint of the 15 m alternative likely would result in a range of impacts between no burial of surfgrass on the larger rocks and up to 0.2 m (0.7 ft) of burial of surfgrass on the smaller 0.3m (1 ft) boulders. Some of the surfgrass in the shallower area, thus, would experience burial of between about 25 and

35 percent of its blade length. Burial of surfgrass on the outer portions of T-street reef would be minimal. Surfgrass is adapted to partial sand burial, routinely survives seasonal sand burial of part of its blades, and can recover quickly via regrowth if the root system is intact; however, the degree of sand burial surfgrass can withstand is not well documented . Some of the surfgrass in the deepest portion of T-Street reef has 2/3 of its blades covered with sand, which suggests that surfgrass could withstand temporary burial of up to 2/3 of its blade length. A recent laboratory study of *Phyllospadix scouoleri* suggested that short term sand burial may result in shoot mortality, decreased shoot counts, and reduced growth of surfgrass. The study found that shoot density decreased compared to controls for a burial depth of 25 cm (0.8 ft), but not shallower burial depths. Mean shoot growth rate decreased in all burial treatments. Therefore, the 15 m Beach Width Alternative may result in some degradation of the shallower portion of the surfgrass habitat, but would not result in a substantial loss of surfgrass. For the 15 m alternative, the sand from the beach fill is predicted to move out of the equilibrium footprint within four years. The continuing renourishments are not expected to have differing impacts on surfgrass from the initial nourishment.

Kelp Beds: High-value reef habitat that supports giant kelp, feather boa kelp, gorgonians, palm kelp, and sparse surfgrass is located approximately 300 to 400 m (1,000 to 1,300 ft) from shore. Little or none of the fill from the 15 m alternative is expected to reach this area.

Lobsters: In addition to partial burial of surfgrass, offshore movement of sediment may result in filling in some holes and crevices in the shallow subtidal that are used by lobsters. These shallow subtidal reef areas are periodically covered and uncovered by sand naturally (i.e., in the absence of a beach nourishment project). The beach fill from this alternative would have only minimal effects on the large kelp and reef area near the end of San Clemente Pier and other rocky habitat farther than about 150 meters (500 ft) from shore and would not degrade that habitat for lobsters.

Resource Agencies: NOAA Fisheries (NMFS) has some concerns about this alternative because of the potential surfgrass impacts, but the Fish and Wildlife Service (FWS) and CA Department of Fish and Game (CFG) seemed to be in concert with this alternative. Nonetheless, the FWS is developing and composing the mandated Fish and Wildlife Coordination Act Report (CAR). The FWS will use information and concerns from NMFS and CDFG in developing their consensus CAR. In addition, as stated in Section 5.4.2 of the EIS, the NED Plan is not expected to have significant impacts on Essential Fish Habitat in Reach 6.

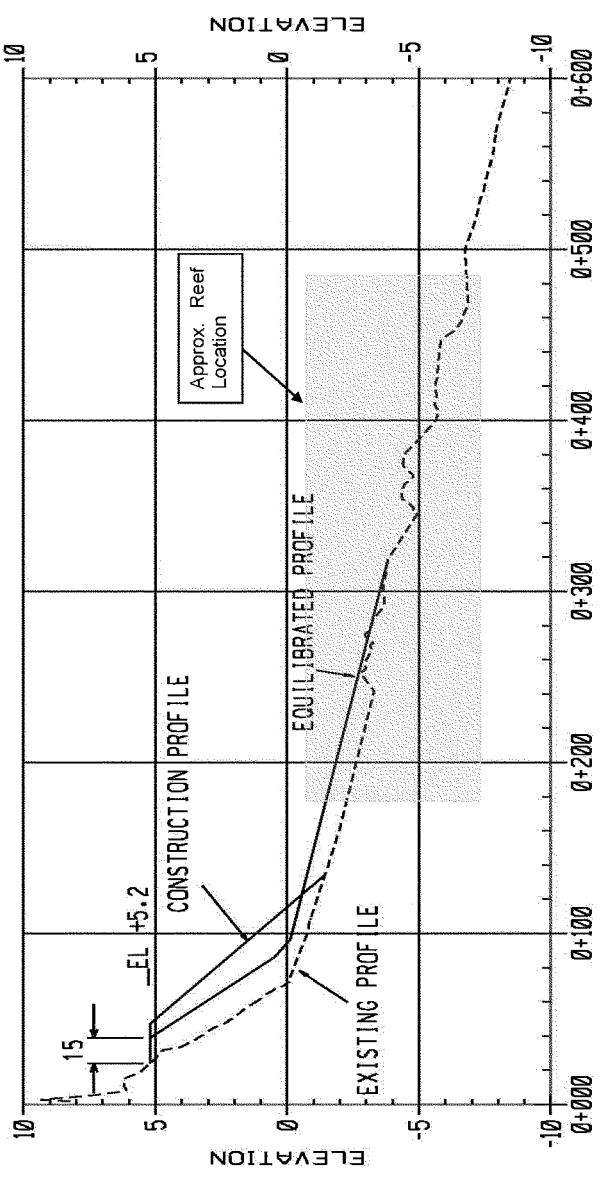


Figure 4-7 15 m Alternative

Alternative 3 – 20 meters

Surfing: Impacts would potentially be greater than the 15 m alternative, with both takeoff and close out potentially being affected, thus causing an abrupt "take off" and a much shorter "close out" and reducing the effects on wave formation. .

Surfgrass: Based on the cross section profile, the 20 meter alternative (see **Figure 4-8**) would result in sand cover over most of the T-Street Reef. The predicted depth of burial of the inshore portions of the reef would be about 1 m (3 ft). Surfgrass growing on the 0.3 to 0.6 m (1 to 2 ft) boulders in this area would have their blades covered by 0.3 to 1.2 m (1 to 4 ft) of sand. Some surfgrass growing on the smaller 0.3 m (1 ft) boulders would be buried completely. Surfgrass with 1 meter (3 ft) blades on 0.6 m (2 ft) boulders would only have about 1/3 to 1/2 of their blades buried. On the offshore portions of the reef burial would range from about 0.2 to 0.8 m (0.8 to 2.7 ft) with most of the burial between about 0.5 to 0.6 m (1.5 to 2 ft). Surfgrass on the 0.3 m (1 ft) boulders that are typical of offshore would have between 0 and 93 percent of their blade lengths covered by sand. Because some of surfgrass on the offshore edge of the reef already has up to 2/3 of its blade length buried, some surfgrass at the offshore edge of the reef would be completely buried. Therefore, the 20 meter alternative would be expected to result in some effects on all of the surfgrass habitat on T-Street Reef and complete loss of some of the surfgrass throughout the reef.

Kelp: Approximately 20 percent of the offshore reef that supports kelp and other sensitive resources would be within the equilibrium footprint of the 20 m alternative. The increase in sediment thickness on the affected portion of the offshore reef would be expected to range from less than 0.3 to 1 m (1 to 3 ft). The portions of the reef affected by sediment transport might not support kelp recruitment and sea fans, which are sensitive to sedimentation, may be killed. Holes and crevices used by fishes, crabs, and lobsters may be filled with sediment.

Lobster: Much of the reef habitat used by lobster out to about the depth of the end of the Pier may be affected by sedimentation. Holes and crevices in the rocks that lobster use for shelter may become filled with sand with some degradation of habitat.

Resource Agencies: The FWS' CAR could have a negative slant to its conclusion for this alternative for surfgrass and other marine resources that will be affected, such as the micro and macro benthic invertebrates as well as effects to essential fish habitat. FWS could conclude that the 20 meter alternative is not the least damaging alternative.

The Corps will develop and submit, under the California Coastal Commission's Federal Consistency Program, a Coastal Consistency Determination (CCD) to the California Coastal Commission (CCC) staff, which may result in a negative staff report to the CCC Commissioners. Much will depend on how surfing is affected under the Coastal Act's Section 30220 Protection of certain water-oriented activities as well as Sections 30230, 30231, 30233(d).

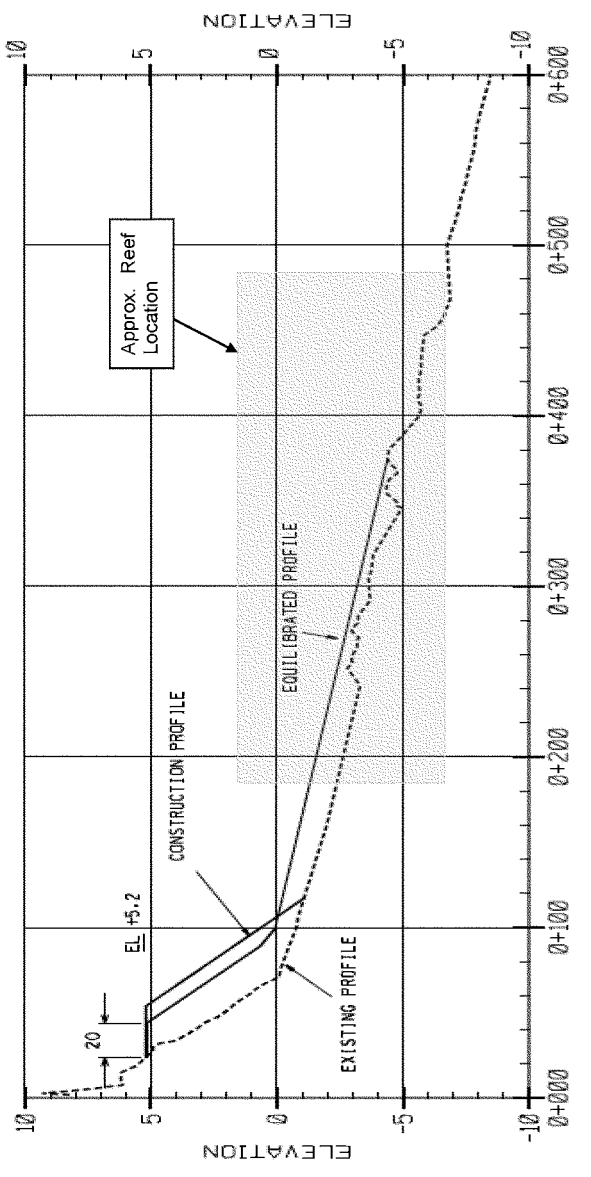


Figure 4-8 20 m Alternative

Alternative 4 – 25 meters

Surfing: Impacts would potentially be greater than the 15 m alternative, with both takeoff and close out potentially being affected.

Surfgrass: The impacts to surfgrass on T-street Reef for the 25 meter alternative (see **Figure 4-9**) would be similar to the impacts of the 20 m alternative.

Kelp: The equilibrium footprint of the 25 m alternative would affect about 40 percent of the reef and kelp bed offshore of San Clemente Pier. Sediment cover may retard kelp recruitment on the affected portion of the reef. Sea fans may suffer negative impacts from sedimentation. Holes used by lobsters, crabs, fishes, and other animals may become filled with sediment.

Lobster: The 25 m alternative will affect rocky habitat used by lobster out to about 366 meters (1200 ft) from shore.

Resource Agencies: Same as above for 20 meter, but a greater probability (<95%) of receiving a negative staff report to the CCC Commissioners.

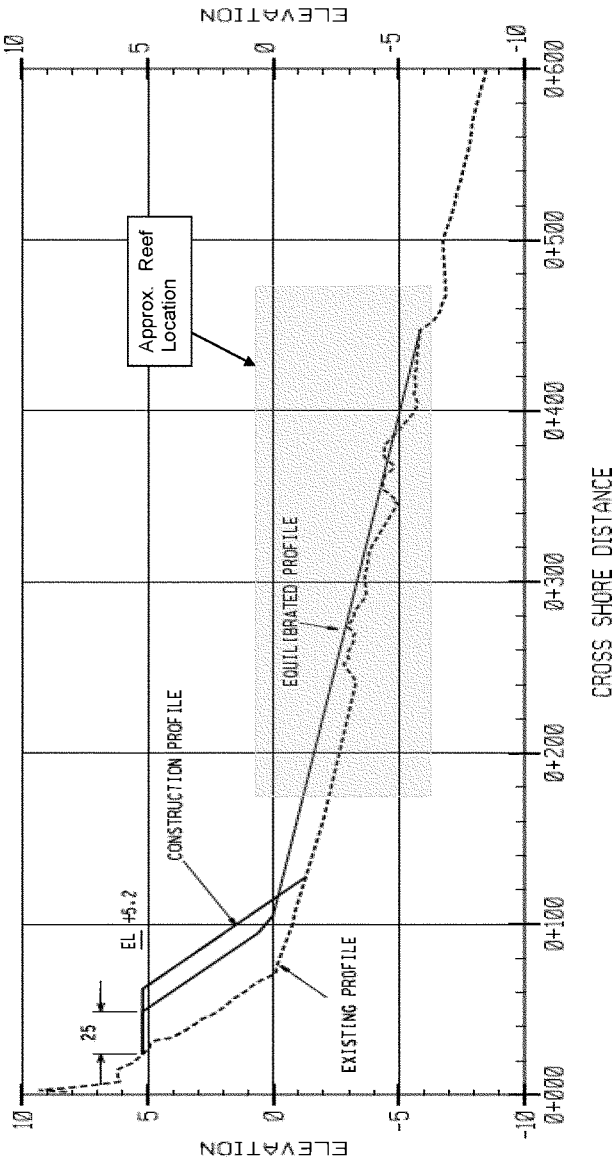


Figure 4-9 25 m Alternative

Alternative 5 – 30 meters

Surfing: Impacts would potentially be greater than the 15 m alternative, with both takeoff and close out potentially being affected.

Surfgrass: Impacts of the 30 m alternative (see **Figure 4-10**) to the surfgrass on T-street reef would be similar to the 20 and 25 m alternatives. The entire reef would be affected by sedimentation resulting in degradation of the entire habitat.

Kelp: The equilibrium footprint of the 30 m alternative would result in sedimentation of about 60 percent of the reef off San Clemente Pier. Sediment cover may retard kelp recruitment on the affected portion of the reef. Sea fans may suffer negative impacts from sedimentation. Holes used by lobsters, crabs, fishes, and other animals may become filled with sediment.

Lobster: The 30 m alternative will affect rocky habitat used by lobster out to about 457 meters (1500 ft) from shore.

Resource Agencies: Same as above for 20 meter, but a greater probability (<95%) of receiving a ***denial*** report to the CCC Commissioners.

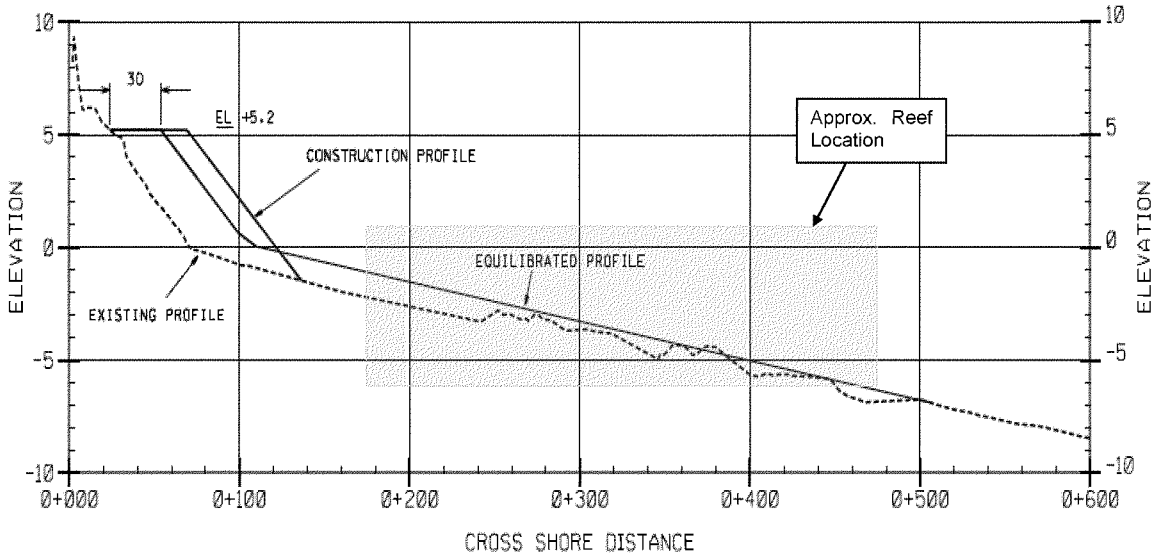


Figure 4-10 30 m Alternative

Alternative 6 – 35 meters

Surfing: The final equilibrium profile of this alternative is shown in **Figure 4-11**. Since the surfing area extends from the existing shoreline to approximately 200 m seaward, this creates an immediate potential for impacts to the surfing area. As sand is introduced into the reef system, the characteristic reef shape could be modified and/or lost as it becomes covered by a sand bar. The refractive abilities of the reef may be modified or lost, lessening the focusing effect of the reef and thereby erasing the "point break" characteristics of T-Street. As the reef continues to fill in with sand, the overall bathymetry of the area may begin to become straight and parallel and the wave will lose its ability to "feel" the reef. The wave may begin to exhibit more spilling characteristics normally associated with beach breaks. This also has the potential to modify the consolidated "take-off" zone and be replaced by a more disorganized situation containing many "take off" zones with shorter, more varied break directions. The straightening contours may also cause the wave to tend to break all at once, termed a "close-out" condition. Further flattening of the slope in the reef area due to sand introduction into the reef system ultimately has the potential to change the characteristic plunging point break to a quasi- spilling beach break

Surfgrass: Impacts of the 35 meter alternative on T-street reef would be similar to the impacts of the 20, 25 and 30 meter alternatives because the entire reef would be affected by sedimentation. The shallow portions of the reef may be buried by over a meter of sand (about 3 ft). This level of sedimentation would result in at least partial burial of all of the shallow surfgrass in the inshore portions of the reef. Surfgrass on the smaller boulders would be completely buried, and surfgrass on the larger boulders would have ½ to 2/3 of their blade length buried. On the offshore portions of the reef, burial impacts would be expected to range from about 0.3 m (1 ft) to 0.8 m (2.7 ft). Because some of the surfgrass at the offshore edge of the reef already has up to 2/3 of its blade length buried, some surfgrass at the offshore edge of the reef may be completely buried. Therefore, the 35 m alternative has the potential to result in substantial burial of surfgrass with likely significant adverse impacts on the surfgrass habitat.

Kelp: The 35 m alternative would result in sedimentation of considerable reef habitat that supports giant kelp, feather boa kelp, gorgonians, palm kelp and sparse surfgrass. Sediment from the 35 m alternative would affect about 70 percent of the offshore reef. The increase in sediment thickness in this reef habitat may be as much as 1 m (3.3 ft) in places. The burial of up to a meter of reef habitat may include some of the smaller rocks and prevent the recruitment of kelp. The sedimentation also may kill gorgonians and fill in crevices used by lobster. The 35 m alternative, thus, has the potential to result in substantial degradation of high-value nearshore reef habitat.

Lobster: The 35 m alternative would affect a greater amount of rocky habitat used by lobster than any of the other alternatives. The majority of rock patches and reefs in the project area would experience sedimentation effects from this alternative.

Resource Agencies: Same as above for 20 meter, but ***denial*** from staff report to the CCC Commissioners.

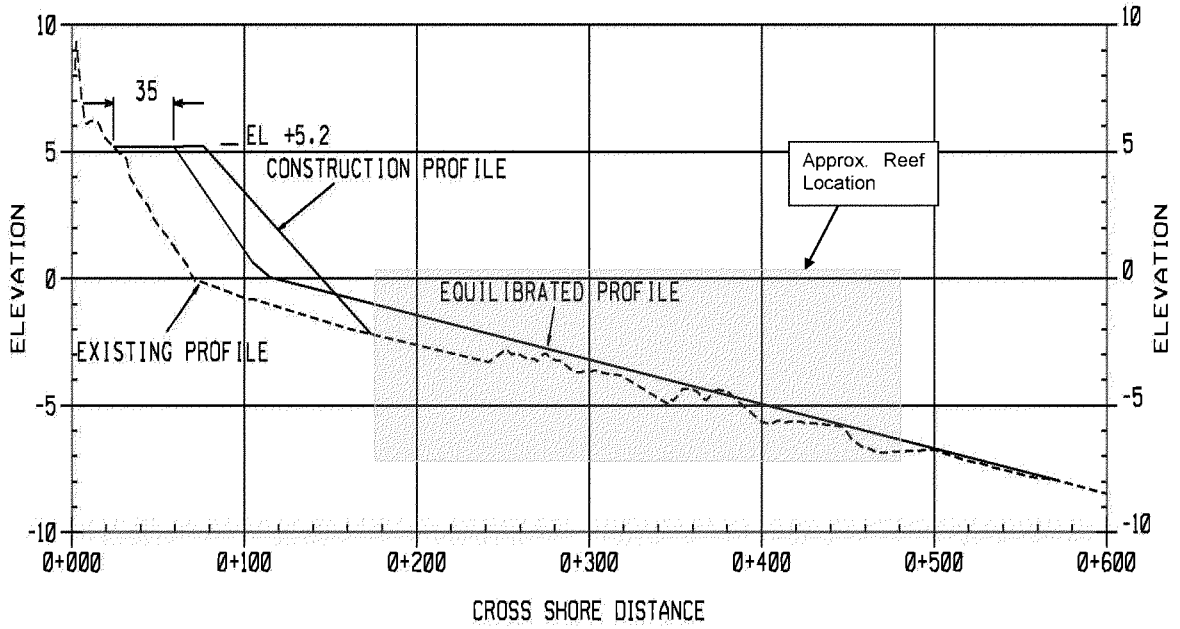


Figure 4-11 35 m Alternative

4.11.2 The Environmentally Preferred Plan: 15 m (50 ft) Beach Width Alternative

For the reasons described in the section above, it was concluded that the 15 m Beach Fill Alternative is the Environmentally Preferred Plan.

4.12 Summary of Potential Environmental Consequences for the NED Plan

The sand placement footprint for the NED plan does not include any kelp beds, surfgrass, or rocky intertidal areas, therefore, no direct impacts to sensitive habitats would occur from the placement of sand on the beach.

Following initial placement, a portion of the sand may move upcoast, downcoast, and offshore depending on the magnitude, direction, and period of waves. The nearest significant rocky intertidal area to the proposed beach fill location is at Mariposa Point, approximately 485 m (1,600 ft) north of the northern end of the beach fill site at Linda Lane. The net movement of beach sands in the Project area is expected to be southerly, but some northerly movement may occasionally occur. Based on monitoring of the SANDAG beach fill project at Oceanside, most sand movement is expected to be toward the south (USACE 2009). Therefore, it is unlikely that significant quantities of sand will be transported to the north to the rocky intertidal habitat at Mariposa Point. The equilibrium footprint for the 15 m (50 ft) Beach Width Alternative indicates that sand will not extend as far upcoast as Mariposa Point.

In addition, the proposed alternative would not place anchors for the mono buoy, where the hopper dredge will moor while it discharges sand to the beach, or place the sinker pipeline that will pump the sediment to shore from the hopper dredge on any sensitive habitat. The construction contractor shall avoid placement of anchors or the submerged pipeline onto reef habitat, which could crush attached organisms. The construction contractor shall also avoid side to side movement of the anchors or pipeline as they are placed, which could abrade surfgrass, algae, or attached invertebrates. If a substantial amount of surfgrass or kelp were affected by placement and removal of anchors and pipelines, the impact would be considered significant. These impacts would be avoided and minimized by performing a pre-construction survey to identify anchor and pipeline locations that would avoid sensitive resources. Because most of the surfgrass in the Project area grows on T-Street reef, it is possible to avoid surfgrass by avoiding the reef when laying the pipeline. In addition, to avoid impacts to reefs that support kelp and other sensitive species such as gorgonians and surfgrass, the hopper dredge should moor inshore of these reefs, which are located approximately 350 to 400 m (1,200 to 1,300 ft) from the beach.

4.12.1 Potential Impacts

Habitat Impacts

The 15 m (50 ft) beach width alternative would use the dredged sand to widen approximately 1,040 m (3,412 ft) of San Clemente Beach coastline. The immediate post-construction width of the beach would be approximately 23 m (76 ft), but through winnowing and adjustment the eventual beach width would be about 15 m (50 ft). The construction footprint for this alternative would be approximately 113,242 m^2 (28 acres (ac)). The equilibrium footprint, resulting from some of the placed sand moving offshore, would be approximately 499,286 m^2 (124 ac).

The proposed fill would be expected to have varying levels of burial impacts due to seasonal cross-shore movement of sediment (Appendix D of the EIS/EIR). During the summer months, the equilibrium profile is expected to be biased towards the shoreline. During the summer, when lower wave energy conditions are prevalent, sediment typically migrates across the profile from deeper water to shallower water, resulting in a net accumulation of sediment in the foreshore. During the winter months, the equilibrium profile would be biased toward the offshore bar. Higher energy winter wave conditions cause sediment to move across the profile from shallower water to deeper water, resulting in a net gain of sediment towards the offshore tail of the profile.

The beach fill proposed for San Clemente would be expected to perform in a manner consistent with other recent beach fills. **Figure 4-12** shows the profile for a recent fill by SANDAG of 319,960 m^3 (421,000 cy) along 1,321 m (4,400 ft) of beach at Oceanside. This profile shows a movement of up to 2 m (6 ft) of thickness across the profile. In general, beyond about 0 MLLW, the post beach fill profiles were within the range observed prior to the beachfill. **Figure 4-7** shows the cross sectional distribution of this sediment for the 15 m (50 ft) Beach Width Alternative.

These temporary burial impacts in the nearshore area could result in temporary adverse effects, including partial burial of T-Street reef. Although these effects would be adverse, because they would be short-term and only would occur in the inshore portions of the reef, they would not result in a substantial adverse modification of nearshore topography.

Surfing Impacts

Some of the sand placed on the beach for the 15 m (50 ft) Beach Width Alternative would move offshore. At T-Street reef, most of this sand would accumulate in the shallower portions of the reef. The potential effects on the nearshore wave dynamics could be considered adverse depending on the consideration (e.g., surfing or sand transport). The sand from the 15 m (50 ft) Beach Width Alternative would persist for up to four years, however, the level of burial is expected to steadily decrease during this time at about a 4 m (13 ft) loss per year erosion rate. Therefore, the impacts to wave characteristics, although potentially adverse, would be relatively short-term and less than significant.

The impacts on surfing quality from this sand movement are not rigorously quantifiable. Because the equilibrium footprint would not extend into the offshore portions of the reef, it would not be likely to significantly modify the refractive abilities of the most seaward extent of the reef. However, the 15 m (50 ft) Beach Width Alternative may have impacts to the surf zone region between the shoreline and the "take-off" zone, or the area where surfers start their ride as the surfboard is propelled by the wave. The surfing experience might consist of a normal "take-off," but then "close-out" as the wave encounters the straightened bathymetric contours inshore (USACE 2009); a "close-out" condition is when a wave breaks along its entire length at once. Although impacts due to the wider beach may occur, historic aerial photographs of San Clemente Beach at the Pier indicate that the beach width in 1990 was approximately 17 m (55 ft) wide and no records have been found that indicate surfing ceased within the Project area during that time.

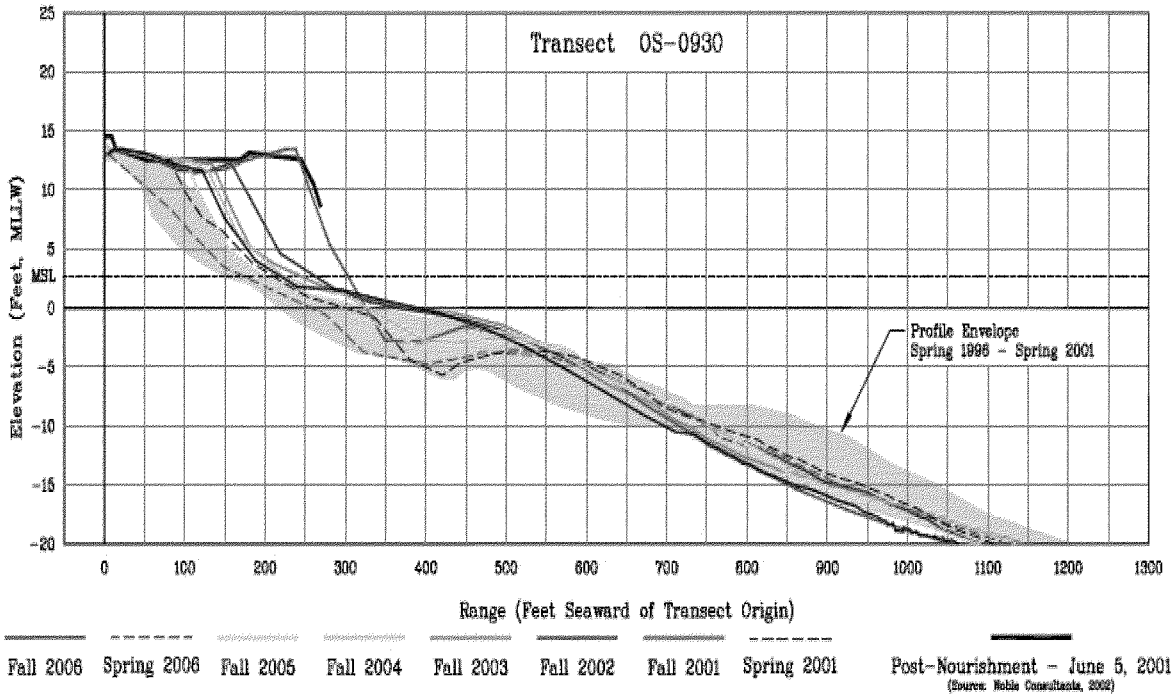


Figure 4-12 SANDAG Oceanside Beach Fill Profiles (Before and After Construction)

5 RECOMMENDED PLAN

5.1 General

The NED Plan is the plan that has a benefit-to-cost ratio greater than one and produces the greatest net benefits. The alternatives, with limited recreational benefits, range from 1.48 to 1.88 and $914,469 to $1,299,188 for B/C ratios and average annual net benefit, respectively, for the base sea level case. The Alternatives range from 1.80 to 2.20 and $1,536,756 to $1,847,666 for B/C ratios and average annual net benefit respectively for the max sea level case. Based on the model optimization and analysis of the costs and benefits outlined above and documented in the appendices, Alternative 2, the 15 m beach width has the greatest economic benefits and is the NED Plan for both the base sea level case and the max sea level case. If max sea level rise did occur during the 50 year life of the project then the NED plan could be adjusted to meet the max sea level rise case.

USACE guidance states that all plans and designs shall be evaluated to determine how sensitive they are to these various rates of future local mean sea-level rise, how this sensitivity affects calculated risk, and what design or operations and maintenance measures can be implemented to minimize this risk.

For a project such as a beach nourishment project for which the beach is typically re-nourished every 5-10 years, the local mean sea level will be reevaluated every 5-10 years (in this case every 6 years), prior to renourishment, and accommodation for sea-level rise can be made during each renourishment period.

The effects of the maximum sea-level rise case on the NED Plan are relatively minor. The number of fills over the project life increase from 9.11 to 9.66 with maximum sea-level rise. Average Annual costs show a similar slight increase from $1,429,767 to $1,539,981. Benefits do increase with the increases in without project damages. The B/C ratio increases from the base sea-level case's 1.80 to 2.20 under maximum sea-level rise. Net annual NED benefits show a similar increase from $1,384,478 to $1,693,824. These results indicate the NED Plan is manageable with monitoring and is unlikely to have a significant degree of risk under sea-level rise. Sea-level rise analysis results for each alternative are discussed in detail in Appendix D of the EIS/EIR and the Economics Appendix.

5.2 Detailed Cost Estimate for the Recommended Plan

After identification of the NED Plan using the San Clemente Economics and Engineering model, a risk-based cost analysis was performed on the recommended plan. This required analysis incorporates qualitative and quantitative cost and schedule uncertainties associated with the project to determine a project contingency and, subsequently, the fully-funded project cost. The fully-funded project cost (shown in **Table 6-5**) is used and directly referenced when requesting project Authorization and Appropriation. The detailed analysis is fully described and presented in the Cost Engineering Appendix and follows guidance laid out in ETL 1110-2-573. The Project Cost and Schedule Risk Analysis (CSRA) Report was prepared in compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

The revised project cost is approximately 38% greater than the San Clemente model's estimate. A proportional increase to the initial fill cost of the model run would raise its cost to $10.45

million. The NPV of the project construction stream would be $42 million or $2 million on an annual basis. The revised Annual NED Benefits and B/C ratio can be found in T**able 5-1**.

Table 5-1 Alternative 2 - 15 meters Revised Annual NED Benefits & B/C Ratio
(50 yr amortization at 4.125%, FY11 Price Level)

Category	W/O Project	Alternative 2	Benefits/Costs
Structural Damages - Annual			
RR Construction & O&M Costs	$1,280,000	$13,000	$1,260,000
Trail Damage	$82,000	$6,000	$75,000
Structure & Content Damage	$63,000	$16,000	$47,000
RR Delay Costs	$0	$0	$ 0
Total Damage/Reduction	$1,420,000	$36,000	$1,380,000
Recreation – Annual			
Total Recreation Value	$10,700,000	$12,300,000	$1,660,000
TOTAL ANNUAL BENEFITS			$3,040,000
ANNUAL COSTS			$2,140,000
ANNUAL NET BENEFITS (UNLIMITED)			$901,000
B/C RATIO (UNLIMITED)			1.4

5.3 Recommended Plan

The recommended plan is developed by considering the storm damage reduction and recreational potential of various beach fill configuration alternatives and optimization based on the average annual benefits and the benefit/cost ratio. Primary optimization parameters of each alternative are the dimensions of the base beach width and sacrificial beach width of the cross-sectional design profile. An array of base beach widths and sacrificial beach widths yields a matrix of Project alternatives. Based on the evaluation of potential environmental impacts, the NED Plan, the 15 m (50 ft) Beach Width Alternative, is the recommended plan since it meets the storm damage reduction needs of the study area and has the least environmental effects of the alternatives.

Figure 5-1 shows in red a schematic of the recommended plan. A cross-section of the recommended plan is shown in **Figure 5-2. Figures 5-3** through **5-8** are visual simulations prepared by the Non-Federal Sponsor (City of San Clemente) to help depict the NED Plan. Although the visual simulations were prepared using data from this report, the simulations should be considered approximate and not an exact representation. Importantly, the visual simulations are intended only as a visual aid to help depict what the proposed project might look like several months after initial sand placement.

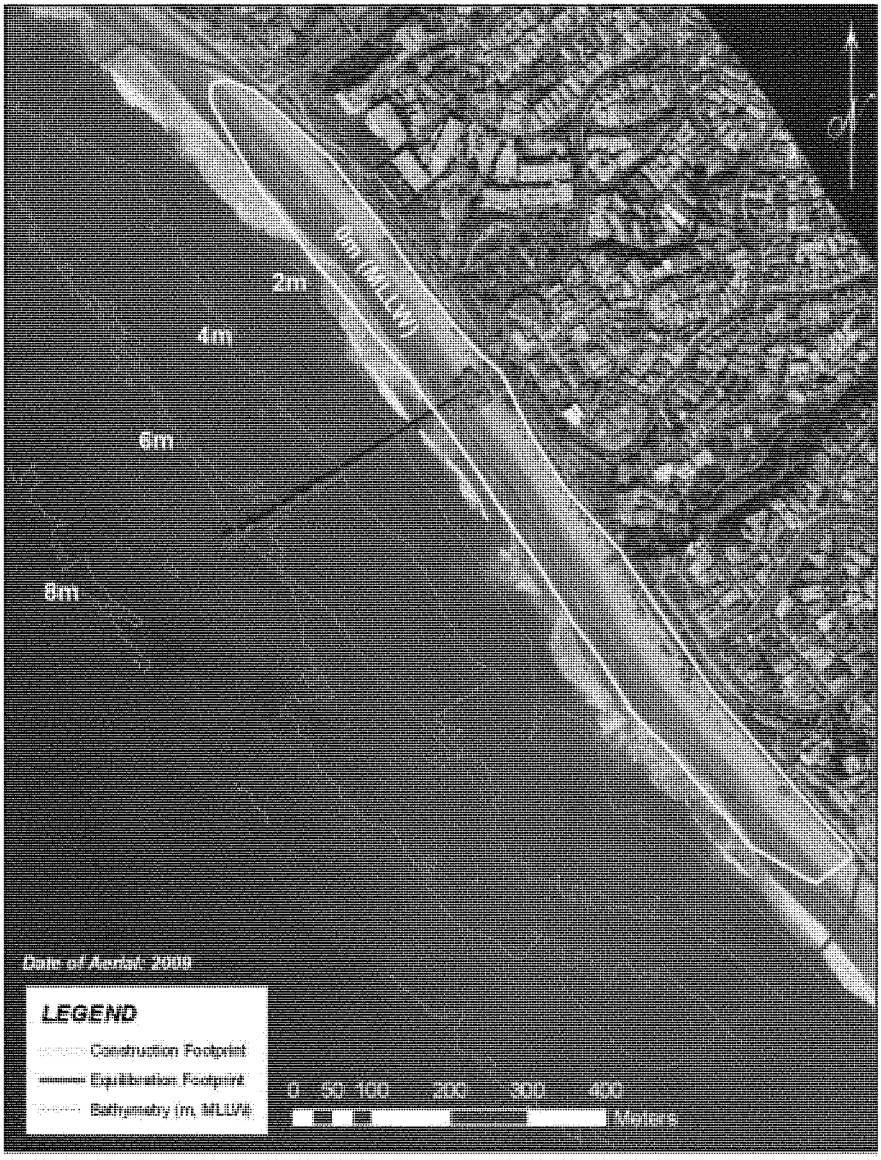


Figure 5-1 Recommended Plan Alternative 2, 15 m (50 ft) Beach Width

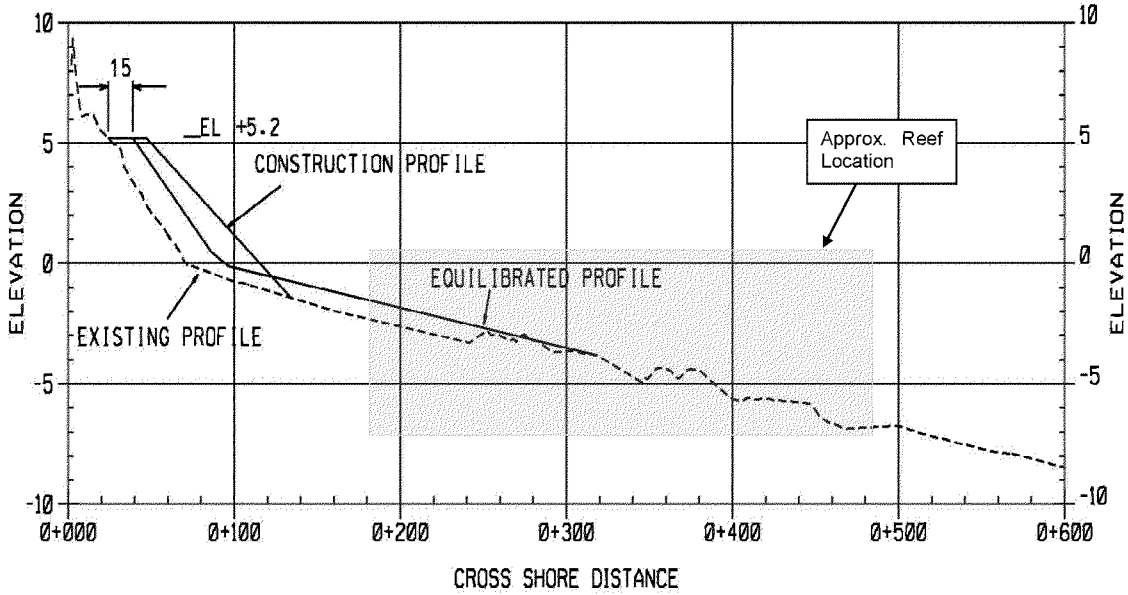


Figure 5-2 Cross Section Beach Fill of Recommended Plan

Before project

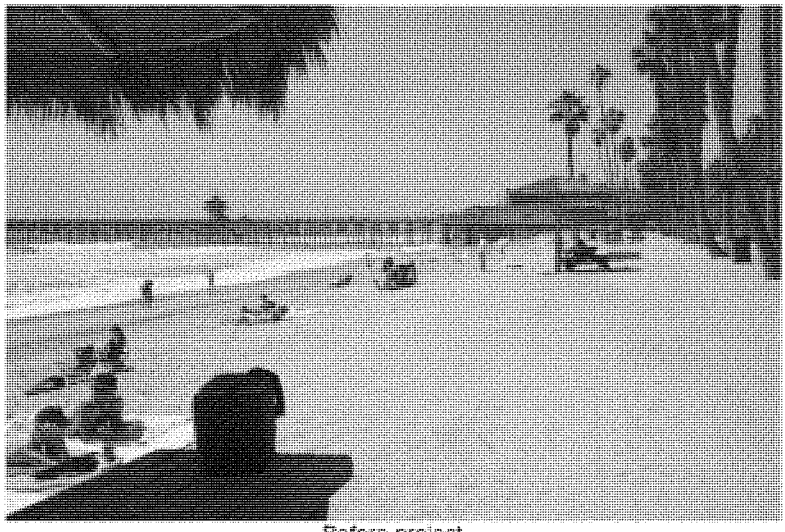
After project

Figure 5-3 View #1: From T-Street Overpass Looking North Towards the Pier

Before project

After project

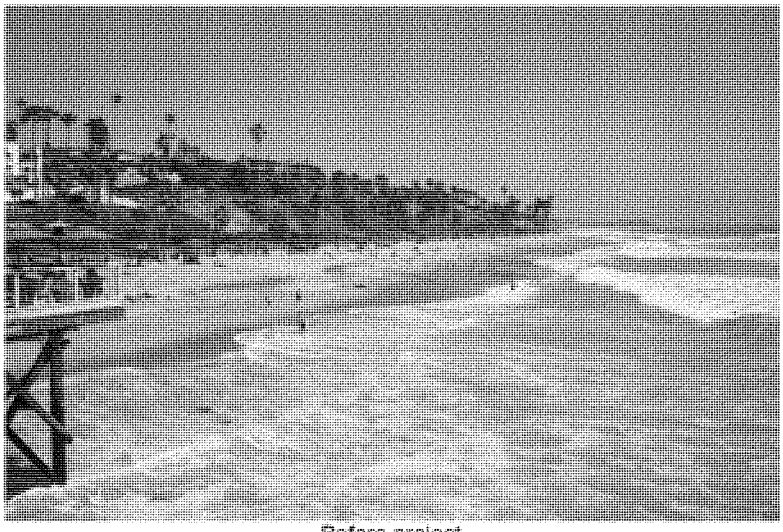
Figure 5-4 View #2: From T-Street Restroom Looking North Towards the Pier



Before project

After project

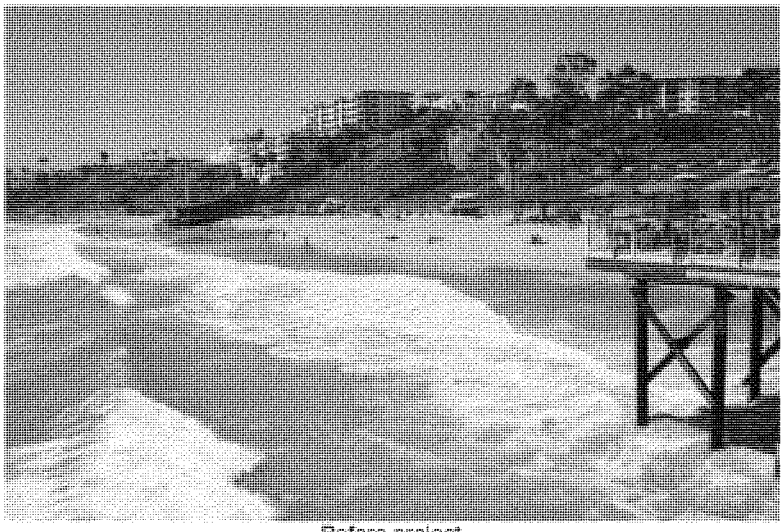
Figure 5-5 View #3: From North of T-Street Canyon Outlet Looking North Towards the Pier



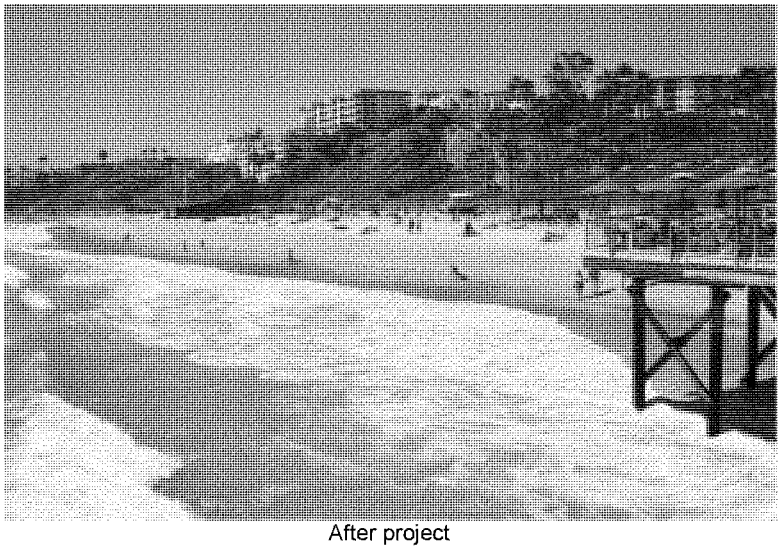
Before project

After project

Figure 5-6 View #4: From Pier Looking South



Before project



After project

Figure 5-7 View #5: From Pier Looking North

Before project

After project

Figure 5-8 View #6: From South of Marine Safety Building Looking South Towards the Pier

5.3.1 Parking and Access

Per ER 1165-2-130, sufficient public parking and reasonable access must be available in order for the Federal government to participate in shore protection projects. Sufficient parking and public access is provided to the project area. Of the current demand for parking spaces of almost 1100, there are almost that same number of spaces available within a 5-minute walk to the beach and even more spaces available if the distance is extended to 0.8 km (0.5 mi). There are 4 access points to the beach within the project area and one just north of the project area. Additional information on the types of access and parking available can be found in the Economics Appendix.

5.4 General Description of Activities

5.4.1 Beach Replenishment

The recommended plan is expected to perform in a manner consistent with other recent fills within the southern California region. A similar beach nourishment operation was performed in 2001 by the San Diego Association of Governments (SANDAG 2000). The project entailed dredging 1.6 million m^3 (2.1 million cy) of beach compatible sediments from 6 borrow sites for placement on 12 receiver beaches in San Diego County. Extensive project monitoring has been conducted semi-annually since project construction. The similarities of this construction project relative to the morphologic conditions, oceanographic climate, sediment characteristics, and construction techniques make this project directly comparable to San Clemente.

Much of San Diego County is morphologically similar to San Clemente. The similarities include high coastal bluffs, a close-to-shore rock platform, and typically narrow sand beaches (or often none). It is typical that background shoreline change rates throughout the region are small, on the order of -0.3 m/yr (-1 ft/yr) or less. It is noted, however, that the wave/sediment regime within San Diego County can vary substantially alongshore. Due to offshore island sheltering (waves) and submarine canyons (sediment transport), micro wave/sediment climates can and do exist. This makes any specific location-to-location comparisons difficult to substantiate.

Monitoring of the SANDAG receiver sites has been conducted semiannually since project construction. The beach at Oceanside is the transect that is deemed most applicable to San Clemente. At Oceanside Beach, the fill quantity (322,000 m^3 [421,000 cy]), median grain size (0.64 mm [0.03 in]), alongshore length (1,341 m [4,400 ft]), and fill width (56 m [185 ft]) are comparable to the recommended plan of this study, and its performance is deemed representative of expected performance at San Clemente. Estimates based on the SANDAG monitoring data suggest the San Clemente fill will erode on average at a rate of 3.9 meters per year (12.8 ft/yr). The data discussed in Appendix D of the EIS/EIR indicates that a beach fill erodes at substantially higher rates than the native beach. Due to the time varying nature of the wave climate, sediment supply to the beach, and other factors driving longshore sediment transport, it is expected that the beach will erode at a greater rate in some years, at a slower rate in some years, and possibly accrete in other years. According to the Coastal Damage Model results, it is anticipated that a fill will last about five and a half years.

A preliminary estimate of the volume of beach-compatible material was computed for Borrow Area No.2. Approximately 15,650,000 m^3 (20,500,000 cy) of near-shore beach-compatible material was calculated using a 4.5 m (15 ft) dredge depth. This material is suitable for near-shore placement at San Clemente Beach. The preliminary estimated amount of material for the initial placement is 192,000 m^3 (251,000 cy) of material on the beach or in the nearshore

environment. The total quantity of sediment required over the 50-year project lifetime based on 8 renourishments is 1,728,000 m^3 (2,260,000 cy). Thus, the sediment volume for the borrow site is sufficient for the recommended project alternative.

Variations in grain size occur within the borrow sediments. The simplifying assumption was made that the fill will be comprised of a blended mix of sediments represented by the mean grain size of the borrow materials. Construction observations on other beach fills within the Los Angeles District indicate a large percentage of borrow material fines are winnowed immediately during placement operations. As borrow materials are placed, the typical high wave energy washes out fines very quickly resulting in the coarser fraction within the fill area. There is little reason to believe that San Clemente will behave differently. Although it is expected that this fill will be constructed by hopper dredge methods, it was not deemed feasible to describe the materials within the fill or the fill performance on a scow-by-scow basis.

Hopper Dredge

This project will be constructed with hopper dredging equipment with pump ashore capability and conventional earthmoving equipment. Typical Los Angeles District beach fill projects require large capacity open-ocean capable dredges. Operational requirements typically result in hydraulic cutter head and/or hopper style dredges. The borrow site for this project is 35 km (21 miles) from the receiver beach and it is anticipated that the borrow site haul/pumping distance will require hopper dredging equipment utilization. Although Appendix E of the EIS/EIR recommends the use of cutterhead or mechanical dredging methods to ensure the blending of sediments and to reduce % fines, Appendix D of the EIS/EIR has recommended hopper dredging be implemented due to the distance between the borrow and placement sites. Appendix E of the EIS/EIR does state, however, that if hopper methods are used, cuts should be made as deep as possible to obtain the coarsest material possible.

Monobuoy w/ Hopper

The hopper dredge requires a monobuoy to discharge its sand onto the beach. A mono buoy is a floating pipeline connection platform that is moored to the seafloor, and is used to interconnect with a steel sinker pipeline that carries the slurry along the seafloor to the beach. The mono buoy is generally anchored to the seabed at an appropriate depth and location to serve the project needs, depending on locations of sensitive resources and engineering considerations. From one monobuoy location, sand can be pumped directly onshore.

Onshore Placement

The hopper dredge is filled at the designated borrow site at Oceanside and hauled 30 km (18.6 miles) to San Clemente. For the hopper methods, sand is combined with seawater until it reaches the consistency of slurry. At the receiver beach, the dredge is attached to a moored floating section of pipeline extending 450 meters (1,500 ft) to the shoreline. The material is re-suspended and discharged through its on-board pumping system to the receiver site.

Existing sand at the receiver site can be used to build a small, "L"-shaped berm to anchor the sand placement operations. The short side of the "L" is transverse to the shoreline and is approximately the same width as the design beach. The long side is shore parallel, at the seaward edge of the design beach footprint.

When slurry is pumped onto the beach, it is pumped between this berm and toe. This berm reduces ocean water turbidity by allowing all the sand to settle out inside the bermed area while the seawater is channeled just inside the long berm until it reaches the open end where it drains across the shore platform and into the ocean. Temporary dikes within this berm will direct the pumped sand for settlement in designated areas. Once a section of berm is filled in with sand, another berm is created, the pipeline is moved or extended into the new berm area, and the process begins again

As the material is deposited behind the berm, the sand is usually spread using two bulldozers and one front-end loader to direct the flow of the sand slurry and form a gradual slope to the existing beach elevation.

For each receiver site, berm construction may be adjusted from the design requirements during fill placement depending on actual field conditions. The measurements indicated for the width of the berms are the initial placement widths. The berms would be subject to the forces of the waves and weather once constructed, and will eventually settle down to a natural grade for the beach.

Construction Access and Staging Areas

Beach access for the construction equipment and crew will be split between open space on the beach and a city owned public parking lot and is shown in **Figure 5-9**. An open area exists along the beach immediately adjacent and north of the Pier and in the immediate vicinity of the Marine Safety Headquarters. It is expected this site will be used for the contractors' office trailer, parking area for heavy earthmoving equipment, and storage area for dredge pipe and other miscellaneous materials. This site is used extensively for access to the Marine Safety Headquarters and other municipal operations and as such poses no new environmental considerations, minimizes disturbance to the environment, and is ideally located for contractor ease of operations. Although access to this area is controlled by a signal controlled, at-grade railroad crossing, it is anticipated that there will be no significant restrictions on utilization of this portion of the contractors work and storage area.

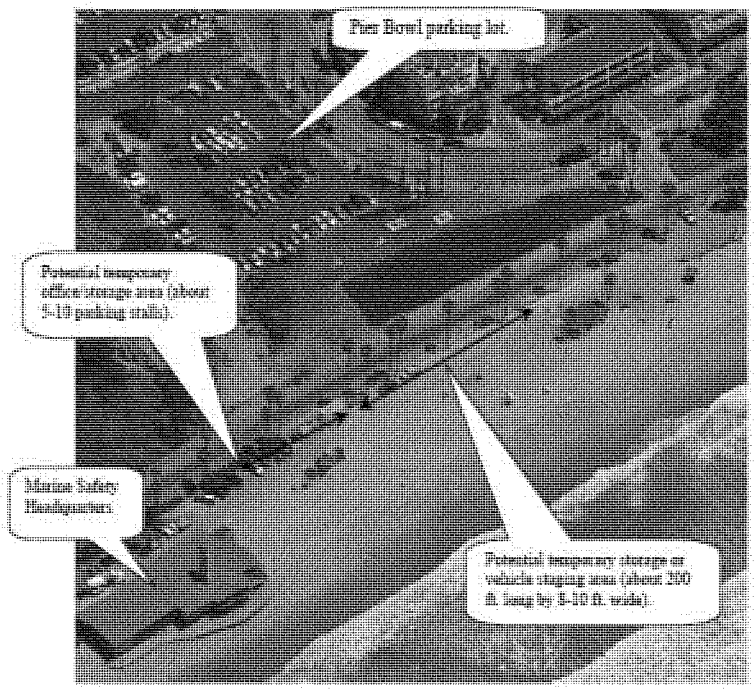


Figure 5-9 Work Storage Area

The Pier Bowl parking lot will also be a component of the contractors' work and storage area. This parking lot is a metered, city-owned parking lot for public access to the beach and pier area. Several parking spaces will be restricted for contractor privately owned vehicles. The contractors' dredge and vessels will require off-site mooring and berthing space. There is no mooring area available within the City of San Clemente. The nearest suitable mooring area is Dana Point Harbor, a small craft harbor approximately 8 km (5 mi) north

Public Access

For the beach fill operation, the only impacts to public beach access would occur at the point of discharge. Approximately 90 m (300 ft) of beach would be inaccessible to the public around the discharge pipeline and berms. In addition, there would be intermittent restrictions on public access for approximately 107 m (350 ft) on either side of this discharge zone. This space would be needed for maneuvering heavy equipment during construction of the temporary berms.

5.4.2 Future Project Beach Profile Monitoring

The purpose of this monitoring is to allow the timing and the detailed design of the periodic nourishment to be optimized. Surveying of the beach and seabed morphology is paramount to

the monitoring efforts. Changes in beach and seabed morphology will define the sediment transport patterns at the shoreline and ultimately the short term and long term beach erosion processes. Alongshore transects will be crucial to determine the effects, if any, the proposed project has on updrift and/or downdrift shorelines. The monitoring period will be for the 50-year period of Federal involvement. However, not all aspects of the monitoring plan will be conducted each year. A more detailed description can be found in Appendix D of the EIS/EIR.

5.4.3 OMRR&R Activities

The sponsor is committed to performing operation and maintenance on the existing facilities such as maintaining public access and facilities, and construction of temporary berms. It is not anticipated that there will be incremental costs for performing these activities under the recommended plan, therefore, the operation, maintenance, repair, replacement, and rehabilitation costs over the lifetime, because of the project, are anticipated to be zero.

5.5 Completeness

Guidance in Water Resources Development Act (WRDA) 1996 states that:

> *"(B) RECOMMENDATIONS FOR SHORE PROTECTION PROJECTS.—*
> *(i) IN GENERAL.—The Secretary shall recommend to Congress the authorization or reauthorization of shore protection projects based on the studies conducted under subparagraph (A).*
> *(ii) CONSIDERATIONS.—In making recommendations, the Secretary shall consider the economic and ecological benefits of the shore protection project.*
> *(C) COORDINATION OF PROJECTS.—In conducting studies and making recommendations for a shore protection project under this paragraph, the Secretary shall—*
> *(i) determine whether there is any other project being carried out by the Secretary or the head of another Federal agency that may be complementary to the shore protection project; and*
> *(ii) if there is such a complementary project, describe the efforts that will be made to coordinate the projects."*

This guidance aims to ensure that all areas within the original study area are not at significant risk and to consider other potential Federal government interests. The initial study area included 10 Reaches, but only Reach 6 was brought forward as a viable USACE Civil Works project. The future without project condition assumption is that the SCRRA will construct a seawall along all the reaches if the railroad is at risk for damage dues to waves when a certain criteria is met. It is assumed by this study that those 9 reaches not covered by this project will eventually be protected. There may be additional Federal interest in protecting the railroad because of its national defense significance as a STRACNET. The construction of this project would not limit nor induce actions to reduce the damage risk in the other reaches.

5.6 Environmental Effects of Recommended Plan

Table 5-2 highlights the status of compliance with the applicable Federal and State Environmental Regulations.

Table 5-2 Environmental Compliance

Title of Regulation or Public Law	Compliance
FEDERAL ENVIRONMENTAL REGULATIONS	
National Environmental Policy Act of 1969 (Public Law 91-190) as amended - *42 USC 4321 et seq.*	In Compliance
ER-200-2-2, 33 CFR 230, March 1988 - *33 CFR 230*	In Compliance
Coastal Zone Management Act of 1972 and California Coastal Act of 1976 – *16 USC 1451 et seq.*	In Compliance
Clean Water Act of 1977 (Public Law 95-217) - *42 USC 7401 et seq.*	See paragraph below
Rivers and Harbors Act of 1899 - *33 USC 401-413*	In Compliance
Fish and Wildlife Coordination Act of 1958 (Public Law 85-624) – *16 USC 661-666*	In Compliance
Federal Endangered Species Act of 1973 - *16 USC 1531*	In Compliance
Magnuson-Stevens Fishery Management and Conservation Act, as amended 1996 (Public Law 104-267) - *16 USC 1801*	In Compliance
Marine Mammal Protection Act of 1972 - *16 USC 1361*	In Compliance
Migratory Bird Treaty Act, as amended (16 USC 703-711) - *16 USC 703-711*	In Compliance
Executive Order 11990	In Compliance
Executive Order 11991	In Compliance
National Historic Preservation Act of 1966, as amended (16 USC 479) – *16 USC 470*	In Compliance
Clean Air Act of 1972 - *42 USC 7401 et seq.*	In Compliance
Executive Order 12088	In Compliance
Executive Order 12898	In Compliance
Executive Order 13045	In Compliance
Federal Water Project Recreation Act (Public Law 89-72), July 9, 1965 – *16 USC 4601*	In Compliance
STATE ENVIRONMENTAL REGULATIONS	
California Environmental Quality Act (Public Resources Code, Sections 21000-29 21177)	In Compliance
California Coastal Act of 1976, as amended	In Compliance
Porter-Cologne Water Quality Control Act of 1966 (California Water Code §§13000-13999.10)	In Compliance
California State Lands Commission (Sections 6216 and 6303)	On-going
California Endangered Species Act (California Fish and Game Code Sections 2050-2116)	In Compliance
LOCAL ENVIRONMENTAL REGULATIONS	
South Coast Air Quality Management Plan (AQMP); South Coast Air Quality Management District (SCAQMD) and Southern California Association of Governments (SCAG)	In Compliance

A CWA 404(b)(1) analysis that is complete and is provided in Appendix A of the Final EIS/EIR in accordance with Section 404(b)(1) of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) as amended by the Clean Water Act of 1977 (Public Law 95-217). The intent of the analysis is to state and evaluate information regarding the effects of the discharge of dredged or fill material into waters of the United States. The document discusses the effects of the dredging, the initial sand placement and future renourishment actions.

Appropriate and practicable steps taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem are discussed as avoidance, minimization, and compensation measures. To satisfy requirements of the Federal CWA, USACE will submit this Final EIS/EIR and appropriate technical documentation to the San Diego RWQCB, which is delegated with implementing the CWA within the region, for their review for CWA Section 401 certification, pursuant to 33 CFR 336.1(a)(1). Upon review of the submittal, the RWQCB would evaluate if issuance of a Section 401-water quality certification is appropriate. USACE will continue to coordinate with the RWQCB throughout the remaining study, design and construction phases of this project. USACE has determined that full compliance with CWA Section 404 is met and thus may invoke, if needed, CWA 404(r), once the project is authorized by Congress.

5.6.1 Effects Found

Issues that were brought forward for the proposed San Clemente Shoreline Protection Project for further analysis and included in the accompanying Final EIS/EIR included topography, geology and geography, oceanographic and coastal processes, water and sediment quality, biological resources: including but not limited to essential fish habitat and long-term net loss in the habitat value of surfgrass, kelp beds, or other sensitive biological habitat, cultural resources, noise, socioeconomics, transportation, land use, recreation, public safety, and public utilities. This analysis determined that the proposed project would not have a long-term significant effect on these elements.

Regarding biological impacts, the Corps does not expect to see any impacts to the T-Street reef and the surfgrass vegetation, and thus concludes that no mitigation is required. Nonetheless, if effects are observed, a monitoring, mitigation, and reporting plan (MMRP) has been developed in concert with the resource agencies. This plan will undergo further scrutiny during PED by a team including ERDC Submerged Aquatic Vegetation Restoration Research Program (SAVRRP) experts and the resource agencies. If impacts are not observed, the Corps will continue to monitor for effects and will continue to collaborate with ERDC and the resource agencies to identify an appropriate mitigation design in the future if determined to be needed. Mitigation funds are included as part of the contingency funds for the project. The expectation is that while there may be negligible effects to the inner rocky reef and surfgrass vegetation, actual monitoring data will be needed to support this determination, or to identify that there will be no significant impacts. Monitoring for 2 years immediately post construction is proposed to determine actual impacts

5.6.2 Significant Unavoidable Adverse Effects

The EIS/EIR considered the potential impacts of the proposed alternatives, in addition to the No Action Alternative, according to several resource categories: topography, geology and geography, oceanographic and coastal processes, water and sediment quality, biological resources, cultural resources, aesthetics, air quality, noise, socioeconomics, transportation, land use, recreation, public safety, and public utilities.

5.6.3 Environmental Commitments

Table 5-3 shows the environmental commitments to be undertaken by the Corps to ensure environmental impacts are reduced to a level of insignificance where possible.

Table 5-3 Summary of Design Features and Monitoring Commitments

Design Features	Purpose	Timing	Implementation Responsibility
Air quality			
Use of BACTs and Contingency Measures for construction activities	To reduce air emissions	During all construction activities	Construction contractor
Construction equipment will be properly maintained and tuned	To reduce air emissions	During all construction activities	Construction contractor
Maintain at least a 12 percent saturation level of the sand	To reduce air emissions	During beach fill activities	Construction contractor
Prohibit truck idling in excess of five minutes	To reduce air emissions	During all construction activities	Construction contractor
Where feasible, use aqueous or emulsified diesel fuel for construction equipment.	To reduce air emissions	During all construction activities	Construction contractor
Where feasible, use diesel oxidation catalytic converter	To reduce air emissions	During all construction activities	Construction contractor
Where feasible, require the use of newer, lower-emitting trucks to transport construction workers as well as equipment and material to and from construction sites	To reduce air emissions	During all construction activities	Construction contractor
Water Quality, Sediments, Oceanography			
Construct "L"-shaped berms	Anchor sand placement operations and reduce nearshore turbidity	During beach fill	Construction contractor
Monitor turbidity	To reduce impacts related to turbidity	During dredging and beach fill activities	Construction contractor
Prepare SWPPP and OSPRP	Ensure minimal contamination from fuel leaks, if any	During all construction activities	Construction contractor

Design Features	Purpose	Timing	Implementation Responsibility
Cultural Resources			
Prior to construction, offshore borrow areas 1 and 2 will be subjected to an underwater remote sensing survey in order to determine if submerged cultural resources are present within these areas.	Avoid potentially undisturbed, submerged cultural resources.	Prior to dredging activities	Construction contractor
Noise			
On-shore construction activities must be limited to less than 12 hours per day.	Minimize noise emissions	During beach nourishment/notch fill	Construction contractor
Recreation			
The contract specifications shall require the contractor to fence/secure off areas of construction from public access, including construction staging areas and active construction areas, including the beach and nearshore zone.	Avoid safety hazards to recreation-goers	During beach nourishment	Construction contractor
Biological Resources			
The project includes a Monitoring and Mitigation Plan (see Appendix B of the EIS/R) to account for potential impacts to biological resources once the placed sand has equilibrated. No impacts are expected, however, the Plan will account for any potential impacts.	Minimize biological impacts	Monitoring 2 years prior to and post-construction	Construction contractor and Corps Project Managers and PED designers.

Design Features	Purpose	Timing	Implementation Responsibility
Public safety			
The dredge would be equipped with markings and lightings in accordance with the U.S. Coast Guard regulations. The location and schedule of the dredge would be published in the U.S. Coast Guard Local Notice to Mariners. The dredge would travel at very low speeds (approximately 1.5 knots) during dredging operations. The travel speed during transport would be approximately 5 knots. During dredging and nourishment activities, proper advanced notice to mariners would be obtained, and navigational traffic would not be allowed within the offshore borrow site area or mooring/discharge area offshore of Oceanside.	Warn boaters/ fishermen of dredging activities to ensure avoidance	Before and during dredging activities and beach nourishment	USACE resident engineer
Socioeconomics			
The local commercial fishermen's association shall be provided with written notification of the intended start date of on shore construction, offshore construction, maps of project-related vessel transportation routes, and its duration. Noticing shall include a point of contact throughout the entire construction phase to respond to concerns regarding interference and/or other issues associated with local commercial fishing operations.	Avoid gear conflicts and provide for compensation if loss occurs	Thirty days prior to the start of construction	Coast Guard (via construction contractor) and USACE

Design Features	Purpose	Timing	Implementation Responsibility
Monitoring Commitments			
Monitor turbidity levels	To avoid turbidity impacts to fish and aquatic species	During dredging operations and beach fill activities	Construction Contractor
Any earthmoving associated with this project that will involve previously undisturbed soil will be monitored by a qualified archeologist who meets the Secretary of Interior's Standards for an Archeologist (see 36 CFR Part 61). If a previously unidentified cultural resource (i.e., property) that may be eligible for the NRHP is discovered, all earthmoving activities in the vicinity of the discovery shall be diverted until the USACE complies with 36 CFR § 800.13(a)(2).	Avoid any potentially undisturbed cultural resources.	During beach fill activities	Construction Contractor, qualified archeologist, in coordination with USACE
Monitor for grunion spawning in construction area, until eggs hatch (minimum of one lunar month) and surveys show no subsequent spawning	Avoid grunion eggs and protect until hatched	April through September and per CDFG annual pamphlet *Expected Grunion Runs.*	Qualified biologist

6 IMPLEMENTATION OF THE RECOMMENDED PLAN

6.1 General

This chapter presents the Federal and non-Federal responsibilities for implementing the recommended plan. This includes Federal and non-Federal project cost sharing requirements and the division of responsibilities between the Federal government and the Non-Federal Sponsors, the City of San Clemente. It also lists the steps toward project approval, and a schedule of the major milestones for the design and construction of the recommended plan.

6.2 Cost Apportionment for the Recommended Plan

Cost sharing for initial construction of the recommended plan would be consistent with that specified in Section 103(c)(5) of WRDA 86 as amended by WRDA 96 (generally 65 percent Federal and 35 percent non-Federal). Cost sharing for periodic nourishment (continuing construction) would be consistent with Section 103(d) of WRDA 86 as amended by Section 215 of WRDA 99, which requires that such costs be shared 50 percent Federal and 50 percent non-Federal. The final division of specific responsibilities will be formalized in the project partnership agreement (PPA).

These general cost shares apply for developed public or private shores where there is adequate public access and use. For public non-Federal shores, such as a park, the cost sharing for initial construction and each renourishment is 50/50 and for private non-developed shores the cost sharing is 100 percent non-Federal. Federal shores are cost shared 100 percent Federal.

The study area consists mostly of developed public shores and will be therefore subject to the general cost sharing of 65% Federal, 35% non-Federal for the initial project and 50/50 for each renourishment.

Table 6-1 displays the study area land use in terms of shoreline length.

Table 6-1 Study Area Land Use

Land Type	Length
Developed public	1040 m
Total Project Length	**1040 m**

Tables 6-2 and **6-3**, below, display the currently assumed Federal cost sharing for initial construction and each renourishment respectively.

Table 6-2 Federal Cost Share: Initial Construction

Land Type	Percent Federal Share
Developed public	65%

Table 6-3 Federal Cost Share: Renourishment

Land Type	Percent Federal Share
Developed public	50%

Based on these calculations, cost sharing for the project will be as follows:

- Initial construction costs, including sunk costs, are cost shared at 65% Federal and 35% non-Federal.
- Costs for project performance monitoring in support of continuing construction, used to refine plans for the beach renourishment, are cost shared at 50% Federal and 50% non-Federal.
- Total beach renourishment costs are cost shared at 50% Federal and 50% non-Federal.

Table 6-4 indicates that the project first costs at January 2011 Price Levels are $11,100,000 of which non-Federal costs total $3,880,000 and Federal costs total $7,220,000.

Table 6-4 Federal and Non-Federal Initial Costs of the Recommended Plan
January 2011 Price Levels

		Non-Federal		Federal	
	Total Cost	%	Cost	%	Cost
Cash	$11,100,000		$3,870,000		$7,220,000
Real Estate (LERRDs)	$12,000		$12,000		
Cost Share: First Costs	$11,100,000	35	$3,880,000	65	$7,220,000
Cost Share: Continuing Construction	$84,900,000	50	$42,500,000	50	$42,500,000

Finally, **Table 6-5** illustrates the fully funded cost apportionment for the total project. It shows that the fully funded project cost is $154,000,000 of which $75,500,000 (49%) is non-Federal and $78,500,000 (51%) is Federal.

Table 6-5 Federal and Non-Federal Cost Apportionment for the Total Project
Fully Funded Cost Estimate

Item	Total Project Cost	Non-Federal Cost	Federal Cost
Initial Construction			
Cash	$11,200,000	$3,910,000	$7,280,000
Non-Federal LERRD's	$12,000	$12,000	
Total Initial Cost	$11,200,000	$3,920,000	$7,280,000
Total Continuing Construction Cost (not discounted)	$142,000,000	$71,200,000	$71,200,000
Total Project Cost	$154,000,000	$75,000,000	$78,000,000
Percentage Share		49	51

The Total Initial Cost for nourishment includes initial sand costs, Mob/Demob, PED, SA, and Non-Federal LERRD's. The Total Continuing Construction Cost is the total cost of the project, including nourishments and monitoring, after the initial fill is constructed. Fully Funded Project Cost is the sum of Total Initial Cost and Total Continuing Construction Cost.

6.3 Division of Plan Responsibilities

The Federal Government and the City of San Clemente are responsible for implementation of the recommended plan, including the sharing of costs and maintenance. In addition, certain responsibilities are required by each party in accordance with Federal law.

6.3.1 Federal Responsibilities

Responsibilities of the Federal Government for implementation of the recommended plan include:

a) Sharing a percentage of the costs for Planning, Engineering and Design (PED), including preparation of the Plans and Specifications, which is cost shared at the same percentage that applies to construction of the project.
b) Sharing a percentage of construction costs for the project.
c) Administering contracts for construction and supervision of the project after authorization funding, and receipt of non-Federal assurances.

6.3.2 Non-Federal Responsibilities

Federal law requires that a local non-Federal sponsor provide and guarantee certain local cooperation items to ensure equitable participation in a project and to ensure continual maintenance and public receipt of the intended benefits. The particulars of the recommended plan were carefully reviewed and a set of applicable project partnering items established to include cost sharing of the Project as prescribed in the above paragraphs. The local non-Federal sponsors will:

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands

and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits (See **Table 6-2** and **Table 6-3**) and as further specified below:

(1) Enter into an agreement that provides, prior to construction, 25 percent of design costs;
(2) Provide, during the first year of construction, any additional funds needed to cover the non-federal share of design costs;
(3) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of any relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the project;
(4) Provide, during construction, any additional amounts as are necessary to make their total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;

b. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in,

on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

g. Assume, as between the Federal government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

h. Agree, as between the Federal government and the Non-Federal Sponsor, that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. If applicable, comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of floodplain management plans; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c))."';

k. Provide the non-Federal share of that portion of the costs of data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

l. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

m. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized;

n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the project;

o. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

q. For so long as the project remains authorized, the Non-Federal Sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based;

r. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;

s. Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element; and

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the Corps of Engineers.

6.4 Local Sponsor Financial Capability

Local funds for this project will be provided by the City of San Clemente and the State of California, through the California Department of Boating and Waterways. The California Department of Boating and Waterways' Beach Nourishment Program is funded through annual appropriations. Under that Program the State will fund 85% of the local share and the City will be required to contribute 15% of the local share.

6.5 Project Partnership Agreement

Prior to advertisement for the Construction Contract, a Project Partnership Agreement (PPA) will be required to be signed by the Federal Government and the City of San Clemente, requiring formal assurances of local cooperation from the City. This agreement will be prepared and negotiated during the Plans and Specifications Phase.

6.6 Approval and Implementation

The necessary reviews and activities leading to approval and implementation of the recommended plan are listed below:

a. Environmental Impact Statement Filing - the FEIS will be circulated to State and Federal Agencies as directed by HQUSACE for the 30-Day State and Agency review. The District will concurrently distribute the FEIS to parties not included on the HQUSACE mailing list. The District will then file the decision document and FEIS together with the proposed report of the Chief of Engineers with EPA.

b. Chief of Engineers Approval - Chief of Engineer signs the report signifying approval of the project recommendation and submits the following to ASA (CW): the Chief of Engineers Report, the FEIS, and the unsigned ROD.

c. ASA (CW) Approval - The Assistant Secretary of the Army for Civil Works will review the documents to determine the level of administration support for the Chief of Engineers recommendation. The ASA (CW) will formally submit the report to the Office of Management and Budget (OMB). OMB will review the recommendation to determine its relationship to the program of the President. OMB will approve the release of the report to Congress.

d. Funds could be provided, when appropriated in the budget, for preconstruction, engineering and design (PED), upon issuance of the Division Commander's public notice announcing the completion of the final report and pending project authorization for construction.

e. Surveys, model studies, and detailed engineering and design for PED studies will be accomplished first and then plans and specifications will be completed, upon receipt of funds.

Construction would be performed with Federal and non-Federal funds, once the construction project was advertised and awarded.

7 PUBLIC INVOLVEMENT, REVIEW, AND CONSULTATION

7.1 Coordination and Public Views

Public workshops, scoping meetings, and coordination with Federal, State, and local agencies have been accomplished to aid in the formulation and evaluation of the proposed recommended plan.

The final Feasibility Report, EIS/EIR has been coordinated with representatives from EPA, US Fish and Wildlife Service, National Marine Fisheries, California State Fish and Game, and the City of San Clemente.

7.2 Public Involvement

A Public Involvement Program was established for the feasibility study, and is being accomplished through representatives from the City of San Clemente, and the Corps of Engineers, Los Angeles District. Activities include:

- The City of San Clemente and Corps of Engineers, Los Angeles District websites will be used to provide information on the study status, updates, meeting schedules and summaries.
- Development of a public informational brochures, project messages, and vehicles for administering public participation in the study and decision making process.
- Preparation of newspaper articles.
- Public Workshops and meetings are to be held to obtain public views, comments, and opinions on factors that should be considered in the study, review of study results, and decision-making on alternatives to be considered and proposed recommendations.

7.3 Public Workshop

A co-chaired public workshop was held on 10 January 2002 at the San Clemente Senior Center to inform the public of the feasibility study and to solicit public input. Additionally, an overview of the NEPA/CEQA compliance regulations was presented along with the announcement of the initiation of the public scoping period. The intent of the scoping process is to encourage participation in the environmental review process from public agencies, special interest groups and the general public in the identification of the key issues and concerns relevant to the scope of the EIS/EIR.

There were about 50 people who attended the public workshop or submitted information, representing a number of agencies, interest groups, and local residents. Some of the agencies and interest groups participating in the meeting included San Clemente Coastal Advisory Committee, San Clemente Marine Safety Division, San Clemente Beaches, Parks, and Recreation Commission, San Clemente Ocean Festival, Capistrano Bay District, Citizens and Surfers of San Clemente, Surfrider Foundation, Restore the Shore/Railroad Corridor Safety Education Panel, and California Lobster and Trap Fishermen's Association.

The response from the general public who attended the session was generally positive. Many of the participants voiced support for efforts to restore the San Clemente Beaches, though there were also many concerns and questions regarding potential adverse impacts.

7.3.1 Public Concerns

A number of public concerns have been identified during the Public Workshop. Additional input was received through coordination with the sponsor and other agencies. The public and agency concerns form the bases of the initial problem and needs statements addressed in this report, and considerations that should be addressed in developing and evaluating alternative plans. The comments and suggestions received have been summarized as follows, in no particular order:

a. Use of groins or other hard structures. There was general opposition and concern expressed on the use of groins or other hard structures to retain sand on the beach.
b. Impacts of revetment and seawalls. Concern was expressed regarding the impacts of revetment and seawalls on exacerbating erosion.
c. Impacts of Dana Point Harbor. Several interests expressed concern with the impact of Dana Point Harbor on sand movement towards the San Clemente Beaches.
d. Impacts of San Juan Creek. Many indicated concern with the impacts of actions in the San Juan Creek watershed, such as sand mining and paving, that is reducing the watersheds sand and sediment contributions to the San Clemente coast.
e. Consideration of managed retreat. Several indicated a desire for managed retreat to be considered as an alternative measure to meet study objectives.
f. Consider aesthetics. An interest expressed the need to consider aesthetics as part of evaluating alternative plans.
g. Desire for continued monitoring. The need to continue monitoring the coast including the beach, surfing areas, and near shore ecosystem was expressed as an important part of any study or project.
h. Impact on nearshore resources and ecosystem. Damage to surf grass and lobsters was noted as a major concern to commercial fishermen as well as recreation snorkeling.
i. High cost of sand rapidly lost. A concern was expressed on the high cost of sand renourishment and the rapid erosion of the material as experienced with recent sand replenishment projects.
j. Time requirements and need for temporary solution. There was concern expressed on the relatively long period of time required to implement a permanent solution, and that a temporary measure should be taken as soon as possible to reduce the current vulnerability of the beaches and associated development.
k. Impacts on surfing breaks and reefs. Concern was expressed on the impact of plans on various surfing wave breaks including point breaks, reef breaks, and beach breaks. These breaks will be impacted differently by different shore protection measures. Riveria is going to be impacted strongly, if there is sand dumped there. The beach breaks, basically are going to be heavily impacted by any sand replenishment project.
l. Consider impacts to local businesses and community. The study should consider the impacts of continued erosion and loss of the recreation beaches and the benefits of restoring the beach on local businesses and the community.
m. Analysis of Historic Littoral Cell Conditions . There is interest in an analysis being made of the entire littoral cell to include sediment changes over seasons and time, the impacts of storms, and consideration of developing an equilibrium condition between sand sources and losses along the San Clemente beaches.
n. Artificial surfing reefs. There was interest in consideration of artificial surfing reefs such as Pratt's reef, to be considered in the study, which could improve surfing as

well as reduce erosion of the beaches. This could include consideration of using geo-textile bags to create "narrow neck reefs" to meet these objectives.

o. Opportunistic beach fill program. It was noted that the City of San Clemente has an Opportunistic beach fill program to allow suitable beach material to be placed on the beach as various projects make such material available.
p. Surfing is critical to the community culture of San Clemente. It was noted that the City of San Clemente was one of the centers of developing California's surfing interest, and there are numerous organizations and businesses that support this activity.
q. Railroad relocation. It was noted that there have been discussions regarding the possible relocation of the railroad line as part of high-speed rail, double tracking and other projects. Accordingly, the study should consider the potential for relocation of the railroad including possible beneficial impacts to the beaches and recreation use.
r. Quality of sand. Some concerns were mentioned on the quality of the material to be placed on the beach and the potential for fine silty material to cause impacts to the nearshore ecosystem.
s. Consideration of public safety and public access. It was noted that the existing rail line limits access to the beach and causes major public safety concerns. This should be addressed as part of the study.

A 45-day public review of the Draft EIS/EIR was conducte in August and September of 2010. A final public meeting was held on August 19, 2010 to present the findings of the study and to provide the public an opportunity to express their views on the results and recommendations of the pre-authorization study. Comments included concerns with some of the engineering and environmental assumptions and analyses and the need to develop an acceptable "monitoring and mitigation plan". All comments have been addressed and our responses are included in the Section 14.0. Additional conference calls and meetings with the Resource Agencies were held to address some of their concerns over the "monitoring and mitigation plan" and revisions have been made to Appendix B based on these discussions.

7.4 Institutional Involvement

7.4.1 Study Team

During the feasibility study, staff from the Corps of Engineers, Los Angeles District, the City of San Clemente, the State of California Boating and Waterways, and other interests participated in developing and analyzing information for the study. They participated directly in the study effort and on the Executive Committee. This involvement is expected to lead to the general support for the implementation of a *recommended plan*.

7.4.2 Agency Participation

During the feasibility study, coordination with the U.S. Fish and Wildlife Service (USFWS) was conducted in accordance with the Fish and Wildlife Coordination Act. The USFWS will be providing the Corps with a Planning Aid Letter Report, Coordination Act Report that includes their views on the *recommended plan* and will be included in the final feasibility report issued for public review. The USFWS will also provide a final Coordination Act Report, which will be included in the final report. All USFWS recommendations have been given full consideration. The USFWS has coordinated their report with the National Marine Fisheries Service and the California Department of Fish and Game. The Planning Aid Report provided by USFWS will present substantial information on ecosystem conditions including types of species and habitats,

as well as threatened and endangered species related to the study area. The report also includes a preliminary evaluation of potential impacts associated with the alternative plans considered in the study. Based on this evaluation, the Planning Aid Report will provide recommendations to be considered in developing and evaluating alternative plans.

7.5 Additional Required Coordination

The final report on the study results and tentative recommendations will be formally coordinated with a number of Federal and State agencies as required by Federal and state laws and policies. The final report includes a Coastal Consistency Determination, which will be submitted to the California Coastal Commission for their concurrence in the findings. The final report will also be submitted to the Regional Water Quality Control Office for their approval related to the Clean Water Act as well as regional Air Quality Control offices. The final report and proposed recommendations will be provide to the State Historic Preservation Officer for their approval on the impacts and recommendations associated with cultural and historic resources. Other Federal and State agencies that will receive copies of the final report for their review and approval include Federal and State Environmental Protection Agencies, the State Clearinghouse, and other agency interests.

Other organizations that have participated in the study process to date and will be requested to provide formal comments include the following agencies and groups:

Federal Agencies
U.S. Fish and Wildlife Service
U.S. Geological Survey
National Marine Fisheries Service
National Fish and Wildlife Foundation
Environmental Protection Agency

Local Committees/Groups
Surfrider Foundation, International Headquarters
California Lobster and Trap Fishermen's Association
Capistrano Bay District
Citizens and Surfers of San Clemente
Restore the Shore/Railroad Corridor Safety Education Panel
Southern California Wetlands Recovery Project

State Agencies
California Department of Boating and Waterways
California State Resources
California State Lands Commission
California Coastal Commission
California Coastal Conservancy
California Department of Fish and Game
California Regional Water Quality Control Board
California Regional Air Quality Control Board
California State Historic Preservation Officer

County of Orange Agencies
County Board of Supervisors
Orange County Beach Group
Orange County Transportation Authority

City Governments
San Clemente & San Juan Capistrano
San Clemente Coastal Advisory Committee
San Clemente Beaches, Parks, and Recreation Commission
San Clemente Marine Safety Division
San Clemente Ocean Festival

7.6 Report Recipients

A mailing list of Federal, State, County, local and regional agencies, environmental organizations, and interested groups and individuals is available upon request. These interests will receive notice of the availability of the draft and final feasibility report documents and other notifications on report and project decisions and status.

8 RECOMMENDATIONS

I recommend that the selected plan for storm damage risk reduction along the shoreline within the corporate boundaries of the City of San Clemente as described in this report be authorized as a Federal project; with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable. The recommended plan is estimated to have an initial total cost of $11,100,000 (January 2011 price levels). Of this cost, 65%, or $7,220,000 will be the responsibility of the Federal Government and, 35%, or $3,880,000 will be the responsibility of the City of San Clemente.

The recommended plan further includes periodic nourishment at 6 year intervals within the 50-year project lifetime for a total of eight periodic renourishment episodes, project beach monitoring for periodic nourishment planning, environmental monitoring, and mitigation plans, if required as described in Appendix B of the EIS/EIR. The recommended plan is estimated to have an average annual cost for construction of $2,140,000 over the 50-year project lifetime and a total continuing construction cost of $84,900,000 (January 2011 price levels). Of this cost, 50% or $42,500,000 will be the responsibility of the Federal Government and 50% or $42,500,000 will be the responsibility of the City of San Clemente.

This recommendation is made with the provision that before implementation, the City of San Clemente will, in addition to the general requirements of law for this type of project, agree to the following requirements:

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits (See **Table 6-2** and **Table 6-3**) and as further specified below:
   (1) Enter into an agreement that provides, prior to construction, 25 percent of design costs;
   (2) Provide, during the first year of construction, any additional funds needed to cover the non-federal share of design costs;
   (3) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of any relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the project;
   (4) Provide, during construction, any additional amounts as are necessary to make their total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;

b. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in

accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

g. Assume, as between the Federal Government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

h. Agree, as between the Federal Government and the Non-Federal Sponsor, that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. If applicable, comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of floodplain management plans; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c))."";

k. Provide the non-Federal share of that portion of the costs of data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

l. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

m. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the project;

o. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

q. For so long as the project remains authorized, the Non-Federal Sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based;

r. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;

s. Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element; and

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the Federal Government.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

R. Mark Toy, P.E.
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District Engineer
Los Angeles District

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FINAL

JOINT ENVIRONMENTAL IMPACT STATEMENT/ ENVIRONMENTAL IMPACT REPORT

Volume I

SAN CLEMENTE SHORELINE PROTECTION PROJECT

San Clemente, CA

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EXECUTIVE SUMMARY

This Final Joint Environmental Impact Statement/Environmental Impact Report (Final EIS/EIR) has been prepared for the Los Angeles District of the US Army Corps of Engineers (USACE) and the City of San Clemente (Local non-Federal sponsor) to analyze potential environmental impacts associated with the proposed action and alternatives for providing shoreline protection to approximately 3,412 feet ([ft], 1,040 meters [m]) of the San Clemente shoreline from coastal storms.

The USACE is the Federal lead agency responsible for compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. § 4331 (1996)), and the City of San Clemente (City) is the lead agency under the California Environmental Quality Act (CEQA) of 1970 (Cal. Pub. Res. Code § 21,000 et seq.), as amended. This Final EIS/EIR has been prepared at the project-level of detail and complies with the requirements of both NEPA and CEQA.

PROJECT AREA

The City of San Clemente is located along the coast of southern California about 60 miles (100 kilometers) south of Los Angeles at the southern end of Orange County near the border of San Diego County. The study area is encompassed within the City of San Clemente and extends approximately 3,412 ft (1,040 m) from Linda Lane to T-Street and is located within the San Clemente 7.5-minute U.S. Geological Survey (USGS) topographic quadrangle in Section 4 of Township 9 South and Range 7 West.

OVERVIEW

Beach erosion is an ongoing problem along the San Clemente shoreline. Over the past 20 years, average beach widths in the City's beaches have been gradually reduced to about 50 ft (15 m), a reduction of more than 50 percent compared to beach measurements from 1958 and 1981. San Clemente beaches were especially impacted by the El Niño Southern Oscillation (ENSO) storms of 1983 and 1998. Bottom elevation surveys conducted since 1981 along the San Clemente Municipal Pier (Pier) indicate that the cross-shore is deepened with a maximum fluctuation of about 15 ft (4.6 m) at various locations. Changes to the beach shoreline caused by erosion have reduced recreational opportunities and are threatening the stability of City facilities, private property, and a major southern California commuter rail corridor.

Running along the entire length of the San Clemente shoreline, a portion of the Los Angeles to San Diego (LOSSAN) railroad corridor, a major passenger rail line linking the coastal cities of southern California, including Los Angeles and San Diego, runs between the beach and the coastal bluffs through San Clemente and is owned by the Orange County Transportation Authority (OCTA). This nationally strategic rail corridor is among the busiest in the country. Riprap along the seaward side of the rail corridor provides some protection to the tracks. This corridor is operated by the Southern California Regional Rail Authority (SCRRA). Loss of shore protection and recreational beach width threatens the railroad and is a continuous problem for the City of San Clemente.

The purpose of the San Clemente Shoreline Protection Project (Project) is to provide shore protection through nourishment of the beach at the Pier. Developing and maintaining the beach is needed to prevent the severe beach erosion that results from winter storms and to prevent damage to adjacent beachfront structures, including the heavily used rail line that runs along the beach through the City. In addition to the above, the loss of sand at the beach would have an impact on beach recreation, which contributes to the local economy, and would reduce the ecological functioning of the sand beach/littoral zone.

The San Clemente Shoreline Reconnaissance Study, a Section 905(b) Analysis of the Water Resources Development Act of 1986 (WRDA 86), was prepared as an initial response to the Energy and Water Appropriations Act of 2000, Public Law 106-60, 29 September 1999, which reads as follows:

> "The Committee recommendation includes funds for the Corps of Engineers to conduct a reconnaissance study investigating shoreline protection alternatives for San Clemente, California."

PROPOSED PROJECT

Two scales of the Beach Fill Alternative were analyzed; both consist of dredging material from offshore Oceanside, then hauling and placing it at San Clemente Beach. The proposed Project is a 50 foot (15 m) resultant beach width. Beach fill would be 3,412 ft (1,040 m) long with a +17 ft (+5.2 m) crest elevation. The dredge volume is estimated to be approximately 251,000 cubic yards (192,000 m^3). Dredge material gradation is 6 to 12 percent of fines, 5 to 8 percent of gravel/cobbles, and the rest is sand. Material classification assumed is 10 percent fines, 83 percent sand and 7 percent gravel. Maintenance nourishment efforts will occur when the shoreline reaches the 0 ft base beach width (i.e., approximately 35 ft [11 m]) over the project life of 50 years. Maintenance nourishment efforts would return the beach to the design beach width 50 ft (15 m) and would involve up to approximately 251,000 cy (192,000 m^3) of material. Construction for initial fill is anticipated to begin in 2012.

Construction Method

The proposed Project will be constructed with hopper dredging equipment with pump ashore capability and conventional earthmoving equipment. Typical Los Angeles District beach fill projects require large capacity open-ocean capable dredges. A medium-sized hopper dredge (e.g., Sugar Island) would be used. The hopper dredge effective capacity is estimated at 1,700 cy (1,300 m^3) and 3.2 loads per day. The hopper dredge would pump out the dredge material via a 24-inch pipe line at 1,800 cy/hr (1,376 m^3/hr). The hopper dredge will be filled at the designated borrow site approximately one mile offshore of Oceanside and hauled approximately 21 miles (35 km) to San Clemente. At the receiver beach, the dredge will be attached to a moored floating section of pipeline extending 1,500 ft (457 m) to the shoreline. The material would be re-suspended and discharged through the on-board pumping system to the receiver site.

The hopper dredge requires a mono buoy to discharge its sand onto the beach. A mono buoy is a floating pipeline connection platform that is moored to the seafloor, and is used to interconnect

with a steel sinker pipeline that carries the slurry along the seafloor to the beach. For this Project, the mono buoy would be anchored in at least 25 ft (7.6 m) of water, between 2,500 and 5,000 ft (762 to 1,524 m) from shore and in the appropriate location in relation to sensitive resources and engineering considerations. From one mono buoy location, sand can be pumped directly onshore and up to approximately 2,000 ft (610 m) alongshore in either direction.

Dredging would be performed 24 hours a day, 7 days a week. Shore equipment would work 12 hours a day, 7 days a week. The proposed Project duration is estimated at 46 working days over the course of 4 months.

Onshore Placement Method

Sand would be combined with seawater until it reaches the consistency of slurry. It then would be conveyed to the beach either via pipeline or a combination of hopper dredge and pipeline, as described above.

Existing sand at the receiver site would be used to build a small, "L"-shaped berm to anchor the sand placement operations. The short side of the "L" would be transverse (crosswise) to the shoreline and would be approximately 50 ft (15 m) long. The long side would be shore parallel at the seaward edge and would be approximately 200 ft (61 m) long. Berm construction may be adjusted from the design requirements during fill placement depending on actual field conditions. The crosswise side of the berm would be constructed to allow alongshore landward beach access for emergency access at all times.

The slurry would be pumped onto the beach between this berm and toe. The berm reduces ocean water turbidity by allowing all the sand to settle inside the bermed area while the seawater is channeled along the berm until it reaches the open end where it drains into the ocean. Temporary dikes within the berm will allow sand to settle in designated areas. Once a 200 ft (61 m) section of berm is filled in with sand, another 200 ft (61 m) of berm will be created, the pipeline will be moved or extended on the dry beach only into the new berm area, and the process would begin again; the pipeline along the seafloor would not be moved. As the material is deposited behind the berm, the sand would be spread using two bulldozers and one front-end loader to direct the flow of the sand slurry and form a gradual slope to the existing beach elevation. The berm would be subject to the forces of the waves and weather once constructed and will eventually settle down to a natural grade for the beach.

Construction Access and Staging Areas

Beach access for the construction equipment and crew will be split between open space on the beach and a City-owned public parking lot. An open area exists along the beach immediately adjacent and north of the Pier and in the immediate vicinity of the Marine Safety Headquarters. It is expected this site will be used for the contractors' office trailer, parking area for heavy earthmoving equipment, and storage area for dredge pipe and other miscellaneous materials. This site is used extensively for access to the Marine Safety Headquarters and other municipal operations. It poses no new environmental considerations, minimizes disturbance to the environment, and is ideally located for contractor ease of operations. Although access to this

area is controlled by a signal controlled, at-grade railroad crossing, it is anticipated that there will be no significant restrictions on utilization of this portion of the contractors work and storage area.

The contractors' dredge and vessels will require off-site mooring and berthing space. There is no mooring area available within the City of San Clemente. The nearest suitable mooring area is Dana Point Harbor, a small craft harbor approximately 5 mi (8 km) north.

Public Access

For the beach fill operation, up to 300 ft (91 m) of beach would be inaccessible to the public around the discharge pipeline and berms. In addition, there would be intermittent restrictions on public access for approximately 350 ft (107 m) on either side of this discharge zone. This space would be needed for maneuvering heavy equipment during construction of the temporary berms.

Future Project Beach Profile Monitoring

Long-term shoreline erosional processes create damages through long-term profile translation landward and the increasing potential for wave related damages. The landward advancing shoreline reduces the beach width available for storm damage protection, thereby increasing the probability of wave related damages to facilities and structures. Long-term beach erosion also results in the gradual reduction of the beach surface area available for recreation. The peak erosion rate is –0.7 ft/yr (–0.21 m/yr), the maximum erosion rate is -1.5 ft/yr (–0.46 m/yr), and the maximum accretion rate is +1.24 ft/yr (+0.38 m/yr).

The purpose of this monitoring is to allow the timing and the detailed design of the periodic nourishment to be optimized. Surveying of the beach and seabed morphology is paramount to the monitoring efforts. Changes in beach and seabed morphology will define the sediment transport patterns at the shoreline and ultimately the short-term and long-term beach erosion processes. Alongshore transects will be crucial to determine the effects, if any, the proposed Project has on updrift and/or downdrift shorelines. The monitoring period will be for the 50-year period of Federal involvement. However, not all aspects of the monitoring plan will be conducted each year.

Maintenance nourishment efforts will occur when the shoreline reaches the 0 ft base beach width (i.e., approximately 35 ft [11 m]). Maintenance nourishment efforts would return the beach to the design beach width 50 ft (15 m) and would involve up to approximately 251,000 cy (192,000 m^3) of material. Maintenance nourishment efforts also would be dependent upon available funding at the time of request.

ENVIRONMENTAL CONSEQUENCES

Issues that were found not to be significant for the proposed Project included land use and policy. Issues that were found to be less than significant without the need for mitigation measures were geology and topography, noise, transportation, aesthetics, and public health and safety. The construction and long-term maintenance of the proposed Project would not have a

significant effect on these elements, and the analyses of these issues are detailed in the environmental consequences section.

Although significant impacts to biological resources (i.e., surfgrass) and recreation (i.e., surfing) are not likely to occur due to the footprint and temporary nature of the Project, mitigation measures will be implemented if monitoring demonstrates impacts are significant. If a substantial amount of surfgrass were lost, impacts may not be mitigable to not significant. If adverse impacts to surfgrass beyond those anticipated for the species to recover are observed from the monitoring, subsequent nourishment activities will be modified to avoid or minimize these impacts as part of adaptive management. If adverse impacts still are observed after all reasonable attempts to avoid or minimize impacts have been exhausted, additional renourishment would not occur until impacted surfgrass has recovered or a mitigation measure is accepted. A consistently successful method to transplant surfgrass has not yet been devised, although recent experiments may provide new options. A Mitigation Monitoring and Reporting Plan has been prepared to address potential mitigation, if necessary. Likewise, if surfing is demonstrated to be significantly impacted, mitigation measures will be implemented; however, creation of an artificial surfing reef has not yet been successful off the coast of California.

Environmental Justice

The construction and long-term maintenance of the proposed Project would not be expected to have any negative effect on minority or low-income populations. In addition, the expansion of the beach width would be a public improvement that would benefit residences and businesses alike.

Irreversible and Irretrievable Commitment of Resources

The proposed Project would result in the placement of approximately 251,000 cy of dredged beach-compatible fill material along a 3,412 ft long and 50 ft wide beach adjacent to the San Clemente Pier. The Project would nourish the eroded existing beach, which would provide recreational opportunities not only for residents, but also contribute to the regional tourist industry. The proposed action would result in the consumptive use of nonrenewable energy sources and labor required to operate dredges, trucks, pumping equipment, and grading equipment. These commitments of resources could have otherwise been applied to projects other than the proposed action. However, the proposed Project would not result in the use of a substantial amount of resources. Additionally, no natural resources would be permanently destroyed, and beach replenishment would be considered beneficial to the region.

Growth Inducing Impacts

A benefit of the proposed Project would be the enhancement or continuation of the recreational usage of the beach at San Clemente Pier. Protection of the beach shoreline provides an amenity for local residents and tourists. The resulting recreational benefits derived from the additional beach area would not be expected to increase the demand for public services and utilities, nor create a need for additional recreational facilities above current projections. Fewer than 100 workers would be involved in construction of the proposed Project, and they would be expected

to primarily be drawn by the local work force. The San Clemente Shoreline Protection Project would not involve any new development or add any people to the local population. The proposed Project would have no growth-inducing impacts.

Energy Requirements and Conservation Potential of Alternatives and Mitigation Measures

The proposed Project would implement several mitigation measures that would reduce inefficient, wasteful, and unnecessary consumption of energy. The energy requirements for the proposed construction activity would be confined to fuel for the dredge, labor transportation, and other construction equipment. Examples of mitigation measures include use of a diesel oxidation catalytic converter for the dredge and the use of newer, lower-emitting trucks to transport construction workers as well as equipment and material to and from construction sites, such as the use of "low-sulfur diesel for construction equipment and diesel particulate filters for diesel equipment and trucks". The use of alternative clean fuel, such as electric or compressed natural gas-powered construction equipment with oxidation catalysts instead of gasoline- or diesel-powered engines, is also recommended. However, where diesel equipment must be used because there are no practical alternatives, it is recommended that the construction contractors use low-sulfur diesel. In addition, the proposed Project does not involve the trucking of materials, which would decrease the use of trucking equipment typically associated with a beach nourishment project. The minimal use of pieces of construction equipment and implementation of the mitigation measures recommended would allow impacts to energy to be less than significant.

Relationship between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

Implementation of the proposed Project would not result in any environmental impacts that would significantly narrow the range of beneficial uses of the environment or pose long-term risks to health, safety, or the general welfare of the public communities surrounding the beach at San Clemente Pier. Rather, the Project would provide for future beneficial beach resources (e.g., recreational activities, sandy shoreline habitat).

PUBLIC INVOLVEMENT

This Final Joint EIS/EIR will be circulated for a public review period of 45 days to appropriate resource agencies, local interest groups, and individuals. All comments and concerns that are received during the review period shall be incorporated into the final EIS/EIR.

Send Comments to:
Mr. Thomas Keeney, Ecologist/Biological Sciences Manager
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Phone (213) 452-3875

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Appendix E – Geotechnical Report
Appendix F – Agency Coordination and Public Involvement
Appendix G – Coordination Act Report

1.0 INTRODUCTION

This Final Joint Environmental Impact Statement/Environmental Impact Report (Final EIS/EIR) has been prepared for the Los Angeles District of the U.S. Army Corps of Engineers (USACE) and the City of San Clemente (Local non-Federal sponsor) for the San Clemente Shoreline Protection Project (Project). This Final EIS/EIR analyzes potential environmental impacts associated with the proposed action and alternatives for providing shoreline protection to approximately 3,412 feet ([ft], 1,040 meters [m]) of the San Clemente shoreline from coastal storms.

This joint EIS/EIR is an informational document to advise decision-makers and the general public of the benefits and potential adverse impacts of the Project as well as feasible alternatives. This document assesses short-term, long-term, and cumulative impacts and benefits of the Project. This Final EIS/EIR also is intended to provide information to all agencies whose discretionary approvals must be obtained for Project actions.

The USACE is the Federal lead agency responsible for compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. § 4331 (1996)), and the City of San Clemente (City) is the lead agency under the California Environmental Quality Act (CEQA) of 1970 (Cal. Pub. Res. Code § 21,000 et seq.), as amended. This Final EIS/EIR has been prepared at the project-level of detail and complies with the requirements of both NEPA and CEQA.

1.1 Study Area

The City of San Clemente is located along the coast of southern California about 60 miles ([mi], 100 kilometers ([km]) south of Los Angeles at the southern end of Orange County near the border of San Diego County (Figure 1-1). The study area is encompassed within the City of San Clemente and extends approximately 3,412 ft (1,040 m) from Linda Lane to T-Street (Figure 1-2) and is located within the San Clemente 7.5-minute U.S. Geological Survey (USGS) topographic quadrangle in Section 4 of Township 9 South and Range 7 West. The communities of Capistrano Beach and Dana Point are located upcoast of the study area; San Onofre State Beach Park and the Marine Corps Base Camp Pendleton (MCBCP) are located to the south. The study area is in the 48th Congressional District. A borrow area at Oceanside has been identified as the potential source for beach replenishment material.

Along the entire length of the San Clemente shoreline, a portion of the Los Angeles to San Diego (LOSSAN) railroad corridor, a major passenger rail line linking the coastal cities of southern California, runs between the beach and the coastal bluffs through San Clemente and is owned by the Orange County Transportation Authority (OCTA). This nationally strategic rail corridor is among the busiest in the country. Riprap along the seaward side of the rail corridor provides some protection to the tracks. The railroad seaward slope incorporates the conventional ballast construction and has a slope of 1:1 horizontal:vertical (H:V). This corridor is operated by the Southern California Regional Rail Authority (SCRRA). Loss of beach width threatens the railroad and is a continuous problem for the City of San Clemente.

Figure 1-1 Vicinity Map

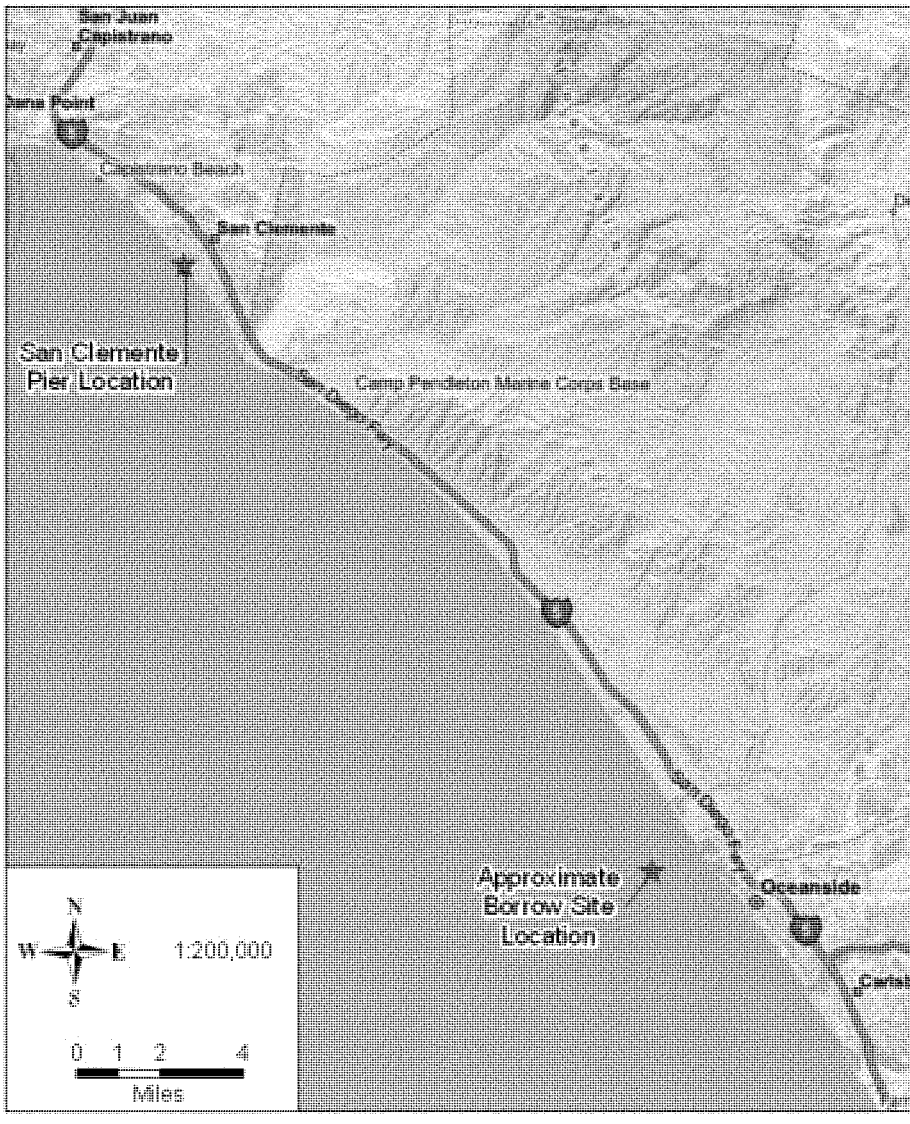
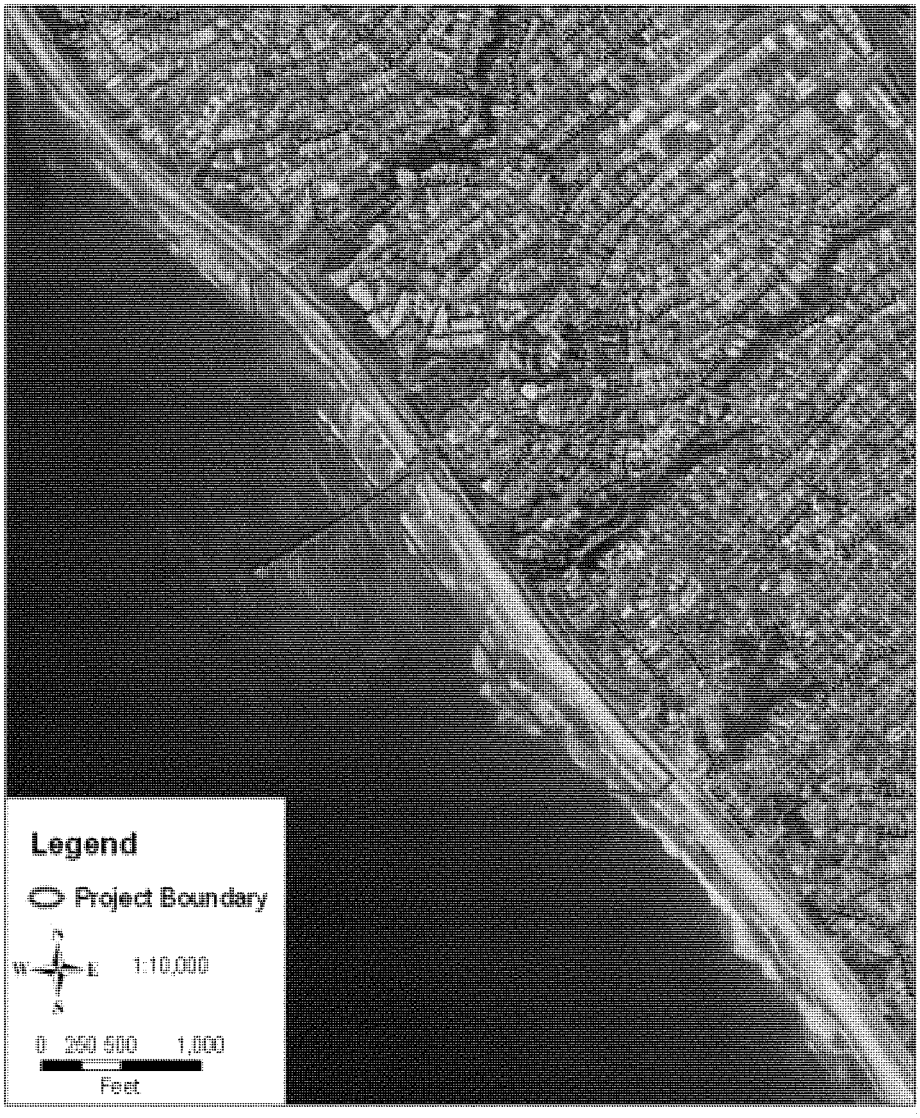


Figure 1-2 Location Map



1.2 Project Background

The City of San Clemente was founded in 1925, incorporated in 1928, and was originally promoted as "The Spanish Village," designed to be a residential settlement featuring white stucco homes with red tile roofs sited on wide, meandering streets with ocean views. The San Clemente Municipal Pier (Pier) extends approximately 1,200 ft (400 m) into the Pacific Ocean and is part of the recreational appeal for tourists/visitors of San Clemente City Beach and the 100-acre (40-hectare) State Beach, locally renowned as one of the premier surfing locales in the region.

Prior to urban development in the 1990s, the beaches within the study area remained relatively stable because of a balanced sediment supply delivered from the San Juan Creek to the Oceanside littoral cell. However, documented historical beach widths above the Mean Sea Level (MSL) line between T-Street and Mariposa Point were as narrow as 25 m (82 ft) in the winter months during this time period (USACE-SPL, 1991). As a consequence, storm damages occurred in the past (e.g., 1964, 1983, 1988, and 1993), as the protective buffer beach width was narrow, particularly in the winter season.

Since the 1990s, the project area has experienced chronic, mild, long-term erosion. Shoreline retreat is a result of the decrease of fluvial sand supply resulting from the concreting of creeks and rivers, upstream dams, and urban development. Continued future shoreline retreat is expected to result in storm waves breaking directly upon the railroad ballast, which significantly threatens the operation of the rail corridor. Continued future shoreline retreat also will subject public facilities to storm wave-induced damages. These facilities, maintained by the City of San Clemente, include the Marine Safety Building, public restroom facilities located on the beach, lifeguard stations, parking areas, and paving near the pier.

The railroad is a vital transportation link for passenger and freight service between cities in San Diego, Orange, and Los Angeles counties. The Department of Defense has designated this right-of-way as a Strategic Rail Corridor with great significance to National defense. Due to chronic beach erosion, the railroad corridor between the bluff and the beach is threatened by undermining. Metrolink has been randomly placing riprap along the segment between North Beach and the Marine Safety Building to reduce wave energy impacts on the railroad tracks. Train service has been delayed during winter storm events in order to provide extra precautionary measures to allow trains to move safely through the area. Crews are dispatched during high tide and storm conditions to visually inspect for track damage that could potentially cause derailments. The impact of riprap placement over the years has resulted in a cumulative decrease of lateral beach access.

1.3 Document Organization

This document is organized to assist the reader through the various steps taken by the USACE and the City to thoroughly and adequately analyze the environmental consequences of this Project. In general, this document defines the problem, presents possible solutions, and describes the existing conditions and the consequences of each alternative on baseline

conditions. Through this analysis, and other economic analyses, a preferred alternative was selected as the proposed action.

The purpose, need, and the objectives associated with protection of the San Clemente shoreline are described in Section 2.0 of this joint EIS/EIR. Alternatives are described in Section 3.0. Baseline environmental conditions are described in Section 4.0, and the environmental consequences associated with each alternative are discussed in Section 5.0. Different aspects of impact assessment, such as cumulative impacts, unavoidable significant impacts, and mitigation measures, among others, are discussed in Sections 6.0 through 9.0. Other NEPA and CEQA required analyses are presented in Section 10.0. Public and interagency involvement is described in Section 11.0. The preparers and reviewers of the joint EIS/EIR are listed in Section 12.0. References are provided in Section 13.0. The appendices provide background data and supporting documentation and analyses.

2.0 NEED FOR AND OBJECTIVES OF PROPOSED ACTION

2.1 Purpose and Need

The purpose of this Project is to provide shore protection through nourishment of the beach at the City of San Clemente Pier. Developing and maintaining the beach is needed to prevent the severe beach erosion that results from winter storms and to prevent damage to adjacent beachfront structures, including the heavily used rail line that runs along the beach through the City. In addition to the above, the loss of sand at the beach would have a negative impact on recreation, which supports the local economy, and would reduce the ecological functioning of the sand beach/littoral zone.

A number of public concerns were identified during the course of the reconnaissance study. Initial concerns were expressed in the study authorization. Additional input was received through coordination with the City and other agencies. The public interest related to the establishment of planning objectives and planning constraints are:

1. To reduce the potential for storm damages to the LOSSAN Rail Corridor rail facilities and rail line operations, located along the beaches of the City of San Clemente;
2. To reduce the potential for storm damages to public beach facilities;
3. To restore the recreation beach along the Pacific Coast of the City of San Clemente;
4. To preserve the nearshore ecosystem that supports commercial lobster, fisherman, and snorkeling activities;
5. To preserve and enhance opportunities for surfing along the San Clemente coast; and
6. To improve public access and safety to the recreation beach areas of the City of San Clemente.

2.1.1 Storm Damages

Prior to the 1990s, the beaches within the study area were marginally stable as sufficient sediment was supplied from San Juan Creek to the Oceanside littoral cell. This was prior to upland urban development that deprived the sand supply resulting from the damming and concreting of creeks and rivers, and urban development. As a result, the beaches provide minimal protection against storm-induced damages to the railroad and public facilities. The documented historical beach width above the Mean Sea Level (MSL) line between T-Street and Mariposa Point was as narrow as 25 meters (82 ft) in the winter months (USACE-SPL, 1991). As a consequence, storm damages occurred in the past (e.g., 1964, 1983, 1988, and 1993), as the protective buffer beach width was narrow, particularly in the winter season.

The narrowing of the beaches along the shoreline has subjected the public facilities to wave-induced damages. These facilities include the Marine Safety Building, public restrooms, lifeguard stations, parking areas, and concession stands. The meteorological conditions of El Nino occurred in the years 1983, 1988, and 1998. The majority of repairs in the years of 1983 and 1988 were due to damages to the San Clemente Pier. The City spent $2,109,000 in Pier

repairs in 1983 and $2,305,000 in 1988. In addition, repair costs for a revetment in the community of Capistrano Shores totaled $288,000. In addition, the City is spending $5,000 per year to use a tractor to reduce the steepness of the shoreline.

2.1.2 Threat to the Railroad Corridor

Due to chronic beach erosion, the railroad corridor between the bluff and the beach is threatened by undermining. In response, OCTA has been randomly placing riprap stones along the most critical segment between North Beach and the Marine Safety Building to reduce wave impacts on the railroad tracks. This maintenance practice of adding additional stones to the existing under-designed revetment has cost OCTA an average of $200,000 to $300,000 every three years. If the loss of sand continues as expected, the cost to protect the tracks with riprap will increase. The cumulative impact of stone placement over the years has resulted in a reduction of lateral beach access. This railroad is a vital transportation link for passenger and freight service. In addition, the Department of Defense (DOD) has designated this right-of-way as a Strategic Rail Corridor with great significance to National defense. During winter storm events, train service has been delayed in order to provide extra precautionary measures to move the trains safely through the area. Crews are dispatched during high tide and storm conditions to visually inspect for track damage that could cause derailments. Continued erosion along the San Clemente shoreline will lead to further disruption of rail service.

2.1.3 Public Safety and Liability

As a result of the continued beach erosion throughout the City's shoreline, a number of public safety concerns have surfaced. Public restrooms are located on the beach, seaward (west) of the railroad tracks; continued damages to these facilities may require their relocation to the landward side (east) of the railroad tracks. This would result in beachgoers continually crossing the tracks to use the restrooms. Depending on the location of construction of restrooms, if necessary under managed retreat, crossing the tracks may be dangerous if beachgoers decide to do so rather than use the designated pedestrian crossings. There currently are safe pedestrian crossings for beachgoers to cross the tracks and access the beach. A public safety issue may create because it is expected that many will cross the railroad tracks in an unsafe manner. Furthermore, the loss of sand within the active nearshore profile has exposed underlying hard substrate. A public safety issue is created because the exposed material, in many cases, remains underwater and hidden from sight, posing a number of potential dangers to unwary recreational swimmers. The City is liable for accidents resulting from exposed man-made structures. The adverse economic impact associated with the City's liability has the potential to be substantial.

2.1.4 Recreation Opportunity

San Clemente has an annual tourist visitation of about two million people, or approximately 60 percent non-residents. Continuous shoreline retreat will further degrade the City's beaches and significantly impact beach recreation, tourism, and economic benefits.

2.2 Project Objective

The objective of the San Clemente Shoreline Protection Project is:

1. To reduce the potential for storm damages to facilities located along the coast of the City of San Clemente, including recreation beach facilities and the LOSSAN Rail Corridor, and
2. To restore and maintain recreation use along the Pacific Coast of the City of San Clemente.

These objectives were accomplished by formulating and evaluating an array of feasible alternatives and identifying the one that most effectively reduces storm-related risks and damages while complying with Local, State, and Federal environmental laws and regulations. The scope of this Final EIS/EIR describes the physical, environmental, and socioeconomic baseline conditions and identifies the environmental consequences of the alternatives, including future without Project conditions (No Action Alternative).

2.3 Study Authority

The San Clemente Shoreline Reconnaissance Study, a Section 905(b) Analysis of the Water Resources Development Act of 1986 (WRDA 86), was prepared as an initial response to the Energy and Water Appropriations Act of 2000, Public Law 106-60, 29 September 1999, which reads as follows:

> "The Committee recommendation includes funds for the Corps of Engineers to conduct a reconnaissance study investigating shoreline protection alternatives for San Clemente, California."

In addition, Section 208 of the Flood Control Act of 1965 states:

> "The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the localities specifically named in this section...Coasts of Washington, Oregon, and California to determine advisability of protection work against storm and tidal waves."

This Final EIS/EIR supports the USACE feasibility study for the Project; the feasibility study incorporates the conclusions of this EIS/EIR. Since storm damage risk management is an output with a high budget priority, and preventing storm damages is the primary output of the alternatives to be evaluated in the feasibility phase, there is a strong Federal interest in participating in the proposed Project. Long-term erosion can reasonably be expected to undermine and increase the flood potential of existing public and private structures along the San Clemente shoreline. As the width of the sandy beach decreases over time, winter storm damages

will have a greater impact on the public transportation corridor and residential communities. The proposed Project construction would be dependent upon authorization by Congress.

2.4 Compliance with Applicable Regulatory Statutes and Permit Requirements

Federal and State environmental requirements considered in the preparation of this Final EIS/EIR are briefly reviewed in this subsection. The City shall use the environmental analysis included in this Final EIS/EIR to support permit applications and other required compliance activities pursuant to the respective laws, orders, and regulations.

2.4.1 Federal Environmental Regulations

2.4.1.1 National Environmental Policy Act of 1969 (Public Law 91-190) as amended

This Final EIS/EIR has been prepared in accordance with the requirements of the NEPA of 1969 (42 USC 43221, as amended) and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508), dated 1 July 1988. NEPA requires that agencies of the Federal Government shall implement an environmental impact analysis program in order to evaluate "major federal actions significantly affecting the quality of the human environment". A "major federal action" may include projects financed, assisted, conducted, regulated, or approved by a federal agency. NEPA regulations were followed in the preparation of this EIS.

2.4.1.2 ER-200-2-2, 33 CFR 230, March 1988

This engineer regulation (ER) provides guidance for implementation of the procedural provisions of the NEPA for the Civil Works Program of the USACE. It supplements CEQ regulations 40 Code of Federal Regulations (CFR) 1500-1508, November 29, 1978, in accordance with CEQ regulations. Wherever the guidance in this regulation is unclear or not specific, the reader is referred to the CEQ regulations. This regulation is applicable to all the USACE responsibility for preparing and processing environmental documents in support of civil works functions.

2.4.1.3 Coastal Zone Management Act of 1972 and California Coastal Act of 1976

The Coastal Zone Management Act (CZMA) preserves, protects, develops, and, where possible, restores or enhances the Nation's coastal zone resources for this and succeeding generations. This Final EIS/EIR shall act as the Coastal Consistency Determination (CCD) to the California Coastal Commission (CCC), in satisfaction of CZMA requirements, Section 106(d), to certify consistency to the maximum extent practicable with an approved State Coastal Zone Management Plan. The USACE shall submit the Final EIS/EIR to the CCC for their review and approval. The USACE has determined that the Project is consistent to the maximum extent practicable with the CZMA. The USACE shall obtain concurrence from the CCC prior to construction.

2.4.1.4 Clean Water Act of 1977 (Public Law 95-217)

The Clean Water Act (CWA) governs discharge or dredge of materials in the waters of the United States, and it governs pollution control and water quality of waterways throughout the U.S. Its intent, in part, is to restore and maintain the biological integrity of the Nation's waters. The goals and standards of the CWA are enforced through permit provisions.

Section 404 outlines the permit program required for dredging or filling the Nation's waterways. The USACE does not issue itself a permit for civil works projects. Therefore, a Section 404(b)(1) analysis has been prepared. USACE has determined that full compliance with CWA Section 404 is met and thus may invoke, if needed, CWA 404(r), once the project is authorized by Congress. Section 404(b)(1) addresses project-related impacts to the waters of the U.S. and provides appropriate mitigation measures to minimize impacts. Section 230.10(a) of the 404(b)(1) guidelines requires consideration of a "practicable alternative to the proposed discharge which would have less impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences". Section 230.10(a)(2) states that "an alternative is practicable if it is available and capable of being done after taking into consideration costs, existing technology, and logistics in light of overall project purposes." Section 230.10(a)(4) states "for actions subject to NEPA, where the Corps of Engineers is the permitting agency, the analysis of alternatives required for NEPA environmental documents, including supplemental Corps NEPA documents, will in most cases provide the information for the evaluation of alternatives under these Guidelines."

The City must follow all the environmental commitments identified in the EIS/EIR where applicable. The USACE shall continue to coordinate with the Regional Water Quality Control Board (RWQCB) throughout the CWA process and construction activities.

2.4.1.5 Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act prohibits the unauthorized obstruction or alteration of any navigable waters of the United States, and authorizes the USACE to regulate all activities that affect the course, capacity, or coordination of waters of the U.S. Navigable waters of the U.S. are defined in 33 CFR Part 329 as those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. USACE has complied with River and Harbors Act in the development of this Final EIS/EIR.

2.4.1.6 Fish and Wildlife Coordination Act of 1958 (Public Law 85-624, 16 USC 661-666(c))

The Fish and Wildlife Coordination Act (FWCA) protects fish and wildlife from Federal actions that result in the control or modification of a natural stream or water body. The FWCA requires consultation with the U.S. Fish and Wildlife Service (USFWS), the California Department of Fish and Game (CDFG), and National Oceanographic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries), all of which has been coordinated with during the initial and current stages of planning, development of the proposed alternatives, environmental commitments, and potential mitigation measures. The USACE shall continue to coordinate with

NOAA Fisheries throughout the NEPA process and construction activities. The Final Coordination Act Report (CAR) is included as Appendix G.

2.4.1.7 Federal Endangered Species Act of 1973

The Federal Endangered Species Act of 1973 (ESA) protects endangered and threatened species by prohibiting Federal actions that would jeopardize the continued existence of such species or result in the destruction or adverse modification of habitat of such species. Coordination with respect to Federal endangered and threatened species has occurred with both USFWS and NOAA Fisheries in the development of this Final EIS/EIR. NOAA Fisheries provided conservation recommendations during the public review period and these recommendations are addressed in Section 14.0 of this Final EIS/EIR. Federally endangered or threatened species that inhabit the Project area are listed and discussed in Section 4.0.

Under Section 7(a)(2) of the ESA, Federal agencies must consult with Federal resource agencies (i.e., USFWS, NOAA Fisheries) and prepare a Biological Assessment (BA) if listed species and/or critical habitat are present in an area to be impacted by Project activity. The USFWS and/or NOAA Fisheries then would prepare a Biological Opinion (BO) on how the action would affect the species and/or its critical habitat, and would suggest reasonable and prudent measures to avoid jeopardizing the continued existence of the species or adversely modifying its critical habitat. If prior to and/or during construction it is determined that Federal endangered and threatened species would be adversely impacted, the USACE would initiate Section 7 consultation.

2.4.1.8 Magnuson-Stevens Fishery Management and Conservation Act, as amended 1996 (Public Law 104-267)

Federal agencies must consult with NOAA Fisheries on actions that may adversely affect Essential Fish Habitat (EFH). EFH is defined as those "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". NOAA Fisheries encourages streamlining the consultation process using review procedures under NEPA, FWCA, CWA, and/or ESA, provided that documents meet requirements for EFH assessments under Section 600.920(g). EFH assessments must include (1) a description of the proposed action, (2) an analysis of effects, including cumulative effects, (3) the Federal agency's views regarding the effects of the action on EFH, and (4) proposed mitigation, if applicable. The description and evaluation of EFH for the coastal zone is included in this Final EIS/EIR in Section 5.4.

2.4.1.9 Marine Mammal Protectiou Act of 1972

The Marine Mammal Protection Act (MMPA) protects marine mammals and establishes a marine mammal commission to regulate such protection. The requirements of this act were considered in the evaluation of environmental consequences of the proposed Project and alternatives.

2.4.1.10 Migratory Bird Treaty Act, as amended (16 USC 703-711)

The Migratory Bird Treaty Act (MBTA), as amended, provides legal protection for almost all breeding bird species occurring in the United States by restricting the killing, taking, collecting, and selling or purchasing of native bird species or their parts, nests, or eggs. Certain game bird species are allowed to be hunted for specific periods determined by Federal and State governments. The intent of the MBTA is to eliminate any commercial market for migratory birds, feathers, or bird parts, especially for eagles and other birds of prey. The MBTA was considered in the evaluation of environmental consequences of the proposed Project and alternatives.

2.4.1.11 Executive Order 11990

This order requires that governmental agencies, in carrying out their responsibilities, provide leadership and "take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands". This order was considered in the development of the proposed Project and alternatives.

2.4.1.12 Executive Order 11991

This order is related to the protection and enhancement of environmental quality. Section 1 of this order directs the CEQ to issue guidelines to Federal agencies for implementing procedural provisions of NEPA (1969). The guidelines recommend early EIS preparation and impact statements that are concise, clear, and supported by evidence that agencies have made the necessary analyses. These guidelines (ER 200-2-2, 33 CFR 230 March 1988) were followed in the preparation of this Final EIS/EIR.

2.4.1.13 National Historic Preservation Act of 1966, as amended (16 USC 479)

Section 106 of the National Historic Preservation Act (NHPA) established the National Register of Historic Places (NRHP), which is a master list of historic properties of national, State, and Local significance. Under Section 106, agencies are required to consider the effects of their actions on properties that may be eligible for or are listed in the NRHP. The NRHP established the Advisory Council on Historic Preservation (ACHP) to comment on Federally licensed, funded, or executed undertakings affecting National Register properties. Regulations of the ACHP (36 CFR 800, 1997) provide guidance for Federal agencies to meet Section 106 requirements. This process involves consultation with the State Historic Preservation Officer (SHPO), the ACHP, and other interested parties, including Native American Tribes, as warranted.

2.4.1.14 Clean Air Act of 1972

The Clean Air Act (CAA) regulates emissions of air pollutants to protect the nation's air quality. The CAA is applicable to permits and planning procedures related to the disposal of dredged materials onshore and in open waters within 3 mi (4.8 km) of the nearest shoreline. Section 118 of the CAA (42 USC 7418) requires all Federal agencies engaged in activities that may result in

the discharge of air pollutants to comply with Federal and State laws, and interstate and local requirements regarding control and abatement of air pollution. Section 176(c) requires all Federal projects to conform to U.S. Environmental Protection Agency (USEPA) approved or promulgated State Implementation Plans (SIPs). This act was considered in the evaluation of environmental consequences of the proposed Project and alternatives. In addition, the Project has been coordinated with the Off-Road Inventory and Assessments Section of the ARB regarding the method of determining effects of the daily rail activity. A CAA Conformity Analysis was prepared for this Project.

2.4.1.15 Executive Order 12088

This order requires Federal compliance with applicable pollution control standards concerning air and water pollution, and hazardous materials and substances. Federal agencies are directed to consult with State and Local agencies concerning the best techniques and methods available for the prevention, control, and abatement of environmental pollution. This order was considered in the development of the proposed Project and alternatives.

2.4.1.16 Executive Order 12898

This executive order requires that the joint EIS/EIR analyze the impacts of federal actions on minority and low-income populations and provides opportunities for input on the joint EIS/EIR by affected communities. The alternatives developed for the Final EIS/EIR were based on a set of criteria that did not discriminate on the basis of race, color, or national origin. The proposed Project would not have an impact on minority communities or low-income populations.

2.4.1.17 Executive Order 13045

This order addresses "Environmental Health and Safety Risks to Children". This order is designed to focus Federal attention on actions that affect human health and safety conditions that may disproportionately affect children. The proposed Project would not disproportionately impact children in the region of influence.

2.4.1.18 Federal Water Project Recreation Act (Public Law 89-72), July 9, 1965

This act requires that any Federal water project must give full consideration to opportunities afforded by the project for outdoor recreation and fish and wildlife enhancement. The proposed Project would provide opportunity for recreational activities by development of beach, including recreational use areas, which would be primarily passive in nature.

2.4.2 State Environmental Regulations

2.4.2.1 California Environmental Quality Act (Public Resources Code, Sections 21000-21177)

CEQA requires that State and Local agencies consider environmental consequences and project alternatives before a decision is made to implement a project requiring State or Local

government approval, financing, or participation by the State of California. In addition, CEQA requires the identification of ways to avoid or reduce environmental degradation or prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures. This joint EIS/EIR was prepared in accordance with this regulation.

2.4.2.2 California Coastal Act of 1976, as amended

The act specifies basic goals for coastal conservation and development related to protection, enhancement, and restoration of coastal resources, giving priority to "coastal-dependent" uses and maximizing public access to California residents and visitors. The act defines the "coastal zone" of California, which generally extends 3.0 mi (4.8 km) out to sea and inland generally 1,000 yards ([yd], 914 m). It may be extended further inland in certain circumstances. It also is less than 1,000 yd (914 m) wide in some urban areas. Each city and county in California on the coast must prepare a Local Coastal Program (LCP) for all areas within the coastal zone. The LCP includes Land Use Plans (LUPs), zoning ordinance amendments, and map changes to reflect the Coastal Act and LCP goals and policies at the local level. This act was considered in the preparation of this joint EIS/EIR.

2.4.2.3 Porter-Cologne Water Quality Control Act of 1966 (California Water Code §§ 13000-13999.10)

This act mandates that activities that may affect waters of the State shall be regulated to attain the highest quality. The RWQCB provides regulations for a "non-degradation policy" that are especially protective of waters with high quality. This act was considered in the evaluation of consequences of the proposed Project and alternatives.

2.4.2.4 California State Lands Commission

The California State Lands Commission (CSLC) has regulatory authority to administer, sell, lease or dispose of the public lands owned by the State or under its control, including not only school lands but tidelands, submerged lands, swamp and overflowed lands, and beds of navigable rivers and lakes (California Public Resources Code [PRC] Section 6216). The CSLC created the California Coastal Sanctuary, which includes all State waters subject to tidal influence, such as the study area. California PRC Section 6303 requires that a Lease Agreement for Utilization of Sovereign Lands be issued prior to initiation of any project that occurs on State-owned lands.

2.4.2.5 California Endangered Species Act (California Fish and Game Code Sections 2050-2116)

The California Endangered Species Act (CESA) parallels the Federal ESA. As a responsible agency, the CDFG has regulatory authority over State-listed endangered and threatened species. If a proposed Project may affect species that are listed as threatened or endangered under both the State and Federal Endangered Species Acts, then such Project is subject to CEQA and NEPA review, and the CDFG shall participate to the greatest extent practicable in the Federal endangered species consultation. The State legislature encourages cooperative and simultaneous

findings between State and Federal agencies. Further, the General Counsel for the CDFG has issued a memorandum to CDFG regional managers and division chiefs clarifying the CESA consultation process wherein, if a Federal BO has been prepared for a species, the CDFG must use this BO in lieu of its own findings unless it is inconsistent with CESA. CDFG Code Section 2095 authorizes participation in Federal consultation and adoption of a Federal BO. By adopting the Federal BO, the CDFG need not issue a taking permit per Section 2081 of the State Code. If the BO is consistent with CESA, the CDFG will complete a 2095 form in finalizing the adoption of the BO. If the Federal BO is found to be inconsistent with CESA, the CDFG will issue its own BO per Section 2090 of the State Code and may issue a 2081 take permit with conditions of approval. The proposed Project would comply with this act.

2.4.3 Local Environmental Regulations

The City of San Clemente is responsible for compliance with and executing local actions with a number of regional environmental regulations.

2.4.3.1 South Coast Air Quality Management Plan (AQMP); South Coast Air Quality Management District (SCAQMD) and Southern California Association of Governments (SCAG)

The SCAQMD is intended to provide compliance with the Federal Clean Air Act. Essentially, it incorporates mechanisms to reduce source and mobile pollutants. To facilitate compliance with the SCAQMD requirements, San Clemente is participating as a member of a countywide Air Quality Technical Advisory Committee which is responsible for the identification of applicable local implementation mechanisms and model ordinances.

3.0 ALTERNATIVES

This section presents the process used to formulate alternative plans and evaluation criteria leading to the recommendation of the Proposed Action for implementation. Under NEPA, reasonable alternatives are those that are practical or feasible from a technical or economic perspective and based on common sense (46 Federal Register 18026, as amended, 51 Federal Register 15618). Under CEQA, reasonable alternatives are those that would feasibly attain most of the project objectives, but would avoid or substantially lessen any of the significant effects of the project (California Code Regulations, Title 14, § 15126.6(a)). Factors used to determine feasibility include site suitability, economic limitations, consistency with local plans and policies, other plan or regulatory limitations, and jurisdictional boundaries.

3.1 Plan Formulation of Alternatives

Plan formulation begins with a large array of management measures and then screens these measures through a series of increasingly focused analysis and comparison. A management measure is a feature or activity at a site addressing one or more of the planning objectives. Management measures should address planning objectives, which represent desired positive changes, as well as planning constraints, which represent restrictions that should not be violated. A preliminary screening of the measures eliminates those that prove unacceptable or infeasible. Measures passing this initial screening are developed and screened further until a final array of measures is selected. Any implementable combination of these measures may be considered a separate alternative. Each final alternative receives equal development, analysis, and comparison.

Alternatives were formulated to maximize storm damage reduction and minimize cost and were recommended when their benefits exceeded their costs. Improvements to safety and recreational opportunities resulting from any alternative were considered incidental to the main objective of reducing storm damages. All alternatives were analyzed under both the NEPA and the CEQA review processes.

3.1.1 Evaluation Criteria

In general, the planning process needs to consider measures to avoid or mitigate any significant adverse impacts associated with the planning constraints. The planning constraints for this study are the following:

a. Preserve the nearshore ecosystem that supports commercial lobster and fishing industries and snorkeling activities;

b. Preserve the opportunities for surfing along the Pacific coast of the City of San Clemente;

c. Preserve any critical habitat that supports Federal or State threatened and endangered species;

d. Preserve water quality characteristics along the coast and near shore areas of the City of San Clemente;

e. Preserve cultural and historic features located in the study area;

f. Preserve air quality conditions within the study area.

A wide variety of measures were considered and assessed, some of which were found to be infeasible due to technical, economic, or environmental constraints. Measures that were considered feasible during the plan formulation process were screened and developed into project alternatives for full analysis.

3.1.2 Screening-level Comparison

Alternatives to address the reduction of potential storm damages were developed considering different scopes of plans by varying levels of protection, such as protecting only against frequent minor storm events as compared to protecting against the less frequent major storm events. Previous consideration was given to protecting several reaches or the entire study area (i.e., entire San Clemente coastline) as compared to certain reaches of the study area. For the planning objective involving restoration of beach area for recreation use, consideration also was given to different levels of restoration involving very wide beaches that may be needed on the highest peak use days only, compared to narrower beaches that may be used more frequently on average peak use days. Alternatives for this objective also were looked at by study reach, where some reaches may have minimal use for recreation. Screening of these alternatives was considered based on the evaluation criteria stated above, including economic costs and benefits, environmental impacts, and significant impacts to the planning constraints. Mitigation measures to avoid or minimize these impacts were incorporated into the alternative plans, as necessary.

The descriptions and results of the evaluations of the measures considered in this study are presented below. The detailed accounts of the comparisons between project alternatives are included in the San Clemente Shoreline Final Feasibility Report.

3.1.2.1 Non-structural Measures Considered

Anything that achieves the Project objectives without a structure is considered a non-structural alternative.

Managed Retreat

Managed retreat is a term commonly used to describe a policy that restricts or opposes efforts to control long-term retreat of the shoreline. It has been used to describe policies ranging from complete removal of all shore protection structures to simply not allowing new structures to be built.

For this Project area, managed retreat of coastal development would include relocation of the railroad and beach facilities due to the continued erosion of the recreation beach area. At this time, most of the public beach facilities are located along the backshore in the Project area. Continued erosion and storm wave attack would likely eliminate any beach area available for recreation use and may eliminate the need for facilities or relocate some facilities (e.g., restrooms) to the landward side of the railroad. The relocation of the railroad would be

extremely costly, and any decision for such relocation is beyond the scope and intent of this study. Managed retreat is not considered a viable non-structural measure.

3.1.2.2 Structural Measures Considered

Structural measures considered include revetments, sheet pile seawalls, breakwaters, offshore reefs, and groins.

Beach Fill

For the purpose of this document, beach fill or nourishment was the only soft structure measure considered viable for this area. Beach nourishment involves placement of compatible sand from a borrow area to effectively widen the beach. The beach fill material acts as a buffer, dissipating storm waves and run-up over the wider profile.

The beach fill design parameters were determined by considering various combinations of beach-fill widths and different replenishment cycles. Each option had one combination of an initial beach width and a repetitive duration for the subsequent renourishment cycles. The optimal option was the one that yielded the maximum net benefit. The Los Angeles District coastal engineering section developed the WENDY Model for Simulating Shoreline Change, which was used to predict the shoreline morphology over multiple years as waves redistribute sand after it is placed mechanically on the beach. The optimization consisted of finding the beach width and replenishment period for both segments that maximized the net benefits while avoiding impacts to known sensitive nearshore habitat.

Beach nourishment may use offshore or onshore borrow sites. In the study area, offshore sources have historically been used for several reasons. Prior offshore studies of the area conducted by the USACE have identified potential sources of sand suitable for an offshore borrow site. The potential offshore borrow sites in the study area were investigated for beach-compatible sand located by previous investigations off Oceanside by the San Diego Association of Governments (SANDAG 2000) and USACE (1993).

For this Project, offshore dredging would be required for the beach fill alternative. Available offshore borrow sites exist, and sand would be delivered to the beach fill sites using hopper dredges with pumpout or large cutter suction dredges. For the hopper dredge with pumpout, temporary nearshore pipeline and mono buoys would be positioned at about the 30 ft (9 m) depth contour to permit the dredge to pump each load directly ashore.

Revetments and Seawalls

Revetments are "flexible" structures (i.e., not locked in concrete) made of placed quarry stone. They are typically built of 3- to 5-ton stone over a layer of smaller stone over a layer of fill designed to stop shoreline retreat and to protect landslide improvements from damage by wave action. Revetments are generally effective if maintained, but they encroach significantly onto the beach. The seawall structural measure typically requires less spatial area and maintenance.

Sheet pile walls are steel or precast concrete panels vertically placed in the ground to form continuous seawalls for protecting back beach improvements.

Offshore Reefs and Breakwaters

Offshore reefs or submerged breakwaters would protect the shoreline against direct wave attack and reduce the transmitted wave energy to less damaging levels along the beach. Breakwaters are concrete or rock walls built roughly parallel to the shore just beyond the breaker zone to absorb wave energy by stopping transmission or breaking the wave before it hits the beach. They can be permeable or solid, depending on desired amount of wave energy absorption versus reflection.

Submerged artificial reef type designs for the purpose of sand retention and storm damage reduction come in many forms, but may be simplified into "soft" and "hard" designs. In the soft designs, nearshore sand berms are constructed of dredged sand placed parallel to the beach in shallow water. The "soft" breakwater reduces incident wave height, and gradual onshore migration of the sediment can contribute to renourishment of the adjacent shoreline, providing the berm itself is stable enough to withstand the wave environment.

"Hard" submerged breakwaters, which include "artificial reefs", reduce wave energy through breaking and dissipation. They are generally not as effective as surface piercing breakwaters at retaining sand, but do not generally have the adverse effects on surfing conditions that surface-visible structures do and may enhance surfing conditions if designed for dual purpose.

Although much theoretical research has been conducted, real world data on the performance of artificial reefs as sand retention structures is only now becoming available because few reefs have been built. In addition, most of these reefs were built in either Florida or Australia, where conditions differ greatly from the Southern California coastline. Pratte's Reef was constructed off of El Segundo, California out of large geotube sand bags as an experimental surfing reef to mitigate impacts from construction of a groin, but was ultimately too small (200 thirteen-ton bags within an area of approximately 244 ft by 92 ft) and too far offshore to have any noticeable impact on the shoreline (M&N, SANDAG 2000). An artificial reef with the purpose of sand retention would require to be constructed on a much larger scale to be effective along the entire Project length.

Shore Perpendicular Structures

Cross-shore sand retention structures, such as groins and jetties, are constructed perpendicular to the shore to form fillets that can slow beach erosion by trapping littoral sediment. Most of the littoral drift occurs inshore of the normal breaker line under prevailing wave conditions (about the 7- to 10-ft (2- to 3-m) depth contours on the Pacific coast). Hence, extension of sand retention structures beyond about MLLW is generally uneconomical (USACE 1984).

The shore perpendicular structures are generally utilized to preserve a minimum berm width and slow erosion rates so that renourishment volumes may be smaller and episodes less frequent. The amount of sand trapped by the structure depends on the permeability, height, and length of

the structure and the amount of sand in the littoral system. As material accumulates on the updrift side of the structure, supply to the downdrift side is reduced. This results in local beach accretion on the updrift side of the structure and erosion for some distance downshore. After the beach near the structure adjusts to an "equilibrium" stage in accordance with the wave conditions, all littoral drift either will pass the structure directly over it or diverted around the seaward end of the structure. Because of the potential adverse effects on downdrift beaches, groins and similar structures should be used only after careful consideration of the factors involved.

3.1.2.3 Comparison of Management Measures to Evaluation Criteria

Ultimately, the alternative plans identified in this study should follow the general guidelines listed below. Therefore, the management measures that become the alternative plans also must follow the following guidelines.

Technical Feasibility - The recommended plan presented should be complete and sound, and in sufficient detail to allow development of engineering plans and specifications.

Economic Feasibility - Any potential project that is in the Federal interest must display feasibility by satisfying benefit-cost (B/C) criteria. Generally, this ratio must be greater than one to allow Federal participation in continued study and any project proposal. In addition, the sponsoring agency is required to show their ability and willingness to fund their share of any recommended project as required by the Principles and Guidelines.

Environmental Impacts - Applicable environmental requirements must be met for a feasibility level study. Environmental acceptability must be ascertained; and adverse impacts should be avoided if possible or minimized if avoidance is not possible. The screening of alternatives based on environmental acceptability limitations are conducted with respect to Federal environmental statutes. Federal examples include the Coastal Zone Management Act (CZMA) and the Fish and Wildlife Coordination Act (FWCA). The California Coastal Commission currently interprets the CZMA in a manner that favors almost any type of shore protection over rock revetments and/or seawalls, especially in areas where there is a lot of public beach use and recreation. A revetment of the size necessary at this site would have very little chance of obtaining a Coastal Consistency Determination.

Public Acceptability - The alternative options and plans should be acceptable to the local residents, agencies, organization, and the non-Federal sponsor(s), as well as the interested State and Federal agencies. The local sponsor has indicated that they are severely constrained by public opinion and cannot support any recommendation that meets with severe public opposition. Unacceptable plans include any visible offshore structure and any structure that significantly impedes beach access, such as rock revetments.

Table 3-1 compares the management measures to the evaluation criteria.

Table 3-1 Comparison of Management Measures to Environmental Evaluation Criteria

Management Measure	Meets Purpose and Need	Technically Feasible	Economically Feasible	Environmentally Acceptable	Acceptable to Public
Beach fill	Yes	Yes	Yes	Yes	Maybe
Managed Retreat	Maybe	Yes	No	No	Maybe
Revetment	Maybe	Yes	Maybe	No	No
Seawall	No	Yes	Yes	No	No
Groin	Yes	Maybe	No	No	No
Visible Offshore Breakwater	Maybe	Yes	No	No	No
Submerged Reef	Maybe	No	No	Maybe	Maybe

Beach nourishment is highly effective at protecting the coastline as long as the beach is maintained. A wide beach berm resulting from beach fill can effectively provide a buffer against storm wave attack and improve recreational safety and opportunities significantly. Beach fill would address all of the problems and concerns.

Revetments and sheet pile walls would effectively address storm damage concerns; however, they do not address beach recreation concerns. Seawalls and revetments are placed parallel to the shoreline as a last line of defense to protect adjacent land areas from direct wave attack, flooding, and erosion. As such, they often provide the most reliable form of shoreline protection; however, they do nothing to increase beach width and can impede public access to the beach. Revetments are the most economic structural measures. Revetments are less aesthetically pleasing than beach replenishment or seawall. Revetments are difficult and hazardous for pedestrians to cross, and they severely impede access to the beach. In addition, they take up a significant portion of the beach width and impede alongshore access, constituting a significant impact to public access. Revetments would extend seaward up to 33 ft (10 m), which would result in no beach in the winter and would severely limit available beach space in the summertime.

The California Coastal Commission currently interprets the Coastal Act in such a way that favors almost any type of shore protection over rock revetment, especially in areas with high public beach use and recreation. The size of this Project would be a constraint. Local, well-organized, and well-funded citizens groups, including Surfrider Foundation, have expressed strong opposition to revetments both in public meetings and in litigation. Any proposed project including revetment would encounter severe opposition from these groups.

Groins are cross-shore retention structures that act as a barrier to alongshore sediment transport. Offshore breakwaters are effective at retaining sand, but are expensive and require a healthy source of littoral sand to perform their sand trapping function.

3.2 Measures Eliminated from Further Study

After reviewing the possible alternatives that were considered for the Project, only the beach fill alternatives were carried forward into the final array. Although all of the screening criteria were deemed important, the primary screening criteria included potential permanent and temporary impacts on Essential Fish Habitat, inconsistencies with the Coastal Zone Management Act, and project costs. Construction footprints for either breakwaters or groins would potentially have a permanent impact on Essential Fish Habitat. Consistency with the Coastal Zone Management Act was a criterion for eliminating breakwaters, groins, and revetments. The high cost of implementing the remaining alternatives, compared to beach nourishment, would not maximize NED benefits and achieve the Planning Objectives.

The cost for beach nourishment will depend on the sand volume required for reconstruction, the need for retention structures, and the frequency of renourishment. Revetments would be the least costly alternative, but they have limited benefits addressing problems associated with San Clemente's sand loss. The only consideration of a seawall is as a protective measure used by the railroad to protect their tracks and is not carried forward as a separate alternative.

Visible breakwaters were considered, however they were screened out of the final analysis due to public safety issues, extremely high cost, impact on down-coast littoral transport, impact on surfing, impact on aesthetics, and most importantly, and lack of support from the local sponsor and local community. Soft breakwaters and submerged reefs are generally not suited for the type of wave environment in the study area because the relatively small grain sizes of available sand would not be stable when subject to the wave-induced bottom currents. Therefore, soft submerged berms were not carried into the final analysis.

Groins would entail extremely high costs, lack of public/sponsor support, severe impact on lateral beach access, potential impacts to downdrift beaches, and concerns regarding effectiveness because groins have not been very effective in similar areas with limited sand supply. This measure was screened out of the final analysis.

3.3 Measures Carried Forward

Beach nourishment is highly effective at protecting the coastline as long as the beach is maintained. A wide beach berm resulting from beach fill can effectively provide a buffer against storm wave attack, and improve recreational safety and opportunities significantly. Beach fill is the only measure that met all the environmental evaluation criteria mentioned above.

3.4 Description of Alternatives

3.4.1 No Action

The USACE is required to consider the No Action, or Future without Project, Alternative to comply with the requirements of NEPA. The No Action Alternative assumes that no project would be implemented by the Federal government to achieve the planning objectives. For the purposes of the initial screening, the No Action Alternative assumes the SCRRA's existing maintenance plan will continue to be implemented, which may result in potential damage to the railroad ballast and tracks, but without any measures implemented by the City to address continued erosion of the recreation beaches near the San Clemente Pier. With the No Action Alternative, the erosion-prone beaches are assumed to be further depleted and storm damages would be expected to increase in severity, increasing the threat to the railroad corridor. Public safety and liability problems would not be resolved, and recreational activity on the beaches would be degraded, resulting in a loss of associated economic benefits.

Due to chronic beach erosion in recent years that resulted in storm wave attack directly against the railroad corridor, the SCRRA and OCTA have constructed un-engineered riprap revetment segment by segment in the San Clemente area where the railroad ballast and tracks are vulnerable to storm wave-induced damages. The SCRRA has been side-dumping riprap stones in a random but controlled manner along the most critical segment between North Beach and the Marine Safety Building to mitigate wave-induced impacts on the railroad tracks. The cumulative impact of stone placement over the years has been a curtailment of lateral beach access. SCCRA is in the process of modifying the existing maintenance practices in response to evolving California Coastal Commission policies. In order to avoid and minimize any possible service disruption, it may become necessary or mandatory for the SCRRA to construct an "engineered" seawall.

3.4.2 Beach Fill Alternative

The Beach Fill Alternative consists of dredging material from offshore Oceanside (Figure 3-1), then hauling and placing it at San Clemente Beach. The borrow site (Borrow Area 2) is approximately 940 acres, with a 128 acre area instead the borrow site (Borrow Area 2A) that contains the more desirable material. The beach fill design parameters were determined by considering various combinations of beach-fill widths (i.e., between 10 m and 60 m at 5 m intervals) and different replenishment cycles. These combinations are scales (e.g., 10 m, 15 m, 20 m, etc. beach width) of the same alternative (i.e., beach fill). Two beach widths have been chosen that reasonably represent the scales that were modeled (i.e., 15 m and 35 m), but were expected to have apparent differences in environmental impacts based on preliminary screening. The 15 m beach width was chosen to represent the smallest scale beach width that met the project objectives. The 35 m beach width was chosen to represent the largest scale beach width that met project objectives. Although it is recognized that these two widths are scales of the same alternative, they are addressed in this document as two separate alternatives.

3.4.2.1 Common Design Elements of Action Alternatives

The following design elements were determined to optimize the effectiveness of the beach nourishment alternative. The model outputs are principally economic values, annual net benefits, and benefit cost ratio (BCR). According to USACE planning guidelines, an economically justified plan satisfies the conditions of BCR greater than 1.0 and annual net benefits greater than 0. Unique features of the two alternatives are described in Section 3.4.2.2.

Alongshore Length

Approximately 3,412 ft (1,040 m) of shoreline within the City are recommended for nourishment. The area is approximately centered about the Pier; the south limit is located immediately south of the T-Street overpass, while the north limit is located immediately north of the Marine Safety Headquarters. A taper continues an additional 330 ft (100 m) to the north and south to merge with the existing shoreline.

Berm Crest Elevation

The design berm elevation for this study has been set at +17 feet (+5.2 m) MLLW. This elevation matches the height of the natural berm of adjacent healthy beaches, which has been established by numerous surveys over the years. Historical beach profiles measured over the years indicate natural, stable berm elevations are approximately +17 feet (+5.2 m) MLLW. A design berm lower than the natural berm will form a ridge along the crest, which when overtopped by high water will produce flooding and ponding on the berm. A design berm higher than the natural berm will produce a beach face slope steeper than the natural beach and may result in formation of scarps that interfere with recreational use and other environmental uses.

Foreshore Slope

The design foreshore slope is established at 8H:1V. This slope matches the natural foreshore slope of adjacent beaches that has been established by numerous surveys and measurements over the years. Direct measurements obtained by the City of San Clemente indicate natural, stable foreshore slopes range between 4-18H:1V, with 8H:1V as the most common value. This slope has been shown to be a stable mean value between the seasonal variations.

The construction foreshore slope is established at 13H:1V. Los Angeles District beach fill construction experience with standard earthmoving equipment indicates that slightly flatter foreshore slopes are easier to construct. The post-construction foreshore is expected to evolve through an adjustment process known as equilibration. Natural foreshore processes would re-distribute a portion of the original fill volume throughout the profile.

Sediment Quantity

The volume of beach compatible sand for the different alternatives is provided in Section 3.4.2.2. The recommended quantity was derived from consideration of the planform (i.e., plan view) area and volume/area relationships. The volume/area value of 1.5 yd^3/ft^2 (12.3 m^3/m^2) was used in

the present study; a value of 0.5 yd^3/ft^2 (4.1 m^3/m^2) has been shown to result in rapid erosion of the fill while the range of 1.0-1.5 yd^3/ft^2 (8.2-12.3 m^3/m^2) typically yields more realistic estimates of sediment requirement per surface area. Engineering practice in southern California indicates volume/area relationships are the most reliable predictor for fill quantities. It is expected that this quantity will have the greatest in-place stability.

A fill quantity is provided for each alternative to fill the design prism, including additional overfill requirements. The volume of sand represents a geometric area equivalent to the respective beach width. The construction profile is initially overfilled with the expectation that equilibration process will result in the design profile. Dredge material gradation is 6 to 12 percent of fines, 5 to 8 percent of gravel/cobbles, and the rest is sand. Material classification assumed is 10 percent fines, 83 percent sand, and 7 percent gravel.

Berm (or Beach) Width

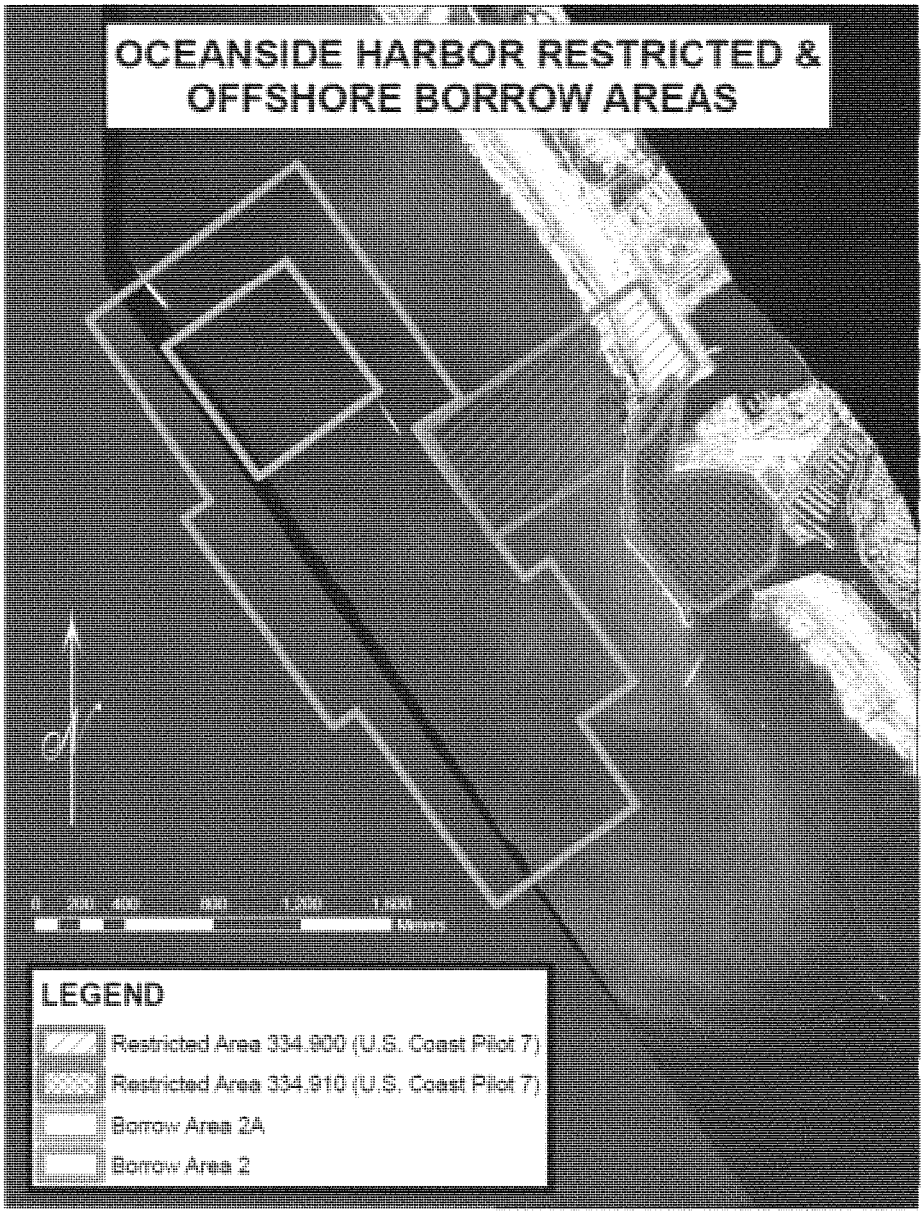
The berm width for the different alternatives considered is provided in Section 3.4.2.2. Berm width in this study is defined as that portion of the beach between the foreshore berm contour and a fixed location on the backshore, or the "dry" portion of the beach not subject to erosion. In this study, the seaward edge of the railroad revetment is considered the fixed point on the backshore. Several scales (e.g., 10 m, 15 m, 20 m, etc.) of berm width were originally modeled to determine the optimal width for the proposed Project. Two of these berm widths were considered for further analysis.

Similar to the fill quantity, in order to achieve the design intent, an additional width of beach is required. This material is placed to offset expected beach fill losses due to anticipated winnowing and equilibration of the construction profile. At the time of construction, the actual immediate post-construction width will be more than the equilibration or resultant beach width. The initial fill profile is expected to evolve through an adjustment process known as equilibration. Natural foreshore processes will re-distribute a portion of the original fill volume throughout the profile. The overfill material has been added to the design quantity to account for the equilibration process.

Nourishment Interval

A periodic nourishment interval is not optimized explicitly, but is a result of the sacrificial beach width optimization. The sacrificial beach width represents a period of time between successive nourishments. The sacrificial beach width divided by the mean long-term erosion rate will yield an approximate value for the nourishment interval. For example, a 66 ft (20 m) sacrificial beach width divided by 13 ft/yr (4.0 m/yr) long-term erosion rate approximately equals a 5-year periodic nourishment interval. Therefore, optimization of the sacrificial beach width will yield the periodic nourishment interval.

Figure 3-1 – Oceanside Borrow Site



3.4.2.2 Unique Features of Action Alternatives

50 ft (15 m) Beach Width Alternative

The design berm width for this alternative is approximately 50 ft (15 m). At the time of construction, the actual immediate post-construction width is expected to be approximately 76 ft (23 m). The recommended plan will require approximately 251,000 cy (192,000 m^3) of beach compatible sand. In other words, approximately 251,000 cy (192,000 m^3) in-place will create an immediate post-construction dry beach width of 76 ft (23 m) (Figure 3-2). It is expected that up to 26 ft (8 m) of dry beach width will be distributed from the foreshore to the profile during the equilibration process. This alternative is estimated to take 46 working days to complete.

115 ft (35 m) Beach Width Alternative

The design berm width for this alternative is approximately 115 ft (35 m). At the time of construction, the actual immediate post-construction width is expected to be approximately 171 ft (52 m). The recommended plan will require approximately 586,000 cy (448,000 m^3) of beach compatible sand. In other words, approximately 586,000 cy (448,000 m^3) in-place will create an immediate post-construction dry beach width of 171 ft (52 m) (Figure 3-3). It is expected that up to 56 ft (17 m) of dry beach width will be distributed from the foreshore to the profile during the equilibration process. This alternative is estimated to take 108 working days to complete.

3.4.2.3 Construction Method for Action Alternatives

The proposed Project, regardless of the action alternative chosen, will be constructed with hopper dredging equipment with pump ashore capability and conventional earthmoving equipment. Typical Los Angeles District beach fill projects require large capacity open-ocean capable dredges.

A medium-sized hopper dredge (e.g., Sugar Island) would be used. The hopper dredge effective capacity is estimated at 1,700 cy (1,300 m^3) and 3.2 loads per day. The hopper dredge would pump out the dredge material via a 24-inch pipeline at 1,800 cy/hr (1,376 m^3/hr). The hopper dredge would be filled at the designated borrow site at Oceanside and hauled approximately 21 miles (35 km) to San Clemente. At the receiver beach, the dredge would be attached to a moored floating section of pipeline extending 1,500 ft (457 m) to the shoreline. The material would be re-suspended and discharged through the on-board pumping system to the receiver site.

The hopper dredge requires a mono buoy to discharge its sand onto the beach. A mono buoy is a floating pipeline connection platform that is moored to the seafloor, and is used to interconnect with a steel sinker pipeline that carries the slurry along the seafloor to the beach. For this Project the mono buoy would be anchored in at least 25 ft (7.6 m) of water, between 2,500 and 5,000 ft (762 m to 1,524 m) from shore and in the appropriate location in relation to sensitive resources and engineering considerations. From one mono buoy location, sand can be pumped directly onshore and up to approximately 2,000 ft (610 m) alongshore in either direction.

Dredging would be performed 24 hours a day, 7 days a week. Shore equipment would work 12 hours a day, 7 days a week. The Project duration is estimated at four months. Anticipated number of working days differs between the alternatives. Construction is anticipated to begin in 2012.

Onshore Placement Method

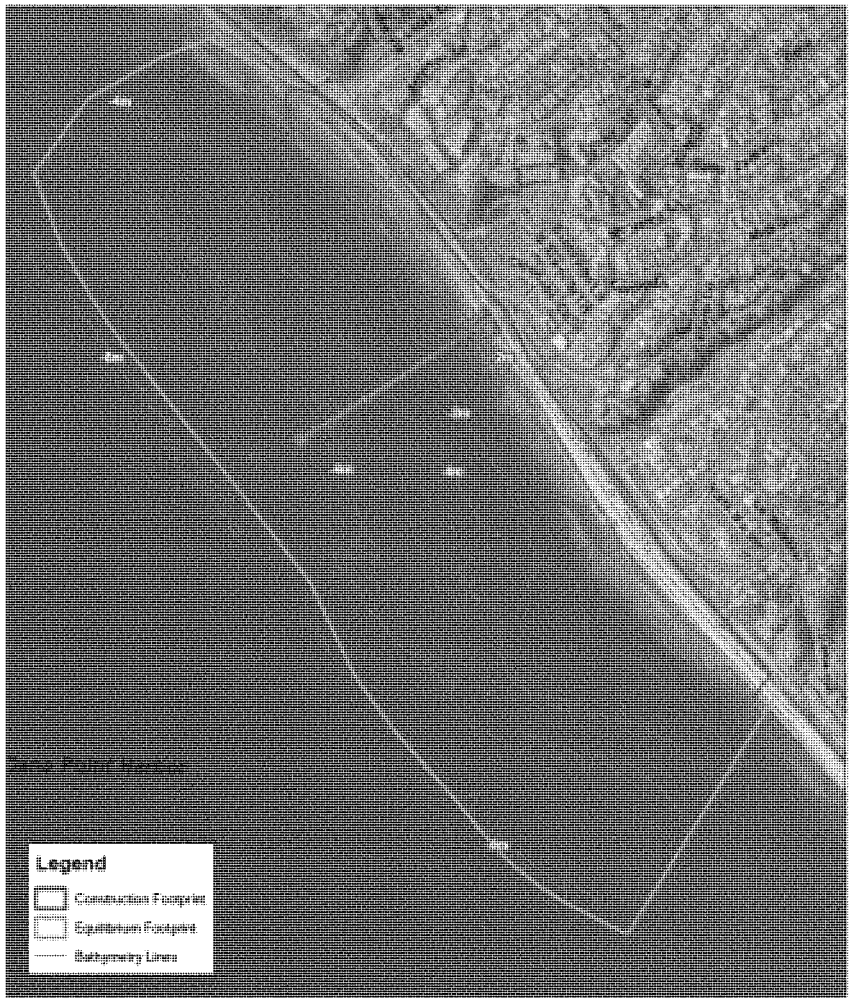
Sand would be combined with seawater until it reaches the consistency of slurry. It then would be conveyed to the beach via either pipeline or a combination of hopper dredge and pipeline, as described above.

Existing sand at the receiver site would be used to build a small, "L"-shaped berm to anchor the sand placement operations. The short side of the "L" would be transverse (crosswise) to the shoreline and would be the proposed width. The long side would be parallel to the shore at the seaward edge and would be approximately 200 ft (61 m) long. Berm construction may be adjusted from the design requirements during fill placement depending on actual field conditions. The crosswise side of the berm would be constructed to allow alongshore landward beach access for emergency access at all times.

The slurry would be pumped onto the beach between this berm and toe. The berm reduces ocean water turbidity by allowing all the sand to settle out inside the bermed area while the seawater is channeled along the berm until it reaches the open end where it drains into the ocean. Temporary dikes within the berm will allow sand to settle in designated areas. Once a 200 ft (61 m) section of berm is filled in with sand, another 200 ft (61 m) of berm would be created, the pipeline would be moved or extended into the new berm area, and the process would begin again. As the material is deposited behind the berm, the sand would be spread using two bulldozers and one front-end loader to direct the flow of the sand slurry and form a gradual slope to the existing beach elevation. The berm would be subject to the forces of the waves and weather once constructed and would eventually settle down to a natural grade for the beach.

Figure 3-2 Plan View of 50 ft (15 m) Beach Width Alternative

Figure 3-3 Plan View of 115 ft (35 m) Beach Width Alternative

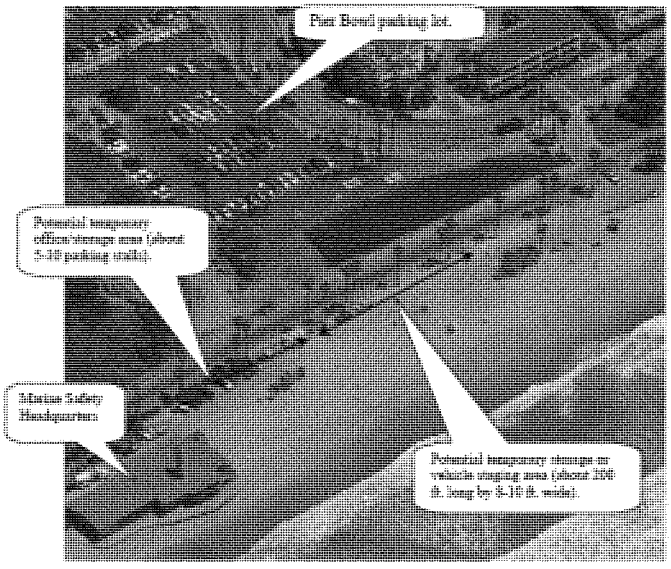


Construction Access and Staging Areas

Beach access for the construction equipment and crew would be split between open space on the beach and a city owned public parking lot and is shown in Figure 3-4. An open area exists along the beach immediately adjacent and north of the Pier and in the immediate vicinity of the Marine Safety Headquarters. It is expected this site would be used for the contractors' office trailer, parking area for heavy earthmoving equipment, and storage area for dredge pipe and other miscellaneous materials. This site is used extensively for access to the Marine Safety Headquarters and other municipal operations. It poses no new environmental considerations, minimizes disturbance to the environment, and is ideally located for contractor ease of operations. Although access to this area is controlled by a signal controlled, at-grade railroad crossing, it is anticipated that there would be no significant restrictions on utilization of this portion of the contractors work and storage area.

The contractors' dredge and vessels would require off-site mooring and berthing space. There is no mooring area available within the City of San Clemente. The nearest suitable mooring area is Dana Point Harbor, a small craft harbor approximately 5 mi (8 km) north.

Figure 3-4 Beach Access and Staging Areas



3.4.2.4 Public Access

For the beach fill operation, up to 300 ft (91 m) of beach would be inaccessible to the public around the discharge pipeline and berms. In addition, there would be intermittent restrictions on public access for approximately 350 ft (107 m) on either side of this discharge zone. This space would be needed for maneuvering heavy equipment during construction of the temporary berms.

3.4.2.5 Future Project Beach Profile Monitoring

Long-term shoreline erosional processes create damages through long-term profile translation landward and the increasing potential for wave related damages. The landward advancing shoreline reduces the beach width available for storm damage protection thereby increasing the probability of wave related damages to facilities and structures. Long-term beach erosion also results in the gradual reduction of the beach surface area available for recreation. The peak erosion rate is –0.7 ft/yr (–0.21 m/yr), the maximum erosion rate is -1.5 ft/yr (–0.46 m/yr), and the maximum accretion rate is +1.24 ft/yr (+0.38 m/yr).

The purpose of this monitoring is to allow the timing and the detailed design of the periodic nourishment to be optimized. Surveying of the beach and seabed morphology is paramount to the monitoring efforts. Changes in beach and seabed morphology will define the sediment transport patterns at the shoreline and ultimately the short term and long-term beach erosion processes. Alongshore transects will be crucial to determine the effects, if any, of the proposed Project on updrift and/or downdrift shorelines. The monitoring period will be for the 50-year period of Federal involvement. However, not all aspects of the monitoring plan will be conducted each year.

Maintenance nourishment efforts would occur when the shoreline reaches the base beach width (i.e., approximately 35 ft [11 m]). Based on a maximum erosion rate of -12.8 feet per year (3.9 m/yr), nourishment for the 50 ft (15 m) wide beach would be required approximately every 6 years and nourishment for the 115 ft (35 m) wide beach would be required approximately every 10 years. Maintenance nourishment efforts would return the beach to the design beach width, either 50 ft (15 m) or 115 ft (35 m), and would involve up to a similar amount of material as original construction based on the design beach width. Maintenance nourishment efforts also would be dependent upon available funding at the time of request.

3.5 Comparative Impacts Criteria of Alternative Plans

Alternatives were compared using the following four formulation criteria suggested by the U.S. Water Resources Council.

Completeness - Completeness is a determination of whether or not the plan includes all elements necessary to achieve the objectives of the plan. It is an indication of the degree that the outputs of the plan are dependent upon the action of others.

Effectiveness – All of the plans in the final array provide some contribution to the planning objectives. Effectiveness is defined as a measure of the extent to which a plan achieves its objectives.

Efficiency – All of the plans in the final array provide net benefits. Efficiency is a measure of the cost effectiveness of the plan expressed in net benefits.

Acceptability – All of the plans in the final array must be in accordance with Federal law and policy. The comparison of acceptability is defined as acceptance of the plan to the local sponsor and the concerned public.

3.6 Recommended Plan Alternative

Alternatives were considered that may have fewer direct, indirect, and cumulative impacts to aquatic resources that still meet the Project purpose. Potential project related impacts are provided in the alternatives analysis in Section 5.0 of this report. The 50 ft (15 m) Beach Width Alternative is identified as the **recommended plan**.

The recommended plan is developed by considering the storm damage reduction and recreational potential of various beach fill configuration alternatives and optimization based on the average annual benefits and the benefit/cost ratio. Primary optimization parameters of each alternative are the dimensions of the base beach width and sacrificial beach width of the cross-sectional design profile. An array of sacrificial beach widths yields a matrix of Project alternatives. Based on the evaluation of management measures above and the comparison of the alternatives formulated for this study, the tentatively recommended plan is the 50 ft (15 m) Beach Width Alternative.

The recommended plan is expected to perform in a manner consistent with other recent fills within the southern California region. A similar beach nourishment operation was performed in 2001 by the San Diego Association of Governments (SANDAG 2000). The project entailed dredging 2 million cubic yards (1.5 million cubic meters) of beach compatible sediments from 6 borrow sites for placement on 12 receiver beaches. The wide spread locations of the receiver beaches relative to the borrow locations required the use of a trailing suction hopper dredge. Sediment discharge was accomplished by pumping through floating pipelines to the beach. The dry land operation is expected to be conducted by conventional earthmoving equipment, including bulldozers and front-end loaders. Ancillary equipment is expected to include small maintenance/tool trailers and small service trucks. Oceanside Beach is the transect deemed most applicable to San Clemente. At Oceanside Beach, the fill quantity (421,000 cy / 322,000 m^3), median grain size (0.64 mm [0.03 in]), alongshore length (4,400 ft [1,341 m]), and fill width (185 ft [56 m]) are comparable to the recommended plan of this study, and its performance is deemed representative of expected performance at San Clemente.

Estimates based on the SANDAG monitoring data suggest the San Clemente fill will erode on average at a rate of 12.8 feet per year (3.9 m/yr). A beach fill erodes at substantially higher rates than the native beach. Due to the time varying nature of the wave climate, sediment supply to the beach, and other factors driving longshore sediment transport, it is expected that the beach

will erode at a greater rate in some years, at a slower rate in some years, and possibly accrete in other years. Based on a 50 ft (15 m) wide beach, and the 12.8 ft/yr (3.9 m/yr) erosion rate, it is anticipated that a fill will last about 6 years on average.

4.0 AFFECTED ENVIRONMENT

4.1 Meteorology and Air Quality

4.1.1 Climate/Meteorology

The proposed San Clemente Shoreline Project lies in the South Coast Air Basin (SCAB), with a borrow area located in the San Diego Air Basin.

4.1.1.1 South Coast Air Basiu (SCAB)

The SCAB includes all of Orange County as well as the non-desert portions of Los Angeles, Riverside, and San Bernardino counties. The SCAB is located in a coastal plain with connecting broad valleys and low hills, bounded by the Pacific Ocean in the southwest quadrant with high mountains forming the remainder of the perimeter. The general region lies in the semi-permanent high-pressure zone of the eastern Pacific. As a result, the climate is mild, tempered by cool sea breezes. This usually mild climatological pattern is interrupted infrequently by periods of extremely hot weather, winter storms, or Santa Ana winds.

The annual average temperature varies little throughout the SCAB, ranging from the low to middle 60s, measured in degrees Fahrenheit (°F). With a more pronounced oceanic influence, coastal areas show less variability in annual minimum and maximum temperatures than inland areas. The climatological station located in Laguna Beach (to the north) reports a yearly average of 61°F. The average low is reported at 44°F in January while the average high is 77°F in August and September.

In contrast to a very steady pattern of temperature, rainfall is seasonally and annually highly variable. Almost all rain falls from November through April. Summer rainfall is normally restricted to widely scattered thundershowers near the coast with slightly heavier shower activity in the east and over the mountains. Rainfall averages around 12.45 inches per year in the Project area, again, as measured at Laguna Beach.

Although the SCAB has a semi-arid climate, the air near the surface is typically moist because of the presence of a shallow marine layer. Except for infrequent periods when dry, continental air is brought into the SCAB by off shore winds, the ocean effect is dominant. Periods of heavy fog, especially along the coastline, are frequent; and low stratus clouds, often referred to as "high fog" are a characteristic climatic feature. Annual average humidity is 70 percent at the coast and 57 percent in the east portions of the SCAB.

Wind patterns across the south coastal region are characterized by westerly and southwesterly onshore winds during the day and easterly or northeasterly breezes at night. Wind speed is somewhat greater during the dry summer months than during the rainy winter season. Annually, typical winds in the project area average about 6 to 8 miles per hour during the day and 2 to 8 miles per hour during the night.

Between the periods of dominant airflow, periods of air stagnation may occur, both in the morning and evening hours. Whether such a period of stagnation occurs is one of the critical determinants of air quality conditions on any given day. During the winter and fall months, surface high-pressure systems over the SCAB, combined with other meteorological conditions, can result in very strong, downslope Santa Ana winds. These winds normally have duration of a few days before predominant meteorological conditions are reestablished.

In conjunction with the two characteristic wind patterns that affect the rate and orientation of horizontal pollutant transport, there are two similarly distinct types of temperature inversions that control the vertical depth through which pollutants are mixed. These inversions are the marine/subsidence inversion and the radiation inversion. The height of the base of the inversion at any given time is known as the "mixing height". This mixing height can change under conditions when the top of the inversion does not change. The combination of winds and inversions are critical determinants in leading to the highly degraded air quality in summer, and the generally good air quality in the winter in the project area.

4.1.1.2 San Diego Air Basin (SDAB)

The SDAB covers 4,260 square miles and lies in the southwest corner of California and comprises the entire San Diego region. The topography in the San Diego region varies greatly, from beaches on the west to mountains and desert on the east. Much of the topography in between consists of mesa tops intersected by canyon areas. The topography in the San Diego region, along with local meteorology, influences the dispersal and movement of pollutants in the basin.

The weather of the San Diego region, as in most of southern California, is influenced by the Pacific Ocean and its semi-permanent high-pressure systems that result in dry, warm summers and mild, occasionally wet winters. The average temperature ranges from the mid 40s to the high 90s. Most of the county's precipitation falls from November to April, with infrequent (approximately ten percent) precipitation during the summer.

The interaction of ocean, land, and the Pacific High Pressure Zone maintains clear skies for much of the year and drives the prevailing winds. Local terrain is often the dominant factor inland, and winds in inland mountainous areas tend to blow through the valleys during the day and down the hills and valleys at night.

4.1.2 Ambient Air Quality

The following characterization of the baseline atmospheric environment includes an evaluation of the ambient air quality and applicable rules, regulations, and standards for the area. Because the Project has the ability to release gaseous emissions of criteria pollutants and dust into the ambient air, it falls under the ambient air quality standards promulgated on the local, state, and federal levels.

4.1.2.1 Baseline Air Quality

Topographical features that affect the transport and diffusion of pollutants in the project area include the mountain ranges to the northeast that prevent the transport of pollutants. Air quality in the SCAB generally ranges from fair to poor and is similar to air quality in most of coastal Southern California. The entire region experiences heavy concentrations of air pollutants during prolonged periods of stable atmospheric conditions. During the past 20 years, the SDAB has experienced a decline in the number of days with unhealthy levels of ozone despite the region's growth in population and vehicle miles traveled, which both contribute to air pollution problems. This improvement in air quality clearly shows that efforts to reduce air pollution are working.

Pollutants emitted into the air from stationary and mobile sources affect the ambient air quality. Stationary sources can be divided into two major subcategories: point sources and area sources. Point sources consist of one or more emission sources at a facility with an identified location and are usually associated with manufacturing and industrial processing plants. Area sources are widely distributed and produce many small emissions, such as residential water heaters.

Mobile sources refer to emissions from motor vehicles, including tailpipe and evaporative emissions, and are classified as either on-road or off-road. On-road sources are a combination of emissions from automobiles, trucks, and indirect sources. Indirect sources are sources that by themselves may not emit air contaminants; however, they indirectly cause the generation of air pollutants by attracting vehicle trips or consuming energy. Examples of indirect sources include an office complex or commercial center that generates commuter trips and consumes energy resources through the use of natural gas for space and water heating. Indirect sources also include actions proposed by local governments, such as redevelopment districts and private projects involving the development of either large buildings or tracts. In addition, indirect sources include those emissions created by the distance vehicles travel. Off-road sources include aircraft, ships, trains, and self-propelled construction equipment.

4.1.2.2 Affected Environment

Existing levels of ambient air quality and historical trends and projections in the project area are best documented by measurements made by the SCAQMD. The sand placement is located within the southern portion of Source Receptor Area (SRA) 21 Capistrano Valley. The closest monitoring station to the San Clemente area is located at Lake Forest (Saddleback Valley SRA 19). Excepting NO_2 that is not monitored in this area, data from the monitoring station in SRA 19 are summarized in Table 4-1. Data for NO_2 included in Table 4-1 are as monitored in the North Coastal SRA 18. The borrow area is located near Oceanside. The nearest monitoring station to the borrow site is located at Camp Pendleton. The Camp Pendleton site measures ozone, $PM_{2.5}$, and NO_2. Table 4-1 also includes ambient data for Camp Pendleton.

At the SCAG monitoring sites, ozone pollution decreased between 2004 and 2005 with an increase again in 2006 and decrease in 2007 with 5 days experiencing a violation of the federal hourly standard. The SCAG data show recurring violations of and fluctuations in both the State and Federal ozone standards and no clear trend is apparent. The SCAG data also indicate that the area occasionally exceeds the PM_{10} and $PM_{2.5}$ State and Federal standards with only one day

in 2006 that exceeded the standards for either pollutant. The CO and NO_2 standards have not been violated in the last five years at this station.

Table 4-1 Ambient Air Quality Monitoring Summary

Pollutant/Standard	Number of Days Thresholds Were Exceeded and Maximum Levels During Such Violations				
	2003	2004	2005	2006	2007
Ozone – Lake Forest					
State 1-Hour > 0.09 ppm	16	11	3	13	5
State 8-Hour > 0.07 ppm	ND	20	6	17	10
Federal 1-Hour > 0.12 ppm	4	0	1	0	0
Federal 8-Hour > 0.08 ppm	8	0	1	6	2
Max. 1-Hour Conc. (ppm)	0.153	0.116	0.125	0.12	0.108
Max. 8-Hour Conc. (ppm)	0.105	0.089	0.085	0.105	0.089
Ozone – Camp Pendleton					
State 1-Hour > 0.09 ppm	4	4	0	0	0
State 8-Hour > 0.07 ppm	10	12	2	5	4
Federal 1-Hour > 0.12 ppm	0	0	0	0	0
Federal 8-Hour > 0.08 ppm	5	6	0	0	0
Max. 1-Hour Conc. (ppm)	0.099	0.110	0.090	0.086	0.083
Max. 8-Hour Conc. (ppm)	0.084	0.095	0.074	0.073	0.074
Carbon Monoxide – Lake Forest					
State 8-Hour > 9.0 ppm	0	0	0	0	0
Federal 8-Hour ≥ 9.5 ppm	0	0	0	0	0
Max 1-Hour Conc. (ppm)	3	2	2	2	3
Max. 8-Hour Conc. (ppm)	1.8	1.6	1.6	1.8	2.1
Nitrogen Dioxide – SRA 18					
State 1-Hour ≥ 0.25 ppm	0	0	0	0	0
Max. 1-Hour Conc. (ppm)	0.11	0.10	0.09	0.10	0.07
Nitrogen Dioxide – Camp Pendleton					
State 1-Hour ≥ 0.25 ppm	0	0	0	0	0
Max. 1-Hour Conc. (ppm)	0.11	0.10	0.09	0.10	0.07
Inhalable Particulates (PM_{10})[2] – Lake Forest					
State 24-Hour > 50 µg/m^3	3.5	0.0	0.0	2.0	5
Federal 24-Hour > 150 µg/m^3	0.0	0.0	0	0	0
Max. 24-Hour Conc. (µg/m^3)	64	47	41	57	74
Inhalable Particulates ($PM_{2.5}$)[2] – Lake Forest					
Federal 24-Hour > 65 µg/m^3	0.0	0.0	0.0	0.9	0.0
Max. 24-Hour Conc. (µg/m^3)	50.6	49.4	35.4	47.0	46.9

[1] NO_2 as measured at the North Coastal Orange County monitoring station. All other pollutants as measured at the Saddleback monitoring station.
[2] Percent of samples exceeding standard.
ppm: parts per million; µg/m^3: micrograms per cubic meter
Source: South Coast Air Quality Management District

At the SDAG monitoring sites, ozone pollution stayed fairly steady between 2004 and 2005 and actually decreased between 2005 and 2007 with an average of 3 days experiencing a violation of the State hourly standard during those three years. The NO_2 standards have not been violated in the last five years at this station.

4.1.2.3 Sensitive Receptors

Some land uses are considered more sensitive to air pollution than others due to the types of population groups or activities involved. Sensitive population groups include children, the elderly, the acutely ill, and the chronically ill, especially those with cardio-respiratory diseases. Residential areas are considered to be sensitive to air pollution because residents (including children and the elderly) tend to be at home for extended periods of time, resulting in sustained exposure to any pollutants present. Schools are also considered as sensitive as children are present for extended durations and engage in regular outdoor activities. Recreational land uses are considered moderately sensitive to air pollution because exercise places a high demand on respiratory functions, which can be impaired by air pollution. Sensitive receptors in the Project vicinity include several residential neighborhoods approximately 196 feet from the Project site.

4.1.3 Regulatory Framework

The following characterization of the baseline atmospheric environment includes an evaluation of the ambient air quality and applicable rules, regulations, and standards for the area. Because the Project has the ability to release gaseous emissions of criteria pollutants and dust into the ambient air, it falls under the ambient air quality standards promulgated on the Local, State, and federal levels.

4.1.3.1 Criteria Pollutants

Federal and State laws regulate the air pollutants emitted into the ambient air by stationary and mobile sources. These regulated air pollutants are known as "criteria air pollutants" and are categorized as primary and secondary pollutants. Primary air pollutants are those that are emitted directly from sources. Carbon monoxide (CO), reactive organic gases (ROG), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and most fine particulate matter (PM_{10}, $PM_{2.5}$), including lead (Pb) and fugitive dust; are primary air pollutants. Of these CO, SO_2, PM_{10}, and $PM_{2.5}$ are criteria pollutants. ROG and NO_X are criteria pollutant precursors that go on to form secondary criteria pollutants through chemical and photochemical reaction in the atmosphere. Ozone (O_3) and nitrogen dioxide (NO_2) are the principal secondary pollutants. A description of each of these primary and secondary criteria air pollutants and their known health effects is presented in Appendix C.

4.1.3.2 Toxic Air Contaminants

The public's exposure to toxic air contaminants (TACs) is a significant environmental health issue in California. In 1983, the California Legislature enacted a program to identify the health effects of TACs and to reduce exposure to these contaminants to protect the public health. The Health and Safety Code defines a TAC as "an air pollutant which may cause or contribute to an

increase in mortality or in serious illness, or which may pose a present or potential hazard to human health". A substance that is listed as a hazardous air pollutant pursuant to subsection (b) of Section 112 of the Federal Act (42 USC Sec. 7412[b]) is a toxic air contaminant. Under State law, the California Environmental Protection Agency, acting through the CARB, is authorized to identify a substance as a TAC if it determines the substance is an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health.

California regulates TACs primarily through AB 1807 (Tanner Air Toxics Act) and AB 2588 (Air Toxics "Hot Spot" Information and Assessment Act of 1987). The Tanner Air Toxics Act sets forth a formal procedure for CARB to designate substances as TACs. Once a TAC is identified, CARB adopts an "airborne toxics control measure" for sources that emit designated TACs. If there is a safe threshold for a substance at which there is no toxic effect, the control measure must reduce exposure to below that threshold. If there is no safe threshold, the measure must incorporate toxics best available control technology (T-BACT) to minimize emissions.

Air toxics from stationary sources are also regulated in California under the Air Toxics "Hot Spot" Information and Assessment Act of 1987. Under AB 2588, toxic air contaminant emissions from individual facilities are quantified and prioritized by the air quality management district or air pollution control district. High priority facilities are required to perform a health risk assessment and, if specific thresholds are exceeded, required to communicate the results to the public in the form of notices and public meetings.

To date the CARB has designated nearly 200 compounds as TACs. Additionally, the CARB has implemented control measures for a number of compounds that pose high risks and show potential for effective control. The majority of the estimated health risks from TACs can be attributed to a relatively few compounds, the most important being particulate matter from diesel-fueled engines.

4.1.3.3 Other Effects of Air Pollution

Just as humans are affected by air pollution, so too are plants and animals. Animals must breathe the same air and are subject to the same types of negative health effects. Certain plants and trees may absorb air pollutants that can stunt their development or cause premature death.

There are also numerous impacts to the human economy including lost workdays due to illness, a desire on the part of business to locate in areas with a healthy environment, and increased expenses from medical costs. Pollutants may also lower visibility and cause damage to property. Certain air pollutants are responsible for discoloring painted surfaces, eating away at stones used in buildings, dissolving the mortar that holds bricks together, and cracking tires and other items made from rubber.

4.1.3.4 Federal Ambient Air Quality Standards (AAQS)

The Federal Clean Air Act Amendment of 1971 (CAA) established national Ambient Air Quality Standards (AAQS) with states retaining the option to adopt more stringent standards or to

include other pollution species. These standards are the levels of air quality considered safe, with an adequate margin of safety, to protect the public health and welfare. They are designed to protect those "sensitive receptors" most susceptible to further respiratory distress such as asthmatics, the elderly, very young children, people already weakened by other disease or illness, and persons engaged in strenuous work or exercise. Healthy adults can tolerate occasional exposure to air pollutant concentrations considerably above these minimum standards before adverse effects are observed.

Both the State of California and the federal government have established health based AAQS for six air pollutants. As shown in Table 4-2, these pollutants include ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, suspended particulate matter (PM_{10}, $PM_{2.5}$), and lead. In addition, the State has set standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility reducing particles. These standards are designed to protect the health and welfare of the populace with a reasonable margin of safety.

In addition to primary and secondary AAQS, the State of California has established a set of episode criteria for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter. These criteria refer to episode levels representing periods of short-term exposure to air pollutants that actually threaten public health.

4.1.3.5 Air Quality Management Planning

The SCAQMD and the Southern California Association of Governments (SCAG) are the agencies responsible for preparing the Air Quality Management Plan (AQMP) for the SCAB. Since 1979, a number of AQMPs have been prepared. The 1997 AQMP, updated in 1999 and replaced in 2003, was based on the 1994 AQMP and ultimately the 1991 AQMP, and was designed to comply with State and Federal requirements, reduce the high level of pollutant emissions in the SCAB, and ensure clean air for the region through various control measures. To accomplish its task, the 1991 AQMP relied on a multilevel partnership of governmental agencies at the Federal, State, regional, and local level. These agencies (i.e., the USEPA, CARB, local governments, SCAG, and SCAQMD) are the cornerstones that implement AQMP programs.

The 2003 AQMP, adopted in August 2003, updated the attainment demonstration for the Federal standards for ozone and PM_{10}; replaced the 1997 attainment demonstration for the Federal CO standard and provided a basis for a maintenance plan for CO for the future; and updated the maintenance plan for the Federal NO_2 standard that the SCAB has met since 1992.

The most recent comprehensive plan was adopted on July 13, 2007. The 2007 comprehensive plan is designed to meet the State and Federal CAA planning requirements and focuses on ozone and $PM_{2.5}$. The 2007 comprehensive plan incorporates significant new emissions inventories, ambient measurements, scientific data, control strategies, and air quality modeling.

Areas that meet the ambient air quality standards are classified as "attainment" areas while areas that do not meet these standards are classified as "non-attainment" areas. The classifications for ozone non-attainment include and range in magnitude from: marginal, moderate, serious, severe, and extreme. The attainment status for the SCAB is included in Table 4-3.

Table 4-2 Ambient Air Quality Standards for Priority Pollutants

Pollutant	Averaging Time	California Standard	Federal Primary Standard	Major Pollutant Sources
Ozone (O_3)	1 hour	0.09 ppm	*	Motor vehicles, paints, coatings, and solvents.
	8 hours	0.070	0.075 ppm	
Carbon Monoxide (CO)	1 hour	20 ppm	35 ppm	Internal combustion engines, primarily gasoline-powered motor vehicles.
	8 hours	9.0 ppm	9 ppm	
Nitrogen Dioxide (NO_2)	Annual Average	*	0.053 ppm	Motor vehicles, petroleum-refining operations, industrial sources, aircraft, ships, and railroads.
	1 hour	0.18 ppm	*	
Sulfur Dioxide (SO_2)	Annual Average	*	0.03 ppm	Fuel combustion, chemical plants, sulfur recovery plants, and metal processing.
	1 hour	0.25 ppm	*	
	24 hours	0.04 ppm	0.14 ppm	
Suspended Particulate Matter (PM_{10})	Annual Arithmetic Mean	20 $\mu g/m^3$	50 $\mu g/m^3$	Dust and fume-producing construction, industrial, and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g. wind-raised dust and ocean sprays).
	24 hours	50 $\mu g/m^3$	150 $\mu g/m^3$	
Suspended Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 $\mu g/m^3$	15 $\mu g/m^3$	Dust and fume-producing construction, industrial, and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g. wind-raised dust and ocean sprays).
	24 hours	*	35 $\mu g/m^3$	
Lead (Pb)	Monthly	1.5 $\mu g/m^3$	*	Present source: lead smelters, battery manufacturing & recycling facilities. Past source: combustion of leaded gasoline.
	Quarterly	*	1.5 $\mu g/m^3$	
Sulfates (SO_4)	24 hours	25 $\mu g/m^3$	*	Industrial processes.

ppm: parts per million; $\mu g/m^3$: micrograms per cubic meter
* = standard is not used for this pollutant/duration by this entity.

Table 4-3 Attainment Status for the SCAB

Pollutant	State Status	Federal Status
Ozone (1-hour)	Extreme Non-attainment	Extreme Non-attainment (under the prior standard)
Ozone (8-hour)	Extreme Non-Attainment	Extreme
PM_{10}	Serious Non-attainment	Serious Non-attainment
$PM_{2.5}$	Non-attainment	Non-attainment
CO	Attainment	Attainment/Maintenance
NO_2	Attainment	Attainment/Maintenance

On April 15, 2010, EPA signed a final rule to grant requests to reclassify SCAB from "severe-17" to "extreme". The SCAB also is designated as attainment of the CAAQS for SO2, lead, and sulfates. Areas that are designated as Severe 17 for the ozone standard must meet attainment of the 8-hour standard by 2021 (2024 if reclassified to Extreme). Areas considered as serious non-attainment of the PM10 standards must have reached attainment by the end of 2006, or as expeditiously as possible. The $PM_{2.5}$ attainment date is to be met in the year 2015.

General Conformity

The EPA established the General Conformity Rule on November 30, 1993. The rule implements the CAA conformity provision, which mandates that the Federal government not engage, support, or provide financial assistance for licensing or permitting, or approve any activity not conforming to an approved CAA implementation plan. The purpose of the General Conformity Rule was to ensure that Federal activities do not hamper local efforts to control air pollution. The total quantified emissions of nonattainment or maintenance pollutants from both direct and indirect sources is compared to rates listed in Title 40, Part 51, Section 51.853(b), considered the *de minimis* levels, where, if they are determined to exceed those levels, the Federal agency is required to conduct a Conformity Determination.

Since all on-shore activities are located at the main project site in San Clemente, the *de minimis* levels are based on attainment designations/classifications in the SCAB. Table 4.3a shows the General Conformity *de minimis* levels.

Table 4-4a General Conformity *De Minimis* Levels

Pollutant	Classification	Tons/yr
Ozone	Extreme	10
PM_{10}	Serious	70
CO	Maintenance	100
NO_2	Maintenance	100

4.1.3.6 Standard Conditions and Uniform Codes

All projects constructed in the SCAB are subject to Standard Conditions and Uniform Codes. Compliance with these provisions is mandatory and as such, does not constitute mitigation under CEQA. Those conditions specific to air quality that would apply to the Project are included below:

- Adherence to SCAQMD Rule 403, which sets requirements for dust control associated with grading and construction activities.
- Adherence to SCAQMD Rules 431.1 and 431.2, which require the use of low sulfur fuel for stationary construction equipment.

During construction, the project would be subject to SCAQMD Rule 403 (fugitive dust). SCAQMD Rule 403 does not require a permit for construction activities, per se, but rather, sets forth general and specific requirements for all construction sites (as well as other fugitive dust sources) in the SCAB. The general requirement prohibits a person from causing or allowing emissions of fugitive dust from construction (or other fugitive dust source) such that the presence of such dust remains visible in the atmosphere beyond the property line of the emissions source. SCAQMD Rule 403 also prohibits a construction site from causing an incremental PM_{10} concentration impact at the property line of more than 50 micrograms per cubic meter as determined through PM_{10} high-volume sampling, but the concentration standard and associated PM_{10} sampling do not apply if specific measures identified in the rule are implemented and appropriately documented.

4.1.3.7 Greenhouse Gas Emissions

In 2005, in recognition of California's vulnerability to the effects of climate change, Governor Schwarzenegger established Executive Order S-3-05, which sets forth a series of target dates by which statewide emission of greenhouse gas would be progressively reduced, as follows:

- By 2010, reduce greenhouse gas emissions to 2000 levels;
- By 2020, reduce greenhouse gas emissions to 1990 levels; and
- By 2050, reduce greenhouse gas emissions to 80 percent below 1990 levels.

In 2006, California passed the California Global Warming Solutions Act of 2006 (AB 32; California Health and Safety Code Division 25.5, Sections 38500, et seq.), which requires CARB to design and implement emission limits, regulations, and other measures, such that feasible and cost-effective statewide greenhouse gas emissions are reduced to 1990 levels by 2020 (representing an approximate 25 percent reduction in emissions).

Discrete early action measures are measures that will be in place and enforceable by January 1, 2010. The discrete early action items include: (1) a Low Carbon Fuel standards for ethanol, biodiesel, hydrogen, electricity, compressed natural gas, liquefied petroleum gas, and biogas; (2)

restrictions on High Global Warming Potential Refrigerants; (3) Landfill Methane Capture; (4) Smartway Truck Efficiency; (5) Port Electrification; (6) Reduction of perfluorocarbons from the semiconductor industry; (7) Reduction of propellants in consumer products; (8) Tire inflation; and (9) Sulfur Hexafluoride (SF6) reductions from non-electricity sector.

The 2020 target reductions are currently estimated to be 174 million metric tons of carbon dioxide (CO2) equivalent (MMTCO2E). In total, the recommended early actions have the potential to reduce greenhouse gas emissions by at least 42 MMTCO2E emissions by 2020, representing about 25 percent of the estimated reductions needed by 2020. The CARB Board adopted Resolution 07-55 in December 2007, approving 427 MMTCO2E as the statewide greenhouse gas emissions limit for 2020, which is equivalent to the 1990 emissions level. The measures are in the sectors of fuels, transportation, forestry, agriculture, education, energy efficiency, commercial, solid waste, cement, oil and gas, electricity, and fire suppression.

4.2 Geology and Topography

This discussion of the existing topographic and geologic features of the Project area was based on the Geotechnical Report prepared by the Geotechnical Branch of the USACE (USACE 2005b) and the Coastal Engineering Appendix to the San Clemente Shoreline Feasibility Study (USACE 2009, Appendix D). Those reports contain a summary of geologic conditions in the Project area as well as the results of sediment testing performed by the USACE in 1993 and 2003 and SANDAG in 1999.

The shoreline in the Project area consists mainly of narrow, gently to moderately sloping sandy beaches backed by high, coastal bluffs. This sandy beach grades into a foreshore consisting of cobble and gravel pockets at the water's edge. At Mariposa Point, located some 980 feet (300 meters) northwest of the San Clemente Pier, offshore rocks, and boulders protrude from the high intertidal sand beach and become the dominant habitat type throughout the mid and low intertidal zones. The extensive rocky intertidal habitat at Mariposa Point consists of a series of low-lying shale reef platforms that begin mid-beach and extend into the subtidal zone along with individual high relief boulders.

4.2.1 Offshore

The area offshore of San Clemente is a part of the Capistrano Bight, located at the eastern edge of the Gulf of Santa Catalina. This area is described as that part of the California coast known as the "Continental Borderland", as there is no real continental shelf in this part of the coast. The area from Dana Point Harbor in Orange County downcoast to La Jolla in San Diego County is further defined as the "Oceanside Littoral Cell". San Clemente Beach is located in the extreme upper portion of this Littoral Cell. Published information for the bedrock exposures of most of the offshore area, exclusive of San Clemente Beach and the Channel Islands, is sparse and is based upon scattered bottom samples and reconnaissance type geophysical investigations. Local lifeguards and divers have informally stated that the ocean floor area offshore contained only bedrock and there were no deposits of beach sand.

In May 2002, bathymetric surveys, seismic surveys, sub-bottom profiling, and a side scan sonar survey were conducted offshore of San Clemente Beach to determine the presence or absence of shallow bedrock. The bathymetric survey indicates that the ocean bottom slopes gradually seawards from an elevation 0 Mean Lower Low Water (MLLW) at the shoreline to an elevation deeper than -100 ft (-32.8 m) MLLW at a distance of about 0.9 mi (1,500 m) from shore. The seafloor slope direction is southwest - normal to the beach. The seafloor gradient averages 0.9 percent (slope 110H:1V) but varies locally. The inshore gradient between 10 to 20 ft (3 to 6 m) is 5 percent off San Clemente Beach and decreases farther to the northwest.

The geophysical surveys further indicated that the ocean floor is a bedrock surface covered with a thin veneer of littoral sediments that vary in thickness from about 0 to about 1 ft (0.32 m) or more, out to a distance of 4,950 ft (1,500 m) from the shoreline. This surficial sediment cover likely changes seasonally as beach sands migrate cross-shore.

Several bedrock spurs extend out from shore; the largest one is the seaward extension of the San Mateo Point. These spurs may rise several meters above the intervening swales. The San Mateo Rocks northwest of San Mateo Point are isolated and may be remnant spurs. Bedrock outcrops the seafloor in places between the shore and about the 50 ft (15 m) isobath. Where outcrops occur, the seafloor is uneven from the resistant bedrock mounds. Some of the larger outcrops rise as much as 20 ft (6 m) above the surrounding seabed. The topography seaward of the outcrops is a smooth seafloor with an even slope. The smooth texture is the result of unconsolidated recent sediment deposition.

The proposed borrow area for the beach replenishment is located approximately 21 mi (35 km) downcoast of San Clemente Beach, approximately 1 mi (1.7 km) north of Oceanside Harbor, Oceanside, California. The borrow site is sand bottom, although some artificial reefs have been identified in the vicinity (SANDAG 2000).

4.2.2 Onshore

The San Clemente area comprises a part of the western flank of the Peninsular Ranges Geologic Province of southern California and includes areas of the western foothills of the Santa Ana Mountains and the southeastern flank of the San Joaquin Hills. The Peninsular Ranges extend from the Palos Verdes Peninsula in the north to the tip of Baja California in the south. The bedrock exposures in the area are comprised of marine sedimentary and volcanic rocks of Miocene, Pliocene and Pleistocene ages. The bedrock formations both onshore and offshore consist of the San Mateo Formation, an arkosic sandstone of Pleistocene age; the Capistrano Formation, a series of silty shales, mudstones, siltstones, and coarse sandstones of late Miocene and early Pliocene age; and the San Onofre Breccia, which is a series of volcanic breccias, ash flows, and tuffs derived from large landslides during volcanic eruptions, interbeded with layers of fine-grained volcanic ash deposited into fresh or salt water and is of Miocene age.

On the San Clemente Beach marine erosion has formed a broad wave-cut terrace, which extends back from the coastline and lies several meters above sea level. This relatively flat-lying surface is cut mainly in rocks of the Capistrano Formation of late Miocene and early Pliocene age and is mantled with poorly consolidated non-marine alluvial cover of Holocene and Pleistocene age and

marine terrace deposits of Upper Pleistocene age. The non-marine cover consists of poorly bedded fine-grained sediments. The marine terrace deposits consist of poorly consolidated sands, sandstones, and conglomerates. The beach, which begins at the foot of the wave-cut terrace, is composed of fine to medium-grained sands and silty sands. Because of various seasonal cycles of sand deposition and erosion and the lack of adequate natural beach re-nourishment, the beach varies in width from 0 to 200 ft (0 to 60 m). Within the Project area the beach width meanders from 0 ft wide to 76 ft (23 m) to 0 ft to 129 ft (39 m) and back to 0 ft along the reach.

4.2.3 Geologic Hazards

4.2.3.1 Landslides

Several landslides have been mapped in the hills and mountains that form the eastern boundary of San Clemente Beach. These are shown on an accompanying geologic map "Natural Slope Stability as Related to Geology, San Clemente Area, Orange and San Diego Counties, California, Special Report 98" published by the California Division of Mines and Geology. The geologic map indicates that there are seven small areas of the bluff behind the beach, extending from the San Clemente Pier to San Mateo Point, which contain landslide deposits. None of these slides extend all of the way onto the beach, so they are not a potential problem for beach nourishment. Neither the literature search nor the offshore seismic and side-scan sonar surveys indicate any landslides offshore of the beach.

4.2.3.2 Seismicity

All of southern California including the San Clemente area is seismically active. There are several major northwest-southeast trending faults in both the onshore and the offshore areas east and west of San Clemente. The Whittier-Elsinore, Agua Caliente, San Jacinto, and the San Andreas Fault zones are located approximately 20 mi (32 km), 27 mi (43 km), 40 mi (64 km), and 62 mi (100 km) northeast of San Clemente, respectively. The Newport-Inglewood–Rose Canyon Fault lies approximately 5 mi (8 km) offshore of the beach. The Palos Verdes Fault zone parallels the Pacific Coast offshore from the San Pedro – Long Beach area to La Jolla, and lies about 18 mi (29 km) from the coastline. The San Clemente Island Fault zone lies approximately 55 mi (88 km) offshore and is parallel to the Newport-Inglewood-Rose Canyon Fault zone. These three faults trend parallel to the onshore faults. The Christianitos Fault, which is the closest fault to the Project area, trends northwest-southeast, and passes through the mountain ranges behind the San Clemente area and trends down San Mateo Creek and goes offshore to parallel the coastline near San Onofre in a southerly direction past Oceanside. The fault is located approximately 1 to 5 mi (2-8 km) offshore of San Clemente Beach. This well-studied fault is considered to be inactive. This information is based on the absence of displacement of the boulder layer just above the platform and also the lack of displacement of the 90 ft (27 m) of overlying dark-brown alluvial deposits above.

4.2.3.3 Soils

According to data published by U.S. Department of Agriculture, Soil Survey, the shoreline south of Dana Point through San Clemente is indicated as Beaches (115) with the exception of the area between Dana Point and Dana Cove (within Dana Point Harbor). That area is listed as Cieneba sandy loam (142), 30 to 75 percent slope, eroded. Adjacent soils, from at or near Paso De Cristobal southward to San Mateo Point, are composed of Myford Sandy Loam (177), 9 to 30 percent slopes, eroded.

From Paseo De Cristobal northward near San Clemente Pier, adjacent soils are Xerorthents loamy (220), cut and fill areas, 15 to 30 percent slopes. North of San Clemente Pier adjacent soils near the outfall of Segunda Deshecha (creek) are Calleguas Clay loam (134), in the Northernmost portion, 50 to 75 percent slopes, eroded, and Sorrento clay loam (209), 2 to 9 percent slopes, to the south of Calleguas Clay loam, and Aloe clay (101), 15 to 30 percent slopes south of Sorrento clay loam.

A small area near Poche, located near a trailer park, consists of Riverwash (191), with Cropley clay (149), 2 to 9 percent slopes, on each side. Capistrano Beach southward to Poche is listed as Cieneba sandy loam (142), 30 to 75 percent slopes, eroded. Near San Juan Capistrano, San Juan Creek and Trabuco Creek converge with their combined outfall at Doheny State Beach (Capistrano Beach). These soils are depicted as Riverwash (191) and Metz loamy sand (163) on both sides of the outfall.

4.3 Water Quality, Sediments, and Oceanography

Water quality is affected by a variety of factors including oceanographic processes, climatic conditions, atmospheric fallout, river runoff, municipal wastewater outfalls, minor industrial outfalls, non-point source runoff, and vessel discharges. Currents, waves, and seasonal variations, as well as episodic events, such as El Niño Southern Oscillation (ENSO) conditions, are the main factors that affect fluctuations from surface to bottom waters.

Rivers and streams discharge and transport freshwater, suspended sediments (turbidity), nutrients, debris, and contaminants from agricultural and urban runoff to nearshore waters. Ocean wastewater outfalls discharge treated sewage effluent, which introduces suspended solids and pollutants to the marine environment. Storm drains with coastal outlets introduce non-point source inputs of pollutants and debris to the ocean.

The mouths of two streams are within 3 mi (5 km) of the beach placement area: the mouth of Prima Deshecha Cañada Creek, which is approximately 2 mi (3.2 km) northwest of the study area boundary and discharges to the ocean at Poche Beach, and Segunda Deshecha Cañada Creek, which is approximately 1.5 mi (2.4 km) northwest of the study area boundary and discharges to the ocean at North Beach. Several storm drain outlets are also within the study area. Two major rivers enter the ocean near the Oceanside borrow site. These are the Santa Margarita River and the San Luis Rey River. In addition, the City of Oceanside's Ocean outfall discharges an average of about 17.5 million gallons per day of treated sewage through a 250 foot (75 m) long diffuser section at a depth of approximately 100 feet (30 m).

Several water quality-monitoring programs have study locations within the study area and in the watersheds which drain into the study area in order to compare conditions of the waters to the water quality objectives set forth by the California Ocean Plan (SWRCB 2005) and requirements of other regulations. The objectives established in the California Ocean Plan to protect marine aquatic life are given in Table 4-5. The objectives represent thresholds below which beneficial uses of waters will be unimpaired. Relevant baseline physical and chemical characteristics of waters within the study area are described in Section 4.3.1, bacterial characteristics are described in Section 4.3.2, and sediments are described in Section 4.3.3.

A CWA 404(b)(1) analysis that is complete and is provided in Appendix A in accordance with Section 404(b)(1) of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) as amended by the Clean Water Act of 1977 (Public Law 95-217). The intent of the analysis is to state and evaluate information regarding the effects of the discharge of dredged or fill material into waters of the United States. The document discusses the effects of the dredging, the initial sand placement and future renourishment actions. Appropriate and practicable steps taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem are discussed as avoidance, minimization, and compensation measures. To satisfy requirements of the Federal CWA, USACE will submit this Final EIS/EIR and appropriate technical documentation to the San Diego RWQCB, which is delegated with implementing the CWA within the region, for their review for CWA Section 401 certification, pursuant to 33 CFR 336.1(a)(1). Upon review of the submittal, the RWQCB would evaluate if issuance of a Section 401-water quality certification is appropriate. USACE will continue to coordinate with the RWQCB throughout the remaining study, design and construction phases of this project. USACE has determined that full compliance with CWA Section 404 is met and thus may invoke, if needed, CWA 404(r), once the project is authorized by Congress.

Table 4-5 California Ocean Plan Water Quality Objectives

A. Bacterial Characteristics
   1. Water-Contact Standards
      Within a zone bounded by the shoreline and a distance of 1,000 feet (305 meters) from the shoreline or the 30-foot (9 meter) depth contour, whichever is further from the shoreline and in areas outside this zone used for water contact sports, as determined by the Regional Board, but including all kelp beds, the following bacterial objectives shall be maintained throughout the water column:
      30-day Geometric Mean - the following standards are based on the geometric mean of the five most recent samples from each site:
         Total coliform density shall not exceed 1,000 per 100ml;
         Fecal coliform density shall not exceed 200 per 100 ml; and
         Enterococcus density shall not exceed 35 per 100 ml.
      Single Sample Maximum:
         Total coliform density shall not exceed 10,000 per 100 ml;
         Fecal coliform density shall not exceed 400 per 100 ml;
         Enterococcus density shall not exceed 104 per 100 ml; and
         Total coliform density shall not exceed 1000 per 100 ml when the fecal coliform/total coliform ratio exceeds 0.1
      The "Initial Dilution Zone" of wastewater outfalls shall be excluded from designation as "kelp beds" for purposes of bacterial standards and Regional Boards should recommend extension of such exclusion zone where warranted to the State Board (for consideration under Chapter III.H.) Adventitious assemblages of kelp plants on waste discharge structures (e.g., outfall pipes and diffusers) do not constitute kelp beds for purposed of bacterial standards.
   2. Shellfish Harvesting Standards
      At all areas where shellfish may be harvested for human consumption, as determined by the Regional Board, the following bacterial objectives shall be maintained throughout the water column:
      The median total coliform density shall not exceed 70 per 100 ml and not more than 10 percent of the samples shall exceed 230 per 100 ml.

B. Bacterial Assessment and Remedial Action Requirements
   Describes guidelines for monitoring enterococcus bacteria. (See Plan for full description).

C. Physical Characteristics
   1. Floating particulates and grease and oil shall not be visible.
   2. The discharge of the waste shall not cause aesthetically undesirable discoloration of the ocean surface.
   3. Natural light shall not be significantly reduced at any point outside the initial dilution zone as a result of the discharge of waste.
   4. The rate of deposition of inert solids and the characteristics of inert solids in ocean sediments shall not be changed such that benthic communities are degraded.

D. Chemical Characteristics
   1. The dissolved oxygen concentration shall not at any time be depressed more than 10 percent from which occurs naturally, as a result of the discharge of oxygen demanding waste materials.
   2. The pH shall not be changed at any time more than 0.2 units from that which occurs naturally.
   3. The dissolved sulfide concentration of waters in and near sediments shall not be significantly increased above that present under natural conditions.
   4. The concentration of substances set forth in Chapter Ii, Table B in marine sediments shall not be increased to levels which would degrade indigenous biota.
   5. The concentration of organic materials in marine sediments shall not be increased to levels which would degrade marine life.
   6. Nutrient materials shall not cause objectionable aquatic growths or degrade indigenous biota.

E. Biological Characteristics
   1. Marine communities, including vertebrate, invertebrate and plant species, shall not be degraded.
   2. The natural taste, odor and color of fish, shellfish, or other marine resources used for human consumption shall not be altered.
   3. The concentration of organic materials in fish, shellfish or other marine resources used for human consumption shall not be bioaccumulated to levels that are harmful to human health.

F. Radioactivity
   1. Discharge of radioactive waste shall not degrade marine life.

4.3.1 Water Column Physical and Chemical Characteristics

4.3.1.1 Temperature

Offshore waters, such as those at the borrow site, typically are stratified (development of thermocline/pycnocline) during the summer and fall, unstratified during the winter, and transitional (e.g., stratification weakening or increasing) in late fall and spring. Thermoclines represent barriers to mixing between surface and bottom waters. Water temperatures in the study area range from 57.2 to 67.1 °F (14.0 to 19.5 degrees Celsius [°C]) near the surface (USACE 2004). During summer, surface waters are up to 50 °F (10 °C) warmer than in deeper water. Shallow nearshore waters are generally unstratified year round due to turbulent mixing and shallower depths.

4.3.1.2 Salinity

Salinity levels range from 22 to 34 parts per thousand (ppt) within the study area (USACE 2004). Nearshore ocean salinity is generally uniform, from approximately 33 to 34 ppt. Seasonally, the near-surface salinity can decrease near the Prima Deshecha and Segunda Deshecha watersheds following storm-related discharges of freshwater and/or (historically) intermittent discharges of sewage into the river.

4.3.1.3 Dissolved Oxygen

Dissolved oxygen values range from 6.5 to 10 milligrams per liter (mg/L) (USACE 2004). Natural deviations of dissolved oxygen result from a combination of factors, including intrusions of water masses, primary production (phytoplankton blooms), and upwelling/down welling events. Concentrations of dissolved oxygen in surface and nearshore waters generally are high due to mixing at the water/atmosphere interface and continuous wave action.

4.3.1.4 pH

Values for pH range from 7.4 to 7.6 within the study area (USACE 2004). Slightly higher pH levels occur during May through September when water temperatures are warmer (SANDAG 2000).

4.3.1.5 Suspended Particulate Matter (Turbidity) and Light Transmission

Light penetration in seawater is the limiting factor associated with photosynthetic growth of phytoplankton, kelp, and other marine plants. Waters tend to be more turbid in the winter due to greater wave energy, surface runoff, and river discharges. Runoff related discharges and associated natural turbidity occur in pulses rather than as continual discharges (Continental Shelf Associates 1984). Other seasonal reductions in water clarity may occur in spring and summer due to plankton and suspended particles concentrating near the thermocline. Phytoplankton blooms (e.g., red tides) may reduce light transmittance (transmissivity) levels in summer months.

Water clarity is measured using a variety of methods, including percent light transmittance, suspended solids concentration, and the nephelometric method, which measures and compares light scattered by a water sample and light scattered by a reference solution. In general, light transmittance tends to increase and suspended solid concentrations decrease with distance from shore. Transmissivity levels typically range from 40 to 90 percent offshore (MEC 1997).

Similar to transmissivity values, total suspended solids (i.e., particulate) concentrations are lower offshore than nearshore. Highest concentrations generally are recorded after storm events or occasionally in the summer, probably due to phytoplankton blooms (MEC 1997).

Nearshore measurements ranging from less than 1 to 11 Nephelometric Turbidity Units (NTU) represent typical background values; however, values of 50 to 187 NTU also have been reported at locations in northern San Diego County (USACE 2005a). These naturally occurring elevations in turbidity were related to high waves and/or storms.

4.3.1.6 Nutrients

Nutrient concentrations for nearshore waters typically are higher near the bottom than near the surface, except during upwelling periods. Nearshore nutrient concentrations may be elevated in areas of wastewater discharge and near the outlet of rivers, lagoons, bays, and harbors.

Typical nutrient concentrations in nearshore waters of the Southern California Bight (SCB) are nitrates at approximately 5 to 200 nanomoles per liter; phosphates at approximately 100 to 500 nanomoles per liter; and ammonium at approximately 300 nanomoles per liter (Eganhouse and Venktesan 1993). Discharges from Prima Deshecha Cañada Creek and Segunda Deshecha Cañada Creek likely represent an important seasonal source of nutrients to nearshore waters off San Clemente. Upwelling events also contribute nutrients to surface waters.

4.3.2 Bacterial Characteristics

Several storm drains have outlets onto beaches within the study area and its vicinity. The City of San Clemente and the County of Orange have been required to monitor bacterial levels at storm drain outlets and in the adjacent surf zone since January 2003 as part of the Coastal Storm Drain Outfall Monitoring (CSDM) Program (County of Orange et al. 2003). For the CSDM Program, monitoring was conducted on both the discharge from the storm drain and the surf zone 25 yards (23 meters) up-coast and 25 yards (23 meters) down-coast of the storm drain to ocean interface. Grab samples were collected weekly for the analysis of total coliform, fecal coliform, and Enterococcus bacteria. An estimate of the flow rate from the storm drain was made and the temperatures of the storm drain discharge and the surf zone down-coast were measured (County of Orange et al. 2006).

During the monitoring period of July 2005 through June 2006, bacteria levels at nine out of ten monitoring stations within the study area or within two miles of its boundaries met California Ocean Plan standards in 90 percent or more results. The tenth monitoring station, located at Poche Beach approximately two miles north of the study area, exceeded Ocean Plan standards in

10-40 percent of results during the monitoring period (County of Orange et al. 2006). Poche Beach is at the outlet of the Prima Deshecha Flood Control Channel.

4.3.3 Sediments

The primary natural sand supply for the beaches on the Pacific Coast is provided by the rivers and streams which transport the sediment to the coast during the winter and spring storms. Eroding sea cliffs and bluffs provide a secondary source of sediment. The waves and currents distribute the sand as it arrives at the coast. The adjacent beaches are replenished as the flow of sand moves alongshore. The predominate direction of the sand movement along southern California beaches is north to south, notwithstanding seasonal local variations. Generally the best places to find suitable beach sand for replenishment are at the deltas of the various streams that empty into the ocean. There are no such streams in the vicinity of San Clemente except for the mouth of San Juan Creek, which empties into the ocean at Capistrano Beach, south of Dana Point and north of San Clemente. Prior exploration by others has indicated that the sediments at this location are too fine-grained and are unsuitable for beach replenishment. Accordingly, in January 2003, a vibracore exploration was first conducted about 1 mi (1.6 km) offshore of San Clemente Beach for a distance of about 6.2 mi (10 km) parallel to the coastline to determine if suitable sand was present. The results were negative; on the second day of the exploration, the vibracore was moved offshore near the mouth of the Santa Margarita River, a few miles northwest of Oceanside Harbor.

The sediments in the Project area are described as silty sands and sandy silts, as determined by both the geophysical surveys conducted in Summer 2002 and core samples derived from six vibracore test holes conducted in January 2003. The vibracore holes were placed and sampled at random locations offshore of the City of San Clemente from the vicinity of the San Clemente Pier downcoast to San Mateo Point (i.e., the Orange County-San Diego County Line). The test holes were placed at least one mile offshore in order to avoid the shallow bedrock encountered by the seismic survey. The elevations of the mudline at the holes varied from -54 ft (-17.7 m) MLLW to -62.2 ft (-20.4 m) MLLW, which is the limit of the most economical dredging operations. The exploration indicated that at 1 mi (1.73 km) seawards of the beach, the bedrock is still fairly shallow and was encountered between 5.1 ft (1.6 m) to 12.2 ft (3.7 m) below the mud line. The sediments encountered overlying the bedrock were silts and fine-grained sands, visually deemed unsuitable for beach replenishment. The exploration program was moved to Oceanside near the mouth of the Santa Margarita River, where previous reconnaissance exploration had indicated suitable material.

In August 2003, 26 additional test holes were sampled with a vibracore for a beach replenishment study at the Oceanside Beach site. The purpose of the study was to determine if there was enough suitable sand for a beach replenishment program at both San Clemente and Oceanside. The depth of the holes varied from 9.5 ft (2.9 m) to 20 ft (6.1 m), and averaged 13.7 ft (4.2 m). The mudline elevations of the holes varied from -36.4 ft (-11.1 m) to -57.1 ft (-17.4 m) MLLW. These holes were explored and sampled in the same proposed borrow area, but were placed to fill in the gaps between prior holes and obtain more information about certain reaches of the area in more detail.

In 1999, SANDAG explored and sampled 35 vibracore holes in this same proposed borrow area. From these sites, two offshore beach compatible sites were chosen: site SO-9, located north of Oceanside Harbor, and site SO-8, located south of Oceanside Harbor.

Site SO-8 contained 12 of the vibracore holes. These vibracore holes varied in depth from 3.6 to 17.1 ft (1.1 to 5.2 m). The mudline elevations of the holes varied from -53.5 to -70 ft (-16.3 to -21.3 m) MLLW. The site identified 4.7 million cubic yards (3.6 million cubic meters) of fine-grained, somewhat silty sand which is suitable for beach nourishment purposes. This sand is located beneath 4 to13 ft (1.2 to 4.0 m) of unsuitable sandy silt and silty sand.

Site SO-9 contained 23 vibracore holes. These vibracore holes varied in depth from 4.0 to 17.3 ft (1.2 to 5.3 m). The mudline elevations of the holes varied from -48 to -59 ft (-14.6 to -18.0 m) MLLW. The site identified 0.9 million cubic yards (0.7 million cubic meters) of suitable fine- to medium-grained sand near shore 3 to 13 ft (0.9 to 4.0 m) thick. At the SO-9 borrow site, three layers of sediments were found (SANDAG 2000). The top (surficial) layer consists of sandy silt. The grain-size analyses showed this surficial layer to be approximately 0 to 2 ft (0.6 m) deep over the dredge site, and unsuitable for beach nourishment material. Beneath the surficial silt is a layer of fine- to medium grained sand that is suitable for beach replenishment. This sand layer is 2 to 13 ft (0.6 to 3.9 m) thick, and is exposed on the seafloor surface along the central region of the site. SANDAG later removed some of the material in water deeper than 50 ft (16.4 m) and placed the material on various portions of the beach in Oceanside and vicinity.

As part of the contract for the January 2003 program, Group Delta, a Geotechnical Engineering Consultant, produced a report of project activities and results therein, entitled "Vibracore Exploration Program, San Clemente Beach Shoreline, Orange and San Diego Counties, California" (Group Delta 2003) for the Geotechnical Branch of the Los Angeles District.

4.3.3.1 San Clemente (Borrow Area #1)

Sampled materials encountered with Borrow Site #1 were generally greenish-gray silty, very-fine grained sands and sandy silts with minor amounts of shell fragments. A soft, micaceous wackestone bedrock was encountered in possibly four of the holes, causing refusal of the vibracore. These materials appeared to be too fine grained for beach nourishment purposes. Samples for chemical analysis were not taken, as the recovered sediments were too fine to be placed onto the beach.

Physical tests were performed on eight selected samples from this borrow area. Group Delta reported that the samples show an average of 0.9 percent gravel, 51.5 percent sand and 47.6 percent fines passing the #200 sieve. The percent fines ranged from 21 percent to 67 percent. These values show that the sampled area off of San Clemente Beach does not contain suitable compatible beach replenishment material.

4.3.3.2 Oceanside (Borrow Area #2)

The sampled materials were generally fine-grained sands with local silty intervals and minor amounts of shell fragments. Significant laterally discontinuous gravel/cobble beds and lenses were encountered throughout the area, but the thicknesses generally averaged 2 ft (0.65 m) or less. Often the gravel intervals possessed supporting dense, silty sand material, which acted as a "pavement" holding the cobbles tightly, making the core penetration difficult. Shell and shell fragments were encountered throughout the area.

Physical tests were performed on 91 samples from this borrow area. The samples showed an average of 12.3 percent gravel, 81.4 percent sand and 6.3 percent fines passing the #200 sieve. A total of 25 out of the 27 test holes within the Oceanside site are beach-compatible, with the total fines of 12 percent or less.

4.3.3.3 Sediment Quality

Chemical testing of the proposed borrow area offshore Oceanside has been done by the San Diego Association of Governments (SANDAG 2000) and the USACE (1993). The analytical results are summarized and compared to the Sediment Quality Guidelines (SQGs) in Table 4-6. The Sediment Quality Guidelines (SQGs) are based on Puget Sound Dredged Disposal Analysis (PSSDA) and NOAA guidelines. The PSSDA screening level (SL) identifies the concentration below which sediment is expected to have no unacceptable adverse effects. The higher value is the maximum level (ML) above which effects are likely. The NOAA published effects-based sediment quality values for evaluating the potential for constituents in sediment to cause adverse biological effects are referred to as Effects Range-Low (ER-L) and Effects Range-Median (ER-M). Sediment samples in which all chemical concentrations are below ER-L values are not expected to be toxic. Generally, effects may occasionally be expected when chemical concentrations occur between ER-L and ER-M values. The probability of toxicity is expected to increase with the number and level of exceedances above the ER-M. These values are not accepted standards or criteria, but rather provide effects-based guidelines. Since SQGs have not been developed for southern California, these are used as an initial, informal evaluation to determine the need for further Tier II or Tier III testing.

Table 4-6 San Clemente Shoreline Project – Borrow Area #2 Sediment Composite Sample: Chemical Results

	Analytical Method [1]	Method Reporting Limit / Detection Limit	Units [2]	Sediment Quality Guidelines (SQGs) (Long et al., 1999) ERL	(Long et al., 1999) ERM	(PSDDA, 1998) SL	(PSDDA, 1998) ML	USACE 2003		SANDAG 2000
PHYSICAL CONVENTIONALS										
Total Solids (dry weight)	EPA 160.3	0.1	%					75.1	75.2	
Total Volatile Solids	SM 2540-E	0.1	%					0.62	0.6	
pH	EPA 150.1	0.1	pH units					8.31	8.3	
Ammonia-N	SM 4500-NH3 F	0.01	mg/L					.63	0.6	
Total Organic Carbon (dry weight)	Plumb, 1981 EPA 415.1	0.01	%					0.15	0.09	0.08%
Dissolved Sulfides	SM 4500-S2 D	0.002	mg/L					ND	ND	
Oil and Grease	EPA 1664	0.1	mg/L					ND	ND	
TPH-Diesel	EPA 8015m	0.25	mg/kg					ND	ND	
TPH-Motor Oil	EPA 8015m	0.25	mg/kg					ND	ND	
TRPH	EPA 415.1	0.1	mg/kg					ND	ND	
METALS										
Aluminum (Al)	EPA 6020	1	mg/kg					5840	5960	
Antimony (Sb)	EPA 6020	0.05	mg/kg			15	200	0.1	0.1	
Arsenic (As)	EPA 6020	0.05	mg/kg	8.2	70	57	700	1.43	1.37	1.2
Barium (Ba)	EPA 6020	0.05	mg/kg					33.7	32.5	
Beryllium (Be)	EPA 6020	0.01	mg/kg					0.11	0.12	
Cadmium (Cd)	EPA 6020	0.01	mg/kg	1.2	9.6	5.1	14	0.03	0.02	<0.1
Chromium (Cr)	EPA 6020	0.05	mg/kg	81	370			9.11	10.4	6.2
Cobalt (Co)	EPA 6020	0.01	mg/kg					1.6	1.59	
Copper (Cu)	EPA 6020	0.01	mg/kg	34	270	390	1,300	2.53	2.52	3.0
Iron (Fe)	EPA 6020	1	mg/kg					6580	6470	
Lead (Pb)	EPA 6020	0.01	mg/kg	46.7	218	450	1,200	0.86	0.89	0.9
Manganese (Mn)	EPA 6020	0.05	mg/kg					90.2	94.6	
Mercury (Hg)	EPA 6020	0.005	mg/kg	0.15	0.71	0.41	2.3	0.03	0.03	<0.03
Molybdenum (Mo)	EPA 6020	0.05	mg/kg					0.41	0.55	
Nickel (Ni)	EPA 6020	0.01	mg/kg	20.9	51.6	140	370	3.69	4.25	2.5
Selenium (Se)	EPA 6020	0.05	mg/kg					0.25	0.26	<0.1
Silver (Ag)	EPA 6020	0.01	mg/kg	1	3.7	6.1	8.4	0.02	0.01	<0.1
Strontium (Sr)	EPA 6020	0.05	mg/kg					25.1	24.6	
Thallium (Tl)	EPA 6020	0.01	mg/kg					0.08	0.08	
Tin (Sn)	EPA 6020	0.05	mg/kg					0.5	0.57	
Titanium (Ti)	EPA 6020	0.05	mg/kg					755	791	
Vanadium (VO	EPA 6020	0.05	mg/kg					19.7	19.6	
Zinc (Zn)	EPA 6020	0.05	mg/kg	150	410	410	3,800	13.6	13.2	14.2
ORGANICS										
PESTICIDES										
Total Chlorinated Pesticides [4]			ug/kg	5.22	62	56.9	69.0			ND
Aldrin	EPA 8270	1	ug/kg			10		ND	ND	
alpha BHC	EPA 8270	1	ug/kg					ND	ND	

	Analytical Method [1]	Method Reporting Limit / Detection Limit	Units [2]	Sediment Quality Guidelines (SQGs) ERL (Long et al., 1999)	ERM (Long et al., 1999)	SL (PSDDA, 1998)	ML (PSDDA, 1998)	USACE 2003		SANDAG 2000
alpha-Chlordane	EPA 8270	1	ug/kg			10		ND	ND	
beta-BHC	EPA 8270	1	ug/kg					ND	ND	
delta-BHC	EPA 8270	1	ug/kg					ND	ND	
Dieldrin	EPA 8270	1	ug/kg	0.02	8.0	10		ND	ND	
Endosulfan I	EPA 8270	1	ug/kg					ND	ND	
Endosulfan II	EPA 8270	1	ug/kg					ND	ND	
Endosulfan Sulfate	EPA 8270	1	ug/kg					ND	ND	
Endrin	EPA 8270	1	ug/kg					ND	ND	
Endrin Aldelhyde	EPA 8270		ug/kg					ND	ND	
gamma-BHC Lindane	EPA 8270	1	ug/kg			10		ND	ND	
gamma-Chlordane	EPA 8270	1	ug/kg					ND	ND	
Heptachlor	EPA 8270	1	ug/kg			10		ND	ND	
Heptachlor Epoxide	EPA 8270	1	ug/kg					ND	ND	
Methoxychlor	EPA 8270	1	ug/kg					ND	ND	
Mirex	EPA 8270	1	ug/kg					ND	ND	
Toxaphene	EPA 8270	10	ug/kg					ND	ND	
Trans-Nonachlor	EPA 8270	1	ug/kg					ND	ND	
Total DDT [5]	EPA 8270	0	ug/kg	1.58	46.1	6.9	69.0	0	0	
2,4'-DDD	EPA 8270	1	ug/kg					ND	ND	
2,4'-DDD	EPA 8270	1	ug/kg					ND	ND	
2,4'-DDD	EPA 8270	1	ug/kg					ND	ND	
4,4'-DDD	EPA 8270	1	ug/kg	1.0	7.0			ND	ND	
4,4'-DDE	EPA 8270	1	ug/kg	2.2	27			ND	ND	
4,4'-DDT	EPA 8270	1	ug/kg	2.0	20			ND	ND	
ORGANOTINS										
Total Organotins[4]	Krone, et al. 1989	1	ug/kg					0	0	
Monobutyltin	Krone, et al. 1989	1	ug/kg					ND	ND	
Dibutyltin	Krone, et al. 1989	1	ug/kg					ND	ND	
Tributyltin	Krone, et al. 1989	1	ug/kg					ND	ND	
Tetrabutyltin	Krone, et al. 1989	1	ug/kg			0.15[7]		ND	ND	
PHTHALATES										
Total phthalates[4]			ug/kg			23,170		8.4	8.8	
Bis (2-ethylhexyl) phthalate	EPA 8270	5	ug/kg			8,300		8.4	8.8	
Butyl benzyl phthalate	EPA 8270	5	ug/kg			970		ND	ND	
Diethyl phthalate	EPA 8270	5	ug/kg			1,200		ND	ND	
Dimethyl phthalate	EPA 8270	5	ug/kg			1,400		ND	ND	
Di-n-butyl phthalate	EPA 8270	5	ug/kg			5,100		ND	ND	
Di-n-butyl phthalate	EPA 8270	5.	ug/kg			6,200		ND	ND	
POLYCHLORINATED BIPHENYLS (PCB)										
Total PCBs[4]			ug/kg	22.7	18	130	3,100	0	0	ND
Aroclor 1016	EPA 8270	10	ug/kg					ND	ND	
Aroclor 1221	EPA 8270	10	ug/kg					ND	ND	
Aroclor 1232	EPA 8270	10	ug/kg					ND	ND	
Aroclor 1242	EPA 8270	10	ug/kg					ND	ND	
Aroclor 1248	EPA 8270	10	ug/kg					ND	ND	
Aroclor 1254	EPA 8270	10	ug/kg					ND	ND	

	Analytical Method [1]	Method Reporting Limit / Detection Limit	Units [2]	Sediment Quality Guidelines (SQGs) ERL (Long et al., 1999)	ERM (Long et al., 1999)	SL (PSDDA, 1998)	ML (PSDDA, 1998)	USACE 2003		SANDAG 2000
Aroclor 1260	EPA 8270	10	ug/kg					ND	ND	
POLYNUCLEAR AROMATICS HYDROCARBONS (PAH)										
Total PAHs[4]			ug/kg	4,02	44,7			0	0	ND
1-Methylnaphthalene	EPA 8270	1	ug/kg					ND	ND	
1-Methyphenanthrene	EPA 8270	1	ug/kg					ND	ND	
2,3,5-Trimethylnaphthalene	EPA 8270	1	ug/kg					ND	ND	
2,6-Dimethylnaphthalene	EPA 8270	1	ug/kg					ND	ND	
2-Methylnaphthalene	EPA 8270	1	ug/kg	70	67	670	1,900	ND	ND	
Acenaphthene	EPA 8270	1	ug/kg	16	50	500	2,000	ND	ND	
Acenaphthylene	EPA 8270	1	ug/kg	44	64	560	1,300	ND	ND	
Anthracene	EPA 8270	1	ug/kg	85.	1,0	960	13,000	ND	ND	
Benzo(a)anthracene	EPA 8270	1	ug/kg	26	1,6	1,300	5,100	ND	ND	
Benzo(a,e)pyrene	EPA 8270	1	ug/kg	43	1,6	1,600	3,600	ND	ND	
Benzo(b)fluoranthene	EPA 8270	1	ug/kg			1,600	4,950	ND	ND	
Benzo(k)fluranthene	EPA 8270	1	ug/kg			1,600	4,950	ND	ND	
Biphenyl	EPA 8270	1	ug/kg					ND	ND	
Chrysene	EPA 8270	1	ug/kg	38	2,8	1,400	21,000	ND	ND	
Dibenzo(a,h) anthracene	EPA 8270	1	ug/kg	63.	26	230	1,900	ND	ND	
Fluoranthene	EPA 8270	1	ug/kg	60	5,1	1,700	30,00	ND	ND	
Fluorene	EPA 8270	1	ug/kg	19	54	540	3,600	ND	ND	
Indeno(1,2,3-CD)pyrene	EPA 8270	1	ug/kg			600	4,400	ND	ND	
Naphthalene	EPA 8270	1	ug/kg	16	2,1	2,100	2,400	ND	ND	
Perlene	EPA 8270	1	ug/kg					ND	ND	
Phenanthrene	EPA 8270	1	ug/kg	24	1,5	1,500	21,000	ND	ND	
Pyrene	EPA 8270	1	ug/kg	66	2,6	2,600	16,000	ND	ND	
PHENOLS										
Total Phenols			ug/kg			1582	5777	0	0	ND
2,4,6-Trichlorophenol	EPA 8270	50	ug/kg			29	310	ND	ND	
2,4-Dichlorophenol	EPA 8270	50	ug/kg			29	210	ND	ND	
2,4-Dimethylphenol	EPA 8270	100	ug/kg			29	210	ND	ND	
2,4-Dinitrophenol	EPA 8270	200	ug/kg			29	210	ND	ND	
2-Chlorophenol	EPA 8270	50	ug/kg					ND	ND	
2-Methy-4,6-dinitrophenol	EPA 8270	500	ug/kg					ND	ND	
2-Nitrophenol	EPA 8270	100	ug/kg					ND	ND	
4-Chloro-3-methyphenol	EPA 8270	100	ug/kg					ND	ND	
4-Nitrophenol	EPA 8270	100	ug/kg					ND	ND	
Pentachlorophenol	EPA 8270	50	ug/kg			400	690	ND	ND	
Phenol	EPA 8270	100	ug/kg					ND	ND	

(1) Analytical Method
EPA = United States Environmental Protection Agency
EPA Methods are EPA SW-846, 1994 3rd Edition or EPA 600/4-79-020, March 1983
APHA = American Public Health Association
APHA Method is APHA Standard Methods, 18th Edition, 1992
Plumb = Procedure for Handling and Chemical Analysis of Sediment and Water Samples. Tech. Rep USEPA/CE-81, Russell H. Plumb, Jr. 1981.

(2) Units: mg/kg = milligrams per kilogram, parts per million (dry weight unless otherwise noted)
ug/kg = micrograms per kilogram, parts per billion (dry weight unless otherwise noted)

(3) ND = not detected in this analysis or less than Method Reporting Limit value for the particular compound(s) of interest
(4) Total Chlorinated Pesticides, Total Organotins, Total Phthalates, Total PCBs, Total PAHs, and Total Phenols = sum of named compounds and their derivatives
(5) Total DDT = sum of 4,4'-DDE, 4,4'-DDD; and 4,4'-DDT

The total organic carbon concentration was 0.08 percent in the SANDAG samples and 0.15 percent in the USACE samples. Contaminant concentrations of metals, pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), phthalates, and phenols were non-detectible to low and well below all the thresholds in the SQGs for both sample sets. No dichlorodiphenyltrichloroethane (DDT) or chlorinated pesticides were detected in the samples. The bulk chemistry data indicated that chemicals detected within the sediments at the proposed borrow site are at very low levels and do not exceed the SQGs. Therefore, the borrow source sediments appear suitable for placement at the receiving beach.

4.3.4 Oceanographic Characteristics and Coastal Processes

Water levels and wave energy influence the amount and erosive force of water on the beach (USACE 2005b). Oceanographic conditions and the transport of sediment along the shoreline and on the beaches are described in the following subsections. Additional description of oceanographic characteristics is in the Coastal Engineering Appendix (Appendix D).

4.3.4.1 Water Levels

Water levels within the surf zone vary according to four primary factors: (1) astronomical tides, (2) storm surge and wave set-up, (3) climatic variation related to ENSO events, and (4) long-term changes in sea level.

Tides

The tides at San Clemente are mixed, semi-diurnal tides with two unequal high tides and low tides roughly per day. Tidal variations are caused by the passage of two harmonic tidal waves; one with a period of 12.5 hours and one with a period of 25 hours. This causes a difference in height between successive high and low waters. The result is two high waters and two low waters each day, consisting of a higher high water (HHW) and a lower high water (LHW), and a higher low water (HLW) and a lower low water (LLW).

A greater than average range between HHW and LLW occurs when the moon, sun, and earth are aligned with each other to create a large gravitational effect. This spring tide corresponds to the phenomenon of a new or full moon. Neap tides, which occur during the first and third quarters of the moon, have a narrower range between HHW and LLW. In this situation, the moon, sun, and earth are perpendicular to each other, thereby reducing the gravitational effects on water levels.

There is no tidal data available for the immediate San Clemente area, however, the tidal datum elevations at La Jolla, California, are shown in Table 4-7 and are assumed representative of those at San Clemente. The mean tidal range for the Project area is 5.4 ft (1.6 m). The tidal epoch is

1983 to 2001. The La Jolla National Ocean Service (NOS) Primary Tide Station is located approximately 81 km (50 miles) from the San Clemente Pier. In southern California, tides typically have spatial characteristics on the order of hundreds of kilometers. Datum information for an NOS tidal station located at Newport Bay Harbor (station discontinued in 1994) located approximately 30 km (19 miles) from San Clemente indicates MSL and MHHW differences of 0.02 m and 0.03 m respectively. Therefore, the sea level variation between La Jolla and San Clemente is assumed to be negligible.

Table 4-7 Tidal Datum Elevations at La Jolla, CA

Tidal Datum	Elevation ft, (m)
Highest observed water level (11/13/97)	+7.65 (2.33)
Mean Higher High Water (MHHW)	+5.33 (1.62)
Mean High Water (MHW)	+4.60 (1.40)
Mean Sea Level (MSL)	+2.73 (0.83)
Mean Tide Level (MTL)	+2.75 (0.84)
North American Vertical Datum – 1988 (NAVD)	+0.19 (0.06)
Mean Low Water (MLW)	+0.90 (0.28)
Mean Lower Low Water (MLLW)	0.00
Lowest observed water level (12/17/33)	-2.87 (-0.87)
Elevations are referenced to MLLW.	

Storm Surge

Water levels may be higher during storms because of winds and atmospheric pressure. Storm surge is the super-elevation of the tidal level at the coast due to wind stresses and atmospheric pressure fluctuations acting upon the sea surface. Wind and atmospheric fluctuations associated with strong storms in southern California typically produce 1-2 ft (0.3-0.6 m) storm surges (Appendix D). Due to a narrow continental shelf and the absence of tropical storms and/or hurricanes, storm surge heights on the California coast are small compared to those on the east and Gulf coasts, where extreme surge heights of 3-10 ft (1-3 m) are more typical, and a peak 25 ft (8 m) was documented during Hurricane Camille in 1969. West coast storm surges typically have time scales of one to three days, with longer surge episodes possible due to bunching of successive storms.

El Niño Southern Oscillation Event

ENSO events are global-scale climatic variations with a duration lasting for approximately two to seven years. They represent an oscillatory exchange of atmospheric mass as manifested by a decrease in sea surface pressure in the eastern tropical Pacific Ocean, a decrease in the easterly trade winds, and an increase in sea level on the west coast of North and South America (USACE 1986). The interaction between the atmospheric and oceanic environment during these events drives climatic changes that can result in significant modifications of wave climate along the world's coasts.

The severe winter seasons of 1982 to 1983 and 1997 to 1998, which produced some of the most severe storms to ever impact the southern California coast, were the result of the intense ENSO events. The atmospheric disturbance associated with these two events caused abnormally warm water temperatures, a reversal of the westerly trade winds, and an increase in the monthly mean sea levels (MSL) by as much as 0.42 ft (0.13 m) in 1982 to 1983 and 0.52 ft (0.16 m) in 1997 to 1998 at La Jolla, near San Diego (Flick 1998).

Sea Level Rise

Relative sea level rise has Project impacts from two primary considerations: 1) long-term beach erosion, and 2) increased wave run-up and overtopping. Although the exact magnitude of the future sea level rise is unknown, the main contributions will come from both ocean water thermal expansion and the meltwater from continental glaciers and the Antarctic ice sheet. The proportion of each contribution depends largely upon the actual global distribution of the temperature increase, the resulting precipitation amounts, the glacial response and dynamics, the time scale of oceanic mixing, and the stability of the west Antarctic ice sheet (USACE 2005a). The present best estimates regarding sea level rise within southern California vary between 0.1 and 0.2 ft (0.03 to 0.06 m) in a time span of 25 years. Historic trends at San Diego, California, indicate a positive sea level rise of +0.008 ft/yr (+0.00245 m/yr) based on water level measurements during the period 1950-1999 (Appendix D). However, based on the two-dimensional model of the Bruun Rule, the long term shoreline change at San Clemente due to sea level rise is estimated at 0.32 ft/yr (0.10 m/yr).

4.3.4.2 Waves

Perhaps more than any other oceanographic factors, waves determine the fate of sediment movement and the associated impacts to the coastal environment. Essentially, waves are the driving force in generating the alongshore currents that are responsible for moving sand, suspended by wave action, along the coast (USACE 2005a). In shallow water, the circular motion within the water column can induce the resuspension and transport of bottom sediments.

Waves, especially in association with high tides, can damage coastal structures. Wave height and high-velocity swell tend to be most prominent during winter and spring due to storms from the North Pacific. The greater the wave energy, the more rip currents develop, causing elevated turbidity in nearshore water.

Wave Patterns

Wind waves and swell within the study area are produced by six basic meteorological weather patterns. These include extratropical storm swells in the northern hemisphere (north or northwest swell), wind swells generated by northwest winds in the outer coastal waters (wind swell), westerly (west sea) and southeasterly (southeast sea) local seas, tropical storm swells and hurricanes off the Mexican coast, and southerly swells originating in the southern hemisphere (southerly swell).

The Channel Islands archipelago (San Miguel, Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, San Nicolas, and San Clemente) provide some sheltering to the coastal region depending on the swell approach direction. The swell window, which is open to the severe extratropical storms of the northern hemisphere, extends from approximately 277 degrees to 284 degrees. The exposure zone open to the southern swell and tropical storm swell extends from approximately 257 degrees to 190 degrees. The San Clemente coast is open to northwest wind swell and local seas from the west and southeast. The basic weather patterns in the study area are described below.

Extratropical Cyclone of the Northern Hemisphere (North or Northwest Swell)
This weather system represents the category of the most severe waves reaching the California coast. Northern hemisphere swell waves are usually produced by specific, remote meteorological disturbances, including Aleutian storms, subtropical storms north of Hawaii, tropical hurricanes, and strong winds in the eastern North Pacific. Deepwater wave heights rarely exceed 10 ft (3 m), with wave periods ranging from 12 to 18 seconds. However, during extreme northern hemisphere storm events, wave heights may exceed 20 ft (6 m) with periods ranging from 18 to 22 seconds.

Northwest Winds in the Outer Coastal Waters (Wind Swell)
Annually, the predominant wave action along the study area is due to the prevailing northwest winds north and west of the southern California coastal waters. This is particularly true during the spring and summer months. Moderate northwesters will produce breaker heights of 4 to 6 ft (1.2 to 1.8 m), while strong events can generate breaking wave heights ranging from 6 to 9 ft (1.8 to 2.7 m) with typical periods ranging from approximately 6 to 10 seconds.

West to Northwest Local Sea (West Sea)
Westerly winds can be divided into two types: (1) temperature-induced sea breezes, and (2) gradient winds. When strong enough, these winds may generate wind waves. The strongest sea breezes occur during the late spring and summer months, while the lightest winds occur during December and January. Gradient winds are typically confined to the months of November through May, with the peak occurring in March or early April. They usually occur following a frontal passage or with the development of a cold low-pressure area over the southwestern United States. The latter produces the strongest winds with duration of up to three days. Under such conditions, locally generated wind waves combine with components of the northwest swell generated off the California coast.

Pre-frontal Local Sea (Southeast Sea)
The study area coastline may be vulnerable to storm conditions related to winds blowing strongly from the southeast to southwest along the coast prior to a frontal passage. These winds typically turn toward the south-southeast to south a short distance offshore. Wind waves, with peak energies averaging between 6 and 8 seconds, reach the shore with minimal losses due to island sheltering or refraction. Wave heights are generally in the range of 4 to 8 ft (1.2 to 2.4 m). Extreme wave heights are rare because the fetch and often times the duration of these wind waves are short-lived. The fetch is defined as a region in which the wind speed and direction are reasonably constant.

Tropical Storm Swell
Tropical cyclones are produced by tropical hurricanes that commonly develop at low latitudes off the west coast of Mexico from July to October. These storms first move west as they depart the coast of mainland Mexico, then curve north and northeast before dissipating in the colder waters off Baja California. The swell waves generated by these events usually do not exceed 6 ft (1.8 m) in height. However, on rare occasions the offshore waters are warm enough to facilitate hurricane migration to more northern latitudes than usual. In September 1939, a hurricane passed directly over southern California, generating recorded wave heights of 26.9 ft (8.2 m). This storm caused widespread damage along the coast.

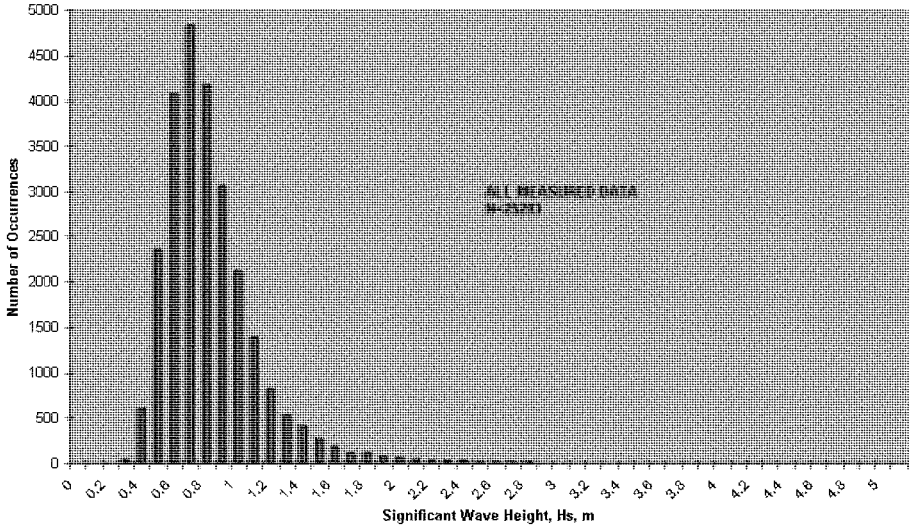
Extratropical Cyclone of the Southern Hemisphere (Southerly Swell)
From the months of April through October, and to a lesser extent the remainder of the year, large South Pacific storm systems traversing the ocean between south latitude 40 degrees and 60 degrees from Australia to South America send swells northward to the west coast of Central and North America. Typical southern hemisphere swell rarely exceeds 4 ft (1.2 m) in height in deep water, but with periods ranging between 18 and 21 seconds, they can break at over twice that height when they reach the coast. The southern swell also causes a reversal in the predominantly southward flow of littoral sand. During summer months, these waves dominate the littoral processes of the region driving alongshore currents northward as the northern-hemisphere swells are kept at bay.

Wave Characteristics Offshore San Clemente

Wave climatology information is available for the offshore area of San Clemente in the form of direct measurements as part of the Coastal Data Information Program (CDIP). The CDIP shallow-water station most applicable to San Clemente is the San Clemente Sxy slope array (Station ID 052) located approximately 1, 000 ft (300 m) offshore of the San Clemente Pier in 34 ft (10.2 m) of water. The Sxy slope array is a directional wave height recorder with a 178-month record during the period 1983-1998 at nominally four observations per day. The height and direction data records are intermittent reporting approximately 141 months of the 178 available; one long gap that occurred during the period July 1988 through July 1991, accounts for the majority of missing records. These data records are used to determine the daily and annual wave climate, the extreme wave analysis, and data input into wave transformation and shoreline damage numerical models.

The histogram for significant wave height off San Clemente is shown in Figure 4-1. Figure 4-I illustrates that the most commonly occurring significant wave height is in the range 2.7-3.3 ft (0.80-1.00 m). Figure 4-1 also illustrates the complete absence of very large significant wave heights (> 13ft [4.0 m]). The maximum recorded significant wave height is 12 ft (3.63 m). The lack of higher recorded waves may be due to several conditions, including the fact that the Sxy slope array measures the wave climate in 33 ft (10 m) of water, whereas waves observed closer to the breaking depth will be larger due to shoaling. Also, the wave data are spectral-energy based (Hmo) rather than statistically based ($H_{1/3}$), which tends to under-represent wave heights compared to statistically based wave data. The wave climate is measured in the vicinity of the Pier and is assumed representative of the entire San Clemente Project area.

Figure 4-1 Significant Wave Height Histogram for Waves off San Clemente, 1983-1998



The winter wave climatology can be developed from the measured wave climate. Because the severest wave climate occurs during the winter season, the wave climatology was developed based on the winter wave population. The wave data was categorized based on the December-March winter meteorological season. The histograms for the winter significant wave height are shown in Figure 4-2.

Based on the measured data, the annual maximum wave heights for each year were determined. The annual maximum wave heights are shown in Table 4-8. Figure 4-3 illustrates that the dominant wave periods off San Clemente are in the range 12-14 seconds, with a smaller secondary peak at 6-8 seconds. The two peaks in the distribution demonstrate the dual sea/swell nature of the wave climate. Shorter period waves are typically associated with sea conditions; longer period waves are typically associated with swell conditions.

Figure **4-4** shows directional approach data for waves off San Clemente. This figure illustrates that approximately 91 percent of the waves approach from the relatively narrow 20-degree band between 230°-240°, and all other approach directions are minor or negligible. Shoreline normal in the San Clemente area is 235°. There is a very small fraction of waves (0.7 percent) approaching from 160°-220°, directions considered to be of tropical depression or southern hemisphere origins. Significantly, the predominant westerly wave direction envelops both local seas and extra-tropical swell.

Figure 4-2 Significant Wave Height Histogram off San Clemente, Winter Data, 1983-1998

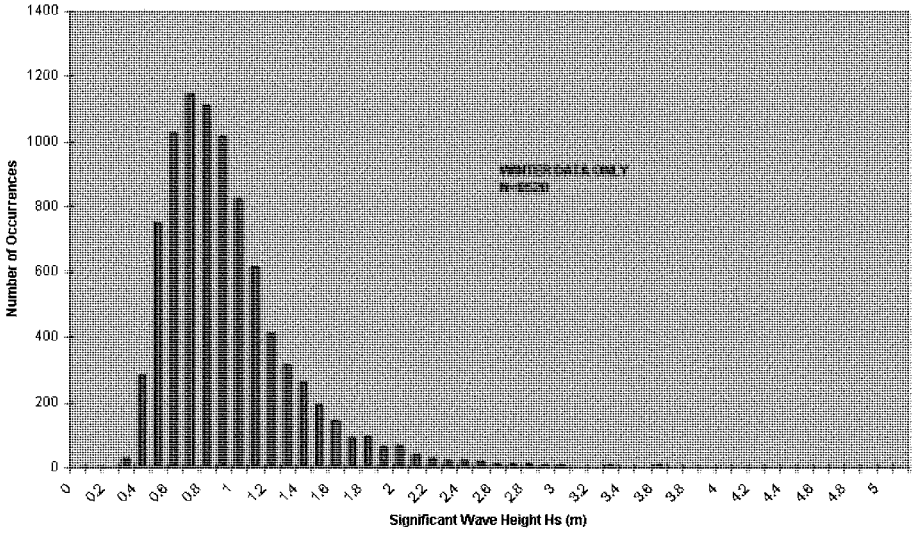


Table 4-8 Annual Maximum Wave Heights off San Clemente, 1983-1998

Year	Mo/Dy	Hs, m (ft)	Tp (sec)	Dir (deg)
1983	Dec 10	10.2, (3.10)	14.2	248
1984	Apr 01	6.1, (1.85)	6.1	273
1985	Nov 29	7.2, (2.18)	6.1	227
1986	Feb 16	11.7, (3.56)	16.0	234
1987	Mar 16	7.4, (2.24)	8.5	254
1988	Jan 18	11.9, (3.63)	14.2	218
1991	Nov 15	6.8, (2.06)	18.3	212
1992	Jan 30	7.6, (2.32)	14.2	250
1993	Feb 18	8.7, (2.66)	8.0	197
1994	Feb 07	6.6, (2.00)	7.3	191
1995	Jan 05	10.6, (3.22)	9.1	205
1996	Oct 26	7.4, (2.24)	8.8	259
1997	Dec 06	7.6 ,(2.31)	6.4	207
1998	Jan 30	9.8, (2.99)	18.3	238

Figure 4-3 Spectral Peak Period Histogram for Waves off San Clemente, 1983-1996

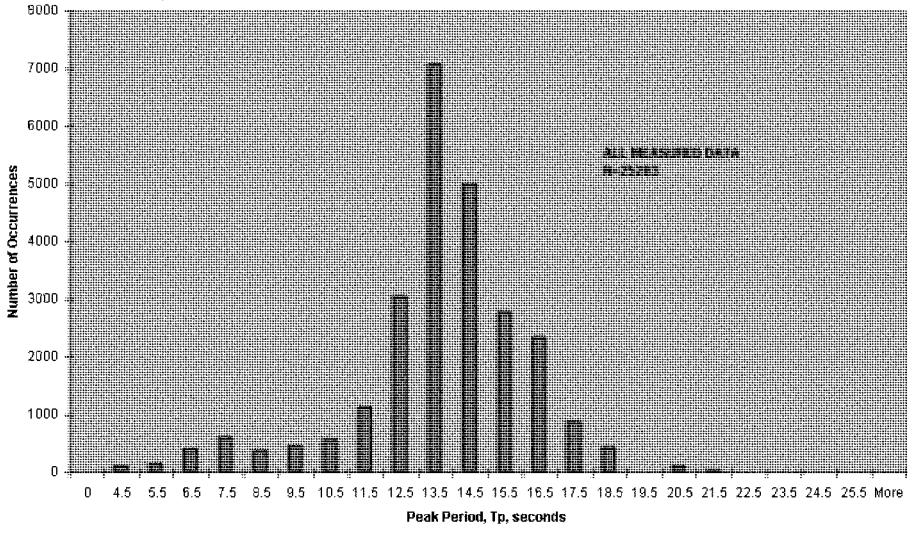
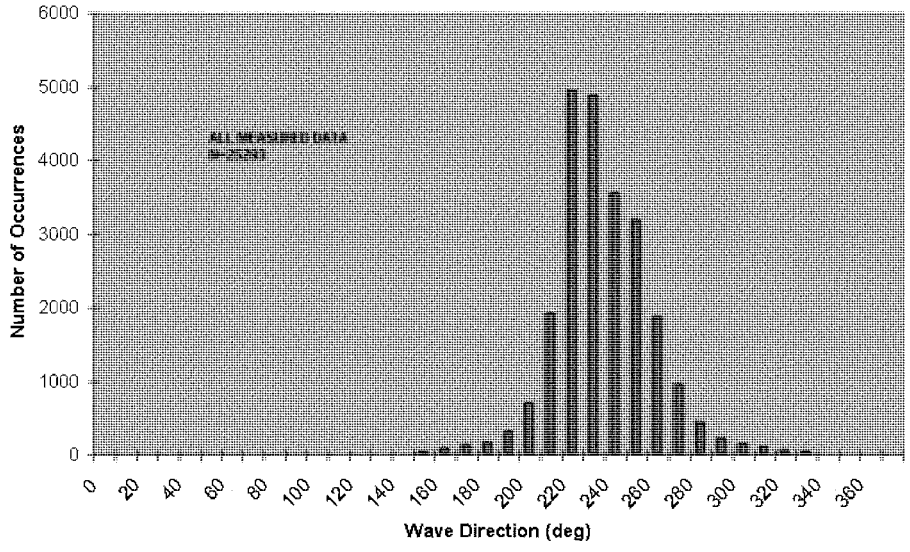


Figure 4-4 Wave Direction Histogram for Waves off San Clemente, 1983-1996



4.3.4.3 Littoral Processes and Sediment Transport

Beaches are dynamic environments subject to seasonal movement of sand offshore during the winter (erosion) and onshore (accretion) during the summer (USACE 2005a). Sand also is transported alongshore during its offshore-onshore sedimentation cycle.

Oceanside Littoral Cell

San Clemente is within the Oceanside Littoral Cell. The Oceanside Littoral Cell extends for 53.5 mi (86 km) from Dana Point in Orange County to Point La Jolla in San Diego County. The shoreline within the Oceanside Littoral Cell displays a wide variety of coastal features including cliffs, headlands, beaches composed of sand and/or cobbles, rivers, creeks, tidal lagoons and marshes, submarine canyons, man-made shore and bluff protection devices of many kinds, and major harbor structures. The littoral cell includes two small craft harbors, Dana Point Harbor and Oceanside Harbor. Dana Point Harbor is located on the northern end of the littoral cell, while Oceanside Harbor is in the center of the cell.

The cell is divided into three sub-cells based on natural physiographic units: (1) Dana Point to San Mateo Point, (2) San Mateo Point to Carlsbad Submarine Canyon, and (3) Carlsbad Submarine Canyon to Point La Jolla. The City of San Clemente is located in the north sub-cell.

Sediment Sources

Numerous rivers and small streams discharge sediment into the Oceanside Littoral Cell, as shown in Figure 4-5. San Juan Creek and San Mateo Creek are considered major river systems for the influx of sediment into the north sub-cell. Table 4-9 provides a range of estimates of the sediment loads carried by fluvial systems of this littoral sub-cell.

Sediment Budget

A sediment budget for without-project conditions has been developed based primarily on the Coast of California Storm and Tidal Wave Study (CCSTWS, USACE 1991). Development of the sediment budget involves defining the sediment sources, sinks, and losses; transport modes; erosion and accretion rates; and balancing the resultant budget.

The analysis of the budget of sediment for this cell has been carried out for three time periods: (1) the period from 1900 – 1938, (2) a mild, uniform weather period from 1960 – 1978, and (3) a period of more variable wave climate covered by the CCSTWS studies from 1983 – 1990. The 1900 – 1938 "natural" budget permits an uncluttered look at the cell as it predates construction of dams and Oceanside Harbor, although it necessarily draws on some findings from later studies. The mild, uniform period from 1960 – 1978 was selected to evaluate the effects of Oceanside Harbor at a time when the wave climate was consistent from year to year and less variable than the present wave climate. The last period of more variable wave climate, 1983 – 1990, emphasizes the change in wave climate from one that gave a consistent, strong, southerly littoral transport to one that yields a more variable transport with a net northerly component in some years. The resultant sediment budget for the three time periods is shown in Table 4-10.

Figure 4-5 Major Rivers and Drainage Basins, Oceanside Littoral Cell

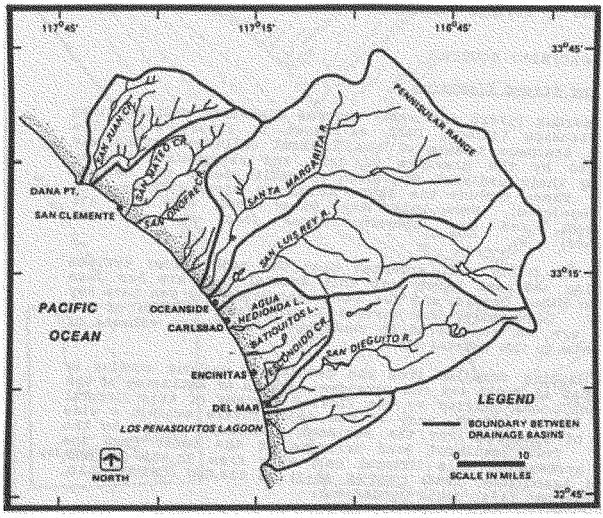


Table 4-9 Sediment Discharge from Rivers and Streams

	San Juan	San Clemente	San Mateo
Drainage Area mi^2 (ha)	175.5 (45,455)	19.9 (5,154)	132 (34,188)
	River / Stream Discharge Rate yd^3/yr (m^3/yr)		
Study			
Moffatt&Nichol 1977	17,000 (12,980)	14,340 (10,964)	2,240 (1,702)
CCSTWS 84-4 (1984)			32,000 (24,427)
Simons/Li 1985	8,000 (6,107)		16,000 (12,213)
CCSTWS 88-3 (Simons/Li 1988)	20,440 (15,603)	1,030 (786)	4,885 (3,729)
CCSTWS 90-2 (Moffatt&Nichol 1990)	36,000 (27,480)		8,400 (6,412)
COE-LAD 1999	52,071 (39,749)		

Table 4-10 Sediment Budget for Oceanside Littoral Cell (North – San Clemente) in 1000 m^3/yr

	1900-1938		1960-1978		1983-1990	
	Input	Output	Input	Output	Input	Output
Ql	0	130	0	130	0	35
Qn	0	15	0	15	0	5
Qb,o	130	45	90	45	45	0
Qa	0	0	90	0	0	0
Qr,s	65	0	45	0	0	0
Total	+195	-190	+225	-190	+45	-40
Net (t)/'V ∂∂	+5		+35		+5	
tX / ∂∂ (m/yr)	+0.03		+0.18		+0.03	

Notes:

Q = total sand transport rate into or out of cell, m^3/yr
a = artificial nourishment, bypassing, dredging, etc
b = bluff lands erosion; includes sea cliffs, gullies, coastal terrace, slumps, etc as distinct from rivers
l = longshore transport of sand in and near the surf zone
n = nearshore transport along the coast, outside the surf zone
o = onshore/offshore transport at the base of the shore rise
r = river yield to the coast
s = lost to submarine canyons
∂V' / ∂t = sand volume change rate, m^3/yr
∂X/ ∂t = shoreline change rate, m/yr

The resultant sediment budget indicates the shoreline is essentially in balance between erosion and accretion. The budget is considered to be in balance when the shoreline change rate ($\partial X/\partial t$), computed from the volume flux, is less than 0.1 ft/yr (0.03 m/yr). The shoreline indicates a balance in the "natural" time period and the most recent variable wave climate time period. The net volume flux indicates the budget is very slightly accretional during the uniform wave climate period.

Long Term Shoreline Change

Historical Shoreline Change

Shoreline changes within the Oceanside Littoral Cell were investigated by the CCSTWS using historical maps and nautical charts, aerial photos, and the results of ground and bathymetric survey efforts. The results of these extensive efforts are shown in Table 4-11.

Table 4-11 indicates the alongshore variation of shoreline change within the immediate vicinity of San Clemente. The San Clemente study area is between SC 1623 (State Beach) and SC 1720 (Shore cliffs). There are contradictory trends observed in the data. The data sets are out of phase with adjacent locations; a location is erosional while the adjacent transect is accretional and vice versa. The mean values during the 1940-1960 and 1960-1980 periods are similar in magnitude; the mean values during the 1980-1989 period are remarkably higher. Detailed inspection of the data indicates a shoreline that is either erosional, balanced, or accretional. During the period 1940-1960, the shoreline indicated essentially zero change with a +2.5 ft/yr (+0.76 m/yr) change

in the vicinity of SC 1680 (Linda Lane). During the period 1960-1980, the shoreline vacillated alongshore between positive and negative. The shoreline change was approximately equal between positive and negative ranging from -0.7 ft/yr (-0.21 m/yr) and +0.6 ft/yr (+0.18 m/yr). During the period 1980-1989, the shoreline was predominantly positive with accretion rates ranging from + 1.4ft/yr (+0.43 m/yr) to +7.2 ft/yr (+2.16 m/yr); an erosion value of -2 ft/yr (-0.61 m/yr) was recorded at SC 1660 (T-Street).

Table 4-11 Long Term Shoreline Change Rates in San Clemente Area

	MHHW Shoreline Change Rate (ft/yr [m/yr])			Max Seasonal MHHW Movement (ft [m])	
Location	**1940-1960**	**1960-1980**	**1980-1989**	**Summer**	**Winter**
SC1623	-0.20 (-0.06)	-0.7 (-0.21)	7.10 (2.16)	25.4 (7.7)	-26 (-7.9)
SC1660	0.0 (0.00)	0.60 (0.18)	-2.00(-0.61)	17.0 (5.2)	-34 (-10.4)
SC 1680	2.50 (0.76)	-0.40 (-0.12)	1.40 (0.43)	45.5 (13.9)	-57.4 (-17.5)
SC 1720	0.0 (0.00)	0.00 (0.00)	4.80 (1.46)	30.0 (9.2)	-27 (-8.2)
DB 1805	-1.90 (-0.58)	8.10 (2.47)	-12.30 (-3.75	25.0 (7.6)	-45.6 (-13.9)
DB 1850	-0.60 (-0.18)	9.31 (2.84)	----------	2.7 (0.8)	-70.2 (-21.4)
DB 1895	2.50 (0.76)	-0.40 (-0.12)	-0.50 (-0.15)	24.6 (7.5)	-31.4 (-9.6)
DB 1900	0.00 (0.00)	-1.90 (-0.58)	-10.0(-3.05)	59.8 (18.2)	-91.4 (-27.9)

Current Beach Width Monitoring

The City of San Clemente initiated a beach monitoring program to document changes in the condition of the shore between Dana Point Harbor and San Mateo Point. The results of this program provide a basis for evaluating the impacts of natural events and anthropogenic operations. The program includes semi-annual full cross-shore profile surveys at 11 representative sites and bi-monthly beach width measurements at 9 of the 11 profile sites.

Transect locations are shown in Table 4-12. The 11 profile locations include 6 historical locations originally established by the CCSTWS, and 5 locations established specifically for the beach monitoring program.

Recent Shoreline Change Rate

The shoreline change rate can be determined from the aggregate measured data collected in support of the CCSTWS and the City of San Clemente beach width monitoring program. The data is a compilation of measurements obtained in the 1980s through the present.

Table 4-12 San Clemente Area Beach Profile Transects

Site #	Transect Designation	Location	Origin
1	DB-1850	N. Doheny State Beach	CCSTWS
2	DB-1805	N. Doheny State Beach	CCSTWS
3	SC-1720	Shore cliffs	CCSTWS
4	SC-1705	Capistrano Trailer Court	Est. Oct. 2001
5	SC-1700	North Beach	Est. Oct. 2001
6	SC-1695	Dije Court	Est. Oct. 2001
7	SC-1680	Linda Lane	CCSTWS
8	SC-1660	T-Street	CCSTWS
9	SC-1645	Lost Winds	Est. Oct. 2001
10	SC1623	San Clemente State Beach	CCSTWS
11	SC-1605	Cottons Point	Est. Oct. 2001

It is noted that this beach width data set is expressed relative to the MSL contour. The beach widths are the distance between a fixed point on the backshore and the approximate location of the MSL contour. This MSL beach width incorporates a portion of the "wet" beach (e.g., the foreshore between the MSL contour and the berm), whereas the berm beach width definition, which is used in this study, incorporates only the "dry" portion of the beach. The MSL beach widths will be inherently greater than the berm beach widths. The MSL indicates a positive beach width where the beach has been previously defined in many reaches as having zero width. Based on a typical beach slope of 8H:1V, a berm elevation of +20.6 ft (+6.2 m) and a MSL contour elevation of +5.5 ft (+1.64 m), the estimated horizontal beach width attributable to this contour elevation difference is approximately 114 ft (35 m). It can be shown that the dry beach width is zero at Linda Lane and near zero at the other locations. Thus, the data sets are consistent with the conclusions developed in this study. It is assumed that the trend for the berm widths will coincide with the trend for the MSL data.

Figure 4-6 shows the measured data for the four locations that are historical to the CCSTWS (solid lines). The linear regression for each data set is shown as dotted lines. The slope of the lines represents the mean shoreline trend for each respective data set. State Beach, T-Street, and Linda Lane show a declining beach width while the beach width trend at Shorecliffs indicates widening.

The long-term shoreline change rate data sets are shown in Table 4-13. The measured data is shown for the four locations that are historical to the CCSTWS. The shoreline change data sets are considered together to obtain representative values for the entire study area. The mean shoreline change rate is –0.7 ft/yr (-0.20 m/yr), the maximum erosion rate is –2.0 ft/yr (-0.61 m/yr) and the maximum accretion rate is +1.24 ft/yr (0.38 m/yr).

There are contradictory trends observed in the data. The Shorecliffs data set is out of phase with the other three. The three data sets around the Pier are consistent in trend and phase. The data sets indicate consistent erosion and accretion trends at the same time. The mean values are similar in magnitude. The data set at Shorecliffs is nearly opposite in behavior. The beach is

erosional and/or accretional when the others are accretional and/or erosional. The data in the 1980s is consistent among data sets. After the long absence of data in the 1990s, the 2002 data indicates a loss of beach width.

Figure 4-6 Recent Shoreline Change - MSL Beach Width (m)

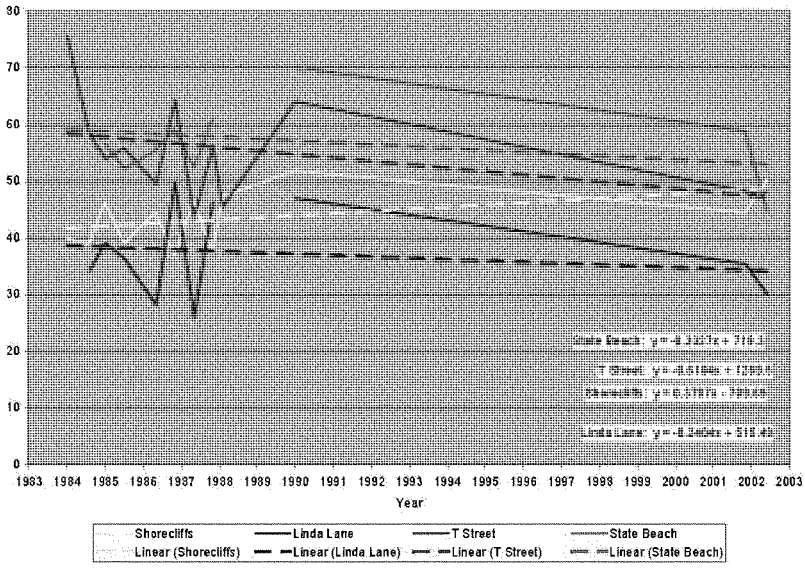


Table 4-13 Summary of Recent Long Term Shoreline Change Rates

Location	Erosion Rate ft/yr (m/yr)
SC 1720, Shorecliffs	+1.24 (+0.38)
SC 1680, Linda Lane	-0.79 (-0.24)
SC 1660, T–Street	-2.00 (-0.61)
SC 1623, State Beach	-1.09 (-0.33)

Cross-shore Profiles

Cross-shore profiles are compiled from the LIDAR topographic data and bathymetric measured data. Profiles from the vicinity of San Clemente Pier and Mariposa Point are representative of the beach and the armored shoreline respectively that are characteristic in the Project area (Figure 4-7 and Figure 4-8). Only the portion of the profile from the bluff to the waterline is

shown to better illustrate the detail of the foreshore and backshore regions. The profile centerline is established at the seaward rail of the SCRRA railroad.

The Pier area beach profile indicates a typical berm elevation of +17 ft (+5.2 m), a typical foreshore slope of 8H:1V – 10H:1V, an offshore slope of 110H:1V, and a railroad elevation of approximately +21 ft (+6.4 m). The Mariposa Point area profile indicates a mean revetment elevation of +23 ft (+6.9 m), typical revetment slope of 1H:1V, toe elevation at approximately 0.0 ft, an offshore slope of 110H:1V, and a railroad elevation of approximately +21 ft (6.4 m).

Figure 4-7 Cross-Shore Profile of Beach

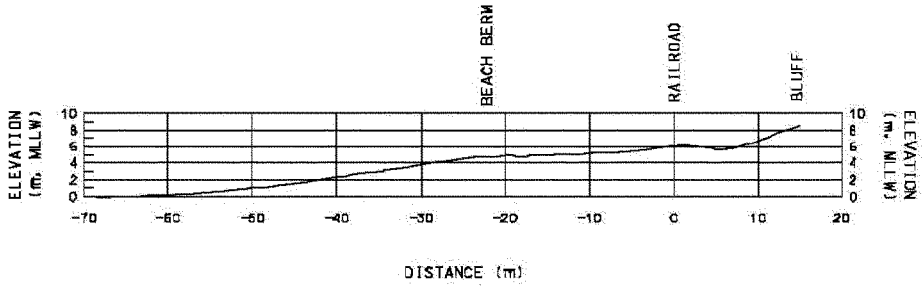
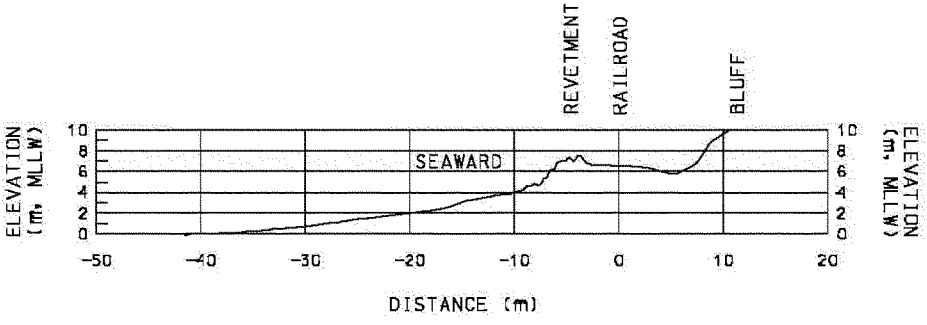


Figure 4-8 Cross-Shore Profile of Armored Shoreline



Sediment Profile Thickness

Data collected for the Sand Thickness Survey Report (USACE 1988) allows estimation of the available sediment supply and consequently any potential limits to erosion. This study conducted jet probing along various profiles to determine the available sediment thickness. Three profiles in the San Clemente area were jet probed including SC-1623 (San Clemente State Beach), SC-1660 (T-Street) and SC-1720 (Capistrano Shores). The survey results indicate the sediment thickness cross-shore along the profile. The results are summarized in Table 4-14.

On profile SC-1623, the sediment thickness ranges from 0.3-10.5 ft (0.1-3.2 m). The average

profile is consistently thick 7.7-10.5 ft (2.4-3.2 m) across the beach locations and is near zero 0.4-1.8 ft (0.1-0.6 m) across the seaward portion of the profile.

On profile SC-1660, the sediment thickness ranges from 0-14.8 ft (0-4.5 m). The average profile is consistently thick 6.9-14.8 ft (2.1-4.5 m) across the beach locations and is near zero 0.4-2.2 ft (0.1-0.7 m) across the inner seaward portion of the profile. The data indicates a thickness of 8.8 ft (2.7 m) at the furthest offshore location.

On profile SC-1720, the sediment thickness ranges from 0-15 ft (0-4.6 m). The average profile is consistently thick 3.3-14.9 ft (1.0-4.5 m) across the beach locations and is near zero 0-7 ft (0-0.2 m) across the seaward portion of the profile.

The measurement results identified cobbles, boulders, and other hard substrate at various depths along the profile. The observations include "some pebbles scattered on beach surface and some boulders visible at backshore" and "offshore sand-stone outcrops with local bottom relief of 1 ft (0.30 m)". This information is consistent with 2002 geologic information collected during geophysical studies conducted as part of this study, and reported in the Geotechnical Appendix (Appendix E).

Table 4-14 Summary of Sand Thickness

		Probe Location		Sand Thickness		
Range Line	No.	Range ft (m)	Elevation (MLLW) ft (m)	1 ft (m)	2 ft (m)	Average ft (m)
SC-1623	1	69.3 (21.1)	13.5 (4.1)	9.9 (3.0)	10.2 (3.1)	10.1 (3.1)
SC-1623	2	113.5 (34.6)	11.1 (3.4)	10.5 (3.2)	10.4 (3.2)	10.5 (3.2)
SC-1623	3	169.6 (51.7)	6.9 (2.1)	7.7 (2.4)	7.6 (2.3)	7.7 (2.4)
SC-1623	4	636.8 (194.2)	-11.4 (-3.5)	0.3 (0.1)	0.4 (0.1)	0.4 (0.1)
SC-1623	5	872.8 (266.1)	-19.6 (-6.0)	0.8 (0.2)	0.9 (0.3)	0.9 (0.3)
SC-1623	6	1,653.8 (504.2)	-30.5 (-9.3)	1.8 (0.6)	1.8 (0.6)	1.8 (0.6)
SC-1660	1	37.6(11.5)	16.3 (5.0)	14.8 (4.5)	14.8 (4.5)	14.8 (4.5)
SC-1660	2	77.2 (23.5)	10.2 (3.1)	11.0 (3.4)	11.4 (3.5)	11.2 (3.4)
SC-1660	3	140.6 (42.9)	4.8 (1.5)	7.2 (2.2)	6.6 (2.0)	6.9 (2.1)
SC-1660	4	763.5 (232.8)	-10.1 (-3.1)	0.0 (0.0)	0.8 (0.2)	0.4 (0.1)
SC-1660	5	1,516.5 (462.4)	-21.3 (-6.5)	2.0 (0.6)	2.3 (0.7)	2.2 (0.7)
SC-1660	6	2,209.5 (673.6)	-29.6 (-9.0)	8.5 (2.6)	9.0 (2.7)	8.8 (2.7)
SC-1720	1	35.9 (10.9)	15.4 (4.7)	15.0 (4.6)	14.8 (4.5)	14.9 (4.5)
SC-1720	2	81.4 (24.8)	8.7 (2.7)	9.2 (2.8)	9.9 (3.0)	9.6 (2.9)
SC-1720	3	152.6 (46.5)	1.9 (0.6)	3.3 (1.0)	3.3 (1.0)	3.3 (1.0)
SC-1720	4	541.9 (165.2)	-8.1 (-2.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
SC-1720	5	1,622.9 (494.8)	-21.9 (-6.7)	0.5 (0.2)	0.5 (0.2)	0.5 (0.2)
SC-1720	6	2,884.9 (879.5)	-28.3 (-8.6)	0.5 (0.2)	0.8 (0.2)	0.7 (0.2)

4.4 Biological Resources

These sections describe biological resources found in the vicinity of the proposed beach fill and borrow site areas along the San Clemente coastline. These descriptions are based upon existing literature on the Southern California Bight (SCB), which includes the eastern coastline of the Pacific Ocean from Point Conception, California, to Baja California, as well as the results of intertidal and subtidal reconnaissance site surveys conducted on March 13 and June 26, 2000, by Coastal Resources Management (CRM 2000), surfgrass surveys performed by Chambers Group in March 2008 and a kelp and surfgrass survey performed by Chambers Group in July 2009. A terrestrial biology survey was performed by Chambers Group on May 18, 2008.

Surfgrass (*Phyllospadix torreyi* and *P. Scouleri*) and giant kelp (*Macrocystis pyrifera*) are considered to be particularly valuable marine habitats by the resource agencies because they provide shelter for fishes and invertebrates, attachment sites for sessile invertebrates, and form the basis of many marine food chains, both as living material and detritus. Surfgrass and giant kelp beds occur in limited areas along the southern California coast, usually on hard bottom substrate, compared to much more common soft bottom habitat.

4.4.1 Terrestrial Shoreline Habitat

4.4.1.1 Vegetation

Residential and commercial development, a train railway, recreational activities, and introduced non-native, exotic plants have largely eliminated native terrestrial vegetation along the San Clemente shoreline and adjacent upland areas. The beach area is heavily used for recreation, and upland vegetation is limited primarily to ornamentals and a few patches of native vegetation. The vegetation is typified by common non-native species such as iceplant (*Lampranthus spp.*), sea rocket (*Cakile maritima*), African daisy (*Gazania spp.*), and mature palm trees. Native vegetation consists primarily of saltgrass (*Distichlis spicata*) and jimson weed (*Datura wrightii*). These sandy beach back bluffs are outside the Project area. The San Clemente Project study boundary does not include any of the terrestrial vegetation types east of the railroad tracks and, therefore, these are omitted from further analysis.

4.4.2 Marine Shoreline and Offshore Habitats

The predominant intertidal habitat along San Clemente's shoreline is sandy beach, although some rocky outcrops that extend from mid-beach to the low intertidal are present at Mariposa Point, north of San Clemente Pier. Beyond the surf zone, the seafloor is a mosaic of sand and low-to-high relief patch reef. Some pinnacles of the reef are visible in the nearshore zone at low tide while two prominent offshore pinnacles break the surface offshore of Mariposa Point and south of the San Clemente Pier. Other reef habitats are located south of the Pier offshore of T-Street that extends west, and then north around the end of the San Clemente Pier (Figure 4-9).

4.4.2.1 Rocky Intertidal

Although the predominant intertidal habitat along San Clemente's shoreline is sandy beach, an area of significant rocky intertidal is present at Mariposa Point, 3,200 ft (975 m) north of the San Clemente Pier and approximately 1,600 ft (488 m) north of the northern end of the proposed beach fill site at Linda Lane. Boulders and rocky outcroppings in this area support a variety of algal species (CRM 2000). In the high intertidal, boulders support filamentous green algae (*Enteromorpha* spp.). The mid to low intertidal algae composition is dominated by encrusting red algae (*Lithophyllum* spp., *Lithothamnion* spp.), encrusting brown algae (*Pseudolithoderma* spp.), and coralline algae (*Corallina* spp.). Green algae (*Enteromorpha* spp. and *Ulva* spp.) and several species of filamentous red algae also occur in these zones. Larger brown algae species colonize the base of the intertidal reef throughout the area, including palm kelp (*Eisenia aborea*) and feather boa kelp (*Egregia menziesii*). Surfgrass (*Phyllospadix torreyi*), an important species that enhances the biological value of nearshore habitat, is present in the low intertidal beginning approximately 300 ft (91 m) offshore of the sand beach. Surfgrass serves as a nursery for California spiny lobster (*Panulirus interruptus*) and provides shelter for a variety of juvenile and adult fishes. Surfgrass is present throughout the low intertidal platform of Mariposa Point, which is upcoast outside of the project area. Surfgrass off Mariposa Point occurs a minimum of three feet above the sand line with no more than one inch of sand covering the surface of the rocks. Surfgrass blades in this area are 1 to 2 ft (0.3 to 0.6 m) in length.

A diverse mid-to-low intertidal invertebrate community is found on boulders as well as the surfaces of the low-lying platform reefs at Mariposa Point (CRM 2000). The most common sessile invertebrate in this area is the California mussel (*Mytilus californianus*), which occurs throughout the mid and low intertidal zones, forming masses on the sides and upper surfaces of the boulders and platform reefs. Other common to abundant invertebrates in this area include the solitary and colonial forms of the anemone (*Anthopleura aggregate*), limpets (*Collisella scabra*, *Tectura* spp., *Collisella digitalis*), chitons (*Mopalia muscosa* and *Nuttalina californica*), acorn barnacles (*Balanus glandula*), and snails (*Acanthina spirata*). Although not common, the reef-building sandcastle tubeworm (*Phragmatopoma californica*) was found around the base of several boulders in the mid-intertidal zone.

Up to ten species of fish utilize the low to minus tidal zones of rocky intertidal habitats in the SCB (MEC 2002). Wooly sculpin (*Clinocottus analis*) is one of the more commonly encountered fish species in tidepools, but juvenile opaleye (*Girella nigricans*), rockpool blenny (*Hypsoblennius gilberti*), spotted kelpfish (*Gibbonsia elegans*), and California clingfish (*Gobiesox rhessodon*) also may be present (Cross and Allen 1993).

Figure 4-9 Historic Kelp Canopy and Reef Map

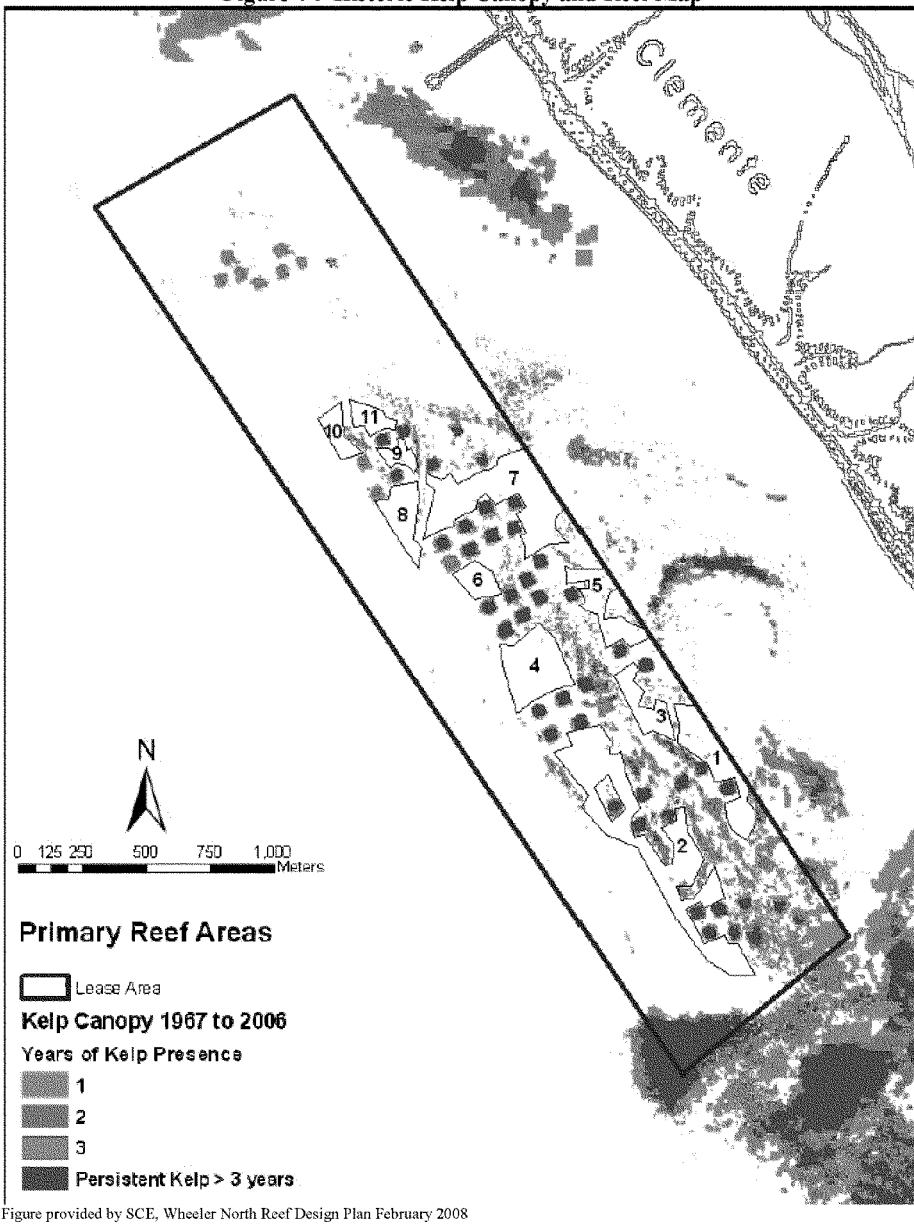


Figure provided by SCE, Wheeler North Reef Design Plan February 2008

4.4.2.2 Sandy Intertidal

The sandy beach along the San Clemente shore is variable in width. The shoreline at Mariposa Point consists of a riprap backshore environment that protects the railroad tracks. Immediately seaward of the riprap is a variable-width and gentle-to-moderate sloping sandy beach approximately 33 to 100 ft (10 to 30 m) in width. The rocky intertidal habitat described above in Section 4.4.1.1 lies seaward of this stretch of sandy beach. The beach within the Project footprint between Linda Lane and T-Street is narrow. A stone revetment to the north and an access road to the south provide backing along the beach at Linda Lane, which is fronted by a steeply sloping sandy beach to the water line. There is also a rock riprap that protects the lifeguard headquarters from wave run-up in front of buildings along this section of the shoreline. South of the Pier the beach is narrow and lies alongside the railroad tracks.

Sandy beaches in California are inhabited by an abundant invertebrate community that is an important food source for vertebrate predators, including shorebirds, seabirds, and fishes (Dugan et al. 2000). Intertidal invertebrates of sandy beaches show a characteristic zonation related to tidal exposure. The composition of the invertebrate community at a given beach, as well as the zonation, tends to be extremely dynamic due to the highly mobile nature of the sandy substrate and the resources on which these animals depend (Dugan and Hubbard 2006). Most exposed sandy beaches have two to three zones inhabited by distinct groups of mobile animals. These zones generally correspond to the relatively dry substrate of the upper intertidal zone at and above the drift line, the damp sand of the mid-intertidal zone, and the wet sand of the lower intertidal zone.

The lower intertidal zone (swash zone) in southern California sandy beaches is dominated by the filter feeding mole crab, *Emerita analoga*, which moves up and down the beach with the tides. The polychaete "bloodworm", *Euzonus*, also is common in the mid to lower intertidal. In the upper intertidal, drift kelp is an important source of food for many invertebrates. Common organisms associated with macrophyte wrack include beach hoppers (*Megalorchestia* spp.), kelp flies (*Coleopa vanduzeei*), isopods (*Alloniscus perconvexus* and *Tylos punctata*), and various species of beetles.

The sandy intertidal is also used by a nearshore fish, the California grunion (*Leuresthes tenuis*), which lays its eggs in the high intertidal zone between March and August. During the grunion spawning season, eggs and developing embryos are buried in the sand to incubate between the highest tides of each month, at the full and new moon (Martin 2006). The eggs incubate a few inches deep in the sand and hatch approximately 10 days later during the next series of high tides (Chambers Group 2002). Grunion are known to spawn on the beach in the vicinity of San Clemente Pier (K. Martin, Pepperdine University, pers. comm., 2007).

4.4.2.3 Subtidal Hardbottom

The shallow subtidal zone for much of the Project area is a mixture of sand and boulders, with occasional outcrops of exposed shale bedrock (CRM 2000). Historically, offshore kelp beds, dominated by giant kelp (*Macrocystis pyrifera*) with an understory of feather boa kelp (*Egregia*

menziesii) and palm kelp (*Eisenia arborea*), have been prevalent along this section of coastline. The kelp canopy within the project area has fluctuated considerably over the last decade. Figure 4-9 shows the kelp canopy between 1967 and 2006 and is an indication of reef habitat deeper than approximately 20 feet (6 meters). During surveys in June 2000, CRM found low to moderate density kelp beds with little or no surface canopy 2,000 ft (610 m) off of Mariposa Point at depths between (-23 and -28 ft) (–7.0 and –8.5 m) MLLW. Another bed was observed 650 ft (198 m) off San Clemente Pier (T-Street) at a depth of 16 ft (4.9 m) in October 1999. This patch was not observed during the June 2000 survey (CRM 2000). Much of the kelp observed in June 2000 was ragged and covered with fouling ectoprocts (*Bryozoa*); however, newly settled recruit plants were also present (CRM 2000). In March 2008, kelp canopy was sparse in the project area. In July 2009, a thick kelp bed was observed on the considerable reef formations offshore and south of San Clemente Pier. Figure 4-10 shows the kelp mapped in July 2009. The kelp bed in 2009 corresponds generally with the historical kelp mapped previously (Figure 4-9).

The most extensive reef formations in the vicinity of San Clemente Pier are located off Mariposa Point, north of the project area. The shallow subtidal reefs off Mariposa Point have well-developed macrophyte growth, including dense stands of understory species of kelp and surfgrass (CRM 2000). These inshore reefs are approximately 300 to 700 ft (90 to 210 m) from the shoreline, and some of the rocks have several feet of vertical relief. Most, however, are sand inundated boulders less than 2 to 3 ft (0.6 to 1 m) in height. Surfgrass on these shallow subtidal reefs grows a minimum of 1 ft (0.3 m) above the sand line and have blades up to 2 ft (0.6 m) long.

The nearest high relief reef is located 2,000 ft (610 m) offshore of Mariposa Point (Washrock Reef) at depths between -23 and -28 ft (-7 and -8.4 m) MLLW. A 400 foot by 200 foot (120 meter by 60 meter) patch (1.83 acres or 7,434 square meters) of giant kelp was observed inshore of the Washrock Reef just north of the Pier at a depth of 26 ft (8 m) in October 1999 which persisted at least through June 2000 (CRM 2000). The apex of Washrock Reef is dominated by mussels (*Mytilus californianus* and *M. edulis*). Other characteristic reef organisms observed during the CRM June 2000 survey included gorgonians (*Muricea californica* and *M. fructicosa*), keyhole limpet (*Megathura crenulata*), purple and red sea urchin (*Strongylocentrotus purpuratus* and *S. franciscanus*), California sea cucumber (*Parastichopus californicus*), Kellet's whelk (*Kelletia kelletii*), and sea stars (*Pisaster brevispinus* and *P. giganteus*). Fishes observed included spotted sand bass (*Paralabrax maculofasciatus*), kelp bass (*P. clathratus*), seniorita (*Oxyjulis californicus*), bat ray (*Myliobatis californica*), and black perch (*Embiotica jacksoni*). Other fishes that are commonly associated with nearshore reef habitats with developed stands of perennial vegetation above 3 ft (1 m) in height also would be expected to occur within the Project area Species associated with southern California nearshore reefs include barred sand bass (*P. nebulifer*); shiner, walleye, and dwarf surfperches (*Embiotocidae*); California sheephead (*Semicossyphus pulcher*); garibaldi (*Hypsypops rubicundus*); jack mackerel (*Trachurus symmetricus*); giant kelpfish (*Heterostichus rostratus*); painted greenling (*Oxylebius pictus*); and halfmoon (*Medialuna californiensis*) (MEC 2002, Thompson et al. 1993).

Offshore the northern end of the proposed beach fill site at Linda Lane, low relief boulders occur at depths greater than 9 ft (2.7 m) MLLW (CRM 2000). Boulders appear to be frequently scoured and are characterized by growth of red turf algae and crustose corallines. Coastal

Resources Management observed surfgrass at this depth off the northern portion of the Linda Lane area, approximately 300 ft (90 m) from the shoreline. The surfgrass occurred on the upper surfaces of 1 ft (0.3 m) high boulders. Blades were approximately 2 to 3 ft (0.6 to 0.9 m) long. Chambers Group surveyed for surfgrass in the Project area in March of 2008. Offshore of the northern portion of the proposed sand placement area between San Clemente Pier and Linda Lane, only scattered patches of surfgrass were observed (Figure 4-10).

South of San Clemente Pier, cobble and reef habitat occur offshore beginning at a depth of -1.2 to (-4 to -5 ft) (-1.5 m) MLLW and extending to at least -11 ft (- 3.3 m) MLLW (CRM 2000). Surfgrass meadows are located approximately 300 ft (90 m) from the shoreline on T-street Reef. The surfgrass grows on 1 to 2 ft (0.3 to 0.6 m) high boulders and has blades that are 2 to 3 ft (0.6 to 0.9 m) long. Farther offshore surfgrass cover declines. Surfgrass at the deeper depths (-11 ft [- 3.3 m] MLLW) was growing on 1 ft (0.3 m) high boulders inundated with sand. In some cases, two-thirds of the length of the surfgrass blades were covered with sand and only 1 ft (0.3 m) of the blades remained above the sand line. Figure 4-10 shows surfgrass mapped by Chambers Group during the March 2008 survey. South of San Clemente Pier, surfgrass grows on the T-Street Reef starting at a water depth of between -4 and -6 ft (-1.2 and-1.8 m) MLLW and extending offshore to a water depth of between -11 and -13 ft (-3.3 and -3.9 m) MLLW.

The subtidal reef habitat south of the Pier is extensive and angles around the tip of San Clemente Pier. This reef formation is shown on Figure 4-10. Larger macrophytes observed on the reef include giant kelp, feather boa kelp (*Endarchne binghamiae*) and bladder chain kelp (*Cystoseira/ Halidrys*) (CRM 2000). A small patch of giant kelp consisting of 12 plants was observed 650 ft (197 m) south of the Pier at a depth of 16 ft (5 m) in October 1999, but was not observed in June 2000. Kelp canopy was observed on the entire reef in July 2009.

California spiny lobster (*Panulirus interruptus*) is common in the subtidal reef habitat in the project area. Commercial lobster fishermen set traps in the area during the lobster fishing season of October through mid-March and lobster also are fished in the area by SCUBA divers. Abalone (*Haliotis rufescens*) have been reported historically in the general project area (Blunt 1980), but were not observed during any of the recent surveys.

4.4.2.4 Subtidal Softbottom

Benthic invertebrate species typical of Southern California nearshore soft bottom habitats include polychaete worms (e.g., *Diopatra spp., Loimia medusa, Pista pacifica*), sand dollars (*Dendraster excentricus*), crabs (*Heterocrypta occidentalis, Portunis xantusii, Randallia ornata*), hermit crabs (*Pagurus spp., Pagurites spp.*), marine snails (*Nassarius fossatus, Olivella biplicata, Polinices spp.*), clams (*Ensis spp.*), armored sea stars (*Astropecten armatus*), tube anemones (*Harenactis attenuata, Zaolutus actius*), sea pens (*Stylatula elongata*), and sea pansies (*Renilla kollikeri*) (MEC 2002, Thompson et al., 1993).

Figure 4-10 Surfgrass Survey

Prepared by Chambers Group, Inc.
3313 003

Final San Clemente Shoreline Protection EIS/EIR
Prepared for U.S. Army Corps of Engineers

Fish commonly found over shallow sandy subtidal habitat (less than 30 ft or 9m) in southern California include California halibut (*Paralichthys californicus*), speckled sanddabs (Citharichthys *stigmaeus*), barred surfperch (*Amphistichus argenteus*), white croaker (*Genyonemus lineatus*), bat ray (*Myliobatus californica*), and shovelnose guitarfish (*Rhinobatos productus*) (MEC 2002, SANDAG 2000). Northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), Pacific bonito (*Sarda chiliensis*), and topsmelt (*Athernops affinis*) are commonly encountered in the water column just beyond the surf zone (MEC 2002, SANDAG 2000).

The proposed borrow site offshore Oceanside (SO-9) was described by SANDAG (2000). The proposed borrow site consists of sand bottom habitat at between 45 and 60 ft (14 and 18 m) water depth. Fishes and invertebrates found in the vicinity of the Oceanside borrow site are typical of these depths on southern California offshore soft bottoms (SANDAG 2000). The most abundant invertebrate taxa identified for the Oceanside borrow site include several species of polychaete worms (*Diopatra* spp., *Euclymeninae* sp., *Melinna oculata, Metasychis disparidentatus, Paraprionospio pinnata, Petalodymene pacifica, Pista disjuncta, Spiophanes missionensis, Streblosoma* sp.) and the amphipod *Ampelisca cristata* (SANDAG 2000). Abundant fish species include longfin sanddab (*Citharichthys xanthostigma*), barred sand bass (*Paralabrax nebulifer*), California halibut, California lizardfish (*Synodus lucioceps*), and fantail sole (*Xystreurys liolepis*) (SANDAG 2000).

4.4.2.5 Essential Fish Habitat

In accordance with the 1996 amendments to the Magnuson-Stevens Fishery Management and Conservation Act, an assessment of Essential Fish Habitat (EFH) was conducted for the proposed Project. NOAA Fisheries provided conservation recommendations during the public comment period and these recommendations are addressed in Section 14.0 of this Final EIS/EIR. The Project is located within an area designated as EFH for two Fishery Management Plans (FMPs): Coastal Pelagic Species Fishery Management Plan and Pacific Coast Groundfish Fishery Management Plan. Many of the 86 species federally managed under these plans are known or expected to occur in the area and could be affected by the proposed Project. All of the five species managed under the Coastal Pelagic Species Fishery Management Plan are likely to occur in the Project area. These pelagic species are northern anchovy, Pacific sardine (*Sardinops sagax)*, Pacific mackerel (*Scomber japonicus*), jack mackerel, and market squid (*Loligo opalescens*). Approximately 16 species managed under the Pacific Coast Groundfish Fishery Management Plan are likely to occur in the Project area. These species include leopard shark (*Triakis semifasciata*), big skate (*Raja binoculata*), spiny dogfish (*Squalus acanthias*), cabezon (*Scorpaenichthys marmoratus*), four species of flatfish (*Pleuronichthys decurrens, Microstomus pacificus, Pleuronectes vetulis, Citharichthys sordidus*), and at least eight species of rockfish (*Sebastes chrysomelas, S. auriculatus, S. caurinus, S. rastrelliger, S. atrovirens, S. serranoides, S. serriceps and Scorpaena guttata*).

