The Economics of Regional Sediment Management in Ventura and Santa Barbara Counties: A Pilot Study

Interim Report

To The

Coastal Sediment Management Workgroup

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Executive Summary

This report examines the costs and benefits of using opportunistic sediment[1] to nourish sediment depleted beaches as an alternative to the traditional policy of disposing this material in the least expensive manner. Dredged material is typically placed on an adjacent or nearby beach while upland materials are typically taken to landfills. The study focuses on Santa Barbara and Ventura Counties, examining three potential receiver sites (Carpinteria City and State beaches, Goleta County Beach, and Rincon Parkway beach and possible sources of sediment for those receiver sites (Santa Barbara, Ventura and Channel Islands harbors; various debris basins and dams). This study is not meant to be part of a specific feasibility study for a particular project and should be considered preliminary.

Placing dredged material in the near-shore adjacent to sediment depleted beaches appears to be the most cost effective policy by a wide margin. While benefits of near-shore placement are lower than placement onshore, the costs of barging and placing sediment near-shore are much lower. Conservatively assuming that material placed in the near shore yields one-third of the benefits of an equivalent amount of material placed on shore, the benefit/cost ratio of near shore placement is *much* higher. Pumping onshore from hopper dredges or barges adds significantly to the expense and yields cost per cubic yard which are not significantly cheaper than traditional nourishment projects. This difference could save taxpayers millions of dollars per nourishment cycle.

The use of material from flood control structures is also cost effective when these structures are relatively close to a receiver site. Trucking and sorting costs are typically much higher than those associated with barging of dredge material and near shore placement. The amount of cost effective material available is relatively small compared to dredging projects, and this type of placement may be more appropriate for small maintenance-type nourishment projects rather than large restoration efforts.

Cost effective sources of sediment for Carpenteria beaches include barging from all three harbors, hopper dredging from Santa Barbara Harbor, and select flood control projects located within 33 miles of the receiver site. Barging from all three harbors and select flood control projects within 40 miles provide cost-effective potential sources of sediment for Goleta Beach. Rincon Parkway's cost-effect potential sources are limited to barged materials from the three harbors.

A proposed benefits transfer (BT) function has been developed in this paper to better quantify the increased recreational value of increasing beach width as part of the benefit to cost comparison. A standard benefits transfer function for the State of California would be useful for many policy makers involved in managing coastal resources, not just restoration projects. The BT function needs to be refined further but addresses inconsistencies and flawed methodology currently in use by the USACE.

[1] Opportunistic sediment is defined for purposes of this report as material which becomes available though routine maintenance of harbors, flood control projects, wetlands projects and other public works efforts.

RECOMMENDATIONS;

Government authorities should coordinate policy and environmental and other restrictions to promote the use of opportunistic sediment where feasible, beginning with dredge material from harbors.

The State of California, in cooperation with local and Federal government agencies, should develop protocols for moving opportunistic sediment to sediment depleted beaches where cost effective.

Once protocols are established, State and/or local government needs to develop a financing mechanism to pay for the incremental costs associated with the regional management of this sediment.

While the Corps is mandated to use the lowest cost disposal technique (typically the closest beach whether or not it's sediment starved), this requirement should not preclude development of policies by California that would ultimately improve the quality of life for Californians and also save the taxpayer money. Some details must be negotiated between Federal, State and local stakeholders—who will pay the differential cost, environmental restrictions, etc., but the benefits of these policies are high relative to the costs.

Given the very high B/C ratios this study has found, it is likely that other sediment starved areas in the State, notable north San Diego County, would also be good candidates for the use of opportunistic sediment. Although some local costs (e.g., trucking) may vary from region to region within the State, the basic methodology used here can be extended to other regions in the State.

Given the limited experience with near-shore placement, this report recommends that the State fund a demonstration project that carefully monitors the movement of sand from the near shore to nearby beaches and throughout the littoral cell.

An information exchange system or specified entity should be established to coordinate the exchange of information in advance of dredging activities to facilitate the opportunity to use opportunistic sediment at sediment depleted sites, such as the beaches identified in this report.

As a result of a request by CSMW members, Dr. King's report ("Report") has been peer reviewed by Dr. Linwood Pendleton and Linda Lent (USACE). The concerns raised in these reviews will be addressed in a later report. In particular, the Benefits Transfer (BT) portion of the report needs to be refined and given more micro-foundations and better empirical support. The BT analysis was meant to be preliminary and needs to be improved before a full tool can be developed for use by policy makers

1. Introduction

This study has been funded by the State of California Resources Agency under their Coastal Impact Assistance Program, as part of the California Sediment Master Plan being implemented by the Coastal Sediment Management Workgroup (CSMW). This particular study focuses on the economics of moving opportunistic sediment created through dredging and clearing of flood control projects. The purpose of this study is to examine whether using opportunistic sediment is economically feasible as part of a program of beach nourishment for sediment depleted beaches in southern California.

In 2002, the State of California published the *California Beach Restoration Study*, which discussed the concept of regional sediment management in some detail.[2] The study suggested that a protocol be developed for Regional Sediment Management (RSM), so that government policy makers could make use of opportunistic sediment.

This study is *not* meant to be part of a specific feasibility study for a particular project. Instead, this study has several goals:

1. To provide reasonable estimates of the benefits and costs of moving opportunistic sediment;
2. To identify which project types are the most promising (in terms of benefits and costs);
3. To analyze where gaps in knowledge exist and suggest solutions which will enable policy-makers to make better choices;
4. To create a preliminary data analysis for regional sediment management that can be imported into a GIS model accessible to Federal, State and local policymakers.
5. To suggest future directions for research on the economics of RSM;
6. To recommend new methods for estimating the recreational value of California's beaches.
7. To begin developing an efficient protocol for the use of opportunistic sediment and to suggest efficient ways to develop a full protocol.

Geographic Scope of the Study

Given the complexity of the task at hand, this study focuses on one specific area, encompassing much of Santa Barbara and Ventura County. This particular area has numerous flood control projects, several beaches that would benefit from nourishment, at least one potential wetlands project, one dam (Matilija) which will likely be decommissioned and several harbors, three of which will be examined in this study. Also, unlike other counties in southern California, this area has fewer beaches that provide the right combination of recreational amenities and weather for ideal beach recreation, so nourishing beaches that provide adequate amenities has the potential to yield high benefits.

[2] See http://dbw.ca.gov/beachreport.htm, in particular section 7.

At the beginning of the study, participants identified three beaches which could potentially benefit from nourishment projects: Carpinteria, Goleta beach, and the narrow beach along Rincon parkway.

An earlier study for the U.S. Army Corps of Engineers examined Carpinteria, Oxnard, and Oil Piers beaches.[3] That study only examined dredge material from Ventura Harbor and examined beaches identified by the Corps as having potential for RSM. This study expands the scope of the earlier Corps study to several dozen sites, including two additional harbors (Channel Islands and Santa Barbara, and numerous dams and debris basins in the two counties. In addition, the study identifies two other beaches (Rincon and Goleta) which provide more potential for recreational value. (Carpinteria's State and City beaches are examined in both studies.) Finally, this study refines the transportation function employed in the earlier study and examines the feasibility of near shore placement of opportunistic sediment.

Outline of Report

Section 2 will examine available beaches and the recreational opportunities in Santa Barbara and Ventura Counties. Section 3 presents the economic methodology involved in estimating recreational value and creates a new (preliminary) protocol for estimating recreational value using benefits transfer. Section 4 examines the three specific beaches identified in this study as well as the potential benefits of nourishment. Section 5 examines the sources of opportunistic sediment in the two counties. Section 6 analyzes the costs of moving opportunistic sediment. Section 7 estimates the benefits and costs of transporting sediment to the three beach sites. Section 8 concludes the study and suggests specific policy recommendations as well as areas for further research.

[3] See "The ArcGIS Coastal Sediment Analyst: A Prototype Decision Support Tool for Regional Sediment Management," prepared for the U.S. Army Corps of Engineers, Los Angeles District, by Dept of Geography, USC, 2004.

2. Beaches and Recreation in the Study Area

Demographics

Table 2.1: Demographics of Study Area[4]

County	2004 Population	2010 Projected Population	2020 Projected Population	% Increase 2004-2010	% Increase 2004-2020
Ventura	802,400	860,664	924,410	7.3%	15.2%
Santa Barbara	414,800	440,337	464,019	6.2%	11.9%
Kern	724,900	808,808	950,112	11.6%	31.1%
Total	1,942,100	2,109,809	2,338,541	8.6%	20.4%
California	36,104,000	39,246,767	43,851,741	8.7%	21.5%

Table 2.1 presents demographic data for the study area, Ventura County and Santa Barbara County from the California State Department of Finance's Demographic Unit. The table also includes Kern County, which is inland, since day-trippers from Bakersfield and other parts of Kern County have easy access to beaches in Santa Barbara and Ventura County (and other California Coastal beaches are farther away). The State's projections indicate that the three County area will grow 8.6% from 2004 to 2010 and 20.4% from 2004-2020. If one assumes that the demand for beach recreation will grow in proportion to the population, then demand for beach recreation will grow substantially over the next decade and beyond.[5]

Beaches and the Quality of Recreation in the Study Area

Before determining the beaches to be carefully examined in the study, an inventory of beaches in the study area was created, defined as all significant beaches north of (and including) Port Hueneme and south of (and including) Gaviota. The beaches inventoried vary significantly in terms of amenities, access, and weather.

Table 2.2 presents an inventory of beaches in Ventura County north of (and including) Port Hueneme. This assessment of access, the relative availability of amenities, erosion issues, weather and overall recreational value is based on site visits, interviews with locals, as well as references such as the California Coastal Access Guide.[6] Further, although the table above does not discuss parking, the site visits indicate there is adequate parking given the demand for beach recreation at virtually all of these beaches, even on weekends (in contrast to many other Southern California beaches). Unfortunately, the recreational value of these beaches is mostly fair to poor. Please note that these valuations only consider swimming and sunbathing, not surfing or camping, since the first two activities are most dependent upon wide sandy beaches with good weather and

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[4] See http://www.dof.ca.gov/HTML/DEMOGRAP/repndat.htm#projections.

[5] It should be noted that the growth in population in this area will be heavily weighted toward Hispanics, however, numerous studies indicate that Hispanics go to the beach at roughly the same rate as the general population. See, for example, http://marineeconomics.noaa.gov/SCBeach/welcome.html.

[6] See *California Coastal Access Guide*, California Coastal Commission, published by UC Press, 2003. Also, see *California Beaches*, by Parke Puterbaugh and Alan Bisbort, Avalon Travel Publishing, 2003.

amenities; some beaches, notably Surfers Point, provide very good recreational opportunities for surfers, but nourishing these beaches will not significantly enhance the recreational value for surfers.

Table 2.2: Beaches in Ventura County (North of Hueneme)

Beach	Access	Facilities	Erosion Issues	Weather	Overall Recreational Value
Ormond Beach	Poor	Poor	Unknown	Poor	Poor
Hueneme	Moderate	Fair	Nourished	Poor	Fair
Silver Strand Beach	Poor	Fair	Nourished	Poor	Fair to Poor
Hollywood Beach	Poor	Fair	Ample Sand	Poor	Fair to Poor
Channel Islands Harbor Beach	Good	Fair	Ample Sand	Poor	Fair to Poor
Oxnard Beach Park	Good	Fair	Ample Sand	Poor	Poor
Mandalay Beach County Park	Good	Fair	Ample Sand	Poor	Poor
McGrath State Beach	Good	Poor	Nourished	Poor	Poor
Surfers' Knoll	Fair	Poor	Unknown	Poor	Poor
Harbor Cove Beach	Fair	Poor	Unknown	Poor	Poor
Marina Park	Excellent	Poor	Unknown	Poor	Fair to Poor
San Buenaventura State Beach	Excellent	Good	None	Poor	Fair to Poor
Promenade Park	Excellent	Good	Unknown	Poor	Fair to Poor
Surfers' Point	Excellent	Fair-Poor	Eroded	Poor	Fair to Poor
Emma Woods State Park	Good	Fair	Eroded	Moderate	Fair
Solimar Beach	Good	Poor	Unknown	Moderate	Poor
Faria Beach County Park	Good	Poor	Unknown	Moderate	Poor
Rincon Parkway North	Excellent	Poor	Severe	Moderate	Poor
Hobson County Park	Good	Fair	Unknown	Moderate	Poor
Oil Piers Beach	Fair	Poor	Eroded	Moderate	Poor
Mussel Shoals Beach	Fair	Poor	Unknown	Moderate	Poor
La Conchita Beach	Good	Poor	Unknown	Moderate	Poor

All the beaches in Oxnard and Ventura County have poor to fair weather, even in the summer. While most California beaches are subject to fog in the early morning, on a typical day it will burn off between 10 am and noon (depending upon the day and the beach). However, many of the beaches in this study area have more fog and much more wind and are colder than is typical, making them less desirable for recreation, especially sunbathing and swimming. The author made several site visits to Oxnard’s beaches in the summer and found many to be virtually empty. Interviews with locals indicated that the weather was the primary factor.

The poor weather and relatively low attendance at most of these beaches makes them poor candidates for nourishment. Further, the major beaches in Ventura County (i.e., Silver Strand, San Buenaventura) are relatively wide given their attendance. Adding sand to beaches with an adequate supply will not significantly enhance recreational value. Ironically, as can be seen from the table above, some of these beaches are nourished by the Army Corps of Engineers. Corps policy, as mandated by the U.S. Congress, is only concerned with the lowest cost of disposal, not relative costs and benefits.

Table 2.3: Beaches in Santa Barbara County

Beach	Access	Amenities	Erosion Issues	Weather	Overall Recreational Value
Rincon Point	Good	Poor		Moderate	Poor
Rincon Beach Cty Park	Good	Poor		Moderate	Poor
Carpinteria State Beach	Good	Good	Eroding	Good	Very Good
Carpinteria City Beach	Excellent	Excellent	Eroding	Good	Excellent
Padaro Beach	Poor	Poor		Good	Poor
Loon Point	Poor	Poor		Good	Poor
Miramar Beach	Fair	Poor		Good	Poor
Hammond's Beach	Poor	Poor		Good	Poor
Butterfly Beach	Poor	Poor		Good	Poor
East Beach	Excellent	Fair	Nourished	Fair	Fair
West Beach	Excellent	Fair	Nourished	Fair	Fair
Leadbetter Beach	Excellent	Good		Fair	Fair
Mesa Lane Beach	Poor	Poor		Good	Fair
Arroyo Burro Beach	Poor	Poor		Good	Poor
Goleta Beach Cty Park	Fair	Good	Eroding	Good	Good
Isla Vista Cty Park	Poor	Poor		Good	Poor
Santa Barbara Shores	Poor	Poor		Good	Poor
Sands Beach	Poor	Poor		Good	Poor
Bacara Beach	Fair	Poor		Good	Poor
El Capitan	Poor	Fair		Fair	Fair
Refugio	Poor	Poor		Fair	Fair
San Onofre	Poor	Fair		Fair	Fair
Gaviota	Poor	Fair		Fair	Fair

Table 2.3 above presents the same inventory for beaches in Santa Barbara County, up to Gaviota beach. The weather in Santa Barbara County, while still poorer than many areas in Los Angeles, Orange and San Diego County, is significantly better than in Ventura County. Given the weather and available facilities, the most promising beaches are Carpinteria City and State beach and Goleta County Park beach. Both Carpinteria and Goleta are eroding.

