U.S. Army Corps of Engineers
Los Angeles District

The ArcGIS Coastal Sediment Analyst: A Prototype Decision Support tool for Regional Sediment Management

Appendix A – Coastal and Economic Analyses

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July 2004

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1. INTRODUCTION

The National Regional Sediment Management (RSM) Program was implemented to develop methodologies and protocols to address and abate site-specific shoreline erosion problem at regional scales. The U.S. Army Corps of Engineers, Los Angeles District has been given the task to implement the California component of the National RSM Program. This report presents the coastal and economic analyses for a study conducted in support of the California component of the National RSM Program to develop a pilot ArcGIS decision support tool for Regional Sediment Management.

1.1 STUDY AUTHORITY

This study is being conducted in accordance of the National Shoreline Erosion Control Development and Demonstration Program (Section 227) of the Water Resource and Development Act of 1996.

1.2 STUDY PURPOSE AND SCOPE

The purpose of this Coastal and Economic Analyses Appendix is to provide a preliminary evaluation on the differential cost and benefits in disposing dredged sediment from the Ventura Harbor to three beach locations other than McGrath Beach or South Beach – the normal disposal areas. The cost functions developed for the study were on a conceptual level to be used as input to the pilot ArcGIS tool presented in the Main Report that is being developed to provide a management tool to evaluate future dredging and disposal options along the California coast. The Ventura Harbor dredging and disposal operation were selected only as an example to demonstrate the concept of using ArcGIS as a decision tool for Regional Sediment Management. Hence, as noted in the Main Report, the placement scenarios presented in the report were for illustration only, and were not intended to be realistic projects that could be implemented as specified. In addition, the cost functions and benefit analyses were done at a crude level with broad assumptions to cover a wide range of possible transportation and disposal scenarios to test the pilot GIS-based model, hence, the examples shown should not be viewed as sufficient analyses for any site-specific scenarios.

The following tasks were performed to meet the purpose of this study.

- Create a cost function for dredge material disposal.

- Compute benefits associated with placing the dredged material from Ventura Harbor onto three alternative beach fill sites.
- Evaluate the differential cost versus regional benefits for the three selected alternative sites.

1.3 PRIOR STUDIES

1.3.1 Prior Studies by the Corps

The Study Area has been investigated extensively by the U.S. Army Corps of Engineers (USACE), which has performed its first erosion study of the Santa Barbara shoreline in 1938. Since then, USACE has performed many other shoreline erosion or shore protection studies in the Study Area. The following list some of the study reports prepared by the USACE.

- “Beach Erosion at Santa Barbara”, Prepared by U.S. Army Corps of Engineers, 1938.
- “Shore Protection Report on Proposed Harbor Improvements at Ventura and Hueneme”. Prepared by U.S. Army Corps of Engineers, 1940.
- “Beach Erosion Control Report on Cooperative Study of Pacific Coastline of the State of California, Carpinteria to Point Mugu”. Prepared by U.S. Army Corps of Engineers, 1951.
- “Beach Erosion Control Report on Cooperative Study of Coast of Southern California, Point Conception to Mexican Boundary, Appendix VII, Interim Report”. Prepared by U.S. Army Corps of Engineers, Los Angeles District, 1960.
- “Beach Erosion Control Report on Cooperative Study of Coast of Southern California, Point Conception to Mexican Boundary, Appendix VII, 2nd Interim Report”. Prepared by U.S. Army Corps of Engineers, Los Angeles District, 1962.
- “Inspection Tour of Shoreline Santa Barbara to Imperial Beach”. Prepared by U.S. Army Corps of Engineers, 1978.
- “Beach Erosion Initial Appraisal, Santa Barbara County, California”. Prepared by U.S. Army Corps of Engineers, 1986.
- “Santa Barbara County Beach Erosion and Storm Damage Reconnaissance Study”. Prepared by U.S. Army Corps of Engineers, 1990.
- “Santa Barbara and Ventura Counties Shoreline, California”. Prepared by U.S. Army Corps of Engineers, Los Angeles District, 1997.

In addition to the above shoreline protection and erosion studies, USACE has performed the following studies related to the development of the Ventura Harbor.

- “Survey Report for Navigation, Ventura Harbor”. Prepared by U.S. Army Corps of Engineers, 1968a.
- “Design Memorandum No. 1”. Prepared by U.S. Army Corps of Engineers, 1970.
- “Memorandum for Record, Ventura Model Study”. Prepared by U.S. Army Corps of Engineers, 1980.
- “Feasibility Study, Ventura Harbor”. Prepared by U.S. Army Corps of Engineers, 1989.
- “Basis for Design, Estimate of Cost, Ventura Harbor”. Prepared by U.S. Army Corps of Engineers, 1992.

1.3.2 Prior Studies by Others

The Study Area has also been extensively studied by others. A partial list of major studies in addition to those listed in the References is presented below.

- “Beach Erosion and Pier Study”. Prepared for City of Carpinteria, Prepared by Bailard/Jenkins Consultants, 1982.
- “Annual Project Summary for Winter Protection Berm Project”. Prepared by City of Carpinteria, 1986-1996.
- “Coastal Sand Management Plan; Santa Barbara/Ventura County Coastline”. Prepared for BEACON by Nobel Consultants, Inc., 1989.
- “South Central Coast Beach Enhancement Program Criteria and Concept Design”. Prepared for BEACON by Moffat & Nichol Engineers, 1991.

1.4 EXISTING FEDERAL PROJECTS

Existing federal project in the Study Area includes maintaining the navigation channel into the Ventura Harbor and the placement of the dredged material onto McGrath Beach, as well as the Ventura Pierpoint and the groinfield.

2. STUDY AREA

2.1 LOCATIONS AND DESCRIPTIONS

The study area is located along a stretch of 22 miles of coastline from Carpinteria Beach in Santa Barbara County to Oxnard Shores in the Ventura County. A site location map for the study area is shown in Figure 2.1. The map shows the location for Ventura Harbor where maintenance dredging is required, and McGrath Beach where dredged material is currently being disposed. In the figure, the three alternative disposal sites – Carpinteria Beach, Oil Piers Beach and Oxnard Shores, are also shown. Table 2.1 below summarizes the distances between Ventura Harbor and the three alternative beach fill sites.

Table 2.1 Distances between Ventura Harbor and Alternative Beach Fill Sites

BEACH FILL SITE	APPROXIMATE DISTANCE FROM VENTURA HARBOR (MILES)
Carpinteria State Beach	17.5
Oil Piers	13.0
Oxnard Shores	4.5

2.2 COASTAL PROCESSES AND TRENDS

2.2.1 Water Levels

The ocean water levels in the study area are influenced primarily by the astronomical tides that result from the gravitational forces of the celestial bodies, primarily the earth, sun, and moon. The other factors that affect the ocean water levels include temperature variations, for example during El Nino Southern Oscillation (ENSO), barometric pressure changes, wind setup (i.e., storm surge), and wave setup. These factors are secondary in magnitude and episodic (e.g., hours, days, and seasons) in nature; hence the effects are relatively small and short-term. Therefore, the long-term representation of the ocean water levels is comprised primarily of the astronomical tide component.

(Source: 3-D TopoQuads)

Figure 2.1 - Site Location Map

Tides along the Southern California coastline are of the mixed semi-diurnal nature, with two high and two low tides of different magnitude in each lunar day. The National Oceanic and Atmospheric Administration (NOAA) monitors gauging stations around the United States to obtain ocean water level measurements. NOAA analyzes the data collected from these gauges to prepare long-term, ocean water level statistics. The NOAA station closest to the study area that has been updated with the latest tidal epoch (1983-2001) is located at Ricon Island. Tidal characteristics along the study area based on the latest tidal epoch (1983-2001) are presented in Table 2.2.

Storm surge along the Southern California coastline is small with typical amplitude of 1 foot or less. Strong ENSO events have an averaged return period of 14 years with 0.2 feet tidal departures lasting for about two to three years (USACE, 1997).

Table 2.2 Tidal Elevation at Ricon Island (Tide Epoch: 1983-2001)

DATUM	ELEVATION (FT, MLLW)
Highest Observed Water Level (1/27/1983)	7.8
Mean Higher High Water (MHHW)	5.6
Mean High Water (MHW)	4.7
Mean Tide Level (MTL)	2.8
Mean Low Water (MLW)	1.0
Mean Lower Low Water (MLLW)	0.0
Lowest Observed Water Level (1/16/1965)	-2.3

Source: National Ocean Service Tidal Bench Mark sheet for Ricon Island

2.2.2 Waves and Currents

The Santa Barbara and Ventura County coastline is partially sheltered from waves by the Santa Barbara Channel Islands – San Miguel, Santa Rosa, Santa Cruz, and Anacapa Islands. Therefore, the coastline is primarily exposed to waves from the west and southeast, as well as the southern swells passing through the Anacapa passage between Santa Cruz and Anacapa Islands.

The prevailing and storm wave climate at Santa Barbara and Ventura shorelines are composed of wind, swell, and local sea waves produced by six meteorological patterns: Northern Pacific extratropical cyclones, tropical cyclones, extratropical cyclones of the southern hemisphere, wind swells, west to northwest local seas, and pre-frontal local seas. Among these six meteorological patterns, the extratropical cyclones of the northern hemisphere impact the coastline the most, with the induced storms frequently causing significant damages to private and public facilities within the coastal area.

Deep water waves propagating towards coastline are altered by refraction, diffraction, and shoaling effects. The dominant breaker pattern between Point Conception and Point Mugu results in a unidirectional component of alongshore transport. As the shoreline orientation shifts to a more north/south direction near the Ventura River, the intensity of incident wave energy increase. This increase in wave energy results in a corresponding gradient of alongshore energy flux that increases from Isla Vista to a maximum between Ventura Harbor and Oxnard Shores. Moving south along the coast, the wave sheltering of Channel Islands reduces the wave energy at the south facing shoreline between Hueneme Beach and Point Mugu. The nearshore wave energy is also decreased in the vicinity of the two submarine canyons, Hueneme and Mugu Canyon (USACE, 1997).

Nearshore currents are driven by waves breaking on the shoreline at an oblique angle. The alongshore flow along the Santa Barbara and Ventura County shoreline is predominantly west to east because of the prevailing directionality of wave incidence mentioned above. Cross-shore currents exist throughout the study area, especially during high surf. These currents tend to concentrate at creek mouths and near structures, but can appear anywhere along the coastline in the forms of rip currents. The offshore currents consist of the large-scale coastal currents and the tidal and event-driven fluctuations. Among the major coastal currents, the Southern California Countercurrent has the highest velocity with maxima as high as 15 to 30 cm/sec (0.49 to 0.98 ft/sec) (USACE, 1997).

2.2.3 Littoral Processes

The study area is located within the Santa Barbara Littoral Cell, which extends from Point Conception to Point Mugu. The Santa Barbara Littoral Cell is the longest littoral cell in Southern California with a distance of 154 kilometers (96 miles) and is composed of a variety of coastal types and shoreline orientations. The principal feature of this littoral cell is the west to east net alongshore littoral transport direction. The offshore wave sheltering of Channel Islands, as discussed previously, results in an essentially unilateral movement of sand along the coastline from west to east. The shoreline orientation shifts in the southern portion of the Santa Barbara Littoral Cell to a more north/south directions along the Ventura and Oxnard portion. The wave exposure is shifted to the southern hemisphere swell, thus the littoral transport direction is an upcoast reversal in the southern portion of the Santa

Barbara Littoral Cell. However, since the dominant wave energy is from the west, the reversed transport volume is estimated to be only a small fraction of the total annual volume. The Hueneme and Mugu Submarine Canyons intercept most, if not all, of the littoral material (USACE, 1997).

3. DREDGING AND DISPOSAL OPERATIONS AT VENTURA HARBOR

3.1 CURRENT PRACTICE

Ventura Harbor is located next to the mouth of the Santa Clara River, about 28 miles southeast of Santa Barbara Harbor and seven miles northwest of Port Hueneme Harbor. It resides within the City of San Buenaventura (Ventura), County of Ventura. The harbor is an artificial commercial and recreational harbor developed by the Ventura Port District in 1963. Three breakwaters along with an entrance channel, turning basin, and three berthing basins were constructed. In 1969, when severe storm flooding of Santa Clara River damaged the harbor, USACE repaired the damages and reinforced the levy between the Santa Clara River delta and the harbor. An offshore breakwater was constructed in 1971 to form a sand trap to reduce shoaling at the entrance channel. Now, the Los Angeles District of USACE maintains the navigation features in the harbor and performs periodic dredging.

The Harbor and the local shoreline are situated such that waves originating from the west cause sediment to move predominantly in the downcoast direction. During most of the year, clean beach sand from upcoast beaches and the Ventura River migrates downcoast along the beaches into the sand traps and entrance channel. Littoral drift material has accumulated at a rate that required annual dredging of the entrance channel to maintain safe navigational depths of 20 to 30 feet below Mean Lower Low Water (MLLW). Dredged material has been deposited primarily at McGrath State Beach, south of the Santa Clara River. If the McGrath site is not available, dredged material will be deposited at South Beach. Historical maintenance dredging volumes and costs form 1969 to 2003 are summarized in Table 3.1 in the following page.

As shown in the table, over 21 million cubic yards (cy) of material have been dredged since 1969, or nearly 600,000 cy on an average annual basis. The harbor has been dredged 31 times over the 35-year period, or about 0.89 times per year. After adjusting for inflation, over $52 million has been spent on dredging the Harbor since 1969. The inflation-adjusted average dredging cost per cubic yard is approximately $3.29 (in Oct 2003 price level), with a range of $2.29 to $5.19.

Table 3.1 Historical Dredging Volumes and Costs (October 2002 Price Levels)

FY	Dredging Volume CY	Total Cost	Cost Index*	Updated Cost	Updated Cost/CY
1969	1,883,000	$1,242,780	4.779	$5,939,827	$3.15
1970	325,000	$318,500	4.508	$1,435,809	$4.42
1971	1,208,000	NA	4.114		
1972	17,000	NA	3.863		
1973	1,194,000	$1,334,292	3.651	$4,870,868	$4.08
1974	420,000	$607,269	3.234	$1,963,930	$4.68
1976	152,000	$280,000	2.560	$716,685	$4.72
1977	754,000	NA	2.375		
1978	498,000	NA	2.223		
1979	1,022,000	$1,387,491	1.986	$2,754,976	$2.70
1981	1,133,000	$1,987,141	1.506	$2,992,889	$2.64
1983	1,186,000	$2,230,367	1.421	$3,169,952	$2.67
1984	1,215,000	$1,977,006	1.381	$2,730,280	$2.25
1986	850,000	$1,588,000	1.419	$2,252,826	$2.65
1987	363,000	$902,245	1.462	$1,318,697	$3.63
1988	800,000	$1,375,863	1.428	$1,964,625	$2.46
1989	230,000	$544,486	1.376	$749,302	$3.26
1990	218,000	$527,163	1.322	$696,911	$3.20
1991	377,000	$800,422	1.307	$1,046,245	$2.78
1992	525,000	$993,523	1.287	$1,278,522	$2.44
1993	486,000	$891,864	1.252	$1,116,618	$2.30
1994	470,000	$1,965,100	1.241	$2,439,071	$5.19
1995	271,000	$1,122,417	1.207	$1,354,963	$5.00
1996	833,000	$1,726,350	1.162	$2,006,421	$2.41
1997	449,000	NA	1.133		
1998	742,000	$1,989,014	1.147	$2,280,879	$3.07
1999	639,000	$2,228,892	1.127	$2,512,573	$3.93
2000	818,000	$2,248,290	1.049	$2,358,226	$2.88
2001	625,000	$1,945,000	1.039	$2,021,476	$3.23
2002	670,000	$1,888,972	1.036	$1,957,777	$2.92
2003	670,000	$1,888,972	1.000	$1,888,972	$2.82
Total	*21,043,000*	*Cy*		*$55,819,319*	
Years	*35*				
Average	*601,229*	*Cy*			*$3.29*

* Civil Works Construction Cost Index, Navigation Port & Harbor Component (USACE 2003)
Source: USACE – Los Angeles District

4. ALTERNATIVE DISPOSAL SITES

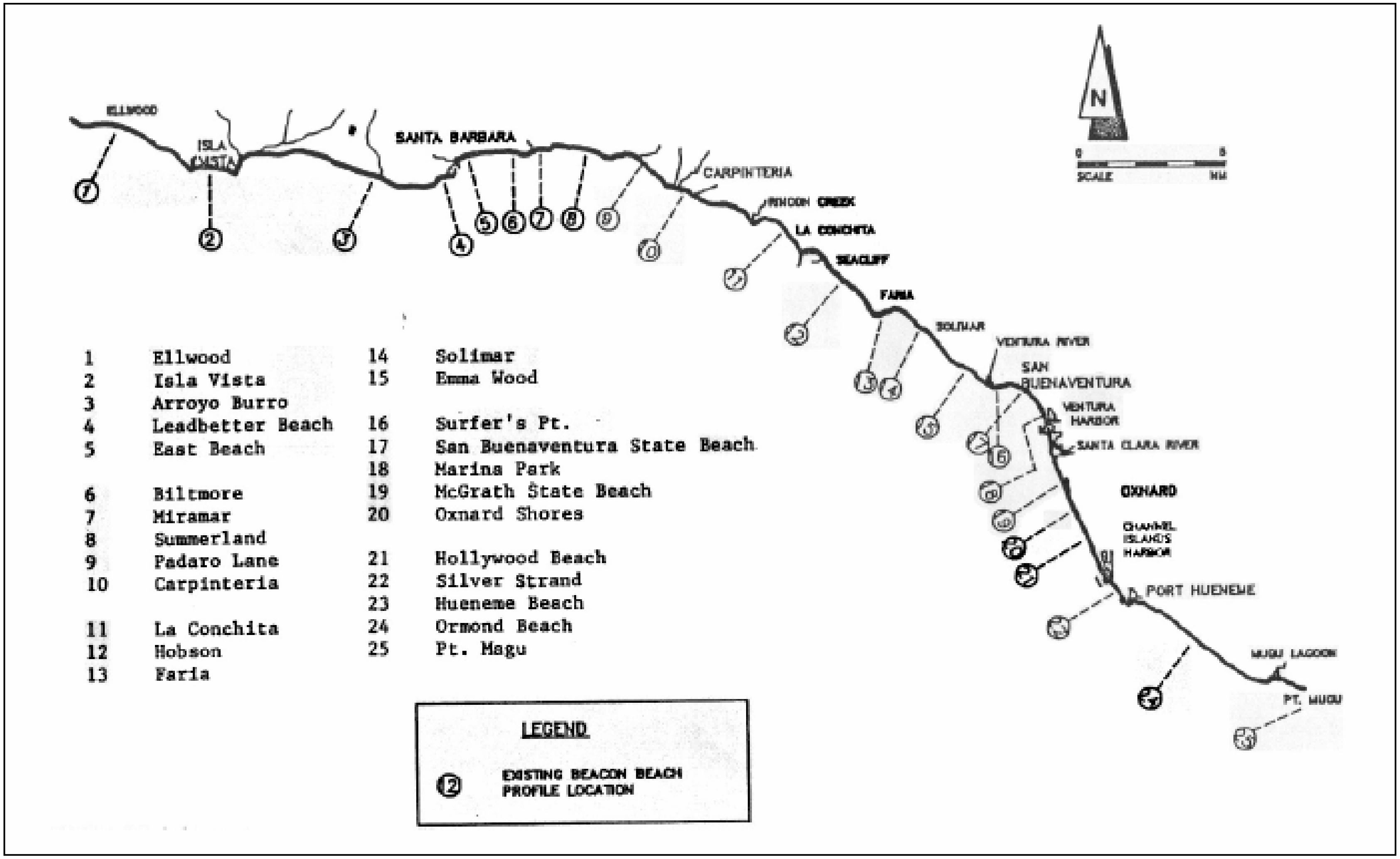
4.1 OVERVIEW

In this section, the characteristic of the three selected alternative beach fill sites - Carpinteria Beach, Oil Piers and Oxnard Shores, are described. Historical beach profiles for the area were analyzed to provide background information on the beach conditions of the three sites. Recreation and amenities at each beach are described. In addition, results of beach surveys conducted at the beaches to collect beach user information are summarized.

4.2 AVAILABLE BEACH PROFILE DATA

The USACE, Los Angeles District had collected beach profiles along the Santa Barbara and Ventura County shorelines between 1938 and the 1970's. Since 1987, the Beach Erosion Authority for Clean Oceans and Nourishment (BEACON) has established a series of 25 beach profile stations between Elwood and Mugu Beaches. A map showing these 25 beach profile stations is shown in Figure 4.1. As shown in the figure, those stations including the selected beach fill sites Carpinteria (Station #10) and Oxnard Shores (Station #20) for this study. Profile data was collected at October 1987, April 1988, December 1992, and October 1997. Another survey was established between Ventura Harbor and Channel Islands Harbor in September 1994. Survey covered three of the existing profile stations (including Oxnard Shores) in addition to seven new stations. For this study, the BEACON beach profiles were used to establish the average beach conditions for Carpinteria Beach and Oxnard Shores.

As a condition for the demolition of the Mobile Seacliff Oil Piers, the California Coastal Commission imposed a 5-year (1998-2002) beach monitoring program to observe shoreline changes adjacent to the Oil Piers. The monitoring program consists of monthly beach profile surveys for the first two years and quarterly surveys for the remaining three years. The most recently available survey data at the Oil Piers Beach were used to establish the baseline condition at the Oil Piers Beach.



(Reference: BEACON 1989)

Figure 4.1 - BEACON Beach Profile Stations

4.3 CARPINTERIA STATE AND CITY BEACHES

Carpinteria's State and City Beaches are located in the City of Carpinteria, Santa Barbara County. The shoreline stretches over one mile of the Santa Barbara coast and is owned by both the City and State. This beach is narrow and back by public and private developments, state park facilities and the Santa Monica Creek estuary. Figure 4.2 shows photographs of the beach taken in August, 2003. The photograph on top shows the western end of the beach owned by the City, while the bottom photograph shows the eastern end of the beach owned by the State.

Since the construction of the Santa Barbara Harbor in 1929, the beach has erosion problem because the harbor breakwater effectively block the alongshore movement of sand. 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 sever shoreline recession but insufficient quantities to rebuild the eroded beaches.

Sediments samples collected near Ash Avenue by BEACON (2001) indicates that the medium grain size (D_{50}) for the beach sand is 0.195 mm with a fines content (passing the #200 sieve) of 5%. Beach profiles collected by BEACON (2001) for Years 1987, 1988, 1992 and 1997 are shown in Figure 4.3. Based on beach profile data taken from1958 to 1987, USACE (1997) estimated that the shoreline along Carpinteria Beach had been eroding at about 13 feet/year. Adding survey data taken between 1987 and 1997, the average shoreline erosion at Carpinteria Beach was found to be about 12 ft/yr from 1958 to 1997.

4.3.1 Recreation and Amenities

Carpinteria City and State beaches provide a wide variety of amenities for beachgoers including day-trippers and visitors on extended stays. In addition to swimming, the State beach provides camping facilities, picnicking and some fishing, as well as opportunities for surfing. The City beach has volleyball courts and is adjacent to numerous condominiums which are rented weekly for visitors. The downtown area provides other amenities. Carpinteria is ranked among the top twenty beaches in the US by Florida International University's Stephen Leatherman—it is the only beach in California to receive this award.

The beach is highly ranked by Dr Leatherman and its visitors because of the clean, soft sand (especially the City beach - the City cleans the sand regularly), the gentle surf, and good lifeguard services. In this regard, the beach at Carpinteria has fewer substitutes than most other beaches, particularly given its location.

(a) Western End (City Beach)

(b) Eastern End (State Beach)

Figure 4.2 - Photographs of Carpinteria Beach

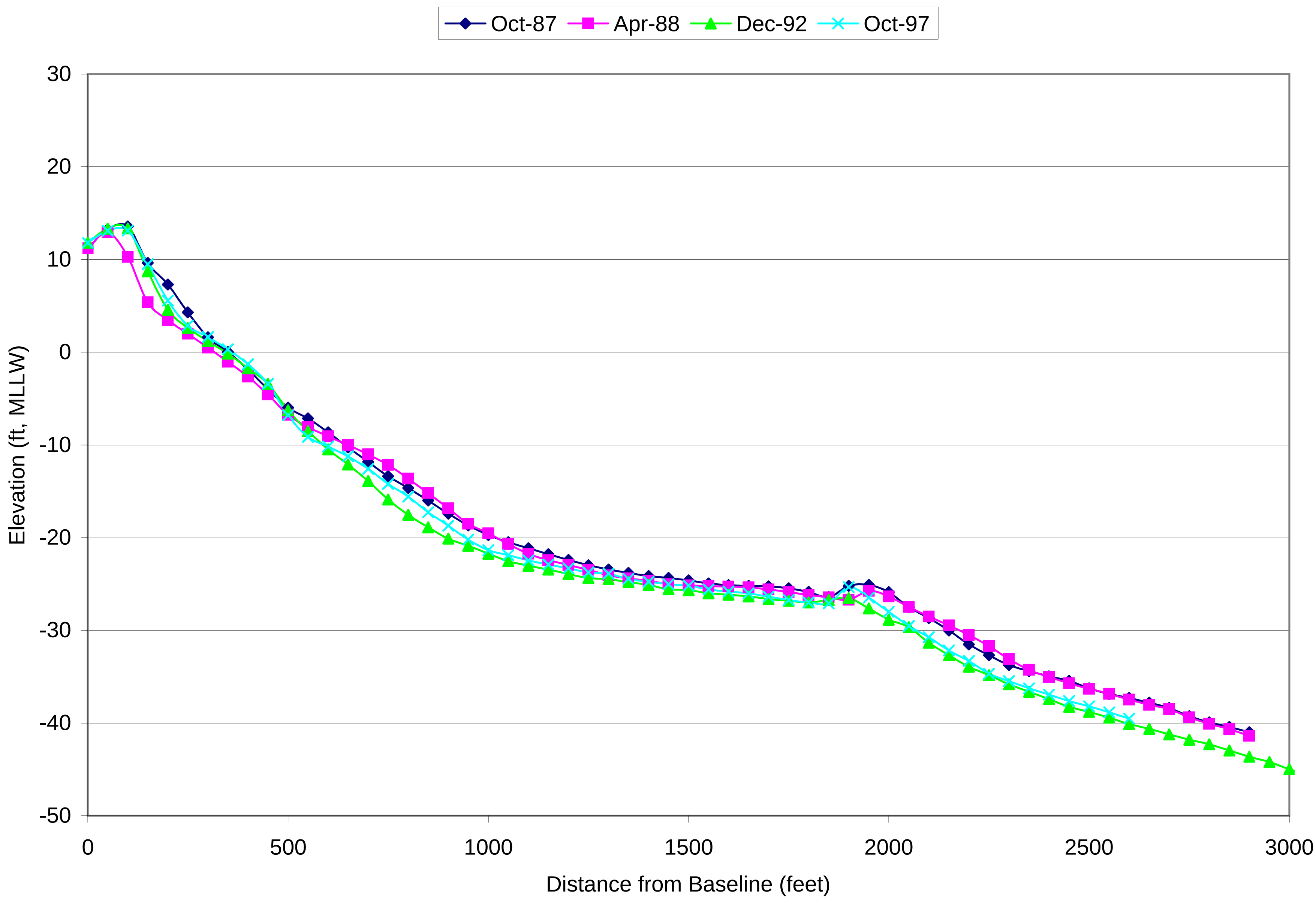


Figure 4.3 - Historical Beach Profiles at Carpinteria Beach

In contrast to many beach towns in southern California, Carpinteria provides adequate parking, even during crowded days. Parking near the City beach is free for two hours and parking at the State beach is available for a fee. Access is off of Highway 101 through the town. Although traffic is heavy in the summer, access is good.

