Silver Strand Shoreline
Imperial Beach, CA

Final General Reevaluation Report
October 2002

U.S. Army Corps of Engineers
Los Angeles District
911 Wilshire Boulevard
Los Angeles, California

Executive Summary

Introduction

The City of Imperial Beach lies within the Silver Strand littoral cell, which extends from Point Loma to south of the US/Mexico border. The Silver Strand Shoreline was initially a natural sand spit, supplied with sediment primarily by the Tijuana River. Since the 1940s and construction of dams and reservoirs on the river, the ocean side of the Silver Strand has had to be artificially renourished to reduce beach erosion. Currently, the southern part of the Silver Strand littoral cell is eroding, while there is some accretion in the north (upcoast).

The shoreline at the City of Imperial Beach is severely impacted by this erosion. Estimates of the sediment budget indicate that approximately 76,000 cubic meters (100,000 cubic yards) per year is eroding from the Imperial Beach reach, corresponding to a shoreline retreat rate of two meters per year (6.6 feet per year). Many private property owners have constructed stone revetments or vertical seawalls to protect their property, but these non-continuous protection structures do not solve the erosion issue, and may fail as the beach recedes. Intermittent beach fills have been constructed, but not at a sufficient quantity to halt the shoreline retreat. At the current retreat rate, the shoreline in the North Reach is expected to reach the first line of development by 2007.

The following figures show the built-up area of the City of Imperial Beach during a high tide in January 1998. The left-hand photograph was taken from Ebony Avenue looking north (North Reach). The right-hand photograph was taken from Ebony Avenue looking south (South Reach). The cobbles exposed in this photograph indicate a complete loss of beach sand in the South Reach due to seasonal beach erosion.

History of This Project

The Corps was authorized by the River and Harbor Act of 1958 to build five stone groins along the City of Imperial Beach beach front to stabilize, restore and maintain the former recreational beach, and to prevent over wash into the back shore areas. The plan of improvement provided for a system of five stone groins, the northernmost at the north end of the existing U. S. Naval Radio

Station seawall and the other four at intervals of about 300 meters (1,000 feet). Construction was supposed to start with the northernmost groin and proceed as the downcoast side of each groin filled with sand. Groin No. 1 (northernmost) was completed in September 1959 and extended in 1963. Groin No. 2 was completed in January 1961. The groins were not effective and the project was deferred.

The City requested that the Corps reactivate the project and investigate alternative means to stabilize and restore the beach. A Post Authorization Change Report, reflecting a submerged offshore breakwater in lieu of a groin system, was approved by the Chief of Engineers in 1979. After award of a construction contract in 1985, a Federal District Court enjoined the project on the basis that significant changes had occurred since the Environmental Impact Study (EIS) had been prepared in 1978. The main concern raised by opponents of the project was that the EIS did not evaluate the impacts of constructing the project in phases, including the impacts if one or more of the phases could not be completed. A suit was brought by Knox (Surfrider Foundation) vs. the City of Imperial Beach. The construction was terminated, but as the contract had already been awarded, project cost-shared, contributed funds could not be reimbursed to the local interests. The Imperial Beach authorized project was re-classified to deferred category in 1993-94.

Without-Project Conditions and Damages

During the winter of 1952-53, storm waves caused the shoreline to recede and local residents suffered damages estimated at up to $25,000 (1953 dollars) to private and public property. In 1980 and again in 1983, waves damaged the municipal pier. It was badly damaged during the storm of 1988, and has since been replaced with a longer, higher structure.

In January 1988, a significant storm attacked the Southern California coast with high winds and waves. According to the Imperial Beach Times of February 1988, the 2.3-meter (7.5-foot) high tide plus 97-kilometer per hour (60-mph) winds sent waves as high as 6 meters (20 feet) crashing against the shore, hurling water, sand, and seaweed between and through oceanfront homes, flooding streets, cars, and low-lying structures behind the beach for up to three blocks from the ocean. Electricity and telephone lines were interrupted. The clean-up cost was $100,000, and damages to buildings were estimated at $165,000 (1988 dollars).

If no action is taken at the City of Imperial Beach, its properties and structures will be susceptible to damages caused by erosion (including loss of land and of properties), inundation, and wave attack. In the South Reach, local and private interests have installed revetment across the beach face of the majority of the beachfront buildings. Where the revetment ends just south of the development, high tides and winter storms wash debris and sand around the revetment and cause nuisance flooding to the southernmost end of Seacoast Drive. However, the revetment is expected to stabilize the long-term erosion in the South Reach, so that no loss of land or major loss of property is anticipated.

Storm damage protection structures in the North Reach vary between individual properties, consisting of rip rap, engineered revetments and various types of vertical seawalls. These protection devices vary significantly in effectiveness at reducing wave related damages. Local policies in the North Reach prohibit additional stone revetments, and while new structures are being built with vertical seawalls, the high costs associated with seawalls rule out their construction for many existing property owners. Since the shoreline protection in the North Reach is and will remain discontinuous, it is not expected to halt the long-term erosion. Loss of land and structures is therefore anticipated.

In both the North and South Reach, the beach will continue to narrow under the without-project conditions, leading to a decline in recreational value.

Alternatives Considered

A broad set of project alternatives was initially considered:

1. Beach nourishment alone;
2. Breakwaters with beach nourishment;
3. Additional and extended groins with beach nourishment;
4. A new continuous revetment in the North Reach;
5. A new continuous revetment in the North Reach and a raised revetment in the South Reach;
6. A new seawall in the North Reach.

The only project alternative that met all of the planning objectives, particularly of economic efficiency and public and regulatory acceptability, was the beach nourishment alternative. This alternative was carried forward for further analysis.

A set of beach nourishment alternatives was then defined. For all alternatives, the design berm cross-section and slope were defined to match the historical beach profiles at Imperial Beach and at neighboring healthy beaches. 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 also indicates that the erosion rate has been increased relative to the rate for a berm at the natural elevation, which is an inefficient use of beach fill material. The resulting design berm elevation is +4.0 meters (+13 feet) MLLW, with the foreshore slope set at 15H:1V. The proposed beach nourishment is 2,165 meters (7,100 feet) long, extending from the northerly groin to the southern end of development.

The required sand would be dredged from offshore, from one of two borrow areas. Borrow Area A is located approximately 2 kilometers (1.2 miles) north of the Imperial Beach pier. Borrow Area B is located approximately 4.5 kilometers (2.8 miles) south of the Imperial Beach pier. Both borrow areas contain beach compatible sand, and enough sand is believed to be present in either borrow area alone for the preferred project alternative.

Beach nourishment alternatives were developed by considering different beach widths and different periodic nourishment intervals. Inundation and wave force analyses indicate that structure damages attenuate to zero after the nourishment beach width (the distance from the existing berm limit to the filled foreshore berm) is 25 meters (82 feet) or greater. A 12 meter (39 foot) nourishment beach width was defined as a minimum project, for which some damages are anticipated during the project lifetime. A 54 meter (177 foot) nourishment beach width was defined as the maximum project, being the maximum size that is economical to construct and with no damages anticipated during the project lifetime. Intermediate projects were also defined, giving the following set of project alternatives determined by the beach width:

1. Beach width 12 m (39 feet), fill volume 450,000 m^3 (590,000 cubic yards);
2. Beach width 25 m (82 feet), fill volume 925,000 m^3 (1,210,000 cubic yards);
3. Beach width 34 m (112 feet), fill volume 1,250,000 m^3 (1,635,000 cubic yards);
4. Beach width 54 m (177 feet), fill volume 2,000,000 m^3 (2,615,000 cubic yards).

This set of alternatives is considered in the economic optimization procedure that identifies the National Economic Development (NED) plan.

In conjunction with the beach width alternatives, a set of periodic nourishment intervals was developed. The base nourishment beach width provides the minimum protective width that reduces or eliminates structure damages. The periodic nourishment provides the sacrificial portion of the beach which is allowed to erode to the base beach width and then refilled. The nourishment intervals were based on the concept of minimum, maximum, and intermediate candidate nourishment intervals. The minimum nourishment interval was defined at 5 years and is the shortest interval which is realistic and cost efficient to construct. The precedent for this 5 year nourishment interval is the Orange County Beach Erosion Control Project (Surfside-Sunset) conducted by the Los Angeles District. The maximum project is defined as the one-time quantity of beach fill for which no renourishment is anticipated to be necessary in the 50 year project lifetime. Intermediate level projects were defined, giving a set of five periodic nourishment intervals: 5, 10, 15, 22 and 50 years.

The primary consideration in selecting the periodic nourishment interval is the associated cost. Since the advance nourishment portion of the beach is considered sacrificial, it is not considered in the estimate of project benefits. Therefore, it is possible to optimize separately for the base nourishment beach width and the periodic nourishment interval. The following table gives the annualized cost of periodic nourishment for each periodic nourishment interval.

Nourishment Interval	Average Annual Cost
5 year	$775,882
10 year	**$636,052**
15 year	$646,074
22 year	$718,340
50 year	$1,161,468

Since project benefits are not affected by the periodic nourishment interval, it can be concluded that the 10-year nourishment interval, with the lowest annualized cost, is the most cost-effective.

With the periodic nourishment interval defined, the economically optimal beach width alternative can be determined. Annual project benefits for each beach width alternative are given in the following table. The primary focus of this project is the reduction of property damage due to long-term erosion, inundation and wave attack. However, recreational benefits will accrue from the project, and are included in the analysis.

	Without-Project	Alternative 1 12 meters	Alternative 2 25 meters	Alternative 3 34 meters	Alternative 4 54 meters
Storm Damages	$ 1,793,000	$ 83,000	-	-	-
Benefits	-	$ 1,710,000	$ 1,793,000	$ 1,793,000	$ 1,793,000
Recreation Costs	$ 987,000	$ 40,000	$ 3,000	-	-
Benefits	-	$ 947,000	$ 984,000	$ 987,000	$ 987,000
Total Benefits	**-**	**$ 2,657,000**	**$ 2,777,000**	**$ 2,780,000**	**$ 2,780,000**

With a 10-year periodic nourishment interval, the benefit-cost (B/C) ratio and net benefits for each alternative are listed below.

	Alternative 1 12 meters	Alternative 2 25 meters	Alternative 3 34 meters	Alternative 4 54 meters
Annualized Cost	**$1,377,000**	**$1,554,000**	**$1,676,000**	**$1,956,000**
Damage Benefits	$ 1,710,000	$ 1,793,000	$ 1,793,000	$ 1,793,000
Recreation Benefits	$ 947,000	$ 984,000	$ 987,000	$ 987,000
Annualized Total Benefits	**$ 2,657,000**	**$ 2,777,000**	**$ 2,780,000**	**$ 2,780,000**
B/C Ratio	**1.93**	**1.79**	**1.66**	**1.42**
Net Benefits	**$1,280,000**	**$1,223,000**	**$1,104,000**	**$824,000**

The Recommended Plan is the NED Plan is the plan that has a benefit-to-cost ratio greater than unity and produces the greatest benefits. **Alternative 1 with a 10-year nourishment cycle is the Recommended Plan** of the four alternatives and five nourishment cycles considered.

Environmental Impacts

The following table summarizes the environmental impacts of both the without-project alternative and the Recommended Plan. The significance categories are defined as follows:

- Class I: Significant impact that cannot be mitigated to a level that is not significant
- Class II: Significant impact that can be mitigated to a level that is not significant
- Class III: Potentially adverse impact but not significant
- Class IV: Beneficial impact
- NI: No Impact.

Environmental Issue	Without-project Alternative					Recommended Plan				
Significance Category	**I**	**II**	**III**	**IV**	**NI**	**I**	**II**	**III**	**IV**	**NI**
Topography / Geology	Y						Y		Y	
Coastal Processes					Y			Y	Y	
Water Resources					Y			Y		
Essential Fish Habitat					Y			Y		
Biological Resources					Y			Y	Y	
Cultural Resources					Y		Y			
Aesthetics			Y					Y	Y	
Air Quality			Y					Y		
Noise		Y					Y	Y		
Socioeconomics			Y						Y	
Transportation			Y				Y	Y		
Land Use	Y							Y	Y	
Recreation	Y		Y				Y	Y	Y	

Unavoidable significant impacts associated with the without-project condition include the following:

- ***Topography / Geology and Land Use***: Erosive and geotechnical failures on the slope upon which beachfront properties are located.

- ***Recreation***: Restriction of recreational uses associated with onshore activities.

No unavoidable significant impacts result from implementation of the Recommended Plan. The following impacts require mitigation to be reduced to a level that is less than significant:

- ***Topography / Geology***: Chronic or large leaks and spills from construction equipment could contaminate soil and water.

- ***Cultural Resources***: The identification of cultural resources in the project's area of potential effects (APE) has not been completed. Therefore, the potential exists for the presence of National Register eligible properties within the project's APE.

- ***Noise***: Short-term construction noise impacts are anticipated.

- ***Transportation***: Construction equipment and staging areas may impose access restrictions and safety problems.

- ***Recreation***: Fill material that contains shell fragments could have an adverse effect on users of the beach. The south end of the study area, which is currently not included in the designated swim area, would likely attract more swimmers since some of the typical swim areas could be closed; swimmers could thereby be exposed to perilous ocean conditions in an area not patrolled by lifeguards. Finally, construction equipment and staging areas would impede beach access and use.

Mitigation measures are proposed that would reduce these impacts to less than significant. With mitigation, environmental resources would experience either adverse but insignificant impacts, beneficial impacts, or no impact during construction or in the long term.

Recommended (National Economic Development) Plan

The recommended (NED) plan, Alternative 1, involves construction of a base beach fill consisting of 450,000 cubic meters (589,000 cubic yards) of suitable beach sand, plus a sacrificial advance beach fill of 764,000 cubic meters (1,000,000 cubic yards), for a total initial beach fill of 1,214,000 cubic meters (1,589,000 cubic yards). The placement will be 2,165 meters (7,100 feet) long extending from the northerly groin to the southern end of the development, providing a base nourishment beach width of 12 meters (39 feet) at an elevation of +4 meters (+13 feet) MLLW. The additional sacrificial beach width will be 20 meters (66 feet), so that initially the nourished beach will be 32 meters (105 feet) wider than the existing beach.

The nourished beach is expected to erode to the 12-meter (39-foot) width after 10 years. It will be renourished with a sacrificial advance beach fill of 764,000 cubic meters (1,000,000 cubic yards) every 10 years within the 50-year project lifetime.

The benefits of the Recommended Plan include structural, recreational and environmental benefits. Along the South Reach, the project will provide a sandy beach fronting the revetment and will minimize nuisance flooding to the southernmost end of Seacoast Drive. Along the North Reach, the project will provide protection for the existing coastal structures during coastal storms from being undermined, condemned, or destroyed.

Recreational benefits arise from the wider beach. Under without-project conditions, significant transfer costs will be incurred as recreational users of the beach are forced to travel to other beaches. The greater beach capacity will decrease these transfer costs.

A breakdown of the benefits of the Recommended Plan is given on the following page. The costs and benefits are annualized over the 50-year project lifetime. The net project benefit is estimated at $1,280,000 annually, with a benefit-to-cost ratio of 1.93.

Damages	Without-Project	Recommended Plan	Benefits
Erosion (structures)	$ 265,000	$ 0	$265,000
Erosion (land loss)	$ 450,000	$ 0	$ 450,000
Utility Relocation	$ 142,000	$ 0	$ 142,000
Wave Attack	$ 476,000	$ 0	$ 476,000
Inundation	$ 336,000	$ 12,000	$ 324,000
Clean-up Costs	$ 34,000	$ 1,000	$ 33,000
Revetment O & M	$ 90,000	$ 0	$ 90,000
Revetment Repair	$ 0	$ 70,000	($ 70,000)
Total Damage Benefits			$ 1,710,000
Recreation Transfers			$ 947,000
		Total Annualized Benefits	$ 2,657,000
		Total Annualized Costs	$ 1,377,000
		Benefit-to-Cost Ratio	**1.93**
		Net Benefit	**$ 1,280,000**

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Chapter 1 - Introduction

1.1 Study Authority

This General Reevaluation Report was authorized by Sec. 101, Public Law 85-500, River and Harbor Act of 1958, approved July 3, 1958, 72 Stat. 298, being in accordance with recommendations of the Chief of Engineers in House Document 399, 84th Congress, 2d. Session, stating in part:

"SEC. 101. That the following works of improvement of rivers and harbors and other waterways for navigation, flood control, and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers, in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated: ...San Diego County: House Document Number 399, Eighty-fourth Congress..."

1.2 Study Purpose and Scope

The purpose of this General Reevaluation Report is to define a solution to the existing beach erosion problem along the Silver Strand shoreline in the City of Imperial Beach in San Diego County, California, that reduces storm-related damages and complies with local, state, and Federal environmental laws and regulations.

The Feasibility Study reported here evaluated the viable alternative plans using established criteria including engineering, economics, and environmental quality. This report identifies the National Economic Development (NED) plan based on that alternative which attains the highest net benefits of all acceptable alternatives. It also includes sufficient engineering and design of project features to prepare the baseline cost estimate. Based on the results of this Feasibility Study, and coordination of the findings with interested Federal and non-Federal agencies and other public interests, a plan will be selected for proposed implementation.

The Feasibility Study was conducted in accordance with current U.S. Army Corps of Engineers (Corps) 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.

1.3 Study Participation and Coordination

This General Reevaluation report was prepared by the Los Angeles District, U.S. Army Corps of Engineers, in coordination with the Local Sponsor, the City of Imperial Beach, with support from the State of California, Boating and Waterways and the San Diego Unified Port District.

Throughout this study process, coordination with federal, state and local agencies has been accomplished to aid in the formulation and evaluation of the proposed Recommended Plan. These agencies included US Environmental Protection Agency (EPA), US Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), California State Fish and Game

(CSFG), Regional Water Quality Control Board (RWQCB), California Coastal Commission (CCC), local municipalities and other interested parties.

1.4 Corps Projects and Prior Studies

The following is a list of Corps studies and reports conducted in the Silver Strand Littoral Cell.

1960 San Diego County, California, Beach Erosion Control Study, Appendix IV, Phase 2, authorized by House Document 465.

1977 Imperial Beach, California Design of Structures for Beach Erosion Control, a hydraulic model investigation, WES Technical Report H-77-15.

1977 Breakwater Stability Study, Imperial Beach, California, a hydraulic model investigation, WES Technical Report H-77-22.

1978 Final Environmental Statement, Imperial Beach Erosion Control Project, San Diego, California, submitted in accordance with NEPA PL 91-190.

1978 Design Memorandum No. 4, General Design Memorandum, Imperial Beach Erosion Control Project, San Diego County, California, Main Report and Appendices, a project plan described in House Document 399 of the 84th Congress and authorized by PL 85-500.

1978 Effects of Beach Replenishment on the Nearshore Fauna at Imperial Beach, California, CERC MR 78-4.

1983 Imperial Beach Breakwater Monitoring Program, Final Proposal.

1984 Imperial Beach Breakwater Monitoring Program, Final (Revised) Proposal.

1984 Imperial Beach Erosion Control Project, Monitoring Program Results Report.

1985 Zuniga Jetty, San Diego, California, Lessons Learned, authorized in 1949 House Document 303, 81st Congress.

1985 U. S. Naval Amphibious Base, Coronado, Beach Replenishment Plan, authorized by Naval request, Special Project M1-84.

1990 Monitoring of a Nearshore Dredge Material Disposal Berm at Silver Strand State Park, San Diego, California. Pre-construction survey December 1988, final April 1991.

1991 Coast of California Storm and Tidal Waves Study - State of the Coast Report - San Diego Region, authorized through the Flood Control Act of 1965, and funds appropriated in 1981 by the 97th Congress.

1995 Silver Strand Shoreline (San Diego County, California) Reconnaissance Study Final Report. Authorized by resolution of the Committee on Public Works and Transportation of the House of Representatives, and adopted May 21, 1991.

1.4.1 Existing Corps Project

The Corps was authorized by the River and Harbor Act of 1958 to build five stone groins along the City of Imperial Beach beach front to stabilize, restore and maintain the former recreational beach, and to prevent over wash into the back shore areas. The plan of improvement provided for a system of five stone groins, the northernmost at the north end of the existing U. S. Naval Radio Station seawall and the other four at intervals of about 300 meters (1,000 feet). The southernmost groin was to be 120 meters (400 feet) south of Coronado Avenue (now Imperial Beach Boulevard). Construction was supposed to start with the northernmost groin and proceed as the downcoast side of each groin filled with sand. Groin No. 1 (northernmost) was completed in September 1959 and extended in 1963. Groin No. 2 was completed in January 1961 and has a total length of 120 meters (400 feet). The groins were not effective and the project was deferred.