Attendance

Table 2.4 presents official estimates of attendance at some of the beaches in the Study area. Many beaches do not take attendance and have no records. The two beaches with the greatest attendance, Carpinteria and Goleta are part of this study. However, it should be noted that these attendance numbers include all visitors, though many may not go near the beach. In particular at Ventura and Goleta many visitors go to the park for a picnic and do not go on the sand.[7]

Table 2.4: Estimated Attendance at Selected Beaches in Study Area

Beach	High Season	Low Season	Total
Carpinteria City and State	1,400,000	500,000	1,900,000
East, West Leadbetter (Santa Barbara)	200,000	200,000	400,000
Ventura (City Beach)	356,865	357,080	713,945
Ventura (Cove Beach)	96,210	73,570	169,780
McGrath Beach	56,018	57,928	113,945
San Buenaventura	494,460	422,360	916,820
Emma Woods	63,260	85,085	148,345
Rincon Parkway	35,000	18,000	53,000
Goleta County Park	675,000	675,000	1,350,000
Siver Strand (Oxnard)	30,000	50,000	80,000
Faria	12,000	7,000	19,000
Hobson	15,000	7,000	22,000

[7] No attempt has been made to analyze the attendance data presented above—this is the topic of a future study which has been approved for 2005-6. The data is collected using car counts or lifeguard counts or estimates and methodologies differ.

3. Estimating Recreational Value

Measuring the economic value of beach recreation is more challenging than measuring the value of market goods that are bought and sold. The economic value of a market good is the sum of what individuals are willing to pay for it in the marketplace. Economists consider beach recreation a consumer good. However, the State of California provides beaches for free (though some beaches charge a small fee for parking). Consequently, there are no explicit prices that can be used to compute the value individuals receive from visiting a beach, or the total economic benefit (consumer surplus) that accrues to all visitors to that beach.

Economists have developed several techniques for estimating the economic value of a day at the beach. The two most common techniques used are the travel cost method (TCM), which uses the cost of travel to the beach as an implicit price of admission, and the contingent valuation method (CVM), which employs survey data questioning how much people are willing to pay for a day at the beach. Of course, different people have different valuations and travel costs, but a sound analysis will estimate the average value of a day at the beach for a typical visitor, usually in high season. A number of studies of specific beaches in California have been conducted.

Estimates of beach value per day for beaches with a high recreational value (e.g., Huntington Beach) range from $10 to $30. The most comprehensive study currently underway, the Southern California Beach Valuation Project[8] examines a panel of day-trippers in southern California and uses a Random Utility Model (RUM) to estimate the value of a beach day.[9] The advantage of RUM's is that these models specifically account for the fact that one beach may be a close substitute for another beach—hence if one beach disappears or erodes, people will go to another beach. Unfortunately, the project focused on southern California beach goers and thus may underestimate the value of these beaches somewhat.

According to Linwood Pendleton of UCLA, a principal in the project, the preliminary results from the *Southern California Beach Valuation Project* indicate a maximum value for a beach day is probably around $14 and, as a practical matter even the best beaches (e.g., Huntington) have a value of around $10 per user per day. Of course beaches with fewer amenities or poorer weather (e.g., McGrath beach) would be assigned a much lower number.

Benefits Transfer

When no analysis exists, economists generally use a technique referred to as "benefits transfer" (BT). BT entails comparing recreational sites with similar amenities[10], similar substitutes and similar visitor populations and other socio-economic data. For example, if a typical day at Huntington Beach is worth $10 a day, a day at Newport Beach might also be worth $10 a day, whereas a day at a beach with fewer amenities (e.g., Ventura

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[8] See http://www.marineeconomics.noaa.gov/SCBeach/laobeach1.html.
[9] See http://marineeconomics.noaa.gov/SCBeach/welcome.html for the latest papers. Much of our information comes from Linwood Pendleton, Associate Professor, UCLA who works on the project.
[10] Economists use the term amenities to refer to any characteristics of a good that would add to consumer demand. In the case of a beach, amenities may be natural (weather, location) or developed by human (snack bars, toilets) or potentially both (beach width).

City beach) would be lower. For BT to work properly, one must create a methodology for assessing the recreational value of a particular beach. Several Federal agencies, most notable the US Army Corps of Engineers (USACE) have developed a scale from 1-100 to asses the value of a recreation day with certain amenities assigned a subtotal of the total 100 points (see Table 3.1). The Corps methodology is described in USACE Report # ER 1105-2.[11]

Table 3.1: U.S. Army Corps of Engineers Point Values for Beach Recreation

USACE Benefits Transfer Methodology	
Criteria	**Total Possible Points**
Recreation Experience	30
Availibility of Opportunity	18
Carrying Capacity	14
Accessibility	18
Environmental	20
Total	100

The USACE criteria spell out how to assign point values to each beach (or other recreation site) depending upon the criteria. Unfortunately, the Corps methodology has some limitations:

1. The Corps methodology relies on addition of amenities—you have five categories and assign certain points to each. While this addition method is clearly convenient, it does not have a sound grounding in economic theory or the experience of beach goers. To give one example, in the Corps rating system, suppose that the recreational experience rates zero points, but all other categories (access, availability, etc.) rate full points. In this case the beach would rate 70 points. However if the recreational *experience* is lacking, then the recreational *value* of the beach is likely close to zero.

2. The point values assigned by the Corps are inconsistent with people's preferences, as expressed in surveys of beach visitors. For example, the Corps definition of the "carrying capacity" of a beach is flawed.

3. The Corps' method assumes that more recreational opportunities (e.g., volleyball on the beach) imply higher values. This may or may not be true. For example, Carpinteria has relatively few recreational opportunities, but is highly valued by many as a child friendly beach.

A more realistic approach to valuing a beach or other recreational site would be to assume that the value of each amenity is multiplicative—that is, one should rate each amenity on an appropriately defined scale and then multiply each amenity's point value to derive a final index. The index can then be translated (as the Corps' methodology is) to a day use value.

[11] See U.S. Army Corps of Engineers, Report # ER 1105-2, pp. 98-102, 28 December 1990 for more detail on this methodology.

This study proposes that the State of California create its own criteria to assess the recreational value of beaches in the State based on the following criteria. The discussion here is preliminary and not meant to be a final, definitive analysis. The following criteria should be included in any analysis:

1. **Weather**: typically California beaches are overcast early in the morning and clear before noon, though some beaches remain overcast for a significant number of days. In assessing the weather the number of sunny days, average temperature of the air and water, currents, and wind could all be considered. For example, Oxnard suffers from a large number of cloudy days, windy and cold weather and colder than average water temperature. Despite the wind, the waves are not particularly good for surfers.
2. **Water Quality**: Water Quality has become a critical issue for southern California, leading to the closing of many beaches.
3. **Beach Width and Quality**: Beach width is an important criterion, particularly in an examination of the use of opportunistic sediment for beach nourishment. While wider is not always better, as a general rule, everything else equal, people prefer wider beaches. Most beaches in southern California have good sand quality (and little cobble except near shore), so sand quality is not an important issue for this study.
4. **Overcrowding**: Previous surveys of beach goers generally indicate that overcrowded beaches are considered less desirable.[12] Crowding can be measured in a number of ways. Typically, it is measured by the amount of sand available per person, though crowding can also occur in the water, in parking lots, snack bars, etc.
5. **Beach Facilities and Services**: In addition to criteria 1-4 above, beach goers generally prefer restrooms, trashcans, and lifeguards. Most (but not all) also prefer some food facilities and other shops.
6. **Availability of Substitutes**: If similar beaches are available within a short distance, a beach is less valuable—in particular it may not make sense to nourish a beach if another similar beach is available nearby. However in making an assessment of substitutes one must keep in mind the differing preferences of beach users, e.g., some prefer a City beach with an urban ambiance while other prefer a more "natural" beach. One other critical issue often overlooked in studies of California beaches is congestion and availability of parking. In particular, Los Angeles, San Diego and Orange County have plenty of beaches with similar amenities, but virtually all of these beaches are crowded on summer weekends and parking is often unavailable after noon.

As a second preliminary step, this paper proposes the point system in Table 3.2. Please keep in mind that the system being developed here is still tentative and that assigning values here is always somewhat subjective. Also keep in mind that the rating will depend

[12] See Philip King, Overcrowding and the Demand for Beaches in California, prepared for the California Department of Boating and Waterways, April 2001. One exception was at Newport City beach, filled with teenagers, many of whom like crowded beaches.

on what type of recreational value one is examining. Surfing requires a significantly different mix of recreational factors. Also, seasonality obviously plays a role as well.

Table 3.2: A New Rating System for Benefits Transfer

Amenity	Point Value
Weather	0-100%
Water Quality /Surf	0-100%
Beach Width and Quality	0-100%
Overcrowding	0-100%
Beach Facilities and Services	0-100%
Availability of Substitutes	0-100%

This study focuses on recreational values in the high season with an emphasis (85%) on sunbathing/swimming and some concern (15%) for surfing.[13]

With that limitation in mind, the following criteria are used to determine individual amenity point values:

- **Weather**: Points are assigned according to the number of warm sunny days. A perfect score of 100 would indicate that every day is warm and sunny. High winds are a negative factor. A score of 90-100 indicates almost perfect weather. Since virtually all southern California beaches have morning fog it is unlikely any California beach would score in the 90s. Some beaches where sunshine is predominant after 10 or 11 am (e.g., Huntington) should score in the 80s. Beaches with generally poor weather (e.g., Oxnard) would score below 50%.
- **Water Quality/Waves**: Some beaches in southern California (e.g., Huntington) are closed periodically due to poor water quality. A perfect score for water quality indicates that there are no water quality issues and no closures. Some beaches (e.g. Carpinteria) come close. Surf is a more difficult category since surfers and swimmers sometimes have diametrically opposed preferences. Since nourishment is the key issue, this report focuses on swimmer preferences for surf with some consideration for surfers. An ideal amount of surf could be little surf (Carpinteria) or moderate surf (San Clemente).
- **Beach Width and Quality**: The ideal beach width is approximately 100-250 ft. (e.g. Huntington). Narrower beaches are scored lower in direct proportion to width. Few beaches in California are too wide but it is possible that a beach could be so wide that access is restricted. The quality of the beach depends on the quality of the sand—a fine white sandy beach is ideal and a beach with cobble is much less desirable.

[13] In the future it would be useful to pay more attention to surfing.

- **Overcrowding**: The USACE often follows a policy that 100 square feet of space is necessary per person. In practice this variable is difficult to measure without a precise study. The value here also must be a composite of weekday and weekend values and, of course crowding depends on beach width and availability of parking. A score of 100 would indicate a beach where crowding is not an issue. (It does not mean no crowds and, of course, some beach visitors like crowds up to a point.) A low score is indicative of a beach where crowds significantly degrade the experience.
- **Other Recreational Amenities**: This category is primarily concerned with manmade recreational amenities. Restrooms, some snack facilities and other retail, and lifeguards services all generally add to the level of amenities. While the USACE considers a wide availability of recreational opportunities to be a plus, in some cases consumers prefer a beach primarily for sunbathing. A beach with a score of 90-100 would have all the man-made amenities associated with a good quality beach (lifeguards, snack bars, close availability of retail and rental).
- **Availability of Substitutes**: A beach would score high if there were few substitutes available nearby. If a beach has a particular set of attributes that are hard to find elsewhere, then it would score higher as well. If substitutes are available but already crowded, one must also take this factor into account. As a practical matter, in southern California there are a wide array of beaches available nearby, but most are crowded on weekends. High quality beaches that are not particularly close to other similar quality beaches (Carpinteria, San Clemente) should score higher.

The final point value assigned will also be in a percentage between 0 and 100. The final value is obtained as follows:

(1) Final Point Value = $M*A_{1*} A_{2*} A_{3*} A_{4*} A_{5*} A_6$

Where: A_i represents the amenities described above and $0 \leq A_i \leq 1$

Where: M is the maximum value of a beach day (e.g., $14)

Creating an Index

Assigning, weighting, and multiplying amenity values must be done carefully for BT to be accurate. In particular, economic theory suggests that the interaction of the amenity terms is not quite as simple as in equation (1) above. For example, assume that a beach that scores 100% in all categories is worth $14. To calculate the value of a beach which scores 50% is all six categories, apply equation (1) above:

(2) Final Point Value = $\$14*A_{1*} A_{2*} A_{3*} A_{4*} A_{5*} A_6$

$= \$14 *0.5*0.5*0.5*0.5*0.5*0.5$

$= \$0.22$

In other words, this methodology implies that a middling beach is worth only 22 cents per day—far too low. Economic theory suggests that the amenities should be weighted differently. In particular, the amount of satisfaction (or utility) that a consumer earns from going to the beach is a function of the amenity levels:

(3) Value of a Beach Day = $f(A_1, A_2, A_3, A_4, A_5, A_6)$

A standard functional form used by economists is the Cobb-Douglas function:

(4) Value of a Beach Day = $A_1^a * A_2^b * A_3^c * A_4^d * A_5^e * A_6^f$

Where: $a + b + c + d + e + f = 1$

In the equation above, each of the terms, A_i , represents the point values (in percentages from 0 to 100) from Table 3.2 above. The superscripts **a** through **f** represents the relative weightings of each amenity term. If all terms are weighted equally, then each is worth 0.1667; however, some amenities may be weighted somewhat higher. To return to our previous example (equation 2 above) under this scheme, a beach with a rating of 50% for each amenity would receive a final value of 50% of the maximum value for a beach day. So if the maximum value is $14, our hypothetical middling beach would be weighted at $7. One could argue that a middling beach should be worth more (or less); then the weighting scheme for each amenity could be adjusted.

Beach Width and Overcrowding

Unfortunately, though beach nourishment is and will continue to be an important public policy issue, few detailed studies have estimated the benefits of adding sand to a beach. Since the purpose of this report is to assess the net benefits of beach nourishment projects at various beaches in California, amenities (3) and (4), beach width and overcrowding, are particularly critical to this report.

In equation (4) above, the value of a beach day increases with the width of the beach and the amount of space each person has. If these amenities are weighted close to zero (i.e., **c** and **d**, the exponent terms for amenity 3 and 4, are close to zero) adding more beach width has little impact on the value of a beach day. Increasing the relative weighting implies that beach width and crowding are more important to beach goers.

It also should be pointed out that this function exhibits "diminishing returns"—as one increases beach width the additional value diminishes. In other words, all things equal, increasing beach width by 25 linear feet will have a greater impact on an eroded beach than a wide sandy beach.