4.3.2 Beach Use Survey

Dr. King has conducted two significant beach surveys at Carpinteria - one in the summer of 2001 for the City of Carpinteria (King, 2002a) and the other was prepared for the State of California as part of a larger project (King and Symes, 2003). In addition, Dr. King prepared a preliminary analysis of erosion at Carpinteria for the State in April 2001 (King, 2001) based on surveys conducted the previous summer. This section will present the most important results from the survey conducted in 2001 (and published in 2002), which focused on the recreational value of the beach and the level of amenities provided. Complete survey results are presented in Attachment A.

The survey was pre-tested in early July and then a full-scale survey was conducted in late July and August. Surveyors were carefully trained to zigzag along the beach and choose respondents in a random fashion (i.e., choosing every nth group). Both weekday and weekend, as well as morning and afternoon times were chosen to reflect actual visitation patterns as well.

A written questionnaire was composed, and the questions were vetted by Mr. Matt Roberts, the Director of Parks and Recreation, and other officials in Carpinteria. The questions were then pre-tested on the beach, problematic questions were re-written, and again the questionnaire was sent to Mr. Roberts for comments. Respondents were given a choice of filling out the written questionnaire themselves or having the questions read to them. The vast majority (roughly 90%) chose to fill out the survey themselves. All respondents were told that the survey was conducted under the auspices of the City of Carpinteria through a professor at San Francisco State University and that the purpose was to learn more about beach attendance. Surveyors were told not to say that the survey was designed to “help” the beach since this type of pre-survey discussion is known to bias results. A high percentage of people approached (over 85%) agreed to answer the questions. A high participation rate is reassuring since it also reduces the possibility of bias (if people who choose not to respond have different characteristics from people who do). Overall 283 households participated in the survey representing over 1,100 visitors. Briefly, the main points of the survey are as follows:

- Visitors to Carpinteria come from a wide variety of destinations, with 82.8% arriving from out of town.

- The composition of visitors was split evenly between people on day-trips (48.5%) and those staying overnight in the area (50.2%). [1.3% did not respond.]

- Of those visitors staying overnight, 26.9% were campers, 25.2% stayed at a hotel, 35.3% stayed in house/condo rentals and 12.6% stayed with friends.

- A significant majority of people replied that clean beaches, restrooms, and lifeguards were important to them.

A complete presentation of the results is provided in Attachment A. However, certain key results critical to the analysis are summarized below.

Question 1: How far away from this beach do you live (your **primary** residence)?

LOCATION	FREQUENCY
In Carpinteria	17.2%
Outside Carpinteria, but within 20 miles	8.8%
Within 60 miles	24.7%
More than 60 miles but in California	41.0%
In the US, but not in California	7.0%
Outside the US	1.3%

The results from this question indicate that most visitors (74%) come from more than twenty miles to go to Carpinteria and almost half come from more than sixty miles. This result is significant since it indicates a willingness to drive a considerable distance to get to the beach. The result is especially significant given that many other potential substitute beaches exist near Carpinteria. It is consistent with respondents' anecdotal responses that Carpinteria is a unique beach.

Question 7: Please check the most appropriate box.

RESPONSE	FREQUENCY
Day Trip from home	48.5%
Trip or Vacation to the area	50.2%
Non response	1.3%

Question 12: We'd like to know how important visiting the beach is for your trip/vacation.

RESPONSE	FREQUENCY
The beach is important to me--No beach, no trip	61.2%
If there were no beach I might not come or would stay less often	19.2%
I would still come but I like the fact that I can go to the beach	17.1%
I can take the beach or leave it; it would not affect my decision	2.5%

Questions 7 and 12 indicate that just over half of visitors were staying overnight and most of these (61% of overall respondents but a far higher percentage of overnight visitors) indicated that the beach was the primary reason for their trip. This result is significant since it indicates that Carpinteria Beach has significant recreational value.

Question 18: What was your reason for coming to this beach?

RESPONSE	FREQUENCY
So I could swim	9.1%
So my children could play/swim	34.9%
To surf	2.5%
To hike	1.1%
To play on the beach	8.5%
To hang-out on the beach	40.0%
To walk my dog	0.5%
I like the beach	0.4%
Relaxation	1.8%
Non response	1.3%

Question 18 of the survey asked respondents about their activities on the beach. The responses indicated a wide variety of activities, with "hanging-out" (40%) and allowing children to swim (34%) the primary answers.

Question 19: What is the minimum width a beach needs to be before you would stop going?

WIDTH	FREQUENCY
5 ft	3.1%
10 ft	7.9%
20 ft	15.2%
40 ft	0.4%
50 ft	26.7%
100 ft	19.4%
200 ft	13.7%
Doesn't Matter	1.8%
Write in*	1.3%
Non response	10.6%

Question 19 focuses on a critical component for this study, beach width. Roughly 60% of respondents indicate that 50 feet was a minimum width necessary for beach recreation at Carpinteria. Given the current rate of erosion (indeed many parts of the beach already have less than 50 feet of width even at low tide) this is a significant result and indicates that the substantial recreational value of Carpinteria Beach is threatened by erosion.

Question 20 examined whether, for Carpinteria's visitors, whether other types of recreation were equivalent to beaches. About half of respondents indicated that swimming pools were not equivalent, with 42% indicating it was "somewhat equivalent," lakes and reservoirs were considered a better substitute (though few are available near Carpinteria). Surprisingly, 45% said State or National parks were not equivalent and few thought movies were equivalent.

When asked about amenities, most visitors indicated that restrooms (85%) and lifeguards (74%) were "very important" and virtually everyone (99%) said that clean beaches were very important. Showers, food concessions, picnic courts, and drinking fountains were considered less important and volleyball courts (though they currently exist) were not considered important.

4.4 OIL PIERS BEACH

Oil Piers Beach is located in northern Ventura County along Highway 101. Its name is in reference to the recently (1998) demolished Mobil Seacliff Oil Piers. As shown in a photograph taken in August 2003 (Figure 4.4), the beach is backed by a high rock revetment and a bluff. In the past, this site was a popular spot for surfers. However, since the piers were demolished, this spot is not surfed as heavily. Beach access is provided along an access road that runs parallel the Pacific Ocean and via pedestrian underpasses under Highway 101.

Based on the BEACON study (2001), the beach material has a median grain size (D_{50}) of 0.18 mm and a fines content of 13%. A beach profile surveyed on October 2000 (Beacon, 2001) is provided in Figure 4.5. Based on the beach profiles collected between 1998 and 2002, Oil Piers Beach has been eroding at about 12 feet/year.

4.4.1 Recreation and Amenities

In contrast to Carpinteria, Oil Piers Beach provides few amenities. Parking is along a dirt shoulder of a basic access road from Highway 101. There are no bathrooms, no drinking fountains, no concessions, no garbage cans and no lifeguards. Visitors to the beach are primarily surfers with a few jet skiers as well. The quality of the sand is good and some respondents to our survey (see below) were concerned about adding lower quality sand to the beach.

At one time the beach was very popular, particularly for surfers. The old oil pier (for which the beach is named) provided a break which surfers found useful. Since the pier was removed the beach has become less popular. Access to the beach is fairly simple for frequent visitors who know the way, but poor for those who are not aware of the beach's location.

4.4.2 Beach Use Survey

A short survey was developed for this project to asses the recreation value, use and composition of visitors to the beach. Unfortunately the time frame for this survey was extremely narrow and visitors were sampled on Labor Day weekend. While this ensured a fairly large sample, we are somewhat concerned about the issue of "selection" bias, particularly in regard to the composition of visitors. The sample size was also quite small (38 people) though 85-90% of people on the beach responded, so we believe our sample is quite representative of the people on the beach those days.

Figure 4.4 - Photograph of Oil Piers Beach

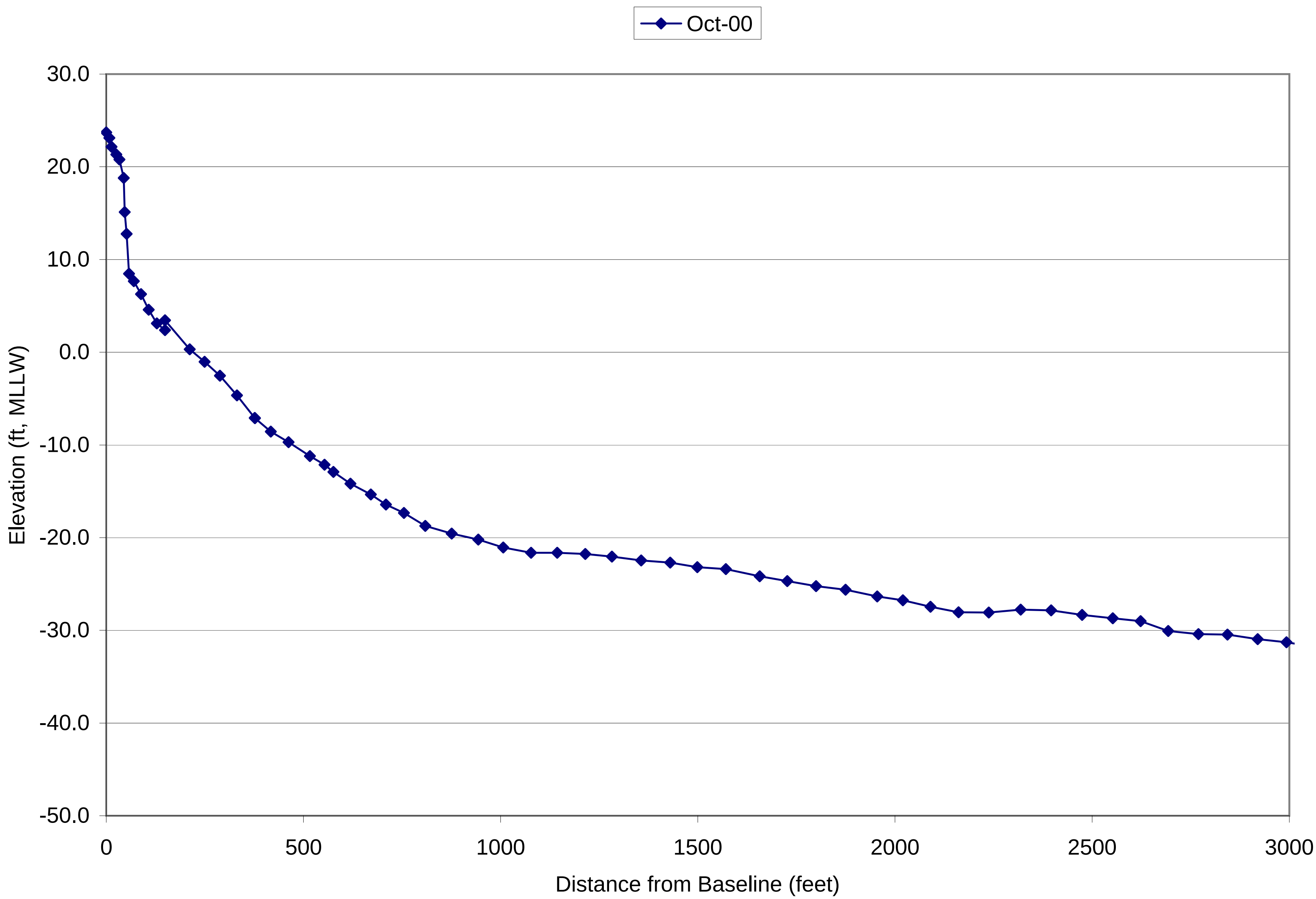


Figure 4.5 - Historical Beach Profile at Oil Piers Beach

Question 1: How far away from this beach do you live (your **primary** residence)?

LOCATION	FREQUENCY
Within 20 miles	63.20%
Within 60 miles	26.30%
More than 60 miles but in California	10.50%
In the US, but not in California	0.00%
Outside the US	0.00%

As one would expect, our survey indicates that "Oil Piers" beach is predominately a local beach, with 63% of respondents reporting that they lived within 20 miles. Our previous two site visits on Fridays in July and August also indicated that the beach is predominantly local. However, our survey on Labor Day indicated a surprisingly high number of visitors from farther away, 26% between 20-60 miles and 10% more than 60 miles. We believe that these numbers maybe somewhat overstate the degree to which visitors are willing to drive to visit Oil Piers. On the other hand, since most visitors indicated that they come to Oil Piers frequently (see question 3 below), our sample is probably not too skewed. Since a significant number of people are willing to drive more than 20 miles (and thus these people could find many other substitute beaches), Oil Piers does offer a significant degree of recreational potential.

Question 2: We'd like to know, how many people **from your household** are in your group today?

NUMBER OF PEOPLE	1	2	3	4	5 TO 7	8 TO 15
FREQUENCY	20.6%	16.2%	24.3%	24.3%	8.1%	5.4%

Question 2a: Of these people, how many are under 16?

NUMBER UNDER AGE 16	0	1	2	3 TO 4	5 TO 8
FREQUENCY	35.3%	26.5%	32.4%	0.0%	5.9%

Questions 2 and 2a indicate that Oil Piers also has the potential to be a family destination, though our observations during the week are that few children are present.

Question 3: How many days this year will you go to "**Oil Piers**" beach?

Number of Days	0 to 5	6 to 20	21 to 40	41 to 80	81 to 120	121 to 200	More than 200
Frequency	32.4%	21.6%	21.6%	8.1%	10.8%	2.7%	2.7%

A significant number of people (almost half) go more than 21 days a year, typical of a "local" beach

Question 4: How many days this year will you go to any beach, including this one?

Number of Days	1 to 5	6 to 20	21 to 40	41 to 80	81 to 120	121 to 200	More than 200
Frequency	13.2%	10.5%	28.9%	21.1%	10.5%	2.6%	13.2%

Question 5: On a typical day, how many hours do you spend at **"Oil Piers"** beach?

Number of Hours	Less than 1 hour	1-3 hours	3-5 hours	5-8 hours	More than 8 hours
Frequency	0.0%	13.5%	67.6%	18.9%	0.0%

Question 5a: What is the primary reason you and your group go to **"Oil Piers"** beach?

Primary Reason	To surf	To swim	So children can swim	To relax on the beach
Frequency	23.7%	44.7%	34.2%	76.3%

*Many people checked multiple boxes for this question.

The results of 5a are somewhat surprising and, we believe, not representative. Only 24% indicated that surfing was part of their reason for going to "Oil Piers." This is clearly understated, but again indicates a potential for other recreational activities.

Question 6: Do you ever go to beaches other than this one?

Answer	Yes	No
Frequency	86.8%	13.2%

Question 6a: What beach do you go to most often, other than this beach?

We received a wide variety of responses to this question. The most common answers were Carpinteria, Ventura and Solimar, but few respondents gave the same answers.

Question 6b: How many days a year do you go to the beach you listed in 6a?

Our results here indicated that most visitors went to other beaches frequently as well, with a mean of 36 days at other beaches.

Question 6c: Please compare the alternative beach you listed in 6a to "Oil Piers" beach. We would like you to compare your overall satisfaction including services available at the beach. Please **DO NOT** consider the time it takes to get to the beach in your rating.

The other beach is:

Worse than "Oil Piers"   Same   Better than "Oil Piers"

|..........|..........|............|.........||..........|...........|...........|...........|

0%   25%   50%   75%   100%   125%   150%   175%   200%

ANSWER	**0 TO 49%**	**50 TO 99%**	**100% (SAME)**	**101 TO 150%**	**151 TO 200%**
FREQUENCY	12.9%	19.4%	25.8%	29.0%	12.9%

Question 6c is a qualitative question meant to evaluate whether the other beaches that respondents visit are good substitutes. In general, most respondents indicated that there were other alternatives as good or better (68%), though a substantial number (32%) indicated that they preferred Oil Piers. Given the lack of amenities, this result seems somewhat surprising, but it is likely that some of the people who go to Oil Piers prefer a beach with fewer amenities (perhaps because they tend to be less crowded).

Question 7: Please check the most appropriate box:

ANSWER	**FREQUENCY**
I'm here on a day trip.	97.3%
I'm on a trip/vacation away from my permanent residence.	2.7%

This result is not surprising. Even on Labor Day weekend, the vast majority of respondents (97%) are on day trips.

Question 8: The State and Federal Governments are considering using public money to add more sand to "Oil Piers" beach. This sand would increase the width of the beach.

Question 8a: Suppose the width of "Oil Piers" beach was doubled. How **much** more often would you go?

Answer	**The same amount**	**1 to 25%**	**26 to 50%**	**51 to 75%**	**76 to 100%**
Frequency	63.9%	2.8%	25.0%	5.6%	2.8%

The results here are significant, especially given that the survey was conducted on one of the most crowded weekends of the year. 64% of respondents stated that adding more sand would not increase their attendance. However, 25% indicated that they would come 26-50% more often if beach width was doubled, but only a small number (8%) indicated that they would come more than 50% more often if beach width was doubled. *Overall, the results indicate that doubling beach width would increase attendance among current users by 15.7%.* Keep in mind that the survey did not sample from the population of people who do not go to Oil Piers at all, but might go if the beach width was wider. These results will be discussed in more detail in section 6.3.

Question 8b: Suppose the width of "Oil Piers" beach was doubled. How much **more** recreational value would you receive from a wider beach.

Answer	**The same amount**	**1 to 25%**	**26 to 50%**	**51 to 75%**	**76 to 100%**
Frequency	47.2%	11.1%	19.4%	11.1%	11.1%

Our results here indicate that widening the beach will provide significantly more recreational value for those who already attend with just over half of respondents indicating that doubling beach size would significantly increase quality. *The mean response was that doubling the beach width would increase recreational value by 25.4%.*

Question 8c: Suppose that the width of "Oil Piers" beach was **halved**. How much **less** often would you go?

ANSWER	THE SAME AMOUNT	1 TO 25%	26 TO 50%	51 TO 75%	76 TO 100%
FREQUENCY	41.7%	30.6%	13.9%	11.1%	2.8%

A substantial number (58%) also indicated that erosion of the beach would affect recreational quality. *The mean response was that halving beach size would reduce attendance by 18.4%.*

Question 8d: Suppose that the width of "Oil Piers" beach was halved. How much **less** recreational value would you receive from a narrower beach.

ANSWER	THE SAME AMOUNT	1 TO 25%	26 TO 50%	51 TO 75%	76 TO 100%
FREQUENCY	47.2%	19.4%	16.7%	11.1%	5.6%

A substantial number (58%) also indicated that erosion of the beach would affect recreational quality. *The mean response was that halving beach size would reduce the recreational value by 18.4%* (the same reduction as above).

Question 9: How old are you?

AGE	16-19	20-24	25-34	35-44	45-54	55-64	65-74	75 OR OLDER
FREQUENCY	0.0%	25.7%	28.6%	31.4%	11.4%	2.9%	0.0%	0.0%

As one would expect, beach goers at Oil Piers are predominantly young and white and have attended college (see below).

Question 10: What is your ethnicity?

ETHNICITY	WHITE	HISPANIC	ASIAN/PACIFIC ISLANDER	BLACK	OTHER
FREQUENCY	77.1%	14.3%	5.7%	0.0%	5.7%

*One person checked two boxes.

Question 11: What is your highest level of Education?

Educational Attainment	Less than High School	High School	Some College	College Degree	Post Graduate
Frequency	0.0%	8.6%	37.1%	45.7%	8.6%

Question 12: Including yourself, how many people are in your current household (people you live and share financial resources with)?

Number of People	1	2	3	4	5 to 6	7 to 9	10 or more
Frequency	2.9%	31.4%	22.9%	31.4%	8.6%	2.9%	0.0%

Question 13: What would you estimate is the current yearly income of your entire household (before taxes)?

Income	Frequency
Less than $9,999	3.1%
$10,000-14,999	6.3%
$15,000-24,999	0.0%
$25,000-34,999	3.1%
$35,000-49,999	28.1%
$50,000-74,999	9.4%
$75,000-99,999	18.8%
$100,000-149,999	18.8%
$150,000 or more	12.5%

4.5 Oxnard Shores

The Oxnard Shores beach fill site is along a stretch of 2.4 miles of shoreline in the City of Oxnard, Ventura County. The beach fill site being considered is between the W. Fifth Street at the north and the Oxnard State Beach at the south. As shown in the photographs taken in

August 2003 (Figure 4.6), beaches along Oxnard Shores are in general rather wide. Samples taken near the W. Fifth Street by BEACON (2001) indicates that the median grain size (D_{50}) of the beach sand is 0.21mm with a fines content (passing the #200 sieve) of 6.3%. Beach profiles taken in Years 1987, 1988, 1992, 1994 and 1997 are shown in Figure 4.7. Historically, this stretch of shoreline has been eroding at about 4 feet/year (USACE, 1997).

4.5.1 Recreation and Amenities

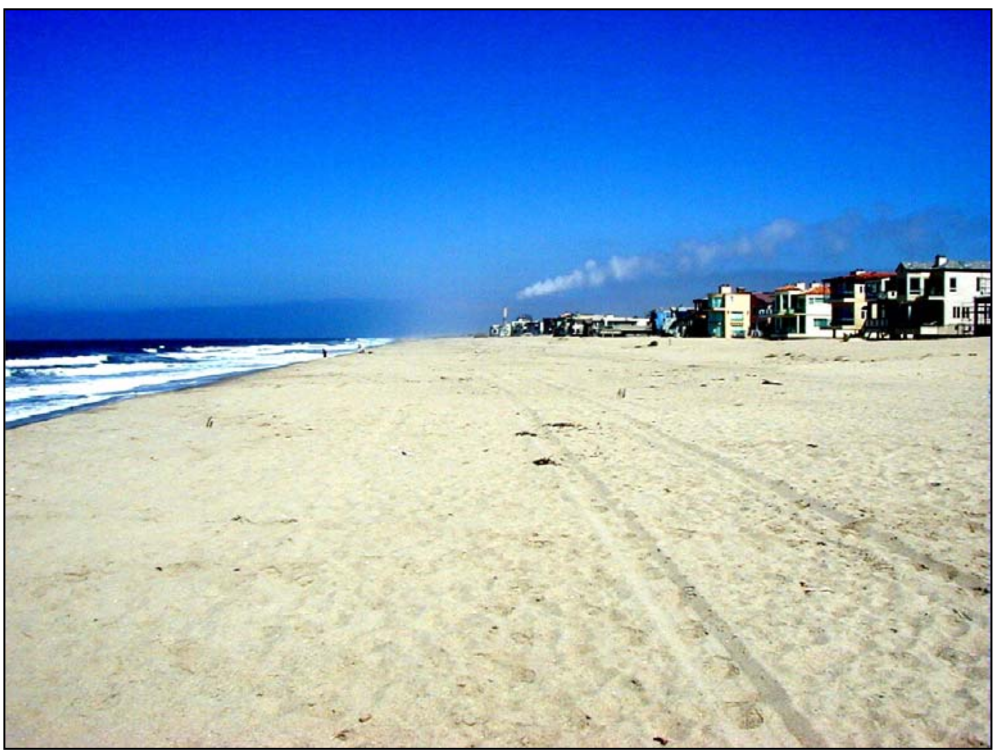
Oxnard provides a large number of wide sandy beaches. The focus of this analysis is on the beaches on the northern end at Oxnard shores including Oxnard shores beach, parts of Mandalay County Park and Oxnard State beach. Oxnard Shores and Oxnard State Beach lie just north and south of a large resort/hotel structure. North of this structure is a very large park, with plenty of parking, at least two restroom buildings, a number of well kept grass field spaces, picnic tables, barbeque pits and sand volleyball courts. On weekends, this park is crowded with families picnicking. Parking is also available in adjacent residential areas, though this parking is less convenient

The beach area tends to be more crowded near the park than farther north. Given the relatively wide beach here, most people recreate near the water. Away from the park, there are no lifeguards, restrooms or other facilities available. There are no concessions along any of these beaches. Mandalay County Park beach is more sparsely populated by fishermen and families. Parking is limited.

A number of State and local officials we interviewed indicated that the weather also plays a significant role at Oxnard. The area has a significantly greater number of cold windy days and foggy days, compared to Carpinteria and Oil Piers beach, which limits the recreational value of the beach. A number of respondents (see survey below) commented on the quality of the water, which is somewhat darkish. The perception of mediocre water quality may be an issue in Oxnard.

We conducted two site visits of the area on Fridays in July and August. The beach was sparsely populated (with fewer than one person for every hundred yards of beach) and virtually no one was in the water. Our general impression was that the amount of sand currently available at Oxnard is more than adequate.