The City requested that the Corps reactivate the project and investigate alternative means to stabilize and restore the beach. A Post Authorization Change Report, reflecting a submerged offshore breakwater in lieu of a groin system, was approved by the Chief of Engineers in 1979. After award of a construction contract in 1985, a Federal District Court enjoined the project on the basis that significant changes had occurred since the Environmental Impact Study (EIS) had been prepared in 1978. The main concern raised by opponents of the project was that the EIS did not evaluate the impacts of constructing the project in phases, including the impacts if one or more of the phases could not be completed. A suit was brought by Knox (Surfrider Foundation) vs. the City of Imperial Beach. The construction was terminated, but as the contract had already been awarded, project cost-shared, contributed funds could not be reimbursed to the local interests. The Imperial Beach authorized project was re-classified to deferred category in 1993-94.

1.4.2 Other Corps Projects

The following is a list of other Corps projects built in the Silver Strand Littoral Cell.

1977 Placement of 840,000 cubic meters (1.1 million cubic yards) of beach fill from a San Diego Harbor dredging project to create a 45-meter (150-foot) wide, 1500-meter (5,000-foot) long beach at Imperial Beach.

1990 Nearshore placement and monitoring of 145,000 cubic meters (190,000 cubic yards) of material dredged from the entrance of San Diego Harbor and deposited offshore of Silver Strand State Beach, San Diego, California, 1988-1991, WES DRP-1-01.

1995 Maintenance dredging at San Diego Bay Entrance of 153,000 cubic meters (200,000 cubic yards) of material deposited in the nearshore area of Silver Strand Shoreline.

1.5 Other Projects

Other related non-Corps coastal projects along the Silver Strand Littoral Cell are listed below.

1946 Placement of 20 million cubic meters (26 million cubic yards) of dredge material north of Silver Strand State Beach.

1957 Construction of a 300-meter (1,000-foot) revetment at south Imperial Beach.

1963 Imperial Beach municipal pier construction.

1967 Placement of 30,600 cubic meters (40,000 cubic yards) of beach fill at Naval Amphibious Base.

1967 Construction of 180-meter (600-foot) steel pile bulkhead at Naval Radio Station.

1975 Construction of revetment on Playas de Tijuana Beach in Mexico.

1976 Placement of 2.7 million cubic meters (3.5 million cubic yards) of beach fill north of Silver Strand State Beach.

1983 Repair of Imperial Beach Pier, and addition of a 75-meter (250-foot) T-platform.

1985 Placement of 840,000 cubic meters (1.1 million cubic yards) of beach fill at the Naval Amphibious Base.

1990 Reconstruction of the municipal pier at Imperial Beach to 450 meters (1,500 feet) in length.

1995 Placement of 177,000 cubic meters (233,000 cubic yards) of dredge material from U. S. Navy San Diego Bay Pier 2 dredging project in the nearshore area of Imperial Beach south of the municipal pier.

1995 Placement of 31,500 cubic meters (41,000 cubic yards) of dredge material from U. S. Coast Guard Ballast Point in the nearshore area of Imperial Beach south of the municipal pier.

2001 Placement of 92,000 cubic meters (120,000 cubic yards) of beach fill from an offshore borrow site as part of the SANDAG Regional Beach Replenishment Project.

Chapter 2 - Study Area

2.1 Overview

The Silver Strand is a relatively narrow sand spit that extends northward from the Tijuana River inlet to a landmass at the entrance of the San Diego Bay, in San Diego County, California. It separates San Diego Bay from the Pacific Ocean, and includes from north to south the shorelines of the North Island Naval Air Station, the City of Coronado, the Navy Amphibious Base, Silver Strand State Beach, the Naval Radio Station, and Imperial Beach. The Silver Strand shoreline is located within the jurisdictions of both the City of Coronado and the City of Imperial Beach.

The study area is located along the southernmost stretch of the Silver Strand shoreline that corresponds with the corporate boundary of the City of Imperial Beach, approximately 5.8 kilometers (3.6 miles) from the U.S. Naval Radio Station to the U.S./Mexico border. Figure 2-1 shows a map of the study area.

North of the study area, the Silver Strand was originally a naturally occurring sand spit (see Figure 2-2). Fill placed in 1944 connected the two landmasses. Historically, beach erosion has occurred along the entire shoreline, and its beaches have been maintained by renourishment since the 1940s.

The major regional physical features are the Tijuana River estuary and delta and the ocean side shoreline of the sandy beaches of the Silver Strand. The Silver Strand Littoral Cell extends approximately 27 kilometers (17 miles) from the Zuniga Jetty at the entrance of San Diego Bay downcoast to Playas de Tijuana located 5 kilometers (3 miles) south of the U.S./Mexico border.

Figure 2-1: Study Area Map

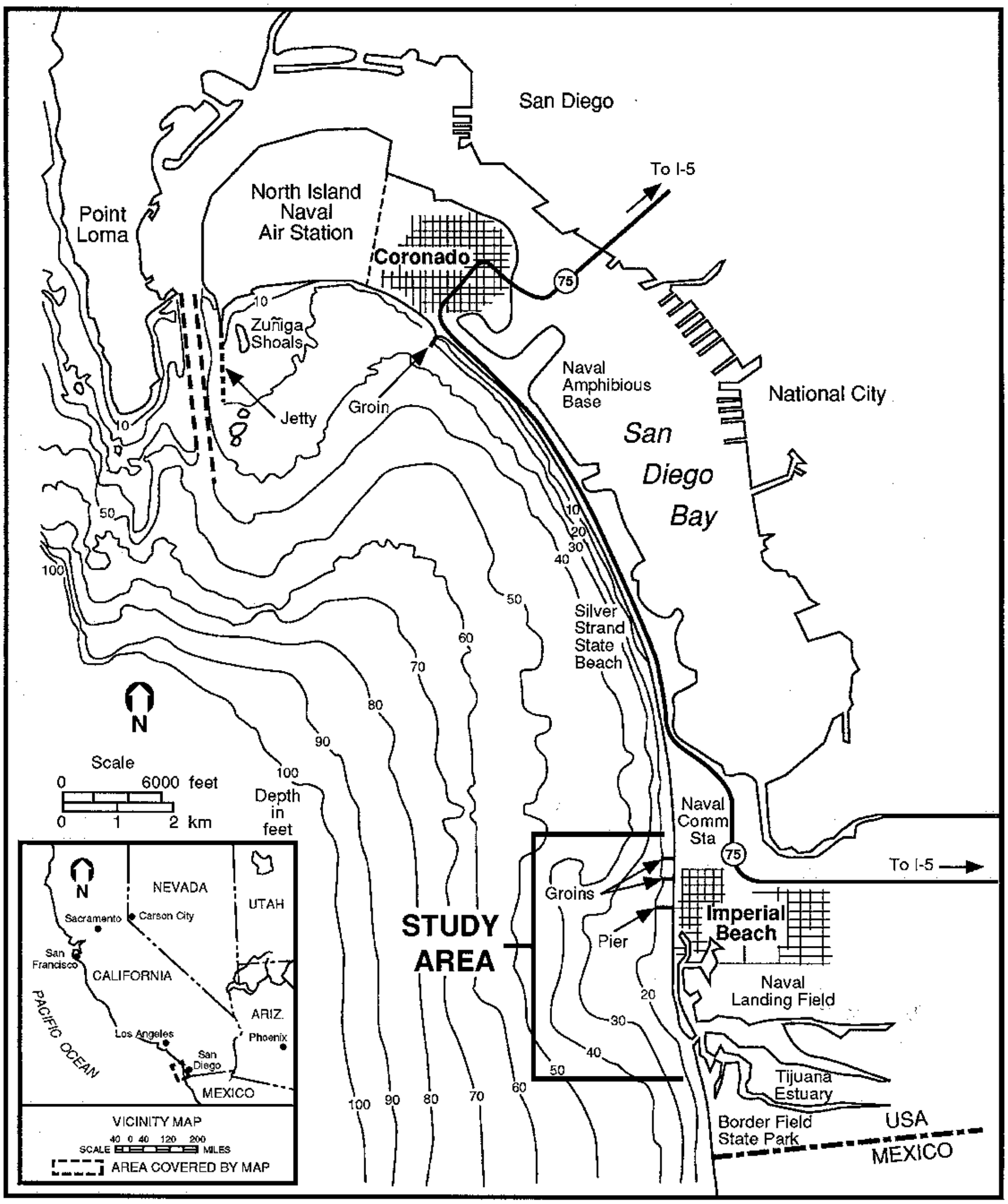
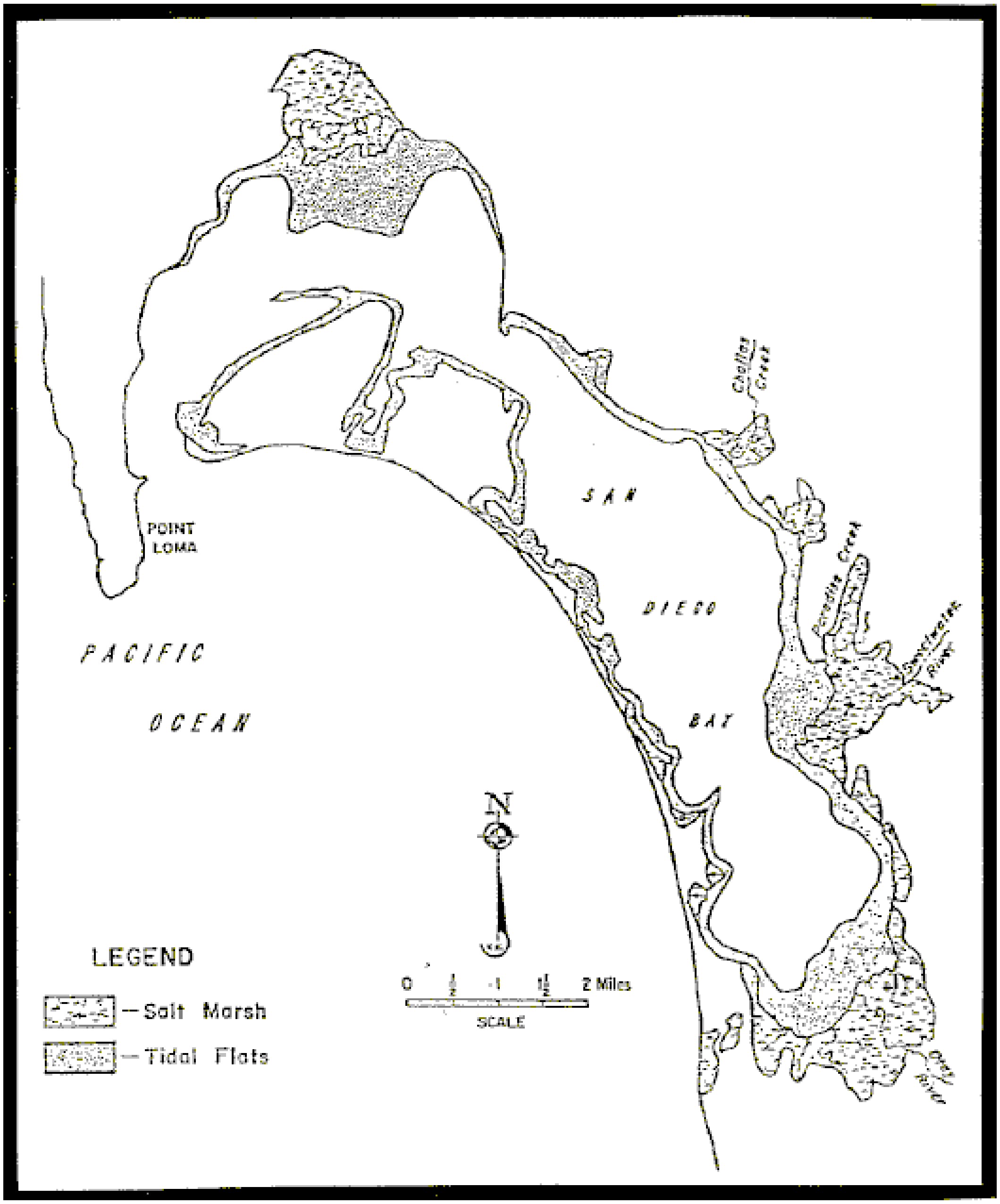


Figure 2-2: The Silver Strand, 1857



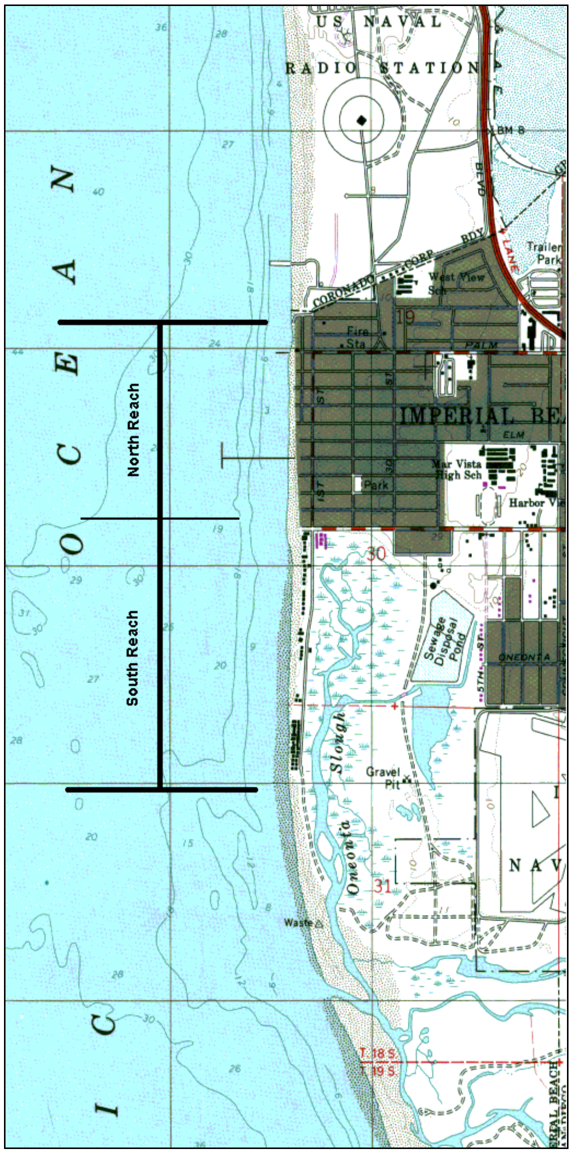
Source: Local Coastal Program, Coronado City Council, 1979

2.1.1 Reaches

The Silver Strand beach is divided into three reaches for reference purposes: Imperial, Silver Strand, and Coronado. This study is primarily concerned with the Imperial Reach. The following defines the reach boundaries in kilometers from the United States/Mexico international border, and describes the major projects and shoreline features located within each reach.

Imperial Reach: The Imperial Reach extends from the international border at kilometer 0.0 to kilometer 8.0 (mile 5.0), a little north of the corporate boundary of the City of Imperial Beach. Approximately two kilometers of this area are developed. The developed portion of the Imperial Reach is the study area; it is further divided into two sub-reaches, Imperial North and Imperial South, depicted in Figure 2-3. The low sandy dunes begin again downcoast of the developed area.

Figure 2-3: Imperial North and South Sub-Reaches (study area)



Imperial North extends from the northern boundary of the City of Imperial Beach south to Ebony Avenue. Most of the residential structures that front the narrow beach have no additional protection. Some structures are inadequately protected with rubble-mound revetment. A few new apartment and condominiums are protected by sea walls varying in size, construction and level of protection.

Imperial South extends from Ebony Avenue to the southern limit of Seacoast Drive. This city portion of the reach is characterized by a very narrow beach backed by a massive riprap wall composed of 4,000-7,000 kilogram (4 to 7 ton) stones in front of the development. Southward of the study area, the beach widens, and low dunes extend past the Tijuana River estuary outlet to the U.S. Border.

Silver Strand Reach: The Silver Strand Reach extends from the southern end of San Diego Bay at kilometer 8.0 (mile 5.0) to the groin at the Hotel Del Coronado at kilometer 17.7 (mile 11.0). The MSL beach width along this reach, according to the CCSTWS, ranges from 60 meters (200 feet) in the south to 180 meters (600 feet) near the northern end.

Coronado Reach: The Coronado Reach extends from the hooked groin at the Hotel Del Coronado at kilometer 17.7 (mile 11.0) to Zuniga Jetty at kilometer 21.9 (mile 13.7). In general, the beach in this area is wide and accreting. The CCSTWS, Main Report, indicates that MSL beach widths in this reach range up to 215 meters (705 feet).

2.2 Geotechnical Conditions

2.2.1 Geology and Geomorphology

San Diego County lies within the geomorphic Peninsular Range Province of Southern California. This Province is characterized by a flat coastal plain with steep sloped hills and a series of northwest to southwest trending elongate mountain ranges dissected by faults that are separated from one another by alluvial valleys.

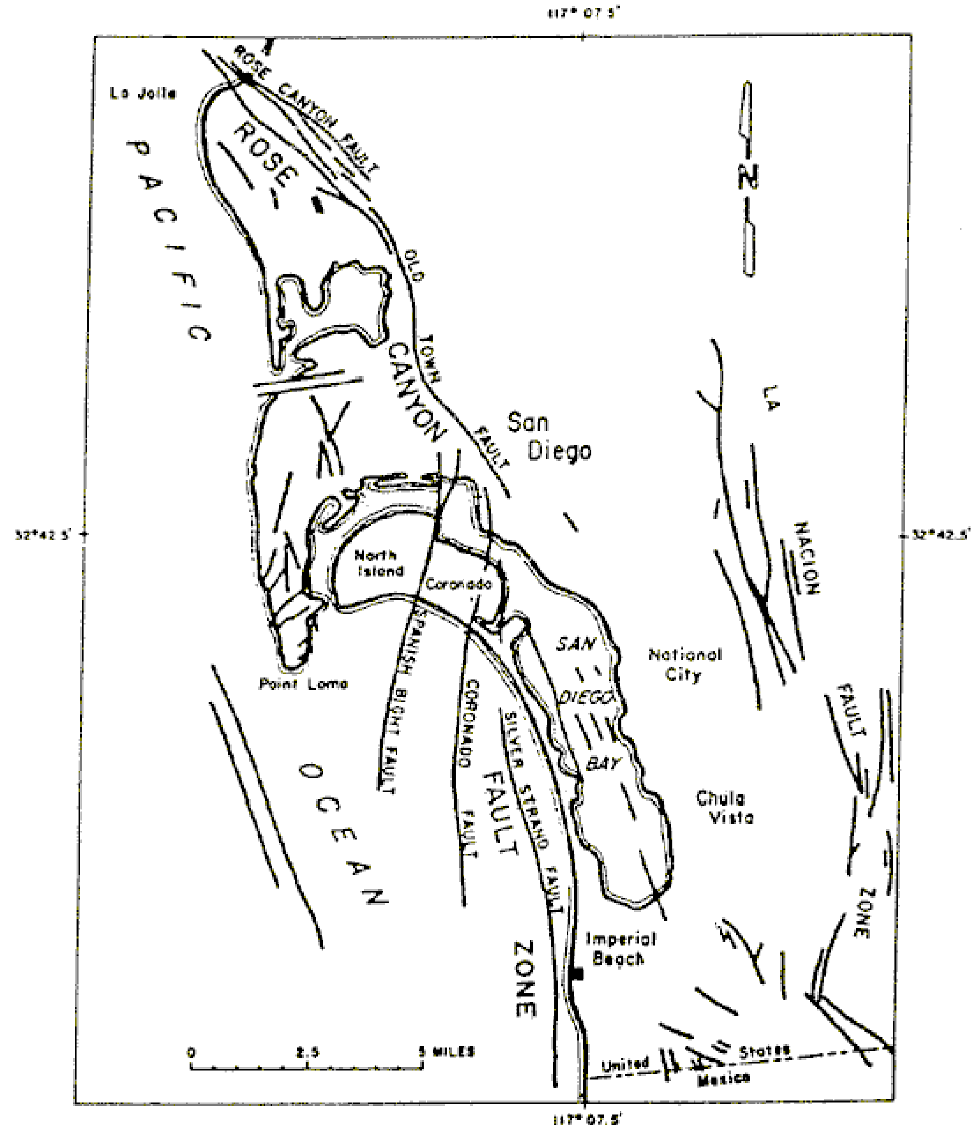
San Diego Bay’s outermost coastal areas sit upon recent Quaternary beach sand, alluvium, artificial fill and older Quaternary sandstone, whereas the inner city is founded on recent Quaternary alluvium and older Quaternary sandstone.

Silver Strand is situated near the western edges of a down-dropped fault-controlled basin. The basin is a localized north-south trending structural feature that is centered beneath San Diego Bay and extends from the U.S.-Mexico border to Mission Valley. The Silver Strand is a littoral formed spit and terrace island composed of Quaternary recent (Holocene) and older (Pleistocene) sediments and sedimentary rock deposits of the coastal plain.

2.2.2 Seismicity

Although the San Diego area is part of the southern California region of high seismicity, historical records indicate that the San Diego region is one of the more stable areas. Over the last 200 years, all damaging earthquakes have occurred outside a 72-kilometer (45-mile) radius from Silver Strand. The last earthquake of significant magnitude (5.6) was in 1862 with an epicenter 16-kilometers (10 miles) offshore from Silver Strand.