The author's previous studies of consumers' preferences[14] indicate that doubling the beach width of a typical (somewhat eroded) beach in Southern California increases the value of a beach day by 15-20%, though it varies by beach. This result corresponds to a weighting of close to 0.15 to 0.20 for exponent "c" in equation 4. Our estimates indicate that crowding is also a concern for beach goers, roughly equivalent to an exponent "d" weighting of 10-20%. It should be noted, though, that these numbers are very tentative and more study is needed. Finally, it should also be pointed out that increasing beach width accomplishes two goals. The additional width is desirable, and the increased width means that more space is available on the beach, which reduces crowding; consequently doubling beach width may increase the value of a beach day by as much as 50% at a crowded eroded beach.

Nourishing a beach may also increase attendance, which increases the total recreational value, (more beach days) but also reduces the value per day when the beach becomes more crowded. One other factor to take into account is parking. Some beaches may be capacity constrained by limited parking (e.g., La Jolla shores beach on any summer weekend).

Suggested Weighting Scheme

As already noted, more empirical work is need to calibrate a BT model for California's beaches. However, since part of the purpose of this study is to advance our knowledge of the recreational value of California's beaches, and to suggest further areas for inquiry, this report suggests a tentative weighting scheme, based the author's experience over the past ten years. As mentioned above, our weightings for beach with and quality are consistent with our empirical work. Also keep in mind that (unlike the Corps' methodology) all of these categories are important simply because if any one category receives a rating of 0%, the recreational value is zero. For example, 20% might seem to be too low a value for weather, but a beach with few nice days (e.g., Oxnard) will receive a very low recreational value even if all other categories rate highly.

Table 3.3 presents our suggested weighting for each amenity. More empirical work is needed to refine these values.

Table 3.3: A New Rating System for Benefits Transfer (Non-Surfers)

Amenity	Relative Weighting
Weather	20%
Water Quality/Surf	20%
Beach Width and Quality	15%
Overcrowding	15%
Facilities and Servicers	15%
Availability of Substitutes	15%

[14] See Philip King, Overcrowding and the Demand for Beaches in California, prepared for the California Department of Boating and Waterways, April 2001.

Our weighting values above do not differ dramatically from an equal weighting scheme. Since our focus here is not on surfing, surf is lumped in with water quality. However for surfers, this amenity would likely rate at least 50%.

Applying our Methodology to Huntington Beach

Huntington Beach's recreational value has been studied extensively and was the subject of a significant lawsuit, the *American Trader* case. Michael Hannemann, a world-renowned environmental economist, concluded that the recreational value of a day at Huntington Beach was worth approximately $16, in 2004 dollars.[15] However, a more recent study, part of the *Southern California Beach Project*, used a more sophisticated model. Table 3.4 applies our own methodology to Huntington Beach. Recent work by the economists in the *Southern California Beach Project* indicates that a perfect beach would score no more than $14. Studies of the recreational value of beaches in California vary. This report assumes that a day at a perfect beach with 100% point values would be worth $14. A day at Huntington Beach, which offers excellent amenities, would then be worth $11.18.

Table 3.4: Applying our BT Methodology to Huntington Beach

Amenity	Amenity Point Value	Weight	Weighted Amenity Value
Weather	85%	20.00%	96.8%
Water Quality	75%	20.00%	94.4%
Beach Width and Quality	95%	15.00%	99.2%
Overcrowding	75%	15.00%	95.8%
Facilities/Services	95%	15.00%	99.2%
Availability of Substitutes	60%	15.00%	92.6%
Total Index Value		100%	79.8%
Maximum Value per day	$ 14.00		
Huntington Beach Value	$ 11.18		

In Table 3.4 above, the amenity point value in the second column corresponds to the recreational value for each category. For example, Huntington Beach has been assigned a weather value of 85% since the weather in Huntington is generally good, though mornings are often overcast. On the other hand, since Huntington has had some water quality issues, a lower point value of 75% was applied. Overall Huntington scores well. Its lowest value, 60% is for availability of substitutes, reflecting the fact that many other beaches are available nearby. This estimate of $11.18 is consistent with other recent work by the *Southern California Beach Project*.

[15] [15] See http://marineeconomics.noaa.gov/SCBeach/welcome.html.

4. Analysis of Specific Beaches

Carpinteria State and City Beaches

Recreation and Amenities

Carpinteria City and State beaches provide a wide variety of facilities and recreational opportunities for beachgoers including day-trippers and those 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 that are rented weekly for visitors. Florida International University's Stephen Leatherman ranks Carpinteria among the top twenty beaches in the US—it is the only beach in California to receive this award. The author of this report has conducted several surveys at the two beaches. When respondents are asked why they come to Carpinteria, most answer that it is an ideal beach for children. 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.

In contrast to many beach towns, 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 route 101 through the town. Although traffic is heavy in the summer, access is fairly easy.

Results of Surveys

The author of this study conducted two surveys at Carpinteria, one in the summer of 2001 was conducted for the City of Carpinteria,[16] the other was prepared for the State of California as part of a larger project.[17] In addition, the author prepared a preliminary analysis of erosion at Carpinteria for the State in April 2000[18] and conducted numerous site visits for the State and the City over the past four years. This section will present the most important results from the 2001 survey, which focused on the recreational value of the beach and the level of man-made amenities provided.

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). Weekday/weekend and morning/afternoon times were chosen to reflect actual visitation patterns as well. The results of the survey are presented in the next section.

A written questionnaire was composed, and Matt Roberts, and other officials in Carpinteria vetted the questions. The questions were then pre-tested on the beach, problematic questions were re-written, and again the questionnaire was sent to Mr.

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[16] *Economic Analysis of Beach Spending and the Recreational Benefits of Beaches in the City of Carpinteria*, prepared for the City of Carpinteria, Philip G. King, 2002.
[17] *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, Philip King and Douglas Symes, 2003.
[18] *Shoreline Protection Survey 2000*, prepared for the State of California, Philip King, 2000

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 groups participated in the survey representing over 1100 visitors. Briefly, the main results 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 an earlier report[19], however, this report presents results which are critical to the analysis in this report.

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%

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.

[19] See Philip G. King, Economic Analysis of Beach Spending and the Recreational Benefits of Beaches in the City of Carpinteria. Prepared for the City of Carpinteria, 2002.-

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

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%

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's beach has significant recreational value.

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 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 focuses on a critical component for this study, beach width. Roughly 60% of respondents indicated that 50 feet or more 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's beaches is threatened by erosion.

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%

Valuing the Recreational Benefits of Carpinteria

2002 Travel Cost Analysis

To calculate the value of a day at the beach this report used information provided by the 2001 survey along with observations in several site visits. The complete details of the calculations are rather technical and hence are presented in another report.[20] The methodology was as follows:

- Estimated the demand curve for beach visits using the travel cost method;
- Estimated consumer surplus by integrating the demand curve.

The 2002 Report (based on Summer 2001 data) estimated the value of one beach day at Carpinteria, $23.38 per person per day during high season. For low season (October through early May) the report employed a conservative estimate of $3 per day.[21] This

[20] See King, Philip G., *Economic Analysis of Beach Spending and the Recreational Benefits of Beaches in the City of Carpinteria*, prepared for the City of Carpinteria, Philip G. King, 2002. Available at http://online.sfsu.edu/~pgking/carpenteria.pdf.
[21] 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.

value is consistent with other values estimated for Southern California beaches as well as figures used by the U.S. National Parks service[22], but is substantially higher than the value estimated using the USACE methodology, even taking into account the higher value attributable to camping. The number reflects the fact that a substantial number of people are willing to travel quite far to spend a day at Carpinteria's beaches.

However, the 2002 report did not fully take into account the availability of substitute beaches, though it should be noted from the general survey data that many visitors consider Carpinteria's beaches 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.

Applying the Proposed Methodology to Carpinteria

Table 4.1: Carpinteria City and State Beach: High Season Value

Amenity	Amenity Point Value	Weight	Weighted Amenity Value
Weather	85%	20.00%	96.8%
Water Quality	95%	20.00%	99.0%
Beach Width and Quality	40%	15.00%	87.2%
Overcrowding	55%	15.00%	91.4%
Other Recreational	80%	15.00%	96.7%
Availability of Substitutes	85%	15.00%	97.6%
Total Index Value		100%	72.1%
Maximum Value per day	$ 14.00		
Carpinteria Value	$ 10.09		

Table 4.1 presents the analysis of Carpinteria during High Season based on this report's BT methodology. The two critical areas of concern for Carpinteria are beach width (the quality of the sand is fine) and overcrowding. Overall, the analysis indicates a day use value of $10.09.[23]

[22] See, for example, Chapman, D., Hanemann, M., and Ruud, P., 1998, "The American Trader Oil Spill," and National Park Service. *Benefits Estimation.*

[23] This estimate is significantly lower than our own travel cost analysis of $23.38 but it is difficult to factor in substitution issues. Our estimate of $10.09 a day may very well be too conservative given the number of people who are willing to stay overnight in Carpinteria. See [23] King, Philip G., *Economic Analysis of Beach Spending and the Recreational Benefits of Beaches in the City of Carpinteria*, prepared for the City of Carpinteria, Philip G. King, 2002.

Table 4.2: Carpinteria City and State Beach: Low Season Value

Amenity	Amenity Point Value	Weight	Weighted Amenity Value
Weather	20%	20.00%	72.5%
Water Quality	20%	20.00%	72.5%
Beach Width and	50%	15.00%	90.1%
Overcrowding	80%	15.00%	96.7%
Other Recreational	10%	15.00%	70.8%
Availability of	10%	15.00%	70.8%
Total Index Value	0%	100%	23.0%
Maximum Value per	$ 14.00		
Carpinteria Value	$ 3.22		

Table 4.2 presents Carpinteria's beaches recreational value during Low Season based on the BT methodology developed in this report. Overall, the analysis indicates a day use value of $3.22.

Attendance

Unfortunately, Carpinteria does not keep seasonal attendance records. Matt Roberts, who is in charge of Parks and Recreation for the City estimates that high season (Mid May to Mid September) attendance is 1.6 million people for both the City and State beaches. The author of this report estimated low season attendance to be 300,000. This estimate is consistent with the numerous site visits made by the author. It is also consistent with estimates other southern California beaches with similar levels of crowding over similar areas, such as San Clemente City beach.

Total Value of Carpinteria's Beaches

Table 4.3 below provides estimates of the total recreational value of Carpinteria's City and State beaches for both high and low season. Overall, the total recreational value is estimated at $17 million per year.

Table 4.3 Total Recreational Value of Carpinteria's Beaches

Season	Day Use Value	Attendence	Recreational value
High	$ 10.09	1,600,000	$ 16,144,000.00
Low	$ 3.22	300,000	$ 966,000.00
Total			$ 17,110,000.00

Goleta

Recreation and Amenities

Goleta Beach is part of the Goleta beach County Park operated by Santa Barbara County. It is located about eight miles northwest of the City of Santa Barbara. The beach is a popular spot for picnickers as well as swimmers, sunbathers and fishermen. Based on several site visits, the author would rate the level of amenities as moderate. Ample parking is available, a number of picnic tables and fire pits exist; there are lifeguard facilities and County Park rangers as well as a pier and restaurant.

The sandy beach is eroding. The author spoke with several County Park officials in the summer of 2003 who stated that the beach has been steadily eroding and some of the picnic tables have been moved back away from the shore. At the northern end of the beach there was little sand. (The beach was nourished later that summer but is still narrow.) The officials stated that eventually erosion would seriously reduce the area currently used for picnicking area. He stated that gas lines would also be threatened if erosion continued.

Survey Results

The author conducted a brief survey in August of 2003. The sample size was small (under 50) so the results of this survey are meant to be descriptive and not definitive. The results of the survey are tabulated in the next section. Briefly:

- Most (80%) visitors were local, day-trippers who frequented other local beaches as well.
- On average, visitors rated Goleta beach somewhat worse than other beaches they attended in the area.
- A significant minority (mostly swimmers) reported that increasing beach width would increase recreational value (37%) and a smaller percentage indicated they would also go more often with a wider beach (26%).

Goleta Survey Results

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

Location	**In Goleta**	**Outside Goleta, 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	56.3%	23.4%	3.1%	6.3%	7.8%	3.1%

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	11.1%	30.2%	20.6%	11.1%	12.7%	7.9%	1.6%	4.8%

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

Number under age 16	**0**	**1**	**2**	**3**	**4**
Frequency	63.2%	10.5%	12.3%	10.5%	3.5%

3. How many days this year will you go to Goleta Park?

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	23.3%	41.7%	10.0%	8.3%	3.3%	8.3%	5.0%

4. How many days this year will you go to the beach (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	5.0%	38.3%	21.7%	10.0%	11.7%	3.3%	10.0%

5. On a typical day, how many hours do you spend at Goleta Park?

Number of Hours	**Less than 1 hour**	**1-3 hours**	**3-5 hours**	**5-8 hours**	**More than 8 hours**
Frequency	8.1%	53.2%	33.9%	4.8%	0.0%

5a. On a typical day, how many hours do you and people in your group spend **on the beach** at Goleta Park?

Number of Hours	**We never go on the beach**	**Less than 1 hour**	**1-3 hours**	**3-5 hours**	**5-8 hours**
Frequency	0.0%	3.3%	63.9%	29.5%	3.3%

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

Answer	**Yes**	**No**
Frequency	87.5%	12.5%

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

Various beaches in the area—no one beach stood out.

6c. Please compare the alternative beach you listed in 6a to Goleta 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.

Worse than Goleta   Same   Better than Goleta

|……….|……….|……….|……….||……….|……….|……….|……….|

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	5.6%	20.4%	33.3%	13.0%	27.8%

7. Please check the most appropriate box:

Answer	Frequency
I'm here on a day trip.	82.0%
I'm on a trip/vacation away from my **permanent** residence.	18.0%

8. The State and Federal Governments are considering using public money to add more sand to Goleta beach. This sand would increase the width of the beach and help protect structures immediately inland.

8a. Suppose that the width of Goleta 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	73.8%	13.1%	9.8%	1.6%	1.6%

8b. Suppose that the width of Goleta 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	62.3%	13.1%	13.1%	6.6%	4.9%

9. How old are you?

Age	**16-19**	**20-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65-74**	**75 or older**
Frequency	7.9%	22.2%	19.0%	22.2%	14.3%	9.5%	1.6%	3.2%

10. What is your ethnicity?

Ethnicity	**White**	**Hispanic**	**Asian/Pacific Islander**	**Black**
Frequency	77.4%	22.6%	3.2%	1.6%

*Some people checked multiple boxes.