(a) Southern End near Oxnard Beach Park



(b) Northern End near West Fifth Street

Figure 4.6 - Photographs of Oxnard Shores

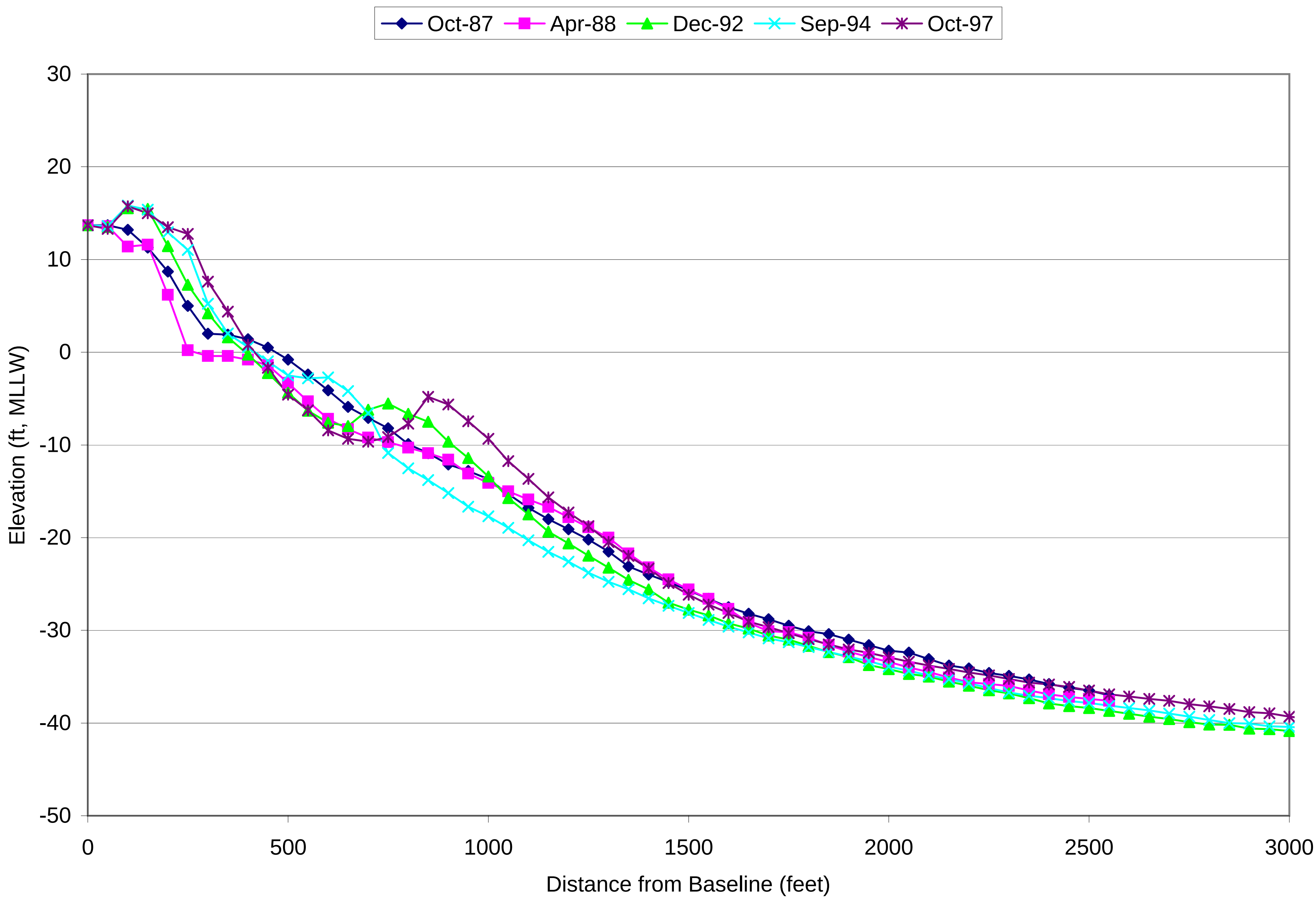


Figure 4.7 - Historical Beach Profiles at Oxnard Shores

4.5.2 Beach Use Survey

A short survey was conducted for this project to asses the recreation value, use and composition of visitors to the beach. Unfortunately the time frame for this survey was extremely narrow and visitors were sampled on Labor Day weekend. While this ensured a fairly large sample, we are somewhat concerned about the issue of "selection" bias, particularly in regard to the composition of visitors. The sample size was also quite small (68 people) though 85-90% of people on the beach responded, so we believe our sample is quite representative of the people on the beach those days.

Question 1: How far away from this beach do you live (your **primary** residence)?

LOCATION	FREQUENCY
In Oxnard	20.6%
Outside Oxnard, but within 20 miles	23.5%
Within 60 miles	32.4%
More than 60 miles but in California	22.1%
In the US, but not in California	1.5%
Outside the US	0.0%

Although the results are skewed by Labor Day, they indicate that a substantial number of people are willing to travel to Oxnard, with just over half indicating that they came from more than 60 miles. Whether these visitors came primarily for the beaches is not known. A substantial number of these people were families with children (see question 2 below).

Question 2: We'd like to know how many people **from your household** are in your group today.

LOCATION	0	1	2	3	4	5	6	7 OR MORE
FREQUENCY	1.5%	16.4%	17.9%	17.9%	17.9%	14.9%	7.5%	6.0%

Question 2a: Of these people, how many are under 16?

NUMBER UNDER AGE 16	0	1	2	3	4
FREQUENCY	29.2%	27.7%	15.4%	20.0%	7.7%

Question 3: How many days this year will you go to this beach in Oxnard?

NUMBER OF DAYS	0 TO 5	6 TO 20	21 TO 40	41 TO 80	81 TO 120	121 TO 200	MORE THAN 200
FREQUENCY	50.7%	29.9%	4.5%	1.5%	1.5%	4.5%	7.5%

Question 3 indicates that most visitors come relatively infrequently compared to most other beaches we have surveyed in California.

Question 4: How many days this year will you go to any beach, including this one?

NUMBER OF DAYS	1 TO 5	6 TO 20	21 TO 40	41 TO 80	81 TO 120	121 TO 200	MORE THAN 200
FREQUENCY	24.6%	33.8%	18.5%	3.1%	3.1%	7.7%	9.2%

Question 5: On a typical day, how many hours do you spend at this beach?

NUMBER OF HOURS	LESS THAN 1 HOUR	1-3 HOURS	3-5 HOURS	5-8 HOURS	MORE THAN 8 HOURS
FREQUENCY	2.9%	38.2%	44.1%	13.2%	1.5%

Question 5a: What is the primary reason you and your group go to this beach?

PRIMARY REASON	TO SURF	TO SWIM	SO CHILDREN CAN SWIM	TO RELAX ON THE BEACH
FREQUENCY	16.0%	11.7%	18.1%	54.3%

*Many people checked multiple answers to this question. So the values represent the percentage that each answer was selected compared to all answers selected.

Question 6: Do you ever go to beaches other than this one?

ANSWER	YES	NO
FREQUENCY	89.4%	10.6%

Question 6a: What beach do you go to most often, other than this beach?

Respondents mentioned Manhattan Beach, Ventura Beach, Huntington Beach and Zuma Beach most often, indicating most probably came from the south.

Question 6b: How many days a year do you go to the beach you listed in 6a?

Our results indicated most people go an average of 30 days a year to other beaches, which is slightly higher than is typical for this type of survey.

Question 6c: Please compare the alternative beach you listed in 6a to this beach. We would like you to compare your overall satisfaction including services available at the beach. Please **DO NOT** consider the time it takes to get to the beach in your rating.

The other beach is:

Worse than "Oil Piers" Same Better than "Oil Piers"

|...........|...........|............|.........||...........|............|...........|...........|

0% 25% 50% 75% 100% 125% 150% 175% 200%

ANSWER	0 TO 49%	50 TO 99%	100% (SAME)	101 TO 150%	151 TO 200%
FREQUENCY	5.3%	36.8%	19.3%	28.1%	10.5%

Slightly more people indicated that they preferred other beaches to Oxnard, indicating that other substitutes are clearly viable options.

Question 7: Please check the most appropriate box:

ANSWER	FREQUENCY
I'm here on a day trip.	73.8%
I'm on a trip/vacation away from my permanent residence.	26.2%

Just over 25% indicated that they were staying overnight in the area, though this result is skewed by the fact that the survey was conducted on Labor Day weekend. We would expect a smaller percentage during the rest of the year, however there are a substantial number of condo owners in the area with permanent residences elsewhere.

Question 8: The State and Federal Governments are considering using public money to add more sand to Oxnard beach. This sand would increase the width of the beach.

Question 8a: Suppose the width of this beach was doubled. How **much** more often would you go?

ANSWER	THE SAME AMOUNT	1 TO 25%	26 TO 50%	51 TO 75%	76 TO 100%
FREQUENCY	83.1%	3.1%	6.2%	1.5%	6.2%

Our results here are not surprising given the adequate width of the beaches at Oxnard. 83% of respondents indicated that doubling of beach width would not increase their attendance. Overall, our data indicates that doubling the beach width would only increase attendance by 9%. Indeed, we think that this result, if anything, overstates the case.

Question 8b: Suppose the width of this beach was doubled. How much more recreational value would you receive from a wider beach.

ANSWER	THE SAME AMOUNT	1 TO 25%	26 TO 50%	51 TO 75%	76 TO 100%
FREQUENCY	70.8%	9.2%	12.3%	3.1%	4.6%

A slightly greater number of people indicated that increasing width would increase recreational value. Overall, our data indicate that doubling the beach width would increase recreational value by 11.7%.

Question 8c: Suppose that the width of this beach was **halved**. How much **less** often would you go?

Answer	The same amount	1 to 25%	26 to 50%	51 to 75%	76 to 100%
Frequency	57.1%	15.9%	15.9%	4.8%	6.3%

Halving beach width would have a modest effect on attendance and recreational value. Overall, our data indicates that halving the beach width would decrease attendance by 16.5% and recreational value by 25.4%.

Question 8d: Suppose that the width of this beach was halved. How much less recreational value would you receive from a narrower beach.

Answer	The same amount	1 to 25%	26 to 50%	51 to 75%	76 to 100%
Frequency	38.1%	21.9%	20.3%	10.9%	9.4%

Question 9: How old are you?

Age	16-19	20-24	25-34	35-44	45-54	55-64	65-74	75 or older
Frequency	10.8%	15.4%	15.4%	29.2%	20.0%	6.2%	3.1%	0.0%

Question 10: What is your ethnicity?

Ethnicity	White	Hispanic	Asian/Pacific Islander	Black	Other
Frequency	73.8%	21.5%	4.6%	1.5%	3.1%

*Two people checked multiple boxes.

Question 11: What is your highest level of Education?

Educational Attainment	Less than High School	High School	Some College	College Degree	Post Graduate
Frequency	0.0%	9.2%	40.0%	29.2%	23.1%

Question 12: Including yourself, how many people are in your current household (people you live and share financial resources with)?

Number of People	1	2	3	4	5 to 6	7 to 9	10 or more
Frequency	7.8%	23.4%	21.9%	23.4%	20.3%	1.6%	1.6%

Question 13: What would you estimate is the current yearly income of your entire household (before taxes)?

Income	Frequency
Less than $9,999	0.0%
$10,000-14,999	0.0%
$15,000-24,999	1.6%
$25,000-34,999	4.9%
$35,000-49,999	13.1%
$50,000-74,999	21.3%
$75,000-99,999	16.4%
$100,000-149,999	11.5%
$150,000 or more	31.1%

4.6 Alternative Disposal Scenarios

In Section 5, the additional cost to transport and dispose the dredged material from Ventura Harbor to the three alternative sites via different methods will be discussed. The associated benefits for the increased beach width will be discussed in Section 6. The cost functions and benefits are developed over a wide range of parameters such that sufficient data will be developed for the pilot GIS-based model, not limited to the four scenarios described below. However, for the study addressed in this report, four specific alternative disposal scenarios will be presented as examples for the testing of the ArcGIS tool. These four scenarios are developed based on the assumption that 150,000 cy out of the 600,000 cy dredged annually from the Ventura Harbor will be placed at McGrath Beach to maintain the existing condition there. The remaining 450,000 cy will be disposed at the three alternative sites under the following four scenarios.

- Scenario 1 - All the remaining 450,000 cy goes to Carpinteria Beach.
- Scenario 2 - 275,000[1] cy goes to Oil Piers, 175,000 cy goes to Carpinteria Beach.
- Scenario 3 - All the remaining 450,000 cy goes to Oxnard Shores.
- Scenario 4 - One-third of the remaining material goes to each alternative site, i.e. 150,000 cy to each site.

These four disposable scenarios were selected only as examples for testing the pilot ArcGIS model and were not intended as realistic implementable disposal alternatives for Ventura Harbor dredging project.

[1] 275,000 cy is the maximum volume Oil Piers Beach can take annually (BEACON 2001)

5. COST FUNCTION FOR DREDGED MATERIAL DISPOSAL

5.1 OVERVIEW

In this section, unit cost for different transportation and disposal methods are evaluated. The cost functions are developed to cover a wide range of transportation modes and distances to be used as input for the ArcGIS tool. These cost functions were developed based on simplified assumptions, and were not intended to be in a detail sufficient for any site-specific conditions. These crude estimates of unit cost were used to establish generic cost functions for the pilot ArcGIS model, which will use the Ventura Harbor dredging as an example to evaluate the transportation costs for disposing different quantities of dredged material from Ventura Harbor to the three alternative beach sites. Since the cost functions were developed to cover a wide range of dredged volumes, transportation mode, and transportation distances, some of the scenarios when viewed individually would be unrealistic. For example, the use of railroad to transport a small dredge volume over a short distance, or the use of truck to transport a large volume over a long distance may both be unrealistic.

5.2 TRANSPORTATION AND DISPOSAL METHODS

5.2.1 Hydraulic Pipeline

The use of hydraulic pipeline is the current practice in delivering the Ventura Harbor dredged sediment to McGrath Beach. Under this method, floating or submerged pipelines are connected to the pipeline dredger to deliver the dredged material to the receiver beach area. If the pumping distance is too long such that the hydraulic losses in the pipe is causing the deposition of sediment along the pipes, booster pumps can be use to achieve the goal of pumping the sediment over a longer distance. However, the efficiency of this method decreases as the distances become too long. In addition, this method would be most cost effective if there is no physical obstacle between the dredged locations and the nourishment area. In general, this method is best for short distance between the dredged area and the receiver beach.

5.2.2 Truck

Truck haul of dredged material can be economically competitive for short distance (say up to 50 miles). At greater distances, transport by truck is labor- and fuel-intensive and not economically justifiable. The simplicity of loading and unloading requirements and the relative abundance of available roadways make truck hauling technically feasible.

The capacity of dump trailers range from 16 to 20 cy, and 22 to 60 cy for rear/bottom dump truck. Dump and tank compartments are suitable for hauling dredged material. Dump and tank compartment can be mounted on a trailer chassis or a single gas or diesel powered tractor chassis and towed by a tractor. Trailer gates and hatches can be sealed with rubber gaskets, straw or other material to prevent leaking or spillage.

The cost advantage of truck transportation is that it requires no costly fixed plant. On the other hand, the unit cost will be high in long distance, and it needs a large number of round trips on the roads. The transport route from dredged to disposal site need to be investigated and planned. Some public and residential streets may have restrictions for heavy trucks. Environmental impacts such as traffic congestion, air pollution and noise for the neighborhood need to be considered as well.

5.2.3 Railroad

Rail haul using the unit train concept is technically feasible and economically competitive with other transport modes for hauling dredged material for a long distance (over 100 miles). A unit train is one reserved to carry one commodity (dredged material) from specific points on a tightly regulated schedule. Facilities are required for rapid loading and unloading to make the unit train concept work and to enable benefits from reduced rates on large volumes of bulk movement. Bottom dump cars or rotary car dumpers can be used for rapid loading and unloading. Economic feasibility demands the utilization of existing railroad tracks; however, the building of short intermediate spurs may be required to reach disposal areas.

Only Carpinteria Beach and Oil Piers beach fill sites have railroad nearby. Oxnard Shores still need trucks to transport material from railroad station to the disposal site.

5.2.4 Scow and Tow

Barges and scows, used in combination with mechanical dredges, have been one of the most used methods of transporting large quantities of dredged material over long distances. Barges are designed with bottom doors or with a split-hull and the contents can be emptied in a few seconds.

5.2.5 Hopper Dredge and Pumpout

Hopper dredges consist of a ship-type hull with an internal hopper to hold material dredged from the bottom. The material is brought to the surface through a suction pipe and draghead and discharged into hoppers built in the vessel. Hopper dredges are capable of transporting the material for long distances in the self-contained hopper. Like barge, hopper dredges normally discharge the material from the bottom of the vessel by opening the hopper doors.

However, some hopper dredges are equipped to pump out the material from the hopper much like a hydraulic pipeline dredge.

5.3 COST FUNCTIONS

As discussed above, pipeline dredging and direct pumping of the dredged material through pipeline is the current practice in the maintenance dredging at Ventura Harbor. Hence, the cost of disposal of the dredged material from Ventura Harbor to the nourishment site is imbedded in the dredging cost. Since the purpose of the current study is to determine the "additional" cost of transporting and disposing the Ventura Harbor, the cost functions developed for this study only consider the transportation and disposal cost, i.e. dredging cost is not considered.

Transportation unit costs were determined for the truck, railroad, and scow and tow methods. The hopper dredge and pump-out method was not considered for the cost evaluation since it is difficult to separate the dredging cost from the total cost (including transportation and disposal costs) for this method. The unit costs were estimated based on various dredge volumes and transport distances for application in the GIS cost-function model. Table 5.1 summarizes the transportation and disposal unit costs based on volume, distance, and transportation methods. The volumes were based on 20, 40, 60, 80, and 100% of the total available volume of 600,000 cy. The transportation distance was based on the distance from the borrow site ranging from 2 to 300 miles. These cost estimates are graphically represented in Figure 5.1. Rail has the highest starting unit cost between $37 to $38 and increases at a slower rate with increasing distance compared to the other methods. The truck method starts between $4 and $5, but has the fastest increase in unit cost over increasing distance. Beyond 175 miles, the truck unit cost exceeds the railroad unit cost. The scow and tow method has the lowest unit cost over the entire range of transport distances.

It has to be noted that the unit costs shown were developed based on broad assumptions that may not be applicable for some site-specific conditions. For example, the cost for using railroad was estimated based on the assumption that railroad tracks are available directly to the site, hence, cost for laying temporary tracks were not included. For the use of scow-and-tow, if it is desirable to pump the sand directly onto the beach instead of disposing as a submerged berm, additional pumping cost is not included in the cost function. In addition, cost associated with mitigating environmental impacts has not been considered.

More details and assumptions used for the cost estimates for the three mode of transportation are provided in Attachment B.

Table 5.1 Comparison of Transportation and Disposal Unit Costs by Volumes, Distances, and Transportation Methods

Total Volume (cy) of Available Material = 600,000

Dist. from Borrow Site	Mode of Transportation		
20% of Total Dredged Volume	**120,000 cy**		
Miles	Truck	Railroad	Scow & Tow
2	$5.21	$37.77	$3.55
5	$5.86	$37.77	$3.92
10	$6.97	$37.77	$4.54
15	$8.06	$37.77	$5.16
20	$9.14	$37.77	$5.77
25	$10.22	$37.77	$6.39
50	$15.69	$37.77	$9.47
100	$26.85	$39.92	$15.64
150	$37.14	$41.34	$21.80
300	$69.88	$42.77	$40.30
40% of Total Dredged Volume	**240,000 cy**		
Miles	Truck	Railroad	Scow & Tow
2	$4.79	$37.36	$2.30
5	$5.44	$37.36	$2.67
10	$6.55	$37.36	$3.29
15	$7.64	$37.36	$3.91
20	$8.72	$37.36	$4.52
25	$9.80	$37.36	$5.14
50	$15.27	$37.36	$8.22
100	$26.43	$39.50	$14.39
150	$36.72	$40.93	$20.55
300	$69.47	$42.36	$39.05
60% of Total Dredged Volume	**360,000 cy**		
Miles	Truck	Railroad	Scow & Tow
2	$4.65	$37.22	$1.89
5	$5.30	$37.22	$2.26
10	$6.41	$37.22	$2.87
15	$7.50	$37.22	$3.49
20	$8.58	$37.22	$4.11
25	$9.66	$37.22	$4.72
50	$15.13	$37.22	$7.81
100	$26.29	$39.36	$13.97
150	$36.58	$40.79	$20.14
300	$69.33	$42.22	$38.63

Dist. from Borrow Site	Mode of Transportation		
80% of Total Dredged Volume	**480,000 cy**		
Miles	Truck	Railroad	Scow & Tow
2	$4.58	$37.15	$1.68
5	$5.23	$37.15	$2.05
10	$6.34	$37.15	$2.67
15	$7.43	$37.15	$3.28
20	$8.52	$37.15	$3.90
25	$9.59	$37.15	$4.52
50	$15.06	$37.15	$7.60
100	$26.22	$39.29	$13.76
150	$36.52	$40.72	$19.93
300	$69.26	$42.15	$38.42
100% of Total Dredged Volume	**600,000 cy**		
Miles	Truck	Railroad	Scow & Tow
2	$4.54	$37.11	$1.55
5	$5.19	$37.11	$1.92
10	$6.30	$37.11	$2.54
15	$7.39	$37.11	$3.16
20	$8.47	$37.11	$3.77
25	$9.55	$37.11	$4.39
50	$15.02	$37.11	$7.47
100	$26.18	$39.25	$13.64
150	$36.47	$40.68	$19.80
300	$69.22	$42.11	$38.30

Note

1. All costs do not include dredging cost.

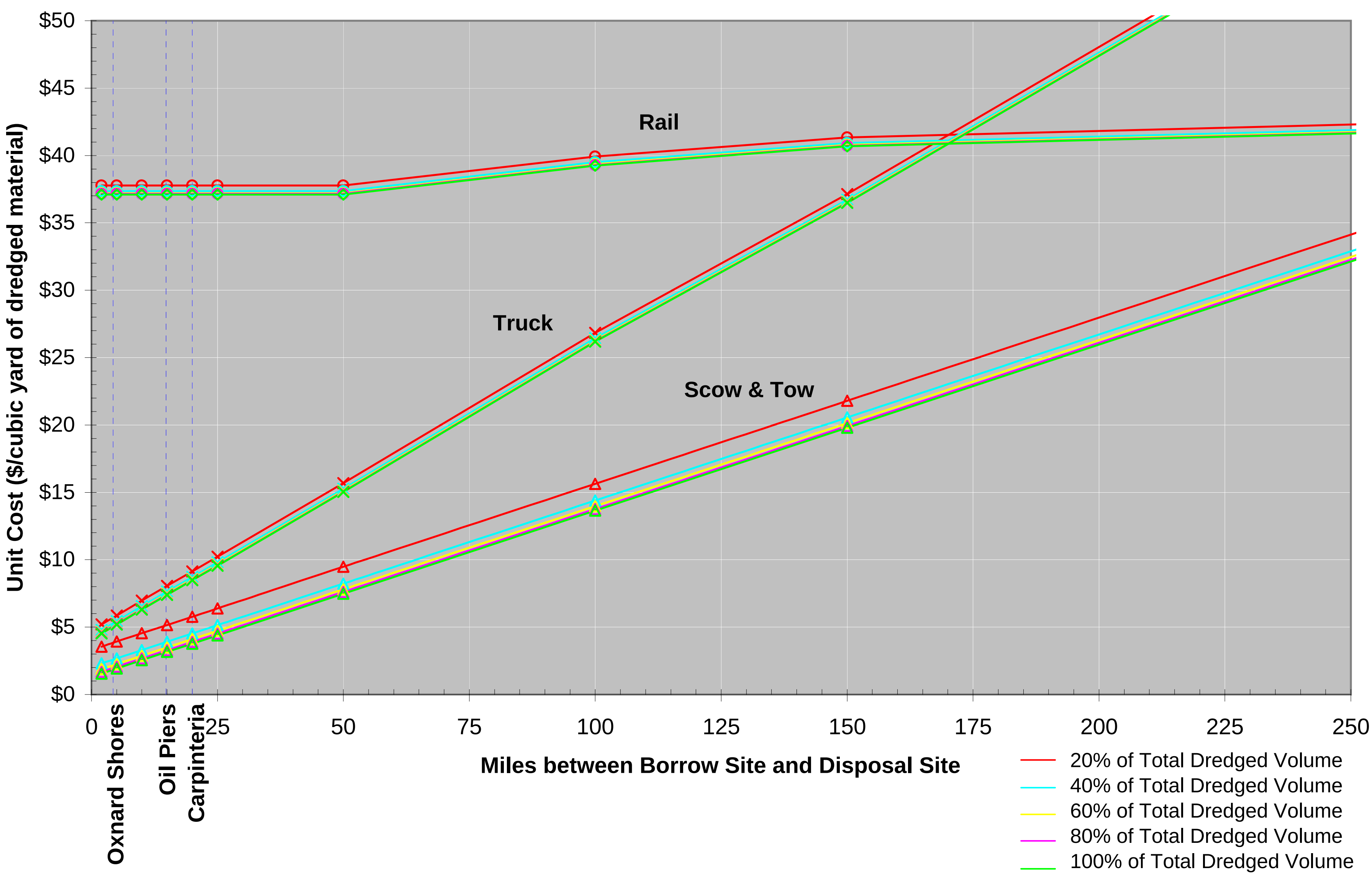


Figure 5.1 - Comparison of Transporation and Disposal Unit Costs

6. BENEFITS FOR BEACH FILL ALTERNATIVES

6.1 OVERVIEW

The following sections summarize the analyses to determine the benefits of using the available Ventura Harbor dredge material for beach nourishment at Carpinteria Beach, Oil Piers, and Oxnard Shores. Simple analytical analyses were performed to estimate the increase in beach width for a given placement volume (Section 6.2), and the subsequent reduction in beach width over a 20-year period (Section 6.3). Given the increase in beach width, the additional recreational benefits were calculated from the increase in attendance and recreational value associated with a wider beach. The method used to determine the recreational benefit is fairly general and allows variation of the current beach width according to existing conditions, the current discount rate, and the additional amount of beach fill available (Section 6.4).

As noted in the Main Report, these simple analytical analyses were intended to provide example data for testing the pilot GIS-based model, they were not intended to be sufficient analyses for the placement scenarios presented in the report.

6.2 BEACH FILL CHARACTERISTICS

Figures 6.1 to 6.3 show the beach fill lengths and locations for the Carpinteria Beach, Oil Piers Beach and Oxnard Shores, respectively. Assuming the beachfill material has similar grain size characteristics as the native beach material, the increase in beach width, W, at each of the three beaches was estimated as:

$$W = \frac{V}{L \times (B + D_c)}$$

where V *is* the beachfill volume, L is the beachfill length, B is berm height, D_c is the depth of closure.

Assuming a combined beach profile height (B+D_C) of 30 ft, the increase in beach widths for placing 20, 40, 60 and 80% of the dredged material from Ventura Harbor on the three beach locations were calculated and shown in Figure 6.4. The placement of 20% (120,000 cy) of the Ventura Harbor dredged material on the three beaches will result in an increase of beach widths of about 20 to 35 feet. The placement of 80% (480,000 cy) of the dredged material can result in an increase in beach area of about 80 to 130 feet.