Figure 2-4: Regional Fault Map



There are seven recognized active fault zones capable of producing earthquakes that could be felt at Silver Strand. The Rose Canyon and Coronado Bank faults, shown in Figure 2-4, could generate the most damage because they are the closest. Active branches of the Rose Canyon fault lie less than 1.6 kilometers (1 mile) offshore from Imperial Beach, and are believed to be an extension of the Newport-Inglewood fault zone.

Ground failure can be caused by both natural and man-induced activities such as: surface fault displacement, liquefaction and differential settlement from earthquakes; and subsidence from subsurface mining of solids, over pumping of groundwater and drilling of oil and gas.

2.2.3 Beaches

The Silver Strand beaches are composed primarily of clean sands and silty sands. The largest natural source of sand for the Silver Strand was the Tijuana River. The mean grain size decreases upcoast (the predominant longshore drift direction) from approximately 0.25 mm down to 0.15 mm.

Portions of Imperial Beach are covered by a gravel and cobble shingle due to a depleted sand supply. The gravel and cobbles are derived from an older Holocene riverbed alluvium of the Tijuana River.

2.3 Climate

The area enjoys the semi-arid subtropical Mediterranean climate typical of coastal southern California, characterized by warm, dry summers and mild winters. Temperatures average 12 °C (54 °F) in January and 21 °C (70 °F) in August. The average annual precipitation along the coastal area is about 250 millimeters (10 inches), occurring primarily from November to March. Most of the rainfall occurs during winter storms, and fog is common during the winter months. Winds are generally of low velocity. Prevailing winds are from the northwest and west, blowing onshore nearly every afternoon. Tropical storms generated in the Pacific Ocean occasionally bring stronger winds, but these are generally of short duration.

2.4 Coastal Processes

The study area is entirely within the Silver Strand Littoral Cell. This littoral cell extends approximately 27 kilometers (17 miles) from the headland at the south end of the Playas de Tijuana, 5 kilometers (3 miles) south of the United States/Mexico border, and upcoast to the Zuniga Jetty on the south side entrance of San Diego Bay. Detailed descriptions of coastal parameters, calculations, discussion of methodologies, and relevant tables are presented in the Coastal Engineering Appendix.

2.4.1 Tides

Tides along the southern California coastline are of the semi-diurnal type, consisting of two high and two low tides each of different magnitude. Table 2.1 shows tidal datum levels at San Diego Bay, which are equivalent to those at Imperial Beach. The tidal epoch is 1960 to 1978.

Table 2.1: Tide Datum Elevations at San Diego Bay.

Tidal Datum	Elevation meters (feet), MLLW
Highest observed water level (01/27/83)	2.55 (8.4)
Mean Higher High Water (MHHW)	1.75 (5.7)
Mean High Water (MHW)	1.52 (5.0)
Mean Sea Level (MSL)	0.95 (3.1)
Mean Tide Level (MTL)	0.90 (3.0)
National Geodetic Datum - 1929 (NGVD)	0.83 (2.7)
Mean Low Water (MLW)	0.29 (1.0)
Mean Lower Low Water (MLLW)	0.00 (0.0)
Lowest observed water level (12/17/73)	-0.88 (-2.9)

2.4.1.1 Sea Level Change

Historic trends at San Diego, CA indicate a positive sea level rise of 2.6 mm per year. If these past trends continue, a sea level rise of 0.13 meters is expected over the next 50 years.

2.4.2 Bathymetry/Topography

Bathymetric and topographic survey data were obtained from publicly available information and 1997 measured surveys respectively.

The nearshore bathymetry is shown in Figure 2-1. The nearshore morphology is dominated by Point Loma, Zuniga Shoals, and Delta Point.

Terrestrial topographic data were obtained from August 1997 aerial photogrammetric surveys conducted as part of this study. Topographic maps compiled from the data provided detailed information on the beach, revetment, and nearby structure ground elevations.

Representative cross-shore beach profiles developed from the 1997 data substantiate previously known trends: the north reach beach is generally wider than the south reach beach, and the beach in the north reach between the municipal pier and the south groin is wider than that between the groins. The data indicate foreshore beach slopes of about 1:15 (vertical : horizontal).

2.4.3 Waves

Measured wave data were taken from a directional wave height recorder placed offshore of the Imperial Beach Pier in 11 meters of water as part of the Coastal Data Information Program (CDIP). The instrument provided wave data records from 1983-1987 at nominally four observations per day. The Coastal Engineering Appendix gives details of the data records. In general, the most commonly occurring wave height is in the range 0.6 to 0.7 meters (2.0 to 2.3 feet). The most probable wave periods are in the range 5-7 seconds, with a secondary peak at 13 seconds. Approximately 91% of the waves approach from the relatively narrow 20-degree band between 260° and 280°, and all other approach directions are minor or negligible. Figure 2-5 illustrates the wave exposure for the San Diego region.

Figure 2-5: Wave Exposure for the San Diego Region

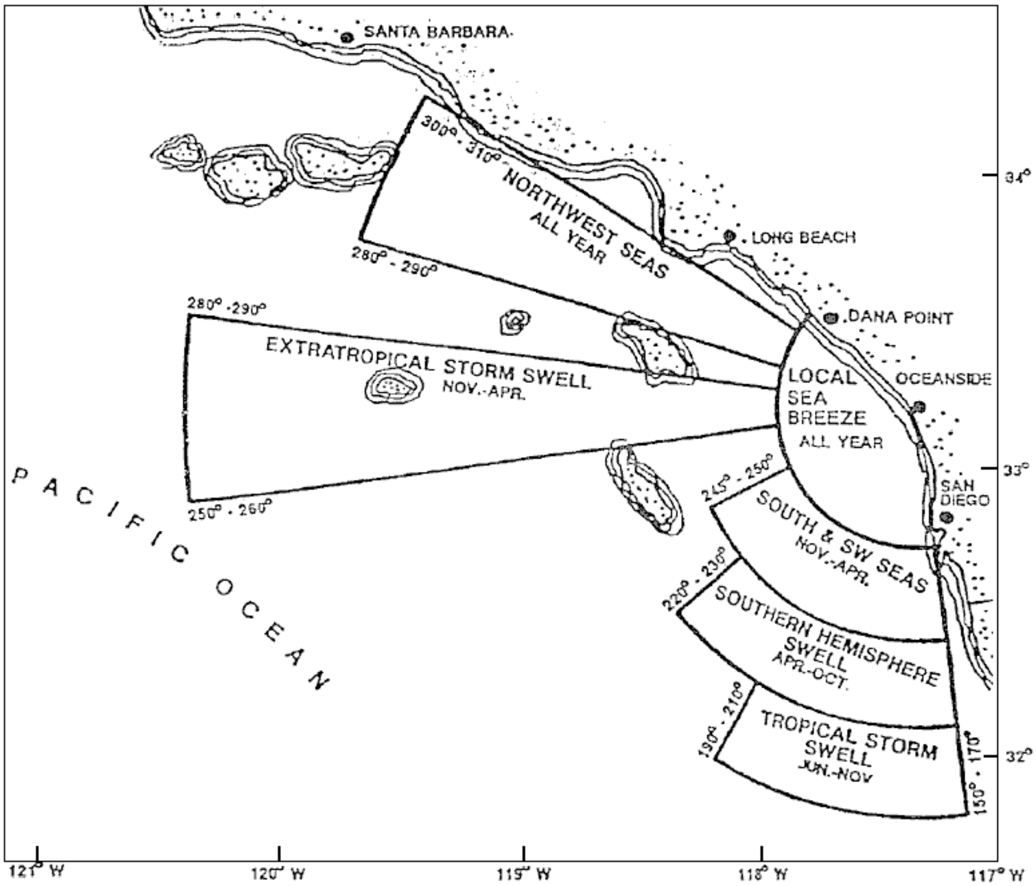


Table 2.2 presents the extreme nearshore waves (significant wave height) for the entire Silver Strand cell by return period. The significant wave heights were determined in the prior Reconnaissance Study, using data from 34 severe storm events between 1904 and 1988. For the more extreme events (greater return periods), the waves are depth-limited, that is, the significant wave height in the nearshore is limited by the fact that waves above a certain height will break.

Table 2.2: Imperial Beach Extreme Wave Heights (Depth 8 meters)

Return Period (Years)	Significant Wave Height (m)	Runup (MLLW, North sub-reach) (m)	Runup (MLLW, South sub-reach) (m)
100	6.2	6.4	6.6
50	6.2	5.9	6.2
25	6.1	5.5	5.9
10	5.3	4.8	5.4
5	4.8	4.3	5.0
1	4.2	3.2	3.9

2.4.4 Sediment Budget

The sediment budget for future without-project conditions was based on the Coast of California Storm and Tidal Wave Study, San Diego Region, 1991 (CCSTWS). The budget includes the sediment sources, sinks, and losses; transport modes; and erosion and accretion rates. Table 2.3, from the CCSTWS, summarizes the budget. The sediment budget shows a net volume loss of 76,000 cubic meters per year (100,000 cubic yards per year) from the Imperial Reach.

Table 2.3: Future Sediment Budget, Silver Strand Littoral Cell (1000 m^3 per year)

Variable	Range of Estimates	Selected
Coronado		
Q_{lin} (north)[1]	130 to 138	130
Q_{out}	92 to 122	92
Volume Change	+38 to +15	+38
Silver Strand		
Ql_{in} (north)	50 to 153	76
Ql_{out} (north)	138 to 130	130
Q_a[2]	0 to 38	38
Volume Change	-88 to +61	-15
Imperial		
Ql_{out} (north)	153 to 50	76
Ql_{out} (south)	0 to 153	54
Q_{river}[3]	107 to 13	46
Q_{delta}[4]	15 to 0	8
Volume Change	-31 to -190	-76

[1] Q_l - Longshore transport. Q_{lin} is into the sub-cell while "(north)" indicates direction.
[2] Q_a - Artificial fill
[3] Q_{river} - Input from Tijuana River
[4] Q_{delta} - Input from erosion of river delta

2.4.5 Shoreline Change

Based on historical shoreline positions, the current net erosion rate corresponds to shoreline retreat at a rate of approximately 2 meters per year (6.6 feet per year).

Geotechnical investigations of sand thickness in the south reach carried out in 1988 indicated that, with a net volume loss of 76,000 cubic meters per year (100,000 cubic yards per year), sand would be available to erode from the beach for 25 years – that is, until 2013. After this time, the available sand thickness would be eroded and the beach would consist largely of sand and pebbles. This analysis assumes that geotechnical conditions in the north reach are identical to the south reach.

The photogrammetric survey carried out in 1997 updated this estimate. The survey provided updated measurements of beach widths throughout the study area. Based upon these beach widths, the available sand thickness was projected to erode after 10 years – that is, by 2007. After 10 years, it is assumed that the semi-armored shoreline presented by the cobbles and boulders will retard the shoreline erosion. Continued future erosion beyond 2007 will begin to undermine the seaward coastal structures. The natural armoring of cobbles and boulders, the presence of hard structures, and assumed human intervention will together retard the natural rate of shoreline change. This report assumes that after 2007, the shoreline change rate will drop from its current 2 meters per year (6.6 feet per year) to 1 meter per year (3.3 feet per year).

2.5 Environmental Resources

This section summarizes the description of environmental resources and threatened and endangered species given in the Environmental Impact Statement (EIS) included with this report.

2.5.1 Water Resources

Nearshore ocean water conditions are summarized as follows.

- Water temperatures range from approximately 14°C (57°F) (winter minimum) to 22°C (72°F) (summer maximum). During summer, surface water temperatures are up to 10°C (18°F) warmer than those in deeper waters are.

- Nearshore salinity is generally uniform, from 33 to 34 ppt. Seasonally, the near-surface salinity can decrease near the mouth of the Tijuana River following storm-related discharges of freshwater and/or (historically) intermittent discharges of sewage into the river.

- Dissolved oxygen concentrations typically lie between 6.5 and 10 milligrams per liter (mg/L), but may drop below 5 mg/L at depths of 60 meters (200 feet).

- Light transmittance (indicating water clarity) was measured at 75% to 87% by the City of San Diego (1996). Some reduction was associated with storm activity, particularly in shallower, nearshore waters. Both light and nutrients are needed to support photosynthesis by attached and planktonic plants.

- Nutrient concentrations are expected to be similar to those elsewhere in the Southern California Bight: nitrates at 5 to 200 nanomoles per liter; phosphates at 100 to 500 nanomoles per liter; and ammonium at 300 nanomoles per liter. Discharges from the Tijuana River and Estuary likely represent an important seasonal source of nutrients to nearshore waters. Upwelling events also contribute nutrients to surface waters

Historically, bacterial levels in nearshore surface waters of the study area have been affected by episodic discharges of domestic sewage carried by the Tijuana River and flowing north along the coast. These releases have resulted in beach closures for periods up to several days following reduction or elimination of these sources. Recent diversions of flows from Mexico to the Tijuana River have reduced the frequency of these events, although facility problems resulting in discharges of untreated sewage to the river still occur occasionally.

Runoff from the Tijuana River reportedly contains the highest concentrations of suspended solids, metals (cadmium, chromium, copper, nickel, lead, and zinc), and total polychlorinated biphenyls (PCBs), and the second highest concentrations of DDT, among the eight largest creeks and rivers in southern California, with an estimated 2.2 kg of total polycyclic aromatic hydrocarbons (PAHs) released annually to coastal waters.

The National Oceanic and Atmospheric Administration (NOAA) Mussel Watch program has monitored chemical contaminants in seawater at a site on the Imperial Beach north jetty since 1986 by collecting and analyzing the tissues of filter-feeding mussels, which are used as a sentinel organism for marine water quality. Results from 1986 through 1993 showed significant declines in concentrations of mercury, selenium, total chlordane, and total PCBs, but significant increases in total PAHs. Total DDT concentrations in mussel tissues were characterized as high during each of four years and total dieldrin concentrations were considered high during one of four years. These trends likely reflect changes in the magnitudes of regional input sources.

No measurements of water quality conditions have been conducted at the offshore borrow areas.

2.5.2 Biological Resources

State or federally listed threatened and endangered species that likely occur in the vicinity of the study area, or are otherwise of high concern because of status and vulnerability, include the following:

- ***Salt marsh bird's beak***: This state- and federally listed endangered plant occurs in upper intertidal estuarine salt marsh habitats, often in wetland-upland transition zones. The Tijuana River Estuary is one of only five locations where this plant occurs.

- ***California brown pelican***: This state- and federally listed endangered species nests on offshore islands but is a common visitor and seasonal resident in the study area, foraging in nearshore waters and resting on piers and other shoreline structures. It is one of the most common waterbirds in San Diego Bay.

- ***Light-footed clapper rail***: This state- and federally listed endangered species nests in cordgrass marshes bordering channel-mudflat habitats in the Tijuana River Estuary, especially in the central and northern parts of the estuary.

- ***Western snowy plover***: This federally listed threatened species (also a state species of special concern) nests on sandy beaches and open flats, foraging along adjacent shorelines. Known nesting sites include dikes in the Salt Works in southern San Diego Bay, dunes at the mouth of the Tijuana River, and beaches on the outer coast of North Island and the Silver Strand. Wintering and migratory birds are also present, foraging and resting on beaches of the region. Area beaches north and south of the city of Imperial Beach are designated Critical Habitat for this species.

- ***California least tern***: This state- and federally listed endangered species nests in the beach and dunes fronting the Tijuana River estuary and forages in nearshore waters of the estuary, open ocean, and San Diego Bay. Nesting also occurs at other sites around San Diego Bay. The total breeding population in this region averages 150-300 pairs. This species is present in the region from early spring through late summer, wintering in Mexico.

- ***Belding's savannah sparrow***: This state-listed endangered species (also a federal species of concern) is a resident of the Tijuana River estuary, inhabiting pickleweed marsh of middle- to upper-intertidal elevations. As of 1990, roughly 300 pairs nested in the estuary, accounting for at least 10 percent of the state's population.

- ***Pacific pocket mouse***: This federally listed endangered species (also a states special concern species) appears closely associated with fine sandy soils supporting open coastal scrub, coastal strand, or salt marsh vegetation. It is endemic to the immediate coast of southern California and was known historically from the margins of the Tijuana River estuary, but was not found there in a recent intensive trapping effort.

Table 2.4 lists state and federally recognized threatened and endangered species, and Table 2.5 lists species of concern that may occur in the general vicinity of the Imperial Beach study area, including the Silver Strand, Tijuana River estuary, southern San Diego Bay, and adjacent areas. References for these occurrences are found in the Environmental Appendix. Vegetated coastal dunes north and south of Imperial Beach support a variety of state- and federally recognized species of concern. Several species of concern are reasonably likely on intertidal beaches and manmade structures, and offshore.

No threatened or endangered fish species occur in the general project region. Several species of threatened and endangered marine mammals (such as blue, fin, sei, humpback, and sperm whales) may occur in deep offshore areas off the San Diego County coast, but none are expected in the project area.

Table 2.4: Rare, Threatened, and Endangered Species Potentially Occurring in the Vicinity of Imperial Beach

Common Name (Scientific Name)	Status[1]	Occurrence
		PLANTS
Coastal dunes milk vetch *(Astragalus tener var. titi)*	FE, SE	Occurs north of Silver Strand Bayside campground; possible in coastal dunes north and south of Imperial Beach. Flowers March-May.
Salt marsh bird's beak (*Cordylanthus maritimus ssp. maritimus*)	FE, SE	Upper salt marsh communities, Tijuana River estuary, also at Sweetwater Marsh. Flowers May-October.
		BIRDS
Marbled murrelet *(Brachyramphus marmoratus)*	FT, CSC	Extremely rare visitor, photographed at Imperial Beach pier in 1979.
Western snowy plover *(Charadruis alexandrinus nivosus)*	FT, CSC	Several nesting locations around San Diego Bay, Silver Strand, and North Island; uncommon migrant, winter visitor; forages on beaches. Undeveloped shoreline areas north and south of the city of Imperial Beach are included in designated critical habitat for the species.
American peregrine falcon *(Falco peregrinus anatum)*	FE, SE	Occasionally seen foraging in San Diego Bay, associated with shorebirds, waterfowl. Nests on Coronado Bridge; possible foraging in study area.
Belding's savanna sparrow *(Passerculus sandwichensis beldingi)*	FSC, SE	Nests in pickleweed salt marshes, including those of the Tijuana River estuary; forages in marshes, coastal strand habitats.
California brown pelican *(Pelecanus occidentalis californicus)*	SE, FE	Frequent foraging in open water habitats throughout study area and resting along shoreline.
Light-footed clapper rail *(Rallus longirostris levipes)*	FE, SE	Resident of cordgrass-dominated low to middle salt marsh, with important nesting areas in Tijuana River estuary, San Diego Bay tidal marshes.
California least tern *(Sterna antillarum browni)*	FE, SE	Nesting locations in open habitats with sandy substratum around San Diego Bay on dunes and flats, partially developed shoreline areas; nests on NTC, North Island airfield, Delta Beach, Coronado Cays, and Tijuana River mouth; forages in nearshore waters.
		MAMMALS
Pacific pocket mouse *(Perognathus longimembris pacificus)*	FE, CSC	Historically present in open coastal scrub along immediate coast of southern California, recently rediscovered (Dana Point, Camp Pendleton); possible in coastal grassland and scrub habitats along the immediate coast.

1. FE = Federally listed as endangered; SE = State listed as endangered
FT = Federally listed as threatened
FSC = Federal Species of Concern; CSC = State listed Species of Special Concern

Table 2.5: Candidate/Special Concern Species Potentially Occurring in the Vicinity of Imperial Beach

Common Name (*Scientific Name*)	Status[1]	Occurrence
		PLANTS
Ahanisma (*Aphanisma blitoides*)	FSC, CNPS 1B	Records from coastal alkaline areas around San Diego Bay, including Imperial Beach. Flowers April-May.
Orcutt's bird's beak (*Cordylanthus orcuttianus)*	FSC, CNPS 2	Coastal scrub, on coastal slopes, Otay area, Tijuana Hills. Flowers March-Sept.
Coastal wallflower (*Erysimum ammophilum)*	FSC	Occurred historically along the Silver Strand but not observed in recent years; flowers February-May.
Coulter's saltmarsh daisy (*Lasthenia glabrata ssp. coulteri*)	FSC, CNPS 1B	Saline flats, known from Tijuana River estuary; flowers February-May.
Nuttall's lotus (*Lotus nuttallianus)*	FSC, CNPS 1B	Occasional in coastal dunes, old fill sites around San Diego Bay including Border Field State Park, Naval Amphibious Base, Coronado, Sweetwater Marsh, Naval Radio Receiving Marsh, and north and south Delta Beach. Observed in back dunes north of Imperial Beach (this study). Flowers March-June.
Coast woolly heads (*Nemacaulis denudata var. denudata*)	CNPS 2	Coastal dune habitats, with Nuttall's lotus. Flowers April-September.
Beach broom rape (*Orobanche parishii ssp. brachyloba*)	FSC, CNPS 1B	On sandy beaches; parasitic, known hosts include *Atriplex californica* and *Isocoma veneta*. Flowers May-September.
		INVERTEBRATES
Peninsular Range shoulderband snail (*Hemlinthoglypta traski coelata)*	FSC	Possible along beach fronts, sandy hummocks in study area.
California brackish water snail (*mimic tryonia)* (Tryonia imitator)	FSC	Possible in brackish areas of Tijuana River estuary.
Saltmarsh wandering skipper butterfly (*Panoquina errans*)	FSC	Larvae develop on saltgrass (moist, saline soils), occurs in salt marsh of Tijuana River estuary.
Barrier beach tiger beetle (*Cicindela hirticolis gravida)*	FSC	Found on clean, dry light-colored sand; possible on the Silver Strand.
Oblivious tiger beetle (*Cicindela latesignata obliviosa)*	FSC	Sandy intertidal flats; cited by USFWS as occurring in project region, but unconfirmed by other sources.
Globose dune beetle (*Coelus globosus)*	FSC	Found under dune vegetation, likely in vegetated dunes in study area.