11. What is your highest level of Education?

Educational Attainment	**Did not finish High School**	**High School**	**Some College**	**College Degree**	**Post Graduate**
Frequency	3.2%	9.5%	31.7%	34.9%	20.6%

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	19.0%	30.2%	15.9%	17.5%	17.5%	0.0%	0.0%

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

Income	Frequency
Less than $9,999	3.4%
$10,000-14,999	1.7%
$15,000-24,999	5.2%
$25,000-34,999	19.0%
$35,000-49,999	15.5%
$50,000-74,999	25.9%
$75,000-99,999	8.6%
$100,000-149,999	15.5%
$150,000 or more	5.2%

Valuing the Recreational Benefits of Goleta Beach

No formal analysis of Goleta Park or Goleta Beach's recreational value exists. The analysis provided here will use benefits transfer aided by several site visits, interviews with Park officials as well as survey results. Tables 4.4 and 4.5 apply the benefits transfer methodology created in this report to Goleta. This methodology yields an estimate of $6.12 worth of non-market value for an average day-visitor during high season and $3.38 for low season. The relatively high low season value results from the fact that many visitors use picnic facilities or the pier, which is less influenced by the season.

Table 4.4: Goleta Beach: High Season Value

Amenity	Amenity Point Value	Weight	Weighted Amenity Value
Weather	60%	20.00%	90.3%
Water Quality/Surf	70%	20.00%	93.1%
Beach Width and Quality	8%	15.00%	68.5%
Overcrowding	80%	15.00%	96.7%
Other Recreational	40%	15.00%	87.2%
Availability of Substitutes	50%	15.00%	90.1%
Total Index Value		100%	43.8%
Maximum Value per day	$ 14.00		
Goleta Value	$ 6.13		

Table 4.5: Goleta Beach: Low Season Value

Amenity	Amenity Point Value	Weight	Weighted Amenity Value
Weather	15%	20.00%	68.4%
Water Quality	60%	20.00%	90.3%
Beach Width and Quality	8%	15.00%	68.5%
Overcrowding	80%	15.00%	96.7%
Other Recreational	20%	15.00%	78.6%
Availability of Substitutes	15%	15.00%	75.2%
Total Index Value		100%	24.2%
Maximum Value per day	$ 14.00		
Huntington Value	$ 3.39		

Attendance

As reported in Table 2.4, the official attendance number indicates that 1.35 million people attend Goleta beach. This (Santa Barbara County) estimate is based on a car count based on parking figures. However, interviews with County Park officials indicate that approximately 15% of this figure may be due to UC Santa Barbara students parking at Goleta and making a short hike to the UCSB campus. To be conservative, this report has reduced the estimate to 1million visitors per year. Most of these visitors do not go on the beach, though many may find that it adds to their recreational experience. Park Rangers estimated that 25% of visitors in high season go on the beach and a significantly lower number, perhaps 10% -15% in low season.

Total Value of Goleta Park and Beach

Table 4.6 summarizes the estimate of the recreational value of Goleta beach: the total value is $5 million.

Table 4.6: Total Recreational Value of Goleta Beach

Season	Day Use Value	Attendence	Recreational value
High	$ 6.13	600,000	$ 3,678,000.00
Low	$ 3.39	400,000	$ 1,356,000.00
Total			$ 5,034,000.00

Rincon Parkway

Recreation and Amenities

Rincon Parkway (not to be confused with Rincon Point or Rincon Beach) lies about 4 miles north of Ventura, just off of highway 101. The area is quite popular with recreational vehicles and during high season (and low season on many weekends) the parking area just adjacent is packed with RV's. Recreational facilities are minimal, with rather primitive toilets and nothing else. The beach consists of a narrow strip of sand that often disappears at high tide. The beach is rarely wider than 6 feet. Despite the minimal facilities, the area is popular with RVers and some surfers and the weather is significantly better (sunnier) than the area to the south.

The beach has excellent access and if it were rezoned for cars instead of RVs it would have adequate parking.

Survey Results

The author conducted a brief survey in August of 2003. The sample size was small (under 50) so the results of this survey are meant to be descriptive and not definitive. The results of the survey are tabulated in the next section. Briefly:

- Despite the large number of RV's, the vast majority of visitors were local, day-trippers who frequented other local beaches as well.
- The beach is popular with families; visitors go on average three weeks a year.
- On average, visitors rated Rincon Parkway beach somewhat better than other beaches they attended in the area (which is odd given the lack of facilities and narrowness of the beach).
- A majority of visitors said that adding sand to the beach would significantly increase recreational value.
- About one third said that they would go more often if beach width was doubled.

Survey Results

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

Location	Within 20 miles	Within 60 miles	More than 60 miles but in California	In the US, but not in California	Outside the US
Frequency	72.9%	13.6%	11.9%	0.0%	1.7%

1. 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	1.7%	13.6%	23.7%	16.9%	28.8%	8.5%	1.7%	5.1%

1a. Of these people, how many are under 16?

Number under age 16	0	1	2	3	4	5
Frequency	36.8%	26.3%	22.8%	8.8%	3.5%	1.8%

2. How many days this year will you go to Rincon Parkway?

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	19.6%	33.9%	28.6%	8.9%	3.6%	0.0%	5.4%

3. How many days this year will you go to the beach (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	3.5%	21.1%	29.8%	26.3%	5.3%	5.3%	8.8%

5. On a typical day, how many hours do you spend at Rincon Parkway?

Number of Hours	**Less than 1 hour**	**1-3 hours**	**3-5 hours**	**5-8 hours**	**More than 8 hours**
Frequency	5.1%	25.4%	42.4%	18.6%	8.5%

5a. On a typical day, how many hours do you and people in your group spend **on the beach** at Rincon Parkway?

Number of Hours	**We never go on the beach**	**Less than 1 hour**	**1-3 hours**	**3-5 hours**	**5-8 hours**
Frequency	0.0%	0.0%	37.3%	40.7%	22.0%

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

Answer	**Yes**	**No**
Frequency	88.1%	11.9%

6c. Please compare the alternative beach you listed in 6a to Rincon Parkway 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.

Worse than Rincon Same Better than Rincon

|…… ….|…… …|…… …|…… …||…… ….|… ……|… ……|… ……|

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	7.8%	31.4%	35.3%	25.5%	0.0%

7. Please check the most appropriate box:

Answer	Frequency
I'm here on a day trip.	87.3%
I'm on a trip/vacation away from my **permanent** residence.	12.7%

8. The State and Federal Governments are considering using public money to add more sand to Rincon Parkway beach. This sand would increase the width of the beach and help protect structures immediately inland.

8a. Suppose that the width of Rincon Parkway 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	62.5%	10.7%	16.1%	8.9%	1.8%

8b. Suppose that the width of Rincon Parkway 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	46.3%	16.7%	18.5%	11.1%	7.4%

9. How old are you?

Age	**16-19**	**20-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65-74**	**75 or older**
Frequency	5.3%	7.0%	21.1%	33.3%	29.8%	1.8%	1.8%	0.0%

10. What is your ethnicity?

Ethnicity	**White**	**Hispanic**	**Asian/Pacific Islander**	**Black**
Frequency	98.2%	5.3%	1.8%	0.0%

*Several people checked multiple boxes.

11. What is your highest level of Education?

Educational Attainment	**Did not finish High School**	**High School**	**Some College**	**College Degree**	**Post Graduate**
Frequency	1.8%	7.0%	42.1%	29.8%	19.3%

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	8.9%	23.2%	14.3%	39.3%	12.5%	1.8%	0.0%

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	1.9%
$15,000-24,999	0.0%
$25,000-34,999	0.0%
$35,000-49,999	13.2%
$50,000-74,999	13.2%
$75,000-99,999	22.6%
$100,000-149,999	28.3%
$150,000 or more	20.8%

Valuing the Recreational Benefits of Rincon Parkway

No formal analysis of Rincon Parkway's recreational value exists. This paper will employ the benefits transfer analysis, aided by site visits and the survey results. Table 4.7 presents this estimate during high season: Rincon Parkway beach generates $3.09 worth of non-market value for an average day-visitor during high season and $2.15 for low season (Table 4.8). These low valuations are the result of poor recreational facilities and services and the limited amount of sand, as well as mediocre weather. If this beach is nourished, it would also benefit from adding complementary facilities such as better restrooms, lifeguard services, snack bars, etc.

Table 4.7: Rincon Parkway: High Season Value

Amenity	Amenity Point Value	Weight	Weighted Amenity Value
Weather	40%	20.00%	83.3%
Water Quality/Surf	50%	20.00%	87.1%
Beach Width and	3%	15.00%	59.1%
Overcrowding	70%	15.00%	94.8%
Other Recreational	7%	15.00%	67.1%
Substitutes	25%	15.00%	81.2%
Total Index Value		100%	22.1%
Maximum Value per	$ 14.00		
Goleta Value	$ 3.09		

Table 4.8: Rincon Parkway: Low Season Value

Amenity	Amenity Point Value	Weight	Weighted Amenity Value
Weather	15%	20.00%	68.4%
Water Quality	50%	20.00%	87.1%
Beach Width and	3%	15.00%	59.1%
Overcrowding	80%	15.00%	96.7%
Other Recreational	5%	15.00%	63.8%
Substitutes	10%	15.00%	70.8%
Total Index Value		100%	15.4%
Maximum Value per	$ 14.00		
Huntington Value	$ 2.16		

Attendance

The official attendance number indicates that 53,000 visitors attend Rincon Parkway, with 35,000 attending during high season (Table 2.4). However, this estimate is based on parking fee receipts and does not include others who park nearby and go to the beach, which, according to the survey data, seems to be the majority of visitors. The analysis of recreational value employed here, based on official data, site visits, and survey data assumes that 80,000 visitors attend the beach during high season and 20,000 attend during low season.

Total Value of Rincon Parkway

Table 4.9 presents this report's estimate of the recreational value of Rincon Parkway beach, just under $291,000.

Table 4.9: Total Recreational Value of Rincon Parkway

Season	Day Use Value	Attendence	Recreational value
High	$ 3.09	80,000	$ 247,200.00
Low	$ 2.16	20,000	$ 43,200.00
Total			$ 290,400.00

5. Sources of Opportunistic Sediment

One of the primary purposes of this report is to identify sources of opportunistic sediment that can be used for beach nourishment. This section will discuss various sources in the study region and present an inventory of these sources. Some of the discussion here represents a natural extension of the work completed in the California Beach Restoration Study.[24] This report has identified several sources of opportunistic sediment in the region and divided these sources into two main categories: dredge material, and material from dams and debris basins.

Dredge Material

Ventura Harbor

The U.S. Army Corps of Engineers dredges a number of harbors in the area. Table 5.1 presents data from the Corps of engineers for dredging at Ventura harbor, which is located at the mouth of the Santa Clara River, within the City of Ventura. In the 34 year period from 1969-2002, the Corps dredged 29 times, though in the last twenty years dredging took place almost every year. A substantial amount of beach compatible material has been dredged, over 19 million cubic yards, or an average of 564,511 cubic yards per year. This is an enormous amount of material and, as discussed later, this material could have a substantial impact on beaches in the area. Most of the material is placed (due to Congressional mandate to use the lowest cost disposal site) on McGrath beach, despite the low recreational value at McGrath and the substantial amount of sand already at McGrath. The average cost of dredging and placement is $3.14 per cubic yard.[25] However, our main concern in this report is the incremental cost of shipping the sand to an alternate location beside the current location where the material is deposited.

[24] See http://dbw.ca.gov/beachreport.htm, in particular section 7
[25] See State of California, California Beach Restoration Study, January 2002, available at http://dbw.ca.gov/beachreport.htm..

Table 5.1: Dredge Material from Ventura Harbor[26]

Year	Volume Dredged (cubic yards)
1969	1,883,000
1970	325,000
1972	2,400,000
1973	1,193,820
1974	420,000
1976	152,000
1979	1,021,500
1983	1,186,000
1984	1,214,671
1986	850,000
1987	363,100
1988	800,000
1989	230,314
1990	217,913
1991	377,183
1992	524,702
1993	486,478
1994	470,000
1995	271,357
1996	833,000
1997	449,128
1998	741,975
1999	639,173
2000	818,477
2001	655,000
2002	669,566
Total	19,193,357
Avg./year	564,511

Santa Barbara Harbor

The Corps also dredges material at Santa Barbara's Harbor. The material is pumped onto Santa Barbara's West Beach (and occasionally East Beach) through a permanent pipeline. Most of the sand is beach compatible, though on occasion (e.g., 1995) the material has a higher percentage of "fines" than is typical for beach compatible sand. Table 5.2 presents the dredging data from the US Army Corps.

[26] Source USACE—Los Angeles District.

Table 5.2: Dredge Material from Santa Barbara Harbor[27]

Year	Type of Work	Est Yards	Disposal Location
1973	Maintenance	225,000	West Beach
1974	Maintenance	380,000	West Beach
1975	Emergency	50,000	West Beach
1976	Maintenance	93,500	West Beach
1977	Maintenance	350,000	West Beach
1978	Maintenance	350,000	West Beach
1979	Maintenance	350,000	West Beach
1984	Maintenance	400,000	West Beach
1985	Maintenance	400,000	West Beach
1986	Maintenance	400,000	West Beach
1987	Maintenance	400,000	West Beach
1988	Maintenance	400,000	West Beach
1989	Maintenance	400,000	West Beach
1989	Emerg Dredg	132,689	East Beach
1990	Maintenance	100,000	East Beach
1991	Maintenance	250,000	East Beach
1992	Maintenance	250,000	East Beach
1993	Maintenance	672,000	West Beach
1994	Maintenance	300,000	West Beach
1995	Maintenance	550,000	West Beach
1996	Maintenance	503,580	West Beach
1997	Maintenance	503,580	West Beach
1998	Maintenance	503,580	West Beach
1999	Maintenance	523,200	West Beach
2000	Maintenance	523,200	West Beach
2001	Maintenance	523,200	West Beach
2002	Maintenance	418,544	West Beach
2003	Maintenance	444,703	West Beach
Total		11,466,776	
Avg./Year		369,896	

A substantial amount of beach compatible material has been placed on West and East beach. In the 31 years presented above, 11.5 million cubic yards have been dredged and placed on the beaches, for an average of just under 370,000 per year.

[27] Source USACE; thanks to Dina Aman of the USACE for her help.

Channel Islands Harbor

The Corps also conducts a substantial amount of dredging in the Channel Island harbor in Oxnard. The harbor is located several miles south of Ventura harbor. The dredge material from Channel Islands harbor has been primarily pumped to Hueneme beach via a pipeline. The placement on Hueneme is by Congressional mandate (since it is the lowest cost site). Approximately 250,000 to 300,000 cubic yards per cycle (about 16%) is placed on Silver Strand.[28]

Table 5.3: Dredge Material from Channel Islands Harbor[29]

Year	Cubic Yards
1968	1,620,000
1969	2,824,000
1971	2,500,000
1973	2,500,000
1975	1,519,711
1977	2,370,000
1979	1,980,244
1981	1,640,000
1983	1,260,553
1985	1,850,000
1987	1,993,956
1989	1,720,000
1991	1,429,157
1993	1,100,000
1995	876,666
1997	1,309,000
1998	1,638,018
1999	1,117,406
2001	1,222,934
2003	2,050,116
Total	34,521,761
Avg./cycle	1,726,088
Avg./Year	958,938

Table 5.3 above presents data on the dredging activity from Channel Islands Harbor since 1968. The harbor generates a substantial quantity of beach compatible sand, averaging just under 1 million cubic yards per year and 1.7 million cubic yards per dredge cycle.

