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REF:OCCL:TM

CDUA: MA-3633
Acceptance Date: September 17, 2012
180-Day Expiration Date: March 16, 2013

SEP 26 2012

MEMORANDUM

TO: Gary L. Hooser, Director
Office of Environmental Quality Control

FROM: Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

SUBJECT: Draft Environmental Assessment (EA) for Conservation District Use Application (CDUA) MA-3633 for the Stable Road Beach Groins Project Located Upon Submerged Land Offshore of Spreckelsville, Maui, Makai of TMK:(2) 3-8-002:71, 74, 77 & 78

The Office of Conservation and Coastal Lands has reviewed the draft EA for the subject project, and anticipates a Finding of No Significant Impact (FONSI) determination. Please publish notice of availability for this project in the October 8, 2012 issue of the Environmental Notice. We have enclosed a hard copy and a pdf. copy on CD of the draft EA document. A copy of our acceptance letter and a copy of the applicant's Publication Form are also enclosed. An electronic copy of the publication form has been forwarded to your Office via e-mail.

Should you wish to provide comments regarding this project, please respond by the suspense date noted above. If no response is received by the suspense date, we will assume there are no comments. Please contact Tiger Mills of our Office of Conservation and Coastal Lands staff at 587-0382 should you have any questions.

Enclosures

DRAFT ENVIRONMENTAL ASSESSMENT WITH FINDING OF NO SIGNIFICANT IMPACT

in support of

STABLE ROAD BEACH GROINS REPLACEMENT PROJECT

15 July 2012

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DOCUMENT SUMMARY

<u>Need for Action</u> - The 600 foot long Project Beach is located along a portion of Stable Road between Kanaha Beach Park to the west and Kahului Airport to the east on Maui's north shore (see Cover Photo.) The Project Beach has experienced chronic beach erosion and beach retreat with an unusually high rate of beach and land loss from 2006 to 2010. The region has a diminished sand supply to sufficiently nourish the Project Beach due to seven decades of sand mining for the updrift Paia Lime Kiln and other uses. The County of Maui Beach Management Plan identified the overall Stable Road Beach as an "erosion hotspot" and some of the Stable Road Beach as "lost beach" where there is a lack of recreational beach and lateral beach access. The Project Beach is a valuable resource providing the following public functions and environmental benefits:

- Used extensively for diverse recreational activities, provides open space and lateral beach access;
- Provides beach and shoreline habitat to endangered species;
- Functions as a buffer to land based pollution entering into the ocean;
- Protects land from eroding and contaminating the ocean with land based pollutants, thus preserving water quality, marine life and reef health.

These resources are under threat of degradation and loss if no action is taken. The County of Maui Beach Management Plan and the State of Hawaii Coastal Zone Management Program both stress the need to restore, protect and preserve Maui and Hawaii beaches respectively. **The Need for Action is to preserve and protect the Project Beach.**

<u>Previous Action</u> - To initially address the Project Need, the Applicant (Stable Road Beach Restoration Foundation, Inc.) implemented a Small Scale Beach Nourishment Evaluation Project (SSBN MA 08-01) in the spring of 2010, which significantly reduced the rate of beach erosion and prevented land loss. The project's integrated design approach is recommended by the State of Hawaii Coastal Erosion Management Program (COEMAP) to reduce the rate of beach loss where chronic beach erosion. The integrated design approach included nourishing the beach with offshore sand combined with installing four temporary, sand retention devices (groins). The purpose of the SSBN Evaluation Project was to restore and protect the Project Beach and to be a pilot project to provide environmental impact and groin field performance information. Four environmental factors were monitored before, during and after construction activity to generate a comprehensive picture of project effects to the nearshore environment.

Approvals for the SSBN Evaluation Project took two and one-half years of extensive review, environmental monitoring scope determination and performance criteria/metrics input by at least fourteen different Federal, State and County agencies, plus many interested groups and individuals. The result was a carefully implemented project with periodic environmental monitoring and performance assessments which were compared to Performance Criteria and Metrics established during the project's planning and review process. The project also included Best Management Practices to avoid or mitigate any potential environmental impacts during construction.

While the initial beach sand nourishment was lost from the Project Beach during the first season, the temporary groins performed successfully during subsequent seasons retaining naturally accreted beach sand without an adverse environmental impact. The SSBN Evaluation Project demonstrated the viability of a sand retention approach as a long solution to chronic beach erosion at the Project Beach. The SSBN Project's environmental monitoring program provided a source of site-specific, empirical data that is valuable and important in understanding the influence of the Proposed Action on the Project Beach and adjacent beaches. Therefore, the Environmental Assessment (EA) process was able to use real, reliable and factual data and performance assessments for a similar action on the Project Beach as opposed to relying on theoretical assumptions, empirical relationships developed in a laboratory or other untested predictions.

The environmental assessment from the SSBN Evaluation Project's monitoring data concluded that the project had no adverse environmental impact on beach erosion, water quality, benthic habitat or lateral beach access within or outside the Project Area.

Purpose of Action - The temporary groins are approved until 25 June 2014 and will not last indefinitely due to their geotextile material's lack of ability to withstand abrasions from the wash of sand and gravel in the beach surge zone. The COEMAP states "Beach Erosion Control is more appropriate where the problem is chronic erosion due to a diminished sediment supply". **The Purpose of Action is to protect and preserve the Project Beach in a longer lasting and more sustainable manner than the temporary groins approved for the SSBN Evaluation Project.** Without Action, there is a probability of the Project Beach to naturally transform into a Lost Beach with no sand as has occurred previously seasonally at parts of the Project Beach and at nearby beaches.

Alternatives Considered - Several different approaches to beach erosion control were identified from the COEMAP, and Alternatives considered and assessed in the EA include the following:

1. Proposed Action - Replace Existing Geotube Groins with Rock Groins
2. No Action
3. Replace Existing Geotube Groins with Rock Groins and Possibly Nourish the Project Beach with Inland Sand

Other Alternatives considered but eliminated from further consideration due to not meeting the Need for and Purpose of Action included the following:

4. Replace Existing Geotube Groins with Rock Groins and Possibly Nourish the Project Beach with Offshore Sand
5. Annually Nourish the Project Beach with Inland Sand
6. Annually Nourish the Project Beach with Offshore Sand
7. Relocate Residential Structures
8. Build a Seawall or Revetment

Proposed Action - The Proposed Action of Replace Existing Geotube Groins with Rock Groins is the most similar project to the SSBN Evaluation Project but with significantly less construction activity and disturbance. Its work scope is simply to remove the SSBN Evaluation Projects' four, temporary, sand filled, geotube groins and to replace them with three or four, longer lasting, rock groins of the same scale and in the same general locations. The replacement groins will be similar to the numerous rock groins downdrift of the Project Beach toward Kanaha Beach Park that have been in place for at least 72 years and have significantly the beach erosion rate compared to adjacent beaches.

Affected Environment - The EA identified Affected Environment Factors by the Proposed Action which included Physical, Water Quality, Biological, Cultural, Recreational, Visual, Economic plus Social. For each Factor, related Resources were identified and described; and for each Resource, the Environmental Consequences that may result from the Proposed Action and evaluated Alternatives along with Mitigation Measures were evaluated in order to determine potential long-and short- term, adverse environmental consequences.

Environmental Consequences - **The EA concluded the following:**

- **The Proposed Action will result in zero adverse environmental impacts (no primary and secondary, no short-term and long-term, no local or regional plus no cumulative impacts); however, it may result in four short-term, potentially adverse localized environmental impacts during construction which can be avoided or mitigated using Best Management Practices proven to be successful during the SSBN Evaluation Project. One Mitigation Measure is pre-fill of the new groin field - the existing groin field has retained beach sand naturally from seasonal accretion to sufficiently pre-fill the new groin field to maintain longshore sand transport in order to not adversely affect downdrift beaches.**

- **The Proposed Action will result in twelve long-term, positive environmental impacts; and these include the preservation of the following important Resources: sand beach, land, shoreline vegetation, ocean nearshore water quality, marine life, reef health, beach and shoreline habitats, recreational beach use, lateral beach access, visual character, local economy, State and County tax revenue plus no use of public funds.**

- **The No Action Alternative will result in fourteen long-term, adverse environmental impacts including the continued decline and potential loss of the same twelve, important Resources benefitted by the Proposed Action, as well as a decline of nearshore water quality and neighborhood character.**

- **The Replace Existing Geotube Groins with Rock Groins and Possibly Nourish the Project Beach with Inland Sand Alternative will result in zero adverse environmental impacts (no primary and secondary, no short-term and long-term, no local or regional plus no cumulative impacts); however, it may result in four short-term, potentially adverse localized environmental impacts during**

construction which can be avoided or mitigated using Best Management Practices proven to be successful during the SSBN Evaluation Project.

Significant Criteria - Hawaii Revised Statutes (HRS 343) and Hawaii Administrative Rules (HAR, 200-11) require an evaluation of twelve Significant Criteria to determine if the Proposed Action will cause an adverse impact. **The EA concluded there is no significant impact affecting State of Hawaii Significant Criteria by the Proposed Action or the Alternative of Replace Existing Geotube Groins with Rock Groins and Possibly Nourish the Project Beach with Inland Sand.**

Notice of Anticipated Determination - Finding of No Significant Impact - There are no unresolved issues, and it has been concluded by the EA pertaining to the Proposed Action that a Finding of No Significant Impact is appropriate. Therefore, no Environmental Impact Statement is required.

Reasons Supporting Anticipated Determination - The Proposed Action is consistent with and supported by the following evaluations:

- **Environmental Consequences** - No adverse environmental impacts, twelve positive environmental impacts and fourteen adverse environmental impacts if No Action

- **Significant Criteria** - No adverse effect to Significant Criteria and a finding of No Significant Impact consistent with State of Hawaii Revised Statutes and Administrative Rules

- **Governmental Adopted Plans and Policies**:

  County of Maui - Beach Management Plan

  State of Hawaii - Coastal Zone Management Program, Coastal Erosion Management Plan, Integrated Shoreline Policy, Shoreline Hardening Policy and Coastal Management Policy

  Federal - Coastal Zone Protection Act

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1.0 BACKGROUND

1.1 INTRODUCTION

The Stable Road Beach Restoration Foundation, Inc. (SRBRFI) was formed by seven Stable Road neighborhood home owners in 2007 for the sole purpose of restoring a portion of beach along Stable Road that was in the process of becoming a lost beach due to chronic beach erosion. The SRBRFI is the Applicant for the Proposed Action, and it has prepared this Environmental Assessment (EA) with assistance and overview by environmental and technical experts after six years of investigation and study of environmental conditions affecting chronic beach erosion and retreat at the Project Beach.

The Project Beach has experienced chronic beach erosion for decades based on the University of Hawaii, Erosion Hazard Rate Map, and from 2006 to 2010 the beach experienced up to a four-fold increase of the historic, annual erosion rate and beach retreat from the Map. The history of this coastal area includes seven decades of sand mining for the previous Paia Lime Kiln and for other uses, which has reduced the regional sediment supply for natural beach nourishment.

Recommended in the State of Hawaii Coastal Erosion Management Plan (COEMAP) for beaches with chronic erosion due to diminished sediment supply is a Beach Erosion Control solution. .

Per Hawaii Administrative Rules (HAR) Section 11-200-08, an EA is not required for "replacement or reconstruction of existing structures and facilities where the new structure will be located generally on the same site and will have substantially the same purpose, capacity, density, height and dimensions as the structure replaced". This is the situation for the Proposed Action; however, this EA was nevertheless prepared to assess the Proposed Action, Alternative Actions considered, Environmental Consequences and any Mitigation required.

Implemented by the Applicant in 2010 was a Small Scale Beach Nourishment (SSBN) Evaluation Project consisting of installing four, temporary geotube groins combined with beach nourishment using offshore sand. The temporary groins are permitted to remain until 25 June 2014.

The environmental monitoring record of the SSBN Project's temporary groins' performance indicates the temporary groins have: 1) successfully retained beach sand at the Project Beach, 2) stopped beach retreat and land loss and 3) caused no adverse environmental impact to the Affected Environment of the Project Area. Thus, the Applicant is proposing to replace the temporary groins with rock groins which are needed as a longer lasting and more sustainable solution to Beach Erosion Control. No additional beach nourishment appears to be needed since the SSBN Evaluation Project's two year performance record indicates the groin field has sufficiently retained beach sand all seasons from naturally occurring accretion primarily during fall and winter accretion seasons to: 1) protect and preserve the Project Beach, 2) continue longshore sand transport to downdrift beaches and 3) prefill the new groin field to not deprive downdrift beaches of future longshore sand transport.

Due to the previous monitoring data and performance assessments of the similar SSBN Evaluation Project, the information available to perform an environmental assessment of the Proposed Action has already been obtained and forms an empirical base from which to make predictable environmental assessments. The use of site specific and empirical data provides added reliability and certainty to the EA process and its conclusions.

The purpose of this EA is to identify and assess any potential impacts to the Affected Environment associated with the Proposed Action of groin replacement and to consider Alternatives to the Proposed Action.

This Draft EA was prepared in accordance with the EA requirements of the National Environmental Policy Act (NEPA) including Guidelines and Checklist; plus with the State of Hawaii Administrative Rules (HAR), Chapter 200 and Hawaii Revised Statutes (HRS), Chapter 343.

1.2 PROJECT LOCATION

The Project Beach is located on the north shore of Maui, in Spreckelsville, north of the Kahului Airport (see Figure 1).

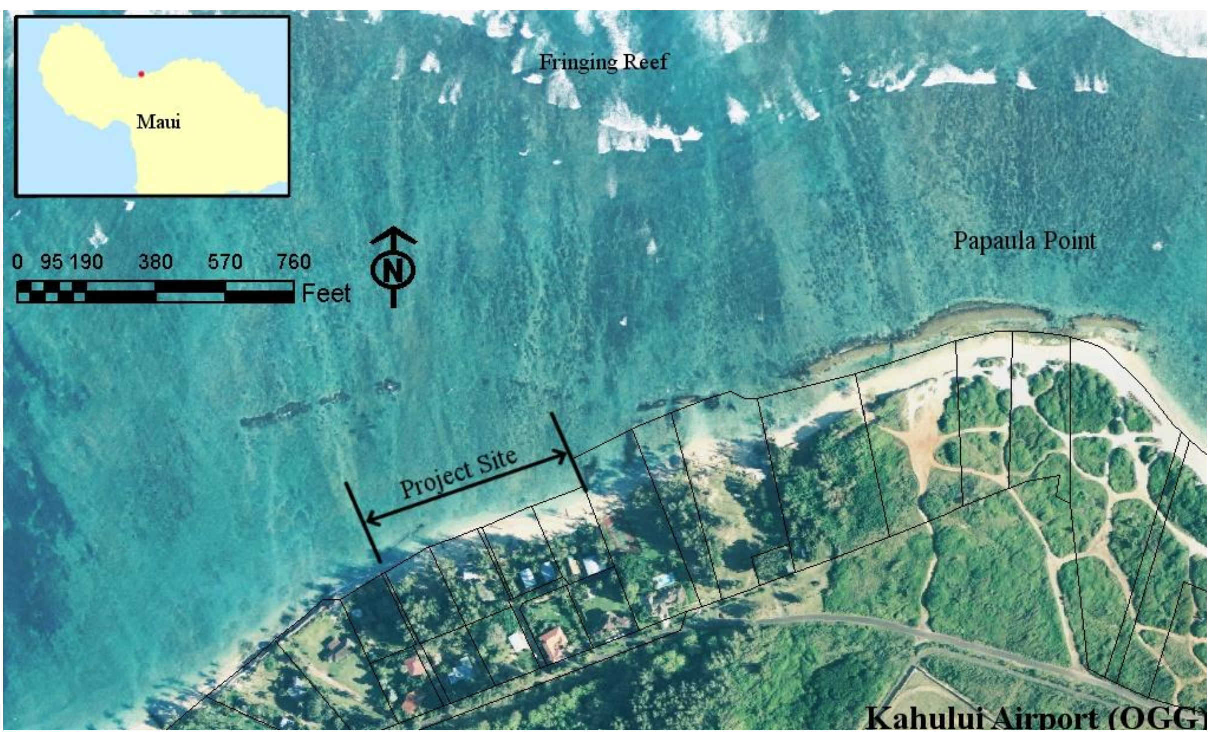

Figure 1- Project Location/Area Map

The east boundary of the Project Beach is approximately 1,200 feet southwest of Papaula Point, and the Project Beach extends along the shoreline to the southwest 600 feet. Approximately 4,000 feet to the west of the Project Beach is Kanaha Beach Park.

The Project Beach is parallel to a portion of Stable Road and fronts four residential lots with TMK nos. (2) 3-8-002:071, 077, 074 and 078 (see Figure 2), and the Project Beach is flanked at each end with existing, hardened shoreline structures which define the extent and uniqueness of the Project Beach.

Figure 2 - Project Site/TMK Map (Fronting Lots 071, 077, 074 and 078)

1.3 PROJECT BEACH USE

Historically, the Project Beach was used for traditional cultural uses including fishing, diving, swimming, walking, recreating, picnicking, relaxing and enjoying scenery. Since the early 1980's, the beach has also been used by water sport enthusiasts with the growth of surfing, windsurfing, kite boarding and paddle boarding. Presently, the Project Beach supports a diversity of both historic and contemporary recreational activity and use.

1.4 PROJECT AREA EROSION HISTORY

In the1900's the Paia Lime Kiln constructed by HC&S was located approximately 2.5 miles east and updrift of the Project Beach. For over 70 years from 1907 to the late 1970's, sand and coral were excavated from the beaches in Paia and Spreckelsville to manufacture hydrated lime for plantation uses, to build railroads and airstrips plus to produce cement during wartime.

By the 1920's beach erosion along Stable Road was a concern, so in 1925 an approximately 400 foot long concrete seawall was constructed fronting residential properties 100 feet downdrift of the Project Beach to the southwest in order to protect them from land loss. Before 1940, approximately 14 rock groins were constructed in front of this seawall and downdrift of it through Kanaha Beach Park further to the southwest to prevent beach loss (see Photo 1).

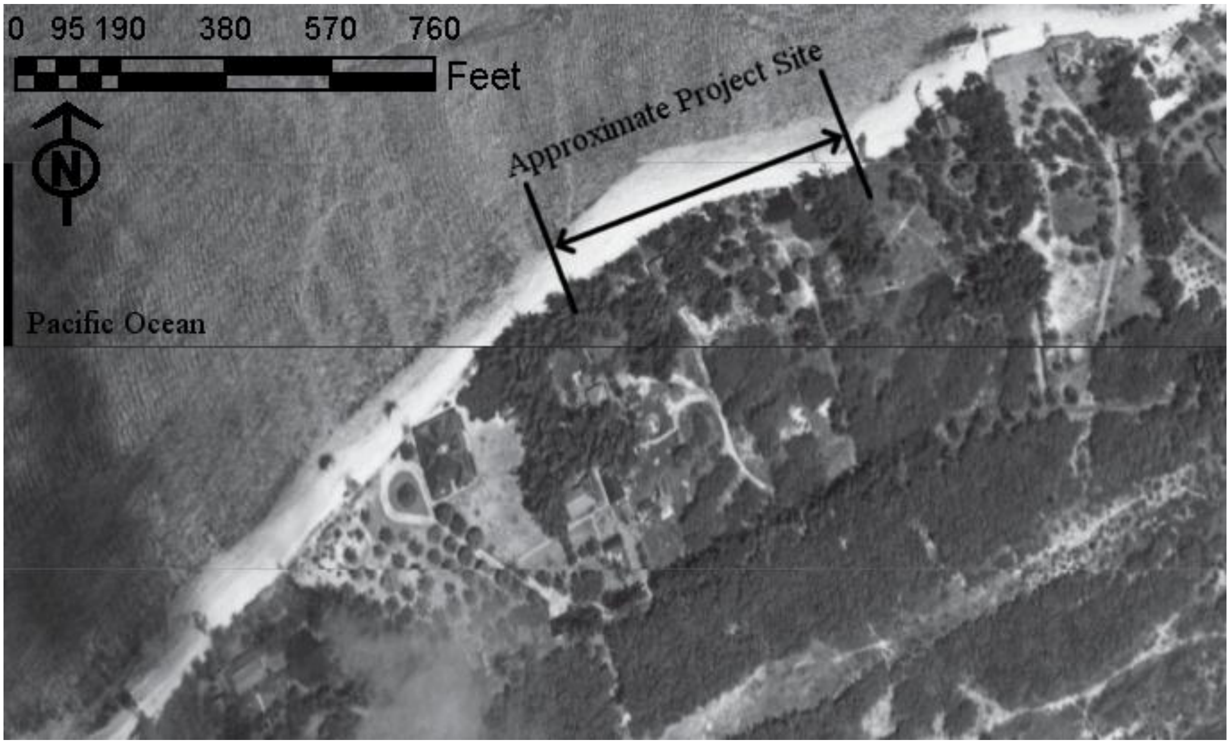

Photo 1 - Local Vicinity Aerial Photograph, 1940 - Note Seawall and Groins Southwest of Project Site

In 1954, HC&S commissioned Doak Cox, a well-respected geologist from Oahu, to study how much more sand could be removed from Spreckelsville and Paia beaches for use by the Paia Lime Kiln without adversely affecting the beaches. His report "The Spreckelsville Beach Problem" recommended ceasing sand removal from these beaches; however, beach sand mining continued for another 25 years. By 1997, the beach in front at the east end of the downdrift seawall was lost (see Photo 2).

Photo 2 – Local Vicinity Aerial Photograph, 1997

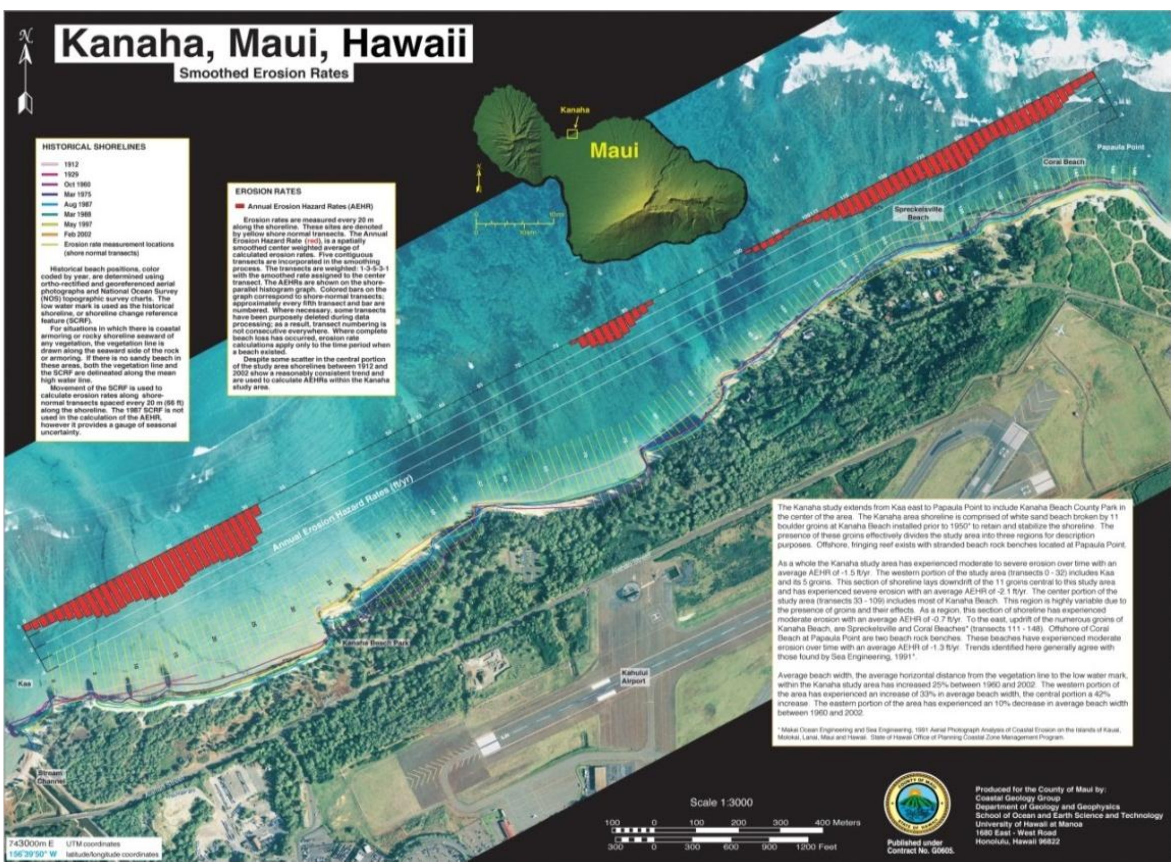

Figure 3 - U. H. Annual Erosion Hazard Rate Map

The Project Beach has experienced chronic beach erosion and beach retreat for decades based on studies by the University of Hawaii (U.H.) from 1912 (see Figure 3). The U.H. Erosion Hazard Rate Map is based on aerial photographic data from 1960 to 2002. The map indicates at the area of the Project Beach by different color historical shorelines, an average, annual erosion rate of approximately 1.3 feet and in the text for the same eastern portion of the study area, a 10% decrease of average Beach Width during this 42 year period. Evident from the different color, historical shorelines is significant beach retreat at the Project Beach over time since 1912. On the contrary, at the center portion of the study area immediately west of the Project Beach, where there are approximately 14 rock groins in front of residences, and including the east end of Kanaha Beach Park, the map indicates in the text an average, annual erosion rate of .7 feet with a 42% increase of average beach width over the same time. The groins on the immediate downdrift beaches have demonstrated for more than 72 years, the ability of rock groins in the region to reduce beach erosion.

More recently, the Project Beach experienced a four-fold increase of the historic U.H., annual erosion and beach retreat rates from 2006 to 2010 until the installation of the temporary groins of the SSBN Evaluation Project. Other areas in the vicinity from 2006 to the present have experienced significantly increased rates of annual beach erosion and land loss including Kanaha Beach Park to the west and Baldwin Beach Park in Paia to the east.

At Baldwin Beach Park the restroom building fell into the ocean at the end of summer in 2011 due to beach retreat causing the land under the building to be exposed and eroded (see Photo 3).

Photo 3 – Beach Erosion at Baldwin Beach Park, 25 August 2011

According to the 25 August 2011 edition of The Maui News:

> the popular beach park experiences erosion issues annually at the end of summer. Summer trade wind swells push sand from the east end near the old lime kiln toward "Baby Beach" at the west end. This natural process creates sheer sand faces along the beach and exposes trees in the ironwood forest on the east end. In 2006, this seasonal phenomenon took down a shower and damaged a lifeguard tower.

Maui County owns a residential structure located at Baldwin Beach Park and according to the 22 February 2012 edition of The Maui News:

> Mayor Arakawa transmitted a resolution to the Maui County Council last month asking for authorization to dispose of the "Montana Beach" structures by public auction. In a letter, he said a county task force considered a number of options for the house but determined that it had to be removed because of the "exceptionally high" erosion fronting the property at Baldwin Beach Park.

A recent Regional Management Study by the U.S. Army Corps of Engineers of Maui's north shore region identified the Kanaha Littoral Cell, which includes the Project Area at its east end, as the fastest eroding cell on Maui's north shore with an annual sediment loss of 10,500 cubic yards for approximately 15,000 feet of shoreline (see Figure 4); whereas the next fastest eroding area is the updrift Baldwin Park cell, which has an annual loss of only 2,400 cubic yards. The theory for the high rate of erosion at the Kanaha cell is that after seven decades of sand mining of this coastal zone and updrift beaches 2.5 miles to Paia, the cell has a diminished, natural sediment supply updrift to sufficiently nourish its beaches.

Figure 4 - Regional Annual Sediment Loss Map

The County of Maui in its 1997 Beach Management Plan identified the overall Stable Road Beach area as an “Erosion Hotspot” which is classified as such “where there has been noticeable environmental effect and/or a decrease in recreational use”, and it has also identified some of the Stable Road Beach area as “Lost Beach” which is where there is a “lack a recreational beach, and lateral shoreline access is very difficult - if not impossible“. **The County of Maui Beach Management Plan states regarding the Need for Maui’s beaches: “it is imperative that they be preserved, protected and restored where possible”.**

The State of Hawaii in response to the federal Coastal Zone Management Act in 1972 adopted its Coastal Zone Management Program in 1977 to protect, preserve and restore coastal resources including recreation, historic, scenic and open space, ecosystems, economic uses, public use and recreation and marine, while protecting against coastal hazards and managing development.

During the spring and summer seasons, the Project Beach typically has experienced beach erosion and land loss starting at its far east end due to seasonally strong trade winds combined with high tides plus from the adverse effect of the adjacent rock seawall fronting the tennis court. The Project Beach started experiencing higher than previous historic rates of beach erosion and land loss starting in 2006 (see Photo 4).

During the fall and winter seasons, the Project Beach typically has experienced beach erosion and land loss starting at its far west end due to large surf from north Pacific swells combined with high tides plus from the adverse effect of the adjacent rock revetment and concrete seawall. The safety of the home on Lot 3 at this location is threatened (see Photo 5).

Photo 4 - Beach and Land Erosion at Project Beach Looking East, 22 August 2006

Photo 5 – Beach and Land Erosion at West End of Project Beach (Lot 3), 23 August 2010

Photo 6 – Beach and Land Erosion Causing Pollution at Project Beach, August 2008

As beach sand erodes and is eventually lost, upland banks and vegetation are left exposed. The upland bank provides little or no resistance to erosion causing land, trees and vegetation to fall onto the beach and into the ocean. The dead vegetation restricts beach use and lateral beach access in addition to creating a safety hazard, especially during times of high tides and large waves (see Photo 4). The erosion of these historically terrestrial soils releases fine sediment and organic matter in the nearshore, increasing turbidity and impairing water quality (Photo 6).

The sand beach also acts as a natural buffer to land based sources of pollution such as discharges from in-ground sewage leach fields and cesspools containing nitrates plus contaminated sediment from toxic chemicals in pesticides. Prior to implementation of the SSBN Evaluation Project, parts of the Project Beach were entirely lost seasonally, and the contaminants were able to flow directly into the ocean (see Photo 7 taken at low tide). These pollutants degrade water quality and adversely affect the health of the ocean marine environment.

Photo 7 – Beach and Land Erosion Causing Pollution at Project Beach, 4 August 2009

The loss of beach area limits the available habitat for endangered species including the Hawaiian Monk Seal and the Hawaiian Green and Hawksbill Sea Turtles. The loss of upland vegetation along the shoreline has also reduced habitat for numerous shore birds (see Photo 7).

1.5 NEED FOR ACTION

Based on the very apparent history of localized beach erosion and beach retreat, predicted future sea level rise, recent and possible future tsunamis plus potential extreme wave and high tide events causing continuing and accelerated beach erosion, beach loss, beach retreat plus physical and environmental damage, it was evident to the Applicant in 2007 there was a Need for Action in order to preserve and protect the Project Beach from possibly becoming a lost beach as has happened at nearby beaches in the region.

1.6 PREVIOUS APPROVALS AND ACTIONS

In order to begin Action to restore the Project Beach, the Applicant requested approvals for removal of fallen, dead trees and other miscellaneous debris from the beach (see Photo 4). This work was approved by the following agencies:

- County of Maui as SMA Exempt
- State Department of Land and Natural Resources, Land Division for Right of Entry

The work was performed during the late summer of 2007, and 39 tons of debris were removed from the public beach and disposed of legally at the Applicant's expense.

Subsequently, some of the ocean front property owners at the Project Beach were permitted by the DLNR, Office of Conservation and Coastal Lands to install temporary sand bag erosion control protection against eroded land embankments during the summer in 2009 in order to reduce the rate of land erosion and to preserve the Project Beach. The rough surf and high tides destroyed these sand bags a month after their installation, and the sand bags were removed; however, this project did help reduce the volume of seasonal land loss.

1.7 EXISTING SSBN EVALUATION PROJECT

1.7.1 <u>Project Purpose</u>

The Applicant considered several approaches as how best to take Action to address the Need for Action to preserve and protect the Project Beach. The State of Hawaii Coastal Erosion Management Program (COEMAP) recommends several management alternatives to control beach erosion including "Erosion Control" defined as "Coastal erosion control techniques use structures that are designed to reduce sediment losses and thus slow the rate of erosion." The COEMAP states "The Beach Erosion Control approach is more appropriate for areas where the problem is chronic erosion due to diminished sediment supply. These structures can be very useful in areas where it is too expensive to maintain a beach by continuing to bring in large quantities of sand from an outside source. Groins, breakwaters and headlands work best in areas where longshore transport is much more dominant than cross-shore transport in moving sediment out of the Project Area." This recommendation was applicable to the conditions at the Project Beach. The COEMAP further stated a Beach Erosion Control approach "could include offshore breakwaters, and certain types of attached structures (T-head groins) used in combination with nourishment to stabilize particularly dynamic beach segments where erosion would be controlled effectively without negative impacts."

The COEMAP recommended the State develop a Small Scale Beach Nourishment (SSBN) Program for the purposes of expediting small-scale beach nourishment projects and information gathering, This program is in effect and managed by the Office of Conservation and Coastal Lands (OCCL) Division of the Department of Land and Natural Resources (DLNR).

After studying several alternative approaches and the feasibility of a SSBN approach, the Applicant chose to obtain approvals and implement a SSBN Evaluation Project, which consisted of an integrated design approach combining installation of groins for sand retention and beach nourishment to increase the beach width to previous historic locations. An additional benefit of this approach was information gathering, and the SSBN Evaluation Project was intended as a pilot and evaluation project.

1.7.2 Scoping Process

Prior to the submission of any applications for SSBN Evaluation Project approvals, the Applicant publicized and arranged a public Scoping Meeting with interested citizens, groups and agency representatives in June of 2008 to discuss the proposed SSBN Evaluation Project in order to preliminarily identify issues of concern. Approximately 50 people attended the meeting which was very productive in terms of dialogue and identifying issues of concern. Most of the attendees were local divers and fishers who were primarily concerned about the possible impact to the marine environment.

Subsequent to the meeting, the Applicant held several meetings with an appointed representative of the divers and fishers as well as agency's representatives to discuss the identified issues in greater depth and to develop methods to address the citizens' concerns. The concerns were addressed and mitigated by the Applicant developing Performance Monitoring Guidelines Criteria and Metrics pre-, during and post-construction for the identified factors.

1.7.3 Approvals And Action

In order to preserve, protect and restore the Project Beach, the Applicant requested approval to construct Beach Erosion Control using an integrated design approach consisting of installing temporary sand retention devices (groins) and nourishing the beach with offshore sand. Without the sand retention devices, the Project was not sustainable or feasible since the sand nourishment would soon disappear due to the chronic beach erosion.

The Project Scope also included monitoring and assessing potential environmental effects of the construction activities and assessing the groins' erosion control performance in order to evaluate the potential of more permanent erosion control devices in the future. Approvals and permits were granted from the following governmental agencies for the Applicant to construct in 2010 a Small Scale Beach Nourishment (SSBN) Evaluation Project (SSBN MA-08-01):

- County of Maui, Planning Department
- Hawaii State Department of Health, Clean Water Branch
- Hawaii State Department of Land and Natural Resources, Office of Conservation and Coastal Lands
- Hawaii State Department of Land and Natural Resources, Land Division
- United States Army Corps of Engineers

The following governmental agencies also reviewed and provided recommendations for the SSBN Evaluation Project:

- Hawaii State Department of Land and Natural Resources, Department of Aquatic Resources

- Hawaii State Department of Land and Natural Resources, Department of Historic Preservation
- Hawaii State Department of Land and Natural Resources, Beach Nourishment Panel of Technical Experts
- Hawaii State Office of Hawaiian Affairs
- Hawaii State Office of Planning, Coastal Zone Management Program
- University of Hawaii, Sea Grant Program
- United States Fish and Wildlife Service
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service
- National Oceanic and Atmospheric Administration, Pacific Islands Regional Office

The approval processes for the SSBN Evaluation Project was extensive and consisted of review and comment by fourteen Federal, State and County agencies plus by interested groups and individuals. Four Public Notices of the proposed SSBN Evaluation Project were published including in the Environmental Newsletter, The Maui News, County of Maui Planning Department Public Hearing Agenda and the Board of Land and Natural Resources Public Meeting Agenda. No negative comments were received or presented at the meetings.
As a result, the SSBN Evaluation Project approvals were granted conditional upon the Applicant addressing four identified environmental factors by providing pre-, during and post-construction environmental monitoring and performance assessments of Water Quality, Benthic Habitat, Beach Erosion and Lateral Beach Access. The Project's environmental monitoring program was developed from a positive collaboration with representatives and input from many government agencies and from meetings with interested citizens. Consequentially, Project Performance Monitoring and Criteria/Metrics were developed for each environmental factor.

The SSBN Evaluation Project approval by the DLNR, OCCL is still active and existing since it permits the use of temporary groins until 25 June 2014. The approval requires the Applicant to either remove the temporary groins or replace the temporary groins with more permanent groins, upon new approval, prior to expiration of SSBN Evaluation Project approval.

The construction of the SSBN Evaluation Project occurred from April through June 2010, and the work consisted of first installing the four, temporary, geotextile groins on the beach; nourishing the beach by dredging and pumping offshore sand onto the beach; and by finally placing and shaping the beach from the pumped sand. During the work, the Project's Best Management Practices were adhered to.

1.7.4 <u>Environmental Monitoring</u>

The Federal EPA, seven step, Data Quality Objectives (DQO) process was used to develop the Project's Performance Monitoring and Criteria/Metrics Guidelines for each of the four environmental factors to be monitored and assessed including: environmental monitoring scope and procedures, monitoring frequencies and duration, monitoring study areas plus data assessment with consistency and analytical methodology for comparison to Performance Criteria/Metrics. The Guidelines were established during several planning and review meetings with agency representatives and interested citizens. All environmental monitoring was performed in accordance with the Guidelines.

Pre-construction, environmental monitoring started for Water Quality, Benthic Habitat, Beach Erosion and Lateral Beach Access in order to establish ambient baseline conditions. These data were used as a comparative basis for project performance data assessment, as well as to quantify and measure any changes from project related activity.

During construction, environmental monitoring continued for Water Quality and Lateral Beach Access. Post-construction, environmental monitoring continued immediately post-construction for all four environmental factors per the Guidelines.

Specifically, beach erosion monitoring consisted of regularly scheduled, seasonal instrument surveys by a licensed land surveyor. Surveyed were twelve beach profile locations (transects) including one updrift , six at the Project Beach plus five to approximately 600 feet downdrift. The same profile locations were surveyed each time with the same top of bank locations to consistently measure beach change over time. From beach profile drawings at each transect produced by the surveyor, computer software calculated the beach sand volume at each transect. Tables were used to record and compare Beach Width and Beach Sand Volume calculations at each transect for each survey time Within the Project Area and Outside the Project Area updrift and downdrift locations. The Tables are located in the Two Year Beach Erosion Monitoring and Metrics Report (see Appendix 9.2).

In addition to using a pre- to post-construction comparative approach for performance assessment, pre-determined Performance Criteria/Metrics were included in the Guidelines for assessment of monitoring data at each monitoring cycle for comparison to established metrics or other performance criteria. Periodic Monitoring Reports were submitted to the appropriate governmental agencies in accordance with Project approval conditions and the Guidelines.

The Project's environmental monitoring effort represents a total of 460 monitoring data collections and assessments over two years for the four environmental factors, excluding pre-construction baseline data collection. The environmental monitoring and assessments effort has been comprehensive and extensive.

The Guidelines stipulate that environmental monitoring for each environmental factor should continue during the post-construction, one year equilibrating period until it was determined there was no post-construction change of conditions compared to pre-construction attributable to the Project, other than positive effects.

1.7.5 Performance Assessment

A significant purpose of the SSBN Evaluation Project was to be a pilot project for evaluation and information leading to a longer term solution to erosion control at the Project Beach. The monitoring data and performance assessments from what was essentially a site-specific, full scale model produced real, empirical and thus more reliable information than is typically available to evaluate the effectiveness of this particular beach erosion control technique.

Water Quality, Benthic Habitat and Lateral Beach Access environmental monitoring data analysis and performance assessments Within and Outside the Project Area conducted for one year indicated there was: 1) no change of conditions compared to pre-construction, 2) no adverse environmental effects during and after construction and 3) compliance with the Project's Performance Criteria/Metrics); therefore, no environmental monitoring beyond the one year equilibrating period was necessary or required for these three environmental factors per the Project's Performance Monitoring and Criteria/Metrics Guidelines. This finding was noted in the Summary and Conclusions Report - One Year Post-Construction

Performance Monitoring (see Appendix 9.1), and this report was submitted to the State and County approval agencies.

Beach Erosion (shoreline change) environmental monitoring data analysis and performance assessments Within and Outside the Project Area conducted for one year indicated there was: 1) an overall gain of Beach Width and Sand Volume at the Project Beach and updrift beach compared to pre-construction (see Figures 5, 6, 7 and 8), 2) a reduction of Beach Width and Beach Sand Volume at the downdrift beach at transect 1 (see Figures 6 and 8), and 3) compliance with the Project's Performance Criteria/Metrics.

The during construction sand loss at the Project Beach was from normal seasonal erosion plus increased by the impact of construction producing an unstable beach condition. The overall gain occurred despite the Project Beach losing Beach Sand Volume from the tsunami during the 2011 winter season.

The reduction has occurred seasonally at the downdrift beach located at transect 1, which has a 440 foot long hardened shoreline extending from its downdrift end updrift to the Project Beach. This beach lost a less proportional amount of beach sand volume during the same periods as the Project Area; nevertheless, an investigation of possible causes of the downdrift beach reductions was commenced. The preliminary assessment concluded the changes at the downdrift beach were not attributed to the groin field of the SSBN Evaluation Project Beach, thus the SSBN Evaluation Project was in compliance with the Project's Performance Criteria/Metrics. To collect more data for a longer term assessment of the reduction, the Applicant decided to continue environmental monitoring and performance assessments for Beach Erosion beyond the one year equilibrating period.

Beach Erosion performance for the one year period was included in the Summary and Conclusions Report - One Year, Post-Construction Performance Monitoring (see Appendix 9.1), and this report was submitted to the State and County approval agencies.

