The Distribution of Shore Protection Benefits
A Preliminary Examination

DRAFT

U.S. Army Corps of Engineers, Institute for Water Resources

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Preface

This report, "The Distribution of Shore Protection Benefits: A Preliminary Examination" was prepared by the Army Corps of Engineers in response to a request by the U.S. Office of Management and Budget (OMB). The Army Corps of Engineers was requested to review existing shore protection related literature and studies to identify information that might assist in making future budgetary and cost sharing decisions relating to the Corps' shore protection program.

The OMB expressed concern that the report does not provide an acceptable basis for policy-making, and that further studies are needed. The Corps intends to conduct those further studies on this subject as part of the more comprehensive National Shoreline Management Study that was recently initiated.

While this report adds significantly to the limited professional literature on this important subject of how benefits from shore protection projects are distributed, it is a preliminary effort. As such, it does not represent an official position on the subject and may be modified as the result of further studies.

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This report was the product of collaboration of many individuals both within the Corps of Engineers and a number of academic researchers and professional analysts. We would like to thank them for their assistance and to recognize their contributions here.

A number of Corps staff members assisted by providing information and insights regarding specific shore protection projects.

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The U.S. Army Engineer Institute for Water Resources provided technical and management support for this report. Dr. Eugene Stakhiv directed the effort as Chief of the Policy and Special Studies Division. The Director of the Institute for Water Resources is Mr. Robert Pietrowsky. Ms. Anne Sudar provided technical assistance and data collection. Ms. Lynn Martin, Mr. Ted Hillyer and Dr. David Moser reviewed several draft versions of the report and provided comments and suggestions that improved the structure and content of the study.

Executive Summary

The President's fiscal year (FY) 2002 budget proposed to increase the non-Federal cost share for the beach re-nourishment component of shore protection projects. Presently, the existing cost-sharing formula for the nourishment portion of beach nourishment projects is generally 65 percent Federal and 35 percent non-Federal for projects authorized in the Water Resources Development Act of 1999 or prior to that. For projects authorized after the 1999 Act, cost sharing is generally 50 percent Federal and 50 percent non-Federal for practical purposes although there is a "phase-in" period.

The President's proposed FY 2003 formula called for reversing the percentages to require 35 percent of the re-nourishment project costs to be funded by the Federal government and 65 percent from the non-Federal sponsor. The new formula would not only be applied to recommendations for authorizations of future re-nourishment projects, but it would also be applied to those projects that have been authorized but not completed and existing projects with continuing re-nourishment requirements. This change was made to more appropriately reflect the distribution of economic benefits that shore protection projects provide to State and local sponsors. In addition, the Administration wants to ensure that the Federal government's long-term nourishment obligations do not "crowd-out" other important Federal expenditure needs.

In order to ensure that the Administration's proposal to increase the local share of the costs for the beach re-nourishment component of shore protection projects is based on sound reasoning and empirical observation, the U.S. Office of Management and Budget (OMB) is interested in determining,

- Who benefits from shore protection projects?
- What is the distribution of project benefits?
- Do increases in tax revenues that stem from Federal shore protection projects affect the capacity of non-Federal sponsors to pay for the projects?

An internal review within OMB found insufficient information to address these questions. As a result, the U.S. Army Corps of Engineers Institute for Water Resources (IWR) was asked to address the questions above. In its investigation, IWR reviewed available

- Shore protection project reports from the Corps and other agencies,
- Academic and professional studies of beach economies,
- Literature on environmental effects of shore protection projects,
- Information concerning fiscal effects (tax revenues and transfers) of shore protection projects, and
- Information on the extent and nature of State and local participation in cost sharing for shore protection.

ES.1 Results of the Literature Review

Summary of Shore Protection Environmental Effects: Although Corps beach projects do not extend beyond historical beach limits, the introduction of a large volume of sand into a beach area can result in significant physical changes, including subaerial changes in sand composition and attributes and subtidal changes in sedimentation, turbidity and water quality. However, studies monitoring the effects of beach nourishment projects have shown no significant long-term impacts on the environment.

In the short-term, beach nourishment activities may detrimentally affect organisms that inhabit the beach area; however, the plant and animal species in beach environments are adapted to survive environmental changes created by the natural cycle of sand erosion and accretion. These changes are experienced on a daily basis with the tides. The natural changes also occur on a seasonal basis as the beaches experience rapid, extensive retreat during the winter storm events and as beaches gradually and progressively rebuild during lower and longer waves between storm events. The results of biological monitoring programs indicate that the effects of beach nourishment projects on littoral organisms are short-lived.

The adverse environmental effects of the beach nourishment projects are minimized or avoided altogether through the use of sound management practices, such as using fill material that is well suited to the existing beach, installing silt screens where necessary, timing nourishment activities to avoid interfering with the nesting season for various species, and dredging borrow material in thin layers and/or strips rather than deep holes.

Many beach nourishment projects have also had beneficial environmental effects. For example, nourished beaches can create new nesting areas for endangered sea turtles, spawning grounds for horseshoe crabs and habitat for piping plover and least terns.

Summary of State and Local Cost-sharing Participation: Five states were surveyed as to their participation in the non-Federal share of Corps beach nourishment projects, with the following results: California—85% to 100%; Florida—50%; Delaware—100%; New Jersey—75%; and North Carolina—75%. The sources of state funding for beach nourishment varies from state legislature appropriations (California, Florida, and North Carolina), a real estate transfer tax (New Jersey), and to an accommodation tax (Delaware). The remaining non-Federal share of the project costs is usually paid by the local community.

Summary of Tourism Data: This study reports the most current data available on beach tourism for the states of Florida, California, Texas, New Jersey, and North Carolina. Data reported include the origin and destination, activities, and demographic attributes of beach visitors in each state. Beach tourism data was generally available through either a state economic development agency, a state department of tourism, or through academic research conducted by one of the state universities. In some cases, beach related tourism data was not reported independent of other types of tourism. In

other cases, detailed recreation data was available for one or two beaches in a state, but not for all beaches statewide.

Summary of the Distribution of Shore Protection Benefits: Regional economic development (RED) benefits are generally not examined in Corps shore protection project reports. However, Section 220 of WRDA 2000 and subsequent implementation guidance directs that all Corps studies consider, and evaluate and display (if appropriate), all potential project benefits for shore protection; including hurricane and storm damage reduction benefits, environmental protection and restoration benefits, and recreation benefits. In addition, Corps Districts are encouraged to be receptive to requests from non-Federal sponsors to include in feasibility studies the evaluation of benefits not normally considered, including those that are regional and local in nature. The distribution of national economic development (NED) benefits amongst beneficiaries is not found in Corps shore protection project reports. Academic and professional studies of the economic effects of beaches

- Examine the distribution of beneficial effects from a regional perspective
- Assume that impacts (income, tax revenues, employment, etc.) attributed to the rest of the nation would not otherwise occur in the absence of beaches
- Do not identify all elements of RED benefits of beach economies
- Are inconsistent with one another in terms of impacts that are measured and the methods used to measure them

Consequently, the present literature does not adequately address the issues of the distribution of shore protection benefits.

ES.2 Analysis of the Distribution of Shore Protection Benefits

IWR undertook this study to evaluate the distribution of both the national and regional economic development benefits of a shore protection project. The NED benefits considered included storm damage reduction benefits, recreation benefits, and other NED benefits (i.e., reductions in maintenance and emergency costs). RED benefits of shore protection are defined as the change in "net value added" resulting from subsequent recreational activities associated with alternative project plans. Net value added is the sum of employee compensation, proprietors' income, property income, and indirect business taxes (value added) adjusted for the transfers of commuters' income and tax revenues and for the local costs of managing and maintaining the beaches.

Distributing NED Benefits of Shore Protection Projects: NED benefits are distributed as follows in this study: storm damage reduction benefits are distributed according to the residence patterns of the affected property owners, recreation benefits are distributed by the residence patterns of the beach users, and other NED benefits are assigned to the area outside the beach region (i.e., the rest of the nation).

The distribution of shore protection benefits was analyzed using a hypothetical beach new nourishment project that has a "dry sand" (dry beach area above the mean

high water level) component that is one mile long by 100 feet wide. Quantities of sand were estimated that would not only create the "dry sand" component but also would extend out beyond the shoreline for storm damage protection and recreation. It was determined that the amount of sand needed to provide the appropriate level of shore protection varies according to the intensity of wave action on the beach. A "low" energy beach with our hypothetical configuration requires 500,000 cubic yards of sand and a "high" energy beach requires 700,000 cubic yards of sand. A middle quantity of sand (600,000 cubic yards) was used for the hypothetical beach nourishment project. Average annual benefits per cubic yard of sand for each of the NED benefit categories (i.e., for storm damage reduction, recreation, and other NED benefits) were estimated based on sand quantities and benefits for a sample of completed and authorized Corps beach nourishment projects. Storm damage reduction benefits and other NED benefits were based on the total amount of sand used for the hypothetical new nourishment project. Recreation benefits were based on the quantity of sand used for the "dry sand" portion of the nourishment project. The NED benefits for each benefit category of the hypothetical nourishment project were estimated by multiplying the estimated quantities of sand by the average annual benefits per cubic yard of sand for completed and authorized Corps shore protection projects. Total estimated average annual NED benefits for the hypothetical project are estimated to be $1.65 million ($920,000 for storm damage reduction benefits, $609,000 for recreation benefits, and $123,000 for "other" NED benefits). Not having access to empirical data for a real beach nourishment project, the parameters concerning the proportion of property owner and beach users residing in the beach region were estimated based on data for a coastal county reflecting a "typical" regional setting. The residential patterns were either estimated with data from the 2000 Census of Population or borrowed from selected past studies of beach economies. Based on the NED benefit estimates above and the derived beach parameters, it is estimated that approximately one-third of the NED benefits accrue to the beach region and two-thirds to the "rest of the nation" region.

Two other coastal regions were chosen to provide the residential patterns for property owners and beach users for simulation purposes. These regions were selected to provide a range of parameter values that reflect a much more "rural" beach region and a much more "urban" beach region. When the type of region in which the beach is located is considered (i.e., the residential patterns of property owners and beach users are different for the "typical", rural, and urban beach regions), the distribution of NED benefits differs to some extent. The findings indicate that approximately half of the NED benefits accrue locally for the rural beach region and about 40 percent of the NED benefits would accrue locally to the urban beach region.

The NED benefits of shore protection accruing locally not only varied between one-third and one half, they also failed to be consistent for the beach regions considered; the local proportion of NED benefits was greater for both the rural and urban regions than for the "typical" beach region. Given the variability found here, it is extremely important to understand that the distributional patterns of the NED benefits for shore protection projects depend on the residential patterns of the property owners and the beach users. These patterns are specific to each community and, as a consequence, the distribution of

NED benefits is also site-specific for each project. It should be noted that the NED benefit estimates for the "low" energy beach were smaller than for the hypothetical nourishment project and larger for the "high" energy beach, as would be expected, because the NED benefit estimates were related to the quantity of sand. However, the distribution of benefits between the beach region and the rest of the nation did not change much.

The effect of increased beach visitation due to the nourishment project on the distribution of NED benefits was evaluated; increases in visitation considered were 0, 5, 10, 15, 20, and 25 percent. Increases in visitation are partially based on the capacity of the hypothetical beach nourishment project. In addition, only real increases in visitation on peak visitation days are attributed to NED benefits. Corps District staff reported a variety of "unit-day" and "travel cost" method values that have been used when visitation is expected to increase due a beach nourishment project; "beach experience" values have typically varied between $2 and $5 under the "with project" conditions. However, another Federal agency indicated that their unit-day values for beach experiences are in the $15 to $20 range. Increases in visitation raised the level of NED benefits but had little effect on the distribution of NED benefits, regardless of the unit-day value.

Distributing RED Benefits of Shore Protection Projects: RED benefits are distributed to the beach region and to the rest of the nation according to the net value added impacts that occur in each of the respective regions due to spending of tourists at the beach. However, the net value added impacts that occur in each region are measured from each region's point of view. Consequently, the RED benefits for the beach region are the net value added impacts within the beach region due to spending by all beach visitors residing outside the beach region. The RED benefits for the "rest of nation" region are those net value added impacts occurring in the rest of the nation due to beach spending by foreign beach visitors only.

The RED analysis was carried out under several assumptions. First, it is assumed (for RED only) that the unemployment rate is not zero. This has the effect of permitting resources to flow between regions without negative impacts to occur in locations where the resources originated. Second, it is assumed that people's propensity to consume out of their incomes does not change due to the existence of a beach or because of a nourishment project. This means that the money spent at the beach will be spent whether a beach exists or not. If the beach is not available, then the users will spend their money on something else. The assumption also implies that any impacts (jobs, income, etc.) that might occur due to beach spending will occur in any event. At the local level, an exception to this assumption occurs when local beach users substitute going to a local beach for visits to beaches located outside the beach region. On a national level, foreign visitors may change the length of stay within the country or not come the U.S. at all (i.e., spend less money within the U.S.) if beaches are not available.

The net value added impacts (or RED benefits) for both the beach region and the rest of the nation were computed using a regional input-output analysis of recreational spending by visitors to the beach. To simulate the net value added effects of the existing

beach on the economies of the beach region and the "rest of the nation" region, the net value added effects of one million beach visits per year by outside tourists during the year were evaluated. The decision to use "one million" beach visits by outside tourists was made to simulate the importance of the existing beach on the economy of the respective region and to demonstrate the procedures that were used to compute the net value added impacts and their distribution between the beach region and the rest of the nation.

On average for the "typical" region, it is estimated that one million outside beach visitors annually spend $88.1 million within the beach region. Of that total, $49.9 million is a direct economic stimulus to the beach region economy. The cumulative economic "ripples" created by the direct stimulus result in an estimated total economic impact on local businesses of $71.5 million per year. In addition to other economic resources required for these economic "ripples" to occur, a total of almost 2,000 full-time jobs are created annually who are paid an estimated $25.5 million in wages and salaries. Total value added (or gross regional product) created per year by these economic changes is $48.3 million. It is estimated that the local workers who commute from places outside the beach region take $5.8 million of the value added with them. Also, it is estimated that $12.3 million in State and Federal taxes accrue each year outside the beach region. The beach community is estimated to incur just under $2.0 million in beach management and maintenance costs annually to support the beach activity. All together, the net value added effect on the beach region is $28.2 million. Computed in a similar fashion, the net value added effect on the rest of the nation due to beach spending by foreign tourists is estimated to be $31.9 million annually. Taken together, approximately 47 percent of the RED benefits or net value added effects are expected to accrue to the "typical" beach region and 53 percent to the rest of the nation. However, if the beach had been located in the rural region then approximately 40 percent of the RED benefits would accrue locally, while half of the RED benefits would accrue locally if the beach were in the urban region.

The effects on the distribution of RED benefits due to increases in visitation stemming from the hypothetical new beach nourishment project were analyzed; specifically resulting from incremental increases in beach visitation of 0, 5, 10, 15, 20, and 25 percent. It is assumed that increases in visitation are based on the capacity of the hypothetical beach nourishment project. However, instead of only considering increases in visitation during peak visitation days (for NED benefits), increases in visitation for the entire year are evaluated for RED benefits. Because input-output is mathematically "linear", all impacts resulting from increases in visitation are proportional to the change in visitation relative to existing visitation levels (i.e., one million outside beach visits). Consequently, the magnitude of the net value added effects increases in proportion to the increase in beach visitation, however, the distribution of RED benefits does not change.

A number of beach officials have indicated that beach visitation may not initially change as beaches are not nourished and allowed to erode. However, it appears that the mix of beach visitors and activities do change. It has been casually observed that the new visitors use the beaches differently; they use the beach more during low tide and less during high tide, they camp more and stay in "expensive" hotels and motels less; they

dine in restaurants less frequently, etc. These changes mean that "fewer" dollars flow into the beach economy and the RED effects are smaller as a consequence. These effects were simulated by determining what would happen if the outside beach visitors to the "typical" beach region behaved like the outside beach visitors to the rural beach region. That is, rather than the million outside beach tourists now spending $88.1 million per year, they will spend $66.7 million per year. It is also assumed that the pattern of expenditures will change accordingly. Relative to the "typical" situation, the drop in spending by outside tourists will mean a drop in RED benefits by $8 million both for the beach region and for the rest of the nation.

Local Fiscal Effects of Beach Nourishment Projects: Local tax revenues generated by recreation-related activities at existing beaches may be larger than required to fund related beach management and maintenance costs. The implication is that beaches have more than enough money to fund the additional non-Federal cost-share for the beach re-nourishment component of the shore protection program. However, even if local tax revenue collected are greater than needed to cover beach management and maintenance costs, the "excess" revenues are probably being currently used to help fund other important local public services and, therefore, they may not readily available to fund an increase in the non-Federal cost-share.

However, the local tax revenues that are collected as a result of "new" beach visitation due to the hypothetical beach nourishment project could be used to fund the increased non-Federal cost share. The non-Federal cost share of 65 percent of the project costs as recommended in the President's FY'02 budget was calculated by applying an assumed "cost-benefit" ratio of 2.0 to the estimated total NED benefits that result from increases in visitation due to the hypothetical beach nourishment project; increases in visitation considered are 0, 5, 10, 15, 20, and 25 percent. There are various methods that non-Federal sponsors use to fund their share of the project costs. One method of funding the non-Federal cost share is to "float" a municipal bond to be paid for in annual increments over a period of time (for example, 20 years). The total cost of the bond includes not only the principle (i.e., the non-Federal cost share) but also the interest that would accrue for the period of the bond. The bond is assumed to have a 5 percent annual interest rate compounded annually (the September 2001 rate of interest for 20-year State and local general obligation bonds is 5.09 percent). If no "new" visitation is induced by the hypothetical beach nourishment project or if the quality of the beach experience is not improved, then there will be no additional local tax revenues available to fund any of the non-Federal cost-share (even to cover the existing 35 percent cost share requirement). Under the increased visitation scenarios for the "typical" beach region, annual excess local tax revenues collected would be less than the annual cost of a bond to fund the increased non-Federal share of the hypothetical project costs for all increases of visitation considered. Even if the "typical" beach region's project benefit/cost ratio was as large as 3.0, the annual excess local tax revenues are still less than the annual cost of the bond for the "typical" beach region. If the State in which the beach and the "typical" region are located paid 75 percent of non-Federal cost-share (as some States do), the annual excess local tax revenues would still be less than the annual bond cost for 25 percent of the non-Federal cost-share. Even if a 50 percent non-Federal cost-share were instituted and the

State paid 75 percent, the annual excess local tax revenues would be less than the annual cost of the bond for any increase in visitation considered (0, 5, 10, 15, 20, and 25 percent).

Note that annual local tax revenues in the rural region are estimated to be less than annual beach management costs for all increases in beach visitation. Therefore, there are no expected excess local tax revenues collected to help fund the non-Federal share of project costs in these areas. In addition, urban regions would also be unable to pay for the entire non-Federal cost-share based on the annual excess local tax revenues collected due to any of the increases in visitation considered. However, if the State participated in the hypothetical beach nourishment project and pays 75 percent of the non-Federal cost-share, then visitation will need to increase in the range of 15 to 20 percent in order for the annual excess local tax revenues to be greater than the annual bond cost (if the non-Federal cost-share is 65 percent for the urban region). If the non-Federal cost-share is 50 percent and the State pays 75 percent, then beach visitation would need to increase in the range of 10 to 15 percent before annual excess local tax revenues are greater than the annual bond cost for the urban region.

Finally, if the hypothetical beach nourishment project were not implemented and the beach were allowed to erode initially, there appears to be concern that the fiscal conditions within the beach region might degrade; not so much because visitation will decline but because spending by tourists will decline. If, for example, outside beach visitors to the "typical" beach region were to spend and behave similar to those in a rural region, then the amount of local tax revenues collected will drop. In this case, they are estimated to drop to a level just above that needed to cover the beach management and maintenance costs. It is not asserted that these changes reflect any actual events. However, they might reflect the possible concerns of public officials responsible for managing and maintaining beaches.

ES.3 Conclusions

- **Due to the sensitivity of the estimated shares of NED and RED benefits that accrue locally, it is important not to "generalize" the results provided here.** The findings here depend on the specific parameter values that are used in the analysis. These parameters have been chosen from selected studies of beach economies. Also, the regions used in the analysis, although real coastal counties that contain beaches, are chosen based their representative characteristics of average, rural, and urban coastal counties. Specific results and conclusions of the present study may change substantially with better information. The shares of NED and RED benefits that accrue locally could be computed on a "case-by-case" basis when projects are evaluated. A more comprehensive study of the distribution of the benefits of shore protection projects could be undertaken with one of its purposes to produce more general results than provided here.

- **National cost sharing decision should not be made based on the subjective findings and hypothetical situations portrayed in this study.** The analysis

included many assumptions and hypothetical scenarios in order to demonstrate a methodology that could be used to analyze individual beach project situations, if pertinent data could be developed and collected. The methodology appears to warrant further development and application in establishing a reasonable distribution of shore protection benefits in regard to where beneficiaries live and the origin of visitors to the beaches.

- **For the "typical beach area" considered and the geographic distributions of the primary residence of beach property owners and beach users, approximately 35 percent of the national economic development benefits (storm damage reduction benefits, recreation benefits, and other NED benefits) from a beach nourishment project accrue to people within the beach region and 65 percent accrue to people who reside elsewhere.** The "typical" beach region was used because it reflected an average regional setting for which the great majority of Corps shore protection projects are located. However, considering more rural or more urban beach settings (regions), higher percentages of NED benefits (as high as 50 percent for a rural beach region) were found to accrue to people locally. Examining the business opportunities related to associated recreational activities, about 47 percent of the regional economic development benefits accrued to people residing in the "typical" beach region and 53 percent elsewhere. The local percentage of RED benefits varied between 40 and 50 percent for the rural and urban regions considered.

- **Periodic beach re-nourishment often has beneficial environmental effects.** Many Corps beach nourishment projects have produced environmental benefits, such as providing new nesting area for sea turtles, spawning grounds for horseshoe crabs, and habitat for piping plover, least terns and sea-beach amaranth.

- **The most current and comprehensive monitoring of the environmental effects of beach nourishment projects indicate that nourishment projects have no significant impacts in the long-run, when appropriate management practices are exercised, as established by Corps regulations and guidelines.** The plant and animal species existing in littoral areas are adapted to survive in the dynamic environment created by the natural cycle of sand erosion and accretion.

- **Properly engineered and constructed beach nourishment projects avoid potential adverse environmental impacts.** In doing the literature search for this study of the potential environmental consequences of nourishment projects, it became apparent that the Corps has developed extensive expertise and general procedures for avoiding potential adverse environmental consequences due to the many years of experience in designing and constructing these types of projects.

- **While beach nourishment does accelerate certain dynamic processes that can tax the capacity of species to adapt, Corps engineering guidelines specify the use of engineering and monitoring practices to avoid detrimental impacts.** Practices employed by Corps engineers include planting beach plants to replace

damaged plants and create pedestrian barriers, conducting construction activities in the fall and winter season to avoid interfering with nesting and spawning season for near shore and beach animals, using sand that is closely matched to sand on the existing beach, establishing buffer zones around reefs and other sensitive habitats near the borrow site to prevent damage from turbidity or physical contact during dredging, monitoring turbidity levels and implementing dredging operations designed to minimize turbidity

- **With no increase in recreation visitation induced by a project and when there is no improvement in the quality of the beach experience, the increase in regional benefits is zero.** Many Corps feasibility studies anticipate no increase in tourism that satisfies unmet recreational demand with a Federal shore protection project. The regional economic benefits are tied to the related expenditures that beach visitors bring to the beach community. Without new infusions of money, there will be no regional economic impacts induced by a shore protection project.

- **The impact of a hypothetical one million recreation visitors from outside the beach region was shown in order to provide a perspective of the existing value of tourism to beach communities with approximately 2-3 million in total annual visitations.** The analysis of the hypothetical million outside recreation visitors was also to demonstrate and test the methodology used to evaluate the regional economic development benefits of shore protection projects.

- **Increases in recreation visitation induced by a beach nourishment project generate corresponding increases in potential regional economic benefits.** Increases in visitation in the of 0 to 25% were found to result in potential regional economic gains in the range of 0 to 10.7%

- **All 5 states surveyed participate in cost sharing the non-Federal share of Federal and even local projects.** However, the extent to which States participate in cost sharing with the non-Federal sponsors of shore protection projects varies. There are also a wide variety of funding mechanisms used by States and local communities to fund the non-Federal share of shore protection projects.

- **Given the variability of NED benefits for shore protection that accrue locally, it is extremely important to understand that the distributional patterns of the NED benefits for shore protection projects depend on the residential patterns of the property owners and the beach users.**

- **The fiscal capacity of State and local sponsors to fund the President's proposed 65 percent non-Federal share of re-nourishment costs will not improve if beach nourishment projects do not increase beach visitation or if the quality of the beach experience is not improved.** Beaches that do not experience increases in visitation as a result of nourishment projects will not experience any regional economic impact because lack of new visitation will not

generate any new spending for recreation. Local tax revenues, one of the impact elements affected beach visitor spending, will also not change. As a result, no additional funds would be available to help fund any increases in the non-Federal cost-share.

- **Although increases in visitation at beaches located within "typical" beach regions due to beach nourishment will likely increase annual local tax revenues above the needs for beach management and maintenance, the increases in annual "excess" local tax revenues are unlikely to be large enough to fund an increased non-Federal cost-share from the current 35 to 50 percent to 50 or 65 percent of the project re-nourishment costs, even if the State participates by paying as much as 75 percent of the non-Federal cost-share.**

- **Additional and creative funding mechanisms, other than existing local taxes and fees systems, may be needed to help beach communities fund their portion of any proposed increases in non-Federal cost-shares, even if the State would pay a significant portion of the increased share of project costs.** The large majority of the Corps' beach nourishment projects are located in regions that most like the "typical" beach region in this report and very few of the beach region would be categorized as either "rural" or "urban" when defined as in this report.

- **Urban regions may be capable of funding the proposed increased non-Federal cost-share with beach visitation increases in the range of 10 to 20 percent if the State participates in paying a significant portion of the non-Federal cost-share.** However, few of the past, current, or authorized Corps beach nourishment projects are located in regions that might be classified as "urban": for example, urban beach regions would include Miami Beach, Fl, Virginia Beach, VA, northern New Jersey shore and Long Island, NY in the vicinity of New York City, and a few others.

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Chapter 1
Introduction

General non-Federal sponsor cost sharing is 35 percent of the costs associated with the re-nourishment component of the Corps Shore Protection Program. The President's fiscal year 2002 budget proposed to raise the general local cost share for beach re-nourishment to 65 percent. The new formula would not only be applied to recommendations for authorizations of future re-nourishment projects, but it would also be applied to those projects that have been authorized but not completed and existing projects with continuing re-nourishment requirements. This change was made to more appropriately reflect the distribution of economic benefits that shore protection projects provide to State and local sponsors. In addition, the Administration wants to ensure that the Federal government's long-term nourishment obligations do no "crowd-out" other important Federal expenditure needs.

The purpose of this report is to review pertinent literature on the distribution of shore protection benefits and to attempt an analysis of the potential value of beach projects to local and national economies. These findings may be used to support the Administration's proposal to increase non-Federal cost sharing for the re-nourishment component. The report addresses the following three questions:

1. Who benefits from shore protection projects?
2. How are project benefits distributed?
3. Do increases in tax revenues that stem form Federal shore protection projects affect the capacity of non-Federal sponsors to pay for the projects?

During the process of completing this report a literature review was conducted covering five issues of interest.

1. Academic and professional studies of beach economies,
2. Environmental effects of shore protection projects,
3. Fiscal effects (tax revenues and transfers) of shore protection projects,
4. Measures of beach tourism and recreation activities, and

5. The extent and nature of State and local participation in cost sharing for shore protection.

Summaries of the beach tourism and recreation data found are described in appendix C of this study. Information pertaining to state and local cost-share participation are provided in Appendix E. The remaining issue reviews are discussed in the text of the report.

Chapter 2 briefly reviews the history of shore protection in the United States from its inception to the present time. The philosophical shift from the use of structures for managing beach erosion and storm damage problems to the use of more functionally successful techniques that replicate the protective characteristics of natural beaches and dune systems is reviewed. Also, a historical review of the Corps' shore protection authorizations and construction activities is presented, including the expansion and consolidation of Federal responsibilities for shore protection activities following W.W.II. Finally, an explanation is provided of shore protection project purposes and periodic nourishment is introduced as a component of shore protection continuing construction and non-Federal requirements are discussed.

Chapter 3 addresses the question of how to evaluate the distribution of the economic benefits created by beach nourishment projects between the local and national interests. This chapter describes two different types of economic effects a beach nourishment project can have: net regional economic impacts and project-induced increases in the value of beach related services. Measures for both types of effects are described and a review is provided of the methods used in current studies to evaluate the economic benefits of beach nourishment projects. After providing an evaluation of the approaches taken in these studies, Chapter 3 introduces and demonstrates a method that can be applied consistently across all shore protection projects to comprehensively evaluate the economic benefits of beach nourishment and to address the question of how benefits are distributed among the local and national interests. The method is applied to three case studies, representing three beach regions surrounded by varying degrees of economic activity. The approach introduced measures both the regional economic

development (RED) effects, as well as changes in the value of beach related services, measured as "national economic development" or NED effects. The results of the case studies are reported and discussed.

Finally, Chapter 4 provides a review of the current literature addressing the environmental effects of beach nourishment projects. From the information provided in the literature, as well as from interviews and information obtained from Corps district offices, this chapter describes the changes that occur in the three regions affected by beach nourishment activities, the subaerial zone, the subtidal zone and the borrow site. The beneficial effects of beach nourishment are described. Also, a discussion is provided of the deleterious effects nourishment activities can have on littoral biota if appropriate management practices are not utilized during the course of a project. The management practices and procedures followed by the Corps to avoid negative environmental impacts are described.

Chapter 2
Shore Protection in the United States

Interest in shore protection began in New Jersey in the latter part of the 19th century and the early decades of the 20th century due to intense development of beach resorts near the burgeoning populations of New York City and Philadelphia. These beaches were the first to recognize the problems arising from erosion and other storm effects. Millions of dollars were spent in New Jersey on early erosion projects that were uncoordinated and often inappropriate, minimally effective, or even counterproductive. It was soon realized that the efforts of individual property owners were not capable of coping with the problems of coastal erosion and that a broader-based approach was necessary.

In response to the increasing problems of coastal erosion, the New Jersey legislature appropriated money in 1922 for a formal investigation of the changes taking place along the state's coastline. In Washington, DC, at about the same time, a Committee on Shoreline Studies was formed to examine shore erosion matters under the Division of Geology and Geography of the National Research Council. The American Shore and Beach Preservation Association was created as an outcome of the Committee's activities. An early objective of the association was to get the affected states to accept responsibilities for their beaches. However, within a year of its formation (1926), the association was lobbying to have the Federal government assume the function of unifying and coordinating the efforts of states with regard to shoreline problems. As a result, Congress enacted PL 71-520 in 1930 that authorized the U.S. Army Corps of Engineers to engage in shore protection studies in cooperation with state agencies and to establish a Beach Erosion Board. Throughout the 1930's the Federal in shore protection was essentially limited to cooperative analysis, planning studies, and technical advisory services. The costs of these planning efforts were shared on an equal basis between the Federal government and non-Federal interests. However, the Corps' involvement in shore protection studies virtually ended with the onset of World War II.

The *1971 National Shoreline Study* (House Document No. 93-121, 93rd Congress, 1st Session, Volumes 1-5, June 29, 1973) documents a national shoreline inventory that was completed in 1971. The study indicates that there are a little more than 84,000 miles of ocean, estuarine, and Great Lakes shorelines (including Alaska, Hawaii, Puerto Rico, and the Virgin Islands). Of this total shoreline distance, 20,500 miles were identified as experiencing a significant degree of shore erosion.[1] Of the 20,500 miles of shoreline that had significant erosion, 2,700 miles have been identified as having critical erosion problems (Table 2.1). Critical erosion is "where erosion presents a serious problem because the rate of erosion is considered in conjunction with economic, industrial, recreational, agricultural, navigational, demographic, ecological, and other relevant factors, indicates that action to halt such erosion may be justified."

Table 2.1: Assessment of Coastal Shorelines by Region (miles)

Region	Total Shoreline	Significant Erosion	Critical Erosion
North Atlantic	8,620	7,260	1,090
South Atlantic-Gulf	14,620	2,820	980
Lower Mississippi	1,940	1,580	30
Texas Gulf	2,500	360	100
Great Lakes	3,680	1,260	220
Alaska	47,300	5,100	100
North Pacific	2,840	260	70
California	1,810	1,550	80
Hawaii	930	110	30
U.S. Total	84,240	20,500	2,700

Source: 1971 National Shoreline Study. Shoreline mileage does not include small shore protection projects in the Continuing Authorities Program

During the period covered by the shoreline inventory, the Corps had completed 82 specifically authorized projects covering 226 miles of shorelines. Another 41 projects and studies protecting an additional 337 miles of coastline had been authorized but not constructed. However, these projects do not include the numerous state, county, city, and

[1] If Alaska is excluded, the Nation's shoreline is about 37,000 miles, of which 15,400 miles experience significant erosion.

private shoreline projects for which the Corps participates in its Continuing Authorities program. The relatively few major Federal projects in the face of the number of miles of shoreline experiencing critical erosion problems is due, in part, to the stringent Federal project feasibility criteria. These criteria, including benefit/cost analysis, virtually limit shore protection projects to densely developed areas with high economic value and public access.

2.1 Shift from Structures to Beach Nourishment

The main approach to beach erosion and storm damage problems in the United States and elsewhere prior to World War II was to use fixed structures, usually groins, seawalls, and jetties. These structures met with varying degrees of success. By the 1920's and 1930's, the use of fixed structures had proliferated along certain resort sections of the Nation's coastline to such an extent that these structures impeded the recreational use of the beaches.

By the late 1940's and early 1950's, it was increasingly realized that, in many situations, techniques that replicated the protective characteristics of natural beach and dune systems were more cost-effective and functionally successful than solely relying on the traditional coastal defense structures of the past. This concept, pioneered by the Corps, emphasized the use of artificial beaches and dunes as economically efficient and highly effective method of dissipating wave energy. The aesthetic and recreational values of artificially created beaches were other important considerations.

Federal legislation related to beach nourishment (i.e., the recurrent need to replenish sand along restored beaches) has contributed to the broad acceptance that now exists for the use of artificial beaches as the primary means of shore protection. Until 1956, periodic nourishment was considered a form of maintenance that was totally a non-Federal responsibility. Legislation enacted in 1956 classified beach nourishment as a continuing construction activity that is eligible for Federal cost sharing, when beach nourishment is used as a substitute for protective measures. The 1956 Act recommended

a nourishment period of 10 years. Subsequent authorizations have extended the period of Federal participation in beach nourishment to 15 years in 1976 and to 50 years in 1986.