Dams and Debris Basins

In addition to harbors, dams and debris basins have a significant amount of material available. Unfortunately, not all of this material is beach compatible. No precise estimate exists and the amount of compatible sand varies from year to year and by dam

[28] Although Silver Strand is not the lowest cost alternative, the USACE places material here regularly.
[29] Source USACE; thanks to Jeffrey Cole of the USACE for his help.

and debris basin. According to the *California Beach Restoration Study,*[30] over 1.5 million cubic yards of beach compatible sand are trapped by dams and debris basins in California each year. The study recommended that a protocol be developed for the use of opportunistic sediment for beach nourishment from dams and debris basins, which is one of the purposes of this report.

Estimates of the amount of beach compatible sand vary. The *California Beach Restoration Study* estimated that 50% of the material behind dams and debris basins is beach compatible, but other State and County officials provided estimates ranging from 20-50%. This compares unfavorably with dredge material which is (according to interviews with numerous State, County and USACE officials) 85-90% beach compatible, with the remainder mostly comprised of fines, which wash away quickly after dredging, and some cobble which also is sorted naturally by tidal processes and drifts inshore. The material in dams and debris basins consists of sands, fines, cobble and many other materials. In addition to the lower yield, sorting the material from dams and debris basins to ensure beach compatibility involves additional expense that would not be incurred if the material was used for landfill or many other purposes. These issues are discussed in more detail in the next section.

Ventura County Debris Basins

Data for all debris basins in Ventura County was obtained from the *Detention Dams and Debris Basins Manual* published by the Ventura County Flood Control District.[31] The manual contains detailed information on each debris basin and dam. Table 5.4 summarizes the most salient data. Where no information is available the respective cell was left blank. Many of the debris basins have relatively small capacities; indeed the average debris basin capacity is approximately 45,000 cubic yards. However a handful of debris basins contain a substantial amount of material. Moreover, if one examines the estimates of the amount of sediment generated in a 25-year flood or fire, they are often significantly greater than the total capacity of the basin. Further, while the average removal per year is low (just under 10,000 cy per site), removal of material from debris basins is episodic, generally during storms (often El Nino related), so that the amount of material available is quite a bit larger than the average.

[30] See http://dbw.ca.gov/beachreport.htm, p. 7-39.
[31] *Detention Dams and Debris Basins Manual*, Ventura County Flood Control District, June 1999.

Table 5.4: Material from Ventura County Debris Basins[32]

Name	Maximum capacity (cu. yd.)	Remaining Capacity	Avg removal /yr.	Maximum Removal	25 yr storm	25 year burn
Dent	4,100	2900	611	3,662	928	1,346
San Antonio Creek	30,000	2640	3,631	26,600	249,693	362,170
Stewart Canyon Creek	328,300	319154	5,854	328,274	112,000	161,000
Adams	84,200	78080	61,505	61,505	50,410	74,500
Arundell Barranca	28,266		11,666	76,334	23,150	33,200
Cavin Road	8,700		331	5,640	4,992	7,238
Fagan Canyon	88,400	81470	8,570	42,850	35,931	52,803
Runkle		94950	4,645	126,150	23,186	33,379
Santa Rosa Road	15,000	13900	537	7,700	6,834	9,900
South Branch Arroyo Conejo		21750			54,450	69,670
St. Johns	87,600	72690	207	3,936	1,565	2,271
Tapo Hills No. 1	51,820	58900			3,150	1,580
Tapo Hills No. 2	56,000	54150	566	6,500	2,184	3,167
West Camarillo Hills East	4,800	4440	298	2,554	618	897
West Camarillo Hills West	22,500	19560	1,269	15,900	547	794
Lower Calleguas Creek			98,450	644,000		
Franklin Barranca	24,500	1402			6,247	9,058
Jepson Wash	54,750	18800	9,847	41,720	29,990	43,000
Real Wash	31,600	28150	8,490	28,250	6,000	8,600
Warring Canyon	59,500	52500	10,383	50,650	27,200	39,000
Coyote Canyon	25,300	19730	5,318	21,800	78,348	113,604
Crestview	11,100	11100			567	824
Edgemore	4,000	3898	438	2,500	511	741
Erringer Road	39,400	39400			6,506	9,437
Ferro	37,700	25870	1,062	7,605	4,246	6,158
Fox Barranca	19,300	16460	4,791	16,000	54,329	78,803
Gabbert Canyon	49,050	53140	14,031	58,190	30,800	44,200
Honda West	14,300	12884	941	10,500	30,473	44,200
Las Posas	15,200	12384	480	11,250	563	818

Dams controlled by Ventura County

Ventura County's debris basins manual also contains data on dams maintained by the Ventura County Flood Control District. Table 5.5 presents essentially the same data for dams as Table 5.4 did for debris basins. Please note that several other dams controlled by Federal authorities, as well as Matilija dam, will be discussed later in this section. Most of the dams are small (average size is 111,000 cubic yards), however Las Llasas Canyon comprises roughly 2/3 of the total capacity of all six dams.

[32] *Detention Dams and Debris Basins Manual*, Ventura County Flood Control District, June 1999.

Table 5.5: Material from Ventura County Controlled Dams[33]

Name	Maximum debris storage (cu. yd.)	Remaining Capacity	Avg removal/ yr.	Maximum Removal	25 yr storm	25 year burn
Arundell Barranca	28,266	64,800	25,363	101,450	12,403	17,990
Sycamore Canyon	172,500	1,064,800	-	-	32,560	44,080
Las Llajas Canyon	451,724	934	211	4,009	193,400	282,000
Las Posas	2,726	2,726	668	4,009	563	818
Peach Hill Wash	5,676	11,970	-	-	2,486	3,606
Ramona DD3-16M + DB3-16	4,665	4,825	398	4,110	563	818

Santa Barbara County Debris Basins

Table 5.6 contains available data for debris basins in Santa Barbara County obtained from the County Flood Control District.[34] Like Ventura County, many of these debris basins are small. Removal typically occurs during floods. In 1997, virtually all of these basins were cleaned out on an emergency basis. While the average debris basin capacity is only 35,000 cubic yards, during the 1997 floods, most debris basins were cleared out more than once and they contained considerably more than their "maximum" capacity.

[33] *Detention Dams and Debris Basins Manual*, Ventura County Flood Control District, June 1999.
[34] Obtained from Karl Treiberg, Santa Barbara County Flood Control District. Thanks to Karl for all of his help with this project.

Table 5.6: Material from Santa Barbara County Flood Control Projects[35]

Basin	Design Capacity (cubic yards)	Remaining Capacity (1996)	% Design Capacity
Arroyo Paredon Creek	24,000	6,783	28%
Cold Springs Creek	20,450	13,836	69%
East Toro Cyn. Creek	15,000	4,395	29%
Franklin #14	41,000		
Franklin - Miller	5,600		
Franklin High School #10	11,600		
Franklin High School #11	12,000		
Franklin Main	12,400	6,676	54%
Gobernador Creek	46,500	22,598	49%
Lillingston Cyn Creek	45,000		
Lower West Toro Creek	56,000	22,481	40%
Maria Ygnacio - East	60,000	27,834	46%
Maria Ygnacio - Main	30,000	16,192	54%
Mission Creek	15,000	4,518	30%
Oil Canyon	11,000	100	
Rattlesnake Creek	8,300	3,720	46%
Romero Creek	27,000	16,531	61%
San Antonio Creek	34,000	16,266	48%
San Roque Creek	40,000	15,148	38%
San Ysidro Creek	11,000	2,260	20%
Santa Monica	208,000	100,873	48%
Upper West Toro Creek	29,000	8,711	30%
TOTAL	762,850		
Average	34,675		

Larger Dams

There are several dams in the study area not listed by the County Flood Control districts. These dams are typically much larger, and contain more sediment, than county dams. Table 5.7 lists these dams. The average of these dams has a reservoir capacity of 181 million cubic yards and a sedimentation rate of several hundred thousand cubic yards per year. One dam, Matilija, is almost completely filled with sediment and has been the subject of a decommissioning study by the Army Corps of Engineers.

[35]Obtained from Karl Treiberg, Santa Barbara County Flood Control District.

Table 5.7: Material from Dams in Study Area[36]

Dam	Reservoir capacity (cu. yd.)	% Capacity Remaining	Year of Last Survey	Sedimentation Rate (cu. yd./yr.)
Bradbury	330,665,000	92%	2000	580,000
Casitas	409,702,000			
Matilija	2,903,400	7%	1999	200,000
Twitchell	241,950,000	71%	1999	1,730,000
Santa Felicia	161,300,000	87%	1996	500,000
Total	1,146,520,400			
Average	229,304,080			

Matilija Dam

Matilija dam was completed in 1947 about half a mile upstream from the point where Matilija creek and the Ventura River merge. The dam soon began to trap sediment behind its walls, and as table 5.7 indicates, 93% of the reservoir contained sediment in 1999. The Army Corps commissioned a study of the costs and benefits of decommissioning the dam.[37] The report studied a number of options including full removal of the dam and removal in phases. Some of the plans call for the removal of sediment and some call for allowing the sediment to be washed down the river by natural processes. The final status of the dam is still under discussion.

Table 5.8 presents the Corps' best estimates of the amount of material available. The total amount of beach compatible sand is estimated to be just over 2 million cubic yards. The Corps preliminary results also indicate low toxicity. Further, much of the sediment is stratified by type, so that removal of beach compatible sand may be some what more cost effective.

Table 5.8: Material from Matilija Dams by Type (cubic yards)[38]

Material Type	Reservoir	Delta	Upstream Channel	Total
Silt	1,900,000	670,000	210,000	2,780,000
Sand	200,000	1,400,000	420,000	2,020,000
Gravel Plus		350,000	610,000	960,000
Total	2,100,000	2,420,000	1,240,000	5,760,000

Wetlands Projects

One other project deserves mention in the study area. The Carpinteria Salt Marsh is a 230 acre estuary located in just north of Carpinteria along the Coast. Much of the marsh

[36] From *California Beach Restoration Study*, Table 7.6, p. 7-36. Please note that the estimate for Matilija is somewhat different from the more recent estimate prepared by the USACE. Both estimates indicate a significant amount of material.
[37] See "Matilija Dam Ecosystem Restoration: Alternative Analysis Draft Report (F4) Milestone," August 2003. Available at: http://www.matilijadam.org/public-report.htm.
[38] Ibid, p. 6-12, Table 5.

has filled in and silt and sand need to be removed to create wetlands. While some of the material is too fine for placement on the beach, City officials estimate that at least 10,000 cubic yards are suitable. Indeed, current plans involve using this material and placing it on Carpinteria's beaches.[39]

Summary

In short, there is a large amount of opportunistic material available in the area for beach restoration. Kim Sterrett of the California Department of Boating and Waterways estimates that the total amount needed for nourishment projects in Ventura and Santa Barbara Counties is no more than a few hundred thousand cubic yards per year. Our data indicate that this quantity is available, with dredge material from harbors representing the largest potential source.

[39] See Carpinteria's Salt Marsh Enhancement Program: Final EIR, State Clearinghouse # 2003021016, Santa Barbara County Flood Control District, June 2003. This study also relied on interviews and emails from Karl Treiberg, Santa Barbara County Flood Control District, and Matt Roberts, City of Carpinteria,

6. Cost of Moving Sediment

This section develops a cost function associated with moving (and in some cases sorting) sand from the sediment source to the receiver beach. Before proceeding with the analysis, it will be useful to define "cost" in a more meaningful way.

This paper makes the following distinctions:

> **Marginal or incremental cost**: the cost associated with producing (or in this case transporting or sorting) an additional unit. In most of the discussion below, the incremental cost will involve the additional cost of moving or sorting one more cubic yard of material.
>
> **Fixed Cost**: the cost associated with a fixed plant or other item that has already been produced and cannot be easily moved. A fixed cost must be incurred even if one produces nothing. The Corps often refers to these costs as "mobilization" and "demobilization" costs. Costs of a permanent pipeline may also be fixed costs.
>
> **Sorting Costs**: Sorting costs involve the costs of separating beach compatible sediment (80-90% sand, the rest fines) from other material.
>
> **Economies of Scale**: these occur when producing larger quantities of an item result in lower per unit costs. In the case of trucking sand, few economies of scale exist; in the case of barging, substantial economies exist up to a point.
>
> **Constant Returns to Scale**: occur when producing larger quantities of an item (e.g., transporting sand by truck) result in the same per unit costs.

Modes of Transportation

Several different means exist for dredging and transporting sediment. All of these techniques may be cost effective depending upon the distance, the volume of material moved, the amount, type and placement of dredge material and whether transport is by sea or on land. The main mechanisms for dredging and transporting sediment are:

1. **Hydraulic Dredge and Pipeline**: Dredge material is pumped from the donor site to the receiver site. This technique is currently used to pump material from Santa Barbara harbor to East and West beaches and from Ventura harbor to McGrath beach and at Channel Islands to pump to various beaches. Hydraulic pipelines are cost effective when the material is being pumped for a short distance (no more than three or four miles). They are not feasible for longer distances or where geographic features make laying a pipeline difficult. In general pipelines are not feasible for the projects considered in this study, since the distances are more than 3-4 miles. Pipelines typically involve a significant fixed cost, though some dredges contain pipelines that are transportable (see below).

2. **Truck**: Sediment obtained from debris basins or dams may be transported by truck. Typical trucks used have 23 ton capacity, though in some cases 40 and 60 ton capacity trucks could be used. Trucks are useful for most nourishment projects, as long as access for the truck is available, though the unit costs are

typically higher than other types of transport, particularly when large amounts of material are being moved.

3. **Scow and Tow**: Barges and scows containing dredge material can be moved by tugboat from the donor site to the receiver site. Since all receiver sites are beaches, moving material by barge is feasible. Material can be placed in the near shore area for a significantly lower expense (see discussion below). However, the material will not immediately impact beach width. Some scows and barges also are equipped with a pump out capability so that the material can be moved on shore, however the cost is significantly higher. When the donor sites are harbors and ports, scow and tow is generally cost effective.
4. **Hopper Dredge/Pumpout**: Hopper dredges dredge the material, transport the material and place it on the receiver site. Unfortunately, hopper dredges are quite expensive since the cost includes dredging, transport and pump out. Hopper dredge costs will be discussed in detail below.

Creating a Cost Function

This report relied on interviews with numerous individuals from the Corps, engineering consulting firms, and from individuals involved in the construction industry.[40] All costs are in 2005 dollars.