Beach Erosion (shoreline change) environmental monitoring data analysis and performance assessments Within and Outside the Project Area conducted for two years with four unique erosion/accretion seasons each year plus varying weather conditions indicated there was: 1) a continued overall gain of Beach Width and Sand Volume at the Project Beach (see Figures 5 and 7), 2) a leveling of Beach Width and Sand Volume at the updrift beach (see Figures 6 and 8), 3) a continued overall reduction of Beach Width and Beach Sand Volume at the downdrift beach located at transect 1 despite seasons of accretion (see Figures 6 and 8) and 4) compliance with the Project's Performance Criteria/Metrics.

The downdrift beach has both gained and lost beach sand volume during seasons post-construction, as has the Project Beach. The monitoring data indicated the downdrift beach had a gradual reduction of Beach Width and Sand Volume over time. Additional studies of this beach and possible causes of its erosion resulted in the conclusion the reductions at the downdrift beach located at transect 1 were not attributed to the groin field of the SSBN Evaluation Project. Assessments concluded: 1) the downdrift beach was too far from the groin field to cause erosion 440 feet away, especially considering the continuous, hardened shoreline between causing reflected waves between it and the groin field and 2) visual observations the groin field did not interrupt longshore sand transport. The probable causes of the reduction at the downdrift beach are a combination of factors including: 1) documented historic trend of local, long-term beach erosion and beach retreat resulting in the beach being at a tipping point of accelerated beach loss, 2) documented increase of the long-term, annual beach erosion rate for the region, 3) documented adverse effects to a beach from a hardened shoreline at and updrift of the beach and 4) documented unusually early and windier than normal weather. Also long-term assessments concluded there is documentation of comparable previous seasonal and historic beach conditions at the downdrift beach.

A Two Year Beach Erosion Performance Monitoring and Metrics Report with these findings was submitted to the State and County approval agencies (see Appendix 9.2).

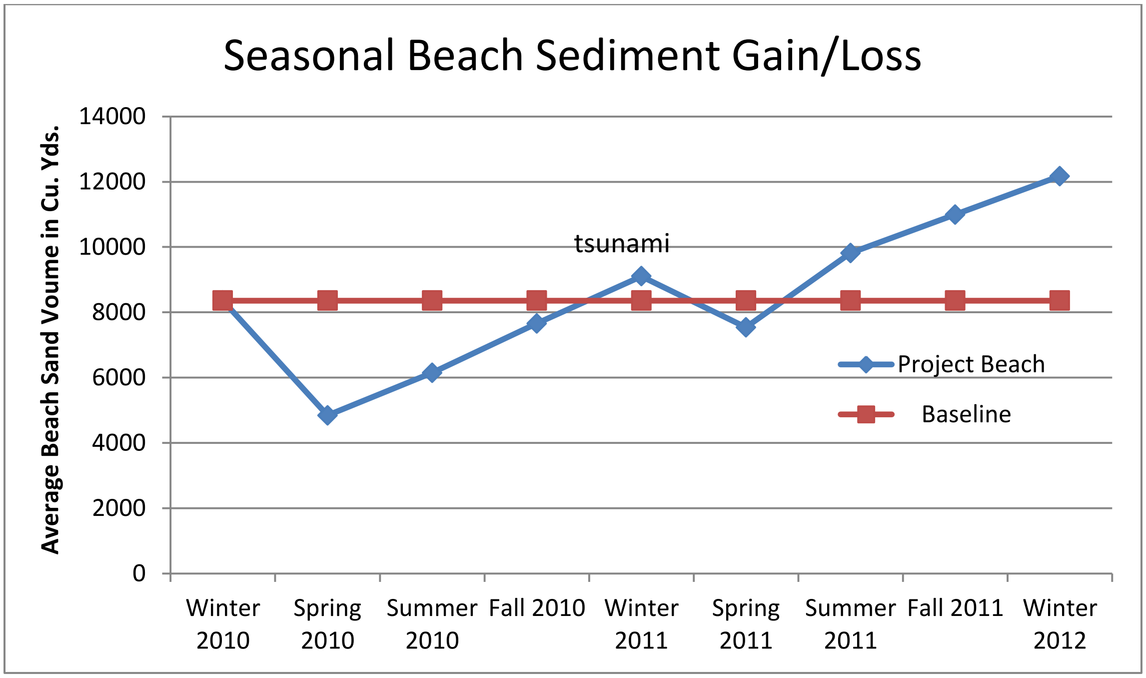

Figure 5 - Project Beach Seasonal Sediment Gain/Loss

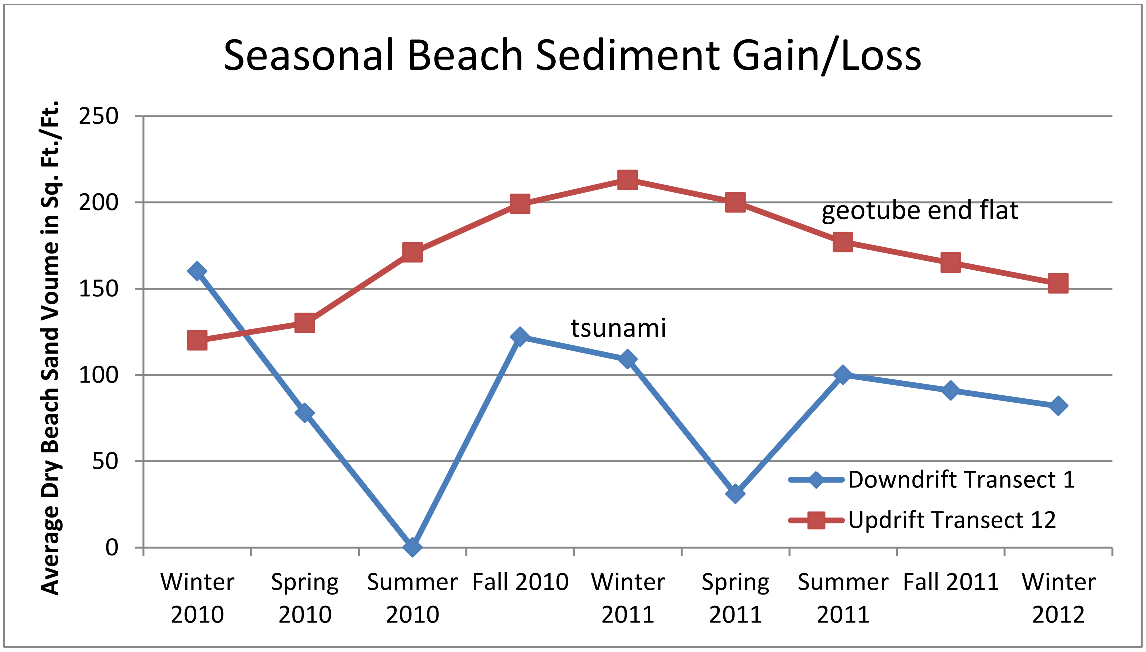

Figure 6 - Outside Project Area Seasonal Sediment Gain/Loss

Outside Project Area figures are at a specific transect location on a beach; whereas, Project Beach figures are for the entire Project Beach.

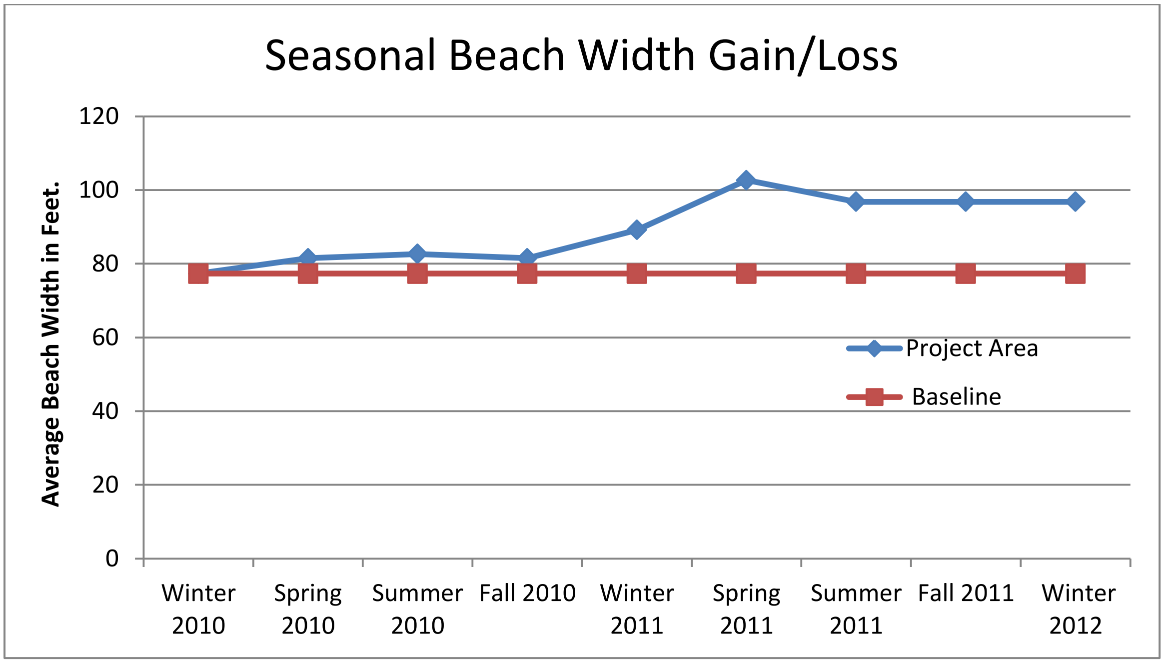

Figure 7 - Project Beach Seasonal Beach Width Gain/Loss

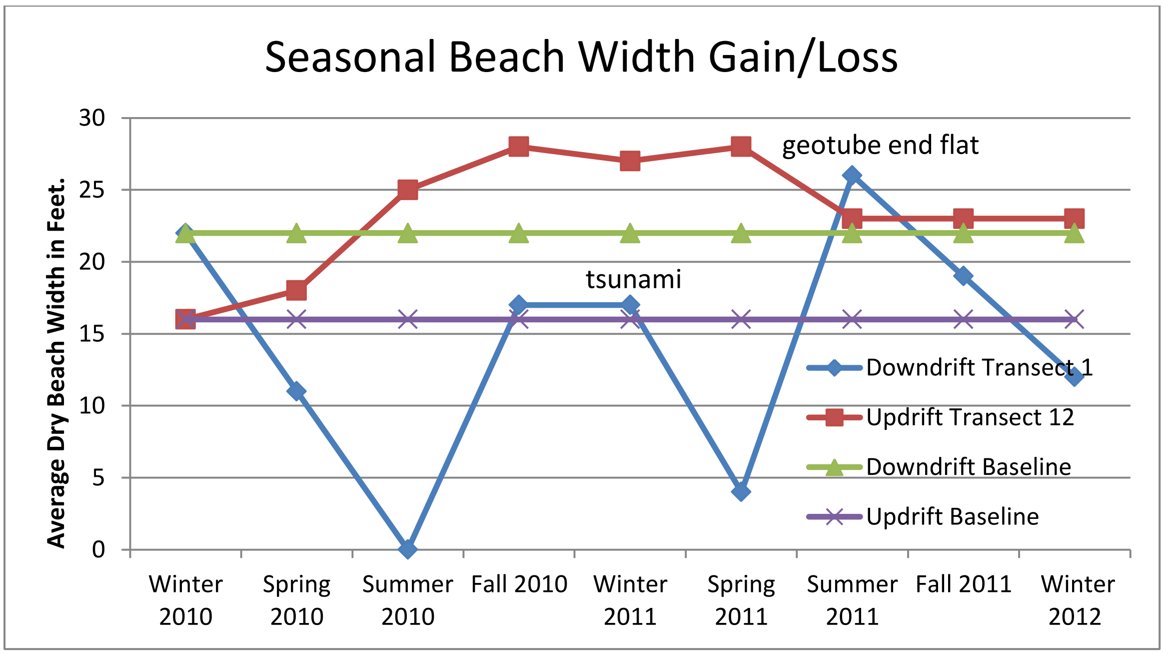

Figure 8 - Outside Project Area Seasonal Beach Width Gain/Loss

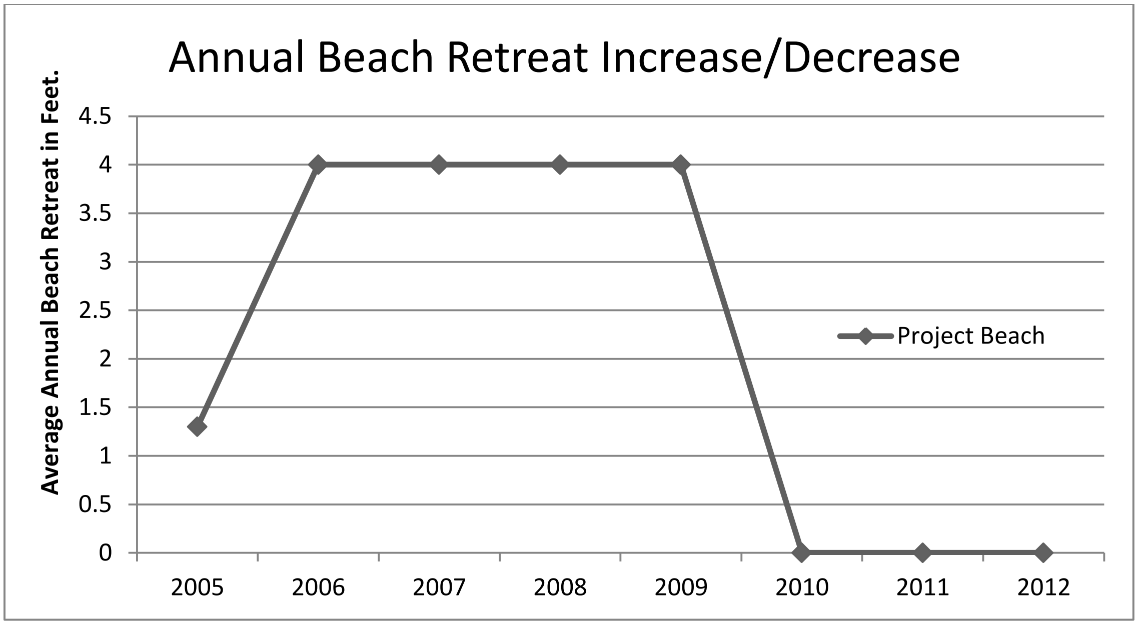

Figure 9 – Project Beach Annual Beach Retreat Increase/Decrease

No Beach Retreat is shown for Outside the Project Area because of existing seawalls.

Visual analysis of the Project Beach indicates the success of the temporary groins in preventing beach erosion and land loss.

Photo 8 - East End of Project Beach, 2 April 2012 (compare to Photos 4, 6, 7, pages 17-19)

Photograph 8 shows the east end of the Project Beach full of sand post-construction in August 2010. August is historically the time of year when spring and summer seasons' trade winds result in the most severe beach erosion at the east end of the Project Beach (compare to pre-construction Photos 4, 6 and 7, pages 17-19).

Photo 9 - West End of Project Beach (Lot 33), 6 May 2012 (compare to Photo 5, page 18)

Photograph 9 shows the west end of the Project Beach, which has naturally gained sand over time without a significant fall and winter seasons' loss from large, north Pacific swells (compare to Photo 5, page 18 prior to the SSBN Evaluation Project).

The Project's Summary and Conclusions Report - Two Year Environmental Monitoring and Performance Assessment for Beach Erosion (see Appendix 9.2) indicates continued positive performance of the SSBN Evaluation Project related to: 1) retention of Project Beach Sand Volume and Beach Width, 2) prevention of Beach Retreat and Land Loss plus 3) avoidance of adverse environmental effects.

The two year Beach Erosion environmental monitoring data also indicates: the Project Beach is self-sustaining in terms of annual Beach Sand Volume and Beach Width. Thus the groin field is functioning properly reducing seasonal beach sand loss and by facilitating retention of Beach Sand Volume from natural accretion during the fall and winter seasons (see Figure 5).

The Project Beach has been restored, preserved and protected by the installation of groins as sediment retention devices. The existing SSBN Evaluation Project successfully accomplished the Project's goals, and has generated a body of empirical data regarding possible environmental impacts to resources including water quality, benthic habitat, and beach quality at the Project Site. These data are highly valuable as a pilot project in the context of pursuing the Proposed Action as they are rigorous, site specific and collected in support of collaboratively established BMP's and monitoring programs.

1.7.6 Tsunami Effect

The Project Beach is subject to flood damage from a tsunami. The area is designated as Flood Zone VE (coastal flood zone with velocity hazard) on the current FIRM Map (see Figure 10). **On 11 March 2011, tsunami waves from Japan pounded the Project Beach and surged onto the upland properties without any significant beach erosion or land loss and with no damage to the temporary groins.**

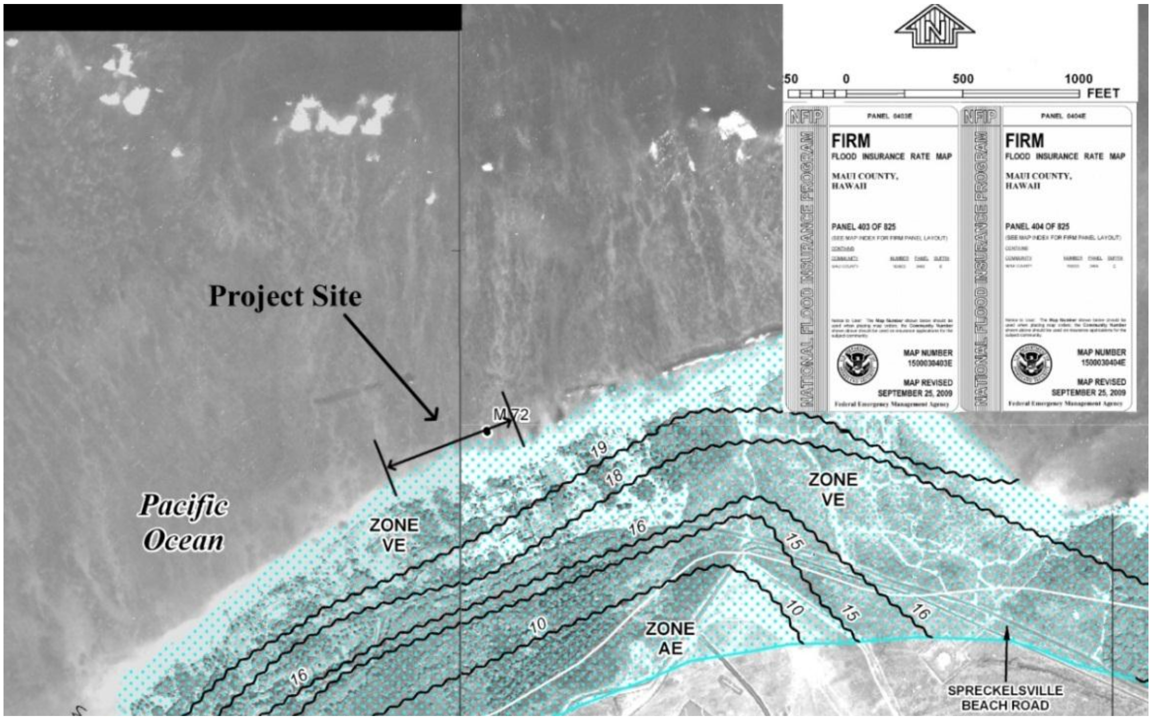

Figure 10 – Flood Insurance Rate Map (FIRM)

The tsunami decreased Beach Sand Volume at the Project Beach due to its flattening the previously mounded beach, and the waves pushed the beach sand mounds onto upland properties. At the east half of the Project Beach, beach sand was returned from the adjoining properties to the beach; however, beach sand remains on yards at the west half.

The level of the beach sand at the shoreline was the same elevation as the adjoining land for most of the Project Beach prior to the tsunami due to the groins having retained beach sand. Thus the tsunami waves flowed over the shoreline since there were no exposed land embankments to erode except at the far west end of the Project Beach; whereas, tsunami waves eroded exposed land embankments elsewhere in the neighborhood and region.

1.7.7 Cumulative Effects

There are cumulatively beneficial effects of the SSBN Evaluation Project including:

- Reducing the rate of beach erosion stabilizing Beach Width and Beach Sand Volume.

- Eliminating land erosion and land loss, thus preventing land based pollutants directly entering the ocean.
- Preserving water quality.
- Preserving marine life and reef health.
- Preserving beach habitat and endangered species (see Photo 10).

Photo 10 - Hawksbill Turtle Nest at Project Beach, December 2010

Members of the Hawaiian Hawksbill Turtle Recovery Project observed approximately 100 baby turtles leave the nest and venture across the beach to the ocean. Members returned two days later to locate any unexposed eggs and trapped baby turtles, and they found both helping the hatched turtles find their way to water.

There was no turtle nest near this location years prior, and it is doubtful the nest could have occurred since before 2010 the nest site was mostly dirt. The SSBN Evaluation Project's beach nourishment added significant beach sand near the shoreline where the nest was located just a few months prior; and the Project's temporary groins retained the beach sand for the nest site to be possible.

- Preserving the Project Beach as a cultural resource.
- Preserving public open space and scenic value.
- Preserving public beach recreational uses and lateral beach access.

- Preserving State and County income from residents and tourists.

1.7.9 Approval Expiration

The SSBN Evaluation Project's DLNR, OCCL Approval states "Authorization for the geotube groins is temporary and will expire four (4) years after completion of the initial construction of the project" which will be 25 June 2014. The geotube material is not sufficient to withstand continual movement and abrasion from sand and gravel at the waterline on Maui's north shore, so the temporary geotube groins require constant maintenance and periodic replacement. Geotube groins are not a sustainable and thus not a long-term solution for Beach Erosion Control at the Project Beach.

2.0 NEED FOR AND PURPOSE OF PROPOSED ACTION

2.1 NEED AND PURPOSE

Due to decades of chronic beach erosion and land loss with a recently accelerated rate of localized beach erosion combined with rising sea levels, recent and possible future tsunamis plus extreme wind and tide events, **the Need for Action is to preserve and protect the Project Beach.** The Purpose of the previously installed SSBN Evaluation Project was twofold:

- To temporarily restore the Project Beach by nourishing the beach with offshore sand and to preserve and protect the Project Beach by installing temporary, sand retention devices (groins) in order to retain beach sand. Beach nourishment also allowed the newly installed groin field to be filled with sand immediately so as not to trap sand and prevent longshore transport downdrift until the Project Beach reached equilibrium.

- To evaluate the Project's performance as a pilot project in terms of accomplishing the SSBN Evaluation Project purpose and goal of no adverse environmental effect, and specifically to evaluate the impact and performance of the temporary groins' ability to retain beach sand at the Project Beach.

Based on the successful performance of the SSBN Evaluation Project, **the Purpose of Action is to preserve and protect the Project Beach in a longer lasting and more sustainable manner than with the temporary geotube groins approved for the SSBN Evaluation Project.** This Purpose is consistent with the stated Need of the County of Maui in its Beach Management Plan and the stated goals of the State of Hawaii's Coastal Zone Management Program (see Section 1.4).

If the Project Beach were to further erode, the loss of more beach sand and land would cause the continuation of land based pollution directly entering the ocean resulting in a long-term decline of water quality from land sources including sewage cesspools and leach fields, fertilizer nutrients, pesticides and other toxic chemicals plus from turbidity from fine sand, silt and clay soil; as well as the probable collapse of the home at the west end of the Project Beach onto the beach and into the ocean. This home presently has its foundation exposed and undermined due to land erosion (see Photo 5, page 18). The long-term decline of water quality could result in a decline of marine life health, which could negatively affect marine species and potentially damage the health of the fringing reef.

Without the Proposed Action, the Project Beach may eventually become a Lost Beach, as has occurred at other nearby locations, and contribute to the decline of water quality, benthic habitat, beach habitat (used by endangered sea turtles and monk seals), shoreline habitat, beach use, lateral beach access and visual character. This beach is supports important recreational and cultural activities for residents of Maui, as well as for visitors.

2.2 PROPOSED ACTION SUMMARY

Due to the success of the existing SSBN Evaluation Project in accomplishing its goals and Purpose, the Proposed Action is the preferred Alternative since it is similar and less complex than the existing SSBN Evaluation Project and other Alternatives. The work scope of the Proposed Action is simply to remove the SSBN Evaluation Project's existing, four, temporary, geotextile groins and to replace them with three or four more durable rock groins in the same general location and of the same scale as the existing, temporary groins. See Section 3.2.1 for more information.

Based on the successful implementation of the SSBN Evaluation Project, aspects of that project will be utilized for the Proposed Action including Environmental Monitoring and Best Management Practices during construction.

The Proposed Action is the logical next step and conclusion to the existing SSBN Evaluation Project which served as a pilot project and empirical information source.

2.3 SCHEDULE

The proposed implementation schedule is to remove the temporary groins and install the replacement groins as soon as possible as weather and conditions permit after all approvals and permits are received in order to minimize the on-going maintenance work for the temporary groins. Most likely the construction will occur during the late summer, fall or winter season when the existing groin field is pre-filled or will be in the near future, weather is the calmest, high tides are the lowest and seasonal longshore transport subsides. Once all approvals are obtained, the Applicant will prepare a specific construction schedule and construction start date to notify all approval agencies.

2.4 FUNDING

Although the proposed work is to occur on a public beach, and there are substantial public benefits; there will be no public funds expended. All funding will be with private funds from the Applicant.

3.0 ALTERNATIVES CONSIDERED INCLUDING THE PROPOSED ACTION

3.1 INTRODUCTION

The State of Hawaii Coastal Erosion Management Program (COEMAP) identified five possible alternatives to manage beach erosion including:

1. Abandonment - do nothing
2. Beach Restoration - fill beach with sand
3. Beach Erosion Control - slow erosion rate
4. Adaptation - live with it
5. Hardening - build walls

Based on the COEMAP alternatives and combinations of those alternatives, the Project team identified nine potential Action scenarios for consideration as follows:

1. Replace Existing Geotube Groins with Rock Groins Alternative - Replace four existing, temporary geotube groins with three or four longer lasting, rock groins in the same general location and of the same scale. Per the COEMAP, this is a Beach Erosion Control approach.

2. Do Nothing Alternative or No Action Alternative - Remove the temporary groins per the SSBN Evaluation Project approval requirements and make no modifications. Per the COEMAP, this is an Abandonment approach.

3. Extend Use Of Temporary Geotube Groins Alternative- Obtain approvals to extend the approval duration of the existing, temporary geotube groins in the same location and of the same scale. Per the COEMAP, this is a Beach Erosion Control approach

4. Annually Nourish Project Beach with Inland Sand Alternative - Remove temporary groins per the SSBN Evaluation Project approval requirements, and annually nourish the Project Beach with inland sand. Per the COEMAP, this is a Beach Restoration approach.

5. Annually Nourish Project Beach with Offshore Sand Alternative - Remove temporary groins per the SSBN Evaluation Project approval requirements, and annually nourish the Project Beach with offshore sand. Per the COEMAP, this is a Beach Restoration approach.

6. Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative - Replace four existing, temporary, geotube groins with three or four longer lasting, rock groins in the same general location and of the same scale combined with possibly nourish the Project Beach with inland sand. Per the COEMAP, this is a combined Beach Erosion Control and Beach Restoration approach.

7. Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Offshore Sand Alternative - Replace four existing, temporary, geotube groins with three or four, longer lasting, rock groins in the same general location and of the same scale combined with possibly nourish Project Beach with offshore sand. Per the COEMAP, this is a combined Beach Erosion Control and Beach Restoration approach.

8. Relocate Residential Structures Alternative - Remove temporary groins per the SSBN Evaluation Project approval requirements, and relocate existing adjoining residences when necessary due to beach retreat and land loss from beach erosion. Per the COEMAP, this is an Adaption approach.

9. Build Seawall or Revetment Alternative - Remove temporary groins per the SSBN Evaluation Project approval requirements and build a seawall or revetment at the Project Beach. Per the COEMAP, this is a Hardening approach.

3.2 PROPOSED ACTION - REPLACE EXISTING GEOTUBE GROINS WITH ROCK GROINS

This Alternative is described as scenario #1 in Section 3.1. Under this scenario, the scope of work is to remove the SSBN Project's existing four temporary geotube groins and to replace them with either three or four more durable rock groins in the same general location and of the same scale as the existing, temporary groins. The final number of proposed replacement groins will be decided after the 2012 spring/summer season of Beach Erosion monitoring and performance assessment.

The COEMAP recommends "for beaches where the problem is chronic erosion due to diminished sand supply, Beach Erosion Control is more appropriate". The Proposed Action is a Beach Erosion Control approach consistent with the COEMAP.

The Proposed Action is a logical conclusion to the existing SSBN Evaluation Project, and the Proposed Action is the preferred Alternative due to its simplicity and similarity to the existing SSBN Evaluation Project.

The Need for Action is to preserve and protect the Project Beach, and the Purpose of Action is to preserve and protect the Project Beach in a longer lasting and more sustainable manner than with the temporary geotube groins approved for the SSBN Evaluation Project. The Proposed Action accomplishes the Need for and Purpose of Action.

3.2.1 Design

3.2.1.a Groin Locations and Configuration

Because of the successful performance of the existing, temporary geotube groins in accomplishing the SSBN Evaluation Project's Purpose, which is the same as that of the Proposed Action, the design of the Proposed Action's replacement rock groins is similar to those of the SSBN Evaluation Project.

Existing, Temporary Geotube Groins:

The existing, temporary groins are located perpendicular to the shoreline on the approximately 600 foot long Project Beach (see Figure 11). There are two end or terminal groins and two middle groins generally spaced evenly apart, thus forming three beach segments each approximately 200 feet wide. The landward ends of the easterly three groins are located approximately 10 feet seaward of the vegetated shoreline, and these 100 foot long groins extend across the beach and into the ocean. The landward end of the west end groin overlaps the seaward end of the rock revetment to its west approximately 15 feet, but does not extend near the shoreline as the other groins. The length of the west end groin should be extended inland to be closer to the shoreline similar to the other groins in order to prevent waves from bypassing its landward end when high tides and large waves cause scouring at the downdrift side of the existing west end groin. The existing groin lengths were designed to be relatively short into the ocean and without tails at the seaward ends of the middle two groins in order to minimize interference with the various recreational and cultural nearshore water activities. The existing groins' spacing is similar to the U.S. Army Corps of Engineers' general standard with a distance between groins (200 feet+/-) of approximately two to three times the effective in-water groin length (65 feet).

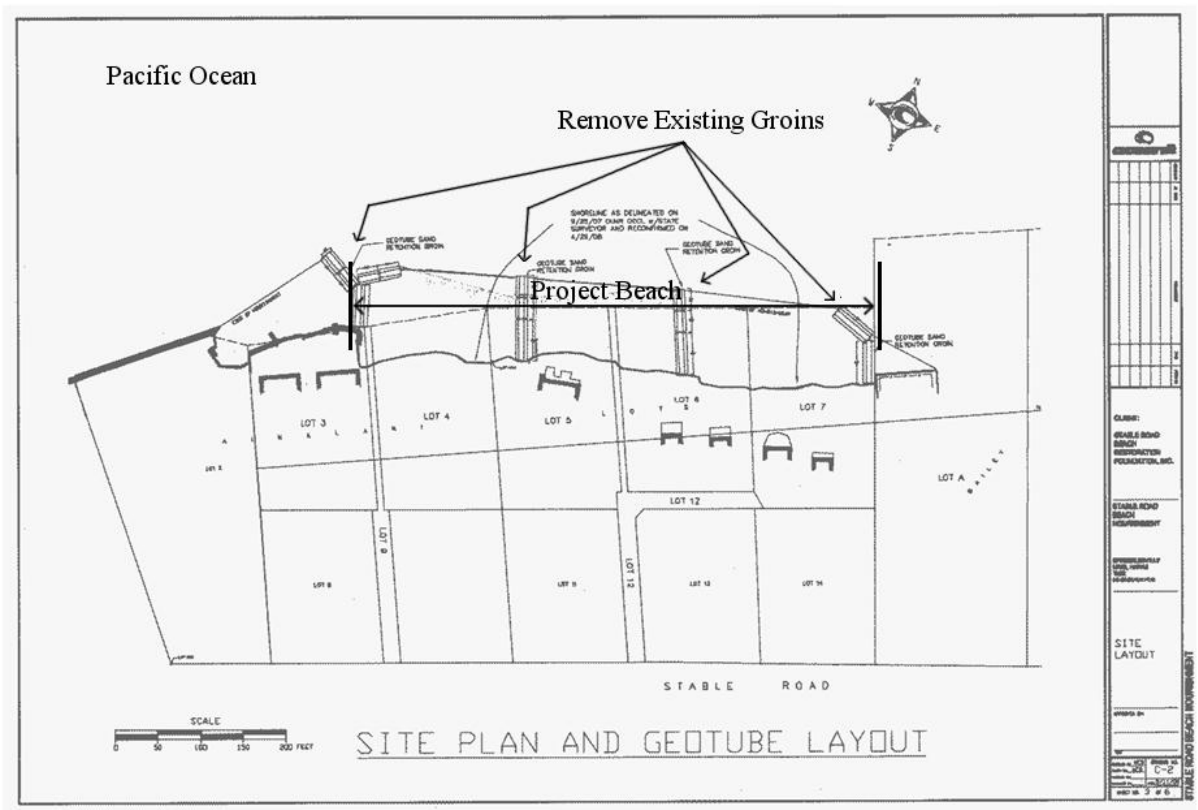

Figure 11 - Existing SSBN Evaluation Project Site/Existing Structures to be Removed/Coastal Resources Map

During the 2011 winter season, the angled west tail of the existing west end groin became damaged, then flattened and ineffective. The west tail of this groin was intended to retain sand downdrift of the groin which occurred without the tail, so it was determined the west tail of the west end groin was unnecessary. The existing west end groin and specifically its angled east tail were intended primarily to retain sand and reduce historic erosion at the west end of the Project Beach during the fall and winter seasons, which the groin successfully did. The east tail of this groin allowed the beach toe to remain at the same seaward location during all seasons, thus preserving beach width and sufficient wave run-up distance before eroding the shoreline. The east tail also accommodated sand retention at the west end of the Project Beach during the spring and summer seasons, while still allowing longshore sand transport to downdrift areas.

Also during the 2010 winter season, the angled tail of the existing east end groin was damaged by a floating tree, and this section was replaced and located to be more in line with the landward end of the groin. The intent of the angled tail was to retain more sand at the east end of the Project Beach during the fall and winter seasons; however, this was unnecessary since this groin without an angled tail performed well in retaining beach sand at this location.

Replacement Rock Groins:

Because of the successful performance of the existing, temporary geotube groins in accomplishing the SSBN Evaluation Project's Goals, the design of the replacement rock groins is similar. The terminal or end groins of the groin field are the most important in preserving the Project Beach, and the lessons learned from the performance assessments and modifications of these groins during the SSBN Evaluation Project are reflected in the configuration of the replacement, terminal groins. The west end replacement groin has only an angled east tail as presently exists; and its length has been extended inland to near the shoreline, as all other existing groins, to prevent water bypassing the landward end of the terminal groin when high tides and large surf in order to eliminate downdrift scouring between the rock groin and the rock revetment. The east end replacement and middle groins have a straight configuration as presently exists.

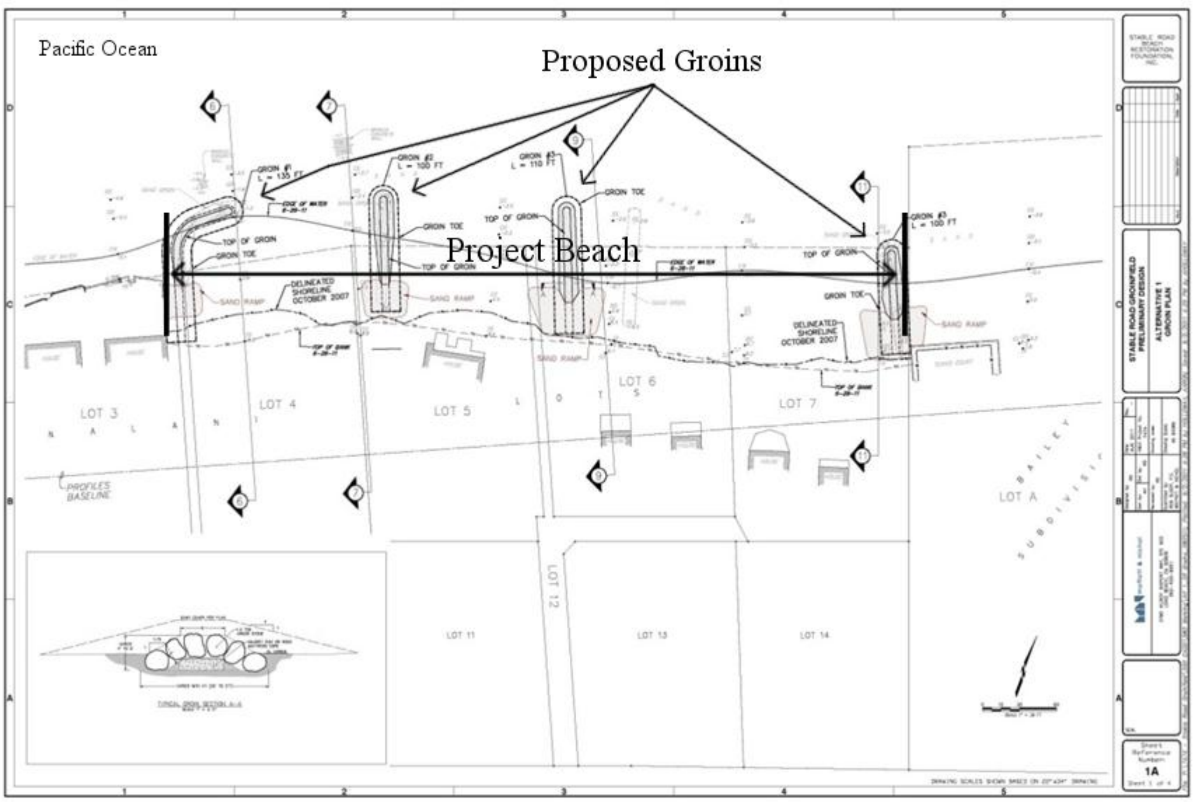

Figure 12 - Proposed Action Site Plan and Replacement Groin Cross Section - 4 Groin Plan

Figure 12 shows two terminal end and two middle groins previously described, and Figure 13 shows two terminal ends and only one middle groin as an alternative plan. The idea behind the 3 groin alternative was to reduce the groin footprint on the beach by eliminating the center-west groin which appears to be the least effective groin in the system. The 3 groin plan is being evaluated during the 2012 spring/summer since the existing middle groins have been buried for several months and/or become flat due to holes from coral abrasion.

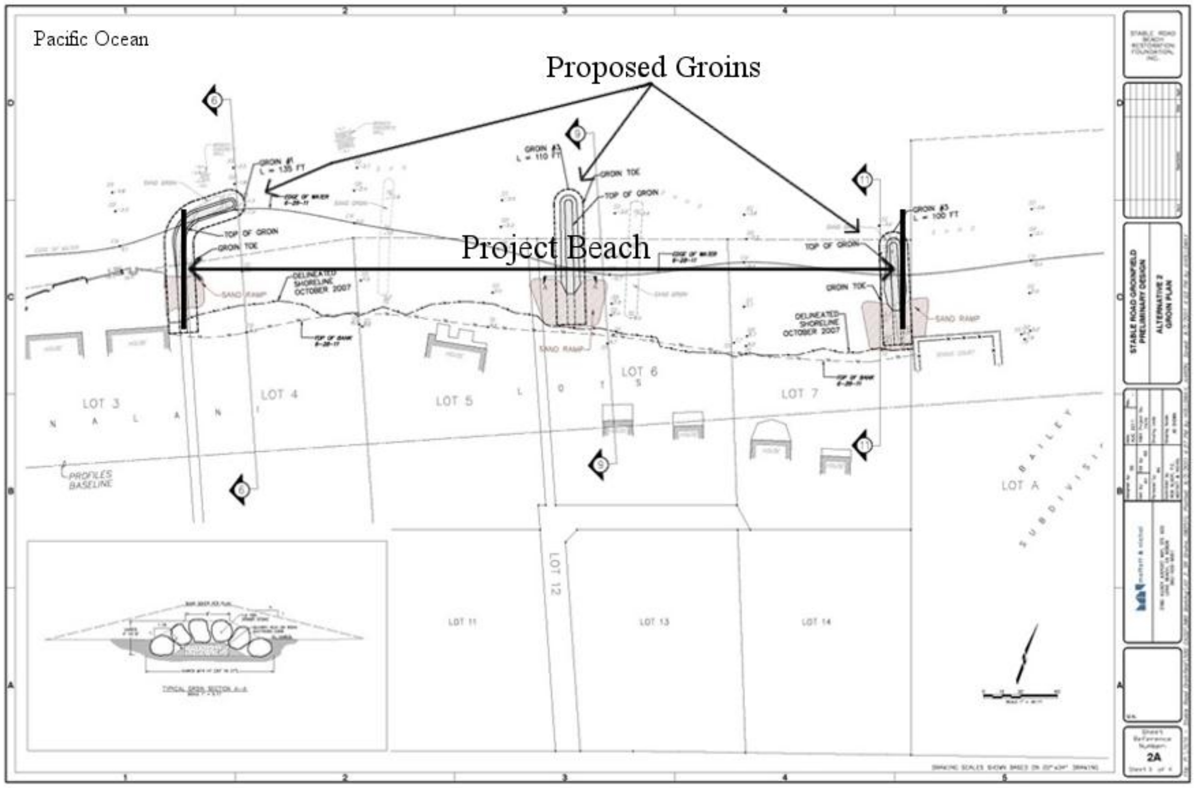

Figure 13 - Proposed Action Site Plan and Replacement Groin Cross Section - 3 Groin Plan

The landward ends of the replacement groins are located approximately 10 feet from the shoreline as existing, except the landward end of the west end groin is located at the existing shoreline in order for the groin to overlap the house foundation to prevent additional downdrift scouring between the groin and the house foundation plus rock revetment. The length of each of the easterly three groins is 100 feet, the same as existing, and the length of the west end groin has been increased inland to the shoreline by approximately 40 feet beyond existing.

The visible or exposed length of the replacement groins will be significantly less than their actual length since their landward ends will be buried below the beach level below a sand ramp (see Figures 12 and 13), and the visible length of the replacement groins will be generally the same as the existing, temporary groins.