Presently, the features of shore protection projects usually consist of one or a combination of the following functional elements: beach and dune fills, groins, seawalls, revetments, breakwaters, bulkheads, and sand transfer plants. There is no specific or singular functional feature that can be applied universally to solve all shore protection problems. Most project sites have some unique characteristics and must be evaluated on the basis of their particular attributes in order to develop a project plan that affords the best balance between functional performance, cost-efficiency, return of economic benefits, and environmental acceptability. The protection of relatively lone reaches of shoreline, more often than not, involves the placement of beach fill and the provision of subsequent periodic nourishment. However, even in these cases, many project sites require detailed assessments to determine, for example, whether or not groins are needed for all or part of the fill or how much fill to place, how long the fill will last before needing to be re-nourished, and whether a dune fill or seawall should be used to account for storm tide effects.

2.2 Historical Shore Protection Authorizations and Construction

Between 1930 and 1994 there have been 137 shore protection projects authorized by Congress with some degree of Federal participation. Prior to 1950, only five projects were authorized. In the most active year, 1954, eighteen shore protection projects were authorized. The large number of projects authorized during the 1950's and 1960's was a direct result of the numerous major coastal storms that occurred during those years.

It should be noted that there are fewer projects built than authorized. In response to the large number of authorizations during the 50's and 60's, both the number of beach restoration projects completed and the volumes of sand placed increased during the 1960's and peaked in the 1970's. However, due to the lack of water resource authorizations in the 1970's, construction declined in the 1980's. In response to WRDA

’86, the decade of the 90’s has seen a resurgence of construction. There have been as many projects completed in the 1990-93 period as there was during the entire decade of the 80’s.

Six legislative acts, called the Continuing Authorities Program as a group, authorize the Secretary of the Army, through the Chief of Engineers, to plan, design, and construct certain types of water resource improvements without specific Congressional authorization. Three of these authorities pertain partly or entirely to shoreline protection and beach erosion control projects

- Section 14, Flood Control Act of 1946 (PL 79-526), as amended (Emergency stream bank and shoreline erosion protection of public facilities and services). The program applies only partly to the shoreline and beach erosion control projects. The limit for Federal funding per project is currently $500,000 with a program limit of $12,500,000 per year.

- Section 103, River and Harbor Act of 1962 (PL 87-874), as amended originally Section 3, an Act authorizing Federal participation in the cost of protecting the shores of publicly owned property, approved August 13, 1946 (Beach erosion control). The limit for Federal funding per project is currently $2,000,000 with a program limit of $30,000,000 per year.

- Section 111, River and Harbor Act of 1968 (PL 90-483), as amended (Mitigation of shoreline erosion damage caused by Federal navigation projects). The limit for Federal funding per project is currently $2,000,000 with no yearly program limit.

Prior to the enactment of Section 103 of the 1962 River and Harbor Act and Section 111 of the 1968 river and Harbor Act, several shore protection projects were authorized that were small in size and cost. All of these projects were located either in the New England Division (21 projects) or in the Los Angles District (5 projects). Had the Continuing Authority Program been in effect at the time, these projects would have been constructed under those authorities.

2.3 Evolution of Federal Interest and Cost Sharing

Federal responsibilities for shore protection significantly expanded and consolidated after World War II.[2] The body of law enacted during this time has established an overall program in which Congress has authorized Federal involvement to prevent or control shore erosion caused by wind, tidal generated waves, and currents along the nation's coasts and shores and to prevent property damage and loss of life from hurricanes and storm flooding. Federal participation in shore protection includes research and development, planning, design, construction management, and Federal cost sharing. Responsibility for executing the shore protection program has been vested in the Secretary of the Army acting through the Chief of Engineers, U.S. Army Corps of Engineers.

Shore protection projects in the recent past have been traditionally developed for the purpose of beach erosion control and/or hurricane protection. Beach erosion control projects provided for the restoration of publicly owned shores that are open to the general public. Private properties could be included if such protection and restoration was incidental to the protection of publicly owned shores or if such protection would result in public use and benefits. Public use meant access by all on equal terms. For beach erosion control project, study costs were 100 percent Federal; costs of construction were 50 percent Federal for non-Federal public shores; and 70 percent Federal for non-Federal public shore parks and conservation areas. Hurricane protection features costs were shared on the basis of 70 percent Federal and 30 percent non-Federal.

With the enactment of the Water Resources Development Act of 1986 (WRDA '86), Congress established hurricane and storm damage reduction as a project purpose to which costs should be assigned. Section 103 indicates that beach erosion control is no longer recognized as a project purpose. However, costs of constructing beach erosion control measures will be assigned to "appropriate" project purposes, with cost sharing

[2] See Appendix A for a chronological summary of 15 legislative acts that have been established since World War II.

percentages determined by the purposes to which costs are assigned. The appropriate project purposes are hurricane and storm damage reduction (65/35 Federal/non-Federal) and recreation (50/50 Federal/non-Federal). Costs are shared on these two purposes while taking land ownership and public use into consideration. Feasibility study costs are shared on a 50/50 basis.

In Section 933 of WRDA '86, dredged materials from navigation projects is recognized as a desirable potential source of material for beach nourishment. When placement of dredged material on a beach or beaches is the least costly acceptable means for disposal, the placement shall be considered integral to the navigation project and shall be cost shared accordingly. When placement of dredged material on a beach or beaches is more costly than the least costly alternative, the Federal government is authorized to provide 50 percent of the costs greater than the least costly alternative providing all local cooperation requirements are met. When the additional cost for placement of dredged material is not justified, the Corps may still perform the work if the State requests it and non-Federal interests contribute 100 percent of the added cost of disposal.

Under Section 934 of WRDA '86, Federal aid for periodic beach nourishment at existing projects may be extended as necessary without further Congressional authorization for a period not to exceed 50 years from the date of start of project construction, although the extension to 50 years of not automatic. After notification by the Corps that the nourishment period is about to expire, the project sponsor must request an extension and express a willingness to share the costs. Evaluation of such projects will be made using current evaluation guidelines and policies.

2.4 Project Purposes

Prior to the enactment of WRDA '86, shore protection projects were traditionally developed for the purpose of beach erosion control and/or hurricane protection. Beach erosion control projects provided for restoration of publicly owned shores available for use by the general public. Private properties could be included if such protection and

restoration was incidental to the protection of publicly owned shores or if such protection would result in public use benefits. Public use was not a condition for Federal participation in hurricane protection because it is considered analogous to flood control. When both purposes were served by a project, costs were allocated between purposes. WRDA '86 discontinued shore (beach) erosion control as a project purpose. However, four other project purposes are recognized; hurricane and storm damage reduction, recreation, navigation, and mitigation.

Hurricane and Storm Damage Reduction: Section 103(d) of WRDA '86 established hurricane and storm damage reduction as a project purpose, where cost sharing is 65 percent Federal and 35 percent non-Federal.

Recreation: Department of the Army policy precludes the use of Civil Works funds for implementing recreation-oriented projects due to current budget constraints. Section 103 of WRDA '86 provides for a 50/50 cost sharing of the separable cost of this feature.

Navigation: In certain instances, material dredged from such activities can be used for beach fill purposes when it is incidental to the Corps mission of maintaining the Nation's rivers and harbors. Authority for such operations was contained in Public Law 94-587 (Water Resources Development Act of 1976), as amended by Section 933 of WRDA '86. Currently this authority and related regulations allow Federal participation if 50 percent of the added costs of dredged material placement for beach nourishment purposes (in relation to the least cost navigation disposal alternative). This condition holds providing the placement is economically justified and other conditions common to Civil Works storm damage reduction projects are met. Where all of these conditions cannot be met, placement can still be made if non-Federal interests provide all of the added costs and the placement is environmentally acceptable and in the public interest.

Mitigation: Beach fill measures (structural and non-structural) may be used as corrective measures under the authority of Section 111 of the Rivers and Harbor Act of 1968 (PL 90-483), as amended, if these measures are demonstrated to be economically justified and if an existing Federal navigation project is identified (to a quantifiable degree) as contributing factor in erosion and attendant damage along an adjacent shore. This authority is one of the Corps' "Continuing Authorities" programs that do not require specific project authorization by Congress unless the total costs of corrective measures under Section 111 exceed $2,000,000.

Ecosystem Restoration and Protection: The Corps can pursue ecosystem restoration and protection needs and opportunities in coastal areas through specific authorizations and programmatic authorities such as Section 204, 206, and Section 1135. Cost sharing is 65 percent Federal and 35 percent non-Federal, except under Section 1135 where it is 75 percent Federal and 25 percent non-Federal. In addition, suitable dredged material can be used beneficially to restore or protect valuable ecological resources.

2.5 Operations and Maintenance

Under the provisions of WRDA '86, the non-Federal sponsor must operate, maintain, repair, replace, and rehabilitate (O&M) a completed shore protection project. A unique aspect of beach fill projects is the provision for continuing Federal participation in the periodic nourishment of such projects where sand is placed on the beach, berm, or dune to replenish eroded material. Periodic nourishment is considered a continuing construction feature for funding and cost sharing purposes. It is undertaken when necessary to replace storm induced sand losses and to prevent excessive interim erosion of the authorized beach design profile.

Operation activities of a beach fill project include assuring public access and safety, providing basic amenities, protection of dunes, prevention of encroachments, and monitoring of beach design section conditions. Operation of the project should also

assure that no acts of man erode or damage the integrity of the beach fill, berm and/or dune, or any structure that may be part of the project.

Maintenance of a shore protection project includes maintaining, replacement, repair, or rehabilitation of the measures/structures comprising the project. For a beach fill project, the primary maintenance responsibility is to maintain the beach, berm, and dune design section by sand relocation (moving sand laterally along the beach) and profile reshaping (moving sand perpendicular to the shore). It does not include beach nourishment that is incorporated in the project as deferred construction. Maintenance also includes the maintenance, replacement, and repair of dune walk-overs, dune vegetation or sand fencing and to make all necessary repairs that assure the integrity and working order of any fixed structures.

Chapter 3
The Economic Development Effects of Beach Nourishment Projects and Their Geographic Distribution: A Case Study Analysis

The President's fiscal year (FY) 2002 budget proposes to increase the local share of the costs for the re-nourishment component of shore protection projects in order to more appropriately reflect the distribution of economic benefits that these projects provide to State and local sponsors. The Administration wants to ensure that the Federal Government's long-term nourishment obligations do not "crowd-out" other important funding priorities. Obviously, such a proposal is a major concern for the affected non-Federal cost-sharing partners, who will now have to pay a higher share of the shore protection costs. In order to ensure that the Administration's proposal to increase the local share of the costs for the re-nourishment component of shore protection projects is a sound change in policy, this chapter addresses the following issues:

1. What are the economic benefits of shore protection projects?
2. Who are the beneficiaries of shore protection projects' benefits?
3. What is the relative distribution of the benefits among the beneficiaries?
4. Do increases in tax revenues that stem from Federal shore protection projects affect the capacity of Federal and non-Federal interests' to pay for shore protection projects?

This chapter presents and demonstrates a method of comprehensively evaluating the benefits of beach nourishment that can be consistently applied across all shore protection projects to address the question of how the economic benefits of beach nourishment projects are distributed among the local, state and national interests. The purpose of this study is to describe and demonstrate such a method.

In this study, benefits of shore protection are defined to be both the tradition national economic development (NED) benefits of shore protection and the related regional economic development (RED) benefits. NED benefits measure the increased

value of services provided by beaches, including storm damage reduction benefits, other NED benefits (reduction in emergency and facility maintenance costs), and recreational benefits. RED benefits are changes in regional economic activity associated with a beach nourishment project, measured as the income changes that stem from changes in recreational activities due to the initial construction and periodic nourishment of beaches.[3] Income is broadly defined as "net value added" to include not only wages and salaries but other components also.[4] The "net" means that reductions in value added income are made for transfers of income from the beach region to other places within the nation due to commuting patterns, for transfers of State and national tax revenues from the beach area, and for beach management and maintenance costs.

The Federal Shore Protection program currently costs the nation's taxpayers about $100 million a year.[5] Compared to the entire Federal budget, the money spent on shore protection appears rather modest. However, these expenditures must still be weighed against the benefits that these projects provide. The U.S. Army Corps of Engineers does a benefit-cost analysis of every shore protection project. The Corps' benefit-cost procedures view these projects from a National perspective. The procedures ensure that the value of a project's beneficial effects is greater than the cost of the project. In addition, the project option that will provide the greatest increase in the net value of the national output of goods and services is called the national economic development or NED plan.

[3] There are other types of RED benefits not included in this report. For example, if the storm protection measures decrease the risks of storm damages property owners may decide to undertake enhancement activities on their properties (such as constructing new out-buildings or new roofs for their houses). These activities would generate RED effects. However, if the shore protection measures are not undertaken then construction activities will occur due to the period storms. These, too, generate RED effects. The differences in these two RED effects would have to be calculated. Without the data to perform a detailed analysis it was assumed that the without project RED effects would be equal to or greater than the with project RED effects of construction activities. However, if a more in-depth and comprehensive study of the RED effects of shore protection activities were undertaken, then the RED effects due to storm damage reduction should be evaluated and reported.

[4] In addition to wages and salaries (employee compensation), value added includes all payments to other factors of production; such as proprietors' income (approximately means small business owners), profits, rents, indirect business taxes (taxes on business activities), and other miscellaneous income-type items.

[5] Over the past 45 years, the average annual Federal shore protection outlay is actually less than $50 million. It is only in the recent fiscal years that it has reached $80 to $100 million.

The NED procedures place the greatest emphasis on the private property that is immediately adjacent to the coastline and accounts for the majority of the storm damages prevented with the implementation of a storm damage reduction project. However, it may not be reasonable to assume that a healthy beach with natural dunes and vegetation will benefit only that first row of homes and businesses. All of the homeowners spend money in the region. Hotels attract tourists, who also spend money. Local residents who live inland come to the beach to recreate. They, too, spend money. There are a variety of service businesses, from t-shirt vendors to banks, whose existence depends on these expenditures. In addition, there is an environmental benefit derived from nourishing our beaches. Property owners do not retreat from an eroding shorefront. They build seawalls and other hard structures to protect their property. These hard structures, which often exacerbate beach erosion, provide an unfriendly home to the birds and turtles that nest in the sand. In addition, other beneficial aspects of coastal regions are not accounted for in the NED evaluation process. For example, the U.S. commercial fishing industry produced and marketed products valued at $10.8 billion in 1993. Saltwater recreational anglers generated $15 billion from 64 million fishing trips. In 1990, 2.15 billion tons of cargo valued at over $500 billion moved through the nation's seaports.[6] While all of these coastal effects are recognized, it is difficult to identify the differences in these effects with and without a storm damage reduction project.

3.1 A Review of Recent Studies of the Economic Benefits of Shore Protection Projects

Beach communities have responded to the administration's proposed increase in the local share of beach nourishment costs by pointing to a variety of economic benefits that beaches contribute to the state and national economies, as well as to local beach communities. For example, from a study of the economic benefits generated by beaches in Broward County, FL (Stronge and Schultz, 1997), out-of-state visitors to Broward

[6] The H. John Heinz Center for Science, the Economy, and the Environment found that, in 1996, saltwater recreational fishermen spent $8.7 billion on a variety of items to participate in their fishing. These dollars are reported to have a "ripple" effect of $25.1 billion, supported the equivalent of 288,000 full-time jobs, and generated $1,24 billion in State and Federal taxes, according to a 1998 study by the American Sportfishing Association.

County beaches are reported to have generated $350 million in annual economic benefits to the county. Furthermore, Broward's beaches produced over $28 million per year in county property taxes and nearly 18,000 jobs. Similarly, drawing on a 1997 study by PRI of the economic value of California beaches, "Beach tourism spending contributes over $10 billion in direct benefits to the state and another $17 million in indirect benefits…." and that "Beach tourism creates a half million California jobs and $1 billion in state sales, income and gas tax revenues". Results of a 1998 study of the economic consequences of a 5-year beach nourishment project on Delaware beaches indicate that, "Beach tourism (in Delaware) generates $173.2 million in expenditures each year." The Delaware study finds that as beach erosion occurs over the 5 year period examined, consumer expenditures will decline by $30.2 million, 625 beach jobs will be lost, wages and salaries will fall by $11.5 million, local and state tax revenues will fall by $2.3 million, and beach area property values will decline by nearly $43 million dollars over the five year period.

In general, the literature search determined that studies of the economic effects of beach nourishment projects are actually describing two different types of economic effects. One type of effect is the net regional economic impacts of a beach nourishment project. The second type of effect examined is the increase in value of beach related services resulting from a beach nourishment project. These two types of economic effects require two different measures.

3.1.1 Changes in the Value of Beach Related Services

Beach nourishment projects can provide a variety of services that are enjoyed by people. These include storm damage protection for waterfront properties as well as improved beach access and aesthetic conditions for recreationists. These services have value because they improve the well being of the people who benefit from them. The Principles and Guidelines (P&G) refer to these improvements as "National Economic Development (NED) benefits". The NED benefits of a beach nourishment project include any increases in the value of services provided by the beach, relative to what the

value of those services would have been, had the beach nourishment project not been undertaken. NED benefits are expressed as monetary measures of the improved well being of individuals that benefit from those services. In order to evaluate the improved well being of individuals in monetary terms, a proxy is used—the amount that people would be willing to pay for the improvement (referred to as "willingness-to-pay" or WTP). There are a variety of analytical techniques for approximating individuals' willingness-to-pay for the advantages offered by beach nourishment.

For example, in the 1997 examination of Broward County beaches, William Stronge assumed that the direct benefits of beach areas are capitalized into the value of beach properties. Stronge points out that if a beach is vulnerable to storm damages, its property value will be discounted according to the expected property loss that it might incur. With beach nourishment, the property value loss would diminish as the risk of storm damage is lessened. Also, Stronge argues that the protection afforded to surrounding public infrastructure, such as bridges and roads should show up in property values, as well as improved recreation opportunities and enhanced aesthetics. Therefore, as a measure of the direct economic benefits of Broward County beaches, Stronge compared property values on barrier islands to property values on mainland as the basis for estimating the effects of the presence of beaches to property values. After making a small adjustment to subtract out the contribution of beach recreation opportunities available to mainland residents, Stronge found that "The beaches in Broward County contribute $1.4 billion in property values in the county. This amounts to about 2.2 percent of the property value in the county. About $1 billion of the contribution of beaches to property values occurs on the barrier islands, and $302.4 million occurs on the mainland." (Stronge and Schultz, 1997)

As another example, in a 1999 Delaware study researcher Linda Lent measures the economic benefits of a beach nourishment project as "…dollars that would be lost to the economy in the absence of nourishment". These lost dollars take the form of losses in consumer surplus as fewer people visit the beaches to recreate as well as losses in property values as the narrowing beach results in increase risks of storm damage,

diminished aesthetic attributes, and other undesirable effects that are capitalized into land prices.

Finally, the estimates of the value of service provided by California's beaches are measured by beach user's stated willingness-to-pay to prevent erosion of the existing beaches. The benefits of reduced storm damages due to beach nourishment are calculated using Corps guidelines established for measuring NED benefits.

3.1.2 Changes in Regional Economic Activity

The second type of economic benefit is the extent to which a beach nourishment project stimulates the local economy in a region by generating new tourist spending in the area. If a beach nourishment project results in attracting new tourists, new economic activity will be generated in the local economy as tourists spend their money on restaurants, lodging, equipment, souvenirs, etc. However, the extent to which the local economy is stimulated is not limited to the amount of money directly spent by the tourists. Instead, the economic impacts of the new tourist spending continue to ripple through the economy as the initial spending generates new rounds of expenditures.

For example, in the 1999 study of Delaware beaches, Linda Lent measures the diminished economic activity associated with allowing a beach to erode over a 5-year period, as fewer tourists visit the beach area and spend money there. In his study of Broward County, FL beaches, Stronge argues that the presence of the beach has regional economic impacts. Stronge reasons that, because beaches contribute to higher property values, it follows that households occupying these properties would tend to have higher incomes than households occupying properties not fronted by a beach. According to Stronge, this means that the higher income households would tend to spend more money in the regional economy than would lower income households. Therefore, declined property values resulting from beach erosion, could also have regional economic impacts as lower income families begin to occupy beach area residential properties and less money is spent in the local economy. Stronge traces out the "ripple effects" of spending

the local economy as the recipients of money spent by beach visitors, in turn spend the money elsewhere in the local economy. Stronge calculates the regional economic impacts of beaches on spending by barrier island residents, mainland residents, and non-residents visiting Broward County beaches. In making these calculations, Stronge accounts for the fact that not all occupants of residential properties on the barrier islands are actually residents of Broward County. Stronge also adjusts his calculations of spending by mainland residents to account for the fact that not all beach related spending would be lost in the absence of a beach. Stronge argues that, while the spending of frequent beach users on beach equipment and visits might be lost, the spending done by occasional beach users would probably still occur in the county in the form of spending on some other recreational activity.[7] Similarly, in his estimates of spending by non-residents, Stronge accounts for the fact that tourist spending in Broward county would only decline in the absence of a beach if the tourists declined to spend there money on any other activity in the county.[8] Stronge accounts for the fact that not all spending by beach users will be lost in the absence of a beach.

Using surveys data collected from 600 California residents, King and Potepan (1997) provide two different measures of the economic impacts of California beaches. They estimate the spending impacts of California beaches on the state economy. Unlike Stronge, King and Potepan do not account for the possibility that current beach related expenditures in the local economy might occur even in the absence of a beach. Instead, they estimated the regional economic impacts of beach related expenditures as though all of the spending would be lost in the absence of a beach.

[7] Stronge accomplishes this by taking the average of a "maximum" and "minimum" spending value. The maximum value is equal to total residential spending. The minimum value equals only the spending of frequent residential beach users, i.e., those users who visit the beach at least once a week in the summer or winter. This minimum value assumes that only the spending of the frequent beach users would be lost in the absence of a beach, because the occasional beach users would continue to spend their money on some other recreation activity or product. (Stronge and Schultz, 1997)

[8] Again, Stronge takes the average of the "maximum" and "minimum" estimates of beach related non-residential spending. The maximum value equals the total expenditures by non-residents visiting the beaches in Broward County. The minimum value equals expenditures of only those out-of-county tourists who say that they would not have come to Broward County if there were no beaches to visit. (Stronge and Schultz, 1997)

3.1.3 A Critique of the Recent Studies of the Benefits of Shore Protection Projects

While the study findings reported by Marlowe (1999) and others in the literature do suggest that beach nourishment projects offer economic benefits at the local, state and national levels, the results cannot be easily compared across studies (see Table 3.1). While at the most general level, Lent, Stronge, and King are all examining the same two types of economic effects, (i.e., the net regional economic impacts and the increase in value of beach related services), the specific effects they measure differ. For example, while Stronge and King estimate the economic value of storm damage protection provided by beaches, storm damage reduction are not considered in Lent's study.

Table 3.1 A Comparison of Beach Nourishment Economic Effects

Study	*Economic Value of Beach Services*	*Regional Economic Activity*
Lent (1998)—measures loss of economic benefits associated with shoreline erosion of Delaware beaches over a five year period.	1. Recreation—measured as loss in consumer surplus as fewer people visit the beaches to recreate. 2. Recreation – measured as diminished WTP for rental property as capitalized into property values.	1. Losses in economic activity in the state of Delaware due to reduced beach tourism expenditures.
Stronge (1997) – measures the economic impacts of beaches on Broward County, Florida.	1. Storm damage reduction to private properties and public infrastructure – measured as a property value premium. 2. Improved aesthetics – also measured as a property value premium	1. Increases in economic activity generated as higher income households occupy the area and produce higher levels of spending.
King (1997) – measures the economic effects of beaches on California's economy.	1. Value of beaches to tourists – includes a variety of beach related services. Economic value measured by beach user's stated willingness-to-pay to prevent erosion of the existing beaches. 2. Storm damage reduction to structures- as calculated by the Corps of Engineers for a case study in Oceanside, California using procedures established in the P&G.	1. They estimate the spending impacts of California beaches on the state economy.

In addition, the researchers have used different methods of analysis from one study to the next. For example, Stronge uses property value premiums as a measure of both the value of storm damage protection afforded to private structures and public infrastructure, as well as the aesthetic improvements associated with beach nourishment. The storm damage reduction benefits reported by King are calculated using the methods established by the Corps for calculating storm damage reduction NED benefits.

As another example, Lent measures the effects of beach tourism on the Delaware economy in terms of reductions in the number of tourists associated with beach erosion. Alternatively, Stronge assumes that the impacts of beach nourishment take the form of increased spending by beach residents, rather than by changes in the number of individuals visiting the beaches. Stronge reasons that nourishing Broward County beaches will result in higher valued properties occupied by higher income households that will spend more money than lower income residents.

Importantly, analysts that have estimated economic effects on the rest of the nation due to beach activities (such as income, employment, and tax revenue transfers) have used the perspective of the beach, county, region, or State in determining these effects. This is assumes implicitly that the impacts on the rest of the nation would not have otherwise occurred had the beach not existed. For example, people from Minnesota that go to a beach in Florida will not spend the money they would have spent at the beach, if the beach had to close (because of sharks, pollution, etc.). It is possible that they might go to the Bahamas instead, however, for a single beach the number of these beach visitors is probably small. It seems more appropriate to us, to count only those impacts occurring in the rest of the nation that are due to spending by foreign beach visitors. Similarly, we consider it appropriate to count only those economic effects occurring in a beach region that are due to spending by beach visitors who reside outside the beach region.

3.2 The Relationship Between National Economic Development and Regional Economic Development Benefits

The Federal objective in water project planning is defined in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Watt, 1983, p. iv) as monetary contributions to national economic development (NED). Contributions to NED are increases in the net value of the national output of goods and services. The project option with the largest net NED contribution is called the NED plan. The NED principle is first and foremost a Federal investment criterion. Its essential purpose is to determine whether construction of a water resource project by the Federal government is feasible. The NED principle articulates a framework to assist in making this decision. Inputs are required to produce these projects and inputs have value because we have the opportunity to use them for other purposes. Analyses are undertaken to assure that the value of the outputs (benefits) of Corps projects (for example, for storm damage reduction projects) is greater than the value of the inputs (costs) that are used to implement the projects. Therefore, the challenge is to decide how to use these inputs to achieve the greatest socially valued outputs after the costs have been accounted for.

One of the primary assumptions underlying the NED principle is that all resources (labor and non-labor) are fully employed. If all resources are fully employed, this means that all resources have alternative uses (i.e., they have opportunity costs). The significance of this assumption is that it provides a rationale for using market prices. To an economist, "full employment" of labor does not mean the absence of unemployment. It is generally recognized that there is some "normal" level of unemployment in the economy. Even when the economy is strong, with plentiful jobs, there are people who are unemployed because they are changing jobs or careers, moving to another part of the country, graduating from school, entering the work force for the first time, or reentering the workforce after some absence.

A practical consequence of assuming that all resources area fully employed is that national and regional economic impacts of projects that result from transferring resources from existing uses to the project (possibly from one part of the country to the project site) are also assumed to be zero on a national basis. Perhaps the most frustrating experience for any non-Federal partner is to hear that something that they know will benefit their community is not counted by the Corps because it is "regional economic" development, not "national economic" development.

Recreation is a major activity of many regions of the U.S. Shore front recreation and tourism activities (e.g., bathing, boating, fishing, and sightseeing) are vital economic components for many beach communities and States. Consider an example of a hypothetical beach community that has recently experienced a beach nourishment project. Further, assume that the expanded beach area will attract an estimated 150 thousand out-of-state visitors annually (many similar projects result in no increased visitation). However, for discussion purposes it is further assumed that people will spend an estimated $50 each, adding 7.5 million dollars to the local economy. The money will be spent on licenses, food, supplies, gasoline, lodging, etc. Part of this spending by visitors will become the income of local residents. The local residents will, in turn, spend this money in local barbershops, taverns, furniture and clothing stores, etc. creating income for these shop owners. And so it goes until the money initially introduced to the local economy leaks out through taxes, savings, and purchases outside the region. The $7.5 million brought into the region by the hypothetical new visitors would represent an increase in local sales that would eventually exceed the initial $7.5 million before these multiplier effects diminish.

It is because the multiplier effects can be so large relative to the size of the local economy that maintaining or increasing recreation visitation is so important to local people, businesses, and public officials. These are major economic effects that represent the very livelihoods of many local residents. It is not difficult to understand why they are often stunned and disappointed to learn that these very real and important effects are not

considered as project benefits. On the other hand, regional economic development (RED) effects are the changes in regional economic activity (often measured in terms of income and employment) that result from the NED options. Because RED effects are assumed to be the result of transfers of resources from one or more regions of the country to the project region, they cannot possibly contribute to the net value of the nation's output of goods and services (i.e., NED). Therefore, RED effects are not included in NED computations.[9]

3.3 Analyzing the National Economic Development Benefits Of Shore Protection Projects

3.3.1 National Economic Development Benefits of Shore Protection

Benefits from shore protection projects arise by reducing damages to coastal property and improvements. These are causes by erosion, water, and waves. Nourishment moves the shoreline seaward from property creating a sacrificial buffer for property reducing the frequency of erosion. This buffer dissipates wave energy before the waves reach structures. There are three major categories of national economic development (NED) benefits of shore protection projects: storm damage reduction benefits, other NED benefits, and recreation benefits. Since a project may protect against both storm damages from flooding and wave attack as well as erosion, it is necessary to evaluate the benefits of each type of protection to avoid double counting of benefits. Other NED benefits include reduced maintenance of existing coastal protection structures. Also, recreation benefits capture the value of enhanced recreational experiences by users of affected beaches as well as the value of the recreation experience for new visitors if there is an identified unmet demand for recreation in that area.

[9] Current NED procedures do allow for the use of the income of otherwise unemployed or underemployed workers to be included as a project benefit. However, not all income generated by a project is allowed to be counted as a project benefit. Because of identification and measurement problems and because unemployment is regarded as a temporary phenomenon, only the income of those onsite labor resources employed in the construction or installation of a project can be counted. This category of project benefit applies only to geographic areas that have annual rates of unemployment substantially above the nation average over an extended period of time.

Alternative project plans are formulated in a systematic manner to ensure that all reasonable solutions are evaluated. Usually, a number of alternative plans are identified early in the planning process and are refined in subsequent study iterations. Policy implementation guidance issued as a result of the Water Resources Development Act of 1986 (WRDA'86) specified that shore protection must be formulated for one purpose: i.e., to provide for hurricane/storm damage reduction. Any increase or enhancement of recreational opportunities that may also result is considered incidental. Such recreational benefits are considered NED benefits, and they should be included in the economic analysis. However, additional beach fill, beyond that needed to achieve the NED plan storm damage reduction purpose, or to better satisfy recreation demand is a separable recreational feature that is not an Administration budgetary priority.

3.3.1.1 Storm Damage Reduction Benefits

In many areas, damages caused by wave action causing the force of tons of water against beachfront structures can be the most significant coastal effect. Many benefits from storm damage reduction come from the reduction of inundation damages from coastal flooding. These benefits include the saving of structures and contents from flood and salt water damage and the reduction of clean-up costs, production losses, and flood fighting expenses.

Measures for reduction of beach erosion may also include tangible primary benefits. Damages due to shore erosion include physical losses of land and beach and associated damages to improvements such as roads, buildings, and other facilities. The loss of protective structures or an increasing threat of storm damage may cause owners to defer maintenance of existing structures or construction of new (replacement) facilities with resulting depression of economic values. Projects for the primary purpose of beach erosion control often result in incidental benefits for other purposes. These benefits, such as increased fish and wildlife habitat, reduction in shoaling at navigation projects, reduction in tidal flood damages, and incidental benefits to private property downdrift of

a shore protection project, could be evaluated and credited to the beach erosion control project.

3.3.1.2 Other NED Benefits

Other NED benefits of shore protection projects include reductions in emergency costs and reductions in the maintenance of existing structures. Emergency costs include both those expenses that result form the risk of a storm and those expenses that result form the storm itself. These include expenses for monitoring and forecasting storm problems, emergency evacuation, temporary relocation, administrative costs of disaster relief (but not the relief itself, that is a transfer), public clean-up costs, and increased costs of police, fire, and military patrol. Structures in the immediate vicinity of the shore may require more frequent maintenance because of recurring incidents of erosion. Benefits can be claimed to the extent that a project would reduce the extra maintenance.

3.3.1.3 Recreation Benefits

Recreational benefits are those benefits derived from the availability of beach recreational areas and the demand for use of those areas by residents and tourists. Recreational benefits are currently evaluated using the "unit day value" method, the similar projects method, the travel cost method, or the contingent value method.

The unit day value is intended to represent the users' average "willingness-to-pay" for a day of recreational activity at the site. When properly formulated unit day values are applied to the estimated beach use, under the with and without project conditions. The method inherently relies on professional judgment to arrive at a project-specific unit day value for both conditions. Consistent application of the procedure for each alternative being evaluated will produce meaningful estimates of value. When using the unit day value method, departure from the published range of values is not permissible.

This method applies a simulated market value to estimated annual beach use benefits. The simulated value is "judgmentally" derived from a range of values agreed to by Federal water resource agencies. Project specific values are estimated by applying a point system for various criteria. Under the point system, planners evaluate and assign points for each of the 5 criteria to determine the total points under with and without project conditions. Dollar values are identified for various recreation activities and total for each activity.

The travel cost method uses the variable costs of travel as a proxy for determining the net "willingness-to-pay" for consumption of recreation activities. According to this method, people have the option of enjoying a recreation day at many possible sites. Though the sites are similar (and can be considered substitutes) they each provide slightly different recreation opportunities. Individuals' recreation decisions reflect by the costs incurred and the benefits obtained from a site visit. These costs include travel expenditures and the value of time spent traveling. These costs decrease with proximity to the site. The travel cost method equates the implicit price of each site characteristic with the additional benefits its usage provides. By observing the pattern of site usage by individuals located different distances from the site, analysts can estimate a demand curve for the site.

The contingent value method differs from the travel cost method in that it does not rely on observed behavior to estimate benefits. Instead, surveys are used to elicit information about either an individuals' "willingness-to-pay" (WTP) or "willingness-to-accept" (WTA) payment for a change in some environmental characteristic of a project. Careful survey design is crucial to the validity of results by this method. While either the WTP or the WTA can be used to measure benefits, there is subtle but important difference between them. WTP answers the question, "Given the initial quality/quantity of an environmental attribute, how much would you be willing to pay to see a specific improvement?" WTA answers the question, "An improvement in environmental quality is going to take place. How much would you be willing to accept in lieu of the improvement?" Though estimated benefits are associated with the same environmental

change, the answers can diverge significantly depending on which measure is used. The accuracy of the contingent value method relies heavily on survey respondents being well informed. They must understand and be familiar with the commodity being valued. Also, when the survey is administered, the environmental change being evaluated must be explicitly stated. If the respondent's level of uncertainty is limited, the contingent value method can generate accurate estimates.

3.3.2 A Method for Distributing the NED Benefits of Shore Protection Projects: A Case Study

NED benefits were distributed between the beach region (defined to be the area encompassing the beach, its community, and the surrounding environs—usually the county or counties where the beach is located)[10] and the rest of the nation according to the residence patterns of those persons for whom the benefits accrue. For example, it is assumed that storm damage reduction benefits accrue to owners of those properties directly affected by the protection measures. Therefore, storm damage reduction benefits are distributed according to the residence patterns of the affected property owners. Similarly, it is assumed that project related recreation benefits accrue to the beach users. Accordingly, recreation benefits are distributed by the residence patterns of the beach users. The other NED benefits were assigned as "national". This is somewhat arbitrary, however, these benefits typically represent a small percentage of the total NED benefits.