Common Name (*Scientific Name*)	Status[1]	Occurrence
		REPTILES
Silvery legless lizard (*Anniella pulchra pulchra*)	FSC, CSC	Associated with dune plant root systems; known from Tijuana River estuary. Also possible in dunes north of Imperial Beach.
Orange-throated whiptail (*Cnemidophorus hyperythrus)*	FSC, CSC	Coastal scrub, chaparral habitats, possible in study area (USFWS 1994b), most likely in backdune coastal scrub habitats at north end of study area and at Tijuana River estuary.
Coastal western whiptail (*Cnemidophorus tigris multiscutatus*)	FSC	Coastal scrub, widely distributed in southern California, possible in vegetated dune and coastal scrub habitats in study area.
San Diego banded gecko (*Coleonyx variegatus abbotti*)	FSC	Coastal foothills, possible in study area.
Northern red diamond rattlesnake (*Crotalus ruber ruber)*	FSC, CSC	Widespread in San Diego County, possible in study area, most likely in backdune coastal scrub habitats.
San Diego ringneck snake (*Diadophis punctatus similis)*	FSC	Moist places throughout San Diego County, possible in study area.
Coronado skink (*Eumeces skiltonianus interparietalis*)	FSC, CSC	Silver strand endemic, possible in study area.
Coastal rosy boa (*Lichanura trivirgata rosafusca*)	FSC	Widespread in rocky chaparral habitats of San Diego County, cited by USFWS as possible in study area.
San Diego horned lizard (*Phyronsoma coronatum blainvillii*)	FSC, CSC	Inhabits sandy soils, feeds on wood ants, harvester ants. Known from backdune habitats on the Silver Strand.
Coast patch-nosed snake (*Salvadora hexalepis virgultea*)	FSC, CSC	Scrub habitats, widespread in San Diego County, possible in study area.
		BIRDS
Cooper's hawk (*Accipiter cooperi)*	CSC	Fall migrant at Point Loma, possible transient elsewhere.
Sharp-shinned hawk (*Accipiter striatus*)	CSC	Occasionally seen during winter migration; fall migrants at Point Loma.
Tricolored blackbird (*Agelaius tricolor)*	FSC, CSC	Freshwater marshes; doubtful in study area given lack of habitat.
Short-eared owl (*Asio flammeus*)	CSC (nesting only)	Winter visitor to salt marshes, e.g., Sweetwater Marsh.
Western burrowing owl (*Athene cunicularia hypugea*)	FSC, CSC	Occupies ground squirrel burrows in coastal dune areas; large colony on North Island; also possible on riprap.
Black tern (*Chlidonias niger*)	FSC, CSC	Uncommon migrant, summer visitor, San Diego Bay, Tijuana River estuary.
Northern harrier (*Circus cyaneus*)	CSC (nesting only)	Occasional migrant, reported from south San Diego Bay, Tijuana River estuary.
Reddish egret (*Egretta rufescens*)	FSC, CSC	Rare visitor to San Diego Bay, occurs in salt marshes, shorelines of sloughs and river channels.
California horned lark (*Eremophila alpestris actia*)	CSC	Nesting population around San Diego Bay, also a common migrant; possible along Silver Strand, Tijuana River estuary.
Merlin (*Falco columbarius*)	CSC	Rare winter and early spring migrant, predatory on shorebirds; likely as an occasional forager in study area.

Common Name (*Scientific Name*)	**Status[1]**	**Occurrence**
Prairie falcon (*Falco mexicanus*)	CSC (nesting only)	Rare to uncommon migrant, winter visitor; occurs in fields, grassland; doubtful in study area.
Common loon (*Gavia immer*)	CSC (breeding only)	In San Diego Bay, uncommon to fairly common migrant and winter visitor, rare to uncommon in summer; expected less frequently in open ocean, Tijuana River estuary.
Loggerhead shrike (*Lanius ludovicianus*)	CSC	Resident of beach and upland areas around San Diego Bay; expected along Silver Strand and around Tijuana River estuary.
California gull (*Larus californicus)*	CSC (nesting colony only)	Abundant fall-through-spring resident in shoreline habitats, throughout San Diego Bay.
Long-billed curlew (*Numenius americanus*)	CSC (breeding only)	Common during migration, winter, occasional as a summer visitor; occurs on mudflats, salt marshes, fields.
Osprey (*Pandion haliaatus carolinensis*)	CSC (nesting only)	Uncommon visitor (non-breeding) occasionally along North Island shoreline; observed feeding on fish in Oneonta Slough, January 2001.
Large-billed savannah sparrow (*Passerculus sandwishensis rostratus*)	FSC, CSC	Formerly a winter visitor, not seen recently (Unitt 1984); possible at Tijuana River.
Double-crested cormorant (*Phalacrocorax auritus)*	CSC (rookery only)	Common non-breeding visitor, rookery at Saltworks in south San Diego Bay; expected along shoreline of North Island and along Silver Strand.
White-faced Ibis (*Plegadis chihi*)	FSC, CSC	Uncommon migrant, rare winter visitor; reported from Tijuana River mouth.
Black skimmer (*Rynchops niger*)	CSC (nesting colony only)	Common resident, breeding in south San Diego Bay; likely in nearshore habitats on North Island and elsewhere.
Elegant tern (*Sterna elegans*)	FSC, CSC (nesting colony only)	Nesting colony in south San Diego Bay; common on beaches, mudflats, open water, and resting on shoreline structures; likely along Silver Strand.
Gull-billed tern (*Sterna nilotica*)	CSC (nesting colony only)	Nests at Saltworks in south San Diego Bay, most sightings also in south bay; possible foraging along Silver Strand.
MAMMALS		
San Diego black-tailed jackrabbit (*Lepus californicus bennetti*)	FSC, CSC	Locally common along Silver Strand; observed at Silver Strand State Beach, January 2001.
Dulzura California pocket mouse (*Perognathus californicus femoralis*)	FSC, CSC	Open scrub habitats, Santa Margarita River mouth, southward into Baja California.
Northwestern San Diego pocket mouse (*Perognathus fallax fallax*)	FSC, CSC	Open scrub habitats, western San Diego County and Baja California.

Notes: 1. FSC = Federal Species of Concern; SE = State listed as endangered
ST = State listed as threatened; CSC = State listed Species of Special Concern
CNPS 1B = California Native Plant Society List 1B, rare and endangered throughout range
CNPS 2 = California Native Plant Society List 2, rare and endangered in California but not elsewhere

2.5.3 Cultural Resources

The terrestrial portion of the study area was surveyed in 1973 by Ezell, an archeologist for the San Diego State University, with negative results. A survey of the beach portions of the project was performed again in 1994 by the Corps. No cultural resources of any significance were observed. The buildings along the beach and the Imperial Beach pier are all less than 50 years in age. The absence of archeological remains can be attributed to erosional and depositional processes. The land-based deposits within the study area are derived primarily from the Tijuana River downcoast, as well as dredge materials from San Diego Bay.

The marine portion of the study area, however, has not been completely surveyed. Six underwater resources are potentially located within the project's area of potential effects, based upon: USACE consultation with the State of California, Department of Parks and Recreation; review of Department of Interior, Minerals Management Service archeological site and shipwreck data; and two shipwreck publications, *Shipwrecks of Southern California* (Marshall, 1978) and *California Shipwrecks, Footsteps in the Sea* (Cardone and Smith, 1989). The six resources are shown in Table 2.6.

Table 2.6: Underwater Resources Potentially Within the Study Area.

Resource type	Name	Date of Loss
Barge	Sea Products	1931
[unknown]	Y C #689	1943
Submarine	S-37	1945
Bomb Target	[unknown]	[unknown]
Destroyer	USS Hogan	[unknown]
Military Aircraft	S2F Tracker	[unknown]

The submarine S-37 (SS-142) was launched in 1919 and earned five battle stars during World War II (U.S. Naval Historical Center, 1976). S-37 was decommissioned in 1945 and was sunk off Imperial Beach to be used as a target for aerial bombing. The submarine is potentially eligible for listing in the National Register of Historic Places.

2.5.4 Aesthetics

Views to the west of the entire study area are of the Pacific Ocean. With the exception of Pacific Ocean views, the northern portion of the study area is generally disturbed and is not of high scenic quality. Conversely, the southern portion of the study area, which includes the beach frontage areas of the Tijuana River Estuary and Border Field State Park, is generally devoid of human development and consists mainly of natural views. However, views to the south from Border Field State Park toward Mexico include the densely populated and highly urbanized City of Tijuana.

2.5.5 Air Quality

Air pollution along the Silver Strand Shoreline is similar to that in the San Diego Bay area, which is relatively good for all pollutants except ozone (in nonattainment of national and state ambient air quality standards) and fine particulates (PM_{10}) (in nonattainment of state standards). Calm air and temperature inversions frequently result in a concentration of polluted air, although afternoon sea breezes usually disperse the pollutants.

2.5.6 Noise

Background noise levels are generally low, due to the limited traffic and residential nature of the area. Three major sources of noise exist in Imperial Beach: vehicular traffic along major arterial roadways, particularly during peak hours; helicopter noise from Imperial Beach Naval Outlying Landing Field (Ream Field) located south of the city of Imperial Beach, occurring periodically throughout the day; and temporary construction activities. Noise levels occasionally impair normal conversation.

2.6 Social and Economic Factors

2.6.1 Demographics

Imperial Beach, first known as South San Diego, was incorporated in 1956. Since its incorporation, the population has risen steadily from about 12,000 to 26,512 in 1990. It is a primarily residential community.

Tourist and other commercial industry are minimal, and most employment opportunities are found outside the city. From a commercial and employment perspective, Imperial Beach serves as a low-cost bedroom community primarily for the City of San Diego. The goal of the City of Imperial Beach is to retain the quality of life and atmosphere of a small beach-oriented town, not overcrowded or exclusive, and with a relaxed pace of activities.

2.6.2 Transportation

Imperial Beach is easily accessible from Interstate Highway 5 (I-5), which parallels the coastline in San Diego County. State Route 75 (Silver Strand Boulevard) links Coronado and Imperial Beach and runs north-south the length of the Silver Strand. In Imperial Beach, it changes direction and becomes an east-west highway (Palm Avenue) through town, which intersects I-5. There is access along the entire shorefront from Seacoast Drive and its intersecting streets, which terminate at the beach. Bus transport is available on Silver Strand Boulevard between the Cities of Coronado and Imperial Beach, as well as along Seacoast Drive.

2.6.3 Land Use

Other than military use on the U. S. Naval facilities, the primary land use along the ocean side of Imperial Beach is for residential housing and recreation. The two State beaches, Silver Strand State Beach and Border Field State Park, provide additional recreational opportunities.

1. ***Residential/Commercial***: Imperial Beach beachfront is built out to the City's 1982 General Plan and Coastal Plan restrictions, primarily as residential housing. There are 102 residential-type structures, four commercial structures, and four vacant lots along the beachfront. Future development will take place through new construction, upgrade and re-use of existing parcels.

   The beachfront area is zoned for light commercial, single family residential and medium-to-high density residential. Buildings are constructed on the beach berm along the shoreline. Several small commercial enterprises are located on the backside of the beachfront along Seacoast Drive from Palm Avenue to Imperial Beach Boulevard. Seacoast Drive runs the length of the backshore, south from Carnation Avenue to beyond Encanto Avenue.

2. ***Recreation*****:** In general, the study area is of high recreational value. Recreational activities in the study area include surfing, swimming, sun-bathing, sport fishing, recreational boating, water and jet skiing, bicycling, beach walking, and jogging. In addition, there are numerous visual resources including coastal views, and wetland areas with their associated unique vegetation and wildlife. The Tijuana Estuary, part of the Border Field State Park, is located south of the City of Imperial Beach. Recreational activities at the estuary include bird watching, picnicking, and sightseeing for day visitors only. A bike path runs the length of the Silver Strand Boulevard.

Chapter 3 - Problem

3.1 Statement of the Problem

The Silver Strand Shoreline was initially a natural sand spit, supplied with sediment primarily by the Tijuana River. Since the 1940s and construction of dams and reservoirs on the river, the ocean side of the Silver Strand has had to be artificially renourished to reduce beach erosion. Currently, erosion is occurring at the study area, while accretion is occurring upcoast.

The sediment budget indicates that approximately 76,000 cubic meters (100,000 cubic yards) per year is expected to erode from Imperial Beach; 15,200 cubic meters (20,000 cubic yards) per year is expected to erode from Silver Strand State Beach; and Coronado Beach is expected to accrete 38,000 cubic meters (50,000 cubic yards) per year. In other words, Imperial Beach is highly erosive, Silver Strand State Beach is negligibly erosive, and Coronado Beach is accretional.

The City of Imperial Beach shoreline is severely impacted by this erosion. Many private property owners have constructed stone revetments or vertical seawalls to protect their property, but these non-continuous protection structures do not solve the erosion issue, and may fail as the beach recedes. Interim measures to reduce beach nourishment have included intermittent beach fills, such as the following:

- 840,000 cubic meters (1.1 million cubic yards) of sand in 1977;
- 31,500 cubic meters (41,000 cubic yards) of dredged material placed by the Coast Guard, and 177,000 cubic meters (233,000 cubic yards) placed by the Navy in nearshore mounds south of the municipal pier in 1995;
- 92,000 cubic meters (120,000 cubic yards) of beach fill from an offshore borrow site placed as part of the SANDAG Regional Beach Replenishment Project in 2001.

A more complete list of projects in the area is given in Sections 1.4 and 1.5. In general, the amount of sand supplied to the beach should roughly equal the annual longshore transport demand.

The most critical area of the Silver Strand Shoreline in terms of present-day erosion is the six-kilometer (four-mile) stretch from the Tijuana River north to the northern boundary of the City of Imperial Beach. Figures 3-1 and 3-2 show the study area during a high tide in January 1998. The top photo was taken from Ebony Avenue looking north (North Reach). The bottom photo was taken from Ebony Avenue looking south (South Reach). The cobbles exposed in Figure 3-2 indicate a complete loss of beach sand in the south reach due to seasonal beach erosion.

Figure 3-1: North Reach

Figure 3-2: South Reach

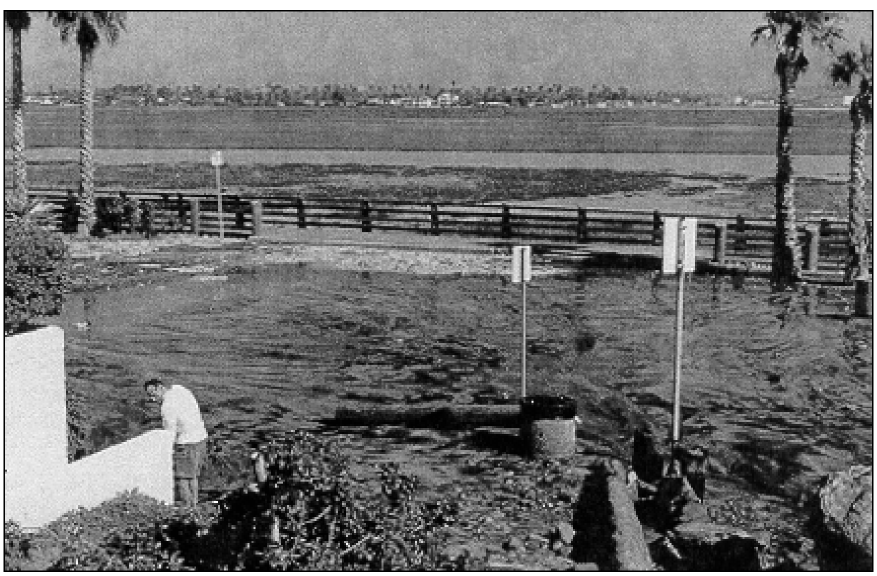
3.1.1 South Reach

3.1.1.1 South Reach Existing Conditions

Local and private interests have installed revetment across the beach face of the majority of the beachfront buildings in Imperial South reach. Winter beach erosion leaves the beach completely depleted of sand with the resultant cobbles and boulders exposed. Where the revetment ends just south of the development, high tides and winter storms wash debris and sand around the revetment and cause nuisance flooding to the southernmost end of Seacoast Drive. Figures 3-3 and 3-4 show the area before and after a winter high tide in January 1998.

Figure 3-3: Seacoast Drive – before

Figure 3-4: Seacoast Drive – after



Condominiums located immediately behind the revetment are subject to damages caused by overtopping waves during significant winter storm events. Figure 3-5 shows a wave overtopping the revetment during a 1992 winter storm.

Figure 3-5: South Reach during 1992 storm

Due to overtopping waves, flanking of the revetment to the south and overwash from the Tijuana Estuary, Seacoast Drive often experiences flooding during significant storm events. Figures 3-6 and 3-7 show Seacoast Drive following a heavy coastal storm on January 18, 1988.

Figure 3-6: Seacoast Drive January 88

Figure 3-7: Seacoast Drive January 88

3.1.1.2 South Reach Expected Future Without-Project Conditions

The shoreline change rate for future without-project conditions has been developed based on the CCSTWS (see Section 2.4.5 of this report and the Coastal Appendix for details). It is assumed that the existing shoreline in the South Reach will erode to the rubble-mound revetment by 2007. After this, no further shoreline translation will occur. The revetment will stabilize and fix the position of the shoreline. Therefore, structure damages due to direct loss of the structure from undermining are not anticipated. Nuisance flooding of Seacoast Drive during high tides will become more frequent. Structures behind the revetment will be at much greater risk of damages from overtopping waves and inundation.

3.1.2 North Reach

3.1.2.1 North Reach Existing Conditions

Storm damage protection structures in the North Reach vary between individual properties, consisting of rip rap, engineered revetments and various types of vertical seawalls. Many of these structures appear to have been built prior to the implementation of the Coastal Act of 1976, and subsequent to the City's involvement in issuing coastal development permits. Newer structures have been built with stone revetment or vertical seawalls. These protection devices vary significantly in effectiveness at reducing wave related damages.

The beach width in the north reach transitions to 20 meters from the northern limit of the south reach to the south groin. Between the south groin and the north groin, the beach width is effectively zero. This suggests that littoral sediments are being trapped by the south groin; however, there is a lack of sediment available to fill the groin field compartment. Figure 3-8 is a photo taken from the south groin looking south. Figure 3-9 shows the beach from the south groin looking north.

Figure 3-8: View from south groin looking south

Figure 3-9: View from south groin looking north

Since there is varying protection from the force of the pounding surf, structures along this reach are highly susceptible to wave impact damages during winter coastal storm events. Inundation caused by wave runup is also a serious threat to the structures immediately fronting the beach as well as those along the backshore. Figure 3-10 shows a structure that was damaged by wave impact and inundation during a severe winter storm in 1983.

Figure 3-10: Residential structure damaged, 1983

Figure 3-11 shows damage during construction of the new pier plaza following a storm in the winter of 1998. The new pier plaza has since been completely rebuilt incorporating concrete capped sheetpile seawalls into its design.

Figure 3-11: Damage during construction of the new Pier Plaza, Winter 1998

Figure 3-12 shows extremely high storm surf during the same storm. The pier was constructed at an elevation of +9.6 meters (+31.5 feet) MLLW. As the photo shows, some sets were at least that high during the storm.

Figure 3-12: High storm surf, Winter 1998

Figure 3-13 shows the eroded beach following the storm. The unengineered, discontinuous rip-rap provided little protection against the severe storm surf.

Figure 3-13: Eroded beach following the storm, Winter 1998

3.1.2.2 North Reach Expected Future Without-Project Conditions

Based on the shoreline change rate as described in the Coastal Engineering Appendix, the shoreline in the north reach is expected to continue to erode at a rate of 2 meters per year (6.6 feet per year) until 2007. At that point, the shoreline will be approximately at the line representing the first row of coastal development. These structures will be at great risk of wave impact and inundation damages during a strong coastal storm. As the shoreline continues to erode at the predicted reduced rate of 1 meter per year (3.3 feet per year) starting from 2007, some structures fronting the shoreline will be undermined, condemned, or destroyed.

