5. PUBLIC BEACH RESTORATION PROGRAM

The Public Beach Restoration Program (PBRP) was created in 1999 by Assembly Bill 64 (Ducheny; Public Beach Restoration Act). A motivating factor behind the legislation was the continued loss of public beach due to man's activities in upland watersheds and along the shoreline. The PBRP is administered by the Department of Boating and Waterways (DBW).

5.1 Overview

The Public Beach Restoration Program provides a funding vehicle for the legislature to support restoration, enhancement, and maintenance of one of California's most valued resources – the beaches.

During the past century, intense coastal and inland development have significantly impacted California's beaches. Dams, debris basins and stream channelization have decreased the natural sediment supply to the coast, while harbor structures have interrupted alongshore sand movement. Consequently, many public beaches are eroded, unable to meet growing recreational demands.

Public beach loss will continue without beach nourishment. Already-narrow beaches will be further strained to meet the increasing needs of the growing population. Many of the broad beaches enjoyed today were produced by beach nourishment programs. However, the number of nourishment projects conducted in California has decreased dramatically in recent decades. These wide beaches have begun to narrow, and will continue to do so without sand replenishment. The implications of continued beach erosion include diminished recreational opportunities, lost tourism revenues, and increased damage from coastal storms, such as those that occurred during the 1997-98 El Niño winter.

A key component of the PBRP is the promotion of both local and federal partnerships with the state. On the local level, the DBW has joined with regional management agencies such as SANDAG (San Diego Association of Governments) and BEACON (Beach Erosion Authority for Clean Oceans and Nourishment) to support beach nourishment projects. A federal partnership has been forged with the U.S. Army Corps of Engineers (Corps). In 2001, the DBW coordinated nine projects with the Corps. A typical Corps project uses a multi-phase approach, and may have a life of 50 years. The project commences with a reconnaissance study, followed by a detailed feasibility study, an engineering and design phase, and, finally, construction. In 2001, the initial construction phase was cost-shared on a 65 % federal /35% nonfederal basis. If necessary, costs of maintenance phases are shared on a 50/50 basis.

5.2 Activities Undertaken Through the Public Beach Restoration Program

Funding for the initial year of the program (fiscal year 1999-2000) was limited to $500,000. These funds were used to support beach nourishment projects and studies in San Francisco, Santa Cruz, Ventura, Huntington Beach, and San Diego.

The state budget for fiscal year 2000-2001 provided $10 million in grants to be administered by the DBW, representing a substantial funding increase over prior years. Following a review of grant applications submitted by local agencies, funds were allocated for 16 beach related projects. The projects are summarized briefly in Table 5.1.

Table 5.1 Projects and Funding for the Public Beach Restoration Program (FY 2000-01)

Recipient	Project	Funding
City of San Francisco	Nourishment at Ocean Beach	$1,000,000
BEACON	Nourishment at Goleta County Beach[2]	$650,000
City of Carpinteria	Corps feasibility study of beach nourishment alternatives at city beaches [1]	$200,000
City of Port Hueneme	Dune restoration and vegetation at city beach park	$129,500
Los Angeles County	Partial funding for the Coast of California Storm and Tidal Waves Study-LA County	$500,000
City of Long Beach	Corps feasibility study of beach nourishment at Peninsula Beach [1]	$100,000
City of Seal Beach	Corps feasibility study of alternatives to increase nourishment intervals at Surfside-Sunset [1]	$113,750
Surfside-Sunset Project	Nourishment at Surfside-Sunset feeder beach [1]	$3,850,000
City of Huntington Beach	Corps feasibility study of beach nourishment alternatives at Huntington Cliffs [1]	$255,250
City of Newport Beach	Nourishment feasibility study at Balboa Island, Newport Bay	$40,000
City of San Clemente	Corps feasibility study of beach nourishment alternatives at city beaches [1]	$425,000
SANDAG Regional Beach Restoration Project	Nourishment at 12 beaches in San Diego County [2]	$1,236,500
City of Encinitas[3]	Corps feasibility study of beach nourishment alternatives at city beaches [1]	$400,000
City of Solana Beach[3]	Corps feasibility study of beach nourishment alternatives at city beaches [1]	$400,000
City of Imperial Beach	Corps feasibility study of beach nourishment at city beaches [1]	$200,000
Scripps Inst. of Oceanography	Southern California Beach Processes Study	$500,000

[1] Matching funds [2] Supplemental funds [3] The Encinitas and Solana Beach studies will be combined

The grants awarded for the 2000-2001 fiscal year will support projects ranging from local and regional beach nourishment programs to Corps feasibility studies. As shown in Table 5.2, the majority of the program budget, approximately 69%, will be used to conduct beach nourishment projects. Cost-shared projects with the Corps constitute 26% of the program budget, with the remaining funds to be used for additional research into beach erosion and California coastal processes.

Table 5.2 Funding Allocation for the Public Beach Restoration Program (FY 2000-01)

Project Category	*Number of Projects*	*Total Funding (FY2000-2001)*	*Percentage of Program Budget*
Beach Nourishment and Restoration	5	$6,866,000	69%
Corps of Engineers Projects	9	$2,594,000	26%
Research and Other Studies	2	$540,000	5%
Total	*16*	*$10,000,000*	*100%*

5.2.1 Annual Nourishment at Ocean Beach, San Francisco County

Grant Recipient: City and County of San Francisco
Grant Amount: $1,000,000
Project Type: Beach Nourishment

Background

Severe winter storms have caused increased beach and seacliff erosion at Ocean Beach, San Francisco. The highest rates of erosion have occurred between Sloat Boulevard and Fort Mason. Several public improvements have been threatened, most notably the Great Highway and an underground sewer transport structure (CCSF, 2000).

In an attempt to limit erosion, rock revetments were constructed at several locations along the Great Highway during the early 1990's. However, continued erosion along unprotected portions of the seacliffs and waning public support for the use of hard structures prompted the city to pursue alternative long-term solutions. Proposed alternatives have included constructing offshore reefs, restoring a sand dune system, building seawalls, and managed retreat and relocation of the Great Highway.

A beach nourishment program was implemented as a short-term solution. Nearly 10,000 cubic yards of material were placed on the beach in September 1999. Renourishment operations conducted in 2000 provided an additional 7,000 cubic yards of sand. The fill material was barged

from a shoal off of Angel Island in the Bay. The 1999 and 2000 nourishment episodes were conducted for a cost of $500,000 and $450,000, respectively (Burke, 2001).

In both cases, the sand was placed against the bluff base to create a protective barrier. The majority of the nourishment material was eroded during the winter storm season. However, bluff recession was minimized.

Planned Project

A portion of the grant provided by the PBRP will support the annual re-nourishment of Ocean Beach from 2001 to 2003. Additionally, the local cost share for a planned Corps study will be partially funded by the grant.

Initial beach fill activities were scheduled for Fall 2001, with the placement of nearly 8,000 cubic yards of material. Similar to the previous nourishment operations, sand would be placed along the base of the bluffs (above the Mean High Water Line). A 60- to 70-ft wide sand berm would protect 250 feet of bluff and public development over the 2001-2002 winter (CCSF, 2001). The material would serve as a sacrificial barrier, which may be lost completely during the storm season. The estimated project cost was $450,000.