In most cases removal of sediment is mandated by Federal, State or local ordinance, so removal of sediment can be considered a sunk cost (e.g., it does not change the costs of using opportunistic sediment since dredging will occur anyway). Further, the material must be moved to a designated receiver site, typically the lowest cost disposal site. In this case one should subtract the costs associated with moving material to the low cost site. For example, if material from a debris basin is trucked 8 miles away to a landfill and the alternative is trucking the material to a beach 25 miles away, then the transportation cost for the additional 17 miles will be used in the estimate. The costs of sorting and placing the sand on the beach should also be included, since these costs will only be incurred if the material is used for nourishment. To give one other example, if a hydraulic pipeline is employed, most of the costs are fixed and there will be little savings from moving the material by other means.

Trucking

In general, trucking exhibits constant returns to scale[41]--adding more trucks does not change per unit costs significantly. The minimum load is about 23 tons; the amount one truck can carry. However since the minimum contract is often for a half day or a day, the

[40] In particular, thanks to Joe Ryan, Mo Chang, and George Domurat of the USACE. John Moore of Noble Consultants was extremely helpful. Leonard Juhnke of Manson Construction was also helpful. The report used earlier work by Everest consultants and discussions with John Lindsay at Waste by Rail as well as officials at Granite Construction in Santa Barbara. Also, see "The ArcGIS Coastal Sediment Analyst: A Prototype Decision Support Tool for Regional Sediment Management," prepared for the U.S. Army Corps of Engineers, Los Angeles District, by Dept of Geography, USC, 2004.

[41] One could argue that transactions cost fall somewhat for larger transactions, but there is no evidence of this. Indeed for large jobs, the increase in demand for trucking services may drive prices up a bit.

minimum load necessary is some multiple of 23, depending upon the distance between sites. Since the quantities here are in the hundreds or thousands of tons, this constraint is not an issue.

The estimates presented here rely on interviews with engineers and contractors.[42] As one can see in Tables 6.1 and 6.2 below, the fixed cost of loading/unloading the truck is approximately $5 per cubic yard. After that, the sand can be moved for 35 cents per cubic yard per mile. All of the calculations here and below assume a round trip, i.e., the truck will move the material and return to the site.

Much of the material to be trucked comes from debris basins and dams. This material is typically mixed, containing cobble, silts and other material (brush, trees, etc.) and must be sorted to obtain beach compatible sand. The cost of this sorting varies, but a reasonable estimate is $4.50 per cubic yard. This sorting consists of screening followed by separation with a hydro-cyclone.

Table 6.1: Cost Parameters and Assumptions for Trucking and Sorting Sand

Item	Cost Parameter
Cost of Truck per Day	$600
Capacity of Truck (tons)	23
Weight of cy of sand (tons)	1.6
Cy of sand per truck	14.375
Speed of Truck (mph)	30
Loading/Unloading Time (Hrs.)	1

Table 6.2 Costs of Trucking and Sorting Sand

Costs per Cubic Yard (8hr day)		
Cost of Loading/Unloading	$	5.22
Cost per Mile	$	0.35
Cost of Sorting	$	4.50

In interviews with Corps officials and others, it was also noted that many debris basins and some dams are typically cleaned out on an emergency basis, during flood events. Most recently, in 1997 Santa Barbara County had to clean out all of their debris basins in a very short period of time. In this case, the costs of removal are considerably higher. Several people indicated that doubling the non-emergency average was a good rule of thumb.

Moving Sand by Barge

Another feasible option in some cases involves moving sand by barge. In this case study, all of the harbor dredge material can be barged to any beach in the State. Calculating the

[42] See footnote 40 for the names of the individuals.

costs of barging is slightly more complicated than calculating trucking costs. The estimates presented here use typical daily rates for barges and tugboats, and are summarized in Table 6.3. A tugboat costs $8500 per day and can tow three barges carrying 4000 cubic yards each at a cost of $2500 per day. Given the high expense involved, these operations are conducted 24 hrs/day and the hourly cost estimates employed here reflect this assumption.

Table 6.3 Costs of Barge and Tugboat per Day

Item		
Cost of 4000 cy barge/day	$	2,500.00
Cost of Tugboat	$	8,500.00
Daily Cost Tugboat and 3 barges	$	16,000.00
Cost per hour Tugboat and 3 barges	$	666.67

Table 6.4 presents estimates of the average time it would take to load/unload these barges as well as the time it takes to move the barges.

Table 6.4 Time and Cost for Loading and Transporting Sand with Barge

Time per barge trip	Hours		Cost
Loading/Unloading	1.50	$	1,000.00
Transport per mile	0.30	$	200.00
Loading per Cubic Yard		$	0.08
Transport per Cubic Yard per Mile		$	0.02

Using the above data, one can estimate the costs of loading and transporting sand. Since the material under consideration for barging (from Ports and Harbors) is already being placed on beaches, there is no need for sorting, which lowers costs considerably. The overall cost of barging per cubic yard is significantly lower than trucking. The cost per cubic yard per mile is 2 cents vs. 35 cents by truck. However, using a scow and tow also is likely to require using a different type of dredging operation (e.g., clamshell), which may add to the cost. This issue is discussed at the end of this section.

Another option, the costs of Scow and Tow with pump out onto a beach, are not estimated. These costs are as high or higher than using a hopper dredge. Another variation, using a barge with a built in pump, is similar in cost to a hopper dredge.[43]

Hopper Dredge

A hopper dredge has the ability to dredge, transport and pump out the material. In many ways a hopper dredge is the ideal solution for moving opportunistic sediment from a harbor to a beach. Unfortunately, there are some constraints involved. A hopper dredge

[43] For this information the report relied on Leonard Juhnke from Manson construction.

is not suitable for many purposes. In the three harbors examined here, a hopper dredge could be used for approximately 1/3 of the dredge material on Channel Islands and Ventura Harbors.[44] However, the engineers indicated that Santa Barbara's harbor is quite shallow and thus difficult or impossible for a hopper dredge to work in.

Hopper dredges are also limited in availability. At most, only two small (~1500cy) hopper dredges are available on the west coast: the Westport, operated by Manson construction, and the Sugar Island, used in the SANDAG operation. The costs of each depend upon market conditions. Average values are used here, based on conversations with Corps and industry officials. It should also be noted that given the limited supply, an increased demand for hopper dredges due to the use of regional sediment management could drive costs higher.

Tables 6.5 and 6.6 summarize the calculations without mobilization and bulldozing costs, which will be added later. The fixed costs of dredging and pumping out are $6.67 per cy and the costs of transport are $0.32 per cubic yard per mile.

Table 6.5: Cost Parameters and Assumptions for Hopper Dredge

Item	Cost Parameter	
Cost per 24 hr day	$	40,000
Cost per hour	$	1,667
Speed mph		7
Dredge time hrs		2
Pump out time		4
Capacity of hopper cy		1500

Table 6.6 Costs of Hopper Dredge

Time per barge trip		Hours
Dredge/Pump Out		6.00
Cost of Transport per mile	$	476.19
Dredge/Pump Out per Cubic Yard	$	6.67
Transport per Cubic Yard per Mile	$	0.32

Costs of Moving Sand from Harbors

A GIS program was used to calculate the shipping distances from the three harbors in the study (Ventura, Channel Islands, and Santa Barbara) to the three beaches in the study and used cost calculations to estimate the cost per cubic yard for tow and scow and hopper dredge. Please note that these costs do not include the costs of mobilization as well as some other additional costs that vary with the amount used. These numbers are meant to be indicative of the cost per cubic yard for transport to the three sites. The data is summarized in Tables 6.7 and 6.8.

[44] Estimate from Joe Ryan of USACE and Leonard Juhnke of Manson Construction.

As one can see, the transport costs for tow and scow are quite low, around 25 to 35 cents per cubic yard. Given the additional costs of only 2 cents per cubic yard per mile, transport to farther locations may also be feasible. Hopper dredges, on the other hand, cost at least $10 per cubic yard for even short (10-15 mile) hauls. When one adds in mobilization costs (typically $200-300 thousand), the cost per cubic yard rises by another dollar or two per cubic yard, depending upon the amount dredged.

Table 6.7: Costs of Moving Sand by Barge from Harbors per Cubic Yard

Harbor	Distance to Goleta (miles)	Loading, Unloading and Transportation Cost/CY	Distance to Carpinteria (miles)	Loading, Unloading and Transportation Cost/CY	Distance to Rincon (miles)	Loading, Unloading and Transportation Cost/CY
SB Harbor	8.1	$ 0.35	10.1	$ 0.25	$ 20.43	$ 0.76
Ventura	58.6	$ 2.04	14.8	$ 0.58	$ 8.26	$ 0.36
Channel Island	64.4	$ 2.23	24.8	$ 0.91	$ 18.30	$ 0.69
Lowest Cost		$ 0.35		$ 0.25		$ 0.36

Table 6.8: Costs of Moving Sand by Hopper Dredge from Harbors per Cubic Yard

Harbor	Distance to Goleta (miles)	Loading, Unloading and Transportation Cost/CY	Distance to Carpinteria (miles)	Loading, Unloading and Transportation Cost/CY	Distance to Rincon (miles)	Loading, Unloading and Transportation Cost/CY
Ventura	58.6	$ 25.28	14.8	$ 11.36	8.3	$ 9.29
Channel Island	64.4	$ 27.11	24.8	$ 14.55	18.3	$ 12.47
Lowest Cost		$ 25.28		$ 11.36		$ 9.29

Costs of Moving Sand from Dams and Debris Basins

This report also estimated the distance for moving sand by truck from dams and debris basins to the three beach sites. The calculations employed a GIS program, which included a map with viable roads. In some cases the distances are much farther than linear ("as the crow flies") distances. In addition, since dams and debris basins are not always located close to roads, some of these estimates may also involve some trucking up to roads nearby. Since the purpose of the study is to look at the incremental costs of moving sand to the beach, and the material would typically be trucked about 8 miles away, the analysis subtracts the costs of loading (the sand must be loaded to be trucked to wherever) and the costs of 8 miles of transportation. This figure varies by debris basin, and in some cases by truckload, but interviews with officials involve indicates that 8 miles is a good average.

Tables 6.9, 6.10 and 6.11 summarize all of the information for trucking to Rincon, Carpinteria and Goleta beaches. "Net Costs" are calculated based on the assumption that the material would have to be loaded, trucked 8 miles, and unloaded to an alternative site. In other words, "net costs" reflects trucking costs greater than 8 miles. "Cost plus Sorting" adds the $4.50 sorting cost to the net (trucking) cost in the preceding column.

In many cases costs are several multiples higher than those associated with moving by barge. While a couple of sites are close to beaches, (e.g., Maria Ignacio is close to Goleta) most sites are far enough away to make costs range from roughly $6 per cubic yard and higher. In the case of Rincon Parkway, there are no sites that would cost less than $24 per cubic yard. For Goleta and Carpinteria, a few debris basins are worth exploring. However, even the cheapest sites are two to three times more costly per cubic yard than barging and most sites are significantly higher. The primary reason for the higher costs are: (1) the costs of sorting are quite high, (2) the distances are typically farther and, (3) trucking is more expensive per mile.

The County of Santa Barbara Flood Control district has placed some material from debris basins at Goleta beach. It should also be noted that for the material from local debris basins, the costs of sorting represents the primary expense and these costs might be lower in some cases. Local use of opportunistic sediment makes sense where feasible, though the amount of material available from debris basins is much smaller than available dredge material.[45]

Table 6.9: Incremental Cost of Moving Sand from Dams and Debris Basins to Goleta (per Cubic Yard)

Debris Basins/Dam	Distance to Goleta (miles)	Net Cost	Cost plus Sorting
Cold Springs Creek	38.9	$ 10.82	$ 15.32
Maria Ygnacio - East	11.9	$ 1.37	$ 5.87
Maria Ygnacio - Main	10.9	$ 1.02	$ 5.52
San Antonio Creek	25.3	$ 6.06	$ 10.56
San Roque Creek	15.8	$ 2.73	$ 7.23
Santa Monica	106.5	$ 34.48	$ 38.98
Sycamore Canyon Dam	29.2	$ 7.42	$ 11.92
Bradbury	71.1	$ 22.09	$ 26.59
Twitchell	374.1	$ 128.14	$ 132.64

[45] Thanks to Karl Treiberg of Santa Barbara County for help.

Table 6.10: Incremental Cost of Moving Sand from Dams and Debris Basins to Carpinteria (per Cubic Yard)

Debris Basins/Dam	Distance to Carpinteria (miles)	Net Cost	Cost plus Sorting
Arroyo Paredon	8.3	$ 0.11	$ 4.61
Cold Springs Creek	33.2	$ 8.82	$ 13.32
Gobernador Creek	7.6	$ (0.14)	$ 4.36
Lower West Toro Creek	15.3	$ 2.56	$ 7.06
Romero Creek	21.5	$ 4.73	$ 9.23
Upper West Toro Creek	18.1	$ 3.54	$ 8.04
Bradbury	130.5	$ 42.88	$ 47.38
Twitchell	335.5	$ 114.63	$ 119.13

Table 6.11: Incremental Cost of Moving Sand from Debris Basins in Ventura County to Rincon Parkway (per Cubic Yard)

Debris Basin	Distance to Rincon (miles)	Net Cost (Cubic Yard)	Cost plus Sorting
Adams	78.2	$ 24.57	$ 29.07
Cavin Road	140.6	$ 46.41	$ 50.91
Coyote Canyon	95.6	$ 30.66	$ 35.16
Crestview	91.4	$ 29.19	$ 33.69
Edgemore	94.1	$ 30.14	$ 34.64
Fagan	85.3	$ 27.06	$ 31.56
Ferro	77.9	$ 24.47	$ 28.97
Fox Barranca	95.9	$ 30.77	$ 35.27
Franklin	65.1	$ 19.99	$ 24.49
Gabbert Canyon	112.8	$ 36.68	$ 41.18
Honda West	92.1	$ 29.44	$ 33.94
Jepson	118.4	$ 38.64	$ 43.14
Real	152.2	$ 50.47	$ 54.97
St. Johns	105.4	$ 34.09	$ 38.59
San Antonio	75.6	$ 23.66	$ 28.16
Santa Rosa	116.3	$ 37.91	$ 42.41
South Branch Arroyo Conejo	129.9	$ 42.67	$ 47.17
Stewart	69.7	$ 21.60	$ 26.10
Tapo Hills #1	157.0	$ 52.15	$ 56.65
Tapo Hills #2	156.1	$ 51.84	$ 56.34
Warring	152.3	$ 50.51	$ 55.01
W. Camarillo East	93.3	$ 29.86	$ 34.36
W. Camarillo West	91.2	$ 29.12	$ 33.62

Additional Costs for Barging Projects

It is possible to use hydraulic dredging and barges. However, doing so requires that some material will over wash—the material pumped out by the hydraulic dredge flows over and the sand settles in the barge. This technique actually has one advantage, since the material transported will have fewer fines than otherwise. However, the resulting turbidity could create an environmental impact that might need to be mitigated. One can use a silk screen to reduce the flow of fines into the water and hence reduce turbidity. The cost of such an operation is probably $80-$100 thousand. This analysis assumes that such a technique will not be necessary. If it is, then the additional cost will be between $0.25 and $1 per cubic yard depending upon the total quantity removed.