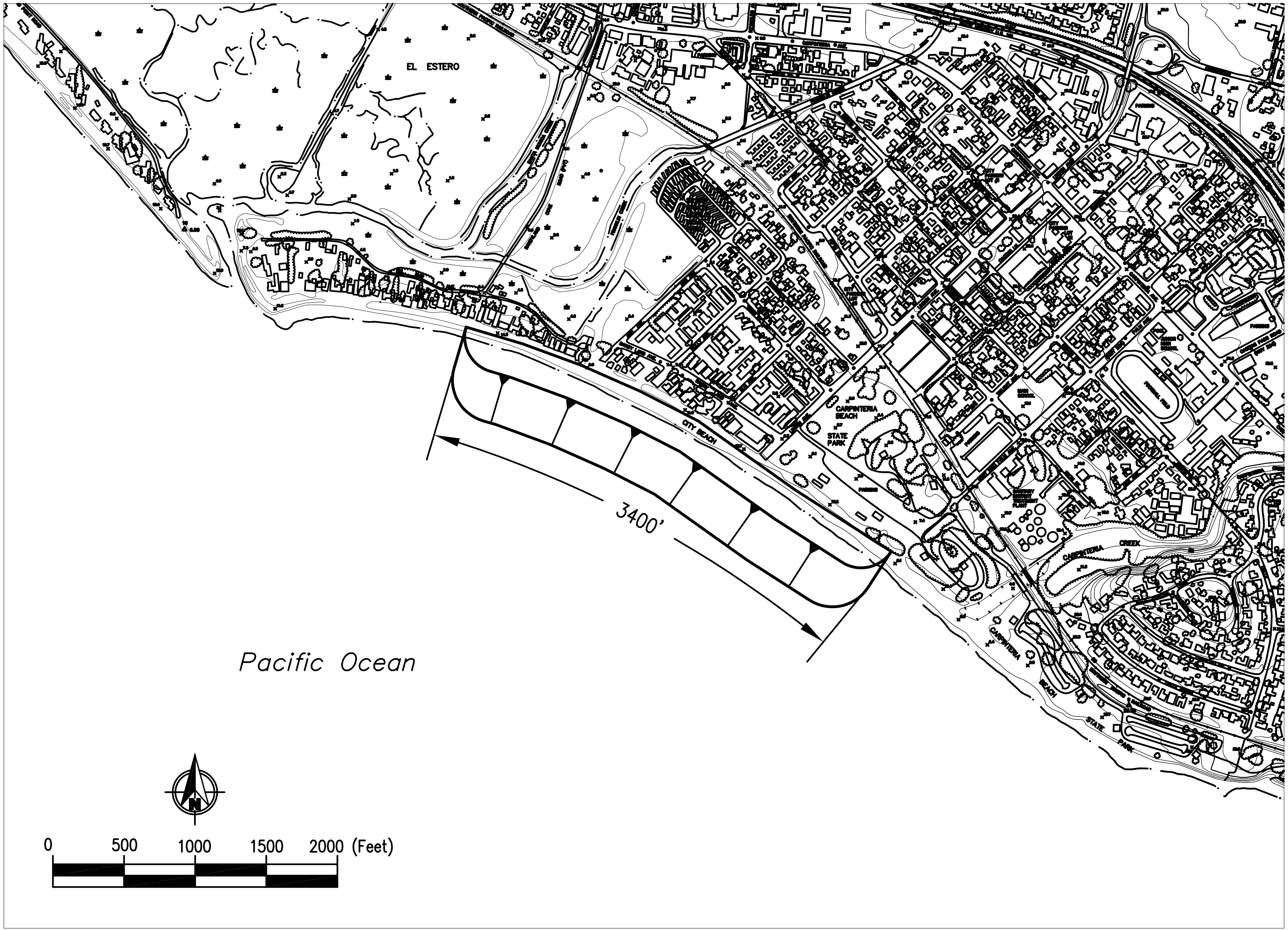


Figure 6.1 - Carpinteria Beach - Beach Fill Location

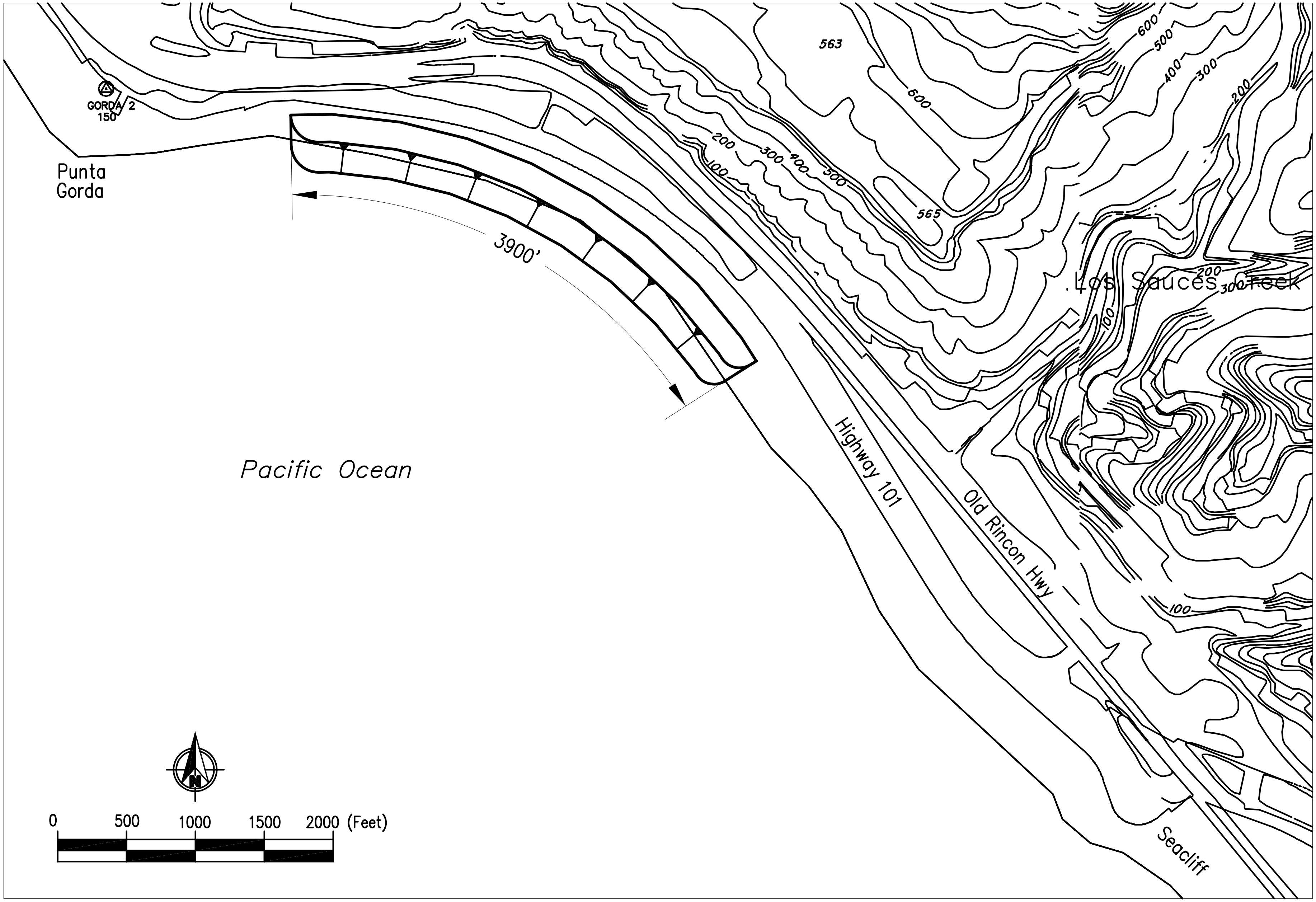


Figure 6.2 - Oil Piers Beach - Beach Fill Location

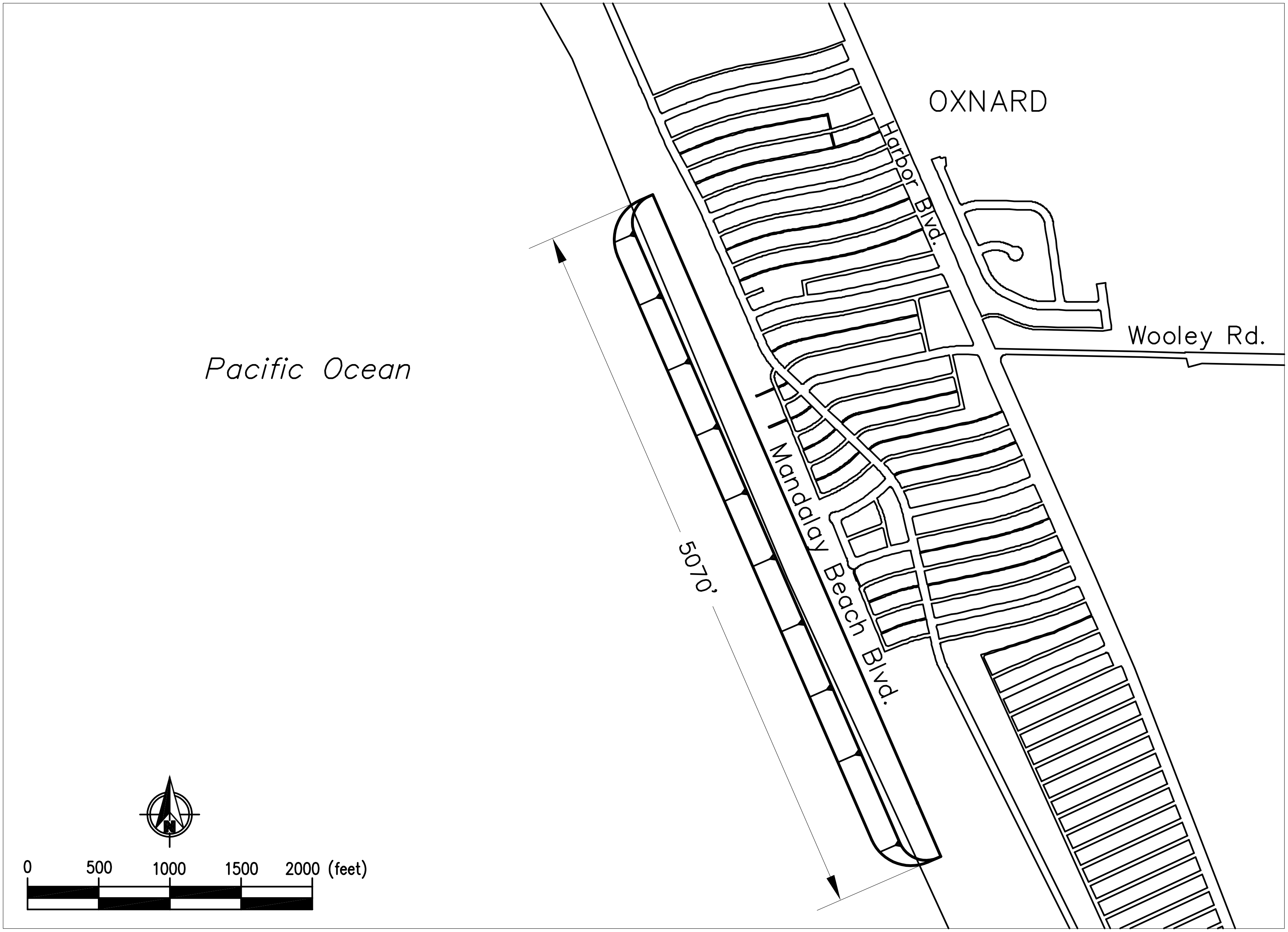


Figure 6.3 - Oxnard Shores - Beach Fill Location

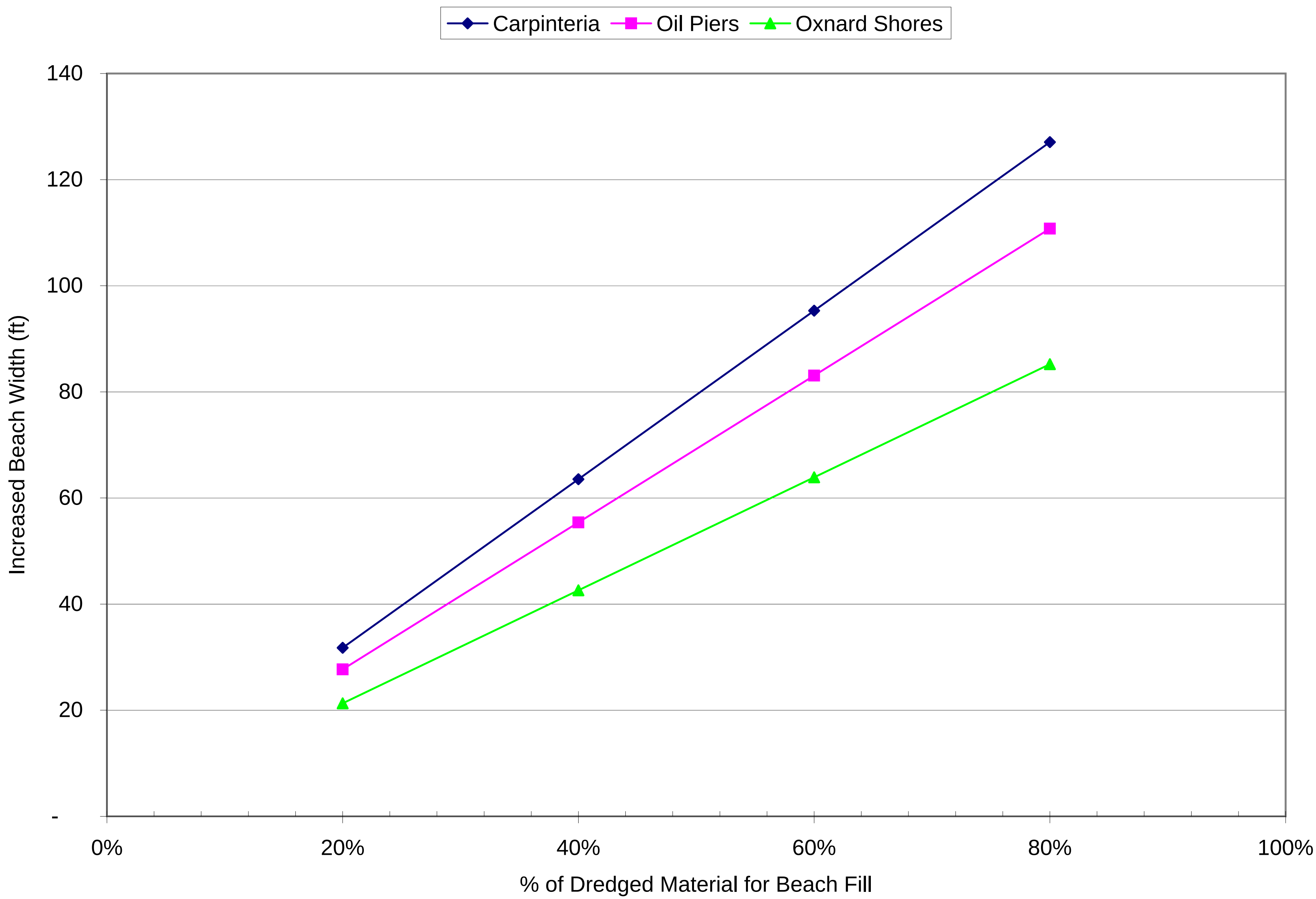


Figure 6.4 - Increase in Beach Width

6.3 PROJECTED BEACH EROSION/CHANGE IN PLANFORM

New beach fills spread laterally along the shoreline in upcoast and downcoast directions as waves rework the artificial deposit to restore the beach to its natural equilibrium shape. A diffusion theory is generally used to describe the lateral spreading of newly placed beach fill (Dean, 2002). The spreading rate depends on the longshore diffusivity (G), which is a function the wave energy (wave height) and other physical characteristics of the shoreline. The longshore diffusivity established for the study area by USACE (1997) was used to estimate the change in beach planforms over time.

Figure 6.5 shows an example of the change in beach planform over time for Carpinteria Beach. The figures illustrate the lateral spreading and change in beach widths 1, 5, 10 and 20 years after the initial placement of 80% of the Ventura Harbor dredged material (600,000 cy) on the beach. The predicted increased beach widths based on the range of beach fill volumes for the Carpinteria Beach, Oil Piers Beach and Oxnard Shores are shown in Figures 6.6 to 6.8, respectively. The results show that the beach fills rapidly diffuses initially, followed by subsequently slower lateral spreading and reduction in beach widths.

6.4 RECREATIONAL BENEFITS

Economists have devised a number of standard ways to calculate the economic value of what is referred to as "non-market goods," that is, goods that are free. In the case of beaches, it is clear that people place a value on the beach (despite paying parking fees) as demonstrated by their willingness to fly or drive substantial distances to get to a beach and often in heavy traffic. One widely accepted and used method of calculating the economic value of a day at the beach is the "travel cost method." This method estimates the cost of traveling to and from the beach as a measure of the willingness of visitors to pay. The travel cost method is officially approved by USACE to measure ability to pay, and it is widely used in the economic profession to value recreational sites like beaches.

To calculate the willingness to pay for a day at the beaches, information provided by the survey coupled with attendance data is used to estimate consumer surplus for the beaches. The travel cost method generally involves the following:

- Estimate the demand curve for beach visits using the travel cost method
- Estimate consumer surplus by integrating the demand curve