5.2.2 Nourishment at Goleta Beach, Santa Barbara County

Grant Recipient:	BEACON
Grant Amount:	$650,000
Project Type:	Beach Nourishment

Background

The shoreline along Santa Barbara and Ventura Counties has experienced long-term erosion at many locations. The Beach Erosion Authority for Clean Oceans and Nourishment (BEACON), a Joint Powers Agency, was founded in 1987 to protect and enhance the region's beaches. Since its formation, BEACON has implemented an ongoing coastal monitoring program and has conducted comprehensive studies to better understand the nature of the shoreline erosion occurring within its jurisdiction.

A principal cause of the erosion is human-induced changes to the natural sediment supply system. Construction of dams on the Ventura and Santa Clara Rivers and debris basins on smaller streams has significantly reduced the volume of sand reaching the coast from inland watersheds (Chapter 7, this report). Additionally, the area's four harbors (Santa Barbara, Ventura, Channel Islands, and Port Hueneme) act as littoral barriers, effectively blocking the natural alongshore movement of sand. Periodic sand bypassing has been conducted at each of the

harbors in order to mitigate downcoast beach erosion and maintain navigable depths (Noble Consultants, 1989). However, the sediment supply lost from upland (riverine) sources could be offset by introducing new material from an outside source. To address this problem, BEACON has developed a Regional Sand Management Plan.

The primary component of BEACON's sand management plan is the implementation of a large-scale beach nourishment program utilizing sand from offshore borrow sites (BEACON, 2000). The plan calls for periodic nourishment at several "receiver beaches" along the coast. Subsequently, these sites will serve as "feeder beaches" as waves and currents transport the sand alongshore, nourishing downcoast beaches. Unlike traditional beach fill operations, the material will be placed just offshore of the surf zone to form an artificial sand bar. This technique provides an estimated cost savings of over 50% relative to pumping the sand onto the dry beach.

Planned Project

The PBRP grant provided partial funding for a $1.75 million demonstration project at Goleta County Beach to test the effectiveness of the proposed nearshore placement method. The State Coastal Conservancy provided the remainder of the project cost. If successful, the sand would gradually move onshore, nourish Goleta Beach, and eventually migrate south to adjacent beaches. The project site is shown in Plate 5.1.

Approximately 250,000 cubic yards of sediment would be excavated from an offshore sand deposit and transported by hopper dredge to the project site. Previous studies indicate that the borrow site, located 1.5 miles offshore in a water depth of about 60 feet, may contain as much as 24 million cubic yards of sand. Once on site, the hopper dredge would deposit the material in water depths of 15 to 25 feet, forming a sand bar with a crest elevation approximately 10 feet below the sea surface. Operations would be conducted during the late spring or summer, when ocean conditions are conducive to onshore sand movement and safe maritime operations.

The effectiveness of the nourishment project would be monitored over the following year with a series of periodic beach profile surveys. Shoreline changes would be documented at Goleta Beach as well as the adjacent upcoast and downcoast beaches. The monitoring program also would investigate the environmental impacts of the project.

The use of the nearshore placement technique is not unprecedented in California. In 1991, approximately 1.3 million cubic yards of sand were dredged from the Santa Ana River and placed in a nearshore mound off the coast of West Newport Beach in water depths of 15 to 30 feet (Mesa, 1996). Beach profiles were collected periodically to monitor the fate of the nourishment material. The beaches located in the immediate vicinity of the project became wider, reflecting the onshore migration of the sediment.

Plate 5.1 Aerial view of Goleta County Beach, 1998 (photo courtesy of Moffatt and Nichol)

Although the primary objective of the BEACON project is to demonstrate the effectiveness of the nearshore placement method, Goleta Beach was selected specifically to provide immediate protection from chronic erosion at the site. During the 1999-2000 winter season, storm waves eroded approximately 30 feet of the park's grassy area and damaged several irrigation lines. A temporary rock revetment was constructed to limit further damage and preserve recreational opportunities at the park. However, due to public opposition and a negative environmental review by the California Coastal Commission, revetment removal was required, exposing the park to continued damage. If, as predicted, the nourishment material migrates onshore, the increased beach width at the site would provide a buffer against damaging storm waves during the following winter.

5.2.3 Feasibility Study at Carpinteria, Santa Barbara County

Grant Recipient:	City of Carpinteria
Grant Amount:	$200,000
Project Type:	Corps of Engineers Feasibility Study

Background

The Carpinteria shoreline spans over 1 mile of the Santa Barbara County coast and is owned by both the city and the State. The sandy beaches are typically narrow, and backed by public and

private developments, state park facilities, and the Santa Monica Creek estuary. Plate 5.2 shows a narrow beach found in the area.

Plate 5.2 Carpinteria Beach near Linden Avenue, February 1987

Erosion problems at the city shoreline began soon after completion of Santa Barbara Harbor in 1929. Despite intentions to minimize adverse effects to the shoreline, the harbor breakwater effectively blocked the alongshore movement of sand. Previously-wide beaches were deprived of sediment, resulting in chronic downcoast erosion. Seawalls and revetments were constructed to protect development at several locations.

A sand bypassing program was implemented in 1933 to compensate for the interruption in natural sediment transport. The operations essentially restored the littoral system to the pre-harbor status-quo, providing enough sand to avoid severe shoreline recession but insufficient quantities to rebuild the eroded beaches.

Upland developments have sustained damages from erosion and coastal flooding on several occasions, including $128,000 in damages following a 1995 storm. In 2001, as many as 14 structures were threatened by recurring erosion. At 2001 erosion rates, estimated at 5 feet/year by the Corps, the structures may be destroyed by 2013 (USACE, 2001). Continued erosion also will limit recreational opportunities at Carpinteria, known unofficially as the safest beach in the world.

Planned Project

The PBRP grant financed a portion of the non-federal cost for a Corps Feasibility Study. The objectives of the feasibility study are (USACE, 2001):

1.) Restore recreational value of beaches;

2.) Preserve and enhance habitat for species dependent upon sandy beaches; and

3.) Reduce coastal storm damage.

Beach nourishment, the Corps' primary alternative, would provide recreational opportunities, the desired habitat, and storm protection. Several offshore borrow sites were known to exist in the area, and would be dredged to acquire the necessary fill material. Both beach face and nearshore bar placement would be investigated. Sand retention devices, designed to prolong the effectiveness of a beach fill, would be considered.

5.2.4 Dune Restoration at City of Port Hueneme, Ventura County

Grant Recipient:	City of Port Hueneme
Grant Amount:	$129,500
Project Type:	Dune Restoration

Background

Severe coastal erosion at Hueneme Beach began in the 1940's following the construction of the Port Hueneme Naval Facility (Noble Consultants, 1989). The arrowhead jetties that stabilize the harbor entrance block the natural alongshore flow of sediment, isolating the downcoast beach from its only natural source of sand replenishment. Channel Islands Harbor, built approximately 1 mile to the northeast in 1960, further contributed to the problem.

The erosion problem is successfully mitigated by a Corps sand bypassing program that transports the sand, impounded updrift of Channel Islands Harbor, to Hueneme Beach on a bi-annual basis. Since the program commenced in the 1960's, approximately 1.19 million cubic yards of sand per year have been placed downcoast of Port Hueneme (Wiegel, 1994). During the 2000 bypassing operation, the Corps nourished Hueneme Beach with 948,000 cubic yards of material (City of Port Hueneme, 2000).

Despite the success of the sand bypassing program, sand loss by aeolian, or wind-blown, processes continues to be a problem for the city of Port Hueneme. A brisk afternoon seabreeze transports sand from the beach onto Surfside Drive and into the adjacent residential areas. The wind-blown sediment creates costly maintenance problems related to street sweeping and road repair.