3.2.1.b Groin Height and Visibility

<u>Existing, Temporary Geotube Groins:</u>

The existing, temporary geotube groins are constructed from sand filled, geotextile tubes with either a 15 or 30 foot circumference. When the tubes are filled with sand, their shape is an oval, being wider across than tall. The existing 15 foot circumference tubes are approximately 2.5 feet tall and 6.5 feet wide, and the existing 30 foot circumference tubes are approximately 5 feet tall and 13.5 feet wide. The landward 50 foot long segments of the existing, easterly three groins are comprised of two 15 foot circumference bottom tubes placed side by side with a center top tube of the same circumference stacked on top pyramid style for an overall groin height of approximately 5 feet and an overall groin width of approximately 15 feet, which is similar to height and width of the existing, single 30 foot circumference tube groin segments elsewhere. The height of the existing, temporary groins is not totally visible since the groins are mostly buried below the sand on the beach, particularly at their landward ends; and their seaward ends are mostly submerged below the high tide level.

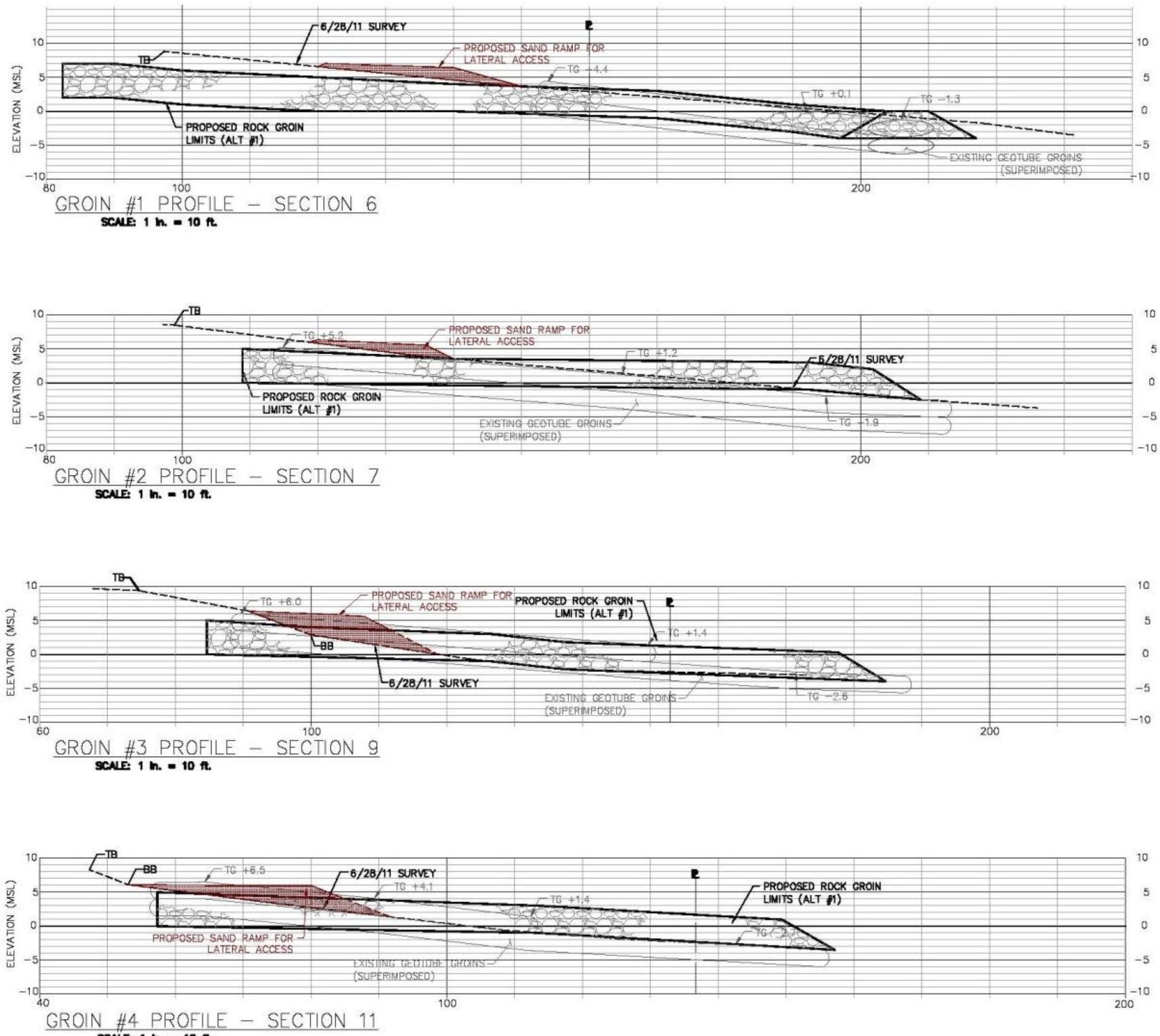

Figure 14 – Replacement Groins and Beach Profiles/Topography – 4 Groin Plan

<u>Replacement Rock Groins:</u>

The height of the replacement rock groins will be generally the same as the existing, temporary geotube groins and less than the SSBN Project's approved groin height in most cases. The wider base of the pyramid shaped replacement groins (see Replacement Groin's Cross Section, Figures 12 and 13) will be mostly buried to reduce the apparent groin size and visibility as is the pyramid base of the existing groins. The landward ends of the replacement groins will be buried below the sand on the beach to below the level of the land bank, and excavated sand from the existing groins' removal and replacement will be piled on top of the groins at their landward ends to assure groin burial and lateral beach access (see Figures 12, 13, 14 and 15). The top of the replacement groins near their middle will be slightly above the beach sand level and are sloped down to follow the beach profile to the water where the groins will extend into and below the water level as presently exists at the Project Beach and at downdrift beaches (see Photo 11, page). The top of the replacement groins will be low enough to allow waves and water at high tides to flow over and through gaps at their top, thus allowing the natural, longshore sediment transport process nearshore to continue as presently exists.

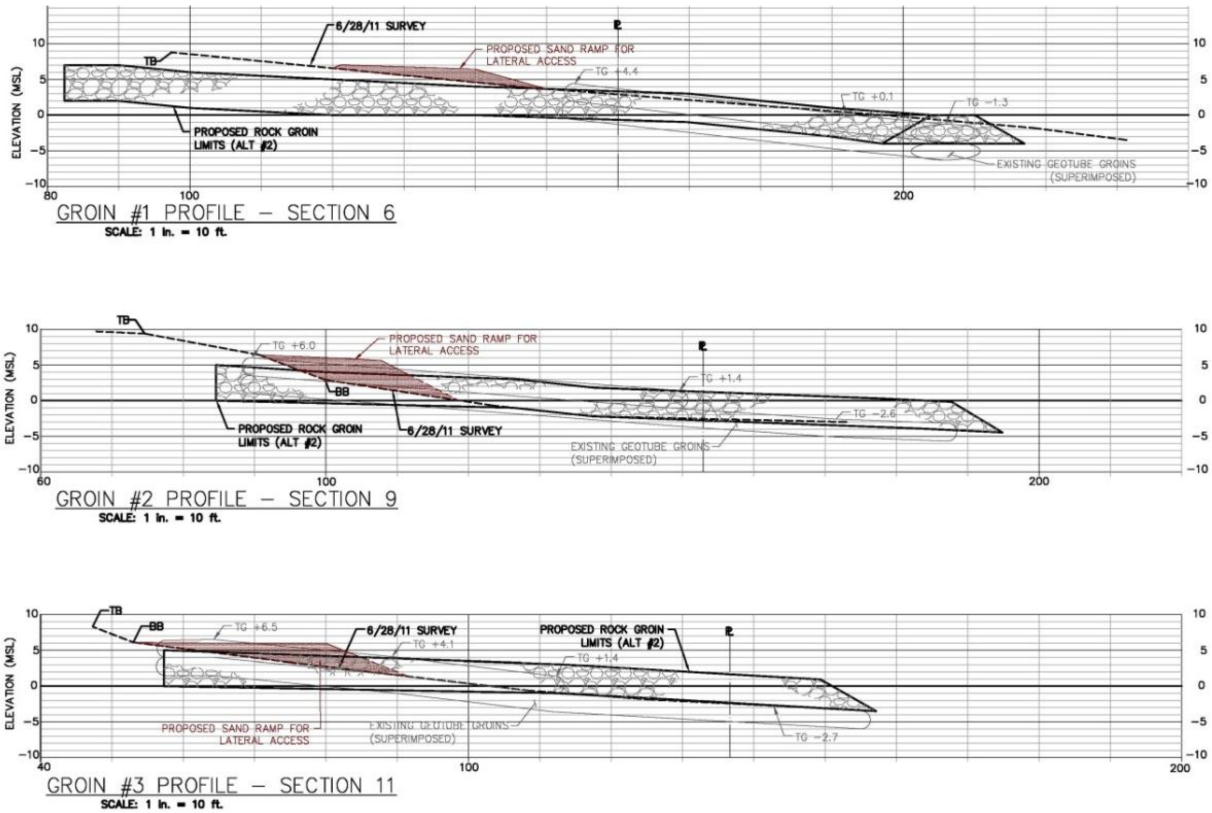

Figure 15 – Replacement Groins and Beach Profiles/Topography – 3 Groin Plan

3.2.1.c Groin Material

Rock was selected for the replacement groin material because it is: a natural material, durable, readily available, and has a natural visual character with the same appearance as other nearby groins in place for more than 70 years that people are accustom to seeing. Other groin materials were considered such as concrete, treated wood, railroad ties, metal sheeting, and wood or steel pilings, but they are ill-suited to the natural site character. The replacement groins are designed to be similar in appearance to the several, existing rock groins located at the beaches immediately downdrift of the Project Beach (see Photo 11), but with larger rock for longer-term stability.

The replacement groins are proposed to be constructed with 1.5 ton (2 foot diameter +/-) rocks placed around a longitudinal core of smaller rocks for long-term groin stability (see Replacement Groin Cross Section in Figures 12 and 13). This design approach is consistent with the U. S. Army Corps of Engineers' standards which have been developed after many groin installation assessments.

Photo 11 - Existing Rock Groins Downdrift of Project Beach.

The Project's Coastal Engineer sized the groin rocks and designed the groin cross section based on studies of: local wave magnitude and direction history; weather conditions including tides, current, wind and waves; tidal wave impacts; SSBN Evaluation Project Beach Erosion monitoring data; observations of the region; previous groin design experience; plus the 72+ year old downdrift groins still in place.

There are approximately 14 rock groins immediately downdrift of the Project Beach (see Photo 1, page 13). Per the U. H. Annual Erosion Hazard Rate Map, the downdrift area has had approximately half the annual erosion rate of the Project Beach and has had a 42% increase of average beach width compared to a 10% loss for the Project Beach during the same time from 1960 to 2002. Rock groins have proven to be an effective beach erosion control approach in the region.

3.2.2 Construction

3.2.2.a Construction Activities, Sequence and Means

1. Neighborhood Signage Installation - Installation of neighborhood informational and safety signage by hand.

2. Construction Staging Area Preparation - The construction staging area will be located inland at the south side of Stable Road, and the beach access road will be located directly in-line from the staging area to the Project Beach, where previously located for construction of the existing SSBN Evaluation Project (see Figure 16).

   The construction staging area will be cleared of vegetation without grading by a tractor for a portable restroom, waste container, construction equipment, employee parking plus building materials. The existing access road has a gravel and sand surface, which is intended to remain. The replacement groin rocks are presently stock piled offsite at a construction yard, thus requiring no geological disturbance.

The rocks will be washed at their offsite location to remove sediment prior to delivery in stages by truck to the Project Beach.

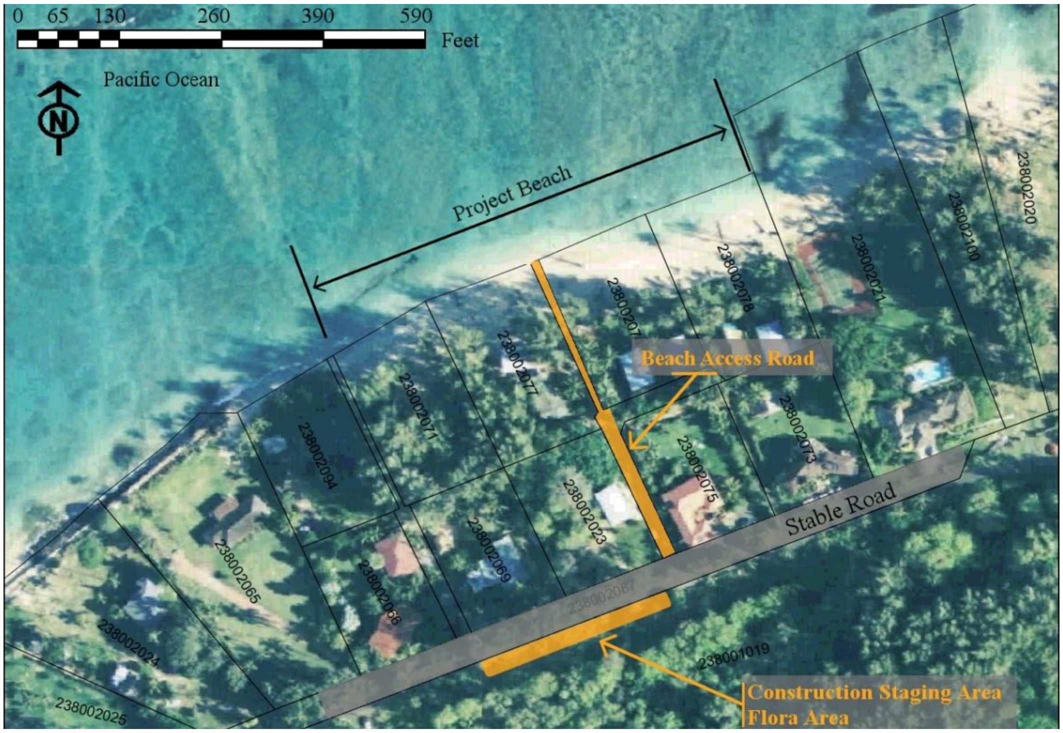

Figure 16 - Proposed Construction Staging Area, Beach Access Road, Existing Access, Flora Area and Resources Map

3. Pre-Construction Water Quality Environmental Monitoring – Includes calibration of the electronic monitoring probes (2), placement of monitoring probes in water located outside the work area sediment barrier and at the updrift “control” location plus obtaining water bottle samples at the same locations for a laboratory to measure and record pre-construction water quality (see Appendix 9.3 Performance Monitoring and Metrics/Criteria Guidelines for Water Quality).

4. Project Beach Signage Installation - Installation of Project Beach informational and safety signage by hand.

   Construction activities and water quality monitoring will occur on a groin by groin basis as groins are replaced for the terminal groins first and then the middle groin(s) as follows:

5. Sediment Barrier Installation - Installation of perimeter sediment barrier by hand around existing groin to be removed (see Figure 17).

6. Existing Groin Removal – Cutting of the existing, geotextile groin tubes using razor knives by hand; excavation of sand fill from the tubes and stockpiling the excavated sand near the beach shoreline using a track excavator; removing the geotextile tubes and scour aprons’ material by the excavator and hand, plus disposing the removed geotextile material in the waste container at the staging area using the excavator and a forklift for transport.

7. Replacement Groin Installation – Excavation of beach sand for replacement groin and stockpiling excavated sand near beach shoreline using a track excavator; placement of the groin core mat and installation of small quarry run rock on mat by the excavator and hand, placement of the large, surface rock around the core and backfilling around installed groin with previously excavated sand using the track excavator; removal of the perimeter sediment barrier and restoration of the beach construction area to the previous condition by hand.

8. Final Clean-Up – Cleaning and restoring the Project Beach, beach access road and staging area by track excavator and hand.

3.2.2.b Construction Duration Estimate (Work Days)

Activity	Work Day +/-
1. Neighborhood Signage Installation:	1
2. Construction Staging Area Preparation:	1 - 2
3. Pre-Construction Water Quality Monitoring:	-7 to1
4. Project Beach Signage Installation:	1
5. Sediment Barrier Installation - Groin 1:	3
6. Existing Groin Removal - Groin 1:	3
7. Replacement Groin Installation - Groin 1:	4 - 8
8. Sediment Barrier Installation - Groin 2:	9
9. Existing Groin Removal - Groin 2:	9
10. Replacement Groin Installation - Groin 2:	10 - 14
11. Sediment Barrier Installation - Groin 3:	15
12. Existing Groin Removal - Groin 3:	15
13. Replacement Groin Installation - Groin 3:	16 - 20*
14. Sediment Barrier Installation - Groin 4:	21
15. Existing Groin Removal - Groin 4:	21
16. Replacement Groin Installation - Groin 4:	22 - 26
17. Final Clean-Up:	27 - 30*

***** The duration is 23 work days +/- if there are three replacement groins.

3.2.3 Best Management Practices

Site Specific Best Management Practices (BMP's) scheduled during construction include Sediment and Pollution Control, Lateral Beach Access Control and Neighborhood Comfort and Safety Control. The BMP's are similar to those successfully employed for the previously constructed SSBN Evaluation Project and include the following measures:

3.2.3.a Water Quality Sediment Control

- Install floating silt curtain (sediment barrier) in ocean around submerged groin end during existing groin removal and replacement groin construction (see Figure 17).

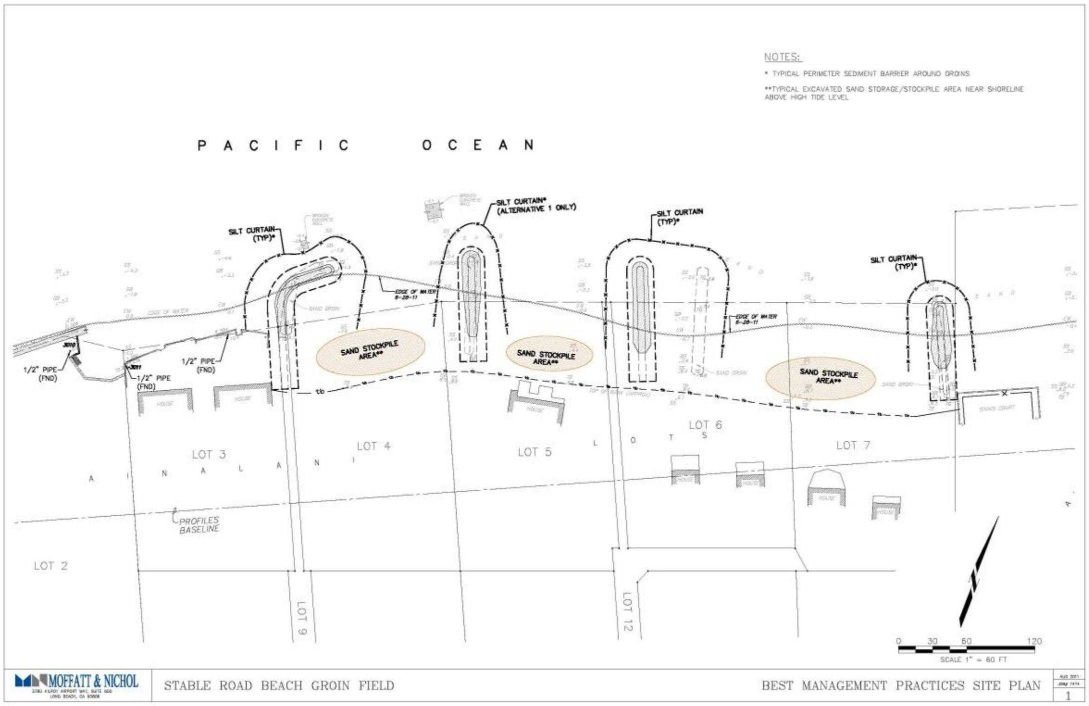

Figure 17 - Proposed Sediment Barrier and Sand Storage Location BMP Map

- Wash groin rock offsite prior to placement.
- Locate excavated sand near shoreline and above high tide level during existing groin removal and replacement groin installation (see Figure 17).
- Perform no sand discharge to ocean work during periods of inclement weather.
- Minimize sand discharge to ocean during extreme high tides.
- Restrict construction equipment from the water except at wave run-up area.
- Install runoff prevention at construction staging and beach access areas by using erosion barriers when there is inclement weather.
- Restore construction staging area and beach access road at completion of work.

3.2.3.b Water Quality Pollution Control

- Use U. S. Coast Guard approved, bio-degradable lubricants in construction equipment accessing the beach.
- Refuel and park construction equipment at inland construction staging or beach access road and not on the beach.
- Provide fuel spill kit at fueling areas.
- Dispose of waste materials at approved refuse sites.

3.2.3.c Lateral Beach Access Control

- Install informational and safety signage at Project Beach.
- Maintain pedestrian access across the Project Beach during all work and non-work hours to extent possible while maintaining safety.
- Crew at construction area to monitor, control and facilitate lateral beach access during construction.

3.2.3.d Neighborhood Comfort and Safety Control

- Work during daylight hours.
- Comply with County and State noise statutes.
- Provide dust control at beach access road.
- Limit construction vehicle speed at beach access road and provide safety signs.
- Park construction and employee vehicles at staging area.
- Locate portable toilet at staging area.
- Limit and control road blockage during deliveries and transport with safety personnel.
- Daily clean beach and beach access road from construction material and debris.

3.2.4 Environmental Monitoring

The previously constructed SSBN Evaluation Project had more extensive and longer duration construction activity than the Proposed Action due to its combination of temporary groins installation (2 weeks - similar to the replacement groins installation work), plus dredging and pumping offshore sand nourishment with final beach sand distribution and shaping (10 weeks). From experience, the greatest possibility for any adverse environmental effect was during the disruptive construction phase.

The replacement groins are of the same general design and locations as the existing, temporary, sand filled geotube groins. The greatest impact documented from installation of the temporary groins was during the sand-filling process when turbidity resulted from the pumping activity. The Proposed Action will not involve any offshore sand dredging, pipeline transport of sand over the fringing reef or any pumping of sand to create groins. Therefore, the impact of installing replacement rock groins will be significantly less than that of the temporary groin construction.

Experience with the more extensive construction activity of the SSBN Evaluation Project demonstrated no threat to Water Quality, Benthic Habitat, Lateral Beach Access or Beach Erosion during or after construction. Since the Proposed Action will require considerably less construction activity with limited in-water disturbance, and the established Best Management Practices (BMP's) were successful, there is no need to monitor Benthic Habitat, Beach Erosion and Lateral Beach Access during construction of the Proposed Action.

There is, however, a need and benefit to monitor Water Quality during construction of the Proposed Action to control any potentially adverse effect from possible project related turbidity and to implement BMP's when turbidity readings possibly exceed the Guidelines Criteria/Metrics, which are based on State standards.

3.2.4.a Water Quality Monitoring

Water Quality monitoring will occur pre-construction outside the Project Beach and at an updrift "control" site to establish the ambient and relative turbidity condition as a baseline, and monitoring will continue during construction at the activity site and the "control" site. If the turbidity level exceeds the Guideline's Criteria/Metric, work will stop until the water quality is compliant and/or adjustments will be made to construction practices in accordance with the BMP's (see Appendix Section 9.3 Performance Monitoring and Criteria/Metrics Guidelines for

Water Quality). These Guidelines are similar to those approved and successfully utilized for the SSBN Evaluation Project.

3.3 NO ACTION ALTERNATIVE

This Alternative is described as scenario #2 in Section 3.1 and is an Abandonment approach per the COEMAP. The No Action Alternative is the same as the “Do Nothing Alternative”. Under this scenario, the scope of work is to remove the SSBN Project’s existing, temporary groins before 25 June 2014 per the existing SSBN Evaluation Project approval conditions and do nothing else.

Until removal, the existing groins would require considerable maintenance and replacement since their geotextile construction is not sufficient to withstand dead coral abrasion at the active north shore environment.

After removal of the temporary groins, the beach sand and the land would be eroded as before the SSBN Evaluation Project constructed in 2010.

The Need for Action is to preserve and protect the Project Beach. The Purpose of Action is to preserve and protect the Project Beach in a longer lasting and more sustainable manner than with the existing, temporary groins approved for the SSBN Evaluation Project. Although this Alternative does not accomplish the Need for and Purpose of Action, No Action must be considered as an Alternative under the NEPA process.

3.4 REPLACE EXISTING GEOTUBE GROINS WITH ROCK GROINS COMBINED WITH POSSIBLY NOURISH PROJECT BEACH WITH INLAND SAND ALTERNATIVE

This Alternative is described as scenario #6 in Section 3.1 and is a combination of a Beach Erosion and Beach Nourishment approaches consistent with the COEMAP. Under this scenario, the scope of work is to remove the SSBN Evaluation Project’s existing, four temporary geotube groins; to replace them with either three or four more durable rock groins in the same general location and of the same scale as the existing, temporary groins (the final number of proposed replacement groins will be decided after the 2012 spring/summer season of Beach Erosion monitoring and performance assessment); and to possibly nourish the Project Beach subsequently, if and when necessary, with Maui dune sand having grain size and characteristics meeting DLNR, OCCL standards.

This Alternative is similar to the Proposed Action - “Replace Existing Geotube Groins with Rock Groins” scenario described as scenario #1 in Section 3.2 and is combined with scenario #4 described in Section 3.1 -“Annually Nourish Project Beach with Inland Sand” , except that beach nourishment would occur only if and when necessary to maintain a minimum beach width and beach sand volume.

This is not the Proposed Action since it is not the preferred Alternative because it is more complex and appears not to be necessary based on the ability of the Project Beach with groins to retain sufficient naturally accreted sand during the year, thus eliminating the need for beach nourishment (see Figure 5, page 25).

3.4.1 Design

3.4.1.a Groins

The replacement rock groins would be the same location, configuration, height, visibility and material as those of the Proposed Action (see Section 3.2.1).

3.4.1.b Nourishment Location

Possible beach nourishment would include a volume of inland sand to nourish the Project Beach if and when needed. The maximum estimated volume of beach nourishment sand to be placed at one time is anticipated to be approximately 300 cubic yards based on a 300 foot long half of Project Beach length with a 6 foot high dune. Possible beach nourishment sand would be placed at the east half of the Project Beach in the spring and summer and at the west half during fall and winter seasons near the top of the beach along the shoreline as a dune to slowly feed and nourish the beach during high tide episodes.

3.4.1.c Nourishment Material

Nourishment material would be inland Maui dune sand. Proposed is to wash the sand to clean it from contaminants, if existing, using a proven washing technique with equipment located offsite before delivery and placement at the Project Beach. The sand material would meet the following DLNR, OCCL quality standards:

1. Contain no more than six (6) per cent fine material (#200 sieve - 0.074mm);
2. Contain no more than ten (10) per cent coarse material (#4 sieve - 4.76 mm);
3. Grain size distribution falling within 20% of existing beach grain size distribution;
4. Overall ratio of fill sand to existing beach sand not exceeding 1.5/1;
5. Free of contaminants including silt, clay, sludge, organic matter, turbidity, grease, pollutants and others;
6. Primarily composed of naturally occurring carbonate beach or dune sand.

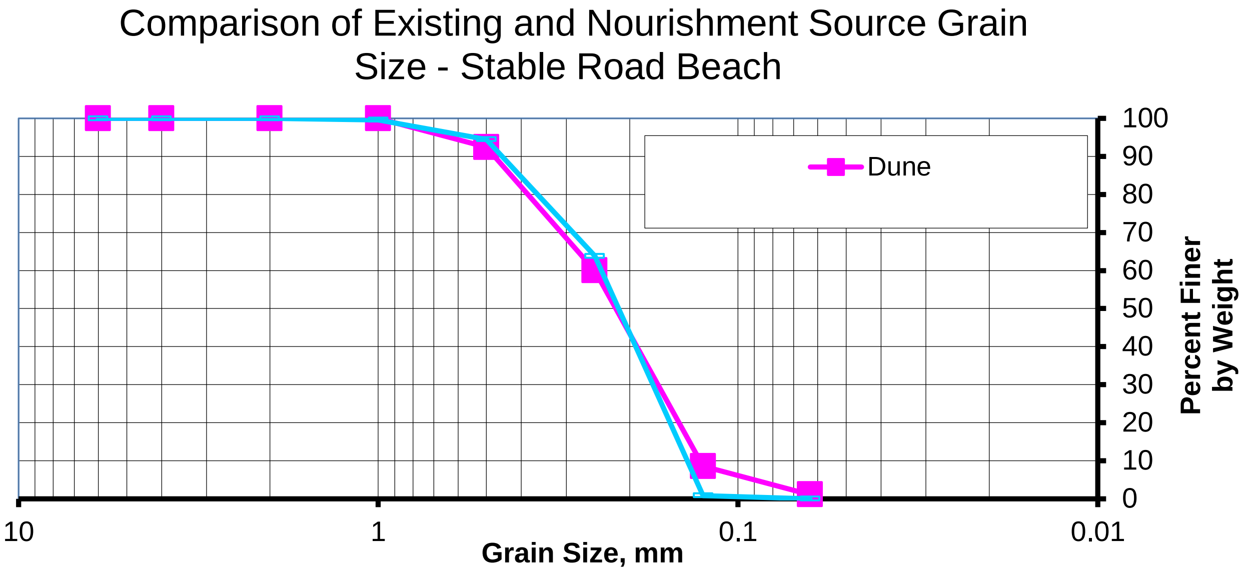

Figure 18 – Existing Beach and Maui Dune Sand Size Grain Distribution Comparison

Maui dune sand is available from Ameron Hawaii and Hawaiian Cement. Contained in the application for the SSBN Evaluation Project was an analysis of Existing Beach Sand Grain Size compared to Maui Dune sand, and the existing sand at the top of beach location where the Maui dune sand would be placed has a comparable grain size distribution to Maui dune sand (see Figure 18). DLNR, OCCL nourishment sand standards 1 through 3 are able to be achieved based on this data and comparison of Existing Beach and Maui Dune sand. Standard 4 is readily achieved since the ratio of dune sand to existing beach sand would be approximately 0.025/1. The sand cleaning, if necessary, would satisfy standard 5, and the fill sand is dune sand satisfying standard 6.

3.4.2 Construction

3.4.2.a Construction Activities, Sequence and Means

Construction of the replacement rock groins is the same as that of the Proposed Action (see Section 3.2.2), and possible beach nourishment as a subsequent phase when necessary would include the following activities, sequence and means:

1. Neighborhood Signage Installation - Installation of neighborhood informational and safety signage by hand.

2. Collecting and Washing Sand - Washing to be by proven means and equipment if necessary to remove contaminants.
3. Transport of Sand to Project Beach - By truck directly to Project Beach via the beach access road (see Figure 16).

4. Sand Deposit and Spreading at Project Beach - By loader above the high tide level. This work would occur during periods of low tides.

3.4.2.b Construction Duration Estimate (Work Days)

Initial Activity - Groins Replacement	Work Day +/-
1. Neighborhood Signage Installation:	1
2. Construction Staging Area Preparation:	1 - 2
3. Pre-Construction Water Quality Monitoring:	-7 to1
4. Project Beach Signage Installation:	1
5. Sediment Barrier Installation - Groin 1:	3
6. Existing Groin Removal - Groin 1:	3
7. Replacement Groin Installation - Groin 1:	4 - 8
8. Sediment Barrier Installation - Groin 2:	9
9. Existing Groin Removal - Groin 2:	9
10. Replacement Groin Installation - Groin 2:	10 - 14
11. Sediment Barrier Installation - Groin 3:	15
12. Existing Groin Removal - Groin 3:	15
13. Replacement Groin Installation - Groin 3:	16 - 20*
14. Sediment Barrier Installation - Groin 4:	21
15. Existing Groin Removal - Groin 4:	21
16. Replacement Groin Installation - Groin 4:	22 - 26
17. Final Clean-Up:	27 - 30*

* The duration is 23 work days +/- if there are three replacement groins.

Subsequent Activity - Beach Nourishment	Work Day +/-
1. Neighborhood Signage Installation:	1
2. Collecting and Washing Sand	1 - 4
3. Transport of Sand	2 - 4
4. Sand Deposit and Spreading	2 - 4

3.4.3 Best Management Practices

Site Specific Best Management Practices (BMP's) scheduled during construction include Sediment and Pollution Control, Lateral Beach Access Control and Neighborhood Comfort and Safety Control. These BMP's are similar to those of the Proposed Action and successfully employed for the previously constructed SSBN Evaluation Project (see Section 3.2.3).

3.4.4 Environmental Monitoring

Environmental Monitoring during construction includes the same scope as the Proposed Project for Water Quality for the removal of the temporary geotube groins and installation of rock groins (see Section 3.2.4); and during possible subsequent beach nourishment, no monitoring is necessary since there will be no direct discharge of sediment to the ocean. Sand nourishment deposits will be located above the mean tide level and would be slowly released to the Project Beach during high tides as dune sand naturally releases.

3.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER ASSESSMENT

Of the nine Alternatives originally identified, six were considered but eliminated from further consideration since they could not meet the Need for Action - to preserve and protect the Project Beach and/or the Purpose of Action - to preserve and protect the Project Beach in a longer lasting and more sustainable manner than with the existing, temporary groins approved for the SSBN Evaluation Project. The Alternatives eliminated from further consideration are as follows:

3.5.1 Extend Use of Temporary Geotube Groins Alternative

This Alternative is described as scenario # 3 in Section 3.1 and is a Beach Erosion Control approach consistent with the COEMAP. Under this scenario, the scope of work is to obtain new approvals to extend the duration of the existing, temporary geotube groins beyond the existing SSBN Evaluation Project expiration date of 25 July 2014 and to install new, replacement geotube groins of the same or similar material in the same general locations and with the same scale as the existing temporary groins when necessary for maintenance as the existing groins deteriorate.

The existing geotube groins would require expensive, periodic maintenance and replacement before and after approval since the geotextile construction is not sufficient to withstand dead coral abrasion at the active north shore environment, plus an extended use approval period may be limited; therefore, this scenario is not sustainable in the long-term.

Although this scenario would accomplish in the short-term the Need of Action - to preserve and protect the Project Beach, it would not accomplish the Purpose of Action - to preserve and protect the Project Beach for the long-term and in a sustainable manner than with the temporary geotube groins approved for the SSBN Evaluation Project. As a result of this analysis, this Alternative was eliminated from further consideration.

3.5.2 Annually Nourish Project Beach with Inland Sand Alternative

This Alternative is described as scenario #4 in Section 3.1 and is a Beach Restoration approach per the COEMAP. Under this scenario, the scope of work is to remove the existing, temporary geotube groins per the existing SSBN Evaluation Project approval expiration by 25 July 2014 and to annually nourish the Project Beach with inland sand trucked to the beach and spread at the Project Beach. This scenario would require annual beach nourishment to preserve the existing beach width and sand volume since the removed groins presently act as sand retention devices. Without installing replacement groins, beach nourishment would be required every year based on the previous rate of beach width and sand volume loss history at the Project Beach and the history of the nearby Sugar Cove Condominiums' need for annual beach nourishment.

This Alternative is expensive, temporarily disruptive to beach use and requires a long-term financial commitment to which the Applicant cannot commit; therefore, this scenario is not sustainable in the long-term.
Although this scenario would accomplish the Need for Action - to preserve and protect the Project Beach, it would not accomplish the Purpose of Action - to preserve and protect the Project Beach in a longer lasting and more sustainable manner than with the temporary geotube groins approved for the SSBN Evaluation Project. As a result of this analysis, this Alternative was eliminated from further consideration.

3.5.3 Annually Nourish Project Beach with Offshore Sand Alternative

This Alternative is described as scenario #5 in Section 3.1 and is a Beach Nourishment approach consistent with the COEMAP. Under this scenario, the scope of work is to remove the existing, temporary geotube groins per the existing SSBN Evaluation Project approval expiration by 25 July 2014 and to annually nourish the Project Beach with sand dredged and pumped from an offshore site similar to the process used for the SSBN Evaluation Project. This scenario is similar to scenario #4 described above (see Section 3.5.2), and it would also require annual beach nourishment.

This Alternative is more expensive than nourishing the Project Beach with inland sand, is potentially disruptive to the ocean environment due an invasive process with several steps taking many weeks and requiring extensive mitigation to offset any short-term effects, is temporarily disruptive to beach use and requires a long-term financial commitment to which the Applicant cannot commit; therefore, this scenario is not sustainable in the long-term.

Although this scenario would accomplish the Need for Action - to preserve and protect the Project Beach, it would not accomplish the Purpose of Action - to preserve and protect the Project Beach in a longer lasting and more sustainable manner than with the temporary geotube groins approved for the SSBN Evaluation Project. As a result of this analysis, this Alternative was eliminated from further consideration.

3.5.4 Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Offshore Sand Alternative

This Alternative is described as scenario #7 in Section 3.1 and is a combination of Beach Erosion Control and Beach Nourishment per the COEMAP. Under this scenario, the scope of work is to remove the existing, temporary geotube groins per the existing SSBN Evaluation Project approval expiration by 25 July 2014; to replace them with either three or four more durable rock groins in the same general location and of the same scale as the existing, temporary groins (the final number of proposed replacement groins will be decided after the 2012 spring/summer season of Beach Erosion monitoring and performance assessment); and to possibly nourish the Project Beach with sand dredged and pumped from an offshore site similar to the process used for the SSBN Evaluation Project. This scenario is similar to a combination of scenarios #1 and #5 (see Sections 3.1 and 3.5.3); however, it would not require annual beach nourishment as scenario #5 since the rock groins will retain beach sand and reduce annual sediment loss.

Because of the successful performance of the groins as sand retention devices with the SSBN Evaluation Project, the Project Beach has reached dynamic equilibrium with the natural accretion of beach sand during the fall and winter seasons and the retention of accreted beach sand during all four seasons. With groins, the Project Beach has reached a volume of beach sand to be self-sustaining without beach nourishment.
Beach nourishment using offshore sand is disruptive and expensive, even if not done annually, and requires a long term-financial commitment (see Section 3.5.3); therefore, this scenario is not sustainable. Scenario #6 (see Section 3.4) is more sustainable, if it were necessary, than this scenario.

Although this scenario would accomplish the Need for Action - to preserve and protect the Project Beach, it would not accomplish the Purpose of Action - to preserve and protect the Project Beach in a longer lasting and more sustainable manner than with the temporary geotube groins approved for the SSBN Evaluation Project. As a result of this analysis, this Alternative was eliminated from further consideration.

3.5.5 Relocate Residential Structures Alternative

This Alternative is described as "Relocate Residential Structures" scenario #8 in Section 3.1 and is an Adaptation approach. Under this scenario, the scope of work is to remove the existing, temporary geotube groins per the existing SSBN Evaluation Project approval expiration by 25 July 2014 and to relocate or remove existing houses and in-ground sewage systems adjoining the Project Beach when necessary as chronic beach retreat resumes.

The five residential lots affected by Project Beach erosion and beach retreat have 9 homes on them. The lots are small with little room for relocation of structures. If most structures were to be relocated, the distance that they could be set back from the receding shoreline would not be significant enough to justify the expense of relocation, especially because present rates of erosion (1-4 feet per year) threaten to eliminate these lots entirely within the next few decades.

There is no community sewage system along Stable Road, so each home has either a sewage cesspool or septic tank with a leach field in the remaining, small yard space fronting the beach; and any relocation of the sewage disposal areas, if possible, would add additional expense and complications.

The feasibility and probability for relocation or removal of the existing homes by their owners is not positive.

This scenario would possibly protect existing structures fronting the Project Beach; however, it would not accomplish the Need for Action - to preserve and protect the Project Beach, and it would not accomplish the Purpose of Action - to preserve and protect the Project Beach in a longer lasting and more sustainable manner than with the temporary geotube groins approved for the SSBN Evaluation Project. As a result of this analysis, this Alternative was eliminated from further consideration.

3.5.6 Build Seawall or Revetment Alternative

This Alternative is described as “Build Seawall or Revetment” scenario #9 in Section 3.1 and is a Hardening approach per the COEMAP. Under this scenario, the scope of work is to remove the existing, temporary geotube groins per the existing SSBN Evaluation Project permit expiration and to construct a seawall or revetment across the Project Beach. The seawall or revetment would connect to existing seawalls and revetments at each end of the Project Beach, which were installed decades ago to prevent land loss at these locations due to the chronic erosion.
This Alternative is expensive, disruptive to beach use and lateral beach access, plus it causes possible loss of beach width sand volume in front of the seawall or revetment; therefore, this scenario is not sustainable in the long-tem.

This scenario would eliminate land erosion and its adverse environmental consequences; however, it would not accomplish the Need for Action - to preserve and protect the Project Beach and the Purpose of Action - to preserve and protect the Project Beach in a longer lasting and more sustainable manner than with the temporary geotube groins approved for the SSBN Evaluation Project. As a result of this analysis, this Alternative was eliminated from further consideration at this time.

If the chronic beach erosion and beach retreat were to continue at the Project Beach and not be abated by the Proposed Action, a seawall or revetment will be reconsidered by the Applicant as necessary in the future to protect the land, nearshore ocean water quality and adjacent residential structures as a last resort.

4.0 AFFECTED ENVIRONMENT FACTORS

4.1 INTRODUCTION

This Section describes the Affected Environment Factors at the Project Area and for areas immediately updrift and downdrift. The previous SSBN Evaluation Project included the same areas for environmental monitoring. A list of relevant Environment Factors and potentially Affected Factor's Resources was compiled from the NEPA Environmental Factors Checklist produced by the California Environmental Quality Act (CEQA) to develop the Scoping Summary, which is similar to the Scope content from the scoping process of the SSBN Evaluation Project described in Section 1.7.2 Factors considered but excluded from consideration due to not being affected include Agriculture Resources, Air Quality, Geology /Soils, Hazards & Hazardous Materials, Land Use/Planning, Mineral Resources, Population/Housing, Public Services, Transportation/Traffic and Utilities/Service Systems.

4.2 PHYSICAL FACTORS

4.2.1 Project Area Resource

4.2.1.a Location – Project Area

The Project Beach is approximately 600 feet long and averages 84 feet wide containing approximately 50,000 square feet of sand beach to the mean sea level. The Project Beach is the area directly benefitting from the Proposed Action. The land adjoining the Project Beach is developed with seven ocean front residences (see Cover Photo).

The Project Beach functions as a littoral cell, in which beach sand erodes at its ends seasonally with sand shifting east and west (see Section 1.4). The littoral cell is flanked at both ends by hardened shorelines with a rock seawall at the east end and a rock revetment and concrete seawall at the west end. The Cover Photo shows the Project Area with four temporary groins from the SSBN Evaluation Project. The two groins at each end of the Project Beach are visible, but those in the center are not since they are buried by naturally accreted sand.