3.3.2.1 Distributing the NED Benefits of a Shore Protection Project: A Case Study

Ideally, we would have preferred to analyze an existing or proposed shore protection project. However, we required a "case" study project that had information for both a NED analysis and a RED analysis. Project evaluation procedures used by the Corps would have allowed an analysis of the distribution of NED benefits for virtually any completed or current shore protection project. Because RED analysis does not contribute to the NED analysis of a project, RED analysis is not normally implemented as

[10] Some economic impact analysts use a convenient "commuting distance" concept for defining the beach region; e.g., a 30 or 50-mile radius.

part of the evaluation of a shore protection project. Consequently, information necessary to carry out a RED analysis (such as the spending patterns of beach visitors) is not normally available for Corps shore protection projects. Therefore, we chose to analyze a "hypothetical" shore protection project that provides storm damage reduction benefits, recreation benefits, and other NED benefits (i.e., emergency and maintenance cost reductions).

The beach area, its community, and the project evaluated here, although hypothetical, are configured to approximate "average" conditions and have project specific characteristics for projects usually evaluated by the Corps. The hypothetical project is located in a "Beach Community" (see Figure 3.1). The beach community has usual array of merchants, activities, and services found at many beach communities. The "hypothetical" beach nourishment project proposed for the beach will mitigate the expected erosion over the next several decades. The nourishment profile of the project beach is shown in Figure 3.2. The nourishment project is one mile long and will extend the existing beach by 100 feet. It is estimated that 600,000 cubic yards (CY) of sand will be required for the beach nourishment project.[11]

[11] Staff of the Wilmington District of the U.S. Army Corps of Engineers estimated that a typical mile long and 100 feet wide beach nourishment project would require 500,000 CY of sand for a "low" energy beach and 700,000 CY of sand for a "high" energy beach. We chose the middle value of 600,000 CY of sand for our "proposed" project to reflect a "medium" energy beach.

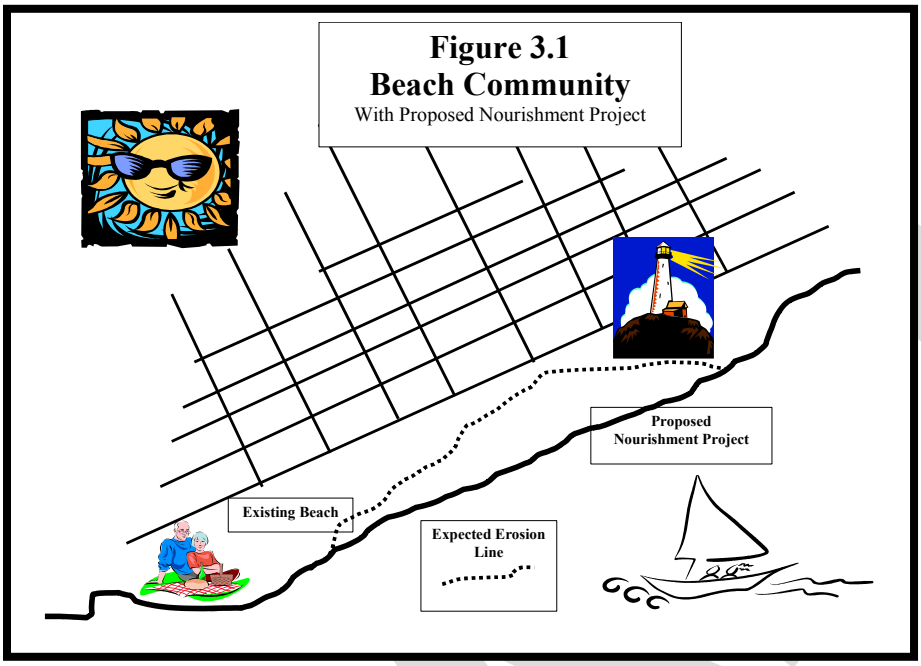


Figure 3.1
Beach Community
With Proposed Nourishment Project
Proposed
Nourishment Project
Existing Beach
Expected Erosion
Line

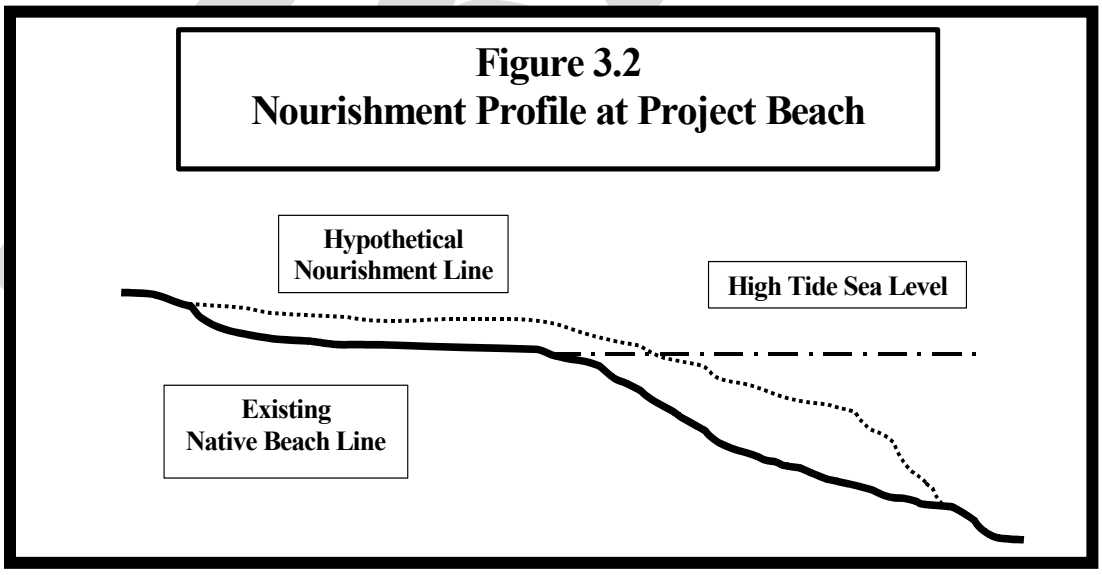


Figure 3.2
Nourishment Profile at Project Beach
Hypothetical
Nourishment Line
High Tide Sea Level
Existing
Native Beach Line

Table 3.2: Average Annual Benefits by Project ($/cubic yard in 2000 price levels)

Project Name	Project Price Year	Cubic Yards of Sand (000)	Average Annual Benefits per Cubic Yard of Sand			
			Storm Damage Reduction	Recreation	Other NED Benfits	Total Benefits
Harrison CO, MS	1948	5,700	$0.0000	$0.0000	$0.5691	$0.5691
Presque Isle, PA	1948	4,426	$0.0484	$0.4036	$0.0807	$0.5327
Channel Islands Habor, CA	1957	6,225	$0.2717	$0.0492	$0.0669	$0.3879
Long Island, Fire Is. To Montauk Pnt, Southampton to Beach Hampton , NY	1958	1,800	$4.0935	$0.4605	$0.0000	$4.5539
Carolina Beach & Vicinity, NC	1960	3,597	$0.3453	$0.2166	$0.0458	$0.6076
Oceanside, CA	1960	2,400	$0.1336	$0.0870	$0.0000	$0.2206
Wrightsville Beach, NC	1960	2,993	$0.2605	$0.0892	$0.0323	$0.3819
Fort Macon, NC	1961	93	$17.5563	$5.3691	$0.0000	$22.9253
Ventura-Pierpont, CA	1962	883	$0.8091	$0.3875	$0.0000	$1.1966
Surfside/Sunset, CA	1962	14,303	$0.7559	$0.1116	$0.0179	$0.8854
Fort Pierce Beach, FL	1962	718	$0.4535	$0.4979	$0.0000	$0.9514
Coast of CA, Point Mugu to San Pedro	1966	1,405	$0.0757	$1.6682	$0.0000	$1.7439
Hamlin Beach State Park, NY	1969	317	$0.0000	$3.2697	$0.0000	$3.2697
Long Lsland, Fire Island to Jones Inlet, NY	1970	4,123	$2.4134	$0.0000	$2.0980	$4.5113
Tybee Island, GA	1970	2,267	$0.0000	$0.6320	$0.0437	$0.6756
Brevard CO Cape Canaveral, FL	1972	1,250	$0.0000	$0.6789	$0.0330	$0.7119
Palm Beach CO Delray Beach, FL	1973	1,340	$0.3247	$1.3956	$0.0000	$1.7204
Rockaway, NYC	1974	6,364	$0.0384	$2.5311	$0.1860	$2.7555
Duval CO, FL	1974	2,486	$0.4940	$2.7370	$0.1293	$3.3608
Dade CO, FL	1974	14,601	$0.3464	$3.4388	$0.0682	$3.8534
Pinellas CO Treasure Island, FL	1974	600	$0.8790	$0.0000	$1.1410	$2.0201
Lakeview Park Coop, OH	1975	125	$0.0000	$10.3960	$0.0000	$10.3960
Broward CO, FL Segment 3	1978	3,070	$0.1439	$2.0495	$0.0084	$2.2018
Brevard CO, Indialantic/Melbourne, FL	1978	540	$0.0562	$5.6441	$0.0000	$5.7004
Grand Isle & Vicinity, LA	1978	2,870	$1.0012	$0.5567	$0.1794	$1.7374
Corpus Christi Beach, TX	1975	742	$0.0086	$4.3223	$0.0000	$4.3309
Broward CO, FL Segment 2	1980	1,030	$3.1083	$1.1463	$0.1359	$4.3906
Sherwood Island State Park, CT	1981	113	$0.3621	$11.9564	$0.0000	$12.3186
Pinellas CO, Long Key, FL	1984	253	$1.8211	$1.0088	$0.3406	$3.1706
Pinellas CO, Sand Key, FL	1984	2,707	$3.0074	$2.7435	$0.1727	$5.9235
Palm Beach CO, Lake Worth Inlet to South Lake Worth Inlet, FL	1986	875	$9.4901	$0.0000	$0.0000	$2.5605
Cape May Inlet to Lower Twp, NJ	1987	1,365	$3.3060	$0.9506	$0.1777	$4.4343
Maumee Bay, OH	1988	143	$0.0682	$25.8612	$0.0000	$25.9294
Great Egg Harbor & Pech Beach, NJ	1988	6,070	$6.2118	$1.3667	$0.0556	$7.6341
Revere Beach, MA	1988	670	$0.0000	$0.1412	$2.8430	$2.9842
Lee CO, Captiva Island, FL	1988	1,418	$0.9004	$0.5543	$0.0000	$1.4547
Ocean City, MD	1989	4,941	$3.7811	$0.1501	$0.0000	$3.9312
Folly Beach, SC	1990	3,100	$0.7926	$0.5963	$0.0000	$1.3889
Manatee CO, FL	1991	2,200	$2.2168	$0.1845	$0.0000	$2.4012
Cape Henlopen to Fenwick Island, DE	**1995**	**1,437**	**$2.0468**	**$0.6636**	**$0.0228**	**$2.7332**
Brevard County (North Reach), FL	**1996**	**2,500**	**$1.3925**	**$0.4320**	**$0.0000**	**$1.8069**
Brevard County (South Reach), FL	**1996**	**1,645**	**$2.1210**	**$0.0814**	**$0.0000**	**$2.2024**
Jones Inlet to East Rockaway Inlet, NY	**1995**	**8,600**	**$1.9653**	**$0.2016**	**$0.0000**	**$2.2064**
Cape Henlopen to Fenwick Island-Bethany Beach, DE	**1998**	**1,456**	**$2.0106**	**$0.2844**	**$0.1509**	**$2.4532**
Cape Henlopen to Fenwick Island-South Bethany, DE	**1998**	**1,996**	**$0.9051**	**$0.1635**	**$0.1080**	**$1.1766**
Broadkill Beach, DE	**1996**	**1,305**	**$1.4776**	**$0.0000**	**$0.0000**	**$1.4776**
Brigantine Inlet to Great Egg Harbor Inlet, NJ	**1998**	**648**	**$1.3580**	**$0.2119**	**$0.0994**	**$1.6694**
Oakwood Beach, NJ	**1998**	**332**	**$1.6865**	**$0.0000**	**$0.4137**	**$2.1002**
Reeds Beach and Pierces Beach-Reeds Beach, NJ	**1998**	**78**	**$6.5445**	**$0.0000**	**$0.0000**	**$6.5486**
Reeds Beach and Pierces Beach-Pierces Beach, NJ	**1998**	**171**	**$0.8248**	**$0.0000**	**$0.0000**	**$0.8248**
Townsends Inlet to Cape May Inlet, NJ	**1997**	**4,447**	**$1.8097**	**$0.5276**	**$0.2970**	**$2.6344**
Villas and Vicinity, NJ	**1998**	**950**	**$0.3080**	**$0.0000**	**$0.0000**	**$0.3080**
Raritan Bay and Sandy Hook Bay Huricane, NJ	**1999**	**379**	**$8.0114**	**$0.5344**	**$0.4935**	**$9.0393**
Dare County Beaches North, NC	**1999**	**4,300**	**$1.7611**	**$0.4432**	**$0.0336**	**$2.2378**
Dare County Beaches South, NC	**1999**	**8,040**	**$3.0581**	**$0.2499**	**$0.0465**	**$3.3544**
Barnegat Inlet to Little Egg Inlet, NJ	**1999**	**7,400**	**$1.1135**	**$0.2749**	**$0.1465**	**$1.5349**

Source: Theodore M. Hillyer. 1996. Final Report: An Analysis of the U.S. Army Corps of Engineers Shore Protection Program, IWR Report 96-PS-1. Alexandria, VA: U.S. Army Engineer Institute for Water Resources (June). Project information listed in bold has been taken from project summary reports that have been submitted to the U.S. Army Chief of Engineers. These projects have been authorized thorugh legislation and may not have been completed.

To estimate NED benefits for the "proposed" project, we need estimates of the average annual benefits per CY of sand for each type of NED benefits. Table 3.2 provides estimates of annual average benefits per CY of sand by type of NED benefit estimate for both completed and currently authorized shore protection projects. Both storm damage reduction and other NED benefits are related to the total quantity of sand used for the nourishment project. Ideally, recreation benefits should be related to the area of the created beach (i.e., one mile long by 100 feet wide). However, Table 3.2 only provides CY of sand. Therefore, recreation benefits are related to the quantity of sand on the beach area (i.e., 137,000 CY of sand).[12] Based on the estimates provide in Table 3.2, the weighted average annual NED benefits per CY of sand, quantities of sand, and annual average benefits for each NED benefit category are:

Benefit Category	Benefit/CY	Sand (000CY)	Average Annual Benefits ($000)
Storm damage reduction	$1.5329	600	$920
Recreation	$4.4431	137	$609
Other NED	$0.2045	600	$123
Total benefits			$1,651*

*Total shown does not equal sum of benefits due to rounding.

The region in which the beach and its community is important for the RED analysis because much of the goods and services needed for the beach merchants to operate are provided by the firms located in the region and because many of the employees working at the beach find their residences there also. A beach region was chosen to reflect the "typical" attributes and conditions of regions where a majority of Corps shore protection projects are located.

[12] Corps District staff at Wilmington, NC indicated that a typical depth of sand on the beach area (one mile long and 100 feet wide) varies between 4 feet deep and 10 feet deep.

A "typical" beach region was chosen based on an existing coastal county that contains an actual beach. Demographic data for this county were collected from the 2000 Census of Population. Economic data for the county was provided by the most recent (1999) release of the Regional Economic Information System at the U.S. Bureau of Economic Analysis. Data shown in Table 3.3 paint an interesting picture of our "typical" beach area. For example, it has a moderate population of almost 60 thousand inhabitants with an average density a little less than 115 people per square mile. There are about 41 thousand housing units, a lot compared to the number of inhabitants. However, almost one-third of the housing units are normally vacant for seasonal, recreational, or occasional use. This is consistent with a region that is significantly dependent on beaches. Economically, workers in this county currently earn, on average, about $20,000 in wages and salaries per year. Retail trade and services establishments are the major employers in this county, employing almost half of all jobs found in the county. About 12 percent of the workers employed in local jobs commute from residences located outside the county. It is estimated that 35.1 percent of the county's property owners also live in the county. Approximately 41 percent of the beach users live within the county and 14.1 percent are from places outside U.S.

Two other coastal counties were chosen to provide contrasting attributes and characteristics. The purpose of the contrasting coastal counties is to provide the bases for comparing the results for our "typical" beach region with those if the beach were located in a very rural region of if the beach were found in a highly urban beach region. In other words, they were chosen to test the sensitivity results to conditions much different than for the "typical" beach region. Rural regions are different than the "typical" region because they tend to be more agriculturally oriented, less sparsely populated, and the firms would be expected to provide fewer goods and services required at the beach. Urban regions, on the other hand, would be more economically diverse, more densely populated, and the firms would be expected to supply more of the goods and services needed at the beach as compared with the "typical" beach region. It is expected that the "multiplier" effects of beach activities to be smaller for the rural beach regions and larger for the urban beach regions than for the "typical" beach region.

Table 3.3: Regional Profiles of Three Beach Regions

Characteristic	Regions by Level of Economic Development		
	Typical	Rural	Urban
2000 Census of Population			
Total population (number)	59,400	29,900	160,300
Median age (years)	42.3	40.4	36.3
65 years and over (percent)	17.2%	13.8%	12.8%
Total households (number)	25,200	12,700	68,200
Average household personal income (dollars)	$59,408	$59,258	$63,419
Total housing units (number)	40,900	26,700	79,600
Occupied (percent)	61.6%	47.6%	85.6%
Vacant for seasonal, recreational, or occasional use (percent)	32.6%	50.1%	5.5%
Land area (square miles)	520	384	200
Density (people per square mile)	114.2	78.0	801.5
BEA profile (1999)			
Personal income (thousands of dollars)	$1,448,400	$728,100	$4,184,500
Average earnings per job (dollars)	$19,900	$20,500	$28,300
Total full-time and part-time employment (number)	31,700	24,500	109,400
Employment by sector (all percent)			
Wage and salary employment	75.2%	75.0%	84.9%
Proprietors' employment	24.8%	25.0%	15.1%
Farm proprietors' employment	0.4%	0.0%	0.1%
Nonfarm proprietors' employment	24.5%	25.0%	15.0%
Private employment	84.5%	89.1%	85.8%
Ag. services, forestry, fishing, & mining	4.8%	4.7%	1.4%
Construction	8.6%	11.2%	8.6%
Manufacturing	6.4%	2.8%	8.4%
Transportation and public utilities	3.4%	2.2%	4.0%
Wholesale trade	3.0%	2.1%	3.9%
Retail trade	24.6%	28.2%	22.0%
Finance, insurance, and real estate	9.1%	14.6%	7.7%
Services	24.5%	23.4%	29.7%
Government and government enterprises	15.5%	10.9%	14.2%
Workers that live locally (percent)	88.0%	82.0%	80.0%
Beach parameters			
Property owners that reside locally (percent)*	35.1%	46.1%	53.6%
Beach users: Local (percent)	41.0%	60.8%	29.0%
Rest of state (percent)	13.0%	9.9%	16.0%
Rest of U.S. (percent)	31.9%	8.9%	38.2%
Foreign (percent)	14.1%	8.9%	16.8%

* Computed as the percent of housing units that are owner-occupied adjusted for homeowner vacancy rate

It is interesting to note several of the common and contrasting demographic and economic characteristics that the rural and urban regions have with our "typical" beach region (Table 3.3). For example, compared with the "typical" beach region, the rural region has a much higher share of its housing stock that is vacant for seasonal use while the urban region has a much lower share of its housing stock that is vacant for seasonal

use. Both the rural and urban regions have larger percentages of workers commuting from residences outside their respective counties than does the "typical" beach region. Similarly, the percentages of the property owners that reside locally (within the county) are greater for both of the contrasting coastal counties than for the "typical" beach region. In comparison with the "typical" region, the percentage of beach users that reside locally is much larger for the rural region and much smaller for the urban region. The percentage of beach users that are foreign residents is lower for the rural region and higher for the urban region as compared with the "typical" beach region.

Table 3.4: Distribution of National Economic Development Benefits of Shore Protection Project (Medium Energy Protection) With No Additional Recreation Demand (000 dollars in 2000 prices)

	Beach Area Benefits	Rest of Nation Benefits	Total NED Benefits	Benefits ($/CY) of Sand	Sand (000 CY)
Typical Beach Region					
Storm damage reduction	$323	$597	$920	$1.5329	600
Recreation for existing demand	$250	$359	$609	$4.4431	137
Other	$0	$123	$123	$0.2045	600
Total	$572	$1,079	$1,651		
Regional distribution	34.7%	65.3%			
Rural Beach Region					
Storm damage reduction	$424	$496	$920	$1.5329	600
Recreation for existing demand	$370	$239	$609	$4.4431	137
Other	$0	$123	$123	$0.2045	600
Total	$794	$857	$1,651		
Regional distribution	48.1%	51.9%			
Urban Beach Region					
Storm damage reduction	$493	$427	$920	$1.5329	600
Recreation for existing demand	$177	$432	$609	$4.4431	137
Other	$0	$123	$123	$0.2045	600
Total	$670	$982	$1,651		
Regional distribution	40.5%	59.5%			

The distribution of NED benefits was computed using the beach parameters for the "typical" beach region found in Table 3.3. As previously explained, storm damage reduction benefits are distributed according to the residence patterns of property owners and recreation benefits are distributed by the residence patterns of the beach users. Other NED benefits are assigned to the "rest of the nation" region. These computations are

shown in Table 3.4. The results for the "typical" beach region indicate that approximately one third the NED benefits accrue to persons residing within the beach region and two thirds accrue to persons in the "rest of the nation" region. If the beach had been located in a rural region, then just under a half of the NED benefits would accrue to local residents. However, if the beach had been located within an urban region, then a little more than 40 percent of the NED would have accrued to local residents.[13]

It should be noted here that these results should be considered and used with a great deal of care because the distributional results are highly sensitive to the specific beach parameters used to distribute the NED benefits. One critical factor in determining the distribution of storm damage reduction NED benefits is the proportion of property owners that reside locally. The estimated value of this parameter for the three regions is an average for the entire region, not just for the immediate beach area. The residence pattern of the property owners at the beach could be quite different than for the region as a whole. For example, in a study of Delaware's beaches the researchers found that 27.6 percent of the beach property owners resided locally (within the region surrounding the beach).[14] If we use this value for the proportion of property owners residing locally, rather than the 35.1 percent value found in Table 3.3 for the typical region, then the 30.5 percent of NED benefits would accrue to residents of the "typical" beach region. All of this means that if accurate evaluations of the distributions of NED benefits for shore protection projects is desirable, then it is necessary to acquire "good" estimates of critical parameters like the proportion of property owners that reside locally based on site-specific values (probably those that are based on survey results).

[13] Interestingly, a similar distributional pattern of NED benefits is found for "low" and "high" energy beach protection. Tables F.1 and F.2 report the distributional patterns for the "low" and "high" energy beach protection simulations.

[14] Linda Lent and Christopher Jones in *The Economic Effects of a Five Year Nourishment Program of the Ocean Beaches of Delaware*. A Final Report for the Delaware Department of Natural Resources and Environmental Control. Bethesda, MD: Jack Faucett Associates (March 1998).

3.3.2.2 Extending the Case Study to Consider Induced Recreation Visitation

So far the case study has not identified whether the proposed beach nourishment project will affect recreation uses of the nourished beach. A telephone survey of the staff of Corps of Engineers Districts that have shore protection projects indicates a mix of professional opinions and experiences concerning whether nourishment projects induce increased visitation for the beaches beyond expected recreational visitation growth without the project. Some staff members indicated that they did not observe any increase in beach usage after beaches were nourished and others said that they did find that beach use increased moderately after a nourishment project (for one project it was indicated that there was a rather large increases in beach use—as large as 25 percent).

We extended the case study to consider the effects of incremental increases in beach use on the distribution of NED benefits. The increments considered are 0, 5, 10, 15, 20, and 25 percentage increases in beach use due to the proposed beach nourishment project. We estimate these increases in beach use based on the capacity of the proposed nourished beach (i.e., one mile long and 100 feet wide). The usual way to determine the capacity of a beach is to assume that each person optimally requires 100 square feet of beach space in order to feel comfortable. In addition, it is assumed that each 100 square foot space has a "turn-over" rate of 2, meaning that it is expected that people spend half a day actually on the sand. If the space of the proposed nourished beach is fully occupied, then it can handle 10,560 beach visitors each day it is used. A 5 percent increase in beach use in relation to the beach capacity means that 5 percent of the beach capacity is used by new visitors, an increase of 528 visitors. We assume that the capacity of the beach is only critical during peak days of the "beach season" (between Memorial Day and Labor Day). It is assumed that increases in beach use are easily accommodated during the non-peak days of the year by the existing beach capacity. That is, NED benefits are only claimed for the peak days. Data from the Corps of Engineers District Office at Wilmington, NC indicate that there are 30 peak days during the beach season (these

include weekends and holidays). This means that 5 percent increases in beach use during the 30 peak days is an increase of 15,840 beach visits.

Table 3.5: Distribution of National Economic Development Benefits of Shore Protection Project (Medium Energy Protection) With Varying Recreation Demand, Unit-Day Value is $2.00 (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total NED	
	Benefits	%	Benefits	%	Benefits	New Visits
Typical Beach Region						
No increase in beach use	$572	34.6%	$1,079	65.4%	$1,651	0
5% increase in beach use	$585	34.8%	$1,097	65.2%	$1,682	15,840
10% increse in beach use	$598	34.9%	$1,116	65.1%	$1,714	31,680
15% increase in beach use	$611	35.0%	$1,135	65.0%	$1,746	47,520
20% increase in beach use	$624	35.1%	$1,154	64.9%	$1,778	63,360
25% increase in beach use	$637	35.2%	$1,172	64.8%	$1,809	79,200
Rural Beach Region						
No increase in beach use	$794	48.1%	$857	51.9%	$1,651	0
5% increase in beach use	$813	48.3%	$869	51.7%	$1,682	15,840
10% increse in beach use	$833	48.6%	$882	51.4%	$1,715	31,680
15% increase in beach use	$852	48.8%	$894	51.2%	$1,746	47,520
20% increase in beach use	$871	49.0%	$907	51.0%	$1,778	63,360
25% increase in beach use	$890	49.2%	$919	50.8%	$1,809	79,200
Urban Beach Region						
No increase in beach use	$670	40.6%	$982	59.4%	$1,652	0
5% increase in beach use	$679	40.3%	$1,004	59.7%	$1,683	15,840
10% increse in beach use	$688	40.1%	$1,027	59.9%	$1,715	31,680
15% increase in beach use	$697	39.9%	$1,049	60.1%	$1,746	47,520
20% increase in beach use	$706	39.7%	$1,072	60.3%	$1,778	63,360
25% increase in beach use	$715	39.5%	$1,094	60.5%	$1,809	79,200

The next step in considering the effects of induced beach visitation on the distribution of NED benefits of shore projects is to determine an average monetary value for each of the new beach visits. The results of the telephone survey of Corps District staff that have evaluated shore protection projects indicated that they have used both the "unit day" value and the "travel cost" methods for evaluating the value of recreational experiences at beaches. The "with-project" user values used by Corps staff ranges from $2.00 per day to $5.17 per day (2000 price levels). Other State and Federal agencies use unit-day values that would indicate that the Corps of Engineers might be undervaluing the experience-value of beaches. One agency, the National Oceanic and Atmospheric Administration (NOAA) has used a unit-day value as high as $17.38 (2000 price levels) in their 1993 American Trader Law Suite due to a Southern California oil spill.[15]

[15] The unit-day value that NOAA used was provided by David Chapman of NOAA.

Using a with-project daily unit-day value of $2.00 per person distributions of NED benefits were compute for each increment of increased recreational beach use (i.e., 0, 5, 10, 15, 20, and 25 percentage increases). These computations for the typical beach region are shown in Table 3.5. The basic notion is that NED benefits get larger as the beach use increases, however, the distribution of NED benefits between the beach region and the rest of the nation does not change much. Also the relationships between distribution of NED benefits for our typical beach region and the distributions for the rural and urban regions also do not change (results also found in Table 3.5). Similar tables (Tables F.3 though F.10) provide results for variations in the selection of recreation values and for differences in the wave intensity at the beach.

3.4 A Framework for Evaluating the Regional Economic Development Benefits of Shore Protection Projects

Regional economic effects of recreational activities are interesting and their magnitudes can be quite startling at times. Recent studies of the regional economic effects due to beach related activities in the literature provide a variety of measures that could be interpreted as regional benefits, such as income, employment, sales, or tax revenues. For example on the West Coast, California's beaches experienced more days of visitor attendance in 1996 than all of the State's other tourist attractions combined—including Disneyland. Beach tourists' spending contributed more than $10 billion directly to the State and almost another $17 billion indirectly. This amounted to almost 3 percent of the State's total economic activity. Beach tourism is responsible for a half million of California's jobs and $1 billion in State sales, income, and gasoline tax revenues.[16] On the East Coast, Delaware receives 5.1 million "person trips" each year where just 21,000 people reside in beach communities. Another 373,000 people live within easy access to the State's beaches. Beach tourism generates $173.2 million in spending within the State each year. With a significant erosion problem, it is estimated that Delaware's beaches will lose over 471,000 visitor-days a year if the erosion continues. The loss in the State's tourism is expected to climb to over 516,000 visitor-

[16] Data are from a study by the University of San Francisco's Public Research Institute (King and Potepan, 1997).

days per year after 5 years of erosion. During this five-year period, beach erosion will cost an estimated $30.2 million in consumer expenditures, the loss of 625 beach area jobs, and the reduction of wages and salaries by $11.5 million. Business profits will drop by $1.6 million and State and local tax revenues will decrease by $2.3 million.[17]

3.4.1 Defining Regional Economic Development Benefits

The problem is that there is no generally accepted definition and measure of "regional benefit". The "Principles and Guidelines" (1983, p. 11) defines regional economic development benefits as the regional income and employment that result from each alternative project plan. Unfortunately, the term "income" is not further refined to aid analysts as to its meaning or intent. Income could mean "wages and salaries". In addition to wages and salaries, it might also include "proprietors' income" or may even be more broadly defined. The same lack of definition for income also plagues many of the academic and professional economic impact studies of beaches. For the present analysis, we define "regional income" as broadly as possible and we use changes in regional income as measures for changes in regional benefit.[18]

The gross domestic product (GDP) is one of the broadest and most widely used measures of the overall health of an economy and the well being of its citizens.[19] The GDP is the sum of the value of all goods and services that are produced to meet the demands of the economy's citizens, investors, governments, and foreign buyers. Against this production, the GDP also measures the nation's income payments and other factor costs. GDP and its components are compiled and presented as a set of national income and product accounts (NIPA). The basic purpose of the NIPA is to provide a coherent and comprehensive picture of the Nation's economy. The account shows the composition of production and the distribution of the incomes that are earned in the

[17] March 1998 study by Jack Faucett Associates (Bethseda, MD) in cooperation with independent consultants Linda Lent and Christopher Jones for the Delaware Department of Natural Resources and Environmental Control.
[18] We report employment and output effects, however, we use income as defined above as the basic measure of regional benefit.
[19] Much of the discussion presented here is based on that given by Seskin and Parker (1998).

process of production. In the NIPA, production consists of goods, services, and structures that are produced during the current period.[20] The NIPA is a double-entry account that provides a comprehensive and unduplicated measure of economic activity within a consistently defined framework. Together with a set of similarly configured regional accounts, the NIPA can be used to trace the principal economic flows among the major sectors and regions of the economy.

Figure 3.3
Summary National Income and Product Accounts

Gross Domestic Product	**Gross Domestic Product**
Equals	**Equals**
Wages and salaries	**Personal consumption expenditures**
Plus profits	**Plus gross private investment**
Profits tax Dividends paid (net) Undistributed profits	Fixed private investment Change in business inventories
Plus proprietors' and rental income	**Plus net exports of goods and services**
Plus net interest	Exports Imports
Plus indirect business taxes	**Plus government purchases**
Plus other charges against production	

The basic configuration of the NIPA (Figure 3.3) is a double-entry account that shows, on the right side, gross domestic product is measured by the sum of goods and services produced in the United States and sold to final users and, on the left side, GDP is

[20] Gains and losses from the sale of non-produced assets, such as land, from the sale financial assets (e.g., stocks and bonds), or from holding goods in inventory are not included because they were not produced during the current period.

measured by the incomes earned in production (including a "statistical discrepancy" between the two measures.[21] Intermediate purchases by business that are used to produce other goods and services are excluded from the NIPA and GDP. On the left side, the entries represent payments to factors of production; i.e., wages and salaries, profits, proprietors' and rental income, net interest, indirect business taxes, and other charges.[22] On the right side, the entries measure the value of production that is sold to final users; i.e., purchases by persons, by business for investment, by governments (Federal, State, and local), by foreign citizens (exports) for U.S.-made goods and services, and by U.S. residents for foreign-made goods and services (imports). It is important to note that GDP can be measured using by either the income or product sides of the NIPA. This provides a method evaluating the "beneficial" effects of project impacts. It is often difficult, because of data limitations, to determine whether the subsequent direct and indirect sales generated due to recreational projects represent sales to final users or to intermediate producers (i.e., from the product side).

On a regional level, gross regional product (GRP) is analogous to gross domestic product. For states, this is called "gross state product" or GSP (Friedenberg and Beemiller, 1997). In concept, the GRP for an industry is equivalent to its gross output (sales or receipts and other operating income, commodity taxes, and inventory change) minus its intermediate inputs (consumption of goods and services purchased from other U.S. industries or imported). As a result, GRP is the regional counterpart for the Nation's gross domestic product. In practice, GRP measures the sum of costs incurred (such as compensation of employees, net interest, and indirect business taxes) and the profits earned in production—see the left-hand side of Figure 3.4.[23] Often, these items are called

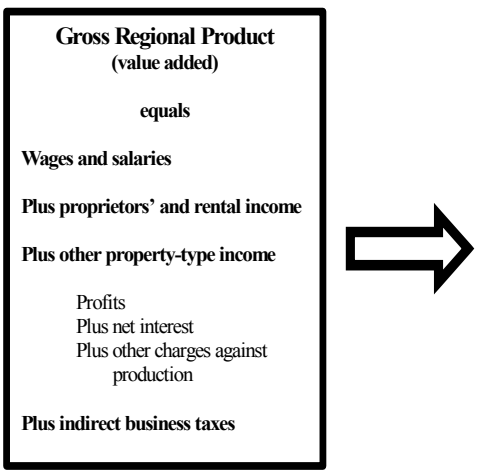
[21] The National Income and Product Account is one of several accounts that comprise the full set of National Accounts. Other accounts that are compiled are the Personal Income and Outlay Account, the Government Receipts and Expenditures Account, the Foreign Transactions Account, and the Gross Saving and Investment Account. Efforts are also made to compile several related ancillary accounts; for example, the National Input-Output Accounts and the Gross State Product Accounts.