Installation of a sand retention wall as part of the West Beach Public Promenade Extension provided a partial solution to the wind-blown sediment problem along the western end of Hueneme Beach. Although the wall provides an effective barrier to wind-blown sand from the beach, sediment from small relict dunes located between the wall and the street continues to migrate landward. The eastern portion of Hueneme Beach lacks a sand retention wall, with only an unstable dune field to impede wind-blown sediment.

Planned Project

The city of Port Hueneme planned to implement a dune revegetation project with the funds awarded through the PBRP (City of Port Hueneme, 2000). The objective of the project was to create stable sand dunes, which would provide a natural barrier to wind-blown sediment in upland areas. A similar revegetation project conducted along the far eastern portion of the beach proved successful in stabilizing the dunes and preventing excessive wind-blown sedimentation. Habit restoration is an additional benefit of the project.

The project plan provided for landscaping along the upland side of the West Beach Promenade sand retention wall, the dunes along the eastern portion of Hueneme Beach, and an area between two public parking lots (Lots B and C). Work was scheduled to commence in Summer 2001, with construction performed by city crews over an 8-week period. The PBRP grant funded 85% of the project cost.

5.2.5 Coast of California Storm and Tidal Waves Study – Los Angeles Region

Grant Recipient:	Los Angeles County
Grant Amount:	$500,000
Project Type:	Corps of Engineers Regional Shoreline Study

Background

The Coast of California Storm and Tidal Waves Study (CCSTWS) was authorized by Congress under the Flood Control Act of 1965. The general objective of the CCSTWS is to develop a coastal information database that can be used by federal, state, and local governments, homeowners and beach users to implement rational and well-formulated actions and policies for the California coastal zone.

The study commenced in the San Diego region (Dana Point to the U.S. Mexico Border) in 1983. The South Coast region CCSTWS, addressing the Orange County shoreline between the Los Angeles/Long Beach Harbor Complex and Dana Point, was initiated in 1992 following completion of the San Diego Region CCSTWS. Planning for the next phase of the study, the Los Angeles Region CCSTWS, was progressing in 2001.

Los Angeles County established a Beach Nourishment Task Force in 1999 with the specific objective of developing a long-term, regional plan to manage coastal erosion and beach nourishment along the county coastline. In addition to county officials, the task force includes the Corps, coastal communities, state and federal agencies, and public and private interest groups. It is anticipated that the results from the Los Angeles Region CCSTWS will be the basis of the county's long-term coastal management strategy.

Planned Project

To advance the work of the Beach Nourishment Task Force, the Los Angeles County partnered with the Corps to conduct the Los Angeles region CCSTWS. The PBRP grant provided a portion of the Los Angeles County cost share for the first two years of the five-year, $5.2 million study.

As indicated previously, the general goal of the CCSTWS program is to provide engineers, scientists and policy makers with the information necessary to develop and implement sound coastal management strategies. Specific objectives of the Los Angeles region CCSTWS are (County of Los Angeles, 2000):

- Perform a coastal processes analysis for use in future studies and projects;
- Establish criteria for the quality of beach-suitable nourishment material;
- Identify and characterize potential sources of beach nourishment material;
- Identify areas with long-standing coastal erosion issues and provide recommendations for future projects or studies to mitigate the problems;
- Establish a GIS database that integrates numerical models for predicting long-term shoreline changes and the impacts of pollutant discharges on coastal water quality; and
- Develop a long-term sediment management plan for the Los Angeles region.

The study was scheduled to commence in the 2001-2002 fiscal year. Data acquisition efforts, including installation of wave gauges and collection of beach profile data, began in Fall 2001.

5.2.6 Feasibility Study at Peninsula Beach, Los Angeles County

Grant Recipient:	City of Long Beach
Grant Amount:	$100,000
Project Type:	Corps of Engineers Feasibility Study

Background

The majority of the Long Beach oceanfront is sheltered from storm waves by the offshore breakwaters of the Los Angeles/Long Beach Harbor Complex. At Peninsula Beach, however,

ocean waves pass between the eastern end of the breakwater and the Alamitos Bay entrance jetties and proceed unimpeded to the coast, eroding the shoreline (Coastal Frontiers, 1995).

Plate 5.3 Erosion pattern at Peninsula Beach

As shown in Plate 5.3, the typical pattern of shoreline change is sediment erosion at the central portion of Peninsula Beach and deposition on the sheltered beaches located to the west. Approximately 2,500 feet of shoreline, between 59th Place and 71st Place, are subject to active erosion. Shoreline recession approaching 100 feet is not uncommon at some locations during a typical year.

The eroding beach is backed by 93 oceanfront homes and an aging timber bulkhead and boardwalk. When the beach is narrow, these homes and public structures are subject to coastal flooding. Furthermore, recreational opportunities and the associated economic benefits are diminished as the beach becomes narrower.

Several solutions for restoring this section of shoreline have been investigated. Beach stabilization concepts that have been implemented in the past include both sand and gravel nourishment, artificial seaweed installation, a submerged breakwater composed of large sandbags, and a groin field. Shore restoration concepts that have been studied to date include the extension of either the Long Beach Breakwater, the Alamitos Bay Entrance West Jetty, or both; submerged offshore breakwaters; groin fields; segmented offshore breakwaters; and a perched beach (an offshore sill intended to trap sand on the beach).

The city of Long Beach currently conducts an annual re-nourishment program to maintain Peninsula Beach. The program is a backpassing operation that transfers sand from the wide, sheltered beaches in the lee of the Long Beach Breakwater to the narrow, exposed shoreline of Peninsula Beach. A typical nourishment episode transfers between 75,000 and 100,000 cubic yards of sand at an approximate cost of $150,000.

Planned Project

Despite the relatively low cost of the beach nourishment operations, the program has been criticized because the activities must be repeated on a regular basis. In hopes of decreasing the cost of providing annual nourishment and increasing recreation opportunities and the level of storm protection at Peninsula Beach, the city of Long Beach and the Corps plan to conduct a feasibility study of shoreline restoration alternatives (City of Long Beach, 2000). The grant awarded through the Program would provide a portion of the non-federal share of the cost. The total estimated cost for the two-year study program is $800,000.

The general objective of the Corps feasibility study is to develop a long-term solution to the beach erosion problem. Specific objectives of the study are:

- Maintain recreational beach opportunities;
- Preserve and enhance the environment;
- Control beach erosion damage; and
- Reduce coastal storm flood damage.

5.2.7 Surfside-Sunset Nourishment Program, Orange County

Grant Recipient:	State Contribution to Federally-Sponsored Project
Grant Amount:	$3,850,000
Project Type:	Beach Nourishment

Background

The Surfside-Sunset Nourishment Program was initiated in 1964 as a component of the Orange County Beach Erosion Control Project. The goal of the program is to mitigate erosion of Surfside-Sunset Beach, and nourish the Orange County shoreline north of Newport Harbor. To accomplish this objective, periodic beach nourishment is performed at Surfside-Sunset Beach, which then functions as a "feeder beach" as waves and currents transport sand alongshore and nourish the downcoast beaches. The project is funded jointly by the Corps, Orange County and the State of California (through the DBW).