4.4.2.6 Birds

A diverse variety of resident and migratory seabirds and shorebirds are commonly observed along southern California beaches and offshore waters. Seabirds, such as pelicans, terns, and

cormorants, forage for fish in the nearshore ocean. Gulls and shorebirds utilize sandy upper tidal beaches as roosts. Gulls feed on fish and invertebrates, particularly near the edge of the kelp canopy. Shorebirds probe for invertebrates in the damp sands of the middle and low intertidal zones, and some species also forage for small fish and invertebrates in the rocky intertidal. Kelp and surfgrass that have washed ashore harbor invertebrates provide good foraging areas for gulls and shorebirds.

The seabirds that are most commonly observed along the beaches and ocean waters offshore of Orange and San Diego counties include Heerman's gull (*Larus heermanni*), ring-billed gull (*L. delawarensis*), western gull (*L. occidentalis*), California brown pelican (*Pelecanus occidentalis californicus)*, surf scoter (*Melinita perspicillata*), terns (*Sterna spp.*), grebes (*Podicipedidae*), and double-crested (*Phalacrocorax auritus*), and pelagic (*P. pelagicus*) cormorants (Chambers Group 2002, MEC 2002).

A variety of shorebirds would be expected to use the beach in the vicinity of San Clemente Pier. Commonly observed species include the following shorebirds: marbled godwit (*Limosa fedoa*), sanderling (*Calidris alba*), whimbrel (*Numenius phaeopus*), willet (*Catoptrophorus semipalmatus*), black-bellied plover (*Pluvialis squatarola*), western sandpiper (*Calidris mauri*), and least sandpiper (*Calidris minutilla*) (McConnaughey and McConnaughey 1988, Chambers Group 2002, MEC 2002).

4.4.2.7 Marine Mammals (Non-Endangered)

The marine mammals that occur in the Southern California Bight have been described in detail in previous studies and environmental documents (e.g., Bonnell et al. 1981, 1983; Bonnell and Dailey 1993; Dohl et al. 1981, 1983; ADL 1984; Barlow et al. 1995, 1997; Barlow and Gerrodette 1996; Koski et al. 1998; DeLong and Melin 2000; Stewart and Yochem 2000). Although as many as 36 species of marine mammals inhabit or visit the Southern California Bight, including 6 species of pinnipeds (seals and sea lions), 29 species of cetaceans (whales, porpoises, and dolphins), and the sea otter, only about 6 species are expected to occur in the nearshore waters of the San Clemente study area on a regular basis. These include two pinnipeds, one whale, and three dolphin species (described below). Other species also may occur in the study area on an irregular basis.

California sea lion

The California sea lion (*Zalophus californianus*) ranges from British Columbia to Mexico. The current U.S. population size is estimated at 237,000-244,000 animals (Carretta et al. 2007). In the Southern California Bight, California sea lions currently breed on four islands: San Miguel, San Nicolas, Santa Barbara, and San Clemente. California sea lions are common along the California coast and occur within the project area.

Harbor seals

Harbor seals (*Phoca vitulina*) range from Mexico to the Aleutians. The North Pacific population is centered in Alaska (Hoover, 1988), and about 34,233 harbor seals are found in California

(Carretta et al. 2007). Peak harbor seal populations on land occur during the species' spring breeding and pupping season and early summer molt. Harbor seals forage relatively close to shore and occasionally "haul out" onto land at various times of the day for an indefinite period of time (Seaworld 2002). Harbor seals regularly haul out on large, exposed rocks south of the San Clemente sand placement site.

Gray Whale

Two separate populations of gray whales (*Eschrichtius robustus*) are recognized for the North Pacific: the eastern, or Californian, population and the Korean, or western, population (Le Duc et al. 2000). Gray whales also existed in the North Atlantic up to the 16th century, but this population became extinct probably due to whaling (Henderson 1984). The Californian population of gray whales migrates through southern California waters twice a year on its way between Mexican breeding lagoons and feeding grounds in the Bering Sea. The southbound migration through the Southern California Bight begins in December and lasts through February; the northbound migration is more prolonged, lasting from February through May with a peak in March (Bonnell and Dailey 1993). Gray whales are generally absent from southern California waters from August through November. Migrating gray whales generally travel along the near-shore shallow continental shelf within 2 mi (3 km) of the shoreline over most of the route (Graham 1989). This proximity to shore makes gray whales vulnerable to numerous threats by human activities, including industrial activities, oil exploration and extraction, shipping traffic, pollution, and whale-watching tourism (Crane 1992).

Bottlenose Dolphin

There are two California populations of bottlenose dolphins (*Tursiops truncatus*), coastal and offshore. Coastal bottlenose dolphins, which are the population that is most likely to occur in the study area, generally are found within approximately a mile (1-2 km) of shore, primarily from Point Conception south into Mexican waters. The coastal population appears to form small resident groups that range along the coastline, especially off Orange and San Diego counties (Weller and Defran 1989). The coastal population is estimated at about 323 animals (Carretta et al. 2007).

Pacific White-sided Dolphin

Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) are found year-round in southern California and are widely distributed in the Southern California Bight. The distribution of this species shifts seasonally and they are most abundant in inshore waters in the spring and summer (Bonnell and Dailey 1993). They would be expected to occur occasionally in the project area at the borrow site and offshore the receiver site.

Common Dolphin

Short-beak common dolphin (*Delphinus delphis*) and long-beak common dolphin *D.bairdii*) are found year-round in southern California waters. The short-beak common dolphin is the most abundant cetacean off California, but generally occurs far offshore. The long-beak common

dolphin is more likely to occur in nearshore waters. Either species may occasionally occur in the project area either at the borrow site or off the San Clemente receiver beach.

4.4.2.8 Wildlife

Wildlife species detected within the majority of the Project area are typical of the highly disturbed, heavily utilized sandy beach habitat. Shorebirds and seabirds are described above. Terrestrial wildlife that would be expected include American crows (*Corvus brachyrhynchos*), rock doves (*Columba livia*), and California ground squirrels (*Spermophilus beecheyi*).

Although the project reach is within heavily-urbanized downtown San Clemente, there are some canyons, including Linda Lane, the canyon between Cazador Land and Trafalgar Lane/Esplanade, and the canyon just south of T-street, that would be expected to support urban adapted mammals, including coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*) and opossum (*Didelphis virginiana*). These mammals may occasionally wander onto the beach at night or early morning.

4.4.3 Special Status Listed Species

Section 7(c) of the ESA, as amended, requires that a federal agency request from the appropriate authority a list of threatened and/or endangered species present in an area of a proposed major federal action. Because of a lack of natural terrestrial habitat within the Project footprint, sensitive terrestrial plants and animals would not be expected to occur in the Project area. lists sensitive species with the potential to occur on the beach in the Project area or offshore in the vicinity of the borrow sites and/or the beach fill site. Potential impacts to these species are addressed in Section 5.4 of this joint EIS/EIR.

4.4.3.1 White Abalone (Federal Endangered)

In May 2001, white abalone (*Haliotis sorensoni*) became the first marine invertebrate to be listed as a Federal endangered species. White abalone is a mollusk that occurs on rocky habitat from Point Conception to Baja California at 80 to 200 ft (24 to 60 m) depths (Hobday and Tegner 2000). White abalone has been recorded in water as shallow as 25 ft (7.5 m) in the Santa Barbara Channel (Aspen 2005). White abalone typically is found in open low relief rock or boulder habitat surrounded by sand (Hobday and Tegner 2000). There has been a greater than 99 percent decline in both the abundance and density of white abalone in California since the 1970s (Hobday and Tegner 2000). The abalone fishery contributed to the decline of white abalone by overharvesting and reduced the density to the point where recruitment success has been unlikely. White abalone have a low potential to occur in the shallow subtidal habitat offshore San Clemente. Although this species has been found in water as shallow as 25 ft (7.5 m) off Santa Barbara, it generally is in water depths greater than 80 ft (24m) especially in the southern part of its range. No white abalone were observed during biological surveys of the Project area (CRM 2000).

Table 4-15 Special Status Listed Species that May Occur in the San Clemente Pier or Oceanside

Common Name	Scientific Name	Status	General Habitat	Distribution	Potential For Occurrence In Project Area
Invertebrates					
White Abalone	*Haliotis sorenseni*	FE	Open, low relief rock or boulder habitat surrounded by sand at 80 to 200 ft (24 to 60 m) depths (Hobday and Tegner 2000)	Point Conception to Baja California	Low
Fishes					
Southern steelhead	*Oncorhynchus mykiss*	FE (south of Point Conception)	Spawn in cool, clear, well-oxygenated streams. Higher-elevation headwaters are primary spawning and rearing areas. Southern steelhead likely have greater physiological tolerances to warmer water and more variable conditions.	The Southern California Evolutionarily Significant Unit of steelhead extends from the Santa Maria River to the U.S.-Mexico Border. Steelhead have recently been reported from San Mateo Creek on Camp Pendleton just south of San Clemente, and the Santa Margarita near the borrow site	Low
Birds					
Western snowy plover	*Charadrius alexandrinus nivosus*	FT	Beaches (migration and wintering)	Nests in sandy areas on beaches, bays and islands from Washington State to Baja California. Nearest nesting sites are on Camp Pendleton	Absent. Sea and Sage Audubon performed a 2010 winter survey; San Clemente Beaches were not included because beach habitat within the project placement footprint, as well as in Oceanside, are narrow and heavily used by people. Philip Unitt, San Diego Natural History Museum, Birds of San Diego County, Memoir 13, 1984, does not show snowy plovers in north portion of the county. California State Parks has tracked snowy plovers during winter window surveys and has driven San Clemente State Beach many times with zero plovers observed over the years (David Pryor, personal communication, February 2011).

Common Name	Scientific Name	Status	General Habitat	Distribution	Potential For Occurrence In Project Area
California least tern	*Sterna antillarum browni*	FE; SE (nesting colony)	Nearshore waters; breeding populations in California are restricted to coastal locations; forage close to their breeding colonies in bays, harbors, and nearshore ocean waters	Nesting occurs from the San Francisco Bay area to Baja California. Nearest nesting sites are on Camp Pendleton.	Absent Project would not occur when they are present in California

Notes:
FE = Federal Endangered
ST = State Threatened
FT = Federal Threatened
SE = State Endangered
Potential for Occurrence
Absent – species is restricted to habitats, environmental conditions or seasons that do not coincide with the project site or timing
Low – records for this species do not exist within the immediate vicinity of the site and/or habitats or environmental conditions needed to support the species are of low quality
Moderate – either an historical record exists of the species in the immediate vicinity of the site and marginal habitat exists on the site, or the habitat requirements and environmental conditions associated with the species occur within the site but no historical records exist of the species in the vicinity of the site
High- both historical records exist of the species within the site or its immediate vicinity and the habitat requirements and environmental conditions associated with the species occur on the site

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4.4.3.2 Tidewater Goby (Federal Endangered)

The tidewater goby was listed as endangered on February 4, 1994, (59 FR 5498) and is categorized as a California Special Concern (CSC) species by CDFG. A recovery plan for this species was finalized in 2006 (USFWS 2005a), and critical habitat has been proposed (USFWS 2007b). Gobies are mostly coastal lagoon fishes that prefer shallow, usually brackish water (Love 1996). Primary tidewater goby habitat is found in small, shallow coastal lagoons that are separated from the ocean most of the year by beach barriers. This includes shallow areas of bays and areas near stream mouths in uppermost brackish portions of larger bays. The U.S. Fish and Wildlife Service designated critical habitat for the tidewater goby on November 20, 2000 (65 FR 69693-69717). Critical habitat includes stream channels and their associated wetlands, flood plains, and estuaries. Critical habitat within the vicinity of the San Clemente beach site includes San Mateo Creek and San Onofre Creek. Near the San Clemente Project area, populations of tidewater gobies, although highly variable in number, occur at San Mateo Creek and San Onofre Creek. Critical habitat onshore of the Oceanside borrow site includes Las Flores/Las Pulgas Creeks, Hidden Lagoon, Aliso Canyon, Cockleburr Canyon and the Santa Margarita River on Camp Pendleton as well as the San Luis Rey River near Oceanside Harbor. Within the last 10 years, tidewater gobies have been collected in Las Flores Creek, Hidden Lagoon, Aliso Canyon, and Cockleburr Canyon.

4.4.3.3 Steelhead Trout (Federal Endangered)

The effective date for listing the Southern California Evolutionarily Significant Unit (ESU) of west coast steelhead (*Oncorhynchus mykiss*) as endangered and the South Central California Coast ESU as threatened is October 17, 1997 (63 FR 32996). Steelheads from the Southern California ESU have already been extirpated from much of their historical range. There is a strong concern about the widespread degradation, destruction, and blockage of freshwater habitats within the region, and the potential results of continuing habitat destruction and water allocation problems. Total abundance of steelhead in the South-Central Coast ESU is extremely low and declining. Risk factors for this ESU are habitat deterioration due to sedimentation, and flooding related to land management practices.

Steelheads, like all salmon, need clean, cool water with plenty of oxygen and low amounts of suspended solids and contaminants. They also need gravel and rocks to spawn. Fine sediment is lethal to steelhead. Steelheads also require large, woody debris and deep pools in the river, which provide refuge from predators and resting places during storms. San Mateo Creek is the nearest occurrence of steelhead near the San Clemente Project. Historically, San Mateo Creek was one of the most productive streams for southern steelhead. In a report to NOAA Fisheries, the U.S. Marine Corps Base, Camp Pendleton (MCBCP) in coordination with the CDFG determined that San Mateo Creek in northern San Diego County still supports a small population of the southern California steelhead. This is based upon field surveys completed in 2003 by biologist from MCBCP and CDFG (S. Glowacki, pers. comm. 2004). Even though this steelhead population is relatively small, large adults were found. Southern steelhead also has been found in the Santa Margarita River near the borrow site.

4.4.3.4 California Brown Pelican (Federal and State Endangered)

The California brown pelican was delisted from the Federal endangered species list on November 17, 2009 by the U.S. Fish and Wildlife Service (74 FR 59443); it was delisted from the State endangered species list in a vote by Fish and Game Commission in February 2009

4.4.3.5 California Least Tern (Federal and State Endangered)

The California least tern was listed as endangered on October 13, 1970, (35 FR 16047) and State listed as endangered in June 27, 2004. A recovery plan for the species was published in 1980 (USFWS 1980), and was revised in 1985 (USFWS 1985). Critical habitat was never designated. The breeding range of the California least tern population occupies specific localized breeding colonies from about April to September each year. Colonies are usually in close proximity to a lagoons or estuary or river confluences with the ocean environs where they obtain most of the small fish they consume, although they may also forage up to 2 to 3 mi (3.2 to 4.8 km) from the beach in the near shore. Large numbers of least terns breed on the Marine Corps Base Camp Pendleton (MCBCP), 12 to 14 miles south of the Project area. In 2006, there were 1,423 nesting pairs of least terns at MCBCP (Marschalek 2007). Most of these (1,265 pairs) documented in the 2006 breeding survey were at the mouth of the Santa Margarita River. The nearest colonies to the Project area were at White Beach, approximately 14 mi (22 km) south of the proposed beach fill site, where 137 pairs bred in 2006 and at Red Beach, approximately 12mi (19 km) south of the Project site where 21 pairs bred (Marschalek 2007). The Oceanside borrow site is within the foraging range of the Santa Margarita River colony.

Least terns are known to use the near shore waters for foraging as they make their northbound and southbound migration treks. There are no known records of least terns using the San Clemente Pier sandy beach habitat for nesting or for night roosts.

4.4.3.6 Western Snowy Plover (Federal Threatened)

The coastal population of the western snowy plover was listed as threatened in the Federal Register on March 5, 1993, (58 FR 12864) and is a CSC. A recovery plan for this species was finalized in 2007 (USFWS 2007a). Designation of critical habitat was published in the Federal Register on December 7, 1999, (64 FR 68507) and last revised in 2005 (USFWS 2005b). This population is defined as those individuals that nest adjacent to tidal waters, and includes all nesting birds on the mainland coast, peninsulas, offshore islands, adjacent bays, estuaries, and coastal rivers. The breeding range of the threatened population extends along the Pacific coast of North America from southern Washington to southern Baja California, Mexico. The winter range is somewhat broader and may extend to Central America (Page et al. 1995); however, most plovers winter south of California.

The nesting habitat of the coastal population is mainly dune-backed beaches, barrier beaches, salt flats, and salt evaporation ponds. Habitat of wintering birds includes beaches where nesting is not known to occur. In the U.S., over 150 currently used or historical nesting and/or wintering areas have been identified, most of which (about 85 percent) are in California. Snowy plovers do not nest within the Project area, which consists of beaches subjected to a high degree of human

use. San Onofre Beach, approximately 5 miles south of the proposed Project area, in northern San Diego County, has been designated as Critical Habitat for the western snowy plover (USFWS 2005b). Snowy plovers nest on MCBCP at White Beach (approximately 14 mi [22 km] south of the Project area) and the Santa Margarita River (about 16 mi [26 km] south of the beach fill area) (Powell et al. 2002).

The coastal population consists of both resident and migratory birds. Some birds winter in the breeding areas, while others migrate north or south to wintering areas. Current population data for California is 1,444 adult plovers.

Sea and Sage Audubon performed a 2010 winter survey; San Clemente Beaches were not included because beach habitat within the project placement footprint, as well as in Oceanside, are narrow and heavily used by people. Philip Unitt, San Diego Natural History Museum, Birds of San Diego County, Memoir 13, 1984, does not show snowy plovers in north portion of the county. California State Parks has tracked snowy plovers during winter window surveys and has driven San Clemente State Beach many times with zero plovers observed over the years (David Pryor, personal communication, February 2011).

4.4.3.7 Xantus' Murrelet (State Threatened)

Xantus' murrelet range from Baja California to Oregon and Washington (National Geographic 2001). Xantus' murrelets are common spring and summer residents to the Channel Islands and nearshore islands and offshore mainland waters (Lehman 1994). They nest colonially in only 12 to 15 locations, including Santa Barbara, Anacapa, San Miguel, Santa Catalina, San Clemente, and Santa Cruz islands. Santa Barbara Island contains the largest breeding concentration of this species in the world (McChesney et al. 2000, Burkett et al. 2003). An effort to remove black rats from Anacapa Island has re-established nesting by Xantus' murrelets there. This species forages throughout the SCB from these nest sites, particularly in the area between Santa Barbara and Santa Catalina islands and the mainland, but densities are low (Mills et al. 2005). They are rarely seen close to shore in Orange County (Hamilton and Willick 1996). Unitt (1984) mentions a few sightings off Point Loma that might be less than 0.5 mi (0.8 km) from shore, but it is not explicitly stated. Unitt states that many sightings are not distinguished between Xantus's and Craveri's murrelets, but it is most likely that they are Xantus's rather than Craveri's because Xantus's are much more common in the SCB (Harry Carter, pers. comm., 10 March 2008).

4.4.3.8 Listed Marine Mammals

Two species of pinniped designated as Federal Threatened and six species of Federal Endangered whales have an unlikely potential to occur in the nearshore waters off San Clemente and Oceanside. The threatened pinnipeds are the Guadalupe fur seal (*Arctocephalus townsendi*) and the Stellar sea lion (*Eumetopias jubata*). The Endangered whales are blue whale (*Balaenoptera musculus*), sei whale (*B. borealis*), fin whale (*B. physalus*), humpback whale (*Megaptera novaeangliae*), northern right whale (*Eubalaena glacialis*), and sperm whale (*Physeter macrocephalus*). The presence of any of these species within the project area is not expected.

4.4.4 Conservation/Habitat Management Plan

San Clemente is within the Orange County Southern Subregion Natural Communities Conservation Plan (NCCP). The purpose of the Southern NCCP is to protect designated open space and conserve identified listed and unlisted species (Covered Species) and associated vegetation communities, including upland, aquatic and riparian resources (Conserved Vegetation Communities), through the long-term management of the natural communities that provide habitat essential to the survival of these wildlife and plant species. The Southern NCCP/ Master Streambed Alteration Agreement/ Habitat Conservation Plan (Southern NCCP/MSAA/HCP) has been prepared by the County of Orange in cooperation with the CDFG and the USFWS in accordance with the provisions of the State Natural Community Conservation Planning Act of 1991, Sections 1600 et seq. of the California Fish and Game Code, and the Federal Endangered Species Act (ESA).

4.5 Cultural Resources

Cultural resources include prehistoric archaeological sites, historic archaeological sites, and historic structures, and consist of artifacts, food waste, structures, and facilities made by people in the past. Prehistoric archaeological sites are places that contain the material remains of activities carried out by the native population of the area (Native Americans) prior to the arrival of Europeans in southern California. Artifacts found in prehistoric sites include flaked stone tools such as projectile points, knives, scrapers, and drills; ground stone tools such as manos, metates, mortars, and pestles for grinding seeds and nuts; and bone tools, such as awls. Prehistoric sites and features include hearths, bedrock mortars, rockshelters, rock art, and burials.

Historic archaeological sites are places that contain the material remains of activities carried out by people during the period when written records were produced after the arrival of Europeans. Historic archaeological materials usually consist of refuse, such as bottles, cans, and food waste, deposited near structure foundations. Archaeological investigation of historic period sites is usually supplemented by historic research using written records. Historic structures include houses, commercial structures, industrial facilities, and other structures and facilities more than 50 years old.

4.5.1 Regulatory Setting

4.5.1.1 Federal Level

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires federal agencies to take into account the effects of their undertakings on cultural resources eligible for the National Register of Historic Places (National Register). The action must demonstrate compliance with the NHPA, Public Law 89-665; 16 U.S.C. 470-470m, as amended, 16 U.S.C. 460b, 470l-470n, and 36 CFR 800, as amended (August 5, 2004).

Cultural resources are identified using two principal methods. Before starting, a project, a records and literature search is conducted at repositories of archeological site records. The search may show that an archeological or historical survey has been conducted in the project area

and that cultural resources have been identified. That information may be enough to proceed with the significance evaluation stage of the project. If no previous survey has been done, or if a previous survey was either out of date or inadequate, a pedestrian survey of the ground surface within the proposed project boundaries may be conducted. Subsurface testing may also be performed if deemed appropriate by the cultural resources professional.

After a cultural resource(s) has been identified during a survey or record and literature search the federal agency overseeing the undertaking proceeds to determine whether the cultural resource is eligible for listing in the National Register of Historic Places (National Register). Section 106 of the National Historic Preservation Act mandates this process. The Federal Regulation that guides the process is found at 36 CFR 800.

For a cultural resource to be determined eligible for listing in the National Register it has to meet certain criteria. The resource has to be either minimally 50 years old or exhibit exceptional importance. After meeting the age requirement, cultural resources are evaluated according to four criteria: a, b, c, and d. The National Register criteria for evaluation as defined in 36 CFR 60.4 are:

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and

a. that are associated with events that have made a significant contribution to the broad patterns of our history; or
b. that are associated with the lives of persons significant in our past; or
c. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
d. that have yielded, or may be likely to yield, information important in prehistory or history.

After a cultural resource has been determined eligible for inclusion in the National Register, it is accorded the same level of protection as a property that is included. It then becomes formally known as a "historic property" regardless of age.

4.5.1.2 State Level

Like NEPA, the CEQA also considers the effects of a project on cultural resources. CEQA applies to all projects undertaken by a public agency (State or Local), any special district (e.g., a school district), and any public college or university. The CEQA Guidelines are the implementing measures for CEQA. The CEQA Guidelines §15064.5 (14 California Code of Regulations [CCR]) indicate a project may have a significant environmental effect if it causes "substantial adverse change" in the significance of an "historical resource" or a "unique archaeological resource" as defined or referenced in 14 CCR §15064.5(b,c) (1998). Such

changes include "physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource would be materially impaired" (14 CCR §15064.5 [b]).

Cultural resources are identified and evaluated for listing in the California Register of Historic Resources (California Register). Cultural resources that have been determined eligible for listing in the California Register are referred to as "historical resources". CEQA (PRC Sections 21002(b), 21083.2, and 21084.1) recognizes historical resources as part of the environment. The California Register is an authoritative guide to the State's historical resources and to which properties are considered significant for purposes of CEQA. The California Register Criteria of Significance are similar to that of the National Register. An historical resource must be significant at the Local, State, or national level, under one or more of the following four criteria:

1. It is associated with events that have made a significant contribution to the broad patterns of local or regional history, or the cultural heritage of California or the United States; or
2. It is associated with the lives of persons important to local, California, or national history; or
3. It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of a master, or possesses high artistic values; or
4. It has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California, or the nation.

4.5.1.3 Local Level

The City of San Clemente's General Plan addresses historical resources in its Cultural Resources Element, adopted in 1993. The City of San Clemente also is a Certified Local Government under the NHPA. As a result, San Clemente is required to maintain a system for inventory and survey of historic properties that is consistent with the California Office of Historic Preservation guidelines. The City of San Clemente uses California Register criteria for making determinations of significance (http://san-clemente.org/sc/standard.aspx?pageid=439), accessed January 8, 2008).

4.5.2 Area of Potential Effects (APE)

For the purpose of identification of existing cultural resources for this Project, the Project's APE includes three non-contiguous areas, which are located both onshore and offshore. The onshore portion of the APE includes the approximately 3,411 ft (1,040 m) long and 82 ft (25 m) wide strip of shoreline centered around the San Clemente Municipal Pier from approximately the Marine Safety Headquarters building to just south of the T-Street overpass. The offshore portion of the APE includes the offshore borrow site, Area 2, located off the coast of Oceanside.

Local prehistory and history are briefly summarized here in order to provide a context for further discussion of the known archaeological and historical remains within the APE and vicinity.

4.5.3 Cultural Context

This section summarizes the archaeology within and adjacent to the southern California coastline from Doheny State Beach to San Mateo Point. A variety of different regional chronologies, often with overlapping terminology, have been used in coastal southern California, and they vary from region to region. Today, the prehistory of Orange County is generally divided into three major temporal periods: Paleoindian, Archaic, and Late Prehistoric. These time periods are characterized by patterns in material culture that are thought to represent distinct regional trends in the economic and social organization of prehistoric groups. In addition, particular scholars referring to specific areas utilize a number of cultural terms synonymously with these temporal labels. For example, Warren (1968) in reference to the southern California coast and specifically Orange County prefers Encinitas Tradition for Archaic and Shoshonean for Late Prehistoric.

4.5.3.1 Paleoindian Period

The antiquity of human occupation in the New World has been the subject of considerable debate over the last few decades. The currently accepted model is that humans first entered the western hemisphere between 12,000 and 15,000 years B.P. (before present). There is currently no firm evidence of human occupation in coastal southern California prior to 12,000 B.P. Thus, this period begins with the first evidence of human occupation and ends with the extinction of Pleistocene game around 9,000 B.C. (before Christ). No Paleoindian period sites are known within Orange County, but several have been found in San Diego County. Warren (1968) named this local cultural tradition the San Dieguito Tradition. The artifact assemblage for this period consists mostly of lithic (stone/rock) artifacts: large projectile points, scrapers, and choppers. Paleoindian subsistence was based on the hunting of large Pleistocene game. Social groups/families would have stayed with a major kill as until it was depleted of all its nutritional and functional value. Researchers argue that such an economy could only support groups no larger than extended families. Around 9,000 B.C. the Pleistocene Epoch ended, and the large game animals became extinct. No longer able to continue their big game hunting tradition, the Paleoindian people were forced to utilize other resources to meet their economic needs.

4.5.3.2 Archaic Period

The Archaic period is commonly subdivided into Early (9,000-6,000 B.C.), Middle (6,000-4,000 B.C.), and Late Archaic period (4,000-2,000 B.C.). In addition, Wallace (1955) refers to this as Horizon II Milling Stone, and Warren (1968) calls it the Encinitas Tradition. Subsistence during the Early Archaic came primarily from plants and small animals, fishing, and shellfish. By the Middle Archaic, hard seeds were included in the diet as evidenced by the abundance of manos and metates found within these sites. By the Late Archaic, social groups grew in numbers and became more sedentary. Groups migrated seasonally depending on food availability rather than randomly following game animals.

4.5.3.3 Late Prehistoric Period

The Late Prehistoric period is generally considered to have begun between 1,300 and 800 years ago (Moratto 1984). In general, this period has been characterized by the appearance of small

pressure flaked arrow points (Cottonwood Triangular and Desert Side-notched points) indicative of bow and arrow technology, the appearance of ceramics, the replacement of flexed inhumations with cremations, the possible appearance of the mortar and pestle, and an emphasis on inland plant food collecting and processing, especially of acorns. In addition, sedentary villages with populations of up to 1,500 persons along with decorated tools and ornaments are attributed to this period. Warren (1968) called this period Shoshonean; named after the migration of Shoshonean-speakers, known as the Shoshonean wedge, to mostly what is now Orange County from the inland deserts about 1,500 years ago. Researchers have recorded this migration to the origin of the Late Prehistoric period. Following this influx of new people, the tribal landscape in the Southern California Coastal regions was altered by differentiation of tribes into the discrete cultural groups that were present at the time of European contact (Wallace 1955).

4.5.3.4 Post-Contact Native American Ethnohistory

The Post-Contact period began in 1769 A.D. (after Christ), when Gaspar de Portola led an overland expedition from San Diego to Monterey, CA. The first permanent settlement in Orange County came when San Juan Capistrano was selected as the site for a mission in the spring of 1775. The establishment of the San Juan Capistrano Mission in 1776 and the San Luis Rey de Franciscan Mission in 1798 further impacted traditional coastal settlement systems. Acculturation, assimilation, and the introduction of Old World diseases greatly disrupted and reduced Native American populations, and by the early 1800s traditional coastal villages were largely abandoned.

This Project area falls primarily within the territory of the Juaneño Tribe. They are known as the Juaneño because of their association and proximity with the San Juan Capistrano Mission. According to Bean and Shipek (1978), the Juaneño and Luiseño are considered to be ethnologically and linguistically the same, but have been subdivided due to missionization during the Spanish period. Today, the Juaneño Indians have distinguished themselves by gaining State recognition and seeking Federal recognition as a discrete Indian tribe.

Our knowledge of California Indian life prior to European contact is based mostly on knowledge gained from archaeological investigations. Since California tribes were generally peaceful and did not offer warlike resistance to European settlers, they did not receive the notoriety more aggressive groups enjoyed. In addition, consequently American researchers became interested in Indian ethnohistory only after their pre-contact cultural traditions and languages were virtually destroyed. As a result, we know very little about traditional coastal life, except what can be gleaned from mission records. Nineteenth and Twentieth century ethnohistoric reconstructions provide only minimal insight into coastal adaptations.

Father Boscana's "Chinigchinich" is, in the words of Kroeber, "the most intensive and best written account of the customs and religion of any group of California Indians in the mission days" (1925:636). The Juaneño practiced puberty rites and mourning rituals. Both these ceremonies were held within a sacred, enclosed structure called the Wankech. Uninitiated persons were not allowed to enter this structure, and once inside voices were kept to a whisper. The structure contained an altar consisting of an effigy of the god Chinigchinich and a sand

painting. According to Brown, "the center of the Juaneño religion was Chinigchinich, the last of a series of heroic mythological figures. The heroes were originally from the stars, and the sagas told of them formed the Juaneño religious beliefs" (1997).

Puberty rites were practiced for both boys and girls. Male initiation included the use of datura, a hallucinogen, in order to "see" the animal that would help protect them from future dangers. The animal was usually a coyote, bear, crow or raven, or a rattlesnake. Female initiation required that the girl fast and lie in a pit lined with heated stones for several days while older women sang and younger women danced around her. The mourning ceremony consisted of cremating the decedent usually just hours after death. The pyre was lit by a designated individual who obtained this privilege by descent. The Juaneño had medicine men or shamans, but very little is known about them or their practices. In addition, the Juaneño used a calendar. According to Kroeber, "ten months were named...the year was definitely divided by the solstices...the month or moon in which the solstice fell was somewhat longer than the others, after which there followed four regular lunations...nothing like this attempt to combine a lunar and solar count has yet been reported from any other people in California" (1925:644). The office of chief was inherited from paternal lineage.

4.5.3.5 Euro-American History

The Hispanic era in California's history includes the Spanish Colonial (1769-1820) and Mexican Republic (1820-1846) periods. This era witnessed the transition from a society dominated by religious and military institutions consisting of missions and presidios to a civilian population residing on large ranchos or in pueblos.

By the early 1820s, California came under Mexico's rule, and in 1834 the missions were secularized. This resulted in political imbalance and Indian uprisings against the Mexican rancheros. Secularization of mission lands began shortly after the declaration of Mexican Independence in 1821. Nine thousand acres of land, including the area of San Clemente, were granted to Filipe Carrillo in 1846 as Rancho Los Desaechos (Brown 1997). Carrillo failed to submit his claim to the U.S. Land Commission after the United States took possession of the area from Mexico, and as a result the rancho changed hands several times (Brown 1997).

Named after one of the offshore southern Channel Islands, the city of San Clemente was founded by a former mayor of Seattle, Ole Hanson, in 1925 (Brock 1985). San Clemente was among the first master planned communities built from totally open land in the United States. Before erecting a single structure on the rolling coastal hills, Ole Hanson laid out an expansive plan based on the Spanish Colonial architectural style including restaurants, a clubhouse, residences, public parks, a public pool, a fishing pier, and even equestrian trails. Hanson's residential community, promoted as "The Spanish Village," featured wide, meandering streets that conformed to the contours of the hills, houses situated to provide an ocean view, and mandatory white stucco exteriors and red tile roofs for every building. San Clemente was incorporated in 1928 and grew rapidly until the Depression, when development halted. The growth rate picked up again during the 1950s and was later boosted by construction of the San Diego Freeway.

Today, the Spanish Village by the Sea is more heterogeneous than Hanson had envisioned, but historic homeowners and current planning and development all reflect increasing esteem for his red-roofed, white-walled Spanish architecture dream. Historic homeowners must abide by city codes that protect the aesthetic spirit and style of early San Clemente. New development east of the Interstate 5 freeway now elevates Spanish Colonial Revival architecture to new interpretations, incorporating red roofs, balconies, and promenades as the demographics of San Clemente shift and new residents are drawn to the Mediterranean charm of this community. Perhaps the best example of San Clemente's increasing appreciation for its past is the restoration underway at the Casa Romantica, which was Ole Hanson's bluff top home at the time of the City's founding. The Casa Romantica was completed in 1928, and after Hanson lost it to the bank during the Great Depression, the Casa passed through various owners. The wear and tear of time and neglect took its toll, and at one point the outstanding landmark seemed destined for demolition. Fortunately, a group of local activists pushed hard for the Casa Romantica's rescue and directed its destiny away from commercial alternatives and toward a use that will benefit all of the community—that of a Cultural Center and Gardens.

4.5.4 Records and Literature Search Results

In 2002, the USACE (Lydia Lopez-Cruz) conducted a cultural resources records search of the APE and vicinity through the California Historical Resources Information System at the South Central Coastal Information Center (CHRIS-SCCIC) at California State University, Fullerton, to determine if the APE (1) has been surveyed for cultural resources; and (2) contains any recorded cultural resources or historic properties. Ms. Lopez-Cruz reviewed the California Office of Historic Preservation's Historic Resources Inventory, which includes the National Register of Historic Places, California Register of Historical Resources, State Historic Landmarks, and Points of Historic Interest listings.

The records search results indicate that the APE has not been surveyed for cultural resources. In 1997, RMW Paleo Associates, Inc., conducted a cultural resources survey for the pedestrian and bicycle path located within the Atchison Topeka and Santa Fe Railroad right of way immediately adjacent to the APE (Brown 1997). No cultural resources were identified during this survey.

CHRIS-SCCIC records indicated that no recorded cultural resources or historic properties have been recorded within the APE. While no sites have been recorded within the Project area, three prehistoric shell midden sites (CA-ORA-101, -102, and -103) and one isolated piece of basalt flaked stone (30-100074) have been recorded within the Project area vicinity (

Table 4-15).

Table 4-15 Summary of Recorded Archaeological Resources within Project Vicinity

Resource	Description	Location (mi)*	Evaluated for NR?	Reference
CA-ORA-101	Shell midden	1.0 SE	No	Smethe 1954
CA-ORA-102	Shell midden, village site, manos, bowls	1.2 SE	No	Waldeck 1948
CA-ORA-103	Shell midden, hammerstone, manos	1.2 SE	No	Waldeck 1948
30-100074	Basalt denticular flake	1.6 NW	N/A	Maxon 1996

**Distance from San Clemente Municipal Pier*

In addition, the National Register lists two properties located in the Project area vicinity: Casa Romantica and San Clemente Beach Club. These historic properties are described in Table 4-16 below.

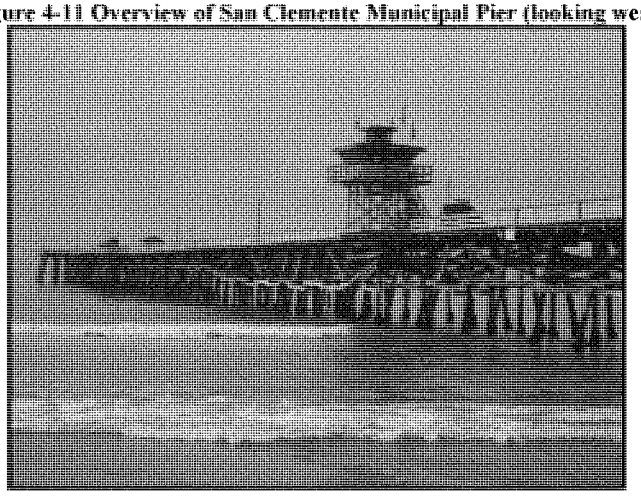
Table 4-16 Summary of National Register Properties within Project Vicinity

Resource	Address	Location (mi)*	Date listed on NR
Casa Romantica	415 Avenida Granada	0.2 N	1991-12-27
San Clemente Beach Club	Avenida Boca De La Playa	0.9 N	1981-04-09

**Distance from San Clemente Municipal Pier*

One locally significant historic resource is located within the Project area: the San Clemente Municipal Pier (Figure 4-11). The City's original pier was designed by engineer William Ayer and constructed by the City of San Clemente in 1928 (HRG 2006). This pier was demolished by storms in 1939. William Ayer designed a new pier which was built in 1940; this pier was severely damaged by storms in 1983. As a result, the pier was substantially reconstructed after this storm event. Therefore, the extant pier structure does not retain much original construction material, but it does retain the same form and appearance of the original 1928 pier. In 2006, the City of San Clemente commissioned a historic resources survey update in order to update its Historic Structures list (HRG 2006). At this time, the San Clemente Municipal Pier was formally recorded and evaluated by Historic Resources Group, Inc (HRG 2006). HRG determined that the Pier was eligible at the local level under criterion A, and it is listed on the City's Historic Structures List. The USACE has determined that Pier is not eligible for listing in the California Register or National Register.

Figure 4-11 Overview of San Clemente Municipal Pier (looking west)



In order to assess the cultural sensitivity of the offshore portions of the APE (i.e., Offshore Borrow Areas 1 and 2), the USACE (Amy M. Holmes) contacted nautical archeologist Heather MacFarlane of MacFarlane Archaeological Consultants in Ventura, California. Ms. MacFarlane consulted her personal database of submerged resource information for the southern California coast and consulted with Mr. Jeff Carothers of FUGRO West, a geosciences and marine survey firm. Areas 1 and 2 have not been surveyed for submerged cultural resources. In 2002, FUGRO West performed a borrow site survey for the USACE between the shore and the eastern edge of Area 1; this survey did not cover Area 1.

Area 1 has low sensitivity for submerged resources, as no known historic shipwrecks are within the boundaries of Area 1. Area 2 is moderately sensitive for submerged cultural resources, as there is a cluster of seven historic shipwrecks within Area 2 or its vicinity (Personal Communication, Heather MacFarlane, January 10, 2008).

4.5.5 Pedestrian Survey Results

On January 3, 2008, the USACE (Amy M. Holmes) conducted a pedestrian survey of the onshore part of the APE. This included an inspection of the beach shoreline and bike path from the San Clemente Metrolink Station south to the T-Street overpass. Ms. Holmes inspected the ground surface for cultural resources. In addition, Ms. Holmes inspected the San Clemente Municipal Pier and the proposed construction staging areas in its vicinity.

Besides the historic San Clemente Municipal Pier, no cultural resources were relocated or identified during the pedestrian survey of the onshore part of the APE. This area has been disturbed by the placement of imported beach sands, the railroad, and the hike and bike path, paved driveways, and other associated infrastructure such as utility lines.

4.5.6 Native American Consultation

On January 7, 2008, the USACE contacted the California Native American Heritage Commission (NAHC) requesting that they perform a search of their Sacred Lands File in order to identify any Native American cultural sites inside or within the vicinity of the APE. The NAHC provided a list of Native American contacts that are affiliated with the San Clemente area. Copies of the public draft of this document were sent to representatives of the Juaneño people named on NAHC's Native American Contact List for review and comment. No comments were received during the comment period.

4.5.7 Section 106 Consultation and Coordination

In accordance with 36 CFR 800.3, the USACE sent an initial letter, the Public Draft EIS/EIR, and will send the Final EIS/EIR to the California State Historic Preservation Officer (SHPO) and Native American Tribes, including the Juaneno Band of Mission Indians, named by the NAHC advising them of this proposed Project and the Corps' determinations.

4.6 Ground and Vessel Transportation

Local streets, roads and railway transport methods will not be used in the proposed Project except for construction crew commuting to and from the Project site. Instead, offshore collection locations of beach replenishment material will be made available via offshore gathering of oceanographic deposition. This will be accomplished utilizing collection barges.

4.6.1 Ground Transportation

4.6.1.1 Major Highways

Interstate 5 (I-5), which is a primary transportation link between Los Angeles and San Diego counties, runs in a north-south direction parallel to the coastline, ranging approximately 0.5 to 1.25 mi (0.8 to 2.01 km) inland from the coast. I-5 is designated a freeway through San Clemente and consists of eight travel lanes. El Camino Real (or U.S. Highway 101) runs parallel to the Pacific Ocean coastline in a north-south orientation ranging approximately 315 ft to 1,600 ft (96 to 483 m) from the coast. El Camino Real is a four-lane roadway designated a secondary roadway.

The principal access route to the San Clemente Pier from I-5 is via local streets, following either West Avenida Palizada or Avenida Presidio to El Camino Real to Avenida Victoria. Other local streets that lead to Avenida Victoria include Avenida Del Mar and Avenida Rosa. Principal access to Linda Lane Park (Park) (approximate northern boundary of Project site) is via West Avenida Palizada or Camino Del Mar to Encino Lane, with parking at the Park. Principal access to T-Street beach (approximate southern boundary of Project site) is via El Camino Real to Trafalgar Lane to Esplanade, with parking on West Paseo de Cristobal. Table 4-17 provides the average daily traffic for local roadways leading to the Project site.

Table 4-17 Average Daily Traffic (ADT) along Local Roadways

	ADT
El Camino Real	
Between Avenida Palizada and Avenida Cabrillo	19,000
Between Avenida Cabrillo and Avenida del Mar	17,000
Between Avenida del Mar and Paseo del Cristobal	15,000
Avenida Palizada	
Between I-5 and Avenida de la Estrella	22,000
Between Avenida de la Estrella and El Camino Real	19,000
Avenida del Mar Between El Camino Real and Ola Vista	6,000
Avenida Victoria Between El Camino Real and Ola Vista	5,000
Ola Vista Between Avenida Palizada and Paseo del Cristobal	3,000

Source: City of San Clemente 2007

4.6.1.2 Rail System

The rail corridor provides a major source of commuter travel for the entire South Pacific portion of southern California. Commuter rail stops at San Clemente Pier include two daily Amtrak trains between late April and October and weekend and holiday service year round, as well as two Metrolink weekend train stops. Presently, rail service safety requires occasional preventative maintenance in the form of monitoring the rail bed for erosion and utilizing riprap to prevent erosion. According to OCTA, it has been necessary to place riprap along the most critical segment between North Beach and the Marine Safety Building to decrease wave erosion impacts. Crews are dispatched during high tide and story conditions to visually inspect the track for damage that could cause derailment. This railroad is a vital transportation link for passenger and freight service. Furthermore, the Department of Defense has designated this right-of-way as a Strategic Rail Corridor with great significance to National Defense. Continued erosion along the San Clemente shoreline would lead to further disruption of rail service, National Security issues, and transportation delays.

4.6.2 Vessel Transportation

Commercial boats, fishing boats, and recreational vessels currently traverse the overall Project area between the coasts of Orange and San Diego counties. Most vessels operate out of Dana Point Harbor, approximately 5.5 mi (8.9 km) upcoast of the Project site, and Oceanside Harbor, approximately 20 mi (32 km) downcoast of the Project site.

4.7 Land Use and Policy

4.7.1 Land Use

The City of San Clemente, including the unincorporated area, is comprised primarily of residential, industrial, commercial, agricultural, and vacant properties. The proposed site is along the coast and within the "Pier Bowl" district of San Clemente. The Pier Bowl is a

pedestrian-oriented, mixed-use center accommodating uses that support coastal recreational activities, including retail, restaurant, office, cultural, hotel/motel, bed and breakfast establishments, and residential.

The Pacific Ocean bounds the site to the west. The beach and Pier are public parks and publicly owned open space (OS1). No physical features exist that divide the existing land use along the San Clemente beaches. North and inland of the Pier, the proposed site is bordered by the Metrolink Station and parking lot, coastal related retail (CRC1-p-A), mixed-use including overnight accommodations (MU 4-3-p-A), mixed use including neighborhood and community serving commercial (MU 4-2-p-A), and public areas. South and inland of the Pier, the proposed site is bordered by public areas, mixed use including neighborhood and community serving commercial (MU 4-1-p-A), and coastal related retail (CRC1-p-A).

4.7.2 Policy

This section identifies the local land use policies, in particular the policies of the California Coastal Act (CCA), along with the adopted environmental plans and goals of the City of San Clemente in accordance with CEQA Guidelines 15125(b).

4.7.2.1 California Coastal Act

CCA Policy 30251: Scenic and visual qualities.
The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas.

CCA Section 30230: Marine resources; maintenance.

> Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.

CCA Section 30231 Biological productivity; water quality.
The biological productivity and the quality of coastal water, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface water flow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.

CCA Section 30240: Environmentally sensitive habitat areas; adjacent developments.

(a) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas.

(b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas. Coastal Plan Policy 9-1:

> Prior to the issuance of a development permit, all projects on parcels shown on the land use plan and/or resource maps with a Habitat Area overlay designation or within 250 ft of such designation or projects affecting an environmentally sensitive habitat area [ESHA] shall be found to be in conformity with the applicable habitat protection policies of the land use plan. All development plans, grading plans, etc., shall show the precise location of the habitat(s) potentially affected by the proposed project. Projects which could adversely impact an environmentally sensitive habitat may be subject to a site inspection by a qualified biologist to be selected jointly by the County and the applicant.

CCA Section 30235: Construction altering natural shoreline.

Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply. Existing marine structures causing water stagnation contributing to pollution problems and fish kills should be phased out or upgraded where feasible.

CCA Section 30607.7: Coastal development permit for sand replenishment requirements.

(a) A coastal development permit for sand replenishment requires the project applicant to provide onsite monitoring and supervision during the implementation of the permit.

A permit subject to subdivision a) may not be issued until the project applicant provides the issuing agency a plan for onsite monitoring and supervision during the implementation of the permit.

CCA Section 30244: Where development would adversely impact archaeological or paleontological resources as identified by the State Historic Preservation Officer, reasonable mitigation measures shall be required.

CCA Section 30210: Development not to interfere with access.

In carrying out the requirement of Section 4 of Article X of the California Constitution, maximum access, which shall be conspicuously posted, and recreational opportunities shall be provided for the people consistent with public safety needs and the need to protect public rights, rights of property owners, and natural resource areas from overuse.

CCA Section 30214: Implementation of public access policies; legislative intent.
The public access policies of this article shall be implemented in a manner that takes into account the need to regulate the time, place, and manner of public access depending on the facts and circumstances of each case including, but not limited to, the following: "...(2) The capacity of the site to sustain use and at what level of intensity, (3) The appropriateness of limiting public access to the right to pass and repass depending on such factors as the fragility of the natural resources in the area..."

CCA Section 30220: Protection of certain water-oriented activities.
Coastal areas suited for water-oriented recreational activities that cannot readily be provided at inland water areas shall be protected for such uses.

CCA Section 30221: Oceanfront land; protection for recreational use and development.
Oceanfront land suitable for recreational use shall be protected for recreational use and development unless present and foreseeable future demand for public or commercial recreational activities that could be accommodated on the property is already adequately provided for in the area.

CCA Section 30233: Diking, filling or dredging; continued movement of sediments and nutrients.
(a) The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible, less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects, and shall be limited to the following...
    (1) incidental public services (e.g., burying cables and pipes);
    (2) mineral extraction, including sand for restoring beaches, except in environmentally sensitive areas;
    (3) restoration purposes;
(b) Dredging and spoils disposal shall be planned and carried out to avoid significant disruption to marine and wildlife habitats and water circulation. Dredge spoils suitable for beach replenishment should be transported for such purposes to appropriate beaches or into suitable longshore current systems.

4.7.2.2 Coastal Element of San Clemente General Plan

302.V.1: Designate lands for the provision of recreational open spaces on the Coastal Land Use Plan Map which are sufficient to meet the needs of existing and future residents (GP Policy 1.9.1).

302.V.2 Designate lands for the provision of passive and visual open space on the Coastal Land Use Plan Map, which provide a balance to the urban and suburban development of the City (GP Policy 1.9.2).

302.V.3: Designate lands for the protection of significant environmental resources and protection of life and property from environmental hazards on the Coastal Land Use Plan Map (GP Policy 1.9.3).

302.V.4: Provide for the development of additional open spaces for recreational purposes in accordance with the Parks and Recreation Element and Master Plan of Parks and Recreation (GP Policy 1.9.10).

302.VII.3: The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed:

a. To protect public views to and along the ocean and scenic coastal area.

b. To minimize the alteration of coastal bluffs and canyons.

c. Where feasible, to restore and enhance visual quality in visually degraded areas (PRC 3025 1).

d. Require that projects be designed and developed to achieve a high level of quality, distinctive character, and compatibility with existing uses and development in accordance with this Element and the Urban Design Element (GP Policy 1.3.6).

302.VII.6: Where development would adversely impact archaeological or paleontological resources, as identified by the State Historic Preservation Officer, reasonable mitigation measures shall be required (PRC 30244).

302.VII.10: Require a Biological Assessment Report for any development located along a coastal canyon or bluff when the development results in the removal of any native vegetation and when an Initial Study has determined that there is a potential for a significant adverse impact to biological resources. The Biological Assessment Report shall:

a. Be prepared by a qualified professional and addresses the proposed project's impact on State and Federally listed and candidate plants and animals; California Department of Fish and Game (CDFG) Special Animals; natural communities of high inventory priority with the CDFG's Nongame Heritage Program, and any other special interest species or communities identified in the General Plan Technical Background Report, or those hereafter named by State or Federal trustee agencies;

b. Identify mitigation measures necessary to eliminate significant adverse impacts to sensitive biological resources; and

c. Define a program for monitoring and evaluating the effectiveness of the specified mitigation measures (GP Policy 10.1.3).

303.IX.1: Improvements to beach facilities and beach access points which are administered by the City of San Clemente shall specifically be intended to provide for the maintenance and enhancement of maximum public use of the beach and ocean.

303.IX.4: The maintenance and enhancement of public non-vehicular access to the shoreline shall be of primary importance when evaluating any future public or private improvements in the Coastal Zone.

303.IX.5: The City's five primary beach access points are:

- San Clemente Beach Club
- Linda Lane
- Municipal Pier
- T-Street
- Avenida Calafia (San Clemente State Beach)

303.IX.6: Develop a comprehensive network of improved beach access facilities at all designated primary beach access points which will ultimately provide safe access to all City owned beaches (GP Policy 8.10).

303.IX.7: The City of San Clemente shall promote not only increased access to the shoreline, but increased safety of access. Improved access for the handicapped shall be provided at least one of the primary access points administered by the City.

303.IX.14: Public access from the nearest public roadway to the shoreline and along the coast shall be provided in new development projects except where:

a. It is inconsistent with public safety, military security needs or the protection of fragile coastal resources;

b. Adequate access exists nearby; or

c. Agriculture would be adversely affected.

303.IX.16: For purposes of this section, "new development" does not include: d. Any repair or maintenance activity for which the Coastal Commission has determined, pursuant to Section 30601, that a coastal development permit will be required unless the Commission determines that such activity will have an adverse impact on lateral public access along the beach.

304.XI.1: Coastal areas suited for water oriented recreational activities, including surfing, body boarding, body surfing and other activities that can not readily be provided at inland water areas shall be protected for such uses (PRC 30220).

304.XI.3: Designate lands for the provision of recreational open spaces on the Coastal Land Use Plan Map which are sufficient to meet the needs of existing and future residents (GP Policy 1.9.1).

304.XI.4: Protect the City's recreational resources including the recreational facilities, parks, surfing areas, and community events identified in section 207 of this plan.

304.XI.5: Provide for the acquisition and development of parks and recreational lands and facilities in accordance with the Growth Management Element (I 1.1, I 1.2, I 1.6, and I 1.7).

304.XI.6: Expand and continue existing public and private cultural and fine art facilities and activities (GP Policy 7.12).

304.XI.9: Increase the community's involvement in the use of recreational spaces encouraging recreational opportunities unique to San Clemente which will contribute to continuing visitation and economic development (GP Policy 8.1).

304.XI.10: Maintain the valuable beach resources as a fundamental element to conserve and develop sensitively, thus enhancing the quality and livability of the City of San Clemente (GP Policy 8.7).

304.XI.11: Locate and enhance the beach areas that will accept limited recreational development without destroying existing natural beauty (GP Policy 8.7.2).

304.XI.13: Emphasize the protection, enhancement, and sensitive development of park and open space areas which possess great scenic, environmental, historic, and cultural values.

305.XII.5: Preserve the aesthetic resources of the City, including coastal bluffs, visually significant ridgelines, and coastal canyons, and significant public views (GP Policy 10.2).

305.XII.8: Work in conjunction with the California Coastal Commission with the expressed intent to develop implementation programs that will preserve and maintain the physical features of the Coastal Zone including bluffs, canyons and beaches (GP Policy 10.2.5).

305.XI1.9: Promote the preservation of significant public view corridors to the ocean (GP Policy 10.2.7).

306.XIV.1: Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific and educational purposes (PRC *30230).*

306.XIV.2: The biological productivity and the quality of coastal waters,...appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of wastewater discharges and entrainment, controlling runoff, preventing; depletion of ground water supplies and substantial interference with surface waterflow and encouraging wastewater reclamation (PRC *3023* 1).

306.XIV.3: The diking, filling or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of the California Coastal Act and the City of San Clemente Coastal Element, where feasible mitigation measures have been provided to minimize adverse environmental effects, and shall be limited to the following:

- In open coastal waters, for new or expanded boating facilities and/or placement of structural pilings for public recreational piers that provide public access and public recreational opportunities.
- Incidental public service purposes, including, but not limited to, burying cables and pipes or inspection of piers and maintenance of existing intake and outfall lines.
- Mineral extraction on City beaches shall be prohibited except for sand used for restorative purposes.
- Restoration purposes.
- Nature study, aquaculture, or similar resource dependent activities.

Dredging and soils disposal shall be planned and carried out to avoid significant disruption to marine and wildlife habitats and water circulation. Dredge soils suitable for beach replenishment should be transported for such purposes to appropriate beaches or into suitable longshore current systems. Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal dependent uses or protect existing structures or public beaches in danger from erosion and when designed to eliminate or mitigate adverse impact on local shoreline sand supply. Existing marine structures causing water stagnation contributing to pollution problems and fish kills should be phased out or upgraded, where feasible (PRC 30235).

306.XIV.4: Provide a clean and enjoyable marine environment that sufficiently meets the needs of beach users (GP Policy 7.7).

306.XIV.5: Maintain and enhance the City's beaches and marine resources (GP Policy 7.8).

306.XIV.6: Provide adequate marine safety and medical aid services (GP Policy 7.6).

306.XIV.7: Continue monitoring sand movement, researching the impacts of coastal erosion and methods of mitigating further coastal damage to San Clemente's beaches environment (GP Policy 7.8.1).

306:XIV.8: Maintain a healthy coastline, preventing degradation of the community's visual and environmental resources (GP Policy 7.9).

306.XIV.10: Continue to support the creation of a wildlife sanctuary for various habitats along the coast to preserve and protect the natural beach environment (GP Policy 7.9.2).

306.XIV.11: Permit extraction of significant mineral resources, such as borrow material, which may be used for beach replenishment, as an interim use prior to development (GP Policy 10.7).

306.XIV.12: Despite the fact that much of the responsibility for protection of water resources lies with regional and State agencies, there are several measures the City can take to help further protect coastal waters. These include the following:

h. The construction of revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls and other protective devices are discouraged and shall be permitted only when such construction is required to serve coastal dependent uses or to protect existing structures or public beaches in danger from erosion. In no way shall such structures prohibit or impact coastal access, beaches or coastal recreational areas.

307.XV.1 Encourage activities which improve the natural biological value, integrity and corridor function of the coastal canyons through vegetation restoration, control of alien plants and animals, and landscape buffering (GP Policy 10.1.9).

307.XV.2: Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on such resources shall be allowed within such areas. "Environmentally sensitive area" means any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments (PRC 30240(a)).

307.XV.3: Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade such areas, and shall be compatible with the continuance of such habitat areas (PRC 30240(b)).

307.XV.4: Designate lands for the protection of significant environmental resources and protection of life and property from environmental hazards on the Coastal Land Use Plan Map (GP Policy 1.9.3).

307.XV.6: Require that applications for development in the areas which an Initial Study has determined there is potential for significant adverse impacts to biological resources [therefore requiring an Environmental Impact Report (EIR) or Mitigated Negative Declaration (MND)] shall include a Biological Assessment Report which:

a. Is prepared by a qualified professional which addresses the proposed project's impact on State and Federally listed and candidate plants and animals; California Department of Fish and Game (CDFG) Special Animals; natural communities of high inventory priority with the CDFG's Nongame Heritage Program, and any other special interest species or communities identified in the General Plan Technical Background Report, or those hereafter named by State or Federal trustee agencies;

b. Identifies mitigation measures necessary to eliminate significant adverse impacts to sensitive biological resources; and

c. Defines a program for monitoring and evaluating the effectiveness of the specified mitigation measures (I 10.2, I 10.3, and I 10.9).

307.XV.7: Review of all projects within the Coastal Zone shall include an assessment of the potential impact on natural habitat areas.

307.XV.8: The City shall pursue grants and other funding sources to perform a biological study of the designated natural habitat areas in the Coastal Zone.

307.XV.10: The analysis and evaluation of large-scale development projects shall include a comprehensive inventory of biologic resources prepared by a qualified biologist. A determination should be made of the area's importance as a native habitat, including identification of rare and endangered species.

307.XV.15: Identify the key beach areas which are important to protect through land use regulation because of their inherent environmental, ecological, and/or aesthetic contributions.

307.XV.16: Maintain the presence of parklands and open space in the Coastal Zone in order to conserve and enhance the natural environment thereby improving the quality and livability of the City of San Clemente.

307.XV.17: Identify those major areas of the City which are important to protect through land use regulation or public ownership because of their inherent environmental, ecological, and/or aesthetic contribution to the scenic and natural qualities of San Clemente.

307.XV.18: Operate and maintain San Clemente Park and Recreation facilities through programs that are designed for the most effective use and enhancement of the park site at the minimum possible cost.

4.7.2.3 San Clemente General Plan

GP 1.7.1: Designate lands for the development of coastal related commercial, recreational, lodging, and supporting uses on the Land Use Plan Map and establish standards to ensure their compatibility with adjacent residential neighborhoods and commercial districts *(I 1.1, I 1.3, and I 1.5)*.

GP 1.7.3: Allow for the continued use of the City's public beaches for coastal recreational uses *(I 1.1 and I 1.3)*

GP 1.9.3: Designate lands for the protection of significant environmental resources and protection of life and property from environmental hazards on the Land Use Plan Map *(I 1.1, I 1.3, and I 1.5)*.

GP 1.9.4: Accommodate active parklands, beaches, or other open space uses in areas designated as "OS 1" (encompasses publicly owned properties) in accordance with the standards stipulated in Table 1-3 of the General Plan *(I 1.1, I 1.2, I 1.3, I 1.5, and I 1.6)*.

GP 1.14.8: Accommodate the development of public recreational uses *(I 1.1, I 1.5, and I 1.8)*.

GP 4.3.1: Maintain a city-wide level of service (LOS) not exceeding LOS "D" for intersections during the peak hours, with the exception of the intersection of the I-5 southbound ramps at Avenida Pico, unless the City determines an exception is warranted on an interim basis in

accordance with the adopted "exception process" specified in the Growth Management Element (I 4.2).

GP 4.3.2: Maintain a city-wide level of service (LOS) for links not to exceed LOS "C" for Primary arterials, Secondary arterials and Local streets; not to exceed LOS "D" for Major arterials; and not to exceed LOS "E" for Commercial facilities (I 4.2).

GP 6.1.1: Require that new development does not degrade surface or groundwater (*I 6.1, I 6.3, I 6.4 and I 6.5*).

GP 7.8.1: Continue monitoring sand movement, researching the impacts of coastal erosion and methods of mitigating further coastal damage to San Clemente's beaches environment (*I 7.18*).

GP 7.9.2: Continue to support the creation of a wildlife sanctuary for various habitats along the coast to preserve and protect the natural beach environment (*I 7.21*).

GP 8.7.1: Identify the key beach areas which are important to protect through land use regulation because of their inherent environmental, ecological and/or aesthetic contributions (*I 8.16, I 8.17 and I 8.35*).

GP 8.7.2: Locate and enhance the beach areas that will accept limited recreational development without destroying existing natural beauty (*I 8.21*).

GP 8.7.3: Enhance the Pier and North Beach area to function as the "hubs" of San Clemente beach facilities (*I 8.21*).

GP 8.8.1: Identify those major areas of the City that are important to protect through land use regulation or public ownership because of their inherent environmental, ecological and/or aesthetic contribution to the scenic and natural qualities of San Clemente (*I 8.16, I 8.17 and I 8.35*).

GP 8.8.2: Provide cooperative leadership between private interests and other public agencies to protect and enhance both land and water resources (*I 8.22*).

GP 10.1.1: Acquire and maintain the most current information available regarding the status and location of sensitive biological elements (species and natural communities) within the City (*I 10.1*).

GP 10.1.3: Require that applications for development in the UA, and for areas which an Initial Study has determined there is potential for significant adverse impacts to biological resources [therefore requiring an Environmental Impact Report (EIR) or Mitigated Negative Declaration (MND)] shall include a Biological Assessment Report which:

a. Is prepared by a qualified professional which addresses the proposed project's impact on State and Federally listed and candidate plants and animals; California Department of Fish and Game (CDFG) Special Animals; natural communities of high inventory priority with the CDFG's Nongame Heritage Program, and any other special interest species or

communities identified in the General Plan Technical Background Report, or those hereafter named by State or Federal trustee agencies;

b. Identifies mitigation measures necessary to eliminate significant adverse impacts to sensitive biological resources; and

c. Defines a program for monitoring and evaluating the effectiveness of the specified mitigation measures (*I 10.2, I 10.3, and I 10.9*).

GP 10.1.4: Review proposed projects in the UA to evaluate their conformance with the following policies and standards.

a. The development plan shall fully consider the nature of biological resources present, and all reasonable measures shall be taken to avoid significant impacts, including retention of sufficient natural space where appropriate.

b. The development plan shall retain watercourses, riparian habitat, and wetlands in natural condition to the maximum extent feasible.

c. The development shall incorporate habitat linkages (wildlife corridors) to adjacent open spaces, as appropriate.

d. The development shall incorporate fences, walls, or vegetative cover to buffer habitat areas, linkages or corridors from development, as appropriate.

e. Roads and utilities shall be located and designed such that conflicts with biological resources, habitat areas, linkages or corridors are minimized.

f. The development shall utilize appropriate open space or conservation easements when necessary in order to protect sensitive species or their habitats.

g. The development shall mitigate unavoidable adverse impacts to sensitive habitats by replacement on an in-kind basis, i.e.; riparian habitat is to be replaced by riparian habitat of the same type. Furthermore, replacement shall be based on a ratio determined by the California State Fish and Game Department and/or USFWS in order to account for the potentially diminished habitat values of replacement habitat. Such replacement should occur on the original development site whenever possible. Alternatively, replacement can be effected by protection of similar intact habitats elsewhere (off-site but preferably within the City's Sphere of Influence) in perpetuity through acquisition and provision for an appropriate conservation easement or dedication (*I 10.2, I 10.3, and I 10.9*).

GP 10.1.8: Preserve, where possible, the habitat of several in-fact endangered species, including those listed in Table 10-1 (of the General Plan) and those which may be considered by the City in the future (*I 10.2, and I 10.3*).

GP 10.1.10: Continue to support the City's participation and enrollment in the State's Natural Communities Conservation Planning Program (NC.P.) (*I 10.4*).

GP 10.3.3: Continue the implementation of the City's existing ordinance for preservation of designated historic sites and structures. Adopt a Preservation Ordinance that will authorize the City to designate any vegetation or archaeological site deemed to be of historical, archaeological,

or cultural significance a San Clemente City Historical Point, Site or District. Such ordinance shall conform to State and Federal criteria for establishing a preservation ordinance *(I 10.16).*

GP 10.3.7: Require that all City-owned properties designated as historic resources are maintained in a manner that is aesthetically and/or functionally compatible with such resources *(I 10.18 and I 10.19).*

GP 10.9.1: Require that new development utilize appropriate AQMD air quality mitigation measures (SMMs and BAMMs) *(I 10.32).*

GP 13.3.1: Identify tsunami susceptible areas, and require that specific measures be taken by the developer, builder or property owner, as necessary, to prevent or reduce damage from these hazards and the risks upon human safety (*I 13.1 and I 13.4*).

GP 13.3.2: Consider the City's participation in and, receipt of, information from the National Weather Service's Weather Wire System for Local Tsunami Warnings (*I 13.5*).

GP 14.2.1: Require that in areas where existing or future noise levels exceed an Ldn of 60 dB (A) exterior and an Ldn of 45 dB (A) interior, all development of new housing, health care facilities, schools, libraries, religious facilities, and other "noise sensitive" land uses include appropriate buffering and/or construction mitigation measures that will reduce noise exposure to levels within acceptable limits (*I 14.3, I 14.4 and I 14.5*).

GP 14.2.2: Require new industrial, commercial, and related land uses, or the expansion of existing land uses demonstrate that such new or expanded uses would not be directly responsible for causing ambient noise levels to exceed and Ldn of 65 dB (A) exterior upon areas containing housing, schools, health care facilities, or other "noise sensitive" land uses as depicted in the General Plan) (*I 14.4 and I 14.7*).

GP 14.2.3: Require development in all areas where the ambient noise level exceeds an Ldn of 60 dB (A) to conduct an acoustical analysis and incorporate special design and construction measures in their construction, as necessary, to reduce interior noise levels to within the 45 dB (A) Ldn level (*I 14.3*).

GP 14.3.3: Require that any municipal vehicles or noise-generating mechanical equipment purchased or used by the City of San Clemente comply with noise performance standards consistent
with the best available noise reduction technology (*I 14.10*).

GP 14.6.1: Ensure that the prohibitions relative to legal hours of operation for construction activities contained within the existing City of San Clemente Noise Ordinance and/or any future/revised Noise Ordinance be strictly adhered to and enforced (*I 14.15*).

GP 14.6.2: Require that construction activities adjacent to residential land uses and dwelling units be regulated, as necessary, to prevent the generation of adverse and/or excessive noise impacts (*I 14.15*).

GP 14.6.3: Require construction activities to employ feasible and practical techniques and practices which minimize the generation of adverse and/or excessive noise impacts on adjacent land uses (*I 14.15*).

4.7.2.4 Local Coastal Program

GP I 1.3 On adoption of the updated General Plan, it will be necessary to revise the City of San Clemente's Local Coastal Element, LCP (as required by the California Coastal Act) to ensure consistency between the two documents. The LCP Land Use Plan was adopted in 1984 and updated in 1988 and the Local Implementing Ordinance has not been finalized. Land use provisions of the LCP will need to be adjusted to reflect the Land Use Element, including the use of common classification and development standards. Among the policies which will necessitate review of the LCP are those for the Pier Bowl and North Beach which permit some intensification of coastal-related visitor-serving uses. Policies and standards pertaining to open space, biological resource management, and environmental hazards will also require review and potential modification to reflect the Land Use Element and Environmental Resources and Hazards Sections. In concert, it will be necessary to complete the (unfinished) Local Implementing Ordinance. Both documents shall be submitted to the California Coastal Commission for review and certification.

4.8 Noise

The Project beach site is currently beach property. Residential land uses exist approximately 200 ft (60 meters) north-northeast along the majority of the Project length interspersed with minimal amount of commercial property. The beach continues to meander along the shore generally northwest and southeast of the Project site, and the San Clemente Pier and Pacific Ocean are adjacent to the Project site to the west. The Project's borrow pit site is approximately 2,624 ft (800 m) offshore of the coast of Oceanside Harbor. The nearest residential properties are located approximately 4,265 ft (1,300 m) east of the borrow pit location.

4.8.1 Noise Terminology

Noise is defined as unwanted or objectionable sound. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance and, in the extreme, hearing impairment. The unit of measurement used to describe a noise level is the decibel (dB). The human ear is not equally sensitive to all frequencies within the sound spectrum. Therefore, the "A weighted" noise scale, which weights the frequencies to which humans are sensitive, is used for measurements. Noise levels using A weighted measurements are written dB(A) or dBA. Decibels are measured on a logarithmic scale, which quantifies sound intensity in a manner similar to the Richter scale used for earthquake magnitudes. Thus, a doubling of the energy of a noise source, such as doubling a traffic volume, would increase the noise level by 3 dBA; a halving of the energy would result in a 3-dBA decrease. Table 4-18 shows the relationship of various noise levels to commonly experienced noise events.

Table 4-18 Sound Levels of Typical Noise Sources and Noise Environments

Noise Source (at a Given Distance)	Scale of A-Weighted Sound Level in Decibels	Noise Environment	Human Judgment of Noise Loudness (Relative to a Reference Loudness of 70 Decibels*)
Military Jet Take-off with After-burner (50 ft [15m]) Civil Defense Siren (100 ft [30 m])	130	Carrier Flight Deck	
Commercial Jet Take-off (200 ft [61 m])	120	Airport Runway	Threshold of Pain *32 times as loud
Pile Driver (50 ft [15 m])	110	Rock Music Concert	*16 times as loud
Ambulance Siren (100 ft [30 m]) Newspaper Press (5 ft [1.5 m]) Power Lawn Mower (3 ft [0.9 m]) Motorcycle (25 ft [8 m]) Propeller Plane Flyover (1,000 ft [305 m]) Diesel Truck, 40 mph (64 kmph) (50 ft [15 m]) Garbage Disposal (3 ft [0.9 m])	100 90 80	Boiler Room Priuting Press Plant High Urban Ambient Sound	Very Loud *8 times as loud *4 times as loud *2 times as loud
Passenger Car, 65 mph (105 kmph) (25 ft [8 m]) Living Room Stereo (15 ft [5 m]) Vacuum Cleaner (3 ft [0.9 m]) Electronic Typewriter (10 ft [3 m])	70	Busy Shopping Mall Indoor Sports Park	Moderately Loud *70 dB (Reference Loudness)
Normal Conversation (5 ft [1.5 m]) Air Conditioning Unit (100 ft [30 m])	60	Data Processing Center Department Store	*1/2 as loud
Light Traffic (100 ft [30 m])	50	Private Business Office	*1/4 as loud
Bird Calls (distant)	40	Lower Limit of Urban Ambient Sound	Quiet *1/8 as loud
Soft Whisper (5 ft [1.5 m])	30 20 10	Rural Residential Area Quiet Bedroom	Just Audible Threshold of Hearing

Average noise levels over a period of minutes or hours are usually expressed as dB Leq, or the equivalent noise level for that period of time. For example, Leq(3) would represent a three-hour average. When no period is specified, a one-hour average is assumed. Noise standards for land use compatibility, which are addressed in the Hesperia General Plan Noise Element, are stated in terms of the Community Noise Equivalent Level (CNEL), Equivalent Noise Level (LEQ), and the Day-Night Average Noise Level (Ldn). CNEL is a 24-hour weighted average measure of community noise. The computation of CNEL adds 5 dBA to the average hourly noise levels between 7 p.m. and 10 p.m. (evening hours), and 10 dBA to the average hourly noise levels between 10 p.m. and 7:00 a.m. (nighttime hours). This weighting accounts for the increased human sensitivity to noise in the evening and nighttime hours. Ldn is a very similar 24-hour weighted average that weights only the nighttime hours and not the evening hours.

It is widely accepted that the average healthy ear can barely perceive changes of 3 dBA, increases or decreases; that a change of 5 dBA is readily perceptible, and that an increase (decrease) of 10 dBA sounds twice (half) as loud (Caltrans 1998).

4.8.2 Regulatory Setting

The City of San Clemente noise standards are identified in the City's Municipal Code (Ch 8.48 Noise Control). The Municipal Code states that ambient noise levels shall be no greater than the noise levels identified for each land use. Table 4-19 is a re-creation of the City of San Clemente's Noise Standard Table.

Table 4-19 San Clemente Noise Standards

	7:00 A.M. to 10:00 P.M.	10:00 P.M. to 7:00 A.M.
Residential		
Exterior	55 dBA	50 dBA
Interior	50 dBA	40 dBA
Commercial	65 dBA	60 dBA
Industrial	70 dBA	70 dBA

Sensitive Receptors

Also of concern are project-generated impacts to sensitive receptors in the Project area. Sensitive receptors of noise include residences and schools. Noise generated on the proposed beach nourishment property that impacts noise sensitive receptors are subject to the Exterior Noise Standards cited above. Sensitive receptors are activities or land uses that may be subject to the stress of significant interference from noise. Land uses associated with sensitive receptors often include residential dwellings, mobile homes, hospitals, nursing homes, education facilities, and libraries. Existing residential units approximately 190 feet (58 meters) to the north-northeast of the beach restoration site, 2,500 ft (762 m) from the dredge (while traveling between borrow pit and beach site), and 4,200 ft (1,280 m) to the east of the borrow pit area are the closest sensitive receptors in the Project area.

4.9 Recreation

This section presents information on recreational activities and opportunities within the San Clemente Beach area, and summarizes the recreation setting. Residential and open space (including recreation) are the predominant land uses within the study area. The Beaches, Parks and Recreation Department are responsible for citywide maintenance and management of recreational programs and facilities. Its operating divisions include, among others: Marine Safety, Beaches and Parks Maintenance, and Recreation.

4.9.1 Beaches

San Clemente is home to 4.7 miles (7.6 km) of white, sandy beaches that parallel the southwest side of the City. Popular activities for beachgoers are surfing, sunbathing, jogging, skin diving,

swimming, body surfing, picnicking, camping, and hiking along the many trails located on the bluffs overlooking the beach. Because there are no paved paths on the beach, beach wheelchairs are available at the lifeguard station at the Pier. Within a mile of the borrow site are Camp Pendleton and Oceanside Beaches.

4.9.1.1 Linda Lane

Linda Lane Park is the approximate northern boundary of the Project site and is located at the end of Linda Lane. It has beach access through a short tunnel under the railroad tracks, a children's play area, a grassy area, an ocean view, and picnic tables, but no restrooms. Linda Lane has a metered parking area available between 9 a.m. and 7 p.m.

4.9.1.2 San Clemente Beach and Pier

The San Clemente City Beach and Fishing Pier (Pier Bowl) is accessible through a tunnel under the railroad tracks from the large public parking lot at the bottom of Avenida Del Mar. Surfing is more popular on the immediate north side of the Pier than the south. However, immediately south of the Pier is popular with swimmers and bodyboarders. T-Street, further south of the Pier, is a more popular surfing location within the Project area. The beach near the Pier provides lifeguards, bus stop, food stands, picnic tables, rentals, showers, basketball courts, volleyball, firepits, and easy access to the Amtrak station platform and shopping. The beach at the Pier Bowl has a parking lot with free parking available between 5 p.m. and 10 a.m. and paid parking between 10 a.m. and 5 p.m., as well as parking meters from 9 a.m. to 7 p.m. Parking on residential streets also is available for beachgoers.

San Clemente Pier is an approximately 1,296 ft (395 m) long pier with fantastic views of the Pacific Ocean. The Pier was built by Ole Hanson in 1928. In 1939, and again in 1983, strong storms damaged the Pier, which required it to be rebuilt in both instances. The Pier offers free fishing, has indoor/outdoor restaurant dining, restrooms, a bait and tackle shop, fish cleaning sinks, and is a great location to watch sports activities, such as surfing competitions. Anglers fishing from the Pier have caught small sharks, halibut, sand bass, sculpin, barracuda, and small yellowtail. Parque del Mar is located across the railroad tracks from the Pier at Avenida del Mar and Alameda Lane and provides easy beach access, walking/jogging opportunities, a grassy area, an ocean view, and picnic area/tables/benches.

4.9.1.3 T-Street

T-Street is the approximate southern boundary of the Project site and is located at the end of Esplanade following Trafalgar Lane. Access to the beach is by an overpass to the train tracks and a flight of stairs. A large sand bar makes the water shallow and the beach popular for most beachgoers. This beach also provides a snack bar, restrooms, lifeguard tower, and easy access to shopping. T-Street has a metered parking area available between 9 a.m. and 7 p.m.

4.9.2 Annual Events

San Clemente hosts many yearly events. The San Clemente Ocean Festival is held annually in July. It includes activities and events, such as waterman and waterwoman competitions, surfing contests, a sand castle building competition, and fishing. The Festival also includes a woody car exhibit, art show, and a free concert. Another annual event is the Fourth of July fireworks show located at the San Clemente Pier. Finally, San Clemente hosts a Seafest every October. The Seafest features a chowder cook-off with the whole community competing for the best chowder, as well as a surf contest, business expo, and arts & crafts show. Oceanside Harbor Days are held annually at the end of September/beginning of October.

4.9.3 Beaches, Parks and Recreation Department

4.9.3.1 Marine Safety

The Marine Safety Division is responsible for the lifeguard operation on the City's 20 acres (8 hectares) of sand beach. In addition, the division manages seven snack bars, restaurants (including the Fisherman's Restaurant), bait and tackle shops, and pier telescope concession operations. This division provides ocean rescue, first aid, law enforcement and various public education programs including a junior lifeguard and instructional surfing. Other duties include monitoring related environmental issues such as offshore oil and coastal erosion and water quality monitoring on an ongoing basis. The division also assists in planning related capital improvement projects. The Marine Safety Division also manages beach-related special events.

4.9.3.2 Beach and Park Maintenance

The Beaches and Parks Maintenance Division promotes, provides and facilitates park and recreational services. The department is responsible for the maintenance of the City's 20 acres (8 hectares) of beach, which is the primary attribute within the Project area. The department is also responsible for other recreational type facilities, including 147.77 acres (59.8 hectares) at 25 parks and beach accesses, trees located in parks and on the beaches, and the San Clemente Pier.

4.10 Aesthetics

The views to the west of the entire Project site are of the Pacific Ocean. Nearly the entire Project site is lined with palm trees beachside of the railroad tracks. At the northern portion of the Project site, the Project site is viewable from adjacent beach areas, residential areas located atop the bluffs adjacent to the beach, visitors at Linda Lane Park, and the Pier. At the center of the Project site, the Project site is viewable from the Pier, from commercial businesses, located both on the Pier and east of the railroad tracks, residences, and visitors at Parque del Mar and Linda Lane Park. At the southern end of the Project site, the Project site is viewable from adjacent beach areas, the parking meters at West Paseo de Cristobal, pedestrians on the overpass, residential areas located atop the bluffs adjacent to the beach, and the Pier. In addition, the entire Project site is visible to nearshore and offshore recreational users, as well as to passengers on passing trains.

The California Coastal Act includes the protection of the scenic and visual qualities of coastal areas, including the protection of views to and along the ocean, minimization of the alteration of natural landforms, and necessary actions to restore and enhance visual quality in visually degraded areas. The Project is consistent with Policy 10.2.5 of the City of San Clemente General Plan Natural and Historic/Cultural Resources Element, which promotes development of programs "that will preserve and maintain the physical features of the coastal zone including bluffs, canyons, and beaches."

4.11 Public Health and Safety

For purposes of this EIS/EIR, public health and safety issues are defined as those that directly affect the continued ability to protect and preserve life and property at locations along the proposed Project site. Specifically, these issues are lifeguard services, recreational safety, and vessel safety. Sediment and chemical comparisons of dredged material and the Project site have been completed and there would be no risk to health or safety. This issue is not addressed further.

The lifeguards are responsible for all recreational safety measures along the beach. Safety measures include manned lifeguard towers and regular vehicle patrols during the summer months. The Marine Safety Division is normally staffed from 8:00 am until dusk (changes seasonally). The main lifeguard tower on the Pier is normally manned by 8:20 each morning, with lifeguard towers on the beach staffed as needed during the off-season. Lifeguard towers are typically more heavily staffed on weekends during summer months. Normal summer staffing for the Project site is listed below. Lifeguard towers between those listed below open later and close earlier, depending upon crowd conditions.

Tower 4 (Linda Lane) – 10 a.m. until 6 p.m.

Tower 1 (South side of Pier) – 10 a.m. until 6 p.m.

Tower 5 (T-Street) – 9 a.m. until 7 p.m.

4.12 Socioeconomics/Environmental Justice

4.12.1 Local Socioeconomic Conditions

Socioeconomic data for the City of San Clemente are sourced from the City of San Clemente Housing Element of the General Plan, last updated in June 2002. San Clemente is the southern-most city in Orange County. Its coastal setting, Mediterranean climate, and rolling hills provide a unique and attractive living environment. This resort setting affects the City's employment characteristics and economic base.

San Clemente has been one of the fastest growing cities in Orange County (County) since 1980. This growth peaked by 1985 and 1990 with a 6.7 percent annual growth rate compared to

1.7 percent for the rest of the County, and although growth slowed following this period, San Clemente's average annual growth rate has been slightly higher than the County's growth rate to the present. Since 1980, the City's population nearly doubled from 27,322 persons to 50,032 persons in 2000.

Housing development grew proportionately with this fast pace of growth. The City's housing stock grew from 13,233 units in 1980 to 20,872 units in 2000, with the largest increase in housing growth occurring between 1985 and 1990. Based on the Department of Housing and Urban Development (HUD) Income Categories for Orange County in 2000, 54 percent of San Clemente households ranged in the very low ($34,800) to moderate (up to $83,500) income categories. Based on the 1990 Census, the ratio of owner to renter in San Clemente was 59 percent to 41 percent. Households consisted of 66 percent families, 24 percent single persons, and 10 percent other. The race/ethnicity ratio of San Clemente residents based on the 1990 Census was 84 percent Caucasian, 12 percent Hispanic, 6 percent Black, 3 percent Asian, and 4 percent Other.

San Clemente is located within relatively easy commuting distances from employment centers in Los Angeles and Orange counties, as well as fast-growing northern San Diego County and Camp Pendleton. Based on the 1990 Census, 68 percent of San Clemente residents were employed in either managerial/professional, technical, sales, or administrative occupations. In contrast, the labor market within San Clemente in 1996 was predominantly retail (24 percent) or services (30 percent). Due to the higher wages offered in nearby areas and the relatively low cost of living in San Clemente, the City hosts a large number of commuters. However, a need for lower-wage labor in the commercial and service centers continues to increase in San Clemente, especially in relation to the tourism industry.

In a study by King and Symes (2003), nine California beaches were evaluated based on their economic impact on California. King and Symes (2003) suggest that the California economy would suffer a net loss of billions of dollars if California beaches were to decline to the point where tourism was significantly affected. Beach visitors help create employment at the beach and other facilities used by visitors. Given the importance of tourism in California, tens of millions of visits and billions of dollars per year depend on beaches (King and Symes 2003).

4.12.2 Onsite Socioeconomic Conditions

The Project area is located along the San Clemente shoreline, which is characterized by narrow, linear sandy beach, backed by high coastal bluffs. Thus, development within the confines of the Project area boundaries is generally limited.

Several commercial structures are located along the shoreline and within the Project area. The focal point of the beach is a 1,312 ft (400m) fishing pier, which houses a bait-and-tackle shop and a full-service restaurant. Semi-permanent rental shops, which offer umbrellas, surfboards, body boards, and other beach accessories, are also located along the beach. Several fast-food restaurants are located at T-Street Beach. These commercial uses provide employment opportunities, mostly in the relatively low-paying retail and service sectors. Most of these commercial uses are directly related to the tourist trade associated with beach visitors.

Public facilities within the Project area are operated and maintained by the City of San Clemente and the Orange County Department of Harbors, Beaches, and Parks. These facilities include the Marine Safety Building, public restroom facilities, lifeguard stations, parking areas, and paving near the Pier. These facilities also provide employment opportunities similar to the commercial uses and directly related to beach visitors.

Surfing as well as camping, picnicking, and other dispersed recreation are a large recreational economic base to the local and, in particular, to the City of San Clemente economies. Surfing is a major component of San Clemente's recreational base. Surfing has been recorded at the north side and south side of San Clemente Pier, including T-Street since the early 1960s.

5.0 ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTION AND ALTERNATIVES

5.1 Air Quality and Meteorology

5.1.1 Significance Criteria

Projected air emissions are prepared in accordance with the methodologies provided by the South Coast Air Quality Management District (SCAQMD) as included in its *CEQA Air Quality Handbook, April 1993* (*Handbook*) as well as its Internet updates included on its web site. For the purposes of this analysis, construction is estimated to occur in 2012 with the 50 ft (15 m) Beach Width Alternative taking approximately 46 working days and the 115 ft (35 m) Beach Width Alternative taking 108 working days. This analysis also considered the on-going, daily operations of the railroad.

Thresholds of significance for individual projects used the SCAQMD *Handbook* as well as updates included on the SCAQMD Internet Web site. The *Handbook* recommends assessing emissions of reactive organic compounds (ROG) as an indicator of ozone. For ease of the reader, the included analysis follows the outline of the CEQA Checklist.

The San Diego Air Pollution Control District does not provide quantitative thresholds for determining the significance of construction or mobile source-related impacts. However, the District specifies Air Quality Impact Analysis (AQIA) trigger levels for new or modified stationary sources. If these incremental levels for stationary sources are exceeded, an AQIA must be performed for the proposed new or modified source. Although these trigger levels do not generally apply to mobile sources or general land development projects, for comparative purposes San Diego County has established AQIAs as screening-level thresholds (SLTs). The County has stated that the SLTs may used to evaluate the increased emissions which would be discharged to the SDAB from proposed land development projects.

The information on San Diego's thresholds are presented for informational purposes since all on-shore emissions are located in the SCAB and off-shore sources are not under the jurisdiction of the local air district's, therefore not subject to thresholds.

5.1.1.3 Regional Thresholds of Significance

The following significance thresholds (Table 5-1) for air quality have been established by the SCAQMD on a daily basis for construction and operations emissions and Table 5-I also shows the SLTs for San Diego County:

Table 5-1 Thresholds of Significance

	SCAG Regional		SDAG Screening Level		
Pollutant	Construction Emissions (lbs/day)	Operations Emissions (lbs/day)	Total Emissions (lbs/hr)	Total Emissions lbs/day	Total Emissions tons/year
ROG	75	55			
NOx	100	55	25	250	40
CO	550	550	100	550	100
PM10	150	150	----	100	15
PM2.5	55	55	----	55	10
SOx	150	150	25	250	40
Lead and lead compounds	NA	NA	----	3.2	0.6
VOC	NA	NA	----	75	13.7

During construction or operation, if any of the identified daily SCAG air pollutant thresholds are exceeded by the proposed Project, then the project's air quality impacts may be considered significant. The SCAQMD indicates in Chapter 6 of its *Handbook* that it considers a project to be mitigated to a level of insignificance if its primary effects are mitigated below the thresholds provided above.

In the SDAG, in the event that project emissions exceed the SLTs, specific modeling will be required for NO_2, SO_2, CO, and lead to demonstrate that the project's ground-level concentrations, including appropriate background levels, do not exceed the NAAQS and CAAQS. For ozone precursors, PM_{10} and $PM_{2.5}$, exceedances of the SLTs results in a significant impact.

5.1.1.4 Localized Thresholds of Significance (LST)

In addition to the mass daily threshold values presented above, the SCAQMD has established the following threshold criteria to determine if a project has the potential to contribute to an exceedance of the State Ambient Air Quality Standards as included in Table 4-2.

- California State 1-hour CO standard of 20.0 ppm
- California State 8-hour CO standard of 9.0 ppm
- California State 1-hour NO_2 standard of 0.25 ppm
- SCAQMD 24-hour construction PM_{10} LST of 10.4 $\mu g/m^3$
- SCAQMD 24-hour construction $PM_{2.5}$ LST of 10.4 $\mu g/m^3$
- SCAQMD 24-hour operational PM_{10} LST of 2.5 $\mu g/m^3$
- SCAQMD 24-hour operational $PM_{2.5}$ LST of 2.5 $\mu g/m^3$

The significance of localized emissions impacts depends on whether ambient levels in the vicinity of the project are above or below State standards. In the case of CO and NO_2, if ambient levels are below the standards, a project is considered to have a significant impact if project emissions result in an exceedance of one or more of these standards. If ambient levels already exceed a State or federal standard, then project emissions are considered significant if they increase ambient concentrations by a measurable amount. This would apply to both PM_{10} and $PM_{2.5}$; both of which are non-attainment pollutants. In these cases, local emissions are considered significant if they exceed 10.4 $\mu g/m^3$ during construction or 2.5 $\mu g/m^3$ during the subsequent operation of the site, both as measured at the proximate sensitive receptor locations.

5.1.1.5 Additional Indicators

The SCAQMD recommends that "additional indicators" should be used as screening criteria with respect to air quality. Additional factors relevant to the Project at hand identified in the *Handbook* include the following significance criteria:

- Interference with the attainment of the federal or State ambient air quality standards by either violating or contributing to an existing or projected air quality violation.
- Emit carcinogenic or toxic contaminants that exceed the maximum individual cancer risk of 10 in one million.

Again, the SCAQMD indicates in Chapter 6 of its *Handbook* that it considers a project to be mitigated to a level of insignificance if its effects are mitigated below the thresholds provided above.

5.1.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact AQ-50-1: *Conflict with or obstruct implementation of the applicable air quality plan*

The Project action represents the placement of sand on the beach. The Project would not result in significant localized air quality impacts at the proximate receptor locations and would implement those measures included in the AQMP considered as feasible and, as such, the Project is consistent with the goals of the AQMP and does not present a significant impact.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact AQ-50-2: *Violate any air quality standard or contribute substantially to an existing or projected air quality violation*

Air quality impacts may occur during site preparation, grading, and sporadic maintenance activities required for implementation of the proposed land use. Maintenance could take place once every 6 years depending on need and financial ability. Maintenance would result in a repetition of the initial construction activities. The Project involves approximately 4 ac of

resultant dry beach nourishment for the 50 ft Beach Width Alternative. There are no building construction or paving activities associated with this Project. Construction would occur over approximately 46 working days over a four month period. Values used for analysis are included in Appendix C.

Localized Construction Impacts

In addition to the mass Project and daily regional thresholds, Project construction has the potential to raise local ambient pollutant concentrations, which are existing pollutant concentrations within the Project area, not including the construction activities of the Project (e.g., exhaust from regular traffic to/from the beach, along the highways, etc). This could present a significant impact if these concentrations were to exceed the allowable emissions as a function of receptor distance from the site boundary.

The analysis makes use of methodology included in the SCAQMD *Final Localized Significance Threshold Methodology* (*Methodology*). In accordance with the *Methodology*, analysis is only to include exhaust and dust emissions associated with those pieces of equipment that actually operate onsite and omits vehicle trips that are distributed over a large area. In the *Methodology*, the SCAQMD notes receptor locations as "offsite locations where persons may be exposed to the emissions from project activities. Receptor locations include residential, commercial, and industrial land use areas; and any other areas where persons can be situated for an hour or longer at a time."

In accordance with the *Methodology*, receptor locations are to consider the actual location of the receptors. If these locations are unknown, or varied, they may be assumed to be located at distances of 82, 164, 328, 656, and 1,640 feet (25, 50, 100, 200, and 500 m). In cases where proximate receptors may be closer than 82 ft (25 m), as per the *Methodology*, a value of 82 ft (25 m) is to be used in the analysis as a worst-case scenario. Because the closest receptor to the Project area is approximately 180 ft (55 m) away, the recommended SCAQMD default distance is used for this analysis comparison.

In the cases of CO and NO_2, the projected concentration is then added to an assumed ambient concentration in order to determine if the CAAQS would be exceeded. This ambient concentration is source-area dependant and is based on the peak value observed over the last three years of accumulated data at the nearest air monitoring station (previously provided in Table 4.1). Because PM_{10} and $PM_{2.5}$ are non-attainment pollutants, no ambient concentration is added. Instead, in both cases, a short-term construction standard defined as a measurable increase of 10.4 $\mu g/m^3$ is to be applied at the proximate sensitive receptor locations. Table 5-2 presents the daily projected emissions from onsite construction as well as the projected concentrations at the various default and actual receptor distances. Note that all concentrations are within their respective criteria and the impact is less than significant.

Table 5-2
Localized Construction Emissions Concentrations[1]

Distance	CO (1-Hr Conc.)[2]	CO (8-Hr Conc.)[3]	NO_2 (1-Hr Conc.)[4]	PM_{10} (24-Hr Conc.)	$PM_{2.5}$ (24-Hr Conc.)
Peak Daily On-site Emissions (lb/day)	43.6	43.6	94.9	9.7	4.0
Concentration at 25 m	3.08	2.16	0.11	10.31	3.83
Concentration at 50 m	3.07	2.15	0.11	8.50	3.31
Concentration at 55 m (Nearest Actual Receptor)	3.07	2.15	0.11	8.20	3.21
Concentration at 100 m	3.06	2.14	0.11	6.25	2.51
Concentration at 200 m	3.04	2.13	0.11	4.10	1.67
Concentration at 500 m	3.02	2.11	0.11	1.91	0.78
Ambient Air Quality Standard	20 ppm	9.0 ppm	0.18 ppm	10.4 $\mu g/m^3$	10.4 $\mu g/m^3$
Exceeds Standard?	**NO**	**NO**	**NO**	**NO**	**NO**

[1] CO and NO_2 are in ppm, PM_{10} and $PM_{2.5}$ are in $\mu g/m^3$.
[2] Includes a background concentration of 3.0 ppm.
[3] Includes a background concentration of 2.1 ppm.
[4] Includes a background concentration of 0.10 ppm.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact AQ-50-3: *Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in non-attainment under an applicable Federal or State ambient air quality standards.*

Site Construction Impacts

Emissions associated with on-shore heavy equipment are based on the OffRoad2007 model runs as provided by the SCAQMD on their Internet web site for year 2010 construction equipment. The SCAQMD presents emissions for most pieces of heavy construction equipment at differing horsepower levels generated using the OffRoad2007 Computer Model. The actual horsepower of the anticipated pieces of equipment (e.g., Cat D10 dozers at 580 hp and 988 Front-end loaders at 430 hp) were then extrapolated from the two pieces of similar equipment with the nearest horsepower ratings above and below the expected piece of equipment.

Some dust with its attendant PM_{10} and $PM_{2.5}$ would also be generated from the onshore movement of sand. The 50 ft Beach Width Alternative would result in approximately 4 ac dry beach. The area of disturbance would occur over approximately 46 work days.

The URBEMIS2007 model developed to determine the emissions associated with land-use projects estimates that each acre disturbed generates 20 pounds of PM_{10} and that 25 percent of the construction area is active at any one time. As such, using the URBEMIS model would result in 1 acre of disturbance daily for the 50 ft Beach Width Alternative. As a conservative approach, this analysis assumes that 25 percent of the larger area is disturbed for either alternative resulting in a disturbance of approximately 2.25 acres daily and, in the absence of any dust suppression, 45 pounds of PM_{10}.

Like all projects in the South Coast Air Basin, the construction would be subject to SCAQMD Rule 403 requiring dust control. The URBEMIS2007 model estimates that twice daily watering reduced the dust by about 50 percent whereas thrice daily watering raises this value to about 65 percent. The materials to be placed on the beach are ocean bottom sediment and are pumped onto the beach as a slurry. Because the material is totally saturated, little if any dust is released during its movement. As such, a control efficiency value of 85 percent was assumed for dust suppression as a conservative estimate.

In accordance with Rule 403, the SCAQMD requires that contractors implement Best Available Control Technology (BACT) for construction activities. Rule 403 identifies a set of specific measures for projects less than 50 acres. These requirements, as applicable to this Project, are included in Table 5-3 Note that these measures are regulatory requirements and as such, do not constitute mitigation under CEQA. The conditions included in Table 5-3 apply to construction activities conducted during normal wind conditions (i.e., with wind gusts less than 25 mph). The contingency measures, included in Table 5-4, shall be applied to those periods when instantaneous wind gusts meet or exceed 25 mph.

Data and emissions for the watercraft are based on data supplied by Moffatt & Nichol. The barge is estimated at approximately 4,300 hp for propulsion and 1,700 hp for the dredge pump. Additionally, a generator and auxiliary power source would also be used and are each rated at 565 hp. A tug would assist unloading operations and is estimated at 4,268 hp.

Emissions would also be generated from the construction crew in their daily commutes and by the onsite use of two pick-up trucks. Emissions for these vehicles were based on the EMFAC2007 computer model and assume Year 2010 emission factors. The total daily emissions generated by vehicle travel in Orange County projected by the EMFAC2007 model was divided by the total number of daily miles by vehicle type and a grams-per-mile by vehicle type is determined. Members of the construction crew are each estimated to travel 25.4 miles round-trip in accordance with the URBEMIS2007 computer model for home-to-work travel distances in Orange County.

Table 5-3
Required Best Available Control Measures for Fugitive Dust
(Applicable to All Construction Activity Sources)

Source Category	Control Measures	Guidance
Disturbed soil	• Stabilize disturbed soil throughout the construction site; and • Stabilize disturbed soil between structures.	• Limit vehicular traffic and disturbances on soils where possible; • If interior block walls are planned, install as early as possible; • Apply water or a stabilizing agent in sufficient quantities to prevent the generation of visible dust plumes; and • This measure applies to both inactive and active sites, during workdays, weekends, holidays, and windy conditions.
Earth-moving activities	• Pre-apply water to depth of proposed cuts; • Re-apply water as necessary to maintain soils in a damp condition and to ensure that visible emissions do not exceed 100 feet in any direction; • Stabilize soils once earth-moving activities are complete; and • Limit speed of earthmoving equipment to 10 mph.	• Grade each project phase separately, timed to coincide with construction phase; • Upwind fencing can prevent material movement on site; and • Apply water or a stabilizing agent in sufficient quantities to prevent the generation of visible dust plumes.
Staging areas	• Stabilize staging areas during use; and • Stabilize staging area soils at project completion. • Locate construction equipment and staging zones away from sensitive receptors and fresh air intakes to buildings and air conditioners.	• Limit size of staging area; • Limit vehicle speeds to 15 miles per hour (24 kilometers per hour); and • Limit number and size of staging area entrances/exits.
Paved road track-out	• Cover all haul vehicles	• Comply with the vehicle freeboard requirements of Section 23114 of the California Vehicle Code for

		both public and private roads.
Traffic areas for construction activities	• Stabilize all off-road traffic and parking areas; • Stabilize all haul routes; • Direct construction traffic over established haul routes; and • Limit speeds to 15 miles per hour (mph).	• Apply gravel/paving to all haul routes as soon as possible to all future roadway areas; and • Barriers can be used to ensure vehicles are used only on established parking areas/haul routes.

Table 5-4
Contingency Control Measures for Fugitive Dust During High Winds in Excess of 25 MPH

Fugitive Dust Source Category	Control Measures
Earth-moving	• Cease all active operations; or • Apply water to soil not more than 15 minutes prior to moving such soil.
Disturbed surface areas	• Apply water to all unstabilized disturbed areas three times per day. If there is any evidence of wind-driven fugitive dust, watering frequency is increased to a minimum of four times per day.
Unpaved roads	• Apply water twice per hour during active operation.
Open storage piles	• Apply water twice per hour; or • Install temporary coverings.
All categories	Executive Officer and the USEPA as equivalent to the methods specified in this table may be used.

In this case, the total number of vehicles was raised from 10 to 12 to account for the use of two onsite pick-up trucks during the day. Actual miles for these two pick-ups would be less than the 25.4-mile value used in the analysis, but these emissions are minimal relative to those of the offshore and heavy equipment and more accurate data as to their use would not change the outcome of the analysis.

The 50 ft Beach Width Alternative would use the same level of equipment on a daily basis. As shown in Table 5-5, NOx, ROG, and $PM_{2.5}$ emissions for on-shore sources would not exceed their respective thresholds of 100, 75, and 55 pounds per day. Other on-shore sources in the project area include the railroad operations (an off-road source); project emissions would not cumulatively contribute to these background emissions due to the infrequent stops at this particular unstaffed, platform station. Project emissions, therefore, would not be significant. For informational purposes, the off-shore source emissions would be divided into 68 percent in the SDAB and 32 percent in the SCAB. Model results appear in Appendix C. Because this alternative will not exceed criteria pollutant thresholds, no cumulatively considerable net increase of any criteria pollutant would be anticipated. In addition, this alternative does not exceed the

general conformity *de minimis* levels, identifying it as a conforming project and does not need a Conformity Determination.

Mitigation Measures: Site construction may approach the daily threshold for NO_x emissions. Applicable mitigation for NO_x is included below. The included measures would also reduce ROG and $PM_{2.5}$ for on-shore heavy equipment exhaust.

MM-AQ-50-3.1: The construction contractors shall use on-shore heavy equipment that meets Tier II or higher air pollutant emission standards where these standards are applicable and equipment available.

Table 5-5 Comparison of Unmitigated Projected Construction Emissions and Criteria Values for 50 ft Beach Width Alternative

	CO	NOx	ROG	SO_X	Total PM_{10}[1]	Total $PM_{2.5}$[2]	CO_2
Lbs/Day							
On Shore Equipment	43.2	94.9	12.4	0.1	3.9	3.4	8,277.0
Dust	0	0	0	0	6.8	1.4	0
On Shore Vehicles	2.5	0.2	0.3	0.0	0.0	0.0	291.8
Off Shore Sources	327.4	2,185.5	63.9	140.4	66.2	58.9	108,722.6
All Sources	373.1	2,280.6	76.6	140.5	76.98	63.7	117,291.4
On Shore Sources	**45.7**	**95.1**	**12.7**	**0.1**	**10.7**	**4.8**	**8,568.8**
Daily Threshold[4]	550	100	75	150	150	55	NT[3]
Significant?	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Tons/year presented for Conformity purposes							
On Shore Sources	1.1	2.2	0.3	0.0	0.1	0.1	197.1
De minimis level[5]	100	10	10	NT[3]	70	NT[3]	NT[3]
Significant?	**NO**	**NO**	**NO**	---	**NO**	---	---

[1] Assumes 85 percent control efficiency for wet material.
[2] Based on 99 percent of the PM_{10} for on-road emissions, 89 percent of the PM_{10} for off-road emissions, and 21 percent of the PM_{10} for fugitive dust.
[3] NT – No Threshold.
[4] Thresholds apply only to onshore sources.
[5] General conformity *de minimis* levels

MM-AQ-50-3.2: All heavy equipment shall be maintained and tuned per manufacturer's specifications to perform at California Air Resources Board (CARB) and/or EPA certification, where applicable, levels and to perform at verified standards applicable to retrofit technologies.

The requirement for Tier II heavy equipment, where applicable, could reduce NO_x emissions by about 40 percent and particulate emissions by about 25 percent over Tier I equipment levels. A higher percentage reduction would be achieved over the use of equipment-produced prior to Tier I requirements. Because the status of the actual equipment assemblage, as well as those pieces subject to Tier II requirements, is variable, the overall reduction in NO_x emissions could be less than the 40 percent reduction noted for the use of Tier II equipment. $PM_{2.5}$ emissions, assuming TIER II equipment, reduces particulate levels by 25 percent.

CO and ROG levels associated with on-shore heavy equipment construction would also be reduced. If the 40 percent reduction associated with NO_x control is also applied to ROG, on-shore heavy equipment ROG would be reduced from 12.4 to 7.4 pounds per day.

Table 5-6 presents the results of the mitigation. Modeling details are included as Appendix C.

Table 5-6 Comparison of Mitigated Construction Emissions and Criteria Values for the 50 ft Beach Width Alternative

	CO	NO_X	ROG	SO_X	Total PM_{10}[1]	Total $PM_{2.5}$[2]	CO_2
Lbs/Day							
On Shore Equipment	43.2	56.9	7.4	0.1	2.9	2.6	8,277.0
Dust	0	0	0	0	6.8	1.4	0
On Shore Vehicles	2.5	0.2	0.3	0.0	0.0	0.0	291.8
Off Shore Sources	327.4	2,185.5	63.9	140.4	66.2	58.9	108,722.6
All Sources	373.1	2,242.6	71.6	140.5	75.98	62.9	117,291.4
On Shore Sources	**45.7**	**57.1**	**7.7**	**0.1**	**9.7**	**4.0**	**8,568.8**
Daily Threshold[6]	550	100	75	150	150	55	NT[3]
Significant?	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Tons/year presented for Conformity purposes							
On Shore Sources	1.1	1.3	0.2	0.0	0.1	0.1	197.1
De minimis level[5]	100	10	10	NT[3]	70	NT[3]	NT[3]
Significant?	**NO**	**NO**	**NO**	---	**NO**	---	--

[1] Assumes 85 percent control efficiency for wet material.
[2] Based on 99 percent of the PM_{10} for on-road emissions, 89 percent of the PM_{10} for off-road emissions, and 21 percent of the PM_{10} for fugitive dust.
[3] NT – No Threshold.
[4] Based on 46 working days.
[5] Based on 108 working days.
[6] Thresholds apply only to onshore sources.

Summary of Significant Unavoidable Impacts: None

Impact AQ-50-4: *Expose sensitive receptors to substantial air pollutant concentrations*

As demonstrated in Section 4.2.1, daily emissions for CO, NOx, PM_{10}, and $PM_{2.5}$ were modeled to determine their concentration and contribution to the ambient concentrations within the Project vicinity and as shown in Table 5-2, the concentrations of emissions are below the localized significance threshold criteria. As such, construction activities will not result in potential exposure of sensitive receptors to substantial pollutant concentrations.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact AQ-50-5: *Create objectionable odors affecting a substantial number of people*

Project construction would involve the use of heavy equipment creating exhaust pollutants from onsite earth. With regards to nuisance odors, any air quality impacts will be confined to the immediate vicinity of the equipment itself. By the time such emissions reach any sensitive receptor sites away from the Project site, they will be diluted to well below any level of air quality concern.

Sediments to be placed on the beach would not contain a high level of organic debris and thus, while an odor may be noted, it would be typical of any odor associated with low tide conditions. This impact is, therefore, considered not significant.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact AQ-50-6: *Generate greenhouse gases*

At this time, greenhouse gases (primarily CO_2) are not regulated as a criteria pollutant and there are no significance criteria for these emissions. Furthermore, the Final 2007 AQMP does not set CEQA targets that can be used to determine any potential threshold values. Nevertheless, in order to provide decision-makers with as much information as possible, this analysis quantifies, to the extent feasible, potential greenhouse gas emissions associated with the proposed development.

Construction activities would consume fuel and result in the generation of greenhouse gases. Construction CO_2 emissions associated with the use of on-shore heavy equipment are as projected by the OffRoad2007 model included on the SCAQMD Internet web site. CO_2 emissions for the ocean-going vessels are based on fuel use factors included in Table A9-3-E (Fuel Use Estimates Per Horsepower Hour) of the SCAQMD *Handbook* and CO_2 emissions are based on the BAAQMD document, Source Inventory of Bay Area Greenhouse Gas Emissions, Table B: Generalized GHG Emission Factors (Lbs/Usage Unit) and are included in Table 5-5. In accordance with the construction schedule, approximately 5,395,405.4 lbs (2,697.7 tons) of CO_2 would be produced during the 46 working days associated with the 50 ft Beach Width Alternative.

In accordance with the 2007 AQMP, the emission levels in California are estimated to be 532 million metric tons (568.4 short tons) CO_2 equivalent for 2010. At approximately 2,697.7 tons, the 50 ft Beach Width Alternative represents about 0.0005 percent of this State's annual CO_2 emissions budget.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

5.1.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact AQ-115-1: *Conflict with or obstruct implementation of the applicable air quality plan*

The Project action represents the placement of sand on the beach. The Project would not result in significant localized air quality impacts at the proximate receptor locations and would implement those measures included in the AQMP considered as feasible and, as such, the Project is consistent with the goals of the AQMP and does not present a significant impact.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact AQ-115-2: *Violate any air quality standard or contribute substantially to an existing or projected air quality violation*

As with the 50 ft Beach Width Alternative, air quality impacts may occur during site preparation, grading, and sporadic maintenance activities required for implementation of the proposed land use. Maintenance could take place once every 10 years depending on need and financial ability. Maintenance would result in a repetition of the initial construction activities. The Project involves approximately 9 ac of resultant dry beach nourishment for the 115 ft Beach Width Alternative. No building construction or paving activities are associated with this Project. Construction would occur over approximately 108 working days over a four month period. Values used for analysis are included in Appendix C.

Localized Construction Impacts

As with the 50 ft Beach Width Alternative, Project construction has the potential to raise local ambient pollutant concentrations, which are existing pollutant concentrations within the Project area, not including the construction activities of the Project (e.g., exhaust from regular traffic to/from the beach, along the highways, etc). This could present a significant impact if these concentrations were to exceed the allowable emissions as a function of receptor distance from the site boundary. Because construction equipment will be similar to the 50 ft Beach Width Alternative on a daily basis, all concentrations are within their respective criteria and the impact is less than significant.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact AQ-115-3: *Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in non-attainment under an applicable Federal or State ambient air quality standards.*

Site Construction Impacts

As with the 50 ft Beach Width Alternative, emissions associated with on-shore heavy equipment are based on the OffRoad2007 model runs as provided by the SCAQMD on their Internet web site for year 2010 construction equipment. The actual horsepower of the anticipated pieces of equipment (e.g., Cat D10 dozers at 580 hp and 988 Front-end loaders at 430 hp) for this Project were then extrapolated from the two pieces of similar equipment with the nearest horsepower ratings above and below the expected piece of equipment. Some dust with its attendant PM_{10} and $PM_{2.5}$ would also be generated from the onshore movement of sand. The 115 ft Beach Width Alternative would result in approximately 9 ac dry beach. The area of disturbance would occur over approximately 108 work days.

The URBEMIS2007 model developed to determine the emissions associated with land-use projects estimates that each acre disturbed generates 20 pounds of PM_{10} and that 25 percent of the construction area is active at any one time. As such, using the URBEMIS model would result in 2.25 acre of disturbance daily for the 115 ft Beach Width Alternative. As a conservative approach, this analysis assumes a disturbance of approximately 2.25 acres daily and, in the absence of any dust suppression, 45 pounds of PM_{10}.

Like all projects in the South Coast Air Basin, the construction would be subject to SCAQMD Rule 403 requiring dust control. The URBEMIS2007 model estimates that twice daily watering reduced the dust by about 50 percent whereas thrice daily watering raises this value to about 65 percent. The materials to be placed on the beach are ocean bottom and are pumped onto the beach as a slurry. Because the material is totally saturated, little if any dust is released during its movement. As such, a control efficiency value of 85 percent was assumed for dust suppression as a conservative estimate.

Data and emissions for the watercraft are based on data supplied by Moffatt & Nichol. The initial beach nourishment would involve a barge and associated tow boats traveling from Oceanside Harbor to the Project site. The hopper dredge will be filled at the designated borrow site approximately one mile offshore of Oceanside and hauled approximately 21 miles (35 km) to San Clemente. The barge is estimated at approximately 4,300 hp for propulsion and 1,700 hp for the dredge pump. Additionally, a generator and auxiliary power source would also be used and are each rated at 565 hp. A tug would assist unloading operations and is estimated at 4,268 hp.

Since the borrow site is in the SDAB and the project site is in the SCAB, emissions were assigned to the separate basins by assigning all of the loading emissions, half of the idling emissions and 81 percent of the vessel travel emissions to the SDAB and all of the unloading emissions, half of the idling emissions, 19 percent of the vessel travel emissions and all of the on-shore emissions to the SCAB. In total, all the on-shore and 32 percent of the off-shore emissions will be in the SCAB and the other 68 percent of the off-shore emissions would be in the SDAB.

Emissions also would be generated from the construction crew in their daily commutes and by the onsite use of two pick-up trucks. Emissions for these vehicles were based on the EMFAC2007 computer model and assume Year 2010 emission factors. The total daily emissions generated by vehicle travel in Orange County projected by the EMFAC2007 model was divided

by the total number of daily miles by vehicle type and a grams-per-mile by vehicle type is determined. Members of the construction crew are each estimated to travel 25.4 miles round-trip in accordance with the URBEMIS2007 computer model for home-to-work travel distances in Orange County.

In this case, the total number of vehicles was raised from 10 to 12 to account for the use of two onsite pick-up trucks during the day. Actual miles for these two pick-ups would be less than the 25.4-mile value used in the analysis, but these emissions are minimal relative to those of the offshore and heavy equipment and more accurate data as to their use would not change the outcome of the analysis.

The 115 ft Beach Width Alternative would use the same level of equipment on a daily basis. As shown in Table 5-7, NOx, ROG, and $PM_{2.5}$ emissions for onshore sources would not exceed their respective thresholds of 100, 75, and 55 pounds per day. Other on-shore sources in the project area include the railroad operations (an off-road source); project emissions would not cumulatively contribute to these background emissions due to the infrequent stops at this particular unstaffed, platform station. Project emissions, therefore, would not be significant. Model results appear in Appendix C. Because this alternative will not exceed criteria pollutant thresholds, no cumulatively considerable net increase of any criteria pollutant would be anticipated.

Mitigation Measures: Implement MM-AQ-50-3.1 and MM-AQ-50-3.2.

The requirement for Tier II heavy equipment, where applicable, could reduce NO_x emissions by about 40 percent and particulate emissions by about 25 percent over Tier I equipment levels. A higher percentage reduction would be achieved over the use of equipment-produced prior to Tier I requirements. Because the status of the actual equipment assemblage, as well as those pieces subject to Tier II requirements, is variable, the overall reduction in NO_x emissions could be less than the 40 percent reduction noted for the use of Tier II equipment. $PM_{2.5}$ emissions, assuming use of TIER II equipment, reduces particulate levels by 25 percent. In addition, this alternative does not exceed the general conformity *de minimis* levels, identifying it as a conforming project and does not require a Conformity Determination.

CO and ROG levels associated with on-shore heavy equipment construction would also be reduced. If the 40 percent reduction associated with NO_x control is also applied to ROG, on-shore heavy equipment ROG would be reduced from 12.4 to 7.4 pounds per day.

Table 5-8 presents the results of the mitigation. Modeling details are included as Appendix C.

Summary of Significant Unavoidable Impacts: None

Table 5-7 Comparison of Unmitigated Projected Construction Emissions and Criteria Values for 115 ft Beach Width Alternative

	CO	NOx	ROG	SO_X	Total PM_{10}[1]	Total $PM_{2.5}$[2]	CO_2
Lbs/Day							
On Shore Equipment	43.2	94.9	12.4	0.1	3.9	3.4	8,277.0
Dust	0	0	0	0	6.8	1.4	0
On Shore Vehicles	2.5	0.2	0.3	0.0	0.0	0.0	291.8
Off Shore Sources	327.4	2,185.5	63.9	140.4	66.2	58.9	108,722.6
All Sources	373.1	2,280.6	76.6	140.5	76.98	63.7	117,291.4
On Shore Sources	**45.7**	**95.1**	**12.7**	**0.1**	**10.7**	**4.8**	**8,568.8**
Daily Threshold[4]	550	100	75	150	150	55	NT[3]
Significant?	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Tons/year presented for Conformity purposes							
On Shore Sources	2.5	5.1	0.7	0.0	0.2	0.2	462.7
De minimis level[5]	100	10	10	NT[3]	70	NT[3]	NT[3]
Significant?	**NO**	**NO**	**NO**	---	**NO**	---	---

[1] Assumes 85 percent control efficiency for wet material.
[2] Based on 99 percent of the PM_{10} for on-road emissions, 89 percent of the PM_{10} for off-road emissions, and 21 percent of the PM_{10} for fugitive dust.
[3] NT – No Threshold.
[4] Thresholds apply only to onshore sources.
[5] General conformity *de minimis* levels

Table 5-8 Comparison of Mitigated Construction Emissions and Criteria Values

	CO	NOx	ROG	SO_X	Total PM_{10}[1]	Total $PM_{2.5}$[2]	CO_2
Lbs/Day							
On Shore Equipment	43.2	56.9	7.4	0.1	2.9	2.6	8,277.0
Dust	0	0	0	0	6.8	1.4	0
On Shore Vehicles	2.5	0.2	0.3	0.0	0.0	0.0	291.8
Off Shore Sources	327.4	2,185.5	63.9	140.4	66.2	58.9	108,722.6
All Sources	373.1	2,242.6	71.6	140.5	75.98	62.9	117,291.4
On Shore Sources	**45.7**	**57.1**	**7.7**	**0.1**	**9.7**	**4.0**	**8,568.8**
Daily Threshold:	550	100	75	150	150	55	NT[3]
Significant?	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Tons/year presented for Conformity purposes							
On Shore Sources	2.5	3.1	0.4	0.0	0.2	0.1	462.7
De minimis level[5]	100	10	10	NT[3]	70	NT[3]	NT[3]
Significant?	**NO**	**NO**	**NO**	---	**NO**	---	---

[1] Assumes 85 percent control efficiency for wet material.
[2] Based on 99 percent of the PM_{10} for on-road emissions, 89 percent of the PM_{10} for off-road emissions, and 21 percent of the PM_{10} for fugitive dust.
[3] NT – No Threshold.
[4] Thresholds apply only to onshore sources.
[5] General conformity *de minimis* levels

Impact AQ-115-4: *Expose sensitive receptors to substantial air pollutant concentrations*

As demonstrated in Section 4.1.3 above, daily emissions for CO, NOx, PM_{10}, and $PM_{2.5}$ were modeled to determine their concentration and contribution to the ambient concentrations within the Project vicinity and as shown in Table 5-2, the concentrations of emissions are below the localized significance threshold criteria. As such, Project construction activities will not result in potential exposure of sensitive receptors to substantial pollutant concentrations.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact AQ-115-5: *Create objectionable odors affecting a substantial number of people.*

Project construction would involve the use of heavy equipment creating exhaust pollutants from onsite earth. With regards to nuisance odors, any air quality impacts will be confined to the immediate vicinity of the equipment itself. By the time such emissions reach any sensitive receptor sites away from the Project site, they will be diluted to well below any level of air quality concern.

Sediments to be placed on the beach would not contain a high level of organic debris and thus, while an odor may be noted, it would be typical of any odor associated with low tide conditions. This impact is therefore considered not significant.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact AQ-115-6: *Generate greenhouse gases*

As with the 50 ft Beach Width Alternative, construction activities would consume fuel and result in the generation of greenhouse gases. In accordance with the Project construction schedule, approximately 582,703,786.0 lbs (291,351.9 tons) would be produced during the 108 working days associated with the 115 ft Beach Width Alternative.

In accordance with the 2007 AQMP, the emission levels in California are estimated to be 532 million metric tons (568.4 short tons) CO_2 equivalent for 2010. At about 291,351.9 tons, the 115 ft Beach Width Alternative represents about 0.05 percent if the State's annual CO_2 emissions budget.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

5.1.4 Impacts of the No Action Alternative

The No Action Alternative would not involve any dredging or beach nourishment activity and no impacts to air quality would occur from the lack of these construction activities. However, under the No Action Alternative, potential maintenance activities by SCRRA may create emissions associated with equipment used to maintain and protect the railroad ballast and tracks, such as emergency seawalls.

5.2 Geology and Topography

5.2.1 Significance Criteria

An impact to geology and topography will be considered significant if a project alternative results in:

- Substantial adverse modification of any unique geologic features;
- Substantial adverse increase in coastal erosion; and/or
- Substantial adverse modification of beach or nearshore topography.

5.2.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact ER-50-1: *Substantial adverse modification of any unique geologic features.*

The 50 ft Beach Width Alternative will alter topography by excavating soft bottom offshore of Oceanside and placing the sediment on the beach at San Clemente to widen the beach. Neither the relatively featureless ocean bottom offshore Oceanside or the sand beach at San Clemente is a unique geologic feature. Subtidal soft bottom areas and sandy beaches are widespread in southern California. Therefore, the 50 ft Beach Width Alternative would not result in substantial adverse modification of any unique geologic feature.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact ER-50-2: *Substantial adverse increase in coastal erosion.*

Currently, beach erosion threatens City facilities and private properties as well as the railroad. The proposed action would provide sand to San Clemente beach to offset beach erosion and protect structures. Therefore, the impacts of the 50 ft Beach Width Alternative would offset coastal erosion and would be beneficial.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact ER-50-3: *Substantial adverse modification of beach or nearshore topography.*

Dredging at the Oceanside source site would deepen the bathymetry of a portion of the site by several feet. The proposed dredging would follow accepted marine engineering practices regarding construction and geotechnical limitation associated with borrow site cut slopes. The proposed borrow site has been previously dredged for beach sand. The site is outside the depth of closure and, therefore, the pit would not intercept the littoral sand that typically rebuilds beaches in the summer. Excavation of sand offshore Oceanside would not result in a substantial adverse modification of nearshore bathymetry. The impacts to geology and topography of dredging would not be significant.

The 50 ft Beach Width Alternative would use the dredged sand to widen approximately 3,411 ft (1,040 m) of San Clemente Beach coastline. The immediate post-construction width of the beach would be approximately 76 ft (23 m), but through winnowing and adjustment the eventual beach width would be about 50 ft (15 m). Figure 3-2 shows the construction footprint and the equilibrium footprint of the 50 ft Beach Width Alternative. The construction footprint for this alternative would be approximately 28 acres (ac) (113,242 m^2). The equilibrium footprint, resulting from some of the placed sand moving offshore, would be approximately 124 ac (499,286 m^2).

The proposed fill would be expected to have varying levels of burial impacts due to seasonal crossshore movement of sediment (Appendix D). During the summer months, the equilibrium profile is expected to be biased towards the shoreline. During the summer, when lower wave energy conditions are prevalent, sediment typically migrates across the profile from deeper water to shallower water, resulting in a net accumulation of sediment in the foreshore. During the winter months, the equilibrium profile would be biased toward the offshore bar. Higher energy winter wave conditions cause sediment to move across the profile from shallower water to deeper water, resulting in a net gain of sediment towards the offshore tail of the profile.

The beach fill proposed for San Clemente would be expected to perform in a manner consistent with other recent beach fills. Figure 5-1 shows the profile for a recent fill by SANDAG of 421,000 cy (319,960 m^3) along 4,400 ft (1,321 m) of beach at Oceanside. This profile shows a movement of up to 6 ft (2 m) of thickness across the profile. In general, beyond about 0 MLLW, the post beach fill profiles were within the range observed prior to the beachfill. Figure 5-2 shows the cross sectional distribution of this sediment for the 50 ft Beach Width Alternative.

These temporary burial impacts in the nearshore area could result in temporary adverse effects, including partial burial of T-Street reef. Although these effects would be adverse, because they would be short-term and only would occur in the inshore portions of the reef, they would not result in a substantial adverse modification of nearshore topography.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Figure 5-1 SANDAG Oceanside Beach Fill Profiles (Before and After Construction)

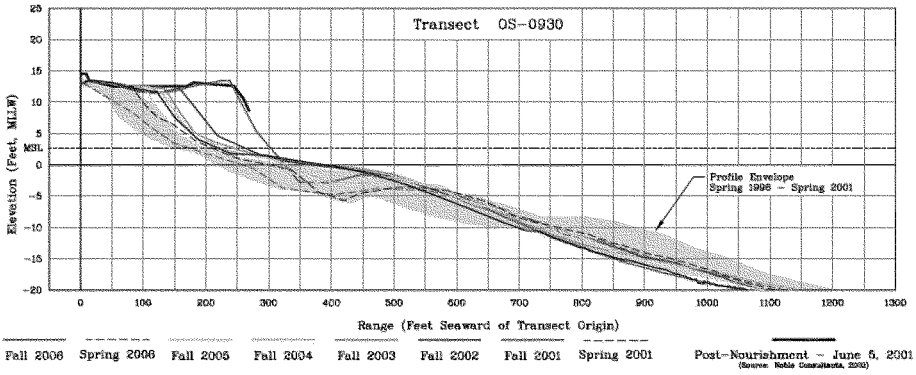
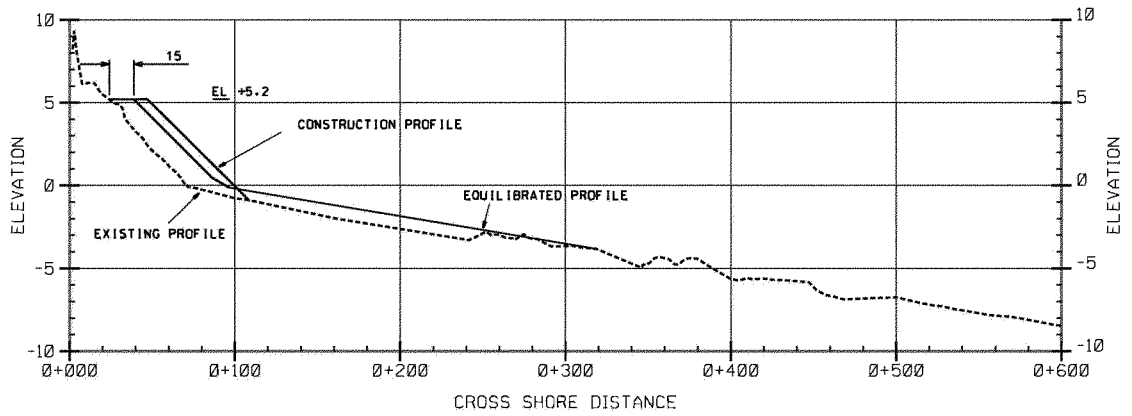


Figure 5-2 Cross Section Profile of the 50 ft Beach Width Alternative



5.2.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact ER-115-1: *Substantial adverse modification of any unique geologic features.*

The 115 ft Beach Width Alternative will alter topography by excavating soft bottom offshore of Oceanside and placing the sediment on the beach at San Clemente to widen the beach. Neither the relatively featureless ocean bottom offshore Oceanside or the sand beach at San Clemente is a unique geologic feature. Subtidal soft bottom areas and sandy beaches are widespread in southern California. Therefore, the 115 ft Beach Width Alternative would not result in substantial adverse modification of any unique geologic feature.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact ER-115-2: *Substantial adverse increase in coastal erosion*

Currently, beach erosion threatens City facilities and private properties as well as the railroad. The 115 ft Beach Width Alternative would provide sand to San Clemente beach to offset beach erosion and protect structures. Therefore, the impacts of this alternative would be beneficial. Because the 115 ft Beach Width Alternative would provide a wider beach than the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative would be more effective in off-setting the impacts of beach erosion.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact ER-115-3: *Substantial adverse modification of beach or nearshore topography*

Dredging at the Oceanside source site for the 115 ft Beach Width Alternative would deepen the bathymetry of a portion of the site by several feet. The proposed dredging would follow accepted marine engineering practices regarding construction and geotechnical limitation associated with borrow site cut slopes. The proposed borrow site has been previously dredged for beach sand. The site is outside the depth of closure and, therefore, the pit would not intercept the littoral sand that typically rebuilds beaches in the summer. Excavation of sand offshore Oceanside would not result in a substantial adverse modification of nearshore bathymetry. The impacts to geology and topography of dredging would not be significant.

To achieve a design beach width of 115 ft (35 m), the construction beach width would be 174 ft (53 m). This sand will move alongshore (primarily downcoast) and offshore. For the 115 ft Beach Width Alternative, the sand would cover an area of approximately 39 ac (158, 248 m^2) after construction. At equilibrium, the sand would cover a footprint of 205 ac (828, 281 m^2) (Figure 3-3). Figure 5-3 shows the cross sectional distribution of this sediment for the 115 ft Beach Width Alternative. At equilibrium, the depth of burial would be greatest at the shoreline where it would be up to 19 ft (6 m) thick. At the seaward toe of the equilibrium profile, burial

would range between 1 to 3 ft (0.3 and 1.0 m) thick (Appendix D). The sediment would be expected to gradually move out of the project area within 10 years.

As shown in Figure 5-3, the 115 ft Beach Width Alternative would result in substantial burial impacts to T-Street reef. The 115 ft Beach Width Alternative also would bury other shallow rocky habitat within the Project area. The burial of T-Street reef would be expected to result in adverse impacts for up to 10 years. In addition, the 115 ft Beach Width Alternative would result in likely sedimentation of offshore reefs that support biological resources. Monitoring efforts of a slightly smaller beach fill project off the coast at Oceanside (SANDAG project) indicated that below a water depth of 0 MLLW, the profiles after the fill event were within the same range of profiles observed prior to the fill event, which was in water depths up to about -10 ft (-3 m). Some of the post-fill profiles were within the upper range of pre-fill depths observed. It is possible that the greater volume of fill proposed for the 115 ft Beach Width Alternative (448,000 m^3 for this Project compared to 319,960 m^3 for SANDAG) could result in burial beyond existing profiles. If the 115 ft Beach Width Alternative modifies nearshore bathymetry in such a way as to result in burial and degradation of rocky subtidal habitat, it would have a significant adverse impact on geology and topography.

Mitigation Measures:

MM-ER-115-2.1: Sediment profiles shall be monitored following the beach fill. If significant burial of natural reef occurs, future fill events beyond the initial fill shall not occur. If the reef does not return, an equivalent amount of mitigation reef shall be constructed at a water depth that would create nearshore topography similar to that of T-Street reef.

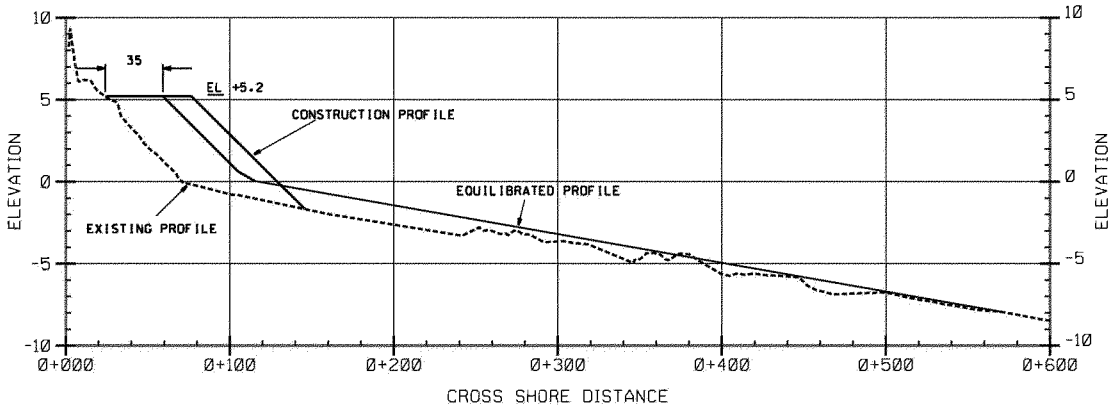
Summary of Significant Unavoidable Impacts: The 115 ft Beach Width Alternative would result in substantial burial of reef that would result in modification of the nearshore topography. These impacts would occur for up to 10 years. Monitoring and documentation of impacts and the avoidance of future beach fills would allow the reefs off San Clemente to eventually recover to their existing values. Creation of a mitigation reef would replicate some of the topography lost to the beach fill, but a mitigation reef may not support the biological or recreational uses it currently sustains.

5.2.4 Impacts Related to the No Action Alternative

Under the No Action alternative, there would be no alteration of bathymetry and topography by dredging sand from offshore Oceanside and placing it on the beach near San Clemente Pier. The sediment at the Oceanside borrow site may be dredged for other projects.

Under the No Action alternative, the beach at San Clemente would continue to erode, resulting in a further loss of sand depth and width. The denuded beach would provide little protection for the railroad and to public and private structures. Damage to structures may occur under high wave conditions. The narrow beach would limit recreational opportunities for beachgoers and would provide little foraging area for shorebirds and spawning area for grunion. Continued erosion of San Clemente Beach would be a substantial adverse modification of beach or nearshore topography and, therefore, a significant impact.

Figure 5-3 Cross Section Profile of 115 ft (35 m) Beach Width Alternative



Under the No Action alternative, emergency seawalls may be constructed to protect structures from wave damage. Construction of seawalls would be an adverse modification of beach topography. However, because a relatively small amount of beach would be affected, the impact would not be substantial and would not be considered significant.

5.3 Water Resources (Water Quality, Sediments, and Oceanography)

5.3.1 Significance Criteria

Impacts to marine water quality are considered significant if any of the following apply:

- The water quality objectives in the California Ocean Plan (SWRCB 2005) are violated; and/or
- Project operations or discharges that change background levels of chemical and physical constituents or elevate turbidity would produce long-term changes in the receiving environment of the site, area, or region that would impair the beneficial uses of the receiving water.

Impacts are considered less than significant if the project would result in elevation of contaminants, but the levels remain below water quality criteria or if elevation of contaminant concentrations above criteria occurs only within a couple of hundred feet or less of the point of discharge for a few hours or less.

An impact to oceanographic conditions or coastal processes would be considered significant if any of the following apply:

- Nearshore wave characteristics are substantially and adversely altered;
- Nearshore sediment transport is substantially and adversely altered; and/or
- Shoreline erosion is substantially increased.

5.3.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact WR-50-1: *The water quality objectives in the California Ocean Plan (SWRCB 2005) are violated.*

As described in Section 4.3 and shown in Table 4-6, the sediment at the Oceanside borrow site has very low levels of contaminants. Therefore, resuspension of sediments during dredging and run-off into the ocean from sediments placed on the beach at San Clemente would not result in an increase in the concentration of contaminants in ocean waters or cause a violation of any water quality objective related to contaminants.

Dredging and beach construction activities will involve the use of vessels and construction vehicles on and near the ocean. An accident or the improper handling of materials could result in

the introduction of fuels or other hazardous material to the ocean. The introduction of fuels or other contaminants to marine waters would be a potentially significant impact. Impacts may be reduced to not significant through adherence to a Stormwater Pollution Prevention Plan (SWPPP) and an Oil Spill Prevention and Response Plan (OSPRP).

The primary potential for degradation of water quality from the proposed beach nourishment is through the generation of turbidity during dredging and sediment discharge to the beach. The California Ocean Plan states "Natural light shall not be significantly reduced at any point outside the initial dilution zone as the result of the discharge of waste." The sediment at the Oceanside source site is generally fine-grained sands with local silty intervals (USACE 2005b). The calculated fines content of the composite gradation is 8.0 percent. Because the material at the borrow site consists primarily of sand-sized particles that settle rapidly, these plumes would not be extensive. As material is loaded into the hopper bins, the dredge may overflow elutriate down the center of the hull through vertical overflow pipes. Thus, the hopper dredge may create a surface turbidity plume, which, under worst-case conditions, may extend for 1,000 ft (300 m) or more. SANDAG estimated the average turbidity plumes expected from dredging at the Oceanside borrow site using the overall mean grain size diameter and the average current speed (SANDAG 2000). The estimated average down current distance of the turbidity plume was estimated to be 272 to 329 ft (82 to 99 m) (SANDAG 2000). Turbidity monitoring of dredging with a hopper dredge during the SANDAG Regional Beach Sand project identified only small plumes in the vicinity of the dredge (AMEC 2002); plumes did not exceed 2,700 yd^2 (2,100 m^2). Therefore, the amount of turbidity expected during dredging at the Oceanside source site is expected to be minor. However, in a worst-case scenario, if a silt layer is encountered during conditions of high currents, the creation of extensive turbidity plumes during dredging would be a significant impact.

Turbidity plumes generated during discharge of offshore sediments to receiver sites also have the potential to degrade nearshore waters. However, turbidity plumes would be expected to be confined primarily to the naturally turbid surf zone and associated rip currents. Construction monitoring during the SANDAG project in San Diego County documented that beach fill operations generated turbidity plumes that ranged between 2,640 and 10,000 ft (800 and 3,000 m) and were greatly influenced by rip currents. The turbidity plumes remained in the surf zone unless rip currents carried them offshore (SANDAG 2002). The proposed Project method of discharging the sediments behind an L-shaped berm allows fine particles to settle prior to introduction to the ocean and reduces the potential for nearshore turbidity. Because turbidity plumes generated during initial placement of sediments on receiver beaches would primarily be confined to the surf zone and rip currents, areas that are naturally turbid, degradation of coastal waters by turbidity from the proposed Project would not be expected to occur. However, should a worst-case scenario of more extensive turbidity plumes be created during beach construction, impacts would be significant.

Water quality impacts due to turbidity at the borrow site during construction are expected to be minor and temporary. The geotechnical analysis indicates that variations in sediment quality occur within the borrow sediments. The borrow area tends to have small pockets and/or lenses of sediment that contain higher fines content than are customarily acceptable as beach fill. However, the overall gradation of the borrow area as a unit indicates the borrow area is

acceptable for beach placement. It is expected that this project will be constructed by hopper dredge methods instead of hydraulic cutter head methods. Hopper dredge methods result in shallow excavations as opposed to excavating the borrow area as a larger unit that can be achieved by hydraulic cutter head. Thus, the pockets and/or lenses of finer grained materials will tend to be delivered to the fill site. The simplifying assumption was made that the fill will be comprised of a blended mix of sediments represented by the mean grain size of the borrow materials. Observations from numerous nearshore and beach fill construction projects within the Los Angeles District indicate a significant percentage of borrow material fines are winnowed immediately during placement operations in the surf zone. Standard construction practice includes turbidity monitoring both updrift and downdrift of the dredge. Due to rapid winnowing and naturally elevated ambient turbidity levels within the surf zone, insignificant turbidity impacts from dredging/fill operations are typically the rule rather than the exception. Therefore, construction related turbidity impacts are expected to be temporary.

Impacts to water quality during periodic maintenance renourishment would be similar to those for initial beach construction. Each renourishment event would involve approximately 251,000 cy (192,000 m^3) every six years for an estimated eight renourishment cycles over the Project life. Degradation of water quality due to periodic maintenance is not expected to occur; however, if extensive turbidity were to occur, the impact would be potentially significant, but temporary.

Mitigation Measures:

MM-WR-50-1.1: A SWPPP and an OSPRP shall be prepared for all construction activities. These plans shall specify specific measures that shall be taken during dredging and beach construction to avoid introducing contaminants to the ocean via leaks and spills. All measures shall be adhered to during Project construction.

MM-WR-50-1.2: Turbidity shall be monitored during dredging. If a visible turbidity plume is observed beyond the immediate dredging area, dredging activities shall be modified (e.g., decrease the rate of dredging, move to a new dredge location) until the turbidity plume disperses. Turbidity also shall be monitored during beach fill operations. If significant turbidity (i.e., a visible turbidity plume beyond the surf zone or rip current area) is observed, beach fill operations shall be modified (e.g., by slowing the rate of fill) until the turbidity plume disperses.

Summary of Significant Unavoidable Impacts: None

Impact WR-50-2: *Project operations or discharges that change background levels of chemical and physical constituents or elevate turbidity would produce long-term changes in the receiving environment of the site, area, or region that would impair the beneficial uses of the receiving water.*

Beneficial uses of ocean waters off San Clemente and Oceanside include marine habitat, wildlife habitat, navigation, water-related recreation that involves body contact with water, non-contact water recreation, and habitat for threatened and endangered species, (RWQCB 1994). The sediment that will be dredged at the Oceanside source site and discharged on San Clemente

Beach will not expose wildlife, marine life, or recreational ocean users to elevated levels of pollutants.

Based on information discussed above under Impact WR-50-1, turbidity during dredging at the Oceanside source site is expected to be minimal, and turbidity during discharge of sediments to the beach is expected to be confined to the surf zone and rip currents. The proposed Project is scheduled to occur between late August/early September through March, outside of the least tern breeding and grunion spawning seasons. The closest breeding colony to the San Clemente Beach receiver site is at Red Beach, approximately 12 mi (19 km) south of the receiver site. The large least tern nesting colony at the Santa Margarita River is within about 1.5 mi (2.4 km) from the Oceanside borrow site. Turbidity generated during sand placement on San Clemente Beach would have little effect on the foraging activity of least terns, but turbidity generated during excavation of sediment at the Oceanside borrow site would be within the foraging range of nesting least terns. However, because the proposed Project is scheduled to occur outside of the California least tern breeding season, there would be no impact on breeding least terns. In addition, if turbidity plumes were to occur at the Project site, any least terns foraging in the Project area would be expected to move to a nearby, more suitable foraging site. Therefore, impacts to California least tern due to turbidity would be less than significant.

Mitigation Measure: Implement MM-WR-50-1.2.

Summary of Significant Unavoidable Impacts: None

Impact WR-50-3: *Nearshore wave characteristics are substantially and adversely altered.*

Dredging at an offshore borrow site may have the potential to alter the nearshore wave conditions over the depression. Theoretically, waves passing over the deepened pit could increase or decrease in height compared to the existing condition. However, the proposed dredge borrow area has a very small footprint in relation to the overall bathymetric field traversed by waves approaching shore (USACE 2005, Chambers Group 2007). Therefore, the dredge pit will function as a nearly imperceptible variation to approaching waves. Similar offshore dredging projects have occurred off Southern California with no impacts to waves (Chambers Group 2007). For example, the USACE regularly dredges sand for beach nourishment at Surfside and Sunset Beaches in Orange County from a borrow area at similar depth to the Oceanside source site. No perceptible effects have been documented to waves traversing the site (Patterson and Young 1989).

Another concern is that erosion of sediment from the beach fill will alter nearshore bathymetry and change wave characteristics. T-Street is a popular surfing site located immediately south of San Clemente Pier and directly offshore of the T-Street overpass. The T-Street break is due to a permanent, hard bottom reef that rises above the seabed (Appendix D). Figure 5-4 is a plan view plot of the bathymetric contours that show this seabed feature. The immediately adjacent contours are straight and parallel, while the reef at T-Street is a seabed perturbation such that its elevation, shape, and orientation to incoming waves are a unique combination that tends to shoal waves to a peak with a resulting plunging "left" (from the ocean facing the shore, wave that breaks from right to left) and "right" (from the ocean facing the shore, wave that breaks from left

to right). The slope of the beach and the types of waves approaching the surf zone determine which type of breaker (i.e., form of the wave at breaking) will be predominant. Because of the hard bottom bathymetry, there is a wide range of incident wave conditions (Appendix D). The configuration and orientation of the reef to incoming waves create consistent surfing waves, making T-Street a popular break in the Orange County coastal area. High steepness waves result in plunging breakers, which are associated with beaches with steeper gradients. Types of breakers identified by Galvin (1968) that are discussed for this Project include spilling and plunging breaks. Spilling breakers occur gradually over a distance, where the wave crest becomes unstable and cascades ("spills") down the shoreward face of the wave producing a foamy, white water surface. Plunging breakers are waves that occur when the crest advances faster than the base of the breaker, curls over the shoreward face of the wave, and then falls forward into the trough of the wave, resulting in a high splash.

Figure 5-5 is a cross section plot of the bathymetric contours at T-Street. The measured bathymetry data indicate that the reef extends from the shoreline to approximately 1,200 ft (400 m) offshore. The surfing extends from the beach to about 600 ft (200 m) offshore and typically is in water depths less than 15 ft (5 m). The surfing area is closer to the beach than the actual reef location, as incoming waves require time and space to be transformed by the reef bathymetry.

Some of the sand placed on the beach for the 50 ft Beach Width Alternative would move offshore. At T-Street reef, most of this sand would accumulate in the shallower portions of the reef. The potential effects on the nearshore wave characteristics could be considered adverse depending on the wave use under consideration (e.g., surfing or sand transport). Sand from the 50 ft Beach Width Alternative would be present for up to 6 years, however, the level of burial is expected to steadily decrease during this time at about a 13 ft (4.0 m) loss per year erosion rate. Similar impacts would be expected to occur during each nourishment event. The impacts to wave characteristics, although potentially adverse, would be relatively short-term and less than significant for each nourishment cycle.

The impacts to surfing from this sand movement are not rigorously quantifiable. Because the equilibrium footprint would not extend into the offshore portions of the reef, it would not be likely to modify significantly the refractive abilities of the most seaward extent to the reef. However, the 50 ft Beach Width Alternative may have impacts to the surf zone region between the shoreline and the "take-off" zone, or the area where surfers start their ride as the surfboard is propelled by the wave. The surfing experience might consist of a normal "take-off," but then "close-out" as the wave encounters the straightened bathymetric contours inshore (Appendix D); a "close-out" condition is when a wave breaks along its entire length at once. Although impacts due to the wider beach may occur, historic aerial photographs of San Clemente Beach at the Pier (Figure 5-6) indicate that the beach width in 1990 was approximately 55 ft (17 m) wide and no records have been found that indicate surfing ceased within the Project area during that time.

Figure 5-4 Plan View of T-Street Surf Break Bathymetry

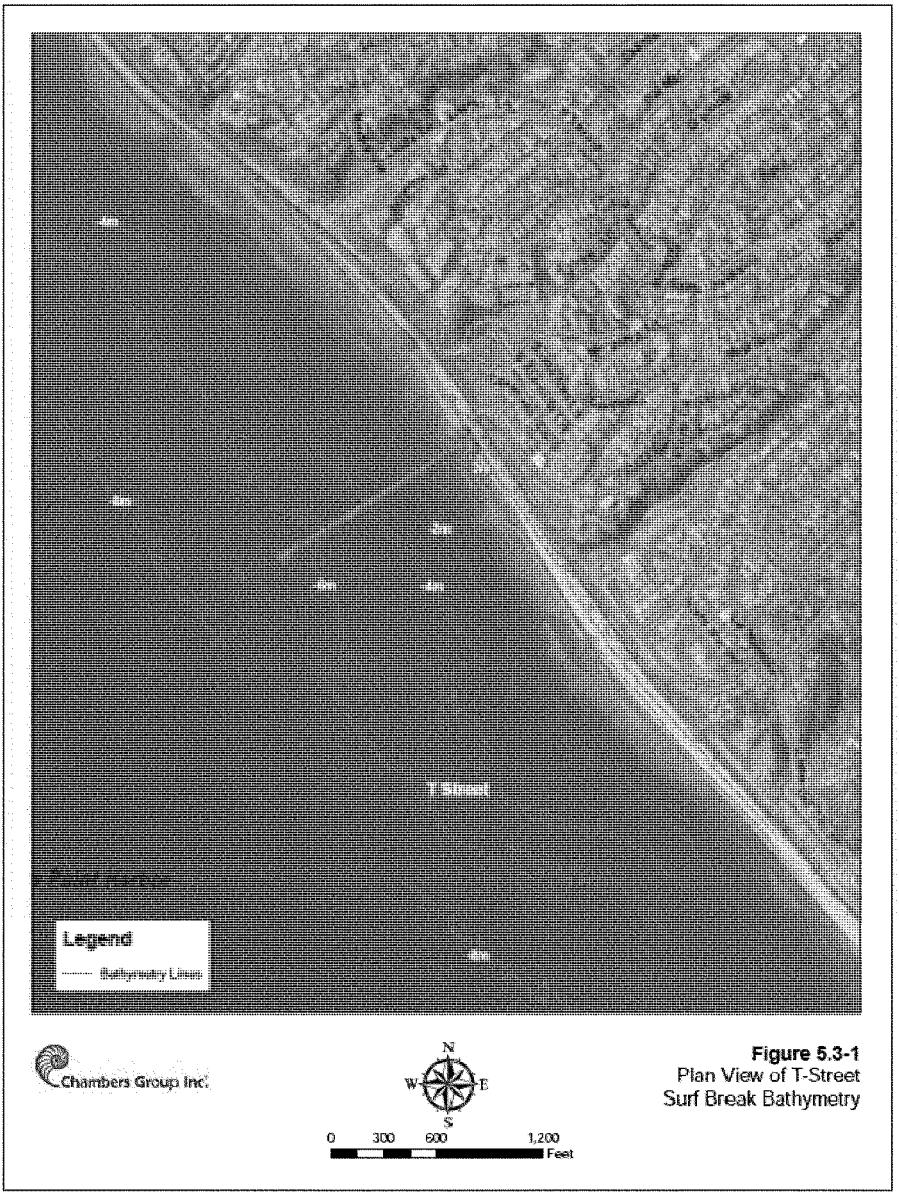


Figure 5-5 Cross Section of T-Street Surf Break Bathymetry (Distances in Feet)

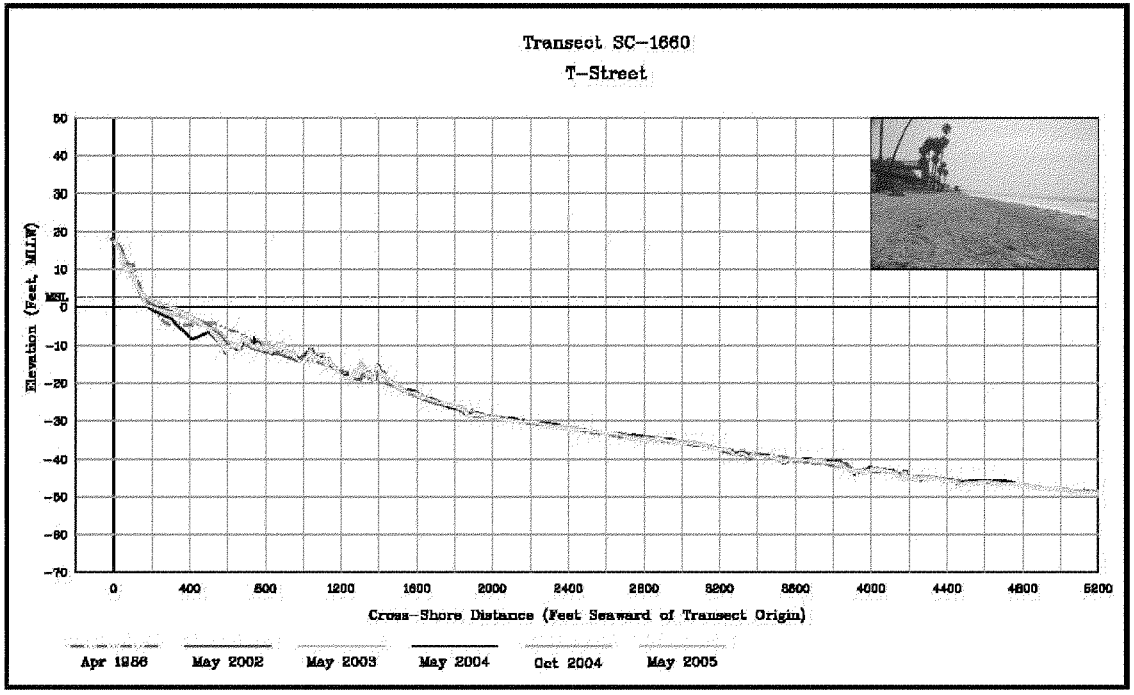


Figure 5-6 Historic Aerial Photograph of San Clemente Pier Shoreline

Mitigation Measures: None.

Summary of Significant Unavoidable Impacts: None

Impact WR-50-4: *Nearshore sediment transport is substantially and adversely altered.*

The proposed borrow/dredge site offshore of Oceanside Harbor is at a water depth beyond the depth of closure for sediment transport off Oceanside (SANDAG 2000). Therefore, deepening the area to obtain sand will not interrupt the littoral transport of sand.

It is possible that by widening the beach at San Clemente Pier, a sand groin could be created and sand moving downcoast by littoral transport could be blocked resulting in erosion of downcoast beaches (USACE 2005b). However, any sand blocked on the upcoast beach would be compensated on the downcoast beach by the erosion and downcoast transport of the beach fill. Conclusions drawn from the SANDAG monitoring data of the Oceanside Beach fill suggests the proposed Project beach fill will erode primarily in the south longshore direction (Appendix D). The SANDAG long-term monitoring data indicates that beaches in the south Oceanside and north Carlsbad regions gained significantly since project construction. The data further suggests that the Oceanside fill has merged with the adjacent Carlsbad fill. Considering that Carlsbad Beach is south of Oceanside Beach and that the longshore drift is primarily in the southern direction, the beach width increase can be directly attributed to south directed longshore sediment transport of the fill material. Therefore, even if the widened beach at San Clemente intercepted the downcoast transport of sand, no adverse effects would occur because erosion of the San Clemente Beach fill would nourish downcoast beaches.

Mitigation Measure: None.

Summary of Significant Unavoidable Impacts: None

Impact WR-50-5: *Shoreline erosion is substantially increased*

As discussed above under Impact WR 5.3.2-4, the sand source site will not rob the littoral cell of sediment because it is located beyond the depth of closure, and the widening of the beach in San Clemente is expected to nourish downcoast beaches, not cause erosion. The beach nourishment is designed to offset problems caused by beach erosion in San Clemente. The proposed beach fill would protect structures and the railroad and would be a benefit.

Mitigation Measures: None.

Summary of Significant Unavoidable Impacts: None

5.3.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact WR-115-1: *The water quality objectives in the California Ocean Plan (SWRCB 2005) are violated.*

The 115 ft Beach Width Alternative would not be expected to result in an elevation of contaminants in the Project area. The sediment at the Oceanside borrow site has very low levels of contaminants. Adherence to a SWPPP and OSPRP would prevent the introduction of fuels or other hazardous materials to the ocean during Project construction.

The primary potential for degradation of water quality from the 115 ft Beach Width Alternative would be through the generation of turbidity during dredging and sediment discharge to the beach. Impacts of turbidity for the 115 ft Beach Width Alternative would be similar to those described above for the 50 ft Beach Width Alternative. The only difference between the two beach width alternatives with respect to turbidity is that the 115 ft Beach Width Alternative would take 108 days to construct compared to 46 days for the 50 ft Beach Width Alternative. Therefore, potential turbidity impacts would occur over a greater period of time for the 115 ft Beach Width Alternative. Turbidity during dredging would be expected to be minor at the Oceanside dredge site, and would be confined to the naturally turbid surf zone at the beach site. However, should a worst-case scenario of more extensive turbidity plumes be created during beach construction, impacts would be significant.

Mitigation Measures: Implement MM-WR-50-1.1 and MM-WR-50-1.2.

Summary of Significant Unavoidable Impacts: None

Impact WR-115-2: *Project operations or discharges that change background levels of chemical and physical constituents or elevate turbidity would produce long-term changes in the receiving environment of the site, area, or region that would impair the beneficial uses of the receiving water.*

The 115 ft Beach Width Alternative would not be expected to cause long-term changes in water column characteristics that would impair the beneficial uses of the receiving waters. The 115 ft Beach Width Alternative may elevate turbidity during the approximately four months of beach construction.

Mitigation Measure: Implement MM-WR-50-1.1.

Summary of Significant Unavoidable Impacts: None

Impact WR-115-3: *Nearshore wave characteristics are substantially and adversely altered*

Dredging for the 115 ft Beach Width Alternative at the Oceanside borrow site would not be expected to alter wave characteristics. The dredge pit will function as a nearly imperceptible variation to approaching waves.

However, the 115 ft Beach Width Alternative could have significant effects on the wave breaking characteristics at the T-Street reef. Figure 5-3 shows the expected equilibrium profile of the 115 ft Beach Width Alternative at T-Street reef. Natural seasonal cross-shore transport mechanisms potentially could change the seabed up to 6 ft (2 m). A sand layer of 6 ft thickness

on T-Street reef could have unquantifiable, but significant effects to the wave breaking characteristics (Appendix D). As the reef fills in from the sand, the characteristic reef shape could be modified and/or lost as it becomes covered by a sand bar. The refractive abilities of the reef may be modified or lost, lessening the focusing effect of the reef and changing the point break characteristics of T-Street. As the reef continues to fill in, the overall bathymetry of the area may begin to become straight and parallel and the wave will lose its ability to "feel" the reef. The wave may begin to exhibit more spilling characteristics normally associated with beach breaks. The consolidated "take-off" zone may be replaced by a more disorganized situation containing many "take-off" zones with shorter, more varied break directions. The straightening contours may cause the wave to tend to break all at once, creating a "close out" condition. Flattening of the slope in the reef area due to sedimentation ultimately has the potential to change the characteristic plunging point break to a quasi-spilling beach break. The sediment from the 115 ft Beach Width Alternative would erode from the reef over time, but would take up to 10 years to disappear from the equilibrium footprint. Substantial alteration of the wave characteristics at T-Street reef for up to 10 years would be a significant adverse impact.

Mitigation Measure:

MM-WR-115-3.1: Wave characteristics at T-Street should be monitored before and after beach construction. If surfing is degraded and does not recover within 10 years, future nourishment events should not occur. If surf characteristics still do not recover after 10 years, a mitigation surfing reef shall be constructed.

Summary of Significant Unavoidable Impacts: The 115 ft Beach Width Alternative would result in substantial burial of T-Street reef and adverse modification of the wave characteristics there. The sediment from the beach fill would gradually erode from the reef throughout a ten year period. It is unknown precisely when during this period the surf would regain its pre-project characteristics. Monitoring and documentation of impacts and the avoidance of future beach fills, would allow the wave characteristics to recover. Creation of a mitigation surfing reef similar in size to the T-Street reef would replicate some of the surfing values, but a mitigation surfing reef may not generate wave profiles equivalent to those at T-Street reef.

Impact WR-115-4: *Nearshore sediment transport is substantially and adversely altered.*

The proposed borrow/dredge site offshore of Oceanside Harbor is at a water depth beyond the depth of closure for sediment transport off Oceanside. Therefore, deepening the area to obtain sand will not interrupt the littoral transport of sand.

As described for the 50 ft Beach Width Alternative, widening of the beach near San Clemente Pier would not result in the erosion of downcoast beaches. Even if the widened beach at San Clemente intercepted the downcoast transport of sand, no adverse effects would occur because erosion of the San Clemente Beach fill would nourish downcoast beaches.

Mitigation Measure: None.

Summary of Significant Unavoidable Impacts: None

Impact WR-115-5: *Shoreline erosion is substantially increased*

As discussed above, the sand source site will not rob the littoral cell of sediment because it is located beyond the depth of closure, and the widening of the beach in San Clemente is expected to nourish downcoast beaches, not cause erosion. The 115 ft Beach Width Alternative is designed to offset problems caused by beach erosion in San Clemente. The proposed beach fill would protect structures and the railroad.

Mitigation Measures: None.

Summary of Significant Unavoidable Impacts: None

5.3.4 Impacts Related to the No Action Alternative

Under the No Action Alternative, there would be no additional turbidity in the Project area caused by dredging off Oceanside and discharging the sediments to San Clemente Beach. Under the No Action Alternative, the Project area would still experience elevated turbidity at times from storm runoff from rivers and flood control channels and resuspension of sediments by wave action.

Under the No Action alternative, there would be no alteration of bathymetry by dredging sand from offshore Oceanside or discharging sand at San Clemente and, therefore, no potential to alter wave characteristics. The sediment at the Oceanside borrow site may be dredged for other projects.

Under the No Action alternative, the beach at San Clemente would continue to erode resulting in a further loss of sand depth and width. The denuded beach would provide little protection for the railroad and to public and private structures. Damage to structures may occur under high wave conditions.

Under the No Action alternative, emergency seawalls may be constructed to prevent surf damage to structures. These sea walls may have minor effects on nearshore sediment transport, but these effects would not be substantial. The impacts of sea walls on sediment transport would not be significant.

5.4 Biological Resources

5.4.1 Significance Criteria

An impact to biological resources will be considered significant if a project alternative results in:

- A direct adverse effect on the population of a threatened or endangered species or the loss or disturbance of important habitat for a listed species;

- A long-term net loss in the habitat value of a sensitive biological habitat. For the purposes of this analysis, kelp beds, and well developed rocky intertidal and surfgrass beds are considered sensitive biological habitats;
- Substantial impedence to the breeding, movement or migration of fish or wildlife;
- Substantial loss to the population of any native fish, wildlife or vegetation. For the purpose of this analysis, substantial is defined as a change in a population that is detectable over natural variability for a period of five years or more; and/or
- Substantial adverse impact on Essential Fish Habitat.

5.4.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact BR-50-1: *A direct adverse effect on the population of a special status listed species or the loss or disturbance of important habitat for a listed species.*

As discussed in Section 4.4, the listed species are unlikely to occur in the Project area, including white abalone, southern steelhead, western snowy plover, and eight species of marine mammals. For these species, the Project area specifically does not include appropriate primary constituent habitat elements. These taxa would not be impacted by the project implementation.

Least terns breed at Camp Pendleton between mid-April and early August. The proposed Project is scheduled to occur between late August/early September through March. The closest breeding colony to the San Clemente Beach receiver site is at Red Beach, approximately 12 mi (19 km) south of the receiver site. The large least tern nesting colony at the Santa Margarita River is within about 1.5 mi (2.4 km) from the Oceanside borrow site. Turbidity generated during sand placement on San Clemente Beach would have little effect on the foraging activity of least terns, but turbidity generated during excavation of sediment at the Oceanside borrow site would be within the foraging range of nesting least terns. However, because the proposed Project is scheduled to occur outside of the California least tern breeding season, there would be no impact on breeding least terns.

Federal threatened western snowy plovers do not breed in the vicinity of San Clemente Beach and have rarely, if ever, been noted foraging in the Project area during the winter. This is based upon several wintering plover surveys, most recently in 2006, in which no snowy plovers were observed. The USACE LAD has conducted several beach and surf zone disposal operations within snowy plover habitat during both nesting and wintering seasons without any observed negative impact (USACE 2001). Because San Clemente Beach is not an important habitat for snowy plovers, temporary disturbance is not considered a significant impact.

Sea and Sage Audubon performed a 2010 winter survey; San Clemente Beaches were not included because beach habitat within the project placement footprint, as well as in Oceanside, are narrow and heavily used by people. Philip Unitt, San Diego Natural History Museum, Birds of San Diego County, Memoir 13, 1984, does not show snowy plovers in north portion of the county. California State Parks has tracked snowy plovers during winter window surveys and has driven San Clemente State Beach many times with zero plovers observed over the years (David Pryor, personal communication, February 2011).

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact BR-50-2: *A long-term net loss in the habitat value of a sensitive biological habitat. For the purposes of this analysis, kelp beds, surfgrass beds, and well developed rocky intertidal are considered sensitive biological habitats.*

Figure 4-10 shows the construction and equilibrium footprints for the 50 ft Beach Width Alternative in relationship to surfgrass and kelp in the Project area. The sand placement footprint does not include any kelp beds, surfgrass, or rocky intertidal areas. Therefore, no direct impacts to sensitive habitats would occur from the placement of sand on the beach. In addition, the proposed Project would not place anchors for the mono buoy, where the hopper dredge will moor while it discharges sand to the beach, or place the sinker pipeline that will pump the sediment to shore from the hopper dredge on any sensitive habitat. The construction contractor shall avoid placement of anchors or the submerged pipeline onto reef habitat, which could crush attached organisms. The construction contractor shall also avoid side to side movement of the anchors or pipeline as they are placed, which could abrade surfgrass, algae, or attached invertebrates. If a substantial amount of surfgrass or kelp were affected by placement and removal of anchors and pipelines, the impact would be considered significant. These impacts would be avoided and minimized by performing a pre-construction survey to identify anchor and pipeline locations that would avoid sensitive resources. Because most of the surfgrass in the Project area grows on T-Street reef, it is possible to avoid surfgrass by avoiding the reef when laying the pipeline. In addition, to avoid impacts to reefs that support kelp and other sensitive species such as gorgonians and surfgrass, the hopper dredge should moor inshore of these reefs, which are located approximately 1,000 to 1,300 ft (300 to 400 m) from the beach.

Following initial placement, a portion of the sand may move upcoast, downcoast, and offshore depending on the magnitude, direction, and period of waves. Most of the sand movement is expected to be downcoast and offshore. The nearest significant rocky intertidal area to the proposed beach fill location is at Mariposa Point, approximately 1,600 ft (485 m) north of the northern end of the beach fill site at Linda Lane. The net movement of beach sands in the Project area is expected to be southerly, but some northerly movement may occasionally occur. Based on monitoring of the SANDAG beach fill project at Oceanside, most sand movement is expected to be toward the south (Appendix D). Therefore, it is unlikely that significant quantities of sand will be transported to the north to the rocky intertidal habitat at Mariposa Point. The equilibrium footprint for the 50 ft Beach Width Alternative indicates that sand will not extend as far upcoast as Mariposa Point (Figure 3-2). Therefore, the proposed action would not be expected to result in the net loss of habitat value of sensitive rocky intertidal habitat, and impacts to rocky intertidal habitat would not be significant.

The available evidence also suggests that the proposed action will not result in a long-term net loss in habitat value of surfgrass beds. Figure 5-2 shows the predicted equilibrium cross-section footprint of the 50 ft Beach Width Alternative at T-street reef. This profile suggests that most of the sediment accumulation will occur in the inshore area. Surfgrass in this area grows on 1 to 2

ft (0.3 to 0.6 m) boulders and has average blade lengths of 2 to 3 ft (0.6 to 0.9 m). Therefore, the equilibrium footprint of the 50 ft Beach Width Alternative likely would result in a range of impacts between no burial of surfgrass on the larger rocks and partial burial on the smaller boulders. Burial of surfgrass on the outer portions of T-street reef would be minimal. Surfgrass is adapted to partial sand burial, routinely survives seasonal sand burial of part of its blades, and can recover quickly via regrowth if the root system is intact; however, the degree of sand burial surfgrass can withstand is not well documented (SANDAG 2000). CRM (2000) observed surfgrass in the deepest portion of T-Street reef with 2/3 of its blades covered with sand, which suggested surfgrass could withstand temporary burial of up to 2/3 of its blade length.

To predict the potential burial of surfgrass at San Clemente, CRM and Moffatt and Nichol analyzed impacts to surfgrass from a similar proposed beach fill project at Linda Lane and T-Street (CRM 2000). Their analysis predicted that placement of 175,000 cy (133,000 m^3) of sand at Linda Lane and T-Street would result in a maximum 1 ft (0.3 m) burial of surfgrass for less than six months. Approximately 1 ft (0.3 m) of burial would bury less than 50 percent of the surfgrass blade length at these sites. Based on observation of burial of existing offshore surfgrass in the area, CRM (2000) proposed a criterion of sand burial of no more than 2/3 of the blade length for six months or less as a level that surfgrass can withstand, and concluded that burial of less than half the blade lengths for less than six months would not be expected to result in long-term damage (CRM 2000).

A recent laboratory study of *Phyllospadix scouoleri* suggested that short term sand burial may result in shoot mortality, decreased shoot counts, and reduced growth of surfgrass (Craig et al. 2008). The study found that shoot density decreased compared to controls for a burial depth of 0.8 feet (25 cm), but not shallower burial depths. Mean shoot growth rate decreased in all burial treatments. Therefore, the 50 ft Beach Width Alternative may result in some degradation of the shallower portion of the surfgrass habitat, but would not result in a significant loss of surfgrass. For the 50 ft Beach Width Alternative, the sand from the beach fill is predicted to move out of the equilibrium footprint within 6 years.

Considerable reef habitat that supports giant kelp, feather boa kelp, gorgonians, palm kelp, and sparse surfgrass is located approximately 1,000 to 1,300 ft (300 to 400 m) from shore. Little or none of the fill from the 50 ft Beach Width Alternative is expected to reach this area. The CRM and Moffatt & Nichol analysis predicted that less than 0.2 ft (0.06 m) of sand from the San Clemente beach fill would accrete in the kelp beds (CRM 2000). Similarly, beach profile monitoring of a somewhat larger volume of sand placed on the beach at Oceanside detected very little movement of the sand at 1,000 ft (300 m) or more from shore (Appendix D). Based on this information, it is unlikely that the proposed action would result in the transport of enough sand into kelp bed areas to result in a long-term net loss of the habitat.

Biological monitoring of sensitive habitats, including rocky intertidal, shallow subtidal reefs, and kelp forests, was conducted following implementation of the SANDAG Regional Beach Sand project, which placed sand on several beaches in San Diego County (AMEC 2005). Beach profile and biological monitoring data indicated a great deal of spatial and temporal variability in sediment transport. High sand levels were observed in the intertidal 15 months after the placement of 101,000 cy (76,760 m^3) of sand on Cardiff State Beach, but the sand deposition

was apparently unrelated to the beach nourishment event because similarly high sand levels were documented at the control site. There was no evidence of sand burial or scour effects at either the site near the beach fill or the control site except for a few buried mussels at the offshore reef at the Cardiff site.

Of 18 shallow subtidal reef locations monitored to assess potential impacts of the SANDAG project, only three showed an increase in sediment cover that may have been a result of the project (AMEC 2005). A monitoring site near Batiquitos Lagoon showed increased sedimentation two years following the SANDAG beach fill, suggesting a cause and effect relationship, but the increased sand levels were within variation observed during monitoring of the site before the beach fill. The increase in sediment cover at this site did not appear to have any biological effects because the cover and abundance of indicator species did not change. A monitoring site in North Carlsbad showed an increase in cover following the SANDAG beach fill and an associated decrease in surfgrass cover. However, there were multiple sources of sediment near this site and it is unclear to what extent the observed effects were related to the SANDAG project. The third site that showed a significant increase in sedimentation following the SANDAG beach fill was at Solana Beach. The SANDAG project was the only apparent source of sediment at this site. The increased sedimentation did not appear to affect surfgrass cover, but shoot density declined, possibly in response to the increased sedimentation.

Of the kelp bed sites monitored as part of the SANDAG program, some showed relatively constant sand cover, and some showed an increase in sediment cover following the SANDAG beach fill (AMEC 2005). The sand cover observed at the sites with increased sedimentation was within levels observed during pre-project monitoring, suggesting natural variation. The increases in sand cover did not appear to affect the distribution and abundance pattern of kelp bed indicator species. Giant kelp recruitment and persistence either increased or remained stable during the period following the SANDAG Regional Beach Sand project.

Monitoring of shallow subtidal kelp beds and lower intertidal surfgrass in Santa Barbara County indicated similar effects to those observed after the SANDAG project following a beach fill project at Goleta Beach (Chambers Group 2007). Approximately 77,526 cy (58,920 m^3) of sand was placed on Goleta Beach in 2003. The rocky intertidal areas downcoast from Goleta Beach increased in sand cover and depth and decreased in surfgrass cover in the winter following the beach nourishment project. These changes may have been related to sand from beach nourishment. However, surfgrass and sand cover following the beach nourishment event were within the variability shown at the site prior to beach nourishment. Surfgrass cover recovered rapidly later in 2004 as sand moved out of the area, indicating that the sand deposition was a brief occurrence.

No effects of the Santa Barbara beach nourishment project were observed on the Goleta Bay kelp beds until April 2005, 2-1/2 years following the beach fill (Chambers Group 2007). In April, 2005, following a wet winter storm season, sand increased on all Goleta Bay transects, and kelp declined. Although some of the sediment observed in the Goleta kelp beds probably came from the beach nourishment project, the sediment from the beach fill project was dwarfed by other inputs, including discharge of material dredged from sloughs by the Flood Control District into the surf zone and sediment input from Goleta Slough during and following the storms. By

September 2006, sand decreased on two of the shallow subtidal transects, and kelp was at pre-project densities. The most downcoast transect continued to be buried by sand. By August 2007, sediment decreased on the most downcoast transect, although sediment was still above pre-beach fill levels; and kelp density, although increasing, was still low. The kelp monitoring indicated that sedimentation (from beach fill in conjunction with other sources) may affect shallow kelp beds but that recovery occurs within about two to three years.

All of the available evidence indicates that the proposed action will have minor transitory effects, if any, on sensitive habitats in the vicinity of San Clemente Beach. The proposed beach fill is unlikely to result in a long-term net loss of a sensitive biological habitat. However, in a worst-case scenario, it is possible that the sand might not behave as predicted and that a large volume of sand could move into a sensitive biological habitat for a period that was long enough to result in permanent surfgrass loss or long-term cover of reefs. Therefore, shallow subtidal surfgrass beds off San Clemente Beach shall be monitored to document whether any long-term degradation that can be attributed to the proposed action occurs.

In addition to partial burial of surfgrass, offshore movement of sediment may result in filling in some holes and crevices in the shallow subtidal that are used by lobsters. These shallow subtidal reef areas are periodically covered and uncovered by sand naturally (i.e., in the absence of a beach nourishment project). The beach fill from this alternative would have only minimal effects on the considerable reef area near the end of San Clemente Pier and would not degrade that habitat for lobsters. Temporary degradation of a limited amount of inshore lobster habitat would not be significant.

Because the movement of sediment in the Oceanside littoral cell is primarily downcoast, burial of rocky intertidal habitat at Mariposa Point is highly unlikely. Similarly, the kelp bed areas are far enough offshore that little sediment from the proposed beach fill would be likely to reach them. Impacts to rocky intertidal habitat or kelp beds is expected to be less than significant.

Periodic renourishment at San Clemente would occur approximately every 6 years. The impacts of renourishment to sensitive habitats would be similar to those of initial placement. Effects, if any, are expected to be transitory and within natural variation. Because observations of other beach fill projects have documented that observed effects on sensitive habitats last between six months and two years, maintenance renourishment at a frequency of every 6 years would not be expected to result in permanent degradation of sensitive habitats. Sensitive habitats should be monitored to document any effects that may occur from beach renourishment. If impacts to surfgrass are observed, subsequent nourishment activities will be modified. If long-term impacts still are observed after modifying renourishment, then renourishment would not occur again until impacted surfgrass has recovered or mitigation is implemented.

Mitigation Measures:

MM-BR-50-2.1: An underwater survey for kelp and surfgrass shall be conducted by marine biologists prior to the initiation of beach fill activities. Based on the survey, a mooring location and a pipeline route shall be selected that minimizes contact with surfgrass and kelp habitat. If kelp and surfgrass cannot be avoided completely, immediately following beach fill activities,

another survey of the mooring and pipeline areas shall be conducted to determine whether kelp and surfgrass were damaged. If substantial damage to surfgrass or kelp occurs, an additional survey shall be conducted six months after the beach fill to determine if kelp and surfgrass have recovered. If substantial damage to kelp and eelgrass is still observed, restoration of habitat shall be implemented in consultation with the resource agencies.

MM-BR-50-2.2: Shallow subtidal surfgrass beds in the vicinity of San Clemente Beach shall be monitored to determine whether the proposed action adversely affects shallow subtidal reefs and surfgrass. Underwater transects shall be established offshore and downcoast from the proposed receiver beach. Control transects also shall be established upcoast of the project area. The transects shall be monitored by qualified biologists before and after the proposed action to determine whether the beach fill results in a long-term loss of surfgrass and/or reef habitat. The mitigation and monitoring plan is included as Appendix B. If adverse significant impacts to surfgrass and/or reef habitat compared to controls and baseline conditions are observed from the monitoring, subsequent nourishment activities will be modified to avoid or minimize these impacts as part of adaptive management. If adverse significant impacts still are observed after all reasonable attempts to avoid or minimize impacts have been exhausted, additional renourishment would not occur until impacted surfgrass has recovered or compensatory mitigation is completed. Compensatory mitigation will consist of the creation of shallow rocky habitat in the Project area at a site to be determined in consultation with NOAA Fisheries and CDFG. Rocky reef habitat will be created in the Project area at a ratio of 1 acre of rocky reef habitat created for 1 acre of rocky reef habitat buried. If the monitoring determines that surfgrass has been affected by the Project, an experimental surfgrass restoration will be implemented. A successful method to transplant surfgrass has not been demonstrated, but recent studies by researchers at the University of California, Santa Barbara, have demonstrated some success restoring surfgrass using sprigs (Bull et al 2004).

Summary of Significant Unavoidable Impacts:

If a substantial amount of surfgrass were lost, impacts may remain significant even with mitigation. Although the beach fill sand would be expected to move out of the equilibrium footprint within 6 years, because models are not precise, it is not clear if surfgrass would recover. If adverse significant impacts to surfgrass are observed from the monitoring, subsequent nourishment activities will be modified to avoid or minimize these impacts as part of adaptive management. If adverse significant impacts still are observed after all reasonable attempts to avoid or minimize impacts have been exhausted, additional renourishment would not occur until impacted surfgrass has recovered or and compensatory mitigation is completed. A consistently successful method to transplant surfgrass has not yet been devised, although recent experiments may provide new options. Potential mitigation, if necessary, is described in the Mitigation Monitoring and Reporting Plan (Appendix B).

Impact BR-50-3: *Substantial impedance to the breeding, movement or migration of fish or wildlife.*

The waters offshore San Clemente Beach are used for migration by gray whales. It is expected that gray whales would avoid the immediate vicinity of the dredge area. There is evidence of

marine mammals avoiding dredging operations (Richardson et al. 1995). Because the noise, turbidity and disturbance of dredging would be limited the immediate area surrounding the dredging activities, the area gray whales will avoid would consist of a small portion of the gray whale migration area. Therefore, dredging would not result in a substantial impedance to the movement or migration of gray whales or other marine mammals that may be migrating through the area.

Grunion may use the beach at San Clemente for spawning. This fish lays its eggs in the high intertidal zone between March and August. The beach fill will not occur during the grunion spawning season. Therefore, beach construction would not impact grunion.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact BR-50-4: *Substantial loss to the population of any native fish, wildlife or vegetation. For the purpose of this analysis substantial is defined as a change in a population that is detectable over natural variability for a period of five years or more.*

Offshore Dredging

Most of the benthic invertebrates within the area dredged from offshore Oceanside would be killed by the dredging. The borrow sites demensions are large enough in which benthics invertebrates will ingress from other near source populations. The borrow site (Borrow Area 2), located offshore Oceanside (shown in Figure 3-1) is approximately 940 acres, with a 128 acre area instead the borrow site (Borrow Area 2A) that contains the more desirable material. Some mobile organisms such as crabs may escape the dredge. Recovery of the benthic invertebrate community would be expected to begin almost immediately with settlement of larvae and immigration of mobile species from nearby unaffected areas. Recovery of the infaunal community to values comparable to pre-dredging levels may occur in as little time as six months or as long as two years, with an average of about one year (CSLC, USFWS, and USACE 2001). In some studies, diversity and abundance of benthic invertebrates increased after dredging after a short recovery period. Periodic sampling following the 1990 dredging of the Surfside/Sunset borrow site off Orange County initially found fewer macroinvertebrates than undredged control areas, but within less than 1 year there were no differences compared to control areas (Chambers Group 1992). The Surfside/Sunset borrow site was excavated again in 1997. Biological sampling of the site in 1999 observed more macroinvertebrate species and a greater abundance of organisms at the borrow site compared to nearby control areas (D. Diener, MEC Analytical Systems, personal communication 2000). Chambers Group (1996) sampled a borrow pit within Long Beach Harbor and found that the abundance, number of taxa, and species composition within the borrow site was similar to that in shallower areas outside the pit. The impact of dredging on invertebrates is not significant because the affected area would be small and the biota would recover quickly. There would not be a discernible impact on the population of any species.

Fishes would be expected to avoid the dredging area during dredging operations. Fish sampling was conducted following dredging in Marina del Rey Harbor and an unusually low number of fish species was collected compared to pre-dredging surveys (Soule et al. 1993). The investigators concluded that the dredging had disturbed the fishes. Within a few months, the number of fish species collected returned to pre-dredging levels. Laboratory studies have found that all life stages of estuarine and coastal fishes can survive high levels of turbidity for 24 hours or more (La Salle et al. 1991, Clarke and Wilber 2000). Fishes within the Oceanside source site would not be expected to be exposed to high enough sediment concentrations for long enough duration to suffer lethal or sublethal effects. Avoidance of the immediate dredging area and the turbidity plume generated during dredging would not be a significant impact on fishes. There would be no discernible impact on the population of any fish species.

Dredging at the Oceanside borrow site will temporarily reduce the invertebrate prey base for fishes such as turbots and white croakers that feed on benthic invertebrates. Recovery of the benthic invertebrate community is expected to take less than a year. Temporary degradation of a relatively small amount of foraging habitat is not expected to have a significant impact on fishes. Surveys of the Surfside/Sunset borrow site off Orange County found fewer fish immediately following a 1990 dredging episode, but within less than a year there were no differences compared to control areas (Chambers Group 1992). Sampling of the Surfside/Sunset borrow area in 1999 following a 1997 dredging episode detected a greater number of fish species, but lower total fish abundance at the borrow site compared to control areas (D. Diener, MEC Analytical Systems, personal communication 2000). Temporary reduction of the prey base within a small portion of the foraging habitat for bottom-feeding fishes would not be a significant impact. There would be no discernible impact on the population of any fish species.

The Oceanside borrow site is not located near any marine mammal breeding sites or important haul out, foraging, or congregating areas. The offshore habitat in the vicinity of Oceanside experiences a high level of vessel activity and considerable natural turbidity. Temporary disturbance to a small portion of the habitat of marine mammals would not have a significant impact. There would be no discernible impact on the population of any marine mammal species.

Sand Placement

Discharge of offshore sand onto receiver beaches would bury intertidal invertebrates living in the sand of receiver beaches. Most studies have found that the diversity, biomass, and abundance of sandy intertidal invertebrates declines following beach nourishment but that the community recovers within a few months (Ray and Clarke 2001, Parr et al 1978). Therefore, the effects of beach nourishment on sandy intertidal invertebrates would not be expected to be significant.

The proposed placement of sediments behind a dike would reduce the suspended sediment concentrations in the discharge. Nearshore fishes are highly unlikely to be exposed to suspended sediment concentrations that would have lethal or sublethal effects. Because the turbidity would be limited in extent and would be confined to the naturally turbid surf zone and rip current areas, significant impacts of turbidity to nearshore fishes are unlikely. Some fishes may avoid the turbid areas. Temporary turbidity within a limited area in the vicinity of the surf zone would not

have a discernible impact on the population of any fish species, and impacts would not be significant.

It is expected that shorebirds will avoid the immediate areas where people and equipment are constructing the beach. Chambers Group (2005) monitored dredging of a sand bar in the Talbert Channel in Huntington Beach and placement of the dredged sand in the upper intertidal of the adjacent beach. Shorebirds avoided the immediate areas where the dredging and disposal activities were occurring but foraged undisturbed in the mid- to lower intertidal on the adjacent beaches. However, AMEC (2002) noted that during the SANDAG project some shorebirds (e.g., sandpipers, godwits, curlews) were present on the receiver sites during beach discharge of sediments. Gulls were attracted to the discharge and fed on invertebrates and fishes that were in the dredged material as it was being pumped to the beach. Because beach nourishment activities would be confined to the immediate vicinity of construction activities within a limited beach fill area, avoidance of the beach fill area by shorebirds would not be a significant impact. There would be no discernible impact to the population of any species.

Turbidity plumes generated during beach fill operations at the receiver sites could interfere with foraging by visually-feeding birds such as gulls, terns, pelicans and cormorants. However, turbidity plumes would be expected to be confined primarily to the naturally turbid surf zone and associated rip currents. Therefore, the impacts of turbidity from the discharge of sediments to receiver beaches would not be expected to be significant.

Shorebirds that forage in the intertidal could be affected if beachfill resulted in a substantial loss of their invertebrate prey base. However, as discussed above, the sandy intertidal invertebrate community has been observed to recover from sand burial within a few months (Ray and Clarke 2001, Parr et al. 1978). Beach fill would occur only on a limited portion of the available sandy beach in the San Clemente area. Therefore, the proposed action is not expected to have a significant impact on the prey base for shorebirds. The greater amount of sand on San Clemente Beach following beach nourishment would be expected to have a beneficial effect on marine birds by increasing resting habitat. The SANDAG project appeared to have had a positive effect on bird use of receiver beaches in Encinitas (SAIC 2005). Prior to beach nourishment, few birds were observed on beaches with extensive cobble cover or shallow sand depths in the upper and middle intertidal zones. Following beach nourishment, the total number of bird species and bird abundance increased on receiver sites and was higher than on non-receiver sites. The increase in bird use at the sand placement sites following beach nourishment was thought to be a result of the greater beach widths created by the beach nourishment project. Similarly CZR Incorporated (2003) found that resting behavior of laughing gulls and royal terns increased following beach nourishment in North Carolina, although feeding behavior by gulls and terns did not change following beach nourishment. The behavioral data suggested that gulls and terns increased the percentage of their time spent resting after beach nourishment probably because of the greater available beach space. However, CZR Incorporated found little evidence that the North Carolina beach nourishment project affected shorebird abundance.

Most of the turbidity would be confined to the naturally turbid surf zone and associated rip currents. Bottlenose dolphins are the marine mammal most likely to occur within the surf zone. Because of the limited area affected by Project-generated turbidity plumes in relationship to the

much wider foraging area of marine mammals, beach nourishment at the receiver sites would not have a significant impact on marine mammals.

Impacts to marine organisms from renourishment, approximately every 6 years, would be similar to those of initial beach construction. Each renourishment event would involve approximately 251,000 cy (192,000 m^3) for an estimated eight renourishment cycles over the Project life. Because invertebrate communities in the dredge and beach placement areas would be expected to recover in between six months and two years, a substantial loss in these invertebrate populations would not be expected to occur. Other impacts of dredging and beach fill, including temporary disturbance and turbidity, are short term and would not cause substantial population losses. The impacts of renourishment on marine populations would not be significant.

Mitigation Measure: None.

Summary of Significant Unavoidable Impacts: None

Impact BR-50-5: *Substantial adverse impact on Essential Fish Habitat*

As discussed in Section 4.4.2.5, the Project area includes Essential Fish Habitat that supports numerous species managed under the Magnuson-Stevens Fishery Management and Conservation Act. Surfgrass and kelp forests are particularly important habitats for many fishes because these areas provide food and shelter. Potential impacts of the proposed action to these sensitive biological habitats were discussed under Impact BR-50-2. Mitigation Measure MM-BR-50-2.1 would insure that mooring of the hopper dredge and temporary placement of a pipeline to pump sand to the beach would not occur within significant kelp or surfgrass habitat.

Cross shore movement of sand from the 50 ft Beach Width Alternative would not impact kelp habitat, but may have some impacts to surfgrass. The predicted sand increase from the 50 ft Beach Width Alternative likely would be within the range tolerated by surfgrass without substantial loss. However, Mitigation Measure BR-50-2 would be implemented to monitor surfgrass and mitigate impacts if any occur.

Impact BR-50-3 discusses potential impact of beach construction to grunion spawning. The proposed beach construction would not impact grunion spawning because it would occur outside the grunion spawning season of March to August.

The impacts to fishes of dredging at the Oceanside borrow site and turbidity that may occur in nearshore waters during discharge of dredged sediments to the beach are discussed under Impact BR-50-4. Impacts to EFH of these activities would be of short duration and limited spatial extent. The benthic invertebrate community, which is the prey base for many fish species, would recover in-between renourishment events, which would occur approximately every 6 years. A substantial adverse impact on EFH would not occur and impacts would not be significant.

Mitigation Measures: Implement MM-BR-50-2.1 and MM-BR-50-2.2.

Summary of Significant Unavoidable Impacts:

If a substantial amount of surfgrass were lost, impacts may remain significant even with mitigation. Although the beach fill sand would be expected to move out of the equilibrium footprint within 6 years, it is not clear if surfgrass would recover. If adverse significant impacts to surfgrass are observed from the monitoring, subsequent nourishment activities will be modified to avoid or minimize these impacts as part of adaptive management. If adverse significant impacts still are observed after all reasonable attempts to avoid or minimize impacts have been exhausted, additional renourishment would not occur until impacted surfgrass has recovered or compensatory mitigation is completed. A consistently successful method to transplant surfgrass has not yet been devised, although recent experiments may provide new options. Potential mitigation, if necessary, is described in the Mitigation Monitoring and Reporting Plan (Appendix B).

5.4.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact BR-115-1: *A direct adverse effect on the population of a special status listed species or the loss or disturbance of important habitat for a listed species.*

Impacts of the 115 ft Beach Width Alternative on special status species would be similar to those of the 50 ft Beach Width Alternative. Turbidity potentially could affect foraging by California least terns. California least terns breed on the beaches of Camp Pendleton near the Oceanside borrow area. Because the Project would occur outside of the least tern breeding season, turbidity generated during dredging would not affect them.

Western snowy plovers do not breed near San Clemente Beach and rarely forage there. Because San Clemente Beach is not important habitat for snowy plovers, if one or two individuals were temporarily disturbed by beach construction, the impact would not be significant.

Mitigation Measures: None.

Summary of Significant Unavoidable Impacts: None

Impact BR-115-2: *A long-term net loss in the habitat value of a sensitive biological habitat. For the purposes of this analysis, kelp beds, surfgrass beds, and well developed rocky intertidal are considered sensitive biological habitats.*

Figure 4-10 shows the construction and equilibrium footprints for the 115 ft Beach Width Alternative in relationship to surfgrass and kelp in the Project area. The sand placement footprint does not include any kelp beds, surfgrass, or rocky intertidal areas. Therefore, no direct impacts to sensitive habitats would occur from the placement of sand on the beach. Like the 50 ft Beach Width Alternative, placement of a mono buoy and a temporary pipeline on the bottom potentially could damage sensitive biological resources like kelp and surfgrass. Impacts may be reduced to not significant by avoiding the placement of these temporary structures in sensitive habitats.

Following initial placement, a portion of the sand may move upcoast, downcoast, and offshore depending on the magnitude, direction, and period of waves. Figure 3-3 shows the equilibrium footprint of the 115 ft Beach Width Alternative. Beach fill from the 115 ft Beach Width Alternative is not expected to extend upcoast as far as the significant rocky intertidal habitat at Mariposa Point. Therefore, like the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative would not have a significant impact to rocky intertidal habitat.

Figure 5-3 shows the cross-section of the equilibrium footprint of the 115 ft Beach Width Alternative at T-Street reef. The equilibrium profile suggests that the 115 ft Beach Width Alternative will result in burial impacts of the entire reef. The shallow portions of the reef may be buried by over a meter of sand (about 4 feet). This level of sedimentation would result in at least partial burial of all of the shallow surfgrass in the inshore portions of the reef. On the offshore portions of the reef, burial impacts would be expected to range from partial burial to complete burial. Therefore, the 115 ft Beach Width Alternative has the potential to result in substantial burial of surfgrass over the entire reef with likely significant impacts on the surfgrass habitat. The sediment from the 115 ft Beach Width Alternative would move out of the area in about 10 years. It is not known to what extent surfgrass would eventually recover if renourishment did not occur.

The 115 ft Beach Width Alternative also would result in sedimentation of considerable reef habitat that supports giant kelp, feather boa kelp, gorgonians, palm kelp and sparse surfgrass. The burial of up to a meter or more of reef habitat may include some of the smaller rocks and prevent the recruitment of kelp. The sedimentation also may kill gorgonians and fill in crevices used by lobster. The 115 ft Beach Width Alternative, thus, has the potential to result in significant degradation of high-value nearshore reef habitat. Degradation of reef habitat that supports sensitive biological resources would be a significant adverse impact.

Although biological monitoring of beach fill projects has indicated that previous beach fills have resulted in minor temporary impacts on sensitive habitat, the monitored projects involved beach fills with substantially smaller volumes of sediment than the 115 ft Beach Width Alternative that would place 586,000 cy (448,000 m^3) on San Clemente Beach. It is likely that the greater volume of sediment would result in greater impacts and that those impacts may be more persistent. It is not known to what extent resources would recover, if at all, between maintenance events scheduled to occur every 10 years for the 115 ft Beach Width Alternative. Even if renourishment did not occur, the ability of resources to recover from the predicted burial impacts is unknown.

Mitigation Measures: Implement MM-BR-50-2.1 and MM-BR-50-2.2

Summary of Significant Unavoidable Impacts

If a substantial amount of surfgrass were lost or if significant burial occurred within the kelp bed near San Clemente Pier, impacts may be significant even with mitigation. Although the beach fill sand would be expected to move out of the equilibrium footprint within 10 years, because models are not precise, it is not clear if surfgrass and high value reef habitat would recover. If adverse significant impacts to surfgrass are observed from the monitoring, subsequent

nourishment activities will be modified to avoid or minimize these impacts as part of adaptive management. If adverse significant impacts still are observed after all reasonable attempts to avoid or minimize impacts have been exhausted, additional renourishment would not occur until impacted surfgrass has recovered or compensatory mitigation is completed. A consistently successful method to transplant surfgrass has not yet been devised, although recent experiments may provide new options. Potential mitigation, if necessary, is described in the Mitigation Monitoring and Reporting Plan (Appendix B).

Impact BR-115-3: *Substantial impedance to the breeding, movement or migration of fish or wildlife.*

Like the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative would not interfere with the migration of whales or other marine mammals. Because beach construction would not occur during the grunion spawning season of March through August, the Project would not impact grunion spawning.

Mitigation Measures: None

Summary of Significant Unavoidable Impacts: None

Impact BR-115-4: *Substantial loss to the population of any native fish, wildlife or vegetation. For the purpose of this analysis substantial is defined as a change in a population that is detectable over natural variability for a period of five years or more.*

With the exception of impacts to surfgrass and high value reefs discussed under Impact BR 5.4.3-2, the impacts of offshore dredging and sand placement on fish, wildlife and vegetation would be the same for the 115 ft Beach Width Alternative as for the 50 ft Beach Width Alternative. Dredging at the Oceanside borrow side and placement of sand on the beach at San Clemente would be a temporary disturbance that would not result in substantial loss to the population of any native fish wildlife or vegetation. The 115 ft Beach Width Alternative would require a longer construction period than the 50 ft Beach Width Alternative, but renourishment would occur less frequently (every 10 years compared to every 6 years for the 50 ft Beach Width Alternative).

Mitigation Measures: None.

Summary of Significant Unavoidable Impacts: None

Impact BR-115-5: *Substantial adverse impact on Essential Fish Habitat*

Surfgrass and kelp forests are particularly important habitats for many fishes because these areas provide food and shelter. Potential impacts of the proposed action to these sensitive biological habitats were discussed under Impact BR-50-2. Mitigation Measure MM-BR-50-2.1 would insure that mooring of the hopper dredge and temporary placement of a pipeline to pump sand to the beach would not occur within significant kelp or surfgrass habitat.

The offshore movement of the sand placed on the beach for the 115 ft Beach Width Alternative is likely to result in significant burial impacts to surfgrass and high value reef habitat that supports kelp beds. Mitigation Measure MM-BR-50-2.2 would provide for monitoring and mitigation to address those impacts. However, it is unknown if the affected habitats would fully recover and if the mitigation (creation of reef habitat and an experimental surfgrass transplant) would fully replace the lost habitats especially surfgrass, which is difficult to restore.

Impact BR-115-3 discusses potential impact of beach construction to grunion spawning. The proposed beach construction would not impact grunion spawning because it would occur outside the grunion spawning season of March to August.

The impacts to fishes of dredging at the Oceanside borrow site and turbidity that may occur in nearshore waters during discharge of dredged sediments to the beach are discussed under Impact BR-115-4. Impacts to EFH of these activities would be of short duration and limited spatial extent. The benthic invertebrate community, which is the prey base for many fish species, would recover in-between renourishment, which would occur approximately every 10 years. A substantial adverse impact on EFH would not occur and impacts would not be significant.

Mitigation Measures: Implement MM-BR-50-2.1 and BR-50-2.2.

Summary of Significant Unavoidable Impacts:

If a substantial amount of surfgrass were lost or if significant burial occurred within the kelp bed near San Clemente Pier, impacts may remain significant even after mitigation. Although the beach fill sand would be expected to move out of the equilibrium footprint within 10 years, it is not clear if surfgrass and high value reef habitat would recover. If adverse significant impacts to surfgrass are observed from the monitoring, subsequent nourishment activities will be modified to avoid or minimize these impacts as part of adaptive management. If adverse significant impacts still are observed after all reasonable attempts to avoid or minimize impacts have been exhausted, additional renourishment would not occur until impacted surfgrass has recovered or compensatory mitigation is completed. A consistently successful method to transplant surfgrass has not yet been devised, although recent experiments may provide new options. Potential mitigation, if necessary, is described in the Mitigation Monitoring and Reporting Plan (Appendix B).

5.4.4 Impacts Related to the No Action Alternative

Under the No Action alternative, none of the impacts associated with offshore dredging and beach construction would occur. There would be no potential for turbidity plumes that may be generated during Project-related dredging off Oceanside or beach placement to temporarily impact bird foraging. Under the No Action Alternative, there would be no potential for organisms at the borrow site or on the beach at San Clemente to be disturbed temporarily by beach nourishment activities.

Under the No Action Alternative, there would be no potential for sensitive surfgrass or kelp habitat to be damaged by the placement of mooring anchors or the submerged pipeline. Under the No Action Alternative, there would be no potential for sediment dredged off Oceanside and placed on the beach at San Clemente to migrate into sensitive shallow subtidal habitats and bury rocks and surfgrass. However, rocks and surfgrass in the San Clemente area still could be subjected to sand inundation from natural sediment movement and/or other projects that discharge sediment to the beach or nearshore zone.

Under the No Action Alternative, the beach area in the vicinity of San Clemente would continue to be depleted of sand. The narrow beach would reduce foraging opportunities for the western snowy plover and other shorebirds. The impacts of a reduced beach width would not be significant because snowy plovers do not breed near San Clemente, and San Clemente Beach is not an important wintering habitat for them. The reduced beach width would not have a discernible impact on the population of any shorebird species. A narrow beach at San Clemente also would reduce the amount of spawning habitat available for grunion. Although opportunities for grunion spawning are limited, it is unlikely that narrowing of the beach at San Clemente would have a discernible impact on the grunion population.

Under the No Action Alternative, it is likely that emergency seawalls would be constructed to protect structures. These emergency seawalls would result in a reduction of beach space for birds and upper beach invertebrates. This limited loss of beach space for bird foraging and roosting and invertebrates would not be a significant impact.

5.4.5 Summary of Biological Resources Effects and Issues

During the DEIS/R review process, and in preparing the FWCA CAR, several issues were raised by regulatory resources agencies: FWS/Carlsbad, NMFS/Long Beach, CDFG/Region V Marine Division, and EPA. The most important of these, discussed below, are:

1. Baseline biological surveys
2. Mitigation ratios
3. Opportunistic beach nourishment
4. Upfront mitigation funds and implementation

5.4.5.1 Baseline biological surveys

The FEIS/R uses the best available scientific data for the subject analysis. As noted in the FEIS/R, 25 transects were established and monitored by recognized experts and knowledgeable marine ecologists. These field data clearly capture the extent of rocky reef, single boulders, and surfgrass. The larger rocky reef was delineated by divers floating buoys to the surface demarcating the approximate edge of the reef and a biologist in a kayak at the surface recording GPS points of the surfaced buoys. Twelve GPS points delineated this reef, known as the T-Street Rocky Reef.

No data exists that depicts or illustrates the extent of rocky reef or surfgrass for the entire locale. On 31 January 2011, two years after regular coordination meetings commenced, NMFS

recommended use of San Diego Nearshore Program data from the UC San Diego website. The Corps compared the Nearshore Program data from the UC San Diego website http://nearshore.ucsd.edu/, and found the data justify and compliment the Corps mapped distribution of rocky reef and single boulders. Figure 4-10 and Figure 5-7 through Figure 5-9

illustrate the comparison of the US Army, Corps of Engineers San Clemente Shoreline rocky reef and surfgrass vegetation to the University of California, San Diego, Nearshore Mapping Program.

These figures show the Corps surfgrass survey results along with the outer T- Street reef in comparison to the Nearshore Program data from the UC San Diego web site. Comparison reveals that the large kelp bed mapping by the Corps (see Figure 4.4-2 in the FEIS/R) is more detailed and in the same geographic distribution alignment as the UCSD Nearshore program raster data. Furthermore, the Corps data is much more detailed in its distribution from the shoreline to a line 500 feet off-shore. The UCSD Nearshore data has little, if any, data with the same area distance.

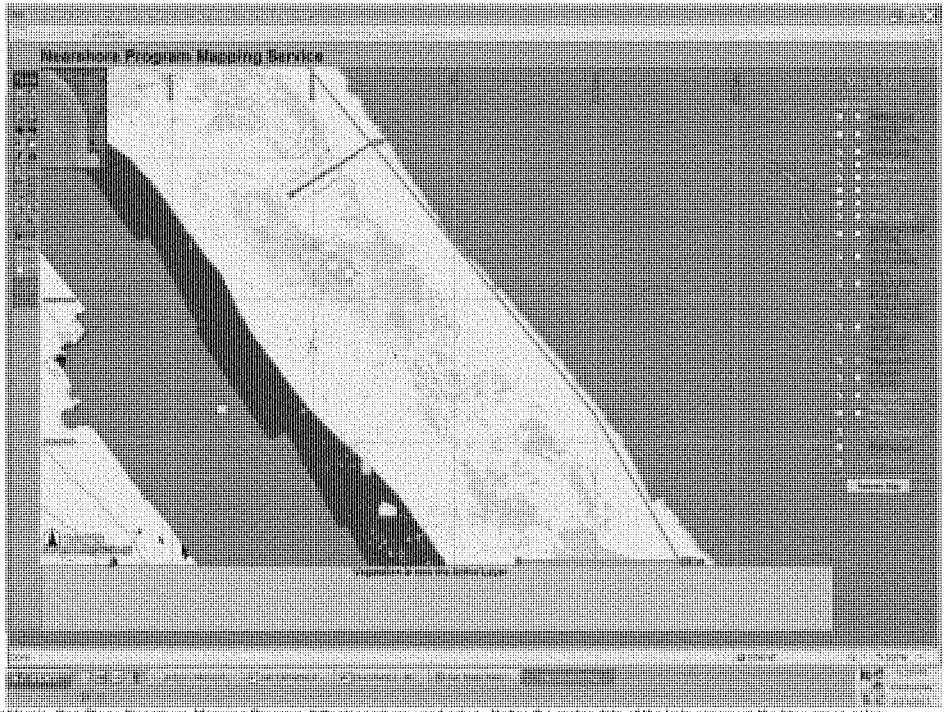
While the Corps acknowledges that there are scattered rocks within and outside the equilibrium footprint, the total acreages of these scattered rocks is not enough to change the analysis. Furthermore, field sampling indicates that the surfgrass in this vicinity inhabits and is growing on 1 to 2 ft (0.3 to 0.6 m) boulders, and has average blade lengths of 2 to 3 ft (0.6 to 0.9 m). Nevertheless, during the PED phase, the Corps may utilize the U.S. Army Engineer Research and Development Center's (ERDC) Submerged Aquatic Vegetation Early Warning System (SAVEWS), discussed below, to refine this analysis.

The Submersed Aquatic Vegetation Early Warning System (SAVEWS) is a semi-automated acoustic-based measurement system that can detect and characterize submersed aquatic vegetation (SAV) while operating from a small survey boat. It uses an off-the-shelf digital echo sounder, with a narrow single-beam high-frequency transducer, and global positioning system (GPS) equipment to digitally record echo intensity and position data on a laptop. Software developed at the U.S. Army Engineer Research and Development Center (ERDC-EL) processes the distinct signature of SAV within the recorded signal to determine depth, plant height, and plant coverage every few meters along transect lines.

The resource agencies commented that the baseline surveys for surfgrass and rocky reef were conducted at a cursory reconnaissance level and, therefore, were inadequate to depict their respective distributions.

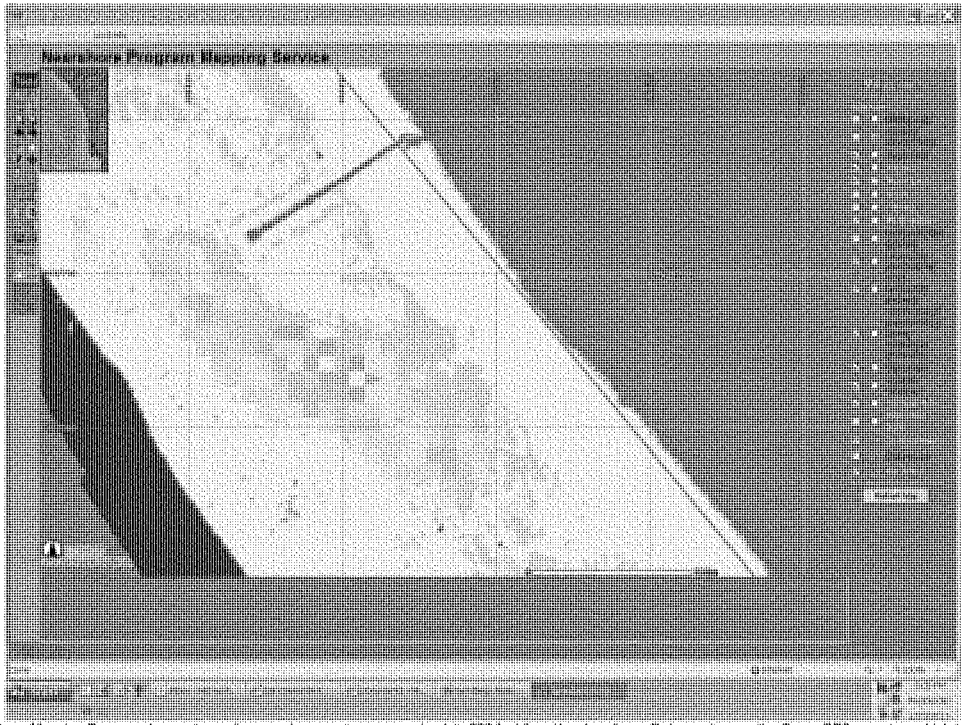
It should be clear that the Corps rocky reef and surfgrass surveys were conducted at more than just reconnaissance or cursory levels. The absence of surfgrass and reef in some transects should not be construed as an absence of scrutiny, e.g., the seagrass did not disappear. Above all, the surveys provided the information needed to assess potential impacts, and the basis needed for discussion and evaluation of project alternatives, along with potential monitoring and mitigation.

Figure 5-7 UC San Diego Nearshore Mapping Program



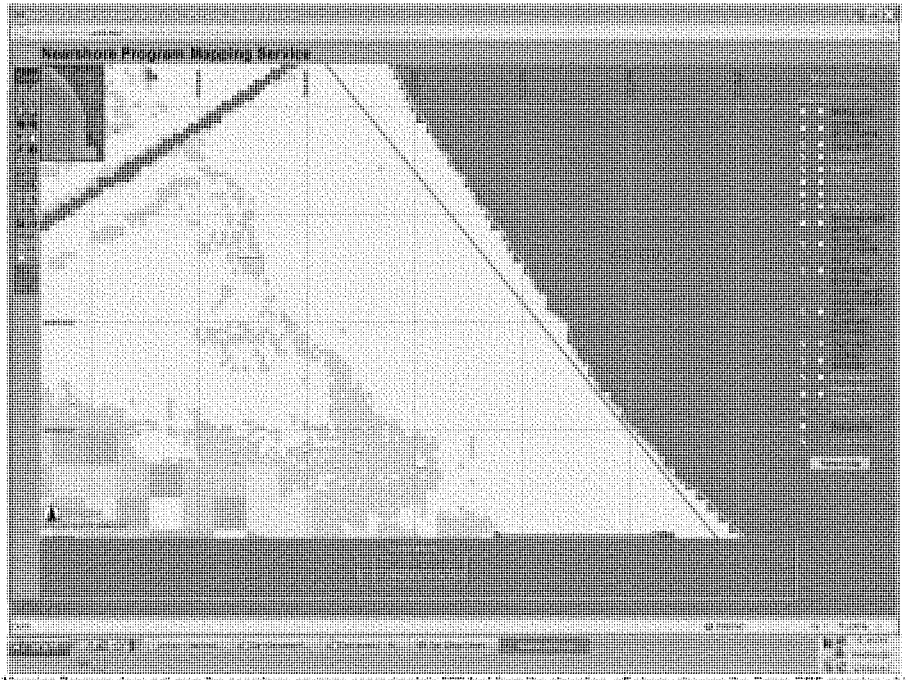
University of California, San Diego Nearshore Mapping Program http://nearshore.ucsd.edu/. Notice the raster data of the help canopy in the blue green color.

Figure 5-8 UCSD Nearshore Program Data 500 Feet From Shoreline



UCSD Nearshore Mapping Program does not map the nearshore environ approximately 500 feet from the shoreline, offshore whereas the Corps GPS mapping, which included 25 transects, did map rocks and outcrops inside the 500 feet zone.

Figure 5-9 UCSD Nearshore Program Data



UCSD Nearshore Mapping Program does not map the nearshore environment approximately 500 feet from the shoreline, offshore whereas the Corps GPS mapping which included 25 transects did map rocks and surfgrass inside the 500 feet zone.

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5.4.5.2 Mitigation Ratios

The resource agencies want mitigation to be provided for prior to or concurrent with project impacts, and supplemented as needed to offset any additional, significant long-term adverse impacts documented under the monitoring program. If mitigation is not provided in advance of project impacts, the mitigation plan should address temporal losses of resources and include adequate compensation to address such losses at a greater than 1:1 mitigation ratio. The value and amount of "out of kind" mitigation proposed also needs further evaluation and discussion with the resource agencies. Out of kind mitigation is generally considered adequate only if conservation to impact ratios is proposed at a greater than 1:1 ratio.

The Corps does not see any effects or impacts to the T-Street reef and the surfgrass vegetation, and thus concludes that no mitigation is required. Nonetheless, if effects are observed a monitoring, mitigation and reporting plan (MMRP) has been developed in concert with the resources agencies. This plan will undergo further scrutiny during the PED by a team including ERDC Submerged Aquatic Vegetation Restoration Research Program (SAVRRP) experts and the resources agencies. If impacts are not observed, the Corps will continue to monitor for effects and will continue to collaborate with ERDC and the resources agencies to identify an appropriate mitigation design in the future if determined to be needed.

No ATR or IEPR comments raised this as a concern, and uncertainty persists as to whether there will be any impacts at all to rocky reef and surfgrass vegetation from the recommended alternative. Because of this, monitoring and adaptive management are included as an integral component of the project's implementation plan. If and when impacts are detected, they will be compensated for.

Corps planning policy is clear on the use of functional habitat evaluation assessment or functional assessments (FA):

> *Mitigation Planning Objectives. Mitigation planning objectives are clearly written statements that prescribe specific actions to be taken to avoid and minimize adverse impacts, and identifies specific amounts (units of measurement, e.g. , habitat units) of compensation required to replace or substitute for remaining, significant unavoidable losses" [ER 1105-2-100, App C, Paragraph C-3.b (13)]* and *"habitat-based evaluation methodologies... shall be used to describe and evaluate ecological resources and impacts" [ER 1105-2-100, App C, Paragraph C-3 d)]*

The Corps does not use ratios, but instead a scientific based approach through the use of functional habitat evaluation assessment (FA). A basic FA was used in the best professional judgment (BPJ) approach, and a more robust FA will be accomplished in PED during monitoring of the project and reference sites. The Corps impact analysis was thorough in its thought process, and based in collaboration with the resources agencies during a series of conference meetings.

A BPJ analysis was used to determine if impacts would occur in part and to what extent to the rocky reef and corresponding surfgrass vegetation. A BPJ approach was taken because: 1) there

are no functional habitat evaluation assessment models or accounting systems for rocky reef habitat certified, or otherwise accepted, by the Corps Environmental Professional Center of Expertise (PCX), and 2) potential impacts to the rocky reef and surfgrass vegetation, as analyzed using a certified coastal engineering model, would be negligible on ecological resources.

The Corps doesn't have any type of "functional assessment" or "habitat assessment" designed, in turn, specifically for seagrasses (D Shafer. PhD, ERDC, personal communication, March 2011). The problem with developing a Habitat Suitability Index (HSI) type analysis for surfgrass is that there is insufficient information to construct standard HSI curves. Surfgrass has been so little studied that it is not clear if investigators could even come up with a species list of organisms unique to that habitat, much less create a curve that shows the relationship between surfgrass percent cover and "habitat value" (D. Shafer, PhD, ERDC, personal communication, March 2011).

This lack of data dictated a simpler interim approach based on presence/absence of surfgrass. Absence could be subdivided into areas that have the potential to function as surfgrass habitat (e.g. suitable depth, hard substrate) and those that have habitat unsuitable to support surfgrass (e.g. soft bottom, below depth limits) (D. Shafer, PhD, ERDC, personal communication, March 2011).

Scientific literature (Wyllie-Echeverria et. al 2007) indicates that surfgrass *Phyllospadix torreyi* is distributed widely along the entire Pacific Coast; and occurs from the northern tip of Vancouver Island, Canada to Isla Santa Margarita (Phillips 1979, Ramirez- Garcia et al. 2002), Baja, California, with its primary abundance south of Monterey, California (Phillips 1979). It is, however, unknown if P. *torreyi* is unique for a certain array of marine organisms or if it provides foraging, cover, and spawning habitat for obligate fish.

Based again on the coastal engineering beach profiles, it is uncertain if the rocky reef and surfgrass vegetation will be affected at all by project implementation. The marine ecologists who sampled the T-street reef (Rick Ware, M.S., Coastal Resources Management [15 years], and Noel Davis, PhD, Chambers Group [35 years]) are extremely experienced and knowledgeable in their sampling design, implementation of data collection, and data analysis.

The best available scientific data suggest that the 50 foot (15 meters) proposed action will have negligible effects on the habitat value of surfgrass beds. The coastal engineering model shows the predicted equilibrium cross-section footprint of the 50 ft (15 m) Beach Width Alternative at T-street reef. This profile indicates that most of the sediment accumulation will occur in the inshore area. Surfgrass in this area grows on 1 to 2 ft (0.3 to 0.6 m) boulders and has average blade lengths of 2 to 3 ft (0.6 to 0.9 m). The equilibrium footprint of the 50 ft (15 m) Beach Width Alternative likely would result in a range of negligible effects of no burial of surfgrass on the larger rocks to partial burial on the smaller boulders. Burial of surfgrass on the outer portions of T-street reef would not occur. Surfgrass is adapted to partial sand burial, routinely survives seasonal sand burial of part of its blades, and can recover quickly via regrowth if the root system is intact. The degree of sand burial surfgrass can withstand, however, is not well documented (SANDAG 2000). However, Coastal Resources Management (CRM 2000) observed surfgrass in

the deepest portion of T-Street reef with 2/3 of its blades covered with sand, which suggested surfgrass could withstand temporary burial of up to 2/3 of its blade length.

To predict the potential burial of surfgrass at San Clemente, CRM and Moffatt and Nichol analyzed impacts to surfgrass from a similar proposed beach fill project at Linda Lane and T-Street (CRM 2000). Their analysis predicted that placement of 175,000 cy (133,000 m^3) of sand at Linda Lane and T-Street would result in a maximum 1 ft (0.3 m) burial of surfgrass for less than six months. Approximately 1 ft (0.3 m) of burial would bury less than 50 percent of the surfgrass blade length at these sites. Based on observation of burial of existing offshore surfgrass in the area, CRM (2000) proposed a criterion of sand burial of no more than 2/3 of the blade length for six months or less as a level that surfgrass can withstand, and concluded that burial of less than half the blade lengths for less than six months would not be expected to result in long-term damage (CRM 2000).

The estimate that approximately 20 percent of the reef or 1 acre would experience significant burial was determined by superimposing the sand distribution cross section predicted by Corps coastal engineers on the offshore bathymetry and by delineating the reef as well as the surfgrass locations measured in the field by Chambers Group. The sand distribution analysis predicted that the equilibrium footprint of the beach fill would extend to about 60 percent of the reef and to the entire identified surfgrass habitat, but that only the inner portion of the reef would receive substantial sand burial. Beyond the inner portions of the reef, the sand layer was predicted to be just a thin layer that would not bury surfgrass blades. The inner portion of the reef where the cross section showed burial was about 20 percent of the reef. Because the reef is about 5 acres in extent, the area of impact was estimated to be 1 acre.

A recent laboratory study of *Phyllospadix scouoleri* suggested that short term sand burial may result in shoot mortality, decreased shoot counts, and reduced growth of surfgrass (Craig et al. 2008). The study found that shoot density decreased compared to controls for a burial depth of 0.8 feet (25 cm), but not shallower burial depths. Mean shoot growth rate decreased in all burial treatments. Therefore, the 50 ft (15 m) Beach Width Alternative may result in some negligible degradation of the shallower portion (inner T-Street reef) of the surfgrass habitat, but would not result in loss of surfgrass. For the 50 ft (15 m) Beach Width Alternative, the sand from the beach fill is predicted to move out of the equilibrium footprint within 6 years.

Considerable reef habitat that supports giant kelp, feather boa kelp, gorgonians, palm kelp, and sparse surfgrass is located approximately 1,000 to 1,300 ft (300 to 400 m) from shore. None of the fill from the 50 ft (15 m) Beach Width Alternative is expected to reach this area. The CRM and Moffatt & Nichol analysis predicted that less than 0.2 ft (0.06 m) of sand from the San Clemente beach fill would accrete in the kelp beds (CRM 2000). Similarly, beach profile monitoring of a somewhat larger volume of sand placed on the beach at Oceanside detected very little movement of the sand at 1,000 ft (300 m) or more from shore. Based on this information, negligible effects of the proposed action would result in the transport of enough sand into kelp bed areas to result in a long-term net loss of the habitat.

A BPJ was accomplished by the marine ecologists who have sampled the T-street reef, as well as the rocky reefs adjacent to the project site, and who are extremely experienced and

knowledgeable in their sampling design, implementation of data collection, and data analysis. During the PED phase a more robust functional habitat evaluation assessment will be accomplished using ERDC's Submerged Aquatic Vegetation Restoration Research Program and/or the Northwest Habitat Institute's Combined Habitat Assessment Protocol (CHAP). CHAP has undergone independent scientific review in the Pacific Northwest and is under review with the Corps PCX.

Mitigation funds are included as part of the contingency funds for the project. The expectation is that while there may be negligible effects to the inner rocky reef and surfgrass vegetation; actual monitoring data will be needed to support this determination, or to identify that there will be no significant impacts. Monitoring for 2 years immediately post construction is proposed to determine actual impacts.

The Project has a mitigation budget that accommodates 1 acre of impacts to surfgrass plus 1 acre of impacts to reef, for a total potential impact to 2 acres of resources as a worst-case scenario. Initial modeling by the Corps shows that there is potential to impact 20 percent of the inshore edge of T-Street reef; and 5 acres of the T-Street reef. Twenty percent of the inshore edge is a reasonably foreseeable estimate of impacts based on a best professional judgment functional habitat evaluation assessment and the coastal engineering model. Both the BPJ FA and the coastal engineering model considered the potential depth in addition to area; however that detail is not in inches, but in feet. A greater impact area would be unlikely, but an additional acre of potential impacts was included in the contingency mitigation budget to account for an unlikely worst-case scenario.

The Corps does not use ratios, but instead a scientific-based approach through the use of functional habitat evaluation assessment. A basic FA was used in the BPJ approach and a more robust FA will be accomplished in PED during the monitoring of the project site and the reference site. As previously stated, *Phyllospadix torreyi* is distributed widely along the entire Pacific Coast; and occurs from the northern tip of Vancouver Island to Baja, California, with its primary abundance south of Monterey, California. It is not known if P. *torreyi* is unique for a certain array of marine organisms or if it provides foraging, cover, and spawning habitat for obligate fish. It has been stated by CDFG that it provides forage for juvenile lobster, a CDFG harvest taxa.

Because resource agency recommendations for mitigation were only clarified in their response to the DEIS, development and certification of a habitat model to assess surfgrass impacts was not previously contemplated. NMFS recommended using their mitigation ratio calculator and started the high end ratio at 5:1. Other agencies (EPA and CDFG) wanted to use the Corps Regulatory Division 1.5:1 as the minimum ratio. To accomplish this, $3.7 million dollars are included in the cost of the recommended alternative for monitoring, mitigation, and reporting as a contingency. Nonetheless, contingency costs are included in total project costs, but monitoring may ultimately determine that less mitigation acres is required and thus costs may be lower.

Absent readily available models to assess potential impacts to surfgrass (such as habitat evaluation procedures habitat suitability indices) technical experts at ERDC concur that patch/size of impacts is the appropriate metric to use as the feasibility planning phase approaches

closure. Model development will be pursued during PED, in turn, as a basis for monitoring, assessing and documenting any impacts immediately before and at regular intervals after initial sand placement.

Habitat Equivalency Analysis appears to be a good approach in this situation (D. Shafer, PhD, ERDC, personal communication, March 2011). According to ERDC, it has been successfully used for seagrass habitat in other settings.

Although percent cover is commonly used as a metric, there is a lack of science to justify inferring a linear relationship between SAV percent cover and habitat function. Data is lacking, for example, with which to say 80% SAV cover is twice as good as 40% cover for juvenile lobster habitat utilization (D. Shafer, PhD, ERDC, personal; communication, March 2011). ERDC recommended consideration, for now, of patch size/area as the only metric which we can speak to now with any degree of scientific confidence. There are at least a couple of modeling (HEAT) and habitat accounting system (CHAP) approaches to for use later on, as proposed, to assess effects of San Clemente sand placement.

The Corps developed cost effectiveness/ incremental cost analysis (CE/ICA) table in the mitigation plan/report showing costs and acres (where acres are our substitute for outputs) for various mitigation alternatives (L. Skaggs, Corps South Pacific Division [SPD], personal communication, March 2011). Surfgrass restoration is estimated to cost $2 million per acre, a linear relationship; while kelp forest restoration costs $500k per acre. A simple graphic display of the costs and acres for the various alternatives reveal why the recommended alternative represents the "best" mitigation plan (L. Skaggs, Corps SPD, personal communication, March 2011). Since costs and outputs/acres are linear, in the sense that there are no efficiencies or inefficiencies as surfgrass production rates change, the selection of the alternative becomes a question of "how much surfgrass output is needed to compensate for estimated impacts" (L. Skaggs, Corps SPD, personal communication, March 2011).

An Institute for Water Resources (IWR) Planning Suite analysis on the costs and outputs was accomplished and provided for mitigation alternatives (Figure 5-10 and Figure 5-11). Figure 5-10 shows the cost effectiveness of the contingent mitigation based upon the IWR Planning Suite analysis illustrates that kelp is the Best Buy followed by surfgrass for all alternatives. Figure 5-11 shows the cost effectiveness of the contingent mitigation based upon the IWR Planning Suite analysis illustrates that kelp is the Best Buy. The distributions show, that Group C kelp restoration is the most cost effective and the only Best Buy solution. If the kelp restoration is excluded from the mix, then Group C surfgrass would be the most efficient (and the only Best Buy solution). Acres were the only metric used to characterize outputs, since no other habitat values are available. It is critical to note that if kelp is acceptable as a restoration outcome, the natural resources would obtain as much kelp as surfgrass for 1/14 the cost (for 5 acres). If the Corps were to only plan to recommend 1 acre of surfgrass for mitigation, then the natural resources could gain 5 times as much kelp (5 acres) for less than 1/3 the cost.

Figure 5-10 San Clemente Shoreline Protection Mitigation Alternatives

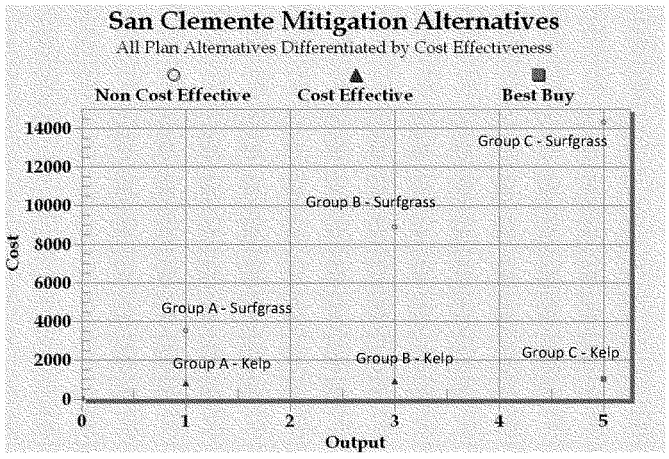
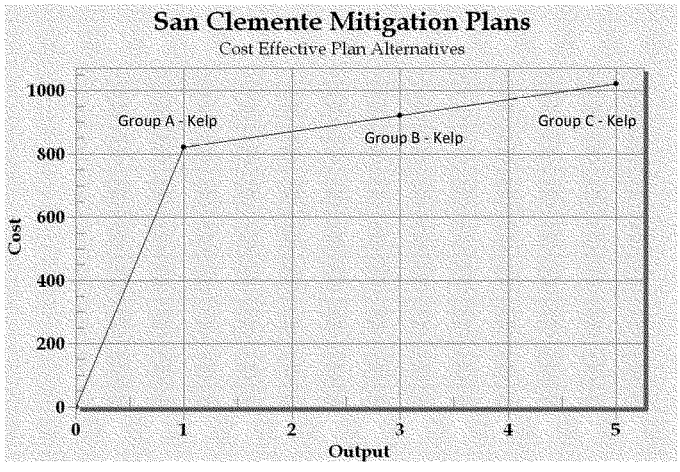


Figure 5-11 San Clemente Shoreline Protection Mitigation Plans



5.4.5.3 Opportunistic Beach Nourishment

The City of San Clemente has adopted a program to actively pursue opportunities for obtaining suitable sand for placement on San Clemente's beaches for erosion control and recreational benefits. The program is designed to obtain surplus sand from upland construction, development, or dredging projects in the region and place it on the City's beaches as nourishment. The purpose of the program is to capitalize on opportunities to obtain beach quality sand from construction projects and other sources when it becomes available. If the sand is determined to be beach-compatible, the material will be placed on the beach or nearshore area at a selected location, rather than disposing of it at an inland disposal site.

The four placement sites and one stockpile site include:

1. The beach at North Beach, just south of the San Clemente Metrolink train station and at the terminus of Avenida Pico, extending a distance of 1,500 feet, referred to as the North Beach Fill Site;
2. The beach near Linda Lane, south of Mariposa Point and north of the pier, extending a distance of 1,500 feet, referred to as the Linda Lane Beach Fill Site;
3. The beach north of the beach commonly known as T-Street Beach, extending from the pier 1,000 feet south, referred to as the T-Street North Beach Fill Site;
4. The beach south of the beach commonly known T-Street Beach, extending south a distance of 1,200 feet referred to as the T-Street South Beach Fill Site; and
5. The Animal Shelter stockpile site located east of Avenido Pico and north of 'El Camino Real.

During the last five renewals of the Corps Regulatory opportunistic beach nourishment permit, the applicant did not use the permit even once. The key point the opportunistic program takes into consideration is the condition of the beach before sand placement. If beach locations at San Clemente do not need sand, it is not placed. Multiple placement sites are considered in an opportunistic program, and there are no guarantees that San Clemente will receive any sand at all. Sand is not placed at every site every time sand is available. Opportunistic programs, moreover, typically have volumes of sand magnitudes smaller than would be required at this beach (e.g., 10,000 to 40,000 cy instead of 200,000 cy). In addition, any future renourishment for this project will be based on the need for said sand. It does not automatically get renourished every 5 years. That is simply the estimated time frame when the beach is expected to retreat to a width of zero ft (0 m). If there is no need for renourishment at 5 years, the beach will not be renourished. There is no additive effect of both projects, in sum, that would result in over-nourishing the project site. Over-nourishment is unlikely since the beach has already retreated dramatically from the historic width.

The City of San Clemente's Corps Regulatory permit will be conditioned (J. Lambert, personal communication, March 2011) to not allow any opportunistic beach nourishment once the PED phase has commenced, most likely sometime in FY2012. The opportunistic beach nourishment cannot affect the Shoreline Protection project's reference site at Mariposa Point or and down coast littoral zone sand movement.

5.4.6 Upfront mitigation, endowments, third party agreements and implementation

It is the Corps policy in ER 1105-2-100, App C, Paragraph C-3 d. (1) (a) and following:

e. Mitigation Planning and Recommendations.
(1) General. District commanders shall ensure that project-caused adverse impacts to ecological resources have been avoided or minimized to the extent practicable, and that remaining, unavoidable impacts have been compensated to the extent justified. The recommended plan and the NED plan, if not one in the same, shall contain sufficient mitigation ecological resources (Section 906(d), WRDA '86). Any such mitigation measures will be fully justified.

The Corps typically plans to implement mitigation features, along with other project features, in the construction phase. While this scenario is typically based on known impacts to be mitigated, in this case there may be a planned lag to truly define the impacts that the models suggest may occur. Mitigation funds are included as part of the contingency funds for the project because effects to the inner rocky reef and surfgrass vegetation, if any, are uncertain. The expectation is that at most negligible effects and impacts to the inner rocky reef and surfgrass vegetation will occur; however, actual monitoring data are needed to support said predicted negligible effects. Mitigation is typically conducted before construction, but typically the likely impacts are known, which is not the case for this project. Monitoring for 2 years immediately post construction is proposed to determine what actual impacts are.

No direct placement of sand on the reef is proposed. The equilibrium footprint is that demonstrated as potentially extending to inner portions of the reef. Based on the best available scientific and coastal engineering data, it is predicted that there will be negligible effects to the rocky reef and surfgrass vegetation. Monitoring for 2 years immediately post construction is proposed to determine what actual impacts, if any, do occur. After the first four years (2 years pre-action, 2 years post-action) of monitoring, if the rocky reef and surfgrass vegetation illustrate effects based on triggers specifically determined by the marine ecologists deemed most knowledgeable and experience, the current plan is to attempt "in-kind" mitigation as the primary mode. If "in-kind" mitigation is not successful, based on success criteria developed in PED in consultation with said experts, the mitigation would be adjusted to "out-of-kind" mitigation. Because of numerous uncertainties surrounding surfgrass restoration, that is, the Corps will develop a compensatory secondary mitigation plan (out-of-kind). In sum, mitigation funds are included as part of the contingency funds for the project because impacts cannot reasonably be determined at this time.

Federal funds cannot be provided to establish an endowment fund for long-term mitigation because of the prohibition against "advance payments" set forth in 31 U.S. Code Section 3324. Federal law prohibits payment under a contract to provide goods and services may not be for more than the value of the goods or services already delivered or provided. The Corps cannot provide funds unless and until it receives goods or services.

The Corps can obtain mitigation services only under a competitively solicited FAR contract. It cannot fund a designated "third party" for mitigation services. Finally, funds obligated under an FY 11 contract must be spent in FY 11.

5.5 Cultural Resources

5.5.1 Significance Criteria

Adverse effects to sites and properties listed on, or eligible for, the NRHP are evaluated based on the Criteria of Adverse Effect as outlined in 36 (CFR) 800.5 of the regulations implementing Section 106 of the NHPA. The criteria of adverse effect is as follows:

An adverse effect is found when an undertaking may alter, directly or indirectly, the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of an historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register.

- An adverse effect is found when an undertaking may alter, directly or indirectly, the characteristics of an historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of an historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register.
- Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.
- Adverse effects on historic properties include, but are not limited to: (i) Physical destruction of or damage to all or part of the property; (ii) Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation and provision of handicapped access, that is not consistent with the Secretary's Standards for the Treatment of Historic Properties (36 CFR part 68) and applicable guidelines; (iii) Removal of the property from its historic location; (iv) Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance; (v) Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features; (vi) Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and, (vii) Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

5.5.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Based on investigations conducted by Los Angeles District archeologists, the USACE has determined that there are no historic properties within the onshore portion of the Area of Potential Effect (APE). However, the San Clemente Municipal Pier is located within the APE, and it is considered locally significant and is listed on the City's Historic Structures List. Project activities along the onshore portion of the Project area involve the placement of dredged sands onto the beach. This alternative will most likely not impact the San Clemente Municipal Pier in any way. The proposed construction staging areas will be in nearby paved parking lots adjacent to the beach and Pier; these areas are already disturbed by development.

As for the offshore portions of the APE, the USACE has yet to determine whether or not these areas contain historic properties. Remote sensing surveys will be used to locate submerged cultural resources.

Mitigation Measures:

MM-CR-50-1: Any earthmoving associated with this Project that will involve previously undisturbed soil will be monitored by a qualified archeologist who meets the Secretary of Interior's Standards for an Archeologist (see 36 CFR Part 61). Earthmoving includes grubbing and ground clearing, grading, and excavation activities. If a previously unidentified cultural resource (i.e., property) that may be eligible for the NRHP is discovered, all earthmoving activities in the vicinity of the discovery shall be diverted until the USACE complies with 36 CFR § 800.13(a)(2).

MM-CR-50-2: Prior to construction, offshore borrow areas 1 and 2 will be subjected to an underwater remote sensing survey in order to determine if submerged cultural resources are present within these areas. The USACE will comply with Section 106 of the NRHP and its implementing regulations at 36 CFR 800, as amended. This compliance involves the identification and evaluation of cultural resources and consultation with the California State Historic Preservation Officer (SHPO), Native American tribes, and interested parties.

Significant and Unavoidable Impacts: None.

5.5.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

As with the 50 ft Beach Width Alternative, there are no historic properties within the onshore portion of the Area of Potential Effect (APE). However, the San Clemente Municipal Pier is located within the APE, and it is considered locally significant and is listed on the City's Historic Structures List. Project activities along the onshore portion of the Project area involve the placement of dredged sands onto the beach. This alternative will most likely not impact the San Clemente Municipal Pier in any way. The proposed construction staging areas will be in nearby paved parking lots adjacent to the beach and Pier; these areas are already disturbed by development.

As for the offshore portions of the APE, the USACE has yet to determine whether or not these areas contain historic properties. Remote sensing surveys will be used to locate submerged cultural resources.

Mitigation Measures: Implement MM-CR-50-1 and MM-CR-50-2.

Significant and Unavoidable Impacts: None.

5.5.4 Impacts Related to the No Action Alternative

Under the No Action Alternative, it is likely that emergency seawalls would be constructed to protect structures. This alternative would not result in any impacts to historic properties and thus would not disturb the site of the Proposed Action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.6 Ground and Vessel Transportation

5.6.1 Significance Criteria

An impact to transportation will be considered significant if a project alternative:

- Causes an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections);
- Exceeds, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways;
- Results in a change in air traffic patterns, including either an increase in traffic levels or a change in location, that result in substantial safety risks;
- Substantially increases hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment);
- Results in inadequate emergency access;
- Results in inadequate parking capacity;
- Conflicts with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks).

5.6.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact T-50-1: *Causes an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections).*

The initial beach nourishment proposes no trucking of materials for disposal. The only ground traffic that will be associated with the Project will be associated with the construction workers traveling to and from the construction site. The increase in ground traffic would not be substantial in relation to the existing traffic load or capacity of the street system. The initial beach nourishment would involve a barge and associated tow boats traveling from Oceanside Harbor to the Project site. Offshore dredge equipment has the potential to result in a hazard to boat traffic. However, during dredging and nourishment operations, proper advanced notice to mariners would be provided, and navigational traffic would not be allowed within the offshore borrow site area or mooring/discharge area directly offshore of Oceanside Harbor or San Clemente Pier. In addition, the proposed Project is not in an area of active navigation. Long-term maintenance would create the same impacts as the proposed action approximately every 6 years. The dredging operator shall pre-coordinate all planned dredging and transport operations with Camp Pendleton. Construction and maintenance impacts would be considered less than significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-50-2: *Exceeds, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways.*

The initial beach nourishment proposes no trucking of materials for disposal. The only traffic that will be associated with the Project will be that associated with the construction workers traveling to and from the construction site. The Project would not exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways. Therefore, impacts would be considered not significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-50-3: *Results in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks.*

The only traffic that will be associated with the Project will be that associated with the construction workers traveling to and from the construction site. The proposed Project involves

dredging and beach nourishment only and would not result in a change in air traffic patterns. Therefore, impacts would be considered not significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-50-4: *Substantially increases hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment).*

The proposed Project involves dredging and beach nourishment only and would not increase hazards due to design features or incompatible uses. Therefore, impacts would be considered not significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-50-5: *Results in inadequate emergency access.*

The initial beach nourishment involves the building of sand berms to create fill areas; however, only one of these areas will be constructed at any given time and shall be small segments of the beach so that minimal impacts to the beach would occur. In addition, there will always be alongshore beach access during this process. The Project would have a less than significant impact on emergency access.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-50-6: *Results in inadequate parking capacity.*

The initial beach nourishment proposes no trucking of materials for disposal. The only traffic that will be associated with the Project will be that associated with the construction workers traveling to and from the construction site. Parking lots are located at Linda Lane Park, across the street from the Pier, and at T-Street. In addition, there is street parking on the local streets. Parking capacity will not be impacted. Therefore, impacts would be considered not significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-50-7: *Conflicts with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks).*

The proposed Project involves dredging and beach nourishment only and would not conflict with adopted policies, plans, or programs supporting alternative transportation. Therefore, impacts would be considered not significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.6.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact T-115-1: *Causes an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections).*

The 115 ft Beach Width Alternative proposes no trucking of materials for disposal. The only ground traffic that will be associated with this alternative will be associated with the construction workers traveling to and from the construction site. The number of construction workers would be the same as for the proposed action and therefore the associated daily traffic would be the same. The length of the construction period associated with this alternative would be greater than the proposed action but the repetition of the long-term maintenance would be less frequent. The increase in ground traffic would not be substantial in relation to the existing traffic load or capacity of the street system.

As with the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative would involve a barge and associated tow boats traveling from Oceanside Harbor to the Project site. The number of daily trips would be the same as the proposed action. The length of the construction period associated with this alternative would be greater than the proposed action but the repetition of the long-term maintenance would be less frequent. Offshore dredge equipment has the potential to result in a hazard to boat traffic. However, during dredging and nourishment operations, proper advanced notice to mariners would be provided, and navigational traffic would not be allowed within the offshore borrow site area or mooring/discharge area directly offshore of Oceanside Harbor or San Clemente Pier. In addition, the 115 ft Beach Width Alternative is not in an area of active navigation. Long-term maintenance would create the same impacts as the proposed action though at a less frequent rate of approximately every 10 years. Construction and maintenance impacts would be considered less than significant and the similar to the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-115-2: *Exceeds, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways.*

As with the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative proposes no trucking of materials for disposal. The only traffic that will be associated with this alternative will be that of the construction workers traveling to and from the construction site. The number of construction workers would be the same as for the proposed action and therefore the associated daily traffic would be the same. The length of the construction period associated with this alternative would be greater than the proposed action but the repetition of the long-term maintenance would be less frequent. This alternative would not exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways. Therefore, impacts would be considered not significant and the similar to the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-115-3: *Results in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks.*

The only traffic that will be associated with this alternative will be that associated with the construction workers traveling to and from the construction site. As with the proposed action, the 115 ft Beach Width Alternative involves dredging and beach nourishment only and would not result in a change in air traffic patterns. Therefore, impacts would be considered not significant and the same as the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-115-4: *Substantially increases hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment).*

As with the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative Project involves dredging and beach nourishment only and would not increase hazards due to design features or incompatible uses. Therefore, impacts would be considered not significant and the same as the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-115-5: *Results in inadequate emergency access.*

As with the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative involves the building of sand berms to create fill areas; however, only one of these areas will be constructed at any given time and shall be small segments of the beach so that minimal impacts to the beach would occur. In addition, there will always be alongshore beach access during this process. This Alternative would have a less than significant impact on emergency access and the similar to the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-115-6: *Results in inadequate parking capacity.*

The 115 ft Beach Width Alternative proposes no trucking of materials for disposal. The only traffic that will be associated with this alternative will be that associated with the construction workers traveling to and from the construction site. The number of construction workers would be the same as for the 50 ft Beach Width Alternative and, therefore, the associated daily traffic would be the same. The length of the construction period associated with this alternative would be greater than the proposed action but the repetition of the long-term maintenance would be less frequent. Parking lots are located at Linda Lane Park, across the street from the Pier, and at T-Street. In addition, there is street parking on the local streets. Parking capacity will not be significantly impacted. Therefore, impacts would be considered not significant and the similar to the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact T-115-7: *Conflicts with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks).*

The 115 ft Beach Width Alternative involves dredging and beach nourishment only and would not conflict with adopted policies, plans, or programs supporting alternative transportation. Therefore, impacts would be considered not significant and the same as the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.6.4 Impacts Related to the No Action Alternative

Under the No Action Alternative, it is likely that emergency seawalls would be constructed to protect structures. This alternative would not result in any impacts to ground or vessel transportation and thus would not disturb the proposed Project area.

5.7 Land Use and Policy

5.7.1 Significance Criteria

An impact to land use will be considered significant if a project alternative:

- Physically divides an established community;
- Conflicts with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect; and/or
- Conflicts with any applicable habitat conservation plan or natural community conservation plan.

5.7.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact LU-50-1: *Physically divides an established community.*

The construction and long-term maintenance of the proposed Project will neither disrupt nor divide any established community and, therefore, will have no impact on an established community.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact LU-50-2: *Conflicts with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect.*

The construction and long-term maintenance (i.e., renourishment) of the proposed Project does not conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Project adopted for the purpose of avoiding or mitigating an environmental effect and there would be no impact.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact LU-50-3: *Conflicts with any applicable habitat conservation plan or natural community conservation plan.*

The City of San Clemente became a signatory agency in the Orange County Southern Natural Community Conservation Plan (NCCP)/Habitat Conservation Plan (HCP) subregional plan in May 1993. The construction and long-term maintenance of the proposed Project will not conflict with the OC southern NCCP/HCP and, therefore, impacts would be considered not significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.7.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact LU-115-1: *Physically divides an established community.*

The construction and long-term maintenance of the 115 ft Beach Width Alternative will neither disrupt nor divide any established community and, therefore, will have no impact on an established community, same as the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact LU-115-2: *Conflicts with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect.*

The construction and long-term maintenance of the 115 ft Beach Width Alternative does not conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Project adopted for the purpose of avoiding or mitigating an environmental effect and there would be no impact, same as the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact LU-115-3: *Conflicts with any applicable habitat conservation plan or natural community conservation plan.*

The City of San Clemente became a signatory agency in the Orange County Southern NCCP/ HCP subregional plan in May 1993. The construction and long-term maintenance of the 115 ft Beach Width Alternative will not conflict with the OC Southern NCCP/HCP and, therefore, impacts would be considered not significant, same as the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.7.4 Impacts Related to the No Action Alternative

The No Action Alternative would not involve any dredging or beach nourishment activity. No impacts to land use would occur from the lack of these construction activities. Under the No Action Alternative, it is likely that emergency seawalls would be constructed to protect structures. Potential maintenance activities by SCRRA would have no impact on land use.

5.8 Noise

5.8.1 Significance Criteria

For stationary sources, the applicable noise standards include criteria established by local as well as any State regulations applicable to the proposed Project. Mobile-source noise (i.e., vehicle and vessel noise) is preempted from local regulation. Here an impact is considered significant if the existing noise levels exceed the objectives of the General Plan (i.e., 60 dBA CNEL for residential and noise sensitive areas) and the Project were to increase this noise level by 3 dBA (barely noticeable in an exterior environment); or if the Project adds 5 dBA (noticeable to most people) and the resultant noise level remains under the objectives of the General Plan.

All projects constructed in the City of San Clemente are subject to standard conditions set forth in the Municipal Code. The City of San Clemente noise standards are identified in Municipal Code Ch 8.48 (Noise Control) (Table 5-9).

Table 5-9 San Clemente Noise Standards

	7:00 AM to 10:00 PM	10:00 PM to 7:00 AM
Residential		
Exterior	55 dBA	50 dBA
Interior	50 dBA	40 dBA
Commercial	65 dBA	60 dBA
Industrial	70 dBA	70 dBA

Compliance with these provisions is mandatory and as such, does not constitute mitigation under CEQA. Those conditions specific to noise are included below:

- City Municipal Code Section 8.48.090, *Exemptions from Chapter*, that exempts noise sources associated with construction activities, provided said activities do not take place outside the hours of 7:00 a.m. and 6:00 p.m. Monday through Friday and 8:00 a.m. to 6:00 p.m. on Saturday, with no construction allowed on Sundays and City-observed holidays unless a permit is granted by the Community Development Director or his or her authorized representative.

- Any activity or equipment to the extent that design regulation thereby has been preempted by State or Federal law. This would include noise generated from the use of on-road and ocean-going vehicles.

5.8.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact N-50-1: *Exposure of Persons to or Generation of Noise Levels in Excess of Standards Established in the Local General Plan or Noise Ordinance, or Applicable Standards of Other Agencies.*

In accordance with the City of San Clemente Municipal Code, sensitive residential land uses carry a daytime noise standard of 55 dBA between the hours of 7:00 a.m. and 10:00 p.m. and a nighttime standard of 50 dBA between the hours of 10:00 p.m. and 7:00 a.m.

However, in accordance with the City Municipal Code, construction is exempt from these standards so long as it is restricted to between the hours of 7:00 a.m. and 6:00 p.m., Monday through Friday and 8:00 a.m. to 6:00 p.m. on Saturday, with no construction allowed on Sundays and City-observed holidays unless a permit is granted by the Community Development Director or his or her authorized representative. These hours are requisite within the City and therefore, adherence to these hours is mandatory and does not constitute mitigation.

Because on-shore construction would not be performed outside of these hours, it is exempt from the stationary-source noise standards and therefore would not expose local residents to noise levels in excess of any regulatory standards and the impact is less than significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact N-50-2: *Exposure of Persons to or Generation of Excessive Groundborne Vibration or Groundborne Noise Levels.*

The 50 ft Beach Width Alternative would result in the addition of sand to the City of San Clemente beach. Excessive groundborne vibration is typically associated with such activities as large-scale demolition, pile driving, or blasting, none of which would be required during site construction. Only minimal groundborne vibrations would be created during Project construction activities associated site development and no significant vibration impacts would result from Project development.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact N-50-3: *A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.*

The 50 ft Beach Width Alternative represents a construction effort with a duration of 46 days. The Project would not result in any new structures nor is it expected to increase beach attendance and its associated traffic. As such, there would not be a permanent increase in the ambient noise levels and the impact is less than significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact N-50-4: *A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.*

Noise levels associated with construction activities would be higher than the ambient noise levels in the Project area, but would subside once construction of the Project is completed. Two types of noise impacts could occur during the construction phase. First, the transport of workers and equipment to the construction site would incrementally increase noise levels along site access roadways. Four pieces of heavy construction equipment would initially be delivered to the staging area and would be removed at the end of the construction period. Additionally, 10 workers (and vehicles) would make the daily commute to the construction site. Even though there could be a relatively high single event noise exposure potential with passing trucks during the mobilization and demobilization of the heavy equipment (a maximum noise level of 86 dBA at 50 feet), the increase in daily construction traffic is minimal and any addition to on-road noise would be less than 1 dBA when averaged over a 24-hour period, and would therefore have a less than significant impact on noise receptors along the vehicle routes.

The second type of impact is related to noise generated by onsite construction equipment and local residents would be subject to elevated noise levels due its operation. The FHWA provides noise data for construction equipment in its publication FHWA Highway Construction Noise Handbook (August 2006). The 50 ft Beach Width Alternative would use two front-end loaders and two dozers to conduct the on-shore activities. The FHWA document notes that of 55 measurements taken of bulldozers, the maximum measured levels (Lmax) averaged 82 dBA as measured at a distance of 50 feet. The logrithmetic average (Leq) noise is projected at 78 dBA also as measured at a distance of 50 feet. Similarly, front-end loaders are averaged at 79 dBA Lmax (75 dBA Leq) at 50 feet based on 96 measurements. If a loader and dozer were to work together in unison, the Leq is calculated at approximately 80 dBA as measured at a distance of 50 feet. This value is then used to determine the potential impact of the project.

The nearest existing residents are located to the northeast at a distance of about 55 - 60 meters from the closest point of the Project area. Assuming that these pieces generated a noise level of 80 dBA Leq at 50 feet, the resultant exterior noise at the receptor is calculated at 68 dBA Leq. Interior noise levels with windows closed would be reduced by over 20 dBA from this value. Most of the time, these levels (both exterior and interior) would be considerably lower due to increased distance as this represents the point where the equipment is operating most proximate to any given resident.

As noted above, the beach is located within the 65 dBA CNEL contour while the proximate receptors are estimated at about 60 dBA CNEL. Assuming that the daytime noise levels approximate the CNEL (i.e., 60 dBA at the receptors), the Project could raise noise at the most proximate receptors to approximately 69 dBA for an increase of 9 dBA. This level exceeds the 3-dBA threshold where the resultant noise is anticipated to exceed the goals of the Noise Element (i.e., 60 dBA CNEL for sensitive land uses) and the impact is considered as potentially significant.

Assuming that two pieces of heavy equipment work in unison, the equipment would produce a noise level of 60 dBA Leq as measured at a distance of approximately 500 ft (152 m). This also is the assumed ambient noise level at the residents and the addition of this construction noise would result in a composite noise level of 63 dBA Leq. This 500 ft (152 m) then represents the distance to the point of a 3-dBA increase for a significant impact. As such, any construction within 500 ft (152 m) of the proximate residents could create a significant impact.

On occasion, beach-based heavy equipment may be required to operate at night to keep up with the dredge. Any use of land-side equipment outside of the hours of 7:00 a.m. and 6:00 p.m. on weekdays, 8:00 a.m. and 6:00 on Saturdays, or at any time on Sundays or City-observed holidays represents a potentially significant impact.

Use of the dredge would also create noise. The dredge would use diesel engines for propulsion, dredging activities, and to provide on-board electric power. Dredge operations are projected to occur 24-hours per day, 7-days per week. A tug boat would be used to position the unit.

The noise produced by the dredge is based on data obtained by Mestre Greve and documented by Helix Environmental (Upper Newport Bay Unit III Sediment Control and Enhancement Project, Volume II Initial Study Technical Appendices, October 15, 1996). That report addressed the use of a 500 hp hydraulic dredge and measured a noise level of 67 dBA at a distance of 100 feet. The Project could use a dredge that is as much as 10 times more powerful than the unit measured by Helix. Assuming that the noise level is directly related to the power level, dredge noise would be approximately 10 dBA louder than that measured by Helix and here a value of 77 dBA as measured at 100 feet is assumed for dredging operations. The dredge would be assisted by a tug boat of approximately 4,268 horsepower. This would essentially double the use of offshore horsepower increasing this noise by 3 dBA. As such, offshore activities are estimated at 80 dBA as measured at a distance of 100 feet, or roughly 6 dBA louder than the two pieces of shore equipment working in unison if the noise was projected at a similar distance.

At its nearest point, the dredge would be positioned at about 2,500 ft (763 m) from receptors at San Clemente during pump-out, and about 4,200 ft (1,280 m) from the Oceanside receptors at the borrow site. Assuming that the dredge and tug work in unison off San Clemente, the noise at the proximate receptors is calculated at 52 dBA Leq. When added to the 60-dBA ambient level, at the receptor locations, the composite noise is calculated at 60.6 dBA for an increase of 0.6 dBA.

When added to the on-shore construction noise when heavy equipment operates proximate to the residents (i.e., 69 dBA Leq at the receptors), the composite noise is calculated at 69.1 dBA for an increase of 0.1 dBA. In summary, while the noise from the dredge may be audible when working late at night, its increase to the ambient noise is too small to be significant. Furthermore, the noise of the dredge is too low to add substantially to the noise of the on-shore equipment.

At a distance of approximately 4,200 ft (1,280 m) from receptors at the Oceanside borrow site, the dredge would produce a noise level of 44.5 dBA Leq. Assuming that the receptors in the Oceanside area also are subject to an existing level of 60 dBA, the addition of 44.5 dBA results in a composite level of 60.1 dBA for an increase of just 0.1 dBA. This level of increase is too small to be notable and is well under the 3-dBA threshold and would not be significant.

Mitigation Measures:

MM-N-50-3.1: The City of San Clemente Noise Element discusses the potential impacts of construction noise on the residents and requires construction to employ feasible and practical techniques and practices that minimize the generation of excessive noise on adjacent land uses. The Applicant shall implement the following:

- Regardless of dredge activity timing, on-shore equipment shall be restricted to the hours included in the City of San Clemente Noise Ordinance discussed above.
- To reduce the nuisance value of on-shore construction noise, on-shore construction activities located within 500 ft (152 m) of any residential unit shall not begin before 8:00 a.m. (as opposed to 7:00 a.m. as allowed in the Noise Ordinance). Work beyond may be performed in accordance with the hours included in the City Noise Ordinance. This

provision shall not apply to any equipment mobilizing from the staging area that may pass within 500 ft (152 m) so long as it is not actively engaged in the movement of sand.

- During all construction, the Project contractors shall equip all on-shore construction equipment with properly operating and maintained mufflers and engine shrouds consistent with manufacturers' standards.
- All heavy equipment shall be maintained in a proper state of tune as per the manufacturers' specifications.
- The Project contractor shall place any stationary construction equipment as far as feasible from proximate receptor locations and oriented such that emitted noise is directed away from sensitive receptors.

Implementation of these, or equally effective, measures would reduce the impact to less a less than significant level.

Significant and Unavoidable Impacts: None.

Impact N-50-5: *For a Project Located Within an Airport Land Use Plan or, Where Such a Plan Has Not Been Adopted, Within Two Miles of a Public Airport or Public Use Airport, Would the Project Expose People Residing or Working in the Project Area to Excessive Noise Levels.*

The Project site is not located within two miles of any airports and would not result in significant exposure to aircraft noise.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact N-50-6: *For a Project Within the Vicinity of a Private Airstrip, Would the Project Expose People Residing or Working in the Project Area to Excessive Noise Levels.*

The proposed Project is not located in the vicinity of a private airstrip and would not be impacted by private airport operations.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.8.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact N-115-1: *Exposure of Persons to or Generation of Noise Levels in Excess of Standards Established in the Local General Plan or Noise Ordinance, or Applicable Standards of Other Agencies.*

As with the 50 ft Beach Width Alternative, because on-shore construction would not be performed outside of these hours, it is exempt from the stationary-source noise standards and, therefore, would not expose local residents to noise levels in excess of any regulatory standards and the impact is less than significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact N-115-2: *Exposure of Persons to or Generation of Excessive Groundborne Vibration or Groundborne Noise Levels.*

The 115 ft Beach Width Alternative would result in the addition of sand to the City of San Clemente beach. Excessive groundborne vibration is typically associated with such activities as large-scale demolition, pile driving, or blasting, none of which would be required during site construction. Only minimal groundborne vibrations would be created during Project construction activities associated site development and no significant vibration impacts would result from Project development.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact N-115-3: *A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.*

The 115 ft Beach Width Alternative represents a construction effort with a duration of 108 days. The Project would not result in any new structures nor is it expected to increase beach attendance and its associated traffic. As such, there would not be a permanent increase in the ambient noise levels and the impact is less than significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact N-115-4: *A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.*

As with the 50 ft Beach Width Alternative, noise levels associated with construction activities would be higher than the ambient noise levels in the Project area, but would subside once construction of the Project is completed. Two types of noise impacts could occur during the construction phase. First, the transport of workers and equipment to the construction site would incrementally increase noise levels along site access roadways. Additionally, 10 workers (and

vehicles) would make the daily commute to the construction site. Even though there could be a relatively high single event noise exposure potential with passing trucks during the mobilization and demobilization of the heavy equipment (a maximum noise level of 86 dBA at 50 feet), the increase in daily construction traffic is minimal and any addition to on-road noise would be less than 1 dBA when averaged over a 24-hour period, and would therefore have a less than significant impact on noise receptors along the vehicle routes.

The second type of impact is related to noise generated by onsite construction equipment and local residents would be subject to elevated noise levels due its operation. The 115 ft Beach Width Alternative would use two front-end loaders and two dozers to conduct the on-shore activities. The nearest existing residents are located to the northeast at a distance of about 55 - 60 meters from the closest point of the Project area. Assuming that these pieces generated a noise level of 80 dBA Leq at 50 feet, the resultant exterior noise at the receptor is calculated at 68 dBA Leq. Interior noise levels with windows closed would be reduced by over 20 dBA from this value. Most of the time, these levels (both exterior and interior) would be considerably lower due to increased distance as this represents the point where the equipment is operating most proximate to any given resident. As with the 50 ft Beach Width Alternative, any construction within 500 ft (152 m) of the proximate residents could create a significant impact.

As noted above, the beach is located within the 65 dBA CNEL contour while the proximate receptors are estimated at about 60 dBA CNEL. Assuming that the daytime noise levels approximate the CNEL (i.e., 60 dBA at the receptors), the Project could raise noise at the most proximate receptors to approximately 69 dBA for an increase of 9 dBA. This level exceeds the 3-dBA threshold where the resultant noise is anticipated to exceed the goals of the Noise Element (i.e., 60 dBA CNEL for sensitive land uses) and the impact is considered as potentially significant.

On occasion, beach-based heavy equipment may be required to operate at night to keep up with the dredge. Any use of land-side equipment outside of the hours of 7:00 a.m. and 6:00 p.m. on weekdays, 8:00 a.m. and 6:00 on Saturdays, or at any time on Sundays or City-observed holidays represents a potentially significant impact.

Use of the dredge would also create noise. The dredge would use diesel engines for propulsion, dredging activities, and to provide on-board electric power. Dredge operations are projected to occur 24-hours per day, 7-days per week. A tug boat would be used to position the unit.

Similar to the 50 ft Beach Width Alternative, offshore activities are estimated at 80 dBA as measured at a distance of 100 feet, or roughly 6 dBA louder than the two pieces of shore equipment working in unison if the noise was projected at a similar distance. At its nearest point, the dredge would be positioned at about 2,500 ft (763 m) from receptors at San Clemente during pump-out, and about 4,200 ft (1,280 m) from the Oceanside receptors at the borrow site. Assuming that the dredge and tug work in unison off San Clemente, the noise at the proximate receptors is calculated at 52 dBA Leq. When added to the 60-dBA ambient level, at the receptor locations, the composite noise is calculated at 60.6 dBA for an increase of 0.6 dBA.

When added to the on-shore construction noise when heavy equipment operates proximate to the residents (i.e., 69 dBA Leq at the receptors), the composite noise is calculated at 69.1 dBA for an increase of 0.1 dBA. In summary, while the noise from the dredge may be audible when working late at night, its increase to the ambient noise is too small to be significant. Furthermore, the noise of the dredge is too low to add substantially to the noise of the on-shore equipment.

At a distance of approximately 4,200 ft (1,280 m) from receptors at the Oceanside borrow site, the dredge would produce a noise level of 44.5 dBA Leq. Assuming that the receptors in the Oceanside area are also subject to an existing level of 60 dBA, the addition of 44.5 dBA results in a composite level of 60.1 dBA for an increase of just 0.1 dBA. This level of increase is too small to be notable and is well under the 3-dBA threshold and would not be significant.

Mitigation Measures: Implement MM-N-50-4.1.

Significant and Unavoidable Impacts: None.

Impact N-50-5: *For a Project Located Within an Airport Land Use Plan or, Where Such a Plan Has Not Been Adopted, Within Two Miles of a Public Airport or Public Use Airport, Would the Project Expose People Residing or Working in the Project Area to Excessive Noise Levels.*

The Project site is not located within 2 miles of any airports and would not result in significant exposure to aircraft noise.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact N-50-6: *For a Project Within the Vicinity of a Private Airstrip, Would the Project Expose People Residing or Working in the Project Area to Excessive Noise Levels.*

The proposed Project is not located in the vicinity of a private airstrip and would not be impacted by private airport operations.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.8.4 Impacts Related to the No Action Alternative

The No Action Alternative would not involve any dredging or beach nourishment activity and no impacts to noise would occur from the lack of these construction activities. Under the No Action Alternative, it is likely that emergency seawalls would be constructed to protect structures. Potential maintenance activities by SCRRA may create noise associated with equipment used to

maintain the railroad ballast and tracks. The amount of equipment and time needed to conduct potential maintenance activities is anticipated to be adverse, but less than significant.

5.9 Recreation

5.9.1 Significance Criteria

An impact to recreation will be considered significant if a project alternative:

- Increases the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated; and/or
- Includes recreational facilities or require the construction or expansion of recreational facilities, which might have an adverse physical effect on the environment.

5.9.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact REC-50-1: *Increases the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated.*

During the beach nourishment, portions of the beach, nearshore zone, and potentially the Pier would be closed to public use. Recreational beach users would be limited to the amount of beach available to them during construction, based on the various closure periods, and may choose to visit a nearby beach instead. Given the short-term period of construction (up to four months), impacts would be considered significant, but temporary. The displacement of recreational users to the various nearby beaches would be temporary and short-term.

Long-term maintenance activities would create similar impacts as the initial construction. Therefore, physical deterioration of other recreational facilities associated with these other beaches would be less than significant.

Mitigation Measures: None

Significant and Unavoidable Impacts: None.

Impact REC-50-2: *Includes recreational facilities or requires the construction or expansion of recreational facilities, which might have an adverse physical effect on the environment.*

The beach nourishment provides for a wider beach area and greater opportunities for beach activities, enhancing the beach available for recreation users. The 50 ft Beach Width Alternative would not result in the construction or expansion of any recreational facilities that would have an adverse physical effect on the environment. Long-term maintenance activities would create similar impacts as the initial construction. The wider beach would be a benefit to beach recreation users.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact REC-50-3: *Results in a substantial degradation of the recreational experience at San Clemente Beach.*

As discussed in Section 5.3 under Impact WR-50-3, some of the sediment placed on San Clemente Beach to widen the beach to 50 ft would be carried offshore. Some of this sediment would settle on T-Street reef, a popular surfing area south of San Clemente Pier. The T-Street surfing location is within the alongshore extent of the proposed beach nourishment. The reef at T-Street is a seabed perturbation such that its elevation, shape, and orientation to incoming waves are a unique combination that tends to shoal waves to a peak with a resulting plunging "left" (from the surfer's perspective, wave that breaks from right to left) and "right" (from the surfer's perspective, wave that breaks from left to right), which results in a variety of waves and favorable surfing characteristics. The configuration and orientation of the reef to incoming waves create consistent surfing waves, making T-Street a popular break in the Orange County coastal area. High steepness waves result in plunging breakers, which are associated with beaches with steeper gradients. Plunging breakers descend very quickly and with substantial force; noted for a "lip," or shoreward facing edge, at the top of the wave. With the proper set of conditions, the plunging lip can create a "tube" or barrel." The consistent steepness of the wave coupled with the structure of the lip enables surfers to consistently reach higher speeds and perform more maneuvers.The surfing extends from the beach to about 600 ft (200 m) offshore and typically is in water depths less than 15 ft (5 m). The surfing area is closer to the beach than the actual reef location, as incoming waves require time and space to be transformed by the reef bathymetry.

- As discussed in Section 5.3.2, most of this sediment would settle in the inshore portion of the reef and would not affect the refractive abilities of the reef or the characteristics of the "take-off." However, as the wave encounters the straightened bathymetry inshore, it may "close-out," resulting in a shorter ride. This condition would be temporary and would lessen as the sediment moved off the reef steadily over the course of 6 years at a long-term erosion rate of 13 ft (4 m) per year. Although impacts due to the wider beach may occur, historic aerial photographs of San Clemente Beach at the Pier (Figure 5-6) indicate that the beach width in 1990 was approximately 55 ft (17 m) wide and no records have been found that indicate surfing ceased within the Project area during that time. Because the shorter rides are a temporary condition, impacts to surfing would not be significant.

The wider beach would improve the recreational experience for sunbathers, walkers/joggers, and picnickers. More beach area would be available for these activities.

Mitigation Measures: None

Significant and Unavoidable Impacts: None

Impact REC-50-4: *Results in a safety hazard to recreational beach users*

Heavy equipment working in an active public use area poses safety issues for adults and children. Children may be prone to come close to the equipment both during equipment operation on the beach and storage within staging areas.

Offshore dredge equipment has the potential to result in a hazard to boat traffic. During dredging and nourishment activities, proper advanced notice to mariners would be obtained and navigational traffic would not be allowed within the offshore borrow site area or mooring/discharge area offshore of Oceanside. It is unlikely that recreational vessels, such as kayaks, sailboats, jet-skiers, and paddleboards would use this area close to shore and close to the Pier.

A beach fill project has the potential to create public safety impacts to swimmers and waders. The two major impacts are derived from deeper water and reflected waves (Appendix D). When sand is introduced artificially into the littoral system, a beach fill can create deeper water conditions than the naturally occurring conditions (Appendix D). During construction of the beach fill, it is typical that the construction foreshore (beach) slope is steeper than the naturally occurring foreshore (beach) slope. It also is typical that the foreshore slope remains steeper than the natural condition for a period of time during the profile adjustment (equilibration) process. The newly created foreshore area, created by advancing the foreshore seaward, is now in deeper water than the previously existing natural condition. Also, during the profile equilibration process, an alongshore trough may form or the existing condition may become deeper. The swimming/wading public often perceives this trough as a "drop-off". Recreational beach goers may have become accustomed to the shallow waters normally associated with the existing swash zone. Swimmers and waders, thus, may be unexpectedly confronted with deeper water resulting in hazardous conditions. Furthermore, deeper water in the surf zone allows larger waves to propagate than the naturally occurring shallow water condition. This increased water depth in the surf zone enables larger waves to break very close to the shore. This is commonly referred to as "shore break" or "shore pound". The recreating public, which may have become accustomed to a mild wave condition, is suddenly confronted with a higher energy wave climate.

Reflected waves also can potentially degrade the surfing experience. Reflected waves propagating seaward can pass through normal incoming waves with no effect, or can meet incoming waves and create a condition known as destructive interference. The outbound and inbound waves meet and the resulting transfer of energy can cause the waves to pitch up in a chaotic sea state. The surfing experience could be degraded by the presence of these outbound waves as well as the resultant chaotic sea state.

In some locations nationwide, an increase in lifeguard rescue missions follow immediately after a beach fill construction project. In addition, signage would be provided to inform swimmers of potential hazards. The beach closure would prevent surfers from accessing the beach near the Pier, and the resulting wider beach would create a longer path for surfers to cross before reaching the water. In addition, the contract specifications shall require the contractor to fence/secure off areas of construction from public access, including construction staging areas and active

construction areas, including the beach and nearshore zone. The effects on public safety while the beach fill Project is reaching equilibrium would be a significant, but temporary, impact.

Mitigation Measures:

MM-REC-50-4.1: Provide signs to warn swimmers, waders and surfers of potentially hazardous surf conditions. Provide extra lifeguards.

Significant and Unavoidable Impacts: None

5.9.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact REC-115-1: *Increases the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated.*

Like the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative would result in recreational beachgoers being precluded from portions of the beach and ocean during beach construction. The construction period for the 115 ft Beach Width Alternative is 108 days compared to 46 days for the 50 ft Beach Width Alternative. Therefore, portions of the area around San Clemente Pier would be closed to the public for a longer period. Because portions of San Clemente Beach would still be open to the public at all times, the use of other beaches during construction of the 115 ft Alternative would not be expected to result in a significant impacts to other beaches, parks, or recreational facilities.

Mitigation Measures: None

Significant and Unavoidable Impacts: None.

Impact REC-115-2: *Includes recreational facilities or requires the construction or expansion of recreational facilities, which might have an adverse physical effect on the environment.*

The beach nourishment provides for a wider beach area and greater opportunities for beach activities, enhancing the beach available for recreation users. The 115 ft Beach Width Alternative would not result in the construction or expansion of any recreational facilities that would have an adverse physical effect on the environment. Long-term maintenance activities would create similar impacts as the initial construction. The wider beach would be a benefit to beach recreation users.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact REC-115-3: *Results in a substantial degradation of the recreational experience at San Clemente Beach.*

The impacts of the 115 ft Beach Width Alternative on the waves at T-Street reef is discussed in Section 5.3.3. Some of the sediment placed on the beach for the 115 ft Beach Width Alternative would move offshore and settle on T-Street reef. The 115 ft Beach Width Alternative could result in a sand layer of up to 6 ft (2 m) thickness on T-Street reef. This burial would have unquantifiable, but significant adverse effects to the wave breaking characteristics of the reef. The refractive abilities of the reef may be modified or lost, lessening the focusing effect of the reef and removing the point break characteristics of T-Street reef. Flattening of the slope in the reef area due to sedimentation has the potential to change the characteristic plunging point break to a quasi-spilling beach break and less desirable surfing conditions. Sedimentation in the shallow portion of the reef may result in "close-out" conditions and shorter rides. The sediment from the 115 ft Beach Width Alternative may be present on T-Street reef for up to 10 years. Because the 115 ft Beach Width Alternative has the potential to substantially modify the waves at T-Street reef and because these differences could persist for as much as 10 years, the impact on recreation is considered significant.

The much wider beach that would be created by the 115 ft Beach Width Alternative than the 50 ft Alternative would be a beneficial impact for sunbathers, walkers/joggers, and picnickers.

Mitigation Measure: Implement MM-WR-115-3.1.

Summary of Significant Unavoidable Impacts: The 115 ft Beach Width Alternative would result in substantial burial of T-street Reef and adverse modification of the wave characteristics there. The surfing experience would be degraded. The impacts may occur for about 10 years. Monitoring and documentation of impacts and the avoidance of future beach fills, would allow the wave characteristics to recover. Creation of an artificial surfing reef would replicate some of the surfing values, but an artificial surfing reef may not generate wave profiles equivalent to those at T-Street

Impact REC-115-4: *Results in a safety hazard to recreational beach users*

As described for the 50 ft Beach Width Alternative, immediately following beach construction, there may be changes in the surf zone that would result in conditions that could be hazardous to swimmers, waders, and surfers until the beach reaches equilibrium. Hazardous conditions to beachgoers would be a significant adverse impact.

Mitigation Measures: Implement MM-WR-50-4.1.

Summary of Significant Unavoidable Impacts: None

5.9.4 Impacts Related to the No Action Alternative

The No Action Alternative would not involve any dredging or beach nourishment activity. No impacts to recreation would occur from the lack of these construction activities. However, the narrowing beach profile, or potential lack of any sandy beach, would prevent recreational beach use. Under the No Action Alternative, it is likely that emergency seawalls would be constructed to protect structures. Potential maintenance activities by SCRRA may prevent use of the narrow beach because of equipment used to maintain the railroad ballast and tracks. The amount of equipment and time needed to conduct potential maintenance activities is anticipated to be less than significant.

5.10 Aesthetics

5.10.1 Significance Criteria

An impact to aesthetics will be considered significant if a project alternative:

- Has a substantial adverse effect on a scenic vista;
- Substantially damages scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a State scenic highway;
- Substantially degrades the existing visual character or quality of the site and its surroundings; and/or
- Creates a new source of substantial light or glare which would adversely affect day or nighttime views in the area.

5.10.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact AES-50-1: *Has a substantial adverse effect on a scenic vista.*

The beach and Pier at the Project site at San Clemente is visible from the surrounding area, and views from the beach include the Pacific Ocean. Potential closure of the Pier and the viewing area it provides would interfere with the public enjoyment of the surrounding visual environment. Construction equipment on the beach may obstruct visual views of recreational users at ground level. The dredge equipment may also disrupt visual resources of the ocean vista. The visual enjoyment of the public would be temporarily interrupted or obstructed by the presence of the construction equipment on either a concentrated, small section of the beach or spread out along the length of the beach. The impacts to the scenic vista would be short-term and temporary, which would be less than significant. Long-term maintenance activities would create similar impacts as the initial construction. The resulting wider beach would enhance the view of the beach and result in a visual benefit.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact AES-50-2: *Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway.*

The California Department of Transportation (Caltrans) designates roadways that provide scenic views as official Scenic Highways or Corridors. A highway can be officially designated a State Scenic Highway when the local jurisdiction adopts a scenic corridor protection program, applies to Caltrans for scenic highway approval, and receives notification that the highway has been designated as an official State Scenic Highway. The Project site is not located near a designated State scenic highway. Therefore, the proposed Project would have no impact on scenic resources within a State highway.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact AES-50-3: *Substantially degrade the existing visual character or quality of the site and its surroundings*

The proposed Project would result in a wider beach, which would be a minor alteration of the visual character of the existing environment. During the construction phase, the visual character of the site would be affected by construction activities and the presence of construction equipment and materials; however, the construction phase is temporary, and as such, would not result in permanent adverse effects to the visual character of the site. The resulting wider beach would enhance the view of the beach and result in a visual benefit. Long-term maintenance activities would create similar impacts as the initial construction. Therefore, the Project would not substantially degrade the existing visual quality of the surrounding area, and impacts would be less than significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact AES-50-4: *Create a new source of substantial light or glare, which would adversely affect day or nighttime views in the area.*

No light and glare impacts would occur as a result of the beach nourishment because no lighting or new source of glare is proposed. The dredge would potentially use lights during nighttime dredging activities; however, the dredging activities are short-term and temporary, if used, and would not create a new source of substantial light or glare that would impact visual resources. Long-term maintenance activities would create similar impacts as the initial construction. Therefore, the proposed Project would have less than significant impacts on day or nighttime views in the area.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.10.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact AES-115-1: *Has a substantial adverse effect on a scenic vista.*

As with the 50 ft Beach Width Alternative, potential closure of the Pier and the viewing area it provides would interfere with the public enjoyment of the surrounding visual environment. Construction equipment on the beach may obstruct visual views of recreational users at ground level. The dredge equipment may also disrupt visual resources of the ocean vista. The visual enjoyment of the public would be temporarily interrupted or obstructed by the presence of the construction equipment on either a concentrated, small section of the beach or spread out along the length of the beach. This temporary impact would be of a longer duration than with the 50 ft Beach Width Alternative. However, the impacts to the scenic vista would be short-term and temporary, which would be less than significant. Long-term maintenance activities would create similar impacts as the initial construction. These long-term maintenance activities would occur less frequently than with the 50 ft Beach Width Alternative. The resulting wider beach would enhance the view of the beach and result in a visual benefit. This benefit would be potentially greater with this alternative, due to greater width of the beach.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact AES-115-2: *Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway.*

As with the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative is not located near a designated State scenic highway. Therefore, this Alternative would have no impact on scenic resources within a State highway, same as the proposed action.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact AES-115-3: *Substantially degrade the existing visual character or quality of the site and its surroundings*

The 115 ft Beach Width Alternative would result in a wider beach, which would be a minor alteration of the visual character of the existing environment. During the construction phase, the visual character of the site would be affected by construction activities and the presence of construction equipment and materials. This temporary impact would be of a longer duration than

with the 50 ft Beach Width Alternative. However, the construction phase is temporary, and as such, would not result in permanent adverse effects to the visual character of the site. As with the 50 ft Beach Width Alternative, the resulting wider beach would enhance the view of the beach and result in a visual benefit. This benefit would be potentially greater with this Alternative, due to greater width of the beach. Long-term maintenance activities would create similar impacts as the initial construction. These long-term maintenance activities would occur less frequently than with the 50 ft Beach Width Alternative. Similar to the the 50 ft Beach Width Alternative, this Alternative would not substantially degrade the existing visual quality of the surrounding area, and impacts would be less than significant.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact AES-115-4: *Create a new source of substantial light or glare, which would adversely affect day or nighttime views in the area.*

As with the 50 ft Beach Width Alternative, no light and glare impacts would occur as a result of the 115 ft Beach Width Alternative because no lighting or new source of glare is proposed. The dredge would potentially use lights during nighttime dredging activities; however, the dredging activities are short-term and temporary, if used, and would not create a new source of substantial light or glare that would impact visual resources. Long-term maintenance activities would create similar impacts as the initial construction. Similar to the 50 ft Beach Width Alternative, the 115 ft Beach Width Alternative would have less than significant impacts on day or nighttime views in the area.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.10.4 Impacts Related to the No Action Alternative

The No Action Alternative would not involve any dredging or beach nourishment activity. No impacts to aesthetics would occur from the lack of these construction activities. However, the narrowing beach profile, or potential lack of any sandy beach, would prevent visual enjoyment of the sandy beach vista. Under the No Action Alternative, it is likely that emergency seawalls would be constructed to protect structures. Potential maintenance activities by SCRRA may include views of additional rocks/rip-rap used to maintain the railroad ballast and tracks. The change in the visual environment due to potential maintenance activities is anticipated to be less than significant.

5.11 Public Health and Safety

5.11.1 Significance Criteria

An impact to public health and safety will be considered significant if a project alternative would result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:

- Fire protection;
- Police protection;
- Schools;
- Parks; and/or
- Other public facilities.

5.11.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact PHS-50-1: *Substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for fire protection, police protection, schools, parks, and/or other public facilities.*

The proposed Project would not provide new or physically altered government facilities that would impact fire protection, police protection, schools, parks, and/or public facilities. However, as stated in the recreation analysis, the 50 ft Beach Width Alternative may potentially expose the public to potential safety hazards. Heavy equipment working in an active public use area poses safety issues for adults and children. Children may be prone to come close to the equipment both during equipment operation on the beach and storage within staging areas. In addition, offshore dredge equipment has the potential to result in a hazard to boat traffic. The dredge would be equipped with markings and lightings in accordance with the U.S. Coast Guard regulations. The location and schedule of the dredge would be published in the U.S. Coast Guard Local Notice to Mariners. The dredge would travel at very low speeds (approximately 1.5 knots) during dredging operations. The travel speed during transport would be approximately 5 knots. During dredging and nourishment activities, proper advanced notice to mariners would be obtained, and navigational traffic would not be allowed within the offshore borrow site area or mooring/discharge area offshore of Oceanside. It is unlikely that recreational vessels, such as kayaks, sailboats, jet-skiers, and paddleboards would use this area close to shore and close to the Pier; however, signage would be provided to inform these recreational users of potential hazards. In addition, signage would be provided to inform swimmers of potential hazards. Long-term maintenance activities would create similar impacts as the initial construction. The proposed Project would be temporary and short-term, and impacts would be less than significant.

Mitigation Measures: Implement MM-WR 5.9.2-4.1.

Significant and Unavoidable Impacts: None.

5.11.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact PHS-115-1: *Substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for fire protection, police protection, schools, parks, and/or other public facilities.*

The same potential, temporary, safety hazards to the public would occur during the construction of the 115 ft Beach Width Alternative as with the 50 ft Beach Width Alternative. These temporary impacts would be of a longer duration than with the proposed action. Long-term maintenance activities would create similar impacts as the initial construction. The long-term maintenance activities associated with this alternative would occur less frequently than with the 50 ft Beach width alternative. Similar to the proposed action, the 115 ft Beach Width Alternative would be temporary and short-term, and impacts would be less than significant.

Mitigation Measures: Implement MM-WR-50-4.1.

Significant and Unavoidable Impacts: None.

5.11.4 Impacts Related to the No Action Alternative

Under the No Action Alternative, it is likely that emergency seawalls would be constructed to protect structures. As a result of the continued beach erosion throughout San Clemente Beach, a number of public safety concerns have surfaced. Public restrooms are located on the beach, seaward (west) of the railroad tracks. Continued damages to these facilities may require their relocation to the landward side (east) of the railroad tracks. This would require pedestrians to continually cross the tracks to use the restrooms. A public safety issue is created because many will cross the railroad tracks in an unsafe manner. Furthermore, the loss of sand within the active nearshore profile has exposed underlying hard substrate and man-made structures. A public safety issue is created because the exposed material, in many cases, remains underwater and hidden from sight, posing a number of potential dangers to unwary recreational swimmers. The City of San Clemente is liable for accidents resulting from exposed man-made structures. The economic impact associated with the City's liability has the potential to be substantial.

5.12 Socioeconomics/Environmental Justice

5.12.1 Significance Criteria

An impact to socioeconomics/environmental justice will be considered significant if a project alternative:

- Impacts a sector of the economy, productivity, competition, prices, or jobs;
- Impacts the welfare of minority or low-income populations; and/or
- Impacts the fiscal and physical ability of the local governmental agencies to meet the needs of the public following the project-related changes in the local population.

5.12.2 Impacts Related to the 50 ft (15 m) Beach Width Alternative

Impact SEJ-50-1: *Impacts a sector of the economy, productivity, competition, prices, or jobs.*

Maintaining the beach will maintain or increase tourism according to King and Symes (2003). The socioeconomic effects of beach replenishment at San Clemente would be considered a beneficial impact. The wider sandy beach would provide greater recreation opportunity, opportunity for public access, enhance tourism in the region, and increase local recreation revenue due to increased numbers of visitors to the beaches. In addition, the creation of construction jobs associated with the shoreline improvements would be a beneficial impact to the study area.

No significant direct population, employment, income, or housing impacts are expected to result from the offshore construction activities, either on a local basis or regional basis. Long-term maintenance activities would create similar impacts as the initial construction. Offshore construction operations (i.e., vessel traffic and dredging) may potentially conflict with local commercial fishing operations during winter months, including gear/equipment damage and the disruption of fishing locations. Thirty days prior to the start of construction, the local commercial fishermen's association shall be provided with written notification of the intended start date of on shore construction, offshore construction, maps of Project-related vessel transportation routes, and its duration. Noticing shall include a point of contact throughout the entire construction phase to respond to concerns regarding interference and/or other issues associated with local commercial fishing operations. Impacts would be considered less than significant.

Mitigation Measures: None

Significant and Unavoidable Impacts: None.

Impact SEJ-50-2: *Impacts the welfare of minority or low-income populations.*

The construction and long-term maintenance of the proposed Project would not be expected to have any negative effect on minority or low-income populations. In addition, the expansion of the beach width would be a public improvement that would benefit residences and businesses alike.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact SEJ-50-3: *Impacts the fiscal and physical ability of the local governmental agencies to meet the needs of the public following the project-related changes in the local population.*

No significant direct population, employment, income, or housing impacts are expected to result from the proposed action, either on a local basis or regional basis. Although the shoreline protection improvements may increase opportunities for recreation, the Project alone would not increase the need for housing in the area, nor would it contribute to an environmental justice concern. The personnel required for the operation activities related to the proposed action are not expected to create population immigration, either directly or indirectly, into the area. Long-term maintenance activities would create similar impacts as the initial construction. Therefore, the proposed Project would not alter regional or local population projections and would have no significant impacts related to population immigration, such as a decrease in housing availability or an increase in the number of jobs in the area.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.12.3 Impacts Related to the 115 ft (35 m) Beach Width Alternative

Impact SEJ-115-1: *Impacts a sector of the economy, productivity, competition, prices, or jobs.*

Maintaining the beach will maintain or increase tourism according to King and Symes (2003). As with the proposed action, the socioeconomic effects of beach replenishment at San Clemente would be considered a beneficial impact. The wider sandy beach would provide greater recreation opportunity, opportunity for public access, enhance tourism in the region, and increase local recreation revenue due to increased numbers of visitors to the beaches. This benefit would be potentially greater with this alternative, due to greater width of the beach. In addition, the creation of construction jobs associated with the shoreline improvements would be a beneficial impact to the study area. The length of the construction effort would be longer with this Alternative than with the proposed action. No significant direct population, employment, income, or housing impacts are expected to result from the offshore construction activities, either on a local basis or regional basis. Long-term maintenance activities would create similar impacts as the initial construction but would occur less frequently than with the proposed action. Offshore construction operations (i.e., vessel traffic and dredging) may potentially conflict with

local commercial fishing operations during winter months, including gear/equipment damage and the disruption of fishing locations. Thirty days prior to the start of construction, the local commercial fishermen's association shall be provided with written notification of the intended start date of on shore construction, offshore construction, maps of Project-related vessel transportation routes, and its duration. Noticing shall include a point of contact throughout the entire construction phase to respond to concerns regarding interference and/or other issues associated with local commercial fishing operations. Impacts would be considered less than significant, similar to the proposed action.

Mitigation Measures: None

Significant and Unavoidable Impacts: None.

Impact SEJ-115-2: *Impacts the welfare of minority or low-income populations.*

Similar to the proposed action, the construction and long-term maintenance of the 115 ft Beach Width Alternative would not be expected to have any negative effect on minority or low-income populations. In addition, the expansion of the beach width would be a public improvement that would benefit residences and businesses alike.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

Impact SEJ-115-3: *Impacts the fiscal and physical ability of the local governmental agencies to meet the needs of the public following the project-related changes in the local population.*

As with the proposed action, no significant direct population, employment, income, or housing impacts are expected to result from the 115 ft Beach Width Alternative, either on a local basis or regional basis. Although the shoreline protection improvements may increase opportunities for recreation, this alternative alone would not increase the need for housing in the area, nor would it contribute to an environmental justice concern. The personnel required for the operation activities related to this alternative are not expected to create population immigration, either directly or indirectly, into the area. Long-term maintenance activities would create similar impacts as the initial construction. Therefore, similar to the proposed action, the 115 ft Beach Width Alternative would not alter regional or local population projections and would have no significant impacts related to population immigration, such as a decrease in housing availability or an increase in the number of jobs in the area.

Mitigation Measures: None.

Significant and Unavoidable Impacts: None.

5.12.4 Impacts Related to the No Action Alternative

No population immigration-related socioeconomic impacts (e.g., impacts on housing or employment) are expected under the No Action Alternative. However, beaches would continue to erode in the future, which may increase the potential for some loss of recreational uses and access to beaches. Also, it is likely that emergency seawalls would be constructed to protect structures. There may be a net loss in economy due to the lack of beach visitors, which would be a potentially significant impact.

6.0 CUMULATIVE IMPACT ANALYSIS

6.1 Description of Cumulative Projects

6.1.1 Dana Point Harbor Maintenance Dredging

Dana Point Harbor is located in Capistrano Bay on the southern Orange County coastline, approximately half way between Los Angeles and San Diego. The main elements of the project include (1) maintenance dredging of the navigational channels, anchorages, turning basins, and areas under docks affected by sediment build up, (2) disposal of dredged material, and (3) reuse of suitable clean material to enhance the sediment quality of the interior harbor beach and nourishment for the County Park portion of Capistrano Beach. The design project depths in the dredging area vary from -8 ft (-2 m) MLLW at the Boat Launch Ramp and Youth and Group Docks to -15 ft (5 m) MLLW in the East Anchorage and Main Channel, and 1 foot (0.3 m) of removal of the top layer of fine sand at "Baby Beach." The project is anticipated to take up to four months to complete.

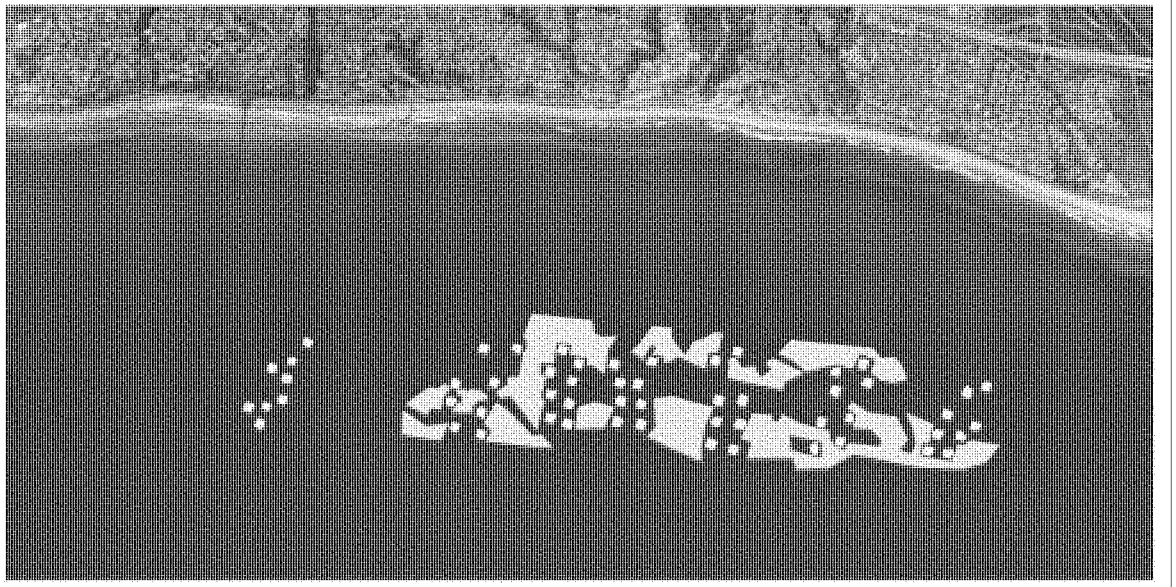
The total quantity of dredge material is estimated to be up to 155,700 cy (119,041 m^3). Up to 63,200 cy (48,319 m^3) will be disposed at an EPA approved site (LA-3), located approximately 14 mi (23 km) from the entrance of Dana Point Harbor. Up to 9,500 cy (7,263 m^3) of clean coarse sand material will be used to replace the top layer of fine sand material removed from "Baby Beach," and up to 83,000 cy (63,458 m^3) of clean coarse sand material is anticipated to be used to nourish San Juan Capistrano County Beach, placed either directly on the dry beach or placed in the nearshore littoral zone.

Material will be removed using clamshell dredge equipment, loaded onto bottom-dump scows, and transported to the LA-3 ocean disposal site offshore of Capistrano Beach, or to Baby Beach. For Capistrano or Baby Beach, tugboats would then position the scow for bottom dumping into the nearshore/surfzone area. The alternative method would be to remove material using a cutter/suction head dredge and hydraulically pump via pipeline to Capistrano or Baby Beach, potentially with the assistance of a booster pump. The material would be placed into fill dikes on the beach and final grading would be performed using bulldozers.

6.1.2 San Onofre Nuclear Generating Station Kelp Reef Project

The Wheeler J. North Reef, or the San Onofre Nuclear Generating Station (SONGS) kelp mitigation reef, is located offshore of San Clemente, California, in water depths of approximately 38 to 49 ft (11.5 to 15 m). The entire kelp reef project area is an 862-acre (349 hectares) leased parcel located 0.6 mi (1 km) offshore of the San Clemente beach between the San Clemente Pier and San Mateo Point. The southern end of the reef is about two miles north of SONGS and just north of San Mateo Point and extends north three miles to the City of San Clemente Pier. The kelp reef project is approximately 3,200 ft offshore from the seaward boundary of the Project footprint (Figure 6-1).

Figure 6-1 Proximity of Wheeler North Reef to Project Site



The kelp reef was proposed to be constructed in two phases. Phase 1, constructed in September 1999, covers 22.4 ac (9.1 ha) of sea floor. This was the experimental stage and 56 modules were designed to test the viability of using different types and densities of material (e.g., quarry rock versus concrete rubble). Each module has a two-dimensional footprint of 132 ft x 132 ft (40 m x 40 m). The modules are grouped into seven clusters or blocks in the leased area.

The Phase 2 reef was begun in June 2008 and is a 127.6-ac, (51.6 ha) low profile (< 3 ft [1 m]), single-layer reef constructed of quarry rock, which will be distributed on the benthos in quantities similar to those of the lowest substrate density (i.e., 42% bottom coverage) used for the Phase 1 experimental reef. The design of the Phase 2 mitigation reef consists of 11 polygons, varying in area from 2.4 to 37.5 ac (1 to 15.2 ha). The reef construction duration was estimated at 100 working days.

The final reef design locates the Phase 2 mitigation reef in close proximity to the San Mateo Kelp Bed, avoids hard substrate areas, maintains the integrity of the Phase 1 reef modules, provides for navigation channels, and avoids areas of historical kelp growth as well as areas of special interest to local fisheries.

6.1.3 Railroad Operations

Commuter rail stops at San Clemente Pier include two daily Amtrak trains between late April and October and weekend and holiday service year round, as well as two Metrolink weekend train stops. Presently, rail service safety requires occasional preventative maintenance in the form of monitoring the rail bed for erosion and utilizing riprap to prevent erosion. Due to chronic beach erosion, the railroad corridor between the bluff and the beach is threatened by undermining. In response, OCTA has been randomly placing riprap stones along the most critical segment between North Beach and the Marine Safety Building to reduce wave impacts on the railroad tracks. The cumulative impact of stone placement over the years has resulted in a reduction of lateral beach access.

6.2 Analysis of Cumulative Impacts

6.2.1 Air Quality and Meteorology

Construction of the related projects would be short-term and depending on the extent of construction, could have effects similar to or greater than that of the proposed Project. Even with the prescribed mitigation, the proposed action is anticipated to exceed the significance threshold limitations for NO_x and $PM_{2.5}$. In accordance with SCAQMD methodology, projects that exceed the daily threshold values and cannot be mitigated to less than the SCAQMD thresholds add significantly to the cumulative impact. As such, the beach fill Project also is considered as significant at the cumulative level.

With respect to cumulative emissions concentrations and their potential impact on sensitive receptors, the localized impact analysis demonstrates that all emissions levels would remain within their respective threshold values and the beach fill Project would not result in emissions in

excess of the Ambient Air Quality Standards. As such, the Project does not add to a cumulative violation of the standards.

6.2.2 Geology and Topography

The placement of approximately 117,800 cy (90,117 m^3) of sediment from the dredging of Dana Point Harbor on the beach or into the nearshore zone at Capistrano Beach would add sediment to the Oceanside littoral cell. Capistrano Beach is approximately 4 mi (6.4 km) upcoast from San Clemente Pier. Some of the Dana Point Harbor sediment would be expected to be moved gradually downcoast by littoral processes and would act cumulatively with either action alternative to widen the beach at San Clemente. The Dana Point Harbor Dredging project would act cumulatively with the Project to offset the impacts of coastal erosion.

Some of the sediment from the Dana Point Dredging may be deposited offshore in the vicinity of shallow reefs off San Clemente where it would act cumulatively with either action alternative to increase the sand accumulation in and around the reefs. However, the monitoring of the large SANDAG beach fill at Oceanside Beach indicates that little sediment from the project would be expected to accumulate in the nearshore area beyond naturally occurring variations. The incremental addition of a percentage of a smaller volume of sand discharged upcoast would not be expected to significantly add to sand build-up on reefs. The cumulative impacts of the Dana Point Dredging project and the proposed action would not result in a substantial adverse modification of nearshore topography.

Sediment from the proposed Project and the Dana Point Dredging project would not be expected to affect Wheeler J. North Reef, which is approximately 3,200 ft offshore, beyond the area of the final proposed Project beach profile.

6.2.3 Water Resources

The discharge of sediment from the Dana Point Harbor Dredging project to Capistrano Beach will act cumulatively with the proposed action to add sediment to the Oceanside littoral cell. The proposed action will act in a cumulative fashion with the Dana Point Harbor Dredging project to offset erosion on beaches in south Orange County and northern San Diego County. Most of the sediment from these projects is expected to accumulate on downcoast beaches or in the very shallow nearshore area between the foreshore and the bar. Beach fill would be deposited onshore and would be expected to move offshore in a manner that would not alter the wave characteristics of popular surf breaks, such as T-Street, and would not be expected to affect Wheeler J. North Reef approximately 3,200 ft seaward of the proposed Project footprint.

Like the proposed action, the Dana Point Harbor Dredging project would discharge sediments to the beach or nearshore zone and thus may cause a temporary localized increase in turbidity in nearshore waters. The discharge of sediments from Dana Point Harbor dredging would occur at Capistrano Beach approximately 4 mi (6.4 km) from the proposed action. Even if the projects occurred at the same time, the turbidity plumes would be sufficiently distant that they would not interact with each other. Monitoring of turbidity and adjustment of operations to avoid extensive turbidity plumes would mitigate any cumulative impacts of turbidity from these projects.

6.2.4 Biological Resources

Like the proposed action, the Dana Point Harbor Dredging project would generate temporary turbidity that could interfere with the foraging activities of visual predators including the State and Federal endangered California least tern and State and Federal endangered California brown pelican. Theoretically, the turbidity from both projects could have a cumulative impact on these sensitive bird species if both projects generated extensive turbidity at the same time, thus reducing foraging potential for least terns and brown pelicans over a greater area than would occur from either project alone. Neither the Dana Point Harbor project nor San Clemente Pier is near a least tern or a brown pelican nesting site. The Dana Point Harbor project would not contribute to cumulative effects of turbidity on nesting least terns. The Dana Point Harbor project could contribute to cumulative effects of turbidity on foraging least terns and brown pelicans away from their breeding areas, but turbidity plumes from these projects would be limited in time and area.

Neither the Project action nor the Dana Point Harbor project is near a nesting colony of the federal threatened western snowy plover. Therefore, the projects will have no cumulative effects on nesting plovers.

Both the proposed Project action and the Dana Point Dredging project would avoid placing sediment directly on sensitive biological habitats. The placement of pipelines to pump sand to the beach has the potential to damage sensitive marine resources if the pipeline or anchors are placed on rocky habitat. Because the projects are in different locations, any impacts of pipeline placement would affect different areas and would not act cumulatively to impact the same area. The impacts of pipeline and anchor placement could be mitigated to not significant by locating pipelines in areas that would minimize impacts on sensitive habitats based on a biological survey of the area.

There is potential that movement of discharged sediments could result in accumulation around sensitive biological habitats, including rocky intertidal, surfgrass, offshore reefs, and kelp beds. Because sand from the Dana Point Dredging project eventually will be transported downcoast towards San Clemente, there is some potential that sediment from both projects could accumulate at the same reefs. If sensitive habitat were buried for an extended period, impacts could be significant. However, the monitoring of the large SANDAG beach fill at Oceanside Beach indicates that little sediment from the proposed action would be expected to accumulate in the nearshore area beyond naturally occurring variations. The incremental addition of a percentage of a smaller volume of sand discharged upcoast from the dredging of Dana Point Harbor would not be expected to significantly add to sand build-up on reefs. Of sensitive resources in the Project area, surfgrass is most likely to be affected by sand accumulation because it grows in shallow nearshore areas where sand is most likely to be deposited. Surfgrass is adapted to periodic sand movement, and the analysis in Section 5.4.2 indicates that sediment from the proposed action would not be deposited in sufficient volume and for a long enough period to harm surfgrass. The incremental addition of a portion of a smaller amount of sediment discharged over 4 mi (6 km) upcoast is unlikely to add sufficient sediment to adversely affect surfgrass. Sediment from the proposed action and the Dana Point Dredging Project would not be

expected to affect Wheeler J. North Reef, which is approximately 3,200 ft offshore, beyond the area where beach fill sand would be transported.

6.2.5 Cultural Resources

The proposed Project would not be expected to contribute to the loss of cultural resources. The Dana Point Harbor and Wheeler North Reef projects also would not impact cultural resources. There would be no cumulative effect on cultural resources.

6.2.6 Ground and Vessel Transportation

The Dana Point Harbor project proposes limited, if any, trucking of materials for disposal. The proposed Project does not propose any trucking of materials. If both projects were to occur simultaneously and dredging equipment for both projects were active at the same time, there would be an increase in the number of vessels in the Project areas. However, the dredge equipment for the Dana Point Harbor project would be separate from the dredging efforts for the proposed Project at San Clemente, which would originate out of Oceanside Harbor. The dredges for both projects would not be expected to present a navigation hazard for fishing or recreational boaters either in the harbors or offshore, as these vessels near the harbors often operate in the presence of other vessels and obstacles with little incident. The proposed Project would create cumulative impacts to vessel traffic that would be less than significant.

The proposed Project would occur at least two years after the construction of the Wheeler North Reef project and, therefore, would not have any cumulative impacts to transportation in conjunction with that project.

6.2.7 Land Use and Policy

Construction and future periodic beach nourishment for the proposed Project would occur as necessary and would have no adverse impact to land use or any policies or plans. As such, the proposed Project would not contribute to any cumulative land use impacts in conjunction with either the Dana Point Harbor or Wheeler North Reef projects.

6.2.8 Noise

Because the cumulative projects are spaced apart both in time and location, the stationary noise from both construction and operations is not measurably additive and any cumulative impact would stem from the incremental addition of traffic associated with the various projects. The beach fill Project includes no operational traffic and contributes only 10 vehicles to the roads through the Project area during construction. Any cumulative impact would be less than significant.

6.2.9 Recreation

There is the possibility that the initial beach fill or future maintenance nourishment activity may occur simultaneously along with the Dana Point Harbor project. There is a potential for dredge

equipment for the proposed Project to be present at the same time as the Dana Point Harbor project. The cumulative presence of dredging equipment may interrupt recreational activity in the Project vicinity for the duration of construction. Assuming beach use is low during the construction period, cumulative impacts may be potentially significant, but temporary and short-term.

The proposed Project would occur at least two years after the construction of the Wheeler North Reef project and, therefore, would not have any cumulative impacts to recreation in conjunction with that project.

6.2.10 Aesthetics

The impacts to aesthetics from the proposed Project and Dana Point Harbor project both are temporary and construction related and will not result in the permanent obstruction of any scenic vistas or open views, nor will the Project create an aesthetically offensive viewshed. If both projects were to occur at the same time, there would be multiple dredges within 5 miles of each other, in addition to the associated tug boats, barge, and crew boats during construction. The temporary impacts of the construction equipment are temporary and less than significant.

The proposed Project would occur at least two years after the construction of the Wheeler North Reef project; because impacts to aesthetics for the proposed Project are construction related only, the proposed Project would not have any cumulative impacts to aesthetics in conjunction with the Wheeler North Reef project.

6.2.11 Public Health and Safety

The proposed Project and Dana Point Harbor Dredging projects are both temporary and construction related only; they will not impact the capacities of public services or utilities. If both projects were to occur at the same time, there may be a potentially significant impact on the safety of recreation users on the beach and in the water. For both projects, the dredge would be equipped with markings and lightings in accordance with the U.S. Coast Guard regulations. The location and schedule of the dredge would be published in the U.S. Coast Guard Local Notice to Mariners. The dredge would travel at very low speeds (approximately 1.5 knots) during dredging operations. The travel speed during transport is approximately 5 knots. The dredge would not be expected to present a navigation hazard for fishing or recreational boaters either in the harbor or offshore of the project sites, as these vessels often operate in the presence of other vessels and obstacles with little incident. Even if both the proposed Project and Dana Point Harbor Dredging project were to occur at the same time, implementation of mitigation measures for each project would create cumulative impacts that would be temporary and short-term and would be less than significant.

The Wheeler North Reef project has been constructed; because impacts to public health and safety for the proposed Project are construction related only, the proposed Project would not have any cumulative impacts to public health and safety in conjunction with the Wheeler North Reef project.

6.2.12 Socioeconomics/Environmental Justice

The Dana Point Harbor Dredging project would not have any impacts on socioeconomics/environmental justice; therefore, no cumulative impacts would result in conjunction with the proposed Project. The proposed Project would occur at least two years after the construction of the Wheeler North Reef project; because impacts to socioeconomics/environmental justice for the proposed Project are construction related only, the proposed Project would not have any cumulative impacts to socioeconomics/environmental justice in conjunction with the Wheeler North Reef project.

7.0 ENVIRONMENTAL COMMITMENTS

The following table lists the actions committed to be undertaken by the USACE for the proposed action to ensure environmental impacts are reduced to the extent possible. These actions may be part of design of the Project as may be best management practices or specific features to reduce environmental impacts; there may be monitoring activities to alert the USACE and the contractor to potential environmental impacts; and there may be mitigation measures to compensate for actual impacts to the environment.

Table 7-1 Summary of design features and monitoring commitments

Design Features	Purpose	Timing	Implementation Responsibility
Air quality			
Use of BACTs and Contingency Measures for construction activities	To reduce air emissions	During all construction activities	Construction contractor
Construction equipment will be properly maintained and tuned	To reduce air emissions	During all construction activities	Construction contractor
Maintain at least a 12 percent saturation level of the sand	To reduce air emissions	During beach fill activities	Construction contractor
Prohibit truck idling in excess of five minutes	To reduce air emissions	During all construction activities	Construction contractor
Where feasible, use aqueous or emulsified diesel fuel for construction equipment.	To reduce air emissions	During all construction activities	Construction contractor
Where feasible, use diesel oxidation catalytic converter	To reduce air emissions	During all construction activities	Construction contractor
Where feasible, require the use of newer, lower-emitting trucks to transport construction workers as well as equipment and material to and from construction sites	To reduce air emissions	During all construction activities	Construction contractor
Water Quality, Sediments, Oceanography			
Construct "L"-shaped berms	Anchor sand placement operations and reduce nearshore turbidity	During beach fill	Construction contractor

Table 7-1 Summary of design features and monitoring commitments (continued)

Design Features	Purpose	Timing	Implementation Responsibility
Monitor turbidity	To reduce impacts related to turbidity	During dredging and beach fill activities	Construction contractor
Prepare SWPPP and OSPRP	Ensure minimal contamination from fuel leaks, if any	During all construction activities	Construction contractor
Biological Resources			
An underwater survey for kelp and surfgrass shall be conducted by marine biologists prior to the initiation of beach fill activities. Based on the survey, a mooring location and a pipeline route shall be selected that minimizes contact with surfgrass and kelp habitat. If kelp and surfgrass cannot be avoided completely, immediately following beach fill activities, another survey of the mooring and pipeline areas shall be conducted to determine whether kelp and surfgrass were damaged. If substantial damage to surfgrass or kelp occurs, an additional survey shall be conducted six months after the beach fill to determine if kelp and surfgrass have recovered. If substantial damage to kelp and eelgrass is still observed, restoration of habitat shall be implemented in consultation with the resource agencies.	Mooring Location and pipe placement to ensure avoidance and minimization to marine resources	During dredging and beach fill activities	USACE qualified marine ecologist or his/her designated marine ecologist.