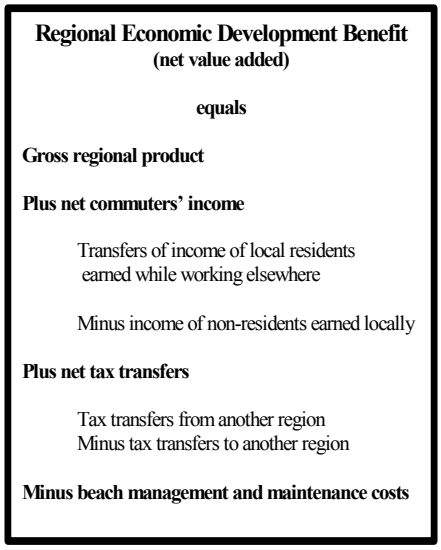
[22] Other charges include business transfer payments, consumption of fixed assets, and net income from the rest of the world. See Appendix B for a complete listing and detailed definition of the components of GDP from the income side of the accounts.

[23] GRP includes, in concept, all income items found in gross domestic product except for the statistical discrepancy. The statistically discrepancy is not often allocated to regions because of insufficient information.

"value added". Data on the income side of the income and product account are readily available from both public and commercial sources at many levels of geography (i.e., GSP for states and GRP for local areas).[24] Most available regional input-output models are configured to generate impact estimates based on the GRP concept. As a result, if appropriately implemented regional economic impact estimates can be provided to address changes in GRP due to project-related beach recreation activities.

Figure 3.4
Regional Economic Development Benefits





[24] The U.S. Bureau of Economic Analysis compiles and publishes Gross State Product data. The Minnesota IMPLAN Group makes these data commercially available for counties.

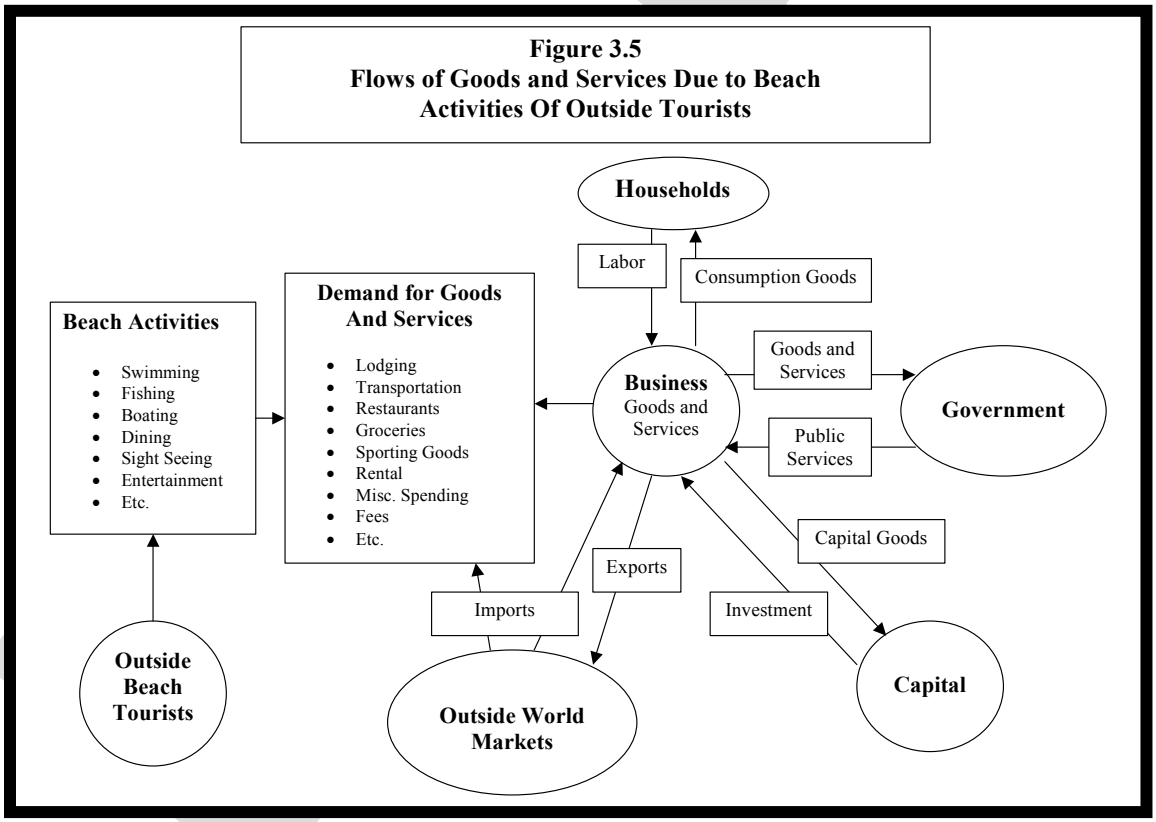
Changes in gross regional product measure the changes in the overall level of economic activity within a region. However, regions are more "open" than their national counterpart. This means that workers good and services flow through and between geographic areas almost without notice or measurement in the United States. Employees can work in one region and commute from residences in other areas. When this happen, the income they earn commutes with them. Also, the wages and salaries earn are taxes by Federal and most State governments. Excise and sales taxes are collected by State agencies. In addition, beach communities are responsible for managing and maintaining beach areas for the tourists to enjoy. The management and maintenance activities include, among other things, cleaning beach areas, employing lifeguards and safety personnel, providing parking facilities and other beach infrastructures, and floating bonds for required for future beach related investments. These commuting and tax revenue transfers from beach regions to other areas of the nation and maintenance requirements need to be accounted for our regional economic development framework. These adjustments to gross regional product are shown in the right-hand side of Figure 3.4. Our measure of regional economic development (RED) benefits is the change in "net value added" or GRP plus net commuters' income, plus net tax transfers, and minus beach management and maintenance costs.

3.4.2 Estimating Regional Economic Development Benefits

Most analysts estimate the regional economic effects of recreational activities—including beach recreation activities—using a variation of a simple methodological approach described by Propst, Stynes, Chang, and Jackson (1998). Four factors must be estimated and multiplied together to determine the economic impacts of visitor spending on a region; (1) the number of visits per year, (2) the spending per visitor; (3) the capture rate, and (4) the regional economic multiplier.

Economic Impact = # of visits × spending per visit × capture rate × regional economic multiplier

Each of the components of the economic impact will be discussed in greater detail below. However, to introduce the reader to the basic concepts behind economic impact analysis, the meaning of the components and a simple example will be presented here. See Appendix D for a more detailed discussion of several important issues related to estimating regional economic impacts.[25]



[25] Appendix D includes discussions of input-output analysis, estimating capture rates, defining regions for economic impact analysis, and regional economic impact modeling frameworks other than input-output sis.

Beach economies are complex systems of relationships between tourists, local merchants, other nearby businesses, workers, public and private institutions (e.g., governmental agencies), and related business entities outside the region surrounding the beach area. Figure 3.5 attempts to capture the essence of these relationships in graphical form. Suppose, for example, that 250,000 people visit the beach during a year (the first component of the impact formula). In a simplified manner, the way in which the beach economy works is that tourist come to the beach to participate in one or more recreational and related activities such as swimming, sun bathing, fishing, boating, and sight seeing. They may also dine in one of the fine restaurants or buy groceries and have a picnic. Camping facilities and local hotels and motels are often used for overnight visits.

While participating in these activities, tourists will frequently shop in local stores in order to purchase needed goods and services that will enhance their activities. These purchases may include a wide variety of commodities such as sporting goods (rods, reels, bait, etc.), groceries (for example, bread, milk, seafood, and snack foods), clothes (e.g., tee shirts and swim suits), or film and film development. In addition, the visitors may need to rent a car or a boat. They will usually need to purchase gas with these rental items. Based on a Texas study of a "typical" beach area, each tourist spends an average of $88 for goods and services at the beach and within the surrounding region (the second component of the economic impact); Fesenmaier, etal (1987). Together, the product of the first two impact components is the total amount of spending that beach visitors bring into the beach area. For our example, the beach visitors spent $22,000,000 (250,000 × $88) during the year for goods and services within the beach area in conjunction with their beach activities.

The third component of the economic impact (the capture rate) is the rate at which the beach area is able to capture the money being spent by beach visitors. It is not hard to understand that everything purchased at the beach may not be made in the beach region. This is shown as imports of goods and services from sources outside the region that are, in turn, sold directly to the beach tourists. For example, a beach tourist might purchase a

t-shirt from a local vendor. The shirt may be made in a factory someplace other than the beach (e.g., in Mississippi). However, the service provided by the local merchant while selling the shirt to the tourist was provided within the beach area. So, the capture rate can be any number between zero and one. A capture rate such as 0.3 means that 30 percent of the money spent by visitors at the beach is captured by the area's businesses. Higher capture rates indicate that the respective region is able to supply more of what beach tourists want during their visits. In many economic impact studies, the "direct effect" of visitor spending is equal to the capture rate times the total visitor spending; i.e., the direct spending effect for our example is $6,600,000 (0.3 × $22,000,000).

Finally, the fourth component of the economic impact is the regional economic multiplier. The regional economic multiplier provides an estimate of economic circulation—or ripple effect—within the local economy (e.g., see the "spider web" formation in Figure 3.5). For example, a regional economic multiplier of 2.5 means that an original stimulus of $1— or the direct spending effect—will continue to circulate as an indirect effect throughout the local economy 1.5 times beyond the original stimulus (2.5 – 1.0). This means that the total spending effect of beach activities on the local economy for our example is $16,500,000 (2.5 × $6,600,000) while the indirect beach spending effect is $9,900,000 (1.5 × $6,600,000).

3.4.3 A Method of Distributing RED Benefits of Beach Recreation Activities

Distributing the RED benefits of shore protection projects is somewhat more complicated than distributing the NED benefits. The economic impacts that have their source within a beach region not only affects economic activity within the region but also places quite distant from the beach. For example, a rod and reel purchased from a "bait and tackle" shop at the beach not only provides income for the employees and owners of the shop, the purchase also affects the incomes of the employees and owners of the manufacturing plant that made the rod and reel as well as the trucking company the hauled the rod and reel from the plant to the merchant's shop. However, if the tourist that bought the rod and reel and the bait shop would have gone to a lake to fish and purchased

a rod and reel there, then the economic effects at the manufacturing plant would occur anyway. For the nation as a whole the two scenarios are very much the same. However, in this case, the income generated at the beach bait shop would not take place. Consequently, it is not appropriate to count the effects at the rod and reel manufacturing plant as part of a "rest of the nation" regional economic development benefit. More generally this kind of "double counting" is precisely what is attributed as a national effect in many regional economic impact studies of beach activities.

There are several assumptions made here that can affect the distribution of RED benefits. First, for RED benefits only, it is assumed that the unemployment rate is not zero.[26] This assumption permits the positive regional economic effects of beach activities within the beach region without having to also estimate the corresponding negative regional economic effects in the rest of the nation region.[27] To some extent, this is not that critical because so many of the beach workers are students and spouses. These workers are often only in the workforce for the summer season.

Second, we assume that the proportion of income that people spend will not change if a beach is not available for their use. That is, money spent at the beach would otherwise be spent on some other activity or for some goods and services. This assumption has some basis on the national level. Table 3.6 presents personal income data published recently by the U.S. Bureau of Economic Analysis.
The personal income and expenditure data indicates that people in the U.S. spend approximately 80 percent of their annual personal income with little variation over the period 1960 to 2000. The practical consequence of this assumption is that only the impacts of beach visitors from outside the region under consideration can be counted as its regional economic development benefits.[28]

[26] A zero unemployment rate assumption is commonly used for computing NED benefits.
[27] That is, the resources necessary for the positive effects in the beach region are available without requiring reductions due to their leaving one productive activity for another.
[28] One exception to this assumption comes from the situation in which the local beach user substitutes the local beach for a beach outside the beach region. Another exception is the case where the domestic beach user would travel outside the nation if the beach were not available.

Table 3.6: Disposition of U.S. Personal Income (billions of dollars in current prices)

Year	Personal Income	Personal Taxes & Nontax Payments	Personal Outlays	Personal Savings	Percent of Personal Income	
					Outlays	Savinngs
1930	$76.5	$1.9	$71.3	$3.2	93.2%	4.2%
1935	$60.5	$1.3	$56.6	$2.6	93.6%	4.3%
1940	$78.6	$1.9	$72.2	$4.5	91.9%	5.7%
1945	$171.9	$19.8	$120.8	$31.4	70.3%	18.3%
1950	$229.9	$19.3	$195.4	$15.2	85.0%	6.6%
1955	$316.8	$33.4	$263.8	$19.5	83.3%	6.2%
1960	$412.7	$46.6	$339.8	$26.4	82.3%	6.4%
1965	$557.4	$58.4	$456.2	$42.7	81.8%	7.7%
1970	$841.1	$104.6	$667.0	$69.5	79.3%	8.3%
1975	$1,331.7	$150.3	$1,056.2	$125.2	79.3%	9.4%
1980	$2,323.9	$304.2	$1,814.1	$205.6	78.1%	8.8%
1985	$3,515.0	$428.5	$2,803.9	$282.6	79.8%	8.0%
1990	$4,903.2	$609.6	$3,959.3	$334.3	80.7%	6.8%
1995	$6,200.9	$778.3	$5,120.2	$302.4	82.6%	4.9%
2000	$8,319.2	$1,288.2	$6,963.3	$67.7	83.7%	0.8%

Source: U.S. Bureau of Economic Analysis. 2001. Table 4--National Income and Disposition of Personal Income. *Survey of Current Business* (August) page 137.

The personal income and expenditure data indicates that people in the U.S. spend approximately 80 percent of their annual personal income with little variation over the period 1960 to 2000. The practical consequence of this assumption is that only the impacts of beach visitors from outside the region under consideration can be counted as its regional economic development benefits.[29] For example, the net value added impacts that occur within the beach region due to visitors from places outside the beach region are counted as the RED benefits for the beach region. Similarly, the net value added impacts that occur within the "rest of the nation" region due to only the foreign beach visitors are counted as the RED benefits for the "rest of the nation" region.

[29] One exception to this assumption comes from the situation in which the local beach user substitutes the local beach for a beach outside the beach region. Another exception is the case where the domestic beach user would travel outside the nation if the beach were not available.

Another reason for considering only net value added impacts due to beach users from places outside the region being considered is that the regional economic impact models used here to compute the value added impacts treat the income generation and consumption process as "endogenous" to the model.[30] The importance of this distinction type of beach user rests on the fact that purchases by beach users from outside the region are considered exports for local businesses while purchases by local beach users are considered as part of their normal consumption expenditures. This means that, for the case of the beach region, the local consumption of beach related activities is a personal consumption activity and is already accounted for by the beach region model. For the "rest of the nation" region the use of the beach by domestic residents is also a consumption activity and is also accounted for by the "rest of the nation" region model.

3.4.4 Distributing RED Benefits: The Case Study Reconsidered

Like the case study used above to analyzed the distribution of NED benefits of shore protection, we would have preferred to examine the RED benefits of an actual or proposed shore protection project. Because we did not have access to spending for such a project, we chose to continue the analysis of our case study approach. In this study we examine the distribution of the RED benefits of the existing beach activities and the distribution of RED benefits of increases in the use of the beach due to the proposed hypothetical shore protection project. In addition, we are interested in what might happen if the project were not implemented and the shore line were allowed to naturally erode. Again, we also use the "typical" beach region as a "frame of reference" and compare its results with those for both rural and urban beach regions (see Table 3.3 for the basic set of demographic and economic characteristics of the three regions considered).[31]

[30] The technical term in input-output analysis is that we are using Type-II multipliers.
[31] Again, the data and the analysis of the RED benefits that follows are for three actual coastal counties that contain beach areas.

3.4.4.1 The RED Benefits of an Existing Beach

What is the RED value of an existing beach prior to consideration for a Federal shore protection project? The purpose of this analysis of the RED benefits of an existing beach is three-fold; (1) to explain the basic economic relationships that existing beaches have with their regions, (2) to provide an "order of magnitude" estimate of the value of an existing beach to the region in which it is located, and (3) to demonstrate the efficacy of the methodology for distributing RED benefits that has been developed here. While hypothetical, it does provide an indication of the magnitude of the regional importance of an existing beach with a visitation of one million recreation users a year from outside the region. Many existing beaches have outside visitations about this magnitude. The decisio9n to use "one million" beach visits by outside tourists was made to simulate the importance of the existing beach on the economy of the respective region and to demonstrate the procedures that are used to compute the net value added impacts and their distribution between the beach region and the rest of the nation.

The basic relationships of the beach economy were explained earlier and are shown schematically in Figure 3.5. Ideally, we would have liked to have access to spending patterns based on surveys of the beach users who actually visit an existing beach area. However, such survey results are unavailable. Therefore, we chose to use spending patterns based on survey results that we assume are representative of the beach users at our "typical" beach area. In addition, we also use "representative" spending patterns for the rural and urban beach areas. Table 3.7 provide these spending data on a daily "per visitor" basis and for a million visits from outside the region.[32] RED benefit results for annual visitation levels either lower or higher than a million annual visits can

[32] Our daily "per visitor" beach spending levels appear to be consistent with those found in other studies. For example, in a recent survey of travel and tourism expenditures at New Jersey beaches the average daily "per person" expenditures were $70 for people making only day trips, were $134 for people making overnight trips, and were $111 for the average visitor (all in 2000 price levels): prepared by Longwoods International for the 2000 New Jersey Travel Research Program, New Jersey Commerce and Economic Growth Commission (May 2001).

be derived from the results we present here by making appropriate simple proportional adjustments.

The "net value added" effects (RED benefits) within the "typical" beach region due to a million outside beach visitors were estimated using a "Type-II" regional input-output model for the "typical" beach region compiled from the IMPLAN Input-Output System.[33] Because the input-output model is configured for approximately 500 industrial sectors, the expenditures shown in Table 3.7 had to be further decomposed in much finer spending categories. This was accomplished using "bridge" tables for recreational spending developed by Propst, Stynes, Lee, and Jackson (1992).

Table 3.7: Recreational Spending in Beach Region Due Outside Tourists (2000 prices)

	Daily Spending per Visitor (dollars)			Spending Due to a Million Daily Visits ($000)		
Category	Typical	Rural	Urban	Typical	Rural	Urban
Lodging	$11.53	$7.93	$28.49	$11,532	$7,934	$28,485
Transportation	$11.00	$19.03	$17.08	$10,998	$19,027	$17,079
Restaurant	$13.29	$9.98	$42.88	$13,292	$9,977	$42,877
Grocery & Misc	$35.37	$18.71	$28.05	$35,367	$18,713	$28,045
Fishing	$12.00	$4.84	$6.96	$12,004	$4,839	$6,960
Rental	$2.33	$2.36	$2.47	$2,325	$2,357	$2,467
Fees	$2.59	$3.90	$2.86	$2,592	$3,896	$2,860
Total	$88.11	$66.74	$128.77	$88,111	$66,743	$128,773

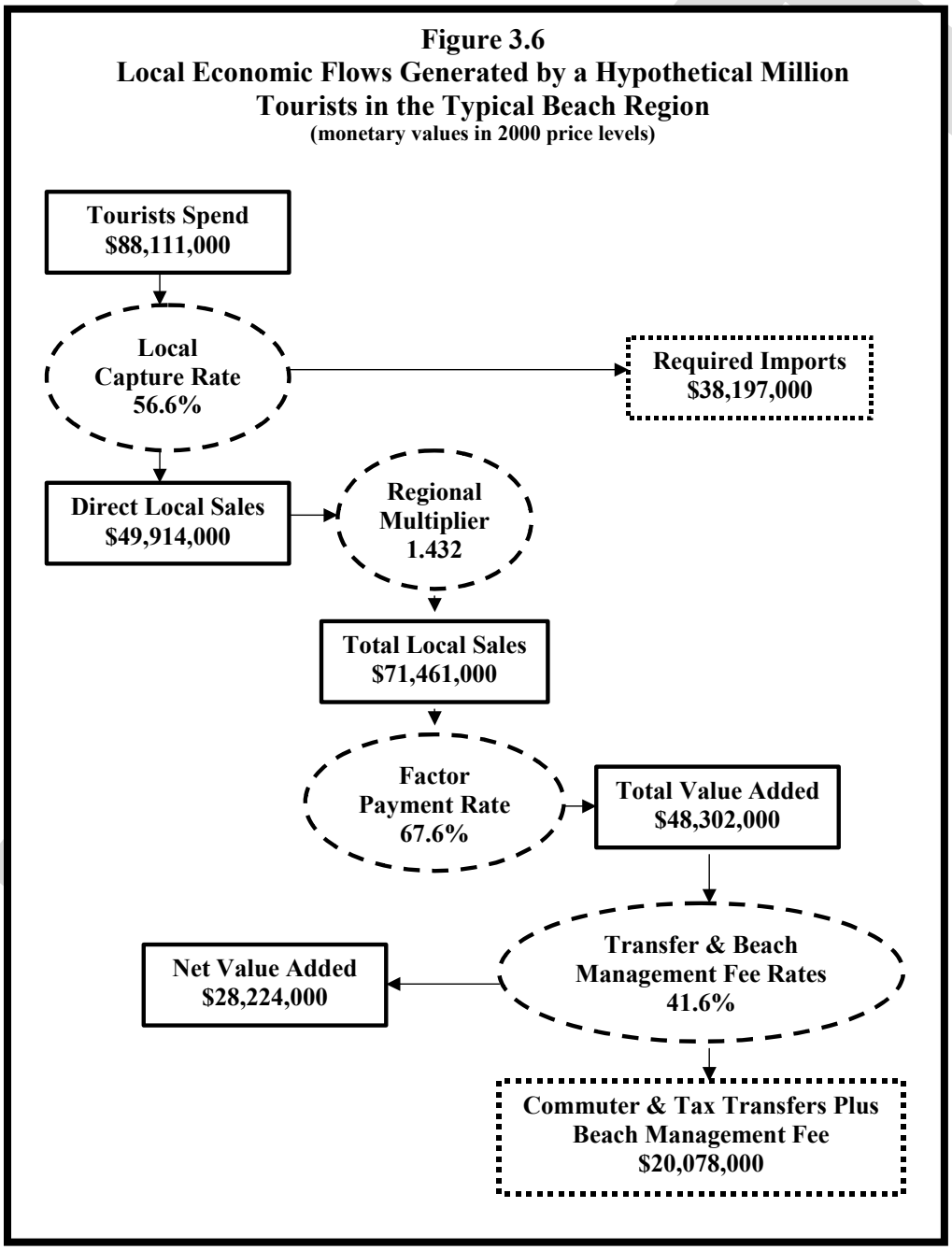
Note: Monetary values in the original study are updated to reflect 2000 price levels.
Source: Daniel R. Resenmaier, etal. 1987, *Regional and Statewide Economic Impacts of Sport Fishing, Other Recreational Activities, and Commercial Fishing Associated with Major Bays and Estuaries of the Texas Gulf Coast.* Report perpared for the Texas Department of Recreation and Parks (August).

The analysis of the RED benefits of a hypothetical million outside visitors to the "typical" beach region is pictured in Figure 3.6. The analysis shown in Figure 3.6 is highly aggregated. The rates and multipliers shown are weighted averages of the corresponding values in the IMPLAN input-output model and are only shown for

[33] Scott A. Lindall and Douglas C. Olson. 2000. *The IMPLAN Input-Output System*. Stillwater, MN: Minnesota IMPLAN Group.

illustrative purposes. They only represent the specific impact scenario that is analyzed for the "typical" beach region. They cannot be interpreted as representative for any other scenario in this region or any other region.

Figure 3.6
Local Economic Flows Generated by a Hypothetical Million Tourists in the Typical Beach Region
(monetary values in 2000 price levels)



Following the flow diagram in Figure 3.6, a hypothetical million visitors from outside the "typical" beach region come to enjoy the beach and, in turn, spend a little more than $88.1 million on goods and services purchased from local merchants. Given the availability of these goods and services from local businesses, the region economy is able to capture 56.6% of the beach visitor spending, or $49.9 million ($38.2 million of the goods and services have to directly imported from outside the region). On average, there is a 1.432 total multiplier effect on the regional economy.

This means that due to the direct effect of $49.9 million due to beach visitation by non-residents, total sales in local businesses will increase by approximately $71.5 million. It is estimated that factors of production (labor, proprietors, landlords, capitalists, and governments, or value added) will get $48.3 million of the increased local sales (67.6 percent). Commuter and tax revenue transfers and beach management and maintenance costs require about $20.1 million of the increased value added, leaving $28.2 million in the hands of the residents of the "typical" beach region.[34]

The "net value added" effects within "rest of the nation" due to the foreign beach visitors were computed in a similar fashion. First, we computed the economic impacts of foreign beach visitation (23.9 percent of the outside beach visitors, computed from information in Table 3.3) on the "typical" beach region and on the entire nation. A national "Type-II" input-output model was also compiled with the IMPLAN Input-Output System. We assumed that foreign beach visitors spend their money at the beach just like all outside visitors to the beach. Then, we subtracted the impacts due to foreign beach visitors in the beach area from the impacts due to foreign beach visitors in the entire nation. The RED benefits for both the "typical" and "rest of the nation" regions are presented in Table 3.8. All together, about 47 percent of the combined RED benefits

[34] A more "traditional" presentation of the economic impacts in the "typical" beach region is given in Table F.11. In addition, to the impact results provided in Figure 3.6, we estimate that the beach spending by a million outside visitors generates almost 2,000 full-time jobs in the region. It is also important to note that the "trade and services" sectors are the most heavily impacted by the beach visitation (these sectors account for more than 80 percent of the total output and employment impacts). Similar results are provided for the rural and urban beach regions in Tables F.12 and F.13

accrue to the "typical" beach region. Contrast this with the results for the rural and urban beach regions that get 40 percent and 50 percent of the RED benefits, respectively.

Table 3.8: Distribution of Regional Economic Development Benefits of Recreation Due to One Million Hypothetical Outside Visitors ($000 in 2000 prices)

	Beach Area Due to All Outside Visitors	Rest of the Nation Due to Foreign Visitors Only
Typical Beach Region		
Employee Compensation	$25,466	$13,220
Proprietors' Income	$6,098	$1,761
Other Property Income	$9,430	$7,083
Indirect Business Taxes	$7,308	$2,146
Gross Regional Product	$48,302	$24,209
Net commuters' income	-$5,796	$1,385
Net tax transfers	-$12,298	$6,312
Beach management costs	-$1,984	$0
Regional economic development benefits	$28,224	$31,907
Regional distribution	46.9%	53.1%
Local tax revenues collected	$3,239	
Rural Beach Region		
Employee Compensation	$17,637	$9,566
Proprietors' Income	$3,576	$1,429
Other Property Income	$6,587	$5,082
Indirect Business Taxes	$4,347	$1,829
Gross Regional Product	$32,147	$17,905
Net commuters' income	-$5,786	$1,314
Net tax transfers	-$8,479	$4,458
Beach management costs	-$1,984	$0
Regional economic development benefits	$15,898	$23,677
Regional distribution	40.2%	59.8%
Local tax revenues collected	$1,906	
Urban Beach Region		
Employee Compensation	$52,823	$18,004
Proprietors' Income	$8,414	$2,604
Other Property Income	$18,123	$9,503
Indirect Business Taxes	$12,499	$2,905
Gross Regional Product	$91,859	$33,016
Net commuters' income	-$18,372	$4,354
Net tax transfers	-$24,048	$9,691
Beach management costs	-$1,984	$0
Regional economic development benefits	$47,455	$47,061
Regional distribution	50.2%	49.8%
Local tax revenues collected	$5,355	

3.4.4.2 The RED Benefits of Increased Beach Use Due to the Proposed Project

The effects on the distribution of RED benefits due increases in visitation stemming from the hypothetical beach nourishment project were analyzed; specifically resulting from incrementally increasing beach visitation by 0, 5, 10, 15, 20, and 25 percent. It is assumed that increases in visitation are based on the capacity of the hypothetical beach nourishment project (as defined by the "hypothetical beach nourishment project). However, instead of only considering real increases in visitation during peak visitation days (for NED benefits), increases in visitation for the entire year are evaluated for RED benefits. Because input-output is mathematically "linear", all impacts resulting from increases in visitation are proportional to the change in visitation relative to existing visitation levels (i.e., one million outside beach visits). Consequently, the magnitude of the net value added effects increases in proportion to the increase in beach visitation, however, the distribution of RED benefits does not change; see Table 3.9.

Table 3.9: Distribution of Regional Economic Development Benefits of Shore Protection Project With Varying Recreation Demand (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total RED	New Outside
	Benefits	%	Benefits	%	Benefits	Visitors
Typical Beach Region						
No increase in beach use	$0		$0		$0	0
5% increase in beach use	$605	43.8%	$776	56.2%	$1,381	23,882
10% increse in beach use	$1,210	43.8%	$1,552	56.2%	$2,762	47,764
15% increase in beach use	$1,814	43.8%	$2,328	56.2%	$4,142	71,646
20% increase in beach use	$2,419	43.8%	$3,104	56.2%	$5,523	95,527
25% increase in beach use	$3,024	43.8%	$3,880	56.2%	$6,904	119,409
Rural Beach Region						
No increase in beach use	$0		$0		$0	0
5% increase in beach use	$571	40.2%	$851	59.8%	$1,422	35,945
10% increse in beach use	$1,143	40.2%	$1,702	59.8%	$2,845	71,889
15% increase in beach use	$1,714	40.2%	$2,553	59.8%	$4,267	107,834
20% increase in beach use	$2,286	40.2%	$3,404	59.8%	$5,690	143,778
25% increase in beach use	$2,857	40.2%	$4,255	59.8%	$7,112	179,723
Urban Beach Region						
No increase in beach use	$0		$0		$0	0
5% increase in beach use	$2,132	51.5%	$2,010	48.5%	$4,142	43,255
10% increse in beach use	$4,264	51.5%	$4,019	48.5%	$8,283	86,511
15% increase in beach use	$6,396	51.5%	$6,029	48.5%	$12,425	129,766
20% increase in beach use	$8,529	51.5%	$8,039	48.5%	$16,568	173,022
25% increase in beach use	$10,661	51.5%	$10,048	48.5%	$20,709	216,277

Using the net value added impacts within the "typical" beach region as a basis for determining importance of increases in visitation on the local economy, a 5 percent increase in visitation induced by the hypothetical beach nourishment project will increase the region's net value added from beach related activities by 2.1 percent (i.e., by comparing the net value added impacts in Table 3.9 with those in Table 3.8).[35] A 10 percent increase in visitation will improve the region's net value added by 4.3 percent, and so on. An increase in visitation of 25 percent will raise the region's net value added by 10.7 percent. Interestingly, the increases in regional net value added are large for both the rural and urban beach regions than for the "typical" region. For the rural beach region, increases in visitation of 0, 5, 10, 15, 20, and 25 percent will increase net value added, respectively, by 0, 3.6, 7.2, 10.8, 14.4, and 18 percent. The corresponding percentage increases in net value added for the urban region are 0, 4.5, 9, 13.5, 18, and 22.5 percent. Several reasons account for these differences. For example, both the level of spending per visitor and percentage of beach visitors residing outside the rural beach region are lower than for the "typical" beach region. Consequently, the net value added impact of the existing beach is smaller for the rural region than for the "typical" beach region (56 percent smaller) and, as a result, the rural region's net value added impacts due to increases in visitation are larger percentages of the existing beach's net value added impacts than for the "typical" region. On the other hand, the larger economic multiplier effects and level of spending by outside visitors within the urban region explain the larger percentage increases in net value added due to increases in visitation than in either the "typical" or rural beach regions.

3.4.4.3 The RED Benefits of Allowing the Beach to Erode

A number of beach officials have indicated that beach visitation may not change as beaches are not nourished and allowed to erode and accrete naturally. However, it appears that the mix of beach visitors and activities do change. It has been casually observed that the new visitors use the beaches differently; they use the beach more during

[35] Of course, no increase in visitation will have no affect the region's net value added.

low tide and less during high tide, they camp more and stay in "expensive" hotels and motels less; they dine in restaurants less frequently, etc. These changes mean that "fewer" dollars flow into the beach economy and the RED effects are smaller as a consequence. These effects were simulated by determining what would happen if the outside beach visitors to the typical beach region behaved like the outside beach visitors to the rural beach region. That is, rather than the hypothetical million outside beach tourists now spending $88.1 million per year, they will spend $66.7 million per year. It is also assumed that the pattern of expenditures will change accordingly. Relative to the typical situation, the drop in spending by outside tourists will mean a drop in RED benefits by $8 million both for the beach region and for the rest of the nation (Table 3.10)

Table 3.10: Distribution of Regional Economic Development Benefits of Recreation in Typical Region Due to a Reduction in Visitor Spending ($000 in 2000 prices)

	Beach Area Due to All Outside Visitors	Rest of Nation Due to Foreign Visitors Only
RED Benefits from Typical Propensity to Spend		
Employee Compensation	$25,466	$13,220
Proprietors' Income	$6,098	$1,761
Other Property Income	$9,430	$7,083
Indirect Business Taxes	$7,308	$2,146
Gross Regional Product	$48,302	$24,209
Net commuters' income	-$5,796	$1,385
Net tax transfers	-$12,298	$6,312
Beach management costs	-$1,984	$0
Regional economic development benefits	$28,224	$31,907
Region distribution	46.9%	53.1%
Local tax revenues collected	$3,239	
RED Benfits from Rural Propensity to Spend		
Employee Compensation	$18,559	$9,851
Proprietors' Income	$4,483	$1,287
Other Property Income	$7,011	$5,249
Indirect Business Taxes	$5,208	$1,720
Gross Regional Product	$35,261	$18,107
Net commuters' income	-$4,231	$1,011
Net tax transfers	-$8,899	$4,458
Beach management costs	-$1,984	$0
Regional economic development benefits	$20,147	$23,577
Region distribution	46.1%	53.9%
Local tax revenues collected	$2,322	
Net Regionas Economic Development Benefits		
Employee Compensation	-$6,907	-$3,368
Proprietors' Income	-$1,615	-$474
Other Property Income	-$2,419	-$1,834
Indirect Business Taxes	-$2,100	-$426
Gross Regional Product	-$13,041	-$6,102
Net commuters' income	$1,565	-$374
Net tax transfers	$3,399	-$1,854
Beach management costs	$0	$0
Regional economic development benefits	-$8,077	-$8,330
Region distribution	49.2%	50.8%
Local tax revenues collected	-$917	

3.5 The Fiscal Impacts of Beaches

Local tax revenues generated by recreation activities at existing beaches may be larger than required to fund related beach management and maintenance costs. The implication is that beaches have more than enough money to fund the additional non-Federal cost-share for the beach re-nourishment component of the shore protection program. However, even if it can be shown that local tax revenues collected are greater than needed to cover beach management and maintenance costs,[36] the "excess" revenues are probably being currently used to help fund other important local public services and, therefore, they may not be readily available to fund an increase in the non-Federal cost-share for an existing project. In-depth analysis of beach economies using appropriate survey data and relevant fiscal budget information would be required, before definite conclusions could be drawn concerning the fiscal conditions of beach communities.