As the beach erodes, individual homeowners, condominiums and commercial property owners will seek opportunities to protect their properties. However, their ability to do so is constrained by the provisions of the California Coastal Act. The California Coastal Act was adopted by the State of California in 1976. The purpose of the Act is to provide protection of California's 1,100-mile coastline for the benefit of current and future generations. Coastal cities in California are required to adopt the policies contained in the Coastal Act as part of their Local Coastal Plan (LCP). Policies of the Coastal Act include the following:

- Protection and expansion of public access to the shoreline;
- Protection, enhancement and restoration of environmentally sensitive habitats, including habitat for rare or endangered plants or animals;
- Protection of the scenic beauty of coastal landscapes and seascapes.

The California Coastal Commission (CCC) is a State regulatory agency empowered to enforce the Coastal Act. Authority to grant building permits has been delegated to local coastal municipalities for coastal structures proposed landward of the mean high tide line. Any proposed project in the coastal zone that extends seaward of the mean high tide line must have approval by the California Coastal Commission prior to construction. Additionally, the California State Lands Commission owns virtually all of California’s 1,100-mile coastline seaward of the mean high tide line, and any proposed project that extends seaward of the mean high tide line must obtain a Lease of State Lands. Therefore, an individual property owner in Imperial Beach must apply for a building permit from the City’s Department of Community Development and/or the California Coastal Commission prior to constructing any storm damage protection structure.

The Local Coastal Plan of the City of Imperial Beach forbids any additional rock revetments to be constructed in the North Reach. Thus, above the mean high tide line, the only permanent storm damage protective structures that can obtain permits are seawalls.[1]

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1 The CCC also issues emergency permits for storm damage protection structures when there is an immediate threat of damage to property. Structures permitted are typically considered temporary. Therefore, the CCC requires, as a condition of the permit, that the structure be removed when the threat no longer exists.

Further, the Coastal Act stipulates that a storm damage protection structure will be permitted only when designed to "eliminate or mitigate adverse impacts on local shoreline sand supply". A seawall designed to protect a single property could cause accelerated erosion to neighboring properties at its flanks. As a condition of the permit, the CCC may insist that the applicant provide additional sand supply in an amount equal to the increased erosion caused by the structure.

The costs of seawall construction and of sand mitigation can both be significant. The Economics Appendix examines the likely costs and benefits of seawall construction within the constraints of the California Coastal Act. The Appendix concludes that, given those constraints, it will not be cost-effective for most property owners in the North Reach to construct seawalls. This is consistent with the results of the reconnaissance-level analysis, which ruled out construction of a continuous seawall as a viable action alternative on the grounds of economic efficiency as well as public and regulatory acceptability (see Section 4.4.7).

It is concluded that under the without-project condition, new seawalls will most likely protect only a small fraction of residences and commercial properties. The present condition of the north reach, with discontinuous shore protection subject to outflanking, will continue. Once the eroding shoreline reaches the existing line of development, beachfront structures will be undermined and condemned or destroyed.

3.2 History of Storm and Erosion Damages

In the Imperial Beach study area there has been damage to public and private property from storms at various locations along the coast. Historical beach recession has been experienced at Imperial Beach. There is little written documentation of these damages, however, and copies of damage assessment reports to the Federal Emergency Management Agency (FEMA) were not available.

During the winter of 1952-53, storm waves caused the shoreline to recede and local residents suffered damages estimated at up to $25,000 (1953 dollars) to private and public property. In 1980 and again in 1983, waves damaged the municipal pier. It was badly damaged during the storm of 1988, and has since been replaced with a longer, higher structure.

In January 1988, a significant storm attacked the coast with high winds and waves. According to the Imperial Beach Times (February, 1988), the 2.3 meters (7.5 foot) high tide plus 97 kilometers/hour (60 mph) winds sent waves as high as 6.1 meters (20 feet) crashing against the shore, hurling water, sand, and seaweed between and through oceanfront homes, flooding streets, cars, and low-lying structures behind the beach for up to three blocks from the ocean. Electricity and telephone lines were temporarily knocked out as well. Clean-up costs, estimated by the Imperial Beach Times, were $100,000, and damages to buildings were estimated at $165,000 from the January, 1988 storm (1988 dollars).

3.3 Without-Project Damage Potential

Under without-project conditions, City of Imperial Beach, the properties and structures therein will be susceptible to damages caused by inundation, erosion and wave attack. The recreational value of the beach will diminish over time as the beach continues to erode.

Structure damages under without-project conditions are calculated separately for the north reach and the south reach. Structures in the north reach are susceptible to inundation and wave attack damages. In addition, long-term erosion will eventually cause structures to be condemned, undermined, or destroyed. In the south reach, structures are susceptible to inundation and wave attack damages, only. As previously stated, erosion will terminate at the existing revetment by 2007.

3.3.1 Erosion, Inundation and Wave Attack Damages

A model was developed of the north and south reaches that calculates estimated damages dependent on changing beach profile for different storm events. Economic data and probability models were combined with data from Coastal Engineering to show damages anticipated to occur during the study period. Three different damage mechanisms were profiled: erosion, inundation, and wave attack.

3.3.1.1 Erosion

Along the south reach, local and private interests have installed revetments across the beach face for the majority of the beachfront buildings. Newer structures have been built with stone revetments or vertical seawalls. Long-term erosion is not anticipated to destroy structures in the south reach.

As previously stated, long-term erosion will affect structures along the north reach. Using the analysis presented in the Coastal Engineering Appendix, the assumed erosion rate is 2 meters per year (6.6 feet per year) until 2007, reducing to 1 meter per year (3.3 feet per year) thereafter.

A structure can be destroyed either by erosion or by wave attack. Once a structure is determined to be condemned or destroyed due to erosion, it is no longer available for further damage by inundation or wave attack. Conversely, once a structure is determined to be destroyed by wave attack, it is no longer available for damage by long-term erosion. The City of Imperial Beach's policies forbid construction on land threatened by erosion.

Table 3.1 below shows the number of structures destroyed and the Net Present Value (NPV) and annualized value of the structure and contents, in five-year increments. In later years, the probability that any given structure has already been destroyed by wave attack can be high. Taking this into account, the expected damages due to long-term erosion for that structure become relatively low.

Using the current Federal discount rate of 6⅛%, annualized damages caused by long-term erosion under without-project conditions total $265,000 for structure and content damages and $450,000 for land loss damages, making a total of $715,000 annually for erosion damages.

Table 3.1: Erosion Damages North Reach (×1000)

Year	Structures Destroyed	Structure + Content Damages	Structure Demolition	NPV of Damages + Demolition	Land Loss (sq.ft.)	Land Loss Value	NPV of Land Loss
1	0	$ 0	$ 0	$ 0	0	$ 0	$ 0
5	0	$ 0	$ 0	$ 0	0	$ 0	$ 0
10	5	$ 2,222	$ 159	$ 1,314	69,967	$ 5,248	$ 2,896
15	6	$ 5,233	$ 516	$ 2,357	88,293	$ 6,622	$ 2,715
20	7	$ 1,031	$ 96	$ 343	32,546	$ 2,441	$ 743
25	0	$ 0	$ 0	$ 0	0	$ 0	$ 0
30	1	$ 84	$ 7	$ 15	6,100	$ 458	$ 77
35	5	$ 470	$ 43	$ 64	21,000	$ 1,575	$ 197
40	2	$ 11	$ 1	$ 1	20,226	$ 1,517	$ 141
45	3	$ 142	$ 13	$ 10	18,520	$ 1,389	$ 95
50	3	$ 5	$ 5	$ 0.3	26,873	$ 2,015	$ 109
			Total NPV	**$ 4,104**		**Total NPV**	**$ 6,973**
			Annualized	**$ 265**		**Annualized**	**$ 450**

3.3.1.2 Utility Relocation due to Erosion

No significant damages to roads or utilities are expected. However, as land is lost through erosion underground utilities will be vulnerable to damage or destruction. To avoid anticipated damage or destruction the City will move the utilities in-land from Ocean Lane to Seacoast Drive (between the cross streets of Carnation to Palm) to a less vulnerable and more secure location. The City has identified the following utilities, tasks associated with their relocation and related expenses shown in Table 3.2 below. City officials indicated this project would be completed in stages over a five-year period starting 15 years into the study period (2017). The annualized damages resulting from the need to relocate underground utilities amount to $142,000 (rounded).

Table 3.2: Underground Utility Relocation, North Reach

Description of Work		Total Cost
Construct new service line and reconnect service. Existing service will be capped off and abandoned	Gas	$1,140,568
	Electric	$687,388
	Water	$553,000
	Sanitary Sewer	$1,412,136
	Storm Sewer	$1,750,000
	Telephone	$102,700
	Cable TV	$102,272
Street removal and demolition		$268,480
	TOTAL	**$6,016,544**
	NPV	$2,197,757
	Annualized	**$141,874**

Note: All cost information provided by the City of Imperial Beach May 16, 2001 and updated / verified March 2002

3.3.1.3 Wave Attack

Wave attack damages were based on the probability that a structure will be destroyed by direct wave attack before it is undermined or destroyed through erosion. Coastal Engineering supplied data on wave attack calculated for various storm events (1-year, 5-year, 10-year, 25-year and 100-year) at five-year increments, correlated to the expected beach profile in that year. Structures were grouped based on when it was expected they would be destroyed. A standard storm damage probability table was used to calculate damages. To avoid double counting damages, wave attack damages were calculated up to the year when it was expected that long term erosion would destroy the structure. At that point, the structure was removed from the damage inventory.

As summarized in Table 3.3, under without-project conditions wave attack damages for the north reach amounted to an annualized amount of $89,000 and for the south reach amounted to an annualized amount of $387,000.

Table 3.3: Summary of Without-Project Wave Attack Damages

	North	South	Total
Total NPV	$ 1,374,000	$ 5,989,000	**$ 7,363,000**
Annualized	$ 89,000	$ 387,000	**$ 476,000**

3.3.1.4 Inundation

Levels of inundation at each storm frequency were based upon structure and revetment elevations, wave runup, and distance from the revetment to the structure.

Wave runup elevations for various storm return periods are shown in Table 3.4. In the South Reach, after 2007 no further shoreline retreat is assumed to occur. The beach profile is anticipated to steepen, and runup heights for a given storm will become greater. Further details are presented in the Coastal Engineering and Economic Appendices.

Table 3.4: Wave Runup at Each Reach by Storm Frequency (in meters (feet), MLLW)

Storm Frequency (Years)	Imperial North Reach All Years	Imperial South Reach	
		Year 2002	Year 2051
1	3.2 (10.4)	3.9 (12.8)	5.3 (17.3)
5	4.3 (14.2)	5.0 (16.3)	6.6 (21.7)
10	4.8 (15.8)	5.4 (17.8)	7.2 (23.6)
25	5.5 (17.9)	5.9 (19.4)	7.9 (25.9)
50	5.9 (19.4)	6.2 (20.5)	8.3 (27.3)
100	6.4 (20.9)	6.6 (21.5)	8.7 (28.7)

Inundation damages were calculated for each structure in the study area. Percent damages from inundation were based upon the 1997 (the most recent available) Depth Damage Curve from FEMA, and applied to the structure and content values. Table 3.5 summarizes the inundation damages for each reach. As structures were destroyed from erosion, they were removed from the inventory of available structures susceptible to damages. The net present value of inundation damages to all structures, during the 50-year study period, using the current Federal discount rate of 6⅛% was $1,923,000 in the north reach and $3,278,000 in the south reach. The average annualized damages for all structures and frequencies was $124,000 in the north reach and $212,000 in the south reach.

Table 3.5: Inundation Damages by Reach

	North	South	Total
Total NPV	$ 1,923,000	$ 3,278,000	**$ 5,201,000**
Annualized	$ 124,000	$ 212,000	**$ 336,000**

3.3.2 Other Damages

Following a storm event the City provides cleanup services to the affected areas. This includes, among other tasks, clearing streets, sidewalks and other public area of debris, sand and water to make these areas safe and unobstructed. Detailed cost information was provided by the City based on past experience (1988 and 1998 storms and other smaller events) and how a similar situation would be managed today. The annualized average clean-up cost for both reaches was $34,000.

Information acquired from the City of Imperial Beach states that no septic systems are located within the study area.

During the field reconnaissance, only sparse landscaping was observed at residences with the majority of the landscaping being on the public properties. Approximately 1,500 square meters (16,000 square feet) of landscaping were observed. Damages to landscaping are not included here.

The south reach revetment has suffered documented damages over its service life. This revetment was constructed incrementally since the 1970's by private efforts using various levels of engineering and design. Over the ensuing years the structure has been subjected to several storms of varying magnitudes. Generally the revetment is in fair condition, having experienced some damages during the service life. Therefore, additional future damages associated with revetment O&M are expected during the without-project condition life cycle. These future damages were estimated at $90,000 annually, based on the construction cost of a similar revetment if constructed today.

The north reach revetment has also suffered damages over its service life. The north reach revetment is discontinuous and would not be able to halt erosion in the north reach. Under the without-project conditions the north reach would soon be outflanked so that it would not be cost-effective for property owners to continue to maintain it. Therefore, no future damages are included in the analysis for maintenance of the north reach revetment under without-project conditions. (Under Alternative 1with-project conditions, it would remain cost-effective to maintain this revetment, so future damages are shown for that alternative only; see the Economics Appendix for details).

3.3.3 Recreation Damages and Transfer Costs

Recreation damages in the study area are directly related to the loss of beach width over time under without-project conditions. The value of recreation in the study area was calculated using a unit-day value method consistent with guidance provided in ER 1105-2-100. The unit-day value method consists of multiplying the number of users per day by an administratively derived unit-day value (see the Economic Appendix for further details). The value of the recreation experience per user was determined to be $5.32 per day.

The base year (2002) capacity of Imperial Beach is 5,396 people. This is based on an average width of 23 meters (76 feet), and a length of 2,165 meters (7,100 feet) for a total area of 49,795 square meters (536,000 square feet) as described in the Economics Appendix. Carrying capacity of the beach assumed 9.3 square meters (100 square feet) per person and the value of the recreation experience is $5.32 per user. Expected capacity is provided in Table 3.6.

Table 3.6: Beach Capacities – Without-Project Conditions

Year	Capacity[1]	Capacity with Turnover[2]
1997	10,920	38,219
2002	5,396	18,886
2010	2,601	9,105
2020	273	954
2030	0	0
2040	0	0
2045	0	0
2051	0	0

[1] Assuming 9.3 square meters (100 square feet) per person and no turnover
[2] Turnover estimated by City of Imperial Beach, Ocean/Beach Safety Division, at 3.5

It was determined through interviews with local recreation experts that users of Imperial Beach were intent on beach recreation and that non-coastal recreation facilities were not considered as alternatives. However, no recreational value will actually be lost under without-project conditions. This is because there are two adjacent beaches, Silver Strand and Coronado, which have greater capacity and offer similar recreation experience. Silver Strand is located 4 miles north of Imperial Beach, and Coronado is 8 miles north. Over time as Imperial Beach erodes, under the without-project conditions, users are expected to move to these adjacent beaches. Transfer costs – the cost of additional time (opportunity cost) and vehicle operation cost users are willing to expend – will be incurred under without-project conditions.

To calculate the transfer costs, an even distribution of users between Silver Strand and Coronado was assumed requiring, on average, an additional 6-mile drive. Table 3.7 shows the projected number of users, the beach capacity and excess number of users expected to transfer to Silver Strand or Coronado beaches during the study period. Even in its base (2002) condition, Imperial Beach does not have an adequate beach width to accommodate the number of users during peak summer weekends.

Table 3.7: Projected Users vs. Capacity 2002 – 2051
Without-Project Conditions

Year	Daily Users Projected	Daily User Capacity	Daily Excess Users	Days per Seasonal Category	Total Excess Users
2002					
Peak Summer	31,530	18,886	12,644	6	75,864
2010					
Peak Summer	34,485	9,105	25,380	6	152,280
Summer Weekend	18,622	9,105	9,517	30	285,506
2020					
Peak Summer	37,345	954	36,391	6	218,345
Summer Weekend	20,166	954	19,212	30	576,362
Summer Weekday	8,337	954	7,383	86	634,959
Non-Summer Days	2,859	954	1,904	243	462,737
2030					
Peak Summer	40,443	0	40,443	6	242,660
Summer Weekend	21,839	0	21,839	30	655,182
Summer Weekday	9,029	0	9,029	86	776,512
Non-Summer Days	3,096	0	3,096	243	752,246
2040					
Peak Summer	43,797	0	43,797	6	262,780
Summer Weekend	23,650	0	23,650	30	709,506
Summer Weekday	9,778	0	9,778	86	840,896
Non-Summer Days	3,352	0	3,352	243	814,618
2051					
Peak Summer	43,797	0	43,797	6	262,780
Summer Weekend	23,650	0	23,650	30	709,506
Summer Weekday	9,778	0	9,778	86	840,896
Non-Summer Days	3,352	0	3,352	243	814,618

Based on the numbers of projected excess users from Table 3.7, Table 3.8 shows the cost of additional time (opportunity cost) and vehicle operation cost users are willing to expend at the given years. The total recreational transfer costs, for the entire project period 2002 to 2051, is equivalent to an annualized value of $987,000.

Table 3.8: Annual Opportunity and Vehicle Operating Costs Without-Project Conditions

Year	Opportunity Cost	Total Vehicle Operating Cost	Total Annual Costs
2002	$40,517	$27,311	$67,828
2010	$233,809	$157,603	$391,412
2020	$1,010,680	$681,265	$1,691,944
2030	$1,295,979	$873,576	$2,169,555
2040	$1,403,434	$946,008	$2,349,442
2051	$1,403,434	$946,008	$2,349,442

The Opportunity Cost is based on the median family income, $28.89 per hour for all occupations in San Diego County (1/31/2002), U.S. Department of Housing and Urban Development (HUD), Los Angeles Office. The average number of people (excess users) per vehicle is taken to be 2.5 (City of Imperial Beach), and the additional six-mile trip is assumed to last 12 minutes. The standard 23.1% wage multiplier for recreational opportunity costs is used. Vehicle operating cost equals $0.15 per mile, source Runzheimer Vehicle Standard Cost Schedule (9/2001).

3.3.4 Summary of Damages

Table 3.9 summarizes the annual without-project damages by reach. In the south reach total without-project storm damages are $706,000 and in the north reach, without-project storm damages are $1,087,000. Recreation opportunity and vehicle operating costs are $493,500 in each reach.

Table 3.9: Imperial Beach Annualized Without-Project Damages

Damage Category	North Reach	South Reach	Total
Erosion	$ 265,000	-	$ 265,000
Land Loss	$ 450,000	-	$ 450,000
Utility Relocation	$ 142,000	-	$ 142,000
Wave Attack	$ 89,000	$ 387,000	$ 476,000
Inundation	$ 124,000	$ 212,000	$ 336,000
Clean-up Costs	$ 17,000	$ 17,000	$ 34,000
Revetment O & M	-	$ 90,000	$ 90,000
Total Storm Related Damages	**$ 1,087,000**	**$ 706,000**	**$ 1,793,000**
Recreation Travel & Time Costs	**$ 493,500**	**$ 493,500**	**$ 987,000**
Total	**$ 1,580,500**	**$ 1,199,500**	**$ 2,780,000**

3.3.5 Environmental

The sandy beach at Imperial Beach and areas adjacent to it provide habitats for some marine species and birds, such as the grunion and least tern. These species are affected by the diminishing beach (i.e., loss of nesting and other habitats). The adjacent beach areas are also affected. With the change in habitat over time due to erosion of the sandy beach to narrow cobble and hardpan, these habitats will diminish or be lost, but some intertidal organisms will probably colonize the new intertidal zone to some degree.

There do not appear to be any environmental enhancement or restoration opportunities for this area during without-project conditions. Although there is a large estuary in the backshore and downcoast area, no significant negative impacts to the estuary are expected from complete loss of the sand beach at Imperial Beach.

Chapter 4 - Plan Formulation

4.1 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. 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 the 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 coasts and shores.

4.2 Planning 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.

- ***Reduce storm damage potential in the study area; specifically, the City of Imperial Beach.*** Reducing the potential for damages to residential, commercial, and public facilities resulting from the forces of storm and tidal waves is a major objective of any hurricane and storm damage reduction plan. The parameters used to measure the contribution of each plan to this objective were reduction of erosion, wave force, and inundation damages. Recreation outputs created by any alternative are considered incidental to the main objective of reducing storm related damages.

- ***Preserve or improve the environmental resources in the study area.*** Environmental resources in the study area include the beach, the nearshore aquatic habitat, and the Tijuana Estuary. The parameters used to measure the contribution of each plan to this objective the preservation or improvement of these resources. All plans must undergo both National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) environmental review processes. The purpose of the Environmental Impact Statement (EIS) is to identify and disclose information about the potentially significant environmental effects of the alternatives and recommended plan.

4.3 Planning Criteria

Alternative plans, including the NED plan, were formulated in consideration of four criteria: Completeness; effectiveness; efficiency; and acceptability.