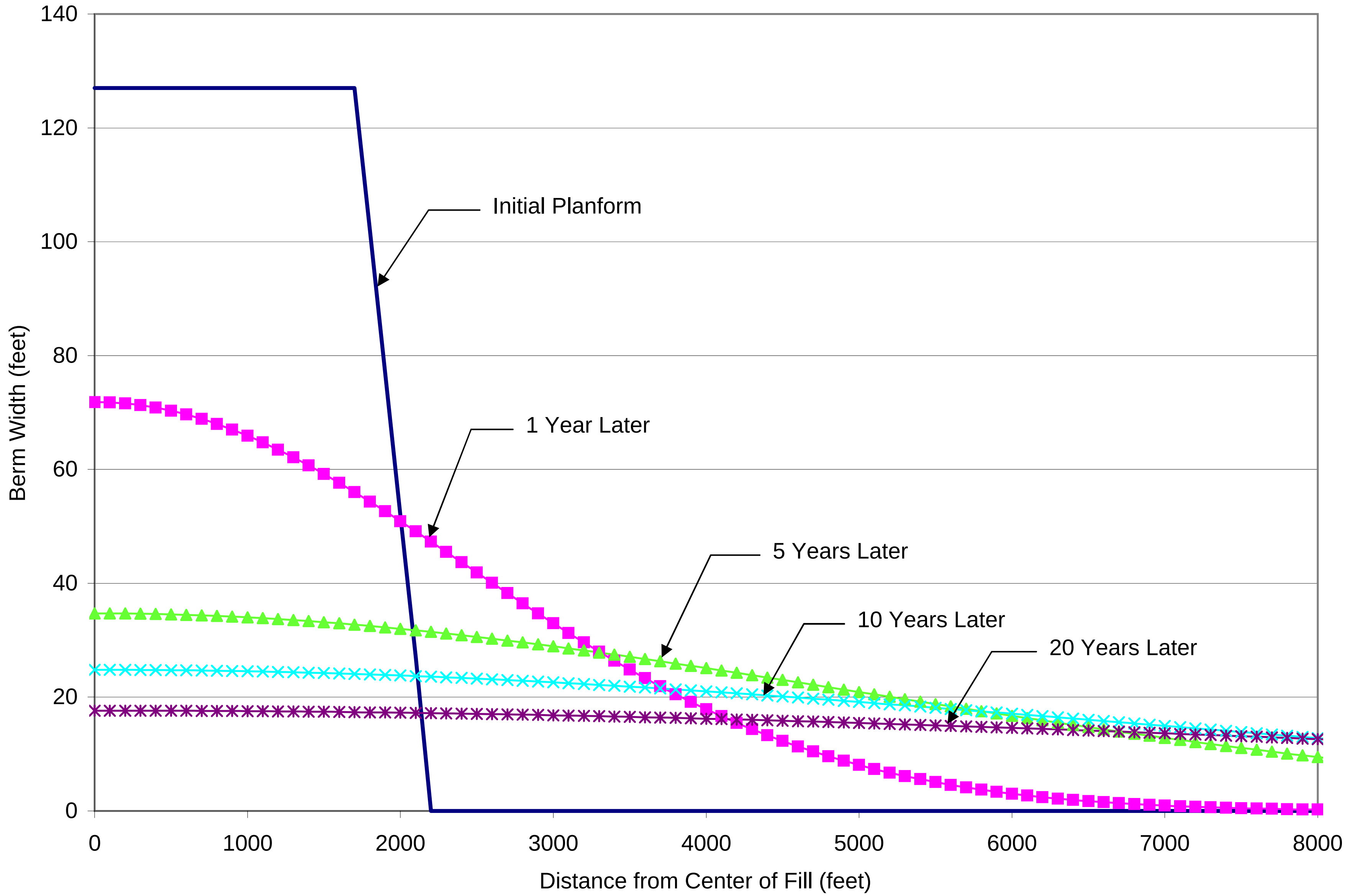


Figure 6.5 - Beach Fill Evolution at Carpinteria Beach

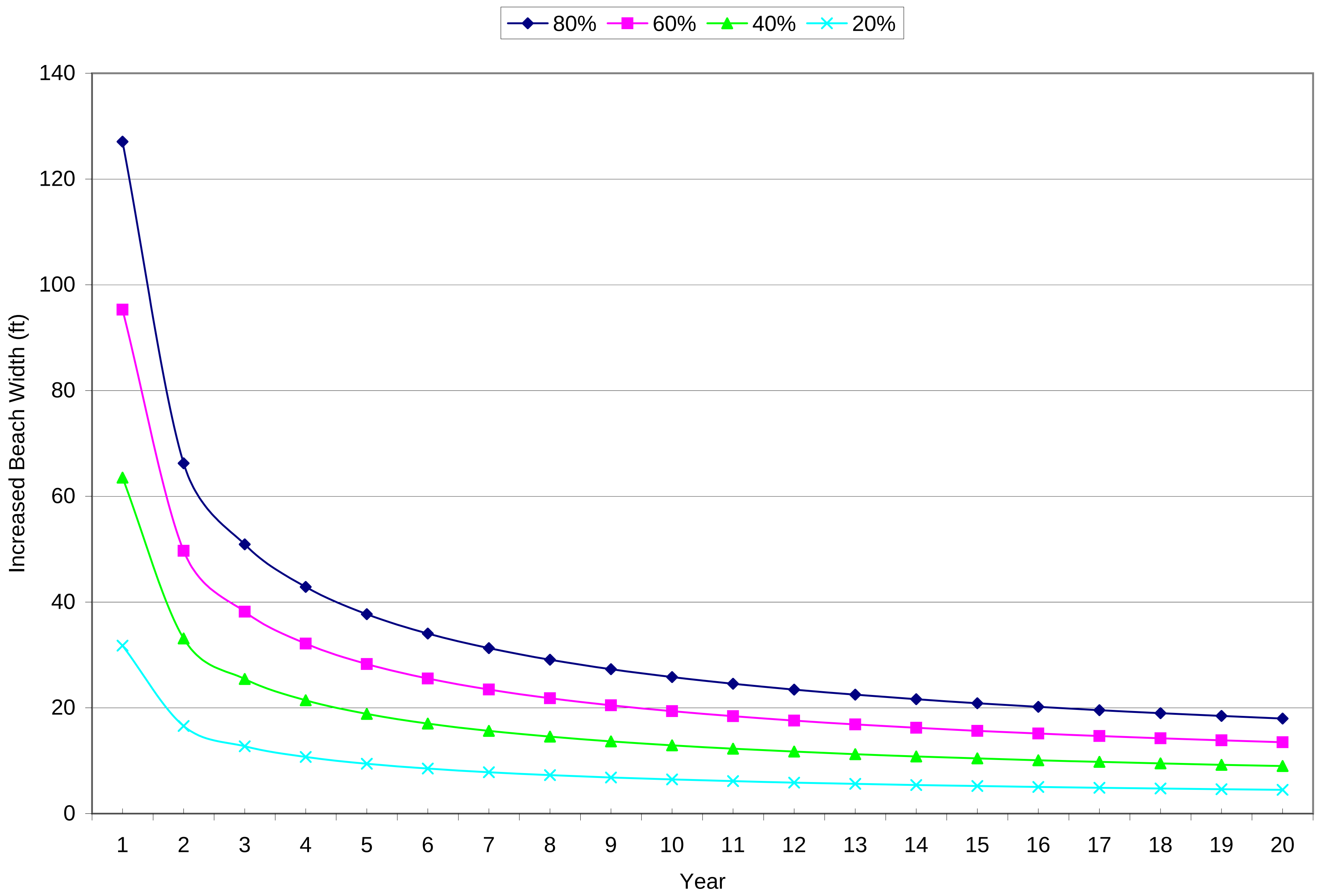


Figure 6.6 - Beach Width Evolution at Carpinteria Beach

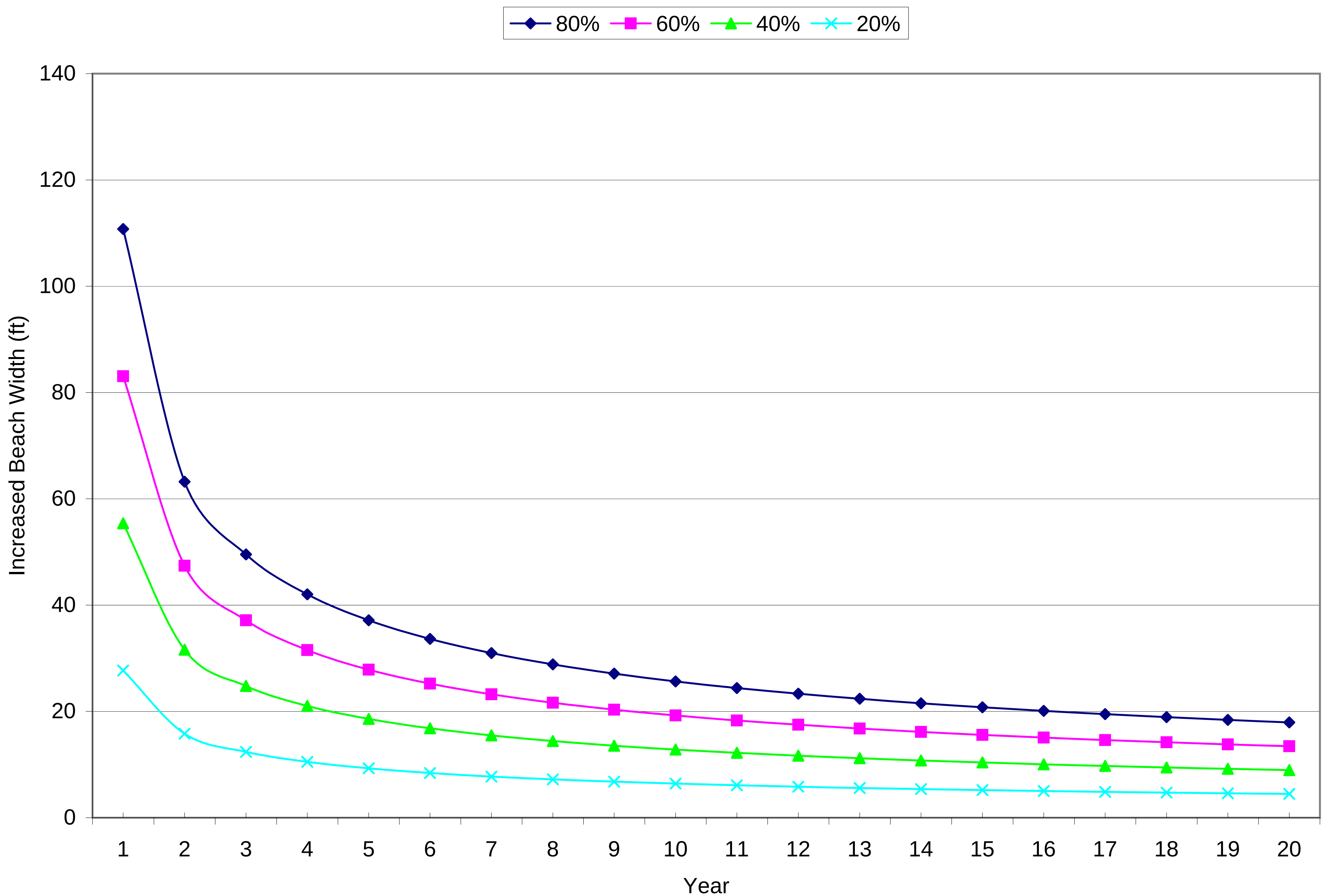


Figure 6.7 - Beach Width Evolution at Oil Piers Beach

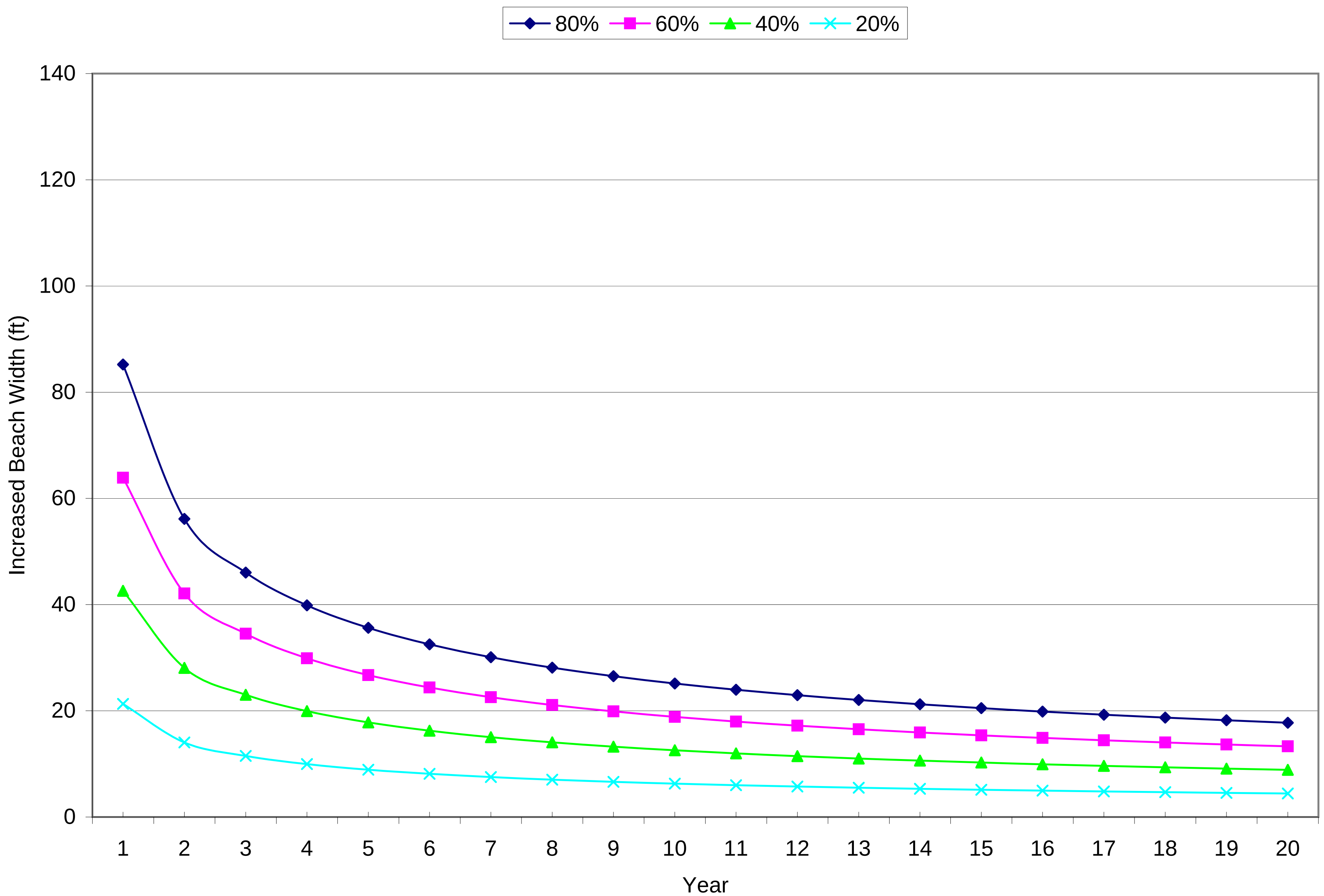


Figure 6.8 - Beach Width Evolution at Oxnard Shores

The day-use value of each beach was determined for the high season (late May through mid September) and low season (October through early May). The value was calculated based on point values using the USACE method (USACE, 1990) and visitor surveys. The day-use value and the seasonal attendance was then used to compute the beach fill benefits.

For the beach fill benefits, the four specific scenarios described in Section 4.6 were analyzed. For each scenario, the increase in beach width over a 20-year period was determined for the recreational benefit.

6.4.1 Carpinteria Beach

Based on summer 2001 data, the value of one beach day at Carpinteria was estimated at $23.38 per person per day during the high season (King, 2002a). For the low season, a conservative estimate of $3 per day[2] was used. This value is consistent with other economist’s estimates for Southern California beaches (e.g., see Hanemann and Rudd, 1998), but is substantially higher than the value used by the USACE, even taking into account the higher value attributable to camping. Our estimate reflects the fact that a substantial number of people are willing to travel quite far to spend a day at Carpinteria Beach, which provides a significantly different set of amenities compared to other beaches in California. The study conducted by King (2002a) did not fully take into account the availability of substitutes, though it should be noted from our general survey data that many visitors consider Carpinteria Beach unique and that the amenities provided there are superior to most other beaches in the area. Perhaps most important is the fact that it is considered to be a children’s beach.

Table 6.1 presents the US Army Corps methodology for assessing the unit day value of recreation. For each of the categories shown in the table, a point value has been assigned using the Corps methodology. For more information on this methodology, the reader is referred to USACE (1990). Overall, we have assessed Carpinteria’s beach at 92 points. This is a high valuation but appropriate for the only beach in California ranked in the top 50 in the US. Indeed, one might argue for a higher score. The score of 92 points translates into a day unit value of $4.60 in July 1, 1982 dollars and $8.71 in August 2003 dollars.

In an earlier study, Dr. King used the travel cost method to derive an estimate of $23.38 for a day at Carpinteria’s beaches (King 2002a). The estimate of $23 is in line with other studies of the value of a beach day at a major southern California beach. It should be noted that policy makers who use the model which will be developed from this study may choose different values for a day at the beach. The ArcGIS model will eventually allow the end user to input his or her own dollar values. For the purposes of this study, an average of the two

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[2] Low season visits are considered less valuable by economists since they involve local visitors, who have a low travel cost, and who typically use the beach for lower value uses, such as walking.

values discussed above ($8.71 and $23.38)--$16.05 person per day in high season (late May to mid September). For off season visitation (which is small) unit day value of $3 was used, which we believe is reasonable.

Table 6.1 Point Values for Off-Season Recreation at Carpinteria Beach

CRITERIA	TOTAL POSSIBLE POINTS	POINTS ASSIGNED
Recreation Experience	30	28
Availability (Substitutes)	18	16
Capacity	14	11
Accessibility	18	18
Environmental	20	19
Total	**100**	**92**

Source: USACE, 1990

Attendance

Unfortunately, Carpinteria does not keep seasonal attendance records. However, we have visited the beach for several years and spoken to lifeguards and to Matt Roberts, who is in charge of Parks and Recreation for the City. Mr. Roberts estimates the high season (Mid May to Mid September) attendance to be 1.6 million people for both the City and State beaches and a significantly smaller low season attendance estimated at 300,000. This estimate is consistent with the numerous site visits and with estimates of other southern California with similar levels of crowding over similar areas, such as San Clemente City Beach.

Recreational Value

Table 6.2 below provides the total recreational value of Carpinteria's City and State beaches for both the high and low season. Overall, the total recreational value is $26.6 million per year.

Table 6.2 Total Recreational Value of Carpinteria Beach

SEASON	DAY USE VALUE	EST. ATTENDANCE	RECREATIONAL VALUE
High Season	$16.05	1,600,00	$25,672,000
Low Season	$3.00	300,000	$900,000
Total		1,900,000	$26,572,000

Costs and Benefits of Erosion and Additional Beach Fill

Estimating the benefits of additional beach fill is difficult and most of the literature on the recreational value of beaches ignores the critical issue of beach nourishment. A series of survey questions were created for the State of California, which elicit responses to two key questions: (1) will increasing or decreasing a beaches width increase the respondents visitation to that beach, (2) will a wider (or narrower) beach increase (or decrease) the visitors recreational experience. Dr. King conducted a survey at several beaches in southern California in 2000 (King, 2001) which found, in general, that respondents preferred wider beaches and, everything else equal, they would attend wider beaches more often. Responses varied depending upon beach width. As one would expect, respondents indicated that widening particularly narrow beaches (e.g., those in Carlsbad) would significantly increase their attendance and perceived recreational value. On the other hand, increasing the width of beaches which are already quite wide (e.g., Huntington Beach) added little in terms of value or attendance. There was some evidence of self-selection (i.e., visitors who attended narrow beaches tended to be less bothered by lack of beach width than others), nevertheless the report concluded that at all but the widest beaches, there was a significant demand for beach nourishment and that the narrower the beach, the larger the benefit. Survey data from beaches similar to Carpinteria were analyzed. Applying this analysis to Carpinteria, we conclude that doubling beach width would increase attendance by 20% and recreational value (per visitor) by 18%. It should be noted that while these assumptions are consistent with the current survey results, estimating the precise changes in attendance and recreational value is difficult. More study in this area is needed, in particular, direct observations of changes in attendance after nourishment.

Benefits of Beach Fill

Scenario 1

Table 6.3 presents our estimate of the gain in recreational value from adding 450,000 cy of beach fill to Carpinteria's beaches. If we discount the twenty years of gains at a 6% rate, we estimate the total benefit to be $32.5 million. The increased beach width is calculated based on an initial beach width of 150 feet.

Table 6.3 Increased Value of 450,000 cy of Beach Fill

Year	Increased Beach Width (ft)	Increased Beach Width (%)	Total Beach Width (ft)	Gain in Recreational Value	PV of Gain (Year 1)
1	119	79%	269	$8,769,469	$8,769,469
2	62	41%	212	$4,572,922	$4,069,884
3	48	32%	198	$3,514,573	$2,950,903
4	40	27%	190	$2,958,185	$2,343,160
5	35	24%	185	$2,602,489	$1,944,731
6	32	21%	182	$2,350,235	$1,656,823
7	29	20%	179	$2,159,427	$1,436,142
8	27	18%	177	$2,008,604	$1,260,223
9	26	17%	176	$1,885,512	$1,116,032
10	24	16%	174	$1,782,581	$995,384
11	23	15%	173	$1,694,849	$892,825
12	22	15%	172	$1,618,910	$804,549
13	21	14%	171	$1,552,339	$727,797
14	20	14%	170	$1,493,357	$660,513
15	20	13%	170	$1,440,624	$601,122
16	19	13%	169	$1,393,108	$548,392
17	18	12%	168	$1,350,003	$501,343
18	18	12%	168	$1,310,667	$459,184
19	17	12%	167	$1,274,579	$421,265
20	17	11%	167	$1,241,317	$387,049
Total				**$46,973,749**	**$32,546,789**

<u>Scenario 2</u>

Table 6.4 presents our estimate of the gain in recreational value from adding 175,000 cy of beach fill to Carpinteria's beaches. If we discount the twenty years of gains at a 6% rate, we estimate the total benefit to be $12.6 million.

Table 6.4 Increased Value of 175,000 cy of Beach Fill

Year	Increased Beach Width (ft)	Increased Beach Width (%)	Total Beach Width (ft)	Gain in Recreational Value	PV of Gain (Year 1)
1	46	31%	196	$3,389,879	$3,389,879
2	24	16%	174	$1,767,684	$1,573,233
3	18	12%	168	$1,358,574	$1,140,685
4	16	10%	166	$1,143,500	$905,759
5	14	9%	164	$1,006,004	$751,745
6	12	8%	162	$908,494	$640,452
7	11	8%	161	$834,737	$555,147
8	11	7%	161	$776,435	$487,145
9	10	7%	160	$728,854	$431,407
10	9	6%	159	$689,065	$384,770
11	9	6%	159	$655,152	$345,126
12	8	6%	158	$625,797	$311,002
13	8	5%	158	$600,064	$281,333
14	8	5%	158	$577,264	$255,324
15	8	5%	158	$556,880	$232,366
16	7	5%	157	$538,512	$211,983
17	7	5%	157	$521,850	$193,797
18	7	5%	157	$506,644	$177,500
19	7	4%	157	$492,695	$162,842
20	7	4%	157	$479,837	$149,615
Total				**$18,157,920**	**$12,581,112**

Scenario 4

Table 6.5 presents our estimate of the gain in recreational value from adding 150,000 cy of beach fill to Carpinteria's beaches. If we discount the twenty years of gains at a 6% rate, we estimate the total benefit to be $10.9 million.

Table 6.5 Increased Value of 150,000 cy of Beach Fill

YEAR	INCREASED BEACH WIDTH (FT)	INCREASED BEACH WIDTH (%)	TOTAL BEACH WIDTH (FT)	GAIN IN RECREATIONAL VALUE	PV OF GAIN (YEAR 0)
1	40	27%	190	$2,947,721	$2,947,721
2	21	14%	171	$1,537,117	$1,368,028
3	16	11%	166	$1,181,369	$991,900
4	13	9%	163	$994,348	$787,617
5	12	8%	162	$874,786	$653,691
6	11	7%	161	$789,995	$556,915
7	10	7%	160	$725,858	$482,737
8	9	6%	159	$675,161	$423,604
9	9	6%	159	$633,786	$375,137
10	8	5%	158	$599,187	$334,583
11	8	5%	158	$569,697	$300,109
12	7	5%	157	$544,171	$270,436
13	7	5%	157	$521,795	$244,638
14	7	5%	157	$501,969	$222,021
15	7	4%	157	$484,243	$202,058
16	6	4%	156	$468,272	$184,333
17	6	4%	156	$453,783	$168,519
18	6	4%	156	$440,560	$154,348
19	6	4%	156	$428,430	$141,602
20	6	4%	156	$417,249	$130,100
TOTAL				**$15,789,495**	**$10,940,097**

6.4.2 Oil Piers Beach

Table 6.6 presents the US Army Corps methodology for assessing the unit day value of recreation. For each of the categories shown in the table, a point value has been assigned using the Corps methodology. For more information on this methodology, the reader is referred to USACE (1990). Given the relative lack of amenities, we have assessed Oil Piers beach at 43 points, the score would be even lower but Oil Piers is used heavily by surfers and hence has value for a specialized activity; it also has relatively easy access. The score of 43 points translates into a day unit value of $3.00 in July 1, 1982 dollars and $5.68 in August 2003 dollars.[3] We have assumed that off season value is the same, since surfers surf year round.

Table 6.6 Point Values for Recreation at Oil Piers

CRITERIA	TOTAL POSSIBLE POINTS	POINTS ASSIGNED
Recreation Experience	30	15
Availability (Substitutes)	18	6
Capacity	14	5
Accessibility	18	12
Environmental	20	5
Total	**100**	**43**

Source: USACE, 1990

The methodology used by the USACE is rather conservative and yields estimates that are significantly lower than other studies of similar beach in California. This is particularly true given that many use Oil Piers as for surfing, which is generally considered to be a higher value activity. Applying a benefits transfer analysis, from studies of other beaches in California, we believe a value of $8 a day is more reasonable. Since surfing is a year round activity, we apply this value to attendance year-round. It should be noted that policy makers who use the ArcGIS decision support tool presented in the main report may choose different values for a day at the beach.

[3] Adjusting using the CPI index at www.bls.gov.

Attendance

No official attendance records are available. We interviewed Karl Treiberg, Environmental Planner for the County of Santa Barbara, who told us that attendance was much before the piers were removed (the piers created a break for surfers). He provided some information about attendance. We used data from three site visits, estimated use per day and turnover. From these calculations, we estimate that Oil Piers beach receives 23,000 visitors per year. It should be noted that we do not have a great degree of confidence in this estimate; indeed, we could be off by a factor of two.

Recreational Value

Given our estimates of day use value and attendance, we can calculate the recreational value of Oil Piers beach. Table 6.7 presents our estimate of the Recreational Value of Oil Piers Beach, which is $184,800 per year.

Table 6.7 Recreational Value of Oil Piers Beach

Season	Day Use Value	Estimated Attendance	Recreational Value
Year Round	$8.00	23,100	$184,800

Benefits of Beach Fill

Scenario 2

Table 6.8 presents our estimate of the gain in recreational value from adding 275,000 cy of beach fill to Oil Piers beach. If we discount the twenty years of gains at a 6% rate, we estimate the total benefit to be $396,000. The increased beach width is calculated based on an initial beach width of 50 feet.

Table 6.8 Increased Value of 275,000 cy of Beach Fill

Year	Increased Beach Width (ft)	Increased Beach Width (%)	Total Beach Width (ft)	Gain in Recreational Value	PV of Gain (Year 1)
1	65	130%	115	$99,940	$99,940
2	36	72%	86	$55,272	$49,192
3	28	56%	78	$43,325	$36,376
4	24	48%	74	$36,765	$29,121
5	21	42%	71	$32,487	$24,276
6	19	38%	69	$29,420	$20,740
7	18	35%	68	$27,083	$18,012
8	16	33%	66	$25,226	$15,827
9	15	31%	65	$23,705	$14,031
10	15	29%	65	$22,430	$12,525
11	14	28%	64	$21,340	$11,242
12	13	27%	63	$20,395	$10,136
13	13	25%	63	$19,566	$9,173
14	12	24%	62	$18,830	$8,328
15	12	24%	62	$18,171	$7,582
16	11	23%	61	$17,577	$6,919
17	11	22%	61	$17,037	$6,327
18	11	22%	61	$16,545	$5,796
19	10	21%	60	$16,092	$5,319
20	10	20%	60	$15,675	$4,888
Total				**$576,881**	**$395,750**

<u>Scenario 4</u>

Table 6.9 presents our estimate of the gain in recreational value from adding 150,000 cy of beach fill to Oil Piers beach. If we discount the twenty years of gains at a 6% rate, we estimate the total benefit to be $218,000.

Table 6.9 Increased Value of 150,000 cy of Beach Fill

YEAR	INCREASED BEACH WIDTH (FT)	INCREASED BEACH WIDTH (%)	TOTAL BEACH WIDTH (FT)	GAIN IN RECREATIONAL VALUE	PV OF GAIN (YEAR 0)
1	35	70%	85	$53,814	$53,814
2	20	40%	70	$30,707	$27,329
3	16	31%	66	$24,069	$20,209
4	13	27%	63	$20,425	$16,178
5	12	23%	62	$18,049	$13,487
6	11	21%	61	$16,344	$11,522
7	10	20%	60	$15,046	$10,007
8	9	18%	59	$14,015	$8,793
9	9	17%	59	$13,170	$7,795
10	8	16%	58	$12,461	$6,958
11	8	15%	58	$11,856	$6,245
12	7	15%	57	$11,331	$5,631
13	7	14%	57	$10,870	$5,096
14	7	14%	57	$10,461	$4,627
15	7	13%	57	$10,095	$4,212
16	6	13%	56	$9,765	$3,844
17	6	12%	56	$9,465	$3,515
18	6	12%	56	$9,191	$3,220
19	6	12%	56	$8,940	$2,955
20	6	11%	56	$8,708	$2,715
TOTAL				**$318,781**	**$218,153**

6.4.3 Oxnard Shores

Table 6.10 below presents the USACE methodology for assessing the unit day value of recreation at Oxnard Shores. For each of the categories shown in the table, a point value has been assigned using the Corps methodology. For more information on this methodology, the reader is referred to USACE (1990). The level of amenities varies significantly depending upon the location but we have taken an average level. Further, although these amenities are greater than Oil Piers, there are few opportunities for surfing and access is poor at many locations relative to Oil Piers. Consequently, we have given Oxnard a score of 37 points. The score of 37 points translates into a day unit value of $3.00 in July 1, 1982 dollars and $5.68 in August 2003 dollars. We have assumed that off season value is the same.

Table 6.10 Point Values for Recreation at Oxnard Shores

CRITERIA	TOTAL POSSIBLE POINTS	POINTS ASSIGNED
Recreation Experience	30	10
Availability (Substitutes)	18	2
Capacity	14	5
Accessibility	18	13
Environmental	20	7
TOTAL	**100**	**37**

Source: USACE, 1990

The methodology used by the USACE is rather conservative and yields estimates that are significantly lower than other studies of similar beach in California. Applying a benefits transfer analysis, from studies of other beaches in California, we believe a value of $9 a day is more reasonable. It should be noted that policy makers who use the ArcGIS decision support tool presented in the main report may choose different values for a day at the beach.

Attendance

No official attendance records are available. We estimated the yearly attendance at 80,500 based on our own observations and interviews with local beach-goers. While we believe that our estimate is reasonable, it should be noted that we could be off by a factor of two.

Recreational Value

Given our estimates of day use value and attendance, we can calculate the recreational value of Oxnard Shores/Mandalay Park beaches. Table 6.11 presents our estimate of the Recreational Value of Oxnard Shores/Mandalay Park beaches, which is $728,000 per year.

Table 6.11 Recreational Value of Oxnard Shores Beach

SEASON	DAY USE VALUE	ESTIMATED ATTENDANCE	RECREATIONAL VALUE
YEAR ROUND	$9.00	80,850	$727,650

Benefits of Beach Fill

Scenario 3

Table 6.12 presents our estimate of the gain in recreational value from adding 450,000 cy of beach fill to Oxnard Shores beach. If we discount the twenty years of gains at a 6% rate, we estimate the total benefit to be $234,000. It should be noted that this estimate is based on limited data. The increased beach width is calculated based on an initial beach width of 250 feet.

Table 6.12 Increased Value of 450,000 cy of Beach Fill

Year	Increased Beach Width (ft)	Increased Beach Width (%)	Total Beach Width (ft)	Gain in Recreational Value	PV of Gain (Year 0)
1	80	32%	330	$48,898	$48,898
2	53	21%	303	$32,218	$28,674
3	43	17%	293	$26,413	$22,177
4	37	15%	287	$22,879	$18,122
5	33	13%	283	$20,454	$15,284
6	31	12%	281	$18,661	$13,156
7	28	11%	278	$17,269	$11,485
8	26	11%	276	$16,146	$10,130
9	25	10%	275	$15,217	$9,007
10	24	9%	274	$14,432	$8,059
11	23	9%	273	$13,757	$7,247
12	22	9%	272	$13,168	$6,544
13	21	8%	271	$12,649	$5,930
14	20	8%	270	$12,186	$5,390
15	19	8%	269	$11,771	$4,912
16	19	7%	269	$11,396	$4,486
17	18	7%	268	$11,054	$4,105
18	18	7%	268	$10,741	$3,763
19	17	7%	267	$10,454	$3,455
20	17	7%	267	$10,188	$3,177
Total				**$349,961**	**$234,000**

Scenario 4

Table 6.13 presents our estimate of the gain in recreational value from adding 150,000 cy of beach fill to Oxnard Shores beach. If we discount the twenty years of gains at a 6% rate, we estimate the total benefit to be $78,900.

Table 6.13 Increased Value of 150,000 cy of Beach Fill

Year	Increased Beach Width (ft)	Increased Beach Width (%)	Total Beach Width (ft)	Gain in Recreational Value	PV of Gain (Year 1)
1	27	11%	277	$16,503	$16,503
2	18	7%	268	$10,874	$9,678
3	15	6%	265	$8,914	$7,485
4	13	5%	263	$7,722	$6,116
5	11	5%	261	$6,903	$5,158
6	10	4%	260	$6,298	$4,440
7	10	4%	260	$5,828	$3,876
8	9	4%	259	$5,449	$3,419
9	8	3%	258	$5,136	$3,040
10	8	3%	258	$4,871	$2,720
11	8	3%	258	$4,643	$2,446
12	7	3%	257	$4,444	$2,209
13	7	3%	257	$4,269	$2,001
14	7	3%	257	$4,113	$1,819
15	6	3%	256	$3,973	$1,658
16	6	3%	256	$3,846	$1,514
17	6	2%	256	$3,731	$1,385
18	6	2%	256	$3,625	$1,270
19	6	2%	256	$3,528	$1,166
20	6	2%	256	$3,439	$1,072
Total				**$118,108**	**$78,975**

6.4.4 Benefits of Beach Fill by Scenario

Scenario 1

Adding 450,000 cy of sand to Carpinteria's beaches would provide an estimated gain of $32.2 million (discounted at 6% per year) in recreational value.