Even though local tax revenues collected at existing beaches may not be appropriately considered available to fund the increases in the non-Federal cost-share of an exiting beach nourishment project, the local tax revenues that are collected as a result of "new" visitation due to beach nourishment due to a new Federal nourishment project could be used to fund the increased non-Federal cost-share. By applying the 65 percent non-Federal cost-share, as recommended by the President's FY'03 budget, is applied to the estimated project costs for the hypothetical beach nourishment project. The estimated annual NED benefits for the beach project is $1,651,000. Suppose that the benefit/cost ratio for this project is 2.0. Then the estimated non-Federal cost-share for the hypothetical beach nourishment project is $26,829,000 ($0.65 \times 50 \times \$1{,}651{,}000 \div 2$). There are a number of ways in which non-Federal sponsors can use to fund their share of

[36] For example, local tax revenues collected in the "typical" beach region are a little more than 60 percent greater than the beach management costs (Table 3.10). And for the urban beach region, the local tax revenues collected are more than 2.5 times the beach management costs. However, local tax revenues collected are slightly less than the beach management costs in the rural beach region.

the project costs. One method is to "float" a municipal bond and pay the annual cost of the bond out of local tax revenues or other sources of local revenue (e.g., parking fees, "bed" taxes, beach tolls, etc.). Using a 20-year municipal bond that has an annual 5 percent rate of interest,[37] the annual cost of the bond to cover the principal (non-Federal cost-share) and accumulated interest is $1,847,000. Some states pay the entire non-Federal cost-share, other states pay for a portion of the cost-share, and others do not participate in cost sharing with the local sponsor. If the State provides 100 percent of the non-Federal cost-share, then the increase in non-Federal cost-share to 65 percent will place no additional burden on the local project sponsor.[38] If the State does not participate in project cost sharing, then the local project sponsor is burdened with the entire non-Federal cost-share (i.e., the annual payment of $1,847,000). However, if the State participates in project cost sharing, then the local sponsor's obligation is reduced accordingly. Suppose the State provides 75 percent of the non-Federal cost-share, then the annual cost of the bond will be $462,000.

Table 3.11: Cost Sharing Requirements ($000 in 2000 prices) Sensitivity Analysis

	Total NED Benefits	Project Cost-Share for Selected Benefit/Cost Ratios			Annual Payment Required for a 20 Year Bond Accrued at A 5% Interest Rate for Selected Benefit/Cost Ratios			25 % of Annual Payment for Selected Benefit/Cost Ratios		
		1.0	2.0	3.0	1.0	2.0	3.0	1.0	2.0	3.0
65 % Cost Sharing	$1,651	$53,658	$26,829	$17,886	$3,694	$1,847	$1,231	$924	$462	$308
50 % Cost Sharing	$1,651	$41,275	$20,638	$13,758	$2,842	$1,421	$947	$710	$355	$237
35 % Cost Sharing	$1,651	$28,893	$14,446	$9,631	$1,989	$995	$663	$497	$249	$166

Assumes daily "unit-day" value is $2.00 per person and medium energy protection

Table 3.11 provides a sensitivity analysis for varying estimates of the local cost sharing requirements under several assumptions. For example, what is the local cost sharing obligation if the project had been marginal (i.e., cost/benefit ratio of 1.0) of if the project had a better cost-benefit ratio than assumed (i.e., 3.0). In addition, Table 3.24

[37] The September 2001 rate of interest for 20-year State and local general obligation bonds is 5.09 percent.
[38] However, the State may object.

shows the effect on the local cost sharing requirements if the non-Federal cost-share were raised to 50 percent (instead of the proposed 65 percent). Also, what are the cost-share obligations if the non-Federal cost-share requirement remains at 35 percent.

Table 3.12 shows the local tax revenues in excess of beach management and maintenance costs that will be available to fund the non-Federal cost-share of the hypothetical beach nourishment project in "typical", rural, and urban region for increases in beach visitation of 0, 5, 10, 15, 20, and 25 percent. Obviously, if the hypothetical beach nourishment project does not attract any additional visitation, then there will be no local tax revenues available to fund the nourishment project. Therefore, the local sponsor will have to find the additional revenues in some manner if they want the hypothetical beach nourishment project.

Table 3.12: Beach Costs and Local Tax Revenues for Varying Increases in Recreation Visitation ($000 in 2000 prices)

	Tax Revenues Net of Beach Costs	Beach Costs	Local Tax Revenues
Typical Beach Region			
No increase in beach use	$0	$0	$0
5% increase in beach use	$30	$47	$77
10% increase in beach use	$60	$95	$155
15% increase in beach use	$90	$142	$232
20% increase in beach use	$119	$190	$309
25% increase in beach use	$150	$237	$387
Rural Beach Region			
No increase in beach use	$0	$0	$0
5% increase in beach use	-$2	$71	$69
10% increase in beach use	-$6	$143	$137
15% increase in beach use	-$8	$214	$206
20% increase in beach use	-$11	$285	$274
25% increase in beach use	-$14	$357	$343
Urban Beach Region			
No increase in beach use	$0	$0	$0
5% increase in beach use	$146	$86	$232
10% increase in beach use	$291	$172	$463
15% increase in beach use	$438	$257	$695
20% increase in beach use	$584	$343	$927
25% increase in beach use	$729	$429	$1,158

They could "economize" by "belt-tightening" on other local public services. Or, they could develop an additional revenue source; for example, charge an additional "sales" tax on top of the existing sales tax. For the proposed 65 percent non-Federal cost-share, the local sponsor will need to charge an additional "sales" tax of 2.1 percent (i.e., based on an annual bond cost of $1,848,000 and annual sales of $88,111,000) if they have to pay for the entire non-Federal cost-share with no assistance from the State. If the State pays for 75 percent of the non-Federal cost-share, then the additional local "sales" tax will be 0.52 percent (i.e., based on annual bond cost of $462,000 and annual sales of $88,111,000).

For the typical beach region, local tax revenues in excess of the estimated beach management and maintenance costs increase as beach visitation increases, however, even with a 25 percent increase in annual visitation local tax revenues in excess of beach costs are estimated to be $150,000 annually. This amount is not enough to cover the annual cost of the 20-year municipal bond, $462,000 (assuming the non-Federal cost-share is 65 percent, a 5 percent annual interest rate, a benefit/cost ratio equal to 2.0, and the State provides 75 percent of the local cost-share). If the local sponsor raises these extra funds via an additional "sales" tax, then the additional tax rate will be 0.35 percent (based on an annual bond costs of $312,000 and annual sales of $88,111,000).

For the rural beach region, the annual local tax revenues collected are less than the annual beach management and maintenance costs. As a result, the local sponsor will not only have to find additional revenues to fund their share of the non-Federal cost-share, they will need extra funds to help pay for the beach costs that are not covered by local tax revenues. For the urban beach region that has no assistance for the non-Federal cost-share from the State, local annual tax revenues in excess of annual beach costs are less than what the annual cost of a bond, regardless of the visitation increases considered.

As a result, they will have to raise additional revenues in some manner. However, if the State pays for 75 percent of the non-Federal cost-share, the excess local tax revenues generated by approximately a 15 percent increase in visitation (i.e., $438,000) will be enough for the urban region to fund the annual cost of the municipal bond ($462,000) without having to raise additional revenues from other sources.

Finally, if the hypothetical beach nourishment project were not implemented and the beach were allowed to erode, there is a concern that the fiscal conditions within the beach region might degrade; not so much because visitation will decline but because spending by tourists will decline. If, for example, outside beach visitors to the "typical" beach region were to spend and behave similar to those in a rural region, then the amount of local tax revenues collected will drop. In this case, they are estimated to drop to a level just above that needed to cover the beach management and maintenance costs. It is not asserted that these changes reflect any actual events. They do reflect the possible concerns of public officials responsible for managing and maintaining beaches.

Chapter 4
Environmental Effects of Beach Nourishment Projects

A beach nourishment project is a type of storm damage reduction project that involves placing sand on a beach, or along a shoreline to widen the area and increase the volume of sand available to absorb and dissipate wave energy. Sand is usually dredged from a borrow site and deposited on the eroding shoreline. The re-nourished beach is considered a "soft" or nonpermanent design profile that will require periodic renourishment to continue to provide storm damage reduction. Beach nourishment has the virtue of being "…the only engineered shore protection alternative that directly addresses the problem of a sand budget deficit…" by adding sand to an eroding system and maintaining the natural littoral sand balance. (NRC, 1995)

Periodic renourishment often has beneficial environmental effects. A renourished beach can provide new nesting area for sea turtles, spawning grounds for horseshoe crabs and habitat for piping plover and least terns. In some cases, beach nourishment projects are formulated for the primary purpose of environmental restoration. For example, a project designed for Reeds Beach and Pierces Point, N.J., along the Delaware Bay coastline, was formulated to provide a beach berm that will result in 17 acres of habitat for horseshoe crabs, shorebirds and migratory birds. Without nourishment, it is projected that this area will lose 21 acres of fish and wildlife habitat to erosion over the upcoming 50 years. Erosion at a rate of one foot per year would reduce spawning habitat for horseshoe crabs. In turn, migratory birds, which feed on horseshoe crab eggs, would lose an important food source.

The plant and animal species existing in littoral areas are adapted to survive in the dynamic environment created by the natural cycle of sand erosion and accretion. Beach nourishment, however, accelerates certain dynamic processes, and taxes the capacity of benthic species to adapt. More importantly, however, negative impacts on the plant and

animal species that inhabit the subaerial and subtidal zones can largely be avoided by adhering to appropriate management practices, as specified in Corps regulations and project planning guidance, in compliance with state and federal environmental statutes and regulations. From its many years of involvement in these types of projects, the Corps has developed extensive expertise and general procedures for avoiding adverse environmental consequences of beach nourishment. Many Corps regulations and planning guidances provide guidelines for utilizing suitable practices. Some of the most directly pertinent include engineering regulations ER 200-2-2 Procedures for Implementing NEPA and ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies. Engineering manuals, EM 1110-2-1204, Environmental Engineering for Coastal Protection and EM 1110-2-1004, Coastal Project Monitoring, also provides guidelines for conducting environmental studies, monitoring the effects of coastal projects and avoiding damages to the environment. Additionally, all Corps projects are required to comply with Federal environmental statutes and regulations, including the following described in Table 4.1.

This section will look at the three regions that are affected by beach nourishment activities, the subaerial zone, the subtidal zone and the borrow site. The subaerial zone includes those areas of the beach that are visible above the mean low tide line. The subaerial zone consists of two, distinct zones, the supralittoral zone, which is the dry part of a beach that lies beyond the reach of the average high tide, and the intertidal zone, which is the part of the beach that lies between the average high tide and low tide marks.

The physical changes that occur in these three areas during the course of nourishment activities will be described, as well as management practices used in Corps projects to prevent possible effects on the biota that inhabit these areas. Specific reference will be made to a seven-year biological monitoring program recently completed by the New York District of the Corps and the State of New Jersey. (Corps, 2001) The biological monitoring program (hereafter referred to as "the New Jersey study") was initiated in 1993 and examined six reaches of high energy beaches extending along the New Jersey shore to identify any adverse or beneficial effects of beach nourishment in both the borrow area (dredged area) and beach area. Nourishment projects were

conducted during the study period along reaches extending from Manasquan Inlet to Shark River, and from Shark River Inlet to Asbury Park. One beach, extending from Asbury Park to the northern edge of Deal remained untouched during the course of the study, acting as a control site. The study findings are the most recent and most extensive results available documenting the environmental benefits and costs of beach nourishment projects.

Table 4.1: Federal Statutes Relevant to Beach Nourishment Projects[39]

Federal Statute	*Description*
National Environmental Policy Act of 1969 (Public Law 91-190)	Requires coordination between the Corps of Engineers districts and Federal, state county and municipal agencies concerning any environmental impacts of a beach nourishment project.
Coastal Zone Management Act of 1972 (Public Law 92-593)	Requires that any proposed dredging activity comply with the Federal Coastal Zone Management Program.
The Endangered Species Act	Requires all Federal agencies to seek to conserve endangered and threatened species and to utilize their authorities in furtherance of the purposes of the Act, i.e. to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved and to provide a program for the conservation of such endangered and threatened species.
Clean Water Act of 1977 (Public Law 95-217)	Requires that an evaluation in compliance with Section 404 of this act be included in all Environmental Impact Statements.

4.1 Subaerial Zone

Biota found in subaerial zone: The subaerial zone includes both the supralittoral zone, the dry area of the beach above mean high tide, and the intertidal zone, the wet part of the beach that falls between the mean high and low tide lines. Animal life found on a sandy beach include burrowing species, such as talitrid and haustoriid

[39] Information taken from IWR Report 96-PS-1, Shoreline Protection and Beach Erosion Control Study Final Report: An analysis of the U.S. Army Corps of Engineers Shore Protection Program.

amphipod species and, in southern beaches, ghost crabs. Animal species in the intertidal zone include haustoriid amphipods, polychaetes, isopods, mollusks, large crustaceans, such as mole crabs and burrowing shrimp. The biological monitoring program conducted along the New Jersey shore found that species inhabiting the intertidal area included species of rhynchocoels, polychaetes, oligochaetes, mole crabs and haustoriid amphipods.

Physical changes that occur with nourishment: With beach nourishment, the largest amount of sand is placed in the supralittoral and intertidal zones. To a certain extent, this dispersal of sand mimics the naturally occurring process of sand deposition; except that sand is generally spread over a larger area and at greater depths than might naturally occur. Generally, the greatest amount of sand is distributed across the upper reaches of the beach, an area where the diversity and abundance of animal and plant life are relatively limited. However, the amount of sand flowing from the supralittoral zone into the intertidal zone can be substantial, ranging anywhere from centimeters to more than a meter.

Corp projects utilize a variety of management practices designed to ensure that the physical attributes of the sand used in a beach nourishment project are suitable and will not detrimentally affect the environment. Beach nourishment can alter sand compaction, shear resistance, moisture content, grain size and shape, and initially increases the slope of the beach. A study by Peterson et.al. (2000) examining the physical consequences of beach nourishment on the beaches of Bogue Banks, a barrier island along the North Carolina coast, observed that 5-10 weeks after completion of the nourishment activity, the intertidal areas were somewhat more compacted (surface was harder) and the color of the beach was gray rather than the brownish white of the existing beach. Other physical changes to the beach may result depending upon the type of sand used as fill material.

Corps management practices include monitoring for sand compaction and, where warranted, tilling the beach to offset compaction. Consideration of sand compaction is also made in the selection of fill material, with the use of coarse, round sand to reduce

beach hardness. Ideally projects will use sand that is similar in its composition and coarseness to sand on the existing beach. Corps regulations emphasize that the sources of beach fill must be similar in terms of grain size to the existing sand on the beach. Generally, fine-grained, silty materials are avoided as fill material. Sand that has a high content of fine-grained clay or silty material can result in excessive turbidity and sedimentation, which will detrimentally impact underwater plant and animals.

Effects on biota in subaerial zone: One potential effect of beach nourishment closely studied is the consequences of sand burial on burrowing species. Animal life on sandy beaches is generally well adapted to the dynamic environment of a littoral area. However, if the volume of sand distributed across the beach is too great, organisms burrowing in the beach can be smothered, unless they can dig through the additional sand, or leave the area altogether. (NRC, 1995) Adriaanse and Coosen (1991) state that most benthic species will die if covered by sediment at a depth of 0.5m or more. Depths ranging from 0.01 to 0.5m will allow a limited number of species to burrow up through the additional sand and avoid suffocation. (Adriaanse, 1991)

Overall, the studies reviewed found that beach nourishment may result in the short-term loss of burrowing species due to smothering or abandonment. However, study results also show that these infaunal populations (i.e. organisms living in sediments on the ocean floor) recover over a relatively short period of time, ranging from a few weeks, to a few months (NRC, 1995)

Authors of the 1995 review warn that some of the sampling techniques used in these studies were flawed. In some cases, the number of samples collected was limited, or the frequency and length of time over which sampling took place was insufficient. (NRC, 1995) Nevertheless, the New Jersey study, the most comprehensive long-term study available, supports the general finding that there are no long-term impacts on infaunal populations. During the course of the New Jersey monitoring program, several intertidal infaunal assemblages were examined, including rhynchocoels, polychaetes, including *Scolelepis squamata, Protodriloides*, and *Microphthalmus*, mole crabs and

several haustoriid amphipods. (NJ, 2001) The results of the monitoring indicated that these infaunal assemblages incurred only short-term declines in abundance, biomass and diversity. The period of recovery lasted from only 2 – 6.5 months. Recovery periods at the upper end of this range generally occurred when beach nourishment activities were completed at the low point in the seasonal cycle of infaunal abundance. The New Jersey study concludes that monitoring results show no significant long-term impacts of beach nourishment activities on intertidal infaunal species.

It has been suggested that even a temporary loss of infaunal species can have secondary short-term effects on the bird and marine life that rely on such species as a food source. No studies were found examining the effects of beach nourishment on the feeding patterns of birds, fish and other marine life that rely on infaunal food sources. However, discussions with biologists in the Jacksonville District Corps offices indicated that, because the recovery period for benthic species has proven to be short, there is limited concern over loss of food sources. Additionally, the new material deposited on the beach with a nourishment activity often brings new organisms with it, providing a substitute food source.

Beach nourishment may have beneficial environmental effects on the supralittoral zone, by providing enhanced nesting habitat for endangered sea turtle species, including the loggerhead, leatherback and green turtles. These sea turtle species emerge from the ocean at night to lay their eggs in the supralittoral zone. By enhancing the supralittoral zone, beach nourishment can help restore nesting habitat for the turtles.

Selection of appropriate sand for beach renourishment is important to maintaining suitable nesting habitat. Physical changes in sand attributes, such as texture, moisture content, temperature, gas diffusion rates and organic matter can all interfere with successful sea turtle nesting. (Hillyer, 1996) If the sand texture is not fine enough to maintain the structure of the nest, the nest will collapse and the emerging hatchlings are unable to reach the surface. If sand texture is too fine, the rate of gas diffusion is inhibited, arresting embryonic development. A change in sand color can affect the

amount of heat absorbed from the sunlight, altering the temperature of the nesting site. Changing beach temperatures effect nest site selection, incubation duration, sex ratio and hatchling success rates. Sand moisture levels can also interfere with successful hatching and emergence of juvenile turtles.

As was previously described, it is standard practice on Corps projects to select sand that is a close match to the existing beach material, or is an improvement upon the existing materials in terms of creating suitable habitat. Additionally, methods of spreading the sand immediately following nourishment to approach an equilibrium profile have been used to reduce the development of scarps that might act as barriers to sea turtles. A 1995 review of beach nourishment studies described several monitoring programs examining the effects of beach nourishment on turtle hatchling survival. In general, these studies have found no significant difference between hatching and emergence success on nourished and unnourished beaches. (NRC, 1995) In fact, the results of one study suggested that hatchling success and hatchling weights improved on a nourished beach in Boca Raton, Florida, compared to an adjacent, unnourished beach. (NRC, 1995)

In addition to creating nesting areas for sea turtles, beach nourishment projects have benefited other species, for example, by providing spawning grounds for horseshoe crabs and habitat for piping plover. Another example is a nourishment project recently completed on Faulkner Island, Connecticut. The re-nourished beach created habitat for terns, and the US Fish and Wildlife Service reported an additional 600+ more common tern nests than were found last year, prior to construction. Other management practices are employed in Corps projects to minimize interference with beach animals, including the planting of beach plants to replace damaged plants and create pedestrian barriers, conducting construction activities in fall and winter season when nesting and spawning season is past and many animals have migrated out of the area, minimizing vehicle use, limiting lighting of the beach, reducing storage of piping on the beach and locating the pipeline parallel to the beach and as distant from the high tide line as possible to reduce disturbance of beach animals.

4.2 Subtidal zone

Biota found in subtidal zone: Animal and plant life found in the subtidal zone adjacent to the beach include benthic invertebrate (i.e. invertebrates living on or beneath the ocean floor), epifaunal invertebrate (i.e. invertebrates living in the sediments on the floor of the ocean), reef communities and the fish and crustaceans that feed on or live in these habitats. Infaunal macroinvertebrates include polychaetes, amphipods, isopods, decapods, polychaets, mollusks, and echinoderms. Many of the epibenthic invertebrates (i.e. invertebrates living above the sea floor) and finfish species found in the nearshore area (i.e. the area seaward of the zone of breaking waves, referred to as the surfzone) are commercially valuable, such as several shrimp species found in the Gulf coast area. Reef habitats found along the Florida coastline include sessile species (i.e. organisms that are permanently affixed in one place and immobile) including sponges, octocorals, hard corals, hydrozoans, bryozoans, ascideans and algae that grows on these other organisms. Reef habitats also include epibenthic invertebrate and finfish species that forage and seek shelter in the reefs.

Animal life in the nearshore area examined in the New Jersey study included the wedge clam, polychaetes (Magelona papillicornis and Asabellides oculata), bivalves (Spisula solidissima and Tellina agilis) and amphipods (Acanthohaustorius millsi and Psammonys nobilis). Fish larva found in the nearshore and surfzone area included 33 families of fish.

Physical changes that occur with nourishment: Generally, most of the sand deposited during a beach nourishment project is distributed on the supralittoral and subtidal areas of the beach; however, some shallow, underwater habitats can also be buried. If appropriate management practices are not used, beach nourishment can physically alter both sand-bottom habitats and reefs by sand burial as the beach expands with nourishment. Other physical alterations to the subtidal zone include increased sedimentation beyond the surf zone as sand filters back into the sea, changes in the depth and surface features of the ocean floor that may also alter wave action and increased

turbidity. The movement of sand off of the nourished beach into the surf zone can have the beneficial effect of providing additional sand supply for surrounding beaches, outside of the project area. However, the down-flow of sand can also result in increased sedimentation in areas beyond the surf zone in the nearshore zone, particularly if the fill material consists of a high percentage of silt and clay material.

Effects on biota in subtidal zone: Marine communities in the subtidal zone are generally not as well adapted to endure the consequences of sand accretion and erosion as are organisms found in the supralittoral and intertidal zone. Mobile invertebrates and fish in the nearshore zone should be able to avoid the direct effects of a nourishment project, simply by migrating outside of the immediate area. Fish larva in the surf zone, however, may be damaged by increased turbidity. Also, sessile species of plants and animals found in hard bottom reefs or in sea grass beds are vulnerable to turbidity. Increased sedimentation can impair the filter-feeding process used by many of these organisms, inhibit photosynthesis, or smother the organisms. (NRC, 1995)

While some marine organisms found in the subtidal zone are vulnerable to the effects of turbidity, studies reviewed indicated that the effects of beach nourishment projects in the subtidal zone have been limited and short-term. The New Jersey study monitored changes in turbidity and sedimentation associated with beach nourishment activities. It was found that beach nourishment did result in short-term increases in turbidity with suspended sediments prominent in the swash zone in the immediate area of the project operations; however, sediment concentrations dispersed rapidly. Elsewhere, any short-term turbidity effects rarely exceeded 25 milligrams per liter. The study points out that this amount is comparable to the concentrations found in estuaries or produced during storms.

Two surveys of fish populations in Florida conducted before and after beach nourishment indicated that beach nourishment had no damaging effects on the composition and abundance of the fish sampled. (NRC, 1995) A 1995 review of studies examining the environmental effects of beach nourishment indicates that no studies have

been conducted examining the effects of nourishment on crustacean populations in the nearshore area, such as penaeid shrimps. (NRC, 1995)

The 1995 review also describes the findings of a series of studies examining the effects of beach nourishment activities on nearshore soft bottom community. Results of these studies suggest that nourishment activities have only limited, short-term effects. However, the book notes that many of these studies had inadequate sampling designs that could result in the underestimation of beach nourishment impacts. (NRC, 1995)

In the surf zone, the New Jersey study found that beach nourishment had the short-term effect in one beach nourishment location of reducing the abundance of bluefin and increasing the number of benthic feeders. The study concludes that these changes occurred along with the suspension of benthic material associated with beach nourishment disturbances. In the long-term, however, the study finds that neither finfish abundance nor distribution differed in the nourished beach surfzone areas.

The New Jersey study also monitored the effects of beach nourishment on the composition and availability of food sources for kingfish and silversides over a two-year period following completion of a beach nourishment project. The study found no negative impacts on the availability of food sources or foraging success for kingfish or silversides. No differences were observed in the composition of food sources for kingfish or silversides in the nourished and non-nourished beach areas, based on an examination of the composition prey biomass. Nor was there a difference in the number of fish found with filled stomachs.

A similar examination was made of the food sources for bottom feeding fish, including winter flounder, summer flounder and scup. No significant difference attributable to beach nourishment was detected in the quantity or composition of the food supply for these fish species. (New Jersey, 2001)

The New Jersey study also attempted to identify any differences in larval fish habitat in the surf zone caused by beach nourishment. A comparison of fish larva populations in the surf zone of a renourished area to the surf zone in an area of the designated study control zone suggested that no differences existed in fish larva (ichthyoplankton) abundance, size and species composition. The study, however, was unable to establish a direct beach to beach comparison between its designated study and control beaches because of the timing of the beach nourishment activities relative to the period of time in which sampling takes place. As a result, the significance of the findings may be limited. The New Jersey study further points out that adequate sampling of ichthyoplankton in the surf zone is difficult to achieve. The dynamic nature of a high-energy beach and the ever-changing and broad distribution of fish larvae make it difficult to identify anything but very large changes in ichthyoplankton density and composition.

4.3 Borrow Site

Sources of sand for beach nourishment can include upland sand deposits, estuaries, lagoons, inlets, sandy shoals dredged to clear channels for navigation and deposits in the nearshore area. The most common source of sand used in nourishment projects is nearshore deposits.

Physical changes that occur with nourishment: Borrow site conditions during and following dredging will vary depending upon the equipment and techniques used. A 1995 review of studies examining the environmental effects of beach nourishment indicates that few studies have been conducted of the long-terms changes in the depth, sediment composition and shape of the ocean floor of nearshore borrow areas. (NRC, 1995) Of the studies included in the review, most found that average sand grain size in the borrow area decreased after dredging, resulting in a higher silt/clay composition. This increase in the concentration of silty materials occurs as the finer, silt particles tend to go into suspension as the borrow area is dredged. These particles are slow to fall out of suspension, resulting in increased turbidity. Also, although little data exists measuring

the rate at which borrow sites refill, general observations indicate that, in cases where a deep hole is created, borrow areas tend to fill in slowly.

Effects on biota in borrow site: One concern with dredging a nearshore borrow site is that dredging may remove benthic species along with the sand, which may affect other species that rely on the benthos as a food source. Restoration of benthic species generally occurs as organisms from surrounding areas migrate back into the borrow area; however, the initial size and distribution of the new benthic community may be significantly different from the original community. For example, in the New Jersey study, a decrease in the abundance, biomass and size of sand dollars was noted in the borrow area after dredging. While the abundance of sand dollars was restored quickly after dredging occurred, the biomass required 2 – 2.5 years to recover. The diminished sand dollar biomass could be attributed either to the selective removal of older, mature sand dollars with dredging, or to the recolonization of the borrow site by smaller specimens (New Jersey, 2001)

With the exception of the period of recovery required for sand dollar populations, the findings of the New Jersey study indicate that all other infaunal assemblages monitored recovered within one year after dredging. The New Jersey study also looked for changes in the composition and abundance of finfish in the borrow area following dredging. As measured by catch-per-unit effort, no significant difference in species composition or abundance of finfish was found. The New Jersey study also monitored the feeding habits of winter flounder and summer flounder. No changes were detected in either winter or summer flounder foraging before, during or after borrow site dredging.

Dredging also churns up the fine, silty sediments on the ocean floor. If these sediments remain in suspension and increase water turbidity, they can inhibit phytoplankton photosynthesis by blocking out the sunlight. Increased turbidity can also interfere with filter feeders. When the ratio of suspended sediments to edible plankton is increased, filter feeders obtain less edible material per filtering effort. Additionally, extreme levels of turbidity may simply clog or damage the gills and filtering capabilities

of filter feeders. (Adriaanse, 1991) Increased turbidity can also interfere with the hunting success of fish and birds that rely on sight to capture their prey. (Adriaanse, 1991)

Corps projects utilize a variety of management practice to avoid turbidity in the borrow site area. Turbidity is monitored during dredging. Practices to minimize turbidity vary depending upon the site conditions. In some cases, use of a suction dredge without a cutterhead may reduce the amount of sedimentation created. In some cases, only one hopper dredge is operated at a time, to avoid excessive sedimentation in the water. Also, dredging operations may move back and forth along a long, linear strip, instead of creating a large, round pit in one area. Moving along a linear path while dredging avoids creating a sustained sediment plume in a single area. Borrow site selection is also critical in avoiding detrimental environmental effects. The borrow site is selected as far away from sensitive habitat as possible. Additionally, a buffer zone is established around any nearby reefs to protect from damage, either by physical contact or by increased turbidity.

Chapter 5
Summary and Findings

The President's proposed FY 2003 formula called for reversing the percentages to generally require 35 percent of the re-nourishment project costs to be funded by the Federal government and 65 percent from the non-Federal sponsor. The new formula would not only be applied to recommendations for authorizations of future re-nourishment projects, but it would also be applied to those projects that have been authorized but not completed and existing projects with continuing re-nourishment requirements. This was proposed to more appropriately reflect the distribution of economic benefits that shore protection projects provide to State and local sponsors. In addition, the Administration wants to ensure that the Federal government's long-term nourishment obligations do not "crowd-out" other important Federal expenditure needs.

The purpose of this study is to evaluate the distribution of both the national and regional economic development benefits of a shore protection project. The NED benefits considered included storm damage reduction benefits, recreation benefits, and other NED benefits (i.e., reductions in maintenance and emergency costs). RED benefits of shore protection are defined as the change in "value added" (i.e., the sum of employee compensation, proprietors' income, property income, indirect business taxes) resulting from subsequent recreational activities associated with alternative project plans adjusted for commuters' income, tax revenue transfers, and local beach management and maintenance costs. In order to provide support for the Administration's proposal to increase the local share of the costs for the beach re-nourishment component of shore protection, the following questions were addressed,

- Who benefits from shore protection projects?
- What is the distribution of project benefits?
- Do increases in tax revenues that stem from Federal shore protection projects affect the capacity of non-Federal sponsors to pay for the projects?

5.1 The Distribution of NED Benefits of Shore Protection Projects

NED benefits are distributed as follows in this study: storm damage reduction benefits are distributed according to the residence patterns of the affected property owners, recreation benefits are distributed by the residence patterns of the beach users, and other NED benefits are assigned to the area outside the beach region (i.e., the rest of the nation).

The distribution of shore protection benefits was analyzed using a hypothetical new beach new nourishment project that has a dry beach area above the mean high water level component that is one mile long by 100 feet wide. Quantities of sand were estimated that would not only create the "dry sand" component but also would extend out into the near shore area for storm damage protection, functional stability, and recreation. It was determined that the amount of sand needed to provide the appropriate level of shore protection varies according to the intensity of wave action on the beach. A quantity of sand (600,000 cubic yards) was used for the hypothetical beach nourishment project to reflect a "medium" energy beach. Average annual benefits per cubic yard of sand for each of the NED benefit categories (i.e., for storm damage reduction, recreation, and other NED benefits) were estimated based on sand quantities and benefits for a sample of completed and authorized Corps beach nourishment projects. Storm damage reduction benefits and other NED benefits were based on the total amount of sand used for the hypothetical new nourishment project. Recreation benefits were based on the quantity of sand used for the "dry sand" portion of the nourishment project. The NED benefits for each benefit category of the hypothetical nourishment project were estimated by multiplying the estimated quantities of sand by the average annual benefits per cubic yard of sand for completed and authorized Corps shore protection projects. Total estimated average annual NED benefits for the hypothetical project are estimated to be $1.65 million ($920,000 for storm damage reduction benefits, $609,000 for recreation benefits, and $123,000 for other NED benefits). Not having access to empirical data for a real beach nourishment project, the parameters concerning the proportion of property owner and beach users residing in the beach region were estimated based on data for a coastal

county reflecting a "typical" regional setting. The residential patterns were either estimated with data from the 2000 Census of Population or borrowed from selected past studies of beach economies. Based on the NED benefit estimates above and the derived beach parameters, it is estimated that approximately one-third of the NED benefits accrue to the beach region and two-thirds to the rest of the nation.

Two other coastal regions were chosen to provide the residential patterns for property owners and beach users for simulation purposes. These regions were selected to provide a range of parameter values that reflect a much more "rural" beach region and a much more "urban" beach region. When the type of region in which the beach is located is considered (i.e., the residential patterns of property owners and beach users are different for the "typical", rural, and urban beach regions), the distribution of NED benefits differs to some extent. The findings indicate that approximately half of the NED benefits accrue locally for the rural beach region and about 40 percent of the NED benefits would accrue locally to the urban beach region. Given the variability found here, it is extremely important to understand that the distributional patterns of the NED benefits for shore protection projects depend on the residential patterns of the property owners and the beach users. These patterns are specific to each community and, as a consequence, the distribution of NED benefits is also site-specific for each project. It should be noted that the NED benefit estimates for the "low" energy beach were smaller than for the hypothetical nourishment project and larger for the "high" energy beach, as would be expected, because the NED benefit estimates were related to the quantity of sand. However, the distribution of benefits between the beach region and the rest of the nation did not change much.

The effect of increased beach visitation due to the nourishment project on the distribution of NED benefits was evaluated; increases in visitation considered were 0, 5, 10, 15, 20, and 25 percent. Increases in visitation are partially based on the capacity of the hypothetical beach nourishment project. In addition, only real increases in visitation on peak visitation days are attributed to NED benefits. Corps District staff reported a variety of "unit-day" and "travel cost" method values that have been used when visitation

is expected to increase due a beach nourishment project; "beach experience" values have typically varied between $2 and $5 under the "with project" conditions. However, another Federal agency indicated that their unit-day values for beach experiences are in the $15 to $20 range. Increases in visitation raised the level of NED benefits but had little effect on the distribution of NED benefits, regardless of the unit-day value.

5.2 The Distribution of RED Benefits of Shore Protection Projects

RED benefits are distributed to the beach region and to the rest of the nation according to the net value added impacts that occur in each of the respective regions due to spending of tourists at the beach. However, the net value added impacts that occur in each region are measured from each region's point of view. Consequently, the RED benefits for the beach region are the net value added impacts within the beach region due to spending by all beach visitors residing outside the beach region. The RED benefits for the rest of nation are those net value added impacts occurring in the rest of the nation due to beach spending by foreign beach visitors only.

The RED analysis was carried out under several assumptions. First, it is assumed (for RED only) that the unemployment rate is not zero. This has the effect of permitting resources to flow between regions without negative impacts to occur in locations where the resources originated. Second, it is assumed that people's propensity to consume out of their incomes does not change due to the existence of a beach or because of a nourishment project. This means that the money spent at the beach will be spent whether a beach exists or not. If the beach is not available, then the users will spend their money on something else. The assumption also implies that any impacts (jobs, income, etc.) that might occur due to beach spending will occur in any event. At the local level, an exception to this assumption occurs when local beach users substitute going to a local beach for visits to beaches located outside the beach region. On a national level, foreign visitors may change the length of stay within the country or not come the U.S. at all (i.e., spend less money within the U.S.) if beaches are not available.

The net value added impacts (or RED benefits) for both the beach region and the rest of the nation were computed using a regional input-output analysis of recreational spending by visitors to the beach. To simulate the net value added effects of the existing beach on the economies of the beach region and the "rest of the nation" region, the net value added effects of one million beach visits per year by outside tourists during the year were evaluated. The decision to use "one million" beach visits by outside tourists was made to simulate the importance of the existing beach on the economy of the respective region and to demonstrate the procedures that were used to compute the net value added impacts and their distribution between the beach region and the rest of the nation.