Table 7-1 Summary of design features and monitoring commitments (continued)

Cultural Resources			
Prior to construction, offshore borrow areas 1 and 2 will be subjected to an underwater remote sensing survey in order to determine if submerged cultural resources are present within these areas.	Avoid potentially undisturbed, submerged cultural resources.	Prior to dredging activities	USACE qualified archaeologist or his/her designated archaeologist
Noise			
On-shore construction activities must be limited to less than 9 hours per day.	Minimize noise emissions	During beach nourishment/notch fill	Construction contractor
Recreation			
The contract specifications shall require the contractor to fence/secure off areas of construction from public access, including construction staging areas and active construction areas, including the beach and nearshore zone.	Avoid safety hazards to recreation-goers	During beach nourishment	Construction contractor

Table 7-1 Summary of design features and monitoring commitments (continued)

Design Features	Purpose	Timing	Implementation Responsibility
Public safety			
The dredge would be equipped with markings and lightings in accordance with the U.S. Coast Guard regulations. The location and schedule of the dredge would be published in the U.S. Coast Guard Local Notice to Mariners. The dredge would travel at very low speeds (approximately 1.5 knots) during dredging operations. The travel speed during transport would be approximately 5 knots. During dredging and nourishment activities, proper advanced notice to mariners would be obtained, and navigational traffic would not be allowed within the offshore borrow site area or mooring/discharge area offshore of Oceanside.	Warn boaters/ fishermen of dredging activities to ensure avoidance	Before and during dredging activities and beach nourishment	USACE resident engineer
Socioeconomics			
The local commercial fishermen's association shall be provided with written notification of the intended start date of on shore construction, offshore construction, maps of project-related vessel transportation routes, and its duration. Noticing shall include a point of contact throughout the entire construction phase to respond to concerns regarding interference and/or other issues associated with local commercial fishing operations.	Avoid gear conflicts and provide for compensation if loss occurs	Thirty days prior to the start of construction	Coast Guard (via construction contractor) and USACE
Monitoring Commitments			
Monitor turbidity levels	To avoid turbidity impacts to fish and aquatic species	During dredging operations and beach fill activities	Construction Contractor

Table 7-1 Summary of design features and monitoring commitments (continued)

Design Features	Purpose	Timing	Implementation Responsibility
Any earthmoving associated with this Project that will involve previously undisturbed soil will be monitored by a qualified archeologist who meets the Secretary of Interior's Standards for an Archeologist (see 36 CFR Part 61). If a previously unidentified cultural resource (i.e., property) that may be eligible for the NRHP is discovered, all earthmoving activities in the vicinity of the discovery shall be diverted until the USACE complies with 36 CFR § 800.13(a)(2).	Avoid any potentially undisturbed cultural resources.	During beach fill activities	USACE qualified archaeologist or his/her designated archaeologist

8.0 OTHER NEPA/CEQA REQUIRED ANALYSES

8.1 Effects Found Not to be Significant

Issues that were found not to be significant for the proposed Project included land use and policy. Issues that were found to be less than significant without the need for mitigation measures were geology and topography, noise, transportation, recreation, aesthetics, and public health and safety. The construction and long-term maintenance of the proposed Project would not have a significant effect on these elements and the analyses of these issues are detailed in the environmental consequences section.

8.2 Unavoidable Significant Impacts

The environmental impacts of the proposed Project are described in the environmental consequences section of this Final EIS/EIR. The proposed Project presents one impact that may be significant and cannot be reduced to less than significant levels through the application of feasible mitigation measures are summarized below. A complete description of this impact is presented in the environmental consequences section.

8.3 Irreversible and Irretrievable Commitment of Resources

Section 15126(c) of the CEQA Guidelines requires an EIR to address any significant irreversible environmental changes and irretrievable commitment of resources that may occur as a result of alternative implementation. Resources which are irreversibly or irretrievably committed to a project are those that are typically used on a long-term or permanent basis; however, some are considered short-term resources that cannot be recovered and are thus considered irretrievable. These resources may include the use of non-renewable resources, such as fuel, wood, or other natural or cultural resources. Human labor also is considered a nonretrievable resource because labor used for the proposed action would not be used for other purposes. The unavoidable destruction of natural resources which limit the range of potential uses of that particular environment would also be considered an irreversible or irretrievable commitment of resources.

The proposed Project would result in the placement of approximately 251,000 cy (192,000 m^3) of dredged beach-compatible fill material along a 3,412 ft long and 50 ft wide beach adjacent to the San Clemente Pier. The Project would nourish the eroded existing beach, which would provide recreational opportunities not only for residents, but also contribute to the regional tourist industry. The proposed action would result in the consumptive use of nonrenewable energy sources and labor required to operate dredges, trucks, pumping equipment, and grading equipment. These commitments of resources could have otherwise been applied to projects other than the proposed action. However, the proposed Project would not result in the use of a substantial amount of resources. Additionally, no natural resources would be permanently destroyed and beach replenishment would be considered beneficial to the region.

8.4 Growth Inducing Impacts

Under CEQA Guidelines Section 15126.2(d), an EIR must discuss the ways in which the proposed action and alternatives could foster economic or population growth or the construction of additional housing, either directly or indirectly, in the area of population growth or the construction of additional housing, either directly or indirectly, in the area surrounding the proposed action. Analysis of growth-inducing effects includes those characteristics of the action that may encourage and facilitate activities that, either individually or cumulatively, would affect the environment. Population increases, for example, may impose new burdens on existing community service facilities. Similarly, improvement of access routes may encourage growth in previously undeveloped areas. Growth may be considered beneficial, adverse, or of no significance environmentally, depending on its actual impacts to the environmental resources present.

A benefit of the proposed Project would be the enhancement or continuation of the recreational usage of the beach at San Clemente Pier. Protection of the beach shoreline provides an amenity for local residents and tourists. The resulting temporary recreational benefits derived from the additional beach area would not be expected to increase the demand for public services and utilities, nor create a need for additional recreational facilities above current projections. Fewer than 100 workers would be involved in construction of the proposed Project, and they would be expected to primarily be drawn by the local work force. The San Clemente Shoreline Protection Project would not involve any new development or add any people to the local population. The proposed Project would have no growth-inducing impacts.

8.5 Energy Requirements and Conservation Potential of Alternatives and Mitigation Measures

Under Appendix F of the CEQA Guidelines, EIRs are required to include a discussion of the potential energy impacts of proposed projects, with particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy. Potential energy considerations include energy consuming equipment and processes for construction, operation, and/or removal of the Project, energy requirements by fuel type for each Project stage, energy conservation and design features, energy costs and supplies, and transportation use requirements (e.g., estimated daily trips by mode).

The proposed Project would implement several mitigation measures that would reduce inefficient, wasteful, and unnecessary consumption of energy. The energy requirements for the proposed construction activity would be confined to fuel for the dredge, labor transportation, and other construction equipment. Examples of mitigation measures include use of a diesel oxidation catalytic converter for the dredge and the use of newer, lower-emitting trucks to transport construction workers as well as equipment and material to and from construction sites, such as the use of "low-sulfur diesel for construction equipment and diesel particulate filters for diesel equipment and trucks." The use of alternative clean fuel, such as electric or compressed natural gas-powered construction equipment with oxidation catalysts instead of gasoline- or diesel-

powered engines, is also recommended. However, where diesel equipment has to be used because there are no practical alternatives, it is recommended the construction contractors use low-sulfur diesel. In addition, the proposed Project does not involve the trucking of materials, which would decrease the use of trucking equipment typically associated with a beach nourishment project. The minimal use of pieces of construction equipment and implementation of the mitigation measures recommended would allow impacts to energy to be less than significant.

8.6 Relationship between Short-term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

The CEQ under NEPA Regulations (40 CFR Part 1500 et seq.) require that an EIS discuss issues related to environmental sustainability. The discussion relates to environmental consequences, including consideration of "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (42 USC Section 4332[C][iv]).

Implementation of the proposed Project would not result in any environmental impacts that would significantly narrow the range of beneficial uses of the environment or pose long-term risks to health, safety, or the general welfare of the public communities surrounding the beach at San Clemente Pier. Rather, the Project would provide for future beneficial beach resources (e.g., recreational activities, sandy shoreline habitat).

9.0 PUBLIC INVOLVEMENT AND INTERAGENCY COORDINATION

9.1 Required Coordination

This EIS/EIR was circulated for a public review period of 45 days, from August 6 through September 20, 2010, to appropriate resource agencies, local interest groups, and individuals (see Section 13 for distribution list). A public meeting was held at the Community Development Office at 910 Calle Negocio, San Clemente, CA 92673, on August 19, 2010, at 7 p.m. All comments and concerns that were received during the review period have been incorporated into the Final EIS/EIR.

9.2 Public Involvement

Public involvement is a process by which interested and affected individuals, organizations, agencies, and government entities are consulted and included in the decision-making process of a planning effort. In providing public service, the Federal role in water resources planning is to respond to what the public perceives as problems and opportunities and to formulate and select alternative plans that reflect public preferences. In addition, the National Environmental Policy Act (PL 91-190), among other Federal laws and regulations, mandate public involvement. Federal planning policies, USACE practice, and regulations have consistently required and encouraged this practice. All this must occur, however, with the awareness that the USACE cannot relinquish its legislated decision-making responsibility.

9.2.1 Public Participation

Two of the milestones in the Corps of Engineers South Pacific Division (CESPD) milestone system have been established specifically for the purpose of providing a public forum to receive public input. Public participation through the NEPA/CEQA review process is through both a formal public scoping period and a public and agency review period.

To announce the start of the report scoping, a public notice was issued to local residents, Federal, State, and Local agencies, and interested groups. The recipients were invited to provide input to the study, including the scoping of the environmental issues that should be addressed throughout the study. The Notice of Intent (NOI) was published in the Federal Register. The Notice of Preparation (NOP) was distributed with the NOI and has been approved by the lead CEQA agency, the City of San Clemente. The notice announced a public workshop, where the public were given the opportunity to comment.

A 45-day public review of the Draft EIS/EIR was conducte in August and September of 2010. A final public meeting was held on August 19, 2010 to present the findings of the study and to provide the public an opportunity to express their views on the results and recommendations of the pre-authorization study. Comments included concerns with some of the engineering and environmental assumptions and analyses and the need to develop an acceptable "monitoring and mitigation plan". All comments have been addressed and our responses are included in the Section 14.0. Additional conference calls and meetings with the Resource Agencies were held to

address some of their concerns over the "monitoring and mitigation plan" and revisions have been made to Appendix B based on these discussions.

9.3 Interagency Coordination

The USACE is the lead agency for NEPA, and the City of San Clemente is the lead/responsible agency for CEQA. This Final EIS/EIR is prepared as a joint document. The implementation or construction phase of the proposed action will be cost-shared with the local sponsor, the City of San Clemente. Therefore, this document is prepared in compliance with NEPA and CEQA regulations.

The proposed action was coordinated with the concerned resource agencies during preparation of the Final EIS/EIR to ensure that the proposed action complies with the requirements of the applicable laws and regulations. A summary of coordination is provided in the following sections.

Pursuant to specific legislative mandates and to assist in the preparation of this document, formal and informal coordination has been initiated with various agencies. The following summarizes the coordination and consultation efforts.

9.3.1 U.S. Fish and Wildlife Service

Coordination with USFWS regarding biological impacts and mitigation has been on-going. The Final EIS/EIR has been prepared to determine the effect of the proposed action on Federal listed species (Section 5.4). In compliance with the FWCA, the USACE has conducted on-going coordination efforts during initial and current stages of planning for this Project. The USACE met with resource agencies, including the USFWS, NOAA Fisheries, and CDFG on October 16, 2007, May 15 and December 16, 2008, July 16, 2009, and January 31, 2011, to discuss the proposed Project and alternatives. The main topics of discussions included the current status of the proposed Project, Project alternatives, and potential environmental issues.

9.3.2 U.S. Army Corps of Engineers, Regulatory Branch

The proposed Project has been coordinated with the USACE Regulatory Branch, which is responsible for issuing the Section 404 permit for dredging. Coordination with USACE Regulatory Branch is on-going. The USACE does not issue itself a 404 permit, but must comply with the CWA. The USACE will complete a 404(b)(1) analysis to ensure Project compliance with the CWA.

9.3.3 U.S. Environmental Protection Agency

The USACE has coordinated with the USEPA throughout the NEPA process and construction activities.

9.3.4 National Marine Fisheries Service

The USACE met with resource agencies, including NOAA Fisheries, on October 16, 2007 and December 16, 2008, to discuss the proposed Project and alternatives. The USACE has been coordinating with the NOAA Fisheries regarding EFH. Dredging and fill placement construction activities are not anticipated to have significant impacts to EFH. USACE shall continue to coordinate with the NOAA Fisheries throughout the NEPA process and construction activities.

9.3.5 California Coastal Commission

USACE shall continue to coordinate with the CCC throughout the NEPA process and construction activities. The Corps is preparing a Coastal Consistent Determination (CCD) in accordance with Federal Coastal Zone Management Act (CZMA), 16 U.S.C. §1455(d), and regulations at 15 C.F.R. §930 et seq. It is the responsibility of the Corps to determine if a proposed federal activity affects the coastal use of resources in a manner that is not consistent with the California Coastal Management Plan (CCMP) that California has adopted and implemented.

9.3.6 California State Lands Commission

USACE has coordinated with the CSLC throughout the NEPA process and construction activities.

9.3.7 California Department of Fish and Game

The USACE met with resource agencies, including CDFG, on May 15 and December 16, 2008 and July 16, 2009 to discuss the proposed Project and alternatives. USACE has been coordinating with the CDFG regarding State listed species. Dredging and fill placement construction activities are not anticipated to have significant impacts to State listed species. USACE shall continue to coordinate with the CDFG throughout the CEQA process and construction activities.

9.3.8 California State Historic Preservation Officer/Advisory Council on Historic Preservation

An initial letter was sent to the California SHPO in accordance with Section 106 implementing regulations 36 CFR 800, as amended. This initial consultation described the APE and outlined the steps the USACE has taken to identify historic properties within the APE.

Based on identification efforts to date, there are no historic properties within the APE. A report on these efforts was prepared and sent to the SHPO, with a determination as to whether the Project will affect historic properties. The Project is in compliance with the Act.

9.3.9 Regional Water Quality Control Board

To satisfy requirements of the Federal CWA, USACE would submit this Final EIS/EIR and appropriate technical documentation to the San Diego RWQCB, tasked with implementing the CWA within the region, for their review for CWA Section 401 certification, pursuant to 33 CFR 336.1(a)(1). Upon review of the submittal, the RWQCB would evaluate if issuance of a 401-water quality certification is appropriate. The USACE shall continue to coordinate with the RWQCB throughout the CWA process and construction activities.

9.3.10 Other Agencies/Public Interest Groups

In addition to the above, USACE shall continue coordination efforts with various agencies to minimize impacts to fishing activities and marine resources that may result from placement of beach fill.

9.4 Required Permits and Approvals

Table 9-1 List of Federal, State, and Local Project Approvals

Agency	Permit/Approval
Federal	
USACE	• Permit under Section 404 of the Clean Water Act, 33 U.S.C. Section 1344 • Section 10 of the River and Harbors Act of 1899, 33 U.S.C Section 403
USFWS	• Fish and Wildlife Coordination Act, 16 U.S.C. Section 661-666
NMFS	• Magnuson-Stevens Fishery Management and Conservation Act, 1996 amendments
State	
CSLC	• Long-term management lease to CDFG or USFWS
RWQCB	• Section 401 Water Quality Certification • Compliance with waste discharge requirements for dredge and fill
SHPO	• Compliance and Coordination with SHPO under NHPA 1966, Section 106 (as defined in 36 CFR 60 and 36 CFR 800)
CCC	• Federal Consistency Determination
Local/Regional	
County of Orange	• Grading permit
County of Orange Vector Control	• Review for public health concerns
South Coast Air Quality Management District (SCAQMD)	• Construction-related air permits
SCAQMD/EPA	• Federal Air Conformity Determination

- The RWQCB may use the Joint EIS/EIR to consider Water Quality Certification under Section 401 of the Clean Water Act, as well as to consider granting permits for waste discharge requirements for dredge and fill.
- The SCAQMD may use the Joint EIS/EIR to consider construction-related air permits and for the Federal Air Conformity Determination.

10.0 LIST OF PREPARERS AND REVIEWERS

Agencies and contractors responsible for the preparation and review of this EIS/EIR include the following:

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11.0 GLOSSARY, ACRONYMS, AND ABBREVIATIONS

11.3 Acronyms

AAQS	Ambient Air Quality Standards
ACHP	Advisory Council on Historic Preservation
A.D.	After Christ, of the Christian era
a.m.	Ante meridiem, before noon
APE	Area of Potential Effects
AQMP	Air Quality Management Plan
BA	Biological Assessment
BACT	Best Available Control Technology
B/C	Benefit/Cost ratio
B.C.	Before Christ, before the Christian era
BO	Biological Opinion
BP	Before present
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CCC	California Coastal Commission
CCD	Coastal Consistency Determination
CCR	California Code of Regulations
CCSTWS	Coast of California Storm and Tidal Waves Study
CDIP	Coastal Data Information Program
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act of 1970
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CHRIS-SCCIC	California Historical Resources Information System at the South Central Coastal Information Center
CNEL	Community Noise Equivalent Level
CSC	California Species of Special Concern
CSDM	Coastal Storm Drain Outfall Monitoring
CSLC	California State Lands Commission
CWA	Clean Water Act of 1977
CZMA	Coastal Zone Management Act
DOD	Department of Defense
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ENSO	El Niño-Southern Oscillation
ER	Engineer Regulation
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ESA	Federal Endangered Species Act of 1973

ESU	Evolutionarily Significant Unit
FE	Federal-listed, endangered species
FT	Federal-listed, threatened species
FWCA	Fish and Wildlife Coordination Act of 1958
GIS	Geographic Information System
HCP	Habitat Conservation Plan
HHW	Higher High Water
HLW	Higher Low Water
HUD	Department of Housing and Urban Development
I-5	Interstate 5 Freeway
LCP	Local Coastal Program
LHW	Lower High Water
LLW	Lower Low Water
LOSSAN	Los Angeles to San Diego
LST	Localized Significance Threshold
LUP	Land Use Plan
MBTA	Migratory Bird Treaty Act
MCBCP	U.S. Marine Corps Base, Camp Pendleton
MHHW	mean higher high water
MHTL	mean high tide line
ML	maximum level
MLW	mean low water
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act of 1972
MSL	Mean Sea Level
MSAA	Master Streambed Alteration Agreement
NAAQS	National Ambient Air Quality Standards
NAHC	National Historic Preservation Act
NCCP	Natural Communities Conservation Plan
NEPA	National Environmental Policy Act of 1969
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NOAA	National Oceanographic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NOI	Notice of Intent
NOP	Notice of Preparation
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
OCTA	Orange County Transportation Authority
OSPRP	Oil Spill Prevention and Response Plan
p.m.	Post meridiem, after noon
PRC	Public Resources Code
PSSDA	Puget Sound Dredged Disposal Analysis
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board

SANDAG	San Diego Association of Governments
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCB	Southern California Bight
SCRRA	Southern California Regional Rail Authority
SE	State-listed, endangered species
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SL	screening level
SQG	Sediment Quality Guidelines
SRA	Source Receptor Area
ST	State-listed, threatened species
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	California State Water Resources Control Board
T-BACT	Toxics Best Available Control Technology
USACE	United States Army Corps of Engineers, Los Angeles District
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WRDA	Water Resources Development Act

11.4 Chemical Abbreviations

CO	carbon monoxide
DDT	dichlorodiphenyltrichloroethane
NO_2	nitrogen dioxide
NOx	oxides of nitrogen
O_3	ozone
PAHs	polycyclic aromatic hydrocarbons
Pb	lead
PCBs	polychlorinated biphenyls
PM_{10}	particulate matter equal to or less than 10 microns in size
$PM_{2.5}$	fine particulate matter equal to or less than 2.5 microns in size
ROG	reactive organic gases
SO_2	sulfur dioxide
SOx	oxides of sulfur
TAC	toxic air contaminants

11.5 Units of Measurement

ac	acre(s)
°C	degrees Celsius
dB	decibels
dBA	decibels using A weighted measurements

°F	degrees Fahrenheit
ft	foot/feet
ft/sec	feet per second
ft^2	square feet
ha	hectare
hp	horsepower
H:V	horizontal:vertical
kg	kilograms
km	kilometer(s)
lbs	pounds
L_{dn}	Day-night average noise level
L_{eq}	equivalent noise level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mi	mile(s)
mi^2	square mile(s)
mL	milliliter(s)
mm	millimeter(s)
mph	miles per hour
NTU	Nephelometric Turbidity Unit(s)
ppm	parts per million
ppt	parts per thousand
yd	yard(s)
yd^2	square yard(s)
yd^3	cubic yard(s)
yd^3/ft	cubic yard(s) per foot
yr	year
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
%	percent

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STATE

Milford Wayne Donaldson
State Historic Preservation Officer
Office of Historic Preservation
1725 23rd Street, Suite 100
Sacramento, CA 95816

Department of Water Resources
1416 9th Street
Sacramento, CA 95814

California Coastal Commission
45 Fremont St, Ste 2000
San Francisco, CA 94105

California Coastal Commission
South Coast District Office
200 Oceangate, 10th Floor
Long Beach, CA 90802-4416

California Department of Fish and Game
South Coast Region (Region 5)
4949 Viewridge Ave.
San Diego, CA 92123

Caltrans District 12
3347 Michelson Drive, Suite 100
Irvine, CA 92612

State Clearing House
1400 Tenth Street
Sacramento, CA 95812-3044

California Coastal Conservancy
1330 Broadway, 13th Floor
Oakland, CA 94612

California State Lands Commission
100 Howe Ave, Suite 100 South
Sacramento, CA 95825-8202

San Diego Regional Water Quality Control Board
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340

Native American Heritage Commission
915 Capitol Mall, Room 364
Sacramento, CA 95814

COUNTY

South Coast AQMD
21865 Copley Dr.
Diamond Bar, CA 91765-4182

Organizations

Natural Resources Defense Council
1314 Second Street
Santa Monica, CA 90401

Southern California Edison
P.O. Box 800
Rosemead, CA 91770

Center for Biological Diversity
351 California Street, Suite 600
San Francisco, CA 94104

Center for Biological Diversity
PMB 447, 8033 Sunset Blvd.
Los Angeles, CA 90046-2401

Sierra Club Angeles Chapter
3435 Wilshire Blvd #320
Los Angeles, CA 90010-1904

Surfrider Foundation
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34145 Pacific Coast Hwy, #619
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14.0 RESPONSE TO COMMENTS

No.	Commenter	Comment	Response
Federal Agencies			
D.F. Levi, Commanding Officer, Marine Corps Base, Camp Pendleton, September 15, 2010			
1	Marine Corps	General. The location of the proposed borrow site depicted in Figures 1.1-1, 1.3-1 and throughout the DEIR/DEIS would be more accurately identified as located off Camp Pendleton since it is directly west of Camp Del Mar and the Del Mar Boat basin not the Oceanside Harbor area as currently stated.	The borrow site (Area 2) is offshore of both the Camp Del Mar Boat Basin and Oceanside Harbor as shown in Geotechnical Appendix Plate 1, ranging from 0.75 to 1.0 miles. This will be clarified throughout the report(s).
2	Marine Corps	General. The proposed borrow site and transit routes appear to be in close proximity or through nautical restricted areas that exist in the vicinity of the Camp Del Mar area and further up the coast off Red Beach of Marine Corps Base Camp Pendleton. The Coast Guard has listed and, described these restricted areas off Camp Pendleton in detail in their publication: Coast Pilot 7 in §334.900, §334.905 and §334.91O. Regulations for these areas prohibit several activities including dredging and anchoring. As sites are in close proximity to the proposed borrow site the Draft EISIEIR should incorporate some information regarding their existence and restrictions.	Inquiry was made with the Marine Corps Base Camp Pendleton (MCBCP), Land Management Branch as well as the US Coast Guard publication Coast Pilot 7 in §334.900, §334.905 and §334.910. Both sources have indicated that the borrow site and the transit location are not within a restricted area. The FEIS/R will replace a figure that depicts the borrow site location as Figure 3.4-1, page 3-9 in reference to "restricted areas 334.900 and restricted area 334.910" (U.S. Coast Pilot 7).
3	Marine Corps	Page 1-1 Study Area -the proposed borrow area is outside the described study area. Does it have its own study area? If so where is it addressed?	Detail is focused on the San Clemente beach placement site because 1) there are no onshore impacts associated with dredging at the Oceanside borrow site and because 2) information on the Oceanside borrow side was included in the EIR/EA for the San Diego Regional Beach Sand Project (SANDAG 2000) and is incorporated by reference. Where pertinent, information on the Oceanside borrow site is included in Section 4.0. Section 4.2.1 describes the location and substrate of the borrow site. Section 4.3.1 is a general description of water column physical and chemical characteristics and is applicable to the Oceanside borrow site. Section 4.3.3 specifically contains information on sediments at the Oceanside borrow site. Section 4.3.4 on

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			oceanographic characteristics and coastal processes is applicable to the Oceanside borrow site as well as San Clemente because both sites are in the same littoral cell. Section 4.4.2 includes information on the biology of the Oceanside borrow site.
4	Marine Corps	Page 3-1 Evaluation Criteria. Were any planning constraints considered for the impact caused by the dredging at the borrow site? Such as -"Preserve water quality characteristics along the coast and near shore areas in the vicinity of the borrow site"	Impacts of dredging at the borrow site were evaluated against the significance criteria for the relevant issue areas (Section 5). To the extent feasible, it was a project objective to avoid or mitigate for significant impacts. The relevant significance criteria for water quality that were applied to dredging at the borrow site were: "Impacts to marine water quality are considered significant if any of the following apply: • The water quality objectives in the California Ocean Plan (SWRCB 2005) are violated; and/or • Project operations or discharges that change background levels of chemical and physical constituents or elevate turbidity would produce long-term changes in the receiving environment of the site, area, or region that would impair the beneficial uses of the receiving water. Impacts are considered less than significant if the project would result in elevation of contaminants, but the levels remain below water quality criteria or if elevation of contaminant concentrations above criteria occurs only within a couple of hundred feet or less of the point of discharge for a few hours or less."
5	Marine Corps	Page 3-3 Beach Fill. Lines 27 and 28 states "Beach nourishment may use offshore or onshore borrow sites. In the study area, offshore sources have historically been used for several reasons." Please include the reasons for excluding onshore borrow sites.	Offshore sites were chosen using the SANDAG (2000) study discussed, which identified offshore sources in the project vicinity. Onshore sources were not carried forward as they were not as technically or economically feasible.

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6	Marine Corps	Page 3-9. Figure 3.4-1-Oceanside Borrow Site Map. Recommend that this graphic be changed to a Navigational Chart for more clarity of the borrow site's location.	The FEIS/R will replace a figure that depicts the borrow site location as Figure 3.4-1, page 3-9 in reference to "restricted areas 334.900 and restricted area 334.910 (U.S. Coast Pilot 7). A navigational chart is not necessary and would be more confusing to the general public. The dredge operator will know and will be well versed on navigation charts for the dredge.
7	Marine Corps	Page 4-1 Affected Environment Since part of the project includes dredging material at the borrow site, information on that location should be included in the Affected Environment Chapter.	Please see the Response to Comment 3. The affected environment at the borrow site is discussed for the relevant issue areas in Section 4.
8	Marine Corps	Page 4-1 Meteorology and Air Quality needs to include discussions about San Diego Air Pollution Control District (SDAPCD) since there will be emissions in that Air District.	Information for the San Diego Air Basin has been added to the FEIS/R.
9	Marine Corps	Page 4-13 Water Quality, Sediments, and Oceanography should discuss discharges in the vicinity of the borrow site.	Section 4.3.1 has been amended to include information on discharges near the Oceanside borrow site.
10	Marine Corps	Page 4-38 Biological Resources Lines 7 and 8 states - "These sections describe biological resources found in the vicinity of the proposed beach fill and borrow site areas along the San Clemente coastline." The proposed borrow site is along the Camp Pendleton/Oceanside coastline. Does this section cover that site or only the potential borrow site near San Clemente? Some sections like Page 4-45 lines 26-36 provide information on the proposed borrow site along the Camp Pendleton/Oceanside coastline and others like Table 4-14 focus only on the San Clemente site ignoring biological resources in the immediate vicinity of the proposed borrow site.	The biological resources section addresses both the San Clemente beach placement site and the Oceanside borrow area. Some additional text has been added to clarify the relationship between sensitive resources and the borrow site.
11	Marine Corps	Table 4-14 Special Status Listed Species that May Occur in the San Clemente Pier or Oceanside Borrow Site Areas: -Southern steelhead has also been found in the Santa Margarita River near the proposed borrow site.	Table 4-14 will be revised to indicate taxa that will not be present and those that could be present, but their occurrence is negligible or very low. 1. Southern steelhead will not be affected because the project action implementation will occur at a time when they are not present.

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		-Western snowy plover nesting sites are located within about one mile of the proposed Oceanside borrow site as such the "Potential For Occurrence in the Project Area" should be high. -California least tern nesting sites are located within about one mile of the proposed Oceanside borrow site as such the "Potential For Occurrence in the Project Area" should be high.	2. Snowy plover will not be affected by the action implementation because these charadrids will not be breeding during the project implementation. Sea and Sage Audubon performed a 2010 winter survey. San Clemente Beaches were not included. Beach habitat within the project placement footprint, as well as in Oceanside, are narrow and heavily used by people. Philip Unitt, San Diego Natural History Museum, Birds of San Diego County, Memoir 13, 1984, does not show snowy plovers in north portion of the county. California State Parks has tracked snowy plovers during winter window surveys and has driven San Clemente State Beach many times with zero plovers observed over the years (David Pryor, personal communication, February 2011). Snowy plovers will not use the borrow site and any wintering activity will not be affected by actions at the borrow site off-shore. Potential for occurrence remains negligible to low, at best. In comparison, the Landing Craft, Air Cushion (LCAC) Transport would be expected to have orders of magnitude greater effect on snowy plovers than the borrow site operations. 3. Least terns will not be affected by the action implementation because these larids will not be breeding during the project implementation. Least terns will be on their southern latitude wintering grounds during project implementation. Potential for occurrence remains negligible.
12	Marine Corps	Page 4-51 Section 4.4.3.3 Steelhead Trout (Federal Endangered) -Southern steelhead has also been found in the Santa Margarita River near the proposed borrow site.	It is recognized that southern steelhead migrate up the Santa Margarita River and this information will be added to the FEIS/R. However, there will be no effect to southern steelhead because this taxon will not be

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			present during sand placement activities due to the season and the fish would be expected to avoid the barge activities at the borrow site in the same manner they would avoid any other vessel in the area.
13	Marine Corps	Page 4-51 Section 4.4.3.5 California Least Tern (Federal and State Endangered)-Lines 3 & 4 Large numbers of California least tern nesting sites are located within about one mile of the proposed Oceanside borrow portion of the project area and are likely to forage at the proposed borrow site.	Least terns will not be affected by the action implementation because these larids will not be breeding during the project implementation. Least terns will be on their southern latitude wintering grounds during project implementation. Potential for occurrence remains negligible.
14	Marine Corps	Page 4-51 Section 4.4.3.6 Western Snowy Plover (Federal Threatened) Lines 37 & 38-The Santa Margarita River nesting site is located within about one mile of the proposed Oceanside borrow portion of the project area.	Snowy plover will not be affected by the action implementation because these charadrids will not be breeding during the project implementation. Wintering snowy plovers will be few, if any on the beaches opposite the borrow site and the site is 0.75 to 1.0 miles off-shore and thus will not be affected by borrow site activities.
15	Marine Corps	Page 4-57 Section 4.5.2 Area of Potential Effects (APE) states "The offshore portion of the APE includes two offshore borrow sites, Areas 1 and 2. Area 1 is located southwest of the San Clemente Municipal Pier, and Area 2 is located off the coast of Oceanside." Section 4.5.3 summarizes the archaeology within and adjacent to the southern California coastline from Doheny State Beach to San Mateo Point. Where is the summary for Area 2 which is located off the coast of Camp Pendleton/Oceanside?	During the Design Phase, an underwater remote sensing survey of the borrow site (Area 2) will be conducted for the purpose of identifying any resources that may be present. If resources are identified, they will be evaluated for inclusion in the National Register of Historic Places (NRHP). If any are determined to be eligible for the NRHP, avoidance or mitigation efforts would be implemented. These compliance procedures will be coordinated with the SHPPO officer and consistent with Section 106 of the National Historic Preservation Act (36CFR800).
16	Marine Corps	Page 4-64 Section 4.6.2 Vessel Transportation - Oceanside Harbor may be 20 miles from the San Clemente portion of the project area but it is within one mile of the Proposed Borrow Site. The section should also address Marine Corps and Navy use of the area near and between the two portions of the project site and dredge barge impacts on those uses. This may also be the place to address the nautical restricted areas listed and described in the Coast Guard publication known as Coast	Inquiry was made with the Marine Corps Base Camp Pendleton (MCBCP), Land Management Branch and as well as the US Coast Guard publication Coast Pilot 7 in §334.900, §334.905 and §334.910. Both sources have indicate that the borrow site and the transit location are not with a restricted area. The FEIS/R will replace a figure that depicts the borrow site location as Figure 3.4-1, page 3-9 in reference to "restricted areas 334.900 and restricted area 334.910

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		Pilot 7 that are in the vicinity of the Camp Del Mar area (in addition to a 3rd restricted area located further up the coast off Red Beach). The planned borrow site for this project is located within the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA), as noted on most nautical charts (extends approximately 5.5 miles out from the southern end of the Camp Pendleton/Oceanside Harbor north breakwater and north to just south of San Mateo point). While that should not be a problem and dredging operations would not be prevented off the southern coast of Camp Pendleton, nevertheless, advance coordination of any planned dredging operations in or near the CPAVTA is required. The Final EIR/EIS for this project should include a provision that the dredging operator pre-coordinate all planned dredging and transport operations with Camp Pendleton. If the Base is made aware of such offshore dredging operations and transport in advance, this activity can be incorporated into the Daily Training Schedule and efforts can be made to deconflict any potential Naval or Marine Corps amphibious training operations that may also be planned in close proximity to the dredging site and throughout the CPAVTA.	(U.S. Coast Pilot 7). Dredging will occur in the winter months outside environmental (e.g., nesting least tern) windows. Dredging will occur between early September and the end of March. Oceanside Harbor Days are held at the end of September/beginning of October and will be avoided. All other annual sailing events that occur near the Harbor will be coordinated and avoided. The Corps will contact the CPAVTA and obtain schedules of training activity occurring in the ocean and coordinate dredging activities to avoid and conflict/interference. The FEIS/R now includes a provision that the dredging operator shall pre-coordinate all planned dredging and transport operations with Camp Pendleton.
17	Marine Corps	Page 4-80 Section 4.9.1 Beaches -fails to address Camp Pendleton and Oceanside beaches which are located within one mile of the proposed borrow site.	MCBCP beaches will be added to the FEIS/R.
18	Marine Corps	Page 4-81 Section 4.9.2 Annual Events -fails to address Camp Pendleton Del Mar Recreation Beach and Oceanside Harbor Events which are located within one mile of the proposed borrow site.	Dredging will occur between early September and the end of March. Dredging activities will occur approximately 0.75 to 1.0 miles from the shoreline and would not be expected to have any effects on the Oceanside Harbor Events occurring onshore except for the aesthetic view of a dredge in the distance. The addition of one relatively small dredge in the area near the harbor where naval vessels are common would not be expected to affect the general public during this event. All other annual sailing events that occur near the Harbor will be coordinated and

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			avoided.
19	Marine Corps	Page 5-1 Section 5-1 Air Quality and Meteorology -Where is the discussion for emissions within the SDAPCD?	Information for the San Diego Air Basin has been added to the FEIS/R.
20	Marine Corps	Page 5-25 Impact WR-50-2: Would there be any potential impact from turbidity during dredging to southern steelhead attempting to enter the Santa Margarita River during the rainy season?	As described in Section 5.3.2, turbidity generated during dredging at the Oceanside borrow site is expected to affect a relatively small area. Observations during dredging at the Oceanside borrow site for the San Diego Regional Beach Sand Project identified only small plumes that did not exceed 2,700 square yards in extent. Southern steelhead enter southern California streams during the winter season when streams are flowing and nearshore waters are naturally turbid from stream discharges. Turbidity from dredging at the Oceanside borrow site would not be expected to have a significant effect on southern steelhead.
21	Marine Corps	Page 5-35 Section 5.4 Biological Resources -Lines 25 & 26 -with the discovery of southern steelhead in the Santa Margarita River its potential to occur in the project area (borrow site) is higher than identified in the draft EISIEIR.	The assessment of potential to occur is accurate as currently stated in the document. The potential for southern steelhead to occur at the Santa Margarita River during project implementation remains negligible to low. Because steelhead may change the stream they inhabit from one year to the next, the discovery of southern steelhead in the Santa Margarita River in one year does not increase the potential for the species to occur in the project area; further discoveries within the river would need to validate that the recent occurrence was not a chance occurrence.
22	Marine Corps	Page 5-45 -Impact BR-115-1: A direct adverse effect on the population of a special status listed species or the loss or disturbance of important habitat for a listed species. Lines 34-36Western snowy plovers also breed on the beaches of Camp Pendleton near the Oceanside borrow area.	Snowy plover will not be affected by the action implementation because these charadrids will not be breeding during the project implementation. Wintering snowy plovers will be few, if any, on the beaches opposite the borrow site and the site is 0.75 to 1.0 miles off-shore and thus will not be affected by borrow site activities. California State Parks has tracked snowy plovers during winter window surveys and has driven San Clemente State Beach many times with

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			zero plovers observed over the years (David Pryor, personal communication, February 2011). Thus, snowy plovers will not be disturbed during the winter season and their breeding habitat at MCBCP will not be affected during project implementation. Snowy plovers are added to the discussion on page 5-45, Section 5.4.3.
23	Marine Corps	Page 5-52 Section 5.6 Ground and Vessel Transportation only talks about ground transportation impacts. There is nothing about impacts to ocean vessel transportation. As noted earlier in Section 4.6.2 Vessel Transportation, the planned borrow site for this project is located within the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA and advance coordination of any planned dredging operations in or near the CPAVTA is required. If Camp Pendleton is made aware of such offshore dredging operations and transport in advance, this activity can be incorporated into the Daily Training Schedule and efforts can be made to deconflict any potential Naval or Marine Corps amphibious training operations that may also be planned in close proximity to the dredging site and throughout the CPAVTA.	The Corps will contact the CPAVTA and obtain schedules of training activity occurring in the ocean and coordinate dredging activities to avoid and conflict/interference.
24	Marine Corps	Page 5-60, Section 5.8 -Noise -What are the noise standards/criteria on shore in the vicinity of the borrow site? This would seem important to support the statement in lines 1 and 2 on page 564, and 26 through 30 on page 5-67.	As described in Section 5.8.2, the noise of the dredging activities at the Oceanside borrow site to onshore receptors would be 44.5 dBA leq. The increase in noise to sensitive receptors would be imperceptible. The noise of the dredge onshore would be less than the noise of breaking waves. Therefore, noise criteria for the City of Oceanside would not be applicable because noise from the dredge would not be discernible to sensitive receptors onshore.
25	Marine Corps	Page 5-77, Section 5.11 -Public Health and Safety -It appears the planned borrow site for this project is located within the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA), as noted on most nautical charts. While that should not be a problem and dredging operations	Inquiry was made with the Marine Corps Base Camp Pendleton (MCBCP), Land Management Branch and as well as the US Coast Guard publication Coast Pilot 7 in §334.900, §334.905 and §334.910. Both sources have indicate that the borrow site and the transit

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		would not be prevented off the southern coast of Camp Pendleton, nevertheless, advance coordination of any planned dredging operations in or near the CPAVTA is strongly recommended. The Final EIR/EIS for this project should include a provision that the dredging operator pre-coordinate all planned dredging and transport operations with the Camp Pendleton Range Scheduling department in the Range Operations Division. If the Base is made aware of such offshore dredging operations and transport in advance, this activity can be incorporated into the Daily Training Schedule and efforts can be made to deconflict any potential Naval or Marine Corps amphibious training operations that may also be planned in close proximity to the dredging site and throughout the CPAVTA.	location are not with a restricted area. The FEIS/R will replace a figure that depicts the borrow site location as Figure 3.4-1, page 3-9 in reference to "restricted areas 334.900 and restricted area 334.910" (U.S. Coast Pilot 7). As with all US Army Corps projects that are within DoD Ranges, coordination will ensue during project implementation.
26	Marine Corps	Page 6.1 Description of Cumulative Projects -Why isn't the Oceanside Harbor Dredging project include in the Cumulative Impact Analysis since it is located within one mile of the borrow site?	Oceanside Harbor dredging is not included as a cumulative project for the dredging at the Oceanside borrow site because the impacts of the two dredging projects would not be expected to interact cumulatively. The dredging at the Oceanside borrow site would not affect the shoreline environment, including Oceanside Harbor. Dredging at Oceanside Harbor would not be expected to affect the environment in the vicinity of the borrow site about 1 mile offshore.
27	Marine Corps	Page 7-1 Section 7.0 Environmental Commitments -Since the planned borrow site for this project is located within the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA), as noted on most nautical charts the commitment that the dredging operator pre~coordinate all planned dredging and transport operations with Camp Pendleton should be added. If the Base is made aware of such offshore dredging operations and transport in advance, this activity can be incorporated into the Daily Training Schedule and efforts can be made to deconflict any potential Naval or Marine Corps amphibious training operations that may also be planned in close proximity to the dredging site and throughout the CPAVTA.	Inquiry was made with the Marine Corps Base Camp Pendleton (MCBCP), Land Management Branch and as well as the US Coast Guard publication Coast Pilot 7 in §334.900, §334.905 and §334.910. Both sources have indicate that the borrow site and the transit location are not with a restricted area. The FEIS/R will replace a figure that depicts the borrow site location as Figure 3.4-1, page 3-9 in reference to "restricted areas 334.900 and restricted area 334.910" (U.S. Coast Pilot 7). As with all US Army Corps projects that are within DoD Ranges, coordination will ensue during project

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			implementation.
28	Marine Corps	Page 9-3 Section 9.3.10 Other Agencies/Public Interest Groups -Coordination with MCB Camp Pendleton is required for all activity that takes place in the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA), as noted on most nautical charts.	Inquiry was made with the Marine Corps Base Camp Pendleton (MCBCP), Land Management Branch and as well as the US Coast Guard publication Coast Pilot 7 in §334.900, §334.905 and §334.910. Both sources have indicate that the borrow site and the transit location are not with a restricted area. The FEIS/R will replace a figure that depicts the borrow site location as Figure 3.4-1, page 3-9 in reference to "restricted areas 334.900 and restricted area 334.910" (U.S. Coast Pilot 7). As with all US Army Corps projects that are within DoD Ranges, coordination will ensue during project implementation.
Kathleen M. Goforth, Manager, Environmental Review Office, EPA, September 20, 2010			
29	EPA	Project Purpose and Need: Page 2-6 of the DEIS states that the purpose and need are "to prevent the severe beach erosion that results from winter storms and to prevent damage to adjacent beachfront structures, including the heavily used rail line". However, the DEIS does not clearly demonstrate whether placement would be a "beneficial use" at the proposed location through the rebuilding of an eroding beach. The DEIS section on the relationship between the sediment budget and long-term shoreline change does not appear to support that the beach is eroding. For example, the DEIS states that the "resultant sediment budget indicates the shoreline is essentially in balance between erosion and accretion" (see Section 4.3.4.3). The table on shoreline change also demonstrates that the shoreline has varied between eroding, accreting, and balanced (see Table 4-10) with the maximum erosion rate of minus 2 feet/year at T-street. The sediment budget and the long-term shoreline change studies referenced on DEIS p. 4-36 conflict with the more	It is recognized that the shoreline change data set used in the present analysis is limited at best. However, this was the most recent data available for this area at the time this analysis was conducted; there was no other data available. While data intensive information resulting in conclusive findings is preferred, the best available data provided the results in this analysis. It is further recognized that the shoreline change data set results in a less than desired numerical presentation. However, the results are consistent with the overall shoreline change scenario in this region. The sediment budget indicates the shoreline is in balance, neither accretional nor erosional (+0.03 m/yr). Inclusion of recent monitoring data results in a marginally erosive shoreline (-0.10 m/yr). The very small annual change signal is masked within the much larger envelope of seasonal changes. The seasonal variations are on order of 15 m and thus are two orders of magnitude larger than the mean annual

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		recent studies cited on DEIS p. 4-35 that appear to support the downward trend of beach width in the project location. However, according to the DEIS, it has been eight years since the last study, the most recent beach width being measured in 2002 (Table 4.3-6). Due to the time elapsed, the high variability of beach width in the past, and the appearance of conflicting information with the historical and long-term analyses, we recommend that the DEIS include the results of more recent beach width monitoring in the project location. Other project purposes include protection of railroad infrastructure from wave erosion. Section 4.6.1.2 of the DEIS states that the Orange County Transportation Authority has placed "riprap along the most critical segment between North Beach and the Marine Safety Building to decrease wave erosion impacts"; however much of this segment is not within the project footprint, and the project area south of the Marine Safety Building has no protecting riprap. The DEIS should address why the project area south of the Marine Safety Building has no protecting riprap. If this area is not considered part of the "critical segment", the DEIS should explain the purpose and need of including the area in the project. *Recommendations:* The FEIS should include an analysis of all existing data to clearly demonstrate a net loss of sediment deposition over the project area, and that local beach profiles show the effects of such erosion and thus are in need of replenishment. The FEIS should also provide clarification of the U.S. Army Corps of Engineers' (USACE) anticipated erosion rate of 12.8 feet per year (see Section 3.4.2.5) and why this rate is higher than historical erosion rates (-2 ft/year at T-street). For additional clarity, we also recommend that the sediment budget (Table 4-9) and long-term shoreline change (Table 4.3-6) sections include	long term signal. The three survey lines SC 1680 (Linda Lane), SC 1660 (T Street), and SC 1623 (State Beach) are south of Mariposa Point (Reach 7) whereas SC 1720 (Shorecliffs) is north of Mariposa Point. Mariposa Point, although physically small, is morphologically significant as it represents a salient feature in an otherwise uniform section of shoreline. This salient is a micro morphological separation between Shorecliffs and the other three survey lines. These three lines south of Mariposa Point are consistent in erosional trend whereas the Shorecliffs trend is accretional. Uncertainties in the results of this analysis are assumed captured within the design long term shoreline change distribution. The design distribution is a triangular form with a minimum (max erosion) of -0.46 m/yr, a maximum (max accretion) of +0.38 m/yr, a peak of -0.21 m/yr, resulting in a mean value of -0.10 m/yr. The Coastal Engineering Appendix has been amended to include a narrative that summarizes the sediment budget and erosion rates. This narrative discusses the larger littoral cell, the smaller project reach within, and their relationship to the measured sediment budget and erosion rates. This narrative further emphasizes the marginally negative long-term erosion rate and the implications on observed and future damages.

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		a map and description of the sampling stations, as well as a depiction of shoreline change during each of the represented periods.	
30	EPA	The FEIS should include more information on the National Security issues surrounding the single track LOSSAN railroad adjacent to the project area. Page 4-65 of the DEIS states that the Department of Defense has designated this right-of-way as a Strategic Rail Corridor with great significance to National Defense. However, little information. is given regarding how or when this determination was made. We note that the Federal Railroad Administration filed a Environmental Impact Statement in 2007 (Final Program Environmental Impact Statement for LOSSAN, Los Angeles to San Diego Proposed Rail Corridor Improvements in the State of California (CEQ# 20070465)) calling for the relocation of the LOSSAN railroad away from the Shoreline with plans to run a new line adjacent to Interstate 5. Recommendation: The FEIS should include the results of consultation with the Department of Defense to ensure that all project alternatives are consistent with current National Security policy.	The FEIS is consistent with NEPA and Corps plan formulation policy. It is not the responsibility of the US Army Corps of Engineers to describe the Department of Defense designation of this right-of-way as a Strategic Rail Corridor with great significance to National Defense. It is not crucial to this project if the Federal Railroad Administration filed a Environmental Impact Statement in 2007 calling for the relocation of the LOSSAN railroad away from the Shoreline with plans to run a new line adjacent to Interstate 5. The purpose of this Project is not predicated on the protection of the LOSSAN Railroad. EPA should discuss the railroad relocation project directly with Department of Defense. Recommendation is noted.
31	EPA	Alternatives Analysis: The DEIS includes a no-action alternative and two action alternatives. The two action alternatives include nourishment of the same linear project area but with different beach widths, (50 feet and 115 feet). While the proposed project (50 feet width option) would have fewer impacts from fill activity than the 115 feet alternative, both alternatives would have similar adverse environmental and recreational impacts in the	The alternatives presented in the report were developed through the Corps' plan formulation and coastal engineering processes for a storm damage reduction study. Consideration was given to all potential impacts and benefits. The 15-m plan produces the highest net benefits to the nation while causing the least potential impacts (represents the LEDPA). Thru this plan formulation process, a 10-m plan was analyzed and it resulted in fewer net benefits, but similar potential impacts as the 15-m

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		same linear project areas. *Recommendation:* The FEIS should include, at a minimum, an additional alternative that reduces the amount of linear project footprint. EPA suggests that an alternative excluding fill south of the Marine Safety Building may meet the needs of the project while greatly reducing adverse impacts to surfing, coral reefs, and surfgrass. The FEIS alternatives analysis should include a reasonable range of practicable alternatives that meet the project purpose and demonstrate the project's compliance with the CWA Section 404(b)(1) Guidelines and selection of the Least Environmentally Damaging Practicable Alternative LEDPA.	plan. The current recommended plan contains an adaptive management element in that monitoring of the equilibrated/dispersed sediment will be done to possibly modify future renourishment activities for the purpose of reducing impacts to an acceptable level. This could entail placing sediment in different locations, within the project area, or reducing the overall volume of sediment place.
32	EPA	Air Quality (General Conformity): EPA is concerned that applicability of the general conformity program has not been appropriately addressed in the DEIS. The project area is in Orange County, California. This county is part of a larger area that is not meeting federal air quality standards for ozone. The DEIS states that "The area may request a higher classification" (DEIS Vol. 2 p. 12). In fact, the area was reclassified to extreme nonattainment for the 1997 ozone national ambient air quality standards (NAAQS) on June 4, 2010. For this reason, the area now has a lower applicability threshold for general conformity. The DEIS is not clear that the applicability threshold used for analysis was 25 tons per year (tpy); however, we believe this to be the case, and want to clarify that the required threshold for analysis is 10 tpy. For more information go to: http://www.epa.gov/oaqps001/greenbk/gfr2rpt2.html.	Information related to General Conformity, including the re-designation to extreme, was added to the document.

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		Recommendation: The FEIS should state clearly that the general conformity threshold is 10 tpy. Provide the results of the General Conformity applicability analysis to indicate whether the preferred alternative is above or below this de minimis level. If it is over de minimis, indicate the method that will be used to demonstrate that the project conforms to the applicable state implementation plan (SIP) for the area.	
33	EPA	Air Quality Analysis: The DEIS reports that the project will have no long-term impacts and a temporary short term adverse impact to air quality, but does not comprehensively assess the Project's operational and construction direct, indirect, or cumulative impacts to air quality. The FEIS should include a complete description of potential impacts and ways to reduce those impacts. In particular, EPA has concerns regarding the apparent lack of both an air quality impact assessment of fill placement, and a staging area plan that minimizes exposures to sensitive receptors and residents.	The FEIS/R addresses the temporary short-term impacts related to construction and does not identify any operational long-term emissions associated with the project. Impacts from fill placement were addressed and mitigations were added to ensure the staging areas will minimize exposures to sensitive receptors.
34	EPA	Construction Mitigation Measures: EPA commends USACE for incorporating mitigation strategies to reduce or minimize air pollutant, paving, and fugitive dust emissions. However, in addition to idling restrictions, proper maintenance of equipment, and the selection of construction equipment based on low emission factors, this Project should incorporate more stringent emission controls for PM and ozone precursors for construction-related activity. *Recommendations:* Due to the serious. nature of the particulate matter of 10 microns or less (PM_{10}) and $PM_{2.5}$ conditions in the South Coast Air Basin, EPA recommends that the best available control measures (BACM) for these pollutants be implemented at all times and that the FEIS and ROD incorporate the Construction Emissions Mitigation Plan. We recommend that all applicable requirements under the	Additional mitigation measures were added to the FEIS/R. Costs have been included in the project contingency.

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		South Coast Air Quality Management District (SCAQMD) Rules and the following additional measures be incorporated into the Construction Emissions Mitigation Plan. Fugitive Dust Source Controls: • Stabilize open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate. This applies to both inactive and active sites, during workdays, weekends, holidays, and windy conditions. • Install wind fencing, and phase grading operations, where appropriate, and operate water trucks for stabilization of surfaces under windy conditions. • When hauling material and operating non-earthmoving equipment, prevent spillage, and limit speeds to 15 miles per hour (mph). Limit speed of earthmoving equipment to 10 mph. Mobile and Stationary Source Controls: • Reduce use, trips, and unnecessary idling from heavy equipment. • Maintain and tune engines per manufacturer's specifications to perform at California Air Resources Board (CARB) and/or EPA certification, where applicable, levels and to perform at verified standards applicable to retrofit technologies. Employ periodic, unscheduled inspections to limit unnecessary idling and to ensure that construction equipment is properly maintained, tuned, and modified consistent with established specifications. CARB has a number of mobile source anti-idling requirements. See their website at: http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm • Prohibit any tampering with engines and require continuing adherence to manufacturer's recommendations • If practicable, lease new, clean equipment meeting the most stringent of applicable Federal or State Standards. In general, only Tier 2 or newer engines	

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		should be employed in the construction phase. • Utilize EPA-registered particulate traps and other appropriate controls where suitable, to reduce emissions of diesel particulate matter and other pollutants at the construction site. Administrative controls: • Identify all commitments to reduce construction emissions and incorporate these reductions into the air quality analysis to reflect additional air quality improvements that would result from adopting specific air quality measures. • Identify where implementation of mitigation measures is rejected based on economic infeasibility. • Prepare an inventory of all equipment prior to construction, and identify the suitability of add-on emission controls for each piece of equipment before groundbreaking. (Suitability of control devices is based on: whether there is reduced normal availability of the construction equipment due to increased downtime and/or power output, whether there may be significant damage. caused to the construction equipment engine, or whether there may be a significant risk to nearby workers or the public.) Meet CARB diesel fuel requirement for off-road and on-highway (i.e., 15 ppm), and where appropriate use alternative fuels such as natural gas and electric. • Develop construction traffic and parking management plan that minimizes traffic interference and maintains traffic flow. • Identify sensitive receptors in the project area, such as children, elderly, and infirm, and specify the means by which you will minimize impacts to these populations. For example, locate construction equipment and staging zones away from sensitive receptors and fresh air intakes to buildings and air conditioners.	
35	EPA	EPA is concerned that the air quality analysis in the DEIS does not include emissions associated with the multiple collection barge trips needed to remove and transport fill	The DEIS/R did include the analysis of multiple trips moving fill from the borrow site to the project site. The FEIS/R did not require revision to the air quality

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		from the project site nor does the DEIS appear to include estimates of the number of necessary collection barge trips, distance traveled, and corresponding air emissions. *Recommendations:* The FEIS should include a revised air quality analysis and updated emissions comparison to SCAQMD significance thresholds to account for the emissions from the equipment required to transport fill. The FEIS should also commit to additional minimization measures for these emissions.	analysis.
36	EPA	Water Resources: Although a CWA Section 404 permit is not needed for the proposed action, the project must be in compliance with the CWA Section 404(b)(l) Guidelines. Also, the FEIS and ROD will serve as the basis for future permits that will be needed for maintenance of beach nourishment. Under the proposed action, sand replenishment will have to be done every five or six years to restore the design beach width and those actions may need a permit. While the project will have impacts to high value marine habitats, including special aquatic sites (defined at 40 CFR 230.3(q-1)), the Section 404(b)(1) Alternatives Analysis (Appendix A) concludes that all impacts are localized and temporary, and therefore, insignificant. There is no discussion of the basis for this conclusion. As a result of the large volumes of sand being placed on receiver beaches, the proposed project could lead to significant and unavoidable adverse impacts on surface water quality and fisheries from increased turbidity and fill in special aquatic sites. Other short-and long-term threats to water quality include construction-related containments such as oil and hydraulic fluid and increased turbidity that	The basis for the conclusion that impacts to water quality and high value marine habitats will be localized and transitory is discussed in Sections 5.3.2 and 5.4.2. The conclusions were based on modeling of predicted sediment transport from the placement site and observations made during previous beach nourishment projects in southern California on turbidity and impacts to high value marine habitats. A monitoring and mitigation program is proposed for high value marine habitats to confirm that high value marine habitats are not affected and that mitigation measures are implemented if they are. The potential impacts of turbidity and construction related contaminants are addressed in Section 5.3.2. Mitigation measures MM-WR-50-1.1 and MM-WR-50-1.2 are proposed to reduce those impacts to insignificant. As discussed in Section 4.4, subtidal surveys of the project area were conducted by Coastal Resources Management in March and June 2000 and by Chambers Group in March 2008 and July 2009. A survey of the shoreline in the project area was conducted by Chambers Group on May 18, 2008.

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		would occur during the future, associated maintenance activities for the proposed project. *Recommendations:* The FEIS should include a comprehensive biological survey of the San Clemente shoreline. The FEIS should address the potential of the project to contribute to elevated turbidity levels. The USACE should consider marine design modifications regarding factors such as location and size, to minimize these environmental impacts. Additional minimization measures for impacts to the aquatic environment should be discussed in the FEIS. Minimization measures include timing and rate of fill placement. The USACE should commit to placement in fall or winter to better mimic natural shoreline turbidity processes and reduce impacts during high recreational use times, and to develop debris management plans to ensure that the borrow site materials do not deposit trash, or other debris that may be harmful to the ocean environment.	As discussed in Section 3.4.2.3 and Section 5.3.2, project construction has been designed to minimize turbidity. The sand would be placed on the beach behind an L-shaped sand berm. Retention by the berm allows sediments to settle and greatly reduces turbidity. Construction would be during the fall or winter to reduce and avoid impacts to the marine environment.
37	EPA	Source & Quality of Beach Nourishment Materials: The DEIS briefly considers sources of sand such as onshore and offshore borrow sites (DEIS p. 3-3); however, it then goes on to state, "for this project offshore dredging would be required". Any opportunities for further minimizing impacts to the aquatic environment by using sand from other USACE permitted projects, or using sources from which the dredging might provide enhancement of environmental, navigational, or recreational conditions should be discussed in the FEIS. We note that the chemical testing of the sediments in the proposed Oceanside borrow pit occurred several years	As stated in the Geotechnical Engineering Appendix, an adequate level of analysis for borrow site selection and testing has been conducted (per USACE guidelines). Sections 3.5.1 and 3.5.2 describe methodology for borrow site selection and suitability based on both grain size characteristics and presence of contaminants. Borrow site Area 2 was found to be compatible and contains no contaminants. Section 4.2.2 describes the Bulk Chemistry borrow testing form the same USACE'03 Investigation

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		ago. Due to this lapse of time, additional testing may be necessary. The DEIS did not describe the initial sampling scheme (depth of cores, how many cores) nor whether the cores went down to anticipated dredging depth. Additionally, the table did not provide a chemical reference sample along a beach transect at the proposed receiving site. The DEIS provides insufficient discussion of the regulatory approval process of material for testing. A Sampling and Analysis Plan (SAP) for tiered testing, pursuant to the Inland Testing Manual should be required for each placement within the beach nourishment program. The SAP should examine the source material and the receiver site sediments and address tiered testing requirements (including grain size and the need for other testing) and be reviewed by the USACE, USEPA, Coastal Commission, and the RWQCB for concurrence prior to any sampling of the materials. All SAP's and approvals should be reviewed by the interagency dredging group run by the Los Angeles USACE s District (SC-DMMT). *Recommendation:* The USACE should evaluate and discuss in the FEIS the opportunity to coordinate with other projects that may produce suitable material for beach nourishment purposes. The ROD should include a commitment to consideration of opportunistic sources of beach nourishment material prior to each nourishment cycle. The discussion of the chemical testing of the proposed Oceanside borrow site should be expanded in the FEIS to include pertinent information such as core depth and number of samples. The FEIS should also describe, and the ROD should commit, to project review through an interagency	(Attachment 1 provides detailed analysis). Stephen John (EPA, personal communication) stated that since the August USACE sampling did not identify contaminants, no additional analysis is required.

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		regulatory approval process (i.e., SC-DMMT) to ensure that the sediments are suitable for ocean placement.	
38	EPA	Biological Quality Surveys and Monitoring: We acknowledge the USACE commitment to a 50 year monitoring period (over the life of the project). As discussed in the DEIS, surveys and monitoring have typically been incorporated into beach nourishment projects. The document cites the San Diego Association of Governments' (SANDAG) "monitoring data that suggest the San Clemente fill will erode on average at a rate of 12.8 feet per year (3.9 m/yr)", (p. 3-18). To counter this erosion, the DEIS states that proposed project monitoring would be required to assess replenishment schedules. However, the document does not sufficiently discuss a biological monitoring plan. This information should be included in order to evaluate the effectiveness of the proposed action in protecting biological diversity/quality. The monitoring plan should include pre-and post-project dive surveys and benthic community sampling of the borrow site and the receiver site to ensure that each benthic community returns to its pre-project density and structure. We stress that any monitoring should have appropriate adaptive management to ensure minimal impacts to aquatic resources. The Coastal Sediment Management Workgroup is currently preparing a document outlining practices to minimize impacts to aquatic resources. The adaptive management process should allow for incorporation of these practices and associated principles and any other developments in regional sediment management over the life of the project. *Recommendation:* The FEIS should include a detailed description of a	A biological monitoring plan is included as Mitigation Measure MM-BR-50-2.2. The biological monitoring plan is described in detail in Appendix B.

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		survey/monitoring program for the biological impacts of the Proposed Project, and commit to its incorporation as a required project element. The monitoring program should have a clear adaptive management strategy to ensure that the aquatic environment is protected.	
39	EPA	Endangered Species: The DEIS insufficiently evaluates the potential impacts to endangered species. For example, the document states, "No proposed or endangered species are expected to be present on the site" (DEIS p.A-IO). The basis for this statement is unclear due to the lack of a complete shoreline biological survey. *Recommendation:* The FEIS should include a comprehensive biological survey of the entire project area as well as the borrow site, including a complete review of species that may be affected by the project. The results of consultation with the United States Fish and Wildlife Service and National Oceanic and Atmospheric Administration (NOAA), if appropriate, regarding threatened or endangered species or critical habitat should be included in the FEIS. Beach nourishment activities should avoid the nesting seasons for listed species, such as the least tern.	As clearly stated and outlined in the FWS and NMFS *Endangered Species Consultation Handbook: Procedures for Conducting Consultations and Conferences Activities under Section 7 of the Endangered Species Act* (USFWS/NMFS 1998), the action agency (i.e., the Corps) makes the effects determination of the action on federal listed taxa. The ESA guidelines state that the "best scientific data available" be used in an analysis. Based on the concept of "available data," new data is not required to be collected and comprehensive biological surveys do not need to be performed, where these activities would be cost prohibitive and unreasonable. For this project, these activities would yield no new substantial information that is not already known. The project action is avoiding all listed taxa, as stated.
40	EPA	Cumulative Impacts: Given that the Project will take place over the next 50 years, the FEIS should include a comprehensive list of other projects in the area that are under construction or planned within that time frame, such as ecosystem restoration opportunities at San Elijo Lagoon, and related cumulative impacts. The DEIS states, "most of the sediment from the project is expected to accumulate on down coast beaches" (p.6-4). The feasibility of periodically replenishing beaches should be analyzed and incorporated in plans for future growth. An analysis of how future projects, in conjunction with the proposed Project,	In the project area, net littoral transport is southward. It is expected that the fill material will have the most influence immediately adjacent the fill area in the San Clemente State Beach area. The fill material will tend to slowly redistribute across the profile as it drifts southward. San Elijo Lagoon is approximately 36 miles south of the fill area. The fill quantity being relatively small is expected to have no down drift impacts to San Elijo Lagoon. Project monitoring will include transect lines outside of the fill area both north and south to monitor fill movement.

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		may cumulatively impact the health of the affected resources should be addressed in this section. *Recommendation:* The FEIS should include a comprehensive discussion of all types of reasonably foreseeable projects that may take place in the area during the construction period, such as the LOSSAN Proposed Rail Corridor Improvements, the San Elijo Lagoon restoration, and others, and predict the cumulative impacts on affected resources.	
41	EPA	Climate Change: Current research estimates that climate change could cause sea level rise and change the amount, timing, and intensity of rain and storm events. The Pacific Institute has created maps estimating flood risk due to sea level rise in the San Clemente Shoreline area; to see the map go to: http://www.pacinst.org/reports/sealevelrise/hazmaps/San Clemente.pdf *Recommendation:* The FEIS should describe and evaluate projected climate change consequences such as sea level rise, frequency of high intensity storms, and amplified rain events; their effects on the beaches; and how these effects could change re-nourishment plans for the San Clemente Shoreline Protection Project.	Sea level change is quantitatively addressed in accordance with current USACE guidance and is included in the Coastal Engineering Appendix. Sea level change analysis includes scenarios for three rates of sea level change: existing, medium, and high. The risk and uncertainty model incorporates sea level change and the model sensitivity is discussed in the main report. The recommended plan is expected is perform functionally under all 3 predicted sea level rise scenarios as explained in the report. This study assumes stationarity relative to high intensity storms and amplified rain events. In other words, this study assumes that future high intensity storms and amplified rain events will be similar in magnitude to past high intensity storms and amplified rain events. There is no USACE guidance for escalating the magnitude of future storm and/or rain events due to climate change. The risk and uncertainty model used in this analysis incorporates extreme storm events. The risk and uncertainty model randomly selects storm events based on their probability. Extreme storm events will be selected (albeit infrequently) and their impacts incorporated into the results.
42	EPA	Executive Order 11988: Floodplain Mgmnt: Per Flood Insurance Rate Maps (FIRM), portions of the	The recommended plan is located within FIRM#: 06059C0536Jand is within a VE zone with BFE 13.

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		project footprint may be in a Zone VE Coastal Flood Zone with velocity hazard with a established base flood elevation (BFE). See FIRM#: 06059C0536J Orange Co Uninc & Inc Areas 12/03/2009. Executive Order 11988 Floodplain Management requires federal agencies to avoid, to the extent possible, the long and short-term adverse impacts associated with the occupancy and modification of floodplains. For more information go to: http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/zone_ve.shtm. *Recommendation:* The FEIS should discuss any impacts that the Proposed Project may have on the potential for flooding.	High velocity impacts including direct structure damages and flooding were quantitatively addressed within the risk and uncertainty model. The damage categories are fully described in the Coastal Engineering Appendix and the economic summary is fully described in the Economics Appendix. The recommended plan is designed to alleviate high velocity damages and will not induce additional flood damages. The recommended plan is not expected to encourage additional occupancy and/or development within the project footprint.
Robert S. Hoffman, Assistant Regional Administrator for Habitat Conservation, NOAA Fisheries, September 20,2010			
43	NMFS	NEPA (Affected Area): The DEIS should elaborate on the quantity of habitat affected by the proposed action. For example, the acreage of benthic habitat affected by dredging operations should be provided, Similarly, the estimated area affected by sediment placement should be provided, This estimate should account for both direct impacts associated with sediment placement and indirect impacts associated with the equilibrium footprint. In addition, the estimated rates and depth of burial within the equilibrium footprint should be provided.	The borrow area footprint is approximately 535,396 sq m (132.2 acre). The immediate fill construction footprint is approximately 102,271 sq m (25.3 acre). At equilibrium, the fill footprint for the 15 m alternative is approximately 534,401 sq m (132.0 acre).
44	NMFS	NEPA (Submerged Reef Alternative): The objectives of the proposed project are to 1) reduce storm-related damages to public and private properties and 2) enhance and maintain beach recreation and associated economic tourism benefits. The DEIS also identified a number of planning constraints that inform the evaluation criteria for the various alternatives. These constraints are 1) preserve the nearshore ecosystem that supports commercial lobster and fishing industries and snorkeling activities; 2) preserve the opportunities for surfing; 3) preserve critical habitat that supports listed species; 4) preserve water quality characteristics; 5) preserve cultural and historical	In order to be effective, a submerged reef alternative typically needs to be in relatively shallow water. Submerged reefs constructed worldwide are typically in water depths less than 6 m (20 ft). The Oil Piers project placed the submerged reef at 200 m (600 ft) offshore. At San Clemente, this depth (and distance offshore) would place an artificial reef directly on top of the natural reefs existing in the project area, including T-Street reef, thereby increasing ecosystem impacts. A properly designed submerged reef would reduce

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		features; and 6) preserve air quality conditions. The DEIS then incorporated the objectives and constraints of the project into the following evaluation criteria: addresses purpose and need, technical feasibility, economic feasibility, environmental impacts, and public acceptability. Of the alternatives identified, NMFS believes additional analysis of the submerged reef alternative is warranted. Moreover, additional justification should be provided for the comparisons and conclusions made for the varying alternatives, as summarized in Table 3-1. NMFS is aware of initial planning efforts in Ventura County (i.e. Oil Piers) and northern San Diego County (i.e. Fletcher Cove) to evaluate the application of submerged reefs for beach protection and other benefits. The initial documents prepared for these projects support the potential feasibility of this approach. Moreover, submerged reefs provide additional habitat benefits and, if designed properly, may improve surfing conditions. According to a report developed for the Corps planning process for the Oil Piers Ventura County project, studies of benefits associated with the construction of multi-purpose reefs at various locations around the world have all shown significant benefit/cost ratios. The lowest was approximately 20: 1 for a small reef in Bournemouth, UK, to over 60: I for the Narrowneck reef on the Gold Coast, Australia. A recent report for a multipurpose reef in Wellington, New Zealand, estimated a conservative benefit to cost ratio of 24:1. Although NMFS does not believe submerged reefs are a panacea for erosion control, they may impede erosion at local scales. They minimize many negative aspects of other erosion control methods and have the potential to benefit ecosystems, tourists and local communities. Thus, NMFS believes this alternative warrants further discussion and evaluation in the DEIS.	wave energy in the lee of the structure with possibly ancillary benefits to recreation. Wave energy reduction in the structure lee would aid retainage of sand on the beach; however, this reduction would not eliminate the need for sand placement and/or nourishment. A beach fill would still be required. A beach fill of approximately 11,000 cu m along approximately 340 m of beach was proposed for the Oil Piers Submerged Reef Project. Based on a comparison of the beach fill to beach length, as well as the requirement to place an artificial reef on top of existing natural reefs, a submerged reef alternative would have greater impacts to the project environment than the proposed action.

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45	NMFS	NEPA (Analysis): Balancing Ecosystem Services The proposed project involves some inherent trade-offs. Protection of existing infrastructure and maintaining recreational opportunities associated with beach usage are obvious ecosystem services that may be provided by this project. However, repeated beach till projects may have an environmental cost to various natural resources (e.g. surfgrass, rocky reefs, intertidal and shallow subtidal invertebrate assemblages, fishery resources). These costs need to be incorporated into the analysis to ensure the benefit to cost ratio is not skewed. Prior to the commitment of federal resources, a clear evaluation should be provided that examines the expected costs over the long-term. Without such an analysis, it would be difficult to accurately predict whether the proposed project would be in the public's best interest.	According to USACE guidelines, the economic evaluation of all proposed alternatives need to account for all the positive and negative impacts related the implementation of the project. Therefore, the economic analysis included the benefits of reducing damages to the infrastructure and increasing recreational opportunities in the project area due to the implementation of the recommended project. In addition, the economic analysis should include any mitigation costs that would account for any negative impact due to implementation of the recommended project. The mitigation costs will include all the activities that will be needed to resolve any expected negative impacts due to the implementation of the Project. Currently, the environmental evaluation of the recommended project has identified not any specific environmental impacts due to project but has recommended that costs for monitoring should be accounted for in the overall costs for the project. Therefore, the benefit/cost ratio for the recommended plan includes the extra costs for monitoring of possible negative impacts due to the implementation of the project.
46	NMFS	NEPA (Analysis): Adequacy of Monitoring Studies Peterson and Bishop (2005) reviewed 46 beach monitoring studies and showed that 1) only 11 percent of the studies controlled for both natural spatial and temporal variation in their analyses; 2) 56 percent reached conclusions that were not adequately supported; and 3) 49 percent failed to meet publication standards for citation and synthesis of related work. They opined that regulatory and resource agency practices are in urgent need of reform as the risk of cumulative impacts grows in the face of sea level rise, climate change, and increased coastal development. NMFS notes that, with the exception of one project from the 1970s, all the studies that were reviewed	The southern California studies cited in the document used fixed transects. Therefore, if a change on a transect is observed, the biologists can be confident that a change actually occurred and is not the result of spatial variation. What is much more difficult is to determine the cause of a change because numerous natural events affect marine communities. No southern California studies have detected major degradation of marine resources following a beach nourishment project. Therefore, the weight of the evidence does not suggest that such degradation will occur from the San Clemente project. In addition, the Corps considered sea level rise as provided in the guidance in Engineer Circular "Water

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		were on the Atlantic or Gulf coastlines. Thus, their results may not be directly applicable to projects implemented in Southern California. However, NMFS shares the concerns expressed by the authors that the presumption that nourishment projects are ecologically benign may be based upon an incomplete and flawed body of science. If previous monitoring results in Southern California are to be used as support for conclusions that impacts to biological resources are minor and/or insignificant, NMFS believes a more rigorous examination of their sampling design, statistical analyses, and conclusions are necessary.	Resource Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs" (2009). The circular identifies that sensitivity of alternative plans and designs to the rates of future local mean sea level change should be determined. Design or operations and maintenance measures should be identified to minimize adverse consequences while maximizing beneficial effects. For each alternative sensitive to sea level change, potential timing and cost consequences should be evaluated during the plan formulation process.
47	NMFS	NEPA (Analysis): Cumulative Impact Analysis: The cumulative impact analysis does not include the opportunistic program that has recently been permitted by Corps Regulatory Division (SPL-2004-00838-JPL). This is a 5-year opportunistic beach nourishment program to place a maximum of 300,000 cubic yards of sediment per year on four different sites within the coastal zone of the City of San Clemente. This project would use opportunistic fill sources and cover a maximum of 29 acres of tidal habitat. The disposal sites include one at North Beach, one at Linda Lane, and two at T-Street. In addition, a stockpile site is proposed near the intersection of Avenido Pico and El Camino Road. Given the spatial overlap and proximity, NMFS believes this program should be evaluated within the cumulative impact analysis. In addition, the DEIS should evaluate how climate change may affect the frequency of nourishment events. Sea level rise, increased frequency and severity of storms, and increased wave height are expected climate change impacts that may exacerbate existing beach erosion rates and may increase the frequency of nourishment events. These may all affect the fate of sediment placed for beach	The opportunistic program is not included in the cumulative impacts analysis because if the project proposed in this EIS/EIR occurs, the opportunistic program would not place sand on project area beaches. There will not be two beach nourishment projects occurring concurrently within this project area. The Corps considered sea level rise as provided in the guidance in Engineer Circular "Water Resource Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs" (2009). Historic trends at San Diego, California indicate a positive sea level rise of +2.45 mm/yr based on water level measurements during the period 1950-1999. If past trends are projected into the future at San Diego, a sea level rise of 0.12 m (0.4 ft) would be expected during the 50 year period of economic analysis. The NRC Curve III estimates sea level rise, during the 50 year economic period of analysis, to be 0.70 m (2.3 ft). Relative sea level rise has project impacts from two primary considerations: 1) long-term beach erosion, and 2) increased wave run-up and overtopping. The effects of sea level rise are addressed in Appendix D of the EIS/EIR.

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		nourishment purposes and subsequent movements into the nearshore environment and should, thus, be considered in the cumulative impact analysis.	The Recommended (NED) Plan is formulated on the basis of continuous monitoring of beach fill erosion and renourishment. This monitoring would be expected to identify any rapid change in sea level through an unanticipated change in renourishment requirements. Although sea level change should be identified through the frequency of renourishment, the Recommended (NED) Plan still requires an assessment of how sensitive its performance is to sea level change. To examine the NED Plan under sea level change a sensitivity analysis was performed , based on the NRC Curve III, assuming a maximum sea-level rise of 0.70 meters over 50-years, as a point of reference the base case assumes a sea-level rise of 0.12 meters. This sea level change was incorporated into the model along with an adjustment to the construction cost of the seawall and simulated over the array of alternatives. Based on the model optimization and analysis of the costs and benefits the 50 ft beach width alternative has the greatest economic benefits and is the NED Plan for both the base sea level case and the max sea level case. If max sea level rise did occur during the 50 year life of the project then the NED plan could be adjusted to meet the max sea level rise case. For a project such as a beach nourishment project for which the beach is typically re-nourished every 5-10 years, the local mean sea level will be reevaluated every 5-10 years (in this case every 6 years), prior to renourishment, and accommodation for sea-level rise can be made during each renourishment period. The effects of the maximum sea-level rise case on the NED Plan are relatively minor. The number of fills over the project life increase from 9.11 to 9.66 with maximum sea-level rise.
48	NMFS	NEPA (Analysis): Environmental Commitments:	Section 7 of the DEIS/DEIR has been amended to include environmental commitments for biological

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		Section 7 of the DEIS identifies a variety of environmental commitments for the proposed action. However, no commitments are provided to address biological resources. NMFS recommends that this section be amended to include mitigation measures for biological resources.	resources.
49	NMFS	Endangered Species Act: Section 7 of the Endangered Species Act (ESA; see 16 U.S.C. § 1536(a)(2)» requires federal agencies to consult with the Secretary of Commerce and/or the Secretary of the Interior to insure that "any action authorized, funded, or carried out by such agency ... is not likely to jeopardize the continued existence of any endangered species or threatened species .... " *See also* 50 C.F.R. part 400. In Section 4 of the Joint DEIS/DEIR, the following ESA-listed species were described as having the potential to occur in the nearshore waters off San Clemente and Oceanside, CA: Guadalupe fur seal *(Arctocephalus townsendi),* blue whale *(Balaenoptera musculus),* fin whale *(B. physalus),* humpback whale *(Megaptera novaeangliae),* Steller sea lion *(Eumetopias jubatus),* northern right whale *(Eubalaena glacialis),* sei whale *(B. borealis),* sperm whale *(Physeter macrocephalus),* loggerhead sea turtle *(Caretta caretta),* green sea turtle *(Chelonia mydas),* Pacific olive ridley sea turtle *(Lepidochelys olivacea),* leatherback sea turtle *(Dermochelys coriacea),* and white abalone *(Haliotis sorenseni).* Black abalone *(Haliotis cracherodii)* was listed as endangered under the ESA on January 14,2009 (74 FR 1937) and should also be included as having the potential to occur in the project area. If the Corps determines that their proposed project may affect any ESA-listed species under NMFS' jurisdiction, including whales, seals, sea lions, abalone and sea	As part of the responsibilities under the ESA Section 7 consultation process, the Corps has made a no effect determination of the project implementation on the listed marine mammals discussed in Section 4. The discussion of no effect on these marine mammals is detailed in Section 5. Currently, black abalone does not occur within the project area. The proposed rule for listing critical habitat for the black abalone indicates that nearest locale is the Palos Verdes Peninsula to Los Angeles Harbor region. They currently do not occur on the rocky reef within the project area and the potential to occur remains negligible.

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		turtles, the Corps should request concurrence from NMFS.	
50	NMFS	Marine Mammal Protection Act: Whales, dolphins, porpoises, seals, and sea lions are protected under the MMP A. *See 16* U .S.C. § 1361 *et seq.* Under the MMP A, it is generally illegal to "take" a marine mammal without prior authorization from NMFS. "Take" is defined as harassing, hunting, capturing, or killing, or attempting to harass, hunt, capture, or kill any marine mammal. Except with respect to military readiness activities and certain scientific research conducted by, or on behalf of, the Federal Government, "harassment" is defined as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. Harassment of marine mammals may occur if hauled animals flush the haul out site and/or move out of the immediate aquatic area to increase their distance from dredging related activities, such as noise associated with the dredging, presence of workers, or unfamiliar activity in proximity to a haul out site. The measured sound exposure levels of a clamshell dredge may range between 75-88 dBA (re 20 iJPa) at 50 feet. Animals have been observed flushing from haul out sites at a sound exposure level of less than 100 dBA, and it is possible that marine mammals may modify their behavior as a result of the noise produced by the dredging operations. NMFS recommends including detailed information on the expected impacts that dredging will or will not have on marine mammals. The DEIS/EIR indicated that it is expected that marine mammals in the vicinity of the project area, specifically	The dredge area is not in the vicinity of any marine mammal haul out sites. Although marine mammals possibly could be present in the dredging area, the site has not been identified as one of importance to any marine mammal species. The area is offshore Camp Pendleton and Oceanside Harbor where large vessels capable of disturbing marine mammals come and go on a regular basis. Disturbance to marine mammals from the dredging would be minimal. The surf zone where turbidity from sand placement would temporarily occur is often naturally turbid and beach placement activities would occur during late fall and winter when turbidity is most likely to occur. Turbidity, natural or man-made, is assumed to impact marine mammals; however, because of the time of year when the project would occur, and the temporary nature of the impact, effects on marine mammals would be minimal. An Incidental Harassment Authorization under the Marine Mammal Protection Act has not been required for similar beach nourishment projects.

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		gray whales *(Eschrichtius robustus)*, would be expected to avoid the immediate vicinity of the dredging area, and that the turbidity plumes from the project would have an adverse impact on bottlenose dolphins *(Tursiops truncatus)*. Please note the definition of a "take" under the MMP A and that the rapid exit from the project area could be considered harassment under the MMP A. In addition, avoidance is not considered a mitigation measure to reduce impacts to marine mammals should the action cause harassment and animals avoid the project area. Please provide more detail as to why the turbidity plumes would have an adverse impact on bottlenose dolphins. Based on the information provided in the DEIS/EIR regarding the potential take of marine mammals, it may be necessary to receive authorization from NMFS under the MMP A for this proposed project.	
51	NMFS	Magnuson-Stevens Fishery Conservation and Management Act (Action Area): The proposed project occurs within EFH for various federally managed fish species within Coastal Pelagic Species, Pacific Groundfish Species, and Highly Migratory Species Fishery Management Plans (FMPs). In addition, the project occurs within areas designated as habitat areas of particular concern (HAPC) for various federally managed fish species within the Pacific Groundfish FMP. HAPC are described in the regulations as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under MSA; however, federal projects with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process. As defined in the Pacific Groundfish FMP, San Clemente contains the following types of HAPC: surf grass, rocky reef and canopy kelp.	The FEIS/R uses the best scientific data available for inclusion into the analysis. The Corps' marine ecology contractor conducted several dives along 25 transects, as noted in the FEIS/R. These field data were more than reconnaissance level field investigations. The data clearly and unequivocally captures the distribution extent of rocky reef, single boulders, and the extent of surfgrass distribution. The larger rocky reef was delineated by divers floating buoys to the surface demarcating the approximate edge of the reef and a biologist in a kayak at the surface recording GPS points of the surfaced buoys. There are 12 GPS points that delineated the approximate area of the T-Street Rocky Reef. Rocky intertidal habitat is addressed in Section 5.4.2. Because sand transport is expected to be primarily to the south, significant rocky intertidal upcoast of the project area is not expected to be impacted by sand placement. The extensive reef and kelp offshore San Clemente pier was mapped and is shown in Figure

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		Figure 4.4-2 depicts the observed surf grass in relationship to the dive transects, expected impact area (i.e. equilibrium footprint), and kelp habitat. Scattered surfgrass amongst boulders have been observed in the northern portion of the Linda Lane impact area. More extensive rocky reef and surf grass habitat occur in the southern portion of the impact area at T - street. The survey information provided does not delineate areal extent of rocky reef and surfgrass within the impact area. Appendix B estimated the T –street reef to be 5 acres. No quantification of area and/or coverage was provided for the scattered boulders and surfgrass habitat. Rocky intertidal and more expansive subtidal rocky reef and associated kelp habitat exists in areas immediately adjacent to the expected impact area.	4.4-2. The scattered boulder and surfgrass habitat occurs throughout the shallow water area offshore the sand placement site. This area was characterized by several subtidal transects. The area is mostly sand with scattered boulders throughout the area at relatively low density. The entire area appears to be bedrock covered by a shallow sand layer that shifts. The lack of encrusting biota on many of the boulder suggests that rocks are covered and uncovered periodically. There currently is no available data that depicts or illustrates the rocky reef or surf grass of the entire locale. NMFS recommended using the San Diego Nearshore Program data from the UC San Diego website. The use of the website with these data was not recommended until 31 Janaury 2011, after two years of coordinating with NMFS. In a comparison of the data from the Nearshore Program (http://nearshore.ucsd.edu) to data collected from project surveys, the Nearshore Program data justifies and compliments the Corps mapping distribution of the rocky reef and single boulders. The attached noted illustrations (RTC Exhibit A) show the Corps surfgrass survey results along with the outer T- Street reef in comparison to the Nearshore Program data from the UC San Diego website. The large kelp bed mapped by the Corps Figure 4.4-2 in the FEIS/R is, in fact, more detailed and in the same geographic distribution alignment as the UCSD Nearshore program raster data. Furthermore, the Corps data is much more detailed in is distribution from the shoreline 500 feet off-shore, whereas the UCSD Nearshore data has little, if any, data within the area that is 500 feet from shore. The Corps acknowledges that there are scattered

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			rocks within and outside the equilibrium footprint and the total acreages of those scattered rocks are not expected to change the data analysis. Nevertheless, the Corps may, during the PED phase, utilize the Corps ERDC Submerged Aquatic Vegetation Early Warning System, which is a semi-automated acoustic-based measurement system that can detect and characterize submersed aquatic vegetation (SAV) while operating from a small survey boat. It uses an off-the-shelf digital echo sounder, with a narrow single-beam high-frequency transducer, and global positioning system (GPS) equipment to digitally record echo intensity and position data on a laptop. Software developed at the U.S. Army Engineer Research and Development Center (ERDC-EL) processes the distinct signature of SAV within the recorded signal to determine depth, plant height, and plant coverage every few meters along transect lines.
52	NMFS	Magnuson-Stevens Fishery Conservation and Management Act (Effects of the Action): Based on information provided in the EFH assessment and developed during consultation, NMFS concludes that proposed action would adversely affect EFH for various federally managed species within Coastal Pelagics Species, Highly Migratory Species, and Pacific Groundfish FMPs. Dredging will disturb benthic organisms within the project footprint via direct removal or indirect mortality from an associated turbidity plume. Sediment from the beach fill project will be redistributed by wave and tidal energy onto nearshore areas, which may bury rocky reef habitat, surfgrass habitat, and benthic organisms that serve as prey for a variety of fishery species. In addition, turbidity generated from the beach fill will adversely affect the light regime in the immediate nearshore area, which may reduce the quality and/or quantity of surfgrass and kelp habitat.	During the two year coordination meeting efforts, the Corps consulted with the NMFS on the EFH as required. The NMFS was part of the EFH process and did not express the concerns identified in this comment and subsequent comments regarding "Effects of the Action" during the EFH coordination two year timeframe. The Corps analyzed all alternatives (35 meter to 5 meter in 5 meter increments). The 15 meter alternative was the environmentally least impacting while maintaining the benefit/cost ratio required by the Corps policy. The borrow site is immediately off-shore from the Oceanside Harbor, an area of maximum disturbance by vessel traffic, including MCBCP Landing Craft, Air Cushion (LCAC) Transport. The Del Mar - Boat Basin, as well as Oceanside Harbor, has undergone harbor dredging for many decades and the fish populations in the nearshore environment persist. The dredging operations proposed in this project action

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			are similar to, and not greater than, on-going dredging activities at the Oceanside Harbor Dredging borrow site. A revised monitoring, mitigation, and reporting plan has undergone several iterations reviews, several by the resources agencies and by the Crops SPD, HQ, and ERDC.
53	NMFS	Surf grass habitat is likely to be impacted by beach nourishment and shoreline protection projects that place sand either directly or indirectly onto surf grass beds (Craig et al 2008). As described in the 404(b)(1) Guidelines, the discharge of dredged or fill material may reduce the value of vegetated shallows as nesting, spawning, nursery, cover, and forage areas, as well as their value in protecting shorelines from erosion and wave actions. In addition, the primary productivity of the system would be reduced if impacts were to occur. Surfgrasses exhibit late successional traits, recover very slowly from disturbance, require facilitation from algae before settling, and are strong competitors (Turner 1985). Removal of surfgrass from a rocky reef community has profound impacts to community structure (Turner 1985). Thus, surfgrass habitat is largely determined by patterns of disturbance. Repeated beach nourishment efforts likely will increase this rate of disturbance to these systems. Slow recovery times suggest that disturbances to these communities may be ecologically significant. The DEIS acknowledges that some burial will occur and that the inshore areas of the impact area will be most affected by burial. However, the DEIS asserts that the proposed action will not result in a long-term net loss in habitat value of surfgrass. In addition, it states that the proposed project will have no significant adverse effects on special aquatic sites. NMFS does not believe these conclusions are adequately supported by the analysis.	There is little surfgrass in the scattered rock and sand area. The surfgrass is confined to occurrence on some of the boulders within this area. The exposed rocks are themselves not dense and difficult to quantify. The only actual surfgrass bed within the project area is that which was mapped on T-street Reef. The potential for impacts to this reef was discussed in Section 5.4. The DEIS/R acknowledged that there may be some impacts to surfgrass habitat, particularly in the shallower portions of the reef. The mitigation, monitoring and reporting plan in the FEIS/R provides for the monitoring of surfgrass habitat and mitigation if persistent impacts are documented.

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		Previous predictions of burial associated with placement of 175,000 cubic yards were described in the DEIS that indicated an estimated maximum 1 foot burial of surfgrass for less than six months. Short term burial at depths of 0.8 feet exhibited a statistically significant decline in shoot count within a laboratory setting (Craig et al, 2008). Furthermore, the DEIS indicates that some portions of surf grass habitat within the equilibrium footprint already exhibit some burial. Thus, the additive impact associated with this beach fill project may exacerbate existing conditions for surf grass habitat. Based upon the above and that the proposed project involves approximately 40% more sediment than previous predictions, NMFS believes the proposed project would reduce the quality of surfgrass habitat in the project vicinity. Given the uncertainties associated with modeling, there is also a real potential for reductions in the quantity of surf grass habitat. Galst and Anderson (2008) have suggested that surf grass is important for nearshore fish communities and reductions in surf grass could negatively affect recruitment patterns. Specifically, experimental reductions in coverage of seagrass (ranging from 7 to 180 square meters) resulted in significant decreases in the density of newly recruited fish species. Similarly, NMFS expects reductions in coverage and/or density may reduce other ecological services provided by surfgrass, such as primary productivity, substrate for epibiota, and wave energy dissipation.	
54	NMFS	To date, NMFS is unaware of any comprehensive survey to delineate surfgrass and rocky reef in the project area. According to Appendix B of the DEIS, which describes a biological resources monitoring program, the general area of the T -street reef is approximately 5 acres. Appendix B further states that potential burial of the inshore edge of T - Street is uncertain, but, if it were to occur, it would be expected to occur in the approximately 20 percent inshore edge of the T -street reef area. Scattered patches of rocky	There is little surfgrass in the scattered rock and sand area. The surfgrass is confined to occurrence on some of the boulders within this area. The exposed rocks are themselves not dense and difficult to quantify. The only actual surfgrass bed within the project area is that which was mapped on T-street Reef. The potential for impacts to this reef was discussed in Section 5.4. The mitigation, monitoring and reporting plan in the FEIS/R will document the

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		reef and surfgrass may also exist in other areas of the footprint, but no estimates are given to quantify the extent of the impact. Given the lack of detailed habitat characterization and uncertainty associated with burial predictions, it is difficult to estimate the quantity of surfgrass habitat that may be affected. Hard-bottom habitats, such as rocky reefs, are present within and adjacent to the project area. These hard-bottom habitats provide substrate for a diversity of algae and invertebrate species, which are utilized by a number of different fish species. Many organisms adapted to rocky reef habitats are highly susceptible to burial and/or sediment scour. Thus, burial and/or increased scour may diminish the ecological functions provided by rocky reefs. Some increased level of burial and/or scour is expected to occur to rocky reef areas within the equilibrium footprint. However, the DEIS suggests that the proposed action will have only minor transitory effects, but acknowledges that unforeseen impacts may occur and that resource monitoring is appropriate. Significant burial is not expected in the rocky intertidal areas near Mariposa Point or the more extensive subtidal rocky reefs and kelp habitat found near Mariposa Point and immediately offshore (approximately 1,000 to 1,300 feet from the beach) of the estimated impact area.	amount of surfgrass habitat impacted by the project and would provide for mitigation if impacts persist.
55	NMFS	The proposed project will increase turbidity within the project area due to dredging and beach fill operations. Based upon monitoring conducted at another dredging operation in Oceanside, the estimated average down coast distance of the turbidity plume was between 272 and 329 feet. Turbidity monitoring of a hopper dredge operation for a regional beach sand project indicated that plumes did not exceed 2,700 square yards (0.56 acres). Construction monitoring during a regional beach sand project indicated that turbidity plumes ranged between 2,640 and 10,000 feet and were largely confined to the surf zone. Beach nourishments create turbidity plumes, an	Impacts from dredging were addressed in Impact BR-50-4. The DEIS/R stated that "[r]ecovery of the benthic invertebrate community would be expected to begin almost immediately with settlement of larvae and immigration of mobile species from nearby unaffected areas. Recovery of the infaunal community to values comparable to pre-dredging levels may occur in as little time as six months or as long as two years, with an average of about one year (CSLC, USFWS, and USACE 2001). The impact of dredging on invertebrates is not significant because the affected area would be small and the biota would

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		area of water with a high concentration of suspended sediments that can last for days and cover habitats adjacent to the project site. Turbidity decreases light penetration and therefore has adverse effects on seagrass and canopy kelp habitats. These plants form the basis of highly productive systems and any losses would adversely affect nearshore EFH. In addition, turbidity plumes may alter fish behavior. Many fishes wi1 llikely disperse away from the turbidity plume as fine particulates can clog gill rakers and decreased visibility can make foraging more difficult. Sessile, filter feeding invertebrates may experience mortality, as suspended sediments can clog feeding apparatus.	recover quickly. There would not be a discernible impact on the population of any species."
56	NMFS	Impacts to rocky reef, surfgrass, and/or kelp habitat may also occur if anchor moorings and/or the slurry pipeline were placed on these sensitive habitats. The DEIS indicates that placement of moorings and pipelines shall avoid these sensitive habitats. However, a more detailed and comprehensive habitat survey should be conducted to properly delineate the areas to avoid.	As discussed in Section 5.4, prior to the placement of the pipeline that will pump the sand to shore from the hopper dredge, a detailed survey will be done of the area proposed for the pipeline and a route will be identified that minimizes impacts to rocks and surfgrass.
57	NMFS	California grunion *(Leuresthes tenuis)* spawn on sandy beach habitats throughout the Southern California Bight every year from March to August. On full and new moons, eggs are deposited in the sand above the high tide line shortly after spring high tides. Two weeks later, corresponding with spring high tides, larval grunion hatch from eggs and return to the water. Beach nourishment can cause mortality by burying developing eggs. Heavy machinery and other disturbances during construction could also kill developing or juvenile grunion. However, the proposed project would not impact grunion spawning because it has committed to occur outside the grunion spawning season of March to August.	Comment noted.
58	NMFS	EFH Conservation Recommendations: As described in the above effects analysis, NMFS has determined that the proposed action would adversely	The monitoring and mitigation plan in Appendix B has been revised to include mitigation for loss of surfgrass and reef habitat. If surfgrass mitigation fails, a contingency plan has been developed to plant kelp on

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		affect EFH for various federally managed fish species within the Coastal Pelagics, Highly Migratory Species, and Pacific Groundfish FMPs. Therefore, pursuant to section 305(b)(4)(A) of the MSA, NMFS offers the following EFH conservation recommendations to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH. 1) Given the high ecological values associated with surfgrass and rocky reef habitat, NMFS believes unavoidable reductions in quantity and/or quality of these habitats should be addressed via compensatory mitigation. The Corps and project sponsor should develop a contingency mitigation plan in consultation with NMFS and other interested agencies prior to the record of decision for the proposed project. The contingency mitigation plan should be based upon a reasonable estimate of potential impacts to rocky reef and surfgrass habitat. This estimate should be developed and agreed upon by Corps, NMFS, and other interested agencies prior to the record of decision for the proposed project. This estimate may then be used as the basis for determining the approximate cost of implementing a mitigation project and should be incorporated into the benefit to cost ratio of the proposed project. In addition, the estimated cost can serve as the basis for providing financial assurances that will ensure a high level of confidence that the compensatory mitigation project will be completed if impacts are observed. c. The Corps and/or the project partner should include in-kind surfgrass restoration, establishment, and/or enhancement as part of the mitigation plan. According to the 2008 mitigation rule, compensatory mitigation is defined as the restoration (re-establishment	an offshore reef.

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		or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved. The rule suggests that compensation for unavoidable impacts to difficult to replace (DTR) resources (e.g. bogs, fens, springs, streams, etc.) should be provided through in-kind rehabilitation, enhancement or preservation. Given the slow recovery time and the difficulties associated with restoring this habitat, NMFS believes that surfgrass should be considered a DTR resource. Therefore, NMFS believes the Corps and/or the project partner should include in-kind surfgrass restoration or establishment as part of the mitigation plan. b. Given the uncertainty associated with surfgrass mitigation success, the Corps and/or the project partner should develop a contingency plan should surfgrass mitigation efforts fail. Based upon discussions with the Corps, kelp mitigation may be the most appropriate out-of-kind approach if in-kind mitigation does not yield positive results. Therefore, the Corps and/or the project partner should design an artificial reef capable of supporting kelp habitat that would offset similar ecological functions that were lost due to surfgrass impacts. c. The Corps and/or the project partner should coordinate with NMFS and other interested agencies to determine an appropriate mitigation ratio for impacts to surfgrass and rocky reef habitat. 2) A scientifically defensible monitoring plan should be developed prior to a record of decision on the proposed project.	

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		The purpose of the monitoring plan is to detect environmental impacts associated with the proposed project and serve as the basis for determining whether compensatory mitigation is appropriate. Results from the monitoring plan will inform the development of a final mitigation plan, which will be based upon the approach described in the contingency mitigation plan. The monitoring plan should be described in greater detail than the program currently described in Appendix B. The sampling design and statistical analyses should be clearly described and should be based upon fundamental principles of statistical inference. This monitoring plan should be reviewed and approved by the Corps, NMFS, and other interested resource agencies prior to a record of decision. In addition, to ensure adequate scientific rigor, consideration should be given to involving an independent review by recognized, biostatistical experts.	
59	NMFS	EFH Conservation Recommendations (Statutory Response Requirements): Please be advised that regulations at section 305(b)(4)(B) of the MSA and 50 CFR 600.920(k) of the MSA require your office to provide a written response to this letter within 30 days of its receipt and at least 10 days prior to final approval of the action. A preliminary response is acceptable if final action cannot be completed within 30 days. Your final response must include a description of measures to be required to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with our EFH conservation recommendations, you must provide an explanation of the reasons for not implementing those recommendations. The reasons must include the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.	Comment noted.
60	NMFS	EFH Conservation Recommendations (Supplemental	If the project changes substantially, EFH consultation

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		Consultation): Pursuant to 50 CFR 600.920(1), the U.S. Army Corps of Engineers must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations.	will be reinitiated.
61	NMFS	Fish and Wildlife Coordination Act Comments: The purpose of the FWCA is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development [16 U.S.C. 661]. The FWCA establishes a consultation requirement for federal departments and agencies that undertake any action that proposes to modify any stream or other body of water for any purpose, including navigation and drainage [16 U.S.C 662(a)]. Consistent with this consultation requirement, NMFS provides recommendations and comments to federal action agencies for the purpose of conserving fish and wildlife resources. The FWCA allows the opportunity to offer recommendations for the conservation of species and habitats beyond those currently managed under MSA and ESA. According to Subpart E Section 230.43 of the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (404(b)(1) Guidelines), vegetated shallows are considered special aquatic sites (SAS). SAS are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region. This status provides special consideration when evaluating actions involving dredged	As stated, the purpose of the FWCA is to ensure that the fish and wildlife resources receive consideration in project alternative development and selection. The FWCA is an action that is taken between the FWS and the Corps, not the NMFS; these comments are noted, but inappropriate for the purposes of FWCA. Furthermore, the Corps San Clemente Shoreline Protection has, in fact, considered the fish and wildlife resources in the alternative development and selection. FWS, as well as other resources agencies, were invited and/or attended several coordination meetings in which the coastal engineering profiles were presented, given, and discussed with the resources agencies, of which NMFS was included. Effects of the project implementation of each alternatives (35m, 30m, 25m, 20m, 15m, 10m, and 5m) were discussed and the effects to fish and wildlife, including EFH as well as federal and state listed taxa, including grunion spawning season. As the action agency, the Corps has made a "no effect" determination on federal listed taxa, including green sea turtles, which are thoroughly discussed in Section 5 of the FEIS/R. Fish and wildlife resources were considered in the alternative selection by reducing the effects of the project on fish and wildlife from the 35 meter to the 15

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		or fill material pursuant to Section 404 of the Clean Water Act. Vegetated shallows are defined as permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation. NMFS believes surfgrass should be considered a SAS and receive special consideration when evaluating actions involving discharge of dredged or fill material. Surfgrasses are considered to be among the most productive seagrass systems on the planet (Ramirez-Garcia et al. 1998). Galst and Anderson (2008) indicate that surfgrass beds serve as an important habitat for nearshore fishes, and the loss of surfgrass from disturbance has negative consequences for recruitment success. Surf grass also serves as an important nursery habitat for a variety of invertebrates, such as California spiny lobster (Engle 1979, as cited in MPLA Initiative 2009), and as habitat for algae (Stewart and Myers 1980, as cited in MLPA Initiative 2009). Shaw (1986) suggests that the importance of surfgrass as a nursery for juvenile lobsters in southern California is clearly apparent and the disturbance or destruction of this habitat could seriously decrease lobster abundance. Surfgrass is also important foraging habitat for the endangered green turtle on the Pacific side of the Baja Peninsula (Lopez-Mendilaharsu et al2005). Although utilization of nearshore habitats in southern California is less understood, sub-populations of the endangered green turtle are known to utilize San Diego Bay and the Long Beach area for foraging. If surfgrass serves a similar function in southern California, then adverse effects to surfgrass habitat may have a negative impact on habitat used by this listed species. NMFS has determined that rocky reef and surfgrass habitat may be negatively impacted by proposed project activities. As such, EFH Conservation Recommendations provided above also serve as FWCA recommendations to	meter alternative. Effects of the project implementation for each of the alternatives were discussed with special emphasis on rocky reef and surfgrass with emphasis with the FWS, who is responsible under FWCA to prepare the Coordination Act Report (CAR) and in which the Corps has a MIPR to prepare the CAR. A functional assessment habitat evaluation using best professional judgment was accomplished and is presented in the summary of the FEIS/R. The conclusions of implementing the 15 meter alternative are based on this functional assessment habitat assessment in which the conclusion is that there will be no impacts to rocky reef or surfgrass due to project implementation of the 15 meter alternative. It is the FWS responsibility to coordinate their actions with the CDFG and the NMFS. The NMFS comments were given to the Corps before the Corps received the FWS's draft CAR. Lastly, the FWCA is very clear that the FWS presents the action agency with recommendations that are discretionary for implementation and are recommendations, not requirements. At the 31 Janaury 2011 project conference between the Corps and the resources agencies, there were agreements and non-agreements to the FWCA draft CAR recommendations. As previously stated, a MMRP has undergone several reviews and revisions from the resources agencies as well as Corps's internal review with SPD, HQ, and external review with the Los Angeles District ATR review team. The document has undergone external (outside the Corps) review and currently is being

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		compensate for these negative impacts.	reviewed by the Corps ERDC Submerged Aquatic Vegetation Restoration Research Program. The revised MMRP is found as Appendix B and implementation will commence implementation in the PED phase. The Corps LAD will employ the services of the Corps ERDC Submerged Aquatic Vegetation Restoration Research Program for implementation of the MMRP, including development of mitigation triggers and success criteria alongside the resources agencies. Most importantly, it must be determined if impacts to rocky reef and surfgrass with project implementation will occur. Monitoring of rocky reef and surfgrass will commence two years prior to project implementation at the project site as well as the reference site. It must be noted and understood that the best scientific information was used in the coastal engineering model that has been certified by knowledgeable and experienced experts. A more robust functional assessment habitat evaluation will be performed during the PED phase.
State Agencies			
Cy R. Oggins, Chief, Division of Environmental Planning and Management, CSLC, September 15, 2010			
62	State Lands Commission	*COMMENT:* Please be advised that both the borrow site and the receiver site involve sovereign lands under the jurisdiction of the CSLC. Use of the borrow site will require authorization from the Commission for the issuance of a dredging lease. The receiver site appears to overlap the lease area under Lease No. PRC 8567.9 issued by the CSLC to the city of San Clemente for the 'City of San Clemente Opportunistic Beach Replenishment Program.' Use of the receiver site will require the city of San Clemente to amend Lease No. PRC 8567.9 to accommodate the project. Lease applications can be	Section 18 of the Real Estate Appendix explains that the City of San Clemente will obtain a lease for the borrow area from the CA State Lands Commission. The limits of placement under the opportunistic lease PRC 8567.9 do fall within the proposed limits of the current project and the City will request Lease 8567.9 be amended if necessary.

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		accessed via our website at http://www.slc.ca.gov	
63	State Lands Commission	In order to provide the basis for an effective mitigation monitoring program as required by CEQA, CSLC staff recommends that the table be revised to include a comprehensive summary of all the mitigation measures and monitoring commitments relied upon in the EIS/EIR, and at a minimum reflect the following revisions: • Table 7-1 should include several omitted mitigation measures identified in Section 5 including Geology/Topography (MM-ER-115-2.1), Biological Resources (MM-BR-50-2.1 and 2.2), Cultural Resources (MM-CR-50.1), Noise (MM-N-50-3.1), and Recreation (MM-R-50-4.1). • The table should reference or incorporate all components of the Biological Resources Monitoring Plan in Appx B. • The mitigation measures in the table should be numbered to indicate the corresponding section or appendix where they originated.	The mitigation measures indicated have been added to Table 7-1. The biological resources mitigation and monitoring plan in Appendix B will be referenced in the table.
Marija Vojkovich, Regional Manager, Marine Region, DFG, September 30, 2010			
64	CA DFG	General: The Department wants to stress the importance that the project be designed carefully in order to primarily avoid adverse biological impacts to sensitive marine species to the maximum extent possible. Our concerns relate to potential impacts to rocky reefs, surfgrass, marine algae, and the fish and invertebrate communities that utilize these for critical habitat. Many marine species, such as rockfish, *Sebastes* spp, and other fish species managed under the Department's Nearshore Fishery Management Plan (NFMP), use these important habitats for breeding, shelter, spawning, foraging and resting. The NFMP species are found primarily in rocky reef or kelp habitat in nearshore waters. A list and description of NFMP fish species can be found on the Department's website at http://www.dfg.ca.gov/marine/nfmp/pdfs/section1_chap2.pdf. Additionally, the federally endangered black	Currently, black abalone does not occur within the project area. The proposed rule for listing critical habitat for the black abalone indicates that nearest locale is the Palos Verdes Peninsula in the Los Angeles Harbor region. They currently do not occur on the rocky reef within the project area and the potential to occur is negligible. The term "critical habitat" should not be used as to confuse the federal legal term of listed taxa critical habitat. There is not officially listed critical habitat for any listed taxa within the borrow site or the beach receiver site. Impacts to rocky reefs, surfgrass, marine algae, and the fish and invertebrate communities that use these habitats are discussed in Section 5.4.2. The 15 ft. (50

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		abalone, *Haliotis cracherodii,* and several other abalone species could occur in the project area inhabiting kelp and rocky reef habitats. The California spiny lobster, *Panulirus interruptus*, a recreationally and commercially important species, also inhabits the project area. Lobsters rely upon the reefs and surfgrass in the area for spawning, foraging and shelter.	m) beach width alternative minimizes impacts associated with a larger beach fill while still providing substantial project benefits.
65	CA DFG	Project Alternatives: In order to reduce risk and protect important offshore sensitive species and habitats, the Department recommends that the alternatives analysis be modified to include analysis of a more conservative alternative, such as a reduced quantity of sand for the project or a different deposition location on the beach. Kelp and rocky reefs in the project area are critical habitat for the black abalone, and surfgrass habitat is essential for spawning and as a nursery for juvenile fish, lobsters and other invertebrates. Additionally, surfgrass and kelp provide root system structure that helps to stabilize sand.	During the two year coordination meeting efforts, the Corps consulted with the CDFG. The CDFG was part of the process and did not express the concerns identified in this comment during the coordination two year timeframe. The Corps analyzed all alternatives (35 meter to 5 meter). The 15 meter alternative was the environmentally least impacting while maintaining the benefit/cost ratio required by the Corps policy. Furthermore, the Corps did, in fact, perform the required Essential Fish Habitat "consultation" as required by the MSA with CDFG's presence in the discussion. As previously stated, the Corps is aware of the marine aquatic vegetation (surfgrass and kelp). CDFG was presented the coastal engineering beach profile analysis in which discussion of the effects of the project would or would not occur. It was explained to CDFG that the beach receiver site is on the high portion of the dry sandy beach, not the surf zone or nearshore waters. It was further explained that the natural high tides and storm surge would distribute the receiver site sand onto the beach width, thus emulating a natural process; hence, the equilibrium will take four to six months to occur. No sand will be placed directly by project activities into the equilibrium footprint outside of the dry beach. As discussed in Section 3.4.2, a range of beach width alternatives were considered. The 15 meter

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			alternative was the alternative that provided the highest benefits to cost ratio while minimizing impacts to valuable marine habitats. Based on models of post-placement sand deposition, the 10 meter beach width alternative would have similar potential impacts on sensitive marine habitats as the 15 meter alternative but would have less project benefits. A 5 meter beach fill alternative would not have a positive benefit to cost ratio. Placement of fill on a shorter length of beach would not reduce the potential impacts to rocky reef and surfgrass habitats. Based upon the coastal engineering model that has been certified by national known experts internal and external to the Corps, the 15 meter profile indicates that there would be no impact to the T-Street rocky reef or surfgrass. The Corps does discuss the potential for impacts to a small inner portion of the T-Street rocky reef and potentially to surfgrass. Nonetheless, that remains unknown. Furthermore, as previously stated, a MMRP has undergone several reviews and revisions from the resources agencies including CDFG as well as Corps's internal review with SPD, HQ, and the external to the Los Angeles District ATR review team. The document has undergone external (outside the Corps) review and currently is being reviewed by the Corps ERDC Submerged Aquatic Vegetation Restoration Research Program. The revised MMRP is found as Appendix B and implementation will commence implementation in the PED phase with monitoring activities discussed in the MMRP.
66	CA DFG	The DEIS/DEIR proposes a surfgrass compensatory mitigation plan for an experimental surfgrass transplantation contingent upon unexpected adverse	Appendix B has been revised to include a back up mitigation plan. Kelp would be transplanted to an offshore reef if the experimental surfgrass transplant

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		impacts, such as a significant loss of surfgrass area or reduction in density of surfgrass mats. There is no indication in the DEIS/DEIR of a secondary plan if the experimental surfgrass transplant is not successful. The Department suggests that a back up mitigation plan should be available in the event that the experimental surfgrass transplant does not succeed. Additionally, habitat compensation and the criteria for triggering compensatory mitigation should be further discussed and agreed upon with the Department and other resource agencies. The Department will continue to work with the Corps to develop adequate mitigation and monitoring plans that will sufficiently avoid and minimize the risk of burial and other adverse impacts to sensitive species and habitats.	fails.
67	CA DFG	Monitoring Plans: There are two mitigation and monitoring plans presented in the DEIS/DEIR for surfgrass habitat; one for the offshore reefs, referred to as MM-BR-50-2.2, and one for the habitats along the mooring and slurry pipeline route on the sea floor, referred to as MM-BR-50-2.1. The Department concurs that these two areas will need baseline surveys conducted prior to the project and post construction surveys that monitor for significant damages or degradation of surfgrass, kelp and reef habitat. The Department always advises that avoidance measures be used first and to the maximum extent practicable. The DEIS/DEIR minimization plan for surfgrass and kelp suggests that the Corps has already determined that avoidance measures are not feasible. However, the Department believes that the mooring and sea floor pipeline plan could be revised so that the routes avoid impacts completely. The Department is willing to work with the Corps to discuss and develop an alternative pipeline route. The MM-BR-50-2.2 surfgrass and reef habitat mitigation and monitoring plan of the DEIS/DEIR is limited to pre- and post- construction, with no monitoring during construction. The Department believes that it is appropriate to monitor surfgrass and reefs during the	As discussed in Section 5.4.2, mitigation measure MM-BR-50-2.1 specifies that based on the pre-construction surveys, a pipeline route be selected that minimizes contact with surfgrass and kelp habitat. A route that completely avoids contact with these resources would be the route that minimizes impacts if such a route exists. A route that has some contact with kelp and/or eelgrass would only be selected if a route that avoids these resources completely cannot be found. Mitigation measure MM-BR-50-2.2 proposes pre- and post-construction monitoring of reefs and surfgrass, because impacts, if any, would not be expected to be observed during construction when sand is placed directly on the beach, but following construction as the waves re-distribute this sand and move some of it offshore and downcoast where it may deposit in reef and surfgrass habitats.

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		construction activities because of the uncertainty of adverse impacts predicted in the DEIS/DEIR. The Department's recommendation for additional monitoring to avoid potential impacts is based mainly on the fact that there has not been consistent success from surfgrass transplantation projects in the past. Additionally, the best available transplantation techniques for surfgrass are still considered experimental at this time. The Department also recommends that if monitoring during the sand deposition indicates signs of adverse effects (i.e. significant burial) to surfgrass and/or reef habitat, then construction activity should be stopped and re-evaluated before permanent damages are done. The project could continue with possible modifications, such as re-locating the deposition area on the beach, to avoid or minimize adverse impacts. Monitoring should continue to evaluate the effectiveness of any modifications to project activities. A revised monitoring plan should incorporate these recommendations.	
68	CA DFG	Reporting: Reporting procedures are lacking from all plans. The Department expects to receive all survey and monitoring reports, within three to five days for preliminary results and 30 days for final reports, in order to have time to review and respond to potential impacts to marine habitats.	CDFG will receive all survey and monitoring reports, as requested.
Local Agencies and Organizations			
Mark Rauscher, Beach Campaigns Manager, Surfrider, E-mail, September 20, 2011			
69	Surfrider	Section 1.2 Project Background ***Thoroughly describe the private property threatened by shoreline changes.*** The document states: "Changes to the beach shoreline caused by erosion have reduced recreational opportunities and are threatening the stability of City facilities, private property, and a major Southern CA commuter rail corridor."	There are no private structures on the ocean side of the SCRRA rail line within the project area. All references to private structures have been removed from the document.

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		It is unclear what "private property" is under threat by shoreline changes, and what protection it would be afforded by the proposed project. It is our understanding that all structures all structures constructed west of the railroad within the project area are public facilities. It is important to describe the structures accurately as their storm-damage protection provides the economic benefits of such a project. This lack of private property should also be reflected in Sections 2.1: Purpose and Need and 2.2: Project Objective.	
70	Surfrider	Section 2.1.2: Threat to the Railroad Corridor ***Provide clear and supported justification for the future necessity of seawall construction in a no-project alternative.*** As noted, the railroad corridor has varying levels of hard protection along the project stretch. Yet the railroad has successfully managed erosion and wave attack issues for relatively low cost. The document does not explicitly describe which sections are more at risk, nor why the presumption is made that continued rock placement will not be allowed in the future, necessitating the need for a highly engineered and costly seawall as described in Coastal Engineering Appendix, Section 4.4. Given that the bulk of the economic justification for this project relies on this particular prediction of future conditions, it requires a more robust explanation. Section 4.4 states: "It will become mandatory for the SCRRA to construct seawalls in the future. Project formulation indicates that due to evolving law and coastal structure construction regulations, the ability for the SCRRA to use revetment methods will expire." Yet the previous language within the section does not	Future necessity of seawall is documented in a July 19, 2005 letter from OCTA (owner of the Orange County region LOSSAN) stating they would expect to support future construction of a seawall.

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		support this statement. In addition, this project does not even encompass the most threatened portion of the railroad, as areas to the north (Mariposa) and to the south (Calafia) are at much higher risk of wave impact damages, yet OCTA has not attempted to gain permits for a permanent vertical seawall at these sections.	
71	Surfrider	Section 2.1.3: Public Safety and Liability. ***Correct the discussion of the public safety issues due to moved infrastructure in a "managed retreat" alternative.*** The document claims that erosion threatens public restrooms, which could require relocation if erosion trends continue. It goes on to state that such a relocation would cause a public safety issue due to the resultant increase in pedestrian railroad crossings. This premise is incorrect. The public restrooms which are located west of the railroads within the project area occur at T---Street and the Pier. T---Street already has a railroad overpass preventing any direct pedestrian crossings. The Pier already has a railroad underpass allowing safe passage below the railroad. Hence, no increase in pedestrian crossings need occur if restroom facilities are relocated east of the railroad.	Report will be revised to reflect the following: "Depending on the location of construction of restrooms, if necessary under managed retreat, crossing the tracks may be dangerous if beachgoers decide to do so rather than use the designated pedestrian crossings. There are currently safe pedestrian crossings for beachgoers to cross the tracks and access the beach."
72	Surfrider	4.3.4.3: Littoral Processes and Sediment Transport. ***Documented processes do not support the need for the project.*** The *Sediment Budget* section shows that the long---term sediment budget for this section is essentially in equilibrium, with net erosion equaling net accretion. The *Long Term Shoreline Change* section also finds variable net positive and net negative changes both along shore and through time. This would indicate that in the long term San Clemente's shoreline is nearly unchanged, and that sediment likely moves alongshore in pulses with portions	It is recognized that the shoreline change data set used in the present analysis is limited at best. However, this was all the data available for this area at the time this analysis was conducted. While data intensive information resulting in conclusive findings is preferred, the best available data resulted in this analysis. It is further recognized that the shoreline change data set results in a less than desired numerical presentation. However, the results are consistent with the overall shoreline change scenario in this region.

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		of the city's beaches growing while others are shrinking. Particularly striking is the quote: "During the period 1980-1989, the shoreline was predominantly positive with accretion rates ranging from + 1.4ft/yr (+0.43 m/yr) to +7.2 ft/yr (+2.16 m/yr)." This is the period that experienced the strong 1983 El Nino winter storms, but which apparently survived with little net erosion. The *Recent Shoreline Change Rate* attempts to show moderate shoreline width reductions, but is not consistent throughout the study area, with beach widening shown at Shorecliffs. There are also an extremely low number of data points (at least 12 years missing in the recent past) to be able to conclusively define the nature or extent of observed shoreline change. Because of this it is unclear if the single data point at the end of the time series represents a long term negative trend, or simply a perturbation in a highly active shoreline as seen in the first ten years of the time series. In other words, does the beach come and go with the weather and storm conditions, and we're only observing a single point in time?	The sediment budget indicates the shoreline is essentially in balance, neither accretional nor erosional (+0.03 m/yr). Inclusion of recent monitoring data results in a marginally erosive shoreline (-0.10 m/yr). The very small annual change signal is masked within the much larger envelope of seasonal changes. The seasonal variations are on order of 15 m and thus are two orders of magnitude larger than the mean annual long term signal. The three survey lines SC 1680 (Linda Lane), SC 1660 (T Street), and SC 1623 (State Beach) are south of Mariposa Point whereas SC 1720 (Shorecliffs) is north of Mariposa Point. Mariposa Point, although physically small, is morphologically significant as it represents a salient feature in an otherwise uniform section of shoreline. This salient is a micro morphological separation between Shorecliffs and the other three survey lines. These three lines south of Mariposa Point are consistent in erosional trend whereas the Shorecliffs trend is accretional. Uncertainties in the results of this analysis are assumed captured within the design long term shoreline change distribution. The design distribution is a triangular form with a minimum (max erosion) of -0.46 m/yr, a maximum (max accretion) of +0.38 m/yr, a peak of -0.21 m/yr, resulting in a mean value of -0.10 m/yr. This means that some years will be erosional, some years will be accretional, and the average value will be slightly negative (-0.3 ft/yr).
73	Surfrider	Impact WR--50--3: Nearshore wave characteristics (50 ft alternative). ***Monitoring of surfing quality should be designated as mitigation under all project alternatives.*** There is potential for adverse impacts on surfing as described in this section as well as in the Engineering	The following text was revised in the Coastal Appendix; revised text is underlined. Survey methods will consist of topographic measurements, bathymetric measurements, <u>surf quality observations</u>, and video stereo photogrammetric methods. The monitoring period <u>will</u>

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		Appendix (6.3.4), yet no mitigation measures are provided. The 115 ft alternative predicts definitively adverse impacts to wave characteristics and does suggest monitoring of surf conditions followed by adjustment of subsequent renourishments if surfing is degraded and does not recover. Based on the description of potential impacts within the Engineering Appendix, in particular, there is a possibility of severe degradation of surfing quality. As such, we request that monitoring of surfing quality before and after construction be provided as mitigation of any chosen project, including the 50 ft alternative. Potential impacts as described could pose a significant degradation of wave quality: "The surfing experience might consist of a normal "take---off," but then "close---out" as the wave encounters the straightened bathymetric contours inshore" and would justify the need for monitoring and mitigation if these impacts are experienced. In addition, meeting notes in the appendices specifically state that monitoring of surfing quality is to be undertaken. This needs to be reflected within the body of the impacts analysis. This monitoring and mitigation should reflect the discussion of impacts from the 115 ft alternative below. ***Impacts to wave characteristics in the designated surfing zone north of the pier must be evaluated and described.*** Within section Impact WR-50-3 and WR-115-3, there is no mention of surfing anywhere aside from T-Street. While T-Street is a consistently high-quality surfing area, surfing is often restricted there under "black ball" conditions when the lifeguards ban hard-board surfing for the bulk of the day during the summer. At these times surfing within the project stretch is restricted to the area directly north of the pier, causing the pier zone to become incrementally more	begin one year before construction (for the surf quality observations) and continue for the 50-year period of Federal involvement. The table of monitoring costs has been modified to reflect the surf quality monitoring.

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		valuable for use.	
74	Surfrider	Impact MM--WR--115--3.1: Nearshore waves characteristics (115 ft alternative). ***Timing for mitigation measure should be shortened.*** Under the 115 ft alternative, it is estimated that surfing waves could be significantly degraded for a period of 10 years. This is beyond the estimated period of return for future nourishments. An allowance of 10 years degradation and monitoring before future plans are adjusted is unacceptable. Similar to surfgrass, direct mitigation or reconstruction of the resource is not currently possible, and no time allotment is provided for the surfgrass mitigation (MM---ER---115---2.1). In addition, artificial surfing reefs are not viable as mitigation for lost surfing resources, and a greater emphasis on adverse impact prevention should be made.	Due to the likelihood of significant impacts to both habitat and surfing resources (nearshore waves), the 115 ft alternative was not chosen as the Recommended Plan. Following the process of first trying to avoid, if necessary, then minimize, and as a last resort to mitigate impacts, the recommended plan of a 50-ft wide beach was identified as the Recommended Plan.
Tom Bonigut, P.E., Assistant City Engineer, City of San Clemente - Public Works Dept., September 10, 2010			
75	City Staff	Sand compatibility and acceptability. Is there a QA/QC process to ensure that the borrow site sand will be suitable for placement on San Clemente beaches, and if for some reason it is not, what is the backup plan for borrow sites? This is a really important one, as we are receiving feedback that the Oceanside borrow site does not provide quality beach sand, and that a borrow site further site (name escapes me) is actually better.	The usual Corps or Los Angeles District specific procedure QA check for borrow site consistency is to perform random grain size analysis tests of the dredged material collected in the dredge process during the final construction phase of project: For example: Assuming on-the-beach placement: Most of the time, the majority of the QA samples will be collected at the end of pipe discharge for on beach placement. If hopper dredge is used, then additional sampling should occur from the hopper to confirm or collaborate sediment sizes discharged from hopper discharge pipe prior to discharge onto beach or onto nearshore. The number of such samples is dependent on the amount of material placed per event. For nearshore placement, the samples would be collected from the dredge containment device prior to placement (e.g., from hopper bin if hopper dredge used). The answer is that QA samples are collected

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			from both at the end of dredge pipe and in the container of dredge if hopper dredge is used. The Los Angeles Geotechnical Branch policy on the frequency, and number of samples is as follows: For total dredge material placement volumes of less than about 500,000 cubic yards, the frequency of sampling is = 1 QA sample per 35,000 cubic yards of material placed or per 35,000 cubic yard event. For greater than 500,000 cubic yards and up to 1,000,000 cubic yards, the frequency of sampling is = 1 QA sample per 50,000 cubic yard event. For greater than 1,000,000 cubic yards, the frequency of sampling is = 1 QA sample per 75,000 cubic yards. The QA is performed during the construction phase and included in construction specs for the Contractor to actually perform the collection and laboratory testing of QA samples as such. The purpose of the QA is to provide actual test data to show the consistency of dredge material over time and to provide information for Corps mgmt to make decisions on quality of dredge material and/or to make recommendations or direct the Contractor to move into a better area of the designated borrow area, during the actual dredging event. At this time, there is not a backup plan is for poor quality material that will eventually be dredged, other than that we have already made a selection of the most suitable borrow site, based on expected grain size compatibility that best matches the San Clemente beach renourishment study needs. The borrow site(s) selected and identified within the feasibility study can have sediment quality that is variable depending on

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			areas dredged within this selected borrow site(s). The dredged sediment can be expected to changes over time with depth of sediment stratigraphy encountered during actual dredging (i.e., it can better or worse depending on, for example, if a specific poor quality layer of sediment or borrow material is encountered and dredged in a specific time event, and then another better layer or increasing quality of sediment or material is encountered in another specific time event). However, the geotech explorations and sieve analysis thus so far provided, indicate that the borrow area(s) selected are overall acceptable for compatibility with the San Clemente study area.
76	City Staff	Beach monitoring. Is there any discussion about what we think would happen to beaches south of the project area? I.e. since there is a net southward sand movement, what might happen to those beaches and surf breaks? Would or should the monitoring plan address some of those areas too? We certainly need to ensure, to the extent possible, that we don't impact surf breaks south of the project area.	Net littoral transport is southward. It is expected that the fill material will have the most influence immediately adjacent the fill area up to the state beach area. The fill material will tend to slowly redistribute across the profile as it drifts southward. The fill quantity being relatively small is expected to have little or no impacts down drift of Cottons Point (Trestles). Project monitoring will include transect lines outside of the fill area both north and south to monitor fill movement.
77	City Staff	Can the discussion about the reference line for the project be improved? It's unclear to some what the starting point is for determining where the 15-meter beach width starts? Is it fixed throughout the project area (e.g. some offset from the rail line), or does it vary according to some other criterion? Also, is it fixed in time according to current conditions? I.e. what if our beach erodes significantly between now and the time an actual project is constructed? Will the beach berm width reference line be shifted also, or would the project be as described currently? Is it possible to define a seaward project limit instead of using a reference line that could change over time?	The fill line is the location of the +5.2 m contour (+17 ft) at the time of the fill. The fill will be a uniform 15 m parallel to this contour, thus the fill will mimic the existing shoreline in shape. The report will be amended to strengthen this description. The model does show renourishments will be conducted when the beach erodes back to the berm position at the time of fill. Project Authorization will specify actual renourishment interval (every 6 years) and quantity; however, implementation is sometimes dependent on funding available.

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George Gregory, E-mail, September 17, 2010			
78	George Gregory	it seems ludicrous to replenish the beach sands without promoting erosion and passive replenishment	The fill is expected to undergo an initial equilibration process then form a stable beach, which hopefully will not produce a more rapid rate of erosion than currently experienced.
79	George Gregory	if sands will migrates south may we please replenish north beach first thus supplying the pier area 2nd	Pumping onshore will be conducted to maximize the efficiency of operation and minimize negative environmental impacts.
80	George Gregory	if the near costal quarry's where relocated away would this not help with passive and aggressive replenishment of san clement ,capo beach, beaches & soils	In general, the presence of sand mining operations within the San Juan Creek portion of the watershed could have an overall impact of sediment supply to the beaches in the San Clemente area.
81	George Gregory	are their plans to use the spoils from any excavation or tunneling up in the ortages ,For costal replenishment or building material .Thus using the spoils to replace native soils and or releasing and allowing to pass thru the quarry native soils to the shore	All sediment will be hopper dredged from Borrow Area 2 offshore of Camp Del Mar Boat Basin and Oceanside Harbor and pumped onshore via pipeline.
82	George Gregory	it seam important to keep up the allusion of success that a supply of sand can bring. with constant permits equipment and plans in place ,available and maintained for train transportation of sand and soils for the grooming and maintenance of the coastal resources. possibly hedging are bet and augmenting strategic and civil and possible emergency capabilities (the volley ball court is like playing on dull broken glass)train car loads are fairly efficient and affordable compared to truck loads. Possible improving the quality of soils from distant and local sources	Comment noted.
83	George Gregory	lastly it seems to be a shame the energy used to harvest the soils do not seem to be of any benefit in the first place as in deepening a harbor or entrance improving wet lands or impoundments or importing away proofed soils from a site like Santa Ana river basin and flood control projects	The Corps study process identified dredging material from Borrow Area 2 as the alternative in the Federal Interest.

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Lynn Hughes, Letter, September 14, 2010			
84	Lynn Hughes	Page 9: Problem Identification. Does not include the economic impacts from erosion that would reduce the income to local visitor/tourist serving businesses, and loss of taxes and other revenues to the city, including bedroom taxes, sales taxes, and property taxes; and beach parking and beach concession revenues. It does not include the added cost to provide lifeguard and other protective services to safely keep the public away from hazardous conditions and to protect, relocate, or replace public improvements. Additionally, it does not speak to the potential liability or defense costs from lawsuits due to the injury or death to beach goers as the result of exposed natural and man-made dangers.	Concur with your comment that the economic evaluation did not account for regional economic impacts related to the erosion of the shoreline. It would be expected that the local economy will be impacted by the erosion of the shoreline. However, the USACE guidelines for determining federal interest in coastal shoreline project is mainly based on reducing infrastructure damages(recreational buildings, future protection measures, and impacts on transportation) instead on regional impacts like tourism, local taxes and decreases in concession sales. Based on the availability of funding for the study and schedule for the study, the economist for the study determined that any evaluation of the regional impacts will be limited for the study.
85	Lynn Hughes	Page 9: Problem Identification, mentions potential danger of exposed underlying hard substrate and man-made. Page 10, Problem Statement, mentions reduces recreational space on an already space-limited beach. I would suggest that more emphasis be placed in both areas regarding the fact that the erosion not only causes a reduction of recreational space, but can present public dangers from exposed man-made and natural hard structures. This condition can make shoreline and offshore ocean areas unsafe, hence unusable by the public. San Clemente City Lifeguards have had to post and, at times, restrict the use of some near shore and off shore ocean areas due to these dangers. This is no easy task, since these hazardous conditions can become exposed overnight and are difficult to detect during changing tidal and surf conditions. This task is further complicated by strong wave and currents. A swimmer can enter the water in a location that is relatively safe and be swept down the beach hundreds of feet in a matter of a few minutes where	Comment is understood and has already been emphasized throughout the report(s), including the Coastal Engineering Appendix and Draft Main Report (page 17 and page 60 paragraph 1).

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		there might be exposed dangers that are under water and, therefore, undetectable.	
86	Lynn Hughes	ES-1, under Overview, the same point regarding the dangers of exposed hard structures and its economic impacts should be made here as well. Also, it should be further emphasized, possibly under the Executive Summary, Project Background, page 1-4, that the LOSSAN railroad Riprap is not engineered and therefore subject to continual undermining and failure during periods of erosion. It is possible that the tracks could be undermined to the extent that the railroad tracks could not safely carry the load of railway cars brought in to drop addition rock.	Discussion will be inserted in this section regarding dangers of hard structures. Discussion will be placed in Executive Summary, pg 1-4 explaining that most of the placed rip-rap is un-engineered and, thus, not guaranteed to provide any level of protection.
Keith Aiken, E-mail, September 23, 2010			
87	Keith Aiken	The train track running on top of San Clemente beaches is at the root of the problem.	Correct, much of the project justification lies in the without project assumption that the railroad would need to be protected by a seawall.
88	Keith Aiken	It's hard to believe an alternate rail route cannot be found – especially with the desire of Amtrak to increase rail traffic.	Potential for an alternative route is discussed in the main report. No plans currently exist to relocate/reroute the railroad at this time and any efforts would be astronomically costly.
89	Keith Aiken	Experience has shown that sea walls accelerate beach erosion. The sea walls already built by Amtrak, to protect rail lines, are accelerating beach sand erosion. Why isn't Amtrak being held responsible for its part in adding to the problem and mandated to help with sand replenishment costs?	This is an issue separate of the study area (specifically Reach 6) being considered for this project as no seawalls exist in Reach 6. Basis for this Federal cost-shared project lies in protection of shoreline infrastructure in Reach 6 and the associated benefits versus costs of doing this.
90	Keith Aiken	We were told by the geologists that most all sand migrates southward; so why not add sand at North Beach? North Beach has been severely impacted and is in need of sand replenishment. Plus the sand eroded from North Beach would help to replenish sand on all San Clemente beaches as it migrates south. At the very least, sand could be deposited at North Beach and not in the T-street area – as sand will naturally move into that area from sand replenishment on beaches north of T-street.	Placement of sand will occur along the beach within only Reach 6, as described in the report. Adaptive management will be used as explained in the report to minimize environmental impacts and create a uniform 15-m wide beach through equilibration of the sand.
Don Kunze, Public Meeting, August 19, 2010			

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91	Don Kunze	Where did San Clemente sand go?? Why?? Why not bring it back.	Littoral (sediment) transport in the San Clemente region is predominantly towards the south (San Onofre). This movement of sand along the coast is a natural occurrence; therefore, the sand transported to the south is needed to supply sediment to those beaches.
92	Don Kunze	Did Dana Point Harbor affect us? How about nuclear plant affect?	Dana Point Harbor as well as the nuclear power plant have no known effect on the beaches in San Clemente.
93	Don Kunze	What about new rock reef and kelp?	The reference to new rock reef and kelp is unclear. If in reference to Southern California Edison Reefs constructed as mitigation for the impacts of the San Onofre Nuclear Power Plant, a separate environmental document was prepared specifically for that project and is not included as part of this proposed Project.
94	Don Kunze	Seems to be less sand and more rock (pebbles) than ever. Why?? Since 1983.	There is less sand and more rock because of natural erosive processes, this caused the need for this project.
95	Don Kunze	Being a taxpayer cost to me?	The initial nourishment event will be cost-shared 65% Federal and 35% non-Federal. Each of the subsequent renourishment events will be cost-shared 50% Federal and 50% non-Federal.

APPENDIX A – 404(b)(1)

SECTION 404(b)(1) EVALUATION OF THE EFFECTS OF THE DISCHARGE OF DREDGED OR FILL MATERIAL INTO WATERS OF THE UNITED STATES: SAN CLEMENTE SHORELINE PROTECTION PROJECT

I. Introduction:

The following evaluation is provided in accordance with Section 404(b)(1) of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) as amended by the Clean Water Act of 1977 (Public Law 95-217). The intent of this document is to state and evaluate information regarding the effects of the discharge of dredged or fill material into waters of the United States.

II. Project Description:

a. **Location:** San Clemente Beach in the City of San Clemente, Orange County, California

b. **General Description:** The City of San Clemente is located along the coast of southern California about 60 miles (100 kilometers) south of Los Angeles at the southern end of Orange County near the border of San Diego County. The study area is on the beach near San Clemente Pier within the City of San Clemente and extends approximately 3,412 feet (1,040 meters) from Linda Lane to T-Street and is located within the San Clemente 7.5-minute U.S. Geological Survey (USGS) topographic quadrangle in Section 4 of Township 9 South and Range 7 West. The Proposed Project consists of dredging material from offshore Oceanside, then hauling and placing it at San Clemente Beach. The proposed Project is a 50 foot (15 m) resultant beach width. Beach fill would be 3,412 ft (1,040 m) long with a +17 ft (+5.2 m) crest elevation. The dredge volume is estimated to be approximately 251,130 cubic yards (192,000 m^3). Construction is anticipated to begin in 2012.

c. **Authority and Purpose:** The purpose of the San Clemente Shoreline Project (Project) is to provide shore protection through nourishment of the beach at the San Clemente Municipal Pier. Developing and maintaining the beach is needed to prevent the severe beach erosion that results from winter storms and to prevent damage to adjacent beachfront structures, including the heavily used rail line that runs along the beach through the city. In addition to the above, the loss of sand at the beach would have a negative impact on recreation, which supports the local economy, and would reduce the ecological functioning of the sand beach/littoral zone.

d. General Description of Dredged or Fill Material:

1. **General Characteristics of Material:** Dredge material gradation is 6-12 percent of fines, 5-8 percent of gravel/cobbles, and the rest is sand. Material classification assumed is 10 percent fines, 83 percent sand and 7 percent gravel.

2. **Quantity of Material:** The recommended plan will require approximately 251,000 cy (192,000 m3) of beach compatible sand.

3. **Source of Material:** The recommended plan consists of dredging material from offshore Oceanside, then hauling and placing it at San Clemente Beach.

e. Description of the Proposed Discharge Sites:

1. **Location:** The discharge site is approximately 3,412 ft (1,040 m) of shoreline within the City of San Clemente. The area is approximately centered about San Clemente Pier; the south limit of the proposed beach fill is located immediately south of the T-Street overpass, while the north limit is located immediately north of the Marine Safety Headquarters. A major passenger rail line linking the coastal cities of Southern California runs between the beach and the coastal bluffs.

2. **Size:** The pier area beach profile indicates a typical berm elevation of +17 ft (+5.2 m), a typical foreshore slope of 8H:1V – 10H:1V, an offshore slope of 110H:1V, and a railroad elevation of approximately +21 ft (+6.4 m).

3. **Type of Site:** The shoreline in the Project area consists mainly of narrow, gently to moderately sloping sandy beaches backed by high, coastal bluffs. This sandy beach grades into a foreshore consisting of cobble and gravel pockets at the water's edge.

4. **Type(s) of Habitat:** The Project area consists of sandy beach, upland vegetation, intertidal habitat, and low-to-high relief patch reef.

5. **Timing and Duration of Discharge:** Dredging would be performed 24 hours a day, 7 days a week. Shore equipment would work 9 hours a day, 6 days a week. The Project duration is estimated at four months. Construction is anticipated to begin in 2012.

f. **Description of Disposal Methods:** The proposed project will be constructed with hopper dredging equipment with pump ashore capability and conventional earthmoving equipment. At the receiver beach, the dredge will be attached to a moored floating section of pipeline extending 1,500 ft (457 m) to the shoreline. The material would be re-suspended and discharged through the on-board pumping

system to the receiver site. Existing sand at the receiver site would be used to build a small, "L"-shaped berm to anchor the sand placement operations. The short side of the "L" would be transverse (crosswise) to the shoreline and would be the proposed width. The long side would be parallel to the shore at the seaward edge and would be approximately 200 ft (61 m) long. The slurry would be pumped onto the beach between this berm and toe. The berm reduces ocean water turbidity by allowing all the sand to settle out inside the bermed area while the seawater is channeled along the berm until it reaches the open end where it drains into the ocean. Temporary dikes within the berm will allow sand to settle in designated areas. Once a 200 ft (61 m) section of berm is filled in with sand, another 200 ft (61 m) of berm will be created, the pipeline will be moved or extended into the new berm area, and the process would begin again. As the material is deposited behind the berm, the sand would be spread using two bulldozers and one front-end loader to direct the flow of the sand slurry and form a gradual slope to the existing beach elevation.

III. Factual Determinations

A. Physical Substrate Determinations:

1. **Substrate elevation and slope:** Because of various seasonal cycles of sand deposition and erosion and the lack of adequate natural beach re-nourishment, the beach varies in width from 0 to 200 ft (0 to 60 m). The Proposed Project would construct a 50 ft (15 m) wide beach with a + 17 ft (+5.2 m) crest elevation along 3,412 ft (1,040 m) of beach in the Project area.

2. **Sediment type:** The beach in San Clemente is composed of fine to medium grained sands and silty sands. Material classification assumed is 10 percent fines, 83 percent sand and 7 percent gravel.

3. **Dredged/fill material movement:** Within the Project area, the beach width meanders from 0 ft wide to 76 ft (23 m) to 0 ft to 129 ft (39 m) and back to 0 ft along the reach.

4. **Physical effects on benthos:** The Project will alter topography by excavating soft bottom offshore of Oceanside and placing the sediment on the beach at San Clemente to widen the beach. Neither the relatively featureless ocean bottom offshore Oceanside nor the sand beach at San Clemente is a unique geologic feature. Excavation of sand offshore Oceanside would not result in a substantial modification of nearshore bathymetry. There may be temporary burial impacts in the nearshore area, including partial burial of T-Street reef in the inshore portions; however, this burial would be short term if it were to occur.

5. **Actions taken to minimize impacts:** There are no significant impacts to the physical substrate. No minimization measures are required.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. **Water**

a. Salinity

Salinity would not be altered by the proposed project.

b. Water chemistry

Water chemistry would not be altered by the proposed project.

c. Clarity

Clarity would not be altered by the proposed project.

d. Color

Water color would not be altered by the proposed project.

e. Odor

Water odor would not be altered by the proposed project.

f. Taste

Water taste would not be altered by the proposed project.

g. Dissolved gas levels

Dissolved gas levels would not be altered by the proposed project.

h. Nutrients

Nutrients would not be altered by the proposed project.

i. Eutrophication

Eutrophication would not be altered by the proposed project.

j. Others as appropriate

No other water characteristics would be altered by the proposed project.

2. **Current patterns and circulation**

   a. Current patterns and flow:

      The Project area is within the littoral zone where waves are the primary force in generating the alongshore currents that are responsible for moving sand, suspended by wave action, along the coast. Approximately 91 percent of the waves off San Clemente approach from the relatively narrow 20-degree band between 230°-240°, and all other approach directions are minor or negligible. This predominately westerly wave approach means that alongshore currents in the project area are mainly downcoast.

   b. Velocity:

      The proposed project would not impact the velocity of the waves within the project area.

   c. Stratification:

      Because the proposed project occurs within a dynamic environment, there would be no impacts to stratification.

   d. Hydrologic regime:

      Because the proposed project occurs within ocean waters, the hydrologic regime would not be impacted.

3. **Normal water level fluctuations:** The proposed project would not alter normal water level fluctuations.

4. **Salinity gradients:** The proposed project would not alter salinity gradients.

5. **Actions that will be taken to minimize impacts:** The proposed project does not impact water circulation, fluctuation, or salinity; no actions are required to minimize impacts.

C. Suspended Particulate/Turbidity Determinations

1. **Expected changes in suspended particulates and turbidity levels in vicinity of disposal site:** Turbidity plumes generated during the discharge of offshore sediments to the receiver site have the potential to degrade nearshore waters. However, turbidity plumes would be expected to be confined primarily to the naturally turbid surf zone and associated rip currents. Construction monitoring during the SANDAG project in San Diego County documented that beach fill operations generated turbidity plumes that ranged between 2,640 and 10,000 ft (800 and 3,000 m) and were greatly influenced by rip currents. The turbidity

plumes remained in the surf zone unless rip currents carried them offshore (SANDAG 2002). The proposed project method of discharging the sediments behind an L-shaped berm allows fine particles to settle prior to introduction to the ocean and reduces the potential for nearshore turbidity. Because turbidity plumes generated during initial placement of sediments on receiver beaches would primarily be confined to the surf zone and rip currents, areas that are naturally turbid, degradation of coastal waters by turbidity from the proposed project would not be expected to occur.

2. Effects on chemical and physical properties of the water column:

a. Light penetration:

With the exception of temporary elevations of turbidity within the surf zone during discharge to the receiver site, the proposed project would not alter light penetration of the water column.

b. Dissolved oxygen:

Because of the dynamic environment of the project area, the proposed project would not alter dissolved oxygen levels in the water column.

c. Toxic metals and organics:

The proposed project may introduce non-detectable to very low levels of toxic metals and organics; however the levels would be below all the thresholds in the Sediment Quality Guidelines.

d. Pathogens:

The proposed project would not introduce pathogens into the water column.

e. Aesthetics:

With the exception of temporary elevations of turbidity within the surf zone during discharge to the receiver site, the proposed project would not alter the aesthetics of the water column.

f. Others as appropriate

There are no other chemical or physical properties of the water column that would be affected by the proposed project.

3. **Effects on biota**

a. Primary production, photosynthesis:

Although temporary elevations of turbidity within the surf zone during discharge to the receiver site may occur, the proposed project would not alter light penetration of the water column and, therefore, would not impact primary production or photosynthesis.

b. Suspension/filter feeders:

The effect of project related turbidity on local suspension and filter-feeding invertebrate and fish populations is unknown, but even complete loss would result in immediate recolonization, and impacts would be expected to be short-term and insignificant. Any appreciable turbidity increase may cause clogging of respiratory and feeding apparatus of sedentary bottom fish and filter feeders. Motile organisms, however, would evacuate and avoid the area and temporarily relocate to adjacent undisturbed areas. Most of the impacts would be confined to the immediate vicinity of disposal activities. Algae and non-motile marine invertebrates may experience higher localized mortality rates during rock placement. Those species currently inhibitory exposed surfaces would be destroyed, but new surfaces would be quickly recolonized. Most studies have found that the diversity, biomass, and abundance of sandy intertidal invertebrates declines following beach nourishment, but that the community recovers within a few months.

c. Sight feeders:

The proposed placement of sediments behind a dike would reduce the suspended sediment concentrations in the discharge. Turbidity plumes generated during beach fill operations at the receiver sites could interfere with foraging by visually-feeding birds such as gulls, terns, pelicans and cormorants. However, turbidity plumes would be expected to be confined primarily to the naturally turbid surf zone and associated rip currents. Therefore, the impacts of turbidity from the discharge of sediments to receiver beaches would not be expected to be significant.

4. **Actions taken to minimize impacts:** The proposed project has been designed to minimize impacts by placing sandy material behind a berm before introduction to ocean waters. Impacts to biota are not expected to be significant; therefore, no further minimization efforts are required.

D. **Contaminant Determinations:** The sediments proposed for the beach fill have been tested and found to contain very low levels of contaminants. Contaminant concentrations of metals, pesticides, polychlorinated biphenyls (PCBs), polycyclic

aromatic hydrocarbons (PAHs), phthalates, and phenols were non-detectible to low and well below all the thresholds in the Sediment Quality Guidelines. No dichlorodiphenyltrichloroethane (DDT) or chlorinated pesticides were detected in the samples.

E. Aquatic Ecosystem and Organism Determinations

1. **Effects on plankton:** Project related turbidity plumes would be expected to be confined primarily to the naturally turbid surf zone and associated rip currents No significant reduction in plankton is expected due to project generated turbidity.

2. **Effects on benthos:** Most of the benthic invertebrates within the area dredged from offshore Oceanside would be killed by the dredging. Some mobile organisms such as crabs may escape the dredge. Recovery of the benthic invertebrate community would be expected to begin almost immediately with settlement of larvae and immigration of mobile species from nearby unaffected areas. Recovery of the infaunal community to values comparable to pre-dredging levels may occur in as little time as six months or as long as two years, with an average of about one year. Discharge of offshore sand onto receiver beaches would bury intertidal invertebrates living in the sand of receiver beaches. Most studies have found that the diversity, biomass, and abundance of sandy intertidal invertebrates declines following beach nourishment but that the community recovers within a few months. Therefore, the effects of beach nourishment on sandy intertidal invertebrates would be temporary and would not be expected to be significant.

3. **Effects on nekton:** Nearshore fishes are highly unlikely to be exposed to suspended sediment concentrations that would have lethal or sublethal effects. Because the turbidity would be limited in extent and would be confined to the naturally turbid surf zone and rip current areas, significant impacts of turbidity to nearshore fishes are unlikely. Some fishes may avoid the turbid areas. Temporary turbidity within a limited area in the vicinity of the surf zone would not have a discernible impact on the population of any fish species.

4. **Effects on aquatic food web:** As discussed above, impacts to the aquatic food web are expected to be temporary and insignificant.

5. **Effects on special aquatic sites:**

   a. Sanctuaries and refuges:

      There are no sanctuaries or refuges on the project site.

b. Wetlands:

There are no wetlands on the project site.

c. Mud flats:

There are no mudflats on the project site.

d. Vegetated shallows:

Special aquatic sites in the project area include surfgrass beds and kelp beds. The sand placement footprint does not include any kelp beds, surfgrass, or rocky intertidal areas. Therefore, no direct impacts to sensitive habitats would occur from the placement of sand on the beach. In addition, the Proposed Project would not place anchors for the monobuoy, where the hopper dredge will moor while it discharges sand to the beach, or place the sinker pipeline that will pump the sediment to shore from the hopper dredge on any sensitive habitat. The Project also will avoid side to side movement of the anchors or pipeline as they are placed, which could abrade surfgrass, algae, or attached invertebrates. Sediment placed on the beach may gradually move offshore and downcoast. The nearest kelp bed is located 1,200 ft (360 m) offshore of the San Clemente Beach fill area. Because most of the surfgrass in the Project area grows on T-Street reef, it is possible to avoid surfgrass by avoiding the reef when laying the pipeline. In addition, to avoid impacts to reefs that support kelp and other sensitive species such as gorgonians and surfgrass, the hopper dredge should moor inshore of these reefs, which are located approximately 1,000 to 1,300 ft (300 to 400 m) from the beach. Based on beach profile monitoring of a similar volume of fill at Oceanside and a previous analysis for a lower volume of fill near San Clemente Pier, very little of the sand placed on the beach at San Clemente would be expected to migrate offshore into the kelp beds. The only significant surfgrass in the project area is at T-Street Reef in the surfzone. Because of the high wave energy in this area, any sand from the beach fill that was moved into the T-Street surfgrass bed would be expected to be rapidly resuspended and moved downcoast by wave action. However, if impacts to surfgrass in this area are observed, mitigation will be implemented as described in the Biological Resources Monitoring Plan (Appendix B of the EIS/EIR).

e. Coral reefs:

There are no coral reefs on the project site.

f. Riffle and pool complexes:

There are no riffle and pool complexes on the project site.

6. **Threatened and endangered species:**

   There are no federal or state listed taxa that would use or inhabit the project site during project implementation and no habitat is present. There is no designated critical habitat on the site. No proposed or endangered species are expected to be present on the site and there is no proposed critical habitat on the site.

7. **Other wildlife:**

   The greater amount of sand on San Clemente Beach following beach nourishment would be expected to have a beneficial effect on shorebird birds in a marine environment by increasing resting habitat. Several beach nourishment projects have documented greater use of the beach for resting by a variety of birds such as gulls, shorebirds, and other larids following the placement of sand on the beach. The increased sand beach also may increase foraging opportunities for shorebirds that feed on sandy intertidal invertebrates.

   The Corps continues on-going coordination with USFWS regarding biological impacts and mitigation in compliance with the Fish and Wildlife Coordination Act. The USACE met with resource agencies, including the USFWS, on several occasions, to discuss the proposed project and alternatives. Other invitees and attendees included NOAA Fisheries and CDFG. The main topics of discussion included the proposed project, project alternatives, and potential environmental issues.

8. **Actions to minimize impacts:** The proposed project has been designed to minimize impacts by placing sandy material behind a berm before introduction to ocean waters. Impacts to the aquatic ecosystem and organisms are not expected to be significant; therefore, no further minimization efforts are required.

F. Proposed Disposal Site Determinations

1. **Mixing zone determination:**

   Discharge will be onto the beach behind a berm not into the water column. The berm will tend to trap particles but some of the water will run back into the surf zone temporarily generating turbidity. Construction monitoring during a similar beach nourishment project in San Diego County documented that beach fill operations generated turbidity plumes that ranged between 2,640 and 10,000 ft (800 and 3,000 m) and were greatly influenced by rip currents. The turbidity plumes remained in the surf zone unless rip currents carried them offshore.

2. Determination of compliance with applicable water quality standards

3. Potential effects on human use characteristic:

a. Municipal and private water supply:

The proposed project would have no effect on municipal or private water supplies or water conservation.

b. Recreational and commercial fisheries:

On shore construction may temporarily interfere with shore fishing activities in the immediate project area. Offshore construction operations (i.e., vessel traffic and dredging) may potentially conflict with local commercial fishing operations during winter months, including gear/equipment damage and the disruption of fishing locations. Thirty days prior to the start of construction, the local commercial fishermen's association shall be provided with written notification of the intended start date of on shore construction, offshore construction, maps of project-related vessel transportation routes, and its duration. Noticing shall include a point of contact throughout the entire construction phase to respond to concerns regarding interference and/or other issues associated with local commercial fishing operations. Impacts would be considered less than significant.

c. Water related recreation:

During the beach construction, portions of the beach, nearshore zone, and potentially the Pier would be closed to public use. Impacts would be temporary (up to four months) During dredging and nourishment activities, proper advanced notice to mariners would be obtained and navigational traffic would not be allowed within the offshore borrow site area or mooring/discharge area. In addition, signage would be provided to inform swimmers of potential hazards. The beach closure would prevent surfers from accessing the beach near the Pier. Recreational users would be required to visit a different beach or different portions of the beach during the closure periods. The displacement of recreational users to the various nearby beaches would be temporary and short-term. However, the proposed project would not impact surfing conditions or other water sports once completed.

In the long-term, the beach nourishment would create a wider beach area and greater opportunities for beach activities, enhancing the beach available for recreation users. The wider beach would be a benefit to beach

recreation users. Long-term maintenance activities would create similar impacts as the initial construction.

d. Aesthetics:

The proposed project would result in a wider beach, which would be a minor alteration of the visual character of the existing environment. During the construction phase, the visual character of the site would be affected by construction activities and the presence of construction equipment and materials; however, the construction phase is temporary, and as such, would not result in permanent effects to the visual character of the site. In the long term, the resulting wider beach would enhance the view of the beach and result in a visual benefit. Long-term maintenance activities would create similar impacts as the initial construction.

e. Parks, National and historical monuments, National seashores, wilderness areas, research sites, and similar preserves:

The proposed project would have temporary construction impacts to San Clemente City Beach, but in the long-term would enhance the beach by providing a wider sandy beach. The proposed project would not have any effect on national and historic monuments, national seashores, wild and scenic rivers, wilderness areas or research sites.

G. **Determination of cumulative effects on the aquatic ecosystem:** All the potential effects of the project would occur at the site. No indirect offsite effects are anticipated. The Proposed Project would not cause downcoast erosion. The only cumulative project that has the potential to interact with the proposed project is the Dana Point Dredging Project, which would place about 83,000 cubic yards of sediment dredged from the harbor either on Capistrano Beach or in the nearshore zone off of Capistrano Beach. The discharge of sediment from the Dana Point Harbor Dredging project to Capistrano Beach will act cumulatively with the proposed action to add sediment to the Oceanside littoral cell. The proposed action will act in a cumulative fashion with the Dana Point Harbor Dredging project to offset erosion on beaches in south Orange County and northern San Diego County. Most of the sediment from these projects is expected to accumulate on downcoast beaches or in the very shallow nearshore area between the foreshore and the bar. Beach fill would be deposited onshore and would be expected to move offshore in a manner that would not alter the wave characteristics of popular surf breaks, such as T-Street, and would not be expected to affect Wheeler J. North Reef approximately 3,200 ft seaward of the proposed project footprint.

Like the proposed action, the Dana Point Harbor Dredging project would discharge sediments to the beach or nearshore zone and thus may cause a temporary localized increase in turbidity in nearshore waters. The discharge of sediments from Dana Point Harbor dredging would occur at Capistrano Beach approximately 4 miles (6.4

km) from the proposed action. Even if the projects occurred at the same time, the turbidity plumes would be sufficiently distant that they would not interact with each other. Monitoring of turbidity and adjustment of operations to avoid extensive turbidity plumes would mitigate any cumulative impacts of turbidity from these projects. The incremental addition of a portion of a smaller amount of sediment discharged over 4 mi (6.4 km) upcoast is unlikely to add sufficient sediment to affect surfgrass or shallow reefs in the San Clemente area.

The Proposed Project will not have any indirect effects on the human environment. Impacts of the Proposed Project on the human environment include temporary impacts to air quality, transportation, noise, recreation, aesthetics, navigation, and public safety during construction. The only project that would act cumulatively with the Proposed Project on the human environment would be the Dana Point Dredging Project if it occurred simultaneously with the Proposed Project. Because the Dana Point Dredging Project would be 4 miles upcoast from the Proposed Project and because construction of both projects would be temporary, the cumulative effects of these two projects on the human environment would be negligible.

There have been no previously permitted cumulative actions on the site. The proposed sediment source area offshore of Oceanside was used to supply sand to San Diego beaches for the SANDAG project. The San Onofre Nuclear Generating Station Kelp Reef Project involved construction of a reef of quarry rock offshore San Clemente in the summer of 2008. The San Onofre Nuclear Generating Station Kelp Reef Project occurred offshore the Proposed Project. Because construction of these two projects would occur at different times, there would be no cumulative construction impacts. The San Onofre Nuclear Generating Station Kelp Reef would be too far offshore from the Proposed Project to be affected by sediment placed on San Clemente Beach.

H. **Determination of secondary effects on the aquatic ecosystem:** Impacts of the Proposed Project are all temporary construction impacts. Significant impacts to sensitive species are avoided. Other temporary construction impacts are minimized by the design features and environmental commitments of the Proposed Project.

Findings of Compliance

A. **Adaption of the Section 404(b)(1) Guidelines to this Evaluation:** No significant adaptations of the guidelines were made relative to this evaluation.

B. **Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem:** Section 3.2 of the EIS/EIR identifies the measures that were considered, but not carried forward for the project, including the various (5 m to 35 m) scales of beach nourishment not discussed further in the EIS/EIR. Sections 3.3 and 3.4 of the EIS/EIR discuss the beach nourishment alternative and the 15 m and 35 m scales of beach nourishment. There are no alternative disposal methods

available for this project which would be 1) more consistent with the project authorization that mandates disposal into the littoral drift system, or 2) have a less environmentally damaging resultant.

C. **Compliance with Applicable State Water Quality Standards:** To satisfy requirements of the Federal CWA, the Corps will submit this Final EIS/EIR and appropriate technical documentation to the San Diego RWQCB, tasked with implementing the CWA within the region, for their review for CWA Section 401 certification, pursuant to 33 CFR 336.1(a)(1). Upon review of the submittal, the RWQCB would issue a 401 certification. The Corps will continue to coordinate with the RWQCB throughout the CWA process and construction activities.

D. **Compliance with Applicable Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act:** No toxic materials are known or likely to occur in the project area.

E. **Compliance with Endangered Species Act of 1973:** Formal consultation was not required with the USFWS under the ESA because the Corps, as the action agency, made a no effect determination and is avoiding all federal listed taxa. However, under Section 7(a)(2) of the ESA, Federal agencies must consult with Federal resource agencies (i.e., USFWS, NOAA Fisheries) and prepare a Biological Assessment (BA) if listed species and/or critical habitat are present in an area to be impacted by Project activity. The USFWS and/or NOAA Fisheries then would prepare a Biological Opinion (BO) on how the action would affect the species and/or its critical habitat, and would suggest reasonable and prudent measures to avoid jeopardizing the continued existence of the species or adversely modifying its critical habitat. If prior to and/or during construction it is determined that Federal endangered and threatened species would be adversely impacted, the USACE would initiate Section 7 consultation.

F. **Compliance with Specified Protection Measure for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972:** No sanctuaries as designated by the Marine Protection, Research and Sanctuaries Act of 1972 will be affected by the proposed project.

G. **Evaluation of Extent of Degradation of the Waters of the United States**

1. **Significant adverse effects on human health and welfare:**

a. Municipal and private water supplies

The proposed project will have no significant adverse effects on municipal and private water supplies.

b. Recreation and commercial fisheries

The proposed project will have no significant adverse effects on recreation and commercial fisheries.

c. Plankton

The proposed project will have no significant adverse effects on plankton.

d. Fish

The proposed project will have no significant adverse effects on fish.

e. Shellfish

The proposed project will have no significant adverse effects on shellfish.

f. Wildlife

The proposed project will have no significant adverse effects on wildlife.

g. Special aquatic sites

The proposed project will have no significant adverse effects on special aquatic sites.

2. **Significant adverse effects on life stages of aquatic life and other wildlife dependent on aquatic ecosystems:** The proposed project will have no significant adverse effects on life stages of aquatic life and other wildlife dependent on aquatic ecosystems.

3. **Significant adverse effects on aquatic ecosystem diversity, productivity, and stability:** The proposed project will have no significant adverse effects on aquatic ecosystem diversity, productivity, and stability.

4. **Significant adverse effects on recreational, aesthetic, and economic values:** The proposed project will have no significant adverse effects on recreational, aesthetic, and economic values.

H. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem

Avoidance

- Beach fill will avoid the grunion spawning season since there will be no construction during this time period. However, if beach fill would to occur during the grunion spawning season of March to August, a qualified biologist shall observe the receiver beach during all predicted grunion runs and mark areas

where grunion spawning occurs. All beach construction activities shall avoid these designated spawning areas until the next predicted high tide series to allow grunion eggs to hatch.

- Beach nourishment will avoid the least tern nesting season by implementing the project outside the season. The least tern nesting season is April 15 to September 15; nearest colony is 15 miles south (down coast) of the Project site.
- Prior to construction, offshore borrow areas 1 and 2 will be subjected to an underwater remote sensing survey in order to determine if submerged cultural resources are present within these areas. If cultural resources are indicated, dredging will avoid those areas.
- To avoid public safety impacts to beach goers, the contract specifications shall require the contractor to fence/secure areas of construction from public access, including construction staging areas and active construction areas, including the beach and nearshore zone.

Minimization

- To minimize air quality impacts, use Best Available Control Technology during construction.
- To minimize turbidity, discharge sediments to the beach behind L-shaped berms.
- To minimize turbidity, monitor turbidity during sediment discharge and if significant turbidity is observed, modify operations (such as by slowing rate of discharge) until turbidity abates
- To minimize potential for contaminant leaks and spills during construction, prepare and adhere to a Storm Water Pollution Prevention Plan and Oil Spill Response Plan.
- To minimize noise impacts, limit construction activities to less than 9 hours per day.
- To minimize navigation impacts and threats to vessel safety, the dredge would be equipped with markings and lightings in accordance with the U.S. Coast Guard regulations. The location and schedule of the dredge would be published in the U.S. Coast Guard Local Notice to Mariners. The dredge would travel at very low speeds (approximately 1.5 knots) during dredging operations. The travel speed during transport would be approximately 5 knots. During dredging and nourishment activities, proper advanced notice to mariners would be obtained, and navigational traffic would not be allowed within the offshore borrow site area or mooring/discharge area offshore of Oceanside.
- To minimize conflicts with fishermen, the local commercial fishermen's association shall be provided with written notification of the intended start date of on shore construction, offshore construction, maps of project-related vessel transportation routes, and its duration. Noticing shall include a point of contact throughout the entire construction phase to respond to concerns regarding interference and/or other issues associated with local commercial fishing operations.

Compensation

- Mitigation would be triggered only if conditions observed during the monitoring period reach thresholds identified in the monitoring plan and persist through the two year post-construction monitoring period, as there may be transitory effects and subsequent recovery.
- If significant impacts to surfgrass and reef habitat are observed, renourishment events would be modified to avoid impacts. Although several studies currently are being conducted to successfully transplant surfgrass and may show potential for success, to date success rates have not been consistent and studies are on-going. Mitigation will be based on the results of monitoring conducted before and after sand placement, as identified in the Mitigation Plan in Appendix B of the EIS/EIR. The Corps will coordinate these efforts with the resource agencies.

I. On the Basis of the Guidelines, the Proposed Disposal Sites(s) for the Discharge of Dredged or Fill Material is

☐ Specified as complying with the requirements of these guidelines; or,

☒ Specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem; or,

☐ Specified as failing to comply with the requirements of these guidelines.

APPENDIX B – BIOLOGICAL RESOURCES MONITORING PLAN

Rocky Reef/Surfgrass Monitoring, Mitigation, and Reporting Plan

Rocky Reef/Surfgrass Habitat

This appendix outlines 1) a pre- and post-construction monitoring program for rocky reef/surfgrass habitat in the San Clemente Pier area (Reach 6) to determine if project mitigation would be necessary; 2) a preliminary mitigation implementation plan, if mitigation is determined to be necessary; and 3) a preliminary mitigation monitoring plan, if mitigation is determined to be necessary. The final monitoring plan will be prepared during the pre-construction engineering design (PED) phase of the project. The details of these plans will be finalized in conference with knowledgeable, experienced, and qualified marine ecologists. The monitoring shall be performed by knowledgeable, experienced, and qualified marine biologists. These knowledgeable, experienced, and qualified marine ecologists may come from a variety of various agencies, organizations, institutions, or community centers of practice and expertise, such as academia - University of California, Corps Engineer Research and Development Center (ERDC), NOAA National Marine Fisheries Southwest Fisheries Sciences Center, USGS Western Ecological Research Center, other federal and state agencies, as well as consulting marine ecologists. CDFG, FWS, and NMFS regulatory resources agency staff will also be involved with the review process.

Pre- and Post-Construction Monitoring Plan

The Proposed Project has been designed to avoid or minimize impacts to sensitive biological resources to the maximum extent practicable. Currently, potential project impacts have been identified using a conservative coastal engineering model. The nature of the coastal engineering model has uncertainties due to multiple variables within the natural environment. Impacts to rocky reef and surfgrass reef are expected to be none to very minor, but currently are unknown. A post-construction monitoring strategy has been developed to determine if the project results in permanent loss of either rocky reef and/or surf grass. Based on the model, it is estimated that in a worst case about 20 percent of the reef or 1 acre may be impacted by the beach fill. For the purpose of costing, it is assumed that 1 acre of surfgrass and an additional 1 acre of reef without surfgrass could be impacted and require compensatory mitigation.

Mitigation would be triggered only if certain conditions occur during, and persist through, the two year post-construction monitoring period, as there may be transitory effects and subsequent recovery that would not be apparent in a shorter period of time. Persist means that observed sand burial of reef and/or loss of surfgrass continues to be significantly different on T-street reef compared to controls in all monitoring periods after the initial observed effect. During the two year post-construction monitoring, the reference site will be monitored to assess the natural variation, if possible, in rocky reef and surfgrass reef. Other published and unpublished literature will also be used in this analysis.

The following criterion is suggested as a potential trigger for implementing the potential mitigation.

- A persistent decrease in surfgrass cover or surfgrass density and an increase in sand cover and/or depth that is statistically significantly different than the controls and the baseline at the 0.05 confidence level (i.e., p-value = 0.05).

Actual triggers would be determined in coordination with knowledgeable, experienced, and qualified marine biologists and specific resource agencies prior to initiation of post-construction monitoring activities. These knowledgeable, experienced, and qualified marine ecologists may come from a variety of various agencies, organizations, institutions, or community centers of practice and expertise, such as academia - University of California, Corps Engineer Research and Development Center (ERDC), NOAA National Marine Fisheries Southwest Fisheries Sciences Center, USGS Western Ecological Research Center, other federal and state agencies, as well as consulting marine ecologists. CDFG, FWS, and NMFS regulatory resources agency staff will also be involved with the review process.

Proposed Pre- and Post-Construction Monitoring Activities

Prior to the implementation of the monitoring program, the extent of reef habitat throughout the entire predicted equilibrium footprint for the project will be mapped using side scan sonar or another appropriate method. This information will be used in the Monitoring Plan to establish transect lines.

Transects shall be established in the rocky reef area containing the surfgrass bed on T-Street reef (Project area) and in a control area of similar depth upcoast of the beach fill near Mariposa Point. Mariposa Point is considered an appropriate control because 1) it is close to the Project area and thus subjected to a similar wave climate, 2) supports surfgrass at a range of depths similar to T-Street reef, and 3) is upcoast of the beach fill out of the path of littoral drift, which is strongly downcoast in the San Clemente area. The transects shall be permanent transects with repeated use during all monitoring stages. Transects should cover, at a minimum, the inshore portion, middle, and offshore portion of the reef. The same number of transects should be established in the control area as in the T-Street reef area and the transects should be at similar depths. On each transect, the following parameters should be monitored at a minimum: 1) surfgrass density (i.e., number of shoots per square meter), 2) percent cover of surfgrass, sand, and rock, and 3) sand depth. The line intercept method is recommended for measuring percent cover and sand depth.

Transects should be monitored at the following intervals:

Pre-project monitoring (two years previous to beach nourishment):
- Twice within winter/spring
- Twice within summer/fall

Pre-project baseline monitoring (one year previous to beach nourishment):
- within one month prior to start
- 3 months prior to start
- 6 months prior to start
- 1 year prior to start

Post-construction:

Year One
- within one month after completion
- 3 months after completion
- 6 months after completion
- 1 year after completion

Year Two
- Twice within winter/spring
- Twice within summer/fall

Biological resources within the project area identified as potentially being impacted include surfgrass patches and rocky reef habitat at T-Street. Because a survey was not conducted to delineate the T-street reef, the general area of the T-street reef was based on the outer extent of mapped surfgrass locations (approximately 5 acres). Actual delineation of the T-street reef will need to be identified prior to the pre-construction survey. This survey would use side scan sonar or another appropriate methodology to delineate T-street reef and other reef habitat within the potential equilibrium footprint of the sand placement. Potential project impacts to these resources were based on modeling that indicates sand movement may extend to the offshore/outer edge of the reef; however, sand at the offshore/outer edge of the reef would be thin and not significant. Potential burial of the inshore edge of T-Street reef is uncertain; however, in a reasonable worst case scenario, approximately 20 percent of the inshore edge of the T-Street reef area (about 1 acre) may be buried. These knowledgeable, experienced, and qualified marine ecologists may come from a variety of various agencies, organizations, institutions, or community centers of practice and expertise, such as academia - University of California, Corps Engineer Research and Development Center (ERDC), NOAA National Marine Fisheries Southwest Fisheries Sciences Center, USGS Western Ecological Research Center, other federal and state agencies, as well as consulting marine ecologists. CDFG, FWS, and NMFS regulatory resources agency staff will also be involved with the review process. If significant impacts to these biological resources are observed, renourishment events would be modified to avoid or minimize impacts to the extent practicable and project mitigation would be implemented.

Pre- and Post-Construction Monitoring Costs

Pre-construction Monitoring
This cost assumes that permanent transects will be established. One day is allotted to install the markers and up to four days to conduct the survey at both the reference site and T-street reef, taking into consideration the wave environment in the project area and assuming three transects. This survey is assumed to occur within one year prior to construction activities.

a. Side-scan sonar survey	$200,000
b. Pre-construction Monitoring: (two years prior to beach nourishment):	
o Twice within winter/spring; Twice within summer/fall:	$131,000

c. Pre-construction Baseline Monitoring:
(one year prior to beach nourishment):
- 4 events (one month, 3 months, 6 months, 1 year) $120,000

d. Pre-construction Report (2 years prior and 1 year prior) $ 10,000
Subtotal ***$461,000***

Post-Construction Monitoring
This cost assumes that permanent transects will be established. One day is allotted to find or re-install the markers and up to four days to conduct the survey at both the reference site and T-street reef, assuming three transects.

a. Year One
- 4 events (one month, 3 months, 6 months, 1 year): $120,000

b. Year Two
- Twice within winter/spring; Twice within summer/fall: $ 131,000

c. Post-construction Report (Years One and Two) $ 10,000
Subtotal ***$261,000***

Renourishment Pre- and Post-Construction Surveys

A standardized and consistent survey protocol will be developed during the PED phase for future beach renourishment cycles. The information collected from monitoring during the initial nourishment event will provide baseline information to compare future beach conditions. Because baseline information will be readily available for the Project site, the survey protocol for renourishment activities will focus on a single pre- and post-construction survey rather than the monitoring period proposed for initial nourishment activities.

Project Mitigation

If mitigation were required based on results of the post-construction monitoring, rocky reef and surfgrass mitigation shall each be conducted at an equivalent functional value to the impacted area. Because it will take at least two years to identify impacts, some temporal loss of surfgrass, if impacts were to occur, is unavoidable. Recovery of impacted resources will also occur as sand is redistributed within the littoral cell. Additionally, if impacts were to occur, future beach fills would be modified to avoid future impacts; any observed burial of reef or surfgrass would be temporary because sand would be expected to move out of the project area.

Reef habitat mitigation shall be constructed at an equivalent functional value of shallow and deep water reef proportional to the area of surfgrass on reef impacted. The area of surfgrass loss will be mitigated with an equal area of shallow water reef; the area of reef without surfgrass will be mitigated as deep water reef. Shallow water reef would be constructed on the offshore/outer edge of the existing reef; deep water reef would be constructed at approximately 30 foot water depth. Shallow water reef shall be constructed with a final top elevation of -10 to -14 feet Mean Lower Low Water. Construction of a reef that is shallower than the outer edge of T-Street reef is not proposed because construction methods would not be practical (e.g., a barge with the reef

construction materials would not be able to operate in very shallow water). Construction of a very shallow reef would need to be constructed by building a temporary road from shore; such a road would have significant impacts. Although the surfgrass mitigation reef would be deeper than the impact area, if surfgrass transplants are successful, the slightly deeper reef would replace the lost surfgrass resource. Deep water reef shall be constructed similar to the Southern California Edison Reefs constructed as mitigation for the impacts of the San Onofre Nuclear Power Plant. For example, if the monitoring shows 1 acre of reef impact and 1 acre of surfgrass impact, 1 acre of shallow water reef would be constructed and 1 acre of deep water reef. Mitigation would be implemented in the Project area at sites to be determined in coordination with knowledgeable, experienced, and qualified marine biologists. These knowledgeable, experienced, and qualified marine ecologists may come from a variety of various agencies, organizations, institutions, or community centers of practice and expertise, such as academia - University of California, Corps Engineer Research and Development Center (ERDC), NOAA National Marine Fisheries Southwest Fisheries Sciences Center, USGS Western Ecological Research Center, other federal and state agencies, as well as consulting marine ecologists. CDFG, FWS, and NMFS regulatory resources agency staff will also be involved with the review process.

Although several studies currently are being conducted to determine how to successfully transplant surfgrass and may show potential for success, success rates to date have not been consistent. Due to the absence of an established, successful method for mitigation of loss of surfgrass itself, proposed mitigation currently is focused upon restoration of the rocky reef that surfgrass currently uses as habitat. However, as previously described, if it is determined that surfgrass has been affected by the Project and a change is shown not to be due to natural variation, an experimental surfgrass transplant shall be implemented in addition to the construction of a shallow rocky reef. Currently, surfgrass transplant success is much higher for subtidal than for intertidal conditions and, therefore, surfgrass mitigation efforts for this project will focus on subtidal transplants only. The methodology for the surfgrass transplant shall be the transplant of sprigs from a donor bed to the new reef using the method developed by Bull et al. (2004). The contractor may propose an alternative transplant method, if evidence can be presented that the alternative method has as great or greater chance of success as the sprig transplant method. To avoid harvesting effects to the subject surfgrass bed, donor material will be taken from a larger area of surfgrass.

A fraction of the shallow water reef shall be test planted with surfgrass. The transplant will be conducted in the late summer/early fall, the time of year when most surfgrass seeds are released and germinate in southern California.

An area equal to approximately 25 percent of the surfgrass impact area (not to exceed 0.1 acre) will be test planted. Success of the transplant shall be determined after six months based on survivorship, percentage change in the number of leaves and the amount of areal coverage. The experimental transplant will be considered successful if the sprigs survive and there is a net increase in number of leaves and aerial coverage. Experimental surfgrass transects have shown that if the transplant is not successful, the transplants die and the reef is bare. If the transplants survive, surfgrass grows. If the test transplant is successful, the remainder of the surfgrass impact area will be planted on the shallow water reef with surfgrass. If the test transplant is

unsuccessful, mitigation will be conducted out of kind using kelp transplant on the deep water reef at an equivalent functional value; one acre, in the case of the costed scenario.

Project Mitigation Monitoring Plan

Similar to the Post-Construction Monitoring Plan, transects shall be established in the rocky reef area containing the surfgrass bed on the mitigation reef (if the experimental surfgrass transplant is successful) and in a reference site (control area) of similar depth upcoast near Mariposa Point. The transects shall be permanent transects. The same number of transects should be established in the control area as in the mitigation areas and transects should be at similar depths. On each surfgrass transect, the following parameters should be monitored at a minimum: 1) surfgrass density (i.e., number of shoots per square meter), 2) percent cover of surfgrass, sand, and rock, 3) sand depth, and 4) identification and quantity of flora and fauna. The line intercept method is recommended for measuring percent cover and sand depth.

Transects should be monitored at the following intervals, if successful:

***Post-mitigation implementation*:**

Year One
- within one month after completion
- 3 months after completion
- 6 months after completion
- 1 year after completion

Years Two through Five
- Once within winter/spring
- Once within summer/fall

Success Criteria

Success criteria of surfgrass would include determining if measured parameters are significantly different than the reference transects. Success criteria for the mitigation reef itself would include no complete permanent burial of the reef. Because of the predominantly sandy bottom environment in the project area, placement of the deep water rocky reef would be considered successful if a characteristic invertebrate and fish community were to become established. On each surfgrass transect, the following parameters should be monitored and evaluated at a minimum: 1) surfgrass density (i.e., number of shoots per square meter), 2) percent cover of surfgrass, sand, and rock, 3) sand depth, and 4) identification and quantity of flora and fauna. The line intercept method is recommended for measuring percent cover and sand depth. Specific success criteria will be developed during the Preconstruction, Engineering and Design (PED) phase. General success criteria will consist of the following:

1. Approximately 50% - 60% of the fish, invertebrates, and algae found at the reference site occur at the mitigation site two years post-mitigation.
2. Approximately 50% - 60% of surfgrass survival at the mitigation site two years post-mitigation implementation.

Project Mitigation Monitoring Costs

Reef Construction and Transplant Costs

Costs for reef construction and transplant costs would be based on actual impacts. The estimated costs for one acre of shallow surfgrass reef and one acre of deep water reef are provided below for reference. This scenario assumes successful test transplant operations. If test transplant operations are not successful, then compensatory mitigation would be triggered.

Shallow water reef design and construction (1 acre)	$2 million
Deep water reef construction (1 acre)	$500,000
Surfgrass transplant (1 acre)	
Test (0.1 acre)	$25,000
Mitigation – if Test successful (0.9 acre)	*$225,000*
Subtotal (*test successful*)	***$2,750,000***
Deep water reef construction (1 acre)	$500,000
Surfgrass transplant (1 acre)	
Test (0.1 acre)	$25,000
Subtotal (*test not successful*)	***$525,000***

Project Mitigation Monitoring Activities

a. Year One	$120,000
o after implementation - 4 events (one month, 3 months, 6 months, 1 year)	
b. Year Two	$65,500
o 2 events (once within winter/spring; once within summer/fall)	
c. Annual Report Years One and Two	$5,000
Subtotal (*test successful*)	***$190,500***

Compensatory Mitigation

If the surfgrass test planting is not successful, then out-of-kind and potentially off-site compensatory mitigation that has an equivalent functional value to the area of surfgrass on reef impacted is to occur via kelp planting on the deep water reef constructed during the previous project mitigation. Using the example of 1 acre of reef impacts and 1 acre of surfgrass impacts, if the surfgrass transplant is not successful, 1 acre of kelp will be planted on the 1 acre of deep water reef built during the project mitigation. All mitigation for kelp shall be monitored for 5 years.

Compensatory Mitigation Monitoring Plan

Similar to the Post-Construction Monitoring Plan, transects shall be established in the rocky reef area containing the kelp bed on the deep water mitigation reef (if the surfgrass transplant is unsuccessful) and in a reference site (control area) of similar depth upcoast near Mariposa Point. The transects shall be permanent transects. The same number of transects should be established in the control area as in the mitigation areas and transects should be at similar depths. On each kelp transect, the following parameters should be monitored at a minimum: 1) kelp density (number of kelp plants per square meter) of each age class, 2) holdfast diameter of each adult kelp plant on the transect, 3) number of stipes of each adult kelp plant on the transect and 4) identification and quantity of associated flora and fauna.

Transects should be monitored at the following intervals:

***Post-compensatory mitigation implementation*:**

Year One
- within one month after completion
- 3 months after completion
- 6 months after completion
- 1 year after completion

Years Two through Five
- Once within winter/spring
- Once within summer/fall

Success Criteria

Success criteria of kelp would include determining if the measured parameters are significantly different than the reference transects. Success criteria for the mitigation reef itself (if it is not planted with kelp) would include no complete permanent burial of the reef. Because of the predominantly sandy bottom environment in the project area, placement of the deep water rocky reef would be considered successful if a characteristic invertebrate and fish community were to become established. On each kelp transect, the following parameters should be monitored and evaluated at a minimum: 1) kelp density (number of kelp plants per square meter) of each age class, 2) holdfast diameter of each adult kelp plant on the transect, 3) number of stipes of each adult kelp plant on the transect and 4) identification and quantity of associated flora and fauna. Specific success criteria will be developed during the Preconstruction, Engineering and Design (PED) phase. General success criteria will consist of the following:

1. Approximately 50% - 60% of the fish, invertebrates, and algae found at the reference site occur at the mitigation site two years post-mitigation.
2. Approximately 50% - 60% of kelp survival at the mitigation site two years post-mitigation implementation.

Compensatory Mitigation Installation/Implementation Costs

Kelp Transplant Costs

Costs for transplant costs would be based on actual impacts. The costs of reef construction are included above in Project Mitigation for the surfgrass mitigation. This assumes the shallow water reef and deep water reef that were constructed during the Project Mitigation will not be removed; the costs for the compensatory mitigation would be in addition to the Project Mitigation costs above. The estimated costs for a one acre kelp transplant are provided below for reference. This scenario assumes unsuccessful test surfgrass transplant operations.

Kelp Transplant (1 acre)	$50,000
Subtotal (*test unsuccessful*)	***$50,000***

Compensatory Mitigation Monitoring Activities (Only if test transplant is unsuccessful and deep water rocky reef is constructed)

a. Year One	$120,000
o after implementation - 4 events (one month, 3 months, 6 months, 1 year)	
b. Year Two	$65,500
o 2 events (once within winter/spring; once within summer/fall)	
c. Annual Report Years One and Two	$5,000
Subtotal (*test unsuccessful*)	***$190,500***

Summary of Pre and Post Construction Monitoring

Activity		Cost
Pre-construction monitoring		
Side-scan sonar[1]		[$200,000]
2 years prior to construction - 4 events		$131,000
1 year prior to construction – 4 events		$120,000
Pre-construction report		$10,000
	Subtotal	**$261,000**
Post-construction monitoring		
Year 1 – 4 events		$120,000
Year 2 – 4 events		$131,000
Post-construction report		$10,000
	Subtotal	**$261,000**
Total Pre and Post Construction Monitoring[2]		*$522,000*

1 = Side scan sonar is already within coastal engineering monitoring and it will be completed and shared data
2 = the pre and post monitoring costs are not part of the mitigation costs; they are scheduled for implementation whether mitigation is necessary and implemented or not necessary and therefore not implemented.

Summary of Mitigation and Monitoring Costs

Mitigation and Monitoring - Surfgrass	
1 acre shallow reef construction	$2,000,000
1 acre deep reef construction	$500,000
1 acre surfgrass transplant	
Test (0.1 acre)	$25,000
Mitigation – *if test successful* (0.9 acre)	$225,000
Year 1 monitoring - 4 events *(if test successful)*	$120,000
Year 2 monitoring - 2 events *(if test successful)*	$65,500
Report *(if test successful)*	$5,000
Subtotal	**$2,940,500**
Mitigation and Monitoring - Kelp	
1 acre shallow reef construction	$2,000,000
1 acre deep reef construction	$500,000
1 acre surfgrass transplant	
Test (0.1 acre)	$25,000
1 acre kelp transplant *(if test not successful)*	$50,000
Year 1 monitoring - 4 events *(if test not successful)*	$120,000
Year 2 monitoring - 2 events *(if test not successful)*	$65,500
Report *(if test not successful)*	$5,000
Subtotal	**$2,765,500**
Summary Mitigation and Monitoring Cost[3]	
Mitigation – Surfgrass successful (Transplant Surfgrass)	*$2,940,500*
Mitigation – Surfgrass not successful (Transplant Kelp)	*$2,765,500*

3 = The cost for the Mitigation – Surfgrass successful (Transplant Surfgrass) includes the cost of constructing both shallow and deep rocky reef as does Mitigation – Surfgrass not successful (Transplant Kelp).

FINAL

JOINT ENVIRONMENTAL IMPACT STATEMENT/ ENVIRONMENTAL IMPACT REPORT APPENDICES

Volume II

SAN CLEMENTE SHORELINE PROTECTION PROJECT

San Clemente, CA

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June 2011

APPENDIX C – AIR QUALITY ANALYSIS REPORT

AIR QUALITY ANALYSIS REPORT
SAN CLEMENTE SHORELINE PROJECT
SAN CLEMENTE, CALIFORNIA

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March 2011

EXECUTIVE SUMMARY

This air quality evaluation was prepared in accordance with the requirements of the California Environmental Quality Act (CEQA) to determine if significant air quality impacts are likely to occur in conjunction with the type and scale of development associated with the proposed San Clemente Shoreline Project (Project).

The Project considered in this analysis proposes replenishing the sand at San Clemente Beach due to ongoing erosion. Two alternatives are addressed. The first examines the placement of approximately 251,127 cubic yards of sand over an area of about 4 acres and a period of about 46 working days. The second alternative examines the placement of approximately 585,962 cubic yards of sand over an area of about 9 acres and a period of 108 working days. In either case the sand would be dredged and hauled from a borrow site approximately 21 miles down coast from the San Clemente Beach site, in Oceanside, California. The Project is approximately centered about the San Clemente Pier; the south limit of the proposed beach fill is located immediately south of the T-Street overpass while the north limit is located immediately north of the Marine Safety Headquarters in the City of San Clemente.

The impact analysis contained in this report was prepared in accordance with the methodologies provided by the South Coast Air Quality Management District (SCAQMD) as included in its CEQA *Air Quality Handbook* (*Handbook*) as well as the SCAQMD Internet web site updates. Localized impacts from construction were determined using methodology provided by the SCAQMD in its document *Final Localized Significance Threshold Methodology* (Methodology). Regional operational and long-term localized impacts are not analyzed as there is no long-term operational phase to the Project. Once the beach is replenished there are no on-going operational/maintenance activities that are associated with the project and no construction of any buildings is associated with the Project.

The analysis finds that short-term emissions of NOx, ROG, and $PM_{2.5}$ particulate matter have the potential to exceed their respective threshold values leading to a significant cumulative impact. The included mitigation could reduce ROG to below significant thresholds; however NOx and $PM_{2.5}$, primarily from ocean-going vessel traffic, will remain significant for the Project.

The proposed Project would not involve growth-inducing impacts or cause an exceedance of established population or growth projections. Furthermore, with the included mitigation discussed below, emissions of all criteria pollutants are reduced as feasible. However, even with the included mitigation, the Project would remain significant for short- term construction emissions of NOx and $PM_{2.5}$. Because the Project incorporates the most current viable mitigation (i.e., Tier II onshore heavy equipment) and because these emissions are short-term and do not occur beyond the Project's construction period, they do not represent a violation of the goals and objectives of the Air Quality Management Program (AQMP). Additionally, the project would not result in significant localized air quality impacts. As such, the project is consistent with the goals of the AQMP, and in this respect does not present a significant impact.

MITIGATION MEASURES

Construction Period NOx, ROG, and $PM_{2.5}$ Emissions Mitigation Measures:

- The Applicant shall specify that the construction contractors shall use onshore heavy equipment that meets Tier II or higher air pollutant emission standards where these standards are applicable and equipment available.
- All heavy equipment shall be maintained and tuned per manufacturer's specifications to perform at California Air Resources Board (CARB) and/or EPA certification, where applicable, levels and to perform at verified standards applicable to retrofit technologies.

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LIST OF ACRONYMS AND ABBREVIATIONS

^{O}F	degrees Fahrenheit
µg	microgram
AAQS	Ambient Air Quality Standards
ADP	Attainment Demonstration and Reasonable Further progress Plan
ADT	Average Daily Trips
AQMP	Air Quality Management Program
BACT	Best Available Control Technology
C	Annual average concentration in $\mu g/m^3$
CAA	Federal Clean Air Act
CAAQS	California Ambient Air Quality Standards
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
CAT	Climate Action Team
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CO	Carbon Monoxide
CO2	Carbon Dioxide
DPM	Diesel Particulate Matter
EMFAC2007	On-Road Emission Factors published by the CARB in 2007
EPA	Environmental Protection Agency
Gal	gallon
Handbook	CEQA Air Quality Handbook
Lbs	pounds
LOS	Level of Service

LST	Localized Significance Thresholds
MMTCO2E	million metric tons of carbon dioxide
Methodology	Final Localized Significance Threshold Methodology
m^3	cubic meters
mph	miles per hour
NAAQS	National Ambient Air Quality Standards
N_2O	Nitrous Oxide
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides
O_3	Ozone
OEHHA	Office of Environmental Health Hazard Assessment
Pb	Lead
PM	Particulate Matter
PM_{10}	Particulate Matter of 10 microns or less in size
$PM_{2.5}$	Particulate Matter of 2.5 microns or less in size
ppm	Parts per Million
PUC	Public Utilities Commission
REL	Reference exposure level
ROC	Reactive Organic Compounds
ROG	Reactive Organic Gases
SCAB	South Coast Air Basin
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SIP	State Implementation Plans

SO_2	Sulfur Dioxide
SO_3	Sulfur Trioxide
SOx	Sulfur Oxides
SRA	source Receptor Area
TAC	Toxic Air Contaminant
T-BACT	Best Available Control Technology for Toxic Air Contaminants
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
Yr	year

SECTION 1.0 – METHODOLOGY

This air quality evaluation was prepared in accordance with the requirements of the California Environmental Quality Act (CEQA) to determine if significant air quality impacts are likely to occur in conjunction with the type and scale of development associated with the proposed San Clemente Shoreline Project (Project).

The impact analysis contained in this report was prepared in accordance with the methodologies provided by the South Coast Air Quality Management District (SCAQMD) as included in its Handbook as well as its Internet web site updates. Localized impacts from construction were determined using methodology provided by the SCAQMD in its document Methodology. Regional operational and long-term localized impacts are not analyzed as there is no long-term operational phase to the Project. Once the beach is replenished there are no additional construction or operational/maintenance activities associated with the Project.

The proposed Project involves the restoration of a stretch of beach that is either approximately 15 or 35 meters wide by 1,040 meters long. The two widths would accommodate either 251,127 or 585,962 cubic yards of sand, respectively, that will be dredged from a borrow site approximately 21 miles down coast from the existing beach. The existing site is vacant and relatively flat land. For the purposes of this analysis, construction is estimated to occur in 2010 and take approximately 46 or 108 working days for the two alternatives, respectively.

SECTION 2.0 – EXISTING CONDITIONS

2.1. CLIMATE/METEOROLOGY

The proposed Project lies in the South Coast Air Basin (SCAB) that includes all of Orange County, as well as the non-desert portions of Los Angeles, Riverside, and San Bernardino Counties. In addition, the project borrow area is located in the San Diego Air Basin.

2.1.1 South Coast Air Basin (SCAB)

The SCAB is located in a coastal plain with connecting broad valleys and low hills, bounded by the Pacific Ocean in the southwest quadrant with high mountains forming the remainder of the perimeter. The general region lies in the semi-permanent high-pressure zone of the eastern Pacific. As a result, the climate is mild, tempered by cool sea breezes. This usually mild climatological pattern is interrupted infrequently by periods of extremely hot weather, winter storms, or Santa Ana winds.

The annual average temperature varies little throughout the SCAB, ranging from the low to middle 60s, measured in degrees Fahrenheit (^{o}F). With a more pronounced oceanic influence, coastal areas show less variability in annual minimum and maximum temperatures than inland areas. The climatological station located in Laguna Beach (to the north) reports a yearly average of 61^{o}F. The average low is reported at 44^{o}F in January while the average high is 77^{o}F in August and September.

In contrast to a very steady pattern of temperature, rainfall is seasonally and annually highly variable. Almost all rain falls from November through April. Summer rainfall is normally restricted to widely scattered thundershowers near the coast with slightly heavier shower activity in the east and over the mountains. Rainfall averages around 12.45 inches per year in the Project area, again, as measured at Laguna Beach.

Although the SCAB has a semi-arid climate, the air near the surface is typically moist because of the presence of a shallow marine layer. Except for infrequent periods when dry, continental air is brought into the SCAB by off shore winds, the ocean effect is dominant. Periods of heavy fog, especially along the coastline, are frequent; and low stratus clouds, often referred to as "high fog" are a characteristic climatic feature. Annual average humidity is 70 percent at the coast and 57 percent in the east portions of the SCAB.

Wind patterns across the south coastal region are characterized by westerly and southwesterly onshore winds during the day and easterly or northeasterly breezes at night. Wind speed is somewhat greater during the dry summer months than during the rainy winter season. Annually, typical winds in the project area average about 6 to 8 miles per hour during the day and 2 to 8 miles per hour during the night.

Between the periods of dominant airflow, periods of air stagnation may occur, both in the morning and evening hours. Whether such a period of stagnation occurs is one of the critical determinants of air quality conditions on any given day. During the winter and fall months, surface high-pressure systems over the SCAB, combined with other meteorological conditions,

can result in very strong, downslope Santa Ana winds. These winds normally have duration of a few days before predominant meteorological conditions are reestablished.

In conjunction with the two characteristic wind patterns that affect the rate and orientation of horizontal pollutant transport, there are two similarly distinct types of temperature inversions that control the vertical depth through which pollutants are mixed. These inversions are the marine/subsidence inversion and the radiation inversion. The height of the base of the inversion at any given time is known as the "mixing height." This mixing height can change under conditions when the top of the inversion does not change. The combination of winds and inversions are critical determinants in leading to the highly degraded air quality in summer, and the generally good air quality in the winter in the project area.

2.1.2 San Diego Air Basin (SDAB)

The SDAB covers 4,260 square miles and lies in the southwest corner of California and comprises the entire San Diego region. The topography in the San Diego region varies greatly, from beaches on the west to mountains and desert on the east. Much of the topography in between consists of mesa tops intersected by canyon areas. The topography in the San Diego region, along with local meteorology, influences the dispersal and movement of pollutants in the basin.

The weather of the San Diego region, as in most of southern California, is influenced by the Pacific Ocean and its semi-permanent high-pressure systems that result in dry, warm summers and mild, occasionally wet winters. The average temperature ranges from the mid 40s to the high 90s. Most of the county's precipitation falls from November to April, with infrequent (approximately ten percent) precipitation during the summer.

The interaction of ocean, land, and the Pacific High Pressure Zone maintains clear skies for much of the year and drives the prevailing winds. Local terrain is often the dominant factor inland, and winds in inland mountainous areas tend to blow through the valleys during the day and down the hills and valleys at night.

2.2. AMBIENT AIR QUALITY

The following characterization of the baseline atmospheric environment includes an evaluation of the ambient air quality and applicable rules, regulations, and standards for the area. Because the Project has the ability to release gaseous emissions of criteria pollutants and dust into the ambient air, it falls under the ambient air quality standards promulgated on the local, state, and federal levels.

2.2.1 Affected Environment

The proposed Project site is subject to the rules and regulations imposed by the SCAQMD; however, the SCAQMD reports to the California Air Resources Board (CARB). Therefore, all emissions are also governed by both the California Ambient Air Quality Standards (CAAQS) as well as the National Ambient Air Quality Standards (NAAQS).

Topographical features that affect the transport and diffusion of pollutants in the project area include the mountain ranges to the northeast that prevent the transport of pollutants. Air quality in the SCAB generally ranges from fair to poor and is similar to air quality in most of coastal Southern California. The entire region experiences heavy concentrations of air pollutants during prolonged periods of stable atmospheric conditions. During the past 20 years, the SDAB has experienced a decline in the number of days with unhealthy levels of ozone despite the region's growth in population and vehicle miles traveled, which both contribute to air pollution problems. This improvement in air quality clearly shows that our efforts to reduce air pollution are working.

Pollutants emitted into the air from stationary and mobile sources affect the ambient air quality. Stationary sources can be divided into two major subcategories: point sources and area sources. Point sources consist of one or more emission sources at a facility with an identified location and are usually associated with manufacturing and industrial processing plants. Area sources are widely distributed and produce many small emissions, such as residential water heaters.

Mobile sources refer to emissions from motor vehicles, including tailpipe and evaporative emissions, and are classified as either on-road or off-road. On-road sources are a combination of emissions from automobiles, trucks, and indirect sources. Indirect sources are sources that by themselves may not emit air contaminants; however, they indirectly cause the generation of air pollutants by attracting vehicle trips or consuming energy. Examples of indirect sources include an office complex or commercial center that generates commuter trips and consumes energy resources through the use of natural gas for space and water heating. Indirect sources also include actions proposed by local governments, such as redevelopment districts and private projects involving the development of either large buildings or tracts. In addition, indirect sources include those emissions created by the distance vehicles travel. Off-road sources include aircraft, ships, trains, and self-propelled construction equipment.

2.2.2 Criteria Air Pollutants

Federal and State laws regulate the air pollutants emitted into the ambient air by stationary and mobile sources. These regulated air pollutants are known as "criteria air pollutants" and are categorized as primary and secondary pollutants. Primary air pollutants are those that are emitted directly from sources. Carbon monoxide (CO), reactive organic gases (ROG), nitrogen oxides (NOx), sulfur dioxide (SO_2), and most fine particulate matter (PM_{10}, $PM_{2.5}$) including lead (Pb) and fugitive dust; are primary air pollutants. Of these CO, SO_2, PM_{10}, and $PM_{2.5}$ are criteria pollutants. ROG and NOx are criteria pollutant precursors and go on to form secondary criteria pollutants through chemical and photochemical reaction in the atmosphere. Ozone (O_3) and nitrogen dioxide (NO_2) are the principal secondary pollutants.

Presented below is a description of each of these primary and secondary criteria air pollutants and their known health effects.

Carbon Monoxide (CO) is a colorless, odorless, toxic gas produced by incomplete combustion of carbon substances (e.g., gasoline or diesel fuel). The primary adverse health effect associated with CO is the interference of normal oxygen transfer to the blood, which may result in tissue

oxygen deprivation. The major sources of CO in the SCAB are on-road vehicles, aircraft, and off-road vehicles and equipment (CARB 2006).

Reactive Organic Gases (ROGs) are defined as any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. ROGs consist of non-methane hydrocarbons and oxygenated hydrocarbons. Hydrocarbons are organic compounds that contain only hydrogen and carbon atoms. Non-methane hydrocarbons are hydrocarbons that do not contain the un-reactive hydrocarbon, methane. Oxygenated hydrocarbons are hydrocarbons with oxygenated functional groups attached.

It should be noted that there are no state or national ambient air quality standard for ROGs because they are not classified as criteria pollutants. They are regulated, however, because a reduction in ROGs emissions reduces certain chemical reactions that contribute to the formulation of ozone. ROGs are also transformed into organic aerosols in the atmosphere, which contribute to higher PM_{10} and lower visibility. Although health-based standards have not been established for ROGs, health effects can occur from exposures to high concentrations because of interference with oxygen uptake. In general, concentrations of ROG are suspected to cause eye, nose, and throat irritation; headaches, loss of coordination, nausea, damage to liver, kidney, and the central nervous system (EPA 2005).

The major sources of ROG in the SCAB are on-road motor vehicles and solvent evaporation.

Nitrogen Oxides (NOx) serve as integral participants in the process of photochemical smog production. The two major forms of NOx are nitric oxide (NO) and nitrogen dioxide (NO_2). NO is a colorless, odorless gas formed from atmospheric nitrogen and oxygen when combustion takes place under high temperature and/or high pressure. NO_2 is a reddish-brown irritating gas formed by the combination of NO and oxygen.

NOx acts as an acute respiratory irritant and increases susceptibility to respiratory pathogens. NOx is also an ozone precursor. A precursor is a directly emitted air contaminant that, when released into the atmosphere, forms, causes to be formed, or contributes to the formation of a secondary air contaminant for which an Ambient Air Quality Standard (AAQS) has been adopted, or whose presence in the atmosphere will contribute to the violation of one or more AAQS. When NOx and ROG are released in the atmosphere, they can chemically react with one another in the presence of sunlight to form ozone.

The major source of NOx in the SCAB is on-road vehicles (CARB 2006). Stationary commercial and service source fuel combustion also contribute to the total NOx emissions in the SCAB (CARB 2006).

Nitrogen Dioxide (NO_2) is a byproduct of fuel combustion. The principal form of NO_2 produced by combustion is NO, but NO reacts to form NO_2, creating the mixture of NO and NO_2 commonly called NOx. The U.S. Environmental Protection Agency (USEPA) has concluded that the only form of NOx that exists at a level to cause public health concerns is NO_2 (EPA 1997). NO_2 acts as an acute irritant and, in equal concentrations, is more injurious than NO. At atmospheric concentrations, however, NO_2 is only potentially irritating. There is some indication

of a relationship between NO_2 and chronic pulmonary fibrosis. Some increase in bronchitis in children (two and three years old) has also been observed at concentrations below 0.3 part per million (ppm). NO_2 absorbs blue light; the result is a brownish-red cast to the atmosphere and reduced visibility. NO_2 also contributes to the formation of PM_{10} (particulates having an aerodynamic diameter of 10 microns or 0.0004 inch or less in diameter).

Ozone (O_3) is one of a number of substances called photochemical oxidants that are formed when reactive organic compounds (ROC) and NOx (both byproducts of the internal combustion engine) react with sunlight. Ozone is present in relatively high concentrations in the SCAB, and the damaging effects of photochemical smog are generally related to the concentrations of Ozone. Ozone may pose a health threat to those who already suffer from respiratory diseases as well as healthy people. Additionally, Ozone has been tied to crop damage, typically in the form of stunted growth and pre-mature death. Ozone can also act as a corrosive resulting in property damage such as the embrittlement of rubber products.

Lead (Pb) is a heavy metal that can exist in air pollution as an aerosol particle component. An aerosol is a collection of solid, liquid, or mixed-phase particles suspended in the air. Lead was first regulated as an air pollutant in 1976. Leaded gasoline was first marketed in 1923 and was used in motor vehicles until around 1970. The exclusion of lead from gasoline helped to decrease emissions of lead in the United States from 219,000 to 4,000 short tons per year between 1970 and 1997.

Lead ore crushing, lead-ore smelting, and battery manufacturing are currently the largest sources of lead in the atmosphere in the United States. Other sources include dust from soils contaminated with lead-based paint, solid waste disposal, and crustal physical weathering. The mechanisms by which lead can be removed from the atmosphere (sinks) include deposition to soils, ice caps, oceans, and inhalation.

Lead accumulates in bones, soft tissue, and blood and can affect the kidneys, liver, and nervous system. The more serious effects of lead poisoning include behavior disorders, mental retardation, and neurological impairment. Low levels of lead in fetuses and young children can result in nervous system damage, which can cause learning deficiencies and low IQs. Lead may also contribute to high blood pressure and heart disease. Lead concentrations once exceeded the state and national air quality standards by a wide margin, but have not exceeded state or national air quality standards at any regular monitoring station since 1982. Lead is no longer an additive to normal gasoline, which is the main reason that the concentration of lead in the air is low. The proposed Project will not emit lead, and therefore, it is eliminated from further review in this analysis.

Sulfur Dioxide (SO_2) is a colorless, pungent gas. At levels greater than 0.5 ppm, the gas has a strong odor, similar to rotten eggs. Sulfuric acid is formed from sulfur dioxide, which is an aerosol particle component that may lead to acid deposition. Acid deposition into water, vegetation, soil, or other materials can harm natural resources and materials. Sulfur oxides (SOx) include sulfur dioxide and sulfur trioxide (SO_3). Although sulfur dioxide concentrations have been reduced to levels well below state and national standards, further reductions are desirable because SO_2 is a precursor to sulfates. Sulfates are a particulate formed through the photochemical oxidation of SO_2. Long-term exposure to high levels of SO_2 can cause irritation

of existing cardiovascular disease, respiratory illness, and changes in the defenses in the lungs. When people with asthma are exposed to high levels of SO_2 for short periods of time during moderate activity, effects may include wheezing, chest tightness, or shortness of breath.

Particulate Matter (PM) consists of finely divided solids or liquids such as soot, dust, aerosols, fumes, and mists. Two forms of fine particulate are now recognized. Coarse particles, or PM_{10}, include that portion of the particulate matter with an aerodynamic diameter of 10 microns (i.e., ten one-millionths of a meter or 0.0004 inch) or less. Fine particles, or $PM_{2.5}$, have an aerodynamic diameter of 2.5 microns that is 2.5 one-millionths of a meter or 0.0001 inch or less. Particulate discharge into the atmosphere results primarily from industrial, agricultural, construction, and transportation activities; however, wind action on the arid landscape also contributes substantially to the local particulate loading. Both PM_{10} and $PM_{2.5}$ may adversely affect the human respiratory system, especially in those people who are naturally sensitive or susceptible to breathing problems.

Fugitive Dust poses primarily two public health and safety concerns. The first concern is that of respiratory problems attributable to the suspended particulates in the air. The second concern is that of motor vehicle accidents caused by reduced visibility during severe wind conditions. Fugitive dust may also cause significant property damage during strong windstorms by acting as an abrasive material agent (much like sandblasting activities). Finally, fugitive dust can result in a nuisance factor due to the soiling of proximate structures and vehicles.

Diesel Particulate Matter (DPM) is a mixture of many exhaust particles and gases that is produced when an engine burns diesel fuel. Many compounds found in diesel exhaust are carcinogenic, including 16 that are classified as possibly carcinogenic by the International Agency for Research on Cancer. DPM includes the particle-phase constituents in diesel exhaust. Some short-term (acute) effects of diesel exhaust include eye, nose, throat and lung irritation, and can cause coughs, headaches, light-headedness and nausea. Diesel exhaust is a major source of ambient particulate matter pollution as well, and numerous studies have linked elevated particle levels in the air to increased hospital admission, emergency room visits, asthma attacks, and premature deaths among those suffering from respiratory problems (Office of Environmental Health Hazard Assessment 2002). DPM in the SCAB poses the greatest cancer risk of all the toxic air pollutants.

2.2.3 Toxic Air Contaminants

The public's exposure to toxic air contaminants (TACs) is a significant environmental health issue in California. In 1983, the California Legislature enacted a program to identify the health effects of TACs and to reduce exposure to these contaminants to protect the public health. The Health and Safety Code defines a TAC as "an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health." A substance that is listed as a hazardous air pollutant pursuant to subsection (b) of Section 112 of the Federal Act (42 USC Sec. 7412[b]) is a toxic air contaminant. Under State law, the California EPA, acting through the CARB, is authorized to identify a substance as a TAC if it determines the substance is an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health.

California regulates TACs primarily through AB 1807 (Tanner Air Toxics Act) and AB 2588 (Air Toxics "Hot Spot" Information and Assessment Act of 1987). The Tanner Air Toxics Act sets forth a formal procedure for CARB to designate substances as TACs. Once a TAC is identified, CARB adopts an "airborne toxics control measure" for sources that emit designated TACs. If there is a safe threshold for a substance at which there is no toxic effect, the control measure must reduce exposure to below that threshold. If there is no safe threshold, the measure must incorporate toxics best available control technology (T-BACT) to minimize emissions.

Air toxics from stationary sources are also regulated in California under the Air Toxics "Hot Spot" Information and Assessment Act of 1987. Under AB 2588, toxic air contaminant emissions from individual facilities are quantified and prioritized by the air quality management district or air pollution control district. High priority facilities are required to perform a health risk assessment and, if specific thresholds are exceeded, required to communicate the results to the public in the form of notices and public meetings.

To date the CARB has designated nearly 200 compounds as TACs. Additionally, the CARB has implemented control measures for a number of compounds that pose high risks and show potential for effective control. The majority of the estimated health risks from TACs can be attributed to a relatively few compounds, the most important being PM from diesel-fueled engines.

2.2.4 Other Effects of Air Pollution

Just as humans are affected by air pollution, so too are plants and animals. Animals must breathe the same air and are subject to the same types of negative health effects. Certain plants and trees may absorb air pollutants that can stunt their development or cause premature death.

There are also numerous impacts to the human economy including lost workdays due to illness, a desire on the part of business to locate in areas with a healthy environment, and increased expenses from medical costs. Pollutants may also lower visibility and cause damage to property. Certain air pollutants are responsible for discoloring painted surfaces, eating away at stones used in buildings, dissolving the mortar that holds bricks together, and cracking tires and other items made from rubber.

2.3. FEDERAL AMBIENT AIR QUALITY STANDARDS (AAQS)

The Federal Clean Air Act Amendment of 1971 (CAA) established NAAQS with states retaining the option to adopt more stringent standards or to include other pollution species. These standards are the levels of air quality considered safe, with an adequate margin of safety, to protect the public health and welfare. They are designed to protect those "sensitive receptors" most susceptible to further respiratory distress such as asthmatics, the elderly, very young children, people already weakened by other disease or illness, and persons engaged in strenuous work or exercise. Healthy adults can tolerate occasional exposure to air pollutant concentrations considerably above these minimum standards before adverse effects are observed.

Both the State of California and the Federal government have established health based AAQS for six air pollutants. As shown in Table 1, these pollutants include ozone, carbon monoxide,

nitrogen dioxide, sulfur dioxide, suspended particulate matter (PM_{10}, $PM_{2.5}$), and lead. In addition, the State has set standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility reducing particles. These standards are designed to protect the health and welfare of the populace with a reasonable margin of safety.

Table 1
Ambient Air Quality Standards for Priority Pollutants

Pollutant	Averaging Time	California Standard	Federal Primary Standard	Major Pollutant Sources
Ozone (O_3)	1 hour	0.09 ppm	*	Motor vehicles, paints, coatings, and solvents.
	8 hours	0.070	0.075 ppm	
Carbon Monoxide (CO)	1 hour	20 ppm	35 ppm	Internal combustion engines, primarily gasoline-powered motor vehicles.
	8 hours	9.0 ppm	9 ppm	
Nitrogen Dioxide (NO_2)	Annual Average	*	0.053 ppm	Motor vehicles, petroleum-refining operations, industrial sources, aircraft, ships, and railroads.
	1 hour	0.18 ppm	*	
Sulfur Dioxide (SO_2)	Annual Average	*	0.03 ppm	Fuel combustion, chemical plants, sulfur recovery plants, and metal processing.
	1 hour	0.25 ppm	*	
	24 hours	0.04 ppm	0.14 ppm	
Suspended Particulate Matter (PM_{10})	Annual Arithmetic Mean	20 $\mu g/m^3$	50 $\mu g/m^3$	Dust and fume-producing construction, industrial, and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g., wind-raised dust and ocean sprays).
	24 hours	50 $\mu g/m^3$	150 $\mu g/m^3$	
Suspended Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 $\mu g/m^3$	15 $\mu g/m^3$	Dust and fume-producing construction, industrial, and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g., wind-raised dust and ocean sprays).
	24 hours	*	35 $\mu g/m^3$	
Lead (Pb)	Monthly	1.5 $\mu g/m^3$	*	Present source: lead smelters, battery manufacturing and recycling facilities. Past source: combustion of leaded gasoline.
	Quarterly	*	1.5 $\mu g/m^3$	
Sulfates (SO_4)	24 hours	25 $\mu g/m^3$	*	Industrial processes.

Ppm: parts per million; $\mu g/m^3$: micrograms per cubic meter

* = standard is not used for this pollutant/duration by this entity.

In addition to primary and secondary AAQS, the State of California has established a set of episode criteria for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter. These criteria refer to episode levels representing periods of short-term exposure to air pollutants that actually threaten public health.

2.4. AIR QUALITY MANAGEMENT PLANNING

The SCAQMD and the Southern California Association of Governments (SCAG) are the agencies responsible for preparing the Air Quality Management Plan (AQMP) for the SCAB. Since 1979, a number of AQMPs have been prepared. The 1997 AQMP, updated in 1999 and replaced in 2003, was based on the 1994 AQMP and ultimately the 1991 AQMP, and was designed to comply with State and Federal requirements, reduce the high level of pollutant emissions in the SCAB, and ensure clean air for the region through various control measures. To accomplish its task, the 1991 AQMP relied on a multilevel partnership of governmental agencies at the Federal, State, regional, and local level. These agencies (i.e., the USEPA, CARB, local governments, SCAG, and SCAQMD) are the cornerstones that implement AQMP programs.

The 2003 AQMP, adopted in August 2003, updated the attainment demonstration for the Federal standards for ozone and PM_{10}; replaced the 1997 attainment demonstration for the Federal CO standard and provided a basis for a maintenance plan for CO for the future; and updated the maintenance plan for the Federal NO_2 standard that the SCAB has met since 1992.

The most recent comprehensive plan is the 2007 AQMP adopted on July 13, 2007. The 2007 AQMP is designed to meet the State and Federal CAA planning requirements and focuses on ozone and $PM_{2.5}$. The 2007 AQMP incorporates significant new emissions inventories, ambient measurements, scientific data, control strategies, and air quality modeling.

Areas that meet the ambient air quality standards are classified as "attainment" areas while areas that do not meet these standards are classified as "non-attainment" areas. The classifications for ozone non-attainment include and range in magnitude from: marginal, moderate, serious, severe, and extreme. The State and Federal attainment status for the SCAB are included in Table 2.

Table 2
Attainment Status for the SCAB

Pollutant	State Status	Federal Status
Ozone (1-hour)	Extreme Non-attainment	Extreme Non-attainment (under the prior standard)
Ozone (8-hour)	Extreme Non-Attainment	Extreme
PM_{10}	Serious Non-attainment	Serious Non-attainment
$PM_{2.5}$	Non-attainment	Non-attainment
CO	Attainment	Attainment/Maintenance
NO_2	Attainment	Attainment/Maintenance

On April 15, 2010, EPA signed a final rule to grant requests to reclassify SCAB from "severe-17" to "extreme". The SCAB also is designated as attainment of the CAAQS for SO_2, lead, and sulfates. Areas that are designated as Severe 17 for the ozone standard must meet attainment of the 8-hour standard by 2021 (2024 if reclassified to Extreme). Areas considered as serious non-attainment of the PM_{10} standards must have reached attainment by the end of 2006, or as expeditiously as possible. The $PM_{2.5}$ attainment date is to be met in the year 2015.

2.4.1 Federal Clean Air Act Requirements

The Federal CAA requires plans to provide for the implementation of all reasonably available control measures including the adoption of reasonably available control technology for reducing emissions from existing sources. Emission control innovations in the form of market-based approaches are explicitly encouraged by the CAA. The SCAQMD is the first local agency in the country to adopt a market-based approach for controlling stationary source emissions of oxides of nitrogen and sulfur. Other Federal requirements addressed include mechanisms to track plan implementation and milestone compliance for O_3 and CO.

The USEPA has recently phased out the federal 1-hour ozone standard and replaced it with a new 8-hour standard to protect against longer exposure periods. However, the SCAB still experiences ozone levels over the prior federal 1-hour standard on more than 20 days per year. The 2007 AQMP shows that by 2010, the SCAB will still exceed the federal 1-hour ozone standard by 20 percent despite the implementation of existing air quality programs. The SCAQMD and a number of environmental organizations have litigated against USEPA's revocation of the 1-hour standard with the case still pending.

The new 8-hour ozone standard is set at a concentration of 0.08 parts per million (ppm) and represents a tightening of the existing 1-hour ozone standard that was set at 0.12 ppm. Under the form of the standard adopted by the USEPA, areas are allowed to disregard their three worst measurements every year and average their fourth highest measurements over three years to determine if they meet the standard.

For particulate matter, the USEPA established new annual and 24-hour standards for $PM_{2.5}$ to complement the existing PM_{10} standards. The new annual $PM_{2.5}$ standard is set at 15 micrograms per cubic meter and the new 24-hour $PM_{2.5}$ standard was set at 65 micrograms per cubic meter. This level has now been further reduced to 35 micrograms per cubic meter. The annual component of the standard was set to provide protection against typical day-to-day exposures as well as longer-term exposures, while the daily component protects against more extreme short-term events. For the new 24-hour $PM_{2.5}$ standard, the form of the standard is based on the 98th percentile of 24-hour $PM_{2.5}$ concentrations measured in a year (averaged over three years) at the monitoring site with the highest measured values in an area. This form of the standard will reduce the impact of a single high exposure event that may be due to unusual meteorological conditions and thus provide a more stable basis for effective control programs.

While USEPA has retained the current annual PM_{10} standard of 50 micrograms per cubic meter, it has modified the form of the 24-hour PM_{10} standard set at 150 micrograms per cubic meter. More specifically, USEPA revised the one-expected exceedance form of the current standard with a 99th percentile form, averaged over three years.

The State Implementation Plans (SIP) that will incorporate attainment demonstrations with the new 8-hour ozone and $PM_{2.5}$ standards are expected to be required within three years of the air quality designations or by 2007. Therefore, the current regulatory control strategies will continue to focus on attaining the 1-hour ozone standard with the recognition that these controls will have benefits toward attaining the 8-hour ozone and $PM_{2.5}$ standards. The USEPA is considering several options in transitioning from the 1-hour to the 8-hour standard, while ensuring that no backsliding will occur. Based on the recent consent decree guidance, it is most likely that the SCAB will have to meet the federal $PM_{2.5}$ standards by 2015 and the 8-hour ozone standard by 2021 or 2024 if the area is redesignated as "Extreme."

2.4.2 2007 Air Quality Management Plan (AQMP)

The South Coast Air Quality Management District (SCAQMD) and the Southern California Association of Governments (SCAG) are the agencies responsible for preparing the AQMP for the SCAB. Since 1979, a number of AQMPs have been prepared. The 1997 AQMP, updated in 1999 and replaced in 2003, was based on the 1994 AQMP and ultimately the 1991 AQMP and was designed to comply with State and federal requirements, reduce the high level of pollutant emissions in the SCAB, and ensure clean air for the region through various control measures. To accomplish its task, the 1991 AQMP relied on a multilevel partnership of governmental agencies at the federal, State, regional, and local level. These agencies (i.e., the USEPA, CARB, local governments, SCAG, and SCAQMD) are the cornerstones that implement the AQMP programs.

The most recent comprehensive plan is the 2007 AQMP adopted on July 13, 2007. The 2007 AQMP employs up-to-date science and analytical tools and incorporates a comprehensive strategy aimed at controlling pollution from all sources, including stationary sources, on-road and off-road mobile sources, and area sources.

The 2007 Plan proposes attainment demonstration of the federal $PM_{2.5}$ standards through a more focused control of SOx, directly emitted $PM_{2.5}$, and NOx supplemented with VOC by 2014. The 8-hour ozone control strategy builds upon the $PM_{2.5}$ strategy, augmented with additional VOC

reductions to meet the standard by 2020. An extended attainment date (i.e., additional three years) is allowed under the Clean Air Act if a "bump-up" request is made by the state showing the need for such extension.

The 2007 AQMP proposes policies and measures currently contemplated by responsible agencies to achieve federal standards for healthful air quality in the SCAB and those portions of the Salton Sea Air SCAB (formerly named the Southeast Desert Air Basin) that are under SCAQMD jurisdiction (Coachella Valley).

The 2007 Plan also addresses several federal planning requirements and incorporates significant new scientific data, primarily in the form of updated emissions inventories, ambient measurements, new meteorological episodes, and new air quality modeling tools.

The 2007 Plan builds upon the approaches taken in the 2003 AQMP for the SCAB for the attainment of the federal ozone air quality standard. However, this new Plan highlights the significant amount of reductions needed and the urgent need to identify additional strategies, especially in the area of mobile sources, to meet all federal criteria pollutant standards within the timeframes allowed under federal Clean Air Act.

The 2007 AQMP updates the attainment demonstration for the federal standards for ozone and particulate matter (PM_{10}); replaces the 1997 attainment demonstration for the federal carbon monoxide (CO) standard and provides a basis for a maintenance plan for CO for the future; and updates the maintenance plan for the federal nitrogen dioxide (NO_2) standard that the SCAB has met since 1992.

Areas that meet the ambient air quality standards are classified as "attainment" areas while areas that do not meet these standards are classified as "non-attainment" areas. The severity of the classifications for ozone non-attainment includes and range in magnitude from: marginal, moderate, serious, severe, and extreme. The attainment status for the SCAB is included in Table 2, above.

The SCAB is also designated as attainment of the CAAQS for SO_2, lead, and sulfates. Areas that are designated as Severe 17 for the ozone standard must meet attainment of the 8-hour standard by 2021 (2024 if reclassified to Extreme). Areas considered as serious non-attainment of the PM_{10} standards must have reached attainment by the end of 2006, or as expeditiously as possible. The $PM_{2.5}$ attainment date is to be met in the year 2015.

2.4.3 Greenhouse Gas Emissions

In 2005, in recognition of California's vulnerability to the effects of climate change, Governor Schwarzenegger established Executive Order S-3-05, which sets forth a series of target dates by which statewide emission of greenhouse gas would be progressively reduced, as follows:

- By 2010, reduce greenhouse gas emissions to 2000 levels;
- By 2020, reduce greenhouse gas emissions to 1990 levels; and

- By 2050, reduce greenhouse gas emissions to 80 percent below 1990 levels.

In 2006, California passed the California Global Warming Solutions Act of 2006 (AB 32; California Health and Safety Code Division 25.5, Sections 38500, et seq.), which requires CARB to design and implement emission limits, regulations, and other measures, such that feasible and cost-effective statewide greenhouse gas emissions are reduced to 1990 levels by 2020 (representing an approximate 25 percent reduction in emissions).

In June 2007, CARB directed staff to pursue 37 early actions for reducing greenhouse gas emissions under AB 32. The broad spectrum of strategies to be developed – including a Low Carbon Fuel Standard, regulations for refrigerants with high global warming potentials, guidance and protocols for local governments to facilitate greenhouse gas reductions, and green ports – reflects that the serious threat of climate change requires action as soon as possible.

In addition to approving the greenhouse gas reduction strategies, CARB directed staff to further evaluate early action recommendations made at the June 2007 meeting, and to report back to CARB within 6 months. The general sentiment of CARB suggested a desire to try to pursue greater greenhouse gas emissions reductions in California in the near-term. Since the June 2007 CARB hearing, CARB staff has evaluated all 48 recommendations submitted by several stakeholder and several internally-generated staff ideas and published the Expanded List of Early Action Measures To Reduce Greenhouse Gas Emissions In California, recommended for board consideration in October 2007. Based on its additional analysis, CARB staff is recommending the expansion of the early action list to a total of 44 measures. Nine of the strategies meet the AB 32 definition of discrete early action measures. Discrete early action measures are measures that will be in place and enforceable by January 1, 2010. The discrete early action items include: (1) a Low Carbon Fuel standards for ethanol, biodiesel, hydrogen, electricity, compressed natural gas, liquefied petroleum gas, and biogas; (2) restrictions on High Global Warming Potential Refrigerants; (3) Landfill Methane Capture; (4) Smartway Truck Efficiency; (5) Port Electrification; (6) Reduction of perfluorocarbons from the semiconductor industry; (7) Reduction of propellants in consumer products; (8) Tire inflation; and (9) Sulfur Hexafluoride (SF6) reductions from non-electricity sector.

The 2020 target reductions are currently estimated to be 174 million metric tons of carbon dioxide (CO2) equivalent (MMTCO2E). In total, the recommended early actions have the potential to reduce greenhouse gas emissions by at least 42 MMTCO2E emissions by 2020, representing about 25 percent of the estimated reductions needed by 2020. The CARB Board adopted Resolution 07-55 in December 2007, approving 427 MMTCO2E as the statewide greenhouse gas emissions limit for 2020, which is equivalent to the 1990 emissions level. The measures are in the sectors of fuels, transportation, forestry, agriculture, education, energy efficiency, commercial, solid waste, cement, oil and gas, electricity, and fire suppression.

2.5. BASELINE AIR QUALITY

Existing levels of ambient air quality and historical trends and projections in the project area are best documented by measurements made by the SCAQMD. The project is located within the southern portion of Source Receptor Area (SRA) 21 Capistrano Valley. The closest monitoring station to the San Clemente area is located at Lake Forest (Saddleback Valley SRA 19).

Excepting NO_2 that is not monitored in this area, data from the monitoring station in SRA 19 are summarized in Table 3. Data for NO_2 included in Table 3 are as monitored in the North Coastal SRA 18. The borrow area is located near Oceanside. The nearest monitoring station to the borrow site is located at Camp Pendleton. The Camp Pendleton site measures ozone, PM2.5, and NO2. Table 3 also includes ambient data for Camp Pendleton.

Table 3
Ambient Air Quality Monitoring Summary

Pollutant/Standard	Number of Days Thresholds Were Exceeded and Maximum Levels During Such Violations				
	2003	2004	2005	2006	2007
Ozone – Lake Forest					
State 1-Hour > 0.09 ppm	16	11	3	13	5
State 8-Hour > 0.07 ppm	ND	20	6	17	10
Federal 1-Hour > 0.12 ppm	4	0	1	0	0
Federal 8-Hour > 0.08 ppm	8	0	1	6	2
Max. 1-Hour Conc. (ppm)	0.153	0.116	0.125	0.12	0.108
Max. 8-Hour Conc. (ppm)	0.105	0.089	0.085	0.105	0.089
Ozone – Camp Pendleton					
State 1-Hour > 0.09 ppm	4	4	0	0	0
State 8-Hour > 0.07 ppm	10	12	2	5	4
Federal 1-Hour > 0.12 ppm	0	0	0	0	0
Federal 8-Hour > 0.08 ppm	5	6	0	0	0
Max. 1-Hour Conc. (ppm)	0.099	0.110	0.090	0.086	0.083
Max. 8-Hour Conc. (ppm)	0.084	0.095	0.074	0.073	0.074
Carbon Monoxide – Lake Forest					
State 8-Hour > 9.0 ppm	0	0	0	0	0
Federal 8-Hour ≥ 9.5 ppm	0	0	0	0	0
Max 1-Hour Conc. (ppm)	3	2	2	2	3
Max. 8-Hour Conc. (ppm)	1.8	1.6	1.6	1.8	2.1
Nitrogen Dioxide – SRA 18					
State 1-Hour ≥ 0.25 ppm	0	0	0	0	0
Max. 1-Hour Conc. (ppm)	0.11	0.10	0.09	0.10	0.07
Nitrogen Dioxide – Camp Pendleton					
State 1-Hour ≥ 0.25 ppm	0	0	0	0	0
Max. 1-Hour Conc. (ppm)	0.11	0.10	0.09	0.10	0.07
Inhalable Particulates (PM_{10})[2] – Lake Forest					
State 24-Hour > 50 $\mu g/m^3$	3.5	0.0	0.0	2.0	5
Federal 24-Hour > 150 $\mu g/m^3$	0.0	0.0	0	0	0
Max. 24-Hour Conc. ($\mu g/m^3$)	64	47	41	57	74
Inhalable Particulates ($PM_{2.5}$)[2] – Lake Forest					
Federal 24-Hour > 65 $\mu g/m^3$	0.0	0.0	0.0	0.9	0.0
Max. 24-Hour Conc. ($\mu g/m^3$)	50.6	49.4	35.4	47.0	46.9

[1] NO_2 as measured at the North Coastal Orange County monitoring station. All other pollutants as measured at the Saddleback monitoring station.
[2] Percent of samples exceeding standard.
ppm: parts per million; $\mu g/m^3$: micrograms per cubic meter
Source: South Coast Air Quality Management District

At the SCAG monitoring sites, ozone pollution decreased between 2004 and 2005 with an increase again in 2006 and decrease in 2007 with 5 days experiencing a violation of the federal hourly standard. The SCAG data show recurring violations of and fluctuations in both the State and Federal ozone standards and no clear trend is apparent. The SCAG data also indicate that the area occasionally exceeds the PM_{10} and $PM_{2.5}$ State and Federal standards with only one day in 2006 that exceeded the standards for either pollutant. The CO and NO_2 standards have not been violated in the last five years at this station.

At the SDAG monitoring sites, ozone pollution stayed fairly steady between 2004 and 2005 and actually decreased between 2005 and 2007 with an average of 3 days experiencing a violation of the State hourly standard during those three years. The NO_2 standards have not been violated in the last five years at this station.

2.6. STANDARD CONDITIONS AND UNIFORM CODES

All projects constructed in the SCAB are subject to Standard Conditions and Uniform Codes. Compliance with these provisions is mandatory and as such, does not constitute mitigation under CEQA. Those conditions specific to air quality that would apply to the project are included below:

- Adherence to SCAQMD Rule 403, which sets requirements for dust control associated with grading and construction activities.
- Adherence to SCAQMD Rules 431.1 and 431.2, which require the use of low sulfur fuel for stationary construction equipment.

During construction, the project would be subject to SCAQMD Rule 403 (fugitive dust). SCAQMD Rule 403 does not require a permit for construction activities, per se, but rather, sets forth general and specific requirements for all construction sites (as well as other fugitive dust sources) in the SCAB. The general requirement prohibits a person from causing or allowing emissions of fugitive dust from construction (or other fugitive dust source) such that the presence of such dust remains visible in the atmosphere beyond the property line of the emissions source. SCAQMD Rule 403 also prohibits a construction site from causing an incremental PM_{10} concentration impact at the property line of more than 50 micrograms per cubic meter as determined through PM_{10} high-volume sampling, but the concentration standard and associated PM_{10} sampling do not apply if specific measures identified in the rule are implemented and appropriately documented.

In accordance with Rule 403, the SCAQMD requires that contractors implement Best Available Control Technology (BACT) for construction activities. Rule 403 identifies a set of specific measures for projects less than 50 acres. These requirements are included in Table 4. Note that these measures are regulatory requirements and as such, do not constitute mitigation under CEQA.

The conditions included in Table 4 apply to construction activities conducted during normal wind conditions (i.e., with wind gusts less than 25 miles per hour). The contingency measures,

included in Table 5, shall be applied to those periods when instantaneous wind gusts meet or exceed 25 miles per hour (mph).

Table 4
Required Best Available Control Measures for Fugitive Dust
(Applicable to All Construction Activity Sources)

Source Category	Control Measures	Guidance
Disturbed soil	• Stabilize disturbed soil throughout the construction site; and • Stabilize disturbed soil between structures.	• Limit vehicular traffic and disturbances on soils where possible; • If interior block walls are planned, install as early as possible; • Apply water or a stabilizing agent in sufficient quantities to prevent the generation of visible dust plumes; and • This measure applies to both inactive and active sites, during workdays, weekends, holidays, and windy conditions.
Earth-moving activities	• Pre-apply water to depth of proposed cuts; • Re-apply water as necessary to maintain soils in a damp condition and to ensure that visible emissions do not exceed 100 feet in any direction; • Stabilize soils once earth-moving activities are complete; and • Limit speed of earthmoving equipment to 10 mph.	• Grade each project phase separately, timed to coincide with construction phase; • Upwind fencing can prevent material movement on site; and • Apply water or a stabilizing agent in sufficient quantities to prevent the generation of visible dust plumes.
Staging areas	• Stabilize staging areas during use; and • Stabilize staging area soils at project completion. • Locate construction equipment and staging zones away from sensitive receptors and fresh air intakes to buildings and air conditioners.	• Limit size of staging area; • Limit vehicle speeds to 15 miles per hour (24 kilometers per hour); and • Limit nnmber and size of staging area entrances/exits.
Paved road track-out	• Cover all haul vehicles	• Comply with the vehicle freeboard requirements of Section 23114 of the California Vehicle Code for both public and private roads.
Traffic areas for construction activities	• Stabilize all off-road traffic and parking areas; • Stabilize all haul routes; • Direct construction traffic over established haul routes; and • Limit speeds to 15 miles per hour (mph).	• Apply gravel/paving to all haul routes as soon as possible to all futnre roadway areas; and • Barriers can be used to ensure vehicles are used only on established parking areas/haul routes.

Table 5
Contingency Control Measures for Fugitive Dust
During High Winds in Excess of 25 MPH

Fugitive Dust Source Category	Control Measures
Earth-moving	• Cease all active operations; or • Apply water to soil not more than 15 minutes prior to moving such soil.
Disturbed surface areas	• Apply water to all unstabilized disturbed areas three times per day. If there is any evidence of wind-driven fugitive dust, watering frequency is increased to a minimum of four times per day.
Unpaved roads	• Apply water twice per hour during active operation.
Open storage piles	• Apply water twice per hour; or • Install temporary coverings.
All categories	Executive Officer and the USEPA as equivalent to the methods specified in this table may be used.

2.7. SENSITIVE RECEPTORS

Some land uses are considered more sensitive to air pollution than others due to the types of population groups or activities involved. Sensitive population groups include children, the elderly, the acutely ill, and the chronically ill, especially those with cardio-respiratory diseases. Residential areas are considered to be sensitive to air pollution because residents (including children and the elderly) tend to be at home for extended periods of time, resulting in sustained exposure to any pollutants present. Schools are also considered as sensitive as children are present for extended durations and engage in regular outdoor activities. Recreational land uses are considered moderately sensitive to air pollution because exercise places a high demand on respiratory functions, which can be impaired by air pollution. Sensitive receptors in the Project vicinity include several residential neighborhoods approximately 196 feet from the Project site.

SECTION 3.0 – THRESHOLDS OF SIGNIFICANCE

The State CEQA Guidelines suggest, from an "air quality" perspective, that a project would normally be judged to produce a significant or potentially significant effect on the environment if the project were to:

- Conflict with or obstruct implementation of the applicable air quality plan.
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation.
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State AAQS.
- Expose sensitive receptors to substantial air pollutant concentrations.
- Create objectionable odors affecting a substantial number of people.

As indicated in Section 15064(i)(1) of the State CEQA Guidelines, "cumulatively considerable" is defined to mean "that the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects."

In order to determine whether or not a proposed project would cause a significant effect on the environment, the impact of the project must be determined by examining the types and levels of emissions generated and its impacts on factors that affect air quality. To accomplish this determination of significance, the SCAQMD has established air pollution thresholds against which a proposed project can be evaluated and assist lead agencies in determining whether or not the proposed project is significant. If the thresholds are exceeded by a proposed project, then it should be considered significant.

While, the final determination of significance thresholds is within the purview of the lead agency pursuant to the State CEQA Guidelines, the SCAQMD recommends that the following air pollution thresholds be used by lead agencies in determining whether the construction or operational phase of a proposed project is significant. If the lead agency finds that the proposed project has the potential to exceed any of the air pollution thresholds, the project should be considered significant. These threshold factors are included below.

3.1. THRESHOLDS OF SIGNIFICANCE

The following significance thresholds (Table 6) for air quality have been established by the SCAQMD on a daily basis for construction and operations emissions and Table 6 also shows the SLTs for San Diego County:

Table 6
Thresholds of Significance

	SCAG Regional		SDAG Screening Level		
Pollutant	Construction Emissions (lbs/day)	Operations Emissions (lbs/day)	Total Emissions (lbs/hr)	Total Emissions lbs/day	Total Emissions tons/year
ROG	75	55			
NOx	100	55	25	250	40
CO	550	550	100	550	100
PM10	150	150	----	100	15
PM2.5	55	55	----	55	10
SOx	150	150	25	250	40
Lead and lead compounds	NA	NA	----	3.2	0.6
VOC	NA	NA	----	75	13.7

During construction or operation, if any of the identified daily air pollutant thresholds are exceeded by the proposed Project, then the project's air quality impacts may be considered significant. The SCAQMD indicates in Chapter 6 of its Handbook that it considers a project to be mitigated to a level of insignificance if its primary effects are mitigated below the thresholds provided above.

In the SDAG, the event that project emissions exceed the SLTs, specific modeling will be required for NO_2, SO_2, CO, and lead to demonstrate that the project's ground-level concentrations, including appropriate background levels, do not exceed the NAAQS and CAAQS. For ozone precursors, PM_{10} and $PM_{2.5}$, exceedances of the SLTs results in a significant impact.

3.2. LOCALIZED THRESHOLDS OF SIGNIFICANCE (LST)

In addition to the mass daily threshold values presented above, the SCAQMD has established the following threshold criteria to determine if a project has the potential to contribute to an exceedance of the State Ambient Air Quality Standards (SAAQ) as included in Table 1, Section 2.

- California State 1-hour CO standard of 20.0 ppm
- California State 8-hour CO standard of 9.0 ppm
- California State 1-hour NO_2 standard of 0.25 ppm
- SCAQMD 24-hour construction PM_{10} LST of 10.4 $\mu g/m^3$
- SCAQMD 24-hour construction $PM_{2.5}$ LST of 10.4 $\mu g/m^3$
- SCAQMD 24-hour operational PM_{10} LST of 2.5 $\mu g/m^3$
- SCAQMD 24-hour operational $PM_{2.5}$ LST of 2.5 $\mu g/m^3$

The significance of localized emissions impacts depends on whether ambient levels in the vicinity of the Project are above or below State standards. In the case of CO and NO_2, if ambient levels are below the standards, a project is considered to have a significant impact if project emissions result in an exceedance of one or more of these standards. If ambient levels already exceed a State or federal standard, then project emissions are considered significant if they increase ambient concentrations by a measurable amount. This would apply to both PM_{10} and $PM_{2.5}$; both of which are non-attainment pollutants. In these cases, local emissions are considered as significant if they exceed 10.4 $\mu g/m^3$ during construction or 2.5 $\mu g/m^3$ during the subsequent operation of the site, both as measured at the proximate sensitive receptor locations.

3.3. ADDITIONAL INDICATORS

The SCAQMD recommends that "additional indicators" should be used as screening criteria with respect to air quality. Additional factors relevant to the project at hand identified in the Handbook include the following significance criteria:

- Interference with the attainment of the Federal or State AAQS by either violating or contributing to an existing or projected air quality violation.
- Emit carcinogenic or toxic contaminants that exceed the maximum individual cancer risk of 10 in one million.

Again, the SCAQMD indicates in Chapter 6 of its Handbook that it considers a project to be mitigated to a level of insignificance if its effects are mitigated below the thresholds provided above.

SECTION 4.0 – ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The Project involves the nourishment of a 1,040-meter stretch of San Clemente Beach. Projected air emissions are prepared in accordance with the methodologies provided by the South Coast Air Quality Management District (SCAQMD) as included in its *CEQA Air Quality Handbook, April 1993 (Handbook)* as well as its Internet updates included on its web site. For the purposes of this analysis, construction is estimated to occur in 2010 with the 15-meter width alternative taking approximately 46 working days and the 35-meter width alternative taking 108 working days.

The calculated emissions of the project are compared to thresholds of significance for individual projects using the SCAQMD *Handbook* as well as updates included on the SCAQMD Internet Web site. The *Handbook* recommends assessing emissions of reactive organic compounds (ROC) as an indicator of ozone. For ease of the reader, the included analysis follows the outline of the CEQA Checklist.

The San Diego Air Pollution Control District does not provide quantitative thresholds for determining the significance of construction or mobile source-related impacts. However, the District specifies Air Quality Impact Analysis (AQIA) trigger levels for new or modified stationary sources. If these incremental levels for stationary sources are exceeded, an AQIA must be performed for the proposed new or modified source. Although these trigger levels do not generally apply to mobile sources or general land development projects, for comparative purposes San Diego County has established AQIAs as screening-level thresholds (SLTs). The County has stated that the SLTs may used to evaluate the increased emissions which would be discharged to the SDAB from proposed land development projects.

The information on San Diego's thresholds are presented for informational purposes since all on-shore emissions are located in the SCAB and off-shore sources are not under the jurisdiction of the local air district's, therefore not subject to thresholds.

4.1. PROJECT CONSISTENCY WITH THE APPLICABLE AIR QUALITY PLAN

The Project action represents the placement of sand on the beach. The Project would not result in significant localized air quality impacts at the proximate receptor locations and would implement those measures included in the AQMP considered as feasible and, as such, the Project is consistent with the goals of the AQMP and does not present a significant impact.

4.2. PROJECT POTENTIAL TO VIOLATE OR ADD TO A VIOLATION OF AN AIR QUALITY STANDARD

CEQA inquires as to whether a project would violate any air quality standard or contribute substantially to an existing or projected air quality violation. A violation could occur over the short-term during project construction, or over the long-term during its subsequent operation. As there is no long-term operation portion of this project, only the short-term construction portion is discussed below.

4.2.1 Localized Construction Impacts

Project construction has the potential to raise local ambient pollutant concentrations. This could present a significant impact if these concentrations were to exceed the allowable emissions as a function of receptor distance from the site boundary.

The analysis makes use of methodology included in the SCAQMD Methodology. In accordance with the Methodology, the analysis is only to include exhaust and dust emissions associated with those pieces of equipment that actually operate on-site and omits vehicle trips that are distributed over a large area. This omission would include vessel traffic that travels 21 miles between Oceanside and the offshore pump-out area near the Project site.

In the Methodology, the SCAQMD notes receptor locations as "off-site locations where persons may be exposed to the emissions from project activities. Receptor locations include residential, commercial, and industrial land use areas; and any other areas where persons can be situated for an hour or longer at a time."

In accordance with the Methodology, receptor locations are to consider the actual location of the receptors. If these locations are unknown, or varied, they may be assumed to be located at distances of 25, 50, 100, 200, and 500 meters. In cases where proximate receptors may be closer than 25 meters, as per the Methodology, a value of 25 meters is to be used in the analysis as a worst-case scenario. In addition to the actual closest receptors to the Project area at approximately 55 meters away, the recommended SCAQMD default distances were used in this analysis for comparison.

In the cases of CO and NO_2, the projected concentration is then added to an assumed ambient concentration in order to determine if the State AAQS would be exceeded. This ambient concentration is source-area dependant and is based on the peak value observed over the last three years of accumulated data at the nearest air monitoring station (Table 3). Because PM_{10} and $PM_{2.5}$ are non-attainment pollutants, no ambient concentration is added. Instead, in both cases, a short-term construction standard defined as a measurable increase of 10.4 $\mu g/m^3$ is to be applied at the proximate sensitive receptor locations. Table 7 presents the daily projected emissions from on-site construction as well as the projected concentrations at the various default and actual receptor distances. Note that all concentrations are within their respective criteria and the impact is less than significant.

Table 7
Localized Construction Emissions Concentrations[1]

Distance	CO (1-Hr Conc.)[2]	CO (8-Hr Conc.)[3]	NO_2 (1-Hr Conc.)[4]	PM_{10} (24-Hr Conc.)	$PM_{2.5}$ (24-Hr Conc.)
Peak Daily Onsite Emissions (lb/day)	43.6	43.6	94.9	9.7	4.0
Concentration at 25 meters	3.08	2.16	0.11	10.31	3.83
Concentration at 50 meters	3.07	2.15	0.11	8.50	3.31
Concentration at 55 meters (Nearest Actual Receptor)	3.07	2.15	0.11	8.20	3.21
Concentration at 100 meters	3.06	2.14	0.11	6.25	2.51
Concentration at 200 meters	3.04	2.13	0.11	4.10	1.67
Concentration at 500 meters	3.02	2.11	0.11	1.91	0.78
Ambient Air Quality Standard	20 ppm	9.0 ppm	0.18 ppm	10.4 $\mu g/m^3$	10.4 $\mu g/m^3$
Exceeds Standard?	**No**	**No**	**No**	**No**	**No**

[1] CO and NO_2 are in ppm, PM_{10} and $PM_{2.5}$ are in $\mu g/m^3$.
[2] Includes a background concentration of 3.0 ppm.
[3] Includes a background concentration of 2.1 ppm.
[4] Includes a background concentration of 0.10 ppm.

4.3. PROJECT POTENTIAL TO RESULT IN A CUMULATIVELY CONSIDERABLE INCREASE IN CRITERIA POLLUTANTS

CEQA inquires as to whether a project would result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State AAQS (including releasing emissions which exceed quantitative thresholds for ozone precursors).

4.3.1 Site Construction

Air quality impacts may occur during site preparation, grading, and sporadic maintenance activities required for implementation of the proposed land use. Maintenance could take place once every six years depending on need and financial ability. Maintenance would result in a repetition of the initial construction activities.

The Project includes two alternatives that involve approximately 4 and 9 acres of beach nourishment for the 15- and 35-meter widths, respectively. There is no building construction or paving activities associated with this project. Construction would occur over approximately 46 and 108 working days, respectively. Values used for analysis are included in Appendix A.

Table 8 summarizes the daily emissions for construction in comparison with the SCAQMD regional thresholds of significance. Emissions associated with onshore heavy equipment are

based on the OffRoad2007 model runs as provided by the SCAQMD on their Internet web site for year 2010 construction equipment. The SCAQMD presents emissions for most pieces of heavy construction equipment at differing horsepower levels generated using the OffRoad2007 Computer Model. The actual horsepower of the anticipated pieces of equipment (i.e., Cat D10 dozers at 580 hp and 988 Front-end loaders at 430 hp) were then extrapolated from the two pieces of similar equipment with the nearest horsepower ratings above and below the expected piece of equipment.

Some dust with its attendant PM_{10} and $PM_{2.5}$ would also be generated from the onshore movement of sand. The 15- and 35-meter Project alternatives would encompass approximately 4 and 9 acres, respectively. The daily area of disturbance would be approximately the same for both alternatives, with the difference being in the duration of the disturbance.

The URBEMIS2007 model developed to determine the emissions associated with land-use projects estimates that each acre disturbed generates 20 pounds of PM_{10} and that 25 percent of the construction area is active at any one time. As such, using the URBEMIS model would result in 1 acre of disturbance daily for the 15-meter alternative and 2.25 acres daily for the 35-meter alternative. As a conservative approach, this analysis assumes that 25 percent of the larger area is disturbed for either alternative resulting in a disturbance of approximately 2.25 acres daily and, in the absence of any dust suppression, 45 pounds of PM_{10}.

Like all projects in the South Coast Air Basin, the construction would be subject to SCAQMD Rule 403 requiring dust control. The URBEMIS2007 model estimates that twice daily watering reduced the dust by about 50 percent whereas thrice daily watering raises this value to about 65 percent. The materials to be placed on the beach are ocean bottom and are pumped onto the beach as a slurry. Because the material is totally saturated, little if any dust is released during its movement. As such, a control efficiency value of 85 percent was assumed for dust suppression as a conservative estimate.

Since the borrow site is in the SDAB and the project site is in the SCAB, emissions were assigned to the separate basins by assigning all of the loading emissions, half of the idling emissions and 81 percent of the sailing emissions to the SDAB and all of the unloading emissions, half of the idling emissions, 19 percent of the sailing emissions and all of the on-shore emissions to the SCAB. In total, all the on-shore and 32 percent of the off-shore emissions will be in the SCAB and the other 68 percent of the off-shore emissions would be in the SDAB.

Table 8
Comparison of Unmitigated Projected Construction Emissions and Criteria Values

	CO	NO_X	ROG	SO_X	Total PM_{10}[1]	Total $PM_{2.5}$[2]	CO_2
Lbs/Day							
On Shore Equipment	43.2	94.9	12.4	0.1	3.9	3.4	8,277.0
Dust	0	0	0	0	6.8	1.4	0
On Shore Vehicles	2.5	0.2	0.3	0.0	0.0	0.0	291.8

Off Shore Sources	327.4	2,185.5	63.9	140.4	66.2	58.9	108,722.6
All Sources	373.1	2,280.6	76.6	140.5	76.9	63.7	117,291.4
On Shore Sources	**45.7**	**95.1**	**12.7**	**0.1**	**10.7**	**4.8**	**8,568.8**
Daily Threshold:	550	100	75	150	150	55	NT[3]
Significant ?	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Pounds and Tons/Alternative							
50 Feet (15 Meter) Width Alternative							
Pounds	17,163.0	104,906.5	3,519.2	6,463.9	3,532.9	2,833.3	5,395,405.4
Tons	8.6	52.5	1.8	3.2	1.8	1.5	2,697.7
115 Feet (35 Meter) Width Alternative							
Pounds	1,853,603.2	11,329,898.3	380,072.7	698,095.8	381,553.7	316,792.3	582,703,786.0
Tons	926.8	5,664.9	190.0	349.0	190.8	158.4	291,351.9

[1] Assumes 85 percent control efficiency for wet material.
[2] Based on 99 percent of the PM_{10} for on-road emissions, 89 percent of the PM_{10} for off-road emissions, and 21 percent of the PM_{10} for fugitive dust.
[3] NT – No Threshold.

Data and emissions for the watercraft are based on data supplied by Moffatt & Nichol. The barge is estimated at approximately 4,300 hp for propulsion and 1,700 hp for the dredge pump. Additionally, a generator and auxiliary power source would also be used and are each rated at 565 hp. A tug would assist unloading operations and is estimated at 4,268 hp.

Since the borrow site is in the SDAB and the project site is in the SCAB, emissions were assigned to the separate basins by assigning all of the loading emissions, half of the idling emissions and 81 percent of the sailing emissions to the SDAB and all of the unloading emissions, half of the idling emissions, 19 percent of the sailing emissions and all of the on-shore emissions to the SCAB. In total, all the on-shore and 32 percent of the off-shore emissions will be in the SCAB and the other 68 percent of the off-shore emissions would be in the SDAB.

Emissions would also be generated from the construction crew in their daily commutes and by the on-site use of two pick-up trucks. Emissions for these vehicles were based on the EMFAC2007 computer model and assume Year 2010 emission factors. The total daily emissions generated by vehicle travel in Orange County projected by the EMFAC2007 model was divided by the total number of daily miles by vehicle type and a grams-per-mile by vehicle type is determined. Members of the construction crew are each estimated to travel 25.4 miles round-trip in accordance with the URBEMIS2007 computer model for home-to-work travel distances in Orange County.

In this case, the total number of vehicles was raised from 10 to 12 to account for the use of two on-site pick-up trucks during the day. Actual miles for these two pick-ups would be less than the 25.4-mile value used in the analysis, but these emissions are minimal relative to those of the offshore and heavy equipment and more accurate data as to their use would not change the outcome of the analysis.

The two Project alternatives would use the same level of equipment on a daily basis with the difference being in the timeframe involved. As shown in Table 8, NOx, ROG, and $PM_{2.5}$ emissions could exceed their respective thresholds of 100, 75, and 55 pounds per day. These exceedences represent a potentially significant impact. Model results appear in Appendix A.

4.3.1.1 Mitigation Measures

Site construction could exceed the daily threshold for NOx, ROG, and $PM_{2.5}$ emissions. Particulate emissions, including PM_{10} and $PM_{2.5}$ are subject to Rule 403 and mitigation for an exceedance condition is usually in the form of additional soil wetting. However, as noted in the analysis, the material is pumped to the beach as a slurry and is completely saturated resulting in very little fugitive dust and its resultant particulates. As such, enhanced watering is neither prescribed nor should it be necessary. Because the bulk of the $PM_{2.5}$ is produced by offshore sources, there is little control over these emissions. Applicable mitigation for NOx and ROG are included below. The included measures would also reduce $PM_{2.5}$ for onshore heavy equipment exhaust.

4.3.1.2 NOx, ROG, and $PM_{2.5}$ Emissions Mitigation Measures

- The Applicant shall specify that the construction contractors shall use onshore heavy equipment that meets Tier II or higher air pollutant emission standards where these standards are applicable and equipment available.

- All heavy equipment shall be maintained and tuned per manufacturer's specifications to perform at California Air Resources Board (CARB) and/or EPA certification, where applicable, levels and to perform at verified standards applicable to retrofit technologies.

4.3.1.3 Residual Impacts

The requirement for Tier II heavy equipment, where applicable, could reduce NOx emissions by about 40 percent and particulate emissions by about 25 percent over Tier I equipment levels. A higher percentage reduction would be achieved over the use of equipment-produced prior to Tier I requirements. Because the status of the actual equipment assemblage, as well as those pieces subject to Tier II requirements, is variable, the overall reduction in NOx emissions could be less than the 40 percent reduction noted for the use of Tier II equipment. Based on the NOx levels included in Table 8, even if a 40 percent reduction were obtained for all onshore heavy equipment, the NOx impact is expected to remain significant and unavoidable as do $PM_{2.5}$ emissions assuming this TIER II equipment reduces particulate levels by 25 percent.

CO and ROG levels associated with onshore heavy equipment construction would also be reduced. If the 40 percent reduction associated with NOx control is also applied to ROG, onshore heavy equipment ROG would be reduced from 12.4 to 7.4 pounds per day. Total daily ROG would be reduced to 71.6 pounds per day and the impact of ROG could be reduced to less than significant.

Table 9 presents the results of the mitigation. Note that even with mitigation, NOx and $PM_{2.5}$ emissions remain above their respective daily significance thresholds. Modeling details are included as Appendix A.

Table 9
Comparison of Mitigated Construction Emissions and Criteria Values

	CO	NOx	ROG	SOX	Total PM_{10}1	Total $PM_{2.5}$2	CO2
Lbs/Day							
On Shore Equipment	43.2	56.9	7.4	0.1	2.9	2.6	8,277.0
Dust	---	---	---	---	6.8	1.4	---
On Shore Vehicles	2.5	0.2	0.3	0.0	0.0	0.0	291.8
Off Shore Sources	327.4	2,185.5	63.9	140.4	66.2	58.9	108,722.6
All Sources	373.1	2,242.6	71.6	140.5	76.8	63.8	117,291.4
On Shore Sources	**45.7**	**57.1**	**7.7**	**0.1**	**9.7**	**4.0**	**8,568.8**
Daily Threshold:	550	100	75	150	150	55	NT[3]
Significant ?	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Pounds and Tons/Alternative							
15 Meter Width Alternative4							
Pounds	17,163.0	103,161.1	3,291.4	6,463.9	3,532.9	2,833.3	5,395,405.4
Tons	8.6	51.6	1.6	3.2	1.8	1.5	2,697.7
35 Meter Width Alternative5							
Pounds	1,853,603.2	11,141,399.7	355,468.2	698,095.8	381,553.7	316,792.3	582,703,786.0
Tons	926.8	5,570.7	177.7	349.0	190.8	158.4	291,351.9

[1] Assumes 85 percent control efficiency for wet material.
[2] Based on 99 percent of the PM_{10} for on-road emissions, 89 percent of the PM_{10} for off-road emissions, and 21 percent of the PM_{10} for fugitive dust.
[3] NT – No Threshold.
[4] Based on 46 working days.
[5] Based on 108 working days.

4.3.2 Site Operations

The Proposed nourishment project does not include an operational phase. Therefore, there are no operational emissions associated with the Proposed Project.

4.4. PROJECT POTENTIAL TO EXPOSE SENSITIVE RECEPTORS TO SUBSTANTIAL POLLUTANT CONCENTRATIONS

Construction of the Project presents the potential to expose sensitive receptors to substantial pollutant concentrations. This consideration is addressed below.

4.4.1 Short-Term (Construction) Impacts

As demonstrated in Section 4.2.1 above, daily emissions for CO, NOx, PM_{10}, and $PM_{2.5}$ were modeled to determine their concentration and contribution to the ambient concentrations within the Project vicinity and as shown in Table 7 above, the concentrations of emissions are below the localized significance threshold criteria. As such, Project construction activities will not result in potential exposure of sensitive receptors to substantial pollutant concentrations.

4.4.2 Long-Term (Operational) Impacts

The Proposed nourishment project does not include an operational phase. Therefore there are no long-term impacts associated with the Proposed Project.

4.5. PROJECT POTENTIAL CREATE OBJECTIONABLE ODORS

Project construction would involve the use of heavy equipment creating exhaust pollutants from on-site earth. With regard to nuisance odors, any air quality impacts will be confined to the immediate vicinity of the equipment itself. By the time such emissions reach any sensitive receptor sites away from the Project site, they will be diluted to well below any level of air quality concern.

Sediments to be placed on the beach would not contain a high level of organic debris and thus, while an odor may be noted, it would be typical of any odor associated with low tide conditions. This impact is therefore considered not significant.

4.6. GREENHOUSE GAS EMISSIONS

At this time, greenhouse gases (primarily CO2) are not regulated as a criteria pollutant and there are no significant criteria for these emissions. Furthermore, the Final 2007 AQMP does not set CEQA targets that can be used to determine any potential threshold values. Nevertheless, in order to provide decision-makers with as much information as possible, this analysis quantifies, to the extent feasible, potential greenhouse gas emissions associated with the proposed development.

4.6.1 Construction

Construction activities would consume fuel and result in the generation of greenhouse gases. Construction CO2 emissions associated with the use of onshore heavy equipment are as projected by the OffRoad2007 model included on the SCAQMD Internet web site. CO2 emissions for the ocean-going vessels are based on fuel use factors included in Table A9-3-E (Fuel Use Estimates Per Horsepower Hour) of the SCAQMD *Handbook* and CO2 emissions are based on the BAAQMD document, *Source Inventory of Bay Area Greenhouse Gas Emissions*, Table B: Generalized GHG Emission Factors (Lbs/Usage Unit) and are included in Table 8, above. In accordance with the Project construction schedule, approximately 5,395,405.4pounds (2,697.7 tons) of CO2 would be produced during the 46 working days associated with the 15-meter width alternative and approximately 582,703,786.0 pounds (291,351.9 tons) would be produced during the 108 working days associated with the 35-meter width alternative.

In accordance with the 2007 AQMP, the emission levels in California are estimated to be 532 million metric tons (568.4 short tons) CO2 equivalent for 2010. At approximately 2,697.7 tons, the 15-meter width alternative represents about 0.0005 percent of this State's annual CO2 emissions budget. At about 291,351.9 tons, the 35-meter width alternative represents about 0.05 percent if the State's annual CO2 emissions budget.

SECTION 5.0 – CUMULATIVE IMPACTS

The CEQA Guidelines require that projects be evaluated with respect to their contribution to the cumulative effects resulting from past, present, and probable future projects. This contribution with respect to air emissions would typically include both construction and operational emissions. In this case, the Project represents a construction effort. There are no physical structures to be built nor would the Project increase attendance at the beach.

Construction of the related projects would be short-term and depending on the extent of construction, could have effects similar to or greater than that of the proposed project. Even with the prescribed mitigation, the Project is anticipated to exceed the significance threshold limitations for NOx and $PM_{2.5}$. In accordance with SCAQMD methodology, projects that exceed the daily threshold values and cannot be mitigated to less than the SCAQMD thresholds add significantly to the cumulative impact. As such, the Project is also considered as significant at the cumulative level.

With respect to cumulative emissions concentrations and their potential impact on sensitive receptors, the localized impact analysis demonstrates that all emissions levels would remain within their respective threshold values and the Project would not result in emissions in excess of the AAQS. As such, the Project does not add to a cumulative violation of the standards.

SECTION 6.0 – REFERENCES

Bay Area Air Quality Management District
Source Inventory of Bay Area Greenhouse Gas Emissions, December 2008.

California Air Pollution Control Officers Association
Air Toxics Assessment Manual, October 1, 1987.

California Air Resources Board
EMFAC2007 Computer Model, Version 2.3, November 1, 2006.
URBEMIS2007 Computer Model, Version 9.2.2, September 2007.

South Coast Air Quality Management District
A Climatological Air Quality Profile, California South Coast Air Basin, January 1980.
Air Pollution Data Monitoring Cards (2003, 2004, 2005, 2006, 2007).
Rules and Regulations, 2007.
Final 2007 AQMP, July 13, 2007.
Final 2003 AQMP, August 1 2003.
Off-Road Mobile Source Emission Factors, October 10, 2008.
Final-Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 Significance Thresholds, October 2006.
Sample Construction Scenarios for Projects Less than Five Acres in Size, February 2005.
Final Localized Significance Threshold Methodology, June 2003
SCAQMD CEQA Air Quality Handbook, April 1993.

Southern California Association of Governments
1997 Air Quality Management Plan, 1997.

United States Environmental Protection Agency
SCREEN3 Dispersion Model, Version Dated 95250

Western Regional Climate Center
http://www.wrcc.dri.edu/Climsum.html

APPENDIX A – CALCULATION OF UNMITIGATED CONSTRUCTION EMISSIONS

APPENDIX A
CALCULATION OF UNMITIGATED CONSTRUCTION EMISSIONS

The included spreadsheet may be used to determine average daily emissions associated with project construction. Heavy equipment emission factors are as projected using the OFFROAD2007 Model runs as included on the SCAQMD Internet web site. Dredge and tug criteria pollutant emissions are based on emission factors provided by Jim McNally of Moffatt & Nichol. Dredge and tug CO2 emissions are based on the BAAQMD document, Source Inventory of Bay Area Greenhouse Gas Emissions. Vehicle Emissions are based on an Orange County Year 2010 model run of the CARB EMFAC2007 computer model. The total daily vehicle emissions for each vehicle class included in the model was divided by the total number of vehicles miles traveled in each class so that an average emission rate per mile could be determined. Worker vehicles are a composite of light duty autos, light duty trucks less than 3,750 pounds, and light trucks between 3,751 and 5,150 pounds. Per the URBEMIS2007 computer model, Orange County trip lengths are set at 25.4 miles per trips for workers and 30 miles per trips for trucks. While 10 workers are anticipated, 12 vehicles are assumed to account for the two to be used on-site during the day. PM_{10} emissions associated with dust are based on the assumptions included in the URBEMIS2007 computer model. The model reports that 20 pounds of PM_{10} are generated per acre disturbed per day and the active area is 25 percent of the site. This analysis assumes 25 percent of the 35-meter width, 9-acre site. A conservative control efficiency of 85 percent is then assumed for the movement of saturated beach sand.

$PM_{2.5}$ emissions are based on 99 percent of vehicle emissions, 89 percent of off-road diesel emissions, and 21 percent of fugitive dust.

INPUT ASSUMPTIONS										
Heavy Equipment Emissions (All Diesel Except Where Noted)					**Exhaust Emission Factors (Pounds per Horsepower-Hour)**					
Equipment Type	**#Days**	**Hr/Day**	**Hp**	**Load %**	**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**CO2**
Dredge Propulsion Loading	1	4.58	4300	65	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Propulsion Sailing	1	11.99	4300	80	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Propulsion Unloading	1	3.2	4300	5	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Propulsion Idling	1	1.83	4300	5	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Pump/Jets Loading	1	4.58	1700	65	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Pump/Jets Sailing	1	11.99	1700	5	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Pump/Jets Unloading	1	3.2	1700	70	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Pump/Jets Idling	1	1.83	1700	0	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Tug Unloading	1	3.2	4268	40	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Generators	1	7.67	565	35	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Auxiliary	1	7.67	565	35	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Crew Boat (in gal/hr)	1	20	2.8	50	0.14	0.34	0.18	0.027	0	1.4784
Dozer (@ rated load factor)	2	10	580	100	0.003002328	0.005529528	0.000725584	4.48243E-06	0.000236143	0.456676738
Front-End Loader (@ rated load factor)	2	10	430	100	0.000979162	0.003571376	0.000461013	3.89824E-06	0.000130941	0.346457444

Mobile Source Emissions				Exhaust Emission Factors (Pounds per Mile)					
Vehicle Class	**# Trips**	**Mi/Trip**		**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**CO2**
Workers (Inc. Autos & Trks Under 5,151 Lbs)	12	25.4		0.008152033	0.000729368	0.000894025	9.1476E-06	8.3548E-05	0.95744843
Heavy-Heavy Trucks (33,001 - 60,000 lb)	0	30		0.0225	0.034684466	0.003859223	4.85437E-05	0.001553398	4.004854369

Dust Emissions				PM10 Emission factor (Pounds per Acre per Day)
Area Disturbed	**# Acres**	**# Days**	**% Control**	**PM10 (#/Acre)**
Active Area	2.25	1	85	20.00

OUTPUT VALUES							
Heavy Equipment Emissions	**Exhaust Emissions (Pounds Total)**						
Equipment Type	**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**PM2.5**	**CO2**
Dredge Propulsion Loading	56.3	378.9	10.2	24.3	11.5	10.3	18,925.1
Dredge Propulsion Sailing	181.5	1,220.9	33.0	78.4	37.1	33.0	60,977.5
Dredge Propulsion Unloading	3.0	20.4	0.6	1.3	0.6	0.6	1,017.1
Dredge Propulsion Idling	1.7	11.6	0.3	0.7	0.4	0.3	581.7
Dredge Pump/Jets Loading	22.3	149.8	4.0	9.6	4.6	4.1	7,482.0
Dredge Pump/Jets Sailing	4.5	30.2	0.8	1.9	0.9	0.8	1,506.7
Dredge Pump/Jets Unloading	16.8	112.7	3.0	7.2	3.4	3.1	5,629.7
Dredge Pump/Jets Idling	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tug Unloading	24.0	161.7	4.4	10.4	4.9	4.4	8,076.6
Dredge Generators	6.7	44.9	1.2	2.9	1.4	1.2	2,242.4
Auxiliary	6.7	44.9	1.2	2.9	1.4	1.2	2,242.4
Crew Boat	3.9	9.5	5.0	0.8	0.0	0.0	41.4
Dozer	34.8	64.1	8.4	0.1	2.7	2.4	5,297.5
Front-End Loader	8.4	30.7	4.0	0.0	1.1	1.0	2,979.5
Total Daily Emissions (Pounds)	370.6	2,280.4	76.2	140.5	70.0	62.3	116,999.6
Total Daily Emissions (Tons)	0.2	1.1	0.0	0.1	0.0	0.0	58.5

OUTPUT VALUES							
Mobile Source Emissions	**Exhaust Emissions (Pounds Total)**						
Vehicle Class	**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**PM2.5**	**CO2**
Workers (Inc. Autos & Trks Under 5,151 Lbs)	2.5	0.2	0.3	0.0	0.0	0.0	291.8
Heavy-Heavy Trucks (33,001 - 60,000 lb)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Mobile-Source Emissions (Pounds)	2.5	0.2	0.3	0.0	0.0	0.0	291.8
Total Mobile-Source Emissions (Tons)	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Dust Emissions	**Dust PM10 Emissions (Pounds Total)**						
Area Disturbed					**PM10**	**PM2.5**	
Active Area					6.8	1.4	
Total PM10 From Dust Emissions (Pounds)					6.8	1.4	
Total PM10 From Dust Emissions (Tons)							
Total Daily Emissions	**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**PM2.5**	**CO2**
Pounds	373.1	2,280.6	76.5	140.5	76.8	63.8	117,291.4
Tons	0.2	1.1	0.0	0.1	0.0	0.0	58.6
Emissions for 46 days							
Pounds	17,163.0	104,906.5	3,519.2	6,463.9	3,532.9	2,933.3	5,395,405.4
Tons	8.6	52.5	1.8	3.2	1.8	1.5	2,697.7
Emissions for 108 days							
Pounds	1,853,603.2	11,329,898.3	380,072.7	698,095.8	381,553.7	316,792.3	582,703,786.0
Tons	926.8	5,664.9	190.0	349.0	190.8	158.4	291,351.9

APPENDIX B – CALCULATION OF MITIGATED CONSTRUCTION EMISSIONS

APPENDIX B
CALCULATION OF UNMITIGATED CONSTRUCTION EMISSIONS

The included spreadsheet may be used to determine average daily emissions associated with project construction. Heavy equipment emission factors are as projected using the OFFROAD2007 Model runs as included on the SCAQMD Internet web site. Dredge and tug criteria pollutant emissions are based on emission factors provided by Jim McNally of Moffatt & Nichol. Dredge and tug CO2 emissions are based on the BAAQMD document, Source Inventory of Bay Area Greenhouse Gas Emissions. Vehicle Emissions are based on an Orange County Year 2010 model run of the CARB EMFAC2007 computer model. The total daily vehicle emissions for each vehicle class included in the model was divided by the total number of vehicles miles traveled in each class so that an average emission rate per mile could be determined. Worker vehicles are a composite of light duty autos, light duty trucks less than 3,750 pounds, and light trucks between 3,751 and 5,150 pounds. Per the URBEMIS2007 computer model, Orange County trip lengths are set at 25.4 miles per trips for workers and 30 miles per trips for trucks. While 10 workers are anticipated, 12 vehicles are assumed to account for the two to be used on-site during the day. PM10 emissions associated with dust are based on the assumptions included in the URBEMIS2007 computer model. The model reports that 20 pounds of PM10 are generated per acre disturbed per day and the active area is 25 percent of the site. This analysis assumes 25 percent of the 35-meter width, 9-acre site. A conservative control efficiency of 85 percent is then assumed for the movement of saturated beach sand. PM2.5 emissions are based on 99 percent of vehicle emissions, 89 percent of off-road diesel emissions, and 21 percent of fugitive dust.

INPUT ASSUMPTIONS											
Heavy Equipment Emissions (All Diesel Except Where Noted)						Exhaust Emission Factors (Pounds per Horsepower-Hour)					
Equipment Type		**#Days**	**Hr/Day**	**Hp**	**Load %**	**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**CO2**
Dredge Propulsion Loading		1	4.58	4300	65	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Propulsion Sailing		1	11.99	4300	80	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Propulsion Unloading		1	3.2	4300	5	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Propulsion Idling		1	1.83	4300	5	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Pump/Jets Loading		1	4.58	1700	65	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Pump/Jets Sailing		1	11.99	1700	5	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Pump/Jets Unloading		1	3.2	1700	70	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Pump/Jets Idling		1	1.83	1700	0	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Tug Unloading		1	3.2	4268	40	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Dredge Generators		1	7.67	565	35	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Auxiliary		1	7.67	565	35	0.0044	0.0296	0.0008	0.0019	0.0009	1.4784
Crew Boat	(in gal/hr)	1	20	2.8	50	0.14	0.34	0.18	0.027	0	1.4784
Dozer	(@ rated load factor)	2	10	580	100	0.003002328	0.005529528	0.000725584	4.48243E-06	0.000236143	0.456676738
Front-End Loader	(@ rated load factor)	2	10	430	100	0.000979162	0.003571376	0.000461013	3.89824E-06	0.000130941	0.346457444
Mobile Source Emissions						**Exhaust Emission Factors (Pounds per Mile)**					
Vehicle Class			**# Trips**	**Mi/Trip**		**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**CO2**
Workers (Inc. Autos & Trks Under 5,151 Lbs)			12	25.4		0.008152033	0.000729368	0.000894025	9.1476E-06	8.3548E-05	0.95744843
Heavy-Heavy Trucks (33,001 - 60,000 lb)			0	30		0.0225	0.034684466	0.003859223	4.85437E-05	0.001553398	4.004854369
Dust Emissions						**PM10 Emission factor (Pounds per Acre per Day)**					
Area Disturbed			**# Acres**	**# Days**	**% Control**					**PM10 (#/Acre)**	
Active Area			2.25	1	85					20.00	

OUTPUT VALUES							
Heavy Equipment Emissions	**Exhaust Emissions (Pounds Total)**						
Equipment Type	**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**PM2.5**	**CO2**
Dredge Propulsion Loading	56.3	378.9	10.2	24.3	11.5	10.3	18,925.1
Dredge Propulsion Sailing	181.5	1,220.9	33.0	78.4	37.1	33.0	60,977.5
Dredge Propulsion Unloading	3.0	20.4	0.6	1.3	0.6	0.6	1,017.1
Dredge Propulsion Idling	1.7	11.6	0.3	0.7	0.4	0.3	581.7
Dredge Pump/Jets Loading	22.3	149.8	4.0	9.6	4.6	4.1	7,482.0
Dredge Pump/Jets Sailing	4.5	30.2	0.8	1.9	0.9	0.8	1,506.7
Dredge Pump/Jets Unloading	16.8	112.7	3.0	7.2	3.4	3.1	5,629.7
Dredge Pump/Jets Idling	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tug Unloading	24.0	161.7	4.4	10.4	4.9	4.4	8,076.6
Dredge Generators	6.7	44.9	1.2	2.9	1.4	1.2	2,242.4
Auxiliary	6.7	44.9	1.2	2.9	1.4	1.2	2,242.4
Crew Boat	3.9	9.5	5.0	0.8	0.0	0.0	41.4
Dozer	34.8	64.1	8.4	0.1	2.7	2.4	5,297.5
Front-End Loader	8.4	30.7	4.0	0.0	1.1	1.0	2,979.5
Total Daily Emissions (Pounds)	370.6	2,280.4	76.2	140.5	70.0	62.3	116,999.6
Total Daily Emissions (Tons)	0.2	1.1	0.0	0.1	0.0	0.0	58.5
Mobile Source Emissions	**Exhaust Emissions (Pounds Total)**						
Vehicle Class	**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**PM2.5**	**CO2**
Workers (Inc. Autos & Trks Under 5,151 Lbs)	2.5	0.2	0.3	0.0	0.0	0.0	291.8
Heavy-Heavy Trucks (33,001 - 60,000 lb)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Mobile-Source Emissions (Pounds)	2.5	0.2	0.3	0.0	0.0	0.0	291.8
Total Mobile-Source Emissions (Tons)	0.0	0.0	0.0	0.0	0.0	0.0	0.1

OUTPUT VALUES							
Dust Emissions	**Dust PM10 Emissions (Pounds Total)**						
Area Disturbed					**PM10**	**PM2.5**	
Active Area					6.8	1.4	
Total PM10 From Dust Emissions (Pounds)					6.8	1.4	
Total PM10 From Dust Emissions (Tons)							
Total Daily Emissions	**CO**	**NOx**	**ROG**	**SOx**	**PM10**	**PM2.5**	**CO2**
Pounds	373.1	2,280.6	76.5	140.5	76.8	63.8	117,291.4
Tons	0.2	1.1	0.0	0.1	0.0	0.0	58.6
Emissions for 46 days							
Pounds	17,163.0	104,906.5	3,519.2	6,463.9	3,532.9	2,933.3	5,395,405.4
Tons	8.6	52.5	1.8	3.2	1.8	1.5	2,697.7
Emissions for 108 days							
Pounds	1,853,603.2	11,329,898.3	380,072.7	698,095.8	381,553.7	316,792.3	582,703,786.0
Tons	926.8	5,664.9	190.0	349.0	190.8	158.4	291,351.9

APPENDIX C – LOCALIZED SIGNIFICANCE THRESHOLD DISPERSION MODELING METHODOLOGY FOR CONSTRUCTION AND OPERATION EMISSIONS

APPENDIX C
LOCALIZED SIGNIFICANCE THRESHOLD DISPERSION MODELING METHODOLOGY FOR CONSTRUCTION AND OPERATIONAL EMISSIONS

In accordance with the SCAQMD criteria, peak daily emissions for CO, NO_2, PM_{10}, and $PM_{2.5}$ were modeled to determine their concentration and contribution to the ambient concentrations within the project vicinity. The analysis makes use of methodology included in the SCAQMD *Methodology* (SCAQMD, June 2003).

Modeling was performed using the USEPA SCREEN3 dispersion model and includes those emissions sources that operate continually at the site (i.e., heavy equipment) and two pick-up trucks. Mobile source emissions (i.e., worker commutes and haul trips) are not to be included in the analysis as these emissions are spread over a large area and do not represent a localized source. The maximum daily unmitigated emissions for CO, NOx, PM_{10}, and $PM_{2.5}$ were determined based on emissions projections included in the analysis.

For construction, highest values are as presented in Table 8 of the analysis. PM_{10} and $PM_{2.5}$ were further broken down into fugitive dust and exhaust particulates as these are released at differing heights.

An average hourly emission rate was determined and the average hourly emission rate in grams per second was calculated.

CO = 43.6 lb/day x 454 gm/lb / 10 hr/day / 60 min/hr / 60 sec/min = 0.55 gm/sec

NOx = 94.9 lb/day x 454 gm/lb / 10 hr/day / 60 min/hr / 60 sec/min = 1.20 gm/sec

PM_{10} dust = 6.8 lb/day x 454 gm/lb / 10 hr/day / 60 min/hr / 60 sec/min = 0.09 gm/sec

PM_{10} exhaust = 2.9 lb/day x 454 gm/lb / 10 hr/day / 60 min/hr / 60 sec/min = 0.04 gm/sec

$PM_{2.5}$ dust = 1.4 lb/day x 454 gm/lb / 10 hr/day / 60 min/hr / 60 sec/min = 0.02 gm/sec

$PM_{2.5}$ exhaust = 2.6 lb/day x 454 gm/lb / 8 hr/day / 60 min/hr / 60 sec/min = 0.03 gm/sec

These values were then divided by the project area and a 1-hour concentration was derived. In accordance with the URBEMIS2007 model, the daily disturbed area represents 25 percent of the site (i.e., 2.25 acres) and the total site is based on the 9-acre area.

9 acres x 43,560 ft2/acre x 0.0929 ft2/m2 = 36,421 m2

CO = 0.55 gm/sec / 36,421 m2 = 0.00001510 gm/sec/m2

NOx = 1.20 gm/sec / 36,421 m2 = 0.00003286 gm/sec/m2

PM_{10} dust = 0.09 gm/sec / 36,421 m2 = 0.00000235 gm/sec/m2

PM_{10} exhaust = 0.58 gm/sec / 36,421 m2 = 0.00000100 gm/sec/m2

$PM_{2.5}$ dust = 0.02 gm/sec / 36,421 m2 = 0.00000048 gm/sec/m2

$PM_{2.5}$ exhaust = 0.03 gm/sec / 36,421 m2 = 0.00000090 gm/sec/m2

These values were then modeled as an area source using the USEPA SCREEN3 dispersion model. Model parameters were selected in accordance with the *Methodology*. Accordingly, the emissions plume was set at an elevation of 5 meters while the receptors were set at an elevation of 2 meters. As a reasonable worst-case, the highest atmospheric stability class was used in the modeling effort. In accordance with the discussion of local meteorology, daily wind speed was set at 6 mph (2.68 m/sec), the minimum average daily wind speed through the project area.

According to the *Methodology*, receptors are to be located at their actual distances or may be assumed to be located at distances of 25, 50, 100, 200, and 500 meters. In cases where proximate receptors may be closer than 25 meters, as per the *Methodology*, a value of 25 meters is to be used in the analysis as a worst-case scenario. The closest receptors are actually about 55 meters from the site.

In the case of the 1-hour CO standard, the modeled concentration was added directly to an assumed ambient concentration. This ambient concentration is source-area dependant and is based on the peak 1-hour value observed over the last three years of accumulated data (i.e., 3 ppm). In the case of CO, SCREEN3 reports results in terms of $\mu g/m^3$. However, the standard is in ppm and the value obtained from the SCREEN3 model must be converted.

For CO, the conversion factor is:

Conc. (ppm) / Conc. ($\mu g/m^3$) = pressure (mb) / Temp (k) x molecular wt / 8.314E-2

Conc. (ppm) / Conc. ($\mu g/m^3$) = 1,013.25 mb / 293.15 k x 28 / 8.314E-2

= 1,164.1

As an example, in the case of CO, the SCREEN3 Model projects a CO concentration of 93.78 $\mu g/m^3$ at 25 meters.

93.78 $\mu g/m^3$ / 1,164.1 = 0.08 ppm

This value is then added to the ambient concentration (i.e., 3 ppm).

For the 8-hour CO standard, the 1-hour concentration is multiplied by a persistence factor of 0.7 as recommended by the California Air Pollution Control Officers Association (Air Toxics Assessment Manual, October 1, 1987). The resultant value was added to the peak 8-hour value observed over the last three years of accumulated data, (i.e., 2.1 ppm).

In the case of NO_2 the calculation is slightly more complex. The ambient air quality standards are written in terms of NO_2. However, heavy equipment primarily emits NO that then goes on to form NO_2. As such, the Methodology includes factors than can be used to determine NO_2 concentrations at varying distances. These factors are included in the following table.

The NOx concentration modeled using the SCREEN3 model was then multiplied by the NO_2/NOx ratio. Like CO, SCREEN3 reports NOx concentrations in $\mu g/m^3$ while the standard is in ppm. In this case, the conversion is:

Conc. (ppm) / Conc. ($\mu g/m^3$) = 1,013.25 mb / 293.15k x 46 / 8.314E-2

= 1,912.4

NO_2-to-NOx Ratio as a Function of Downwind Distance	
Downwind Distance (m)	***NO_2/NOx Ratio***
20	0.053
25[1]	0.054
50	0.059
55[1]	0.060
100	0.074
200	0.114
500	0.258

[1] Value is not included in the SCAQMD methodology and is extrapolated.

As an example, in the case of NOx, the SCREEN3 Model projects a concentration of 204.1 $\mu g/m^3$ at 25 meters.

$$204.1\ \mu g/\ m^3 \times 0.054 / 1{,}912.4 = 0.0058\ ppm$$

The resultant value is added to the peak 1-hour value observed over the last three years of accumulated data, (i.e., 0.10 ppm).

In the cases of PM_{10} and $PM_{2.5}$, no ambient concentration is added. However, in both cases, construction is subject to a 24-hour concentration standard of 10.4 $\mu g/\ m^3$. For the 24-hour standard, the 1-hour concentration is multiplied by a persistence factor of 0.4 as recommended by the California Air Pollution Control Officers Association (Air Toxics Assessment Manual, October 1, 1987). Because exhaust emissions and fugitive dust are produced at different heights (i.e., 5 and 1 meter, respectively), these emissions were modeled separately and their resultant concentrations added at the receptor locations. Results of the analysis are included below.

Review of Table 7 shows the CO, NOx, PM_{10}, and $PM_{2.5}$ values associated with on-site emissions sources. Table 9 presents the peak daily projected emissions from on-site construction as well as the projected concentrations at the various default receptor distances. Note that both PM_{10} and $PM_{2.5}$ are projected to exceed their thresholds at local receptor locations and the impact is potentially significant.

Localized Construction Emissions Concentrations[1]					
Distance	**CO (1-Hr Conc.)[2]**	**CO (8-Hr Conc.)[3]**	**NO_2 (1-Hr Conc.)[4]**	**PM_{10} (24-Hr Conc.)**	**$PM_{2.5}$ (24-Hr Conc.)**
Peak Daily Onsite Emissions (lb/day)	43.6	43.6	94.9	9.7	4.0
Concentration at 25 meters	3.08	2.16	0.11	10.31	3.83
Concentration at 50 meters	3.07	2.15	0.11	8.50	3.31
Concentration at 55 meters (Nearest Receptor)	3.07	2.15	0.11	8.20	3.21
Concentration at 100 meters	3.06	2.14	0.11	6.25	2.51
Concentration at 200 meters	3.04	2.13	0.11	4.10	1.67
Concentration at 500 meters	3.02	2.11	0.11	1.91	0.78
Ambient Air Quality Standard	20 ppm	9.0 ppm	0.18 ppm	10.4 $\mu g/m^3$	10.4 $\mu g/m^3$
Exceeds Standard?	No	No	No	No	No

[1] CO and NO_2 are in ppm, PM_{10} and $PM_{2.5}$ are in $\mu g/m^3$.
[2] Includes a background concentration of34 ppm.
[3] Includes a background concentration of 2.1 ppm.
[4] Includes a background concentration of 0.10 ppm.

APPENDIX D – COASTAL ENGINEERING REPORT

San Clemente Shoreline Feasibility Study
Orange County, California

COASTAL ENGINEERING APPENDIX

Final Report

U.S. Army Corps of Engineers
Los Angeles District

JULY 2011

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1 GENERAL

1.1 *Introduction*

This appendix describes technical design aspects for the San Clemente Shoreline Feasibility Study for shoreline improvements in the City of San Clemente, California. The purpose of this appendix is to conduct a detailed evaluation of the existing conditions and of the proposed alternatives for determination of the recommended plan. Evaluation of these alternatives includes an analysis of baseline coastal processes, detailed technical design, and potential design impacts on shoreline processes.

1.1.1 Risk and Uncertainty

This study at San Clemente is conducted using the principles of Risk & Uncertainty (R/U) in compliance with U.S. Army Corps of Engineers policy that requires all new Federally funded flood control and flood damage reduction studies incorporate the principles of R/U. U.S. Army Corps of Engineers policy guidelines for R/U are defined in Engineer Regulation 1105-2-101 (Dept. of Army 1996). R/U is intrinsic in water resources planning and design and arises from measurement errors and the inherent variability of complex physical phenomena.

The model used in the present study is an integrated coastal engineering – economics analytical framework for evaluating the physical performance and economic costs of shore protection projects, particularly, beach nourishment along sandy shores. The model has been implemented as an event-based Monte Carlo life cycle simulation tool that is run on desktop computers. This model initiates with coastal engineering data and input, performs a series of engineering and economic computations, and concludes with economic outputs. The model inputs consist of probability distributions for various coastal engineering parameters. The model outputs consist of histograms of individual damage benefit categories. The model is fully described in Section 5.

1.1.2 Significant References

This study references significantly a predecessor document. The Coast of California Storm and Tidal Wave Study (CCSTWS) prepared by the Los Angeles District (USACE-SPL, 1991). The CCSTWS study was a thorough, comprehensive, and complex analysis of a portion of the southern California shoreline which includes the San Clemente area.

This technical appendix also references significantly a predecessor construction project. A regional shoreline nourishment project was performed in 2001 by the San Diego Association of Governments (SANDAG). The project entailed dredging 1.6 million cubic meters (m^3) (2.1 million cubic yards (yd^3)) of beach compatible sediments from six borrow sites for placement on twelve receiver beaches in San Diego County. The similarities of this construction project make this project directly comparable to this study. A complete description of the twelve receiver beaches is described in Sec 2.5.11.

1.1.3 Units

This study at San Clemente is conducted under the SI (metric) system of measurement as part of the U.S. Army Corps of Engineers compliance with Federal policy that requires all new Federally funded construction work be conducted in SI units, if requested by the local sponsor. Much of the existing coastal processes analyses were originally developed utilizing the Imperial

measurement system (feet). All units and/or dimensions are converted to metric equivalents using standard conversion factors. Some dimensions are shown in both systems (Imperial units in parentheses) to aid in understanding comparisons with historical documents.

1.2 *Previous Reports*

There are no previous Federal reports that directly address the San Clemente study area being considered under this authority. Some previous reports exist which incorporate the San Clemente area indirectly as a component of the larger coastal region, such as the aforementioned CCSTWS. The prevailing literature typically emphasizes San Juan Creek and the immediate adjacent coastal area encompassed by Doheny State Beach, or the San Onofre area.

2 BASELINE COASTAL AND OCEANOGRAPHIC CONDITIONS

2.1 *Study Area Definition*

The Oceanside Littoral cell is approximately 86 km (53.5 miles) long extending from Dana Point to the La Jolla submarine canyon. Dana Point, the north end of the cell is a near complete barrier to the littoral transport of sand. Point La Jolla at the south end of the cell, is also a near-complete barrier. Analysis of shoreline changes in the Oceanside Cell address six sub-reaches within the cell. The sub-reach inclusive of the study area is the San Mateo – Dana Point cell. The Oceanside Littoral cell boundaries were selected based on geomorphic and cultural features such as river and lagoon entrances, harbor structures, and other shoreline change features.

The current study area is bounded between San Mateo Point and Dana Point. The study area is approximately 12.1 km (7.5 miles) long. The study area is further sub-divided into ten reaches for reference purposes numbered consecutively Reach 1 – Reach 10. The study area is shown in **Figure 2-1**; close-up views are shown in **Figures 2-2** thru **2-4**.

2.1.1 Project Baseline

The seaward rail of the Southern California Regional Railroad Authority (SCRRA) is considered to be the project baseline. The SCRRA railroad line bisects the length of the project area. The railroad is constructed on conventional elevated crushed rock ballast. The railroad is constructed along the base of the bluff throughout the reach and is a prominent feature that completely separates the active beach from the bluff. The beach is only accessible via pedestrian underpasses/overpasses or storm water culverts interspersed along the length. Whereas typically the beach and bluffs are considered joined together as components in an active littoral system, the presence of the railroad completely isolates the bluff from the beach. Virtually all sediment inputs and bluff-related influences are restricted. Furthermore, the railroad resembles and acts as a protective revetment. In several areas the railroad is the primary structural feature that protects the bluffs and upland development from direct wave attack. In several areas the beach has completely eroded and exposed the railroad, thus, the railroad has fixed the position of the shoreline. Thus the railroad is the de facto protective structure for the bluffs. The railroad, acting as a protective structure and fixing the position of the shoreline, is assumed to be permanent and always exist throughout the project lifecycle. Therefore, the railroad is considered the landward boundary and no storm damages are considered landward of the railroad. The project baseline is assumed to be the seaward rail of the SCRRA railroad. Since the railroad is assumed to be a constant feature throughout the project lifecycle, the seaward rail provided a convenient feature to define a horizontal alignment.

2.1.2 Reach Description

SCRRA has incorporated discontinuous levels of protective rock armoring along the railroad length. Four of the reaches consist of conventional rock ballast gradation which ranges from ¾" – 2-1/2". Four of the reaches have been improved with rock armoring of approximately 100 lbs – 4 tons (~1 ft – 4 ft) on the seaward slope. The general condition of the revetment is not uniform and appears to be fair/poor along the entire length. Information obtained from SCRRA indicates that the revetment armor stone was not individually placed in the same manner in which conventional coastal armor stone structures are constructed. Instead the revetment was constructed via rail car side dump methods. However, even though the design and methods of construction were inconsistent with conventional coastal engineering practice, the larger armor

stone affords substantially greater protection against hydraulic forces over conventionally sized rock ballast and offer substantial benefits to the railroad structure. This improvement in protective armoring is a primary consideration for project reach delineation.

The reach boundaries are defined in meters northward from San Mateo Point and shoreline features located within each reach are described. The project reaches are defined based on an arbitrary assumed Station 0+000 at San Mateo Point.

Reach 1: Reach 1 extends from San Mateo Point at Sta 0+146 to Sta 1+115. The reach is 969 m long and is the southern portion of San Clemente State Beach. The beach width is zero at the southern boundary and gradually increases to 41 m wide. The railroad track elevation is approximately +6.4 m[1]. The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +7.0 m. There are no structures seaward of the railroad; some residential structures exist immediately landward of the railroad.

Reach 2: Reach 2 extends from Sta 1+115 to Sta 1+795. The reach is 680 m long and is encompassed within San Clemente State Beach. The beach width is approximately 40 m wide at the southern boundary and gradually decreases to 9 m wide. The railroad track elevation is approximately +6.4-7.6 m. The railroad seaward slope incorporates the conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.4-7.6 m. There are no structures seaward of the railroad; the underpass for San Clemente State Beach is included within this reach.

Reach 3: Reach 3 extends from Sta 1+795 to Sta 2+395. The reach is 600 m long is encompassed within San Clemente State Beach. The beach width is approximately 9 m wide at the southern boundary and quickly becomes zero throughout the remainder of the reach. The railroad track elevation is approximately +6.4 m. The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +7.0 m. There are no structures seaward of the railroad; Calafia Beach Park is on the landward side of the railroad.

Reach 4: Reach 4 extends from Sta 2+395 to Sta 3+127. The reach is 732 m long and encompasses San Clemente State Beach on the southern 30% and City of San Clemente on the northern 70%. The beach width is approximately 30 m wide at the southern boundary, transitions to 60 m wide in the middle, and transitions to 10 m wide at the northern boundary. The railroad track elevation is approximately +6.3 m. The railroad seaward slope incorporates the conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.3 m. There are no structures seaward of the railroad; some residential structures exist immediately landward of the railroad.

Reach 5: Reach 5 extends from Sta 3+127 to Sta 3+540. The reach is 413 m long and is encompassed within the City of San Clemente. The beach width is 0 m wide throughout the reach. The railroad track elevation is approximately +6.5 m. The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +6.5 m. There are no structures seaward of the railroad; some residential structures exist immediately landward of the railroad.

[1] All elevations and/or depths are in meters referred to Mean Lower Low Water (MLLW) unless otherwise noted.

Reach 6: Reach 6 extends from Sta 3+540 to Sta 4+580. The reach is 1040 m long and is encompassed within the City of San Clemente. The beach width meanders from 0 m wide to 23 m to 0 m to 39 m and back to 0 m along the reach. The railroad track elevation is approximately +6.3 m. The railroad seaward slope incorporates the conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.9 m. This reach includes the majority of the significant structures along the beach.

Reach 7: Reach 7 extends from Sta 4+580 to Sta 5+661. The reach is 1081 m long and is encompassed within the City of San Clemente and is known as "Mariposa Point". The beach width is 0 m wide throughout the reach. The railroad track elevation is approximately +6.5 m. The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +6.9 m. Historical information indicates that this reach has been armored with revetment since at least the 1930's. There are no structures seaward or landward of the railroad.

Reach 8: Reach 8 extends from Sta 5+661 to Sta 6+008. The reach is 347 m long and is encompassed within the City of San Clemente. The beach width varies from 40 m wide at the southern boundary to 0 m at the northern boundary. The railroad track elevation is approximately +6.3 m. The railroad seaward slope incorporates the conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.9 m.

Reach 9: Reach 9 extends from Sta 6+008 to Sta 7+109. The reach is 1101 m long and is encompassed within the City of San Clemente and is known as "Capistrano Shores". Capistrano Shores is a private community of manufactured housing constructed in the 1950's. A timber seawall that is fronted by a rubblemound rock revetment protects the reach. The armor stone is estimated to be 2-5 tons, has a slope of 1H:1V, and a crest elevation of approximately +6.0 m. The general condition of the revetment is not uniform and appears to be fair/poor along the entire length. The beach width is 0 m wide throughout the reach. The railroad is located substantially landward of the revetment and as such is no longer considered the project landward boundary. There are no structures seaward of the revetment.

Reach 10: Reach 10 extends from Sta 7+109 to Dana Point Harbor. The reach is approximately 5,000 m long and extends to the northern boundary of the study area. The Reconnaissance Report identified the potential project area from San Mateo Point to Capistrano Shores (Reach 1-9). The area north of Capistrano Shores is designated Reach 10 and will be considered only in the context of engineering considerations where physical continuity is required and/or necessary for the analysis.

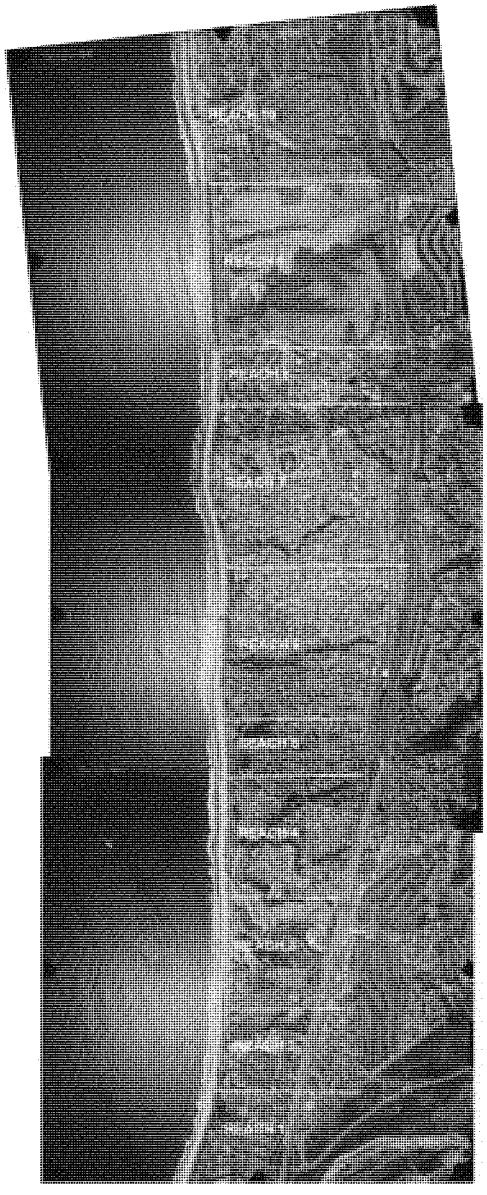

Figure 2-1 Study Area Reach

Figure 2-2 Typical View of Beach, North From Pier

Figure 2-3 Typical View of Beach, South From Pier

Figure 2-4 Typical View of Beach and Railroad

2.2 *Water Levels*

2.2.1 Tides

Tides at San Clemente are unequal mixed semi-diurnal. There is no tidal data available for the immediate San Clemente area, however, the tidal datum elevations at La Jolla, CA are shown in **Table 2-1** and are assumed representative of those at San Clemente. The tidal epoch is 1983 to 2001. The La Jolla National Ocean Service (NOS) Primary Tide Station is located approximately 81 km (50 miles) from the San Clemente Pier. In southern California, tides typically have spatial characteristics on the order of hundreds of kilometers. Datum information for an NOS tidal station located at Newport Bay Harbor (station discontinued in 1994) located approximately 30 km (19 miles) from San Clemente indicates MSL and MHHW differences of 0.02 m and 0.03 m respectively. Therefore, the sea level variation between La Jolla and San Clemente is assumed to be negligible.

Table 2-1 Tidal Datum Elevations at La Jolla, CA

Tidal Datum	Elevation m, (ft)
Highest observed water level (11/13/97)	+2.33 (7.65)
Mean Higher High Water (MHHW)	+1.62 (5.33)
Mean High Water (MHW)	+1.40 (4.60)
Mean Sea Level (MSL)	+0.83 (2.73)
Mean Tide Level (MTL)	+0.84 (2.75)
North American Vertical Datum – 1988 (NAVD)	+0.06 (0.19)
Mean Low Water (MLW)	+0.28 (0.90)
Mean Lower Low Water (MLLW)	0.00
Lowest observed water level (12/17/33)	-0.87 (-2.87)
Elevations are referenced to MLLW.	

2.2.2 Storm Surge

Storm surge is the super-elevation of the tidal level at the coast due to wind stresses and atmospheric pressure fluctuations acting upon the sea surface. Wind and atmospheric fluctuations associated with strong storms in southern California typically produce 0.3-0.6 m (1-2 ft) storm surges (CCSTWS). Due to a narrow continental shelf and the absence of tropical storms and/or hurricanes, storm surge heights on the California coast are small compared to those on the east and Gulf coasts where extreme surge heights of 1-3 m (3-10 ft) are more typical and a peak 8 m (25 ft) was documented during Hurricane Camille in 1969. West coast storm surges typically have time scales of 1-3 days, with longer surge episodes possible due to bunching of successive storms.

2.2.3 Relative Sea Level Change

The U.S. Army Corps of Engineers considers potential relative sea level change in every feasibility study undertaken within the coastal zone. Corps of Engineers policy guidelines for sea level rise is defined in Engineer Regulation 1105-2-100 (Dept. of Army 2000). This regulation requires that relative sea level change be considered for a range of scenarios. Project planning should consider what impact a higher relative sea level rise (or fall) rate would have on the design compared to the historical rate. A sensitivity analysis should be conducted to determine what effect (if any) changes in sea level would have on plan evaluation and selection. This analysis should be based, as a minimum, on the extrapolation of the local, historical record of relative sea level rise as the low level and Curve 3 from the National Research Council report as the high level.

Historic regional sea level trends based on yearly mean sea level records are published by the NOS (National Ocean Service, 2001). Monthly mean sea level variations are analyzed for 117 stations of the NOS National Water Level Observation Network having between 25 and 146 years of data. Monthly MSL data are used to obtain the average seasonal cycle, the residual time series, and the autoregressive coefficient of the residual with accurate estimates of

standard errors. Historic trends at San Diego, California indicate a positive sea level rise of +2.45 mm/yr based on water level measurements during the period 1950-1999. If past trends are projected into the future at San Diego, a sea level rise of 0.12 m (0.4 ft) would be expected during the 50 year period of economic analysis.

In establishing its current policy, the U.S. Army Corps of Engineers has chosen to follow the recommendations of the National Research Council (NRC), as described in the publication *Responding to Changes in Sea Level: Engineering Implications* (National Research Council, 1987). This publication assumes three possible scenarios for eustatic sea level rise to the year 2100, where Curve 3 (the third scenario) is identified as the extreme sea level case which should be considered for feasibility studies. These scenarios are described by the equation

$$E(t) = 0.0012t + bt^2 \quad (1)$$

t represents years, starting in 1986, b is a constant, and E(t) is the eustatic sea level rise, in meters, as a function of t.

For the three scenarios proposed by the NRC, b is equal to 2.8E-5 for Curve 1, 6.6E-5 for Curve 2, and 1.05E-4 for Curve 3 resulting in eustatic sea level rise values, by the year 2100, of 0.5 meters, 1.0 meters, and 1.5 meters, respectively. Adjusting for the study time period (where the economic base year is 2012) results in a total sea level rise during the 50 year economic period of analysis of 0.70 m (2.3 ft).

No additional sea level change to account for geologic displacement was added to the NRC Curve 3 estimate. The NRC accounts for eustatic sea level change only; the Curve 3 sea level change is considered very conservative and results in a total 50 year sea level change of 0.7 m, or approximately 14 mm/yr. This is compared to the 50 year sea level change of 0.12 m, or 2.45 mm/yr based on actual measurements. In general the EC assumes that 1.8 mm/yr in sea level change for historic conditions is contributed to the water level rising and the balance is due to geological displacement. It is noted that the measured historic rate of 2.45 mm/yr includes both eustatic and geologic components. Therefore, 0.65 mm/yr can be attributed to geologic displacement. As the Curve 3 estimate is 5.7 times greater than the combined measured rate, it is believed that an additional 0.65 mm/yr is negligible and was not incorporated into the Curve 3 estimate.

Relative sea level change has project impacts from two primary considerations: 1) long-term beach erosion, and 2) increased wave runup and overtopping. The effects of sea level rise are addressed separately in Section 2.5.10.

2.3 *Topography / Marine Geophysical*

2.3.1 Topography

Terrestrial topographic data were obtained from March 2002 aerial LIDAR surveys conducted as a part of this study. LIDAR (Light Detection And Ranging) is a state-of-the-art survey system that allows high-speed collection of topographic data. The system employs a helicopter-mounted range-finding laser that is coupled with a highly accurate GPS positioning system to collect precise GPS measurements, platform attitude, laser ranges, and imagery data. The LIDAR system collects terrain information at a rate of 10,000 points per second. A full description of the survey is described in Chance (John Chance, 2002).

Topographic information was collected at a horizontal point spacing on order of 0.1 meter that allowed detailed information to be collected of the beach, revetment, railroad, and near structure ground elevations. High-resolution topographic data allowed the development of high-resolution digital terrain models of all project features. Detailed mapping in the damage/flood areas provided existing beach contours, beach widths, berm elevations, foreshore slopes, and structure pad horizontal locations. Detailed mapping of the revetments and railroad provided accurate crest elevations.

The topographic data was adjusted for datum consistency with the marine survey data. The LIDAR topographic data was collected in the North American Vertical Datum of 1988 (NAVD88). It is usual and customary that coastal engineering projects are relative to an ocean-related datum, typically Mean Sea Level or Mean Lower Low Water. Survey control information indicates that NAVD88 = +0.14 m (+0.45 ft) MLLW at La Jolla, CA and NAVD88 = +0.12 m (+0.38 ft) MLLW at Newport Bay Harbor Entrance. Therefore, it was assumed NAVD88 = +0.13 m (+0.41 ft) at San Clemente and all topographic (LIDAR) measurements were adjusted down by –0.13 m (-0.41 ft).

2.3.2 Marine Geophysical

The marine geophysical data used in this analysis were obtained from June 2002 nearshore surveys conducted as a part of this study. A multi-sensor survey was conducted to collect bathymetry, side scan sonar, and sub-bottom geophysical information; a full description of the survey is described in Fugro (Fugro, 2002). The multibeam bathymetric survey provides point elevation data of the seabed in order to develop an accurate digital terrain model. The subbottom profile survey was conducted to delineate stratigraphic conditions, the presence or absence of sandy materials, the boundaries separating the consolidated and unconsolidated materials, define the depth to shallow bedrock if such exists, identify faults, paleochannels, and other anomalous geologic conditions within the survey area. The side scan sonar survey was used to acquire sonar imagery of the seabed in order to distinguish and map features/types and correlate surficial sediment types with the geophysical subbottom system. Sediment grab samples were collected for correlation with the survey data. The survey covered a corridor of approximately 14 km alongshore from approximately San Juan Creek near Dana Point to San Mateo Creek by 2.25 km cross-shore from the surf zone to 2500 meters offshore in approximately 23 meters water depth. The survey utilized closely spaced survey lines and resulted in the collection of approximately 534 km of geophysical data.

A full geological interpretation of the results can be found in the Geotechnical Appendix; a summary of some of the results is discussed below.

Bathymetry: The water depths in the survey area range from 3 meters near the beach to 23 meters offshore. The seafloor slope direction is southwest – normal to the beach. The seafloor gradient averages 0.9% (slope 110H:1V) but varies locally. The inshore gradient between 3-6 meters is 5% off San Clemente State Beach. This gradient decreases farther to the northwest.

Several bedrock spurs extend out from shore; the largest one is the seaward extension of the San Mateo Point. These spurs may rise several meters above the intervening swales. The San Mateo Rocks northwest of San Mateo Point are isolated and may be remnant spurs. Bedrock outcrops the seafloor in places between the shore and about the 15-meter isobath. Where outcrops occur, the seafloor is uneven from the resistant bedrock mounds. Some of the larger outcrops rise as much as 6 meters above the surrounding seabed. The gradients along some

of these outcrop slopes can be as high as 33% (18°). A smooth seafloor with an even slope forms the topography seaward of the outcrops. This smooth texture is a result of unconsolidated recent sediment deposition.

Surficial Features and Sediment Thickness: The side scan sonar data clearly show areas where bedrock is exposed, and . In several locations, survey data could not be acquired as the kelp was too thick to navigate through. It is well established that bedrock is necessary for kelp growth. The bedrock exposures are mapped as either areas where exposures comprise greater than 50% of the seabed and zones where scattered rock covers 10-50% of the area.

Unconsolidated surficial sediment predominates in the scattered rock zones. The subbottom profile data reveal an immeasurably thin surficial veneer overlies the bedrock. This surficial sediment cover likely changes seasonally as beach sands migrate cross-shore. It is expected that within the shallower water depths where sediment caps the bedrock, the sediment thickness is probably less than 0.3 meter (1 foot).