- ***Completeness*** is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.

- ***Effectiveness*** is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.
- ***Efficiency*** is the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.
- ***Acceptability*** is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

4.4 Preliminary Alternative Plans

The Silver Strand Shoreline Reconnaissance Study dated December 1995 provided the initial framework for the development of alternative plans. The development of plans to achieve the planning objectives began with the consideration of all possible measures to reduce storm damages in the study area. Concurrently, consideration was given to preserving or enhancing the environmental quality of the study area. All measures were analyzed based on their applicability and general feasibility in the study area. These alternatives were progressively screened and refined throughout the entire planning process until a final array of alternatives was arrived at for detailed analysis, comparison, and ultimately selection of a recommended plan.

4.4.1 No Action

The Corps of Engineers is required to consider the option of “No Action” as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). The No Action Plan is synonymous with the without-project condition described in this report. The No Action Plan forms the basis against which all other plans are measured.

4.4.2 Alternative 1: Beach Nourishment

Construction of an initial beach fill consisting of 1,689,000 cubic meters (2,209,000 cubic yards) of compatible beach sand and periodic nourishment of 764,000 cubic meters (1,000,000 cubic yards). The fill would be 2,165 meters (7,100 feet) long extending from the north groin to the southern limit of development. The initial fill would extend the beach approximately 46 meters (150 feet) seaward at a berm elevation of +4.0 meters (+13 feet) MLLW. Every 10 years the fill is expected to erode to 25 meters (80 feet) wide, when a 764,000 cubic meter (1,000,000 cubic yard) fill would be placed extending the beach to the 46 meter (150 foot) width.

This alternative would provide significant additional storm damage protection compared to the no action plan by providing a protective buffer beach between the storm waves and the upland development. Any environmental benefits provided by the existing beach could be enhanced with this alternative. This alternative would also provide additional recreation benefits, although these benefits are considered incidental to the overall project purpose of storm damage protection. The planning objectives were met by this alternative. This alternative meets all planning criteria. Therefore, this alternative was carried forward for further formulation.

4.4.3 Alternative 2: Breakwaters with Beach Nourishment

A series of 5 offshore detached breakwaters would be constructed. The breakwaters would each be 336 meters (1,100 feet) long, with a crest height of +1.5 meters (5 feet) MLLW, side slopes of 2:1, and the base at -4.6 meters (-15 feet) MLLW. Using the guidance of Hudson and the Shore Protection Manual (SPM), a 16 ton armor stone was selected. A 2 ton underlayer stone was selected and a bedding layer of quarry run would be used.

The 925,000 cubic meter (1,239,000) beach fill would be 2,165 meters (7,100 feet) long extending from the north groin to the southern limit of development. The beach fill would extend the beach approximately 25 meters (80 feet) seaward at a berm elevation of +4.0 meters (+13 feet) MLLW. The offshore breakwaters are designed to retain the wider beach throughout the project life.

This alternative provides storm protection by significantly reducing the wave energy that is transmitted to the shoreline and providing a protective buffer of sand between the storm waves and the upland development. Erosion would be reduced in the project area behind the structures. Any environmental benefits provided by the existing beach could be enhanced with this alternative. This alternative also provides additional recreation benefits, although these benefits are considered incidental to the overall project purpose of storm damage protection. This alternative provides no greater storm damage protection than afforded by the beach nourishment alternative. However, the cost of this alternative is significantly higher. In addition, offshore breakwaters proposed in the past at Imperial Beach have been met with significant public opposition. The area is a popular surfing area and reducing the wave energy with a breakwater could significantly impact the surfing conditions. This alternative meets the planning objectives but does not meet the planning criteria of efficiency and acceptability. For these reasons, this alternative was not considered for further analysis.

4.4.4 Alternative 3: Groins with Beach Nourishment

This alternative consists of construction of seven new groins and extension of the two existing groins. The full length of the groins would be approximately 244 meters (800 feet), at a crest elevation of +5.5 meters (+18 feet) MLLW, side slopes of 2:1, extending to approximately the -3.7 meter (-12 feet) MLLW contour. A 12 ton armor stone and a 2 ton underlayer stone was selected; a bedding layer of quarry run would be used.

The 925,000 cubic meter (1,239,000) beach fill would be 2,165 meters (7,100 feet) long extending from the north groin to the southern limit of development. The beach fill would extend the beach approximately 25 meters (80 feet) seaward at a berm elevation of +4.0 meters (+13 feet) MLLW.

This alternative provides similar storm protection to the beach nourishment alternative by providing a protective buffer beach between the storm waves and the upland development. The placement of groins would likely reduce the rate of erosion in the project area. Any environmental benefits provided by the existing beach could be enhanced with this alternative. This alternative would also provide additional recreation benefits, although these benefits are considered incidental to the overall project purpose of storm damage protection. However, this alternative may cause increased erosion downdrift of the project area. In addition, this alternative is significantly more costly than the beach nourishment alternative. This alternative meets the planning objectives but does not meet the planning criteria of efficiency and acceptability. For these reasons, this alternative was not considered for further analysis.

4.4.5 Alternative 4: New Revetment

The 945 meter (3,100 feet) revetment will extend from the northern groin at Palm Avenue to the existing revetment near Imperial Beach Blvd. The revetment crest will be at +6.1 meters (+20 feet) MLLW and the toe will be at -0.6 meters (-2 feet) MLLW, which will match the existing revetment located near Imperial Beach Blvd. Common construction practice dictates the use of graded armor stone and filter fabric. In order to replicate the existing revetment south of Imperial Beach Blvd., two layers of 5 ton stone were selected at a 1.5H:1V slope.

This alternative provides storm protection to the north reach by providing a protective armor layer between the storm waves and the upland development. The new revetment would be tied into the south reach revetment to provide a continuous protective structure. However, the City's General Plan prohibits the construction of any new revetment north of Imperial Beach Blvd in favor of vertical seawalls. In addition, the California Coastal Commission would strongly recommend the incorporation of beach nourishment seaward of the structure to protect against encroachment seaward of the mean high tide line prior to their approval of any revetment alternative. The cost of this alternative with the additional cost of beach nourishment would exceed the cost of beach nourishment alone. This alternative would provide less storm protection benefits than the beach nourishment alternative since it will only provide additional protection to the north reach. Environmental resources would not be preserved nor improved by this alternative. This alternative does not sufficiently fulfill the planning objectives nor does it meet the criteria of efficiency and acceptability. For these reasons, this alternative was not considered for further analysis.

4.4.6 Alternative 5: New and Raised Revetment

The 945 meters (3,100 feet) of new revetment will extend from the northern groin at Palm Avenue to the existing revetment near Imperial Beach Blvd. The revetment crest will be at +7.3 meters (+24 feet) MLLW. In addition 1,220 meters (4,000 feet) of existing revetment will have its crest raised from +6.1 meters (+20 feet) MLLW to +7.3 meters (+24 feet) MLLW.

This alternative would provide similar protection to the beach nourishment alternative. The same policy issues would apply to this alternative as to Alternative 6. Furthermore, the cost to construct the revetment by itself (not including the added cost of beach nourishment) is significantly greater than the beach nourishment alternative. This alternative does not fulfill the planning objective of preserving or improving the environmental resources nor does it meet the criteria of efficiency and acceptability. For these reasons, this alternative was not considered for further analysis.

4.4.7 Alternative 6: New Seawall

The 945 meter (3,100 foot) steel/concrete seawall will extend from the northern groin at Palm Avenue to the existing revetment near Imperial Beach Blvd. The seawall will consist of steel sheet pile and a concrete cap. The seawall crest elevation will be at +6.1 meters (+20 feet) MLLW. Common construction practice dictates the use of filter fabric on the landward side and armor stone to protect the toe from scour.

This alternative provides storm protection to the north reach by providing a protective armor wall barrier between the storm waves and the upland development. The seawall will extend to the northern limit of the south reach revetment to provide a continuous protective structure at +6.1 meters MLLW over the full length of the project area. It is presumed that the shoreline will continue to erode to the vertical seawall, after which no further shoreline translation will occur. The seawall will stabilize and fix the shoreline. This alternative would comply with the City's General Plan. However, due in part to the geotechnical conditions found in the area, the cost to construct a vertical seawall is much greater than the revetment alternative. In addition, similar to the two revetment alternatives, the California Coastal Commission would strongly recommend the incorporation of beach nourishment seaward of the structure to protect against encroachment seaward of the mean high tide line. The cost of this alternative would exceed the cost of the beach nourishment alternative. This alternative would provide less storm protection benefits than are afforded by the beach nourishment alternative since it will only provide protection to the north reach. This alternative does not sufficiently fulfill the planning objectives nor does it meet the criteria of efficiency and acceptability. For these reasons, this alternative was not considered for further analysis.

4.4.8 Alternative Carried Forward

The beach nourishment alternative was the only alternative to meet the planning objectives and satisfy all or most of the planning criteria. Therefore this alternative alone was carried forward for detailed analysis and refinement.

4.5 Development of Beach Nourishment Alternatives

4.5.1 Procedures

The design of Federal beach fill projects is based on an economic optimization procedure which produces the NED Plan. The NED plan is developed by considering the storm damage reduction potential of various beach fill design alternatives and the average annual cost. Primary design parameters of each alternative include the physical dimensions of the cross-sectional design profile and the volume of sand required to obtain the design profile. Beach fill design berms are characterized by berm crest elevation, berm width, and foreshore slope. Additionally, the schedule and quantities for periodic renourishment must be determined.

4.5.2 Berm Cross-Section

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.

The beach fill design parameters used in this analysis are consistent with the natural conditions at the project site and technical guidance. The design berm elevation for this study has been set at +4.0 meters (+13 feet) MLLW, and the foreshore slope has been set at 15H:1V. These parameters match the natural berm and foreshore parameters 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 +4.0 meters (+13 feet) MLLW. A foreshore slope of 15H:1V has been shown to be a stable mean value between the seasonal variations.

4.5.3 Base Nourishment Beach Width

Base nourishment beach widths of 12 meters, 25 meters, 34 meters and 54 meters (39 feet, 82 feet, 112 feet and 177 feet) from the existing berm limit to the filled foreshore berm are considered.

The inundation and wave force analyses used in the present study indicate that structure damages attenuate to zero after the nourishment beach width is 25 meters (82 feet) or greater. There are two structure damage categories considered in this analysis: inundation and wave force damages. The severity of each damage category is in part based on the beach width and setback distance for each structure. A base nourishment beach width of 25 meters (82 feet) corresponds to 925,000 cubic meters (1,210,000 cubic yards) of fill, and is considered the minimum necessary to eliminate inundation and wave force damages due to storm waves and runup.

A 12 meter (39 foot) nourishment beach width alternative is also included in the analysis. A 12 meter (39 foot) nourishment beach width is expected to accrue periodic damages through the evaluation period; some inundation damages are expected during extreme storms. This alternative indicates some residual damages and provides the lower bound for the economic evaluation and optimization procedure.

4.5.4 Periodic Nourishment Intervals

A set of periodic nourishment intervals is developed that in conjunction with the base beach width allow for the economic optimization procedure to identify the NED plan. The base nourishment beach width provides the minimum protective width that reduces or eliminates structure damages. The periodic nourishment provides the sacrificial portion of the beach which is allowed to erode to the base beach width and then refilled. The nourishment intervals were based on the concept of minimum, maximum, and intermediate candidate nourishment intervals. The minimum nourishment interval was defined at 5 years and is the shortest interval which is realistic and cost efficient to construct. The precedent for this 5 year nourishment interval is the Orange County Beach Erosion Control Project (Surfside-Sunset) conducted by the Los Angeles District. This project is a continuing construction shoreline erosion control effort that in part establishes beach nourishment on approximately a 5 year interval. The maximum project is defined as the one-time quantity of beach fill in which no damages are expected in the 50 year project lifetime. Intermediate level projects at the 10 year, 15 year, and 22 year periods were then developed.

Economic considerations associated with dredging significantly affect the selection of periodic nourishment intervals and the economic optimization procedure. Typical Los Angeles District beach fill projects require large capacity open-ocean capable dredges. Dredging mobilization and de-mobilization (mob/demob) costs tend to be large and fixed in magnitude. Operational requirements typically result in hydraulic cutter head and/or hopper style dredges. These larger style dredges have higher associated operational costs. Hydraulic cutter head dredges may require booster pumps depending on the distances and quantities involved. Hopper dredges may have somewhat lower mob/demob costs, however, beach placement requires long pipeline lengths so a certain portion of the mob/demob costs are similar.

The mobilization/demobilization costs and unit prices are primary inputs into the economic optimization procedure. Cost efficiency in the unit price per cubic meter of dredge material is gained when the beach fill quantities become large. Fixed mob/demob costs significantly influence the overall “effective” unit prices. It is usually less cost effective to mobilize large capacity open-ocean capable dredges for small quantity projects; higher unit prices are expected for smaller quantities. The overall effective unit price and therefore the cost efficiency increases with increasing beach fill quantities and decreases with decreasing beach fill quantities. To offset this effect, the time value of money means that it becomes less cost effective to construct a single, massive beach fill at the start of the project – rather than to postpone some of the costs by carrying out periodic nourishment within the project lifetime.

Information described in the coastal engineering baseline conditions provides the governing technical criteria to develop the quantities associated with each nourishment interval. The governing criteria in this analysis are the sediment budget loss rate of 76,000 cubic meters per year (99,000 cubic yards per year) and the shoreline erosion rate of 2 meters per year (6.6 feet per year) that were developed by the CCSTWS. The sediment budget loss rate when used in combination with the erosion rate determines a nourishment quantity for each nourishment interval.

4.5.5 Nearshore Placement

Nearshore placement was evaluated as a method of dredge material disposal. Nearshore placement is increasingly gaining the favor of the Corps of Engineers and other regulatory permitting agencies throughout the nation. Nearshore placement is an alternative to direct placement on the beach, typically referred to as "profile nourishment", as the placement is farther out on the beach profile than the sub-aerial beach. The concept of nearshore disposal possesses several attractive features including: a) the dredge material is disposed of in much more natural conditions than direct beach disposal; b) has direct benefits if the material migrates onto the beach in the form of increased beach width; c) has indirect benefits to the shoreline as long as the material remains within the littoral system; d) the dredge material is allowed to sort itself by natural processes resulting in a more natural distribution throughout the littoral system; e) nearshore disposal requires little if any shore-bound equipment which minimizes the environmental impacts on fragile beach ecosystems and recreational beach users; f) disposal methods can be guided to enhance recreational opportunities for the sport of surfing; and g) nearshore disposal allows for new methods of dredge material disposal which could lead to lowering of Corps of Engineers dredging costs.

The primary design question for nearshore placement of sand is how and at what rate the sand will move to the beach. Current engineering methods and design guidance have significant theoretical and practical limitations. Modeling results described in the Coastal Appendix indicate that nearshore placement is not a cost-effective alternative at this time. Migration rates developed were on the order of 10 years. Furthermore, considerable uncertainty exists as to the percentage of sand placed in the nearshore that will move onto the sub-aerial portion of the beach. Direct beach placement effectively results in 100% of the dredged quantity is placed on the beach. Nearshore placement results in a percentage less than 100% that actually migrates onto the sub-aerial portion of the beach. This has significant implications to the project economic analysis. For a desired sub-aerial beach area, nearshore placement will require a larger initial dredge quantity resulting in an overall decreased cost-effectiveness. Also, recreational benefits are based in part on the area of dry beach that is available for recreational users. For these technical and economic considerations, nearshore placement was no longer carried forward as a project alternative.

4.5.6 Project Monitoring

Project performance monitoring in support of continuing construction will include bathymetric and topographic surveys every three years, together with a nearly continuous record of the beach topography obtained from the video-based stereo photogrammetric Argus Beach Measurement System. The monitoring period will be for the 50-year period of Federal involvement. The main purpose of project performance monitoring is to allow better planning of continuing construction (periodic renourishment), both in terms of the timing of the renourishment and details of the beach fill construction. However, information obtained from the project monitoring may also indicate that the breakwater, groin, revetment or other similar hard structure options are appropriate in the future.

4.6 Description of Alternatives

Four alternatives were considered, representing different base nourishment beach widths (that is, the width from the existing berm limit to the filled foreshore berm).

For each project alternative, five periodic nourishment intervals were considered. The primary consideration in selecting the periodic nourishment interval is the associated cost. Since the advance nourishment portion of the beach is considered sacrificial, it is not considered in the estimate of project benefits. Therefore, it is possible to optimize separately for the base nourishment beach width and the periodic nourishment interval.

4.6.1 Base Nourishment Beach Widths

The four alternatives for base nourishment beach width are as follows.

4.6.1.1 Alternative 1: 12 meters

This alternative involves construction of an initial beach fill consisting of 450,000 cubic meters (590,000 cubic yards) of suitable beach sand, plus a sacrificial beach fill determined by the periodic nourishment interval (5 to 50 years). The placement would be 2,165 meters (7,100 feet) long extending from the northerly groin to the southern end of the development, providing a base nourishment beach width of 12 meters (39 feet) at an elevation of +4 meters (+13 feet) MLLW. The nourished beach is expected to erode to the 12-meter (39-foot) width at the end of each periodic nourishment interval, and would be renourished at that time.

Alternative 1 is the minimum project, defined as the quantity which is realistic and economical to construct and which is expected to provide some effectiveness against damages through the evaluation period. A beach width of 25 meters (82 feet) has been determined to be the minimum width for which no inundation or wave force damages are anticipated.

4.6.1.2 Alternative 2: 25 meters

This alternative involves construction of an initial beach fill consisting of 925,000 cubic meters (1,210,000 cubic yards) of suitable beach sand, plus a sacrificial beach fill determined by the periodic nourishment interval (5 to 50 years). The placement would be 2,165 meters (7,100 feet) long extending from the northerly groin to the southern end of the development, providing a base nourishment beach width of 25 meters (82 feet) at an elevation of +4 meters (+13 feet) MLLW. The nourished beach is expected to erode to the 25-meter (82-foot) width at the end of each periodic nourishment interval, and would be renourished at that time.

Alternative 2 is an intermediate project, defined as the quantity which is realistic and economical to construct and which is expected to protect against damages throughout the evaluation period. A beach width of 25 meters (82 feet) has been determined to be the minimum width for which no inundation or wave force damages are anticipated.

4.6.1.3 Alternative 3: 34 meters

This alternative involves construction of an initial beach fill consisting of 1,250,000 cubic meters (1,635,000 cubic yards) of suitable beach sand, plus a sacrificial beach fill determined by the periodic nourishment interval (5 to 50 years). The placement would be 2,165 meters (7,100 feet) long extending from the northerly groin to the southern end of the development, providing a base nourishment beach width of 34 meters (112 feet) at an elevation of +4 meters (+13 feet) MLLW. The nourished beach is expected to erode to the 34-meter (112-foot) width at the end of each periodic nourishment interval, and would be renourished at that time.

Alternative 3 is an intermediate project, between Alternative 2 (the minimum project that is anticipated to provide complete protection against inundation and wave force damage) and Alternative 4 (the maximum project that is realistic and economical to construct).

4.6.1.4 Alternative 4: 54 meters

This alternative involves construction of an initial beach fill consisting of 2,000,000 cubic meters (2,615,000 cubic yards) of suitable beach sand, plus a sacrificial beach fill determined by the periodic nourishment interval (5 to 50 years). The placement would be 2,165 meters (7,100 feet) long extending from the northerly groin to the southern end of the development, providing a base nourishment beach width of 54 meters (177 feet) at an elevation of +4 meters (+13 feet) MLLW. The nourished beach is expected to erode to the 54-meter (177-foot) width at the end of each periodic nourishment interval, and would be renourished at that time.

Alternative 4 is defined as the maximum project that is realistic and economical to construct. No inundation or wave force damages are expected during the project lifetime for Alternative 4.

4.6.2 Periodic Nourishment Intervals

The five alternatives for the periodic nourishment interval are as follows.

4.6.2.1 Five-Year Nourishment Interval

This alternative involves an initial beach fill containing 382,000 cubic meters (500,000 cubic yards) in addition to the base nourishment quantity described for each base nourishment beach width alternative in Section 4.6.1. This would provide a total beach width 10 meters (33 feet) greater than the base nourishment beach width. The sacrificial 10 meters (33 feet) of beach width is anticipated to erode after 5 years, at which point a further beach fill of 382,000 cubic meters (500,000 cubic yards) will be constructed. Periodic nourishment will continue at 5-year intervals throughout the project lifetime, for a total of 10 nourishments.

This minimum nourishment interval is defined as the minimum quantity of beach fill which is realistic and economical to construct.

4.6.2.2 Ten-Year Nourishment Interval

This alternative involves an initial beach fill containing 764,000 cubic meters (1,000,000 cubic yards) in addition to the base nourishment quantity described for each base nourishment beach width alternative in Section 4.6.1. This would provide a total beach width 20 meters (66 feet) greater than the base nourishment beach width. The sacrificial 20 meters (66 feet) of beach width is anticipated to erode after 10 years, at which point a further beach fill of 764,000 cubic meters (1,000,000 cubic yards) will be constructed. Periodic nourishment will continue at 10-year intervals throughout the project lifetime, for a total of 5 nourishments.