On average for the "typical" region, it is estimated that one million outside beach visitors annually spend $88.1 million within the beach region. Of that total, $49.9 million is a direct economic stimulus to the beach region economy. The cumulative economic "ripples" created by the direct stimulus result in an estimated total economic impact on local businesses of $71.5 million per year. In addition to other economic resources required for these economic "ripples" to occur, a total of almost 2,000 full-time jobs are created annually who are paid an estimated $25.5 million in wages and salaries. Total value added (or gross regional product) created per year by these economic changes is $48.3 million. It is estimated that the local workers who commute from places outside the beach region take $5.8 million of the value added with them. Also, it is estimated that $12.3 million in State and Federal taxes accrue each year outside the beach region. The beach community is estimated to incur just under $2.0 million in beach management and maintenance costs annually to support the beach activity. All together, the net value added effect on the beach region is $28.2 million. Computed in a similar fashion, the net value added effect on the rest of the nation due to beach spending by foreign tourists is estimated to be $31.9 million annually. Taken together, approximately 47 percent of the RED benefits or net value added effects are expected to accrue to the "typical" beach region and 53 percent to the rest of the nation. However, if the beach had been located in the rural region then approximately 40 percent of the RED benefits would accrue locally, while half of the RED benefits would accrue locally if the beach were in the urban region.

The effects on the distribution of RED benefits due to increases in visitation stemming from the hypothetical new beach nourishment project were analyzed; specifically resulting from incremental increases in beach visitation of 0, 5, 10, 15, 20, and 25 percent. It is assumed that increases in visitation are based on the capacity of the hypothetical beach nourishment project. However, instead of only considering increases in visitation during peak visitation days (for NED benefits), increases in visitation for the entire year are evaluated for RED benefits. Because input-output is mathematically "linear", all impacts resulting from increases in visitation are proportional to the change in visitation relative to existing visitation levels (i.e., one million outside beach visits). Consequently, the magnitude of the net value added effects increases in proportion to the increase in beach visitation, however, the distribution of RED benefits does not change.

A number of beach officials have indicated that beach visitation may not initially change as beaches are not nourished and allowed to erode. However, it appears that the mix of beach visitors and activities do change. It has been casually observed that the new visitors use the beaches differently; they use the beach more during low tide and less during high tide, they camp more and stay in "expensive" hotels and motels less; they dine in restaurants less frequently, etc. These changes mean that "fewer" dollars flow into the beach economy and the RED effects are smaller as a consequence. These effects were simulated by determining what would happen if the outside beach visitors to the "typical" beach region behaved like the outside beach visitors to the rural beach region. That is, rather than the million outside beach tourists now spending $88.1 million per year, they will spend $66.7 million per year. It is also assumed that the pattern of expenditures will change accordingly. Relative to the "typical" situation, the drop in spending by outside tourists will mean a drop in RED benefits by $8 million both for the beach region and for the rest of the nation.

5.3 Local Fiscal Effects of Beach Nourishment Projects

Local tax revenues generated by recreation-related activities at existing beaches may be larger than required to fund related beach management and maintenance costs. The implication is that beaches have more than enough money to fund the additional non-Federal cost-share for the beach re-nourishment component of the shore protection program. However, even if local tax revenue collected are greater than needed to cover beach management and maintenance costs, the "excess" revenues are probably being currently used to help fund other important local public services and, therefore, they may not readily available to fund an increase in the non-Federal cost-share.

However, the local tax revenues that are collected as a result of "new" beach visitation due to the hypothetical beach nourishment project could be used to fund the increased non-Federal cost share. The non-Federal cost share of 65 percent of the project costs as recommended in the President's FY'02 budget was calculated by applying an assumed "cost-benefit" ratio of 2.0 to the estimated total NED benefits that result from increases in visitation due to the hypothetical beach nourishment project; increases in visitation considered are 0, 5, 10, 15, 20, and 25 percent. There are various methods that non-Federal sponsors use to fund their share of the project costs. One method of funding the non-Federal cost share is to "float" a municipal bond to be paid for in annual increments over a period of time (for example, 20 years). The total cost of the bond includes not only the principle (i.e., the non-Federal cost share) but also the interest that would accrue for the period of the bond. The bond is assumed to have a 5 percent annual interest rate compounded annually (the September 2001 rate of interest for 20-year State and local general obligation bonds is 5.09 percent). If no "new" visitation is induced by the hypothetical beach nourishment project or if the quality of the beach experience is not improved, then there will be no additional local tax revenues available to fund any of the non-Federal cost-share (even to cover the existing 35 percent cost share requirement). Under the increased visitation scenarios for the "typical" beach region, annual excess local tax revenues collected would be less than the annual cost of a bond to fund the increased non-Federal share of the hypothetical project costs for all increases of visitation

considered. Even if the "typical" beach region's project benefit/cost ratio was as large as 3.0, the annual excess local tax revenues are still less than the annual cost of the bond for the "typical" beach region. If the State in which the beach and the "typical" region are located paid 75 percent of non-Federal cost-share (as some States do), the annual excess local tax revenues would still be less than the annual bond cost for 25 percent of the non-Federal cost-share. Even if a 50 percent non-Federal cost-share were instituted and the State paid 75 percent, the annual excess local tax revenues would be less than the annual cost of the bond for any increase in visitation considered (0, 5, 10, 15, 20, and 25 percent).

Note that annual local tax revenues in the rural region are estimated to be less than annual beach management costs for all increases in beach visitation. Therefore, there are no expected excess local tax revenues collected to help fund the non-Federal share of project costs in these areas. In addition, urban regions would also be unable to pay for the entire non-Federal cost-share based on the annual excess local tax revenues collected due to any of the increases in visitation considered. However, if the State participated in the hypothetical beach nourishment project and pays 75 percent of the non-Federal cost-share, then visitation will need to increase in the range of 15 to 20 percent in order for the annual excess local tax revenues to be greater than the annual bond cost (if the non-Federal cost-share is 65 percent for the urban region). If the non-Federal cost-share is 50 percent and the State pays 75 percent, then beach visitation would need to increase in the range of 10 to 15 percent before annual excess local tax revenues are greater than the annual bond cost for the urban region.

Finally, if the hypothetical beach nourishment project were not implemented and the beach were allowed to erode initially, there appears to be concern that the fiscal conditions within the beach region might degrade; not so much because visitation will decline but because spending by tourists will decline. If, for example, outside beach visitors to the "typical" beach region were to spend and behave similar to those in a rural region, then the amount of local tax revenues collected will drop. In this case, they are estimated to drop to a level just above that needed to cover the beach management and

maintenance costs. It is not asserted that these changes reflect any actual events. However, they might reflect the possible concerns of public officials responsible for managing and maintaining beaches.

5.4 Environmental Effects of Beach Nourishment Projects

Periodic re-nourishment of beaches often has beneficial environmental effects. Many Corps beach nourishment projects have produced environmental benefits, such as providing new nesting area for sea turtles, spawning grounds for horseshoe crabs, and habitat for piping plover, least terns and seabeach amaranth.

The studies included in this overview generally indicated limited and short-lived impacts of beach nourishment activities in the subaerial zone, subtidal zone and borrow site, when appropriate management practices are exercised, as established by Corps regulations and guidelines. The plant and animal species existing in littoral areas are adapted to survive in the dynamic environment created by the natural cycle of sand erosion and accretion. While in the short-term, beach nourishment can result in physical changes to the beach environment; Corps engineering guidelines specify the use of engineering and monitoring practices to avoid detrimental impacts. Practices employed by Corps engineers include planting beach plants to replace damaged plants and create pedestrian barriers, conducting construction activities in the fall and winter season to avoid interfering with nesting and spawning season for nearshore and beach animals, using sand that is closely matched to sand on the existing beach, establishing buffer zones around reefs and other sensitive habitats near the borrow site to prevent damage from turbidity or physical contact during dredging, monitoring turbidity levels and implementing dredging operations designed to minimize turbidity.

None of the studies reviewed attempted to distribute the incidence of any beach nourishment environmental impacts between the local community and the rest of the nation. There are also, however, financial costs associated with environmental considerations made during beach nourishment activities. Such considerations include

the monitoring of a nourishment project to identify possible environmental impacts. There are also costs associated with any special measures taken to protect environmental resources such as the examples given above. The costs associated with these types of environmental considerations are distributed between the non-federal sponsor and the federal government according to the cost-share arrangement established for the project.

5.5 Conclusions

- **Due to the sensitivity of the estimated shares of NED and RED benefits that accrue locally, it is important not to "generalize" the results provided here.** The findings here depend on the specific parameter values that are used in the analysis. These parameters have been chosen from selected studies of beach economies. Also, the regions used in the analysis, although real coastal counties that contain beaches, are chosen based their representative characteristics of average, rural, and urban coastal counties. Specific results and conclusions of the present study may change substantially with better information. The shares of NED and RED benefits that accrue locally could be computed on a "case-by-case" basis when projects are evaluated. A more comprehensive study of the distribution of the benefits of shore protection projects could be undertaken with one of its purposes to produce more general results than provided here.

- **National cost sharing decision should not be made based on the subjective findings and hypothetical situations portrayed in this study.** The analysis included many assumptions and hypothetical scenarios in order to demonstrate a methodology that could be used to analyze individual beach project situations, if pertinent data could be developed and collected. The methodology appears to warrant further development and application in establishing a reasonable distribution of shore protection benefits in regard to where beneficiaries live and the origin of visitors to the beaches.

- **For the "typical beach area" considered and the geographic distributions of the primary residence of beach property owners and beach users, approximately 35 percent of the national economic development benefits (storm damage reduction benefits, recreation benefits, and other NED benefits) from a beach nourishment project accrue to people within the beach region and 65 percent accrue to people who reside elsewhere.** The "typical" beach region was used because it reflected an average regional setting for which the great majority of Corps shore protection projects are located. However, considering more rural or more urban beach settings (regions), higher percentages of NED benefits (as high as 50 percent for a rural beach region) were found to accrue to people locally. Examining the business opportunities related to associated recreational activities, about 47 percent of the regional economic development benefits accrued to people residing in the "typical" beach region and

53 percent elsewhere. The local percentage of RED benefits varied between 40 and 50 percent for the rural and urban regions considered.

- **Periodic beach re-nourishment often has beneficial environmental effects.** Many Corps beach nourishment projects have produced environmental benefits, such as providing new nesting area for sea turtles, spawning grounds for horseshoe crabs, and habitat for piping plover, least terns and sea-beach amaranth.

- **The most current and comprehensive monitoring of the environmental effects of beach nourishment projects indicate that nourishment projects have no significant impacts in the long-run, when appropriate management practices are exercised, as established by Corps regulations and guidelines.** The plant and animal species existing in littoral areas are adapted to survive in the dynamic environment created by the natural cycle of sand erosion and accretion.

- **Properly engineered and constructed beach nourishment projects avoid potential adverse environmental impacts.** In doing the literature search for this study of the potential environmental consequences of nourishment projects, it became apparent that the Corps has developed extensive expertise and general procedures for avoiding potential adverse environmental consequences due to the many years of experience in designing and constructing these types of projects.

- **While beach nourishment does accelerate certain dynamic processes that can tax the capacity of species to adapt, Corps engineering guidelines specify the use of engineering and monitoring practices to avoid detrimental impacts.** Practices employed by Corps engineers include planting beach plants to replace damaged plants and create pedestrian barriers, conducting construction activities in the fall and winter season to avoid interfering with nesting and spawning season for near shore and beach animals, using sand that is closely matched to sand on the existing beach, establishing buffer zones around reefs and other sensitive habitats near the borrow site to prevent damage from turbidity or physical contact during dredging, monitoring turbidity levels and implementing dredging operations designed to minimize turbidity

- **With no increase in recreation visitation induced by a project and when there is no improvement in the quality of the beach experience, the increase in regional benefits is zero.** Many Corps feasibility studies anticipate no increase in tourism that satisfies unmet recreational demand with a Federal shore protection project. The regional economic benefits are tied to the related expenditures that beach visitors bring to the beach community. Without new infusions of money, there will be no regional economic impacts induced by a shore protection project.

- **The impact of a hypothetical one million recreation visitors from outside the beach region was shown in order to provide a perspective of the existing value of tourism to beach communities with approximately 2-3 million in**

total annual visitations. The analysis of the hypothetical million outside recreation visitors was also to demonstrate and test the methodology used to evaluate the regional economic development benefits of shore protection projects.

- **Increases in recreation visitation induced by a beach nourishment project generate corresponding increases in potential regional economic benefits.** Increases in visitation in the of 0 to 25% were found to result in potential regional economic gains in the range of 0 to 10.7%

- **All 5 states surveyed participate in cost sharing the non-Federal share of Federal and even local projects.** However, the extent to which States participate in cost sharing with the non-Federal sponsors of shore protection projects varies. There are also a wide variety of funding mechanisms used by States and local communities to fund the non-Federal share of shore protection projects.

- **Given the variability of NED benefits for shore protection that accrue locally, it is extremely important to understand that the distributional patterns of the NED benefits for shore protection projects depend on the residential patterns of the property owners and the beach users.**

- **The fiscal capacity of State and local sponsors to fund the President's proposed 65 percent non-Federal share of re-nourishment costs will not improve if beach nourishment projects do not increase beach visitation or if the quality of the beach experience is not improved.** Beaches that do not experience increases in visitation as a result of nourishment projects will not experience any regional economic impact because lack of new visitation will not generate any new spending for recreation. Local tax revenues, one of the impact elements affected beach visitor spending, will also not change. As a result, no additional funds would be available to help fund any increases in the non-Federal cost-share.

- **Although increases in visitation at beaches located within "typical" beach regions due to beach nourishment will likely increase annual local tax revenues above the needs for beach management and maintenance, the increases in annual "excess" local tax revenues are unlikely to be large enough to fund an increased non-Federal cost-share from the current 35 to 50 percent to 50 or 65 percent of the project re-nourishment costs, even if the State participates by paying as much as 75 percent of the non-Federal cost-share.**

- **Additional and creative funding mechanisms, other than existing local taxes and fees systems, may be needed to help beach communities fund their portion of any proposed increases in non-Federal cost-shares, even if the State would pay a significant portion of the increased share of project costs.** The large majority of the Corps' beach nourishment projects are located in regions that most like the "typical" beach region in this report and very few of the

beach region would be categorized as either “rural” or “urban” when defined as in this report.

- **Urban regions may be capable of funding the proposed increased non-Federal cost-share with beach visitation increases in the range of 10 to 20 percent if the State participates in paying a significant portion of the non-Federal cost-share.** However, few of the past, current, or authorized Corps beach nourishment projects are located in regions that might be classified as “urban”: for example, urban beach regions would include Miami Beach, Fl, Virginia Beach, VA, northern New Jersey shore and Long Island, NY in the vicinity of New York City, and a few others.

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Appendix A
Shoreline Protection and Beach Erosion Control Authorizing Legislation

1. **An Act Authorizing General Shoreline Investments at Federal Expense, PL 79-166, 31 July 1945.** This Act established authority for the Beach Erosion Board to pursue a program of general investigation and research and to publish technical papers.

2. **Section 14, River and Harbor Act of 1946, PL 79-526, 24 July 1946.** Section 14 authorized emergency bank protection works to prevent flood damage to highways, bridge approaches, and public works.

3. **An Act Authorizing Federal Participation in the Cost of Protecting the Shores of Publicly Owned Property, PL 79-727, 13 August 1946.** This Act authorized Federal participation up to one-third (⅓) of the cost, but not the maintenance of protecting shores of publicly owned property.

4. **PL 84-71, 15 June 1955.** Specifically authorized studies of the coastal and tidal areas of the eastern and southern U.S. with reference to areas where damages had occurred from hurricanes.

5. **PL 84-99, 28 June 1955.** This Act authorized an emergency fund for flood emergency preparation, flood fighting and rescue operations or for repair or restoration of flood control work threatened or destroyed by flood.

6. **PL 84-826, 28 July 1956.** Section 1© defines periodic beach nourishment as "construction" for the protection of shores, when it is the most suitable and economical remedial measure. Section 1(d) provided for Federal assistance to privately owned shores if there is benefit from public use or from protection of nearby public property.

7. **Section 203, River and Harbor Act of 1958, PL 85-500, 3 July 1958.** This section added provisions of local cooperation on three hurricane flood protection projects that established an administrative precedent for cost sharing of hurricane projects. Non-Federal interests were required to assume thirty (30) percent of total first costs, including the value of land, easement and rights of way, and the operations and maintenance of projects.

8. **Section 103, River and Harbor Act of 1962, PL 87-874, 23 October 1962.**

   Shore Protection: Section 103 amended Section 3 of the Act approved 13 August 1946, as amended by the Act approved 28 July 1956 and indicated the extent of

Federal participation in the cost of beach erosion and shore protection (50 percent of the construction cost when the beach is publicly owned or used, and 70 percent Federal participation for seashore parks and conservation areas when certain conditions of ownership and use of the beaches are met)—these provisions are modified by the provisions of PL 99-662.

Small Beach Erosion Projects: Authority for the Secretary of the Army to undertake construction of small beach and shore protection projects was also established under Section 103.

9. **PL 99-172, 7 November 1963.** Section 1 abolished the Beach Erosion Board and established the Coastal Engineering Research Center.

10. **Sections 111 and 215, River and Harbor and Flood Control Act of 1968, PL 90-483, 13 August 1968.**

    Section 111: This section authorized investigation and construction of projects to prevent or mitigate shore damages resulting from Federal navigation works, at full Federal cost limited to $1,000,000 per project. Amended 17 November 1986 by Section 915(f) and 940, PL 99-662 that, among other things, increased the limit on Federal costs per project to $2,000,000.

    Section 215: This section authorized reimbursement (including credit against local cooperation requirements) for work performed by non-Federal public bodies after authorization of water resource development projects. Execution of a prior agreement with the Corps was required and reimbursement was not to exceed $1,000,000 for any single project. Amended by Section 913 PL 99-662 and by Section 12, PL 100-676 to increase the limit on reimbursements per project.

11. **Sections 12 and 208, River and Harbor and Flood Control Act of 1970, PL 91-611, 31 December 1970.**

    Section 12: This section increased the limit on Federal costs for small beach erosion projects from $500,000 to $1,000,000. The annual authorization limit was also raised to $25,000,000. Limits have subsequently been raised further (most recently by PL 99-662).

    Section 208: This section authorized discretionary modifications in Federal participation in cost sharing for hurricane protection projects.

12. **Section 55, Water Resources Development Act of 1974, PL 93-251, 7 March 1974.** Section 55 authorizes technical and engineering assistance to non-Federal public interests in developing shore and stream bank erosion.

13. **Sections 145 and 156, Water Resources Development Act of 1976, PL 94-587, 22 October 1976.**

Section 145: This section authorized the placement of sand obtained from dredging operations on adjacent beaches if requested by the interested state government and in the public interest—with the increased costs paid by local interests. Amended by Section 933, PL 99-662, to allow for Federal funding of 50 percent of the increased costs. This section was further amended by Section 207 of PL 102-580 to permit agreements for placement of fill on beaches to be with political subdivisions of a state.

Section 156: This section authorizes the Corps to extend Federal aid in periodic beach nourishment up to 15 years from date of initiation of construction. Amended by Section 934 of PL 99-662 to allow for extension of up to 50 years.

14. **Sections 103, 933, 934, and 940, Water Resources Development Act of 1986, PL 99-662, 17 November 1986.**

Section 103: Section 103 establishes new non-Federal cost sharing requirements of 35 percent for hurricane and storm damage prevention and 50 percent for separable recreation.

Section 933: This section modifies Section 145 of PL 94-587 to authorize 50 percent Federal cost sharing of the extra costs for using dredged sand from Federal navigation improvements and maintenance efforts for beach nourishment.

Section 934: Section 934 modifies Section 156 of PL 94-587 to authorize the Corps to extend aid in periodic nourishment up to 50 years from the date of initiation of project construction.

Section 940: This section amends Section 111 of PL 90-483 to allow implementation of non-structural measures to mitigate shore damages resulting from Federal navigation works; to require local interests to operate and maintain Section 111measures; and to require cost sharing of implementation costs in the same proportion as for the works causing the shore damage.

15. **Section 206, Water Resources Development Act of 1992, PL 102-580, 31 October 1992.** Under this section, non-Federal interests are authorized to undertake shoreline protection projects on the coastline of the United States, subject to obtaining any permits required pursuant to Federal and State laws in advance of actual construction and subject to prior approval of the Secretary of the Army.

16. **Section 640, Water Resources Development Act of 1996, PL 104-303, 31 December 1996**. Under this section the Secretary may select a disposal method that is not the least cost option if the incremental costs are reasonable in relation to the environmental benefits, including wetlands development and shoreline erosion control. The law clarifies shore protection policy to maintain a Federal in

shoreline and beach protection and restoration, including the use of periodic beach nourishment. The law also established a National Shoreline Erosion Control Development and Demonstration Program (not funded).

17. **Sections 215 and 217, Water Resources Development Act of 1999, PL 106-53, 17 August 1999.**

Section 215: This section modifies Section 103(d) of WRDA'86 by changing the non-Federal share of periodic nourishment costs to 45 percent after 1 January 2002 and to 50 percent after 1 January 2003. This is for projects in reports authorized for construction after these dates.

Section 217: This section modifies Section 145 of WRDA'76 by changing 50 percent to 35 percent.

Appendix B
Income Components of U.S. Gross Domestic Product, 1996
(Billions of dollars)

Compensation of employees	4,426.9
Wage & salary accruals	3,633.6
Disbursements	3,632.5
Wage accruals less disbursements	1.1
Supplements to wages & salaries	793.3
Employer contributions for social insurance	385.7
Other labor income	407.6
Proprietor's income with inventory & capital consumption adjustments	520.3
Rental income of persons with capital consumption adjustment	146.3
Corporate profits with inventory valuation & capital consumption adjustments	735.9
Corporate profits with inventory valuation adjustment	674.1
Profits before tax	676.6
Profits tax liability	229.0
Profits after tax	447.6
Dividends	304.8
Undistributed profits	142.8
Inventory valuation adjustment	-2.5
Capital consumption adjustment	61.8
Net interest	425.1
National Income	**6,254.5**
Business transfer payments	33.6
To persons	26.0
To the rest of the world	7.6
Indirect business tax & non-tax liability	604.8
Less: Subsidies less current surplus of government enterprises	25.4
Consumption of fixed capital	830.1
Private	682.7
Government	147.4
General government	125.1
Government enterprises	22.3
Gross National Income	**7,697.6**
Less: Receipts of factor income form the rest of the world	234.3
Plus: Payments of factor income to the rest of the world	232.6
Gross Domestic Income	**7,695.9**
Statistical discrepancy	-59.9
Gross Domestic Product	**7,636.0**

Source: U.S. Bureau of Economic Analysis (BEA) *A Guide to the NIPA's: Methodology, National Income and Product Accounts, 1929-1997*. Washington, DC: U.S. Department of Commerce (June 2001).

Definition of Terms

Compensation of employees is the income accruing to employees as remuneration for their work. It is the sum of wage and salary accruals and of supplements to wages and salaries.

Wage & salary accruals consist of the monetary remuneration of employees, including the compensation of corporate officers; commissions, tips, and bonuses; voluntary employee contributions to certain deferred compensation plans, such as 401(k) plans; and receipts in kind that represent income. Wage and salary accruals consist of ***disbursements*** and ***wage accruals less disbursements***. Disbursements are wages and salaries as just defined except that retroactive wage payments are recorded when paid rather than when earned. Accruals less disbursements is the difference between wages earned, or accrued, and wages paid, or disbursed. In the NIPA's, wages accrued is the appropriate measure for national income, and wages disbursed is the appropriate measure for personal income.

Supplements to wages & salaries consist of employer contributions for social insurance and other labor income. ***Employer contributions for social insurance*** consist of employer payments under the following Federal and State and local government programs: Old-age, survivors, and disability insurance (social security); hospital insurance; unemployment insurance; railroad retirement; government employee retirement; pension benefit guaranty; veterans life insurance; publicly administered workers' compensation; military medical insurance; and temporary disability insurance. ***Other labor income*** consists of employer payments (including payments in kind) to private pension and profit-sharing plans, private group health and life insurance plans, privately administered workers' compensation plans, supplemental unemployment benefit plans, corporate directors' fees, and several minor categories of employee compensation, including judicial fees to jurors and witnesses, compensation of prison inmates, and marriage fees to justices of the peace.

Proprietor's income with inventory & capital consumption adjustments are the current-production income (including income in kind) of sole proprietorships and partnerships and of tax-exempt cooperatives. The imputed net rental income of owner-occupants of farm dwellings is included; the imputed net rental income of owner-occupants of non-farm dwellings is included in rental income of persons (described below). Proprietors' income excludes dividends and monetary interest received by non-financial business and rental incomes received by persons not primarily engaged in the real estate business; these income are included in dividends, net interest, and rental income of persons.

Rental income of persons with capital consumption adjustment is the net current-production income of persons from the rental of real property except for the income of persons primarily engaged in the real estate business; the imputed net rental income of owner-occupants of non-farm dwellings; and the royalties received by persons from patents, copyrights, and rights to natural resources.

Corporate profits with inventory valuation & capital consumption adjustments are the net current-production income of organizations treated as corporations in the NIPA's. These organizations consist of all entities required to file Federal corporate tax returns, including mutual financial institutions and cooperatives subject to Federal income tax; private non-insured pension funds; non-profit institutions that primarily serve business; Federal Reserve banks; and federally sponsored credit agencies. With several differences, this income is measured as receipts less expenses as defined in Federal tax law. Among these differences: receipts exclude capital gains and dividends received, expenses exclude depletion and capital losses and losses resulting from bad debts, inventory withdrawals are valued at replacement cost, and depreciation is on a consistent accounting basis and is valued at replacement cost using depreciation profiles based on empirical evidence on used-asset prices that generally suggest a geometric pattern of price declines. Because national income is defined as the income of U.S. residents, its profits component includes and excludes income earned in the United States by the rest of the world.

Profits before tax are the income of organizations treated as corporations in the NIPA's except that it reflects the inventory- and depreciation-accounting practices used for Federal income tax returns. It consists of profits tax liability, dividends, and undistributed corporate profits.

Profits tax liability is the sum of Federal, State, and local income taxes on all income subject to taxes; this income includes capital gains and other income excluded from profits before tax. The taxes are measured on an accrual basis, net of applicable tax credits.

Profits after tax are profits before tax less profits tax liability. It consists of dividends and undistributed corporate profits. ***Dividends*** are payments in cash or other assets, excluding the corporations' own stock, that are made by corporations located in the United States and abroad to stockholders who are U.S. residents. The payments are measured net of dividends received by U.S. corporations. Dividends paid to State and local government social insurance funds and general government are included. ***Undistributed profits*** are corporate profits after tax less dividends.

Inventory valuation adjustment for corporations is the difference between the cost of inventory withdrawals as valued in the source data used to determine profits before tax and the cost of withdrawals valued at replacement cost. It is needed because inventories as reported in the source data are often charged to cost of sales (that is, withdrawn) at their acquisition (historical) cost rather than at their replacement cost (the concept underlying the NIPA's). As prices change, companies that value inventory withdrawals at acquisition cost may realize profits or losses. Inventory profits, a capital-gains-like element in profits, result from an increase in inventory prices, and inventory losses, a capital-loss-like element of profits, result from a decrease inventory prices. In the NIPA's, inventory profits of losses are shown as adjustments to business income (corporate profits and non-farm proprietors' income); they are shown as the inventory valuation adjustment with the sign reversed. No adjustment is needed to farm proprietors' income because farm inventories are measured on a current-market-cost basis.

Net interest is the interest paid by private business less the interest received by private business, plus the interest received from the rest of the world less the interest paid to the rest of the world. Interest payments on mortgage and home improvement loans and on home equity loans are counted as interest paid by business because home ownership is treated as a business in the NIPA's. In addition to monetary interest, net interest includes imputed interest, which is paid by corporate financial business and is measured as the difference between the property income received on depositors' or policyholders' funds and the amount of property income paid out explicitly. The imputed interest paid by life insurance carriers and non-insured pension plans attributes their investment income to persons in the period it is earned. The imputed interest payments by financial intermediaries other than life insurance carriers and private non-insured pension plans to persons, governments, and to the rest of the world have imputed service charges as counter entries in gross domestic product and in net receipts of factor income from the rest of the world; they are included in personal consumption expenditures, in government consumption expenditures and gross investment, and in exports of goods and services, respectively.

Business transfer payments consist of payments to persons and to the rest of the world by private business for which no current services are performed. Business transfer payments ***to persons*** consist primarily of liability payments of non-profit institutions. Business transfer payments ***to the rest of the world*** are non-resident taxes—taxes paid by domestic corporations to foreign governments.

Indirect business tax & non-tax liability consists of (1) tax liabilities that are chargeable to business expense in the calculation of profit-type incomes and (2) certain other business liabilities to general government agencies that are treated like taxes. Indirect business taxes include taxes on sales, property, and production. Employer contributions for social insurance are not included. Taxes on corporate incomes are not included; these taxes cannot be calculated until profits are known, and in that sense, they are not a business expense. Non-taxes includes regulatory and inspection fees, special assessments, fines and forfeitures, rents and royalties, and donations. Non-taxes generally exclude business purchases from general government agencies of goods and services that are similar to those provided by the private sector. Government receipts from the sales of such products are netted against government consumption expenditures.

Subsidies less current surplus of government enterprises. ***Subsidies*** are the monetary grants paid by government agencies to private business and to government enterprises at another level of government.

The ***current surplus of government enterprises*** is their current operating revenue and subsidies received from other levels of government less their current expenses. In the calculation of their current surplus, no deduction is made for net interest paid. The current surplus of government enterprises is not counted as a profit-type income, and therefore, it is not counted as a factor charge. Subsidies and current surplus are shown as a combined entry because deficits incurred by some government enterprises may result from selling goods to business at below-market prices in lieu of giving them subsidies.

Consumption of fixed capital is a charge for the using up of private and government fixed capital located in the United States. It is based on studies of prices of used equipment and structures in resale markets. For general government and for non-profit institutions that primarily serve individuals, it is recorded in government consumption expenditures and in personal consumption expenditures, respectively, as the value of the current services of the fixed capital assets owned and used by these entities. ***Private capital consumption allowances*** consist of tax-return-based depreciation charges for corporations and non-farm proprietorships and of historical-cost depreciation (calculated by BEA using a geometric pattern of price declines) for farm proprietorships, rental income of persons, and non-profit institutions. ***Private capital consumption adjustment*** is the difference between private capital consumption allowances and private consumption of fixed capital.

R*eceipts of factor income form the rest of the world* consist of receipts by U.S. residents of interest and dividends, of reinvested earnings of foreign affiliates of U.S. corporations, and of compensation paid to U.S. residents by foreigners.

Payments of factor income to the rest of the world consist of payments to foreign residents of interest and dividends, of reinvested earnings of U.S. affiliates of foreign corporations, and of compensation paid to foreigners by U.S. residents.

Statistical discrepancy is an "income" component that reconciles the income product sides of the NIPA's. It arises because the two sides are estimated using independent and imperfect data.

Appendix C
Review of Economic Studies of Beach Tourism and Recreation

The following section provides an overview of the information currently available for describing beach tourism and recreation activities in the following states: Florida, California, Texas, New Jersey, and North Carolina. In general, beach tourism data in each state was available through either a state economic development agency, a state department of tourism, or through academic research conducted by one of the state universities. In some cases, beach related tourism data was not reported independent of other types of tourism. In other cases, detailed recreation data was available for one or two beaches in a state, but not for all beaches, statewide.

C.1 Florida

Origin and Destination of Beach Visitors: The best estimates found for beach-related tourism in Florida were provided by a survey of 4,556 recreational beach users in Broward County, Florida to determine the effect of recreational benefits on mainland property values. The survey, described in Stronge, 1997, was conducted over the period of one year (May 1995 – 1996). The survey results distinguish between beach visitors that are Broward County residents, residents elsewhere in Florida, residents elsewhere in the United States, or international visitors. Survey results indicated that Broward County beaches received a total of 7,169,446 beach visits during the 1995-1996 time period. 48.2% of all visits were made by Broward County residents (3,457,371 visits), 8.6% of all visits were made by Florida residents outside of Broward county (618,139 visits), 30% of all visits were made by US residents coming from outside of the state of Florida (2,140,824 visits) and 13.2 of all visits were made by international visitors (953,112 visits). (Stronge, 1997)

The survey results indicated that 3,093,936 of the total 7,169,446 visits made to Florida beaches in the 1995-'96 time period were made by out of state visitors. These visits were made by a total of 768,359 out-of-state visitors, including both US residents and international visitors. The total number of out-of-state visitors was broken out according to the permanent residence of the visitor. Of the 556,413 out-of-state visitors coming to Broward County beaches from elsewhere in the U.S., 273,662 (35.6%) came from the Northeast, 122,872 (16%) came from the Midwest, 123,772 (16.1%) traveled from the South and 36,107 (4.7%) came from the West. Of the 211,946 international visitors, 135,802 originated from Canada, 63,392 originated from Europe, 9,318 came from Latin America and 3,434 arrived from other international locations. (Stronge, 1997)

Of the total 3,093,936 visits made to Broward county beaches by out-of-state visitors, 69.2% (2,140,824 visits) were made by visitors residing elsewhere within the United States and 30.8% (953,112 visits) were made by international travelers. Of the total visits made by out-of-state visitors, 41% (1,267,677 visits) were made by U.S. residents from the Northeast, 13.1% (405,367 visits) were made by U.S. residents from the Midwest, 11.8% (365,061 visits) were made by U.S. residents from the South and 3.3% (102,719 visits) were made by U.S. residents from the West. The remaining visits were made by international travelers, with 21.6% of visits (668,826 visits) paid by Canadians, 7.3% (225,695 visits) paid by Europeans, 1.5% (47,435 visits) made by residents of Latin America and the remaining 0.4% of visits (11,156 visits) made by residents of other international locations. (Stronge, 1997)

Including both in-state and out-of-state residents, 1,661,233 people visited Broward County beaches from May 1995-April 1996. In the summertime, 814,509 visitors paid 3.1 million visits and 846,724 visitors paid 4 million visits in the winter. (Stronge, 1997)

A measure of state-wide beach related tourism activities can be found in *Outdoor Recreation in Florida 2000 Florida's Statewide Comprehensive Outdoor Recreation Plan (SCORP, 2000).* This comprehensive plan was developed by the Department of

Environmental Protection's Division of Recreation and Parks for the purpose of evaluating current and future recreation demand in the state of Florida. In *SCORP, 2000*, the demand for saltwater beach activities is measured using actual participation rates in beach-related activities. Estimates of the demand for beach activities were based on information collected in a August 1992 – July 1993 survey of 3,169 randomly selected Florida residents and tourists conducted by the University of Florida, Department of Recreation, Parks and Tourism. The survey data was compiled into demand estimates for 1999 and projections were then made for future demand for beach activities in 2005 and 2010. Estimates of demand are expressed in terms of "user occasions". Each user occasion represents one individual participating in one event at one time, regardless of the length of time over which the activity takes place. The estimated demand for saltwater beach activities in 2000 (study used 1999 estimates for the year 2000) was 154,932,616 user occasions. Projected for the year 2005, the number of user occasions involving saltwater beach activities are projected to rise to 174,017,175. In the year 2010, the projected number of user occasions involving saltwater activities increases to 192,946,060.