The Project Area shoreline faces NNW and typically receives long-shore trade winds and swells from the NE in the spring and summer and cross-shore NW Pacific swells in the fall and winter. Before the implementation of the SSBN Evaluation Project, there would be a minimal or no beach during the summer at the east end and minimal or no beach during the winter at the west end of the Project Beach due to the scouring effect of the seasonal swells especially at high tide periods exacerbated by the flanking, hardened shorelines. From 2006 to 2009 the land in front of the residences adjoining the beach eroded so much that each year from four to six feet of land was lost.

There is a mostly undeveloped land and vegetated dune areas with one remaining home immediately updrift and east of the Project Beach. Foundations of one home east of the remaining home and one at the Project Beach have been undermined and can be found in the intertidal region evidencing significant beach loss this area over time. A series of beaches with headlands continues to the northeast, and many of these beaches have significantly eroded to where there is no beach left but only land embankments or seawalls constructed for protection of developed property. Further east, Baldwin Beach Park has shown signs of severe beach erosion and a higher rate of land loss recently (see Section 1.4).

Immediately to the southwest of the Project Area, there is a rock revetment and long, concrete seawall. Continuing along the southwest coastline, there are many manmade rock groins that were constructed prior to 1940 based on a historic aerial photograph (see Photo 1, page 13). These groins continue westerly past Kanaha Beach Park nearly to the County of Maui's Sewage Treatment Facility. The rock groins hold sand and helped preserve the beach in front of the downdrift homes west of the long seawall. It is evident that at least 72 years ago there was a concern about chronic erosion on this stretch of beach. Kanaha Beach Park has accreted sand over many years, but severe erosion is visible at both ends of the Park in the last few years.

Immediately offshore of the Project Area and extending approximately 2.5 miles along the shoreline, a fringing reef varies from 0.2 to 0.5 miles offshore (see Figure 1, page 11). Aerial photographs show this emergent reef to be fronted by finger and groove formations out to a distance of up to 1 mile offshore.

4.2.1.b Beach – Project Area

The Project Beach is sandy with an average width to mean sea level of 84 feet and average cross slope of approximately 10%. The elevation of the land at the shoreline averages approximately eight feet above mean sea level (4Cover Photo). The beach width and slope are minimally sufficient to limit wave run-up during high tides and large fall/winter wave surges to the shoreline for most of the year, except in December and January when the combination of tides and large waves cause higher surges. During these two months, the wave run-up may extend over the top of the land at the shoreline if the beach sand level is the same as the land at the shoreline, especially if there is no shoreline vegetation; or in the case where there is an exposed land embankment with a vertical drop to the beach sand, the wave run-up hits and erodes the land embankments a few days each month.

The University of Hawaii Erosion Hazard Rate Map with data from a 2002 aerial photo indicates "moderate to severe erosion" for the Kanaha area, and specifically at the Project Beach an annual erosion rate of approximately 1.3 feet with a 10% reduction of average beach width reduction from 1960 to 2002 (see Figure 3, page 13). The Project Beach has experienced a significantly higher (400%) annual beach erosion rate with consequentially an increased annual erosion rate with an increased rate of beach width reduction and land loss in the last four years from 2006 to 2010.

The recently published Regional Sediment Management study of Maui's north shore by Moffatt & Nichol for the U.S Army Corps of Engineers indicates the Kanaha area has recently experienced the highest rate of coastal erosion on Maui's north shore with an increased regional sediment loss for the Project Beach region (see Figure 4, page 16).

Typically during the spring/summer trade wind seasons, the beach width and sand volume increase at the west end and decrease at the east end of the Project Beach; and during the fall/winter north Pacific swell seasons, the beach width and sand volume decrease at the west end and increase at the east end of the Project Beach (see Section 1.4).

Prior to the SSBN Evaluation Project, the spring/summer trade winds typically started scouring the Project Beach sand nearshore at its far east end in the spring; and by mid-summer, the east end beach had minimal beach width and sand volume remaining with an approximately five foot high exposed land embankment (see Photo 7, page 19). The east end beach sand scouring and loss started in the early spring; and by the end of summer, the beach narrowing and sand loss progressed laterally a distance of approximately 300 feet from east to west.

The fall/winter north Pacific swells typically started eroding the beach sand nearshore at its far west end in the fall; and by mid-winter, the west end beach had minimal beach width and sand volume remaining with an approximately five foot high exposed land embankment at its west end (see Photo 5, page 17). The west end beach sand scouring and loss started in the fall; and by the end of winter, beach narrowing and sand loss progressed laterally a distance of approximately 300 feet long from west to east.

4.2.1.c Land – Project Area

The seasonal cycle of sand loss and deposition, affecting beach width and sand volume, also drives a seasonal pattern in loss of land from embankments from the embankments exposed by beach sand depletion. During moderately high tides, this erosion spreads from east to west in the spring/summer and vice versa in the fall/winter, causing consistent land erosion and loss across the Project Beach throughout the year.

The seven residences fronting the Project Beach have relatively small lots approximately 1/6 to 1/3 acre in size (see Cover Photo). The residences have sewage cesspools and septic tanks with leach fields for sewage disposal located on small areas of land between the homes and beach. These properties have lost considerable land during the last decade and especially from 2006 through 2009, thus exposing some of the septic drainage pipes along the eroded embankment at the beach (see Photo 7, page 19) and reducing the leach field dispersal area. The residence at the west end of the Project Beach has lost so much land that a corner of its foundation is exposed at the land embankment (see Photo 4, page 17) thus placing the residence in peril from a large surf erosion event.

The land of the residences' ocean front yards fronting the Project Beach consists of sandy soils with clay soil layers. When this land erodes due to the waves and high tides, the land drops into the ocean, thus contributing land based pollution including clay soils causing turbidity (see Photo 6, page 18); nitrogen from fertilizers and leach fields stimulating algae growth; plus chemicals from pesticides can be toxic to marine life. The land of the ocean front yards of the two residences at the west is protected from erosion by a rock revetment, and it has imported fill soil of an unknown type.

4.2.1.d Shoreline – Project Area

Currently, the Project Beach shoreline length is approximately 37% vegetated with shrubs and vines that have roots to help the soil from eroding so rapidly (see Cover Photo). There was 75% shoreline vegetation in 2008; however, the accelerated rate of beach erosion and resultant land loss from 2006 to 2009 resulted in a significant decrease of shoreline vegetation (see Photo 6, page 18). Along with the loss of shoreline shrubs and vines, there were numerous trees near the shoreline that died with many falling onto the beach and into the ocean from land erosion (see Photo 4, page 17).

The annual loss of beach-fronting land took with it some of the erosion retarding vegetation, which had also provided habitat to coastal species, including birds.

4.2.2 Outside Project Area Resource

4.2.2.a Location – Outside Project Area

The Outside Project Area is included in this EA since it may be affected by the Proposed Action due to its proximity being either immediately updrift or downdrift of the Project Beach. For the SSBN Evaluation Project, areas contiguous to the Project Area were included in the environmental monitoring, which consisted of a 100 foot wide updrift area and a 520 foot wide downdrift area. The downdrift area monitored is larger because Project impact is potentially greater down-drift due to wave and current direction.

The updrift area is shown in the Cover Photo, and the downdrift area is partially shown in the Cover Photo with the remainder shown in Photo 1.

4.2.2.b Beach – Outside Project Area

The updrift beach is sandy with an average beach width and a cross slope similar to the east end of the Project Beach since the beach sand movement is similar (see Cover Photo). The updrift area is subject to the same seasonal wave and tidal forces as the Project Beach; however, the seawall at the updrift beach has caused seasonal loss of sand beach in front of the seawall and exposed numerous, large rock piles plus an exposure of adjacent land embankments during spring/summer seasons.

Downdrift of the Project Beach and west of the small beach cove located between the rock revetment and start of concrete seawall (see Cover Photo), the sand beach has been lost, presumably due to the area’s hardened shoreline. The 1940 aerial photograph (see Photo 1, page 13) shows a sand beach at the downdrift area in front of the east half of the seawall, but by 1997 there was no sand beach in front of this seawall area (see Photo 2, page 14). Today, there is no sand beach for at least 370 feet downdrift of the Project Beach.

The 1940 aerial photograph shows several rock groins from the east end of the seawall westerly to Kanaha Beach Park. It is logical to assume there was concern of historic beach erosion this area before 1940 due to the seawall built in 1925 and rock groins shown in 1940, at least 72 years ago.

The University of Hawaii Erosion Hazard Rate Map with data from a 2002 aerial photo indicates “moderate to severe erosion” for the Kanaha area, and specifically at the immediate downdrift area an annual erosion rate of approximately 0.5 feet (see Figure 3, Page 14).

The recently published Regional Sediment Management study for the Kanaha area, including the Outside Project Areas, by Moffatt & Nichol for the U.S Army Corps of Engineers indicates the Kanaha area has recently experienced the highest rate of coastal erosion on Maui’s north shore with an increased regional sediment loss for the Project Beach region (see Figure 4, page 16).

Typically during the spring/summer trade wind seasons, the beach widths and sand volumes decrease immediately updrift and downdrift of the Project Area, and during the fall/winter north Pacific swell seasons, the beach widths and sand volumes increase.

4.2.2.c Land – Outside Project Area

The updrift area is a sandy beach and has a 72 foot wide seawall immediately east of the Project Beach; and further east, there is a sand beach to the shoreline (see Cover Photo). The land at the updrift area is similar to that at the Project Beach composed of sand and layers of clay soil. There are signs of historic beach sand and land loss at the updrift area as evidenced by the numerous dead trees fallen in the water at the shoreline and stacked along the shoreline.

The down-drift area consists of an approximate 50 foot long sand beach cove with a perimeter seawall immediately downdrift of the rock revetment and then a concrete seawall approximately 400 feet long to the west (see Cover Photo). There is no exposed land downdrift due to the continuous seawall (see Photo 1, page 13). A portion of the east end of the concrete seawall has fallen into ocean and is still present (see Cover Photo).

4.2.2.d Shoreline – Outside Project Area

The only Outside Project Area shoreline that exists is immediately east of the updrift seawall due to the presence of seawalls at the entire downdrift area. This small portion of updrift shoreline is vegetated (see Cover Photo).

4.2.3 Construction Staging and Beach Access Area Resource

4.2.3.a Location - Construction Staging and Beach Access Area

The construction staging area for the Proposed Action is located adjacent to Stable Road at its south side, where it was located for the SSBN Evaluation Project (see Figure 16, page 42). This area is approximately 60 feet wide and 200 feet long parallel to Stable Road. Access to the construction staging area is directly from the paved Stable Road. Construction staging area access to the beach is across Stable Road by a 20 to 12 foot wide beach access driveway between Lots 5 and 6 (see Figures 2 and 16, pages 12 and 42), where it was located for the SSBN Evaluation Project.

4.2.3.b Land - Construction Staging and Beach Access Area

The construction staging area is generally flat requiring no site grading or earthwork, and it is vegetated with grasses. After the SSBN Evaluation Project completion, the same staging area was cleaned and left to naturally re-vegetate, which it did in a few months. The construction beach access road is generally level and was covered with gravel during the SSBN Evaluation Project for a distance as dust control.

The shoreline at the beach access road does not have any vegetation, so there is existing good access to the sand beach.

4.3 OCEAN WATER QUALITY FACTORS

4.3.1 Nearshore Water Quality Resource

Upland of the Project Beach are mostly cane fields, which have been in existence and fertilized for decades; and closer is the Kahului Airport which has large paved runways and surfaces that discharge rainfall toward the ocean (see Cover Photo).

During low tide, rivulets of brackish water can be seen draining through the sand beach to the ocean. Salinity tests conducted in the nearshore waters along the Project Beach and adjacent shoreline to the east during low tide indicate the flow of ground water to the intertidal area.

Under conditions of a stable sand beach coastline with significant groundwater in-flow, beach rock shelves often form along the shoreline. As tides push ocean water and fresh ground water through the calcium carbonate sand, the differing pH of seawater (~8) and fresh water (~6.5) tends to dissolve and re-precipitate the calcium around the sand grains causing the sand to lilhify into stone. Where beach rock is formed through a sand beach, the slope of the beach can often be seen petrified in layers of the rock. The point immediately to the east of the Project Beach is a beach rock shoreline with tide-pools often forming between this shelf and the beach. Offshore and to the west of the Project Beach, remnants of what appear to be prehistoric beach rock shoreline features mark the likely extent of a pre-historic shoreline.

Nearshore water quality is affected by the land fronting the Project Beach which is improved with seven homes, all of which have landscaping and septic leach fields or cesspools (see Photo 7, page 19). The land discharges nutrients from sewage cesspools or from septic tanks with leach fields as well as from fertilizers used for landscaping. It is also typical for homeowners to use pesticides for pest control, so the land also discharges toxic chemicals. The land's clay soil has added significant turbidity in the ocean when eroded (see Photo 6, page 18).

The Project Beach frequently does have naturally occurring sediment movement, and turbidity. Natural, nearshore turbidity is coupled to tidal cycles, and is greatest during periods of high tides and wave activity.

4.3.2 Reef and Lagoon Water Quality Resource

There is a lot of diving activity in the lagoon for octopus, and the lagoon is reported to be relatively abundant with octopus. According to the Hawaii Coral Reef Assessment and Monitoring Program (CRAMP), which has a monitoring site updrift of the Project Beach to the east and offshore of Papalau Point (see Figure 1, page 11), there is very low species richness, density, biomass and diversity of fish observed in the lagoon or at the reef. The reef does have greater than average cover and diversity of macro-algae coral. The reef appears to be relatively healthy due to the dynamic flow of open ocean water across it, and good reef health depends on pristine water quality.

4.4 BIOLOGICAL FACTORS

4.4.1 Shorezone Habitat Resource

The shorezone beach and vegetated shoreline have been habitat to many protected species observed along the Project Beach including: Wedge Tail Shearwater birds, Hawksbill and Green Turtles plus Hawaiian Monk Seals. During the fall of 2010, a Hawksbill turtle nest was located in the center of the Project Beach, and its hatchlings successfully left the nest in December (see Photo 10, page 30).

There was no recent history of a turtle nest near this location prior to this siting, and it is doubtful the nest could have been dug there in previous years. Before the SSBN Evaluation Project, the nest site was mostly dirt. The SSBN Evaluation Project's beach nourishment and sand retention groins facilitated significant sand near the shoreline where the nest was located just a few months after construction completion.

4.4.2 <u>Nearshore Benthic Habitat Resource</u>

At the Project Beach nearshore area, there is a beach rock shelf with a 15-20% seaward slope with a 1 to 2 foot thick stacked plate like structure typical of these formations. During low tide, rivulets of brackish (to taste) ground water can be seen draining through the sand beach to the ocean. Between the beach rock and the sand beach, the bottom is covered either by sand or a mixture of coral rubble.

Nearshore sediment composition is primarily highly mobile sand, and its abundance decreases with distance from shore (see Cover Photo). Sand is progressively replaced by more stable cobble and rock with distance substrates with distance from shore. Gravel abundance is consistent and low throughout the Project area. Patches of exposed reef rock forming solid substrate is more abundant outside the nearshore region and is encountered with decreasing frequency the greater the distance from shore. The nearshore habitat is characteristic of a shallow back-reef lagoon with a well-defined reef crest several hundred feet offshore.

Correlated to distance from shore is the abundance of algae and invertebrates, and consequently a decrease in bare sediment. Where found, beds of macro-algae reach as much as 85% cover, but more commonly, they do not exceed 50% cover. Extensive beds of zooanthids (colonial sea anemones) are common. Occasionally, stable substrate such as reef rock or large rocks provide habitat for corals, macro-algae and invertebrates. In all zones, corals are present but not abundant with more corals offshore than nearshore.

4.5 CULTURAL AND HISTORIC FACTORS

4.5.1 <u>Cultural Artifacts and Burials Resource</u>

The area affected by the Proposed Action is the Project Beach, from which the sand comes and goes with erosion cycles. During the previous SSBN Evaluation Project, excavation of the same depth as proposed occurred on the sand beach at the areas of the existing and proposed groins, and no cultural artifacts or burial remains were discovered nor have they been observed during periods of substantial beach sand loss (see Photo 7, page 19).

4.5.2 <u>Cultural and Recreation Resource</u>

The Project Beach and its ocean waters are extensively used by the public for many diverse cultural and recreational activities including: windsurfing, kite boarding, surfing, paddling, fishing, diving, snorkeling, swimming, walking/jogging, picnicking and sunbathing. The Project Beach is internationally renowned for its windsurfing and kite boarding because of its orientation and exposure to the trade winds, and diving for Octupus and fishing in the lagoon is also very popular.

In 2010, the Applicant completed the SSBN Evaluation Project which significantly stabilized and reduced the rate of historic beach width and sand volume losses, thus temporarily preserving recreational beach use for the entire Project Beach (see Cover Photo) until a longer lasting solution could be implemented.

4.5.3 Lateral Beach Access Resource

Public lateral beach access to the Project Beach is from the nearby public parking at both the Kanaha Beach Park at the west and from the Kahului Airport beach (Camp 1) at the east.

Lateral access across the Project Beach has been unsafe and difficult when the beach seasonally eroded (see Photo 6, page 18) and had numerous fallen trees restricting beach use (see Photo 4, page 17). In 2007, the Applicant removed 39 tons of dead trees and debris to restore unrestricted beach use and lateral access (see Cover Photo).

4.5.4 Visual Resource

The Project Beach is a scenic resource due to its visual character (see Photo 8, page 27), and its visual character has been impaired during periods of seasonal erosion in the past (see Photos 4 and 7, pages 17 and 19). Beside the beach’s visual character, another visual resource are the scenic vistas from the beach to the West Maui Mountains and the ocean with waves, wind, whales and ships coming and going to Kahului Harbor.

4.6 ECONOMIC FACTORS

4.6.1 Local Economy Resource

There are several homes in the neighborhood that have vacation rentals for visitors who come from all over the world, many annually, due to the attraction and the world wide notoriety of the Project Beach’s recreational opportunities. Tourism is Maui’s largest industry, and tourist visits affect the local economy.

4.6.2 Tax Revenue Resource

The County of Maui collects transient accommodations tax from vacation rentals and also collects general excise tax from goods and services purchased by tourists. The County also collects property tax from local homeowners.

The State of Hawaii collects personal income tax from local homeowners, many of whom receive income from vacation rentals in their homes.

4.6.3 Financial Resource

There are no public funds available for beach preservation other than at the more famous and valuable Oahu beaches.

4.7 SOCIAL FACTORS

4.7.1 Neighborhood Resource

The Project Area neighbors choose to live in the Project Beach neighborhood as a matter of lifestyle, which is primarily related to their use and enjoyment of the Project Beach, plus some generate income from vacation rentals in their home.

5.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

5.1 INTRODUCTION

This Section describes the Environmental Consequences (impacts) to the Resources of the Affected Environment Factors that could result from implementation of the Proposed Action and the two Alternatives included for evaluation. Other Alternatives were identified and considered, but eliminated from further consideration because they did not meet the Need for and Purpose of Action. The impacts identified in this Section are either adverse, positive or none. For each identified potentially adverse impact, proposed Mitigation measures are prescribed to make the adverse impact inconsequential.

The descriptions in this Environmental Consequences Section are of the same heading and in the same order as are those of the Affected Environment Factors in Section 4.0 for continuity.

5.2 PHYSICAL FACTORS

5.2.1 Project Area Resource

5.2.1.a Location – Project Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action there will be no impact to the Project Area location.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative there will be no impact to the Project Area location.

   Mitigation Measures: No Mitigation measures are required.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative there will be no impact to the Project Area location.

   Mitigation Measures: No Mitigation measures are required.

5.2.1.b Beach – Project Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there would be no adverse impacts to the Project Area beach as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there would be a positive, long-term impact to the Project Area beach due to the preservation of beach width and sand volume that has been historically lost. The installation of longer lasting rock groins will continue the preservation of beach width and sand volume over time.

The preservation of the Project Area beach will consequently have the direct effect of preserving cultural and historic beach use, lateral beach access, visual character, beach habitat and land; plus the cumulative effects of preserving the vegetated shoreline, shoreline habitat, nearshore water quality and marine life health, neighborhood attraction, local economy and tax revenues (see Cover Photo).

Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term adverse impact to the Project Area beach because the beach will continue to erode and retreat with a high probability of permanent of beach loss over time as evidenced by the beach loss history at the Kahului Airport lands east of the Project Area and consequently results in loss of: land contributing land based pollution directly to the ocean (see Photo 7, page 19), water quality resulting in adverse impacts to the marine ecosystem (see Photo 6, page 18), vegetated shoreline and shoreline habitat, beach habitat, cultural and historic beach use, lateral public access, visual character neighborhood attraction, local economy and tax revenue (see Photo 4, page 17).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic the rate of beach erosion and consequently Project Area beach loss.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there would be no adverse impacts to the Project Area beach as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there would be a positive, long-term impact to the Project Area beach due to the preservation of beach width and sand volume that has been historically lost. The installation of the longer lasting groins combined with possible beach nourishment from Maui dune sand will continue the preservation of beach width and sand volume over time.

   The preservation of the Project Beach will consequently have the direct effect of preserving cultural and historic beach use, lateral beach access, visual character, beach habitat and land; plus will have a cumulative effect of preserving vegetated shoreline, shoreline habitat, nearshore water quality and marine life health, neighborhood attraction, local economy and tax revenues (see Cover Photo).

   Mitigation Measures: No Mitigation measures will be required.

5.2.1.c Land – Project Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to the Project Area land as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there will be a positive, long-term impact to the Project Area land due to the reduction of land lost. The installation of longer lasting groins will continue to stabilize and reduce the rate of beach erosion,

plus to preserve beach width and wave run-up area; thus not allowing the waves at high tides to hit the land embankments which then fall into the ocean (see Cover Photo).

The preservation of the Project Area land will directly reduce land based pollution from entering the ocean including: nitrogen from landscaping fertilizer plus from sewage leach fields and septic tanks causing algae growth and reef decline; from pesticides' toxic chemicals causing health risks to marine life; and from clay soils causing turbidity and water quality decline. Further, the reduction of land lost will preserve the home at the west end of the Project Beach whose foundation has been undermined and with the potential outcome of the home falling onto the beach and into the ocean, which would be another source of land based pollution.

Mitigation Measures: No Mitigation measures will be required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to the Project Area land because the land will continue to erode and be lost into the ocean (see Photo 7, page 17), consequently causing land based pollution, described Under the Proposed Action above, to directly enter the ocean and to adversely impact nearshore water quality and the health of marine life (see Photo 6, page 18). Also the home at the west end of the Project Beach may be lost due to an unsafe condition if land loss continues (see Photo 5, page17).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion and consequently Project Area land loss.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse impact to the Project Area land as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there will be a positive, long-term impact to the Project Area land due to the reduction of land lost. The installation of longer lasting rock groins combined with possible beach nourishment from Maui dune sand will continue to stabilize and reduce the rate of beach erosion, plus to preserve beach width and wave run-up area; thus not allowing the waves at high tides to hit the land embankments which then fall into the ocean (see Cover Photo).

   The preservation of the Project Area land will directly reduce land based pollution from entering the ocean including: nitrogen from landscaping fertilizer plus from sewage leach fields and septic tanks causing algae growth and reef decline; from pesticides' toxic chemicals causing health risks to marine life; and from clay soil causing turbidity and water quality decline. . Further, the reduction of land lost will preserve the home at the west end of the Project Beach whose foundation has been undermined and with the potential outcome of the home falling onto the beach and into the ocean, which would be another source of land based pollution.

   Mitigation Measures: No Mitigation measures will be required.

5.2.1.d Shoreline – Project Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there would be no adverse impacts to the Project Area shoreline as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there would be a positive, long-term impact to the Project Area shoreline due to the reduction of land lost and consequently shoreline vegetation lost. The installation of the longer lasting groins will continue to reduce and stabilize the historic rate of beach erosion plus maintain beach width and wave run-up area (see Cover Photo.); thus not allowing waves at high tides to hit land embankments and the vegetated shoreline which then fall into the ocean

   The preservation of the Project Area vegetated shoreline will also help reduce land erosion due to vegetation root structure stabilizing the soil, and the vegetated shoreline will have greater than localized benefits since it will consequently preserve the shoreline as habitat.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to the Project Area vegetated shoreline because the land and consequently the shoreline will continue to be eroded and lost into the ocean, resulting in a loss of any remaining vegetated shoreline for land erosion resistance and a permanent loss of shoreline habitat (see Photo 6, page 18).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion and consequently Project Area land loss and thus shoreline vegetation loss.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there would be no adverse impacts to the Project Area shoreline as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there would be a positive, long-term impact to the Project Area shoreline due to the reduction of land lost and consequently shoreline vegetation lost. The installation of the longer lasting groins combined with possible beach nourishment from Maui dune sand will continue to reduce and stabilize the historic rate of beach erosion plus maintain beach width and wave run-up area, thus not allowing the waves at high tides to hit the land embankments and vegetated shoreline which then fall into the ocean (see Cover Photo).

   The preservation of the Project Area vegetated shoreline will help reduce land erosion due to the vegetative root structure, and it will have greater than localized benefits since it will consequently preserve the shoreline as habitat.

   Mitigation Measures: No Mitigation measures are required.

5.2.2 Outside Project Area Resource

5.2.2.a Location – Outside Project Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no impact to the Outside Project Area location.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be no impact to the Outside Project Area location.

   Mitigation Measures: No Mitigation measures are required.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no impact to the Outside Project Area location.

   Mitigation Measures: No Mitigation measures are required.

5.2.2.b Beach – Outside Project Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no impact to the Outside Project Area downdrift beach (see Section 1.4) per the Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5). Recent reductions overall of Beach Width and Sand Volume at the downdrift beach at transect 12 are not attributed to the SSBN Evaluation Project, as described in the Two Year Beach Erosion Performance Monitoring/Metrics Report (see Appendix 9.2) and Section 1.7.5.

   Under the Proposed Action, there will be a positive impact to the Outside Project Area updrift beach per the Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5). This beach will continue to be preserved by the Proposed Action (see Cover Photo).

   Mitigation Measures: Mitigation Measures are proposed to help alleviate any possible beach erosion impact to the downdrift beach located at transect 1 by the Proposed Action. The Mitigation Measures include: 1) pre-fill or forthcoming natural fill of the replacement groin field, 2) preserving Project Beach sand during construction to maintain groin field pre-fill and 3) adding beach sand to the Project Beach during construction to increase pre-fill volume.

   During the fall and winter seasons, the Project Beach accretes sand from cross shore sand transport by large north Pacific waves; and during these seasons, longshore transport is minimal due to the predominate large wave direction, and NE trade winds are light to moderate. During the spring and summer seasons, north Pacific waves dissipate significantly and NE strong trade winds prevail causing a strong westerly current, beach erosion and longshore transport.

The potential exists for a new groin field to impound sand and interrupt longshore sand transport processes until the groin field is full. The benefit of the existing groin field is that it has already retained beach sand to prefill the replacement groin field in order to not adversely impact downdrift beaches. Proper timing of groin replacement is important so the existing groin field is either pre-filled or will be filled in the near future to assure a pre-filled replacement groin field.

Therefore as a Mitigation Measure, the Proposed Action will be implemented either when the existing groin field is sufficiently pre-filled, typically in the fall and winter; or when the forthcoming season will fill the new groin field, typically during late summer. These times also occur when longshore transport has subsided or will subside soon.

Figure 7, page 25 indicates during the first year after the one year equilibrating period that Project Beach Width was stable during the 2011 summer. Photo 12 taken 5 October 2011 shows the SSBN Evaluation Project groin field full of sand since the middle groins are buried and sand is at the top of the terminal groins at their updrift side.

Photo 12 – Project Beach Aerial Photograph, 5 October 2011

Per the data in Figure 5, page 24, there was approximately 10,128 cu. yds. of Beach Sand Volume on the Project Beach at the end of 2011 summer, which is an approximate 21% increase compared to the pre-construction beach sand volume.

Therefore, replacement groin field construction will occur when there is or will be in the near future at the Project Beach either: 1) a visual beach condition similar to the 5 October 2011 photograph as a criteria or 2) approximately 10,000 cu. yds. of existing Beach Sand Volume as a metric.

Another Mitigation Measure is the placement of excavated sand from the temporary groins' removal near the top of the beach above the high tide level, to the extent possible, to minimize the potential of existing beach sand migration from the Project Beach to maintain existing groin field pre-fill capacity.

An additional Mitigation Measure is the sand fill removed from the temporary geotube groins will be added to the Project Beach to increase existing groin field pre-fill capacity.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be no impact to the Outside Project Area downdrift area; however, the updrift beach will continue to erode and retreat as it has historically.

   Mitigation Measures: No Mitigation measures are required.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under the Proposed Action, there will be no impact to the Outside Project Area downdrift beach (see Section 1.4) per the Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5). Changes at the downdrift area are not attributed to the SSBN Evaluation Project, as noted in the Two Year Beach Erosion Performance Monitoring/Metrics Report. The changes are due to several factors including: the downdrift area having a continuously hardened shoreline with a long-term history of beach loss and advancing beach retreat, documented adverse erosion effects of seawalls to beaches in front and downdrift, too great of downdrift distance from the Project's closest groin to have effect downdrift areas and the ability of the Project's groins to allow the natural process of longshore sand transport.

   Under the Proposed Action, there will be a positive impact to the Outside Project Area updrift beach per the Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5). This beach will continue to be preserved by the Proposed Action (see Cover Photo).

   Mitigation Measures: The same Mitigation Measures will be implemented as for the Proposed Action described above.

5.2.2.c Land – Outside Project Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no impact to the Outside Project Area land, as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5), because almost all the areas outside the Project Area have seawalls to protect and preserve the land (see Section 1.4). The one area without a seawall across it entirely is immediately updrift of the Project Area, and this beach has been accreting sand since the implementation of the previous SSBN Evaluation Project which reduces the possibility of beach erosion and consequential land loss, which is a positive long-term impact.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will no impact to the Outside Project Area land due to its hardened shoreline.

   Mitigation Measures: No Mitigation measures are required.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand

Alternative: Under this Alternative, there will be no impact to the Outside Project area land, as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5), because almost all the areas outside the Project Area have seawalls to protect and preserve the land (see Section 1.4). The one area without a seawall across it entirely is immediately updrift of the Project Area, and this beach has been accreting sand since the implementation of the previous SSBN Evaluation Project which reduces the possibility of beach erosion and consequential land loss, which is a positive long-term impact.

Mitigation Measures: No Mitigation measures are required.

5.2.2.d Shoreline – Outside Project Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no impact to the Outside Project Area shoreline, as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5), because almost all of the areas downdrift and updrift Outside the Project Area have seawalls and no vegetated shoreline (see Section 1.4). The one area without a seawall across it entirely is updrift of the Project Area, and this beach has been accreting sand since the implementation of the previous SSBN Evaluation Project which reduces the possibility of beach erosion and consequential loss of vegetated shoreline, which is a positive long-term impact.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be no impact to the Outside Project Area shoreline due to its hardened shoreline.

   Mitigation Measures: No Mitigation measures are required.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no impact to the Outside Project area shoreline, as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5), because almost all of the areas downdrift and updrift outside the Project Area have seawalls and no vegetated shoreline (see Section 1.4). The one area without a seawall across it entirely is updrift of the Project Area, and this beach has been accreting sand since the implementation of the previous SSBN Evaluation Project which reduces the possibility of beach erosion and consequential loss of vegetated shoreline, which is a positive long-term impact.

   Mitigation Measures: No Mitigation measures are required.

5.2.3 Construction Staging And Beach Access Area Resource

5.2.3.a Location - Construction Staging and Beach Access Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no impact to the construction staging and beach access area location.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be no impact to the construction staging and beach access location.

   Mitigation Measures: No Mitigation measures are required.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no impact to the construction staging and beach access area location.

   Mitigation Measures: No Mitigation measures are required.

5.2.3.b Land - Construction Staging and Beach Access Area

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there is the potential to adversely impact the land of the construction staging and beach access areas (see 3.2.2.a) for the short-term during construction because of land disturbance causing storm runoff and dust, from petroleum products' polluting the land and because of loss of vegetation.

   Mitigation Measures: Mitigation Measures for Sediment and Pollution Control including storm runoff containment, dust control, fuel spill containment and clean-up, designated parking areas plus re-vegetation are part of the Project's Best Management Practices (see Section 3.2.3) to mitigate potential short-term impacts during construction.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be no impact to the construction staging and beach access area land.

   Mitigation Measures: No Mitigation measures are required.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there is the potential to adversely impact the land of the construction staging and beach access areas (see 3.2.2.a) for the short-term during construction because of land disturbance causing storm runoff and dust, from petroleum products' polluting the land and because of loss of vegetation.

   Mitigation Measures: Mitigation Measures for Sediment and Pollution Control including storm runoff containment, dust control, fuel spill containment and clean-up, designated parking areas plus re-vegetation are part of the Project's Best

Management Practices (see Section 3.2.2) to mitigate potential short-term impacts during construction.

5.3 OCEAN WATER QUALITY FACTORS

5.3.1 Nearshore Water Quality Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse, long-term impact to ocean nearshore water quality as evidenced by the positive Water Quality Performance Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there will be a positive, long-term impact to nearshore water quality. Preservation of the beach provides a buffer to land based pollution (see Cover Photo) and prevents the erosion of land resulting in a reduction of land based pollution from nitrogen and chemicals from fertilizers, sewage leach fields, septic tanks and pesticides, plus from eroded clay soil causing turbidity.

   Under the Proposed Action, there is the potential to adversely impact the nearshore water quality for the short-term during construction because of dirty groin rock, turbidity from sand discharge and from petroleum products' pollution.

   Mitigation Measures: Mitigation Measures for Sediment and Pollution Control including groin rock washing offsite, sediment discharge containment using silt curtains in water at groin construction zones and use of biodegradable lubricants for beach construction equipment are part of the Project's Best Management Practices (see Section 3.2.3) to mitigate any potential short-term impacts during construction.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to the nearshore water quality because continued beach erosion and land loss land loss 1.) eliminates the beach as a buffer to terrestrial pollution release (see Photo 7, page 19) and 2.) leads to release of chemical pollutants found in coastal lots including nitrogen from fertilizers and sewage treatment and toxins from pesticides plus increased turbidity due to suspension of clay and organic matter contained in the terrestrial soils that are washed away (see Photo 6, page 18).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion and consequently reducing the historic rate of land loss and land based pollution from directly entering the ocean.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse, long-term impact to ocean nearshore water quality as evidenced by the positive Water Quality Performance Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5). The relatively small quantity of Maui dune sand possibly used as beach nourishment (2% of Project Beach sand volume) will have no adverse impact to ocean nearshore water quality since the sand will be free of contaminants and be

of a similar grain size as existing at the same location on the Project Beach during the spring and summer seasons.

There will be a positive, long-term impact to nearshore water quality Preservation of the beach provides a buffer to land based pollution (see Cover Photo) and prevents the erosion of land resulting in a reduction of land based pollution from nitrogen and chemicals from fertilizers, sewage leach fields, septic tanks and pesticides, plus from eroded clay soil causing turbidity.

Under the Proposed Action, there is the potential to adversely impact the nearshore water quality for the short-term during construction because of dirty groin rock, turbidity from sand discharge and from petroleum products' pollution.

Mitigation Measures: Mitigation Measures for Sediment and Pollution Control including washing groin rock offsite, sediment discharge containment using silt curtains in water at groin construction zones, use of biodegradable lubricants for beach construction equipment and washing Maui Dune sand offsite if contaminated are part of the Project's Best Management Practices (see Section 3.2.3) to mitigate any potential short-term impacts during construction and possible subsequent beach nourishment with Maui dune sand.

5.3.2 Reef And Lagoon Water Quality Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to the fringing reef and intervening lagoon because of no adverse impact to nearshore water quality (see Section 5.3.1); however, there will be a positive, long-term impact to the health of the fringing reef and lagoon. Preservation of the beach provides a buffer to land based pollution (see Cover Photo) and prevents the erosion of land resulting in a reduction of land based pollution from nitrogen and chemicals from fertilizers, sewage leach fields, septic tanks and pesticides, plus from eroded clay soil causing turbidity. Coral reefs require pristine water quality for good health.

   Mitigation Measures: No additional Mitigation measures are required beyond those in Section 5.3.1 for nearshore water quality.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term adverse impact to the health of the fringing and intervening lagoon reef because of a continuation of adverse impacts to nearshore water quality due to the continuation of the historic loss of the beach as a buffer between land based pollution and the ocean and due to the continuation of historic land lost into the ocean and consequently a continuation of land base pollution to the nearshore waters from nitrogen and chemicals from fertilizers, sewage leach fields, septic tanks and pesticides (see Photo 7, page 19), plus from eroded clay soil causing turbidity (see Photo 6, page 18).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion and consequently reduce the historic rate of land loss and land based pollution from directly entering the ocean.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse impact to the fringing reef and intervening lagoon because of no adverse impact to nearshore water quality (see Section 5.3.1); however, there will be a positive, long-term impact to the health of the fringing reef and lagoon. Preservation of the beach provides a buffer to land based pollution (see Cover Photo) and prevents the erosion of land resulting in a reduction of land based pollution from nitrogen and chemicals from fertilizers, sewage leach fields, septic tanks and pesticides, plus from eroded clay soil causing turbidity. Coral reefs require pristine water quality for good health.

   Mitigation Measures: No additional Mitigation measures are required beyond those in Section 5.3.1 for nearshore water quality.

5.4 BIOLOGICAL FACTORS

5.4.1 Shorezone Habitat Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to the Project Beach shorezone habitat as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5) and by the recent Hawksbill Turtle nest and hatchlings at the Project Beach (see Photo 10, page 30); however, there will be a positive, long-term impact to Project Beach shorezone habitat. Preservation of the beach will also preserve shoreline vegetation, both of which have been habitat to endangered species including Hawaiian Turtles and Monk Seals (See Cover Photo). The recent Hawksbill Turtle nest and hatchlings at the Project Beach are preliminary evidence that the habitat has already become more suitable to the natural communities of Hawaiian shores.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to the Project Beach shorezone habitat because of continued beach and land loss with a consequential loss of beach and shoreline habitat (see Photo 6 and 7, pages 18 and 19).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion and consequently preserve the beach as habitat and to reduce the rate of historic land loss and thus the loss of shoreline vegetation as habitat.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse, long-term impact to the Project Beach shorezone habitat as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5) and by the recent Hawksbill Turtle nest and hatchlings at the Project Beach (see Photo 10, page 30). The beach nourishment sand location is at

the top of the beach along and not in the shoreline. The nourishment sand will gradually release down the beach to the ocean as does natural beach dune sand.

There will be a positive, long-term impact to the Project Beach shorezone habitat. Preservation of the beach will also preserve shoreline vegetation, both of which have been habitat to endangered species including Hawaiian Turtles and Monk Seals (See Cover Photo). The recent Hawksbill Turtle nest and hatchlings at the Project Beach are preliminary evidence that the habitat has already become more suitable to the natural communities of Hawaiian shores.

Mitigation Measures: No Mitigation measures are required.

5.4.2 Nearshore Benthic Habitat Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to the nearshore benthic habitat as evidenced by the positive Benthic Habitat Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there will be a positive, long-term impact to nearshore benthic habitat. Preservation of the beach will help preserve water quality (see Section 5.3.1) and consequently benthic habitat.

   Mitigation Measures: No additional Mitigation measures are required beyond those in Section 5.3.1 for nearshore water quality.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to the nearshore benthic habitat because of the adverse impact to water quality due to the continued loss of the beach as a buffer between land based pollution and the ocean and due to the continuation of land lost into the ocean and consequently resulting in a continuation of land based pollution from nitrogen and chemicals from fertilizers, sewage leach fields, septic tanks and pesticides (see Photo 7, page 19), plus from eroded clay soil causing turbidity (see Photo 6, page 18).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion and consequently reduce the historic rate of land loss and land based pollution from directly entering the ocean thus improving the health of nearshore benthic habitat.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse impact to the nearshore benthic habitat as evidenced by the positive Benthic Habitat Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project The relatively small quantity of Maui dune sand possibly used as beach nourishment (2%) of Project Beach sand volume) will have no adverse impact to ocean nearshore water quality since the sand will be free of contaminants and be of a similar grain size as existing on the Project Beach at the same location during the spring and summer seasons.

Preservation of the beach will help preserve water quality (see Section 5.3.1) and consequently benthic habitat.

Mitigation Measures: No additional Mitigation measures are required beyond those in Section 5.3.1 for nearshore water quality.

5.5 CULTURAL AND HISTORIC FACTORS

5.5.1 Cultural Artifacts And Burials Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to cultural artifacts and burials as evidenced by the experience of the previously implemented SSBN Evaluation Project which had the same excavation depths and locations on the Project Beach as the proposed groins. No artifacts or burial remains were discovered then. Also during previous beach erosion seasons when areas of the beach width and sand volume were lost down to the hard rock shelf, no artifacts or burials were observed.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be no impact to cultural artifacts and burials.

   Mitigation Measures: No Mitigation measures are required.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse impact to cultural artifacts and burials as evidenced by the experience of the previously implemented SSBN Evaluation Project which had the construction same excavation depths and locations on the Project Beach as the proposed groins. No artifacts or burial remains were discovered then. Also during previous beach erosion seasons when areas of the beach width and sand volume were lost down to the hard rock shelf, no artifacts or burials were observed.

   Mitigation Measures: No Mitigation measures are required.

5.5.2 Cultural and Recreation Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to beach cultural and recreational beach use as evidenced by the positive beach erosion rate reduction per the Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there will be a positive, long-term impact to beach use. Preservation of the beach will preserve beach width and sand volume throughout the year (see Cover Photo) and consequentially preserve historic cultural and recreational beach uses.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to recreational beach use because of the continuation of beach erosion resulting in the possible, permanent loss of the beach, the continuation of fallen trees from the eroded land onto the beach (see Photo 4, page 17) and a decline of nearshore water quality (see Photo 6, page 18).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion and beach loss which consequently preserves beach recreation and reduces land erosion, which protects shoreline trees from falling onto the beach and nearshore water quality from land based pollutants.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse impact to cultural and recreational beach use as evidenced by the positive beach erosion reduction per the Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there will be a positive, long-term impact to beach recreation use. Preservation of the beach will preserve beach width and sand volume throughout the year (see Cover Photo) and consequentially preserve historic cultural and recreational beach uses.

   Mitigation Measures: No Mitigation measures are required.