The ten-year nourishment interval is defined as an intermediate between the minimum and maximum intervals described in this section.

4.6.2.3 Fifteen-Year Nourishment Interval

This alternative involves an initial beach fill containing 1,146,000 cubic meters (1,500,000 cubic yards) in addition to the base nourishment quantity described for each base nourishment beach width alternative in Section 4.6.1. This would provide a total beach width 30 meters (98 feet) greater than the base nourishment beach width. The sacrificial 30 meters (98 feet) of beach width is anticipated to erode after 15 years, at which point a further beach fill of 1,146,000 cubic meters (1,500,000 cubic yards) will be constructed. Periodic nourishment will continue at 15-year intervals throughout the project lifetime, for a total of 4 nourishments.

The 15-year nourishment interval is defined as an intermediate between the minimum and maximum intervals described in this section.

4.6.2.4 Twenty-Two-Year Nourishment Interval

This alternative involves an initial beach fill containing 1,681,000 cubic meters (2,200,000 cubic yards) in addition to the base nourishment quantity described for each base nourishment beach width alternative in Section 4.6.1. This would provide a total beach width 44 meters (144 feet) greater than the base nourishment beach width. The sacrificial 44 meters (144 feet) of beach width is anticipated to erode after 22 years, at which point a further beach fill of 1,681,000 cubic meters (2,200,000 cubic yards) will be constructed. Periodic nourishment will continue at 22-year intervals throughout the project lifetime, for a total of 3 nourishments.

The 22-year nourishment interval is defined as an intermediate between the minimum and maximum intervals described in this section.

4.6.2.5 Fifty-Year Nourishment Interval

This alternative involves an initial beach fill containing 3,820,000 cubic meters (5,000,000 cubic yards) in addition to the base nourishment quantity described for each base nourishment beach width alternative in Section 4.6.1. This would provide a total beach width 100 meters (330 feet) greater than the base nourishment beach width. The sacrificial 100 meters (330 feet) of beach width is anticipated to erode after 50 years, the end of the project lifetime.

This maximum nourishment interval is defined as the maximum quantity of beach fill which is realistic and economical to construct. With this maximum nourishment interval, all of the sand would be placed during the initial beach fill – no further renourishments would be required.

4.7 Borrow Sites

4.7.1 Offshore Borrow Sites

Prior offshore studies of the area conducted by the Corps and other government and private agencies have identified three potential sources of sand. The first is located 9.7 kilometers (6 miles) north of Imperial Beach offshore of the U.S. Marine/Naval Reservation. The second is located approximately 3.6 kilometers (2¼ miles) south of Imperial Beach and extends approximately 6.4 kilometers (4 miles) offshore. The third is located 2.8 kilometers (1¾ miles) south of Imperial Beach and extends 8 kilometers (5 miles) offshore. See the Geotechnical Appendix for detailed information on prior offshore investigations.

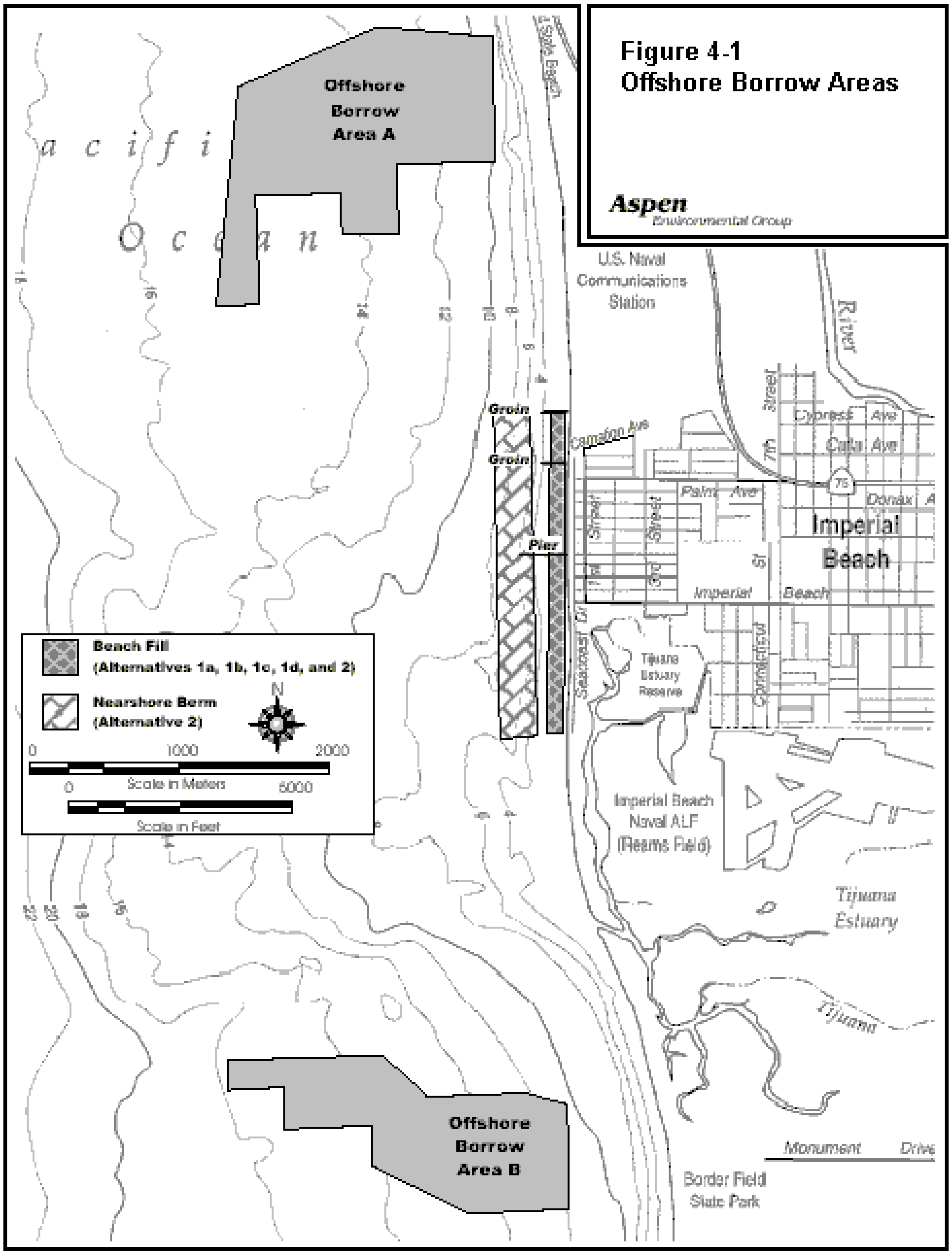
Based on this information, new investigations were conducted. Two potential borrow areas were explored. Borrow Area A is located approximately 2 kilometers (1.2 miles) north of the Imperial Beach pier. Borrow Area B is located approximately 4.5 kilometers (2.8 miles) south of the Imperial Beach pier. Fifty boreholes were completed by the Corps, and twenty-two Van-Veen sediment grab samples were completed within the borrow areas. The locations of the borrow areas are shown in Figure 4-1.

The tests showed that both borrow areas A or B are suitable for providing beach compatible materials, although site B is of slightly higher quality in terms of grain size compatibility.

- The sediment within borrow sites A and B consists of a beach compatible fine to medium grained silty sand (more than 12% "fines") with fine to coarse grained gravels, cobbles, seashells up to 8 centimeters (3 inches) in diameter and occasional moderately cemented seashell layers.

- The bulk sediment chemistry test results of the sediments (sand) within both the borrow areas are similar to the test results for the sediments at the receiving beach. The borrow area sediments are therefore considered uncontaminated.

Figure 4-1: Offshore Borrow Area Locations



- The total volume of compatible sediment within borrow area A is approximately 6,000,000 cubic meters (7,900,000 cubic yards). Borrow area B contains approximately 6,200,000 cubic meters (8,200,000 cubic yards) of compatible sediment. At this time, the volume of sediment in these areas is enough to supply the approximately 4,300,000 to 7,000,000 cubic meters (5,600,000 to 9,200,000 cubic yards) of sediment required for beach nourishment alternatives 1 through 4, together with the associated periodic renourishment required through the 50-year lifetime of the project.

- The relative density of the sediment within both of the borrow sites increases with depth. Hydraulic cutterhead or mechanical dredging methods are recommended to ensure blending of the sediments throughout the total dredge depth. Hopper dredging is not recommended.

4.7.2 Alternative Borrow Sites

A number of alternative onshore and offshore borrow sites were also considered for the project. However, the known alternatives borrow sites were found to provide sediment that was less desirable from an economic, technical or environmental standpoint than the selected borrow sites.

- The shoaled area near Coronado beach and near Zuniga Jetty was looked at as a possible source of sand for the project. However, the area is more than 5 kilometers (3-miles) away from the receiver beach site. A distance of 5 kilometers (3 miles) or is the economical cutoff for consideration of borrow areas, since the cost of dredging increases sharply with distance from the borrow site. Additionally, the composite grain sizes for this borrow area were too small to fit the grain size composite envelope for the Imperial Beach site.

- The City of San Diego has several reservoirs available as a possible source of sand. The sediment available at these sites is believed to be at most 200,000 cubic meters (260,000 cubic yards). The material is mostly too fine for beach material and is now located in environmentally sensitive areas behind the reservoirs of the dams.

- The Nelson and Sloan quarry is located approximately 16 kilometers (10-miles) east of Imperial Beach, just north of the Mexico border and along the south boundary of the Tijuana River flood plain. The quarry produces sand and gravel materials, as well as large derrick stone. The quantity of sand available is unknown but is believed that the quarry can produce enough sand to fulfill the needs of this project. The production of this sand would involve high costs, since the quarry would have to be mined and the material processed in order to produce a beach compatible type of material.

- Colorado River Sand is captured at several sedimentation basins along the Colorado River, near the U.S/Mexico border. The basins are located approximately 290 kilometers (180 miles) due east of Imperial Beach on Interstate 8. The sand was tested in 1998 by Woodward Clyde Consultants and meets Corps requirements for beach compatibility for this project. Woodward Clyde estimated the quantity of sand in 1998 to be approximately 7,600,000 cubic meters (10,000,000 cubic yards). However, the cost to provide this sand to the project site is greater than the cost to dredge and place sand on the beach for this project.

4.7.3 Other sources

Other sources of sand may be made available to Imperial Beach. These include dredged material from future U. S. Navy dredging projects and the Corps of Engineers San Diego Bay entrance maintenance dredging.

4.8 Project Cost Estimates

Preliminary cost estimates were prepared for each of the alternatives and for the different periodic nourishment intervals.

Since the additional beach width created by the periodic advance nourishment is considered sacrificial, it is not included in the benefit calculations. Therefore, the most economically advantageous periodic nourishment interval is that with the lowest annualized construction costs. The periodic nourishment interval can be optimized independently of the base nourishment beach width.

Table 4.1 gives the cost estimate for each nourishment cycle for the periodic advance nourishment, based on a unit price of $4.71 per cubic meter and mob/demob costs of $2,000,000. These preliminary cost estimates were developed by transferring cost data from similar projects and historical data.

Table 4.1: Estimated Per-Nourishment Costs for Periodic Nourishment

	5 year	10 year	15 year	22 year	50 year
Width (m)	10	20	30	47	100
Unit Price (/m^3)	$4.71	$4.71	$4.71	$4.71	$4.71
Volume (m^3)	382,000	764,000	1,146,000	1,681,000	3,820,000
Dredging	$1,799,220	$3,598,440	$5,397,660	$7,917,510	$17,992,200
Mob / Demob	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000
Total Cost	$3,799,220	$5,598,440	$7,397,660	$9,917,510	$19,992,200

The total and annualized costs of the construction component (initial and periodic nourishment) of each project alternative are developed in the Economic Appendix, and the annualized costs are summarized in Table 4.2. The effective unit costs of renourishment decrease with increasing renourishment volumes as a result of the relatively large mob/demob costs. This tends to make the larger renourishment intervals more cost-effective. However, with the larger renourishment intervals, the sacrificial beach tends to be constructed earlier in the project cycle, increasing the net present value and so increasing the annualized costs of the periodic nourishment. There is a tradeoff between these two effects. Table 4.2 shows that the optimum periodic nourishment interval is 10 years for each project alternative. This optimized nourishment interval is used in the total project cost estimates given below.

Table 4.2: Estimated Annualized Costs for Periodic Nourishment

Renourishment Cycles and Quantities		Base Nourishment Beach Widths and Quantities			
		Alternative 1 12 meters 450,000 m^3	**Alternative 2 25 meters 925,000 m^3**	**Alternative 3 34 meters 1,250,000 m^3**	**Alternative 4 54 meters 2,000,000 m^3**
	5 year 382,000 m^3	$1,041,812	$1,186,236	$1,285,052	$1,513,089
	10 year 764,000 m^3	**$901,982**	**$1,046,405**	**$1,145,221**	**$1,373,258**
	15 year 1,146,000 m^3	$912,004	$1,056,427	$1,155,243	$1,383,280
	22 year 1,681,000 m^3	$985,430	$1,129,853	$1,228,669	$1,456,706
	50 year 3,820,000 m^3	$1,427,398	$1,571,822	$1,670,638	$1,898,675

Table 4.3 gives the total estimated project costs, including construction of the base nourishment beach and periodic nourishment. The preliminary estimated total project cost includes planning, engineering and design, and construction management. A contingency factor is added to the project to reflect the uncertainties with respect to quantities, cost, level of design, and environmental concerns.

Table 4.3: Estimated Total Project Costs

	Alternative 1 12 meters	Alternative 2 25 meters	Alternative 3 34 meters	Alternative 4 54 meters
Costs				
Dredge Volume (m^3)	*1,214,000*	*1,689,000*	*2,014,000*	*2,764,000*
Unit Cost	*$ 4.71*	*$ 4.71*	*$ 4.71*	*$ 4.71*
Dredge Cost	$5,717,940	$7,955,190	$9,485,940	$13,018,440
Mob/Demob	$2,000,000	$2,000,000	$2,000,000	$2,000,000
Subtotal Costs	$7,717,940	$9,955,190	$11,485,940	$15,018,440
Contingency 15%	$1,157,691	$1,493,279	$1,722,891	$2,252,766
Total Dredging Costs	**$8,875,631**	**$11,448,469**	**$13,208,831**	**$17,271,206**
PED	$1,500,000	$1,500,000	$1,500,000	$1,500,000
S & A	$864,289	$1,023,805	$1,132,948	$1,384,815
Real Estate	$29,500	$29,500	$29,500	$29,500
First Cost Initial Dredging	**$11,269,420**	**$14,001,774**	**$15,871,279**	**$20,185,521**
Interest During Construction	$84,054	$104,434	$118,378	$150,556
NPV Future Dredging	$6,254,581	$6,254,581	$6,254,581	$6,254,581
Contingency 15%	$938,187	$938,187	$938,187	$938,187
NPV Future PED, S & A	$2,017,106	$2,017,106	$2,017,106	$2,017,106
NPV Project Monitoring	$761,548	$761,548	$761,548	$761,548
Gross Investment	**$21,324,896**	**$24,077,629**	**$25,961,078**	**$30,307,498**
Total Annualized Cost	**$1,377,000**	**$1,554,000**	**$1,676,000**	**$1,956,000**

4.9 Project Benefits

The project benefits include structural, recreational and environmental benefits. Along the South Reach, the project will provide a sandy beach fronting the revetment and will minimize any nuisance flooding to the southernmost end of Seacoast Drive. Along the North Reach, the project will provide protection for the existing coastal structures during coastal storms from being undermined, condemned, or destroyed.

Recreational benefits arise from the wider beach. Under without-project conditions, significant transfer costs will be incurred as recreational users of the beach are forced to travel to other beaches. The greater beach capacity will decrease these transfer costs.

Environmentally, the project will provide adequate habitat for some marine species and birds, such as the grunion and least tern. These species will have an increase of nesting and other habitats resulting from the project.

4.10 Associated Evaluation Criteria

Current Corps policy describes the Recommended Plan or NED Plan as the plan that has a benefit-to-cost ratio greater than 1; maximizes net benefits; and where two cost-effective plans produce no significantly different levels of net benefits, the less costly plan is to be the NED plan even though the level of outputs may be less.

An economic analysis of the total plan costs and benefits for each of the final alternative plans was conducted by comparing the cost for implementation with expected benefits of the plan on an annual basis. This determines the Recommended Plan based on maximizing annual net NED benefits. See the Economic Appendix for detailed economic analysis of the alternative plans. Table 4.4 summarizes the annualized damage savings for each alternative plan, assuming a 10-year periodic nourishment interval as previously discussed. This table includes both storm-related property damage and recreation transfer costs.

Table 4.4: Benefits by Alternative: Annualized Values

	Without-Project	Alternative 1 12 meters	Alternative 2 25 meters	Alternative 3 34 meters	Alternative 4 54 meters
Storm Damages	$ 1,793,000	$ 83,000	-	-	-
Benefits	-	$ 1,710,000	$ 1,793,000	$ 1,793,000	$ 1,793,000
Recreation Costs	$ 987,000	$ 40,000	$ 3,000	-	-
Benefits	-	$ 947,000	$ 984,000	$ 987,000	$ 987,000
Total Benefits	**-**	**$ 2,657,000**	**$ 2,777,000**	**$ 2,780,000**	**$ 2,780,000**

Table 4.5 computes the benefit to cost ratio and the net NED benefits.

Table 4.5: Benefit to Cost Ratio and Net Benefit by Alternative

	Alternative 1 12 meters	Alternative 2 25 meters	Alternative 3 34 meters	Alternative 4 54 meters
Annualized Cost	**$1,377,000**	**$1,554,000**	**$1,676,000**	**$1,956,000**
Damage Benefits	$ 1,710,000	$ 1,793,000	$ 1,793,000	$ 1,793,000
Recreation Benefits	$ 947,000	$ 984,000	$ 987,000	$ 987,000
Annualized Total Benefits	**$ 2,657,000**	**$ 2,777,000**	**$ 2,780,000**	**$ 2,780,000**
B/C Ratio	**1.93**	**1.79**	**1.66**	**1.42**
Net Benefits	**$1,280,000**	**$1,223,000**	**$1,104,000**	**$824,000**

Based on these results, the NED plan is **Alternative 1, with a 10-year nourishment cycle**.

Chapter 5 - Recommended Plan

5.1 General

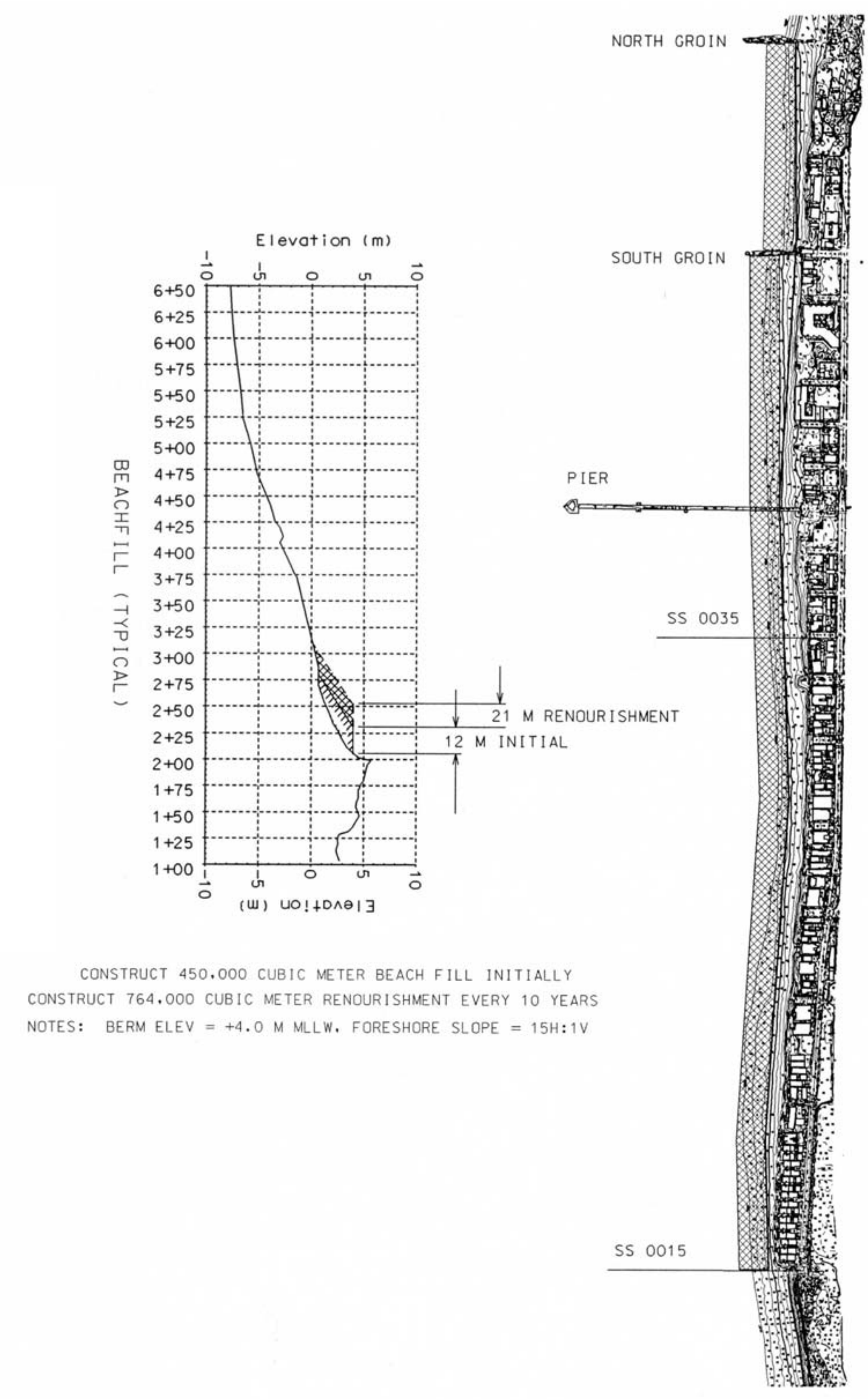
The Recommended Plan is the NED Plan is the plan that has a benefit-to-cost ratio greater than 1 and produces the greatest benefits. Alternative 1 with a 10-year nourishment cycle is the Recommended Plan of the four alternatives and five nourishment cycles considered. Figure 5-1 illustrates the Recommended Plan.