No other measures of beach related tourism were found for the entire state of Florida, with the exception of one study, also conducted by Dr. Stronge. Stronge (1994) reports that in 1993, 7 million international visitors 7 million international visitors came to Florida's beaches. This estimate was produced from a statistical analysis of data from the Florida Division of Tourism that is reported in greater detail in Stronge (1994).

Activities: The survey results reported in Stronge, 1997 distinguished between visitors that considered the beach to be the main destination of their trip, and visitors considering the beach to be a secondary destination. Of the total 768,359 visitors to Broward county beaches arriving from out-of-state, 648,339 (84.4%) indicated that the

beach was their main destination and 120,019 (15.6%) indicated that the beach was not their main destination.[40] (Stronge, 1997)

Of those visitors to Broward County beaches, the survey results indicated that 86% of all subjects surveyed visited Broward County beaches to swim or sunbathe. 7.1% came to the beach to walk or search for seashells, 0.2% visited the beach to fish and 6.6% came to the beach for other reasons. (Stronge, 1997) On average, a beach visit lasted 3.3 hours.

The same survey subjects were asked to describe any spending done as part of their beach visit. The survey results indicate that mainland and barrier island residents of Broward County spent a total of $23,102,343 (1995-'96 dollars) on recreational beach use. $12,250,987 of total expenditures were spent at or on the way to the beach and the remaining $10,851,356 was spend on beach equipment and accessories. Beach visitors that were not residents of Broward County spent a total of $285,253,992 on beach related expenditures as well as on other, travel related expenses such as lodging, food, local transportation, etc. (Stronge, 1997)

The Broward county survey also provided information on spending per tourist and per tourist-day for lodging, dining, food/groceries, recreation/entertainment, shopping, car/gas, and other expenditures. (Stronge, 1997) Spending on each of these categories was broken out by geographic origin of the tourist, including tourists from elsewhere in Florida, tourists from outside of Florida, but within the United States, and international tourists. (Stronge, 1997)

Characteristics of Tourists: The survey conducted for Stronge, 1997 collected information on the length of stay of visitors in the county, the age, occupation and income of beach users. (Stronge, 1997) Results of the Broward County survey indicated that the average age of an adult visiting Broward County beaches is 40 years old. Winter

[40] This breakdown is done in even more detail (e.g. how many visitors would not have come to Broward Co. at all if there were no beaches, how many would come less often and how many would come as often if there were no beaches) for both main-destination and not-main-destination visitors.

visitors tended to be older, on average, than summertime visitors. Winter visitors were also more likely to be retired (19.3%) than summertime visitors (9.6%). Of those visitors not retired, 9.6% were students, 4.9% were homemakers, 1.4% were unemployed, 66.9% were employed and 1.9% were in some other occupation. The median income of Broward County beach users was $43,600 (1995-'96 dollars), with a slightly higher median for summertime visitors ($44,900) than for wintertime visitors ($42,700). (Stronge and Schultz, 1997)

C.2 California

Origin and Destination of Beach Visitors: In a 1995 survey conducted by the Public Research Institute (PRI) at San Francisco University, 641 randomly selected California residents were questioned about the types of beach related activities they participate in. (King and Potepan, 1997) This 1995 survey reports the average household spending for one-day trips and for overnight trips by state residents as well as out-of-state residents and foreign tourists. The survey results indicated that, of the 641 households in California responding to the survey, 409 (63.8%) had taken at least one day-trip (a trip lasting no longer than one day) during the previous year. Of those households that took day trips to the beach, the average number of day trips taken in a year was 15.24, with an average of 4 people taking the trip together. 234 households (36.5%) indicated that they had taken at least one overnight trip to the beach over the preceding year. Of those households taking overnight trips, 4.6 overnight trips were taken per year, with each trip lasting an average of 2.65 days. (King and Potepan, 1997)

In a 1997 study by Philip King and Michael Potepan, an estimate of out-of-state tourists visiting California beaches was calculated using information from a 1996 survey of 13,279 beach visitors conducted by the California Department of Boating and Waterways. (King and Potepan, 1997) In this survey, beach visitors were asked to indicate whether their permanent residence was in- or out-of- state. Using data from the California Department of Boating and Waterway survey, King and Potepan estimate that 85.01 M beach attendance days attributable to California beaches are from out-of-state

tourists. An estimated 32.08 M out of state tourists visited California's beaches in 1995, for an average of 2.65 days. (King and Potepan, 1997)

Activities: In a 1999 study, Philip King updated the 1995 survey data to produce estimates of beach visitor spending in 1998 on a variety of categories, accounting for changes in income and population growth that may have occurred since the 1995 survey. Categories considered included gas and auto ($2,270.66 M), beach related lodging, ($3,141.97 M), parking and entrance fees ($418.23 M), food and drink from stores ($2740.27 M), restaurants ($3,459.28 M), equipment rental ($717.81 M), beach sporting goods ($372.34 M) and incidentals ($923.48 M). Estimates of beach spending were further broken out by day-trip visitors, overnight visitors and out of state visitors. (King, 1999)

Appendix A of a March, 1997 study prepared by The Resources Agency of the state of California, titled *California's Ocean Resources: An Agenda for the Future*, provides several estimates participation in coastal recreation on California beaches. The study indicates that over 2.2 M sport fishing licenses were issued by the state in 1992. Approximately 2/3 of the total licenses issued permit both inland and ocean fishing, therefore, it is difficult to determin what proportion of these fishing licenses are used for coastal fishing, rather than inland fishing trips. The remaining 471,500 licenses issued allow fishing only in the Pacific Ocean, providing a lower bound to the possible range of estimates of the total coastal fishing rights exercised. Approximately 270 commercial fishing boats transported ocean sport fishermen in 1991, with a total of 660,000 fishermen catching 4.2 million fish on these trips. (The Resources Agency, 1997)

Also, the study reports a total of 55,904 coastal marina berths in California in 1991. 1991 attendance of California state parks and recreation areas in California's coastal areas was reported as a total of 36.9M, with 33.64 M persons taking day trips and 3.24 persons on overnight camping trips. (The Resources Agency, 1997)

The California Office of Tourism defines travel as requiring a trip that includes at least one night spent away from home or requires traveling at least 50 miles from home. (The Resources Agency, 1997)

Characteristics of Tourists: No source of information was found providing demographic characteristics of beach tourists in California**.**

C.3 Texas

Origin and Destination of Beach Visitors: Estimates are provided for participation in recreational activities along Texas bays and estuaries in a series of reports prepared by the Texas Department of Recreation and Parks and the Texas A&M University Department of Agricultural Economics. (Fesenmaier et al., 1987) Activities accounted for in the estimates include sports fishing, hunting, picnicking, swimming, camping, pleasure boating and sightseeing along six, Texas Gulf Coast estuaries, including the Nueces and Mission-Aransas estuary, the Laguna Madre estuary, the Guadalup Estuary, the Lavaca-Tres Palaacios estuary, the Trinity-San Jacinto estuary and the Sabine-Neches estuary. Surveys were used, along with published information on commercial fishing to develop estimates of the number of visits to the Gulf Coast of Texas by Texas state residents. The survey results indicated that approximately 10,251,901 visits are paid to the Texas coast by Texas state residents in 1986. (Fesenmaier et al., 1987)

The only other source of beach-related tourism data for the State of Texas was found in *The 2000 Report of Travel to Texas* prepared by the Texas Department of Economic Development and D.K. Shifflet & Associates Ltd.. (TDED, 2001) This annual report collects data describing tourism activities in Texas during the preceding year, including the number, origins and activities of tourists visiting different regions of Texas. While much information is available on the activities and characteristics of tourists in Texas, the report does not isolate this information for beach-related tourism, alone. The only beach related tourism information contained in the report is the estimate that 7%

(12.4M) of the total 177M person-trips made to Texas, involved a visited to the beach or a waterfront. A person-trip is equal to one trip, taken by one person, regardless of the length of the trip. (TDED, 2001)

Activities: Of the 10,251,901 visits recorded in the 1987 reports prepared by the Texas Department of Recreations for six bays and estuaries along the Gulf Coast, 55% of these visits (6,032,892) were by fishermen. It was found that camping and sport fishing accounted for 43.3% of the time allocated to recreational activity on beach visits, swimming was allocated 20.6% of recreational time and sightseeing was allocated 17.1% of recreational time. Of the total $586,579,324 expenditures in 1986 by Gulf coast visitors, the survey data indicated that 32.3% ($189,908,202) was spent on transportation, 10% ($58,774,446) was spent on Lodging, 24.9% ($145,985,311) was spent on restaurants, 18.7% ($109,662,105) was spent on groceries, 2.6% ($15,353,460) was spent on rental of recreation equipment, 4% ($23,510,020) was spent on entrance, participation and guided tour fees, and 7.5% ($43,385,780) was spent on fishing-related items. (Fesenmaier et. al., 1987)

Characteristics of Tourists: No information was found on the characteristics of tourists visiting beaches along the Texas Gulf Coast.

C.4 New Jersey

Origin and Destination of Beach Visitors: The number of both day and overnight trips in the shore region of New Jersey is recorded in a report presenting data for the 2000 travel year, prepared by Longwoods International for the New Jersey Office of Travel and Tourism. The Longwoods report also indicates that, of the 37.4 M overnight, non-business related trips taken in New Jersey, 9% (4.1M) were taken for the primary purpose of going to the beach. Of the 117.5 M non-business related day-trips taken in New Jersey, 13% (16.4 M) were taken for the primary purpose of going to the

beach. These estimates suggest that a total of 20.5 M trips were taken in New Jersey for the purpose of going to the beach during the 2000 travel year.

Of the total number of trips identified as trips to the beach, 85% of trips were taken by travelers originating from the Mid-Atlantic area of the U.S., 2% originated from the New England area, 10% originated from the South Atlantic region of the U.S. and 3% originated from other locations.

Activities: The Longwoods report also describes the types of activities travelers participated in during both day and overnight trips in New Jersey during the year 2000. Of the total 44 M overnight trips (including both business and non-business related trips) taken in New Jersey, on 23% of the trips (10.2 M trips) travelers went to an ocean beach. 20% (8.8 M trips) of overnight trips involved participating in boardwalk activities. On 2% of the overnight trips (1.1 M), travelers participated in saltwater fishing. Of the total 125 M day trips taken in New Jersey, 24% (30 M trips) involved visiting an ocean beach, 18% (22.4 M trips) involved participating in boardwalk activities, 2% (2.4 M trips) included saltwater fishing and less than 1% (0.3 M trips) involved surfing.

Of all adults visiting N.J. beaches for at least one night in 2000, 56% visited a casino, 98% visited the beach, 46% spent time touring and 22% attended special events. Of all adults visiting N.J. beaches in 2000, 11% engaged in cultural tourism activities, 5% engaged in Eco-Tourism activities and 6% engaged in historic tourism activities.

Characteristics of Tourists: The average age of an adult taking an overnight trip to a N.J. beach in the year 2000, was 41, according to the Longwoods study. Of the adult individuals taking overnight trips to N.J. beaches in 2000, 38% had an income of $75K or greater, 24% had an income of $50 – $75K, 25% had an income of $25-$49K and 13% had an income of less than $25K. 89% of the adult individuals taking overnight trips to N.J. beaches traveled under 300 miles to reach their destination, 6% traveled 300-500 miles, and 5% traveled 500-1,000 miles. The total average number of nights away for adults taking overnight trips to the beaches in N.J. is 6.2 nights. 0.1 of these nights is

spent in other states, with the remaining 6.1 nights spent in N.J. Throughout the year, 7% of overnight beach trips are taken from January to March, 26% are taken from April to June, 63% are taken from July through September and 4% are taken from October through December.

C.5 North Carolina

Origin and Destination of Beach Visitors: The only estimate found of beach related tourism in the state of North Carolina is provided as part of the North Carolina Department of Commerce's, Tourism Division's 1999 Domestic Coastal Region Travel Summary (available on the web at www.nccommerce.com/tourism/econ/demo). According to this report, in 1999 close to 11 million visitors from the U.S. visiting the North Carolina coastal region. Of these 11M visitors, 53% (5.83 M) went to the beach. While the report contains additional information pertaining to the activities and attributes of tourists in North Carolina, this information is not broken out for beach related tourism, alone

Table C.1: Information Sources Explored

California	• King, Philip and Potepan, Michael, J.; *The Economic Value of California's Beaches a Report Commissioned by the California Department of Boating and Waterways*; Public Research Institute; May, 1997. • King, Philip; *TheFiscal Impact of Beaches in California A Report Commissioned by the California Department of Boating and Waterways*; Public Research Institute, San Francisco State University; September, 1999. • Burroughs, James T.; Baird, Brian E.; Miller-Henson, Melissa; Hatfield, Sheila; *California's Ocean Resources: An Agenda for the Future*; The Resources Agency of the state of California; March 1997. • Resource Agency of California; *Draft Policy on Coastal Erosion Planning and Response and Background Material*; March 26, 2001. • Philip King, Public Research Institute (415) 338-2108, pgking@sfsu.edu or sharking@pacbell.net (this is a home e-mail). Personal communication • King, Philip G.; Potepan, Michael; *An Economic Evaluation of Beaches in California*; Public Research Institute at San Francisco State University (date unknown)
Florida	• William Stronge, PhD. strongew@fau.edu or strongew@acc.fau.edu (561) 297-2833 • Pat Evans (805) 488-2200 @ Florida Parks and Planning (Evans responded to a call that I placed for either Gail Baxley or Al Gregory, also at Parks and Planning. Wayne Stevens at Recreation and Parks at (850-414-8558) recommended I contact them.) • Steve Holland, PhD. Center for Tourism Research and Development (352-392-4042 ext. 1313 • Fred Bell – Florida State University (850) 644-7092 • Department of Environmental Protection, Division of Recreation and Parks, Parks and Planning; *Outdoor Recreation in Florida 2000 Florida's Statewide Comprehensive Outdoor Recreation Plan (SCORP, 2000).* • Stronge, William B. (1994) "Beaches, Tourism and Economic Development", Shore and Beach, 62, 2:68. April, 1994 • Stronge, William B.; Schultz, Ronald R., *Broward County Beaches: An Economic Study 1995-96*; Prepared for: Broward County Department of Natural Resource Protection, Biological Resources Division; January, 1997. • Stronge, William B., *The Economics of Government Funding for Beach Nourishment Projects: The Florida Case* • Stronge, William B.; *The Economic Benefits of Florida's Beaches: Local, State and National Impacts*; Florida Atlantic University • Stronge, William B.; *The Economic Value of Our Beaches and Coastal Properties*; Florida Atlantic University. • Barry Pettigoff at Visit Florida (850) 488-5607 ext. 346
Texas	• Fesenmaier, Daniel R.; Um, Seoho; Roehl, Wesley S.;, Mills, Allan S.; Ozuna, Teofilo Jr.; Jones, Lonnie, L.; Guajardo, Ramon Q.; *Regional and Statewide Economic Impacts of Sport Fishing, Other Recreational Activities, and Commercial Fishing Associated with Major Bays and Estuaries of the Texas Gulf Coast Executive Summary.*, Prepared for the Texas Water Development Board by Department of Recreation and Parks and Department of Agricultural Economics, Texax A&M Univeristy; August, 1987. • TDED (Texas Department of Economic Development and D.K. Shifflet & Associates, Ltd, *2000 Report of Travel to Texas*; August, 2001. • Also spoke with Dee Lindsay (512) 936-0438 of the Texas Travel Research and Statistics Office. She directed me to the TDED, 2001 document. She also indicated that data was available describing demographic information of Texas tourists, tourism spending by county and the resulting state and local tax impacts of tourist activity in Texas; however, none of this information is isolated for beach-related tourism, alone. • Dan Quandt – 1-800-SOPADRE - South Padre Island Convention and Visitors Bureau
North Carolina	• Wakeman, Douglas J.; *The Economic of Beach Replenishment in North Carolina What We Don't Know CAN Hurt Us.*; School of Business at Meredith College, Raleigh, NC; March 5, 2000. • Jim Robertson, Media Assistant at the North Carolina Department of Commerce (919) 733-7559. • Regional Demographic Travel Scope Study, prepared by the Travel Industry Association of America www.nccommerce.com/tourism/econ. • 1999 Domestic Coastal Region Travel Summary; prepared by the North Carolina Department of Commerce, Tourism Division. http://www.nccommerce.com/tourism/econ/demo.
New Jersey	• International, *2000 New Jersey Travel Research Program Travel and Tourism in New Jersey* New Jersey Commerce and Economic Growth Commission Office of Travel and Tourism, Trenton, New Jersey, May 2001. • Noreen Bodman - Executive Director of the Office of Travel & Tourism, New Jersey Commerce & Economic Growth Commission

Appendix D
Issues Related to Estimating Regional Economic Effects Of Recreational Spending

D.1 Input-Output Methodology

Most impact analyses of beach-related spending are carried out using input-output models.[41] Two of the most popular input-output modeling systems currently in use are IMPLAN and RIMS-II.[42] IMPLAN is produced privately from the Minnesota IMPLAN Group, Inc. (1996) and RIMS-II (Bernat, Ambargis, Repice, and Szczesniak, 1997) is available from the U.S. Bureau of Economic Analysis. Input-output models developed by both systems have been used in studies of the regional economic effects due recreation-related activities—including beach activities. Because regional input-output tables are no longer compiled from locally surveyed data sources, these regional input-output modeling systems share one very basic characteristic. They both use the national input-output accounts as the source of technological and trading patterns. From there they use different methods and data to adjust these national relationships to reflect the availability of goods and services from local sources. One important structural difference between the two systems is that IMPLAN produces impact multipliers not only for output and employment, but also for all components of value added (employee compensation, proprietors' income, other property income, and indirect business taxes). On the other hand, RIMS-II generates impact multipliers for output, employment, and earnings.

An input-output model is based on a set of double entry accounts, for example, as shown in Figure D.1. Along the rows, the transaction table records deliveries of goods and services either to other industries (intermediate demand) or to final demand

[41] For a detailed presentation of input-output analysis, the reader should refer to either Hewings (1985) or Miller and Blair (1985).

[42] Other input-output modeling systems (e.g., ADOTMATR, RSRI, and SCHAFFER) have been developed and used for many regional economic analyses, however, they appear to be used less frequently than either IMPLAN or RIMS-II. These systems have been compared and evaluated by Brucker, Hastings, and Latham (1987 & 1990).

(consumers, investors, governments, and foreigner purchasers). The transaction table also displays the inputs (by column) for industrial production processes for required commodities and for value added (such as wages and salaries, taxes, profits, rents, etc.). These latter elements of the transaction table (i.e., the value added) provide a convenient and consistent connection with the income product accounts discussed earlier. In fact, the value added concept of the income and product accounts (that define gross regional product) is exactly the same as the value added concept of within the input-output accounts.

Figure D.1: Simple Regional Input-Output Transactions Table

		Intermediate Sector by Industry				Final Demand				Total Output
Intermediate Sector		A	B	C	D	Household	Gov't	Exports	Capital	
by Industry	A	$300	$400	$100	$500	$1,600	$500	$200	$700	$4,300
	B	$50	$200	$1,000	$300	$100	$200	$100	$900	$2,850
	C	$1,000	$200	$100	$700	$100	$300	$200	$500	$3,100
	D	$0	$800	$200	$500	$700	$0	$0	$400	$2,600
Primary Sectors										
	Households	$1,900	$300	$1,000	$400					
	Government	$200	$100	$200	$100					
	Imports	$200	$300	$300	$0					
	Capital	$650	$550	$200	$100					
	Total Input	$4,300	$2,850	$3,100	$2,600					

Source: Edgar M. Hoover, 1975, *An Introduction to Regional Economics, 2nd Edition*. New York: Alfred A. Knopf, p. 226.

The input-output accounts are transformed into a predictive model of regional economic impacts when four basic assumptions are applied. First it is assumed that the projects being analyzed will not substantially change methods of production used businesses or the spending behavior of the consumers within the economy, at least during the time frame of the impact analysis. This usually means that size of the project is "small" in relation to the size of the economy. Second, the production processes used by businesses are linear meaning that for every sector doubling the use of all required inputs (such as labor) will result in a doubling of the sectors output level. Third, industrial inputs are used by sectors in fixed proportions to output levels. That is, if 0.5 percent of

output is used to hire and use a particular input (e.g., labor) then this proportion will not change regardless of the production level (see Figure D.2). And fourth, there are no possibilities of substitution between input requirements.

Figure D.2: Input Coefficients for Intermediate Sectors

Purchases From ($)		Per Dollar's Worth of Gross Output			
		A	B	C	D
Intermediate Sectors					
	A	0.070	0.140	0.032	0.192
	B	0.012	0.070	0.323	0.115
	C	0.233	0.070	0.032	0.269
	D	0.000	0.281	0.065	0.192
Primary Sectors					
	Households	0.442	0.105	0.323	0.154
	Government	0.047	0.035	0.065	0.038
	Imports	0.047	0.105	0.097	0.000
	Capital	0.151	0.193	0.064	0.038
Totals		1.000	1.000	1.000	1.000

Columns do not always add exactly to to totals due to rounding.
Source: Edgar M. Hoover, 1975, *An Introduction to Regional* Economics, 2nd Edition. New York: Alfred A. Knopf, p. 226.

Mathematically, an input-output model is a large set of simultaneous equations that are solved to derived changes in industrial output levels that are necessary to satisfy changes in the final demand for goods and services (see Figure D.3). The input-output model will develop a unique estimate of output change for every sector defined by the model (the number of sectors can be as few as ten or twenty or as many as several hundred or more). The output changes calculated by the model will be larger than the final demand changes because certain commodities are necessarily produced and consumed during the process of producing the goods and services for final demand. For

example, in order for bread to be purchased by a consumer at a grocery store wheat has to be first produced and then consumed (i.e., converted to flour) so that the bread can be made for the consumer to buy. These "intermediate" stages of production and consumption are the reason for the multiplier or "ripple" effects generated by tourist expenditures at the beach. They also represent "double-counting" of effects and are the reason why they are not included in income and product accounts. However, they form the basis on which other types of impact effects are derived. For example, once the total output changes due to a change in final demand have been computed, then the process of converting the output changes to employment changes are relatively easy. Project related employment changes are computed by assuming a proportional and fixed relationship between each industry's employment and output levels and applying these proportions to their respective estimated output changes. Similar calculations can be made for project-related changes in value added and each of its components (i.e., employee compensation, proprietor's income, other property-type income, and indirect business taxes).

D.2 Capture Rate

The capture rate is the rate at which the beach area is able to capture money being spent by beach visitors that provide a direct stimulus to the region's economy. As mentioned above, the number of capture rate required for an impact analysis of beach spending will depend on the number of industrial sectors in the regional economic model. An economic base model only requires one capture rate, however, input-output models can require several hundred or more capture rates.

Figure D.3: Total Direct and Indirect Effects of an Increase in Final Demand

Purchases From ($)	Per Dollar of Increased Final Demand				A, B, C, & D Combined
	A	B	C	D	
Intermediate Sectors					
A	1.118	0.289	0.157	0.359	0.661
B	0.126	1.234	0.439	0.352	0.439
C	0.297	0.284	1.171	0.501	0.477
D	0.068	0.452	0.247	1.400	0.400
Total	1.609	2.259	2.014	2.612	1.977
Primary Sectors					
Households	0.614	0.419	0.532	0.574	0.554
Government	0.079	0.092	0.108	0.115	0.092
Imports	0.095	0.171	0.167	0.103	0.123
Capital	0.215	0.317	0.193	0.207	0.231

Figures in combined column show the impact of an added dollar of aggregate final demand sales by all intermediate activities, apportioned in the same proportions as these activities shared in the final demand sales shown in transactions table (Figure D.1). This means added final demand sales of $0.46 by A, $0.20 by B, $0.17 by C, and $0.17 by D.
Source: Edgar M. Hoover, 1975, *An Introduction to Regional* Economics, 2nd Edition. New York: Alfred A. Knopf, p. 226.

Economic base model use an impact multiplier that is akin to the "Keynesian" income multiplier found in traditional macroeconomics. In this formulation, the multiplier is equal to one divided by the propensity of people to save plus their tax rate. Alternatively, the multiplier is also equal to one divided by one minus the propensity for people to consume out of their income. Suppose that people in the U.S. consume approximately 80 percent of their personal income.[43] This means that they save and are taxed about 20 percent of the personal income. The implied multiplier is 5 ($1 \div 0.2$). By knowing the value of the multiplier and using simple algebraic manipulation of the multiplier formulation, the propensity to consume can be identified as 0.8. The value of

[43] According to the National Income and Product Accounts compiled by the U.S. Bureau of Economic Analysis, historical consumption rates have been approximately 80 percent for the last 50 years (BEA, 2001).

saving and tax rate (0.2) is a measure of leakage in the economic system. The greater the leakage is in the system, the smaller the multiplier effect will be. Within a regional economy, leakages within the economic system are much greater due to their "openness" in the form of regional import of goods and services. As a consequence, regional economic base multipliers or less than two are not uncommon. A regional multiplier of two implies propensity to consume from locally available markets of 0.5 or approximately half of what consumers want to purchase can be found in local markets. Alternatively, a propensity to consume from local sources of 0.25 (or one-fourth) implies a regional multiplier of 1.333.

Two very commonly used methods of estimating capture rates by industrial sectors are "location quotients" and "regional purchase" coefficients.[44] Location quotients ($LQ's$) are used by RIMS-II to adjust the national input-output table to reflect local demand and supply conditions. A location quotient for a local industry is the ratio of the industry's local concentration (e.g., the percent of local employment in the sector) to its national counterpart (i.e., the percent of national employment in the sector). The basic idea is that if the industry's local concentration is equal to or greater than the national concentration then the industry must be satisfying the local needs for the industry's production. If, on the other hand, the industry's local concentration is lower than that for the nation, then there are greater demands for its products that can be met from local sources—or the region must be importing the remainder of its requirements. The value of each industry's LQ is then the "key" for its regional capture rate. That is, if the industry's location quotient is greater than or equal to one, then its capture rate is set to one. If the location quotient is less than one, then the industry capture rate is set equal to the location quotient. The source of data required to compile a set of industry capture rates based on the location quotient procedure is most often the latest County Business Patterns (CBP) data from the U.S. Bureau of the Census.

[44] Interregional trade flow estimates that are estimated using the U.S. Department of Transportations' Commodity Flow Surveys are under investigation by several research teams; Peterson and Beck (2000) and Southworth and Peterson (2000).

Regional purchase coefficients (*RPC's*) are used by IMPLAN for its regional adjustment of the national input-output table. A regional purchase coefficient represents the proportion of local demand for a specific commodity that is available from local production. This definition uses a concept that is very much the same as is used by RIMS-II based on location quotients. However, in addition to the use of location quotients, IMPLAN computes its regional purchase coefficients via "regression analysis" with added demand and supply indicators. These additional demand and supply indicators include regional employee compensation for the industry, regional employment relative to national employment for the respective industry, and the relative size of the region (measured by land area). Regional purchase coefficients are available through the IMPLAN modeling system.

D.3 Defining Regions for Economic Impact Analysis

How does one decide to define the region that is going to provide the geographic setting for socioeconomic impact analysis? Of the many factors in performing an economic impact analysis, one of the most subjective issues is the definition of the geographic region to be used. For people not accustomed to conducting regional economic impact analysis, justifying a particular study area may not be easy and is often surrounded by many thorny and uncomfortable issues. The justifications of most study areas often are ignored—perhaps because the region is predefined (e.g., for an analysis of the fiscal impact of a tax cut within Alabama) or maybe because the regional was the only available unit of observation for a "cross-section" study. Unfortunately, few universally accepted rules are available to help choose an appropriate study area. As a result, careful thought should always be exercised when delineating an appropriate area for analysis.

Other than a geographic aggregate, what is a region? There are as many answers to this question as there are people who use geographic settings for their analyses. Such diversity of opinion is due mostly to the different uses of spatial aggregates. The regional definitions commonly used in recent studies of the economic effects of beach activities

appear to be the geographic are within convenient access to the beach under study. For example, this may include those counties whose population centers fall within 30 or 50 miles from the beach. This is a practical, though arbitrary approach to an issue that can be sensitive at times.[45] Most regional and urban analysts performing socioeconomic impact analysis prefer to use a "functional area" concept for defining study regions.[46] Regions defined in this way explicitly consider the economic linkages and spatial dimensions between the residential population and the businesses in the geographic area. In other words, commuting and trading patterns are of prime concern. This type of regional is often called "nodal" because:

> *... the region is perceived as being composed of heterogeneous nodes of different size (cities, towns, villages, and sparsely populated rural areas) that are linked together functionally. These functional links can be identified through observation of flows of people, factors, goods, and communications* (Richardson, 1979, p. 21).

An examination of a map shows that population and businesses are not spread evenly over space, but are concentrated at specific locations called "agglomerations". The factors that generate these agglomerations are varied; e.g., transportation advantages (such as the confluence of several rivers), resource deposits, factor endowments, local infrastructure (such as good schools and public transportation facilities), climate, and even proximity to firms that supply needed production requirements or provide ready markets.

Beyond the general guidelines for region types (above) and the restriction of using counties as the smallest geographic units, there is little formal advice about defining

[45] Two other methods of defining regions are frequently used. First, regions are sometimes delineated along administrative or political boundaries (e.g., the State of Alabama or Montgomery County, Maryland). It is often claimed that since the institutional framework within which economic and social policies are designed and implemented is of overriding importance, then the geographic unit of analysis should coincide with the same administrative or political boundaries. Second, homogeneneity of one form or another can be used to justify some regions. For example, one can envision coal mining regions, river-basin regions, air pollution regions, or even German-speaking areas. What binds these areas is usually some common physical, economic, social, or statistical characteristic.

[46] The concept of a functional economic area (FEA) appears attributable to Karl Fox: see K.A. Fox and T.K. Kuman, "The Functional Economic Area: Delineation and Implications for Economic Analysis and Policy." Papers and Proceedings, Regional Science Association, Vol. 15 (1965), pp. 57-85.

regions. However, when an analyst decides to delineate a study area, the decision is based on his/her considered judgment, possibly from past experience and specific knowledge of the area under study. At a practical level, another important issue is determining the smallest geographic unit for when relevant data are available. For the most part, counties provide these data.[47] With respect to economic impact analysis, it is probably obvious that a region should be the geographic area in which the significant economic and social consequences of a project occur.

The definition of the affected region must include all of the ingredients of a self-sustaining region--local businesses, local government, and local population. The region must reflect the limits of the economic activity associated with the affected population. This is not an easy definition to satisfy and numerous "simplistic" attempts at a standard methodology have failed. However, it is obvious that the following considerations should be included in the definition of an economic region:

- The ***availability of local shopping opportunities*** is a factor in an appropriate regional definition. The location of new malls or other popular shopping opportunities can dictate an expansion in the region's size if no comparable opportunities exist in the immediate vicinity.

- The ***"journey-to-work" time*** for local employees often dictates part of the regional definition. On average, a journey-to-time of one hour or so is considered common. However, some regions in the country are characterized by longer travel times than others. The perception of travel time is affected significantly by the quality of the transportation network, the availability of mass transit, and what impacts are felt during "rush hour" peaks.

- ***Local customs and culture*** also can often influence where the boundaries of a region should be set. Long versus short commute patterns, willingness to approach the "inner city," the sense of local community, and other factors can be used for the region definitions.

[47] Although some data are available at the census tract level (e.g., population and income) that could possibly be used to delineate regions, the data needed to analyze economic impacts are most readily available only at the county level, unless one is willing to conduct expensive and time-consuming surveys.

An important note should be made of the relationship between the size of the study region and the subsequently estimated impacts (Chalmers and Anderson, 1977, p. 13). A larger area usually implies larger populations, greater factor endowments, richer resource deposits, and more readily available productive supplies. All these attributes make for more integrated and more diverse economic structures that, in turn, lead to larger socioeconomic impacts. On the other hand, larger regions also tend to dilute the significance of socioeconomic impacts, which means that the relative significance of impacts tends to become smaller as the region gets larger.

D.4 Other Types of Regional Economic Impact Models

Regardless of its purpose, a regional economic impact analysis has two basic ingredients: converting the alternative scenarios that comprise the proposed action into sets of final demand changes and estimating the factors that relate the initial changes in final demand to the resulting total changes in local economic activity (i.e., the model). The objective of an economic analysis can be quite involved; e.g., an analyst may be interested in evaluating the effects of introducing a new plant in an area, of changing the local tax structure, of a military realignment action, of constructing a public works project, etc. Regional analysts have several alternative modeling frameworks other than input-output at their disposal for regional economic studies. This section reviews two widely used regional economic impact models, economic base and econometric. In addition, the estimation of final demand changes for proposed scenarios is not discussed here.

Economic Base Model: To introduce the economic base model one can think of a household with one wage earner. Obviously, the household's income and it standard-of-living increases and decreases as the wages earned by the head fluctuates. Just like the household, one can envision a local economy that has a great dependence on external sources of demand for the level of its internal welfare; in other words, if it is an "open"

economy. The economic base model provides a simple framework in which to analyze such situations. The economic base model has a considerable history (Isard etal, 1998).

Economic base models "bifurcate" or classify local economic activities into two general sectors; i.e., either into an export sector or into a service sector. The export sector includes those firms that sell their products to businesses and households outside the boundaries of the local economy. In addition, establishments within the local economy that cause funds to flow into the area by their activities (such as tourist facilities and federal government offices) are also considered export industries. The local service sector, in contrast, is made up of those firms that sell their goods and services within the local economy, either to firms in the export sector or to the local populace. The model works to the extent that, external changes resulting in increases (decreases) in export activity cause increases (decreases) in the payroll or export firms which are transmitted to the local service sector establishments. Furthermore, the inflow or outflow of money causes activity in local services to change by a multiple of the original change (i.e., the multiplier effect) as the influx of funds is spent and re-spent in the local economy or as the initial withdrawal of funds causes decreases in local sales which, in turn, causes further decreases in local sales as payrolls and employment shrink. For expansions, re-circulation continues until the leakages from the system (such as imports, savings, and taxes) exhaust the amount of initial influx. In cases of decreases in export activity, the cumulative decline is halted by decreases in imports, savings, and taxes. Note that export based models predict that, without "new" injections of funds to the local economy through its export sector, the local economy will stagnate because service activities can only respond to changes in local economic conditions.

Most derivations of economic base models use an analogy from Keynesian income-consumption theory. This approach has at least two advantages. One, it couches economic base theory in the mainstream of economic thought. This leads to the economic base framework for no other reason than it is consistent with historic development of economic theory. And two, it also provides a formal structure within which the reasons for economic change can be analyzed.

The economic base model is essentially "short-run" in nature. The model assumes an economy is initially in equilibrium and describes the changes required to reach a new equilibrium position after an exogenous change occurs. Prices, wages, and technology are assumed constant. Changes in the distribution of income and resource allocations are also not permitted.