5.5.3 Lateral Beach Access Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to lateral beach access as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there will be a positive, long-term impact to lateral beach access. Preservation of the beach will preserve lateral public access (see Cover Photo) and prevent land loss with falling trees onto the beach.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to lateral beach because of the continuation of the beach erosion resulting in possible, permanent beach loss (see Photo 6, page 18) and of land lost with fallen trees on the beach from the eroded land onto the beach (see Photo 4, page 17).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion, which otherwise may result in permanent beach loss, and to reduce the historic rate of land erosion which will result in fallen trees onto the beach from land erosion and thus the loss of safe and passable lateral beach access.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse impact to lateral beach access as evidenced by the positive Beach Erosion Monitoring and Performance Assessments of the previously implemented SSBN Evaluation Project (see Section 1.7.5); however, there will be a positive, long-term impact to lateral beach access. Preservation of the beach will preserve lateral public access (see Cover Photo) and prevent land loss with falling trees onto the beach.

   Mitigation Measures: No Mitigation measures are required.

5.5.4 Visual Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no impact to scenic vistas from the Project Beach, and there will be a long-term positive impact to the preservation of visual character by preserving the beach (see Cover Photo) compared to previous seasonal conditions when the beach and land eroded resulting in beach width and sand volume reduction, land banks with exposed utilities, ocean turbidity and fallen trees on the beach (see Photos 4, 6 and 7, pages 17, 18 and 19).

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to the visual character of the beach during seasonal periods when the beach has significant erosion resulting in beach width and sand volume reduction (see Photo 6, page 18) and in land erosion resulting in exposed land banks (see Photo 7, page 19), ocean turbidity from clay soil erosion (see Photo 6, page 18) and fallen trees onto the beach (see Photo 4, page 17).

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (natural rock groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion and of historic land loss thus preserving the visual character of the beach.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no impact to scenic vistas from the Project Beach, and there will be a long-term positive impact to the preservation of visual character by preserving the beach (see Cover Photo) compared to previous seasonal conditions when the beach and land eroded resulting in beach width and sand volume reduction, land banks with exposed utilities, ocean turbidity and fallen trees on the beach (see Photos 4, 6 and 7, pages 17, 18 and 19).

   Mitigation Measures: No Mitigation measures are required.

5.6 ECONOMIC FACTORS

5.6.1 Local Economy Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to the local economy; however, there will be long-term, positive impact to the local economy. Preservation of the beach will preserve the beach attraction to mainland and international tourists (see Cover Photo). Tourists routinely visit and stay near the Project Beach for its visual character, windsurfing and kite boarding. Tourism spending for local goods, services and accommodations helps the local economy plus provides employment for residents.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to the local economy because of the continuation of beach erosion, land loss and possible permanent beach loss (see Photos 4 and 6, pages 16 and 17). Visitations from mainland and international tourists may be reduced, thus reducing goods and services purchased by tourists and rental income to residents.

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to preserve Project Beach use and attraction for tourists and consequently preserving tourists' spending for local goods and services plus renting from local residents.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse impact to the local economy; however, there will be long-term, positive impact to the local economy. Preservation of the beach will preserve the beach attraction to mainland and international tourists (see Cover Photo). Tourists routinely visit and stay near the Project Beach for its visual character, windsurfing and kite boarding. Tourism spending for local goods, services and accommodations helps the local economy plus provides employment for residents.

   Mitigation Measures: No Mitigation measures are required.

5.6.2 Tax Revenue Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to tax revenues; however, there will a long-term positive impact to tax revenues. Preservation of the beach will preserve the beach attraction for tourists (see Cover Photo) and consequently preserve tourism spending for local goods, services and accommodations. Tourism spending contributes to County and State revenue from transient accommodation tax, general excise tax, personal income tax of residents and local homeowners who receive employment and rental income, plus property tax from local property owners whose property values are preserved due to the beach and land preservation.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, County and State tax revenues will be adversely impacted by reduced revenues from transient accommodation tax, general excise tax, personal income tax from local homeowners who would otherwise receive employment and rental income plus property tax from local property owners whose property values are decreased if there is a continuation of beach erosion, possible permanent beach loss and land loss (see Photos 4 and 5, pages 17 and 18). Additional land erosion at the foundation of the residence at the west end of the Project Beach (see Photo 5, page18) will continue Under the No Action Alternative, thus threatening the building's safety and ability to be occupied which will result in a loss of neighborhood property values and property tax revenue to the County.

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to reduce and stabilize the historic rate of beach erosion and of historic land loss preserving the beach use and attraction for tourists and consequently preserving County and State revenue from tourism and from local property owners whose property values are preserved.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse impact to tax revenues; however, there will a long-term positive impact to tax revenues. Preservation of the beach will preserve the beach attraction for tourists (see Cover Photo) and consequently preserve tourism spending for local goods, services and accommodations. Tourism spending contributes to County and State revenue from transient accommodation tax, general excise tax, personal income tax of residents and local homeowners who receive employment and rental income, plus property tax from local property owners whose property values are preserved due to the beach and land preservation.

   Mitigation Measures: No Mitigation measures are required.

5.6.3 Financial Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be no adverse impact to public County and State funds since the Project's construction cost is to be paid with private funds by the Applicant.

   Mitigation Measures: No Mitigation measures are required.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be no impact.

   Mitigation Measures: No Mitigation measures are required.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be no adverse impact to public County and State funds since the Project's construction cost is to be paid with private funds by the Applicant.

   Mitigation Measures: No Mitigation measures are required.

5.7 SOCIAL FACTORS

5.7.1 Neighborhood Resource

1. Environmental Consequences of Proposed Action: Under the Proposed Action, there will be a short-term and no long-term, adverse impact to the neighborhood; however, there will be a long-term, positive impact. Preservation of the beach will preserve the Project Beach for neighbors to use and enjoy (see Cover Photo).

   Mitigation Measures: Mitigation Measures for Neighborhood Comfort Control including controls for dust, noise, construction hours, safety and parking are part of the Project's Best Management Practices (see Section 3.2.3) to offset the potential short-term impacts during construction.

2. Environmental Consequences of No Action Alternative: Under the No Action Alternative, there will be a long-term, adverse impact to the neighborhood and neighbors because of the continuation of historic beach erosion and historic land loss (see Photos 4 and 6, pages 17 and 18) consequently diminishing the Project Beach usability and enjoyment for all neighbors to use and enjoy.

   Mitigation Measures: The Mitigation measure required is the installation of beach sand retention devices (groins) per the Proposed Action to preserving Project Beach use and enjoyment for neighbors and consequently preserving neighborhood character and stability.

3. Environmental Consequences of Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Alternative: Under this Alternative, there will be a short-term and no long-term, adverse impact to the neighborhood; however, there will be a long-term, positive impact. Preservation of the beach will preserve the Project Beach for neighbors to use and enjoy (see Cover Photo).

   Mitigation Measures: No Mitigation measures are required.

5.8 CUMULATIVE IMPACTS

5.8.1 Proposed Action

The Proposed Action will have no long-term, adverse environmental impacts and thus no cumulative, long-term adverse impacts. The Proposed Action will, however, have several direct and cumulative positive impacts including preserving the following:

- Beach
- Cultural and historic beach uses
- Lateral beach access
- Visual character
- Beach habitat
- Land
- Vegetated shoreline

- Shoreline habitat
- Nearshore water quality
- Marine life health
- Lagoon and reef water quality and health
- Neighborhood attraction
- Neighborhood property values
- Local economy
- County and State tax revenues

5.8.2 No Action Alternative

The No Action Alternative would have Significant short- and long-term, localized and regional, plus cumulative adverse environmental impacts. Figure 19 indicates cumulative, adverse impacts of the No Action Alternative:

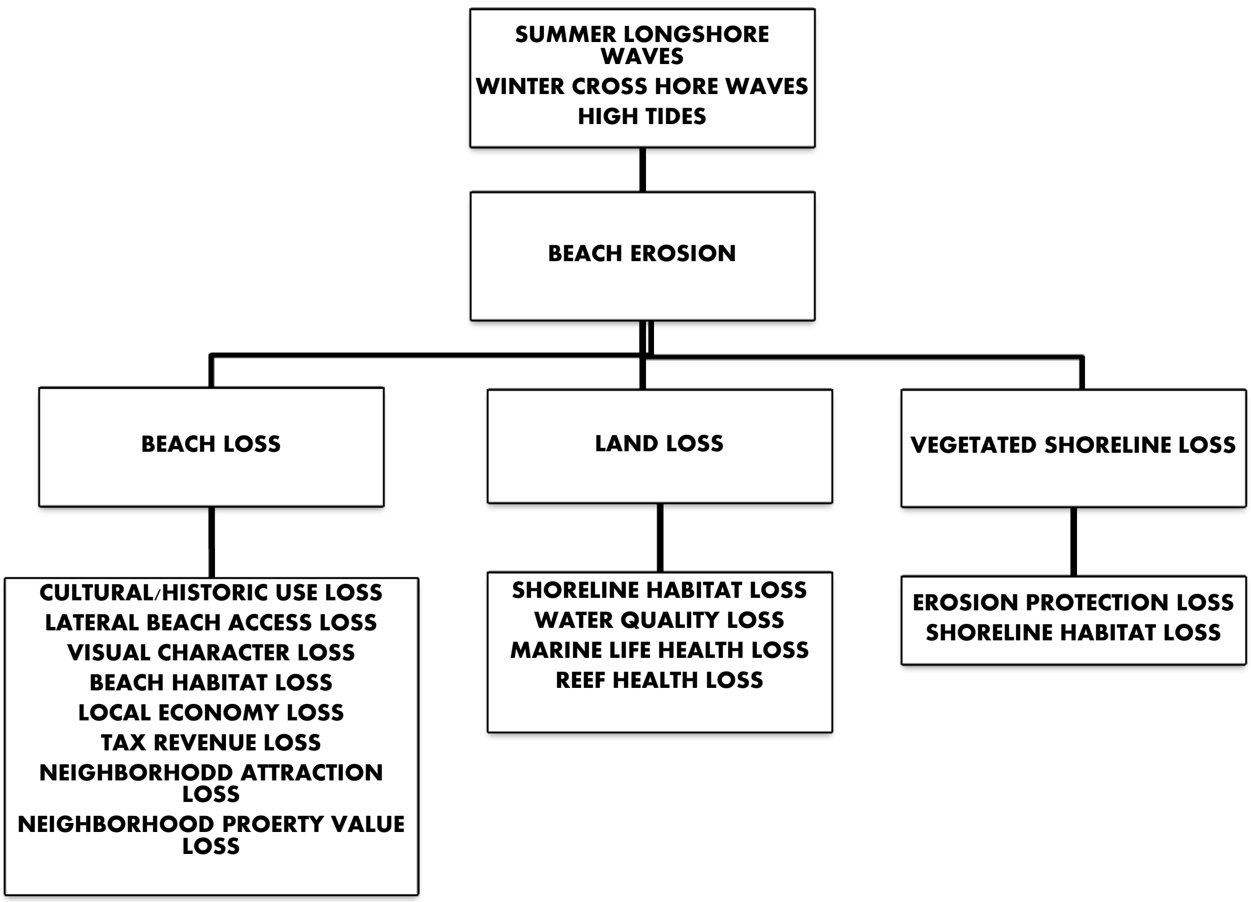

Figure 19 – No Action Alternative Cumulative, Adverse Effects Chart

5.8.3 Replace Existing Geotube Groins With Rock Groins Combined With Possibly Nourish Project Beach With Inland Sand Alternative

This Alternative will have no long-term, adverse environmental impacts and thus no cumulative, long-term adverse impacts. This Alternative will, however, have several direct and cumulative positive impacts including preserving the following:

- Beach
- Cultural and historic beach uses
- Lateral beach access
- Visual character
- Beach habitat
- Land
- Vegetated shoreline
- Shoreline habitat
- Nearshore water quality
- Marine life health
- Lagoon and reef water quality and health
- Neighborhood attraction
- Neighborhood property values
- Local economy
- County and State tax revenues

6.0 DETERMINATION

6.1 Decisions Needed

Decisions required to be made regarding the information in this document per Hawaii Administrative Rules, Title 11, Chapter 200 and Hawaii Revised Statutes, Chapter 343 include the following:

- Whether any significant issues have been raised by the Proposed Action or any of the Alternative Actions.
- Whether the Proposed Action or any of the Alternative Actions would result in Significant Impact to the environment.
- Whether a Finding of No Significant Impact (FONSI) may be made from the Environmental Assessment of the Proposed Action or will the Applicant be required to prepare an Environmental Impact Statement (EIS).

6.2 Environmental Impact

The Proposed Action is to remove four existing, temporary geotube groins of a previously implemented and successful and pilot project - Small Scale Beach Nourishment Evaluation Project (SSBN MA 08-01) and to replace the temporary groins with three or four longer lasting, rock groins in the same general location and the same scale as existing.

The construction activity of the Proposed Action includes placing sediment retention barrier, removal and disposal of the existing groins' geotextile material, beach sand excavation for the placement of the new rock groins, placement of new groin rock and backfill around the groin rock with the excavated sand.

Based on eight seasons of environmental monitoring and performance assessments of the SSBN Evaluation Project which produced empirical data from 2010 to 2012, the Proposed Action will have no adverse, short-term or long-term, localized or regional, primary or secondary plus individual or cumulative impacts to the environment. Any potential adverse, short-term impacts of slightly increased turbidity will be mitigated on site to be non-existent or less than significant, and they certainly will be less significant than those of the SSBN Evaluation Project, which were shown to be insignificant. To mitigate a potentially adverse impact to downdrift beaches, the existing groin field is sufficiently pre-filled with naturally accreted sand to not impound sand and interrupt longshore sand transport.

On the other hand, there are several significant positive environmental impacts that will result from implementing the Proposed Action. Per Section 4.0 Environmental Consequences and Mitigation Measures, the Proposed Action results in twelve positive long-term, localized and regional, primary and secondary, cumulative environmental impacts to important Resources of the Affected Environmental Factors. The Action Alternative considered for assessment (see Section 3.4); provides the same twelve positive benefits. The No Action Alternative results in fourteen adverse long-term, localized and regional, primary and secondary plus individual and cumulative environmental impacts to the same Resources (see Table 1).

Resource of Affected Environment Factor	Proposed Action Impact	No Action Alternative Impact	Replace Existing Geotube Groins with Rock Groins Combined with Possibly Nourish Project Beach with Inland Sand Altern.
Project Area Location	None	None	None
Project Area Beach	Positive	Negative	Positive
Project Area Land	Positive	Negative	Positive
Project Area Shoreline Vegetation	Positive	Negative	Positive
Outside Project Area Location	None	None	None
Outside Project Area Beach	None w/ Mitigation	None	None w/ Mitigation
Outside Project Area Land	None	None	None
Outside Project Area Shoreline Vegetation	None	None	None
Construction Staging/Beach Access Location	None	None	None
Construction Staging/Beach Access Land	None w/ Mitigation	None	None w/ Mitigation
Ocean Nearshore Water Quality	None w/ Mitigation	Negative	None w/ Mitigation
Ocean Marine Life and Reef Health	Positive	Negative	Positive
Shorezone Habitat	Positive	Negative	Positive
Nearshore Benthic Habitat	Positive	Negative	Positive
Cultural Artifacts	None	None	None
Recreational Beach Use	Positive	Negative	Positive
Lateral Beach Access	Positive	Negative	Positive
Visual Character	Positive	Negative	Positive
Local Economy	Positive	Negative	Positive
Tax Revenue	Positive	Negative	Positive
Financial Resource	Positive	Negative	Positive
Neighborhood	None w/ Mitigation	Negative	None w/ Mitigation

Table 1 – Affected Environment Factors Summary

The Mitigation indicated in the Table 1 is required to offset any possible adverse short-term environmental impact during construction so any impact may be non-existent or less than Significant.

6.3 Significant Criteria

Based on "Significant Criteria" listed in Section 12 of Hawaii Administrative Rules Title 11, Chapter 200, an Applicant or agency must determine whether an action may have a Significant Impact on the environment, including all phases of the project; expected consequences both primary and secondary; its cumulative impact with other projects and its short and long term impacts. In making the Determination, the following "Significant Criteria" Rules established by the HAR were used as the basis for identifying whether the Proposed Action has any Significant Impact. Review of the Significant Criteria reached the following conclusions:

1. **Irrevocable commitment to loss or destruction of any natural or cultural resource**

   No - the Proposed Action will be implemented on the Project Beach similar to the previously approved and successfully performing SSBN Evaluation Project which has not resulted in an irrevocable commitment to loss or destruction to any natural resource or cultural resource. Conversely, the Proposed Action will preserve the quality of the Project Beach and ocean waters, including for cultural uses. No cultural resource was encountered during previous excavations of the same areas, so none will be impacted.

2. **Curtails the range of beneficial uses of the environment.**

   No - the Proposed Action will not curtail the range of historic, cultural and visual beneficial uses of the beach and ocean; but will positively preserve, to the extent possible, the ability of the public to beneficially use and enjoy the beach and access the ocean.

3. **Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders.**

   No - the Proposed Action will not conflict with the State's long-term environmental policies, goals and guidelines, and will positively allow the previously approved beach erosion control to last longer with longer-term benefits.

4. **Substantially affects the economic welfare, social welfare, and cultural practices of the community or State.**

   No - the Proposed Action will not substantially affect the economic welfare, social welfare and cultural practices of the community or State, but it will preserve the local economic income from tourist vacation rentals and spending for goods and services; will preserve the economic value of local properties and income to homeowners who rent rooms to tourists; will preserve the social welfare of neighbors and public who are attracted to, use and enjoy the Project Beach; and will preserve the beach and nearshore water quality for cultural practices.

5. **Substantially affects public health.**

   No - the proposed Action will not adversely affect public health, but will positively affect it by preserving the beach as a buffer from land based pollution to the ocean.

6. **Involves substantial secondary impacts, such as population changes or effects on public facilities.**

   No - the Proposed Action will have no secondary impacts on population changes or effect public facilities; but by preserving the beach, it may reduce the public burden of maintaining an important public beach.

7. **Involves a substantial degradation of environmental quality.**

   No - the Proposed Action will not involve a degradation of environmental quality; but it will positively improve environmental quality by preserving beach, land, shoreline vegetation, beach and shoreline habitat, water quality plus marine life and reef health.

8. **Is individually limited and cumulatively has considerable effect upon the environment or involves a commitment for larger actions.**

   No - the Proposed Action has no individual or cumulative adverse effect upon the environment, nor does it involve a commitment for larger actions. The Proposed Action does however reduce the public burden to provide a larger action to preserve important environmental resources.

9. **Substantially affects a rare, threatened, or endangered species, or its habitat.**

   No - the Proposed Action does not adversely affect a rare, threatened or endangered species, or its habitat; however, it does positively preserve the beach and shoreline habitat for protected species including Green and Hawksbill Turtles plus the Hawaiian Monk Seal, which frequent the Project Beach.

10. **Detrimentally affects air or water quality or ambient noise levels.**

    No - the Proposed Action will not detrimentally affect air or water quality or ambient noise levels. The proposed Action has the potential to adversely affect short-term, localized air and water quality plus ambient noise levels during the short construction period, but the effects will be mitigated to be non-existent or less than substantial by the Project's BMP's.

11. **Affects or is likely to suffer damage by being located in an environmentally sensitive area such as flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal views.**

    No - the Proposed Action will not affect or is likely to suffer damage by being located in an environmentally sensitive area which is classified as flood zone, tsunami zone, beach, erosion-prone and coastal view area because similar rock groins located at the beach immediately west of the Project Area have been in place before 1940, and they have not been adversely affected or significantly damaged by the flood zone, previous tsunamis, beach erosion or land and erosion. Also, the Project Beach and temporary groins were not damaged by the recent 2011 tsunami. The Project Beach condition as a result of the temporary groins protected adjacent developed land from erosion. Because the temporary groins preserved the Project Beach, the beach as a visual resource has been maintained.

12. **Substantially affects scenic vistas and view planes identified in County or State plans or studies.**

    No - the Proposed Action will not substantially affect scenic vistas and view planes identified in County or State plans or studies because the height of the proposed rock groins are relatively low to the water and the beach profile. The groins will be partially buried by beach sand and will not affect scenic vistas or view planes. The proposed groins are a visual improvement compared to a lost beach that could result if the Project Beach is not preserved by the Proposed Action.

13. **Requires substantial energy consumption.**

    No - the Proposed Action will not result in substantial energy consumption, except for a relatively small amount of fuel consumed during the short construction period by equipment.

6.4 Notice of Anticipated Determination - Finding of No Significant Impact (FONSI)

Based on the analysis of Environmental Impacts (Section 6.2) and Significant Criteria (Section 6.3) of this Environmental Assessment and in accordance with provisions of Hawaii Revised Statutes (HRS), Chapter 343 and Hawaii Administrative Rules (HAR) 11-200, there is no adverse short-term or long-term, localized or regional, primary or secondary plus individual or cumulative impact to the environment from the Proposed Action. As such, a Notice of Anticipated Determination of a Finding of No Significant Impact (FONSI) for the Proposed Action is appropriate.

Based on a Finding of No Significant Impact (FONSI), no Environmental Impact Statement should be necessary.

6.5 Reasons Supporting Anticipated Determination

The nature and scale of the Proposed Action are such that no Significant Impact is anticipated. This is based on the success of eight seasons of environmental monitoring and performance assessment of the previously implemented SSBN Evaluation Project which has four groins of the same scale and in the same locations as the Proposed Action.

The previously approved SSBN Evaluation Project was scoped and reviewed for two and one-half years by at least fourteen different Federal, State and County agencies as well as by several interested groups and individuals. It had thorough scoping, review, scrutiny and input before its implementation.

The previously reviewed and implemented SSBN Evaluation Project has produced positive results with valuable, non-theoretical, empirical data for an accurate and reliable environmental assessment of the Proposed Action.

There are twelve positive, long-term environmental impacts of the Proposed Action which are beneficial to the environment and the public. The relatively few possible negative, short-term environmental impacts of the Proposed Action during construction

identified in this EA can be avoided, mitigated and minimized to be less than Significant through implementation of proven construction phase Best Management Practices (BMP's).

Without the Proposed Action or under the No Action Alternative, there will be a continuation of long-term adverse, cumulative impact to the environment.

The Proposed Action is consistent with the positive evaluation of Significant Criteria in HAR, Title 11, Chapter 200 and HRS, Chapter 343 to make a Finding of No Significant Impact (FONSI).

The Proposed Action is consistent with the following Federal, State and County Plans, Programs and Policies:

<u>County of Maui</u> – Beach Management Plan

<u>State of Hawaii</u> – Coastal Zone Management Program
Integrated Shoreline Policy
Shoreline Hardening Policy
Coastal Management Policy

<u>Federal</u> – Coastal Zone Management Program

7.0 LIST OF CONTRIBUTORS

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8.0 LIST OF REQUIRED PERMITS AND APPROVALS

County of Maui - Special Management Area and Shoreline Setback

State of Hawaii - Department of Land and Natural Resources, Office of Conservation and Coastal Lands - Conservation District Use Permit (CDUP)

Department of Land and Natural Resources, Land Division - Right of Entry Permit and possible modification of existing Revocable Permit for groins located on State land

Department of Health, Clean Water Branch – Water Quality Certification, Section 4040 Clean Water Act

Federal - U. S. Army Corps of Engineers - Section 10 of Rivers and Harbors Act and Section 404 Clean Water Act

9.0 APPENDIX

9.1 Summary and Conclusions Report - One Year, Post-Construction Performance Monitoring, 31 July 2011

9.2 Two Year Beach Erosion Performance Monitoring and Metrics Report, 15 April 2012

9.3 Performance Monitoring and Criteria/Metrics Guidelines for Water Quality, 31 August 2011

9.4 Comments and Responses to Draft Environmental Assessment

(To Be Inserted When Available)

APPENDIX - 9.1 Summary and Conclusions Report – One Year, Post-Construction Performance Monitoring

STABLE ROAD BEACH NOURISHMENT EVALUATION PROJECT
SSBN MA 08-01 & WQC 0000751/DA - POH-2008-00064

SUMMARY REPORT & CONCLUSIONS

ONE YEAR, POST-CONSTRUCTION PERFORMANCE MONITORING

31 July 2011

Prepared for:
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1.0 PROJECT BACKGROUND

1.1 Project Need:

The Annual Erosion Hazard Rate Map for the Project Area established by the University of Hawaii from historical photos until 2002 has been 1.5 feet per year, and the average beach width across the Project Area has decreased 10% from 1960 to 2002; whereas, the beach width downdrift, where there are 11 rock groins, has increased 42% during the same period.

Starting in 2006, the Project Beach experienced up to a three-fold increase in annual erosion compared to previous years with considerable seasonal beach sand loss and permanent land loss (see Photo 1).

Recently, the U.S. Army Corps of Engineers performed a Regional Sediment Management study for Maui's north shore based on more recent photographic data from 2007, and it determined the Project region is now within the fastest eroding zone on Maui's north shore with a substantial increase to its annual erosion rate and sediment loss.

Photo 1- Beach and Land Loss at East End of Project Beach, 22 August 2006

With the increased annual erosion starting in 2006, the Project Area has consequently experienced the following adverse environmental effects:

- A seasonal loss of beach width and thus recreational use and lateral beach access, which is dangerous at high tides and during large surf (see Photo 1).

- A permanent loss of land falling into the ocean, thus jeopardizing water quality, marine life and reef health from exposed sewage leach field pipes with directly discharged sewage waste, reduced leach field areas, land based fertilizers, toxic chemicals and clay soil turbidity (see Photos 2 and 3).

Photo 2 - Beach and Land Loss within Project Area, 4 August 2009 - Pre-Construction

- A loss of beach and shoreline, thus a loss of habitat to endangered species including the Hawaiian Monk Seal, Green and Hawksbill Sea Turtles plus shore birds (see Photo 3).

- The land of a home at the west end of the Project Beach has eroded to expose the building foundation, thus jeopardizing the home's safety and environment (see Photo 4).

Photo 3 – Beach and Land Loss with Land Pollution at Project Beach, August 2008

Photo 4- Beach and Land Loss at West End of Project Beach, 23 August 2010

1.2 History of Seasonal Changes:

The coastline of the Project Area plus updrift and downdrift beaches has an established and predictable, seasonal pattern of sand accretion and sand loss because of the coastline orientation to seasonal waves. During the fall and winter seasons, the beaches gain sand from cross shore sand transport caused by north Pacific storms and on-shore waves, coupled with diminished trade winds. The same beaches lose sand in the spring and summer seasons due to longshore currents and side-shore waves caused by strong trade winds and side-shore wind swells.

During the spring and summer seasons, the longshore currents and waves scour the Project Beach and transport beach sand laterally resulting in reduced beach width and beach sand volume, especially during periods of high tides. When the beach sand is lost, the beach width is reduced, and then the longshore waves scour and erode the exposed land embankments, resulting in land loss. Although the beach may re-gain sand during the next fall and winter accretion seasons, there is no replacement for the lost land, which has resulted in shoreline retreat inland each year.

Beach loss and then land loss start at the east end of the Project Beach during the spring and summer seasons, and this loss is accelerated by the immediate updrift seawall. During the winter when the waves change direction to on-shore, beach loss and then land loss has occurred at the west end of the Project Beach, and this loss is caused by the adjoining rock revetment to the west creating an eddy.

1.3 Project Intent, Description and Design:

The Project Intent is to preserve the Project Beach and to prevent land loss for environmental and public benefit without adversely affecting the nearshore environment including updrift and downdrift beaches.

The Project Description is a Small Scale Beach Nourishment (SSBN) Project with beach nourishment from dredging, pumping and placing clean, offshore sand of the same color and grain size as the beach sand in three cells at the Project Beach between four, temporary sand retention devices (groins). The groins are temporary for evaluation purposes and constructed of geotextile tubes filled with beach sand.

The Project Design included both beach nourishment and groins to retain sand. There were two benefits of beach nourishment: First, it was anticipated that the installation of the Project's groin field may temporarily slow the rate of longshore sand transport from and through the Project Area until the groin field became full of sand. The pumped and placed sand was intended to fill the cells of the groin field in order for it to reach its containment capacity, thus not trapping sand and to allow longshore sand transport immediately after construction. Second, the Project Beach was deficient of sand due to its inability to retain naturally accreted sand during the fall and winter seasons, and the beach nourishment would help compensate for the recently increased high rate of annual erosion.

Without the groins, the pumped beach nourishment sand plus the natural fall and winter seasons' accreted sand would disappear from the beach in a short time, as has historically occurred during the spring and summer seasons. The groin field was designed to retain a sufficient volume of sand on the Project Beach between groins in order to preserve the beach and to protect the land from seasonal erosion, as well as to allow for the continuation of natural, longshore sand transport through and from the Project Area around and over the submerged, seaward ends of the four groins for the benefit of the downdrift beaches.

1.4 Environmental Monitoring Plans Development:

During the Project's permit applications' processing and review by 14 Federal, State and County agencies plus by several interested citizens and groups, comments were received regarding specific environmental issues of concern. Due to uniqueness of the Project, there was uncertainty as to the Project's performance and environmental effects, thus conditions were included in the Project's Approvals requiring post-construction monitoring and impact assessments focused on the identified areas of concern.

Environmental Monitoring Plans were developed by the applicant and its environmental consultants to establish protocol, Performance Criteria/Metrics and Remedial Actions if there were possible non-compliance with the Performance Criteria/Metrics. The draft Plans were reviewed by the same governmental agencies plus interested individuals and groups before their finalization into Performance Monitoring and Metrics Guidelines for Water Quality, for Benthic Habitat and for Beach Erosion, plus into a Lateral Beach Access Plan.

1.5 Performance Monitoring:

Project monitoring programs included: procedures, study areas, frequencies and duration, analytical methodology, data assessment, plus performance criteria and metrics, which were established in each Guideline. Monitoring started pre-construction for Water Quality, Benthic Habitat and Beach Erosion to establish baseline conditions pre-construction, which provided the basis for Project performance data assessments and comparison to measure and determine Project success. Monitoring during construction included Water Quality and

Lateral Beach Access, and monitoring post-construction included all four aspects per the Guidelines. Periodic Monitoring Reports have been submitted to the appropriate governmental agencies in accordance with Approvals' conditions, and this Report is a Summary of the previous Reports' monitoring and Project performance assessments. Monitoring for each environmental factor was required to occur post-construction for three years, or until "there was no change of conditions attributable to the Project", other than positive effects.

1.6 Groin Field Installation and Beach Nourishment:

Project construction started 7 April 2010 with the temporary groins' installation complete by 5 May, beach nourishment sand dredging and pumping from 6 May until 8 June and sand placement/beach shaping by 25 June 2010.

The beach nourishment goal was to dredge and pump 6,000 cubic yards of the SSBN approved 10,000 cubic yards of offshore sand to the Project Area; however, only approximately 2,886 cubic yards was able to be pumped and placed on the Project Beach due to a continuation of extremely windy conditions and accumulating equipment fatigue. Once the dredging/pumping stopped, immediately thereafter the height of the center two groins on the beach was lowered by removing the two groins' sand filled, top tubes to lower the designed beach height by 50% and thus the groin field's 6,000 cubic yard containment capacity by 50%, in order for the groin field containment capacity to be commensurate with the actual volume of pumped and placed sand (2,886 cubic yards).

Despite this change of design, the Project's temporary groin field has performed well to preserve sand and land at the Project Beach and to allow longshore sand transport to naturally occur from, within and through the Project Beach from updrift to downdrift beaches.

2.0 PERFORMANCE MONITORING

2.1 Water Quality

2.1.1 Monitoring Program: Monitoring of Water Quality was intended to observe and record if there were any adverse environmental effects to ocean Water Quality attributable to the Project from construction equipment; dredging, pumping and placing sand; and increased sand movement after construction.

The possible pollution from equipment oils, grease and fuels was anticipated to be minimal since Best Management Practices were utilized to restrict areas of refueling, to prevent possible spillages and to immediately contain any possible spillages. Monitoring for this source of possible pollution was by visual means.

The possible pollution from dredging, pumping and placing sand plus sand movement was suspended sediment measured by ocean water turbidity. Turbidity was monitored by visual means for plumes in the ocean, by periodic bottle sampling of ocean water at work areas with laboratory analysis and by electronic probes continually monitoring ocean water at work areas by measuring and recording turbidity levels every 15 minutes. The monitoring occurred pre-construction to identify ambient conditions and during all phases of construction. The monitoring locations totaled seven including the offshore sand dredging/pumping source, plus six nearshore areas close to work activity at the Project Beach, updrift of the Project beach as a “control area” and downdrift in the direction of nearshore current (see Figure 1).

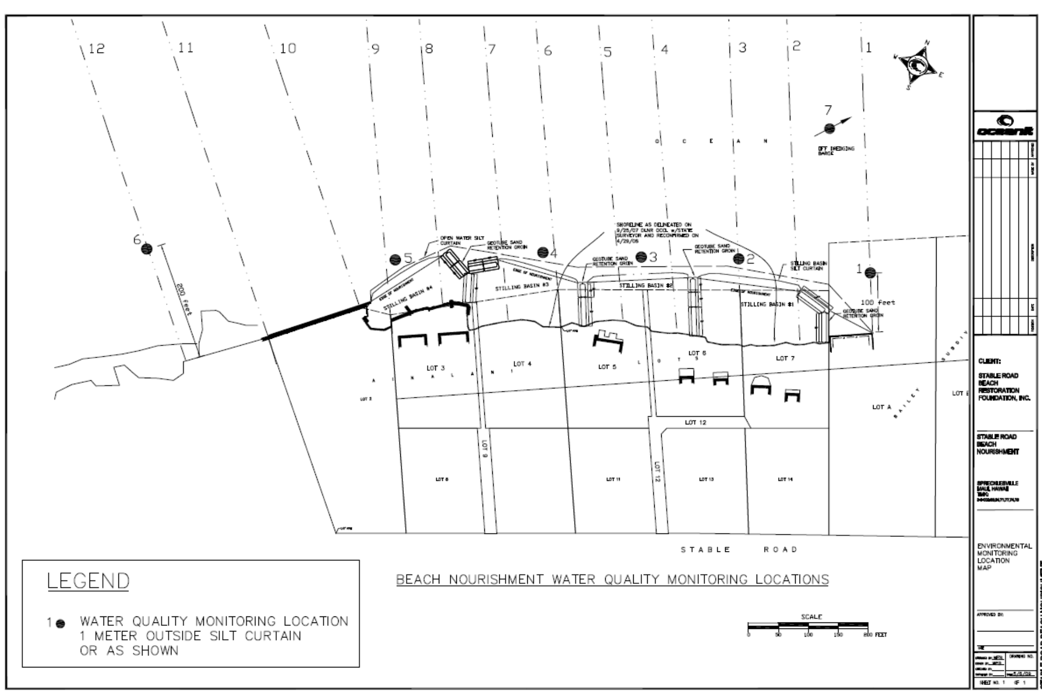


Figure 1 – Water Quality Monitoring Map – 7 Locations

Best Management Practices were developed to control and contain possible turbidity including sediment barriers in the water around work areas during construction, a distilling basin for pumped slurry, regulated pumping, hand dredging and construction activity stoppages if excess turbidity and/or plumes were observed.

2.1.2 Performance Criteria/Metrics: The Guideline included established Water Quality Criteria from the State of Hawaii Administrative Rules (HAR), Chapter 11-54-4(b) for pollutant discharge into marine waters. The possible Project pollutants were identified as oils, grease and fuel from construction equipment plus ocean turbidity from sand during the filling of the groin tubes and the dredging, pumping and placing of the offshore sand.

The State Water Quality Criteria for oils, grease and fuel is for ocean water to be free of these substances.

The State Water Quality Criteria applicable to this Project Area (Class A open coastal waters with a Class II bottom) limits the level of acceptable turbidity measured in Nephelometric Turbidity Units (NTU) for wet analysis of a sample set as follows:

Geometric Mean	10%	2%
0.50 NTU	1.25 NTU	2.00 NTU

The geometric mean of sample set may not exceed the Criteria. No more than 10% of samples may exceed 10% of respective Criteria, and no more than 2% of samples may exceed 2% of respective Criteria.

The Water Quality Monitoring Guidelines sought to identify change in Water Quality within the Project Area and downdrift caused by the Project. Monitoring for change relied on comparisons with pre-construction survey data established as a baseline, as well as comparisons with the updrift Control site to account for seasonal variations. The Control site is uninfluenced by the Project due to it being updrift of the Project Area with a steady, natural, longshore current downdrift.

The Project’s Performance Criteria/Metrics recognized that many nearshore environments naturally deviate from the State Water Quality Criteria due to local conditions caused by waves with turbulence; thus, the Project’s Water Quality Performance Metrics/Criteria for turbidity was the pre-construction base line, which was higher than the State Criteria. Prior to construction, ambient water samples were collected for laboratory analysis plus electronic probes were employed to record Water Quality at the six nearshore sampling locations plus at the offshore sand source. The pre-construction baseline data is as follows:

Nearshore Pre-Construction Baseline:

Source	Geometric Mean	10%	2%
Laboratory Analysis	1.11 NTU	3.48 NTU	5.85 NTU
Laboratory Analysis	6.84 mg/l	8.32 mg/l	9.13 mg/l
Probe	9.70 NTU	14.62 NTU	17.28 NTU

Offshore Pre-Construction Baseline:

Source	Geometric Mean	10%	2%
Laboratory Analysis:	0.76 NTU	1.38 NTU	1.96 NTU
Laboratory Analysis	2.39 mg/l	6.23 mg/l	8.33 mg/l
Probe	9.81 NTU	11.97 NTU	13.20 NTU

The electronic probes provided continuous monitoring of in-situ conditions, and they were not expected to be directly comparable to the laboratory analysis values from the bottle samples taken at the same time and locations. The pre-construction data from the probes was still comparable to during and post-construction data from the same probes.

Mg/l (milligrams/liter) is the measured units for Total Suspended Solids (TSS).

2.1.3 Data Assessment: The Water Quality monitoring data assessments for one year, post-construction indicated no visible oil, grease or fuel spillage. There were no turbidity plumes of a significant duration, and turbidity measurements measured in NTU were compliant with the Performance Criteria/Metrics as indicated in Figure 2.

Nearshore Water Quality:

Laboratory Analysis: Laboratory analysis of Nearshore Water Quality from bottle samples for turbidity and total suspended solids indicated only three dates when the Geometric Mean value exceeded the established baseline on 1 May 2010, 30 December 2010, and 8 July 2011. None of the bottle samples exceeded the 10% or 2% thresholds. On 1 May 2010 and 30 December 2010, one sample of total suspended solids exceeded the 10% rule, and on 30 December 2010 this value also exceeded the 2% rule. Project construction had been completed by July 2010. On 8 July 2011, three samples of total suspended samples exceeded both the 10% and 2% rule. In each case, the set of samples taken as a whole was not statistically or significantly different from the dataset used to construct the baseline (t-test, α=0.05). This test was true for both types of laboratory analytes (TSS and NTU).

Local physical conditions affect turbidity greatly (wind, waves and tide); however, the variability among Water Quality data sets over time was small (see Figure 2). Physical conditions on the ground during the establishment of the pre-construction baseline were more quiescent than much of the rest of the year. Differences among these data are more representative of seasonal and meteorological forces than the result of Project related activity.

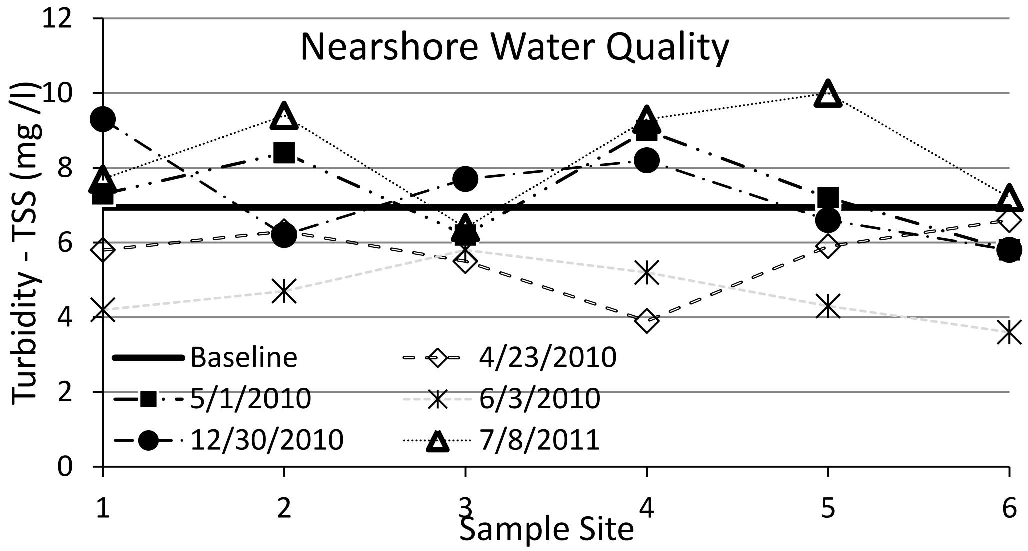


Figure 2 - Laboratory Analyses of Nearshore Water Quality

Sample Site 1 is the "control" sample from updrift of the Project Area.

Probe Data: Daily summaries of electronic probe based measurements for the Nearshore Water Quality contained four days when the Geometric Mean exceeded the established baseline value, one day where the 10% rule was exceeded and seven days where the 2% rule was exceeded. Exceeding the 2% rule required only two samples in 24 hours. These data demonstrate that no large or persistent plumes of turbidity were detected during Project activity in the nearshore.

Laboratory and probe data for turbidity, normalized to their individually established, pre-construction baselines, show that Nearshore Water Quality has been variable since the start of monitoring in April 2010. Laboratory analyses have fluctuated near the baseline throughout this first year of equilibration, ranging from 50% to 150% of that value. This is a modest envelope in both absolute and relative terms (see Figure 3). This variability is also seen at the Project Control Site and the State Department of Health monitoring of nearshore turbidity at nearby beaches Kanaha and Spreckelsville (see Figure 4); for example, the 8 July 2011 Lab value indicated in Figure 3 (1.75 NTU) exceeds the baseline as does the value from the Project Control site (1.94 NTU) collected at the same time (one year post-construction). Seasonal variability is naturally high.