Major alterations to the natural condition of the San Pedro littoral cell began in 1889 with construction of the Los Angeles/Long Beach Harbor Complex. Additional harbor development and navigation projects at the San Gabriel River mouth and Anaheim Bay effectively extended erosion to Surfside-Sunset Beach by the mid-1940's. Inland development, particularly flood control projects, also contributed to the changes in the natural condition of the beaches.

This extensive development significantly impacted the coastal processes of the region. Some beaches benefited from these changed conditions while others did not. Erosion was particularly severe along the beaches fronting the communities of Surfside-Sunset Beach and West Newport Beach, where wave action has caused coastal flooding and property losses.

The initial nourishment effort conducted under the Surfside-Sunset Project was completed in June 1964 and provided 4 million cubic yards of beach sand. Subsequently, between 1971 and 1997, over 10 million cubic yards of additional sand were placed on the Surfside-Sunset feeder beach. Although the initial replenishment utilized material from within the Naval Weapons Station, the majority of the sand placed since 1979 originated from nearshore borrow sites. Plate 5.4 shows wide beaches at Surfside-Sunset and Bolsa Chica two years after a nourishment operation.

Plate 5.4 Surfside Sunset and Bolsa Chica Beaches, August 1986.

A primary component of the South Coast Region (Orange County) CCSTWS was an evaluation of the Surfside-Sunset nourishment project. A detailed analysis of beach widths and sediment volumes between 1963 and 1997 indicated that the vast majority of nourishment material placed

on the beach has remained in the littoral system (USACE, 1999). Furthermore, beach widths throughout the region were found to increase at an average rate exceeding 4 feet per year.

Planned Project

A portion of the non-federal contribution for the Surfside-Sunset nourishment effort was provided by the PBRP grant. The balance of the $13 million project would be funded by the Corps and Orange County. Operations were scheduled to begin in October 2001 and be completed within four months.

An estimated 1.8 million cubic yards of sand would be excavated from an offshore borrow site, using conventional hydraulic dredging equipment, and pumped onto Surfside-Sunset Beach (Mesa, 2001). The nourishment material would be placed between the east jetty of Anaheim Bay and Anderson Street in Sunset Beach, a distance of approximately 3,500 feet. The resulting beach width would be approximately 500 feet, increasing the recreational opportunities at Surfside-Sunset Beach.

The borrow site is located offshore of Bolsa Chica in water depths of 42 to 55 feet. Geotechnical investigations indicate that the offshore site potentially contains 2.5 million cubic yards of suitable nourishment material. Sources of beach-quality sand located in closer proximity to Surfside-Sunset Beach were exploited during previous project phases, thereby necessitating the large transport distance for the current nourishment episode.

5.2.8 Feasibility Study at Surfside-Sunset Beach, Orange County

Grant Recipient:	City of Seal Beach
Grant Amount:	$113,750
Project Type:	Corps of Engineers Feasibility Study

Background

The ongoing chronic erosion at Surfside-Sunset Beach is directly attributable to extensive coastal development in Los Angeles and Orange Counties. Historically, Surfside-Sunset Beach benefited from the natural longshore drift that delivered sediment from the nearby Los Angeles and San Gabriel Rivers and upcoast beaches. However, following construction of flood control measures on these rivers, construction of the jetties at Anaheim Bay (for the U.S. Navy Weapons Station, Seal Beach) and the breakwaters of the Long Beach – Los Angeles Harbor Complex, significant changes occurred to the natural condition of the region. Surfside-Sunset Beach, located adjacent to the Naval Weapons Station, was adversely affected by these changes.

Erosion problems at Surfside-Sunset Beach began in the mid 1940's soon after completion of the Naval Weapons Station (City of Seal Beach, 2000). To provide protection for homes along the eroding beach, a revetment was first built by the Navy in 1945 and most recently refurbished in the 1990's. The first beach nourishment operations also were conducted in 1945 (Shaw, 1980). Since that time, over 16 million cubic yards of sand have been placed on Surfside-Sunset Beach. The majority of beach nourishment at the site has been performed under the auspices of the U.S. Army Corps of Engineers Orange County Beach Erosion Control Project.

The Surfside-Sunset Nourishment Program, discussed previously in Section 5.2.7, was implemented as part of the overall Orange County Beach Erosion Control Project. The primary objectives of the nourishment program were to 1) provide shore protection for Surfside-Sunset Beach, and 2) replenish the downcoast beaches with sand. Since the program's inception in 1963, Surfside-Sunset Beach has been re-nourished at intervals of 4-8 years. During the most recent nourishment episode, completed in Fall 1997, approximately 1.6 million cubic yards of sand were added to the beach.

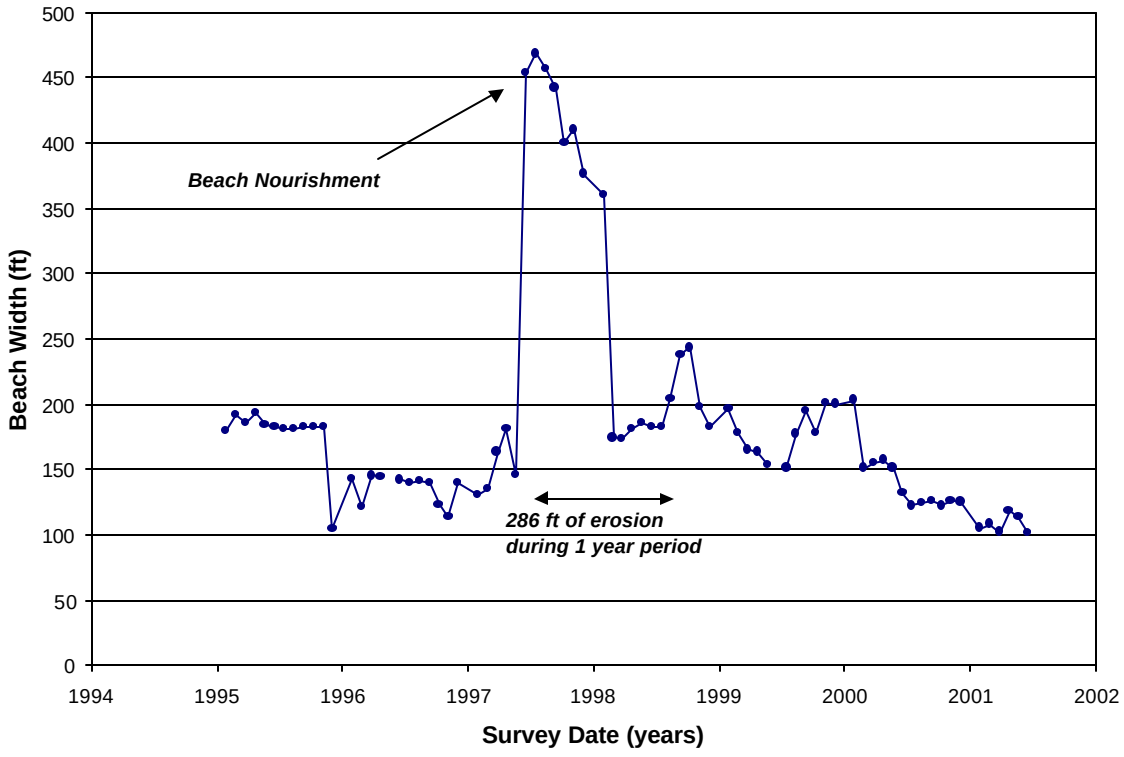

Figure 5.1 Beach width measured at Surfside-Sunset Beach, 1995-2001

Results from the South Coast Region CCSTWS indicate that the Corps' nourishment program has been successful in replenishing the shoreline south of Surfside-Sunset Beach (USACE, 1999). However, wide beaches adequate for recreation and storm protection at Surfside-Sunset

are realized for only a short period following nourishment episodes. As indicated in Figure 5.1, which shows monthly beach width measured at Surfside-Sunset Beach preceding and following the 1997 nourishment, the benefits of the beach fill are often lost within the first year of the project. It should be noted that this period encompasses the 1997-98 El-Niño winter.