5.2 Recommended Plan Description

This alternative involves construction of a base beach fill consisting of 450,000 cubic meters (589,000 cubic yards) of suitable beach sand, plus a sacrificial advance beach fill of 764,000 cubic meters (1,000,000 cubic yards), for a total initial beach fill of 1,214,000 cubic meters (1,589,000 cubic yards). The placement will be 2,165 meters (7,100 feet) long extending from the northerly groin to the southern end of the development, providing a base nourishment beach width of 12 meters (39 feet) at an elevation of +4 meters (+13 feet) MLLW. The additional sacrificial beach width will be 20 meters (66 feet), so that initially the nourished beach will be 32 meters (105 feet) wider than the existing beach.

The nourished beach is expected to erode to the 12-meter (39-foot) width after 10 years. It will be renourished with a sacrificial advance beach fill of 764,000 cubic meters (1,000,000 cubic yards) every 10 years within the 50-year project lifetime.

Figure 5-1: Recommended Plan



5.3 Project Costs

Table 5.1 presents a summary of the project costs for the Recommended Plan.

Table 5.1: Project Costs for the Recommended Plan

Item	Costs
Year 1	
Mob / Demob	$2,000,000
Dredging Costs	$5,717,940
Contingency 15%	$1,157,691
PED	$1,500,000
S & A	$864,289
Real Estate	$29,500
Interest During Construction	$84,054
Year 1 Total Costs	$11,353,474
Year 1 NPV	**$11,353,474**
All Years 1 through 50	
Total Monitoring Costs	$2,350,000
Project Monitoring NPV	**$761,548**
Years 11, 21, 31, 41	
Mob / Demob	$2,000,000
Construction Costs	$3,598,440
Contingency 15%	$839,766
PED	$832,000
S & A	$973,500
Total Costs	$8,243,706
Year 11 NPV	**$4,549,309**
Year 21 NPV	**$2,510,547**
Year 31 NPV	**$1,385,452**
Year 41 NPV	**$764,565**
Future Nourishment NPV	**$9,209,873**
Totals (rounded)	
Total NPV	**$21,325,000**
Annualized	**$1,377,000**

5.4 Project Benefits

The benefits of the Recommended Plan include structural, recreational and environmental benefits. Along the South Reach, the project will provide a sandy beach fronting the revetment and will minimize any nuisance flooding to the southernmost end of Seacoast Drive. Along the North Reach, the project will provide protection for the existing coastal structures during coastal storms from being undermined, condemned, or destroyed. Recreational benefits arise from the wider beach in both reaches. Under without-project conditions, significant transfer costs will be incurred as recreational users of the beach are forced to travel to other beaches. The greater beach capacity will decrease these transfer costs.

Environmentally, the project will provide adequate habitat for some marine species and birds, such as the grunion and least tern. These species will have an increase of nesting and other habitats resulting from the project.

5.5 Economic Analysis

Table 5.2 presents the economic analysis for the Recommended Plan based on a comparison of costs and benefits on an equivalent annual basis. The average annual cost of the project is $1,377,000, and the average annual benefits are $2,657,000. Therefore, the project has a benefit-to-cost ratio of 1.93 to 1, with an average annual net benefit of $1,280,000.

Table 5.2: Economic Analysis of the Recommended Plan
(Annualized Average Costs and Benefits)

Damages	Without-Project	Recommended Plan	Benefits
Erosion (structures)	$ 265,000	$ 0	$265,000
Erosion (land loss)	$ 450,000	$ 0	$ 450,000
Utility Relocation	$ 142,000	$ 0	$ 142,000
Wave Attack	$ 476,000	$ 0	$ 476,000
Inundation	$ 336,000	$ 12,000	$ 324,000
Clean-up Costs	$ 34,000	$ 1,000	$ 33,000
Revetment O & M [1]	$ 90,000	$ 0	$ 90,000
Revetment Repair [2]	$ 0	$ 70,000	($ 70,000)
Total Damage Benefits			$ 1,710,000
Recreation Transfers			$ 947,000
		Total Annualized Benefits	$ 2,657,000
		Total Annualized Costs	$ 1,377,000
		Benefit-to-Cost Ratio	**1.93**
		Net Benefit	**$ 1,280,000**

1 South Reach revetment
2 It is not cost-effective to repair the North Reach revetment under without-project conditions, because it is soon outflanked and destroyed.

5.6 Environmental Impacts

The environmental impacts and mitigation plans associated with the Recommended Plan are presented in detail in the Environmental Appendix. Table 5.3 summarizes the environmental impacts of both the without-project alternative and the Recommended Plan. The analysis was based on without- and with-project assessment of impacts to environmental resources and attributes, regional economic development, and other considerations including cultural resources, transportation, and economic growth. The significance categories are defined as follows:

- Class I: Significant impact that cannot be mitigated to a level that is not significant
- Class II: Significant impact that can be mitigated to a level that is not significant
- Class III: Potentially adverse impact but not significant
- Class IV: Beneficial impact
- NI: No Impact.

Table 5.3: Environmental Impacts of the Recommended Plan

Environmental Issue	Without-project Alternative					Recommended Plan				
Significance Category	**I**	**II**	**III**	**IV**	**NI**	**I**	**II**	**III**	**IV**	**NI**
Topography / Geology	Y						Y		Y	
Coastal Processes					Y			Y	Y	
Water Resources					Y			Y		
Essential Fish Habitat					Y			Y		
Biological Resources					Y			Y	Y	
Cultural Resources					Y		Y			
Aesthetics			Y					Y	Y	
Air Quality			Y					Y		
Noise		Y					Y	Y		
Socioeconomics			Y						Y	
Transportation			Y				Y	Y		
Land Use	Y							Y	Y	
Recreation	Y		Y				Y	Y	Y	

There are no unavoidable significant impacts resulting from implementation of the Recommended Plan. With mitigation, resources addressed in this document would experience either adverse but insignificant impacts, beneficial impacts, or no impact during construction or in the long term.

There are several significant impacts that can be mitigated to a level that is less than significant. The following mitigation measures for the Recommended Plan are proposed in the EIS.

Topography and Geology

Chronic or large leaks and spills from construction equipment could contaminate soil and water.

G-1 Preparation of a Spill Prevention, Containment and Countermeasures Plan that specifies fueling procedures, equipment maintenance procedures, and containment and cleanup measures to be followed in the event of a spill.

Cultural resources

The identification of cultural resources in the project's area of potential effects (APE) has not been completed. Therefore, the potential exists for the presence of National Register eligible properties within the project's APE.

C-1 Prior to final approval for construction of the project, an underwater archeological and remote sensing survey of proposed borrow site Areas A and B will be performed. The findings of the survey shall be subsequently used to identify and implement any mitigation measures that may be necessary to minimize offshore impacts to a level of less than significant.

Noise

Short-term construction noise impacts are anticipated.

N-1 Onshore staging areas shall be located to avoid noise impacts to sensitive receptors (schools, hospitals, residential areas, etc.).

N-2 Conduct all onshore construction activities involving motorized equipment between the hours of 7 a.m. and 7 p.m. Monday through Saturday.

N-3 Maintain properly functioning mufflers on all internal combustion and vehicle engines used in construction and direct muffler exhaust away from sensitive receptor locations to reduce noise levels at the receptor locations to the maximum extent feasible.

N-4 Construction contractor shall provide advance notice by mail to all residents and property owners on the west side of Seacoast Drive between two and four weeks prior to construction. The announcement shall state specifically where and when construction will occur in the area. If construction delays of more than seven days occur, an additional notice shall be made, either in person or by mail. Notices shall provide tips on reducing noise intrusion, for example, by closing windows facing the planned construction. The contractor shall also publish a notice of the impending construction in local newspapers, stating when and where construction will occur.

N-5 Construction contractor shall identify and provide a public liaison person before and during construction to respond to concerns of neighboring residents about noise disturbance. Construction contractor shall also establish a toll-free telephone number for receiving questions or complaints during construction and develop procedures for promptly responding to callers and recording the disposition of calls. Procedures for reaching the public liaison officer via telephone or in person shall be included in the notices distributed to the public in accordance with Mitigation Measure N-4. If construction noise complaints are received, temporary noise curtains or shields shall be employed to reduce construction noise to levels that would not cause disturbances to anyone working or residing in the area, per Section 9.32.020 of the City of Imperial Beach General Plan.

Transportation

Construction staging areas may impose access restrictions and safety problems.

T-1 Standard construction practices and safety precautions shall be incorporated into the design of the project staging area(s). Construction staging areas shall be clearly marked and appropriately guarded to ensure public safety.

Recreation

Fill material that contains shell fragments could have an adverse effect on users of the beach.

R-1 Periodically remove shell fragments, if present, from beach using a sand sweeper or other mechanical separation device.

The south end of the study area, which is currently not included in the designated swim area, would likely attract more swimmers since some of the typical swim areas could be closed. Swimmers could be exposed to perilous ocean conditions in an area not patrolled by lifeguards.

R-2 Extend lifeguard services south of Imperial Beach Boulevard to the end of Seacoast Drive during construction of shore protection measures.

Construction equipment and staging areas would impede beach access and use.

R-3 Post signs to announce construction and maintenance activities two to three weeks prior to their inception. Maintain postings within the duration period of the activity.

Chapter 6 - Plan Implementation

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 Sponsor, the City of Imperial Beach. 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 Current Authorized Project

The original beach erosion control project for Imperial Beach, San Diego County, California was authorized by the River and Harbor Act of 1958 (Public Law 85-500). The authorized project entailed the construction of five (5) stone groins (2 of the 5 groins were actually constructed) at a cost share ratio of 40% Federal and 60% non-Federal. A modified project for shore protection at Imperial Beach was recommended and approved by the Office of the Chief of Engineers on October 22, 1979 as a post-authorization change to the originally authorized project. The plan for improvement entailed the construction of a submerged breakwater offshore of the City of Imperial Beach to be cost shared at a ratio of 57% Federal and 43% non-Federal. This ratio was computed based on a formula extracted from ER 1120-2-110 (dated before the Water Resources Development Act of 1986, WRDA), and is given as follows:

$$F = [(A/C)+(B/C) \times 0.5]100$$

where:

F = Federal share of total construction costs, percent
A = beach frontage of shore owned by Federal agencies, feet.
B = beach frontage of shore owned by non-Federal public agencies, feet.
C = total beach frontage (A+B), feet.

For the Federal improvement project (submerged breakwater), the approximate values were:

A = 700 feet (210 meters)
B = 4300 feet (1310 meters)
C = 500 feet (150 meters)

Construction of the improvement project was terminated in 1985 in compliance to a Federal court decision resulting from opposition to the project from many interests.

6.3 Cost Apportionment for the Recommended Plan

The Recommended NED Plan presented in this report is completely different from that currently authorized; therefore, implementation will require new congressional authority. Cost sharing for initial construction of the NED 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 215 of WRDA 99, which requires that such costs be shared 50 percent Federal and 50 percent non-Federal.

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 Imperial Beach study area consists mostly of developed public or private 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. Dunes Park and Pier Plaza Park in the North Reach are considered public parks. The portion of the project that protects these areas will be subject to 50% Federal, 50% non-Federal initial and renourishment cost sharing. Four privately owned vacant lots currently exist in the North Reach. The portion of the Federal project that would protect privately owned vacant lots would be cost shared 100% non-Federal. Development plans are currently underway for at least one of these lots. It is assumed that these lots will be developed prior to project construction. Therefore, cost sharing for the portion of the project protecting these areas will be subject to the general cost sharing. If, upon execution of a Project Construction Agreement (PCA), these lands are still undeveloped, project cost sharing will be modified to reflect 100% non-Federal cost sharing for those portions. 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 or private shores	2042 m (6700 ft)
Public park	122 m (400 ft)
Total Project Length	2,164 m (7,100 ft)

Table 6.2 and Table 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	Fraction	Percent Federal Share	Weighted Federal Share
Developed public or private shores	$\frac{2042}{2164} = 0.94$	0.65	0.61
Public park	$\frac{122}{2164} = 0.06$	0.5	0.03
Total Federal cost share initial construction			**0.64**

Table 6.3: Federal Cost Share: Renourishment

Land Type	Fraction	Percent Federal Share	Weighted Federal Share
Developed public or private shores	$\frac{2042}{2164} = 0.94$	0.5	0.47
Public park	$\frac{122}{2164} = 0.06$	0.5	0.03
Total Federal cost share renourishment			**0.50**

Based on these calculations, cost sharing for the project will be as follows:

- Initial construction costs, including sunk costs, are cost shared at 64% Federal and 36% 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.

Tables 6.4 and 6.5 present the Federal and non-Federal apportionment of the costs for the Recommended Plan. Table 6.4 indicates that the project first costs are $11,270,000, of which non-Federal costs total $4,057,200 and Federal costs total $7,212,800. Additionally, the General Reevaluation Report (GRR) costs were initially 100% Federal funded. The non-Federal sponsor is required to repay a fraction of these costs equal to the non-Federal fraction of the construction first costs, that is, 36%. Since the sunk GRR costs are $1,700,000, the non-Federal sponsor will be required to repay $612,000 in addition to the first costs of construction.

Table 6.4: Federal and Non-Federal Initial Costs of the Recommended Plan

		Non-Federal		Federal	
	Total Cost	**%**	**Cost**	**%**	**Cost**
Cash	$11,240,000		$4,027,200		$7,212,800
Real Estate (LERRD's)	$30,000		$30,000		$0
Cost Share: First Costs	**$11,270,000**	36%	**$4,057,200**	64%	**$7,212,800**
Sunk GRR Costs	**$1,700,000**	36%	**$612,000**	64%	**$1,088,000**

Table 6.5 presents the Federal and non-Federal apportionment of the future costs (renourishment and project monitoring to refine renourishment plans) for the Recommended Plan. This Table indicates that the future project costs for renourishment and for performance monitoring in support of continuing construction (renourishment) are $35,325,000, of which $17,662,500 are Federal and $17,662,500 are non-Federal.

Table 6.5: Federal and Non-Federal Future Costs of the Recommended Plan

		Non-Federal		Federal	
	Total Cost	**%**	**Cost**	**%**	**Cost**
Performance Monitoring Costs	$2,350,000		$1,175,000		$1,175,000
Renourishment Costs	$32,975,000		$16,487,500		$16,487,500
Cost Share: Continuing Construction	**$35,325,000**	50%	**$17,662,500**	50%	**$17,662,500**
Average Annual Cost: Continuing Construction	**$706,500**	50%	**$353,250**	50%	**$353,250**

Finally, Table 6.6 illustrates the cost apportionment for the total project, at October 2001 price levels. Including sunk costs, this shows that the ultimate project cost is $48,295,000, of which $22,331,700 (46.2%) is non-Federal and $25,963,300 (53.8%) is Federal.

Table 6.6: Federal and Non-Federal Cost Apportionment for the Total Project

Item	**Total Project Cost**	**Non-Federal Cost**	**Federal Cost**
Initial Construction (including sunk costs)			
Cash	$12,940,000	$4,639,200	$8,300,800
Non-Federal LERRD’s	$30,000	$30,000	-
Total Initial Cost	$12,970,000	$4,669,200	$8,300,800
Total Continuing Construction Cost (not discounted)	$35,325,000	$17,662,500	$17,662,500
Ultimate Project Cost	**$48,295,000**	**$22,331,700**	**$25,963,300**
Percentage Share		**46.2%**	**53.8%**

6.4 Division of Plan Responsibilities

The Federal Government and the City of Imperial Beach 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.

6.4.1 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. See Table 6.4 and Table 6.5.

c. Administering contracts for construction and supervision of the project after authorization funding, and receipt of non-Federal assurances.

6.4.2 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 local cooperation items established to include cost sharing of the Project as prescribed in the above paragraphs. The City of Imperial Beach as the local non-Federal sponsor will:

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction 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 6.4 and Table 6.5) and as further specified below:

   (1) Enter into an agreement that provides, prior to construction, 25 percent of design costs;

   (2) Provide, during 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 its total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction 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, and repair the completed 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 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 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, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army", and 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 flood plain management plans;

k. Provide the non-Federal share of that portion of the costs of mitigation and 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.

6.5 Project Cooperation Agreement

Prior to advertisement for the Construction Contract, a Project Cooperation Agreement will be required to be signed by the Federal Government and the City of Imperial Beach committing each party to the responsibilities for implementing and maintaining the project. 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 Assist. 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.

f. Prior to advertisement for the construction contract, formal assurances of local cooperation in the form of a Local Cooperation Agreement will be required from non-Federal interests (the Local Sponsor).

g. Construction would be initiated with Federal and non-Federal contributed funds, once the construction project was advertised and awarded.

Chapter 7 - 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.

A Public Involvement Workshop was held on May 1, 1997 at the City of Imperial Beach, based upon the findings in the Reconnaissance Report. This report recommended either beach nourishment or nearshore sand nourishment, that is, placement of sand in the nearshore area to provide a nearby source of sand for the beach. Public comment was generally in accordance with this approach.

The draft Feasibility Report and Draft EIS/EIR were released in June, 2002, and were coordinated with representatives from EPA, US Fish and Wildlife Service, National Marine Fisheries, California State Department of Fish and Game, and the City of Imperial Beach. A Public Meeting was held on July 24, 2002 at the City of Imperial Beach, during the 45-day review period. The review period ended on August 12, 2002. Public comment was generally favorable.

The recommended plan changed after the end of the public comment period, in response to comments from HQUSACE regarding details of the economic analysis. The change was from Alternative 2 to Alternative 1. Since the new recommended alternative is a smaller project, environmental impacts will be less and the Draft EIS/EIR was not recirculated. An additional public meeting was held on September 18, 2002 to solicit public comment on the change.

Public comments received during the public review period ending August 12, 2002 (including a transcript of the July, 2002 public meeting and written comments received) are included in this volume. Responses to these comments have been incorporated into the Final EIS/EIR.

Chapter 8 - Recommendation

I recommend that the selected plan for storm damage protection along the shoreline within the corporate boundaries of the City of Imperial Beach as described in this report be authorized as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable. The recommended plan is estimated to have an initial total cost of $12,970,000 (October 2001 price levels). Of this cost, 64% or $8,300,800 will be the responsibility of the Federal government and 36% or $4,669,200 will be the responsibility of the City of Imperial Beach.

The recommended plan further includes periodic nourishment at ten-year intervals within the 50-year project lifetime for a total of four periodic renourishment episodes, and project monitoring for periodic nourishment planning. The recommended plan is estimated to have an average annual cost for periodic beach nourishment of $706,500 over the 50-year project lifetime. Of this cost, 50% or $353,250 will be the responsibility of the Federal government and 50% or $353,250 will be the responsibility of the City of Imperial Beach.

As a result of the GRR study recommendations for a new authorization of the selected plan, I recommend de-authorization of the plan previously authorized under Section 101 of the River and Harbor Act of 1958.

This recommendation is made with the provision that before implementation, the City of Imperial Beach 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 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 and as further specified below:

   (1) Enter into an agreement that provides, prior to construction, 25 percent of design costs;

   (2) Provide, during 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 its total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction 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, and repair the completed 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 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 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, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army", and 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 flood plain management plans;

k. Provide the non-Federal share of that portion of the costs of mitigation and 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.

These recommendations 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 levels within the Executive Branch. Consequently, the recommendations may be modified before they are sent to the Congress as a proposal for authorization and/or implementation funding. However, prior to transmittal to Congress, the Non-Federal Sponsor, State agencies, Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Richard G. Thompson
Colonel, Corps of Engineers
District Engineer