Scenario 2

Adding 175,000 cy of sand to Carpinteria's beaches would provide an estimated gain of $12.6 million (discounted at 6% per year) in recreational value. Adding 275,000 cy of sand to Oil Piers' beach would provide an estimated gain of $396,000 (discounted at 6% per year) in recreational value. Hence, the total increase in recreational value for this scenario is estimated to be about $13.0 million.

Scenario 3

Adding 450,000 cy of sand to Oxnard Shores beach would provide an estimated gain of $238,000 (discounted at 6% per year) in recreational value.

Scenario 4

Adding 150,000 cy of sand to Carpinteria's beaches would provide an estimated gain of $10.9 million (discounted at 6% per year) in recreational value. Adding 150,000 cy of sand to Oil Piers' beach would provide an estimated gain of $218,000 (discounted at 6% per year) in recreational value. Adding 150,000 cy of sand to Oxnard Shores beach would provide an estimated gain of $78,000 (discounted at 6% per year) in recreational value. Hence, the total increase in recreational value for this scenario is estimated to be about $11.2 million.

Summary

This study shows that additional benefits for adding sediment at Oxnard are quite small compared to Carpinteria or Oil Piers Beach. It is also clear that the gains from adding sand at Carpinteria are substantial. The gains to Oil Piers are much smaller compared to Carpinteria but a lot higher than Oxnard Shores. Table 6.14 below summarizes the increase in recreational value for the four beach disposal scenarios.

Table 6.14 Increase in Recreation Value for the Four Beach Disposal Scenarios

SCENARIO	DESCRIPTION	INCREASED RECREATION VALUE (IN MILLION)
1	450,000 cy. to Carpinteria Beach	$ 32.50
2	175,000 cy to Carpinteria Beach, 275,000 cy to Oil Piers Beach	$ 13.00
3	450,000 cy. to Oxnard Shore	$ 0.24
4	150,000 cy each to Carpinteria Beach, Oil Piers Beach and Oxnard Shore	$ 11.20

7. DIFFERENTIAL COST VERSUS REGIONAL BENEFITS

7.1 OVERVIEW

The previous section examined the issue of the estimated recreational benefits to be derived from transporting opportunistic sediment. However, politicians and policy makers are generally also interested in regional impacts, in particular how widening these beaches will influence visitors spending and subsequent increases in taxation. This section examines these impacts, primarily at the State level.

7.2 REGIONAL BENEFITS

In the past 5 years, Dr. King has conducted a number of surveys and analyses of the economic impact and regional benefits of beach spending. Most recently, in the summer of 2002, he conducted a comprehensive survey of over 2,500 beach visitors at various beaches in Southern and central California. Tables 7.1a, 7.1b and 7.1c present data on spending patterns at several beaches for day trippers for US visitors from outside California (who are mostly overnight visitors) and from all visitors. We have comprehensive data for Carpinteria, which was part of our survey; however, we do not have data for Oxnard's beaches or for Oil Piers. Please note in these tables that there are some significant differences in spending patterns depending upon the beach surveyed. Also note that overnight visitors spend substantial more (on lodging and food) than do day trippers.

Table 7.1a Daily Spending (Per Individual) at California Beaches by California Day Trippers

	Gas & Auto	Food from Stores and Take Out	Beer, Wine, and Liquor	Sit-Down Restaurants	Parking	Sundries	Lodging	Total Daily Spending
Carpinteria	$3.05	$4.58	$1.17	$2.86	$0.29	$1.78	$0.00	$13.73
Del Mar/Encinitas/SB*	$2.49	$4.12	$1.91	$4.03	$0.60	$1.61	$0.00	$14.75
Huntington Beach	$4.13	$6.19	$2.42	$5.60	$1.38	$2.19	$0.00	$21.92
Mission Beach	$2.93	$6.18	$4.73	$5.73	$0.41	$1.82	$0.00	$21.80
San Clemente	$3.64	$4.89	$1.00	$4.54	$1.09	$1.22	$0.00	$16.38
Santa Barbara	$3.43	$4.42	$1.44	$5.37	$0.80	$1.89	$0.00	$17.34
Venice Beach	$5.22	$6.82	$3.13	$6.44	$1.68	$2.09	$0.00	$25.38

Table 7.1b Daily Spending (Per Individual) at California Beaches by US Vacationers (Not California)

	Gas & Auto	Food from Stores and Take Out	Beer, Wine, and Liquor	Sit-Down Restaurants	Parking	Sundries	Lodging	Total Daily Spending
Carpinteria	$3.90	$10.42	$3.38	$6.94	$0.42	$2.81	$15.67	$43.54
Del Mar/Encinitas/SB*	$6.06	$7.74	$2.47	$14.23	$1.01	$1.93	$29.35	$62.80
Huntington Beach	$8.47	$9.76	$2.61	$14.63	$1.88	$1.72	$16.78	$55.83
Mission Beach	$8.03	$10.33	$5.01	$14.28	$0.49	$2.53	$30.45	$71.11
San Clemente	$5.27	$9.45	$2.62	$11.00	$0.95	$1.71	$18.43	$49.42
Santa Barbara	$8.31	$8.64	$5.58	$20.53	$1.45	$2.64	$31.58	$78.73
Venice Beach	$7.45	$11.90	$5.22	$16.32	$2.55	$2.42	$17.96	$63.81

Table 7.1c Daily Spending (per Individual) at California Beaches for All Visitors

	Gas & Auto	Food from Stores and Take Out	Beer, Wine, and Liquor	Sit-Down Restaurants	Parking	Sundries	Lodging	Total Daily Spending
Carpinteria	$3.73	$7.78	$2.12	$5.53	$0.45	$1.88	$11.93	$33.41
Del Mar/Encinitas/SB*	$3.68	$6.24	$2.34	$8.50	$0.65	$1.66	$12.53	$35.60
Huntington Beach	$4.80	$6.78	$2.42	$7.49	$1.49	$2.04	$6.96	$31.99
Mission Beach	$5.65	$8.92	$5.03	$11.33	$0.51	$2.25	$20.36	$54.05
San Clemente	$4.15	$6.75	$1.84	$7.76	$1.01	$1.54	$13.42	$36.48
Santa Barbara	$5.53	$6.19	$3.14	$10.94	$1.02	$2.09	$14.32	$43.22
Venice Beach	$7.60	$9.16	$4.25	$11.19	$1.90	$2.22	$21.06	$57.38

*Average for overnight visitors only

For Oil Piers beach and Oxnard, we assume that spending patterns are similar to Carpinteria and Encinitas/Solana/Del Mar beaches, which are at the low end of the entire sample. However Oil Piers beach and Oxnard have significantly fewer overnight visitors than Carpinteria. We conservatively assume that *all* of Oil Piers visitors are day-trippers (97% of our Labor Day sample were day-trippers) visitors and that 80% of Oxnard Shores visitors are day trippers (25% of our Labor Day sample were overnight visitors). Table 7.2 below presents our estimate of spending per visitor at all three beaches using our data from Carpinteria and our assumptions about Oil Piers and Oxnard Shores.

Table 7.2 Estimated Spending per Visitor at three Beaches

BEACH	DAY TRIPPER SPENDING	OVERNIGHT SPENDING	% DAY TRIPPER	SPENDING PER VISITOR
Carpinteria	$13.73			$33.41
Oil Piers	$13.73	$43.54	100%	$13.73
Oxnard	$13.73	$43.54	80%	$19.69

We also have detailed information on spending broken down by type of spending and location of spending for several cities in Southern California as well as detailed information on taxes generated locally by this spending.

Given our estimates of attendance and daily spending per visitor (accounting for the different spending patterns of day trippers and overnight visitors), we have estimated the economic and tax revenue impact for the State of California. We do not have sufficient data to estimate the value for local communities, since there is a great deal of "leakage"—a significant amount of spending occurs outside of the town (e.g., gas, food and even lodging are often purchased outside). Estimating the tax impact is also complicated by the fact that property taxes make up a significant component of the local tax benefit. In addition, Oil Piers beach is located outside of a town and near the border of two counties (Ventura and Santa Barbara). Consequently, estimating local benefits is difficult and depends critically on how one defines "local." As a rule of thumb, based on other more detailed studies we have conducted, we believe that approximately two-thirds of the State benefits would be captured by the cities of Oxnard and Carpinteria, but the benefits from attendance at Oil Piers would be much more disaggregated, though we believe that 80-90% would go to Santa Barbara and Ventura counties.

For our discussion of regional benefits, we believe it is more useful to group the benefits by Scenario, rather than by town.

Scenario 1

Table 7.3 presents the State impact for Scenario 1, where all of the available 450,000 cy goes to Carpinteria's City and State beaches. Given our estimates of attendance and spending, we estimate that, over a twenty year period, the increased beach width created by the addition of sand would generate $ 54 million. Discounting at 6%, this estimate is just over $36.8 million. The discounted estimate of future state tax revenues is $2.9 million.

Table 7.3 State Impact of 450,000 cy to Carpinteria's Beaches

YEAR	INCREASE IN TOTAL SPENDING	PV OF INCREASE	STATE TAX IMPACT (PV)
1	$10,072,001	$9,501,888	$760,151
2	$5,252,139	$4,674,385	$373,950
3	$4,036,593	$3,389,201	$271,136
4	$3,397,565	$2,691,190	$215,295
5	$2,989,037	$2,233,582	$178,686
6	$2,699,315	$1,902,911	$152,232
7	$2,480,167	$1,649,453	$131,956
8	$2,306,943	$1,447,404	$115,792
9	$2,165,568	$1,281,796	$102,543
10	$2,047,348	$1,143,228	$91,458
11	$1,946,585	$1,025,436	$82,034
12	$1,859,367	$924,048	$73,923
13	$1,782,908	$835,897	$66,871
14	$1,715,165	$758,619	$60,689
15	$1,654,599	$690,406	$55,232
16	$1,600,026	$629,844	$50,387
17	$1,550,519	$575,807	$46,064
18	$1,505,340	$527,386	$42,190
19	$1,463,893	$483,835	$38,706
20	$1,425,690	$444,537	$35,562
TOTAL	**$53,950,779**	**$36,810,863**	**$2,944,869**

Scenario 2

Tables 7.4 and 7.5 presents the State impact for Scenario 2, where 175,000 cy goes to Carpinteria's City and State beaches and 275,000 goes to Oil Piers Beach. Given our estimates of attendance and spending, we estimate that, over a twenty year period, the increased beach width created by the addition of sand would generate $20.8 million from Carpinteria's beaches and $0.48 million from Oil Piers Beach. Discounting at 6%, this estimate is just over $14 million at Carpinteria and $322,000 at Oil Piers Beach. The discounted estimate of future state tax revenues is $1.1 million at Carpinteria and $26,000 at Oil Piers Beach.

The difference in these estimates for Carpinteria and Oil Piers is striking, particularly since Scenario 2 calls for more sand to be deposited at Oil Piers and is worth discussing. The main reason for the difference lies in attendance. Carpinteria receives just under 2 million visitors per year and even a modest increase in attendance and spending would generate substantial revenues for the State. In contrast, we estimate that Oil Piers receives 23,000 visitors a year, roughly one per cent of Carpinteria's visitors. Further, these visitors spend less money per visit since virtually all are day trippers. Consequently, even though we estimate the percentage increase in visitors at Oil Piers will be much higher (since the 275,000 cy will add a substantial amount of beach), even a doubling of current visitation would have a relatively small economic impact. Further, given the shortage of parking at Oil Piers and the lack of facilities and amenities[4], using government resources to add sand without adding other amenities would, represent a misallocation of resources. If the State, local or Federal government developed other aspects of Oil Piers beach in conjunction, our estimates might change.

[4] In contrast, parking at Carpinteria is adequate on most days, which is unusual for a Southern California beach town.

Table 7.4 State Impact of 175,000 cy to Carpinteria's Beaches

YEAR	INCREASE IN TOTAL SPENDING	PV OF INCREASE	STATE TAX IMPACT (PV)
1	$3,893,378	$3,672,998	$293,839
2	$2,030,238	$1,806,905	$144,552
3	$1,560,363	$1,310,111	$104,808
4	$1,313,344	$1,040,291	$83,223
5	$1,155,426	$863,401	$69,072
6	$1,043,433	$735,579	$58,846
7	$958,720	$637,603	$51,008
8	$891,759	$559,500	$44,760
9	$837,110	$495,484	$39,638
10	$791,412	$441,920	$35,353
11	$752,461	$396,387	$31,710
12	$718,746	$357,195	$28,575
13	$689,191	$323,119	$25,849
14	$663,005	$293,247	$23,459
15	$639,593	$266,879	$21,350
16	$618,497	$243,469	$19,477
17	$599,360	$222,581	$17,806
18	$581,896	$203,863	$16,309
19	$565,874	$187,028	$14,962
20	$551,107	$171,837	$13,747
TOTAL	**$20,854,923**	**$14,229,409**	**$1,138,352**

Table 7.5 State Impact of 275,000 cy to Oil Piers Beach

YEAR	INCREASE IN TOTAL SPENDING	PV OF INCREASE	STATE TAX IMPACT (PV)
1	$82,462	$77,795	$6,224
2	$45,606	$40,589	$3,247
3	$35,748	$30,015	$2,401
4	$30,335	$24,028	$1,922
5	$26,806	$20,031	$1,602
6	$24,275	$17,113	$1,369
7	$22,347	$14,862	$1,189
8	$20,815	$13,059	$1,045
9	$19,560	$11,577	$926
10	$18,507	$10,334	$827
11	$17,608	$9,276	$742
12	$16,829	$8,363	$669
13	$16,144	$7,569	$606
14	$15,537	$6,872	$550
15	$14,993	$6,256	$500
16	$14,503	$5,709	$457
17	$14,058	$5,221	$418
18	$13,651	$4,783	$383
19	$13,278	$4,389	$351
20	$12,934	$4,033	$323
TOTAL	**$475,995**	**$321,873**	**$25,749**

Scenario 3

Table 7.6 presents the State impact for Scenario 3, where all of the available 450,000 cy goes to Oxnard Shores. Given our figures for attendance and spending, we estimate that, over a twenty year period, the increased beach width created by the addition of sand would generate $365,000. Discounting at 6%, this estimate is $240,000. The discounted estimate of future state tax revenues is $19,000.

Again, it should be noted that the revenues generated here are much lower (by more than a factor of ten) than those estimated for Carpinteria. There are a number of reasons for this result. First and foremost, Oxnard shores already has adequate sand and adding more will add relatively little to current attendance and recreational value. Further, current attendance is much lower (at 80,000 it is about 4% of Carpinteria's) and the other recreational amenities, access and parking are all much poorer than Carpinteria's. One other factor that should be mentioned is Oxnard's poor weather. Even though the beach is only a 45 minute drive south of Carpinteria, the beach experiences a large number of cold windy days that makes Oxnard relatively undesirable.

Table 7.6 State Impact of 450,000 cy to Oxnard Shores

YEAR	INCREASE IN TOTAL SPENDING	PV OF INCREASE	STATE TAX IMPACT (PV)
1	$50,942	$48,058	$3,845
2	$33,565	$29,873	$2,390
3	$27,517	$23,104	$1,848
4	$23,835	$18,880	$1,510
5	$21,309	$15,923	$1,274
6	$19,441	$13,705	$1,096
7	$17,990	$11,965	$957
8	$16,821	$10,554	$844
9	$15,853	$9,384	$751
10	$15,035	$8,396	$672
11	$14,332	$7,550	$604
12	$13,718	$6,818	$545
13	$13,177	$6,178	$494
14	$12,696	$5,615	$449
15	$12,263	$5,117	$409
16	$11,872	$4,673	$374
17	$11,516	$4,277	$342
18	$11,190	$3,921	$314
19	$10,891	$3,600	$288
20	$10,614	$3,310	$265
TOTAL	**$364,578**	**$240,899**	**$19,272**

Scenario 4

Tables 7.7, 7.8, and 7.9 present the State impact for Scenario 4, the available 450,000 cy is distributed evenly among all three proposed sites. We estimate that, over a twenty year period, the increased beach width created by the addition of sand would generate $18 million in Carpinteria, $263,000 at Oil Piers, and $123,000 at Oxnard Shores. Discounting at 6%, these estimate are (respectively) $12 million, $177,000, and $81,000. The discounted estimate of future state tax revenues are $989,000, $14,000, and $7,000.

Table 7.7 State Impact of 150,000 cy to Carpinteria's Beaches

YEAR	INCREASE IN TOTAL SPENDING	PV OF INCREASE	STATE TAX IMPACT (PV)
1	$3,385,547	$3,193,912	$255,513
2	$1,765,425	$1,571,222	$125,698
3	$1,356,838	$1,139,228	$91,138
4	$1,142,039	$904,602	$72,368
5	$1,004,718	$750,784	$60,063
6	$907,333	$639,634	$51,171
7	$833,670	$554,438	$44,355
8	$775,443	$486,523	$38,922
9	$727,922	$430,856	$34,468
10	$688,184	$384,279	$30,742
11	$654,314	$344,685	$27,575
12	$624,997	$310,605	$24,848
13	$599,297	$280,974	$22,478
14	$576,526	$254,998	$20,400
15	$556,168	$232,069	$18,566
16	$537,824	$211,712	$16,937
17	$521,183	$193,549	$15,484
18	$505,997	$177,273	$14,182
19	$492,065	$162,634	$13,011
20	$479,224	$149,424	$11,954
TOTAL	**$18,134,715**	**$12,373,399**	**$989,871**

Table 7.8 State Impact of 150,000 cy to Oil Piers Beach

Year	Increase in Total Spending	PV of Increase	State Tax Impact (PV)
1	$44,403	$41,889	$3,351
2	$25,337	$22,550	$1,804
3	$19,860	$16,675	$1,334
4	$16,853	$13,349	$1,068
5	$14,892	$11,128	$890
6	$13,486	$9,507	$761
7	$12,415	$8,257	$661
8	$11,564	$7,255	$580
9	$10,867	$6,432	$515
10	$10,282	$5,741	$459
11	$9,782	$5,153	$412
12	$9,349	$4,646	$372
13	$8,969	$4,205	$336
14	$8,631	$3,818	$305
15	$8,329	$3,476	$278
16	$8,057	$3,172	$254
17	$7,810	$2,900	$232
18	$7,584	$2,657	$213
19	$7,377	$2,438	$195
20	$7,185	$2,240	$179
Total	**$263,032**	**$177,489**	**$14,199**

Table 7.9 State Impact of 150,000 cy to Oxnard Shores

YEAR	INCREASE IN TOTAL SPENDING	PV OF INCREASE	STATE TAX IMPACT (PV)
1	$17,193	$16,220	$1,298
2	$11,328	$10,082	$807
3	$9,287	$7,798	$624
4	$8,044	$6,372	$510
5	$7,192	$5,374	$430
6	$6,562	$4,626	$370
7	$6,072	$4,038	$323
8	$5,677	$3,562	$285
9	$5,351	$3,167	$253
10	$5,074	$2,833	$227
11	$4,837	$2,548	$204
12	$4,630	$2,301	$184
13	$4,447	$2,085	$167
14	$4,285	$1,895	$152
15	$4,139	$1,727	$138
16	$4,007	$1,577	$126
17	$3,887	$1,443	$115
18	$3,777	$1,323	$106
19	$3,676	$1,215	$97
20	$3,582	$1,117	$89
Total	**$123,045**	**$81,303**	**$6,504**

7.3 COST BENEFIT ANALYSIS

Given the data and analysis presented earlier, we can compare the costs of transporting sand (from Section 5) to the benefits that we have estimated. The tables below present the benefits for each of the four scenarios discussed earlier in terms of recreational benefits, State economic impact benefits and State tax benefits along with the respective benefit/cost ratios. From an economist's standpoint, the ratio of recreational benefits (which measures a consumer's willingness to pay for the recreational benefit) to the costs of providing the benefit is the most important, and we have presented these estimates in bold figures to reflect this importance. If the benefit/cost ratio is greater than one, then the policy is worth pursuing (unless other policies using the same resource yield higher benefits, as is the case here). However, from a State policy maker's point of view, the State impact and tax revenue generated may also be an important consideration, so we have provided these data as well.

Table 7.10 presents the costs and benefits of Scenario 1. The most striking result from the table is that the benefit/cost ratio is 18.3; the ratio of Economic Impact to cost, 20.7, is also high. Indeed, the estimated State tax revenues generated are 1.7 times the cost of the project. Keep in mind that Federal and some additional local taxes generated have not been estimated here and would add to the total estimated taxes generated.

Table 7.10 Costs and Benefits of Scenario 1

ITEM	CARPINTERIA
Least Cost Option	$1,777,500
Recreational Benefit (PV)	$32,546,781
Ratio Recreational Benefit/Cost	**18.3**
State Economic Impact (PV)	$36,810,864
Ratio Economic Impact/Cost	20.7
State Tax Revenues (PV)	$2,944,869
Ratio State Tax Revenue/Cost	1.7

Table 7.11 presents the costs and benefits of Scenario 2. For this scenario, the benefit/cost ratio is 13.8 for Carpinteria, but only 0.4 for Oil Piers beach. The estimated ratios for State economic impact are similar – high for Carpinteria and below 1 for Oil Piers. Estimated State

tax revenues generated at Carpinteria significantly exceed benefits, whereas the State tax revenues at Oil Piers would be very small in proportion to the benefits (about 3%). The overall benefit/cost ratio for the project, at 6.9, is quite high, but this estimate masks the fact that almost all of the benefit (about 97%) comes from Carpinteria.

Table 7.11 Costs and Benefits of Scenario 2

ITEM	CARPINTERIA	OIL PIERS	TOTAL
Least Cost Option	$910,000	$973,500	$1,883,500
Recreational Benefit (PV)	$12581,111	$395,750	$12,976,862
Ratio Recreational Benefit/Cost	**13.8**	**0.41**	**6.9**
State Economic Impact (PV)	$14,229,138	$321,874	$14,551,283
Ratio Economic Impact/Cost	15.6	0.33	21.8
State Tax Revenues (PV)	$1,138,353	25,750	$1,164,103
Ratio State Tax Revenue/Cost	1.3	0.026	0.6

Table 7.12 presents the costs and benefits of Scenario 3. For this scenario, the benefit/cost ratio is 0.25, implying that the benefits are not worth the cost. The estimated ratios for State economic impact are similar and the State tax revenues generated would be a very small in proportion to the benefits (about 2%).

Table 7.12 Costs and Benefits of Scenario 3

ITEM	OXNARD SHORES
Least Cost Option	$918,000
Recreational Benefit (PV)	$234,000
Ratio Recreational Benefit/Cost	**0.25**
State Economic Impact (PV)	$240,898
Ratio Economic Impact/Cost	0.26
State Tax Revenues (PV)	$19,272
Ratio State Tax Revenue/Cost	0.02

Table 7.13 presents the costs and benefits of Scenario 4. For this scenario, the benefit/cost ratio is 13.4 for Carpinteria, but only 0.3 for Oil Piers beach and 0.1 for Oxnard Shores. The estimated ratios for State economic impact are similar – high for Carpinteria and below 1 for Oil Piers and Oxnard. Estimated State tax revenues generated at Carpinteria significantly exceed benefits, whereas the State tax revenues at Oil Piers and Oxnard are small. The overall benefit/cost ratio for the project, at 5.5, is quite high, but this estimate masks the fact that most of the benefit (over 97%) comes from Carpinteria.

Table 7.13 Costs and Benefits of Scenario 4

ITEM	CARPINTERIA	OIL PIERS	OXNARD SHORES	TOTAL
Least Cost Option	$819,000	$690,000	$532,500	$2,041,500
Recreational Benefit (PV)	$10,940,097	$218,153	$78,975	$11,237,225
Ratio Recreational Benefit/Cost	**13.4**	**0.3**	**0.1**	**5.5**
State Economic Impact (PV)	$12,373,400	$177,489	$81,303	$12,632,191
Ratio Economic Impact/Cost	15.1	0.3	0.2	6.2
State Tax Revenues (PV)	$989,872	$14,199	$6,504	$1,010,575
Ratio State Tax Revenue/Cost	1.2	0.02	0.01	0.5

It is quite clear from our estimates placing all of the dredge material on Carpinteria's beaches would maximize public welfare—the benefits exceed the cost by a considerable amount. In contrast, Oxnard shores has a sufficient quantity of sand, relatively poor amenities and weather, so that the additional benefits of adding dredge material are smaller than the cost of transportation. The benefits of moving dredge material are more substantial for Oil Piers beach, but still less than the costs and far less than the benefits of placing the same material at Carpinteria. In short, although political pressures and perhaps some abstract sense of fairness might encourage policy makers to distribute the material to all three beaches, this outcome would represent a waste of valuable material which would benefit the citizens of California more if placed at Carpinteria. One should also keep in mind that 82% of visitors to Carpinteria's beaches live outside of Carpinteria, so it would be incorrect to argue that placing sand on Carpinteria's beaches would not provide benefits to State residents who do not reside in Carpinteria.

7.4 SENSITIVITY ANALYSIS AND LIMITATIONS OF THE STUDY

The data and parameters used in this study vary significantly in their quality and reliability. For the purposes of this discussion, we will divide these data/parameters into three categories:

1. Data about which we are quite confident.
2. Data about which we are fairly confident.
3. Data about which we have less confidence.

In general, we would categorize data on recreational value and spending per visitor on the first category. While there is disagreement among economists (and between the USACE and most economists) about specific recreational value, the relative recreational values of these three beaches are quite clear. Further, there is a growing consensus among economists about the value of a beach day. We also have a great deal of data on spending per visitor throughout the state and the results are quite consistent in different studies. The main difference is generally between day-trippers and overnight visitors. Finally, we believe that our specific data on the composition of visitors to Carpinteria is quite accurate since we have conducted two full studies (only one is discussed here) with large samples.

On the other hand, our estimates of attendance at Carpinteria's beaches would fall into Category 2 above, since it could be off by as much as 25% (and no official attendance estimate is taken). We would note that Carpinteria's estimate is consistent with attendance figures at other city and State beaches which have similar sizes and crowds, such as San Clemente's City beaches. We have less confidence in our estimates of attendance at Oil Piers beach and Oxnard Shores, but we nevertheless believe, after having analyzed attendance at dozens of beaches in Southern California, that we are most like within 50% either way.