Economic base models emphasize the "openness" of regional economies; that is, the importance of trade in inducing regional change. The high degree of interrelatedness between the local economy and the "rest of the world" that drives the model is based solely on a demand orientation where exogenous changes in demand for exports determine regional income and employment changes. Export sales in practice are not the only activity that responds to exogenous forces, even in the short-run, and their omission from the model suggest that economic base studies are appropriate primarily for smaller economies.

Regional Econometric Models: Regional econometric models are multi-equation systems that attempt to describe the structure of a local economy and to estimate its components such as income, employment, and output. Often the Keynesian income-consumption framework provides the theoretical basis for the development of econometric models. But, because of the problems with the availability of relevant data, model builders generally take an eclectic approach and have incorporated specifications that seem to fit special situations rather than what "theory" would suggest. Most econometric models have employed time-series data and have generally been applied to areas with sufficient data (e.g., state or large metropolitan areas). These models and their component relationships are estimated by means of various regression techniques.

Econometric models vary considerably in their degree of sophistication and complexity (see Treyz, 1993). However, a popular theoretical framework for regional econometric models is the economic base theory. But unlike the economic base model (described earlier), where a reduced form summarizes the relationship between initial

changes in export demand and total changes in local economic activity, regional econometric models adopt an explicit system of equations to explain and predict levels of endogenous variables by either exogenous variables or other endogenous variables that are determined by exogenous variables. These types of equation systems can either be simply recursive in nature or more complex to require sophisticated simultaneous equation solving techniques.

Given the great diversity in the construction of econometric models and the lack of a specific theory of regional growth that forms a basis for the structure of these models, it is difficult to identify a general body of conceptual problems common to these undertakings. In fact, the major conceptual problem is the lack of a consistent theoretical base. Constraints on data availability as well as the unique situation of each area are partly responsible for the variation in structure. There are econometric models that contain only eight stochastic equations while other may contain more that one hundred (Treyz, 1993).

In their most elementary form, econometric models offer little information beyond that available from an economic base study. They are typically demand oriented and treat wages and prices as given. They are thus open to many of the same criticisms raised to the economic base model. An elementary econometric model will have a recursive structure and will generally relate endogenous variables to exogenous national variables. The more sophisticated econometric models consider supply-side influences such as investment and the labor force; wages are also estimated by the model as well as non-wage income. These models tend to be simultaneous rather than recursive. These models supply considerable detail and much emphasis is placed on those variables that the modeler considers important.

Implicit in the econometric models is the theory of growth that identifies the sources of growth with external and internal forces. External forces include export industries, which give them similar difficulties in identifying export sectors and in

allocating sales or employment into export and service sectors. Oftentimes, an assumption approach is used to categorize these activities.

Econometric models that incorporate investment and migration into the income-consumption framework are capable of producing dynamic multipliers. As such, they can show the cumulative impact of an exogenous shock over a number of years. As a result, econometric models can be useful for long term forecasting as well as for providing short-run predictions of impacts. The reliability of long-run impact studies is determined to a considerable extent on the availability of data on local investment and interregional migration.

Appendix E
State Participation in and Funding of Corps Beach Nourishment Projects

E.1 California

The State of California does contribute funds for Corps shore protection projects.

For beach nourishment projects, the State pays 100% of the non-federal share if the project is located at a state park. If the project is not a state park, then the State of California pays 85% of the non-federal share.

For structural Corps projects, the State pays up to 50% of the non-federal share.

There is a State shore protection program, independent of the Corps. It is fairly small at the moment, but there are 6 feasibility studies in the works, so it may be growing. The cost sharing formulas for these State shore protection projects are:

Beach nourishment in a state park – State pays 100%
Beach nourishment not in a state park – State pays 85%/ local municipality 15%

Structural projects – State pays 75% / Local municipality 25%

The source of all of this State funding is the State legislature.

Kim Sterrett, California Department of Boating and Waterways, 2000 Evergreen St. Sacramento, CA 95815, (916) 263-8157

E.2 Florida

Until 1998 the State of Florida funded a beach erosion control program which paid up to 75% of the non-federal share of Corps beach nourishment projects. Projects funded under this program were required to meet certain public access and parking criteria. And the typical funding was at the 75% level. The money was appropriated by the state legislature on a line item basis, for specific projects.

In 1998, the policy was changed (even though the law still allows up to 75%), so that now the state pays 50% of the non-federal share of Corps beach nourishment projects. The funding mechanism has changed also. Now $30 million per year is dedicated to beach erosion control projects. A priority list is developed. Some of the criteria factored into this are whether or not there is federal funding (i.e., Corps projects), and whether or not the project is ready to go (with the plans and studies completed and the local sponsor ready to spend money on it).

Some beach erosion control projects are carried out without any federal funding. They are subject to the same funding policy, and must be high enough on the priority list. In these projects, the state pays 50% and the local sponsor pays 50%.

Steve Higgins from Broward County, Florida. (954) 519-1230. The following web site that contains the type of information we are looking for http://www.dep.state.fl.us/beaches.

E.3 Delaware

The state of Delaware pays 100% of the non-federal share of Corps beach nourishment projects, or at least it will pay 100% if any projects are ever built in Delaware. Thus far, there have been lots of studies and planning, but no actual construction, no actual Corps beach nourishment in Delaware.

The State of Delaware funds beach nourishment on all of the Chesapeake Bay beaches, and it has been funding interim beach nourishment at the Atlantic Ocean beaches. The interim beach nourishment is intended to provide protection for 2 or 3 years. When Corps funding begins, more long-term protection will be built, with foredunes as well as beaches.

The state money is derived from two sources. First, since 1971 there has been a Bond Bill which provides $1 million every year for capital improvements to beaches, which includes beach nourishment. The state beach nourishment projects are nominally funded 50/50 state/local. However, in order to lessen the burden on local governments, the state legislature increased the accommodation (hotel) tax by 1%, and this money is given to localities to use as their share of the cost of beach nourishment. This is used as the "local" 50%. So the local governments really don't have to pay anything.

Tony Pratt hopes that the IWR study will take a broad view of the benefits of beach nourishment projects, and 'track the sand', including the benefits which it generates as it moves along the coast, out of one project area, but into another area where benefits are generated. He offered to give any of us who are interested a guided tour/field trip of the beaches in his area.

Tony Pratt of the State of Delaware, (302) 739-4411

E.4 New Jersey

The state of New Jersey pays 75% of the non-federal share of Corps beach nourishment projects. The remaining 25% of the non-federal share is paid by municipalities (towns, cities, etc). If there is more than one municipality in the project area, the cost is divided among them based on how much shoreline each one has. There is also a program whereby the coastal counties will reimburse the municipalities for 10% of the non-federal share of these projects. This reimbursement, however, is not paid until after the project has been completed.

New Jersey also has state beach nourishment projects, independent of the Corps. These projects are funded on a 75% State and 25% Local basis. Coastal counties also reimburse the municipalities for 10% of their share, after the project is completed.

Source of funds. Before 1991, funding for beach nourishment was derived directly from the state legislature via annual appropriations. Bonds were issued in 1977 and 1983 to raise money for shore protection. Since 1993, the program has had stable funding. This

year there was $25 million of dedicated money available for beach nourishment. The source of this money is the real estate transfer tax, which is levied on all real estate transactions. So $25 million of this tax money is dedicated to the beach nourishment program, and the rest goes into the state treasury. There is also a "poison pill" provision, which states that if the $25 million is not given to the beach nourishment program, then the remainder of the tax revenue cannot be used to balance the state budget.

A major force in achieving this stable funding was the Jersey Shore Partnership, an organization of businesses, utility companies, other stakeholders, which was formed following the destructive storms in 1991 and 1992. This group pressured the State legislature into establishing the mechanism for stable funding of the beach nourishment program.

Bernie Moore of the State of New Jersey.

E.5 North Carolina

North Carolina has a program that provides for paying up to 75 percent of the non-Federal share of Corps beach nourishment projects. The money is derived directly from the State legislature, and there is usually enough to pay for the 75 percent. In some cases, it may be slightly less.

John Morris of North Carolina

Appendix F
Detailed Tables

Table F.1:Distribution of National Economic Development Benefits of Shore Protection Project (Low Energy Protection) With No Additional Recreation Demand (000 dollars in 2000 prices)

	Beach Area Benefits	Rest of Nation Benefits	Total NED Benefits	Benefits ($/CY) of Sand	Sand (000 CY)
Typical Beach Region					
Storm damage reduction	$269	$497	$766	$1.5329	500
Recreation for existing demand	$250	$359	$609	$4.4431	137
Other NED	$0	$102	$102	$0.2045	500
Total	$519	$959	$1,477		
Regional distribution	35.1%	64.9%			
Rural Beach Region					
Storm damage reduction	$353	$413	$766	$1.5329	500
Recreation for existing demand	$370	$239	$609	$4.4431	137
Other NED	$0	$102	$102	$0.2045	500
Total	$723	$754	$1,477		
Regional distribution	49.0%	51.0%			
Urban Beach Region					
Storm damage reduction	$411	$356	$766	$1.5329	500
Recreation for existing demand	$177	$432	$609	$4.4431	137
Other NED	$0	$102	$102	$0.2045	500
Total	$587	$890	$1,477		
Regional distribution	39.8%	60.2%			

Table F.2: Distribution of National Economic Development Benefits of Shore Protection Project (High Energy Protection) With No Additional Recreation Demand (000 dollars in 2000 prices)

	Beach Area Benefits	Rest of Nation Benefits	Total NED Benefits	Benefits ($/CY) of Sand	Sand (000 CY)
Typical Beach Region					
Storm damage reduction	$377	$696	$1,073	$1.5329	700
Recreation for existing demand	$250	$359	$609	$4.4431	137
Other	$0	$143	$143	$0.2045	700
Total	$626	$1,199	$1,825		
Regional distribution	34.3%	65.7%			
Rural Beach Region					
Storm damage reduction	$495	$578	$1,073	$1.5329	700
Recreation for existing demand	$370	$239	$609	$4.4431	137
Other	$0	$143	$143	$0.2045	700
Total	$865	$960	$1,825		
Regional distribution	47.4%	52.6%			
Urban Beach Region					
Storm damage reduction	$575	$498	$1,073	$1.5329	700
Recreation for existing demand	$177	$432	$609	$4.4431	137
Other	$0	$143	$143	$0.2045	700
Total	$752	$1,073	$1,825		
Regional distribution	41.2%	58.8%			

Table F.3: Distribution of National Economic Development Benefits of Shore Protection Project (Medium Energy Protection) With Varying Recreation Demand, Unit-Day Value is $5.17 (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total NED	
	Benefits	%	Benefits	%	Benefits	New Visits
Typical Beach Region						
No increase in beach use	$572	34.6%	$1,079	65.4%	$1,651	0
5% increase in beach use	$606	35.0%	$1,127	65.0%	$1,733	15,840
10% increse in beach use	$640	35.3%	$1,175	64.7%	$1,815	31,680
15% increase in beach use	$673	35.5%	$1,224	64.5%	$1,897	47,520
20% increase in beach use	$707	35.7%	$1,272	64.3%	$1,979	63,360
25% increase in beach use	$740	35.9%	$1,320	64.1%	$2,060	79,200
Rural Beach Region						
No increase in beach use	$794	48.1%	$857	51.9%	$1,651	0
5% increase in beach use	$844	48.7%	$889	51.3%	$1,733	15,840
10% increse in beach use	$894	49.3%	$921	50.7%	$1,815	31,680
15% increase in beach use	$943	49.7%	$953	50.3%	$1,896	47,520
20% increase in beach use	$993	50.2%	$985	49.8%	$1,978	63,360
25% increase in beach use	$1,043	50.6%	$1,018	49.4%	$2,061	79,200
Urban Beach Region						
No increase in beach use	$670	40.6%	$982	59.4%	$1,652	0
5% increase in beach use	$693	40.0%	$1,040	60.0%	$1,733	15,840
10% increse in beach use	$717	39.5%	$1,098	60.5%	$1,815	31,680
15% increase in beach use	$741	39.1%	$1,156	60.9%	$1,897	47,520
20% increase in beach use	$765	38.7%	$1,214	61.3%	$1,979	63,360
25% increase in beach use	$788	38.3%	$1,272	61.7%	$2,060	79,200

Table F.4: Distribution of National Economic Development Benefits of Shore Protection Project (Medium Energy Protection) With Varying Recreation Demand, Unit-Day Value is $17.38 (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total NED	
	Benefits	%	Benefits	%	Benefits	New Visits
Typical Beach Region						
No increase in beach use	$572	34.6%	$1,079	65.4%	$1,651	0
5% increase in beach use	$685	35.6%	$1,241	64.4%	$1,926	15,840
10% increse in beach use	$798	36.2%	$1,404	63.8%	$2,202	31,680
15% increase in beach use	$911	36.8%	$1,566	63.2%	$2,477	47,520
20% increase in beach use	$1,024	37.2%	$1,728	62.8%	$2,752	63,360
25% increase in beach use	$1,137	37.5%	$1,891	62.5%	$3,028	79,200
Rural Beach Region						
No increase in beach use	$794	48.1%	$857	51.9%	$1,651	0
5% increase in beach use	$961	49.9%	$965	50.1%	$1,926	15,840
10% increse in beach use	$1,129	51.3%	$1,073	48.7%	$2,202	31,680
15% increase in beach use	$1,296	52.3%	$1,181	47.7%	$2,477	47,520
20% increase in beach use	$1,464	53.2%	$1,289	46.8%	$2,753	63,360
25% increase in beach use	$1,631	53.9%	$1,397	46.1%	$3,028	79,200
Urban Beach Region						
No increase in beach use	$670	40.6%	$982	59.4%	$1,652	0
5% increase in beach use	$749	38.9%	$1,177	61.1%	$1,926	15,840
10% increse in beach use	$829	37.6%	$1,373	62.4%	$2,202	31,680
15% increase in beach use	$909	36.7%	$1,568	63.3%	$2,477	47,520
20% increase in beach use	$989	35.9%	$1,763	64.1%	$2,752	63,360
25% increase in beach use	$1,069	35.3%	$1,959	64.7%	$3,028	79,200

Table F.5: Distribution of National Economic Development Benefits of Shore Protection Project (Low Energy Protection) With Varying Recreation Demand, Unit-Day Value is $2.00 (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total NED	
	Benefits	%	Benefits	%	Benefits	New Visits
Typical Beach Region						
No increase in beach use	$519	35.1%	$959	64.9%	$1,478	0
5% increase in beach use	$532	35.2%	$978	64.8%	$1,510	15,840
10% increse in beach use	$545	35.4%	$996	64.6%	$1,541	31,680
15% increase in beach use	$558	35.5%	$1,015	64.5%	$1,573	47,520
20% increase in beach use	$571	35.6%	$1,034	64.4%	$1,605	63,360
25% increase in beach use	$584	35.7%	$1,052	64.3%	$1,636	79,200
Rural Beach Region						
No increase in beach use	$723	49.0%	$754	51.0%	$1,477	0
5% increase in beach use	$743	49.2%	$766	50.8%	$1,509	15,840
10% increse in beach use	$762	49.4%	$779	50.6%	$1,541	31,680
15% increase in beach use	$781	49.7%	$791	50.3%	$1,572	47,520
20% increase in beach use	$800	49.9%	$804	50.1%	$1,604	63,360
25% increase in beach use	$820	50.1%	$816	49.9%	$1,636	79,200
Urban Beach Region						
No increase in beach use	$587	39.7%	$890	60.3%	$1,477	0
5% increase in beach use	$597	39.5%	$913	60.5%	$1,510	15,840
10% increse in beach use	$606	39.3%	$935	60.7%	$1,541	31,680
15% increase in beach use	$615	39.1%	$958	60.9%	$1,573	47,520
20% increase in beach use	$624	38.9%	$980	61.1%	$1,604	63,360
25% increase in beach use	$633	38.7%	$1,003	61.3%	$1,636	79,200

Table F.6: Distribution of National Economic Development Benefits of Shore Protection Project (Low Energy Protection) With Varying Recreation Demand, Unit-Day Value is $5.17 (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total NED	
	Benefits	%	Benefits	%	Benefits	New Visits
Typical Beach Region						
No increase in beach use	$519	35.1%	$959	64.9%	$1,478	0
5% increase in beach use	$552	35.4%	$1,007	64.6%	$1,559	15,840
10% increse in beach use	$586	35.7%	$1,055	64.3%	$1,641	31,680
15% increase in beach use	$619	35.9%	$1,104	64.1%	$1,723	47,520
20% increase in beach use	$653	36.2%	$1,152	63.8%	$1,805	63,360
25% increase in beach use	$686	36.4%	$1,200	63.6%	$1,886	79,200
Rural Beach Region						
No increase in beach use	$723	49.0%	$754	51.0%	$1,477	0
5% increase in beach use	$773	49.6%	$786	50.4%	$1,559	15,840
10% increse in beach use	$823	50.2%	$818	49.8%	$1,641	31,680
15% increase in beach use	$873	50.7%	$850	49.3%	$1,723	47,520
20% increase in beach use	$923	51.1%	$882	48.9%	$1,805	63,360
25% increase in beach use	$972	51.5%	$914	48.5%	$1,886	79,200
Urban Beach Region						
No increase in beach use	$587	39.7%	$890	60.3%	$1,477	0
5% increase in beach use	$611	39.2%	$948	60.8%	$1,559	15,840
10% increse in beach use	$635	38.7%	$1,006	61.3%	$1,641	31,680
15% increase in beach use	$659	38.2%	$1,064	61.8%	$1,723	47,520
20% increase in beach use	$682	37.8%	$1,123	62.2%	$1,805	63,360
25% increase in beach use	$706	37.4%	$1,181	62.6%	$1,887	79,200

Table F.7: Distribution of National Economic Development Benefits of Shore Protection Project (Low Energy Protection) With Varying Recreation Demand, Unit-Day Value is $17.38 (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total NED	
	Benefits	%	Benefits	%	Benefits	New Visits
Typical Beach Region						
No increase in beach use	$519	35.1%	$959	64.9%	$1,478	0
5% increase in beach use	$631	36.0%	$1,121	64.0%	$1,752	15,840
10% increse in beach use	$744	36.7%	$1,284	63.3%	$2,028	31,680
15% increase in beach use	$857	37.2%	$1,446	62.8%	$2,303	47,520
20% increase in beach use	$970	37.6%	$1,609	62.4%	$2,579	63,360
25% increase in beach use	$1,083	37.9%	$1,771	62.1%	$2,854	79,200
Rural Beach Region						
No increase in beach use	$723	49.0%	$754	51.0%	$1,477	0
5% increase in beach use	$891	50.8%	$862	49.2%	$1,753	15,840
10% increse in beach use	$1,058	52.2%	$970	47.8%	$2,028	31,680
15% increase in beach use	$1,226	53.2%	$1,078	46.8%	$2,304	47,520
20% increase in beach use	$1,393	54.0%	$1,186	46.0%	$2,579	63,360
25% increase in beach use	$1,560	54.7%	$1,294	45.3%	$2,854	79,200
Urban Beach Region						
No increase in beach use	$587	39.7%	$890	60.3%	$1,477	0
5% increase in beach use	$667	38.0%	$1,086	62.0%	$1,753	15,840
10% increse in beach use	$747	36.8%	$1,281	63.2%	$2,028	31,680
15% increase in beach use	$827	35.9%	$1,476	64.1%	$2,303	47,520
20% increase in beach use	$907	35.2%	$1,672	64.8%	$2,579	63,360
25% increase in beach use	$987	34.6%	$1,867	65.4%	$2,854	79,200

Table F.8: Distribution of National Economic Development Benefits of Shore Protection Project (High Energy Protection) With Varying Recreation Demand, Unit-Day Value is $2.00 (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total NED	
	Benefits	%	Benefits	%	Benefits	New Visits
Typical Beach Region						
No increase in beach use	$626	34.3%	$1,199	65.7%	$1,825	0
5% increase in beach use	$639	34.4%	$1,217	65.6%	$1,856	15,840
10% increse in beach use	$652	34.5%	$1,236	65.5%	$1,888	31,680
15% increase in beach use	$665	34.6%	$1,255	65.4%	$1,920	47,520
20% increase in beach use	$678	34.8%	$1,273	65.2%	$1,951	63,360
25% increase in beach use	$691	34.8%	$1,292	65.2%	$1,983	79,200
Rural Beach Region						
No increase in beach use	$865	47.4%	$960	52.6%	$1,825	0
5% increase in beach use	$884	47.6%	$973	52.4%	$1,857	15,840
10% increse in beach use	$903	47.8%	$985	52.2%	$1,888	31,680
15% increase in beach use	$923	48.1%	$997	51.9%	$1,920	47,520
20% increase in beach use	$942	48.3%	$1,010	51.7%	$1,952	63,360
25% increase in beach use	$961	48.5%	$1,022	51.5%	$1,983	79,200
Urban Beach Region						
No increase in beach use	$752	41.2%	$1,073	58.8%	$1,825	0
5% increase in beach use	$761	41.0%	$1,096	59.0%	$1,857	15,840
10% increse in beach use	$770	40.8%	$1,118	59.2%	$1,888	31,680
15% increase in beach use	$779	40.6%	$1,141	59.4%	$1,920	47,520
20% increase in beach use	$788	40.4%	$1,163	59.6%	$1,951	63,360
25% increase in beach use	$798	40.2%	$1,186	59.8%	$1,984	79,200

Table F.9: Distribution of National Economic Development Benefits of Shore Protection Project (High Energy Protection) With Varying Recreation Demand, Unit-Day Value is $5.17 (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total NED	
	Benefits	%	Benefits	%	Benefits	New Visits
Typical Beach Region						
No increase in beach use	$626	34.3%	$1,199	65.7%	$1,825	0
5% increase in beach use	$660	34.6%	$1,247	65.4%	$1,907	15,840
10% increse in beach use	$693	34.9%	$1,295	65.1%	$1,988	31,680
15% increase in beach use	$727	35.1%	$1,344	64.9%	$2,071	47,520
20% increase in beach use	$761	35.3%	$1,392	64.7%	$2,153	63,360
25% increase in beach use	$794	35.5%	$1,440	64.5%	$2,234	79,200
Rural Beach Region						
No increase in beach use	$865	47.4%	$960	52.6%	$1,825	0
5% increase in beach use	$915	48.0%	$992	52.0%	$1,907	15,840
10% increse in beach use	$964	48.5%	$1,024	51.5%	$1,988	31,680
15% increase in beach use	$1,014	49.0%	$1,056	51.0%	$2,070	47,520
20% increase in beach use	$1,064	49.4%	$1,089	50.6%	$2,153	63,360
25% increase in beach use	$1,114	49.8%	$1,121	50.2%	$2,235	79,200
Urban Beach Region						
No increase in beach use	$752	41.2%	$1,073	58.8%	$1,825	0
5% increase in beach use	$775	40.7%	$1,131	59.3%	$1,906	15,840
10% increse in beach use	$799	40.2%	$1,190	59.8%	$1,989	31,680
15% increase in beach use	$823	39.7%	$1,248	60.3%	$2,071	47,520
20% increase in beach use	$847	39.3%	$1,306	60.7%	$2,153	63,360
25% increase in beach use	$870	38.9%	$1,364	61.1%	$2,234	79,200

Table F.10: Distribution of National Economic Development Benefits of Shore Protection Project (High Energy Protection) With Varying Recreation Demand, Unit-Day Value is $17.38 (000 dollars in 2000 prices)

	Beach Area		Rest of the Nation		Total NED	
	Benefits	%	Benefits	%	Benefits	New Visits
Typical Beach Region						
No increase in beach use	$626	34.3%	$1,199	65.7%	$1,825	0
5% increase in beach use	$739	35.2%	$1,361	64.8%	$2,100	15,840
10% increse in beach use	$852	35.9%	$1,524	64.1%	$2,376	31,680
15% increase in beach use	$965	36.4%	$1,686	63.6%	$2,651	47,520
20% increase in beach use	$1,078	36.8%	$1,848	63.2%	$2,926	63,360
25% increase in beach use	$1,191	37.2%	$2,011	62.8%	$3,202	79,200
Rural Beach Region						
No increase in beach use	$865	47.4%	$960	52.6%	$1,825	0
5% increase in beach use	$1,032	49.1%	$1,068	50.9%	$2,100	15,840
10% increse in beach use	$1,200	50.5%	$1,176	49.5%	$2,376	31,680
15% increase in beach use	$1,367	51.6%	$1,284	48.4%	$2,651	47,520
20% increase in beach use	$1,534	52.4%	$1,392	47.6%	$2,926	63,360
25% increase in beach use	$1,702	53.2%	$1,500	46.8%	$3,202	79,200
Urban Beach Region						
No increase in beach use	$752	41.2%	$1,073	58.8%	$1,825	0
5% increase in beach use	$832	39.6%	$1,269	60.4%	$2,101	15,840
10% increse in beach use	$911	38.4%	$1,464	61.6%	$2,375	31,680
15% increase in beach use	$991	37.4%	$1,660	62.6%	$2,651	47,520
20% increase in beach use	$1,071	36.6%	$1,855	63.4%	$2,926	63,360
25% increase in beach use	$1,151	35.9%	$2,051	64.1%	$3,202	79,200

Table F.11: Impacts in the Typical Beach Region Due to a Hypothetical Million Outside Beach Visitors ($000 in 2000 prices)

Industry	Business Sales		Full-Time Employment	Value Added	Employee Compensation	Proprietors' Income	Property Income	Indirect Bus. Taxes
	Direct	Total						
Agriculture	$702	$952	32.5	$779	$276	$341	$152	$9
Mining	$0	$0	0.0	$0	$0	$0	$0	$0
Construction	$0	$2,449	22.2	$826	$436	$142	$239	$10
Manufacturing	$437	$1,124	14.6	$431	$278	$10	$136	$7
TCPU	$980	$3,109	23.3	$1,442	$689	$56	$508	$189
Trade	$27,701	$32,603	1,094.3	$22,374	$12,858	$2,313	$2,641	$4,562
FIRE	$0	$5,176	34.8	$3,390	$428	$33	$2,113	$817
Services	$20,095	$25,756	756.6	$18,854	$10,335	$3,205	$3,600	$1,714
Government	$0	$289	3.6	$204	$162	$0	$42	$0
Other	$0	$2	0.1	$2	$2	$0	$0	$0
Total	$49,914	$71,461	1,981.9	$48,302	$25,466	$6,098	$9,430	$7,308

Table F.12: Impacts in the Rural Beach Region Due to a Hypothetical Million Outside Beach Visitors ($000 in 2000 prices)

Industry	Business Sales		Full-Time Employment	Value Added	Employee Compensation	Proprietors' Income	Property Income	Indirect Bus. Taxes
	Direct	Total						
Agriculture	$140	$208	11.9	$155	$108	$47	$0	$0
Mining	$0	$0	0.0	$0	$0	$0	$0	$0
Construction	$0	$1,663	14.1	$611	$335	$86	$184	$6
Manufacturing	$68	$313	4.5	$149	$95	$4	$48	$2
TCPU	$1,263	$2,787	17.9	$1,199	$596	$42	$400	$162
Trade	$18,236	$21,353	621.8	$14,888	$9,134	$1,243	$1,846	$2,665
FIRE	$0	$3,605	21.5	$2,316	$353	$20	$1,443	$501
Services	$14,117	$17,590	466.6	$12,566	$6,831	$2,134	$2,589	$1,011
Government	$0	$318	3.5	$217	$140	$0	$78	$0
Other	$0	$45	5.5	$45	$45	$0	$0	$0
Total	$33,825	$47,880	1,167.3	$32,147	$17,637	$3,576	$6,587	$4,347

Table F.13: Impacts in the Urban Beach Region Due to a Hypothetical Million Outside Beach Visitors ($000 in 2000 prices)

Industry	Business Sales		Full-Time Employment	Value Added	Employee Compensation	Proprietors' Income	Property Income	Indirect Bus. Taxes
	Direct	Total						
Agriculture	$190	$433	15.8	$293	$99	$166	$27	$2
Mining	$0	$3	0.0	$1	$0	$0	$1	$0
Construction	$0	$4,614	38.1	$1,755	$957	$257	$524	$17
Manufacturing	$874	$4,154	31.9	$1,921	$1,056	$36	$787	$42
TCPU	$2,025	$6,850	52.4	$3,428	$1,761	$136	$1,154	$378
Trade	$55,056	$65,016	1,964.6	$41,196	$26,233	$3,590	$4,952	$6,421
FIRE	$0	$11,314	64.2	$7,044	$1,450	$77	$4,081	$1,436
Services	$33,867	$47,310	1,339.8	$35,599	$20,789	$4,154	$6,454	$4,202
Government	$0	$701	7.6	$495	$352	$0	$143	$0
Other	$0	$126	13.8	$126	$126	$0	$0	$0
Total	$92,012	$140,522	3,528.2	$91,858	$52,823	$8,414	$18,123	$12,499

Appendix G
OMB Memo

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

May 30, 2002

The Honorable R. L. Brownlee
Acting Assistant Secretary of the Army (Civil Works)
108 Army Pentagon, 2E636
Washington, D.C. 20310-0108

Dear Mr. Brownlee:

Thank you for the opportunity to comment on an Army Corps of Engineers (Corps) November 2001 draft preliminary report on the benefits of shore protection projects.

Contemporary shore protection projects generally involve the placement of large volumes of dredged material on a beach. The constructed beaches tend to erode away; many of them require frequent replenishment. For a number of years, the Office of Management and Budget has been concerned about the long-term Federal cost implications of the growing number of these projects. We asked the Corps to prepare this report to facilitate an evaluation of possible cost-sharing changes.

Unfortunately, the report does not provide an acceptable basis for policy-making. I have attached our comments. We would like to work with you to address these concerns as the Corps develops its assumptions, methodology, and scope of work for the broader shore protection study that Congress authorized in the 1999 Water Resources Development Act.

Thank you for your cooperation in preparing the draft report and for your assistance during our review.

Sincerely,

Mark Weatherly

Mark Weatherly
Deputy Associate Director
Energy, Science, and Water

The Distribution of Shore Protection Benefits
Draft Army Corps of Engineers Report, November 2001
Comments of the Office of Management and Budget

Basic Assumptions

The analysis of the hypothetical scenario in the draft report relies upon two key assumptions that lead to a substantial understatement of the benefits that accrue locally:

- It uses an inappropriate measure -- the place of principal residence of the people who own local property or who use the beach -- to allocate the benefits of a project to the "beach region" (local) or to the "rest of the nation" (national). The issue here is not who benefits, but whether the way in which the benefits accrue enable the State or local authorities to support a non-Federal cost-share. That depends largely upon where the benefits will occur, not on where the people who receive the benefits reside most of the year.

- Although the report views some national and some regional economic development benefits as local, it limits the local area to the county or counties in which the shore protection project physically is located. Coastal States typically pay much of the non-Federal costs of these projects, e.g., between 50 percent and 100 percent in the five States that the Corps surveyed. Therefore, we believe the report should have viewed as local all benefits that flow to any resident or business in the State or should have attempted, at a minimum, to estimate the benefits that accrue in-State beyond the county line. Instead, it simply includes them on the national side of the ledger.

Storm Damage Reduction

All storm damage reduction effects redound to the benefit of the local community. By reducing damages to structures and their contents and to local infrastructure, a shore protection project raises local property values compared to the "without project" condition. Since real property is a fixed asset, most of this added value remains within the reach of local authorities and augments their ability to contribute towards the project's construction costs, for example, through property or occupancy taxes. It does not matter that some property owners may reside elsewhere. The project reduces storm damages only locally; for those who live elsewhere, it reduces damages to their second home, rental property, or business; its contents; and the surrounding land.

Recreation

Shore protection projects that support recreation can add significantly to the ability of the State and local sponsor to contribute to the costs of construction. The analysis of the

hypothetical scenario in the report underestimates these local benefits in several ways:

- In limiting the beach region to the county, the report understates the local component of the regional economic development benefits. The people who travel farther to reach the beach are more likely to stay overnight nearby in a hotel or rental unit and to spend money when they get there. Their beach-trip spending beyond the county line is likely to occur mostly in-State, but the report allocates the associated benefits to the "rest of the nation."

- Although spending by foreign tourists in the coastal State is new spending from a national perspective, the added value that it contributes to the national economy primarily benefits the local coastal community and the State.

- The intangible, subjective value of the beach experience generally exceeds the financial costs that beach users incur. For beach users who live within the State either part-time or full-time, all of this consumer surplus is local.

- The State or local authorities can access only a part of this consumer surplus via a user fee without significantly affecting overall tourist spending. Since the amount that they could so collect from out-of-State and foreign visitors is potentially available to help pay for the project, it is a local benefit as well.

- The report treats the Federal tax revenue from spending in the beach region as a benefit that occurs outside the beach region. However, the net effect of a project on Treasury receipts probably is insignificant. In the absence of the project, it is likely that: (1) spending by recreation users (perhaps elsewhere) would generate a similar level of tax revenue; and (2) the alternative Federal investment (same amount spent elsewhere) would produce a comparable level of tax revenue.

Public Finance Capabilities

The draft report does not sufficiently explore a complex question that is central to determining an appropriate non-Federal cost-share. To what extent will the predicted benefits of a shore protection project occur within the reach of local or State authorities and therefore potentially be available to support a non-Federal cost-share?

The draft report assumes that local authorities can support a portion of the project's costs only through belt tightening or by developing an additional source of recreation-based revenue. However, a shore protection project chiefly benefits homes and businesses in the local coastal community. By preserving existing property value and facilitating further coastal development in that community, a project in effect augments the long-term local tax base. The draft report did not examine the extent to which this effect of a project on private property values, under a range of property tax rates that now prevail, contributes to the

revenues that coastal communities now are collecting.

The report also should have examined the option of charging existing users of the beach a fee or a higher fee. It focuses only on the ability of local authorities to raise additional funds from new visitors or a sales tax increase.

In calculating the fiscal capability of State and local interests, the report also makes two significant computational errors:

- It does not represent the stream of payments properly. Beach replenishment occurs periodically over a project's lifetime. The report assumes the local sponsor would issue a bond at the outset of a project that is large enough to pay all future costs up front, years and decades before much of the work actually will occur.

- It also overestimates the up-front sum that non-Federal interests would need to borrow when it multiplies average annual costs by 50. The amount that a local sponsor would borrow is equivalent to the principal of the loan; average annual costs include both the principal and a substantial interest component.

Environmental Impacts

According to the draft report, shore protection projects can benefit species that use the beach such as shorebirds, but cause short-term damage to habitat in the marine subtidal zone. The draft report does not try to assess the relevance, if any, of these benefits to possible changes to the cost-sharing formula.

Project opponents claim that shore protection projects also can lead to more serious long-term impacts, e.g., to fishery habitat areas of particular concern, near estuaries, and in shallow areas that are less subject to littoral drift such as a bay. By facilitating the further development of certain coastal communities and adjacent areas, projects may have other adverse environmental impacts as well. Since the early 1970s, the Corps has recommended dozens of projects that involve periodic beach replenishment, covering major stretches of the New Jersey, Florida, and North Carolina coastlines and significant segments in a few other States. It is involved in a multi-year effort to monitor the biological impact of six projects in New Jersey, but has not examined the cumulative environmental impacts of: (1) the Corps program as a whole; (2) the many other such projects that local authorities and States now fund on their own; and (3) related Federal disaster relief and Federal flood insurance efforts that affect coastal development. The draft report does not address such concerns.