Between scheduled nourishment episodes, both public and private infrastructure are often at risk in winter storms seasons because of critically-narrow beach widths. The rock revetment that serves as the last line of defense along Surfside-Sunset Beach was exposed by wave action in 1995, three years after the 1992 beach fill was completed, and again in 1999, only two years after the most recent nourishment episode prior to this planned project.

Planned Project

The Corps, in a cooperative effort with the city of Seal Beach, proposed to conduct a feasibility study to investigate shoreline restoration alternatives at Surfside-Sunset Beach. The estimated cost of the two-year study effort was $325,000. The PBRP grant financed 70% of the non-federal cost required for project authorization.

The general goal of the study was to identify measures to restore and preserve the public beach, thereby promoting recreational and economic opportunities and providing protection from damaging coastal storms (USACE, 2000a). Non-structural methods of restoration, such as periodic beach nourishment, are preferred by the city. However, sand retention devices designed to prolong the effectiveness of beach replenishment operations also would be investigated.

5.2.9 Feasibility Study at Huntington Beach, Orange County

Grant Recipient:	City of Huntington Beach
Grant Amount:	$255,250
Project Type:	Corps of Engineers Feasibility Study

Background

Huntington Cliffs span approximately 8,000 feet of coastline between Bolsa Chica State Park and 17th Street in Huntington Beach. As shown in Plate 5.5, the northern and southern portions of the reach contain relatively wide sandy beaches, while the central portion is characterized by narrow beaches backed by high coastal bluffs (USACE, 1995). The bluffs in the central portion form a mild promontory, extending further seaward than the surrounding coastline.

Plate 5.5 Huntington Cliffs, October 1994 (looking south towards Huntington Beach Pier)

The sandy beaches that protect the bluffs along the northern and southern portions of the reach have become wider since the Surfside-Sunset Nourishment Program was implemented in 1963. In contrast, the narrow beaches fronting the bluffs along the central portion of the reach have exhibited long-term trends ranging from slight recession to stability. The Corps has speculated that the headland or promontory-type feature created by the bluffs prevents the beach from retaining the nourishment material that moves down the coast from Surfside-Sunset Beach (USACE, 1999). Lacking a significant fronting beach, a non-engineered revetment at the base of the bluffs provides the primary protection from ocean waves, which routinely reach the bluffs during high tides (Plate 5.6).

Gradual, long-term bluff erosion along the central portion of Huntington Cliffs has resulted in facilities losses at Huntington Beach Blufftop Park (City of Huntington Beach, 2000). Damages to security lights, safety railings, and pedestrian walkways have been documented. Parking lot facilities are currently threatened, and continued erosion may eventually impact the Pacific Coast Highway. Public safety issues and lost recreational opportunities resulting from damaged park structures and a persistently-narrow beach are major concerns to the city.

Plate 5.6 Non-engineered revetment at base of bluffs, October 1994

Planned Project

The PBRP grant financed a portion of the non-federal cost contribution required to conduct a Corps Feasibility Study. The total study costs were estimated to be $1.02 million. The primary objective of the feasibility study was to identify appropriate measures to reduce coastal storm damages to public facilities at the Huntington Cliffs (USACE, 2000b).

Alternatives for limiting bluff erosion and protecting the public facilities at the site include beach nourishment along 4,600 feet of shoreline. Beach widths would be increased by 100 to 200 feet.

5.2.10 Feasibility Study at Balboa Island, Orange County

Grant Recipient:	City of Newport Beach
Grant Amount:	$40,000
Project Type:	Feasibility Study

Background

Balboa is a man-made island located in Newport Bay. The island is enclosed by a sheetpile bulkhead and has narrow, fine-grained beaches along the northern and southern shorelines. With 2.5 miles of public sidewalk and beaches, Balboa Island offers the most extensive public access and recreational opportunities of the eight islands located in the Bay. The public facilities, including 23 boat launch areas, draw over 150,000 visitors each day during the peak summer season (City of Newport Beach, 2000).

Although located in a relatively benign wave environment, the public beaches at Balboa Island are experiencing a gradual net loss of sand. The primary mode of erosion is believed to be the offshore movement of fine sand (Moffatt and Nichol, 1982). The ongoing erosion has reduced recreational opportunities and increased maintenance at public boat slips and piers.

The beaches receive small quantities of nourishment material on an irregular basis. All of the material placed on the beaches is dredged from sites in the Bay, usually during maintenance dredging at shoaled boat slips. The City of Newport Beach budget includes $35,000 annually for dredging and nourishment at public Bay beaches. Private individuals also provide nourishment material as a by-product of maintaining adequate depths at residential boat slips. Permits issued by the Corps limit maintenance dredging quantities, and thus nourishment, to 500 cubic yards per instance.

Planned Project

The City of Newport Beach planned to investigate sand nourishment alternatives for restoring the public beaches at Balboa Island (City of Newport Beach, 2000). Among the alternatives under consideration was a large-scale nourishment project along the eastern and southern shorelines of Balboa Island. Fine-grain sand, dredged from offshore of the island, would be used to form the foundation layer of the fill. In order to create a stable beach, coarse-grained material would then be imported and used to construct the upper layer and seaward portions of the fill. This construction technique was successfully implemented for a project at Alameda in San Francisco Bay. The post-nourishment beach would have an average width of 80 feet.

5.2.11 Feasibility Study at San Clemente, Orange County

Grant Recipient:	City of San Clemente
Grant Amount:	$425,000
Project Type:	Corps of Engineers Feasibility Study

Background

Beach erosion along San Clemente's shoreline has become the source of increasing public concern during the last two decades (City of San Clemente, 2000). Since the severe El-Niño winter of 1982-83, the San Clemente shoreline has been gradually receding. The average beach width in the region has been reduced to approximately 50 feet, nearly half of the pre-El-Niño condition (USACE, 2000c). The 4,500-foot stretch of beach between Mariposa Street and Cristobal Street has experienced the greatest reduction in width during the last decade.

Continuing erosion has subjected both public and private development to damage from coastal storms. During the 1997-98 El-Niño winter, storm waves caused $250,000 in damages to a rip-

rap revetment at Capistrano Shores Trailer Court (Plate 5.7). Public facilities, including the Marine Safety Building, restroom facilities, lifeguard stations, and parking lots are threatened during severe winter storms. Further damage to the public rest rooms near the pier may necessitate relocation of the facilities from the beach to the landward side of the railroad tracks.

Plate 5.7 Revetment at Capistrano Shores Trailer Court, June 2001

The railroad corridor passing through the San Clemente area lies between the seacliffs and the ocean (Plate 5.8). Ongoing beach erosion threatens this right-of-way, which has been designated as a Strategic Rail Corridor by the Department of Defense. To protect the railroad tracks during high storm waves and high tide conditions, the Orange County Transportation Authority performs periodic maintenance along an existing rip-rap revetment. Costs to maintain this under-designed revetment have averaged $200,000 to $300,000 every three years.