It is also possible that barging would require the use of a clamshell or other dredge since hydraulic dredging contains large amounts of water. While the average cost of hydraulic dredging is typically $4-$5 per cubic yard, there are significant economies of scale and our examination of Corps contracts indicates that the incremental cost of hydraulic dredging for the quantities involved here are closer to $2.50 per cubic yard. However, the use of a clamshell dredge entails increased mobilization costs (approximately $150,000) and an incremental cost (for the quantities involved) of about $4.50 per cubic yard. These estimates are summarized in Table 6.11. The benefit/cost analysis presented later does not use this data.

Table 6.11: Cost of Switching from Hydraulic to Clamshell Dredging

Beach Fill Amount (cy)	Additional Cost	
50000	$	5.00
100000	$	3.50
150000	$	3.00
200000	$	2.75
250000	$	2.60
300000	$	2.50

Additional Costs for Hopper Dredges

The mobilization costs for a hopper dredge are substantial and depend upon market conditions and how far the hopper is from the sites. This paper estimates that mobilization costs are $300,000, which several sources told us was a reasonable average. The analysis also assumes, as discussed in the paragraph above, that there will be some savings, approximately $2.50 per cubic yard, from reduced hydraulic dredging. Incorporating both of these assumptions yields Table 6.12. For the quantities most likely involved (150,000 to 200,000 cy) there will be a modest reduction of about fifty cents to a dollar a cubic yard, from the estimates provided earlier. This cost is unlikely to have a significant impact on the cost benefit ratios presented in section 7.

Table 6.12: Cost of Switching from Hydraulic to Hopper Dredging

Beach Fill Amount (cy)	Additional Cost/Cy
50000	$ 3.50
100000	$ 0.50
150000	$ (0.50)
200000	$ (1.00)
250000	$ (1.30)
300000	$ (1.50)

Bulldozing

Given the quantities involved here, these costs are likely to be quite low, on the order of $0.20 per cubic yard. Also, the material pumped onto beaches by the Corps requires some bulldozing as well. Given the uncertainties in other estimates, calculating the costs here would add little to the analysis.

7. Benefits of Beach Fill

Sections 3 and 4 discussed the recreational benefits of beaches including the three specific beaches in this study. These sections also discussed how beach width influences the recreational value of a beach. The appendix to this report presents an analysis of the increase in beach width created by employing varying amounts of sand at these beaches—this analysis was generated by Everest International consultants, a coastal engineering consulting firm.

This section combines Everest's work with the economic analysis provided earlier in this report to estimate the benefits of beach nourishment at these three beaches. The analysis converts the beach width estimated by Everest into a percentage increase in beach width. Please note that beach width varies by season, by year, and by location. This analysis employs an average during high season--the benefits in low season are small.

In all of the calculations below, the increases in recreational benefits are generated due to the increased recreational value from increased beach width. Before starting, it will be instructive to give an example. Table 7.1 presents an estimate of the recreational value of Carpinteria's beaches as they are today—the recreational value of a day at this beach is $10.09. For a detailed discussion of this material, please refer back to Section 3.

Table 7.1: Recreational Value of Carpinteria's Beaches

Amenity	Amenity Point Value	Weight	Weighted Amenity Value
Weather	85%	20.00%	96.8%
Water Quality	95%	20.00%	99.0%
Beach Width and Quality	40%	15.00%	87.2%
Overcrowding	55%	15.00%	91.4%
Other Recreational	80%	15.00%	96.7%
Availability of Substitutes	85%	15.00%	97.6%
Total Index Value		100%	72.1%
Maximum Value per day	$ 14.00		
Carpinteria Value	$ 10.09		

Suppose Carpinteria's beach width increases by 50%. Since the beach is wider, the point value of this amenity (beach width) increases. The analysis assumes that the point value increases proportionately[46] so that the amenity value is now 60%. Table 7.2 presents the new estimate for the recreational value of Carpinteria's beaches after nourishment. After nourishment, the day use value increases to $10.71, an increase of 62 cents per person per day. If one multiplies this estimate by the number of users in high season (1.6 million), the resulting increase in recreational value is just over $1 million per year.

Table 7.2: Recreational Value of Carpinteria's Beaches after Nourishment

Amenity	Amenity Point Value	Weight	Weighted Amenity Value
Weather	85%	20.00%	96.8%
Water Quality	95%	20.00%	99.0%
Beach Width and	60%	15.00%	92.6%
Overcrowding	55%	15.00%	91.4%
Other Recreational	80%	15.00%	96.7%
Availability of	85%	15.00%	97.6%
Total Index Value	18%	100%	76.5%
Maximum Value per	$ 14.00		
Carpinteria Value	$ 10.71		

However, beach nourishment also influences the overcrowding amenity in two ways: (1) as beaches become wider, the amount of space per individual increases, decreasing crowding, (2) as beach width increases, more people come, increasing crowding. Both of these effects have been accounted for in the analysis and both are relatively small. The

[46] Note that the recreational value does not increase proportionately since the analysis here employs a Cobb-Douglas type function. See section 3 for discussion.

analysis does not taken into account changes in recreational value when people substitute Carpenteria beach for other beaches they would have gone to before nourishment, but this value will be small, since the main increase in value occurs for people already attending Carpinteria.

The estimates provided in the remainder of this section use only six points in time (years zero through five) since engineers at Everest indicated that this was a reasonable time period. Since some sand is still left, particularly in the case of a large nourishment project, the results underestimate the recreational benefit somewhat (perhaps by 15%-25%).

A discount rate of 5 3/8% was employed here, consistent with the current figure employed by the Corps. This is also an appropriate number for State and local communities given current municipal bond finance rates.

Carpinteria

The tables below present estimates of the increase in recreational value for years zero (the year when nourishment occurs) through five. These monetary values are discounted at a rate of 5 3/8% per year. Table 7.3 summarizes the calculations for the present value (over the five year period) of nourishing Carpinteria's beaches and presents detail for year zero. The final column is the most useful; it estimates the increase in recreational value per cubic yard, which ranges from $31.73 for 50,000 cubic yards to $27.81 for 400,000.[47]

Table 7.3: Value of Nourishing Carpinteria's Beaches

Beach Fill Amount (cy)	% Increased Width Year 0	Increased Day Use Value Year 0	PV Rec. Value Years 0-5	PV Recreation per cubic yard Placement on Beach
50000	13%	$ 0.37	$ 1,586,382.67	$ 31.73
100000	27%	$ 0.72	$ 3,139,329.43	$ 31.39
150000	40%	$ 1.04	$ 4,609,977.57	$ 30.73
200000	53%	$ 1.34	$ 6,106,420.64	$ 30.53
250000	67%	$ 1.62	$ 7,539,690.53	$ 30.16
300000	80%	$ 1.89	$ 8,843,404.34	$ 29.48
350000	93%	$ 2.09	$ 10,149,297.19	$ 29.00
400000	105%	$ 2.20	$ 11,122,356.73	$ 27.81

[47] Our results make sense since the additional value of each yard should decline due to diminishing marginal utility for beach width)

Use of Material in the Near Shore

Another option is the placement of dredge material near shore. Unfortunately, little is known about the flow of dredge material in the near shore, specifically, how much of the material will end up on beaches in the littoral cell. The amount that ends up on the beach also depends upon where the material is placed, how much is placed, and storm patterns in the years after the placement. All of this information is well beyond the original scope of this report, which did not even consider near shore placement. However, since barging and near shore placement is much cheaper, this report will include a rough estimate of the benefits.

The author spoke to a number of coastal engineers working for private consulting firms as well as for the Army Corps of Engineers. Craig Leidersdorf, of *Coastal Frontiers*, is probably the most knowledgeable. He estimated that the benefits of placing material in the near shore are about 20% to 50% of the benefits for an equivalent amount of material placed directly on the beach. This analysis employs a figure of 33%. Table 7.4 presents estimates of the value per cubic yard of near shore placement, which is roughly $10 per cubic yard.

Table 7.4: Value of Near Shore Placement for Carpinteria's Beaches

Beach Fill Amount (cy)	PV Recreation per cubic yard Placement on Beach	PV Recreation per cubic yard Near Shore Placement
50000	$ 31.73	$ 10.57
100000	$ 31.39	$ 10.46
150000	$ 30.73	$ 10.24
200000	$ 30.53	$ 10.18
250000	$ 30.16	$ 10.05
300000	$ 29.48	$ 9.83
350000	$ 29.00	$ 9.67
400000	$ 27.81	$ 9.27

Other Benefits

Another way to calculate the benefits of nourishment is to examine the economic impact. To estimate economic impact, this report used spending surveys taken at Carpinteria.[48] Table 7.5 summarizes the spending and taxes generated by nourishment. The amount of additional spending (which should not be confused with recreational benefits) is between $12 and $13 per cubic yard, substantially higher than the cost of transport. The taxes

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

generated at the State and local levels are roughly $1.50. If one included Federal taxes, the number would be closer to $4. However, it should be noted that most of this revenue represents substitution from other recreation—people who go to Carpinteria's beaches would likely have spent their money elsewhere (on movies, swimming pools, at other beaches). Nevertheless, it is useful to note these values.

Table 7.5: Increased Spending and Taxes from Nourishing Carpinteria's Beaches

Beach Fill Amount (cy)	PV Increased Spending	PV Spending per cubic Yard	PV Increased Taxes	PV Taxes per cubic Yard
50,000	$ 636,756	$ 12.74	$ 73,227	$ 1.46
100,000	$ 1,285,498	$ 12.85	$ 147,832	$ 1.48
150,000	$ 1,922,255	$ 12.82	$ 221,059	$ 1.47
200,000	$ 2,589,804	$ 12.95	$ 297,827	$ 1.49
250,000	$ 3,249,749	$ 13.00	$ 373,721	$ 1.49
300,000	$ 3,867,698	$ 12.89	$ 444,785	$ 1.48
350,000	$ 4,535,247	$ 12.96	$ 521,553	$ 1.49
400,000	$ 5,105,572	$ 12.76	$ 587,141	$ 1.47

Goleta

Table 7.5 summarizes calculations for the increased recreational value of nourishing Goleta beach. The final column presents estimates of the increase in recreational value per cubic yard, which ranges from $15.95 for 50,000 cubic yards to $11.74 for 250,000.[49]

Table 7.5: Value of Nourishing Goleta Beach

Beach Fill Amount (cy)	% Increased Width Year 0	Increased Day Use Value	Increased Recreation Value Year 0	PV Recreation Increase Years 0-5	PV Recreation per cubic yard
50,000	83%	$ 0.54	$ 334,797	$ 797,402.37	$ 15.95
100,000	167%	$ 0.88	$ 562,106	$ 1,431,760.76	$ 14.32
150,000	244%	$ 1.11	$ 727,889	$ 1,963,052.62	$ 13.09
200,000	328%	$ 1.29	$ 875,183	$ 2,496,826.04	$ 12.48
250,000	411%	$ 1.43	$ 1,000,451	$ 2,935,803.82	$ 11.74

[49] The results make sense since the additional value of each yard should decline due to diminishing marginal utility for beach width.

Other Benefits

Another way to calculate the benefits of nourishment is to examine the economic impact. The estimate below uses the same spending surveys used for Carpinteria for both day trippers and overnight visitors, but weighted these differently for Goleta since the vast majority of beach visitors at Goleta are day-trippers (in Carpinteria the mix is close to 50-50). Table 7.6 summarizes the spending and taxes generated by nourishment. The amount of additional spending is between $15 and $16 per cubic yard, substantially higher than the cost of transport. The taxes generated at the State and local levels are roughly $1.80. If one included Federal taxes, the number would be closer to $4.[50]

Table 7.6: Increased Spending and Taxes from Nourishing Goleta Beach

Beach Fill Amount (cy)	PV Increased Spending	PV Spending per cubic Yard	PV Increased Taxes	PV Taxes per cubic Yard
50,000	$ 776,791	$ 15.54	$ 89,331	$ 1.79
100,000	$ 1,542,454	$ 15.42	$ 177,382	$ 1.77
150,000	$ 2,271,946	$ 15.15	$ 261,274	$ 1.74
200,000	$ 3,079,319	$ 15.40	$ 354,122	$ 1.77
250,000	$ 3,814,400	$ 15.26	$ 438,656	$ 1.75

Rincon Parkway

Table 7.7 summarizes the calculations for the value of nourishing Rincon Parkway beach. The final column presents estimates of the increase in recreational value per cubic yard, which ranges from $2.05 for 50,000 cubic yards to $1.11 for 250,000.

Table 7.7: Value of Nourishing Rincon Parkway Beach

Beach Fill Amount (cy)	% Increased Width Year 0	Increased Day Use Value	Increased Recreation Value Year 0	PV Recreation Increase	PV Recreation per cubic yard
50,000	117%	$ 0.35	$ 28,903	$ 102,418.47	$ 2.05
100,000	233%	$ 0.53	$ 46,745	$ 148,359.21	$ 1.48
150,000	233%	$ 0.53	$ 46,745	$ 172,406.52	$ 1.15
200,000	333%	$ 0.64	$ 58,188	$ 222,917.70	$ 1.11
250,000	450%	$ 0.73	$ 68,752	$ 277,733.48	$ 1.11

[50] It may seem paradoxical that Goleta generates more tax dollars than Carpinteria, especially since Carpinteria's visitors spend more ($28) on average per day than Goleta visitors ($18). However, the estimated increase in visitors at Goleta is significantly greater, whereas at Carpinteria most of the increase in recreational benefits came from increase in day use value. The model also predicts some increase in attendance for Goleta.

Other Benefits

One other way to calculate the benefits of nourishment is to examine the economic impact. As with Goleta, surveys taken at Carpinteria were employed. The percentage of day trippers was assumed to be higher since the vast majority of beach visitors are day-trippers (in Carpinteria the mix is close to 50-50). Table 7.8 summarizes the spending and taxes generated by nourishment. The taxes generated at the State and local levels are minimal, ranging from $0.18 to $0.27. If one included Federal taxes, the number would be closer to $1, still very low.

Table 7.8: Increased Spending and Taxes from Nourishing Rincon Parkway Beach

Beach Fill Amount (cy)	PV Increased Spending	PV Spendingper cubic Yard	PV Increased Taxes	PV Taxes per cubic Yard
50,000	$ 117,920	$ 2.36	$ 13,561	$ 0.27
100,000	$ 189,889	$ 1.90	$ 21,837	$ 0.22
150,000	$ 229,830	$ 1.53	$ 26,430	$ 0.18
200,000	$ 326,285	$ 1.63	$ 37,523	$ 0.19
250,000	$ 449,266	$ 1.80	$ 51,666	$ 0.21

8.0 Conclusion

The central purpose of this study was to inventory sediment sources, and develop meaningful criteria to estimate the costs of moving opportunistic sediment to sediment-starved beaches and the recreational benefits of enhanced beach width at these beaches.