The estimates of initial (baseline condition) beach width also matters for the benefit analysis. Beach width varies significantly depending upon the spot where the width is measured, the season, and the year. Nevertheless, the initial beach widths used for this study are based on direct observations in the summer of 2003 from several site visits and shall be fairly representative. On the other hand, estimates of the effect of increasing beach width on additional attendance and additional recreational value per visitor are quite basic, since little is known about these parameters. However, we do believe that the relative effects we have posited (i.e., that additions of dredge material will have relatively higher benefits to narrower beaches and to beaches with higher levels of amenities) are accurate and hence we are quite confident in the relative rankings between different disposal scenarios.

Fortunately, the differences in benefit/cost ratios in the analysis here are quite substantial. For example, distributing 150,000 cy of sand to each beach yields 50 times the benefit to Carpinteria than to Oil Piers Beach and 138 times the benefit to Carpinteria than to Oxnard Shores. Thus, for our analysis to be incorrect, we would have to be off by at least a factor of fifty, which is extremely unlikely, particularly since systematic errors (i.e., overestimating attendance at all sites by 10%) would not change our basic results.

Finally, it should be noted that the cost-benefit model we have developed is more general than the one presented here. We allow for a number of variables to be altered, in particular, the initial beach width (which changes over time), the discount rate, and the amount of dredge material available. These variables are all included in the GIS model so that the user can change the variables as needed. As our knowledge of a given variable changes, or as circumstances change, the new data can easily be used in the GIS model to provide cost-benefit analysis based on the new data.

8. SUMMARY

This Appendix presents a preliminary evaluation of the differential cost and benefits in disposing dredged sediment from Ventura Harbor to three beach locations (Carpinteria City and State Beaches, Oil Piers Beach and the Oxnard Shores) other than McGarth Beach – the normal disposal area. The cost functions developed for the study were on a conceptual level to be used as input to the pilot ArcGIS tool presented in the Main Report that is being developed to provide a management tool to evaluate future dredging and disposal options along the California coast. The Ventura Harbor dredging and disposal operation were selected only as an example to demonstrate the concept of using ArcGIS as a decision tool for Regional Sediment Management. Hence, as noted in the Main Report, the placement scenarios presented in the report were for illustration only, and were not intended to be realistic projects that could be implemented as specified.

Four disposal scenarios were presented as examples, they are:

- Scenario 1 - All the remaining 450,000 cy goes to Carpinteria Beach.
- Scenario 2 - 275,000 cy goes to Oil Piers, 175,000 cy goes to Carpinteria Beach.
- Scenario 3 - All the remaining 450,000 cy goes to Oxnard Shores.
- Scenario 4 - One-third of the remaining material goes to each alternative site, i.e. 150,000 cy to each site.

Based on the likely increase in recreational value created by adding opportunistic beach fill to the three beaches under study, it is quite clear that the most sensible policy would be to move all of the fill to Carpinteria since the benefits are significantly greater than the costs (the benefit cost ratio is 18 to 1). While the benefit cost ratio for Oil Piers Beach is less than one and hence adding beach fill would not be justified, the sand would be far more usefully employed at Carpinteria. Adding more sand to Oxnard Shores is not justified, even though the costs of doing so are lower, because the benefits are quite small.

While, as noted in the report, some of the estimates used are subject to a reasonably large margin of error, the relative magnitudes of the cost-benefit estimates should still be valid since the estimated benefit-cost ratios are substantially different for the three beaches. Even if the absolute values for the benefit analyses are off by an order of magnitude, the conclusion that the Carpinteria Beach has the most benefit will remain the same.

The results also indicate that the use of opportunistic sand can pay for itself in terms of extra tax revenues generated. At least in the case of Carpinteria, the taxes generated at the State level are several times the costs of adding beach fill, indicating that the State of California may have an interest in financing these policies. The results indicate that for a relatively small cost (particularly when compared to the costs of traditional beach nourishment projects conducted by the Corps) one can achieve quite significant benefits.

Although the report only presents the cost-benefit analyses for four specific disposal scenarios, the study includes cost functions covering a wide range of beach nourishment conditions such as transportation methods, distance of travel, increase in beach width for different fill volumes, and change in beach widths over time. These data were incorporated into the pilot GIS-based model presented in the Main Report. With the GIS model, the user can input site specific data for other disposal scenarios, as well as to adjust other economic variables such as beach attendance, recreation values, and discount rates. The pilot GIS model can be used to analyze the cost-benefits for other disposal scenarios not covered by this study.

9. REFERENCES

BEACON. 2001. South Central Coast Beach Enhancement Program Criteria and Concept Design. Prepared by Moffatt & Nichol Engineers. Prepared for Beach Erosion Authority for Clean Oceans and Nourishment. March.

Bureau of Labor Statistics (U.S.). 2000. Consumer Price Index Data. Available at www.bls.gov.

California Coastal Commission. 1997. California Coastal Access Guide. Berkeley: University of California Press.

Chapman, D., Hanemann, M., and Ruud, P. 1998. The American Trader Oil Spill.

Dean. 2002. Beach Nourishment: Theory and Practice.

Department of Finance. 2000. California Statistical Abstract. Department of Finance, State of California, Sacramento California.

King, Philip G. 1999. The Fiscal Impact of Beaches in California. San Francisco State University: Public Research Institute.

King, Philip G. 2001. Overcrowding and the Demand for Public Beaches in California, Prepared for the Department of Boating and Waterways, April 2001.

King, Philip G. 2002a. Economic Analysis of Beach Spending and the Recreational Benefits of Beaches in the City of Carpinteria. Prepared for the City of Carpinteria.

King, Philip G. 2002b. Economic Analysis of Beach Spending and the Recreational Benefits of Beaches in the City of San Clemente. Prepared for the City of San Clemente.

King, Philip G. and Potepan, Michael. 1995. The Economic Value of California's Beaches. San Francisco State University: Public Research Institute.

King, Philip G. and Symes, Douglas. 2003. The Potential Loss in Gross National Product and Gross State Product from a failure to Maintain California's Beaches. Prepared for the State of California.

National Park Service. Benefits Estimation. Available at www.nps.gov/pwro/rtca/benefit.htm.

USACE. 1990. Report # ER 1105-2. U.S. Army Corps of Engineers, pp. 98-102. December 1990.

USACE. 1997. Santa Barbara and Ventura Counties Shoreline, California Final Reconnaissance Report. U.S. Army Corps of Engineers, Los Angeles District. April 1997.

ATTACHMENT A

Complete Survey Results of Carpinteria Beach

Summer 2001

Question 1: How far away from this beach do you live (your **primary** residence)?

Location	In Carpinteria	Outside Carpinteria, but within 20 miles	Within 60 miles	More than 60 miles but in California	In the US, but not in California	Outside the US
Frequency	17.2%	8.8%	24.7%	41.0%	7.0%	1.3%

Question 2: We'd like to know how many people are in your group today (friends and family member) who have approximately the same beach attendance as you and live with or near you.

Number of People	Frequency
1	8.8%
2	14.1%
3	12.8%
4	21.1%
5 to 6	19.4%
7 to 9	15.0%
10 to 12	3.1%
13 or more	5.3%
Non response	0.4%

Question 2a: Of these people, how many are under 16?

Number of People	Frequency
0	28.2%
1	13.2%
2	22.9%
3	12.8%
4	6.6%
5 to 6	8.8%
7 to 9	2.6%
10 to 12	1.3%
13 or more	0.4%
Non response	3.1%

Question 3: How many days this year will you go to **this** (Carpinteria City or State) **Beach**?

Number of Days	Frequency
1 to 3	20.3%
4 to 7	25.6%
8 to 10	9.7%
11 to 14	11.5%
15 to 21	8.8%
21 to 28	6.6%
28 to 50	7.5%
50 to 100	4.4%
More than 100	5.3%
Non Response	0.4%

Question 4: How many additional days this year will you go to **other beaches in California**?

NUMBER OF DAYS	FREQUENCY
0	19.8%
1 to 3	28.6%
4 to 7	18.9%
8 to 10	13.2%
11 to 14	7.0%
15 to 21	4.0%
21 to 28	3.1%
28 to 50	3.1%
50 to 100	1.3%
More than 100	0.9%

Question 5: How did you get to Carpinteria Beach **today**?

Mode of Transportation	CAR	FOOT	RV	STAYING AT BEACH CONDO	BICYCLE
Frequency	74.0%	20.0%	3.7%	0.9%	1.3%

Question 6: How long did it take you to get to this beach **today**?

Time	LESS THAN 20 MINUTES	20 - 45 MINUTES	45 MINUTES - 1½ HOURS	1½ HOURS - 3 HOURS	3 - 5 HOURS	MORE THAN 8 HOURS
Frequency	42.9%	11.7%	14.2%	10.6%	0.7%	0.4%

Question 7: Please check the most appropriate box.

	DAY TRIP FROM HOME	TRIP OR VACATION TO THE AREA	NON RESPONSE
Frequency	48.5%	50.2%	1.3%

Questions 8-15 were only answered by overnight guests.

Question 8: How many days do you plan to be away from home on your current trip?

NUMBER OF DAYS	FREQUENCY
2 days (overnight)	16.0%
3-4 days	26.1%
5-7 days	36.1%
8-10 days	9.2%
11-14 days	5.9%
14-21 days	1.7%
More than 21 days	4.2%
Non response	0.8%

Question 9: How many days will you spend at the beach on your current trip?

NUMBER OF DAYS	FREQUENCY
One day or less	6.7%
2 days (overnight)	16.8%
3-4 days	30.3%
5-7 days	30.3%
8-10 days	7.6%
11-14 days	3.4%
14-21 days	2.5%
More than 21 days	1.7%
Non response	0.8%

Question 10: How did you get to this area?

	DROVE	TOOK PLANE	WALKED	CAMPING HERE	RV
Frequency	94.1%	3.4%	0.8%	0.8%	0.8%

Question 11: Consider how you arrived on this trip (drove, flew, etc.). What best describes your attitude toward the process of traveling?

	I HATE TRAVELING	I DON'T MIND TRAVELING, BUT MY TIME IS VALUABLE	I LIKE TRAVELING
Frequency	2.5%	31.9%	65.5%

Question 12: We'd like to know how important visiting the beach is for your trip/vacation.

	FREQUENCY
The beach is important to me--No beach, no trip	61.2%
If there were no beach I might not come or would stay less often	19.2%
I would still come but I like the fact that I can go to the beach	17.1%
I can take the beach or leave it; it would not affect my decision	2.5%

Question 13: Where are you staying?

	CAMPING	HOTEL	HOUSE OR CONDO RENTAL	WITH FRIENDS/FAMILY
Frequency	26.9%	25.2%	35.3%	12.6%

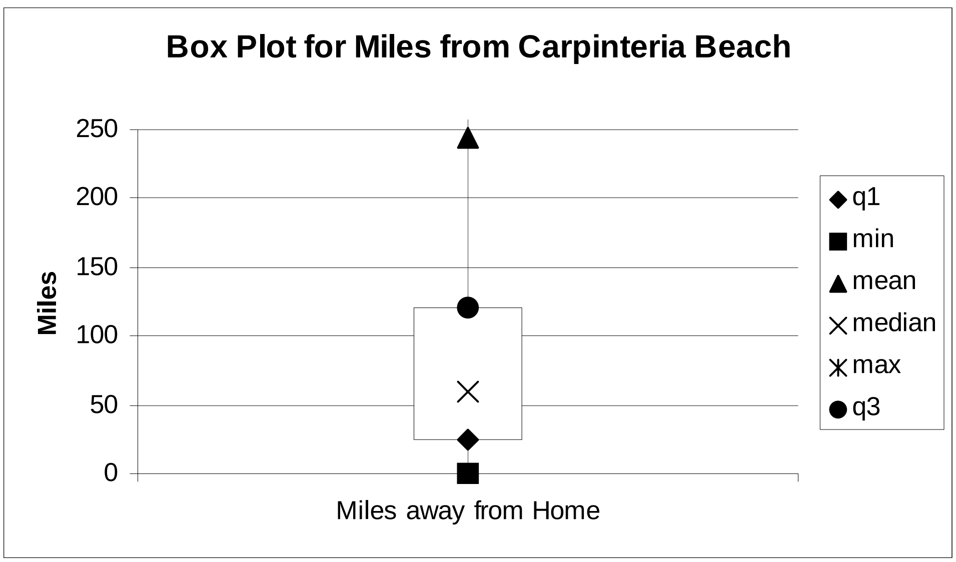
Question 14: If California's beaches disappeared, would you go to beaches in another state/country?

	YES	MAYBE	NO	NON RESPONSE
Frequency	50.4%	31.9%	16.8%	0.8%

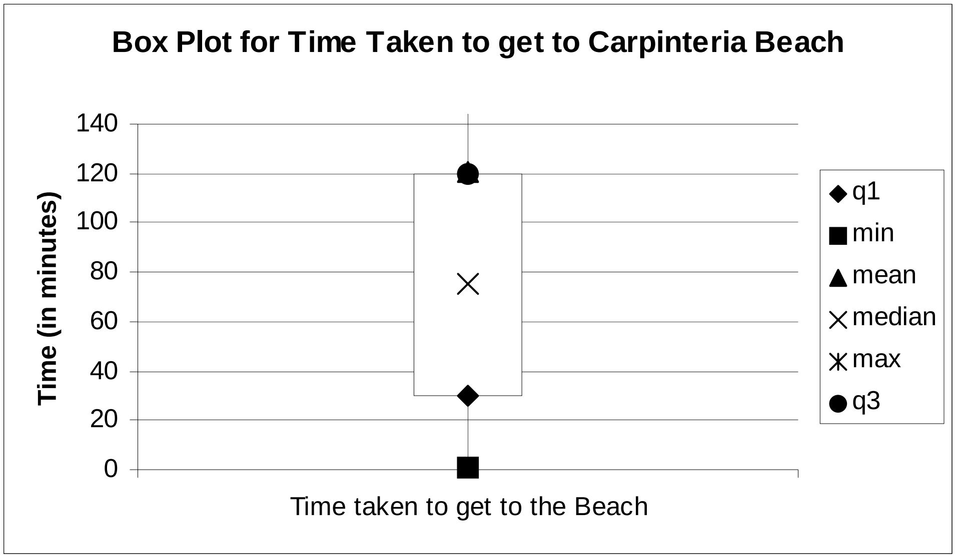
Question 15: On a typical day, how many hours do you spend at the beach?

Length of Time	LESS THAN 1 HOUR	2-3 HOURS	3-5 HOURS	5-8 HOURS	MORE THAN 8 HOURS
Frequency	5.9%	21.0%	42.0%	26.9%	4.2%

Question 16: How many miles away is your home (permanent residence)?



Question 17: How long does it take to get from your (permanent) home to here?



Question 18: What was your reason for coming to this beach?

	FREQUENCY
So I could swim	9.1%
So my children could play/swim	34.9%
To surf	2.5%
To hike	1.1%
To play on the beach	8.5%
To hang-out on the beach	40.0%
To walk my dog	0.5%
I like the beach	0.4%
Relaxation	1.8%
Non response	1.3%

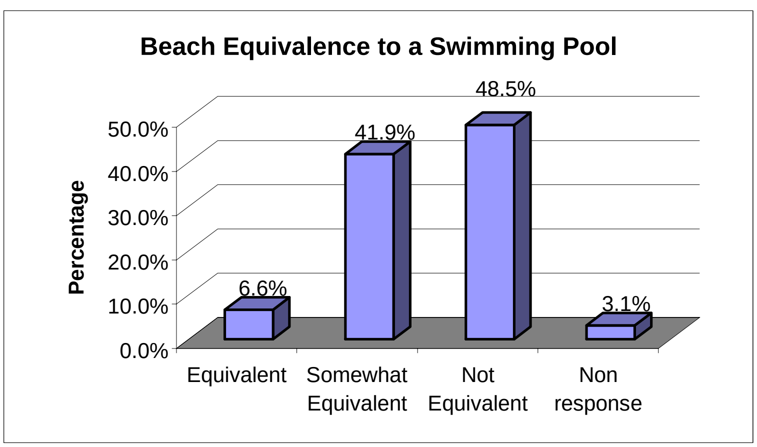
Question 19: What is the minimum width a beach needs to be before you would stop going?

WIDTH	FREQUENCY
5 ft	3.1%
10 ft	7.9%
20 ft	15.2%
40 ft	0.4%
50 ft	26.7%
100 ft	19.4%
200 ft	13.7%
Doesn't Matter	1.8%
Write in*	1.3%
Non response	10.6%

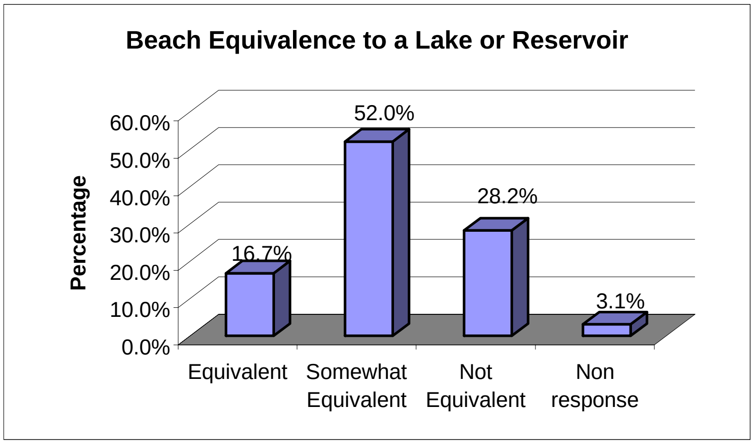
* If only cliffs and no sand.
Wider is better.
As long as there is sand.

Question 20: consider alternate forms of recreation to the beach. How would you rate the following as alternatives to the beach?

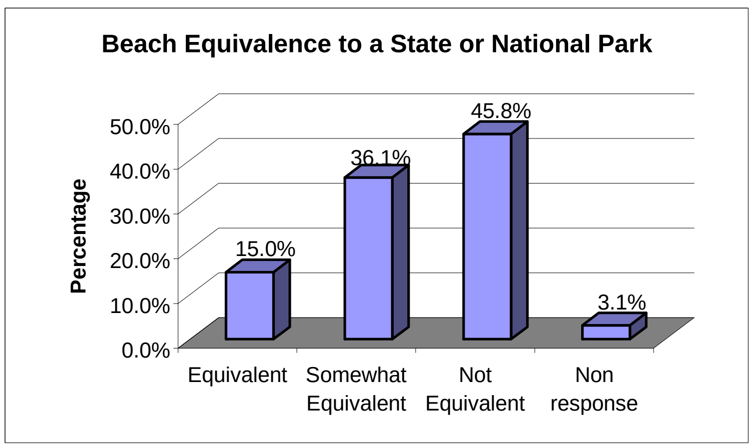
Item 1: Swimming Pool



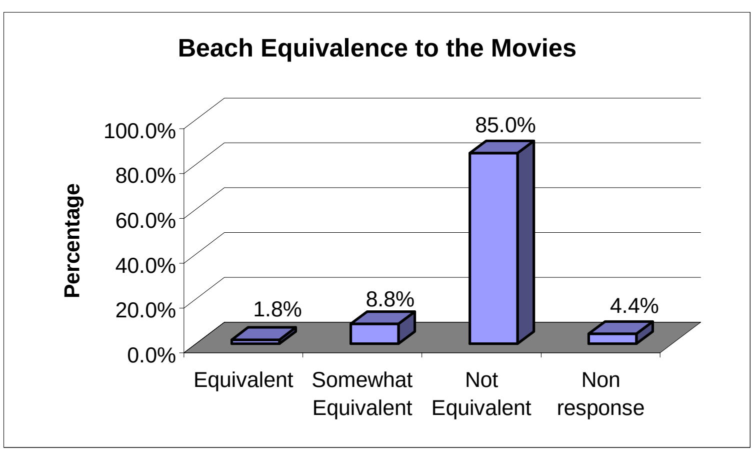
Item 2: Lake or Reservoir



Item 3: State or National Park

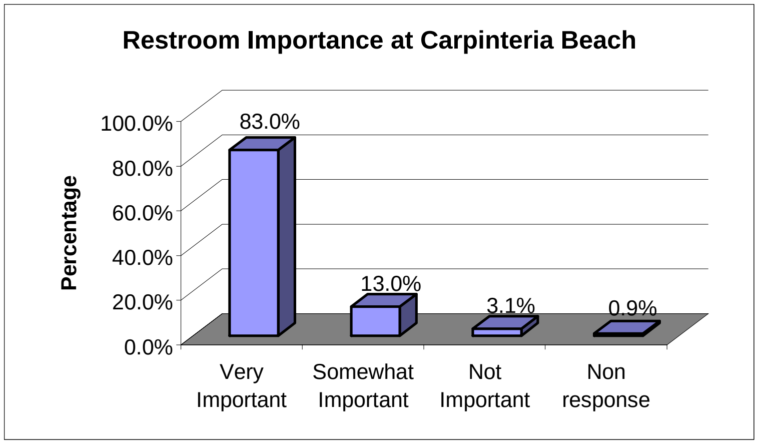


Item 4: Movies

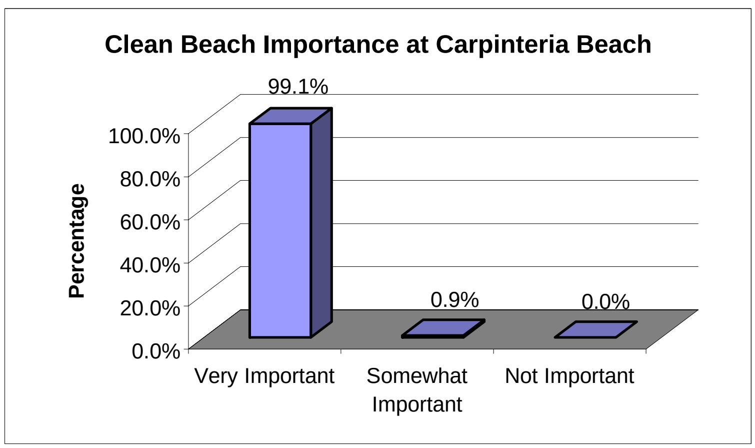


Question 21: How important are the following amenities/services to you?