In addition to storm-induced damages to upland development, potential public safety issues associated with continued beach erosion also concern the city. Lack of beach in front of the railroad tracks and revetments along some sections of the shoreline does not allow safe passage for beach walkers during periods of high surf. These same narrow beaches impede lifeguard response to emergencies. Additionally, a danger is posed to swimmers by hard substrate and man-made structures, which have been exposed by the ongoing sand losses.

Plate 5.8 Railroad right-of-way fronted by narrow San Clemente beaches, June 2001

Planned Project

A portion of the non-federal cost of a Corps Feasibility Study would be supported by the PBRP grant. The goal of the study is to identify methods to accomplish the following specific objectives (USACE, 2000c):

1.) Enhance recreational opportunities;

2.) Protect the railroad corridor; and

3.) Reduce coastal storm damages to public facilities.

Beach nourishment is the favored alternative for addressing the erosion problem. The method would provide both recreational opportunities and storm protection. However, it is the most costly option. Offshore borrow sites would be dredged to acquire the necessary beach fill material. Sand retention devices, designed to prolong the effectiveness of a beach fill, would be considered as part of the nourishment option.

The total cost of the feasibility study was estimated to be $1.7 million. A 2½year study period is anticipated. Data collection efforts in support of the project commenced in Fall 2001.

5.2.12 SANDAG Regional Beach Sand Project, San Diego County

Grant Recipient:	San Diego Association of Governments (SANDAG)
Grant Amount:	$1,236,500
Project Type:	Beach Nourishment

Background

The coast of San Diego County extends from Orange County in the north to the Mexican Border in the south. Two complete littoral cells and the majority of a third cell are encompassed in this 76-mile stretch: the Oceanside Cell in the northern portion, the Mission Bay Cell in the central portion, and the Silver Strand Cell in the southern portion.

The county's beaches were severely eroded during the El-Niño winter of 1982-83, resulting in extensive damage to coastal facilities (Flick, 1993). To address the growing awareness of chronic erosion in many areas, the Coast of California Storm and Tidal Waves Study for the San Diego Region (CCSTWS-SD) was conducted by the Corps from 1983 through 1991 (USACE, 1991). The study identified two stretches of shoreline as sites of critical erosion: (1) the southern half of the Oceanside Cell (from Oceanside Harbor to La Jolla), and (2) the southern half of the Silver Strand Cell (from Imperial Beach to the Mexican Border).

In 1993, the San Diego Association of Governments (SANDAG) adopted a comprehensive plan for erosion mitigation known as the "Shoreline Preservation Strategy for the San Diego Region." The Strategy proposes an extensive beach-building and maintenance program to improve environmental quality, recreation, and storm protection in the coastal zone. A number of relatively modest "opportunistic" beach replenishment projects were undertaken prior to the planned project.

A more ambitious regional beach nourishment project was planned and partially executed as part of the U.S. Navy's Homeporting Project at North Island. To accommodate aircraft carriers, the U.S. Navy conducted major dredging operations in berthing areas and the San Diego Harbor entrance channel. Approximately 7 million cubic yards of sand dredged from these locations were intended to nourish the San Diego County shoreline through beach and nearshore placement. Sand was placed on the beaches of Mission Bay, Del Mar and Oceanside in September 1997; however, munitions were discovered in the sediment and nourishment operations ceased. Removing the munitions from the sand was deemed unfeasible, and the remaining dredged material was transported to the LA-5 deep-water disposal site. Subsequently, the Navy agreed to provide funds for beach nourishment in San Diego County.

Planned Project

Following the failed attempt to restore the shoreline using sand from the Navy homeporting project, the SANDAG Regional Beach Sand Project was initiated (SANDAG, 2000). The PBRP grant provided partial funding for the $17.5 million project. Viewed as the initial step in a long-term effort to restore the beaches, the project was the first regional beach nourishment effort on the West Coast. Recreational enhancement was a primary motive for conducting the project, in light of the substantial economic benefits provided to the region by beach tourism (Chapter 3, this report).

Over two million cubic yards of sand were placed on 12 San Diego area beaches, encompassing six miles of coastline, between April and September 2001. The sand was mined from five offshore borrow sites, using a hydraulic suction dredge, and then pumped onshore. Once onshore, the fill material was spread along the shoreline with earth moving equipment. Table 5.3 lists each site that was replenished, and the approximate nourishment quantities placed.

Table 5.3 San Diego Regional Beach Sand Project Nourishment Sites

Site	Nourishment Quantity (cubic yards)
Oceanside	380,000
North Carlsbad	240,000
South Carlsbad	160,000
Batiquitos, Encinitas	118,000
Leucadia State Beach, Encinitas	130,000
Moonlight State Beach, Encinitas	88,000
Cardiff State Beach, Encinitas	104,000
Fletcher Cove, Solana Beach	140,000
Del Mar	180,000
Torrey Pines State Beach, San Diego	240,000
Mission Beach, San Diego	100,000
Imperial Beach	120,000
Total	***2,000,000***

Source: SANDAG, 2000

Plates 5.9 and 5.10 show the North Carlsbad site before nourishment operations and after 240,000 cubic yards of sand were placed on the beach.

Plate 5.9 Pre-nourishment condition at North Carlsbad site, April 2001

Plate 5.10 Post-nourishment condition at North Carlsbad site, November 2001
(arrows point to approximately the same location on each photo)

A monitoring plan was implemented to determine the fate of the nourishment material. The effort is three-fold, and includes the following primary components:

- Monthly Beach Width Measurements: Obtained by city lifeguards to document short-term shoreline changes.
- Semi-Annual Beach Profile Surveys: To monitor long-term changes of the beach and nearshore zone.
- Semi-Annual Topographic Measurements at Lagoons: To document any impact of nourishment on tidal flow through lagoon inlets.

5.2.13 Feasibility Study at Encinitas and Solana Beach, San Diego County

Grant Recipient:	City of Encinitas and City of Solana Beach
Grant Amount:	$800,000 ($400,000 awarded to each city)
Project Type:	Corps of Engineers Feasibility Study

Background

Narrow sand or cobble beaches fronting unconsolidated bluffs characterize the Encinitas and Solana Beach shoreline. During winter months, beaches may be nonexistent along critical sections of the coast (Plate 5.11). Cardiff, a low-lying area backed by the San Elijo Lagoon, is situated between the bluffs of Encinitas and Solana Beach. In recent years, this stretch of coast has exhibited a narrow cobble berm with little or no sandy beach. Storm damage is common along both the bluff-backed and low-lying stretches of coast, and is attributable to narrow or nonexistent beaches.

Ongoing beach and bluff erosion in Encinitas and Solana Beach threatens public and private development. The primary erosion mechanism is wave undercutting at the base of the seacliff, which leads to instability and catastrophic failure of the upper bluff. Over 90 bluffs failures were reported between 1990 and 2000 (USACE, 2000d). Bluff failures also constitute a significant public safety issue, as evidenced by a January 2000 fatality resulting from a bluff collapse.

Storm-related damages along the Cardiff shoreline are typically associated with coastal flooding and road closures. Area restaurants and businesses spend an estimated $11,000 per storm event on temporary flood prevention measures. Between 1988 and 2000, the Pacific Coast Highway was closed on nearly 50 occasions due to dangers associated with wave overwash and cobbles thrown onto the roadway by stormy seas (USACE, 2000d). In addition to maintenance costs, road closures impact the livelihood of local businesses.