Tables 8.1 to 8.7 summarize the analysis in this report. It should be noted that the analysis only includes five years of benefits; it does not include any storm damage reduction benefits (which are likely to be small though not insignificant in the case of Carpinteria). Thus, our estimates are conservative.

Table 8.1 indicates that transporting sand to Carpinteria is cost-effective. Even an expensive hopper dredge yields a benefit cost ratio of over 3 if 150,000 cubic yards or more is moved. However, this report has found that moving dredge material by barge and placing it in the near shore is likely to be far more cost effective, yielding B/C ratios over 40.

It should be noted that the B/C ratio here contains a fair amount of uncertainty. First, it is difficult to precisely quantify the effect of near shore placement on beach width. Second, our analysis assumes that the turbidity created by using a hydraulic dredge to load barges does not become an issue. If the latter is not true, barging from Ventura or Channel Islands is only slight more expensive and would yields a very high B/C ratio also. Alternatively, one may have to employ screens to reduce turbidity, which would increase the costs somewhat but still yield high B/C ratios.

Table 8.1: Benefit/Cost Ratios for Transporting Dredge Sediment to Carpinteria

Beach Fill Amount (cy)	PV Recreation per cubic yard	Cost (CY) of Hopper Dredge from Ventura Harbor	Benefit Cost Ratio	Cost (CY) of Barging from Santa Barbara Harbor	PV (Near Shore Placement) Recreation per cubic yard	Benefit Cost Ratio
50,000	$ 33.72	$ 14.86	2.3	$ 0.25	$ 11.24	44.5
100,000	$ 33.36	$ 11.86	2.8	$ 0.25	$ 11.12	44.1
150,000	$ 32.66	$ 10.86	3.0	$ 0.25	$ 10.89	43.1
200,000	$ 32.45	$ 10.36	3.1	$ 0.25	$ 10.81	42.8
250,000	$ 32.05	$ 10.06	3.2	$ 0.25	$ 10.68	42.3
300,000	$ 31.33	$ 9.86	3.2	$ 0.25	$ 10.44	41.4
350,000	$ 30.82			$ 0.25	$ 10.27	40.7
400,000	$ 29.55			$ 0.25	$ 9.85	39.0

Table 8.2 presents the same data for Goleta beach. The analysis indicates that using a hopper dredge yields B/C ratios well below one. However, barging and placement near shore is likely to be cost effective.

Table 8.2: Benefit/Cost Ratios for Transporting Dredge Sediment to Goleta Beach

Beach Fill Amount (cy)	PV Recreation per cubic yard	Cost (CY) of Hopper Dredge from Ventura Harbor	Benefit Cost Ratio	Cost (CY) of Barging from Santa Barbara Harbor	PV (Near Shore Placement) Recreation per cubic yard	Benefit Cost Ratio
50,000	$ 15.95	$ 28.78	0.55	$ 0.35	$ 5.31	15.0
100,000	$ 14.32	$ 25.78	0.56	$ 0.35	$ 4.77	13.5
150,000	$ 13.09	$ 24.78	0.53	$ 0.35	$ 4.36	12.3
200,000	$ 12.48	$ 24.28	0.51	$ 0.35	$ 4.16	11.8
250,000	$ 11.74	$ 23.98	0.49	$ 0.35	$ 3.91	11.1

Table 8.3 presents the data for Rincon Parkway. The analysis indicates that using a hopper dredge yields B/C ratios well below one. However, barging and placement near shore yields B/C ratios greater than one, though lower than at the other two sites.

Table 8.3: Benefit/Cost Ratios for Transporting Dredge Sediment to Rincon Parkway

Beach Fill Amount (cy)	PV Recreation per cubic yard	Cost (CY) of Hopper Dredge from Ventura Harbor	Benefit Cost Ratio	Cost (CY) of Barging from Santa Barbara Harbor	PV (Near Shore Placement) Recreation per cubic yard	Benefit Cost Ratio
50,000	$ 2.05	$ 12.79	0.16	$ 0.36	$ 0.68	1.90
100,000	$ 1.48	$ 9.79	0.15	$ 0.36	$ 0.49	1.38
150,000	$ 1.15	$ 8.79	0.13	$ 0.36	$ 0.38	1.07
200,000	$ 1.11	$ 8.29	0.13	$ 0.36	$ 0.37	1.04
250,000	$ 1.11	$ 7.99	0.14	$ 0.36	$ 0.37	1.03

Table 8.4 summarizes the benefit/cost ratios for transporting 50,000 cy of sediment from dams and debris basins to Carpinteria. While these numbers are far smaller than the B/C ratios for moving dredge material, (largely due to the higher cost of sorting and transporting the sediment) many sites yield B/C ratios greater than one. If dredge material is not available for legal, environmental or other reasons, then using material from dams and debris basins may be good policy. However, this report recommends that State, local and Federal policy makers look more closely at using dredge material from harbors first, given the extremely high B/C ratios.

Table 8.4: Benefit/Cost Ratios for Transporting Dam/Debris Basin Sediment to Carpinteria

Debris Basins/Dam	Distance to Carpinteria (miles)	Net Cost	Cost plus Sorting	PV Rec Benefit (CY)	Cost Benefit (CY)
Arroyo Paredon	8.3	$ 0.11	$ 4.61	$ 33.72	7.31
Cold Springs Creek	33.2	$ 8.82	$ 13.32	$ 33.72	2.53
Gobernador Creek	7.6	$ (0.14)	$ 4.36	$ 33.72	7.73
Lower West Toro Creek	15.3	$ 2.56	$ 7.06	$ 33.72	4.78
Romero Creek	21.5	$ 4.73	$ 9.23	$ 33.72	3.65
Upper West Toro Creek	18.1	$ 3.54	$ 8.04	$ 33.72	4.19
Bradbury	130.5	$ 42.88	$ 47.38	$ 33.72	0.71
Twitchell	335.5	$ 114.63	$ 119.13	$ 33.72	0.28

Table 8.5 summarizes the benefit/cost ratios for transporting 50,000 cubic yards of sediment from selected dams and debris basins to Goleta beach. Two of these B/C ratios are higher than the best B/C ratio for moving dredge material (2.26) from Santa Barbara harbor. This indicates that using opportunistic sediment from select debris basins may be sound policy for Goleta beach.

Table 8.5: Benefit/Cost Ratios for Transporting Dam/Debris Basin Sediment to Goleta Beach

Debris Basins/Dam	Distance to Goleta (miles)	Net Cost	Cost plus Sorting	PV Rec Benefit (CY)	Cost Benefit (CY)
Cold Springs Creek	38.9	$ 10.82	$ 15.32	$ 15.95	1.04
Maria Ygnacio - East	11.9	$ 1.37	$ 5.87	$ 15.95	2.72
Maria Ygnacio - Main	10.9	$ 1.02	$ 5.52	$ 15.95	2.89
San Antonio Creek	25.3	$ 6.06	$ 10.56	$ 15.95	1.51
San Roque Creek	15.8	$ 2.73	$ 7.23	$ 15.95	2.21
Santa Monica	106.5	$ 34.48	$ 38.98	$ 15.95	0.41
Sycamore Canyon Dam	29.2	$ 7.42	$ 11.92	$ 15.95	1.34
Bradbury	71.1	$ 22.09	$ 26.59	$ 15.95	0.60
Twitchell	374.1	$ 128.14	$ 132.64	$ 15.95	0.12

Tables 8.6 and 8.7 summarize the benefit/cost ratios for transporting 50,000 cy of sediment from selected dams and debris basins to Rincon Parkway beach. None of these sites yields a B/C ratio higher than 0.1 and this report suggests this potential activity be rejected.

Table 8.6: Benefit/Cost Ratios for Transporting Debris Basin Sediment to Rincon Parkway

Debris Basin	Distance to Rincon (miles)	Net Cost (Cubic Yard)	Cost plus Sorting	PV Rec Benefit (CY)	Cost Benefit (CY)
Adams	78.2	$ 24.57	$ 29.07	$ 2.05	0.07
Cavin Road	140.6	$ 46.41	$ 50.91	$ 2.05	0.04
Coyote Canyon	95.6	$ 30.66	$ 35.16	$ 2.05	0.06
Crestview	91.4	$ 29.19	$ 33.69	$ 2.05	0.06
Edgemore	94.1	$ 30.14	$ 34.64	$ 2.05	0.06
Fagan	85.3	$ 27.06	$ 31.56	$ 2.05	0.06
Ferro	77.9	$ 24.47	$ 28.97	$ 2.05	0.07
Fox Barranca	95.9	$ 30.77	$ 35.27	$ 2.05	0.06
Franklin	65.1	$ 19.99	$ 24.49	$ 2.05	0.08
Gabbert Canyon	112.8	$ 36.68	$ 41.18	$ 2.05	0.05
Honda West	92.1	$ 29.44	$ 33.94	$ 2.05	0.06
Jepson	118.4	$ 38.64	$ 43.14	$ 2.05	0.05
Real	152.2	$ 50.47	$ 54.97	$ 2.05	0.04
St. Johns	105.4	$ 34.09	$ 38.59	$ 2.05	0.05
San Antonio	75.6	$ 23.66	$ 28.16	$ 2.05	0.07
Santa Rosa	116.3	$ 37.91	$ 42.41	$ 2.05	0.05
South Branch Arroyo Conejo	129.9	$ 42.67	$ 47.17	$ 2.05	0.04
Stewart	69.7	$ 21.60	$ 26.10	$ 2.05	0.08
Tapo Hills #1	157.0	$ 52.15	$ 56.65	$ 2.05	0.04
Tapo Hills #2	156.1	$ 51.84	$ 56.34	$ 2.05	0.04
Warring	152.3	$ 50.51	$ 55.01	$ 2.05	0.04
W. Camarillo East	93.3	$ 29.86	$ 34.36	$ 2.05	0.06
W. Camarillo West	91.2	$ 29.12	$ 33.62	$ 2.05	0.06

Table 8.7: Benefit/Cost Ratios for Transporting Dam Sediment to Rincon Parkway

Dam	Distance to Rincon (miles)	Net Cost	Cost plus Sorting	PV Rec Benefit (CY)	Cost Benefit (CY)
Arundell Dam	51.2	$ 15.12	$ 19.62	$ 2.05	0.10
Las Llajas Canyon Dam	160.8	$ 53.48	$ 57.98	$ 2.05	0.04
Las Posas Estates Dam	92.4	$ 29.54	$ 34.04	$ 2.05	0.06
Matilijia	82.0	$ 25.90	$ 30.40	$ 2.05	0.07
Ramona Dam	88.7	$ 28.25	$ 32.75	$ 2.05	0.06
Runkle Canyon Dam	156.0	$ 51.80	$ 56.30	$ 2.05	0.04

Policy Recommendations

The analysis contained in this report indicates that State, local and Federal policy makers should first begin by looking at dredge material from the Corps of Engineers. This material is generally beach compatible, and most of it is already going to beaches with lower recreational value. Further, after over a dozen interviews with Corps officials, engineers from private consulting firms as well as individuals from construction companies involved in dredging, this report concludes that using a barge and placing material in the near shore is likely to be the most cost effective policy. As a first step, the State should conduct a number of pilot projects to monitor the movement of sediment on shore as well as subsequent recreational benefits.

The use of a hopper dredge is cost effective in some cases as well, though less so than barging and placing material near shore. Further, the costs of using a hopper dredge to move opportunistic sediment are likely to be similar to, or even possibly higher than, current nourishment projects, which would likely cost $10-$15 per cubic yard.

Overall this report recommends the following:

1) Placing dredge material near-shore to sediment-depleted beaches is the most cost effective policy. Although benefits of near-shore placement are lower than placement onshore, the costs of barging and placing sediment near-shore are much lower and thus the benefit/cost ratio is much higher. Pumping onshore from hopper dredges or barges adds significantly to the expense and yields cost per cubic yard, which are not significantly cheaper than traditional nourishment projects.

2) The use of opportunistic sediment for near shore placement is significantly cheaper than traditional nourishment projects, which cost approximately $10 per cubic yard. The use of opportunistic sediment placed near-shore can cost less than $0.50 per cubic yard. Even assuming that material placed in the near shore yields one-third of the benefits of that placed on shore, the benefit/cost ratio of near shore placement is *much* higher. This difference could save taxpayers millions of dollars per nourishment cycle.

3) Given the limited experience with near-shore placement, this report recommends that the State fund a demonstration project that carefully monitors the movement of sand from the near shore to nearby beaches and throughout the littoral cell.

4) The benefits transfer (BT) function developed in this paper needs to be refined further. A standard benefits transfer function for the State of California would be useful for many policy makers involved in managing coastal resources, not just nourishment projects. Congestion and parking constraints also need to be added to such a model.

5) Ultimately, the State, in cooperation with local and Federal government agencies, should develop protocols for moving opportunistic sediment to sediment depleted beaches where cost effective.

6) The Corps should continue to work with State and local policy makers to use opportunistic sediment from dredge material at Ventura, Santa Barbara and Channel Islands harbor. Although the Corps is mandated to use the lowest cost disposal technique, this mandate should not preclude policies that would ultimately improve the quality of life for Californians and also save the taxpayer money. Some details must be negotiated between Federal, State and local stakeholders—who will pay the differential cost, environmental restrictions, etc., but the benefits of these policies are high relative to the costs.

7) Local sources of sediment from debris basins should also be considered, especially for Goleta. Some of this material has already been used in Goleta and Carpinteria.

8) Other sediment-starved beaches in California should be examined and the use of opportunistic sediment should be studied in more detail, including a more careful examination of recreational benefits. Given the very high B/C ratios this study has found, it is likely that other sediment starved areas in the State, notable north San Diego County, would also be good candidates for the use of opportunistic sediment. Although some local costs (e.g., trucking) may vary from region to region within the State, the basic methodology used here can be extended to other regions in the State.

Limits of Study

This study is the first of its kind. Although the author is reasonably confident about the general conclusions, more study is needed in some areas. In particular:

- More study of the benefits of beach nourishment is needed. *The Southern California Beach Project* has an extensive analysis of beach visitation and amenities. Unfortunately the analysis does not consider beach width, nor does it consider out of state (or foreign) visitors. *The Southern California Beach Project*'s analysis should be extended so that the data can be used in a meaningful way to analyze the recreational benefits of beach nourishment.
- Better attendance data is also needed.
- A better understanding of the coastal processes involved is essential. In particular knowledge of sand movements on and off shore within a littoral cell. Since this is an economic study, this research is beyond its scope.

As a result of a request by CSMW members, Dr. King's report ("Report") has been peer reviewed by Dr. Linwood Pendleton and Linda Lent (USACE). The concerns raised in these reviews will be addressed in a later report. In particular, the Benefits Transfer (BT) portion of the report needs to be refined and given more micro-foundations and better empirical support. The BT analysis was meant to be preliminary and needs to be improved before a full tool is developed for use by policy makers

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