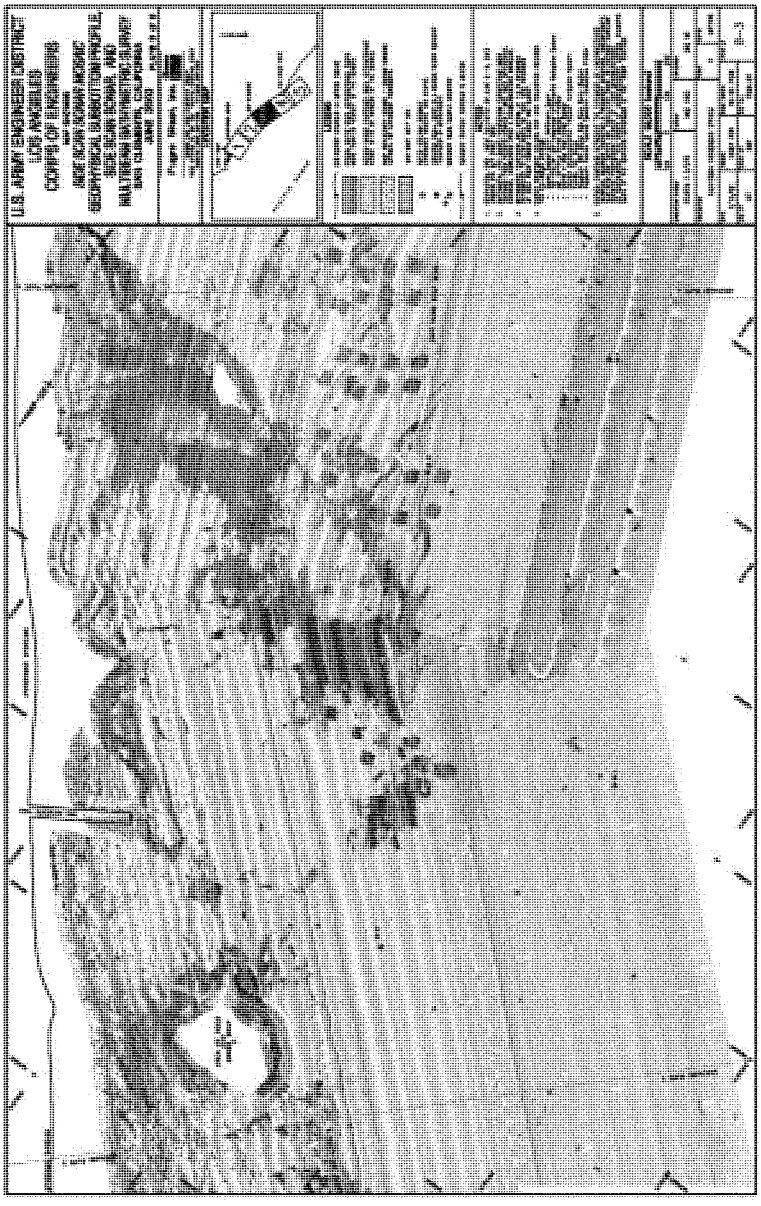

Figure 2-5 Seabed Imagery in Project Vicinity

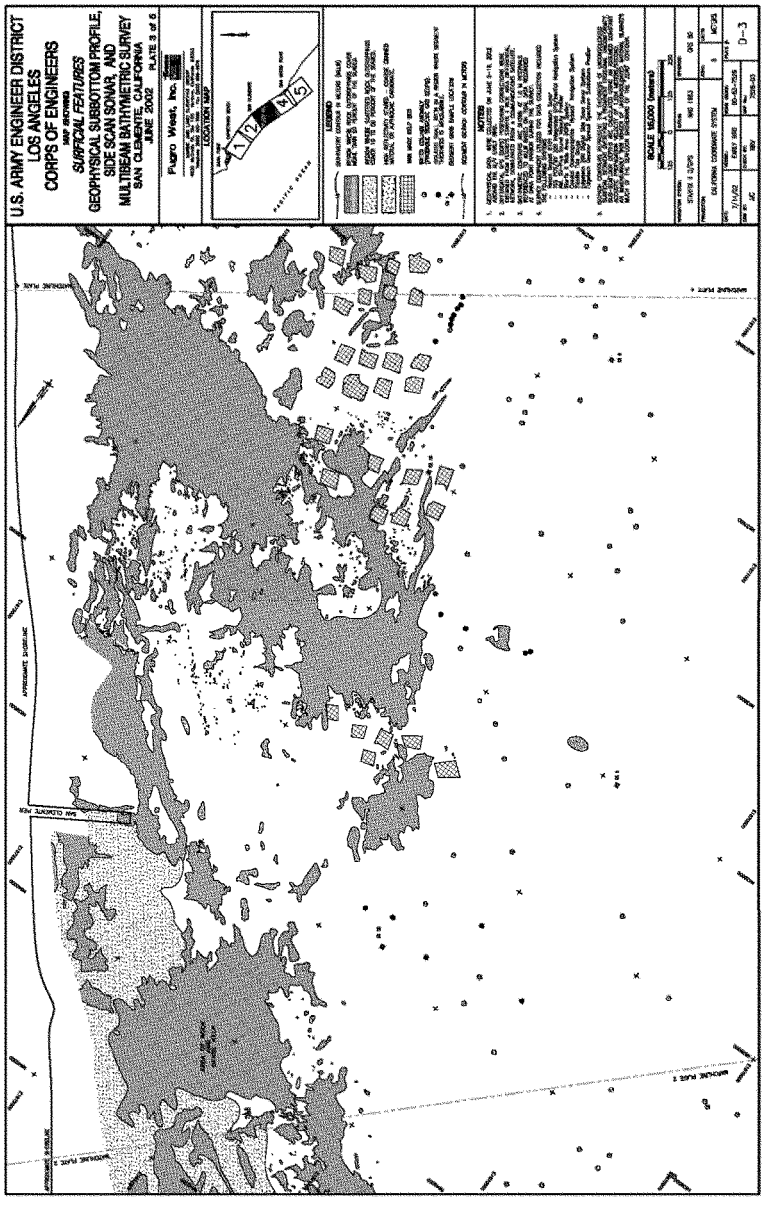

Figure 2-6 Surficial Features Map in Project Vicinity

2.4 *Wave Climatology*

The wave climate at San Clemente can be divided into three primary groups according to origin: west swell, south swell, and seas generated by local winds. Eastern North Pacific hurricanes with a landfall track directed at San Clemente rarely occur and were not considered in this study. The swell windows are illustrated in **Figure 2-7**.

West Swell

West swell waves generally represent the most severe wave climate at San Clemente. These waves are generated by extratropical storms of the North Pacific primarily during the months of November through March and approach San Clemente from the west through a narrow corridor between the south Channel Islands. The swell window tends to be confined to wave periods up to 16 seconds as longer period waves will wrap (refract) into the coast.

South Swell

San Clemente is exposed to southern hemisphere and hurricane swell through a wide corridor from the south to the southwest. Most of this swell arrives during the months of May through October. Swell waves generated by southern hemisphere storms have great decay distances and tend to have lower heights. However, southern hemisphere swell is unconfined for wave periods. Typical southern hemisphere swell are less than 2 m (6 ft) in height with periods ranging up to 20 seconds.

Seas

The daily wave climate at San Clemente is dominated by steep, short-period waves generated by local winds from the west and southwest, although winds can occur from all offshore directions throughout the year. Wave heights are usually between 0.5-1.5 m (2-5 ft) with a mean period of 7 seconds.

Wave climatology information is available for the offshore area of San Clemente in the form of direct measurements as part of the Coastal Data Information Program (CDIP, 2009). The CDIP shallow-water station most applicable to San Clemente is the San Clemente S_{xy} slope array (Station ID 052) located approximately 300 m offshore of the San Clemente Pier in 10.2 meters of water. The S_{xy} slope array is a directional wave height recorder with a 178-month record during the period 1983-1998 at nominally four observations per day. The height and direction data records are intermittent reporting approximately 141 months of the 178 available; one long gap occurring during the period Jul88-Jul91 accounting for the majority of missing records. These data records are used to determine the daily and annual wave climate, the extreme wave analysis, and data input into wave transformation and shoreline damage numerical models.

Determination of the annual wave climate entailed assembling the entire data records. These records are sorted based on height, period, and direction. The resultant univariate and multivariate distributions are discussed and shown hereinafter.

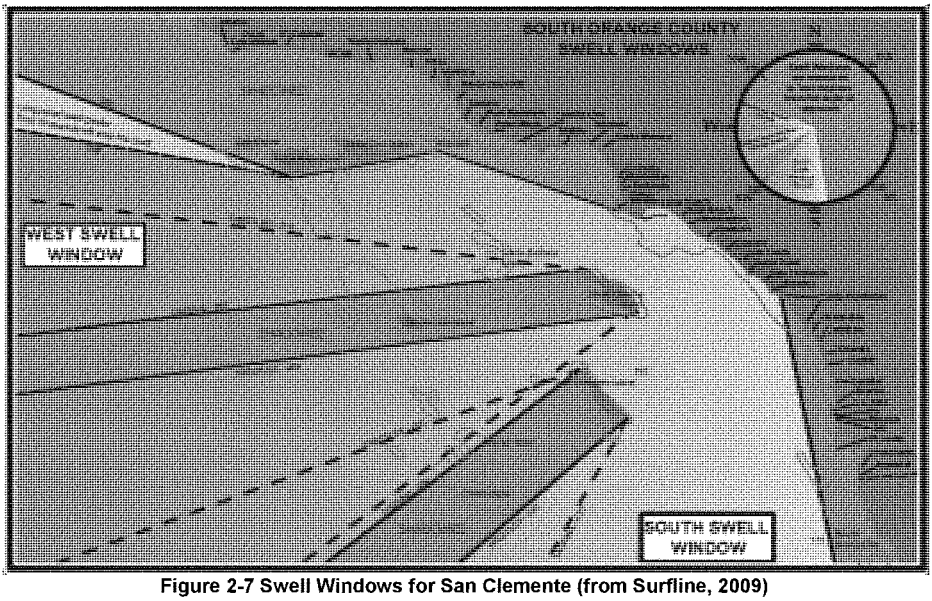

Figure 2-7 Swell Windows for San Clemente (from Surfline, 2009)

2.4.1 Wave Heights

The histograms for significant wave heights are shown in **Figures 2-8 and 2-9**. Several observations can be made regarding the wave climate. **Figure 2-8** illustrates that the most commonly occurring significant wave height is in the range 0.80-1.00 m. This figure also illustrates the complete absence of very large significant wave heights (> 4.0 m). The maximum recorded significant wave height is 3.63 m. This may be due to several conditions including the fact that the S_{xy} slope array measures the wave climate in 10 m of water, whereas waves observed closer to the breaking depth will be larger due to shoaling. Also, the wave data are spectral-energy based (H_{mo}) rather than statistically based ($H_{1/3}$), it is well established that individual wave heights within the wave train represented by H_s ($H_{1/3}$) are substantially larger than the H_{mo} value. The wave climate is measured in the vicinity of the pier and is assumed representative of the entire San Clemente project area.

The winter wave climatology can be developed from the measured wave climate previously discussed. It is recognized that the severest wave climate occurs during the winter season. It was desired to develop the wave climatology based on the winter wave population. The wave data was categorized based on the December-March winter meteorological season. The histograms for the winter significant wave height are shown in **Figure 2-9**.

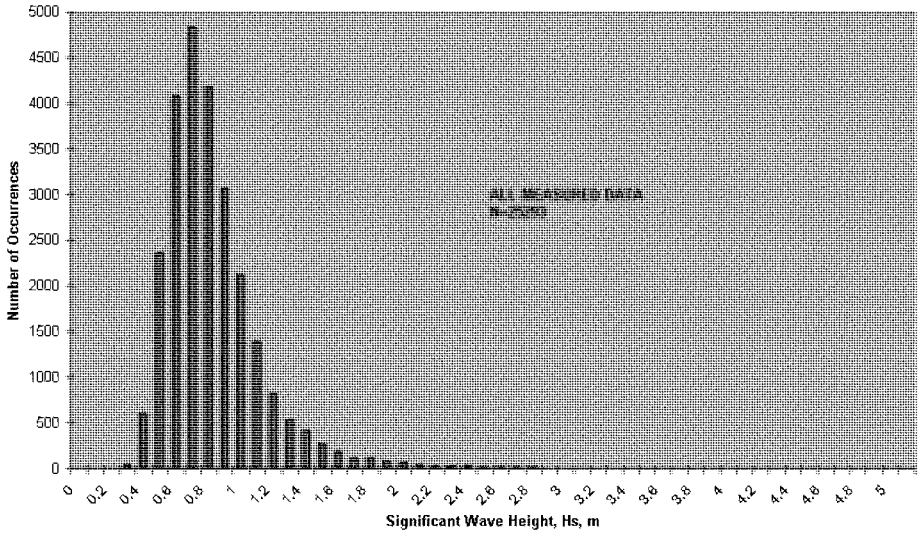

Figure 2-8 Significant Wave Height Histogram, 1983-1998

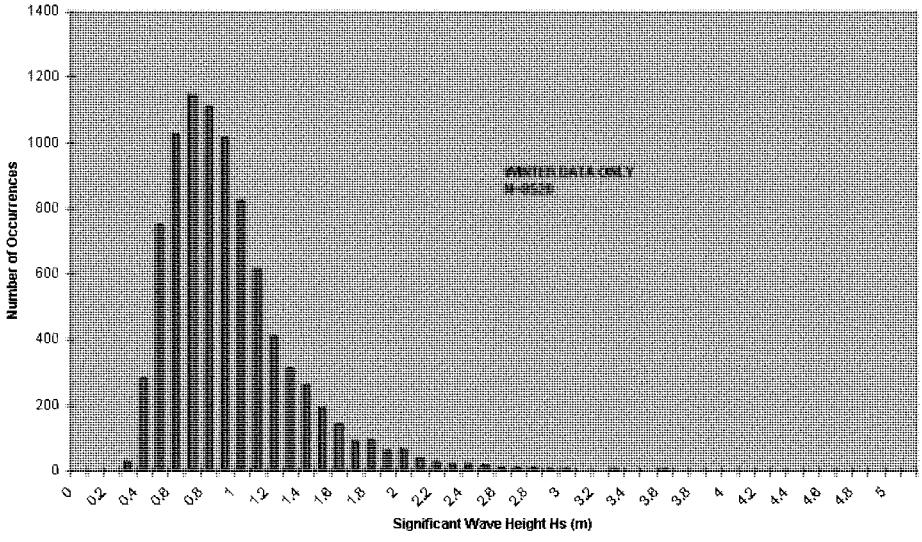

Figure 2-9 Significant Wave Height Histogram, Winter Data, 1983-1998

Based on the measured data, the annual maximum wave heights for each year were determined. The annual maximum wave heights are shown in **Table 2-2**.

Table 2-2 Annual Maximum Wave Heights, 1983-1998 (CDIP, 2009)

Year	Mo/Dy	Hs, m (ft)	Tp (sec)	Dir (deg)
1983	Dec 10	3.1, (10.2)	14.2	248
1984	Apr 01	1.85, (6.1)	6.1	273
1985	Nov 29	2.18, (7.2)	6.1	227
1986	Feb 16	3.56, (11.7)	16	234
1987	Mar 16	2.24, (7.4)	8.5	254
1988	Jan 18	3.63, (11.9)	14.2	218
1991	Nov 15	2.06, (6.8)	18.3	212
1992	Jan 30	2.32, (7.6)	14.2	250
1993	Feb 18	2.66, (8.7)	8	197
1994	Feb 07	2.0, (6.6)	7.3	191
1995	Jan 05	3.22, (10.6)	9.1	205
1996	Oct 26	2.24, (7.4)	8.8	259
1997	Dec 06	2.31, (7.6)	6.4	207
1998	Jan 30	2.99, (9.8)	18.3	238

2.4.2 Wave Periods

Figure 2-10 illustrates that the dominant wave periods are in the range 12-14 seconds, with a smaller secondary peak at 6-8 seconds. The two peaks in the distribution demonstrate the dual sea/swell nature of the wave climate. Shorter period waves are typically associated with sea conditions; longer period waves are typically associated with swell conditions.

2.4.3 Wave Directions

Directional separation of the data results are shown in **Figure 2-11**. This figure illustrates that approximately 91% of the waves approach from the relatively narrow 20-degree band between 230°-240°, and all other approach directions are minor or negligible. Shoreline normal in the San Clemente area is 235°. There is a very small fraction of waves (0.7%) approaching from 160°-220°, directions considered to be of tropical depression or southern hemisphere origins. Significantly, the predominant westerly wave direction envelops both local seas and extratropical swell.

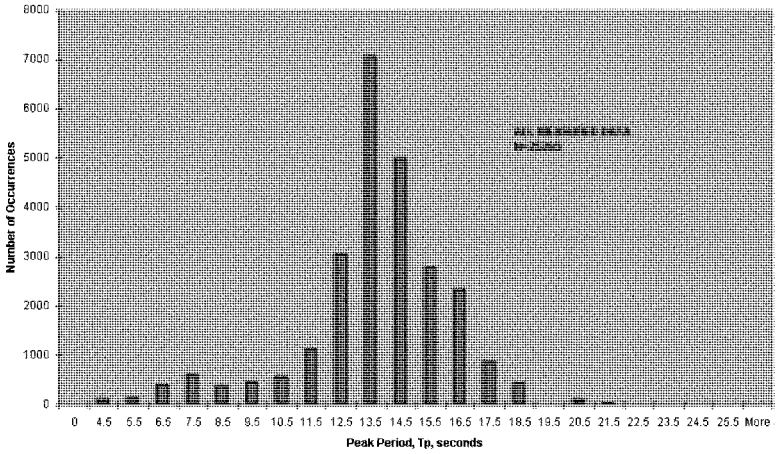

Figure 2-10 Spectral Peak Period Histogram, 1983-1996

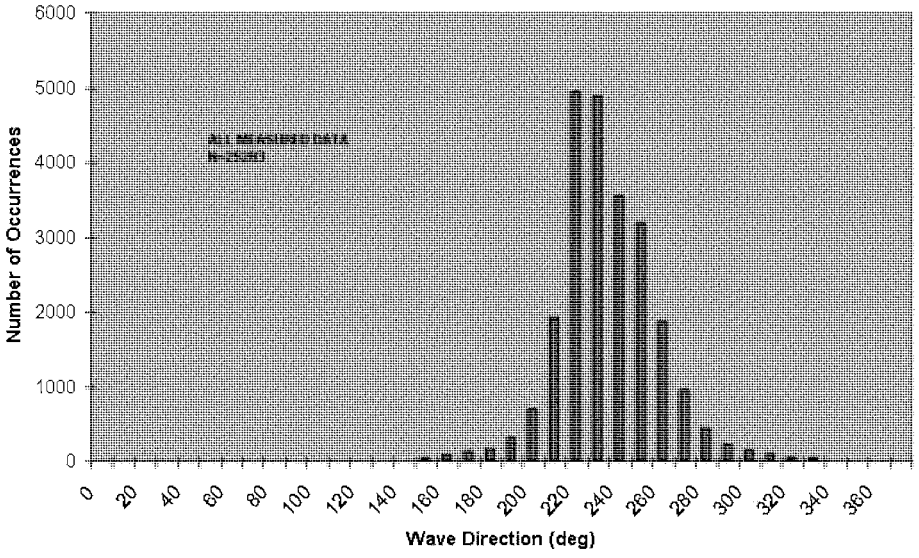

Figure 2-11 Wave Direction Histogram, 1983-1996

2.5 *Littoral Processes and Sediment Transport*

This section describes the sediment budget analysis, the shoreline change analysis, other related input data analysis, and the effects of sea level change for the San Clemente shoreline study area.

2.5.1 Oceanside Littoral Cell

The Oceanside Littoral Cell extends for 86 km (53.5 mi) from Dana Point to Point La Jolla as shown in **Figure 2-12**. The shoreline displays a wide variety of coastal features including cliffs, headlands, beaches composed of sand and/or cobbles, rivers, creeks, tidal lagoons and marshes, submarine canyons, man-made shore and bluff protection devices of many kinds, and major harbor structures. The cell is divided into three sub-cells based on natural physiographic units: (1) Dana Point to San Mateo Point, (2) San Mateo Point to Carlsbad Submarine Canyon, and (3) Carlsbad Submarine Canyon to Point La Jolla. The City of San Clemente is located in the north sub-cell (Dana Point to San Mateo Point).

The littoral cell includes two small craft harbors, Dana Point Harbor and Oceanside Harbor. Dana Point Harbor is located on the northern end of the littoral cell, while Oceanside Harbor is in the center of the cell.

2.5.2 Sediment Sources

Numerous rivers and small streams discharge sediment into the Oceanside Littoral Cell, as shown in **Figure 2-13**. San Juan Creek and San Mateo Creek are considered major river systems for the influx of sediment into the north sub-cell. Extracts from a listing compiled from the results of various studies (CCSTWS) are presented in **Table 2-3** and provides a range of estimates of the sediment loads carried by fluvial systems of this littoral sub-cell. This list is supplemented with a recent study for the San Juan Creek watershed.

Table 2-3 Sediment Discharge from Rivers and Streams

	River / Stream Discharge Rate m^3/yr (yd^3/yr)		
	San Juan	San Clemente	San Mateo
Drainage Area hect (mi2)	45,455 (175.5)	5,154 (19.9)	34,188 (132)
Moffatt&Nichol 1977	12,980 (17,000)	10,946 (14,340)	1,702 (2,240)
CCSTWS 84-4 (1984)			24,427 (32,000)
Simons/Li 1985	6,107 (8,000)		12,213 (16,000)
CCSTWS 88-3 (Simons/Li 1988)	15,603 (20,440)	786 (1,030)	3,729 (4,885)
CCSTWS 90-2 (Moffatt&Nichol 1990)	27,480 (36,000)		6,412 (8,400)
USACE-SPL 1999	39,749 (52,071)		

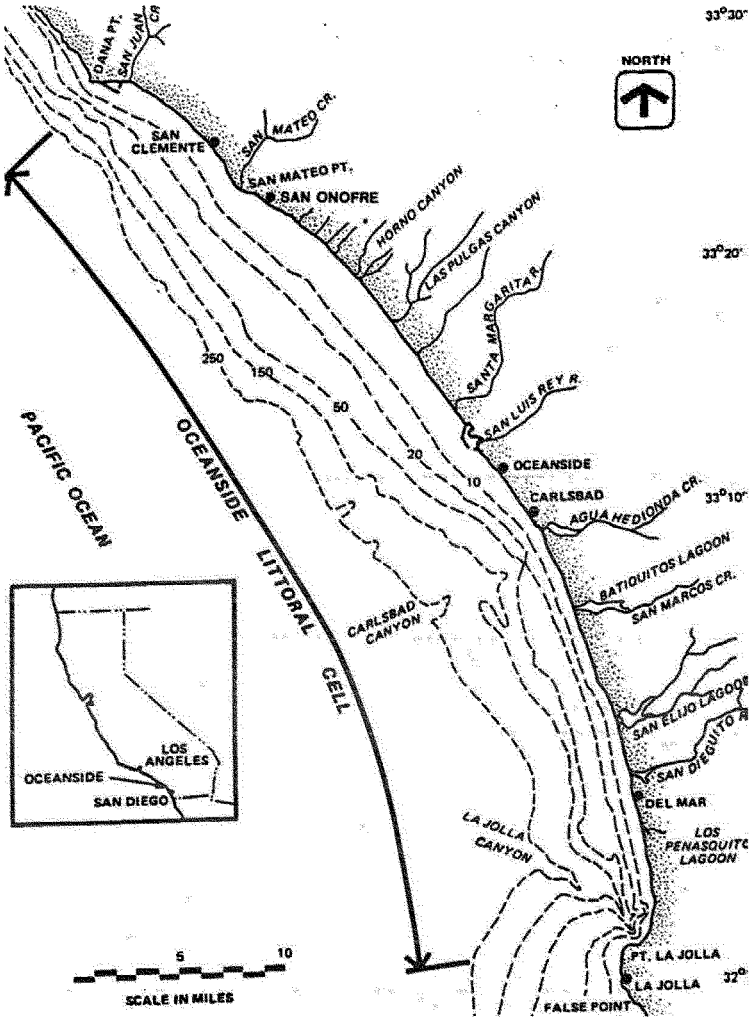

Figure 2-12 Oceanside Littoral Cell

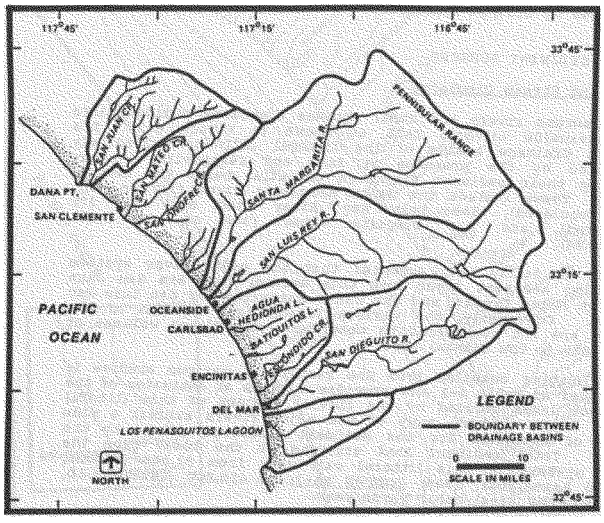

Figure 2-13 Major Rivers and Drainage Basins, Oceanside Littoral Cell

Table 2-3 illustrates the relatively small amount of sediment input from San Juan Creek. San Juan Creek is 7.4 km (4.6 mi) northwest on the updrift[2] side of San Clemente pier. Dana Point is the southern updrift boundary headland for the Oceanside littoral cell where it is presumed no appreciable sediment is entering the cell. Therefore, San Juan Creek represents the only major source sediment input to the immediate project area. San Mateo Creek, although physically closer, is in the downdrift direction and is not believed to be a major contributor of sediments to the project area. The San Juan Creek discharge ranges between 6,107-39,749 m^3/yr (8,000-52,071 yd^3/yr) with a resultant average of 20,383 m^3/yr (26,702 yd^3/yr). This quantity is small given the facts that some of the discharged river material is likely lost offshore as fines and some is lost/trapped updrift prior to reaching the San Clemente project area. It is noted that river flows and the resultant sediment delivery to beaches is episodic due to the semi-arid nature of the climate and watersheds/rivers deliver sediment only during rainy/wet years. Thus, sediment to beaches tends to be delivered in large "pulses", where a large quantity is delivered to the beach in one year followed by several years of low or no sediment delivery.

2.5.3 Sediment Budget

A sediment budget for without-project conditions has been developed based on the CCSTWS. Development of the sediment budget involves defining the sediment sources, sinks, and losses; transport modes; erosion and accretion rates; and balancing the resultant budget. Some additional information was obtained during this study to enhance the previously developed sediment estimates. Compilation of the sediment budget specific to San Clemente is described hereinafter and is further described in the CCSTWS.

2 Directional convention for this study is: "updrift" and "upcoast" refers to northerly and/or westerly direction; and "downdrift" and "downcoast" refers to the southerly and/or easterly direction.

The analysis of the budget of sediment for this cell has been carried out for three time periods: (1) the period from 1900 – 1938, (2) a mild, uniform weather period from 1960 – 1978, and (3) a period of more variable wave climate covered by the CCSTWS studies from 1983 – 1990. The 1900 – 1938 "natural" budget permits an uncluttered look at the cell as it predates construction of dams and Oceanside Harbor, although it necessarily draws on some findings from later studies. The mild, uniform period from 1960-1978 was selected to evaluate the effects of Oceanside Harbor at a time when the wave climate was consistent from year to year and less variable than the present wave climate. The last period of more variable wave climate 1983 – 1990 emphasizes the change in wave climate from one that gave a consistent, strong southerly littoral transport to one that yields a more variable transport with a net northerly component in some years. The resultant sediment budget for the three time periods is shown in **Table 2-4**.

Table 2-4 Sediment Budget for Oceanside Littoral Cell (North – San Clemente) in 1000 m^3 / yr

	1900-1938		1960-1978		1983-1990	
	Input	Output	Input	Output	Input	Output
Q_l	0	130	0	130	0	35
Q_n	0	15	0	15	0	5
$Q_{b,o}$	130	45	90	45	45	0
Q_a	0	0	90	0	0	0
$Q_{r,s}$	65	0	45	0	0	0
Total	+195	-190	+225	-190	+45	-40
Net $(\partial V'/\partial t)$	+5		+35		+5	
$\partial X/\partial t$ (m/yr)	+0.03		+0.18		+0.03	

Notes:
Q = total sand transport rate into or out of cell, m^3/yr
a = artificial nourishment, bypassing, dredging, etc
b = blufflands erosion; includes seacliffs, gullies, coastal terrace, slumps, etc as distinct from rivers
l = longshore transport of sand in and near the surfzone
n = nearshore transport along the coast, outside the surfzone
o = onshore/offshore transport at the base of the shorerise
r = river yield to the coast
s = lost to submarine canyons
$\partial V'/\partial t$ = sand volume change rate, m^3/yr
$\partial X/\partial t$ = shoreline change rate, m/yr

This sediment budget analysis has coarse spatial resolution and would benefit from a reach-specific analysis. Due to the lack of available data, the sediment budget as developed does not allow detailed volumetric budget estimates on a smaller spatial scale. Specifically, the lack of spatially refined data does not allow a detailed volumetric analysis of each project reach. Attempts to improve spatial resolution by using a partial data set or excluding data could result in unrealistic shoreline change rates.

The resultant sediment budget indicates the shoreline is essentially in balance between erosion and accretion. The budget is considered to be in balance when the shoreline change rate $\partial X/\partial t$, computed from the volume flux is less than 0.03 m/yr (0.1 ft/yr). The shoreline indicates a balance in the "natural" time period and the most recent variable wave climate time period.

The net volume flux indicates the budget is very slightly accretional during the uniform wave climate period.

The sediment budget for the sub-cell has been determined to be +5,000 cubic meters per year, with a corresponding +0.03 m/yr shoreline change rate. The positive sign (+) suggests that the shoreline is accretional. However, this volume flux rate is very small and is within the error associated with the analysis. Thus, this sediment budget (and shoreline change rate) could have reasonably been positive or negative. It is noted that 5,000 cubic meters spread over 13 km (8 mi) of shoreline is virtually undetectable.

The littoral sub-cell is dominated by sediment inputs from San Juan Creek at the northern boundary. San Juan Creek presents the single largest source of sediment within the entire sub-cell. Thus, the greatest change rates, both for sediment budget and shoreline change, will be measured in the immediate vicinity of the creek mouth. It is entirely probable, and likely, that other areas of the sub-cell farther removed from San Juan Creek will exhibit a sediment volume flux both negative (erosion) and positive (accretion). In other words, other areas of the littoral sub-cell can be either erosional or accretional yet their signal will be masked by what is occurring in the vicinity of San Juan Creek.

2.5.4 Long Term Shoreline Change

Historical Shoreline Change

Shoreline changes within the Oceanside Littoral Cell were investigated by the CCSTWS using historical maps and nautical charts, aerial photos, and the results of ground and bathymetric survey efforts. The results of these extensive efforts are shown in **Table 2-5**.

The table indicates the alongshore variation of shoreline change within the immediate vicinity of San Clemente; the San Clemente study area is between SC 1623 (State Beach) and SC 1720 (Shorecliffs). There are contradictory trends observed in the data. The data sets are out of phase with adjacent locations; a transect is erosional and/or accretional while the adjacent transect is accretional and/or erosional. The mean values during the 1940-1960 and 1960-1980 periods are similar in magnitude; the mean values during the 1980-1989 period are remarkably higher. Detailed inspection of the data indicates a shoreline that is either erosional, balanced, or accretional. During the period 1940-1960, the shoreline indicated essentially zero change with a +0.76 m/yr change in vicinity of SC 1680. During the period 1960-1980, the shoreline vacillated alongshore between positive and negative. The shoreline change was approximately equal between positive and negative ranging from-0.21 m/yr and +0.18 m/yr. During the period 1980-1989, the shoreline was predominantly positive with accretion rates ranging from +0.43 m/yr to +2.16 m/yr; an erosion value of –0.61 m/yr was recorded at SC 1660.

Table 2-5 Long Term Shoreline Change Rates in San Clemente Area

	MHHW Shoreline Change Rate m/yr (ft/yr)			Max Seasonal MHHW Movement m (ft)	
Location	1940-1960	1960-1980	1980-1989	Summer	Winter
SC 1623	-0.06 (-0.20)	-0.21 (-0.70)	2.16 (7.10)	7.7 (25.4)	-7.9 (-26)
SC 1660	0.00 (0.00)	0.18 (0.60)	-0.61 (-2.00)	5.2 (17)	-10.4 (-34)
SC 1680	0.76 (2.50)	-0.12 (-0.40)	0.43 (1.40)	13.9 (45.5)	-17.5 (-57.4)
SC 1720	0.00 (0.00)	0.00 (0.00)	1.46 (4.80)	9.2 (30)	-8.2 (-27)
DB 1805	-0.58 (-1.90)	2.47 (8.10)	-3.75 (-12.30)	7.6 (25)	-13.9 (-45.6)
DB 1850	-0.18 (-0.60)	2.84 (9.30)		0.8 (2.7)	-21.4 (-70.2)
DB 1895	0.76 (2.50)	-0.12 (-0.40)	-0.15 (-0.50)	7.5 (24.6)	-9.6 (-31.4)
DB 1900	0.00 (0.00)	-0.58 (-1.90)	-3.05 (-10.00)	18.2 (59.8)	-27.9 (-91.4)

Current Beach Width Monitoring

The City of San Clemente initiated a beach monitoring program as part of the non-Federal in-kind contributions (Coastal Frontiers, 2002). The general objective of the monitoring program is to document changes in the condition of the shore between Dana Point Harbor and San Mateo Point thereby providing a basis for evaluating the impacts of natural events and anthropogenic operations. The program includes semi-annual full cross-shore profile surveys at eleven representative sites and bi-monthly beach width measurements at nine of the eleven profile sites. The full cross-shore profiles were obtained by contract whereas City of San Clemente lifeguards obtained the bi-monthly beach width measurements.

A description of the transect locations is given in **Table 2-6**. The eleven profile locations include six historical locations originally established by the CCSTWS, and five locations established specifically for the beach monitoring program.

Table 2-6 San Clemente Area Beach Profile Transects

Site #	Transect Designation	Location	Origin
1	DB-1850	N. Doheny State Beach	CCSTWS
2	DB-1805	N. Doheny State Beach	CCSTWS
3	SC-1720	Shorecliffs	CCSTWS
4	SC-1705	Capistrano Trailer Court	Est. Oct. 2001
5	SC-1700	North Beach	Est. Oct. 2001
6	SC-1695	Dije Court	Est. Oct. 2001
7	SC-1680	Linda Lane	CCSTWS
8	SC-1660	T-Street	CCSTWS
9	SC-1645	Lost Winds	Est. Oct. 2001
10	SC1623	San Clemente State Beach	CCSTWS
11	SC-1605	Cottons Point	Est. Oct. 2001

Recent Shoreline Change Rate

The shoreline change rate can be determined from the aggregate measured data collected in support of the CCSTWS and the City of San Clemente beach width monitoring program. The data is a compilation of measurements obtained in the 1980's thru the present.

It is noted that this beach width data set is expressed relative to the MSL contour as opposed to the berm definition adopted for this study. The beach widths are the distance between a fixed point on the backshore and the approximate location of the MSL contour which is also a commonly accepted definition. This MSL beach width incorporates a portion of the "wet" beach e.g. the foreshore between the MSL contour and the berm whereas the berm beach width definition incorporates only the "dry" portion of the beach. Thus the MSL beach widths will be inherently greater than the berm beach widths. The MSL indicates a positive beach width where the beach has been previously defined in many reaches as having zero width. Based on a typical beach slope of 8H:1V and berm elevation of +5.2 m and a MSL contour elevation of +1.64 m, the estimated horizontal beach width attributable to this contour elevation difference is approximately 35 m (114 ft). Thus it can be shown that the dry beach width is zero at Linda Lane and near zero at the other locations. Thus the data sets are consistent with the conclusions developed in this study. It is assumed that the trend for the berm widths will coincide with the trend for the MSL data.

The measured data is shown for the four locations that are historical to the CCSTWS is shown in **Figure 2-14**. The linear regression for each data set is shown. The slope of the lines represents the mean shoreline trend for each respective data set. The long-term shoreline change rate data sets are shown in **Table 2-7**. The shoreline change data sets are considered together to obtain representative values for the entire study area. The mean shoreline change rate is –0.20 m/yr (-0.7 ft/yr), the maximum erosion rate is –0.61 m/yr (-2.0 ft/yr) and the maximum accretion rate is +0.38 m/yr (+1.24 ft/yr).

There are contradictory trends observed in the data. Shorecliffs is the data set that is out of phase with the other three. The three data sets around the pier are consistent in trend and phase. The data sets indicate consistent erosion and accretion trends at the same time. The mean values are similar in magnitude. The data set at Shorecliffs is nearly opposite in behavior. The beach is erosional and/or accretional when the others are accretional and/or erosional. The data in the 1980's is consistent among data sets. After the long absence of data in the 1990's, the 2002 data indicates a loss of beach width.

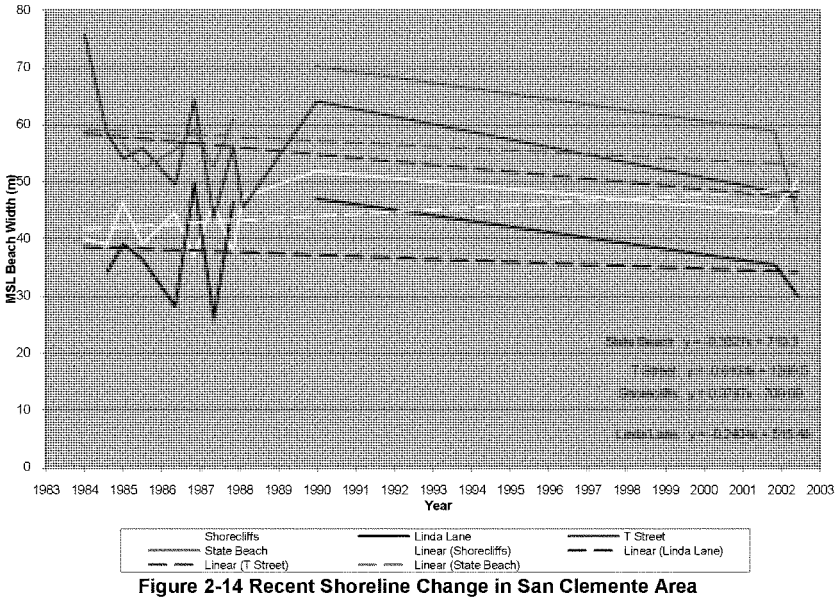

Figure 2-14 Recent Shoreline Change in San Clemente Area

Table 2-7 Summary of Recent Long Term Shoreline Change Rates

Location	Erosion Rate, m/yr (ft/yr)
SC 1720, Shorecliffs	+0.38 (+1.24)
SC 1680, Linda Lane	-0.24 (-0.79)
SC 1660, T – Street	-0.61 (-2.00)
SC 1623, State Beach	-0.33 (-1.09)

2.5.5 Cross-shore Profiles

Cross-shore profiles are compiled from the LIDAR topographic data and bathymetric measured data for Reaches 1-8. Profiles from Reach 6 (vicinity pier area) and Reach 7 (Mariposa Point) are representative of the beach and the armored shoreline respectively that are characteristic in the project area and are shown in **Figure 2-15** and **Figure 2-16**. Only the portion of the profile from the bluff to the waterline is shown to better illustrate the detail of the foreshore and backshore regions. The profile centerline is established at the seaward rail of the SCRRA railroad.

The pier area beach profile indicates a typical berm elevation of +5.2 m (+17 ft), a typical foreshore slope of 8H:1V – 10H:1V, an offshore slope of 110H:1V, and a railroad elevation of approximately +6.4 m (+21 ft).

The Mariposa Point area profile indicates a mean revetment elevation of +6.9 m (+23 ft), typical revetment slope of 1H:1V, toe elevation at approximately 0.0 m, an offshore slope of 110H:1V, and a railroad elevation of approximately +6.4 m (+21ft).

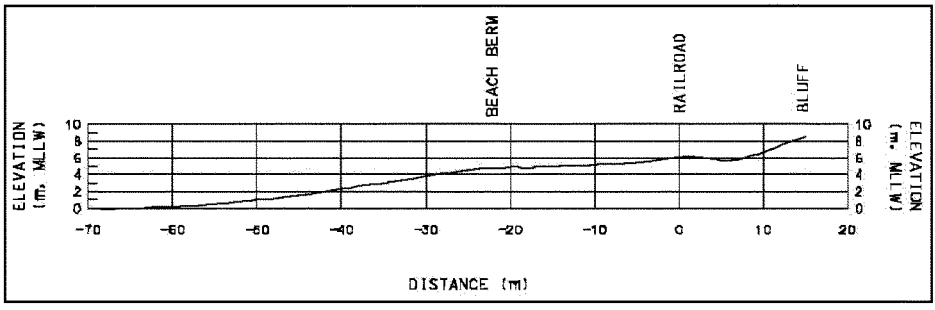

Figure 2-15 Typical Cross-shore Section for Reach 2, Reach 4, Reach 6, Reach 8 (No Revetment)

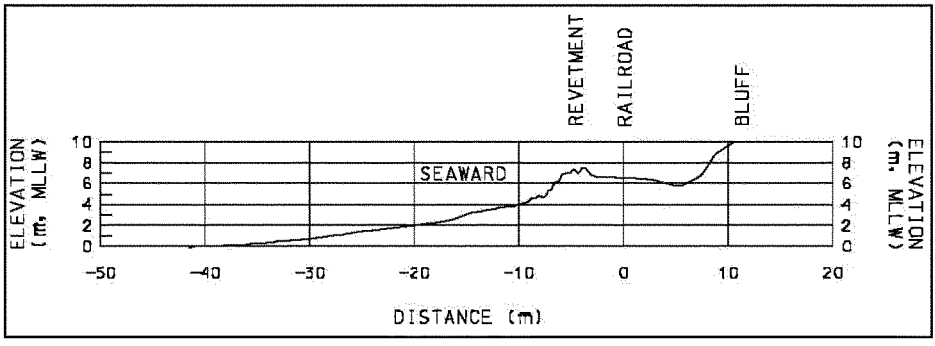

Figure 2-16 Typical Cross-shore Section for Reach 1, Reach 3, Reach 5, Reach 7 (Revetment)

Repetitive cross-shore profiles from the City of San Clemente beach width monitoring program at Linda Lane and T-Street are shown in **Figure 2-17** and **Figure 2-18**. These plots represent five periodic surveys during the period Oct 2001 – Oct 2004 and one survey from Oct 1986. The shallow portion of these plots (above -10 ft) indicates relative consistency throughout. The surveys are relatively consistent throughout with only the May 2004 indicating some change (erosion) in the upper profile. The deeper portions of these plots (below -15 ft) are very consistent throughout with virtually no changes throughout the profile for all surveys. The feature at the -15 ft contour is the reef structure. The overlapping repetitive surveys are indicative of the hard bottom nature of the underlying geology previously described.

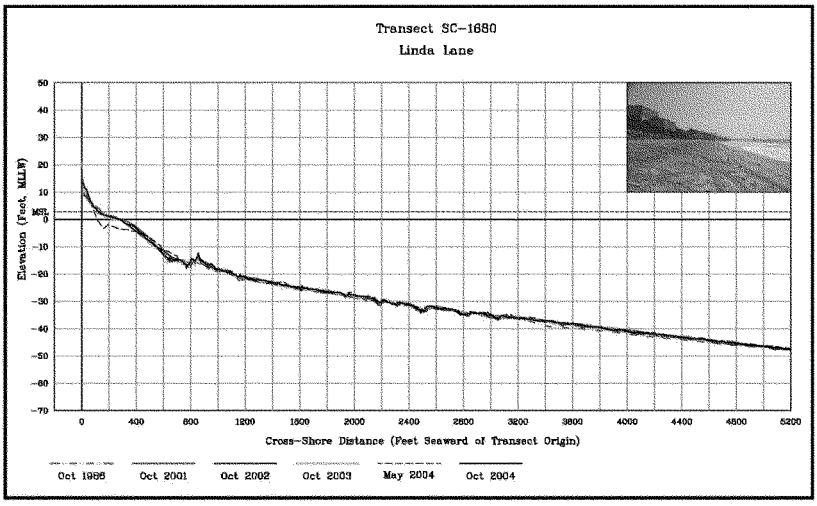

Figure 2-17 Repetitive Cross Sections at Linda Lane (from Coastal Frontiers, 2005)

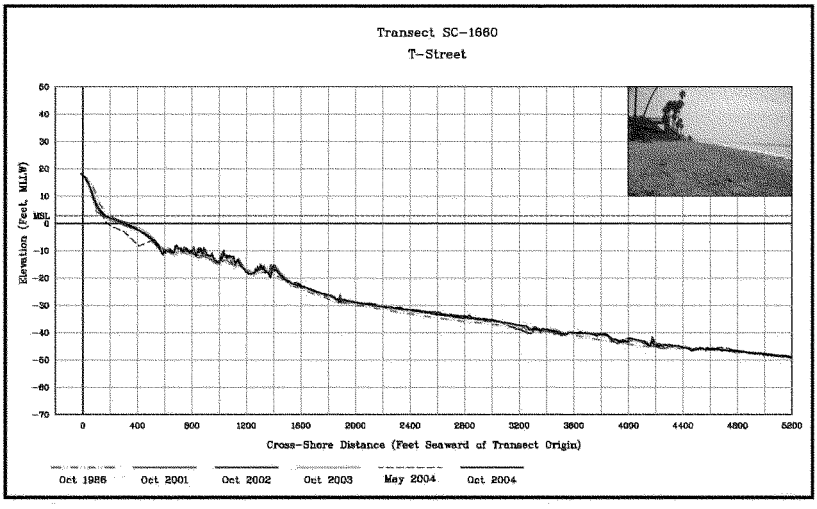

Figure 2-18 Repetitive Cross Sections at T-Street (from Coastal Frontiers, 2005)

2.5.6 Foreshore Slopes

Foreshore slope data was obtained from direct measurements. The City of San Clemente lifeguards obtained direct measurements of the foreshore slope as part of the aforementioned beach width monitoring program. Approximately 21 measurements were obtained 2-3 times each month for a twelve month duration during the period Nov 2001 – Nov 2002 at nine selected locations throughout the study area. The selected locations include all identified in **Table 2-6**, except DB 1850 and DB 1805. The slope was measured in degrees from horizontal and converted to the slope cotangent. Assuming the one year time period is representative of the project period, this data set represents an annual variation of foreshore slope values. A portion of the foreshore slope data is shown in **Table 2-8.**

The histogram of all foreshore measurements is shown in **Figure 2-19**. The gaps in the distribution are a result of the relatively small number of observations, the discrete nature of the values, and the binning effect of the distribution. The measured data is in whole number increments as is the bin increments; some bin increments are not represented by the measured data resulting in gaps in the distribution.

Table 2-8 Sample Beach Monitoring Measurements at T-Street

Date	Width	Slope (deg)	Slope (cotan)
Nov 26, 2001	152	8	7
Dec 13, 2001	152	3	19
Jan 07, 2002	132	4	14
Jan 22, 2002	158	3	19
Feb 07, 2002	151	5	11
Feb 20, 2002	176	5	11
Mar 06, 2002	193	5	11
Mar 22, 2002	155	5	11

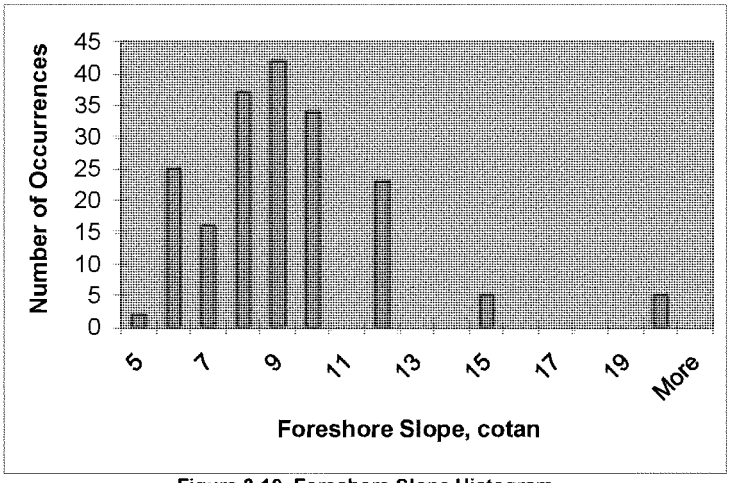

Figure 2-19 Foreshore Slope Histogram

2.5.7 Storm Induced Beach Change

Storm induced beach change is estimated based on measured data not site-specific to San Clemente. Due to historical lack of shoreline studies by Federal or other entities, there is no measured data from the San Clemente project site or the adjacent project area to analyze/predict storm induced beach change. At the initiation of this study all available data sources and references for storm induced beach response for San Clemente were consulted. Not a single observation or measurement of storm induced beach response was found to exist. There is no beach morphological data set which can be used directly to determine storm induced beach response. Thus, a site specific distribution based on measured data could not be developed.

The geologic conditions have previously shown (Sec 2.3.2 and discussed hereinafter) that the area is largely a thin veneer of sediment overlaying a rocky bottom. The beach is a relatively narrow ribbon of sand trapped against the coastal bluffs; the small amount of sediment within the littoral system is worked by waves to the upper limit of the profile. The area conclusively does not contain a full sandy shoreface extending from the backshore to the offshore.

The use of SBEACH, the current USACE predictive model to estimate storm induced shoreline change, was not considered for this study. Due to the fact that a full sandy shoreface does not exist and the nearshore regime is believed controlled by the underlying geology (Sec 2.5.9), predictive models to estimate storm induced shoreline change, i.e. SBEACH, are not believed to be valid and are not believed to accurately represent expected storm induced beach response. The prevailing geologic conditions are not conducive to an expectation of successful SBEACH model performance. The Los Angeles District has an extensive history of unsuccessful attempts to apply SBEACH to local conditions. The District has not been able to achieve model predictions that satisfactorily replicate observed changes.

Adjunct to the SANDAG project monitoring program, the Scripps Institution of Oceanography collected an extensive set of research measurements of the Torrey Pines fill site. Measurements included high resolution pre- and post-storm beach profiles coupled with wave and water level information, exactly the data set necessary to evaluate SBEACH. One of the research products was an impartial evaluation of SBEACH to the measured fill response. This was a systematic evaluation of the sensitivity of the model to the values assigned to the input variables. Scripps concluded SBEACH had "no useful skill in predicting storm-caused erosion of a beach fill with a steep berm".

Absent a measured site-specific distribution or a suite of SBEACH model predictions, measured data from the Orange County Beach Erosion Control Project (Surfside-Sunset) was utilized. Short-term shoreline erosion data have been collected within the Los Angeles District as part of the Surfside-Sunset project. This data set represents a collection of linear beach widths collected at 26 locations over a period of 33 years. This data set is used in the present analysis to estimate shoreline response under storm conditions.

The data set is collected at 26 locations representing various beach and shoreline conditions. Locations are selected which are deemed to be largely free of the influence of coastal structures and their attendant effects on shoreline response. Ten known significant storms were selected for analysis. This results in a subset of measured shoreline response data that is directly correlated to storm input. The aforementioned study area is morphologically very different from the San Clemente study area. The northern Orange County area is primarily wide sandy beaches and a full sand profile. This is compared to the San Clemente study area that has been shown to be primarily a hard bottom area within a thin lens of sand along the shoreline. Thus the San Clemente area has inherently less beach width to exchange cross-shore due to storm response. Therefore, the input distribution collected from northern Orange County was linearly reduced based solely on engineering judgment to more realistically reflect the expected San Clemente shoreline response. A linear relationship was used as no other mathematical relationship or transformation could reasonably or logically be used that would yield realistic results. The "expected" response at San Clemente is a very small storm induced beach response. Consideration was given to the facts that the existing beaches are very narrow, the project area is under geologic control, and the modern record indicates little or no storm induced damages have been recorded even in the most severe storms. The results of this analysis are shown in **Figure 2-20**.

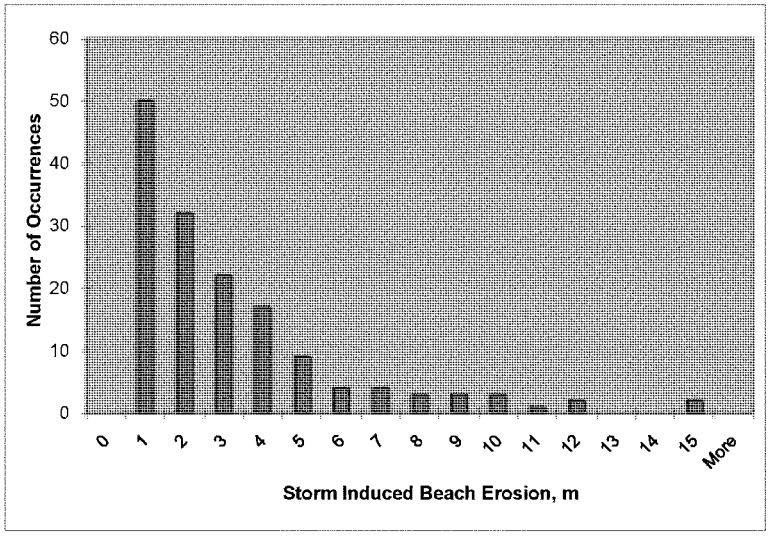

Figure 2-20 Storm Induced Beach Change Histogram

2.5.8 Sediment Profile Thickness

Data collected for the Sand Thickness Survey Report (USACE-SPL 1988) allows estimation of the available sediment supply and consequently any potential limits to erosion. This study conducted jet probing along various profiles to determine the available sediment thickness. Three profiles in the San Clemente area were jet probed including SC-1623 (San Clemente State Beach), SC-1660 (T-Street) and SC-1720 (Capistrano Shores). The survey results indicate the sediment thickness cross-shore along the profile. The results are summarized in T**able 2-9**.

On profile SC-1623, the sediment thickness ranges from 0.1-3.2 meters (0.3-10.5 ft). The average profile is consistently thick 2.4-3.2 m (7.7-10.5 ft) across the beach locations and is near zero 0.1-0.6 m (0.4-1.8 ft) across the seaward portion of the profile.

On profile SC-1660, the sediment thickness ranges from 0.0-4.5 meters (0.0-14.8 ft). The average profile is consistently thick 2.1-4.5 m (6.9-14.8 ft) across the beach locations and is near zero 0.1-0.7 m (0.4-2.2 ft) across the inner seaward portion of the profile. The data indicates a thickness of 2.7 m (8.8 ft) at the furthest offshore location.

On profile SC-1720, the sediment thickness ranges from 0.0-4.6 meters (0.0-15.0 ft). The average profile is consistently thick 1.0-4.5 m (3.3-14.9 ft) across the beach locations and is near zero 0.0-0.2 m (0.0-7 ft) across the seaward portion of the profile.

The measurement results identified cobbles, boulders, and other hard substrate at various depths along the profile. The observations include "some pebbles scattered on beach surface and some boulders visible at backshore" and "offshore sand-stone outcrops with local bottom relief of 1 ft". This information is consistent with 2002 geologic information collected during geophysical studies conducted as part of this study, and reported in the Appendix E of the EIS/EIR.

Table 2-9 Summary of Sand Thickness

	Probe Location			Sand Thickness		
Range Line	No.	Range	Elevation (MLLW)	1	2	Average
SC-1623	1	21.1 m (69.3 ft)	4.1 m (13.5 ft)	3.0 m (9.9 ft)	3.1 m (10.2ft)	3.1 m (10.1ft)
SC-1623	2	34.6 m (113.5 ft)	3.4 m (11.1 ft)	3.2 m (10.5ft)	3.2 m (10.4ft)	3.2 m (10.5ft)
SC-1623	3	51.7 m (169.6 ft)	2.1 m (6.9 ft)	2.4 m (7.7 ft)	2.3 m (7.6 ft)	2.4 m (7.7 ft)
SC-1623	4	194.2 m (636.8 ft)	-3.5 m (-11.4 ft)	0.1 m (0.3 ft)	0.1 m (0.4 ft)	0.1 m (0.4 ft)
SC-1623	5	266.1 m (872.8 ft)	-6.0 m (-19.6 ft)	0.2 m (0.8 ft)	0.3 m (0.9 ft)	0.3 m (0.9 ft)
SC-1623	6	504.2 m (1653.8 ft)	-9.3 m (-30.5 ft)	0.6 m (1.8 ft)	0.6 m (1.8 ft)	0.6 m (1.8 ft)
SC-1660	1	11.5 m (37.6 ft)	5.0 m (16.3 ft)	4.5 m (14.8ft)	4.5 m (14.8ft)	4.5 m (14.8ft)
SC-1660	2	23.5 m (77.2 ft)	3.1 m (10.2 ft)	3.4 m (11.0ft)	3.5 m (11.4ft)	3.4 m (11.2ft)
SC-1660	3	42.9 m (140.6 ft)	1.5 m (4.8 ft)	2.2 m (7.2 ft)	2.0 m (6.6 ft)	2.1 m (6.9 ft)
SC-1660	4	232.8 m (763.5 ft)	-3.1 m (-10.1 ft)	0.0 m (0.0 ft)	0.2 m (0.8 ft)	0.1 m (0.4 ft)
SC-1660	5	462.4 m (1516.5 ft)	-6.5 m (-21.3 ft)	0.6 m (2.0 ft)	0.7 m (2.3 ft)	0.7 m (2.2 ft)
SC-1660	6	673.6 m (2209.5 ft)	-9.0 m (-29.6 ft)	2.6 m (8.5 ft)	2.7 m (9.0 ft)	2.7 m (8.8 ft)
SC-1720	1	10.9 m (35.9 ft)	4.7 m (15.4 ft)	4.6 m (15.0ft)	4.5 m (14.8ft)	4.5 m (14.9ft)
SC-1720	2	24.8 m (81.4 ft)	2.7 m (8.7 ft)	2.8 m (9.2 ft)	3.0 m (9.9 ft)	2.9 m (9.6 ft)
SC-1720	3	46.5 m (152.6 ft)	0.6 m (1.9 ft)	1.0 m (3.3 ft)	1.0 m (3.3 ft)	1.0 m (3.3 ft)
SC-1720	4	165.2 m (541.9 ft)	-2.5 m (-8.1 ft)	0.0 m (0.0 ft)	0.0 m (0.0 ft)	0.0 m (0.0 ft)
SC-1720	5	494.8 m (1622.9 ft)	-6.7 m (-21.9 ft)	0.2 m (0.5 ft)	0.2 m (0.5 ft)	0.2 m (0.5 ft)
SC-1720	6	879.5 m (2884.9 ft)	-8.6 m (-28.3 ft)	0.2 m (0.5 ft)	0.2 m (0.8 ft)	0.2 m (0.7 ft)

2.5.9 Geologic Control

The underlying geologic framework and inherited geological factors appear to be more significant determinants of beach morphology than wave driven dynamics. The underlying geology establishes the framework within which the beach forms and sets the limits to morphological evolution via the shape and volume of accommodation space (McNinch, 2004). Due to the preeminence of the near-field and far-field geologic conditions, it is believed that the beach behavior is greatly influenced by, if not controlled by, the underlying geology and the region is therefore under geologic control.

The offshore geologic conditions were extensively mapped and are fully described in the Appendix E of the EIS/EIR. The geologic mapping indicates that the area from San Juan Creek to San Mateo Creek is essentially hard exposed bedrock throughout the regime. Mapping indicates the offshore regime is primarily hard bottom covered in some places by shallow pockets or a thin veneer of sediment. Raised rock reefs are common and a large rock reef pierces the ocean surface just south of San Clemente pier. The beach is a relatively narrow ribbon of sand trapped against the coastal bluffs; the small amount of sediment within the littoral system is worked by waves to the upper limit of the profile. This description is consistent with other areas within the Oceanside littoral cell. The shoreline within the Oceanside littoral cell displays a wide variety of coastal features indicative of a region under geologic control including cliffs, headlands, beaches composed of cobbles, and submarine canyons.

The sediment within the littoral system forms a thin, surficial veneer over bedrock and there is clearly a strong geological control on its morphology. This underlying bedrock surface establishes a downward limit for profile excursion and thus constrains full profile development. Beach profile morphology is constrained by the low volume available for sediment storage and insufficient sediment inputs from rivers, both inhibiting formation of a full shoreface profile. The offshore part of the shoreface is mostly rock outcrops, whereas the backshore/foreshore portion of the profile is lightly populated by sediments and thus results in a very thin beach. The beach therefore assumes a steeper upper profile than might typically be expected and is unable to evolve a full beach profile.

The planform of the coast southeast of Dana Point is that of a crenulate bay, indicative of general north to south transport. The crenulate shoreline is "pinned" by Dana Point and San Mateo Point. On a smaller scale Mariposa Point also similarly acts like a boundary headland and a narrow sandy beach is "trapped" between Mariposa Point and San Mateo Point. The shoreline at the downdrift (southerly) end at San Mateo Point tends to behave like a fillet; the beach has marginally greater width in this region. This is also consistent with net sediment transport direction of north to south.

The sediment sources described in Sec 2.5.2 are indicative of a region that does not naturally have an abundance of sediment supplied to the beaches. The sediment discharge estimates indicate an average of approximately 20,000 m^3/yr (27,000 yd^3/yr) is delivered annually to the beaches by San Juan Creek. San Juan Creek is located adjacent the boundary headland of the littoral cell and is the only major source of sediment input to the San Clemente area. This is a small quantity relative to some of the larger inputs from other river systems in southern California.

The sediment budget is indicative of a region that does not naturally have an abundance of sediment supplied to the beaches. Engineering estimates indicate approximately 45,000 m^3/yr of sediment are input to the San Clemente region. It is recognized that this represents

approximately 47% of the estimated "natural" sediment inputs prior to anthropogenic development, nonetheless, these values are not believed sufficient to establish development of sand across the full shoreface.

Historical information indicates that the railroad around Mariposa Point has been armored with revetment since at least the 1930's. This is direct evidence that suggests that the shoreline has experienced a paucity of sediment since then, and possibly much earlier. The presence of a sandy shoreline would have obviously eliminated the need for the railroad to construct shoreline erosion protection. Although the historical record is inconclusive, there is no evidence to suggest that there has ever been an expansive sandy beach in front of this section of the railroad.

2.5.10 Sea Level Change

Relative sea level change is considered to have direct impacts on the 50-year future without-project and future with-project conditions. Relative sea level change can be significant for long-term beach erosion rates. As the relative water level rises, a landward migration of the shoreline can be expected assuming the profile shape does not change and the longshore sediment transport is in equilibrium (i.e., no erosion or deposition).

For the existing sea level change condition, the historical shoreline change will be considered constant and will not change due to the total relative sea level change. The total relative sea level change magnitude is small (0.12 m (0.4 ft) per 50 years) whereas the aforementioned CCSTWS historic sediment transport analyses have identified the expected shoreline change rate based on measured data and oceanographic processes. These analyses were based on data time scales similar to the 50-year life of this project. The results of these analyses are considered more accurate and representative than a generalized calculation for long-term erosion rates based solely on sea level rise. Thus, the shoreline change due to sea level rise is not expected to dramatically influence the shoreline change rate, and the shoreline change rates will be held constant.

For the Curve 3 sea level change condition, the historical shoreline change will vary and will change due to the total relative sea level change. The total relative sea level change magnitude is large (0.7 m (2.3 ft) per 50 years) compared to the low level sea level rise estimate which is based on historic measured data. This relatively large change magnitude would likely result in a change in the sediment transport mechanisms, and ultimately a changed sediment budget.

The Bruun Rule is used in the current study to provide an estimate for long term shoreline change rate due to extreme sea level rise. It is very difficult to accurately quantity the change in sediment transport mechanisms as the number of variables governing sediment transport is numerous and their inter-relationships are complex. Furthermore, there is no universally accepted model for estimation of the change of shoreline change rates due to sea level change. The Bruun Rule is a simple, two-dimensional model to estimate shoreline change due to a rise in sea level. The Bruun Rule is given as:

$$R = S/\tan(\theta)$$

Where R = the shoreline recession (landward directed change), S = sea level rise, and θ = slope of beach foreshore.

While recognizing the shortcomings and lack of general consensus on the validity of the Bruun Rule, it nonetheless yields a rapid, semi-quantitative estimation for shoreline retreat in the

presence of sea level rise. Application of the Bruun Rule for San Clemente yields an estimate of 0.10 m/yr (0.32 ft/yr) increase to the mean long term erosion rate. As the measured historic mean long-term erosion rate is 0.10 m/yr (0.33 ft/yr), this coincidentally represents a doubling of the erosion rate due to sea level rise. The implementation of these results is embedded in the model computations (discussed hereinafter).

2.5.11 SANDAG Beach Fills

A regional shoreline nourishment project was performed in 2001 by the San Diego Association of Governments (SANDAG) (Coastal Frontiers, 2006). The project entailed dredging 1.6 million m^3 (2.1 million yd^3) of beach compatible sediments from six borrow sites for placement on twelve receiver beaches in San Diego County. Extensive project monitoring has been conducted semi-annually since project construction. The similarities of this construction project relative to the morphologic conditions, oceanographic climate (waves, tides), sediment characteristics, and construction techniques make this project directly comparable to this study. The pertinent information of the twelve receiver beaches is described in **Table 2-10.** The fill site locations are shown in **Figure 2-21**, **Figure 2-22**, **Figure 2-23**, **Figure 2-24**, **Figure 2-25**, and **Figure 2-26.**

Table 2-10 SANDAG Beach Fills

Receiver Beach	Volume, m^3 (yd^3)	Length, m (ft)	Width, m (ft)	D_{50}, mm	Distance, km (mi)
Imperial	92,000 (120,000)	701 (2,300)	37 (120)	0.24-0.52	108 (67)
Mission	116,000 (151,000)	701 (2,300)	61 (200)	0.52	84 (52)
Torrey Pines	187,000 (245,000)	488 (1,600)	49 (160)	0.14	66 (41)
Del Mar	140,000 (183,000)	976 (3,200)	37 (120)	0.14	61 (38)
Fletcher Cove	112,000 (146,000)	579 (1,900)	21 (70)	0.14	58 (36)
Cardiff	77,000 (101,000)	274 (900)	46 (150)	0.34	55 (34)
Moonlight	80,000 (105,000)	335 (1,100)	55 (180)	0.34-0.62	52 (32)
Leucadia	101,000 (132,000)	823 (2,700)	37 (120)	0.62	48 (30)
Bataquitos	90,000 (117,000)	457 (1,500)	55 (180)	0.62	47 (29)
S. Carlsbad	121,000 (158,000)	610 (2,000)	55 (180)	0.62	43 (27)
N. Carlsbad	172,000 (225,000)	945 (3,100)	30 (100)	0.14-0.62	37 (23)
Oceanside	322,000 (421,000)	1,341 (4,400)	56 (185)	0.62	35 (22)

Note: Distance is from San Clemente Fill Area

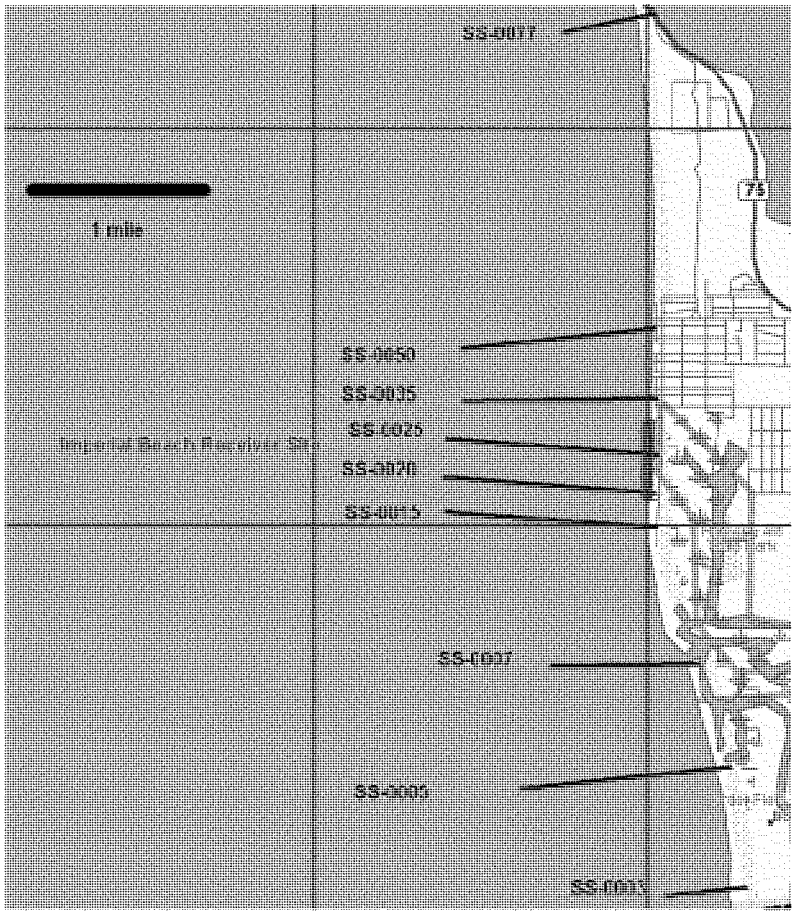

Figure 2-21 Site Location for Imperial Beach Fill (from SANDAG, 2010)

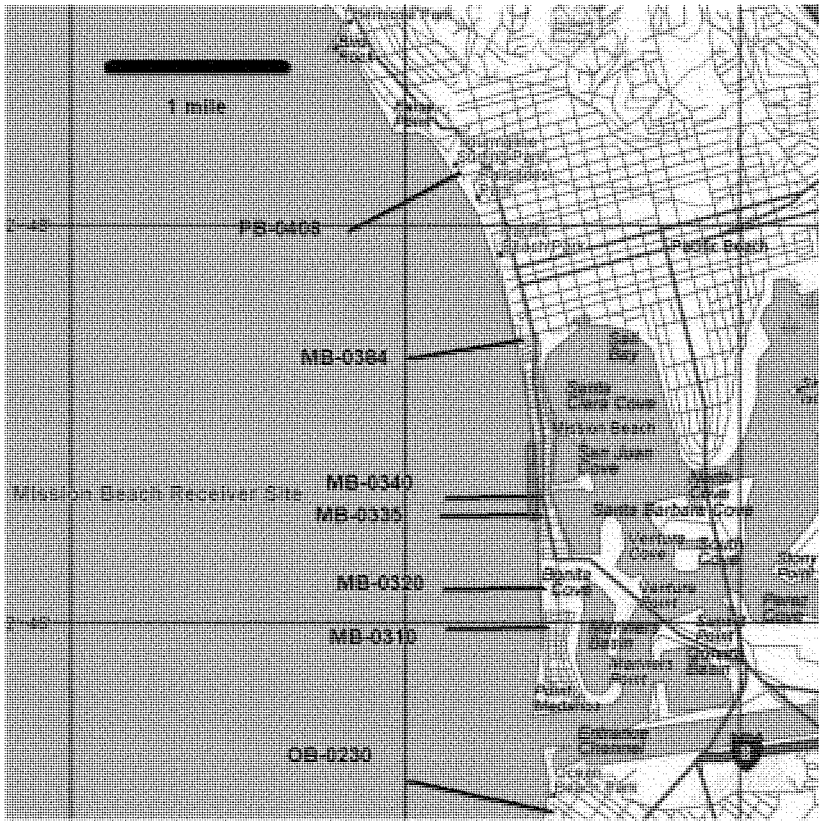

Figure 2-22 Site Location for Mission Beach Fill (from SANDAG, 2010)

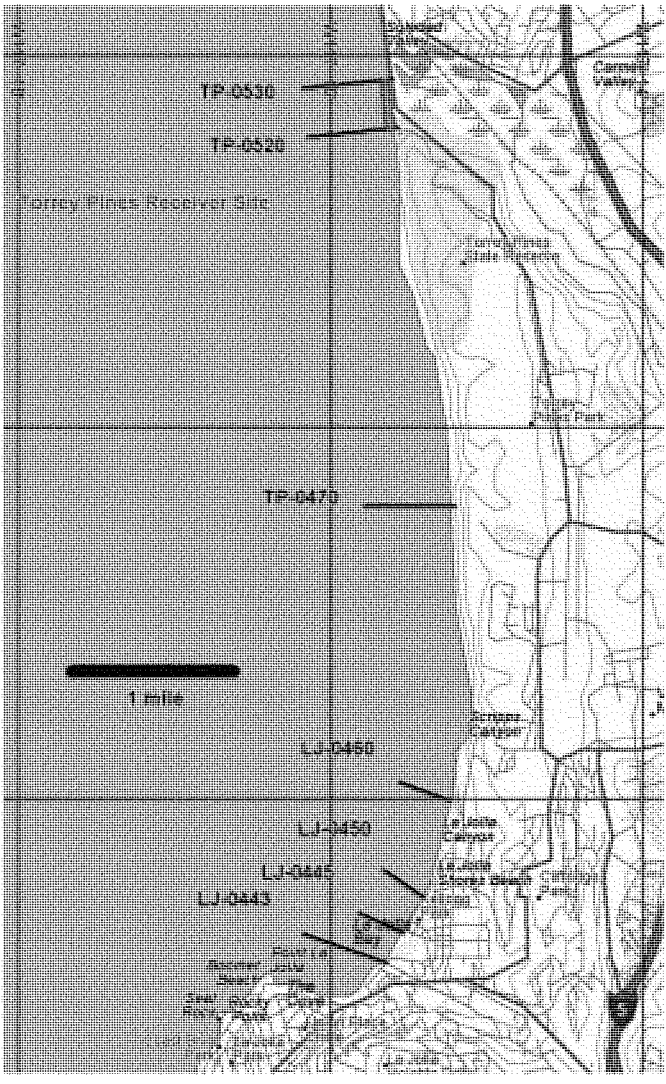

Figure 2-23 Site Location for Torrey Pines Fill (from SANDAG, 2010)

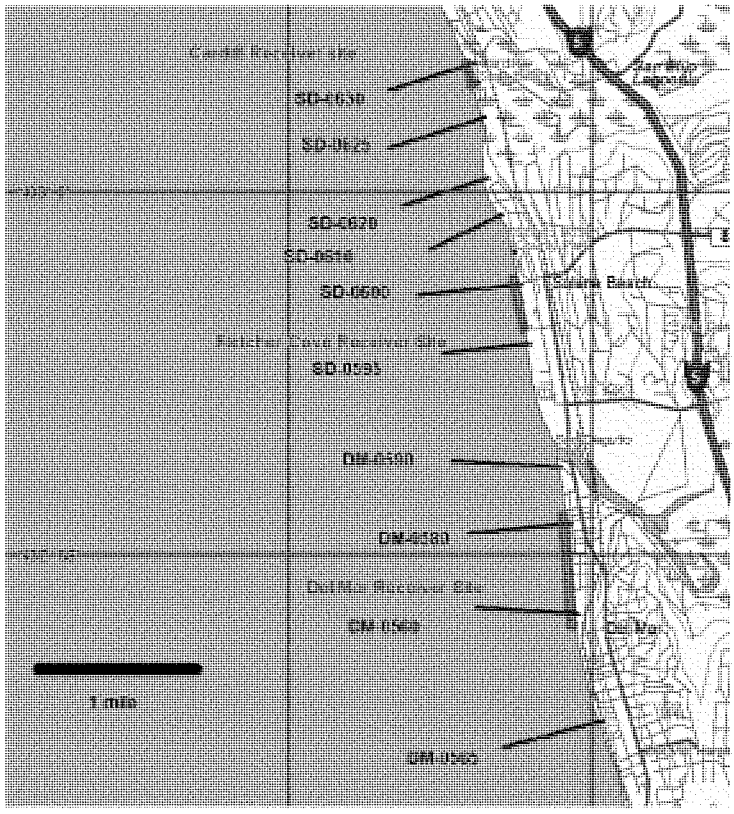

Figure 2-24 Site Location for Del Mar, Fletcher Cove, and Cardiff Fills (from SANDAG, 2010)

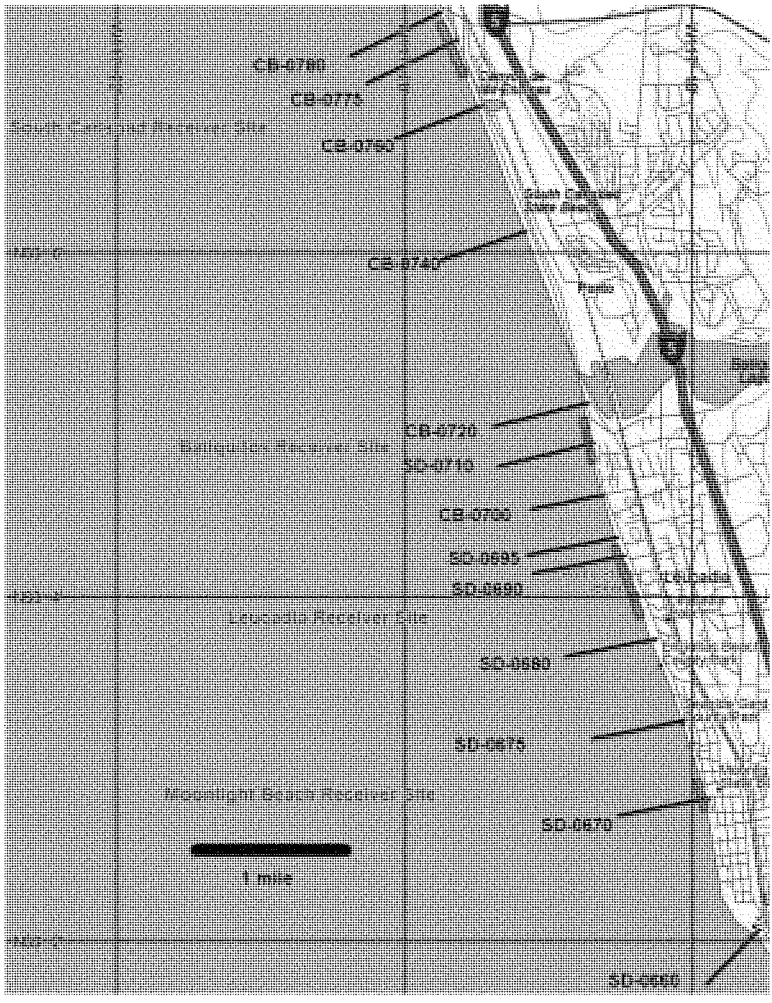

Figure 2-25 Site Location for Moonlight, Leucadia, Batiquitos, and South Carlsbad Fills (from SANDAG, 2010)

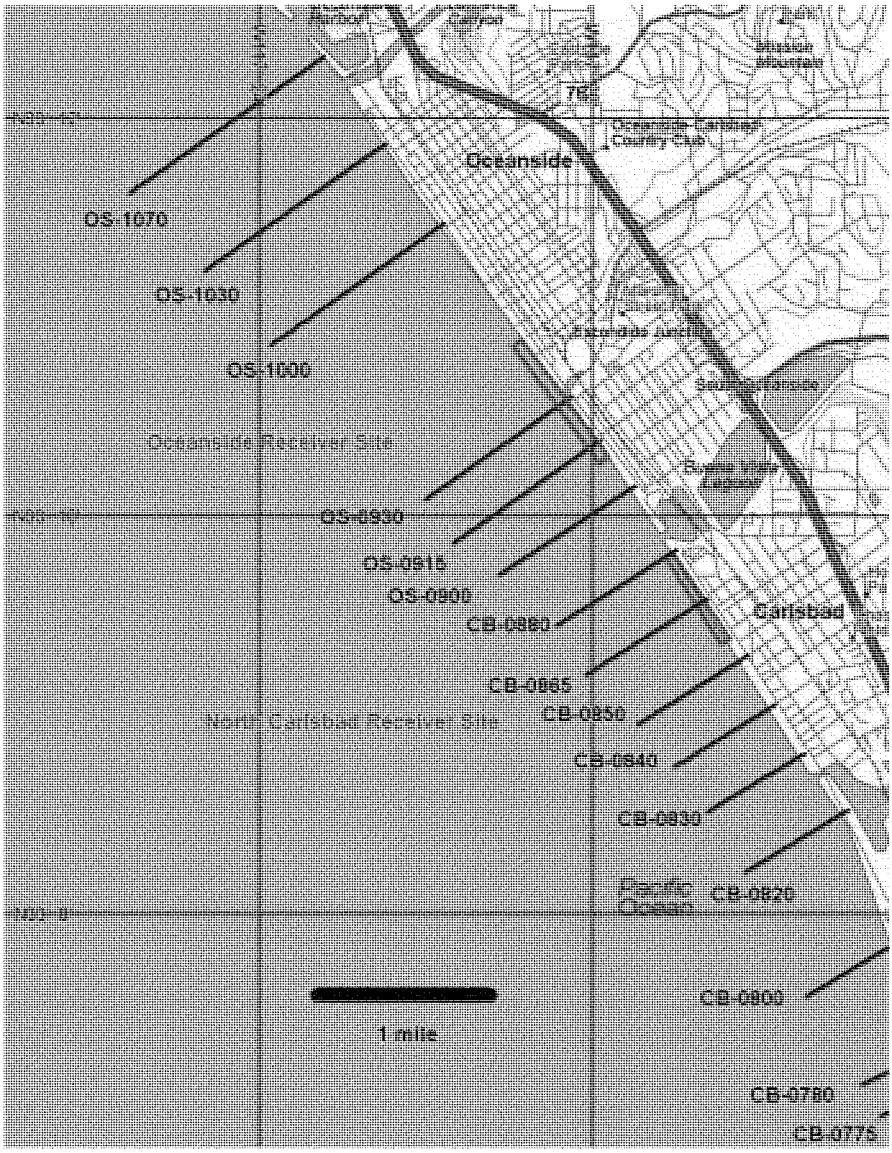

Figure 2-26 Site Location for North Carlsbad and Oceanside Fills (from SANDAG, 2010)

Much of San Diego County is morphologically similar to San Clemente. The similarities include high coastal bluffs, a close-to-shore rock platform, and typically narrow sand beach (or often none). It is typical that background shoreline change rates throughout the region are small, on order of -0.3 m/yr (-1 ft/yr) or less. It is noted, however, that the wave/sediment regime within San Diego County can vary substantially alongshore. Due to offshore island sheltering (waves) and submarine canyons (sediment transport), micro wave/sediment climates can and do exist. This makes any specific location-to-location comparisons difficult to substantiate.

One of the more compelling results of the SANDAG monitoring effort has been the rapid deflation of the beach fills. The result of this analysis is discussed in Sec 3.7.2 and indicates very large annual shoreline excursions, both negative and positive, of up to 18 m. While background erosion rates are very small, measured beach fill shoreline change rates are several meters per year, a 1-2 order of magnitude increase.

A description of each beach fill area follows. The beach fills are grouped by littoral cell. A generalized description of the littoral cell is followed by pertinent observations about the specific beach fill site.

Silver Strand Littoral Cell

The Silver Strand Littoral Cell extends over a 27-km (17-mi) long coastal reach from the headland at the south end of the Playas de Tijuana, Mexico (located 4.8 km (3 mi) south of the U.S. – Mexico international border), to Zuniga Jetty located immediately east of the entrance to San Diego Bay, as shown in **Figure 2-27**. The primary physical features of this littoral cell include the coastal bluffs of the Playas de Tijuana, the Tijuana River delta, and the broad sandy beaches of the Silver Strand. An effective sediment sink in this littoral cell is the shoal located adjacent to Zuniga Jetty, where beach sand transported to the north along the Silver Strand beaches becomes impounded in the lee of Pt. Loma.

The longshore transport rate at the northern end of the littoral cell is estimated to be 91,750 m^3 (120,000 yd^3) annually. The longshore transport rate for the central one-third portion of the littoral cell is estimated to be 122,330 – 137,620 m^3 (160,000 – 180,000 yd^3) annually. The longshore transport rate at the southern end of the littoral cell is estimated to be zero.

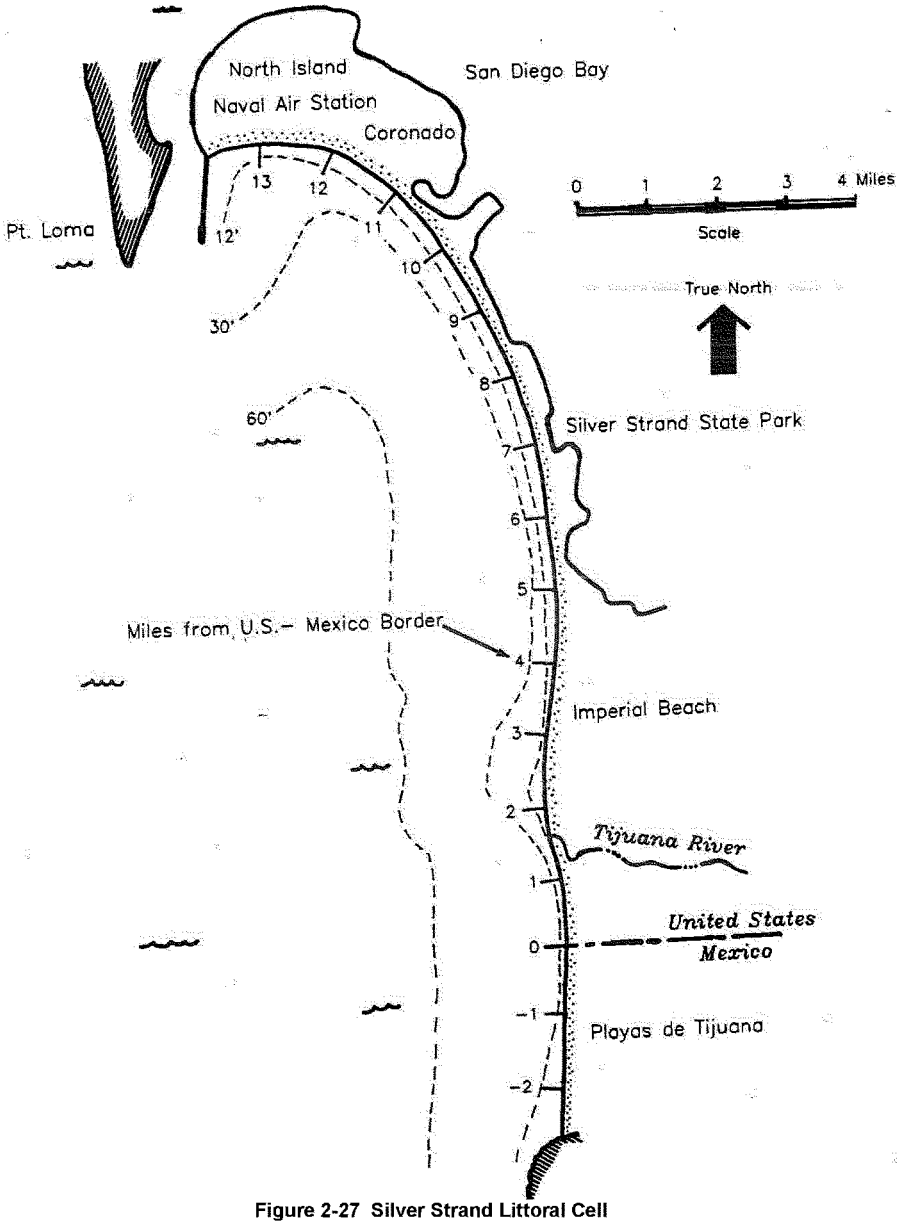

Figure 2-27 Silver Strand Littoral Cell

Imperial Beach: The Imperial Beach fill receiver site is shown in **Figure 2-28**. The receiving beach is predominantly sandy with a small percentage of cobble. Significant morphologic features include the Tijuana River estuary immediately adjacent to the south; the entrance is natural with no man-made controlling structures. Significant man-made features include the Imperial Beach Pier bisecting the receiver site.

Figure 2-28 Imperial Beach Receiver Site (from SANDAG, 2010)

Mission Beach Littoral Cell

The Mission Bay Littoral Cell is a 26.5-km (16.5-mi) long coastal segment bounded on the north by Pt. La Jolla and on the south by Pt. Loma, at the entrance to San Diego Bay, as shown in **Figure 2-29**. The north and south portions of this littoral cell are composed of high rocky bluffs containing pocket beaches of small areal extent. Seacliff recession along these areas has been noted in the past. The 6.4-km (4-mi) long central part of this cell contains sandy beaches including Ocean Beach, Mission Beach, and Pacific Beach. The coast between Mission Beach and Ocean Beach is divided by the jettied entrance to Mission Bay and the San Diego River outlet.

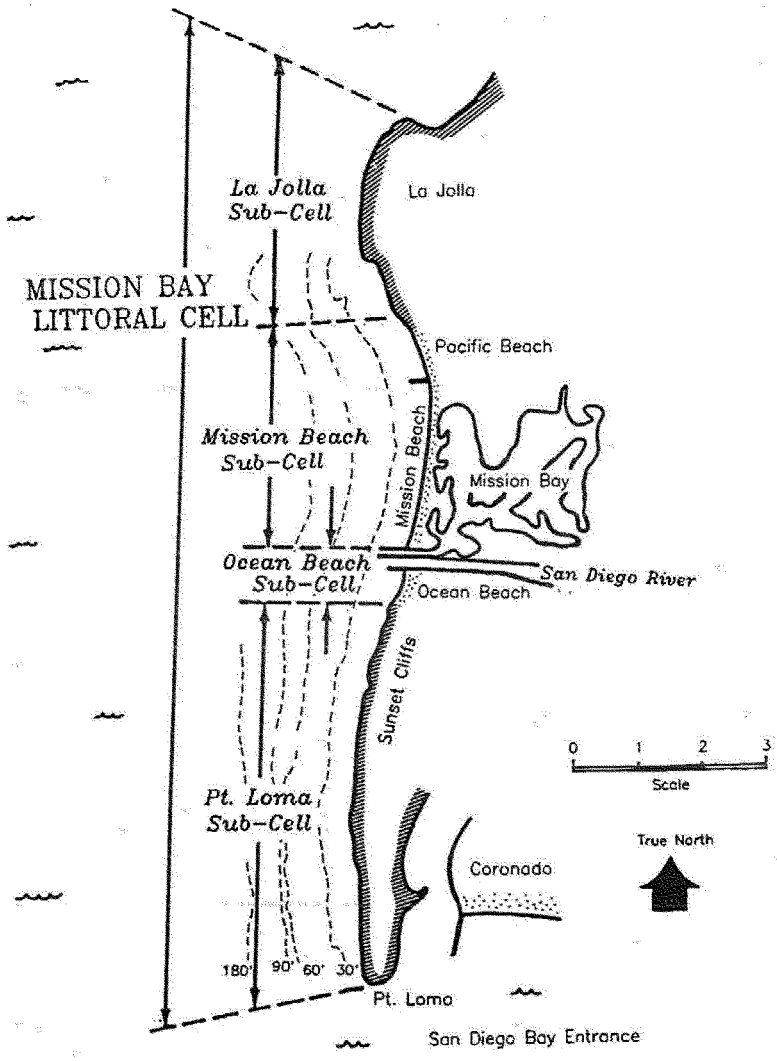

Figure 2-29 Mission Bay Littoral Cell

Within the littoral cell alongshore shifts in sediment volume occur frequently in response to changing wave conditions. Typically, northerly shifts of sediment are experienced during the winter, while this pattern reverses during the summer. A wave hindcast study indicates a gross sediment transport rate of 153,000 m^3 (200,000 yd^3) annually, with an annual net northerly rate of 15,300 m^3 (20,000 yd^3).

Mission Beach: The Mission Beach fill receiver site is shown in **Figure 2-30**. The receiving beach is predominantly sandy. Significant morphologic features include the Mission Bay / San Diego River immediately adjacent to the south. The entrance is controlled by three rubblemound jetties. Other significant man-made features include the Pacific Beach Pier approximately 3 km (1.5 mi) to the north.

Figure 2-30 Mission Beach Receiver Site (from SANDAG, 2010)

Oceanside Littoral Cell

San Clemente is within the Oceanside Littoral Cell. This littoral cell, including the wave climatology, is fully described and subsequently discussed throughout this report.

Torrey Pines: The Torrey Pines fill receiver site is shown in **Figure 2-31**. The receiving beach is predominantly sandy. Significant morphologic features include the Los Penasquitos Lagoon and mouth immediately adjacent to the north. The lagoon mouth is constrained to its location by a highway bridge. The receiver site is bounded by coastal bluffs to the north and south. Significant man-made features include a revetment protecting the adjacent parallel highway.

Figure 2-31 Torrey Pines Receiver Site (from SANDAG, 2010)

Del Mar: The Del Mar fill receiver site is shown in **Figure 2-32**. The receiving beach is predominantly sandy. Significant morphologic features include the Los Penasquitos Lagoon and mouth immediately adjacent to the north. The lagoon mouth is constrained to its location by a highway bridge. The receiver site is bounded by coastal bluffs to the north and south. Significant man-made features include a revetment protecting the adjacent parallel highway.

Figure 2-32 Del Mar Receiver Site (from SANDAG, 2010)

Fletcher Cove: The Fletcher Cove fill receiver site is shown in **Figure 2-33**. Fletcher Cove is a small opening in the otherwise continuous coastal bluffs. The receiving beach is predominantly sandy.

Figure 2-33 Fletcher Cove Receiver Site (from SANDAG, 2010)

Cardiff: The Cardiff fill receiver site is shown in **Figure 2-34**. The receiving beach is predominantly sandy. Significant morphologic features include the San Elijo Lagoon and mouth immediately adjacent to the north. The lagoon mouth is constrained to its location by a highway bridge. Significant man-made features include a revetment protecting the adjacent parallel highway.

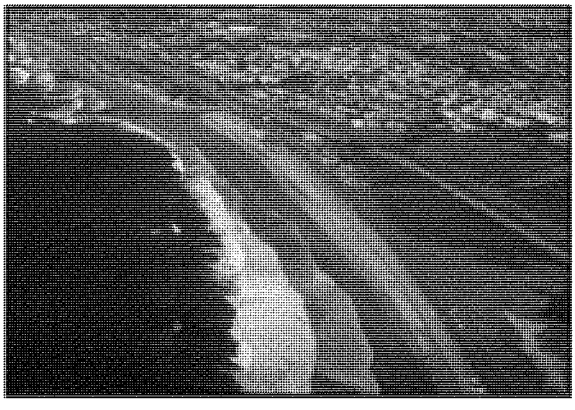

Figure 2-34 Cardiff Receiver Site (from SANDAG, 2010)

Moonlight: The Moonlight Beach fill receiver site is shown in **Figure 2-35**. Moonlight Beach is a small opening in the otherwise continuous coastal bluffs. The receiving beach is predominantly sandy. Significant morphologic features include a small headland (Swami's Reef) immediately adjacent to the south. There are no significant man-made features in the immediate vicinity.

Figure 2-35 Moonlight Receiver Site (from SANDAG, 2010)

Leucadia: The Leucadia fill receiver site is shown in **Figure 2-36**. The receiving beach is predominantly sandy. Significant morphologic features include the continuous high coastal bluffs backing the beach. There are no significant man-made features in the immediate vicinity.

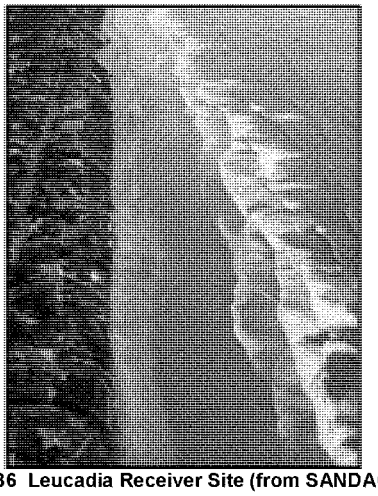

Figure 2-36 Leucadia Receiver Site (from SANDAG, 2010)

Batiquitos: The Batiquitos fill receiver site is shown in **Figure 2-37**. The receiving beach is predominantly sandy. Significant morphologic features include the Batiquitos Lagoon and mouth immediately adjacent to the north. The lagoon mouth is constrained to its location by rubblemound jetties.

Figure 2-37 Batiquitos Receiver Site (from SANDAG, 2010)

South Carlsbad: The South Carlsbad fill receiver site is shown in **Figure 2-38**. The receiving beach is backed by continuous coastal bluffs and is predominantly sandy. Significant morphologic features include a small headland immediately adjacent to the north, and the Agua Hedionda Lagoon and mouth further updrift to the north. The lagoon mouth is constrained to its location by rubblemound jetties. Other significant man-made features include a set of jetties controlling the cooling water intake for the Carlsbad electrical generating facility.

Figure 2-38 South Carlsbad Receiver Site (from SANDAG, 2010)

North Carlsbad: The North Carlsbad fill receiver site is shown in **Figure 2-39**. The receiving beach is predominantly sandy. Significant morphologic features include the Buena Vista Lagoon and mouth immediately adjacent to the north. The lagoon mouth is constrained to its location by perimeter development. There are no significant man-made features in the immediate vicinity.

Figure 2-39 North Carlsbad Receiver Site (from SANDAG, 2010)

Oceanside: The Oceanside fill receiver site is shown in **Figure 2-40**. The receiving beach is predominantly sandy. Significant morphologic features include the Buena Vista Lagoon and mouth immediately adjacent to the south. The lagoon mouth is constrained to its location by perimeter development. There are no significant man-made features in the immediate vicinity.

Figure 2-40 Oceanside Receiver Site (from SANDAG, 2010)

3 DESIGN METHODOLOGY AND CONDITIONS

3.1 *Design Storm Water Levels*

The design storm water level is derived from the linear superposition of the tidal range, an assumed range for storm surge, and sea level rise. It is recognized that tidal level and storm surge are physically independent and statistically independent. The design storm water level (without sea level rise) used in the present analysis ranges from +1.15-2.24 m (MLLW) (+3.8-7.4 ft). Design storm water level is determined based on the following expression:

Design Storm Water Level = TideUniform(0.85,1.64) + SurgeUniform(0.3,0.6) + SeaLevel(SLC, based on NRC exponential curves)

Where SLC = 0.12 m for 50 yr, Sea Level Case 1 (existing level)
Where SLC = 0.7 m for 50 yr, Sea Level Case 3 (extreme level)

The tidal value used in the present analysis is randomly selected from a uniform distribution ranging between 0.85-1.64 m (2.8-5.4 ft). The surge value used in the present analysis is randomly selected from a uniform distribution ranging between 0.3-0.6 m (1-2 ft). It is assumed that the typical storm duration is three days and the typical storm duration peak is one day. The tide could be at any random position of the lunar cycle between neap and spring tides. During the one day storm period peak, the tide could range through the full unequal mixed range between neap tides and spring tides. It is assumed that the tide will rise to the highest tidal level. It is assumed that the neap tide high water condition will range up to the mean tide level, which is +0.85 m MLLW at La Jolla, CA. The mean higher high water condition is +1.64 m MLLW at La Jolla, CA. Thus, the tidal level was randomly selected from a uniform distribution ranging from 0.85-1.64 m MLLW representing the neap tide high and the spring tide high. It is assumed a constant storm surge occurs throughout the period of the storm and is assumed to occur simultaneously with the tidal level. Thus, the linear superposition of the random tide selection and the random surge selection minimizes a probabilistically unlikely set of tidal level / storm surge conditions, i.e. a 100 year recurrence tidal level occurring simultaneously with a 100 year recurrence storm surge level. The peak value of +2.24 m (7.4 ft) is slightly less than the highest observed water level (+2.38 m, +7.8 ft) that occurred during the 1983 storm season. The relative sea level change was added at a exponentially increasing rate between years 1-50 throughout the life-cycle simulation.

3.2 *Design Waves*

The design wave climatology used for this analysis is based on the winter wave climate previously discussed in Section 2.4. The significant wave height statistical analysis is shown in **Figure 3-1**. The lognormal distribution was selected as representative of the sample data set. The lognormal distribution has the form:

$$f(x) = \frac{1}{\sigma x\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{\ln x - \mu}{\sigma}\right)\right]^2$$

where μ = *0.74 (mean)*
σ = *0.39 (standard deviation)*

Although there is no theoretical basis for selection of the lognormal distribution, the lognormal distribution is commonly used in coastal engineering practice to represent significant wave height.

The lognormal probability distribution is truncated for significant wave height values below 2.60 meters (8.5 ft) to represent the annual maximum threshold. Each iteration of the Monte Carlo simulation assumes that the selected wave height is at least an annual storm event. Based on the annual maximum wave heights for the measured data record, the mean annual significant wave height is 2.60 m (8.5 ft). This value is consistent with conventional coastal engineering practice for expected annual maximums within the Los Angeles District. Thus, the simulation is forced to select a significant wave height from the input distribution greater than or equal to 2.60 m.

The lognormal probability distribution is truncated for significant wave height values above 8.0 meters (26.1 ft) due to wave breaking. Significant wave heights above approximately 8.0 meters will break. The concept of depth limited waves is well established in the literature. Based on empirical relationships derived by Weggel, a breaking height H_b can be computed for a given set of parameters including wave period, water depth, and local bottom slope. It can be shown that any wave with a height greater than this computed breaking height will also break. This is termed the depth limited height. For this analysis, significant wave heights in excess of 8.0 m at this 10.2 m depth are not considered due to breaking.

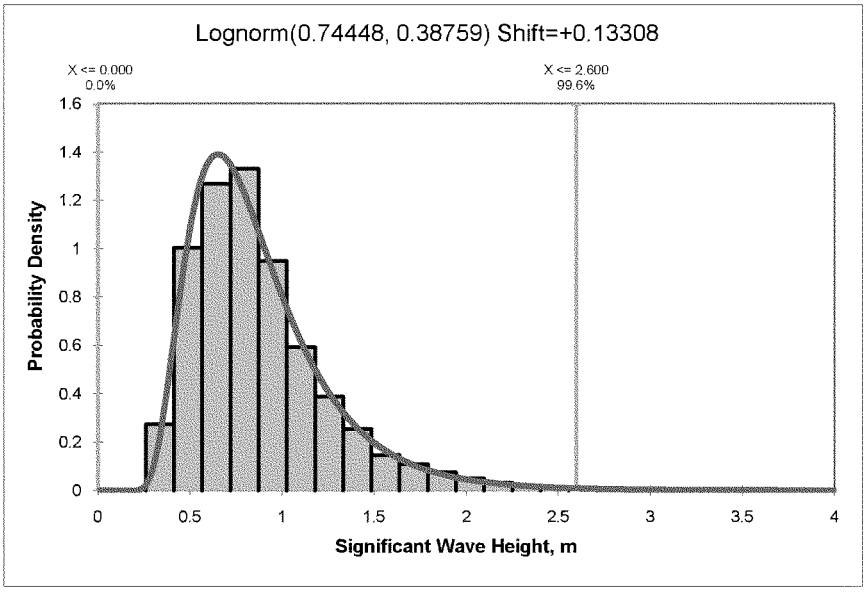

Figure 3-1 Probability Distribution for Significant Wave Height, Winter Data, 1983-1998

3.3 *Design Wave Periods*

The design wave period distribution used for this analysis is developed from the measured wave climate climatology previously discussed. The wave period statistical analysis is shown in **Figure 3-2**. The logistic distribution was selected as representative of the sample data set. The logistic distribution has the form:

$$f(x) = \frac{\operatorname{sech}^2\left(\frac{1}{2}\left(\frac{x-\alpha}{B}\right)\right)}{4B}$$

where

$\alpha = 13.2397$ (location parameter)

$B = 1.3463$ (scale parameter, $B > 0$)

$-\infty \leq x \leq +\infty$

There is no theoretical basis for selection of the logistic distribution, nor is the logistic distribution commonly used in coastal engineering practice to represent significant wave period. For this analysis the logistic distribution was selected for numerical convenience based on the best-fit distribution of the measured data.

The logistic probability distribution is truncated for values below 10 seconds and values above 20 seconds for purposes of the Monte Carlo simulation. The measured wave climate has been demonstrated to have a dual sea/swell nature. It is common coastal engineering practice to identify 8-10 seconds as the delineation between sea and swell. For this analysis, 10 seconds was established as the lower limit for the wave climate. The logistic distribution was selected for purposes of numerical convenience and has a variate range of $+\infty$. It is commonly accepted in coastal engineering practice that swell waves are typically not greater than 25 seconds. Inspection of the histogram for wave periods indicates essentially no waves greater than 20 seconds. For this analysis, 20 seconds was established as the upper limit for the wave climate.

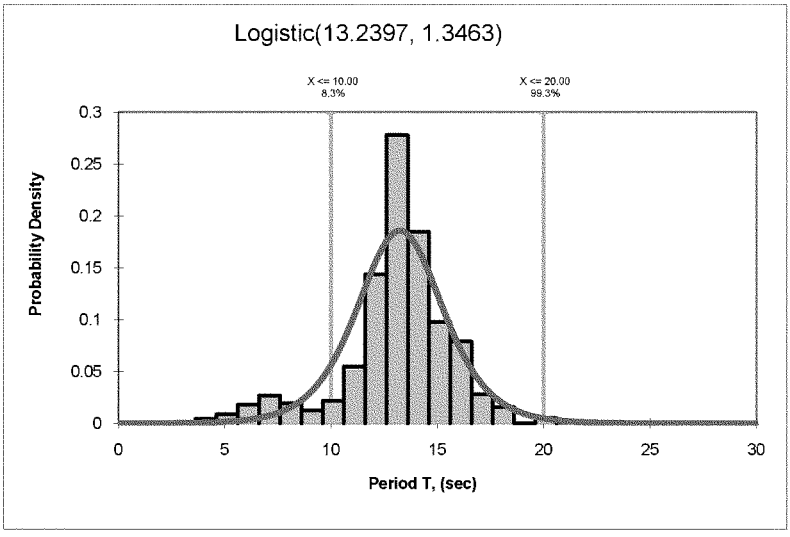

Figure 3-2 Probability Distribution for Spectral Peak Period, Winter Data, 1983-1998

3.4 *Design Wave Runup*

Runup is defined as the maximum vertical elevation of wave uprush above still-water level. Wave uprush consists of two components which include superelevation of the mean water level due to wave action (setup) and fluctuations about that mean (swash). In this analysis runup will be confined to the fluctuations about the mean where runup, R, is defined as a local maximum or peak in the instantaneous water elevation, 0, at the shoreline.

Wave runup is calculated independently for the shoreline conditions represented by the plane beach condition and the revetment condition. The runup is assumed constant within the entire reach since each reach is a uniform type of shoreline consisting of either plane beach or revetment. For each year of the lifecycle simulation runup was determined for each reach based on the input variables, e.g. wave height, wave period, and beach slope. The calculated runup is added to the still water level for the final runup elevation.

The relative sea level change influences the calculation of runup. It was determined that relative sea level change will occur at an exponentially increasing rate (Section 2.2.3). Increasing water depths allow higher runup values for the same incident wave heights. The still water level is incorporated indirectly into the revetment runup calculation in the form of higher wave heights at the structure toe. Since runup is by definition the wave uprush elevation above still water level, the still water level is added directly to both shoreline conditions at the end of the calculation. Thus, an increasing trend is observed in the runup calculations.

3.4.1 Runup on Plane Beach

The method developed by Mase and detailed in the Coastal Engineering Manual (CEM) (USACE, 2002) was used. This predictive equation is valid for irregular wave runup on plane,

impermeable beaches with slope ranging between 5H:1V – 30H:1V. The runup equation is empirically derived based on measured laboratory data and wave setup is incorporated into the calculating procedure. The runup equation has the form:

$$\frac{R_{1/3}}{H_0} = (0.75)1.38\zeta^{0.70}$$

where:

$R_{1/3}$ = *the average of the highest 1/3 of the runups*
H_0 = *the significant deepwater wave height*
ξ = *surf similarity parameter calculated from deepwater wave height and length*

Direct use of the runup equation developed by Mase results in runup values that are believed to be unrealistically large. This observation is consistent with discussion in the CEM where field measurements of runup are consistently lower than the predictive equations. There is some evidence that the runup equation overpredicts by a factor of 2 but is roughly the upper envelope of the data scatter. The calculated run-up values were iteratively calibrated until the calculated values approximately matched the actual known run-up elevations. Based on engineering judgment, it was determined that a factor of 0.75 best represents the calculations to real-world observed values. Therefore, a factor of 0.75 was applied to all runup calculations that more realistically reflects the runup experienced at San Clemente.

3.4.2 Runup on Revetment

The method developed by Hughes (Hughes, 2003b) was used in the present analysis. The general expression for irregular wave runup on smooth, impermeable slopes has the form:

$$\frac{R_{u2\%}}{h} = 1.75\left[1 + e^{-(0.47\cot\alpha)}\left(\frac{M_F}{\rho g h^2}\right)^{\frac{1}{2}}\right] \quad \text{for } 1.5 <= \cot\alpha <= 4.0$$

where:

$R_{u2\%}$ = *runup elevation exceeded by 2% of the incident waves*
h = *water depth at structure toe*
α = *structure slope*
M_F = *wave momentum flux parameter (Hughes parameter)*
ρ = *fluid mass density*
g = *gravitational acceleration*

The wave momentum flux parameter, M_F, is a nondimensional maximum depth-integrated wave momentum flux parameter (Hughes, 2003a). M_F will herein be referred to as the "Hughes parameter" for simplicity. The Hughes parameter characterizes the wave momentum flux, which is closely related to the force loading experienced by coastal structures or any other solid object placed in the wave field. An empirically derived expression for M_F has the form:

$$\left(\frac{M_F}{\rho g h^2}\right)_{max} = A_0\left(\frac{h}{gT^2}\right)^{-A_1}$$

where:

$$A_0 = 0.639\left(\frac{H}{h}\right)^{2.026} \quad \textit{and} \quad A_1 = 0.180\left(\frac{H}{h}\right)^{-0.391}$$

$H = $ *significant wave height at structure toe*

The calculated values of runup are further modified for surface roughness and other factors for consistency with the runup guidance detailed in the CEM, which is based on the method developed by Battjes. The modification factors are given as:

$\gamma_r = 0.6$, roughness coefficient
$\gamma_b = 1$, berm coefficient
$\gamma_h = 1.17$, shallow water coefficient
$\gamma_\beta = 1$, wave angle of incidence coefficient

The following assumptions were made: significant wave runup value, impermeable slope, roughness consisting of 1 layer of rock, non-bermed profile, shallow water conditions (i.e non-Rayleigh distributed), and normally incident.

3.5 *Design Foreshore Slopes*

The design foreshore slope distribution used for this analysis is developed from the measured foreshore slope data previously discussed. The foreshore slope statistical analysis is shown in **Figure 3-3**. The extreme value distribution was selected as representative of the sample data set. The extreme value distribution has the form:

$$f(x) = \frac{1}{b}\left(\frac{1}{e^z + \exp(-z)}\right)$$

where

$$z \equiv \frac{(x-a)}{b}$$

$a = 7.34$ (location parameter)
$b = 1.94$(scale parameter, $b > 0$)
$-\infty \le x \le +\infty$

There is no theoretical basis for selection of the extreme value distribution, nor is the extreme value distribution commonly used in coastal engineering practice to represent foreshore slope. For this analysis the extreme value distribution was selected for numerical convenience based on the best-fit distribution of the measured data.

The extreme value probability distribution is truncated for values below 4 and values above 20 for purposes of the Monte Carlo simulation. The measured foreshore slopes has been demonstrated to have a range between 4 and 20. This range is typical of the foreshore slopes of other beaches located in southern California.

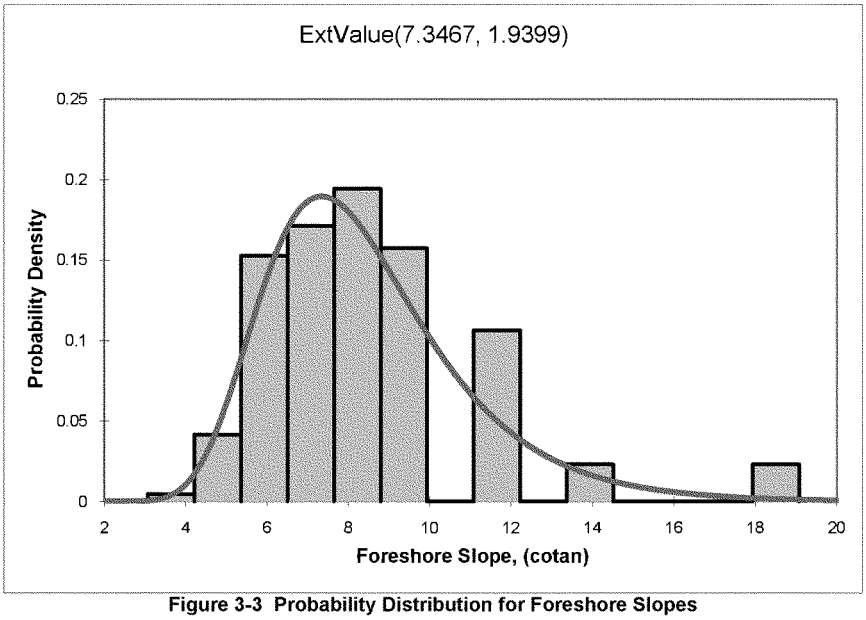

Figure 3-3 Probability Distribution for Foreshore Slopes

3.6 *Design Beach Widths*

Beach width in this study is defined as that portion of the beach between the foreshore berm contour and a fixed location on the backshore. This definition accounts for the "dry" portion of the beach. The term "berm width" is often interchanged with this definition of beach width, however, use of the term "beach" or "beach width" will refer to this definition unless specifically stated otherwise. The foreshore berm contour was determined from a composite profile developed by overlaying multiple cross sections of beach that was not fully eroded. Lines indicating the flat backshore and the sloped foreshore were intersected, yielding a +5.2 m (+17.1 ft) MLLW elevation representative of the foreshore berm.

The winter condition shoreline was used as the starting point for this analysis. The foreshore berm contour position was checked for seasonality by comparing the position of the currently measured contour, then making adjustments based on historical measurements. The 2002 LIDAR topographic survey clearly defined the location of the MHHW contour (+1.65 m). Recent repetitive beach profiles surveys have been conducted by the City of San Clemente (Coastal Frontiers Corporation, 2002) along historical Corps of Engineers survey transect locations. The survey data indicates the MHHW contour location fluctuates seasonally between 48.2-56.8 m (159-186 ft) for SC 1720 (Shorecliffs), 20.8-40.5 m (68-133 ft) for SC 1680 (Linda Lane), and 43.1-59.1 m (141-194) for SC 1623 (State Beach) respectively, from fixed transect backshore origins. The seasonal MSL variations are 8.6 m (28 feet) for SC 1720, 19.7 m (65 feet) for SC 1680, and 16.0 m (52 ft) for SC 1623. The 2002 measured MHHW contour was measured in March, which is at the end of the winter season and thus the shoreline is in the most eroded condition. Therefore, the foreshore berm contour required no adjustment for seasonality.

3.7 *Design Long Term Shoreline Change Rate*

Long-term shoreline erosional processes create damages through long-term profile translation and the increasing potential for wave related damages. Long-term beach erosion causes the mean shoreline position to translate landward. The landward advancing shoreline reduces the beach width available for storm damage protection thereby increasing the probability of wave related damages to facilities and structures. As the shoreline retreats landward, the runup and overtopping damage zone increasingly encroaches on existing development. Landward encroachment of this wave-related damage zone will threaten existing development before the mean shoreline position could retreat far enough to directly threaten the structures by undermining. Long-term beach erosion also results in the gradual reduction of the beach surface area available for recreation.

3.7.1 Without-Project

The without-project long term erosion probability distribution is shown in **Figure 3-4**. The long-term shoreline change rates for the four locations that are historical to the CCSTWS were previously shown in **Table 2-7**. The shoreline change data sets are considered together with the sediment budget estimates to obtain erosion parameters representative for the entire study area. Based on these parameters a triangular distribution for long-term shoreline change rate was developed. The triangular distribution has a mean shoreline change rate of –0.10 m/yr (-0.33 ft/yr), the peak erosion rate is –0.21 m/yr (–0.7 ft/yr), the maximum erosion rate is –0.46 m/yr (-1.5 ft/yr), and the maximum accretion rate is +0.38 m/yr (+1.24 ft/yr).

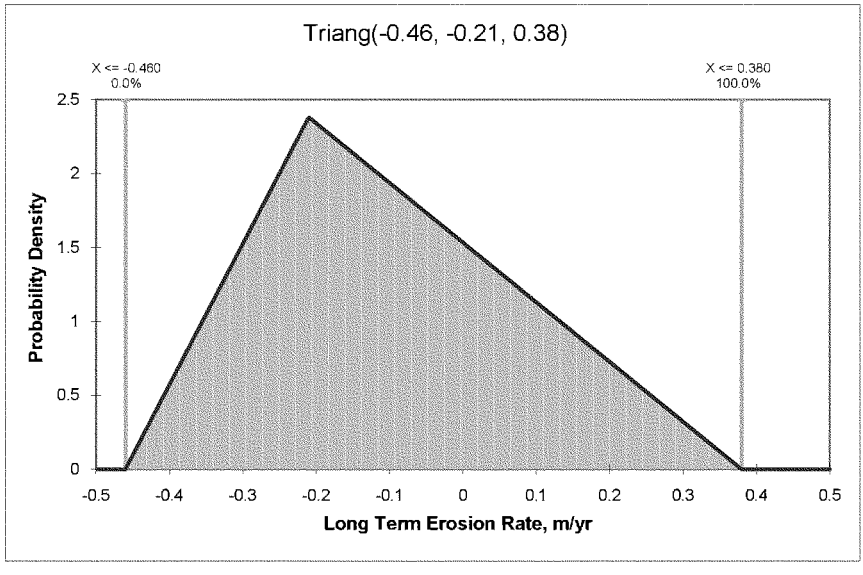

Figure 3-4 Probability Distribution for Without-Project Long Term Erosion Rate

3.7.2 With-Project

The long-term shoreline change rate for this study was based on the monitoring data from the SANDAG regional shoreline nourishment project conducted in southern California in 2001. Measured beach profile data was obtained at 61 transects; 19 transects were identified that crossed directly over a beach fill location. The mean sea level shoreline change was compiled into a histogram shown in **Figure 3-5**. The raw data indicates a range of -18 m (-60 ft) to +8 m (+22 ft), and a mean value of -5.9 m (-19,4 ft). These shoreline change data are considered to obtain erosion parameters representative for the entire study area. Based on these parameters a triangular distribution for long-term shoreline change rate was developed. The triangular distribution has a mean shoreline change rate of –3.9 m/yr (-12.8 ft/yr), the peak erosion rate is –5.5 m/yr (–18.1 ft/yr), the maximum erosion rate is –15.2 m/yr (-50.0 ft/yr), and the maximum accretion rate is +9.2 m/yr (+30.0 ft/yr). The with-project long term erosion probability distribution is shown in **Figure 3-6**.

Another pertinent example of this phenomenon is the Encinitas – Solana Beach Shoreline Feasibility Study conducted in approximately 2004. This area is within San Diego County and very similar to San Clemente with high coastal bluffs, little or no sandy beach, and a rock platform. Background erosion rates were small (0-.2 m/yr (0.5 ft/yr)). A GENESIS shoreline change model study computed future with-project erosion rates of approximately 5 m/yr (16 ft/yr). These predictive results coincide rather neatly with the order of magnitude ratios that have been documented to occur in the region.

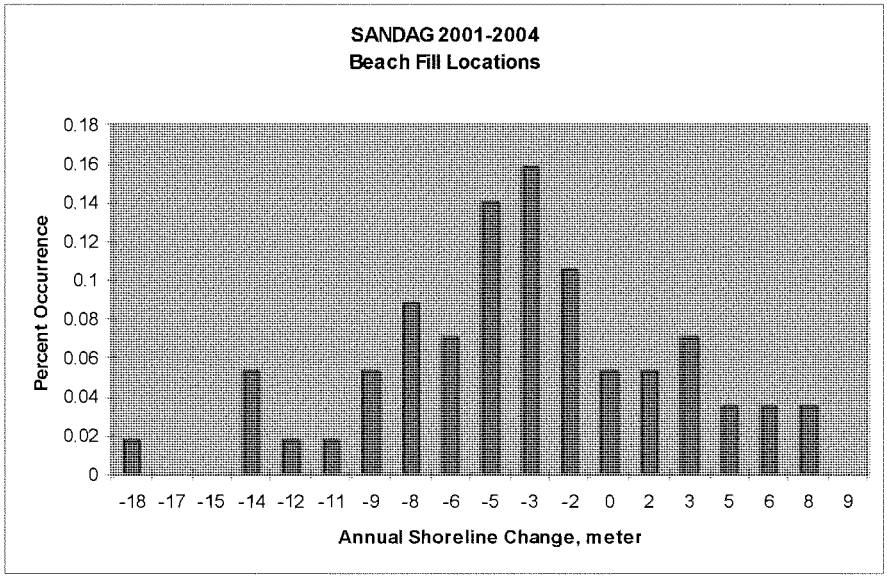

Figure 3-5 Mean Sea Level Shoreline Change from 2001 SANDAG project

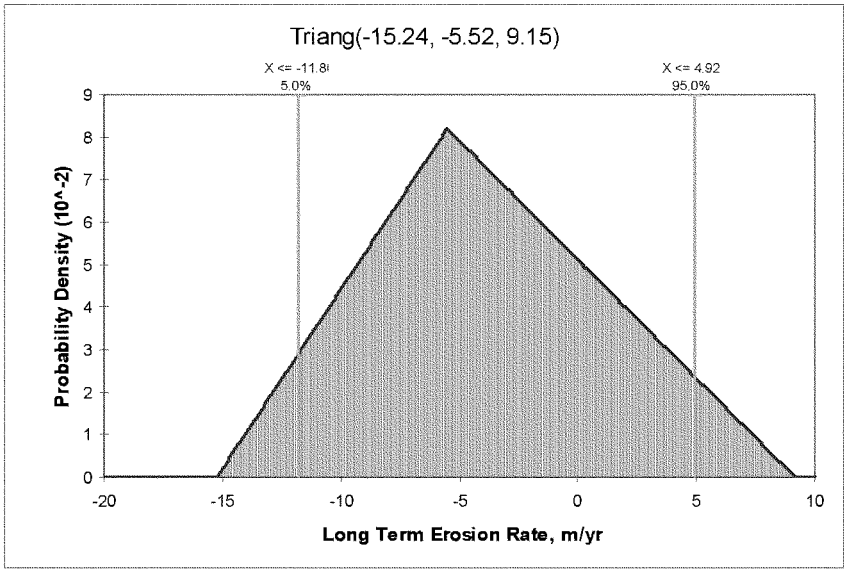

Figure 3-6 Probability Distribution for With-Project Long Term Erosion Rate

3.8 *Design Storm Induced Beach Change*

The design storm induced beach change used in this analysis is based on the storm induced beach change data previously discussed. The storm induced beach change statistical analysis is shown in **Figure 3-7**. The lognormal distribution, previously discussed in Section 3.2, was selected as representative of the sample data set. The following parameters were used:

$$\mu = 3.01 \text{ (mean)}$$
$$\sigma = 3.75 \text{ (standard deviation)}$$

There is no theoretical basis for selection of the lognormal distribution, nor is the lognormal distribution commonly used in coastal engineering practice to represent storm induced beach change. For this analysis the lognormal distribution was selected for numerical convenience based on the best-fit distribution of the measured data from over 30 candidate distributions.

Storm-induced erosion effects on the profile are superimposed on the present and future shoreline positions. Storm profile response can be considered directly correlated to storm severity and therefore significant wave height. Storm induced shoreline response is used to quantify the land loss and associated structure loss during the Monte Carlo simulation. The simulation computes the land loss and structure damages due to storm-induced profile change at annual intervals through the 50-year life cycle. The simulation randomly samples a storm event, and allows the shoreline to retreat according to the amount associated with the storm. If

a structure is located within this storm induced retreat distance, the structure is considered lost and removed from the inventory. The shoreline position is reset to the pre-storm position to avoid double counting of erosion. It is idealistically assumed that the storm-induced profile change is a temporary event and the beach will recover to its pre-storm position. Thus, an artificially induced double counting of the storm-induced erosion is avoided.

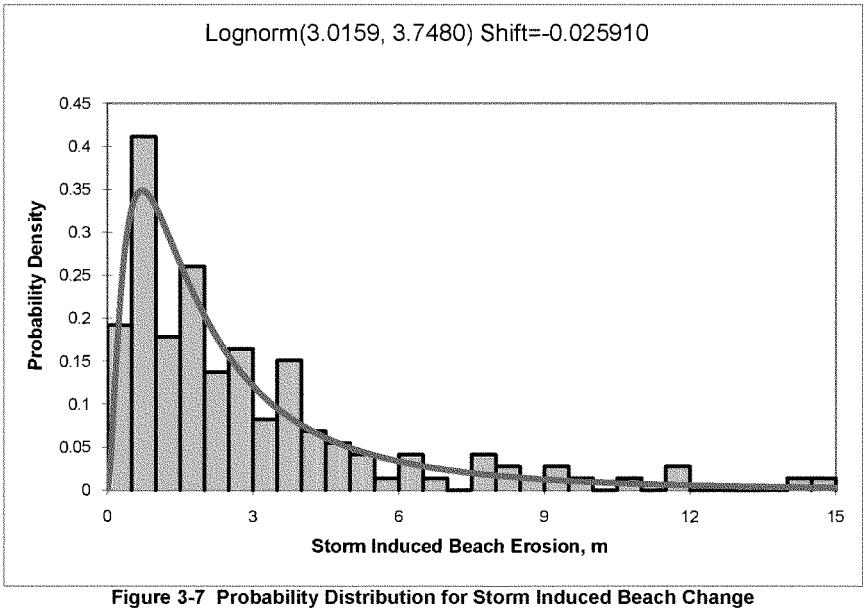

Figure 3-7 Probability Distribution for Storm Induced Beach Change

This design storm induced beach change function was also a result of the model calibration procedures described in Sec 5.3.3.

The storm induced beach change probability distribution is assumed to be identical for the without-project and with-project condition. All storm induced cross-shore transport is expected to be constrained by the fact that the entire project area is controlled by the underlying geology. A continuous sandy shoreface does not exist in this area which is expected to limit substantial storm induced transport. The storm induced beach change for the low probability storm events derived from this distribution can be considered small, however, these results are consistent given the facts that the existing beaches are very narrow and the modern record indicates little or no storm induced changes (and damages) have been recorded even in the most severe storms. While it might be expected that a wider beach (with-project) would have greater storm induced beach change, the distribution shown herein is considered slightly aggressive for the without-project condition based on the limited storm induced beach change data from the measured historical record. Potential fill alternatives considered in this study are expected to be relatively narrow in the cross-shore direction which might be expected to result in marginally small increases in cross-shore transport. However, given the believed slight aggressiveness of the distribution for the without-project condition, this input distribution is believed representative of both the without- and with-project condition.

Due to the recognized uncertainty in the derivation of the sample data set (Sec 2.5.7), a quantitative measure of this uncertainty was applied to the original distribution in the Monte Carlo simulation model. Storm induced erosion must be greater than or equal to zero (positive is erosion). The original distribution was derived via a linear transformation of measured data (Surfside). The uncertainty is another linear distribution about the original distribution. The storm induced erosion probability distribution was modified with another distribution with the following form:

f(x)=RiskDiscrete({0.5,0.6,0.7,0.8,0.9,1,1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,2},
{1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1}, RiskTruncate(0.5, 2))

This distribution is a uniform distribution ranging between 0.5-2.0 in discreet 0.1 increments inclusive of the endpoints. Each value within the range has equal probability. When applied in the Monte Carlo simulation model, this distribution will randomly select any value within the range and multiply the entire distribution by the value. For values less than 1.0, the effect is to compress the original distribution. For values greater than 1.0, the effect is to stretch the original distribution. The value of 1.0 has no affect on the original distribution. Thus the original distribution can be compressed in half (0.5) or stretched by a factor of two (2.0).

3.9 *Damage Mechanisms*

Coastal storm damages at San Clemente consist of: direct structure loss due to long-term erosion; loss of recreational beach due to long-term erosion; direct structure loss due to storm induced erosion; direct structure damages due to inundation; direct structure damages due to wave impact forces, direct railway damages due to wave impact forces; and rail traffic service delays due to wave overtopping. San Clemente has been subdivided into 10 reaches as described in Section 2.1. The separate reaches are treated independently in the without (and with) project conditions with respect to the damage mechanisms experienced by each and the functional requirements of the individual analysis procedures as they are applied. The primary distinction between reaches 1-8 is the absence or presence of armor stone revetment improvements on the railway.

Structure damages are confined to buildings and revetments protecting the railway. Railway damages are not considered north of the Capistrano Shores development, as the railway is landward of this development. Damages are not considered south of San Mateo Point.

3.9.1 Long Term Erosion

Long-term shoreline erosional processes create damages as the mean shoreline position translates landward. The landward advancing shoreline intercepts structures along the shoreline and gradually reduces the beach surface area available for recreation. Long-term erosion is treated equally for each reach. In each reach, it is assumed that the existing shoreline will erode to the SCRRA railway, after which no further shoreline translation will occur. The railway will stabilize and fix the position of the shoreline; thereafter the long-term erosion rate no longer applies. Railroad structure damages due to direct loss of the structure from undermining are not considered.

Structure Loss

Structures are lost to long-term erosion when the structure foundation is undermined due to the landward advancing shoreline. The long-term erosion shoreline change rate function is used to quantify the land loss and associated structure loss in the economic evaluation. The simulation computes the structure and land damages due to long-term shoreline change at annual intervals through the 50-year life cycle. The simulation randomly samples a long-term erosion value, and allows the shoreline to retreat. If a structure footprint is located within this retreat distance, the structure is available for damages dependent on the type of structure.

The structures were classified into four categories: timber slab-on-grade, masonry slab-on-grade; timber pile supported; and masonry pile supported. For slab-on-grade structures, when the shoreline berm position eroded through 50% of the footprint as measured from the seaward wall, the structure was considered lost and removed from the inventory. Pile supported structures are not lost directly to undermining. For pile supported structures, when the shoreline erodes through 100% of the footprint, the structure functionality is lost, i.e. the structure can no longer be reasonably used as intended, and the structure is considered lost. A full description of this functionality concept is found in the Economics Appendix.

Recreation Loss

The landward advancing shoreline reduces the beach surface area available for recreation. The simulation computes the dry beach area (cell length x width) throughout the 50-year life-cycle. A time series of a 50-year life-cycle indicates a continually declining amount of dry beach area. A full description of the recreation analysis is found in the Economics Appendix.

3.9.2 Storm-Induced Erosion

Storm-induced erosion data are used to quantify the land loss and associated structure loss in the model simulation. The simulation computes the structure and land damages due to storm-induced profile change with every storm intervals through the 50-year life cycle. The simulation randomly samples a storm event, and allows the shoreline to retreat according to the amount associated with the storm. If a structure is located within this storm-induced retreat distance, the structure is considered lost and removed from the inventory.

The shoreline position is reset to the pre-storm position to avoid double counting of erosion. The long-term erosion rate was established by the CCSTWS which analyzed decades of measured data and profile information. Embedded within the long-term erosion rate is the fact that storm-induced erosion occurred and is accounted for. It is idealistically assumed that the storm-induced profile change is a temporary event and the beach will recover to its pre-storm position. Thus, an artificially induced double counting of the storm-induced erosion is avoided.

3.9.3 Inundation

Estimation of structure inundation depths requires relating wave runup elevations to the physical positions (setback distances and first floor elevations) of individual structures. A method described in the professional literature is used to develop inundation estimates. No USACE approved methodology has been formulated to predict the transformation of an overtopping wave after it passes the beach or revetment crest. Wave runup propagation over a beach or revetment crest is an extremely complex process. After a wave runs up and overtops the beach

or revetment crest, the wave can be considered a translational bore. An approximate solution is to estimate the bore attenuation or decay function landward of the crest as a function of setback distance.

The estimation of overland bore propagation and decay is based on Cox (Cox and Machemehl, 1986) and modified with considerations from the wave momentum flux theory discussed hereinbefore. The propagating bore is assumed a periodic wave with an initial height proportional to the ratio of the runup elevation and the crest elevation. The propagating wave is modeled after a bore, which qualitatively resembles a spilling breaking wave. Using linear wave theory energy considerations and appropriate bore theory approximations, results in the expression:

$$h = \left(h_i - \frac{5X}{T\sqrt{g}} \right)^2 \quad \text{where:} \quad h_i = \sqrt{\frac{\left(1 - \frac{E}{R}\right)^2 M_F (swl)^2}{1.61}}$$

where h = bore depth at structure, h_i = initial bore depth at crest, R = runup elevation, E = revetment crest elevation, M_F = Hughes parameter, swl = total still water level, X = structure setback distance, T = wave period, and g = gravity term.

This procedure neglects frictional dissipation and percolation, which have been found to have negligible influence compared to the turbulent energy dissipation in a bore. Neglect of those considerations results in a conservative estimation of bore depth. This method assumes the slope behind the berm is level. In this analysis, the measured structure setback distances and pad elevations were used; all randomly sampled input values and the calculated runup values were used. This method yields the inundation depths for each structure. For this analysis, the bore depth, h, is assumed the inundation depth.

The inundation depth is applied to each structure based on the defined depth-damage relationship, and the economic damages computed. A full description of the inundation depth-damage relationships are shown and discussed in the Economics Appendix.

3.9.4 Wave Impact Forces – Structures

Criteria

Structure damages from wave forces begin when wave propagation (or wave runup) intersects the structure seaward boundary. Structure damages due to wave runup were determined based on a comparison of the applied wave force at the structure wall/foundation connection to the critical force that would cause the connection to fail. A critical force of 460 lbs/lf was assumed for conventional timber frame and masonry construction with a slab-on-grade foundation. If the calculated wave force is equal to or exceeds the critical force, the structure is considered 100% damaged. If the calculated wave force is less than the critical force, some partial damages were assumed. This near step function behavior for structure damages is similar in concept with guidance provided by the Federal Emergency Management Agency (FEMA 1998).

This critical force was developed from the minimum applicable requirements for conventional wood-framed and masonry structures in accordance with the 1999 Uniform Building Code (UBC). It is assumed that the existing structures in the study area are conventional wood-framed and masonry structures. No exceptional structural, foundation, or soil conditions were

considered. It was further assumed that the loads due to a traveling water bore would be perpendicular to a solid structural wall. The assumed mode of failure was at the wall-to-foundation connection due to base shear caused by the water bore loading.

The UBC indicates that the minimum connection requirements are identical for timber and masonry construction methods. The UBC allowed for a determination of the minimum connection necessary that satisfies these base shear requirements. According to Chapter 16 of the UBC, for seismic zones 3 and 4 in southern California, the minimum anchor requirements are a #6 5/8 inch anchor bolt at not greater than 6 feet on center; the anchor has a shear capacity of 2750 lbs. Assuming anchors every 6 feet on an infinitely long wall, each anchor resists approximately 460 lbs per linear foot.

Methodology

The method used for structure damages is based on a procedure obtained from the professional literature. No USACE approved methodology has been formulated to predict the forces exerted on a structure due to a propagating bore. After a wave runs up and overtops a beach or revetment, the wave can be considered a translational bore. This translating bore then impacts upon the structure.

The estimation of wave force due to a translating bore is based on Ramsden (Ramsden and Raichlen, 1991). The forces on a vertical wall due to the impact of a bore generated by a broken solitary wave were measured in the laboratory. A previously developed expression for bore development, which described surge forces at the leading edge of a bore propagating over smooth and roughened bottoms was modified. This resulted in the expression:

$$F = \frac{1}{2}\gamma(h+d)^2 + \gamma h^2$$

where F *= force,* γ *= unit weight of seawater,* h *= bore height,* d *= standing water depth.*

This expression includes the ratio of bore celerity to shallow-water wave celerity ($N_f = c/(gh)^2$), which in this analysis is assumed to equal unity. The previously calculated bore heights are the only required input; the standing water depth has the assumed value d = 0.1*h based on the recommendations of Cox and Machemehl.

Wave Impact Forces - Railroad

Structure damages from wave impact forces begin when wave propagation (or wave runup) intersects the structure seaward boundary. The degree of impact loading is a function of the runup elevations and the structure spatial positions. Wave force damages are treated independently and equally for each sub-reach.

There is no known theoretical and/or empirical method for estimating wave impact forces on a railroad. The methods described hereinafter were developed based on engineering judgment and are not commonly used in coastal engineering practice. Structure damages due to wave runup were estimated based on the damage functions shown in **Table 3-1**. The damage relationship is based on runup elevation in lieu of wave height. It is noted that the majority of the railway and associated revetments are above the MHHW elevation. As such, the revetments are not directly exposed to wave heights (such as the case for an offshore

structure), but are directly exposed to wave runup. Incorporating the use of runup elevation allows for consideration of still water level, which has a significant effect on the computed runup elevation.

The percent damage is based on the quantity of armor unit removal for a specific runup elevation (wave height). These damage functions are similar in concept and nature to the percent damage and no-damage criteria described in the Shore Protection Manual (SPM) (USACE-CERC, 1984). A distinction was made between the two primary types of railway protection: a) ballast only (no protection); and b) non-engineered which defines the protection provided by the large armor stone dumped in an uncontrolled (non-engineered) fashion. A 5% no-damage threshold was applied; damages greater than 5% were accrued.

The railroad damage function (**Table 3-1**) was calibrated based on matching known existing annual damages to predicted future annual damages. During the calibration process, the damage function relativity between the ballast only and non-engineered railway was iteratively adjusted. Engineering judgment was applied to correlate input wave runup with realistic expected damages. The expected damages were based on information provided by SCRRA who indicated that annual damages are approximately $100,000 per year to the ballast type railroad. The % damage values shown in **Table 3-1** (Ballast RR) were iteratively adjusted in the model so that the total economic damages in year **1** of the life cycle equaled the existing damages. In other words, the % damage values were adjusted so that the model predicted $100,000 of damage in year 1 which would equal the $100,000 actual damages reported by SCRRA. This iterative method resulted in predicted damages in the initial year of the life-cycle simulation that approximately matched the existing damages experienced by the SCRRA.

Table 3-1 Railroad Damage Functions

Runup Elevation, m (ft)	% Damage for Ballast RR	% Damage for Non-Engineered RR
0	0	0
3.05 (10)	0	0
3.66 (12)	1	0
4.27 (14)	5	0
4.88 (16)	10	1
5.49 (18)	15	5
6.10 (20)	20	10
7.62 (25)	25	15

3.9.5 Railway Traffic Service Delay

Railway traffic service delays result when excessive wave runup elevations and wave overtopping result in a flow rate of water that exceeds the elevation of SCRRA protective revetments. According to the SCRRA, railway traffic service delays have occurred during severe storms due to wave action. The SCRRA has documented two service disruption incidents in the 1960s and 1970s (McGinley, 2003). According to the SCRRA:

> "There was one incident at Mariposa Point (north of the pier) and one south of the pier. Both had service disruptions of about 24 hours. The failure mode was backwash: very large waves broke over the tracks and in running back to the sea carried the ballast and

embankment. He said that he had seen pictures of the waves as high as the trains (that would be 15-16 feet above the rail). He said that the rip-rap there at that time was a smaller section than we have now."

This description of damages is consistent with severe wave runup and overtopping, and the resulting wave rundown removing armor stone from the protective revetment. It is noted that wave heights 15-16 feet above the rail are physically unlikely due to the spatial elevation of the revetment crest and railway. However, an observer standing on the railway might interpret runup and overtopping spray in the presence of strong wind as wave heights. It is also noted that the rock protecting the railway during the observed incidents was smaller than the larger armor stone currently in place.

According to the SCRRA, there has never been a railway stoppage due specifically to conventional inundation. Conventional inundation, defined as still or standing water due to wave overtopping, has never caused a railway traffic service delay. This is intuitively expected as the railway is constructed on an elevated bed that greatly exceeds the elevation that can be reached by conventional still water coastal flooding.

There is no generally accepted guidance or methodology formulated to define the overtopping criteria necessary to interrupt railway service. Estimation of railway traffic service delays requires relating wave runup elevations to the physical positions (setback distances and elevations) of the SCRRA railway. Based on the above eyewitness account, criteria was established which combined runup elevation and a probability of occurrence. Runup elevation should equal or exceed the revetment elevation; the actual rail elevation is set below the revetment crest elevation. Overtopping of the revetment crest will logically result in overtopping of the railroad. If the revetment crest elevation is exceeded by overtopping, thereafter there is a 50-50 probability that this overtopping condition would result in railway traffic service delay. Railway traffic service delay is treated equally and independently for each sub-reach.

The rail service delay criterion is calibrated using the total number of delays experienced during a simulation. The simulation tallies the total number of service delays. Based on the preceding damage description, there were two service delays in the 1960's and 1970's. Presumably this time period extends to the 1950's if not earlier, which is approximately 50 years. Thus, on average there should be approximately 1-2 service delays in each 50-year simulation.

4 WITHOUT-PROJECT AND WITH-PROJECT CONDITIONS

4.1 *General Project Formulation and Policy Considerations*

Project formulation indicates the major damage categories are foregone costs that public entities will incur to protect the LOSSAN corridor, and the loss of public and recreational facilities. The LOSSAN corridor is a major railroad link for freight and passenger traffic between San Diego and Los Angeles. The Orange County Transportation Authority (OCTA) has ownership authority over the LOSSAN corridor; the maintenance of the track is the responsibility of the Southern California Regional Rail Authority (SCRRA).

The study area has been subdivided into 10 reaches, reaches 1-8 distinguished primarily by the presence or absence of armor stone protection along the railroad. In reaches 1, 3, 5, and 7 the railroad has been improved by construction of a revetment. Reaches 2, 4, 6, and 8 are currently unimproved, i.e. are the original ballast construction. Damages to the railroad in Reach 9 are not considered as Reach 9 is protected by a revetment and the railroad is located landward of privately owned homes. Reach 10 extends to the study area boundary and is included in the study to more completely analyze shoreline conditions.

The California Coastal Commission (CCC) is a State regulatory agency empowered to enforce the California Coastal Act, adopted in 1976. The purpose of the Act is to provide protection of California's coastline for the benefit of current and future generations. This includes protection and expansion of public access to the shoreline, protection, enhancement and restoration of environmentally sensitive habitats, and protection of the scenic beauty of coastal landscapes and seascapes.

The CCC is the permit granting authority for all coastal development. The CCC also issues emergency permits for storm damage protection structures when there is an immediate threat of damage to property. These structures are technically considered temporary and therefore the CCC requires, as a condition of the permit, that the structure be removed when the immediate threat no longer exists. In practice, this permit condition is intermittently enforced.

4.2 *Existing SCRRA Track Maintenance Procedures*

The following description and account of maintenance activities was provided by the SCRRA (McGinley, 1998). The detailed account of railway activities is excerpted to highlight those activities that are directly pertinent to the analysis methodology conducted in this study.

> "Under 49 CFR 213.103, the ballast supporting the track must be constructed and maintained to support the track (and trains) and restrain the track from lateral, longitudinal, and vertical movement. In order to maintain this ballast material, it must be protected against erosion by ocean waves. These ocean waves have two effects, they can undercut the embankment, causing the ballast to drop from the track area, and they can dislodge the ballast through their impacts and the resulting backwash. ..."
>
> "The method used to resist this erosion for the last several decades has been to place broken stone rip-rap along the ocean side of the track embankment. (In earlier times, some rip-rap was waste concrete, however that material tended to break up leaving exposed reinforcing steel exposed to persons on the beach.) The size of the stone is from four feet in maximum dimension down to four inches. The stone has come from various quarries in Southern California. Almost all of the rock applied in the 1990 is granite that

has come from Corona or Newberry Springs. The rock is delivered to the roadbed area in railroad cars which dump to the side. Before and after dumping the rock, construction equipment (tracked excavators and rubber tired end loaders) is used to arrange the rock into a uniform row, and to keep it clear of the PUC walkway area alongside the track. This work is done at night because of the need to occupy the tracks with the rail cars. The rock is placed on a 1:1 or 1.5:1 (horizontal to vertical) slope towards the beach, and to a height of about three or four feet higher than the rails. This height is to deflect large waves at high tides, which are otherwise observed to impact the tracks. This placement and replacement of rip-rap is all fixed in location to the 20 to 30 feet west of the centerline of the tracks. ... The SCRRA experience since 1993, and staff experience dating into the 1970's, is that the very steep piles of rock, often underlain by compacted sand. The next stage of erosion is that the high parts of the piled stone settles into these voids, lowering the height of the embankment. This is an approximately annual cycle, with the most erosion occurring in the winters. ... Over the last five years, rock has been installed about annually to replace that lost to erosion."

"The use of random-dumped stone rip-rap has evolved over decades of practical experience and has not been studied or engineered by rigorous methods. It is believed to present an exposure to the ocean which is able to absorb significant energy and to capture some of the smaller stone and sand. ...A more refined barrier against erosion such as large stone set into a planned matrix or a cast concrete wall is too expensive to install under regular railroad maintenance budgets and simply has not been considered. It would appear that a more elaborate barrier would disrupt the beach during construction."

Based on the preceding account it is clear the SCRRA has used and continues to use non-traditional methods of revetment construction and maintenance. The construction and maintenance method consists of side dumping armor stone from a rail car onto the existing ballast slope. The stone follows the ballast slope and/or is allowed to assume a natural angle of repose, with some grooming at the toe area. This method of construction is considered a "non-engineered" revetment.

An "engineered" revetment is a sloping stone structure where the armor stone is placed in a controlled fashion. The quarried stone in the armor layer is typically placed individually to maximize contact between adjacent stones. Maximized contact between armor stones increases stone interlocking and as a result increases the hydraulic stability of the structure. Individually placed armor stone allows for overall steeper structure slopes than can be typically achieved by uncontrolled dumping methods.

4.3 *Existing SCRRA Construction and Operations and Maintenance Costs*

Estimation of construction and Operations and Maintenance (O&M) costs associated with the revetments is required for consideration in the economic analysis. Costs are quantified for existing O&M practices, future construction projects, and O&M of future construction projects. Structure construction and O&M costs are not considered north of the Capistrano Shores development or south of San Mateo Point.

Existing O&M cost information has been provided by the SCRRA. These O&M costs are those directly attributable to the revetments that were constructed in response to direct wave related

damages, and are separate from those costs incurred during routine O&M of the railroad. The revetments have suffered documented damages over its service life. The revetments were constructed incrementally at various times since at least the 1930's according to SCRRA information sources; various levels of engineering and design (or none) were employed. Over the ensuing years the structures have been subjected to several storms of varying intensities. Degradation of the revetments has occurred as evidenced by many instances of over-steepened slopes and ejected and/or displaced armor stones that reduce the overall structural integrity. This has led the SCRRA to conduct maintenance operations on the revetments at various times throughout the revetment life-cycle. Information provided by the SCRRA indicates that approximately $300,000 every 3 years have been expended on these maintenance operations; this equates to approximately $100,000 per year. The SCRRA was unable to provide detailed information that would allow determination of exactly where along the railroad the O&M effort was applied over the years. Therefore, this $100,000 per year average O&M cost was distributed on a per meter basis throughout the four reaches that are currently protected by revetment.

Future damages are expected during the without-project condition life cycle and are expected to increase due to an increase in the length of railroad exposed to the ocean as the beach erodes. Therefore, future costs are expected to be greater than the current rate of expenditures. These future costs were estimated for various scenarios. It is noted that Reaches 2, 4, 6, and 8 are the original ballast construction. Reaches 1, 3, 5, and 7 are the improved revetment reaches.

Three types of construction and their resultant O&M costs were developed and are shown in **Table 4-1**. The construction first costs were based on similar structures built recently in the southern California area. It usual and customary to estimate O&M costs equal to approximately 1% of the construction first cost. The three types of construction are: existing condition; engineered revetment; and seawall.

Table 4-1 Construction and O&M Unit Prices

	First Cost, $/m ($/ft)	O&M Cost, $/m ($/ft)
Existing Condition		$43.46 ($13.25)
Revetment 1 (ballast)	$2,460 ($750)	$43.46 ($13.25)
Revetment 2 (upgrade)	$820 ($250)	$24.61 ($7.50)
Seawall	$29,200 ($8,900)	$98.40 ($30.00)

4.3.1 Existing Condition

The SCRRA is currently placing large armor stone via non-engineered side dump methods previously described. The $100,000 per year average O&M cost incurred under existing conditions was distributed on a per meter basis throughout the four reaches that are currently protected by revetment.

4.3.2 Engineered Revetment

It may become necessary or mandatory for the SCRRA to construct "engineered" revetments. This would entail utilizing a detailed engineering and design process resulting in plans and specifications, and placing the armor stone under controlled stone placement methods. An

engineered revetment would provide increased hydraulic stability over current non-engineered methods. It was assumed that an engineered revetment would largely utilize many of the same revetment parameters as is currently used in the non-engineered placement methods. This would include: revetment elevation, revetment, slope, armor stone size and gradation, armor stone purchase unit price. The significant difference is the development of the engineering and design effort and the controlled armor stone placement methods. The engineered revetment was subdivided into two types: 1) construct engineered revetment on existing ballast railroad; and, 2) upgrade existing non-engineered revetment to an engineered revetment.

4.4 *Future SCRRA Track Maintenance Practices*

The SCRRA has incorporated discontinuous levels of protective rock armoring along the railroad length. Four of the reaches (1, 3, 5, and 7) consist of conventional rock ballast construction; four of the reaches (2, 4, 6, and 8) have been improved with rock armoring on the seaward slope. Information obtained from SCRRA indicates that the armor stone revetments were constructed via rail car side dump methods, as opposed to the individually placed stone that state-of-the-art coastal armor stone structures utilize. This side dump method was deemed a "*non-engineered*" revetment. Furthermore, the SCRRA is also currently maintaining the revetments with this same side dump method. Although the design and methods of construction (and subsequent maintenance) are inconsistent with conventional coastal engineering practice, the larger armor stone affords substantially greater protection against hydraulic forces over conventionally sized rock ballast and offer substantial benefits to the railroad structure. This improvement in protective armoring is a primary consideration for project reach delineation.

The SCCRA is in the process of modifying the existing maintenance practices in response to evolving CCC policies, which has a direct influence on the project formulation. The SCRRA reactively and proactively conducts improvement of the rail bed using the non-engineered (side dump) revetment construction methods in order to avoid and minimize any possible service disruption. It may become necessary or mandatory for the SCRRA to construct an "*engineered*" seawall.

In April of 2003, the SCRRA submitted a permit request to the CCC for maintenance of the existing revetment, which would include the placement of additional armor stone to the revetment. The permit was granted with specific conditions including limiting the maintenance activities to four specific locations, using the minimum amount of stone necessary, establishing a limit line for the existing revetment toe, and participating in studies to evaluate sand replenishment and other potential methods for future protection. Additionally, the CCC indicated concerns that these maintenance activities are adversely affecting recreational resources. "The applicant's repeated placement of rocks has result[ed] in an expansion of the footprint of the structure. Additionally, rocks that fall off the revetment could move into nearshore waters and present a hazard to surfers and swimmers"[3].

The current non-engineered (side dump) revetment maintenance practices will be modified. According to a letter from the CCC to the SCRRA dated February 22, 2005, the SCRRA will continue to side dump armor stone, and will also individually place the stone onto the areas with the improved revetment. This will achieve increased structural performance while also ensuring the existing revetment footprint is not expanded. Based on the CCC Consistency Certification dated May 23, 2003 (CC-033-03) and a letter provided by SCRRA, the SCRRA will no longer be

3 California Coastal Commission Consistency Certification No CC-033-03 May 23, 2003. Page 7.

able to side dump armor stone, but will continue to individually place the armor stone on the revetment. Additionally, SCRRA is in the process of requesting a multi-year permit from the CCC to continue the individual placement of armor stone as the maintenance practice standard.

It will become mandatory for the SCRRA to construct seawalls in the future. Project formulation indicates that due to evolving law and coastal structure construction regulations, the ability for the SCRRA to use revetment methods will expire.

4.5 *Future SCRRA Construction and Operations and Maintenance Costs*

A conceptual seawall design and cost estimate was prepared by the City of San Clemente (Moffatt & Nichol, 2007). The seawall was assumed to be steel reinforced concrete structure founded on bedrock. This type of structure is not common in the southern California shoreline area. A schematic of the sheet pile cross section is shown in **Figure 4-1**. Numerous assumptions were made including, but not limited to, construction materials, foundation conditions, real estate, and permitting. This estimate concludes this seawall cost will range from $21,577-$31,979 per meter ($6,578-$9,750 per foot). It usual and customary to estimate O&M costs equal to approximately 1% of the construction first cost. O&M costs are estimated to range from $216-$320 per meter ($66-$98 per foot). The full report is included as sub-Appendix B.

The seawall unit price was increased 3% to account for the extreme sea level rise condition. Higher future sea levels will require a commensurate higher seawall to offset the sea level rise. The extreme sea level rise increase is 0.7 m; the height of the seawall was increased to match this amount. It was estimated that this seawall height would result in a very small amount of labor and the bulk of the costs could be attributed to an increase in materials (concrete, rebar, etc). The material increase was conservatively estimated to be $984/m ($300/ft) based on a mean unit price of $26,900/m ($8,200/lf).

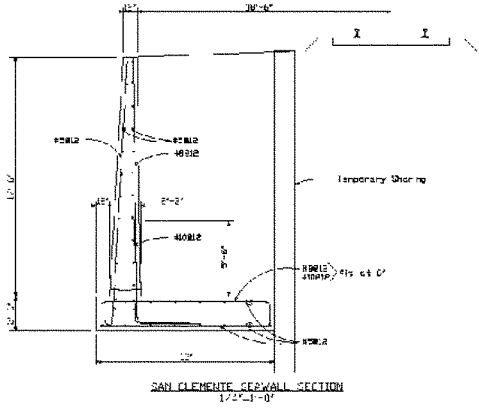

Figure 4-1 Seawall Typical Cross Section

5 NUMERICAL MODEL DESCRIPTION

The model developed for the present study combines the coastal engineering and economic sources of risk and uncertainty within a life-cycle framework. The life-cycle model generates a plausible storm condition, calculates various coastal engineering parameters, and determines the individual damage mechanisms. These are linked to the property inventory to estimate life-cycle property losses. The structure inventory used in this analysis is fully developed and described in the Economics Appendix.

5.1 *Risk and Uncertainty Analysis*

At the time of the initiation of this study there was no Corps of Engineers standard model for R/U analysis for coastal zone storm damage reduction studies. A nationwide model for coastal zone R/U analysis is currently under development by the Corps of Engineers, however, the model completion schedule did not allow for utilization for this study. Other existing Corps of Engineers coastal zone R/U models were evaluated for implementation under this study. These R/U models included Generalized Risk AND Uncertainty Coastal model (GRANDUC) developed by the Wilmington District and the Risk Storm Damage Model developed by the Jacksonville District. These R/U models, which were developed independently at different times by the respective districts, were evaluated extensively. Due to a variety of engineering considerations, technical, programming language, and other reasons, each model was not selected for use for this study. An interim model was developed that is uniquely applicable to the physics and storm conditions that are experienced within the Los Angeles District. This model utilizes many of the concepts and to a large degree is consistent with the nationwide model under development.

The model is an integrated coastal engineering – economics analytical framework for evaluating the physical performance and economic costs of shore protection projects, particularly, beach nourishment along sandy shores. The model has been implemented as an event-based Monte Carlo life cycle simulation tool that is run on desktop computers. The life-cycle model generates a plausible set of storm conditions, calculates various coastal engineering parameters, performs a series of engineering and economic computations and determines the individual damage mechanisms, and concludes with economic outputs. These are linked to the property inventory to estimate life-cycle property losses. The structure inventory used in this analysis and final economic results and discussion are fully developed and described in the Economics Appendix. The model inputs consist of probability distributions for various coastal engineering parameters. The model outputs consist of histograms of individual damage categories, annual net benefits, and benefit/cost ratios for various project features.

The principles of Monte Carlo Simulation are used as the numerical integration technique. The proprietary computer program @RISK (Palisade, 2002) was used to run the R/U analysis. @RISK is an add-in to a standard industry spreadsheet package that provides the necessary tools for executing a Monte Carlo Simulation.

5.2 *Global Model Considerations*

The integrated life-cycle model developed for the present study develops the coastal and oceanographic conditions and parameters at the front-end of the model. The life-cycle model randomly samples various input probability distributions, calculates various coastal engineering parameters, and quantifies the individual damage mechanisms. The model transitions to various economic calculations, and quantifies the damages due to the individual damage mechanisms. Economic output distributions are limited to damage categories only and no

attempt is made to include computation of benefits within the model. There are numerous parameters, computations and concepts within the numerical model. Some of the significant coastal engineering and economic model analysis aspects are discussed below.

5.2.1 Reach Subdivision – Cells

The study area was initially divided into 10 reaches of various lengths based on the presence or absence of armor stone protection along the railroad. In order to provide a finer subdivision for detailed analysis of model performance and interpretation of the results, Reaches 1-9 were further subdivided into 50-meter segments. The number of cells in each model reach is shown in **Table 5-1**.

Table 5-1 Reach Refinement

Reach #	Length (m)	No. Cells
1	969	34
2	680	14
3	600	12
4	732	15
5	413	8
6	1,040	21
7	1,081	22
8	347	7
9	1,101	20
10	~5,000	NA

5.2.2 Seasonality

The model is a single season model where the model wave climate is derived from a single season of the year. It is generally accepted that the most damaging storms in southern California occur during the winter months. Detailed analysis of the wave climate data indicates that the annual maximum wave heights occur in the winter months. Although it is recognized that some moderate wave events can and do occur during the summer season, the winter extratropical storms tend to cause the majority of the economic property losses. Neglecting the seasonality of wave climate results in conservatively severe model simulations, as on average the winter wave climate is more severe than the combined annual wave climate.

5.2.3 Single Storm

The model is a single storm event model where a single storm each year of the life-cycle is assumed to fairly represent the majority of the shoreline change and economic losses. By definition, most storms in a single given year are less severe than the annual storm and are non-damaging. It is observed that typical coastal damages are due to a single storm or swell event. This was clearly observed in the January 1988 when a single swell event that had no associated storm caused widespread coastal damages in southern California. Although multiple storms are not considered in this analysis, it is recognized that multiple independent storms occur every winter season. It is noted that storm "clusters" have been responsible for some of

the most damaging storm years in southern California. This was clearly observed in the 1982-1983 storm season when a series of six independent storm systems caused widespread coastal damages in southern California.

A single storm each year of the life-cycle is assumed to fairly represent the majority of the shoreline change and economic losses. It is recognized that shoreline changes and the resultant economic damages tend to be cumulative throughout the storm season. However, there is little or no data that allows the full and quantitative delineation of the economic damages attributed to individual storms in a cluster of successive storms. Economic loss monitoring and measurement efforts typically are conducted on a time basis that is not in direct response to storm damages. In general it is typical that detailed descriptions of economic damages are recorded and compiled well after the storm season has ended. Therefore, there is no reliable method to individually distribute and compartmentalize the economic damages that do occur to a sequence of storms. Economic losses due to storm damages are fully described in the Economic Appendix.

Each iteration of the Monte Carlo simulation randomly selects a storm event where the significant wave height equal or exceeds the mean annual significant wave height. The storm set population was derived from measured significant wave height data at San Clemente. These data were collected under the Coastal Data Information Program between 1983 and 1998 as described in Section 2.4. The measured storm data set was best-fit with a log-normal probability distribution as described in Section 3.2. Based on the annual maximum wave heights for the measured data record, the mean annual significant wave height is 2.60 m (8.5 ft). This value is consistent with conventional coastal engineering practice for expected annual maximums within the Los Angeles District. The model selects from the portion of the best-fit log-normal probability distribution greater than 2.6 m; the model selects from a truncated distribution which is the "tail" of the distribution. Therefore each iteration of the Monte Carlo simulation forces the selected wave height to be at minimum an annual storm event. There is no provision for a year that does not have a storm; every year in the simulation has one storm.

5.2.4 Independent Sediment Transport Processes

Cross-shore sediment transport and longshore sediment transport were assumed separate and independent in this study. It is convenient to separate nearshore sediment movement into two components, longshore sediment transport and cross-shore sediment transport. This separation is not always valid in a strict sense because it is implicitly based on the assumption of plane and parallel profile contours. The time scale associated with storm-induced beach erosion is on the order of 1-3 days and depends on the level and duration of the wave and tide characteristics, whereas the time scale of beach adjustment is several months to years. Independence of cross-shore and longshore sediment transport relieves the responsibility of rigorously describing the joint morphological processes that occur. Independence of cross-shore and longshore sediment transport processes results in substantial improvement in numerical computational efficiency.

5.2.5 Numerical Simulation Concepts

Computational Efficiency: The model employed in the present study is a spreadsheet-based model in which the Monte Carlo simulation is conducted by a spreadsheet add-in package. Use of the spreadsheet allowed each year of the economic life-cycle to be represented by one column of the spreadsheet. Thus, the spreadsheet nature of the model eliminated the

numerical requirement to iterate for each life-cycle year. Each iteration represents a new simulation that results in substantial numerical computational efficiency.

A single annualized storm event provides substantial numerical simplicity over the numerical complexity inherent in a time-dependent simulation. A single storm each year of the life-cycle relieves the responsibility of rigorously describing the coastal and morphological processes that occur during a time-dependent sequence of storms. This results in substantial improvement in numerical computational efficiency.

Model Convergence: Simulation outputs were monitored for numerical convergence to evaluate the stability of output distributions during a simulation. A convergence criterion of 1.5% was established for convergence statistics for each output distribution. Model execution is continued until all pertinent economic outputs achieve the convergence criterion. Model convergence was typically achieved in less than 1000 simulations.

5.3 *Specific Model Parameters and Criteria*

5.3.1 Railroad Reach Conversion Criteria

The future with-project formulation requires estimation of when the SCRRA will invest in a capital improvement structure (seawall) to protect an investment (railroad). This trigger point is called the railroad reach conversion criteria in the present study. The criteria are comprised of two parts: a minimum beach criterion and a seawall conversion criterion. The minimum beach and seawall conversion criteria work jointly together and estimate when an unimproved (ballast) railroad reach will be improved by construction of an engineered seawall. It is noted that these criteria were developed by economics and plan formulation based on discussions with the SCRRA, correspondence from the CCC to the SCRRA, and best prediction of future human behavior. The minimum beach criterion used in the present study is set at 8 m (26 ft). The seawall conversion criterion used in the present study is a uniform distribution ranging from 29% - 48%; the criterion is randomly selected during the Monte Carlo simulation.

Plan formulation states that the SCRRA will construct a capital improvement structure prior to the initial onset of damages. To date, the SCRRA has conducted maintenance repairs only after suffering actual structural damages. Furthermore, the SCRRA is expected to determine that the annual maintenance expenditures for constructing piecemeal (cell) repairs have combined higher costs than the cost of a single comprehensive (reach) structure. The single comprehensive structure (seawall) will provide the immediate maintenance requirement as well as alleviate future maintenance requirements. Thus, it is assumed that the SCRRA will make an informed business financial decision to invest in a capital project with lower overall costs in lieu of continued piecemeal maintenance expenditures with greater long-term costs.

It is assumed that the SCRRA will conduct shoreline monitoring as part of the decision making process for a capital improvement structure (seawall) and will take action when the beach protecting the railroad is less than or equal to a minimum value. The minimum beach criterion used in the present study is fixed at 8 m (26 ft) and is derived from the 100-yr value for storm induced erosion. The input probability distribution for storm induced erosion (Sec 3.9.2) estimates a 100-yr storm will create 8 m of erosion. The assumption used in this study is that the SCRRA would construct a seawall when there is a 1% chance of damages. When the shoreline is within 8 m of the railroad, a 1% chance storm (100 year event) will erode the entire remaining beach and induce damages. Therefore, the minimum beach criterion becomes a "trigger" for action.

Plan formulation requires estimation when the SCRRA will complete the budget and funding process for a capital improvement structure (seawall). It is expected that the SCRRA will not have the funds immediately available to construct a capital improvement project. The SCRRA is expected to navigate a budget process where funds are authorized and appropriated before plans and specifications and construction occur. This results in an inherent delay between the capital improvement decision and the actual implementation (construction) of a project. The seawall conversion criterion attempts to model this behavior. The seawall conversion criterion is a time-delay criterion and has the effect of accelerating or delaying the decision-making process for implementation of a capital improvement project. The seawall conversion criterion ranges between 0-100 percent. The SCRRA cannot invest in a capital improvement project immediately, i.e. 0%. It is expected the SCRRA will not wait until the entire existing beach is completely eroded, i.e. 100%. The 29% - 48% is an estimate for seawall conversion that encompasses these considerations. Therefore, the seawall conversion criterion also becomes a "trigger" for action.

During the Monte Carlo life-cycle simulation the model tracks the protective beach width in each cell of each unimproved reach (Reaches 2, 4, 6, and 8). When the protective beach width is equal or less than 8 m (26 ft) the model flags this cell. The percentage of flagged cells is computed by the running total number of flagged cells in the reach compared to the total number of cells in the reach. When the flagged percentage equals or exceeds the randomly selected seawall conversion criterion, the model assumes that a seawall is constructed in the reach.

5.3.2 LOSSAN Traffic Service Delay

Railway traffic service delays result when severe wave runup and overtopping exceeds the elevation of SCRRA protective revetments sufficient to interrupt service. The SCRRA has documented two service disruption incidents in the 1960s and 1970s during severe storms due to wave action.

There is no generally accepted guidance or methodology formulated to define the overtopping criteria necessary to interrupt railway service. Therefore, rail traffic service delay was directly related to revetment failure; the rail traffic service delay is based on an assumed failure or breach of the revetment during a severe storm condition. If runup and overtopping conditions are severe enough to cause revetment failure, then the railway traffic would logically be interrupted while the revetment and railway is repaired.

Criteria were established to compute railway traffic service delay that combines runup elevation and a probability of occurrence. Runup elevation must equal or exceed the revetment elevation. Since the actual rail line is constructed at or below the revetment crest elevation, overtopping of the revetment crest will logically result in overtopping of the railroad. During initial model runs excessive railway traffic delays were incurred due to overtopping. In order to calibrate model railway delays with actual recorded railway delays, a probability-based percentage factor was introduced. This percentage factor was used as a calibration coefficient. This coefficient was iteratively reduced from the value of 1 until the model predicted damages matched the observed damages. The resulting percentage coefficient was 0.5. When overtopping exceeds the revetment crest elevation, thereafter there is a 50-50 probability that this overtopping condition will result in revetment failure. The rail traffic service delay criteria are calibrated based on the total number of delays experienced during a simulation. The model simulation tallies the total number of service delays. Based on the damage description provided by the SCRRA, there

were two service delays in the 1960's and 1970's. Presumably this time period extends to the 1950's if not earlier, which is approximately 50 years. Thus, on average the model should (and does) predict approximately 1-2 service delays in each 50-year simulation.

Revetment failure and subsequent railway traffic service delay is treated equally and independently for each reach and each cell. Revetment failure is allowed only if the entire reach has not been converted to a seawall. A seawall is considered to permanently protect the railroad and no failure is allowed.

The rail traffic service delay costs are divided into separate components consisting of costs to repair the railroad and losses to service interruption. Due to the nature of the model, it is possible that multiple railroad cells are damaged at the same time, but only one service delay is counted. Information provided by the SCRRA indicates that a 50 meter long railroad cell could be repaired on the order of hours after incipient damage; therefore multiple cell segments failing at the same time will not have a substantial multiplying effect to the service delay.

5.3.3 Structure Damages

Structure damages are confined to public buildings and infrastructure fronting the railway. Structure damages are not considered south of San Mateo Point or north of the North Beach area. The pier is not considered for structure damages. Structure damages consist of: direct structure loss due to long-term erosion; direct structure loss due to storm induced erosion; direct structure damages due to wave impact forces; and direct structure and contents damages due to inundation. The damage mechanisms are described in detail hereinbefore. The structure inventory is described in detail in the Economic Appendix.

The model conducts a sequential evaluation for damages to each structure in the inventory. The damage sequence is described as follows:

a. Each structure is evaluated for loss due to long-term erosion.
b. Each structure is evaluated for loss due to storm-induced erosion.
c. Each structure is evaluated for loss due to wave impact forces.
d. Each structure is evaluated for inundation damages to the structure and contents.

The model damage sequence evaluates the first three damage mechanisms and removes the structure from the inventory if any of the evaluations are positive. If all evaluations are negative, the model computes the inundation damages.

It is noted that the model calibration process resulted in some adjustment of the storm induced beach change function described in Sec 3.8. The initial storm induced beach change function was generating excessive structural damages that were not correlated with historical damages. The function was incrementally adjusted down (less severe) until the calculated structural damages approximately correlated with the actual observed damages.

A structure not-yet-constructed is included in the present analysis. At some point in the future the City of San Clemente will initiate construction of a beach trail from the North Beach area (Reach 8) to the San Clemente State Beach boundary (Reach 2). Trail completion is expected prior to the economic base year of 2012. In this analysis trail damages are confined to Reach 6.

Trail damages are treated separately from all other structures. The trail in Reach 6 consists of a crushed rock roadway with associated accouterments for a portion of the length. The remainder

of the length consists only of designation of the beach area as a trail with no structural improvements. The model considers the trail as dry land that is eroded by long-term erosion or storm induced erosion. When this land is eroded, the associated portion of the trail is considered lost. The costs of the rock roadway portion of the trail are accumulated. The major trail damages are the future costs incurred for relocation and replacement of the trail to the landward side of the railroad.

5.3.4 Structure Erosion Loss Criterion

Structure losses due to long-term or storm-induced erosion require estimation when the structure will be lost. Structures are lost to long-term or storm-induced erosion when the structure foundation is undermined due to the landward advancing shoreline. The model simulation computes the structure damages due to long-term or storm-induced shoreline change at annual intervals through the 50-year life cycle. The simulation randomly samples a long-term erosion value and a storm event, and allows the shoreline to retreat the amount associated with the phenomenon. When the retreat distance exceeds a percentage of the structure footprint, the structure is considered lost and removed from the inventory.

The structure erosion loss criterion is the percentage of structure footprint necessary to cause structure loss, and is dependent on the type of structure. The structures were classified into four categories: timber slab-on-grade, masonry slab-on-grade; timber pile supported; and masonry pile supported. For slab-on-grade structures, when the shoreline berm position eroded through 50% of the footprint as measured from the seaward wall, the structure was considered lost and removed from the inventory. Pile supported structures are not lost directly to undermining. For pile supported structures, when the shoreline erodes through 100% of the footprint, the structure *functionality* is lost, i.e. the structure can no longer be reasonably used as intended, and the structure is considered lost and removed from the inventory.

5.3.5 Recreational Beach

Long-term erosion and the landward advancing shoreline reduce the beach surface area available for recreation. The model simulation randomly selects a long-term erosion value and computes the dry beach area (aggregate of cell length x width) each year throughout the 50-year life-cycle. A time series plot of a 50-year life-cycle indicates a continually declining amount of dry beach area. A full description of the recreation analysis is found in the Economics Appendix.

5.4 *Methodology and Flowchart*

The simplified methodology and computational flow of the model is described in the following. The structures and railroad are discussed separately to illustrate the various concepts discussed hereinbefore. The economic methodology and computational flow are discussed separately in the Economics Appendix. The general model flowchart is shown in sub-Appendix B.

5.4.1 Structures

The following applies to the structure inventory located seaward of the railroad. The structures included in the inventory are described in the Economics Appendix. There are no structures landward of the railroad where damages are considered. An illustration of the methodology for structure damages is shown in **Figure 5-1**.

a. Initiate model in year 1 with the initial shoreline position. For with-project condition, initial shoreline position includes fill width.
b. Randomly select a long term shoreline change value and establish a new shoreline position.
c. Randomly select a plausible set of oceanographic conditions including: wave height; wave period; still water level (tide + storm surge + sea level change); and foreshore slope.
d. Compute wave runup.
e. Compute overtopping and resultant flooding depths (if any).
f. Compute storm induced shoreline erosion.
g. Compare structure position to determine if structure is lost due to long term erosion. Long-term erosion must erode thru 100% of structure width. If structure is lost, remove from inventory.
h. Compare structure position to determine if structure functionality is lost. Long-term erosion must erode thru 75-100% of structure width (structure dependent, creates island). If structure functionality is lost, remove from inventory.
i. Compare structure position to determine if structure is lost due to storm induced erosion. Storm induced erosion must erode thru 50% of structure width. If structure is lost, remove from inventory.
j. Compute forces to determine if structure is lost due to wave generated forces. Forces must equal or exceed threshold. If structure is lost, remove from inventory.
k. Compare structure first floor elevation to previously computed flooding depth. Compute the structure inundation and content damages.
l. Increment the model time step. For with-project condition, if fill width is 0 (fully eroded) add new fill width. Goto Step (b).

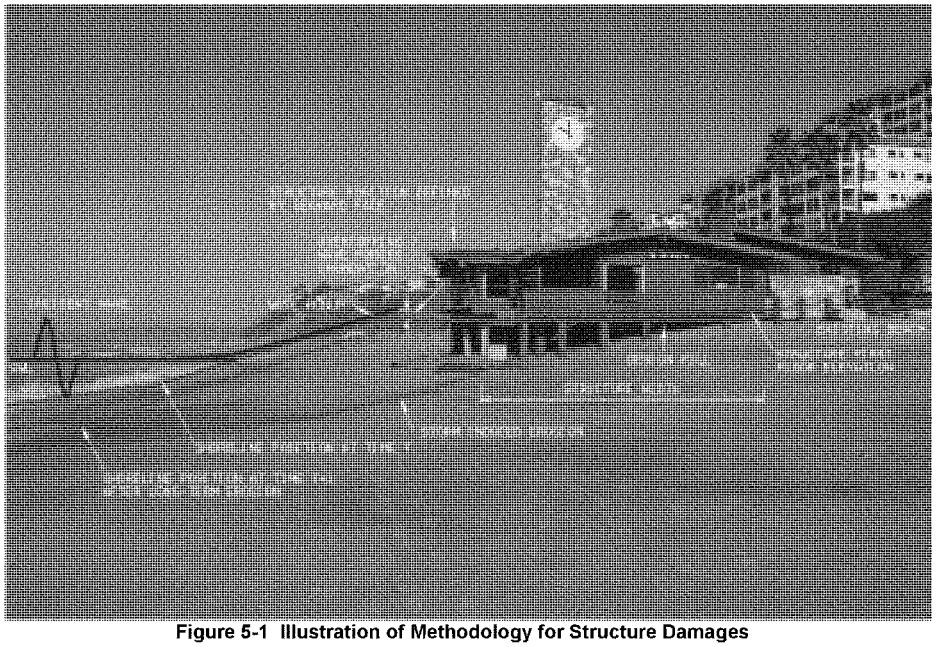

Figure 5-1 Illustration of Methodology for Structure Damages

5.4.2 Railroad

The following describes the railroad damage/conversion process. The railroad is treated as a specialized structure due to its shoreline parallel, linearized nature. The railroad was discretized into cells (described in Sec 5.2.1) for the breach analysis and divided into reaches (described in Sec 2.1) for the seawall conversion analysis. An illustration of the methodology for railroad damages is shown in **Figure 5-2**.

a. Initiate model in year 1 with the initial shoreline position. For with-project condition, initial shoreline position includes fill width.
b. Randomly select a long term shoreline change value and establish a new shoreline position.
c. Randomly select a plausible set of oceanographic conditions including: wave height; wave period; still water level (tide + storm surge + sea level change); and foreshore slope.
d. Compute wave runup.
e. Compute overtopping and resultant flooding depths (if any).
f. Compute storm induced shoreline erosion.
g. Compare long term shoreline position to each RR cell to determine if beach width is less than minimum beach width criterion (8 m). If beach width is less than minimum beach width criterion, store cell as available for conversion.
h. Compare number of RR cells stored as available for conversion to total number of cells in RR reach. Compare to seawall conversion criterion (randomly selected

between 29% - 48%). If number of RR cells is greater than or equal to seawall conversion criteria, convert RR reach from ballast construction to seawall construction.

i. Compare storm induced shoreline position to each RR cell position to determine if RR is damaged (breached). Compute RR traffic delays. (Can only occur if not converted to seawall).

j. Increment the model time step. For with-project condition, if fill width is 0 (fully eroded) add new fill width. Goto Step (b).

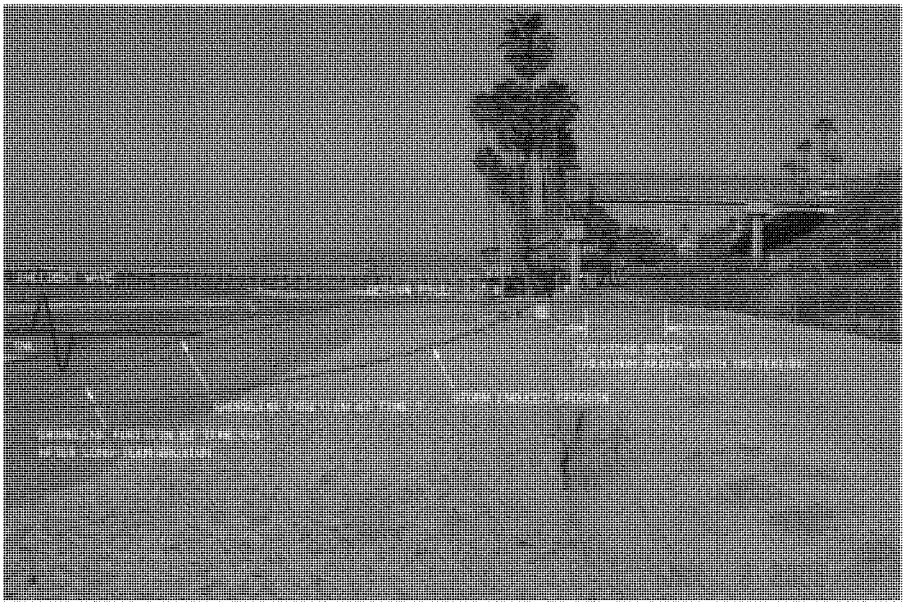

Figure 5-2 Illustration of Methodology for Railroad Damages

6 PLAN SELECTION

6.1 *Description of Alternatives*

The economic optimization procedure is based on selection of beach fill alternatives which identifies the National Economic Development (NED) plan. The NED plan is developed by considering the storm damage reduction and recreational potential of various beach fill configuration alternatives and optimization based on the average annual benefits and the benefit/cost ratio. The only optimization parameter considered is the dimension of the sacrificial beach width of the cross-sectional design profile; base beach width alternatives, beyond the current beach widths, are not considered in the model in this study. The eleven alternatives considered consist of:

Sacrificial beach width (m) = {10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60}

6.1.1 Sacrificial Beach Width

The sacrificial beach width is allowed to completely erode, after which the sacrificial beach width is replaced. The sacrificial beach width represents a time-varying amount of storm damage reduction protection and a time-varying amount of recreation benefits.

6.1.2 Nourishment Interval

A periodic nourishment interval is not optimized explicitly but is a result of the sacrificial beach width optimization. The sacrificial beach width represents a period of time between successive nourishments. The model outputs the total number of fills expected in the 50 year simulation. The number of fills includes the initial construction plus the renourishment cycles. The 50 year period divided by the number of renourishments will yield an approximate value for the nourishment interval. For example, 50 years divided by 8 renourishment cycles approximately equals a 6 year periodic nourishment interval. During the Monte Carlo simulation the sacrificial beach width will last varying lengths of time reflecting the random nature of the erosion processes, but the final output can be expressed in a mean number of years between successive fills. Therefore, optimization of the sacrificial beach width will yield the periodic nourishment interval.

6.1.3 Sea Level Change

The eleven alternatives were run separately for two sea level cases, Case 1 (existing sea level) and Case 3 (extreme sea level), which results in two plans that can be compared for sensitivity analysis in accordance with USACE planning guidelines.

Sea level change is represented within the life-cycle model by a modified long term erosion rate and by modifying the plan alternatives cross-section in addition to the increasing still water level. The mean long term erosion rate is increased by 0.10 m/yr (0.33 ft/yr) which coincidentally represents a doubling of the background erosion rate. The without project long term erosion distribution (Sec 3.7) is uniformly shifted negative by 0.10 m/yr. The beach berm elevation is allowed to increase equally with rising sea level. As sea level rises, it is assumed that the beach will respond with a correspondingly equal rise in berm elevation. This assumption is consistent with the principles of the Bruun Rule assumption discussed in Sec 2.5.10. This has the related affect of modifying the plan alternative cross-section. The berm elevation of each plan alternative is set equal to the berm elevation at that time in the life-cycle analysis. In other

words, as the berm elevation increases in response to sea level rise, the plan alternative berm elevation will also increase. The net result is plan alternatives evaluated in the extreme sea level change scenario will have larger quantities than plan alternatives in the existing sea level change scenario.

Results of this sea level change sensitivity analysis are discussed within the economic appendix and are not further addressed within this engineering appendix.

6.2 *Plan Parameters*

The USACE planning guidelines described in the main report result in the following plan selection:

> Alternative 2, the 15 m wide beach width, is the NED and tentatively recommended plan for the existing sea level change condition. Additional details on plan selection can be found in the Main Report.

Table 6-1 indicates the various plan parameters and the following will describe the physical parameters associated with these plans.

Table 6-1 Alternative Plan Parameters

Alternative	Berm Width (m)	Length (m)	Berm Elev (m, MLLW)	Quantity (m^3)	# of Fills per 50 Years	Fill Interval (Years)
2	15	1,040	5.2	192,000	9	6

The tentatively recommended plan for the existing sea level rise condition consists of an alongshore length of 1,040 m, berm width of 15 m, berm crest elevation of +5.2 m, and requiring 192,000 m^3 (251,000 yd^3) of sand.

The tentatively recommended plan beach fill design consists of an alongshore length, berm width, berm crest elevation, foreshore slope, and quantity requirement. The beach fill design parameters used in this analysis are consistent with the natural conditions at the project site and technical guidance. A plan view and cross section are shown in **Figures 6-1 and 6-2.**

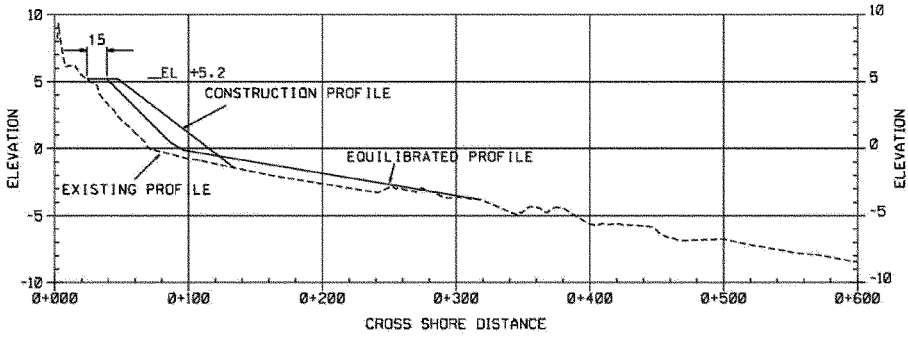

Figure 6-1 Overlay of Construction and Equilibration Profiles for Tentatively Recommended Plan on Existing Profile, Existing Sea Level Change Condition

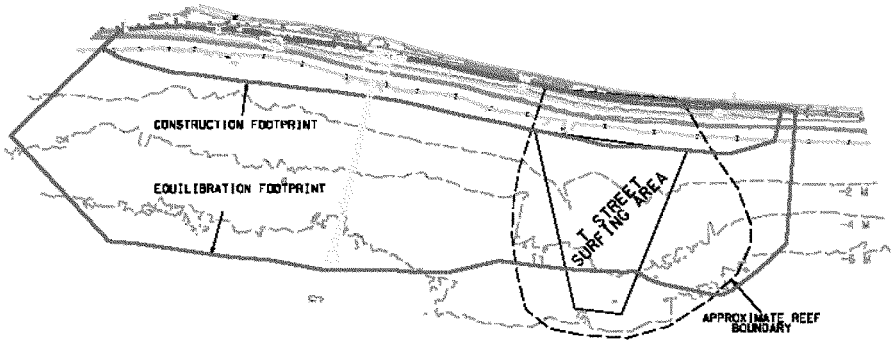

Figure 6-2 Footprint of 15 m Tentatively Recommended Plan, Existing Sea Level Rise Condition

6.2.1 Alongshore Length

Approximately 1,040 m (3,411 ft) of shoreline within the City of San Clemente are recommended for nourishment. The area is approximately centered about the pier; the south limit of the proposed beach fill is located immediately south of the T-Street overpass while the north limit is located immediately north of the Marine Safety Headquarters. For the tentatively recommended plan, a taper continues an additional 50 m (165 feet) to the north and south to merge with the existing shoreline.

6.2.2 Berm Width

The design berm width is 15 m (50 ft). The design berm width in this study is defined as extending the existing berm at elevation +5.2 m (+17.1 ft) the design width. This definition extends the "dry" portion of the beach. In order to achieve the 15 m design intent, an additional width of beach and quantity of material is required. This material is placed to offset expected beach fill losses due to anticipated equilibration of the construction profile. At the time of construction, the actual immediate post-construction width is estimated to be approximately 23 m (75 ft). The initial fill profile is expected to evolve thru an adjustment process known as equilibration. Natural foreshore processes will re-distribute a portion of the original fill volume throughout the profile. The overfill material is added to the design volume to account for the equilibration process and losses due to winnowing.

6.2.3 Berm Crest Elevation

The design berm elevation for the tentatively recommended plan is established at +5.2 meters MLLW (+17 ft). This elevation matches the natural berm of adjacent healthy beaches which have been established by numerous surveys over the years. Historical beach profiles measured over the years indicate natural, stable berm elevations are approximately +5.2 meters MLLW.

Current design guidance recommends the elevation of the design berm should generally correspond to the natural berm crest elevation. If the design berm is lower than the natural berm, a ridge will form along the crest, which when overtopped by high water will produce flooding and ponding on the berm. A design berm higher than the natural berm will produce a beach face slope steeper than the natural beach and may result in formation of scarps that interfere with recreational use and other environmental uses. Scarp formation indicates a higher transport (erosion) rate than a berm at the natural elevation, which is an inefficient use of beach fill material.

The natural berm elevation and slope can be determined by examining beach profile surveys of existing and historical conditions at the project site or at a nearby healthy beach. As beach berms form naturally under low-energy waves, they are typically most well-developed at the end of the summer season. Seasonal profile surveys can be used to examine temporal changes in berm shape and to identify well developed berm features from which to estimate the natural berm height. When survey data indicate alongshore variations in the natural berm height, a representative berm height may be determined either by visual inspection of plots showing the alongshore variations or by computing an average profile shape.

6.2.4 Foreshore Slope

The design foreshore slope is established at 8H:1V. This slope matches the natural foreshore slope of adjacent beaches which have been established by numerous surveys and measurements over the years. Direct measurements obtained by the City of San Clemente (Sec 3.5) indicate natural, stable foreshore slopes range between 4-18H:1V, with 8H:1V as the most common value. This slope has been shown to be a stable mean value between the seasonal variations.

The construction foreshore slope is established at 10H:1V. Los Angeles District beach fill construction experience with standard earthmoving equipment indicates that slightly flatter foreshore slopes are easier to construct. The post-construction foreshore is expected to evolve

thru an adjustment process known as equilibration. Natural foreshore processes will re-distribute a portion of the original fill volume throughout the profile.

6.2.5 Quantity

The tentatively recommended plan will require approximately 192,000 m^3 (251,000 yd^3) (184 m^3/m : 75 yd^3/ft) of beach compatible sand. This quantity is derived from consideration of the planform area and volume/area relationships. The horizontal area of the beach fill planform is computed and multiplied by a volume/area factor. It is usual and customary in the Los Angeles District that this volume/area relationship ranges between 4.1-12.3 m^3/m^2 (0.5-1.5 yd^3/ft^2). The low range of 4.1 m^3/m^2 (0.5 yd^3/ft^2) has been shown to result in rapid erosion of the fill. The range of 8.2-12.3 m^3/m^2 (1.0-1.5 yd^3/ft^2) typically yields more realistic estimates of sediment requirement per surface area. The value of 12.3 m^3/m^2 (1.5 yd^3/ft^2) is used in the present study. Since the volume/area factor is directly proportional to volume placed, a larger quantity is expected to have superior in-place persistance.

Engineering practice within the Los Angeles District indicates volume/area relationships are the most reliable predictor for fill quantities. This method is a simplified volumetric analysis. A prism one foot square by twenty seven feet deep encompasses twenty seven cubic feet, or one cubic yard. As applied to a beach fill, a square foot of beach multiplied by the profile length from berm to toe equals the volume of fill required. If the profile length were twenty seven feet from berm to toe, than the fill volume required would equal one cubic yard. Thus, knowing the desired beach fill planform area leads to a rapid computation of fill volume required.

The present analysis assumes the beach profile length is 9.8 m (32 ft) long. The berm elevation has been established at +5.2 m (+17 ft). The fill toe elevation is assumed to be -4.6 m (-15 ft). The toe elevation is assumed based on the controlling depth of the underlying geology. Bathymetric measurements indicate the profile is controlled by a reef feature at approximately the -4.6 m contour. In the offshore vicinity of T Street, this is evidenced by the reef which generates a highly desired surfing break (see Sec 6.3.4). Repetitive cross-shore profiles in the project fill area indicate active cross-shore sediment transport is primarily constrained between the foreshore and the reef feature. Measurements indicate the sediment is constrained in the offshore direction by the reef feature. As the project fill is similar in size to the volume of sediment that fluctuates naturally, the assumption is made that the fill will be similarly constrained by the reef structure.

The volume/area relationship explicitly accounts for overfill requirements. In the present analysis an overfill factor of 1.27 is used. This factor is embedded within the volume/area fill factor. The 12.3 m^3/m^2 (1.5 yd^3/ft^2) is relative to the actual volume of fill required based on the existing profile geometry defined as 1 meter by 1 meter by 9.8 meters (1 foot by 1 foot by 32 feet). The overfill factor is determined by 12.3/9.8 = 1.27 (32/27=1.27). It is assumed that the overfill factor is uniform throughout the fill length due to the relatively short fill length. The geotechnical analysis recommends an overfill factor of 1.10. This geotechnical overfill computation is in accordance with EM 1110-2-1100 (Coastal Engineering Manual) which incorporates differences in native and fill sediment grain size characteristics. The Coastal Engineering Manual specifically states that these methods are not recommended for final fill requirements but are best used as valuable insight regarding the implications of using fill material with different grain size characteristics. Los Angeles District experience has indicated that fill volumes based on overfill factors based solely on grain size considerations exhibit generally poorer performance than desired. Los Angeles District practice has trended towards overfill factors ranging between 1.25-1.50. Designer preference considered the quality (grain

size and distribution) of fill sediments, the quantity lost to winnowing during construction, and the expected fill performance and resulted in the selected overfill factor.

A fill quantity of 192,000 m^3 results in component volumes of 151,000 m^3 attributed to base fill and 41,000 m^3 attributed to overfill requirements. A volume of 192,000 m^3 represents a geometric area equivalent to a 23 m wide beach. In other words, 192,000 m^3 in-place will create an immediate post-construction dry beach width of 23 m. It is expected that up to 5 m of dry beach width will be distributed from the foreshore to the profile during the equilibration process. Thus, the construction profile is initially overfilled with the expectation that the equilibration process will result in the design profile.

6.3 *Tentatively Recommended Plan – Model Output*

As a result of USACE planning guidelines described in the Main Report, Alternative 2, the 15 m wide beach width, is the NED plan as well as the tentatively recommended plan for the existing sea level change condition. The model used in the present study is an integrated coastal engineering – economics analytical framework for evaluating the physical performance and economic costs of shore protection projects, particularly, beach nourishment along sandy shores. Although this model initiates with coastal engineering data and input, the outputs are principally economic related. Only one of the model outputs is engineering related and can be related back to model performance.

Number of Fills

During the Monte Carlo simulation the sacrificial beach width will last varying lengths of time reflecting the random nature of the erosion processes. The number of required fills is tracked within the model for each life cycle simulation; the model is run for 1000 life cycle simulations and the results are shown in **Figure 6-3**. The histogram is approximately normally distributed, the minimum is 5, the maximum is 15, and the mean value of 9.2. The histogram also illustrates that the most commonly occurring number of fills is 9; statistically speaking the mode is 9. The nourishment interval can be determined directly from these results and is discussed in Section 6.3.3.

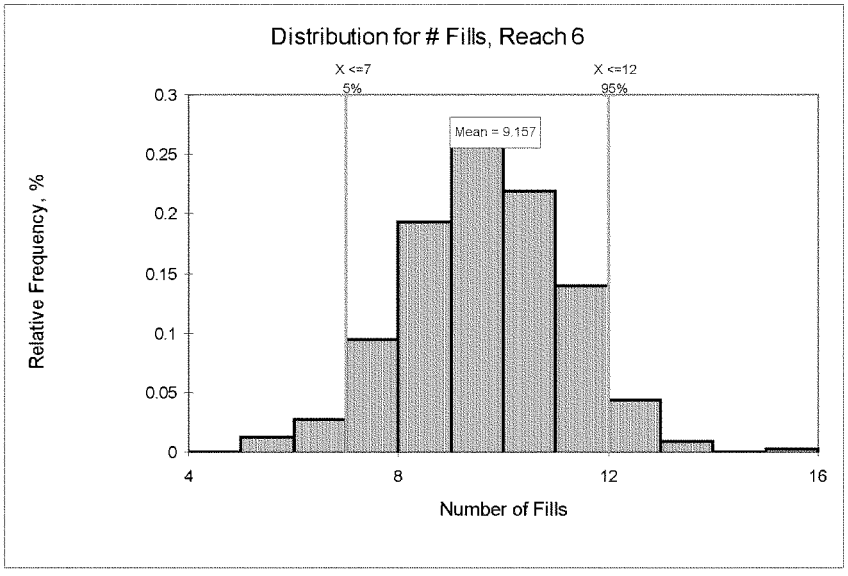

Figure 6-3 Model Output Histogram for Number of Fills Required for Reach 6

6.3.1 Plan Performance

The performance of the tentatively recommended plan is based on the measured performance of the actual beach fills from the SANDAG project in lieu of generalized estimates from predictive numerical models. The tentatively recommended plan is expected to perform in a manner weakly consistent with other recent fills within the southern California region. The geologic conditions have been previously noted to exert control over the study area as the study area is largely rocky bottom within a thin veneer of sediment and a relatively thin ribbon of sand along the shoreline. Since many of the beach fill locations utilized in the SANDAG project are under similar geologic control or some significant geologic influence, it is believed that the performance of the tentatively recommended plan will most likely resemble this performance. The study area is not considered a sandy shoreline and therefore predictive models to estimate long term shoreline evolution and storm induced shoreline change, i.e. GENESIS and SBEACH, are not believed to be valid and are not believed to accurately represent expected beach morphological response.

Monitoring of the SANDAG receiver sites has been conducted semi-annually since project construction. Oceanside Beach (Transect OS-0930), shown in **Figure 6-4** is the transect deemed most applicable to San Clemente. At Oceanside Beach the fill quantity (322,000 m^3 [421,000 cy]), median grain size (0.64 mm [0.03 in]), alongshore length (1,341 m [4,400 ft]), and fill width (56 m [185 ft]) are directly comparable to the recommended plan of this study, and as such its performance is deemed representative of expected performance at San Clemente.

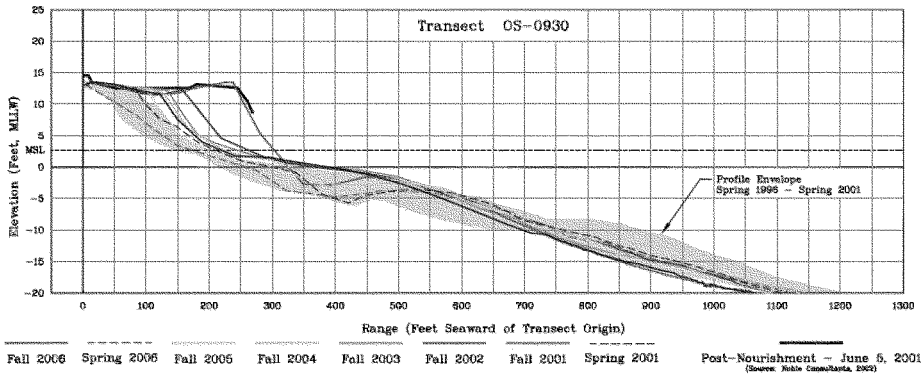

Figure 6-4 Beach Fill Performance at SANDAG Oceanside Beach

Alongshore Distribution

The San Clemente fill is expected to erode primarily in the southeasterly longshore direction based on conclusions drawn from the SANDAG monitoring data. The prevailing wave climate and oceanographic conditions at San Clemente are very similar to those in Oceanside. The SANDAG long-term monitoring data indicates that beaches in the south Oceanside and north Carlsbad region gained significantly since project construction. The data further suggests that the Oceanside fill has merged with the adjacent Carlsbad fill. As Carlsbad Beach is south of Oceanside Beach, and considering that the longshore drift is primarily in the southern direction, the beach width increase can be directly attributed to south directed longshore sediment transport of the fill material.

Some northwesterly longshore transport is expected to occur and some burial effects are expected. While the predominant net transport direction is expected to be southeasterly, some seasonal reversal can and does occur. Seasonal reversal is most expected to occur in the summer months when the occurrence of southern hemisphere swell increases. There is no known method to accurately and reliably predict the precise impacted footprint due to seasonal reversal; it is assumed that the northeasterly footprint will extend the length of the original fill.

Cross-shore Distribution

The plans are expected to establish a new equilibrated seabed profile from the beach berm to the depth of closure. Conclusions drawn from the SANDAG Oceanside Beach monitoring suggests the San Clemente fill will have burial impacts in the cross-shore direction. At present, there are no known cross-shore sediment transport models which have been demonstrated to accurately predict the distribution of material across the existing profile. SANDAG Oceanside Beach data indicates an initial post-construction cross-shore equilibration of the fill material. Fill equilibration is an early occurring process where, due to nearshore processes, the fill undergoes immediate adjustment and is redistributed from the foreshore to lower (deeper) along the profile. The fill continues to redistribute across the profile with time. Measured long term temporal change indicates that a larger portion of the fill that is transported in the cross-shore direction is trapped between the foreshore and the bar, with a lesser percentage migrating to the offshore

tail of the profile. This is consistent with prevailing equilibration theory which suggests the post-fill profile will mimic the existing profile although translated seaward an amount as a function of the fill volume.

Based on the above described concepts of cross-shore distribution, the tentatively recommended plan is expected to create the following seabed burial impacts shown in

Table 6-2. The expected impacts are not uniform across the profile. The depth of burial is greatest at the shoreline, and is expected to range up to 6 m (19 ft) thick. The depth of burial at the seaward toe of the fill footprint is expected to range between 0.3-1.0 m (1-3 ft).

Table 6-2 Tentatively Recommended Plan Footprint Burial Values

Alternative	Construction Footprint Burial (sq m)	Equilibrium Footprint Burial (sq m)
2	107,271	534,401

The proposed fill is expected to have varying levels of burial impacts due to seasonal cross-shore movements of sediment. During the summer months the equilibrium profile is expected to be biased towards the shoreline. During the summer months when lower energy wave conditions are prevalent, it is typical that sediment migrates across the profile from deeper water to shallower water, resulting in a net gain of sediment in the foreshore. During the winter months the equilibrium profile is expected to be biased towards the offshore bar. During the winter months when higher energy wave conditions are prevalent, it is usual that sediment migrates across the profile from shallower water to deeper water, resulting in a net gain of sediment in the offshore bar and towards the offshore tail of the profile.

The burial impacts due to seasonal cross-shore movement of sediment can be quantified based on conclusions drawn from the SANDAG monitoring data. The profile envelope (grey area in **Figure 6-4**) is a result of actual measurements prior to the SANDAG fills. The upper envelope and the lower envelope are based on measurements from Spring 1999 season and Fall 2000 season respectively. Although in different years, this represents the potential changes that can occur between spring (post-winter) and fall (post-summer) conditions. The profile shown includes depths up to 6 m (20 ft) which includes the bar area, the most active area of the profile. The measured data indicates that upwards of 2 m (6 ft) of thickness can be exchanged along the profile, i.e. the profile can gain or lose up to 2 m due to cross-shore transport.

The tentatively recommended plan is expected to persist within the equilibration footprint for 6 years. The burial impacts will decrease as the fill naturally erodes, which will begin shortly after equilibration is reached. At the end of approximately 6 years, the beach and nearshore profiles will return to existing conditions. This is based on the predicted number of fills and the 50 year period of evaluation. It is assumed that the cross-shore footprint width will erode at an approximately constant rate i.e. the seaward toe will shrink in the landward direction at a constant rate during the 6 year period.

The tentatively recommended plan is expected to create burial impacts to rocky bottom habitats. The burial footprint for the plan has been previously described and quantified. Additional impacts are expected due to the rocky bottom nature of the seabed in the project area. The rocky bottom, which is prevalent throughout a large percentage of the seabed, creates a highly irregular seabed with many small nooks and crevices. As the beach fill erodes by normal processes, it is conceivable that these small nooks and crevices will remain filled long past the

normal design life of the fill. A thin veneer of sand could remain in the nooks and crevices if prevailing currents and water orbital motions are not energetic enough to mobilize these sediments and remove them completely from the seabed. The thin veneer of sand is a burial impact that is not captured by the normal erosion process and is not quantifiable but nonetheless probable. The end result will be burial impacts with time periods in excess of the normal burial time periods.

Nourishment Interval

The periodic nourishment interval can be determined directly by the mean value of the number of fills previously shown and discussed in **Figure 6-3**. For the tentatively recommended plan, the model output mean value of 9 represents the average total number of fills, initial construction plus renourishment cycles, expected in the 50 year simulation. The initial construction is followed by 8 renourishment cycles within the 50 years. The 50 year period divided by the number of renourishment cycles required will yield an approximate value for the nourishment interval. For example, 50 years divided by 8 renourishment cycles approximately equals a 6 year periodic nourishment interval. During the Monte Carlo simulation the sacrificial beach width will last varying lengths of time reflecting the random nature of the erosion processes, however, the final output can be expressed in a mean number of years between successive fills.

Surfing

The tentatively recommended plan could potentially have significant burial impacts to wave breaking characteristics. "T-Street" is an extremely popular surfing site located immediately south of San Clemente pier, and directly offshore of the T-Street overpass. The T-Street surfing location is within the alongshore extent of the proposed plan. The T-Street surf break is due to a permanent, hard bottom, reef that rises above the seabed. **Figure 6-5** is a plan view plot of the bathymetric contours illustrating this seabed feature. Whereas the immediately adjacent bathymetric contours are straight and parallel, the reef at T-Street is a seabed perturbation where its elevation, shape, and orientation to incoming waves are a unique combination that tends to shoal waves to a peak with a resulting plunging "left" and "right" which gives rise to its excellent surfing characteristics. The measured bathymetry data indicates the reef extends from the shoreline to approximately 400 meters (1200 ft) offshore. The surfing area extends from approximately from the beach to 200 m (600 ft) offshore and is typically in water depths less than 5 m (15 ft). The surfing area is closer to the beach than the actual reef location as incoming waves require time and space to be transformed by the reef bathymetry.

Due to the fixed hard bottom bathymetry, the surfing conditions at T-Street remain relatively consistent through a wide range of incident wave conditions. The configuration and orientation of the reef to incoming waves creates consistent high performance surfing waves. T-Street is one of the premier reef breaks in the region. High steepness waves result in plunging breakers; plunging breakers are most noted for a "lip" at the top of the wave. With the proper set of conditions, the plunging lip can create a "tube" or "barrel". The consistent steepness of the wave coupled with the structure of the lip enables surfers to consistently reach higher speeds and perform more high performance maneuvers than at other surfing breaks in the region (**Figures 6-6 thru 6-8**).

The following description and account of surfing activities was provided by Surfline (Surfline.com, 2009). This description is excerpted to highlight those activities that are directly pertinent to the analysis methodology conducted in this study.

"T Street is known primarily for one thing -- consistency. The entire West Coast from Jordan River to Cabo could be flat, and T Street, the central hub for San Clemente's finest, would manage to cough up a wave or two that would make some surfer happy. There are a lot of things that help T Street break: sandbars, reefs, rocks and odd seaweed gardens all contribute to the wave's quirky behavior, which can only be described as schizophrenic. It'll transform from San O' to mini-Backdoor in the time it takes to do a bottom turn. Although the T Street fanatics have a million different names for every hole in the reef, the break can best be divided into three spots: the Reef, Cropley's and Beach House.

If you park your car at the base of Trafalgar Street and look straight out from the overpass you will see the main reef. On a strong south swell, lefts hit the outside reef, break slowly, then peel over the inside rock shelf, bowling in a fast down-the-line section. On winter swells, you get the opposite: long, workable rights off the reef ending in a collapsing shorebreak.

Cropley's is strictly a winter break. Named after the owner of a tasty hamburger stand that no longer exists, Cropley's provides fast, zippy right-hand peaks just north of the snack bar. Some swear it's T Street's best wave when it's on -- which isn't very often. It takes just the right swell direction from the northwest.

South of the overpass, there's a sandbar that old-time locals call the "Beach House." It's named after a candy shack that once stood more than two decades ago. On medium-size swells, you can catch some wedgy lefts and rights that are often less crowded and more geared toward shortboards and, yes, sponges."

This surfing description is notable for its initial declaration of consistency. Consistency of surfing conditions can be directly correlated to the fixed, hard bottom of the reef structure. A fixed bottom is constant over time and not subject to the shifting vagaries that sand-based beach breaks are noted for. Although this description mentions sandbars, there are numerous mentions of reefs, rocks, and the rock shelf which are a direct observation of the importance of the rocky bottom to the wave quality. The author also mentions the variety of waves in different locations that break under different swell conditions, a further testament to the ability of the reef to produce highly desirable surfing waves under a wide variety of incident conditions. The author also compares T Street to "mini-Backdoor" which is a direct reference to Banzai Pipeline, arguably the most high performance surf break in the world. The author further makes reference to a commercial structure from several decades ago that is no longer present but long-time users still refer to by name. This is direct evidence that T Street has been a renowned and consistent surf break for several decades.

The following description and account of surfing activities was provided by Stern (Stern, 1977). This description is excerpted to highlight those activities that are directly pertinent to the analysis methodology conducted in this study.

"Swells peak up far outside and form waves rideable in both directions. Waves often hard to paddle into, as they may elusively rise up and then flatten out, not breaking till beach. Occasionally well-shaped fast peaks. Consistently over 3 feet. Closes out at 8 feet. Breaks on all swells. Best at lower tides, when waves are faster and easier to get into.

Good only when completely glassy. Blown out easily by south wind, but west wind may take a little longer. Beach and bottom both sandy. Rips and currents present during sizeable surf."

This reference is a second edition copyrighted in 1977 but the first edition was originally published in 1963. This is direct evidence that the T Street surf break has been a desirable surfing location since surfing became popularized in the United States in the early 1960's. Since the first edition was published in 1963, presumably T Street was known about and being surfed in the 1950's. This description is also notable for its use of the term "consistently". The author mentions rideable waves in both directions. In surfing terminology this is known as a "peak", a highly desirable trait for a surfing location. The author also mentions that T Street breaks on all swells, which means that it can produce surfable waves on a variety of incoming wave conditions throughout the seasons. This is consistent with the description provided by Surfline.

The following description and account of surfing activities was provided by Wright (Wright, 1973). This description is excerpted to highlight those activities that are directly pertinent to the analysis methodology conducted in this study.

"An outside reef break – ¼ mile south of pier. Thick peaks with smooth lefts and rights. Lefts are usually better shaped. Takes any swell and is ridable from 2-8 feet. Becomes a bit tubular as tide drops. Sandy beach and bottom."

This reference is published in 1973 and is further evidence that the T Street surf break has been a desirable surfing location for several decades. The author uses the term "thick peaks", consistent with the description provided by Stern. The author also mentions that the reef produces rideable surf between a moderately wide range of 2-8 feet which is further evidence of the consistent nature of the break. The author uses the term "tubular" which in surfing terminology is a reference to a plunging breaker, the most highly sought after type of breaker.

Based on insights and conclusions gained from the Oceanside Beach monitoring results, the potential for cross-shore transport of the fill could have significant effects on the wave breaking characteristics. The final equilibration footprint of the NED plan will extend the berm location at least 15 m seaward at the shoreline. A larger alternative that would extend the berm approximately 35 m seaward was qualitatively analyzed for surfing impacts. Since the surfing area extends from the existing shoreline to approximately 200 m seaward, this creates an immediate potential for impacts to the surfing area. Additionally, it has been shown that natural seasonal cross-shore transport mechanisms could potentially change the seabed up to 2 m (6 ft) i.e. a sand layer 2 m thickness could settle in the surfing area. A sand layer of this magnitude could have unquantifiable, but very significant effects to the wave breaking characteristics. As sand is introduced into the reef system, the characteristic reef shape could be modified and/or lost as it becomes covered by a sand bar. The refractive abilities of the reef may be modified or lost, lessening the focusing effect of the reef and thereby erasing the "point break" characteristics of T-Street. As the reef continues to fill in with sand, the overall bathymetry of the area may begin to become straight and parallel and the wave will lose its ability to "feel" the reef. The wave may begin to exhibit more spilling characteristics normally associated with

beach breaks. This also has the potential to modify the consolidated "take-off" zone and be replaced by a more disorganized situation containing many "take off" zones with shorter, more varied break directions. The straightening contours may also cause the wave to tend to break all at once, termed a "close-out" condition. Further flattening of the slope in the reef area due to sand introduction into the reef system ultimately has the potential to change the characteristic plunging point break to a quasi- spilling beach break (**Figure 6-8**).

The impacts to surfing due to a smaller project are not rigorously quantifiable, however, the tentatively recommended plan is considerably smaller than the 35 m plan that was analyzed for surfing impacts and would therefore be expected to have less impacts than the larger plan. The equilibration footprint of a smaller beach fill should encroach a shorter distance in the cross shore direction and is thereby less likely to significantly modify the refractive abilities of the most seaward extent of the reef. A smaller beach fill could potentially continue to have significant impacts to the surf zone region between shoreline and the take off zone. This region would continue to be influenced by the seasonal and storm-induced cross shore movement of sand. The surfing experience might consist of a normal take-off after which leads to a "close-out" as the wave encounters the straightened bathymetric contours.

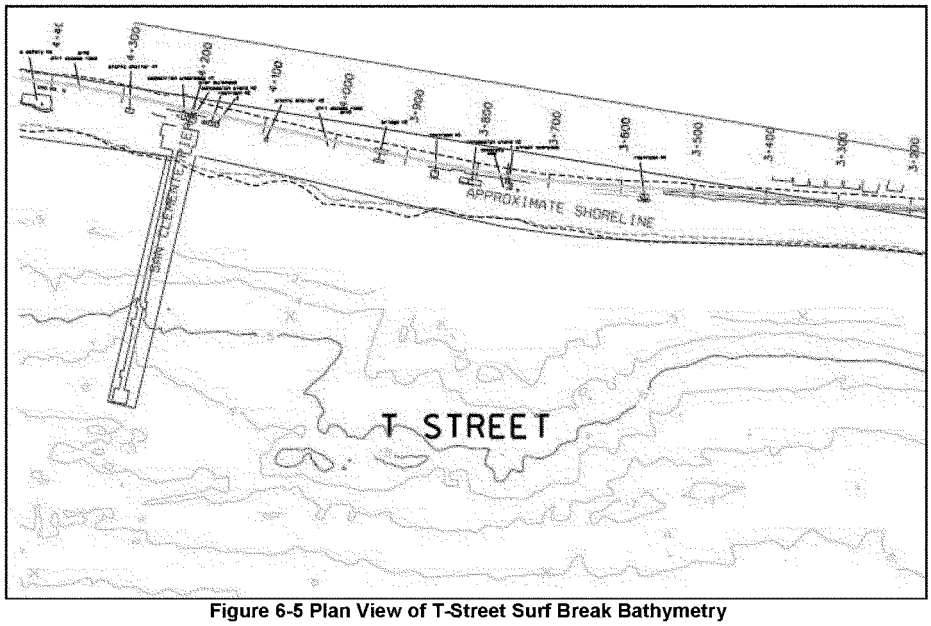

Figure 6-5 Plan View of T-Street Surf Break Bathymetry

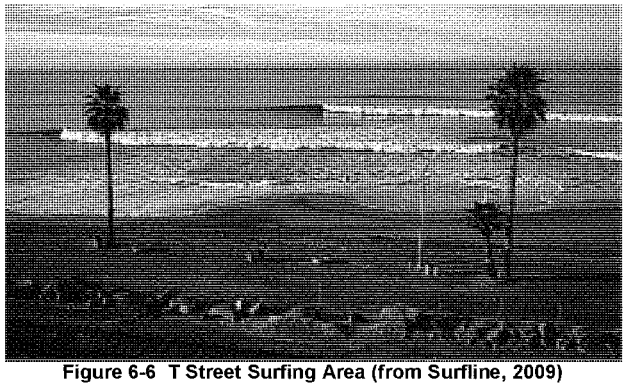

Figure 6-6 T Street Surfing Area (from Surfline, 2009)

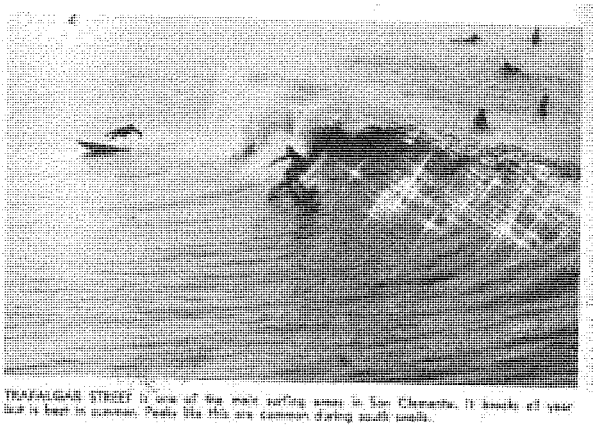

Figure 6-7 Surfers at T Street (from Wright, 1973)

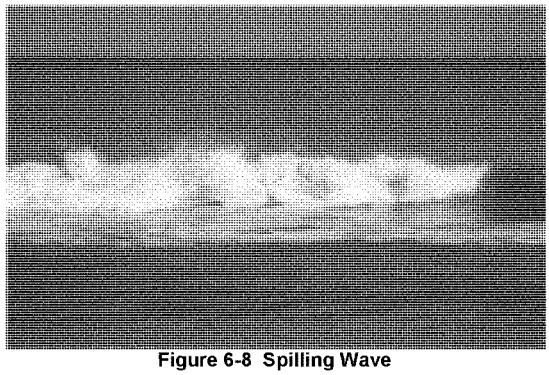

Figure 6-8 Spilling Wave

6.3.2 Public Safety

A beach fill project has the potential to create public safety impacts to swimmers and waders. The two major impacts are derived from deeper water and reflected waves. Experience in some locations nationwide indicates an increase in lifeguard rescue missions immediately after a beach fill construction project. It is noted that the probability of these impacts occurring is neither guaranteed nor quantifiable, and when occurring are typically transient impacts until full profile equilibration is achieved.

When sand is introduced artificially into the littoral system, a beach fill can create deeper water conditions than the naturally occurring conditions. During construction of the beach fill it is typical that the construction foreshore (beach) slope is steeper than the naturally occurring foreshore (beach) slope. It is also typical that the foreshore slope remains steeper than the natural condition for a period of time during the profile adjustment (equilibration) process. The newly created foreshore area, created by advancing the foreshore seaward, is now in deeper water than the previously existing natural condition. Also, during the profile equilibration process, an alongshore trough (runnel) may form or the existing condition may become deeper. The swimming/wading public often perceives this trough as a "drop-off". Whereas the recreating public may have become accustomed to the shallow waters normally associated with the existing swash zone, it is suddenly confronted with a deeper water condition posing an immediate hazard to swimmers and waders. Additionally, deeper water in the surf zone allows larger waves to propagate than the naturally occurring shallow water condition. This increased water depth in the surf zone enables larger waves to break very close to the shore. This is commonly referred to as "shore break" or "shore pound". Whereas the recreating public may have become accustomed to a mild wave condition, it is suddenly confronted with a higher energy wave climate.

The steepening of the foreshore can create reflected waves which pose a potential public safety threat to swimmers and waders. In the natural condition, most incoming waves are attenuated by runup on the naturally occurring beach slope. During the beach fill construction period and the equilibration process, it is possible that incoming waves may be reflected from the unnaturally steeper beach face. These reflected waves can compound the higher wave energy wave climate due to the aforementioned deeper water. Reflection can create a situation of "in and out" waves, comprised of normal waves propagating toward the shoreline colliding with the reflected waves heading out to sea. This has the potential to create hazardous swimming conditions to the recreating public.

Reflected waves can also potentially degrade the surfing experience. Reflected waves propagating seaward can pass through normal incoming waves with no effect, or can meet incoming waves and create a condition known as destructive interference. The outbound and inbound waves meet and the resulting transfer of energy can cause the waves to pitch up in a chaotic sea state. The surfing experience could be degraded dramatically by the presence of these outbound waves as well as the resultant chaotic sea state.

6.3.3 Southern California Edison Artificial Reefs

The tentatively recommended plan for the existing sea level condition is expected to create no significant impacts to the Southern California Edison (SCE) artificial reefs. SCE is undergoing final design plans and specifications for 127.6 acres of low relief artificial rock reefs constructed in the San Clemente area (Coastal Environments, 2008). The reefs are distributed among eleven primary polygons located between San Mateo Point and San Clemente Pier (**Figure 6-9**,

shown in green). The reef polygons are generally located between 11.5 and 15 meters (38-49 ft) depth. The nearest primary polygon (#7) is located approximately 1,500 meters south of the pier and 700 meters offshore beginning in 12 meters water depth.

In southern California it is usual and customary to confine cross-shore sediment transport between the shoreface and approximately 10 meters (30 ft) water depth. This depth is commonly referred to as the depth of closure, and is typically defined as the water depth beyond which repetitive profile surveys (collected over several years) do not detect vertical sea bed changes, generally considered the seaward limit of littoral transport. At construction completion the tentatively recommended plan is expected to engage the existing seabed approximately 1,040 m long centered about the pier, and between the shoreface and depths up to -5 meters. Upon full equilibration the tentatively recommended plan is expected to engage the existing seabed between the shoreface and depths up to 8 meters. Thus, there will be no direct contact between the tentatively recommended plan footprint and the SCE reefs due to construction. The tentatively recommended plan is expected to slowly erode in the downdrift (southeasterly) direction eventually moving along the beach thru the area landward of the reefs. However, the tentatively recommended plan is expected to never exceed the 10 meter depth of closure, and thus is not expected to migrate to the depths where the artificial reef is located.

Construction methods may create some temporary impacts to the SCE reefs. The type of dredging construction equipment utilized (described hereinafter) is expected to create some localized turbidity. It is typical that some turbidity is created during beach filling operations at the point of disposal due to the fines content of the dredge sediments. Also, minor turbidity plumes may be generated by the earthmoving equipment during beach grooming operations. These sediment turbidity plumes are then dispersed by wind, waves, and currents. With the optimum combination of conditions, it is conceivable that this turbidity plume will migrate to the reef area. However, due to the distance between the reef area and construction fill site, and the fact that these turbidity plumes tend to be very short-lived during construction actions, there is expected to be little or no impacts to the reef areas.

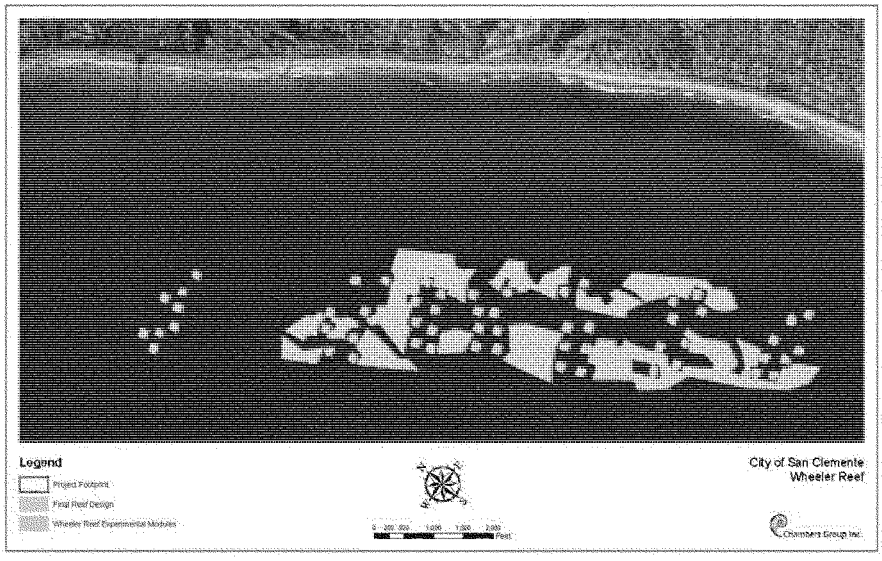

Figure 6-9 Southern California Edison Artificial Reefs

6.4 *Construction Considerations*

6.4.1 Construction Equipment

This project will most likely be constructed with hopper dredging equipment with pump ashore capability and conventional earthmoving equipment. Typical Los Angeles District beach fill projects require large capacity open-ocean capable dredges. Operational requirements typically result in hydraulic cutter head and/or hopper style dredges. The borrow site for this project is 35 km (21 miles) from the receiver beach and it is anticipated that the borrow site haul/pumping distance will require hopper dredging equipment utilization.

A similar beach nourishment operation was performed in 2001 by the San Diego Association of Governments (SANDAG). The project entailed dredging 1.5 million m^3 (2 million cy) of beach compatible sediments from six borrow sites for placement on twelve receiver beaches. The wide spread locations of the receiver beaches relative to the borrow locations required the use of a trailing suction hopper dredge. Sediment discharge was accomplished by pumping through floating pipelines to the beach.

The dry land operation is expected to be conducted by conventional earthmoving equipment including bulldozers and front end loaders. Ancillary equipment is expected to include small maintenance/tool trailers and small service trucks.

6.4.2 Contractors Work and Storage Area

The contractors' work and storage area has been designated by and will be provided by the City of San Clemente. This work and storage area is split between open space on the beach and a city owned public parking lot and is shown in **Figure 6-10**. An open area exists along the beach immediately adjacent and north of the pier and in the immediate vicinity of the Marine Safety Headquarters. It is expected this site will be used for the contractors' office trailer, parking area for heavy earthmoving equipment, and storage area for dredge pipe and other miscellaneous materials. This site is used extensively for access to the Marine Safety Headquarters and other municipal operations and as such poses no new environmental considerations, minimizes disturbance to the environment, and is ideally located for contractor ease of operations. Although access to this area is controlled by a signal controlled, at-grade railroad crossing, it is anticipated that there will be no significant restrictions on utilization of this portion of the contractors work and storage area.

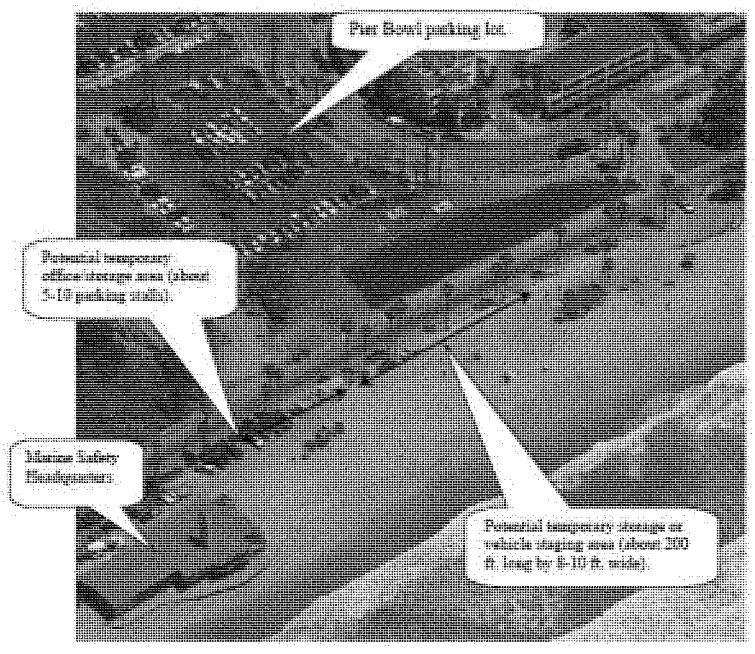

Figure 6-10 Contractor's Work and Storage Area

The Pier Bowl parking lot will also be a component of the contractors' work and storage area. This parking lot is a metered, city-owned parking lot for public access to the beach and pier area. Several parking spaces will be restricted for contractor privately owned vehicles.

The contractors' dredge and vessels will require off-site mooring and berthing space. There is no mooring area available within the City of San Clemente. The nearest suitable mooring area is Dana Point Harbor, a small craft harbor approximately 8 km (5 mi) north.

6.5 *Operation and Maintenance Costs*

Operation and Maintenance (O&M) costs associated with the tentatively recommended plan are expected to consist primarily with routine grooming, shaping, and cleaning of the beach. The tentatively recommended plan does not include any utilities or typical structural improvements associated with beaches such as public access walkways or other such walkover structures. Typical O&M activities are expected to consist of grooming and shaping the beach after storms to smooth out localized sediment accumulations/depletions, and debris cleanup along the beach and at storm drain outlets. These O&M activities are considered non-Federal responsibilities. However, these activities are usual and customary for beaches, and the tentatively recommended plan is not expected to cause an increase in these efforts.

6.6 *Monitoring Plan*

Continuing construction monitoring will be required in support of the continuing construction (nourishment) of the project. The purpose of this monitoring is to allow the timing and the detailed design of the periodic nourishment to be optimized.

Continuing construction monitoring efforts are expected to consist of direct surveys of the beach and seabed morphology. Surveying of the beach and seabed morphology is paramount to the monitoring efforts. Changes in beach and seabed morphology will define the sediment transport patterns at the shoreline and ultimately the short term and long term beach erosion processes. Alongshore transects will be crucial to determine the effects, if any, the proposed project has on updrift and/or downdrift shorelines.

Survey methods will consist of topographic measurements, bathymetric measurements, surf quality observations, and video stereo photogrammetric methods. The monitoring period will begin one year before construction (for the surf quality observations) and continue for the 50-year period of Federal involvement. However, not all aspects of the monitoring plan will be conducted each year. A description of the monitoring features is described below and a summary of the monitoring costs is shown in **Table 6-3**.

Table 6-3 Monitoring Costs

Year	Fill	Profiles	Install	Maint	Report	Width	Surfing	Sum
-1							$6,000	$6,000
0							$6,000	$6,000
1	*	$30,000	$40,000	$35,000	$32,000	$8,000	$6,000	$151,000
2		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
3		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
4		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
5		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
6	*	$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
7		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
8		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
9		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
10		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
11	*	$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
12		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
13		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
14		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
15		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
16	*	$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
17		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
18		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
19		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
20		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
21	*	$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
22		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
23		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
24		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
25		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
26	*	$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
27		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
28		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
29		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
30		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
31	*	$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
32		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
33		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
34		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
35		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
36	*	$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
37		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
38		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
39		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
40		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
41	*	$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
42		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000

43		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
44		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
45		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
46	*	$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
47		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
48		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
49		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000
50		$30,000		$35,000	$32,000	$8,000	$6,000	$111,000

6.6.1 Beach Width

Beach width measurements shall be obtained of the sub-aerial portion of the beach. The beach width is a simple linear measurement from a fixed point on the backshore to the foreshore berm crest. This method provides a systematic record of shoreline response and can be used to yield a good approximation of long-term gains or losses of sediment from a given reach of shoreline. These measurements will yield a highly useful time series of shoreline change. Experience has shown that monthly measurements are the optimal frequency to demonstrate long-term shoreline change. This type of measurement system has been successfully employed by the Los Angeles District for several decades and has repeatedly demonstrated its utility and value. Measurements shall be taken monthly at 9 locations corresponding to historical locations. Measurements shall be taken by the City of San Clemente.

This method requires a very low level effort with an attendant low cost. Each monthly survey can be accomplished in 2-3 hours. The annual cost of monthly beach width measurements is $8,000, based on recent similar costs provided by the City of San Clemente.

6.6.2 Topography / Bathymetry

Conventional topographic measurements will be obtained of the sub-aerial portion of the beach and bathymetric measurements of the surf zone and seabed morphology will be obtained using conventional acoustic sonar methods. Measurements will be obtained along pre-determined transects that coincide with historical transect locations, and mass points to develop a well-defined terrain model of the littoral system. These measurements are planned for twice annually, typically in early spring after the winter erosion season, and in late fall after the summer accretion season.

The cost of each conventional transect survey is $15,000, based on recent similar surveys conducted for the City of San Clemente.

6.6.3 Surf Quality (Surfability)

Surfing and high quality surfable waves are an increasingly valuable resource. An innovative method pioneered by the Los Angeles District has been developed to quantify surf quality (surfability). A trained observer visually estimates the breaking wave climate at the shoreline twice daily, typically at first light and at 1300; the times are approximate. Wave characteristics measured included height, period, and direction. Wave heights from the crest to the trough are visually estimated to the nearest 1 foot. Waves are observed for a period of 5-10 minutes and the minimum, average, and maximum wave heights are estimated. Wave period is based on an

average of 30 waves over the 5-10 minute observation period and is reported to the nearest 1 second. Wave directions are reported relative to the beach normal and estimated to the nearest 5 degrees. Wave directions are recorded as normal (0-10 degrees); slightly from the left (or right) (10-25 degrees); significantly from the left (or right) (greater than 25 degrees). Surf quality is also expressed in common surf language by the observer. Visual observations are supplemented with video recordings.

This method requires a very low level effort with an attendant low cost. The annual cost of twice daily observations is $6,000, based on recent similar efforts conducted in the City of Imperial Beach. The cost of video recording is captured within the video based photogrammetry discussed hereinafter.

6.6.4 Video Based Photogrammetry

Argus Beach Monitoring System is a state-of-the-art video-based stereo photogrammetric method which utilizes multiple video cameras and the principles of stereo photogrammetry to obtain topographic measurements. Multiple video cameras are typically mounted viewing the longshore area of interest and the video cameras obtain continuous imagery of the beach. Data analysis software provides detailed topographic mapping data of the sub-aerial portion of the beach. The beach topography can be sampled such that a nearly continuous time series of the beach can be obtained. It is assumed that this system will be installed initially and maintained annually.

The purchase and install cost of the Argus Beach Monitoring System is $40,000. The annual operating cost is $35,000; this cost includes all routine maintenance and as well as replacement of the system components as they become obsolete. Analysis and reporting equals $32,000 annually. There is a large suite of available analysis products; this value represents a moderate number of analysis products. These costs are based on discussions with Northwest Research Associates, vendors of the Argus system (Northwest Research Associates, 2007).

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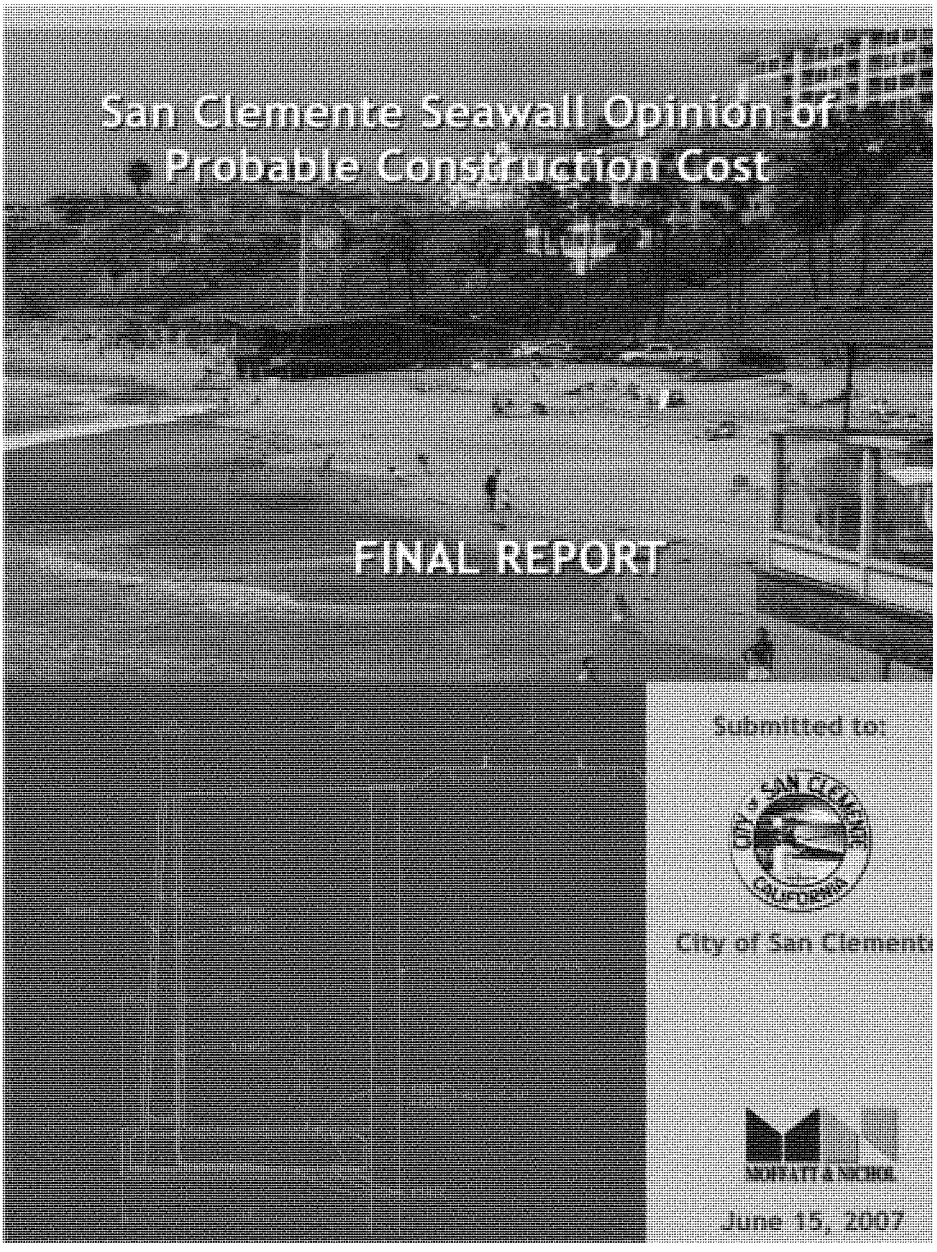
SAN CLEMENTE SHORELINE FEASIBILITY STUDY
ORANGE COUNTY, CALIFORNIA

SUB-APPENDIX A
SEAWALL COST REPORT

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
FEBRUARY 2010


San Clemente Seawall Opinion of Probable Construction Cost
FINAL REPORT
Submitted to:
City of San Clemente
June 15, 2007

SAN CLEMENTE SEAWALL
OPINION OF PROBABLE CONSTRUCTION COST

FINAL REPORT

Prepared for

City of San Clemente
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June 15, 2007

M&N File 6217

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1. Introduction

This report presents the conceptual design support and opinion of probable construction costs for a seawall to protect the existing railroad tracks at the landward side of the pier in San Clemente, CA. The concept has been developed as a project alternative for economical/coastal modeling in the US Army Corps of Engineer's (USACOE) San Clemente Shoreline Erosion Feasibility Study. The purpose of this work effort is to develop a defensible preliminary cost estimate for a seawall that would be constructed if shoreline erosion were to threaten the structural integrity of the existing railroad track. The analysis is based on background information contained in the USACE's "*Shoreline Feasibility Study Without Project Conditions F-3 Draft Final Report*", June 2004.

For this study, the San Clemente shoreline has been divided in to a series of 10 individual reaches, based on based on differences in topography, coastal development and beach conditions. (Table 1-1) The proposed seawall would extend over a small portion of the northern end of Reach 5 and a majority of Reach 6 in the area of the railway that is presently not reveted. (Figure 1-1). The total length of the seawall is estimated to be 1000 meters.

Table 1-1: Study Area Reaches (USACOE 2004)

REACH	RANGE		APPROXIMATE LENGTH (m)
	FROM	TO	
1	San Mateo Point	Palmeras	969
2	Palmeras	3800 Block, Vista Blanca	680
3	3800 Block, Vista Blanca	Calafia	600
4	Calafia	Primavera	732
5	Primavera	Cristobal	413
6	Cristobal	Linda Lane	1,040
7	Linda Lane	1200 Block, Buena Vista	1,081
8	1200 Block, Buena Vista	Pico	347
9	Pico	San Andreas	1,101
10	San Andreas	Dana Point Harbor	5,000

Figure 1-1 – Approximate Seawall Limits

2. Seawall Concept

2.1. Design Criteria/Assumptions

The concept was developed to fit within the framework of the USACOE feasibility study guidelines and includes the following criteria/assumptions:

- The seawall is planned to be a steel-reinforced concrete structure founded on bedrock.
- The seawall will be constructed within the right-of-way for the existing Southern California Regional Rail Authority (SCRRA) railway with a top elevation of +7.0m, Mean Lower Low Water (MLLW). (See Figure 2-1.)
- The seaward extent of the seawall is to be minimized to comply with California Coastal Commission permitting requirements.
- Disturbances to SCRRA railway operations should be minimized.
- Public access to the beach and pier must be maintained during construction.
- The "bedrock" or hardpan at the base of the wall has an allowable bearing capacity greater than 3000 pounds per square foot.
- The "bedrock" or hardpan at the base of the wall is non-erodable and the wall will not require toe scour protection.

2.2. Seawall Section

The seawall section was analyzed for both railway surcharge and seismic loading at it was found that the seismic loading governs for structural section, sliding, and overturning. For adequate sliding resistance, the footing is 2 meters wide and extends very close to the vertical projection of the track cross-ties. To build the wall in this location, it will be necessary to remove and rebuild the track and have the track out of service for the construction period; or install temporary shoring which will require the wall to be at least three and one-half feet further from the track.

Discussions with both the USACE and City of San Clemente indicated that interruptions in the train service would not be feasible, so the seawall should be moved away from the track. The seaward distance of the movement; however is limited by encroachment of the public beach, which is controlled by the California Coastal commission through the permitting process.

The resulting cross section appears in Figure 2-2. The wall has an over-all height of 6 meters. The concrete is $F'_c = 5000$ psi; and reinforcing steel Fy = 60,000 psi, epoxy coated. The temporary shoring consists of driven sheet piles that would be removed after the wall has been backfilled. Since the geotechnical conditions are presently unknown, it is assumed that the sheetpile shoring would have to be performed on both sides of the excavation and tied together.

Per the design criteria, the wall is founded on bedrock that is considered non-erodable; therefore the seawall does not require toe scour protection. This assumption is specified in the USACE F-3 report and supported by "Coastal Engineering Analysis for Marine Safety Building", Coastal Frontiers, January 2004.

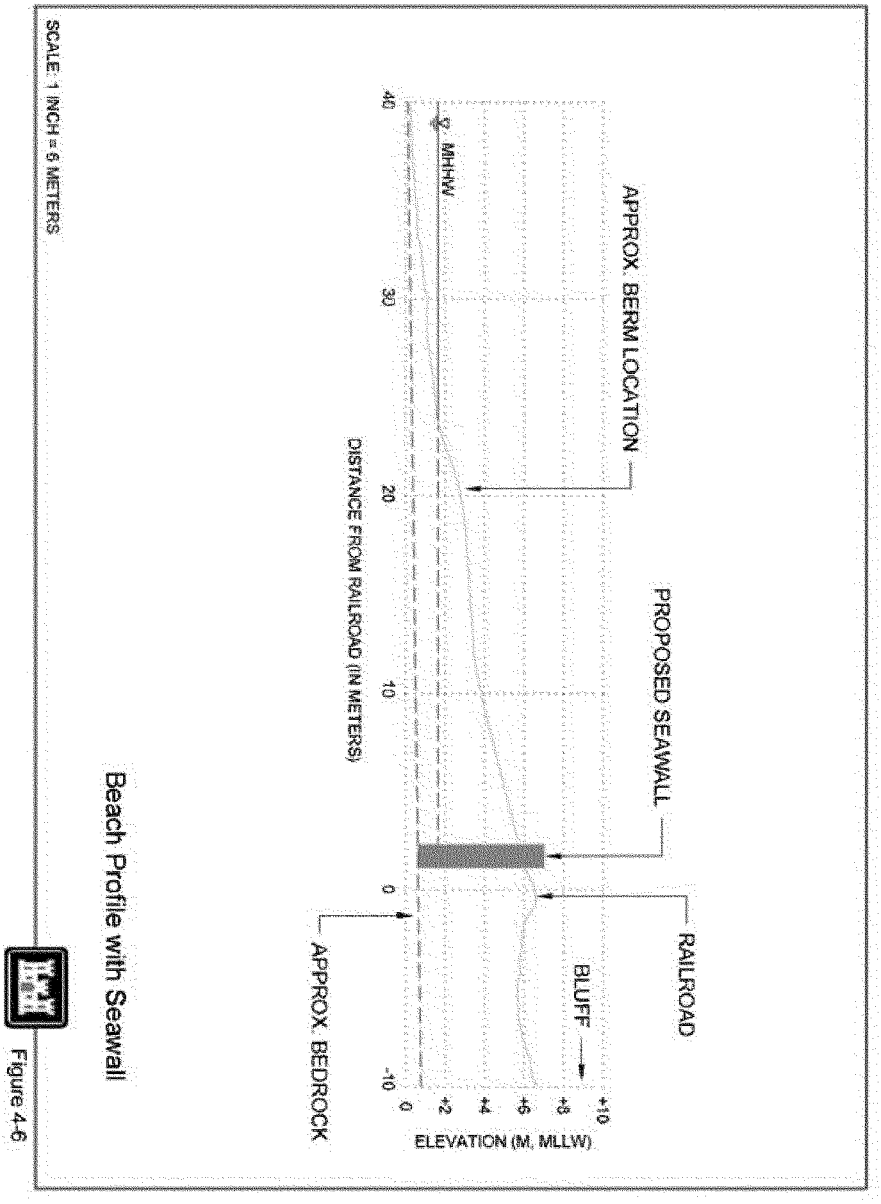

Figure 2-1 – Seawall Location (USACE 2004)

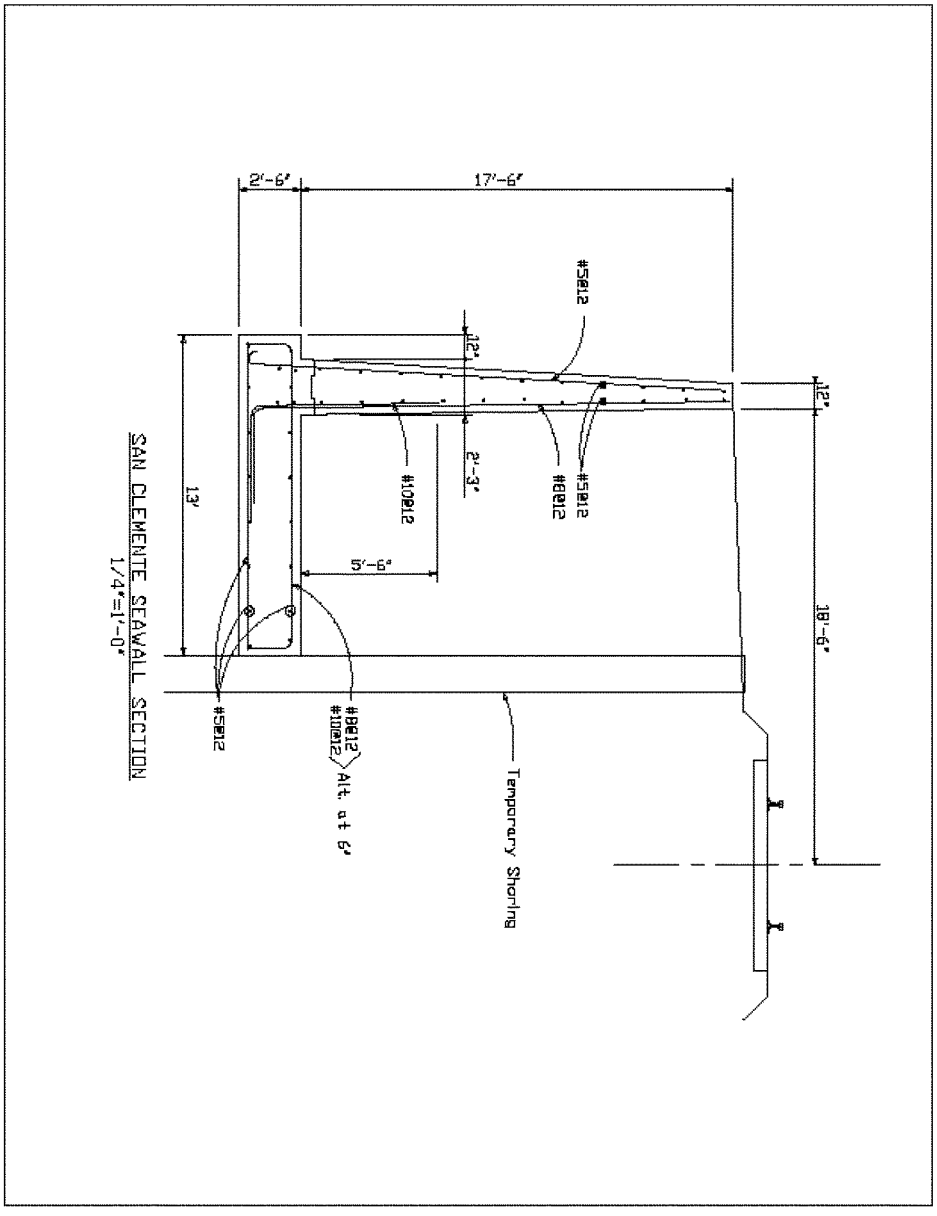

Figure 2-2 – Proposed Cross Section

2.3. Opinion of Probable Construction Costs

There are several elements to the total cost of the seawall, the most significant of which being the construction costs. Considering the proximity to the railroad, the potential for interference and delays is a significant unknown at this stage of the analysis. The opinion of probable construction costs, therefore, includes two different sets of assumptions regarding the production rate for constructing the wall and ancillary railroad costs. The costs also contain the following assumptions:

- Total length of seawall – 1000 meters (3300 feet).
- Work performed during normal daylight hours.
- No utility relocation or interference costs.
- No demolition except removal of existing fence.
- No removal, relocation, or replacement of the SCRRA railroad facilities such as ballast, crossing arms, lighting, etc.
- Sheetpile shoring on both sides of trench.
- Traffic control includes a temporary fence and routing of automobiles and pedestrians.
- Design, bid, build contract structure.
- Contractor Markup - 15%.
- General Contractor Overhead and Field Overhead rate – 10%
- Contingency – 30%

Detailed line item costs appear in Appendices A and B.

2.3.1. Minimum Opinion of Probable Construction Costs

The minimum opinion of probable construction costs for the seawall is presented in Table 2-1. These costs assume that there will be no production delays due to train operations and no other associated railroad costs.

Table 2-1: Opinion of Probable Construction Costs - Minimum

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Demolition	LS	3,300	$10	$51,150
Shoring	SF	132,000	$62	$8,184,000
Excavation	CY	37,000	$31	$1,147,000
Structural Concrete	CY	7,500	$989	$7,420,625
Reinforcing Steel	LB	1,000,000	$3	$3,100,000
Backfill	CY	30,000	$47	$1,395,000
Fence	LF	3,300	$31	$102,300
Traffic Control and Safety Items	LS	1	$308,450	$308,450
TOTAL				**$21,708,525**

For a 1000 meter (3300 feet) wall, the opinion of probable construction cost is approximately $22,000/m ($6,600/ft.) The duration of the project, without major interferences, is estimated to be 13 to 16 weeks.

2.3.2. "Maximum" Costs

Although no analysis can reasonably account for all contingencies and unknown factors, Table 2-2 presents the "maximum" reasonable opinion of probable construction for the seawall. These costs are similar to the minimum costs except they include a 50% reduction in production rates due to train interference, along with additional costs for railroad flagging, railroad inspection, and railroad insurance.

Table 2-2: Opinion of Probable Construction Costs - Maximum

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Demolition	LS	3,300	$10	$86,955
Shoring	SF	132,000	$93	$12,276,000
Excavation	CY	37,000	$47	$1,720,500
Structural Concrete	CY	7,500	$1,465	$10,985,625
Reinforcing Steel	LB	1,000,000	$4	$3,875,000
Backfill	CY	30,000	$70	$2,092,500
Fence	LF	3,300	$31	$153,450
Traffic Control & Safety Items	LS	1	$308,450	$488,250
Railroad Flagging & Inspection	LS	1	$496,000	$496,000
TOTAL				**$32,174,280**

For a 1000 meter (3300 feet) wall, the opinion of probable construction cost is approximately $32,000/m ($9,750/ft.). The duration of the project, including delays is estimated to be 20 to 24 weeks.

2.3.3. Budgeting

For budgeting purposes, it would be reasonable to plan for costs between the two extremes on the order of $27,000,000 and rely on the contingency funds to cover overages. A reasonable schedule would be approximately 16-18 weeks.

2.4. Additional Costs

2.4.1. Permitting

This project will require planning, permitting and environmental review from the appropriate agencies. The agencies that would be potentially involved include the U.S. Army Corps of Engineers (USACOE), California State Lands Commission (CSLC), California Coastal Commission (CCC), State and Regional Water Boards, Air Quality Management District (AQMD), Southern California Regional Rail Authority (SCRRA), and City of San Clemente.

Based on the location of the proposed seawall to be landward of the high tide line, it is assumed that there is no USACOE or CSLC jurisdiction and thus no permits/approvals are required from these agencies. If there is no USACE Section 404 permit, there would not be a need for a Water Board Section 401 certification. Additionally, it is assumed that an Air Quality permit would not be required because the construction equipment is exempted by AQMD Rule 219 and/or the equipment is already permitted by the local AQMD. These assumptions should be verified by coordination with these agencies.

It is likely that permits from the following agencies would be required:

- *California Coastal Commission* – The project requires a Coastal Development Permit for activities within the Coastal Zone. A wave uprush study, in compliance with CCC requirements, would be prepared. An application fee would not be required for this permit if the applicant is the City and it is deemed to be a public works project.
- *State Water Resources Control Board* - A Notice-of-Intent will be filed. The construction contractor would be responsible for preparation of the construction Storm Water Pollution Prevention Plan in accordance with the State Water Resources Control Board NPDES general permit requirements. A fee is required for the filing.
- *Orange County Transportation Authority (OCTA) / Southern California Regional Rail Authority (SCRRA)* – Approvals would be required for construction of the seawall within the railroad right-of-way and potential construction activity impacts on the railroad operations. A fee may be required for this approval. There would be significant coordination required between the City, SCRRA, and the Contractor during construction.
- City of San Clemente - The California Coastal Commission will require an approval-in-concept from the City. It is also assumed that City permits for building/construction and encroachment into the public right-of-way will be required.

The permitting scope would consist of coordination with the potential permitting agencies, applying for and securing permits from each agency, including follow-up with agencies from submittal of applications to issuance of permits as required and attendance at one CCC public hearing. This task would include technical support required to prepare the applications including graphics, quantity calculations, and construction methods. The environmental consultant would provide the permit agencies with any additional information requested subsequent to application submittals.

The environmental review task would entail completing the State environmental review process under the requirements of the California Environmental Quality Act (CEQA). A CEQA Initial Study (IS) would be done to identify the degree of potential environmental impact and it is assumed that a Mitigated Negative Declaration (MND) would be required.

An MND is for projects that may cause significant impacts, but all impacts can be mitigated to levels of less than significant. The City of San Clemente would likely be the lead agency for the project. The tasks include preparation of the administrative draft IS, final draft IS, and final CEQA document, and attendance at one project kick-off meeting. We assume that the printing and mailing of the Draft CEQA documents for public review, and the Final CEQA document for filing and certification would be performed and/or funded by the City. The City staff would assume the responsibility for public distribution of the Draft CEQA document, and certification of the Final CEQA document.

The opinion of probable costs for the permitting process is $55,000, and the environmental review and follow-up task is approximately $45,000 for a total of $100,000.

2.4.2. Design and Engineering

This task includes:

- Field Investigation to determine the final alignment of the wall, interferences from utilities or other structures, location of access points during low sand periods, and geotechnical design criteria.
- Structural design of the wall and access structures, and creation of typical details.
- Preparation of construction drawings and specifications for the wall including access structures and details for mitigating or crossing interferences.
- Preparation of estimated cost of construction at approximately 35% design, and at the end of construction document preparation.
- Meetings with the project stakeholders as needed.

Estimated cost for this task is $245,000. For a more typical construction project of this size (without shoring and railroad requirements) the design fee would be approximately 3% of the construction cost plus field investigation.

2.4.3. Contract Bidding and Award

This task includes:

- Publishing the bid package including instructions to bidders, bid forms, and construction documents.
- Preparing and distributing the invitation to bidders.
- Scheduling and leading a Pre-Bid meeting and site walk for prospective bidders.
- Responding to contractor questions and preparing addendum if necessary.
- Attend bid opening.
- Evaluate bids and make recommendation of most responsive bid.

The estimated cost for this task is $ 25,000.

2.4.4. Contract and Construction Administration

This task includes:

- Scheduling and leading the Pre-Construction meeting.
- Review of contractor submittal and review and response to contractor requests for information (RFI).
- Construction observation including concrete inspection and testing.
- Contract administration including weekly construction meetings, review and approval of contractor requests for payment, processing of contractor submittals and RFI, preparation and processing of change orders if any, scheduling of inspections, and monitoring the contractor's schedule.

Estimated cost for this task is $ 165,000. Construction observation and contract management is dependent on the construction schedule. The given cost is based on actual construction time of sixteen weeks, plus submittal and mobilization time.

2.4.5. Real Estate Costs

The seawall will be located within the SCRRA right-of-way of the railway so there are no anticipated real estate acquisition costs, however, the City may have to enter in to a special agreement with the SCRRA to perform the work.

2.5. Summary of Probable Costs

Table 2-3 presents the total probable costs for the proposed seawall.

Table 2-3: Estimated Total Project Costs

ITEM DESCRIPTION	AMOUNT
Construction	$27,000,000
Permitting	$100,000
Design and Engineering	$245,000
Contract Bidding and Award	$20,000
Contract and Construction Administration	$165,000
Real Estate Costs	$0
TOTAL	**$27,530,000**

APPENDIX A – OPINION OF PROBABLE CONSTRUCTION COSTS
MINIMUM CASE

Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Estimate Summary

ITEM NO.	ITEM DESCRIPTION		UNIT	QUANTITY	UNIT PRICE	AMOUNT
	Demolition		LS	1	$51,150	$51,150
	Shoring (Both sides of Excavation)		SF	132,000	$62	$8,184,000
	Excavation		CY	37,000	$31	$1,147,000
	Structural Concrete		CY	7,500	$989	$7,420,625
	Reinforcing Steel		LB	1,000,000	$3	$3,100,000
	Backfill		CY	30,000	$47	$1,395,000
	Fence		LF	3,300	$31	$102,300
	Traffic Control and Safety Items		LS	1	$308,450	$308,450
		SUBTOTAL				$21,708,525
			SHEET TOTAL			$21,708,525

Assumptions:

1) This estimate does not include any railroad insurance, railroad flagging, or railroad inspection costs
2) This estimate assumes work can be done during normal daylight work shifts with no delays due to trains
3) This estimate does not include any utility relocation or interference costs
4) This estimate does not include any demolition other than removal and replacement of existing fence
5) This estimate does not include removing, replacing or relocating any Railroad facilities such as ballast, crossing arms, utilities, etc.

NOTES: THIS COST ESTIMATE IS AN OPINION OF CONSTRUCTION COST MADE BY THE CONSULTANT. IN PROVIDING OPINIONS OF CONSTRUCTION COST, IT IS RECOGNIZED THAT NEITHER THE CLIENT NOR THE CONSULTANT HAS CONTROL OVER THE COSTS OF LABOR, EQUIPMENT, OR MATERIALS, OR OVER CONTRACTORS' METHODS OF DETERMINING PRICES OR BIDDING. THIS OPINION OF CONSTRUCTION COST IS BASED ON THE CONSULTANT'S REASONABLE PROFESSIONAL JUDGMENT AND EXPERIENCE AND DOES NOT CONSTITUTE A WARRANTY, EXPRESS OR IMPLIED, THAT CONTRACTORS' BIDS OR NEGOTIATED PRICES OF THE WORK WILL NOT VARY FROM THE CLIENT'S BUDGET OR FROM ANY OPINION OF COST PREPARED BY THE CONSULTANT.

Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Demolition

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Remove Fence	LF	3,300	$7	$23,100	$3	$9,900	$10.00	$33,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$23,100		$9,900		$33,000

Contractor Markup (15%)	$4,950
Gen OH and Field OH (10%)	$3,300
Contingency (30%)	$9,900
TOTAL	$51,150

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Date: April 30, 2007

Shoring (Both sides of Excavation)

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Install and Remove Shoring (Both sides)	SF	132,000	$20	$2,640,000	$20	$2,640,000	$40.00	$5,280,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$2,640,000		$2,640,000		$5,280,000
							Contractor Markup (15%)		$792,000
							Gen OH and Field OH (10%)		$528,000
							Contingency (30%)		$1,584,000
							TOTAL		$8,184,000

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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Excavation

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Excavation	CY	37,000	$10	$370,000	$10	$370,000	$20.00	$740,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$370,000		$370,000		$740,000
							Contractor Markup (15%)		$111,000
							Gen OH and Field OH (10%)		$74,000
							Contingency (30%)		$222,000
							TOTAL		$1,147,000

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Activity: City of San Clemente
San Clemente, California

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Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
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Status of Design:
Conceptual

Date: April 30, 2007

Structural Concrete

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Construct Footing	CY	4,000	$225	$900,000	$250	$1,000,000	$475.00	$1,900,000
	Construct Wall	CY	3,500	$400.00	$1,400,000	$425	$1,487,500	$825.00	$2,887,500
					$0		$0	$0.00	$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
		SUBTOTAL	7,500		$2,300,000		$2,487,500		$4,787,500
							Contractor Markup (15%)		$718,125
							Gen OH and Field OH (10%)		$478,750
							Contingency (30%)		$1,436,250
							TOTAL		$7,420,625

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A-E Firm Name:
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Status of Design:
Conceptual

Date: April 30, 2007

Reinforcing Steel

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Furnish and Install Epoxy Coated Rebar	LB	1,000,000	$0.50	$500,000	$2	$1,500,000	$2.00	$2,000,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$500,000		$1,500,000		$2,000,000
								Contractor Markup (15%)	$300,000
								Gen OH and Field OH (10%)	$200,000
								Contingency (30%)	$600,000
								TOTAL	$3,100,000

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Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Backfill

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Backfill Retaining Wall	CY	30,000	$15	$450,000	$15	$450,000	$30.00	$900,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$450,000		$450,000		$900,000
							Contractor Markup (15%)		$135,000
							Gen OH and Field OH (10%)		$90,000
							Contingency (30%)		$270,000
							TOTAL		$1,395,000

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Fence

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Furnish and Install Fence	LF	3,300	$10	$33,000	$10	$33,000	$20.00	$66,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$33,000		$33,000		$66,000
							Contractor Markup (15%)		$9,900
							Gen OH and Field OH (10%)		$6,600
							Contingency (30%)		$19,800
							TOTAL		$102,300

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Traffic Control and Safety Items

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Traffic Control(Pedestrians and automobiles)	LS	1	$50,000	$50,000	$50,000	$50,000	$100,000.00	$100,000
	Temporary Safety Fence	LF	6,600	$10.00	$66,000	$5	$33,000	$15.00	$99,000
					$0		$0	$0.00	$0
		SUBTOTAL			$116,000		$83,000		$199,000
						Contractor Markup (15%)			$29,850
						Gen OH and Field OH (10%)			$19,900
						Contingency (30%)			$59,700
						TOTAL			$308,450

NOTES:
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APPENDIX B – OPINION OF PROBABLE CONSTRUCTION COSTS "MAXIMUM" CASE

Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Estimate Summary

ITEM NO.	ITEM DESCRIPTION		UNIT	QUANTITY	UNIT PRICE	AMOUNT
	Demolition		LS	1	$86,955	$86,955
	Shoring (Both sides of Excavation)		SF	132,000	$93	$12,276,000
	Excavation		CY	37,000	$47	$1,729,500
	Structural Concrete		CY	7,500	$1,465	$10,985,625
	Reinforcing Steel		LB	1,000,000	$4	$3,875,000
	Backfill		CY	30,000	$70	$2,092,500
	Fence		LF	3,300	$47	$153,450
	Traffic Control and Safety Items		LS	1	$488,250	$488,250
	Railroad Flagging and Inspection		LS	1	$496,000	$496,000
		SUBTOTAL				$32,174,280
			SHEET TOTAL			$32,174,280

Assumptions:

1) This estimate does not include any utility relocation or interference costs

2) This estimate does not include any demolition other than removal and replacement of existing fence

3) This estimate does not include removing, replacing or relocating any Railroad facilities such as ballast, crossing arms, utilities, etc.

NOTES: THIS COST ESTIMATE IS AN OPINION OF CONSTRUCTION COST MADE BY THE CONSULTANT. IN PROVIDING OPINIONS OF CONSTRUCTION COST, IT IS RECOGNIZED THAT NEITHER THE CLIENT NOR THE CONSULTANT HAS CONTROL OVER THE COSTS OF LABOR, EQUIPMENT, OR MATERIALS, OR OVER CONTRACTORS' METHODS OF DETERMINING PRICES OR BIDDING. THIS OPINION OF CONSTRUCTION COST IS BASED ON THE CONSULTANT'S REASONABLE PROFESSIONAL JUDGMENT AND EXPERIENCE AND DOES NOT CONSTITUTE A WARRANTY, EXPRESS OR IMPLIED, THAT CONTRACTORS' BIDS OR NEGOTIATED PRICES OF THE WORK WILL NOT VARY FROM THE CLIENT'S BUDGET OR FROM ANY OPINION OF COST PREPARED BY THE CONSULTANT.

Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Demolition

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Remove Fence	LF	3,300	$14	$46,200	$3	$9,900	$17.00	$56,100
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$46,200		$9,900		$56,100
							Contractor Markup (15%)		$8,415
							Gen OH and Field OH (10%)		$5,610
							Contingency (30%)		$16,830
							TOTAL		$86,955

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Shoring (Both sides of Excavation)

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Install and Remove Shoring (Both sides)	SF	132,000	$40	$5,280,000	$20	$2,640,000	$60.00	$7,920,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$5,280,000		$2,640,000		$7,920,000
							Contractor Markup (15%)		$1,188,000
							Gen OH and Field OH (10%)		$792,000
							Contingency (30%)		$2,376,000
							TOTAL		$12,276,000

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est. Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Excavation

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Excavation	CY	37,000	$20	$740,000	$10	$370,000	$30.00	$1,110,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$740,000		$370,000		$1,110,000
							Contractor Markup (15%)		$166,500
							Gen OH and Field OH (10%)		$111,000
							Contingency (30%)		$333,000
							TOTAL		$1,720,500

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Structural Concrete

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Construct Footing	CY	4,000	$450	$1,800,000	$250	$1,000,000	$700.00	$2,800,000
	Construct Wall	CY	3,500	$800.00	$2,800,000	$425	$1,487,500	$1,225.00	$4,287,500
					$0		$0	$0.00	$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
									$0
		SUBTOTAL	7,500		$4,600,000		$2,487,500		$7,087,500
							Contractor Markup (15%)		$1,063,125
							Gen OH and Field OH (10%)		$708,750
							Contingency (30%)		$2,126,250
							TOTAL		$10,985,625

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Reinforcing Steel

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Furnish and Install Epoxy Coated Rebar	LB	1,000,000	$1.00	$1,000,000	$2	$1,500,000	$2.50	$2,500,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$1,000,000		$1,500,000		$2,500,000
							Contractor Markup (15%)		$375,000
							Gen OH and Field OH (10%)		$250,000
							Contingency (30%)		$750,000
							TOTAL		$3,875,000

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Backfill

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Backfill Retaining Wall	CY	30,000	$30	$900,000	$15	$450,000	$45.00	$1,350,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$900,000		$450,000		$1,350,000
							Contractor Markup (15%)		$202,500
							Gen OH and Field OH (10%)		$135,000
							Contingency (30%)		$405,000
							TOTAL		$2,092,500

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Fence

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Furnish and Install Fence	LF	3,300	$20	$66,000	$10	$33,000	$30.00	$99,000
					$0		$0	$0.00	$0
					$0		$0	$0.00	$0
		SUBTOTAL			$66,000		$33,000		$99,000
						Contractor Markup (15%)			$14,850
						Gen OH and Field OH (10%)			$9,900
						Contingency (30%)			$29,700
						TOTAL			$153,450

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Traffic Control and Safety Items

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Traffic Control(Pedestrians and automobiles)	LS	1	$100,000	$100,000	$50,000	$50,000	$150,000.00	$150,000
	Temporary Safety Fence	LF	6,600	$20.00	$132,000	$5	$33,000	$25.00	$165,000
					$0		$0	$0.00	$0
		SUBTOTAL			$232,000		$83,000		$315,000
						Contractor Markup (15%)			$47,250
						Gen OH and Field OH (10%)			$31,500
						Contingency (30%)			$94,500
						TOTAL			$488,250

NOTES:
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Activity: City of San Clemente
San Clemente, California

Project Title: San Clemente Sea Wall

Estimated By:
Firm: M & N
Est: Name: MOD

A-E Firm Name:
Moffatt and Nichol
Checked By:
Status of Design:
Conceptual

Date: April 30, 2007

Railroad Flagging and Inspection

				LABOR COST		MATERIAL COST		TOTAL COST	
ITEM NO	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
	Railroad Flagging	DAYS	250		$0	$700	$175,000	$700.00	$175,000
	Railroad Insurance	LS	1		$0	$100,000	$100,000	$100,000.00	$100,000
	Railroad Inspection	DAYS	50		$0	$900	$45,000	$900.00	$45,000
		SUBTOTAL			$0		$320,000		$320,000
						Contractor Markup (15%)			$48,000
						Gen OH and Field OH (10%)			$32,000
						Contingency (30%)			$96,000
						TOTAL			$496,000

NOTES:
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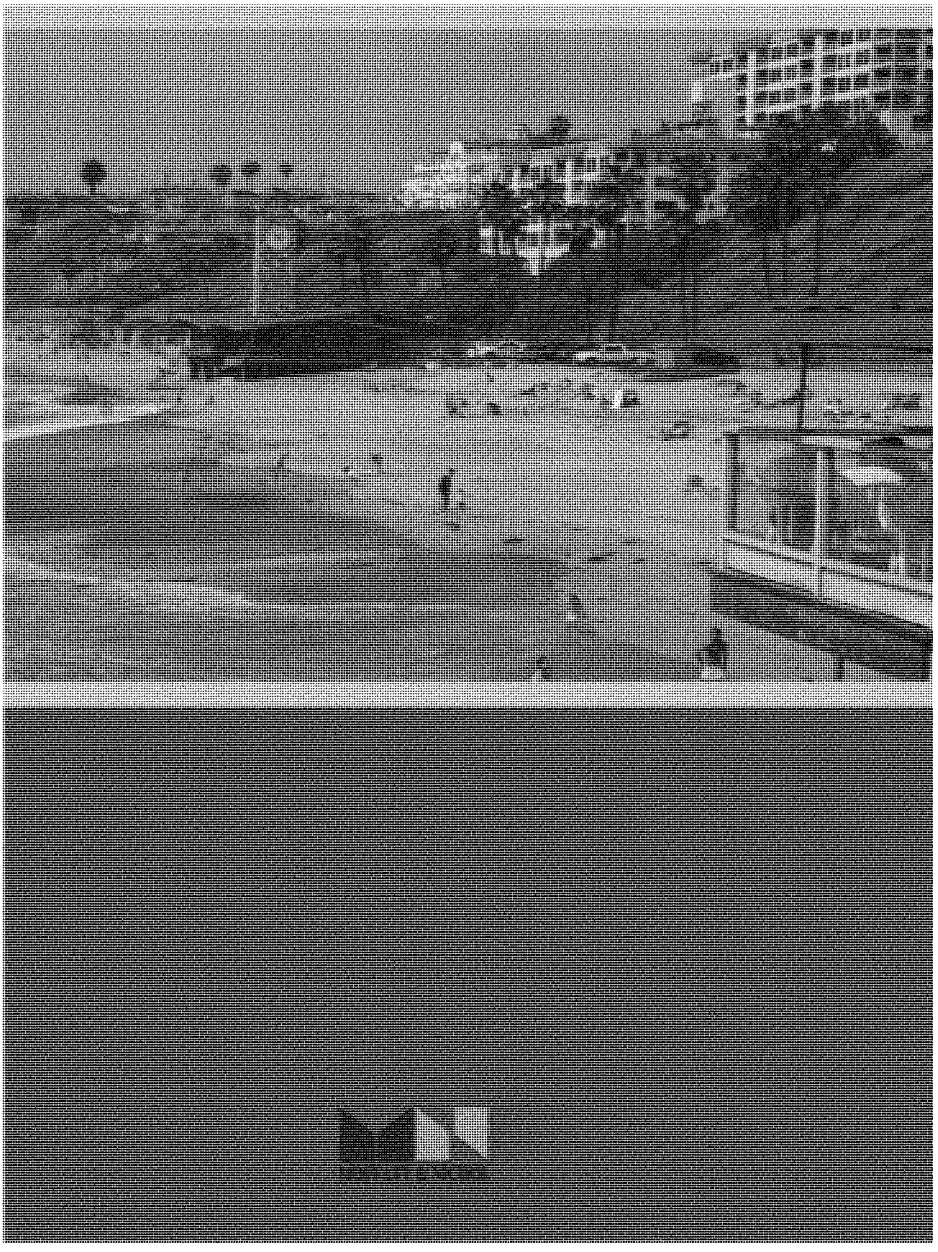
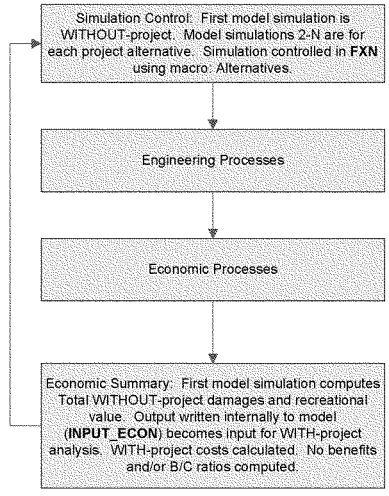


SAN CLEMENTE SHORELINE FEASIBILITY STUDY
ORANGE COUNTY, CALIFORNIA

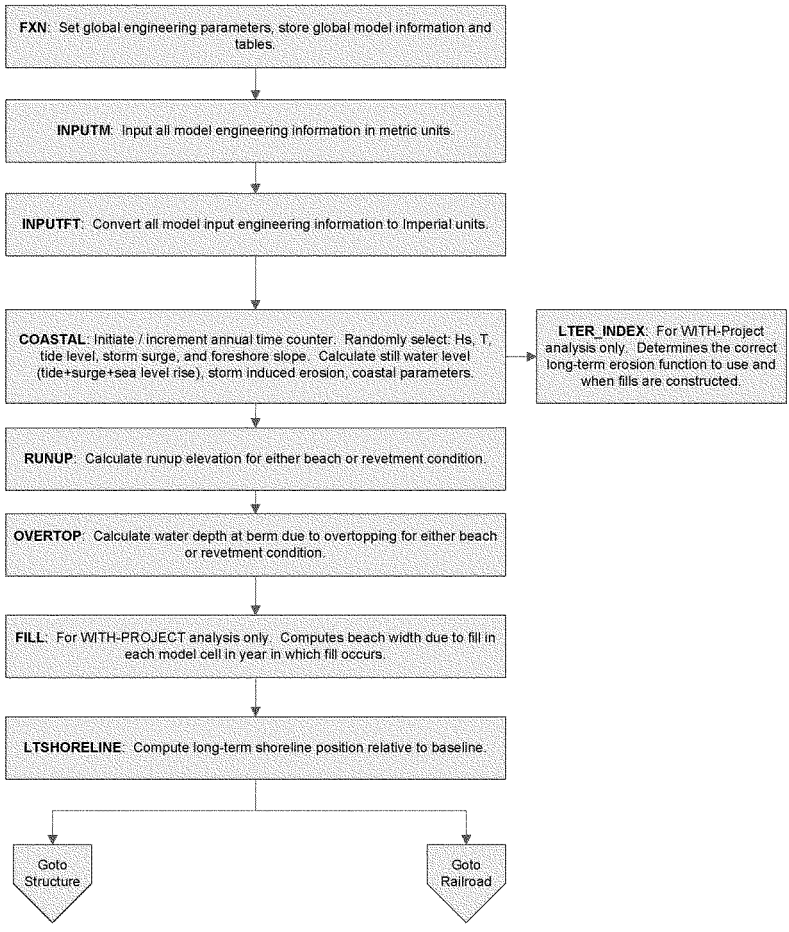
SUB-APPENDIX B
NUMERICAL MODEL FLOWCHART

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
FEBRUARY 2010

GENERAL MODEL FLOW

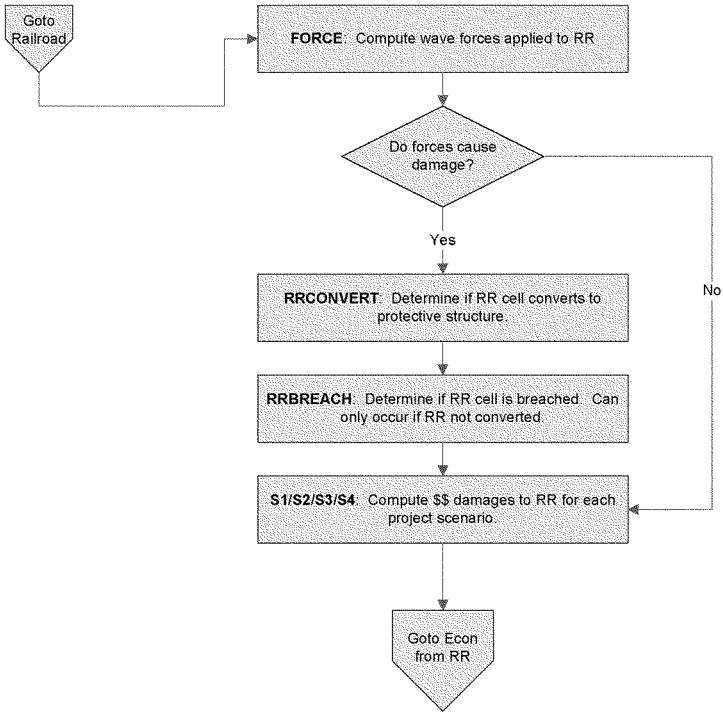


COASTAL ENGINEERING



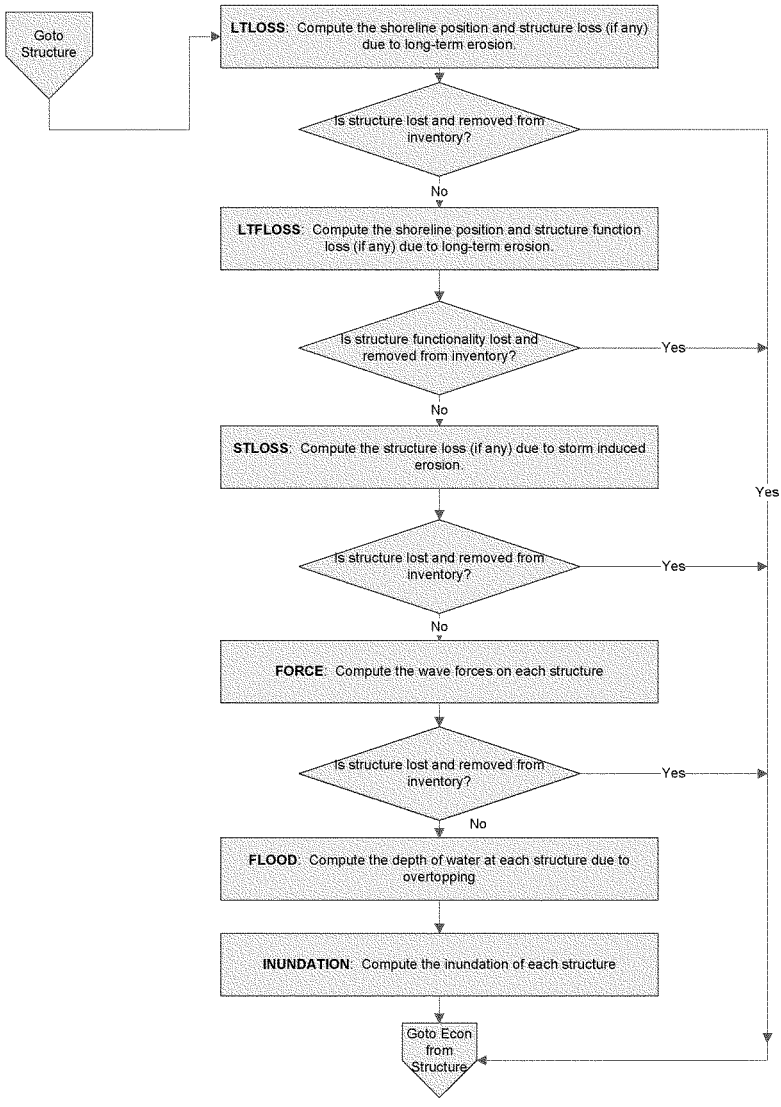
Note: **BOLD** corresponds to model worksheet name.

RAILROAD



Note: **BOLD** corresponds to model worksheet name.

STRUCTURE



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APPENDIX E – GEOTECHNICAL REPORT

San Clemente Shoreline Feasibility Study
Orange County, California

GEOTECHNICAL
APPENDIX

FINAL REPORT

U.S. Army Corps of Engineers
Los Angeles District

JULY 2011

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Attachments

Attachment 1. Group Delta Consultants, 2003. *Vibracore Exploration Program, San Clemente Beach Shoreline, Orange and San Diego Counties, California.* Prepared for U. S. Army Corps of Engineers, Los Angeles District, 21 May 2003, with 5 appendices.

Attachment 2. Soils (Sediment) Logs of USACE (August, 2003) borings O-1 through O-26.

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1 INTRODUCTION

1.1 General

The San Clemente Shoreline project is located at the City of San Clemente, Orange County, California. The non-Federal sponsor of this study is the City of San Clemente. This report was prepared as a technical appendix to the San Clemente Shoreline Feasibility Report. The purpose of this appendix is to provide the basic data and requirements necessary to support the feasibility study for the Corps of Engineers dredging of offshore beach sand and disposing of the material on the beach at San Clemente, California. This report provides a summary of field and laboratory investigations, a description of geotechnical site conditions, recommended parameters for use in design, and documentation for the plans and specifications. Subsequent to technical review of the F-3 Feasibility Report (USACE, 2004), beach transect sampling and compatibility analysis were conducted by Geotechnical Branch. Results of this analysis are reported herein. The nature and dredgeability of the sediments in the proposed offshore borrow areas and their compatibility with the sediments at the proposed receiving beach at San Clemente Beach will be discussed.

1.2 Project Description

The purpose of this project is to provide a solution to the existing beach erosion problem along the shoreline in the City of San Clemente, Orange County, California, that reduces storm-related damages and complies with local, state, and Federal environmental laws and regulations. This report presents the results of recent investigations into possible sources of beach compatible sand for renourishment of San Clemente Beach. Replacement of the sand at San Clemente Beach is required because of ongoing erosion.

The City of San Clemente is located along the coast of southern California at the southern end of Orange County near the border of San Diego County. The study area is bounded by San Mateo Point (located at the southern limits of the City of San Clemente, and, additionally, the boundary between the counties of Orange and San Diego) on the south and Dana Point Harbor on the north. The study area is approximately 12.1 km (7.5 miles) long, and is sub-divided into ten reaches for reference purposes numbered consecutively Reach 1 – Reach 10. Reaches 1 through 8 are located in the City of San Clemente (see Figure 1).

The shoreline in the project area consists mainly of narrow, gently to moderately sloping sandy beaches backed by high coastal bluffs. This sandy beach grades into a foreshore consisting of cobble and gravel pockets at the water's edge. At Mariposa point, located some 300 meters (980 feet) northwest of the San Clemente pier, off-shore rocks and boulders protrude from the high intertidal sand beach and become the dominant habitat type throughout the mid and low intertidal zones. The last extensive rocky intertidal habitat at Mariposa Point consists of a series of low-lying shale reef

platforms that begin mid-beach and extend into the subtidal zone along with individual high relief boulders.

The proposed borrow area for the beach replenishment is located approximately 35 kilometers (21 miles) downcoast of San Clemente Beach, approximately 1.7 kilometers (1 mile) north of Oceanside Harbor, Oceanside, California. See Plate 1 for a plan of the borrow area and Figure 18 for the areas to be nourished at San Clemente beach.

2 GEOLOGY

2.1 Regional Geology

The San Clemente area comprises a part of the western flank of the Peninsular Ranges Geologic Province of southern California. The bedrock exposures in the area are comprised of marine sedimentary and volcanic rocks of Miocene, Pliocene and Pleistocene age. The bedrock formations both onshore and offshore consist of the San Mateo Formation, an arkosic sandstone of Pleistocene age; the Capistrano Formation, a series of silty shales, mudstones, siltstones, and coarse sandstones of late Miocene and early Pliocene age; and the San Onofre Breccia, a Miocene-age series of volcanic breccias, ash flows and tuffs derived from large landslides which occurred during volcanic eruptions, interbedded with layers of fine-grained volcanic ash deposited into fresh or salt water.

The western edge of the Peninsular Ranges Province is the irregular coastal plain. A series of eroded marine and non-marine terraces are prominently displayed on the coastal plain, which ranges in width from about 100 meters (a few hundred feet) to about 18 kilometers (30 miles). A series of sea cliffs have been eroded into these terraces by numerous cycles of submergence and emergence. A narrow beach has formed at the foot of these terraces.

The area offshore of San Clemente is a part of the Capistrano Bight, located at the eastern edge of the Gulf of Santa Catalina. This area is described as that part of the California coast known as the "Continental Borderland", as there is no real continental shelf along this part of the coast. The area from Dana Point Harbor in Orange County downcoast to La Jolla in San Diego County is further defined as the "Oceanside Littoral Cell". San Clemente beach is located in the extreme upper portion of this Littoral Cell. Published information for the bedrock exposures of most of the offshore area, exclusive of San Clemente Beach and the Channel Islands, is sparse and is based upon scattered bottom samples and reconnaissance-type geophysical investigations.

2.2 San Clemente Beach Site Geology

At San Clemente Beach, marine erosion has formed a broad wave-cut terrace which extends back from the coastline and lies several meters above sea level. This relatively flat lying surface is cut mainly in rocks of the Capistrano Formation of late Miocene and early Pliocene age and is mantled with poorly consolidated non-marine alluvial cover of Holocene and Pleistocene age and marine terrace deposits of Upper Pleistocene age. The non-marine cover consists of poorly bedded fine-grained sediments. The marine terrace deposits consist of poorly consolidated sands, sandstones and conglomerates. The beach which begins at the foot of the wave-cut terrace is composed of fine to medium grained sands and silty sands. Because of various seasonal cycles of sand deposition and erosion, and the lack of adequate natural beach renourishment, the beach has eroded, and varies in width from 0 to 60 meters (0 to 200 feet).

Various bathymetric surveys, seismic surveys, sub-bottom profiling, side scan sonar surveys, and limited vibratory coring conducted offshore of San Clemente beach indicate that the ocean floor slopes gradually seawards from the shoreline to a depth of –33 meters (-100 feet) MLLW at a distance of about 1,500 meters (0.9 miles). The geophysical surveys further indicated that the ocean floor is a bedrock surface covered with a thin veneer of silty sand and sandy silt that varies in thickness from 0 meters to about 0.32 meters (1-foot) or more, out to a distance of 1,500 meters from the shoreline.

2.3 Seismicity

All of southern California including the San Clemente area is seismically active. There are several major NW-SE trending faults in both the onshore and the offshore areas east and west of San Clemente. The Whittier-Elsinore, Agua Caliente, San Jacinto and the San Andreas Fault zones are located approximately 32 kilometers (20 miles), 43 kilometers (27 miles), 64 kilometers (40 miles), and 100 kilometers (62 miles) northeast of San Clemente, respectively. The Newport-Inglewood–Rose Canyon Fault lies approximately 8 kilometers (5 miles) offshore of the beach. The Palos Verdes Fault zone parallels the pacific coast offshore from the San Pedro – Long Beach area to La Jolla, and lies about 29 kilometers (18 miles) from the coastline. The San Clemente Island Fault zone lies approximately 88 kilometers (55 miles) offshore and is parallel to the Newport-Inglewood-Rose Canyon Fault zone. These three faults trend parallel to the onshore faults. The Christianitos Fault, which is the closest fault to the project area, trends NW-SE, and passes through the mountain ranges behind the San Clemente area and trends down San Mateo Creek and goes offshore to parallel the coastline near San Onofre in a southerly direction past Oceanside. The fault is located approximately 2 to 8 kilometers (1-5 miles) offshore of San Clemente beach. This well-studied fault is considered to be inactive. Any earthquakes caused by movement along these or other nearby faults would have little effect upon the new sand placed on the beach for replenishment.

3 INVESTIGATIONS

Investigations to characterize the sediments offshore of San Clemente and Oceanside have been performed by: California Department of Boating and Waterways (1983); San Diego Association of Governments (SANDAG) (1999); Fugro-West (2002); and U.S. Army Corps of Engineers (1993, 2003).

3.1 California Department of Boating and Waterways (Osbourne, et al.,1983)

In 1974, a sediment and shallow structural survey of the inner continental shelf of southern California was performed by USACE's Los Angeles District Office. The objectives of this program were to characterize and map the distribution of sand deposits suitable for beach restoration and nourishment. The results of this study and additional published and unpublished reports formed the basis for Osbourne, et al. (1983). This study was a cooperative effort between numerous public and educational institutions (including USACE) to identify, locate, and characterize borrow areas for sand and gravel along the inner continental shelf of southern California. Potential borrow areas were selected using the following criteria: the deposit must lie at depths of no greater than 30 meters (98 feet), the limit of economic dredging, and no shallower than 9 meters (30 feet), the wave breaker zone; the areas should represent prospective sedimentary environments for sandy, low-fines sediments; and the sediments should not be too indurated for dredging. Area III of this report covers the coastline from Dana Point to San Mateo Point (the current Project Area). Area IV covers the Oceanside segment of the continental shelf from the mouth of the Santa Margarita River to just north of Batiquitos Lagoon. Much of the data used to analyze the San Diego shelf portion of the Southern California offshore sediments was supplied by a high resolution seismic and side-scan sonar study contracted by the U.S. Army Coastal Engineering Research Center (Woodward Clyde Consultants, 1979), and a 49-hole vibracore sampling program contracted to Ocean Survey, Inc. (1981) in the same area.

In 1979 the University of Southern California employed a private contractor, Meridian Ocean Systems, Inc., to sample a series of 10 vibracore holes, spaced 1.6 kilometers (one mile) apart from Dana Point downcoast to San Mateo Point ("Area III"). A thin cover of silty, very fine- to fine-grained Holocene sand with clayey silt laminae was found to overlie a dense, friable sandstone bedrock interpreted as the Miocene Vaqueros Formation. The results of this exploration program revealed that the shelf segment between Dana Point and San Mateo Point would not yield sediment deposits suitable for beach nourishment.

Two potential borrow sites were identified within Area IV: SD-I, offshore of Oceanside extending from the mouth of the Santa Margarita River to Oceanside Harbor, with an estimated maximum of 24.9 million cubic meters (32.6 million cubic yards) of suitable sand; and SD-II, located between the mouth of the San Luis Rey River and South Oceanside, with a maximum of 20.7 million cubic meters (27.1 million cubic yards) of

suitable sand. Five previous USACE vibratory core holes were identified within the vicinity of borrow area SD-I, and four were located within and adjacent to area SD-II.

3.2 U.S. Army Corps of Engineers (1993)

In 1993, USACE, Los Angeles District, conducted a study regarding the location, character, and volume of sand deposits suitable for future beach nourishment activities in the Carlsbad/Oceanside area. After a review of previous studies (chiefly Osbourne, et al., 1983, and Fischer, et al., 1983), an offshore vibratory coring investigation was conducted along the Carlsbad/Oceanside coast in June, 1993. Vibratory coring was performed in and around promising borrow sites identified in previous studies (Sites SD-I, SD-II, and SD-III of Osbourne, et al., 1983), and additional cores were taken at 0.8-1.6 km (0.5-1 mile) intervals along the coast in an attempt to ensure that other significant deposits were not overlooked. Coastal Frontiers of Chatsworth, CA performed the sampling. Cores were obtained at 45 sites along the coast offshore from Batiquitos Lagoon (Site SD-III of Osbourne, et al.), Agua Hedionda Lagoon, Carlsbad, Buena Vista Lagoon, the San Luis Rey River (Site SD-II of Osbourne, et al.), Oceanside Harbor (Site SD-I of Osbourne, et al.), and the Santa Margarita River. Seafloor depths ranged from –10.0 to –18.9 meters (-33 to -62 feet) MLLW. From these cores, 128 representative samples were taken for grain size and gradation testing. Only 94 of these samples were actually analyzed, due to budgetary restraints. The results of this investigation indicated excellent beach replenishment material within previously-identified Sites SD-I,II, and III, and incompatible, excessively fine material along the intervening coastline. The vibratory core borehole locations are shown in plan view on Plate 1, and the sediment (soils) logs can be found in Attachment 4.

3.3 SANDAG (1999)

In an effort to identify borrow sources of beach compatible material offshore of San Diego County, the San Diego Association of Governments (SANDAG) instituted the San Diego Regional Sand Project. Based on a review of available historic investigations and literature review, SANDAG identified 10 possible offshore borrow sites adjacent to beaches requiring nourishment between Oceanside and the Mexican border. Potential borrow sites were selected using the following criteria: 1) the source must be located close to the beaches requiring sand nourishment; 2) the deposit must lie at depths of no greater than 24-27 meters (80-90 feet), the economic limit of offshore dredging, and no shallower than 9-15 meters (30-50 feet) of water, the "depth of closure" for seasonal bathymetric profile changes in the San Diego region; and 3) the sand must be suitable for beach replenishment based on guidelines specified by USACE. SANDAG contracted Sea Surveyor, of Benicia, California, to perform offshore surveys at each of these sites. Sea Surveyor conducted geophysical surveys using side scan sonar, a marine magnetometer, and shallow seismic sub-bottom profilers, and collected vibratory core sediment samples at the SANDAG borrow sites in January 1999. Subsamples from the cores were analyzed for lithology and grain size. Sediments from each of the SANDAG vibratory cores were collected for one bulk sediment chemistry sample

representing all of the San Diego County offshore sediment areas explored by SANDAG.

The SANDAG investigations included two beach compatible borrow sites offshore of Oceanside, labeled SO-9, located north of Oceanside Harbor (Site SD-I of Osbourne, et al., 1983), and SO-8, south of Oceanside Harbor and offshore of the San Luis Rey River (immediately south of Site SD-I, and north of Site SD-II of Osbourne, et al., 1983).

Site SO-9 is located offshore of the mouth of the Santa Margarita River at depths of -15 to -24 meters (-50 to -80 feet) MLLW. The site measured 915 m x 1,525 m (3,000 ft x 5,000 ft). Sea Surveyor (1999) notes that previous vibracore investigations found areas of suitable beach sand just inshore of Site SO-9, while a 1993 USACE study identified 1-2 ft of silty sand overlying poorly-graded medium sand with gravel in the area. Sea Surveyor conducted a geophysical survey over the site. Side-scan sonar data indicated the presence of eight artificial reef habitats, comprised of piles of quarry rock, on an otherwise featureless seafloor. These artificial reefs may represent obstructions to dredging. Twelve vibratory cores were drilled (SDG-1 through -12), ranging in penetration from 1.2 to 5.3 meters (4.0 to 17.3 feet). The mud line elevations of the holes varied from -14.6 to -18.0 meters (-48 to -59 feet) MLLW. Sea Surveyor identified a 0.9 to 4.0 meter (3-13 foot) thick layer of suitable fine- to medium-grained sand along the nearshore margin of Site SO-9. They calculated a volume of 0.7 million cubic meters (0.9 million cubic yards) for this material. The sand was overlain by a wedge-shaped layer of unsuitable fine-grained sandy silt ranging in thickness from 0 meters at the nearshore boundary of the site to about 3.0 meters (10 feet) in thickness in the central portion of the area.

Site SO-8 is located offshore of the mouth of the San Luis Rey River, approximately 1.6 kilometers (1 mile) south of Site SO-9, at depths of -15 to -27 meters (-50 to -90 feet) MLLW. The site measured 1,220 m x 1,525 m (4,000 ft x 5,000 ft). Sea Surveyor (1999) noted that 2 cores in the area documented in Osbourne et al. (1983) contained marginal beach nourishment material, while only 1 out of 8 vibratory core holes completed by USACE in 1993 identified promising beach replenishment material. Sea Surveyor conducted a geophysical survey over the site. Side-scan sonar data indicated the presence of four debris piles aligned along the southeast border of the site. These debris piles may represent the remains of artificial reef habitats which may represent obstructions to dredging. Twenty-three (23) vibratory cores were drilled (SDG-13 through -35), ranging in penetration from 1.1 to 5.2 meters (3.6 to 17.1 feet). The mud line elevations of the holes varied from -16.3 to -21.3 meters (-53.5 to -70 feet) MLLW. Site SO-8 identified 3.6 million cubic meters (4.7 million cubic yards) of fine-grained, somewhat silty sand which is suitable for beach nourishment purposes. The sand is located in the northeast portion of the site beneath 1.2 to 4.0 meters (4 to13 feet) of unsuitable sandy silt and silty sand.

See Plate 1 for the SANDAG vibratory core borehole locations for Sites SO-8 and SO-9 (proposed Borrow Site 2). See Attachment 5 for the SANDAG vibratory core sediment (soils) logs. See Table 4 for the gradation analyses of these holes.

3.4 Fugro-West (2002)

In June 2002, Fugro-West, Inc., of Ventura, California, performed a geophysical sub-bottom profile, side scan sonar and a multibeam bathymetric survey off the coast at San Clemente Beach for the Los Angeles District of the Corps of Engineers. The survey began at San Juan Creek near Dana Point (Capistrano Beach) and extended downcoast to San Mateo Point, a distance of approximately 14 kilometers (8.7 miles). The survey began at the surf zone and concluded seaward at approximately 19 meters water depth (about 58 feet). The geophysical surveys were performed in order to determine if shallow bedrock existed on the ocean floor between the shoreline and 1.6 km (1 mile) seaward. The Subbottom Profile was conducted in order to delineate the stratigraphic conditions, the presence or absence of sandy materials, to delineate the boundaries separating the consolidated from the unconsolidated materials, and to define the depth to bedrock. The results of this survey indicate that the coastline surveyed consists of solid bedrock outcropping at the surface of the ocean floor closer to shore and an unconsolidated sediment surface oceanward and beyond the bedrock. Measured perpendicular to shore, this bedrock swath ranges from 1,050 to 1,200 meters (23.3 to 37.2 miles) in horizontal extent from the nearshore. The unconsolidated sediment also ranges from 1,050 to 1,200 meters (3,346 to 3,936 feet) horizontal extent away from this swath, which means it is encountered approximately 3,346 feet offshore. Grab samples were taken of the unconsolidated sediment during the survey and sent to a geotechnical laboratory to testing the engineering properties of the soils. The samples were collected at a depth of no greater than 7 centimeters or about 3 inches. The results indicate the surficial sediment is composed of fine sand (SP) and silt (ML). The thickness of the sediment gradually thickens oceanward to approximately 15 meters (48 feet). Vibratory core samples of the deeper sediment were not collected. The thickness and distribution of the bedrock and unconsolidated sediments are shown on figures 19 through 23, the isopach geology maps.

3.5 U.S. Army Corps of Engineers (2003)

The objectives of the 2003 USACE investigations were to identify and designate an offshore borrow source of sand which could be used to nourish San Clemente Beach. A database search was made to identify and collate existing data in the project area. Thirty-five (35) vibracore holes from the SANDAG (1999) study were incorporated into the database, along with twenty-eight (28) holes from the USACE (1993) program. The holes were located and plotted using MicroStation graphics software. Location, elevation, lithology, and available gradation data were entered into a Geosystem geologic logging program database.

Two areas were selected for investigation: offshore of the beach at the City of San Clemente in Orange County, California (Borrow Area #1), and offshore of Oceanside, San Diego County, California (Borrow Area #2). Explorations were conducted in two separate phases, in January and in August.

3.5.1 January Program

On 20-25 January 2003, vibratory core exploration for suitable beach replenishment material was undertaken in two separate locations: Offshore of the beach at the City of San Clemente in Orange County, California (Borrow Area #1), and offshore of Oceanside, San Diego County, California (Borrow Area #2). Group Delta Consultants of San Diego, California was the prime contractor for the job, while TEG Oceanographic Services of Santa Cruz, California performed the vibracoring work. A final report of project activities and results can be found in Group Delta, 2003 (Attachment 1). The locations of the borrow areas are shown in Figure 1 of Group Delta (2003).

San Clemente: The first area investigated, "Borrow Area #1", is located approximately 0.6 kilometers (1 mile) offshore of San Clemente Beach (Attachment 1, Figure 2), and extends from just upcoast of the San Clemente Pier south to just offshore of San Mateo Point, a distance of approximately 10 kilometers (6.2 miles). A 10-hole vibracore program conducted by USC off of San Clemente Beach from Dana Point to the Santa Margarita River in 1979 failed to locate suitable sand for beach nourishment purposes. The purpose of the 2003 USACE study was reconnaissance in nature, and consisted of spacing the new vibracore holes between the older USC holes in approximately the same area to see if suitable sand could be found in the areas which were unexplored.

Five (5) vibratory core holes (SC-1,3,5,7,8) were sampled within Borrow Area #1. Sites were widely spaced, ranging from 1.1 km (0.7 miles) up to 4.0 km (2.5 miles) between holes. The test holes were placed at least 1.6 kilometers (1 mile) offshore in order to avoid the shallow bedrock indicated by the seismic survey. The elevations of the mudline at the holes varied from -17.7 meters (-54 feet) MLLW to -20.4 meters (62.2 feet) MLLW, considered to be the limit of economical dredging operations. Penetrated depths for the 5 holes ranged from 0.6 to 4.1 meters (2 to 13.5 feet), and averaged 2.7 meters (8.8 feet). A soft, dark gray, micaceous wackestone bedrock was encountered in 3 (possibly 4) of the holes causing vibracore refusal. Core recovery for the 5 holes was 100%.

The vibracore holes encountered silty, very fine-grained sands and sandy silts overlying bedrock at depths varying from 1.6 meters (5.1 feet) to 3.7 meters (12.2 feet). These materials proved to be too fine grained for beach nourishment purposes, verifying the earlier exploration results. Fifteen (15) samples for gradation analysis were taken, of which eight (8) were selected for analysis. See Table 2 for the gradation analyses, and Attachment 6 for the logs of these holes.

Oceanside: The second area investigated, "Borrow Area #2", is located offshore of Oceanside Beach, and is situated between the mouths of the San Luis Rey and Santa Margarita Rivers (Attachment 1, Figure 3). The area is approximately 3 kilometers (2 miles) in length, and depths range from -7 m to -18 m (–25 ft to –60 ft) MLLW. A 1999 vibracore program conducted by the San Diego Association of Governments (SANDAG) investigated two sites off of Oceanside (Sites SO-8 and SO-9) in which volumes of fine- to medium-grained sand which are suitable for beach nourishment purposes were identified. Previous vibracore investigations also found areas of suitable beach sand

just inshore from these sites. Results of these programs were used to locate activities of the 2003 study.

Thirty (30) vibracore holes were completed at twenty-nine (29) sites by the Los Angeles District at Borrow Area #2 (one of the attempted vibracores became stuck in the sediment and was not recovered). The sampled area extends from Loma Alta Creek (in Oceanside) in the south to the mouth of the Santa Margarita River in the north. The exploration covered an area approximately 1,050 meters (3,200 feet) long and 394 meters (1,200 feet) wide, stretching from approximately 1,200 feet north of SANDAG's Site SO-9, to about the midpoint of Site SO-8. Sampled ocean bottom depths ranged from 11.2 meters (34.2 feet) to 17.6 meters (53.7 feet) MLLW. Twenty-seven (27) sites were sampled, and another (SO9-30 and SO9-30A) was tried twice without success (armored with cobbles), and abandoned. Core recovery averaged 96% (excluding the lost core barrel), and 12 of the 29 holes reached the 6.1 meter (20 foot) target depth. 176 sediment samples were taken, and physical tests were performed on 91 of these samples. See Plate 1 for the Plan of Exploration, Table 5 for the gradation analyses, and Attachment 3 for the logs of these holes.

One sample for chemical analysis was collected at each of 25 sites within the limits of the outlined sand resource. These 25 site samples were combined into a single composite sample for chemical analysis. The results of this analysis (see Table 1) indicated no contaminants were present in the sediment.

Sampled materials encountered off of Oceanside were generally fine-medium grained sands with local silty intervals and minor amounts of shell fragments. Significant laterally discontinuous gravel/cobble beds and lenses were encountered throughout the area, but the thicknesses generally averaged 0.65 meters (2 feet) or less. Often the gravel intervals possessed supporting dense silty sand material, which acted as a "pavement" holding the cobbles tightly, making the core penetration difficult. No bedrock was encountered. The preponderance of the sampled material within Borrow Area No.2 was beach-compatible.

3.5.2 **August Program**

The January 2003 USACE vibratory core program conducted off of Oceanside ("Borrow Area #2") identified a resource of fine- to medium-grained sand which is suitable for beach nourishment purposes. This program confirmed, consolidated, and expanded areas of beach-compatible sand located by previous investigations off of Oceanside by the San Diego Association of Governments (SANDAG) (1999) and USACE (1993).

In 21-26 August, 2003, an additional vibratory core exploration for suitable beach replenishment material was undertaken offshore of Oceanside. The objectives of this investigation were to determine if there was a sufficient amount of suitable sand for beach replenishment programs at both San Clemente and Oceanside, and to further expand and to infill data gaps in the offshore borrow source of sand which was identified in January.

The sampled area is located between the mouths of the Santa Margarita and San Luis Rey Rivers, and covers an area approximately 3.1 kilometers (1.9 miles) in length, and 1.4 kilometers (0.9 miles) in width. Sea Surveyor, Inc. of Benicia, California performed the vibracoring work, utilizing a pneumatic Alpine vibracore to collect sediment cores. Twenty-six (26) vibratory core holes were drilled, ranging in penetration from 2.9 meters (9.5 feet) to 6.1 meters (20.0 feet), and averaging 4.2 meters (13.7 feet). Core recovery for the 26 holes was 73%. Only 1 out of 32 drilling attempts reached the 6.1 meter (20 foot) target depth (although 32 holes were cored, only 26 of these were retained and sampled. Discarding of cores was due to poor recovery, or refusal at unacceptably shallow depths. In all cases, a retry at the same location was attempted, while the first attempt was saved. The longest recovered core of the two attempts was retained and assigned a hole number, and the other sample was discarded). The mudline elevations of the holes varied from -11.1 meters (-36.4 feet) to -17.4 meters (-57.1 feet) MLLW. Eighty-five (85) sediment samples from these sites were taken for grain size and gradation analysis. See Plate 1 for the Plan of Exploration, Table 6 for the gradation analyses, and Attachment 2 for the logs of the exploratory vibracore holes.

4 LABORATORY TESTING

4.1 Physical Testing

Physical testing consisted of grain size analysis and Atterberg Limits determination. Laboratory tests were conducted in accordance with ASTM D 422-63, *Standard Test Method for Particle-Size Analysis of Soils* and Atterberg Limits were determined in general accordance with ASTM D 4318-98, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*. Based on the test results, the sediments were classified in accordance with ASTM D 2487-98, *Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).*

4.1.1 1993 USACE Explorations

Ninety-four (94) samples were run for physical analysis at the USACE, Waterways Experiment Station. Partial results of these tests are presented in Table 3.

4.1.2 1999 SANDAG Explorations

MEC Analytical Systems' laboratory located in Carlsbad, California conducted all physical testing for SANDAG's 1999 explorations. The results of these tests are presented in the borehole soils logs (Attachment 5) and tabulated in Table 4. Petrographic analysis of two samples collected from each of the borrow areas was performed at California State University, Northridge by Dr. Peter Fischer, Professor of Geology.

4.1.3 2003 USACE Explorations

The Los Angeles District Soils Laboratory located in El Monte, California conducted all physical testing for the 2003 explorations. The results of the January program are presented in Appendix C of Group Delta (2003), and tabulated in Table 5 of this report. The results of the August program are listed in Table 6.

4.2 Bulk Sediment Chemistry Testing

4.2.1 1999 SANDAG Study

The sediments were analyzed for their chemical constituents according to guidelines provided in the Ocean Disposal Manual (USEPA/USACE 1991) and the California Ocean Plan using analytical methods accepted by the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers. A single sample for chemical analysis was composited from multiple vibratory cores from each of the 10 borrow sites explored by SANDAG. The chemical analysis was performed by Pacific Treatment Analytical Service.

4.2.2 **2003 USACE Study**

As part of the January explorations, sediment samples for chemical analysis were collected from each hole at Borrow Area No.2 according to EPA protocol by TEG personnel. Borrow Area No.1 was not sampled, as the recovered sediments were too fine for beach replenishment purposes. One sample was collected at each site, except for sites SO9-17 and SO9-21, which were composed of unacceptably silty materials, and lay beyond the limits of the outlined sand resource. Sampled lengths were the entire length of recovered core. The 25 individual samples were combined at the chemical laboratory into a single composite sample of the site for chemical analysis. Compositing was not done on-site so as to minimize the loss of volatiles, and possible contamination resulting from open-air mixing. The composite sample was analyzed by CRG Laboratories of Torrance, California. A full tabulation of results can be found in Appendix D of the Group Delta report (Attachment 1). Table 1 is a summary of the results of the chemical analysis of these samples.