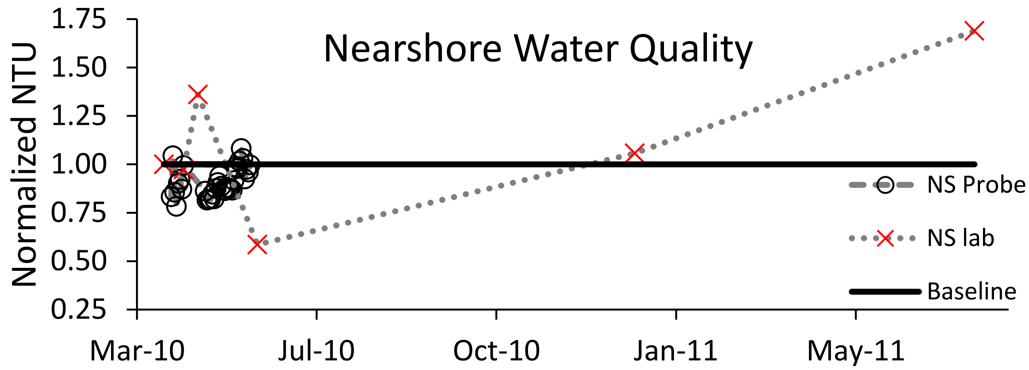


Figure 3 - Probe and Laboratory Analyses of Bottle Samples for Nearshore Water Quality

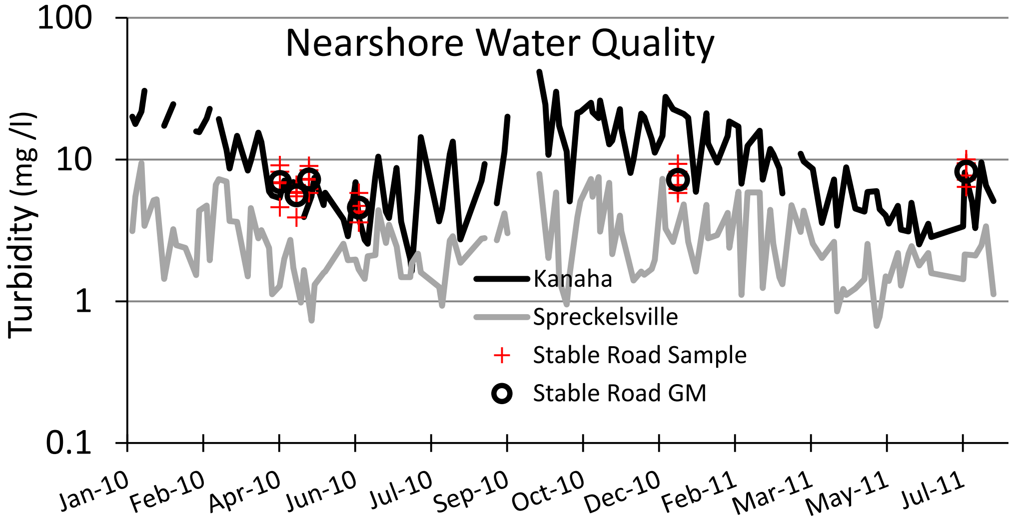


Figure 4 - Time Series Data of DOH and Stable Road Nearshore Water Quality

Offshore Water Quality:

Laboratory Analysis: Laboratory analysis of Offshore Water Quality samples collected in bottles for turbidity indicated no dates when turbidity or total suspended solids exceeded the established baseline value.

Probe Data: Electronic probe data for the Offshore Water Quality indicated no dates when turbidity exceeded the established baseline value.

Laboratory and probe data for turbidity, normalized to their individually established, pre-construction baselines, show Offshore Water Quality changes in Water Quality over time (see Figure 5). Variability in these samples was generally much less than in nearshore values. Interestingly, the low turbidity measured 8 December 2010 is also representative of the variability indicated throughout these datasets.

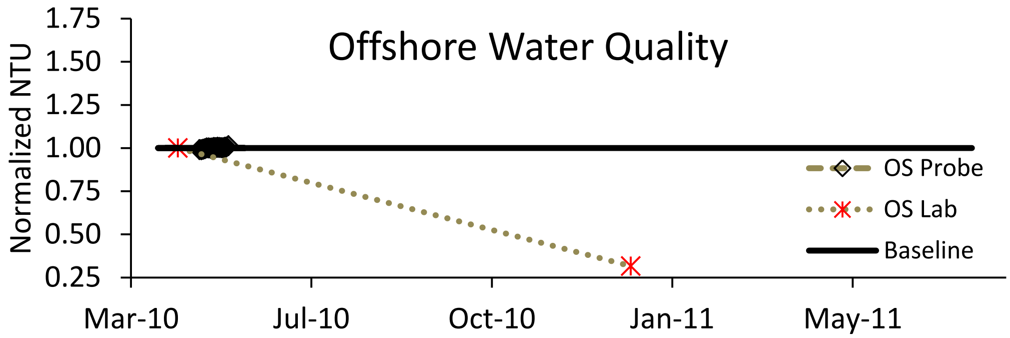


Figure 5 - Probe and Laboratory Analyses for Offshore Water Quality

2.1.4 Criteria/Metrics Compliance/Remedial Action: During construction there was compliance with the oil, grease and fuel Performance Criteria. Monitoring data and assessments at the nearshore and offshore sites indicated that the Project was compliant with the Water Quality Performance Criteria/Metrics during construction and the one year, post-construction period, which is summarized in Table 1 with a "C" indicating Compliance.

Time: Area:	During Constr.	2010 Spring	2010 Summer	2010 Fall	2011 Spring
Nearshore - Probe	C	C	C	C	C
Nearshore - Laboratory	C	C	C	C	C
Offshore - Probe	C	C	C	C	C
Offshore - Laboratory	C	C	C	C	C

Table 1- Water Quality Performance Criteria/Metrics Compliance Summary

Because of Compliance, no Remedial Action was necessary. During construction, results from laboratory and probe Water Quality monitoring were not available instantaneously, so workers visually monitored the Project construction zones to control and contain turbidity. Several brief work stoppages occurred to adjust the perimeter sediment barriers used to contain turbidity according to the Project's Best Management Practices for Water Quality. In each case, the sediment barrier maintenance was proactive and productive, so work resumed.

2.1.5 Need for Monitoring Continuation: There is no need to continue Water Quality monitoring for the following reasons:

- There is no change in Water Quality attributable to the Project.
- All construction equipment was removed over one year ago.
- During construction and for the one year post-construction period, Water Quality was monitored and assessed to be compliant with the Performance Criteria/Metrics.
- The most susceptible time for non-compliance with the Performance Criteria/Metrics was during construction, when the work occurred and immediately thereafter, when the Project Beach was unstable due to construction and was equilibrating.
- Construction was completed over one year ago, and the Project Beach has obtained post-construction equilibrium.

2.2 Benthic Habitat

2.2.1 Monitoring Program: Monitoring of Benthic Habitat was intended to observe and record any effects to the Benthic Habitat and marine life attributable to the Project particularly due to: dredging, pumping and placing sand; pipeline installation, maintenance and removal; plus potentially from the temporary groin field during and after construction. A primary concern was that increased sand cover of Benthic Habitat and high turbidity could adversely affect marine life.

Extensive input from government agencies, interested individuals and groups was used to establish the nearshore and offshore benthic habitat monitoring programs. The nearshore monitoring area consisted of three stratified zones each parallel to the Project Area with Zone A from the shoreline seaward 150 feet, Zone B from 150 to 300 feet seaward and Zone C from 300 to 450 feet seaward (Figure 6). The lateral extent of the nearshore study area was established to include a 450 foot wide area updrift of the Project Area as a Control area uninfluenced by the Project due to a steady, natural, longshore current downdrift, as well as a 500 foot wide area downdrift creating approximately 1,700 foot long Zones and a 765,000 square foot monitoring area. Observed and recorded in the nearshore Zones were benthos, substrate and cover, and 42 randomly distributed sites (7 in each zone of each treatment) were pre-selected for long term monitoring. Each site was marked by a pin and recorded by gps for locational continuity. The offshore sand source had 12 study sites uniformly distributed along intersecting transect lines (Figure 7). The route followed by the pipeline connecting these two zones was also monitored.

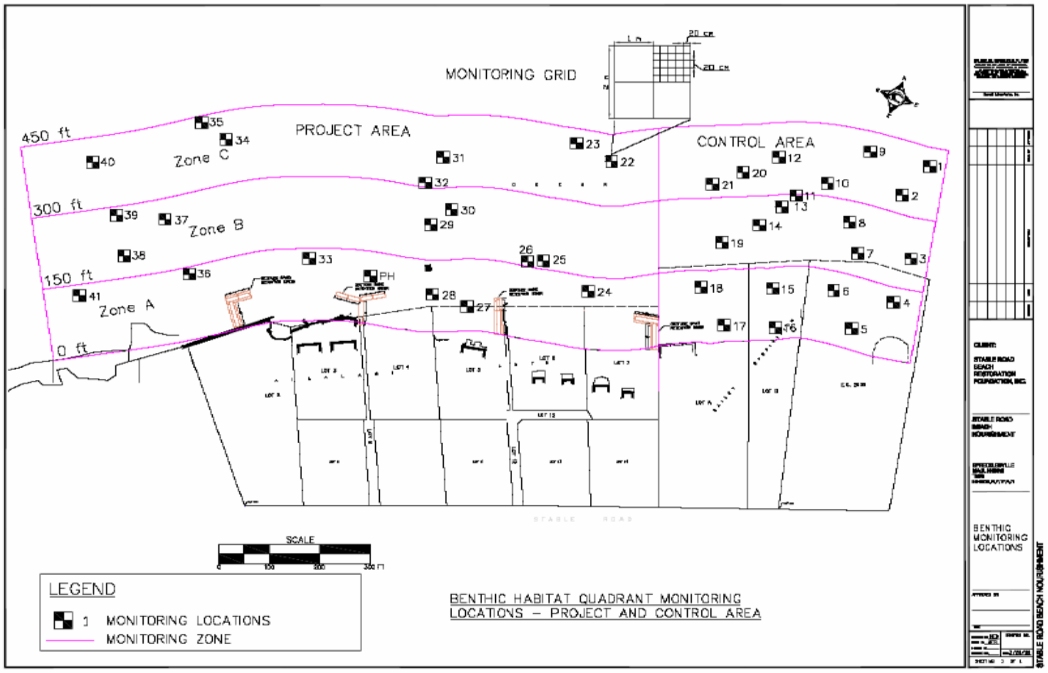


Figure 6 – Benthic Habitat Nearshore Monitoring Map – 42 Locations

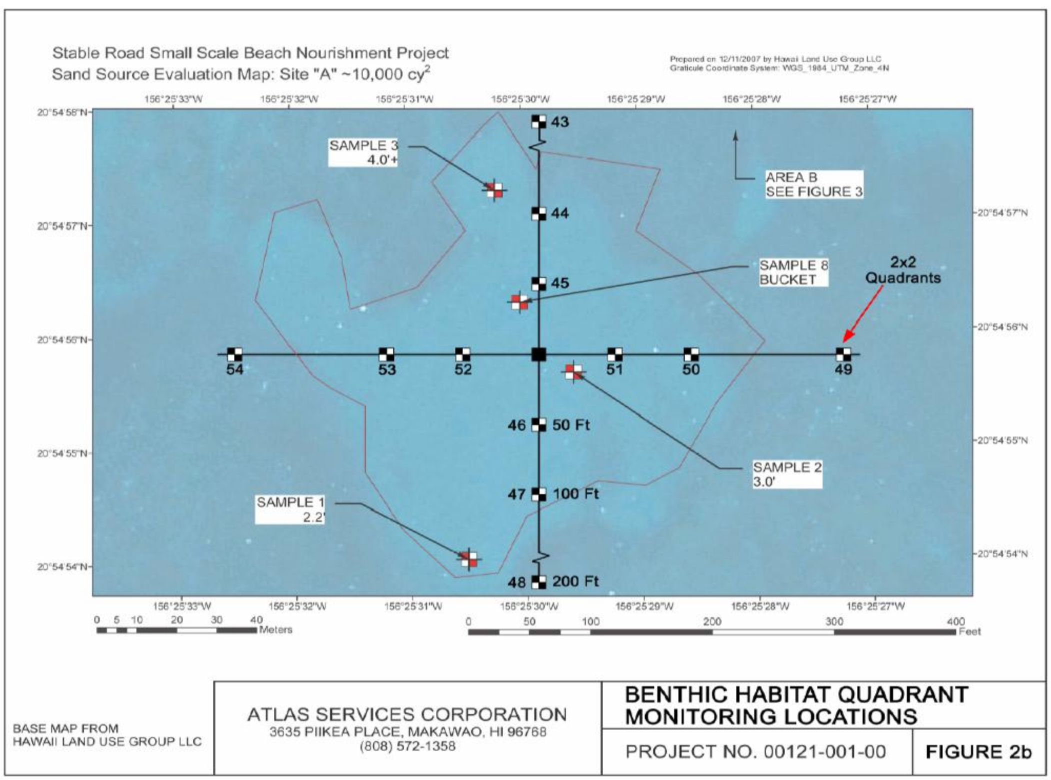


Figure 7 – Benthic Habitat Offshore Monitoring Map – 12 Locations

At each monitoring site, substrate composition and benthic occupancy were characterized in formal visual and photographic surveys pre-and post-construction. Both benthic occupancy and substrate composition were scored based on the percentage cover of each organism type (algae, invertebrate, coral, bare) and substrate type (fine sand, coarse sand, gravel, rock, boulder, solid). Changes in percent cover were evaluated in sequential surveys.

During construction, the Project's Best Management Practices (BMP's) were employed to contain the risks of damage to the Benthic Habitat and communities. The BMP's included regular visual inspection of equipment and the marine environment. A marine biologist pre-determined the pipeline route from visual and videographic surveys to minimize coral damage, and he observed and approved the pipeline location during its installation. During construction, the pipeline route was visually monitored daily by divers from the work crew to reduce impacts of pipeline movement on benthic communities. Several times, work was stopped to better secure the pipeline and to minimize its movement as prescribed in the BMP's.

2.2.2 Performance Criteria/Metrics: The Benthic Habitat Monitoring Guidelines included Performance Criteria/Metrics developed in consultation with the many government agencies, plus interested groups and individuals. The Criteria/Metrics identify the level of sand cover change due to Project activity at each zonally distributed benthic community which would trigger action by the SRBRF as follows:

Nearshore Zone A - Significant
Nearshore Zone B - Significant
Nearshore Zone C - Moderate

Offshore Sand Source - Significant

Pipeline Route - Significant

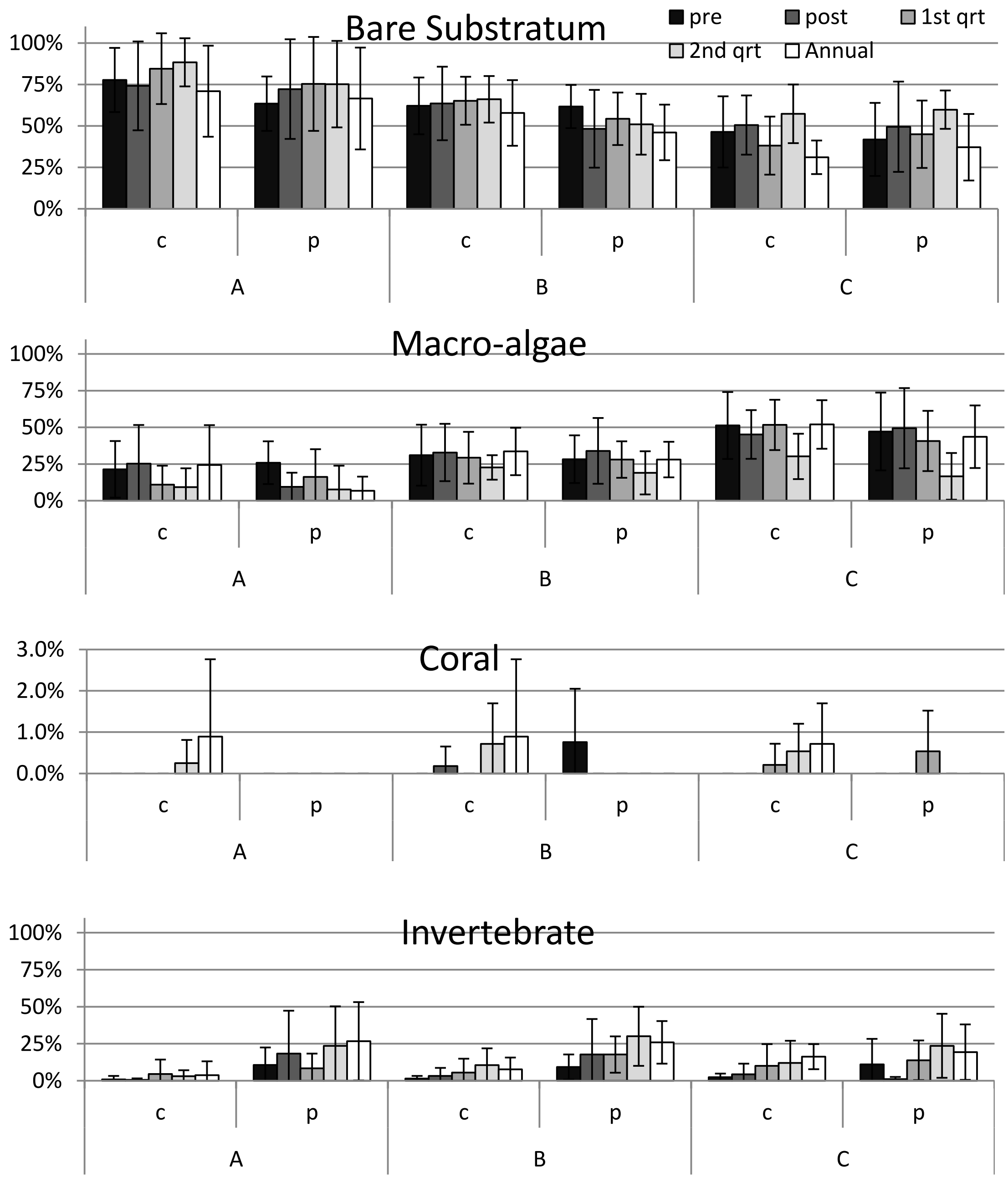
Significant and moderate sand cover change is sand cover that has increased beyond the normal, seasonally adjusted level compared to the Control site, which could cause significant and moderate mortality respectively among the benthic species identified from the monitoring.

The Performance Criteria/Metrics sought to identify changes in community (occupancy) and substrate composition within Project site zones caused by the Project. These comparisons relied on pre-construction survey baselines for the Project site zones, as well as comparisons with updrift Control Sites to account for seasonal variations.

2.2.3 Data Assessment:

Nearshore Benthic Habitat:

<u>Benthic Occupancy</u>: The bars in Figure 8 indicate the percentage cover of Bare Substratum, Macro-Algae, Coral and Invertebrate in the Control (C) and Project (P) regions of nearshore zones A, B and C (0-150, 150-300, and 300-350 feet from shore respectively) indicated at the bottom of each panel.



<u>Figure 8 - Percentage Occupany of Nearshore Benthos</u>

Progressively lighter bars indicate more recent data (Pre-construction, Post-construction, 1st Quarterly, 2nd Quarterly, and 1st Annual – see Legend top right). Error bars show one standard deviation. The verticle axis scale in the panel depicting Coral cover is different from the others.

There were no statistically significant changes in percent cover of any of the benthic community classifications monitored (bare substrate, macro-algae, coral and invertebrate) with the exception of a decrease in algal cover during the winter months, there were no trending shifts in the organisms comprising the Nearshore Benthic Habitat. Even in zones A and B where Project related impacts to Benthic Habitat were anticipated, no effects to the organisms present could be measured or inferred.

Substrate Composition: The only statistically significant change in benthic substrate composition between pre- and post-construction surveys was a decrease in the abundance of gravel in Project zones B and C (see Figure 9). There was no causative link between this finding and Project activity. Apart from gravel at Zones A and B where shifts in sand abundance were anticipated, there were no statistically significant changes in substrate composition. Zone A had the most variable cover of all zones, and this variability was consistent between the Control and Project Areas. Diving in zone A revealed numerous healthy invertebrate populations, including corals, algae zooanthids and mobile fauna.

The three established nearshore zones (A, B, and C) in the Control and Project (C and P) areas are indicated at the bottom of each panel. Progressively lighter bars indicate more recent data (Pre-construction, Post-construction, 1st Quarterly, 2nd Quarterly, and 1st Annual – see Table at upper right). Error bars show one standard deviation. Shaded rectangles indiate treatments where ANOVA indicated statistically significant variation among survey data between pre-construction and 1st annual surveys (Tukey-Kramer).

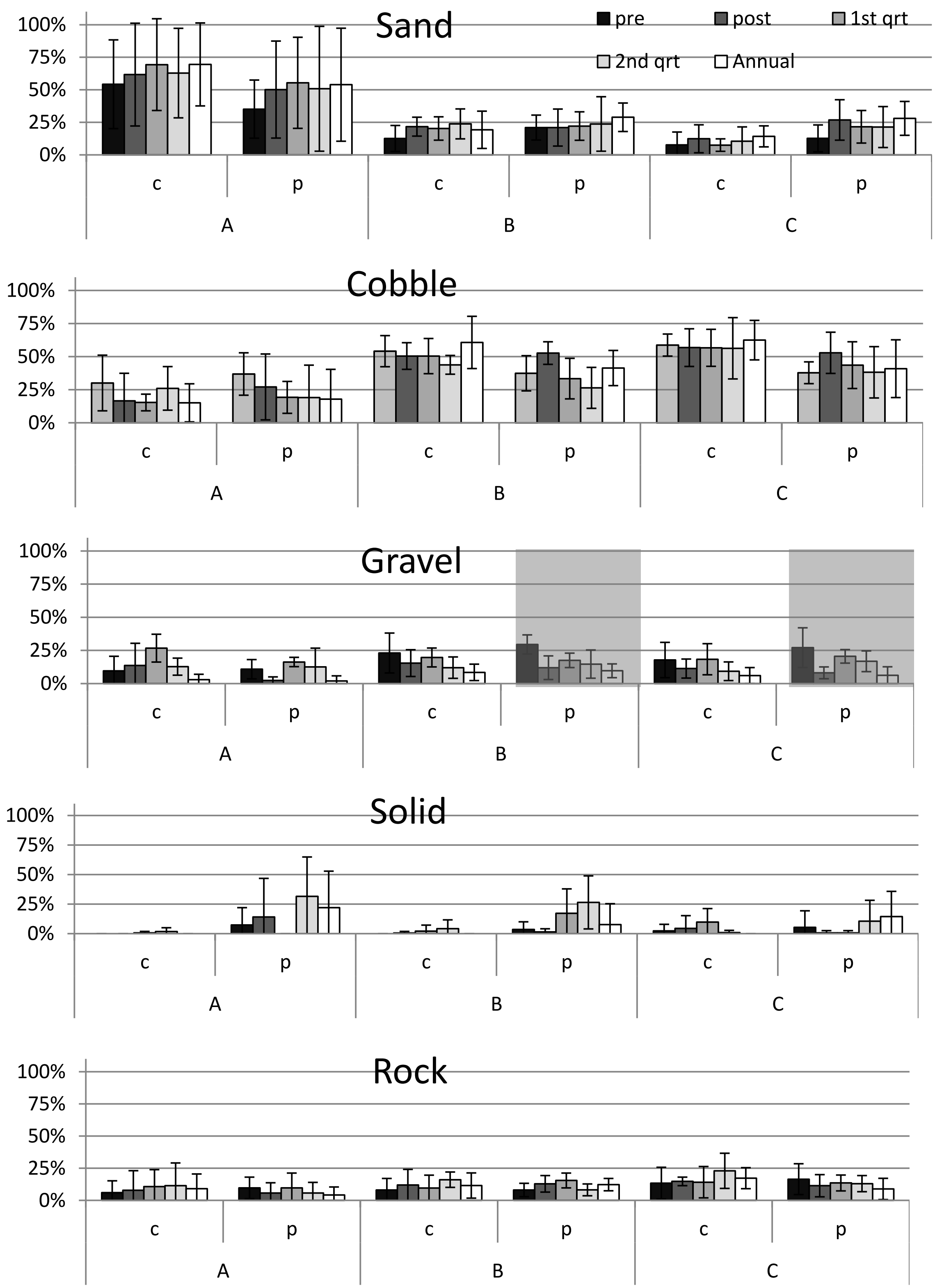


Figure 9 - Percentage Composition of Major Substrate Classifications

2.2.4 Criteria/Metrics Compliance/Remedial Action: During and post-construction, all Benthic Habitat monitoring indicted compliance with the Benthic Habitat Performance Criteria/Metrics as summarized in Table 2 with a "C" indicating compliance with the Performance Criteria/Metrics.

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Area: Time:	2010 Spring	2010 Summer	2010 Fall	2011 Spring
BENTHIC OCCUPANCY/SAND COVER				
Nearshore Zone A	C	C	C	C
Nearshore Zone B	C	C	C	C
Nearshore Zone C	C	C	C	C
Offshore	C	C	C	C
Pipeline Route	C	C	C	C
SUBSTRATE				
Nearshore Zone A	C	C	C	C
Nearshore Zone B	C	C	C	C
Nearshore Zone C	C	C	C	C
Offshore	C	C	C	C
Pipeline Route	C	C	C	C

Table 2 – Benthic Habitat Performance Criteria/Metrics Compliance Summary

Because of Compliance, no Remedial Action was necessary. The Project's Best Management Practices were utilized during construction with daily observations of equipment and the pipeline. Adjustments were routinely made to the pipeline anchors including better securing the pipeline to the cradles plus adding a substantial amount of cradles and weights to better secure the pipeline from moving.

There was minimal damage to Benthic Habitat, including corals. A post-construction survey of the pipeline route identified 2 damaged coral heads greater than 4 inches in diameter - 1 Antler coral (*Pocillipora eydouxi*), and 1 Blue Rice Coral (*Montipora flabellate*), and no consequential damage to significant habitat. It is significant that the harm to coral and adjacent habitat was minimal, especially considering the 2,800 foot length of pipeline and two month duration of construction activity. Monitoring efforts at nearshore and offshore sites as well as along the pipeline route demonstrate that the Benthic Habitat Monitoring Criteria/Metrics have been satisfied through construction and post-construction equilibrating stages of the Project. Continued monitoring of the pipeline route has shown that within 6 months, the benthic communities at sites of the pipeline cradle chaffing had been recolonized by macro-and micro-algae typical of this zone, and that these communities were soon indistinguishable from the adjacent undisturbed habitat.

All pipeline components, including concrete cradles used to support the pipeline above the ocean floor, were removed.

2.2.5 Need for Monitoring Continuation: There is no need to continue Benthic Habitat monitoring for the following reasons:

- There is no change in Benthic Habitat attributable to the Project.
- All construction equipment was removed over one year ago.
- During construction and for the one year, post-construction period, Benthic Habitat was monitored and assessed to be compliant with the Performance Criteria/Metrics.
- The most susceptible time for non-compliance with the Performance Criteria/Metrics was during construction, when the work occurred and immediately thereafter, when the Project Beach was unstable from construction and was equilibrating.
- Construction was completed over one year ago, and the Project Beach has obtained post-construction equilibrium.

2.3 Beach Erosion

2.3.1 Monitoring Program: Monitoring of Beach Erosion was intended to observe and record if there were any adverse effects to Beach Width and Beach Sand Volume plus to Land Loss within, updrift and downdrift of the Project Area attributable to the Project compared to historic photos and the pre-construction condition, particularly due to the Project's temporary groin field.

Beach erosion monitoring locations included 12 pre-selected transects with 1 transect #12 located approximately 100 feet updrift of the Project Area, 8 transects #'s 4-11 located Within the Project Area and 3 transects #'s 1-3 located within 460 feet downdrift of the Project Area, with a total length along the shoreline monitored of approximately 1,550 feet (see Figure 10).

Monitoring was by a licensed surveyor recording the beach profile at each transect for use in calculating Beach Width and Beach Sand Volume and by aerial and beach photography quarterly for comparison of pre-and post-construction conditions seasonally.

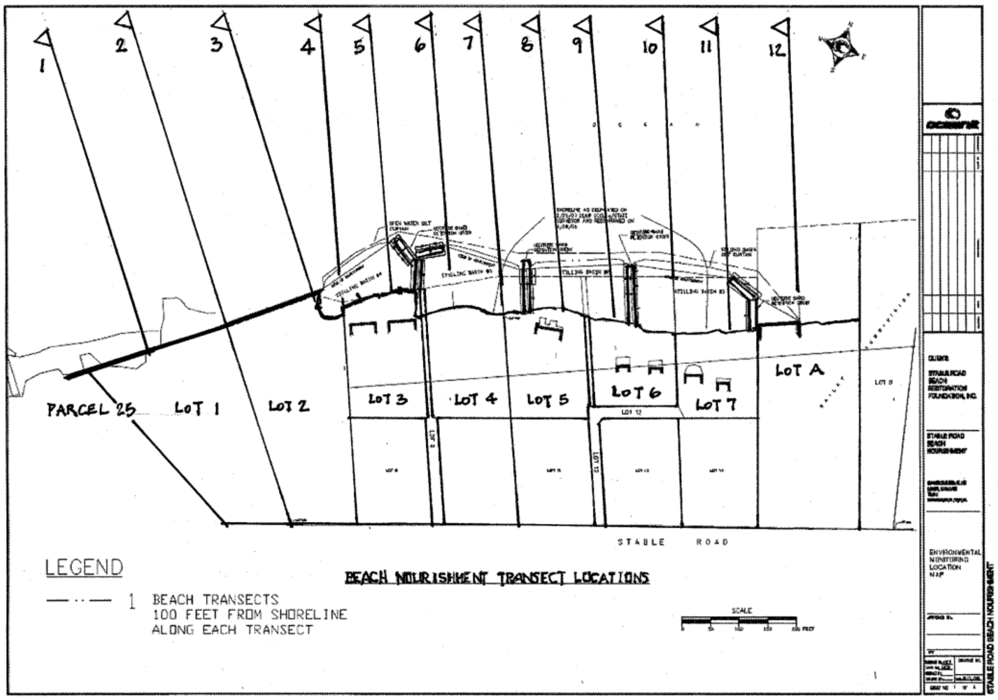


Figure 10 - Beach Erosion Monitoring Locations Map - 12 Locations

2.3.2 Performance Criteria/Metrics: The Project's goals were to eliminate beach erosion and prevent land loss within the Project Area and to not adversely affect updrift and downdrift areas.

The Project's Beach Erosion post-construction Performance Criteria/Metrics minimums are as follows:

	Within Project Area	Outside Project Area
Beach Width:	65% of as-built	100% of Natural, Seasonal
Beach Sand Volume:	65% of as-built	100% of Natural, Seasonal
Land Loss:	0 feet/year	0 feet/year

A 10% variance was anticipated for measurement accuracy.

2.3.3 Data Assessment: The Beach Erosion monitoring data assessments for one year, post-construction are summarized in Figure 11. There are no dry beaches at downdrift transects 2 and 3 to measure, so these locations are not shown in the Figure. The Baselines indicated are the Performance Criteria/Metrics minimums.

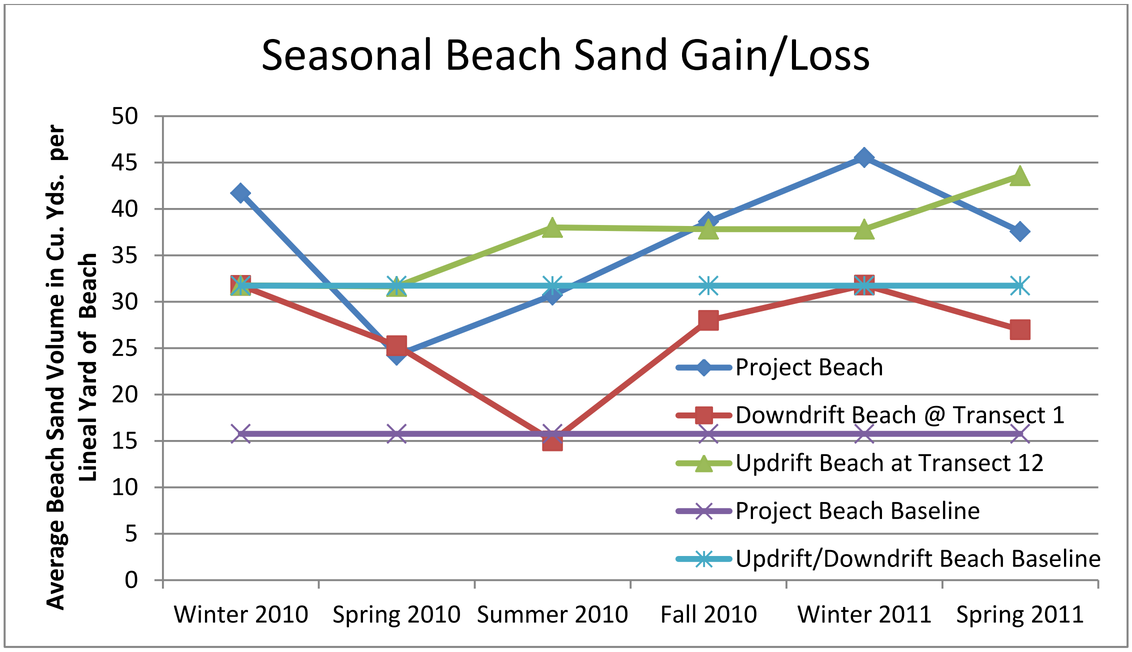


Figure 11 – Seasonal Beach Sand Gain/Loss

The adverse effect of the 11 March 2011 tsunami was to change the rate of seasonal sand accretion during the 2011 winter season from the trend established during the 2010 fall season at the small, downdrift beach located at transect 1, and this is evident in the Graph. This is because the tsunami removed beach sand previously accreted on this beach, and it interrupted the normal winter season accretion process.

During the one year, post-construction period, all beach erosion monitoring locations have been in compliance with the Performance Criteria/Metrics, except the small, downdrift beach located at transect #1 was non-compliant during the 2010 spring and summer plus 2011 spring seasons.

Within the Project Area during the one year, post-construction period, which includes two erosion and two accretion seasons, compared to the immediate post-construction data, the Project Area Beach Width and Beach Sand Volume have increased without any Land Loss, thus the Project attained its goal of preserving the Project Beach.

Outside the Project Area during the same one year, post-construction period compared to the immediate post-construction data, the Beach Width and Beach Sand Volume at updrift transect 12 increased, there was no significant change at transects 2 and 3 where there is no beach, and there was a reduction during two seasons at transect 1.

During the 2010 summer, the SRBRF began to identify and assess possible causes of the previous spring season beach loss immediately after high rate of beach sand loss was observed at the small, downdrift beach, while also providing more frequent survey data during the 2010 fall season as requested by the DLNR. During the 2010 fall and 2011 winter seasons, the small, downdrift beach gained sand, despite the 11 March tsunami causing Beach Sand Volume loss there, and the beach was comparable to previous historic and seasonal conditions; thus, indicating compliance with the Performance Criteria/Metrics during the 2010 fall and 2011 winter seasons. Unfortunately during the 2011 spring season, the beach had an earlier high rate of beach sand loss, possibly due to the tsunami interrupting normal, winter season accretion.

2.3.4 Criteria/Metrics Compliance/Remedial Action: Post-construction, all beach erosion monitoring indicted Performance Criteria/Metrics compliance at 11 of the 12 transect locations as indicated in Table 3 with a "C" indicating compliance and "NC" indicating data non-compliance with the Performance Criteria/Metrics prior to data assessment.

Time: Area:	2010 Spring	2010 Summer	2010 Fall	2011 Winter	2011 Spring
BEACH WIDTH					
Project Area	C	C	C	C	C
Updrift Transect 12	C	C	C	C	C
Downdrift Transect 3	C	C	C	C	C
Downdrift Transect 2	C	C	C	C	C
Downdrift Transect 1	NC	NC	C	C	NC
BEACH SAND VOLUME					
Project Area	C	C	C	C	C
Updrift Transect 12	C	C	C	C	C
Downdrift Transect.3	C	C	C	C	C
Downdrift Transect 2	C	C	C	C	C
Downdrift Transect 1	NC	NC	C	C	NC
LAND LOSS					
Project Area	C	C	C	C	C
Updrift Transect 12	C	C	C	C	C
Downdrift Transect.3	C	C	C	C	C
Downdrift Transect 2	C	C	C	C	C
Downdrift Transect 1	C	C	C	C	C

Table 3 – Beach Erosion Performance Criteria/Metrics Compliance Summary

No Remedial Action due to the non-compliance at transect 1 would be necessary "if the observed beach changes can be attributed to the Project structures (groins) taking into account seasonal and long-term trends" per the Project's Beach Erosion Monitoring Guidelines. No Remedial Action has been taken by the SRBRF since after data assessment, it was determined the beach loss cannot be attributed to the Project's groins or groin field based on the 460 feet of separation distance between the small beach and the Project's closest groin with an intervening seawall; and since there are several pre-existing manmade and natural contributing causes including: long-term and advancing beach retreat, an updrift seawall, unusually early and windy weather plus a regional increase of long-term, annual beach erosion rates. See Section 3.2 for an assessment of the possible Project related and natural causes of the Initial and Increased Seasonal, Downdrift Beach Erosion at Transect 1.

2.3.5 Need for Monitoring Continuation: There is no need to continue Beach Erosion monitoring for the following reasons:

- There is no change in Beach Erosion (except positive changes) attributable to the Project.
- During construction and for the one year, post-construction period, Beach Erosion was monitored and assessed to be compliant with the Performance Criteria/Metrics for 11 of 12 locations, and beach loss at transect 1 is not attributed to the Project structures.
- The time most susceptible for non-compliance with the Performance Criteria/Metrics was immediately after construction when the newly installed groin field may have temporarily disrupted longshore sand transport and during the last year when the Project Beach was unstable from construction disturbance and was equilibrating.
- Construction was completed over one year ago, and the Project Beach has a groin field filled to capacity except for seasonal erosion, and the beach has obtained post-construction equilibrium.

However, beach erosion survey monitoring is proposed to continue for the 2011 summer season to assess the entire 2011 erosion period and for the combined 2011 fall/2012 winter season to assess the subsequent accretion period. Beach erosion photographic monitoring is proposed to continue quarterly during the above periods.

2.4 Lateral Beach Access

2.4.1 Monitoring Program: Monitoring of Lateral Beach Access was intended to observe and record if there were any adverse effects to the Lateral Beach Access attributable to the Project, particularly due to the Project's temporary groin field. Monitoring was visually to observe and to photographically record

Lateral Beach Access at the Project Beach during and after construction at the four groin locations.

2.4.2 Performance Criteria/Metrics: The Performance Criteria is a laterally accessible beach.

2.4.3 Data Assessment: The Lateral Beach Access monitoring data and assessments for one year, post-construction indicated Lateral Beach Access was maintained during and after construction at the Project Area.

2.4.3 Criteria/Metrics Compliance/Remedial Action: The Lateral Beach Access Compliance with the Performance Criteria for one year, post-construction period is summarized in Table 4 with a "C" indicating compliance with the Performance Criteria:

Time: Area:	During Constr.	2010 . Spring	2010 Summer	2010 Fall	2011 Winter	2011 Spring
East End Groin	C	C	C	C	C	C
East Center Groin	C	C	C	C	C	C
West Center Groin	C	C	C	C	C	C
West End Groin	C	C	C	C	C	C

Table 4 - Lateral Beach Access Performance Criteria Compliance Summary

Due to Compliance, no Remedial Action was necessary, although small, sand filled bags were placed at the west end of the Project Beach to serve as steps up to the elevated pathway at the top of the rock revetment to improve the convenience and safety of the pre-existing lateral access transition there.

2.4.4 Need for Monitoring Continuation: There is no need to continue Beach Erosion monitoring for the following reasons:

- There is no change in Lateral Beach Access (except positive changes) attributable to the Project.
- During construction and for the one year, post-construction period, Lateral Beach Access was monitored and assessed to be compliant with the Performance Criteria/Metrics at all locations.
- The time most susceptible for non-compliance with the Performance Criteria/Metrics was during construction with the construction equipment on the beach and safety work zones and after construction when the

Project Beach was unstable from construction disturbance and was equilibrating.

- Construction was completed over one year ago, and the Project Beach has a groin field filled to capacity except for seasonal erosion, and the beach has obtained post-construction equilibrium.

3.0 CONCLUSIONS

3.1 Project Performance Criteria/Metrics Compliance:

Four environmental factors have been monitored at several locations, with several aspects each and at several times during construction and the one year, post-construction period. At all times and at all locations, all the specific environmental factors and aspects were compliant with the Project's established Performance Criteria/Metrics, where noted with a "C", except one aspect during two seasons was non-compliant where noted with a "NC"; and this is summarized in Table 5:

Season: / Area:	During Constr.	2010 Spring	2010 Summer	2010 Fall	2011 Winter	2011 Spring
WATER QUALITY						
Grease, Oil & Fuel (1)	C	-	-	-	-	-
Nearshore - Probe (6)	C	C	-	-	-	-
Nearshore - Bottles (6)	C	C	C	C	-	C
Offshore - Probe (1)	C	C	-	-	-	-
Offshore - Bottle (1)	C	C	C	C	-	-
BENTHIC HABITAT						
Nearshore Zone A (14)	-	C	C	C	-	C
Nearshore Zone B (14)	-	C	C	C	-	C
Nearshore Zone C (14)	-	C	C	C	-	C
Offshore (12)	-	C	C	C	-	-
Pipeline Route (1)	-	C	C	C	-	-
BEACH EROSION						
Project Area (8)	-	C	C	C	C	C
Updrift (1)	-	C	C	C	C	C
Downdrift (3)	-	NC -Tr. 1	NC -Tr. 1	C	C	NC -Tr.1
LATERAL BEACH ACCESS						
East End Groin (1)	C	C	C	C	C	C
East Center Groin (1)	C	C	C	C	C	C
West Center Groin (1)	C	C	C	C	C	C
West End Groin (1)	C	C	C	C	C	C

Table 5 – Summary of Project Performance Criteria/Metrics Compliance

The numbers in parentheses are the quantity of monitoring locations at each Area. The Table where blank (-) indicates no monitoring required.

3.1.1 Water Quality: The monitoring included data assessments from the electronic probes and bottle samples during and immediately after construction at each of the 7 locations and from bottle samples post-construction at 7 and then 6 locations for a total of 49 monitoring data assessments during construction and the one year, post-construction period, plus 14 data collections from the probes and bottle samples pre-construction for the baseline monitoring.