The region's chronically-narrow beaches currently do not provide the protective capacity needed to prevent bluff erosion and coastal flooding. A 1996 U.S. Army Corps of Engineers study found that over 100 bluff-top structures along the most critically-eroded section of the Encinitas shoreline would be threatened within the next 50 years if erosion mitigation measures are not implemented (USACE, 1996). The frequency of highway closures and coastal flooding events in the Cardiff area also are likely to increase without some form of beach restoration.

In addition, beach widths are not adequate to support the current recreational demand. Beach nourishment operations conducted within the reach by SANDAG in summer 2001 created wider recreational beaches and provided temporary protection for portions of the coast.

Plate 5.11 Narrow beaches backed by seacliffs in Encinitas, May 1999

Planned Project

The cities of Encinitas and Solana Beach contracted with the Corps to conduct a feasibility study for restoring the shoreline. A $3.1 million budget was established for the study. The specific objectives of the study are (USACE, 2000d):

1) Restore recreational value of the region's beaches;
2) Mitigate hazardous conditions associated with bluff failures;
3) Prevent Pacific Coast Highway closures during storm events;
4) Protect and enhance the San Elijo Lagoon; and
5) Reduce coastal storm damage to public and private development.

Beach nourishment and managed retreat are among the alternatives being considered in the project. Sand nourishment will help prevent storm damages and generate recreational opportunities by creating a wider beach. In addition, public safety will be improved by reducing bluff collapses. Offshore borrow sites in the area, utilized by the SANDAG Regional Beach Sand Project, would be used to acquire the necessary nourishment material. To prolong the effectiveness of a beach fill, sand retention devices will be considered as part of the nourishment option.

Managed retreat would involve a buyout of residences at risk from bluff failures. Upon establishing an appropriate set-back distance, the properties would be transformed into public open space. This alternative provides the added benefit of modest sediment supply to the beach through continued seacliff erosion (Chapter 8, this report). However, beach recreation and public safety issues related to bluff failures are not directly addressed by this alternative.

5.2.14 Feasibility Study at Imperial Beach, San Diego County

Grant Recipient:	City of Imperial Beach
Grant Amount:	$200,000
Project Type:	Corps of Engineers Feasibility Study

Background

Imperial Beach, the southernmost coastal community in California, spans 1.5 miles of shoreline in San Diego County. The beaches are backed by homes, public facilities, and coastal wetlands.

In contrast to most California regions, the predominant direction of sediment transport along Imperial Beach is south-to-north (USACE, 1986a). This may be attributed to the sheltering effects of Point Loma. The Tijuana River is the primary natural source of sediment to the

beaches. Flood control measures, constructed on both sides of the international border since 1938, have significantly reduced the amount of sand delivered to the coast. The relict Tijuana River delta is a prominent feature at the south end of the city shoreline (Plate 5.12).

Plate 5.12 Imperial Beach shoreline, April 2001

The primary contributors to erosion at Imperial Beach are reduced sediment yield from the Tijuana River, erosion of the relict delta, and human encroachment (DBW, 1994). The sand beaches are typically narrow, and often are nonexistent at areas south of the pier. Shoreline recession rates of 1-2 feet per year have been estimated. Seawalls and revetments have been constructed to protect development at several locations, and groins have been utilized to stabilize the shoreline north of the pier.

Over 34 million cubic yards of sand, derived from construction and dredging in San Diego Harbor, have been utilized to nourish the shoreline south of Point Loma (Flick, 1993). The majority of the material was placed north of Imperial Beach in the mid-1940's. As a result, the Coronado and Silver Strand beaches received the greatest benefits. More recently, dredged material from harbor construction has been transported to Imperial Beach and deposited in nearshore bars, including 233,000 cubic yards dredged from the U.S. Navy Pier 2 in 1997 (SANDAG, 2000). This material migrated shoreward during Summer 1998, increasing the beach width immediately south of the pier.

Planned Project

A Corps feasibility study is planned to identify solutions to erosion problems at Imperial Beach. A portion of the non-federal contribution required to conduct the study will be provided by the PBRP grant.

The objective of the study is to evaluate measures to reduce storm damage along the Silver Strand and Imperial Beach shoreline. Sand replenishment is the primary option for beach restoration. The two alternatives under consideration are (Risko, 2001):

- Alternative 1 – Beach Fill with Periodic Re-Nourishment
- Alternative 2 – Beach Fill with Nearshore Berm and Periodic Re-Nourishment

Re-nourishment cycles under Alternative 1 range from 11 to 50 years. Alternative 2 specifies a re-nourishment interval of 10 years. The estimated study cost is $1.4 million, and will be conducted on a 65% federal and 35% non-federal cost sharing basis.

5.2.15 Southern California Beach Processes Study

Grant Recipient:	Scripps Institute of Oceanography
Grant Amount:	$500,000
Project Type:	Coastal Processes Study

Background

Upon completion of a beach nourishment project, waves and currents redistribute the sand both offshore and alongshore. To predict the evolution of a beach fill, and hence its performance, scientists and engineers typically rely on computer models. The quality of the predictions is a function of the underlying physics of the model, the input wave conditions, site-specific calibrations, and the experience of the scientist or engineer.

The computer models commonly used for beach nourishment design in California were originally developed for East Coast environments. Little research has been done to assess the limitations of these models when applied to the more energetic wave environment and complex coastline in California. A better understanding of these limitations can allow for more realistic beach fill designs.

Planned Project

The PBRP grant funds a portion of the *Southern California Beach Processes Study*. The remainder of the $1 million study is supported by the State of California Resources Agency and the Department of Finance.

The primary objective of the study is to improve the technical basis for beach nourishment design in California. Both wave transformation and beach evolution models will be investigated. A better knowledge of the limitations and capabilities of the available models will promote more effective designs, which will increase the performance and economic viability of projects.

The study will utilize the SANDAG-sponsored beach fill at Torrey Pines as a field laboratory. The project will be monitored extensively over a two-year period. The following tasks will be undertaken:

- *Task 1:* Conduct high-resolution surveys to document the evolution of the Torrey Pines beach fill;
- *Task 2:* Collect wave height and direction data at the Torrey Pines site;
- *Task 3:* Enhance existing wave transformation models to provide improved input data for beach evolution models; and
- *Task 4:* Evaluate the GENESIS and SBEACH numerical models using the wave and beach evolution data obtained in Tasks 1 and 2.

The data collected during the study will be made available on the internet. Scientists and engineers throughout the world will have the opportunity to utilize the high-quality data to study beach fill evolution and sand transport processes.

The results of the study will be documented in a series of reports submitted to the Resources Agency and the DBW. Results will be disseminated to the scientific community through technical journals and conference papers.

Data collection efforts began in Spring 2001, prior to the commencement of beach nourishment operations at the Torrey Pines site.

5.3 Future Needs

The economic value of California's beaches to the national, state, regional and local economies is demonstrated in Chapter 3 of this report. The passage of Assembly Bill 64 in 1999 and the subsequent creation of the PBRP emphasized the need to allocate appropriate financial resources for the nourishment of the state's beaches. In 2000, the DBW conducted a statewide inventory of beach erosion hot spots to identify sites in need of restoration and subsequently estimated the volume of sand necessary to successfully mitigate the erosion problems at each beach.