Since the August USACE sampling program merely infilled and marginally expanded the January project area, and no contaminants in those sediments were identified, it was determined that additional chemical sampling would not be necessary (Mr. Stephen John, EPA, personal communication).

5 ANALYSES

5.1 General

These analyses address the geotechnical characteristics of the sediment, the sediment compatibility, the approximate quantity of compatible borrow material (sediment) and the dredgeability of the sediment. The geotechnical descriptions are based on results of the laboratory physical tests. The compatibility of the borrow materials with the receiving beach materials is based on particle gradation and chemical concentrations. The dredgeability is qualitatively based on particle size gradation and in-situ density, as indicated by the rate of penetration of the vibratory corer.

5.2 Geotechnical Descriptions

The composite gradations are based on materials encountered at locations where the vibratory core holes were drilled. The composite gradations are meant to characterize an area; however, since there is the possibility of variation of materials between vibratory core holes, the composite gradation can vary. Since the soil stratigraphy of this area is a delta or riverbed deposit, localized pockets of materials containing appreciable fines (i.e. silts and clays) should be expected during construction operations. In addition, cobble sized material and moderately cemented seashells can be expected to be encountered in any borrow site in this area.

5.2.1 Proposed Borrow Area No. 1 (San Clemente)

Five vibracore holes (SC-1,-3,-5,-7, and -8) were completed within Borrow Area No.1, and fifteen sediment samples were taken from these holes. On-site logging of the cores suggested that no beach-compatible sands had been recovered. Therefore, in an effort to reduce sample analysis costs, eight of the fifteen samples were selected for analysis at the USACE lab in El Monte. One representative hole (SC-1) was selected for analysis. Also, hole SC-8 off of San Mateo Point was selected as the best chance for possessing suitable sandy material. Holes SC-3, SC-5, and SC-7 were not analyzed. The results of these tests are tabulated in Table 2.

Sampled materials encountered off of San Clemente (Borrow Site No.1) were generally greenish-gray, silty, very fine-grained sands and sandy silts with minor amounts of shell fragments. One of the holes (SC-8) possessed disseminated coarse sand and a few pebbles up to 20 mm in the otherwise fine-grained sediment. The unconsolidated sediments were underlain by a soft, dark gray, micaceous wackestone bedrock in three, or possibly four of the holes.

Group Delta (2003) reported that the samples show an average of 0.9% gravel, 51.5% sand and 47.6% fines passing the #200 sieve. The median grain size (D_{50}) of the material is 0.09 millimeters (0.004 inches). The data show that the sampled area off of San Clemente Beach does not contain suitable beach replenishment material.

5.2.2 Proposed Borrow Area No. 2 (Oceanside)

A total of fifty-three (53) vibratory boreholes were sampled by USACE in 2003 within Borrow Area No.2 (Plate 1). Twenty-seven (27) of these vibratory core holes (SO9-1-3, -5, -7-8, -11, -13-22, -24, -26-29, -31-33, and SO9-40-41) were sampled in the January program, and twenty-six (26) of the core holes (O-1 through O-26) were sampled in the August program. Two to five samples were collected per core for a total of 267 samples (182 samples were collected in January, and 85 samples were collected in August).

176 of the 267 sediment samples taken were run for gradation analysis at the USACE lab in El Monte. All 85 of the samples obtained in August were analyzed. In an effort to reduce sample analysis costs during the January program, a total of 91 out of the total 182 samples were selected for analysis. The criteria used to make this selection included the following:

1) Two holes, SO9-17 and SO9-21, contain silty material and are outside the limits of the explored area of sandy material. These holes were not analyzed.

2) If fine materials were encountered in the bottom of the hole, these samples were eliminated.

3) One representative sample was selected from each (visually) homogeneous logged unit in every hole. If a discrete unit possessed more than one sample, only one of these samples was analyzed.

Tables 5 and 6 show the results of gradation testing on the 2003 samples. The fines content (percent of material passing the 0.075 millimeter (U.S. number 200) sieve) of the materials encountered throughout all of the boreholes ranges from 2% to 41%. The calculated fines content of the composite gradation is 8.0% and the D_{50} is 0.218 millimeters (0.009 inches). Tables 5 and 6 reconstruct the data where samples were not analyzed using the field description and insertion of a similarly described interval from a nearby hole, or expansion of the adjoining sample data within a homogeneous unit. Tables 5 and 6 also include weighted averages for each test boring.

The sampled materials were generally fine-grained sands with local silty intervals and minor amounts of shell fragments. Significant gravel/cobble beds and lenses were encountered throughout the area, but the thicknesses generally averaged 0.65 meters (2 feet) or less. Often the gravel intervals possessed supporting dense silty sand material which acted as a "pavement" holding the cobbles tightly, making the core penetration difficult. Shell and shell fragments were encountered throughout the area. See Figures 2-9 for cross sections through the borrow area. See Plate 1 for the locations of the cross section profiles.

The sediments encountered in the vibratory core explorations show broad scale bedding characteristics. In general, the sediments, to a depth of about 6 meters (20 feet), can be classified into three layers: an upper, surface silt to silty sand layer; a thin

underlying gravel layer; and a thick lower unit composed of sand, with local gravel-rich lenses. These three units are not everywhere present, and show considerable variability in thickness.

The upper silty sand layer is generally 0-1 meter (0-3.3 feet) thick, but thickens considerably along the northwestern, southwestern, and southeastern margins of the site, effectively delimiting the these boundaries of the borrow area. Available data suggests that sediments at dredgeable depths to the north, west, and south of this line are predominately silty sands and silts. In general, the upper silty sand unit ranges from 15-55% fines, and averages around 35% fines.

The uppermost silty sand layer is often underlain by a gravel-rich layer ranging from 0-2.6 meters (0-8.5 feet) in thickness. Where the silty sand layer is not present, the gravel unit is commonly exposed at the surface. This unit ranges from sand with gravel to gravel with sand to sand with gravel to pebbly sand.

Lying beneath (but sometimes interfingered with) the gravel is sand. This unit is highly variable, but generally consists of "beach sand" with fines compositions ranging from 2-4% fines. This sandy layer often contains disseminated pebbles, and interbeds and discontinuous lenses of pebble and cobble concentrations.

Often cobbles, pebbles, and silt are present in the upper 1-2 meters (3.3-6.6 feet) of the borings. Taken as a unit, this material is not beach-compatible. However, it is recommended that the full depth be dredged as a unit, as this would mix the materials, and the resultant overall gradation would be acceptable. Since the vibratory core sample barrel cannot sample clasts with diameters greater than 7.6 cm (3 inches), the maximum size of cobbles (boulders?), as well as the distribution of these clasts is unknown. It is likely that the overall percentage of cobbles and gravel is underrepresented in the gradation data. These unknown variables may adversely affect dredging and pumping operations.

5.2.3 **Receiving Beach.**

In order to determine the compatibility of dredged material with the receiving beach, gradation analysis of the onshore and offshore beach profiles is required. To characterize the potential receiving beaches, eight transects were sampled by USACE from 25 to 27 July 2005. Each transect consisted of collecting surface grab samples between -10 m MLLW and either +4 or +6 m MLLW in 2 m elevation increments. Samples were tested by the Los Angeles District Soils Laboratory for grain size and plasticity. Samples were predominately poorly graded sands and poorly graded sands with silt. Some silty sand and sandy silt was also present, primarily at the deeper, offshore elevations. Many of the offshore samples also had indications of hard, rocky bottom.

The data from two transects sampled by Moffatt and Nichol (2004) were also included in the compatibility analysis. The surface grab samples were collected between -10 and +4 m MLLW in 2 m elevation increments.

The transect locations are shown on Figure 1. The grain size data are shown in Table 7.

5.3 Delineation of Borrow Area 2

The borrow site was defined by grouping together boreholes that were likely to be compatible (sediment containing generally 11% or less fines passing the 0.075 millimeter (U.S. number 200) sieve) with the receiving beach sediments. Boreholes with excessive fines compositions located along the edge of the borrow site were excluded from the borrow area, while boreholes with excessive fines located in the interior of the borrow site were included. The composite gradation for the borrow area was calculated for six different dredge depths: 1 meter, 2 meters, 3 meters, 4 meters, 5 meters, and 6 meters.

1 meter dredge depth: The fines content (percent of material passing the 0.075 millimeter (U.S. number 200) sieve) of the materials encountered throughout all of the boreholes down to a depth of 1 meter ranges from 1% to 40% (see Table 8-a). The calculated fines content of the composite gradation is 12.3%, with 7.8% gravel + cobbles, and the D_{50} is 0.207 millimeters (0.008 inches).

2 meters dredge depth: The fines content of the materials encountered throughout all of the boreholes down to a depth of 2 meters ranges from 1% to 28% (see Table 8-b). Holes which did not reach at least 1.8 meters were not included in the calculations. The calculated fines content of the composite gradation is 8.3%, with 6.5% gravel + cobbles, and the D_{50} is 0.217 millimeters (0.009 inches).

3 meters dredge depth: The fines content of the materials encountered throughout all of the boreholes down to a depth of 3 meters ranges from 1% to 20% (see Table 8-c). Holes which did not reach at least 2.4 meters were not included in the calculations. The calculated fines content of the composite gradation is 6.8%, with 6.6% gravel + cobbles, and the D_{50} is 0.220 millimeters (0.009 inches).

4 meter dredge depth: The fines content of the materials encountered throughout all of the boreholes down to a depth of 4 meters ranges from 1% to 16% (see Table 8-d). Holes which did not reach at least 3.2 meters were not included in the calculations. The calculated fines content of the composite gradation is 6.4%, with 5.4% gravel + cobbles, and the D_{50} is 0.223 millimeters (0.009 inches).

5 meters dredge depth: The fines content of the materials encountered throughout all of the boreholes down to a depth of 5 meters ranges from 2% to 15% (see Table 8-e). Holes which did not reach at least 4.0 meters were not included in the calculations. The calculated fines content of the composite gradation is 5.7%, with 4.3% gravel + cobbles, and the D_{50} is 0.226 millimeters (0.009 inches).

6 meters dredge depth: The fines content of the materials encountered throughout all of the boreholes down to a depth of 6 meters ranges from 2% to 12% (see Table 8-f). Holes which did not reach at least 5.5 meters were not included in the calculations. The

calculated fines content of the composite gradation is 5.7%, with 4.3% gravel + cobbles, and the D_{50} is 0.219 millimeters (0.009 inches).

5.4 Grain Size (Physical) Compatibility

5.4.1 Guidelines

The Los Angeles District Corps of Engineers has established quantitative guidelines for the compatibility of dredge material to receiving beach material. First, a grain size distribution envelope of the receiving beach material is developed showing finest and coarsest limits from the 19.0 to the 0.075-millimeter (¾-inch to U.S. number 200) sieves. Next, a composite gradation curve is developed for the dredge materials, where a composite gradation is defined as the mean gradation of all the types of materials found in the designated area. Dredge material with a composite gradation curve that plots within the limits of the receiving beach material envelope is considered to be compatible with the receiving beach material. In addition, materials are considered compatible when: (1) dredge material is coarser than the coarse limit curve of the receiving beach material if not restricted by aesthetic or environmental reasons; and, (2) material passing the 0.075 millimeter (U.S. number 200) sieve exceeds the finer limit by a maximum of 10 percent.

5.4.2 Borrow Material and Receiving Beach Compatibility

The gradation limits for each of the San Clemente beach reaches were determined along with the composite gradations for different cut depths of the proposed Borrow Area 2 and are listed in Tables 9-a through 9-h. The gradation limits and the proposed borrow source composite gradations are plotted on Figures 10-17. For the entire project gradation limits (the limits associated with all the transect data), each of the proposed borrow composites plot within the envelope or near the coarse gradation limit. All of the composite borrow gradations plot within, or very near, each of the individual San Clemente reaches' limits. Exceptions that did not plot within the limits tended to occur in the gravel, coarse and medium sand sizes, with the borrow composites being slightly coarser. The composite borrow gradations tended to be coarser than the composite beach gradation, especially in the gravel, coarse sand, fine sand, and fines size ranges.

The average median grain size diameter (D_{50}) of the proposed borrow is relatively consistent, varying from 0.21 to 0.23 mm, which is slightly coarser than the average D_{50} of 0.17 mm for the entire San Clemente shoreline project. The borrow D_{50} is generally larger than the individual San Clemente reaches (ranging from 0.12 to 0.17 mm), except for Reach 1 that has an average D_{50} of 0.31 mm and Reach 4 that has an average D_{50} of 0.22 mm. The proposed borrow has fines contents that decrease with depth, ranging from 12 percent with a 1 m cut down to 5 percent with a 6 m cut. This compares favorably with the entire project average of 11 percent and the individual receiving beach averages that vary from 7 to 15 percent fines. The typical sediment properties are shown in Table 10.

5.4.3 Overfill Factor

The overfill factor is the estimated number of cubic meters of borrow material required to produce 1 cubic meter of beach material when the beach is in a condition compatible with the native material. The Overfill Factor was calculated in accordance with EM 1110-2-1100 (USACE, 2002) to provide an indication of the quality as beach fill of each of the proposed cut depths for the proposed Borrow Area 2 with respect to each individual beach reach and for the entire project overall. For the entire project, the Overfill Factor ranged from 1.21 for a 1 m cut in the borrow area down to 1.00 for a 6 m cut. Individual reach values ranged significantly from 1.87 to 1.00, but were typically below 1.25. In general, this indicates, for an Overfill Factor of 1.25, that 1.25 cubic meters of borrow sediment will be required to create 1.0 cubic meter of stable beach. See Table 11 for all of the calculated Overfill Factors and backup data.

Based on this analysis, an Overfill Factor of 1.10 should be used in the design if the proposed Borrow Area 2 is utilized. Furthermore, the Contractor should be required to concentrate his excavation in one area until it has been cut to a depth of at least 4 m, with a preferred cut depth of 6 m, locally.

5.5 Chemical Compatibility of Sediments

5.5.1 SANDAG (1999)

Sediments from each of the SANDAG vibratory cores were collected for one bulk sediment chemistry sample. This sample was later added to sediment samples collected from upcoast explored sites to form one composite chemistry sample. This one composite bulk sediment chemistry sample represented all of the San Diego County offshore sediment areas explored by SANDAG. The full chemical results from this composite sample can be found in Appendix B of SANDAG (1999). Total organic carbon concentrations in the sediments ranged from 0.017 to 0.216%. Total sulfides ranged from 0.2 to 1.1 mg/Kg and dissolved sulfides were mostly non-detectable. Concentrations of pesticides, polychlorinated biphenyls, polynuclear aromatic hydrocarbons, or phenol were also not found. Concentrations of metals, arsenic, chromium, copper, lead, nickel, selenium, and zinc were detected.

5.5.2 USACE (2003)

Cores collected from Borrow Area No.2 by USACE in 2003 were analyzed for contaminants. The analytical results are summarized and compared to the Sediment Quality Guidelines (SQGs) in Table 1. Total organic carbon concentration was 0.15 percent. Contaminant concentrations of metals, pesticides, PCBs, PAHs, Phthalates, and phenols were non-detectible to low, and contaminant concentrations were below Effective Range - Low (ER-L) and Effective Range - Median (ER-M) concentrations. No DDT or Chlorinated Pesticides were detected in the sample.

The Sediment Quality Guidelines (SQGs) referred to above are based on PSSDA SL/MLs and NOAA ERL/ERMs. Since SQGs have not been developed for southern

California, these are used as an initial, informal evaluation to determine the need for further Tier II or Tier III testing.

The bulk chemistry data indicated that chemicals detected within the sediments at Borrow Site No.2 are at very low levels and do not exceed the maximum SQGs. Therefore, the borrow source sediments appear suitable for placement at the receiving beach.

5.6 Sediment Volume Analysis

5.6.1 Borrow Area No.2

A preliminary estimate of the volume of beach-compatible material was computed for the proposed borrow area off of Oceanside. The volume was calculated for a 4.5 meter (15-foot) dredge depth, except in the deeper (seaward) portions of the area, where the bottom of the calculated volume was -19.7 meters (-60 feet) MLLW. The upper (nearshore) limit was -8.2 meters (-25 feet) MLLW. The northern, western and southern limits are delineated by increasingly silty (incompatible) materials. The western margin is not constrained by material composition, only by depth. Using these criteria, an approximate calculation yields approximately 15,650,000 cubic meters (20,500,00 cubic yards) of beach-compatible material.

Subsequent volume calculations using different dredge depths must take into account the layered nature of the sediments. Many locations within the proposed borrow area possess a 0.3-1.5 m (1-5 ft) layer of silty sand at the surface. This material contains roughly 20-30% fines. If the bottom of the volume calculation is raised, this will have the effect of increasing the fines percentage of the remaining material. This may result in not only less material due to a shallower dredge depth, but also may decrease the area of the borrow area.

The 4.5 m (15 ft) dredge depth calculation is well supported by drill data, however, there are limited areas in which borings do not reach this depth. In these cases, surrounding drill data is adequate to provide a compelling geologic interpretation to fill the data gap.

A second volume calculation was made using a 3 m (10 ft) dredge depth, and focusing on the best available contained material (avoiding gravel and silty areas). An area measuring 2,400 ft. x 2,400 ft. was identified to fit the initial required borrow quantity (1,000,000-2,000,000 m^3). This area (the western half of Borrow Area No.2) contains 1,631,000 m^3 (2,130,000 yd^3) of onshore beach-compatible material.

5.6.2 Borrow Area No.2A

A second volume calculation was made using a 3 m (10 ft) dredge depth, and focusing on the best available contained material (avoiding gravel and silty areas). An area measuring 2,400 ft. x 2,400 ft. was identified to fit the initial required borrow quantity (1,000,000-2,000,000 m^3). This area (the north square shaped area inside of Borrow

Area No.2) contains 1,631,000 m^3 (2,130,000 yd^3) of onshore beach-compatible material (plate 2).

5.6.3 Receiving Beach

The Corps of Engineers recommended beach fill volumes for this project are approximately 192,000 m^3 (251,126 yd^3) per beach placement cycle, lasting a total of nine cycles. The total sediment volume required is approximately 1,728,000 m^3 (2,260,134 yd^3). Thus, the sediment volumes for borrow site no. 2 is approximately 15,650,000 m^3 (20,500,000 yd^3) and, of that volume, no. 2A has a volume of approximately 1,631,000 m^3 (2,130,000 yd^3), which is sufficient for the recommended project alternative.

5.7 Dredgeability

Based on the investigation results to date, the sediments within the proposed borrow area can be dredged with either hydraulic cutter head or mechanical dredges. Hopper dredges are the least preferred method because they would not obtain adequate blending of the sediments. In general, the sediments near the surface are finer and get coarser with depth; therefore, a hopper dredge would tend to produce fine fills during the initial placements. Cutter head and mechanical dredges can collect sediments throughout the depth of the dredge prism, creating a mixture of the finer upper sediments and the coarser deeper sediments throughout the duration of dredging.

Relative densities within the proposed borrow areas range from very loose to very dense, typically increasing from very loose to loose at the surface and increasing quickly to dense and very dense with depth. Sediments are primarily medium to fine sands with minor silt and gravel, with a D_{50} averaging approximately 0.21-0.23 millimeters (0.008-0.009 inches).

During the 2003 USACE explorations in proposed Borrow Area No.2, the vibratory corer penetration ranged from 0.61 to 6.1 meters (2 to 20 feet) with an average penetration of 4.5 meters (15 feet). The recommended maximum depth of dredging is 4.5 meters, or 15 feet, for the borrow area, which should be dredged in a single pass of the dredge. Materials deeper than 4.5 meters are not well characterized, owing to the paucity and widespread nature of vibratory core data at these depths. Dredging to depths greater than 4.5 meters may result in the placement of incompatible materials on the beach. Localized areas within the borrow area have been identified for dredging to depths of greater than 4.5 meters, up to a maximum of 6 meters depth.

Dredging in this area will encounter varying quantities of gravels, cobbles, and small boulder size materials, which may be significant in localized areas. If localized areas of significant quantities of these materials are encountered, dredging should be moved to a new location. Occasional trash, debris, and organic materials, including varying quantities of loose seashells and moderately cemented seashells will also be encountered and will have some detrimental effects on dredge production.

No CPT testing has been performed within the proposed borrow area. The dense, silty, gravel/cobble-rich layers encountered throughout the study area might present difficulties for excavation; however, thicknesses generally averaged 0.6 m (2 ft) or less. Often the gravel intervals possessed supporting dense silty sand material which acted like a "pavement", holding the cobbles tightly, making core penetration difficult. Even the loose, clean, sandy intervals often possess disseminated cobbles and pebbles. In addition, the size distribution, and maximum size, of cobbles is unknown, and these factors may affect dredgeability, as well as aesthetics of the receiving beach.

As noted in Section 2.3, side-scan sonar surveys conducted by Sea Surveyor (1999) over SANDAG Sites SO-9 and SO-10 indicated the presence of artificial reef habitats, comprised of piles of quarry rock, on the seafloor. All of these identified artificial reef habitats lie outside of the boundaries of the presently delineated Borrow Area No.2, in deeper waters, from -17 m (-56 ft) to -21 m (-70 ft) MLLW.

The general geology and sediment stratigraphy for Borrow Area No. 2 was re-evaluated in 2008 and as a result, a smaller sub-borrow material within this area has been designated. This sub-borrow area is 2A and represents the optimum location for encountering smaller percentages of coarser materials such as gravels and cobbles (plate 2).

6 DREDGING ACTIVITIES

The SANDAG investigations offshore of Oceanside in 1999 located two sources of beach-compatible material, their Site SO-9, located north of Oceanside Harbor, and Site SO-8, south of Oceanside Harbor and offshore of the San Luis Rey River. SANDAG later removed some of the material in water deeper than 15.2 meters (50 feet) and placed the material on various portions of the beach in Oceanside and vicinity.

7 SUMMARY

- Investigations to characterize the offshore sediments within the vicinity of San Clemente and Oceanside Beaches have been performed by: California Department of Boating and Waterways (1983); San Diego Association of Governments (SANDAG) (1999); Fugro-West (2002); and U.S. Army Corps of Engineers (1993, 2003).

- In 2003, USACE Geotechnical Branch conducted explorations to identify and designate an offshore borrow source of sand which could be used to nourish San Clemente Beach. Two areas were selected for investigation: offshore of the beach at the City of San Clemente in Orange County, California (Borrow Area #1), and offshore of Oceanside, San Diego County, California (Borrow Area #2).

- Sampled materials encountered off of San Clemente (Borrow Area No.1) in 2003 were generally a thin layer of unconsolidated silty, very fine-grained sands and sandy silts underlain by a sandy siltstone bedrock. These sediments do not represent suitable beach replenishment materials.

- USACE sampled a total of fifty-three (53) vibratory boreholes within Borrow Area No.2 in 2003. The sediment within Borrow Area No.2 consists of beach-compatible fine grained sands and with local silty intervals and minor amounts of shell fragments. Significant gravel/cobble beds and lenses were encountered throughout the area, with thicknesses generally averaging 0.65 meters (2 feet) or less.

- In July 2005, to characterize the potential receiving beaches, USACE sampled San Clemente Beach along eight transect lines, at elevations of -10, -8, -6, -4, -2, 0, +2, and +4 meters (-33, -26, -20, -13, -6.5, 0, 6.5 and 13 feet) MLLW. Samples were predominately poorly graded sands and poorly graded sands with silt.

- The bulk sediment chemistry test results of the sediments within Borrow Area No.2 show that contaminant concentrations of metals, pesticides, PCBs, Phthalates, PAHs, DDT, and phenols were non-detectible to low, and contaminant concentrations were below ER-L concentrations. The sediments to be dredged from Borrow Area No.2 are thus acceptable for placement on San Clemente Beach.

- 2A, the smaller sub-borrow material area within Borrow Area 2 has been identified and marked on plate 2. This area represents materials that are expected to be composed mostly of fine sands and lesser percentages of coarser materials, such as gravels and cobbles.

- A preliminary estimate of the volume of beach-compatible material was computed for Borrow Area No.2. Approximately **1,650,000 m^3 (20,500,000 yd^3)**

of near-shore beach-compatible material was calculated using a 4.5 m (15 ft) dredge depth. This material is suitable for near-shore placement at San Clemente Beach.

- The Corps of Engineers recommended beach fill volumes for this project are approximately 192,000 m^3 (251,126 yd^3) per beach placement cycle, lasting a total of nine cycles. The total sediment volume required is approximately 1,728,000 m^3 (2,260,134 yd^3). Thus, the sediment volumes for borrow site no. 2 is approximately 15,650,000 m^3 (20,500,000 yd^3) and, of that volume, no. 2A has a volume of approximately 1,631,000 m^3 (2,130,000 yd^3), which is sufficient for the recommended project alternative.

8 RECOMMENDATIONS

- Borrow Area No.2, dredged to a 4.5 m (15 ft) depth, is the recommended alternative for providing beach compatible materials. The discrete sub-area of Borrow Area No.2A should be first dredged as part of any future dredging events from Borrow Area 2.

- Hydraulic Cutterhead or mechanical dredging methods are preferred because they will ensure blending of the sediments throughout the total dredge depth. Dredging to full project depth is required to ensure proper blending of the stratified sediment found within the borrow area. Hopper dredge methods are least preferred because the initial hopper loads transported to the project from the surface of the borrow area will contain higher fines contents and subsequent loads may vary significantly. However, other considerations, primarily the distance of the borrow area from the receiving beach; make the use of a Hopper dredge economically and operationally justified. Therefore, if hopper methods are used, the sequences should be offset, i.e. cuts should be excavated as deep as possible within a specific prism before moving on to an adjacent prism. This will ensure that the stratified sediments from within the borrow area are blended to the maximum using this method. Cutterhead methods are more efficient than Hydraulic methods when blending of stratified sediments is required.

- Borrow Area 2A is the optimum location and its footprint should be dredged first as part of any future dredging of materials within borrow area No. 2.

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TABLES

Table 1.—San Clemente Shoreline Project – Borrow Area #2 Sediment Composite Sample: Chemical Results

	Analytical Method [1]	Method Reporting Limit/ Detection Limit	Units [2]	Sediment Quality Guidelines (SQGs) ERL (Long et al., 1999)	ERM (Long et al., 1999)	SL (PSDDA, 1998)	ML (PSDDA, 1998)	Sample Testing Results [3]				
PHYSICAL/CONVENTIONALS												
Total Solids (dry weight)	EPA 160.3	0.1	%					75.1	75.2			
Total Volatile Solids	SM 2540-E	0.1	%					0.62	0.6			
pH	EPA 150.1	0.1	pH units					8.31	8.3			
Ammonia-N	SM 4500-NH3 F	0.01	mg/L					0.63	0.6			
Total Organic Carbon (dry weight)	Plumb,1981 EPA 415.1	0.01	%					0.15	0.09			
Dissolved Sulfides	SM 4500-S2 D	0.002	mg/L					ND	ND			
Oil and Grease	EPA 1664	0.1	mg/L					ND	ND			
TPH-Diesel	EPA 8015m	0.25	mg/kg					ND	ND			
TPH-Motor Oil	EPA 8015m	0.25	mg/kg					ND	ND			
TRPH	EPA 415.1	0.1	mg/kg					ND	ND			
METALS												
Aluminum (Al)	EPA 6020	1	mg/kg					5840	5960			
Antimony (Sb)	EPA 6020	0.05	mg/kg			15	200	0.1	0.1			
Arsenic (As)	EPA 6020	0.05	mg/kg	8.2	70	57	700	1.43	1.37			
Barium (Ba)	EPA 6020	0.05	mg/kg					33.7	32.5			
Beryllium (Be)	EPA 6020	0.01	mg/kg					0.11	0.12			
Cadmium (Cd)	EPA 6020	0.01	mg/kg	1.2	9.6	5.1	14	0.03	0.02			
Chromium (Cr)	EPA 6020	0.05	mg/kg	81	370			9.11	10.4			
Cobalt (Co)	EPA 6020	0.01	mg/kg					1.6	1.59			
Copper (Cu)	EPA 6020	0.01	mg/kg	34	270	390	1,300	2.53	2.52			
Iron (Fe)	EPA 6020	1	mg/kg					6580	6470			
Lead (Pb)	EPA 6020	0.01	mg/kg	46.7	218	450	1,200	0.86	0.89			
Manganese (Mn)	EPA 6020	0.05	mg/kg					90.2	94.6			
Mercury (Hg)	EPA 6020	0.005	mg/kg	0.15	0.71	0.41	2.3	0.03	0.03			
Molybdenum (Mo)	EPA 6020	0.05	mg/kg					0.41	0.55			
Nickel (Ni)	EPA 6020	0.01	mg/kg	20.9	51.6	140	370	3.69	4.25			
Selenium (Se)	EPA 6020	0.05	mg/kg					0.25	0.26			
Silver (Ag)	EPA 6020	0.01	mg/kg	1	3.7	6.1	8.4	0.02	0.01			
Strontium (Sr)	EPA 6020	0.05	mg/kg					25.1	24.6			
Thallium (Tl)	EPA 6020	0.01	mg/kg					0.08	0.08			
Tin (Sn)	EPA 6020	0.05	mg/kg					0.5	0.57			
Titanium (Ti)	EPA 6020	0.05	mg/kg					755	791			
Vanadium (V)	EPA 6020	0.05	mg/kg					19.7	19.6			
Zinc (Zn)	EPA 6020	0.05	mg/kg	150	410	410	3,800	13.6	13.2			

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ORGANICS												
PESTICIDES												
Total Chlorinated Pesticides [4]			ug/kg	5.22	62	56.9	69.0					
Aldrin	EPA 8270	1	ug/kg			10		ND	ND			
alpha BHC	EPA 8270	1	ug/kg					ND	ND			
alpha-Chlordane	EPA 8270	1	ug/kg			10		ND	ND			
beta-BHC	EPA 8270	1	ug/kg					ND	ND			
delta-BHC	EPA 8270	1	ug/kg					ND	ND			
Dieldrin	EPA 8270	1	ug/kg	0.02	8.0	10		ND	ND			
Endosulfan I	EPA 8270	1	ug/kg					ND	ND			
Endosulfan II	EPA 8270	1	ug/kg					ND	ND			
Endosulfan Sulfate	EPA 8270	1	ug/kg					ND	ND			
Endrin	EPA 8270	1	ug/kg					ND	ND			
Endrin Aldehhde	EPA 8270	1	ug/kg					ND	ND			
gamma-BHC Lindane	EPA 8270	1	ug/kg			10		ND	ND			
gamma-Chlordane	EPA 8270	1	ug/kg					ND	ND			
Heptachlor	EPA 8270	1	ug/kg			10		ND	ND			
Heptachlor Epoxide	EPA 8270	1	ug/kg					ND	ND			
Methoxychlor	EPA 8270	1	ug/kg					ND	ND			
Mirex	EPA 8270	1	ug/kg					ND	ND			
Toxaphene	EPA 8270	10	ug/kg					ND	ND			
Trans-Nonachlor	EPA 8270	1	ug/kg					ND	ND			
Total DDT [5]	EPA 8270		ug/kg	1.58	46.1	6.9	69.0	0	0			
2,4'-DDD	EPA 8270	1	ug/kg					ND	ND			
2,4'-DDD	EPA 8270	1	ug/kg					ND	ND			
2,4'-DDD	EPA 8270	1	ug/kg					ND	ND			
4,4'-DDD	EPA 8270	1	ug/kg	1.0	7.0			ND	ND			
4,4'-DDE	EPA 8270	1	ug/kg	2.2	27			ND	ND			
4,4'-DDT	EPA 8270	1	ug/kg	2.0	20			ND	ND			
ORGANOTINS												
Total Organotins [6]			ug/kg					0	0			
Monobutyltin	Krone, et al. 1989	1	ug/kg					ND	ND			
Dibutyltin	Krone, et al. 1989	1	ug/kg					ND	ND			
Tributyltin	Krone, et al. 1989	1	ug/kg					ND	ND			
Tetrabutyltin	Krone, et al. 1989	1	ug/kg			0.15 [7]		ND	ND			

Table 1.—San Clemente Shoreline Project – Borrow Area #2 Sediment Composite Sample: Chemical Results

	Analytical Method [1]	Method Reporting Limit/ Detection Limit	Units [2]	Sediment Quality Guidelines (SQGs) ERL (Long et al., 1999)	ERM (Long et al., 1999)	SL (PSDDA, 1998)	ML (PSDDA, 1998)	Sample Testing Results [3]				
PHTHALATES												
Total phthalates [4]			ug/kg			23,170		8.4	8.8			
Bis (2-ethylhexyl) phthalate	EPA 8270	5	ug/kg			8,300		8.4	8.8			
Butyl benzyl phthalate	EPA 8270	5	ug/kg			970		ND	ND			
Diethyl phthalate	EPA 8270	5	ug/kg			1,200		ND	ND			
Dimethyl phthalate	EPA 8270	5	ug/kg			1,400		ND	ND			
Di-n-butyl phthalate	EPA 8270	5	ug/kg			5,100		ND	ND			
Di-n-octyl phthalate	EPA 8270	5	ug/kg			6,200		ND	ND			
POLYCHLORINATED BIPHENYLS (PCB)												
Total PCBs [4]			ug/kg	22.7	180	130	3,100	0	0			
Aroclor 1016	EPA 8270	10	ug/kg					ND	ND			
Aroclor 1221	EPA 8270	10	ug/kg					ND	ND			
Aroclor 1232	EPA 8270	10	ug/kg					ND	ND			
Aroclor 1242	EPA 8270	10	ug/kg					ND	ND			
Aroclor 1248	EPA 8270	10	ug/kg					ND	ND			
Aroclor 1254	EPA 8270	10	ug/kg					ND	ND			
Aroclor 1260	EPA 8270	10	ug/kg					ND	ND			
POLYNUCLEAR AROMATICS HYDROCARBONS (PAH)												
Total PAHs [4]			ug/kg	4,022	44,792			0	0			
1-Methylnaphthalene	EPA 8270	1	ug/kg					ND	ND			
1-Methylphenanthrene	EPA 8270	1	ug/kg					ND	ND			
2,3,5-Trimethylnaphthalene	EPA 8270	1	ug/kg					ND	ND			
2,6-Dimethylnaphthalene	EPA 8270	1	ug/kg					ND	ND			
2-Methylnaphthalene	EPA 8270	1	ug/kg	70	670	670	1,900	ND	ND			
Acenaphthene	EPA 8270	1	ug/kg	16	500	500	2,000	ND	ND			
Acenaphthylene	EPA 8270	1	ug/kg	44	640	560	1,300	ND	ND			
Anthracene	EPA 8270	1	ug/kg	85.3	1,100	960	13,000	ND	ND			
Benzo(a)anthracene	EPA 8270	1	ug/kg	261	1,600	1,300	5,100	ND	ND			
Benzo(a,e)pyrene	EPA 8270	1	ug/kg	430	1,600	1,600	3,600	ND	ND			
Benzo(b)fluoranthene	EPA 8270	1	ug/kg			1,600	4,950	ND	ND			
Benzo(k)fluoranthene	EPA 8270	1	ug/kg			1,600	4,950	ND	ND			

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	Analytical Method [1]	Method Reporting Limit/ Detection Limit	Units [2]	Sediment Quality Guidelines (SQGs) ERL (Long et al., 1999)	ERM (Long et al., 1999)	SL (PSDDA, 1998)	ML (PSDDA, 1998)	Sample Testing Results [3]				
Benzo(g,h,i)perylene	EPA 8270	1	ug/kg			670	3,200	ND	ND			
Biphenyl	EPA 8270	1	ug/kg					ND	ND			
Chrysene	EPA 8270	1	ug/kg	384	2,800	1,400	21,000	ND	ND			
Dibenzo(a,h)anthracene	EPA 8270	1	ug/kg	63.4	260	230	1,900	ND	ND			
Fluoranthene	EPA 8270	1	ug/kg	600	5,100	1,700	30,000	ND	ND			
Fluorene	EPA 8270	1	ug/kg	19	540	540	3,600	ND	ND			
Indeno(1,2,3-cd)pyrene	EPA 8270	1	ug/kg			600	4,400	ND	ND			
Naphthalene	EPA 8270	1	ug/kg	160	2,100	2,100	2,400	ND	ND			
Perylene	EPA 8270	1	ug/kg					ND	ND			
Phenanthrene	EPA 8270	1	ug/kg	240	1,500	1,500	21,000	ND	ND			
Pyrene	EPA 8270	1	ug/kg	665	2,600	2,600	16,000	ND	ND			
PHENOLS												
Total Phenols			ug/kg			1582	5777	0	0			
2,4,6-Trichlorophenol	EPA 8270	50	ug/kg			29	210	ND	ND			
2,4-Dichlorophenol	EPA 8270	50	ug/kg			29	210	ND	ND			
2,4-Dimethylphenol	EPA 8270	100	ug/kg			29	210	ND	ND			
2,4-Dinitrophenol	EPA 8270	200	ug/kg			29	210	ND	ND			
2-Chlorophenol	EPA 8270	50	ug/kg					ND	ND			
2-Methy-4,6-dinitrophenol	EPA 8270	500	ug/kg					ND	ND			
2-Nitrophenol	EPA 8270	100	ug/kg					ND	ND			
4-Chloro-3-methyphenol	EPA 8270	100	ug/kg					ND	ND			
4-Nitrophenol	EPA 8270	100	ug/kg					ND	ND			
Pentachlorophenol	EPA 8270	50	ug/kg			400	690	ND	ND			
Phenol	EPA 8270	100	ug/kg					ND	ND			

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	Analytical Method [1]	Method Reporting Limit/ Detection Limit	Units [2]	Sediment Quality Guidelines (SQGs) ERL	ERM	SL	ML	Sample Testing Results [3]				

Notes:

(1) Analytical Method
EPA = United States Environmnetal Protection Agency
EPA Methods are EPA SW-846, 1994 3rd Edition or EPA 600/4-79-020, March 1983
APHA = American Public Health Association
APHA Method is APHA Standard Methods, 18th Edition, 1992
Plumb = Procedure for Handling and Chemical Analysis of Sediment and Water Samples. Tech Rep. USEPA/CE-81, Russell H. Plumb, Jr., 1981.

(2) Units: mg/kg = milligrams per kilogram, parts per million (dry weight unless otherwise noted)
ug/kg = micrograms per kilogram, parts per billion (dry weight unless otherwise noted)

(3) ND = not detected in this analysis or less than Method Reporting Limit value for the particular compound(s) of interest

(4) Total Chlorinated Pesticides, Total Organotins, Total Phthalates, Total PCBs, Total PAHs, and Total Phenols = sum of named compounds and their derivatives

(5) Total DDT = sum of 4,4'-DDE; 4,4'-DDD; and 4,4'-DDT

Table 2: SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.1
USACE VIBRACORE HOLES (JANUARY, 2003)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS ---SAND (sieve no.)---													Fines	ATTERBERG LIMITS			CLASSIFICATION	
NO.	TOP	BOT		3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI		
SC-1	0.00	0.61	0.61	100	100	100	99	99	98	98	98	98	98	97	97	96	69	44	32			SM	Silty Sand
SC-1	0.61	1.83	1.22	100	100	100	100	99	99	99	99	99	98	98	98	97	80	47	30			SM	Silty Sand
SC-1	1.83	2.74	0.91	100	100	100	100	100	100	100	99	99	99	99	99	97	77	53	37			ML	Sandy Silt
SC-1	2.74	3.66	0.92	100	100	100	100	100	100	100	100	100	99	99	98	96	82	60	46			ML	Sandy Silt
SC-1	3.66	4.11	0.45	100	100	100	100	100	100	100	100	100	100	99	98	91	43	21	14		n/p	SM	Silty Sand
SC-1	**0.00**	**4.11**	**4.11**	**100**	**100**	**100**	**100**	**100**	**99**	**99**	**99**	**99**	**99**	**98**	**98**	**96**	**74**	**48**	**34**			**SM**	**Silty Sand**
SC-3	**0.00**	**0.61**	**0.61**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
SC-5	0.00	0.91	0.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
SC-5	0.91	1.83	0.92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
SC-5	1.83	2.74	0.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
SC-5	2.74	3.72	0.98	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
SC-5	3.72	3.81	0.09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS				
SC-5	**0.00**	**3.81**	**3.81**																				
SC-7	0.00	0.91	0.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
SC-7	0.91	1.55	0.64	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
SC-7	1.55	1.83	0.28	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS				
SC-7	**0.00**	**1.83**	**1.83**																				
SC-8	0.00	0.91	0.91	100	100	100	100	100	100	99	99	99	99	98	98	97	90	67	45			ML	Sandy Silt
SC-8	0.91	2.13	1.22	100	100	100	98	97	96	95	94	92	87	80	75	73	66	53	43			ML	Sandy Silt
SC-8	2.13	3.05	0.92	100	98	93	90	88	86	84	80	75	67	54	47	45	42	36	31			SM	Silty Sand
SC-8	**0.00**	**3.05**	**3.05**	**100**	**99**	**98**	**96**	**95**	**94**	**93**	**91**	**89**	**85**	**78**	**73**	**72**	**66**	**52**	**40**			**ML**	**Sandy Silt**
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.36*	*0.3*	*0.2*	*0.13*	*0.09*	*0.075*	0.063				

NOTE: NA = Not Analyzed; NS = Not Sampled

Table 3 (1 of 3): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
USACE VIBRACORE HOLES (1993)

HOLE NO.	DEPTH (METERS) TOP	DEPTH (METERS) BOT	THICKNESS (METERS)	% FINER #200 SIEVE	CLASSIFICATION	
OS-1	0.00	0.30	0.30	24	SM	Silty Sand
OS-1	0.30	1.52	1.22	1	SP	Poorly Graded Sand With Gravel
OS-1	1.52	3.05	1.53	1	SP	Poorly Graded Sand With Gravel
OS-1	3.05	5.79	2.74	1	SP	Poorly Graded Sand
OS-1	**0.00**	**5.79**	**5.79**	**2**	**SP**	**Poorly Graded Sand With Gravel**
OS-2	0.00	0.30	0.30	34	SM	Silty Sand
OS-2	0.30	0.61	0.31	33	SM	Silty Sand
OS-2	0.61	5.18	4.57	0	SP	Poorly Graded Sand
OS-2	**0.00**	**5.18**	**5.18**	**4**	**SP**	**Poorly Graded Sand**
OS-3	0.00	0.30	0.30	18	SM	Silty Sand
OS-3	0.30	2.74	2.44	2	SP	Poorly Graded Sand
OS-3	2.74	4.11	1.37	19	SM	Silty Sand
OS-3	4.11	5.18	1.07	3	SP	Poorly Graded Sand
OS-3	5.18	5.49	0.31	2	SP	Poorly Graded Sand With Gravel
OS-3	**0.00**	**5.49**	**5.49**	**7**	**SP-SM**	**Poorly Graded Sand With Silt**
OS-4	0.00	0.46	0.46	15	SM	Silty Sand
OS-4	0.46	0.98	0.52	0	GW-GM	Well Graded Gravel With Silt And Sand
OS-4	0.98	1.22	0.24	3	GP	Poorly Graded Gravel
OS-4	**0.00**	**1.22**	**1.22**	**6**	**SP-SM**	**Poorly Graded Sand With Gravel And Silt**
OS-5	0.00	0.30	0.30	1	GP	Poorly Graded Gravel With Sand
OS-5	0.30	1.37	1.07	1	SP	Poorly Graded Sand
OS-5	1.37	1.98	0.61	1	SP	Poorly Graded Sand With Gravel
OS-5	1.98	4.42	2.44	9	SP-SM	Poorly Graded Sand With Silt
OS-5	4.42	5.79	1.37	64	ML	Sandy Silt
OS-5	**0.00**	**5.79**	**5.79**	**19**	**SM**	**Silty Sand**
OS-6	0.00	0.30	0.30	21	SM	Silty Sand With Gravel
OS-6	0.30	4.57	4.27	2	SP	Poorly Graded Sand
OS-6	**0.00**	**4.57**	**4.57**	**3**	**SP**	**Poorly Graded Sand**
OS-7	0.00	2.13	2.13	15	SM	Silty Sand
OS-7	2.13	3.66	1.53	3	SP	Poorly Graded Sand
OS-7	**0.00**	**3.66**	**3.66**	**10**	**SP-SM**	**Poorly Graded Sand With Silt**
OS-8	0.00	3.05	3.05	28	SM	Silty Sand
OS-8	3.05	4.27	1.22	1	SP	Poorly Graded Sand

Table 3 (2 of 3): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2 USACE VIBRACORE HOLES (1993)

HOLE NO.	DEPTH (METERS) TOP	DEPTH (METERS) BOT	THICKNESS (METERS)	% FINER #200 SIEVE	CLASSIFICATION	
OS-11	0.00	0.30	0.30	15	SM	Silty Sand With Gravel
OS-11	0.30	0.61	0.31	1	SP	Poorly Graded Sand
OS-11	0.61	3.35	2.74	1	SP	Poorly Graded Sand
OS-11	3.35	4.88	1.53	1	SP	Poorly Graded Sand
OS-11	**0.00**	**4.88**	**4.88**	**2**	**SP**	**Poorly Graded Sand**
OS-22	0.00	0.46	0.46	24	SM	Silty Sand
OS-22	0.46	0.85	0.39	3	SP	Poorly Graded Sand
OS-22	0.85	1.89	1.04	19	SM	Silty Sand
OS-22	1.89	3.26	1.37	2	SP	Poorly Graded Sand
OS-22	3.26	3.51	0.25	4	SP	Poorly Graded Sand
OS-22	**0.00**	**3.51**	**3.51**	**10**	**SP-SM**	**Poorly Graded Sand With Silt**
OS-23	0.00	0.30	0.30	21	SM	Silty Sand
OS-23	0.30	2.13	1.83	1	SP	Poorly Graded Sand
OS-23	2.13	3.35	1.22	2	SP	Poorly Graded Sand
OS-23	**0.00**	**3.35**	**3.35**	**3**	**SP**	**Poorly Graded Sand**
OS-24	*0.00*	*0.30*	*0.30*	*21*	*SM*	*Silty Sand*
OS-24	*0.30*	*2.04*	*1.74*	*100*	*CL*	*Clay*
OS-24	*2.04*	*2.44*	*0.40*	*64*	*ML*	*Sandy Silt*
OS-24	2.44	2.59	0.15	3	SP	Poorly Graded Sand
OS-24	**0.00**	**2.59**	**2.59**	**80**	**ML**	**Sandy Silt**
OS-25	0.00	1.74	1.74	19	SM	Silty Sand
OS-25	1.74	2.04	0.30	4	GP	Poorly Graded Gravel With Sand
OS-25	2.04	2.65	0.61	1	SP	Poorly Graded Sand
OS-25	**0.00**	**2.65**	**2.65**	**13**	**SP-SM**	**Poorly Graded Sand With Silt And Gravel**
OS-26	0.00	0.30	0.30	26	SM	Silty Sand
OS-26	0.30	0.61	0.31	5	SP-SM	Poorly Graded Sand With Silt And Gravel
OS-26	0.61	2.13	1.52	2	SP	Poorly Graded Sand
OS-26	2.13	3.96	1.83	39	SM	Silty Sand
OS-26	3.96	4.57	0.61	3	SP	Poorly Graded Sand
OS-26	**0.00**	**4.57**	**4.57**	**19**	**SM**	**Silty Sand**
OS-32	0.00	0.76	0.76	21	SM	Silty Sand
OS-32	0.76	5.18	4.42	1	SP	Poorly Graded Sand With Gravel
OS-32	**0.00**	**5.18**	**5.18**	**4**	**SP**	**Poorly Graded Sand With Gravel**

Table 3 (3 of 3): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2 USACE VIBRACORE HOLES (1993)

HOLE NO.	DEPTH (METERS) TOP	DEPTH (METERS) BOT	THICKNESS (METERS)	% FINER #200 SIEVE	CLASSIFICATION	
OS-36	*0.00*	*3.11*	*3.11*	*39*	*SM*	*Silty Sand*
OS-36	*3.11*	*4.21*	*1.10*	*64*	*ML*	*Sandy Silt*
OS-36	**0.00**	**4.21**	**4.21**	**46**	**SM**	**Silty Sand**
OS-37	*0.00*	*4.36*	*4.36*	*39*	*SM*	*Silty Sand*
OS-37	*4.36*	*5.70*	*1.34*	*1*	*SP*	*Poorly Graded Sand*
OS-37	**0.00**	**5.70**	**5.70**	**30**	**SM**	**Silty Sand**
OS-38	**0.00**	**2.23**	**2.23**	**21**	**SM**	**Silty Sand**
OS-39	*0.00*	*0.24*	*0.24*	*39*	*SM*	*Silty Sand*
OS-39	*0.24*	*1.68*	*1.44*	*21*	*SM*	*Silty Sand*
OS-39	*1.68*	*2.44*	*0.76*	*21*	*SM*	*Silty Sand*
OS-39	*2.44*	*3.66*	*1.22*	*87*	*ML*	*Silt*
OS-39	*3.66*	*4.05*	*0.39*	*40*	*SM*	*Silty Sand*
OS-39	**0.00**	**4.05**	**4.05**	**44**	**SM**	**Silty Sand**
OS-40	*0.00*	*0.37*	*0.37*	*1*	*SP*	*Poorly Graded Sand With Gravel*
OS-40	*0.37*	*1.43*	*1.06*	*1*	*SP*	*Poorly Graded Sand*
OS-40	*1.43*	*2.10*	*0.67*	*2*	*SP*	*Poorly Graded Sand*
OS-40	**0.00**	**2.10**	**2.10**	**1**	**SP**	**Poorly Graded Sand**
OS-41	0.00	1.52	1.52	40	SM	Silty Sand
OS-41	*1.52*	*3.35*	*1.83*	*100*	*CL*	*Clay*
OS-41	3.35	3.87	0.52	87	ML	Silt
OS-41	3.87	4.36	0.49	10	SP-SM	Poorly Graded Sand With Silt
OS-41	**0.00**	**4.36**	**4.36**	**67**	**ML**	**Sandy Silt**
OS-42	*0.00*	*0.91*	*0.91*	*40*	*SM*	*Silty Sand*
OS-42	*0.91*	*2.61*	*1.70*	*1*	*SP*	*Poorly Graded Sand*
OS-42	**0.00**	**2.61**	**2.61**	**15**	**SM**	**Silty Sand**
OS-43	0.00	0.61	0.61	11	SP-SM	Poorly Graded Sand With Silt And Gravel
OS-43	0.61	1.22	0.61	51	ML	Sandy Silt
OS-43	1.22	2.74	1.52	1	SP	Poorly Graded Sand With Gravel
OS-43	2.74	3.05	0.31	1	GP	Poorly Graded Gravel With Sand
OS-43	**0.00**	**3.05**	**3.05**	**13**	**SP-SM**	**Poorly Graded Sand With Silt And Gravel**
OS-44	0.00	0.61	0.61	32	SM	Silty Sand
OS-44	0.61	3.35	2.74	1	SP	Poorly Graded Sand
OS-44	**0.00**	**3.35**	**3.35**	**7**	**SP-SM**	**Poorly Graded Sand With Silt**

Note: Italicized entries are values for a different interval with similar visually-logged characteristics (interval not analyzed)

Table 4 (1 of 4): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
SANDAG VIBRACORE HOLES (1999)

HOLE NO.	DEPTH (METERS) TOP	DEPTH (METERS) BOT	THICKNESS (METERS)	%GRAVEL	% FINER #200 SIEVE	CLASSIFICATION	
SDG-1	0.00	1.22	1.22	1	10	SP-SM	Poorly Graded Sand With Silt
SDG-1	1.22	2.26	1.04	32	2	SP	Poorly Graded Sand With Gravel
SDG-1	**0.00**	**2.26**	**2.26**	**15**	**6**	**SP**	**Poorly Graded Sand With Gravel And Silt**
SDG-2	0.00	1.62	1.62	5	3	SP	Poorly Graded Sand
SDG-2	1.62	2.80	1.18	0	2	SP	Poorly Graded Sand
SDG-2	**0.00**	**2.80**	**2.80**	**3**	**3**	**SP**	**Poorly Graded Sand**
SDG-3	0.00	0.61	0.61	0	52	ML	Sandy Silt
SDG-3	0.61	1.43	0.82	1	8	SP-SM	Poorly Graded Sand With Silt
SDG-3	**0.00**	**1.43**	**1.43**	**1**	**27**	**SM**	**Silty Sand**
SDG-4	0.00	1.07	1.07	0	51	ML	Sandy Silt
SDG-4	1.07	1.37	0.30	5	26	SM	Silty Sand
SDG-4	1.37	3.84	2.47	0	1	SP	Poorly Graded Sand
SDG-4	**0.00**	**3.84**	**3.84**	**0**	**17**	**SM**	**Silty Sand**
SDG-5	0.00	1.83	1.83	0	7	SP-SM	Poorly Graded Sand With Silt
SDG-5	1.83	2.50	0.67	22	30	SM	Silty Sand With Gravel
SDG-5	**0.00**	**2.50**	**2.50**	**6**	**13**	**SP-SM**	**Poorly Graded Sand With Silt**
SDG-6	0.00	1.04	1.04	0	11	SP-SM	Poorly Graded Sand With Silt
SDG-6	1.04	3.96	2.92	0	10	SP-SM	Poorly Graded Sand With Silt
SDG-6	3.96	4.66	0.70	20	8	SP-SM	Poorly Graded Sand With Silt And Gravel
SDG-6	**0.00**	**4.66**	**4.66**	**3**	**10**	**SP-SM**	**Poorly Graded Sand With Silt**
SDG-7	0.00	1.83	1.83	1	54	ML	Sandy Silt
SDG-7	1.83	2.13	0.30	14	3	SP	Poorly Graded Sand
SDG-7	**0.00**	**2.13**	**2.13**	**3**	**47**	**ML**	**Sandy Silt**
SDG-8	0.00	1.22	1.22	0	57	ML	Sandy Silt
SDG-8	1.22	1.83	0.61	0	56	ML	Sandy Silt
SDG-8	1.83	2.74	0.91	0	7	SP-SM	Poorly Graded Sand With Silt
SDG-8	2.74	5.27	2.53	32	1	SP	Poorly Graded Sand With Gravel
SDG-8	**0.00**	**5.27**	**5.27**	**15**	**21**	**SM**	**Silty Sand With Gravel**
SDG-9	0.00	0.76	0.76	0	64	ML	Sandy Silt
SDG-9	0.76	1.37	0.61	0	50	ML	Sandy Silt
SDG-9	1.37	3.41	2.04	0	14	SP-SM	Poorly Graded Sand With Silt
SDG-9	**0.00**	**3.41**	**3.41**	**0**	**32**	**SM**	**Silty Sand**
SDG-10	0.00	1.83	1.83	0	53	ML	Sandy Silt
SDG-10	1.83	3.05	1.22	0	3	SP	Poorly Graded Sand
SDG-10	3.05	4.18	1.13	0	5	SP-SM	Poorly Graded Sand With Silt
SDG-10	**0.00**	**4.18**	**4.18**	**0**	**25**	**SM**	**Silty Sand**

Table 4 (2 of 4): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
SANDAG VIBRACORE HOLES (1999)

HOLE NO.	DEPTH (METERS) TOP	DEPTH (METERS) BOT	THICKNESS (METERS)	%GRAVEL	% FINER #200 SIEVE	CLASSIFICATION	
SDG-11	0.00	1.52	1.52	0	63	ML	Sandy Silt
SDG-11	1.52	3.05	1.53	2	30	SM	Silty Sand
SDG-11	3.05	4.39	1.34	0	43	SM	Silty Sand
SDG-11	**0.00**	**4.39**	**4.39**	**1**	**45**	**SM**	**Silty Sand**
SDG-12	0.00	1.22	1.22	0	81	ML	Silt With Sand
SDG-12	1.22	3.32	2.10	0	24	SM	Silty Sand
SDG-12	**0.00**	**3.32**	**3.32**	**0**	**45**	**SM**	**Silty Sand**
SDG-13	0.00	2.44	2.44	0	17	SM	Silty Sand
SDG-13	2.44	3.96	1.52	0	57	ML	Sandy Silt
SDG-13	3.96	5.03	1.07	4	6	SP-SM	Poorly Graded Sand With Silt
SDG-13	**0.00**	**5.03**	**5.03**	**1**	**27**	**SM**	**Silty Sand**
SDG-14	0.00	2.44	2.44	0	49	SM	Silty Sand
SDG-14	2.44	3.66	1.22	1	14	SP-SM	Poorly Graded Sand With Silt
SDG-14	3.66	5.03	1.37	0	9	SP-SM	Poorly Graded Sand With Silt
SDG-14	**0.00**	**5.03**	**5.03**	**0**	**30**	**SM**	**Silty Sand**
SDG-15	0.00	1.68	1.68	0	53	ML	Sandy Silt
SDG-15	1.68	3.05	1.37	0	33	SM	Silty Sand
SDG-15	3.05	5.21	2.16	0	7	SP-SM	Poorly Graded Sand With Silt
SDG-15	**0.00**	**5.21**	**5.21**	**0**	**29**	**SM**	**Silty Sand**
SDG-16	0.00	2.13	2.13	1	50	ML	Sandy Silt
SDG-16	2.13	3.05	0.92	4	13	SP-SM	Poorly Graded Sand With Silt
SDG-16	3.05	4.88	1.83	0	8	SP-SM	Poorly Graded Sand With Silt
SDG-16	**0.00**	**4.88**	**4.88**	**1**	**27**	**SM**	**Silty Sand**
SDG-17	0.00	3.05	3.05	1	54	ML	Sandy Silt
SDG-17	3.05	3.99	0.94	0	6	SP-SM	Poorly Graded Sand With Silt
SDG-17	**0.00**	**3.99**	**3.99**	**1**	**43**	**SM**	**Silty Sand**
SDG-18	0.00	1.22	1.22	0	66	ML	Sandy Silt
SDG-18	1.22	3.72	2.50	1	54	ML	Sandy Silt
SDG-18	**0.00**	**3.72**	**3.72**	**1**	**58**	**ML**	**Sandy Silt**
SDG-19	0.00	1.22	1.22	0	64	ML	Sandy Silt
SDG-19	1.22	3.99	2.77	0	52	ML	Sandy Silt
SDG-19	3.99	4.27	0.28	6	5	SP-SM	Poorly Graded Sand With Silt
SDG-19	**0.00**	**4.27**	**4.27**	**0**	**52**	**ML**	**Sandy Silt**
SDG-20	0.00	2.29	2.29	0	64	ML	Sandy Silt
SDG-20	2.29	3.35	1.06	0	43	SM	Silty Sand
SDG-20	3.35	4.97	1.62	0	8	SP-SM	Poorly Graded Sand With Silt
SDG-20	**0.00**	**4.97**	**4.97**	**0**	**41**	**SM**	**Silty Sand**

Table 4 (3 of 4): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
SANDAG VIBRACORE HOLES (1999)

HOLE NO.	DEPTH (METERS) TOP	DEPTH (METERS) BOT	THICKNESS (METERS)	%GRAVEL	% FINER #200 SIEVE	CLASSIFICATION	
SDG-21	0.00	1.83	1.83	1	54	ML	Sandy Silt
SDG-21	1.83	4.15	2.32	0	9	SP-SM	Poorly Graded Sand With Silt
SDG-21	**0.00**	**4.15**	**4.15**	**0**	**29**	**SM**	**Silty Sand**
SDG-22	0.00	1.98	1.98	0	58	ML	Sandy Silt
SDG-22	1.98	2.90	0.92	0	18	SM	Silty Sand
SDG-22	2.90	5.18	2.28	0	5	SP-SM	Poorly Graded Sand With Silt
SDG-22	**0.00**	**5.18**	**5.18**	**0**	**28**	**SM**	**Silty Sand**
SDG-23	0.00	2.29	2.29	0	67	ML	Sandy Silt
SDG-23	2.29	2.99	0.70	0	16	SM	Silty Sand
SDG-23	**0.00**	**2.99**	**2.99**	**0**	**55**	**ML**	**Sandy Silt**
SDG-24	0.00	2.44	2.44	0	66	ML	Sandy Silt
SDG-24	2.44	4.42	1.98	0	38	SM	Silty Sand
SDG-24	**0.00**	**4.42**	**4.42**	**0**	**53**	**ML**	**Sandy Silt**
SDG-25	0.00	0.91	0.91	0	58	ML	Sandy Silt
SDG-25	0.91	3.05	2.14	4	9	SP-SM	Poorly Graded Sand With Silt
SDG-25	**0.00**	**3.05**	**3.05**	**3**	**24**	**SM**	**Silty Sand**
SDG-26	0.00	3.05	3.05	0	58	ML	Sandy Silt
SDG-26	3.05	4.72	1.67	10	4	SP	Poorly Graded Sand
SDG-26	**0.00**	**4.72**	**4.72**	**4**	**39**	**SM**	**Silty Sand**
SDG-27	0.00	2.74	2.74	0	58	ML	Sandy Silt
SDG-27	2.74	3.44	0.70	0	23	SM	Silty Sand
SDG-27	**0.00**	**3.44**	**3.44**	**0**	**51**	**ML**	**Sandy Silt**
SDG-28	0.00	2.74	2.74	0	61	ML	Sandy Silt
SDG-28	2.74	3.72	0.98	0	7	SP-SM	Poorly Graded Sand With Silt
SDG-28	**0.00**	**3.72**	**3.72**	**0**	**47**	**SM**	**Silty Sand**
SDG-29	0.00	2.13	2.13	0	73	ML	Sandy Silt
SDG-29	2.13	2.96	0.83	0	8	SP-SM	Poorly Graded Sand With Silt
SDG-29	**0.00**	**2.96**	**2.96**	**0**	**55**	**ML**	**Sandy Silt**
SDG-30	0.00	1.68	1.68	0	67	ML	Sandy Silt
SDG-30	1.68	3.51	1.83	0	36	SM	Silty Sand
SDG-30	**0.00**	**3.51**	**3.51**	**0**	**51**	**ML**	**Sandy Silt**
SDG-31	0.00	2.13	2.13	0	61	ML	Sandy Silt
SDG-31	2.13	3.35	1.22	1	24	SM	Silty Sand
SDG-31	**0.00**	**3.35**	**3.35**	**0**	**48**	**SM**	**Silty Sand**

Table 4 (4 of 4): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
SANDAG VIBRACORE HOLES (1999)

HOLE NO.	DEPTH (METERS) TOP	DEPTH (METERS) BOT	THICKNESS (METERS)	%GRAVEL	% FINER #200 SIEVE	CLASSIFICATION	
SDG-32	0.00	1.83	1.83	0	53	ML	Sandy Silt
SDG-32	1.83	3.02	1.19	0	60	ML	Sandy Silt
SDG-32	**0.00**	**3.02**	**3.02**	**0**	**56**	**ML**	**Sandy Silt**
SDG-33	**0.00**	**1.10**	**1.10**	**0**	**56**	**ML**	**Sandy Silt**
SDG-34	**0.00**	**1.19**	**1.19**	**0**	**54**	**ML**	**Sandy Silt**
SDG-35	0.00	1.22	1.22	1	58	ML	Sandy Silt
SDG-35	1.22	1.86	0.64	0	60	ML	Sandy Silt
SDG-35	**0.00**	**1.86**	**1.86**	**1**	**59**	**ML**	**Sandy Silt**

Table 5 (1 of 4): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
USACE VIBRACORE HOLES (JANUARY, 2003)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS ---SAND (sieve no.)---													Fines	ATTERBERG LIMITS			CLASSIFICATION	
NO.	TOP	BOT		3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI		
SO9-1	0.00	2.13	2.13	100	100	100	100	100	100	99	99	99	98	91	55	31	16	12	9		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-1	2.13	3.05	0.92	100	97	91	89	88	88	88	87	87	87	73	28	13	8	6	4		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-1	3.05	5.58	2.53	100	100	100	100	99	99	99	99	98	95	70	22	8	4	4	4		n/p	SP	Poorly Graded Sand
SO9-1	**0.00**	**5.58**	**5.58**	**100**	**100**	**99**	**98**	**98**	**98**	**97**	**97**	**97**	**95**	**79**	**36**	**18**	**9**	**7**	**6**			**SP-SM**	**Poorly Graded Sand With Silt**
SO9-2	0.00	1.53	1.53	100	100	93	84	80	77	77	76	76	74	54	16	5	2	2	2		n/p	SP	Poorly Graded Sand
SO9-2	1.53	3.05	1.53	70	55	52	51	51	51	51	51	51	49	31	10	4	2	2	2		n/p	SP	Poorly Graded Sand With Gravel
SO9-2	**0.00**	**3.05**	**3.05**	**85**	**78**	**73**	**68**	**66**	**64**	**64**	**64**	**64**	**62**	**43**	**13**	**5**	**2**	**2**	**2**			**SP**	**Poorly Graded Sand With Gravel**
SO9-3	0.00	2.74	2.74	100	100	100	100	100	99	99	99	98	94	44	12	5	3	3	2		n/p	SP	Poorly Graded Sand
SO9-3	2.74	4.11	1.37	100	100	96	95	94	94	93	93	92	87	41	11	5	4	4	4		n/p	SP	Poorly Graded Sand
SO9-3	4.11	4.57	0.46	93	81	80	79	79	78	78	76	74	68	31	8	4	3	2	2		n/p	SP	Poorly Graded Sand With Gravel
SO9-3	**0.00**	**4.57**	**4.57**	**99**	**98**	**97**	**96**	**96**	**95**	**95**	**95**	**94**	**89**	**42**	**11**	**5**	**3**	**3**	**3**			**SP**	**Poorly Graded Sand**
SO9-5	0.00	2.83	2.83	100	100	100	100	99	99	98	97	94	90	66	21	7	4	4	3		n/p	SP	Poorly Graded Sand
SO9-5	2.83	6.10	3.27	100	100	100	100	100	100	100	100	100	98	61	11	3	2	2	2		n/p	SP	Poorly Graded Sand
SO9-5	**0.00**	**6.10**	**6.10**	**100**	**100**	**100**	**100**	**100**	**100**	**99**	**99**	**97**	**94**	**63**	**16**	**5**	**3**	**3**	**2**			**SP**	**Poorly Graded Sand**
SO9-7	0.00	1.52	1.52	100	100	100	100	100	99	99	98	97	93	62	28	17	13	10	7		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-7	1.52	2.13	0.61	94	78	72	69	67	66	65	64	63	62	56	48	42	33	22	10		n/p	SM	Silty Sand With Gravel
SO9-7	2.13	2.74	0.61	62	39	30	28	27	26	25	25	24	23	17	9	6	5	4	2		n/p	GP	Poorly Graded Gravel With Sand
SO9-7	2.74	3.96	1.22	95	93	90	89	89	89	88	88	88	84	52	18	7	5	4	3		n/p	SP	Poorly Graded Sand
SO9-7	**0.00**	**3.96**	**3.96**	**92**	**85**	**82**	**81**	**80**	**80**	**79**	**78**	**78**	**75**	**51**	**25**	**16**	**12**	**9**	**5**			**SP-SM**	**Poorly Graded Sand With Silt An**
SO9-8	0.00	1.83	1.83	100	100	100	100	100	100	100	99	93	77	45	17	7	5	4	4		n/p	SP	Poorly Graded Sand
SO9-8	1.83	3.05	1.22	100	100	100	100	100	100	99	94	79	55	27	10	4	2	2	2		n/p	SP	Poorly Graded Sand
SO9-8	3.05	4.27	1.22	100	100	100	97	86	79	77	73	61	44	22	8	3	2	2	2		n/p	SP	Poorly Graded Sand
SO9-8	4.27	4.88	0.61	89	67	11	8	7	7	7	7	6	4	3	1	0	0	0	0		n/p	GP	Poorly Graded Gravel
SO9-8	**0.00**	**4.88**	**4.88**	**99**	**96**	**89**	**88**	**85**	**83**	**82**	**80**	**71**	**54**	**30**	**11**	**4**	**3**	**3**	**3**			**SP**	**Poorly Graded Sand**
SO9-11	0.00	0.46	0.46	*53*	*38*	*32*	*30*	*29*	*29*	*28*	*28*	27	27	*23*	*9*	*5*	*3*	2	*1*		*n/p*	*GP*	*Poorly Graded Gravel With Sand*
SO9-11	0.46	5.03	4.57	100	100	98	97	96	96	95	94	94	91	71	28	11	6	6	5		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-11	**0.00**	**5.03**	**5.03**	**96**	**94**	**92**	**91**	**90**	**90**	**89**	**88**	**88**	**85**	**67**	**26**	**10**	**6**	**6**	**5**			**SP-SM**	**Poorly Graded Sand With Silt**
SO9-13	0.00	0.76	0.76	97	92	90	89	89	89	88	88	88	87	55	16	7	5	4	2		n/p	SP	Poorly Graded Sand
SO9-13	0.76	1.52	0.76	100	100	100	100	100	100	100	100	99	96	67	18	5	2	2	2		n/p	SP	Poorly Graded Sand
SO9-13	1.52	2.29	0.77	100	95	93	93	92	92	92	92	92	90	60	14	4	2	2	2		n/p	SP	Poorly Graded Sand
SO9-13	2.29	4.57	2.28	100	100	99	99	99	99	98	98	98	95	66	21	7	4	3	3		n/p	SP	Poorly Graded Sand
SO9-13	**0.00**	**4.57**	**4.57**	**100**	**98**	**97**	**96**	**96**	**96**	**96**	**96**	**95**	**93**	**63**	**18**	**6**	**3**	**3**	**2**			**SP**	**Poorly Graded Sand**
SO9-14	0.00	0.91	0.91	100	100	100	100	100	100	99	99	97	90	57	24	13	8	5	4		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-14	0.91	1.83	0.92	100	100	100	100	100	100	99	99	96	89	50	20	10	6	5	4		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-14	1.83	2.74	0.91	100	100	100	100	100	99	99	97	91	77	39	17	9	6	5	5		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-14	2.74	3.41	0.67	100	100	100	100	99	99	97	92	84	69	37	17	9	6	5	4		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-14	3.41	3.96	0.55	100	100	100	98	95	89	83	76	69	58	35	16	8	4	3	3		n/p	SP	Poorly Graded Sand
SO9-14	**0.00**	**3.96**	**3.96**	**100**	**100**	**100**	**100**	**99**	**98**	**96**	**94**	**89**	**79**	**45**	**19**	**10**	**6**	**5**	**4**			**SP-SM**	**Poorly Graded Sand With Silt**
Seive size (mm)				***19***	***9.5***	***4.75***	***2.8***	***2***	***1.4***	***1***	***0.71***	***0.5***	***0.36***	***0.3***	***0.2***	***0.13***	***0.09***	***0.075***	**0.063**				

(ASTM - D 2487) Beach Classification

Table 5 (2 of 4): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
USACE VIBRACORE HOLES (JANUARY, 2003)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS ---SAND (sieve no.)---														Fines	ATTERBERG LIMITS		CLASSIFICATION		
NO.	TOP	BOT		3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI			
SO9-15A	0.00	0.46	0.46	80	74	70	69	69	69	69	69	69	68	60	35	21	17	16	14			n/p	SM	Silty Sand With Gravel
SO9-15A	0.46	5.79	5.33	100	100	100	100	100	100	100	100	100	99	98	78	27	9	4	3			n/p	SP	Poorly Graded Sand
SO9-15A	**0.00**	**5.79**	**5.79**	**98**	**98**	**98**	**98**	**98**	**98**	**98**	**98**	**97**	**96**	**77**	**28**	**10**	**5**	**5**	**4**				**SP-SM**	**Poorly Graded Sand With Silt**
SO9-16	0.00	0.31	0.31	100	100	100	100	100	99	99	99	99	99	97	88	76	60	41	26			n/p	SM	Silty Sand
SO9-16	0.30	1.83	1.53	100	100	100	100	100	100	100	100	100	99	94	35	10	4	3	3			n/p	SP	Poorly Graded Sand
SO9-16	**0.00**	**1.83**	**1.83**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**99**	**95**	**44**	**21**	**13**	**9**	**7**				**SP-SM**	**Poorly Graded Sand With Silt**
SO9-18	0.00	2.13	2.13	100	100	100	99	99	99	98	97	96	92	75	35	16	5	3	2			n/p	SP	Poorly Graded Sand
SO9-18	2.13	2.74	0.61	91	89	88	88	88	87	87	85	82	78	60	20	5	2	1	1			n/p	SP	Poorly Graded Sand
SO9-18	2.74	3.66	0.92	100	100	100	99	99	98	95	89	78	70	53	19	5	2	2	2			n/p	SP	Poorly Graded Sand
SO9-18	3.66	4.27	0.61	88	81	77	74	72	69	65	57	42	27	13	5	3	3	2	2			n/p	SP	Poorly Graded Sand With Gravel
SO9-18	4.27	5.94	1.67	100	98	98	98	98	97	97	96	93	83	46	13	5	3	2	2			n/p	SP	Poorly Graded Sand
SO9-18	5.94	6.10	0.16	77	49	23	19	18	18	17	17	17	16	11	4	1	0	0	0			n/p	GP	Poorly Graded Gravel With Sand
SO9-18	**0.00**	**6.10**	**6.10**	**97**	**95**	**94**	**93**	**93**	**92**	**91**	**88**	**84**	**76**	**54**	**21**	**9**	**3**	**2**	**2**				**SP**	**Poorly Graded Sand**
SO9-19	0.00	0.46	0.46	38	22	20	19	17	16	14	13	12	11	8	4	2	2	1	1			n/p	GP	Poorly Graded Gravel With Sand
SO9-19	0.46	1.07	0.61	100	100	100	99	99	98	98	97	95	90	62	20	9	6	5	4			n/p	SP-SM	Poorly Graded Sand With Silt
SO9-19	1.07	2.74	1.68	100	89	82	78	76	75	74	73	71	66	40	13	7	5	4	4			n/p	SP	Poorly Graded Sand With Gravel
SO9-19	2.74	3.05	0.31	48	37	32	30	29	29	28	28	27	25	16	4	2	1	1	1			n/p	GP	Poorly Graded Gravel With Sand
SO9-19	3.05	3.66	0.61	79	64	61	59	58	58	57	57	56	53	36	11	4	2	2	2			n/p	SP	Poorly Graded Sand With Gravel
SO9-19	**0.00**	**3.66**	**3.66**	**84**	**74**	**70**	**67**	**66**	**65**	**64**	**63**	**61**	**58**	**37**	**12**	**6**	**4**	**3**	**3**				**SP**	**Poorly Graded Sand With Gravel**
SO9-20	0.00	2.13	2.13	100	100	100	100	100	99	99	99	99	98	88	33	11	4	3	2			n/p	SP	Poorly Graded Sand
SO9-20	2.13	2.90	0.77	98	95	94	93	93	92	92	92	92	91	80	45	21	7	4	3			n/p	SP	Poorly Graded Sand
SO9-20	2.90	3.20	0.30	100	100	100	100	100	100	100	100	99	98	93	65	34	13	7	5			n/p	SP-SM	Poorly Graded Sand With Silt
SO9-20	**0.00**	**3.20**	**3.20**	**100**	**99**	**99**	**98**	**98**	**97**	**97**	**97**	**97**	**96**	**87**	**39**	**16**	**6**	**4**	**3**				**SP**	**Poorly Graded Sand**
SO9-22	0.00	1.07	1.07	100	100	100	100	99	99	98	97	96	94	92	88	85	59	34	22			n/p	SM	Silty Sand
SO9-22	1.07	1.68	0.61	100	100	98	96	95	93	92	90	87	84	72	56	47	38	27	21			n/p	SM	Silty Sand
SO9-22	1.68	2.13	0.45	57	52	48	47	47	46	46	45	45	44	36	23	17	13	11	9			n/p	GP-GM	Poorly Graded Gravel With Silt Anc
SO9-22	2.13	3.96	1.83	100	100	100	100	100	99	98	93	81	68	41	18	7	3	3	2			n/p	SP	Poorly Graded Sand
SO9-22	3.96	6.10	2.14	100	100	100	100	100	99	99	97	91	74	30	8	5	4	4	4			n/p	SP	Poorly Graded Sand
SO9-22	**0.00**	**6.10**	**6.10**	**97**	**96**	**96**	**96**	**95**	**94**	**94**	**91**	**85**	**74**	**49**	**31**	**25**	**17**	**12**	**9**				**SP-SM**	**Poorly Graded Sand With Silt**
SO9-24	0.00	0.61	0.61	100	100	90	78	72	67	64	61	59	55	43	26	17	14	12	9			n/p	SP-SM	Poorly Graded Sand With Silt
SO9-24	0.61	2.13	1.52	57	52	48	47	47	46	46	45	45	44	36	23	17	13	11	9			n/p	GP-GM	Poorly Graded Gravel With Silt Anc
SO9-24	2.13	3.05	0.92	89	84	84	84	83	83	83	83	82	80	65	30	11	5	4	4			n/p	SP	Poorly Graded Sand With Gravel
SO9-24	3.05	3.96	0.91	100	100	100	100	100	100	99	98	96	90	67	24	9	5	4	4			n/p	SP	Poorly Graded Sand
SO9-24	**0.00**	**3.96**	**3.96**	**81**	**78**	**75**	**73**	**71**	**70**	**70**	**68**	**67**	**65**	**51**	**25**	**14**	**9**	**8**	**7**				**SP-SM**	**Poorly Graded Sand With Silt An**
SO9-26	0.00	0.76	0.76	100	100	100	99	98	97	96	95	94	93	83	54	40	24	15	9			n/p	SM	Silty Sand
SO9-26	0.76	1.07	0.31	53	38	32	30	29	29	28	28	27	27	23	9	5	3	2	1			n/p	GP	Poorly Graded Gravel With Sand
SO9-26	1.07	1.52	0.45	100	100	100	100	100	100	100	100	100	97	62	16	6	4	3	3			n/p	SP	Poorly Graded Sand
SO9-26	1.52	3.35	1.83	100	100	100	100	100	100	100	100	100	99	76	23	7	4	4	3			n/p	SP	Poorly Graded Sand
SO9-26	3.35	3.96	0.61	90	78	72	68	67	65	64	63	61	58	37	16	7	5	4	4			n/p	SP	Poorly Graded Sand With Gravel
SO9-26	**0.00**	**3.96**	**3.96**	**95**	**92**	**90**	**89**	**89**	**88**	**88**	**88**	**87**	**86**	**66**	**26**	**13**	**8**	**6**	**4**				**SP-SM**	**Poorly Graded Sand With Silt**
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.36*	*0.3*	*0.2*	*0.13*	*0.09*	*0.075*	0.063					

(ASTM - D 2487) Beach Classification

Table 5 (3 of 4): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
USACE VIBRACORE HOLES (JANUARY, 2003)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS ---SAND (sieve no.)---														Fines	ATTERBERG LIMITS			CLASSIFICATION	
NO.	TOP	BOT		3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI		
SO9-27	0.00	3.35	3.35	100	100	100	100	100	100	100	99	99	96	71	19	5	3	2	2		n/p	SP	Poorly Graded Sand
SO9-27	3.35	4.57	1.22	100	97	94	93	93	93	93	93	92	89	66	18	5	3	2	2		n/p	SP	Poorly Graded Sand
SO9-27	4.57	5.18	0.61	98	97	95	93	92	90	88	82	72	52	19	5	2	2	2	2		n/p	SP	Poorly Graded Sand
SO9-27	5.18	6.10	0.91	98	96	96	96	96	96	95	94	91	78	28	8	4	4	3	3		n/p	SP	Poorly Graded Sand
SO9-27	**0.00**	**6.10**	**6.10**	**100**	**99**	**98**	**97**	**97**	**97**	**97**	**95**	**94**	**87**	**58**	**16**	**5**	**3**	**2**	**2**			**SP**	**Poorly Graded Sand**
SO9-28	0.00	0.31	0.31	*53*	*38*	*32*	*30*	*29*	*29*	*28*	*28*	*27*	*27*	*23*	*9*	*5*	*3*	*2*	*1*		*n/p*	*GP*	*Poorly Graded Gravel With Sand*
SO9-28	0.31	0.46	0.15	100	100	100	100	100	100	100	100	100	100	99	97	94	89	86	82			ML	Silt
SO9-28	0.46	1.22	0.76	100	100	100	100	100	100	100	100	100	99	94	69	29	11	8	7		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-28	1.22	5.79	4.57	100	100	100	100	100	100	100	100	100	100	99	79	29	7	4	3		n/p	SP	Poorly Graded Sand
SO9-28	**0.00**	**5.79**	**5.79**	**98**	**97**	**96**	**96**	**96**	**96**	**96**	**96**	**96**	**96**	**94**	**74**	**29**	**9**	**7**	**5**			**SP-SM**	**Poorly Graded Sand With Silt**
SO9-29	0.00	2.44	2.44	100	100	100	99	98	97	97	97	96	95	67	25	13	7	5	4		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-29	2.44	3.35	0.91	75	74	73	72	72	72	72	71	71	69	54	18	6	3	2	2		n/p	SP	Poorly Graded Sand With Gravel
SO9-29	3.35	5.64	2.29	100	100	100	100	100	100	100	100	100	99	85	27	8	4	3	3		n/p	SP	Poorly Graded Sand
SO9-29	**0.00**	**5.64**	**5.64**	**96**	**96**	**96**	**95**	**95**	**94**	**94**	**94**	**94**	**92**	**72**	**25**	**10**	**5**	**4**	**3**			**SP**	**Poorly Graded Sand**
SO9-31	0.00	1.52	1.52	100	100	100	99	99	98	98	97	97	94	75	28	11	8	6	4		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-31	1.52	2.44	0.92	100	100	98	97	97	96	96	96	95	94	81	36	12	4	3	3		n/p	SP	Poorly Graded Sand
SO9-31	2.44	3.05	0.61	66	54	51	50	50	49	49	49	49	49	47	26	8	3	2	2		n/p	GP	Poorly Graded Gravel With Sand
SO9-31	3.05	4.88	1.83	100	100	100	100	100	100	100	100	100	98	84	32	12	4	3	3		n/p	SP	Poorly Graded Sand
SO9-31	4.88	6.10	1.22	100	100	100	100	100	100	100	100	100	99	90	32	11	3	2	2		n/p	SP	Poorly Graded Sand
SO9-31	**0.00**	**6.10**	**6.10**	**97**	**95**	**95**	**94**	**94**	**94**	**94**	**94**	**93**	**92**	**79**	**31**	**11**	**5**	**3**	**3**			**SP**	**Poorly Graded Sand**
SO9-32	0.00	0.46	0.46	100	100	100	99	98	97	96	94	93	91	82	71	66	58	40	24		n/p	SM	Silty Sand
SO9-32	0.46	0.91	0.46	46	31	25	23	22	21	20	20	19	18	13	8	6	5	4	2		n/p	GP	Poorly Graded Gravel With Sand
SO9-32	0.91	6.10	5.18	100	100	100	100	100	100	100	99	99	96	87	49	19	6	3	3		n/p	SP	Poorly Graded Sand
SO9-32	**0.00**	**6.10**	**6.10**	**96**	**95**	**94**	**94**	**94**	**94**	**93**	**93**	**90**	**82**	**49**	**22**	**10**	**7**	**6**	**4**			**SP-SM**	**Poorly Graded Sand With Silt**
SO9-33	0.00	0.61	0.61	*100*	*100*	*100*	*100*	*100*	*99*	*99*	*99*	*99*	*98*	*88*	*33*	*11*	*4*	*3*	*2*		*n/p*	*SP*	*Poorly Graded Sand*
SO9-33	0.61	0.91	0.30	*53*	*38*	*32*	*30*	*29*	*29*	*28*	*28*	*27*	*27*	*23*	*9*	*5*	*3*	*2*	*1*		*n/p*	*GP*	*Poorly Graded Gravel With Sand*
SO9-33	0.91	1.83	0.92	100	100	100	100	100	100	100	100	99	97	82	34	13	5	4	4		n/p	SP	Poorly Graded Sand
SO9-33	1.83	3.66	1.83	100	100	100	100	100	100	100	99	98	95	76	31	11	4	3	3		n/p	SP	Poorly Graded Sand
SO9-33	3.66	5.18	1.52	100	100	100	100	99	98	98	97	96	93	75	30	11	4	3	3		n/p	SP	Poorly Graded Sand
SO9-33	5.18	5.64	0.46	100	97	96	83	77	76	76	75	74	72	56	24	9	4	3	3		n/p	SP	Poorly Graded Sand
SO9-33	5.64	6.10	0.46	*53*	*38*	*32*	*30*	*29*	*29*	*28*	*28*	*27*	*27*	*23*	*9*	*5*	*3*	*2*	*1*		*n/p*	*GP*	*Poorly Graded Gravel With Sand*
SO9-33	**0.00**	**6.10**	**6.10**	**94**	**92**	**91**	**90**	**89**	**89**	**89**	**88**	**87**	**85**	**70**	**28**	**10**	**4**	**3**	**3**			**SP**	**Poorly Graded Sand**
SO9-40	0.00	0.61	0.61	100	100	100	98	96	91	88	85	81	75	53	25	14	8	5	4		n/p	SP-SM	Poorly Graded Sand With Silt
SO9-40	0.61	1.52	0.91	75	65	56	51	47	43	39	34	29	25	15	6	2	1	1	1		n/p	SP	Poorly Graded Sand With Gravel
SO9-40	1.52	3.35	1.83	100	97	95	93	89	84	77	66	56	47	32	13	5	3	2	2		n/p	SP	Poorly Graded Sand
SO9-40	3.35	4.57	1.22	100	100	98	97	97	96	94	88	70	46	20	6	3	2	2	2		n/p	SP	Poorly Graded Sand
SO9-40	4.57	5.18	0.61	100	97	93	90	87	83	77	68	58	46	25	7	2	1	1	1		n/p	SP	Poorly Graded Sand
SO9-40	5.18	5.49	0.31	100	100	100	100	100	99	99	98	96	89	46	10	3	2	2	2		n/p	SP	Poorly Graded Sand
SO9-40	**0.00**	**5.49**	**5.49**	**96**	**93**	**90**	**88**	**85**	**81**	**77**	**70**	**60**	**48**	**29**	**11**	**5**	**3**	**2**	**2**			**SP**	**Poorly Graded Sand**
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.36*	*0.3*	*0.2*	*0.13*	*0.09*	*0.075*	0.063				

(ASTM - D 2487) Beach Classification

Table 5 (4 of 4): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
USACE VIBRACORE HOLES (JANUARY, 2003)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS ---SAND (sieve no.)---														Fines	ATTERBERG LIMITS			CLASSIFICATION	
NO.	TOP	BOT		3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI		
SO9-41	0.00	1.83	1.83	100	100	100	99	98	96	95	93	90	86	66	28	12	4	1	1		n/p	SP	Poorly Graded Sand
SO9-41	1.83	2.29	0.46	100	74	64	61	60	60	59	58	56	51	34	13	5	2	2	1		n/p	SP	Poorly Graded Sand With Gravel
SO9-41	2.29	2.90	0.61	89	85	85	85	85	84	84	83	79	71	45	14	4	2	2	2		n/p	SP	Poorly Graded Sand With Gravel
SO9-41	2.90	4.88	1.98	100	100	100	100	100	99	99	96	87	69	29	7	3	2	2	2		n/p	SP	Poorly Graded Sand
SO9-41	**0.00**	**4.88**	**4.88**	**99**	**96**	**95**	**94**	**94**	**92**	**92**	**90**	**84**	**74**	**45**	**16**	**7**	**3**	**2**	**2**			**SP**	**Poorly Graded Sand**
Seive size (mm)				***19***	***9.5***	***4.75***	***2.8***	***2***	***1.4***	***1***	***0.71***	***0.5***	***0.36***	***0.3***	***0.2***	***0.13***	***0.09***	***0.075***	0.063				
				(ASTM - D 2487) Beach Classification																			

Note: Italicized entries are values supplied from a different interval with similar visually-logged characteristics (interval not analyzed)
If core loss occurs at top of hole, analyzed value for the first recovered interval is projected to the surface

Table 6 (1 of 3): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
USACE VIBRACORE HOLES (AUGUST, 2003)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS ---SAND (sieve no.)---														Fines	ATTERBERG LIMITS			CLASSIFICATION	
NO.	TOP	BOT		3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI		
O-1	0.00	0.67	0.67	100	100	100	100	100	99	99	99	99	98	94	89	85	67	39	25			SM	Silty Sand
O-1	0.67	1.52	0.85	100	100	100	100	100	100	100	100	100	100	100	98	95	73	42	24			SM	Silty Sand
O-1	**0.00**	**1.52**	**1.52**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**99**	**97**	**94**	**91**	**70**	**41**	**24**			**SM**	**Silty Sand**
O-2	0.00	1.22	1.22	82	79	76	75	75	75	74	74	73	71	48	15	6	4	3	2		n/p	SP	Poorly Graded Sand With Gravel
O-2	1.22	2.53	1.31	100	99	99	98	98	98	98	98	97	97	95	87	58	31	20	13		n/p	SM	Silty Sand
O-2	2.53	3.48	0.95	72	68	65	63	61	58	56	49	49	46	38	29	18	6	3	2		n/p	SP	Poorly Graded Sand With Gravel
O-2	**0.00**	**3.48**	**3.48**	**86**	**84**	**82**	**80**	**80**	**79**	**78**	**76**	**76**	**74**	**63**	**46**	**29**	**15**	**9**	**6**			**SP-SM**	**Poorly Graded Sand With Silt An**
O-3	0.00	1.22	1.22	100	100	100	100	100	100	100	99	99	99	99	97	89	68	42	24			SM	Silty Sand
O-3	1.22	2.23	1.01	100	100	98	96	95	94	94	93	93	93	92	87	68	35	25	18		n/p	SM	Silty Sand
O-3	2.23	2.87	0.64	90	86	85	85	85	84	84	84	84	83	80	63	32	11	6	5		n/p	SP-SM	Poorly Graded Sand With Silt And
O-3	**0.00**	**2.87**	**2.87**	**98**	**97**	**96**	**95**	**95**	**94**	**94**	**94**	**94**	**93**	**92**	**86**	**69**	**44**	**28**	**18**			**SM**	**Silty Sand**
O-4	0.00	1.22	1.22	82	80	79	78	78	77	77	76	74	71	59	37	25	16	11	7		n/p	SP-SM	Poorly Graded Sand With Silt And
O-4	1.22	2.50	1.28	97	96	94	92	91	90	88	87	85	81	64	22	5	3	2	2		n/p	SP	Poorly Graded Sand
O-4	**0.00**	**2.50**	**2.50**	**90**	**88**	**87**	**85**	**85**	**84**	**83**	**82**	**80**	**76**	**62**	**29**	**15**	**9**	**6**	**4**			**SP**	**Poorly Graded Sand With Silt**
O-5	0.00	0.61	0.61	100	100	100	100	100	100	100	100	100	100	100	99	95	70	40	23			SM	Silty Sand
O-5	0.61	1.37	0.76	100	99	99	99	98	98	98	98	97	97	95	91	81	59	39	24			SM	Silty Sand
O-5	1.37	2.44	1.07	95	94	94	94	94	94	94	94	94	94	92	84	55	16	7	5		n/p	SP-SM	Poorly Graded Sand With Silt
O-5	2.44	3.35	0.91	100	100	100	100	100	100	100	100	99	98	92	67	33	11	6	4		n/p	SP-SM	Poorly Graded Sand With Silt
O-5	**0.00**	**3.35**	**3.35**	**98**	**98**	**98**	**98**	**98**	**98**	**98**	**98**	**97**	**97**	**94**	**84**	**62**	**34**	**20**	**12**			**SM**	**Silty Sand**
O-6	0.00	1.22	1.22	100	100	100	100	100	100	100	100	98	91	62	21	8	5	4	3		n/p	SP	Poorly Graded Sand
O-6	1.22	2.44	1.22	100	100	100	100	100	100	100	98	91	78	45	13	5	3	3	2		n/p	SP	Poorly Graded Sand
O-6	2.44	3.51	1.07	100	100	100	100	100	100	98	93	83	70	40	12	4	3	3	2		n/p	SP	Poorly Graded Sand
O-6	3.51	4.33	0.82	100	100	94	79	69	59	50	45	41	36	21	6	2	2	1	1		n/p	SP	Poorly Graded Sand
O-6	**0.00**	**4.33**	**4.33**	**100**	**100**	**99**	**96**	**94**	**92**	**90**	**87**	**81**	**72**	**44**	**14**	**5**	**3**	**3**	**2**			**SP**	**Poorly Graded Sand**
O-7	0.00	0.76	0.76	100	100	100	100	100	100	100	99	99	99	94	83	77	60	35	22			SM	Silty Sand
O-7	0.76	2.10	1.34	89	87	86	85	85	85	85	85	84	83	56	14	5	3	2	2		n/p	SP	Poorly Graded Sand
O-7	**0.00**	**2.10**	**2.10**	**93**	**92**	**91**	**90**	**90**	**90**	**90**	**90**	**89**	**89**	**70**	**39**	**31**	**24**	**14**	**9**			**SM**	**Silty Sand**
O-8	0.00	0.82	0.82	100	100	100	99	99	98	98	97	96	91	70	46	39	30	19	12		n/p	SM	Silty Sand
O-8	0.82	1.83	1.01	95	94	93	92	92	91	91	91	89	81	40	10	4	3	2	2		n/p	SP	Poorly Graded Sand
O-8	1.83	3.11	1.28	99	98	98	97	97	97	96	95	92	82	46	20	11	9	8	8		n/p	SP-SM	Poorly Graded Sand With Silt
O-8	3.11	3.75	0.64	100	100	100	100	100	100	100	100	99	94	61	20	6	2	2	2		n/p	SP	Poorly Graded Sand
O-8	**0.00**	**3.75**	**3.75**	**98**	**98**	**97**	**97**	**97**	**96**	**96**	**95**	**93**	**86**	**52**	**23**	**14**	**11**	**8**	**6**			**SP**	**Poorly Graded Sand With Silt**
O-9	0.00	0.76	0.76	100	100	100	100	100	99	99	99	98	97	87	64	55	47	31	20			SM	Silty Sand
O-9	0.76	2.13	1.37	100	99	99	99	99	98	98	98	97	94	65	21	8	6	5	4		n/p	SP-SM	Poorly Graded Sand With Silt
O-9	2.13	3.35	1.22	100	100	100	100	100	99	99	98	96	87	45	13	6	5	4	4		n/p	SP	Poorly Graded Sand
O-9	3.35	4.57	1.22	100	100	100	99	99	97	96	93	87	75	40	13	6	4	4	3		n/p	SP	Poorly Graded Sand
O-9	**0.00**	**4.57**	**4.57**	**100**	**100**	**100**	**99**	**99**	**98**	**98**	**97**	**94**	**88**	**57**	**24**	**15**	**12**	**9**	**6**			**SP**	**Poorly Graded Sand With Silt**
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.36*	*0.3*	*0.2*	*0.13*	*0.09*	*0.075*	0.063				

(ASTM - D 2487) Beach Classification

Table 6 (2 of 3): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
USACE VIBRACORE HOLES (AUGUST, 2003)

HOLE NO.	DEPTH (METERS) TOP	DEPTH (METERS) BOT	THICKNESS (METERS)	BEACH SAND GRADATIONS ---SAND (sieve no.)--- 3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	Fines 200	ATTERBERG LIMITS 230	LL	PI	CLASSIFICATION	
O-10	0.00	0.61	0.61	100	100	100	100	99	98	98	97	97	97	91	76	68	55	38	28			SM	Silty Sand
O-10	0.61	2.29	1.68	97	96	95	95	95	94	94	94	94	92	67	24	7	3	2	2		n/p	SP	Poorly Graded Sand
O-10	**0.00**	**2.29**	**2.29**	**98**	**97**	**96**	**96**	**96**	**95**	**95**	**95**	**95**	**93**	**73**	**38**	**23**	**17**	**12**	**9**			**SP**	**Poorly Graded Sand With Silt**
O-11	0.00	0.52	0.52	100	99	98	97	95	94	93	92	89	78	47	27	22	18	13	8		n/p	SM	Silty Sand
O-11	0.52	1.80	1.28	100	93	93	93	92	92	92	90	84	67	31	8	3	2	2	2		n/p	SP	Poorly Graded Sand
O-11	1.80	3.66	1.86	100	99	99	99	99	99	98	98	98	95	70	28	12	5	4	3		n/p	SP	Poorly Graded Sand
O-11	**0.00**	**3.66**	**3.66**	**100**	**97**	**97**	**97**	**96**	**96**	**95**	**94**	**92**	**83**	**53**	**21**	**10**	**6**	**5**	**3**			**SP-SM**	**Poorly Graded Sand With Silt**
O-12	0.00	0.61	0.61	98	98	97	96	96	95	95	94	93	93	91	88	83	61	37	24		n/p	SM	Silty Sand
O-12	0.61	1.83	1.22	98	90	85	81	78	75	72	69	64	57	36	10	3	2	2	2		n/p	SP	Poorly Graded Sand With Gravel
O-12	1.83	3.20	1.37	76	68	63	59	57	55	53	51	47	42	28	10	5	3	3	3		n/p	SP	Poorly Graded Sand With Gravel
O-12	**0.00**	**3.20**	**3.20**	**89**	**82**	**78**	**74**	**72**	**70**	**68**	**66**	**62**	**57**	**43**	**25**	**19**	**14**	**9**	**7**			**SP-SM**	**Poorly Graded Sand With Silt An**
O-13	0.00	0.82	0.82	100	100	99	99	98	98	97	97	96	96	92	80	74	57	35	23			SM	Silty Sand
O-13	0.82	2.53	1.71	100	97	96	95	95	95	95	95	94	91	62	15	4	2	2	2		n/p	SP	Poorly Graded Sand
O-13	2.53	3.96	1.43	100	100	100	100	100	100	100	100	100	100	99	95	90	82	74	62			ML	Silt With Sand
O-13	**0.00**	**3.96**	**3.96**	**100**	**99**	**98**	**98**	**97**	**97**	**97**	**97**	**97**	**95**	**82**	**57**	**50**	**42**	**35**	**28**			**SM**	**Silty Sand**
O-14	0.00	0.52	0.52	100	100	99	99	98	97	97	96	95	93	85	58	43	34	25	18		n/p	SM	Silty Sand
O-14	0.52	1.31	0.79	83	80	78	77	76	75	75	74	74	72	64	26	9	4	3	3		n/p	SP	Poorly Graded Sand With Gravel
O-14	1.31	2.74	1.43	100	99	99	99	99	99	99	99	99	98	98	77	49	31	25	22			SM	Silty Sand
O-14	2.74	3.32	0.58	100	100	100	100	100	100	100	100	99	97	93	84	71	52	41	33			SM	Silty Sand
O-14	**0.00**	**3.32**	**3.32**	**96**	**95**	**94**	**94**	**94**	**93**	**93**	**93**	**92**	**91**	**87**	**63**	**42**	**29**	**23**	**19**			**SM**	**Silty Sand**
O-15	0.00	0.31	0.31	100	100	100	100	100	99	99	99	98	98	95	87	80	69	54	40			ML	Sandy Silt
O-15	0.31	1.52	1.22	100	100	99	99	99	98	98	98	98	98	86	32	10	3	2	2		n/p	SP	Poorly Graded Sand
O-15	1.52	3.05	1.53	100	100	100	100	100	100	99	99	97	93	72	27	8	3	2	2		n/p	SP	Poorly Graded Sand
O-15	3.05	4.27	1.22	100	100	99	99	99	99	98	98	95	89	71	53	43	36	32	28			SM	Silty Sand
O-15	**0.00**	**4.27**	**4.27**	**100**	**100**	**99**	**99**	**99**	**99**	**98**	**98**	**97**	**94**	**77**	**40**	**24**	**17**	**14**	**12**			**SM**	**Silty Sand**
O-16	0.00	1.16	1.16	92	87	82	80	78	77	77	76	76	75	66	28	11	6	5	4		n/p	SP-SM	Poorly Graded Sand With Silt and (
O-16	1.16	1.89	0.73	98	97	95	94	94	94	94	93	93	93	84	38	12	5	3	3			SP	Poorly Graded Sand
O-16	1.89	3.05	1.16	100	100	100	100	100	100	100	100	100	99	88	30	8	3	2	2			SP	Poorly Graded Sand
O-16	3.05	3.35	0.30	100	100	100	100	100	100	100	100	100	99	93	72	63	58	55	50			SM	Sandy Silt
O-16	**0.00**	**3.35**	**3.35**	**97**	**95**	**93**	**92**	**91**	**91**	**91**	**90**	**90**	**89**	**80**	**35**	**15**	**9**	**8**	**7**			**SP-SM**	**Poorly Graded Sand With Silt**
O-17	0.00	1.07	1.07	100	98	96	95	95	94	93	93	92	91	86	66	51	38	25	16		n/p	SM	Silty Sand
O-17	1.07	2.10	1.04	100	100	100	100	100	100	100	100	99	98	78	33	10	3	2	2		n/p	SP	Poorly Graded Sand
O-17	2.10	2.84	0.73	100	100	100	100	100	100	100	100	100	99	97	86	46	18	11	8		n/p	SP-SM	Poorly Graded Sand With Silt
O-17	2.84	3.84	1.01	100	100	100	100	100	100	100	99	99	97	87	56	24	9	5	4		n/p	SP-SM	Poorly Graded Sand With Silt
O-17	**0.00**	**3.84**	**3.84**	**100**	**99**	**99**	**99**	**99**	**98**	**98**	**98**	**97**	**96**	**86**	**58**	**32**	**17**	**11**	**8**			**SP-SM**	**Poorly Graded Sand With Silt**
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.36*	*0.3*	*0.2*	*0.13*	*0.09*	*0.075*	0.063				

(ASTM - D 2487) Beach Classification

Table 6 (3 of 3): SAN CLEMENTE SHORELINE PROJECT - Borrow Area No.2
USACE VIBRACORE HOLES (AUGUST, 2003)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS ---SAND (sieve no.)---														Fines	ATTERBERG LIMITS		CLASSIFICATION	
NO.	TOP	BOT		3/4	3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	LL	PI		
O-18	0.00	0.67	0.67	91	85	80	78	77	76	76	75	75	74	66	37	26	21	17	13		n/p	SM	Silty Sand With Gravel
O-18	0.67	2.29	1.62	100	100	100	100	100	100	100	100	100	98	78	27	8	3	2	2		n/p	SP	Poorly Graded Sand
O-18	2.29	2.96	0.67	100	100	100	100	100	100	100	100	100	100	98	87	49	19	13	11		n/p	SM	Silty Sand
O-18	2.96	4.57	1.61	100	100	100	100	100	100	100	100	100	99	98	94	75	39	29	27			SM	Silty Sand
O-18	**0.00**	**4.57**	**4.57**	**99**	**98**	**97**	**97**	**97**	**96**	**96**	**96**	**96**	**95**	**86**	**61**	**40**	**21**	**15**	**14**			**SM**	**Silty Sand**
O-19	0.00	0.70	0.70	89	83	81	80	79	77	77	76	75	73	65	52	46	36	25	18		n/p	SM	Silty Sand With Gravel
O-19	0.70	2.26	1.56	95	94	93	93	92	92	92	92	91	87	61	20	5	2	1	1		n/p	SP	Poorly Graded Sand
O-19	**0.00**	**2.26**	**2.26**	**93**	**91**	**89**	**89**	**88**	**87**	**87**	**87**	**86**	**83**	**62**	**30**	**18**	**13**	**8**	**6**			**SP**	**Poorly Graded Sand With Silt**
O-20	0.00	0.85	0.85	100	99	96	94	93	90	89	88	86	85	79	57	40	30	22	16		n/p	SM	Silty Sand
O-20	0.85	2.38	1.52	100	100	100	100	100	100	100	100	99	98	81	35	10	3	2	2		n/p	SP	Poorly Graded Sand
O-20	2.38	3.90	1.52	100	100	100	100	100	100	100	99	99	96	72	24	7	4	2	2		n/p	SP	Poorly Graded Sand
O-20	**0.00**	**3.90**	**3.90**	**100**	**100**	**99**	**99**	**98**	**98**	**98**	**97**	**96**	**94**	**77**	**36**	**15**	**9**	**6**	**5**			**SP**	**Poorly Graded Sand With Silt**
O-21	0.00	0.91	0.91	93	89	87	86	85	84	84	83	82	80	68	50	40	24	15	10		n/p	SM	Silty Sand
O-21	0.91	2.44	1.53	100	100	99	99	99	98	98	98	96	90	57	18	5	3	2	2		n/p	SP	Poorly Graded Sand
O-21	**0.00**	**2.44**	**2.44**	**97**	**96**	**95**	**94**	**94**	**93**	**93**	**92**	**91**	**86**	**61**	**30**	**18**	**11**	**7**	**5**			**SP**	**Poorly Graded Sand With Silt**
O-22	0.00	0.70	0.70	100	97	96	95	94	94	93	92	91	88	81	71	65	48	28	18		n/p	SM	Silty Sand
O-22	0.70	1.80	1.10	100	100	100	100	100	100	100	100	99	96	62	15	4	2	2	2		n/p	SP	Poorly Graded Sand
O-22	1.80	2.90	1.10	91	85	82	79	78	76	74	72	69	63	40	11	4	3	2	2		n/p	SP	Poorly Graded Sand With Gravel
O-22	**0.00**	**2.90**	**2.90**	**97**	**94**	**92**	**91**	**90**	**89**	**88**	**87**	**86**	**82**	**58**	**27**	**19**	**13**	**8**	**6**			**SP**	**Poorly Graded Sand With Silt**
O-23	0.00	0.64	0.64	100	100	100	100	99	99	99	98	98	97	94	87	76	52	30	18		n/p	SM	Silty Sand
O-23	0.64	1.83	1.19	93	90	89	88	88	88	87	87	86	83	69	38	20	12	8	5		n/p	SP-SM	Poorly Graded Sand With Silt
O-23	1.83	2.87	1.04	96	95	94	93	93	92	92	91	89	84	61	19	5	3	2	2		n/p	SP	Poorly Graded Sand
O-23	2.87	3.14	0.28	100	100	100	99	99	98	97	97	95	92	77	57	45	34	30	28			SM	Silty Sand
O-23	**0.00**	**3.14**	**3.14**	**96**	**95**	**94**	**93**	**93**	**92**	**92**	**91**	**90**	**87**	**72**	**43**	**29**	**19**	**12**	**9**			**SP-SM**	**Poorly Graded Sand With Silt**
O-24	0.00	0.37	0.37	100	100	100	100	100	99	99	99	98	98	96	93	80	43	28	22			SM	Silty Sand
O-24	0.37	0.67	0.31	69	45	26	20	17	15	14	12	11	11	9	8	7	5	4	3		n/p	GP	Poorly Graded Gravel With Sand
O-24	0.67	1.37	0.70	77	65	59	55	53	51	49	47	44	40	27	10	4	3	2	2		n/p	SP	Poorly Graded Sand With Gravel
O-24	1.37	2.50	1.13	100	100	99	99	99	99	99	98	97	93	69	24	7	4	3	3		n/p	SP	Poorly Graded Sand
O-24	**0.00**	**2.50**	**2.50**	**90**	**83**	**79**	**77**	**76**	**75**	**75**	**73**	**72**	**69**	**54**	**28**	**17**	**10**	**7**	**6**			**SP-SM**	**Poorly Graded Sand With Silt An**
O-25	0.00	0.91	0.91	100	100	100	100	100	100	100	100	100	99	97	92	78	33	19	13		n/p	SM	Silty Sand
O-25	0.91	1.19	0.28	85	83	81	79	78	77	76	74	73	71	62	42	31	20	15	11		n/p	SM	Silty Sand With Gravel
O-25	1.19	2.84	1.65	100	100	100	100	100	100	100	100	100	99	89	41	23	19	18	18		n/p	SM	Silty Sand
O-25	**0.00**	**2.84**	**2.84**	**99**	**98**	**98**	**98**	**98**	**98**	**98**	**97**	**97**	**96**	**89**	**58**	**42**	**24**	**18**	**16**			**SM**	**Silty Sand**
O-26	0.00	0.55	0.55	100	100	100	99	99	98	97	97	96	94	87	74	65	47	31	20			SM	Silty Sand
O-26	0.55	0.88	0.34	88	63	52	48	46	45	44	44	43	42	27	9	4	3	3	2		n/p	SM	Poorly Graded Sand With Gravel
O-26	0.88	1.83	0.95	100	100	100	100	100	100	100	100	100	99	67	15	4	2	2	2		n/p	SM	Poorly Graded Sand
O-26	1.83	2.80	0.97	100	100	100	100	100	100	99	99	98	94	49	13	5	4	3	3		n/p	SM	Poorly Graded Sand
O-26	2.80	3.51	0.70	88	86	85	84	84	83	83	83	82	79	70	54	43	35	31	28			SM	Silty Sand With Gravel
O-26	**0.00**	**3.51**	**3.51**	**96**	**94**	**92**	**92**	**91**	**91**	**90**	**90**	**90**	**87**	**62**	**31**	**22**	**16**	**13**	**10**			**SM**	**Silty Sand**
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.36*	*0.3*	*0.2*	*0.13*	*0.09*	*0.075*	0.063				

(ASTM - D 2487) Beach Classification

Table 7. San Clemente Shoreline Project – Receiving Beach Transects Grain Size Data

		US Standard Sieve Sizes (mm)															
Reach/Transect	Elev. (m, MLLW)	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Reach 1																	
SC 1605	+4						100	98	91	67	33	7	1	1	1	1	1
	+2			100	99	96	89	75	52	28	12	3	1	1	1	1	1
	0	100	98	95	87	80	67	53	36	23	15	6	1	1	1	1	1
	-2					100	99	97	92	83	66	37	15	4	1	1	1
	-4				100	99	98	95	91	84	72	48	29	23	21	21	19
	-6									100	99	98	93	68	21	17	6
	-8	only recovery was a 4 cm gravel															
	-10						100	99	99	99	98	98	96	92	79	65	55
Reach 3																	
SC 1623	+6						100	99	94	76	44	10	2	1	1	1	1
	+4							100	99	94	76	21	3	1	1	1	1
	+2					100	99	94	83	66	44	12	1	1	1	1	1
	0			100	99	97	94	89	83	80	76	60	22	6	1	1	1
	-2		100	99	99	99	99	98	98	98	98	94	63	30	8	8	1
	-4		100	98	98	97	97	97	96	96	96	95	87	48	15	7	4
	-6									100	99	99	97	92	32	12	6
	-8					100	99	99	99	99	99	98	97	95	43	26	9
	-10											100	99	98	74	47	19
Reach 4																	
SC 1645	+6				100	99	98	95	83	57	31	8	1	1	1	1	1
	+4							100	97	84	54	13	2	1	1	1	1
	+2							100	99	92	75	31	6	1	1	1	1
	0									100	98	83	32	10	2	2	1
	-2									100	99	97	62	22	5	1	1
	-4		100	99	99	99	98	98	98	98	97	95	83	57	17	14	3
	-6	100	99	97	96	94	92	89	80	62	55	51	44	36	13	9	1
	-8		100	91	90	89	88	86	80	71	59	43	32	27	22	14	10
	-10								100	99	99	95	80	47	22	16	14
Reach 5																	
T - 2	+6					100	99	98	92	74	47	16	3	1	1	1	1
	+4							100	99	94	75	20	3	1	1	1	1
	+2								100	99	96	63	14	3	1	1	1
	0		100	99	99	99	98	98	95	92	87	70	27	10	3	1	1
	-2										100	96	60	23	6	2	2
	-4		100	99	98	98	97	97	97	96	96	94	84	54	14	10	2
	-6					100	99	98	97	94	92	88	80	63	22	16	4
	-8							100	99	98	97	95	93	91	54	21	10
	-10									100	99	99	98	97	90	67	38

Table 7(continued). San Clemente Shoreline Project – Receiving Beach Transects Grain Size Data

		US Standard Sieve Sizes (mm)															
Reach/Transect	Elev. (m, MLLW)	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Reach 6																	
M&N Linda Lane	+4				100	99	98	90	80	63	41	21	7	1	1	1	
	+2								100	99	96	84	34	8	3	1	
	0		100	99	97	96	95	93	92	90	87	84	53	27	9	2	
	-2				100	99	99	99	99	99	98	98	89	58	20	4	
	-4									100	99	99	94	65	26	10	
	-6										100	99	59	30	14	7	
	-8									100	99	99	98	71	32	16	
	-10			100	99	97	96	94	91	88	83	70	40	19	7	2	
T - 1	+6	98	96	94	93	92	89	85	78	67	51	21	5	2	1	1	1
	+4							100	99	94	78	31	6	2	1	1	1
	+2								100	99	98	78	19	5	1	1	1
	0										100	98	93	91	90	90	90
	-2									100	99	97	72	33	8	7	1
	-4									100	99	99	94	55	14	4	2
	-6								100	99	99	97	83	69	14	4	2
	-8								100	99	99	99	98	96	38	16	10
	-10										100	99	99	98	65	38	20
SC 1600	+6				100	99	98	95	88	72	47	19	5	1	1	1	1
	+4								100	98	89	37	6	1	1	1	1
	+2										100	95	39	13	2	2	1
	0					100	99	99	97	92	87	75	36	13	3	1	1
	-2										100	98	77	33	7	7	1
	-4							100	99	99	98	98	95	85	27	18	5
	-6				100	99	99	99	99	99	98	98	97	93	72	28	9
	-8							100	99	99	99	98	98	97	89	73	57
	-10									100	99	99	99	98	54	32	14
Reach 7																	
SC 1680	+4							100	97	89	73	33	6	2	1	1	1
	+2									100	99	86	15	4	1	1	1
	0					100	99	97	91	77	62	44	44	5	1	1	1
	-2										100	99	91	47	10	3	1
	-4										100	99	94	72	18	14	3
	-6										100	99	98	88	20	8	4
	-8								100	99	99	99	98	95	26	16	6
	-10									100	99	99	99	98	68	35	22

Table 7(continued). San Clemente Shoreline Project – Receiving Beach Transects Grain Size Data

		US Standard Sieve Sizes (mm)															
Reach/Transect	Elev. (m, MLLW)	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Reach 8																	
SC 1700	+6	100	95	91	86	81	72	60	40	22	11	5	2	1	1	1	1
	+4					100	99	97	88	67	36	8	1	1	1	1	1
	+2	100	96	82	63	56	51	44	31	14	6	1	1	1	1	1	1
	0	100	93	66	42	28	18	13	8	4	2	2	1	1	1	1	1
	-2									100	99	97	79	33	6	5	1
	-4										100	99	97	78	16	5	2
	-6								100	99	99	98	96	87	25	9	4
	-8										100	99	99	97	28	18	6
	-10								100	99	99	98	98	96	65	34	20
M&N North Beach	+4	100	99	99	96	94	90	80	66	48	24	6	3	2	1	1	
	+2	100	98	98	98	98	97	95	91	82	57	21	8	2	1	1	
	0				100	97	96	94	91	88	83	70	40	19	7	2	
	-2									100	99	99	90	59	21	5	
	-4						100	99	97	90	70	39	23	11	4	1	
	-6							100	99	98	96	93	89	62	27	12	
	-8											100	97	67	27	10	
	-10										100	99	99	77	47	34	

NOTES:

(1) Except for Moffatt and Nichol (M&N) data, all samples out to -2 m MLLW were surface grab samples collected by hand and samples from -4 m MLLW and deeper were collected using a petite ponar grab sampler. These samples were collected 25-27 July 2005.

(2) Some of the Moffatt and Nichol (M&N) data has been linearly interpolated to match the sieve sizes used by the Los Angeles District.

Table 8-a: SAN CLEMENTE SHORELINE PROJECT - BORROW SITE NO.2
USACE (2003) VIBRACORE HOLES (cut to 1m depth)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS																CLAS	
				GRAVEL(mms)		SAND (sieve no.)												FINES (sieve no)			
NO.	TOP	BOT		19.1	9.5	4	7	10	14	18	25	35	45	60	80	120	170	200	230		
O-1	0.00	1.00	1.00	100	100	100	100	100	99	99	99	99	99	96	92	88	69	40	25	SM	Silty Sand
O-2	0.00	1.00	1.00	82	79	76	75	75	75	74	74	73	71	48	15	6	4	3	2	SP	Poorly Grac
O-4	0.00	1.00	1.00	82	80	79	78	78	77	77	76	74	71	59	37	25	16	11	7	SP-SM	Poorly Grac
O-6	0.00	1.00	1.00	100	100	100	100	100	100	100	100	98	91	62	21	8	5	4	3	SP	Poorly Grac
O-7	0.00	1.00	1.00	97	97	97	96	96	96	96	96	95	95	85	66	60	46	27	17	SM	Silty Sand
O-8	0.00	1.00	1.00	99	99	99	98	98	97	97	96	95	89	65	40	33	25	16	10	SM	Silty Sand
O-9	0.00	1.00	1.00	100	100	100	100	100	99	99	99	98	96	82	54	44	37	25	16	SM	Silty Sand
O-10	0.00	1.00	1.00	99	98	98	98	97	96	96	96	96	95	82	56	44	35	24	18	SM	Silty Sand
O-11	0.00	1.00	1.00	100	96	96	95	94	93	93	91	87	73	39	18	13	10	8	5	SP-SM	Poorly Grac
O-12	0.00	1.00	1.00	98	95	92	90	89	87	86	84	82	79	70	58	52	38	23	15	SM	Silty Sand
O-15	0.00	1.00	1.00	100	100	99	99	99	98	98	98	98	98	89	49	31	23	18	14	SM	Silty Sand
O-16	0.00	1.00	1.00	92	87	82	80	78	77	77	76	76	75	66	28	11	6	5	4	SP-SM	Poorly Grac
O-17	0.00	1.00	1.00	100	98	96	95	95	94	93	93	92	91	86	66	51	38	25	16	SM	Silty Sand
O-18	0.00	1.00	1.00	94	90	87	85	85	84	84	83	83	82	70	34	20	15	12	9	SP-SM	Poorly Grac
O-19	0.00	1.00	1.00	91	86	85	84	83	82	82	81	80	77	64	42	34	26	18	13	SM	Silty Sand \
O-20	0.00	1.00	1.00	100	99	97	95	94	91	91	90	88	87	79	54	36	26	19	14	SM	Silty Sand
O-21	0.00	1.00	1.00	94	90	88	87	86	85	85	84	83	81	67	47	37	22	14	9	SM	Silty Sand
O-22	0.00	1.00	1.00	100	98	97	97	96	96	95	94	93	90	75	54	47	34	20	13	SM	Silty Sand
O-23	0.00	1.00	1.00	97	96	96	96	95	95	95	94	94	92	85	69	56	38	22	13	SM	Silty Sand
O-24	0.00	1.00	1.00	83	72	64	61	59	58	57	55	54	52	47	40	33	18	12	10	SP-SM	Poorly Grac
O-25	0.00	1.00	1.00	99	99	98	98	98	98	98	98	98	97	94	88	74	32	19	13	SM	Silty Sand
O-26	0.00	1.00	1.00	96	88	84	82	81	80	80	80	79	77	65	45	37	27	18	12	SM	Silty Sand
SO9-1	0.00	1.00	1.00	100	100	100	100	100	100	99	99	99	98	91	55	31	16	12	9	SP-SM	Poorly Grac
SO9-2	0.00	1.00	1.00	100	100	93	84	80	77	77	76	76	74	54	16	5	2	2	2	SP	Poorly Grac
SO9-3	0.00	1.00	1.00	100	100	100	100	100	99	99	99	98	94	44	12	5	3	3	2	SP	Poorly Grac
SO9-5	0.00	1.00	1.00	100	100	100	100	99	99	98	97	94	90	66	21	7	4	4	3	SP	Poorly Grac
SO9-7	0.00	1.00	1.00	100	100	100	100	100	99	99	98	97	93	62	28	17	13	10	7	SP-SM	Poorly Grac
SO9-8	0.00	1.00	1.00	100	100	100	100	100	100	100	99	93	77	45	17	7	5	4	4	SP	Poorly Grac
SO9-11	0.00	1.00	1.00	78	71	68	66	65	65	64	64	63	62	49	19	8	5	4	3	SP	Poorly Grac
SO9-13	0.00	1.00	1.00	99	94	92	92	92	92	91	91	91	89	58	16	7	4	4	2	SP	Poorly Grac
SO9-14	0.00	1.00	1.00	100	100	100	100	100	100	99	99	97	90	56	24	13	8	5	4	SP-SM	Poorly Grac
SO9-15A	0.00	1.00	1.00	91	88	86	86	86	86	86	86	85	84	70	31	15	10	10	8	SP-SM	Poorly Grac
SO9-18	0.00	1.00	1.00	100	100	100	99	99	99	98	97	96	92	75	35	16	5	3	2	SP	Poorly Grac
SO9-19	0.00	1.00	1.00	72	64	63	62	62	61	60	59	57	54	37	13	6	4	3	3	SP	Poorly Grac
SO9-20	0.00	1.00	1.00	100	100	100	100	100	99	99	99	99	98	88	33	11	4	3	2	SP	Poorly Grac
SO9-22	0.00	1.00	1.00	100	100	100	100	99	99	98	97	96	94	92	88	85	59	34	22	SM	Silty Sand
SO9-24	0.00	1.00	1.00	89	81	74	66	62	59	57	55	54	51	40	25	17	14	12	9	SP-SM	Poorly Grac
SO9-26	0.00	1.00	1.00	89	85	84	82	81	81	80	79	78	77	69	43	32	19	12	7	SP-SM	Poorly Grac
SO9-27	0.00	1.00	1.00	100	100	100	100	100	100	100	99	99	96	71	19	5	3	2	2	SP	Poorly Grac
SO9-28	0.00	1.00	1.00	86	81	79	79	78	78	78	78	78	77	73	55	32	20	18	17	SM	Silty Sand \
SO9-29	0.00	1.00	1.00	100	100	100	99	98	97	97	97	96	95	67	25	13	7	5	4	SP-SM	Poorly Grac
SO9-31	0.00	1.00	1.00	100	100	100	99	99	98	98	97	97	94	75	28	11	8	6	4	SP-SM	Poorly Grac
SO9-32	0.00	1.00	1.00	75	68	66	64	63	63	62	61	59	57	48	38	33	29	20	12	SM	Silty Sand \
SO9-33	0.00	1.00	1.00	86	81	80	79	79	78	78	78	77	77	68	26	9	4	3	2	SP	Poorly Grac
SO9-40	0.00	1.00	1.00	89	83	79	75	72	67	63	57	51	46	31	13	6	4	2	2	SP	Poorly Grac
SO9-41	0.00	1.00	1.00	100	100	100	99	98	96	95	93	90	86	66	28	12	4	1	1	SP	Poorly Grac
TOTAL			46.00	4357.0	4243.0	4174.0	4120.0	4088.0	4049.0	4027.0	3991.0	3935.0	3803.0	3070.0	1781.0	1243.0	844.0	565.0	391.0		
				94.7	92.2	90.7	89.6	88.9	88.0	87.5	86.8	85.5	82.7	66.7	38.7	27.0	18.3	12.3	8.5	SP-SM	Poorly Grac
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.355*	*0.25*	*0.18*	*0.125*	*0.09*	*0.075*	0.063		

(ASTM - D 2487) Beach Classification

Table 8-b: SAN CLEMENTE BEACH PROJECT - BORROW SITE NO.2
USACE (2003) VIBRACORE HOLES (cut to 2m depth)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS																CLAS.	
				GRAVEL(mms)		SAND (sieve no.)												FINES (sieve no)			
NO.	TOP	BOT		19.1	9.5	4	7	10	14	18	25	35	45	60	80	120	170	200	230		
O-2	0.00	2.00	2.00	89	87	85	84	84	84	83	83	82	81	66	43	26	15	10	6	SP-SM	Poorly Grac
O-4	0.00	2.00	2.00	88	86	85	83	83	82	81	80	78	75	61	31	17	11	7	5	SP-SM	Poorly Grac
O-6	0.00	2.00	2.00	100	100	100	100	100	100	100	99	95	86	55	18	7	4	4	3	SP	Poorly Grac
O-7	0.00	2.00	2.00	93	92	91	91	91	91	91	90	90	89	70	40	32	25	15	10	SM	Silty Sand
O-8	0.00	2.00	2.00	97	97	96	95	95	94	94	94	92	85	53	26	19	15	10	7	SP-SM	Poorly Grac
O-9	0.00	2.00	2.00	100	99	99	99	99	98	98	98	97	95	73	37	26	22	15	10	SM	Silty Sand
O-10	0.00	2.00	2.00	98	97	97	97	96	95	95	95	95	94	74	40	26	19	13	10	SM	Silty Sand
O-11	0.00	2.00	2.00	100	95	95	95	93	93	93	91	87	73	39	15	9	6	5	4	SP-SM	Poorly Grac
O-12	0.00	2.00	2.00	96	91	87	84	82	79	77	75	71	67	52	34	28	20	13	9	SM	Silty Sand
O-15	0.00	2.00	2.00	100	100	99	99	99	99	98	98	98	97	84	39	20	13	10	8	SP-SM	Poorly Grac
O-16	0.00	2.00	2.00	95	91	88	86	85	84	84	84	84	83	74	32	11	5	4	4	SP	Poorly Grac
O-17	0.00	2.00	2.00	100	99	98	97	97	97	96	96	95	94	82	51	32	22	14	9	SM	Silty Sand
O-18	0.00	2.00	2.00	97	95	93	93	92	92	92	92	92	90	74	30	14	9	7	6	SP-SM	Poorly Grac
O-19	0.00	2.00	2.00	93	90	89	88	87	87	87	86	85	82	62	31	19	14	9	7	SP-SM	Poorly Grac
O-20	0.00	2.00	2.00	100	100	98	97	97	96	95	95	93	92	80	44	23	15	11	8	SP-SM	Poorly Grac
O-21	0.00	2.00	2.00	97	95	94	93	93	92	92	91	90	85	62	33	21	13	8	6	SP-SM	Poorly Grac
O-22	0.00	2.00	2.00	99	97	97	96	96	95	95	94	93	90	66	34	25	18	11	8	SP-SM	Poorly Grac
O-23	0.00	2.00	2.00	95	94	93	92	92	92	91	91	90	88	76	52	37	24	15	9	SM	Silty Sand
O-24	0.00	2.00	2.00	87	79	74	72	71	69	69	67	66	63	50	29	19	11	7	6	SP-SM	Poorly Grac
O-25	0.00	2.00	2.00	98	98	97	97	97	97	97	96	96	95	89	64	49	26	18	15	SM	Silty Sand
O-26	0.00	2.00	2.00	98	94	92	91	91	90	90	90	89	88	64	30	21	15	10	7	SP-SM	Poorly Grac
SO9-1	0.00	2.00	2.00	100	100	100	100	100	100	99	99	99	98	91	55	31	16	12	9	SP-SM	Poorly Grac
SO9-2	0.00	2.00	2.00	93	89	83	76	73	71	71	70	70	68	49	15	5	2	2	2	SP	Poorly Grac
SO9-3	0.00	2.00	2.00	100	100	100	100	100	99	99	99	98	94	44	12	5	3	3	2	SP	Poorly Grac
SO9-5	0.00	2.00	2.00	100	100	100	100	99	99	98	97	94	90	66	21	7	4	4	3	SP	Poorly Grac
SO9-7	0.00	2.00	2.00	99	95	93	93	92	91	91	90	89	86	61	33	23	18	13	8	SM	Silty Sand
SO9-8	0.00	2.00	2.00	100	100	100	100	100	100	100	99	92	75	43	16	7	5	4	4	SP	Poorly Grac
SO9-11	0.00	2.00	2.00	89	86	83	82	81	81	80	79	79	76	60	24	10	5	5	4	SP-SM	Poorly Grac
SO9-13	0.00	2.00	2.00	99	96	95	94	94	94	94	94	93	91	61	16	6	3	3	2	SP	Poorly Grac
SO9-14	0.00	2.00	2.00	100	100	100	100	100	100	99	99	96	88	52	22	11	7	5	4	SP-SM	Poorly Grac
SO9-15A	0.00	2.00	2.00	95	94	93	93	93	93	93	93	92	91	74	29	12	7	7	6	SP-SM	Poorly Grac
SO9-18	0.00	2.00	2.00	100	100	100	99	99	99	98	97	96	92	75	35	16	5	3	2	SP	Poorly Grac
SO9-19	0.00	2.00	2.00	86	77	73	71	70	69	68	67	65	61	39	13	6	5	4	3	SP	Poorly Grac
SO9-20	0.00	2.00	2.00	100	100	100	100	100	99	99	99	99	98	88	33	11	4	3	2	SP	Poorly Grac
SO9-22	0.00	2.00	2.00	93	92	91	90	89	89	88	87	85	83	77	68	63	45	28	20	SM	Silty Sand
SO9-24	0.00	2.00	2.00	70	67	61	56	55	52	51	50	49	47	38	24	17	13	11	9	SP-SM	Poorly Grac
SO9-26	0.00	2.00	2.00	93	90	89	89	88	88	87	87	86	85	67	31	19	11	8	5	SP-SM	Poorly Grac
SO9-27	0.00	2.00	2.00	100	100	100	100	100	100	100	99	99	96	71	19	5	3	2	2	SP	Poorly Grac
SO9-28	0.00	2.00	2.00	93	91	90	89	89	89	89	89	89	88	86	66	30	14	11	10	SP-SM	Poorly Grac
SO9-29	0.00	2.00	2.00	100	100	100	99	98	97	97	97	96	95	67	25	13	7	5	4	SP-SM	Poorly Grac
SO9-31	0.00	2.00	2.00	100	100	100	99	99	98	98	97	97	94	76	30	11	7	5	4	SP-SM	Poorly Grac
SO9-32	0.00	2.00	2.00	88	84	83	82	82	81	80	80	78	72	48	28	20	16	12	8	SP-SM	Poorly Grac
SO9-33	0.00	2.00	2.00	93	91	90	90	89	89	89	89	88	87	74	30	11	4	3	3	SP	Poorly Grac
SO9-40	0.00	2.00	2.00	89	83	79	75	72	67	63	57	51	46	31	13	6	4	2	2	SP	Poorly Grac
SO9-41	0.00	2.00	2.00	100	98	97	96	95	93	92	90	87	83	63	27	11	4	1	1	SP	Poorly Grac
TOTAL			90.00	8600.0	8418.0	8294.0	8204.0	8154.0	8088.0	8042.0	7978.0	7850.0	7552.0	5814.0	2876.0	1674.0	1068.0	744.0	552.0		
				95.6	93.5	92.2	91.2	90.6	89.9	89.4	88.6	87.2	83.9	64.6	32.0	18.6	11.9	8.3	6.1	SP-SM	Poorly Grac
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	2	*1.4*	*1*	*0.71*	*0.5*	*0.355*	*0.25*	*0.18*	*0.125*	*0.09*	*0.075*	0.063		

(ASTM - D 2487) Beach Classification

Table 8-c: SAN CLEMENTE BEACH PROJECT - BORROW SITE NO.2
USACE (2003) VIBRACORE HOLES (cut to 3m depth)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS															CLAS.	
				GRAVEL(mms)		SAND (sieve no.)											FINES (sieve no)			
NO.	TOP	BOT		19.1	9.5	4	7	10	14	18	25	35	45	60	80	120	170	200	230	
O-2	0.00	3.00	3.00	88	86	84	83	83	82	82	81	80	78	67	49	31	16	10	7	SP-SM Poorly Grac
O-4	0.00	2.50	2.50	90	88	87	85	85	84	83	82	80	76	62	29	15	9	6	4	SP-SM Poorly Grac
O-6	0.00	3.00	3.00	100	100	100	100	100	100	100	98	92	82	51	16	6	4	3	2	SP Poorly Grac
O-8	0.00	3.00	3.00	98	97	97	96	96	95	95	94	92	84	51	24	16	13	9	7	SP-SM Poorly Grac
O-9	0.00	3.00	3.00	100	100	100	100	100	99	99	98	97	93	65	30	19	16	11	8	SP-SM Poorly Grac
O-11	0.00	3.00	3.00	100	96	96	96	95	95	95	94	90	80	49	19	10	6	5	3	SP-SM Poorly Grac
O-12	0.00	3.00	3.00	89	83	79	75	73	71	69	67	63	58	44	26	20	14	10	7	SP-SM Poorly Grac
O-15	0.00	3.00	3.00	100	100	100	100	100	99	99	99	98	96	80	35	16	10	7	6	SP-SM Poorly Grac
O-16	0.00	3.00	3.00	96	94	92	91	90	90	90	89	89	88	79	31	10	5	3	3	SP Poorly Grac
O-17	0.00	3.00	3.00	100	99	99	98	98	98	98	97	97	96	86	59	34	19	13	9	SM Silty Sand
O-18	0.00	3.00	3.00	98	97	96	95	95	95	95	94	94	93	80	44	22	11	8	7	SP Poorly Grac
O-20	0.00	3.00	3.00	100	100	99	98	98	97	97	96	95	94	79	39	18	11	8	6	SP Poorly Grac
O-21	0.00	2.44	2.44	97	96	95	94	94	93	93	92	91	86	61	30	18	11	7	5	SP Poorly Grac
O-22	0.00	2.90	2.90	97	94	92	91	90	89	88	87	86	82	58	27	19	13	8	6	SP Poorly Grac
O-23	0.00	3.00	3.00	96	94	94	93	93	92	92	91	90	87	72	43	28	18	12	8	SP-SM Poorly Grac
O-24	0.00	2.50	2.50	90	83	79	77	76	75	75	73	72	69	54	28	17	10	7	6	SP-SM Poorly Grac
O-25	0.00	2.84	2.84	99	98	98	98	98	98	98	97	97	96	89	58	42	24	18	16	SM Silty Sand
O-26	0.00	3.00	3.00	98	95	94	93	93	92	92	92	91	89	61	27	18	13	10	7	SP-SM Poorly Grac
SO9-1	0.00	3.00	3.00	100	99	97	97	97	97	96	96	96	95	86	47	26	14	10	8	SP-SM Poorly Grac
SO9-2	0.00	3.00	3.00	85	78	73	68	66	64	64	64	64	62	43	13	5	2	2	2	SP Poorly Grac
SO9-3	0.00	3.00	3.00	100	100	100	100	99	99	98	98	97	93	44	12	5	3	3	2	SP Poorly Grac
SO9-5	0.00	3.00	3.00	100	100	100	100	99	99	98	97	94	90	66	20	7	4	4	3	SP Poorly Grac
SO9-7	0.00	3.00	3.00	91	83	79	78	77	77	76	75	74	72	51	27	19	15	11	6	SP-SM Poorly Grac
SO9-8	0.00	3.00	3.00	100	100	100	100	100	100	100	97	88	68	38	14	6	4	3	3	SP Poorly Grac
SO9-11	0.00	3.00	3.00	93	90	88	87	86	86	85	84	84	81	64	25	10	6	5	4	SP-SM Poorly Grac
SO9-13	0.00	3.00	3.00	99	97	95	95	95	95	94	94	94	92	62	17	6	3	3	2	SP Poorly Grac
SO9-14	0.00	3.00	3.00	100	100	100	100	100	100	99	98	94	84	48	20	11	7	5	4	SP-SM Poorly Grac
SO9-15A	0.00	3.00	3.00	97	96	95	95	95	95	95	95	94	93	75	28	11	6	6	5	SP-SM Poorly Grac
SO9-18	0.00	3.00	3.00	98	98	98	97	97	96	96	94	92	87	70	31	13	4	3	2	SP Poorly Grac
SO9-19	0.00	3.00	3.00	86	77	72	69	68	67	66	65	63	59	38	12	6	4	3	3	SP Poorly Grac
SO9-20	0.00	3.00	3.00	99	99	98	98	98	97	97	97	97	96	86	37	14	5	3	2	SP Poorly Grac
SO9-22	0.00	3.00	3.00	94	93	92	91	91	90	89	87	82	77	65	51	44	32	20	14	SM Silty Sand
SO9-24	0.00	3.00	3.00	75	71	67	64	63	61	60	59	59	57	46	26	15	11	9	8	SP-SM Poorly Grac
SO9-26	0.00	3.00	3.00	95	94	93	93	92	92	92	91	91	90	70	28	15	9	6	4	SP-SM Poorly Grac
SO9-27	0.00	3.00	3.00	100	100	100	100	100	100	100	99	99	96	71	19	5	3	2	2	SP Poorly Grac
SO9-28	0.00	3.00	3.00	94	94	93	93	93	93	93	93	93	92	90	70	30	12	9	8	SP-SM Poorly Grac
SO9-29	0.00	3.00	3.00	95	95	95	94	93	92	92	92	91	90	65	24	12	6	4	4	SP Poorly Grac
SO9-31	0.00	3.00	3.00	94	91	90	89	89	88	88	88	87	86	72	30	11	6	4	3	SP Poorly Grac
SO9-32	0.00	3.00	3.00	92	89	89	88	88	88	87	86	84	77	49	25	15	12	9	6	SP-SM Poorly Grac
SO9-33	0.00	3.00	3.00	95	94	93	93	93	93	93	92	91	89	75	30	11	4	3	3	SP Poorly Grac
SO9-40	0.00	3.00	3.00	92	88	84	81	78	73	68	60	53	46	31	13	6	3	2	2	SP Poorly Grac
SO9-41	0.00	3.00	3.00	98	93	91	90	90	88	87	86	82	77	56	22	9	3	1	1	SP Poorly Grac
TOTAL			124.18	11854.1	11592.7	11427.9	11310.6	11254.2	11165.8	11103.4	10970.8	10759.9	10283.8	7834.8	3707.7	1978.3	1182.2	840.9	643.0	
				95.5	93.4	92.0	91.1	90.6	89.9	89.4	88.3	86.6	82.8	63.1	29.9	15.9	9.5	6.8	5.2	SP-SM Poorly Grac
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.355*	*0.25*	*0.18*	*0.125*	*0.09*	*0.075*	0.063	

(ASTM - D 2487) Beach Classification

Table 8-d: SAN CLEMENTE BEACH PROJECT - BORROW SITE NO.2
USACE (2003) VIBRACORE HOLES (cut to 4m depth)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS																CLAS.	
				GRAVEL(mms)		SAND (sieve no.)												FINES (sieve no)			
NO.	TOP	BOT		19.1	9.5	4	7	10	14	18	25	35	45	60	80	120	170	200	230		
O-2	0.00	3.48	3.48	86	84	82	80	80	79	78	76	76	74	63	46	29	15	9	6	SP-SM	Poorly Grac
O-6	0.00	4.00	4.00	100	100	99	97	96	95	93	91	85	75	46	14	5	3	3	2	SP	Poorly Grac
O-8	0.00	3.75	3.75	98	98	97	97	97	96	96	95	93	86	52	23	14	11	8	6	SP-SM	Poorly Grac
O-9	0.00	4.00	4.00	100	100	100	99	99	98	98	97	95	89	59	25	16	13	9	7	SP-SM	Poorly Grac
O-11	0.00	3.66	3.66	100	97	97	97	96	96	95	94	92	83	53	21	10	6	5	3	SP-SM	Poorly Grac
O-12	0.00	3.20	3.20	89	82	78	74	72	70	68	66	62	57	43	25	19	14	9	7	SP-SM	Poorly Grac
O-15	0.00	4.00	4.00	100	100	99	99	99	99	98	98	97	94	78	39	22	16	13	11	SM	Silty Sand
O-16	0.00	3.35	3.35	97	95	93	92	91	91	91	90	90	89	80	35	15	9	8	7	SP-SM	Poorly Grac
O-17	0.00	3.84	3.84	100	99	99	99	99	98	98	98	97	96	86	58	32	17	11	8	SP-SM	Poorly Grac
O-18	0.00	4.00	4.00	98	97	97	96	96	96	96	96	96	95	85	56	35	18	13	12	SM	Silty Sand
O-20	0.00	3.90	3.90	100	100	99	99	98	98	98	97	96	94	77	36	15	9	6	5	SP	Poorly Grac
O-26	0.00	3.51	3.51	96	94	92	92	91	91	90	90	90	87	62	31	22	16	13	10	SM	Silty Sand
SO9-1	0.00	4.00	4.00	100	99	98	97	97	97	96	96	96	95	82	41	21	11	9	7	SP-SM	Poorly Grac
SO9-3	0.00	4.00	4.00	100	100	99	98	98	97	97	97	96	92	43	12	5	3	3	3	SP	Poorly Grac
SO9-5	0.00	4.00	4.00	100	100	100	100	99	99	99	98	96	92	65	18	6	3	3	3	SP	Poorly Grac
SO9-7	0.00	3.96	3.96	92	85	82	81	80	80	79	78	78	75	51	25	16	12	9	5	SP-SM	Poorly Grac
SO9-8	0.00	4.00	4.00	100	100	100	99	97	95	94	91	81	62	34	13	5	3	3	3	SP	Poorly Grac
SO9-11	0.00	4.00	4.00	95	93	90	89	88	88	87	86	86	84	65	26	10	6	6	5	SP-SM	Poorly Grac
SO9-13	0.00	4.00	4.00	99	98	96	96	96	96	95	95	95	93	63	18	6	3	3	2	SP	Poorly Grac
SO9-14	0.00	3.96	3.96	100	100	100	100	99	98	96	94	89	79	45	19	10	6	5	4	SP-SM	Poorly Grac
SO9-15A	0.00	4.00	4.00	98	97	97	96	96	96	96	96	96	95	76	28	10	5	5	4	SP-SM	Poorly Grac
SO9-18	0.00	4.00	4.00	98	97	96	95	95	94	93	90	85	79	62	26	11	4	2	2	SP	Poorly Grac
SO9-19	0.00	3.66	3.66	84	74	70	67	66	65	64	63	61	58	37	12	6	4	3	3	SP	Poorly Grac
SO9-20	0.00	3.20	3.20	100	99	99	98	98	97	97	97	97	96	87	39	16	6	4	3	SP	Poorly Grac
SO9-22	0.00	4.00	4.00	95	95	94	93	93	92	91	88	82	75	59	43	35	24	16	11	SM	Silty Sand
SO9-24	0.00	3.96	3.96	81	78	75	73	71	70	70	68	67	65	51	25	14	9	8	7	SP-SM	Poorly Grac
SO9-26	0.00	3.96	3.96	95	92	90	89	89	88	88	88	87	86	66	26	13	8	6	4	SP-SM	Poorly Grac
SO9-27	0.00	4.00	4.00	100	100	99	99	99	99	99	98	98	95	70	19	5	3	2	2	SP	Poorly Grac
SO9-28	0.00	4.00	4.00	96	95	95	95	95	95	95	95	94	94	92	72	30	11	8	7	SP-SM	Poorly Grac
SO9-29	0.00	4.00	4.00	94	94	94	93	92	92	92	92	91	90	67	24	11	6	4	3	SP	Poorly Grac
SO9-31	0.00	4.00	4.00	95	93	92	91	91	91	91	90	90	88	74	30	11	5	4	3	SP	Poorly Grac
SO9-32	0.00	4.00	4.00	94	92	91	91	91	91	90	89	87	80	49	24	13	10	7	5	SP-SM	Poorly Grac
SO9-33	0.00	4.00	4.00	96	95	95	95	95	94	94	94	93	91	75	30	11	4	3	3	SP	Poorly Grac
SO9-40	0.00	4.00	4.00	94	91	87	85	82	78	73	65	56	46	29	12	5	3	2	2	SP	Poorly Grac
SO9-41	0.00	4.00	4.00	98	95	94	93	92	91	90	88	84	75	49	18	7	3	2	1	SP	Poorly Grac
TOTAL			135.39	13038.2	12813.0	12649.6	12532.5	12452.1	12363.9	12267.3	12107.9	11833.5	11248.2	8407.3	3889.3	1962.7	1147.3	861.2	677.3		
				96.3	94.6	93.4	92.6	92.0	91.3	90.6	89.4	87.4	83.1	62.1	28.7	14.5	8.5	6.4	5.0	SP-SM	Poorly Grac
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.355*	*0.25*	*0.18*	*0.125*	*0.09*	*0.075*	0.063		

(ASTM - D 2487) Beach Classification

Table 8-e: SAN CLEMENTE BEACH PROJECT - BORROW SITE NO.2
USACE (2003) VIBRACORE HOLES (cut to 5m depth)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS																CLAS	
				GRAVEL(mms)		SAND (sieve no.)												FINES (sieve no)			
NO.	TOP	BOT		19.1	9.5	4	7	10	14	18	25	35	45	60	80	120	170	200	230		
O-6	0.00	4.33	4.33	100	100	99	96	94	92	90	87	81	72	44	14	5	3	3	2	SP	Poorly Grac
O-9	0.00	4.57	4.57	100	100	100	99	99	98	98	97	94	88	57	24	15	12	9	6	SP	Poorly Grac
O-15	0.00	4.27	4.27	100	100	99	99	99	99	98	98	97	94	77	40	24	17	14	12	SM	Silty Sand
O-18	0.00	4.57	4.57	99	98	97	97	97	96	96	96	96	95	86	61	40	21	15	14	SM	Silty Sand
SO9-1	0.00	5.00	5.00	100	99	98	98	97	97	97	97	96	95	79	37	19	10	8	6	SP-SM	Poorly Grac
SO9-3	0.00	4.57	4.57	99	98	97	96	96	95	95	95	94	89	42	11	5	3	3	3	SP	Poorly Grac
SO9-5	0.00	5.00	5.00	100	100	100	100	99	99	99	98	97	93	64	17	5	3	3	2	SP	Poorly Grac
SO9-7	0.00	3.96	3.96	92	85	82	81	80	80	79	78	78	75	51	25	16	12	9	5	SP-SM	Poorly Grac
SO9-8	0.00	4.88	4.88	99	96	89	88	85	83	82	80	71	54	30	11	4	3	3	3	SP	Poorly Grac
SO9-11	0.00	5.00	5.00	96	94	92	91	90	90	89	88	88	85	67	26	10	6	6	5	SP-SM	Poorly Grac
SO9-13	0.00	4.57	4.57	100	98	97	96	96	96	96	96	95	93	63	18	6	3	3	2	SP	Poorly Grac
SO9-14	0.00	3.96	3.96	100	100	100	100	99	98	96	94	89	79	45	19	10	6	5	4	SP-SM	Poorly Grac
SO9-15A	0.00	5.00	5.00	98	98	97	97	97	97	97	97	96	95	76	28	10	5	5	4	SP-SM	Poorly Grac
SO9-18	0.00	5.00	5.00	97	96	95	94	94	93	92	89	84	77	57	23	9	4	2	2	SP	Poorly Grac
SO9-22	0.00	5.00	5.00	96	96	95	95	94	93	93	90	84	75	53	36	29	20	13	10	SP-SM	Poorly Grac
SO9-24	0.00	3.96	3.96	81	78	75	73	71	70	70	68	67	65	51	25	14	9	8	7	SP-SM	Poorly Grac
SO9-26	0.00	3.96	3.96	95	92	90	89	89	88	88	88	87	86	66	26	13	8	6	4	SP-SM	Poorly Grac
SO9-27	0.00	5.00	5.00	100	99	98	98	98	97	97	96	95	91	65	18	5	3	2	2	SP	Poorly Grac
SO9-28	0.00	5.00	5.00	97	96	96	96	96	96	96	96	96	95	94	74	30	10	7	6	SP-SM	Poorly Grac
SO9-29	0.00	5.00	5.00	95	95	95	94	94	93	93	93	93	92	71	24	10	5	4	3	SP	Poorly Grac
SO9-31	0.00	5.00	5.00	96	94	94	93	93	92	92	92	92	90	76	31	11	5	4	3	SP	Poorly Grac
SO9-32	0.00	5.00	5.00	95	94	93	93	93	93	92	91	89	81	49	23	11	8	6	5	SP-SM	Poorly Grac
SO9-33	0.00	5.00	5.00	97	96	96	96	95	95	95	94	94	91	75	30	11	4	3	3	SP	Poorly Grac
SO9-40	0.00	5.00	5.00	95	92	89	87	84	80	76	68	58	46	28	11	5	3	2	2	SP	Poorly Grac
SO9-41	0.00	4.88	4.88	99	96	95	94	94	92	92	90	84	74	45	16	7	3	2	2	SP	Poorly Grac
TOTAL			117.48	11412.4	11248.3	11100.3	11018.0	10938.9	10840.1	10775.4	10623.5	10334.5	9743.6	7132.2	3150.4	1514.3	861.7	670.2	542.8		
				97.1	95.7	94.5	93.8	93.1	92.3	91.7	90.4	88.0	82.9	60.7	26.8	12.9	7.3	5.7	4.6	SP-SM	Poorly Grac
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.355*	*0.25*	*0.18*	*0.125*	*0.09*	*0.075*	0.063		

(ASTM - D 2487) Beach Classification

Table 8-1: SAN CLEMENTE BEACH PROJECT - BORROW SITE NO.2
USACE (2003) VIBRACORE HOLES (cut to 6m depth)

HOLE	DEPTH (METERS)		THICKNESS (METERS)	BEACH SAND GRADATIONS																CLAS	
				GRAVEL(mms)		SAND (sieve no.)												FINES (sieve no)			
NO.	TOP	BOT		19.1	9.5	4	7	10	14	18	25	35	45	60	80	120	170	200	230		
SO9-1	0.00	5.58	5.58	100	100	99	98	98	98	97	97	97	95	79	36	18	9	7	6	SP-SM	Poorly Grac
SO9-5	0.00	6.00	6.00	100	100	100	100	100	100	99	99	97	94	63	16	5	3	3	2	SP	Poorly Grac
SO9-11	0.00	5.03	5.03	96	94	92	91	90	90	89	88	88	85	67	26	10	6	6	5	SP-SM	Poorly Grac
SO9-15A	0.00	5.79	5.79	98	98	98	98	98	98	98	98	97	96	77	28	10	5	5	4	SP-SM	Poorly Grac
SO9-18	0.00	6.00	6.00	98	96	95	94	94	93	92	89	85	77	55	22	9	3	2	2	SP	Poorly Grac
SO9-22	0.00	6.00	6.00	97	96	96	96	95	94	94	91	85	75	49	31	25	18	12	9	SP-SM	Poorly Grac
SO9-27	0.00	6.00	6.00	100	99	98	97	97	97	97	95	94	88	59	16	5	3	2	2	SP	Poorly Grac
SO9-28	0.00	5.79	5.79	98	97	96	96	96	96	96	96	96	96	94	74	29	9	7	5	SP-SM	Poorly Grac
SO9-29	0.00	5.64	5.64	96	96	96	95	95	94	94	94	94	92	72	25	10	5	4	3	SP	Poorly Grac
SO9-31	0.00	6.00	6.00	97	95	95	94	94	94	94	93	93	92	79	31	11	5	3	3	SP	Poorly Grac
SO9-32	0.00	6.00	6.00	96	95	94	94	94	94	93	93	90	82	49	22	11	7	6	5	SP-SM	Poorly Grac
SO9-33	0.00	6.00	6.00	95	93	92	91	90	90	90	89	88	86	71	28	10	4	3	3	SP	Poorly Grac
SO9-40	0.00	5.49	5.49	96	93	90	88	85	81	77	70	60	48	29	11	5	3	2	2	SP	Poorly Grac
TOTAL			75.32	7342.2	7255.9	7194.0	7142.8	7109.3	7069.7	7019.1	6915.6	6752.9	6415.7	4883.2	2119.6	916.4	464.1	358.3	294.6		
				97.5	96.3	95.5	94.8	94.4	93.9	93.2	91.8	89.7	85.2	64.8	28.1	12.2	6.2	4.8	3.9	SP-SM	Poorly Grac
Seive size (mm)				*19*	*9.5*	*4.75*	*2.8*	*2*	*1.4*	*1*	*0.71*	*0.5*	*0.355*	*0.25*	*0.18*	*0.125*	*0.09*	*0.075*	0.063		

(ASTM - D 2487) Beach Classification

Table 9-a. San Clemente (Reach 1) Gradation Envelope and Proposed Borrow Gradations.

	US Standard Sieve Sizes (mm)															
Dredge Area	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Fine Beach Limit - Reach 1									100	99	98	96	92	79	65	55
Borrow Area 2 to 1 m	95	92	91	90	89	88	88	87	86	83	67	39	27	18	12	9
Borrow Area 2 to 2 m	96	94	92	91	91	90	89	89	87	84	65	32	19	12	8	6
Borrow Area 2 to 3 m	95	93	92	91	91	90	89	88	87	83	63	30	16	10	7	5
Borrow Area 2 to 4 m	96	95	93	92	92	91	90	89	87	83	62	29	15	9	6	5
Borrow Area 2 to 5 m	97	96	94	94	93	92	92	90	88	83	60	27	13	7	6	5
Borrow Area 2 to 6 m	97	96	95	95	94	94	93	92	90	85	65	28	12	6	5	4
Coarse Beach Limit - Reach 1	100	98	95	87	80	67	53	36	23	12	3	1	1	1	1	1
Composite Beach Gradation - Reach 1		100	99	98	96	93	88	80	69	56	42	34	27	18	15	12

Table 9-b. San Clemente (Reach 3) Gradation Envelope and Proposed Borrow Gradations.

	US Standard Sieve Sizes (mm)														
Dredge Area	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Fine Beach Limit - Reach 3											100	99	98	74	47	19
Borrow Area 2 to 1 m	95	92	91	90	89	88	88	87	86	83	67	39	27	18	12	9
Borrow Area 2 to 2 m	96	94	92	91	91	90	89	89	87	84	65	32	19	12	8	6
Borrow Area 2 to 3 m	95	93	92	91	91	90	89	88	87	83	63	30	16	10	7	5
Borrow Area 2 to 4 m	96	95	93	92	92	91	90	89	87	83	62	29	15	9	6	5
Borrow Area 2 to 5 m	97	96	94	94	93	92	92	90	88	83	60	27	13	7	6	5
Borrow Area 2 to 6 m	97	96	95	95	94	94	93	92	90	85	65	28	12	6	5	4
Coarse Beach Limit - Reach 3		100	98	98	97	94	89	83	66	44	10	1	1	1	1	1
Composite Beach Gradation - Reach 3				100	99	99	97	95	90	81	65	52	41	20	12	5

Table 9-c. San Clemente (Reach 4) Gradation Envelope and Proposed Borrow Gradations.

	US Standard Sieve Sizes (mm)															
Dredge Area	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Fine Beach Limit - Reach 4									100	99	97	83	57	22	16	14
Borrow Area 2 to 1 m	95	92	91	90	89	88	88	87	86	83	67	39	27	18	12	9
Borrow Area 2 to 2 m	96	94	92	91	91	90	89	89	87	84	65	32	19	12	8	6
Borrow Area 2 to 3 m	95	93	92	91	91	90	89	88	87	83	63	30	16	10	7	5
Borrow Area 2 to 4 m	96	95	93	92	92	91	90	89	87	83	62	29	15	9	6	5
Borrow Area 2 to 5 m	97	96	94	94	93	92	92	90	88	83	60	27	13	7	6	5
Borrow Area 2 to 6 m	97	96	95	95	94	94	93	92	90	85	65	28	12	6	5	4
Coarse Beach Limit - Reach 4	100	99	91	90	89	88	86	80	57	31	8	1	1	1	1	1
Composite Beach Gradation - Reach 4		100	99	98	98	97	96	93	85	74	57	38	22	9	7	4

Table 9-d. San Clemente (Reach 5) Gradation Envelope and Proposed Borrow Gradations.

	US Standard Sieve Sizes (mm)															
Dredge Area	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Fine Beach Limit - Reach 5										100	99	98	97	90	67	38
Borrow Area 2 to 1 m	95	92	91	90	89	88	88	87	86	83	67	39	27	18	12	9
Borrow Area 2 to 2 m	96	94	92	91	91	90	89	89	87	84	65	32	19	12	8	6
Borrow Area 2 to 3 m	95	93	92	91	91	90	89	88	87	83	63	30	16	10	7	5
Borrow Area 2 to 4 m	96	95	93	92	92	91	90	89	87	83	62	29	15	9	6	5
Borrow Area 2 to 5 m	97	96	94	94	93	92	92	90	88	83	60	27	13	7	6	5
Borrow Area 2 to 6 m	97	96	95	95	94	94	93	92	90	85	65	28	12	6	5	4
Coarse Beach Limit - Reach 5		100	99	98	98	97	97	92	74	47	16	3	1	1	1	1
Composite Beach Gradation - Reach 5					100	99	99	98	94	88	71	51	38	21	13	7

Table 9-e. San Clemente (Reach 6) Gradation Envelope and Proposed Borrow Gradations.

	US Standard Sieve Sizes (mm)															
Dredge Area	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Fine Beach Limit - Reach 6										100	99	99	98	90	90	90
Borrow Area 2 to 1 m	95	92	91	90	89	88	88	87	86	83	67	39	27	18	12	9
Borrow Area 2 to 2 m	96	94	92	91	91	90	89	89	87	84	65	32	19	12	8	6
Borrow Area 2 to 3 m	95	93	92	91	91	90	89	88	87	83	63	30	16	10	7	5
Borrow Area 2 to 4 m	96	95	93	92	92	91	90	89	87	83	62	29	15	9	6	5
Borrow Area 2 to 5 m	97	96	94	94	93	92	92	90	88	83	60	27	13	7	6	5
Borrow Area 2 to 6 m	97	96	95	95	94	94	93	92	90	85	65	28	12	6	5	4
Coarse Beach Limit - Reach 6	98	96	94	93	92	89	85	78	63	41	19	5	1	1	1	1
Composite Beach Gradation - Reach 6				100	99	99	98	97	94	90	80	62	45	23	14	12

Table 9-f. San Clemente (Reach 7) Gradation Envelope and Proposed Borrow Gradations.

	US Standard Sieve Sizes (mm)															
Dredge Area	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Fine Beach Limit - Reach 7										100	99	99	98	68	35	22
Borrow Area 2 to 1 m	95	92	91	90	89	88	88	87	86	83	67	39	27	18	12	9
Borrow Area 2 to 2 m	96	94	92	91	91	90	89	89	87	84	65	32	19	12	8	6
Borrow Area 2 to 3 m	95	93	92	91	91	90	89	88	87	83	63	30	16	10	7	5
Borrow Area 2 to 4 m	96	95	93	92	92	91	90	89	87	83	62	29	15	9	6	5
Borrow Area 2 to 5 m	97	96	94	94	93	92	92	90	88	83	60	27	13	7	6	5
Borrow Area 2 to 6 m	97	96	95	95	94	94	93	92	90	85	65	28	12	6	5	4
Coarse Beach Limit - Reach 7					100	99	97	91	77	62	33	6	2	1	1	1
Composite Beach Gradation - Reach 7							100	99	96	92	82	68	51	18	10	5

Table 9-g. San Clemente (Reach 8) Gradation Envelope and Proposed Borrow Gradations.

	US Standard Sieve Sizes (mm)															
Dredge Area	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Fine Beach Limit - Reach 8											100	99	97	65	34	20
Borrow Area 2 to 1 m	95	92	91	90	89	88	88	87	86	83	67	39	27	18	12	9
Borrow Area 2 to 2 m	96	94	92	91	91	90	89	89	87	84	65	32	19	12	8	6
Borrow Area 2 to 3 m	95	93	92	91	91	90	89	88	87	83	63	30	16	10	7	5
Borrow Area 2 to 4 m	96	95	93	92	92	91	90	89	87	83	62	29	15	9	6	5
Borrow Area 2 to 5 m	97	96	94	94	93	92	92	90	88	83	60	27	13	7	6	5
Borrow Area 2 to 6 m	97	96	95	95	94	94	93	92	90	85	65	28	12	6	5	4
Coarse Beach Limit - Reach 8	100	93	66	42	28	18	13	8	4	2	1	1	1	1	1	1
Composite Beach Gradation - Reach 8	100	99	96	93	91	90	87	83	77	69	61	54	41	18	8	4

Table 9-h. San Clemente (Entire Project) Gradation Envelope and Proposed Borrow Gradations.

	US Standard Sieve Sizes (mm)															
Dredge Area	19.0 (3/4")	9.50 (3/8")	4.75 (#4)	2.80 (#7)	2.00 (#10)	1.40 (#14)	1.00 (#18)	0.710 (#25)	0.500 (#35)	0.355 (#45)	0.250 (#60)	0.180 (#80)	0.125 (#120)	0.090 (#170)	0.075 (#200)	0.063 (#230)
Fine Beach Limit - Entire Project											100	99	98	90	90	90
Borrow Area 2 to 1 m	95	92	91	90	89	88	88	87	86	83	67	39	27	18	12	9
Borrow Area 2 to 2 m	96	94	92	91	91	90	89	89	87	84	65	32	19	12	8	6
Borrow Area 2 to 3 m	95	93	92	91	91	90	89	88	87	83	63	30	16	10	7	5
Borrow Area 2 to 4 m	96	95	93	92	92	91	90	89	87	83	62	29	15	9	6	5
Borrow Area 2 to 5 m	97	96	94	94	93	92	92	90	88	83	60	27	13	7	6	5
Borrow Area 2 to 6 m	97	96	95	95	94	94	93	92	90	85	65	28	12	6	5	4
Coarse Beach Limit - Entire Project	98	93	66	42	28	18	13	8	4	2	1	1	1	1	1	1
Composite Beach Gradation - Entire Project		100	99	98	97	97	95	92	87	80	69	54	40	19	11	7

Table 10. San Clemente Shoreline Project - Typical Sediment Properties

	Median Grain Size , D_{50} (mm)	% Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
San Clemente Beach						
Reach 1	0.31 (0.06 - 0.95)	1 (0 - 5)	3 (0 - 15)	34 (1 - 76)	47 (18 - 82)	15 (1 - 65)
Reach 3	0.17 (0.08 - 0.40)	0 (0 - 2)	0 (0 - 3)	14 (0 - 45)	74 (53 - 90)	12 (1 - 47)
Reach 4	0.22 (0.12 - 0.46)	1 (0 - 9)	1 (0 - 3)	19 (1 - 55)	73 (43 - 98)	7 (1 - 16)
Reach 5	0.17 (0.07 - 0.37)	0 (0 - 1)	0 (0 - 1)	9 (0 - 40)	77 (32 - 98)	13 (1 - 67)
Reach 6	0.14 (<0.06 - 0.41)	0 (0 - 1)	0 (0 - 3)	7 (0 - 47)	78 (10 - 98)	14 (1 - 90)
Reach 7	0.12 (0.08 - 0.31)	0 (0 - 0)	0 (0 - 0)	7 (0 - 31)	84 (64 - 98)	10 (1 - 35)
Reach 8	0.16 (0.08 - 3.45)	4 (0 - 34)	5 (0 - 38)	18 (0 - 65)	65 (2 - 95)	8 (1 - 34)
Entire Project	0.17 (<0.06 - 3.45	1 (0 - 34)	1 (0 - 38)	14 (0 - 76)	72 (2 - 98)	11 (1 - 90)
Borrow Area 2						
to 1 m	0.21 (0.08 - 0.47)	4 (0 - 19)	2 (0 - 13)	5 (1 - 24)	72 (38 - 95)	12 (1 - 40)
to 2 m	0.22 (0.10 - 0.71)	3 (0 - 13)	2 (0 - 10)	5 (1 - 24)	77 (37 - 95)	8 (1 - 28)
to 3 m	0.22 (0.14 - 0.44)	3 (0 - 14)	1 (0 - 7)	6 (1 - 29)	78 (47 - 95)	7 (1 - 20)
to 4 m	0.22 (0.15 - 0.41)	3 (0 - 14)	1 (0 - 6)	7 (1 - 31)	79 (49 - 94)	6 (2 - 16)
to 5 m	0.23 (0.14 - 0.40)	3 (0 - 10)	1 (0 - 5)	8 (1 - 32)	79 (50 - 92)	6 (2 - 15)
to 6 m	0.22 (0.15 - 0.38)	2 (0 - 6)	1 (0 - 5)	7 (0 - 31)	82 (52 - 92)	5 (2 - 12)

NOTE: numbers in parentheses are the range of values (minimum - maximum)

Table 11. San Clemente Shoreline Project - Overfill Factors

Area	ϕ_{05}	ϕ_{16}	ϕ_{50}	ϕ_{84}	ϕ_{95}	σ_ϕ	M_ϕ	Sorting Ratio	Mean Difference	R_A
Reach 1 (n)	-0.85	0.23	1.69	3.64	4.84	1.80	1.85			
Borrow Area 2										
to 1 m depth (b)	-4.25	1.31	2.27	3.56	4.41	2.00	2.38	1.11	0.29	1.40
to 2 m depth (b)	-3.83	1.49	2.20	3.18	4.13	1.75	2.29	0.97	0.24	1.50
to 3 m depth (b)	-4.25	1.35	2.17	3.00	3.99	1.78	2.17	0.99	0.18	1.25
to 4 m depth (b)	-3.25	1.35	2.15	2.96	3.99	1.61	2.15	0.89	0.17	1.45
to 5 m depth (b)	-2.83	1.38	2.13	2.87	3.99	1.51	2.13	0.84	0.15	1.52
to 6 m depth (b)	-2.25	1.52	2.17	2.85	3.74	1.33	2.18	0.74	0.18	1.87
Reach 3 (n)	0.49	1.31	2.56	3.60	3.99	1.15	2.49			
Borrow Area 2										
to 1 m depth (b)								1.74	-0.10	1.25
to 2 m depth (b)								1.52	-0.17	1.16
to 3 m depth (b)				Same as Reach 1				1.55	-0.27	1.14
to 4 m depth (b)								1.39	-0.29	1.09
to 5 m depth (b)								1.31	-0.31	1.06
to 6 m depth (b)								1.15	-0.27	1.01
Reach 4 (n)	0.15	1.04	2.16	3.20	3.90	1.17	2.13			
Borrow Area 2										
to 1 m depth (b)								1.72	0.21	1.38
to 2 m depth (b)								1.50	0.14	1.28
to 3 m depth (b)				Same as Reach 1				1.53	0.04	1.25
to 4 m depth (b)								1.38	0.02	1.19
to 5 m depth (b)								1.29	0.00	1.14
to 6 m depth (b)								1.14	0.04	1.08
Reach 5 (n)	0.86	1.60	2.51	3.63	4.08	1.05	2.58			
Borrow Area 2										
to 1 m depth (b)								1.92	-0.19	1.26
to 2 m depth (b)								1.67	-0.28	1.18
to 3 m depth (b)				Same as Reach 1				1.71	-0.39	1.16
to 4 m depth (b)								1.54	-0.41	1.11
to 5 m depth (b)								1.44	-0.43	1.07
to 6 m depth (b)								1.27	-0.38	1.04
Reach 6 (n)	0.81	1.78	2.82	3.67	5.57	1.27	2.76			
Borrow Area 2										
to 1 m depth (b)								1.58	-0.30	1.14
to 2 m depth (b)								1.38	-0.37	1.08
to 3 m depth (b)				Same as Reach 1				1.41	-0.46	1.07
to 4 m depth (b)								1.27	-0.48	1.02
to 5 m depth (b)								1.19	-0.50	1.00
to 6 m depth (b)								1.05	-0.46	1.00
Reach 7 (n)	1.11	1.88	3.01	3.54	3.99	0.89	2.81			
Borrow Area 2										
to 1 m depth (b)								2.25	-0.48	1.25
to 2 m depth (b)								1.96	-0.58	1.17
to 3 m depth (b)				Same as Reach 1				2.00	-0.71	1.15
to 4 m depth (b)								1.80	-0.73	1.11
to 5 m depth (b)								1.69	-0.77	1.08
to 6 m depth (b)								1.49	-0.71	1.05

Table 11(continued). San Clemente Shoreline Project - Overfill Factors

Area	ϕ_{05}	ϕ_{16}	ϕ_{50}	ϕ_{84}	ϕ_{95}	σ_ϕ	M_ϕ	Sorting Ratio	Mean Difference	R_A
Reach 8 (n)	-2.04	0.35	2.62	3.47	3.92	1.77	2.15			
Borrow Area 2										
to 1 m depth (b)								1.13	0.13	1.19
to 2 m depth (b)								0.99	0.08	1.19
to 3 m depth (b)				Same as Reach 1				1.01	0.01	1.06
to 4 m depth (b)								0.91	0.00	1.08
to 5 m depth (b)								0.85	-0.01	1.18
to 6 m depth (b)								0.75	0.02	1.45
Entire Project	0.00	1.19	2.61	3.57	4.13	1.28	2.45			
Borrow Area 2										
to 1 m depth (b)								1.56	-0.06	1.21
to 2 m depth (b)								1.36	-0.13	1.12
to 3 m depth (b)				Same as Reach 1				1.39	-0.22	1.11
to 4 m depth (b)								1.25	-0.23	1.05
to 5 m depth (b)								1.18	-0.26	1.02
to 6 m depth (b)								1.04	-0.21	1.00

NOTES:

(1) The Overfill Factor, R_A, is determined in accordance with procedures in EM 1110-2-1100 (Part 5), Coastal Engineering Manual, Part V, pp. V-4-25 through V-4-26, based on Figure V-4-9 using the calculated sorting ratio and mean difference.

(2) Definitions of Symbols:
- (n) - native beach material (receiving beach)
- (b) - borrow material
- ϕ_{05} - 5th percentile (% retained) in phi units of the composite gradation
- ϕ_{16} - 16th percentile (% retained) in phi units of the composite gradation
- ϕ_{50} - 50th percentile (% retained) in phi units of the composite gradation
- ϕ_{84} - 84th percentile (% retained) in phi units of the composite gradation
- ϕ_{95} - 95th percentile (% retained) in phi units of the composite gradation
- σ_ϕ - standard deviation of the composite gradation
- M_ϕ - the phi mean diameter of the composite grain size distribution
- R_A - overfill factor

(3) Formulas:
- $M_\phi = (\phi_{16} + \phi_{50} + \phi_{84})/3$
- $\sigma_\phi = (\phi_{84} - \phi_{16})/4 + (\phi_{95} - \phi_{05})/6$
- sorting ratio = $\sigma_{\phi b} / \sigma_{\phi n}$
- mean difference = $(M_{\phi b} - M_{\phi n}) / \sigma_{\phi n}$

FIGURES

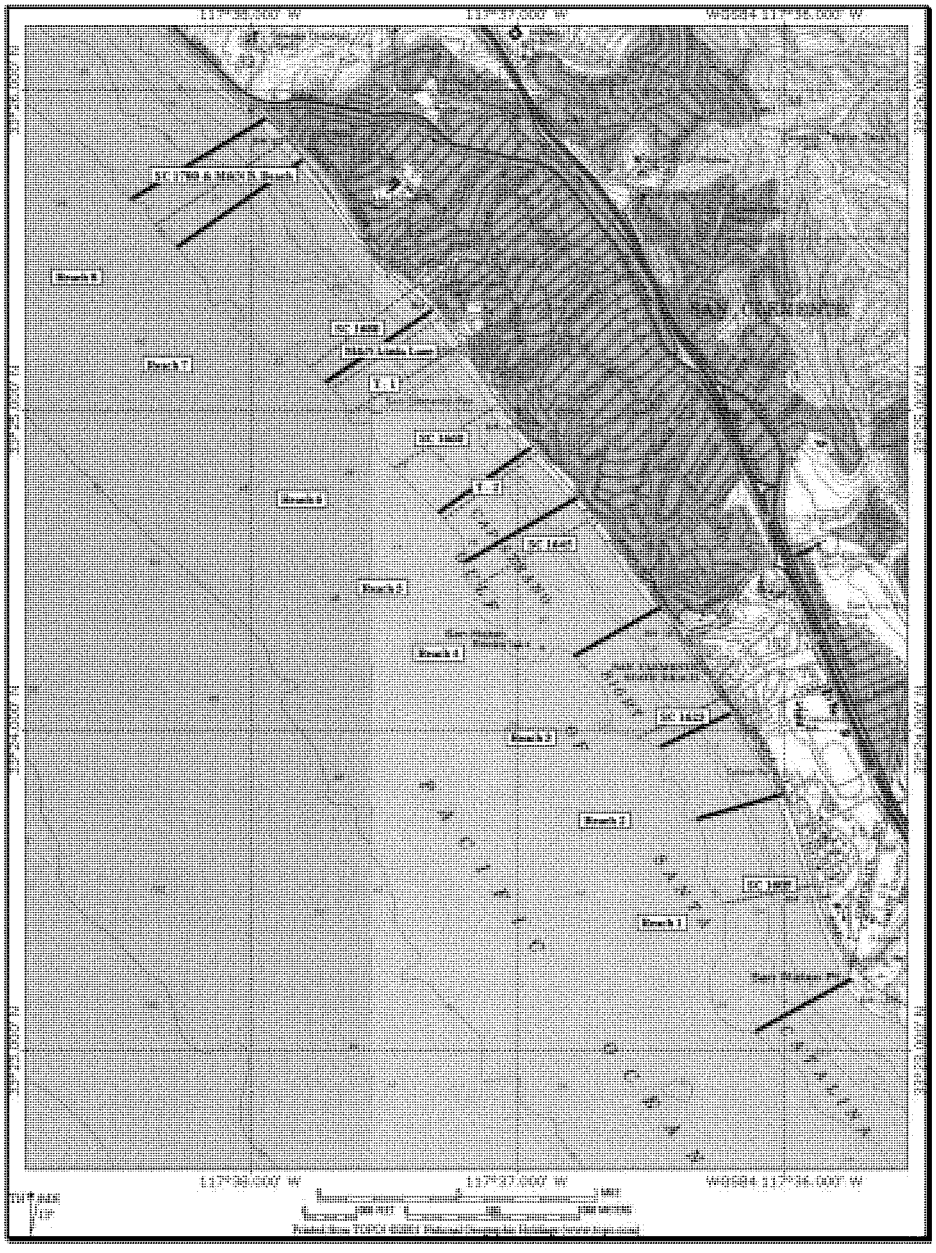
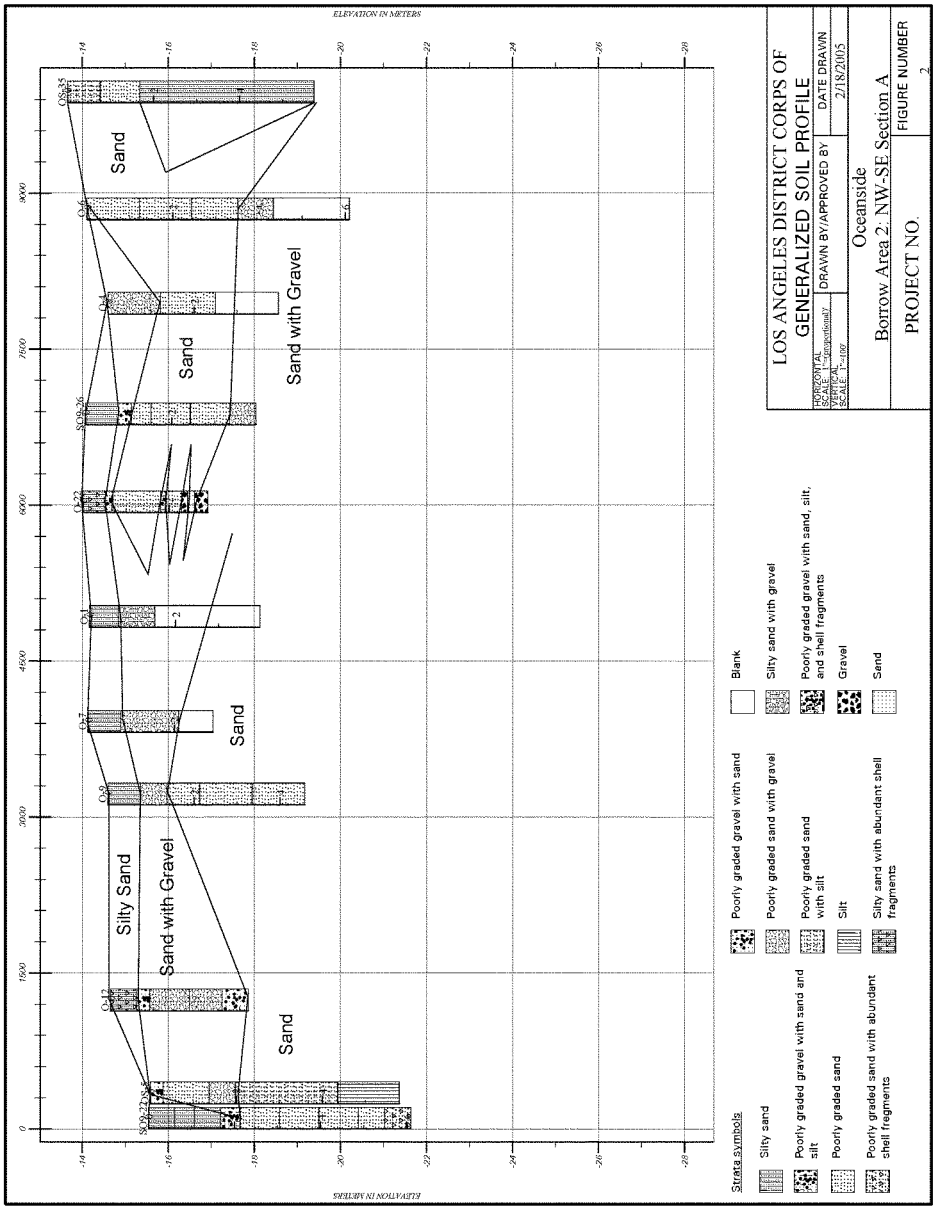
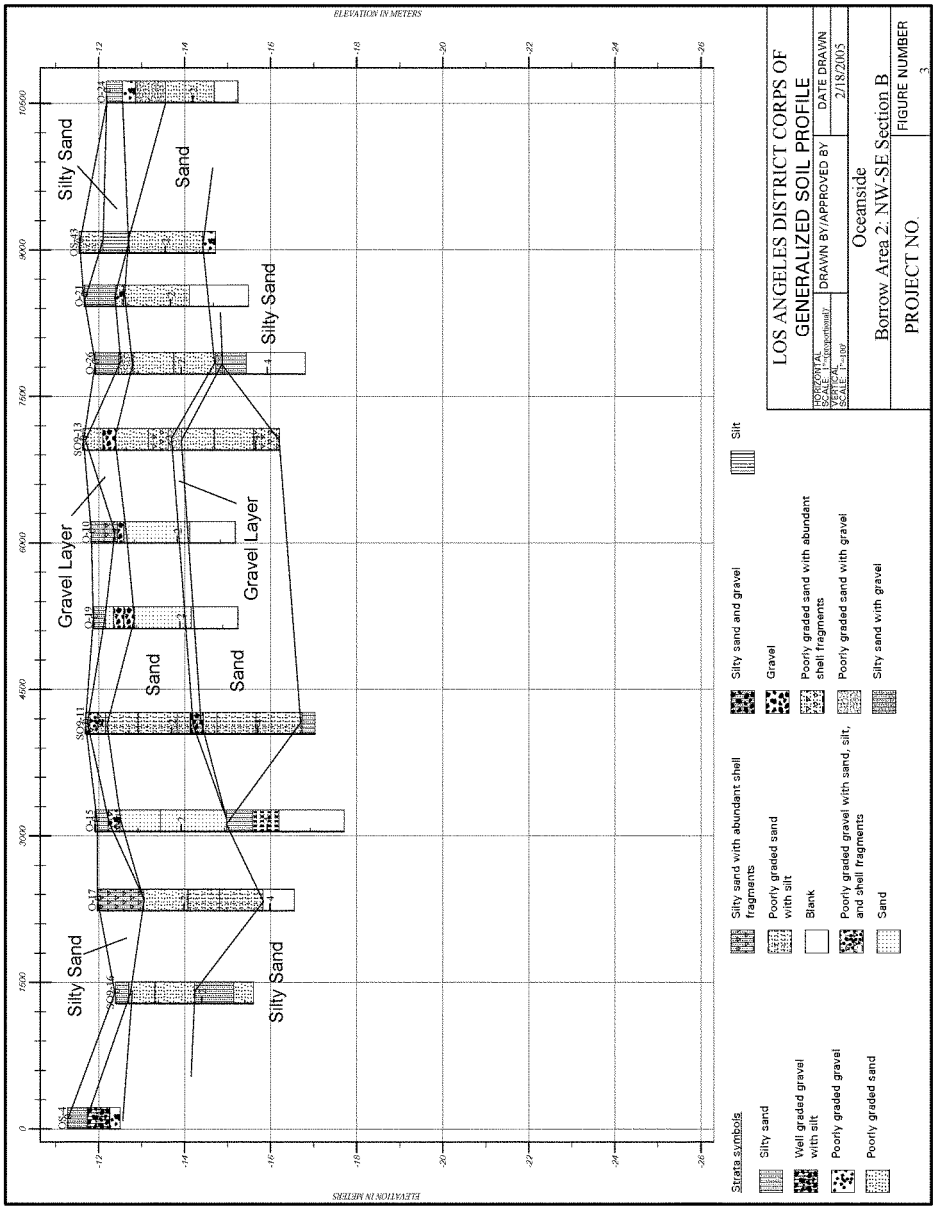
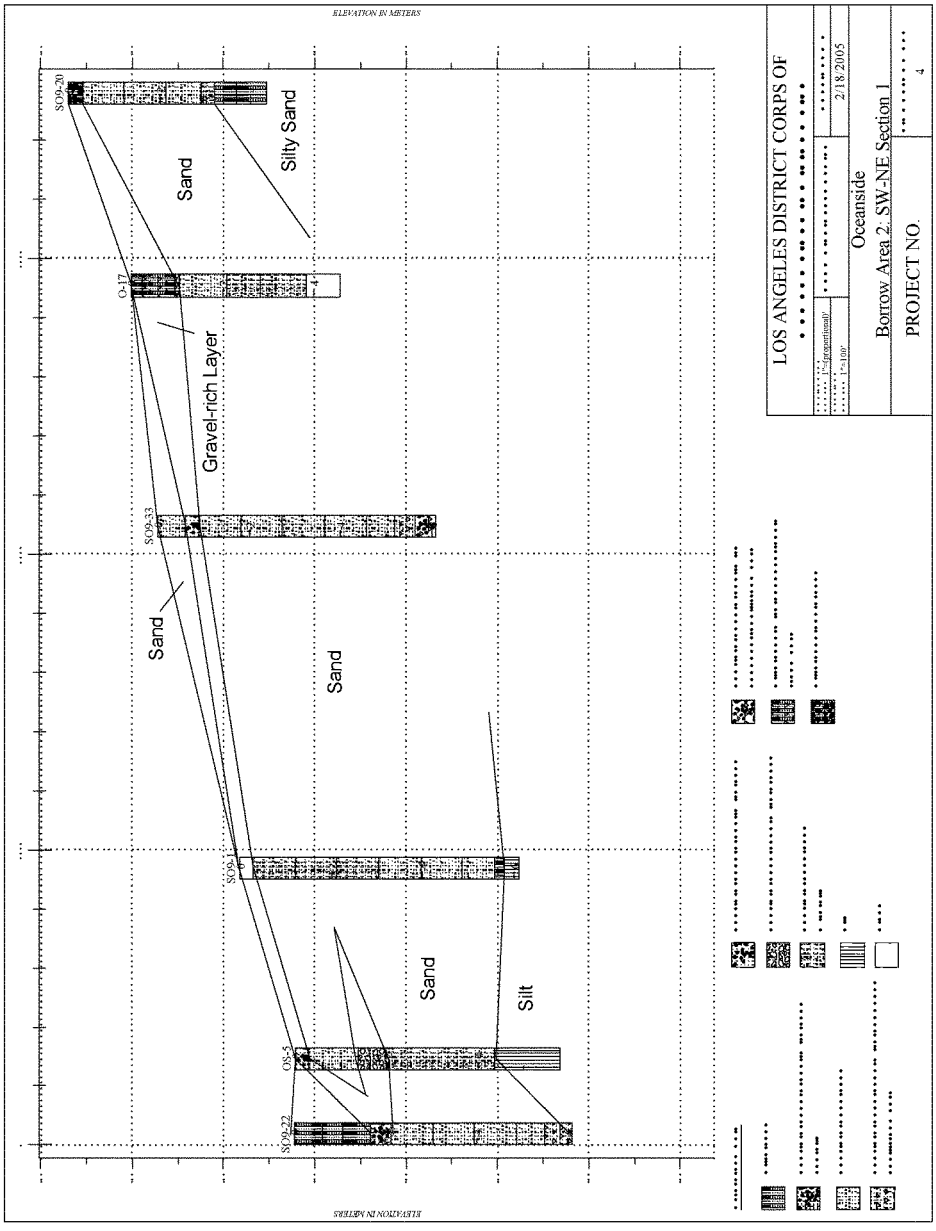
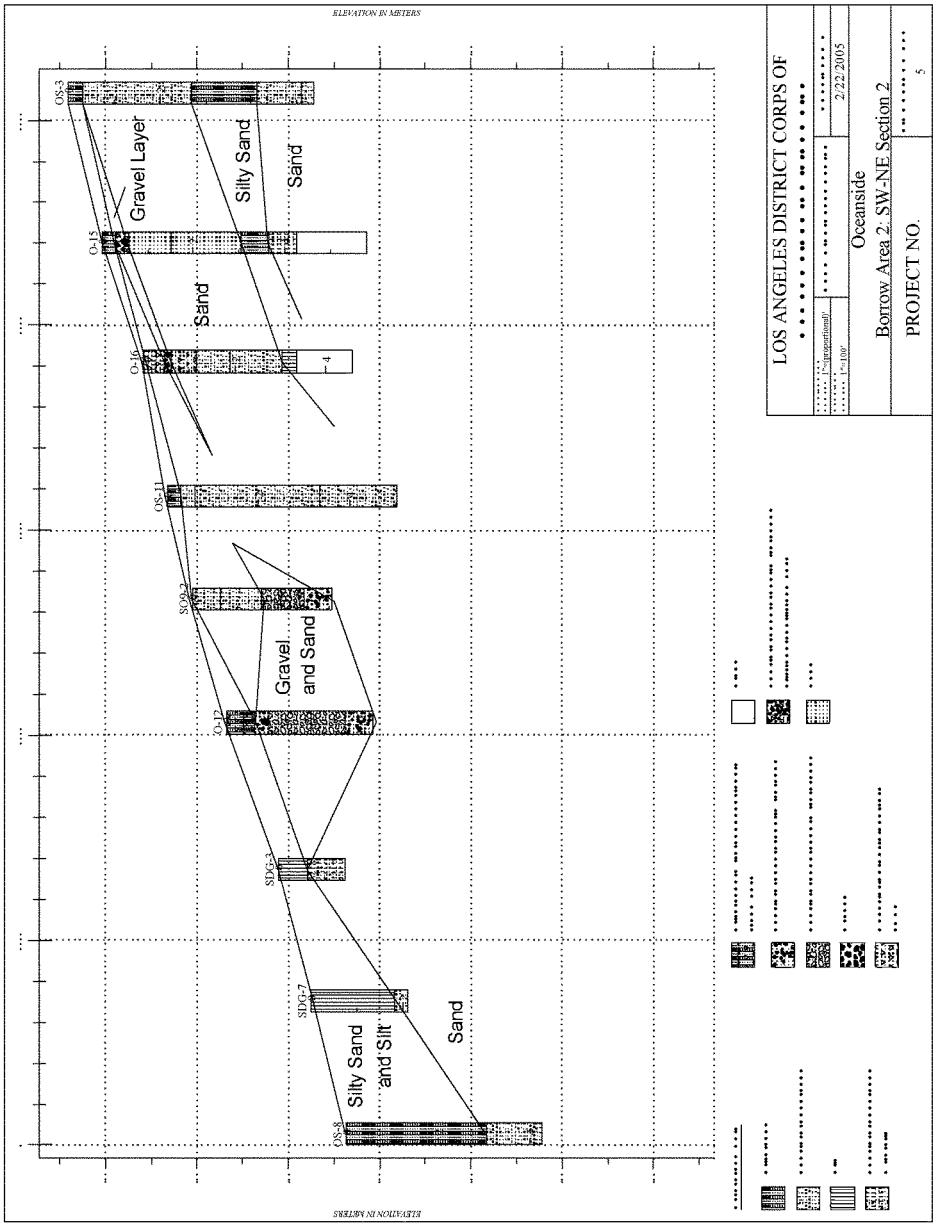


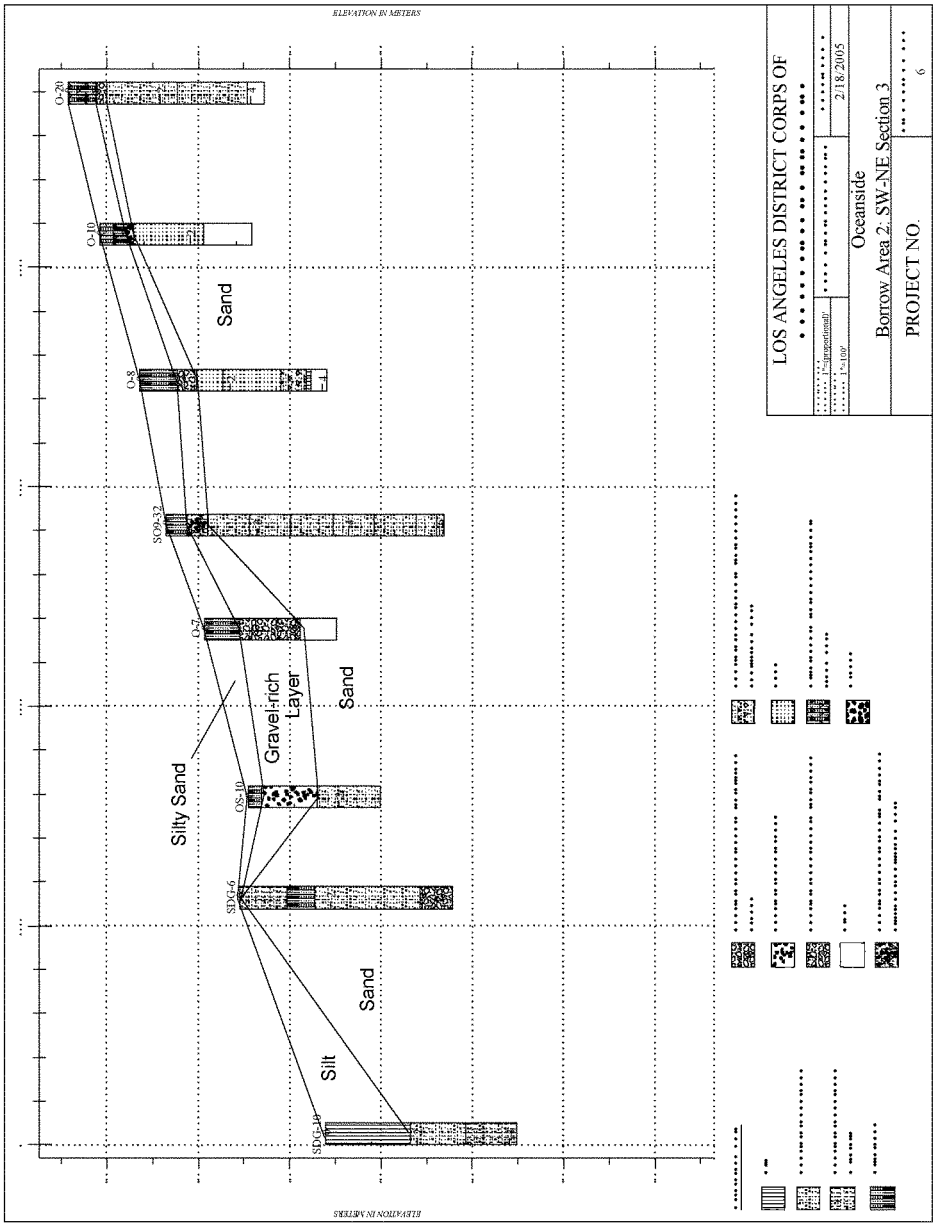
Figure 1. San Clemente Shoreline Study Area Map, showing locations of Reaches and Beach Transects.

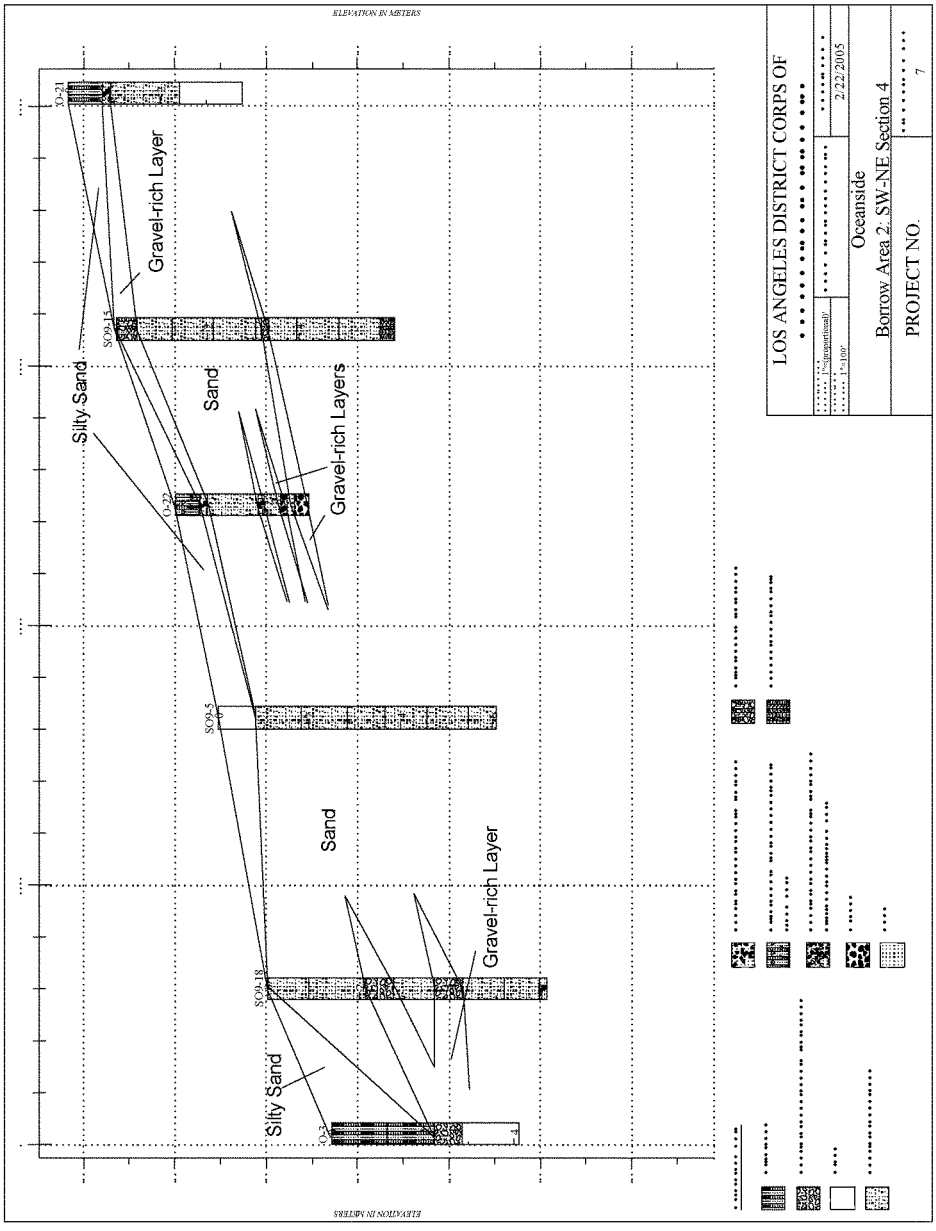

ELEVATION IN METERS
Sand
Silty Sand
Sand with Gravel
Sand
Sand
Sand with Gravel
Strata symbols
Silty sand
Poorly graded gravel with sand and silt
Poorly graded sand
Poorly graded sand with abundant shell fragments
Poorly graded gravel with sand
Poorly graded sand with gravel
Poorly graded sand with silt
Silt
Silty sand with abundant shell fragments
Blank
Silty sand with gravel
Poorly graded gravel with sand, silt, and shell fragments
Gravel
Sand
LOS ANGELES DISTRICT CORPS OF
GENERALIZED SOIL PROFILE
HORIZONTAL
SCALE: 1"=proportional?
VERTICAL
SCALE: 1"=100'
DRAWN BY/APPROVED BY
DATE DRAWN
2/18/2005
Oceanside
Borrow Area 2: NW-SE Section A
PROJECT NO.
FIGURE NUMBER
2

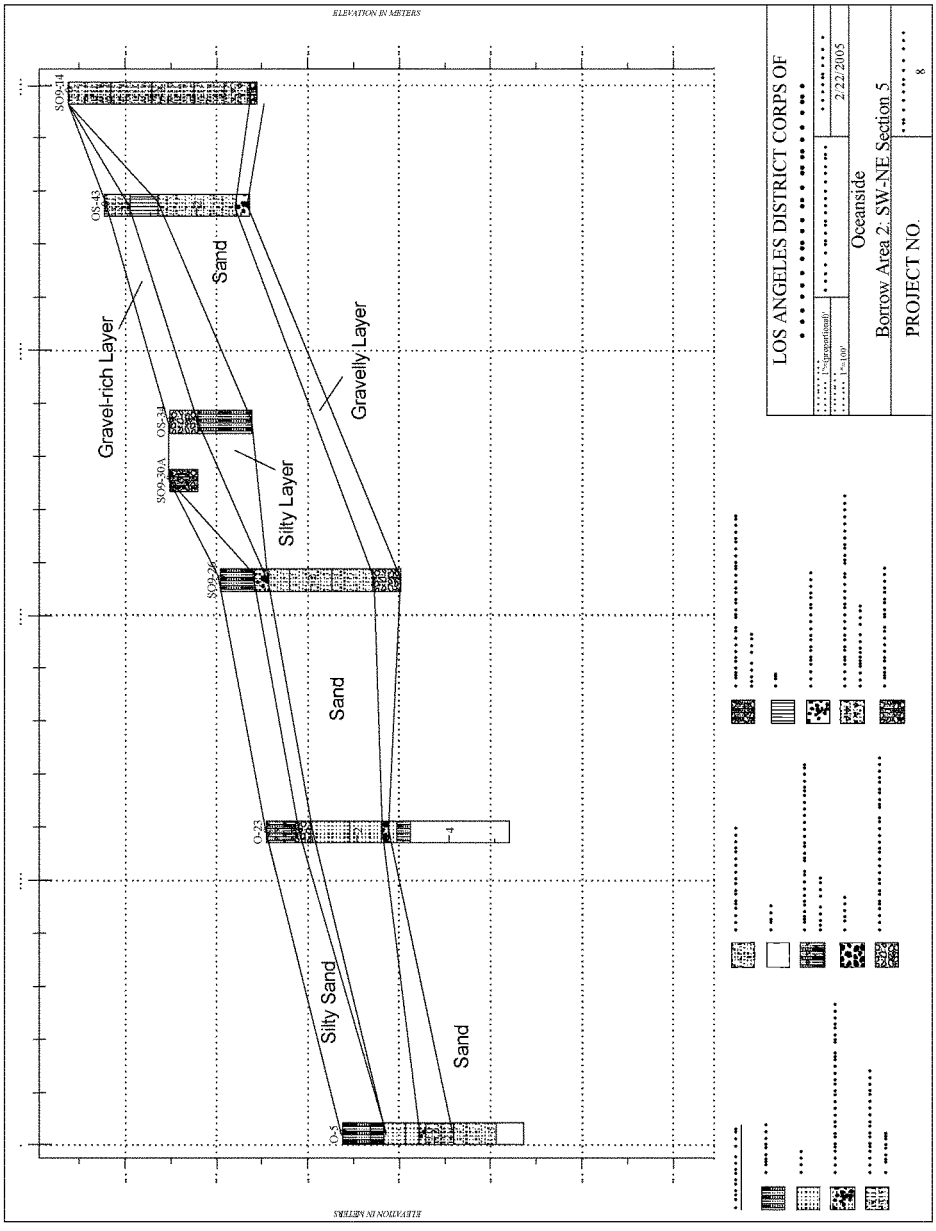

ELEVATION IN METERS
Silty Sand
Gravel Layer
Sand
Silty Sand
Sand
Silty Sand
Gravel Layer
Silty Sand
Strata symbols
Silty sand
Well graded gravel with silt
Poorly graded gravel
Poorly graded sand
Silty sand with abundant shell fragments
Poorly graded sand with silt
Blank
Poorly graded gravel with sand, silt, and shell fragments
Sand
Silty sand and gravel
Gravel
Poorly graded sand with abundant shell fragments
Poorly graded sand with gravel
Silty sand with gravel
Silt
LOS ANGELES DISTRICT CORPS OF
GENERALIZED SOIL PROFILE
HORIZONTAL
SCALE: 1"=100'(notnotional)
VERTICAL
SCALE: 1"=10'
DRAWN BY/APPROVED BY
DATE DRAWN
2/18/2005
Oceanside
Borrow Area 2: NW-SE Section B
PROJECT NO.
FIGURE NUMBER
3

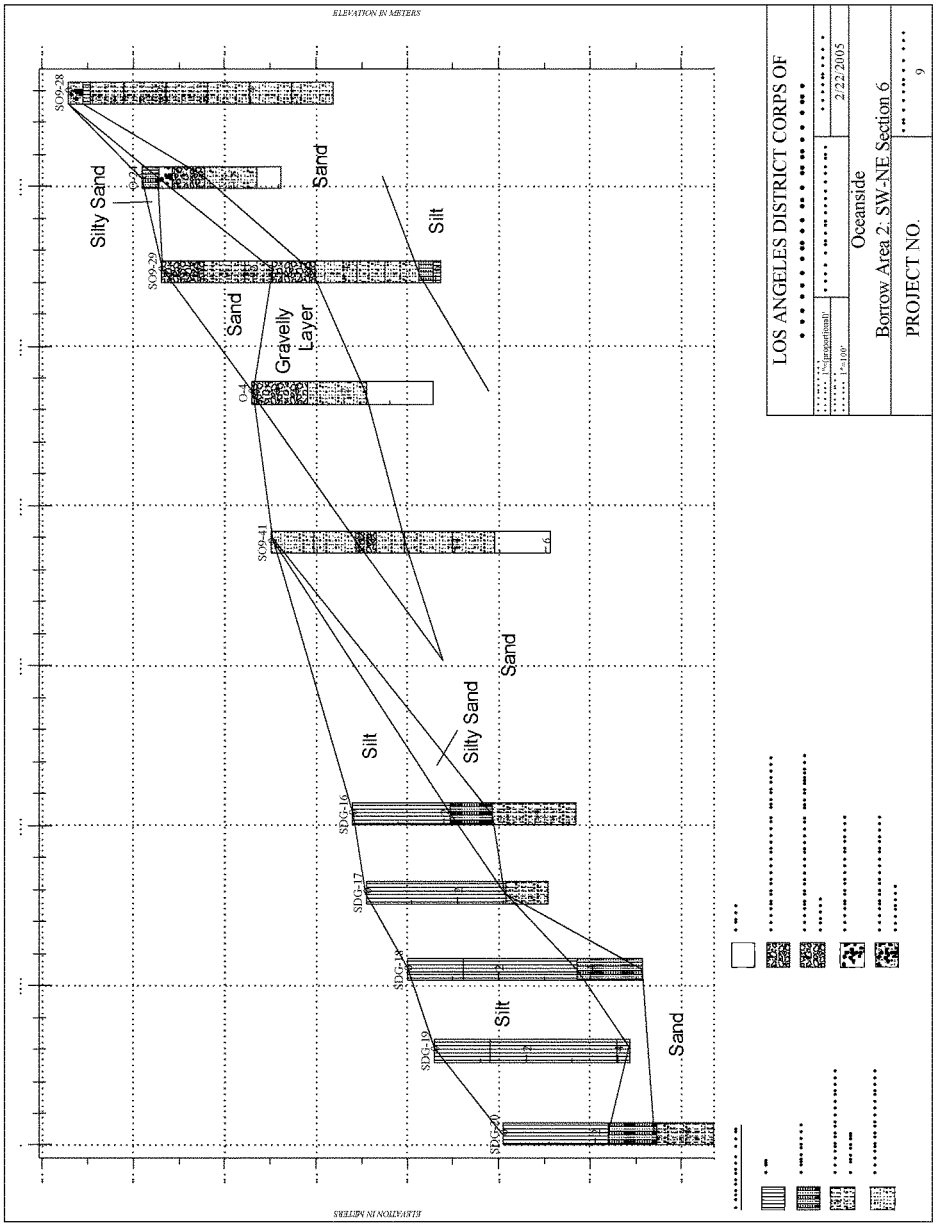

ELEVATION IN METERS
SO9-20
Silty Sand
Sand
OL17
Gravel-rich Layer
SO9-23
Sand
Sand
SO9-1
Sand
Silt
OS-5
SO9-22
ELEVATION IN METERS
LOS ANGELES DISTRICT CORPS OF
2/18/2005
Oceanside
Borrow Area 2: SW-NE Section 1
PROJECT NO.
4


ELEVATION IN METERS
OS-3
OS-15
OS-16
OS-11
SOQ-2
OQ-12
SDG-3
SDG-7
OS-8
Gravel Layer
Silty Sand
Sand
Sand
Gravel and Sand
Silty Sand and Silt
Sand
ELEVATION IN METERS
LOS ANGELES DISTRICT CORPS OF
Oceanside
Borrow Area 2: SW-NE Section 2
2/22/2005
PROJECT NO.
5


ELEVATION IN METERS
O-20
O-10
O-8
SOO-32
O-7
OS-10
SDG-6
SDG-10
Sand
Silty Sand
Gravel-rich Layer
Sand
Silt
Sand
LOS ANGELES DISTRICT CORPS OF
1"=proportional
1"=100'
2/18/2005
Oceanside
Borrow Area 2: SW-NE Section 3
PROJECT NO.
6


ELEVATION IN METERS
ELEVATION IN METERS
SO-21
SO9-15
SO-22
SO9-5
SO9-18
SO-3
Silty Sand
Gravel-rich Layer
Sand
Gravel-rich Layers
Sand
Gravel-rich Layer
Silty Sand
LOS ANGELES DISTRICT CORPS OF
1"=(proportional)"
1"= 100'
2/22/2005
Oceanside
Borrow Area 2: SW-NE Section 4
PROJECT NO.
7


ELEVATION IN METERS
SO9-14
OS-43
OS-34
SO9-30A
SO9-26
O-23
O-5
Gravel-rich Layer
Sand
Silty Layer
Gravelly Layer
Sand
Silty Sand
Sand
LOS ANGELES DISTRICT CORPS OF
Oceanside
Borrow Area 2: SW-NE Section 5
PROJECT NO.
2/22/2005
8


ELEVATION IN METERS
SOG-28
SOG-29
SOG-41
SDG-16
SDG-17
SDG-18
SDG-19
SDG-20
Silty Sand
Sand
Silt
Gravelly Layer
Silty Sand
Sand
Silt
Sand
LOS ANGELES DISTRICT CORPS OF
Oceanside
Borrow Area 2: SW-NE Section 6
2/22/2005
PROJECT NO.
9
ELEVATION IN METERS

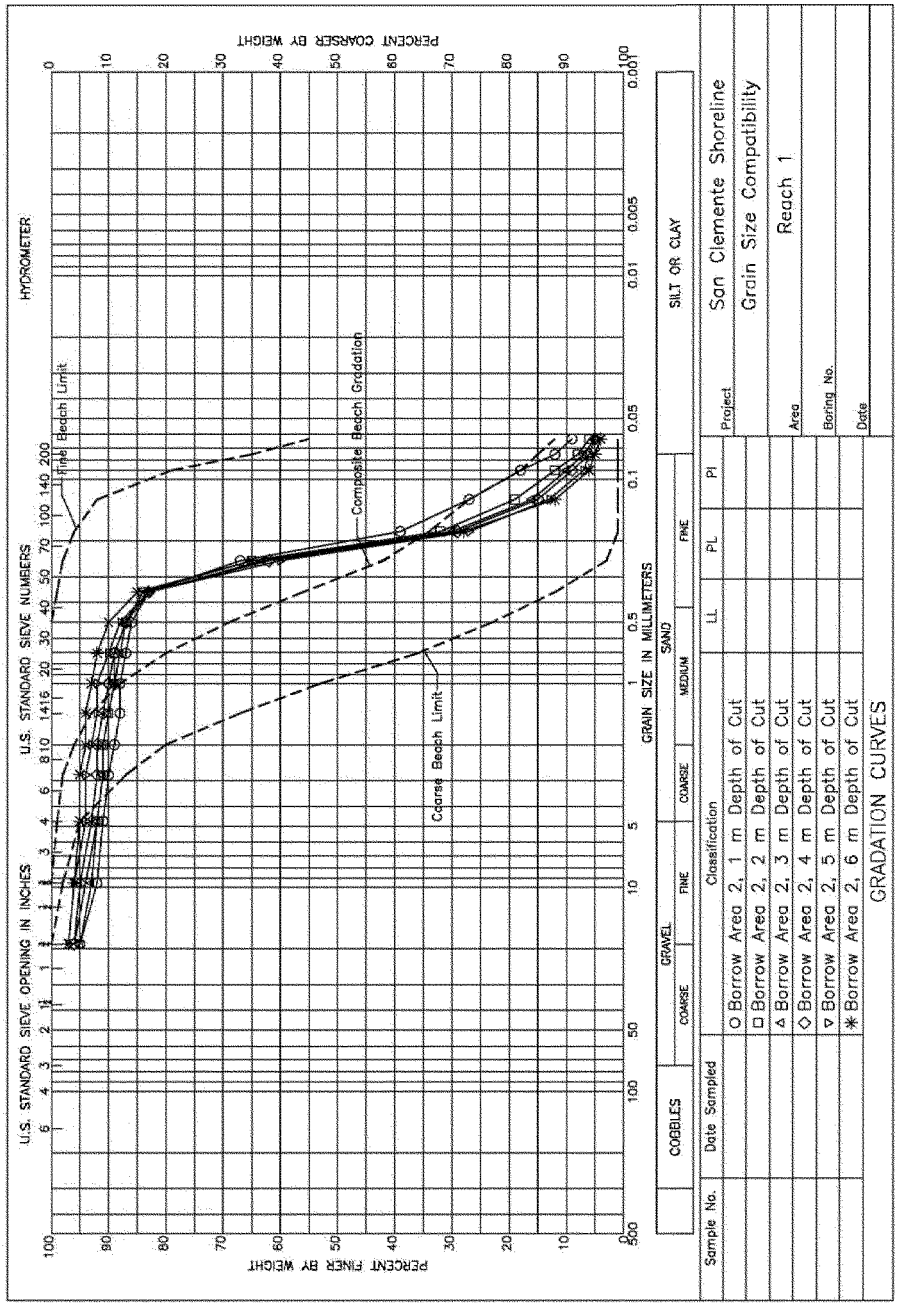


Figure 10. Grain Size Compatibility Curve - Reach 1.

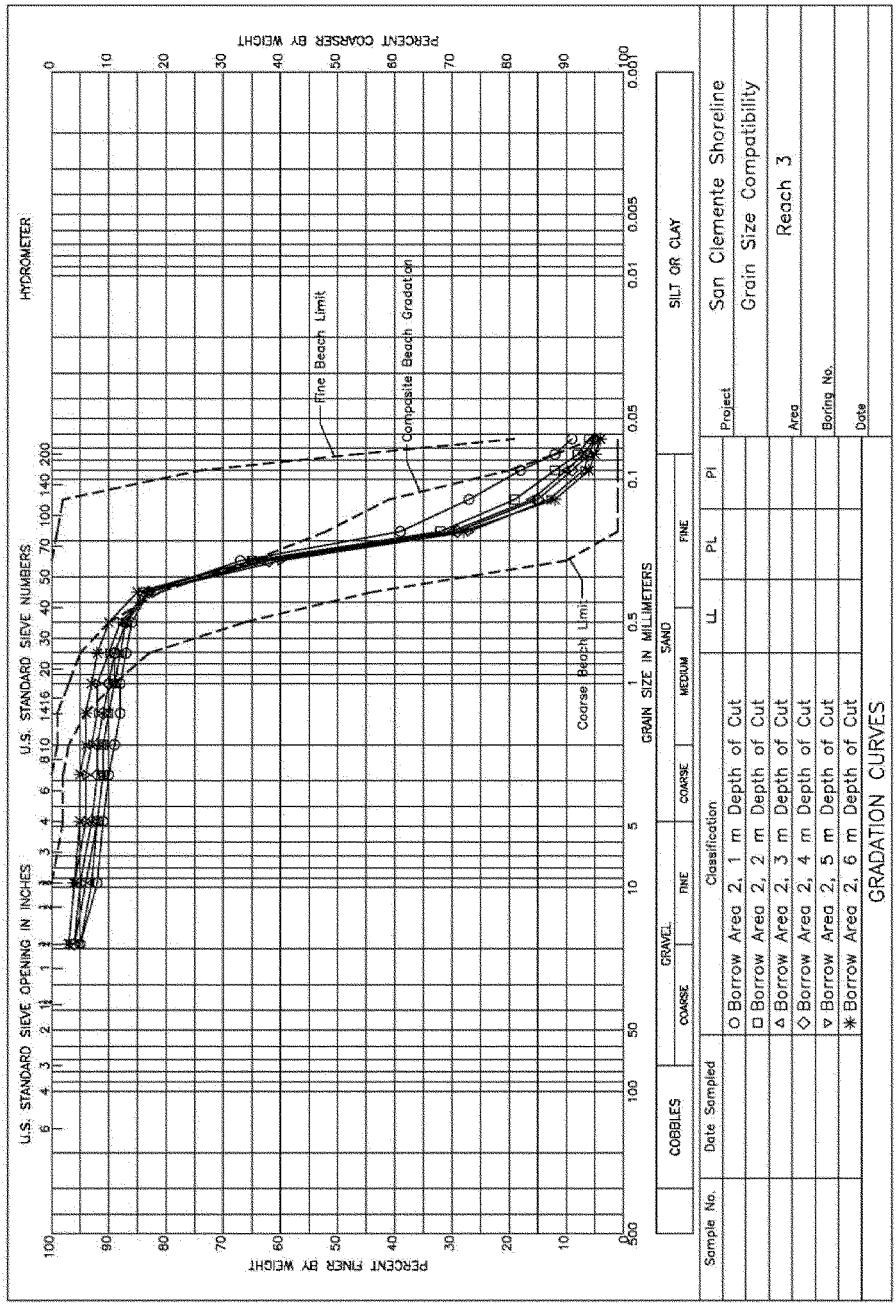


Figure 11. Grain Size Compatibility Curve - Reach 3.

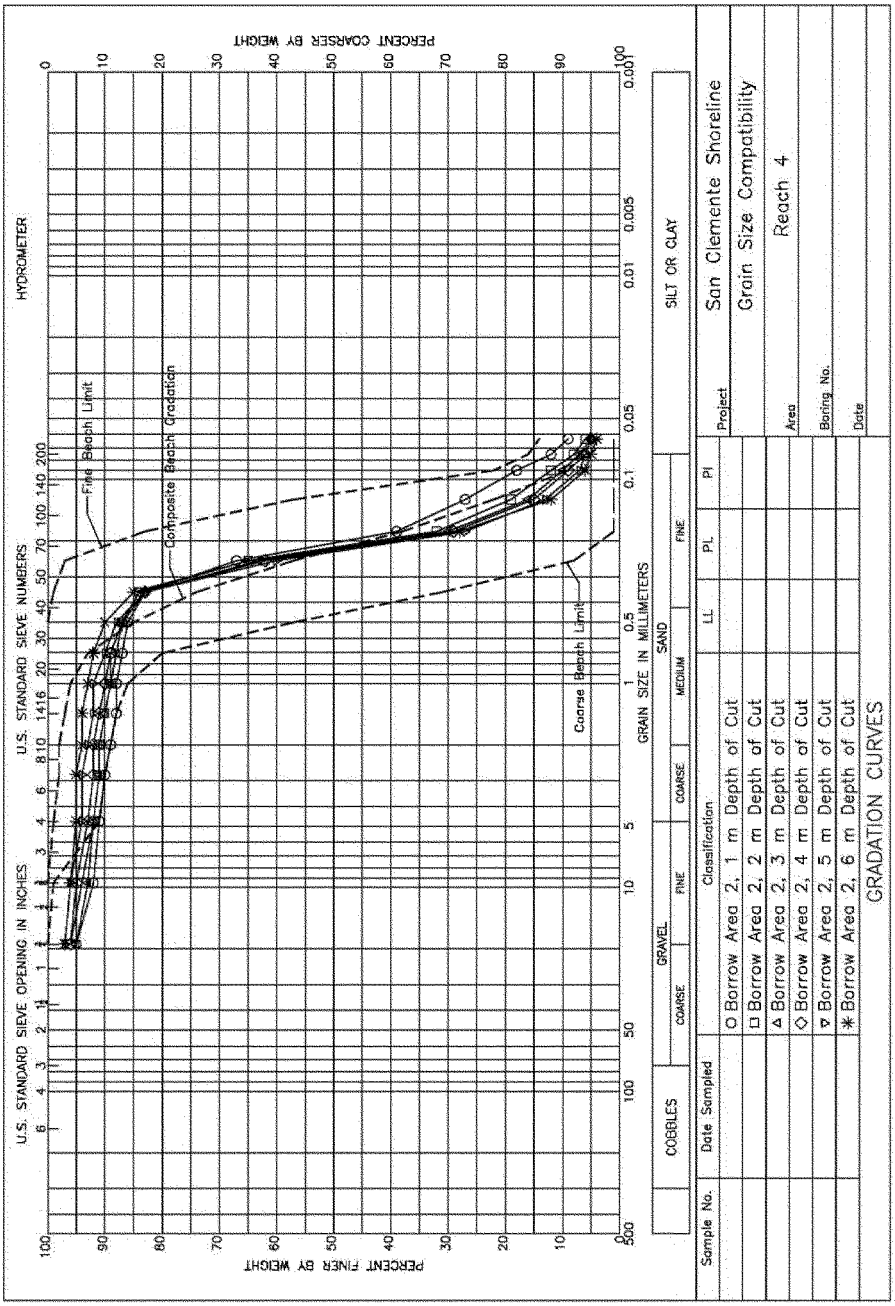


Figure 12. Grain Size Compatibility Curve - Reach 4.

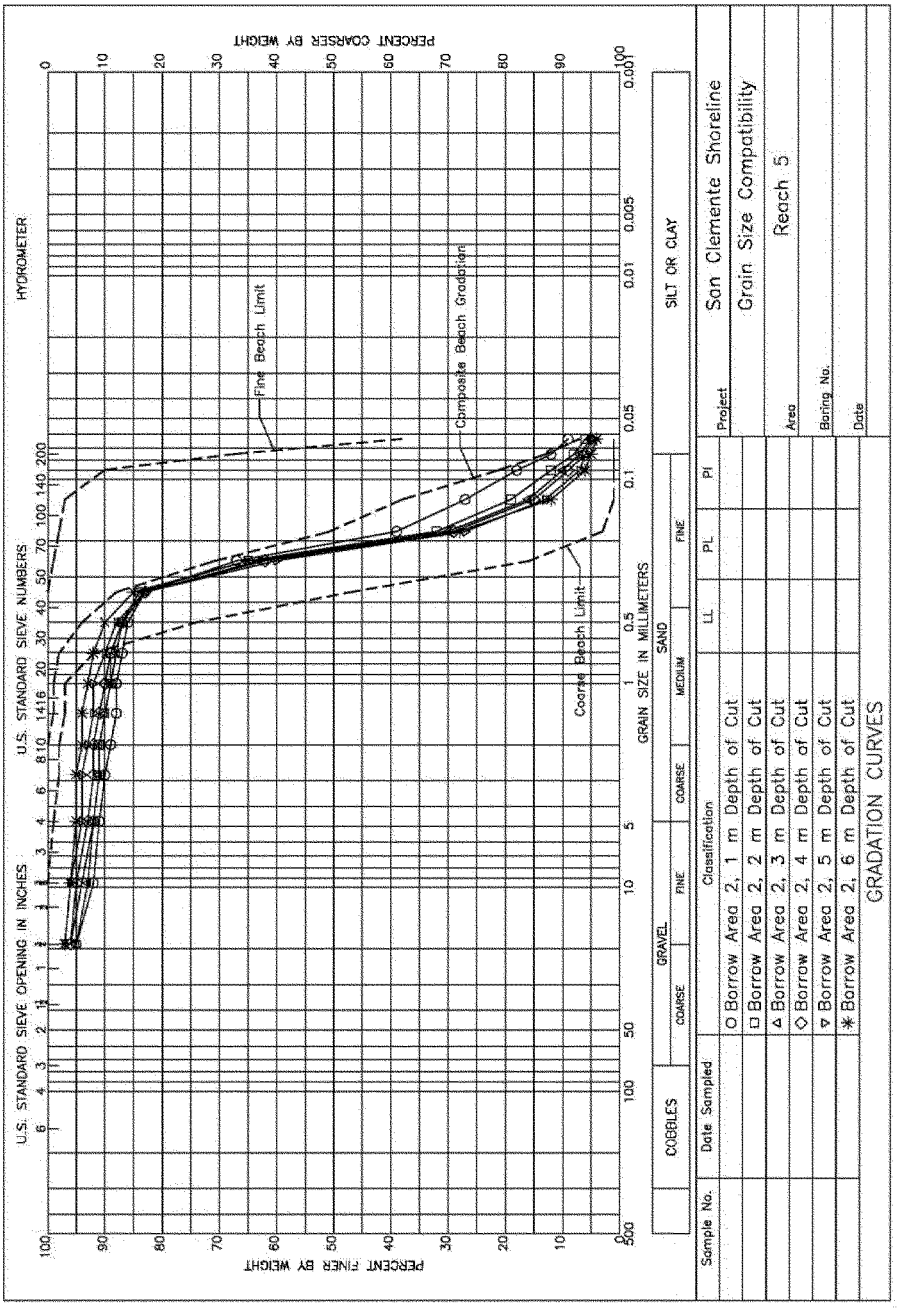


Figure 13. Grain Size Compatibility Curve - Reach 5.

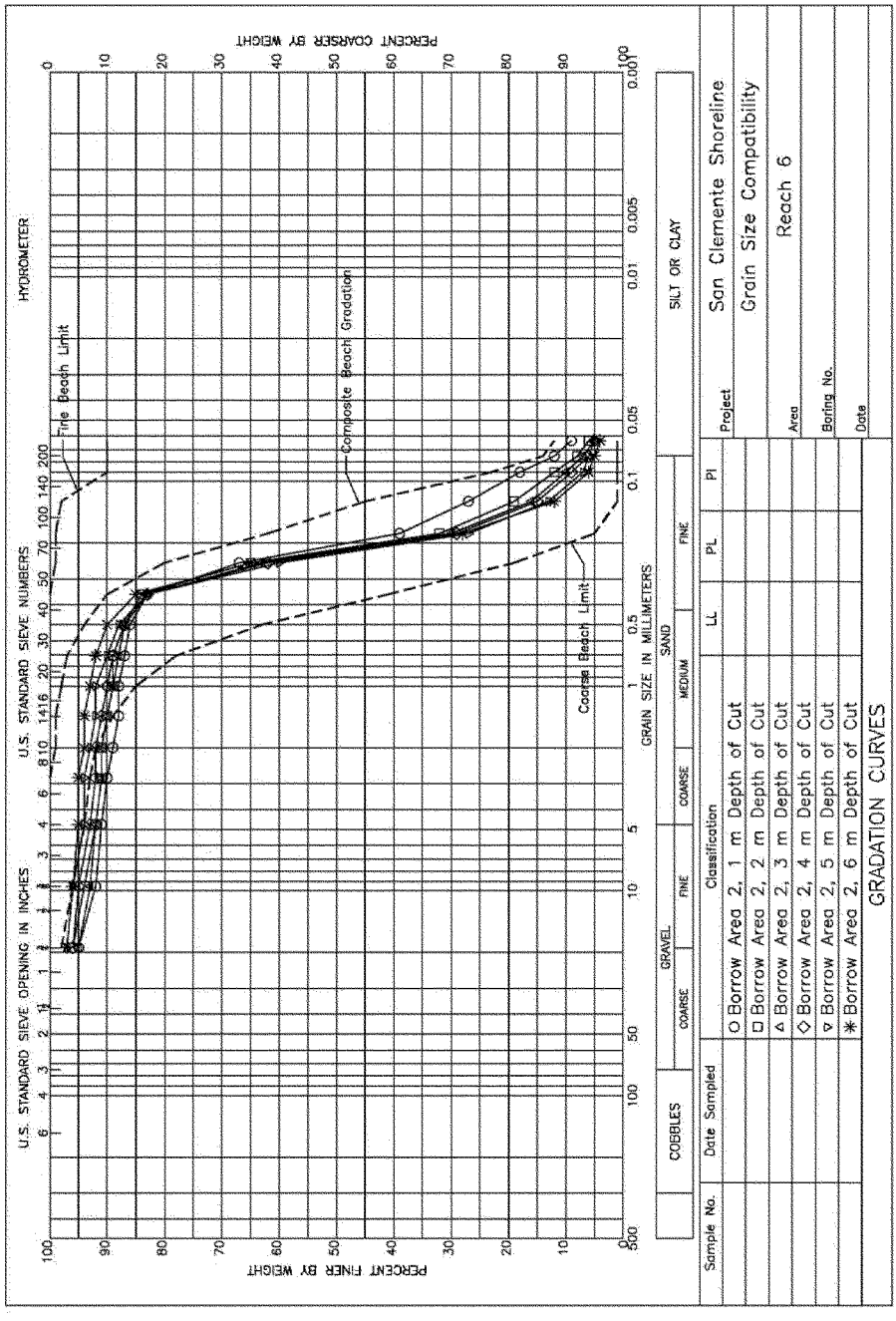


Figure 14. Grain Size Compatibility Curve - Reach 6.

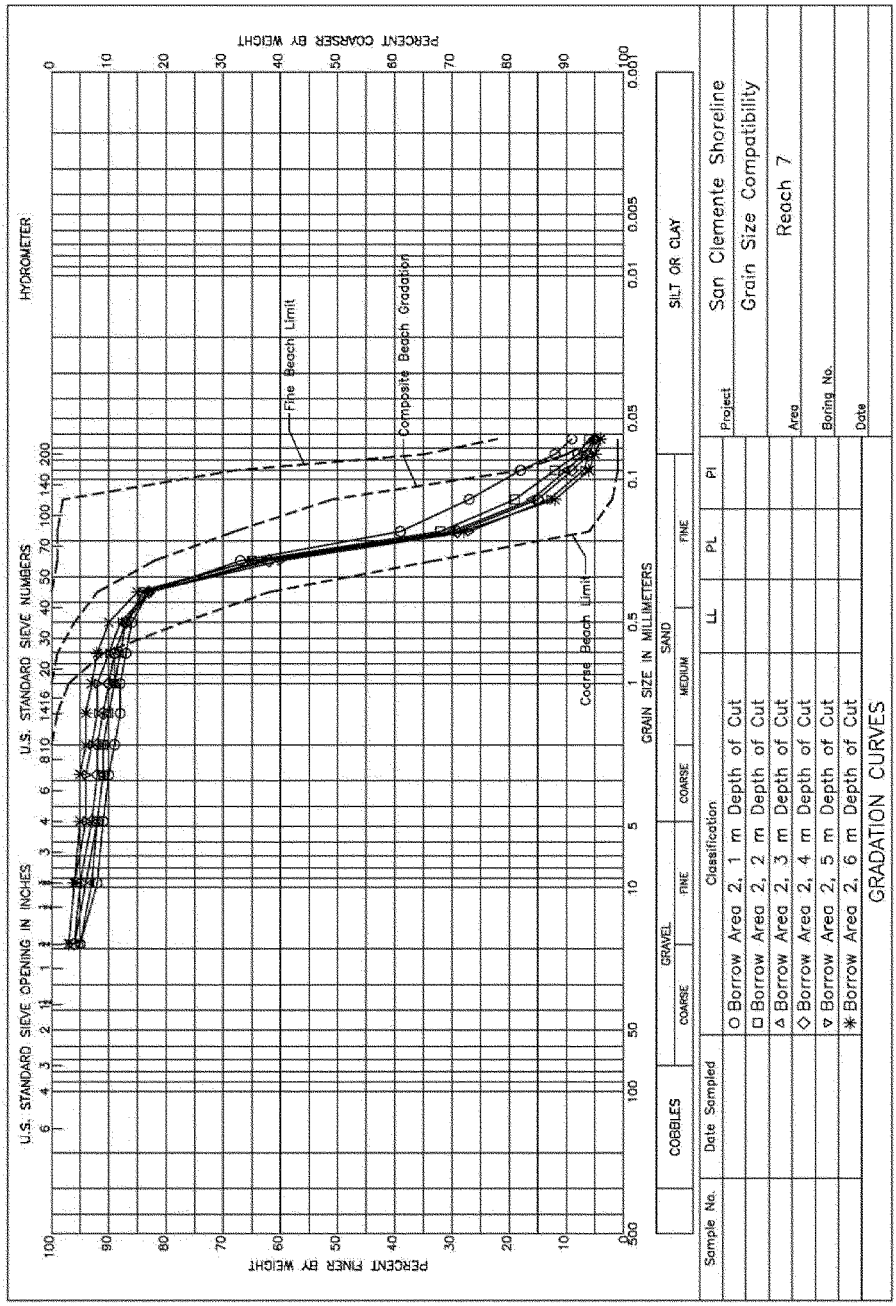


Figure 15. Grain Size Compatibility Curve - Reach 7.

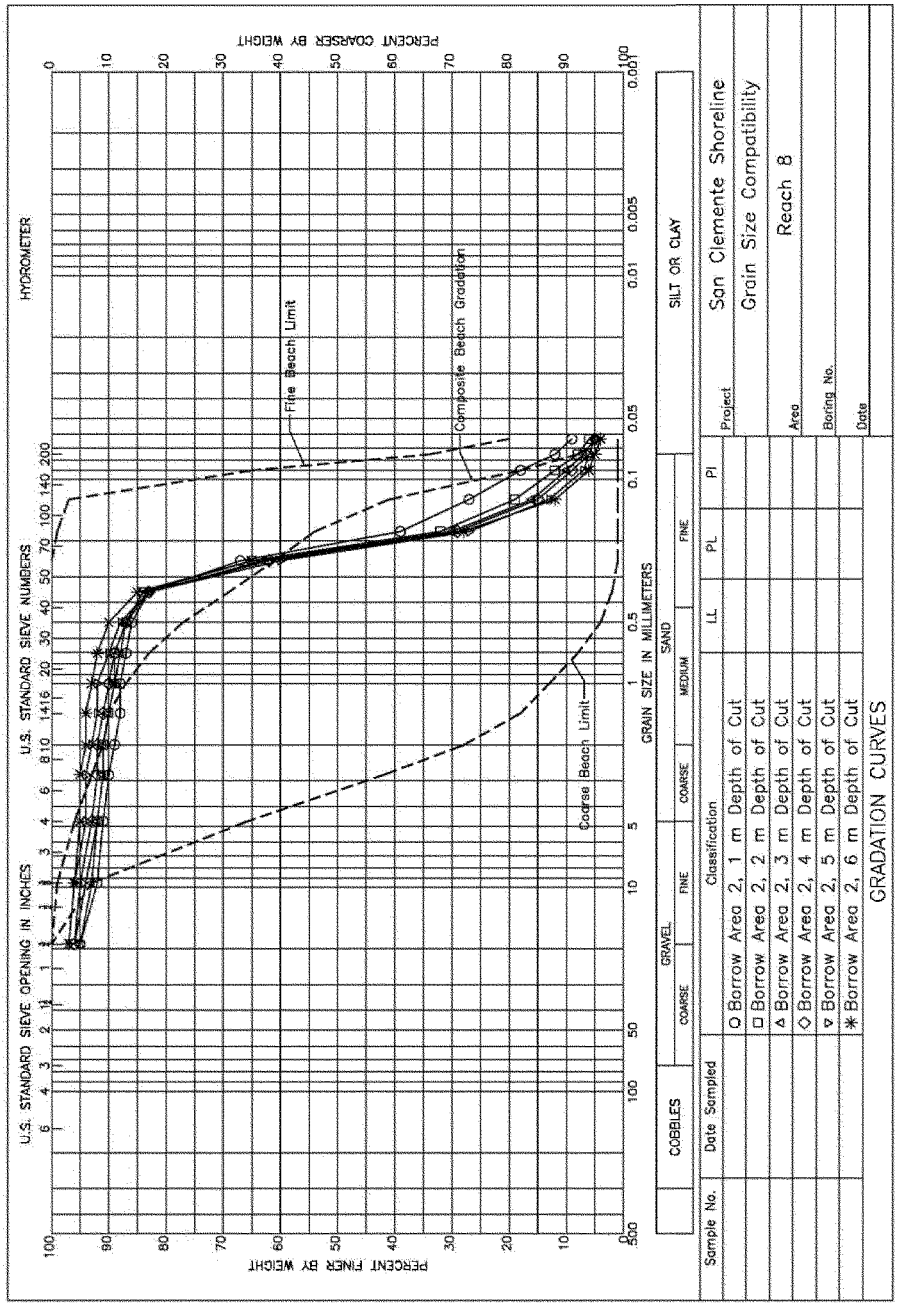


Figure 16. Grain Size Compatibility Curve - Reach 8.

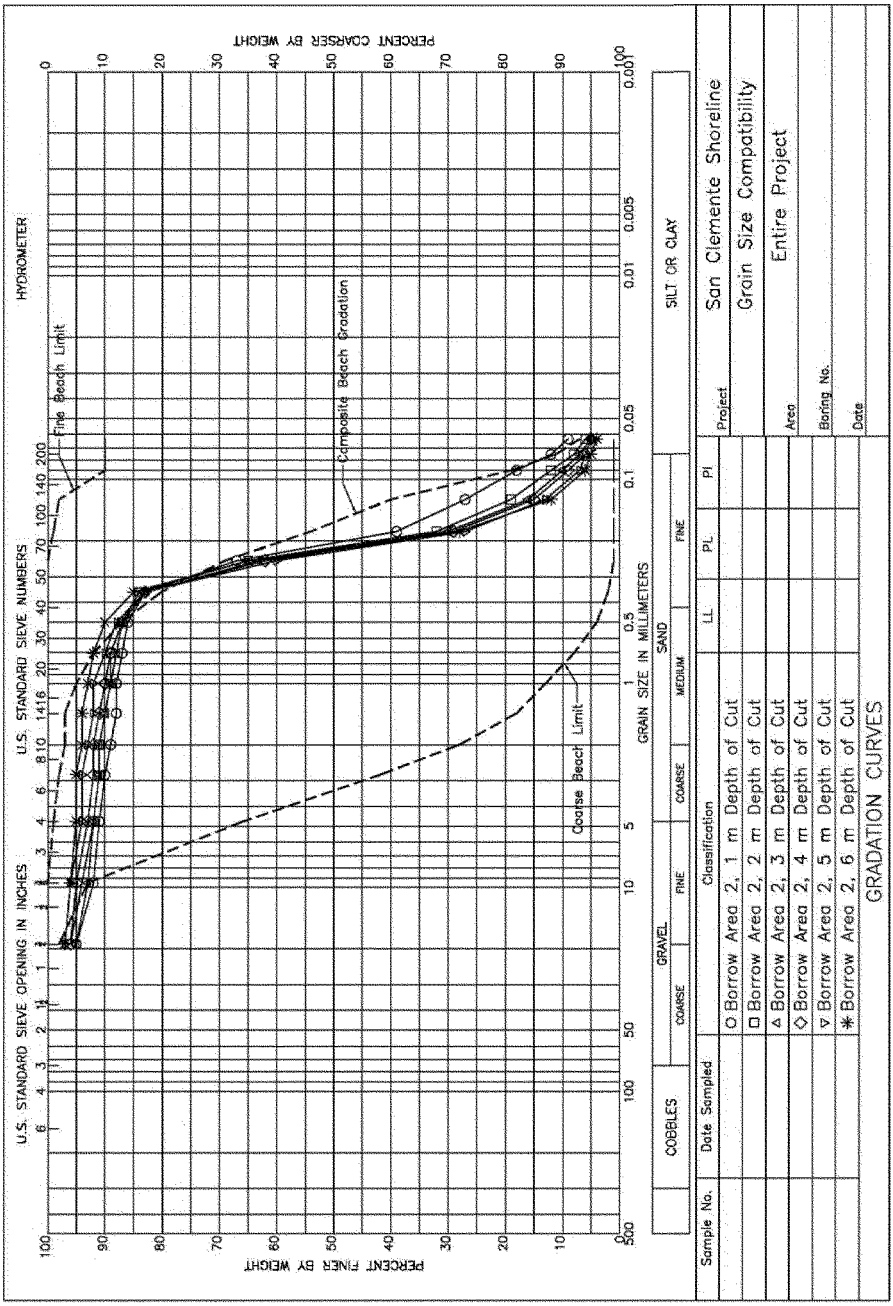
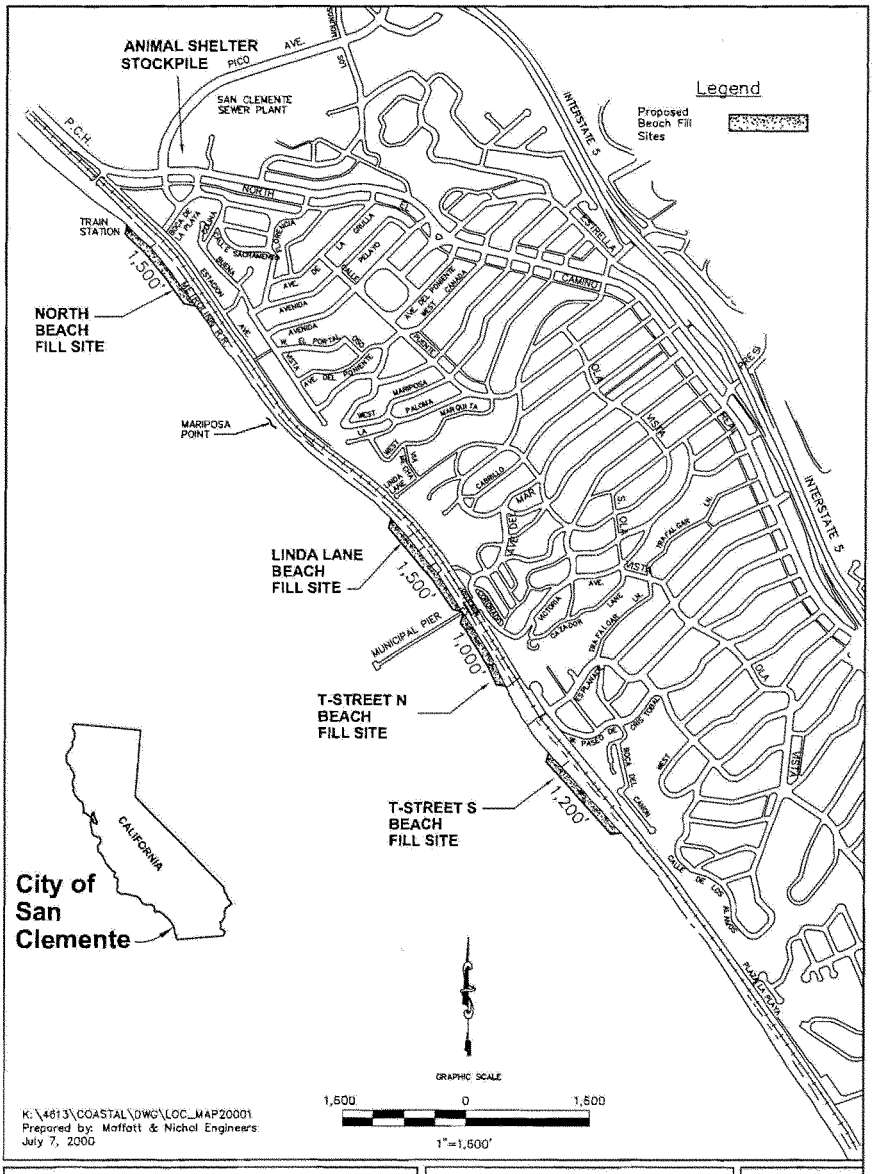


Figure 17. Grain Size Compatibility Curve - Entire Project.



San Clemente Beach Replenishment Program	Site Map and Beach Fill Plan	Figure 18

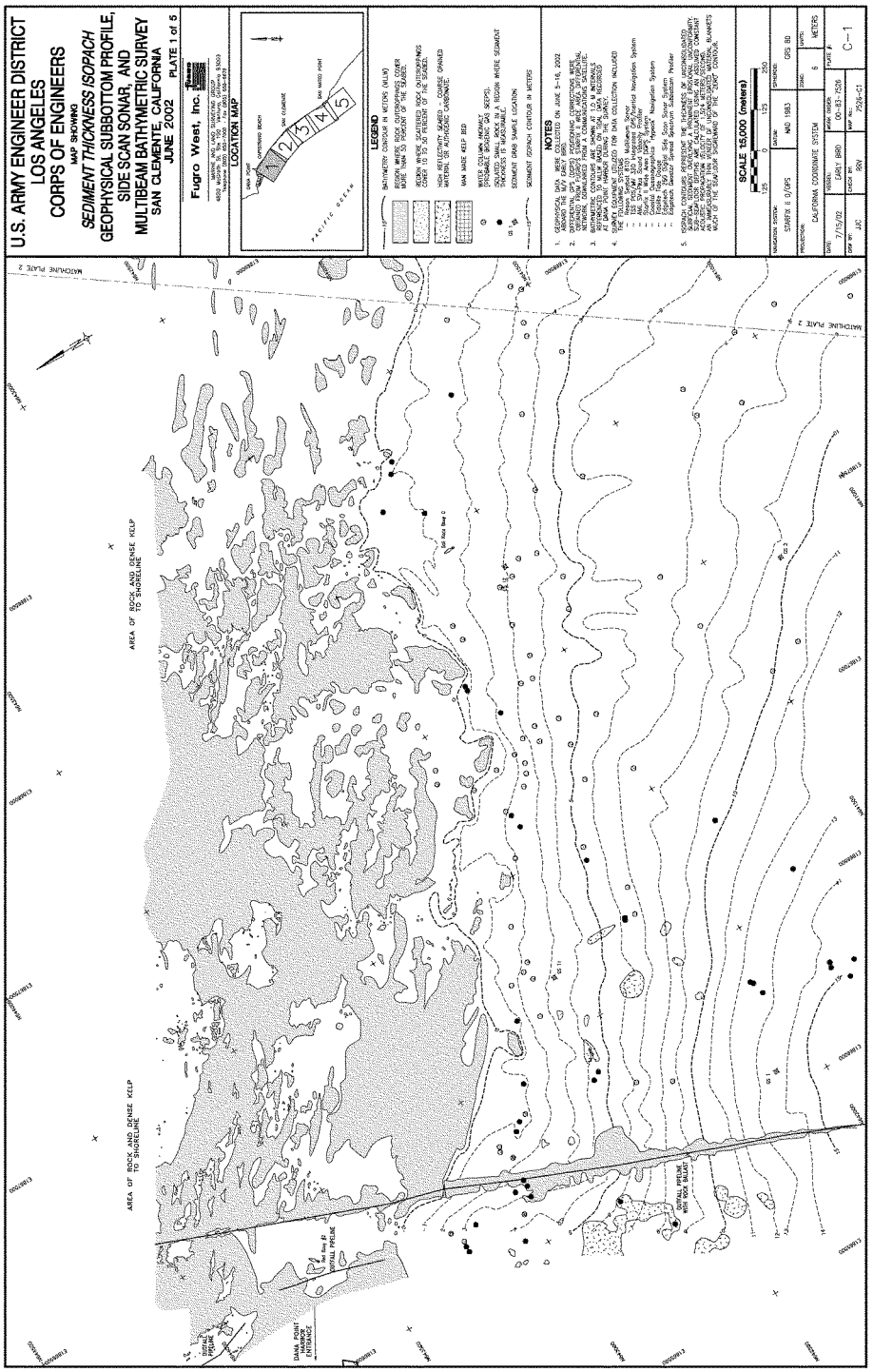

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
MAP SHOWING
SEDIMENT THICKNESS ISOPACH
GEOPHYSICAL SUBBOTTOM PROFILE,
SIDE SCAN SONAR, AND
MULTIBEAM BATHYMETRIC SURVEY
SAN CLEMENTE, CALIFORNIA
JUNE 2002
PLATE 1 of 5
Fugro West, Inc.
LOCATION MAP
LEGEND
BATHYMETRY CONTOUR IN METERS (MLLW)
BEDROCK WHERE SCATTERED ROCK OUTCROPPINGS COVER 10 TO 50 PERCENT OF THE SEABED.
HIGH REFLECTIVITY SEABED - COARSE GRAINED MATERIAL OR ASSOCIATED CARBONATE.
VAN MAKE KELP BED
WATER COLUMN ANOMALY (GAS BUBBLES OR GAS SEEPS).
ISOLATED SMALL ROCK IN A REGION WHERE SEDIMENT THICKNESS IS MARGINAL.
SEDIMENT CORE SAMPLE LOCATION
SEDIMENT ISOPACH CONTOUR IN METERS
NOTES
SCALE 15,000 (meters)
NAVIGATION SYSTEM
STARFIX II D/GPS
DATUM
NAD 1983
SPHEROID
GRS 80
PROJECTION
CALIFORNIA COORDINATE SYSTEM
ZONE
6
UNITS
METERS
DATE
7/15/02
SURVEY
EARLY BIRD
DATA TAPES
00-03-7256
PLATE #
C—1
DRAWN BY
JJC
CHECK BY
RDV
MAP NO.
7256-C1
AREA OF ROCK AND DENSE KELP TO SHORELINE
DANA POINT HARBOR (UNDER CONSTRUCTION)
OUTFALL PIPELINE
SAN MATEO POINT
SAN CLEMENTE
PACIFIC OCEAN

Figure 19

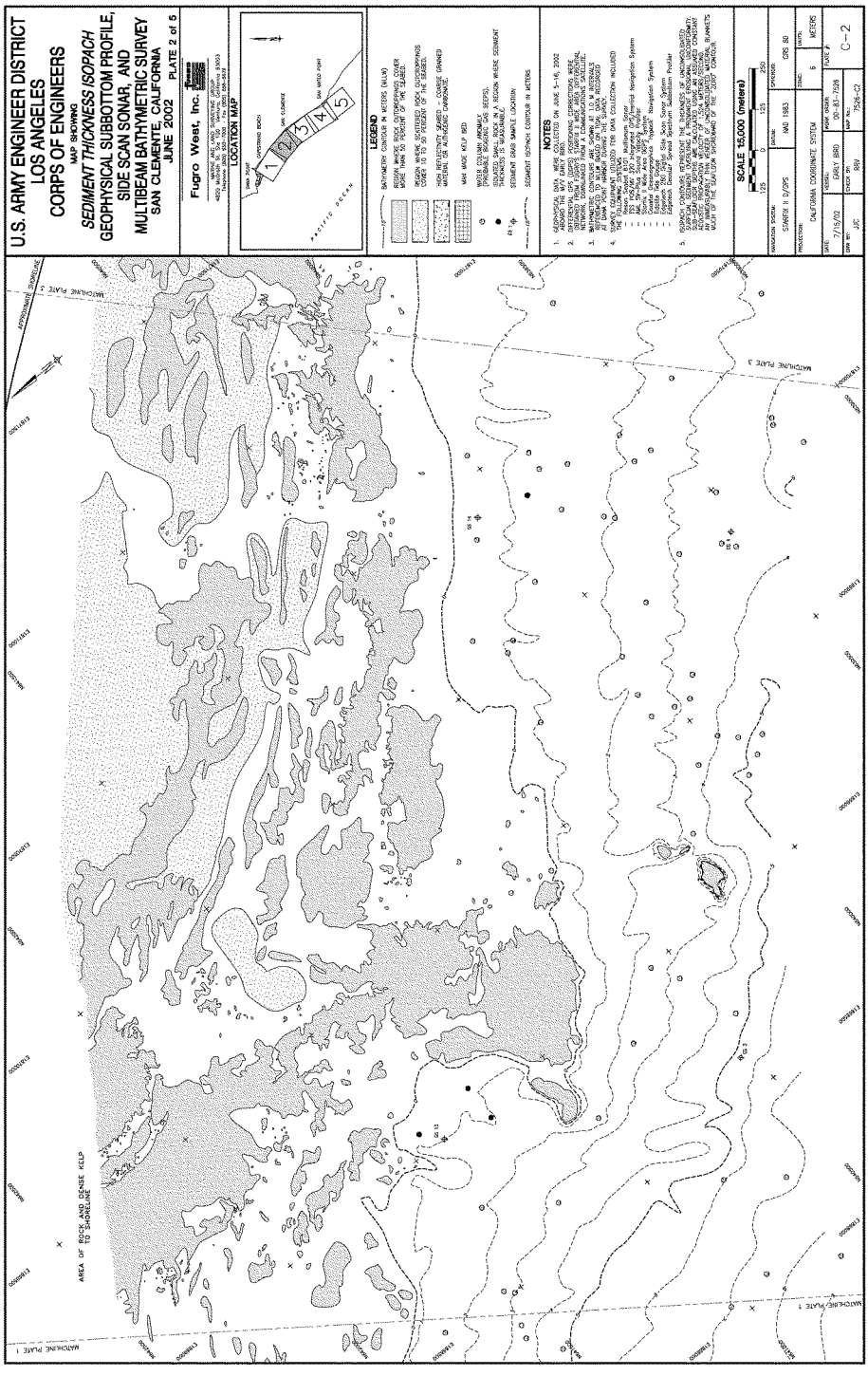

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
MAP SHOWING
SEDIMENT THICKNESS ISOPACH
GEOPHYSICAL SUBBOTTOM PROFILE,
SIDE SCAN SONAR, AND
MULTIBEAM BATHYMETRIC SURVEY
SAN CLEMENTE, CALIFORNIA
JUNE 2002
PLATE 2 of 5
Fugro West, Inc.
LOCATION MAP
LEGEND
NOTES
SCALE 15,000 (meters)
AREA OF ROCK AND DENSE KELP TO SHORELINE
MATCHLINE PLATE 1
MATCHLINE PLATE 3
APPROXIMATE SHORELINE
PACIFIC OCEAN
SAN CLEMENTE
SAN MATEO POINT
C-2

Figure 20

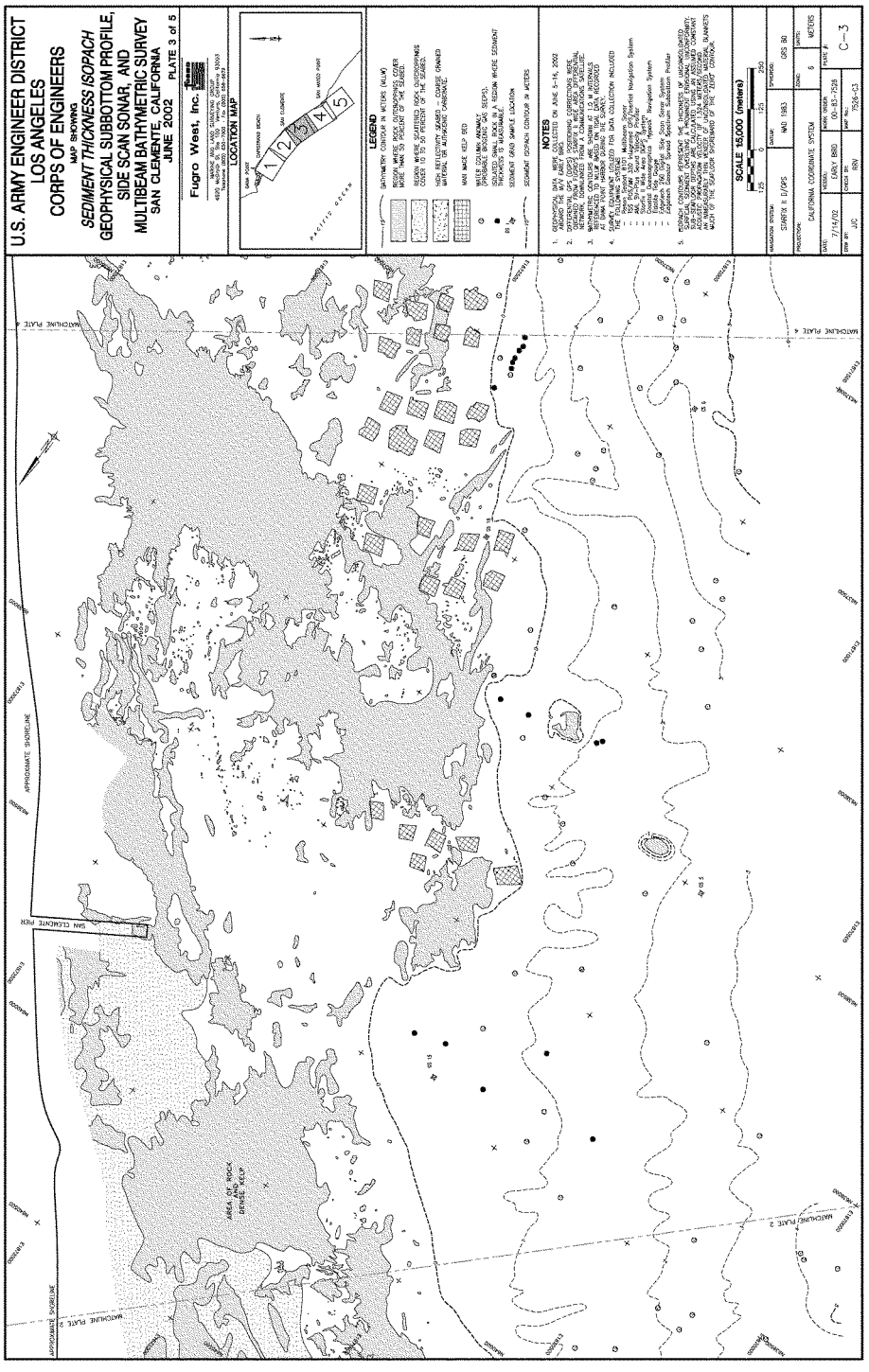

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
MAP SHOWING
SEDIMENT THICKNESS ISOPACH
GEOPHYSICAL SUBBOTTOM PROFILE,
SIDE SCAN SONAR, AND
MULTIBEAM BATHYMETRIC SURVEY
SAN CLEMENTE, CALIFORNIA
JUNE 2002
PLATE 3 of 5
Fugro West, Inc.
LOCATION MAP
LEGEND
BATHYMETRY CONTOUR IN METERS (MLLW)
MAN MADE KELP BED
SEDIMENT GRAB SAMPLE LOCATION
SEDIMENT ISOPACH CONTOUR IN METERS
NOTES
SCALE 15,000 (meters)
SAN CLEMENTE PIER
APPROXIMATE SHORELINE
MATCHLINE PLATE 2
MATCHLINE PLATE 4
AREA OF ROCK
DENSE KELP

Figure 21

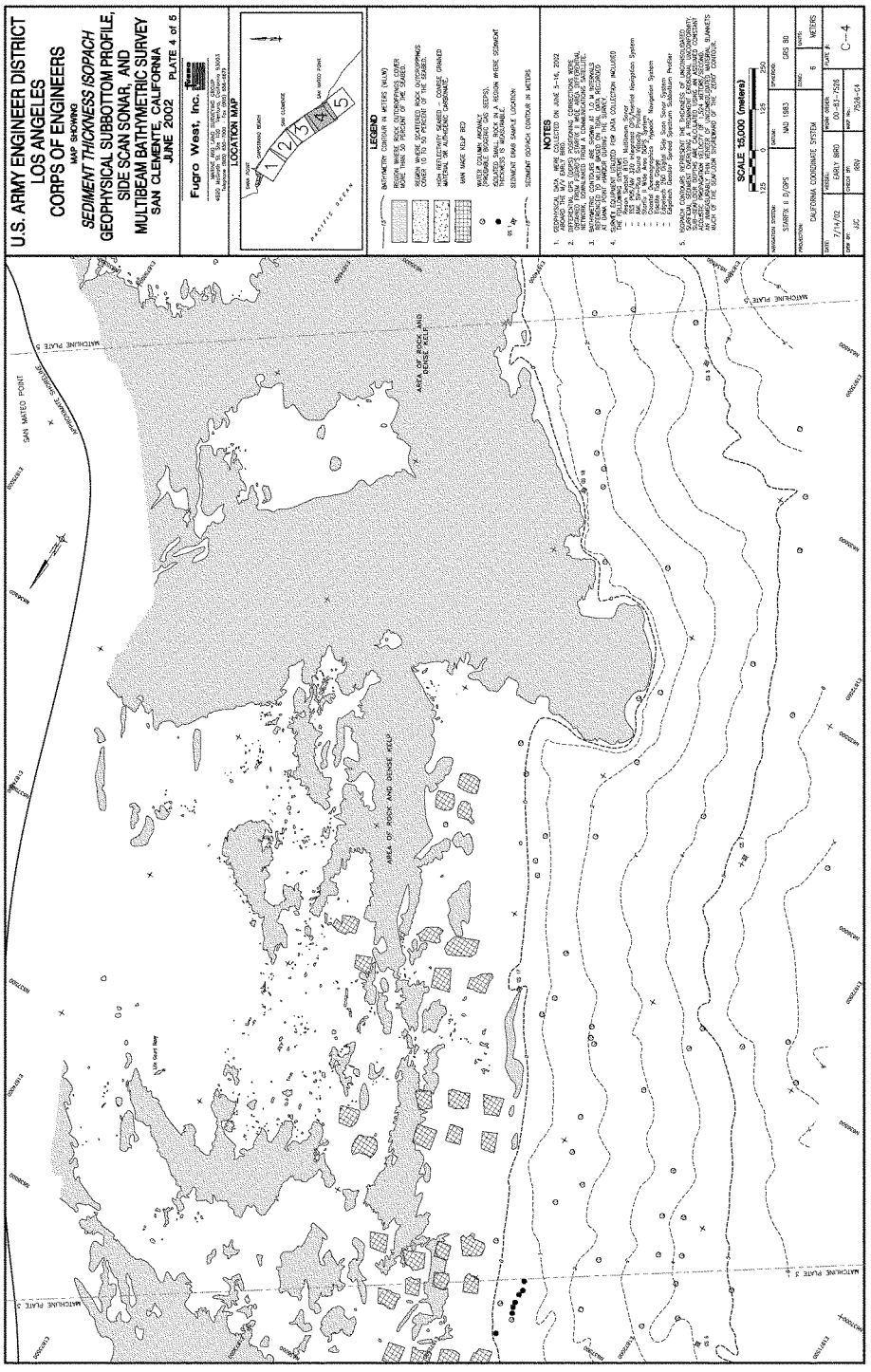

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
MAP SHOWING
SEDIMENT THICKNESS ISOPACH
GEOPHYSICAL SUBBOTTOM PROFILE,
SIDE SCAN SONAR, AND
MULTIBEAM BATHYMETRIC SURVEY
SAN CLEMENTE, CALIFORNIA
JUNE 2002
PLATE 4 of 5
Fugro West, Inc.
LOCATION MAP
LEGEND
NOTES
SCALE 15,000 (meters)
MATCHLINE PLATE 5
SAN MATEO POINT
AREA OF ROCK AND DENSE KELP
PACIFIC OCEAN

Figure 22

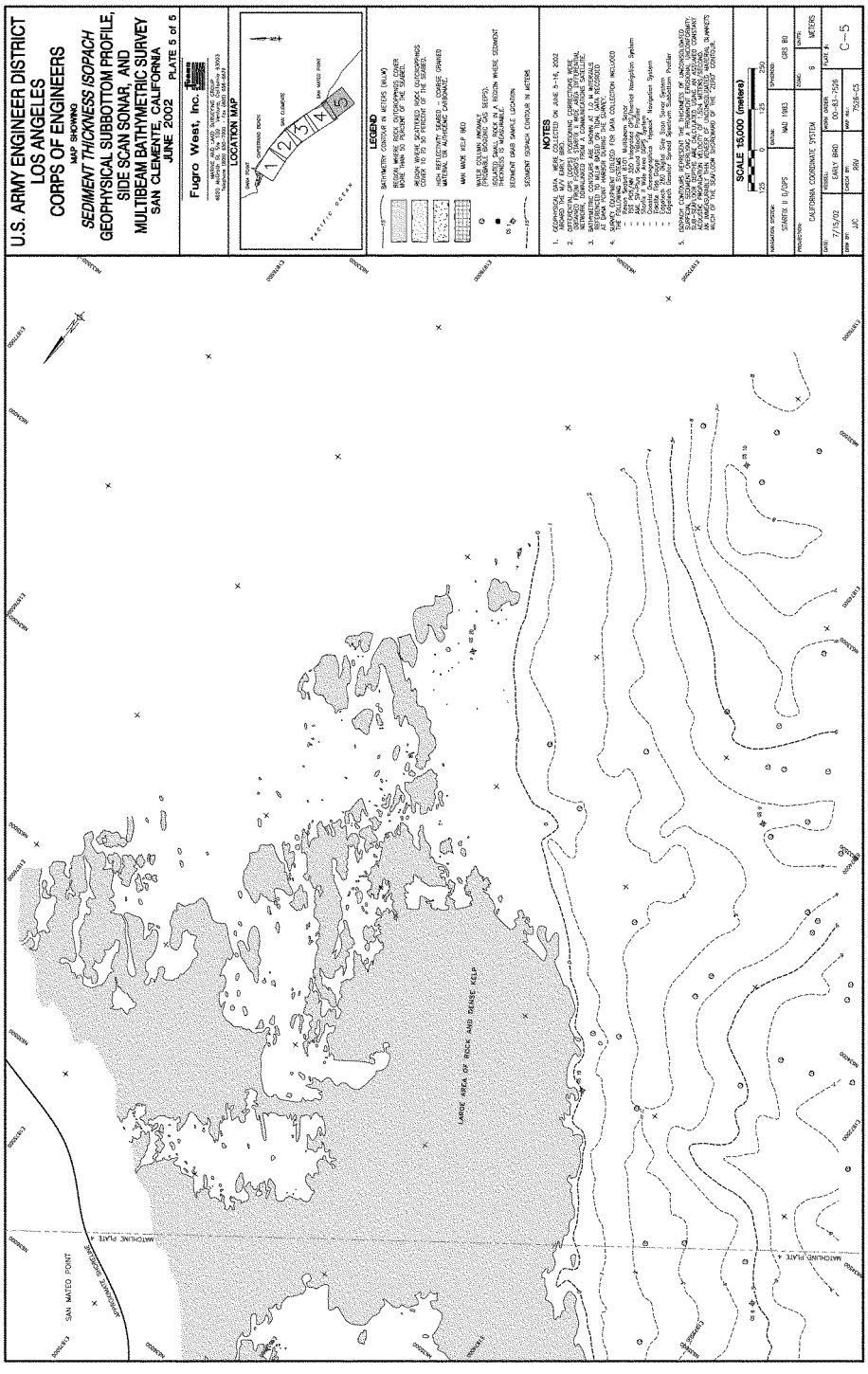
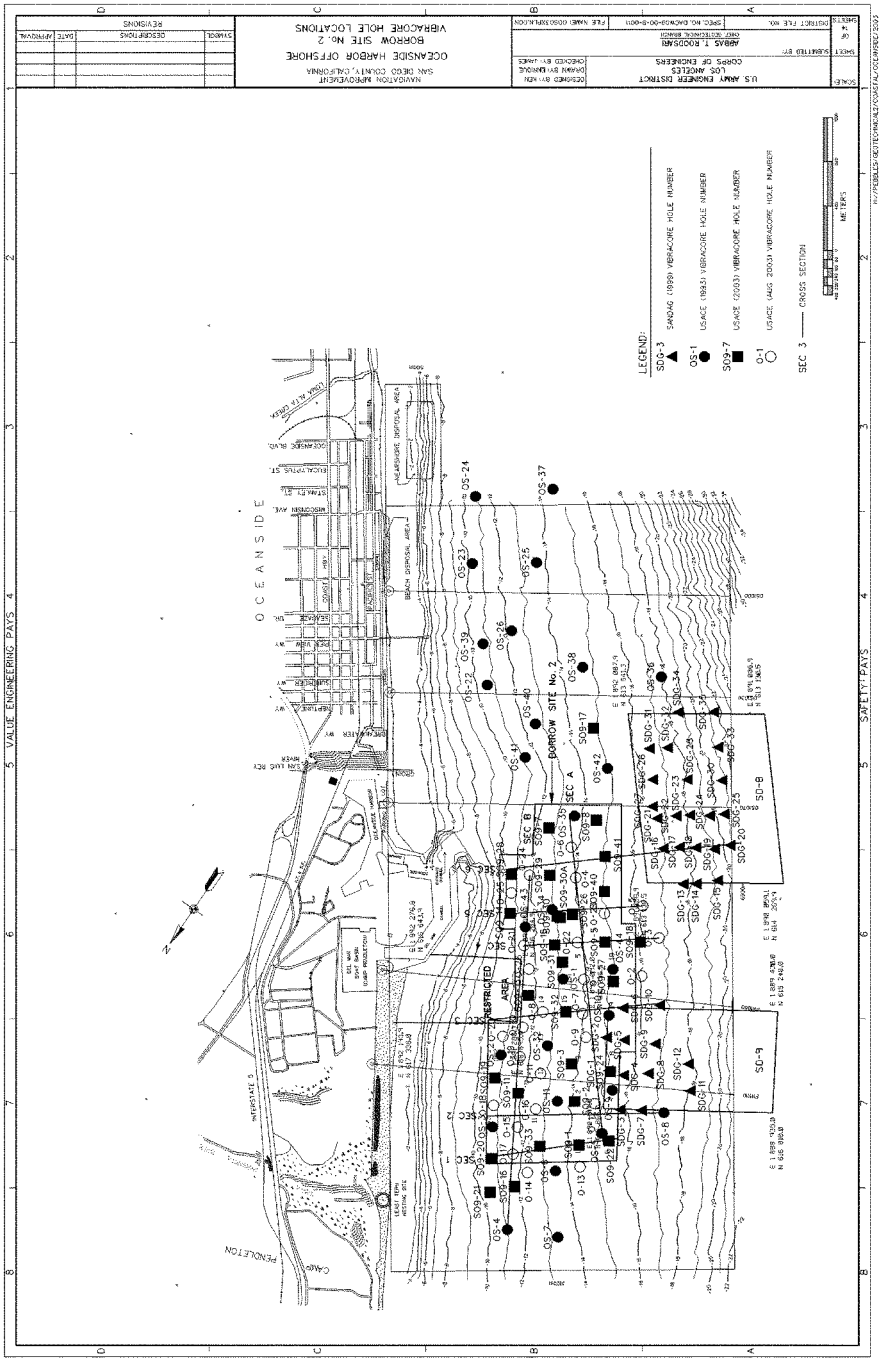
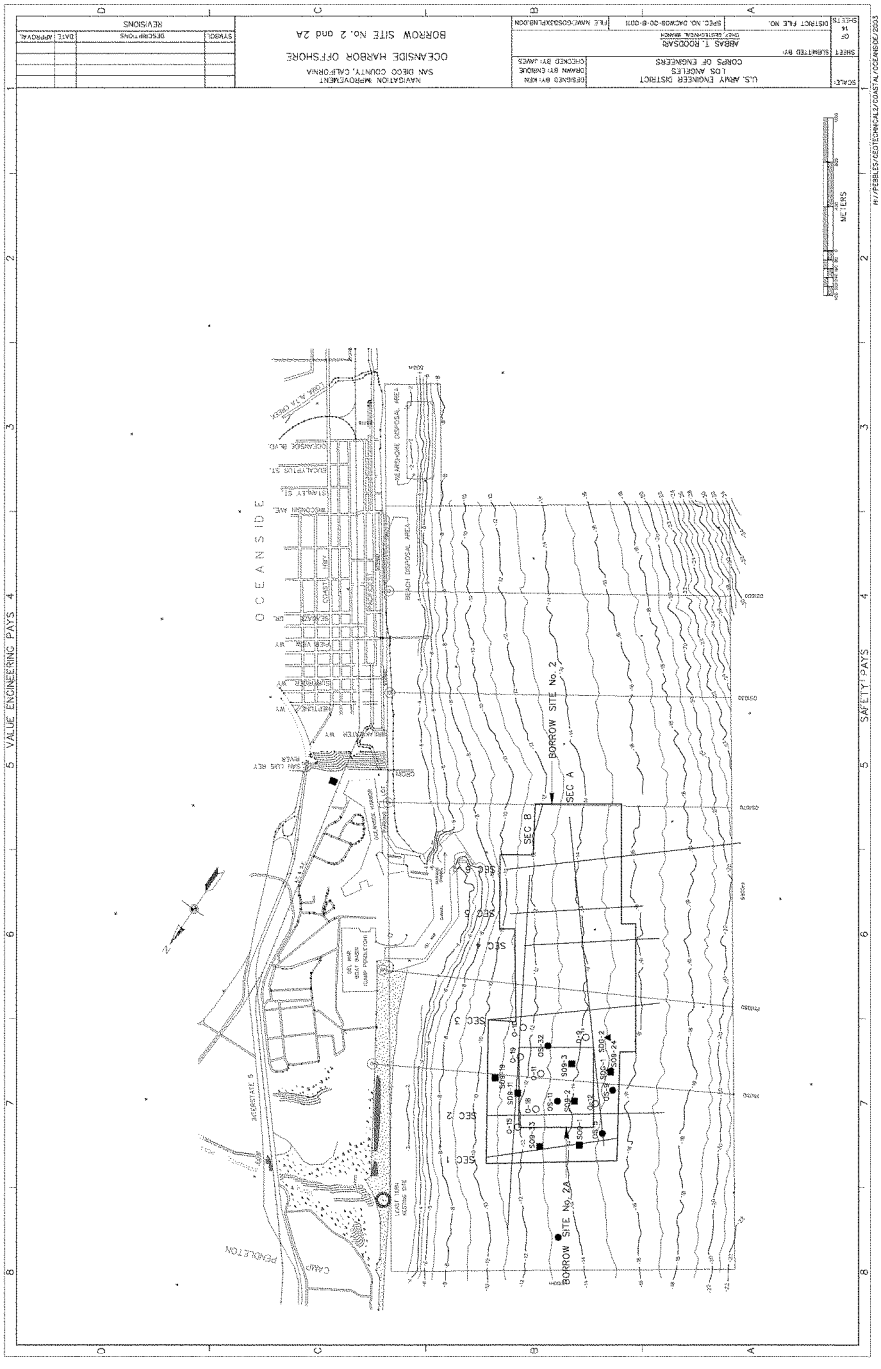

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
MAP SHOWING
SEDIMENT THICKNESS ISOPACH
GEOPHYSICAL SUBBOTTOM PROFILE,
SIDE SCAN SONAR, AND
MULTIBEAM BATHYMETRIC SURVEY
SAN CLEMENTE, CALIFORNIA
JUNE 2002
PLATE 5 of 5
Fugro West, Inc.
LOCATION MAP
LEGEND
BATHYMETRY CONTOUR IN METERS (MLLW)
REGION WHERE ROCK OUTCROPPINGS COVER 10 TO 50 PERCENT OF THE SEABED.
REGION WHERE SCATTERED ROCK OUTCROPPINGS COVER 10 TO 50 PERCENT OF THE SEABED.
HIGH-REFLECTIVITY-SHADED = COARSE GRAINED MATERIAL OR ALTERNATE CARBONATE
KELP BED
WATER COLUMN ANOMALY
ROCK OUTCROPPINGS
ISOLATED SMALL ROCK IN REGION WHERE SEDIMENT THICKNESS IS MEASURABLE
SEDIMENT GRAB SAMPLE LOCATION
SEDIMENT ISOPACH CONTOUR IN METERS
NOTES
SCALE 15,000 (meters)
NAVIGATION SYSTEM:
STARFIX II D/GPS
DATUM:
NAD 1983
SPHEROID:
GRS 80
PROJECTION:
CALIFORNIA COORDINATE SYSTEM
ZONE:
6
UNITS:
METERS
DATE:
7/15/02
DRAWN BY:
JJC
FIELD:
EARLY BIRD
CHECK BY:
RBI
WORK ORDER:
00-83-7256
MAP NO.:
7256-C5
PLATE #:
C—5
SAN MATEO POINT
MATEOLINE PLANT
LARGE AREA OF ROCK AND GIANT KELP

Figure 23

PLATES


OCEANSIDE HARBOR OFFSHORE
BORROW SITE No. 2
VIBRACORE HOLE LOCATIONS
SAN DIEGO COUNTY, CALIFORNIA
US ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
ABBAS T. ROOSTAEI
CHIEF, GEOTECHNICAL BRANCH
SPEC. NO. DACW09-00-B-0011
PLATE 1
LEGEND
SAMOAG (1999) VIBRACORE HOLE NUMBER
USACE (1983) VIBRACORE HOLE NUMBER
USACE (2003) VIBRACORE HOLE NUMBER
USACE (AUG 2003) VIBRACORE HOLE NUMBER
SEC 3 — CROSS SECTION
OCEANSIDE
BORROW SITE No. 2
SEC A
SEC B
SEC C
RESTRICTED AREA
BREAKWATER DISPOSAL AREA
BEACH DISPOSAL AREA
PENDLETON
INTERSTATE 5
VALUE ENGINEERING PAYS
SAFETY PAYS


NAVIGATION IMPROVEMENT
SAN DIEGO COUNTY, CALIFORNIA
OCEANSIDE HARBOR OFFSHORE
BORROW SITE No. 2 and 2A
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
ABBAS T. ROOOSAR
DIST. GEOTECHNICAL BRANCH
SPEC. NO. DACW09-20-B-0001
DISTRICT FILE NO.
SHEETS
SHEET
SCALE:
REVISIONS
VALUE ENGINEERING PAYS
SAFETY PAYS
OCEANSIDE
BORROW SITE No. 2
BORROW SITE No. 2A
SEC A
SEC B
SEC C
SEC D
SEC E
SEC F
SEC G
SEC H
SEC I
SEC J
PENDLETON
PLATE 2

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-1
LOCATION: Station 43
NORTHING (m): 616,022.8 **EASTING (m):** 1,891,018.3 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.4397' **LONGITUDE:** 117°25.1388' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/21/03 **TIME BORING STARTED:** **COMPLETED:**
SOUNDING (m): 15.42 **TIDE (m):** 1.25 **ELEVATION (m):** -14.2 **DATUM:** MLLW
PENETRATION (m): 3.96 **RECOVERY (m):** 1.52 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-14.1	0	Silty very fine grained sand; dark greenish gray; micaceous; live worms; loose; 2.5 cm. of shell hash at base.		1	SM	100	39
-14.84	.67	Silty Sand; med-fine grained; light gray; loose; abundant disseminated 1.3 cm. to 7.6 cm. black well-rounded pebbles; minor shell frags.		2	SM	100	42
-15.69	1.52	No Recovery (pile driven)		NS			
-18.13	3.96						

Penetration Rate
Penetration Rate @ sec/m
40 80 120 160
9393.701
9393.701
9636.483
9479.003
9935.039

REMARKS: Refusal due to very low penetration rate.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-2
LOCATION: Station 44
NORTHING (m): 615,694.2 **EASTING (m):** 1,890,610.8 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.2595' **LONGITUDE:** 117°25.3986' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/21/03 **TIME BORING STARTED:** 1649 **COMPLETED:** 1700
SOUNDING (m): 17.95 **TIDE (m):** 1.46 **ELEVATION (m):** -16.5 **DATUM:** MLLW
PENETRATION (m): 3.96 **RECOVERY (m):** 3.47 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate
-16.4	0	Poorly Graded Sand w/Gravel; Very fine grained sand; dark gray; micaceous		1	SP	76	3.0	
-17.71	1.22	Silty sand; dark gray; abundant shell fragments						
-18.32	1.83	Sand; med. dark gray; homogeneous; even grained.		2	SM	99	20	
-19.02	2.53	Medium grained sand; abundant .6-1.3 cm. rounded black pebbles and shell hash.						
-19.29	2.80	Fine grained sand; dark gray.		3	SP	65	3.0	
-19.57	3.08	Very fine grained to med. grained sand; med. gray; abundant dense packed pebbles and cobbles (<5.1 cm) toward top.						
-19.96	3.47	Core Loss		NS				
-20.45	3.96							

Penetration Rate ⊗ sec/m
40 80 120 160
⊗252.625
⊗328.084
⊗935.039

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-3
LOCATION: Station 48
NORTHING (m): 615,325.1 **EASTING (m):** 1,890,682.8 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.0602' **LONGITUDE:** 117°25.3497' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/22/03 **TIME BORING STARTED:** 1340 **COMPLETED:** 1350
SOUNDING (m): 18.47 **TIDE (m):** 1.04 **ELEVATION (m):** -17.4 **DATUM:** MLLW
PENETRATION (m): 4.11 **RECOVERY (m):** 2.87 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-17.4	0	Silty Sand; dark greenish gray; micaceous; mod- minor shell frags; saturated dense.		1	SM	100	42
-18.65	1.22	Silty Sand; dark greenish gray; micaceous; minor disseminated <2.5 cm. rounded pebbles, esp. assoc. with shell hash layers; saturated; dense.		2	SM	98	25
-19.69	2.26	Poorly Graded Sand w/Silt & Gravel; med. green gray; well-sorted w/dispersed <2.5 cm. rounded black pebbles; tr. shell frags; mod. micaceous; sharp upper contact; moist		3	SP-SM	85	6.0
-20.3	2.87	Core Loss (Pile-driven?)		NS			
-21.54	4.11						

Penetration Rate

Penetration Rate @ sec/m
40 80 120 160

9203.412
9262.467
9501.969
9393.701

REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-4
LOCATION: Station 53
NORTHING (m): 615,320.2 **EASTING (m):** 1,891,610.0 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.0632′ **LONGITUDE:** 117°25.7530′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/22/03 **TIME BORING STARTED:** 1745 **COMPLETED:** 1805
SOUNDING (m): 16.15 **TIDE (m):** 1.55 **ELEVATION (m):** -14.6 **DATUM:** MLLW
PENETRATION (m): 3.96 **RECOVERY (m):** 2.50 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate
-14.6	0	Poorly Graded Sand w/Silt & Gravel; dark gray; mod. shell frags.; dense; sharp lower contact.		1	SP-SM	79	11	
-15.82	1.22	Poorly Graded Sand; Med. fine grained sand with abundant <5.1 cm. rounded black pebbles throughout, esp. in upper .3 m.; mod. shell frags.		2	SP	94	2.0	
-17.1	2.50	Core Loss (Pile-driven?)		NS				
-18.56	3.96							

Penetration Rate ⊗ sec/m
40 80 120 160
9285.433
9393.701
9590.551
9492.126
9787.402

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-5
LOCATION: Station 50
NORTHING (m): 615,174.2 **EASTING (m):** 1,890,972.3 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.9804' **LONGITUDE:** 117°25.1623' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/23/03 **TIME BORING STARTED:** 0828 **COMPLETED:** 0840
SOUNDING (m): 17.89 **TIDE (m):** 1.13 **ELEVATION (m):** -16.8 **DATUM:** MLLW
PENETRATION (m): 3.96 **RECOVERY (m):** 3.35 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m, 40 80 120 160)
-16.7	0	Silty sand; trace shell frags and silt; dark gray; saturated; weak sulfidic odor		1	SM	100	40	
-17.37	.61	Silty sand; dark gray; abundant shell hash; weakly cohesive.						
-17.67	.91	Fine grained sand w/silt; dark gray; very minor shell frags; moist; weakly cohesive; gradational lower contact.		2	SM	99	39	
-18.13	1.37	Medium-fine grained sand; dark gray.						
-18.44	1.68	Gravel; <7.6 cm. rounded, black dense-packed pebbles/ cobbles in med-fine sand; dark gray.						
-18.59	1.83	Medium-fine grained sand w/ silt; clean; dark to med. gray; locally micaceous in <7.6 cm. bands accompanied by <1.3 cm. rounded, black pebbles; moist.		3	SP-SM	94	7.0	
-19.19	2.43	Poorly Graded Sand w/Silt; clean; dark to med. gray; locally micaceous in <3" bands accompanied by <1/2" rounded, black pebbles; moist.		4	SP-SM	100	6.0	
-20.11	3.35	Core Loss (Pile-driven?)		NS				
-20.72	3.96							91148.29

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-6
LOCATION: Station 56
NORTHING (m): 615,121.5 **EASTING (m):** 1,891,802.9 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.9569′ **LONGITUDE:** 117°24.6274′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/23/03 **TIME BORING STARTED:** 0959 **COMPLETED:** 1020
SOUNDING (m): 15.18 **TIDE (m):** 1.07 **ELEVATION (m):** -14.1 **DATUM:** MLLW
PENETRATION (m): 6.10 **RECOVERY (m):** 4.33 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate @ sec/m; 40 80 120 160)
-14.1	0	Poorly Graded Sand; med-light gray-brown; med-fine grained at top, gradually increasing to base; salt-and-pepper, with black, white, and orange grains; somewhat micaceous (granitic source?); saturated, loose; very minor shells.		1	SP	100	4.0	
-15.33	1.22	Poorly Graded Sand; med-light gray-brown; med-fine grained at top, gradually increasing to base; salt-and-pepper, with black, white, and orange grains; somewhat micaceous (granitic souree?); saturated, loose; very minor shells.		2	SP	100	3.0	@223.097
-16.54	2.43	Poorly Graded Sand; med-light gray-brown; med-fine grained at top, gradually increasing to base; salt-and-pepper, with black, white, and orange grains; somewhat micaceous (granitic source?); saturated, loose; very minor shells.		3	SP	100	3.0	@321.522 @364.173 @295.276
-17.62	3.51	Gravel to pebbly sand; mod. well sorted, well-rounded <0.3 cm. pebbles and shell fragments; clast-supported; a few +2.5 cm. cobbles at base.		4	SP	94	1.0	@295.276 @246.063 @246.063
-18.44	4.33	No recovery (pile-driven?)		NS				@246.063 @246.063 @246.063 @295.276 @295.276 @295.276 @393.701
-20.21	6.10							

REMARKS: Gradual increase in grain size w/depth (graded by long vibration time?)