All monitoring data assessments for Water Quality indicated compliance with the Project's Performance Criteria/Metrics.

3.1.2 Benthic Habitat: The monitoring included benthos/cover and substrate data assessments after construction at each of the 55 monitoring locations through the 2010 fall season and then 42 locations for the 2011 spring season with a total of 207 monitoring data assessments for the one year, post-construction period, plus 55 data collections pre-construction for baseline monitoring.

All monitoring data assessments for Benthic Habitat indicated compliance with the Project's Performance Criteria/Metrics.

3.1.3 Beach Erosion: The monitoring included beach width, beach sand volume and land loss data assessments at each of the 12 transect locations for subtotal of 36 data assessments each monitoring time and for a total of 180 monitoring data assessments for the one year, post-construction period, plus 12 data collections pre-construction for baseline monitoring. The one area noted as NC in Table 5 during spring and summer seasons produced data that was non-compliant with the Performance Criteria/Metrics; however, the data assessment concluded the area is compliant since the cause of the data non-compliance was not attributable to the Project (see Section 3.2).

All monitoring data assessments for Beach Erosion indicated compliance with the Project's Performance Criteria/Metrics.

3.1.4 Lateral Beach Access: This monitoring included data assessments for each of the 4 groin locations for a total of 24 monitoring data assessments during construction and for the one year, post-construction period.

All monitoring data assessments for Lateral Beach Access indicated compliance with the Project's Performance Criteria/Metrics.

3.1.5 Summary: The Project's environmental monitoring effort represents a total of 460 monitoring data assessments for the four environmental factors, their aspects, locations and frequencies, excluding pre-construction for baseline data collection. This effort has been comprehensive and extensive, and most outstanding is only one incident of data non-compliance for two seasons with the Project's Performance Criteria/Metrics, which were established with extensive agency and public input. .

The Project has remarkably achieved compliance with all environmental Performance Criteria/Metrics except for one minor data non-compliance of downdrift beach erosion which is now in compliance after an assessment. The Project's environmental monitoring effort was a positive collaboration between many government agencies and public input.

3.2 <u>Causes of Initial and Increased Seasonal, Downdrift Beach Erosion at Transect 1</u>:

The one incident of data non-compliance with the Project's Performance Criteria/Metrics is Beach Erosion at one location during two seasons. Several Project and non-Project related possible causes of the Initial and Increased Seasonal, Downdrift Beach Erosion at Transect 1 were immediately identified post-construction after the area was observed. Possible causes were investigated, assessed and reported in the subsequent Quarterly, Post-Construction Performance Monitoring and Metrics Reports for Beach Erosion. A Summary and Conclusions of possible causes and their applicability are as follows:

3.2.1 Possible Project Causes

<u>Groin Field Effect on Downdrift Beach Erosion</u>:

The Project's groin field cannot physically cause and therefore is <u>not</u> a Possible Cause of the Initial and Increased Seasonal, Downdrift Beach Erosion at the small, downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons for the following reasons:

- <u>Groin Field Effect on Beaches Immediately Downdrift</u> - U.S. Army Corps of Engineers documents indicate groins may have an erosive effect on beaches immediately downdrift of a groin. The small, downdrift beach at transect 1 is <u>not</u> located immediately downdrift of the groin field, but begins approximately 460 downdrift.

- Groin Maximum Downdrift Effect Distance - The U.S. Army Corps of Engineers' Shore Protection Manual, 1984 indicates the separation distance between the Project's closest groin and the beginning of the small, downdrift beach (460 feet) significantly exceeds the distance of Maximum Downdrift Effect of Groin, which is 195 feet for this Project (see Figure 5) based on a maximum ratio of 3 times the Project's groin length, since beyond this distance the groin and groin field loses its effect.

- No Groin Field Effect on Immediate Downdrift Beach - There has been no Beach Width or Beach Sand Volume reduction effect post-construction at the only immediate downdrift beach within the distance of Maximum Downdrift Effect of Groin, which is a small beach cove located between the downdrift rock revetment and the seawall (see Figure 12).

Figure 12 - Maximum Downdrift Effect of Project's Closest Groin

- Dominate Seawall Effect Downdrift - The hardened shoreline downdrift of the Project's groin field consists of a rock revetment and a long seawall between the Project's closest groin and the small, downdrift beach (see Figure 5). The hardened shoreline significantly affects nearshore current and wave direction downdrift of the Project's groin field by causing reflected waves off the seawall when moderate to high trade winds. The effect of the hardened shoreline is more dominate in the downdrift region than the possible effect of the Project's groin field, and it offsets any effect of the groin field downdrift.

<u>Groin Field Effect on Longshore Sand Transport</u>:

Per documentation by Project survey data, research and photographs, the Project's Groin Field Effect on Longshore Sand Transport is <u>not</u> a Possible Cause of the Initial and Increased Seasonal, Downdrift Beach Erosion at the small, downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons for the following reasons:

- <u>Modification of Newly Installed Groin Field to Reduce Capacity</u> - U.S. Army Corps of Engineers documents indicate a newly installed groin field may temporarily interrupt longshore sand transport until the groin field is filled to capacity. Once the Project's offshore sand dredging and pumping onto the Project Beach stopped early June 2010, modifications were immediately made to lower the groins' designed height at the beach, and thus the groin field capacity was reduced by approximately 50% to be commensurate with the actual volume of sand placed in the cells between groins on the beach. The newly installed groin field was at or near capacity immediately post-construction.

- <u>2010 Spring Season High Rate of Beach Sand Volume Loss from Project Beach</u> - By mid-June 2010, seasonal erosion began at the small, downdrift beach at its easterly, upwind end, and by 25 June 2010 the Project construction was complete. The construction timing of the newly installed groin field is coincidental with the beginning of seasonal beach erosion resulting in Beach Sand Volume loss at the small, downdrift beach as well as at the Project Beach; however, survey data indicates during the April/May/June 2010 spring season/construction period, the Project Beach lost approximately 4.82 times as much Beach Sand Volume than at the small, downdrift beach during the same time. The sand lost from the Project Beach moved downdrift toward the small beach.

- <u>2011 Spring Season Full Groin Field</u> - After the 2010 fall and 2011 winter accretion seasons, the Project Beach was full of sand at the beginning of the erosive 2011 spring season, and the groin field was not newly installed then and at capacity with the cells between groins full of sand to the top of the groins. Despite this condition, the small, downdrift beach started significant seasonal erosion one month earlier than in 2010 and two months earlier than in 2009.

- <u>Visible Longshore Sand Transport from Updrift Beaches</u> - Additional to the large volume of Beach Sand Volume lost from the Project Beach during and immediately after construction, Beach Sand Volume from updrift beaches was transported downdrift through the Project's groin field. Longshore sand transport from updrift beaches though the Project's groin field was visually evident May 2010, as well as by April 2011, through the 2010 summer in the afternoons when the trade winds were typically the strongest and the tides the highest daily. Longshore sand transport was able to occur then because the seaward ends of the groins were submerged during moderate to high tides, thus allowing water and sand from nearshore turbidity and erosion to flow over the groins as well as around their seaward ends (see Photo 5).

Photo 5 – Longshore Sand Transport Downdrift Over and Around Project's Closest, West End Groin, 10 June 2011

- Nearshore Current Direction - A study of nearshore ocean currents indicated the direction of current downdrift of the Project Area is divergent from the downdrift shoreline (see Figure 13), thus indicating the downdrift area may not receive much of the longshore transported sand from within and updrift of the Project Area, since most of the transported sand may bypass the downdrift beaches.

Figure 13 – Nearshore Current Direction

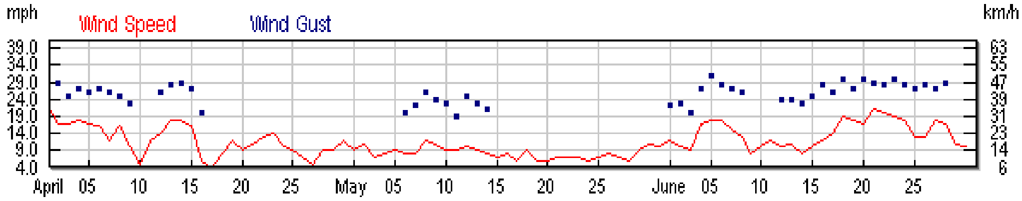
This study was performed when wind swells from trade winds were not significant. When the trade winds and swells increase typically in the afternoons during the spring and summer season, waves reflect from the downdrift seawall causing rebounding waves in an offshore direction and turbulence suspending sand longer, thus reducing the ability of the small, beach to receive and retain sand from updrift beaches via longshore transport.

3.2.2 Possible Natural Causes:

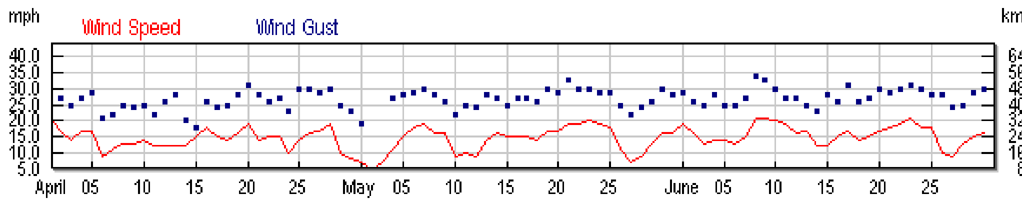
Unusually Early and High Trade Winds:

Per documentation and photographs, the Unusually Early and High Trade Winds is a Contributing Cause of the Initial and Increased Seasonal, Downdrift Beach Erosion at the small, downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons for the following reasons:

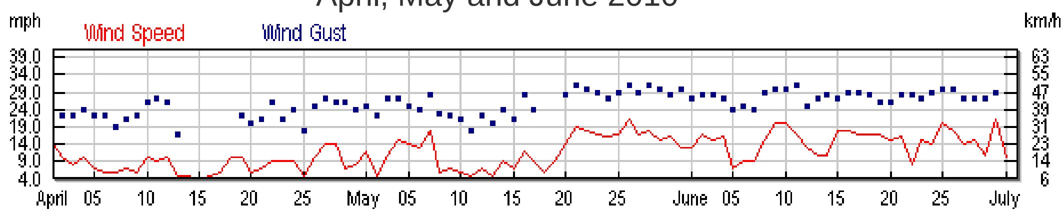
- Unusually Early and High Trade Winds – Documented is Unusually Early and Higher Trade Winds than normal during the 2010 and 2011 spring seasons (based on a five year average from 2005 to 2009) with sustained periods when the wind swell frequency and wave magnitude increase (see Figure 14). The Unusual Seasonal Weather correlates with the timing of the one month earlier than normal start of spring season beach erosion in 2010 at the small, downdrift beach located at transect 1.



April, May and June 2009



April, May and June 2010



April, May and June 2011

Figure 14 – Spring Season Wind History Charts – 2009, 2010 and 2011

- La Niña Episode Effect and Duration - Documented is a La Niña episode from May 2010 through June 2011 which resulted in colder ocean water and higher than normal trade winds (see Table 6). The continuation of the episode through the winter season correlates with the two month earlier than normal start of spring season beach erosion in 2011 at the small, downdrift beach located at transect 1.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2005	**0.7**	**0.5**	0.4	0.4	0.4	0.4	0.4	0.3	0.2	-0.1	-0.4	-0.7
2006	-0.7	-0.6	-0.4	-0.1	0.1	0.2	0.3	**0.5**	**0.6**	**0.9**	**1.1**	**1.1**
2007	**0.8**	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	**-0.7**	**-1.0**	**-1.1**	**-1.3**
2008	**-1.4**	**-1.4**	**-1.1**	**-0.8**	**-0.6**	-0.4	-0.1	0.0	0.0	0.0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	**0.6**	**0.7**	**0.8**	**0.9**	**1.2**	**1.5**	**1.8**
2010	**1.7**	**1.5**	**1.2**	**0.8**	0.3	-0.2	**-0.6**	**-1.0**	**-1.3**	**-1.4**	**-1.4**	**-1.4**
2011	**-1.3**	**-1.2**	**-0.9**	**-0.6**	-0.2							

Table 6 – Cold and Warm Water Episodes by Seasons, 2005 – 2011

- Early and High Trade Winds Effect - High trade winds produce large, frequent and sustained wind swells with side-shore waves that scour the beach with strong downdrift currents during moderate to high tides, which typically occur in the afternoons in the spring and summer seasons at the same time of day when the wind is the strongest.

<u>The early, high trade winds increased the duration of beach erosion and thus the magnitude of beach erosion during the 2010 spring and summer plus 2011 spring seasons</u>.

<u>Historic Trend of Local, Long-Term Beach Retreat</u>:

Per documentation and historic photographs, the Historic Trend of Local, Long-Term Beach Retreat is a Contributing Cause of the Initial and Increased Seasonal, Downdrift Beach Erosion at the small, downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons for the following reasons:

- <u>Advancing Beach Retreat History</u> **-** The 1940, 1960, 1975, 1997, 2002, 2005 and 2007 aerial photographs (see Appendix Photos 15 through 21) document Beach Retreat and Beach Width reductions over time at updrift and within the Project Area with Advancing Beach Retreat moving in a downdrift direction from east to west toward the small, downdrift beach.

- <u>Advancing Beach Loss History at Downdrift Beaches</u> – The downdrift beaches did not have Beach Retreat as did the updrift beaches, because the land at the downdrift beaches was protected by a long seawall constructed in1925 across downdrift Lots 1 and 2. Transect 1 is located at the west half of Lot 1, and Lot 2 is updrift of Lot 1. The noticeable change across Lots 1 and 2 is Beach Width narrowing and Advancing Beach Loss moving from east to west during this time, which is correlates with the pattern and timing of Beach Retreat at the updrift beaches and within the Project Area.

  From 1940 to 1975, there was a wide sand beach in front of the seawall across Lots 1 and 2. By 1997, there was no sand beach in front of easterly Lot 2, and there was a reduction of Beach Width at the east end of the seawall at westerly Lot 1. By 2005, there is less sand beach width in front of the seawall at Lot 1, with noticeable Beach Width narrowing at its updrift, east end and greater exposure of the rock pile/revetment there.

  <u>By 2005, the advancing Beach Loss with a long and hardened shoreline immediately updrift of the small, downdrift beach put this small beach in peril with it being the next in line for total beach loss, as well as resulting in a decreased updrift sediment supply at updrift beaches to naturally nourish this beach.</u>

- Local Annual Erosion Rates - The U.H. Annual Erosion Hazard Map from 2002 aerial photographs (Figure 15) documents higher Beach Erosion rates from east to west updrift of the small, downdrift beach to 2002 with an advancing Beach Loss rate. The rate across Lots 1 and 2 are less because the seawall there protects the shoreline from retreat.

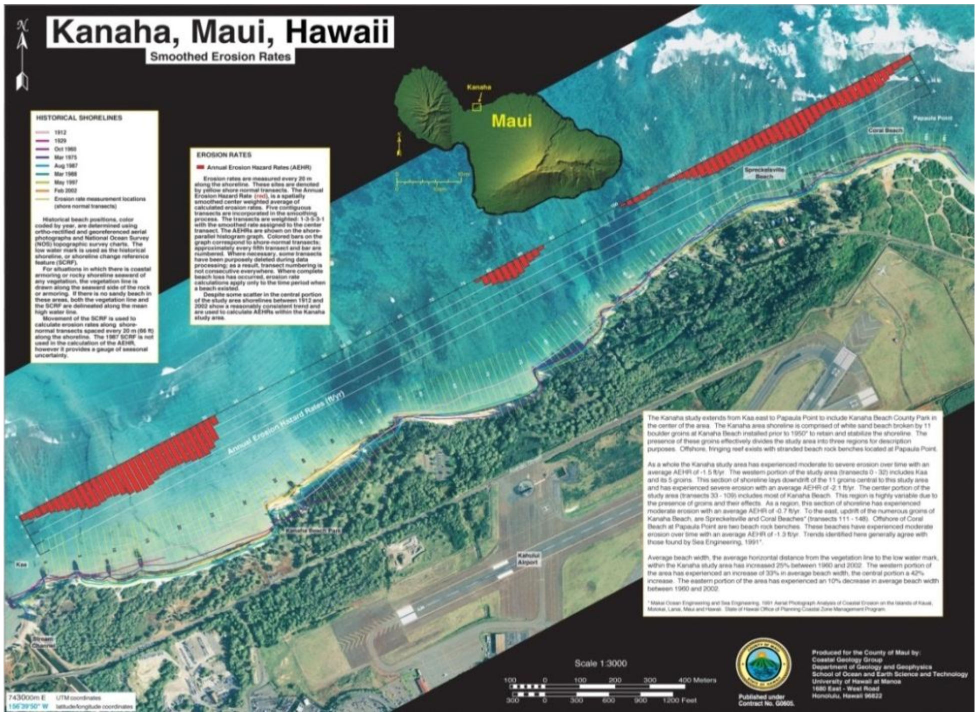


Figure 15 – Annual Erosion Hazard Map

- Local Beach Width Reduction - The U.H. Annual Erosion Hazard Map from 2002 aerial photographs (Figure 15) indicates in its text a 10% decrease of Average Beach Width at its east portion, which includes the Project Area east of the downdrift beach. It is evident Beach Width reduction has occurred immediately updrift of Lot 2, and there is advancing Beach Width reduction at the small, downdrift beach from 1960 to 2002.

- Historic Need for Protection from Long-Term Beach Retreat - The fact that it was deemed necessary or advantageous to construct the long, continuous seawall with four rock groins on the beaches across downdrift Lots 1 and 2 in 1925, indicates a long-term, historic concern about Beach Retreat with Land Loss with possible Beach Width reduction and/or Beach Loss. This need for protection is documented in the 1940 aerial photograph (see Appendix Photo 15).

Local Seawall Effect on Beach Erosion:

Per documentation, the Local Seawall Effect on Beach Erosion is a Contributing Cause of the Initial and Increased Seasonal, Downdrift Beach Erosion at the small, downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons for the following reasons:

- Seawall Effect on Beach Erosion in Front of Seawall - Documented from studies by Tait and Griggs, 1990 are the effects of seawalls to halt erosion leading to land loss behind the seawall and to focus the erosion onto the beach in front of the seawall leading to beach narrowing and beach loss in when longshore waves occur.

  Seawalls cause a swash effect of creating backwash onto a receding beach, and thus seawalls interfere with the nearshore sediment processes if the shoreline retreats to the proximity of the structures. When waves wash up against seawalls, the waves reflect back towards the ocean with much more energy than if the wall were not there (Plant and Griggs,1992).

- Seawall Effect on Beach Erosion Downdrift of Seawall - Documented from studies by Tait and Griggs, 1990 are the effects of seawalls to cause an increased erosion effect on immediate, downdrift beaches and especially to beaches undergoing long-term beach retreat and beach loss due partly to a diminished beach width in front of the seawall and thus a decreased supply of sand sediment immediately updrift that may be transported longshore to downdrift beaches.

  A contributing factor to downdrift beach loss is that the swash reflected by a seawall is directed seaward several seconds earlier than swash on the adjacent natural beach. This increases the backwash duration and velocity, which as a result increases the offshore transport of sand from the downdrift beach since the waves originate from updrift and reflect downdrift offshore (see Photo 6) (Tait and Griggs,1990) .

Photo 6 – Seawall Reflected Waves from Lot 2 toward Small, Downdrift Beach Located at Transect 1, June 2011

Regional Increase of Long-Term, Annual Beach Erosion Rate:

Per documentation, the Regional Increase of the Long-Term, Annual Beach Erosion Rate may be a Contributing Cause of the Initial and Increased Seasonal, Downdrift Beach Erosion at the small, downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons for the following reasons:

- Increase of Historic Beach Erosion Rate at Project Area - Since 2006 until Project construction in 2010, the annual beach erosion rate and consequential land loss at the Project Area was significantly higher than the long-term, Annual Beach Erosion Rate from the U. H. Erosion Hazard Map (Figure 13), which was measured long-term to 2002, by a factor of three. This change of the long-term erosion rate with a higher rate of beach erosion and land loss came abruptly to the Project Area in 2006, and perhaps the small, downdrift beach is experiencing a similar change of the long-term Annual Beach Erosion Rate last documented to 2002 based on natural causes. Other Maui north shore areas also experienced unusually high erosion rates and beach loss during the 2009 and 2010 summer seasons, including updrift Baldwin and downdrift Kanaha Beach Parks.

- Regional Sediment Management Study - At a Regional Sediment Management (RSM) Workshop on 19 January 2011, representatives of the U.S. Army Corps of Engineers stated that based on more recent 2007 aerial photographs, the long-term Annual Beach Erosion Rate for the Kanaha Littoral Cell, which includes the Within and Outside Project Areas, has significantly increased with a significantly increased annual beach sediment loss of -10,550 cu. yd. per year (see Figure 16).

Figure 16 – Kanaha Littoral Cell Annual Beach Sediment Loss

The Corps representatives also stated that there is a change in the long-term trend of the location of the most rapidly eroding zone in the RSM larger study region between Hookipa Beach Park to the east and Paukukalo to the west on Maui's north shore, and the most rapidly eroding zone has shifted from east to west along the coastal region to the Kanaha Littoral Cell.

This significant increase of the long-term beach erosion rate and relocation of the highest rate of regional beach erosion from east to west in the RSM study correlates with the significant increase of the annual beach erosion at the Project Area starting in 2006, and it may contribute to the increased erosion at the small, downdrift beach starting in 2010.

3.2.3 Summary of Causes:

<u>Project Related Causes</u>: These possible causes are concluded to be physically impossible and not applicable to the occurrences.

<u>Natural Causes</u>: These possible causes were concluded to be contributing causes and occurring simultaneously:

- **Historic Trend of Local, Long-Term Beach Retreat: This trend put the beach in peril being next in line for Beach Loss with no immediate, updrift beaches for buffering and sand nourishment. This is the primary cause of beach erosion at the small, downdrift beach located at transect 1, since this beach was at the tipping point of sustainability.**

- **Local Seawall Effect on Beach Erosion: The updrift seawall caused updrift Beach Loss, as well as Beach Width narrowing at the small, downdrift beach. The seawall effect updrift and at the small, downdrift beach exacerbated and increased seasonal erosion with Beach Width reduction and eventual Beach Loss immediately downdrift across the small beach located at transect 1.**

- **Unusually Early and High Trade Winds: The unusually early and high trade winds were the catalyst with the above two contributing causes to the early and initial seasonal beach erosion and at the small, downdrift beach, resulting in a longer erosion duration and thus an increased Beach Sand Volume loss magnitude during the spring and summer seasons.**

- **Regional Increase of Long-Term Beach Erosion Rate: This may be a contributing cause and indicates a regional problem.**

3.3 Need for Monitoring Continuation

The Project Performance Monitoring based on field data and assessments for one year, post-construction of all four environmental factors indicated "no change in conditions attributable to the Project"; therefore, no future monitoring of these areas is necessary per the Project's Guidelines.

Despite this fact, Beach Erosion monitoring will continue for the 2011 summer erosion season and at the end of the 2011 fall and 2012 winter accretion period for further data collection and assessment.

3.4 Project Performance

3.4.1 Project Goals' Attainment: Post-construction, there was no beach erosion resulting in exposed embankments at the land as in previous years. No land was lost at the Project Beach during the 11 March 2011 tsunami except a small amount at the west end of the Project Beach where the home's foundation was exposed.

The Project Goals of Preserving the Project Beach and No Land Loss without adversely affecting the nearshore environment plus updrift and downdrift beaches has been obtained post-construction (see post-construction Photo 8 taken at the same time of year as the previous, pre-construction Photo 7).

Photo 7 - Beach and Land Loss within Project Area, 4 August 2009 - Pre-Construction

Photo 8 - Beach and Land Preservation within Project Area, 17.August 2010 - Post-Construction

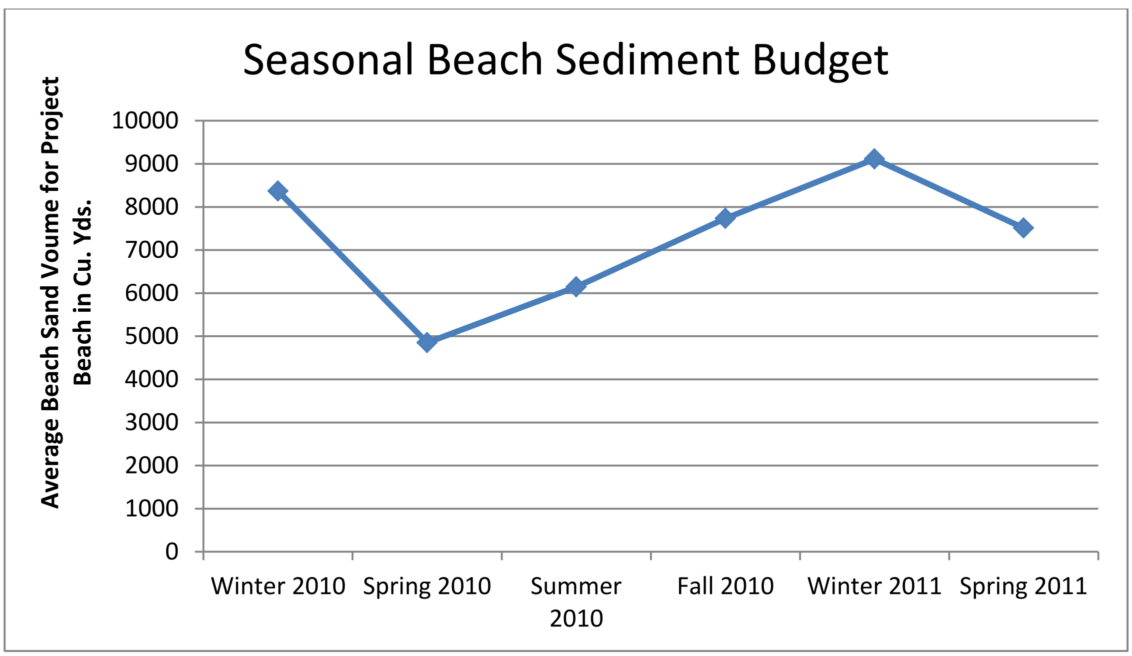
<u>This Project is successful</u>.

3.4.2 Project Beach Annual Sediment Budget: The Annual Sediment Budget for the Project Beach based on survey calculations and events during and after construction described in the Fourth Quarterly, Post-Construction Performance Monitoring and Metrics for Beach Erosion (including sand volume pumped to the beach for nourishment, sand volume retained on the beach for groin fill and the sand volume lost from the 11 March 2011 tsunami) is the difference in Beach Sand Volume accreted or lost over a one year period, including two accretion and two erosion seasons, measured in cubic yards (see Figure 17).

The Project's Annual Sediment Budget is positive as follows:

- One year post-construction: + 2,659 cu. yd.
- One year from pre-construction: +744 cu. yd.*

* Despite the high volume of Beach Sand Volume loss during and immediately after construction due to the initially unstable beach.



<u>Figure 17 - Seasonal Sediment Budget at Project Beach</u>

It is significant that the Project's Annual Sediment Budget is positive, which is indicative that the Project Beach was able to sustain itself for the one year, post-construction period without additional beach nourishment. This is due to the groin field performing properly to retain sand on the beach, while still allowing longshore sand transport to downdrift beaches.

3.4.3 Beach Nourishment Effect: The volume of sand lost during the 2010 spring season (see Figure 10), immediately post-construction was comparable to the 2,886 cu. yds. of offshore beach nourishment sand that was pumped and placed on the Project Beach. The Project's designer/coastal engineer estimated approximately 35% of the beach nourishment sand (1,010 cu. yds.) would be lost immediately after construction due to the initial instability of the beach in addition to the volume lost from seasonal erosion.

There were two reasons for the Project to attempt to nourish the Project Beach with offshore sand:

- Sand Replenishment - First and foremost was to replenish the beach the large volume of sand lost previously from spring and summer seasonal erosion. The Project Beach had experienced unusually high, annual erosion rates starting in 2006, and the region has a diminished natural supply of sand for accretion due to decades of sand mining along its coast.

- Possibility of Temporary Sand Impoundment by Newly Installed Groin Field - A newly installed groin field may cause an interruption of longshore sand transport until its cells are full of sand. By this Project nourishing the beach in conjunction with a groin field installation, it was able to offset temporary impoundment of sand by the groin field and to allow for natural longshore sand transport processes to continue unimpeded. This is demonstrated by the 2,233 cu. yd. of Beach Sand Volume lost during the 2010 spring and summer seasons (see Figure 10), during and immediately after construction, when longshore sand transport was visibly evident. Three months after construction completion, cross shore sand transport started in September and continued for six months with 2,967 cu. yd. of natural beach accretion/nourishment as a result.

The Project's beach nourishment efforts, while falling short of the goal of 6,000 cu. yds. of offshore sand pumped onto the Project Beach, did pump and place approximately 50% of that volume, thus allowing for downdrift beaches to be unaffected by the Project's groin field installation.

3.4.4 Groin Field Effect: The reason for the installation the groin field as temporary is for evaluation study purposes to determine its effectiveness to accomplish the Project goals of retaining beach sand, preventing land loss and not causing adverse environmental effects nearshore.

The purpose of the groin field is to retain beach sand by reducing erosive losses to Beach Width and Beach Sand Volume. Without the groin field, existing beach sand plus the added sand nourishment would have quickly disappeared during the 2010 spring and summer seasons.

The increase of Average Beach Width at the Project Beach from pre-construction is because of the length of each groin which caused the beach toe to shift seaward to a previous historic location near the end of the groin. By preserving the Project Beach and its Beach Width, a result is longer wave run-up width of the beach before waves hit the land, especially at high tide periods, thus protecting the shoreline and land from erosion.

During the spring and summer seasons, when the wave direction is sideshore from the northeast, the beach toe has a curvature at the seaward end of a groin. This downdrift beach toe scouring due to the groins was anticipated by the Project's coastal engineer/designer in its Project Beach Equilibrium Site Plan (see Figure 14). During the fall and winter seasons, when the wave direction changes to generally on-shore due to the northwesterly waves, the beach toe is more of a straight line shape between groin ends and the groin field has no effect on sand accretion from cross shore sand transport.

One year post- construction, the Project Beach is more stable due to the groin field after experiencing four seasons of weather conditions and is in equilibrium, which is defined by NOAA as "when the beach has slope gradient such that the amount of sediment (sand) deposited by waves and currents is balanced by the amount removed by them". The equilibrium is dynamic since "the profile is easily disturbed by strong winds, large waves, and exceptional high tides", but it has been balanced annually as a result of the Project. Prior to the Project, the Project's designer/coastal engineer estimated the annual sediment loss from the Project Beach to be 3,400 cu. yd.

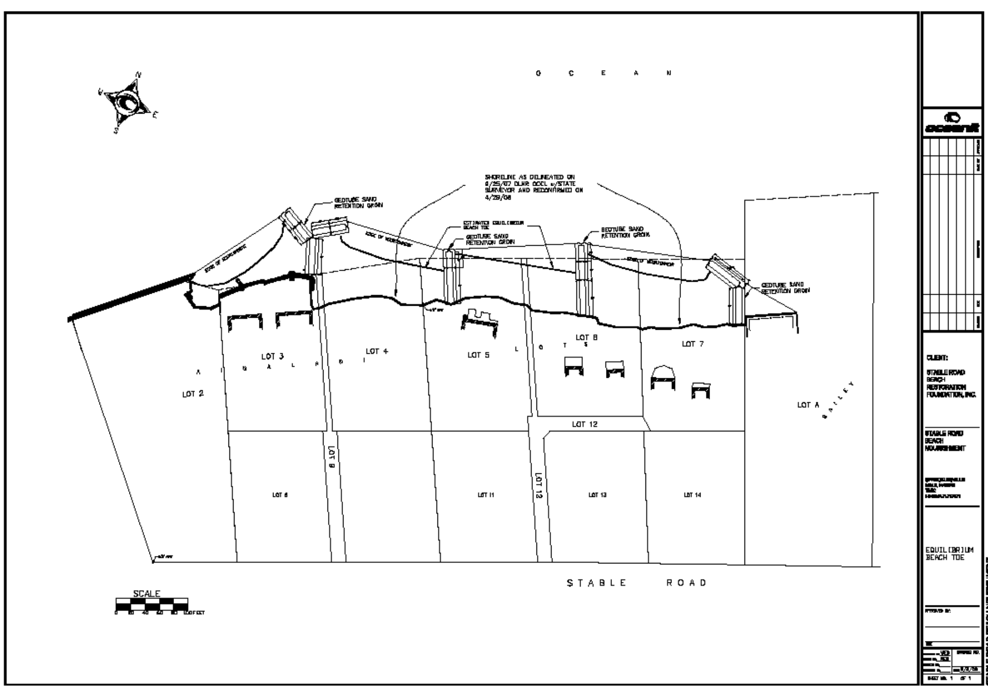


Figure 18 – Project Area Equilibrium Site Plan

3.4.5 Tsunami Effect: The Project Beach prior to the 11 March 2011 tsunami was full of sand from the previous fall and winter seasons' natural sand accretion. The level of the beach sand was the same elevation as the top of the shoreline land, except at the far west end of the Project Beach where the land erosion has exposed the foundation of a home (see Photo 2), so the tsunami waves rolled over most of the beach and land depositing beach sand onto the land. No Project Area land was lost, except some near the foundation of the westerly home. Most of the beach sand that was pushed onto the land by the tsunami has been returned to the Project Beach at its easterly half as a dune at the top of the beach near the shoreline.

Outside the Project Area, the tsunami caused a higher rate of beach sand loss and relocation to the ocean due to the seawall rebound effect, and land was lost where the top of embankments, even above seawalls, were exposed. Some of the accreted beach sand returned after a few weeks to these beaches, but the tsunami impeded and diminished winter season accretion. At the small beach cove immediately downdrift of the Project Area, several concrete slabs and rocks were dislodged from the westerly seawall revetment and easterly rock revetment respectively and deposited in the cove.

One year, post-construction as a result of the Project's successful beach preservation performance, there was preservation of the Project Area beach and land during the tsunami.

3.5 Environmental Benefits:

The Project Intent to preserve the Project Beach and to prevent Land Loss for environmental and public benefit without adversely affecting the nearshore environment has been achieved by the Project based after one year of post-construction monitoring data and assessments with the environmental benefits:

- **Minimal seasonal beach sand loss** at the Project Beach, thus the preservation of the public beach and prevention of land loss. No beach sand or Land Loss outside the Project Area attributable to the Project.

- **No land loss** within the Project Area, except minimally at its west end due to the 11 March 2011 tsunami, thus a preservation of sewage leach field areas and a reduction of land based pollutants from entering the water. No Land Loss outside the Project Area, except due to the 11 March 2011 tsunami.

- **Preservation of Water Quality** by preserving the beach as a buffer between land and ocean and by stopping Land Loss plus land based pollutants from directly entering the ocean.

- **Preservation of Benthic Habitat and marine life** by preserving Water Quality.

- **Preservation of beach and shoreline habitat for endangered species** including Hawaiian Monk Seals, shore birds and sea turtles (the below hatching with article occurred at the middle of the Project Beach post-construction (see Photo 9).

"Baby Turtles Hatch…and A Lucky One is saved"

For the past few months we have been watching a secret area of the beach in anticipation of a Turtle hatching.

That eagerly awaited event took place late last week. Over the course of 2 days possibly over 100 baby turtles dug their way out of the nest and took their first steps toward the sea.

Following a few more days of observation members of the Hawaii Hawksbill Turtle Recovery Project returned to the site, their aim to locate any unopened eggs or trapped live baby turtles.

Photo 9 – Turtle Hatching at Project Beach, 22 December 2011

Posted on December 22, 2010 by ray

- **Preservation of beach use and Lateral Beach Access** by preserving the public beach.

- **Preservation of the home at the west end of the Project Beach** with previous significant land loss and an exposed foundation.

- **No tidal waves damage and no land loss at the Project Beach** from the 11 March 2011 tsunami, except for minor land loss at the west end, which was unlike the consequences at other nearby beaches.

One year post-construction, as a result of the Project's successful performance, there was preservation of several, important environmental elements with no adverse effects; and there were several improvements to pre-construction environmental conditions with public benefit as a result of the Project's successful performance.

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APPENDIX - 9.2 **<u>Two Year Beach Erosion Performance Monitoring and Metrics Report</u>**

STABLE ROAD BEACH NOURISHMENT EVALUATION PROJECT

SSBN MA 08-01

WQC 0000751 / DA POH-2008-00064

BEACH EROSION PERFORMANCE MONITORING AND METRICS

Two Year - Fall 2011/Winter 2012 Seasons Report

15 April 2012

Prepared for:

Stable Road Beach Restoration Foundation (SRBRF)

590 Stable Road

Paia, Hawaii 96779

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1. BACKGROUND

1.1 <u>Project Area Recent History Beach Erosion and Land Loss</u>: As described in the Project's First Quarterly, Post-Construction Monitoring Report - Summer 2010, the Project Beach has experienced a significantly high rate of seasonal beach erosion and consequential land loss starting in 2006 that was much greater than historic averages.

The contributing factor to this beach erosion and land loss is weather caused waves hitting the beach, either from northeasterly trade winds or northwesterly Pacific swells.

During the spring and summer seasons when strong trade winds typically occur, the east end of the Project Beach and land have eroded from northeasterly, short interval waves causing scouring and longshore sand transport to the west. The beach then has become unusable and unsafe (see Photo 1). This erosion is exacerbated by the adverse effects of the adjoining hardened shoreline to the east.

Photo 1 - Beach and Land Erosion Pre-Construction at Project Beach Looking East, 22 August 2006

During the fall and winter seasons when large, north Pacific swells typically occur at intervals, the west end of the Project Beach and land have eroded from northwestly, long interval waves causing cross shore sand transport and scouring exacerbated by the adverse effects of the adjoining hardened shoreline to the west. The safety of the home on Lot 3 at the west end of the Project Beach is

Photo 2 - Land Loss at West End of Project Beach (Lot 3), 23 August 2010

Photo 3 - Beach and Land Erosion, Beach Loss and Land Pollution at Project Beach, August 2008 threatened from this chronic erosion (see Photo 2). This erosion is exacerbated by the adverse effects of the adjoining hardened shoreline to the west.

When the beach erodes and sand is lost, land embankments are exposed and then vulnerable to erosion from waves and currents at high tide periods causing land loss to the ocean and land based pollutants entering the ocean (see Photo 3); thus degrading water quality and the marine environment, which adversely affects the health of coral reefs. Also the beach erosion and subsequent beach sand loss restricts public use and lateral access of the beach, plus the beach and shoreline habitat are lost.

In response to the chronic and recently accelerating rate of beach erosion and land loss, the Stable Road Beach Restoration Foundation (SRBRF) initiated the construction of a Small Scale Beach Nourishment (SSBN) Project during the spring of 2010, which consisted of beach nourishment and the installation of four, temporary sand retention devices (groins). The groins are not permanent in order to allow modifications, if necessary, based on monitoring and assessing their impact and performance in accomplishing the Project's Performance Objectives, which are to increase Beach Width and Beach Sand Volume to previous historic levels and to reduce future rates of beach and land erosion in order to preserve: public beach use and lateral beach access, water quality and marine life health, plus beach and shoreline habitat.

1.2 First Quarterly, Post-Construction Monitoring Report - Summer 2010:

The First Quarterly, Post-Construction Monitoring Report - Summer Season 2010 was prepared in accordance with the Project's approved Performance Monitoring and Metrics for Beach Erosion Guidelines and was submitted in September to the Hawaii State Department of Land and Natural Resources, Office of Conservation and Coastal Lands (DLNR, OCCL) and Department of Health (DOH) for review.

During the spring season of 2010 when the Project was under construction there were earlier and higher than normal northeasterly trade winds (see Section 8.3.1); and combined with several moderate north Pacific swells and high tide periods, the impact was significant longshore waves and current, which at times covered entire beaches in the area and resulted in earlier and higher than normal beach scouring and erosion. During the summer season of 2010, the north Pacific swells dissipated and more normal, northeastly trade winds dominated.

This Report indicated the Project was successfully accomplishing its goals of reduced beach erosion and land loss Within the Project Area during the immediate, post-construction summer season; while Outside the Project Area, earlier and greater than previous seasons' reduction of Beach Width and Beach Sand Volume occurred at one downdrift beach located at transect 1. Due to the reductions, this beach was non-compliant in meeting the Project's Performance

Criteria/Metric, which then required the SRBRF to identify and assess Possible Causes. This Report preliminarily identified and discussed Possible and Probable causes. The preliminary conclusion was that the causes were non-Project related for several reasons, and that further monitoring plus assessment of changes and causes was necessary.

The DLNR, OCCL reviewed this Report and commented about it and the Project in its Project Update Notice of 6 October 2010. Due to unanticipated and coincidental reduction of Beach Width and Beach Sand Volume at a portion of the downdrift beach described in the Report and the letter, the DLNR, OCCL requested additional monthly beach surveys for the second quarterly, post-construction monitoring period instead of the previously approved single survey at the end of the quarterly period.

1.3 Second Quarterly, Post-Construction Monitoring Report - Fall 2010:

The Second Quarterly, Post-Construction Monitoring Report - Fall Season 2010 was formatted as supplemental to the First Quarterly Report, thus sections 2 through 5.1 of the first report were not included. Sections 5.2 through 10 of the Fall Season Report contained the 2010 fall season data and performance assessments. The request by the DLNR, OCCL for increased monthly surveys was performed with the monthly data provided in the Report.

During the 2010 fall season, small northwesterly Pacific swells started mid-September and continued infrequently; and northeasterly trade winds began to decrease in frequency and strength. The result was a typical fall season with an overall accretion of sand on the nearby beaches from dominant cross shore sand transport caused by the northwesterly Pacific swells.

This Report indicated the Project continued to successfully accomplish its goals of reduced beach erosion and no land loss during the summer and fall seasons Within the Project Area; while Outside the Project Area, most of the Beach Width and Beach Sand Volume reduction during the previous spring and summer seasons at the downdrift beach located at transect 1 returned in the fall.

This Report also indicated that the level of sand at the downdrift beach was at a previous, historic level based on a 2002 aerial photo.

1.4 Third Quarterly, Post-Construction Monitoring Report - Winter 2011:

The Third Quarterly, Post-Construction Monitoring Report - Winter Season 2011 was also formatted as supplemental to the First Quarterly Report, thus sections 2 through 5.1 of the first report were not included. Sections 5.2 through 10 of the Winter Season Report contain the 2011 winter season data and performance assessments.