Table 5.4 lists both the candidate sites identified in the DBW's inventory and the feasibility studies funded by the PBRP in fiscal year (FY) 2000-01, as the beaches that will be analyzed as

part of these current feasibility studies also are sites that require beach nourishment. The initial volume listed in the table for each site is based on a minimum berm width of 100 feet throughout the project length (or an equivalent volume of about 100 yd^3 of sand per lineal foot of project length). For the current feasibility projects, the estimated project lengths and sediment volumes are presented in the table.

Table 5.4 Future California Beach Nourishment Requirements

Current Project Commitment	Beach Nourishment Sites		Project Length (ft)	Initial Volume (yd^3) *
	County	Location		
Potential Projects	San Francisco	Ocean Beach	250	8,000
	Alameda	Crown Beach	1,000	100,000
	San Mateo	Coyote Point	2,400	240,000
	Santa Barbara	Refugio State Beach	2,000	200,000
	Santa Barbara	El Capitan State Beach	2,000	200,000
	Santa Barbara	Goleta State Beach	4,000	400,000
	Santa Barbara	Carpinteria State Beach	2,500	250,000
	Ventura	La Conchita	9,000	900,000
	Ventura	Hobson County Park	9,000	900,000
	Ventura	Emma Wood County Beach	7,000	700,000
	Ventura	Pierpont Beach	1,200	120,000
	Los Angeles	Dan Blocker Beach	3,500	350,000
	San Diego	Carlsbad State Beach	15,000	1,500,000
	San Diego	San Diego State Beaches **	8,000	800,000
	San Diego	Mission Beach	2,500	250,000
		Subtotal=	69,350	6,918,000
FY 2000-01 Feasibility Studies ***	Santa Barbara	Carpinteria City Beach	1,500	150,000
	Los Angeles	Peninsula Beach	2,500	250,000
	Orange	Seal Beach	4,000	400,000
	Orange	Huntington Cliffs	4,600	460,000
	Orange	San. Clemente	4,500	450,000
	San Diego	Oceanside	15,000	1,500,000
	San Diego	Encinitas	10,000	1,000,000
	San Diego	Solana Beach	5,280	528,000
	San Diego	Imperial Beach	8,000	800,000
		Subtotal=	55,380	5,538,000
		TOTAL=	**124,730**	**12,456,000**

* All nourishment volumes are designed to supply 100 yd^3/ft of sand (or an equivalent 100-ft berm width over the project length)

** San Diego State Beaches include Batiquitos, Leucadia, Cardiff, and Torrey Pines

*** Estimated lengths and volumes were employed for currently authorized feasibility studies

To calculate the funds required to conduct a successful beach nourishment program throughout the state, the design and construction costs of the projects listed in Table 5.4 were estimated. These estimates and estimates of future maintenance costs are presented in Table 5.5.

Table 5.5 Potential Beach Restoration Costs

(In thousands of dollars)

Project Locations	Total Initial Project Cost *	Federal Share of Initial Cost	State Share of Initial Cost	Total Annual Cost ***	State Share of Annualized Maintenance Cost
Potential Projects					
Ocean Beach **	$0	$0	$0	$450	$225
Crown Beach	$1,300	$845	$455	$260	$130
Coyote Point	$2,560	$1,664	$896	$512	$256
Refugio State Beach	$2,200	$1,430	$770	$440	$220
El Capitan State Beach	$2,200	$1,430	$770	$440	$220
Goleta County Beach	$2,800	$1,820	$980	$560	$280
Carpinteria State Beach	$2,650	$1,723	$927	$530	$265
La Conchita	$8,500	$5,525	$2,975	$1,700	$850
Hobson County Park	$8,500	$5,525	$2,975	$1,700	$850
Emma Wood County Beach	$6,700	$4,355	$2,345	$1,340	$670
Pierpont Beach	$1,480	$962	$518	$296	$148
Dan Blocker Beach	$3,550	$2,308	$1,242	$710	$355
Carlsbad State Beach	$13,900	$9,035	$4,865	$2,780	$1,390
San Diego State Beaches	$7,600	$4,940	$2,660	$1,520	$760
Mission Beach	$2,650	1,723	$927	$265	$133
Subtotal=	$66,590	$43,285	$23,305	$13,503	$6,752
FY 2000-01 PBRP Nourishment Projects					
Surfside-Sunset Beach **	$0	$0	$0	$2,600	$1,300
Subtotal=	$0	$0	$0	$2,600	$1,300
FY 2000-01 PBRP Feasibility Studies					
Carpinteria City Beach	$1,750	$1,138	$612	$350	$175
Peninsula Beach	$2,650	$1,723	$927	$530	$265
Seal Beach	$4,000	$2,600	$1,400	$800	$400
Huntington Cliffs	$4,540	$2,951	$1,589	$908	$454
San Clemente	$4,450	$2,893	$1,557	$890	$445
Oceanside	$13,900	$9,035	$4,865	$2,780	$1,390
Encinitas	$9,400	$6,110	$3,290	$1,880	$940
Solana Beach	$5,152	$3,349	$1,803	$1,030	$515
Imperial Beach	$7,600	$4,940	$2,660	$1,520	$760
Subtotal=	$53,442	$34,739	$18,703	$10,688	$5,344
TOTAL=	**$120,032**	$78,024	**$42,008**	$26,791	**$13,396**

* For all projects not funded currently, costs of $7.50/yd^3 for sand, $400,000 for Design and Construction and 20% contingency have been used. The actual estimated renourishment and construction costs were employed for the currently authorized Surfside-Sunset Beach ongoing nourishment project. No monetary adjustments have been performed for future dollars

** Indicates a 2000-01 PBRP nourishment project for which initial funds have been appropriated already

*** A 5-year replenishment interval has been employed (except for Ocean Beach)

Note: All costs are estimates and are subject to change.

The initial project costs were calculated based on a unit cost of $7.50 per cubic yard. Estimates include engineering design and construction administration costs of $400,000 and a 20%

contingency. To determine the annual cost of maintaining the design integrity of each project, a 5-year renourishment interval was applied to each project, except for Ocean Beach in San Francisco, which is to be nourished before every winter season. It should be noted that beach nourishment projects that are properly renourished at regular intervals with beach-quality material typically require smaller volumes of sand over time to sustain their initial design. If the beaches listed in Table 6.5 are properly maintained, the annual renourishment costs may decrease with time.

Under federal law (Water Resources Development Act of 1986, Section 103; Water Resources Development Act of 1999, Section 218), the non-federal partner is required to pay 35% of the initial implementation cost and 50% of maintenance costs for each project that is cost-shared with the federal government through the Army Corps of Engineers. Accordingly, the state will be required to pay for half of the recurring beach maintenance costs during subsequent renourishment cycles. Table 5.5 lists the state share of the potential initial and annual costs for each project in addition to the total costs. Note that the initial costs for the FY 2000-01 PBRP nourishment projects are not included in the overall totals as they are funded already. To initiate each of the potential projects listed in Table 5.5 not currently funded by the PBRP, the total state and federal cost would be approximately $120 million. Subsequent annual renourishment costs to maintain the initial investment are estimated to be approximately $26.8 million. If the costs of each project were shared with the federal government, then the state's portion would be only $42 million for the initial project costs with a subsequent annual maintenance cost of approximately $13.4 million.

Table 5.5 clearly demonstrates both the commitment that will be required by California in order to restore and maintain its valuable beach resources and the savings that can be expected by aggressively pursuing partnerships with the Corps on beach nourishment projects that provide significant benefits for both the state and federal governments.

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