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-7
LOCATION: Station 41
NORTHING (m): 616,283.4 **EASTING (m):** 1,890,848.0 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.5796′ **LONGITUDE:** 117°25.2503′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/23/03 **TIME BORING STARTED:** 1245 **COMPLETED:** 1258
SOUNDING (m): 15.03 **TIDE (m):** .88 **ELEVATION (m):** -14.1 **DATUM:** MLLW
PENETRATION (m): 2.90 **RECOVERY (m):** 2.10 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m, 40 80 120 160)
-14.1	0	Very fine grained silty sand; dark gray-black; micaceous; trace shell frags; slight sulfidic odor; dense, compact; sharp, irregular lower contact.		1	SM	100	35	
-14.91	.76	Poorly Graded Sand; med-fine grained; med. brownish gray; disseminated rounded <7.6 cm. cobbles, esp. @ .9-1.1 cm., 1.2-1.4 cm.; compact.		2	SP	86	2.0	
-16.25	2.10	Core Loss (Pile-driven?)						@360.892
-17.05	2.90							@787.402

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** O-8
LOCATION: Station 40
NORTHING (m): 616,475.1 — **EASTING (m):** 1,891,148.8 — **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.6852′ — **LONGITUDE:** 117°25.0581′ — **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor — **EQUIPMENT:** Alpine Vibracore — **DIAMETER (cm):** 8.9
DATE DRILLED: 8/23/03 — **TIME BORING STARTED:** 1415 — **COMPLETED:** 1443
SOUNDING (m): 13.66 — **TIDE (m):** .94 — **ELEVATION (m):** -12.7 — **DATUM:** MLLW
PENETRATION (m): 4.11 — **RECOVERY (m):** 3.75 — **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m, 40 80 120 160)
-12.7	0	Silty Sand; fine-med. grained; dark gray; micaceous on top; mod. shell frags; compact.		1	SM	100	19	
-13.54	.82	Gravelly sand; med-fine sand w/abundant rounded black 0.3-3.6 cm. clasts; med brown-gray; minor shell frags.						
-13.97	1.25	Sand; med. grained; med. brown-gray; well-sorted; homogeneous; moist		2	SP	93	2.0	
-14.55	1.83	Poorly Graded Sand w/Silt; med. grained; med. brown-gray; well-sorted; homogeneous; moist		3	SP-SM	98	8.0	9314.961
								9442.913
-15.83	3.11	Poorly Graded Sand; med. grained; med. brown-gray; a few clay balls, shell hash.		4	SP	100	2.0	9393.701
								9688.976
-16.38	3.66	Cohesive black clay/silt with suspended sand.						9885.827
-16.47	3.75	No Recovery (pile-driven?)		NS				9981.1...
-16.83	4.11							

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-9
LOCATION: Station 39
NORTHING (m): 616,436.7 **EASTING (m):** 1,890,700.0 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.6617' **LONGITUDE:** 117°25.3467' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/23/03 **TIME BORING STARTED:** 1603 **COMPLETED:** 1620
SOUNDING (m): 15.85 **TIDE (m):** 1.25 **ELEVATION (m):** -14.6 **DATUM:** MLLW
PENETRATION (m): 4.57 **RECOVERY (m):** 5.73 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-14.6	0	Silty Sand; very fine grained; dark gray to black; micaceous; mod- minor shells increase to base; saturated; very irregular lower contact.		1	SM	100	31	
-15.36	.76	Gravelly sand; granules to 3.8 cm. rounded cobbles in med-fine grained sand.						
-15.97	1.37	Sand; med-fine grained; med. brown-gray; massive, homogeneous; "salt and pepper" ; scattered <0.3 cm. clasts, shell frags; saturated; loose.		2	SP-SM	99	5.0	226.378
-16.73	2.13	Poorly Graded Sand; med-fine grained; med. brown-gray; massive, homogeneous; "salt and pepper" ; scattered <0.3 cm. clasts, shell frags; saturated; loose.		3	SP	100	4.0	295.276 295.276 275.591
-17.95	3.35	Poorly Graded Sand; med-fine grained; med. brown-gray; massive, homogeneous; "salt and pepper" ; scattered <0.3 cm. clasts, shell frags; very gradual increase in grain size to base; lower 0.3 m. had a 7.6 cm. diam. cobble; saturated; loose.		4	SP	100	4.0	246.063 246.063 393.701
-19.17	4.57							688.976

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-10
LOCATION: Station 37
NORTHING (m): 616,693.6 **EASTING (m):** 1,891,212.5 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.8038′ **LONGITUDE:** 117°25.0187′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/24/03 **TIME BORING STARTED:** 0826 **COMPLETED:** 0854
SOUNDING (m): 12.98 **TIDE (m):** 1.16 **ELEVATION (m):** -11.8 **DATUM:** MLLW
PENETRATION (m): 3.35 **RECOVERY (m):** 2.29 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-11.8	0	Silty sand; very fine grained; black; micaceous; non-cohesive; minor shells; live worms.		1	SM	100	38	
-12.12	.3	Fine grained Sand w/Silt; med-gray; clean w/mod.shell frags; irregular patches of black cohesive silty sand.						
-12.43	.61	Gravel; <5.1 cm. black cobbles and shell frags in fine sand.						
-12.58	.76	Poorly Graded Sand; fine grained; clean, well-sorted; light gray; homogeneous; micaceous; only trace shell frags.		2	SP	95	2.0	
-14.11	2.29	No Recovery (Pile-driven?)		NS				9295.276 → 31033.46 → 31033.46 → 31525.59 →
-15.17	3.35							

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-11
LOCATION: Station 31
NORTHING (m): 616,939.9 **EASTING (m):** 1,890,840.9 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.9348′ **LONGITUDE:** 117°25.2596′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/24/03 **TIME BORING STARTED:** 1010 **COMPLETED:** 1040
SOUNDING (m): 13.87 **TIDE (m):** 1.10 **ELEVATION (m):** -12.8 **DATUM:** MLLW
PENETRATION (m): 3.96 **RECOVERY (m):** 3.66 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-12.7	0	Silty Sand; med-fine grained; black to gray-brown; abundant <0.6 cm. pebbles, shell frags; micaceous; upper 5.1 cm. is black micaceous, weakly cohesive silty sand with live worms.		1	SM	98	13	
-13.29	.52	Gravel; <5.1 cm. pebbles/cobbles tightly held in very fine grained silty sand matrix.						
-13.44	.67	Sand; med-fine grained; med gray-brown; "salt and pepper"; minor widely dispersed <0.3 cm. rounded pebbles; trace to minor shell frags; gradational upper and lower contacts.		2	SP	93	2.0	
-14.57	1.80	Poorly Graded Sand; fine-grained; dark- to med-greenish-gray; minor <0.6 cm. pebbles; trace shell frags generally, but abundant in lower 15 cm.		3	SP	99	4.0	
-16.43	3.66	Core Loss		NS				
-16.73	3.96							

REMARKS: No Penetration Rate Data

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-12
LOCATION: Station 29
NORTHING (m): 616,875.0 **EASTING (m):** 1,890,284.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.8963′ **LONGITUDE:** 117°25.6173′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/24/03 **TIME BORING STARTED:** 1217 **COMPLETED:** 1237
SOUNDING (m): 15.48 **TIDE (m):** .82 **ELEVATION (m):** -14.7 **DATUM:** MLLW
PENETRATION (m): 3.20 **RECOVERY (m):** 3.20 **LOGGED BY:** K. Raabe

Strata Elev. (m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m, 40 80 120 160)
-14.6	0	Silty Sand; very fine-grained sand; abundant shell frags; micaceous; sharp lower contact; live worms.		1	SM	97	37	
-15.27	.61	Gravel; 0.3-5.1 cm. gravel in brown-gray med-fine sand.						
-15.57	.91	Pebbly Sand; brown-gray med-fine sand w/ rounded 0.3 cm. to 5.1 cm. clasts; very minor shell frags.		2	SP	85	2.0	
-16.49	1.83	Pebbly sand; brown-gray med-fine sand w/ rounded 0.3 cm to 5.1 cm. clasts; very minor shell frags.		3	SP	63	3.0	9564.304 → 9836.614 →
-17.25	2.59	Gravel; 0.3-5.1 cm. gravel in brown-gray med-fine sand; last 5.1 cm. is mostly <5.1 cm. cobbles.						
-17.86	3.20							9787.402 →

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-13
LOCATION: Station 29
NORTHING (m): 617,417.2 **EASTING (m):** 1,890,064.0 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.1883′ **LONGITUDE:** 117°25.7631′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/24/03 **TIME BORING STARTED:** 1435 **COMPLETED:** 1443
SOUNDING (m): 15.67 **TIDE (m):** .94 **ELEVATION (m):** -14.7 **DATUM:** MLLW
PENETRATION (m): 4.57 **RECOVERY (m):** 3.96 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-14.7	0	Silty fine-grained Sand; dark gray; abundant shell frags; saturated, loose; irregular lower contacts		1	SM	99	35
-15.55	.82	Sand; med-fine grained; clean; med-light gray; mod. shell frags; loose.					
-15.83	1.10	Gravel; close-packed rounded <5.1 cm. pebbles in sand.					
-15.98	1.25	Sand; med-fine grained; clean; med-light gray; mod. shell frags; loose.		2	SP	96	2.0
-17.26	2.53	Sandy silt; black; cohesive; sulfidic; sharp lower contact.					
-17.5	2.77	Laminated black silt and fine sand; extremely micaceous; well-displayed horizontal lamination to thin-bedding; a few 0.3 cm. light gray sand layers; moist to rather dry; stiff weakly cohesive; lagoonal sediment.		3	ML	100	74
-18.69	3.96	No Recovery (pile driven?)		NS			
-19.3	4.57						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-14
LOCATION: Station 16
NORTHING (m): 617,734.5 **EASTING (m):** 1,890,419.7 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.3621′ **LONGITUDE:** 117°25.5364′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/24/03 **TIME BORING STARTED:** 1624 **COMPLETED:** 1630
SOUNDING (m): 13.72 **TIDE (m):** 1.16 **ELEVATION (m):** -12.6 **DATUM:** MLLW
PENETRATION (m): 3.81 **RECOVERY (m):** 3.32 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-12.5	0	Silty Sand; fine-grained, clean med-gray sand w/irregular patches of black, stiff silty sand; abundant shell frags.		1	SM	99	25
-13.08	.52	Gravel; <5.1 cm. rounded cobbles and shell hash in sand.					
-13.26	.70	Sand; med-fine grained; med-gray; clean.		2	SP	78	3.0
-13.72	1.16						
-13.87	1.31	Sand; med-fine grained; med-gray; clean; abundant shell hash.					
		Silty Sand; fine-grained; med-dark gray; trace shell frags; saturated; somewhat stiff.		3	SM	99	25
-15.3	2.74	Silty sand; dark gray; extremely micaceous; laminated; stiff; locally weakly plastic; almost dry.		4	SM	100	41
-15.61	3.05	Sand w/Silt; fine-grained; med-gray; a few <0.3 cm. black silty sand layers; moist.					
-15.88	3.32	No Recovery (pile-driven?)		NS			
-16.37	3.81						

Penetration Rate
Penetration Rate 40 80 120 160 sec/m
683.99

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-15
LOCATION: Station 23
NORTHING (m): 617,452.9 **EASTING (m):** 1,890,729.7 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.2116′ **LONGITUDE:** 117°25.3351′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/24/03 **TIME BORING STARTED:** 1734 **COMPLETED:** 1752
SOUNDING (m): 13.41 **TIDE (m):** 1.49 **ELEVATION (m):** -11.9 **DATUM:** MLLW
PENETRATION (m): 5.79 **RECOVERY (m):** 4.27 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-11.9	0	Sandy Silt; very fine grained; dark gray; micaceous; minor shells; saturated; loose		1	ML	100	54
-12.22	.3	Sandy Gravel; +/- 2.5 cm. rounded clasts in med-fine sand; abundant shell frags.					
-12.5	.58	Sand; med-fine grained; med-gray; clean.		2	SP	99	2.0
-13.44	1.52	Poorly Graded Sand; med-fine grained; med-gray; clean; abundant shell frags in lower 7.6 cm.		3	SP	100	2.0
-14.97	3.05	Silty Sand and Silt; greenish-black; micaceous; some thin-bedding and lamination; moist; sharp upper and lower contacts.					
-15.58	3.66	Sand; med-fine grained; greenish-gray; local silty interbeds and shell concentrations.		4	SM	99	32
-16.19	4.27	No Recovery (Pile-driven?)		NS			
-17.71	5.79						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
⊗246.063
⊗344.488
⊗1181.1
⊗393.701

REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

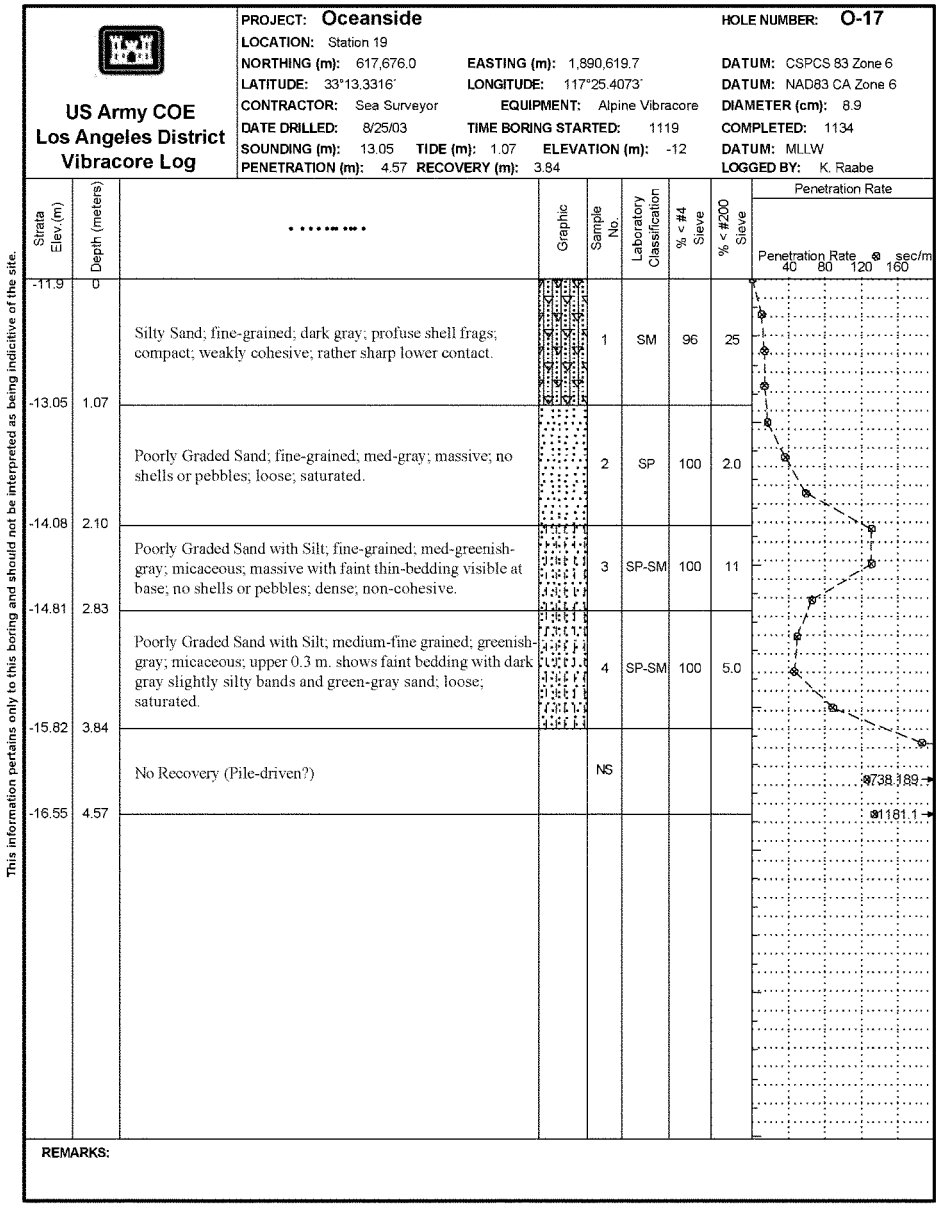
PROJECT: Oceanside **HOLE NUMBER:** O-16
LOCATION: Station 28
NORTHING (m): 617,226.4 **EASTING (m):** 1,890,690.1 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.0889′ **LONGITUDE:** 117°25.3587′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/25/03 **TIME BORING STARTED:** 0928 **COMPLETED:** 0958
SOUNDING (m): 14.08 **TIDE (m):** 1.25 **ELEVATION (m):** -12.8 **DATUM:** MLLW
PENETRATION (m): 4.57 **RECOVERY (m):** 3.35 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-12.8	0	Sand; med-fine sand w/minor silt; dark greenish-gray; profuse shell frags.						
-13.29	.46	Gravel; tight-packed +/-2.5 cm. rounded pebbles in sand w/ shells.		1	SP-SM	82	5.0	
-13.44	.61	Sand; med-fine grained; med-light brownish-gray; abundant shell frags; oyster shells are tightly-packed in sand making drilling/sampling difficult; no pebbles; sharp upper contact.						
-13.99	1.16	Poorly Graded Sand; med-grained; med-gray; mod-abundant shell (oyster) frags; no pebbles; micaceous.		2	SP	95	3.0	246.063
-14.72	1.89	Poorly Graded Sand; med-fine grained; med-gray; clean, homogeneous; no shells or pebbles; loose; sharp lower contact.		3	SP	100	2.0	246.063 984.252 1377.95
-15.88	3.05	Sandy Silt; black; laminated; interbedded w/green-gray med fine sand; very stiff; lagoonal.		4	ML	100	55	1639.764
-16.18	3.35	No Recovery (pile-driven?)		NS				1492.126
-17.4	4.57							1181.1

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS:

Figure


US Army COE
Los Angeles District
Vibracore Log
PROJECT: Oceanside
HOLE NUMBER: O-17
LOCATION: Station 19
NORTHING (m): 617,676.0
EASTING (m): 1,890,619.7
DATUM: CSPCS 83 Zone 6
LATITUDE: 33°13.3316'
LONGITUDE: 117°25.4073'
DATUM: NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor
EQUIPMENT: Alpine Vibracore
DIAMETER (cm): 8.9
DATE DRILLED: 8/25/03
TIME BORING STARTED: 1119
COMPLETED: 1134
SOUNDING (m): 13.05
TIDE (m): 1.07
ELEVATION (m): -12
DATUM: MLLW
PENETRATION (m): 4.57
RECOVERY (m): 3.84
LOGGED BY: K. Raabe
This information pertains only to this boring and should not be interpreted as being indicitive of the site.
Strata Elev.(m)
Depth (meters)
Graphic
Sample No.
Laboratory Classification
% < #4 Sieve
% < #200 Sieve
Penetration Rate
Penetration Rate sec/m
40 80 120 160
-11.9
0
Silty Sand; fine-grained; dark gray; profuse shell frags; compact; weakly cohesive; rather sharp lower contact.
1
SM
96
25
-13.05
1.07
Poorly Graded Sand; fine-grained; med-gray; massive; no shells or pebbles; loose; saturated.
2
SP
100
2.0
-14.08
2.10
Poorly Graded Sand with Silt; fine-grained; med-greenish-gray; micaceous; massive with faint thin-bedding visible at base; no shells or pebbles; dense; non-cohesive.
3
SP-SM
100
11
-14.81
2.83
Poorly Graded Sand with Silt; medium-fine grained; greenish-gray; micaceous; upper 0.3 m. shows faint bedding with dark gray slightly silty bands and green-gray sand; loose; saturated.
4
SP-SM
100
5.0
-15.82
3.84
No Recovery (Pile-driven?)
NS
9738.189
9181.1
-16.55
4.57
REMARKS:

Figure

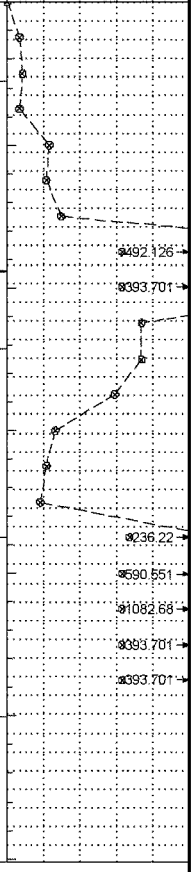
US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-18
LOCATION: Station 27
NORTHING (m): 617,420.6 **EASTING (m):** 1,891,019.9 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.1959′ **LONGITUDE:** 117°25.1479′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/25/03 **TIME BORING STARTED:** 1239 **COMPLETED:** 1301
SOUNDING (m): 11.95 **TIDE (m):** .79 **ELEVATION (m):** -11.2 **DATUM:** MLLW
PENETRATION (m): 6.10 **RECOVERY (m):** 4.57 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-11.1	0	Silty sand; dark greenish-gray; micaceous; loose, non-cohesive.					
-11.46	.3	Pebbly sand and gravel; med-fine sand w/trace dark silt; black, rounded pebbles, generally .6-5.1 cm., esp. near top;		1	SM	80	17
-11.83	.67	abundant shell hash in upper 0.3 m.					
		Poorly Graded Sand; med-fine grained; med-gray; massive; clean; trace shells; no pebbles; loose.		2	SP	100	2.0
-13.45	2.29						
		Silty sand; dark gray; micaceous; a few razor clams; dense; non-cohesive.		3	SM	100	13
-14.12	2.96						
-14.12	2.96	Sandy silt; black; micaceous; plastic; very stiff; almost dry.					
-14.73	3.57						
		Sand with silt; fine-grained micaceous sand with diffuse silty layers; dark greenish-gray.		4	SM	100	29
-15.52	4.36						
-15.73	4.57	Sandy silt; dark greenish-gray; intensely micaceous; plastic; very stiff and dense.					
		No Recovery (pile-driven?)		NS			
-17.26	6.10						

Penetration Rate



REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside			**HOLE NUMBER:** O-19
LOCATION: Station 34			
NORTHING (m): 616,924.7	**EASTING (m):** 1,891,079.6		**DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.9280'	**LONGITUDE:** 117°25.1059'		**DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor	**EQUIPMENT:** Alpine Vibracore		**DIAMETER (cm):** 8.9
DATE DRILLED: 8/25/03	**TIME BORING STARTED:** 1511		**COMPLETED:** 1532
SOUNDING (m): 12.65 **TIDE (m):** .76	**ELEVATION (m):** -11.9		**DATUM:** MLLW
PENETRATION (m): 3.35 **RECOVERY (m):** 2.23			**LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-11.8	0	Silty sand; black; saturated; non-cohesive.						
-12.16	.27	Sand; med-fine grained; med-gray; mod. shell frags; very dense, compacted.		1	SM	81	25	
-12.35	.46	Gravel; 0.3 cm. to 5.1 cm. rounded clasts in sand; very dense.						
-12.59	.70	Gravel; pebble/cobble layer in med-fine sand.						
-12.83	.94	Sand; med-fine grained; med-gray; clean; massive; minor shell frags; loose		2	SP	93	1.0	
-14.15	2.26	No Recovery (Pile-driven?)		NS				9787.402 → 9885.827 → 9787.402 → 9881.1 →
-15.24	3.35							

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

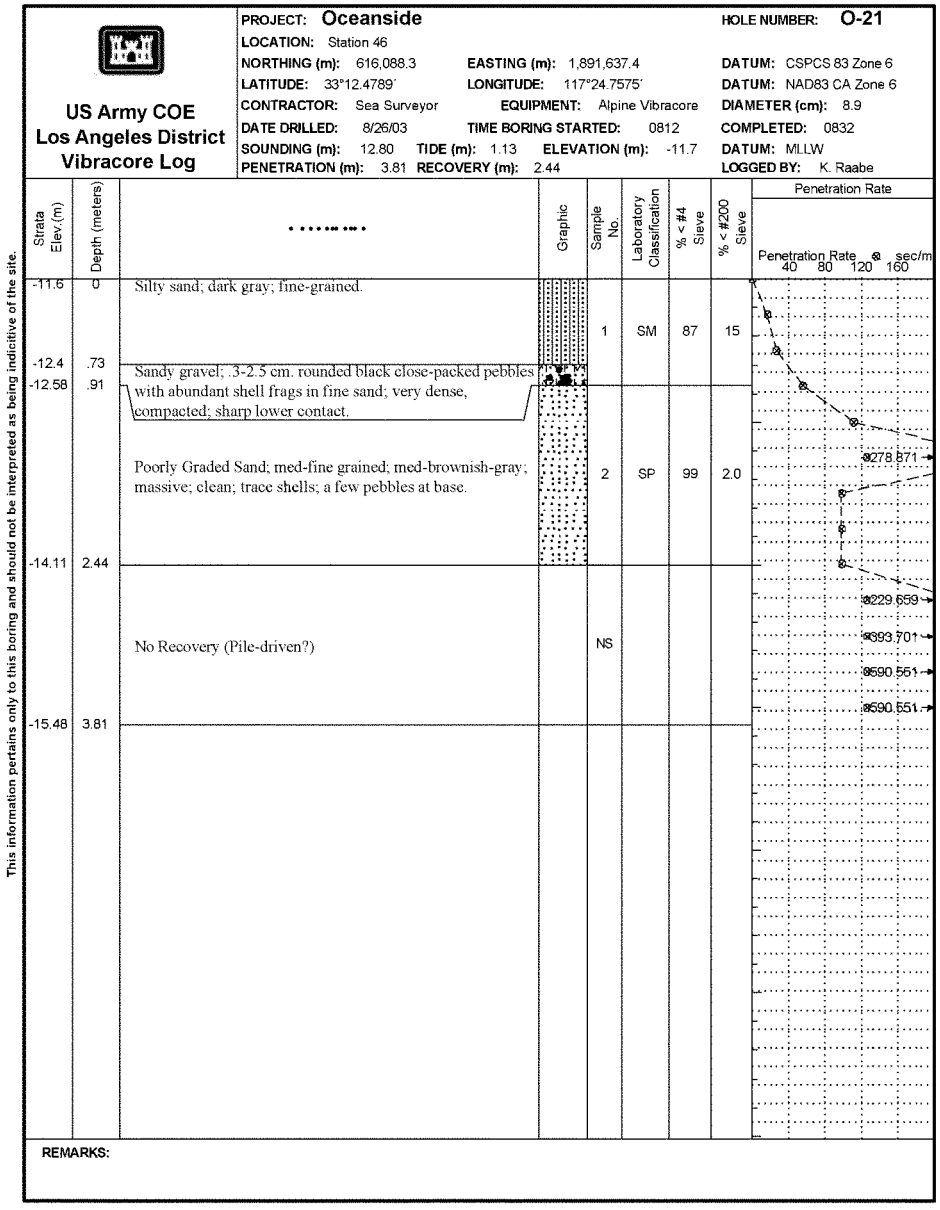
PROJECT: Oceanside — **HOLE NUMBER:** O-20
LOCATION: Station 36
NORTHING (m): 616,867.1 — **EASTING (m):** 1,891,314.3 — **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.8982′ — **LONGITUDE:** 117°24.9544′ — **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor — **EQUIPMENT:** Alpine Vibracore — **DIAMETER (cm):** 8.9
DATE DRILLED: 8/25/03 — **TIME BORING STARTED:** 1728 — **COMPLETED:** 1750
SOUNDING (m): 12.50 — **TIDE (m):** 1.34 — **ELEVATION (m):** -11.2 — **DATUM:** MLLW
PENETRATION (m): 4.27 — **RECOVERY (m):** 3.90 — **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-11.1	0	Silty sand; fine-grained; dark greenish-gray; mod. shells, esp toward base; dense; non-plastic.		1	SM	96	22	
-11.77	.61	Pebbly sand; green-gray; med fine sand w/.3-1.3 cm. pebbles; abundant shell hash at top; saturated; mod-loose.						
-12.01	.85	Poorly Graded Sand; med-fine grained; massive, homogeneous; no shells or pebbles; dense; saturated.		2	SP	100	2.0	9328.084
-13.54	2.38	Poorly Graded Sand; med-fine grained; massive, homogeneous; no shells or pebbles; dense; saturated.		3	SP	100	2.0	9328.084 9428.509 9590.551 9295.276 9393.701
-15.06	3.90	No Recovery (Pile-driven?)		NS				9984.252
-15.43	4.27							

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS:

Figure



US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: O-21
LOCATION: Station 46
NORTHING (m): 616,088.3
EASTING (m): 1,891,637.4
DATUM: CSPCS 83 Zone 6
LATITUDE: 33°12.4789'
LONGITUDE: 117°24.7575'
DATUM: NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor
EQUIPMENT: Alpine Vibracore
DIAMETER (cm): 8.9
DATE DRILLED: 8/26/03
TIME BORING STARTED: 0812
COMPLETED: 0832
SOUNDING (m): 12.80
TIDE (m): 1.13
ELEVATION (m): -11.7
DATUM: MLLW
PENETRATION (m): 3.81
RECOVERY (m): 2.44
LOGGED BY: K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-11.6	0	Silty sand; dark gray; fine-grained.		1	SM	87	15
-12.4	.73	Sandy gravel; .3-2.5 cm. rounded black close-packed pebbles with abundant shell frags in fine sand; very dense, compacted; sharp lower contact.					
-12.58	.91	Poorly Graded Sand; med-fine grained; med-brownish-gray; massive; clean; trace shells; a few pebbles at base.		2	SP	99	2.0
-14.11	2.44	No Recovery (Pile-driven?)		NS			
-15.48	3.81						

Penetration Rate
Penetration Rate @ sec/m
40 80 120 160
@278.871
@229.659
@393.701
@590.551
@590.551

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-22
LOCATION: Station 47
NORTHING (m): 615,787.1 **EASTING (m):** 1,891,258.8 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.3137′ **LONGITUDE:** 117°24.9823′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/26/03 **TIME BORING STARTED:** 1028 **COMPLETED:** 1048
SOUNDING (m): 15.30 **TIDE (m):** 1.28 **ELEVATION (m):** -14 **DATUM:** MLLW
PENETRATION (m): 2.90 **RECOVERY (m):** 2.90 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-14.0	0	Silty Sand; fine-grained; dark gray; mod. shell frags; very dense, compact.		1	SM	96	28	
-14.54	.52	Sandy Gravel; fine-grained dark gray sand with <2.5 cm.						
-14.72	.70	black pebbles; abundant shell frags; dense, compacted.						
		Poorly Graded Sand; med-fine grained; med-gray; loose; minor shells.		2	SP	100	2.0	
-15.82	1.80	Gravel; pebble/cobbles with abundant shell frags in sand.						
-15.94	1.92	Sand; med-fine grained; med-gray; loose; minor shells.						
-16.31	2.29	Gravel; pebble/cobbles with abundant shell frags in sand.		3	SP	82	2.0	@295.276
-16.45	2.43	Sand; med-fine grained; med-gray; loose; minor shells.						
-16.61	2.59	Gravel; pebble/cobbles with abundant shell frags in sand.						@1377.95
-16.92	2.90							@1771.65

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

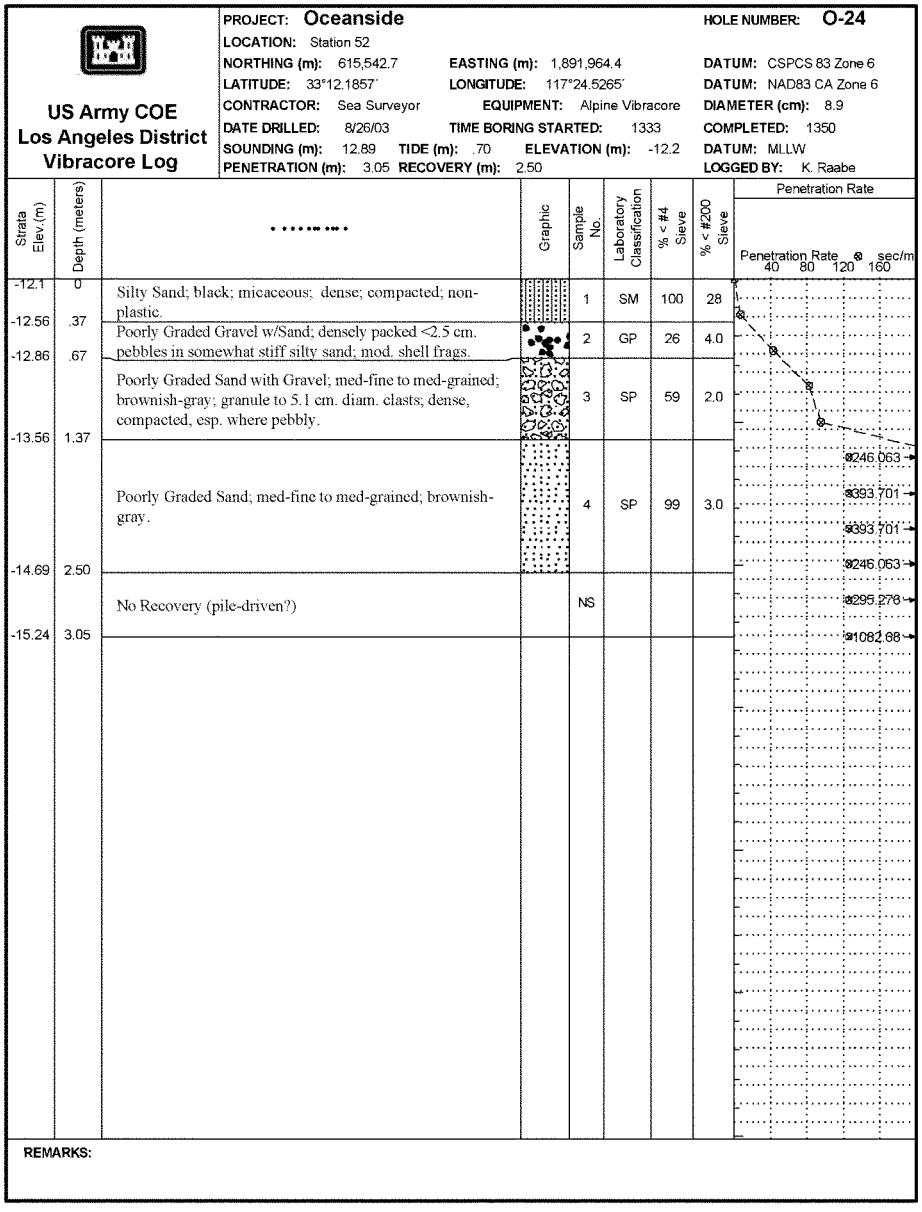
PROJECT: Oceanside **HOLE NUMBER:** O-23
LOCATION: Station 49
NORTHING (m): 615,432.1 **EASTING (m):** 1,891,211.6 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.1213′ **LONGITUDE:** 117°25.0102′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/26/03 **TIME BORING STARTED:** 1157 **COMPLETED:** 1217
SOUNDING (m): 16.15 **TIDE (m):** 1.07 **ELEVATION (m):** -15.1 **DATUM:** MLLW
PENETRATION (m): 5.33 **RECOVERY (m):** 3.14 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m, 40 80 120 160)
-15.0	0	Silty Sand; fine-grained; black; mod-abundant shell frags; upper 0.3 m. is somewhat stiff, weakly plastic, w/ several live worms.		1	SM	100	30	
-15.72	.64	Sandy Gravel with Silt; generally 0.3-2.5 cm. rounded black pebbles in med-fine sand.						
-16.06	.98	Sand; med-fine-grained; med-gray to brownish-gray; salt and pepper; shell frags very minor to trace; rather dense, compacted (by vibracore?).		2	SP-SM	89	8.0	
-16.91	1.83	Sand; med-fine-grained; med-gray to brownish-gray; salt and pepper; shell frags very minor to trace; rather dense, compacted (by vibracore?).		3	SP	94	2.0	223.097
-17.61	2.53	Sandy gravel; generally 0.3-2.5 cm. rounded black pebbles in med-fine sand.						344.488
-17.76	2.68							885.827
-17.95	2.87	Sand; med-fine-grained; med-gray to brownish-gray; salt and pepper; shell frags very minor to trace; rather dense, compacted (by vibracore?).		4	SM	100	30	393.701
-18.22	3.14	Silty Sand; black; sandy silt laminae interbedded w/silty sand and fine-grained sand; weakly plastic; stiff; dry.						
		No Recovery (pile-driven?)		NS				
-20.41	5.33							1148.29

REMARKS:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure



US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: O-24
LOCATION: Station 52
NORTHING (m): 615,542.7
EASTING (m): 1,891,964.4
DATUM: CSPCS 83 Zone 6
LATITUDE: 33°12.1857'
LONGITUDE: 117°24.5265'
DATUM: NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor
EQUIPMENT: Alpine Vibracore
DIAMETER (cm): 8.9
DATE DRILLED: 8/26/03
TIME BORING STARTED: 1333
COMPLETED: 1350
SOUNDING (m): 12.89
TIDE (m): .70
ELEVATION (m): -12.2
DATUM: MLLW
PENETRATION (m): 3.05
RECOVERY (m): 2.50
LOGGED BY: K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-12.1	0	Silty Sand; black; micaceous; dense; compacted; non-plastic.		1	SM	100	28	
-12.56	.37	Poorly Graded Gravel w/Sand; densely packed <2.5 cm. pebbles in somewhat stiff silty sand; mod. shell frags.		2	GP	26	4.0	
-12.86	.67	Poorly Graded Sand with Gravel; med-fine to med-grained; brownish-gray; granule to 5.1 cm. diam. clasts; dense, compacted, esp. where pebbly.		3	SP	59	2.0	
-13.56	1.37	Poorly Graded Sand; med-fine to med-grained; brownish-gray.		4	SP	99	3.0	246.063 393.701 393.701 246.063
-14.69	2.50	No Recovery (pile-driven?)		NS				295.276
-15.24	3.05							1082.68

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-25
LOCATION: Station 51
NORTHING (m): 615,770.7 **EASTING (m):** 1,892,004.1 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.3093′ **LONGITUDE:** 117°24.5026′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/26/03 **TIME BORING STARTED:** 1453 **COMPLETED:** 1510
SOUNDING (m): 11.64 **TIDE (m):** .58 **ELEVATION (m):** -11.1 **DATUM:** MLLW
PENETRATION (m): 3.66 **RECOVERY (m):** 2.83 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-11.0	0	Silty Sand; fine-grained; dark gray; micaceous; trace shell frags; dense.		1	SM	100	19
-11.97	.91	Silty Sand with pebbles/cobbles and shells.		2	SM	81	15
-12.25	1.19	Sand; fine-grained; med-brownish-gray; clean; loose.					
-13.1	2.04	Silty Sand; very fine grained to fine grained; dark gray; sulfidic odor; loose to somewhat compact.		3	SM	100	18
-13.89	2.83	No Recovery (pile-driven?)		NS			
-14.72	3.66						

Penetration Rate
Penetration Rate @ sec/m
40 80 120 160
9246.063
8393.701
9787.402
9590.551
9108268

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS:

Figure

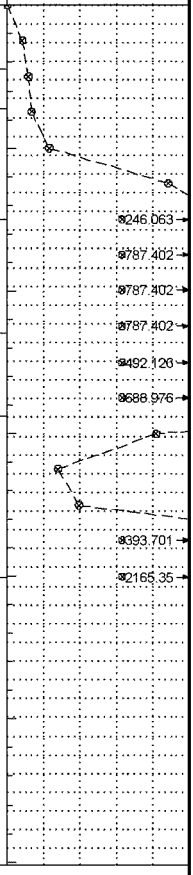
US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** O-26
LOCATION: Station 42
NORTHING (m): 616,236.1 **EASTING (m):** 1,891,476.2 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.5579′ **LONGITUDE:** 117°24.8457′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** Alpine Vibracore **DIAMETER (cm):** 8.9
DATE DRILLED: 8/26/03 **TIME BORING STARTED:** 1623 **COMPLETED:** 1703
SOUNDING (m): 12.74 **TIDE (m):** .82 **ELEVATION (m):** -11.9 **DATUM:** MLLW
PENETRATION (m): 4.88 **RECOVERY (m):** 3.51 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-11.9	0	Silty Sand; dark gray; minor shells; compacted; rather sharp lower contact.		1	SM	100	31
-12.47	.55	Poorly Graded Sand with Gravel; <2.5 cm. rounded pebbles in fine sand; compact.		2	SP	52	3.0
-12.8	.88	Poorly Graded Sand; med-fine grained; light gray; clean; no shells or pebbles; loose to compacted.		3	SP	100	2.0
-13.75	1.83	Poorly Graded Sand; med-fine grained; light gray; clean; no shells or pebbles; loose to compacted.		4	SP	100	3.0
-14.72	2.80	Silty Sand w/Gravel; fine sand with stiff black plastic silt and 0.3-5.1 cm. black pebbles/cobbles.		5	SM	85	31
-14.88	2.96	Silty Sand; med-gray micaceous silty sand and layers of dry, plastic, cohesive sandy silt.					
-15.43	3.51	No Recovery (pile-driven?)		NS			
-16.8	4.88						

Penetration Rate



REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-1
LOCATION:
NORTHING (m): 617,262 **EASTING (m):** 1,890,185 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.1050′ **LONGITUDE:** 117°25.6843′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. Pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/22/03 **TIME BORING STARTED:** 1433 **COMPLETED:** 1453
SOUNDING (m): 15.24 **TIDE (m):** 0.88 **ELEVATION (m):** -14.4 **DATUM:** MLLW
PENETRATION (m): 6.10 **RECOVERY (m):** 5.79 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-14.3	0	No Sample		NS			
-14.66	.30	Poorly Graded Sand with Silt; fine-grained; light gray; micaceous; minor shell frags; widely scattered <1.3 cm. pebbles		1	SP-SM	100.0	12.0
-15.58	1.22	Same as .3-1.22 m.		2			
-16.49	2.13	Poorly Graded Sand with Silt; fine-grained; light gray; micaceous; minor shell frags; widely scattered <1.3 cm. pebbles; a concentration of <1.3 cm. pebbles from 2.29-2.59 cm.		3	SP-SM	91.0	6.0
-17.41	3.05	Poorly Graded Sand; med-fine grained; light gray; micaceous; minor shell frags; widely scattered <1.3 cm pebbles; two +/- 33 cm. cobbles at 3.20 m.		4	SP	100.0	4.0
-18.32	3.96	Poorly Graded Sand; med-fine grained; light gray; micaceous; minor shell frags; widely scattered <1.3 cm. pebbles.		5	SP	100.0	4.0
-19.24	4.88	Poorly Graded Sand; med-fine grained; light gray; micaceous; minor shell frags; widely scattered <1.3 cm. pebbles; Same as 3.96-4.88 m.		6			
-19.94	5.58	Silty Sand; med-gray; micaceous; at 5.64 m. a thick dark brown decomposed woody layer.		7			
-20.15	5.79	Silty Sand to Sandy Silt; med- gray; stiff; sulfidic odor.		8			
-20.46	6.10						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: Samples 2,6,7, and 8 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-2
LOCATION:
NORTHING (m): 616,967 **EASTING (m):** 1,890,448 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.9472′ **LONGITUDE:** 117°25.5129′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800lb. Pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/23/03 **TIME BORING STARTED:** 1545 **COMPLETED:** 1551
SOUNDING (m): 14.63 **TIDE (m):** .74 **ELEVATION (m):** -13.9 **DATUM:** MLLW
PENETRATION (m): 3.05 **RECOVERY (m):** 5.18 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-13.8	0	Poorly graded sand; brownish gray; minor <2.5 cm. rounded black pebbles		1	SP	93.0	2.0
-14.5	.61	Same as 0-.61 m.		2			
-15.41	1.52	Poorly graded sand with gravel; dense-packed 2.5-5.1 cm. pebbles in brown-gray sand		3	SP	52.0	2.0
-16.33	2.44	Pebble-cobble layer with interstitial med-fine sand		4			
-16.94	3.05						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
629.921

REMARKS: Samples 2 and 4 not analyzed.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-3
LOCATION:
NORTHING (m): 616,706 **EASTING (m):** 1,890,665 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.8070′ **LONGITUDE:** 117°25.3714′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. Pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/22/03 **TIME BORING STARTED:** 1600 **COMPLETED:** 1620
SOUNDING (m): 14.02 **TIDE (m):** .37 **ELEVATION (m):** -13.7 **DATUM:** MLLW
PENETRATION (m): 4.57 **RECOVERY (m):** 4.88 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-13.6	0	Same as .91-1.83 m.		1			
-14.56	.91	Poorly graded sand; med fine grained; med-light gray; homogeneous; clean; minor shell fragments		2	SP	100.0	3.0
-15.48	1.83	Same as .91-1.83 m.		3			
-16.39	2.74	Same as 3.35-4.11 m.		4			
-17	3.35	Poorly graded sand; minor scattered black rounded 0.6 cm. pebbles		5	SP	96.0	4.0
-17.76	4.11	Poorly graded sand w/gravel; <2.54 cm. rounded black pebbles in sand; sharp lower contact.		6	SP	80.0	2.0
-18.07	4.42	<5.1 cm. gravel in coarse sand and shell hash.		7			
-18.22	4.57						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
⊗347.769

REMARKS: Samples 1,3,4, and 7 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: **Oceanside** HOLE NUMBER: **SO9-5**
LOCATION:
NORTHING (m): 615,637 EASTING (m): 1,891,059 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°12.2314′ LONGITUDE: 117°25.1096′ DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic EQUIPMENT: 800 lb. Pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/21/03 TIME BORING STARTED: 0755 COMPLETED: 0810
SOUNDING (m): 16.15 TIDE (m): 1.22 ELEVATION (m): -14.9 DATUM: MLLW
PENETRATION (m): 6.1 RECOVERY (m): 5.27 LOGGED BY: K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-14.9	0	No Recovery		NS			
-15.75	.82	Poorly graded med-fine grained sand; abundant shell fragments; mod. 1.3 cm. pebbles		1	SP	100.0	4.0
-16.76	1.83	Same as .82-1.83 cm., except rounded +/-7.6 vm cobbles at 2.83 m. and 2.59 m.; shell hash in lower .30 m.; sharp lower contact.		2			
-17.76	2.83	Same as 3.66-4.57 m.		3			
-18.59	3.66	Poorly graded fine sand; brownish gray; trace <1.3 cm. pebbles; homogeneous		4	SP	100.0	2.0
-19.5	4.57	Same as 3.66-4.57 m.		5			
-20.42	5.49	Same as 3.66-4.57 m.		6			
-21.03	6.1						

Penetration Rate
Penetration Rate @ sec/m
40 80 120 160

REMARKS: Samples 2,3,5, and 6 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-7
LOCATION:
NORTHING (m): 615,097.4 **EASTING (m):** 1,892,066.9 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.9454′ **LONGITUDE:** 117°24.4574′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/25/03 **TIME BORING STARTED:** 1233 **COMPLETED:** 1236
SOUNDING (m): 13.72 **TIDE (m):** .64 **ELEVATION (m):** -13.1 **DATUM:** MLLW
PENETRATION (m): 3.96 **RECOVERY (m):** 3.96 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-13.0	0	Poorly graded sand w/silt; med. gray; mod. dense; moderate local shell frag concentrations.		1	SP-SM	100.0	10.0
-13.99	.91	Same as 0-.91 m.		2			
-14.6	1.52	Silty sand w/gravel; compact; dense; abundant shell frags		3	SM	72.0	22.0
-15.21	2.13	Poorly graded gravel w/sand; dense-packed <5.1 cm. pebbles		4	GP	30.0	4.0
-15.82	2.74	Poorly graded med-fine sand; scattered pebbles; minor shell frags.		5	SP	90.0	4.0
-16.43	3.35	Same as 2.74-3.35 m.		6			
-17.04	3.96						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
429.79

REMARKS: No visibility at end of run TD=3.96 m? Samples 2 and 6 not analyzed.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-8
LOCATION:
NORTHING (m): 614,791 **EASTING (m):** 1,891,763 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.7777′ **LONGITUDE:** 117°24.6494′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/25/03 **TIME BORING STARTED:** 0923 **COMPLETED:** 0934
SOUNDING (m): 16.76 **TIDE (m):** .40 **ELEVATION (m):** -16.4 **DATUM:** MLLW
PENETRATION (m): 4.88 **RECOVERY (m):** 4.88 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-16.3	0	Poorly graded sand; med. fine; brownish gray; massive; micaceous		1	SP	100.0	4.0
-17.27	.91	Same as 0-.91 m.; gradational lower contact.		2			
-18.19	1.83	Poorly graded sand; med. coarse; gray brown; no pebbles.		3	SP	100.0	2.0
-18.79	2.43	Same as 1.83-2.43 m.; gradational lower contact.		4			
-19.41	3.05	Poorly graded sand; gray brown; coarse grained; mod dense; minor shell frags.		5	SP	100.0	2.0
-20.02	3.66	Same as 3.05-3.66 m., but becoming pebbly		6			
-20.63	4.27	Poorly graded gravel; 1.3-2.5 cm. pebbles; minor shells; loose		7	GP	11.0	0.0
-21.24	4.88						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
⊗246.063
⊗282.152
⊗321.522
⊗272.31

REMARKS: Samples 2,4, and 6 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: **Oceanside** HOLE NUMBER: **SO9-11**
LOCATION:
NORTHING (m): 617,204 EASTING (m): 1,890,906 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°13.0779' LONGITUDE: 117°25.2195' DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/21/03 TIME BORING STARTED: 1325 COMPLETED: 1345
SOUNDING (m): 12.8 TIDE (m): 1.1 ELEVATION (m): -11.7 DATUM: MLLW
PENETRATION (m): 5.33 RECOVERY (m): 5.33 LOGGED BY: K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-11.7	0	Cobble layer; <7.6 cm. rounded tight-packed black clasts, shell hash in med-fine sand		1			
-12.16	.46	Same as 1.22-2.13 m.		2			
-12.92	1.22	Poorly graded sand w/silt; fine-grained; minor shells; homogeneous; gray		3	SP-SM	98.0	6.0
-13.83	2.13	Poorly graded sand w/silt; fine-grained; minor shells; homogeneous; gray		4			
-14.13	2.43	Poorly graded sand w/silt and gravel; fine-grained; minor shells; scattered 2.5-5.1 cm. rounded cobbles; gray					
-14.44	2.74	Poorly graded sand w/silt; fine-grained; minor shells; homogeneous; gray					
-14.75	3.05	Same as 1.22-2.13 m.		5			
-15.66	3.96	Same as 1.22-2.13 m.		6			
-16.73	5.03	Silty sand; very fine grained; dark gray; stiff; lower 7.6 cm. plastic; mod sulfidic odor.		7			
-17.03	5.33						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
472.441
301.837
413.386
249.344
833.333

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS: Samples 1,2,4,5,6, and 7 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-13
LOCATION:
NORTHING (m): 616,431 **EASTING (m):** 1,891,340 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.6626′ **LONGITUDE:** 117°24.9344′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/21/03 **TIME BORING STARTED:** 1111 **COMPLETED:** 1131
SOUNDING (m): 13.41 **TIDE (m):** 1.77 **ELEVATION (m):** -11.6 **DATUM:** MLLW
PENETRATION (m): 4.57 **RECOVERY (m):** 5.79 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-11.6	0	Poorly graded sand; fine grained; brown-gray; clean; abundant shells in upper 15.2 cm.		1	SP	90.0	4.0
-12.1	.46	Gravel; rounded <2.5 cm. black pebbles in fine sand; sharp lower contact.					
-12.4	.76	Poorly graded sand; fine grained; homogeneous		2	SP	100.0	2.0
-13.16	1.52	Poorly graded sand; abundant shell frags.		3	SP	93.0	2.0
-13.62	1.98	Poorly graded sand with gravel; <2.5 cm. rounded black pebbles.					
-13.93	2.29	Poorly graded sand; green gray; fine grained; mod-minor shells; homogeneous		4	SP	99.0	3.0
-14.69	3.05	Same as 2.29-3.05 m.		5			
-15.6	3.96	Same as 2.29-3.05 m; shells increasing in lower .91 m.		6			
-16.21	4.57						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
9209.974

REMARKS: Refusal @ .61 m. on first try. Second try refused @ 4.57 m. Samples 5 and 6 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-14
LOCATION:
NORTHING (m): 615,925 **EASTING (m):** 1,891,906 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.3924′ **LONGITUDE:** 117°24.5668′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/21/03 **TIME BORING STARTED:** 0940 **COMPLETED:** 1005
SOUNDING (m): 12.5 **TIDE (m):** 1.74 **ELEVATION (m):** -10.8 **DATUM:** MLLW
PENETRATION (m): 4.11 **RECOVERY (m):** 4.11 **LOGGED BY:** K. Raabe

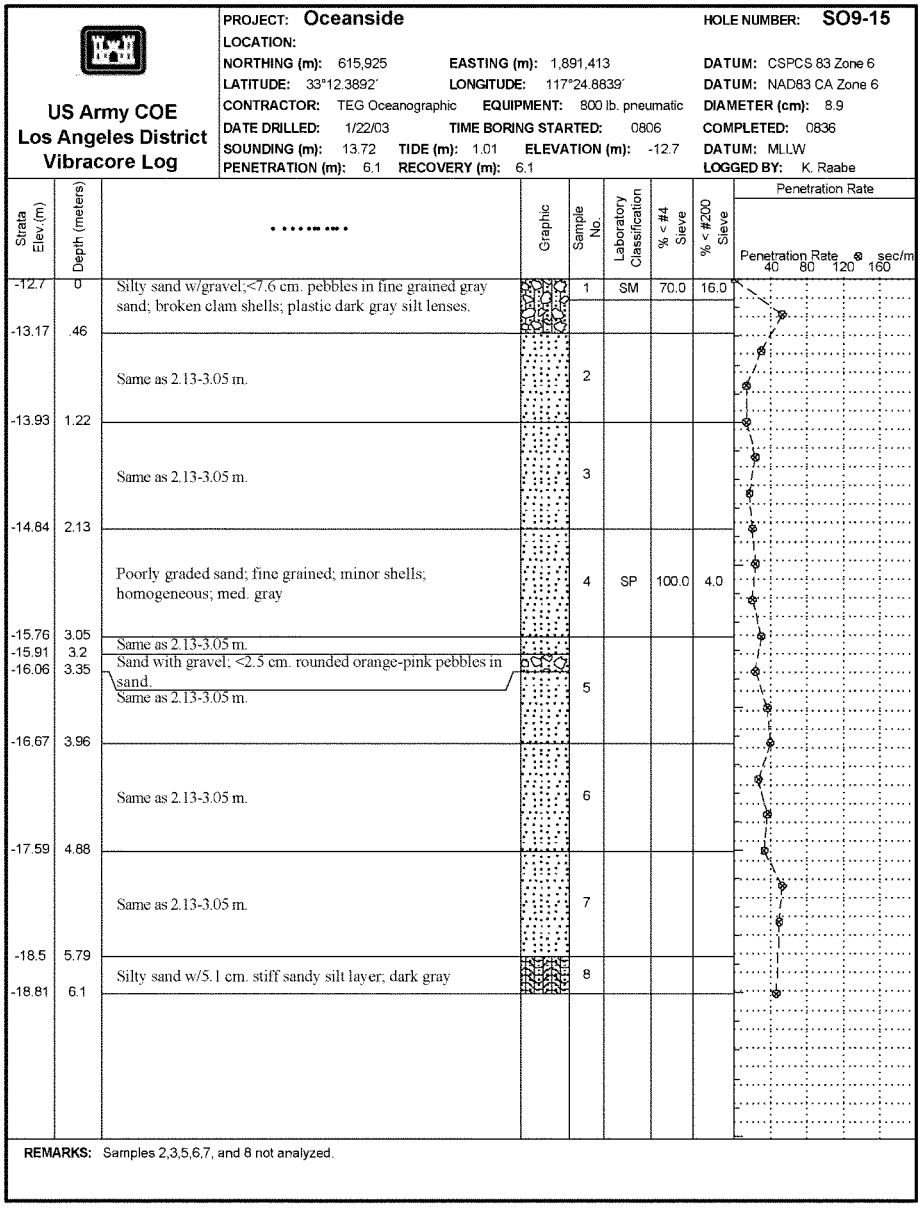
This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-10.7	0	Poorly graded sand w/silt; mod. shell frags		1	SP-SM	100.0	5.0
-11.67	.91	Same as 0-.91 m.		2	SP-SM	100.0	5.0
-12.59	1.83	Same as 0-.91 m.; gradual increase in grain size with depth		3	SP-SM	100.0	5.0
-13.5	2.74	Same as 0-.91 m.; gradual increase in grain size w/ depth		4	SP-SM	100.0	5.0
-14.17	3.41	Poorly graded sand; med-fine grained; abundant shells		5	SP	100.0	3.0
-14.72	3.96			6			
-14.87	4.11	Silty sand w/pebbles; mod shell frags.					

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
209.974
229.659
400.262
282.152
406.824

REMARKS: Sample 6 not analyzed.

Figure



US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SO9-15
LOCATION:
NORTHING (m): 615,925 EASTING (m): 1,891,413 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°12.3892′ LONGITUDE: 117°24.8839′ DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/22/03 TIME BORING STARTED: 0806 COMPLETED: 0836
SOUNDING (m): 13.72 TIDE (m): 1.01 ELEVATION (m): -12.7 DATUM: MLLW
PENETRATION (m): 6.1 RECOVERY (m): 6.1 LOGGED BY: K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-12.7	0	Silty sand w/gravel;<7.6 cm. pebbles in fine grained gray sand; broken clam shells; plastic dark gray silt lenses.		1	SM	70.0	16.0
-13.17	.46	Same as 2.13-3.05 m.		2			
-13.93	1.22	Same as 2.13-3.05 m.		3			
-14.84	2.13	Poorly graded sand; fine grained; minor shells; homogeneous; med. gray		4	SP	100.0	4.0
-15.76	3.05	Same as 2.13-3.05 m.					
-15.91	3.2	Sand with gravel; <2.5 cm. rounded orange-pink pebbles in sand.		5			
-16.06	3.35	Same as 2.13-3.05 m.					
-16.67	3.96	Same as 2.13-3.05 m.		6			
-17.59	4.88	Same as 2.13-3.05 m.		7			
-18.5	5.79	Silty sand w/5.1 cm. stiff sandy silt layer; dark gray		8			
-18.81	6.1						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: Samples 2,3,5,6,7, and 8 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-16
LOCATION:
NORTHING (m): 617,906 **EASTING (m):** 1,890,442 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.4451′ **LONGITUDE:** 117°25.5236′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/21/03 **TIME BORING STARTED:** 1500 **COMPLETED:** 1525
SOUNDING (m): 12.8 **TIDE (m):** .4 **ELEVATION (m):** -12.4 **DATUM:** MLLW
PENETRATION (m): 3.2 **RECOVERY (m):** 5.94 **LOGGED BY:** K. Raabe

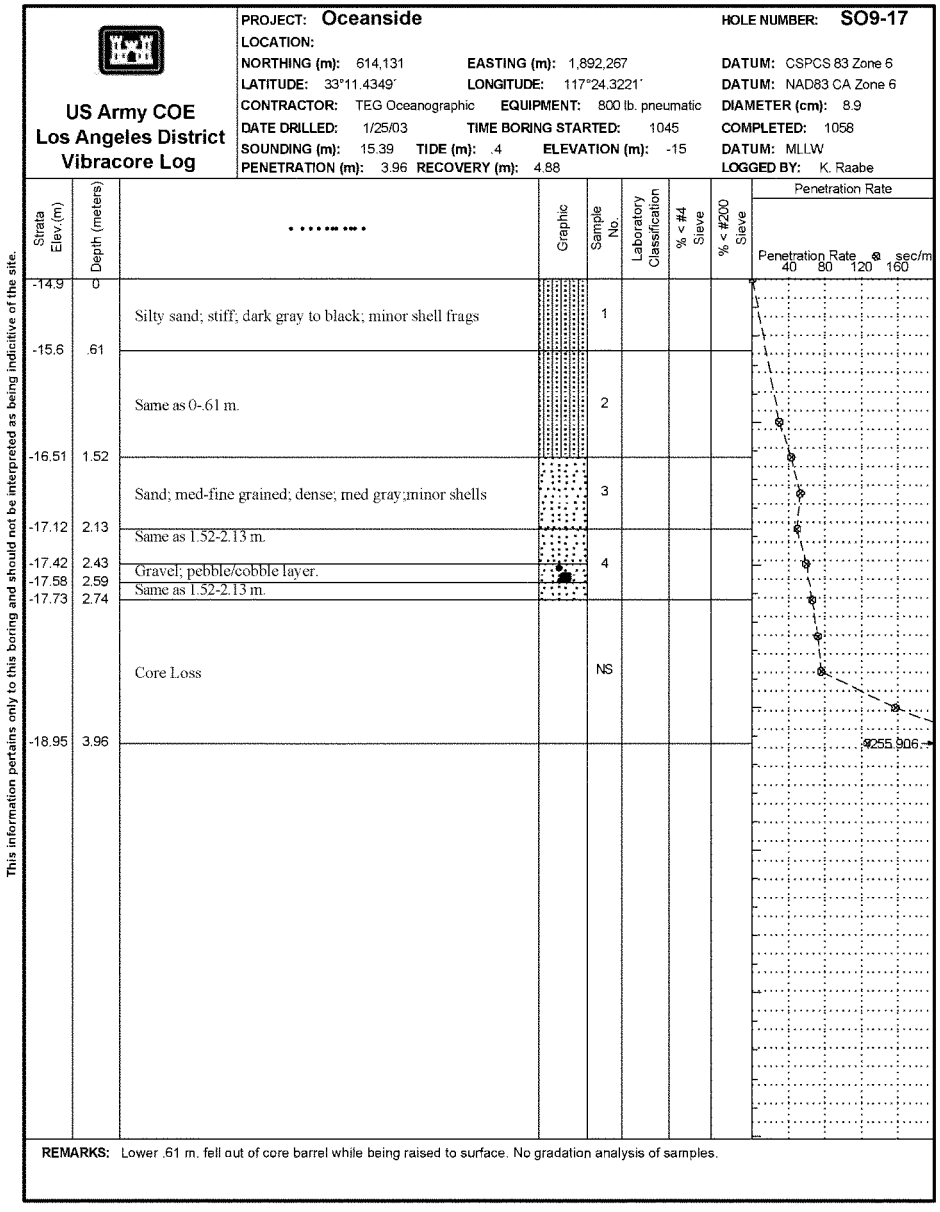
This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-12.4	0	Silty sand; very fine grained; dark gray;minor shells, except for lower 7.6 cm.		1	SM	100	41
-12.7	.3	Same as .91-1.83 m.; minor shells		2			
-13.31	.91	Poorly graded sand; fine grained; 15 cm. shell hash layer at base; light gray		3	SP	100.0	3.0
-14.23	1.83	Silty sand; sulfidic odor dark gray; somewhat plastic		4			
-15.14	2.74	Clean sand; fine grained; gray green color		5			
-15.6	3.2						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
557.743

REMARKS: Refusal on first 2 attempts @ .61 ft. depth. Third try refusal @ 3.2 m. Samples 2, 4, and 5 not analyzed.

Figure



US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SO9-17
LOCATION:
NORTHING (m): 614,131 EASTING (m): 1,892,267 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°11.4349′ LONGITUDE: 117°24.3221′ DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/25/03 TIME BORING STARTED: 1045 COMPLETED: 1058
SOUNDING (m): 15.39 TIDE (m): .4 ELEVATION (m): -15 DATUM: MLLW
PENETRATION (m): 3.96 RECOVERY (m): 4.88 LOGGED BY: K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-14.9	0	Silty sand; stiff; dark gray to black; minor shell frags		1			
-15.6	.61	Same as 0-.61 m.		2			
-16.51	1.52	Sand; med-fine grained; dense; med gray;minor shells		3			
-17.12	2.13	Same as 1.52-2.13 m.		4			
-17.42	2.43	Gravel; pebble/cobble layer.					
-17.58	2.59	Same as 1.52-2.13 m.					
-17.73	2.74	Core Loss		NS			
-18.95	3.96						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
255 906

REMARKS: Lower .61 m. fell out of core barrel while being raised to surface. No gradation analysis of samples.

Figure

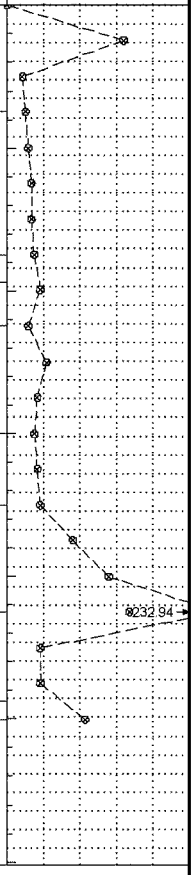
US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** SO9-18
LOCATION:
NORTHING (m): 615,452 — **EASTING (m):** 1,890,800 — **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.1296′ — **LONGITUDE:** 117°25.2752′ — **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic — **EQUIPMENT:** 800 lb. pneumatic — **DIAMETER (cm):** 8.9
DATE DRILLED: 1/25/03 — **TIME BORING STARTED:** 0803 — **COMPLETED:** 0809
SOUNDING (m): 16.61 — **TIDE (m):** 0.58 — **ELEVATION (m):** -16 — **DATUM:** MLLW
PENETRATION (m): 6.1 — **RECOVERY (m):** 6.1 — **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-16.0	0	Same as .91-2.13 m.		1			
-16.94	.91	Poorly graded sand; med-fine grained; scattered shell fragments; med gray color; mod. dense.		2	SP	100.0	3.0
-18.16	2.13	Poorly graded sand; as above w/mod. <6.4 cm. rounded black pebbles; mod. dense		3	SP	88.0	1.0
-18.77	2.74	Poorly graded sand; med-fine grained		4	SP	100.0	2.0
-19.69	3.66	Poorly graded sand w/gravel; fine to coarse sand; scattered <2.5 cm. pebbles; abundant shell frags.		5	SP	77.0	2.0
-20.3	4.27	Poorly graded sand; med-fine grained; homogeneous; mod. dense		6	SP	98.0	2.0
-21.21	5.18	Same as 4.27-5.18 m.		7			
-21.97	5.94	Poorly graded gravel w/sand; dense-packed +/- 2.5 cm. pebbles in med. sand.		8	GP	23.0	0.0
-22.13	6.1						

Penetration Rate



REMARKS: Samples 1, 7, and 8 not analyzed.

Figure

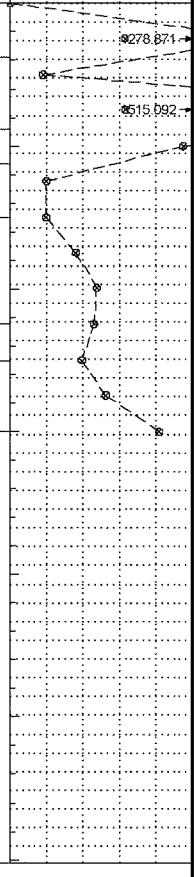
US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-19
LOCATION:
NORTHING (m): 617,210 **EASTING (m):** 1,891,155 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.0828′ **LONGITUDE:** 117°25.0594′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/22/03 **TIME BORING STARTED:** 1010 **COMPLETED:** 1040
SOUNDING (m): 12.19 **TIDE (m):** 1.49 **ELEVATION (m):** -10.7 **DATUM:** MLLW
PENETRATION (m): 3.66 **RECOVERY (m):** 5.18 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-10.7	0	Poorly graded gravel w/sand;<7.6 cm. cobbles/pebbles in fine sand; upper 9 cm. is shell hash and fine sand.		1	GP	20.0	1.0
-11.16	.46	Poorly graded sand w/silt; med-fine sand; mod.shells; light gray.		2	SP-SM	100.0	5.0
-11.77	1.07	Poorly graded sand w/gravel; med-fine sand with scattered <2.5 cm. rounded pebbles; light gray		3	SP	82.0	4.0
-12.53	1.83	Same as 1.07-1.83 m.		4			
-13.44	2.74	Poorly graded gravel w/sand; clast-supported <=7.6 cm. rounded cobbles/pebbles.		5	GP	32.0	1.0
-13.75	3.05	Poorly graded sand w/gravel; clast-supported <=7.6 cm. rounded cobbles/pebbles; increase in cobbles from above unit.		6	SP	61.0	2.0
-14.36	3.66						

Penetration Rate



REMARKS: Met surface refusal on first 2 attempts. Upper .61 m penetrated twice. Sample 4 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

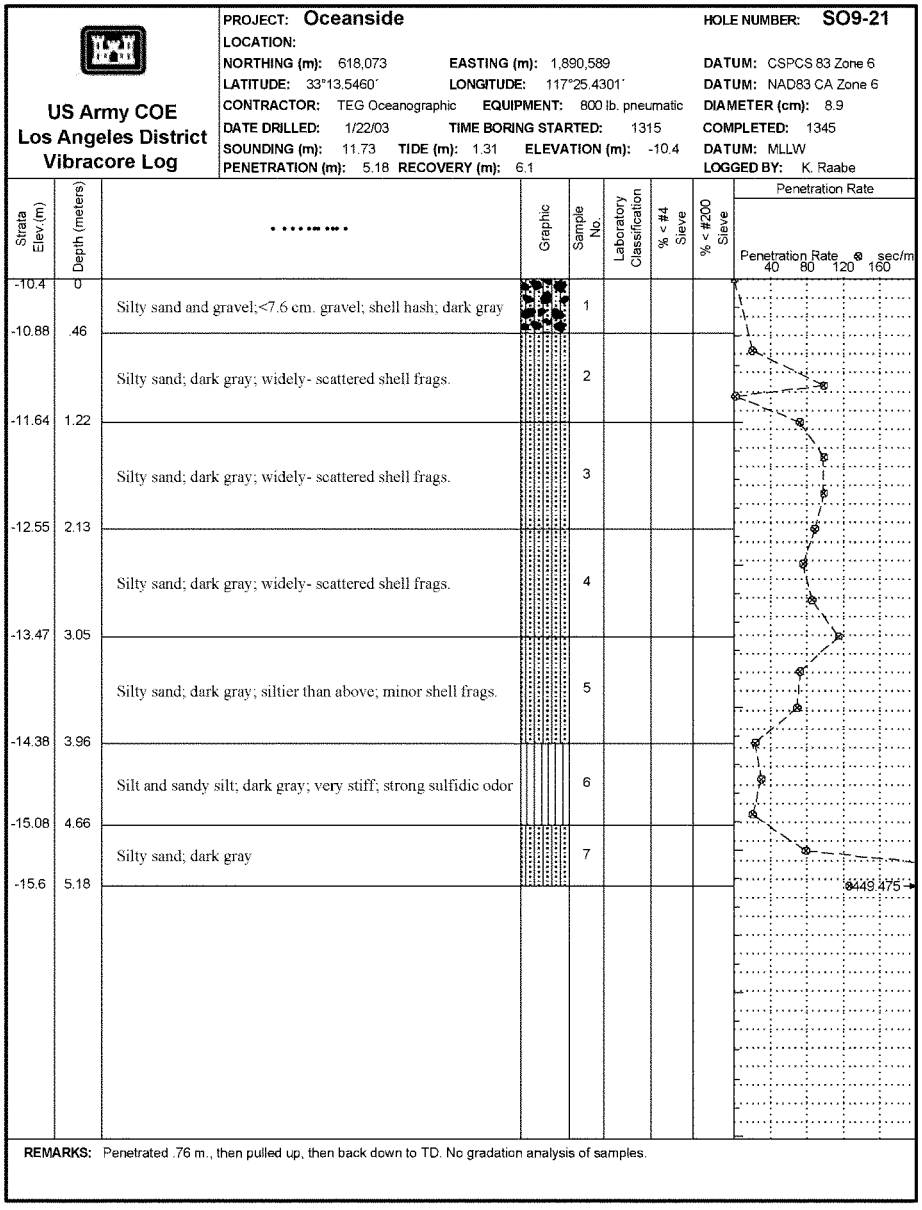
PROJECT: Oceanside **HOLE NUMBER:** SO9-20
LOCATION:
NORTHING (m): 617,819 **EASTING (m):** 1,890,758 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.4101′ **LONGITUDE:** 117°25.3191′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/22/03 **TIME BORING STARTED:** 1200 **COMPLETED:** 1220
SOUNDING (m): 12.19 **TIDE (m):** 1.58 **ELEVATION (m):** -10.6 **DATUM:** MLLW
PENETRATION (m): 4.34 **RECOVERY (m):** 6.1 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-10.6	0	Silty sand and gravel?; near-refusal in cobbles (not recovered)		1				
-10.91	.3	Poorly graded sand; micaceous; fine grained;abundant shells; med gray.		2	SP	100.0	3.0	
-11.83	1.22	Same as .3-1.22 m.		3				
-12.74	2.13	Poorly graded sand as above		4	SP	94.0	4.0	
-13.51	2.90	Poorly graded sand w/silt; dark gray; micaceous		5	SP-SM	100.0	7.0	
-13.81	3.20	Silty sand; micaceous; dark gray		6				
-14.27	3.66	Silty sand; micaceous; dark gray; somewhat stiff		7				
-14.95	4.34							

REMARKS: Penetrated .3 m., then pulled up, then down .76 m., then up, then down to TD. Samples 1,3,6, and 7 not analyzed.

Figure



US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
LOCATION:
HOLE NUMBER: SO9-21
NORTHING (m): 618,073 EASTING (m): 1,890,589 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°13.5460′ LONGITUDE: 117°25.4301′ DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/22/03 TIME BORING STARTED: 1315 COMPLETED: 1345
SOUNDING (m): 11.73 TIDE (m): 1.31 ELEVATION (m): -10.4 DATUM: MLLW
PENETRATION (m): 5.18 RECOVERY (m): 6.1 LOGGED BY: K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-10.4	0	Silty sand and gravel;<7.6 cm. gravel; shell hash; dark gray		1			
-10.88	.46	Silty sand; dark gray; widely- scattered shell frags.		2			
-11.64	1.22	Silty sand; dark gray; widely- scattered shell frags.		3			
-12.55	2.13	Silty sand; dark gray; widely- scattered shell frags.		4			
-13.47	3.05	Silty sand; dark gray; siltier than above; minor shell frags.		5			
-14.38	3.96	Silt and sandy silt; dark gray; very stiff; strong sulfidic odor		6			
-15.08	4.66	Silty sand; dark gray		7			
-15.6	5.18						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
@449.475

REMARKS: Penetrated .76 m., then pulled up, then back down to TD. No gradation analysis of samples.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: **Oceanside** HOLE NUMBER: **SO9-22**
LOCATION:
NORTHING (m): 617,073 EASTING (m): 1,889,986 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°13.0013′ LONGITUDE: 117°25.8106′ DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic Services EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/24/03 TIME BORING STARTED: 0930 COMPLETED: 0939
SOUNDING (m): 16.15 TIDE (m): .61 ELEVATION (m): -15.5 DATUM: MLLW
PENETRATION (m): 6.1 RECOVERY (m): 6.1 LOGGED BY: K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-15.5	0	Silty sand; med.gray;dense; mod-abundant shell frags.		1	SM	100.0	34.0
-16.15	.61	Same as 0-.61 m.		2			
-16.61	1.07	Silty sand; med. gray; mod. dense		3	SM	98.0	27.0
-17.22	1.68	Poorly graded gravel w/silt and sand; <5.1 cm. pebbles; very dense; mod-abundant shells		4	GP-GM	48.0	11.0
-17.67	2.13	Same as 3.05-3.96 m.		5			
-18.59	3.05	Poorly graded sand; med-fine grained;micaceous;lt. gray;tr. pebbles; mod < 2.5 cm. shell frags.		6	SP	100.0	3.0
-19.5	3.96	Same as 4.88-5.49 m.		7			
-20.42	4.88	Poorly graded sand; as above		8	SP	100.0	4.0
-21.03	5.49	Poorly graded sand; as above; lower .3 m w/abundant shells		9			
-21.64	6.10						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: Bent drill rod when pulling out of hole. Samples 2,5,7, and 9 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-24
LOCATION:
NORTHING (m): 616,561 **EASTING (m):** 1,890,337 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.7268′ **LONGITUDE:** 117°25.5812′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/24/03 **TIME BORING STARTED:** 1120 **COMPLETED:** 1140
SOUNDING (m): 16.0 **TIDE (m):** .85 **ELEVATION (m):** -15.2 **DATUM:** MLLW
PENETRATION (m): 3.96 **RECOVERY (m):** 5.49 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-15.1	0	Poorly graded sand w/silt; lt. gray color; lower .3 m. w/shells; minor pebbles					
-15.45	.3	Poorly graded sand w/silt; lt. gray color; w/shell hash, minor pebbles		1	SP-SM	90.0	12.0
-15.76	.61	Gravel w/sand; pebbles, cobbles		2			
-16.67	1.52	Gravel w/sand; densely packed pebbles and cobbles w/ interstitial sand		3			
-17.28	2.13	Poorly graded sand w/gravel; med-fine sand w/pebbles from 2.6-2.9 m.; lt.gray		4	SP	84.0	4.0
-18.2	3.05	Poorly graded sand; med-fine grained; light gray		5	SP	100.0	4.0
-19.11	3.96						

Penetration Rate
Penetration Rate @ sec/m
40 80 120 160
@206.693
@278.871
@252.625
@278.871
@229.659
@508.53

REMARKS: Upper .91 m. drilled 3X (surge knocked over drill), therefore extra sample. Samples 2 and 3 not analyzed.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

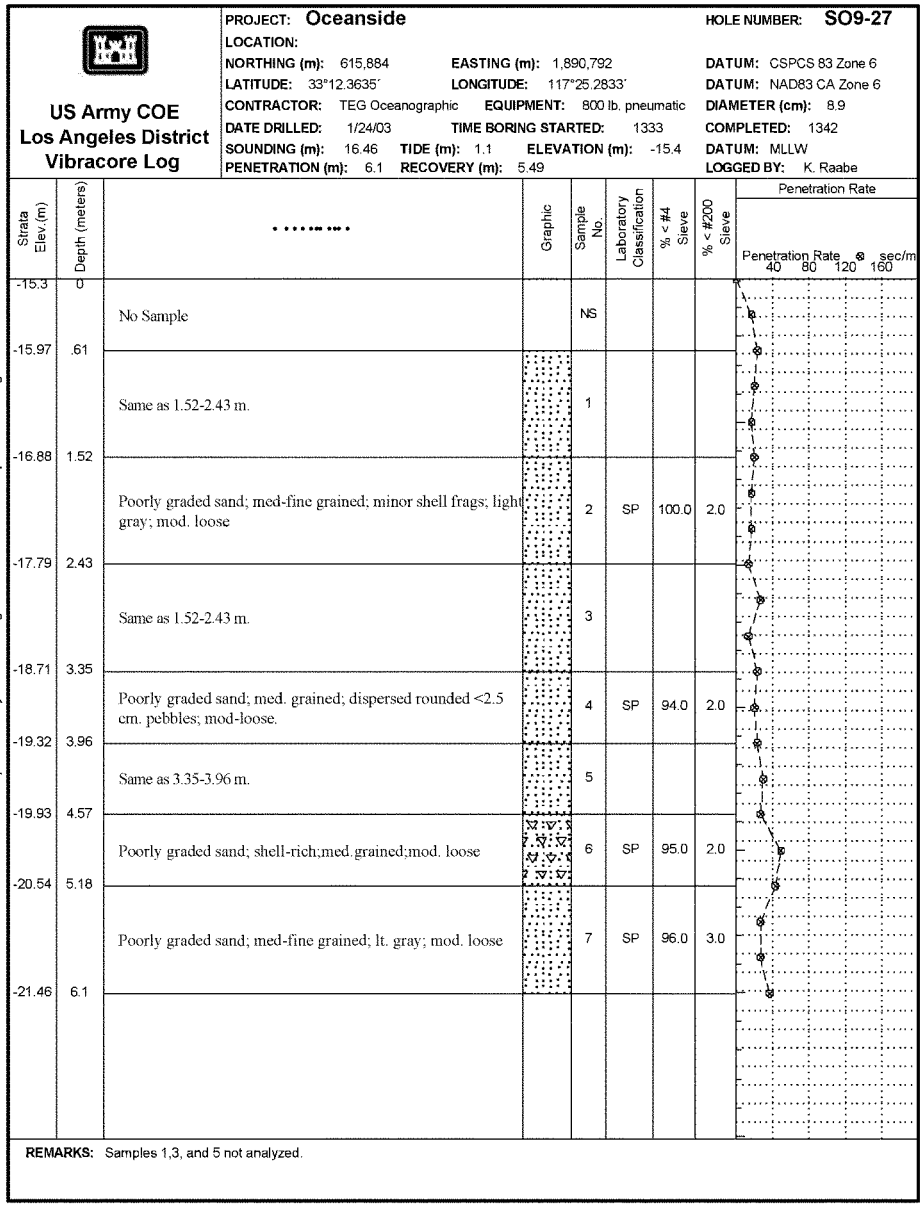
PROJECT: Oceanside **HOLE NUMBER:** SO9-26
LOCATION:
NORTHING (m): 615,606 **EASTING (m):** 1,891,443 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.2171′ **LONGITUDE:** 117°24.2625′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/25/03 **TIME BORING STARTED:** 1400 **COMPLETED:** 1415
SOUNDING (m): 14.94 **TIDE (m):** .85 **ELEVATION (m):** -14.1 **DATUM:** MLLW
PENETRATION (m): 3.96 **RECOVERY (m):** 5.18 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate @ sec/m; 40 80 120 160)
-14.0	0	Silty sand; micaceous;dense, compact; very minor shell frags; med-gray.		1	SM	100.0	15.0	
-14.85	.76	Poorly graded gravel w/sand; med-fine sand w/close-packed 2.5-5.1 cm. pebbles		2	GP	32.0	2.0	@439.633
-15.16	1.07	Poorly graded sand; med-grained; a few pebbles; trace shell frags; light gray.		3	SP	100.0	3.0	@501.969
-15.61	1.52	Poorly graded sand; mod-dense; med-grained; light gray		4	SP	100.0	4.0	@206.693
-16.52	2.43	Same as 1.52-2.43 m.		5				@226.378 @230.22
-17.44	3.35	Poorly graded sand w/gravel; same as above w/<7.6 cm. cobbles and pebbles; dense		6	SP	72.0	4.0	@249.344 @314.961
-18.05	3.96							@291.995

REMARKS: Twice met refusal @ .91 m. Third try made it thru to TD. (extra recovery) Sample 5 not analyzed.

Figure



US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
LOCATION:
HOLE NUMBER: SO9-27
NORTHING (m): 615,884 EASTING (m): 1,890,792 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°12.3635′ LONGITUDE: 117°25.2833′ DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/24/03 TIME BORING STARTED: 1333 COMPLETED: 1342
SOUNDING (m): 16.46 TIDE (m): 1.1 ELEVATION (m): -15.4 DATUM: MLLW
PENETRATION (m): 6.1 RECOVERY (m): 5.49 LOGGED BY: K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-15.3	0	No Sample		NS			
-15.97	.61	Same as 1.52-2.43 m.		1			
-16.88	1.52	Poorly graded sand; med-fine grained; minor shell frags; light gray; mod. loose		2	SP	100.0	2.0
-17.79	2.43	Same as 1.52-2.43 m.		3			
-18.71	3.35	Poorly graded sand; med. grained; dispersed rounded <2.5 cm. pebbles; mod-loose.		4	SP	94.0	2.0
-19.32	3.96	Same as 3.35-3.96 m.		5			
-19.93	4.57	Poorly graded sand; shell-rich;med.grained;mod. loose		6	SP	95.0	2.0
-20.54	5.18	Poorly graded sand; med-fine grained; lt. gray; mod. loose		7	SP	96.0	3.0
-21.46	6.1						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: Samples 1,3, and 5 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: **Oceanside** HOLE NUMBER: **SO9-28**
LOCATION:
NORTHING (m): 615,635 EASTING (m): 1,892,100 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°12.2362' LONGITUDE: 117°24.4397' DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic Services EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/23/03 TIME BORING STARTED: 0810 COMPLETED: 0818
SOUNDING (m): 11.28 TIDE (m): .70 ELEVATION (m): -10.6 DATUM: MLLW
PENETRATION (m): 5.79 RECOVERY (m): 6.10 LOGGED BY: K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-10.5	0	Gravel w/sand; rounded <5.1 cm. pebbles; shell hash; loose		1			
-10.88	.3	Silt; stiff; dark green-gray		2	ML	100.0	86.0
-11.04	.46	Poorly graded sand w/silt; sand is fine grained; med. green gray;no shells or pebbles		3	SP-SM	100	8.0
-11.8	1.22	Same as .46-1.22 m.		4			
-12.71	2.13	Same as .46-1.22 m.		5			
-13.63	3.05	Poorly graded sand; fine grained; light gray; no pebbles or shells		6	SP	100.0	4.0
-14.54	3.96	Same as 3.05-3.96 m.		7			
-15.46	4.88	Same as 3.05-3.96 m.		8			
-16.37	5.79						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
⊗239.501
⊗246.063

REMARKS: First attempt refusal at .91 m. Samples 1,4,5,7, and 8 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-29
LOCATION:
NORTHING (m): 615,440 **EASTING (m):** 1,891,816 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.1294′ **LONGITUDE:** 117°24.6215′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/23/03 **TIME BORING STARTED:** 0920 **COMPLETED:** 0927
SOUNDING (m): 13.56 **TIDE (m):** .94 **ELEVATION (m):** -12.6 **DATUM:** MLLW
PENETRATION (m): 6.1 **RECOVERY (m):** 6.1 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-12.6	0	Poorly graded sand w/silt; sand is fine to med grained; 5% <1.3 cm. pebbles; mod shell frags; loose; lt. brown-gray color		1	SP-SM	100.0	5.0
-13.53	.91	Same as 0-.91 m.		2			
-14.45	1.83	Same as 0-.91 m.		3			
-15.05	2.43	Poorly graded sand w/gravel; med-fine sand w/<3.8 cm. pebbles; med.gray color		4	SP	73.0	2.0
-15.97	3.35	Poorly graded sand; med-fine grained; homogeneous; trace shell frags; gray color		5	SP	100.0	3.0
-16.89	4.27	Same as 3.35-4.27 m.		6			
-17.5	4.88	Same as 3.35-4.27 m.		7			
-18.26	5.64	Silty sand; dark gray; very stiff		8			
-18.56	5.94	Sandy silt;extremely stiff; sulfidic odor; dark gray		9			
-18.72	6.1						

Penetration Rate
Penetration Rate @ sec/m
40 80 120 160

REMARKS: Samples 2,3,6,7,8, and 9 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-30
LOCATION:
NORTHING (m): 615,700 **EASTING (m):** 1,891,545 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.2684′ **LONGITUDE:** 117°24.7973′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/23/03 **TIME BORING STARTED:** 1015 **COMPLETED:** 1035
SOUNDING (m): 14.17 **TIDE (m):** .91 **ELEVATION (m):** -13.3 **DATUM:** MLLW
PENETRATION (m): .61 **RECOVERY (m):** 5.18 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate Penetration Rate ⊗ sec/m 40 80 120 160
-13.2	0	Gravel (<7.6 cm.) in silty sand; somewhat stiff; abundant shell frags		NS				226.378
-13.87	.61							

REMARKS: Refusal @.61 m. in surface cobble layer. 3 attempts. Moved 15.24 m. to SO9-30A.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: **Oceanside** HOLE NUMBER: **SO9-30A**
LOCATION:
NORTHING (m): 615,695.5 EASTING (m): 1,891,518.6 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°12.2657' LONGITUDE: 117°24.8145' DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/23/03 TIME BORING STARTED: COMPLETED:
SOUNDING (m): 14.33 TIDE (m): 1.34 ELEVATION (m): -13 DATUM: MLLW
PENETRATION (m): .61 RECOVERY (m): 5.18 LOGGED BY: K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate @ 40 80 120 160 sec/m)
-12.9	0	Gravel (<7.6 cm.) in silty sand; somewhat stiff; abundant shell frags		NS				
-13.6	.61							

REMARKS: Retry of SO9-30. Unsuccessful. Refusal in surface cobble layer.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-31
LOCATION:
NORTHING (m): 616,011 **EASTING (m):** 1,891,266 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.4346' **LONGITUDE:** 117°24.9795' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/23/03 **TIME BORING STARTED:** 1250 **COMPLETED:** 1310
SOUNDING (m): 14.33 **TIDE (m):** 1.34 **ELEVATION (m):** -13 **DATUM:** MLLW
PENETRATION (m): 6.10 **RECOVERY (m):** 5.49 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-12.9	0	No Sample		NS			
-13.6	.61	Poorly graded sand w/silt; sand is fine-med grained; med. gray; dispersed shell frags		1	SP-SM	100.0	6.0
-14.51	1.52	Poorly graded sand; fine-med grained; med.gray; dispersed shell frags, <=1.3 cm. black pebbles.		2	SP	98	3.0
-15.42	2.43	Poorly graded sand w/gravel; <6.4 cm. gravel w/shell frags in fine sand; lower .3 m. is close-packed.		3	SP	51.0	2.0
-16.04	3.05	Same as 3.96-4.88 m.		4			
-16.95	3.96	Poorly graded sand; med-fine grained; med.gray color; trace shell frags;		5	SP	100.0	3.0
-17.87	4.88	Poorly graded sand; med-fine grained; med.gray color; trace shell frags; homogeneous.		6	SP	100.0	2.0
-18.48	5.49	Same as 4.88-5.49 m.		7			
-19.09	6.10						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: Samples 4 and 7 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: **Oceanside** HOLE NUMBER: **SO9-32**
LOCATION:
NORTHING (m): 616,356 EASTING (m): 1,890,982 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°12.6200' LONGITUDE: 117°24.1648' DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/23/03 TIME BORING STARTED: 1355 COMPLETED: 1409
SOUNDING (m): 14.48 TIDE (m): 1.19 ELEVATION (m): -13.3 DATUM: MLLW
PENETRATION (m): 6.1 RECOVERY (m): 6.1 LOGGED BY: K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-13.2	0	Silty sand;upper 15.2 cm. is med-fine sand w/silt;lower 30 cm. is very dense, stiff, silty sand w/coarse shell frags; dark gray		1	SM	100.0	40.0
-13.75	.46	Poorly graded gravel w/sand; stiff; dark gray; <7.6 cm. close-packed black rounded cobbles; abundant shells; sharp lower contact.		2	GP	25.0	4.0
-14.2	.91	Same as 2.74-3.66 m.		3			
-15.12	1.83	Same as 2.74-3.66 m.		4			
-16.03	2.74	Poorly graded sand;med-fine grained;brown-gray color homogeneous; very minor shells		5	SP	100.0	3.0
-16.95	3.66	Same as 2.74-3.66 m.		6			
-17.86	4.57	Same as 2.74-3.66 m.		7			
-18.78	5.49	Same as 2.74-3.66 m.		8			
-19.23	5.94	Same sand with abundant shell frags; med-gray color.					
-19.39	6.1						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: Samples 3,4,6,7, and 8 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-33
LOCATION:
NORTHING (m): 617,478 **EASTING (m):** 1,890,466 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.2235′ **LONGITUDE:** 117°25.5050′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/24/03 **TIME BORING STARTED:** 0800 **COMPLETED:** 0813
SOUNDING (m): 13.11 **TIDE (m):** .55 **ELEVATION (m):** -12.6 **DATUM:** MLLW
PENETRATION (m): 6.10 **RECOVERY (m):** 5.18 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev. (m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-12.5	0	No Recovery; Sand? (from drill rate)		NS			
-13.17	.61	No Recovery; Gravel? (from drill rate)		NS			
-13.47	.91	Poorly graded sand;med-fine grained; micaceous; light gray color; only trace shell frags.		1	SP	100.0	4.0
-14.39	1.83	Poorly graded sand;med-fine grained; micaceous; light gray color; only trace shell frags.		2	SP	100.0	3.0
-15.3	2.74	Same as 1.83-2.74 m.		3			
-16.22	3.66	Poorly graded sand; same as above w/moderate amount of <.64 cm. shell frags		4	SP	100.0	3.0
-17.13	4.57	Same as 3.66-4.57 m.		5			
-17.74	5.18	Poorly graded sand;med-fine grained w/abundant <3.8 cm. pebbles and shell hash; gradational contacts.		6	SP	96.0	3.0
-18.2	5.64	Gravel; <3.8 cm. rounded black pebbles w/abundant broken shells in upper 15 cm.		7			
-18.66	6.10						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
⊗13.517

REMARKS: Penetrated to .76 m.-refused. Back up, then back down all the way to TD. Samples 3,5, and 7 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SO9-40
LOCATION:
NORTHING (m): 615,011 **EASTING (m):** 1,891,509 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.0350' **LONGITUDE:** 117°24.9333' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/24/03 **TIME BORING STARTED:** 1505 **COMPLETED:** 1510
SOUNDING (m): 16.15 **TIDE (m):** 1.01 **ELEVATION (m):** -15.1 **DATUM:** MLLW
PENETRATION (m): 6.10 **RECOVERY (m):** 5.49 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-15.1	0.0	Poorly graded sand w/silt; abundant <7.6 cm. pebbles/ cobbles; abundant coarse shell frags; med-gray.		1	SP-SM	100.0	5.0
-15.75	.61	Poorly sorted sand w/gravel; med-coarse grained; abundant coarse shell frags; med-gray.		2	SP	56.0	1.0
-16.66	1.52	Poorly graded sand; med-coarse grained;coarse sand sized shell frags		3	SP	95.0	2.0
-17.57	2.43	Same as 1.52-2.43 m.		4			
-18.49	3.35	Poorly graded sand; same as above w/<1.3 cm. rounded black pebbles, shell hash		5	SP	98.0	2.0
-19.1	3.96	Same as 3.35-3.96 m.		6			
-19.71	4.57	Poorly graded sand; med. grained; abundant <2.5 cm. pebbles, shell hash		7	SP	93.0	1.0
-20.32	5.18	Poorly graded sand; med-fine grained;minor shells; med gray color		8	SP	100.0	2.0
-20.63	5.49	No Recovery (pile driven?)		NS			
-21.24	6.10						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: Samples 4 and 6 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: **Oceanside** HOLE NUMBER: **SO9-41**
LOCATION:
NORTHING (m): 615,011 EASTING (m): 1,891,509 DATUM: CSPCS 83 Zone 6
LATITUDE: 33°11.8955′ LONGITUDE: 117°24.8158′ DATUM: NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic EQUIPMENT: 800 lb. pneumatic DIAMETER (cm): 8.9
DATE DRILLED: 1/24/03 TIME BORING STARTED: 1615 COMPLETED: 1621
SOUNDING (m): 15.85 TIDE (m): .82 ELEVATION (m): -15 DATUM: MLLW
PENETRATION (m): 6.10 RECOVERY (m): 4.88 LOGGED BY: K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-15.0	0	Poorly graded sand; med.gray med.grained;dispersed <.6 cm. rounded black pebbles; mod.dense; local shell concentrations		1	SP	100.0	1.0
-15.94	.91	Same as 0-.91 m.		2			
-16.86	1.83	Poorly graded sand; med. grained; <3.8 cm. pebbles; dense, compacted; abundant shell frags.		3	SP	64.0	2.0
-17.32	2.29	Poorly graded sand; med. grained; dispersed 3.8 cm. pebbles; mod. dense		4	SP	85.0	2.0
-17.93	2.90	Poorly graded sand; med. grained; very minor shells and pebbles; mod. dense		5	SP	100.0	2.0
-18.99	3.96	Same as 2.9-3.96 m.		6			
-19.91	4.88	No Recovery (pile driven?)		NS			
-21.13	6.10						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: Samples 2 and 6 not analyzed.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-1
LOCATION: North of Oceanside Harbor
NORTHING (m): 616,129.1 **EASTING (m):** 1,891,170.9 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.496' **LONGITUDE:** 117°24.989' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 0729 **COMPLETED:**
SOUNDING (m): 13.44* **TIDE (m):** **ELEVATION (m):** -13.4 **DATUM:** MLLW
PENETRATION (m): 5.79 **RECOVERY (m):** 5.79 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate 40 80 120 160 sec/m)
-13.4	0	Silty sand; upper .3 m. gray; lower 24 cm. brown w/shell frags		A	SM		24.0	
-13.99	.55	Brown fine-med grained sand w/gravel		B	SP		1.0	
-15.27	1.83	Poorly graded sand w/gravel		C	SP		1.0	
-16.49	3.05	Poorly graded gray med-fine sand w/shells		D	SP		1.0	
-19.23	5.79							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-2
LOCATION: North of Oceanside Harbor
NORTHING (m): 617,010.1 **EASTING (m):** 1,891,228.9 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.973' **LONGITUDE:** 117°24.958' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 0820 **COMPLETED:**
SOUNDING (m): 11.06 **TIDE (m):** **ELEVATION (m):** -11.1 **DATUM:** MLLW
PENETRATION (m): 5.36 **RECOVERY (m):** 5.36 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-11.0	0							
-11.36	.3	Silty sand; dark gray		A	SM		34.0	
-11.61	.55	Silty sand; med.brown w/numerous shell frags		B	SM		33.0	
		Poorly graded sand; med. brown w/very few shell frags		C	SP		0.0	
-16.42	5.36							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-3
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 617,581.1 **EASTING (m):** 1,890,913.7 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.280' **LONGITUDE:** 117°25.165' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 0909 **COMPLETED:**
SOUNDING (m): 11.19 **TIDE (m):** **ELEVATION (m):** -11.2 **DATUM:** MLLW
PENETRATION (m): 5.36 **RECOVERY (m):** 5.36 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-11.1	0	Silty sand; gray; shell frags; occasional gravel		A	SM		18.0	
-11.49	.30	Poorly graded sand; med. gray; occasional shell frags		B	SP		2.0	
-13.87	2.68	Silty sand; dark gray; cohesive; shell frags		C	SM		19.0	
-15.3	4.11	Poorly graded sand; med. gray		D	SP		3.0	
-16.28	5.09	Poorly graded med grained sand w/shell frags		E	SP		2.0	
-16.55	5.36							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-4
LOCATION: Offshore north of Santa Margarita River
NORTHING (m): 618,257.6 **EASTING (m):** 1,890,265.6 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.642' **LONGITUDE:** 117°25.587' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 1010 **COMPLETED:**
SOUNDING (m): 11.28 **TIDE (m):** **ELEVATION (m):** -11.3 **DATUM:** MLLW
PENETRATION (m): 1.22 **RECOVERY (m):** 1.22 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-11.2	0	Silty sand; gray		A	SM		15	
-11.74	.46	Well graded gravel w/silt & sand		B	GW-GM		0.0	
-12.26	.98	Poorly graded gravel; 2.5 cm. diam.		C	GP		3.0	
-12.5	1.22							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** OS-5
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 617,054.7 **EASTING (m):** 1,890,076.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.990' **LONGITUDE:** 117°25.700' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 1033 **COMPLETED:**
SOUNDING (m): 15.58 **TIDE (m):** **ELEVATION (m):** -15.6 **DATUM:** MLLW
PENETRATION (m): 5.79 **RECOVERY (m):** 5.79 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-15.5	0	Poorly graded gravel w/coarse sand		A	GP		1.0	
-15.88	.3	Poorly graded medium grained brown sand		B	SP		1.0	
-16.95	1.37	Poorly graded sand w/gravel; shell frags		C	SP		1.0	
-17.56	1.98	Poorly graded sand w/silt; gray		D	SP-SM		9.0	
-19.94	4.36	Sandy silt; gray; partly cohesive		E	ML		64.0	
-21.37	5.79							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-6
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 617,576 **EASTING (m):** 1,890,220.6 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.273' **LONGITUDE:** 117°25.611' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 1125 **COMPLETED:**
SOUNDING (m): 13.81 **TIDE (m):** **ELEVATION (m):** -13.8 **DATUM:** MLLW
PENETRATION (m): 4.57 **RECOVERY (m):** 4.57 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-13.8	0	Silty sand w/gravel; dk gray; many shell frags		A	SM		21.0	
-14.18	.37	Poorly graded sand; light gray; occasional shells		B	SP		2.0	
-18.38	4.57							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-7
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 618,047.7 **EASTING (m):** 1,889,854.6 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°13.526' **LONGITUDE:** 117°25.850' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 1210 **COMPLETED:**
SOUNDING (m): 13.78 **TIDE (m):** **ELEVATION (m):** -13.8 **DATUM:** MLLW
PENETRATION (m): 3.66 **RECOVERY (m):** 3.66 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-13.7	0	Silty sand; occasional lenses of shells		A	SM		15	
-15.91	2.13	Poorly graded sand; light gray; med-fine grained		B	SP		3.0	
-17.44	3.66							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** OS-8
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 616,579.7 **EASTING (m):** 1,889,732.3 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.731' **LONGITUDE:** 117°25.918' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 1332 **COMPLETED:**
SOUNDING (m): 17.28 **TIDE (m):** **ELEVATION (m):** -17.3 **DATUM:** MLLW
PENETRATION (m): 4.27 **RECOVERY (m):** 4.27 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-17.2	0	Silty sand; occasional shell frags; gray color		A	SM		28.0	
-20.33	3.05	Poorly graded sand; med-grained; light gray color		B	SP		1.0	
-21.55	4.27							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

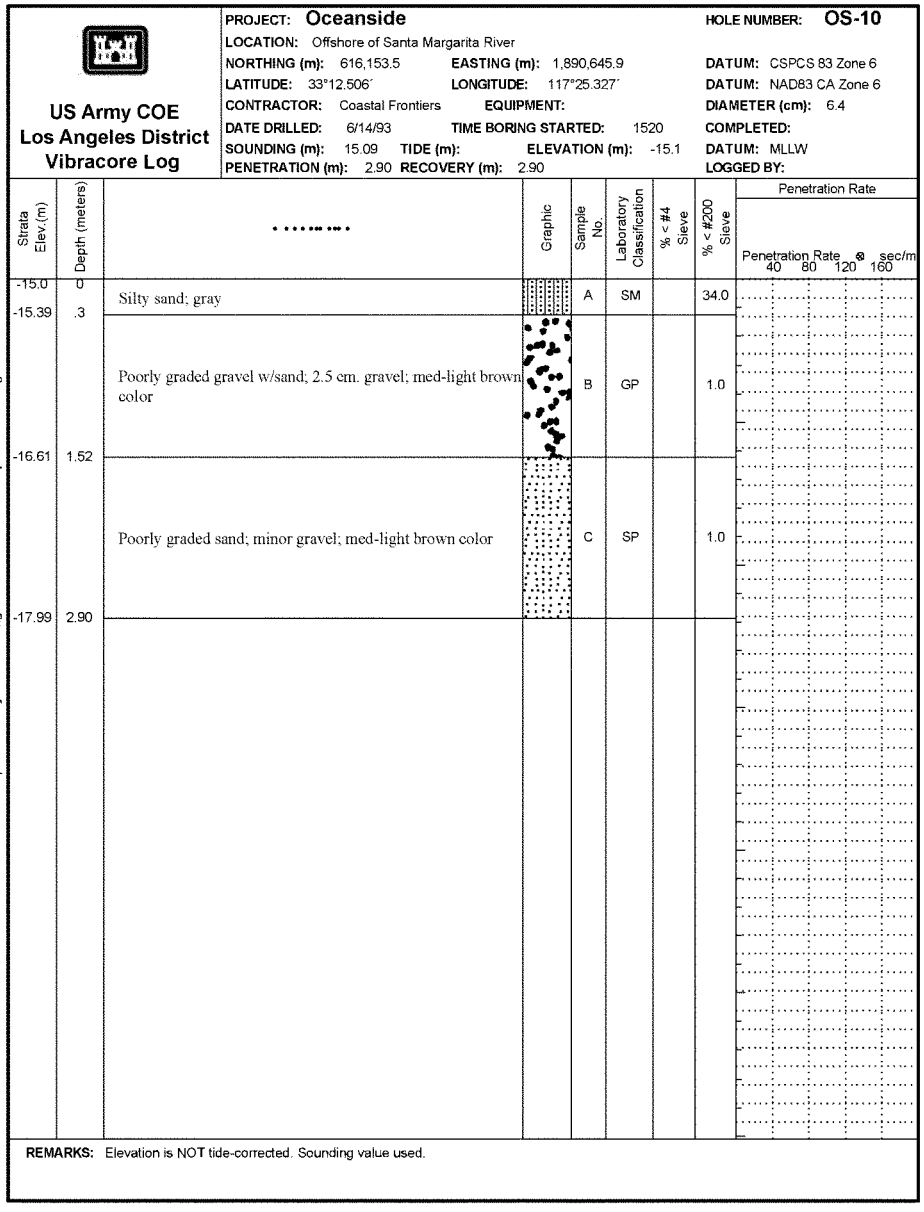
PROJECT: Oceanside **HOLE NUMBER:** OS-9
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 616,684.4 **EASTING (m):** 1,890,227.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.791′ **LONGITUDE:** 117°25.568′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 1437 **COMPLETED:**
SOUNDING (m): 15.24 **TIDE (m):** **ELEVATION (m):** -15.2 **DATUM:** MLLW
PENETRATION (m): 1.10 **RECOVERY (m):** 1.10 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-15.2	0	Silty sand; abundant 2.5 cm. gravel and shell frags		A	SM		18.0	
-16.34	1.10							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure



US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: OS-10
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 616,153.5
EASTING (m): 1,890,645.9
DATUM: CSPCS 83 Zone 6
LATITUDE: 33°12.506'
LONGITUDE: 117°25.327'
DATUM: NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers
EQUIPMENT:
DIAMETER (cm): 6.4
DATE DRILLED: 6/14/93
TIME BORING STARTED: 1520
COMPLETED:
SOUNDING (m): 15.09
TIDE (m):
ELEVATION (m): -15.1
DATUM: MLLW
PENETRATION (m): 2.90
RECOVERY (m): 2.90
LOGGED BY:

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-15.0	0	Silty sand; gray		A	SM		34.0	
-15.39	.3	Poorly graded gravel w/sand; 2.5 cm. gravel; med-light brown color		B	GP		1.0	
-16.61	1.52	Poorly graded sand; minor gravel; med-light brown color		C	SP		1.0	
-17.99	2.90							

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-11
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 617,054.5 **EASTING (m):** 1,890,573.7 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.993′ **LONGITUDE:** 117°25.38′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/14/93 **TIME BORING STARTED:** 1608 **COMPLETED:**
SOUNDING (m): 13.35 **TIDE (m):** **ELEVATION (m):** -13.3 **DATUM:** MLLW
PENETRATION (m): 5.03 **RECOVERY (m):** 5.03 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-13.3	0							
-13.65	.30	Silty sand w/gravel; 2.5 cm. gravel & shell frags		A	SM		15	
-13.96	.61	Poorly graded med-fine grained gray sand		B	SP		1.0	
		Poorly graded med-grained light-brown sand		C	SP		1.0	
-16.7	3.35	Poorly graded med-grained light-brown sand		D	SP		1.0	
-18.38	5.03							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** OS-22
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 614,372 — **EASTING (m):** 1,893,271.2 — **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.558′ — **LONGITUDE:** 117°23.625′ — **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers — **EQUIPMENT:** — **DIAMETER (cm):** 6.4
DATE DRILLED: 6/16/93 — **TIME BORING STARTED:** 0745 — **COMPLETED:**
SOUNDING (m): 10.94 — **TIDE (m):** — **ELEVATION (m):** -10.9 — **DATUM:** MLLW
PENETRATION (m): 3.51 — **RECOVERY (m):** 3.51 — **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-10.9	0	Silty sand w/2.5 cm. gravel		A	SM		24.0	
-11.4	.46	Poorly graded coarse sand; red-brown color		B	SP		3.0	
-11.79	.85	Silty sand; lt. brown; cohesive		C	SM		19.0	
-12.83	1.89	Poorly graded coarse brown sand		D	SP		2.0	
-14.2	3.26	Poorly graded sand; med. brown		E	SP		4.0	
-14.45	3.51							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-23
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 613,559.8 **EASTING (m):** 1,894,017.6 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.123' **LONGITUDE:** 117°23.139' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/16/93 **TIME BORING STARTED:** 0832 **COMPLETED:**
SOUNDING (m): 10.58 **TIDE (m):** **ELEVATION (m):** -10.6 **DATUM:** MLLW
PENETRATION (m): 3.47 **RECOVERY (m):** 3.47 **LOGGED BY:**

Strata Elev. (m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-10.5	0	Silty sand; dk. gray		A	SM		21.0	
-10.88	.30	Poorly graded med-coarse sand; red-brown & lt. gray color		B	SP		1.0	
-12.71	2.13	Poorly graded med-grained sand; lt. brown color		C	SP		2.0	
-14.05	3.47							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-24
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 613,050.8 **EASTING (m):** 1,894,347 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°10.910' **LONGITUDE:** 117°22.915' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/16/93 **TIME BORING STARTED:** 0919 **COMPLETED:**
SOUNDING (m): 10.03 **TIDE (m):** **ELEVATION (m):** -10 **DATUM:** MLLW
PENETRATION (m): 2.59 **RECOVERY (m):** 2.59 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-10.0	0	Silty sand; shell frags		A	SM		21.0	
-10.33	.30	Clay; dense; hard; dk. gray		B	ML	100.0	100.0	
-12.07	2.04	Sandy silt; cohesive; hard; gray and brown		C	ML		64.0	
-12.46	2.43	Poorly graded med-coarse brown sand		D	SP		3.0	
-12.62	2.59							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-25
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 613,215.5 **EASTING (m):** 1,893,552.2 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°10.934' **LONGITUDE:** 117°23.436' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/16/93 **TIME BORING STARTED:** 1007 **COMPLETED:**
SOUNDING (m): 14.36 **TIDE (m):** **ELEVATION (m):** -14.4 **DATUM:** MLLW
PENETRATION (m): 2.65 **RECOVERY (m):** 2.65 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-14.3	0	Silty sand; shells and shell frags; gray color		A	SM		19.0	
-16.1	1.74	Poorly graded gravel w/sand; shell frags & 2.5 cm. gravel		B	GP		4.0	
-16.4	2.04	Poorly graded med-coarse brown sand		C	SP		1.0	
-17.01	2.65							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-26
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 613,847.7 **EASTING (m):** 1,893,375.7 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.275' **LONGITUDE:** 117°23.554' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/16/93 **TIME BORING STARTED:** 1051 **COMPLETED:**
SOUNDING (m): 12.62 **TIDE (m):** **ELEVATION (m):** -12.6 **DATUM:** MLLW
PENETRATION (m): 4.63 **RECOVERY (m):** 4.63 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-12.6	0	Silty sand w/shell frags		A	SM		26.0	
-12.92	.30	Poorly graded coarse sand w/silt & gravel(5.1 cm+)		B	SP-SM		5.0	
-13.23	.61	Poorly graded coarse sand; gray/brown/rust color		C	SP		2.0	
-14.66	2.04	Silty sand; lt. gray; cohesive		D	SM		39.0	
-16.58	3.96	Poorly graded sand; med-lt. brown color		E	SP		3.0	
-17.25	4.63							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-32
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 616,699 **EASTING (m):** 1,890,935.5 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.803' **LONGITUDE:** 117°25.133' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 **TIME BORING STARTED:** 0732 **COMPLETED:**
SOUNDING (m): 12.86 **TIDE (m):** **ELEVATION (m):** -12.9 **DATUM:** MLLW
PENETRATION (m): 5.39 **RECOVERY (m):** 5.39 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-12.8	0	Silty sand; dk. gray; occasional shell frags		A	SM		21.0	
-13.68	.82	Poorly graded med-grained sand w/gravel; occasional layers of shell frags and 2.5 cm. gravel; shell frags 11'-1.2', 12.2'-12.3'		B	SP		1.0	
-18.25	5.39							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-34
LOCATION: Offshore of Santa Margarita River
NORTHING (m): 615,678.6 **EASTING (m):** 1,891,618 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.255' **LONGITUDE:** 117°24.698' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 **TIME BORING STARTED:** 0907 **COMPLETED:**
SOUNDING (m): 12.98 **TIDE (m):** **ELEVATION (m):** -13 **DATUM:** MLLW
PENETRATION (m): 1.80 **RECOVERY (m):** 1.80 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-12.9	0	Poorly graded sand w/gravel (2.5 cm); shell frags		A	SP		1.0	
-13.59	.61	Silty med-grained sand; lt. brown; 2.5 cm. gravel & pebbles		B	SM		29.0	
-14.78	1.80							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-35
LOCATION: Offshore of Oceanside Harbor
NORTHING (m): 614,874.6 **EASTING (m):** 1,891,943.2 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.822' **LONGITUDE:** 117°24.483' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 **TIME BORING STARTED:** 1012 **COMPLETED:**
SOUNDING (m): 13.66 **TIDE (m):** **ELEVATION (m):** -13.7 **DATUM:** MLLW
PENETRATION (m): 5.73 **RECOVERY (m):** 5.73 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-13.6	0	Poorly graded sand w/silt; occasional shell frags; dark gray		A	SP-SM		9.0	
-14.42	.76	Poorly graded fine sand; occasional shell frags & 2.5 cm. gravel		B	SP		1.0	
-15.34	1.68	Silty med-grained sand; light brown		C	SM		33.0	
-19.39	5.73							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-36
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 613,396.7 **EASTING (m):** 1,892,037.1 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.023' **LONGITUDE:** 117°24.412' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 **TIME BORING STARTED:** 1113 **COMPLETED:**
SOUNDING (m): 18.04 **TIDE (m):** **ELEVATION (m):** -18 **DATUM:** MLLW
PENETRATION (m): 4.21 **RECOVERY (m):** 4.21 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-18.0	0	Silty sand; a few shell frags; slightly cohesive ; dark gray		A	SM		39.0	
-21.15	3.11	Sandy silt; gray		B	ML		64.0	
-22.25	4.21							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-37
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 612,591.5 **EASTING (m):** 1,893,817.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°10.598' **LONGITUDE:** 117°23.261' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 **TIME BORING STARTED:** 1210 **COMPLETED:**
SOUNDING (m): 14.81 **TIDE (m):** **ELEVATION (m):** -14.8 **DATUM:** MLLW
PENETRATION (m): 5.70 **RECOVERY (m):** 5.70 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-14.8	0	Silty sand; shell frags; cohesive; dark gray		A	SM		39.0	
-19.17	4.36	Poorly graded fine-med grained brown sand		B	SP		1.0	
-20.51	5.70							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-38
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 613,740.9 **EASTING (m):** 1,892,664.2 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.213′ **LONGITUDE:** 117°24.011′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 **TIME BORING STARTED:** 1339 **COMPLETED:**
SOUNDING (m): 14.63 **TIDE (m):** **ELEVATION (m):** -14.6 **DATUM:** MLLW
PENETRATION (m): 2.23 **RECOVERY (m):** 2.23 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-48	0	Silty sand; occasional shell frags; slightly cohesive; dark gray		A	SM		21.0	
-16.86	2.23							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-39
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 614,092 **EASTING (m):** 1,893,518.3 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.408´ **LONGITUDE:** 117°23.464´ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 **TIME BORING STARTED:** 1425 **COMPLETED:**
SOUNDING (m): 11.22 **TIDE (m):** **ELEVATION (m):** -11.2 **DATUM:** MLLW
PENETRATION (m): 4.05 **RECOVERY (m):** 4.05 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-11.2	0	Silty sand; dark gray		A	SM		39.0	
-11.46	.24	Silty sand; partly cohesive; reddish-brown patches		B	SM		21.0	
-12.9	1.68	Silty sand; mod. cohesive; gray-brown		C	SM		21.0	
-13.65	2.43	Silt; cohesive; red-brown to dark gray		D	ML		87.0	
-14.88	3.66	Silty sand; mod. cohesive		E	SM		40.0	
-15.27	4.05							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-40
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 614,402.1 **EASTING (m):** 1,892,713.5 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.571' **LONGITUDE:** 117°23.984' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 **TIME BORING STARTED:** 1553 **COMPLETED:**
SOUNDING (m): 13.11 **TIDE (m):** **ELEVATION (m):** -13.1 **DATUM:** MLLW
PENETRATION (m): 2.10 **RECOVERY (m):** 2.10 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-13.1	0	Poorly graded sand w/gravel; 2.5 cm. gravel & shell frags; dk gray		A	SP		1.0	
-13.48	.37	Poorly graded light brown coarse grained sand		B	SP		1.0	
-14.54	1.43	Poorly graded light brown med. grained sand		C	SP		2.0	
-15.21	2.10							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** OS-41
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 614,702.7 — **EASTING (m):** 1,892,612.7 — **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.733´ — **LONGITUDE:** 117°24.051´ — **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers — **EQUIPMENT:** — **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 — **TIME BORING STARTED:** 1649 — **COMPLETED:**
SOUNDING (m): 11.34 — **TIDE (m):** — **ELEVATION (m):** -11.3 — **DATUM:** MLLW
PENETRATION (m): 4.36 — **RECOVERY (m):** 4.36 — **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-11.3	0	Silty sand; dk. gray; shell frags from 1.22 m.-1.52 m.		A	SM		40.0
-12.8	1.46	Clay; dk gray; highly cohesive		B	ML	100.0	100.0
-14.63	3.29	Silt; dark gray		C	ML		87.0
-15.18	3.84	Poorly graded sand w/silt		D	SP-SM		10
-15.7	4.36						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-42
LOCATION: Offshore of San Luis Rey River
NORTHING (m): 614,351.4 **EASTING (m):** 1,891,951.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.539' **LONGITUDE:** 117°24.474' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/17/93 **TIME BORING STARTED:** 1736 **COMPLETED:**
SOUNDING (m): 15.06 **TIDE (m):** **ELEVATION (m):** -15.1 **DATUM:** MLLW
PENETRATION (m): 2.65 **RECOVERY (m):** 2.65 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-15.0	0	Silty sand; dark gray; shell frags		A	SM		40.0	
-15.97	.91	Poorly graded fine sand; occasional shell frags		B	SP		1.0	
-17.71	2.65							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** OS-43
LOCATION: Offshore of Oceanside Harbor
NORTHING (m): 615,945.5 **EASTING (m):** 1,891,723.6 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.400' **LONGITUDE:** 117°24.632' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/18/93 **TIME BORING STARTED:** 0613 **COMPLETED:**
SOUNDING (m): 11.55 **TIDE (m):** **ELEVATION (m):** -11.6 **DATUM:** MLLW
PENETRATION (m): 3.17 **RECOVERY (m):** 3.17 **LOGGED BY:**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-11.5	0	Poorly graded sand w/silt & gravel(5.1 cm); shell frags		A	SP-SM		11.0	
-12.1	.55	Sandy silt; med. brown		B	ML		51.0	
-12.71	1.16	Poorly graded sand w/gravel; upper .3 m. coarse sand w/ pebbles & shell frags; middle 1.1 m. med-coarse sand; lower .3 m. coarse sand w/pebbles & shell frags		C	SP		1.0	
-14.42	2.87	Poorly graded gravel w/sand; med-brown; shell frags		D	GP		1.0	
-14.72	3.17							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** OS-44
LOCATION: Offshore of Oceanside Harbor
NORTHING (m): 615,794.3 **EASTING (m):** 1,890,857.9 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.313' **LONGITUDE:** 117°25.188' **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Coastal Frontiers **EQUIPMENT:** **DIAMETER (cm):** 6.4
DATE DRILLED: 6/18/93 **TIME BORING STARTED:** 0732 **COMPLETED:**
SOUNDING (m): 14.81 **TIDE (m):** **ELEVATION (m):** -14.8 **DATUM:** MLLW
PENETRATION (m): 3.41 **RECOVERY (m):** 3.41 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-14.8	0	Silty sand; shell frags in lower 9 cm; dk. gray		A	SM		32.0	
-15.42	.61	Poorly graded med-grained sand; very few shell frags & 5.1 cm. gravel @ 1.07 m.; lt. brown		B	SP		1.0	
-18.22	3.41							

REMARKS: Elevation is NOT tide-corrected. Sounding value used.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-1
LOCATION: SO-9 Site
NORTHING (m): 616,565.9 **EASTING (m):** 1,890,361.2 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.7295′ **LONGITUDE:** 117°25.5656′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/99 **TIME BORING STARTED:** **COMPLETED:**
SOUNDING (m): 14.9* **TIDE (m):** **ELEVATION (m):** -14.9 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 2.26 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-14.9	0	Poorly graded sand with silt		1	SP-SM	100.0	9.9	
-16.12	1.22	Poorly graded sand w/gravel		2	SP	68	2	
-17.16	2.26							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-2
LOCATION: SO-9 Site
NORTHING (m): 616,331.2 **EASTING (m):** 1,890,550.2 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.6037′ **LONGITUDE:** 117°25.4423′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/99 **TIME BORING STARTED:** **COMPLETED:**
SOUNDING (m): 14.6* **TIDE (m):** **ELEVATION (m):** -14.6 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 2.80 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-48	0	Poorly graded sand		1	SP	96.5	3.0	
-16.22	1.62	Poorly graded sand		2	SP	100.0	1.7	
-17.4	2.80							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-3
LOCATION: SO-9 Site
NORTHING (m): 616,787 **EASTING (m):** 1,890,073 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.8475′ **LONGITUDE:** 117°25.7530′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 1424 **COMPLETED:**
SOUNDING (m): 15.8* **TIDE (m):** **ELEVATION (m):** -15.8 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 1.43 **LOGGED BY:** VBC

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m) 40 80 120 160
-15.8	0	Sandy Silt; dark gray; occasional mica.		1	ML	100	52	
-16.41	.61	Poorly Graded Sand w/Silt; medium olive gray; common shells in bottom 15 cm.		2	SP-SM	99	8	
-17.23	1.43							

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** SDG-4
LOCATION: SO-9 Site
NORTHING (m): 616,526 — **EASTING (m):** 1,890,226 — **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.7071′ — **LONGITUDE:** 117°25.6524′ — **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor — **EQUIPMENT:** ALPINE Vibracore — **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 — **TIME BORING STARTED:** 1500 — **COMPLETED:**
SOUNDING (m): 15.8* — **TIDE (m):** — **ELEVATION (m):** -15.8 — **DATUM:** MLLW
PENETRATION (m): ? — **RECOVERY (m):** 3.84 — **LOGGED BY:** PJF

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-15.8	0	Sandy silt; medium to dark olive gray; common mica.		1	ML	100	51	
-16.87	1.07	Silty sand; transitional unit.		2	SM	95	26	
-17.17	1.37	Poorly graded sand; medium to coarse; light yellow, gray to light olive gray; scattered shell fragments; rare mica.		3	SP	100	1	
-19.64	3.84							

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-5
LOCATION: SO-9 Site
NORTHING (m): 616,259 **EASTING (m):** 1,890,400 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.5636′ **LONGITUDE:** 117°25.5383′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 1520 **COMPLETED:**
SOUNDING (m): 15.5* **TIDE (m):** **ELEVATION (m):** -15.5 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 2.93 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-15.5	0	Poorly graded sand w/silt; very fine to medium grained; light to medium gray; rare shell fragments; occasional to common mica; dry to damp.		1	SP-SM	100.0	7.3	
-17.33	1.83	Silty sand w/gravel; dark gray; rare whole small snails and clams.		2	SM	78	30	
-18	2.50	Sandy Gravel. Interval possibly included into above sample.		NS				
-18.43	2.93							

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-6
LOCATION: SO-9 Site
NORTHING (m): 616,024.3 **EASTING (m):** 1,890,578.8 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.4379′ **LONGITUDE:** 117°25.4216′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 1547 **COMPLETED:**
SOUNDING (m): 14.9* **TIDE (m):** **ELEVATION (m):** -14.9 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 4.66 **LOGGED BY:**

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-14.9	0	Poorly graded sand w/silt; very fine to medium grained; light to medium gray; occasional small shell fragments; common mica; dry.		1	SP-SM	100.0	11.4	
-15.94	1.04	Silty Sand; very fine grained; medium olive gray; common shell fragments; saturated.						
-16.55	1.65	Sand; very fine to medium grained; medium gray; common shell fragments; common mica; relatively dry.		2	SP-SM	100.0	10.5	
-18.86	3.96	Poorly graded sand w/silt & gravel; abundant pebbles.		3	SP-SM	98.6	7.5	
-19.56	4.66							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-7
LOCATION: SO-9 Site
NORTHING (m): 616,678.1 **EASTING (m):** 1,889,909.5 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.7875′ **LONGITUDE:** 117°25.8571′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 1623 **COMPLETED:**
SOUNDING (m): 16.5* **TIDE (m):** **ELEVATION (m):** -16.5 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 2.13 **LOGGED BY:** PJF

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-16.5	0	Sandy silt; fine to very fine grained; dark to medium olive gray; common mica throughout with rare shell fragments (thin-shelled clams). 5.1 cm pebble horizon at base.		1	ML	99	54	
-18.33	1.83	Poorly graded sand w/gravel; medium to fine grained; light gray to light olive gray; small 0.6-1.3 cm. pebbles.		2	SP	86	3	
-18.63	2.13							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-8
LOCATION: SO-9 Site
NORTHING (m): 616,377.9 **EASTING (m):** 1,890,049.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.6259′ **LONGITUDE:** 117°25.7649′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 1653 **COMPLETED:**
SOUNDING (m): 16.2* **TIDE (m):** **ELEVATION (m):** -16.2 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 5.27 **LOGGED BY:** VBC

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-16.2	0	Sandy silt; dark gray; common mica.		1	ML	100	57	
-17.42	1.22	Sandy Silt		2	ML	100	56	
-17.82	1.62	Poorly graded sand with silt; medium olive gray; occasional gastropod and clam shells; rare shell fragments.						
-18.03	1.83	Poorly graded sand w/silt; light to medium gray; rare shell fragments; sharp lower contact.		3	SP-SM	100	7	
-18.94	2.74	Poorly sorted sand with gravel; orange gray; common dark rock fragments; occasional small shell fragments.orange gray; common dark rock fragments; occasional small shell fragments.						
-19.71	3.51	Poorly graded sand; orange-yellow-brown; fine to very coarse; well-sorted; occasional mica.		4	SP	68	1	
-20.35	4.15	Poorly graded sand; light yellow-brown; medium to coarse; moderately well-sorted; occasional mica; no fines or shells .						
-21.47	5.27							

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-9
LOCATION: SO-9 Site
NORTHING (m): 616,090.4 **EASTING (m):** 1,890,151.8 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.4719′ **LONGITUDE:** 117°25.6969′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 1835 **COMPLETED:**
SOUNDING (m): 17.1* **TIDE (m):** **ELEVATION (m):** -17.1 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 3.41 **LOGGED BY:** PJF

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m) 40 80 120 160
-17.1	0	Sandy silt; dark olive gray; mica common to abundant throughout; very moist.		1	ML	100	64	
-17.86	.76	Sandy silt; dark to medium olive gray; shell hash lens at base; moderately dry.		2	ML	100	50	
-18.47	1.37	Silty sand; light to medium gray; fine to very fine grained; occasional shell fragments; occasional pebbles (.6-1.3 cm) near base.		3	SM	100	14	
-20.51	3.41							

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-10
LOCATION: SO-9 Site
NORTHING (m): 615,811.2 **EASTING (m):** 1,890,325.8 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.3211′ **LONGITUDE:** 117°25.5829′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 1902 **COMPLETED:**
SOUNDING (m): 16.8* **TIDE (m):** **ELEVATION (m):** -16.8 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 4.18 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-16.8	0	Sandy silt; medium to dark olive gray; common mica; shell fragments below 0.91 m.		1	ML	100	53	
-18.63	1.83	Poorly graded sand; medium olive gray; abundant mica; some pebbles to 5.1 cm at 2.7 m.		2	SP	100	3	
-19.85	3.05	Poorly graded sand w/silt; very fine grained; medium olive gray; drier than above.		3	SP-SM	100	5	
-20.98	4.18							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-11
LOCATION: SO-9 Site
NORTHING (m): 616,280.6 **EASTING (m):** 1,889,627.2 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.5707′ **LONGITUDE:** 117°26.0359′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 1934 **COMPLETED:**
SOUNDING (m): 18.0* **TIDE (m):** **ELEVATION (m):** -18 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 4.39 **LOGGED BY:** PJF

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-18	0	Sandy silt; dark olive gray; mica common throughout; no shell fragments; very moist.		1	ML	100	63	
-19.52	1.52	Silty sand; dark olive gray; rare to common shell fragments.		2	SM	98	30	
-21.05	3.05	Silty sand; medium gray to olive gray; fine grained very rare shell fragments; very abundant mica; firm.		3	SM	100	43	
-22.39	4.39							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-12
LOCATION: SO-9 Site
NORTHING (m): 616,090.7 **EASTING (m):** 1,889,811.3 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°12.4691′ **LONGITUDE:** 117°25.9160′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 2008 **COMPLETED:**
SOUNDING (m): 17.7* **TIDE (m):** **ELEVATION (m):** -17.7 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 3.32 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-17.7	0	Silt with sand; dark olive gray; common mica; burrowing worm at 0.3 m.		1	ML	100	81	
-18.92	1.22	Silty sand; dark olive gray; becoming drier, friable below 2.5 m.		2	SM	100	24	
-21.02	3.32							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** SDG-13
LOCATION: SO-8 Site
NORTHING (m): 614,810.9 — **EASTING (m):** 1,890,794.3 — **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.7827′ — **LONGITUDE:** 117°25.2742′ — **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor — **EQUIPMENT:** ALPINE Vibracore — **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 — **TIME BORING STARTED:** 2043 — **COMPLETED:**
SOUNDING (m): 17.1* — **TIDE (m):** — **ELEVATION (m):** -17.1 — **DATUM:** MLLW
PENETRATION (m): ? — **RECOVERY (m):** 5.03 — **LOGGED BY:** PJF

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-17.1	0	Silty sand; medium olive gray; very fine grained; abundant mica; rare shell fragments; very moist.		1	SM	100	17	
-19.54	2.44	Sandy silt; medium olive gray; slightly more compacted below 3.05 m.		2	ML	100	57	
-21.06	3.96	Poorly graded sand w/silt		3	SP-SM	96	6	
-22.13	5.03							

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-14
LOCATION: SO-8 Site
NORTHING (m): 614,739.9 **EASTING (m):** 1,890,696.2 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.7437′ **LONGITUDE:** 117°25.3368′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 2109 **COMPLETED:**
SOUNDING (m): 18.3* **TIDE (m):** **ELEVATION (m):** -18.3 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 5.03 **LOGGED BY:** VBC

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m) 40 80 120 160
-18.3	0	Silty sand; medium olive gray; very fine grained; abundant mica; rare shell fragments; damp.		1	SM	100	49	
-20.74	2.44	Silty sand; medium olive gray ; very fine grained; abundant mica; rare shell fragments.		2	SM	99	14	
-21.96	3.66	Poorly graded sand with silt; medium dark gray to olive gray; very fine grained; common mica; no shells; very dry; somewhat compact.		3	SP-SM	100	9	
-23.33	5.03							

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside — **HOLE NUMBER:** SDG-15
LOCATION: SO-8 Site
NORTHING (m): 614,600.3 — **EASTING (m):** 1,890,558.7 — **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.6674′ — **LONGITUDE:** 117°25.4243′ — **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor — **EQUIPMENT:** ALPINE Vibracore — **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 — **TIME BORING STARTED:** 2135 — **COMPLETED:**
SOUNDING (m): 18.6* — **TIDE (m):** — **ELEVATION (m):** -18.6 — **DATUM:** MLLW
PENETRATION (m): ? — **RECOVERY (m):** 5.21 — **LOGGED BY:** PJF

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-18.6	0	Sandy silt; dark olive gray; abundant muscovite throughout; rare shell fragments; fluid to appx. 15 cm.		1	ML	100	53	
-20.28	1.68	Silty sand; dark olive gray; abundant muscovite throughout; rare shell fragments.		2	SM	100	33	
-21.65	3.05	Poorly graded sand with silt; light gray to medium olive; very fine to fine; becoming firm, "dry".		3	SP-SM	100	7	
-23.8	5.21							

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-16
LOCATION: SO-8 Site
NORTHING (m): 614,652.7 **EASTING (m):** 1,891,135.1 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.6992′ **LONGITUDE:** 117°25.0538′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 2159 **COMPLETED:**
SOUNDING (m): 16.8* **TIDE (m):** **ELEVATION (m):** -16.8 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 4.88 **LOGGED BY:** VBC

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-16.8	0	Sandy silt; dark olive gray; very fine grained; common razor clam shell fragments throughout; micaceous.		1	ML	99	50	
-18.93	2.13	Silty sand; 5"(?!) diam. sandstone cobble at top.		2	SM	96	13	
-19.85	3.05	Poorly graded sand w/silt; medium gray; fine to very fine; abundant mica in layers.		3	SP-SM	100	8	
-21.68	4.88							

REMARKS: Elevation is tide-corrected, but actual tide value not given

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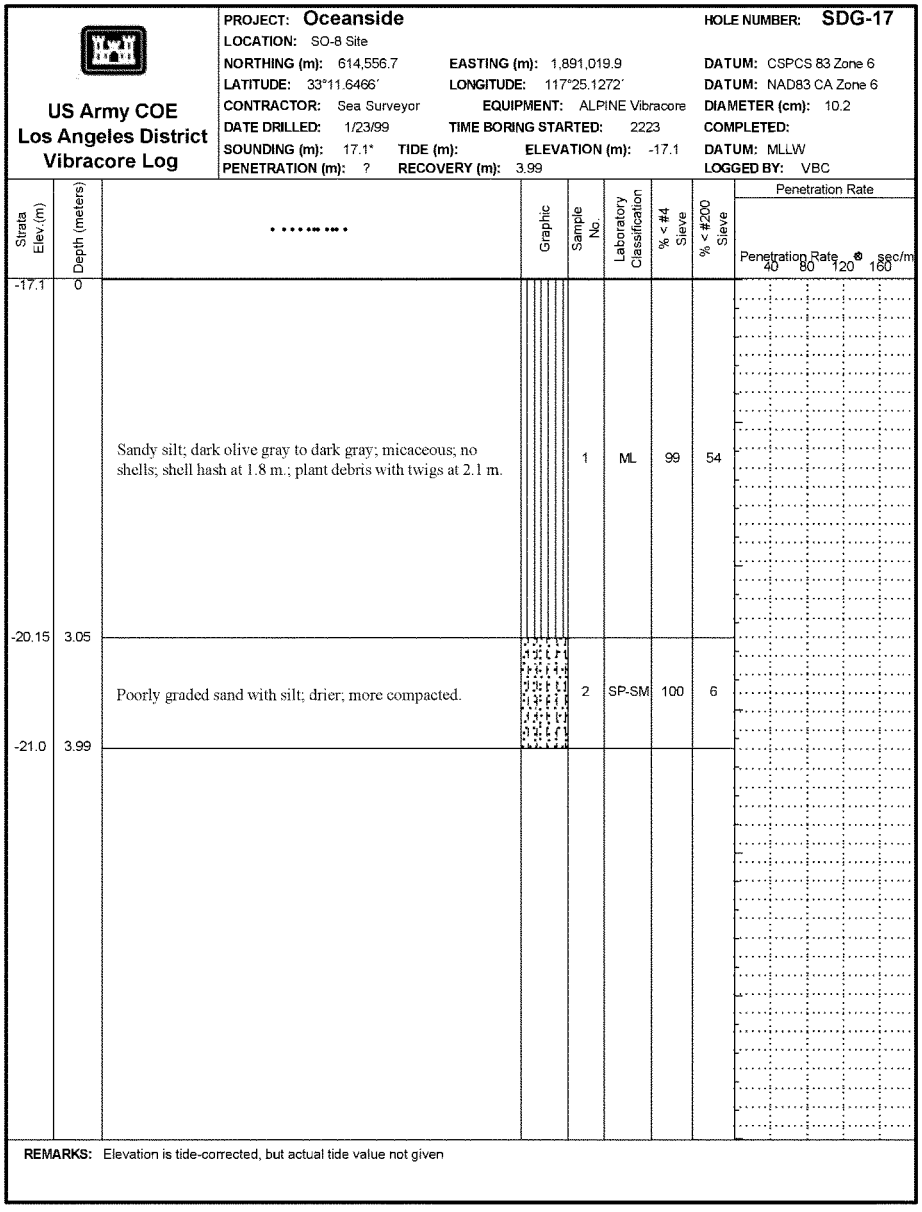
Figure



US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-17
LOCATION: SO-8 Site
NORTHING (m): 614,556.7
EASTING (m): 1,891,019.9
DATUM: CSPCS 83 Zone 6
LATITUDE: 33°11.6466´
LONGITUDE: 117°25.1272´
DATUM: NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor
EQUIPMENT: ALPINE Vibracore
DIAMETER (cm): 10.2
DATE DRILLED: 1/23/99
TIME BORING STARTED: 2223
COMPLETED:
SOUNDING (m): 17.1*
TIDE (m):
ELEVATION (m): -17.1
DATUM: MLLW
PENETRATION (m): ?
RECOVERY (m): 3.99
LOGGED BY: VBC

Strata Elev.(m)	Depth (meters)	Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m) 40 80 120 160
-17.1	0						
		Sandy silt; dark olive gray to dark gray; micaceous; no shells; shell hash at 1.8 m.; plant debris with twigs at 2.1 m.	1	ML	99	54	
-20.15	3.05						
		Poorly graded sand with silt; drier; more compacted.	2	SP-SM	100	6	
-21.0	3.99						

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside			**HOLE NUMBER:** SDG-18
LOCATION: SO-8 Site			
NORTHING (m): 614,476.8	**EASTING (m):** 1,890,893.7		**DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.6026'	**LONGITUDE:** 117°25.2078'		**DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor	**EQUIPMENT:** ALPINE Vibracore		**DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99	**TIME BORING STARTED:** 2244		**COMPLETED:**
SOUNDING (m): 18.0* **TIDE (m):**	**ELEVATION (m):** -18		**DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 5.15			**LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-18	0	Sandy silt; medium olive gray; micaceous; no shells; saturated to 0.91 m, then drier, more compact.		1	ML	100	66	
-19.22	1.22	Sandy silt; dark olive gray; wet.		2	ML	99	54	
-21.72	3.72	Silty sand; light to medium gray; fine to very fine grained; no shells; bedding(?); drier and more compact.		NS				
-23.1	5.15							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-19
LOCATION: SO-8 Site
NORTHING (m): 614,390.9 **EASTING (m):** 1,890,761.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.5553′ **LONGITUDE:** 117°25.2923′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/23/99 **TIME BORING STARTED:** 2307 **COMPLETED:**
SOUNDING (m): 18.6* **TIDE (m):** **ELEVATION (m):** -18.6 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 4.27 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-18.6	0	Sandy silt; dark olive gray; abundantly micaceous; slight organic odor; saturated to 0.91 m.		1	ML	100	64	
-19.82	1.22	Sandy silt; dark olive gray; moist.		2	ML	100	52	
-22.59	3.99	Sandy silt; dark gray.		3	ML	100	52	
-22.87	4.27							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-20
LOCATION: SO-8 Site
NORTHING (m): 614,275.6 **EASTING (m):** 1,890,652.3 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.4923′ **LONGITUDE:** 117°25.3617′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0025 **COMPLETED:**
SOUNDING (m): 20.1* **TIDE (m):** **ELEVATION (m):** -20.1 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 4.97 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-20.1	0	Sandy silt; dark olive gray; abundant mica; rare shell fragments, thin hash layer at base.		1	ML	100	64	
-22.39	2.29	Silty sand; dry, compact.		2	SM	100	43	
-23.45	3.35	Poorly graded sand with silt		3	SP-SM	100	8	
-25.07	4.97							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-21
LOCATION: SO-8 Site
NORTHING (m): 614,458.8 **EASTING (m):** 1,891,334.1 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.5956′ **LONGITUDE:** 117°24.9243′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0055 **COMPLETED:**
SOUNDING (m): 16.5* **TIDE (m):** **ELEVATION (m):** -16.5 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 4.15 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-16.5	0	Sandy silt; dark to medium gray; abundant mica to 0.76 m, common below.		1	ML	99	54	
-18.33	1.83	Poorly graded sand w/silt; dark to medium gray; moist to 3.05 m., then dry, compact; occasional pebbles 3.05-3.66 m.		2	SP-SM	100	9	
-20.65	4.15							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-22
LOCATION: SO-8 Site
NORTHING (m): 614,347.3 **EASTING (m):** 1,891,206.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.5344′ **LONGITUDE:** 117°25.0057′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0125 **COMPLETED:**
SOUNDING (m): 17.1* **TIDE (m):** **ELEVATION (m):** -17.1 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 5.18 **LOGGED BY:** VBC

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-17.1	0	Sandy silt; medium to dark gray; abundant mica to 0.91 m, common below; worms in upper 0.46 m.; "weathered paper detritus" at 1.22 m.		1	ML	100	58	
-19.08	1.98	Silty sand.		2	SM	100	18	
-20	2.90	Poorly graded sand with silt; drier, compact; no shells.		3	SP-SM	100	5	
-22.28	5.18							

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-23
LOCATION: SO-8 Site
NORTHING (m): 614,266.5 **EASTING (m):** 1,891,108.9 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.4901′ **LONGITUDE:** 117°25.0679′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0155 **COMPLETED:**
SOUNDING (m): 18.0* **TIDE (m):** **ELEVATION (m):** -18 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 2.99 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m; 40 80 120 160)
-18	0	Sandy silt; medium to dark olive gray; abundant mica grading down to common; uniform.		1	ML	100	67	
-20.29	2.29	Silty sand; medium olive gray; fine to very fine grained; commonly micaceous; occasional shells; drier to base.		2	SM	100	16	
-20.99	2.99							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

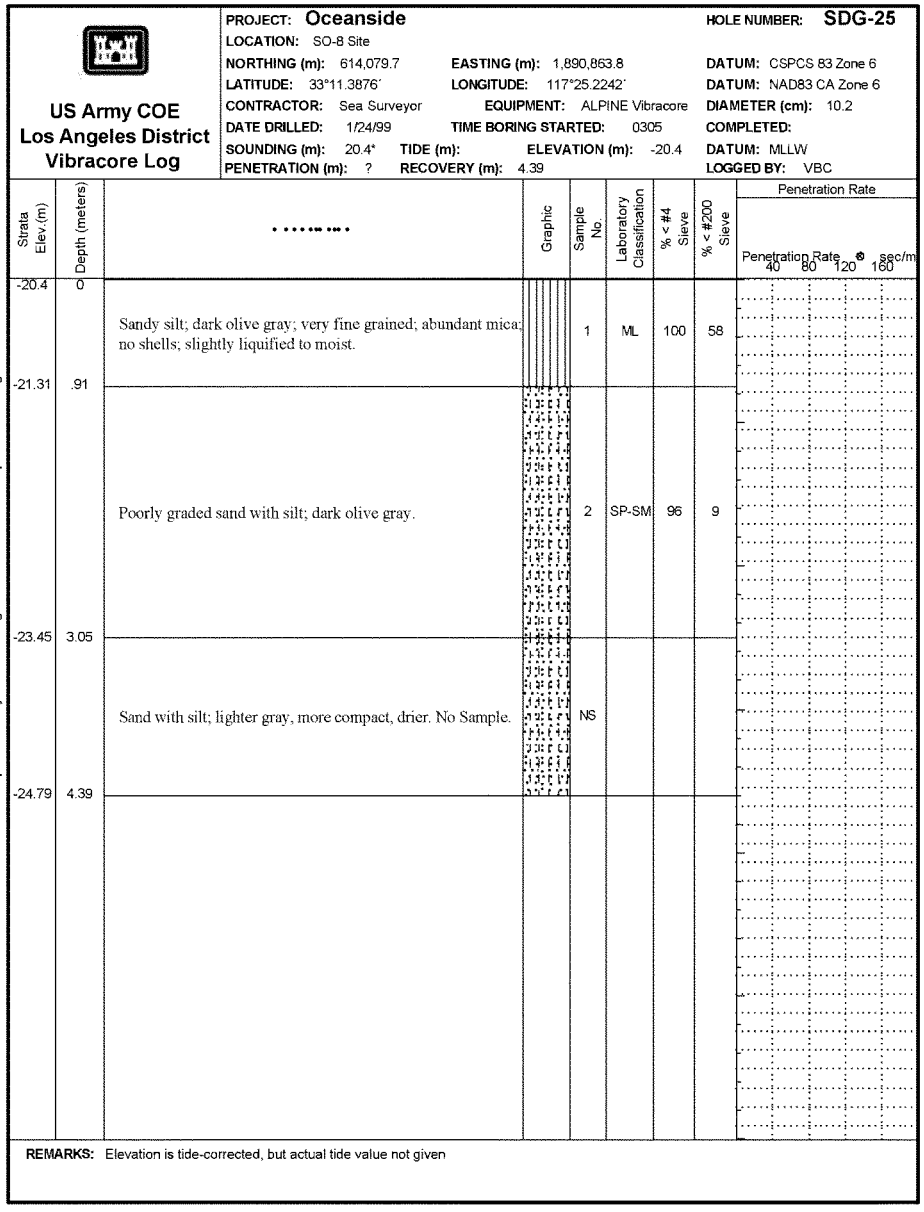
PROJECT: Oceanside **HOLE NUMBER:** SDG-24
LOCATION: SO-8 Site
NORTHING (m): 614,169.3 **EASTING (m):** 1,890,962.6 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.4367′ **LONGITUDE:** 117°25.1613′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0235 **COMPLETED:**
SOUNDING (m): 19.2* **TIDE (m):** **ELEVATION (m):** -19.2 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 4.42 **LOGGED BY:** VBC

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m, 40 80 120 160)
-19.2	0	Sandy silt; medium to dark olive gray; very fine grained; abundant disseminated mica.		1	ML	100	66	
-21.64	2.44	Silty sand; medium gray; fine grained; abundant mica; shell fragments; below 3.05 m. drier, more compact with no shells.		2	SM	100	38	
-23.62	4.42							

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure



US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-25
LOCATION: SO-8 Site
NORTHING (m): 614,079.7
EASTING (m): 1,890,863.8
DATUM: CSPCS 83 Zone 6
LATITUDE: 33°11.3876'
LONGITUDE: 117°25.2242'
DATUM: NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor
EQUIPMENT: ALPINE Vibracore
DIAMETER (cm): 10.2
DATE DRILLED: 1/24/99
TIME BORING STARTED: 0305
COMPLETED:
SOUNDING (m): 20.4*
TIDE (m):
ELEVATION (m): -20.4
DATUM: MLLW
PENETRATION (m): ?
RECOVERY (m): 4.39
LOGGED BY: VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m, 40 80 120 160)
-20.4	0	Sandy silt; dark olive gray; very fine grained; abundant mica; no shells; slightly liquified to moist.		1	ML	100	58	
-21.31	.91	Poorly graded sand with silt; dark olive gray.		2	SP-SM	96	9	
-23.45	3.05	Sand with silt; lighter gray, more compact, drier. No Sample.		NS				
-24.79	4.39							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-26
LOCATION: SO-8 Site
NORTHING (m): 614,200.1 **EASTING (m):** 1,891,563.3 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.4569′ **LONGITUDE:** 117°24.7750′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0340 **COMPLETED:**
SOUNDING (m): 16.5* **TIDE (m):** **ELEVATION (m):** -16.5 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 4.72 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-16.5	0	Sandy silt; dark olive gray; very fine grained; common to abundant fine mica; rare shell fragments, but shell hash layers with small razor shell fragments locally; common plant fragments around 1.8 m.		1	ML	100	58	
-19.55	3.05	Poorly graded sand; medium gray; very fine to fine; dry, compact, browner in color with faint horizontal bedding below 3.96 m.		2	SP	90	4	
-21.22	4.72							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-27
LOCATION: SO-8 Site
NORTHING (m): 614,096.7 **EASTING (m):** 1,891,430.1 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.4002′ **LONGITUDE:** 117°24.8599′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0410 **COMPLETED:**
SOUNDING (m): 17.1* **TIDE (m):** **ELEVATION (m):** -17.1 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 3.44 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-17.1	0	Sandy silt; olive gray; very fine grained; finely micaceous; uniform; very small razor clam fragments; common plant fragments around 1.8 m.		1	ML	100	58	
-19.84	2.74	Silty sand; medium gray; fine to very fine; common razor shell fragments; common mica decreasing downwards; dry, very compact.		2	SM	100	23	
-20.54	3.44							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-28
LOCATION: SO-8 Site
NORTHING (m): 614,018.4 **EASTING (m):** 1,891,309.1 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.3571′ **LONGITUDE:** 117°24.9372′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0430 **COMPLETED:**
SOUNDING (m): 18.0* **TIDE (m):** **ELEVATION (m):** -18 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 3.72 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-18	0	Sandy silt; dark gray; very fine grained; micaceous; rare shell fragments to 0.46 m.; no bedding; drier, more compact, friable, increasing shell fragments at base.		1	ML	100	61	
-20.74	2.74	Poorly graded sand with silt; light gray; fine to very fine grained.		2	SP-SM	100	7	
-21.72	3.72							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-29
LOCATION: SO-8 Site
NORTHING (m): 613,940.1 **EASTING (m):** 1,891,184.2 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.3140′ **LONGITUDE:** 117°25.0171′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0500 **COMPLETED:**
SOUNDING (m): 19.2* **TIDE (m):** **ELEVATION (m):** -19.2 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 2.96 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-19.2	0	Silt with sand; dark olive gray; very fine grained; uniform; occasional muscovite; no shells.		1	ML	100	73	
-21.33	2.13	Poorly graded sand with silt ; dark olive gray; very fine grained; uniform; occasional muscovite; drier, more compact below 2.44 m.		2	SP-SM	100	8	
-22.16	2.96							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-30
LOCATION: SO-8 Site
NORTHING (m): 613,843.1 **EASTING (m):** 1,891,058.9 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.2608′ **LONGITUDE:** 117°25.0970′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0525 **COMPLETED:**
SOUNDING (m): 20.7* **TIDE (m):** **ELEVATION (m):** -20.7 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 3.51 **LOGGED BY:** PJF

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate ⊗ sec/m, 40 80 120 160)
-20.7	0	Sandy silt; medium dark olive gray; common mica throughout 1.3 cm twig at 1.5 m.		1	ML	100	67	
-22.38	1.68	Silty sand; dark olive gray; shell hash at top, and at 2.7 m.		2	SM	100	36	
-24.21	3.51							

REMARKS: Elevation is tide-corrected, but actual tide value not given

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-31
LOCATION: SO-8 Site
NORTHING (m): 613,990.3 **EASTING (m):** 1,891,752.6 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.3446′ **LONGITUDE:** 117°24.6517′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0550 **COMPLETED:**
SOUNDING (m): 16.5* **TIDE (m):** **ELEVATION (m):** -16.5 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 3.35 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-16.5	0	Sandy silt; dark olive gray; uniform; common mica; occasional razor clam fragments and thin-shelled gastropods; more compact and drier below 1.83 m.		1	ML	100	61	
-18.63	2.13	Silty sand; dark olive gray; compact; dry; no shells below 2.53 m.		2	SM	99	24	
-19.85	3.35							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside **HOLE NUMBER:** SDG-32
LOCATION: SO-8 Site
NORTHING (m): 613,891.6 **EASTING (m):** 1,891,620.3 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.2904′ **LONGITUDE:** 117°24.7361′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 0610 **COMPLETED:**
SOUNDING (m): 17.1* **TIDE (m):** **ELEVATION (m):** -17.1 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 3.02 **LOGGED BY:** PJF

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-17.1	0	Sandy silt; dark to medium olive gray; shell hash at base.		1	ML	100	53	
-18.93	1.83	Sandy silt; medium olive gray; common shell hash (pelecypods), turban shell.		2	ML	100	60	
-20.12	3.02							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-33
LOCATION: SO-8 Site
NORTHING (m): 613,619.7 **EASTING (m):** 1,891,256.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.1411′ **LONGITUDE:** 117°24.9683′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 1242 **COMPLETED:**
SOUNDING (m): 21.0* **TIDE (m):** **ELEVATION (m):** -21 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 1.10 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-21	0	Sandy silt; dark olive gray; abundant muscovite; rare small shell fragments.		1	ML	100	56	
-22.1	1.1							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
HOLE NUMBER: SDG-34
LOCATION: SO-8 Site
NORTHING (m): 613,576.7 **EASTING (m):** 1,891,733.4 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.1208′ **LONGITUDE:** 117°24.6611′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 1100 **COMPLETED:**
SOUNDING (m): 18.6* **TIDE (m):** **ELEVATION (m):** -18.6 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 1.19 **LOGGED BY:** PJF

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m) 40 80 120 160
-18.6	0	Sandy silt; dark olive gray; muscovite throughout; rare shell fragments.		1	ML	100	64	
-19.79	1.19							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: Oceanside
LOCATION: SO-8 Site
HOLE NUMBER: SDG-35
NORTHING (m): 613,390.8 **EASTING (m):** 1,891,471.0 **DATUM:** CSPCS 83 Zone 6
LATITUDE: 33°11.0186′ **LONGITUDE:** 117°24.8286′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: Sea Surveyor **EQUIPMENT:** ALPINE Vibracore **DIAMETER (cm):** 10.2
DATE DRILLED: 1/24/99 **TIME BORING STARTED:** 1015 **COMPLETED:**
SOUNDING (m): 21.3* **TIDE (m):** **ELEVATION (m):** -21.3 **DATUM:** MLLW
PENETRATION (m): ? **RECOVERY (m):** 1.86 **LOGGED BY:** VBC

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-21.3	0	Sandy silt; dark olive gray; abundant muscovite; occasional thin-shelled razor clams		1	ML	99	58	
-22.52	1.22	Sandy silt; dark olive gray; abundant muscovite ;occasional thin-shelled razor clams at top.		2	ML	100	60	
-23.16	1.86							

REMARKS: Elevation is tide-corrected, but actual tide value not given

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: San Clemente **HOLE NUMBER:** SC-1
LOCATION: San Clemente Borrow Area #1
NORTHING (m): 634,671 **EASTING (m):** 1,873,567 **DATUM:** NAD83 CA Zone 6
LATITUDE: 33°22.4135′ **LONGITUDE:** 117°36.5253′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/20/03 **TIME BORING STARTED:** 1634 **COMPLETED:** 1656
SOUNDING (m): 16.15 **TIDE (m):** .30 **ELEVATION (m):** -15.8 **DATUM:** MLLW
PENETRATION (m): 4.11 **RECOVERY (m):** 4.11 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve
-15.8	0	Silty sand; med. greenish gray; mod-minor shells		1	SM	100.0	44.0
-16.76	.91	Silty sand; med. greenish gray; mod-minor shells		2	SM	100.0	47.0
-17.68	1.83	Sandy silt; med. greenish gray; mod-minor shells		3	ML	100.0	53.0
-18.59	2.74	Sandy silt; med. greenish gray; mod-minor shells		4	ML	100.0	60.0
-19.51	3.66	Sandstone (bedrock); silty; very fine grained; slightly micaceous; dense, compact; no shells; dry		5	SM	100.0	21.0
-19.96	4.11						

Penetration Rate
Penetration Rate ⊗ sec/m
40 80 120 160
9216.535

REMARKS:

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: San Clemente — **HOLE NUMBER:** SC-3
LOCATION: San Clemente Borrow Area #1
NORTHING (m): 636,380 — **EASTING (m):** 1,872,551 — **DATUM:** NAD83 CA Zone 6
LATITUDE: 33°23.3305' — **LONGITUDE:** 117°37.1947' — **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic — **EQUIPMENT:** 800 lb. pneumatic — **DIAMETER (cm):** 8.9
DATE DRILLED: 1/20/03 — **TIME BORING STARTED:** 1451 — **COMPLETED:** 1525
SOUNDING (m): 16.76 — **TIDE (m):** .27 — **ELEVATION (m):** -16.5 — **DATUM:** MLLW
PENETRATION (m): .61 — **RECOVERY (m):** 2.53 — **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (40 80 120 160 sec/m)
-16.4	0	Silty sand; very fine grained; mod-abundant shell fragments; gray color.		1				
-17.1	.61							9393-701

REMARKS: 3 penetrations @ site due to refusal. Entire recovered core composited. Sample not analyzed.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: San Clemente **HOLE NUMBER:** SC-5
LOCATION: San Clemente Borrow Area #1
NORTHING (m): 636,881 **EASTING (m):** 1,872,127 **DATUM:** NAD83 CA Zone 6
LATITUDE: 33°23.5987′ **LONGITUDE:** 117°37.4729′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/20/03 **TIME BORING STARTED:** 1320 **COMPLETED:** 1353
SOUNDING (m): 17.83 **TIDE (m):** .98 **ELEVATION (m):** -16.8 **DATUM:** MLLW
PENETRATION (m): 3.81 **RECOVERY (m):** 3.81 **LOGGED BY:** K. Raabe

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate
-16.8	0	Silty sand; very fine grained; dark greenish gray; moderate amount of shell frag ments.		1				
-17.76	.91	Silty sand; very fine grained; dark greenish gray; moderate amount of shell frag ments.		2				
-18.68	1.83	Silty sand; very fine grained; dark greenish gray; moderate amount of shell frag ments.		3				
-19.59	2.74	Silty sand; very fine grained; dark greenish gray; moderate amount of shell fragments.		4				
-20.57	3.72							
-20.66	3.81	Sandstone (bedrock); silty/clayey; soft; dark gray		NS				

Penetration Rate ⊗ sec/m
40 80 120 160

REMARKS: No gradation analysis for samples.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: San Clemente — **HOLE NUMBER:** SC-7
LOCATION: San Clemente Borrow Area #1
NORTHING (m): 638,268 **EASTING (m):** 1,871,244 **DATUM:** NAD83 CA Zone 6
LATITUDE: 33°24.3427′ **LONGITUDE:** 117°38.0537′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/20/03 **TIME BORING STARTED:** 1150 **COMPLETED:** 1157
SOUNDING (m): 19.05 **TIDE (m):** 1.71 **ELEVATION (m):** -17.3 **DATUM:** MLLW
PENETRATION (m): 1.83 **RECOVERY (m):** 1.83 **LOGGED BY:** K. Raabe

Strata Elev. (m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (sec/m, 40 80 120 160)
-17.3	0	Silty sand; very fine grained; green-gray; minor shells		1				
-18.25	.91	Silty sand; very fine grained; green-gray; minor shells in upper 0.3 m, abundant below		2				
-18.89	1.55	Sandstone (bedrock); silty/clayey; micaceous; dark gray; weakly foliated		NS				
-19.17	1.83							@400 262

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

REMARKS: No gradation analysis for samples.

Figure

US Army COE
Los Angeles District
Vibracore Log

PROJECT: San Clemente **HOLE NUMBER:** SC-8
LOCATION: San Clemente Borrow Area #1
NORTHING (m): 638,607 **EASTING (m):** 1,870,570 **DATUM:** NAD83 CA Zone 6
LATITUDE: 33°24.5352′ **LONGITUDE:** 117°38.5191′ **DATUM:** NAD83 CA Zone 6
CONTRACTOR: TEG Oceanographic **EQUIPMENT:** 800 lb. pneumatic **DIAMETER (cm):** 8.9
DATE DRILLED: 1/20/03 **TIME BORING STARTED:** 0945 **COMPLETED:** 1000
SOUNDING (m): 20.88 **TIDE (m):** 1.92 **ELEVATION (m):** -19 **DATUM:** MLLW
PENETRATION (m): 3.05 **RECOVERY (m):** 4.66 **LOGGED BY:** K. Raabe

Strata Elev.(m)	Depth (meters)		Graphic	Sample No.	Laboratory Classification	% < #4 Sieve	% < #200 Sieve	Penetration Rate (Penetration Rate @ sec/m; 40 80 120 160)
-18.9	0	Sandy silt; very fine grained; dark gray; local shell concentrations		1	ML	100	67	
-19.87	.91	Sandy silt; very fine grained; dark gray; local shell concentrations; lower 45 cm. has disseminated coarse sand.		2	ML	100.0	53.0	
-21.09	2.13	Silty sand; very fine grained; disseminated coarse sand; lower 15 cm. has rounded small pebbles; local shell concentrations.		3	SM	93.0	36.0	
-21.86	2.90							
-22.01	3.05	Bedrock (not recovered)		NS				298.556

REMARKS: Penetrated .3m, then up, back down to TD. Extra material sucked in.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

APPENDIX F – AGENCY COORDINATION AND PUBLIC INVOLVEMENT

and net savings to the government as a result of those exceptions; records containing contractor information; records containing reimbursable billing information; name, Social Security Number, pay grade and (optionally) address information.

AUTHORITY FOR MAINTENANCE OF THE SYSTEM:

5 U.S.C. 301, Departmental Regulations and E.O. 9397 (SSN).

PURPOSE(S):

To provide managers and supervisors with timely, on-line information regarding audit requirements, programs, and performance.

ROUTINE USES OF RECORDS MAINTAINED IN THE SYSTEM, INCLUDING CATEGORIES OF USERS AND THE PURPOSES OF SUCH USES:

In addition to those disclosures generally permitted under 5 U.S.C. 552a(h) of the Privacy Act, these records or information contained therein may specifically be disclosed outside the DoD as a routine use pursuant to 5 U.S.C. 552a(b)(3) as follows:

The DoD "Blanket Routine Uses" that appear at the beginning of DCAA's compilation of systems of records notices apply to this system.

POLICIES AND PRACTICES FOR STORING, RETRIEVING, ACCESSING, RETAINING, AND DISPOSING OF RECORDS IN THE SYSTEM:

STORAGE:

Records are maintained in an on-line database and on magnetic tape at secure offsite storage.

RETRIEVABILITY:

Records are retrieved by organizational levels, name of employee, Social Security Number, office symbol, audit activity codes, or any other combination of these identifiers.

SAFEGUARDS:

Automated records are protected by restricted access procedures. Access to records is strictly limited to authorized officials with a bona fide need for the records.

RETENTION AND DISPOSAL:

Records are retained indefinitely.

SYSTEM MANAGER(S) AND ADDRESS:

Chief, Information Technology Division, Defense Contract Audit Agency, 4075 Park Avenue, Memphis, TN 38111–7492.

NOTIFICATION PROCEDURE:

Individuals seeking to determine whether information about themselves is contained in this system should address written inquiries to the Chief, Information Technology Division, Defense Contract Audit Agency, 4075 Park Avenue, Memphis, TN 38111–7492.

Individuals must furnish name, Social Security Number, approximate date of record, and geographic area in which consideration was requested for record to be located and identified. Official mailing addresses are published as an appendix to the DCAA's compilation of systems notices.

RECORD ACCESS PROCEDURES:

Individuals seeking access to information about themselves contained in this system should address written inquiries to the Chief, Information Technology Division, Defense Contract Audit Agency, 4075 Park Avenue, Memphis, TN 38111–7492.

Individuals must furnish name, Social Security Number, approximate date of record, and geographic area in which consideration was requested for record to be located and identified.

CONTESTING RECORD PROCEDURES:

DCAA's rules for accessing records, for contesting contents and appealing initial agency determinations are published in DCAA Regulation 5410.10; 32 CFR part 317; or may be obtained from the system manager.

RECORD SOURCE CATEGORIES:

Individual employees, supervisors, audit reports and working papers.

EXEMPTIONS CLAIMED FOR THE SYSTEM:

None.

[FR Doc. 02–671 Filed 1–10–02; 8:45 am]

BILLING CODE 5001–08–P

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Intent To Prepare a Joint Environmental Impact Statement/ Environmental Impact Report for the San Clemente Shoreline Feasibility Study, San Clemente, CA

AGENCY: Army Corps of Engineers (Corps), DoD.

ACTION: Notice of intent.

SUMMARY: The Corps and the city of San Clemente propose to study alternatives to provide shoreline protection to the San Clemente Shoreline. The study is for that portion of the shoreline that runs from Shorecliff Beach to San Mateo Point, approximately eight kilometers (five miles).

FOR FURTHER INFORMATION CONTACT: Questions regarding the scoping process or preparation of the EIS/EIR may be directed to Mr. Paul Rose, Chief, Environmental Resources Branch, U.S. Army Corps of Engineers, P.O. Box 532711, Los Angeles, California, 90053–2325, (213) 452–3840.

SUPPLEMENTARY INFORMATION:

1. Proposed Action

Provide shoreline protection against wave attack from coastal storms to the San Clemente shoreline. Running along the entire length of the San Clemente shoreline is a portion of the Los Angeles to San Diego (Lossan) railroad corridor. The Lossan is a major passenger rail line linking San Diego to the rest of the United States. The Lossan is owned by the Orange County Transportation Authority (OCTA). This commuter rail corridor is among the busiest in the country and separates the beach from the bluff. Loss of shoreline protection and recreational beach width is a continuous problem for the city of San Clemente. Damages to coastal residential and commercial properties from storm-induced waves have become a serious threat over the past several years. The study will investigate alternatives to provide shoreline protection.

2. Alternatives

Alternatives that may be considered include non-structural and/or structural measures to provide protection against wave attack from coastal storms. Non-structural measures include beach and near-shore nourishment with dredged sand.

3. Scoping Process

The Corps and the city of San Clemente are preparing a joint Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) to address potential impacts associated with the proposed project. The Corps is the Lead Federal Agency for compliance with NEPA for the project, and the city of San Clemente is the Lead State Agency for compliance with the CEQA for the non-Federal aspects of the project. The Draft EIS/EIR (DEIS/EIR) document will incorporate public concerns in the analysis of impacts associated with the Proposed Action and associated project alternatives. The DEIS/EIR will be sent out for a 45-day public review period, during which time both written and verbal comments will be solicited on the adequacy of the document. The Final EIS/EIR (FEIS/EIR) will address the comments received on the DEIS/EIR during public review, and will be furnished to all who commented on the DEIS/EIR, and is made available to anyone that requests a copy during

the 30-day public comment period. The final step involves, for the Federal EIS, preparing a Record of Decision (ROD) and, for the state EIR, certifying the EIR and adopting a Mitigation Monitoring and Reporting Plan. The ROD is a concise summary of the decisions made by the Corps from among the alternatives presented in the FEIS/EIR. The ROD can be published immediately after the FEIS public comment period ends. A certified EIR indicates that the environmental document adequately assesses the environmental impacts of the proposed project with respect to CEQA. A formal scoping meeting to solicit public comment and concerns on the proposed action and alternatives will be held on Jannary 10, 2002 at 7 p.m., in the Multipurpose Room (1 & 2) in the San Clemente Senior Center, 242 Avenue Del Mar, San Clemente, California.

Luz D. Ortiz,

Army Federal Register Liaison Officer.

[FR Doc. 02–771 Filed 1–10–02; 8:45 am]

BILLING CODE 3710–KF–M

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Intent To Prepare a Draft Environmental Impact Statement (DEIS) for the Matilija Dam Ecosystem Restoration Feasibility Study, Ventura County, CA

AGENCY: Army Corps of Engineers, DoD.

ACTION: Notice of intent.

SUMMARY: The Los Angeles District of the U.S. Army Corps of Engineers will prepare a DEIS to support the Matilija Dam Ecosystem Restoration Feasibility Study, Ventura County, California. The study area is the Matilija Dam area and downstream to the Venture River Estnary. This study will investigate feasible alternatives to restore the Matilija Creek riverine ecosystem, primarily by removing Matilija Dam. Also, feasible alternatives for the removal of sediment behind the dam and the beneficial use of tbat sediment will be investigated.

The DEIS will analyze the potential impacts (beneficial and adverse) on the environment of a range of alternatives, including the proposed action and the no action alternative. The Los Angeles District and the Ventura County Flood Control District will cooperate in conducting this feasibility study.

ADDRESSES: District Engineer, U.S. Army Corps of Engineers, Los Angeles District, ATTN: CESPL–PD–RQ (R. Farve), P.O. Box 532711, Los Angeles, California 90053–2325.

FOR FURTHER INFORMATION CONTACT: Mr. Rey Farve, Environmental Coordinator, telephone (213) 452–3864, or Mr. Jonathan Vivanti, Study Manager, telephone (213) 452–3809.

SUPPLEMENTARY INFORMATION:

1. Authorization

This feasibility study was authorized by U.S. House of Representatives Committee Resolution on Transportation and Infrastructure (Docket 2593), dated April 15, 1999, which states, in part: "that the Secretary of the Army is reqnested to review the report of the Chief of Engineers on the Ventura River, Ventura County, California, published as House Document 323, 77th Congress, 1st Session, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, in the interest of environmental restoration and protection, and related purposes, with particular attention to restoring anadromous fish populations on Matilija Creek and returning natural sand replenishment to Ventura and other Southern California beaches."

2. Background

Matilija Dam is located on Matilija Creek, a tributary of tbe Ventura River, approximately 16 miles upstream from the Pacific Ocean. The dam is located in Ventura County California, approximately 7 miles and 25 miles from the Cities of Ojai and Ventura, California, respectively. The feasibility study area currently includes tbe Matilija Dam and the area immediately upstream, and downstream of the dam to the Ventura River Estuary. The non-federal sponsor of the feasibility study is the Ventura County Flood Control District.

Matilija Dam was constructed in the late 1940's by Ventura County Flood Control to provide water storage for agricultural needs. Matilija Dam is a concrete arch structure 190 feet in heigbt with an arc length of 620 feet at its crest. Sediment carried by Matilija Creek has deposited behind the dam and filled the reservoir, rendering the structure useless as a water storage facility. It is estimated that 6,000,000 cubic yards of sediment lies trapped behind the dam.

The dam no longer provides any flood control protection dne to sedimentation behind the dam. There is some continued water supply use. The Casitas Municipal Water District currently operates the dam under a lease agreement from the County of Ventura, which expires in 2009. The operation is an integral part of the Robles/Casitas Reservoir water supply facilities and is estimated to currently contribute approximately 400 acre-feet of water per year. This water function, however, is projected to diminish rapidly as the reservoir continues to fill with sediments, and is expected to effectively cease by 2010 after the reservoir fills completely with sediment.

Presently, the dam is considered to be a major contributor to tbe declining numbers of steelhead trout in Matilija Creek. If no action is taken to secure passage for the steelhead trout to reach the upper watershed and its tributaries, the dam will continue to obstruct this endangered species, thereby limiting the amount of spawning and rearing habitat. In addition, the dam would continue to act as a barrier for wildlife movement for other terrestrial and aquatic species.

3. Alternatives

The feasibility study will focus on addressing the problems and needs caused by Matilija Dam with the primary objective of the feasibility stndy being to restore the Matilija Creek riverine ecosystem. Otber objectives that are considered appropriate may involve possible beneficial use of the sediment behind the dam for beach nourishment or other environmental restoration.

In general, alternative plans will investigate reasonable alternatives to restore Matilija Creek, primarily by removing Matilija Dam. Feasible alternatives for the removal of sediment behind the dam and the beneficial use of that sediment will also be investigated. Significant beneficial impacts to the riverine ecosystem (especially to steelhead trout) are expected from restoration alternatives identified in the feasibility study.

4. Scoping Process

Participation of all interested Federal, State, and County agencies, groups with environmental interests, and any interested individuals are encouraged. Public involvement will be most beneficial and worthwhile in identifying the scope of pertinent, significant environmental issues to be addressed, identifying and eliminating from detailed study issues that are not significant, offering useful information such as published or unpublished data, providing direct personal experience or knowledge which informs decision making, and recommending snitable mitigation measnres to offset potential impacts from the proposed action or alternatives.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
Carlsbad, California 92008

In Reply Refer To:
FWS-OR-2620.1

MAR 12 2002

Colonel Richard G. Thompson
District Engineer, Los Angeles District
U.S. Army Corps of Engineers
911 Wilshire Boulevard
Los Angeles, California 90017

Attn: Larry Smith, Environmental Resources Branch

Re: Request for Information on Endangered, Threatened, Proposed, and Candidate Species for the San Clemente Shoreline Feasibility Study, Orange County, California (FP/COE-100)

Dear Colonel Thompson:

The Fish and Wildlife Service (Service) has reviewed your request dated December 3, 2001, and received by our office January 2, 2002, to assess the potential for federally listed, proposed, and candidate species that may occur within the vicinity of the San Clemente Shoreline Feasibility Study, Orange County. To assist you in evaluating the potential occurrence of these species within the area of interest, we are providing the enclosed list, which identifies federally listed endangered, threatened, and proposed species that occur in the general region.

Section 7 of the Endangered Species Act (Act) of 1973, as amended, requires Federal agencies to consult with us, the U.S. Fish and Wildlife Service, should it be determined that their actions may affect federally listed threatened or endangered species. Section 9 of the Act prohibits the "take" (e.g., harm, harassment, pursuit, injury, kill) of federally listed wildlife. "Harm" is further defined to include habitat modification or degradation where it kills or injures wildlife by impairing essential behavioral patterns including breeding, feeding, or sheltering. Take incidental to otherwise lawful activities can be authorized under sections 7 (Federal consultations) and 10 (habitat conservation plans) of the Act.

If a proposed project is authorized, funded, or carried out by a Federal agency and may affect a listed species, then the Federal agency must consult with us on behalf of the applicant, pursuant to section 7 of the Act. In other words, any activity on private land that requires Federal involvement (such as the issuance of a section 404 permit under the Clean Water Act by the U.S. Army Corps of Engineers) and may affect listed species must be reviewed by us to insure that the continued existence of the species would not be jeopardized. During the section 7 process, measures to avoid and minimize project effects to listed species and their habitat will be

identified and incorporated into a biological opinion that includes an incidental take statement that authorizes incidental take by the Federal agency and applicant.

If a proposed project does not involve a Federal agency, but is likely to result in the take of a listed animal species, then the landowner or project proponent should apply for an incidental take permit, pursuant to section 10 of the Act. When an application is made for an incidental take permit, measures to avoid, minimize, or mitigate for effects to listed species and their habitat will be identified and incorporated into a habitat conservation plan. If the habitat conservation plan and the application for the permit meet the issuance criteria, a permit authorizing incidental take is issued.

We do not have site-specific information for this area. Therefore, we recommend that project proponents seek assistance from a biologist familiar with the habitat conditions and associated species in and around their project site to assess the actual potential for direct, indirect and cumulative impacts likely to result from the proposed activity.

In addition to the organisms specified on the enclosed list, we are also concerned for the following habitat community types that could potentially occur in the area and are becoming more rare. These include riparian, coastal sage scrub, freshwater marsh, salt marsh, and aquatic communities.

Please contact the California Department of Fish and Game (CDFG) for State-listed and other sensitive species that may occur in the area of the project. State-listed species are protected under the provisions of the California Endangered Species Act. Rare plant species that may occur in the project area are included in the California Native Plant Society's (CNPS) inventory of rare and endangered vascular plants in California. State-listed and CNPS species require full consideration under the California Environmental Quality Act. The Natural Diversity Data Base of CDFG should also be contacted for a list of taxa that are known to occur in the project vicinity.

Should you have any questions regarding the species list provided, or your responsibilities under the Act, please contact John Hanlon, Chief, Branch of Federal Projects, at (760) 431-9440.

Sincerely,

Anne Hoecker

for

Karen A. Evans
Assistant Field Supervisor

Enclosure

Federally Endangered, Threatened, Proposed, and Candidate Species that May Occur in the Area of the San Clemente Shoreline Feasibility Study Orange County, California

Common Name	Scientific Name	Status
FISH		
Tidewater goby	*Eucyclogobius newberryi*	FE
Southern steelhead	*Oncorhynchus mykiss*	FE
BIRDS		
Brown pelican	*Pelecanus occidentalis*	FE
California least tern	*Sterna antillarum browni*	FE
Western snowy plover	*Charadrius alexandrinus nivosus*	FT
MAMMALS		
Pacific pocket mouse	*Perognathus longimembris pacificus*	FE

FE = Listed as a Federal endangered species
FT = Listed as a Federal threatened species

San Clemente Shoreline Protection
Agency Kick-Off Meeting Notes
16 October 2007

1.0 Purpose

To introduce agency contacts to the project team and project purpose.

2.0 Location

San Clemente Community Center, 100 N. Calle Seville San Clemente, CA 92672

3.0 Meeting Attendees:

Name	Company/Agency	Contact Info
Noel Davis	Chambers Group	949-261-5414 ndavis@chambersgroupinc.com
Lisa Louie	Chambers Group	949-261-5414 llouie@chambersgroupinc.com
Tom Keeney	USACE, Los Angeles	213-452-3857 Thomas.W.Keeney@usace.army.mil
Jim Kelly	USFWS	760-431-9440 x362 jim_kelly@fws.gov
Jennifer Pettis	NMFS	562-980-4046 Jennifer.Pettis@noaa.gov

Bill Poznokas (CDFG) was unable to attend.
Anthony Spina (NMFS-steelhead) indicated via e-mail 15 October 2007 that there are no steelhead issues for this project and no coordination is required.

4.0 Meeting summary

Meeting start time: 10:00 a.m.

- **Project Introduction**

  - City of San Clemente is local sponsor.
  - Project has been scaled down to include Reach 6 (reach surrounding pier) only.
  - Project is strictly nourishment only.
    - To be placed on beach, not in nearshore.
    - Other structural models showed a cost higher than the benefit.
    - Sand to come from regulated borrow site from Oceanside.
  - Managed retreat not feasible without railroad involvement.
  - Railroad does not want to participate in project.
  - Recreation cannot be a benefit - protection of the pier structure provides justification for project; cannot include national defense railroad as justification.

- Baseline conditions (F3) were originally completed for 10 reaches, Chambers Group to update for one reach only.
- Currently preparing alternatives and analysis document (F4), reviewing different scales of alternatives.
- Nourishment typically occurs during winter – should avoid any biological seasons.

- **Environmental Issue Areas**

  - **Biological**
    - Plovers and terns – no known nest sites.
    - No onshore vegetation will be impacted.
    - Need to know disposal sites in relation to sensitive resources.
    - Surfgrass – flowering plant that provides shelter for juvenile fish - grows in buundles – harder to restore than eelgrass – pre/post-construction surveys and mitigation like eelgrass – follow eelgrass guidelines.
    - Map pipeline placement to avoid sensitive habitat.
    - Terns, plovers, pelicans.
    - Abalone, macroinvertebrates.

  - **Recreation**
    - Sand castle building event
    - Surfing at T-street

  - **Air Quality**
    - Dredge analysis
    - Previously analyzed?

- **Next step**

  - Send agencies copy of baseline information ASAP.
  - Send agencies copy of CRM biological report.
  - Define project description for alternatives.
  - Determine POC for CCC, Corps Regulatory, and RWQCB.

- **Future actions**

  - Final CAR in Mar/Apr 2008
  - Prepare NEPA and CEQA document.

End time: 11:15 a.m.

San Clemente Shoreline Protection
CDFG Kick-off Meeting Notes
15 May 2008

1.0 Purpose

To introduce CDFG to the project team and project purpose.

2.0 Location

San Clemente Community Development Department, 910 Calle Negocio, San Clemente, CA 92673

3.0 Meeting Attendees:

Name	Company/Agency	Contact Info
Noel Davis	Chambers Group	949-261-5414 ndavis@chambersgroupinc.com
Lisa Louie	Chambers Group	949-261-5414 llouie@chambersgroupinc.com
Tom Keeney	USACE, Los Angeles	213-452-3857 Thomas.W.Keeney@usace.army.mil
Joe Johnson	USACE, Los Angeles	213-452-3829 Joseph.A.Johnson@usace.army.mil
Tom Bonigut	City of San Clemente	949-361-6187 BonigutT@san-clemente.org
Loni Adams	CDFG	858-627-3985 ladams@dfg.ca.gov

Jim Kelley (USFWS) and Bryant Chesney (NOAA Fisheries) were provided a late notice invitation, but were unable to attend.

4.0 Meeting summary

Meeting start time: 2:20 p.m.

- **Project Introduction**
  - City of San Clemente is local sponsor.
  - Project is strictly nourishment only.
    - To be placed on beach, not in nearshore.
    - 30 m (~511,000 cy) alternative preferred over other beach widths.
      - Shorter beach widths would equate to a smaller impact area.
    - Sand to come from regulated borrow site from Oceanside.
  - Recreation cannot be a benefit - protection of the pier structure provides justification for project; cannot include national defense railroad as justification.

- Baseline conditions (F3) were completed for project reach (surrounding San Clemente Pier) only.
- Currently, alternatives and analysis document (F4) under internal review at USACE.
- Nourishment would occur sometime between late Aug/Sep through mid-Mar – would avoid any environmental seasons for biological resources of concern.

- **Environmental Issue Areas**

  - **Biological**
    - Snowy plovers and least terns – no known nest sites onsite.
    - No onshore vegetation will be impacted.
    - Habitat type onsite not conducive to amphibians.
    - Need to know disposal sites in relation to sensitive resources.
      - Potential resources at Linda Lane and footbridge?
    - Surfgrass – March 2008 surveys – 3 methods of survey [walk beach, SCUBA dive, free-dive (masks and fins)] shows surfgrass just outside of estimated project boundary (well outside of construction boundary).
    - Map pipeline placement to avoid sensitive habitat.
    - Exposed rocks south of pier – potential pinniped haulout?
      - need to investigate
      - lined up at Riviera
    - Terns, plovers, brown pelicans (proposed delisting), macroinvertebrates, grunion.

  - **Water Quality**
    - SWPPP
    - Proposed project is designed to decrease turbidity behind a berm before introduced to wave action
    - Turbidity expected in areas that are already turbid (surfzone)

- **Next step**

  - Send CDFG copy of CRM biological report.

- **Future actions**

  - Public review of draft report anticipated to be distributed in Oct/Nov 2008.

End time: 3:30 p.m.

San Clemente Shoreline Protection
CDFG Kick-off Meeting Notes
16 December 2008

1.0 Purpose

To update the resource agencies on the project status.

2.0 Location

Chambers Group, Inc., Irvine Office, 17671 Cowan Ave., Suite 100, Irvine, CA 92614

3.0 Meeting Attendees:

Name	Company/Agency	Contact Info
Tom Keeney	USACE, Los Angeles	213-452-3857 Thomas.W.Keeney@usace.army.mil
Jennifer Wise	USFWS	760-431-9440 x276 jennifer_wise@fws.gov
Bryant Chesney	NOAA Fisheries	(562) 980-4037 bryant.chesney@noaa.gov
Loni Adams	CDFG	858-627-3985 ladams@dfg.ca.gov
Lisa Louie	Chambers Group	949-261-5414 llouie@chambersgroupinc.com
Noel Davis	Chambers Group	949-261-5414 ndavis@chambersgroupinc.com

4.0 Meeting summary

Meeting start time: 11:00 p.m.

- **Project Background**
  - City of San Clemente is local sponsor.
  - Project is strictly nourishment only.
    - To be placed on beach, not in nearshore.
    - 20 m (~511,000 cy) alternative preferred over other beach widths.
      - Shorter beach widths would equate to a smaller impact area.
    - Sand to come from regulated borrow site from Oceanside.
  - Recreation cannot be a benefit - protection of the pier structure provides justification for project; cannot include national defense railroad as justification.
  - Baseline conditions (F3) were completed for project reach (surrounding San Clemente Pier) only.
  - Alternatives and analysis document (F4) reviewed internally by USACE. However, engineering still working on coastal modeling to include sea level rise

analysis, which should be available by the end of January. Accuracy of predictive modeling is same as comparative modeling.
- Nourishment would occur sometime between late Aug/Sep through mid-Mar – would avoid any environmental seasons for biological resources of concern (e.g., grunion).
- Project currently shows 1.3 B/C (benefits to cost) ratio

- **Effects Section and Concerns**
  - Based on littoral and cross drift for any sand replenishment – used same littoral cell as Oceanside as a comparison.
  - Mariposa is too far for impacts by beach fill.
  - Surfgrass mitigation – potential habitat added (shallow artificial reef at depthor contribute to protected area).
  - Encinitas minimized risk by reducing volume placement
  - Policy statement criteria for state – looking in terms of wetland restoration
  - Surfgrass – covered and uncovered – what is considered significant?
  - Contingency plan is required surfgrass – nothing is provided from first event, but would alter future events, dependent upon results
  - Facilities are a concern, however project cannot include railroad or recreation as benefits
  - Concern with mitigation at a later date if mitigation cannot be agreed upon.
  - Removal of surfgrass concern – it takes a long time to come back and small patches may be missed (polygon does not show transect lines).
  - Require formal monitoring plan?
    - No future replenishment is scheduled until an agreement is reached
    - Mitigation alternative – protect another surfgrass area – is there widescale surfgrass mapping available?
    - Mapped habitat type vs. plants
    - MLPA process – mitigate for surfgrass
  - Other species of interest?
    - No plover or tern concerns
    - Outside of grunion season
  - EFH write-up
    - Need to address all habitat types – species and lifestage impacted/potentially impacted.
    - Stand alone document or make clear reference
  - Recurring language – no impact within natural variation – no impact is a concern – need to identify individual impacts.

- **Next step**

  - Meet again when coastal modeling has been completed and new analysis considered.

San Clemente Shoreline Protection
CDFG Kick-off Meeting Notes
16 July 2009

1.0 Purpose

To update the resource agencies on the project status and present new project alternatives and descriptions.

2.0 Location

Chambers Group, Inc., Irvine Office, 17671 Cowan Ave., Suite 100, Irvine, CA 92614

3.0 Meeting Attendees:

Name	Company/Agency	Contact Info
Tom Keeney	USACE, Los Angeles	213-452-3857 Thomas.W.Keeney@usace.army.mil
Jennifer Wise	USFWS	760-431-9440 x276 jennifer_wise@fws.gov
Loni Adams	CDFG	858-627-3985 ladams@dfg.ca.gov
Lisa Louie	Chambers Group	949-261-5414 llouie@chambersgroupinc.com
Noel Davis	Chambers Group	949-261-5414 ndavis@chambersgroupinc.com

Bryant Chesney (NOAA Fisheries) was provided a late notice invitation, but was unable to attend.

4.0 Meeting summary

Meeting start time: 10:30 a.m.

- **Actions Since Last Meeting**

  - NED plan is the most economically beneficial alternative based on benefits to cost (B/C) ratio
  - Sea level rise was not previously considered and the coastal engineering report was revised to reflect the changes
  - Previous environmental effects/analyses were based on the results of the 2007 coastal engineering modeling effort and report.
  - Revised 2009 coastal engineering report now identifies different coastal impacts, which results in different environmental impacts than the 2007 report.
  - Modeling considered beach widths at 5m increments between 10m and 35m. The 35m alternative was identified as the NED plan. The 10m and 15m beach widths

demonstrated negligible differences in B/C ratios and equilibrium footprints; the 15m beach width was chosen over the 10m alternative because the same area would be impacted, but the 15m would require less replenishment cycles than the 10m while providing the same positive B/C ratio.

- **Updated Project Descriptions**

  - Project now has two action alternatives being considered: 15m beach width and 35m beach width – these alternatives represent the resultant dry beach width.
  - The construction footprint (i.e., the project area where sand is directly placed onto the beach) for the 15m alternative is 23m and the construction footprint for the 35m alternative is 52m.
  - During the equilibration time, the wave action on the beach is expected to disperse the sand that has been placed onto the beach into the equilibrium footprint (i.e., the footprint where sand that has been placed onto the beach is predicted to ultimately end up). The equilibrium footprint was not provided in the 2007 coastal engineering report. The equilibrium footprint of the 35m alternative is greater than that of the 15m alternative. See attached figure.
  - Sand will be dredged from the Oceanside borrow site and hauled to San Clemente where the material will be pumped to the beach via a pipeline. The pipeline would be moored to the seafloor and the material would be pumped onto the beach as a slurry and placed landward of a 200ft L-shaped berm created by pushing existing sand into the appropriate shape. The long arm of the L would be along the water's edge and the short arm of the L would face inland. This berm construction is intended to decrease turbidity by allowing the sand to settle out of the slurry while the seawater drains back to the ocean. Dry sand is then pushed towards the ocean to increase the beach width until the designated beach width is reached. Sand is placed behind this L-shaped berm until the designated beach width is reached. A new 200ft long L-shaped berm is then constructed in the next segment over and the process repeated. Similar project methods currently in construction at Sunset.
  - The pipeline from the dredge would not be dragged across the ocean floor when moving to the next L-shaped berm. An extension to the pipeline will be added on the dry portion of the beach. Also, the pipeline laydown area will be surveyed for biological resources first before recommending the laydown route.
  - Earliest this project would start would be 2010. Anticipated start in 2012. Requires local sponsor funds and Congressional authorization.

- **New Surfgrass Survey**
  - A recent surfgrass survey was conducted to include the entire Project footprint (i.e., construction and equilibrium footprint).
  - The kelp bed immediately seaward of the end of the pier was mapped. The reef had giant kelp, feather boa kelp, surfgrass, and gorgonians.
  - The area was mainly scattered relief/bedrock along the coastline. Surfgrass in the area was sparse and scattered. Density of surfgrass highest at T-Street reef. Red algae and bare patches were prevalent.

- **Environmental Effects**

  - The 15 m alternative would potentially degrade the inshore edge of the surfgrass bed at T-street reef and some burial of smaller rocks would be expected.
  - Modeling typically is more conservative than what's seen in monitoring (e.g., SANDAG, Solana/Encinitas), usually because of random conditions that may occur in any particular year.
  - Conditions of the 15m are comparable to SANDAG.
  - Surfgrass and surfing will be monitored. Adaptive management will determine if changing conditions result in decision not to replenish or modify replenishment. Cycle of replenishment of every 4-5 years is based on the predicted erosion rate occurring every ear and bringing the beach to 0m.
  - Sand sources have disappeared from our littoral system, especially after the El Ninos from the 80s and 90s, where sand was speculated to have been taken out and dropped into the submarine canyons; that sand would not come back. Dams and development also have diminished sand replenishment via natural processes.
  - Evaluation of project effects considering extreme sea level rise is not practical (replenishment events would require over 800,000 cy of sand). If an extreme sea level rise event were to occur, there would be more to take into consideration that potentially would be at risk than the considerations of this project and would require a new project purpose and evaluation.
  - Are there other methods to maintain sand on the beach once it's been placed?
    - o Structural methods typically are not acceptable by CCC.
    - o Offshore breakwaters may be effective, however, not in this situation with the biological resources present.
    - o Structures require maintenance.
  - Long-term monitoring of surfgrass is part of the project. Pre and post construction surveys are proposed for each replenishment activity for the life of the project (50 years). Monitoring is expected to be immediately prior to construction, immediately after construction, then 3, 6, 9, and 12 months after, then once every year for the next 4 years (total of 5 years of post construction monitoring). Need to determine if there are requirements for mitigation for degradation, but not removal of, surfgrass. Need to determine the criteria. Surfgrass typically can withstand 1/3 blade length burial; may affect growth rate and shoot density.
  - Question regarding whether Pismo clam beds are in the area (or any other invertebrates) – invertebrate surveys have not been conducted for the site.
  - Project will avoid grunion season. Project most likely will not start until the day after Labor Day.
  - Outside of least tern season. No concerns with terns, pelicans, or plovers.
  - Mitigation and Monitoring Plan – will mitigate if monitoring shows the project doesn't work and has significant impacts.
  - Need to determine if beach maintenance/raking occurs. Did not look at surfgrass/kelp wrack during walking survey.

- **Next step**

  - Public review anticipated for November 2009.
  - Internal review at Corps and outside District review (within Corps) will occur concurrently.
  - Alternatives Formulation Briefing (AFB) meeting with the local sponsor and USACE HQ. They are allowed 2 months to provide comments.
  - Public review follows incorporation of comments from AFB.
  - Coordination Act Report (CAR) Final is required for Final Report. Draft CAR is not required with the Draft EIS/EIR.
  - Report reviews will go through Center of Excellence (equivalent to science advisory board).

- **Next step**

  - Meet again when coastal modeling has been completed and new analysis considered.

Meeting end time: 12:15 p.m.

San Clemente Shoreline Protection
CDFG Kick-off Meeting Notes
15 September 2009

1.0 Purpose

To update NOAA Fisheries on the project status and present new project alternatives and descriptions.

2.0 Location

Chambers Group, Inc., Santa Ana Office, 5 Hutton Centre Dr., Suite 750, Santa Ana, CA 92707

3.0 Meeting Attendees:

Name	Company/Agency	Contact Info
Tom Keeney	USACE, Los Angeles	213-452-3857 Thomas.W.Keeney@usace.army.mil
Bryant Chesney	NOAA Fisheries	(562) 980-4037 bryant.chesney@noaa.gov
Lisa Louie	Chambers Group	949-261-5414 ext 7289 llouie@chambersgroupinc.com
Noel Davis	Chambers Group	949-261-5414 ext 7208 ndavis@chambersgroupinc.com

4.0 Meeting summary

Meeting start time: 10:20 a.m.

- **Discussion**
  - Recent modeling still shows a positive benefit to cost ratio
  - Concern is that document is not explicit regarding the dollar value tied to mitigation
  - A more developed contingency plan is preferred
  - Recent studies at UCSB testing new surfgrass transplantation method
    - Sprig method – not plug method
  - Would like to see a monitoring plan with criteria in draft EIS
    - External agency review
    - MMRP – coastal monitoring for sand movement and surfgrass
    - Details still aren't worked out for the monitoring plan for pre- and post-monitoring
  - CDFG and NOAA Fisheries will want to review detailed MMRP before finalized
  - Draft CAR most likely will not accompany the draft EIS

- Expect HQ review in October 2009 and Public Review in November 2009
- Consideration of random transects vs permanent transects or a hybrid of these methods
- Need to spell out contingency plan if impacts are observed
  - Impacts to reef
  - Impacts based on coastal engineering report
- Currently, coastal modeling shows effects to reef will be minimal
- Need to find reasonable potential for monitoring – a detailed restoration plan without knowing if or what needs to be restored or if it can be done
- Consideration of adaptive management
  - Are there contingency funds available?
    - for example, will the local sponsor be prepared to cost share $200 per month vs $500 per month
  - public document needs to explicitly show possible plans
- would like to quantify area of direct impact/burial vs indirect impact in acreages
  - x acres buried by y amount
  - area of influence vs area of substantial burial
- not feasible to conduct nourishment in phases in one year due to mob/demobilization costs

- **Surfgrass survey clarification**

  - Survey was by dive transects, except for kelp canopy, which was based on following a path
  - Large substantial strands of surfgrass would have been found by this method
  - Possible to consider LIDAR or sidescan sonar for more comprehensive study of resources in area?

- **Next step**

  - Public review anticipated for November 2009.
  - Internal review at Corps and outside District review (within Corps) will occur concurrently.
  - Alternatives Formulation Briefing (AFB) meeting with the local sponsor and USACE HQ. They are allowed 2 months to provide comments.
  - Public review follows incorporation of comments from AFB.
  - Coordination Act Report (CAR) Final is required for Final Report. Draft CAR is not required with the Draft EIS/EIR.
  - Report reviews will go through Center of Excellence (equivalent to science advisory board).

Meeting end time: 11:15 a.m.

San Clemente Shoreline Protection
Agency Meeting Notes
30 April 2010

1.0 Purpose

To update the resource agencies on the project status and conduct a site visit.

2.0 Location

San Clemente Municipal Pier, 601 Avenida Victoria, San Clemente, CA 92672

3.0 Meeting Attendees:

Name	Company/Agency	Contact Info
Tom Keeney	USACE, Los Angeles	213-452-3875 Thomas.W.Keeney@usace.army.mil
Jennifer Wise	USFWS	760-431-9440 x276 jennifer_wise@fws.gov
Bryant Chesney	NOAA Fisheries	(562) 980-4037 bryant.chesney@noaa.gov
Loni Adams	CDFG	858-627-3985 ladams@dfg.ca.gov
Lisa Louie	Chambers Group	949-261-5414 ext 7289 llouie@chambersgroupinc.com
Noel Davis	Chambers Group	949-261-5414 ext 7208 ndavis@chambersgroupinc.com

4.0 Meeting summary

Meeting start time: 10:30 a.m.

- **Project Location**
  - Identified project boundaries along coast:
    - Mariposa
    - Linda Lane
    - T-Street
- **Updates Since Last Meeting**
  - Coastal engineering modeling was conducted by USACE. Sea level rise was considered in the analysis.
  - Burial of surfgrass would occur regardless of the quantity of sand based on the current model, but the degree of burial (e.g., depth, areal coverage, persistence) varies depending

on the alternative chosen. The 15m alternative was chosen because it had the least amount of modeled impacts while still meeting the project object.
- Proposed 15m plan chosen in an effort to reduce impacts to the extent possible while still having a project
- City of San Clemente would prefer to have 35m beach
- Mitigation and monitoring plan has been prepared, but not yet supplied to the resource agencies. Consideration of recent Santa Barbara surfgrass study was included.

- **Agency Requests**

  - Consideration of alternatives that will avoid the surf grass impacts that the 15m alternative poses (e.g., alternative locations of sand disposal).
  - Robust monitoring plan and contingency plan – including numbers
    - At a minimum, the monitoring plan needs to include mitigation for the expected surf grass burial impacts as well as a contingency for further impacts to surf grass and reef habitat, a plan for monitoring for actual surfgrass/reef impacts, and a plan for monitoring to ensure that you are in compliance with your proposed surf grass/reef habitat mitigation success criteria. Alternatively, a surf grass avoidance plan should be proposed if surf grass mitigation is determined to be infeasible.
    - CDFG expressed concern about the survey method and accurately determining the actual surfgrass burial impacts in the high energy waves of this area, specifically that it may be very difficult or essentially not possible.
  - How will impacts be measured?
  - Possible to survey for baseline trend?
  - Explore ways to retain the proposed sand volume placed at this location to reduce the frequency of sand replenishment necessary in the future (e.g., submerged reef).
  - Was submerged reef considered as a potential alternative under NEPA?
    - No – local sponsor did not want to include "structures" as alternatives
  - Will the opportunistic sand project be included – no
  - Most likely, NOAA Fisheries will come out with comment regarding full array of alternatives.
  - Possible effects of El Nino events should be considered for the near future in the analysis.

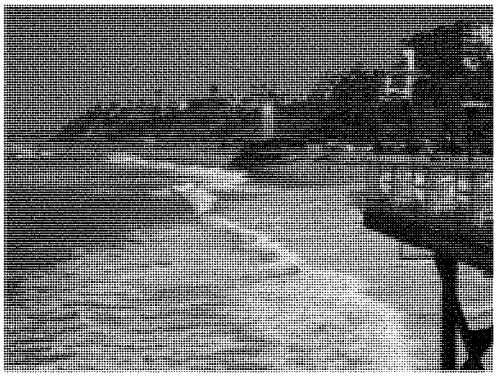
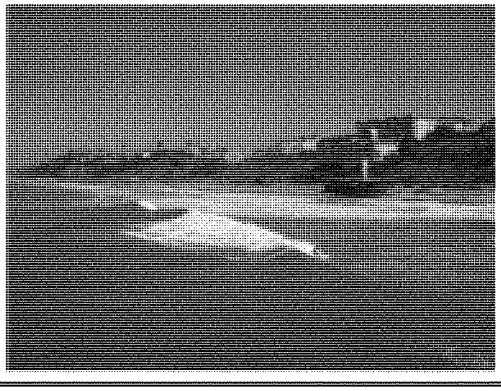
- **Next step**

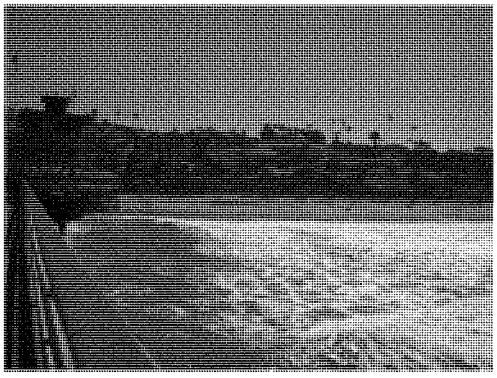
  - Will provide the agencies with:
    - Most updated version of the EIS/EIR
    - Current monitoring report appendix
    - Current calculations of costs for monitoring and mitigation
  - Most answers to agency questions most likely would be answered by the Main Report prepared separately for this project.

Meeting end time: 11:35 a.m.

Photos attached

ATTACHMENT A – SITE PHOTOGRAPHS

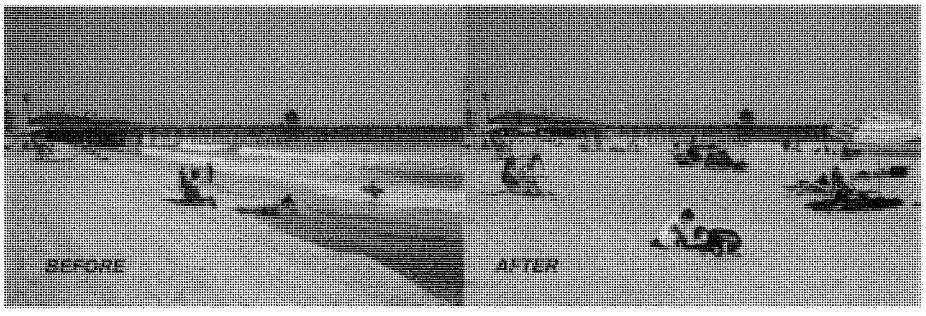
	Facing upcoast from San Clemente Pier towards Marine Safety Building.
	Facing the beach immediately upcoast of the pier from San Clemente Pier.
	Facing upcoast from San Clemente Pier towards Linda Lane.

	Facing the beach immediately downcoast of the pier from San Clemente Pier.
	Facing the beach downcoast of the pier from San Clemente Pier.
	Facing downcoast from San Clemente Pier towards T-Street.

PUBLIC MEETING

Environmental Impact Statement/ Environmental Impact Report for the San Clemente Shoreline Erosion Feasibility Study – Beach Sand Nourishment Project

A presentation by the U.S. Army Corps of Engineers



COASTAL ADVISORY COMMITTEE MEETING
AUGUST 19, 2010
San Clemente Community Development Building
910 Calle Negocio, South Entrance, 2nd Floor
7:00 p.m.

The Draft Environmental Impact Statement is available for review at the San Clemente Library (242 Avenida Del Mar) or online at: www.san-clemente.org.

U.S. ARMY CORPS OF ENGINEERS
SAN CLEMENTE SHORELINE FEASIBILITY STUDY
REQUEST TO SPEAK/WRITTEN COMMENT FORM

NAME *(Please print)*: Mark Rauscher

DO YOU WISH TO SPEAK AT THIS MEETING? ☒ YES ☐ NO

DO YOU WISH TO PRIVATELY GIVE VERBAL COMMENTS TO A COURT REPORTER? ☐ YES ☐ NO

ADDRESS *(Street and Number)*: PO Box 6010

CITY: San Clemente STATE: CA ZIP CODE: 92674

TELEPHONE NO.: 949-492-8170 EMAIL ADDRESS: mrauscher@surfrider.org

FOR MORE INFORMATION ON THE STUDY, VISIT: http://www.san-clemente.org

REGARDLESS OF WHETHER YOU PROVIDE VERBAL COMMENTS TODAY, IF YOU WOULD LIKE TO PROVIDE WRITTEN COMMENTS ON THIS PROJECT, YOU MAY RESPOND BELOW AND SUBMIT THIS SHEET TO A CORPS REPRESENTATIVE OR WRITE TO THE CORPS BY ***SEPTEMBER 23, 2010*** AT: **U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT; PLANNING DIVISION; ATTN: THOMAS KEENEY, CESPL-PD; 915 WILSHIRE AVE; LOS ANGELES, CA 90017.** ALTERNATIVELY, YOU MAY EMAIL COMMENTS TO THE FOLLOWING ADDRESS: thomas.w.keeney@usace.army.mil

DATA REQUIRED BY THE PRIVACY ACT

AUTHORITY: 33 CFR 327
PRINCIPAL PURPOSE: Distributed at Public Meetings and Workshops to provide a record of attendees, and to develop a mailing list for future public meetings in keeping with the policy of OCE to conduct Civil Works Program in an atmosphere of public understanding, trust and mutual cooperation. All interested individuals and agencies are to be informed and afforded an opportunity to be heard and their views considered in arriving at conclusions, decisions, and recommendations in the formulation of civil works proposals, plans, projects, and on the proposed uses of navigable waters.
ROUNTINE USES: Utilized for determining attendance at Public Meetings; determining who desires to speak at Corps Public Meetings and developing mailing lists for various Corps studies.
DISCLOSURE: Voluntary. Failure to provide information may result in not being contacted for future public meetings, etc.

U.S. ARMY CORPS OF ENGINEERS
SAN CLEMENTE SHORELINE FEASIBILITY STUDY
REQUEST TO SPEAK/WRITTEN COMMENT FORM

NAME *(Please print)*: Mike Barnes

DO YOU WISH TO SPEAK AT THIS MEETING? ☒ YES ☐ NO

DO YOU WISH TO PRIVATELY GIVE VERBAL COMMENTS TO A COURT REPORTER? ☐ YES ☒ NO

ADDRESS *(Street and Number)*: 146 W. Ave Lobos Marinos

CITY: San Clemente STATE: CA ZIP CODE: 92672

TELEPHONE NO.: 949 499-7974 EMAIL ADDRESS: meobarnese SbcGlobal.Net

FOR MORE INFORMATION ON THE STUDY, VISIT: http://www.san-clemente.org

REGARDLESS OF WHETHER YOU PROVIDE VERBAL COMMENTS TODAY, IF YOU WOULD LIKE TO PROVIDE WRITTEN COMMENTS ON THIS PROJECT, YOU MAY RESPOND BELOW AND SUBMIT THIS SHEET TO A CORPS REPRESENTATIVE OR WRITE TO THE CORPS BY ***SEPTEMBER 23, 2010*** AT: **U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT; PLANNING DIVISION; ATTN: THOMAS KEENEY, CESPL-PD; 915 WILSHIRE AVE; LOS ANGELES, CA 90017.** ALTERNATIVELY, YOU MAY EMAIL COMMENTS TO THE FOLLOWING ADDRESS: thomas.w.keeney@usace.army.mil

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COMMENTS

COMMENTS

U.S. ARMY CORPS OF ENGINEERS
SAN CLEMENTE SHORELINE FEASIBILITY STUDY
REQUEST TO SPEAK/WRITTEN COMMENT FORM

NAME *(Please print)*: Don Kunze

DO YOU WISH TO SPEAK AT THIS MEETING? ☐ YES ☒ NO

DO YOU WISH TO PRIVATELY GIVE VERBAL COMMENTS TO A COURT REPORTER? ☐ YES ☒ NO

ADDRESS *(Street and Number)*: 107 Ave. San Pico

CITY: San Clemente STATE: CA ZIP CODE: 92672

TELEPHONE NO.: 949 498-2234 EMAIL ADDRESS:

FOR MORE INFORMATION ON THE STUDY, VISIT: http://www.san-clemente.org

REGARDLESS OF WHETHER YOU PROVIDE VERBAL COMMENTS TODAY, IF YOU WOULD LIKE TO PROVIDE WRITTEN COMMENTS ON THIS PROJECT, YOU MAY RESPOND BELOW AND SUBMIT THIS SHEET TO A CORPS REPRESENTATIVE OR WRITE TO THE CORPS BY ***SEPTEMBER 23, 2010*** AT: **U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT; PLANNING DIVISION; ATTN: THOMAS KEENEY, CESPL-PD; 915 WILSHIRE AVE; LOS ANGELES, CA 90017.** ALTERNATIVELY, YOU MAY EMAIL COMMENTS TO THE FOLLOWING ADDRESS: thomas.w.keeney@usace.army.mil

DATA REQUIRED BY THE PRIVACY ACT

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DISCLOSURE: Voluntary. Failure to provide information may result in not being contacted for future public meetings, etc.

COMMENTS

WHERE DID SAN CLEMENTE SAND GO ?? WHY ??
WHY NOT BRING IT BACK.

DID DANA POINT HARBOR AFFECT US ?
HOW ABOUT NUCLEAR PLANT AFFECT ?

WHAT ABOUT NEW ROCK REEF AND KELP ?

SEEMS TO BE LESS SAND AND MORE ROCK (PEBBLES)
THEN EVER WHY ?? SINCE 1983

BEING A TAX PAYER COST TO ME ?

SIGN-IN SHEET

San Clemente Shoreline Feasibility Study Public Meeting of the Draft EIS

August 19, 2010 – 910 Calle Negocio, San Clemente, CA 92673

Name	Address	Phone	Email
Jim DAHL			DAHLJ@SAN-Clemente.org
Bob JORDAN	2934 Calle Frontera		RJORDAN@BIA@MSN.com
Susan Ambrose	204 Ave. de la Riviera		ambrose52@aol.com
Josephine Hermann	1506 Avenida Hacienda	S.C.	
Edward Hermann	" "	S.C.	
Joe Anderson	187 Ave. Salvador	S.C.	JKAMRA@Cox.net
SHARON HEIDER	910 Negocio	3615[illegible]62	
ERIC SWANEZ	236 Ave Montalvo		
George Gomez	139 Avenida Florencia-A	949 492 8685	GeorgeTGomez@COX.NET
GINNY HENDRICKS	2837 BARASCO		GINNY@SANCLEMENTEXCORDER.ORG
C Macbudo	2021 Alamos		
Mark Bonsauer	1205 Nevada St	760 725 4540	MARK.BONSAUER@USMC.MIL
Jerry Townsley	2411 Via Bandita	949 481-1470	—

SIGN-IN SHEET

San Clemente Shoreline Feasibility Study Public Meeting of the Draft EIS

August 19, 2010 – 910 Calle Negocio, San Clemente, CA 92673

Name	Address	Phone	Email
NOEL DAVIS	CHAMBERS GROUP		
LISA LOWE	CHAMBERS GROUP		
DORIS Hale	4118 Calle Bienvenido		
BILL Hoot	2021 Calle de los Alamos	949-498-3944	zblaat@cox.net
Ken Majcher	163 W Mariposa St	949 631-2433	fishermans ally@COX.NET
DON GROUP	111 PASEO DE GRACIA	949 249-4707	GROUMC170@AOL.COM
Tom Wicks	255 Vista Marina		WICKSTL@AOL.COM
PETER SALGADO	115 AVE SAN PABLO	949 285 2415	psalgado@civilsource.com
Mike Barnes			
Keith Aiken	19 Segovia S.C	949.361.3090	
Mark Rauscher	PO Box 6010 SC	949 492 8170	mrauscher@scfriends.org
Dean Kanzaki	107 Ave San Pablo	949-498-2279	
FRED SWEGLES	95 AVE. DEL MAR	949-492-5177	fswegles@ocregister.com
BOB BAKER	300 ESPLANADE	949-361-9031	BAKERSBEACH@COX.NET
TOM KEZMAN	213 W AVE CORDOBA	492795[illegible]	

UNITED STATES MARINE CORPS
MARINE CORPS BASE
BOX 555015
CAMP PENDLETON CALIFORNIA 92055-5015

IN REPLY REFER TO:
5090
ENVSEC/513
SEP 15 2010

From: Commanding Officer, Marine Corps Base, Camp Pendleton CA
To: District Engineer (Mr. Thomas W. Keeney, Planning Division, Environmental Resources Branch), U.S. Army Corps of Engineers, Los Angeles District, P.O. Box 532711, Los Angeles, CA 90053-2325

Subj: COMMENTS ON THE DRAFT JOINT ENVIRONMENTAL IMPACT STATEMENT/ENVIRONMENTAL IMPACT REPORT FOR THE SAN CLEMENTE SHORELINE FEASIBILITY STUDY IN SAN CLEMENTE

Ref: (a) Los Angeles District Corps of Engineers Interested Parties Letter of 6 August 2010

Encl: (1) MCB Camp Pendleton Comments on the Draft Joint Environmental Impact Statement/Environmental Impact Report for the San Clemente Shoreline Feasibility Study in San Clemente

1. In response to reference (a), MCB Camp Pendleton comments on the Draft Joint Environmental Impact Statement/Environmental Impact Report for the San Clemente Shoreline Feasibility Study in San Clemente are provided in enclosure (1).

2. Point of contact for additional information is Mr. Ken Quigley at (760) 725-9733 or kenneth.quigley@usmc.mil.

D.F. LEVI
By direction

Copy to:
CG, MCIWest

MCB Camp Pendleton Comments on the Draft Joint Environmental Impact Statement/Environmental Impact Report for the San Clemente Shoreline Feasibility Study in San Clemente.

1) General. The location of the proposed borrow site depicted in Figures 1.1-1, 1.3-1 and throughout the DEIR/DEIS would be more accurately identified as located off Camp Pendleton since it is directly west of Camp Del Mar and the Del Mar Boat basin not the Oceanside Harbor area as currently stated.

2) General. The proposed borrow site and transit routes appear to be in close proximity or through nautical restricted areas that exist in the vicinity of the Camp Del Mar area and further up the coast off Red Beach of Marine Corps Base Camp Pendleton. The Coast Guard has listed and described these restricted areas off Camp Pendleton in detail in their publication: Coast Pilot 7 in §334.900, §334.905 and §334.910. Regulations for these areas prohibit several activities including dredging and anchoring. As sites are in close proximity to the proposed borrow site the Draft EIS/EIR should incorporate some information regarding their existence and restrictions.

3) Page 1-1 Study Area – the proposed borrow area is outside the described study area. Does it have its own study area? If so where is it addressed?

4) Page 3-1 Evaluation Criteria. Were any planning constraints considered for the impact caused by the dredging at the borrow site? Such as – "Preserve water quality characteristics along the coast and near shore areas in the vicinity of the borrow site"

5) Page 3-3 Beach Fill. Lines 27 and 28 states "Beach nourishment may use offshore or onshore borrow sites. In the study area, offshore sources have historically been used for several reasons." Please include the reasons for excluding onshore borrow sites.

6) Page 3-9. Figure 3.4-1- Oceanside Borrow Site Map. Recommend that this graphic be changed to a Navigational Chart for more clarity of the borrow site's location.

7) Page 4-1 Affected Environment Since part of the project includes dredging material at the borrow site, information on that location should be included in the Affected Environment Chapter.

8) Page 4-1 Meteorology and Air Quality needs to include discussions about San Diego Air Pollution Control District (SDAPCD) since there will be emissions in that Air District.

9) Page 4-13 Water Quality, Sediments, and Oceanography should discuss discharges in the vicinity of the borrow site.

10) Page 4-38 Biological Resources Lines 7 and 8 states – "These sections describe biological resources found in the vicinity of the proposed beach fill and borrow site areas along the San Clemente coastline." The proposed borrow site is along the Camp Pendleton/Oceanside coastline. Does this section cover that site or only the potential borrow site near San Clemente? Some sections like Page 4-45 lines 26-36 provide information on the proposed borrow site along the Camp Pendleton/Oceanside coastline and others like Table 4-14 focus only on the San Clemente site ignoring biological resources in the immediate vicinity of the proposed borrow site.

MCB Camp Pendleton Comments on the Draft Joint Environmental Impact Statement/Environmental Impact Report for the San Clemente Shoreline Feasibility Study in San Clemente.

11) Table 4-14 Special Status Listed Species that May Occur in the San Clemente Pier or Oceanside Borrow Site Areas:

-Southern steelhead has also been found in the Santa Margarita River near the proposed borrow site.

-Western snowy plover nesting sites are located within about one mile of the proposed Oceanside borrow site as such the "Potential For Occurrence in the Project Area" should be high.

-California least tern nesting sites are located within about one mile of the proposed Oceanside borrow site as such the "Potential For Occurrence in the Project Area" should be high.

12) Page 4-51 Section 4.4.3.3 Steelhead Trout (Federal Endangered) - Southern steelhead has also been found in the Santa Margarita River near the proposed borrow site.

13) Page 4-51 Section 4.4.3.5 California Least Tern (Federal and State Endangered)- Lines 3 & 4 Large numbers of California least tern nesting sites are located within about one mile of the proposed Oceanside borrow portion of the project area and are likely to forage at the proposed borrow site.

14) Page 4-51 Section 4.4.3.6 Western Snowy Plover (Federal Threatened) Lines 37 & 38 – The Santa Margarita River nesting site is located within about one mile of the proposed Oceanside borrow portion of the project area.

15) Page 4-57 Section 4.5.2 Area of Potential Effects (APE) states "The offshore portion of the APE includes two offshore borrow sites, Areas 1 and 2. Area 1 is located southwest of the San Clemente Municipal Pier, and Area 2 is located off the coast of Oceanside." Section 4.5.3 summarizes the archaeology within and adjacent to the southern California coastline from Doheny State Beach to San Mateo Point. Where is the summary for Area 2 which is located off the coast of Camp Pendleton/Oceanside?

16) Page 4-64 Section 4.6.2 Vessel Transportation - Oceanside Harbor may be 20 miles from the San Clemente portion of the project area but it is within one mile of the Proposed Borrow Site. The section should also address Marine Corps and Navy use of the area near and between the two portions of the project site and dredge/barge impacts on those uses. This may also be the place to address the nautical restricted areas listed and described in the Coast Guard publication known as Coast Pilot 7 that are in the vicinity of the Camp Del Mar area (in addition to a 3rd restricted area located further up the coast off Red Beach). The planned borrow site for this project is located within the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA), as noted on most nautical charts (extends approximately 5.5 miles out from the southern end of the Camp Pendleton/Oceanside Harbor north breakwater and north to just south of San Mateo point). While that should not be a problem and dredging operations would not be prevented off the southern coast of Camp Pendleton, nevertheless, advance coordination of any planned dredging operations in or near the CPAVTA is required. The Final EIR/EIS for this project should include a provision

that the dredging operator pre-coordinate all planned dredging and transport operations with Camp Pendleton. If the Base is made aware of such offshore dredging operations and transport in advance, this activity can be incorporated into the Daily Training Schedule and efforts can be made to deconflict any potential Naval or Marine Corps amphibious training operations that may also be planned in close proximity to the dredging site and throughout the CPAVTA.

17) Page 4-80 Section 4.9.1 Beaches – fails to address Camp Pendleton and Oceanside beaches which are located within one mile of the proposed borrow site.

18) Page 4-81 Section 4.9.2 Annual Events – fails to address Camp Pendleton Del Mar Recreation Beach and Oceanside Harbor Events which are located within one mile of the proposed borrow site.

19) Page 5-1 Section 5-1 Air Quality and Meteorology – Where is the discussion for emissions within the SDAPCD?

20) Page 5-25 Impact WR-50-2: Would there be any potential impact from turbidity during dredging to southern steelhead attempting to enter the Santa Margarita River during the rainy season?

21) Page 5-35 Section 5.4 Biological Resources – Lines 25 & 26 – with the discovery of southern steelhead in the Santa Margarita River its potential to occur in the project area (borrow site) is higher then identified in the draft EIS/EIR.

22) Page 5-45 - Impact BR-115-1: A direct adverse effect on the population of a special status listed species or the loss or disturbance of important habitat for a listed species. Lines 34-36 – Western snowy plovers also breed on the beaches of Camp Pendleton near the Oceanside borrow area.

23) Page 5-52 Section 5.6 Ground and Vessel Transportation only talks about ground transportation impacts. There is nothing about impacts to ocean vessel transportation. As noted earlier in Section 4.6.2 Vessel Transportation, the planned borrow site for this project is located within the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA and advance coordination of any planned dredging operations in or near the CPAVTA is required. If Camp Pendleton is made aware of such offshore dredging operations and transport in advance, this activity can be incorporated into the Daily Training Schedule and efforts can be made to deconflict any potential Naval or Marine Corps amphibious training operations that may also be planned in close proximity to the dredging site and throughout the CPAVTA.

24) Page 5-60, Section 5.8 - Noise - What are the noise standards/criteria on shore in the vicinity of the borrow site? This would seem important to support the statement in lines 1 and 2 on page 5-64, and 26 through 30 on page 5-67.

MCB Camp Pendleton Comments on the Draft Joint Environmental Impact Statement/Environmental Impact Report for the San Clemente Shoreline Feasibility Study in San Clemente.

25) Page 5-77, Section 5.11 - Public Health and Safety - It appears the planned borrow site for this project is located within the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA), as noted on most nautical charts. While that should not be a problem and dredging operations would not be prevented off the southern coast of Camp Pendleton, nevertheless, advance coordination of any planned dredging operations in or near the CPAVTA is strongly recommended. The Final EIR/EIS for this project should include a provision that the dredging operator pre-coordinate all planned dredging and transport operations with the Camp Pendleton Range Scheduling department in the Range Operations Division. If the Base is made aware of such offshore dredging operations and transport in advance, this activity can be incorporated into the Daily Training Schedule and efforts can be made to deconflict any potential Naval or Marine Corps amphibious training operations that may also be planned in close proximity to the dredging site and throughout the CPAVTA.

26) Page 6.1 Description of Cumulative Projects – Why isn't the Oceanside Harbor Dredging project include in the Cumulative Impact Analysis since it is located within one mile of the borrow site?

27) Page 7-1 Section 7.0 Environmental Commitments - Since the planned borrow site for this project is located within the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA), as noted on most nautical charts the commitment that the dredging operator pre-coordinate all planned dredging and transport operations with Camp Pendleton should be added. If the Base is made aware of such offshore dredging operations and transport in advance, this activity can be incorporated into the Daily Training Schedule and efforts can be made to deconflict any potential Naval or Marine Corps amphibious training operations that may also be planned in close proximity to the dredging site and throughout the CPAVTA.

28) Page 9-3 Section 9.3.10 Other Agencies/Public Interest Groups – Coordination with MCB Camp Pendleton is required for all activity that takes place in the Camp Pendleton Amphibious Vehicle Training Area (CPAVTA), as noted on most nautical charts.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

September 20, 2010

Thomas Keeney
Project Ecologist, Planning Division
U.S. Army USACE of Engineers
P.O. Box 532711
Los Angeles, California 92053-2325

Subject: Draft Environmental Impact Statement for San Clemente Shoreline Protection Project, Orange County California. (CEQ# 20100289)

Dear Mr. Keeney:

The U.S. Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) for San Clemente Shoreline Protection Project, (Project), Orange County California. Our review is provided pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA Implementing Regulations (40 CFR 1500-1508), and Section 309 of the Clean Air Act. Our comments were also prepared in accordance with the provisions of the Federal Guidelines promulgated at 40 CFR 230 under Section 404(b)(1) of the Clean Water Act (CWA).

EPA recognizes the need to protect our shorelines and supports efforts to minimize erosion. We recommend that the Purpose and Need for this project be expanded to include preservation of the natural environmental features in and out of the water, as well as recreational activities currently favored in the area. EPA believes that consideration of additional alternatives is necessary to demonstrate compliance with the CWA Section 404(b)(1) Guidelines and authorization of the LEDPA.

Based on our review of the Proposed Project 50 foot beach width alternative, we have rated the DEIS as *Environmental Concerns – Insufficient Information* (EC-2) (see enclosed "*Summary of Rating Definitions*"), due to our concerns regarding air quality, impacts to waters of the United States (WUS), biological resources, the source and quality of beach nourishment materials, and climate change. The project's nitrogen oxide (NO_x) emissions exceed the conformity threshold. Prior to completing the Final EIS, the U.S. Army Corps of Engineers (USACE) should either revise the project so that the emissions no longer exceed the threshold, or complete a conformity determination for the project. Whichever the case, EPA is ready to coordinate with the USACE to avoid project delays. To clarify a point of apparent confusion, off-site mitigation (or offsets) may be included in a conformity determination, but should not be considered in an analysis to determine the applicability of conformity. We are also concerned that the DEIS includes a monitoring plan to assess nourishment needs yet fails to adequately address monitoring or mitigating plans in the context of environmental impacts from fill activities such as loss of surf grass and water quality.

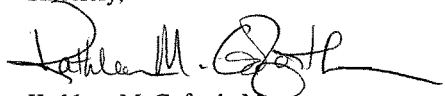
EPA encourages the USACE to include in the Final Environmental Impact Statement (FEIS) the results of a comprehensive biological survey of the San Clemente shoreline. Without such a survey, it is difficult, if not impossible, to accurately evaluate the environmental impacts of the proposed action.

The DEIS states that offshore dredging would be required for the beach fill alternative. EPA encourages the USACE to explore all options to obtain beach nourishment material, including opportunities to use dredged material produced from other USACE projects on the California coast.

In light of climate change and rising sea level, EPA questions the viability of a plan to place sand on a beach over a 50-year period. Reconsideration of the 50 year timeline associated with this project may be necessary to reflect the lifespan of the beach. EPA recognizes the project location is already in a high flood risk area.

We appreciate the opportunity to review this DEIS. When the FEIS is released for public review, please send one hard copy and two CD ROMs to the address above (mail code: CED-2). If you have any questions, please contact James Munson, the lead reviewer for this project, at (415) 972-3800 or munson.james@epa.gov, or me at (415) 972-3521.

Sincerely,



Kathleen M. Goforth, Manager
Environmental Review Office

Enclosures:
Summary of EPA Rating Definitions
Detailed Comments

Cc:
Bryant Chesney, NOAA
Jennifer Wise, USFWS
Loni Adams, CDFG

EPA'S DETAILED COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) SAN CLEMENTE SHORELINE PROTECTION PROJECT, ORANGE COUNTY CALIFORNIA. (CEQ# 20100289) September 20, 2010

Project Purpose and Need

Page 2-6 of the DEIS states that the purpose and need are "to prevent the severe beach erosion that results from winter storms and to prevent damage to adjacent beachfront structures, including the heavily used rail line". However, the DEIS does not clearly demonstrate whether placement would be a "beneficial use" at the proposed location through the rebuilding of an eroding beach. The DEIS section on the relationship between the sediment budget and long-term shoreline change does not appear to support that the beach is eroding. For example, the DEIS states that the "resultant sediment budget indicates the shoreline is essentially in balance between erosion and accretion" (see Section 4.3.4.3). The table on shoreline change also demonstrates that the shoreline has varied between eroding, accreting, and balanced (see Table 4-10) with the maximum erosion rate of minus 2 feet/year at T-street.

The sediment budget and the long-term shoreline change studies referenced on DEIS p. 4-36 conflict with the more recent studies cited on DEIS p. 4-35 that appear to support the downward trend of beach width in the project location. However, according to the DEIS, it has been eight years since the last study, the most recent beach width being measured in 2002 (Table 4.3-6). Due to the time elapsed, the high variability of beach width in the past, and the appearance of conflicting information with the historical and long-term analyses, we recommend that the FEIS include the results of more recent beach width monitoring in the project location.

Other project purposes include protection of railroad infrastructure from wave erosion. Section 4.6.1.2 of the DEIS states that the Orange County Transportation Authority has placed "riprap along the most critical segment between North Beach and the Marine Safety Building to decrease wave erosion impacts"; however much of this segment is not within the project footprint, and the project area south of the Marine Safety Building has no protecting riprap. The FEIS should address why the project area south of the Marine Safety Building has no protecting riprap. If this area is not considered part of the "critical segment", the FEIS should explain the purpose and need of including the area in the project.

Recommendations:

The FEIS should include an analysis of all existing data to clearly demonstrate a net loss of sediment deposition over the project area, and that local beach profiles show the effects of such erosion and thus are in need of replenishment. The FEIS should also provide clarification of the U.S. Army Corps of Engineers' (USACE) anticipated erosion rate of 12.8 feet per year (see Section 3.4.2.5) and why this rate is higher than historical erosion rates (-2 ft/year at T-street). For additional clarity, we also recommend that the sediment budget (Table 4-9) and long-term shoreline change (Table 4.3-6) sections include a map and description of the sampling stations, as well as a depiction of shoreline change during each of the represented periods.

The FEIS should include more information on the National Security issues surrounding the single track LOSSAN railroad adjacent to the project area. Page 4-65 of the DEIS states that the Department of Defense has designated this right-of-way as a Strategic Rail Corridor with great significance to National Defense. However, little information is given regarding how or when this determination was made. We note that the Federal Railroad Administration filed a Environmental Impact Statement in 2007 (Final Program Environmental Impact Statement for LOSSAN, Los Angeles to San Diego Proposed Rail Corridor Improvements in the State of California (CEQ# 20070465)) calling for the relocation of the LOSSAN railroad away from the shoreline with plans to run a new line adjacent to Interstate 5.

Recommendation:
The FEIS should include the results of consultation with the Department of Defense to ensure that all project alternatives are consistent with current National Security policy.

Alternatives Analysis

The DEIS includes a no-action alternative and two action alternatives. The two action alternatives include nourishment of the same linear project area but with different beach widths, (50 feet and 115 feet). While the proposed project (50 feet width option) would have fewer impacts from fill activity than the 115 feet alternative, both alternatives would have similar adverse environmental and recreational impacts in the same linear project areas.

Recommendation:
The FEIS should include, at a minimum, an additional alternative that reduces the amount of linear project footprint. EPA suggests that an alternative excluding fill south of the Marine Safety Building may meet the needs of the project while greatly reducing adverse impacts to surfing, coral reefs, and surfgrass. The FEIS alternatives analysis should include a reasonable range of practicable alternatives that meet the project purpose and demonstrate the project's compliance with the CWA Section 404(b)(1) Guidelines and selection of the Least Environmentally Damaging Practicable Alternative LEDPA.

Air Quality

General Conformity

EPA is concerned that applicability of the general conformity program has not been appropriately addressed in the DEIS. The project area is in Orange County, California. This county is part of a larger area that is not meeting federal air quality standards for ozone. The DEIS states that "The area may request a higher classification" (DEIS Vol. 2 p. 12). In fact, the area was reclassified to extreme nonattainment for the 1997 ozone national ambient air quality standards (NAAQS) on June 4, 2010. For this reason, the area now has a lower applicability threshold for general conformity. The DEIS is not clear that the applicability threshold used for analysis was 25 tons per year (tpy); however, we believe this to be the case, and want to clarify that the required threshold for analysis is 10 tpy. For more information go to: http://www.epa.gov/oaqps001/greenbk/gfr2rpt2.html.

Recommendation:
The FEIS should state clearly that the general conformity threshold is 10 tpy. Provide the results of the General Conformity applicability analysis to indicate whether the preferred alternative is above or below this de minimis level. If it is over de minimis, indicate the method that will be used to demonstrate that the project conforms to the applicable state implementation plan (SIP) for the area.

Air Quality Analysis

The DEIS reports that the project will have no long-term impacts and a temporary short-term adverse impact to air quality, but does not comprehensively assess the Project's operational and construction direct, indirect, or cumulative impacts to air quality. The FEIS should include a complete description of potential impacts and ways to reduce those impacts. In particular, EPA has concerns regarding the apparent lack of both an air quality impact assessment of fill placement, and a staging area plan that minimizes exposures to sensitive receptors and residents.

Construction Mitigation Measures

EPA commends USACE for incorporating mitigation strategies to reduce or minimize air pollutant, paving, and fugitive dust emissions. However, in addition to idling restrictions, proper maintenance of equipment, and the selection of construction equipment based on low emission factors, this Project should incorporate more stringent emission controls for PM and ozone precursors for construction-related activity.

Recommendations:
Due to the serious nature of the particulate matter of 10 microns or less (PM_{10}) and $PM_{2.5}$ conditions in the South Coast Air Basin, EPA recommends that the best available control measures (BACM) for these pollutants be implemented at all times and that the FEIS and ROD incorporate the Construction Emissions Mitigation Plan. We recommend that all applicable requirements under the South Coast Air Quality Management District (SCAQMD) Rules and the following additional measures be incorporated into the Construction Emissions Mitigation Plan.

Fugitive Dust Source Controls:

- Stabilize open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate. This applies to both inactive and active sites, during workdays, weekends, holidays, and windy conditions.
- Install wind fencing, and phase grading operations, where appropriate, and operate water trucks for stabilization of surfaces under windy conditions.
- When hauling material and operating non-earthmoving equipment, prevent spillage, and limit speeds to 15 miles per hour (mph). Limit speed of earth-moving equipment to 10 mph.

Mobile and Stationary Source Controls:

- Reduce use, trips, and unnecessary idling from heavy equipment.
- Maintain and tune engines per manufacturer's specifications to perform at California Air Resources Board (CARB) and/or EPA certification, where applicable, levels and to perform at verified standards applicable to retrofit technologies. Employ periodic, unscheduled inspections to limit unnecessary idling and to ensure that construction equipment is properly maintained, tuned, and modified consistent with established specifications. CARB has a number of mobile source anti-idling requirements. See their website at: http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm
- Prohibit any tampering with engines and require continuing adherence to manufacturer's recommendations
- If practicable, lease new, clean equipment meeting the most stringent of applicable Federal or State Standards. In general, only Tier 2 or newer engines should be employed in the construction phase.
- Utilize EPA-registered particulate traps and other appropriate controls where suitable, to reduce emissions of diesel particulate matter and other pollutants at the construction site.

Administrative controls:

- Identify all commitments to reduce construction emissions and incorporate these reductions into the air quality analysis to reflect additional air quality improvements that would result from adopting specific air quality measures.
- Identify where implementation of mitigation measures is rejected based on economic infeasibility.
- Prepare an inventory of all equipment prior to construction, and identify the suitability of add-on emission controls for each piece of equipment before groundbreaking. (Suitability of control devices is based on: whether there is reduced normal availability of the construction equipment due to increased downtime and/or power output, whether there may be significant damage caused to the construction equipment engine, or whether there may be a significant risk to nearby workers or the public.) Meet CARB diesel fuel requirement for off-road and on-highway (i.e., 15 ppm), and where appropriate use alternative fuels such as natural gas and electric.
- Develop construction traffic and parking management plan that minimizes traffic interference and maintains traffic flow.
- Identify sensitive receptors in the project area, such as children, elderly, and infirm, and specify the means by which you will minimize impacts to these populations. For example, locate construction equipment and staging zones away from sensitive receptors and fresh air intakes to buildings and air conditioners.

Air Quality Impacts Associated with Transporting Fill Material

EPA is concerned that the air quality analysis in the DEIS does not include emissions associated with the multiple collection barge trips needed to remove and transport fill from the project site nor does the DEIS appear to include estimates of the number of necessary collection barge trips, distance traveled, and corresponding air emissions.

Recommendations:
The FEIS should include a revised air quality analysis and updated emissions comparison to SCAQMD significance thresholds to account for the emissions from the equipment required to transport fill. The FEIS should also commit to additional minimization measures for these emissions.

Water Resources

Although a CWA Section 404 permit is not needed for the proposed action, the project must be in compliance with the CWA Section 404(b)(1) Guidelines. Also, the FEIS and ROD will serve as the basis for future permits that will be needed for maintenance of beach nourishment. Under the proposed action, sand replenishment will have to be done every five or six years to restore the design beach width and those actions may need a permit.

While the project will have impacts to high value marine habitats, including special aquatic sites (defined at 40 CFR 230.3(q-1)), the Section 404(b)(1) Alternatives Analysis (Appendix A) concludes that all impacts are localized and temporary, and therefore, insignificant. There is no discussion of the basis for this conclusion.

As a result of the large volumes of sand being placed on receiver beaches, the proposed project could lead to significant and unavoidable adverse impacts on surface water quality and fisheries from increased turbidity and fill in special aquatic sites. Other short- and long-term threats to water quality include construction-related containments such as oil and hydraulic fluid and increased turbidity that would occur during the future, associated maintenance activities for the proposed project.

Recommendations:
The FEIS should include a comprehensive biological survey of the San Clemente shoreline.

The FEIS should address the potential of the project to contribute to elevated turbidity levels. The USACE should consider marine design modifications regarding factors such as location and size, to minimize these environmental impacts.

Additional minimization measures for impacts to the aquatic environment should be discussed in the FEIS. Minimization measures include timing and rate of fill placement. The USACE should commit to placement in fall or winter to better mimic natural shoreline turbidity processes and reduce impacts during high recreational use times, and to develop debris management plans to ensure that the borrow site materials do not deposit trash, or other debris that may be harmful to the ocean environment.

Source & Quality of Beach Nourishment Materials

The DEIS briefly considers sources of sand such as onshore and offshore borrow sites (DEIS p. 3-3); however, it then goes on to state, "for this project offshore dredging would be required". Any opportunities for further minimizing impacts to the aquatic environment by using sand from other USACE permitted projects, or using sources from which the dredging might provide enhancement of environmental, navigational, or recreational conditions should be discussed in the FEIS.

We note that the chemical testing of the sediments in the proposed Oceanside borrow pit occurred several years ago. Due to this lapse of time, additional testing may be necessary. The DEIS did not describe the initial sampling scheme (depth of cores, how many cores) nor whether the cores went down to anticipated dredging depth. Additionally, the table did not provide a chemical reference sample along a beach transect at the proposed receiving site.

The DEIS provides insufficient discussion of the regulatory approval process of material for testing. A Sampling and Analysis Plan (SAP) for tiered testing, pursuant to the Inland Testing Manual should be required for each placement within the beach nourishment program. The SAP should examine the source material and the receiver site sediments and address tiered testing requirements (including grain size and the need for other testing) and be reviewed by the USACE, USEPA, Coastal Commission, and the RWQCB for concurrence prior to any sampling of the materials. All SAP's and approvals should be reviewed by the interagency dredging group run by the Los Angeles USACE s District (SC-DMMT).

Recommendation:
The USACE should evaluate and discuss in the FEIS the opportunity to coordinate with other projects that may produce suitable material for beach nourishment purposes. The ROD should include a commitment to consideration of opportunistic sources of beach nourishment material prior to each nourishment cycle.

The discussion of the chemical testing of the proposed Oceanside borrow site should be expanded in the FEIS to include pertinent information such as core depth and number of samples.

The FEIS should also describe, and the ROD should commit, to project review through an interagency regulatory approval process (i.e. SC-DMMT) to ensure that the sediments are suitable for ocean placement.

Biological Quality Surveys and Monitoring

We acknowledge the USACE commitment to a 50 year monitoring period (over the life of the project). As discussed in the DEIS, surveys and monitoring have typically been incorporated into beach nourishment projects. The document cites the San Diego Association of Governments' (SANDAG) "monitoring data that suggest the San Clemente fill will erode on average at a rate of 12.8 feet per year (3.9 m/yr)", (p. 3-18). To counter this erosion, the DEIS states that proposed project monitoring would be required to assess replenishment schedules.

However, the document does not sufficiently discuss a biological monitoring plan. This information should be included in order to evaluate the effectiveness of the proposed action in protecting biological diversity/quality.

The monitoring plan should include pre- and post-project dive surveys and benthic community sampling of the borrow site and the receiver site to ensure that each benthic community returns to its pre-project density and structure.

We stress that any monitoring should have appropriate adaptive management to ensure minimal impacts to aquatic resources. The Coastal Sediment Management Workgroup is currently preparing a document outlining practices to minimize impacts to aquatic resources. The adaptive management process should allow for incorporation of these practices and associated principles and any other developments in regional sediment management over the life of the project.

Recommendation:
The FEIS should include a detailed description of a survey/monitoring program for the biological impacts of the Proposed Project, and commit to its incorporation as a required project element. The monitoring program should have a clear adaptive management strategy to ensure that the aquatic environment is protected.

Endangered Species

The DEIS insufficiently evaluates the potential impacts to endangered species. For example, the document states, "No proposed or endangered species are expected to be present on the site" (DEIS p.A-10). The basis for this statement is unclear due to the lack of a complete shoreline biological survey.

Recommendation:
The FEIS should include a comprehensive biological survey of the entire project area as well as the borrow site, including a complete review of species that may be affected by the project. The results of consultation with the United States Fish and Wildlife Service and National Oceanic and Atmospheric Administration (NOAA), if appropriate, regarding threatened or endangered species or critical habitat should be included in the FEIS. Beach nourishment activities should avoid the nesting seasons for listed species, such as the least tern.

Cumulative Impacts

Given that the Project will take place over the next 50 years, the FEIS should include a comprehensive list of other projects in the area that are under construction or planned within that time frame, such as ecosystem restoration opportunities at San Elijo Lagoon, and related cumulative impacts. The DEIS states, "most of the sediment from the project is expected to accumulate on down coast beaches" (p.6-4). The feasibility of periodically replenishing beaches should be analyzed and incorporated in plans for future growth. An analysis of how future

projects, in conjunction with the proposed Project, may cumulatively impact the health of the affected resources should be addressed in this section.

Recommendation:
The FEIS should include a comprehensive discussion of all types of reasonably foreseeable projects that may take place in the area during the construction period, such as the LOSSAN Proposed Rail Corridor Improvements, the San Elijo Lagoon restoration, and others, and predict the cumulative impacts on affected resources.

Climate Change

Current research estimates that climate change could cause sea level rise and change the amount, timing, and intensity of rain and storm events. The Pacific Institute has created maps estimating flood risk due to sea level rise in the San Clemente Shoreline area; to see the map go to: http://www.pacinst.org/reports/sea_level_rise/hazmaps/San_Clemente.pdf

Recommendation:
The FEIS should describe and evaluate projected climate change consequences such as sea level rise, frequency of high intensity storms, and amplified rain events; their effects on the beaches; and how these effects could change re-nourishment plans for the San Clemente Shoreline Protection Project.

Executive Order 11988: Floodplain Management

Per Flood Insurance Rate Maps (FIRM), portions of the project footprint may be in a Zone VE Coastal Flood Zone with velocity hazard with a established base flood elevation (BFE). See FIRM#: 06059C0536J Orange Co Unine & Inc Areas 12/03/2009. Executive Order 11988 Floodplain Management requires federal agencies to avoid, to the extent possible, the long and short-term adverse impacts associated with the occupancy and modification of floodplains. For more information go to:
http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/zone_ve.shtm.

Recommendation:
The FEIS should discuss any impacts that the Proposed Project may have on the potential for flooding.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
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SEP 20 2010

Thomas Keeney
Project Ecologist, Planning Division
U.S. Army Corps of Engineers - SPL
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Dear Mr. Keeney:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the U.S. Army Corps of Engineers (Corps) Draft Joint Environmental Impact Statement/Environmental Impact Report (DEIS) for the San Clemente Shoreline Protection Project. NMFS offers the following comments pursuant to section 305(b)(4)(A) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), National Environmental Policy Act (NEPA), Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), and the Fish and Wildlife Coordination Act (FWCA).

Proposed Action

Two scales of beach fill alternatives were analyzed; they both consist of dredging material from offshore Oceanside, then hauling and placing it at San Clemente Beach. For purposes of the essential fish habitat (EFH) consultation, the proposed action is nourishment of 3,412 feet of beach with a + 17 foot berm crest elevation and a width of 50 feet. Approximately 251,130 cubic yards (192,000 m^3) of sediment will be dredged from the Oceanside offshore borrow site to supply nourishment activities. Sediment will be transported to the receiver site using a hopper dredge and mooring buoy. The sediment will be placed on the beach between Linda Lane and T-street. Construction is anticipated to begin in 2012 but may begin as soon as 2010. Similar re-nourishment events would occur approximately every six years, dependent upon monitoring results and funding availability.

National Environmental Policy Act Comments

Affected Area

The DEIS should elaborate on the quantity of habitat affected by the proposed action. For example, the acreage of benthic habitat affected by dredging operations should be provided. Similarly, the estimated area affected by sediment placement should be provided. This estimate should account for both direct impacts associated with sediment

placement and indirect impacts associated with the equilibrium footprint. In addition, the estimated rates and depth of burial within the equilibrium footprint should be provided.

Submerged Reef Alternative

The objectives of the proposed project are to 1) reduce storm-related damages to public and private properties and 2) enhance and maintain beach recreation and associated economic tourism benefits. The DEIS also identified a number of planning constraints that inform the evaluation criteria for the various alternatives. These constraints are 1) preserve the nearshore ecosystem that supports commercial lobster and fishing industries and snorkeling activities; 2) preserve the opportunities for surfing; 3) preserve critical habitat that supports listed species; 4) preserve water quality characteristics; 5) preserve cultural and historical features; and 6) preserve air quality conditions. The DEIS then incorporated the objectives and constraints of the project into the following evaluation criteria: addresses purpose and need, technical feasibility, economic feasibility, environmental impacts, and public acceptability.

Of the alternatives identified, NMFS believes additional analysis of the submerged reef alternative is warranted. Moreover, additional justification should be provided for the comparisons and conclusions made for the varying alternatives, as summarized in Table 3-1. NMFS is aware of initial planning efforts in Ventura County (i.e. Oil Piers) and northern San Diego County (i.e. Fletcher Cove) to evaluate the application of submerged reefs for beach protection and other benefits. The initial documents prepared for these projects support the potential feasibility of this approach. Moreover, submerged reefs provide additional habitat benefits and, if designed properly, may improve surfing conditions.

According to a report developed for the Corps planning process for the Oil Piers Ventura County project, studies of benefits associated with the construction of multi-purpose reefs at various locations around the world have all shown significant benefit/cost ratios. The lowest was approximately 20:1 for a small reef in Bournemouth, UK, to over 60:1 for the Narrowneck reef on the Gold Coast, Australia. A recent report for a multi-purpose reef in Wellington, New Zealand, estimated a conservative benefit to cost ratio of 24:1.

Although NMFS does not believe submerged reefs are a panacea for erosion control, they may impede erosion at local scales. They minimize many negative aspects of other erosion control methods and have the potential to benefit ecosystems, tourists and local communities. Thus, NMFS believes this alternative warrants further discussion and evaluation in the DEIS.

Analysis

Balancing Ecosystem Services

The proposed project involves some inherent trade-offs. Protection of existing infrastructure and maintaining recreational opportunities associated with beach usage are obvious ecosystem services that may be provided by this project. However, repeated beach fill projects may have an environmental cost to various natural resources (e.g. surfgrass, rocky reefs, intertidal and shallow subtidal invertebrate assemblages, fishery resources). These costs need to be incorporated into the analysis to ensure the benefit to cost ratio is not skewed. Prior to the commitment of federal resources, a clear evaluation should be provided that examines the expected costs over the long-term. Without such an analysis, it would be difficult to accurately predict whether the proposed project would be in the public's best interest.

Adequacy of Monitoring Studies

Peterson and Bishop (2005) reviewed 46 beach monitoring studies and showed that 1) only 11 percent of the studies controlled for both natural spatial and temporal variation in their analyses; 2) 56 percent reached conclusions that were not adequately supported; and 3) 49 percent failed to meet publication standards for citation and synthesis of related work. They opined that regulatory and resource agency practices are in urgent need of reform as the risk of cumulative impacts grows in the face of sea level rise, climate change, and increased coastal development. NMFS notes that, with the exception of one project from the 1970s, all the studies that were reviewed were on the Atlantic or Gulf coastlines. Thus, their results may not be directly applicable to projects implemented in Southern California. However, NMFS shares the concerns expressed by the authors that the presumption that nourishment projects are ecologically benign may be based upon an incomplete and flawed body of science. If previous monitoring results in Southern California are to be used as support for conclusions that impacts to biological resources are minor and/or insignificant, NMFS believes a more rigorous examination of their sampling design, statistical analyses, and conclusions are necessary.

Cumulative Impact Analysis

The cumulative impact analysis does not include the opportunistic program that has recently been permitted by Corps Regulatory Division (SPL-2004-00838-JPL). This is a 5-year opportunistic beach nourishment program to place a maximum of 300,000 cubic yards of sediment per year on four different sites within the coastal zone of the City of San Clemente. This project would use opportunistic fill sources and cover a maximum of 29 acres of tidal habitat. The disposal sites include one at North Beach, one at Linda Lane, and two at T-Street. In addition, a stockpile site is proposed near the intersection of Avenido Pico and El Camino Road. Given the spatial overlap and proximity, NMFS believes this program should be evaluated within the cumulative impact analysis.

In addition, the DEIS should evaluate how climate change may affect the frequency of nourishment events. Sea level rise, increased frequency and severity of storms, and increased wave height are expected climate change impacts that may exacerbate existing beach erosion rates and may increase the frequency of nourishment events. These may all affect the fate of sediment placed for beach nourishment purposes and subsequent movements into the nearshore environment and should, thus, be considered in the cumulative impact analysis.

Environmental Commitments

Section 7 of the DEIS identifies a variety of environmental commitments for the proposed action. However, no commitments are provided to address biological resources. NMFS recommends that this section be amended to include mitigation measures for biological resources.

Endangered Species Act Comments

Section 7 of the Endangered Species Act (ESA; see 16 U.S.C. § 1536(a)(2)) requires federal agencies to consult with the Secretary of Commerce and/or the Secretary of the Interior to insure that "any action authorized, funded, or carried out by such agency . . . is not likely to jeopardize the continued existence of any endangered species or threatened species . . . ." *See also* 50 C.F.R. part 400.

In Section 4 of the Joint DEIS/DEIR, the following ESA-listed species were described as having the potential to occur in the nearshore waters off San Clemente and Oceanside, CA: Guadalupe fur seal (*Arctocephalus townsendi*), blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), humpback whale (*Megaptera novaeangliae*), Steller sea lion (*Eumetopias jubatus*), northern right whale (*Eubalaena glacialis*), sei whale (*B. borealis*), sperm whale (*Physeter macrocephalus*), loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), Pacific olive ridley sea turtle (*Lepidochelys olivacea*), leatherback sea turtle (*Dermochelys coriacea*), and white abalone (*Haliotis sorenseni*). Black abalone (*Haliotis cracherodii*) was listed as endangered under the ESA on January 14, 2009 (74 FR 1937) and should also be included as having the potential to occur in the project area.

If the Corps determines that their proposed project may affect any ESA-listed species under NMFS' jurisdiction, including whales, seals, sea lions, abalone and sea turtles, the Corps should request concurrence from NMFS.

Marine Mammal Protection Act Comments

Whales, dolphins, porpoises, seals, and sea lions are protected under the MMPA. *See* 16 U.S.C. § 1361 *et seq.* Under the MMPA, it is generally illegal to "take" a marine mammal without prior authorization from NMFS. "Take" is defined as harassing, hunting, capturing, or killing, or attempting to harass, hunt, capture, or kill any marine mammal. Except with respect to military readiness activities and certain scientific

research conducted by, or on behalf of, the Federal Government, "harassment" is defined as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

Harassment of marine mammals may occur if hauled animals flush the haul out site and/or move out of the immediate aquatic area to increase their distance from dredging-related activities, such as noise associated with the dredging, presence of workers, or unfamiliar activity in proximity to a haul out site. The measured sound exposure levels of a clamshell dredge may range between 75-88 dBA (re 20 μPa) at 50 feet. Animals have been observed flushing from haul out sites at a sound exposure level of less than 100 dBA, and it is possible that marine mammals may modify their behavior as a result of the noise produced by the dredging operations. NMFS recommends including detailed information on the expected impacts that dredging will or will not have on marine mammals.

The DEIS/EIR indicated that it is expected that marine mammals in the vicinity of the project area, specifically gray whales (*Eschrichtius robustus*), would be expected to avoid the immediate vicinity of the dredging area, and that the turbidity plumes from the project would have an adverse impact on bottlenose dolphins (*Tursiops truncatus*). Please note the definition of a "take" under the MMPA and that the rapid exit from the project area could be considered harassment under the MMPA. In addition, avoidance is not considered a mitigation measure to reduce impacts to marine mammals should the action cause harassment and animals avoid the project area. Please provide more detail as to why the turbidity plumes would have an adverse impact on bottlenose dolphins. Based on the information provided in the DEIS/EIR regarding the potential take of marine mammals, it may be necessary to receive authorization from NMFS under the MMPA for this proposed project.

Magnuson-Stevens Fishery Conservation and Management Act Comments

Action Area

The proposed project occurs within EFH for various federally managed fish species within Coastal Pelagic Species, Pacific Groundfish Species, and Highly Migratory Species Fishery Management Plans (FMPs). In addition, the project occurs within areas designated as habitat areas of particular concern (HAPC) for various federally managed fish species within the Pacific Groundfish FMP. HAPC are described in the regulations as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under MSA; however, federal projects with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process. As defined in the Pacific Groundfish FMP, San Clemente contains the following types of HAPC: surfgrass, rocky reef and canopy kelp.

Figure 4.4-2 depicts the observed surfgrass in relationship to the dive transects, expected impact area (i.e. equilibrium footprint), and kelp habitat. Scattered surfgrass amongst boulders have been observed in the northern portion of the Linda Lane impact area. More extensive rocky reef and surfgrass habitat occur in the southern portion of the impact area at T-street. The survey information provided does not delineate areal extent of rocky reef and surfgrass within the impact area. Appendix B estimated the T-street reef to be 5 acres. No quantification of area and/or coverage was provided for the scattered boulders and surfgrass habitat. Rocky intertidal and more expansive subtidal rocky reef and associated kelp habitat exists in areas immediately adjacent to the expected impact area.

Effects of the Action

Based on information provided in the EFH assessment and developed during consultation, NMFS concludes that proposed action would adversely affect EFH for various federally managed species within Coastal Pelagics Species, Highly Migratory Species, and Pacific Groundfish FMPs. Dredging will disturb benthic organisms within the project footprint via direct removal or indirect mortality from an associated turbidity plume. Sediment from the beach fill project will be redistributed by wave and tidal energy onto nearshore areas, which may bury rocky reef habitat, surfgrass habitat, and benthic organisms that serve as prey for a variety of fishery species. In addition, turbidity generated from the beach fill will adversely affect the light regime in the immediate nearshore area, which may reduce the quality and/or quantity of surfgrass and kelp habitat.

Surfgrass habitat is likely to be impacted by beach nourishment and shoreline protection projects that place sand either directly or indirectly onto surf grass beds (Craig et al 2008). As described in the 404(b)(1) Guidelines, the discharge of dredged or fill material may reduce the value of vegetated shallows as nesting, spawning, nursery, cover, and forage areas, as well as their value in protecting shorelines from erosion and wave actions. In addition, the primary productivity of the system would be reduced if impacts were to occur. Surfgrasses exhibit late successional traits, recover very slowly from disturbance, require facilitation from algae before settling, and are strong competitors (Turner 1985). Removal of surfgrass from a rocky reef community has profound impacts to community structure (Turner 1985). Thus, surfgrass habitat is largely determined by patterns of disturbance. Repeated beach nourishment efforts likely will increase this rate of disturbance to these systems. Slow recovery times suggest that disturbances to these communities may be ecologically significant.

The DEIS acknowledges that some burial will occur and that the inshore areas of the impact area will be most affected by burial. However, the DEIS asserts that the proposed action will not result in a long-term net loss in habitat value of surfgrass. In addition, it states that the proposed project will have no significant adverse effects on special aquatic sites. NMFS does not believe these conclusions are adequately supported by the analysis.

Previous predictions of burial associated with placement of 175,000 cubic yards were described in the DEIS that indicated an estimated maximum 1 foot burial of surfgrass for less than six months. Short term burial at depths of 0.8 feet exhibited a statistically significant decline in shoot count within a laboratory setting (Craig et al, 2008). Furthermore, the DEIS indicates that some portions of surfgrass habitat within the equilibrium footprint already exhibit some burial. Thus, the additive impact associated with this beach fill project may exacerbate existing conditions for surfgrass habitat. Based upon the above and that the proposed project involves approximately 40% more sediment than previous predictions, NMFS believes the proposed project would reduce the quality of surfgrass habitat in the project vicinity. Given the uncertainties associated with modeling, there is also a real potential for reductions in the quantity of surfgrass habitat.

Galst and Anderson (2008) have suggested that surfgrass is important for nearshore fish communities and reductions in surfgrass could negatively affect recruitment patterns. Specifically, experimental reductions in coverage of seagrass (ranging from 7 to 180 square meters) resulted in significant decreases in the density of newly recruited fish species. Similarly, NMFS expects reductions in coverage and/or density may reduce other ecological services provided by surfgrass, such as primary productivity, substrate for epibiota, and wave energy dissipation.

To date, NMFS is unaware of any comprehensive survey to delineate surfgrass and rocky reef in the project area. According to Appendix B of the DEIS, which describes a biological resources monitoring program, the general area of the T-street reef is approximately 5 acres. Appendix B further states that potential burial of the inshore edge of T-street is uncertain, but, if it were to occur, it would be expected to occur in the approximately 20 percent inshore edge of the T-street reef area. Scattered patches of rocky reef and surfgrass may also exist in other areas of the footprint, but no estimates are given to quantify the extent of the impact. Given the lack of detailed habitat characterization and uncertainty associated with burial predictions, it is difficult to estimate the quantity of surfgrass habitat that may be affected.

Hard-bottom habitats, such as rocky reefs, are present within and adjacent to the project area. These hard-bottom habitats provide substrate for a diversity of algae and invertebrate species, which are utilized by a number of different fish species. Many organisms adapted to rocky reef habitats are highly susceptible to burial and/or sediment scour. Thus, burial and/or increased scour may diminish the ecological functions provided by rocky reefs. Some increased level of burial and/or scour is expected to occur to rocky reef areas within the equilibrium footprint. However, the DEIS suggests that the proposed action will have only minor transitory effects, but acknowledges that unforeseen impacts may occur and that resource monitoring is appropriate. Significant burial is not expected in the rocky intertidal areas near Mariposa Point or the more extensive subtidal rocky reefs and kelp habitat found near Mariposa Point and immediately offshore (approximately 1,000 to 1,300 feet from the beach) of the estimated impact area.

The proposed project will increase turbidity within the project area due to dredging and beach fill operations. Based upon monitoring conducted at another dredging operation in Oceanside, the estimated average down coast distance of the turbidity plume was between 272 and 329 feet. Turbidity monitoring of a hopper dredge operation for a regional beach sand project indicated that plumes did not exceed 2,700 square yards (0.56 acres). Construction monitoring during a regional beach sand project indicated that turbidity plumes ranged between 2,640 and 10,000 feet and were largely confined to the surfzone. Beach nourishments create turbidity plumes, an area of water with a high concentration of suspended sediments that can last for days and cover habitats adjacent to the project site. Turbidity decreases light penetration and therefore has adverse effects on seagrass and canopy kelp habitats. These plants form the basis of highly productive systems and any losses would adversely affect nearshore EFH. In addition, turbidity plumes may alter fish behavior. Many fishes will likely disperse away from the turbidity plume as fine particulates can clog gill rakers and decreased visibility can make foraging more difficult. Sessile, filter feeding invertebrates may experience mortality, as suspended sediments can clog feeding apparatus.

Impacts to rocky reef, surfgrass, and/or kelp habitat may also occur if anchor moorings and/or the slurry pipeline were placed on these sensitive habitats. The DEIS indicates that placement of moorings and pipelines shall avoid these sensitive habitats. However, a more detailed and comprehensive habitat survey should be conducted to properly delineate the areas to avoid.

California grunion (*Leuresthes tenuis*) spawn on sandy beach habitats throughout the Southern California Bight every year from March to August. On full and new moons, eggs are deposited in the sand above the high tide line shortly after spring high tides. Two weeks later, corresponding with spring high tides, larval grunion hatch from eggs and return to the water. Beach nourishment can cause mortality by burying developing eggs. Heavy machinery and other disturbances during construction could also kill developing or juvenile grunion. However, the proposed project would not impact grunion spawning because it has committed to occur outside the grunion spawning season of March to August.

EFH Conservation Recommendations

As described in the above effects analysis, NMFS has determined that the proposed action would adversely affect EFH for various federally managed fish species within the Coastal Pelagics, Highly Migratory Species, and Pacific Groundfish FMPs. Therefore, pursuant to section 305(b)(4)(A) of the MSA, NMFS offers the following EFH conservation recommendations to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH.

1) **Given the high ecological values associated with surfgrass and rocky reef habitat, NMFS believes unavoidable reductions in quantity and/or quality of these habitats should be addressed via compensatory mitigation. The Corps and project sponsor should develop a contingency mitigation plan in**

consultation with NMFS and other interested agencies prior to the record of decision for the proposed project.

The contingency mitigation plan should be based upon a reasonable estimate of potential impacts to rocky reef and surfgrass habitat. This estimate should be developed and agreed upon by Corps, NMFS, and other interested agencies prior to the record of decision for the proposed project. This estimate may then be used as the basis for determining the approximate cost of implementing a mitigation project and should be incorporated into the benefit to cost ratio of the proposed project. In addition, the estimated cost can serve as the basis for providing financial assurances that will ensure a high level of confidence that the compensatory mitigation project will be completed if impacts are observed.

a. **The Corps and/or the project partner should include in-kind surfgrass restoration, establishment, and/or enhancement as part of the mitigation plan.**

   According to the 2008 mitigation rule, compensatory mitigation is defined as the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved. The rule suggests that compensation for unavoidable impacts to difficult to replace (DTR) resources (e.g. bogs, fens, springs, streams, etc.) should be provided through in-kind rehabilitation, enhancement or preservation. Given the slow recovery time and the difficulties associated with restoring this habitat, NMFS believes that surfgrass should be considered a DTR resource. Therefore, NMFS believes the Corps and/or the project partner should include in-kind surfgrass restoration or establishment as part of the mitigation plan.

b. **Given the uncertainty associated with surfgrass mitigation success, the Corps and/or the project partner should develop a contingency plan should surfgrass mitigation efforts fail.**

   Based upon discussions with the Corps, kelp mitigation may be the most appropriate out-of-kind approach if in-kind mitigation does not yield positive results. Therefore, the Corps and/or the project partner should design an artificial reef capable of supporting kelp habitat that would offset similar ecological functions that were lost due to surfgrass impacts.

c. **The Corps and/or the project partner should coordinate with NMFS and other interested agencies to determine an appropriate mitigation ratio for impacts to surfgrass and rocky reef habitat.**

2) **A scientifically defensible monitoring plan should be developed prior to a record of decision on the proposed project.**

The purpose of the monitoring plan is to detect environmental impacts associated with the proposed project and serve as the basis for determining whether compensatory mitigation is appropriate. Results from the monitoring plan will inform the development of a final mitigation plan, which will be based upon the approach described in the contingency mitigation plan. The monitoring plan should be described in greater detail than the program currently described in Appendix B. The sampling design and statistical analyses should be clearly described and should be based upon fundamental principles of statistical inference. This monitoring plan should be reviewed and approved by the Corps, NMFS, and other interested resource agencies prior to a record of decision. In addition, to ensure adequate scientific rigor, consideration should be given to involving an independent review by recognized, biostatistical experts.

Statutory Response Requirement

Please be advised that regulations at section 305(b)(4)(B) of the MSA and 50 CFR 600.920(k) of the MSA require your office to provide a written response to this letter within 30 days of its receipt and at least 10 days prior to final approval of the action. A preliminary response is acceptable if final action cannot be completed within 30 days. Your final response must include a description of measures to be required to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with our EFH conservation recommendations, you must provide an explanation of the reasons for not implementing those recommendations. The reasons must include the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

Supplemental Consultation

Pursuant to 50 CFR 600.920(l), the U.S. Army Corps of Engineers must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations.

Fish and Wildlife Coordination Act Comments

The purpose of the FWCA is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development [16 U.S.C. 661]. The FWCA establishes a consultation requirement for federal departments and agencies that undertake any action that proposes to modify any stream or other body of water for any purpose, including navigation and drainage [16 U.S.C 662(a)]. Consistent with this consultation requirement, NMFS provides recommendations and comments to federal action agencies for the purpose of conserving fish and wildlife resources. The FWCA allows the

opportunity to offer recommendations for the conservation of species and habitats beyond those currently managed under MSA and ESA.

According to Subpart E Section 230.43 of the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (404(b)(1) Guidelines), vegetated shallows are considered special aquatic sites (SAS). SAS are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region. This status provides special consideration when evaluating actions involving dredged or fill material pursuant to Section 404 of the Clean Water Act. Vegetated shallows are defined as permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation. NMFS believes surfgrass should be considered a SAS and receive special consideration when evaluating actions involving discharge of dredged or fill material.

Surfgrasses are considered to be among the most productive seagrass systems on the planet (Ramírez-García et al. 1998). Galst and Anderson (2008) indicate that surfgrass beds serve as an important habitat for nearshore fishes, and the loss of surfgrass from disturbance has negative consequences for recruitment success. Surfgrass also serves as an important nursery habitat for a variety of invertebrates, such as California spiny lobster (Engle 1979, as cited in MPLA Initiative 2009), and as habitat for algae (Stewart and Myers 1980, as cited in MLPA Initiative 2009). Shaw (1986) suggests that the importance of surfgrass as a nursery for juvenile lobsters in southern California is clearly apparent and the disturbance or destruction of this habitat could seriously decrease lobster abundance. Surfgrass is also important foraging habitat for the endangered green turtle on the Pacific side of the Baja Peninsula (Lopez-Mendilaharsu et al 2005). Although utilization of nearshore habitats in southern California is less understood, sub-populations of the endangered green turtle are known to utilize San Diego Bay and the Long Beach area for foraging. If surfgrass serves a similar function in southern California, then adverse effects to surfgrass habitat may have a negative impact on habitat used by this listed species.

NMFS has determined that rocky reef and surfgrass habitat may be negatively impacted by proposed project activities. As such, EFH Conservation Recommendations provided above also serve as FWCA recommendations to compensate for these negative impacts.

Please contact Mr. Bryant Chesney at (562)980-4037, or via email at Bryant.Chesney@noaa.gov if you have any questions concerning this EFH consultation or require additional information. Please direct questions regarding marine mammals to Ms. Monica DeAngelis at (562)980-3232 or Monica.DeAngelis@noaa.gov, questions regarding sea turtles to Ms. Christina Fahy at (562)980-4023 or

Christina.Fahy@noaa.gov and questions regarding abalone to Ms. Melissa Neuman at (562)980-4115 or Melissa.Neuman@noaa.gov.

Sincerely,

Robert S. Hoffman
Assistant Regional Administrator
for Habitat Conservation

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STATE OF CALIFORNIA ARNOLD SCHWARZENEGGER, *Governor*

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September 15, 2010

File Ref: SCH# 2010084002

Thomas W. Keeney
Project Ecologist, Planning Division
U.S. Army Corps of Engineers - SPL
P.O. Box 532711
Los Angeles, CA 92053-2325

Subject: Joint Environmental Impact Statement/Environmental Impact Report for the San Clemente Shoreline Protection Project

Dear Mr. Keeney:

Staff of the California State Lands Commission (CSLC) has reviewed the subject document. Under the National Environmental Policy Act (NEPA), the Los Angeles District of the U.S. Army Corps of Engineers (USACE) is the federal lead agency. Under the California Environmental Quality Act (CEQA), the city of San Clemente is the Lead Agency and the CSLC is a Responsible and/or Trustee Agency for any and all projects that could directly or indirectly affect sovereign lands, their accompanying Public Trust resources or uses, and the public easement in navigable waters.

As background, the State acquired sovereign ownership of tidelands and submerged lands and beds of navigable waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all the people of the State for Public Trust purposes which include waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space. The landward boundaries of the State's sovereign interests in areas that are subject to tidal action are generally based upon the ordinary high water marks of these waterways as they last existed prior to fill or artificially-induced accretions. In non-tidal navigable waterways the State holds a fee ownership in the bed of the waterway between the two ordinary low water marks. The entire non-tidal navigable waterway between the ordinary high water marks is subject to the Public Trust. The State's sovereign interests are under the jurisdiction of the CSLC.

Components of the San Clemente Shoreline Protection Project (Project), as we understand them, include the following:

- The Project was implemented to analyze potential environmental impacts of proposed alternatives designed to address ongoing beach erosion issues along the city of San Clemente shoreline. Issues of concern include possible future damage to an existing railroad line, public safety and liability problems, and the loss of economic benefits associated with degraded recreational opportunities.
- Two alternatives were considered: a 'No Action' alternative, and a 'Beach Fill' alternative. The Beach Fill alternative considered various combinations of beach fill widths and replenishment cycles. Two beach fill alternatives were selected for analysis and are identified as '50 ft (15m) Beach Width Alternative', and '115 ft (35m) Beach Width Alternative'. Although they share common design elements, they are expected to have different environmental impacts, and so were analyzed as two separate alternatives.
- The '50 ft (15m) Beach Width Alternative' has been identified as the tentatively recommended plan alternative.
- Both selected Beach Fill alternatives involve the dredging of fill material from a borrow site one mile offshore of the city of Oceanside. The '50 ft (15m) Beach Width Alternative' would utilize approximately 251,000 cubic yards (cy) of material to create a 50-foot wide berm and an immediate post-construction dry beach width of approximately 76 feet at the receiver site.
- The receiver site is located at San Clemente Beach, in the city of San Clemente, and extends approximately 3,412 feet from Linda Lane to T Street. The receiver site encompasses the San Clemente Municipal Pier.
- The dredged material would be transported in 1,700 cy loads on a hopper dredge to a mooring location offshore of the beach receiver site and would be pumped onshore via a submerged pipeline.
- Construction is anticipated to begin in 2012 and is expected to take 46 working days to complete, although commencement could begin as early as 2010.

Please be advised that both the borrow site and the receiver site involve sovereign lands under the jurisdiction of the CSLC. Use of the borrow site will require authorization from the Commission for the issuance of a dredging lease. The receiver site appears to overlap the lease area under Lease No. PRC 8567.9 issued by the CSLC to the city of San Clemente for the 'City of San Clemente Opportunistic Beach Replenishment Program'. Use of the receiver site will require the city of San Clemente to amend Lease No. PRC 8567.9 to accommodate the project. Lease applications can be accessed via our website at www.slc.ca.gov.

In order to ensure that the mitigation measures identified in the EIS/EIR are implemented, the lead agency must adopt a program for monitoring the measures it has imposed to mitigate or avoid significant environmental effects (see CEQA Guidelines §15097). Section 7.0 of the EIS/EIR states that Table 7-1 entitled "Summary of design features and monitoring commitments" lists the actions committed to be undertaken by

the USACE for the proposed action to ensure environmental impacts are reduced to the extent possible.

However, the "design features" in the table appear to be an abbreviated and incomplete combination of 1) the mitigation measures identified in Section 5.0 Environmental Consequences of the Proposed Action and Alternatives, and 2) the steps for minimization and compensation identified in Section H of Appendix A entitled "Section 404(b)(1) Evaluation of the Effects of the Discharge of Dredged or Fill Material into Water of the United States: San Clemente Shoreline Protection Project."

In order to provide the basis for an effective mitigation monitoring program as required by CEQA, CSLC staff recommends that the table be revised to include a comprehensive summary of all the mitigation measures and monitoring commitments relied upon in the EIS/EIR, and at a minimum reflect the following revisions:

- Table 7-1 should include several omitted mitigation measures identified in Section 5 including Geology/Topography (MM-ER-115-2.1), Biological Resources (MM-BR-50-2.1 and 2.2), Cultural Resources (MM-CR-50.1), Noise (MM-N-50-3.1), and Recreation (MM-R-50-4.1).
- The table should reference or incorporate all components of the Biological Resources Monitoring Plan in Appendix B.
- The mitigation measures in the table should be numbered to indicate the corresponding section or appendix where they originated.

As a Responsible and Trustee Agency, the CSLC will need to rely on this document for the issuance of a new dredging lease and an amendment of the existing lease specified above. We request that you consider our comments and implement these recommendations prior to adoption of the Final EIR/EIS.

For questions and comments related to the environmental review, please contact Joan Walter, Environmental Scientist, at (916) 574-1310 or by e-mail at joan.walter@slc.ca.gov. Please contact Kenneth Foster, Public Land Management Specialist, at (916) 574-2555 or by e-mail at kenneth.foster@slc.ca.gov for more information about the Commission's sovereign lands leasing jurisdiction.

Sincerely,

Cy R. Oggins, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
Kenneth Foster, LMD, CSLC
Joan Walter, DEPM, CSLC

State of California - The Resources Agency ARNOLD SCHWARZENEGGER, Governor
DEPARTMENT OF FISH AND GAME John McCamman, Director
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September 30, 2010

Thomas W. Keeney
United States Army Corps of Engineers
Planning Division
915 Wilshire Boulevard
Los Angeles, CA 90017

Subject: Draft Environmental Impact Statement/Draft Environmental Impact Report for the City of San Clemente Shoreline Protection Project

Dear Mr. Keeney:

The Department of Fish and Game (Department) has reviewed the Draft Environmental Impact Statement/Draft Environmental Impact Report (DEIS/DEIR) dated July, 2010 for the U.S. Army Corp of Engineer's (Corps) San Clemente Shoreline Protection Project (Project) to be implemented in 2012 or sooner. The preferred project proposal is to dredge 251,130 cubic yards of natural ocean bottom sand from an offshore borrow site located one mile off the coast of Oceanside, California. The sediment is expected to be 10 percent fine sediment, 83 percent sand and seven percent gravel. A hopper dredge will be used to extract the material. At the receiver site (San Clemente Beach), the dredge would be attached to a floating pipeline moored to the sea floor that would carry the discharge slurry of sand and water along the bottom to the beach, approximately 1,500 feet. The beach fill area would be 3,412 feet long with a +17-foot crest elevation, and is estimated to result in a 50-foot beach width. Once started, the proposed project duration is estimated to be 46 working days over the course of four months. The Corps is proposing to repeat this project every six years.

As a trustee for the State's fish and wildlife resources, the Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants and habitat necessary for biologically sustainable populations. In this capacity, the Department administers the California Endangered Species Act, the Native Plant Protection Act, as well as other provisions of the California Fish and Game Code and Title 14 of the California Code of Regulations that afford protection to the State's fish and wildlife. The Department is also responsible for marine biodiversity protection under the Marine Life Protection Act (MLPA) in coastal marine waters of California. Pursuant to our jurisdiction,

the Department submits the following concerns and recommendations regarding the project.

General Comments

The Department wants to stress the importance that the project be designed carefully in order to primarily avoid adverse biological impacts to sensitive marine species to the maximum extent possible. Our concerns relate to potential impacts to rocky reefs, surfgrass, marine algae, and the fish and invertebrate communities that utilize these for critical habitat. Many marine species, such as rockfish, *Sebastes* spp, and other fish species managed under the Department's Nearshore Fishery Management Plan (NFMP), use these important habitats for breeding, shelter, spawning, foraging and resting. The NFMP species are found primarily in rocky reef or kelp habitat in nearshore waters. A list and description of NFMP fish species can be found on the Department's website at www.dfg.ca.gov/marine/nfmp/pdfs/section1_chap2.pdf. Additionally, the federally endangered black abalone, *Haliotis cracherodii,* and several other abalone species could occur in the project area inhabiting kelp and rocky reef habitats. The California spiny lobster, *Panulirus interruptus*, a recreationally and commercially important species, also inhabits the project area. Lobsters rely upon the reefs and surfgrass in the area for spawning, foraging and shelter.

Specific Comments

Project Alternatives

In order to reduce risk and protect important offshore sensitive species and habitats, the Department recommends that the alternatives analysis be modified to include analysis of a more conservative alternative, such as a reduced quantity of sand for the project or a different deposition location on the beach. Kelp and rocky reefs in the project area are critical habitat for the black abalone, and surfgrass habitat is essential for spawning and as a nursery for juvenile fish, lobsters and other invertebrates. Additionally, surfgrass and kelp provide root system structure that helps to stabilize sand.

Mitigation Plan

The DEIS/DEIR proposes a surfgrass compensatory mitigation plan for an experimental surfgrass transplantation contingent upon unexpected adverse impacts, such as a significant loss of surfgrass area or reduction in density of surfgrass mats. There is no indication in the DEIS/DEIR of a secondary plan if the experimental surfgrass transplant is not successful. The Department suggests that a back up mitigation plan should be available in the event that the experimental surfgrass transplant does not succeed. Additionally, habitat compensation and the criteria for triggering compensatory mitigation should be further discussed and agreed upon with the Department and other resource

agencies. The Department will continue to work with the Corps to develop adequate mitigation and monitoring plans that will sufficiently avoid and minimize the risk of burial and other adverse impacts to sensitive species and habitats.

Monitoring Plans

There are two mitigation and monitoring plans presented in the DEIS/DEIR for surfgrass habitat; one for the offshore reefs, referred to as MM-BR-50-2.2, and one for the habitats along the mooring and slurry pipeline route on the sea floor, referred to as MM-BR-50-2.1. The Department concurs that these two areas will need baseline surveys conducted prior to the project and post construction surveys that monitor for significant damages or degradation of surfgrass, kelp and reef habitat. The Department always advises that avoidance measures be used first and to the maximum extent practicable. The DEIS/DEIR minimization plan for surfgrass and kelp suggests that the Corps has already determined that avoidance measures are not feasible. However, the Department believes that the mooring and sea floor pipeline plan could be revised so that the routes avoid impacts completely. The Department is willing to work with the Corps to discuss and develop an alternative pipeline route. The MM-BR-50-2.2 surfgrass and reef habitat mitigation and monitoring plan of the DEIS/DEIR is limited to pre- and post- construction, with no monitoring during construction. The Department believes that it is appropriate to monitor surfgrass and reefs during the construction activities because of the uncertainty of adverse impacts predicted in the DEIS/DEIR.

The Department's recommendation for additional monitoring to avoid potential impacts is based mainly on the fact that there has not been consistent success from surfgrass transplantation projects in the past. Additionally, the best available transplantation techniques for surfgrass are still considered experimental at this time. The Department also recommends that if monitoring during the sand deposition indicates signs of adverse effects (i.e. significant burial) to surfgrass and/or reef habitat, then construction activity should be stopped and re-evaluated before permanent damages are done. The project could continue with possible modifications, such as re-locating the deposition area on the beach, to avoid or minimize adverse impacts. Monitoring should continue to evaluate the effectiveness of any modifications to project activities. A revised monitoring plan should incorporate these recommendations.

Reporting

Reporting procedures are lacking from all plans. The Department expects to receive all survey and monitoring reports, within three to five days for preliminary results and 30 days for final reports, in order to have time to review and respond to potential impacts to marine habitats.

As always, Department personnel are available to discuss our concerns, comments, and recommendations in greater detail. To arrange a discussion, please contact Ms. Loni Adams, Environmental Scientist, Marine Region, located at 4949 Viewridge Ave, San Diego, CA 92123 or by telephone at (858) 627-3985 or via e-mail at ladams@dfg.ca.gov.

Sincerely,

Marija Vojkovich
Regional Manager
Marine Region

cc: Mr. Bryant Chesney
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Ms. Jennifer Wise
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Ms. Vicki Frey
Department of Fish and Game
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Ms. Loni Adams
Department of Fish and Game
4949 Viewridge Avenue
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-----Original Message-----
From: Bonigut, Tom [mailto:BonigutT@san-clemente.org]
Sent: Friday, September 10, 2010 8:05 AM
To: Schlosser, Heather R SPL
Cc: Johnson, Joseph A SPL
Subject: San Clemente study questions

Heather and Joe:

Just passing along several following questions that City staff have raised about the study and proposed project. Maybe some of this is addressed in the reports, but I wanted to share with you to make sure one way or the other we do address these issues:

1. Sand compatibility and acceptability. Is there a QA/QC process to ensure that the borrow site sand will be suitable for placement on San Clemente beaches, and if for some reason it is not, what is the backup plan for borrow sites? This is a really important one, as we are receiving feedback that the Oceanside borrow site does not provide quality beach sand, and that a borrow site further site (name escapes me) is actually better.

2. Beach monitoring. Is there any discussion about what we think would happen to beaches south of the project area? I.e. since there is a net southward sand movement, what might happen to those beaches and surf breaks?
Would or should the monitoring plan address some of those areas too? We certainly need to ensure, to the extent possible, that we don't impact surf breaks south of the project area.

3. Can the discussion about the reference line for the project be improved? It's unclear to some what the starting point is for determining where the 15-meter beach width starts? Is it fixed throughout the project area (e.g. some offset from the rail line), or does it vary according to some other criterion? Also, is it fixed in time according to current conditions?
I.e. what if our beach erodes significantly between now and the time an actual project is constructed? Will the beach berm width reference line be shifted also, or would the project be as described currently? Is it possible to define a seaward project limit instead of using a reference line that could change over time?

No rush, but please call whenever convenient and I can further elaborate on this questions. Thanks.

Tom Bonigut, P.E.
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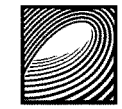
San Clemente, CA 92673
(949) 361-6187

Classification: UNCLASSIFIED
Caveats: NONE



September 20, 2010

Mr. Thomas Keeney
Project Ecologist, Planning Division
U.S. Army Corps of Engineers - SPL
Attn: Thomas W. Keeney
P.O. Box 532711
Los Angeles, CA 92053-2325

Via email: Thomas.W.Keeney@usace.army.mil

Mr. Keeney-

Thank you for the opportunity to comment on Draft Joint Environmental Impact Statement/Environmental Impact Report (Draft EIS/EIR) for the San Clemente Shoreline Feasibility Study in the City of San Clemente, California. The Surfrider Foundation is a non-profit environmental organization dedicated to the protection and enjoyment of the world's oceans, waves and beaches. With our global HQ in San Clemente and a dedicated local membership of thousands, we are particularly sensitive to the management of San Clemente's shoreline. As such, we have been engaged in the development of this project for nearly a decade.

We believe that the completion of this EIS/EIR is simply the starting point for a discussion that needs to be held within our city on the best way to address long-term shoreline change. We hope that the city will develop a more robust coastal management plan that addresses the root causes of shoreline erosion and attempts to manage our coast in a cost-effective and environmentally sensitive manner that reflects the sensibilities of our community. The commitment to a 50-year project with the U.S. Army Corps of Engineers is a serious undertaking with serious fiscal, environmental and social implications. What is the vision we have for our coast? What do we want it to look like and how healthy do we want our beaches and bluffs to be when our children's children are splashing in the waves?

Unfortunately we have yet to see our city have that discussion and we hope that the potential project we are commenting on currently will help to instigate it.

Specific Comments

Section 1.2 Project Background

-Thoroughly describe the private property threatened by shoreline changes.

The document states: *"Changes to the beach shoreline caused by erosion have reduced recreational opportunities and are threatening the stability of City facilities, private property, and a major southern California commuter rail corridor."*

It is unclear what "private property" is under threat by shoreline changes, and what protection it would be afforded by the proposed project. It is our understanding that all structures constructed west of the railroad within the project area are public facilities. It is important to describe the structures accurately as their storm-damage protection provides the economic benefits of such a project.

This lack of private property should also be reflected in Sections 2.1: Purpose and Need and 2.2: Project Objective.

Section 2.1.2: Threat to the Railroad Corridor

-Provide clear and supported justification for the future necessity of seawall construction in a no-project alternative.

As noted, the railroad corridor has varying levels of hard protection along the project stretch. Yet the railroad has successfully managed erosion and wave attack issues for relatively low cost. The document does not explicitly describe which sections are more at risk, nor why the presumption is made that continued rock placement will not be allowed in the future, necessitating the need for a highly engineered and costly seawall as described in Coastal Engineering Appendix, Section 4.4. Given that the bulk of the economic justification for this project relies on this particular prediction of future conditions, it requires a more robust explanation. Section 4.4 states:

> "It will become mandatory for the SCRRA to construct seawalls in the future. Project formulation indicates that due to evolving law and coastal structure construction regulations, the ability for the SCRRA to use revetment methods will expire."

Yet, the previous language within the section does not support this statement.

In addition, this project does not even encompass the most threatened portion of the railroad, as areas to the north (Mariposa) and to the south (Calafia) are at much higher risk of wave impact damages, yet OCTA has not attempted to gain permits for a permanent vertical seawall at these sections.

Section 2.1.3: Public Safety and Liability

-Correct the discussion of the public safety issues due to moved infrastructure in a "managed retreat" alternative.

The document claims that erosion threatens public restrooms, which could require relocation if erosion trends continue. It goes on to state that such a relocation would cause a public safety issue due to the resultant increase in pedestrian railroad

crossings. This premise is incorrect. The public restrooms which are located west of the railroads within the project area occur at T-Street and the Pier. T-Street already has a railroad overpass preventing any direct pedestrian crossings. The Pier already has a railroad underpass allowing safe passage below the railroad. Hence, no increase in pedestrian crossings need occur if restroom facilities are relocated east of the railroad.

4.3.4.3: Littoral Processes and Sediment Transport

-Documented processes do not support the need for the project

The *Sediment Budget* section shows that the long-term sediment budget for this section is essentially in equilibrium, with net erosion equaling net accretion. The *Long Term Shoreline Change* section also finds variable net positive and net negative changes both along shore and through time. This would indicate that in the long term San Clemente's shoreline is nearly unchanged, and that sediment likely moves alongshore in pulses with portions of the city's beaches growing while others are shrinking. Particularly striking is the quote: "During the period 1980-1989, the shoreline was predominantly positive with accretion rates ranging from + 1.4ft/yr (+0.43 m/yr) to +7.2 ft/yr (+2.16 m/yr)." This is the period that experienced the strong 1983 El Nino winter storms, but which apparently survived with little net erosion.

The *Recent Shoreline Change Rate* attempts to show moderate shoreline width reductions, but is not consistent throughout the study area, with beach widening shown at Shorecliffs. There are also an extremely low number of data points (at least 12 years missing in the recent past) to be able to conclusively define the nature or extent of observed shoreline change. Because of this it is unclear if the single data point at the end of the time series represents a long term negative trend, or simply a perturbation in a highly active shoreline as seen in the first ten years of the time series. In other words, does the beach come and go with the weather and storm conditions, and we're only observing a single point in time?

Impact WR-50-3: Nearshore wave characteristics (50 ft alternative)

- Monitoring of surfing quality should be designated as mitigation under all project alternatives.

There is potential for adverse impacts on surfing as described in this section as well as in the Engineering Appendix (6.3.4), yet no mitigation measures are provided. The 115 ft alternative predicts definitively adverse impacts to wave characteristics and does suggest monitoring of surf conditions followed by adjustment of subsequent renourishments if surfing is degraded and does not recover. Based on the description of potential impacts within the Engineering Appendix, in particular, there is a possibility of severe degradation of surfing quality. As such, we request that monitoring of surfing quality before and after construction be provided as mitigation of any chosen project, including the 50 ft alternative. Potential impacts as described could pose a significant degradation of wave quality: "The surfing experience might consist of a normal "take-off," but then "close-out" as the wave encounters the straightened bathymetric contours inshore" and would justify the

need for monitoring and mitigation if these impacts are experienced.

In addition, meeting notes in the appendices specifically state that monitoring of surfing quality is to be undertaken. This needs to be reflected within the body of the impacts analysis. This monitoring and mitigation should reflect the discussion of impacts from the 115 ft alternative below.

- *Impacts to wave characteristics in the designated surfing zone north of the pier must be evaluated and described.*

Within section Impact WR-50-3 and WR-115-3, there is no mention of surfing anywhere aside from T-Street. While T-Street is a consistently high-quality surfing area, surfing is often restricted there under "black ball" conditions when the lifeguards ban hard-board surfing for the bulk of the day during the summer. At these times surfing within the project stretch is restricted to the area directly north of the pier, causing the pier zone to become incrementally more valuable for use.

Impact MM-WR-115-3.1: Nearshore waves characteristics (115 ft alternative)

Timing for mitigation measure should be shortened.

Under the 115 ft alternative, it is estimated that surfing waves could be significantly degraded for a period of 10 years. This is beyond the estimated period of return for future nourishments. An allowance of 10 years degradation and monitoring before future plans are adjusted is unacceptable. Similar to surfgrass, direct mitigation or reconstruction of the resource is not currently possible, and no time allotment is provided for the surfrass mitigation (MM-ER-115-2.1) In addition, artificial surfing reefs are not viable as mitigation for lost surfing resources, and a greater emphasis on adverse impact prevention should be made.

Again, thank you for the opportunity to comment. We look forward to further discussing this project at the city level.

Sincerely,

Mark Rauscher
Beach Campaigns Manager

From: Keeney, Thomas W SPL
To: Schlosser, Heather R SPL; West, Nathaniel ; Lisa Louie llouie@chambersgroupinc.com
Cc: Johnson, Joseph A SPL
Subject: FW: san clemente beach replenishment please confirm email
Date: Friday, September 17, 2010 3:11:40 PM

Comment

thomas
P Please consider the environment before printing this message

-----Original Message-----
From: georgetgregory1@netzero.com [mailto:georgetgregory1@netzero.com]
Sent: Friday, September 17, 2010 10:10 AM
To: Keeney, Thomas W SPL
Subject: san clemente beach replenishmint please comfirm email

1 it seams ludicrous to replenish the beach sands with out promoting erosion and passive replenishment

2 if sands will migrates south may we please replenish north beach first thus supplying the pier area 2nd

3 if the near costal quarry's where relocated away would this not help with passive and aggressive replenishment of san clement ,capo beach, beaches & soils

4 are their plans to use the spoils from any excavation or tunneling up in the ortages ,For costal replenishment or building material .Thus using the spoils to replace native soils and or releasing and allowing to pass thru the quarry native soils to the shore

5 it seam important to keep up the allusion of success that a supply of sand can bring. with constant permits equipment and plans in place ,available and maintained for train transportation of sand and soils for the grooming and maintance of the costal resources. possibly hedging are bet and augmenting strategic and civil and possible emergency capabilities (the volley ball court is like playing on dull broken glass)train car loads are fairly efficient and affordable compared to truck loads. Possible improving the quality of soils from distant and local sources

6 lastly it seams to be a shame the energy used to harvest the soils do not seam to be of any beofitt in the first place

as in deepening a harbor or entrance improving wet lands or impoundments or importing away proofed soils from a site like Santa Ana river basin and flood control projects

lastly thank you for your time and please comments on these questions and statements
georgetgregory1@netzero.com

george gregory

139 avenida florencia-A

san clemente CA 92672

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-----Original Message-----
From: Keith [mailto:keith92672@yahoo.com]
Sent: Thursday, September 23, 2010 10:06 AM
To: Keeney, Thomas W SPL
Subject: San Clemente Beach Study Comments

Dear Representative:

I attended the August Beach Study meeting, here are some comments.

1) The train track running on top of San Clemente beaches is at the root of the problem.

2) It's hard to believe an alternate rail route cannot be found - especially with the desire of Amtrak to increase rail traffic.

3) Experience has shown that sea walls accelerate beach erosion. The sea walls already built by Amtrak, to protect rail lines, are accelerating beach sand erosion. Why isn't Amtrak being held responsible for its part in adding to the problem and mandated to help with sand replenishment costs?

4) We were told by the geologists that most all sand migrates southward; so why not add sand at North Beach? North Beach has been severely impacted and is in need of sand replenishment. Plus the sand eroded from North Beach would help to replenish sand on all San Clemente beaches as it migrates south. At the very least, sand could be deposited at North Beach and not in the T-street area - as sand will naturally move into that area from sand replenishment on beaches north of T-street.

Thank you,

Keith Aiken

September 14, 2010

Mr. Thomas Keeney
Planning Division
US Army Corps of Engineers
PO Box 532711
Los Angeles, CA 90053-2325

Ref. San Clemente Shoreline Feasibility Study Comments

Dr. Mr. Keeney:

Please consider the below comments from a former City of San Clemente Lifeguard from 1974 to 2001.

Page 9, Problem Identification, does not include the economic impacts from erosion that would reduce the income to local visitor/tourist serving businesses, and loss of taxes and other revenues to the city, including bedroom taxes, sales taxes, and property taxes; and beach parking and beach concession revenues.

It does not include the added cost to provide lifeguard and other protective services to safely keep the public away from hazardous conditions and to protect, relocate or replace pubic improvements. Additionally, it does not speak to the potential liability or defense costs from lawsuits due to the injury or death to beach goers as the result of exposed natural and man-made dangers.

Page 9, Problem Identification, mentions potential danger of exposed underlying hard substrate and man-made. Page 10, Problem Statement, mentions reduces recreational space on an already space-limited beach. I would suggest that more emphasis be placed in both areas regarding the fact that the erosion not only causes a reduction of recreational space, but can present public dangers from exposed man-made and natural hard structures. This condition can make shoreline and offshore ocean areas unsafe, hence unusable by the public.

San Clemente City Lifeguards have had to post and, at times, restrict the use of some near shore and off shore ocean areas due to these dangers. This is no easy task, since these hazardous conditions can become exposed overnight and are difficult to detect during changing tidal and surf conditions. This task is further complicated by strong wave and currents. A swimmer can enter the water in a location that is relatively safe and be swept down the beach hundreds of feet in a matter of a few minutes where there might be exposed dangers that are under water and, therefore, undetectable.

Some problems are hard to prevent like when people walk along the beach and try to pass around an obstruction, like the railroad riprap, and are hit by an unpredictable set of waves, resulting in them being washed into the rocks. These situations can often occur at night when visibility is limited and lifeguard personnel are not normally there to warn of such hazards.

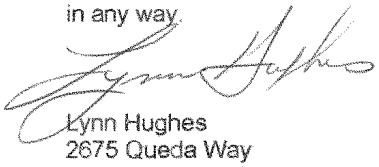
These conditions have prompted lifeguard to have electric lights installed at such areas and/or post hazard warning signs. Ideas such as installing motion detectors to trigger a recorded warning alert have also been considered to manage this type of hazard.

Lifeguards tend to err on the side of safety by restricting the access/use of potentially dangerous water areas, including making sure people do not enter dangerous areas or be swept into dangerous areas. Continued erosion will only increase this danger and the resultant dangers and ocean restrictions. It is not unrealistic that large areas of the City's water area may have to be limited from the public's use during these exposed times. Although the city usually gains beach sand in the spring and summer, when we most need it, the large seasonal deposits of fresh sand have become less and less.

ES-1, under Overview, the same point regarding the dangers of exposed hard structures and its economic impacts should be made here as well. Also, it should be further emphasized, possibly under the Executive Summary, Project Background, page 1-4, that the LOSSAN railroad Riprap is not engineered and therefore subject to continual undermining and failure during periods of erosion. It is possible that the tracks could be undermined to the extent that the railroad tracks could not safely carry the load of railway cars brought in to drop addition rock.

These comments are made after only making a partial review of the draft study, since my new computer kept locking up upon opening many of the study's documents.

Please feel free to contact me if you have any questions, or if I can be of any assistance in any way.



Lynn Hughes
2675 Queda Way
Laguna Beach, CA 92651
(949) 497-3947

APPENDIX G – DRAFT COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, California 92011

In Reply Refer To:
FWS-OR-07B0008-11CPA0003

JUL 26 2011

Colonel R. Mark Toy
District Engineer, Los Angeles
U.S. Army Corps of Engineers
P.O. Box 532711
Los Angeles, California 90053-2325

Attention: Mr. Thomas Keeney, Ecologist/Biological Sciences Manager

Subject: Final Fish and Wildlife Coordination Act Report for the San Clemente Shoreline Protection Project, Orange County, California

Dear Colonel Toy:

Enclosed is our Final Fish and Wildlife Coordination Act Report (Report) for the San Clemente Shoreline Protection Project in Orange County, California. This Report is provided in fulfillment of Scope of Work Agreement Number W81EYN72403881 between our agencies, requesting us to provide Draft and Final Fish and Wildlife Coordination Act reports for the project.

This Report is prepared in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*) and constitutes the final report of the Secretary of Interior as required by section 2(b) of the Act.

If you have any questions regarding the Final Report, please contact Division Chief David Zoutendyk at (760) 431-9440, extension 222.

Sincerely,

Karen A. Goebel

Karen A. Goebel
Assistant Field Supervisor

TAKE PRIDE IN AMERICA

Enclosure (1)

cc:
Lori Adams, California Department of Fish and Game
Bryant Chesney, National Oceanic Atmospheric and Administration
James Munson, Environmental Protection Agency

FINAL FISH AND WILDLIFE COORDINATION ACT REPORT

for the

San Clemente Shoreline Protection Project
Orange County, California

Prepared for the

U.S. Army Corps of Engineers
Los Angeles District

by the

U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
Carlsbad, California

July 2011

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (Corps) has prepared a draft Environmental Impact Study/ Environmental Impact Report (EIS/EIR) to analyze potential environmental impacts associated with the proposed action and alternatives for providing protection to the shoreline of the City of San Clemente (City) from coastal storms. The draft EIR/EIS identifies the preferred alternative as the 15 meter (m) [50 feet (ft)] beach fill alternative, which includes dredging material offshore of the City of Oceanside and hauling and placing it at San Clemente Beach. Beach fill will be 1,040 m (3,412 ft) long with a +5.2 m (+17 ft) crest elevation. The dredge volume is estimated to be about 192,000 cubic meters (m^3) [251,130 cubic yards (y^3)]. Re-nourishment will occur about every 6 years and require about 192,000 m^3 (251,000 y^3) of material for an estimated eight re-nourishment cycles over the 50-year project life.

Beach erosion is an ongoing problem along the San Clemente shoreline. Over the past 20 years, average beach widths in the City's beaches have been gradually reduced to about 15 m (50 ft), a reduction of more than 50 percent compared to beach measurements from 1958 and 1981. Changes to the beach shoreline caused by erosion have reduced recreational opportunities and are threatening the stability of City facilities, private property, and a major southern California commuter rail corridor.

Implementation of the proposed initial and subsequent beach replenishment efforts are expected to result in direct, indirect, and cumulative effects to biological resources during dredging, staging of equipment offshore of the beach replenishment sites, and placement of sand on the replenishment sites. These effects are expected to include direct mortality to biological resources, especially benthic invertebrates. Indirect effects could also occur from increased turbidity, night lighting, and migration of sand from the replenishment sites onto reef and surfgrass areas. Cumulative effects could be experienced over the course of the proposed project through the repetitive replenishment of the beach areas.

PREFACE

This document constitutes the Final Fish and Wildlife Coordination Act Report (Final FWCA Report) in fulfillment of Scope of Work Agreement Number W81EYN72403881 between the U.S. Fish and Wildlife Service (Service) and the U.S. Army Corps of Engineers (Corps) and addresses the potential effects of the San Clemente Shoreline Protection Project on fish and wildlife resources. We have prepared this Final FWCA Report pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*) and in keeping with the spirit and intent of the National Environmental Policy Act (P.L. 91-190). This Final FWCA Report supersedes all of our previous planning input regarding this project.

Coordination between the Service and Corps regarding biological impacts and mitigation has been on-going. The Service met with the Corps, National Oceanic and Atmospheric Administration (NOAA), and California Department of Fish and Game (CDFG) on October 16, 2007; May 15 and December 16, 2008; July 16, 2009; September 15, 2009, and April 30, 2010, and with NOAA, CDFG, and the Environmental Protection Agency (EPA) on September 3, 2010, to discuss the proposed project and alternatives. The main topics of discussions included the current status of the proposed project, project alternatives, and potential environmental issues. The Service received the Draft Joint Environmental Impact Statement/Environmental Impact Report (EIR/EIS) for the project on August 3, 2010. The NOAA, CDFG, and EPA provided comments on the Draft EIR/EIS, and the Service submitted a Draft FWCA Report to the Corps on January 14, 2011.

The Service met with the Corps, NOAA, CDFG and EPA on January 31, 2011, to address comments on the Draft EIR/EIS and recommendations in the Draft FWCA. Several issues were discussed at the meeting including: 1) the adequacy of baseline transect surveys and assumption of a worse case impact of up to only 0.81 hectares (ha) [2 acres (ac)] of surfgrass/reef impacts based on these surveys, even though the entire 2 ha (5-ac) T-Street Reef is expected to be in the equilibrium footprint and subject to sand movement and burial; 2) the use of only a 1 to 1 mitigation ratio in light of temporal loss of at least 2-5 years from the time of impact to completion of mitigation, especially for surfgrass impacts given the uncertainty of surfgrass restoration; 3) the potential to modify the project to a 10-meter (m) [33-foot (ft)] beach width to help minimize potential impacts to surfgrass and reef and mitigation risks/costs due to the uncertainty regarding surfgrass restoration; 4) resource agency approval role in determining appropriate mitigation, criteria for triggering mitigation, success criteria, and monitoring and reporting requirements; 5) the adequacy of the proposed $3 million mitigation fund when mitigation costs are estimated to be up to $3.5 million; 6) potential cumulative impacts from the City's opportunistic beach replenishment program; 7) potential impacts to the intertidal reef at Mariposa Point and use of Mariposa Point as a control in light of these potential impacts and from the City's opportunistic beach replenishment program; 8) the use of only one verses multiple control site(s); and 9) allowing subsequent beach replenishment before any previous impacts are successfully mitigated.

The Corps provided comments on the Draft FWCA Report and an updated Monitoring, Mitigation, and Reporting Plan (MMRP) via electronic mail (email) transmissions dated June 9 and July 20, 2011, respectively. We forwarded the Corps' comments and updated MMRP to NOAA, CDFG, and EPA; the NOAA and CDFG responded that the Corps did not fully address many of their original concerns. The NOAA and CDFG also provided additional comments on the revised MMRP including: 1) the provision for only 2 years of monitoring for any necessary rocky reef mitigation, instead of 5 years as for kelp mitigation; 2) the provision for impacts to shallow reef to be mitigated with deep water reef; and 3) the provision for out-of-kind kelp mitigation for surfgrass impacts that could lead to continual loss of surfgrass from beach replenishment. We have incorporated NOAA and CDFG comments and recommendations relative to the proposed project's potential impacts on fish and wildlife resources and habitats into the recommendations of this Final FWCA Report.

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INTRODUCTION

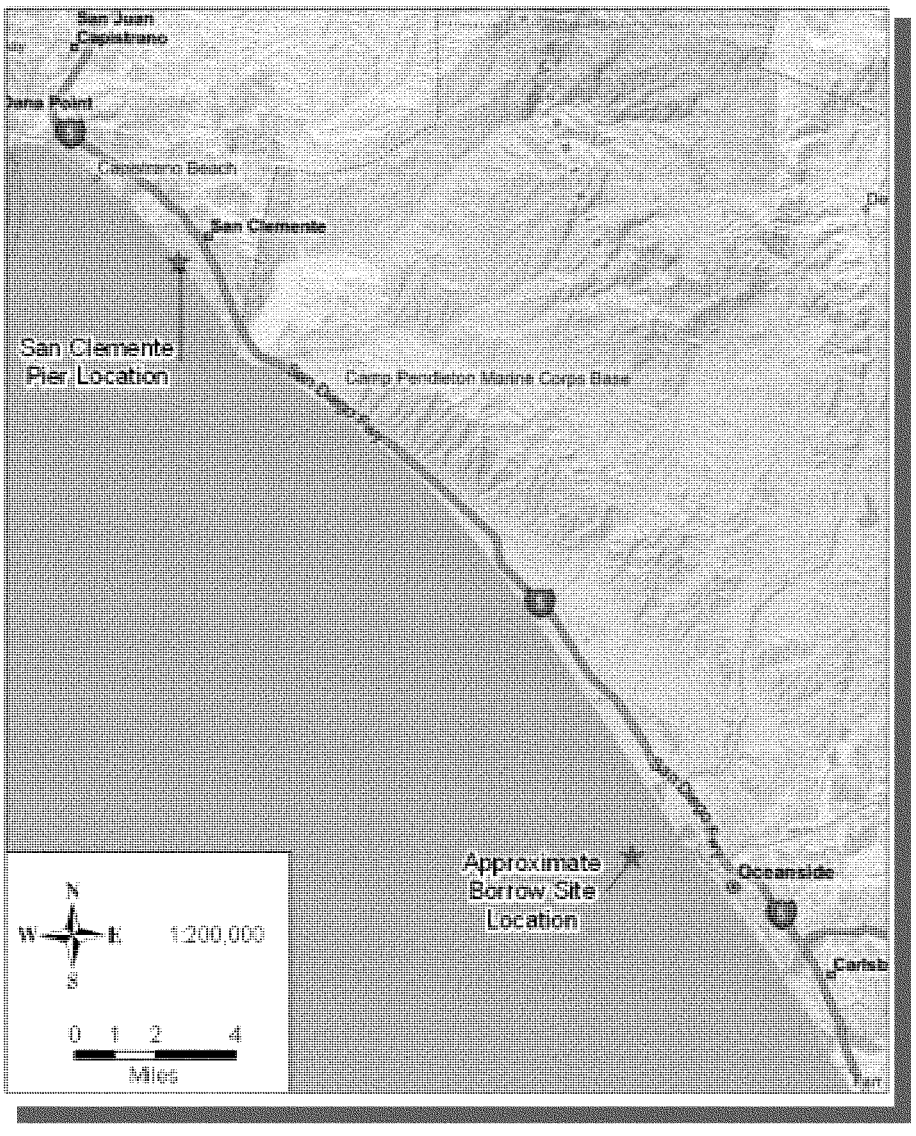
Description of Project Area

The City of San Clemente (City) is located along the coast of southern California about 100 kilometers (km) [60 miles (mi)] south of Los Angeles at the southern end of Orange County near the border of San Diego County. The study area is encompassed within the City and extends about 1,040 meters (m) [3,412 feet (ft)] from Linda Lane to T-Street (Figure 1). A portion of the Los Angeles to San Diego (LOSSAN) rail line runs between the beach and the coastal bluffs through San Clemente. The project area includes the San Clemente Municipal Pier (Pier), beachfront structures, and the Marine Safety Headquarters on the beach. The borrow site for beach replenishment materials is located offshore of the City of Oceanside

Purpose and Need

The purpose of this project is to provide shore protection through nourishment of the beach at the Pier. Developing and maintaining the beach is needed to prevent the severe beach erosion that results from winter storms and to prevent damage to adjacent beachfront structures, including the heavily used LOSSAN rail line that runs along the beach through the City. In addition, the continued loss of sand at the beach would have a negative impact on recreation, which supports the local economy, and would reduce the ecological functioning of the sand beach/littoral zone.

Figure 1 – Project Vicinity Map (Corps 2010)



PROJECT DESCRIPTION

Alternatives

Non-Structural Measures

Managed Retreat

Managed retreat restricts or opposes efforts to control long-term retreat of the shoreline. This can include policies ranging from complete removal of all shore protection structures to simply not allowing new structures to be built. For this project, managed retreat of coastal development would include relocation of the railroad and beach facilities due to the continued erosion of the recreation beach area. Continued erosion and storm wave attack would likely eliminate any beach area available for recreation use and may eliminate the need for facilities or relocate some facilities (e.g., restrooms) to the landward side of the railroad.

Structural Measures

Beach Fill

Beach nourishment involves placement of compatible sand from a borrow area to effectively widen the beach. The beach fill material acts as a buffer, dissipating storm waves and run-up over the wider profile. Beach nourishment may use offshore or onshore borrow sites. In the study area, offshore sources have historically been used for several reasons. Prior offshore studies of the area conducted by the Corps have identified potential sources of sand suitable for an offshore borrow site. The potential offshore borrow sites in the study area were investigated by the San Diego Association of Governments (SANDAG 2000) and the Corps (1993) for beach compatible sand, and appropriate sites were located by these previous investigations offshore of the City Oceanside.

For this project, offshore dredging would be required for the beach fill alternative. Available offshore borrow sites exist, and sand would be delivered to the beach fill sites using hopper dredges with pump-out or large cutter suction dredges. For the hopper dredge with pump-out, temporary near-shore pipeline and mono buoys would be positioned at about the 9 m (30 ft) depth contour to permit the dredge to pump each load directly ashore. A hydraulic dredge with multiple booster pumps would pump material onshore through submerged and floating pipelines.

Revetments and Seawalls

Revetments are flexible structures (i.e., not locked in concrete) made of placed quarry stone. They are typically built of 3- to 5-ton stone over a layer of smaller stone over a layer of fill designed to stop shoreline retreat and to protect landslide improvements from damage by wave action. Seawalls and revetments are placed parallel to the shoreline as a last line of defense to protect adjacent land areas from direct wave attack, flooding, and erosion. Sheet-pile walls are steel or precast concrete panels vertically placed in the ground to form continuous seawalls for

protecting back-beach improvements. Revetments are generally effective if maintained, but they encroach significantly onto the beach. The seawall structural measure typically requires less spatial area and maintenance.

Offshore Reefs and Breakwaters

Offshore reefs or submerged breakwaters would protect the shoreline against direct wave attack and reduce the transmitted wave energy to less damaging levels along the beach. Breakwaters are concrete or rock walls built roughly parallel to the shore just beyond the breaker zone to absorb wave energy by stopping transmission or breaking the wave before it hits the beach. They can be permeable or solid, depending on desired amount of wave energy absorption versus reflection.

Submerged artificial reef-type designs for the purpose of sand retention and storm damage reduction come in many forms, but they may be simplified into "soft" and "hard" designs. In the soft designs, near-shore sand berms are constructed of dredged sand placed parallel to the beach in shallow water. The soft breakwater reduces incident wave height, and gradual onshore migration of the sediment can contribute to re-nourishment of the adjacent shoreline, providing the berm itself is stable enough to withstand the wave environment.

Hard submerged breakwaters, which include artificial reefs, reduce wave energy through breaking and dissipation. They are generally not as effective as surface piercing breakwaters at retaining sand, but they do not generally have the adverse effects on recreational surfing conditions that surface visible structures do and may enhance surfing conditions if designed for dual purpose.

Shore Perpendicular Structures

Cross-shore sand retention structures, such as groins and jetties, are constructed perpendicular to the shore to form fillets that can slow beach erosion by trapping littoral sediment. Groins are cross-shore retention structures that act as a barrier to alongshore sediment transport. Offshore breakwaters are effective at retaining sand, but they are expensive and require a healthy source of littoral sand to perform their sand trapping function.

The shore perpendicular structures are generally used to preserve a minimum berm width and slow erosion rates so that re-nourishment volumes may be smaller and episodes less frequent. The amount of sand trapped by the structure depends on the permeability, height, and length of the structure and the amount of sand in the littoral system. As material accumulates on the up-drift side of the structure, supply to the down-drift side is reduced. This results in local beach accretion on the up-drift side of the structure and erosion for some distance down-shore. After the beach near the structure adjusts to an "equilibrium" stage in accordance with the wave conditions, all littoral drift will pass the structure directly over it or be diverted around the seaward end of the structure.

No Action

The no action alternative assumes that no project would be implemented and that the Southern California Regional Rail Authority's (SCRRA) existing maintenance plan would continue to be implemented, which may result in potential damage to the railroad ballast and tracks, but without any measures implemented by the City to address continued erosion of the recreation beaches near the Pier. With the no action alternative, the erosion-prone beaches are assumed to be further depleted and storm damages would be expected to increase in severity, increasing the threat to the railroad corridor. Public safety and liability problems would not be resolved, and recreational activity on the beaches would be degraded, resulting in a loss of associated economic benefits.

Preferred Alternative

According to the draft EIR/EIS, managed retreat and structural measures do not meet the project's evaluation criteria, which include the technical and economic feasibilities, environmental impacts, and public acceptability. Managed retreat and the no action alternative would not meet the project's purpose and goals. Revetments and seawalls often provide the most reliable form of shoreline protection, but they do not increase beach width and can impede public access to the beach. Offshore structures, including groins, visible offshore breakwaters, and submerged reef are not considered feasible due to cost, public acceptance, and potential environmental impacts.

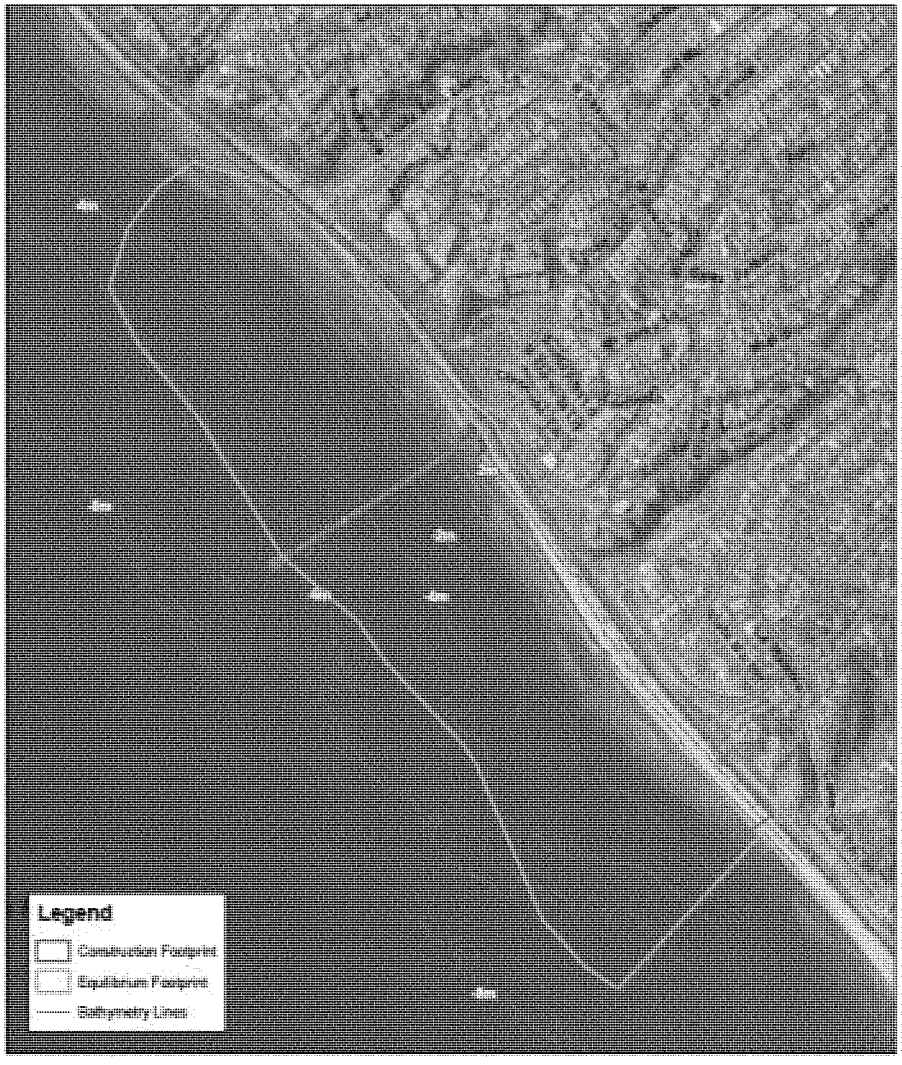
The draft EIR/EIS determined that beach fill is the only measure that met all of the Corps' environmental evaluation criteria.

Beach Fill

The beach fill alternative consists of dredging material offshore of the City of Oceanside, then hauling and placing it at San Clemente Beach. Beach fill will be 1,040 m (3,412 ft) long with a +5.2 m (+17 ft) crest elevation. The beach fill design parameters were determined by the Corps by considering various combinations of beach-fill widths and different replenishment cycles. These combinations [e.g., 15 m (50 ft) and 35 m (115 ft) beach width] are variations of the same alternative (i.e., beach fill). Although it is recognized that these two widths are variations of the same alternative, they are addressed by the Corps as two separate alternatives.

The 15 m (50 ft) beach width alternative would require about 192,000 m^3 (251,000 y^3) of beach compatible sand. At the time of construction, the actual immediate post-construction width would be about 23 m (76 ft) (Figure 2). It is expected that up to 8 m (26 ft) of dry beach width would be distributed from the foreshore to the profile during the equilibration process. This alternative is estimated to take 46 working days to complete.

Figure 2 – Plan View of 15 m (50 ft) Beach Width Alternative (Corps 2010)



The 35 m (115 ft) beach width alternative would require about 448,000 m^3 (586,000 y^3) of beach compatible sand. At the time of construction, the actual immediate post-construction width would be about 52 m (171 ft). It is expected that up to 17 m (56 ft) of dry beach width will be distributed from the foreshore to the profile during the equilibration process. This alternative is estimated to take 108 working days to complete.

Based on the Corps' evaluation of management measures and the comparison of the alternatives formulated for this study, the Corps' recommended plan is the 15 m (50 ft) beach width alternative.

Construction Method

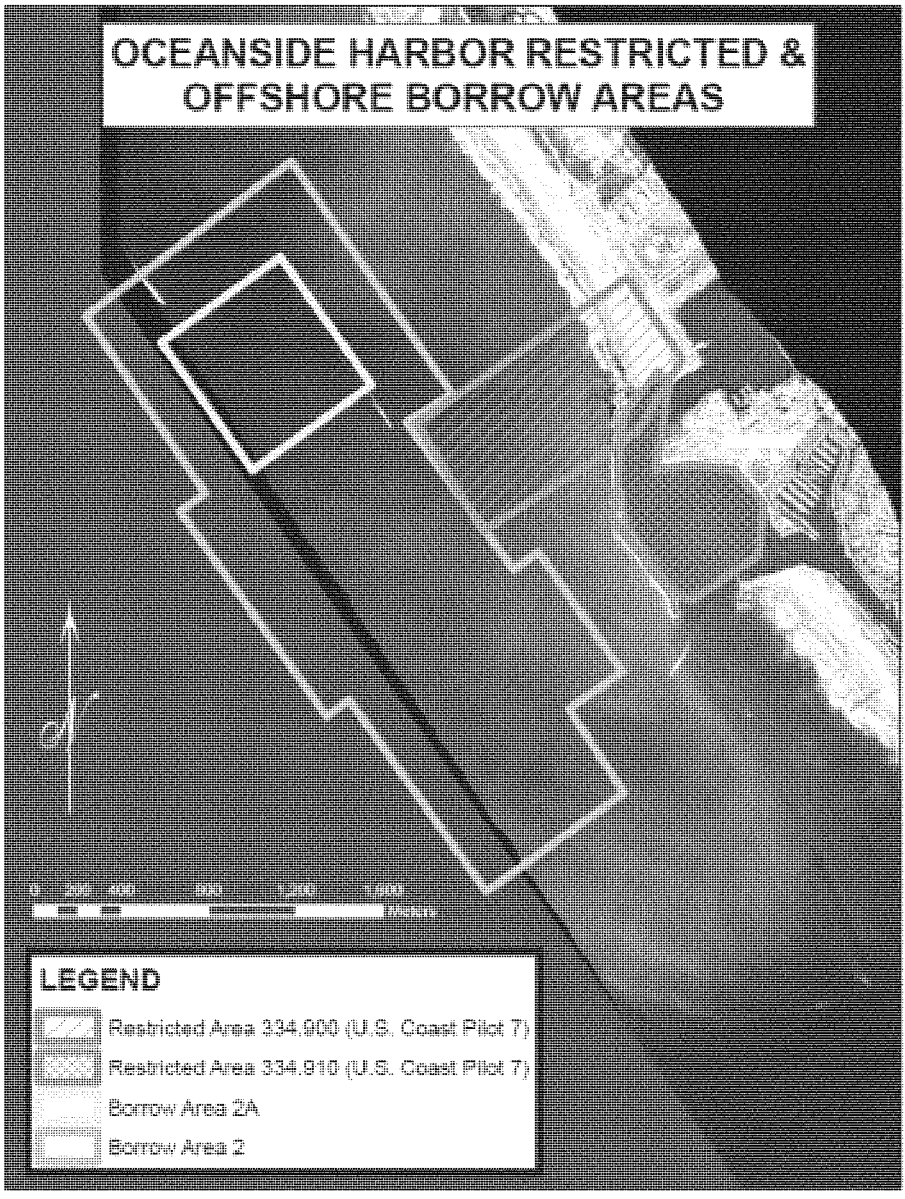
The project would be constructed with hopper dredging equipment with pump ashore capability and conventional earthmoving equipment. A medium-sized hopper dredge would be used, with effective capacity estimated at 1,300 m^3 (1,700 y^3) and 3.2 loads per day. The hopper dredge would pump out the dredge material via a 6-centimeter (cm) [24-inch (in)] pipe line at 1,376 m^3/hr (1,800 y^3/hr). The hopper dredge would be filled at the designated borrow site (i.e., Borrow Area 2 and 2a), which has beach compatible sand with approximately 10 percent fines and is about 1.6 km (1 mile) offshore of the City of Oceanside (Figure 3). The hopper dredge would then haul the dredged material about 35 km (21 mi) north to San Clemente. At the receiver beach, the dredge would be attached to a moored floating section of pipeline extending 457 m (1,500 ft) to the shoreline. The material would be re-suspended and discharged through the on-board pumping system to the receiver site.

The hopper dredge requires a mono buoy to discharge its sand onto the beach. A mono buoy is a floating pipeline connection platform that is moored to the seafloor, and it is used to interconnect with a steel sinker pipeline that carries the slurry along the seafloor to the beach. For this project, the mono buoy would be anchored in at least 7.6 m (25 ft) of water, between 762 to 1,524 m (2,500 and 5,000 ft) from shore and in the appropriate location in relation to sensitive resources and engineering considerations. From one mono buoy location, sand can be pumped directly onshore and up to about 610 m (2,000 ft) alongshore in either direction. Dredging would be performed 24 hours a day, 7 days a week. Shore equipment would work 12 hours a day, 6 days a week.

Onshore Placement Method

Sand would be combined with seawater until it reaches the consistency of slurry. It then would be conveyed to the beach either via pipeline or a combination of hopper dredge and pipeline, as described above. Existing sand at the receiver site would be used to build a small, "L"-shaped berm to anchor the sand placement operations. The short side of the "L" would be transverse (crosswise) to the shoreline and would be about 15 m (50 ft) long. The long side would be shore parallel at the seaward edge and would be about 61 m (200 ft) long. The berm construction may be adjusted from the design requirements during fill placement depending on actual field conditions. The crosswise side of the berm would be constructed to allow alongshore landward beach access for emergency access at all times.

Figure 3 - Offshore Borrow Areas (Corps 2010)

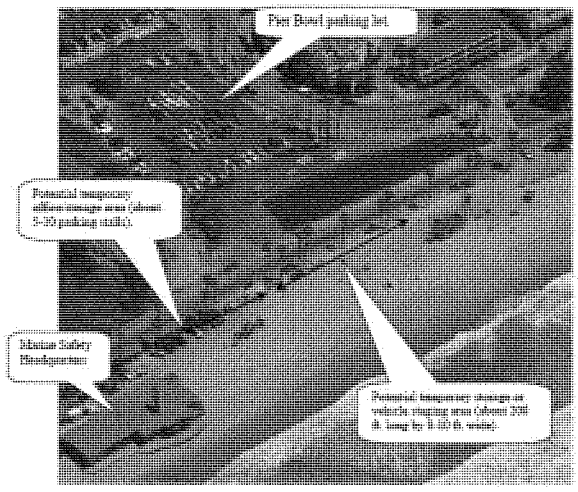


The slurry would be pumped onto the beach between this berm and toe. The berm reduces ocean water turbidity by allowing all the sand to settle inside the bermed area while the seawater is channeled along the berm until it reaches the open end where it drains into the ocean. Temporary dikes within the berm would allow sand to settle in designated areas. Once a 61 m (200 ft) section of berm is filled in with sand, another 61 m (200 ft) of berm would be created, the pipeline would be moved or extended on the dry beach only into the new berm area, and the process would begin again; the pipeline along the seafloor would not be moved. As the material is deposited behind the berm, the sand would be spread using two bulldozers and one front-end loader to direct the flow of the sand slurry and form a gradual slope to the existing beach elevation. The berm would be subject to the forces of the waves and weather once constructed and would eventually settle down to a natural grade for the beach.

Construction Access and Staging Areas

Beach access for the construction equipment and crew would be split between open space on the beach and a City-owned public parking lot (Figure 4) (Corps 2010). An open area exists along the beach immediately adjacent and north of the Pier and in the immediate vicinity of the Marine Safety Headquarters. It is expected this site would be used for the contractors' office trailer, parking area for heavy earthmoving equipment, and storage area for dredge pipe and other miscellaneous materials. This site is used extensively for access to the Marine Safety Headquarters and other municipal operations. The contractors' dredge and vessels would require offsite mooring and berthing space. The nearest suitable mooring area is Dana Point Harbor, a small craft harbor about 8 km (5 mi) north.

Figure 4 Beach Access and Staging Areas (Corps 2010)



Future Project Beach Profile Monitoring

Long-term shoreline erosion processes create damages through long-term profile translation landward and the increasing potential for wave-related damages. The landward advancing shoreline reduces the beach width available for storm damage protection, thereby increasing the probability of wave-related damages to facilities and structures. Long-term beach erosion also results in the gradual reduction of the beach surface area available for recreation. The peak erosion rate is –0.21 m/yr (–0.7 ft/yr); the maximum erosion rate is -0.46 m/yr (-1.5 ft/yr); and the maximum accretion rate is +0.38 m/yr (+1.24 ft/yr).

The purpose of this monitoring is to allow the timing and the detailed design of the periodic nourishment to be optimized. Changes in beach and seabed morphology would define the sediment transport patterns at the shoreline and ultimately the short-term and long-term beach erosion processes. Alongshore transects would be used to determine the effects, if any, of the proposed project on updrift and/or downdrift shorelines. The monitoring period would be for the 50-year period of Federal involvement. However, not all aspects of the monitoring plan would be conducted each year.

Estimates based on the SANDAG monitoring data suggest the San Clemente fill would erode on average at a rate of 3.9 m/yr (12.8 ft/yr). Beach fill erodes at substantially higher rates than the native beach. Due to the varying nature of the wave climate, sediment supply to the beach, and other factors driving long-shore sediment transport, it is expected that the beach would erode at a greater rate in some years, at a slower rate in some years, and possibly accrete in other years. Based on a 15-m (50-ft) wide beach and the 3.9 m/yr (12.8 ft/yr) erosion rate, it is anticipated that a fill would last about 6 years on average.

Maintenance nourishment efforts would occur when the shoreline reaches the 0 m/ft base beach width (i.e., about 11 m [35 ft]). Maintenance nourishment efforts would return the beach to the design beach width 15 m (50 ft) and would involve up to 192,000 m^3 (251,000 y^3) of material. Maintenance nourishment efforts also would be dependent upon available funding at the time of request.

DESCRIPTION OF BIOLOGICAL RESOURCES

Vegetation

The terrestrial land along the San Clemente shoreline and adjacent upland areas include residential and commercial development, a train railway, and some vegetation, which is composed primarily of ornamentals and a few patches of native vegetation. The sandy beach back bluffs are outside of the project area. The project study boundary does not include any of the terrestrial vegetation types east of the railroad tracks.

Marine Shoreline and Offshore Habitats

The predominant intertidal habitat along San Clemente's shoreline is sandy beach, although some rocky outcrops that extend from mid-beach to the low intertidal zone are present at

Mariposa Point, which is north of the Pier. Beyond the surf zone, the seafloor is a mosaic of sand and low-to-high relief patch reef. Some pinnacles of the reef are visible in the near-shore zone at low tide, while two prominent offshore pinnacles break the surface offshore of Mariposa Point and south of the Pier. Other reef habitats are located south of the Pier offshore of T-Street that extends west, and then north around the end of the Pier (Figure 5) (Corps 2010).

Rocky Intertidal

Although the predominant intertidal habitat along San Clemente's shoreline is sandy beach, an area of significant rocky intertidal is present at Mariposa Point, which is 975 m (3,200 ft) north of the Pier and about 488 m (1,600 ft) north of the northern end of the proposed beach fill site at Linda Lane. Boulders and rocky outcroppings in this area support a variety of algal species [Coastal Resources Management (CRM) 2000]. Boulders in the high intertidal area support filamentous green algae (*Enteromorpha* spp.). The mid-to-low intertidal algae composition is dominated by encrusting red algae (*Lithophyllum* spp., *Lithothamnion* spp.), encrusting brown algae (*Pseudolithoderma* spp.), and coralline algae (*Corallina* spp.). Green algae (*Enteromorpha* spp. and *Ulva* spp.) and several species of filamentous red algae also occur in these zones. Larger brown algae species colonize the base of the intertidal reef throughout the area, including palm kelp (*Eisenia aborea*) and feather boa kelp (*Egregia menziesii*).

Surfgrass (*Phyllospadix torreyi* and *P. Scouleri*) is present in the low intertidal beginning about 91 m (300 ft) offshore of the sand beach. Surfgrass serves as a nursery for California spiny lobster (*Panulirus interruptus*) and provides shelter for a variety of juvenile and adult fishes. Surfgrass is present throughout the low intertidal platform of Mariposa Point at a minimum of 0.9 m (3 ft) above the sand line with no more than 2.54 cm (1 in) of sand covering the surface of the rocks. Surfgrass blades in this area are 0.3 to 0.6 m (1 to 2 ft) in length.

A diverse mid-to-low intertidal invertebrate community is found on boulders as well as the surfaces of the low-lying platform reefs at Mariposa Point (CRM 2000). The most common sessile invertebrate in this area is the California mussel (*Mytilus caliornianus*), which occurs throughout the mid and low intertidal zones, forming masses on the sides and upper surfaces of the boulders and platform reefs. Other common to abundant invertebrates in this area include the solitary and colonial forms of the anemone (*Anthopleura aggregate*), limpets (*Collisella scabra*, *Tectura* spp., *Collisella digitalis*), chitons (*Mopalia muscosa* and *Nuttalina californica*), acorn barnacles (*Balanus glandula*), and snails (*Acanthina spirata*). Although not common, the reef-building sandcastle tubeworm (*Phragmatopoma californica*) was found around the base of several boulders in the mid-intertidal zone.

Figure 5 – Historic Kelp Canopy and Reef Map (Corps 2010)

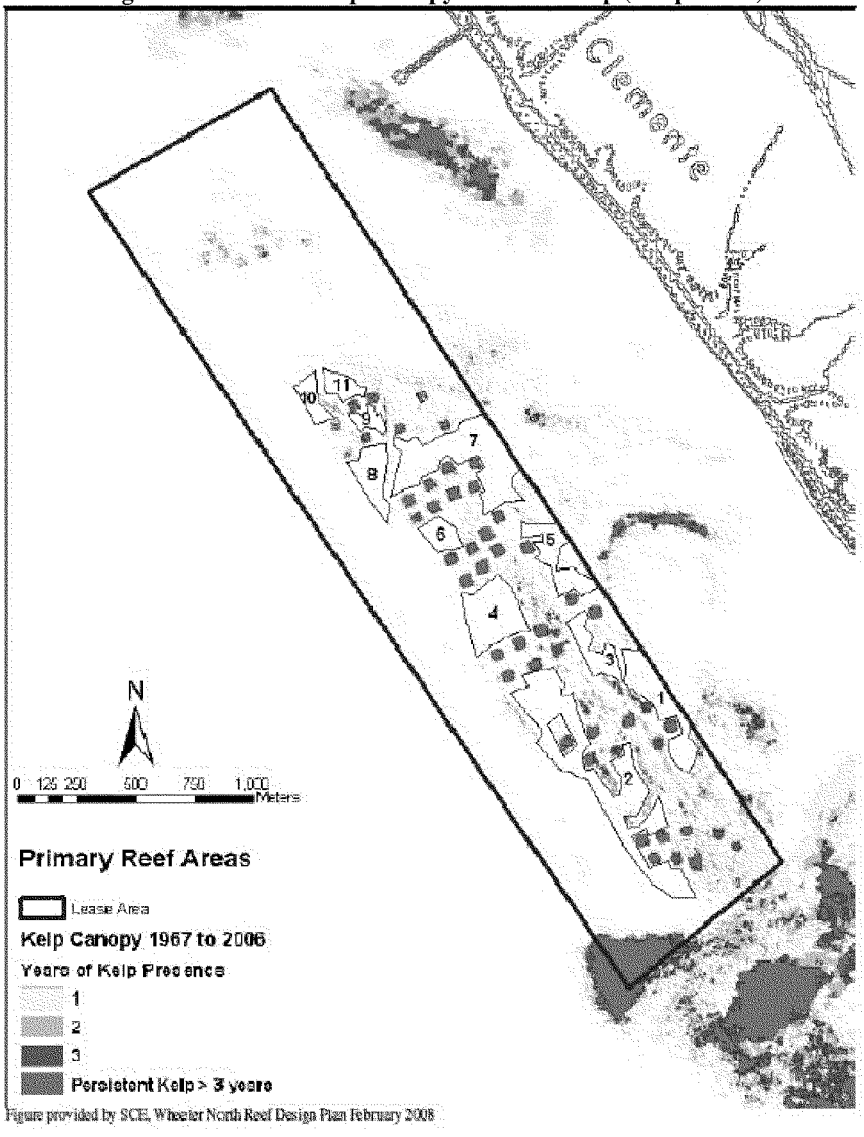


Figure provided by SCE, Wheeler North Reef Design Plan February 2008

Up to ten species of fish use the low-to-minus tidal zones of rocky intertidal habitats in the Southern California Bight (SCB) (MEC 2002). The wooly sculpin (*Clinocottus analis*) is one of the more commonly encountered fish species in tidepools, but juvenile opaleye (*Girella nigricans*), rockpool blenny (*Hypsoblennius gilberti*), spotted kelpfish (*Gibbonsia elegans*), and California clingfish *Gobiesox rhessodon*) may also be present (Cross and Allen 1993).