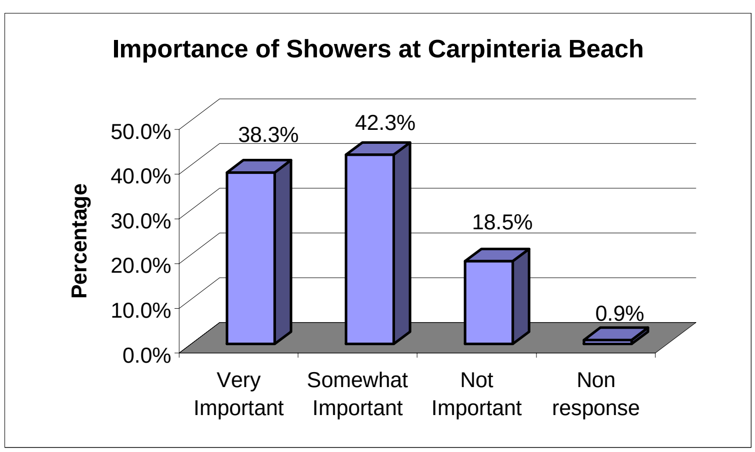
Amenity 1: Restrooms



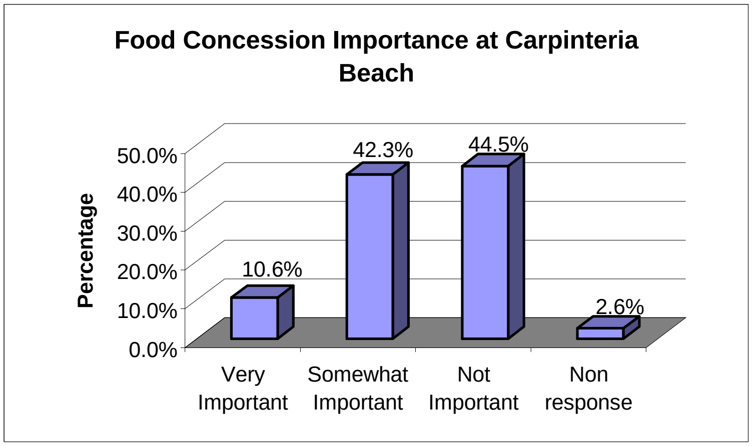
Amenity 2: Clean beaches



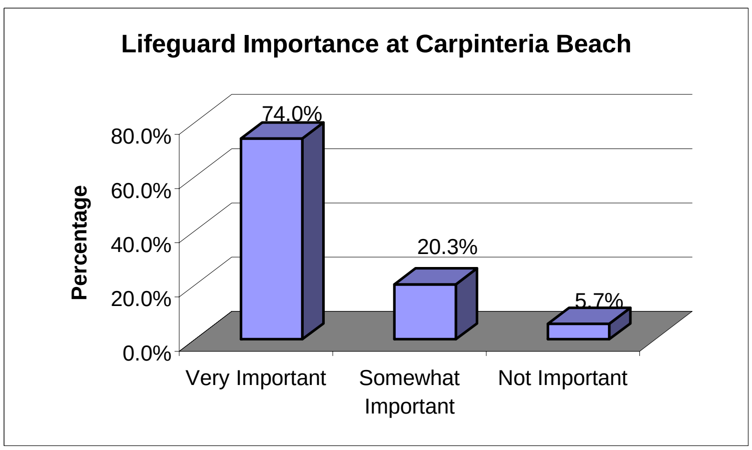
Amenity 3: Showers



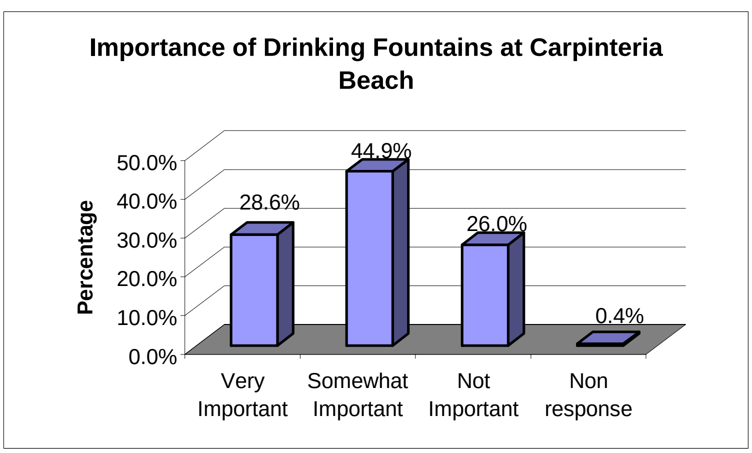
Amenity 4: Food Concession



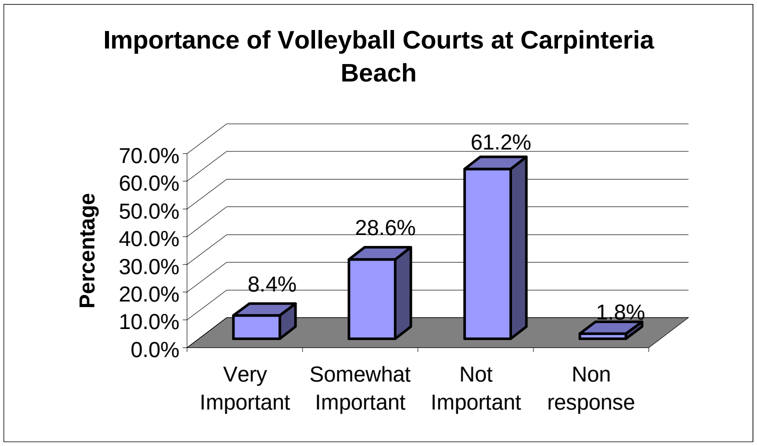
Amenity 5: Lifeguards



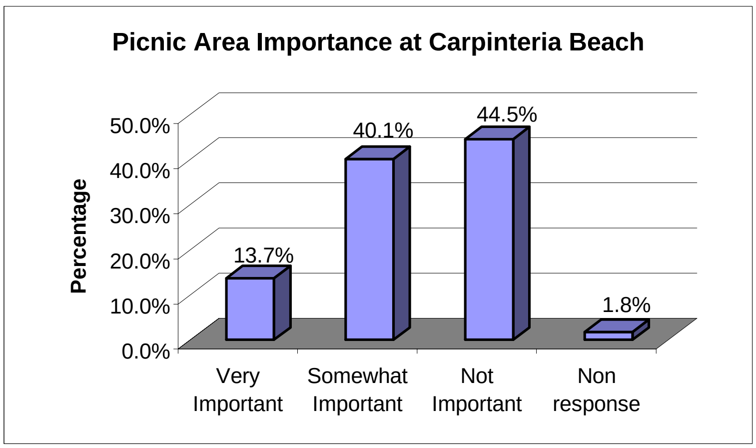
Amenity 6: Drinking Fountains



Amenity 7: Volleyball Courts



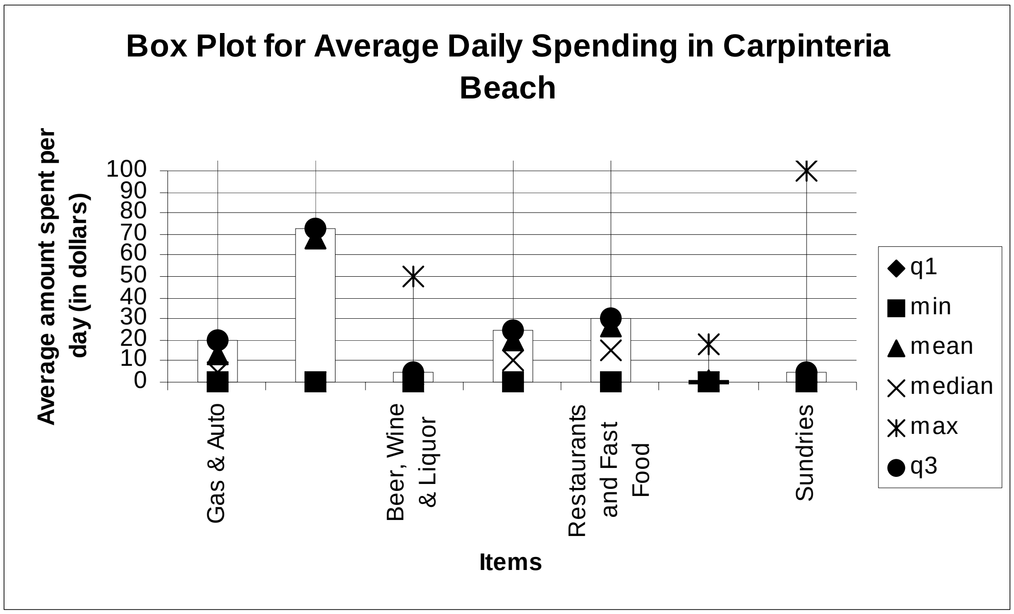
Amenity 8: Picnic area

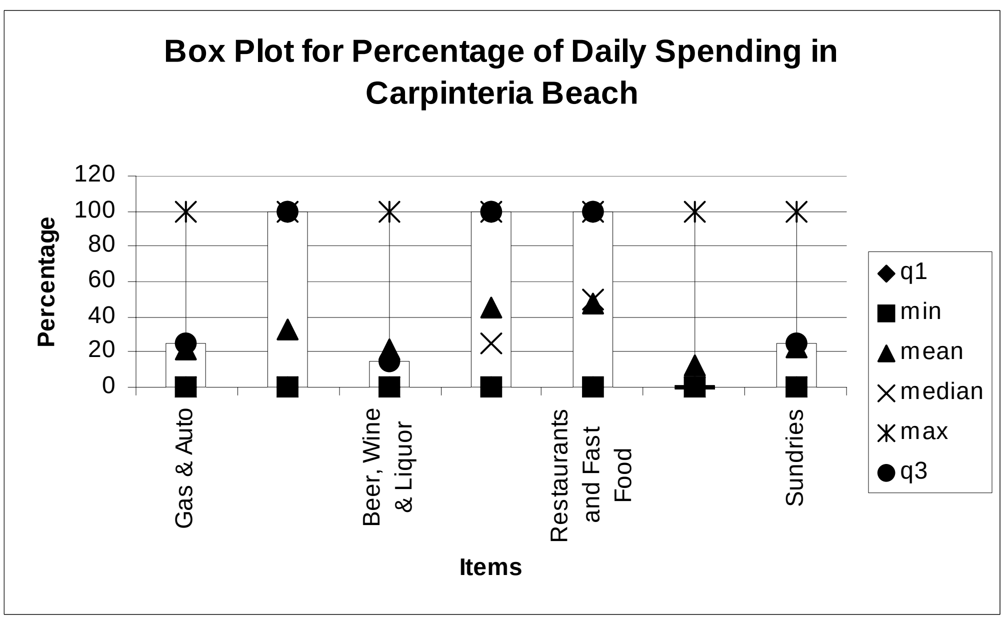


Question 22: Daily Spending.

	DOLLAR AMOUNT	PERCENTAGE OF TOTAL SPENT
Average daily spending in Carpinteria Beach	$101.38	79.5%
Average daily spending outside Carpinteria Beach	$26.20	20.5%

Please refer to the following box plots.

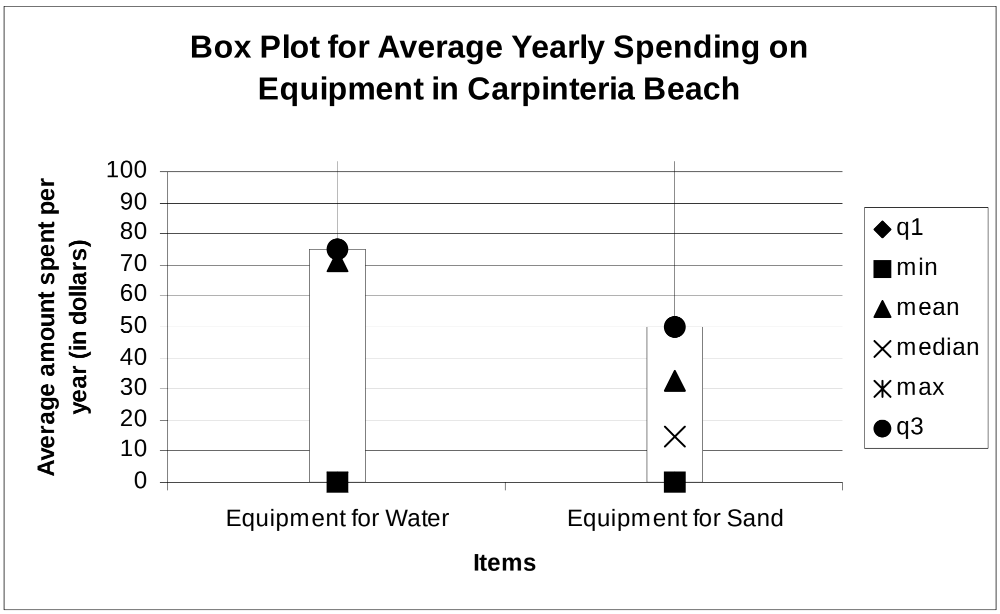


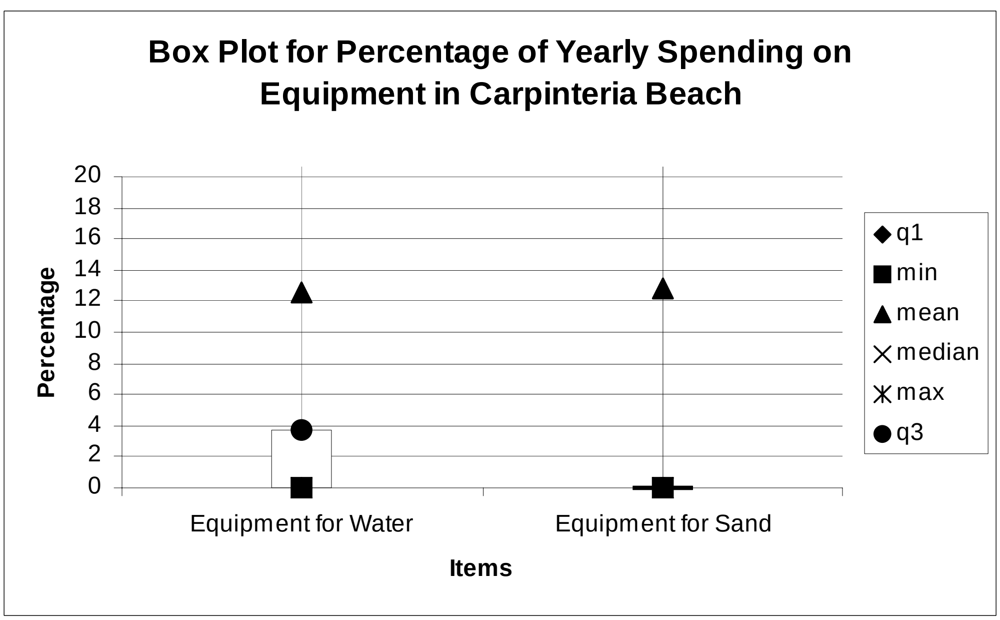


Question 23: Spending on Equipment.

	DOLLAR AMOUNT	PERCENTAGE OF TOTAL SPENT
Average yearly spending in Carpinteria Beach	$32.63	32.3%
Average yearly spending outside Carpinteria Beach	$68.53	67.7%

Please refer to the following box plots.





Question 24: When you go to this beach, how often do you visit downtown Carpinteria?

	NEVER	EVERY DAY	EVERY OTHER DAY	TWICE A WEEK	ONCE A WEEK	NON RESPONSE
Frequency	19.6%	46.7%	16.3%	4.9%	5.4%	7.1%

Question 25: Would you be more likely to go to downtown Carpinteria if a free shuttle were available?

	YES	MAYBE	NO	NON RESPONSE
Frequency	22.8%	26.6%	44.6%	6.0%

Question 26: Are you aware of community activities and shopping in the City?

	FREQUENCY
I know nothing about Carpinteria other than the beach	19.6%
I have a vague idea of what is available	36.4%
I believe I know what is available	38.6%
Non response	5.4%

Question 27: Have you received any information regarding events or activities in the City?

	YES	NO	I'M NOT SURE	NON RESPONSE
Frequency	25.5%	65.2%	3.8%	5.4%

Question 28: Which would you find helpful (check as many as appropriate):

	FREQUENCY*
A map with local activities, restaurants and stores made available to visitors	70.1%
A kiosk with information for visitors	41.8%
Other**	5.4%
I'm not interested in knowing more	9.2%
Non response	7.1%

* Frequency totals more than 100% because of multiple responses.

** Other

- We enjoy the local magazine and Coastal News
- Mailing List
- Free web site
- List of local activities
- Info at camping area when you come in
- Camp ground to let us know flyer or something.
- Mailing list
- Local newspaper
- Info, as above, provided at motel
- No! Will be too crowded!

Question 29: Have you been to the Carpinteria Salt Marsh Nature Park?

	YES	NO	I'M NOT SURE	NON RESPONSE
Frequency	25.5%	67.4%	1.6%	5.4%

Question 30: The City is considering placing a food concession just off the beach. Profits would go to the beach upkeep and lifeguard services. What best describes your reaction? (Check as many as appropriate).

	FREQUENCY*
I like the idea but would probably not use it	12.8%
I would buy small snacks or beverages occasionally	53.7%
I would buy meals to take out occasionally	26.9%
I would buy meals and sit down if seats and tables were available	26.9%
I would go there all the time	7.0%
I don't like the idea	9.7%
Comments**	20.3%
Non response	5.3%

* Frequency totals more than 100% because of multiple responses.

** Comments

- We try to keep our expenses down, so if it was very reasonably priced we might use it.
- Good idea as long as trash didn't become an issue.
- We have it in Hunt Beach – watch out for trash
- If it's good and prices are reasonable, I'll use it. Don't like being gouged. Need beach venders like Cabo San Lucas.
- It's a fine idea as long as the concession stand is low key and not commercial. Carpinteria already has enough fast food places and I wouldn't want to take business away from them.
- Would compete with the spot- unfair. Too much litter.
- Please do not clutter the beach with food concessions- more garbage. We can bring our own. Locals benefit from visitor shopping uptown.
- Sounds great.
- We go to Santa Claus Lane beach sometimes because of Padaro Beach Grill. We would come to Carpinteria for beach and food too.
- Use especially if the money goes back to the city.
- Like idea.
- Excellent idea if it was noticeable that profits went to beach.
- Keep this concession at Linden Beach. Most people would appreciate- small concession- ice cream, drinks, burgers- But keep it small and off the beach.
- I don't like the idea if it increases the crowds. I do not like it.
- If beach is kept clean.
- Keep it natural!
- Very good idea.

- Kiss keep it simple stupid- Owner of a food chane (chain).
- Depends on the day.
- I would use it all the time, especially if it helps keeping beaches clean and safe.
- Great.
- Depends if already use the money allotted for here on the concession stand. No more taxes!
- It takes away from the beauty of the beach.
- Worry about trash.
- But is not gonna affect the area or make it dirty.
- If is not so (much) money and it does go to lifeguard.
- Supply garbage cans and encourage use.
- The Spot and other fast restaurants are plenty close to the beach.
- Could be good for campers or day visitors.
- Love the idea!
- It would bring too much traffic. Carpinteria is a secluded beach lets keep it that way!
- Seems good.
- I think there are enough places to buy food within walking distance to the beach. I would not want to see the city in competition with private business.
- We love this beach because it's free of commercial facilities, unlike most beaches. In addition, food is available close by in town.
- As long as it didn't further create parking problems.
- Think this is a very good idea.
- Teen crowds would start hanging out. I think it is a bad idea. This is a family style area.
- Go for it!
- Depends on type of food.
- Not necessary for us.
- Good idea.
- We like the new bathroom that was put in at the north end of the beach.
- Like the idea of lifeguard spending, but don't know if will use it.
- Too much trash and people. Don't want any more developments!
- A huge sign saying "Profits would go to the beach upkeep and lifeguard services" would attract business.
- But trash cans would be nice ☺

Question 31: How old are you?

Age	16-19	20-24	25-34	35-44	45-54	55-64	65 OR OLDER	NON RESPONSE
Frequency	2.2%	2.9%	13.4%	36.3%	29.3%	9.7%	2.6%	3.5%

Question 32: What is your ethnicity?

Ethnicity	WHITE (CAUCASIAN)	HISPANIC	ASIAN	BLACK (AFRICAN AMERICAN)	OTHER	NON RESPONSE
Frequency	78.6%	13.8%	2.0%	0.8%	0.9%	4.0%

Question 33: What is your highest level of Education?

Level of Education	DID NOT FINISH HIGH SCHOOL	HIGH SCHOOL	SOME COLLEGE	COLLEGE DEGREE	POST GRADUATE DEGREE	NON RESPONSE
Frequency	0.1%	9.4%	29.7%	37.2%	19.6%	4.0%

Question 34: How many people are in your current household (people you live with and share financial resources)?

NUMBER OF PEOPLE	FREQUENCY
1	9.7%
2	17.2%
3	18.9%
4	27.8%
5 to 6	20.3%
7 to 9	1.8%
10 or more	0.4%
Non response	4.0%

Question 35: What would you estimate is the current yearly income of your entire household (before taxes)?

INCOME (IN DOLLARS)	FREQUENCY
Less than 9,999	1.3%
10,000-14,999	0.0%
15,000-24,999	0.9%
25,000-34,999	4.8%
35,000-49,999	15.0%
50,000-74,999	16.3%
75,000-99,999	17.6%
100,000-149,999	18.9%
150,000 or more	11.0%
Non response	14.1%

ATTACHMENT B

Cost Estimates

Cost Estimate for Rail Transportation

Assumptions		
weight of 1 cy material	1.4	ton
load per container	20	ton
container per car	4	containers
no. of cars per set	40	cars
total ton per set	3200	tons
total vol	2286	cy
loader cost/day	$1,400	/day
dozer cost/day	$1,400	/day
mob. & demob. cost	$100,000	/project

Mileage between Borrow Site and Disposal Site	**1-50**	**100**	**150**	**300**
hauling cost/ton	$50	$53	$55	$57
hauling cost/cy	$36	$38	$39	$41
haulage per day (cy)	2286	2286	2286	2286
loader cost/day	$1,400	$1,400	$1,400	$1,400
dozer cost/day	$1,400	$1,400	$1,400	$1,400
For 20% volume				
Mob. & Demob/cy	$0.83	$0.83	$0.83	$0.83
total unit cost/cy	$37.77	$39.92	$41.34	$42.77
For 40% volume				
Mob. & Demob/cy	$0.42	$0.42	$0.42	$0.42
total unit cost/cy	$37.36	$39.50	$40.93	$42.36
For 60% volume				
Mob. & Demob/cy	$0.28	$0.28	$0.28	$0.28
total unit cost/cy	$37.22	$39.36	$40.79	$42.22
For 80% volume				
Mob. & Demob/cy	$0.21	$0.21	$0.21	$0.21
total unit cost/cy	$37.15	$39.29	$40.72	$42.15
For 100% volume				
Mob. & Demob/cy	$0.17	$0.17	$0.17	$0.17
total unit cost/cy	$37.11	$39.25	$40.68	$42.11

Notes

1. Include cost of mobilization and demobilization (for transportation and disposal only) at $200,000 per project.
2. Does not include dredging cost.
3. Cost of traffic impact is not included.
4. Cost does not include engineering and project management costs.
5. Assume that trains are readily available on a daily basis irrespective of the number of destinations and/or length of trips envisaged.
6. Assume no problem of availability of rail tracks, transfer point, loading and unloading stations.
7. Does not include cost of temporary track that may be necessary near disposal site.
8. Assume material to be moved in containers.
9. Containers are carried by rail cars. Each rail car carries 4 containers. A set of rail cars can have 20 to 40 cars.
10. 3 sets of cars are recommended for continuous operation, especially in the case of long trips.
11. Truck may be needed to haul containers from dredging/disposal sites to rail station. Nominal cost is included. For Oxnard Shores, about 5 miles of truck transport will be needed.
12. Cost information is based on conversation with John Lindsey of Waste by Rail, Inc.

Cost Estimate for Truck Transportation

Assumptions

Weight of 1 cy material	1.4	ton
Truck capacity	20	ton
Truck capacity	14.3	cy
Truck	$600	/day
Loader cost	$1,400	/day
Dozer cost	$1,400	/day
Speed of truck	48	mile/hr
Assume load and unload time	0.5	hour
Haulage per day	3,000	ton
Haulage per day	2,143	cy
Mob. & demob. cost	$100,000	/project

Mileage between Borrow Site and Disposal Site	**2**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**50**	**75**	**100**	**150**	**300**
Number of trips per truck per day	13.7	11.3	8.7	7.1	6	5.2	4.5	4.1	3.1	2.2	1.7	1.2	0.6
Number of hours of operation per day	8.0	8.0	8.0	8.0	8.0	8.0	7.9	8.0	8.0	8.0	7.9	8.1	8.1
haulage / day /truck (cy)	196	161	124	101	86	74	64	59	44	31	24	17	9
loader cost / day	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400
dozer cost /day	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400
Number of trucks for 3,000 tons/day	11	13	17	21	25	29	33	37	48	68	88	125	242
transportation/disposal cost/cy	$4.37	$5.02	$6.13	$7.22	$8.31	$9.38	$10.64	$11.55	$14.86	$20.40	$26.01	$36.31	$69.05
For 20% volume													
Mob. & Demob/cy	$0.83	$0.83	$0.83	$0.83	$0.83	$0.83	$0.83	$0.83	$0.83	$0.83	$0.83	$0.83	$0.83
total unit cost/cy	$5.21	$5.86	$6.97	$8.06	$9.14	$10.22	$11.47	$12.38	$15.69	$21.23	$26.85	$37.14	$69.88
For 40% volume													
Mob. & Demob/cy	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42
total unit cost/cy	$4.79	$5.44	$6.55	$7.64	$8.72	$9.80	$11.06	$11.97	$15.27	$20.81	$26.43	$36.72	$69.47
For 60% volume													
Mob. & Demob/cy	$0.28	$0.28	$0.28	$0.28	$0.28	$0.28	$0.28	$0.28	$0.28	$0.28	$0.28	$0.28	$0.28
total unit cost/cy	$4.65	$5.30	$6.41	$7.50	$8.58	$9.66	$10.92	$11.83	$15.13	$20.68	$26.29	$36.58	$69.33
For 80% volume													
Mob. & Demob/cy	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21
total unit cost/cy	$4.58	$5.23	$6.34	$7.43	$8.52	$9.59	$10.85	$11.76	$15.06	$20.61	$26.22	$36.52	$69.26
For 100% volume													
Mob. & Demob/cy	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17
total unit cost/cy	$4.54	$5.19	$6.30	$7.39	$8.47	$9.55	$10.81	$11.72	$15.02	$20.56	$26.18	$36.47	$69.22

Notes

1 Include cost of mobilization and demobilization (for transportation and disposal only) at $100,000 per project.
2 Assume eight hours of labor per day.
3 Trips are not rounded down to a whole number per day, i.e. a trip can take more than a day,
4 Assume dewatering to be done at stockpile at no extra cost.
5 Cost does not include dredging.
6 Cost of traffic impact is not included.
7 Cost does not include engineering and project management costs
8 Cost information is based on conversation with John Lindsey of Waste by Rail, Inc.

Cost Estimate for Scow and Tow

Assumptions

On Station Time	1	hour	
Disposal Hours	0.5	hour	
No. of Large Scows	2	ea	
No. of Small Scows	0	ea	
No. of Large Tows	1	ea	
No. of Small Tows	2	ea	
Average Vessel Speed	6	kts	1knot =1.15 mile/hour =1.85 km/hour
Operation Hours Per Day	17	hours	1mile=1.6 km
Large Scow Capacity	2500	cy	
Small Scow Capacity	1500	cy	
Large Scow Daily Cost	$2,000	/day	
Small Scow Daily Cost	$800	/day	
Large Tow Daily Cost	$6,000	/day	
Small Tow Daily Cost	$3,000	/day	
Equipment Cost Per Day	$16,000	/day	
Mobilization / demobilization	$300,000	/project	
Cost Index (2003/1999)	1.13		From ENR

Distance From borrow Site	Round Trip Hrs. to Site	Total Cycle Time (Trip)	No. Loads Per Day	Production Rate Per Day	Production Daily Cost	Onshore Handling	Total Transport Unit Cost	Including Mob. & Demob, 2003 Adj				
								20%	40%	60%	80%	100%
miles	*hrs*	*hrs*	*ea*	*cy/day*	*$/cy*	*$/cy*	*$/cy*	*$/cy*	*$/cy*	*$/cy*	*$/cy*	*$/cy*
1	0.29	1.79	9.50	23745	$0.67	$0.15	$0.82	$3.43	$2.18	$1.76	$1.56	$1.43
2	0.58	2.08	8.17	20436	$0.78	$0.15	$0.93	$3.55	$2.30	$1.89	$1.68	$1.55
3	0.87	2.37	7.17	17936	$0.89	$0.15	$1.04	$3.68	$2.43	$2.01	$1.80	$1.68
4	1.16	2.66	6.39	15981	$1.00	$0.15	$1.15	$3.80	$2.55	$2.13	$1.93	$1.80
5	1.45	2.95	5.76	14410	$1.11	$0.15	$1.26	$3.92	$2.67	$2.26	$2.05	$1.92
10	2.90	4.40	3.86	9662	$1.66	$0.15	$1.81	$4.54	$3.29	$2.87	$2.67	$2.54
15	4.35	5.85	2.91	7268	$2.20	$0.15	$2.35	$5.16	$3.91	$3.49	$3.28	$3.16
20	5.80	7.30	2.33	5824	$2.75	$0.15	$2.90	$5.77	$4.52	$4.11	$3.90	$3.77
25	7.25	8.75	1.94	4859	$3.29	$0.15	$3.44	$6.39	$5.14	$4.72	$4.52	$4.39
50	14.49	15.99	1.06	2657	$6.02	$0.15	$6.17	$9.47	$8.22	$7.81	$7.60	$7.47
100	28.99	30.49	0.56	1394	$11.48	$0.15	$11.63	$15.64	$14.39	$13.97	$13.76	$13.64
150	43.48	44.98	0.38	945	$16.93	$0.15	$17.08	$21.80	$20.55	$20.14	$19.93	$19.80
200	57.97	59.47	0.29	715	$22.39	$0.15	$22.54	$27.97	$26.72	$26.30	$26.09	$25.97
250	72.46	73.96	0.23	575	$27.85	$0.15	$28.00	$34.13	$32.88	$32.47	$32.26	$32.13
300	86.96	88.46	0.19	480	$33.30	$0.15	$33.45	$40.30	$39.05	$38.63	$38.42	$38.30

Notes

1. Scow and Tow cost information is based on Army Corps Data for the Palos Verdes Shelf project.
2. Include cost of mobilization and demobilization (for transportation and disposal only) at $300,000 per project.
3. Cost does not include engineering and project management costs
4. Two large scows are used.
5. Cost does not include dredging cost.