Sandy Intertidal

The shoreline at Mariposa Point consists of a riprap backshore environment that protects the railroad tracks. The rocky intertidal habitat lies seaward of this stretch of sandy beach. A stone revetment to the north and an access road to the south provide backing along the beach at Linda Lane, which is fronted by a steeply sloping sandy beach to the water line. There is also a rock riprap that protects the lifeguard headquarters from wave run-up in front of buildings along this section of the shoreline.

Sandy beaches in California are inhabited by an abundant invertebrate community that is an important food source for vertebrate predators, including shorebirds, seabirds, and fishes (Dugan et al. 2000). Intertidal invertebrates of sandy beaches show a characteristic zonation related to tidal exposure. The composition of the invertebrate community at a given beach, as well as the zonation, tends to be extremely dynamic due to the highly mobile nature of the sandy substrate and the resources on which these animals depend (Dugan and Hubbard 2006). Most exposed sandy beaches have two to three zones inhabited by distinct groups of mobile animals. These zones generally correspond to the relatively dry substrate of the upper intertidal zone at and above the drift line, the damp sand of the mid-intertidal zone, and the wet sand of the lower intertidal zone.

The lower intertidal zone (swash zone) in southern California sandy beaches is dominated by the filter feeding mole crab, *Emerita analoga*, which moves up and down the beach with the tides. The polychaete "bloodworm," *Euzonus*, also is common in the mid-to-lower intertidal. In the upper intertidal, drift kelp is an important source of food for many invertebrates. Common organisms associated with macrophyte wrack include beach hoppers (*Megalorchestia californiana*), kelp flies (*Coleopa vanduzeei*), isopods (*Alloniscus perconvexus* and *Tylos punctata*), and various species of beetles.

The sandy intertidal is also used by a near-shore fish, the California grunion (*Leuresthes tenuis*), which lays its eggs in the high intertidal zone between March and August. Grunions are known to spawn on the beach in the vicinity of the Pier (Corps 2010).

Subtidal Hardbottom

The shallow subtidal zone for much of the project area is a mixture of sand and boulders, with occasional outcrops of exposed shale bedrock (CRM 2000). Historically, offshore kelp beds, dominated by giant kelp (*Macrocystis pyrifera*) with an understory of feather boa kelp (*Egregia menziesii*) and palm kelp (*Eisenia arborea*), have been prevalent along this section of coastline.

The kelp canopy within the project area has fluctuated considerably over the last decade. During surveys in June 2000, CRM found low to moderate density kelp beds with little or no surface canopy 610 m (2,000 ft) off of Mariposa Point at depths between –7.0 and –8.5 m (-23 and -28 ft) MLLW. Another bed was observed 198 m (650 ft) off the Pier (T-Street) at a depth of 4.9 m (16 ft) in October 1999. This patch was not observed during the June 2000 survey (CRM 2000).

Much of the kelp observed in June 2000 was ragged and covered with fouling ectoprocts (*Bryozoa*); however, newly settled recruit plants were also present (CRM 2000). In March 2008, kelp canopy was sparse in the project area. In July 2009, a thick kelp bed was observed on the considerable reef formations offshore and south of the Pier. The kelp bed in 2009 corresponds generally with the historical kelp mapped previously (Figure 5).

The most extensive reef formations in the vicinity of the Pier are located off Mariposa Point, north of the project area. The shallow subtidal reefs off Mariposa Point have well-developed macrophyte growth, including dense stands of understory species of kelp and surfgrass (CRM 2000). These inshore reefs are about 90 to 210 m (300 to 700 ft) from the shoreline, and some of the rocks have several feet of vertical relief. Most, however, are sand inundated boulders less than 0.6 to 1 m (2 to 3 ft) in height. Surfgrass on these shallow, subtidal reefs grows a minimum of 0.3 m (1 ft) above the sand line and have blades up to 0.6 m (2 ft) long. The nearest high relief reef is located 610 m (2,000 ft) offshore of Mariposa Point (Washrock Reef) at depths between -7 and -8.4 m (-23 and -28 ft) MLLW. A 120 m by 60 m (400 ft by 200 ft) patch of giant kelp was observed inshore of the Washrock Reef just north of the Pier at a depth of 8 m (26 ft) in October 1999, which persisted at least through June 2000 (CRM 2000). The apex of Washrock Reef is dominated by mussels (*Mytilus californianus* and *M. edulis*).

Other characteristic reef organisms observed during the CRM June 2000 survey included gorgonians (*Muricea californica* and *M. fructicosa*), keyhole limpet (*Megathura crenulata*), purple and red sea urchin (*Strongylocentrotus purpuratus* and *S. franciscanus*), California sea cucumber (*Parastichopus californicus*), Kellet's whelk (*Kelletia kelletii*), and sea stars (*Pisaster brevispinus* and *P. giganteus*). Fishes observed included spotted sand bass (*Paralabrax maculofasciatus*), kelp bass (*P. clathratus*), seniorita (*Oxyjulis californicus*), bat ray (*Myliobatis californica*), and black perch (*Embiotica jacksoni*).

Other fishes that are commonly associated with near-shore reef habitats with developed stands of perennial vegetation above 1 m (3 ft) in height also would be expected to occur within the project area, which include barred sand bass (*P. nebulifer*); shiner, walleye, and dwarf surfperches (*Embiotocidae*); California sheephead (*Semicossyphus pulcher*); garibaldi (*Hypsypops rubicundus*); jack mackerel (*Trachurus symmetricus*); giant kelpfish (*Heterostichus rostratus*); painted greenling (*Oxylebius pictus*); and halfmoon (*Medialuna californiensis*) (MEC 2002, Thompson et al. 1993).

Offshore the northern end of the proposed beach fill site at Linda Lane, low relief boulders occur at depths greater than 2.7 m (9 ft) MLLW (CRM 2000). Boulders appear to be frequently scoured and are characterized by growth of red turf algae and crustose corallines. CRM observed surfgrass at this depth off the northern portion of the Linda Lane area, about 90 m (300

ft) from the shoreline. The surfgrass occurred on the upper surfaces of 0.3 m (1 ft) high boulders. Blades were approximately 0.6 to 0.9 m (2 to 3 ft) long.

Chambers Group surveyed for surfgrass in the project area in March of 2008 and July 2009 (Figure 6). Only scattered patches of surfgrass were observed offshore of the northern portion of the proposed sand placement area between the Pier and Linda Lane. South of the Pier, cobble and reef habitat occur offshore beginning at a depth of -1.2 to -1.5 m (-4 to -5 ft) MLLW and extending to at least -3.3 m (-11 ft) MLLW (CRM 2000). Surfgrass meadows are located approximately 90 m (300 ft) from the shoreline on T-Street Reef starting at a water depth of between -1.2 and -1.8 m (-4 and -6 ft) MLLW and extending offshore to a water depth of between -3.3 and -3.9 m (-11 and -13 ft) MLLW. The surfgrass grows on 0.3 to 0.6 m (1 to 2 ft) high boulders and has blades that are 0.6 to 0.9 m (2 to 3 ft) long. Farther offshore surfgrass cover declines. Surfgrass at the deeper depths (-3.3 m [-11 ft] MLLW) grows on 0.3 m (1 ft) high boulders inundated with sand. In some cases, two-thirds of the length of the surfgrass blades were covered with sand and only 0.3 m (1 ft) of the blades remained above the sand line.

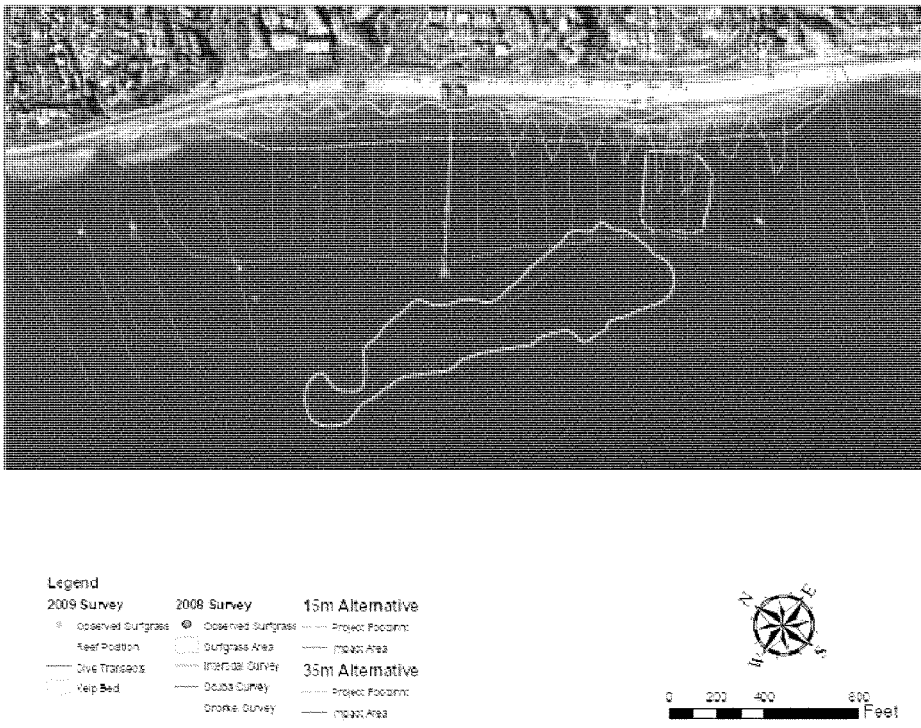
The subtidal reef habitat south of the Pier is extensive and angles around the tip of San Clemente Pier. Larger macrophytes observed on the reef include giant kelp, feather boa kelp (*Endarchne binghamiae*) and bladder chain kelp (*Cystoseira/Halidrys*) (CRM 2000). A small patch of giant kelp consisting of 12 plants was observed 197 m (650 ft) south of the Pier at a depth of 5 m (16 ft) in October 1999, but it was not observed in June 2000. Kelp canopy was observed on the entire reef in July 2009.

Subtidal Softbottom

Benthic invertebrate species typical of Southern California nearshore soft bottom habitats include polychaete worms (e.g., *Diopatra spp., Loimia medusa, Pista pacifica*), sand dollars (*Dendraster excentricus*), crabs (*Heterocrypta occidentalis, Portunis xantusii, Randallia ornata*), hermit crabs (*Pagurus spp., Pagurites spp.*), marine snails (*Nassarius fossatus, Olivella biplicata, Polinices spp.*), clams (*Ensis spp.*), armored sea stars (*Astropecten armatus*), tube anemones (*Harenactis attenuata, Zaolutus actius*), sea pens (*Stylatula elongata*), and sea pansies (*Renilla kollikeri*) (MEC 2002, Thompson et al., 1993).

Fish commonly found over shallow, sandy subtidal habitat [less than 9 m (30 ft)] in southern California include California halibut (*Paralichthys californicus*), speckled sanddabs (Citharichthys *stigmaeus*), barred surfperch (*Amphistichus argenteus*), white croaker (*Genyonemus lineatus*), bat ray (*Myliobatus californica*), and shovelnose guitarfish (*Rhinobatos productus*) (MEC 2002, SANDAG 2000). Northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), Pacific bonito (*Sarda chiliensis*), and topsmelt (*Athernops affinis*) are commonly encountered in the water column just beyond the surfzone (MEC 2002, SANDAG 2000).

Figure 6 – Surfgrass/Reef Survey and Sand Placement and Equilibrium Footprints (Corps 2010)



Borrow Site

The proposed borrow site offshore of the City of Oceanside (SO-9) was described by SANDAG (2000). The proposed borrow site consists of sand bottom habitat at between 14 and 18 m (45 and 60 ft) water depth. Fishes and invertebrates found in the vicinity of the Oceanside borrow site are typical of these depths on southern California offshore soft bottoms (SANDAG 2000). The most abundant invertebrate taxa identified for the Oceanside borrow site include several species of polychaete worms (*Diopatra* spp., *Euclymeninae* sp., *Melinna oculata, Metasychis disparidentatus, Paraprionospio pinnata, Petalodymene pacifica, Pista disjuncta, Spiophanes missionensis, Streblosoma* sp.) and the amphipod *Ampelisca cristata* (SANDAG 2000). Abundant fish species include longfin sanddab (*Citharichthys xanthostigma*), barred sand bass (*Paralabrax nebulifer*), California halibut, California lizardfish (*Synodus lucioceps*), and fantail sole (*Xystreurys liolepis*) (SANDAG 2000).

Wildlife

Wildlife detected within the majority of the project area includes species typically associated with sandy beach habitat that is highly disturbed due to heavy use as recreational beach. Shorebirds and seabirds are described below. Terrestrial wildlife that would be expected include American crows (*Corvus brachyrhynchos*), rock doves (*Columba livia*), and California ground squirrels (*Spermophilus beecheyi*). Although the project reach is within heavily-urbanized downtown San Clemente, there are some canyons, including Linda Lane, the canyon between Cazador Land and Trafalgar Lane/Esplanade, and the canyon just south of T-Street that would be expected to support urban adapted mammals, including coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), and opossum (*Didelphis virginiana*). These mammals may occasionally wander onto the beach at night or early morning in search of prey.

Birds

A variety of resident and migratory seabirds and shorebirds are commonly observed along southern California beaches and offshore waters. Seabirds, such as pelicans, terns, and cormorants, forage for fish in the nearshore ocean. Gulls and shorebirds use sandy upper tidal beaches as roosts. Gulls feed on fish and invertebrates, particularly near the edge of the kelp canopy. Shorebirds probe for invertebrates in the damp sands of the middle and low intertidal zones, and some species also forage for small fish and invertebrates in the rocky intertidal. Kelp and surfgrass that have washed ashore harbor invertebrates and provide good foraging areas for gulls and shorebirds.

The seabirds that are most commonly observed along the beaches and ocean waters offshore of Orange and San Diego counties include Heerman's gull (*Larus heermanni*), ring-billed gull (*L. delawarensis*), western gull (*L. occidentalis*), California brown pelican (*Pelecanus occidentalis californicus*), surf scoter (*Melinita perspicillata*), terns (*Sterna* spp.), grebes (Podicipedidae), double-crested (*Phalacrocorax auritus*), and pelagic (*P. pelagicus*) cormorants (Chambers Group 2002, MEC 2002).

A variety of shorebirds would be expected to use the beach in the vicinity of the Pier. Commonly observed species include the following shorebirds: marbled godwit (*Limosa fedoa*), sanderling (*Calidris alba*), whimbrel (*Numenius phaeopus*), willet (*Catoptrophorus semipalmatus*), black-bellied plover (*Pluvialis squatarola*), western sandpiper (*Calidris mauri*), and least sandpiper (*Calidris minutilla*) (McConnaughey and McConnaughey 1988, Chambers Group 2002, MEC 2002).

Marine Mammals

The marine mammals that occur in the Southern California Bight have been described in detail in previous studies and environmental documents (e.g., Bonnell et al. 1981, 1983; Bonnell and Dailey 1993; Dohl et al. 1981, 1983; ADL 1984; Barlow et al. 1995, 1997; Barlow and Gerrodette 1996; Koski et al. 1998; DeLong and Melin 2000; Stewart and Yochem 2000). As many as 36 species of marine mammals inhabit or visit the Southern California Bight, including 6 species of pinnipeds (seals and sea lions), 29 species of cetaceans (whales, porpoises, and dolphins), and the sea otter; however, only the California sea lion (*Zalophus californianus*), Harbor seal (*Phoca vitulina richardsi)*, Gray whale (*Eschrichtius robustus*), Bottlenose dolphin (*Tursiops truncates*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), and Common dolphin (*Delphinus* spp.) are expected to occur in the nearshore waters of the San Clemente study area on a regular basis.

Essential Fish Habitat

In accordance with the 1996 amendments to the Magnuson-Stevens Fishery Management and Conservation Act (16 U.S.C. 1801 *et seq.*), an assessment of Essential Fish Habitat (EFH) will be conducted for the proposed project. The project is located within an area designated as EFH for two Fishery Management Plans (FMPs): Coastal Pelagic Species Fishery Management Plan and Pacific Coast Groundfish Fishery Management Plan. Many of the 86 species federally managed under these plans are known or expected to occur in the area and could be affected by the proposed project. All of the five species managed under the Coastal Pelagic Species Fishery Management Plan are likely to occur in the project area. These pelagic species are northern anchovy, Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), jack mackerel, and market squid (*Loligo opalescens*). About 16 species managed under the Pacific Coast Groundfish Fishery Management Plan are likely to occur in the project area. These species include leopard shark *(Triakis semifasciata*), big skate *(Raja* binoculata), spiny dogfish *(Squalus acanthias),* cabezon *(Scorpaenichthys marmoratus),* four species of flatfish *(Pleuronichthys decurrens, Microstomus pacificus, Pleuronectes vetulis, Citharichthys sordidus),* and at least eight species of rockfish *(Sebastes chrysomelas, S. auriculatus, S. caurinus, S. rastrelliger, S. atrovirens, S. serranoides, S. serriceps* and *Scorpaena guttata).*

Special Status Listed Species

Sensitive terrestrial plants and animals are not expected to occur in the project area because of a lack of natural terrestrial habitat within the project footprint. Sensitive species with the potential

to occur on the beach in the project area or offshore in the vicinity of the borrow sites and/or the beach fill site are described below.

California Brown Pelican

The brown pelican (*Pelecanus occidentalis*), including the California brown pelican subspecies (*P. o. californicus*), was delisted by the Service from the Federal endangered species list on November 17, 2009 (74 FR 59443). The California brown pelican was delisted from the State endangered species list on June 3, 2009 [California Department of Fish and Game (CDFG) 2011a], but it is still designated as a Fully Protected Species under the Fish and Game Code (CDFG 2011a).

California Least Tern

The California least tern (*Sternula antillarum browni*, "least tern") was listed as endangered on October 13, 1970 (35 FR 16047), and State-listed as endangered on June 27, 1971 (CDFG 2011b). A recovery plan for the species was published in 1980 (Service 1980) and was revised in 1985 (Service 1985). Critical habitat was never designated. The breeding range of the least tern population includes specific localized breeding colonies occupied from about April to September each year. Colonies are usually in proximity to lagoons or estuary or river confluences with the ocean environs where they obtain most of the small fish they consume, although they may also forage up to 3.2 to 4.8 km (2 to 3 mi) from the beach in the near shore.

Large numbers of least terns breed on Marine Corps Base Camp Pendleton (MCBCP), 19 to 22 km (12 to 14 mi) south of the project area. In 2006, there were 1,423 nesting pairs of least terns at MCBCP (Marschalek 2007), with most (1,265) of these pairs documented at the mouth of the Santa Margarita River. The nearest colonies to the project area were at White Beach, about 22 km (14 mi) south of the proposed beach fill site where 137 pairs bred in 2006 and at Red Beach, about 19 km (12 mi) south of the project site where 21 pairs bred (Marschalek 2007). The Oceanside borrow site is within the foraging range of the Santa Margarita River colony. Least terns are known to use the near shore waters for foraging as they make their northbound and southbound migration treks. There are no known records of least terns using the Pier sandy beach habitat for nesting or for night roosts.

Western Snowy Plover

The coastal population of the western snowy plover (*Charadrius alexandrinus nivosus,* "snowy plover") was listed as threatened on March 5, 1993 (58 FR 12864). A recovery plan for this species was finalized in 2007 (Service 2007). Designation of critical habitat was published in the Federal Register on December 7, 1999 (64 FR 68507), and was last revised in 2005 (Service 2005). This population is defined as those individuals that nest adjacent to tidal waters and includes all nesting birds on the mainland coast, peninsulas, offshore islands, adjacent bays, estuaries, and coastal rivers. The breeding range extends along the Pacific coast of North America from southern Washington to southern Baja California, Mexico. The winter range is

somewhat broader and may extend to Central America (Page et al. 1995); however, most snowy plovers winter south of California.

The nesting habitat of the coastal population is mainly dune-backed beaches, barrier beaches, salt flats, and salt evaporation ponds. Habitat of wintering birds includes beaches where nesting is not known to occur. In the U.S., over 150 currently used or historical nesting and/or wintering areas have been identified, most of which (about 85 percent) are in California (Corps 2010).

Although it is possible that snowy plovers intermittently use the beaches within the project area during the winter months and during migration, the project area has not been documented as an important wintering area nor have snowy plovers been documented to nest within the project area, which consists of beaches subjected to a high degree of human use. San Onofre Beach, about 8 km (5 mi) south of the proposed project area, in northern San Diego County, has been designated as critical habitat for the snowy plover (Service 2005). Snowy plovers have nested along less than 15 km (9.3 mi) of coastline on MCBCP, including the southernmost portions of Gold Beach, near the marsh area of Red Beach, around protected least tern sites at the mouth of Aliso Creek at White Beach, along most of Section F or Cockleburr Beach, and in the Santa Margarita River Estuary at Blue Beach and generally along open beach areas in between (Forster 2010).

Marine Mammals

Two species of federally threatened pinnipeds, Guadalupe fur seal (*Arctocephalus townsendi*) and the Stellar sea lion (*Eumetopias jubatus*), and six species of federally endangered whales, blue whale (*Balaenoptera musculus*), sei whale (*B. borealis*), fin whale (*B. physalus*), humpback whale (*Megaptera novaeangliae*), northern right whale (*Blaena glacialis*), and sperm whale (*Physeter macrocephalus*), potentially occur in the nearshore waters off San Clemente and Oceanside. These species potentially could occur in project area waters; however, their presence is considered highly unlikely and is not expected.

IMPACTS OF THE PROPOSED PROJECT ON BIOLOGICAL RESOURCES

Implementation of the proposed initial and subsequent beach replenishment efforts are expected to result in direct, indirect, and cumulative effects to biological resources during dredging, staging of equipment offshore of the beach replenishment sites, and placement of sand on the replenishment sites. These effects are expected to include direct mortality to biological resources, especially benthic invertebrates. Indirect effects could also occur from increased turbidity, night lighting, and migration of sand from the replenishment sites onto reef and surfgrass areas. Cumulative effects could be experienced over the course of the proposed project through the repetitive replenishment of the beach areas.

Bottlenose dolphins are the marine mammal most likely to occur within the project area. However, it is assumed that these and other marine mammals will avoid the project area since they have a much wider foraging area than will be impacted by the project.

Impacts to Birds and Benthic Invertebrates [15 m (50 ft) Beach Width]

Dredging operations will impact approximately 37 ha (91 ac) at Borrow Area 2 [including 3.7 ha (9.1 ac) at Borrow Area 2A) over the 50-year life of the project (Figure 3). Dredging operations at the borrow site will result in the mortality of any benthic invertebrates present. This will cause a temporary reduction in the localized prey base for fishes that feed on benthic invertebrates within the immediate borrow site. It is assumed that the benthic community will be able to recover within between 6 months and 2 years [California State Lands Commission (CSLC) 2001].

Beach fill operations will also impact the invertebrates present in the sandy intertidal areas. This loss of prey base could affect shorebirds that forage in the intertidal area. It is anticipated that shorebirds will avoid the project area. Additionally, the loss of prey base is considered to be temporary since the sandy intertidal invertebrate community has been observed to recover from sand burial within a few months (Burlas et al. 2001, Parr and Lacy 1978).

Dredging and beach fill operations generate turbidity plumes, which could impact invertebrates and fish and could hinder sight-feeding birds, such as the brown pelican, from capturing their fish prey. Turbidity may also affect the light regime, which may impact the surfgrass and kelp habitat. The size and extent of the turbidity plumes that could be created is unknown. Therefore, the level of impact from the turbidity plumes on in-water flora and fauna and to sight-feeding birds is unknown. The high sand content of the dredged material is expected to limit the extent of turbidity plumes from both the dredging and beach fill operations. For the dredging operations, the use of a hopper dredge and site depth is also expected to limit the amount of turbidity underwater and at the water surface. For the beach fill operations, placement of sediments behind a berm is expected to confine turbidity plumes to primarily the naturally turbid surf zone and associated rip currents. In addition, it is anticipated that shorebirds will avoid the immediate areas where people and equipment are constructing the beach.

The greater amount of sand on San Clemente beach following beach nourishment may have a beneficial effect on marine birds by increasing resting habitat. A beach nourishment project in Encinitas performed by the SANDAG appeared to have a positive effect on bird use of the receiver beaches (SAIC 2005). Prior to beach nourishment, few birds were observed on beaches with extensive cobble cover or shallow sand depths in the upper and middle intertidal zones. Following beach nourishment, the total number of bird species and bird abundance increased on receiver sites and was higher than on non-receiver sites. The increase in bird use at the sand placement sites following beach nourishment was thought to be a result of the greater beach widths created by the beach nourishment project.

The project is not anticipated to impact the least tern or the snowy plover. The project is scheduled to occur completely outside of the least tern breeding season (April 1 – September 15), and snowy plovers have not been documented (either none were detected or surveys were not conducted) to nest or winter within the project area (Service 2011a, b), which consists of beaches subjected to a high degree of human use.

Impacts to Sensitive Habitats [15 m (50 ft) Beach Width]

Sensitive habitats, including kelp beds, surfgrass, and rocky intertidal areas may be impacted by sand placement, anchors for the mono buoy (where the hopper dredge will moor while it discharges sand to the beach), and the placement of the sinker pipeline that will pump sediment to shore from the hopper dredge. Impacts from these activities could include crushing organisms, burial of organisms, and scraping surfgrass, algae, or attached invertebrates.

Surfgrass and giant kelp are considered to be particularly valuable marine habitats because they provide shelter for fishes and invertebrates and attachment sites for sessile invertebrates and form the basis of many marine food chains, both as living material and detritus. Surfgrass and giant kelp beds occur in limited areas along the southern California coast, usually on hard bottom substrate, compared to much more common soft bottom habitat.

The sand placement footprint does not include any kelp beds, surfgrass, or rocky intertidal areas (Figure 6). Pre-construction surveys will be conducted to identify anchor and pipeline locations to avoid sensitive resources. Most of the surfgrass grows on T-Street Reef, so it is possible to avoid this reef when laying the pipeline. To avoid impacts to reefs that support kelp and other sensitive species, such as gorgonians and surfgrass, the hopper dredge will moor inshore of these reefs, which are located about 300 to 400 m (1,000 to 1,300 ft) from the beach. In addition, the sand placement footprint does not include any sensitive habitats. Therefore, it is anticipated that direct impacts to sensitive habitats will be avoided.

After initial placement, the sand may move upcoast, downcoast, or offshore, depending on the magnitude, direction, and period of waves, and eventually establish an equilibrium footprint in which cross shore sand movement is expected to occur (Figure 6). Monitoring of the SANDAG beach fill project at Oceanside showed a net sand movement to the south, although some northerly movement occurred during summer months (due to south swells). The beach in San Clemente is more south facing than Oceanside and therefore could be subject to more northerly movement during summer months. The sand is expected to move out of the equilibrium footprint within 6 years.

The nearest significant rocky intertidal area to project area is at Mariposa Point, about 485 m (1,600 ft) north of the northern end of the beach fill site at Linda Lane. According to the predicted equilibrium footprint, sand is not expected to extend as far north as Mariposa Point.

The predicted equilibrium footprint suggests that most of the sediment accumulation will occur in the inshore area to about 259 m (850 ft) from the shoreline (Figure 6). Surfgrass in this area grows on 0.3 to 0.6 m (1 to 2 ft) boulders and has average blade lengths of 0.6 to 0.9 m (2 to 3 ft). Burial of surfgrass and reef on the outer portions of T-Street reef is expected to be minimal. Therefore, the equilibrium footprint is expected to result in a range of impacts between no burial of surfgrass on the larger rocks and partial burial on the smaller boulders.

The roots and rhizomes of surfgrass are normally exposed (Craig et al. 2008), and the degree of sand burial surfgrass can withstand is not well documented (SANDAG 2000). Studies have

demonstrated that short-term burial of surfgrass results in shoot mortality, decreased shoot counts, and reduced growth (Craig et al. 2008). CRM (2000) observed surfgrass in the deepest portion of T-Street Reef with two-thirds of its blades covered with sand, which suggests surfgrass can withstand temporary burial of up to two-thirds of its blade length. However, surfgrasses have late successional traits, and experiments have demonstrated that the recovery of surfgrass after disturbance was slow and variable (Craig et al. 2008, Turner 1985).

Surfgrass appears to be an important habitat for near-shore fishes, and studies demonstrate that surfgrass loss from disturbance has negative effects on recruitment (Galst and Anderson 2008). Galst and Anderson (2008) experimentally disturbed reefs by removing surfgrass, which resulted in significant decreases in the density of fish recruitment. This loss of fish density may reduce the available prey base for shorebirds.

Re-nourishment [15 m (50 ft) Beach Width]

Impacts to marine organisms from re-nourishment, about every 6 years, will be expected to be similar to those of initial beach construction. Each re-nourishment event will involve about 192,000 m^3 for an estimated eight re-nourishment cycles over the project life.

Rocky Reef/Surfgrass Monitoring, Mitigation, and Reporting Plan (as proposed by the Corps)

Rocky Reef/Surfgrass Habitat

This appendix outlines 1) a pre- and post-construction monitoring program for rocky reef/surfgrass habitat in the San Clemente Pier area (Reach 6) to determine if project mitigation would be necessary; 2) a preliminary mitigation implementation plan, if mitigation is determined to be necessary; and 3) a preliminary mitigation monitoring plan, if mitigation is determined to be necessary. The final monitoring plan will be prepared during the pre-construction engineering design (PED) phase of the project. The details of these plans will be finalized in conference with knowledgeable, experienced, and qualified marine ecologists. The monitoring shall be performed by knowledgeable, experienced, and qualified marine biologists. These knowledgeable, experienced, and qualified marine ecologists may come from a variety of various agencies, organizations, institutions, or community centers of practice and expertise, such as academia - University of California, Corps Engineer Research and Development Center (ERDC), NOAA National Marine Fisheries Southwest Fisheries Sciences Center, U.S. Geological Survey (USGS) Western Ecological Research Center, other federal and state agencies, as well as consulting marine ecologists. CDFG, FWS, and NMFS regulatory resources agency staff will also be involved with the review process.

Pre- and Post-Construction Monitoring Plan

The Proposed Project has been designed to avoid or minimize impacts to sensitive biological resources to the maximum extent practicable. Currently, potential project impacts have been identified using a conservative coastal engineering model. The nature of the coastal engineering

model has uncertainties due to multiple variables within the natural environment. Impacts to rocky reef and surfgrass reef are expected to be none to very minor, but currently are unknown. A post-construction monitoring strategy has been developed to determine if the project results in permanent loss of either rocky reef and/or surf grass. Based on the model, it is estimated that in a worst case scenario about 20 percent of the reef or 0.4 ha (1 ac) may be impacted by the beach fill. For the purpose of costing, it is assumed that 0.4 ha (1 ac) of surfgrass and an additional 0.4 ha (1 ac) of reef without surfgrass could be impacted and require compensatory mitigation.

Mitigation would be triggered only if certain conditions occur during, and persist through, the two year post-construction monitoring period, as there may be transitory effects and subsequent recovery that would not be apparent in a shorter period of time. Persist means that observed sand burial of reef and/or loss of surfgrass continues to be significantly different on T-street reef compared to controls in all monitoring periods after the initial observed effect. During the two year post-construction monitoring, the reference site will be monitored to assess the natural variation, if possible, in rocky reef and surfgrass reef. Other published and unpublished literature will also be used in this analysis.

The following criterion is suggested as a potential trigger for implementing the potential mitigation.

- A persistent decrease in surfgrass cover or surfgrass density and an increase in sand cover and/or depth that is statistically significantly different than the controls and the baseline at the 0.05 confidence level (i.e., p-value = 0.05).

Actual triggers would be determined in coordination with knowledgeable, experienced, and qualified marine biologists and specific resource agencies prior to initiation of post-construction monitoring activities. These knowledgeable, experienced, and qualified marine ecologists may come from a variety of various agencies, organizations, institutions, or community centers of practice and expertise, such as academia - University of California, Corps Engineer Research and Development Center (ERDC), NOAA National Marine Fisheries Southwest Fisheries Sciences Center, USGS Western Ecological Research Center, other federal and state agencies, as well as consulting marine ecologists. CDFG, FWS, and NMFS regulatory resources agency staff will also be involved with the review process.

Proposed Pre- and Post-Construction Monitoring Activities

Prior to the implementation of the monitoring program, the extent of reef habitat throughout the entire predicted equilibrium footprint for the project will be mapped using side scan sonar or another appropriate method. This information will be used in the Monitoring Plan to establish transect lines.

Transects shall be established in the rocky reef area containing the surfgrass bed on T-Street reef (Project area) and in a control area of similar depth upcoast of the beach fill near Mariposa Point. Mariposa Point is considered an appropriate control because 1) it is close to the Project area and thus subjected to a similar wave climate, 2) supports surfgrass at a range of depths similar to T-Street reef, and 3) is upcoast of the beach fill out of the path of littoral drift, which is strongly

downcoast in the San Clemente area. The transects shall be permanent transects with repeated use during all monitoring stages. Transects should cover, at a minimum, the inshore portion, middle, and offshore portion of the reef. The same number of transects should be established in the control area as in the T-Street reef area, and the transects should be at similar depths. On each transect, the following parameters should be monitored at a minimum: 1) surfgrass density (i.e., number of shoots per square meter), 2) percent cover of surfgrass, sand, and rock, and 3) sand depth. The line intercept method is recommended for measuring percent cover and sand depth.

Transects should be monitored at the following intervals:

Pre-project monitoring (two years previous to beach nourishment):

- Twice within winter/spring
- Twice within summer/fall

Pre-project baseline monitoring (one year previous to beach nourishment):

- within one month prior to start
- 3 months prior to start
- 6 months prior to start
- 1 year prior to start

Post-construction:

Year One

- within one month after completion
- 3 months after completion
- 6 months after completion
- 1 year after completion

Year Two

- Twice within winter/spring
- Twice within summer/fall

Biological resources within the project area identified as potentially being impacted include surfgrass patches and rocky reef habitat at T-Street. Because a survey was not conducted to delineate the T-street reef, the general area of the T-street reef was based on the outer extent of mapped surfgrass locations [approximately 2 ha (5 ac)]. Actual delineation of the T-street reef will need to be identified prior to the pre-construction survey. This survey would use side scan sonar or another appropriate methodology to delineate T-street reef and other reef habitat within the potential equilibrium footprint of the sand placement. Potential project impacts to these resources were based on modeling that indicates sand movement may extend to the offshore/outer edge of the reef; however, sand at the offshore/outer edge of the reef would be thin and not significant. Potential burial of the inshore edge of T-Street reef is uncertain; however, in a reasonable worst case scenario, approximately 20 percent of the inshore edge of the T-Street reef area [about 0.4 ha (1 ac)] may be buried. These knowledgeable, experienced,

and qualified marine ecologists may come from a variety of various agencies, organizations, institutions, or community centers of practice and expertise, such as academia - University of California, Corps Engineer Research and Development Center (ERDC), NOAA National Marine Fisheries Southwest Fisheries Sciences Center, USGS Western Ecological Research Center, other federal and state agencies, as well as consulting marine ecologists. CDFG, FWS, and NMFS regulatory resources agency staff will also be involved with the review process. If significant impacts to these biological resources are observed, renourishment events would be modified to avoid or minimize impacts to the extent practicable and project mitigation would be implemented.

Pre- and Post-Construction Monitoring Costs

Pre-construction Monitoring
This cost assumes that permanent transects will be established. One day is allotted to install the markers and up to four days to conduct the survey at both the reference site and T-street reef, taking into consideration the wave environment in the project area and assuming three transects. This survey is assumed to occur within one year prior to construction activities.

a. Side-scan sonar survey	$200,000
b. Pre-construction Monitoring: (two years prior to beach nourishment):	
o Twice within winter/spring; Twice within summer/fall:	$131,000
c. Pre-construction Baseline Monitoring: (one year prior to beach nourishment):	
o 4 events (one month, 3 months, 6 months, 1 year)	$120,000
d. Pre-construction Report (2 years prior and 1 year prior)	$ 10,000
Subtotal	***$461,000***

Post-Construction Monitoring
This cost assumes that permanent transects will be established. One day is allotted to find or re-install the markers and up to four days to conduct the survey at both the reference site and T-street reef, assuming three transects.

a. Year One	
o 4 events (one month, 3 months, 6 months, 1 year):	$120,000
b. Year Two	
o Twice within winter/spring; Twice within summer/fall:	$ 131,000
c. Post-construction Report (Years One and Two)	$ 10,000
Subtotal	***$261,000***

Renourishment Pre- and Post-Construction Surveys

A standardized and consistent survey protocol will be developed during the PED phase for future beach renourishment cycles. The information collected from monitoring during the initial

nourishment event will provide baseline information to compare future beach conditions. Because baseline information will be readily available for the Project site, the survey protocol for renourishment activities will focus on a single pre- and post-construction survey rather than the monitoring period proposed for initial nourishment activities.

Project Mitigation

If mitigation were required based on results of the post-construction monitoring, rocky reef and surfgrass mitigation shall each be conducted at an equivalent functional value to the impacted area. Because it will take at least two years to identify impacts, some temporal loss of surfgrass, if impacts were to occur, is unavoidable. Recovery of impacted resources will also occur as sand is redistributed within the littoral cell. Additionally, if impacts were to occur, future beach fills would be modified to avoid future impacts; any observed burial of reef or surfgrass would be temporary because sand would be expected to move out of the project area.

Reef habitat mitigation shall be constructed at an equivalent functional value of shallow and deep water reef proportional to the area of surfgrass on reef impacted. The area of surfgrass loss will be mitigated with an equal area of shallow water reef; the area of reef without surfgrass will be mitigated as deep water reef. Shallow water reef would be constructed on the offshore/outer edge of the existing reef; deep water reef would be constructed at approximately 9.1-m (30-ft) water depth. Shallow water reef shall be constructed with a final top elevation of -3.1 to -4.3 m (-10 to -14 ft) Mean Lower Low Water. Construction of a reef that is shallower than the outer edge of T-Street reef is not proposed because construction methods would not be practical (e.g., a barge with the reef construction materials would not be able to operate in very shallow water). Construction of a very shallow reef would need to be constructed by building a temporary road from shore; such a road would have significant impacts. Although the surfgrass mitigation reef would be deeper than the impact area, if surfgrass transplants are successful, the slightly deeper reef would replace the lost surfgrass resource. Deep water reef shall be constructed similar to the Southern California Edison Reefs constructed as mitigation for the impacts of the San Onofre Nuclear Power Plant. For example, if the monitoring shows 0.4 ha (1 ac) of reef impact and 0.4 ha (1 ac) of surfgrass impact, 0.4 ha (1 ac) of shallow water reef would be constructed and 0.4 ha (1 ac) of deep water reef. Mitigation would be implemented in the Project area at sites to be determined in coordination with knowledgeable, experienced, and qualified marine biologists. These knowledgeable, experienced, and qualified marine ecologists may come from a variety of various agencies, organizations, institutions, or community centers of practice and expertise, such as academia - University of California, Corps Engineer Research and Development Center (ERDC), NOAA National Marine Fisheries Southwest Fisheries Sciences Center, USGS Western Ecological Research Center, other federal and state agencies, as well as consulting marine ecologists. CDFG, FWS, and NMFS regulatory resources agency staff will also be involved with the review process.

Although several studies currently are being conducted to determine how to successfully transplant surfgrass and may show potential for success, success rates to date have not been consistent. Due to the absence of an established, successful method for mitigation of loss of surfgrass itself, proposed mitigation currently is focused upon restoration of the rocky reef that

surfgrass currently uses as habitat. However, as previously described, if it is determined that surfgrass has been affected by the Project and a change is shown not to be due to natural variation, an experimental surfgrass transplant shall be implemented in addition to the construction of a shallow rocky reef. Currently, surfgrass transplant success is much higher for subtidal than for intertidal conditions and, therefore, surfgrass mitigation efforts for this project will focus on subtidal transplants only. The methodology for the surfgrass transplant shall be the transplant of sprigs from a donor bed to the new reef using the method developed by Bull et al. (2004). The contractor may propose an alternative transplant method, if evidence can be presented that the alternative method has as great or greater chance of success as the sprig transplant method. To avoid harvesting effects to the subject surfgrass bed, donor material will be taken from a larger area of surfgrass.

A fraction of the shallow water reef shall be test planted with surfgrass. The transplant will be conducted in the late summer/early fall, the time of year when most surfgrass seeds are released and germinate in southern California.
An area equal to approximately 25 percent of the surfgrass impact area [not to exceed 0.04 ha (0.1 ac)] will be test planted. Success of the transplant shall be determined after six months based on survivorship, percentage change in the number of leaves and the amount of areal coverage. The experimental transplant will be considered successful if the sprigs survive and there is a net increase in number of leaves and aerial coverage. Experimental surfgrass transects have shown that if the transplant is not successful, the transplants die and the reef is bare. If the transplants survive, surfgrass grows. If the test transplant is successful, the remainder of the surfgrass impact area will be planted on the shallow water reef with surfgrass. If the test transplant is unsuccessful, mitigation will be conducted out of kind using kelp transplant on the deep water reef at an equivalent functional value; one acre, in the case of the costed scenario.

Project Mitigation Monitoring Plan

Similar to the Post-Construction Monitoring Plan, transects shall be established in the rocky reef area containing the surfgrass bed on the mitigation reef (if the experimental surfgrass transplant is successful) and in a reference site (control area) of similar depth upcoast near Mariposa Point. The transects shall be permanent transects. The same number of transects should be established in the control area as in the mitigation areas and transects should be at similar depths. On each surfgrass transect, the following parameters should be monitored at a minimum: 1) surfgrass density (i.e., number of shoots per square meter), 2) percent cover of surfgrass, sand, and rock, 3) sand depth, and 4) identification and quantity of flora and fauna. The line intercept method is recommended for measuring percent cover and sand depth.

Transects should be monitored at the following intervals, if successful:

***Post-mitigation implementation*:**

Year One
- within one month after completion
- 3 months after completion
- 6 months after completion
- 1 year after completion

Years Two through Five
- Once within winter/spring
- Once within summer/fall

Success Criteria

Success criteria of surfgrass would include determining if measured parameters are significantly different than the reference transects. Success criteria for the mitigation reef itself would include no complete permanent burial of the reef. Because of the predominantly sandy bottom environment in the project area, placement of the deep water rocky reef would be considered successful if a characteristic invertebrate and fish community were to become established. On each surfgrass transect, the following parameters should be monitored and evaluated at a minimum: 1) surfgrass density (i.e., number of shoots per square meter), 2) percent cover of surfgrass, sand, and rock, 3) sand depth, and 4) identification and quantity of flora and fauna. The line intercept method is recommended for measuring percent cover and sand depth. Specific success criteria will be developed during the Preconstruction, Engineering and Design (PED) phase. General success criteria will consist of the following:

1. Approximately 50% - 60% of the fish, invertebrates, and algae found at the reference site occur at the mitigation site two years post-mitigation.
2. Approximately 50% - 60% of surfgrass survival at the mitigation site two years post-mitigation implementation.

Project Mitigation Monitoring Costs

Reef Construction and Transplant Costs

Costs for reef construction and transplant costs would be based on actual impacts. The estimated costs for 0.4 ha (1 ac) of shallow surfgrass reef and 0.4 ha (1 ac) of deep water reef are provided below for reference. This scenario assumes successful test transplant operations. If test transplant operations are not successful, then compensatory mitigation would be triggered.

Shallow water reef design and construction (1 acre)	$2 million
Deep water reef construction (1 acre)	$500,000

Surfgrass transplant (1 acre)	
Test (0.1 acre)	$25,000
Mitigation – if Test successful (0.9 acre)	*$225,000*
Subtotal (***test successful***)	***$2,750,000***
Deep water reef construction (1 acre)	$500,000
Surfgrass transplant (1 acre)	
Test (0.1 acre)	$25,000
Subtotal (***test not successful***)	***$525,000***

Project Mitigation Monitoring Activities

a. Year One	$120,000
○ after implementation - 4 events (one month, 3 months, 6 months, 1 year)	
b. Year Two	$65,500
○ 2 events (once within winter/spring; once within summer/fall)	
c. Annual Report Years One and Two	$5,000
Subtotal (*test successful*)	***$190,500***

Compensatory Mitigation

If the surfgrass test planting is not successful, then out-of-kind and potentially off-site compensatory mitigation that has an equivalent functional value to the area of surfgrass on reef impacted is to occur via kelp planting on the deep water reef constructed during the previous project mitigation. Using the example of 0.4 ha (1 ac) of reef impacts and 0.4 ha (1 ac) of surfgrass impacts, if the surfgrass transplant is not successful, 0.4 ha (1 ac) of kelp will be planted on the 0.4 ha (1 ac) of deep water reef built during the project mitigation. All mitigation for kelp shall be monitored for 5 years.

Compensatory Mitigation Monitoring Plan

Similar to the Post-Construction Monitoring Plan, transects shall be established in the rocky reef area containing the kelp bed on the deep water mitigation reef (if the surfgrass transplant is unsuccessful) and in a reference site (control area) of similar depth upcoast near Mariposa Point. The transects shall be permanent transects. The same number of transects should be established in the control area as in the mitigation areas and transects should be at similar depths. On each kelp transect, the following parameters should be monitored at a minimum: 1) kelp density (number of kelp plants per square meter) of each age class, 2) holdfast diameter of each adult kelp plant on the transect, 3) number of stipes of each adult kelp plant on the transect and 4) identification and quantity of associated flora and fauna.

Transects should be monitored at the following intervals:

***Post-compensatory mitigation implementation*:**

Year One
- within one month after completion
- 3 months after completion
- 6 months after completion
- 1 year after completion

Years Two through Five
- Once within winter/spring
- Once within summer/fall

Success Criteria

Success criteria of kelp would include determining if the measured parameters are significantly different than the reference transects. Success criteria for the mitigation reef itself (if it is not planted with kelp) would include no complete permanent burial of the reef. Because of the predominantly sandy bottom environment in the project area, placement of the deep water rocky reef would be considered successful if a characteristic invertebrate and fish community were to become established. On each kelp transect, the following parameters should be monitored and evaluated at a minimum: 1) kelp density (number of kelp plants per square meter) of each age class, 2) holdfast diameter of each adult kelp plant on the transect, 3) number of stipes of each adult kelp plant on the transect and 4) identification and quantity of associated flora and fauna. Specific success criteria will be developed during the Preconstruction, Engineering and Design (PED) phase. General success criteria will consist of the following:

1. Approximately 50% - 60% of the fish, invertebrates, and algae found at the reference site occur at the mitigation site two years post-mitigation.
2. Approximately 50% - 60% of kelp survival at the mitigation site two years post-mitigation implementation.

Compensatory Mitigation Installation/Implementation Costs

Kelp Transplant Costs

Costs for transplant costs would be based on actual impacts. The costs of reef construction are included above in Project Mitigation for the surfgrass mitigation. This assumes the shallow water reef and deep water reef that were constructed during the Project Mitigation will not be removed; the costs for the compensatory mitigation would be in addition to the Project Mitigation costs above. The estimated costs for a one acre kelp transplant are provided below for reference. This scenario assumes unsuccessful test surfgrass transplant operations.

Kelp Transplant [0.4 ha (1 ac)]	$50,000
Subtotal (*test unsuccessful*)	***$50,000***

Compensatory Mitigation Monitoring Activities (Only if test transplant is unsuccessful and deep water rocky reef is constructed)

a. Year One o after implementation - 4 events (one month, 3 months, 6 months, 1 year)	$120,000
b. Year Two o 2 events (once within winter/spring; once within summer/fall)	$65,500
c. Annual Report Years One and Two	$5,000
Subtotal (*test unsuccessful*)	***$190,500***

Summary of Pre and Post Construction Monitoring

Activity	**Cost**
Pre-construction monitoring	
Side-scan sonar[1]	[$200,000]
2 years prior to construction - 4 events	$131,000
1 year prior to construction – 4 events	$120,000
Pre-construction report	$10,000
Subtotal	**$261,000**
Post-construction monitoring	
Year 1 – 4 events	$120,000
Year 2 – 4 events	$131,000
Post-construction report	$10,000
Subtotal	**$261,000**
Total Pre and Post Construction Monitoring[2]	*$522,000*

1 = Side scan sonar is already within coastal engineering monitoring and it will be completed and shared data

2 = the pre and post monitoring costs are not part of the mitigation costs; they are scheduled for implementation whether mitigation is necessary and implemented or not necessary and therefore not implemented.

Summary of Mitigation and Monitoring Costs

Mitigation and Monitoring - Surfgrass	
1 acre shallow reef construction	$2,000,000
1 acre deep reef construction	$500,000
1 acre surfgrass transplant	
Test (0.1 acre)	$25,000
Mitigation – *if test successful* (0.9 acre)	$225,000
Year 1 monitoring - 4 events *(if test successful)*	$120,000
Year 2 monitoring - 2 events *(if test successful)*	$65,500
Report *(if test successful)*	$5,000
Subtotal	**$2,940,500**
Mitigation and Monitoring - Kelp	
1 acre shallow reef construction	$2,000,000
1 acre deep reef construction	$500,000
1 acre surfgrass transplant	
Test (0.1 acre)	$25,000
1 acre kelp transplant *(if test not successful)*	$50,000
Year 1 monitoring - 4 events *(if test not successful)*	$120,000
Year 2 monitoring - 2 events *(if test not successful)*	$65,500
Report *(if test not successful)*	$5,000
Subtotal	**$2,765,500**
Summary Mitigation and Monitoring Cost[3]	
Mitigation – Surfgrass successful (Transplant Surfgrass)	*$2,940,500*
Mitigation – Surfgrass not successful (Transplant Kelp)	*$2,765,500*

3 = The cost for the Mitigation – Surfgrass successful (Transplant Surfgrass) includes the cost of constructing both shallow and deep rocky reef as does Mitigation – Surfgrass not successful (Transplant Kelp).

In addition to the information in the MMRP, the Corps' July 14, 2011, email confirms that, if adverse significant impacts are still observed after all reasonable attempts to avoid or minimize impacts have been exhausted, subsequent modified beach renourishment would not occur until impacted surfgrass or reef has recovered or compensatory mitigation is completed.

RECOMMENDATIONS

The FWCA states that "...wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development projects through the effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation...." (16 U.S.C. 661). The revised MMRP above does not fully address the resource agencies' comments and concerns. Incorporation of the following recommendations would address the resource agencies' comments and concerns to avoid, minimize, and compensate for impacts to fish and wildlife resources associated with the San Clemente Shoreline Protection Project:

1) There is a great deal of uncertainty regarding the ability to mitigate impacts to surfgrass in-kind. In addition, the Corps has indicated that a 10-m (33-ft) beach width would achieve the project purpose of storm damage protection and yield an acceptable benefit-cost ratio

for the project. Therefore, the Corps should limit the project to a 10-m (33-ft) beach width to help ensure that significant long-term impacts to surfgrass do not occur and to minimize potential mitigation risks/costs.

2) Only baseline surveys with transects approximately 70 m (230 ft) apart have been completed, which likely did not capture all of the surfgrass/reef resources in the projected equilibrium footprint in which sand movement and burial is expected to occur. In addition, the entire 2-ha (5-ac) T-Street Reef is projected to be in the equilibrium footprint. Therefore, the MMRP assumption of up to only 0.81 ha (2 ac) of surfgrass/reef impacts may significantly underestimate project impacts, and the MMRP should be revised to assume at least 2 ha (5 ac) of surfgrass/reef impacts to help ensure that adequate funds are budgeted for potential mitigation costs.

3) The MMRP proposes to monitor surfgrass/reef mitigation for only 2 years, while it proposes 5 years of monitoring for kelp mitigation. There is no justification for this discrepancy, especially given the uncertainties of surfgrass restoration. Therefore, the MMRP should be revised to include at least 5 years of monitoring of surfgrass/ reef mitigation.

4) The MMRP proposes to mitigate impacts to shallow reef with deep water reef, without sufficient justification as to why it is not feasible to restore shallow reef. This could lead to significant cumulative loss of shallow reef. Therefore, the MMRP should be revised to require impacts to shallow reef be mitigated in-kind, unless the resource agencies concur that this is not feasible and that potential cumulative loss of shallow reef is expected to be minimal.

5) The MMRP proposes to allow impacts to surfgrass to be mitigated with kelp restoration if initial test surfgrass restoration plots fail, which could lead to significant cumulative loss of surfgrass. Therefore, the MMRP should be revised to require impacts to surfgrass be only mitigated in-kind, unless the resource agencies concur that sufficient research and testing has shown that this is not feasible and potential cumulative loss of surfgrass is expected to be minimal.

6) The MMRP does not address potential impacts to the intertidal reef at Mariposa Point north of the beach replenishment site. Although net sand transport in the vicinity of the beach replenishment site is expected to be to the south, Mariposa Point is not far enough north of the project site to assume that no impacts will occur to the intertidal reef there. Therefore, the MMRP should be revised to include monitoring of the intertidal reef at Mariposa Point and mitigation for any significant long term impacts.

7) The MMRP proposes to use Mariposa Point as the only control site assessing impacts from Corps beach replenishment project. However, Mariposa Point could be impacted by the Corps beach replenishment project as well as by the City's opportunistic beach replenishment program. In addition, the use of only one control may not be able to distinguish impacts from beach replenishment from natural variability. Therefore, the

MMRP should be revised to include multiple control sites approved by the resource agencies.

8) Mitigation measures should be planned and provided for prior to or concurrent with project impacts and supplemented as needed to offset any additional, significant long-term adverse impacts documented by the monitoring program. This is especially important for surfgrass because of the uncertainties of surfgrass restoration and at least a 2- to 5-year temporal loss of functions between time of impact and restoration success. If mitigation is not provided in advance of project impacts, the MMRP should be revised to include adequate compensation to address temporal losses as agreed to by the resource agencies.

9) The Corps should monitor the extent of turbidity plumes at the dredge and beach replenishment site throughout the duration of dredging and sand placement activities, or until such point that the resource agencies concur that monitoring is no longer necessary. The MMRP should be revised to include a plan to monitor and report the extent of turbidity plumes and establish acceptable levels and thresholds, which could potentially trigger additional measures. Weekly reports should be submitted to the resource agencies.

10) The MMRP should be revised to include the provision that if significant impacts to surfgrass/reef resources are documented, subsequent modified beach re-nourishment will not occur until the resource agencies concur that mitigation for those impacts is successfully completed, or impacted surfgrass or reef has recovered.

11) After the comprehensive PED phase biological surveys, the Corps should revise the MMRP and receive written concurrence from the resource agencies that it fully addresses mitigation of impacts, criteria for triggering mitigation, success criteria, and monitoring and reporting requirements.

12) The Corps should include the costs of mitigation recommended by the resource agencies in any project budget submitted to Congress for approval. Prior to project implementation, the Corps and City should identify a funding mechanism to guarantee that future funding will be available to implement the mitigation program in the event that mitigation costs exceed the funds appropriated by Congress. For example, funds could be secured by the City through a letter of credit, endowment account, or other legal mechanism approved by the resource agencies sufficient to guarantee mitigation will be implemented to offset adverse impacts of the project.

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San Clemente Shoreline Feasibility Study
Orange County, California

TECHNICAL APPENDICES

FINAL REPORT

U.S. Army Corps of Engineers
Los Angeles District

JULY 2011

San Clemente Shoreline Feasibility Study
Orange County, California

COST ENGINEERING APPENDIX

Final Report

U.S. Army Corps of Engineers
Los Angeles District

JULY 2011

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Table 1.2 – Total Project Cost Summary (TPCS)

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Attachment 1 – Project Cost and Schedule Risk Analysis Report

1 OVERVIEW

This paper discusses the cost assumptions and construction methodology utilized in the San Clemente Beach Nourishment Feasibility Study.

The project consists on dredging material offshore Oceanside, hauling it and placing it at San Clemente Beach. Beach fill is 1,040 m long and 15 m wide with a +5.2 m crest elevation.

The Cost Engineering Dredge Estimating Program (CEDEP) program ensured that the cost estimate was prepared with the best available methods. This program meets the requirements for preparing estimates in lieu of using the Micro-Computer Aided Cost Engineering System (MCACES) software program.

The Cost Engineering Directory of Expertise, located at the Walla Walla District, performed a Project Cost and Schedule Risk Analysis (Attachment 1). In that report, a contingency of 36%, which corresponds to the 80% confidence level, is recommended. The Los Angeles District supports this recommendation because this risk adverse approach appears to be best for a project that is in continuing construction for 50 years.

There are a total of 9 nourishment events through the 50-year life occurring at 6 year intervals. The total dredge volume per nourishment event 1 through 8 is 192,000 m^3 (or 251,000 CY). The total dredge volume for nourishment event 9 is 64,000 m^3 (or 83,900 CY). Cost is based on actual dredged volume in lieu of quantity placed on the receiver beach.

The Current Working Estimate (CWE) meets the Standard USACE Civil Works Work Breakdown Structure (WBS). Refer to Table 1.2, Total Project Cost Summary (TPCS).

2 SUMMARY

2.1 Unit Cost Basis

2.1.1 Direct Cost

Labor rates used to develop the estimate were provided from latest Davis-Bacon Wage Rates for Orange County, Heavy and Dredging, General Decision No. CA100035.

Equipment rates are based on the Department of the Army EP 1110-1-8 "Construction Equipment Ownership and Expense Schedule", Region 7 and CEDEP Equipment Database.

Crew was developed for project specific applications.

Unit costs for mob/demob and hopper dredge operation were calculated using the Hopper Dredge CEDEP program. Unit costs for the pump-out pipelines were calculated from a division of the Pipeline Dredge CEDEP program. Unit costs for the hopper dredge, pump-out pipeline, mob/demob and shore crews were integrated in MCACES (MII).

The dredging cost presented in MII accounts for the construction operation of only one event. Subsequent dredging events involve the same operation.

2.1.2 Quantity and Material Analysis

Dredging area is computed based on the given volume and a bank height of 3-feet.

Dredge material gradation is 6-12% of fines, 5-8% of gravel/cobbles and the rest is sand. Material classification assumed: 10% fines, 83% sand, and 7% gravel. Material classification is directly linked to the excavating or pumping rate of the dredge.

2.1.3 Equipment Selection

Equipment selection and sizing were developed through construction cost estimator experience and consultation with the coastal designer (Chuck Mesa).

The *Sugar Island,* a medium-sized hopper dredge, is selected due to the long haul from the sand source to the receiver beach. The *Sugar Island* maximum safe load capacity is 2,500 CY; however the effective capacity is 1,700 CY for sandy material. The *Sugar Island* pumpout capabilities permit reverse pumping the dredge material via a 24" pipe line @ 1,800 cy/hr.

2.1.4 Fuel Adjustments

Of all the dredging equipment available, hopper dredges are the most sensitive to fuel price fluctuations. The *Sugar Island* average hourly fuel consumption is 175 gal/hr. Out-in-the-ocean delivery marine diesel fuel costs $2.50 per gallon (April 2010). It is assumed there is a ~68% chance that future fuel prices will lie within 50% of $2.50 per gallon, per EST-4 of the Project Cost and Schedule Risk Analysis Report.

2.1.5 Quantity Analysis

Take-off and hauling distances were provided by Coastal Engineering (Chuck Mesa, PE)

2.1.6 Construction Methodology

The hopper dredge is filled at the designated borrow site at Oceanside and hauled 18.6 miles (30 Km) to San Clemente. At the receiver beach, the dredge is attached to a moored floating section of pipeline extending 2,000 feet to the receiver beach. The material is re-suspended and discharged through its on-board pumping system to the receiver site.

Total pump-out pipeline length consists of 1,300 feet of submerged pipe, 200 feet of floating pipe and 500 feet of shore pipe.

Dredging operation mirrors the beach nourishment work that took place at San Diego, in 2001. The selected hopper is equipped with an installation at the bow of the ship, which makes it possible to connect to a moored floating/sunken pipeline in the open sea. The first step in beginning the beach replenishment process involves transporting and installing the sunken/floating beach access pipeline. The dredge is attached to a floating section of the pipeline which is connected to the submerged pipeline section.

Dredge Productivity

1. Effective dredge capacity = 1,703 cy/load considering the material at hand.
2. Average cycle time = 6.55 hours/cycle. It includes: excavating, hauling, connecting to pipeline, pumpout, and returning to borrow site.
3. Loads per day = 2.7 loads/day
4. Effective working time = 730 hr/mo x 80% eff = 584 hr/mo

Production = 1,703 cy/load ÷ 6.55 hr/cycle = 260 cy/hr x 584 hr/mo = 151,840 cy/mo ÷ 30.4 days/month = 4,995 cy/day; round to 5,000 cy/day

2.2 Mobilization and Demobilization

Includes hopper dredge and moored/sunken pipeline transfer, setup and dismantle. Since there is very little hopper dredge work on the west coast, a more likely scenario is that a hopper dredge would mob/demob from the Gulf of Mexico or from the east coast. The distance from New Orleans to Los Angeles is approximately 4,300 nautical miles (5,000 statute miles).

2.3 Contractor Markups

The CWE is based on performing the work using the "Invitation for Bid" contract mechanism. The following markups are applied to the Contractor's work:

Field Office Overhead (Computed) = 3.03%
Home Office Overhead = 4.0%
Profit (Weighted Guidelines) = 8.53%
Bond (Calculated) = 0.89%

2.4 Environmental Monitoring

Environmental monitoring takes places before, during and after dredging for each event. It starts with an Environmental Impact Assessment (EIA) to establish the environmental status of the project and predict how it would change after the project. During the project the environmental monitoring is conducted to confirm that management plan is having the desired effect. Continuation of the monitoring after the project's completion guarantees no long-term negative impacts.

Work will be contracted out. Cost obtained from Planning Division, including markups.

2.5 Physical Monitoring

Physical monitoring involves measuring changes in elevation and volume through successive bathymetric surveys; taking sand samples; and measuring beach profiles. Physical monitoring is needed to quantify the benefits of the sand replenishment project. Work will be contracted out. Costs obtained from Coastal Design and include markups. Costs are annual; however I spread the cost per event (9 events).

2.6 Owner Cost

The following Owner Costs are applied to the CWE.

2.6.1 Preconstruction, Engineering and Design (PED)

Preconstruction, Engineering and Design (PED), including Engineering During Construction (EDC) was estimated at 10% of the Construction. See Table 1.2, Total Project Cost Summary (TPCS).

2.6.2 Construction Management or Supervision & Administration (S&A)

Construction Management was estimated at 6.5% of the Construction cost. See Table 1.2, Total Project Cost Summary (TPCS).

2.6.3 Escalation

Construction Escalation is based on the Civil Works Construction Cost Index System (CWCCIS) EM 1110-2-1304, dated 30 September 2010.

PED and Construction Management Escalation is based on EC 11-2-199 Table 1, Class 1 (Government Personnel) Real Estate Escalation is based on the Construction Price Yearly Index (CPI).

a. CWE Preparation Date: February 4, 2011 (CWBS, Feature Code 06 and 17)
b. Estimate was inflated to mid-point of construction for nine (9) nourishment events starting on October 2011 and reoccurring every 6 years.
c. Construction Period for each nourishment event lasts 2 months, except for the ninth event. The ninth event construction period is 1 month.

See Table 1.2, Total Project Cost Summary (TPCS) for breakdown.

2.7 Schedule of Work

Dredging operation is performed 24-hours a day, 7 days a week.

Shore crew operation is performed 12-hours a day, 7 days a week.

Contract restrictions limit our operating time on the beach to meet noise ordinances. Dredging contracts limit heavy equipment operations on the beach between 7:00 am and 7:00 pm, but marine equipment is allowed to work 24-hours a day.

The shore crew was broken down in two parts: morning crew and night (skeleton) crew. The morning crew consists of a loader (severe conditions), a dozer (severe conditions), fill placer, shoremen and a superintendent. The morning crew will build berms, contain the slurry, distribute the sand and build a gigantic hole for the night pumping if needed. The night crew will consists of 2 shoremen.

Project duration for nourishment event number 1 through 8 is estimated at 2 months.
Project duration for nourishment event number 9 estimated at 1 month.

2.8 Construction Alternative

A combination of hopper/pipeline cutterhead was considered as an alternate procedure but conceptually it was determined to be less economical. The hopper hauls the material, disposes of it temporarily near the shore and a pipeline cutterhead pumps it ashore. The hopper and the hydraulic cutterhead will work independently, since production rates will differ significantly. Hopper unit cost will be approximately $9.50/cy price level and the cutterhead will be approximately $5.80/cy. Hopper-pipeline combination equates to $15.30/cy. It should be noted an increase in quantity due to handling losses will increase the total cost overall, and mob and demob of both plants will double.

3 SYNOPSIS

In summary, the dredging unit cost for beach nourishments events 1 though 8 is $15.36/cy ($20.12/m^3) with 2 months duration.

The dredging unit cost for beach nourishment event number 9 is the same unit cost with 1 month duration.

Mob and Demob equates to $2,124,819 for each nourishment event.

Fed and Non-Fed costs breakdown are 65/35 for the first cycle and 50/50 for the remaining cycles.

2/4/2011 **TABLE 1.1** 2:12 PM

MOBIL & DEMOB COST: $1,434,356

San Clemente Nourishment Cycle 1
CHECKLIST FOR INPUT DATA.

BID QUANTITY	251,520	C.Y.
UNIT COST...	$9.58	PER C.Y.
EXCAV. COST.	$2,409,562	
TIME.....	1.82	MONTHS

PG 1 OF 12: PROJECT TITLES

PROJECT -	San Clemente Nourishment Cycle 1
LOCATION -	Orange County, CA
INVIT # -	N/A
DATE OF EST. -	January 2011
EST. BY -	Juan Dominguez, PE, CCE
MOB. BID ITEM # -	1
EXCAV. BID ITEM # -	2

PG 2 OF 12: TYPE OF EST & IND COSTS

TYPE OF EST. -	Planning Estimate
CONTRACTOR'S O.H. -	0.0%
CONTRACTOR'S PROFIT -	0.0%
CONTRACTOR'S BOND -	0.0%

PG 3 OF 12: EXCAVATION QTY'S

DREDGING AREA -	2,263,680	sf
REQ'D EXCAVATION -	251,520	cyds
PAY OVERDEPTH -	0	cyds
CONTRACT AMOUNT -	251,520	cyds
NOT DREDGED -	0	cyds
NET PAY -	251,520	cyds
NONPAY YARDAGE -	0	cyds
GROSS YARDAGE -	251,520	cyds
NONPAY HEIGHT -	0.0	ft overdig
TOTAL BANK HEIGHT -	3.0	ft

PG 4, 5 & 6 OF 12: PRODUCTION

TYPE OF MATERIAL -	10%	MUD
-	83%	SAND
-	7%	GRAVEL
HOPPER CAPACITY -	3,600	cyds
EFF. HOPPER CAP. -	1,703	cyds
DRDGE RATE (ALL HEADS) -	1,145	cy/hr
ACT. DRAGHDS USED -	2	ea
DRDGE RATE USED -	1,145	cy/hr
TURNS/CYCLE -	2	ea
MIN. PER TURN -	2	min
DISPOSAL DIST -	18.6	mi
TRVL SPD TO DISP -	10.0	mph
TRVL SPD FROM DISP -	11.0	mph
DUMP/CONNECT TIME -	30	min
PUMPOUT RATE -	1800	cy/hr
PIPELINE USED -	0	lf
CLEANUP -	10%	More Time
% EFF WORK TIME -	80.0%	

PG 7 & 8 OF 12: PLANT OWN. & OPER.

DREDGE SELECTED -	SUGAR ISLAND	
DREDGE ACQUIS COST -		
DREDGE CAPITAL IMPROV -	10%	
PROPULSION TUG -	self prop.	/mo
SURVEY VESSEL -	$78,000	/mo
BOOSTER -	$0	/mo
CRANE BARGE -	$0	/mo
TENDER TUG -	$0	/mo
OTHER MARINE -	$0	/mo
SHORE EQUIP -	$0	/mo

PG 9 OF 12: OTHER ADJUSTMENTS

SPECIAL COST/MO (1ST) -	$0	>
SP COST/MO (2ND-14TH) -	$0	From Sheet D\3
SPECIAL COST LS (1ST) -	$0	>
SP COST LS (2ND-14TH) -	$0	From Sheet E

PG 10 OF 12: LOCAL AREA FACTORS

PRESENT YEAR -	2011	
ECONOMIC INDEX -	8102	
LAF -	1.14	
INTEREST RATE -	4.875%	/yr
TIME PERIOD -	Jan 2011	
PIPELINE AVAILABILITY -	9	mos/yr
BUCKET AVAILABILITY -	9	mos/yr
HOPPER AVAILABILITY -	9	mos/yr
FUEL PRICE -	$2.65	/gal

PG 11 OF 12: DREDGE OPER ADJ FACTORS

PUMP LOAD FACTOR -	50%
RPR & MAINT. ADJ -	1.00
JET PUMP USEAGE -	100%

PG 12 OF 12: TRAVEL & PROVISIONS

FREQ PD TRAVEL -	28	days
RT TRAVEL COST -	$500	
GOVT. PERSONNEL -	3	ea
PROVISIONS & SUPP -	$100	/man

LOADS PER DAY -	2.7	
PRODUCTION -	237	gross cy per hour
OPERATING TIME -	584	hours per month
GROSS PRODUCTION -	138,408	cy per month
PAY PRODUCTION -	138,198	pay cy per month

2/4/2011 11:27 AM

TABLE 1.1 - PUMPOUT PIPELINE COST CEDEP

D \ 3 PIPELINE COSTS BID ITEM # 2

PIPELINE SIZE: 24" dredge/booster MATERIAL PUMPED: SAND

	FLOATING PIPELINE						SHORE
1a. Plant Description.....	Pipeline	Joints	Pontoons				Pipeline
Quantity.....>	100	1	2				50
Fixed Units Per Item..>	LF	Set	Each				LF
Unit Price.....>	$129.58	$10,620.00	$10,800.00				$77.05
1e. Plant Value:	$12,958.00	$10,620.00	$21,600.00				$3,852.50
1f. Acquis Year.....	2007	2007	2007				2007
1g. Pres Year.....	2011	---->	---->	---->	---->	---->	---->
1h. Cost of Money Rate.....	4.875%	---->	---->	---->	---->	---->	---->
1i. Disc Money Rate:	3.900%	---->	---->	---->	---->	---->	---->
1j. Hrs Worked/Mo.....	182	---->	---->	---->	---->	---->	---->
2a. LAF.....	1.140	---->	---->	---->	---->	---->	---->
3a. Ec Index <for Acq Yr>...	7221	7221	6101				7221
3b. Ec Index <for 2011>....	8102	---->	---->	---->	---->	---->	---->
4a. Mos Available/Year.....	9	---->	---->	---->	---->	---->	---->
5a. Useful Life (in Yrs)...	3.0	3.0	12.0				3.0
5b. Physical Life (in Hrs).	12,000	12,000	60,000				12,000
5c. SLV Factor.....	0.10	0.10	0.10				0.10
5g. RPR Factor.....	0.05	0.30	0.05				0.05
6a. Depreciation:	30.00%	30.00%	7.50%				30.00%
6b. FCCM:	2.73%	2.73%	2.29%				2.73%
6c. Total Ownership/Year:	32.73%	32.73%	9.79%				32.73%
7a. Yearly Ownership:	$4,241.15	$3,475.93	$2,114.64				$1,260.92
7b. Monthly Ownership:	$471.24	$386.21	$234.96				$140.10
8c. (1) EAF:	1.122	1.122	1.328				1.122
8c. (2) Hrly Repair:	$0.07	$0.34	$0.03				$0.02
8e. Monthly Operating:	$12.74	$61.88	$5.46				$3.64
11. Monthly Rate (EA Item):	$483.98	$448.09	$240.42				$143.74
Monthly Rate Per Section (Sum Of Items):			$1,172.49				$143.74
/ Section Length (In Linear Feet):			100				50
MONTHLY RATES PER LF OF PIPELINE:			$11.72				$2.87
5a. Useful Life (in Yrs)...	6.0	3.0	12.0				3.0
6a. Depreciation:	15.00%	30.00%	7.50%				15.00%
6b. FCCM:	2.44%	2.73%	2.29%				2.44%
6c. Total Ownership/Year:	17.44%	32.73%	9.79%				17.44%
7a. Yearly Ownership:	$2,259.88	$3,475.93	$2,114.64				$671.88
7b. Monthly Ownership:	$251.10	$386.21	$234.96				$74.65
12a. HRLY STANDBY ALLOW:	$0.344	$0.529	$0.322				$0.102
Hrly Standby Rate Per Section (Sum Of Items):			$1.195				$0.102
/ Section Length (In Linear Feet):			100				50
HOURLY STANDBY RATES PER LF OF PIPELINE:			$0.012				$0.002

TABLE 1.2

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County

DISTRICT: Los Angeles District PREPARED: 9-Feb-11
POC: Juan Dominguez, Cost Engineering

This Estimate reflects the scope and schedule in feasibility report; Feasibility

Estimate Prepared: 4-Feb-11
Effective Price Level: Jan 2011

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Spent Thru: Jan 2011 ($K)	FULLY FUNDED PROJECT ESTIMATE COST ($K)	CNTG ($K)	FULL ($K)
06	Environmental Monitoring	$3,240	$1,161	36%	$4,401	1.1%	$3,276	$1,179	$4,455		$5,090	$1,833	$6,923
06	Physical Monitoring (Annual Cost)	$5,598	$2,016	36%	$7,614	1.1%	$5,661	$2,043	$7,704		$8,797	$3,174	$11,971
17	BEACH REPLENISHMENT - Mob/Demob	$19,125	$6,876	36%	$26,001	1.2%	$19,350	$6,957	$26,307		$30,069	$10,811	$40,880
17	BEACH REPLENISHMENT - Dredging Cost	$32,201	$11,584	36%	$43,785	1.2%	$32,576	$11,717	$44,293		$48,957	$17,607	$66,564
	CONSTRUCTION ESTIMATE TOTALS:	**$60,164**	$21,637		$81,801		$60,863	$21,896	$82,759		$92,913	$33,425	$126,338
01	LANDS AND DAMAGES	$72	$26	36%	$98		$72	$27	$99		$294	$108	$402
30	PLANNING, ENGINEERING & DESIGN	$6,273	$2,259	36%	$8,532	2.4%	$6,426	$2,304	$8,730		$11,926	$4,275	$16,201
31	CONSTRUCTION MANAGEMENT	$4,077	$1,467	36%	$5,544	2.4%	$4,176	$1,503	$5,679		$7,837	$2,821	$10,658
	PROJECT COST TOTALS:	**$70,588**	$25,389	36%	$95,975		$71,537	$25,730	$97,267		$112,970	$40,629	**$153,599**

CHIEF, COST ENGINEERING, Mike Newnam

Project Management, Joseph Johnson

CHIEF, REAL ESTATE, Theresa Kaplan

CHIEF, ENGINEERING, Richard Leifield

ESTIMATED FEDERAL COST: 51% **$78,482**
ESTIMATED NON-FEDERAL COST: 49% **$75,117**

ESTIMATED TOTAL PROJECT COST: $153,599

TABLE 1.2

****** TOTAL PROJECT COST SUMMARY ******

***** CONTRACT COST SUMMARY *****

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County
This Estimate reflects the scope and schedule in feasibility report; Feasibility

DISTRICT: Los Angeles District PREPARED: 9-Feb-11
POC: Juan Dominguez, Cost Engineering

		Estimate Prepared:	4-Feb-11			Program Year (Budget EC):	2012							
		Effective Price Level:	Jan 2011			Effective Price Level Date:	1 OCT 11			FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER	Civil Works Feature & Sub-Feature Description		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	BEACH NOURISHMENT - CYCLE No. 1														
06	Environmental Monitoring		$360	$129	36%	$489	1.2%	$364	$131	$495	2012Q1		$364	$131	$495
06	Physical Monitoring (Annual cost)		$622	$224	36%	$846	1.2%	$629	$227	$856	2012Q1		$629	$227	$856
17	BEACH REPLENISHMENT - Mob/Demob		$2,126	$764	36%	$2,889	1.2%	$2,150	$773	$2,923	2012Q1		$2,150	$773	$2,923
17	BEACH REPLENISHMENT - Dredging Cost		$3,864	$1,390	36%	$5,254	1.2%	$3,909	$1,406	$5,315	2012Q1		$3,909	$1,406	$5,315
	CONSTRUCTION ESTIMATE TOTALS:		$6,971	$2,507	36%	$9,478		$7,052	$2,537	$9,589			$7,052	$2,537	$9,589
01	LANDS AND DAMAGES		$8	$3	36%	$11	2.8%	$8	$3	$11	2012Q1		$8	$3	$11
30	PLANNING, ENGINEERING & DESIGN														
2.0%	Project Management		$139	$50	36%	$189	2.4%	$142	$51	$193	2011Q2		$142	$51	$193
2.0%	Planning & Environmental Compliance		$139	$50	36%	$189	2.4%	$142	$51	$193	2011Q2		$142	$51	$193
4.0%	Engineering & Design		$279	$100	36%	$379	2.4%	$286	$102	$388	2011Q2		$286	$102	$388
0.5%	Engineering Tech Review ITR & VE		$35	$13	36%	$48	2.4%	$36	$13	$49	2011Q2		$36	$13	$49
0.5%	Contracting		$35	$13	36%	$48	2.4%	$36	$13	$49	2011Q2		$36	$13	$49
1.0%	Engineering During Construction		$70	$25	36%	$95	2.4%	$72	$26	$98	2012Q1		$72	$26	$98
	Planning During Construction														
	Project Operation														
				PED Subtotal:		$948			PED Subtotal:	$970				PED Subtotal:	$970
31	CONSTRUCTION MANAGEMENT														
6.5%	Construction Management		$453	$163	36%	$616	2.4%	$464	$167	$631	2012Q1		$464	$167	$631
	Project Operation:														
	Project Management														
	CONTRACT COST TOTALS:		$8,129	$2,924		$11,053		$8,238	$2,963	$11,201			$8,238	$2,963	**$11,201**
COST SPLIT															
65.0%	**FEDERAL COST TOTALS:**					$7,184				$7,281					$7,281
35.0%	**NON-FEDERAL COSTS TOTALS:**					$3,869				$3,920					$3,920

TABLE 1.2

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County
This Estimate reflects the scope and schedule in feasibility report; Feasibility

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: 9-Feb-11

Estimate Prepared: 4-Feb-11
Effective Price Level: Jan 2011

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	BEACH NOURISHMENT - CYCLE No. 2													
06	Environmental Monitoring	$360	$129	36%	$489	1.2%	$364	$131	$495	2018Q1	10.8%	$403	$145	$548
06	Physical Monitoring (Annual cost)	$622	$224	36%	$846	1.2%	$629	$227	$856	2018Q1	10.8%	$697	$251	$948
17	BEACH REPLENISHMENT - Mob/Demob	$2,125	$764	36%	$2,889	1.2%	$2,150	$773	$2,923	2018Q1	10.8%	$2,382	$856	$3,238
17	BEACH REPLENISHMENT - Dredging Cost	$3,864	$1,390	36%	$5,254	1.2%	$3,909	$1,406	$5,315	2018Q1	10.8%	$4,330	$1,558	$5,888
	CONSTRUCTION ESTIMATE TOTALS:	$6,971	$2,507	36%	$9,478		$7,052	$2,537	$9,589			$7,812	$2,810	$10,622
01	LANDS AND DAMAGES	$8	$3	36%	$11	2.8%	$8	$3	$11	2018Q1	16.1%	$9	$3	$12
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$139	$50	36%	$189	2.4%	$142	$51	$193	2017Q2	21.7%	$173	$62	$235
2.0%	Planning & Environmental Compliance	$139	$50	36%	$189	2.4%	$142	$51	$193	2017Q2	21.7%	$173	$62	$235
4.0%	Engineering & Design	$279	$100	36%	$379	2.4%	$286	$102	$388	2017Q2	21.7%	$348	$124	$472
0.5%	Engineering Tech Review ITR & VE	$35	$13	36%	$48	2.4%	$36	$13	$49	2017Q2	21.7%	$44	$16	$60
0.5%	Contracting	$35	$13	36%	$48	2.4%	$36	$13	$49	2017Q2	21.7%	$44	$16	$60
1.0%	Engineering During Construction	$70	$25	36%	$95	2.4%	$72	$26	$98	2018Q1	24.9%	$90	$32	$122
	Planning During Construction													
	Project Operation													
			PED Subtotal:		$948			PED Subtotal:	$970				PED Subtotal:	$1,184
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	$453	$163	36%	$616	2.4%	$464	$167	$631	2018Q1	24.9%	$580	$209	$789
	Project Operation:													
	Project Management													
	CONTRACT COST TOTALS:	$8,129	$2,924		$11,053		$8,238	$2,963	$11,201			$9,273	$3,334	**$12,607**
COST SPLIT														
50.0%	**FEDERAL COST TOTALS:**				$5,526				$5,601					$6,304
50.0%	**NON-FEDERAL COSTS TOTALS:**				$5,527				$5,600					$6,303

TABLE 1.2

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County
This Estimate reflects the scope and schedule in feasibility report; Feasibility

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: 9-Feb-11

Estimate Prepared: 4-Feb-11
Effective Price Level: Jan 2011

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	BEACH NOURISHMENT - CYCLE No. 3													
06	Environmental Monitoring	$360	$129	36%	$489	1.2%	$364	$131	$495	2024Q1	23.3%	$449	$162	$611
06	Physical Monitoring (Annual cost)	$622	$224	36%	$846	1.2%	$629	$227	$856	2024Q1	23.3%	$775	$280	$1,056
17	BEACH REPLENISHMENT - Mob/Demob	$2,125	$764	36%	$2,889	1.2%	$2,150	$773	$2,923	2024Q1	23.3%	$2,651	$953	$3,604
17	BEACH REPLENISHMENT - Dredging Cost	$3,864	$1,390	36%	$5,254	1.2%	$3,909	$1,406	$5,315	2024Q1	23.3%	$4,820	$1,733	$6,553
	CONSTRUCTION ESTIMATE TOTALS:	$6,971	$2,507	36%	$9,478		$7,052	$2,537	$9,589			$8,696	$3,128	$11,824
01	LANDS AND DAMAGES	$8	$3	36%	$11	2.8%	$8	$3	$11	2024Q1	32.3%	$11	$4	$15
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$139	$50	36%	$189	2.4%	$142	$51	$193	2023Q2	47.9%	$210	$75	$285
2.0%	Planning & Environmental Compliance	$139	$50	36%	$189	2.4%	$142	$51	$193	2023Q2	47.9%	$210	$75	$285
4.0%	Engineering & Design	$279	$100	36%	$379	2.4%	$286	$102	$388	2023Q2	47.9%	$423	$151	$574
0.5%	Engineering Tech Review ITR & VE	$35	$13	36%	$48	2.4%	$36	$13	$49	2023Q2	47.9%	$53	$19	$72
0.5%	Contracting	$35	$13	36%	$48	2.4%	$36	$13	$49	2023Q2	47.9%	$53	$19	$72
1.0%	Engineering During Construction	$70	$25	36%	$95	2.4%	$72	$26	$98	2024Q1	51.3%	$109	$39	$148
	Planning During Construction													
	Project Operation													
			PED Subtotal:		$948			PED Subtotal:	$970				PED Subtotal:	$1,436
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	$453	$163	36%	$616	2.4%	$464	$167	$631	2024Q1	51.3%	$702	$253	$955
	Project Operation:													
	Project Management													
	CONTRACT COST TOTALS:	$8,129	$2,924		$11,053		$8,238	$2,963	$11,201			$10,467	$3,763	**$14,230**
COST SPLIT														
50.0%	**FEDERAL COST TOTALS:**				$5,526				$5,601					$7,115
50.0%	**NON-FEDERAL COSTS TOTALS:**				$5,527				$5,600					$7,115

TABLE 1.2

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County
This Estimate reflects the scope and schedule in feasibility report; Feasibility

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: 9-Feb-11

		Estimate Prepared: 4-Feb-11 / Effective Price Level: Jan 2011				Program Year (Budget EC): 2012 / Effective Price Level Date: 1 OCT 11				FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	BEACH NOURISHMENT - CYCLE No. 4													
06	Environmental Monitoring	$360	$129	36%	$489	1.2%	$364	$131	$495	2030Q1	37.2%	$499	$180	$679
06	Physical Monitoring (Annual cost)	$622	$224	36%	$846	1.2%	$629	$227	$856	2030Q1	37.2%	$863	$311	$1,174
17	BEACH REPLENISHMENT - Mob/Demob	$2,125	$764	36%	$2,889	1.2%	$2,150	$773	$2,923	2030Q1	37.2%	$2,950	$1,061	$4,011
17	BEACH REPLENISHMENT - Dredging Cost	$3,864	$1,390	36%	$5,254	1.2%	$3,909	$1,406	$5,315	2030Q1	37.2%	$5,364	$1,929	$7,293
	CONSTRUCTION ESTIMATE TOTALS:	$6,971	$2,507	36%	$9,478		$7,052	$2,537	$9,589			$9,676	$3,481	$13,157
01	LANDS AND DAMAGES	$8	$3	36%	$11	2.8%	$8	$3	$11	2030Q1	48.4%	$12	$4	$16
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$139	$50	36%	$189	2.4%	$142	$51	$193	2029Q2	68.6%	$239	$86	$325
2.0%	Planning & Environmental Compliance	$139	$50	36%	$189	2.4%	$142	$51	$193	2029Q2	68.6%	$239	$86	$325
4.0%	Engineering & Design	$279	$100	36%	$379	2.4%	$286	$102	$388	2029Q2	68.6%	$482	$172	$654
0.5%	Engineering Tech Review ITR & VE	$35	$13	36%	$48	2.4%	$36	$13	$49	2029Q2	68.6%	$61	$22	$83
0.5%	Contracting	$35	$13	36%	$48	2.4%	$36	$13	$49	2029Q2	68.6%	$61	$22	$83
1.0%	Engineering During Construction	$70	$25	36%	$95	2.4%	$72	$26	$98	2030Q1	71.0%	$123	$44	$167
	Planning During Construction													
	Project Operation													
			PED Subtotal:		$948			PED Subtotal:	$970				PED Subtotal:	$1,637
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	$453	$163	36%	$616	2.4%	$464	$167	$631	2030Q1	71.0%	$793	$286	$1,079
	Project Operation:													
	Project Management													
	CONTRACT COST TOTALS:	$8,129	$2,924		$11,053		$8,238	$2,983	$11,201			$11,686	$4,203	**$15,889**
COST SPLIT														
50.0%	**FEDERAL COST TOTALS:**				$5,526				$5,601					$7,945
50.0%	**NON-FEDERAL COSTS TOTALS:**				$5,527				$5,600					$7,944

TABLE 1.2

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County
This Estimate reflects the scope and schedule in feasibility report; Feasibility

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering
PREPARED: 9-Feb-11

Estimate Prepared: 4-Feb-11
Effective Price Level: Jan 2011

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	BEACH NOURISHMENT - CYCLE No. 5													
06	Environmental Monitoring	$360	$129	36%	$489	1.2%	$364	$131	$495	2036Q1	52.7%	$556	$200	$756
06	Physical Monitoring (Annual cost)	$822	$224	36%	$846	1.2%	$629	$227	$856	2036Q1	52.7%	$961	$347	$1,308
17	BEACH REPLENISHMENT - Mob/Demob	$2,125	$764	36%	$2,889	1.2%	$2,150	$773	$2,923	2036Q1	52.7%	$3,284	$1,181	$4,465
17	BEACH REPLENISHMENT - Dredging Cost	$3,864	$1,390	36%	$5,254	1.2%	$3,909	$1,406	$5,315	2036Q1	52.7%	$5,970	$2,147	$8,117
	CONSTRUCTION ESTIMATE TOTALS:	$6,971	$2,507	36%	$9,478		$7,052	$2,537	$9,589			$10,771	$3,875	$14,646
01	LANDS AND DAMAGES	$8	$3	36%	$11	2.8%	$8	$3	$11	2036Q1	64.5%	$13	$5	$18
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$139	$50	36%	$189	2.4%	$142	$51	$193	2035Q2	87.9%	$267	$96	$363
2.0%	Planning & Environmental Compliance	$139	$50	36%	$189	2.4%	$142	$51	$193	2035Q2	87.9%	$267	$96	$363
4.0%	Engineering & Design	$279	$100	36%	$379	2.4%	$286	$102	$388	2035Q2	87.9%	$537	$192	$729
0.5%	Engineering Tech Review ITR & VE	$35	$13	36%	$48	2.4%	$36	$13	$49	2035Q2	87.9%	$68	$24	$92
0.5%	Contracting	$35	$13	36%	$48	2.4%	$36	$13	$49	2035Q2	87.9%	$68	$24	$92
1.0%	Engineering During Construction	$70	$25	36%	$95	2.4%	$72	$26	$98	2036Q1	90.3%	$137	$49	$186
	Planning During Construction													
	Project Operation													
			PED Subtotal:		$948			PED Subtotal:	$970				PED Subtotal:	$1,825
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	$453	$163	36%	$616	2.4%	$464	$167	$631	2036Q1	90.3%	$883	$318	$1,201
	Project Operation:													
	Project Management													
	CONTRACT COST TOTALS:	$8,129	$2,924		$11,053		$8,238	$2,963	$11,201			$13,011	$4,679	**$17,690**
COST SPLIT														
50.0%	**FEDERAL COST TOTALS:**				$5,526				$5,601					$8,845
50.0%	**NON-FEDERAL COSTS TOTALS:**				$5,527				$5,600					$8,845

TABLE 1.2

**** TOTAL PROJECT COST SUMMARY ****

*** CONTRACT COST SUMMARY ***

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County
This Estimate reflects the scope and schedule in feasibility report: Feasibility

DISTRICT: Los Angeles District PREPARED: 9-Feb-11
POC: Juan Dominguez, Cost Engineering

		Estimate Prepared: 4-Feb-11				Program Year (Budget EC): 2012				FULLY FUNDED PROJECT ESTIMATE				
		Effective Price Level: Jan 2011				Effective Price Level Date: 1 OCT 11								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	BEACH NOURISHMENT - CYCLE No. 6													
06	Environmental Monitoring	$360	$129	36%	$489	1.2%	$364	$131	$495	2042Q1	69.4%	$616	$222	$838
06	Physical Monitoring (Annual cost)	$622	$224	36%	$846	1.2%	$629	$227	$856	2042Q1	69.4%	$1,065	$384	$1,449
17	BEACH REPLENISHMENT - Mob/Demob	$2,125	$764	36%	$2,889	1.2%	$2,150	$773	$2,923	2042Q1	69.4%	$3,641	$1,309	$4,950
17	BEACH REPLENISHMENT - Dredging Cost	$3,864	$1,390	36%	$5,254	1.2%	$3,909	$1,408	$5,315	2042Q1	69.4%	$6,620	$2,381	$9,001
	CONSTRUCTION ESTIMATE TOTALS:	$6,971	$2,507	36%	$9,478		$7,052	$2,537	$9,589			$11,942	$4,296	$16,238
01	LANDS AND DAMAGES	$8	$3	36%	$11	2.8%	$8	$3	$11	2042Q1	357.5%	$37	$14	$51
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$139	$50	36%	$189	2.4%	$142	$51	$193	2041Q2	107.3%	$294	$106	$400
2.0%	Planning & Environmental Compliance	$139	$50	36%	$189	2.4%	$142	$51	$193	2041Q2	107.3%	$294	$106	$400
4.0%	Engineering & Design	$279	$100	36%	$379	2.4%	$286	$102	$388	2041Q2	107.3%	$593	$211	$804
0.5%	Engineering Tech Review ITR & VE	$35	$13	36%	$48	2.4%	$36	$13	$49	2041Q2	107.3%	$75	$27	$102
0.5%	Contracting	$35	$13	36%	$48	2.4%	$36	$13	$49	2041Q2	107.3%	$75	$27	$102
1.0%	Engineering During Construction	$70	$25	36%	$95	2.4%	$72	$26	$98	2042Q1	109.7%	$151	$55	$206
	Planning During Construction													
	Project Operation													
			PED Subtotal:		$948			PED Subtotal:	$970				PED Subtotal:	$2,014
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	$453	$163	36%	$616	2.4%	$464	$167	$631	2042Q1	109.7%	$973	$350	$1,323
	Project Operation:													
	Project Management													
	CONTRACT COST TOTALS:	$8,129	$2,924		$11,053		$8,238	$2,963	$11,201			$14,434	$5,192	**$19,626**
COST SPLIT														
50.0%	**FEDERAL COST TOTALS:**				$5,526				$5,601					$9,813
50.0%	**NON-FEDERAL COSTS TOTALS:**				$5,527				$5,600					$9,813

Filename: San Clemente - TPCS - 4 Feb 2011 Review by JGN .xlsx
TPCS

TABLE 1.2

*** CONTRACT COST SUMMARY ***

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County
This Estimate reflects the scope and schedule in feasibility report; Feasibility

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: 9-Feb-11

Estimate Prepared: 4-Feb-11
Effective Price Level: Jan 2011

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	BEACH NOURISHMENT - CYCLE No. 7													
06	Environmental Monitoring	$360	$129	36%	$489	1.2%	$364	$131	$495	2048Q1	86.0%	$677	$244	$921
06	Physical Monitoring (Annual cost)	$622	$224	36%	$846	1.2%	$629	$227	$856	2048Q1	86.0%	$1,170	$422	$1,592
17	BEACH REPLENISHMENT - Mob/Demob	$2,125	$764	36%	$2,889	1.2%	$2,150	$773	$2,923	2048Q1	86.0%	$3,999	$1,438	$5,437
17	BEACH REPLENISHMENT - Dredging Cost	$3,864	$1,390	36%	$5,254	1.2%	$3,909	$1,406	$5,315	2048Q1	86.0%	$7,271	$2,615	$9,886
	CONSTRUCTION ESTIMATE TOTALS:	$6,971	$2,507	36%	$9,478		$7,052	$2,537	$9,589			$13,117	$4,719	$17,836
01	LANDS AND DAMAGES	$8	$3	36%	$11	2.0%	$8	$3	$11	2048Q1	750.0%	$68	$25	$93
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$139	$50	36%	$189	2.4%	$142	$51	$193	2047Q2	126.6%	$322	$116	$438
2.0%	Planning & Environmental Compliance	$139	$50	36%	$189	2.4%	$142	$51	$193	2047Q2	126.6%	$322	$116	$438
4.0%	Engineering & Design	$279	$100	36%	$379	2.4%	$286	$102	$388	2047Q2	126.6%	$648	$231	$879
0.5%	Engineering Tech Review ITR & VE	$35	$13	36%	$48	2.4%	$36	$13	$49	2047Q2	126.6%	$82	$29	$111
0.5%	Contracting	$35	$13	36%	$48	2.4%	$36	$13	$49	2047Q2	126.6%	$82	$29	$111
1.0%	Engineering During Construction	$70	$25	36%	$95	2.4%	$72	$26	$98	2048Q1	129.0%	$165	$60	$225
	Planning During Construction													
	Project Operation													
			PED Subtotal:		$948			PED Subtotal:	$970				PED Subtotal:	$2,202
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	$453	$163	36%	$616	2.4%	$464	$167	$631	2048Q1	129.0%	$1,063	$382	$1,445
	Project Operation:													
	Project Management													
	CONTRACT COST TOTALS:	$8,129	$2,924		$11,053		$8,238	$2,963	$11,201			$15,869	$5,707	**$21,576**
COST SPLIT														
50.0%	**FEDERAL COST TOTALS:**				$5,526				$5,601					$10,788
50.0%	**NON-FEDERAL COSTS TOTALS:**				$5,527				$5,600					$10,788

Filename: San Clemente - TPCS - 4 Feb 2011 Review by JGN .xlsx
TPCS

TABLE 1.2

*** CONTRACT COST SUMMARY ***

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County
This Estimate reflects the scope and schedule in feasibility report; Feasibility

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: 9-Feb-11

Estimate Prepared: 4-Feb-11
Effective Price Level: Jan 2011

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL. ($K)
	BEACH NOURISHMENT - CYCLE No. 8													
06	Environmental Monitoring	$360	$129	36%	$489	1.2%	$364	$131	$495	2053Q1	99.9%	$728	$262	$990
06	Physical Monitoring (Annual cost)	$622	$224	36%	$846	1.2%	$629	$227	$856	2053Q1	99.9%	$1,257	$454	$1,711
17	BEACH REPLENISHMENT - Mob/Demob	$2,125	$764	36%	$2,889	1.2%	$2,150	$773	$2,923	2053Q1	99.9%	$4,297	$1,545	$5,842
17	BEACH REPLENISHMENT - Dredging Cost	$3,864	$1,390	36%	$5,254	1.2%	$3,909	$1,406	$5,315	2053Q1	99.9%	$7,813	$2,810	$10,623
	CONSTRUCTION ESTIMATE TOTALS:	$6,971	$2,507	36%	$9,478		$7,052	$2,537	$9,589			$14,095	$5,071	$19,166
01	LANDS AND DAMAGES	$8	$3	36%	$11	2.8%	$8	$3	$11	2053Q1	750.0%	$68	$25	$93
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$139	$50	36%	$189	2.4%	$142	$51	$193	2052Q2	142.7%	$345	$124	$469
2.0%	Planning & Environmental Compliance	$139	$50	36%	$189	2.4%	$142	$51	$193	2052Q2	142.7%	$345	$124	$469
4.0%	Engineering & Design	$279	$100	36%	$379	2.4%	$286	$102	$388	2052Q2	142.7%	$694	$248	$942
0.5%	Engineering Tech Review ITR & VE	$35	$13	36%	$48	2.4%	$36	$13	$49	2052Q2	142.7%	$87	$32	$119
0.5%	Contracting	$35	$13	36%	$48	2.4%	$36	$13	$49	2052Q2	142.7%	$87	$32	$119
1.0%	Engineering During Construction	$70	$25	36%	$95	2.4%	$72	$26	$98	2053Q1	145.1%	$176	$64	$240
	Planning During Construction			36%										
	Project Operation			36%										
			PED Subtotal:		$948		PED Subtotal:		$970			PED Subtotal:		$2,358
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	$453	$163	36%	$616	2.4%	$464	$167	$631	2053Q1	145.1%	$1,137	$409	$1,546
	Project Operation:			36%										
	Project Management			36%										
	CONTRACT COST TOTALS:	$8,129	$2,924		$11,053		$8,238	$2,963	$11,201			$17,034	$6,129	**$23,163**
COST SPLIT														
50.0%	**FEDERAL COST TOTALS:**				$5,526				$5,601					$11,582
50.0%	**NON-FEDERAL COSTS TOTALS:**				$5,527				$5,600					$11,581

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TABLE 1.2

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: San Clemente Beach Nourishment
LOCATION: Orange County
This Estimate reflects the scope and schedule in feasibility report; Feasibility

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering
PREPARED: 9-Feb-11

Estimate Prepared: 4-Feb-11
Effective Price Level: Jan 2011

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	BEACH NOURISHMENT - CYCLE No. 9													
06	Environmental Monitoring	$360	$129	36%	$488	1.2%	$364	$131	$495	2060Q1	119.3%	$798	$287	$1,085
06	Physical Monitoring (Annual cost)	$622	$224	36%	$846	1.2%	$629	$227	$856	2060Q1	119.3%	$1,379	$498	$1,877
17	BEACH REPLENISHMENT - Mob/Demob	$2,125	$764	36%	$2,889	1.2%	$2,150	$773	$2,923	2060Q1	119.3%	$4,715	$1,695	$6,410
17	BEACH REPLENISHMENT - Dredging Cost	$1,289	$464	36%	$1,753	1.2%	$1,304	$469	$1,773	2060Q1	119.3%	$2,860	$1,028	$3,888
	CONSTRUCTION ESTIMATE TOTALS:	$4,396	$1,581	36%	$5,977		$4,447	$1,600	$6,047			$9,752	$3,508	$13,260
01	LANDS AND DAMAGES	$8	$3	36%	$11	2.8%	$8	$3	$11	2060Q1	750.0%	$68	$25	$93
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$139	$50	36%	$189	2.4%	$142	$51	$193	2059Q2	165.3%	$377	$135	$512
2.0%	Planning & Environmental Compliance	$139	$50	36%	$189	2.4%	$142	$51	$193	2059Q2	165.3%	$377	$135	$512
4.0%	Engineering & Design	$279	$100	36%	$379	2.4%	$288	$102	$388	2059Q2	165.3%	$759	$271	$1,030
0.5%	Engineering Tech Review ITR & VE	$35	$13	36%	$48	2.4%	$36	$13	$49	2059Q2	165.3%	$95	$34	$129
0.5%	Contracting	$35	$13	36%	$48	2.4%	$36	$13	$49	2059Q2	165.3%	$95	$34	$129
1.0%	Engineering During Construction	$70	$25	36%	$95	2.4%	$72	$26	$98	2060Q1	167.7%	$193	$70	$263
	Planning During Construction			36%										
	Project Operation			36%										
			PED Subtotal:		$948			PED Subtotal:	$970				PED Subtotal:	$2,575
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	$453	$163	36%	$616	2.4%	$464	$167	$631	2060Q1	167.7%	$1,242	$447	$1,689
	Project Operation:			36%										
	Project Management			36%										
	CONTRACT COST TOTALS:	$5,554	$1,998		$7,552		$5,633	$2,026	$7,659			$12,950	$4,659	**$17,617**
COST SPLIT														
50.0%	**FEDERAL COST TOTALS:**				$3,776				$3,830					$8,809
50.0%	**NON-FEDERAL COSTS TOTALS:**				$3,776				$3,829					$8,808

US Army Corps of Engineers®

San Clemente Beach Nourishment
Feasibility Study
Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Los Angeles District

Prepared by:

U.S. Army Corps of Engineers
Cost Engineering Directory of Expertise, Walla Walla

December 15, 2010

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EXECUTIVE SUMMARY

Under the auspices of the US Army Corps of Engineers (USACE), Los Angeles District, this report presents a recommendation for the total project cost and schedule contingencies for the San Clemente Beach Nourishment Feasibility Study. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis study was conducted for the development of contingency on the total project cost. The purpose of this risk analysis study was to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated total project cost.

Specific to the San Clemente Project, the most likely total project cost (at price level) is estimated at approximately $71 Million. Based on the results of the analysis, the Cost Engineering Directory of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $25 Million, or 36%. This contingency includes $13 Million (19%) for cost growth potential due to risk analyzed in the base cost estimate and $12 Million (17%) for cost growth potential due to risk analyzed in the baseline schedule. Due to the long duration of the project, time value of money effect is the single greatest contributor to cost growth.

Walla Walla Cost Dx performed risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following table ES-1 portrays the development of contingencies. The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Most Likely Cost Estimate	**$70,586,000**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$82,375,420	16.70%
50%	$91,492,778	29.62%
80%	**$95,874,911**	**35.83%**
95%	$101,653,118	44.01%

The following table ES-2 portrays the full costs of the recommended alternative based on the anticipated contracts. The costs are intended to address the congressional request of estimates to implement the project. The contingency is based on an 80% confidence level, as per accepted USACE Civil Works guidance.

Table ES-2. Cost Summary

SAN CLEMENTE		COST ($1,000)	CNTG ($1,000)	TOTAL ($1,000)
01	LANDS AND DAMAGES	72	26	98
06	FISH AND WILDLIFE FACILITIES	3,240	1,161	4,401
06	FISH AND WILDLIFE FACILITIES (Annual Costs)	5,598	2,007	7,605
17	BEACH REPLENISHMENT (Mobilization)	19,125	6,849	25,974
17	BEACH REPLENISHMENT (Dredging)	32,201	11,534	43,735
30	PLANNING, ENGINEERING AND DESIGN	6,273	2,259	8,532
31	CONSTRUCTION MANAGEMENT	4,077	1,458	5,535
	TOTAL PROJECT COSTS	**70,586**	**25,294**	**95,880**
	Schedule Completion with Contingency	**1 Oct 2059**	**63 months**	**11 Jan 2065**

Notes:
1) All costs include the recommended contingency of 36%.
2) Costs exclude O&M and Life Cycle Cost estimates.

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis were Risks EST-4 (Fuel Prices), TL-3 (Uncertainty with the Design of Beach Fill), and EST-2 (Impact of Hopper Size), which together contribute over 52 percent of the statistical cost variance. EST-4 (fuel prices) represents concern that rising fuel prices will cause significant cost growth. TL-3 (Uncertainty with the Design of Beach Fill) represents concern that future surveys may establish different site conditions than currently planned, requiring additional excavation costs. EST-2 (Impact of Hopper Size) represents concern that size of hopper dredges actually used, if they differ from that assumed in the estimate, could cause variance in dredging costs.

The key schedule risk drivers identified through sensitivity analysis were Risks PR-1 (Project Schedule in Question) and RE-1 (Impacts of New Concerns Arising Due to Delay), which together contribute 56 percent of the statistical schedule variance. PR-1 (Project Schedule in Question) represents concern that delay in project authorization would delay project implementation. RE-1 (Impacts of New Concerns Arising Due to Delay) represents concern that delay could allow the project to be subject to new and additional regulatory requirements that would significantly delay project implementation.

Recommendations, as detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), Los Angeles District, this report presents a recommendation for the total project cost and schedule contingencies for the San Clemente Beach Nourishment Feasibility Study.

2.0 BACKGROUND

The project consists on dredging material offshore Oceanside, hauling it and placing it at San Clemente Beach. Beach fill is 1,040 meters long and 15 meters wide with a +5.2 meter crest elevation. There are a total of nine nourishment events through the 50-year life occurring at six-year intervals. The total dredge volume per nourishment event 1 through 8 is 192,000 m^3 (or 251,000 CY). The total dredge volume for nourishment event 9 is 64,000 m^3 (or 83,900 CY). The cost is based on actual dredged volume in lieu of quantity placed on the receiver beach.

As a part of this effort, Los Angeles District requested that the USACE Cost Engineering Directory of Expertise for Civil Works (Cost Engineering Dx) provide an agency technical review (ATR) of the cost estimate and schedule for Recommended Project Plan. That tasking also included providing a risk analysis study to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all project features. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the most likely Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and

statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Los Angeles District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Dx. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering Dx.
- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.
- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Walla Walla Cost Dx facilitated a risk identification and qualitative analysis meeting with the Los Angeles PDT via teleconference on September 30, 2010. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the framework for the risk analysis. The Los Angeles cost engineer assisted in the creation of the cost and schedule risk analysis models, and obtained the assistance of the Walla Walla Cost Dx to complete the analysis and the report.

The initial cost and schedule risk models were completed and results reported on October 27, 2010. Revisions and iterations of the cost and schedule risk model took place between October 27, 2010 and December 14, 2010. The final results were completed and reported on December 14, 2010.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Dx guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT was obtained using creative processes such as brainstorming or other facilitated risk assessment meetings.

Formal PDT meetings were held for the purposes of identifying and assessing risk factors. The formal meeting conducted on September 30, 2010 included the following:

No.	Name	Section	Title
1	Joe Johnson	CESPL-PD	Project Manager
2	Heather Schlosser	CESPL-PD-WS	Lead Planner
3	Nate West	CESPL-PD-WS	Planner
4	Ark Shak	CESPL-ED-DC	Coastal Engineering
5	Greg Dombrosky	CESPL-ED-GD	Soils
6	Jeff Devine	CESPL-ED-GG	Geotechnical Engineering
7	Juan Dominguez	CESPL-ED-DS	Cost Engineering
8	Tom Keeny	CESPL-PD	Environmental
9	Amy Holmes	CESPL-PD-RN	Cultural Resources
10	Glenn Matlock	CENWW-EC-X	Cost Engineer/Risk Facilitator

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings focused primarily on risk factor assessment and quantification.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because

risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the with- and without-project conditions at San Clemente.

a. The MII MCACES (Micro-Computer Aided Cost Estimating Software) file "San Clemente 2010.mlp," as well as accompanying CEDEP (Corps of Engineers Dredge Estimating Program) files were the basis for the cost and schedule risk analyses.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. The schedule was analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and monthly recurring costs (unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay).

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, State Adjustment Factor for California is 1.18, meaning that historical inflation is up to 18% higher than the national average. This represents $12 Million (17%) of the total contingency due to differential between the local market and OMB inflation factors for future construction. Without any risk introduced, the time value of money effect over the project duration of approximately 48 years adds $10.8 Million (or 15%) due to this effect. In other words, the project begins with 15% contingency without risk occurrence.

e. Per the data in the estimate, the Job Office Overhead (JOOH) amount for the Contract Cost comprises approximately 6.0% of the Project Cost at Baseline. However, the project includes nine individual nourishment activities occurring intermittently over nearly 50 years. Thus, the assumed monthly recurring rate for this project is half of the approximate JOOH rate, or 3.0%. For the P80 schedule, this comprises less than 1% of the total contingency due to the accrual of residual fixed costs associated with delay.

f. The Cost Dx guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

g. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each

project milestone to determine if they should be placed on the risk "watch list" for further monitoring and evaluation.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

Table 1 provides the raw construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $25 Million at the P80 confidence level (36% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 30% and 44% of the baseline cost estimate, respectively.

Table 1. Project Cost Contingency Summary

Risk Analysis Forecast	Baseline Estimate	Project Contingency[1,2] ($)	Total Contingency (%)
50% Confidence Level			
Project Cost	$70,586,000	$20,906,778	29.62%
80% Confidence Level			
Project Cost	$70,586,000	$25,288,911	35.83%
100% Confidence Level			
Project Cost	$70,586,000	$56,355,860	79.84%

Notes:
1) These figures combine uncertainty in the baseline cost estimates and schedule.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to total project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

6.3 Schedule and Contingency Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 63 months based on the P80 level of confidence. These contingencies were used to calculate the projected monthly recurring cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected monthly recurring costs.

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)	Contingency (%)
50% Confidence Level			
Total Project Duration	576	51	9%
80% Confidence Level			
Total Project Duration	576	63	11%
100% Confidence Level			
Total Project Duration	576	107	19%

Notes:
1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 2.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

Figure 1. Cost Sensitivity Analysis

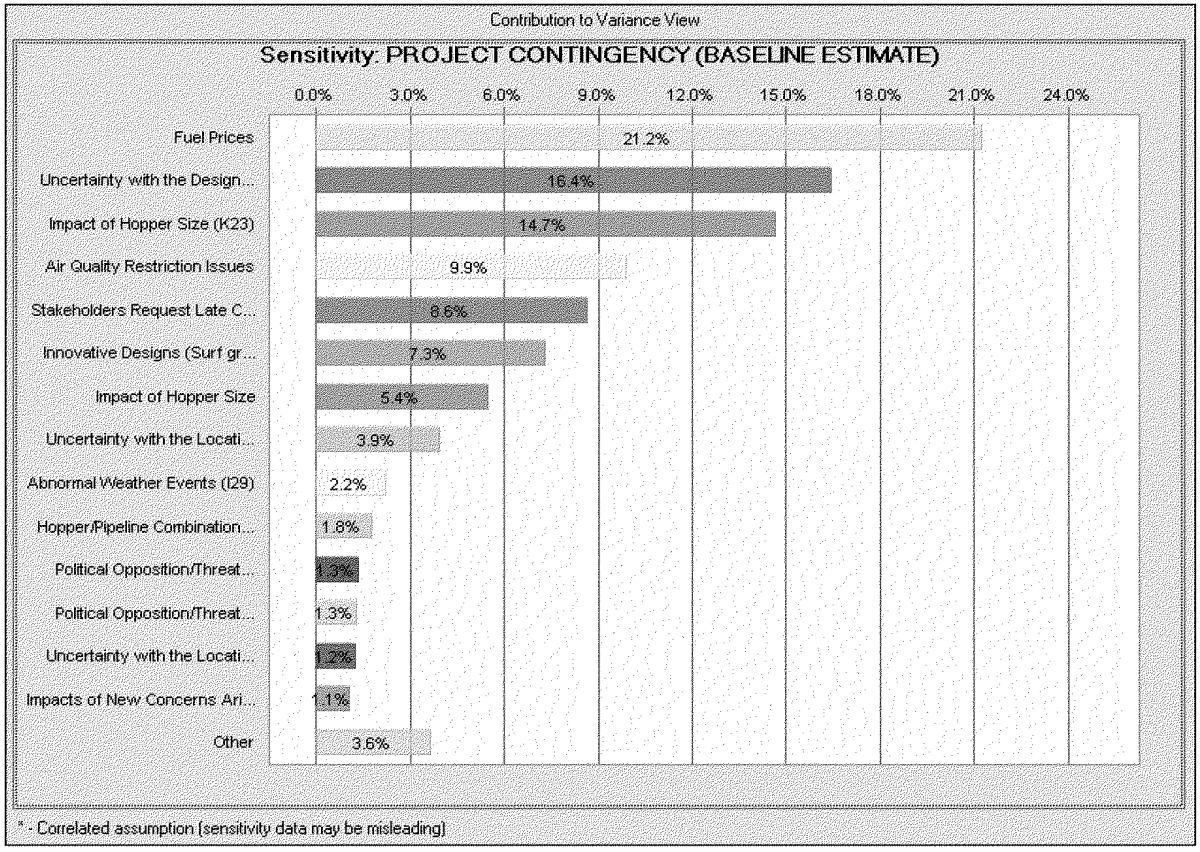

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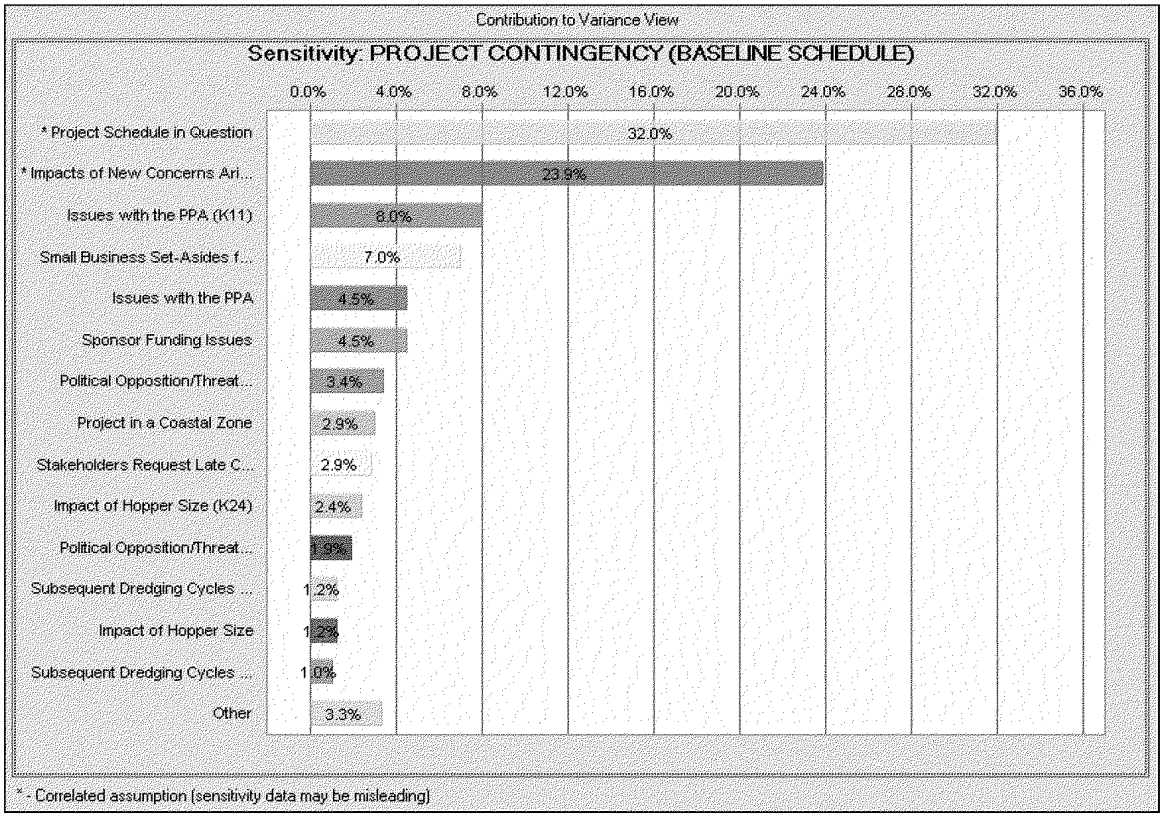
Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Total project cost comparison summaries are provided in Table 3 and Figure 3. Additional major findings and observations of the risk analysis are listed below.

1. The single greatest factor contributing to contingency is the time value of money effect over the 48 year project duration. Without introducing any risk, the differential in the OMB projected rates and local inflation amounts to $10.8 Million (15%) in cost growth.

2. The key cost risk drivers identified through sensitivity analysis were Risks EST-4 (Fuel Prices), TL-3 (Uncertainty with the Design of Beach Fill), and EST-2 (Impact of Hopper Size), which together contribute over 52 percent of the statistical cost variance.

3. The key schedule risk drivers identified through sensitivity analysis were Risks PR-1 (Project Schedule in Question) and RE-1 (Impacts of New Concerns Arising Due to Delay), which together contribute 56 percent of the statistical schedule variance.

4. The schedule was not resource loaded and contains open-ended tasks, and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected monthly recurring costs. Resource impacts related to potential schedule delays could not be evaluated.

5. Operation and maintenance activities were not included in the cost estimate or schedules. Therefore, a full lifecycle risk analysis could not be performed. Risk analysis results or conclusions could be significantly different if the necessary operation and maintenance activities were included.

Table 3. Project Cost Comparison Summary

Confidence Level	Project Cost ($)	Contingency (%)
P0	**$67,625,836**	**-4.19%**
P5	**$82,375,420**	**16.70%**
P10	**$84,659,674**	**19.94%**
P15	**$86,286,085**	**22.24%**
P20	**$87,435,861**	**23.87%**
P25	**$88,281,780**	**25.07%**
P30	**$89,022,417**	**26.12%**
P35	**$89,674,675**	**27.04%**
P40	**$90,311,292**	**27.95%**
P45	**$90,907,503**	**28.79%**
P50	**$91,492,778**	**29.62%**
P55	**$92,124,350**	**30.51%**
P60	**$92,780,818**	**31.44%**
P65	**$93,408,960**	**32.33%**
P70	**$94,083,051**	**33.29%**
P75	**$94,847,932**	**34.37%**
P80	**$95,874,911**	**35.83%**
P85	**$97,118,504**	**37.59%**
P90	**$98,741,900**	**39.89%**
P95	**$101,653,118**	**44.01%**
P100	**$126,941,860**	**79.84%**

Figure 3. Project Cost Summary

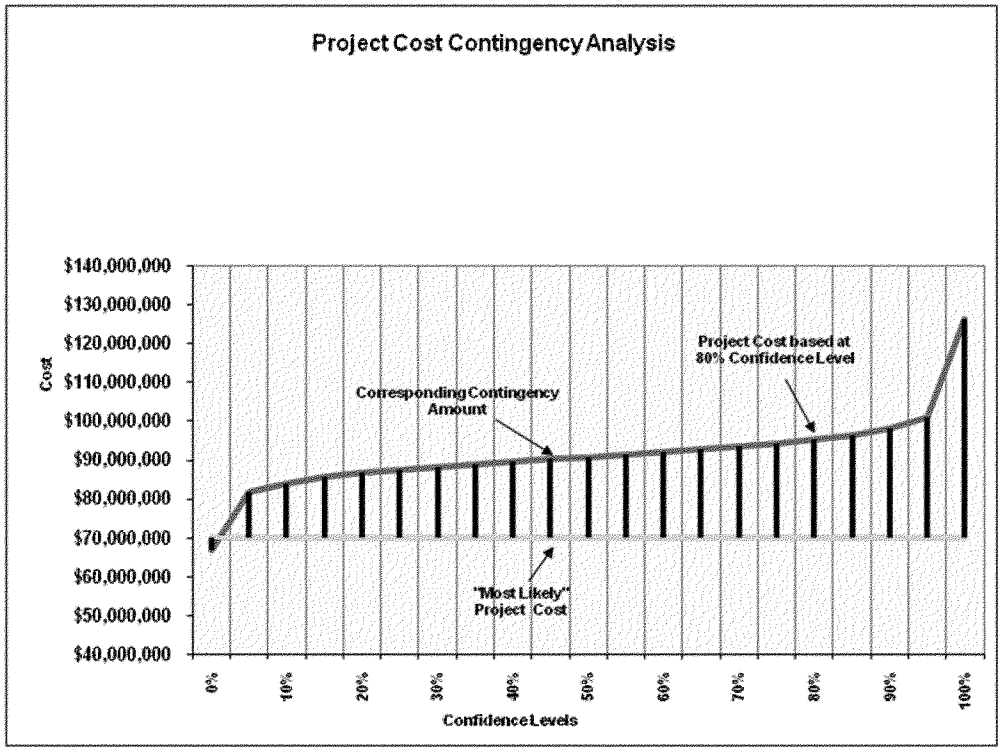


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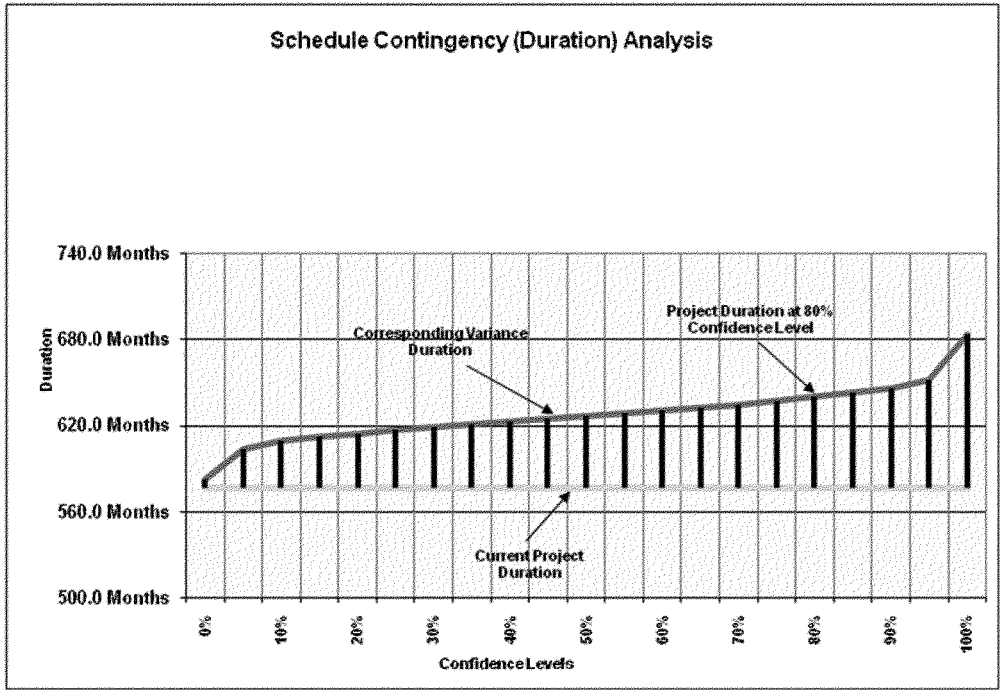
Figure 4. Project Duration Summary



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7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that proactive management of risks does not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

1. Key Cost Risk Drivers: The key cost risk drivers identified through sensitivity analysis were Risks EST-4 (Fuel Prices), TL-3 (Uncertainty with the Design of Beach Fill), and EST-2 (Impact of Hopper Size), which together contribute over 52 percent of the statistical cost variance.

a) Fuel Prices: Project leadership should ensure proactive market research to identify trends and their effect on the project cost. Ultimately, this is an external risk, and its impacts must be communicated to management, and funds should be maintained in project reserve for treatment of this risk.

b) Uncertainty with the Design of Beach Fill: Project leadership should attempt to capture and finalize the scope of the project to the maximum extent possible. It is imperative to identify all features of work and probable methodologies prior to project authorization, continuing to refine scoping details during the Pre-Construction Engineering and Design (PED Phase).

c) Impact of Hopper Size: Project leadership should ensure that the PDT conducts market research to determine the regional trends regarding the availability of equipment to meet the requirements in parallel to the general market research being conducted. The PDT may also consider changing the engineering requirements or methodologies to increase competition and/or the likelihood of equipment being available. Ultimately, this is an external risk, and its impacts must be communicated to management, and funds should be maintained in project reserve for treatment of this risk.

2. Key Schedule Risk Drivers: The key schedule risk drivers identified through sensitivity analysis were Risks PR-1 (Project Schedule in Question) and RE-1 (Impacts of New Concerns Arising Due to Delay), which together contribute 56 percent of the statistical schedule variance.

a) Project Schedule in Question: Project leadership should take proactive measures with respect to the schedule and the timeline for budget approval and disbursement of project funds. Changes to the anticipated timeline with respect to schedule should be controlled and reported to management for expeditious schedule recovery efforts. Ultimately, this is an external risk, and its impacts must be communicated to management, and funds should be maintained in project reserve for treatment of this risk.

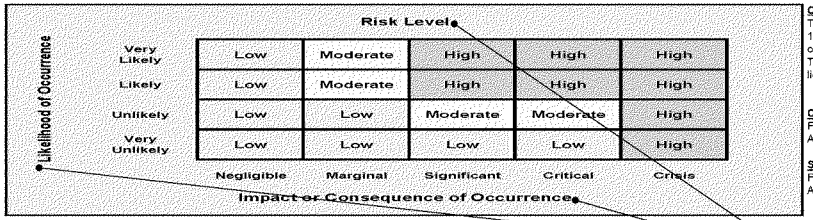
b) Impacts of New Concerns Arising Due to Delay: Project leadership should conduct further research regarding the likelihood of this scenario. Research to determine whether or not this will occur may also identify mitigation strategies that would obviate the occurrence of this risk. Ultimately, this is an external risk, and its impacts must be communicated to management.

3. Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

San Clemente - PDT Risk Register



Overall Project Scope
The project consists on dredging material offshore Oceanside, hauling it and placing it at San Clemente Beach. Beach fill is 1,040 m long and 15 m wide with a +5.2 m crest elevation. There are a total of 9 nourishment events through the 50-year life occurring at 6 year intervals. The total dredge volume per nourishment event 1 through 8 is 192,000 m3 (or 251,000 CY). The total dredge volume for nourishment event 9 is 64,000 m3 (or 83,900 CY). Cost is based on actual dredged volume in lieu of quantity placed on the receiver beach.

Cost Impacts
For the San Clemente Project, any cost impact of $600,000 or higher should be considered at least "Significant." Anything over $300,000 should be considered at least "Marginal."

Schedule Impacts
For the San Clemente Project, any schedule impact of 6 months or greater should be considered at least "Significant." Anything over 3 months should be considered at least "Marginal."

				Project Cost			Project Schedule						
Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*	Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
Contract Risks (Internal Risk Item's are those that are generated, caused, or controlled within the PDT's sphere of influence.)													
	PROJECT & PROGRAM MGMT												
PPM-1	No Control Over Staff Priorities	The District has experienced issues with not having the available manpower to complete the work in a timely manner due to the effects of competing priorities.	This has an effect on controlling staff priorities of work for short periods of time. This could have a larger effect, as it pertains to the authorization schedule.	Very Likely	Negligible	LOW	Very Likely	Marginal	MODERATE	Yes-NotUniform		District Management	Project Schedule
PPM-2	Unplanned Work that Must be Accommodated	If the feasibility study does not obtain approval via the Chief's Report in a timely manner, it could cause rework of all of the feasibility work (in the PED phase).	This risk specifically pertains to schedule risk. There may be issues that are discovered during the extended feasibility period that would cause changes to documents.	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW	Uniform	PPM-4	District Management	Project Cost & Schedule
PPM-3	Sponsor Funding Issues	The local sponsor (City of San Clemente) may not have their share of the funding in the right timing to move forward on the project.	This would impact the overall nourishment schedule.	Unlikely	Negligible	LOW	Unlikely	Significant	MODERATE	Uniform	PR-3	Project Sponsor(s)	Project Schedule
PPM-4	Issues with the PPA	The execution and finalization of the PPA may cause some delay. Show-stopping issues are not anticipated, but it could have an impact if the final agreements are delayed.	This could have an impact on the overall implementation schedule, as the Government cannot advertise until the PPA is signed.	Very Unlikely	Negligible	LOW	Very Likely	Significant	HIGH	Yes-NotUniform	PPM-2	Project Manager	Project Schedule
PPM-5	Coordination/Communication Difficulties	There is the inherent possibility of communication challenges (both internal on the PDT and external with the outside/resource agencies) that affect the overall project cost and schedule risks for implementation. This is not going to stop the project, but could have delay impacts.	This issue could have nominal cost impacts, but could impact the feasibility and implementation schedules. The PDT feels that this is a low risk, due to the fact that the PDT is fairly small, and there are relatively few outside entities to coordinate with.	Very Unlikely	Negligible	LOW	Likely	Negligible	LOW	Triangular		Project Manager	Project Schedule
	CONTRACT ACQUISITION RISKS												
CA-1	Small Business Set-Asides for Biological Monitoring Services	There are biological monitoring services in the overall implementation. These could be set aside for small business or 8(a). The District has experience several challenges with small business contracts in the past for these services.	This issue would primarily cause a cost impact. It could also cause schedule delays, if qualified offerors are unavailable. However, the schedule impact could be mitigated using an IDIQ.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Triangular		Contracting	Contract Cost & Project Schedule
CA-2	Preference for Small Business for One Nourishment Event	Due to the length of the project, there is the possibility that there will be a preference for small business for the last nourishment event (below 100,000 cy).	This could have a small impact on costs. This would only affect the last nourishment.	Likely	Negligible	LOW	Very Unlikely	Negligible	LOW	Triangular		Contracting	Contract Cost

	TECHNICAL RISKS												
TL-1	Uncertainty with the Location of the Borrow Site	There is some uncertainty as to the actual location of the borrow site due to competing projects or public perception of the quality of material at the site.	If another site must be identified and utilized, then it could change the haul distance from approximately 18.5 miles to up to 80 miles. This would have a significant impact on the costs and the schedule. The likelihood is that this borrow site will be available for the first several nourishment events. However, the chances of using the borrow site decrease for the latter cycles.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE	Yes-No/Triangular		Technical Lead	Contract Cost & Project Schedule
TL-2	Quality of Borrow Material	The material at the upper layers is fine and not of as good of quality. Due to the dredging method (hopper), it could present an issue with obtaining sufficient volume of quality material.	The estimate currently assumes 10% fines, 83% sand, and 7% gravel. The risk is that the fine and/or gravel gradation percentages are actually higher. Log results have been obtained for the borrow site. However, there was indication that more could have been obtained. The estimates were prepared with fairly conservative assumptions. Variation in gradations could affect the unit costs of dredging and the dredging time (and the placement costs).	Unlikely	Significant	MODERATE	Unlikely	Marginal	LOW	Yes-No/Triangular		Technical Lead	Contract Cost
TL-3	Uncertainty with the Design of the Beach Fill	Surveys may establish different site conditions that currently estimated, requiring additional excavation.	The PDT is fairly confident in the quantity development and calculations. However, surveys could change the assumptions based on current or future beach conditions. The PDT acknowledges that this could create a range of volume variation by up to 30-50% (increase or decrease).	Unlikely	Significant	MODERATE	Unlikely	Negligible	LOW	Yes-No/Triangular		Technical Lead	Contract Cost
TL-4	Unexploded Ordinances	There is a possibility of encountering unexploded ordinances at the borrow site.	The PDT acknowledges that this has happened before, however unlikely. This would require project shut-down, additional studies, surveys, and investigations. Specifically, this would require moving to a different borrow site.	Very Unlikely	Significant	LOW	Unlikely	Critical	MODERATE	Yes-No/Uniform		N/A	Project Schedule
TL-5	Innovative Designs (Surf grass)	There is some concern that if the resource agencies require restoration of surf grass habitat (may require rock placement as well as planting) beyond the first construction. The issue is that this has not been successfully accomplished before. This would occur after monitoring, if it did occur.	The PDT acknowledges that there may be a request to fund a research design project for the restoration of surf grass habitat (may require rock placement as well as planting).	Likely	Significant	HIGH	Likely	Negligible	LOW	Uniform		Technical Lead	Project Cost

	LANDS AND DAMAGES RISKS												
LD-1	Obtaining a State Land Permit for the Borrow Site	The sponsor has to obtain a State Land Permit for the borrow site to mine material for placement on-shore. The risk would be that State Lands may not want to give the permit to the sponsor	This risk is seen as highly unlikely. The worst case scenario is that this would require that the PDT select a different borrow site. There is the possibility that some additional surveys may be required, as it pertains to habitat and wildlife issues	Very Unlikely	Significant	LOW	Very Unlikely	Marginal	LOW	Yes-NoUniform	PR-4	Real Estate	Project Schedule
	REGULATORY AND ENVIRONMENTAL RISKS												
RE-1	Impacts of New Concerns Arising due to Delay	If the feasibility study is delayed, it could present an opportunity for new environmental issues (e.g. new listed species) to surface that would require rework of feasibility study documents. This has to do specifically with the permits lapsing.	This may have some impact also to costs, if a major environmental concern arises. The District may have to back to the State and to the Coastal Commission for approval, if new issues arise. The effects on cost could be extra work necessary to mitigate the new environmental concerns.	Very Likely	Significant	HIGH	Very Likely	Marginal	MODERATE	Yes-No/Triangular	PR-1	Project Manager	Project Cost & Schedule
RE-2	Subsequent Dredging Cycles at the Same Borrow Site	The resource agencies may want additional assessment to see if the nourishment activities are degrading the borrow area. If the monitoring shows habitat loss, they may require configuration (depth) restrictions, or they may require the use of an alternate location, or they may require additional mitigation features	The probability of restrictions increase with subsequent nourishment events. This is not seen as having impact on the first nourishment activity. The only impacts are to the out-year activities.	Likely	Significant	HIGH	Likely	Marginal	MODERATE	Yes-No/Triangular		Project Manager	Project Cost & Schedule
RE-3	Air Quality Restriction Issues	There has been some concern about the compliance with the air quality standards. This issue affects the bidding competition for the dredging industry due to rule changes to comply with air quality standards.	The local regulators are requiring very onerous requirements specific to engines, dredge configuration, etc. that makes it very difficult to dredgers to comply with the air quality standards. This is already partially considered in the current working estimate.	Likely	Significant	HIGH	Likely	Negligible	LOW	Triangular		Environmental	Contract Cost
RE-4	Adaptive Management Features	There may be a requirement for adaptive management features be included as it pertains to the mitigation and restoration of surf grass losses.	The PDT feels that it is very likely that a full adaptive management plan and features will be required. There is no consideration for adaptive management in the current working estimate.	Likely	Significant	HIGH	Likely	Negligible	LOW	Triangular		Environmental	Contract Cost
RE-5	Project in a Coastal Zone	The PDT has to obtain the approval of the Coastal Commission. There are issues with biological issues, surfing, beach recreation issues, etc. Prior projects have not had issues, but they did not include the rocky habitat, surf grass, and surfing community issues that this project has.	The PDT feels that this would have small impacts to costs, but could impact the schedule significantly. This could ultimately lead to the project proceeding under objection, which would elevate the political sensitivity of the project.	Unlikely	Marginal	LOW	Unlikely	Critical	MODERATE	Yes-NoUniform		Environmental	Project Schedule
	CONSTRUCTION RISKS												
CON-1	Traffic Considerations Due to Proximity to Camp Pendleton	Camp Pendleton Marine Base is nearby, and they do have amphibious landing exercises (including live fire exercises) periodically on the adjacent beaches. This could present navigational outages that would affect dredging productivity.	This would affect the ship haul, affecting dredge unit cost and dredge time due to having to use alternate haul routes. These exercises occur year-round.	Very Likely	Negligible	LOW	Very Likely	Negligible	LOW	Triangular		Technical Lead	Contract Cost
CON-2	Potential for Dense Sand Layers	The presence of dense sand layers could cause shut-downs or issues with productivity.	Further investigations may confirm or deny the presence of dense layers and stave off any potential construction claims. Could decrease the percent effective work time by up to 20%.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE	Yes-No/Triangular		Technical Lead	Contract Cost & Project Schedule
CON-3	Inefficient Contractor	There is a possibility that a new dredging contractor obtains one of the contracts and he is unable to perform the work.	The nature of this type of work makes this unlikely. However, this has happened before.	Very Unlikely	Critical	LOW	Very Unlikely	Critical	LOW	Yes-No/Triangular		Contracting	Contract Cost & Project Schedule

	ESTIMATE AND SCHEDULE RISKS												
EST-1	Hopper/Pipeline Combination Methodology	Potential Use of a combination of hopper/pipeline cutter head was considered as an alternate procedure. The hopper hauls the material, disposes of it temporarily near the shore and the pipeline cutter head pumps it ashore	This conceptual construction alternative will result in a more expensive project: double mob/demob and material double handling losses. This operation is unlikely. If a hopper were to work on this project, it would need to have pump out capabilities.	Unlikely	Significant	MODERATE	Unlikely	Marginal	LOW	Yes-No/Triangular	EST-3	Cost Engineering	Contract Cost
EST-2	Impact of Hopper Size	Baseline estimate considered a medium size hopper, however, there is the possibility of a large or small hopper dredge bidding the job	The use of a large size hopper will result in a lower dredging unit cost (-$/CY). The use of a small size hopper will result in a higher dredging unit cost (+$/CY).	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE	Yes-No/Triangular	EST-6	Cost Engineering	Contract Cost & Project Schedule
EST-3	Availability of Hopper Dredges on West Coast	Baseline estimate considered mob/demob from the East Coast.	Mob/demob from the East Coast was estimated as the worst case, but highly likely, scenario. It is unlikely dredging equipment will mob/demob from a farther location.	Very Unlikely	Critical	LOW	Very Unlikely	Marginal	LOW	Yes-No/Uniform	EST-1	Cost Engineering	Contract Cost & Project Schedule
EST-4	Fuel Prices	Fuel prices are volatile. Current estimated marine diesel fuel is $2.50/gal	Assume a 68% chance that future fuel prices will be within 50% of $2.50/gal (normal distribution)	Very Likely	Marginal	MODERATE	Unlikely	Marginal	LOW	Lognormal		Cost Engineering	Contract Cost
EST-5	Unusual Wave Action/Downtime	This relates to dredge effective working time.	Current estimate assumes a 90% effective working time. It could range from 80% to 100%.	Likely	Marginal	MODERATE	Unlikely	Marginal	LOW	Yes-No/Triangular		Cost Engineering	Contract Cost
EST-6	Dredging Productivity	Dredging productivity may vary based on material classification. Current estimate assumes 1,145 cy/hr.	Fine components range from 6-12%. Gravel+ cobbles range from 5-6%.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Triangular	EST-2	Cost Engineering	Contract Cost & Project Schedule
EST-7	Change in Site Conditions	This relates to longer or shorter hauls for the dredge within the identified borrow site.	Most likely haul distance from borrow site to receiver beach is estimated at 30 Km (18.6 mi). Worst case scenario would be 35 Km (21.7 mi). Best case scenario would be 25 Km (15.5 mi).	Unlikely	Significant	MODERATE	Unlikely	Marginal	LOW	Yes-No/Triangular		N/A	Contract Cost
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)												
PR-1	Project Schedule in Question	The project authorization date is in question. It could be 2011 or 2012. If there are no new starts and no WRDAs, this could lead to extensive delay.	This could impact the overall nourishment schedule start. The PDT is hoping for an authorization through a WRDA 2012, which would begin the appropriation in 2014. It is possible that it could be in 2011.	Very Unlikely	Negligible	LOW	Very Likely	Significant	HIGH	Uniform	RE-1	Project Manager	Project Schedule
PR-2	Abnormal Weather Events	Abnormally excessive waves due to weather events could slow productivity of the hopper dredging	The issue is that the contractor would not be able to complete in the dredging window, meaning that they would have to be remobilized the following year (additional mob and demob costs). This has happened before on previous jobs. The wave issue arises about every 15 years or so	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE	HypergeometricK Ustom		N/A	Project Cost & Schedule
PR-3	Adequacy of Project Funding	There are concerns that the project is funded at all (show-stopping) risk, or that the funding on the federal or non-federal share will happen in a timely fashion	Partial sums could change the contract acquisition and project configuration such that the nourishment events would not be feasible. Not obtaining the needed outlay would stop the event for cost, but could extend the schedule (until enough funds were available)	Very Likely	Negligible	LOW	Very Likely	Significant	HIGH	Yes-No/Uniform	PPM-3	Project Manager	Project Schedule
PR-4	Political Opposition/Threat of Lawsuits	There are local SIGs (i.e. Surf Rider Foundation) that are opposed to the nourishment activities. They could potentially attempt to file a suit against the project. There are also other groups that oppose nourishment activities.	There remains the possibility that political opposition could stop the project or any individual event. It could also create a delay in the activities as well.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Yes-No/Uniform	LD-1	Project Manager	Project Cost & Schedule
PR-5	Stakeholders Request Late Changes	The PDT has discussed the possibility that over the life of the project, stakeholders could request new scope items be added to the project.	Over the course of the entire 50 years, it is likely that changes will be requested. The PDT can contemplate scenarios that would increase scope by at least up to 20%.	Very Likely	Significant	HIGH	Very Likely	Significant	HIGH	Triangular		Project Manager	Project Cost & Schedule

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

USACE Los Angeles District
San Clemente

Initial Risk Register Development Meeting

Date: Thursday, September 30, 2010

No.	Name	Section	Title
1	Joe Johnson	CESPL-PD	Project Manager
2	Heather Schlosser	CESPL-PD-WS	Lead Planner
3	Nate West	CESPL-PD-WS	Planner
4	Ark Shak	CESPL-ED-DC	Coastal Engineering
5	Greg Dombrosky	CESPL-ED-GD	Soils
6	Jeff Devine	CESPL-ED-GG	Geotechnical Engineering
7	Juan Dominguez	CESPL-ED-DS	Cost Engineering
8	Tom Keeny	CESPL-PD	Environmental
9	Amy Holmes	CESPL-PD-RN	Cultural Resources
10	Glenn Matlock	CENWW-EC-X	Cost Engineer/Risk Facilitator

San Clemente - Cost and Schedule Risk Analysis

Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	$70,586,000
Baseline Estimate Cost Contingency Amount ->	$13,012,285
Baseline Estimate Construction Cost (80% Confidence) ->	$83,598,285

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	575.3 Months
Schedule Contingency Duration ->	63.4 Months
Project Schedule Duration (80% Confidence) ->	639.8 Months
Project Schedule Contingency Amount (80% Confidence) ->	$12,278,626

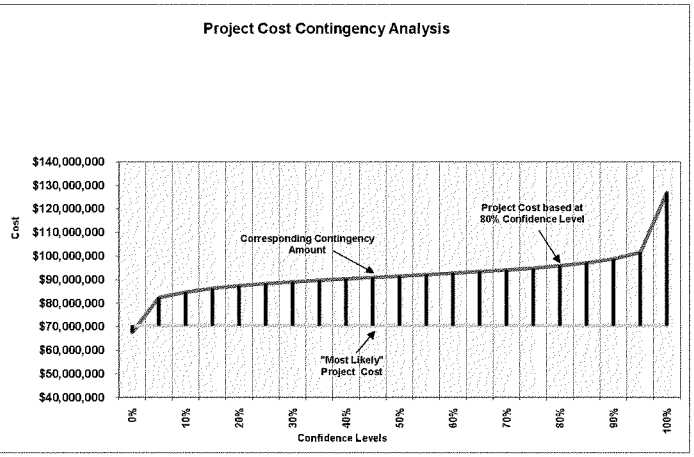
Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	$25,288,911
Project Contingency Percentage (80% Confidence) ->	36%

Project Cost (80% Confidence) ->	$95,874,911

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

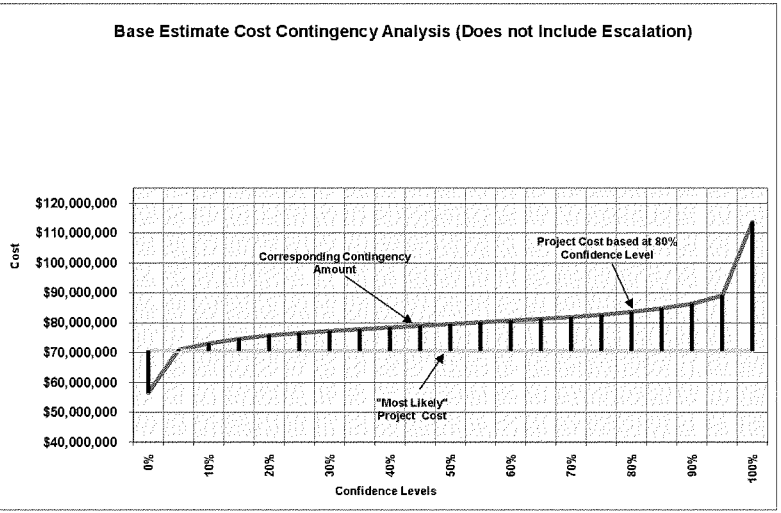
Most Likely Cost Estimate	$70,586,000		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$67,625,836	[illegible]	-4.19%
5%	$82,375,420	$11,789,420	16.70%
10%	$84,659,674	$14,073,674	19.94%
15%	$86,286,085	$15,700,085	22.24%
20%	$87,435,861	$16,849,861	23.87%
25%	$88,281,780	$17,695,780	25.07%
30%	$89,022,417	$18,436,417	26.12%
35%	$89,674,675	$19,088,675	27.04%
40%	$90,311,292	$19,725,292	27.95%
45%	$90,907,503	$20,321,503	28.79%
50%	$91,492,778	$20,906,778	29.62%
55%	$92,124,350	$21,538,350	30.51%
60%	$92,780,818	$22,194,818	31.44%
65%	$93,408,960	$22,822,960	32.33%
70%	$94,083,051	$23,497,051	33.29%
75%	$94,847,932	$24,261,932	34.37%
80%	**$95,874,911**	**$25,288,911**	**35.83%**
85%	$97,118,504	$26,532,504	37.59%
90%	$98,741,900	$28,155,900	39.89%
95%	$101,653,118	$31,067,118	44.01%
100%	$126,941,860	$56,355,860	79.84%



- BASE CONTINGENCY DEVELOPMENT -

Contingency Analysis

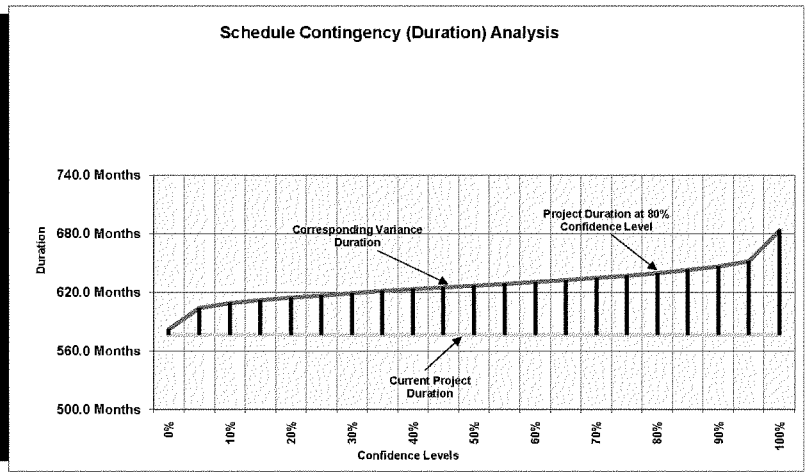
Most Likely Cost Estimate	$70,586,000		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$56,645,428	[illegible]	-19.75%
5%	$70,902,694	$316,693.81	0.45%
10%	$73,076,512	$2,490,512.40	3.53%
15%	$74,635,745	$4,049,744.51	5.74%
20%	$75,727,382	$5,141,382.38	7.28%
25%	$76,521,219	$5,935,219.38	8.41%
30%	$77,208,624	$6,622,624.27	9.38%
35%	$77,812,282	$7,226,282.19	10.24%
40%	$78,405,655	$7,819,655.43	11.08%
45%	$78,964,410	$8,378,410.05	11.87%
50%	$79,507,020	$8,921,019.57	12.64%
55%	$80,097,322	$9,511,321.75	13.47%
60%	$80,710,832	$10,124,831.66	14.34%
65%	$81,294,179	$10,708,178.77	15.17%
70%	$81,919,389	$11,333,388.94	16.06%
75%	$82,631,440	$12,045,440.03	17.06%
80%	$83,598,285	$13,012,285.13	18.43%
85%	$84,773,630	$14,187,629.99	20.10%
90%	$86,315,491	$15,729,490.56	22.28%
95%	$89,103,541	$18,517,541.24	26.23%
100%	$113,680,199	$43,094,198.90	61.05%



- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

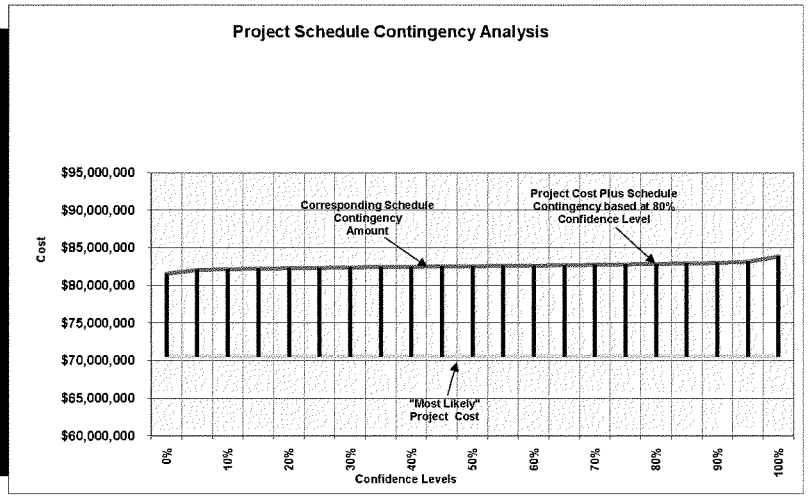
Most Likely Schedule Duration	576.3 Months		
Confidence Level	Project Duration	Contingency	Contingency %
0%	582.2 Months	5.8 Months	1.01%
5%	604.0 Months	27.7 Months	4.81%
10%	608.9 Months	32.6 Months	5.66%
15%	611.9 Months	35.6 Months	6.18%
20%	614.5 Months	38.2 Months	6.62%
25%	616.8 Months	40.5 Months	7.03%
30%	619.2 Months	42.9 Months	7.44%
35%	621.4 Months	45.0 Months	7.81%
40%	623.3 Months	46.9 Months	8.15%
45%	624.9 Months	48.6 Months	8.43%
50%	626.8 Months	50.5 Months	8.76%
55%	628.7 Months	52.3 Months	9.08%
60%	630.6 Months	54.2 Months	9.41%
65%	632.6 Months	56.2 Months	9.76%
70%	634.7 Months	58.4 Months	10.14%
75%	637.1 Months	60.8 Months	10.54%
80%	639.8 Months	63.4 Months	11.01%
85%	642.8 Months	66.5 Months	11.53%
90%	646.4 Months	70.1 Months	12.16%
95%	651.9 Months	75.6 Months	13.11%
100%	683.5 Months	107.2 Months	18.60%

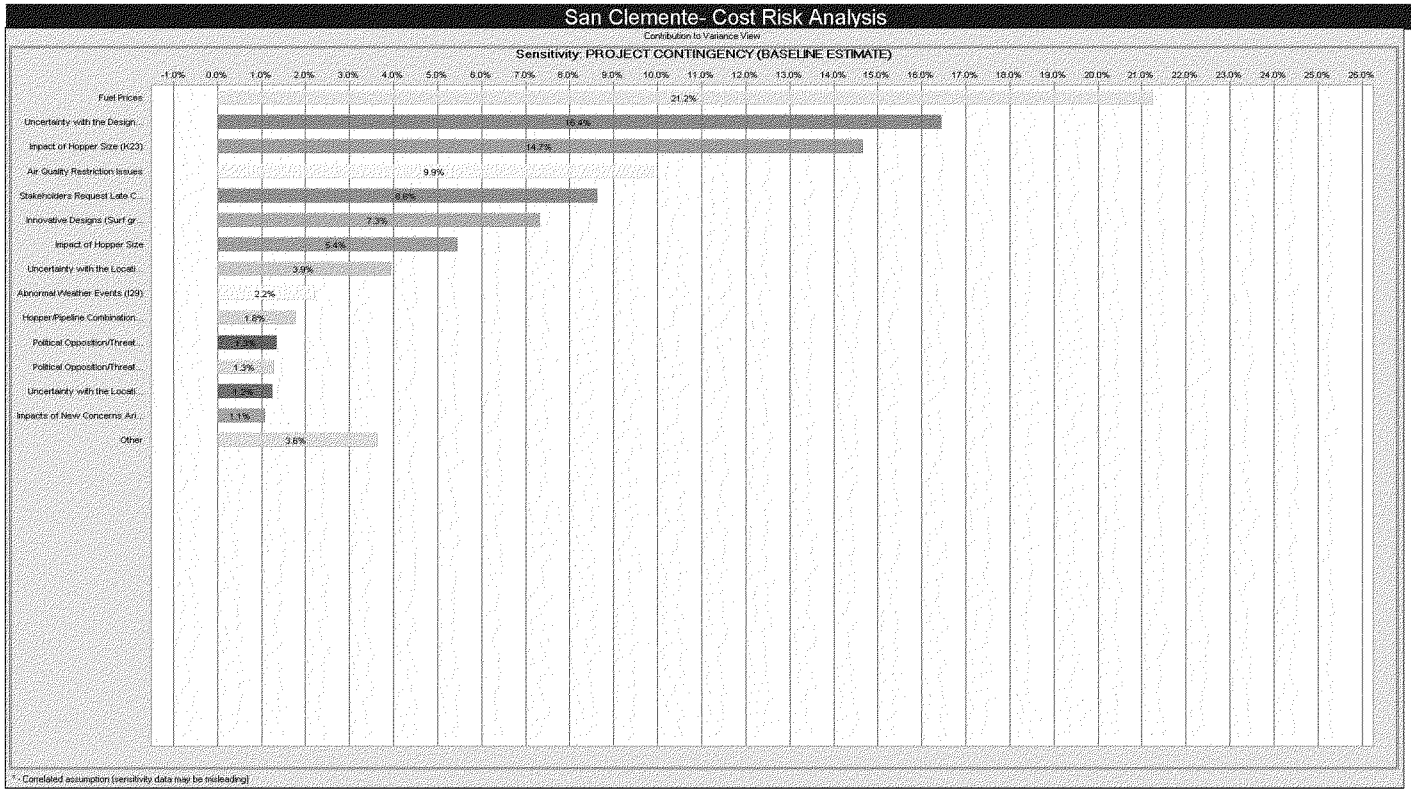


- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$70,586,000		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$81,566,409	$10,980,409	15.56%
5%	$82,058,726	$11,472,726	16.25%
10%	$82,169,162	$11,583,162	16.41%
15%	$82,236,341	$11,650,341	16.51%
20%	$82,294,479	$11,708,479	16.59%
25%	$82,346,561	$11,760,561	16.66%
30%	$82,399,793	$11,813,793	16.74%
35%	$82,448,393	$11,862,393	16.81%
40%	$82,491,636	$11,905,636	16.87%
45%	$82,529,093	$11,943,093	16.92%
50%	$82,571,758	$11,985,758	16.98%
55%	$82,613,028	$12,027,028	17.04%
60%	$82,655,986	$12,069,986	17.10%
65%	$82,700,781	$12,114,781	17.16%
70%	$82,749,662	$12,163,662	17.23%
75%	$82,802,492	$12,216,492	17.31%
80%	$82,862,626	$12,276,626	17.39%
85%	$82,930,874	$12,344,874	17.49%
90%	$83,012,409	$12,426,409	17.60%
95%	$83,135,576	$12,549,576	17.78%
100%	$83,847,661	$13,261,661	18.79%




San Clemente- Cost Risk Analysis
Contribution to Variance View
Sensitivity: PROJECT CONTINGENCY (BASELINE ESTIMATE)
-1.0% 0.0% 1.0% 2.0% 3.0% 4.0% 5.0% 6.0% 7.0% 8.0% 9.0% 10.0% 11.0% 12.0% 13.0% 14.0% 15.0% 16.0% 17.0% 18.0% 19.0% 20.0% 21.0% 22.0% 23.0% 24.0% 25.0% 26.0%
Fuel Prices
21.2%
Uncertainty with the Design...
16.4%
Impact of Hopper Size (K23)
14.7%
Air Quality Restriction Issues
9.9%
Stakeholders Request Late C...
8.6%
Innovative Designs (Surf gr...
7.3%
Impact of Hopper Size
5.4%
Uncertainty with the Locati...
3.9%
Abnormal Weather Events (I29)
2.2%
Hopper/Pipeline Combination...
1.8%
Political Opposition/Threat...
1.3%
Political Opposition/Threat...
1.3%
Uncertainty with the Locati...
1.2%
Impacts of New Concerns Ari...
1.1%
Other
3.8%
* - Correlated assumption (sensitivity data may be misleading)

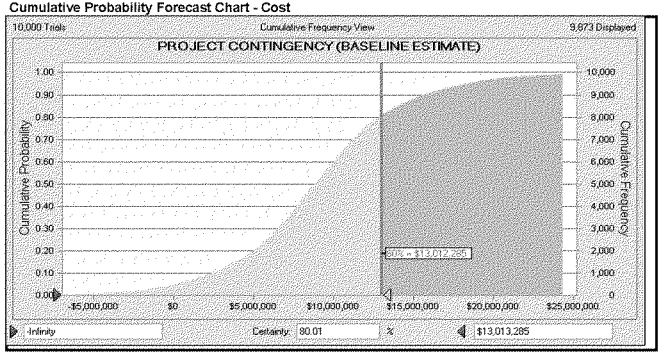
San Clemente - Cost Risk Analysis Model

oject Cost						Crystal Ball Simulation							
						Expected Values ($$$)					Expected Values (%s)		
ct*	Risk Level*	Variance Distribution	Correlation to Other(s)	Correlation Factor	Probability of Occurrence	Low	Most Likely	High	Contingency Model	Notes	Low	Most Likely	High
id, or controlled within the PDT's sphere of influence.)													
nal	MODERATE	Triangular			100%	$0	$0	$300,000	$0		0.00%	0.00%	1.29%
cant	MODERATE	Custom/Triangular			0%	$0	$0	$7,217,709	$0	*Estimated with CEDEP*	0.00%	0.00%	10.23%
cant	MODERATE	Yes-No/Triangular	TL-2	N/A	35%		$0	$12,837,189	$0	*Computed in CEDEP. Correlated to a Risk Removed from the Study.*	-17.90%	0.00%	17.90%
cant	HIGH	Uniform			100%	$0	$0	$3,502,950	$0		0.00%	0.00%	4.96%
cant	HIGH	Yes-No/Triangular			89%	$0	$0	$2,003,310	$0		0.00%	0.00%	2.84%
cant	HIGH	Triangular			100%	$0	$0	$5,000,000	$0		0.00%	0.00%	7.08%
cant	HIGH	Triangular			100%	$0	$0	$1,573,920	$0		0.00%	0.00%	2.23%
nal	LOW	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*Reduced to Low Risk -- Research confirms very little probability of impact*	N/A	N/A	N/A
cant	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*CON-2 IS CAPTURED BY EST-6*	N/A	N/A	N/A
cant	MODERATE	Yes-No/Triangular			11%	$0	$0	$4,737,420	$0	*Estimated with CEDEP. Correlated to a low risk.*	0.00%	0.00%	6.71%
nal	MODERATE	Yes-No/Triangular	EST-6	0.75	59%		$0	$4,737,420	$0		-15.29%	0.00%	6.71%
nal	MODERATE	Lognormal			100%		$0	$9,443,520	$0	*Estimated with CEDEP*	-2.97%	0.00%	13.39%
nal	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*EST-5 IS CAPTURED BY PR-2*	N/A	N/A	N/A
nal	MODERATE	Triangular	EST-2	0.75	100%		$0	$0	$0	*Estimated with CEDEP. Correlated to EST-2 by a factor of 0.75.*	-1.66%	0.00%	0.00%
cant	MODERATE	Yes-No/Triangular			11%		$0	$2,631,900	$0		-3.36%	0.00%	3.73%
used, or controlled exclusively outside the PDT's sphere of influence.)													
cant	MODERATE	Hypergeometric/Custo m			7	$0	$0	$628,600	$0		0.00%	0.00%	0.89%
nal	MODERATE	Yes-No/Uniform			65%	$0	$0	$2,000,000	$0		0.00%	0.00%	2.83%
cant	HIGH	Yes-No/Triangular			10%	$0	$0	$14,008,200	$0		0.00%	0.00%	19.85%
									$0				

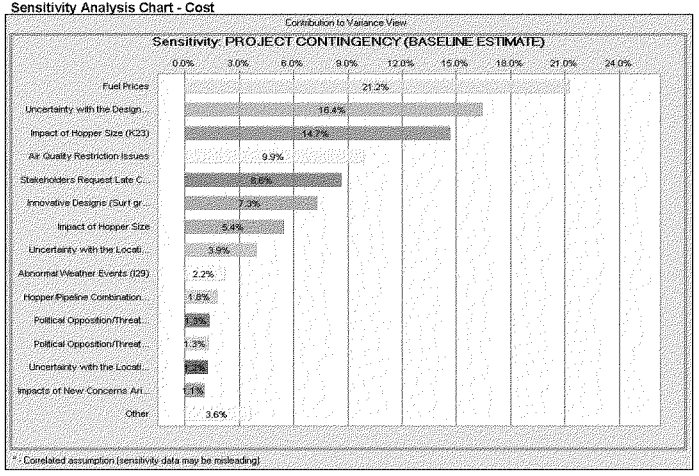
Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

PROJECT CONTINGENCY (BASELINE ESTIMATE)	Percentile	Baseline TPC	Contingency Amount	Baseline w/ Contingency	Contingency %
	0%	$70,586,000	($13,840,572)	$56,645,428	-19.75%
	5%	$70,586,000	$316,694	$70,902,694	0.45%
	10%	$70,586,000	$2,490,512	$73,076,512	3.53%
	15%	$70,586,000	$4,049,745	$74,635,745	5.74%
	20%	$70,586,000	$5,141,382	$75,727,382	7.28%
	25%	$70,586,000	$5,935,219	$76,521,219	8.41%
	30%	$70,586,000	$6,622,624	$77,208,624	9.38%
	35%	$70,586,000	$7,226,282	$77,812,282	10.24%
	40%	$70,586,000	$7,819,655	$78,405,655	11.08%
	45%	$70,586,000	$8,378,410	$78,964,410	11.87%
	50%	$70,586,000	$8,921,020	$79,507,020	12.64%
	55%	$70,586,000	$9,511,322	$80,097,322	13.47%
	60%	$70,586,000	$10,124,832	$80,710,832	14.34%
	65%	$70,586,000	$10,708,179	$81,294,179	15.17%
	70%	$70,586,000	$11,333,389	$81,919,389	16.06%
	75%	$70,586,000	$12,045,440	$82,631,440	17.06%
	80%	$70,586,000	$13,012,285	$83,598,285	18.43%
	85%	$70,586,000	$14,187,630	$84,773,630	20.10%
	90%	$70,586,000	$15,729,491	$86,315,491	22.28%
	95%	$70,586,000	$18,517,541	$89,103,541	26.23%
	100%	$70,586,000	$43,094,199	$113,680,199	61.05%

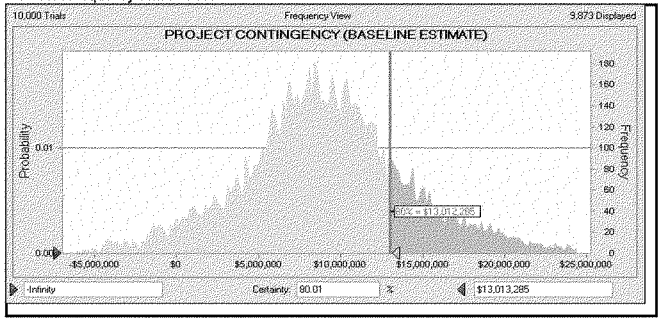
Cumulative Probability Forecast Chart - Cost



Sensitivity Analysis Chart - Cost



Forecast Frequency Chart - Cost



San Clemente - Schedule Risk Analysis
Sensitivity PROJECT CONTINGENCY (BASELINE SCHEDULE)
Contribution to Variance Value
-2.0%
0.0%
2.0%
4.0%
6.0%
8.0%
10.0%
12.0%
14.0%
16.0%
18.0%
20.0%
22.0%
24.0%
26.0%
28.0%
30.0%
32.0%
34.0%
36.0%
* Project Schedule in Question
* Impacts of New Concerns' Act...
Issues with the PPA (4Y41)
Small Business Set-Asides (...
Issues with the PPA
Sponsor Funding Issues
Political Opposition/Threat...
Project in a Coastal Zone
Stakeholders Request Late C...
Impact of Hopper Size (4Y24)
Political Opposition/Threat...
Subsequent Dredging Cycles ...
Impact of Hopper Size
Subsequent Dredging Cycles ...
Other
8.8%
7.0%
4.6%
4.6%
3.4%
2.9%
2.3%
2.4%
1.3%
1.2%
0.8%
1.0%
3.3%
23.9%
32.0%
* - Correlated assumption (sensitivity data may be misleading)

San Clemente - Schedule Risk Analysis Model

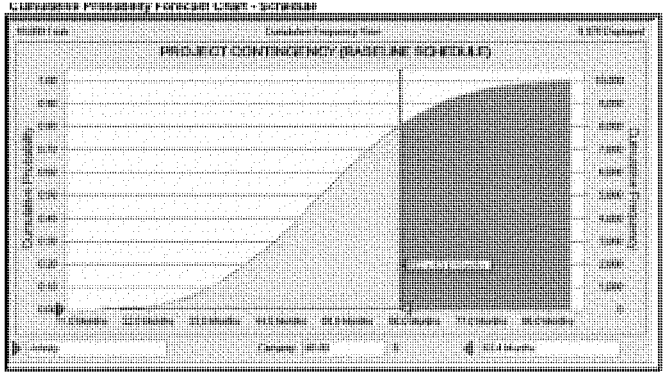
		Project Schedule							Crystal Ball Simulation: Expected Values (Months)					Expected Values (%)		
Risk No.	Risk/Opportunity Event	Likelihood*	Impact*	Risk Level*	Variance Distribution	Correlation to Other(s)	Correlation Factor	Probability of Occurrence	Low	Most Likely	High	Contingency Model	Notes	Low	Most Likely	High
Internal Risks (Internal Risk items are those that are generated, caused, or controlled within the PDT's sphere of influence.)																
PROJECT & PROGRAM MGMT																
PPM-1	No Control Over Staff Priorities	Very Likely	Marginal	MODERATE	Yes-Mid/Uniform			85%	0.0 Months	0.0 Months	6.0 Months	0.0 Months		0.00%	0.00%	1.06%
PPM-3	Sponsor Funding Issues	Unlikely	Significant	MODERATE	Uniform	PR-3	0.5	100%	0.0 Months	0.0 Months	12.0 Months	0.0 Months		0.00%	0.00%	2.08%
PPM-4	Issues with the PPA	Very Likely	Significant	HIGH	Yes-Mid/Uniform			85%	0.0 Months	0.0 Months	18.0 Months	0.0 Months		0.00%	0.00%	3.12%
CONTRACT ACQUISITION RISKS																
CA-1	Small Business Set-Asides for Biological Monitoring Services	Likely	Marginal	MODERATE	Triangular			100%	0.0 Months	0.0 Months	18.0 Months	0.0 Months		0.00%	0.00%	3.12%
TECHNICAL RISKS																
TL-1	Uncertainty with the Location of the Borrow Site	Unlikely	Significant	MODERATE	Yes-No/Triangular			0%	0.0 Months	0.0 Months	4.5 Months	0.0 Months	***Estimated with CEDEP***	0.00%	0.00%	0.78%
TL-4	Unexploded Ordinances	Unlikely	Critical	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	***TL-4 IS CAPTURED BY EST-7***	N/A	N/A	N/A
REGULATORY AND ENVIRONMENTAL RISKS																
RE-1	Impacts of New Concerns Arising due to Delay	Very Likely	Marginal	MODERATE	Yes-No/Triangular	PR-1	0.75	85%	0.0 Months	0.0 Months	12.0 Months	0.0 Months		0.00%	0.00%	2.08%
RE-2	Subsequent Dredging Cycles at the Same Borrow Site	Likely	Marginal	MODERATE	Yes-No/Triangular			65%	0.0 Months	0.0 Months	12.0 Months	0.0 Months		0.00%	0.00%	2.08%
RE-5	Project in a Coastal Zone	Unlikely	Critical	MODERATE	Yes-No/Uniform			30%	0.0 Months	0.0 Months	12.0 Months	0.0 Months		0.00%	0.00%	2.08%
CONSTRUCTION RISKS																
CON-2	Potential for Dense Sand Layers	Unlikely	Significant	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	***CON-2 IS CAPTURED BY EST-6***	N/A	N/A	N/A
ESTIMATE AND SCHEDULE RISKS																
EST-2	Impact of Hopper Size	Very Likely	Marginal	MODERATE	Yes-No/Triangular	EST-6	0.75	50%	-7.0 Months	0.0 Months	19.5 Months	0.0 Months		-1.22%	0.00%	3.21%
EST-6	Dredging Productivity	Likely	Marginal	MODERATE	Triangular	EST-2	0.75	100%	-0.7 Months	0.0 Months	0.0 Months	0.0 Months	***Estimated with CEDEP. Correlated to EST-2 by a factor of 0.75.***	-0.12%	0.00%	0.00%
Programmatic Risks (External Risk items are those that are generated, caused, or controlled by entities outside the PDT's sphere of influence.)																
PR-1	Project Schedule in Question	Very Likely	Significant	HIGH	Uniform	RE-1	0.75	100%	0.0 Months	0.0 Months	24.0 Months	0.0 Months		0.00%	0.00%	4.16%
PR-2	Abnormal Weather Events	Unlikely	Significant	MODERATE	Hypergeometric/Custom			7	0.0 Months	0.0 Months	1.0 Months	0.0 Months		0.00%	0.00%	0.17%
PR-3	Adequacy of Project Funding	Very Likely	Significant	HIGH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	***PR-3 is a Show Stopping Risk - Not Considered for Quantitative Study***	N/A	N/A	N/A
PR-4	Political Opposition/Threat of Lawsuits	Likely	Marginal	MODERATE	Yes-Mid/Uniform			65%	0.0 Months	0.0 Months	12.0 Months	0.0 Months		0.00%	0.00%	2.08%
PR-5	Stakeholders Request Late Changes	Very Likely	Significant	HIGH	Yes-No/Triangular			10%	0.0 Months	0.0 Months	24.0 Months	0.0 Months		0.00%	0.00%	4.16%
												0.0 Months				

Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

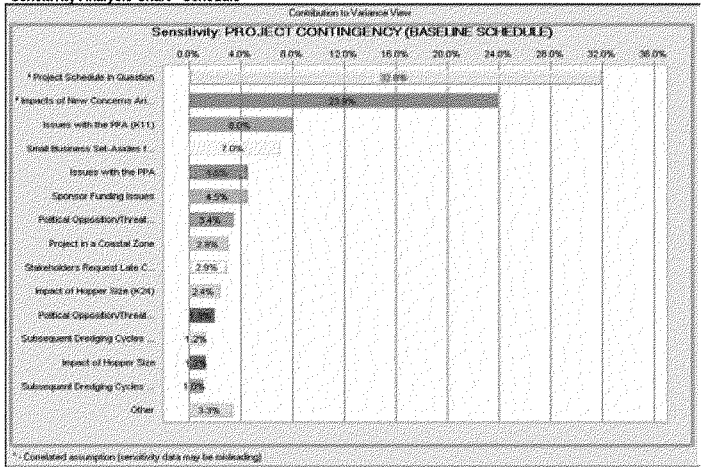
Contingency Summary Table - Schedule

	Percentile	Baseline TPC	Contingency Amount	Baseline w/ Contingency	Contingency %
PROJECT CONTINGENCY (BASELINE SCHEDULE)	0%	576.3 Months	5.8 Months	**582.2 Months**	**1.01%**
	5%	576.3 Months	27.7 Months	**604.0 Months**	**4.81%**
	10%	576.3 Months	32.6 Months	**609.9 Months**	**5.66%**
	15%	576.3 Months	35.6 Months	**611.9 Months**	**6.19%**
	20%	576.3 Months	38.2 Months	**614.5 Months**	**6.62%**
	25%	576.3 Months	40.5 Months	**616.8 Months**	**7.03%**
	30%	576.3 Months	42.9 Months	**619.2 Months**	**7.44%**
	35%	576.3 Months	45.0 Months	**621.4 Months**	**7.81%**
	40%	576.3 Months	46.9 Months	**623.3 Months**	**8.15%**
	45%	576.3 Months	48.6 Months	**624.9 Months**	**8.43%**
	50%	576.3 Months	50.5 Months	**626.8 Months**	**8.76%**
	55%	576.3 Months	52.3 Months	**628.7 Months**	**9.08%**
	60%	576.3 Months	54.2 Months	**630.6 Months**	**9.41%**
	65%	576.3 Months	56.2 Months	**632.6 Months**	**9.76%**
	70%	576.3 Months	58.4 Months	**634.7 Months**	**10.14%**
	75%	576.3 Months	60.8 Months	**637.1 Months**	**10.54%**
	80%	576.3 Months	63.4 Months	**639.8 Months**	**11.01%**
	85%	576.3 Months	66.5 Months	**642.8 Months**	**11.53%**
	90%	576.3 Months	70.1 Months	**646.4 Months**	**12.16%**
	95%	576.3 Months	75.6 Months	**651.9 Months**	**13.11%**
	100%	576.3 Months	107.2 Months	**683.5 Months**	**18.60%**

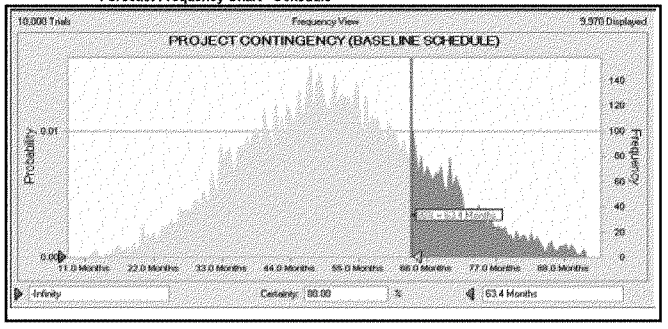
Cumulative Probability Forecast Chart - Schedule



Sensitivity Analysis Chart - Schedule



Forecast Frequency Chart - Schedule



San Clemente - Cost and Schedule Risk Analysis

Enter Estimated Total Project Cost (Price Level)	$70,586,000
Max. Anticipated Annual Amount	$1,470,542
Enter Current OMB Escalation Rate	1.80%
Enter Current Project Location Escalation Rate	2.12%
Enter Assumed Monthly Recurring Cost Rate	3.00%

	Date	Escalation Delta Amount	Monthly Recurring Costs Amount	Total Schedule Contingency
Enter Current Project Start	1-Oct-11			
Enter Baseline Project Completion	1-Oct-59	$10,542,435.83		$10,842,435.83
Project Completion at 5% Confidence	20-Mar-60	$10,954,020.05	$21,364.58	$10,985,498.65
Project Completion at 10% Confidence	25-Jun-60	$11,370,958.45	$10,786.60	$11,472,725.08
Project Completion at 15% Confidence	19-Jun-62	$11,483,340.95	$119,821.14	$11,583,181.09
Project Completion at 20% Confidence	17-Sep-62	$11,519,640.73	$130,791.88	$11,650,540.61
Project Completion at 25% Confidence	3-Dec-62	$11,558,140.05	$145,296.16	$11,708,479.03
Project Completion at 30% Confidence	19-Feb-63	$11,611,788.45	$146,791.40	$11,760,582.82
Project Completion at 35% Confidence	28-Apr-63	$11,666,338.54	$107,804.55	$11,813,793.04
Project Completion at 40% Confidence	1-Jul-63	$11,696,872.13	$165,421.17	$11,862,303.39
Project Completion at 45% Confidence	28-Aug-63	$11,733,151.40	$172,682.99	$11,905,838.39
Project Completion at 50% Confidence	16-Oct-63	$11,764,460.67	$178,598.75	$11,943,062.68
Project Completion at 55% Confidence	15-Dec-63	$11,800,190.95	$185,567.30	$11,985,758.24
Project Completion at 60% Confidence	2-Feb-64	$11,834,727.40	$192,508.91	$12,027,026.31
Project Completion at 65% Confidence	7-Apr-64	$11,870,863.62	$198,222.13	$12,069,085.75
Project Completion at 70% Confidence	6-Jun-64	$11,908,140.95	$206,697.64	$12,114,781.42
Project Completion at 75% Confidence	11-Aug-64	$11,946,642.30	$214,818.63	$12,163,062.23
Project Completion at 80% Confidence	22-Oct-64	$11,990,244.79	$223,247.51	$12,216,492.07
Project Completion at 85% Confidence	11-Jan-65	$12,043,568.56	$233,087.50	$12,278,626.06
Project Completion at 90% Confidence	15-Apr-65	$12,106,881.12	$244,212.71	$12,344,673.82
Project Completion at 95% Confidence	2-Aug-65	$12,196,801.44	$261,507.87	$12,439,409.31
Project Completion at 99% Confidence	15-Oct-66	$12,271,894.76	$277,641.70	$12,549,576.46
Project Completion at 100% Confidence	4-Sep-68	$12,607,700.35	$365,408.76	$13,251,691.11

Entry Required

Do Not Overwrite

Summary Data -- Do Not Overwrite

San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-1	No Control Over Staff Priorities	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

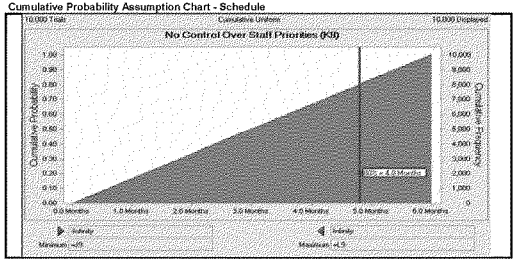
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-1	No Control Over Staff Priorities	Very Likely	Marginal	MODERATE	Yes-No/Uniform	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	

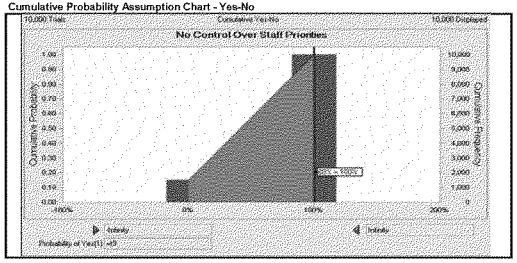
Description	The district has experiences issues with not having the available manpower to complete the work in a timely manner due to the effects of competing priorities.
Development of Low Values	The best case scenario is no change to the current baseline schedule.
Development of High Values	The worst case scenario is that the authorization schedule is delayed by up to 6 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	N/A	0.0 Months	No
10%	N/A	0.6 Months	No
20%	N/A	1.2 Months	Yes
30%	N/A	1.8 Months	Yes
40%	N/A	2.4 Months	Yes
50%	N/A	3.0 Months	Yes
60%	N/A	3.6 Months	Yes
70%	N/A	4.2 Months	Yes
80%	N/A	4.8 Months	Yes
90%	N/A	5.4 Months	Yes
100%	N/A	6.0 Months	Yes

Cumulative Probability Assumption Chart - Schedule



Cumulative Probability Assumption Chart - Yes-No



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-3	Sponsor Funding Issues	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

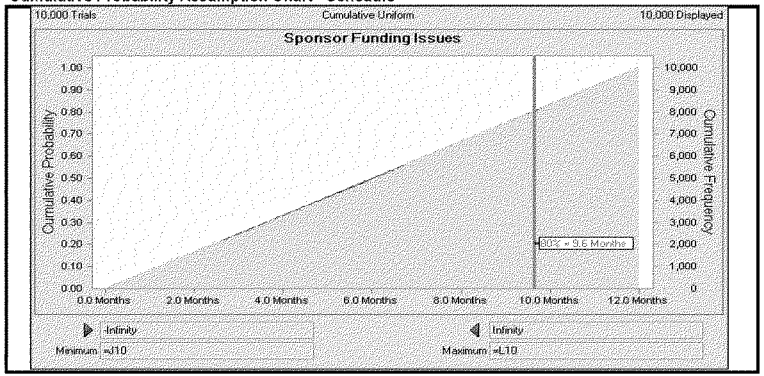
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-3	Sponsor Funding Issues	Unlikely	Significant	MODERATE	Uniform	PR-3	0.5	0.0 Months	0.0 Months	12.0 Months	*Correlated to PR-3 by a factor of 0.5*

Description	The local sponsor (City of San Clemente) may not have their share of the funding in time to move forward on the project.
Development of Low Values	The best case scenario is no change to the current baseline schedule.
Development of High Values	The worst case scenario is that issues that delay the sponsor's cost-share for the project could delay the schedule by up to 1 year.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	1.2 Months
20%	N/A	2.4 Months
30%	N/A	3.7 Months
40%	N/A	4.9 Months
50%	N/A	6.1 Months
60%	N/A	7.2 Months
70%	N/A	8.4 Months
80%	N/A	9.6 Months
90%	N/A	10.8 Months
100%	N/A	12.0 Months

Cumulative Probability Assumption Chart - Schedule



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-4	Issues with the PPA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

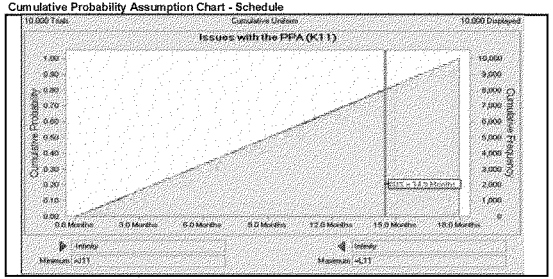
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-4	Issues with the PPA	Very Likely	Significant	HIGH	Yes-No/Uniform	PPM-2	N/A	0.0 Months	0.0 Months	18.0 Months	*Correlated to a low risk*

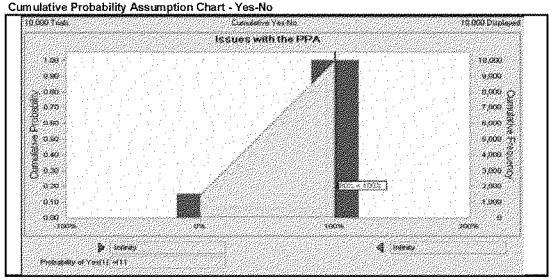
Description	The execution and finalization of the PPA may cause some delay as the government cannot advertise until the PPA is signed.
Development of Low Values	The best case scenario is no change to the current baseline schedule.
Development of High Values	The worst case scenario is that issues with getting the PPA finalized for the project could delay the schedule by up to 18 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	N/A	0.0 Months	No
10%	N/A	1.9 Months	No
20%	N/A	3.6 Months	Yes
30%	N/A	5.5 Months	Yes
40%	N/A	7.3 Months	Yes
50%	N/A	9.0 Months	Yes
60%	N/A	10.9 Months	Yes
70%	N/A	12.7 Months	Yes
80%	N/A	14.5 Months	Yes
90%	N/A	16.2 Months	Yes
100%	N/A	18.0 Months	Yes

Cumulative Probability Assumption Chart - Schedule



Cumulative Probability Assumption Chart - Yes-No



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CA-1	Small Business Set-Asides for Biological Monitoring Services	Likely	Marginal	MODERATE	Triangular	N/A	N/A	$0	$0	$900,000	

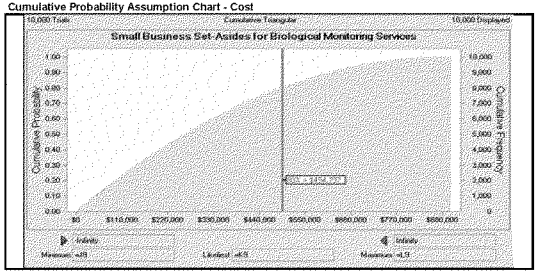
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CA-1	Small Business Set-Asides for Biological Monitoring Services	Likely	Marginal	MODERATE	Triangular	N/A	N/A	0.0 Months	0.0 Months	18.0 Months	

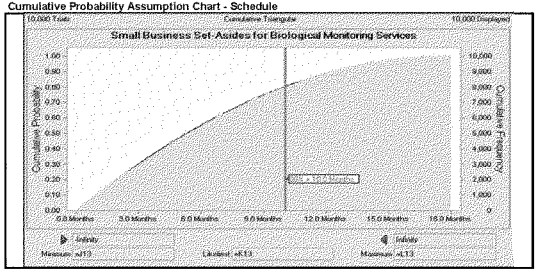
Description	The biological monitoring services could be set aside for a small business or 8(a) which, by previous experience, has caused challenges.
Development of Low Values	Assume no services are set aside to small businesses.
Development of High Values	In the worst case scenario it would cost $100,000 per event times 9 cycles = $900,000. It could delay the project by 2 months per event times 9 cycles = 18 months

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$53	0.0 Months
10%	$47,307	0.9 Months
20%	$98,297	1.9 Months
30%	$145,104	3.0 Months
40%	$202,094	4.2 Months
50%	$262,688	5.4 Months
60%	$327,279	6.7 Months
70%	$403,024	8.2 Months
80%	$494,797	10.0 Months
90%	$610,268	12.3 Months
100%	$986,367	17.9 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL - I	Uncertainty with the Location of the Borrow Site	Unlikely	Significant	MODERATE	Yes - No Triangular	N/A	N/A	$0	$0	$7,217,700	Estimated with CEDEP

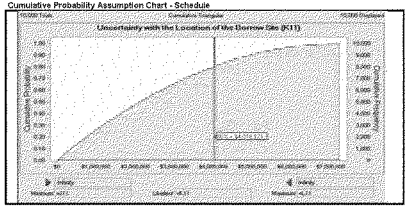
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL - I	Uncertainty with the Location of the Borrow Site	Unlikely	Significant	MODERATE	Yes - No Triangular	N/A	N/A	0.0 Months	0.0 Months	4.5 Months	Estimated with CEDEP

Description	There is some uncertainty about the actual location of the borrow site due to competing projects or public perception of the material quality at the current site.
Development of Low Values	The closest feasible borrow site is at 18.6 miles. This figure was used in the baseline estimate.
Development of High Values	If identified borrow site is unavailable the one-way hauling distance could increase by up to 50.0 miles. This would represent a 98% increase in the dredging unit cost. To capture the borrow site availability over time, I think we can assume with 99% certainty that the borrow site will available for the first 6 dredging cycles. Availability for the last 3 cycles is unknown. Chances of depleting the borrow site or competing with other projects at later cycles are more probable than at earlier cycles.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Custom Probability)
0%	$196	0.0 Months	14.0%
10%	$342,534	0.2 Months	22.0%
20%	$737,932	0.5 Months	29.0%
30%	$1,151,136	0.7 Months	36.0%
40%	$1,616,554	1.0 Months	51.0%
50%	$2,105,670	1.2 Months	51.0%
60%	$2,656,422	1.5 Months	58.0%
70%	$3,250,428	2.0 Months	58.0%
80%	$4,018,171	2.5 Months	65.0%
90%	$4,911,980	3.1 Months	65.0%
100%	$7,151,322	4.5 Months	65.0%

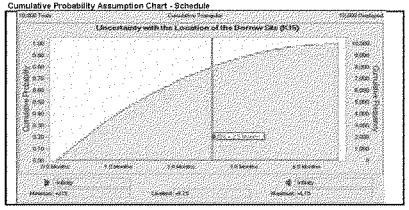
Cumulative Probability Assumption Chart - Schedule



Assumption: Uncertainty with the Location of the Borrow Site (K11)

Percentile	Assumption value	Triangular distribution
0%	$196	$0
10%	$342,534	$370,389
20%	$737,932	$741,993
30%	$1,151,136	$1,178,839
40%	$1,616,554	$1,626,894
50%	$2,105,670	$2,114,816
60%	$2,656,422	$2,652,926
70%	$3,250,428	$3,264,403
80%	$4,018,171	$3,859,846
90%	$4,911,980	$4,895,243
100%	$7,151,322	$7,217,700

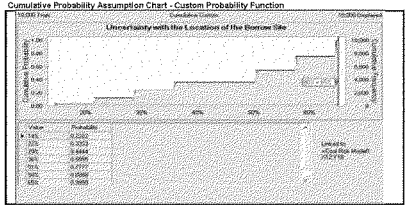
Cumulative Probability Assumption Chart - Schedule



Assumption: Uncertainty with the Location of the Borrow Site (K15)

Percentile	Assumption value	Triangular distribution
0%	0.0 Months	0.0 Months
10%	0.2 Months	0.2 Months
20%	0.5 Months	0.5 Months
30%	0.7 Months	0.7 Months
40%	1.0 Months	1.0 Months
50%	1.2 Months	1.3 Months
60%	1.5 Months	1.7 Months
70%	2.0 Months	2.0 Months
80%	2.5 Months	2.5 Months
90%	3.1 Months	3.1 Months
100%	4.5 Months	4.5 Months

Cumulative Probability Assumption Chart - Custom Probability Function



Assumption: Uncertainty with the Location of the Borrow Site

Percentile	Assumption value	Custom distribution
0%	14%	14%
10%	22%	22%
20%	29%	29%
30%	36%	36%
40%	51%	51%
50%	51%	51%
60%	58%	58%
70%	58%	58%
80%	65%	65%
90%	65%	65%
100%	65%	65%

	Dredging Cost	Assume Probability of Occurring
Cycle 1	$ 3,159,000	0%
Cycle 2	$ 3,159,000	0%
Cycle 3	$ 3,159,000	0%
Cycle 4	$ 3,159,000	0%
Cycle 5	$ 3,159,000	0%
Cycle 6	$ 3,159,000	0%
Cycle 7	$ 3,159,000	Unknown
Cycle 8	$ 3,159,000	Unknown
Cycle 9	$ 1,047,000	Unknown

Total cost for Cycles 7,8,9 = $ 7,365,000

San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-2	Quality of Borrow Material	Unlikely	Significant	MODERATE	Yes-No/Triangular	N/A	N/A	N/A	N/A	N/A	*Captured by EST-6*

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-2	Quality of Borrow Material	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Description	TL-2 was removed from the analysis, as it is captured by EST-6.
Development of Low Values	N/A
Development of High Values	N/A

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	N/A	N/A	N/A
10%	N/A	N/A	N/A
20%	N/A	N/A	N/A
30%	N/A	N/A	N/A
40%	N/A	N/A	N/A
50%	N/A	N/A	N/A
60%	N/A	N/A	N/A
70%	N/A	N/A	N/A
80%	N/A	N/A	N/A
90%	N/A	N/A	N/A
100%	N/A	N/A	N/A

San Clemente - Cost and Schedule Risk Analysis

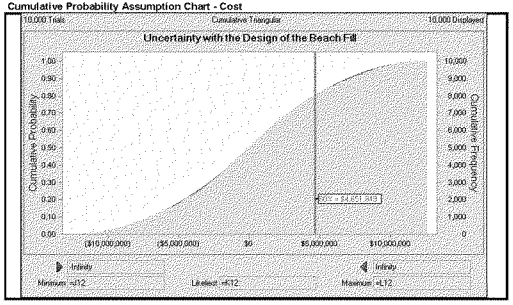
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	TL-3	Uncertainty with the Design of the Beach Fill	Unlikely	Significant	MODERATE	Yes-No/Triangular	TL-2	N/A	($12,638,560)	$0	$12,637,168	*Computed in CEDEP. Correlated to a Risk Removed from the Study.*

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	TL-3	Uncertainty with the Design of the Beach Fill	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

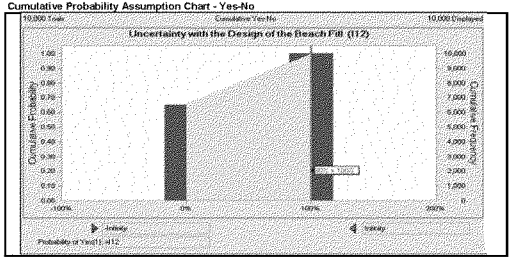
Description	Surveys may establish different site conditions than currently estimated requiring additional excavation.
Development of Low Values	Assume dredging volume decreases by -50% = 251,520 cy (0.50) = 125,760 cy @ $12.56/cy = $1,579,546 times 8 cycles = $12,636,369 +the 9th cycle at $1,047,072 = $13,683,440
Development of High Values	Assume dredging volume increases by +50% = 251,520 cy (1.50) = 377,280 cy @ $12.56/cy = $4,738,637 times 8 cycles = $37,909,096 +the 9th cycle at $1,047,072 = $38,956,168

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	($12,476,879)	N/A	No
10%	($7,030,792)	N/A	No
20%	($4,582,362)	N/A	No
30%	($2,788,781)	N/A	No
40%	($1,323,025)	N/A	No
50%	$9,420	N/A	No
60%	$1,307,522	N/A	No
70%	$2,842,367	N/A	Yes
80%	$4,651,849	N/A	Yes
90%	$7,132,253	N/A	Yes
100%	$12,502,884	N/A	Yes

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Yes-No



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-4	Unexploded Ordinances	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-4	Unexploded Ordinances	Unlikely	Critical	MODERATE	Yes-No/Uniform	N/A	N/A	N/A	N/A	N/A	*Captured by EST-7*

Description	TL-4 was removed from the analysis, as it is captured by EST-7.
Development of Low Values	N/A
Development of High Values	N/A

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	N/A	N/A	N/A
10%	N/A	N/A	N/A
20%	N/A	N/A	N/A
30%	N/A	N/A	N/A
40%	N/A	N/A	N/A
50%	N/A	N/A	N/A
60%	N/A	N/A	N/A
70%	N/A	N/A	N/A
80%	N/A	N/A	N/A
90%	N/A	N/A	N/A
100%	N/A	N/A	N/A

San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-5	Innovative Designs (Surf grass)	Likely	Significant	HIGH	Uniform	N/A	N/A	$0	$0	$3,502,050	

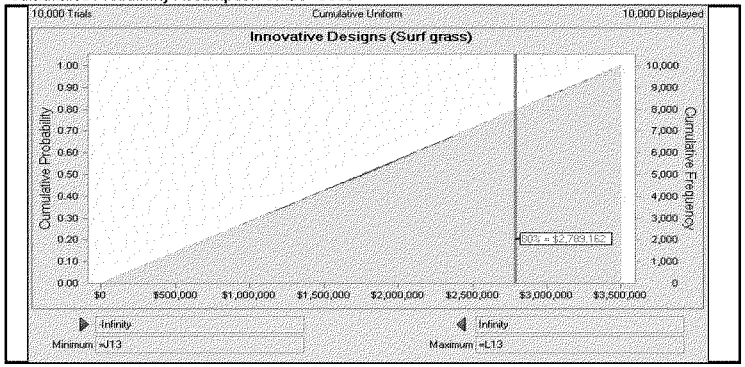
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-5	Innovative Designs (Surf grass)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Description	The resourcing agencies could require restoration of the surf grass habitat beyond the first construction.
Development of Low Values	Assume no request for further research.
Development of High Values	There may be a request to fund a research design project for the restoration of surf grass habitat (may require rock placement as well as planting). Assume project cost is 5% higher than currently estimated.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$203	N/A
10%	$355,812	N/A
20%	$703,662	N/A
30%	$1,054,619	N/A
40%	$1,414,181	N/A
50%	$1,784,256	N/A
60%	$2,114,612	N/A
70%	$2,454,941	N/A
80%	$2,789,162	N/A
90%	$3,154,778	N/A
100%	$3,501,754	N/A

Cumulative Probability Assumption Chart - Cost



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-1	Impacts of New Concerns Arising due to Delay	Very Likely	Significant	HIGH	Yes-No/Triangular	RE-1	0.75	$0	$0	$2,393,310	Correlated to RE-1 by a factor of 0.75

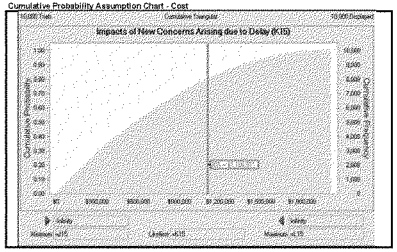
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-1	Impacts of New Concerns Arising due to Delay	Very Likely	Marginal	MODERATE	Yes-No/Triangular	RE-1	0.75	0.0 Months	0.0 Months	12.0 Months	Correlated to RE-1 by a factor of 0.75

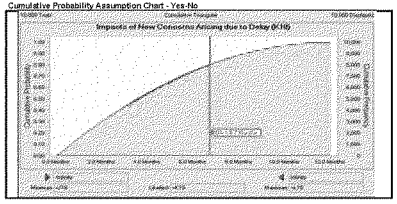
Description	A delay in the feasibility study could present new environmental issues to arise due to a time lapse.
Development of Low Values	The best case scenario is no change to the current baseline estimate and schedule.
Development of High Values	The worst case scenario is that new requirements could be introduced during a period of authorization delay that would require rework of the feasibility documents, due to lapsing permit and emerging environmental concerns. Assume the worst case scenario is costs up to 5% of the projected 99 account, and 3% of the total construction costs and 31 account (assuming new environmental mitigation features), and up to 1 year of delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	$14	0.0 Months	No
10%	$92,286	0.6 Months	No
20%	$200,967	1.3 Months	Yes
30%	$330,563	2.0 Months	Yes
40%	$445,951	2.8 Months	Yes
50%	$576,465	3.6 Months	Yes
60%	$730,065	4.5 Months	Yes
70%	$903,506	5.5 Months	Yes
80%	$1,108,910	6.7 Months	Yes
90%	$1,366,009	8.2 Months	Yes
100%	$1,905,089	11.9 Months	Yes

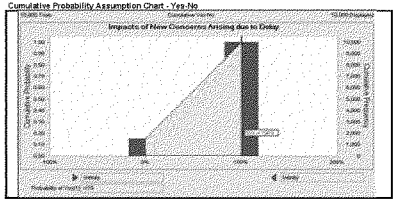
Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Yes-No



Cumulative Probability Assumption Chart - Yes-No



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-2	Subsequent Dredging Cycles at the Same Borrow Site	Likely	Significant	HIGH	Yes-No/Triangular	N/A	N/A	N/A	N/A	N/A	*Captured by TL-3*

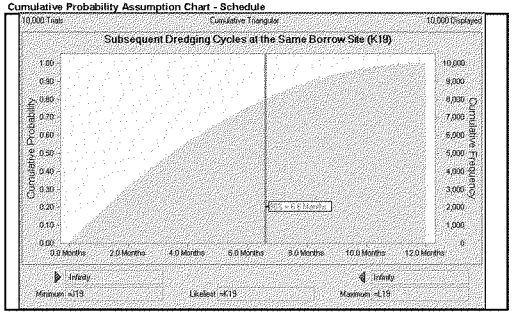
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-2	Subsequent Dredging Cycles at the Same Borrow Site	Likely	Marginal	MODERATE	Yes-No/Triangular	N/A	N/A	0.0 Months	0.0 Months	12.0 Months	

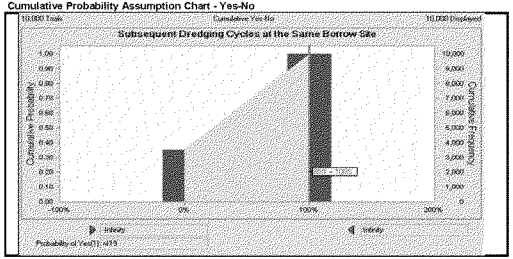
Description	RE-2 was removed from the analysis for cost only, as it is captured by TL-3. Resourcing agencies may require additional assessments at the borrow site due to the dredging activities.
Development of Low Values	The most likely value represents the low value.
Development of High Values	If the monitoring shows habitat loss, they may require configuration (depth) restrictions, or they may require the use of an alternate location, or they may require additional mitigation features. Assume a 10% increase in total cost and up to 1 year of cumulative schedule delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	N/A	0.0 Months	No
10%	N/A	0.6 Months	No
20%	N/A	1.3 Months	No
30%	N/A	1.9 Months	No
40%	N/A	2.6 Months	Yes
50%	N/A	3.5 Months	Yes
60%	N/A	4.4 Months	Yes
70%	N/A	5.4 Months	Yes
80%	N/A	6.6 Months	Yes
90%	N/A	8.2 Months	Yes
100%	N/A	11.9 Months	Yes

Cumulative Probability Assumption Chart - Schedule



Cumulative Probability Assumption Chart - Yes-No



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-3	Air Quality Restriction Issues	Likely	Significant	HIGH	Triangular	N/A	N/A	$0	$0	$5,000,000	

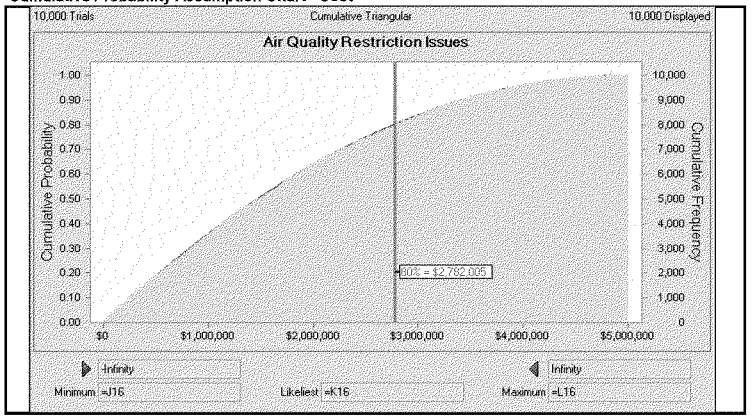
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-3	Air Quality Restriction Issues	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Description	Concerns about compliance with the air quality standards and the affect it will have on the bidding competition as they must comply to the standards.
Development of Low Values	The low value is represented by the most likely cost of not having to meet stricter Air Quality District requirements.
Development of High Values	The cost to re-power a hopper dredge to Tier 2 engines to meet Air Quality District requirements could cost $5 million and take up to 6 months (generators, pump engines, jet pumps, and bow thruster)

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$86	N/A
10%	$251,365	N/A
20%	$534,333	N/A
30%	$831,837	N/A
40%	$1,132,679	N/A
50%	$1,483,353	N/A
60%	$1,843,007	N/A
70%	$2,268,309	N/A
80%	$2,782,005	N/A
90%	$3,412,279	N/A
100%	$4,959,024	N/A

Cumulative Probability Assumption Chart - Cost



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-4	Adaptive Management Features	Likely	Significant	HIGH	Triangular	N/A	N/A	$0	$0	$1,573,920	

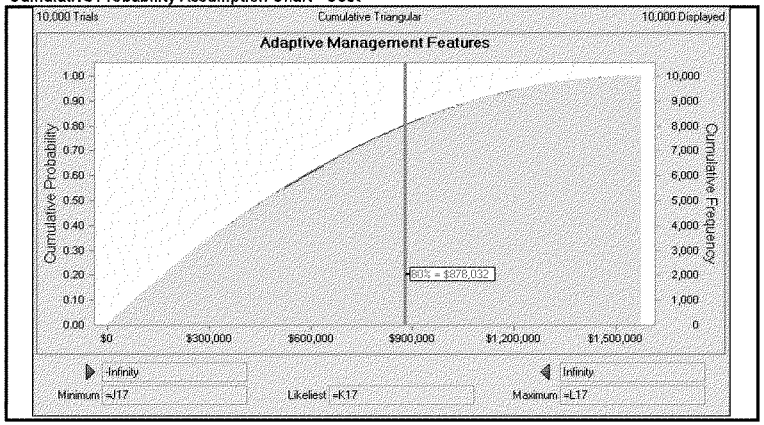
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-4	Adaptive Management Features	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Description	There may be a requirement for adaptive management features to be included as it pertains to the mitigation and restoration of the surf grass losses.
Development of Low Values	The best case scenario is no change to the current baseline estimate.
Development of High Values	The worst case scenario is up to 3% of the total 17 account costs, per regulation for adaptive management features without subsequent authorization.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$141	N/A
10%	$82,091	N/A
20%	$166,139	N/A
30%	$255,950	N/A
40%	$357,186	N/A
50%	$463,743	N/A
60%	$588,752	N/A
70%	$721,135	N/A
80%	$878,032	N/A
90%	$1,079,620	N/A
100%	$1,565,047	N/A

Cumulative Probability Assumption Chart - Cost



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-5	Project in a Coastal Zone	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

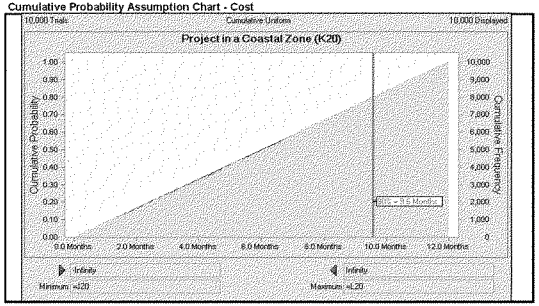
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-5	Project in a Coastal Zone	Unlikely	Critical	MODERATE	Yes-No/Uniform	N/A	N/A	0.0 Months	0.0 Months	12.0 Months	

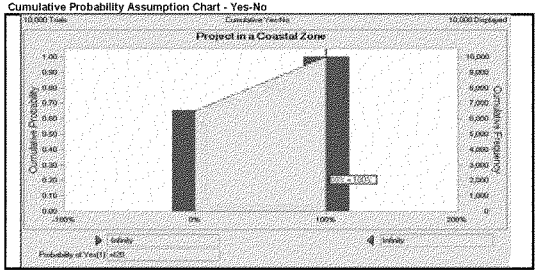
Description	Approval from the Coastal Commission must be obtained.
Development of Low Values	The best case scenario is no change to the current baseline schedule.
Development of High Values	The worst case scenario is that the project must proceed under objections, raising political sensitivity that could delay at least one of the nourishment cycles by up to 1 year.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	N/A	0.0 Months	No
10%	N/A	1.2 Months	No
20%	N/A	2.5 Months	No
30%	N/A	3.7 Months	No
40%	N/A	4.8 Months	No
50%	N/A	6.1 Months	No
60%	N/A	7.2 Months	No
70%	N/A	8.4 Months	Yes
80%	N/A	9.8 Months	Yes
90%	N/A	10.8 Months	Yes
100%	N/A	12.0 Months	Yes

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Yes-No



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-1	Traffic Considerations Due to Proximity to Camp Pendleton	Very Likely	Negligible	LOW	Triangular	N/A	N/A	N/A	N/A	N/A	*Estimated with CEDEP. Research determined that this is a Low Risk.*

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-1	Traffic Considerations Due to Proximity to Camp Pendleton	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*Estimated with CEDEP. Research determined that this is a Low Risk.*

Description	Camp Pendleton Marine Base periodically has amphibious landing exercises on the adjacent beach which could present a navigational outage. Subsequent research revealed that this would not likely cause any measurable interruptions, and is thus a low risk.
Development of Low Values	N/A
Development of High Values	N/A

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	N/A
10%	N/A	N/A
20%	N/A	N/A
30%	N/A	N/A
40%	N/A	N/A
50%	N/A	N/A
60%	N/A	N/A
70%	N/A	N/A
80%	N/A	N/A
90%	N/A	N/A
100%	N/A	N/A

San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-2	Potential for Dense Sand Layers	Unlikely	Significant	MODERATE	Yes-No/Triangular	N/A	N/A	N/A	N/A	N/A	*Estimated with CEDEP. Captured by EST-7*

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-2	Potential for Dense Sand Layers	Unlikely	Significant	MODERATE	Yes-No/Triangular	N/A	N/A	N/A	N/A	N/A	*Estimated with CEDEP. Captured by EST-7*

Description	CON-2 was removed from the analysis, as it is captured by EST-6. Dense sand layers could cause shut-downs or productivity issues.
Development of Low Values	N/A
Development of High Values	N/A

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	N/A	N/A	No
10%	N/A	N/A	No
20%	N/A	N/A	No
30%	N/A	N/A	No
40%	N/A	N/A	Yes
50%	N/A	N/A	Yes
60%	N/A	N/A	Yes
70%	N/A	N/A	Yes
80%	N/A	N/A	Yes
90%	N/A	N/A	Yes
100%	N/A	N/A	Yes

San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-1	Hopper/Pipeline Combination Methodology	Unlikely	Significant	MODERATE	Yes-No/Triangular	EST-3	N/A	$0	$0	$4,737,420	*Estimated with CEDEP. Correlated to a low risk.*

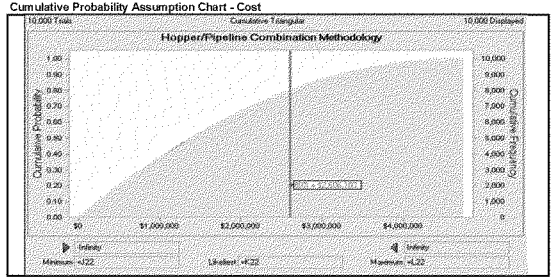
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-1	Hopper/Pipeline Combination Methodology	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

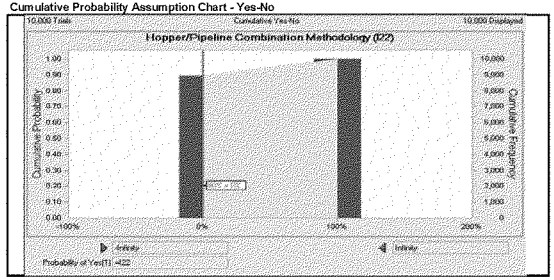
Description	There is the potential for a combination hopper/pipeline cutter head to be used as an alternative procedure.
Development of Low Values	The low and most likely methodology includes a hopper with pump-out capabilities.
Development of High Values	Conceptual hopper/pipeline construction alternative results in an 18% increase in dredging cost based on preliminary cost estimates. Unit cost from the hopper/pipeline combination is $15.30/cy versus the hopper dredging unit cost of $12.56/cy.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	$218	N/A	No
10%	$243,640	N/A	No
20%	$497,265	N/A	No
30%	$774,497	N/A	No
40%	$1,072,193	N/A	No
50%	$1,393,078	N/A	No
60%	$1,736,569	N/A	No
70%	$2,130,417	N/A	No
80%	$2,608,103	N/A	No
90%	$3,222,836	N/A	Yes
100%	$4,683,866	N/A	Yes

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Yes-No



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-2	Impact of Hopper Size	Very Likely	Marginal	MODERATE	Yes-No/Triangular	EST-6	0.75		$0	$4,737,420	Correlated to EST-6 by a factor of 0.75

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-2	Impact of Hopper Size	Very Likely	Marginal	MODERATE	Yes-No/Triangular	EST-6	0.75		0.0 Months	18.5 Months	Correlated to EST-6 by a factor of 0.75

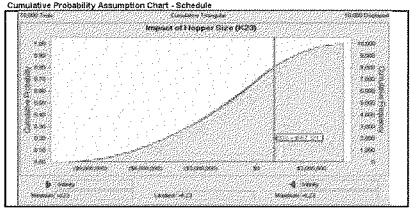
Description:	Baseline estimate considered a medium size hopper, however, there is the possibility of a large or small hopper dredge bidding the job.
Development of Low Values	The use of a small size hopper will result in a dredging unit cost of $14.78/CY and 3.58 months. (See Cell P16 for calculations)
Development of High Values	The use of a large size hopper will result in a lower dredging unit cost of $7.39/CY and 0.72 months. (See Cell P16 for calculations)

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%		-5.6 Months	No
10%		-2.7 Months	No
20%		-1.0 Months	No
30%		0.3 Months	No
40%		1.6 Months	No
50%		3.1 Months	Yes
60%		4.7 Months	Yes
70%	$133,187	5.8 Months	Yes
80%	$367,321	8.7 Months	Yes
90%	$2,014,471	11.8 Months	Yes
100%	$4,705,588	18.4 Months	Yes

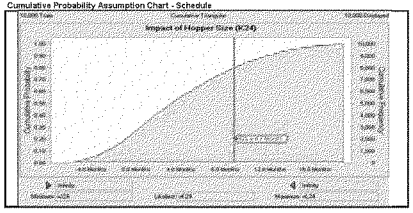
Output from CEDEP runs:

	Unit Cost	% Difference	Duration	% Difference
Low Values (Large dredge)	$ 14.78 /CY	16%	3.58 mo	137%
Most Likely (Medium sized dredge)	$ 12.56 /CY	0%	1.51 mo	0%
High Values (Small dredge)	$ 7.39 /CY	-41%	0.72 mo	-52%

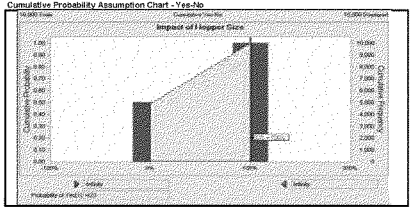
Cumulative Probability Assumption Chart - Schedule



Cumulative Probability Assumption Chart - Schedule



Cumulative Probability Assumption Chart - Yes-No



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-4	Fuel Prices	Very Likely	Marginal	MODERATE	Lognormal	N/A	N/A	[illegible]	$0	$9,443,520	*Estimated with CEDEP*

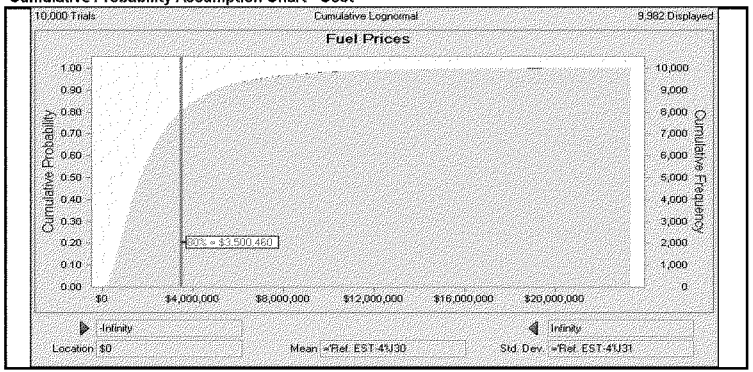
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-4	Fuel Prices	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Description	Fuel prices are volatile.
Development of Low Values	The best case scenario is $2.00/gallon. This represents a 4% decrease in estimated cost: ($12.56/cy - $12.10/cy) / $12.56/cy
Development of High Values	The worst case scenario is $5.00/gallon for marine diesel. This represents an 18% increase in estimated cost: ($14.88/cy - $12.56/cy) / $12.56/cy

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$78,570	N/A
10%	$597,562	N/A
20%	$855,778	N/A
30%	$1,116,907	N/A
40%	$1,399,228	N/A
50%	$1,737,734	N/A
60%	$2,167,073	N/A
70%	$2,688,381	N/A
80%	$3,500,460	N/A
90%	$5,065,409	N/A
100%	$32,496,160	N/A

Cumulative Probability Assumption Chart - Cost



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-5	Unusual Wave Action/Downtime	Likely	Marginal	MODERATE	Yes-No/Triangular	N/A	N/A	N/A	N/A	N/A	*Estimated with CEDEP. EST-5 is captured by PR-2*

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-5	Unusual Wave Action/Downtime	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*Estimated with CEDEP*

Description	EST-5 was removed from the analysis, as it is captured by PR-2. Effects dredge working time.
Development of Low Values	N/A
Development of High Values	N/A

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	N/A	N/A	N/A
10%	N/A	N/A	N/A
20%	N/A	N/A	N/A
30%	N/A	N/A	N/A
40%	N/A	N/A	N/A
50%	N/A	N/A	N/A
60%	N/A	N/A	N/A
70%	N/A	N/A	N/A
80%	N/A	N/A	N/A
90%	N/A	N/A	N/A
100%	N/A	N/A	N/A

San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-6	Dredging Productivity	Likely	Marginal	MODERATE	Triangular	EST-2	0.75	($1,375,000)	$0	$0	*Estimated with CEDEP. Correlated to EST-2 by a factor of 0.75.*

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-6	Dredging Productivity	Likely	Marginal	MODERATE	Triangular	EST-2	0.75	-0.7 Months	0.0 Months	0.0 Months	*Estimated with CEDEP. Correlated to EST-2 by a factor of 0.75.*

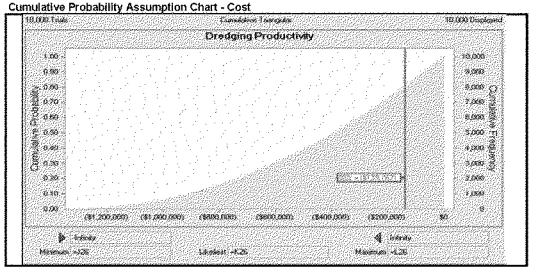
Description	Dredging productivity may vary depending on material classification.
Development of Low Values	Current estimate assumes 1,145 cy/hr (10% mud, 83% sand, 7% gravel). In the best case scenario, 100% sand translates into a production of 1,260 cy/hr. Production translates into a -5% decrease in cost and -5% decrease in dredging time. (See cell P16 for calculations)
Development of High Values	Assume worst case scenario exhibits 6% mud, 86% sand, 8% gravel (Ken Raabe). This translates into a production rate of 1,109 cy/hr. Production dredging time is practically unchanged. (See cell P16 for calculations)

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($1,375,000)	-0.7 Months
10%	($687,500)	-0.5 Months
20%	($687,500)	-0.4 Months
30%	($687,500)	-0.3 Months
40%	($687,500)	-0.2 Months
50%	($687,500)	-0.2 Months
60%	($687,500)	-0.1 Months
70%	($687,500)	-0.1 Months
80%	($687,500)	-0.1 Months
90%	($687,500)	0.0 Months
100%	$0	0.0 Months

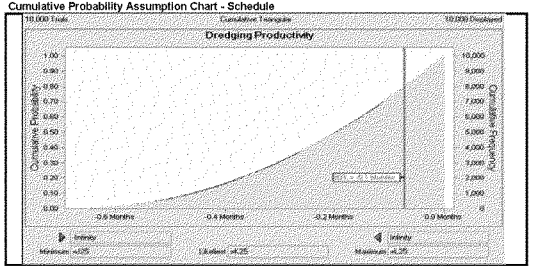
Output from CEDEP runs:

	Unit Cost	% Difference	Duration	% Difference
Low Values	$ 11.89 /CY	-5%	1.43 mo	-5%
Most Likely	$ 12.56 /CY	0%	1.51 mo	0%
High Values	$ 12.57 /CY	0%	1.51 mo	0%

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-7	Change in Site Conditions	Unlikely	Significant	MODERATE	Yes-No/Triangular	N/A	N/A	[illegible]	$0	$2,631,900	*Estimated with CEDEP*

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-7	Change in Site Conditions	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

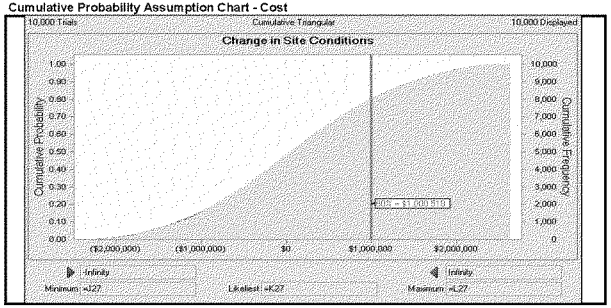
Description	Can cause longer or shorter dredge haul distances, within the same identified borrow site.
Development of Low Values	Most likely haul distance from borrow site to receiver beach is estimated at 30 Km (18.6 mi). Best case scenario would be 25 Km (15.5 mi).
Development of High Values	Worst case scenario would be 35 Km (21.7 mi).

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	[illegible]	N/A	No
10%	[illegible]	N/A	No
20%	[illegible]	N/A	No
30%	[illegible]	N/A	No
40%	[illegible]	N/A	Yes
50%	$53,757	N/A	Yes
60%	$331,348	N/A	Yes
70%	$640,204	N/A	Yes
80%	$1,000,518	N/A	Yes
90%	$1,484,711	N/A	Yes
100%	$2,595,560	N/A	Yes

Output from CEDEP runs:

	Unit Cost		% Difference
Low Values	$ 11.40	/CY	-9%
Most Likely	$ 12.56	/CY	0%
High Values	$ 13.81	/CY	10%

Cumulative Probability Assumption Chart - Cost



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-1	Project Schedule in Question	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

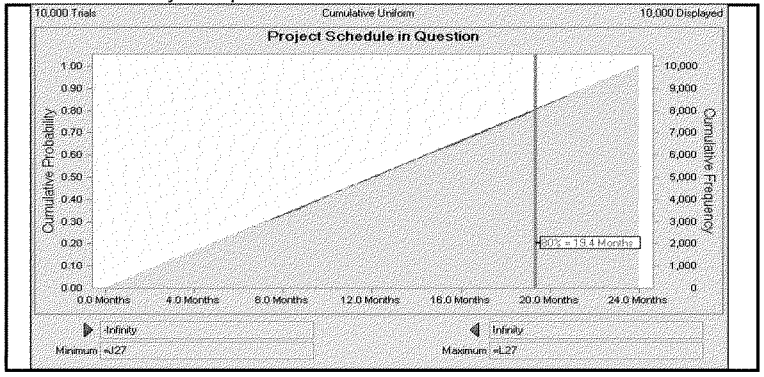
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-1	Project Schedule in Question	Very Likely	Significant	HIGH	Uniform	RE-1	0.75	0.0 Months	0.0 Months	24.0 Months	*Correlated to RE-1 by a factor of 0.75*

Description	The project authorization could be 2011 or 2012.
Development of Low Values	The best case scenario is project authorization in 2011 (no change to current baseline schedule).
Development of High Values	The worst case scenario is project authorization in 2012, a delay of up to 2 years.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	2.4 Months
20%	N/A	4.8 Months
30%	N/A	7.3 Months
40%	N/A	9.7 Months
50%	N/A	12.2 Months
60%	N/A	14.5 Months
70%	N/A	17.0 Months
80%	N/A	19.4 Months
90%	N/A	21.6 Months
100%	N/A	24.0 Months

Cumulative Probability Assumption Chart - Schedule



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-2	Abnormal Weather Events	Unlikely	Significant	MODERATE	Hypergeometric/ Custom	N/A	N/A	$0	$0	$628,900	

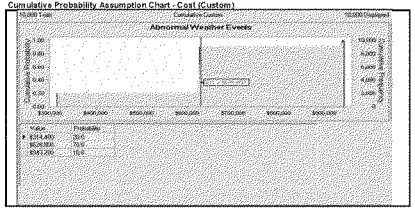
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-2	Abnormal Weather Events	Unlikely	Significant	MODERATE	Hypergeometric/ Custom	N/A	N/A	0.0 Months	0.0 Months	1.0 Months	

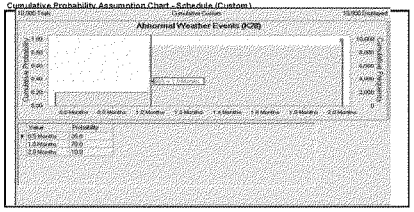
Description	Excessive waves due to weather events could slow dredging productivity. This is modeled as a 2-step process using Hypergeometric and Custom Distributions. There are 9 nourishment periods, abnormal wave action occurs once every 15 years (6.7% probability in any given year), and there are 48 years over which the nourishment periods will take place. The assumption is that there will be additional costs and delays if the abnormal wave action does take place.
Development of Low Values	The best case scenario is no change to the current baseline estimate and schedule.
Development of High Values	The worst case scenario is that since there are 9 nourishments planned, there will likely be some nourishments affected by abnormal wave action. Assume a 20% reduction in effective work time on any given nourishment cycle (a cost in today's dollars of $628,900, and up to 1 month of delay).

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Hypergeometric)
0%	$314,400	0.5 Months	0
10%	$314,400	0.5 Months	0
20%	$628,900	1.0 Months	0
30%	$628,900	1.0 Months	1
40%	$628,900	1.0 Months	1
50%	$628,900	1.0 Months	1
60%	$628,900	1.0 Months	1
70%	$628,900	1.0 Months	2
80%	$628,900	1.0 Months	2
90%	$628,900	2.0 Months	3
100%	$943,200	2.0 Months	6

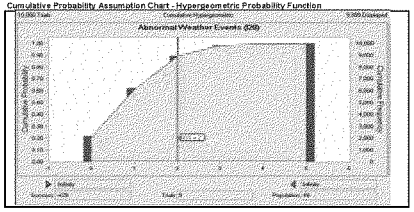
Cumulative Probability Assumption Chart - Cost (Custom)



Cumulative Probability Assumption Chart - Schedule (Custom)



Cumulative Probability Assumption Chart - Hypergeometric Probability Function



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-3	Adequacy of Project Funding	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*PR-3 is a Show-Stopping Risk - Not Considered for Quantitative Study*

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-3	Adequacy of Project Funding	Very Likely	Significant	HIGH	N/A	N/A	N/A	N/A	N/A	N/A	*PR-3 is a Show-Stopping Risk - Not Considered for Quantitative Study*

Description	There are concerns that the funding is received in a timely manner or that the project will be funded at all. This risk is a show-stopping risk for cost, in that if it the project is not authorized in the next two program years, it could so dramatically affect ultimate cost that it would, in fact, be an entirely order of magnitude. However, for schedule, it could mean that the project simply is delayed for a significant period of time.
Development of Low Values	N/A
Development of High Values	N/A

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	N/A	N/A	N/A
10%	N/A	N/A	N/A
20%	N/A	N/A	N/A
30%	N/A	N/A	N/A
40%	N/A	N/A	N/A
50%	N/A	N/A	N/A
60%	N/A	N/A	N/A
70%	N/A	N/A	N/A
80%	N/A	N/A	N/A
90%	N/A	N/A	N/A
100%	N/A	N/A	N/A

San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-4	Political Opposition/Threat of Lawsuits	Likely	Marginal	MODERATE	Yes-No/Uniform	LO-1		$0	$0	$2,000,000	

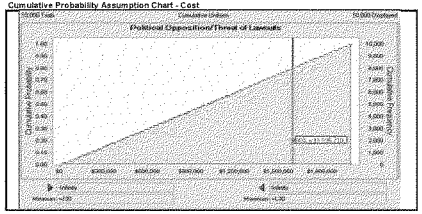
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-4	Political Opposition/Threat of Lawsuits	Likely	Marginal	MODERATE	Yes-No/Uniform	LO-1		6.0 Months	6.0 Months	12.0 Months	

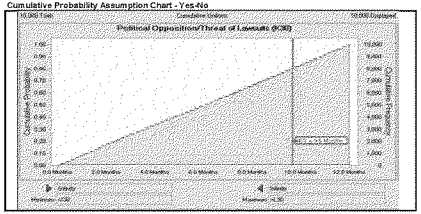
Description	Local SIGs are opposed to the mountment activities and could potentially file a suit against the project.
Development of Low Values	The best case scenario is no change to the current baseline estimate and schedule
Development of High Values	The worst case scenario would be that there are lawsuits and settlement costs incurred. Assume up to $2 million in settlement and legal fees and up to 1 year of delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	$0	6.0 Months	No
10%	$256,125	6.1 Months	No
20%	$454,999	6.3 Months	No
30%	$608,830	6.5 Months	No
40%	$807,231	6.7 Months	Yes
50%	$1,007,253	6.9 Months	Yes
60%	$1,204,987	7.8 Months	Yes
70%	$1,393,654	8.5 Months	Yes
80%	$1,596,710	9.6 Months	Yes
90%	$1,791,797	10.8 Months	Yes
100%	$1,999,869	12.0 Months	Yes

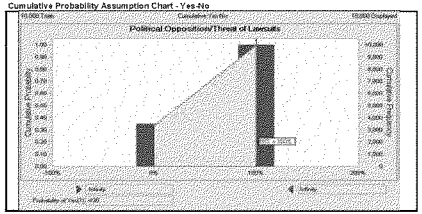
Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Yes-No



Cumulative Probability Assumption Chart - Yes-No



San Clemente - Cost and Schedule Risk Analysis

Cost

Risk Reference No	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PRS	Stakeholders Request Late Changes	Very Likely	Significant	Medium	Triangular	N/A	N/A	$0	$0	$12,000,000	

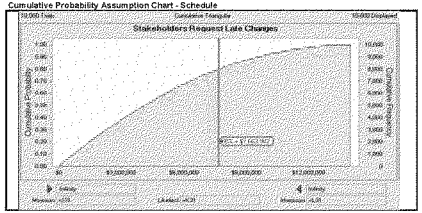
Schedule

Risk Reference No	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PRS	Stakeholders Request Late Changes	Very Likely	Significant	Medium	Triangular	N/A	N/A	0.0 Months	6.0 Months	24.0 Months	

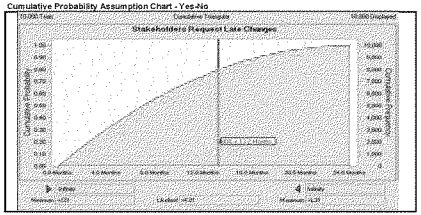
Description	There is a possibility that stakeholders could request new scope items be added to the project
Development of Low Values	The best case scenario is no change to the current baseline estimate and schedule.
Development of High Values	The worst case scenario, per regulation, is up to 20% change in scope, resulting in a 20% increase in project costs and up to 2 years in additional project schedule.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)	Assumption values (Yes-No)
0%	$320	0.0 Months	No
10%	$639,495	1.5 Months	No
20%	$1,436,895	2.6 Months	No
30%	$2,291,839	3.9 Months	No
40%	$3,145,014	5.4 Months	No
50%	$4,084,950	6.9 Months	No
60%	$5,125,559	8.7 Months	No
70%	$6,276,609	10.8 Months	No
80%	$7,603,782	13.2 Months	No
90%	$9,377,443	16.3 Months	Yes
100%	$11,888,537	24.0 Months	Yes

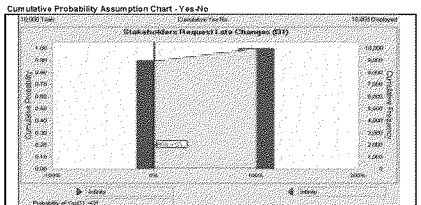
Cumulative Probability Assumption Chart - Schedule



Cumulative Probability Assumption Chart - Yes-No



Cumulative Probability Assumption Chart - Yes-No



San Clemente Shoreline Feasibility Study
Orange County, California

ECONOMICS APPENDIX

FINAL REPORT

U.S. Army Corps of Engineers
Los Angeles District

JULY 2011

EXECUTIVE SUMMARY

This *Storm Damage Reduction Economic Appendix* provides supplemental information for the City of San Clemente and policymakers for the determination of a Federal interest in the protection of assets along the coast in the City of San Clemente. The objectives of this analysis were as follows:

- To estimate annualized costs associated with coastal erosion and storm damages under current conditions in the City
- To develop mitigation alternatives and related conceptual designs
- To conduct a benefit-cost analysis of each flood mitigation alternative. The benefit-cost analysis provides a measure of the "relative" cost-effectiveness of each alternative and is intended to guide the key planning decisions.

Damages considered in this analysis include the costs of repairing or replacing buildings and their contents, public infrastructure, recreation, and a rail line. The cost of storm damage mitigation alternatives includes the costs of construction, property acquisition, permits, and maintenance.

The initial study area extended northward from San Mateo Point to Dana Point Harbor in ten reaches. However, the study area was reduced in the plan formulation process to an area within the City of San Clemente (Reach 6) as the other reaches showed existing levels of storm protection and/or minimal potential structural damage.

Beach-fill was identified as a potential solution to the storm damage process and 12 alternatives were examined. The fill alternatives ranged from 10 meters to 60 meters under a program that would immediately refill after the exhaustion of the previous beach fill. These alternatives were analyzed in a risk & uncertainty life-cycle format subjecting each alternative to the same sequence of future storms.

The results of the analysis indicate that Alternative 2 - 15 meters had the greatest net NED benefits (-$759,626) and highest B/C ratio (0.65) on storm damage reduction benefits (SDRB) alone amongst all the alternatives. Although Alternative 2 does not possess a B/C ratio over 1 on SDRB, ER 1105-2-100 and ER 1165-2-130 allow for the inclusion of an incidental recreation value not to exceed the value of SDRB when recreation value is gained through the project. Net SDRB increase to $624,851 and a B/C value of 1.29 when incidental recreation benefits are included. Incidental recreation guidance allows for the inclusion of all recreation benefits when the project is justified. Alternative 2 with full recreation value has annual net SDRB of $900,794 and a B/C of 1.42.

The economics of Alternative 2 are based on a first fill cost including IDC of $11.11 million. This alternative requires a total of 9.11 fills over the 50-yr project life. Total project cost with IDC is $96,031,000 with an average annual cost of $2,144,104 for Alternative 2 – 15 meters.[1]

[1] San Clemente Beach Nourishment Feasibility, USACE – Los Angeles District Cost Engineering DX – TPCS ATR Certification, 2/9/2011.

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ATTACHMENT A

1 STUDY

This storm damage risk management study of San Clemente, Orange County, California is authorized by Section 208 of the Flood Control Act of 1965 (Title II of Public Law 89-298), which reads:

> *"The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the localities specifically named in this section. ... Coasts of Washington, Oregon, and California to determine advisability of protection work against storm and tidal waves."*

1.1 Study Purpose

The purpose of this economic appendix is to present the storm damage risk management evaluation for San Clemente, California. This evaluation presents a feasibility-level investigation of the expected national economic development (NED) annual storm-related damages to shoreline properties and infrastructure along the shoreline and the benefits and costs of various alternatives formulated to reduce these damages.

1.2 Study Area

The study area is located on the Pacific Ocean coastline in the City of San Clemente, Orange County, California. The City of San Clemente is approximately 97 km (60 miles) south of Los Angeles and 89 km (55 miles) north of San Diego, **Figure 1**. Included in the study area is the entire San Clemente shoreline approximately 8 kilometers (4.8 miles) in length, from Shorecliff Beach to San Mateo Point, and with the area being bounded by San Mateo Point (located at the southern limits of City of San Clemente) to the south and Dana Point Harbor to the north. The study area is approximately 12 km (7.5 miles) long, as shown in **Figure 2**. This area is further sub-divided into ten reaches for reference purposes numbered consecutively Reach 1 – Reach 10. Reaches 1 through 8 are located in the City of San Clemente. The shoreline is characterized by narrow sandy beaches, backed by high coastal bluffs. Running along the entire length of the San Clemente shoreline is a portion of the LOSSAN (Los Angeles to San Diego) railroad corridor, a major passenger and cargo rail line linking San Diego to rest of the United States, owned by the Orange County Transportation Authority (OCTA). This commuter rail corridor is among the busiest in the country and separates the beach from the bluff. The study area southern boundary at San Mateo Point is the boundary between the counties of Orange and San Diego.

1.3 Guidance and Regulation

This economic appendix is formulated to be in accordance with ER 1105-2-100. Damages and costs are expressed as annual values and calculated utilizing the Fiscal Year (FY) 11 discount rate of 4.125 percent with a period of analysis of 50 years. All damages and costs are expressed at an FY11 price level. The base year and future year are 2012 and 2061 respectively.

Figure 1 - Location Map

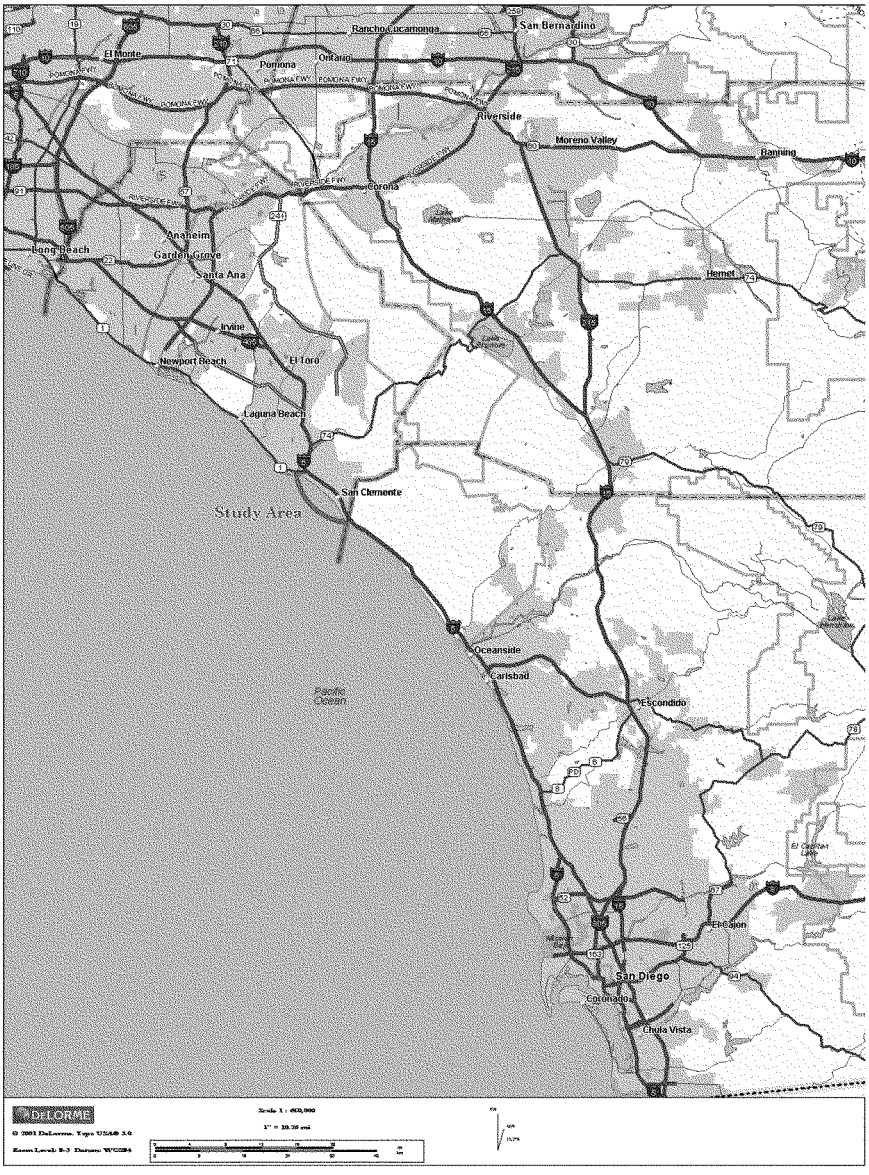


Figure 2 - Study Area

1.4 Historical Damages

Over the past 20 years the beach width along San Clemente shoreline has experienced significant reductions. The narrowing of the beaches along the shoreline has subjected the public facilities and private properties to wave-induced damages. These facilities include the Marine Safety Building, public restrooms, and concession stands. **Table 1** shows the historical damages to public facilities along the shoreline. The meteorological conditions of El Nino occurred in the years 1983, 1988, and 1998. The majority of repairs in the years of 1983 and 1988 were due to damages to the San Clemente Pier. The City had spent $2,109,000 in pier repairs in 1983 and $2,305,000 in 1988. Also, the majority of damages ($288,000) in 1998 were due to repairs costs for a revetment in the community of Capistrano Shores. In addition, the City is spending $5,000 per year to use a tractor to reduce the steepness of the shoreline.

Table 1 - Historical Damages Recreational Facilities
FY11 Price Level

Year	Reason for Expenditure	Amount	Comments
1983	Facility Protection/Storm Damage Repair	$3,277,000	El Nino Storms
1988	Facility Protection/Storm Damage Repair	$3,120,000	El Nino Storms
1994	Storm Damage	$21,600	
1995	Storm Damage Repairs	$7,200	General Repairs
1996	Storm Damage Repairs	$16,500	General Repairs
1997	Facility Protection/Storm Damage Repair	$54,000	Repair of Marine Safety Sheet Pile
1998	Storm Damage Repairs	$376,000	General Repairs
1999	Storm Damage Repairs	$52,000	General Repairs
2000	Storm Damage Repairs	$14,400	General Repairs
2001	Storm Damage Repairs	$63,000	General Repairs
2003	Facility Protection	$202,000	Repair of Marine Safety Sheet Pile

1.5 Reach Boundaries

Reach boundaries are defined in meters northward from San Mateo Point and shoreline features located within each reach are described. Since the railroad is assumed to be a constant feature throughout the period of analysis, the railroad tracks provided a convenient feature to define a horizontal alignment. The section of the study area that has the revetment to protect the railroad is sub-divided into cells with a length of 50 meters (164 ft). Project reaches are defined based on an arbitrary assumed Station 0+000 at San Mateo Point. The study area is divided into 10 reaches. Reaches 10 and 9 are located north of the city limits of San Clemente. Reach 10 extends from the Capistrano Shores development to City of Dana Point. The Capistrano Shores (90 structures) development is located in reach 9. Boundaries for Reaches 1 through 8 were based on the presence of either an improved revetment or conventional ballast along the railroad tracks.

Reach 1: Reach 1 (**Photos 1 and 2**) extends from San Mateo Point at Sta 0+146 to Sta 1+115. The reach is 969 m (3,180 ft) long and is the southern portion of San Clemente State Beach. The beach width is zero at the southern boundary and gradually increases to 41 m wide. The railroad track elevation is approximately +6.4 m (21 ft). The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +7.0 m (23 ft). There are no structures seaward of the railroad; some residential structures exist immediately landward of the railroad. Cells in this reach are numbered from 1 through 19. This reach has a revetment that protects the railroad tracks.

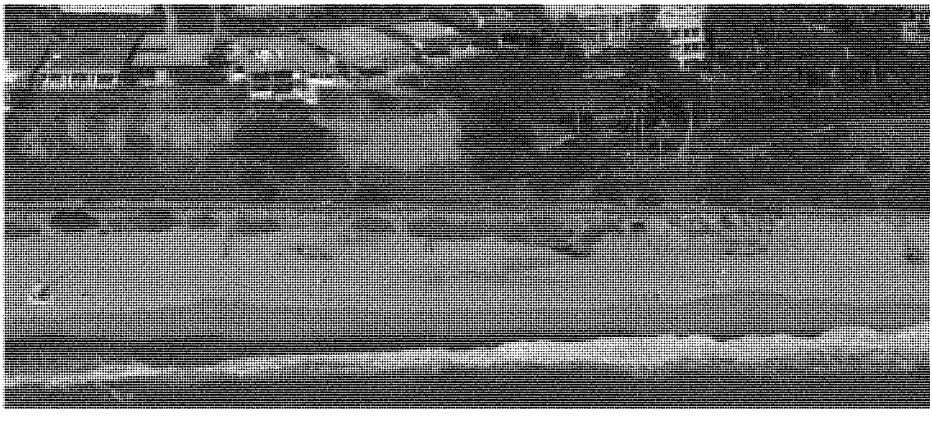
Photo 1 – Reach 1

Photo 2 – Revetment Reach 1

Reach 2: Reach 2 (**Photos 3 and 4**) extends from Sta 1+115 to Sta 1+795. The reach is 680 m (2,230 ft) long and is encompassed within San Clemente State Beach. The beach width is approximately 40 m (130 ft) wide at the southern boundary and gradually decreases to 9 m (30 ft) wide. The railroad track elevation is approximately +6.4 - 7.6 m (21 ft - 25 ft). The railroad seaward slope incorporates the conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.4 - 7.6 m. There are no structures seawards of the railroad; the underpass for San Clemente State Beach is included within this reach. Cells in this reach are numbered from 20 through 33. This reach's existing loose stone revetment does not protect the railroad tracks.

Photo 3 - Reach 2

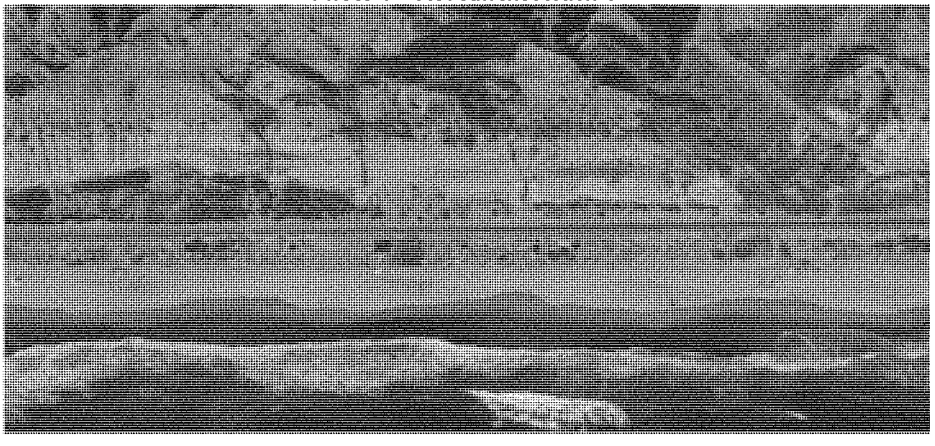
Photo 4 – Revetment Reach 2



Reach 3: Reach 3 (**Photos 5 and 6**) extends from Sta 1+795 to Sta 2+395. The reach is 600 m (1,970 ft) long is encompassed within San Clemente State Beach. The beach width is approximately 9 m (30 ft) wide at the southern boundary and quickly becomes zero throughout the remainder of the reach. The railroad track elevation is approximately +6.4 m (21 ft). The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +7.0 m (23 ft). There are no structures seawards of the railroad; Calafia Beach Park is on the landward side of the railroad. Cells in this reach are numbered from 34 through 45.

Photo 5 - Reach 3

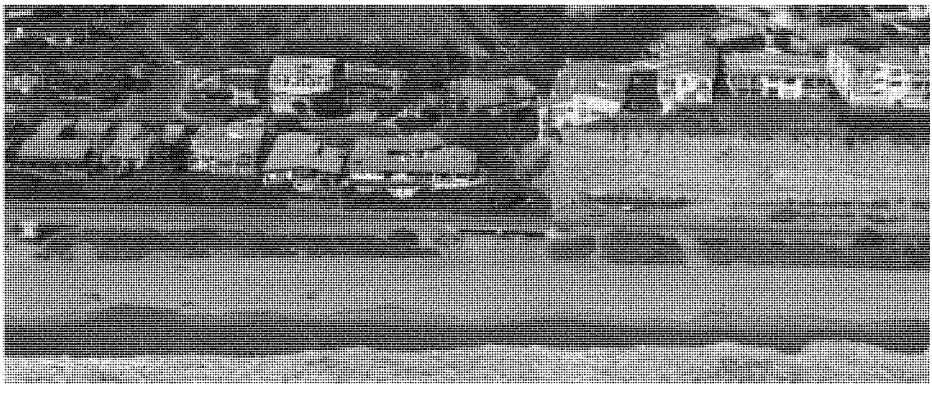
Photo 6 – Revetment Reach 3



Reach 4: Reach 4 (**Photos 7 and 8**) extends from Sta 2+395 to Sta 3+127. The reach is 732 m (2,400 ft) long and encompasses San Clemente State Beach on the southern 30% and City of San Clemente on the northern 70%. Beach width is approximately 30 m (98 ft) wide at the southern boundary, transitions to 60 m (196 ft) wide in the middle, and transitions to 10m (33 ft) wide at the northern boundary. The railroad seaward slope incorporates conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.3 m (21 ft). There are no structures seaward of the railroad; some residential structures exist immediately landward of the railroad. Cells in this reach are numbered from 46 through 60. The reach's existing revetment of loose rock does not protect the railroad tracks.

Photo 7 - Reach 4

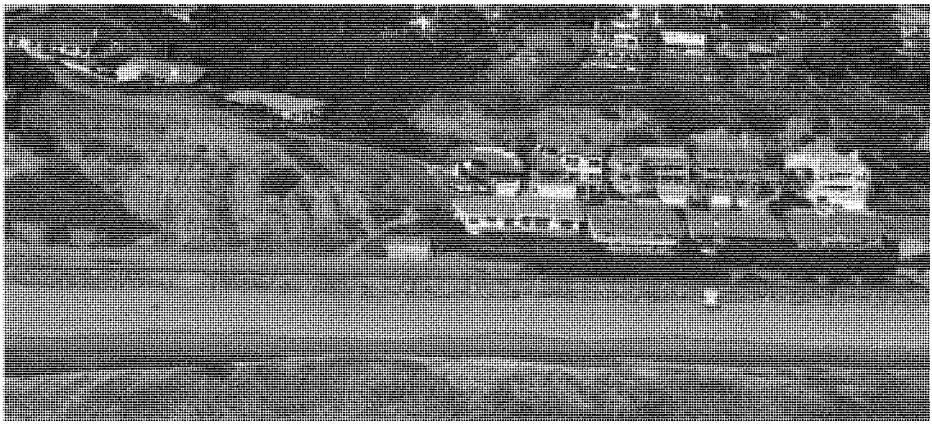
Photo 8 – Revetment Reach 4



Reach 5: Reach 5 (**Photos 9 and 10**) extends from Sta 3+127 to Sta 3+540. The reach is 413 m (1,355 ft) long and is encompassed within the City of San Clemente. Beach width is 0m wide throughout the reach. The railroad seaward slope incorporates improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +6.5 m (21 ft). There are no structures seaward of the railroad; some residential structures exist immediately landward of the railroad. Cells in this reach are numbered from 61 through 68. This reach does have an existing revetment to protect the railroad tracks.

Photo 9 - Reach 5

Photo 10 - Revetment Reach 5



Reach 6: Reach 6 (**Photos 11, 12, 13, and 14**) extends from Sta 3+540 to Sta 4+580. The reach is 1,040 m (3,412 ft) long and is within the City of San Clemente. Beach width meanders from 0 m wide to 23 m (75 ft) to 0 m to 39 m (128 ft) and back to 0 m along the reach. The railroad seaward slope incorporates conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.9 m (23 ft). This reach includes the majority of the significant structures along the beach. Cells in this reach are numbered from 69 through 89. This reach does not have an existing revetment to protect the railroad tracks.

Photo 11 - Reach 6

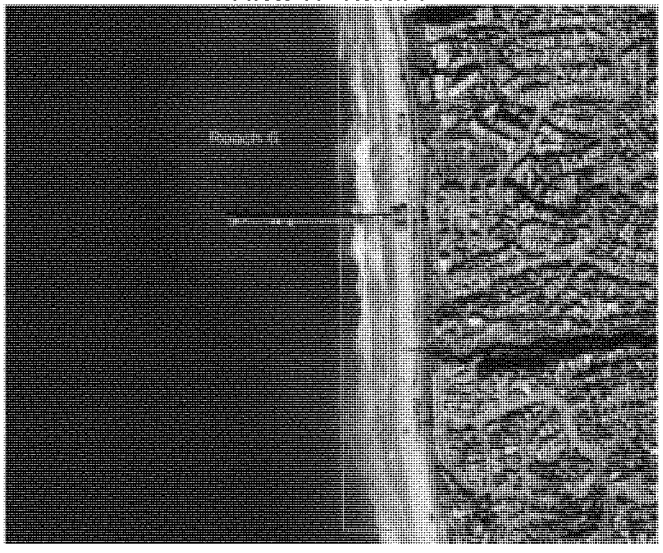


Photo 12 - Revetment Reach 6 (in detail)

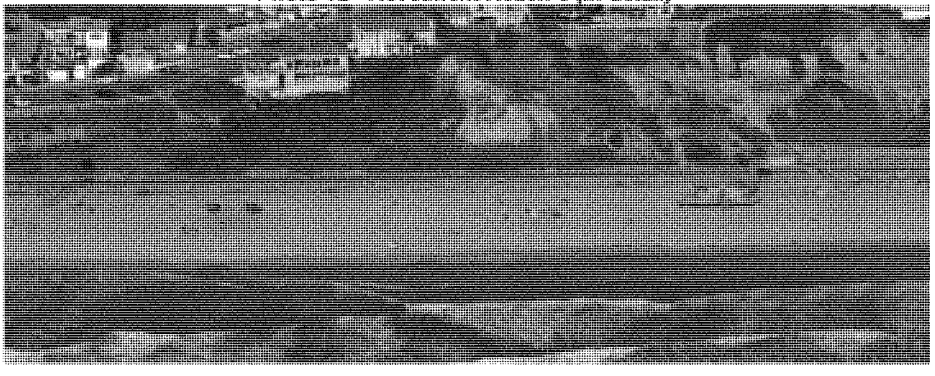


Photo 13 - Reach 6 (Oblique Photos)

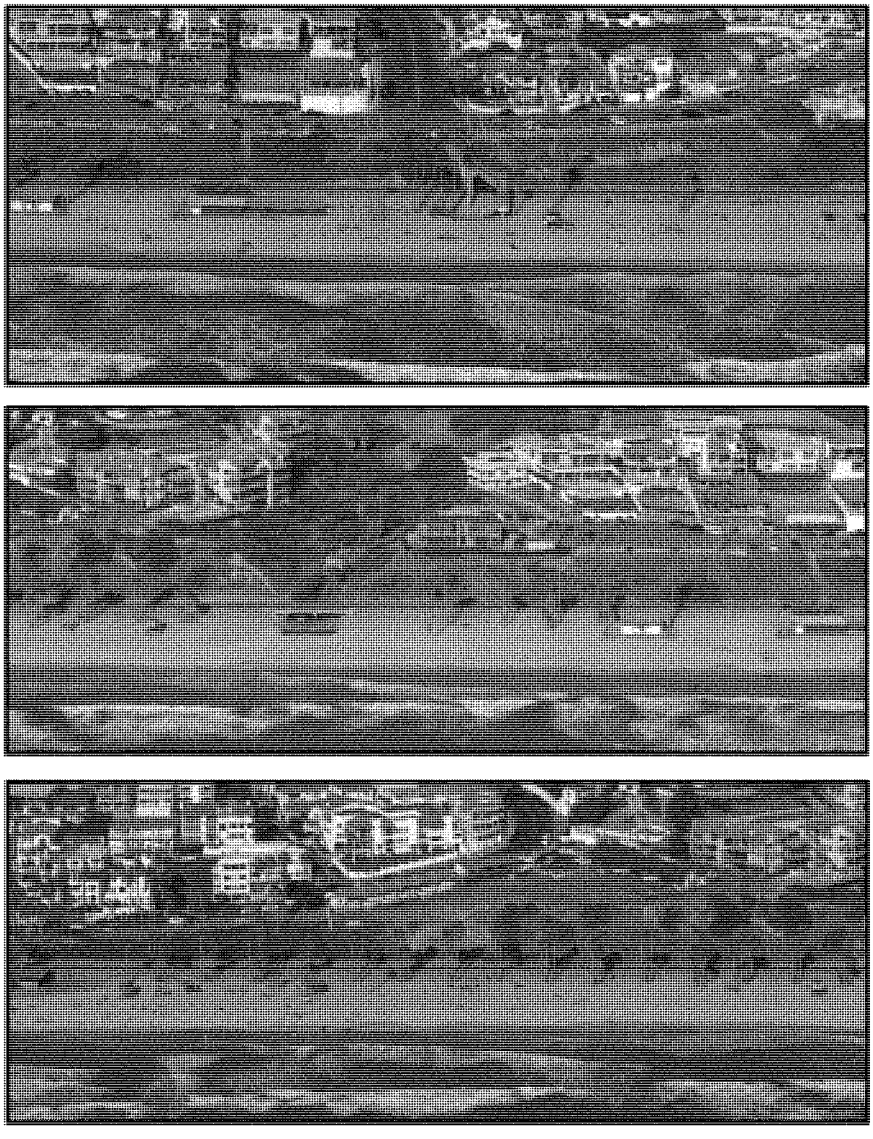
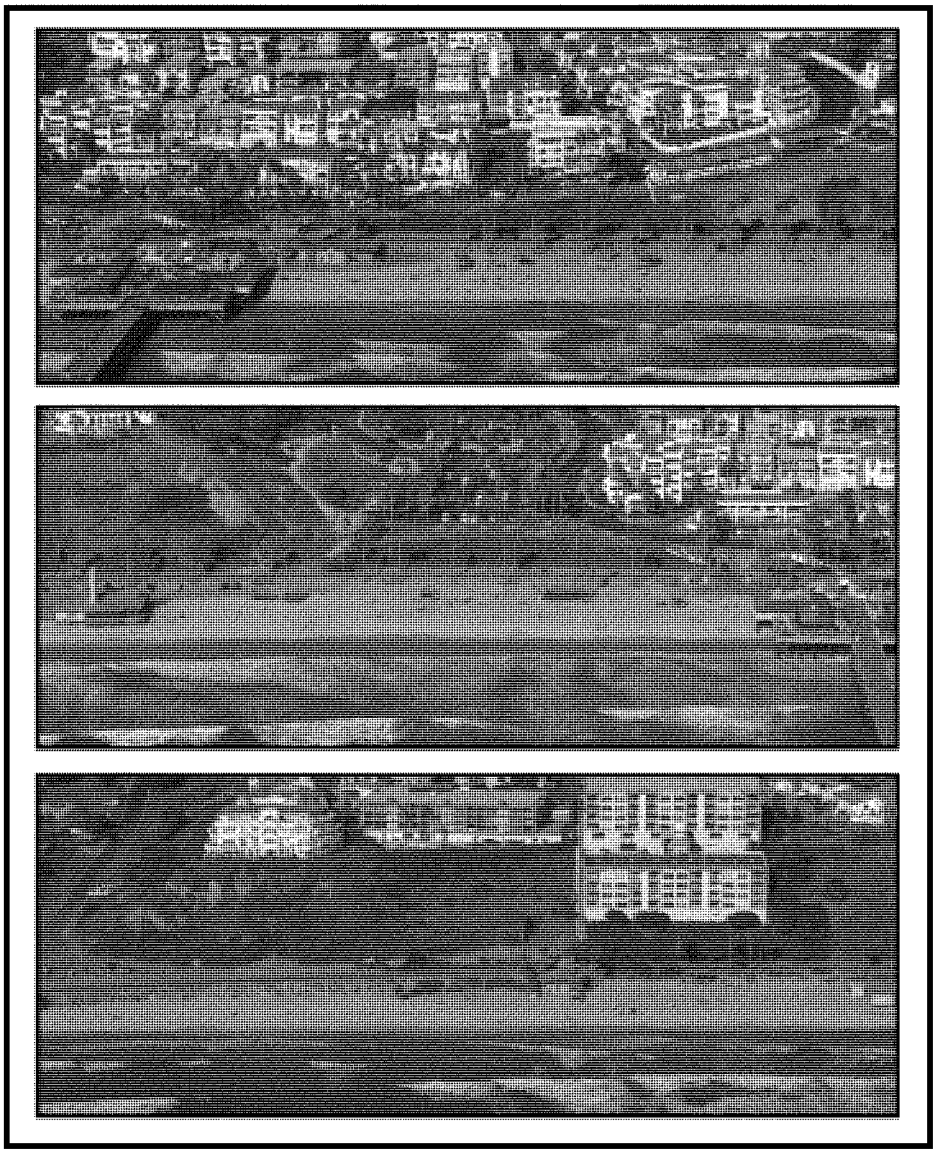


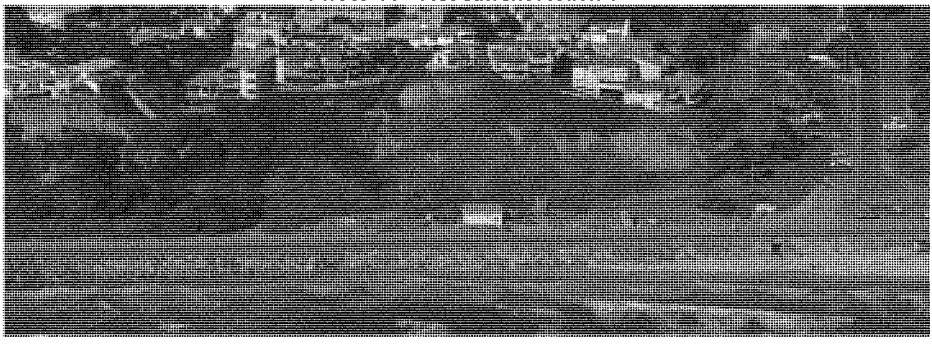
Photo 14 – Reach 6 (Oblique Photos)



Reach 7: Reach 7 (**Photos 15 and 16**) extends from Sta 4+580 to Sta 5+661. The reach is 1,081 m (3,550 ft) long and is encompassed within the City of San Clemente and is known as "Mariposa Point". Beach width is 0 m wide throughout the reach. The railroad seaward slope incorporates improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +6.9 m (23 ft). Historical information indicates that this reach has been armored with revetment since at least the 1930's. There are no structures seaward or landward of the railroad. Cells in this reach are numbered from 90 through 111. This reach does have an existing revetment to protect the railroad tracks.

Photo 15 - Reach 7

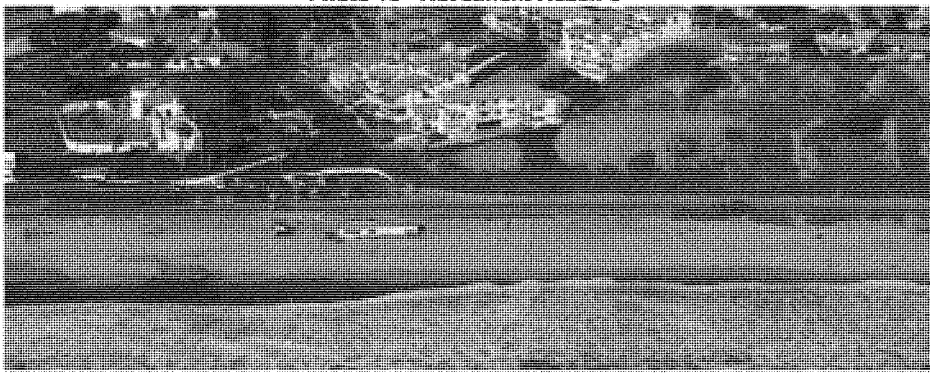
Photo 16 - Revetment Reach 7



Reach 8: Reach 8 (**Photos 17 and 18**) extends from Sta 5+661 to Sta 6+008. The reach is 347 m (1,140 ft) long and is encompassed within the City of San Clemente. Beach width varies from 40 m (130 ft) wide at the southern boundary to 0m at the northern boundary. The railroad seaward slope incorporates conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.9 m (23 ft). Cells in this reach are numbered from 112 through 118. This reach does not have an existing revetment sufficient to protect the railroad tracks. Also, the concession and restroom facility for the north beach is located within this reach.

Photo 17 - Reach 8

Photo 18 - Revetment Reach 8



Reach 9: Reach 9 (**Photos 19 and 20**) extends from Sta 6+008 to Sta 7+109. The reach is 1,101 m (3,610 ft) long and is encompassed within the City of San Clemente and is known as "Capistrano Shores". Capistrano Shores is a private community of manufactured housing constructed in the 1950's. A timber seawall that is fronted by a rubblemound rock revetment protects the reach. The armor stone is estimated to be 2-5 tons, has a slope of 1H:1V, and a crest elevation of approximately +6.0 m (20 ft). General condition of the revetment is not uniform and appears to be fair/poor along the entire length. Beach width is 0 m wide throughout the reach. The railroad is located substantially landward of the revetment and as such is no longer considered the project landward boundary. There are no structures seawards of the revetment. This reach is subdivided into 91 cells. Each cell is based on the boundary of a parcel with a manufactured structure.

Photo 19 - Reach 9

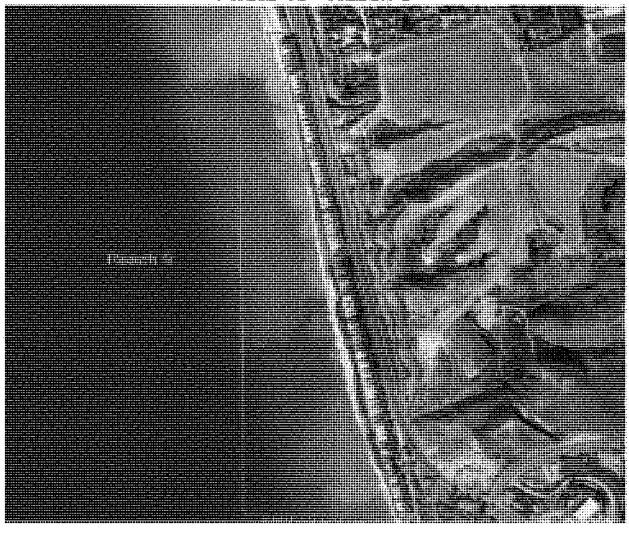
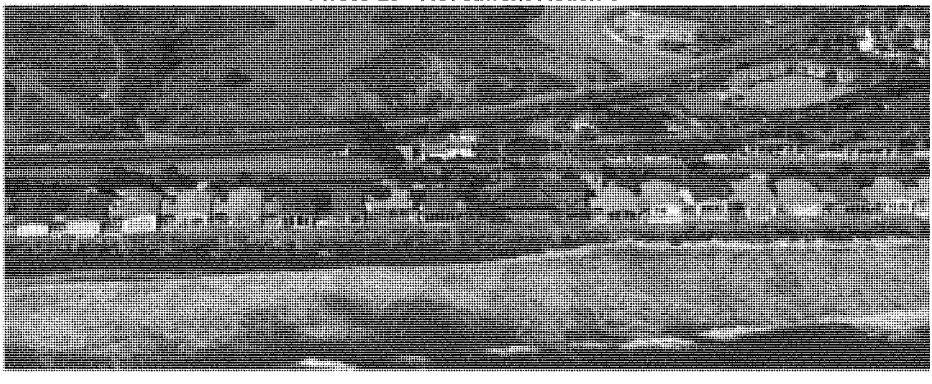


Photo 20 - Revetment Reach 9



Reach 10: Reach 10 (**Photo 21**) extends from Sta 7+109 to Dana Point Harbor. The reach is approximately 5,000 m (16,405 ft) long and extends to the northern boundary of the study area.

Photo 21 - Reach 10

2 DEMOGRAPHIC DATA

The City of San Clemente is located within Orange County, midway between Los Angeles and San Diego. San Clemente is located along Interstate 5 and is bordered on its western side by the Pacific Ocean.

2.1 Population

The majority of Californians live in Southern California. The California Department of Finance (CDOF) estimates the population of Orange County at 3,121,251 as of January 1, 2008, with the City of San Clemente having a population of 67,892[2]. Orange County's population accounts for 8.2% of the State's 38 million inhabitants. San Clemente is comprised of 46 km^2 (18 square miles).

Using the U.S. Bureau of Economic Analysis projection data for the State of California, the state is expected to experience a population increase of more than 28% by 2025, a considerably faster rate of growth than the United States (23%).

The City of San Clemente has experienced rapid growth since 2000. According to CDOF statistics, the City of San Clemente has grown from 49,936 residents in April of 2000 to its current figure of 67,892, an increase of 36.0%. The median age of the population of San Clemente is 38 years. Orange County median age is 31, and the median age for California is 33.6. Orange County has a population of 281,782 of people over the age of 65, which is 9.9-percent of the population.

Using 2000 Census reports, the population of the city of San Clemente is 87.9-percent white. Minority populations include: Asian (2.6%), American Indian and Alaskan Native (0.6%), African American (0.8%), Native Hawaiian (0.18%); and other (5.1%). Approximately 15.9-percent of the population is of Hispanic or Latino heritage. There are 19,395 households and the average household size is 2.56 persons.

2.2 Employment

Figure 3 and **Table 2** indicate the predominant sectors of employment for residents of the study area, according to the U.S. Census Bureau's *2005-2007 American Community Survey.* Important employment sectors include: management and professional services, production and transportation occupations, service occupations, and construction and maintenance.

In 2002 the value of agricultural production was $344.3 million. That ranks the county 19th in the state of California. Leading agricultural commodities include nursery stock and cut flowers, strawberries, tomatoes, peppers, and avocados.

In Orange County, the unemployment rate for March 2009 was 8.5%, up from March 2008's 4.5%. The city of San Clemente has a rate of 6.9%, which is much lower than the rates in both the county and the state (11.2%).

[2] State of California, Department of Finance, *E-1 Population Estimates for Cities, Counties and the State with Annual Percentage Change.* Sacramento, California, May 2008.

Figure 3 - San Clemente Employment

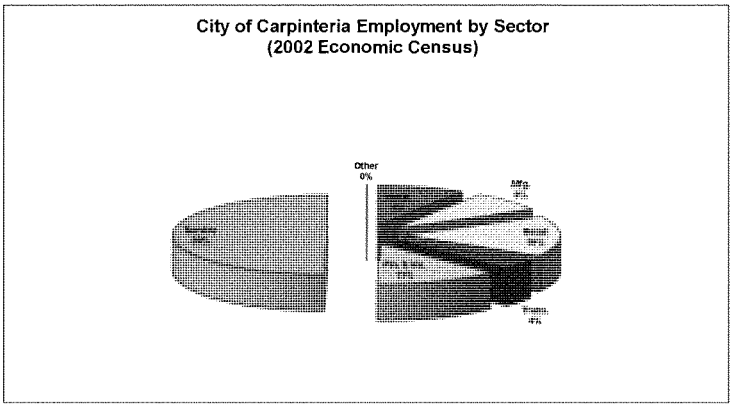


Table 2 – Employment by Industry (2007)

Industry	San Clemente	Orange County	California
Farming & Mining	14	5,525	326,033
Construction	2,752	111,018	1,304,774
Manufacturing	2,430	205,584	1,770,742
Wholesale & Retail	4,933	220,229	2,466,785
Transportation & Warehousing	1,214	50,199	766,388
Finance & Insurance	3,859	183,676	1,745,598
Service	14,970	680,228	8,184,668
Total	**30,172**	**1,456,459**	**16,564,988**

2.3 Income

Among the most common occupations for San Clemente are: sales and office occupations, 28.5%; management, professional, and related occupations, 43.8%; production, transportation, and material moving occupations, 4.6%; service occupations, 15.2%; and construction, extraction, and maintenance occupations, 7.9%. Approximately, 75% of the people employed were private wage and salary workers. According to the *2005-2007 American Community Survey*, the median household income for San Clemente was $82,842 in 2007, with mean household income at $109,987. Eighty-two percent of the households received earnings and 25% received Social Security retirement income, and 17% of the households received other retirement income. The average income from Social Security was $16,133. As shown in **Table 3**, the per capita income and median household income, in the study area are substantially higher than figures for the county and state.

Table 3 - Household Income (2007)

	San Clemente	Orange County	California
Households	22,971	972,040	12,140,888
Less than $15,000	1,524	71,483	1,314,868
$15,000 - $24,999	1,561	68,436	1,184,362
$25,000 - $34,999	1,700	76,620	1,163,795
$35,000 - $49,999	2,156	115,896	1,595,293
$50,000 - $74,999	3,536	173,926	2,187,062
$75,000 or more	12,494	465,679	4,695,508
Median Household Income	$82,842	$71,601	$58,361
Per Capita Income	$43,031	$32,890	$28,049

2.4 Transportation

In 2008 there were over 2,500,000 vehicles registered in Orange County. The county has over 2,700 km (1,700 miles) of streets, roads, and highways. Major interstate highways servicing the county include Interstate 5 (north to south) and I-405 (north to south). There are other freeways connecting cities, notably the 91 and the 73; running east and west, and the Pacific Coast Highway running along the coast. Mean travel time to work in the county is approximately 26 minutes, and 77% of workers drive alone. The county has John Wayne Airport located in Santa Ana that carries domestic flights. Orange County has a Metrolink train system that provides commuters with access to Los Angeles, Riverside, San Bernardino, Ventura, and North San Diego counties. The 15-year old commuter train operates a total of 137 daily trains running over 670 km (416 miles) of track. Amtrak, in partnership with the State of California, operates a commuter service (Pacific Surfliner) through the study area. In FY08 Amtrak reports boardings & alightings at the San Clemente Pier station at 10,092. However, total ridership through the study area is best seen by **Table 4** that shows boardings & alightings from San Diego northward through the study area for FY08.

Table 4 - Pacific Surfliner Ridership - 2008

Station	Boardings & Alightings
San Diego	912,096
San Diego – Old Town	22,531
Solana Beach	448,081
San Clemente Pier	10,092
San Juan Capistrano	263,945

3 WITHOUT PROJECT CONDITION

Without Project damage represents the amount of damage that would occur within the study area throughout the period of analysis, which covers the timeframe between the years of 2012 to 2061. Damages that would occur to structures and infrastructure due to wave force, inundation, and erosion of the shoreline are included. As the causes of damage are interrelated and dependent upon time as well as the shoreline position through time, the analysis applies a net present value approach to quantify the damage at a single reference point in time.

Procedurally, the Without Project damage assessment was conducted by employing a life-cycle approach. The life cycle approach deals with multiple realizations of possible evolution of project functions within the time frame of the period of analysis, as outlined in EM 1110-2-1100. The suite of life cycle realizations is constructed with consideration of the probabilities of key variables

In general, the life cycle approach appears better suited to most coastal engineering applications in contrast to a probabilistic annual approach. Variation with time is an essential ingredient in most coastal projects, and it is directly incorporated into the life cycle approach. Time variation of resistance and functional performance, constraints imposed by construction season and mobilization, even some economic, environmental, and political factors, can be conveniently and flexibly introduced into the life cycle approach. This approach leads to a unified analysis of technical performance and many economic factors which are critical to project success. In addition to its technical and economic strengths, the life cycle approach is more easily understood by non-technical parties involved with a project.

The life cycle approach embodies sequences of storms (including provisions for multiple storms of varying intensity during each year of the life cycle), erosion and post-storm recovery during each event, partial and complete property damage during each event (depending on water level, waves, extent of storm erosion, and type of building construction), cumulative property damage due to a succession of storms, optional repair or rebuilding after a suitable time lag (with conformance to any stricter building codes in effect), and periodic renourishment of the beach when needed and feasible during the life cycle. Typically, a key result from this analysis is the renourishment required during each life cycle, which can be converted to an economic present-worth dollar value. The expected cost and economic risks associated with maintaining the beach can then be realistically assessed by combining information from many different life cycle simulations.

3.1 Existing Development

Generally, structural development seaward of the railroad is minimal throughout the study area with three exceptions. The first exception is Capistrano Shores, in Reach 9, where this development is currently protected by armored stone revetment. The second exception is a small beach restroom/concession building in Reach 8. The final exception is in Reach 6 where there is structural development seaward of the railroad and consists mainly of public recreation related facilities. Major public infrastructure development throughout the study area subject to damage is the revetment protection to the LOSSAN railroad line. Revetment type and quality varies throughout the study area, as previously described. Loss of the LOSSAN transportation corridor would represent a significant NED loss and is the major component in the analysis of federal interest for a storm damage reduction project.

It is assumed that the LOSSAN transportation corridor will be maintained and protected by some means throughout the period of analysis. Under this assumption, the method of determination of federal interest in a potential project is an avoided cost approach – whether or not it is more cost-effective to institute a federal project solution (generally a more comprehensive solution) or to continue with the current local piecemeal approach. The following sections present the investigation of this question.

3.2 Engineering Analysis of Shoreline Erosion

Shoreline erosion functions were developed for the study area shoreline to use in the modeling efforts; a detailed discussion of these functions is presented in the Appendix D of the EIS/EIR. Two major sources of data for the estimates were the Coast of California Storm and Tidal Wave Study (CCSTWS) and the City of San Clemente beach width monitoring program. The data from the two efforts is a compilation of measurements obtained in the 1980's to the present day. The annual shoreline erosion function applicable to Without Project conditions has been modeled through @RISK as a triangular distribution, with a most likely erosion loss of -0.2m (-0.7 ft), a maximum erosion loss of -0.46m (-1.5 ft), and a minimum erosion loss (gain) of 0.37m (1.2 ft). The corresponding parameters applicable to the shoreline erosion under beach fill with project alternatives are -5.5m (-18.1 ft), -15m (-50 ft), and 9m (30 ft). These triangular distributions have mean erosion of -0.1m and -3.9m (-0.33 ft and -12.7 ft) for the Without Project and with beach fill conditions, respectively. Long-term sea level rise for the base case is estimated at 0.12 meters (4.7 inches) with the extreme sea level rise case at 0.70 meters (27.6 inches) over the study period.

3.3 San Clemente Management Policy for Beach Facilities

Based on the Park and Recreation Department current policy, the department will protect the existing facilities as long as it is economically feasible, which is defined by the Department as the repair cost being less that 50% of the estimated value of the facility. Also, the repair or protective measure must be environmentally safe, and erosion must not have reached a point where protection is impractical or illogical. Once a potential protection project fails to pass any of the criteria, the city's policy is to relocate the facility further from the ocean. As this occurs, costs to rebuild will certainly increase due to additional costs of demolition and removal of the existing facilities, the relocation of utilities, the new design work, and the constraints for building new facilities in areas that are currently at capacity or build-out.

3.4 Public Facilities Vulnerable to Erosion and Wave Damages

All public buildings are located in Reach 6 of the study area, with the exception one facility in Reach 8. These buildings provide basic services that enhance the recreation experience for users at San Clemente Beach.

Table 5 shows the square footage and depreciated replacement value of public buildings that are vulnerable to wave attack and damage associated with the erosion of the shoreline. Building costs for these structures are significantly higher than inland, due to costs of protection (sheet pile and caissons) and the building materials necessary for an ocean environment. Estimates of depreciated replacement value for the structures are based on data from Marshall & Swift and construction information provided by the City. Content values are based on information provided by the City. The replacement cost of the pier was excluded from the analysis since the pier is not susceptible to damage from the erosion of the shoreline.

Table 5 - DRV Public Structures Reach 6

FY11 Price Levels

Facility	Sq. Footage	Base Replacement Value	Depreciated Structure	Depreciated Contents
Marine Headquarters	5,675	$2,714,400	$2,035,800	$753,300
North Beach Concession & Restroom	960	$462,000	$346,500	$128,200
Linda Lane Restroom	660	$297,700	$148,900	$1,200
Picnic Shelter #1	500	$29,100	$21,800	$0
Concession South Pier	800	$256,500	$192,300	$71,200
Pier Restroom	660	$310,800	$233,100	$1,200
Picnic Shelter #2	500	$29,100	$21,800	$0
Restroom @ T-Street Beach	1,000	$409,400	$307,100	$1,200
Concession @ T-Street Beach	480	$240,900	$180,700	$66,900
Restroom south T-Street	480	$409,400	$204,700	$1,200
Total	**11,715**	**$5,159,300**	**$3,692,700**	**$1,024,400**

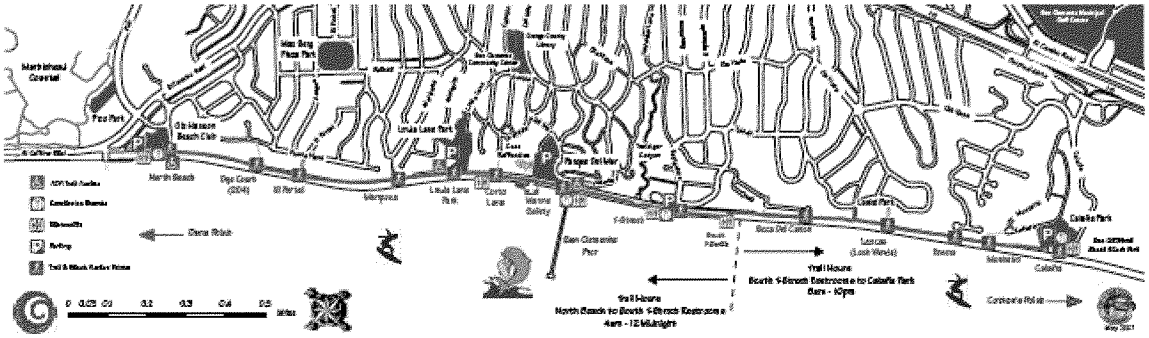
Damage functions for these structures in the analysis employed a wave force/damage function developed by the Coastal Engineering Section and inundation damages according to the Expert Panel Meeting, Houma, Louisiana (Jan 1997), for Commercial Structures - Depth/Damage Relationships for Commercial Structures.[3]

3.4.1 San Clemente Pedestrian Beach Trail

The San Clemente Pedestrian Beach Trail (**Photo 22**) is a multi-use pedestrian beach trail that has been recently completed at a cost of $11.8 million. The 4 km (2.5 miles) trail spans from North Beach to Calafia, and is located at the base of coastal bluffs and the beach within the right of way of the existing rail corridor. The trail consists of a 1.5 – 3 meter-wide (5 to 10 feet) at-grade multi-use path, approximately 260 meter (850 ft) long, 2.4 meter (8 ft) wide elevated walkway "at pitch point" at Mariposa Point, three short bridges to cross drainage channels at Trafalgar, Riviera and Montalvo, improvements to existing El Portal, Montalvo and Mariposa for pedestrian under rail crossings and pedestrian at grade crossings at Dije, El Portal, Corto Lane, "T" Street South and Lost Winds for beach access. The trail is constructed of natural materials, including stabilized decomposed granite, class II base and filter fabric. Barriers consisting of landscaping, rocks and fences are installed between the rail and trail. This new pedestrian trail addresses existing safety and adequacy issues with existing opportunities for public access to and along the coast in San Clemente. Overall safety has improved for pedestrians who cross the train tracks to access the beach in south San Clemente. The San Clemente Pedestrian Beach Trail also serves to form a significant link in the statewide Coastal Trail, making more of the beach accessible to the public by creating a coordinated access system of regional and statewide significance.

[3] Houma depth damage curves are presented in Attachment A.

Photo 22 - San Clemente Beach Trail



3.5 LOSSAN Railroad Corridor

The Los Angeles to San Diego (LOSSAN) corridor is the only railroad link between San Diego and the rest of the United States for passenger and freight railroads to operate, including military operations. This corridor is a major transportation link for passenger traffic, second only to the Washington DC to Boston corridor in terms of Amtrak train density and ridership.

The LOSSAN railroad line bisects the length of the project area. The railroad is constructed on conventional elevated crushed rock ballast, along the base of the bluff throughout the reach. It is a prominent feature that completely separates the active beach from the bluff. Beach accessibility is only available through pedestrian underpasses/overpasses or storm water culverts interspersed along the length. Whereas typically the beach and bluffs are considered together as components in an active littoral system, the presence of the railroad completely isolates the bluff from the beach. Virtually all sediment inputs and bluff-related influences are restricted. Furthermore, the railroad resembles and acts as a protective revetment.

The railroad is a primary structural feature that protects the bluffs and upland development from direct wave attack. In several areas where the beach has completely eroded and exposed the railroad and the railroad has implemented a variety of protection measures that has fixed the position of the shoreline. Overtime, the railroad has become the de facto protective structure for the area. As the previous photos reveal, protection measures vary from engineered revetment to unimproved ballast. These photos also indicate that the railroad enacts proactive measures to protect the rail line from erosion over large sections of area. The rail line serves as a vital commercial, transportation and national security link, as discussed below, that would have severe impacts for the region if disrupted. To prevent disruptions, protection measures have been instituted in advance of imminent threats to the rail line. Previous reach photos indicate protection measures have been taken over expanded areas where a limited area is potentially threatened. Thus, protective measures are not restricted to the limited area of erosion concern, but are extended far beyond the area.

Currently, Metrolink is committed to maintaining the existing revetment areas (Reaches 1, 3, 5, and 7) based on the terms provided in the California Coastal Commission Consistency Certification dated May 23, 2003 (CC-033-03). This Certification identifies a "limit line" defined as the line where the rock meets the sand. This limit line establishes the revetment slope of 1H:1V. Metrolink has committed to not construct or place additional riprap to flatten the slope of the existing revetment seaward of this line. To ensure the slope of the existing revetment remains unchanged, Metrolink intends to maintain this revetment through the strategic placement or "keying in" of rock – a constraint to future protective developments. Erosion will continue throughout the period of analysis and several study reaches are essentially unprotected. As the risk of damage and rail service interruption increases in these sections, Orange County Transportation Authority and Metrolink will need to develop a long-term solution within the Certification constraints.

Therefore, the railroad is assumed to be permanent and always exist throughout the period of analysis, acting as a protective structure and fixing the position of the shoreline. As such, the railroad is considered the landward boundary and no storm damages are considered landward of the railroad. The following sections will introduce the LOSSAN rail line, describe its current and expected future users, and provide an analysis and estimation of the economic damages associated with the rail line that correspond with the study's wave attack and erosion scenario.

3.5.1 History of the LOSSAN Rail Corridor

In 1882 the Atchison, Topeka, and Santa Fe Railway Company (ATSF) constructed the rail line connecting San Diego to San Bernardino, but this line was abandoned after two severe flood episodes that damaged the route. The ASTF constructed the LOSSAN corridor in 1888. The railroad line connected the cities of Fullerton and San Diego.

During the 1980's ATSF, Caltrans, Amtrak and Los Angeles, Orange and San Diego counties shared the costs ($79 million) of LOSSAN Rail Corridor Rehabilitation project. The project included replacement of the 50-year old jointed rail with new, heavier continuous-weld-rail; new wood railroad ties; installation or replacement of some power switches; and surfacing. In addition, since the 1980's the railroad and government agencies have spent $852 million in improving the infrastructure along the LOSSAN corridor.

The ATSF maintained and operated the LOSSAN corridor until 1993 when it was sold to the Orange County Transportation Authority (OCTA). The purchase by OCTA was funded by bond proceeds, the passage of propositions 108 and 116 in 1990, and by the proceeds from local transportation sales tax measures. Conditions of the purchase from the ATSF included the obligation to continue operation of ATSF and Amtrak trains, and the protection of utilities within the right of way. OCTA has assigned the maintenance of the line and operation of commuter trains to Southern California Regional Rail Authority (SCRRA). This maintenance activity includes track and tie inspection and periodic repairs. Also, there is on-going vegetation control and debris removal along the right-of-way, as well as periodic replacement of riprap to protect the track bed from wave action.

Over the past ten years, the wave action in the San Clemente area has restricted train movements periodically, but the railroad facility has not been completely shut down by the threat of waves breaking over the revetment and the tracks. During the 1998 El Nino storm, the area suffered severe damage, and train movements were slowed to ensure safe passage. After the storms in 1998, SCRRA completed considerable repairs to the track and riprap embankment. The OCTA has spent approximately $100,000 per year on riprap replacement. This riprap had to be applied at an increasing rate in recent years to protect the railroad tracks from increased wave attacks as a result of sand erosion. If the sand loss continues, the cost to maintain and extend the riprap can be expected to increase.

In 1996 the ATSF merged into a new corporation, the Burlington Northern and Santa Fe Railway (BNSF). Currently, this line connects with other railroad lines in San Diego. Also, this line connects to the Tijuana and Tecate areas of Baja California Norte (Mexico)

Importantly, the California Department of Transportation, in conjunction with the Federal Railroad Administration, is studying various alternative ways to improve the LOSSAN corridor's ability to meet the expected future increase in traffic demand in the region. While it is not currently known if and when the alternatives may be implemented, such improvements would be expected to further fuel growth in ridership and usage of the LOSSAN rail corridor.

3.5.2 Users of the LOSSAN Rail Corridor

When Amtrak took over passenger service from the Atchison, Topeka & Santa Fe (BNSF) in 1971, only three daily "San Diegan" passenger train round trips were being operated. During the following thirty years Amtrak negotiated additional San Diegan round trips with some funding support from the Caltrans. Eighteen San Diegan trains currently operate daily along this route,

nine in each direction. In 1992 Metrolink commuter rail service began on six local corridors centering in Los Angeles and Orange Counties.

Amtrak reports the Pacific Surfliner (San Diego – Los Angeles – Santa Barbara – San Luis Obispo) as the 2nd busiest corridor in the U.S. during FY06 with a boardings and alightings (B&A) totaling 5,628,909. B&As in the southern section that includes the study area total 3,374,746, excluding Los Angeles station. B&As from the San Clemente pier south total 1,612,064. Total B&As for Amtrak in the entire state for FY06 were 10,153,158. Nearly 16% of Amtrak's state passenger load passes through San Clemente. On an average daily basis, San Clemente serves over 4,400 passengers.

While Amtrak serves what are considered intercity passengers, Metrolink serves commuters along the LOSSAN corridor. Metrolink currently operates 137 train trips per day on seven routes in the Southern California region. Metrolink operates nineteen train trips per day in each direction along various segments within the corridor between Los Angeles Union Station (to the north) and Oceanside (to the south). Of these, six trains travel to or through the Oceanside and San Clemente stations in each direction. The average weekday ridership in April 2007 was 7,841 on the Orange County line. Daily boardings before 8:30 am in Oceanside and San Clemente totaled 540. Nearly 85% of these are traveling in the peak direction, towards Los Angeles Union Station (LAUS). For the entire Orange County Line a total of around 3,099 passengers board during this same period in the peak direction of travel. Of these passengers, nearly 80% of them continue all of the way through to LAUS. Presumably, an equal number of passengers return on the evening peak trains in the opposite direction.

According to Amtrak's 20-Year Improvement Plan from 2001, demand for passenger service along the corridor is expected to continue to grow significantly over the next twenty years and beyond. They project a tripling of the intercity ridership along the LOSSAN corridor between the years 2001 and 2020. However, other forecasts predict slower but still rather strong growth in ridership into the future. For example, a report prepared by Charles River Associates in 2000 for the California High-Speed Rail Authority forecasts that intercity rail trips between Los Angeles and San Diego will increase by approximately two-percent per year through 2015. The report assumes that ridership will increase at the expected rate of population growth in the region. While the forecasts are, unfortunately, not directly comparable, they nonetheless indicate that it is generally agreed that rail ridership over the next twenty years along the corridor will increase, but that the magnitude of the increase is uncertain.

In addition to passenger traffic, the rail corridor is also an important conduit for freight shipments. The Burlington Northern Santa Fe Railway operates, on average, 6-8 trains per 24-hour period between San Diego and Los Angeles. Trains operating during the day average 4,800 tons, which is approximately 60-65 trains cars in length. Trains operating at night are typically performing auto transload service. In addition to general freight, the line handles fuel gas, bulk chemical shipments to the Port of San Diego (principally potash), feed grain, automobile, lumber, and transportation, construction, and military equipment. Also, this line serves the Camp Pendleton Marine Corps Base, the Miramar Naval Air Station, the Southern California's San Onofre nuclear plant, and the San Diego Unified Port District. According to the U.S. Railroad Traffic Atlas, in 1997 BNSF handled between 5 and 10 millions of gross ton-miles per mile on the line between San Diego and Los Angeles. It was also estimated that in 1997 approximately 30,000 freight cars were handled along the rail corridor. More recent estimates were not available. The California Department of Transportation and the Federal Railroad Administration are forecasting that the volume of freight traffic will by 2020 be approximately 50% greater than the current volume.

The rail line is important for domestic freight movements as well as for trade with Mexico. While data was not available for the LOSSAN rail corridor in isolation, according to the Bureau of Transportation Statistics, in October 2004 alone the value of trade by rail between California and Mexico was $163 million.

Finally, the LOSSAN rail corridor is part of the U.S. Department of Defense Strategic Rail Corridor Network (STRACNET). STRACNET is a 30,000 mile interconnected network or rail corridors deemed important for national defense. According to the Military Surface Distribution and Deployment Command (SDDC, formerly MTMC), the principal importance of STRACNET lines relative to other rail lines is that STRACNET has priority with respect to restoration of service in the event of an emergency that results in a large-scale loss of rail lines.

The LOSSAN line is clearly a key transportation link in southern California's railroad infrastructure, and delays in service can and do have significant public and private costs. Ensuring reliable and safe access along the corridor is vital to the interests of the OCTA as it accommodates a large and increasing number of intercity passengers, commuters, and freight. As with many types of infrastructure investments, the value of the rail line to the users and the owner can only be maximized if it provides consistent, reliable service. An intrinsic part of the rail line's value (and the services associated with it) is that it provides a high level of reliability to its users. The OCTA has a very strong incentive to maintain the rail line and, importantly, to protect it from anticipated causes of damage such as damage from wave attack and erosion.

Importantly, in the event of a service disruption along the rail line, depending on the length of the disruption, both short-term and long-term economic and non-economic impacts could be expected. Impacts as a result of a service disruption along the LOSSAN line include: time-value costs to rail passengers, additional operating costs to the rail services, increased repair costs, increased traffic congestion, elevated smog and air pollution levels, and possibly higher goods delivery costs. The following section attempts to estimate the shorter-term monetary impacts that would result from a delay along the rail corridor.

3.6 Estimate of Economic Impacts – LOSSAN Corridor Disruptions

Damage to the rail line in the study area that causes a disruption in rail passenger and freight service would have various adverse economic impacts. The delay could be expected to impose economic damages upon rail travelers in the form of time-value costs, and upon the rail companies in the form of repair costs and additional operating costs. The following text describes this study's estimate of the time-value costs for Metrolink and Amtrak customers, the additional operating costs for both services, and the expected repair costs. The magnitude of the total cost is, of course, dependent on the scale of damage and the duration of the service disruption. The study will assume a) that replacement of a 50m (164 ft) section of track and embankment is needed for each breached location, and b) that service along the line is disrupted for one 24-hour period, being based on consultation with Engineering Division and rail lines.

3.6.1 Time-Value Costs

In order to estimate the time-value costs to passengers of a disruption in service, the methodology used will be that recommended in IWR Report 91-R-12, entitled *'Value of Time Saved for Use in Corps Planning Studies, A Review of the Literature and Recommendations'*. The time-value analysis conducted for this study will rely on passenger data and characteristics

that have been made available by Amtrak and Metrolink. No separate survey was conducted for the purposes of this study.

For Metrolink, the affected passengers are riders of its Orange County Line. Of these individuals, those most likely to be affected are those boarding, alighting, or traveling through the San Clemente and Oceanside stations. For Amtrak, the affected passengers are those on its Pacific Surfliner route that are expected to travel through the San Clemente area, northbound and southbound.

According to officials from both Amtrak and Metrolink, the normal response by the rail services to an event such as that analyzed in this study is to bus passengers around the damaged rail section, connecting them either northbound or southbound to a nearby station. According to Metrolink officials, the most likely response would be to bus the affected passengers between the Irvine station, which is the closest station to San Clemente that is suited to accommodating the bus service, and their connecting station such as Oceanside. According to Metrolink officials, passengers that are bused can expect a total daily delay of approximately one hour in comparison to normal daily train service, for Amtrak service the delay is estimated at one-half hour.

Tables 6 and **7** show the calculated value of the delay for the average person according to trip purpose for the Metrolink and Amtrak services. The value of the average delay for each service, as calculated in the two tables, will be used in subsequent tables as an input to the calculation of total time-value costs for the riders. Median household incomes for Metrolink and Amtrak passengers are estimated from surveys at $38/hr for Metrolink and $30/hr for Amtrak. Using the estimated value of the average delay per person, it is then possible to estimate the total time-value of the delay by considering the expected total number of affected passengers and their trip purpose. This same calculation was made for each year of the study period - through 2061. The results are shown in **Tables 8** through **11**.

Table 6 - Value of Average Delay per Person - Metrolink

Purpose of Trip	(1) Avg Delay [min]*	(2) Avg Delay [hrs]	(3) % of Hourly Income	(4) $ Value of Time per Hour	(5) Value of Avg Delay per Person
Work	60	1	53.8%	20.4	20.4
Personal Business	60	1	64.5%	24.5	24.5
Social/Recreation	60	1	60.0%	22.8	22.8
Vacation	60	1	75.1%	28.5	28.5

*According to Metrolink's officials – based on roundtrip travel.
(1) Average change in travel time (delay) from origin to destination in minutes due to service disruption.
(2) Conversion of (1) into hrs.
(3) Percentage of Median Hourly Family Income to use in calculation of (4). Taken from USACE guidance.
(4) Median Hourly Family Income - $38/hr – multiplied by (3) [Metrolink customer survey].
(5) Calculated by multiplying (4) by (2).

Table 7 - Value of Average Delay per Trip - Amtrak

Purpose of Trip	(1) Avg Delay [min]*	(2) Avg Delay [hrs]	(3) % of Hourly Income	(4) $ Value of Time per Hour	(5) Value of Avg Delay per Person
Work	30	0.5	53.8%	16.1	8.1
Personal Business	30	0.5	64.5%	19.4	9.7
Social/Recreation	30	0.5	60.0%	18.0	9.0
Vacation	30	0.5	75.1%	22.5	11.3

*Based on one-way trips, as estimated by Metrolink's officials.
(1) Average change in travel time (delay) from origin to destination in minutes due to service disruption.
(2) Conversion of (1) into hrs.
(3) Percentage of Median Hourly Family Income to use in calculation of (4). Taken from USACE guidance.
(4) Median Hourly Family Income - $30/hr – multiplied by (3) [Amtrak survey of Pacific Surfliner customers].
(5) Calculated by multiplying (4) by (2).

One notable difference between the Metrolink and the Amtrak data is, according to the on-board surveys, a much higher percentage of passengers riding Amtrak trains are traveling for leisure and vacation purposes, whereas the vast majority of Metrolink riders are commuting for work. The on-board survey conducted by Metrolink show the median household income at around $38/hr; whereas, the Amtrak survey of its Pacific Surfliner customers indicates a median household hourly wage of around $30/hr. Although the median household income for Metrolink riders is approximately 25% higher than the median income for residents in the counties of Orange and San Diego, this may be reasonable given that the Metrolink commuter route going to downtown Los Angeles could be expected to have a higher proportion of professionals and business people.

For this analysis, given the dearth of readily available relevant information, several simplifying assumptions were made to enable the estimation to go forward. It is assumed that passenger ridership is distributed evenly over the week such that the ridership on any given day within a particular year is equal to a given daily average. Also, because the analysis uses household income as opposed to per capita income, in order to attempt to minimize double counting it is important to try and capture the proportion of passengers traveling with spouses or as a family. This was done by simply assuming that half of those traveling for social/recreational or vacation purposes were traveling with other members of their household. This assumption mainly impacts the calculation of time-value cost for Amtrak riders (as opposed to Metrolink riders), as they have a much higher percentage of passengers traveling for leisure purposes.

Tables 8 to 11 show the estimated time-value cost of delays to Metrolink and Amtrak riders at the beginning and the end of the study period. Ridership is assumed to grow at 2% annually for both services over the entire study period, which approximates the forecasted long-term population growth rate in the region. Thus, the 2012 ridership estimate was arrived at by increasing the current ridership figures by 2% per year until 2012.

Table 8 - Total Time Cost of Delay (2012) - Metrolink

Purpose of Trip	(1) $ Value of Avg Delay per Person	(2) % of Total Passengers*	(3) Avg Number of People	(4) Avg Number of People after Adjustment	(5) Total $ Value of Avg Delay
Work	20.4	92%	388	388	7,915
Personal Business	24.5	4%	17	17	417
Social/Recreation	22.8	4%	17	8	182
Vacation	28.5	0%	0	0	0
Total Time Cost of Delay					$8,514

*According to Metrolink on-board survey, Nov. 2004.
(1) From Table 6.
(2) Assumed distribution of purpose of travel.
(3) According to projections, as explained in text.
(4) Adjustment made to capture the percentage occurrence that social/recreational and vacation travelers will be traveling with other household family members – spouses and/or children.
(5) The product of (1) and (4).

Table 9 - Total Time Cost of Delay (2012) - Amtrak

Purpose of Trip	(1) $ Value of Avg Delay per Person	(2) % of Total Passengers*	(3) Avg Number of People	(4) Avg Number of People after Adjustment	(5) Total $ Value of Avg Delay
Work	8.1	20%	716	716	5,800
Personal Business	9.7	9%	322	322	3,123
Social/Recreation	9.0	54%	1932	966	8,694
Vacation	11.3	17%	608	304	3,435
Total Time Cost of Delay					$21,052

*According to Amtrak's Spring 2004 on-board passenger survey.
(1) From Table 7.
(2) Assumed distribution of purpose of travel.
(3) According to projections, as explained in text.
(4) Adjustment made to capture the percentage occurrence that social/recreational and vacation travelers will be traveling with other household family members – spouses and/or children.
(5) The product of (1) and (4).

Table 10 - Total Time Cost of Delay (2061) - Metrolink

Purpose of Trip	(1) $ Value of Avg Delay per Person	(2) % of Total Passengers	(3) Avg Number of People	(4) Avg Number of People after Adjustment	(5) Total $ Value of Avg Delay
Work	20.4	92%	985	985	20,146
Personal Business	24.5	4%	43	43	1,056
Social/Recreation	22.8	4%	43	22	491
Vacation	28.5	0%	0	0	0
Total Time Cost of Delay					$21,693

Table 11 - Total Cost of Delay (2061) - Amtrak

Purpose of Trip	(1) $ Value of Avg Delay per Person	(2) % of Total Passengers	(3) Avg Number of People	(4) Avg Number of People after Adjustment	(5) Total $ Value of Avg Delay
Work	8.1	20%	1,816	1,816	14,656
Personal Business	9.7	9%	817	817	7,907
Social/Recreation	9.0	54%	4,904	2,452	22,066
Vacation	11.3	17%	1,544	772	8,695
Total Time Cost of Delay					$53,324

For each of the services, while it would be expected that some proportion of passengers would choose not to take the train (and, for example, drive instead), the analysis nonetheless assumes that all of the expected passengers will be delayed. This assumption is based on the idea that even those passengers that choose to drive or travel by alternative means would be at least slightly delayed. This seems reasonable in light of the expected future increase in traffic congestion in the region. The EIR/EIS report by Caltrans and U.S. DOT (cited previously) estimates that driving time along the corridor is expected by 2020 to increase by 25% over the current drive time. Under these conditions, according to the report, and assuming no significant capital improvements to the rail or highway corridor, travel by rail would be approximately 15% faster than travel by car along the corridor, with a one-way trip between San Diego and Los Angeles being half an hour faster by rail than by personal vehicle. According to this trend, over the study period, travel by vehicle would be increasingly slower than travel by rail along the LOSSAN corridor, increasing the likelihood that a delay will be unavoidable for individuals that typically ride the train along the corridor. This trend would only be exacerbated in the event that significant improvements to the rail line were made, which appears to only be a question of time.

3.6.2 Estimation of Additional Operating Costs

In addition to the time-value costs associated with a delay, the rail services would typically incur additional costs as a result of having to provide connecting bus service around the affected area. According to Metrolink officials, the total current cost to bus passengers between the Irvine station and Oceanside would currently total approximately $25,000 per day. This estimate includes the cost to hire the necessary buses, the added employee cost as a result of needing more staff to handle the bus transfers, and the costs of rerouting or deadheading equipment to another layover facility. Amtrak officials indicate that they do not always offer bus service to move passengers around a damaged rail section. For this analysis, the total additional operating cost for both services is estimated to be twice the cost to Metrolink alone, but the actual cost could be significantly higher depending on whether Amtrak decided to bus all of its passengers around the affected area, and depending on that day's passenger load. For the analysis these additional operating costs are simply assumed to increase in proportion to the assumed increase in ridership over the study period. This cost is shown for selected years in **Table 12**.

3.6.3 Estimation of Repair/Replacement Cost

The third component of adverse economic impacts incurred as a result of the wave and erosion-induced rail and embankment damage is repair costs. According to SCRRA officials, the cost to replace a 50m (164 ft) section of track and embankment would be approximately $408,000, although the actual cost would depend on the exact length, width, and depth of the erosion. This estimate includes: the cost of new materials, the cost for labor and machines at overtime

rates, and mobilization costs. Also, the repair/replacement cost will ostensibly increase if significant capital improvements are made to the line; one improvement currently under consideration, for example, is to replace the single-tracked segments along the corridor with double-tracked segments.

The table below shows the combined total estimate of the potential growth in damages for a damaging event for selected years of the study period for both the Metrolink and Amtrak services. These include estimates of the time-value costs to delayed passengers, the additional operating costs (bus rental, overtime pay, etc.) to the passenger rail services as a result of the one-day disruption in service, and the repair costs of the damaged section of rail and embankment. The actual damage level of damage is dependent upon shoreline erosion and storm conditions which will be determined under the probabilistic lifecycle conditions of the model.

Table 12 - Total LOSSAN Damage for Single Event, Selected Years

Year	Total Time-Value Cost	Additional Bus and Operating Cost	Repair/Replacement Cost	Total Cost (FY10 Price Level)
2012	$29,566	$51,272	$408,000	$488,838
2020	$35,713	$59,700	$408,000	$503,412
2030	$42,997	$72,774	$408,000	$523,774
2040	$52,551	$88,711	$408,000	$549,262
2050	$64,376	$108,138	$408,000	$580,513
2061	$75,016	$129,235	$408,000	$612,251

3.7 LOSSAN Revetment Operation & Maintenance

The maintenance method used to resist erosion for the last several decades has been to place broken stone riprap along the ocean side of the track embankment. In earlier times, some riprap was comprised of waste concrete; however, that material tended to break, leaving exposed reinforcing steel exposed to persons on the beach. The size of the stone is from a maximum dimension of four feet down to four inches. The stone has come from various quarries in Southern California. Almost all of the rock applied in the 1990's was granite from Corona or Newberry Springs. The rock has been delivered to the roadbed area in railroad cars that dump to the side. Before and after dumping the rock, the construction equipment (tracked excavators and rubber tired end loaders) is used to arrange the rock into a uniform row, and to keep it clear of the PUC walkway area alongside the track. This work is done at night because of the need to occupy the tracks with the rail cars. The rock is placed on a 1:1 or 1.5:1 (horizontal to vertical) slope towards the beach, and to a height of about three or four feet higher than the rails. This height is meant to deflect large waves at high tides, which are otherwise observed to impact the tracks. Placement and replacement of riprap is all fixed in location at 6 to 9 meters (20 to 30 feet) west of the centerline of the tracks. The SCRRA experience since 1993, and staff experience dating into the 1970's, is that the very steep rock piles are often underlain by compacted sand. The next stage of erosion is that the high parts of the piled stone settles into these voids, lowering the height of the embankment. This is an annual cycle, with the most erosion occurring over winter. Over the last five years, rock has been installed almost yearly to replace that lost to erosion.

The maintenance use of random-dumped stone riprap has evolved over decades of practical experience and has not been studied or engineered by rigorous methods. It is believed to present an exposure to the ocean that is able to absorb significant energy and to capture some of the smaller stone and sand.

The operation of a railroad line is a continuous responsibility. Inspections and repairs that can be scheduled in advance and which do not disrupt train operations are performed on weekdays. Troubleshooting must be done at any time there are problems reported by trains or discovered by inspections. Many of the maintenance tasks must be done at night because of the many passenger trains operating during the days. These night projects are similar to the night work that Caltrans does on urban freeways in that it is scheduled to avoid disruption to the majority of users of the corridor. It does impact residential areas with some light and noise.

According to documents provided by the railroad, the railroad spends $200,000 to $300,000 (2000 price level) every three years to maintain the revetment ("non-engineered"). The study team assumed that the current average yearly cost for the maintenance of revetment would be rounded up to $100,000 and the director of Engineering & Construction for SCCRA verified this figure. This riprap has been applied at an increasing rate in recent years to protect the railroad tracks from sand erosion. If the sand loss continues, the cost to maintain and extend the riprap will increase in future.

The $100,000 per year average incurred under existing conditions was distributed on a per square foot basis throughout the four reaches that are currently protected by a revetment. In the future years, the revetment costs increased, with the additional areas that need to be protected by the revetment.

Table 13 shows the first cost of the non-engineered revetment for one 50 meter (164 ft) cell to be $123,000 and the yearly maintenance cost of $2,173. The average annual maintenance cost for the current conditions is $218,800.

3.7.1 Future Without Project Rail Line Protection Scenario

In May 2003, the California Coastal Commission (CCC) proposed changes to the current maintenance plan. The CCC has significant concerns regarding the impacts of the current maintenance plan in regards to natural sand supply and recreational resources. In order for the SCRRA to get a permanent permit for the revetment, the SCRRA must convince the CCC that the revised maintenance plan addresses these impacts. Currently, Metrolink is committed to maintaining existing revetment areas based on the terms provided in the California Coastal Commission Consistency Certification dated May 23, 2003 (CC-033-03). The Certification identifies a "limit line" defined as the line where the rock meets the sand. This limit line establishes the revetment slope of 1H:1V. Metrolink has committed to not construct or place additional riprap to flatten the slope of the existing revetment seaward of this line. To ensure the slope of the existing revetment remains unchanged, Metrolink intends to maintain this revetment through the strategic placement or "keying in" of rock.

Recent discussions among the local stakeholders have indicated that the construction of a seawall is the likely alternative as it provides adequate protection to the rail corridor, minimizes impacts to the remaining beach, and provides safer public access by allowing for organized crossings. Through these discussions with the railroad and the City and the examination of the physical data, a significant concern of the protective effectiveness of the beach develops around a 3 meter (10 foot) width dimension. Under "average" long-term erosion conditions a 3m beach width would require 30 years before being completely eroded away – leaving only the small railroad shoulder buffer between the tracks and ocean. However, if storm induced erosion is entered into the equation, the potential for damage increases dramatically. The 100-yr storm is predicted to erode 8 m (26 ft); accordingly, a 3m wide beach would be endangered by the 100-yr storm.

The process for implementing protective measures beyond those covered by the California Coastal Commission's Certification would be time consuming – several years at the minimum. It is economically unreasonable that railway parties would wait until an imminent danger existed, given the strategic nature of the LOSSAN corridor. Additionally, the City Manager of the City of San Clemente has declared the City's support for the construction of a seawall, and to successfully navigate the current regulatory process to protect the rail corridor along the San Clemente shoreline, OCTA and Metrolink would tend to pursue the construction of seawalls, with various funding partners, in lieu of revetments as the need arises. For these reasons, the study has adopted an 8 m (26 ft) beach width criterion. This 8 m criterion has been implemented in that it coincides with the 100-yr storm erosion potential and conforms to the typical FEMA goal of urban flood protection for insurance removal.

The long-term comprehensive solution of seawall construction is dependent upon shoreline placement entering the 8 m zone. Within a given reach, the model's triggering mechanism for seawall construction requires between 300 and 500 meters (984 and 1,641 feet) of shoreline to be within the 8 m criterion. However, this seawall construction does not eliminate the potential for storm induced damage prior to its construction. Emergency storm related damages to revetment will remain a possibility until the long-term seawall solution is in place. It is probable that an emergency repair may be applied to the damaged cell prior to the comprehensive upgrade or construction of a newly designed seawall during a severe storm event.

Table 13 shows the first costs, operation, maintenance, repairs, and rehabilitation (O&M) costs for cell revetments within the study. The data table also shows the cost uncertainty that was applied to each of the values during the economic analysis. These costs in the model are applied to affected cells as impacted through the period of analysis. O&M costs would occur annually based on the type of revetment within a cell. Revetment is assumed to be increased when damaged within the model. For example, if an unimproved ballast cell is damaged within the model's framework it is assumed to be replaced with engineered revetment in the following year. The process works the same for non-engineered to engineered revetment. However, if the shoreline triggers seawall construction all cells are replaced with a seawall. Over time a cell's O&M costs will vary between normal O&M, improvement, and seawall construction. This resulting annual stream of potential costs is converted to a single annual value through net present value.

Table 13 - R/U Model Construction and O&M Cost Inputs
FY11 Price Levels

Economic Value	Price per Foot	Cost per Cell	Uncertainty Variance
O&M Cost Non-Eng Revetment	$13.25	$2,173	±1%
O&M Cost for Unimproved Ballast	$13.25	$2,173	±1%
O&M Cost for Engineered Revetment	$7.50	$1,230	±15%
First Cost for Engineered Revetment	$750.00	$123,000	±15%
First Cost for Upgrade to Eng Revetment	$250.00	$41,000	±15%
First Cost to Construct Seawall	$8,900.00	$1,712,800	±16.5%
Mitigation Cost for Loss of Sediment Supply[4]	$22.00	$3,608	±15%
Mitigation Cost for Loss of Public Access	$200.00	$32,800	±15%

[4] Pursuant to Section 30235, the California Coastal Commission is required to approve a protective device which alters natural shoreline processes, such as the proposed seawalls, when there is an existing structure in danger from erosion and a seawall is required to protect it; and, when the protection is designed to eliminate or mitigate adverse impacts on shoreline sand supply. In the Encinitas, it was determined that protection was necessary and an in-lieu fee program was derived as the means to mitigate the impacts of the shoreline protective devices on beach sand supply, to be paid by the applicants in-lieu of placing sand on the beach. The payment of the fee was required as a condition of approval of the coastal development permits for shoreline protective devices in accordance with Section 30235 of the Coastal Act.

The amount of the fee was derived through a methodology developed by the Commission staff coastal engineer to quantify the amount of sand that would replace the lost beach area and replace the amount of sand denied to the littoral cell over the life of the structure. The volume of the sand is then multiplied by the cost of transporting and depositing sand on the beach in the project vicinity to determine the fee to be paid in-lieu of placing sand on the beach to mitigate for the lost beach area and material.

The California Coastal Act emphasizes the need to protect public recreational opportunities and to provide public access along the coast. Similarly, the Act also calls for the protection of scenic and aesthetic qualities of coastal resources.

Shoreline structures, such as seawalls, can lead to loss of public access along the beach by: (1) reducing the public beach area when constructed on state-owned beach (in California this represents any area below the mean high tide line; (2) preventing the back beach/bluff from eroding naturally to feed the front beach area; and (3) increasing scouring to additional beach erosion. Seawalls, rip-rap, and other hardened structures can also change the visual character of the beach. Therefore, the California Commission requires mitigation for mitigating these impacts on public access.

4 SAN CLEMENTE RECREATION

San Clemente's beaches are sandy and relatively narrow, approximately 15 m (50 ft) wide at mean high tide in summer and 7.5 m (25 ft) in winter. A section of LOSSAN, the Los Angeles to San Diego railroad corridor, runs along the entire length of the shoreline at the base of coastal bluffs. Except for a pedestrian overpass at the end of Avenue Esplanade and a tunnel under the tracks at the north end of Plaza la Playa, visitors must cross railroad tracks to visit the beach.

The shoreline is divided into three parts: San Clemente State Beach, San Clemente's City Beach, and private beach adjacent to the Shorecliff Mobil Home Park. The State Beach extends for 2.4 km (1.5 mi) north from San Mateo Point to Avenida Calafia. The City Beach is a little more than 4 km (2.5 mi) long, from Avenida Calafia up to Avenida Pico, at the Ole Hanson Beach Club. The private beach is approximately 1.2 km (0.75 mi) in length from Avenida Pico to Camino Capistrano.

For the purpose of this report, we will analyze recreational benefits by reach (Reaches 9 & 10 are excluded). The beach is divided into eight reaches, though one of these has no significant sand. The most important reach is Reach 6, which contains the pier, most of the facilities, and is adjacent to most of the shops and other amenities which make San Clemente's City beach a destination that many people drive a significant distance to get to.

In general terms the economic model is a step-by-step annual approach starting with a projection of overall recreation demand in the San Clemente area. The overall area's recreation demand is split between other beaches and the City's beach at a ratio of 11/89. The City's beach attendance if then further divided into 70% to Reach 6 and the remaining 30% being split between Reaches 1, 2, 3, 4, 5, and 8.

These annual levels of attendance are then divided by season, with 40% going to the winter season and 60% to the summer season. The summer season is then divided into weekday and weekend uses at a 40/60 split. Average total daily attendance is derived by dividing the annual total by the number of days in the season, with winter having 212 days, summer weekday having 109 days, and summer weekend having 44 days. Average peak daily attendance is computed as the total daily attendance divided by the turnover rate (3.3).

The economic model predicts annual total dry beach square footage. Daily beach capacity is computed as dry beach square footage divided by 30 (minimum requirement per person) times the turnover rate. If the daily demand at any season exceeds capacity the excess demand is assumed to be turned away to another recreation source and given a unit day point score of zero that corresponds to a unit day value of $3.58. The excess demand value is included into the overall value of recreation such that when the excess demand is able to attend the beach only the net change in value will be attributable to an improvement.

For the demand that attends the beach, unit day points and values are a function of the amount of beach area a user will have. The amount of area for a user is simply the total dry beach square footage within a reach divided by the average peak daily attendance for that reach. With the variation in attendance by season and use during the week the value of square footage per user varies over the year as does its value. The square footage values correspond to unit day point scores which relates to unit day values that are multiplied by the attendance to arrive at the value of recreation for users. This value plus the value of excess demand gives the total recreational value for a given year.

4.1 General Recreation Amenities and Fees

San Clemente's Municipal Pier dominates the central area of the City Beach (Reach 6). It offers fishing, restaurants, and some other shops. Restrooms and a food concession are located near the base of the pier. Additional shops and restaurants, metered parking and a grassy picnic area with picnic tables are available within a two minute walk from the pier. Restrooms, beach showers, water fountains, picnic tables, fire-pits, and a volleyball court are also available at various other sites along the beach. Surfing and boogie-board equipment is available for rental nearby. Amenities at the State Beach are sparser, but include restrooms, outdoor showers, camping, picnic areas, a snack bar, and parking.

Walk-in access to both the City Beach and the State beach is free. To park, all visitors pay a fee of $5.00/vehicle for day use at the State Beach, and an estimated 30% of drivers visiting the City Beach use metered parking at the rate of $1.00/hour. Campers at the State beach staying in one of the 160 campsites at the State Beach pay $12/day, which includes parking and access to the beach. **Table 14** below presents parking availability for the City of San Clemente by area and type of parking - all parking is metered except for 40 of the 93 places on T-Street within a 0.4 km (0.25 mi) distance. Overall 1072 spaces are available - the majority of these places are within a five minute walk to the beach. If the parking distance from the beach is extended to 0.8 km (0.5 mi) downtown San Clemente and its various parking lots would be included, in addition to the extra street parking.

Table 14 - Parking San Clemente Beach

(*Reach 6 Parking- excluding street parking)

Parking Area	Lot Spaces	Street Parking	Handicapped	**Total**
North Beach	239	87	13	**339**
Linda Lane*		129	4	**133**
Pier*	144	124	7	**275**
T Street*		93	1	**94**
Calafia		227	4	**231**
Total	**383**	**660**	**29**	**1,072**

In 2002 and 2004, Dr. Phillip King conducted two OMB approved surveys on San Clemente beach users. The surveys indicated that 71% of beach goers came by car and the average group size was 2.83 people. Total summertime weekend demand is estimated at 631,857 for 2012 and increasing to 767,175 in 2061. The number of summertime weekend is estimated at 44. **Table 15** shows the estimated parking space demand for the years 2012 and 2061.

Table 15 - Parking Space Demand

Parking Space Demand	2012	2061
Total Summer Weekend Attendance	631,857	767,175
Summer Weekend Days	44	44
Average Summer Weekend Daily Attendance	14,360	17,436
% Arriving by Automobile	0.71	0.71
Daily Attendance by Automobile	10,196	12,379
Average Group Size	2.83	2.83
Number of Vehicles	3,603	4,374
Turnover Rate	3.3	3.3
Parking Space Demand	1,092	1,326

As **Table 15** indicates there is a modest excess demand for parking spaces within 5 minute quarter-mile range. However, if the range is slightly extended parking space availability and the additional train service to San Clemente by Amtrak and Metrolink will be sufficient to handle the demand through the study period.

The City of San Clemente beaches also include a "north beach" which is about 0.8 km (0.5 mi) north of the pier. From the pier, one can only reach north beach by walking along the railroad tracks or driving quite a distance through the City. North beach provides significantly fewer amenities than the main City beach area, though it does offer life guard services, rest rooms and a few other minor facilities. It is mainly frequented by locals. The southern part of San Clemente's City beach (at T Street and south) is similar to the north beach in terms of amenity levels. It also attracts locals, including surfers.

4.2 Attendance

Figure 4 and **Table 16** show annual attendance at San Clemente's beaches in terms of beach days (i.e., each time an individual goes to the beach during the day it is counted as a beach day). From 2000 through 2006, visitations at San Clemente's City and State beaches averaged 2.22 million, with the City beach accounting for 89% of all visits. During this period, overall beach attendance in San Clemente grew, on average, by 3.9% per year. State beach attendance showed no discernable growth between 2000 and 2006. We note that the relatively large variations in attendance at the State Beach since 1998 have been accompanied by opposite variations in attendance at the City Beach. One explanation is that a significant portion of these variations may be the result of attendance shifting from one beach to the other.

Figure 4 - San Clemente Beach Attendance

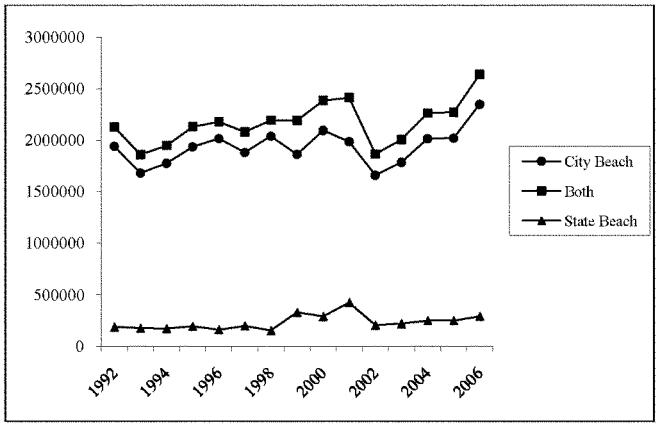
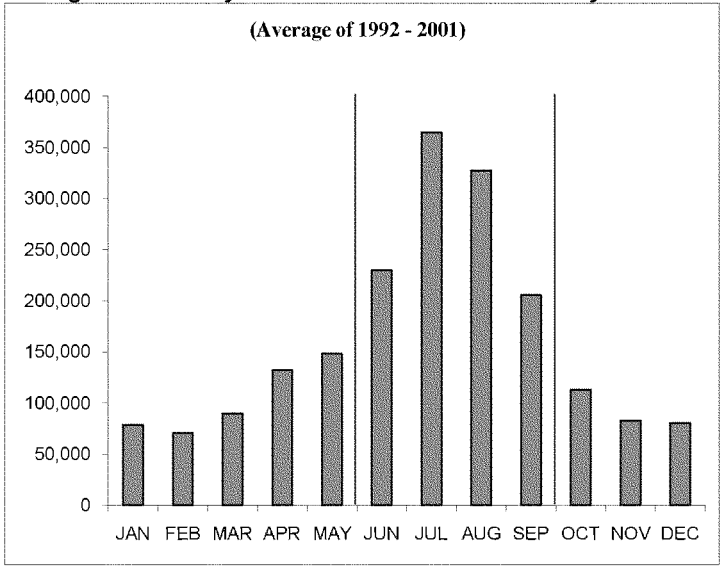


Table 16 - Beach Attendance

Year	Attendance (in 1000s)
1960	233
1970	2,057
1980	1,480
1990	2,068
1991	1,835
1992	1,940
1993	1,614
1994	1,776
1995	1,935
1996	2,016
1997	1,812
1998	2,039
1999	1,626
2000	2,096
2001	1,987
2002	1,865
2003	2,006
2004	2,264
2005	2,670
2006	2,639

Figure 5 illustrates monthly attendance throughout the year at the City Beach. Sixty percent of visits to San Clemente's beaches take place during the "high" season, which we define as between Memorial Day and late September.

Figure 5 - Monthly Attendance at San Clemente's City Beach



4.3 Projected Attendance

Over the past ten years, attendance at San Clemente's beaches has grown by roughly 2.7% a year, while the rate of population growth in Orange County has been 1.5%. Although the rate of growth in beach attendance has exceeded that of population, it is assumed for this study that the future rate of growth of beach attendance will mirror that of population growth. **Table 17** summarizes our estimates of population growth for Orange County and the corresponding increase in attendance. Population estimates to 2050 are taken from the State of California's Department of Finance's Demography Department estimate for 2007.

Table 17 - Projected Beach Attendance

Year	Orange County Population	Avg Yearly % Growth Rate	Total Beach Attendance
2000	2,863,834		2,095,650
2010	3,227,836	1.20%	2,768,827
2020	3,520,265	0.87%	3,019,668
2030	3,705,322	0.51%	3,178,423
2040	3,849,650	0.38%	3,302,244
2050	3,987,625	0.35%	3,420,614

4.3.1 Projected Attendance by Beach and Day

Separate attendance data is only available for the State and City beaches, not by reach. However, through interviews with officials for San Clemente's beaches, numerous visits, and survey, it is estimated that 70% of the current City beach visitors go to Reach 6. Of the remaining 30% of City beach attendance, 18% go to Reach 8 and 12% go to Reaches 1-4. However, Reaches 1-4 also contains the State beach, which has separate attendance figures. A summary of the projection is show in **Table 18**.

Table 18 - Beach Demand by Reach

Year	Total Attendance	City Beach 89%	Reach 6 70%	Reach 8	Other Reaches
2000	2,095,650	1,865,129	1,305,590	151,401	408,138
2010	2,768,827	2,464,256	1,724,979	172,000	567,277
2012	2,817,270	2,507,371	1,755,159	175,009	577,202
2020	3,019,668	2,687,504	1,881,253	187,000	619,251
2030	3,178,423	2,828,797	1,980,158	194,000	654,639
2040	3,302,244	2,938,997	2,057,298	203,000	678,699
2050	3,420,614	3,044,346	2,131,042	211,000	702,304
2060	3,420,614	3,044,346	2,131,042	221,000	692,304
2061	3,420,614	3,044,346	2,131,042	221,000	692,304

It was assumed that demand for beach visits will grow with the population of the surrounding area and have used projections for Orange County; however, neighboring counties have similar growth rates, and inland California Counties will have much faster rates of population growth over the next 50 years, so the estimate of the growth in demand is conservative. However, as discussed in the next section, beach capacity will become constrained in Reach 6 as the beach erodes and population (and hence demand for beach visits) increases.

4.3.2 Beach Capacity

The total projected area of dry beach available under the expected without condition by reach at San Clemente is shown in **Table 19**. During the study period (2012 – 2061) the dry beach area at San Clemente is expected to decline by 187,842 ft^2 – a 36% reduction. In Reach 6 the decline is even greater – a 44% reduction. The reduction in beach area of Reach 6 in combination with the demand growth (**Table 18**) indicates a looming capacity constraint is in the making.

Table 19 - Dry Beach Area
(in square feet)

Year	2007	2012	2020	2030	2040	2050	2060	2061
Reach 1	95,412	93,387	90,146	86,095	82,044	77,993	73,943	73,538
Reach 2	136,687	132,970	127,022	119,588	112,153	104,718	97,284	96,634
Reach 3	7,959	7,413	6,538	5,445	4,351	3,258	2,165	2,055
Reach 4	114,964	110,963	104,560	96,557	88,554	80,551	72,547	71,747
Reach 5	24,764	22,506	18,894	14,378	9,863	6,300	4,019	3,850
Reach 6	126,894	121,209	112,112	100,742	89,371	78,716	69,054	68,134
Reach 7	0	0	0	0	0	0	0	0
Reach 8	36,473	34,847	32,246	28,994	25,742	22,490	19,765	19,494
Total	543,154	523,294	491,518	451,798	412,078	374,026	338,777	335,452

Carrying capacity[5] for the beach, using the study model's assumptions of: 212 off-peak days; 153 summer peak days (44 weekend days); and a turnover rate of 3.3. Summer weekend carrying capacity at San Clemente for Reach 1 in 2007 is: 95,412/30 * 44 * 3.3 = 461,794. Summer weekend capacity is shown in **Table 20**.

Table 20 - Summer Weekend Carrying Capacity

Year	2007	2012	2020	2030	2040	2050	2060	2061
Reach 1	461,794	451,991	436,306	416,700	397,094	377,488	357,883	355,922
Reach 2	661,567	643,575	614,788	578,804	542,821	506,837	470,853	467,707
Reach 3	38,524	35,878	31,645	26,353	21,061	15,769	10,478	9,948
Reach 4	556,428	537,060	506,071	467,336	428,600	389,865	351,129	347,256
Reach 5	119,856	108,929	91,445	69,590	47,735	30,490	19,453	18,633
Reach 6	614,167	586,650	542,623	487,589	432,555	380,984	334,223	329,768
Reach 7	0	0	0	0	0	0	0	0
Reach 8	176,530	168,660	156,069	140,330	124,591	108,852	95,662	94,351

Summer weekend demand with the model's assumptions of a 60/40 split between summer/winter and a 60/40 split between weekend/weekday uses is shown in **Table 21**.

Table 21 - Summer Weekend Demand

Year	2007	2012	2020	2030	2040	2050	2060	2061
Reach 1	56,399	59,705	64,055	67,715	70,204	72,646	71,612	71,612
Reach 2	43,352	45,894	49,237	52,051	53,964	55,841	55,045	55,045
Reach 3	23,168	24,526	26,313	27,816	28,839	29,842	29,417	29,417
Reach 4	42,896	45,411	48,719	51,503	53,396	55,253	54,467	54,467
Reach 5	30,470	32,257	34,607	36,584	37,929	39,248	38,689	38,689
Reach 6	599,097	631,857	677,251	712,857	740,627	767,175	767,175	767,175
Reach 7	0	0	0	0	0	0	0	0
Reach 8	60,470	63,003	67,320	69,840	73,080	75,960	79,560	79,560

[5] Maximum carrying capacity is based on a 30 sqft per person requirement.

Excess summer weekend demand (**Table 21** minus **Table 20**) is shown in **Table 22**.

Table 22 - Excess Summer Weekend Demand

Year	2007	2012	2020	2030	2040	2050	2060	2061
Reach 1	0	0	0	0	0	0	0	0
Reach 2	0	0	0	0	0	0	0	0
Reach 3	0	0	0	1,464	7,778	14,072	18,939	19,468
Reach 4	0	0	0	0	0	0	0	0
Reach 5	0	0	0	0	0	8,758	19,236	20,056
Reach 6	0	45,207	134,628	225,268	308,072	386,191	432,952	437,407
Reach 7	0	0	0	0	0	0	0	0
Reach 8	0	0	0	0	0	0	0	0

4.4 Recreation Value

The value of recreation for Reach 6 was calculated in accordance with the Unit Day Value (UDV) methodology of ER 1105-2-100. The basis for the conversion of UDV point total to dollar value was EGM 11-03. Assessment of UDV points was based on a consensus of Corps economists and contractors experienced in economics and plan formulation. Recognizing that the recreational experience is partially a function of how crowded the beach area might become - a reflection that recreational activities, accessibility, and environmental qualities decline as a beach becomes more congested, - they were asked to evaluate the beach at 3 capacity levels: 30, 100, and 500 ft^2 per person. The 30 ft^2 level was intended to represent full capacity, 100 ft^2 a level of no constraint of beach activities, and 500 ft^2 to represent that any additional space per user would have no impact on the UDV point score. The UDV assessment for the assessment points is shown in **Table 23**. The model employs a linear interpolation between assessed beach utilization points. Recreation value was analyzed at 500, 100, and 30 ft^2 per person, in addition to an excess capacity transfer level of below 30 ft^2.[6]

Table 23 - UDV Point Values

Criteria	Total Possible Points	Points @ 30 ft^2	Points @ 100 ft^2	Points @ 500 ft^2
Recreational Experience	30	0	10	10
Availability of Opportunity	18	4	4	4
Carrying Capacity	14	0	3	13
Accessibility	18	4	13	13
Environmental	20	4	14	19
Total	**100**	**12**	**44**	**59**

UDV point scores and dollar conversion for the index points are shown in **Table 24**.

Table 24 - UDV Points to Dollars (FY11)

Sqft Measure	UDV Points	$ Conversion
Capacity Transfer < 30	0	3.58
30	12	4.35
100	44	7.08
500	59	8.22

[6] It is assumed that additional space beyond 500 ft^2 does not affect UDV, 100 ft^2 per person reflects a beach capacity condition that allows all activities to function as intended, between 30 ft^2 and 100 ft^2 per person beach activities suffer from crowding. All visitations that would reduce average ft^2 use to below 30 ft^2 are assumed to be transferred to other recreational sources.

The model uses a linear interpolation between the assessed points, so for a beach condition where the average space is 47.5 ft^2 the UDV point score would be 20 with a value of $4.70. Similarly, when the average space per beach user is 340 ft^2, the UDV point score would be 53 with a value of $7.82. Expected mean recreation value by season and total value is presented in **Tables 25 to 27** for the expected without condition.

Table 25 - Value of Winter Recreation

(Excluding excess capacity transfers, FY11 Price Levels)[7]

Year	2007	2012	2020	2030	2040	2050	2060	2061
Reach 1	$515,301	$545,509	$585,249	$618,694	$641,433	$663,741	$654,291	$654,291
Reach 2	$396,095	$419,315	$449,862	$475,570	$493,049	$510,197	$502,932	$502,932
Reach 3	$191,521	$200,296	$212,256	$218,822	$218,213	$176,133	$152,183	$150,745
Reach 4	$391,929	$414,905	$445,131	$470,568	$487,863	$504,831	$497,642	$497,642
Reach 5	$278,398	$287,514	$300,731	$306,088	$305,959	$308,750	$225,428	$219,582
Reach 6	$4,772,807	$4,970,612	$5,327,708	$5,110,391	$4,758,118	$4,412,110	$4,238,217	$4,180,253
Reach 7	$0	$0	$0	$0	$0	$0	$0	$0
Reach 8	$529,985	$547,499	$574,988	$591,312	$604,128	$620,340	$641,784	$641,784
Total	$7,078,043	$7,387,661	$7,897,945	$7,793,475	$7,510,803	$7,198,152	$6,914,538	$6,849,290

Table 26 - Value of Summer Recreation

(Excluding excess capacity transfers, FY11 Price Levels)

Year	2007	2012	2020	2030	2040	2050	2060	2061
Reach 1	$733,866	$771,514	$821,954	$868,925	$894,542	$925,654	$906,029	$906,029
Reach 2	$588,333	$619,748	$658,299	$688,943	$710,648	$731,623	$716,251	$716,251
Reach 3	$223,987	$231,820	$242,498	$245,876	$207,890	$168,833	$134,278	$131,114
Reach 4	$573,523	$604,102	$641,582	$674,796	$694,791	$713,983	$698,914	$698,914
Reach 5	$378,687	$398,004	$382,080	$363,354	$351,221	$297,882	$211,069	$205,752
Reach 6	$5,432,613	$5,533,122	$5,332,908	$4,867,862	$4,469,981	$4,164,672	$3,857,018	$3,837,648
Reach 7	$0	$0	$0	$0	$0	$0	$0	$0
Reach 8	$702,741	$695,599	$700,128	$698,400	$706,537	$714,632	$733,225	$733,225
Total	$8,633,750	$8,853,908	$8,779,449	$8,408,155	$8,035,611	$7,717,278	$7,256,785	$7,228,933

Table 27 - Total Value of Recreation

(Excluding excess capacity transfers, FY11 Price Levels)

Year	2007	2012	2020	2030	2040	2050	2060	2061
Reach 1	$1,249,167	$1,317,022	$1,407,203	$1,487,619	$1,535,975	$1,589,396	$1,560,319	$1,560,319
Reach 2	$984,428	$1,039,062	$1,108,161	$1,164,513	$1,203,697	$1,241,820	$1,219,183	$1,219,183
Reach 3	$415,508	$432,116	$454,754	$464,698	$426,103	$344,966	$286,461	$281,859
Reach 4	$965,452	$1,019,006	$1,086,713	$1,145,364	$1,182,654	$1,218,813	$1,196,557	$1,196,557
Reach 5	$657,085	$685,519	$682,811	$669,442	$657,180	$606,632	$436,498	$425,334
Reach 6	$10,205,420	$10,503,733	$10,660,616	$9,978,253	$9,228,100	$8,576,782	$8,095,236	$8,017,901
Reach 7	$0	$0	$0	$0	$0	$0	$0	$0
Reach 8	$1,232,726	$1,243,098	$1,275,116	$1,289,712	$1,310,665	$1,334,972	$1,375,009	$1,375,009
Total	$15,711,793	$16,241,569	$16,677,393	$16,201,631	$15,546,414	$14,915,430	$14,171,323	$14,078,223

[7] When demand exceeds capacity the excess is assumed to transfer to another recreation source at a value of $3.40, a 0 UDV point score. As shown in Table 21, beach capacity exists at other nearby reaches that could absorb transfers if they were inclined to move to other locations.

The recreation value streams for each reach over the study period were transformed on a net present value (NPV) basis and are shown in **Table 28** and converted to an average annual value.

Table 28 - Without Project NPV of Recreation
FY11 Price Levels

	NPV	AA
Reach 1	$30,543,781	$1,452,387
Reach 2	$23,970,041	$1,139,799
Reach 3	$9,325,143	$443,420
Reach 4	$23,535,251	$1,119,125
Reach 5	$13,931,383	$662,451
Reach 6	$224,340,854	$10,667,630
Reach 7	$0	$0
Reach 8	$27,131,260	$1,290,118
Total	$352,777,713	$16,774,930

The value of expected mean recreation on an annual basis (NPV amortized) for the beaches of San Clemente is approximately $16,774,930.

5 STUDY AREA REFINEMENT

The initial study area extended from San Mateo Point north to Dana Point Harbor. Upon closer examination of the characteristics of the area with attention paid to the potential for NED damages and benefits, it was decided to reduce the scope of analysis to Reach 6 only. Reaches 1, 3, 5, 7, 9, and 10 were eliminated from further study due to their current levels of revetment protection – levels significantly greater than the unimproved ballast. A detailed description of the refinement process is presented in Chapter 2 of the Main Report. Reaches 2 and 4 were also eliminated from further study. Although these reaches do not possess improved revetment, their current minimum cell widths are 6 and 9 meters (20 and 30 feet) and average beach widths 19 and 15 meters (63 and 50 feet), respectively; in addition to, the lack of oceanside development suggests NED benefits would be primarily recreational. The small Reach 8 possesses the same general characteristics of Reaches 2 and 4 – unimproved ballast and a fairly wide beach, except for the transition to Reach 9. The transition area between Reaches 8 and 9 may be better served with a localized solution. Therefore, the following sections will mainly deal only with the NED aspects for Reach 6.

6 THE COASTAL STORM DAMAGE MODEL

The model developed for the San Clemente Shoreline Study uses the principles of Risk & Uncertainty (R/U) in compliance with U.S. Army Corps of Engineers policy that requires all new federally funded coastal studies incorporate the principles of R/U. The principal controlling guidance of the analysis comes from the U. S. Army Corps of Engineer's *"Planning Guidance Notebook"* – ER 1105-2-100, with specific guidance from Appendix D – Economic and Social Considerations and EM 1110-2-1100 – *"Planning and Design Process."* Additional guidance on the risk-based analyses has been obtained from EM 1110-2-1619, dated 1 August 1996, *"Engineering and Design - Risk-based Analysis for Flood Damage Reduction Studies."* The application of R/U in this study not only covers traditional elements of damages and coastal processes, but also covers construction costs. The model has been submitted and approved for study-specific use by the study's PCX according to EC 1105-2-407.

This model incorporates R/U by utilizing probability distributions for variables and design parameters where appropriate. It is recognized that the "true" values of the design variables and parameters are frequently not known with certainty and can take a range of values. However, the likelihood of a parameter taking on a particular value by a probability distribution can be described. The probability distribution may be described by its own parameters such as mean, standard deviation, shape, and scale. In some cases, the probability distribution for a parameter may be well established in the engineering literature, or in other cases a best-fit distribution of the measured data may be applied.

Procedurally, the Without Project damage assessment was conducted by employing a life-cycle approach. As outlined in EM 1110-2-1100, the life cycle approach deals with multiple realizations of possible evolution of the project with time during the span of its design life. The suite of life cycle realizations is constructed with consideration of the probabilities of key variables. The life cycle approach appears better suited to most coastal engineering applications. Variation with time is an essential ingredient in most coastal projects, and it is directly incorporated into the life cycle approach. Time variation of resistance and functional performance, constraints imposed by construction season and mobilization, even some economic, environmental, and political factors, can be conveniently and flexibly introduced into the life cycle approach. This approach leads to a unified analysis of technical performance and many economic factors which are critical to project success.

The life cycle embodies sequences of storms (including provisions for multiple storms of varying intensity during each year of the life cycle), erosion and post-storm recovery during each event, partial and complete property damage during each event (depending on water level, waves, extent of storm erosion, and type of building construction), cumulative property damage due to a succession of storms, optional repair or rebuilding after a suitable time lag (with conformance to any stricter building codes in effect), and periodic renourishment of the beach when needed and feasible during the life cycle. Typically, a key result from this analysis is the renourishment required during each life cycle, which can be converted to an economic present-worth dollar value. The expected cost and economic risks associated with maintaining the beach can then be realistically assessed by combining information from many different life cycle simulations. Specific considerations of the model include:

Seasonality: This model is a single season model; seasonality of the wave climate is not considered. It is generally accepted that the most damaging storms in southern California occur during the winter months. Although it is recognized that very large

wave events can and do occur during the summer season, the winter extratropical storms tend to cause the majority of the property losses.

Single Storm: This model is a single storm event model; multiple storms are not considered. It is recognized that several "storms" occur every winter season. In fact, it is generally accepted that storm "clusters" are responsible for some of the most damaging storm years in southern California.

A single annualized storm is believed to fairly represent the majority of the shoreline change and economic losses. It is well established that shoreline changes and the resultant economic damages tend to be cumulative throughout the storm season. However, there is little or no data that allows the full and quantitative delineation of the shoreline changes and economic damages attributed to individual storms in a cluster of successive storms. Shoreline change monitoring and measurement efforts typically are conducted on a time basis that is not in direct response to storm damages. In general it is typical that detailed descriptions of economic damages are recorded and compiled well after the storm season has ended. Therefore, there is no reliable method to individually distribute and compartmentalize the combined shoreline changes and economic damages that do occur to a sequence of storms.

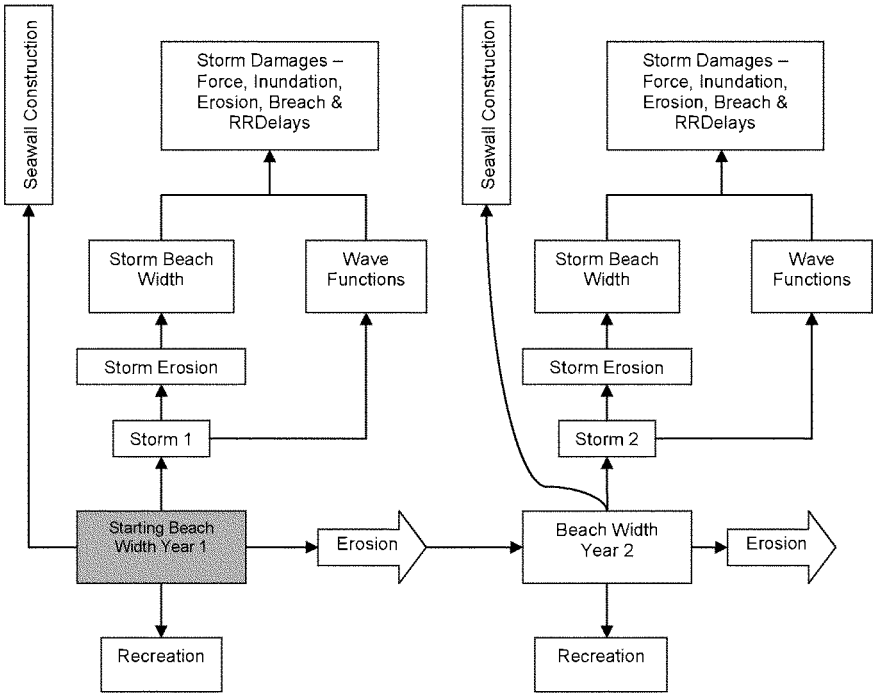
The principles of Monte Carlo simulation are used as the numerical integration technique.[8] The proprietary computer program @RISK (Palisade, 2002, version 4.5) was used to run the R/U analysis. @RISK is an add-in to a standard industry spreadsheet package that provides the necessary tools for executing Monte Carlo simulations.

Simulation results were monitored for numerical convergence stability of output distributions. The model was simulated 1000 times – 1000 fifty year future projections – utilizing a fixed seed process to enable each alternative to be examined under the same Without Project future conditions.

A stylized flow diagram of the model's process is presented in **Diagram 1**.

[8] The actual sampling type employed during simulations is a Latin Hypercube technique to expedite conversion.

Diagram 1 - @RISK Model Without Project Condition



7 WITHOUT PROJECT MODEL RESULTS

The Without Project condition consists of many problems and constraints (see, Main Report Chapter 4). In the Without Project condition it is assumed that the rail lines will protect their assets. The future protection of the rail lines is assumed to be the construction of a seawall, in the absence of a federal project. The R/U model for San Clemente was run for 1000 simulations under the Without Project conditions. Each simulation generates an individual forecast of annual erosions and storms for the 50-year period of analysis. Some of the key inputs to the model are as follows:

1 Long-term annual erosion: Defined in the model as a triangular distribution of Risktriang (-0.46 m, -0.21 m, 0.37 m) or (-1.5 ft, -0.7 ft, 1.2 ft) with a mean annual value of -0.1 m (-0.33 ft).

2 Seawall construction trigger mechanism: Seawall construction is implemented if the number of beach cell having beach widths less than 8 m (26 ft) exceeds the random criterion of RiskDuniform ({6, 7, 8, 9, 10}) – 6 to 10 cells corresponding to 300 to 500 meters or between 28.6 to 47.6 percent of the entire reach. The justification for the range of values used for the seawall conversion criteria of 6-10 cells was based more on a qualitative rather than a quantitative analysis. This range of cells corresponds with a range of widths of 984 feet to 1,640 feet. It was determined that this range was logical because a narrower criteria would show that the seawall would be built within the next couple of years, but the expected timeline to construct a seawall is expected to be four or five years. Therefore, narrower criteria did not seem reasonable to describe the expected response by SCRRA. A larger range for the criteria is expected to cause portions of the rail road track to become too vulnerable to future storm events. Further, it was felt that by applying a range rather than a single number of cells for the criterion addressed the issue of uncertainty.

3 Depreciated structural values based on City construction data and Marshall & Swift without uncertainty (shown in **Table 5**) with first floor elevations (FFE) based on field survey data. FFE is generally at beach level, a zero elevation; with the notable exception of the marine headquarter building at 1 foot above beach level.

4 San Clemente Pedestrian Beach Trail – a Reach 6 DRV of between $2.8 and $3.24 million.

5 The Houma structure & content and District's wave force functions are employed.[9]

6 Transportation damages as outlined by **Table 12**.

7 The LOSSAN construction and O&M costs shown in **Table 13**.

8 The recreation value as indicated by **Table 27**.

9 Interest During Construction (IDC) is calculated using a mid-term full expenditure pattern approach for the initial fill. With a short construction timeframe of 3 to 6 months for any alternative IDC is not a major cost component.

Table 29 presents the results of the model.

[9] These functions are displayed in Attachment A.

Table 29 - Without Project Model Results – Reach 6

FY11 Prices & Discount Rate

	Minimum	Maximum	Mean	5% Probability Value	95% Probability Value
Seawall Construction Year	2009	2058	2021	2011	2036
# of RR Breaches	0	4	0.014	0	0
Damages & Costs:					
RR Construction & O&M Costs - Average Annual (AA)	$220,136	$2,342,507	$1,275,274	$329,605	$1,996,263
Trail Damage - AA	$0	$132,781	$81,821	$0	$121,808
Structure & Content Damage - AA	$3,179	$123,382	$62,923	$26,362	$93,915
RR Delay Costs - AA	$0	$0	$0	$0	$0
Total Damages - AA	$288,514	$2,555,729	$1,420,018	$392,701	$2,181,170
Recreation:					
Reach 6 AA of Recreation	$9,666,171	$11,539,598	$10,667,923	$10,157,058	$11,196,251
AA UDV Reach 6	4.67	5.85	5.24	4.94	5.56
Weekend Sqft - Summer	30	30	30	30	30

The model predicts Reach 6 beach erosion will require the construction of the seawall in 2021, on average. There is a 5% chance that seawall construction will be required before 2011 and a 5% chance that the construction will occur after 2036. Breaching of the LOSSAN corridor appears unlikely – 0.014 times on average during the study period; and as a result delay times are $0. The model also indicates that the summertime weekend beach use will be at maximum capacity (30 ft^2 per user) throughout the study period.

The majority of NED damages/costs are related to LOSSAN construction and O&M costs. This result is as expected with erosion requiring the construction of the seawall. The mean average annual cost to LOSSAN is $1,275,274. The mean annualized value of all damage is $1,420,018.

The model predicts maximum capacity at summertime weekend use; however, the average UDV value (annual value/total annual users) of $5.24 corresponds to an average allotment of 65 ft^2 per user. The mean annualized value of recreation in Reach 6 is $10,667,923.

8 WITH PROJECT ALTERNATIVES ANALYSIS

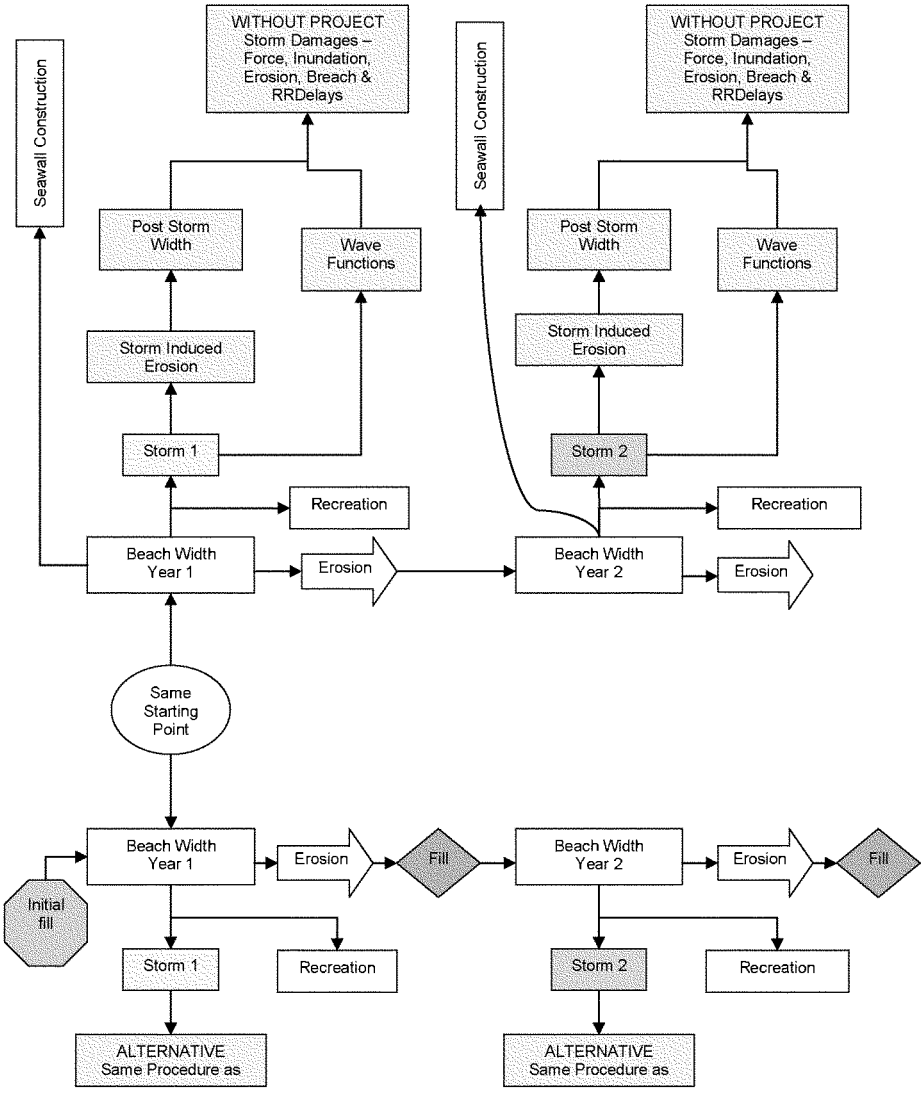
The study team identified a beach fill program as the only viable alternative type given the environmental and political constraints of the study area.[10] The Without Project model was adapted to simultaneously analyze both With and Without Project conditions with each alternative being compared to the same conditions of the Without Project. Comparisons between With and Without Project were accomplished through a fixed seeded storm application. Under this constraint, the model processed the without and alternatives conditions under the exact same storm sequence. This approach is shown in Diagram 2.

The With project condition starts with a beach fill, as Diagram 2 indicates, in addition to the non-construction of a future seawall. The with-project condition is then subject to the same storm as the Without Project condition. Damages are then computed from the storm induced erosion – erosion amounts being identical – but the beach starting points being offset by the fill amount. After recreation values and damages are calculated, the beach is allowed to erode to the next year's starting position.

At the start of the next year, the model examines if any beach fill remains. If there is beach fill remaining the model calculates damages as previously described. If the entire beach fill has been eroded, the model requires a renourishment to the original program size with no fill occurring beyond the 50-year study period. For example, if the original with-project alternative includes a 20 meter beach fill program – the model monitors the remaining fill and when the fill reaches 0, the model renourishes the beach with 20 meters of fill. This approach is more reflective of the actual condition than the more traditional fixed renourishment period approach - where renourishment takes place at a fixed time regardless of the state of the beach. The model processes continue throughout the 50 years of the period of analysis and compares the NPV streams of with- and without-project conditions. The number of iterations was set at 1000. Thus, the model compares 1000 50-year forecasts to develop its distributions. This process was utilized for all alternatives.

[10] See, Main Report for a full discussion of the study area's constraints.

Diagram 2 - With Project Model



8.1 With Project Model Assumptions

In addition to the Without Project assumptions previously discussed, the with-project model includes:

1. Long-term beach fill erosion rate (ft/yr) defined as Risktriang (-15.2 m, -5.5 m, 9.1 m) or (-50 ft, -18.1 ft, 30 ft).
2. An expected cost of sand at $15.36 per cubic yard
3. An expected cost of mob/demob of $2,124,200
4. Initial project PED at 10% of construction cost with future renourishment PED costs of $250,000
5. S&A costs at 6.5% of construction cost
6. Environmental mitigation costs of $360,000 at construction and replenishment
7. Environmental offshore construction cost of $2,300,000 for fills in excess of 15 meters
8. Interest During Construction cost based on a mid-term full expenditure pattern approach for the initial fill
9. Dredge capacity of 166,200 cubic yards per month
10. A renourishment program based on an as need approach
11. No Seawall Construction occurs

8.2 Project Alternatives

The with-project alternatives consist of 11 alternative fill profiles starting at 10 meters and increasing by 5 meters to a maximum of 60 meters, in addition to the Without Project condition.

The R/U model for San Clemente was simultaneously run with all alternatives to ensure that all comparisons of alternatives were conducted under the exact same conditions. Each alternative was evaluated for 1000 simulations of 50-yr projections. The results of the model are presented in **Table 30**.

Table 30 - Analysis of Alternatives

FY11 Prices and Discount Rate

BASE SEA LEVEL RISE CONDITION												
	W/O	10m	15m	20m	25m	30m	35m	40m	45m	50m	55m	60m
Project Total Damages - Average Annual	$1,420,018	$43,148	$35,540	$31,466	$28,614	$26,668	$24,713	$23,475	$21,796	$21,097	$20,328	$19,912
RR Construction & O&M Costs	$1,275,274	$15,629	$13,127	$11,548	$10,523	$9,798	$9,315	$8,911	$8,582	$8,354	$8,124	$7,994
Trail Damage	$81,821	$6,704	$6,400	$6,212	$6,085	$5,996	$5,934	$5,884	$5,847	$5,816	$5,787	$5,766
Structure & Content Damage	$62,923	$20,815	$16,014	$13,707	$12,007	$10,874	$9,464	$8,679	$7,362	$6,927	$6,417	$6,150
RR Delay Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Residual Damages	$1,420,018	$43,148	$35,540	$31,466	$28,614	$26,668	$24,713	$23,475	$21,796	$21,097	$20,328	$19,912
Damage Reduction	$0	$1,376,870	$1,384,478	$1,388,552	$1,391,403	$1,393,350	$1,395,305	$1,396,543	$1,398,227	$1,398,921	$1,399,690	$1,400,105
Incidental Recreation:												
W/O Project Reach 6	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923	$10,667,923
With Project Reach 6	$10,667,923	$12,066,458	$12,328,344	$12,596,809	$12,890,901	$13,179,733	$13,429,489	$13,630,218	$13,814,385	$13,971,137	$14,103,567	$14,223,486
Incidental Recreation Improvement	$0	$1,398,535	$1,660,421	$1,931,886	$2,222,978	$2,511,810	$2,761,566	$2,962,295	$3,146,442	$3,303,214	$3,435,644	$3,555,563
Average UDV Reach 6	$5.24	$6.17	$6.30	$6.43	$6.57	$6.71	$6.84	$6.94	$7.03	$7.11	$7.18	$7.24
Weekend SqFt - Summer	30.00	39.09	44.79	50.59	56.26	62.26	68.27	74.10	80.23	86.48	92.70	99.31
Project Costs:												
Initial Fill Only												
Sand Cost	*$0*	*$2,576,985*	*$3,865,478*	*$5,153,971*	*$6,442,463*	*$7,730,956*	*$9,019,449*	*$10,307,941*	*$11,596,434*	*$12,884,926*	*$14,173,419*	*$15,461,912*
Mob/Demob	*$0*	*$2,124,696*	*$2,124,696*	*$2,124,696*	*$2,124,696*	*$2,124,696*	*$2,124,696*	*$2,124,696*	*$2,124,696*	*$2,124,696*	*$2,124,696*	*$2,124,696*
IDC	*$0*	*$14,008*	*$26,805*	*$43,483*	*$64,057*	*$88,543*	*$116,954*	*$149,306*	*$185,615*	*$225,894*	*$270,160*	*$318,428*
Total Cost Initial Fill (including PED, SA, & Environmental)	*$0*	*$6,002,700*	*$7,516,590*	*$11,334,362*	*$12,856,030*	*$14,381,610*	*$15,911,115*	*$17,444,561*	*$18,981,964*	*$20,523,337*	*$22,068,697*	*$23,618,059*
Average # of Fills Project Lifetime	0	11.83	9.11	7.49	6.40	5.61	5.00	4.53	4.15	3.82	3.55	3.33
Annual Costs	$0	$1,482,807	$1,469,767	$1,590,821	$1,618,043	$1,647,458	$1,681,676	$1,718,396	$1,760,583	$1,798,508	$1,840,874	$1,885,742
Storm Damage Reduction (SDR) Benefits	$0	$1,376,870	$1,384,478	$1,388,552	$1,391,403	$1,393,350	$1,395,305	$1,396,543	$1,398,227	$1,398,921	$1,399,690	$1,400,105
Net Annual SDR Benefits	$0	-$105,937	-$85,289	-$202,269	-$226,639	-$254,108	-$286,370	-$321,856	-$362,356	-$399,588	-$441,184	-$485,637
Incidental Recreation Benefits - (Limited ER 1165-2-130)	$0	$1,376,870	$1,384,478	$1,388,552	$1,391,403	$1,393,350	$1,395,305	$1,396,543	$1,398,227	$1,398,921	$1,399,690	$1,400,105
Total SDR & Recreation Benefits - Limited	$0	$2,753,740	$2,768,955	$2,777,103	$2,782,807	$2,786,700	$2,790,610	$2,793,087	$2,796,454	$2,797,841	$2,799,380	$2,800,211
B/C Ratio - SDR only		0.93	0.94	0.87	0.86	0.85	0.83	0.81	0.79	0.78	0.76	0.74
B/C Ratio - SDR & Recreation (Limited)		1.86	1.88	1.75	1.72	1.69	1.66	1.63	1.59	1.56	1.52	1.48
Annual Net NED Benefits (Limited)		$1,270,933	$1,299,188	$1,186,282	$1,164,764	$1,139,242	$1,108,935	$1,074,687	$1,035,871	$998,333	$958,506	$914,469
Recreation Benefits - ER 1105-2-100, Appendix E, Section IV, E-24.c. Incidental Recreation Benefits - Unlimited		$1,398,535	$1,660,421	$1,931,886	$2,222,978	$2,511,810	$2,761,566	$2,962,295	$3,146,442	$3,303,214	$3,435,644	$3,555,563
Total SDR & Recreation Benefits - Unlimited		$2,775,405	$3,044,898	$3,320,437	$3,614,381	$3,905,161	$4,156,871	$4,358,938	$4,544,669	$4,702,134	$4,835,335	$4,955,669
Annual Net NED Benefits - Unlimited		$1,292,598	$1,575,131	$1,729,617	$1,996,338	$2,257,703	$2,475,196	$2,640,439	$2,784,086	$2,903,626	$2,994,460	$3,069,926
B/C Ratio - SDR & Recreation - Unlimited		1.87	2.07	2.09	2.23	2.37	2.47	2.54	2.58	2.61	2.63	2.63

8.3 NED Benefits – Alternatives Comparison

ER 1105-2-100, Appendix E, Section IV, E-24.c. states:

> *"Formulation and Establishing Corps Participation. Shore protection projects are formulated to provide hurricane and storm damage reduction. Recreation is incidental. The Corps participates only in those projects formulated exclusively for hurricane and storm damage reduction, and justified (BCR≥ 1.0) based solely on damage reduction benefits, or a combination of damage reduction benefits plus (at most) a like amount of incidental recreation benefits. In other words, recreation benefits useable to establish Corps participation may not be more than fifty percent of the total benefits required for justification, which in turn means they may not exceed an amount equal to fifty percent of costs. If the criterion for participation is met, then all recreation benefits are included in the BCR."*

ER 1165-2-130 limits incidental recreation benefits to an equal amount of coastal storm damage reduction benefits when the project's storm damage reduction benefits on their own do not justify the project.

All of the alternatives analyzed do not possess a B/C ratio greater than 1 on coastal storm damage reduction benefits alone. Therefore, each alternative has a limit on incidental recreational benefit equal to the amount of coastal storm damage reduction benefits for the alternative. NED plan selection calls for the alternative with the greatest amount of net NED benefits to be designated as the NED plan. The alternative with the least negative NED benefits and highest B/C ratio considering only coastal storm damages is Alternative 2. The alternative with the greatest net NED benefits is Alternative 2 – 15 meter beach fill when limited incidental recreation benefits are included. The net annual NED benefits for Alternative 2 - 15 meter fill are $1,299,188 with the plan having a B/C ratio of 1.88, on the limited incidental recreation basis of ER 1165-2-130.

9 THE NED PLAN – ALTERNATIVE 2 (15 METER BEACH FILL)

Table 30 presents the model's output data for the analysis of Alternative 2. Alternative 2 would extend the beach 15 meters at a first cost of $7,516,590 for the initial beach fill. Expected costs for the initial fill would be: $3,865,478 for sand; $2,124,896 for mob/demob; $26,805 for IDC; and $1,499,411 for PED, S&A, and environmental mitigation. Over the 50-yr period of analysis the project would require approximately 9.11 fills on average with a range of fills between 5 and 15. The total life-cycle cost of the alternative is $1,469,767 on an annual basis.

Alternative 2 would reduce coastal storm damage on an average annual basis from $1,420,018 to $35,540 – a 99.0% reduction. The major reduction in damages is the avoided cost savings from railroad (principally, seawall) construction. The beach fill program eliminates the need for seawall construction. The Without Project railroad construction and O&M costs (**Table 31**) fall from $1,275,274 to $13,127 under Alternative 2. Structure and content damages under Alternative 2 are reduced by 74% and damages to the trail system fall 92%.

Table 31 - Alternative 2 Damage Reductions (AA)

FY11 Price Levels

Category	W/O Project	Alternative 2	Reduction	% Reduction
RR Construction & O&M Costs	$1,275,274	$13,127	$1,262,147	99.0%
Trail Damage	$81,821	$6,400	$75,421	92.2%
Structure & Content Damage	$62,923	$16,014	$46,909	74.5%
RR Delay Costs	$0	$0	$0	00.0%
Total Damages	$1,420,018	$35,540	$1,384,478	97.5%

Storm damage reduction benefits amount to $1,384,478, on an average annual basis. Total annual benefits are $2,768,956, with an equal amount for recreation.

The mean average annual without project coastal storm damages is about $1.4 million (**Table 30**). **Table 32** shows the 5% and 95% confidence limit values for both the Without Project and Alternative 2 conditions. The following table provides further details on the cumulative probability distribution for damages. Residual with-project coastal storm damages for Alternative 2 are approximately $35,540 (**Table 30**).

An evaluation of this distribution functions shows that there are minimal residual damages throughout the cumulative distributions for Alternative 2. The maximum average annual residual damage from the simulation results was less than $95,000. As a fraction of corresponding without project damages, residual damages are generally less than five percent. These residual damages are primarily comprised of damages to structures and minor costs associated with repairs and maintenance of protection for the railroad tracks. Residual damages are minimal because it is assumed that the shoreline erosion will be monitored, and future renourishment will be implemented as required. As a result, no seawalls are assumed to be constructed under with-project conditions.

Table 32 - Average Annual Residual Damage Distribution

FY11 Price Level and Discount Rate

Percentile	Without Project	Alternative 2
5%	$392,701	$15,862
10%	$631,513	$18,300
15%	$909,898	$20,759
20%	$1,044,348	$23,109
25%	$1,140,501	$25,193
30%	$1,210,294	$26,837
35%	$1,273,875	$28,627
40%	$1,345,718	$30,347
45%	$1,408,137	$32,170
50%	$1,460,990	$34,351
55%	$1,519,347	$36,609
60%	$1,583,820	$38,238
65%	$1,652,023	$40,157
70%	$1,713,148	$42,485
75%	$1,788,377	$44,517
80%	$1,850,486	$46,986
85%	$1,936,866	$49,520
90%	$2,016,752	$54,041
95%	$2,181,170	$59,344

Table 30 shows Alternative 2 on mean Storm Damage Reduction benefits alone has a B/C ratio of 0.94, just slightly below 1.0 NED threshold. The annual cost for Alternative 2 is $1,469,767. Under the limited incidental recreation provisions SDR benefits would have to equal $734,884 with an equal amount of recreation added. If a worst case scenario for Alternative 2 is assumed having residual damages of the 95 percentile ($59,344), the Without Project damages would have to exceed $794,228 ($734,884 + $59,344) for a B/C ratio over 1.0. **Table 32** indicates that there is less than a 15% chance that the Without Project damages would not exceed $794,228.

Alternative 2 has a large impact on recreation. The most notable impact is the effect on summertime weekend user space. Under the Without Project condition summertime weekend space is falls to 30 ft^2 throughout the period of analysis. Under Alternative 2, summertime weekend user space increases to 44.8 ft^2, on average. Although this space is well below the ideal use allotment of 100 ft^2, the beach is no longer congested and will be able to service future demand growth. Alternative 2 increases the overall annual use value of the beach from $5.24 to $6.30 per user. Total recreation value on an average annual basis increases from $10,667,923 to $12,328,344 – a $1,660,421 increase.

ER 1105-2-100, Appendix E, Section IV, E-24.c. states:

> *"Recreation is incidental. The Corps participates only in those projects formulated exclusively for hurricane and storm damage reduction, and justified (BCR ≥ 1.0) based solely on damage reduction benefits, or a combination of damage reduction benefits plus (at most) a like amount of incidental recreation benefits. In other words, recreation benefits useable to establish Corps participation may not be more than fifty percent of the total benefits required for justification, which in turn means they may not exceed an*

amount equal to fifty percent of costs. If the criterion for participation is met, then all recreation benefits are included in the BCR."

Table 30 indicates with recreation on a limited basis Alternative 2 exceeds a B/C ratio of 1 and meets the criterion for participation. Therefore, under the above section all recreation benefits are to be included in the BCR for Alternative 2. The annual NED benefits for Alternative 2 are shown in **Table 33**.

Table 33 - Alternative 2 - 15 meters Annual NED Benefits & B/C Ratio
(50 yr amortization at 4.125%, FY11 Price Level)

Category	W/O Project	Alternative 2	Benefits/Costs
Structural Damages - Annual			
RR Construction & O&M Costs	$1,275,274	$13,127	$1,262,147
Trail Damage	$81,821	$6,400	$75,421
Structure & Content Damage	$62,923	$16,014	$46,909
RR Delay Costs	$0	$0	$ 0
Total Damage/Reduction	$1,420,018	$35,541	$1,384,477
Recreation – Annual			
Total Recreation Value	$10,667,923	$12,328,344	$1,660,421
TOTAL ANNUAL BENEFITS			$3,044,898
ANNUAL COSTS			$1,469,767
ANNUAL NET BENEFITS (UNLIMITED)			$1,575,131
B/C RATIO (UNLIMITED)			2.07

9.1 Residual Risks – Alternative 2

Alternative 2, like the other alternatives, does not provide an absolute level of protection. The level of storm damage protection declines as the beach fill erodes. At its full 15 meters, Alternative 2 provides over 500-yr protection from storm erosion; however, as it erodes its protection from storm erosion lessens. The year prior to complete fill erosion has approximately 8 meters (26 feet) of beach width (4m of fill and 4m of natural beach) in the smallest natural width cells of Reach 6. In these cells the protection level from storm erosion is about the 100-year level. However, the renourishment program for all alternatives is based on the total erosion of fill and renourishment in the following year. It is in this 1 to 2 year window that structures are most vulnerable to storm erosion damage. Residual damages principally occur in this window of time for all alternatives. A systematic approach to advanced replenishment prior to fill exhaustion is nearly impossible given the random nature of fill erosion; unless, a significant program cost premium is willing to be paid. With Alternative 2 having average annual residual damages of $35,540, any advanced renourishment program seems unlikely to be cost effective. The distribution of average annual residual damages for Alternative 2 is shown in **Table 34**.

Table 34 - Average Annual Residual Damages for Alternative 2 - 15 meters

FY11 Price Levels & Discount Rate				
Probability of being below	RR Construction & O&M Costs	Trail Damage	Structure & Content Damage	Total Residual Damage
5%	$6,297	$4,906	$593	$15,862
10%	$6,979	$5,100	$1,325	$18,300
15%	$8,003	$5,263	$2,022	$20,759
20%	$8,844	$5,384	$3,532	$23,109
25%	$9,368	$5,531	$5,304	$25,193
30%	$10,045	$5,687	$7,775	$26,837
35%	$10,769	$5,831	$10,033	$28,627
40%	$11,181	$5,959	$11,535	$30,347
45%	$11,785	$6,087	$12,905	$32,170
50%	$12,546	$6,208	$14,654	$34,351
55%	$13,272	$6,309	$16,441	$36,609
60%	$14,093	$6,486	$18,382	$38,238
65%	$14,647	$6,671	$20,441	$40,157
70%	$15,440	$6,833	$22,511	$42,485
75%	$16,065	$7,104	$24,401	$44,517
80%	$16,942	$7,368	$26,424	$46,986
85%	$18,228	$7,585	$29,583	$49,520
90%	$19,775	$7,979	$32,558	$54,041
95%	$22,094	$8,565	$36,547	$59,344

It should be noted that Total Residual Damage is not simply the sum of the elements, but a function of their varying distributions.

10 SEA-LEVEL RISE SENSITIVITY ANALYSIS

USACE issued the Engineer Circular titled, "Water Resource Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs" on July 1, 2009. The circular provides USACE guidance for incorporating the potential direct and indirect physical effects of projected future sea level change in the engineering, planning, design, and management of USACE projects. The guidance states that potential sea level change must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence. USACE requires a multiple scenario approach to address uncertainty and help develop better risk-informed alternatives. Planning studies and engineering designs should consider alternatives that are developed and assessed for the entire range of possible future rates of sea level change. The alternatives should be evaluated using "low", "intermediate", and "high" rates of future sea level change for both "with" and "without" project conditions. The historic rate of sea level change should be used as the "low" rate. The "intermediate" rate of local mean sea level change should be estimated using the modified Curve I from the National Research Council (NRC) 1987 report titled "Responding to Changes in Sea Level: Engineering Implications". The "high" rate of local sea level change should be estimated using the modified Curve III from the 1987 NRC report. This "high" rate exceeds the upper bounds of IPCC estimates from both 2001 and 2007 to accommodate for the potential rapid loss of ice from Antarctica and Greenland. The sensitivity of alternative plans and designs to the rates of future local mean sea level change should be determined. Design or operations and maintenance measures should be identified to minimize adverse consequences while maximizing beneficial effects. For each alternative sensitive to sea level change, potential timing and cost consequences should be evaluated during the plan formulation process.

The NED Plan formulated on the basis of continuous monitoring of beach fill erosion and renourishment. Plan formulation would be expected to identify any rapid change in sea level through an unanticipated change in renourishment requirements. Although sea level change should be identified through the frequency of renourishment, these plans still require an assessment of how sensitive performance is to sea level change.

To examine the plans under sea level change a sensitivity analysis was performed assuming a mid-range sea-level rise of 0.40 meters and a maximum sea-level rise of 0.70 over 50-years, as a point of reference the base case assumes a sea-level rise of 0.12 meters. Sea level change was incorporated into the model along with an adjustment to the construction cost of the seawall and simulated over the array of alternatives. The results of the model are shown in **Tables 35 and 36**.

Table 35 - Sea-Level Rise Sensitivity - Mid-Range

FY11 Price Levels & Discount Rate

MID RANGE SEA LEVEL RISE CONDITION												
	W/O	10m	15m	20m	25m	30m	35m	40m	45m	50m	55m	60m
Project Total Damages - Average Annual	$1,683,075	$65,469	$52,002	$44,118	$39,301	$35,835	$32,602	$30,735	$28,586	$26,929	$26,230	$25,220
RR Construction & O&M Costs	$1,485,241	$21,141	$17,310	$14,897	$13,275	$12,167	$11,293	$10,623	$10,073	$9,684	$9,363	$9,087
Trail Damage	$92,012	$7,560	$7,087	$6,797	$6,582	$6,441	$6,333	$6,248	$6,182	$6,129	$6,094	$6,060
Structure & Content Damage	$105,822	$36,768	$27,605	$22,434	$18,444	$17,227	$14,976	$13,865	$12,331	$11,116	$10,774	$10,072
RR Delay Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Residual Damages	$1,683,075	$65,469	$52,002	$44,118	$39,301	$35,835	$32,602	$30,735	$28,586	$26,929	$26,230	$25,220
Damage Reduction	$0	$1,617,606	$1,631,073	$1,638,957	$1,643,774	$1,647,241	$1,650,473	$1,652,340	$1,654,489	$1,656,146	$1,656,845	$1,657,856
Incidental Recreation:												
W/O Project Reach 6	$10,114,507	$10,114,507	$10,114,507	$10,114,507	$10,114,507	$10,114,507	$10,114,507	$10,114,507	$10,114,507	$10,114,507	$10,114,507	$10,114,507
With Project Reach 6	$10,114,507	$12,005,507	$12,290,558	$12,574,588	$12,877,686	$13,170,345	$13,424,681	$13,638,027	$13,813,079	$13,975,486	$14,113,524	$14,231,325
Incidental Recreation Improvement	$0	$1,890,999	$2,176,051	$2,460,080	$2,763,189	$3,055,838	$3,310,174	$3,523,519	$3,698,571	$3,860,959	$3,999,017	$4,116,818
Average UDV Reach 6	$4.90	$6.12	$6.27	$6.41	$6.56	$6.70	$6.83	$6.94	$7.03	$7.11	$7.18	$7.24
Weekend Sqft - Summer	30.00	38.57	44.32	50.27	56.18	62.18	68.16	74.30	80.15	86.48	93.05	99.31
Project Costs:												
Initial Fill Only												
Sand Cost	*$0*	*$2,576,955*	*$3,865,478*	*$5,153,971*	*$6,442,463*	*$7,730,956*	*$9,019,449*	*$10,307,941*	*$11,596,434*	*$12,884,926*	*$14,173,419*	*$15,461,912*
Mob/Demob	*$0*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*
IDC	*$0*	*$14,008*	*$26,805*	*$43,483*	*$64,057*	*$88,543*	*$116,954*	*$149,306*	*$185,615*	*$225,894*	*$270,160*	*$318,428*
Total Cost Initial Fill (including PED, SA, & Environmental)	*$0*	*$6,002,700*	*$7,516,590*	*$11,334,362*	*$12,956,030*	*$14,381,610*	*$15,911,119*	*$17,444,561*	*$18,981,964*	*$20,523,337*	*$22,068,697*	*$23,618,059*
Average # of Fills Project Lifetime	0	12.49	9.48	7.76	6.62	5.77	5.16	4.66	4.25	3.93	3.65	3.40
Annual Costs	$0	$1,549,022	$1,520,792	$1,638,316	$1,661,638	$1,686,391	$1,720,459	$1,757,346	$1,792,393	$1,832,556	$1,875,480	$1,915,654
Storm Damage Reduction (SDR) Benefits	$0	$1,617,606	$1,631,073	$1,638,957	$1,643,774	$1,647,241	$1,650,473	$1,652,340	$1,654,489	$1,656,146	$1,656,845	$1,657,856
Net Annual SDR Benefits	$0	$68,583	$110,281	$641	-$17,864	-$39,150	-$69,986	-$105,006	-$137,904	-$176,409	-$218,635	-$257,799
Incidental Recreation Benefits - (Limited ER 1165-2-130)	$0	$1,617,606	$1,631,073	$1,638,957	$1,643,774	$1,647,241	$1,650,473	$1,652,340	$1,654,489	$1,656,146	$1,656,845	$1,657,856
Total SDR & Recreation Benefits - Limited	$0	$3,235,211	$3,262,146	$3,277,914	$3,287,548	$3,294,481	$3,300,947	$3,304,680	$3,308,978	$3,312,293	$3,313,690	$3,315,711
B/C Ratio - SDR only		1.04	1.07	1.00	0.99	0.98	0.96	0.94	0.92	0.90	0.88	0.87
B/C Ratio - SDR & Recreation (Limited)		2.09	2.15	2.00	1.98	1.95	1.92	1.88	1.85	1.81	1.77	1.73
Annual Net NED Benefits (Limited)		$1,686,189	$1,741,354	$1,639,598	$1,625,909	$1,608,090	$1,580,487	$1,547,334	$1,516,585	$1,479,737	$1,438,210	$1,400,057
Recreation Benefits - ER 1105-2-100, Appendix E, Section IV, E-24.c. Incidental Recreation Benefits - Unlimited		$1,890,999	$2,176,051	$2,460,080	$2,763,189	$3,055,838	$3,310,174	$3,523,519	$3,698,571	$3,860,959	$3,999,017	$4,116,818
Total SDR & Recreation Benefits - Unlimited		$3,508,605	$3,807,124	$4,099,037	$4,406,963	$4,703,079	$4,960,647	$5,175,859	$5,353,060	$5,517,105	$5,655,862	$5,774,673
Annual Net NED Benefits - Unlimited		$1,959,583	$2,286,332	$2,460,721	$2,745,324	$3,016,688	$3,240,188	$3,418,513	$3,560,667	$3,684,550	$3,780,381	$3,859,016
B/C Ratio - SDR & Recreation - Unlimited		2.27	2.50	2.50	2.65	2.79	2.88	2.95	2.98	3.01	3.02	3.01

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Table 36 - Sea-Level Rise Sensitivity - Maximum

FY11 Price Levels & Discount Rate

MAXIMUM SEA LEVEL RISE CONDITION												
	W/O	10m	15m	20m	25m	30m	35m	40m	45m	50m	55m	60m
Project Total Damages - Average Annual	$1,764,479	$88,023	$70,655	$59,659	$52,566	$47,407	$43,096	$39,644	$37,050	$34,721	$33,899	$31,901
RR Construction & O&M Costs	$1,548,017	$24,129	$19,347	$16,768	$14,890	$13,571	$12,575	$11,715	$11,004	$10,499	$10,124	$9,725
Trail Damage	$93,756	$8,040	$7,449	$7,130	$6,881	$6,711	$6,586	$6,478	$6,392	$6,329	$6,279	$6,232
Structure & Content Damage	$122,706	$55,854	$43,859	$35,761	$30,787	$27,125	$23,935	$21,454	$19,654	$17,893	$17,496	$15,945
RR Delay Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Residual Damages	$1,764,479	$88,023	$70,655	$59,659	$52,566	$47,407	$43,096	$39,644	$37,050	$34,721	$33,899	$31,901
Damage Reduction	$0	$1,676,456	$1,693,824	$1,704,820	$1,711,913	$1,717,073	$1,721,382	$1,724,834	$1,727,428	$1,729,757	$1,730,580	$1,732,577
Incidental Recreation:												
W/O Project Reach 6	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571	$9,868,571
With Project Reach 6	$9,868,571	$11,957,059	$12,265,743	$12,553,597	$12,861,174	$13,158,188	$13,418,683	$13,629,867	$13,803,937	$13,968,191	$14,107,659	$14,227,080
Incidental Recreation Improvement	$0	$2,088,481	$2,397,172	$2,685,026	$2,992,604	$3,289,595	$3,550,112	$3,761,296	$3,935,366	$4,099,621	$4,239,088	$4,358,509
Average UDV Reach 6	$4.75	$6.08	$6.25	$6.40	$6.55	$6.69	$6.83	$6.94	$7.02	$7.11	$7.18	$7.24
Weekend Sqft - Summer	30.00	38.12	44.00	49.99	55.96	61.97	68.09	74.11	79.92	86.26	92.78	99.10
Project Costs:												
Initial Fill Only												
Sand Cost	*$0*	*$2,576,955*	*$3,865,478*	*$5,153,971*	*$6,442,463*	*$7,730,956*	*$9,019,449*	*$10,307,941*	*$11,596,434*	*$12,884,926*	*$14,173,419*	*$15,461,912*
Mob/Demob	*$0*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*	*$2,124,896*
IDC	*$0*	*$14,008*	*$26,805*	*$43,483*	*$64,057*	*$88,543*	*$116,954*	*$149,306*	*$185,615*	*$225,894*	*$270,160*	*$318,428*
Total Cost Initial Fill (including PED, SA, & Environmental)	*$0*	*$6,002,700*	*$7,516,590*	*$11,334,362*	*$12,856,030*	*$14,381,610*	*$15,911,113*	*$17,444,561*	*$18,981,964*	*$20,523,337*	*$22,068,697*	*$23,618,059*
Average # of Fills Project Lifetime	0	12.85	9.66	7.87	6.68	5.84	5.22	4.72	4.28	3.96	3.68	3.43
Annual Costs	$0	$1,575,028	$1,539,981	$1,655,446	$1,674,777	$1,702,088	$1,735,340	$1,772,492	$1,803,478	$1,844,585	$1,887,256	$1,928,398
Storm Damage Reduction (SDR) Benefits	$0	$1,676,456	$1,693,824	$1,704,820	$1,711,913	$1,717,073	$1,721,382	$1,724,834	$1,727,428	$1,729,757	$1,730,580	$1,732,577
Net Annual SDR Benefits	$0	$101,428	$153,843	$49,374	$37,150	$14,983	-$13,957	-$47,657	-$76,050	-$114,828	-$156,676	-$195,821
Incidental Recreation Benefits - (Limited ER 1165-2-130)	$0	$1,676,456	$1,693,824	$1,704,820	$1,711,913	$1,717,073	$1,721,382	$1,724,834	$1,727,428	$1,729,757	$1,730,580	$1,732,577
Total SDR & Recreation Benefits - Limited	$0	$3,352,912	$3,387,647	$3,409,640	$3,423,841	$3,434,142	$3,442,765	$3,449,668	$3,454,856	$3,459,515	$3,461,160	$3,465,154
B/C Ratio - SDR only		1.06	1.10	1.03	1.02	1.01	0.99	0.97	0.96	0.94	0.92	0.90
B/C Ratio - SDR & Recreation (Limited)		2.13	2.20	2.06	2.04	2.02	1.98	1.95	1.92	1.88	1.83	1.80
Annual Net NED Benefits (Limited)		$1,777,884	$1,847,666	$1,754,194	$1,748,070	$1,732,054	$1,707,425	$1,677,177	$1,651,378	$1,614,929	$1,573,904	$1,536,757
Recreation Benefits - ER 1105-2-100, Appendix E, Section IV, E-24.c. Incidental Recreation Benefits - Unlimited		$2,088,481	$2,397,172	$2,685,026	$2,992,604	$3,289,595	$3,550,112	$3,761,296	$3,935,366	$4,099,621	$4,239,088	$4,358,509
Total SDR & Recreation Benefits - Unlimited		$3,764,937	$4,090,996	$4,389,846	$4,704,524	$5,006,668	$5,271,494	$5,486,131	$5,662,794	$5,829,378	$5,969,668	$6,091,086
Annual Net NED Benefits - Unlimited		$2,189,909	$2,551,014	$2,734,400	$3,029,753	$3,304,578	$3,536,155	$3,713,639	$3,859,316	$3,984,793	$4,082,413	$4,162,688
B/C Ratio - SDR & Recreation - Unlimited		2.39	2.66	2.65	2.81	2.94	3.04	3.10	3.14	3.16	3.16	3.16

As expected, a higher future sea-level rise increases the potential for storm damages. Storm damages increase under the without project condition from the base case's $1.42 million to $1.76 million for the maximum sea-level rise case on an average annual basis. Approximately 80% of the increase in damages is related to the seawall. Under maximum sea-level rise construction of the seawall occurs six years sooner (2015 vs. 2021) and at a higher construction cost. The maximum sea-level rise and mid-range conditions do not produce a change in NED Plan identification of Alternative 2. On a performance basis, the base case NED Plan reduces annual storm damages by about 98%, Alt 2 for the mid-range sea-level by 97%, and the maximum sea-level rise condition by 96% with Alt 2.

In addition to its performance level under sea-level rise conditions, the base case NED Plan of 15 meters requires less than one additional fill on average over the 50-year project life - 9.11 fills versus 9.49 for the mid-range and 9.66 for maximum. These results indicate that the base case NED Plan of a beach fill project of 15 meters is manageable with monitoring and unlikely to carry a significant degree of risk.

11 DETAILED COST ESTIMATE FOR THE TENTATIVE RECOMMENDED PLAN

The San Clemente model attempts to incorporate uncertainty in the areas of coastal engineering, economic damages & benefits, and costs. Uncertainty parameters in coastal and economics are much more developed than in costs. Modeling of cost uncertainty within an overall analysis framework is in its early development stage; and as such, cost estimates undergo a separate analysis to incorporate qualitative uncertainties in addition to quantitative. This additional cost analysis follows the guidance of ETL 1110-2-573 and is presented in the Cost Engineering Appendix of this report. Highlights of this analysis are presented below.

The San Clemente model estimates the mean total cost of Alternative 2 at $69.40 million – slightly less than the most likely cost estimate of the review process. Base cost contingency adds an additional $13.01 million. The cost risk analysis for the project cost contingency analysis is listed in **Table 37**.

Table 37 – Cost Risk Analysis for Project Cost

Most Likely Cost Estimate	**$70,586,000**		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	**$56,645,428**	($13,940,572.25)	**-19.75%**
5%	**$70,902,694**	**$316,693.81**	**0.45%**
10%	**$73,076,512**	**$2,490,512.40**	**3.53%**
15%	**$74,635,745**	**$4,049,744.51**	**5.74%**
20%	**$75,727,382**	**$5,141,382.38**	**7.28%**
25%	**$76,521,219**	**$5,935,219.38**	**8.41%**
30%	**$77,208,624**	**$6,622,624.27**	**9.38%**
35%	**$77,812,282**	**$7,226,282.19**	**10.24%**
40%	**$78,405,655**	**$7,819,655.43**	**11.08%**
45%	**$78,964,410**	**$8,378,410.05**	**11.87%**
50%	**$79,507,020**	**$8,921,019.57**	**12.64%**
55%	**$80,097,322**	**$9,511,321.75**	**13.47%**
60%	**$80,710,832**	**$10,124,831.66**	**14.34%**
65%	**$81,294,179**	**$10,708,178.77**	**15.17%**
70%	**$81,919,389**	**$11,333,388.94**	**16.06%**
75%	**$82,631,440**	**$12,045,440.03**	**17.06%**
80%	**$83,598,285**	**$13,012,285.13**	**18.43%**
85%	**$84,773,630**	**$14,187,629.99**	**20.10%**
90%	**$86,315,491**	**$15,729,490.56**	**22.28%**
95%	**$89,103,541**	**$18,517,541.24**	**26.23%**
100%	**$113,680,199**	**$43,094,198.90**	**61.05%**

However, the San Clemente model does not account for the uncertainty related to schedule. The technical review estimates schedule uncertainty at 63.4 months and a cost of $12.28 million. The following tables, **Table 38** and **Table 39**, provide overview of the cost risk analysis related to the uncertainty in the schedule of future nourishment fills.

Table 38 – Cost Risk Analysis for Schedule (Duration) Contingency

Contingency Analysis

Most Likely Schedule Duration	576.3 Months		
Confidence Level	Project Duration	Contingency	Contingency %
0%	582.2 Months	5.8 Months	1.01%
5%	604.0 Months	27.7 Months	4.81%
10%	608.9 Months	32.6 Months	5.66%
15%	611.9 Months	35.6 Months	6.18%
20%	614.5 Months	38.2 Months	6.62%
25%	616.8 Months	40.5 Months	7.03%
30%	619.2 Months	42.9 Months	7.44%
35%	621.4 Months	45.0 Months	7.81%
40%	623.3 Months	46.9 Months	8.15%
45%	624.9 Months	48.6 Months	8.43%
50%	626.8 Months	50.5 Months	8.76%
55%	628.7 Months	52.3 Months	9.08%
60%	630.6 Months	54.2 Months	9.41%
65%	632.6 Months	56.2 Months	9.76%
70%	634.7 Months	58.4 Months	10.14%
75%	637.1 Months	60.8 Months	10.54%
80%	639.8 Months	63.4 Months	11.01%
85%	642.8 Months	66.5 Months	11.53%
90%	646.4 Months	70.1 Months	12.16%
95%	651.9 Months	75.6 Months	13.11%
100%	683.5 Months	107.2 Months	18.60%

Table 39 – Cost Risk Analysis for Schedule (Cost) Contingency

Contingency Analysis

Most Likely Cost Estimate	$70,586,000		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$81,566,409	$10,980,409	15.56%
5%	$82,058,726	$11,472,726	16.25%
10%	$82,169,162	$11,583,162	16.41%
15%	$82,236,341	$11,650,341	16.51%
20%	$82,294,479	$11,708,479	16.59%
25%	$82,346,561	$11,760,561	16.66%
30%	$82,399,793	$11,813,793	16.74%
35%	$82,448,393	$11,862,393	16.81%
40%	$82,491,636	$11,905,636	16.87%
45%	$82,529,093	$11,943,093	16.92%
50%	$82,571,758	$11,985,758	16.98%
55%	$82,613,028	$12,027,028	17.04%
60%	$82,655,986	$12,069,986	17.10%
65%	$82,700,781	$12,114,781	17.16%
70%	$82,749,662	$12,163,662	17.23%
75%	$82,802,492	$12,216,492	17.31%
80%	$82,862,626	$12,276,626	17.39%
85%	$82,930,874	$12,344,874	17.49%
90%	$83,012,409	$12,426,409	17.60%
95%	$83,135,576	$12,549,576	17.78%
100%	$83,847,661	$13,261,661	18.79%

Base and schedule contingencies increase the overall estimated cost to $95.87 million at an 80% confidence level. **Table 40** provides an overview of cost risk analysis for both costs and schedule.

Table 40 – Cost Risk Analysis for Total Project Cost

Contingency Analysis

Most Likely Cost Estimate	$70,586,000		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$67,625,836	($2,960,164)	-4.19%
5%	$82,375,420	$11,789,420	16.70%
10%	$84,659,674	$14,073,674	19.94%
15%	$86,286,085	$15,700,085	22.24%
20%	$87,435,861	$16,849,861	23.87%
25%	$88,281,780	$17,695,780	25.07%
30%	$89,022,417	$18,436,417	26.12%
35%	$89,674,675	$19,088,675	27.04%
40%	$90,311,292	$19,725,292	27.95%
45%	$90,907,503	$20,321,503	28.79%
50%	$91,492,778	$20,906,778	29.62%
55%	$92,124,350	$21,538,350	30.51%
60%	$92,780,818	$22,194,818	31.44%
65%	$93,408,960	$22,822,960	32.33%
70%	$94,083,051	$23,497,051	33.29%
75%	$94,847,932	$24,261,932	34.37%
80%	$95,874,911	$25,288,911	35.83%
85%	$97,118,504	$26,532,504	37.59%
90%	$98,741,900	$28,155,900	39.89%
95%	$101,653,118	$31,067,118	44.01%
100%	$126,941,860	$56,355,860	79.84%

11.1 Revised Net Benefits and B/C Ratio of Alternative 2

The revised project cost[11] estimate including IDC provided an estimate for initial fill at $11.11 million and for the total cost at $96.03 million. The NPV of the project construction stream would be $45.09 million or $2.14 million on an annual basis. A table showing the amortization of the initial fill and the eight future nourishment fills for Alternative 2 – 15 meters is identified in Attachment A on page A-15.

Table 41 - Alternative 2 - 15 meters Revised Annual NED Benefits & B/C Ratio
(50 yr amortization at 4.125%, FY11 Price Level)

Category	W/O Project	Alternative 2	Benefits/Costs
Structural Damages - Annual			
RR Construction & O&M Costs	$1,275,274	$13,127	$1,262,147
Trail Damage	$81,821	$6,400	$75,421
Structure & Content Damage	$62,923	$16,014	$46,909
RR Delay Costs	$0	$0	$ 0
Total Damage/Reduction	$1,420,018	$35,541	$1,384,477
Recreation – Annual			
Total Recreation Value	$10,667,923	$12,328,344	$1,660,421
TOTAL ANNUAL BENEFITS			$3,044,898
ANNUAL COSTS			$2,144,104
ANNUAL NET BENEFITS (UNLIMITED)			$900,794
B/C RATIO (UNLIMITED)			1.42

The B/C ratio for only SDR benefits is 0.65. SDR benefits coupled with limited recreation benefits exceed a B/C ratio of 1 (1.29) allowing for all recreation benefits to be included under ER 1105-2-100, Appendix E, Section IV, E-24.c.

[11] Cost Engineering DX – TPCS ATR Certification, 2/9/2011

Table 42 - ER 1105-2-100 Appendix H – Economic Table

Equivalent Annual Benefits and Costs	
San Clemente Shoreline Feasibility Study – Cost Engineering DX – ATR Certification	
January 2011 Price Level, 50-Year Period of Analysis, 4.125 Percent Discount Rate	
Investment Costs	
Total Project Construction Costs	$95,975,000
Interest During Construction	$56,000
Total Investment Cost	$96,031,000
Average Annual Costs	
Interest and Amortization of Initial Investment	$2,144,100
OMRR&R	$0
Total Average Annual Costs	$2,144,100
Average Annual Benefits	$3,044,900
Net Annual Benefits	$900,800
Benefit-Cost Ratio	1.42
Benefit-Cost Ratio (computed at 7%)[1]	1.28
[1]Per Executive Order 12893	

12 REGIONAL ECONOMIC DEVELOPMENT

12.1 Regional Economic Development Account

The P&Gs which replace the 1972 "Principles and Standards," direct the studies of major water projects by Federal water resources development agencies. A stated purpose of the P&Gs is to ensure that the formulation and evaluation of water resource studies are done properly and consistently by federal agencies. The federal objective in project planning is to contribute to national economic development (NED) while protecting the environment. NED contributions are increases in the net values of national goods and services outputs, both marketed and non-marketed. A plan, consistent with federal objectives and which maximizes NED benefits, is the "NED plan."

In addition to NED, the P&Gs include three other accounts: regional economic development (RED), environmental quality (EQ), and other social effects (OSE). Collectively, the four accounts are required to include all significant effects of a plan on the human environment. The RED account includes the regional incidence of NED effects, income transfers, and employment effects. The EQ account shows the non-quantifiable effects of a plan on ecological, cultural, and aesthetic attributes of significant natural and cultural resources. The OSE account displays the effects of a plan on urban and community settings and on life, health, and safety.

The P&Gs require only that the NED account be developed for the selection of a plan. However, information on the other three accounts, which may bear significantly on selection of a plan, should be included in the alternative assessment.

The RED account shows the effects of plan alternatives on the distribution of regional economic activity in the area where the plan will have significant income and employment effects. All or most of the NED benefits for a plan will accrue to the region. Effects outside the study region are categorized as "rest of the United States" impacts. The effects on regional income are the sum of 1) the NED income benefits and 2) transfers from outside the region. Income transfers comprise income from implementation outlays, transfers of economic activities, and indirect and induced effects. Indirect effects are those that result from the changed outputs of goods and services in industries which help meet changes in final products and export demands. Induced effects result from changes in consumer expenditures stimulated by changes in personal income. The effects of a plan on regional employment parallel those on regional income. Typically, employment impacts of a plan are developed for individual industries at some level of aggregation in order to discern the distributional impacts on business sectors.

12.2 Relation of the RED Account to Other Accounts

RED impacts include, principally, changes in income and employment. However, the nuances of each of those categories may easily overlap with other accounts defined within the P&Gs. As indicated above, NED impacts are also RED impacts if they occur within the region of interest. However, the NED account is to reflect all effects on the national economy and excludes indirect and induced effects because they represent inter-regional transfers of regional economic activity. Conversely, indirect and induced impacts are shown in the RED account, and differences between it and the NED accounts are therefore accounted for as transfers from or to the rest of the nation.

The RED account may also overlap with the OSE account. The OSE account includes urban and community impacts, in particular those on income, population and employment distribution,

fiscal conditions, and displacement of people and businesses and farms. A flood event may have social impacts through reduced property values, contaminated drinking water, and greater exposure to biological toxins. All may have regional impacts as typically defined by the RED account, but many may not be quantifiable and thus be included in the OSE account. Others which are measurable may fit into the OSE account and concurrently be an RED impact. For example, people in flooded areas may be unable to live in their homes or commute to work. The inability to live in their homes is an OSE impact, while the inability to commute to work is also an OSE impact, but with RED implications. In the latter case, the outputs of industries will decline if employees are unable to reach their places of employment.

12.3 Study Area RED Analysis

Notwithstanding its location of an Orange County oceanside community, the San Clemente beach area provides an important public recreational resource to a growing minority and low-income population. Although the 2005 - 2007 American Community Survey by the Census Bureau reports median family income in San Clemente at $103,500, the percent of families below the poverty line has increased 34.8% since the 2000 Census. Poverty has risen from 4.6% to 6.2% for families within San Clemente. On an individual basis 8.4% of San Clemente's population of 60,355 is below the poverty line. In addition to the increase in poverty, the population of San Clemente has become more diverse. Minority population has risen from the 2000 Census level of 12.1% to 17.5% of the population.

The public beaches of San Clemente provide not only a recreational resource to the community but also a jobs and income resource. Tourism to the beaches stimulates the local economy. To measure the economic impacts of tourism the MGM2 model, an update of the NPS Money Generation Model as originally developed at Michigan State University, and more specifically the MGM2 Shortform version was utilized to measure the differences in economic impacts between the without project and NED project (15 meter fill) conditions.

12.3.1 MGM2 Model

MGM2 estimates both the direct effects and secondary effects of visitor spending. Although economic impact analysis can be quite complex, the basic components and calculations are summarized in the following simple equation:

Economic impacts = Number of Visitors * Average spending per visitor * Economic multipliers

There are three primary inputs to the Money Generation Model:

- Visits
- Average spending
- Multipliers

These inputs typically come from different sources. Visits are derived from attendance use figures or an estimate of the change in visits due to some management decision to be evaluated. Spending averages are typically estimated in surveys of visitors. Multipliers are usually derived from input-output models of the region's economy (RIMS II, IMPLAN, etc.). The model includes some suggested spending averages that may be edited or replaced with local data to represent a given set of visitors. MGM2 offers several sets of multipliers that users may choose from to capture the economy in the region around the site. For the analysis of San

Clemente the default MGM settings of large metro area, high spending, and multipliers were employed.

The documentation of the MGM2 model describes the economic impact concepts as follows.

> **Direct effects** are the changes in sales, income and jobs in those businesses or agencies that initially receive the visitor spending (e.g. the park, motels, campgrounds, restaurants, grocery stores, attractions, retail stores). These impacts are most directly associated with the visitor spending and are therefore itemized in greater detail in MGM2. Direct effects are estimated for key tourism-related sectors. Direct effects are estimated by applying simple ratios (jobs to sales, income to sales, etc.) to the direct sales.
>
> **Secondary or "multiplier" effects** capture what are called indirect and induced effects. These are the changes in economic activity within the region that result from the re-circulation of the money spent by visitors within the local economy. There are two types of secondary effects:
>
> **Indirect effects** are the changes in sales, income and jobs in "backward linked" industries. These are firms that supply goods and services to those businesses that sell directly to the visitor. For example, motels purchase linen supplies, utilities and other goods and services in the local area in order to provide lodging for the visitor.
>
> **Induced effects** are the changes in economic activity in the region resulting from household spending of income earned through a direct or indirect effect of the visitor spending. For example, motel and linen supply employees live in the region and spend the income earned on housing, groceries, education, clothing and other goods and services.
>
> **Total effects** are the sum of direct, indirect and induced effects. Total effects are estimated by applying regional economic multipliers to the estimates of direct sales.
>
> - Direct effects accrue largely to tourism-related businesses in the area.
> - Indirect effects accrue to a broader set of economic sectors that serve these tourism firms.
> - Induced effects are distributed widely across a variety of economic sectors.
>
> Multipliers capture many "rounds" of re-spending of the initial infusion of visitor spending within the region.
>
> **MGM2 reports impacts in terms of four principal measures of economic activity:**
>
> 1. **Sales** are the sales of firms within the region to park visitors. As explained below under "margining", not all visitor spending accrues to the region as direct sales.
>
> 2. **Jobs** are the number of jobs in the region supported by the visitor spending. Job estimates are not full time equivalents, but include part time and seasonal positions.
>
> 3. **Personal income** includes wage and salary income, proprietor's income and employee benefits.
>
> 4. **Value added** is a commonly used measure of the contribution of an industry or region to gross national or gross state product. Value added is personal income plus rents and profits, plus indirect business taxes. As the name implies, it is the "value added" by the region to the final good or service being produced. It can also be defined as the final price of the good or service minus the costs of all of the non-labor inputs to production.

12.3.2 MGM2 Model Inputs & Results

Beach attendance for the MGM2 analysis is based on the expected values of the base sea-level rise condition for both the without and NED (Alternative 2 - 15m) fill conditions. Attendance figures for these conditions are shown in **Table 43**.

Table 43 - MGM2 Model Recreation

Project Year	Without	NED Alt 2
1	1,699,121	1,755,159
10	1,736,476	1,780,503
20	1,743,408	1,831,463
30	1,737,537	1,869,618
40	1,730,262	1,901,163
50	1,684,868	2,131,042

A beach survey of San Clemente conducted by Dr. Phillip King of San Francisco State University in 2004 was utilized to isolate tourism attendance from local attendance. Beach attendance percentages by place of origin are shown in **Table 44**.

Table 44 - Beach Attendance Origins

Origin	Percentage
Local	46.42
Non-Local Day	19.84
Non-Local Overnight	15.54
Outside Area Overnight	18.20

The survey indicated that the average group size was 2.83 people and that the average length of stay for overnight parties was 10 days.

Daily group expenditures for a high expenditure area are from the MGM2 model are shown in **Table 45**.

Table 45 - Daily Beach Expenditures

Type	Daily Group Expenditure
Local	$55.55
Non-Local Day	$87.71
Overnight	$251.43

Daily group expenditure for local day trips was set to $0 within the MGM2 model to isolate the effects of tourism.

MGM2's generic values for multipliers and ratios are shown in **Table 46**.

Table 46 - MGM2 Generic Multipliers

	Type of Region			
	Rural	Small Metro	Large Metro	State
Direct effect ratios				
Capture rate	78%	80%	82%	85%
Income/sales	0.34	0.35	0.37	0.37
Jobs/ MM sales	26.08	22.32	19.98	17.09
Value added/Sales	0.52	0.54	0.56	0.57
Total effect multipliers				
Sales Type SAM	1.32	1.45	1.55	1.63
Total Income/direct sales	0.45	0.52	0.57	0.61
Total jobs/ direct sales	30.56	28.07	26.40	23.58
Total Value added/direct sales	0.72	0.82	0.90	0.97

Regional multipliers are shown in **Table 47**.

Table 47 - MGM2 Regional Multipliers

Direct effect ratios		Total effect multipliers	
Capture rate	82%	Sales Type SAM	1.55
Income/sales	0.37	Total Income/direct sales	0.57
Jobs/ MM sales	19.98	Total jobs/direct sales	26.40
Value added/sales	0.56	Total Value added/direct sales	0.90

The economic impacts of beach tourism spending in San Clemente are shown in the following results of the MGM2 model for various project years (**Table 48**).

Table 48- RED Impacts Increased Beach Attendance for NED Plan

	Year 1	Year 10	Year 20	Year 30	Year 40	Year 50
Recreation Visits	56,038	44,027	88,055	132,081	170,901	446,174
Total Visitor Spending ($000's)	$1,997.26	$1,569.00	$3,138.00	$4,708.00	$6,091.00	$15,902.20
Direct Impacts						
Sales ($000's)	$1,637.76	$1,286.73	$2,573.48	$3,860.18	$4,944.72	$13,039.80
Personal Income ($000's)	$603.32	$474.01	$948.03	$1,422.03	$1,839.98	$4,803.66
Jobs	32.73	25.71	51.43	77.14	99.81	260.58
Value Added ($000's)	$915.45	$719.24	$1,438.49	$2,157.71	$2,791.89	$7,288.82
Total Impacts						
Sales ($000's)	$2,538.52	$1,994.42	$3,988.89	$5,983.27	$7,741.82	$20,211.70
Personal Income ($000's)	$934.00	$733.81	$1,467.64	$2,201.43	$2,848.46	$7,436.52
Jobs	43.23	33.96	67.93	101.89	131.84	344.19
Value Added ($000's)	$1,478.19	$1,161.36	$2,322.74	$3,484.07	$4,508.07	$11,769.30

The preceding table indicates the additional beach area of the NED Plan will have significant economic impacts in San Clemente. In the area additional direct sales from non-resident spending increases from the projects first year of $1.638 million to over $13 million by the study period's end. Personal income growth from this spending climbs from $603 thousand to over $4.8 million with job creation increasing from 33 to 261. When multiplier effects are included sales reach over $20 million, a personal income gain of $7.4 million and additional jobs in excess of 344 will be realized at the study's end over the Without Project condition.

12.3.3 Regional Economic Modeling

Many of the RED effects considered in this report are quantified using regional economic models that are based on the principles of input-output (I-O) analysis. I-O analysis represents a means of measuring the flow of commodities and services among industries, institutions, and final consumers within an economy (or study area). I-O models capture all monetary market transactions in an economy, accounting for inter-industry linkages and availability of regionally-produced goods and services. The resulting mathematical formulae allow I-O models to simulate or predict the economic impacts of a change in one or several economic activities on an entire economy.

I-O analyses use three main metrics to measure economic impacts – industry output, value added, and employment. Industry output refers to the value of goods and services produced in a region. Value added consists of four components – employee compensation, proprietor income, other property income, and indirect business tax. Labor income represents the sum of employee compensation and proprietor income. Lastly, employment is measured by the

number of full- and part time jobs. For the purposes of this study, the focus is on value added, which represents regional income, and employment, which is consistent with the guidance on RED analysis presented in the P&Gs.

The primary input variable for I-O analysis is the dollar change in purchases of products or services for final use, the "final demand." Final demand changes drive I-O models. Industries respond to meet demands directly or indirectly by supplying goods and services to industries responding directly to final demand changes. The primary output variables are predicted changes in direct, indirect, and induced economic output, employment, and income for the affected industries within a study area. Direct economic effects refer to the response of a given industry (i.e., changes in output, income, and employment) based on final demand for that industry. Indirect effects refer to changes in output, income, and employment resulting from the iterations of industries purchasing from other industries caused by the direct economic effects. Induced economic effects refer to changes in output, income, and employment caused by the expenditures associated with new household income generated by direct and indirect economic effects.

The measurement of direct, indirect, and induced linkages within a regional economy is based on the concept of a multiplier. A multiplier is a single number that quantifies the total economic effect resulting from direct effects. For example, an output multiplier of 1.7 for the "widget" production sector indicates that every $100,000 of widgets produced (the direct output of this industry) supports a total of $170,000 in business sales throughout the economy (total output of all industries), including the initial $100,000 in widget output. Several types of multipliers are produced by an I-O model, including output, employment, and income multipliers.

For this study, IMPLAN (IMpact Analysis for PLANning) is used to estimate regional economic effects of the proposed storm damage reduction improvement for San Clemente. IMPLAN is a computer-driven system of software and data commonly used to perform economic impact analysis. It was originally developed by the USDA Forest Service (USFS) to assist in land and resource management planning and has been in use since 1979. It is a widely used for economic analyses by clients in federal, state and local governments, universities, as well as the private sector. The system is now maintained and marketed by the Minnesota IMPLAN Group, Inc. (MIG), which updates the data annually, using information collected at the national, state, county, and local level.

IMPLAN is a "non-survey" or secondary I-O system, as it does not require primary, survey-based data, which is often difficult and expensive to obtain. National technical relationships among industries form the basis for the model, but are adjustable to account for unique regional conditions. Information on regional economic activity is also incorporated into the model. Changes can be made to data elements to account for regional conditions when better information, such as from primary surveys, is available.

The 2004 IMPLAN dataset was used in the analysis, and no adjustments were made to the regional data or economic model. All input values into IMPLAN were aligned to 2008 dollars employing the 2004 I/O modeling database. The RED analysis is based on a single-county model of Orange County where all impacts will occur.

12.3.4 IMPLAN Analysis - NED Plan (Alternative 2 - 15 meter)

Implementation of the proposed selected plan would generate construction-related expenditures and generate demand for construction labor, both of which would provide temporary short-term

benefits to the regional economy. In addition, project implementation would support a number of federal employees, primarily Corps staff, to provide construction management and oversight services. Expenditures on construction goods, materials, and equipment that are made within the region would generate additional economic benefits as spending ripples through the local economy via inter-industry linkages. Further, labor income earned by both construction and federal workers would be re-spent, in part, in the local economy, generating additional economic activity.

Only the initial beach fill construction is considered for the IMPLAN analysis. Future beach fills are at random periods within the overall model's framework and would be extremely difficult to model in the set timing approach of IMPLAN. However, as future fills would approximate the same cost as the initial fill their temporary impacts would be similar to those of the initial fill as measured by IMPLAN.

The initial beach fill for NED plan has an overall cost of approximately $10.4 million. A substantial portion of this cost will not flow into the local economy as the dredging equipment and their owners are non-local. It is estimated that approximately 69% ($7.2 million) of the total cost will occur outside of the local economy. In the IMPLAN model it is assumed that $2.7 million will occur in Sector 41 - Other New Construction and $0.5 million in Sector 11001 - Federal Government Non-Defense.

12.3.5 Orange County Impact Area

Expenditures for this analysis occur solely within Orange County. Project implementation would support a number of federal employees, primarily Corps staff, to provide construction management and oversight services. Expenditures on construction goods, materials, and equipment that are made within the region would generate additional economic benefits as spending ripples through the local economy via inter-industry linkages. Further, labor income earned by both construction and federal workers would be re-spent, in part, in the local economy, generating additional economic activity. The regional multipliers for Orange County by industrial sector are shown in **Table 49**.

Table 49 - Orange County Regional Multipliers

Multiplier	Other New Construction	Federal Non-Defense
Direct/Indirect	1.3069	1.0000
Induced	0.4889	0.6737
Total	1.7957	1.6737

All impacts are assumed to occur within Orange County. The Project is expected to generate a total of $5.6 million in output, which includes the direct value (or cost) of the Project ($3.2 million). Total value added generated by the Project in the region is estimated at $3.47 million over the construction period (as shown in T**able 50**). Lastly, the project would generate a number of jobs both directly and in response to the Project's demands for goods and services (i.e., indirect effects) and spending attributed to direct and indirect labor earnings (i.e., induced effects). Approximate 25 private and public jobs directly supported by the Project, an additional 20 annual jobs would be generated in the region, for a total of about 45 jobs in Orange County.

Table 50 - Regional Economic Benefits NED Plan

Impact	Output	Value Added	Employment
Direct	$3,190,000	$2,011,988	25.1
Indirect	$849,660	$485,736	6.7
Induced	$1,593,544	$974,479	12.9
Total	$5,633,205	$3,472,183	44.8

13 OTHER SOCIAL EFFECTS

The Other Social Effects (OSE) account describes the potential effects of the proposed project alternatives in areas that are not dealt with explicitly in the NED and RED accounts presented above. ER 1105-2-409 states, "Any alternative plan may be selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse in the four Principles and Guidelines evaluation accounts," of which the OSE is one. The Principles and Guidelines state that the OSE, when included in U.S. Army Corps of Engineers documents, should "display plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others."

This particular OSE describes the potential effects of NED Plan construction. The OSE account explores the following categories of effects from the implementation of the NED plan.

- Displacement/impacts to population
- Public health and safety
- Displacement/impacts to minorities and special interest groups
- Displacement/impacts to businesses
- Displacement/impacts to agriculture
- Displacement/impacts to recreational areas
- Community growth
- Project Impacts and Connectivity of the Community

For the analysis of the region of influence (ROI) for direct social effects is defined as the City of San Clemente. This ROI area definition extends beyond the potential construction impact area and was chosen based on the assumption that all substantial direct social effects, if any, associated with a project of this type would be confined to this area.

13.1 Displacement/Impacts to Population

Each of the plans is to be constructed during the off-season of beach activity. Its location is a non-populated public beach; however, residential and commercial locations are nearby. The direct effects of construction is not likely to result in any displacement or impacts to population beyond the health and safety concerns outlined below. Indirect construction effects are also anticipated to be minimal. It is generally assumed that the workers needed for construction would not come from the local labor pool - dredging crews of the ship coming from the ship's home port. Thus, construction-related employment is not likely to increase the population to any significant degree within the ROI.

13.2 Public Health and Safety

The analysis of effects to public health and safety includes environmental effects related to noise, and air quality, and the possible effects to the populace in regard to access to emergency services.

Construction of either plan is likely to produce some adverse effects in regard to noise level, air quality, and near off-shore water quality levels in the construction area. Adverse noise, water and air quality effects will be most prevalent in the spaces directly surrounding the project's features. Where these areas are close to residential areas and other sensitive land uses, direct construction-related effects to health and safety are expected. Sand placement will be accompanied by some temporary increase in noise level, increased turbulence in the near off-

shore waters and some limited air quality decreases. Additionally, the project will not be relocating or displacing any emergency or health-related public services. Therefore, there are no likely construction-related direct effects to health and safety, in regard to access to emergency services.

All effects associated with noise, air quality, and water are generally localized to the areas outlined above, and construction-related indirect effects to health and safety, in regard to an increase in these dangers, are unlikely.

Increased levels of construction within the project area raise the possibility of emergency services experiencing increased activity responding to work-related injuries. Given standard construction health and safety practices, however, it is unlikely that any incremental increase in emergency services demand would be significant. Thus, there are no likely construction-related indirect effects to health and safety, in regard to access to emergency services.

13.3 Displacement/Impacts to Minorities and Special Interest Groups

As discussed above, displacements or relocations related to the construction efforts surrounding the project are unlikely. The construction footprint being on a public beach and the small workforce required for construction indicated an unlikelihood for impacts.

13.4 Displacement/Impacts to Businesses

Displacement or relocations to beach businesses are expected to be temporary and minimal. Construction will impact a limited number of beach concession businesses for a short period of time during the off-season. These impacts are considered insignificant. Given the small labor force and unaffected traffic flows the indirect impacts to businesses outside of the construction area are expected to be insignificant as well.

13.5 Displacement/Impacts to Agriculture

There are no agricultural activities in the area and no impacts are anticipated.

13.6 Displacement/Impacts to Recreational Areas

Construction will take place on a public beach during the off-season. Either plan will cause temporary impacts along the beach as beach fill proceeds along the beachfront. The active beach fill area will be unusable for a short period of time as sand settles and dries and adjacent areas will suffer from an increase in water turbulence. These impacts will move along the beach as the beach fill program progresses. Beach use activities will be impacted in the immediate area of current fill activity, but given the off-season construction timeframe and the overall length of the beach a significant impact is not anticipated.

13.7 Community Growth

Generally, a project is expected to promote growth if it contributes substantially to the population or economics of the area. The NED Plan is not expected to significantly contribute economically to the area during the construction phase in a direct and indirect manner. Additionally, neither plan is expected to contribute to any rise in area population, directly or indirectly, during the construction. Finally, each municipality or county controls growth in their respective areas through land use and growth policies. Other, more powerful economic considerations also

directly influence area growth. Thus, plan construction is not expected to affect community growth, either directly or indirectly, during the construction.

13.8 Project Impacts and Connectivity of the Community

Connectivity is generally defined as the degree to which residents feel a sense of belonging to their neighborhood or municipality. Other important measurements include the level of commitment residents feel to the community and the level of attachment residents have to certain neighbors, groups, or institutions. Generally, these levels are higher as a result of continued association over time. Major impacts to community cohesion are generally caused by displacements to important community businesses, centers of community interactions (churches, community centers, recreation areas) or large tracts of residences. Impacts can also occur through a project separating or dividing individual communities. Finally, visual impacts can affect the quality of adjacent communities, which can sometimes affect community connectivity depending on the severity of the impact.

As discussed above, construction is not expected to displace any residences, businesses, or important community areas. Some temporary recreational impacts will be experienced and potentially people may choose to travel to unaffected recreational points if construction-related disturbances are particularly annoying. However, while a small direct effect in respect to impacts to recreational areas, this minor drop in attendance is not expected to affect community connectivity directly to any significant degree. The NED Plan is not expected to directly affect community connectivity during construction.

Attachment A

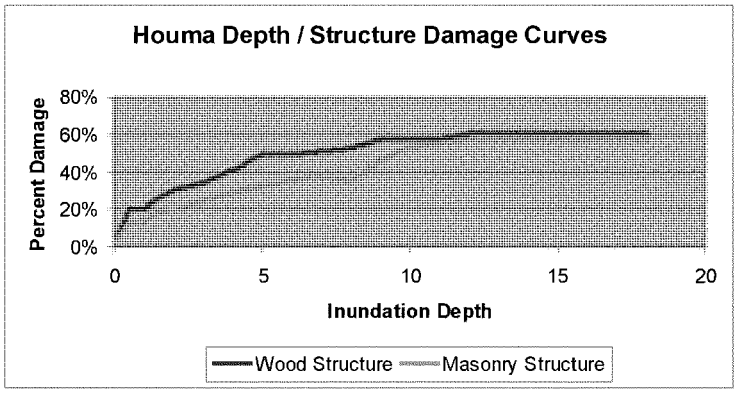
Storm Erosion Sensitivity

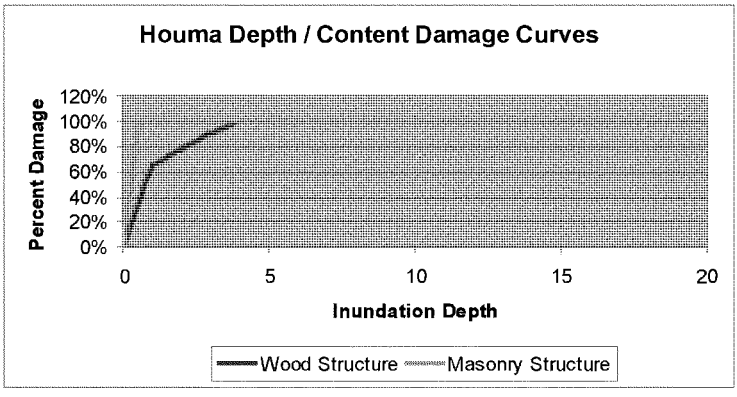
The model employs coastal engineering's best estimate of storm erosion which indicates a potential for 26 ft of storm erosion in the 100-yr event. Although this is the best estimate given the state of available data, some uncertainty surrounds the storm erosion function. To examine the sensitivity of the model to changes in the storm erosion function several storm erosion functions were analyzed for the NED Plan. These functions are of two forms. The first form is of a permanent shift of the erosion function which is held constant throughout the @RISK analysis. The second form is a variable erosion function that changes with iterations within @RISK.

Five permanent erosion function shifts based on a percentage of the "base" 100-yr erosion were analyzed with the results being shown in the Table below. In these cases, the storm erosion function is uniformly shifted by a given percentage and held constant throughout all iterations of an @RISK analysis. The results of the permanent shift are in line with might have been expected. As the potential for storm erosion lessens (percentages below 100%) railroad protection is not as concerning. Seawall construction is pushed further into the future (2041 @ 70% vs. 2021 @ 100%) and without-project damages are reduced to $681,842 from $1,423,953. Percentage increases above the base 100% have the effect of pushing the railroad's construction forward with construction occurring frequently before the base year. Again, without-project damages are decreased as the potential for storm erosion is larger and the current beach width offers less protection.

The second form of sensitivity analysis allowed the storm erosion function to be randomly selected for iteration of the @RISK simulation. Truncated normal distributions centered on 100% with a standard deviation 25% were employed to randomly select storm erosion functions during iterations. As the Table below shows justification of the NED Plan is still present.

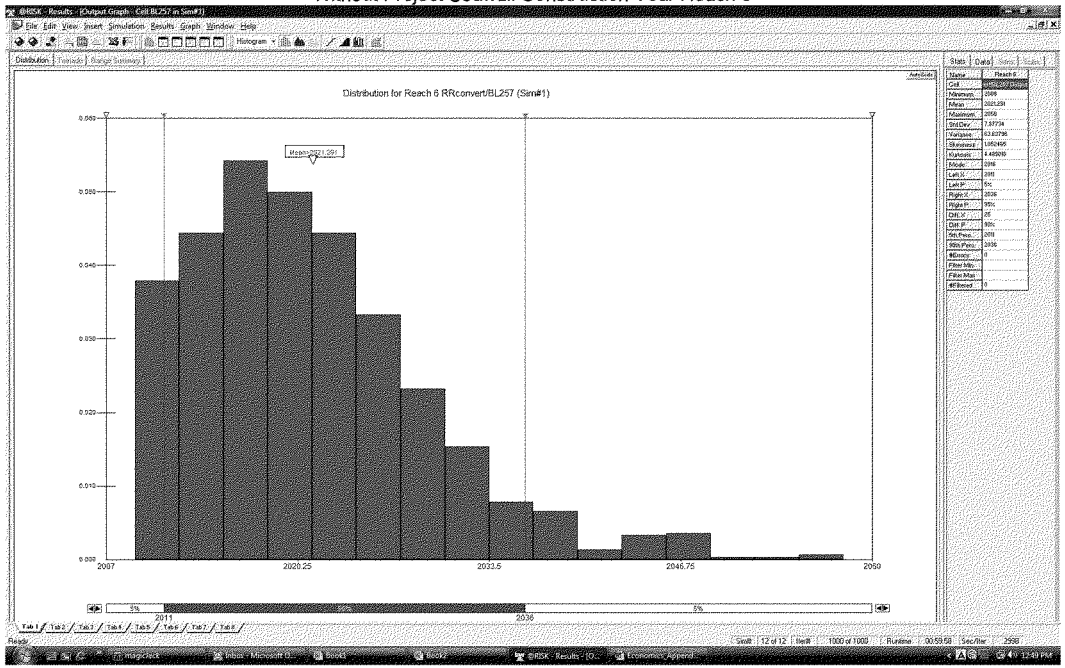
	% of Base 100-yr Strom Erosion						Tnormal
	70%	80%	90%	100%	110%	120%	(.75 to 1.25)
RR Seawall Construction Year	2041	2036	2027	2021	2013	2009	2021
Reach 6 RR Breaches	0.144	0.084	0.026	0.014	0.003	0	0.036
W/O Project Recreation Value	$10,560,580	$10,560,580	$10,560,580	$10,560,580	$10,560,580	$10,560,580	$10,560,580
With Project Recreation Value	$12,172,606	$12,172,606	$12,172,606	$12,172,606	$12,172,606	$12,172,606	$12,172,606
Annual Project Cost	$1,429,684	$1,429,684	$1,429,684	$1,429,684	$1,429,684	$1,429,684	$1,430,210
RR O&M Damages	$577,200	$762,923	$1,112,513	$1,280,305	$981,667	$489,174	$940,765
W/P RR O&M Damages	$6,011	$7,701	$9,132	$13,047	$17,251	$16,962	$12,990
Trail Damages	$41,958	$53,541	$75,056	$83,443	$54,257	$14,620	$57,529
W/P Trail Damages	$4,251	$4,568	$5,428	$6,307	$8,795	$10,426	$7,090
Structure Damages	$62,684	$62,083	$61,264	$60,206	$59,424	$58,355	$59,907
W/P Structure Damages	$13,809	$14,439	$15,068	$15,397	$15,787	$15,942	$15,364
Breach Delay Damages	$0	$0	$0	$0	$0	$0	$0
W/P Breach Delay Damages	$0	$0	$0	$0	$0	$0	$0
Residual Damages	$681,842	$878,547	$1,248,833	$1,423,953	$1,095,348	$562,149	$1,058,201
W/P Residual Damages	$24,072	$26,707	$29,628	$34,751	$41,833	$43,330	$35,443
Damage Reduction	$657,770	$851,839	$1,219,205	$1,389,203	$1,053,515	$518,819	$1,022,758
Net Damage Reduction	($771,914)	($577,845)	($210,479)	($40,481)	($376,169)	($910,865)	($407,452)
Storm Damage Reduction Only B/C	0.46	0.60	0.85	0.97	0.74	0.36	0.72
B/C with Limited Recreation Benefits	0.92	1.19	1.71	1.94	1.47	0.73	1.43


Houma Depth / Structure Damage Curves
Percent Damage
80%
60%
40%
20%
0%
0
5
10
15
20
Inundation Depth
Wood Structure
Masonry Structure


Houma Depth / Content Damage Curves
Percent Damage
120%
100%
80%
60%
40%
20%
0%
0
5
10
15
20
Inundation Depth
Wood Structure
Masonry Structure

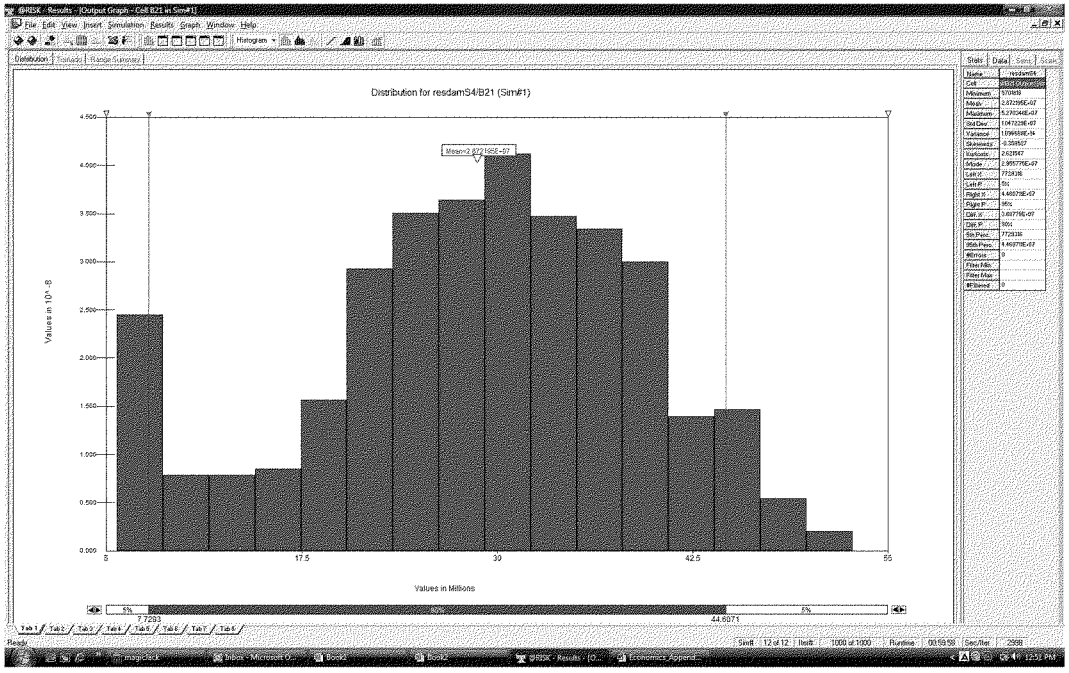
Without Project Model Results:
The following graphs display the output results of the San Clemente @RISK model. It should be noted that many of the graph values are expressed in net present value terms and not annual values.

Without Project Seawall Construction Year Reach 6



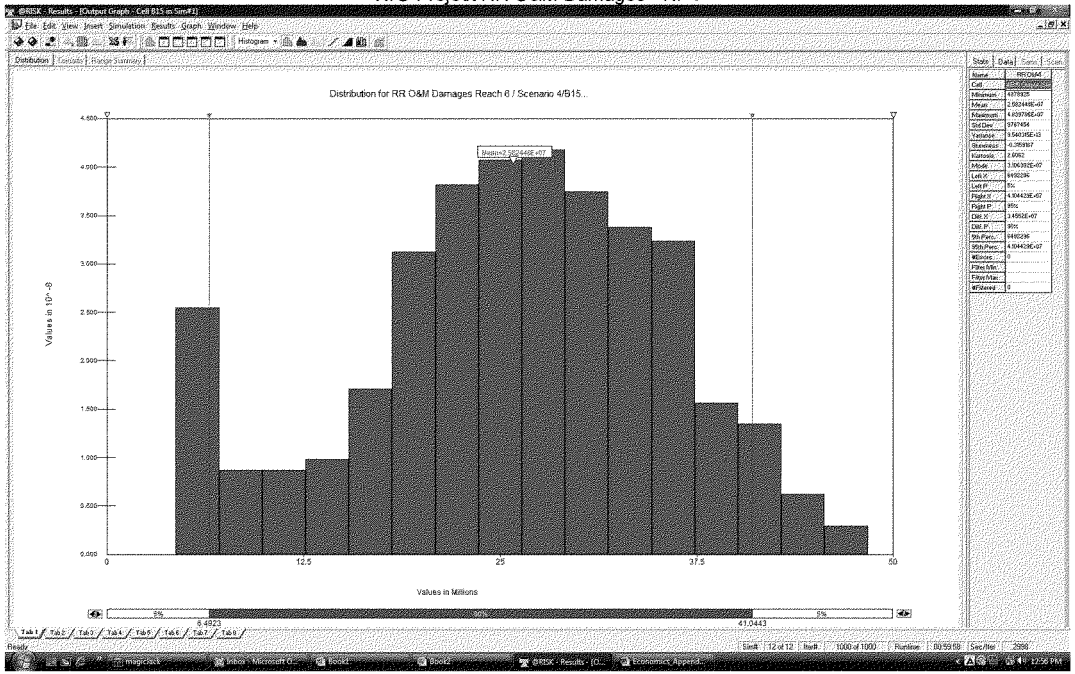
This graph shows the distribution of seawall construction in Reach 6. The data is listed in Table 29 on page 50 in the Appendix.

W/O Project Total Damages - Net Present Value (NPV)



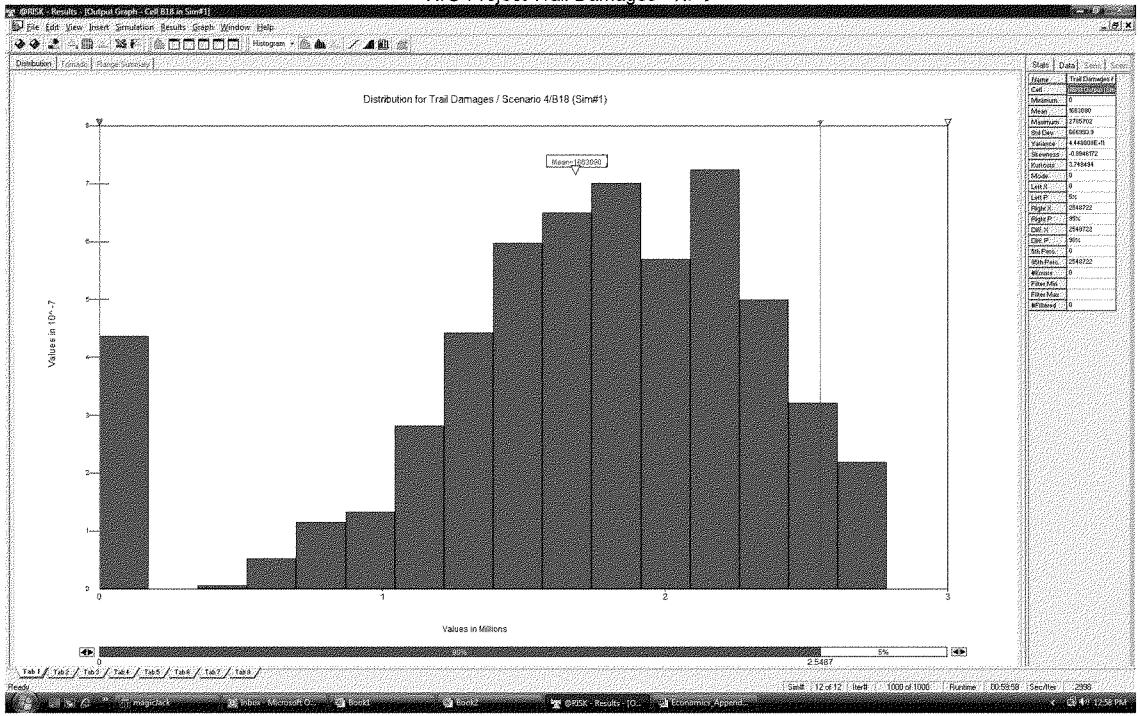
This graph shows the distribution of Total Without Project Damages in Net Present Value (NPV) instead of Annualized. The annualized data is listed in Table 29 on page 50 in the Appendix.

W/O Project RR O&M Damages - NPV



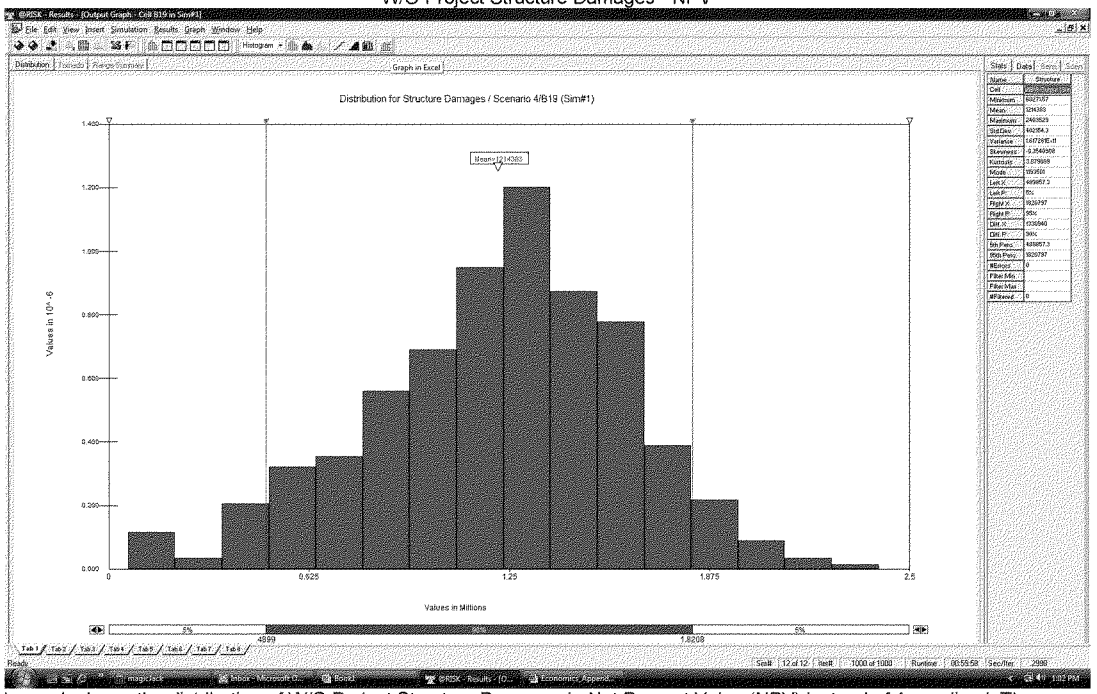
This graph shows the distribution of W/O Project Railroad O&M Damages in Net Present Value (NPV) instead of Annualized. The annualized data is listed in Table 29 on page 50 in the Appendix.

W/O Project Trail Damages - NPV



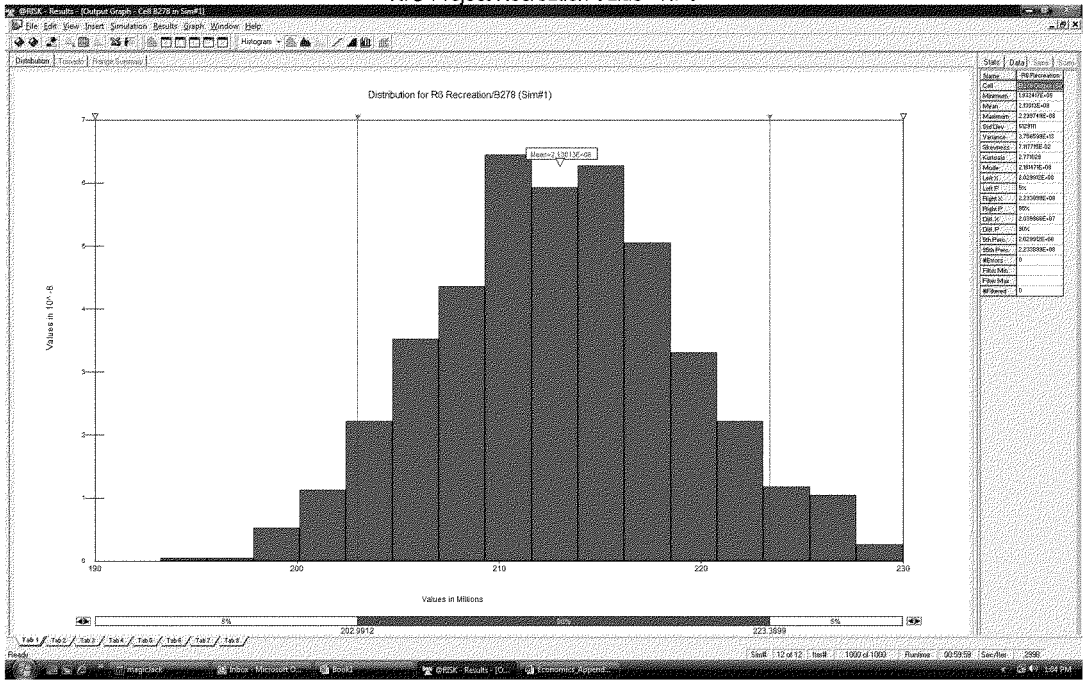
This graph shows the distribution of W/O Project Trail Damages in Net Present Value (NPV) instead of Annualized. The annualized data is listed in Table 29 on page 50 in the Appendix.

W/O Project Structure Damages - NPV



This graph shows the distribution of W/O Project Structure Damages in Net Present Value (NPV) instead of Annualized. The annualized data is listed in Table 29 on page 50 in the Appendix.

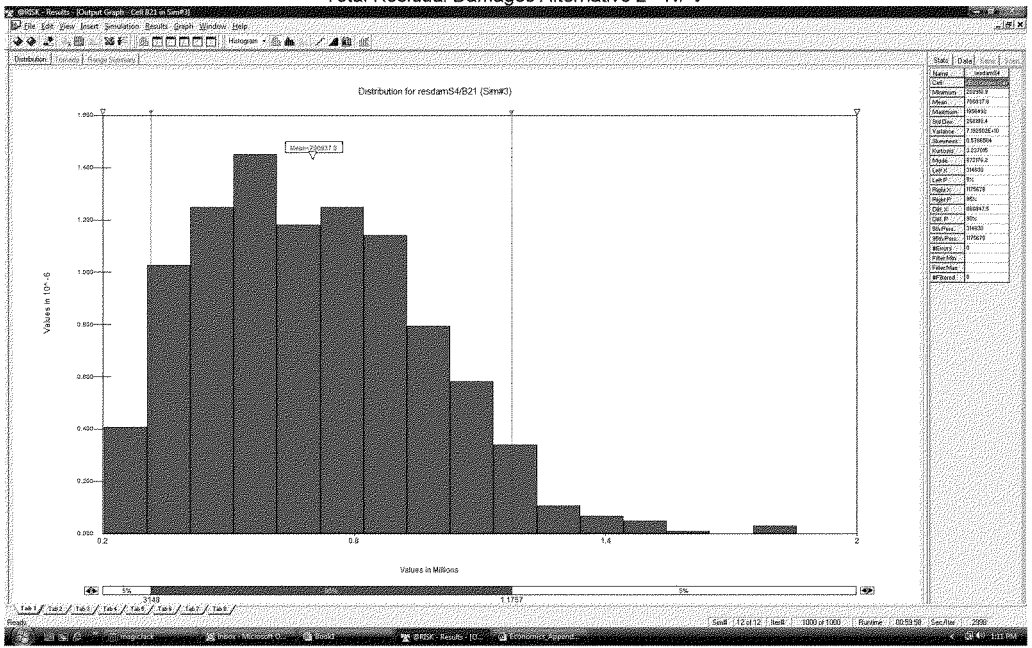
W/O Project Recreation Value - NPV



This graph shows the distribution of W/O Recreation Value in Net Present Value (NPV) instead of Annualized. The annualized data is listed in Table 29 on page 50 in the Appendix.

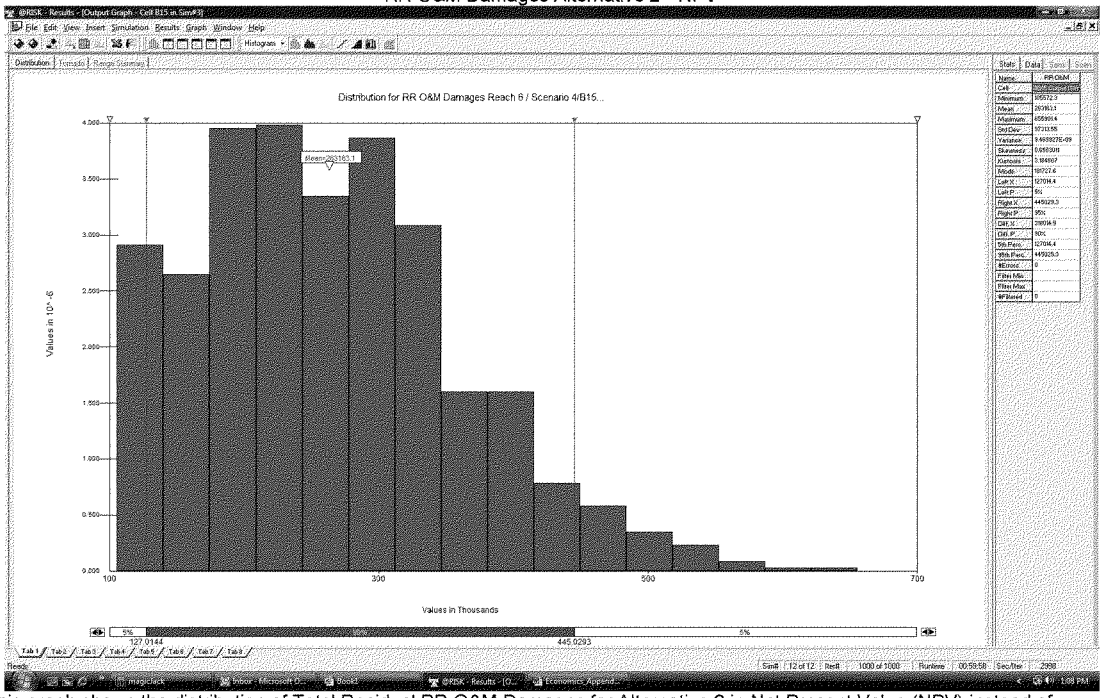
Alternative 2 - 15 meters Model Results

Total Residual Damages Alternative 2 - NPV



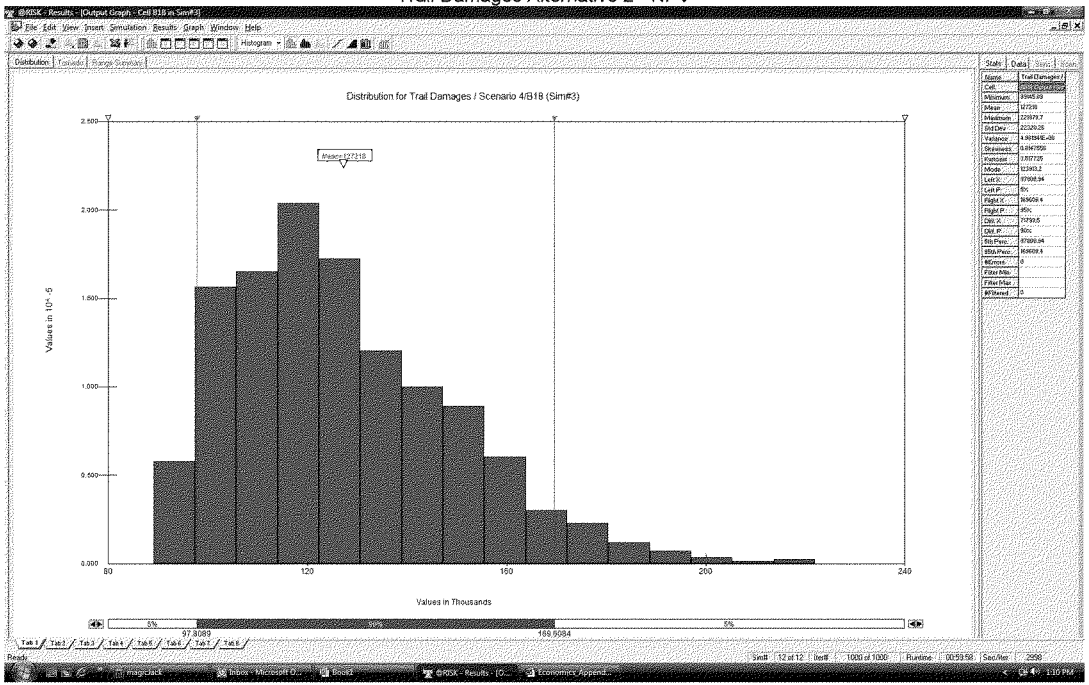
This graph shows the distribution of Total Residual Damages for Alternative 2 in Net Present Value (NPV) instead of Annualized. The annualized data is listed in Table 32 on page 57 in the Appendix.

RR O&M Damages Alternative 2 - NPV



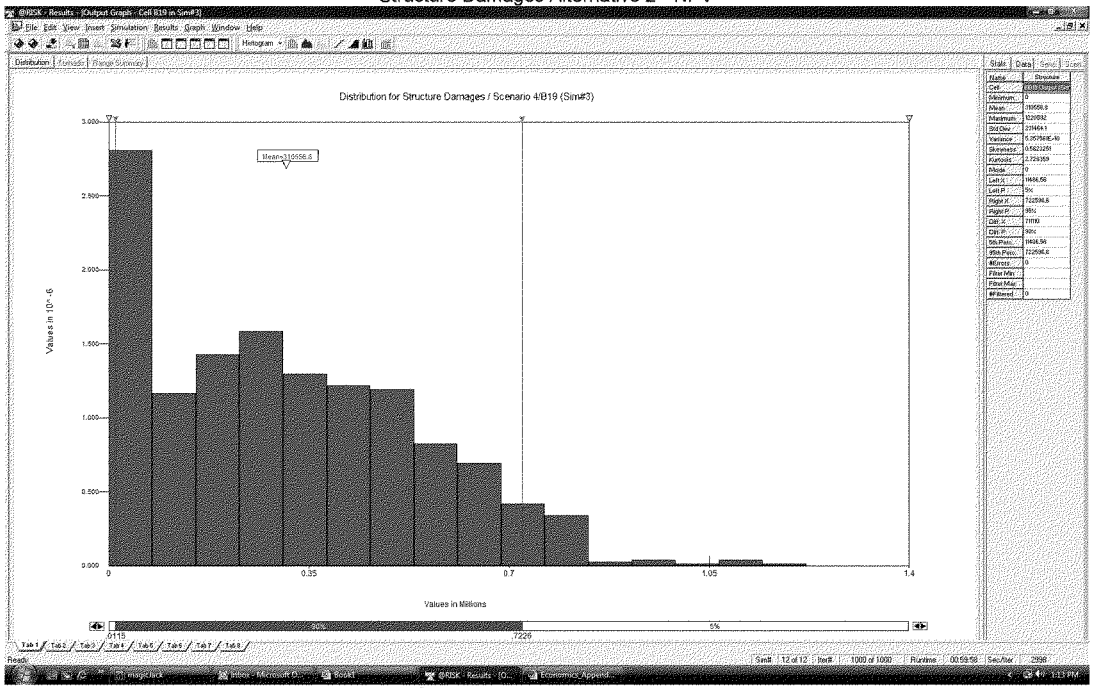
This graph shows the distribution of Total Residual RR O&M Damages for Alternative 2 in Net Present Value (NPV) instead of Annualized. The annualized data is listed in Table 34 on page 59 in the Appendix.

Trail Damages Alternative 2 - NPV



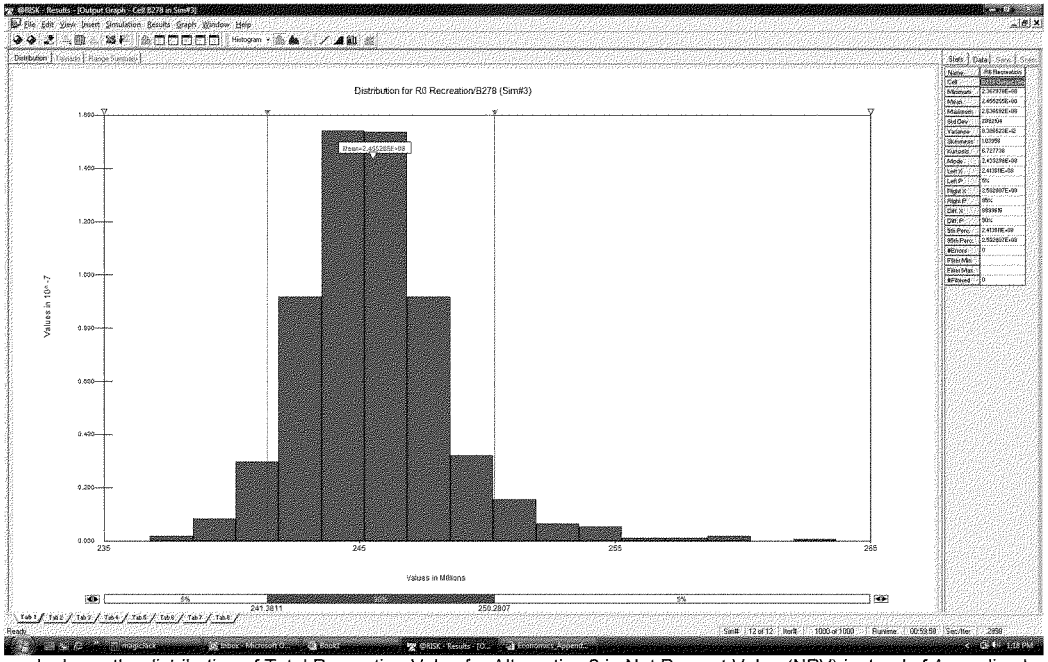
This graph shows the distribution of Total Residual Trail Damages for Alternative 2 in Net Present Value (NPV) instead of Annualized. The annualized data is listed in Table 34 on page 59 in the Appendix.

Structure Damages Alternative 2 - NPV



This graph shows the distribution of Total Residual Structure Damages for Alternative 2 in Net Present Value (NPV) instead of Annualized. The annualized data is listed in Table 34 on page 59 in the Appendix.

Recreation Value Alternative 2 - NPV



This graph shows the distribution of Total Recreation Value for Alternative 2 in Net Present Value (NPV) instead of Annualized.

The following table shows how the preceding economic analysis conducted the 50-year amortization of the initial fill and the eight future fills for Alternative 2 – 15 meters sand re-nourishment plan. The costs are based on the Cost Engineering DX – TPCS ATR Certification Report as of February 9, 2011. The annual costs figure in this table below can be identified in Table 41 on page 68

Calculation of NPV and Annual Costs for Future Fills
50yr amortization at 4.125%, FY11 Price Level

No Fill	Year	Fill Costs
1	0	$11,053,000
2	6	$11,053,000
3	12	$11,053,000
4	18	$11,053,000
5	24	$11,053,000
6	30	$11,053,000
7	36	$11,053,000
8	42	$11,053,000
9	48	$7,551,000
Sum of Fills		$95,975,000
NPV of Fills		$45,034,000
IDC Costs for 1st Fill		$56,000
Total NPV Costs		$45,090,000
Annual Costs		$2,144,000

San Clemente Shoreline Feasibility Study
Orange County, California

MODEL
APPENDIX

Final Report

U.S. Army Corps of Engineers
Los Angeles District

JULY 2011

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1 ECONOMICS MODEL DESCRIPTION

The goal of this appendix is to present a more detailed description of the Coastal/Economic Model for San Clemente from that contained in the Economic Appendix. Although in greater detail, the following will not provide a step-by-step trace of the workings of the Excel spreadsheet model. In particular, the model description is focused on Reach 6 of the study area as other areas have been eliminated for consideration as detailed in the Main Report's plan formulation discussion. Reach 6 is approximately 1,040 m (3,410 ft) in total length and is divided into 21 cells of approximately 50 meters in length.

The Excel model consists of 33 worksheets being run under an @RISK add-in. These worksheets are shown in **Table 1-1.**

Table 1-1 Model Worksheets

Spreadsheet	Description
Readme	General model approach documentation
Fxn	Global engineering parameters and criteria
InputM	Basic structure and cell distance measurements in meters
InputFt	Conversion of InputM to feet
CoastalF	Not in use
Coastrr_ini	Not in use
Coastal	Coastal engineering input and parameter calculations – runup, long-term erosion and storm erosion
LTEr_index	Monitors fill and fill erosion
LTShoreline	Tracks shoreline position
Runup	Calculates runup height by cell
Overtop	Computes the initial depth of water due to overtopping
LTloss	Computes the shoreline position after long-term erosion loss
LTFloss	Computes structure loss due to loss of function due to long-term erosion.
STloss	Determines structure loss due to storm induced erosion
Flood	Computes the depth of water at each structure due to overtopping
Inundation	Computes the inundation depth at each structure
Force	Computes the damage of each structure due to direct wave impact forces
RRconvert	Determines when the unimproved cell and each unimproved reach are converted from original ballast construction to revetment and/or seawall. Contains risk function for construction of seawall.
RRBreach	This sheet computes the breaching of each RR cell. This sheet evaluates the runup elevation + "breach" overtopping criteria (defined in "Fxn" sheet)
ReachInfo	General reach and cell measurement data
Input_econ	General economic structure & content values and unit price data for construction
S1	Not in use
S2	Not in use
S3	Not in use
S4	Railroad Operations & Maintenance & Capital Costs calculations
Econ_Fxn	Economic depth/damage and force/damage functions
Rec	Recreation value calculations
Attend	Recreation attendance calculations
Damage	Inundation, force, erosion damage calculations
DamSum	Structure maximum damage calculation (double counting exclusion process)
Qty	Beach fill quantity calculation
Costs	Annual construction costs incurred for beach fill
Final	Summary spreadsheet of costs, damages, and recreation values

1.1 General

The model's basic setup is a step by step trigger process under two conditions: (1) without project and (2) with beach fill. The process for these conditions in a simplified manner works as follows:

1.1.1 Without Project

It is assumed that the railroad will initiate a general beach erosion solution of seawall construction at some point in the future. It is also assumed that the railroad will construct temporary protection to cells on an as needed basis prior to the construction of the seawall. The trigger point assumed for the railroad is 8 m (26 ft) of beach width, the extent of the 100-yr storm's erosion. Construction of temporary protection (an upgrade from the current unimproved ballast) will occur when beach width is less than 8 m (26 ft) within a cell. When this temporary construction occurs long-term O&M changes will also occur to both the new protection and the beach trail that runs along the rail line on the seaward side.

For seawall construction the trigger is based on the overall level of cells within 8 m (26 ft). It is assumed that when 6 to 10 cells, out of the 21 cells in Reach 6, are within 8 m (26 ft) of beach width the railroad will construct the seawall. The seawall will necessitate the removal of beach trail when constructed as the trail runs along the seaward side of the rail line.

Seawall construction will not impact the natural long-term erosion process of the beach and beach structures will continue to be subject to storm and erosion damage. As time passes, beach widths within the cells of Reach 6 will continue to decline. These smaller widths will reduce the amount of space available to recreation users, and increase the likelihood of storm damage to structures from inundation, wave force, and erosion failure.

1.1.2 With Beach Fill

In the base year a beach fill program is initiated. The fill extends the width of the entire beach by a given amount. Beach fill is assumed to have a different erosion rate than the natural beach - a significantly higher rate of erosion. The fill provides additional protection to the beach structures and rail line with the increase in width. And the added width provides recreational users added value by having more space. This added protection and space declines as the fill erodes back to the underlying natural beach. When the entire beach fill amount is eroded, the following year the fill is replenished and the cycle of beach fill erosion continues.

Under the beach fill program it is assumed that the railroad will not construct a seawall. However, it is assumed that the railroad will continue to place temporary improvements in cells where beach widths fall below 8 m (26 ft) in width.

Beach structures will continue to be subject to storm damages of inundation and force, but at a much lower level, and are unlikely to suffer damages from erosion

1.2 Processes

1.2.1 Erosion

The model contains three types of erosion – (1) long-term erosion of natural beach; (2) long-term erosion of beach fill; and (3) temporary storm induced erosion. Long-term erosions are characterized by triangular risk functions and storm induced erosion by a storm frequency/erosion function.

The natural beach function in Excel is Risktriang (-0.46 m, -0.21 m, 0.37 m) (-1.5 ft, -0.7 ft, 1.2 ft) – having a mean annual erosion rate of -0.1 m (-0.33 ft), with a maximum yearly erosion potential of -0.46 m (-1.5 ft) and the possibility of 0.37 m (1.2 ft) of beach creation.

Annual beach fill erosion is Risktriang (-15.2m, -5.5m, 9.1m) (-50 ft, -18.1 ft, 30 ft) with a mean annual erosion of -3.9 m (-12.7 ft).

The basic model function form is starting at an initial beach width, random long-term and storm induced erosions for the study period are projected (Coastal worksheet), and these erosions are applied in sequence to the initial beach width – with fill erosion being applied when fill is present, as shown in **Figure 1-1**.

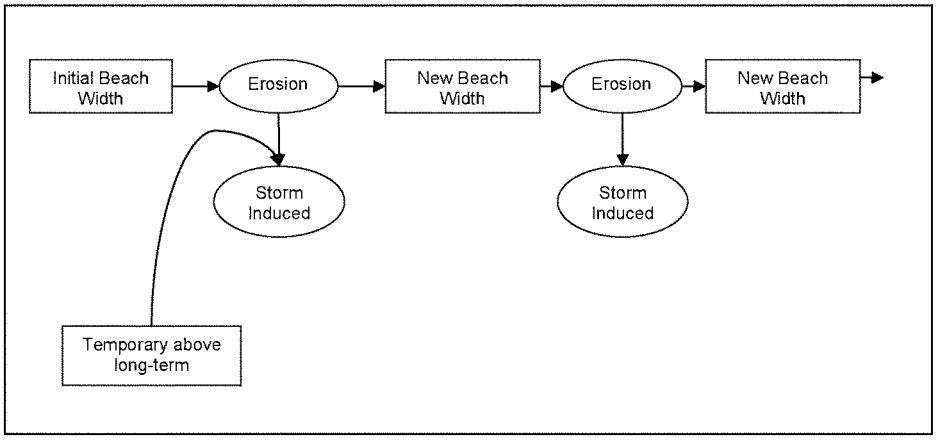


Figure 1-1 Basic Model Function

The worksheet LTShoreline tracks the ending position of the beach and the worksheet STLoss tracks the beach position with storm induced erosion. Storm induced erosion (STLoss) is a significant component in the determination of erosion failure of structures as the undermining of a structure is more likely to occur during a storm event than the gradual long-term process.

1.2.2 Seawall and Beach Fill Mechanisms

Both the seawall (without project) and the beach fill (alternatives) utilize the erosion process above with the inclusion of decision checks. For the seawall, after long-term erosion occurs the model checks to see if a sufficient number of beach cell widths are within the 8 m (26 ft) seawall construction criterion (RRconvert). If a sufficient number exists, the seawall is constructed; if not, the erosion process is continued to the following year. This process continues until either the seawall is constructed or the study's period of analysis is exceeded. Seawall costs are generated through the worksheets Input_econ and S4. The process is shown in **Figure 1-2**.

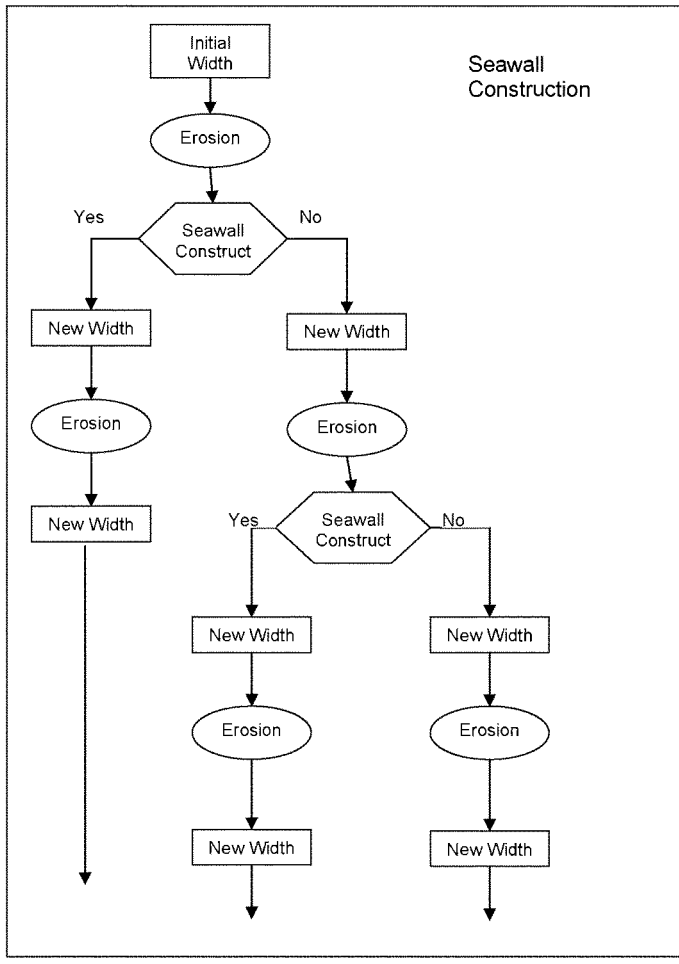


Figure 1-2 Seawall and Beach Fill Mechanisms

The process for the alternatives (beach fills), shown in **Figure 1-3**, is similar to the seawall pattern except that remaining beach fill (LTEr_index) is being analyzed. Alternatives start by

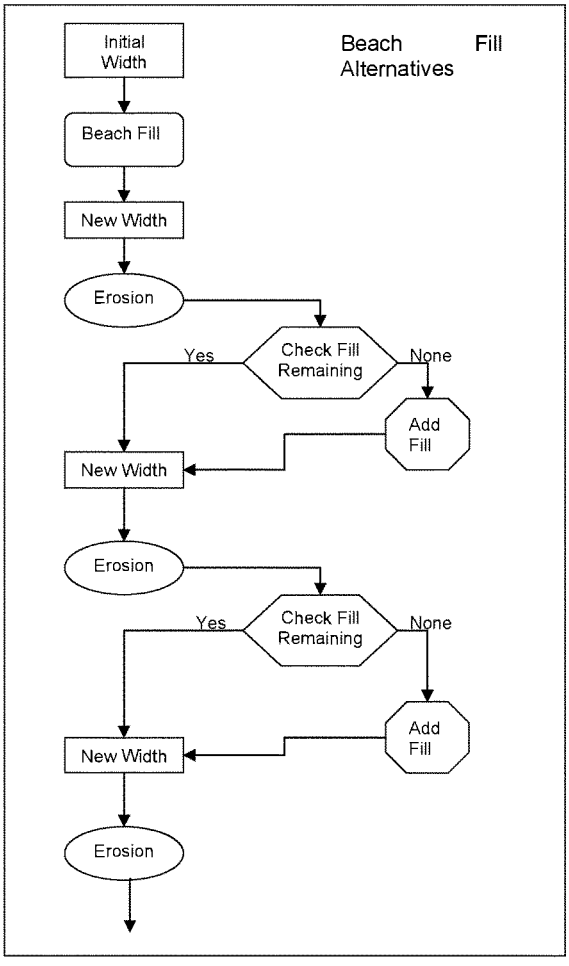


Figure 1-3 Alternatives Process

applying beach fill in the first year and then monitoring the beach fill amount as time passes. When the amount of beach fill reaches zero beach fill is reapplied in the following year to extend the beach to the original project size (Fxn). The cost of the alternative is calculated through the worksheets Input_econ, Qty, and Costs.

Beach fill costs include sand, mob/demob, mitigation costs for the loss of sand supply & public access, monitoring, PED, S&A, and IDC for the initial fill. Sand costs and mob/demob costs are

random costs based on distributional data from cost engineering with sand varying from $10.33 per cubic yard to $26.26 and mob/demob varying from $1.4 million to $2.7 million.

1.2.3 Damages

Damage to property stems from three sources – wave force, inundation, and erosion. Four property damage categories (inundation, erosion, force to structures, and railroad breach) are examined in the model. The three damaging sources are generated on an annual basis through a combination of several worksheets. Common to nearly all damage categories are the worksheets Coastal and LTShoreline. Most of the coastal engineering inputs are contained within the Coastal sheet and shoreline position, both long-term and storm induced, is determined from both of the sheets, shown in **Figure 1-4**. At every year of the model's evaluation period damage calculations are computed for each of the damage categories. The damages from the categories of inundation, erosion, and force to structures are further analyzed in the worksheet Damage to eliminate double counting and to eliminate structures from further analysis if they are destroyed. Damages from the breaching of the railroad are also calculated in the Damage worksheet. Annual damages are summarized in the worksheet DamSum.

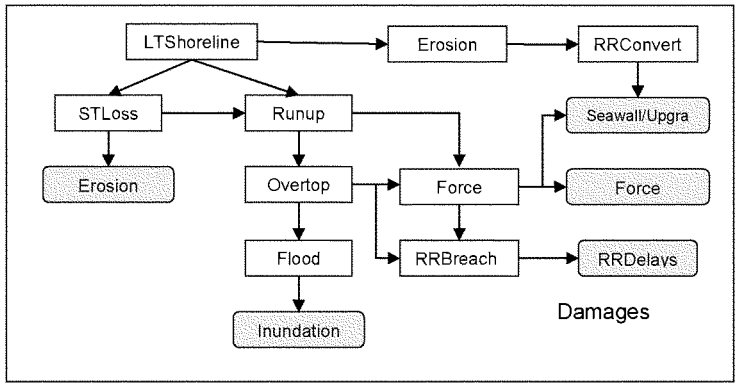


Figure 1-4 Damages Process

Damage functions employed for the analysis of residential & commercial structures include the 1998 FEMA depth/damage functions and the generic risk based damage functions for residential structures (EGM 04-01). The Houma depth/damage functions developed by the New Orleans District were employed for beach based public and restroom structures with all structures subject to the force/loss functions of engineering.

1.2.4 Recreation

The model assumes that total recreation growth in the beach area, both state and city beaches, will mirror that of population growth of the county. Further, the model assumes the split between state and city beaches will remain constant and the splits among reaches within the city beach will also remain constant. Currently, 89% of all beach demand attends the city beach and 70% of this demand attends the beach in Reach 6. Attendance is further assumed to maintain a peak/off-peak split of 60/40 and a weekend/weekday split of 60/40. The year is

assumed to be composed of 212 off-peak days and 153 peak days with 109 peak days being weekday and 44 being weekend days. The daily turnover rate is assumed to be 3.3. Maximum carrying capacity is assumed to occur when the average beach user has 30 square feet of space. Any demand above maximum carrying capacity is assumed to relocate to another beach or other recreational activity.

The value of recreation was calculated in accordance with the Unit Day Value (UDV) methodology of ER 1105-2-100. The basis for the conversion of UDV point total to dollar value was EGM 10-03. The model employs a linear interpolation between assessed beach utilization points. Recreation value was analyzed at 500, 100, and 30 sqft per person, in addition to an excess capacity transfer level of below 30 sqft.[1] The UDV assessment for 100 sqft per person, a level of full use but without significant infringement on the recreational experience through capacity concerns, was 44, as shown in **Table 1-2**.

Table 1-2 UDV at 100 sqft

Criteria	Total Possible Points	Total Points Assigned
Recreational Experience	30	10
Availability of Opportunity	18	4
Carrying Capacity	14	3
Accessibility	18	13
Environmental	20	14
Total	100	44

UDV point scores and dollar conversion for the index points are shown in **Table 1-3.**

Table 1-3 UDV Points to Dollars

Sqft Measure	UDV Points	$ Conversion
Capacity Transfer < 30	0	3.54
30	12	4.30
100	44	7.00
500	59	8.13

Total annual recreation value is computed by multiplying demands (see **Figure 1-5**) by their unit day dollar conversion values and summed. Within the year the available beach area is constant but the demand varies by season and week period, resulting in a variation in available space per user. Therefore, the UDV changes and so does the dollar value conversion throughout the year. When demand would exceed capacity, available space per user below 30 sqft, the excess

[1] It is assumed that additional space beyond 500 sqft does not affect UDV, 100 sqft per person reflects a beach capacity condition that allows all activities to function as intended, between 30 sqft and 100 sqft per person beach activities suffer from crowding. All visitations that would reduce average sqft use to below 30 sqft are assumed to be transferred to other recreational sources.

demand is assumed to transfer to some other recreation activity. To minimize the potential bias when beach fill alternatives are in place and this excess capacity could return to the beach they have been assigned a 0 UDV point level and a value of $3.54. Thus, when excess capacity returns only the net recreation value change is reflected in the total recreation value.

The stream of total annual recreation values is then converted single value on a NPV basis. Project recreation benefits, in accordance with the ER, are evaluated on both a constrained and unconstrained basis. As a first step, in initial project justification, recreation benefits are constrained to the amount of annual damage reduction. If the project's B/C ratio exceeds unity under this constraint, all recreation benefits can be included into the final B/C ratio.

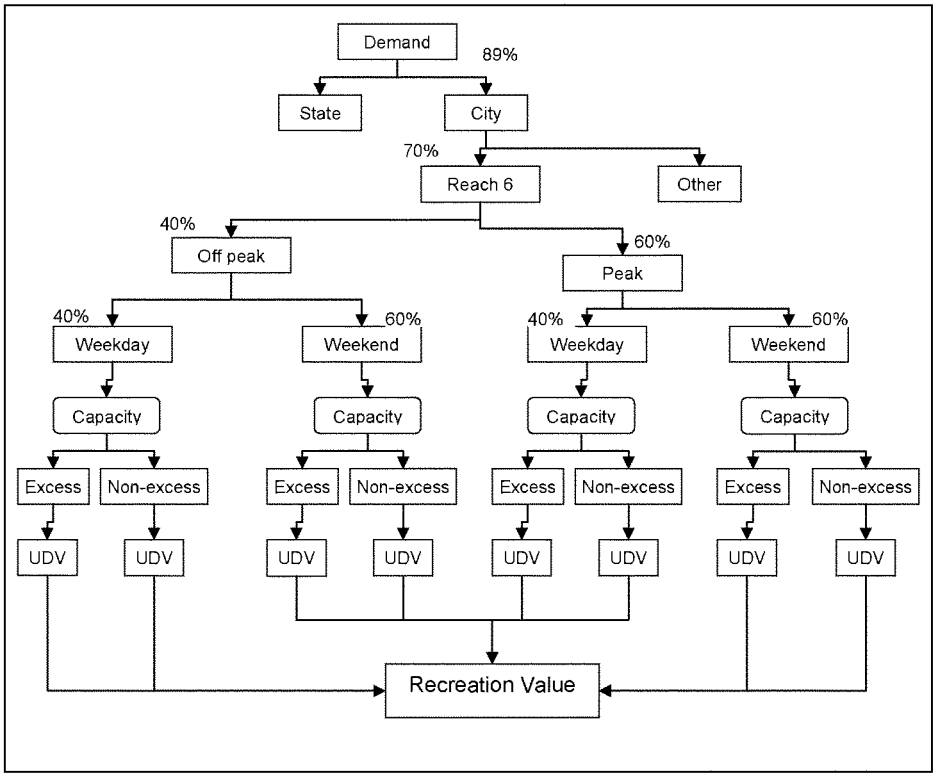


Figure 1-5 Recreation Demand & Valuation

1.3 Model Operation

The San Clemente Coastal Storm Damage Model is single annual storm event model incorporating wave and erosion damages in a risk based environment. The model platform is an Excel spreadsheet with an @RISK add-in. The model operates in an annual step-by-step process. The general framework of the operational process has been conformed in a manner that allows both without project conditions and alternatives to be solved under the same series of annual storms. The @RISK add-in enables the model to be iterated multiple times with data collection for comparison, in addition to is risk capacities. In the current analysis the model was simulated 1,000 times for each alternative using a Latin Hypercube sampling process. A net present value approach is taken with damages to account for the timing difference in the sequences of damages. The sequence of steps for without project analysis is:

1. The starting of position of the beach is analyzed for dry beach area and the cells of the reach are analyzed for width.
2. If a sufficient number of cell widths have fallen within the triggers determination range (8 m {26 ft} or less) for seawall construction (between 6 to 10 cells) – seawall construction is implemented with a corresponding loss of the beach trail as it has to be removed for seawall placement.
3. Coastal engineering processes are determined to produce the annual storm – wave height, runup, erosion, etc.
4. The beach cell width is reduced by the projected storm induced erosion.
5. From the storm induced beach width and coastal functions – inundation levels, force, and erosion footprints are calculated for each structure (buildings, trail, and revetment).
6. At this step damage to buildings is analyzed for each of the three damage mechanisms, and the highest of the three (inundation, force, and erosion) is applied in the analysis to avoid double counting. Also, if structures are considered totally destroyed based upon either force or erosion criteria, they are removed from the inventory of structures available to be damaged in subsequent years.
7. If by Step 2 a seawall is not constructed and a Reach cell (or cells) has been eroded below the 8 m (26 ft) criteria the cell is upgraded to engineering revetment. This upgrade cost is captured in the O&M stream, as well as, the change in O&M costs for engineering revetment in subsequent years for the cell or cells involved. Similarly, for those cells requiring upgrades a change will occur in the O&M costs for the corresponding beach trail segments.
8. The starting beach position is reduced by the long-term natural beach erosion function.
9. Steps 1 through 8 are repeated of the next year.

For alternatives the steps are slightly modified. At Step 1 for the first year of the analysis (2012) the amount of fill for the alternative is added to the beach. Steps 2 through 7 are processed in the same manner. Step 8 has a change in that the long-term erosion rate for beach fill is applied rather than the natural beach; and, Step 9 is changed to the model checks to see if any beach fill remains – if fill remains the model proceeds to the next year based on this beach position, if no fill remains – fill is added prior to the start of the next year. **Figure 1-6** shows the model process.

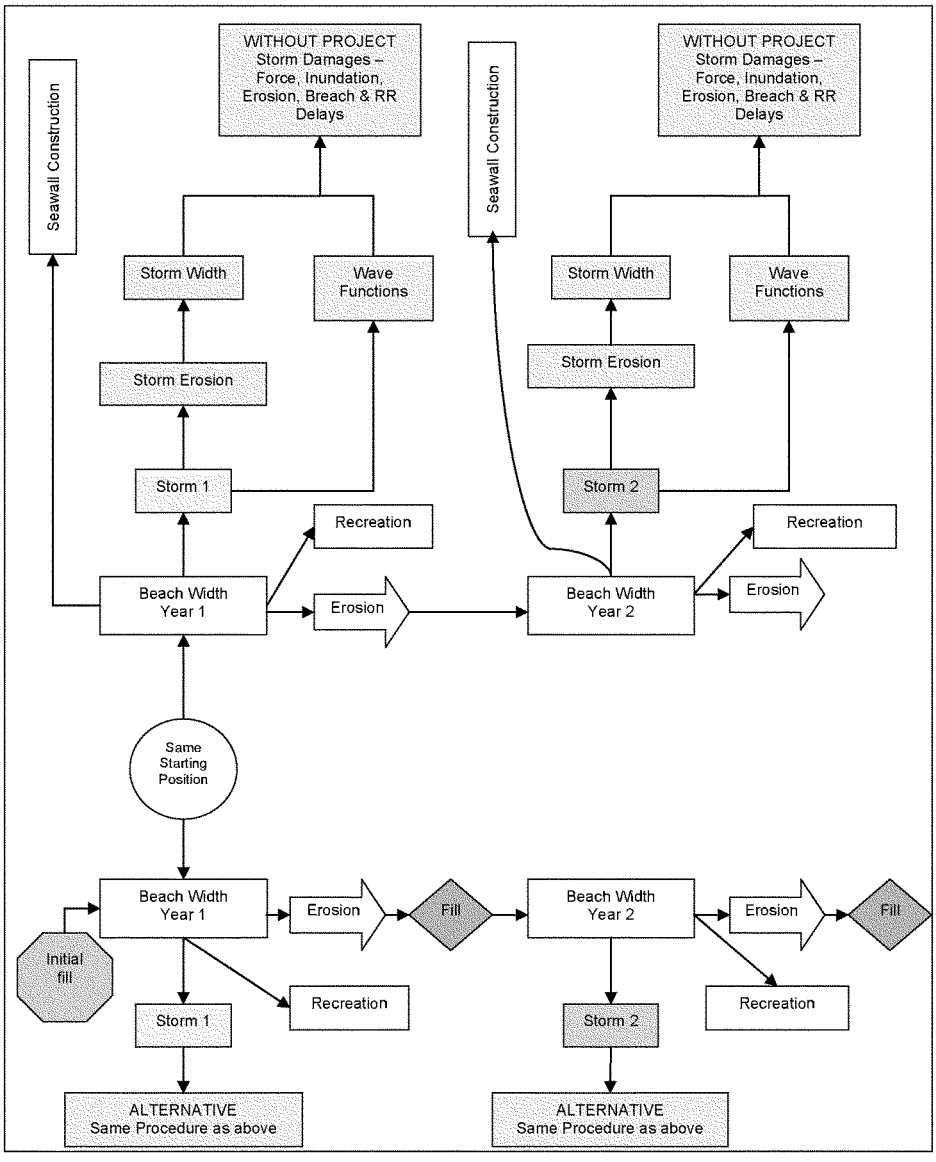


Figure 1-6 Model Operation

1.4 Key Model Variables & Assumptions:

Some of the Model's key variables and assumptions are listed below.

1. Long-term natural beach erosion rate of Risktriang (-0.46 m, -0.21 m, 0.37 m) (-1.5 ft, -0.7 ft, 1.2 ft)
2. Long-term beach fill erosion rate of Risktriang (-15.2m, -5.5m, 9.1m) (-50 ft, -18.1 ft, 30 ft)
3. The railroad will be proactive in the construction of the seawall – construction will be based on a random number of reach cells widths [RiskDUniform(6, 7, 8, 9, 10)] being 8 m (26 ft) or less from the ballast
4. 5% damage to revetment to require upgrade to engineering revetment
5. 50% erosion undermining for structure failure
6. 99% force damage for structure removal (high percentage due to public safety nature of buildings)
7. The model starts computing shoreline positions from pre-base year 2007 thru 2061 with the period of analysis being 2012 (base year) – 2061.
8. Houma damage function (see **Figure 1-7**)
9. Force damage function (see **Table 1-4**)
10. Costs (see **Table 1-5**)
11. Distributional cost characteristics for sand and mob/demob (see **Table 1-6**)
12. Without Project O&M Cost Evaluation: The model examines annually shoreline position and the storm forces exerted on existing revetment. If the shoreline erosion hasn't trigger seawall construction and storm forces exceed the criteria for revetment damage or a cell's width has dropped below the 8 m (26 ft) criteria, the model upgrades the sections damaged based on their initial quality (unimproved ballast, non-engineered, or engineered). If the annual storm does not exceed the damage criteria for upgrade or the 8 m (26 ft) criteria is not violated, the model assumes normal OMRR&R for the sections based on their construction quality. Therefore, for each year prior to seawall construction the overall OMRR&R total consists of normal annual OMRR&R and upgrades. When shoreline erosion triggers the construction of a seawall, each section is replaced with the seawall and the beach trail is removed. Future OMRR&R is based on the seawall being in place. Thus, the annual stream of OMRR&R costs consist of a period of upgrades and revetment OMRR&Rs, seawall construction, followed by annual seawall OMRR&R through the end of the study period. This annual stream is then converted to a single value through the NPV technique, which is followed by amortization.
13. With Project Cost Evaluation: The With Project cost evaluation assumes an alternative is constructed in 2012 (base year). The alternative is initially priced at the required amount of sand, mob/demob, PED, SA, monitoring, mitigation, and IDC. The fill sand is allowed to erode annually by the fill sand erosion function. Once the fill sand is completely eroded, the beach fill is replaced in the following year to the width of the alternative. Thus, a 30m alternative is replaced with a 30m refill when the fill sand is eroded. The time between refills is variable given the random function of erosion. Thus, the annual sequence of an alternative consists of an initial construction in 2012, a space in time before a refill is required, refill, more time, refill, and so on through 2061. This cost stream is similarly converted on a NPV basis and then amortized.

14. Beach Fill Alternatives: The model analyzed 12 alternatives at 5-meter increments starting with a 10-meter fill. The model is simulated for 3 different sea level conditions with each alternative being analyzed 1,000 times.

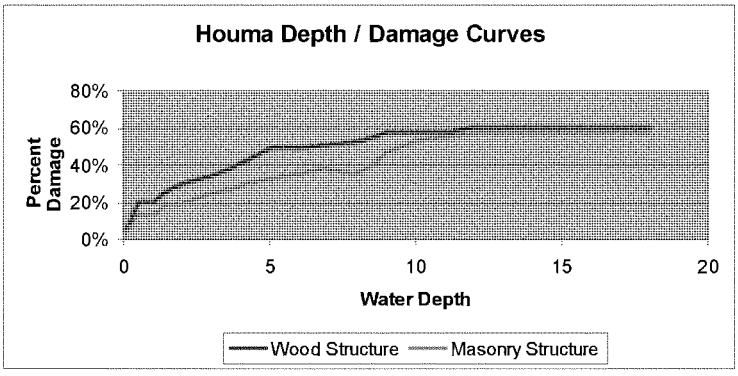


Figure 1-7 Houma Damage Function

Table 1-4 Force Damage Function

		Timber	Conc/Mas	Timber	Conc/Mas
		Slab	Slab	Pile	Pile
Force lb/ft	#	1	2	3	4
0	1	0.00%	0.00%	0.00%	0.00%
50	2	0.00%	0.00%	0.00%	0.00%
100	3	0.00%	0.00%	0.00%	0.00%
150	4	0.00%	0.00%	0.00%	0.00%
200	5	10.00%	10.00%	10.00%	10.00%
250	6	25.00%	25.00%	25.00%	25.00%
300	7	50.00%	50.00%	50.00%	50.00%
350	8	75.00%	75.00%	75.00%	75.00%
400	9	90.00%	90.00%	90.00%	90.00%
460	10	100.00%	100.00%	100.00%	100.00%
500	11	100.00%	100.00%	100.00%	100.00%
550	12	100.00%	100.00%	100.00%	100.00%
600	13	100.00%	100.00%	100.00%	100.00%
650	14	100.00%	100.00%	100.00%	100.00%
700	15	100.00%	100.00%	100.00%	100.00%

Table 1-5 Costs

Per Cell	$ per 50m/foot	
$2,173	$13.25	Annual O&M Cost for Non-engineered Revetment (existing, distributed based on $100,000/yr)
$2,173	$13.25	Annual O&M Cost for Unimproved Ballast if Attacked by Waves
$984	$6.00	Annual O&M Cost for Engineered Revetment
$98,400	$600.00	First Cost to Construct Engineered Revetment on Unimproved Ballast
$32,800	$200.00	First Cost to Upgrade Existing Non-engineered Revetment to Engineered Revetment
$1,575,274	$8,175.00	First Cost to Construct Reinforced Concrete Seawall Along Unimproved Ballast
$13,407	$84.75	Annual O&M Cost for Engineered Seawall
$3,608	$22.00	Mitigation Cost for Loss of Sediment Supply
$32,800	$200.00	Mitigation Cost for Loss of Public Access
$24,600	$150.00	Removal Costs for Revetment
$951	$5.80	Annual O&M Cost For Trail on Seaward Side of RR

Table 1-6 Sand and Mob/Demob Costs

Sand $/cy	Probability	$ Mob/Demob
10.33	0	1,395,242
12.66	0.1	1,836,073
13.33	0.2	1,940,975
13.85	0.3	2,019,420
14.39	0.4	2,084,872
14.88	0.5	2,144,765
15.39	0.6	2,204,725
16.00	0.7	2,265,592
16.78	0.8	2,329,723
17.97	0.9	2,411,010
26.26	1	2,653,343

2 ENGINEERING MODEL DESCRIPTION

2.1 Risk and Uncertainty (R/U) Analysis

The model is an integrated coastal engineering – economics analytical framework for evaluating the physical performance and economic costs of shore protection projects, particularly, beach nourishment along sandy shores. The model has been implemented as an event-based Monte Carlo life cycle simulation tool that is run on desktop computers. The life-cycle model generates a plausible set of storm conditions, calculates various coastal engineering parameters, performs a series of engineering and economic computations and determines the individual damage mechanisms, and concludes with economic outputs. These are linked to the property inventory to estimate life-cycle property losses. The structure inventory used in this analysis and final economic results and discussion are fully developed and described in the Economics Appendix. Economic output distributions are limited to damage categories only and no attempt is made to include computation of benefits within the model.

There are numerous parameters, computations and concepts within the numerical model. Some of the significant coastal engineering model analysis aspects are discussed below. The model inputs consist of probability distributions for various coastal engineering parameters. There is only one output that is engineering related.

The principles of Monte Carlo Simulation are used as the numerical integration technique. The proprietary computer program @RISK was used to run the R/U analysis. @RISK is an add-in to a standard industry spreadsheet package that provides the necessary tools for executing a Monte Carlo Simulation.

2.2 Damage Mechanism Description

Coastal storm damages at San Clemente consist of: direct structure loss due to long-term erosion; direct structure loss due to storm induced erosion; direct structure damages due to inundation; direct structure damages due to wave impact forces, direct railway damages due to wave impact forces; and rail traffic service delays due to wave overtopping. San Clemente has been subdivided into 10 reaches as described hereinafter. The separate reaches are treated independently in the without (and with) project conditions with respect to the damage mechanisms experienced by each and the functional requirements of the individual analysis procedures as they are applied. The primary distinction between reaches 1-8 is the absence or presence of armor stone revetment improvements on the railway.

2.2.1 Long Term Erosion

Long-term shoreline erosional processes create damages as the mean shoreline position translates landward. The landward advancing shoreline intercepts structures along the shoreline and gradually reduces the beach surface area available for recreation. Long-term erosion is treated equally for each reach. In each reach, it is assumed that the existing shoreline will erode to the SCRRA railway, after which no further shoreline translation will occur. The railway will stabilize and fix the position of the shoreline; thereafter the long-term erosion rate no longer applies. Railroad structure damages due to direct loss of the structure from undermining are not considered.

2.2.2 Structure Loss

Structures are lost to long-term erosion when the structure foundation is undermined due to the landward advancing shoreline. The long-term erosion shoreline change rate function is used to quantify the land loss and associated structure loss in the economic evaluation. The simulation computes the structure and land damages due to long-term shoreline change at annual intervals through the 50-year life cycle. The simulation randomly samples a long-term erosion value, and allows the shoreline to retreat. If a structure footprint is located within this retreat distance, the structure is available for damages dependent on the type of structure.

The structures were classified into four categories: timber slab-on-grade, masonry slab-on-grade; timber pile supported; and masonry pile supported. For slab-on-grade structures, when the shoreline berm position eroded through 50% of the footprint as measured from the seaward wall, the structure was considered lost and removed from the inventory. Pile supported structures are not lost directly to undermining. For pile supported structures, when the shoreline erodes through 100% of the footprint, the structure functionality is lost, i.e. the structure can no longer be reasonably used as intended, and the structure is considered lost. A full description of this functionality concept is found in the Economics Appendix.

2.2.3 Storm-Induced Erosion

Storm-induced erosion data are used to quantify the land loss and associated structure loss in the model simulation. The simulation computes the structure and land damages due to storm-induced profile change with every storm through the 50-year life cycle. The simulation randomly samples a storm event, and allows the shoreline to retreat according to the amount associated with the storm. If a structure is located within this storm-induced retreat distance, the structure is considered lost and removed from the inventory.

2.2.4 Inundation

Estimation of structure inundation depths requires relating wave runup elevations to the physical positions (setback distances and first floor elevations) of individual structures. A method described in the professional literature is used to develop inundation estimates. Wave runup propagation over a beach or revetment crest is an extremely complex process. After a wave runs up and overtops the beach or revetment crest, the wave can be considered a translational bore. An approximate solution is to estimate the bore attenuation or decay function landward of the crest as a function of setback distance.

The estimation of overland bore propagation and decay is based on Cox (Cox and Machemehl, 1986) and modified with considerations from the wave momentum flux theory. The propagating bore is assumed a periodic wave with an initial height proportional to the ratio of the runup elevation and the crest elevation. The propagating wave is modeled after a bore, which qualitatively resembles a spilling breaking wave. Using linear wave theory energy considerations and appropriate bore theory approximations, results in the expression:

$$h = \left(h_i - \frac{5X}{T\sqrt{g}} \right)^2 \quad \text{where:} \quad h_i = \sqrt{\frac{\left(1 - \frac{E}{R}\right)^2 M_F (swl)^2}{1.61}}$$

where h = bore depth at structure, h_i = initial bore depth at crest, R = runup elevation, E = revetment crest elevation, M_F = Hughes parameter, swl = total still water level, X = structure setback distance, T = wave period, and g = gravity term.

This procedure neglects frictional dissipation and percolation, which have been found to have negligible influence compared to the turbulent energy dissipation in a bore. Neglect of those considerations results in a conservative estimation of bore depth. This method assumes the slope behind the berm is level. In this analysis, the measured structure setback distances and pad elevations were used; all randomly sampled input values and the calculated runup values were used. This method yields the inundation depths for each structure. For this analysis, the bore depth, h, is assumed the inundation depth.

The inundation depth is applied to each structure based on the defined depth-damage relationship, and the economic damages computed.

2.2.5 Wave Impact Forces - Structures

The method used for structure damages is based on a procedure obtained from the professional literature. After a wave runs up and overtops a beach or revetment, the wave can be considered a translational bore. This translating bore then impacts upon the structure.

The estimation of wave force due to a translating bore is based on Ramsden (Ramsden and Raichlen , 1991). The forces on a vertical wall due to the impact of a bore generated by a broken solitary wave were measured in the laboratory. A previously developed expression for bore development, which described surge forces at the leading edge of a bore propagating over smooth and roughened bottoms was modified. This resulted in the expression:

$$F = \frac{1}{2}\gamma(h+d)^2 + \gamma h^2$$

where F *= force,* γ *= unit weight of seawater,* h *= bore height,* d *= standing water depth.*

This expression includes the ratio of bore celerity to shallow-water wave celerity ($N_f = c/(gh)^2$), which in this analysis is assumed to equal unity. The previously calculated bore heights are the only required input; the standing water depth has the assumed value d = 0.1*h based on the literature recommendations.

2.2.6 Wave Impact Forces - Railroads

Structure damages from wave impact forces begin when wave propagation (or wave runup) intersects the structure seaward boundary. The degree of impact loading is a function of the runup elevations and the structure spatial positions. Wave force damages are treated independently and equally for each sub-reach.

Structure damages due to wave runup were estimated based on the damage functions shown in **Table 2-1**. The damage relationship is based on runup elevation in lieu of wave height. It is noted that the majority of the railway and associated revetments are above the MHHW elevation. As such, the revetments are not directly exposed to wave heights (such as the case for an offshore structure), but are directly exposed to wave runup. Incorporating the use of runup elevation allows for consideration of still water level, which has a significant effect on the computed runup elevation.

The percent damage is based on the quantity of armor unit removal for a specific runup elevation (wave height). These damage functions are similar in concept and nature to the

percent damage and no-damage criteria described in the Shore Protection Manual (SPM) (USACE-CERC, 1984). A distinction was made between the two primary types of railway protection: a) ballast only (no protection); and b) non-engineered which defines the protection provided by the large armor stone dumped in an uncontrolled (non-engineered) fashion. A 5% no-damage threshold was applied; damages greater than 5% were accrued. During model calibration, the damage function relativity between the ballast only and non-engineered railway was iteratively adjusted and calibrated. Engineering judgment was applied to correlate input wave runup with realistic expected damages. This iterative method resulted in predicted damages in the initial year of the life-cycle simulation that approximately matched the existing damages experienced by the SCRRA.

Table 2-1 Railroad Damage Functions

Runup Elevation, m (ft)	% Damage for Ballast RR	% Damage for Non-Engineered RR
0	0	0
3.05 (10)	0	0
3.66 (12)	1	0
4.27 (14)	5	0
4.88 (16)	10	1
5.49 (18)	15	5
6.10 (20)	20	10
7.62 (25)	25	15

2.2.7 Railway Traffic Service Delay

Railway traffic service delays result when excessive wave runup elevations and wave overtopping result in a flow rate of water that exceeds the elevation of SCRRA protective revetments. According to the SCRRA, railway traffic service delays have occurred during severe storms due to wave action. The SCRRA has documented two service disruption incidents in the 1960s and 1970s.

According to the SCRRA, there has never been a railway stoppage due specifically to conventional inundation. Conventional inundation, defined as still or standing water due to wave overtopping, has never caused a railway traffic service delay. This is intuitively expected as the railway is constructed on an elevated bed that greatly exceeds the elevation that can be reached by conventional still water coastal flooding.

There is no generally accepted guidance or methodology formulated to define the overtopping criteria necessary to interrupt railway service. Estimation of railway traffic service delays requires relating wave runup elevations to the physical positions (setback distances and elevations) of the SCRRA railway. Based on eyewitness accounts, criteria was established which combined runup elevation and a probability of occurrence. Runup elevation should equal or exceed the revetment elevation; the actual rail elevation is set below the revetment crest elevation. Overtopping of the revetment crest will logically result in overtopping of the railroad. If the revetment crest elevation is exceeded by overtopping, thereafter there is a 50-50 probability that this overtopping condition would result in railway traffic service delay. Railway traffic service delay is treated equally and independently for each sub-reach.

The rail service delay criterion is calibrated using the total number of delays experienced during a simulation. The simulation tallies the total number of service delays. Based on eyewitness damage descriptions, two service delays occurred in the 1960's and 1970's. Presumably this time period extends to the 1950's if not earlier, which is approximately 50 years. Thus, on average there should be approximately 1-2 service delays in each 50-year simulation.

2.3 Global Engineering Considerations

2.3.1 Reach Subdivision – Cells

The study area was initially divided into 10 reaches of various lengths based on the presence or absence of armor stone protection along the railroad. In order to provide a finer subdivision for detailed analysis of model performance and interpretation of the results, Reaches 1-9 were further subdivided into 50-meter segments. The number of cells in each model reach is shown in **Table 2-2**.

Table 2-2 Reach Refinement

Reach #	Length (m)	No. Cells
1	969	34
2	680	14
3	600	12
4	732	15
5	413	8
6	1,040	21
7	1,081	22
8	347	7
9	1,101	20
10	~5,000	NA

2.3.2 Single Storm

The model is a single storm event model where a single storm each year of the life-cycle is assumed to fairly represent the majority of the shoreline change and economic losses. In the model, the single storm principle is evidenced in the coastal engineering input (sheet COASTAL) where the row labeled "Hs" selects only one value.

2.3.3 Independent Sediment Transport Processes

Cross-shore sediment transport and longshore sediment transport were assumed separate and independent in this model. Independence of cross-shore and longshore sediment transport processes results in substantial improvement in numerical computational efficiency. In the model independent sediment transport processes are evidenced in the long term shoreline (sheet LTSHORELINE) which includes no storm induced processes. It is assumed that the long term shoreline recovers 100% from the pre-storm induced shoreline position.

2.3.4 Numerical Simulation Concepts

Computational Efficiency: The model employed in the present study is a spreadsheet-based model in which the Monte Carlo simulation is conducted by a spreadsheet add-in package. Use of the spreadsheet allowed each year of the economic life-cycle to be represented by one column of the spreadsheet. Thus, the spreadsheet nature of the model eliminated the numerical requirement to iterate for each life-cycle year. Each spreadsheet re-calculation represents a new simulation that results in substantial numerical computational efficiency.

A single annualized storm event provides substantial numerical simplicity over the numerical complexity inherent in a time-dependent simulation. A single storm each year of the life-cycle relieves the responsibility of rigorously describing the coastal and morphological processes that occur during a time-dependent sequence of storms. This results in substantial improvement in numerical computational efficiency.

Model Convergence: Simulation outputs were monitored for numerical convergence to evaluate the stability of output distributions during a simulation. A convergence criterion of 1.5% was established for convergence statistics for each output distribution. Model execution is continued until all pertinent economic outputs achieve the convergence criterion. Model convergence for mean values was typically achieved in less than 1000 simulations.

2.4 Specific Engineering Inputs, Parameters, and Criteria

2.4.1 Still Water Levels

The still water level is derived from the linear superposition of the tidal range, an assumed range for storm surge, and sea level rise. Tidal level and storm surge are physically independent and statistically independent which allows superposition. The design storm water level used in the present analysis ranges from +1.15-2.24 m (MLLW) (+3.8-7.4 ft). Still water level is determined based on the following expression:

Design Storm Water Level = TideUniform(0.85,1.64) + SurgeUniform(0.3,0.6) + SeaLevel(SLC, based on NRC exponential curves)

Where SLC = 0.12 m for 50 yr, Sea Level Case 1 (existing level)
Where SLC = 0.7 m for 50 yr, Sea Level Case 3 (extreme level)

The tidal value is randomly selected from a uniform distribution ranging between 0.85-1.64 m (2.8-5.4 ft). The surge value used in the present analysis is randomly selected from a uniform distribution ranging between 0.3-0.6 m (1-2 ft). It is assumed that the typical storm duration is three days and the typical storm duration peak is one day. The tide could be at any random position of the lunar cycle between neap and spring tides. During the one day storm period peak, the tide could range through the full unequal mixed range between neap tides and spring tides. It is assumed that the tide will rise to the highest tidal level. It is assumed that the neap tide high water condition will range up to the mean tide level, which is +0.85 m MLLW at La Jolla, CA. The mean higher high water condition is +1.64 m MLLW at La Jolla, CA. Thus, the tidal level was randomly selected from a uniform distribution ranging from 0.85-1.64 m MLLW representing the neap tide high and the spring tide high. It is assumed a constant storm surge occurs throughout the period of the storm and is assumed to occur simultaneously with the tidal level. Thus, the linear superposition of the random tide selection and the random surge selection minimizes a probabilistically unlikely set of tidal level / storm surge conditions, i.e. a

100 year recurrence tidal level occurring simultaneously with a 100 year recurrence storm surge level. The peak value of +2.24 m (7.4 ft) is slightly less than the highest observed water level (+2.38 m, +7.8 ft) that occurred during the 1983 storm season. The relative sea level change was added at an exponentially increasing rate between years 1-50 throughout the life-cycle simulation. In the model still water level is shown in the coastal engineering input (sheet COASTAL) row labeled "water level".

2.4.2 Waves

The design wave climatology used is based on the measured winter wave climate. The significant wave height statistical analysis is shown in **Figure 2-1**. The lognormal distribution was selected as representative of the sample data set. The lognormal distribution has the form:

$$f(x) = \frac{1}{\sigma x\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{\ln x - \mu}{\sigma}\right)\right]^2$$

where μ = *0.74 (mean)*

σ = *0.39 (standard deviation)*

Although there is no theoretical basis for selection of the lognormal distribution, the lognormal distribution is commonly used in coastal engineering practice to represent significant wave height.

The lognormal probability distribution is truncated for significant wave height values below 2.60 meters (8.5 ft) to represent the annual maximum threshold. Each iteration of the Monte Carlo simulation randomly selects a storm event where the significant wave height equal or exceeds the mean annual significant wave height. Based on the annual maximum wave heights for the measured data record, the mean annual significant wave height is 2.60 m (8.5 ft). This value is consistent with conventional coastal engineering practice for expected annual maximums within the Los Angeles District. The model selects from the portion of the best-fit log-normal probability distribution greater than 2.6 m; the model selects from a truncated distribution which is the "tail" of the distribution. Therefore each iteration of the Monte Carlo simulation forces the selected wave height to be at minimum an annual storm event. There is no provision for a year that does not have a storm; every year in the simulation has one storm.

The lognormal probability distribution is truncated for significant wave height values above 8.0 meters (26.1 ft) due to depth limitations. Based on empirical relationships derived by Weggel, it can be shown that any wave with a height greater than this computed breaking height will break. For this analysis, significant wave heights in excess of 8.0 m are not considered due to breaking. In the model wave height is shown in the coastal engineering input (sheet COASTAL) row labeled "Hs".

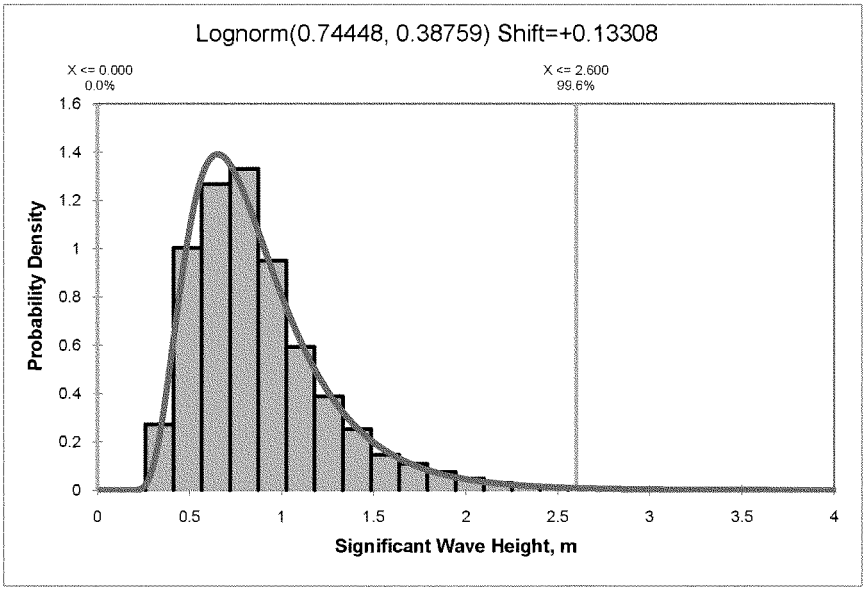


Figure 2-1 Probability Distribution for Significant Wave Height, Winter Data, 1983-1998

2.4.3 Wave Periods

The design wave period distribution used is developed from the measured wave climate climatology. The wave period statistical analysis is shown in **Figure 2-2**. The logistic distribution was selected as representative of the sample data set. The logistic distribution has the form:

$$f(x) = \frac{\operatorname{sech}^2\left(\frac{1}{2}\left(\frac{x-\alpha}{B}\right)\right)}{4B}$$

where

$\alpha = 13.2397$ (location parameter)

$B = 1.3463$ (scale parameter, $B > 0$)

$-\infty \le x \le +\infty$

There is no theoretical basis for selection of the logistic distribution, nor is the logistic distribution commonly used in coastal engineering practice to represent significant wave period. For this analysis the logistic distribution was selected for numerical convenience based on the best-fit distribution of the measured data.

The logistic probability distribution is truncated for values below 10 seconds and values above 20 seconds for purposes of the Monte Carlo simulation. The measured wave climate has been demonstrated to have a dual sea/swell nature. It is common SPL coastal engineering practice to identify 8-10 seconds as the delineation between sea and swell. For this analysis, 10

seconds was established as the lower limit for the wave climate. The logistic distribution was selected for purposes of numerical convenience and has a variate range of $+\infty$. It is commonly accepted in coastal engineering practice that swell waves are typically not greater than 25 seconds. Inspection of the histogram for wave periods indicates essentially no waves greater than 20 seconds. For this analysis, 20 seconds was established as the upper limit for the wave climate. In the model wave period is shown in the coastal engineering input (sheet COASTAL) row labeled "Period".

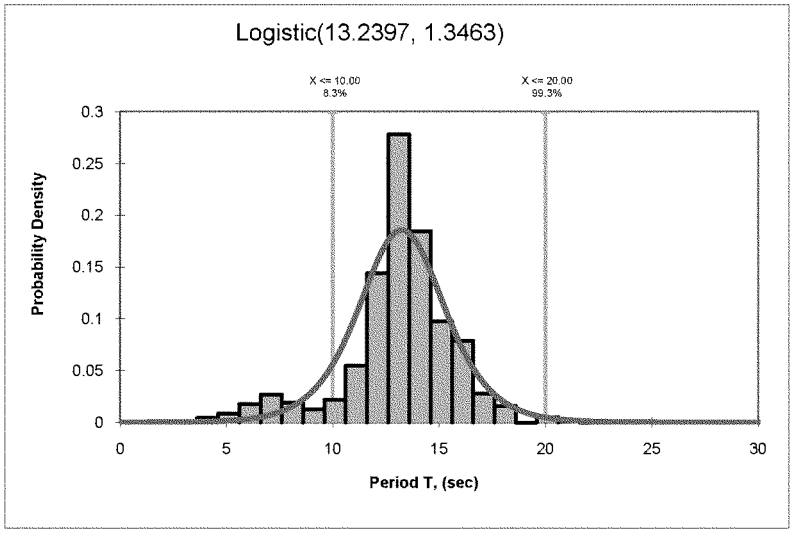


Figure 2-2 Probability Distribution for Spectral Peak Period, Winter Data, 1983-1998

2.4.4 Wave Runup

Runup is defined as the maximum vertical elevation of wave uprush above still-water level. Wave uprush consists of two components which include superelevation of the mean water level due to wave action (setup) and fluctuations about that mean (swash). In this analysis runup will be confined to the fluctuations about the mean where runup, R, is defined as a local maximum or peak in the instantaneous water elevation at the shoreline.

Wave runup is calculated independently for the shoreline conditions represented by the plane beach condition and the revetment condition. The runup is assumed constant within the entire reach since each reach is a uniform type of shoreline consisting of either plane beach or revetment. For each year of the lifecycle simulation runup was determined for each reach based on the input variables, e.g. wave height, wave period, and beach slope. The calculated runup is added to the still water level for the final runup elevation.

The relative sea level change influences the calculation of runup. It was determined that relative sea level change will occur at an exponentially increasing rate. Increasing water depths

allow higher runup values for the same incident wave heights. The still water level is incorporated indirectly into the revetment runup calculation in the form of higher wave heights at the structure toe. Since runup is by definition the wave uprush elevation above still water level, the still water level is added directly to both shoreline conditions at the end of the calculation. Thus, an increasing trend is observed in the runup calculations.

Runup on Plane Beach

The method developed by Mase and detailed in the Coastal Engineering Manual (CEM) (USACE, 2002) was used. This predictive equation is valid for irregular wave runup on plane, impermeable beaches with slope ranging between 5H:1V – 30H:1V. The runup equation is empirically derived based on measured laboratory data and wave setup is incorporated into the calculating procedure. The runup equation has the form:

$$\frac{R_{1/3}}{H_0} = (0.75)1.38\zeta^{0.70}$$

where:

$R_{1/3}$ = *the average of the highest 1/3 of the runups*

H_0 = *the significant deepwater wave height*

ξ = *surf similarity parameter calculated from deepwater wave height and length*

Direct use of the runup equation developed by Mase results in runup values that are believed to be unrealistically large. This observation is consistent with discussion in the CEM where field measurements of runup are consistently lower than the predictive equations. There is some evidence that the runup equation over predicts by a factor of 2 but is roughly the upper envelope of the data scatter. The calculated run-up values were iteratively calibrated until the calculated values approximately matched the actual known run-up elevations. Based on engineering judgment, it was determined that a factor of 0.75 best represents the calculations to real-world observed values. Therefore, a factor of 0.75 was applied to all runup calculations that more realistically reflects the runup experienced at San Clemente. In the model runup is computed in the coastal engineering input (sheet COASTAL) row labeled "Runup 2% Beach".

Runup on Revetment

The method developed by Hughes (Hughes, 2003b) was used in the present analysis. The general expression for irregular wave runup on smooth, impermeable slopes has the form:

$$\frac{R_{u2\%}}{h} = 1.75\left[1 + e^{-(0.47\cot\alpha)}\left(\frac{M_F}{\rho g h^2}\right)^{\frac{1}{2}}\right] \quad \text{for } 1.5 <= \cot\alpha <= 4.0$$

where:

$R_{u2\%}$ = *runup elevation exceeded by 2% of the incident waves*

h = *water depth at structure toe*

α = *structure slope*

M_F = *wave momentum flux parameter (Hughes parameter)*
ρ = *fluid mass density*
g = *gravitational acceleration*

The wave momentum flux parameter, MF, is a nondimensional maximum depth-integrated wave momentum flux parameter (Hughes, 2003a). MF will herein be referred to as the "Hughes parameter" for simplicity. The Hughes parameter characterizes the wave momentum flux, which is closely related to the force loading experienced by coastal structures or any other solid object placed in the wave field. An empirically derived expression for MF has the form:

$$\left(\frac{M_F}{\rho g h^2}\right)_{max} = A_0\left(\frac{h}{gT^2}\right)^{-A_1}$$

where:

$$A_0 = 0.639\left(\frac{H}{h}\right)^{2.026} \quad \textit{and} \quad A_1 = 0.180\left(\frac{H}{h}\right)^{-0.391}$$

H = *significant wave height at structure toe*

The calculated values of runup are further modified for surface roughness and other factors for consistency with the runup guidance detailed in the CEM, which is based on the method developed by Battjes. The modification factors are given as:

γ_r = 0.6, roughness coefficient
γ_b = 1, berm coefficient
γ_h = 1.17, shallow water coefficient
γ_β = 1, wave angle of incidence coefficient

The following assumptions were made: significant wave runup value, impermeable slope, roughness consisting of 1 layer of rock, non-bermed profile, shallow water conditions (i.e. non-Rayleigh distributed), and normally incident. In the model runup is computed in the coastal engineering input (sheet COASTAL) row labeled "Runup Revet 2% Hughes".

2.4.5 Foreshore Slopes

The design foreshore slope distribution used for this analysis is developed from the measured foreshore slope data previously discussed. The foreshore slope statistical analysis is shown in **Figure 2-3**. The extreme value distribution was selected as representative of the sample data set. The extreme value distribution has the form:

$$f(x) = \frac{1}{b}\left(\frac{1}{e^{z} + \exp(-z)}\right)$$

where

$$z \equiv \frac{(x - a)}{b}$$

$a = 7.34$ (location parameter)

$b = 1.94$(scale parameter, $b > 0$)

$-\infty \leq x \leq +\infty$

There is no theoretical basis for selection of the extreme value distribution, nor is the extreme value distribution commonly used in coastal engineering practice to represent foreshore slope. For this analysis the extreme value distribution was selected for numerical convenience based on the best-fit distribution of the measured data.

The extreme value probability distribution is truncated for values below 4 and values above 20 for purposes of the Monte Carlo simulation. The measured foreshore slopes has been demonstrated to have a range between 4 and 20. This range is typical of the foreshore slopes of other beaches located in southern California. In the model, the foreshore slope is shown in the coastal engineering input (sheet COASTAL) row labeled "Beach Slope".

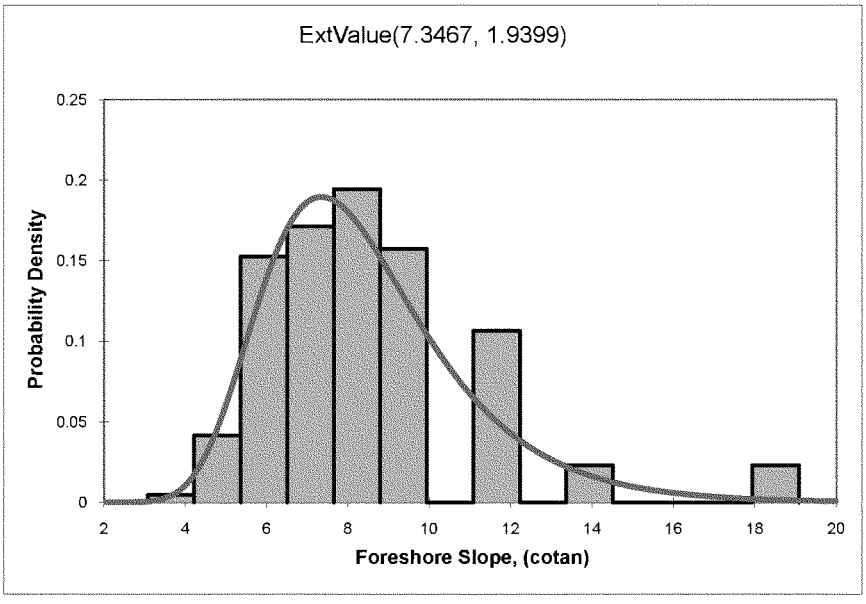


Figure 2-3 Probability Distribution for Foreshore Slopes

2.4.6 Beach Widths

Beach width in this study is defined as that portion of the beach between the foreshore berm contour and a fixed location on the backshore. This definition accounts for the "dry" portion of the beach. The foreshore berm contour was determined from a composite profile developed by overlaying multiple cross sections of beach that was not fully eroded. Lines indicating the flat backshore and the sloped foreshore were intersected, yielding a +5.3 m (+17.4 ft) MLLW elevation representative of the foreshore berm.

2.4.7 Long Term Shoreline Change Rate

Long-term shoreline erosional processes create damages through long-term profile translation and the increasing potential for wave related damages. Long-term beach erosion causes the mean shoreline position to translate landward. The landward advancing shoreline reduces the beach width available for storm damage protection thereby increasing the probability of wave related damages to facilities and structures. As the shoreline retreats landward, the runup and overtopping damage zone increasingly encroaches on existing development. Landward encroachment of this wave-related damage zone will threaten existing development before the mean shoreline position could retreat far enough to directly threaten the structures by undermining. Long-term beach erosion also results in the gradual reduction of the beach surface area available for recreation.

Without-Project

The without-project long term erosion probability distribution is shown in **Figure 2-4**. The long-term shoreline change rates for the four locations that are historical to the CCSTWS. Based on these parameters a triangular distribution for long-term shoreline change rate was developed. The triangular distribution has a mean shoreline change rate of –0.10 m/yr (-0.33 ft/yr), the peak erosion rate is –0.21 m/yr (–0.7 ft/yr), the maximum erosion rate is –0.46 m/yr (-1.5 ft/yr), and the maximum accretion rate is +0.38 m/yr (+1.24 ft/yr). In the model, the without-project long term erosion rate is sampled in the coastal engineering input (sheet LTER_INDEX) row labeled "LT Erosion".

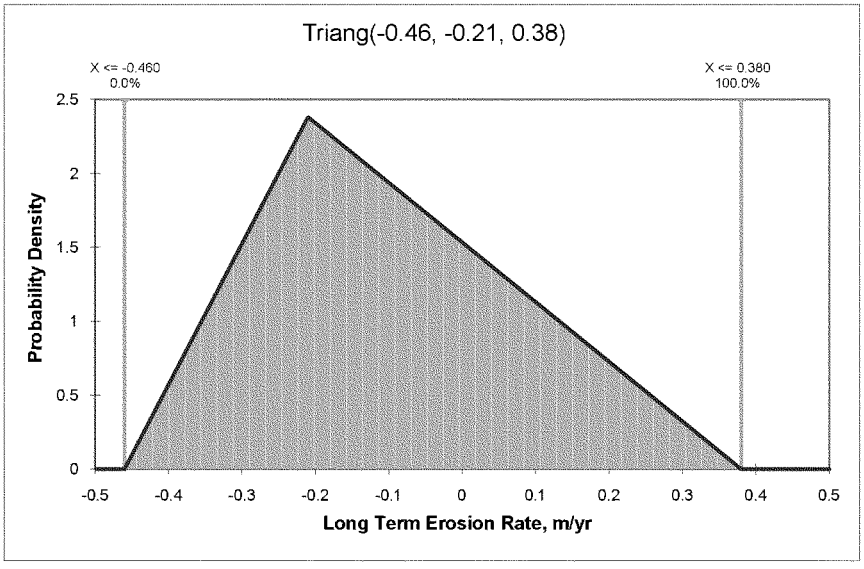


Figure 2-4 Probability Distribution for Without-Project Long Term Erosion Rate

With-Project

The long-term shoreline change rate for this study was based on the monitoring data from the SANDAG regional shoreline nourishment project conducted in southern California in 2001. Measured beach profile data was obtained at 61 transects; 19 transects were identified that crossed directly over a beach fill location. The mean sea level shoreline change was compiled into a histogram shown in **Figure 2-5**. The raw data indicates a range of -18 m (-60 ft) to +8 m (+22 ft), and a mean value of -5.9 m (-19.4 ft). These shoreline change data are considered to obtain erosion parameters representative for the entire study area. Based on these parameters a triangular distribution for long-term shoreline change rate was developed. The triangular distribution has a mean shoreline change rate of –3.9 m/yr (-12.8 ft/yr), the peak erosion rate is –5.5 m/yr (–18.1 ft/yr), the maximum erosion rate is –15.2 m/yr (-50.0 ft/yr), and the maximum accretion rate is +9.2 m/yr (+30.0 ft/yr). The with-project long term erosion probability distribution is shown in **Figure 2-6**. In the model, the with-project long term erosion rate is sampled in the coastal engineering input (sheet LTER_INDEX) row labeled "LT Erosion".

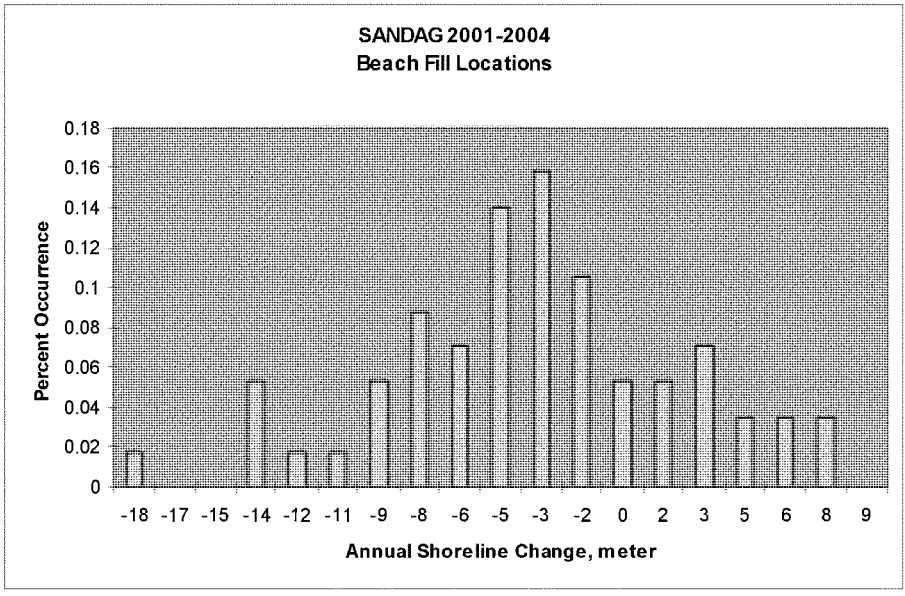


Figure 2-5 Mean Sea Level Shoreline Change from 2001 SANDAG project

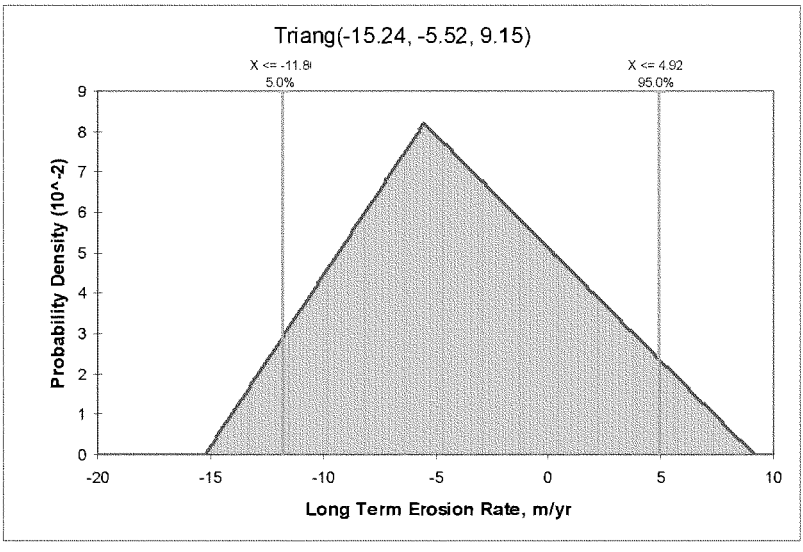


Figure 2-6 Probability Distribution for With-Project Long Term Erosion Rate

2.4.8 Storm Induced Beach Change

The design storm induced beach change used in this analysis is based on the measured storm induced beach change data. The storm induced beach change statistical analysis is shown in **Figure 2-7**. The lognormal distribution was selected as representative of the sample data set. The following parameters were used:

μ = 3.01 (mean)
σ = 3.75 (standard deviation)

There is no theoretical basis for selection of the lognormal distribution, nor is the lognormal distribution commonly used in coastal engineering practice to represent storm induced beach change. For this analysis the lognormal distribution was selected for numerical convenience based on the best-fit distribution of the measured data.

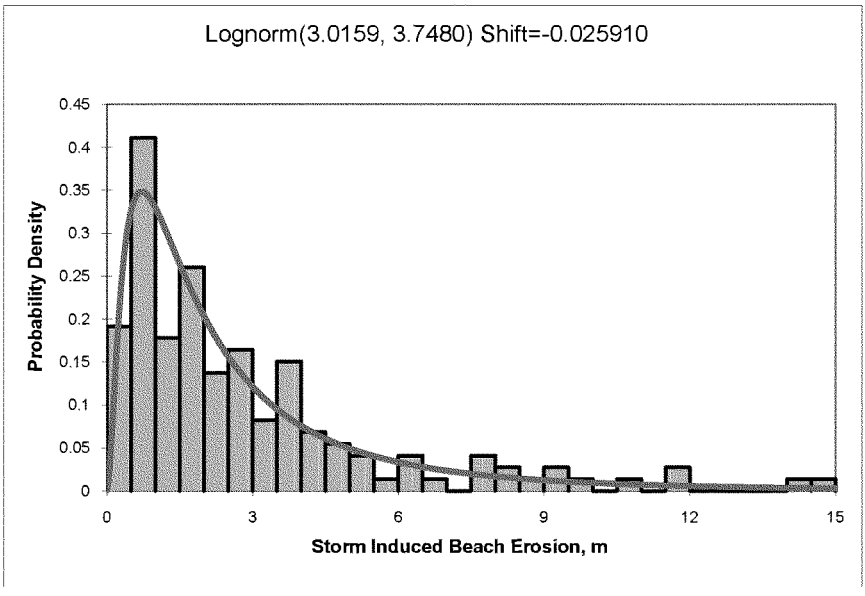


Figure 2-7 Probability Distribution for Storm Induced Beach Change

This design storm induced beach change function was also a result of the model calibration procedures.

The storm induced beach change probability distribution is assumed to be identical for the without-project and with-project condition. All storm induced cross-shore transport is expected to be constrained by the fact that the entire project area is controlled by the underlying geology. A continuous sandy shoreface does not exist in this area which is expected to limit substantial storm induced transport. The storm induced beach change for the low probability storm events

derived from this distribution can be considered small, however, these results are consistent given the facts that the existing beaches are very narrow and the modern record indicates little or no storm induced changes (and damages) have been recorded even in the most severe storms. While it might be expected that a wider beach (with-project) would have greater storm induced beach change, the distribution shown herein is considered slightly aggressive for the without-project condition based on the limited storm induced beach change data from the measured historical record. Potential fill alternatives considered in this study are expected to be relatively narrow in the cross-shore direction which might be expected to result in marginally small increases in cross-shore transport. However, given the believed slight aggressiveness of the distribution for the without-project condition, this input distribution is believed representative of both the without- and with-project condition. In the model, the storm induced erosion is computed in the coastal engineering input (sheet COASTAL) row labeled "Storm Erosion".

2.4.9 Railroad Reach Conversion Criteria

The future with-project formulation requires estimation of when the SCRRA will invest in a capital improvement structure (seawall) to protect an investment (railroad). This trigger point is called the railroad reach conversion criteria in the present study. The criteria are comprised of two parts: a minimum beach criterion and a seawall conversion criterion. The minimum beach and seawall conversion criteria work jointly together and estimate when an unimproved (ballast) railroad reach will be improved by construction of an engineered seawall. It is noted that these criteria were developed by economics and plan formulation based on discussions with the SCRRA, correspondence from the CCC to the SCRRA, and best prediction of future human behavior. The minimum beach criterion used in the present study is set at 8 m (26 ft). The seawall conversion criterion used in the present study is a uniform distribution ranging from 29% - 48%; the criterion is randomly selected during the Monte Carlo simulation.

Plan formulation states that the SCRRA will construct a capital improvement structure prior to the initial onset of damages. To date, the SCRRA has conducted maintenance repairs only after suffering actual structural damages. Furthermore, the SCRRA is expected to determine that the annual maintenance expenditures for constructing piecemeal (cell) repairs have combined higher costs than the cost of a single comprehensive (reach) structure. The single comprehensive structure (seawall) will provide the immediate maintenance requirement as well as alleviate future maintenance requirements. Thus, it is assumed that the SCRRA will make an informed business financial decision to invest in a capital project with lower overall costs in lieu of continued piecemeal maintenance expenditures with greater long-term costs.

It is assumed that the SCRRA will conduct shoreline monitoring as part of the decision making process for a capital improvement structure (seawall) and will take action when the beach protecting the railroad is less than or equal to a minimum value. The minimum beach criterion used in the present study is fixed at 8 m (26 ft) and is derived from the 100-yr value for storm induced erosion. The input probability distribution for storm induced erosion estimates a 100-yr storm will create 8 m of erosion. Economics and plan formulation decided that the SCRRA would construct a seawall when there is a 1% chance of damages. When the shoreline is within 8 m of the railroad, a 1% chance storm (100 year event) will erode the entire remaining beach and induce damages. Therefore, the minimum beach criterion becomes a "trigger" for action. It is noted that this criterion is synthetic and is not based on past/current practice and/or human behavior.

Plan formulation requires estimation when the SCRRA will complete the budget and funding process for a capital improvement structure (seawall). It is expected that the SCRRA will not have the funds immediately available to construct a capital improvement project. The SCRRA is expected to navigate a budget process where funds are authorized and appropriated before plans and specifications and construction occur. This results in an inherent delay between the capital improvement decision and the actual implementation (construction) of a project. The seawall conversion criterion attempts to model this behavior. The seawall conversion criterion is a time-delay criterion and has the effect of accelerating or delaying the decision-making process for implementation of a capital improvement project. The seawall conversion criterion ranges between 0-100 percent. The SCRRA cannot invest in a capital improvement project immediately, i.e. 0%. It is expected the SCRRA will not wait until the entire existing beach is completely eroded, i.e. 100%. The 29% - 48% is an estimate for seawall conversion that encompasses these considerations. Therefore, the seawall conversion criterion also becomes a "trigger" for action. It is noted that this criterion is synthetic and is not based on past/current practice and/or human behavior.

In the model, the railroad conversion criterion is shown in the input (sheet FXN) described as "Trigger, Seawall Construction". During the Monte Carlo life-cycle simulation the model tracks the protective beach width in each cell of each unimproved reach (Reaches 2, 4, 6, and 8). When the protective beach width is equal or less than 8 m (26 ft) the model flags this cell. The percentage of flagged cells is computed by the running total number of flagged cells in the reach compared to the total number of cells in the reach. When the flagged percentage equals or exceeds the randomly selected seawall conversion criterion, the model assumes that a seawall is constructed in the reach.

2.4.10 LOSSAN Traffic Service Delay

Railway traffic service delays result when severe wave runup and overtopping exceeds the elevation of SCRRA protective revetments sufficient to interrupt service. The SCRRA has documented two service disruption incidents in the 1960s and 1970s during severe storms due to wave action.

There is no generally accepted guidance or methodology formulated to define the overtopping criteria necessary to interrupt railway service. Therefore, rail traffic service delay was directly related to revetment failure; the rail traffic service delay is based on an assumed failure or breach of the revetment during a severe storm condition. If runup and overtopping conditions are severe enough to cause revetment failure, then the railway traffic would logically be interrupted while the revetment and railway is repaired.

Criteria were established to compute railway traffic service delay that combines runup elevation and a probability of occurrence. Runup elevation must equal or exceed the revetment elevation. Since the actual rail line is constructed at or below the revetment crest elevation, overtopping of the revetment crest will logically result in overtopping of the railroad. During initial model runs excessive railway traffic delays were incurred due to overtopping. In order to calibrate model railway delays with actual recorded railway delays, a probability-based percentage factor was introduced. This percentage factor was used as a calibration coefficient. This coefficient was iteratively reduced from the value of 1 until the model predicted damages matched the observed damages. The resulting percentage coefficient was 0.5. When overtopping exceeds the revetment crest elevation, thereafter there is a 50-50 probability that this overtopping condition will result in revetment failure. The rail traffic service delay criteria are calibrated based on the total number of delays experienced during a simulation. The model simulation tallies the total

number of service delays. Based on the damage description provided by the SCRRA, there were two service delays in the 1960's and 1970's. Presumably this time period extends to the 1950's if not earlier, which is approximately 50 years. Thus, on average the model should (and does) predict approximately 1-2 service delays in each 50-year simulation.

Revetment failure and subsequent railway traffic service delay is treated equally and independently for each reach and each cell. Revetment failure is allowed only if the entire reach has not been converted to a seawall. A seawall is considered to permanently protect the railroad and no failure is allowed.

The rail traffic service delay costs are divided into separate components consisting of costs to repair the railroad and losses to service interruption. Due to the nature of the model, it is possible that multiple railroad cells are damaged at the same time, but only one service delay is counted. Information provided by the SCRRA indicates that a 50 meter long railroad cell could be repaired on the order of hours after incipient damage; therefore multiple cell segments failing at the same time will not have a substantial multiplying effect to the service delay.

2.4.11 Structure Damages

Structure damages are confined to public buildings and infrastructure fronting the railway. Structure damages are not considered south of San Mateo Point or north of the North Beach area. The pier is not considered for structure damages. Structure damages consist of: direct structure loss due to long-term erosion; direct structure loss due to storm induced erosion; direct structure damages due to wave impact forces; and direct structure and contents damages due to inundation. The damage mechanisms are described in detail hereinbefore. The structure inventory is described in detail in the Economic Appendix.

The model conducts a sequential evaluation for damages to each structure in the inventory. The damage sequence is described as follows:

a. Each structure is evaluated for loss due to long-term erosion.
b. Each structure is evaluated for loss due to storm-induced erosion.
c. Each structure is evaluated for loss due to wave impact forces.
d. Each structure is evaluated for inundation damages to the structure and contents.

The model damage sequence evaluates the first three damage mechanisms and removes the structure from the inventory if any of the evaluations are positive. If all evaluations are negative, the model computes the inundation damages.

Trail damages are treated separately from all other structures. The trail in Reach 6 consists of a crushed rock roadway with associated accouterments for a portion of the length. The remainder of the length consists only of designation of the beach area as a trail with no structural improvements. The model considers the trail as dry land that is eroded by long-term erosion or storm induced erosion. When this land is eroded, the associated portion of the trail is considered lost. The costs of the rock roadway portion of the trail are accumulated. The major trail damages are the future costs incurred for relocation and replacement of the trail to the landward side of the railroad.

2.4.12 Structure Erosion Loss Criterion

Structure losses due to long-term or storm-induced erosion require estimation when the structure will be lost. Structures are lost to long-term or storm-induced erosion when the structure foundation is undermined due to the landward advancing shoreline. The model simulation computes the structure damages due to long-term or storm-induced shoreline change at annual intervals through the 50-year life cycle. The simulation randomly samples a long-term erosion value and a storm event, and allows the shoreline to retreat the amount associated with the phenomenon. When the retreat distance exceeds a percentage of the structure footprint, the structure is considered lost and removed from the inventory.

The structure erosion loss criterion is the percentage of structure footprint necessary to cause structure loss, and is dependent on the type of structure. The structures were classified into four categories: timber slab-on-grade, masonry slab-on-grade; timber pile supported; and masonry pile supported. For slab-on-grade structures, when the shoreline berm position eroded through 50% of the footprint as measured from the seaward wall, the structure was considered lost and removed from the inventory. Pile supported structures are not lost directly to undermining. For pile supported structures, when the shoreline erodes through 100% of the footprint, the structure functionality is lost, i.e. the structure can no longer be reasonably used as intended, and the structure is considered lost and removed from the inventory. In the model, the structure erosion loss criterion is shown in the input column (sheet INPUTM) described as "Structure Erosion Loss Criteria".

2.5 Methodology and Flowchart

The simplified methodology and computational flow of the engineering computations are shown and described in Attachment A. A description of the inputs and variables used on each spreadsheet page within the model is shown. The structures and railroad are discussed separately to illustrate the various concepts.

2.5.1 Structures

The following applies to the structure inventory located seaward of the railroad. The structures included in the inventory are described in the Economics Appendix. There are no structures landward of the railroad where damages are considered. An illustration of the methodology for structure damages is shown in **Figure 2-8**.

a. Initiate model in year 1 with the initial shoreline position. For with-project condition, initial shoreline position includes fill width.
b. Randomly select a long term shoreline change value and establish a new shoreline position.
c. Randomly select a plausible set of oceanographic conditions including: wave height; wave period; still water level (tide + storm surge + sea level change); and foreshore slope.
d. Compute wave runup.
e. Compute overtopping and resultant flooding depths (if any).
f. Compute storm induced shoreline erosion.
g. Compare structure position to determine if structure is lost due to long term erosion. Long-term erosion must erode thru 100% of structure width. If structure is lost, remove from inventory.

h. Compare structure position to determine if structure functionality is lost. Long-term erosion must erode thru 75-100% of structure width (structure dependent, creates island). If structure functionality is lost, remove from inventory.
i. Compare structure position to determine if structure is lost due to storm induced erosion. Storm induced erosion must erode thru 50% of structure width. If structure is lost, remove from inventory.
j. Compute forces to determine if structure is lost due to wave generated forces. Forces must equal or exceed threshold. If structure is lost, remove from inventory.
k. Compare structure first floor elevation to previously computed flooding depth. Compute the structure inundation and content damages.
l. Increment the model time step. For with-project condition, if fill width is 0 (fully eroded) add new fill width. Goto Step (b).

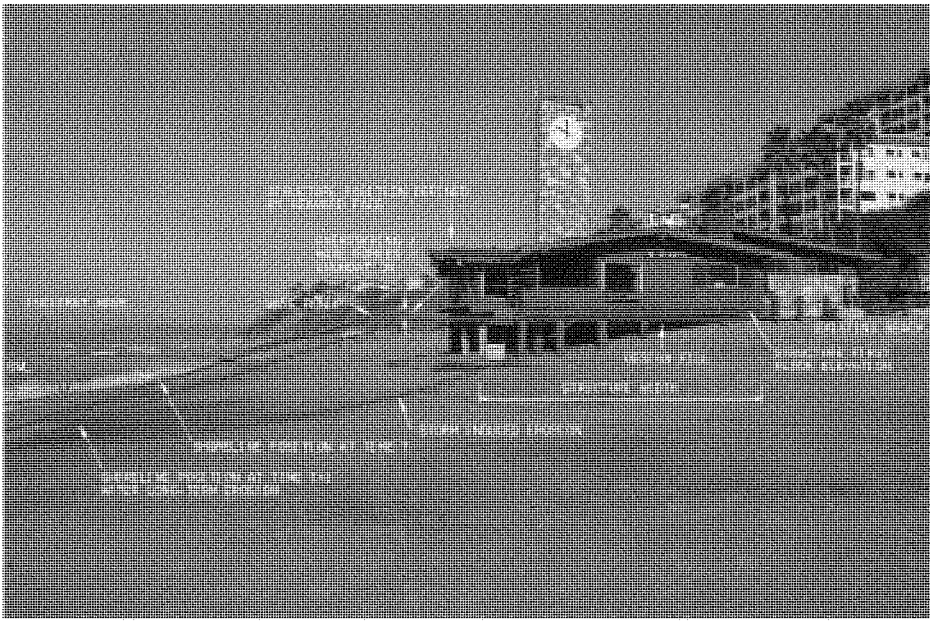


Figure 2-8 Illustration of Methodology for Structure Damages

2.5.2 Railroad

The following describes the railroad damage/conversion process. The railroad is treated as a specialized structure due to its shoreline parallel, linear nature. The railroad was discretized into cells for the breach analysis and divided into reaches for the seawall conversion analysis. An illustration of the methodology for railroad damages is shown in **Figure 2-9**.

a. Initiate model in year 1 with the initial shoreline position. For with-project condition, initial shoreline position includes fill width.

b. Randomly select a long term shoreline change value and establish a new shoreline position.
c. Randomly select a plausible set of oceanographic conditions including: wave height; wave period; still water level (tide + storm surge + sea level change); and foreshore slope.
d. Compute wave runup.
e. Compute overtopping and resultant flooding depths (if any).
f. Compute storm induced shoreline erosion.
g. Compare long term shoreline position to each RR cell to determine if beach width is less than minimum beach width criterion (8 m). If beach width is less than minimum beach width criterion, store cell as available for conversion.
h. Compare number of RR cells stored as available for conversion to total number of cells in RR reach. Compare to seawall conversion criterion (randomly selected between 29% - 48%). If number of RR cells is greater than or equal to seawall conversion criteria, convert RR reach from ballast construction to seawall construction.
i. Compare storm induced shoreline position to each RR cell position to determine if RR is damaged (breached). Compute RR traffic delays. (Can only occur if not converted to seawall).
j. Increment the model time step. For with-project condition, if fill width is 0 (fully eroded) add new fill width. Goto Step (b).

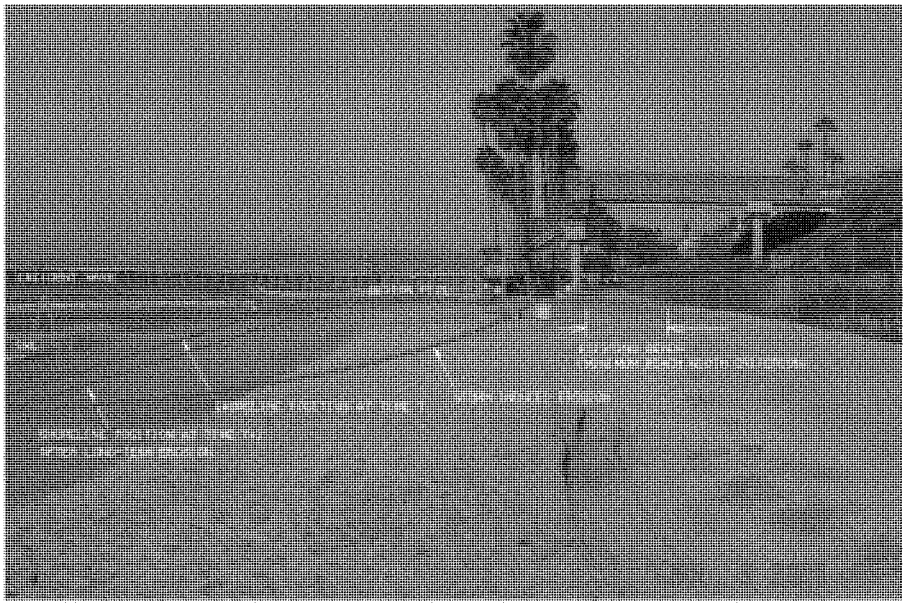
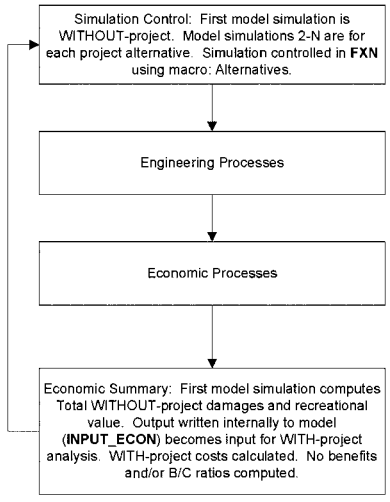


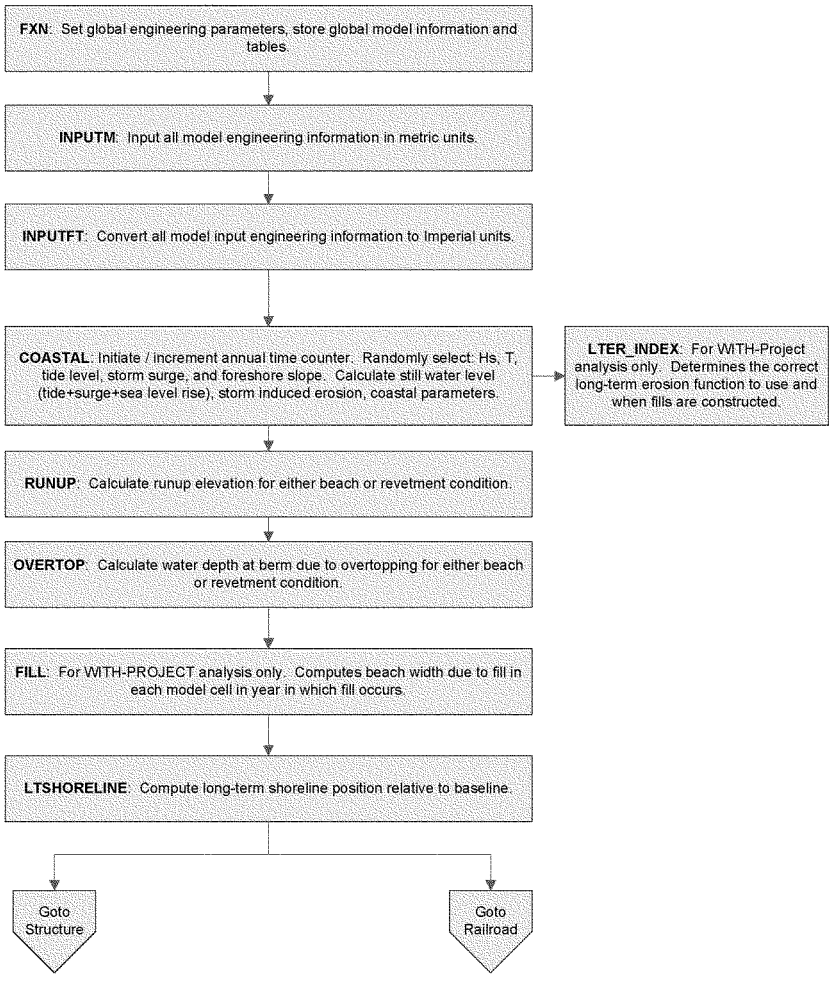
Figure 2-9 Illustration of Methodology for Railroad Damages

ATTACHMENT A
MODEL FLOWCHARTS

GENERAL MODEL FLOW

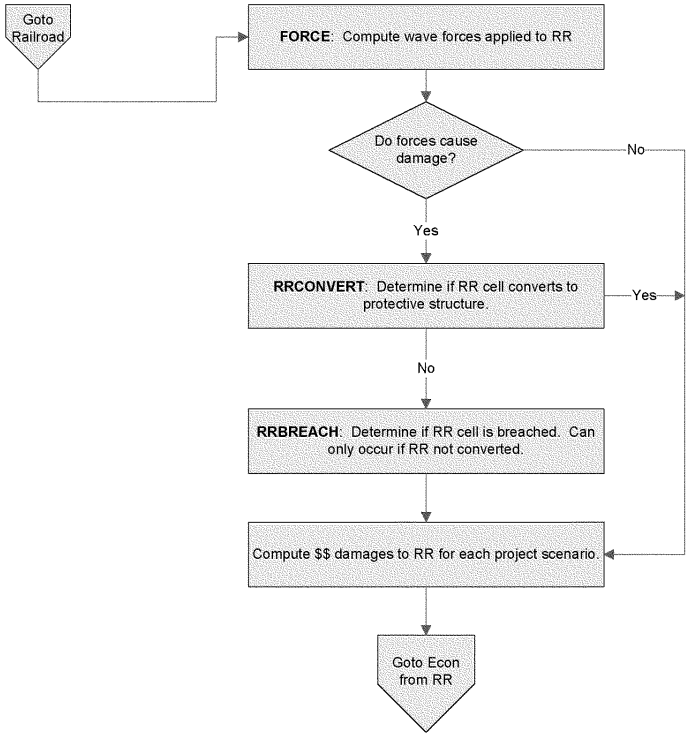


COASTAL ENGINEERING



Note: **BOLD** corresponds to model worksheet name.

RAILROAD



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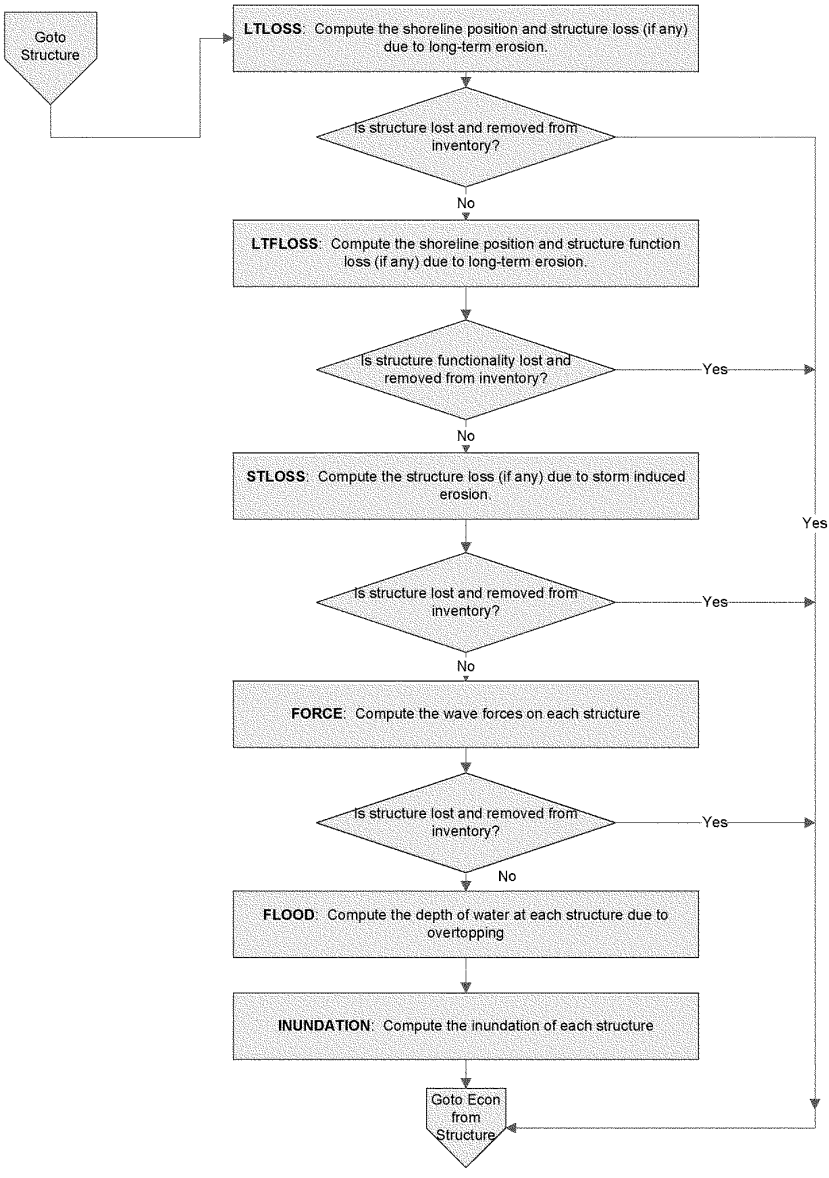
STRUCTURE



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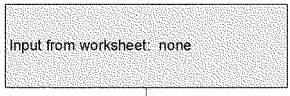
WORKSHEET: FXN



FXN

This sheet sets the global engineering values and parameters. The variable name used in the model is underlined.

Seawall: Trigger value to convert RR to seawall protection

Delay_It: Time delay in years from beginning of data collection (2002) to present

Erosion: W/O project mean annual long term erosion, ft / meter

Convert: % of cell within protection limit to initiate major construction

Damage: Damage criteria, to initiate armor stone repairs

Footprint: % of structure footprint erosion required for storm loss

Forceloss: % of structure damaged by wave forces for total loss

Breach: Runup elevation to exceed RR which will cause breach, ft / meter

Fill: Initial sacrificial beach fill width, ft / meter

Base: Initial base beach fill width, ft / meter

Interval: Nourishment interval, years

Erosionfill: W/ project mean annual long term erosion rate, ft / meter

Force: Force / structure damage table

ForceID: Force / structure damage table

Forceloss: Force / structure damage table

RR_non: Wave damage function for unimproved railroad

RR_eng: Wave damage function for improved railroad

ProbWaves: Storm induced erosion lookup table

ProbErosion: Storm induced erosion lookup table

Sealevel: Sea level rise coefficient

SeaLevel_case: Sea level change condition 1, 2, or 3 for NRC curves (low, medium, high)

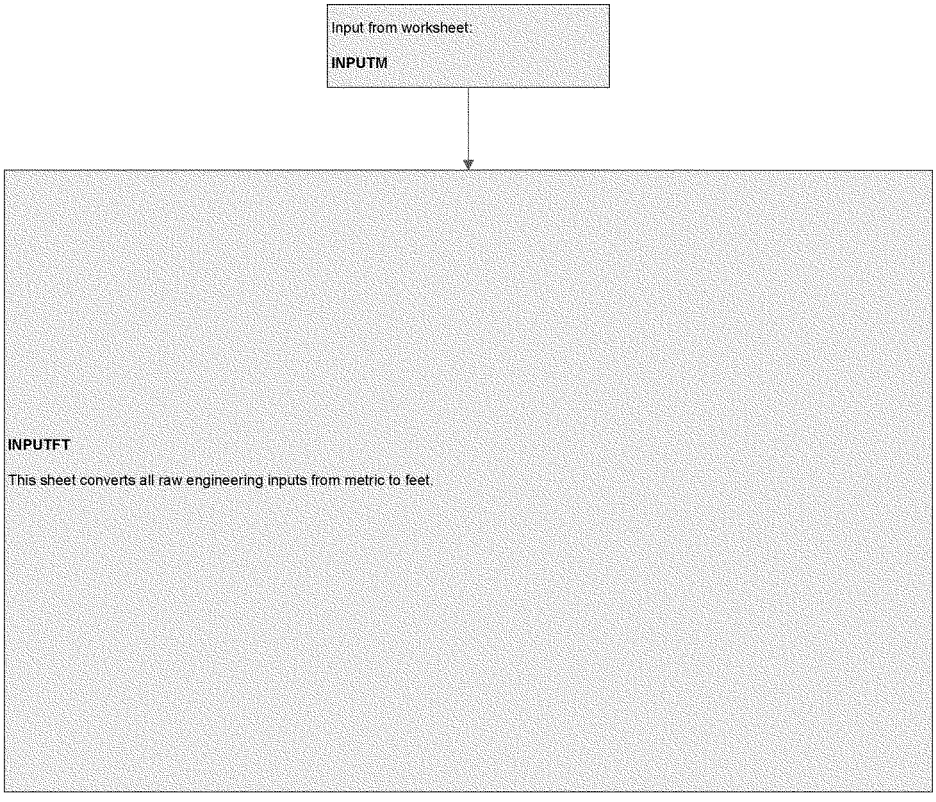
SLR_seawall: seawall cost multiplier due to sea level change

SLR_erosion: change is long term erosion rate due to sea level change ft/yr

Counter: is a counter to iterate for project alternatives

WORKSHEET: INPUTM

WORKSHEET: INPUTFT



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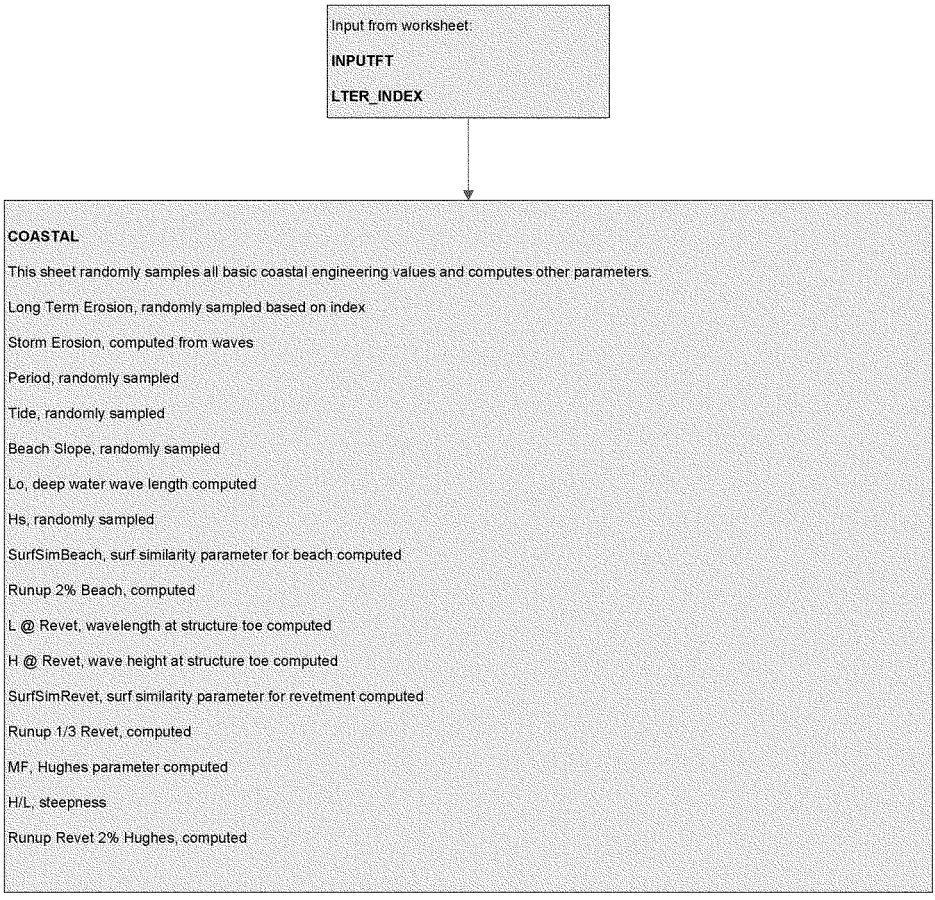
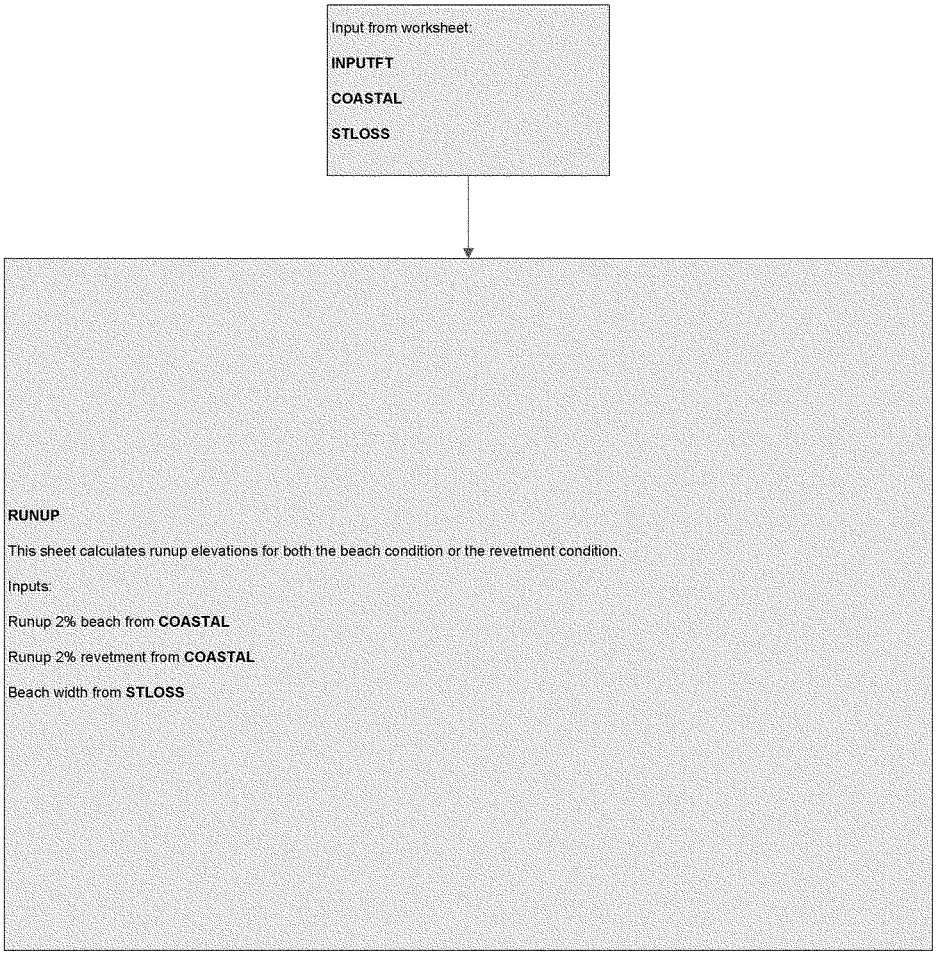


WORKSHEET: LTER_INDEX

WORKSHEET: RUNUP



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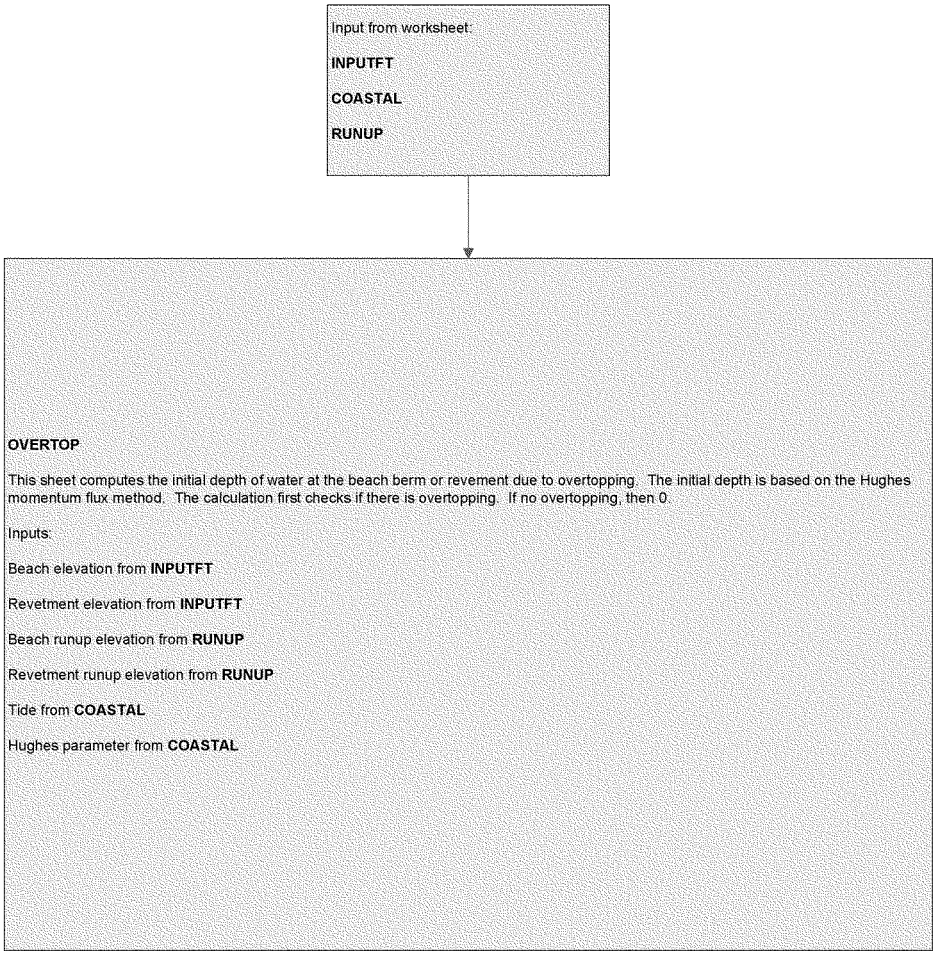

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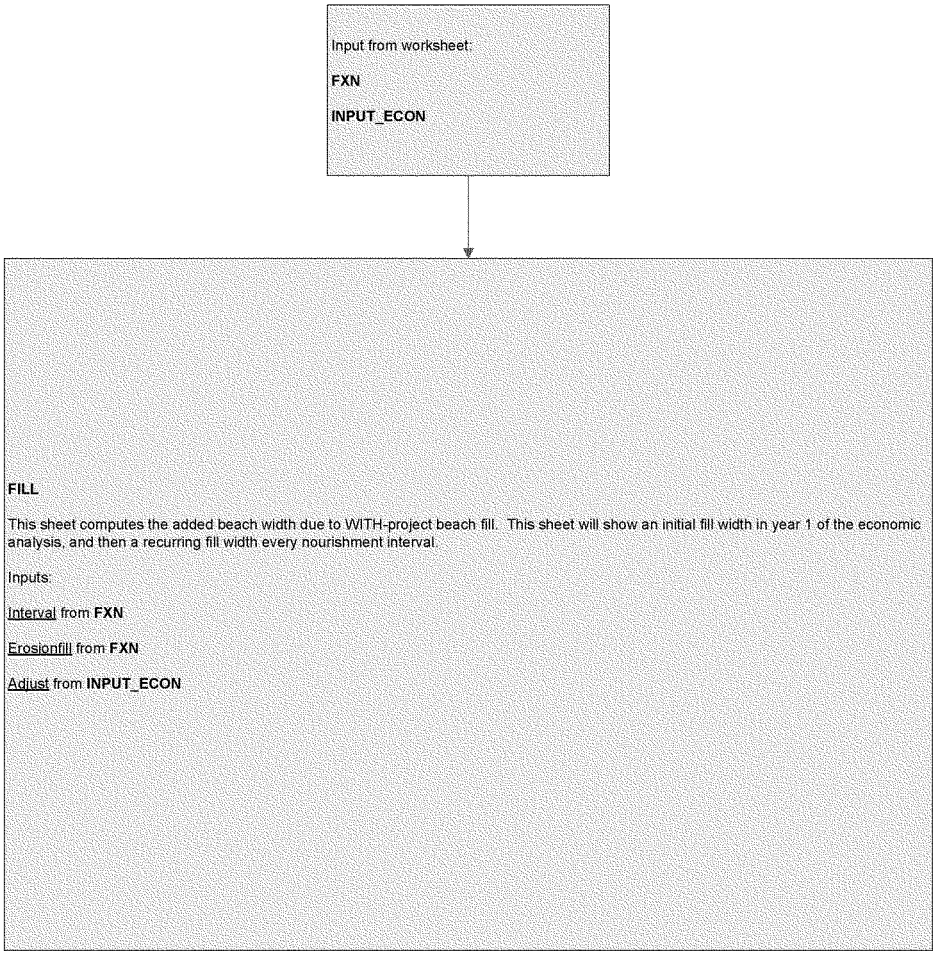
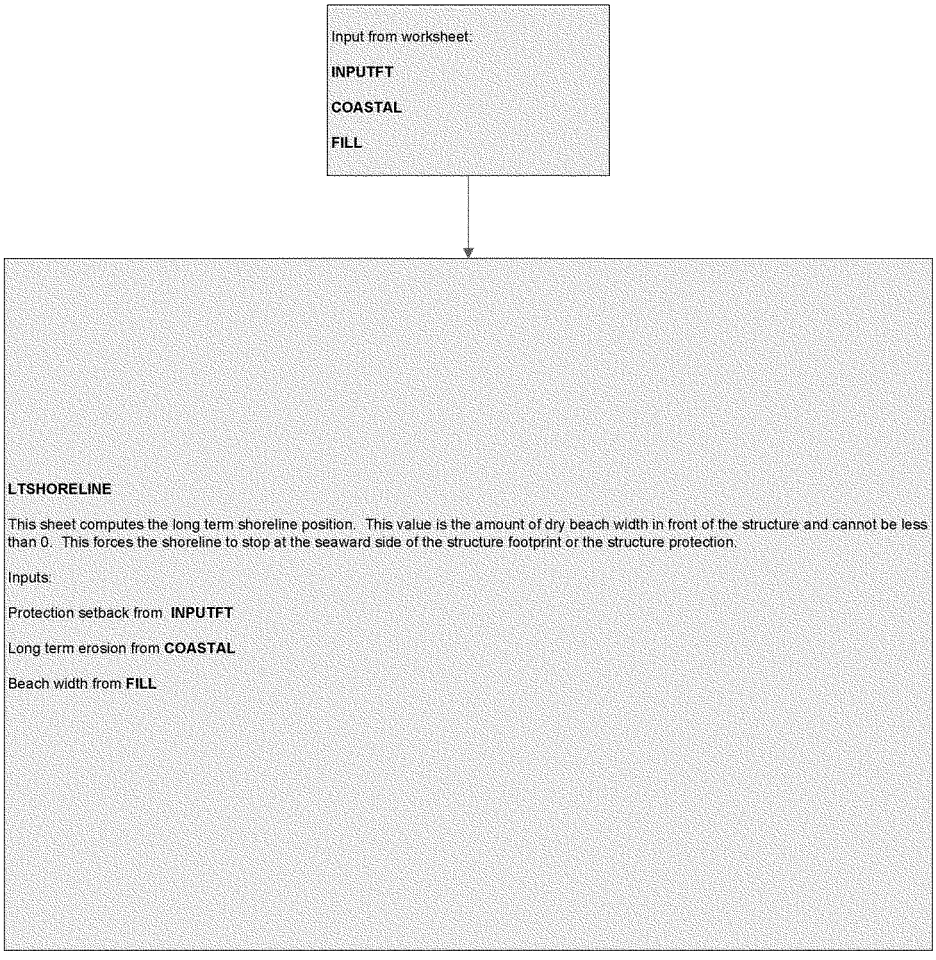


WORKSHEET: LTSHORELINE



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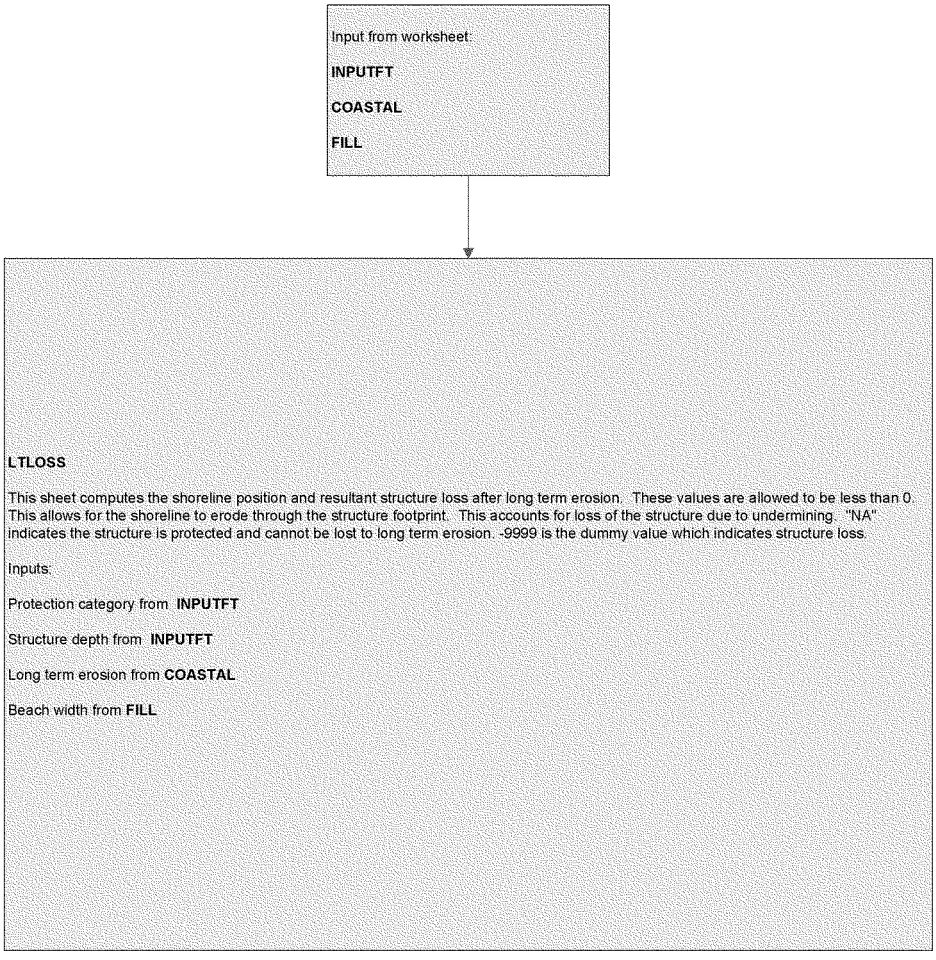

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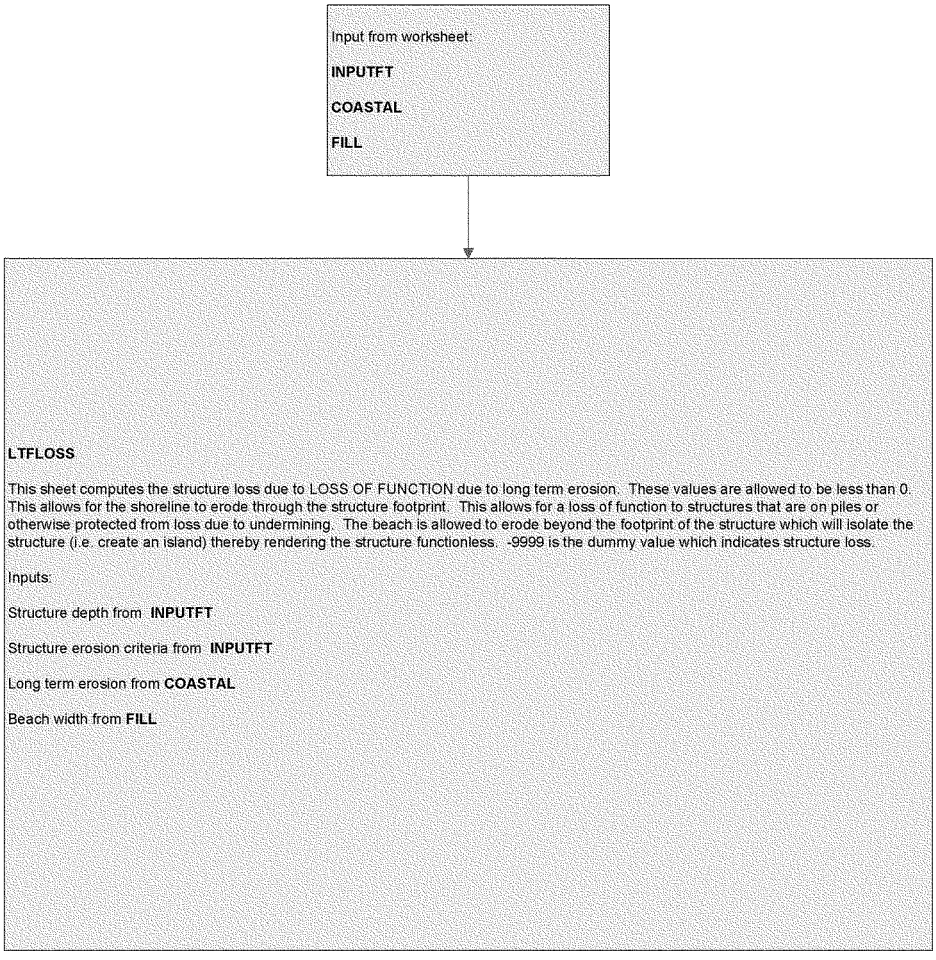
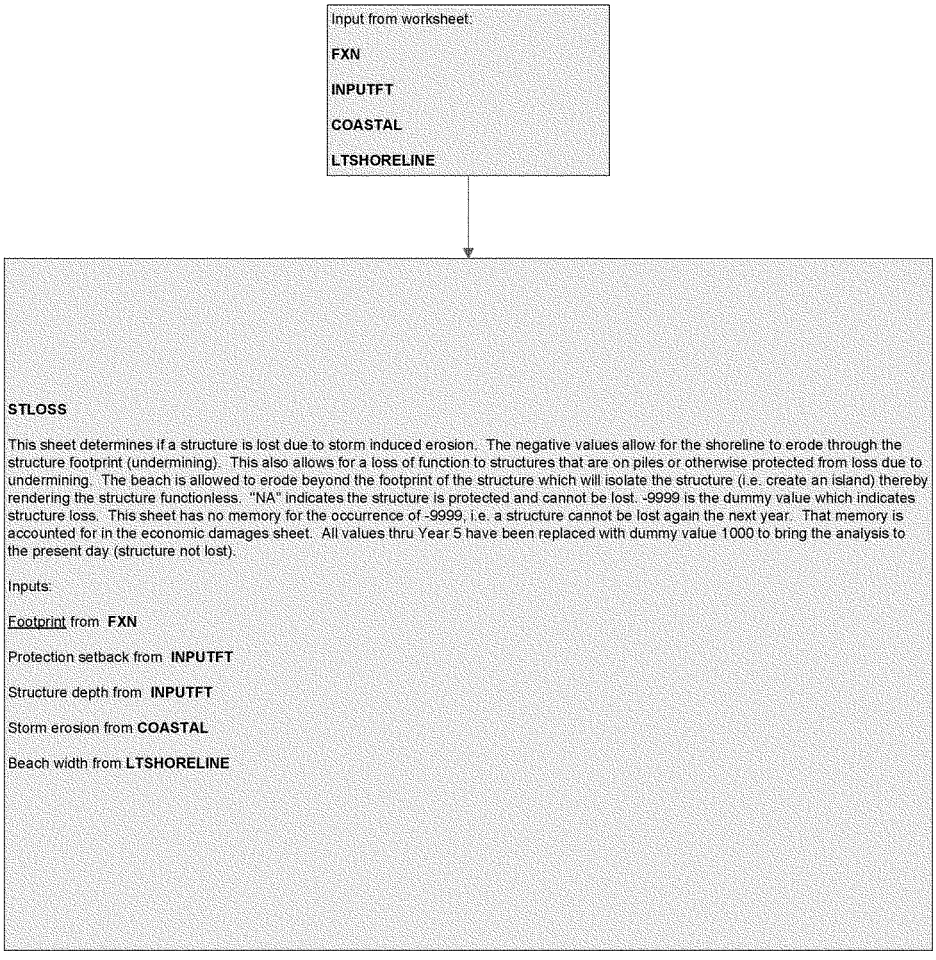


WORKSHEET: STLOSS



WORKSHEET: FLOOD

Input from worksheet:

COASTAL

OVERTOP

LTSHORELINE

FLOOD

This sheet computes the depth of water at each structure due to overtopping. Estimation of structure inundation depths requires relating wave runup elevations to the physical positions (setback distances and first floor elevations) of individual structures. A method described in the professional literature is used to develop inundation estimates. No USACE approved methodology has been formulated to predict the transformation of an overtopping wave after it passes the revetment crest. Wave runup propagation over a revetment is an extremely complex process. After a wave runs up and overtops a revetment, the wave can be considered a translational bore. An approximate solution is to estimate the bore attenuation or decay function landward of the revetment as a function of setback distance.

The estimation of overland bore propagation and decay is based on Cox and Machemehl. The propagating bore is assumed a periodic wave with an initial height related to the runup elevation minus the crest elevation. The propagating wave is modeled after a bore, which qualitatively resembles a spilling breaking wave. Using linear wave theory energy considerations and appropriate bore theory approximations, results in the expression:

h = {hi - (5X/(T*sqrt(g))}^^2

where h = bore depth, hi = initial bore depth, R = runup elevation, E = revetment crest elevation, X = structure setback distance, T = wave period, and g = gravity term. This procedure neglects frictional dissipation and percolation, which have been found to have negligible influence compared to the turbulent energy dissipation in a bore. Neglect of those considerations results in a conservative estimation of bore depth. This method assumes the slope behind the revetment is level. In this analysis, the measured structure setback distances and pad elevations were used, and the calculated runup values were used. This method yields the inundation depths for each structure. For this analysis, the bore depth, h is assumed the inundation depth.

This calculation first checks if the overtopping amount is greater than 0. If not, then 0.

All values thru Year 5 have been replaced with dummy value 0 to bring the analysis to the present day (no flooding).

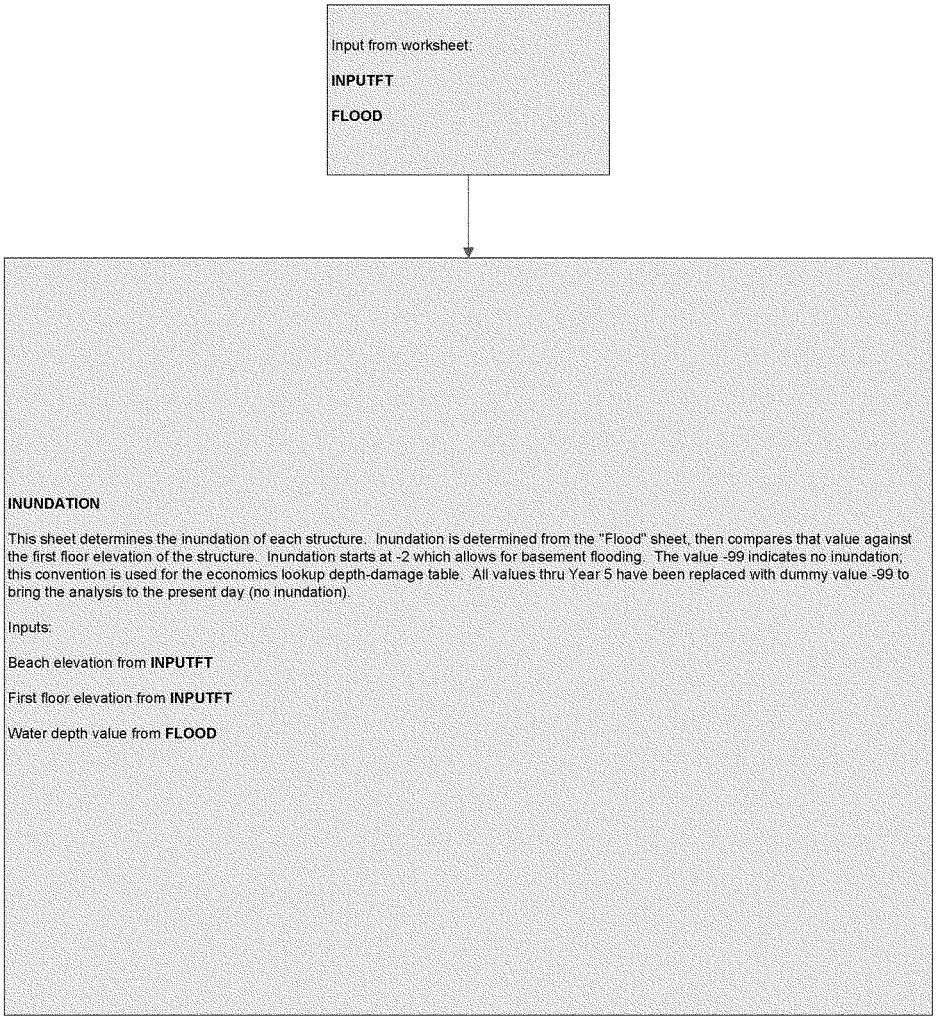
Inputs:

Period from **COASTAL**

Overtopping value from **OVERTOP**

Beach width from **LTSHORELINE**

WORKSHEET: INUNDATION



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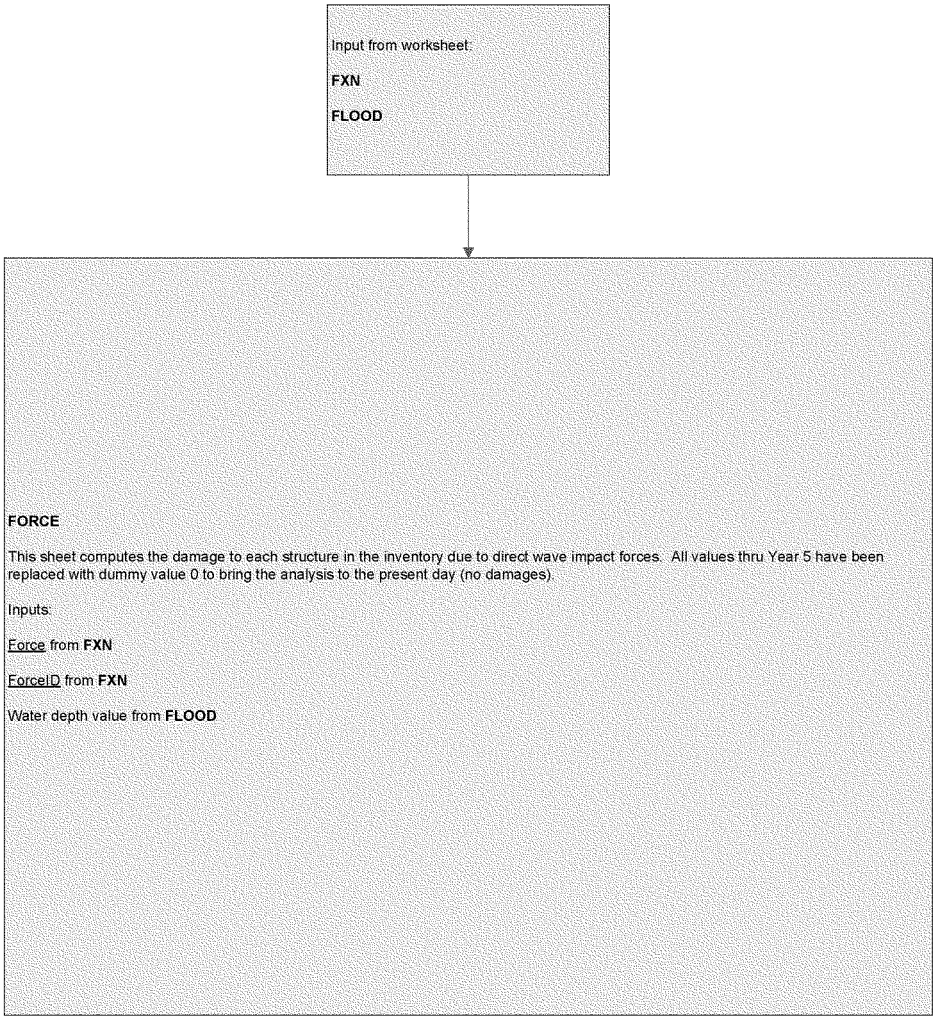
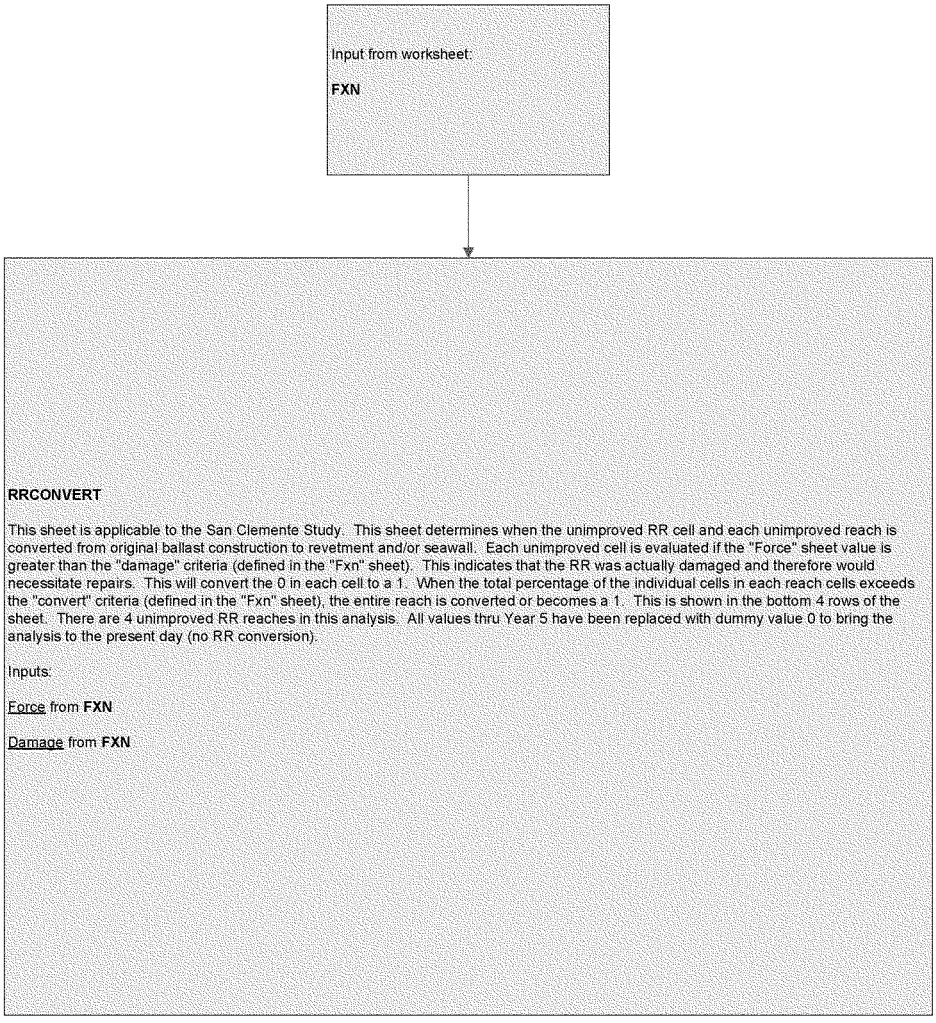
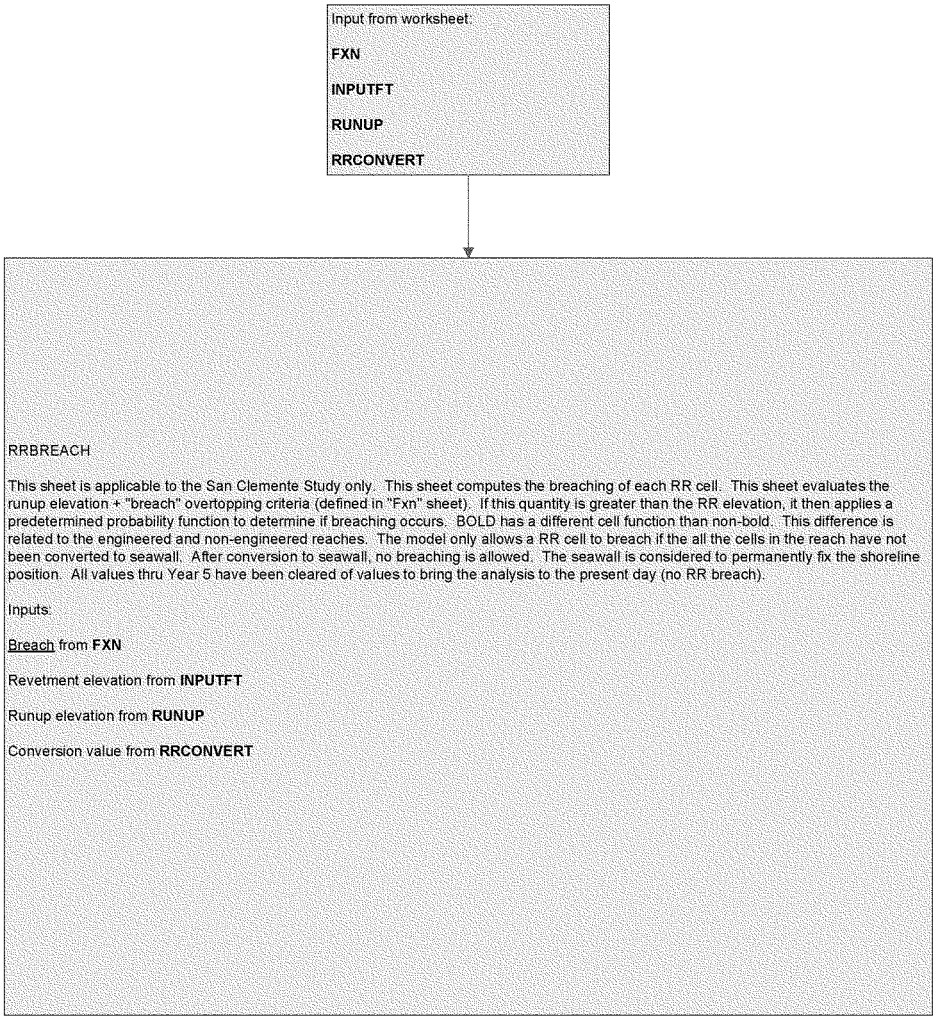


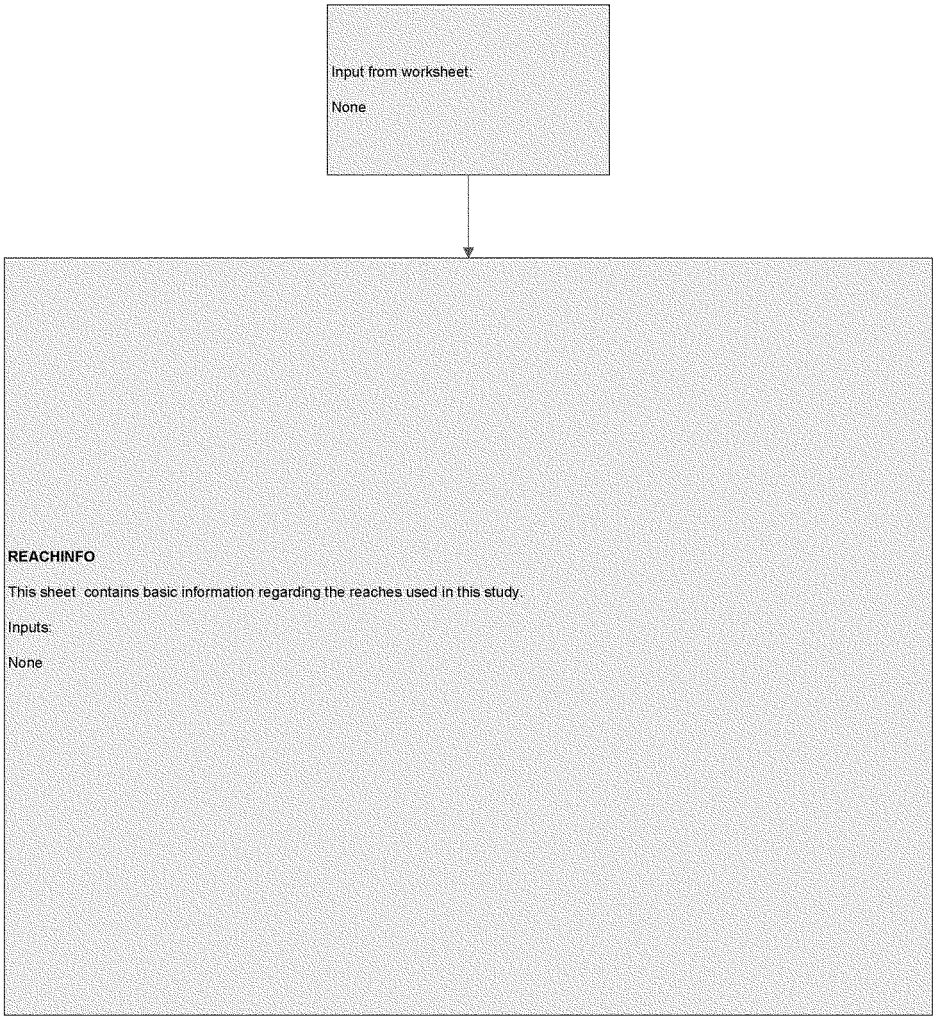
WORKSHEET: RRCONVERT



WORKSHEET: RRBREACH



WORKSHEET: REACHINFO



San Clemente Shoreline Feasibility Study
Orange County, California

REAL ESTATE PLAN

Final Report

U.S. Army Corps of Engineers
Los Angeles District

JULY 2011

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Real Estate Plan

ABSTRACT OF PROJECT DATA

Project Name: San Clemente Shoreline Protection Project

Purpose: This plan is prepared in accordance with ER405-1-12, and is for planning purposes in support of the Feasibility Report for the San Clemente Shoreline Protection Project. This Real Estate Plan is intended to identify the real estate requirements in support of this shoreline protection project, estimated baseline costs using baseline cost estimates, and provide a schedule for accomplishing real estate actions by the Local non-Federal Sponsor, the City of San Clemente.

Study Authority: This feasibility study is authorized under the general authority of the U.S Army Corps of engineers to assess proposed shoreline protection and storm damage reduction under the various coastal and shore protection missions of the Corps of Engineers and the Secretary of the Army. The current study is being prepared as an interim response to the following authority:

Section 208 of the Flood Control Act of 1965 reads:

"*The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and territorial possessions, which include the localities named in this Section….*

Coasts of Washington, Oregon, and California to determine the advisability of protection work against storm and tidal waves."

In addition, the Corps of Engineers was requested under the Energy and Water Development Appropriations Act of 2000, Public Law 106-60 to conduct such a study specific to this locale. Specifically language attending the passage of that Appropriations Act reads:

The Committee recommendation includes funds for the Corps of Engineers to conduct a reconnaissance study investigating shoreline protection alternatives for San Clemente, California.

1.0 PROJECT DESCRIPTION

Project activities for the borrow, transport and placement of the sand on the San Clemente Shoreline will most probably be performed using hopper dredging equipment to extract the material from the offshore borrow area, the use of pump and pipelines to slurry the material over to the near shore area and beach zones, and conventional earthmoving equipment to spread and place the material in the designated fill profile. Previous beach fill projects implemented in the Los Angeles District have used large capacity open ocean type dredges operating at selected and approved dredged material extraction areas operating offshore. The extraction site for this project is approximately 34 km (21) miles from the receiver beach. It is probable that a hopper dredge used in

conjunction with pumping equipment to deliver the material to the beach site would be utilized for this operation. The exact method and types of construction equipment may be modified or adapted slightly from this general scenario as long as all regulatory mandates, contract specifications, and permitting requirements are obtained during construction.

The project activities on the beach are expected to be carried out using conventional earthmoving equipment such as bulldozers and front end loaders to transport and place the material and create the intended beach surface, slope and profile.

The NED plan is to establish a shoreline profile approximately 15 meters (50 feet) wide and roughly 1,040 meters (3,411 feet) in length at the project site. The volume of material to be transported and placed is approximately 192,000 cubic meters (251,000 cubic yards).

2.0 DESCRIPTION OF LANDS, EASEMENTS, AND RIGHTS-OF-WAY

The Non-Federal Sponsor (NFS) will acquire a lease from the California State Lands Commission for the offshore borrow area. The borrow lease will specify the purpose for the borrow and transport of offshore sand material and its specific location and placement for on-shore beach renourishment.

On several similar shore protection projects in Southern California, the Los Angeles District has worked successfully with Non-Federal Sponsors that have acquired these California State Lands Commission leases to implement numerous coastal projects including dredging projects, harbor projects and shoreline protection projects. These instruments are issued by the California State Lands Commission in accordance with their jurisdictional control and administration of state lands and resources. Offshore leases to extract dredged material and on shore use permits issued under the authority of the California State Lands Commission (CSLC) have been used successfully to implement numerous beach renourishment and shoreline protection projects in the District and the Region. The use of what is an essentially a borrow site lease for the extraction and placement of the sand on the beach has been coordinated and endorsed during Agency Technical Review (ATR) and Division level review.

Since this authorization is not "land based" they are not measurable or quantifiable in terms of acreage.

Construction is planned to occur during a period of seasonably mild wave climate between October and perhaps May or possibly extending to June.

Other than the California State Lands Commission leases and permits there are only two small temporary work areas or contractors staging areas located on the upland areas that will be required for the project. Location 1 is a small area within the City of San Clemente public Parking Lot estimated at only 140 square meters (1,500 square feet). Location 2 is another small area in the same City of San Clemente public access area on the beachfront near the Marine Safety Headquarters of approximately 185 square meters (2,000 square feet). These areas are depicted on Figure 2 and presented here below in Table 1

TABLE 1 CONSTRUCTION STAGING/ACCESS AREAS

Designation	Estate	Owner	Area (m^2, ft^2)	Area (acres)
Location 1	Temp Work Area Easement	City SC	140, 1500	0.03
Location 2	Temp Work Area Easement	City of SC	185, 2000	0.04
Offshore Dredge Site and Beach Zone	CSLC Lease	State of CA	0 *Not Measureable	0 * Not Measureable

3.0 CREDITING FOR LANDS, EASEMENTS, AND RIGHTS-OF-WAY

Crediting is expected to follow normal procedures and will be governed by a standard model. There are no extraordinary or special issues affecting these project lands or the project formulation. Credits for administrative and incidental costs for obtaining permits, leases and temporary work areas would also be credited as governed in PPA language.

For a project estimating purposes, the NFS would be eligible to receive credit for the temporary staging and construction use areas and for incidentals and administrative expenses and any fees for the California State Lands Commission lease and permit. Based on consultation with the NFS and CSLC during the formulation of the project and experience with other similar shoreline protection projects a baseline cost estimate has been developed. This baseline cost estimate has been wrapped up into the overall project MCACES estimate under the "Lands and Damages" cost account category. Table 2 represents the "Lands and Damages" baseline cost estimate at February 2008 price levels. The total cost estimate is rounded to $12,000.

TABLE 2 LANDS AND DAMAGES

Recommended Plan	**Land - LERRD'S**
Temporary construction easement to be Acquired by Non-Federal Sponsor	
Temporary work area easement(10 spaces on access road)	$1,650.00
Temporary work area easement (Marine Safety Headquarters Parking Lot)	$1,680.00
Processing fee -California State Lands Commission	$3,025.00
Non-Federal Sponsor owned Land	
Pier Bowl Parking Lot (10 parking spaces)	$1,500.00
Contingency 25%	$ 2,000.00
Non-Federal Administration Costs	$ 1,000.00
LERRD's Total	$ 10,855.00
Federal Administration Costs	$ 1,000.00
Contingency 25%	$ 250.00
Total Real Estate Costs Rounded	$12,100 **$ 12,000**

4.0 ESTATES

There are no non-standard estates required to implement this project.

5.0 FEDERALLY-OWNED LAND

There are no federally owned lands in the project area. There are no existing Federal projects within the project area.

6.0 EXTENT OF NAVIGATION SERVITUDE

The Federal navigation servitude is not being invoked for this project.

7.0 MAP

Maps and exhibits of the project area and the shoreline areas are included as Figures 1, 2, and 3 attached to this Real Estate Plan.

8.0 CONSTRUCTION INDUCED FLOODING

This is a shoreline protection project involving dredging operations and placement of dredged material on the beach. It will not entail any construction induced flooding.

9.0 PL 91-646 RELOCATION ASSISTANCE BENEFITS

There are no Public Law 91-646 relocations to consider within the proposed project area.

10.0 HAZARDOUS WASTE ASSESSMENTS

The sponsors fully understand their responsibilities for assessing the properties for any potential or presence of hazardous waste materials as defined and regulated under CERLA. There are no known "Superfund" sites or sites presently under CERCLA remediation or response orders identified in the project area. There is no known presence of any substances in the project area that are regulated under CERCLA or other environmental statutes or regulations. Assessments and site investigations for the presence of such substances have not been conducted to date. The LERRD estimate is predicated on the assumption that all lands and properties are clean and require no remediation. The model Project Partnership Agreement (PPA) conditions shall be followed in assigning responsibility and cost allocation for such matters.

11.0 DESCRIPTION OF PRESENT OR ANTICIPATED MINERAL ACTIVITY

There is no present or anticipated mineral activity in the proposed project area.

12.0 NON-FEDERAL SPONSORS' ACQUISITION CAPABILITY

The non-Federal sponsor, the City of San Clemente, has the legal authority, the human resource capabilities, and the financial resources to sponsor this project. The project does not involve any condemnation or the use of eminent domain procedures. The City of San Clemente already possesses the on-shore locations needed for temporary work areas and shall make them available for project implementation. As a municipality established by the State of California the City of San Clemente has adequate authority and capability to act as Non Federal Sponsor and to implement all aspects of the project including fulfillment of its NFS obligations as set forth in the PPA. The Sponsor's Capability Checklist is attached.

13.0 ENACTMENT OF ZONING ORDINANCES

No special zoning ordinances will be invoked or used in lieu of acquisition required for the project.

14.0 ACQUISITION SCHEDULE AND MILESTONES.

The following schedule anticipates a WRDA authorization in 2011. Milestones have been appropriately scheduled to provide ample time for prerequisite and following actions such as PPA signing, advertisement and certification of required real estate. Actions such as pre-development and review of a PPA would occur during "PED Phase" so when a WRDA is enacted, project implementation would be ready to. The schedule has been found that it is practical and achievable. This is the earliest date based on the construction window for work on the shoreline and offshore areas. The window dictates that construction would commence in the fall season. The mandates of the seasonal window would mean that construction would occur in the next year should there be any slippage in the "early start- early finish" or best case schedule.

WRDA Authorization for the project	Fall 2011
PPA signed	Dec 2011
Notice to Proceed with Acquisition	By April 2012
Completion of Acquisition	June/July 2012
Authorization for Entry for Construction	July 2012
Advertise Construction Contract	July/August 2012
Construction Contract Award	August/September 2012
Initiate Construction	October 2012

15.0 DESCRIPTION OF FACILITY/UTILITY RELOCATIONS

There are no facility or utility relocations needed for this project. According to the scope of the project, there is no reason to contemplate relocation of alteration of any utilities.

16.0 SUPPORT/OPPOSITION FOR PROJECT

Public participation has taken place throughout the feasibility study phase and preparation of the NEPA project documentation. Several public workshops were held throughout the study process. There is general support for beach nourishment on the San Clemente Shoreline.

17.0 LAND ACQUISITION BEFORE PROJECT PARTNERSHIP AGREEMENT

The Project Sponsor will be advised in writing of the risks associated with acquiring land prior to the execution of the Project Partnership Agreement.

18.0 RECOMMENDED ESTATES

The standard estates for temporary work areas are recommended to be used for this project. The Sponsor will be acquiring a lease to borrow materials from the offshore borrow site and a shoreline use permit from the California State Lands Commission. In the course of project formulation, ATR review , the AFB review and consultation within the District and with Division counterparts, the use of what is essentially a borrow site lease issued by the California State Lands Commission to the Non-Federal Sponsor has been deemed sufficient to implement the project.

Per the California State Lands Commission, California became a state on September 9, 1850, and thereby acquired nearly 4 million acres of land underlying the State's navigable and tidal waterways. Known as "Sovereign Lands", these lands included the beds of 1) more than 120 rivers, streams and sloughs; 2) nearly 40 non-tidal navigable lakes, such as Lake Tahoe and Clear Lake; 3) the tidal navigable bays and lagoons; and 4) the tide and submerged lands adjacent to the entire coast and offshore islands of the State from the mean high tide line to three nautical miles offshore. This watery domain, equal in size to Connecticut and Delaware combined, is managed by the California State Lands Commission.

The State holds its "sovereign lands" in Public Trust. They can only be used for public purposes consistent with provisions of the Public Trust such as fishing, water dependent commerce and navigation, ecological preservation and scientific study.

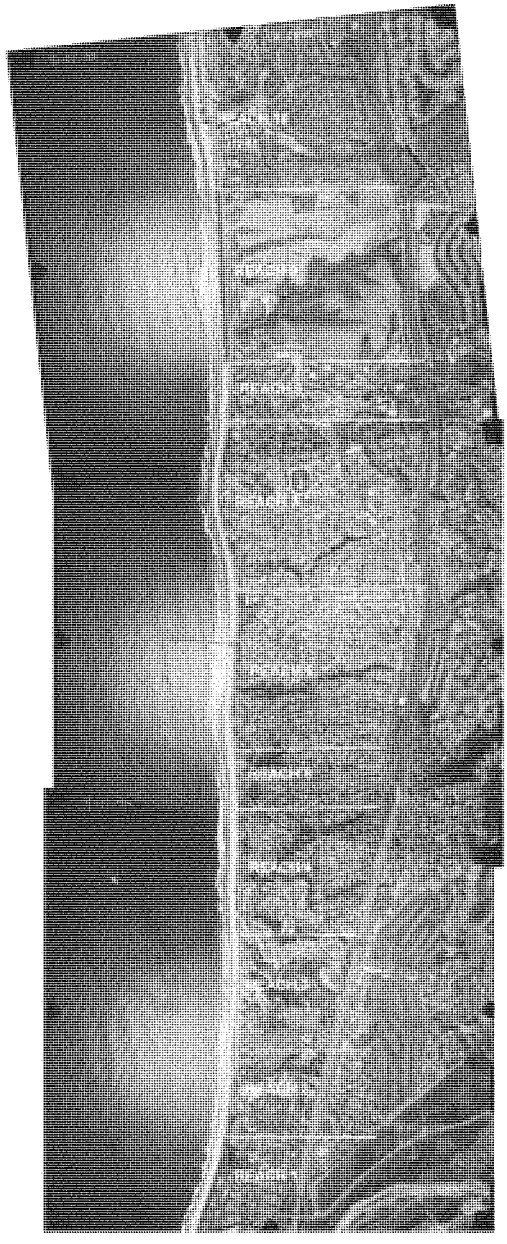

FIGURE 1 STUDY AREA MAP

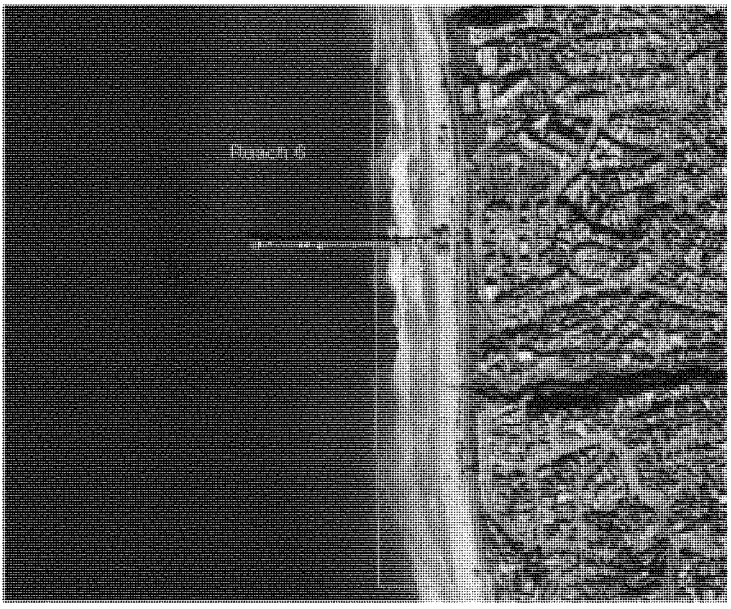

FIGURE 2 PROJECT AREA

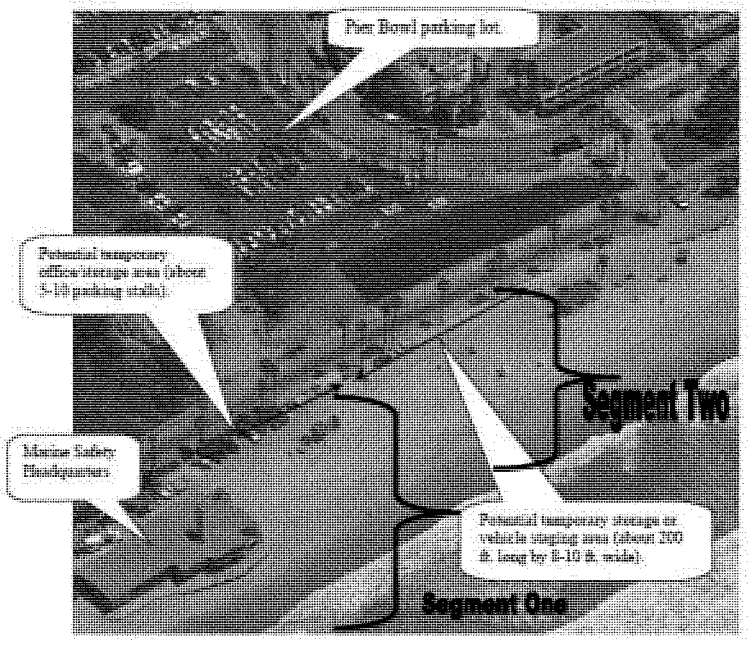

FIGURE 3 PROJECT PLAN VIEW

FIGURE 4 SPONSOR CHECKLIST

ASSESMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY SAN CLEMENTE SHORELINE PROTECTION PROJECT

CITY OF SAN CLEMENTE

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? *Yes.*

b. Does the sponsor have the power of eminent domain for this project? *No. The project involves placing sand on lands owned by the city and by the State of California. The City does not have eminent domain power over the State.*

c. Does the sponsor have a "quick-take" authority for this project? *Yes, provided that the requisite Court order is approved.*

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? *Yes. A license agreement or similar will likely be required from the State lands Commission for placement of sand with State Lands jurisdiction.*

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? *Yes, see above.*

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? *No, since the project will not require acquisition of property.*

b. If the answer to II a is yes, has a reasonable plan been developed to provide such training?

_____

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? *Yes.*

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load if any, and the project schedule? *Yes.*

e. Can the sponsor obtain contractor support, if required, in a timely fashion? *Not applicable.*

f. Will the sponsor likely request USACE assistance in acquiring real estate? *No.*

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? *Yes.*

b. Has the sponsor approved the project/real estate schedule/milestones? *Yes.*

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? *Not applicable (this is sponsor's first USACE project).*

b. With regard to this project, the sponsor is anticipated to be: highly capable/ **fully capable**/moderately capable/marginally capable/insufficiently capable.

V. Coordination:

a. Has this assessment been coordinated with the sponsor? *Yes.*

b. Does the sponsor concur with this assessment? *Yes.*

CITY OF SAN CLEMENTE

George Scarborough, City Manager

Reviewed and approved by:

Theresa M. Kaplan
Chief of LA Asset Management Division