During the 2011 winter season, the northeasterly trade winds were light, and the weather was dominated by intermittent, northwesterly Pacific swells, which were moderate to large in size. The result was with an overall accretion of sand on the nearby beaches from cross shore sand transport.

This Report indicated the Project continued to successfully accomplish its goals of reduced beach erosion and no land loss during the previous summer and fall seasons plus the 2011 winter season Within the Project Area; while Outside the Project Area, almost all of the of the Beach Width and Beach Sand Volume reduction during the previous spring and summer seasons had returned to the downdrift beach located at transect 1 during the fall and early winter seasons with a trend of continuing accretion.

Unfortunately, the recovered Beach Width and Beach Sand Volume at the downdrift beach was adversely affected during late winter by the waves of the tsunami on 11 March, which caused a significant reduction of Beach Sand Volume and land loss at his location. Within a few weeks after the tsunami, most of the lost sand returned to this beach, but the continuation of seasonal accretion was interrupted for at least a month in April by the tsunami.

This Report also indicated that the level of sand at the downdrift beach was at a previous, seasonal level based on a 2010 pre-construction beach photo.

1.5 Fourth Quarterly, Post-Construction Monitoring Report - Spring 2011:

The Fourth Quarterly, Post-Construction Monitoring Report - Spring Season 2011 was also formatted as supplemental to the First Quarterly Report, thus sections 2 through 5.1 of the first report are not included herein. Sections 5.2 through 10 of the Spring Season Report contain the 2011 spring season data and performance assessments.

During the 2011 spring season, the weather was dominated by the northeasterly trade winds, which started early in April, and the trade winds were strong, frequent and sustained at times. The result was a change from the fall/winter beach sand accretion cycle with cross shore sand transport to the beginning of the spring/summer beach erosion and sand loss cycle at the region’s beaches by longshore waves and currents.

The Report indicated the Project continued to successfully accomplish its goals of reduced beach erosion and no land loss Within the Project Area for the one year, post-construction period during the 2010 summer and fall seasons plus during the 2011 winter and spring seasons. Outside the Project Area, the downdrift beach area located at transect 1, which had nearly regained its pre-construction Beach Width and Beach Sand Volume during the 2010 fall and 2011 early winter seasons before the 11 March tsunami, began to erode at its east end in May, which is one month earlier than the previous year.

1.6 Fifth Quarterly, Post-Construction Monitoring Report - Summer 2011:

The Fifth Quarterly, Post-Construction Monitoring Report - Summer Season 2011 was also formatted as supplemental to the First Quarterly Report, thus sections 2 through 5.1 of the first report are not included herein. Sections 5.2 through 10 of the Summer Season Report contained the 2011 summer season data and performance assessments.

During the 2011 summer season, the weather was dominated by the continuation of northeasterly trade winds, which started early in the spring, and the trade winds were strong, frequent and sustained at times. The result was a continuation of the spring/summer beach erosion and sand loss cycle at the region's beaches by longshore waves and currents.

The Report indicated the Project continued to successfully accomplish its goals of reduced beach erosion and no land loss Within the Project Area for the post-construction period during the 2010 summer and fall seasons plus during the 2011 winter, spring and summer seasons. Outside the Project Area, the downdrift beach area located at transect 1, which had nearly regained its pre-construction Beach Width and Beach Sand Volume during the 2010 fall and 2011 early winter seasons before the 11 March tsunami, began to erode at its east end in May, which was one month earlier than the previous year. Despite the early seasonal erosion and contrary to the typical summer erosion cycle, this beach re-gained Beach Width and most of its Beach Sand Volume during the 2011 summer season.

1.7 Two Year Monitoring Report - Fall 2011/Winter 2012:

The Two Year Monitoring Report - Fall 2011/Winter 2012 Seasons was also formatted as supplemental to the First Quarterly Report, thus sections 2 through 5.1 of the first report are not included herein. Sections 5.2 through 10 of the Fall 2011/Winter 2012 Seasons Report contain the 2011 fall and 2011 winter seasons data and performance assessments.

During the 2011 fall/winter 2012 normal accretion seasons, the weather pattern was a continuation of the La Nina cycle with cooler equatorial waters and higher than normal winds. North and northeasterly trade winds dominated, which were strong, frequent and sustained at times; and there were occasional north Pacific swells but few significantly large or sustained swells. The result was alternating cycles of beach erosion with beach sand loss from trade winds and beach sand accretion from the north Pacific swells at the region's beaches. This pattern was different from that of the 2010 and 2011 fall/winter seasons, which had long periods of light trade winds and many large north Pacific swells

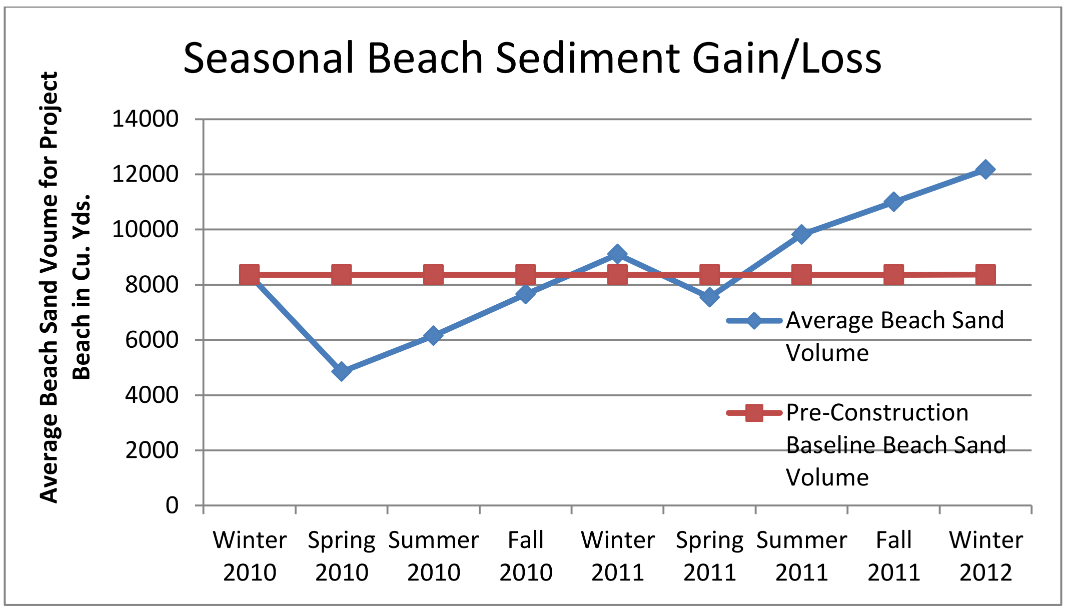
This document is the Two Year Monitoring Report - Fall 2011/Winter 2012 Seasons. The Report indicates the Project continued to successfully accomplish its goals of reduced beach erosion and no land loss Within the Project Area for the post-construction period during the 2011 fall and 2012 winter seasons plus. Outside the Project Area, the downdrift beach area located at transect 1, which had lost Beach Width and Beach Sand Volume during the previous 2011 summer season continued to lose Beach Width and Beach Sand Volume during the 2011 fall and 2012 winter seasons, most likely due to the La Nina effects.

2. DOCUMENT SUMMARY

2.1 Project Performance Within Project Area

- **Project Performance Objectives - The Project Performance Objectives of increased Beach Width and Beach Sand Volume plus reduced rates of future Beach Erosion and Land Loss have been attained. This is due to the installation of temporary, sand retention devices (geotube groins) in the spring of 2010, which allows the Project Beach to naturally retain beach sand from the accretion seasons during the annual erosion seasons.**

- **Two Year Monitoring Results - During the two year monitoring period, the Average Beach Width increased 27%, and the Beach Sand Volume increased 46% at the Project Beach, during four each accretion and erosion seasons (see Graph below).**

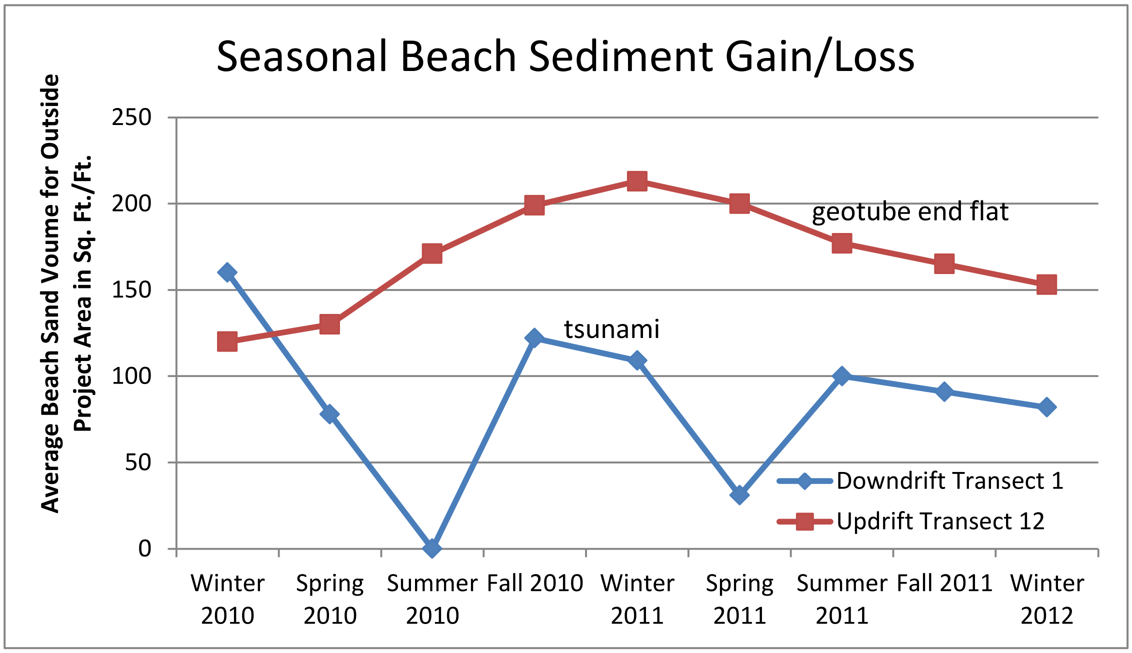


- **Annual Sediment Budget - The monitoring survey data indicates the Project Beach to be self-sustaining post-construction without the need for sand replenishment (see Graph above).**

2.2 Project Performance Outside the Project Area

- **Two Year Monitoring Results - During the two year monitoring period, the Beach Width at updrift transect 12 increased 44%, and its Beach Sand Volume increased 28% during four each accretion and erosion seasons (see Graph below). During the same period, there was no change to Beach Width and Beach Sand Volume at immediate downdrift**

transects 2 and 3; and at the downdrift beach furthest away at transect 1, the Beach Width decreased 45%, and the Beach Sand Volume decreased 48% (see Graph below).



- **Initial and Seasonal Beach Sand Volume Gain and Loss - Beach sand gain and loss is dynamic at the updrift and downdrift beaches from season to season and year to year (see Graph above), and variations of seasonal weather affect these changes. During the 2010 spring season, the downdrift beach at transect 1 lost sand one month earlier than during the 2009 spring; and during the 2011 spring, this beach lost sand one month earlier than during the 2010 spring. During the 2011 summer season the downdrift beach at transect 1 gained sand; but during the 2010 summer, it lost sand. During the 2010 fall season, this beach gained sand; but during the 2011 fall, it lost sand.**

- **Performance Assessment - The assessment of one short-term data source pre-construction for Beach Erosion of Beach Erosion at the downdrift beach at transect 1 is that the Project's Performance Criteria/Metrics was not attained during the two year monitoring period; however, the longer-term assessment of Beach Erosion of Beach Erosion at this beach is that the Project's Performance Criteria/Metrics was attained.**

- **Beach Erosion History of Downdrift Area - Outside the Project Area there is photographic evidence of a long-term trend of advancing beach retreat, beach width narrowing plus of beach loss updrift and at the downdrift beach located at transect 1. Beach erosion at this beach during the 2010 spring and summer plus 2011 spring seasons is not a**

new phenomenon. The fact that the seawall updrift and at this beach was most likely built in 1925, and that the rock groins and seawalls at this beach and immediately updrift are evident in a 1940 aerial photograph indicates a concern about beach erosion and land loss at this stretch of beach 72 to 87 years ago. The long-term, Annual Erosion Hazard Rate for this area has been .5 feet per year from 1960 to 2002, and reported is a regional increase of the long-term beach erosion rate trend based on more recent 2007 aerial photographic data per the recent Regional Sediment Management study by the U. S. Army Corps of Engineers.

- **<u>Possible Causes of Initial and Seasonal Downdrift Beach Erosion at Transect 1</u> - The Project's Performance Criteria/Metrics require Investigative Action to identify and assess the cause of significant changes at monitored beaches Outside the Project Area. This investigation started immediately during the 2010 summer season when it was first apparent that beach erosion at the downdrift beach at transect 1 was earlier and greater than during the previous spring season. Identified and assessed in Section 8 of this Report are two possible Project related causes: Groin Field Effect on Downdrift Beach Erosion and Groin Field Effect on Longshore Sand Transport. Also, four possible non-Project related or natural causes were identified and assessed: Unusually Early and High Trade Winds; Historic Trend of Local, Long-Term Beach Retreat; Seawall Effect on Beach Erosion; and Regional Increase of Long-Term, Annual Beach Erosion Rate.**

- **<u>Causes of Initial and Seasonal Downdrift Beach Erosion at Transect 1</u> - The assessment of the identified Possible Causes concluded in Section 9 of this Report the following causes:**

  <u>Possible Project Causes</u> - It is not physically possible there were adverse impacts by the Project Groin Field Effect on Beach Erosion and Longshore Sand Transport due to the long distance and continuous seawall separating the Project's groin field from the downdrift beach at transect 1.

  <u>Natural Causes</u> - The downdrift beach located at transect 1 was documented to be in peril and at a tipping point of sustainability by 2010 due to a Historic Trend of Local, Long-Term Beach Retreat with decades of local beach width narrowing and beach loss. Documented also are Seawall Effects on Beach Erosion indicating adverse beach erosion effects of seawalls in front of and immediately downdrift, especially on beaches with advancing beach retreat. Additionally documented were Unusually Early and High Trade Winds which acted as a catalyst to start the 2010 and 2011 spring seasons' early beach erosion at a beach in peril and with a seawall to exacerbate beach erosion. Another

contributing cause was a Regional Increase of Long-Term Annual Beach Erosion Rate due to a diminished sediment supply. All four of these natural causes occurred simultaneously at the beginning of the two year monitoring period.

<u>Conclusion of Causes</u> - The cause of the Initial and Seasonal Downdrift Beach Erosion at Transect 1 is not attributed to the Project.

- **<u>Land Loss</u> - No Land Loss Outside the Project Area has occurred during the two year monitoring period, except during the 11 March tsunami when tidal waves hit and eroded exposed land banks, mostly located above seawalls Outside the Project Area.**

- **<u>Project Objective and Performance Criteria/Metrics</u> - The Project Objective of no Project related adverse effect Outside the Project Area have been attained, and the Project's Performance Criteria and Metrics for Beach Erosion have been attained.**

- **<u>Remedial Action</u> - None is required since the cause of the Initial and Seasonal Downdrift Beach Erosion at Transect 1 is not attributed to the Project.**

- **<u>Continuation of Beach Erosion Monitoring</u> - Performance monitoring and assessments for Beach Erosion will continue to further assess Project performance.**

2.3 <u>Conclusions</u>

- **<u>Project Performance Objectives</u> - Within and Outside the Project Area, the Performance Objectives were attained during the two year monitoring period.**

- **<u>Project Performance Criteria/Metrics</u> - Within and Outside the Project Area, the Performance Criteria/Metrics were attained during the two year monitoring period. The Causes of the Initial and Seasonal Downdrift Beach Erosion at Transect 1 are a combination of simultaneous, natural causes, and are not attributed to the Project.**

5.0 DATA MEASUREMENTS AND CALCULATIONS

5.2 Data Measurements and Calculations

The Project Performance Objectives are to increase the Project Beach Width and Beach Sand Volume to previous, historic levels and to reduce the rates of future beach and land erosion. To measure and calculate Beach Width and Beach Sand Volume, instrument survey data was collected for 12 different beach profiles corresponding to 12 approved transect locations, which include transects 4 through 11 at Lots 3 through 7 Within the Project Area, plus transects 1 through 3 at Lots 1 and 2 downdrift of the Project Area plus transect 12 at Lot A updrift of the Project Area (See Figure 1).

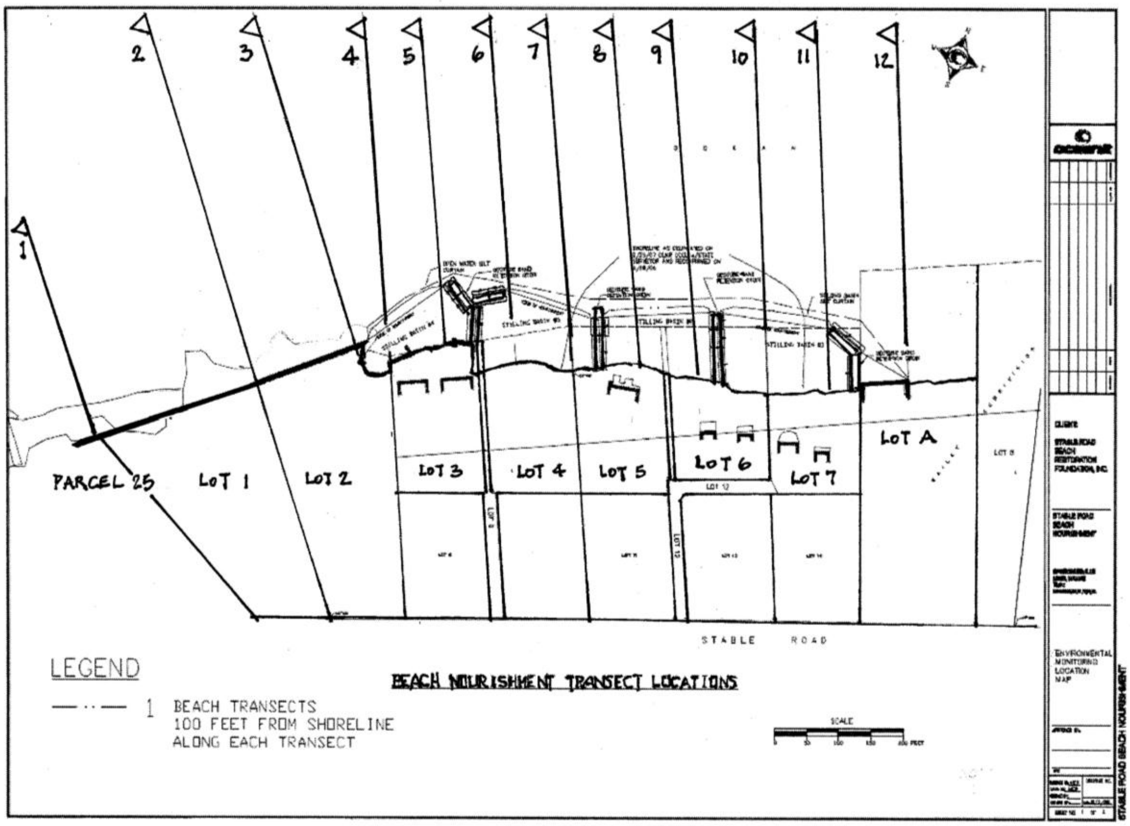


Figure 1 - Site Plan Showing 12 Survey Transect Locations

5.2.1 Within Project Area (Transects 4 through 11)

Beach Width - Within Project Area: Project Area Beach Width is measured in feet from consistent shoreline locations to the Beach Toe for each transect using the data of the surveyor's Profile drawings (see Appendix Figures 2 - 7), and the measurements are indicated in Table 1. The groins are intended to extend Project Beach Width seaward to previous historic locations and thus to preserve

Project Beach Sand Volume; therefore, the Beach Toe measurement basis is used Within the Project Area to best monitor the groins' performance in accomplishing this goal.

For the Previous 2007 surveys, the Beach Widths indicated are only for the transect locations then that are near the transect locations in 2010, and they are all measured from the same shoreline locations for continuity. Three years of erosion seasons occurred since the 2007 data before the pre-construction survey.

	Transects											
Survey	1	2	3	4	5	6	7	8	9	10	11	12
Winter 2010 - Pre-Construction												
4/15/10				58	26	77	83	92	92	67	53	
Spring 2010 - Immediate Post-Construction												
7/1/10				61	36	103	85	91	81	69	60	
Change				3	10	26	2	-1	-11	2	7	
Summer - 2010												
8/9/10				58	36	98	83	85	65	70	73	
Change				0	10	21	0	-7	-27	3	20	
9/13/10				58	33	97	88	83	62	73	93	
Change				0	7	20	5	-9	-30	6	40	
Fall - 2010												
10/19/10				58	30	92	86	83	83	72	71	
Change				0	4	15	3	-9	-9	5	18	
11/16 /10				58	33	85	88	83	75	78	81	
Change				0	7	8	5	-9	-17	11	28	
12/16 /10				58	27	89	83	80	74	79	83	
Change				0	1	12	1	-12	-18	12	50	
	Winter 2011											
3/29/11				58	34	104	102	93	85	92	73	
Change				0	8	27	19	1	-7	25	20	
Spring 2011												
6/28/11				64	43	127	116	93	92	95	93	
Change				6	17	50	33	1	0	28	40	
Summer 2011												
9/27/11				59	45	100	105	110	105	87	74	
Change				1	19	23	22	18	13	20	21	
Fall 2011/Winter 2012												
3/27/12				58	33	104	103	93	118	89	74	
Change				0	7	27	20	1	26	22	21	
Previous												
5/29/07				65		93	83			74	48	
10/15/07				75		93	83			66	54	

Table 1 - Beach Width - Within Project Area

Changes indicated in the Table are from the 4/15/10 pre-construction survey.

There were no significant changes in Beach Width during the 2011 fall and 2012 winter seasons compared to the previous summer season. The easterly groin's seaward end became flat during the summer, which is why Beach Width was less at transects 10 and 11 at the end of summer. The groin segment was replaced with a smaller circumference geotube during the winter, and the new geotube is only one half of its original height. The 2011 fall/2012 winter data is consistent with that at the end of the 2011 winter season one year before.

Overall for the two year monitoring period, when the temporary groins have been in place during four each accretion and erosion seasons, compared to the pre-construction survey data, there is an increase of Beach Width Within the Project Area at all transects except at transect 4 located at the rock revetment. At the Project Beach near groins, the Beach Width was extended an average of 20 feet to an Average Beach Width of 97 feet. The Beach Width is limited by the length of the temporary groins, which is approximately 100 feet from the shoreline.

Overall for a four year period compared to the previous survey data from 2007, there is a significant increase of Beach Width Within the Project Area post-construction at all transects except at transect 4 located at the rock revetment, even after three years of chronic beach erosion before Project construction.

The individual transect Beach Widths are not representative of the overall, Project Area Beach Width since transects are in specific locations to monitor groins' performance. For example, four transects (5, 7, 9 and 11) are located immediately downdrift of groins and in areas of anticipated seasonal beach scouring and sand loss due to the groin.

Beach Sand Volume - Within Project Area: Calculations using AutoCAD software of the Project Area Beach Sand Volumes are measured to the Beach Toe for continuity of measurement basis with Beach Width Within the Project Area and are calculated at each transect from data of the surveyor's Profile drawings (see Appendix Figures 2 - 7) in square feet for a one foot wide strip of beach. Calculations are indicated in Table 2.

Changes indicated in the Table are from the 4/15/10 pre-construction survey.

	Transects											
Survey	1	2	3	4	5	6	7	8	9	10	11	12
Winter 2010 - Pre-Construction												
4/15/10				174	98	360	412	481	497	323	184	
Spring 2010 - Immediate Post-Construction												
7/1//10				187	118	507	239	432	277	248	153	
Change				13	20	147	-173	-49	-220	-75	-31	
	Summer - 2010											
8/9/10				190	108	556	347	469	294	311	248	
Change				16	10	196	-65	-12	-203	-12	64	
9/13/10				179	108	549	325	400	289	341	301	
Change				5	10	189	-87	-81	-208	18	117	
Fall - 2010												

10/19/10				209	122	526	474	409	395	364	331	
Change				35	24	166	62	-72	-102	41	147	
11/16/10				203	107	505	484	413	415	380	379	
Change				29	9	145	72	-68	-82	57	195	
12/16/10				184	100	506	501	402	416	396	394	
Change				10	2	146	89	-79	-81	73	210	
Winter 2011												
3/29/11				180	107	553	518	469	512	486	360	
Change				6	9	193	106	-12	15	163	176	
Spring 2011												
6/28/11				209	145	698	575	424	417	432	368	
Change				35	47	338	163	-57	-80	109	182	
Summer 2011												
9/27/11				187	128	571	550	575	589	472	333	
Change				13	30	211	138	94	92	149	149	
Fall 2011/Winter 2012												
3/27/12				213	98	663	706	734	739	532	353	
Change				39	0	303	294	253	242	209	169	

Table 2 – Beach Sand Volume - Within Project Area

The significant Beach Sand Volume changes during the 2011 fall/2012 winter seasons compared to the previous summer season were increases of Beach Sand Volume at all transects except for a decrease at transect 5 located at the rock revetment. The 2011 fall/2012 winter data indicates a significant increase of Beach Sand Volume, except for a slight decrease at transect 11 due to the deflated seaward end of the east groin, compared to the same seasons one year before.

Overall for the two year monitoring period, when the temporary groins have been in place during four each accretion and erosion seasons, compared to the pre-construction survey data, there is a significant increase of Beach Sand Volume Within the Project Area at all transects except no change at transect 5 located at the rock revetment. This comparison does not account for the effects of sand removal from the Project Beach to fill the groins, added sand nourishment from dredging/pumping and the 11 March 2011 tsunami. See Section 6.1.2 for discussion and assessment.

Within the Project Area, the Beach Sand Volume increase correlates with that of Beach Width described in the previous Section, but Beach Width is limited by the length of the temporary groins.

The individual transect volumes are not representative of the overall, Project Area Beach Sand Volume since transects are in specific locations to monitor groins' performance. For example, four transects (5, 7, 9 and 11) are located immediately downdrift of groins and in areas of anticipated beach scouring and sand loss due to the groin.

Land Loss - Within Project Area: There has been no Land Loss Within the Project Area during the two year monitoring period, except for a slight loss at the west end of the Project Beach due to the 11 March 2011 tsunami; therefore, the Annual Erosion Rate is zero as relates to Project Performance effect Within the Project Area.

Beach Shape - Within Project Area: The overhead or plan view of the post-construction Beach Shape with Beach Toe is indicated in the 2011 fall/2012 winter seasons survey Site Plan drawing (see Appendix Figure 5), and which was confirmed by the same season's aerial photograph (see Appendix Photo 7). The Project Area Beach Shape during the 2011 fall and 2012 winter seasons resembled that shown in the Equilibrium Site Plan (see Appendix Figure 8).

5.2.2 Outside Project Area (Transects 1, 2, 3 and 12)

Beach Width - Outside Project Area: Outside Project Area Dry Beach Width is measured in feet form consistent shoreline locations at each transect using data from the surveyor's Profile drawings (see Appendix Figures 2 - 7), and the measurements are indicated in Table 3. The Dry Beach Width is used as a measurement basis for Outside the Project Area since transects 2 and 4 are located at seawalls with fronting rock piles and without beaches; therefore, these locations do not have a beach toe for measurement as Within the Project Area. The visible and useable beach is the Dry Beach and is measured above the high tide level. Fall 2012 data is interpolated between seasons.

There are no similar transect locations from the previous 2007 surveys for comparison. Transects 1, 2, and 3 are located downdrift of the Project Area, and transect 12 is located updrift.

Changes indicated in the Table are from the 4/15/10 pre-construction survey.

	Transects											
Survey	1	2	3	4	5	6	7	8	9	10	11	12
Winter 2010 - Pre-Construction												
4/15/10	22	0	0									16
Spring 2010 - Immediate Post-Construction												
7/1/10	11	0	0									18
Change	-11	0	0									2
Summer 2010												
8/9/10	0	0	0									23
Change	-22	0	0									7
9/13/10	0	0	0									25
Change	-22	0	0									9
Fall - 2010												

10/19/10	12	0	0									23.5
Change	-10	0	0									7.5
11/16/10	17	0	0									23
Change	-5	0	0									7
12/16/10	17	0	0									28
Change	-5	0	0									12
Winter 2011												
3/29/11	17	0	0									27
Change	-5	0	0									11
Spring 2011												
6/28/11	4	0	0									28
Change	-18	0	0									12
Summer 2011												
9/27/11	26	0	0									23
Change	4	0	0									7
Fall 1011/Winter 2012												
3/27/12	12	0	0									23
Change	-10	0	0									7

Table 3 – Beach Width - Outside Project Area

The significant change during the recent 2011 fall/2012 winter seasons compared to the previous summer season was a decrease of Dry Beach Width at transect 1. There would have been an increase at transect 12, but the seaward end of the east groin became flat during the previous summer and was not replaced until the winter of 2012. The 2011 fall/2012 winter data indicates a decrease of Beach Width at transects 1 and 12 compared to the same seasons one year before.

Overall for the two year monitoring period, when the temporary groins have been in place during four each accretion and erosion seasons, compared to the pre-construction survey data, there was a 44% increase of Dry Beach Width Outside the Project Area at updrift transect 12, a 44% decrease at downdrift transect 1 and no change at downdrift transects 2 and 3. See Section 8 about possible causes of the Initial and Seasonal beach erosion at downdrift transect 1.

Beach Sand Volume - Outside Project Area: Calculations using AutoCAD software of the Outside Project Area Dry Beach Sand Volumes at each transect are calculated from the data of the surveyor's Profile drawings (see Appendix Figures 5, 6 and 7) in square feet for a one foot wide strip of beach are indicated in Table 4. The Dry Beach Sand Volume measurement basis is the same approach as for Dry Beach Width at Outside the Project Area. Fall 2012 data is interpolated between seasons.

Transects 1, 2 and 3 are located downdrift of the Project Area, and transect 12 is located updrift.

Changes indicated in the Table are from the 4/15/10 pre-construction survey.

	Transects											
Survey	1	2	3	4	5	6	7	8	9	10	11	12
Winter 2010 - Pre-Construction												
4/15/10	160	0	0									120
Spring 2010 - Immediate Post-Construction												
7/1/10	78	0	0									130
Change	-82	0	0									10
Summer 2010												
8/9/10	0	0	0									140
Change	-160	0	0									20
9/13/10	0	0	0									171
Change	-160	0	0									51
Fall - 2010												
10/19/10	81	0	0									156
Change	-79	0	0									36
11/16/10	115	0	0									166
Change	-45	0	0									46
12/16/10	122	0	0									199
Change	-38	0	0									79
Winter 2011												
3/29/11	109	0	0									213
Change	- 51	0	0									93
Spring 2011												
6/28/11	31	0	0									200
Change	-129	0	0									80
Summer 2011												
9/27/11	100	0	0									177
Change	-60	0	0									57
Fall 2011/Winter 2012												
3/27/12	82	0	0									153
Change	-78	0	0									33

Table 4 – Beach Sand Volume - Outside Project Area

The significant changes during the recent 2011fall/2012 winter seasons, compared to the previous summer season were an decrease of Dry Beach Sand Volume at transects 1 and 12 and no change at transects 2 and 3. The decrease of Beach Sand Volume at transect 12 is due to the seaward end of its downdrift groin becoming flat during the previous summer and not being replaced until the winter of 2012. The 2011 fall/2012 winter seasons data indicates a decrease of Beach Sand Volume at transects 1 and 2 compared to the same seasons one year before; whereas, during the same seasons one year before there was an increase of Beach Sand Volume

Overall for the two year monitoring period, when the groins have been in place during four each accretion and erosion seasons, compared to the pre-construction survey data, there was a 28% increase of Dry Beach Sand Volume Outside the Project Area at updrift transect 12, a 49% decrease at downdrift transect 1 and no change at downdrift transects 2 and 3. See Section 8 about possible causes of the Initial and Seasonal beach erosion at downdrift transect 1.

The Outside the Project Area Dry Beach Sand Volume data generally correlates with the Dry Beach Width data and changes per the previous Section.

Land Loss - Outside Project Area: There has been no Land Loss Outside the Project Area during the two year monitoring period, except from the 11 March tsunami which sent tidal waves over the seawalls to erode land above; therefore the Annual Land Loss Rate is zero as it relates to the Project's Performance effect on Outside the Project Area.

Beach Shape - Outside Project Area: The overhead or plan view of the Beach Shape with Dry Beach is indicated in the post-construction survey Site Plan drawing (see Appendix Figure 5), and which was confirmed from respective aerial photographs (see Photos 7 and 8). The Outside Project Area Beach Shape resembles the pre-construction Beach Shape for the respective areas (see Appendix Figure 2 and Appendix Photos 4 and 5).

6. PROJECT PERFORMANCE ASSESSMENT

6.1 Within Project Area (Transects 4 through 11):

6.1.1 Beach Width – Within Project Area: The Performance Criteria/Metrics for Within the Project Area is for the Average Beach Width to be greater than or equal to the Design Equilibrium Beach Toe (DEBToe) Beach Widths (65% of as-built Beach Width) up to one year after construction for the Project Area by when the Project Beach was expected to reach equilibrium.

The Project designer/coastal engineer anticipated the Project Beach may lose up to 35% of its Beach Width during the first year equilibrating process. Per the Project Guidelines for Beach Erosion, “Sand will be naturally redistributed offshore and alongshore across the profile within each cell (between groins) until a stable configuration is established. The equilibrating process may result in substantial narrowing of the initial Beach Width. This narrower Beach Width should be the expectation. This beach equilibrium is expected to be reached in one full erosion and accretion cycle by the end of the first year after construction or possibly sooner.” The DEBToe was selected since 35% of the nourished sand beach was expected to be lost to the ocean during the first year, post-construction while the Project Beach was equilibrating. The DEBToe is calculated from the as-built (7/1/10 survey) Beach Width. All metrics allow a 10% variance for measurement accuracy.

Several of the Project Area transects (5, 7, 9 and 11) are located immediately downdrift of a groin, and these areas generally have localized scouring caused by the groin. The data from each of these transects does not truly represent the larger, longitudinal Project Area, but this data is useful for comparison of changes and evaluation of specific areas over time. The Performance Criteria/Metrics intent therefore is to use Average Beach Width in order to be more representative and accurate for purposes of comparison and assessment of larger and unique beach areas plus of the overall Project Area.

The Average Beach Width has been determined for each of four segments of the overall, Project Beach, which are unique areas between groins at the Project Beach (transects 6/7, 8/9 and 10/11) and in front of the revetment (transects 4/5). These areas are each unique in terms of Beach Width, slope, Beach Sand Volume and shape, plus seasonal changes. The Average Beach Width also has been determined for the overall Project Area (transects 4 through 11).

Using survey data from Table 1, the methodology used for determining Average Beach Width for the unique beach segments is a calculation of the average of the Beach Width at the two transects located near the ends of the specific beach segment, and the method used for determining the overall Project Area Average Beach Width is a calculation of the average of the Beach Width at all eight Project Area transects.

	Areas	Revet. Segmt	West Segmt.	Center Segmt.	East Segmt.	Project Area Aver.	Project Beach Aver.
Survey	Transects	4 / 5	6 / 7	8 / 9	10 / 11	4 / 11	6 / 11
Winter 2010 - Pre-Construction							
4/15/10		42	80	92	60	68.5	77.33
Spring 2010 – Immediate Post-Construction							
7/1/10		48.5	94	86	64.5	73.25	81.5
Change		6.5	14	-6	4.5	4.75	4.17
Summer - 2010							
8/9/10		47	90.5	75	71.5	71	79
Change		5	10.5	-17	11.5	2.5	1.67
9/13/10		45.5	92.5	72.5	83	73.37	82.67
Change		3.5	12.5	-19.5	23	4.87	5.33
Fall - 2010							
10/19/10		47	89	83	71.5	72.65	81.17
Change		5	9	-9	11.5	4.15	3.8
11/16/10		45.5	86.5	79	79.5	72.62	81.67
Change		3.5	6.5	-13	19.5	4.12	4.33
12/16/10		42.5	86.5	77	81	71.75	81.5
Change		0.5	6.5	-15	21	3.25	4.17
Winter 2011							
3/29/11		46	103	89	75.5	78.37	89.17
Change		4	23	-3	15.5	9.87	11.84
Spring 2011							
6/28/11		53.5	121.5	92.5	94	90.37	102.67
Change		11.5	41.5	0.5	34	21.87	25.33
Summer 2011							
9/27/11		52	102.5	107.5	80.5	85.63	96.83
Change		10	22.5	15.5	20.5	17.13	19.5
Fall 2011/Winter 2012							
3/27/12		45.5	103.5	105.5	81.5	84.0	96.83
Change		3.5	23.5	13.5	21.5	15.5	19.5
Previous							
5/29/07			88		61	74.5	74.5
10/15/07			88		60	74	74
Comparative							
As-Blt.Toe		48.5	94	86	64.5	73.25	81.5
DEBToe		31.5	61	56	42	47.62	53

Table 5 – Average Beach Width - Within the Project Area

Project Area Average Beach Width calculated from Table 1 data in feet is indicated in Table 5.

Change indicated in the Table is from the 4/15/10 pre-construction survey.

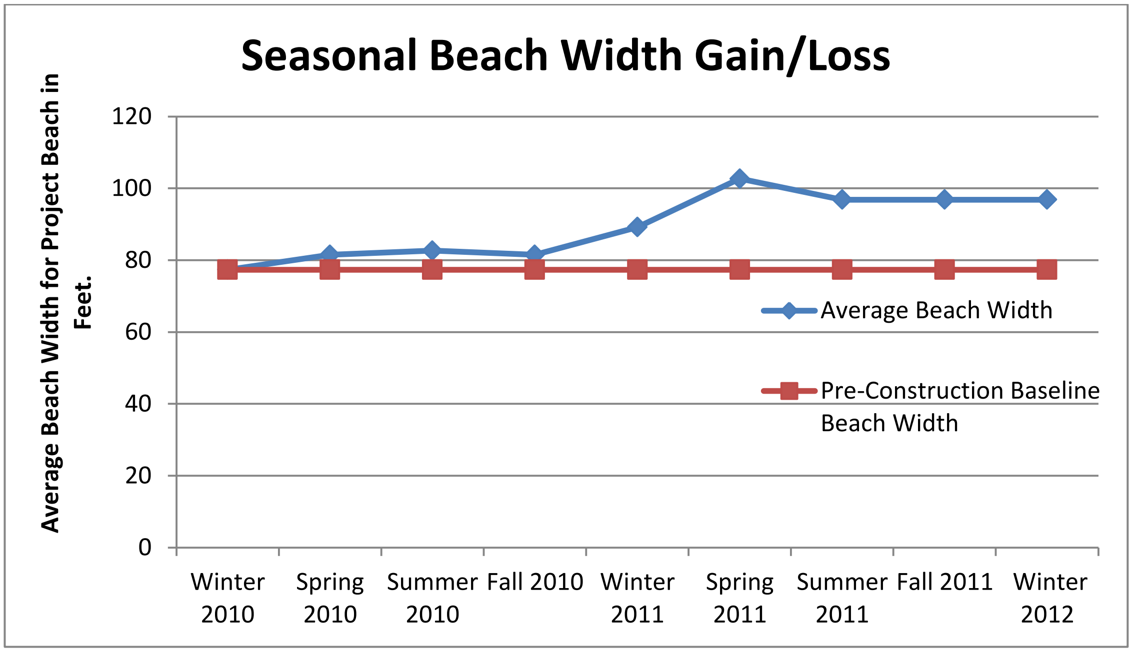


Figure 9 - Project Beach Seasonal Beach Width Gain/Loss

Figure 9 indicates for Average Beach Width the preservation of Beach Width and the establishment of equilibrium widths over time. The Beach Width is limited to the effective length of the groins.

Assessment: The significant changes during the 2011 fall/2012 winter seasons compared to the previous summer season were a slight increase of Average Beach Width at the West and East segments and a slight decrease at the Center and Revetment segments. Compared to the previous winter season, the 2011 fall/2012 winter seasons' Project Beach Width is greater.

Overall for the two year monitoring period, when the groins have been in place during each four accretion and erosion seasons, compared to the pre-construction survey data, there was an increase of Average Beach Width Within the Project Area at all beach segments, a 27% increase at the Project Area and a 25% increase at the Project Beach between groins.

The Project Beach Average Beach Width has increased to be similar to the 100 foot length of the groins at the Project Beach. This was the Project design intent to in order to restore the Beach Width to a previous historic location.

For the one year, post-construction equilibrating period, the Project Area and Project Beach Average Beach Widths were greater than the DEBToe by 65% and 68% respectively.

Performance Criteria/Metrics Attainment: Based on the data from Table 5 for Within the Project Area at the end of the one year equilibrating period, the Average Beach Width at each of the beach segments plus overall at the Project Beach, the Project Beach Width was greater than the Design Equilibrium Beach Toe Average Beach Width; therefore, the Performance Criteria/Metrics' goal was attained for Average Beach Width for Within the Project Area during the one year, post-construction equilibrating period, as well as during the two year monitoring period.

Action: None required.

6.1.2 Beach Sand Volume – Within Project Area: The Performance Criteria/Metrics for Within the Project Area is for the Average Beach Sand Volume to be greater than or equal to the Average Design Equilibrium Beach Toe (DEBToe) Beach Sand Volume (65%) of as-built Beach Sand Volume) up to one year after construction for the Project Area by when the Project Area was expected to reach equilibrium. Beach Sand Volume on the Project Beach was also expected to be affected during the first year equilibrating process since it relates to Beach Width. All metrics allow a 10% variance for measurement accuracy

The rationale and methodology to calculate Average Beach Sand Volume Within the Project Area is similar to that used to calculate Average Beach Width described in Section 6.1.1 for continuity and using survey data from Table 2. Realizing the Beach Sand Volumes at individual transects do not represent the larger picture of Beach Sand Volume for unique beach segments and the overall Project Area since several of the transects are located immediately downdrift of groins, where there is scouring, and others are located not immediately updrift of groins where there would be accumulated sand, the Beach Sand Volumes at each transect are still useful for comparative assessment of specific locations over time.

The beach nourishment sand was spread out unevenly over the 600 foot long Project Beach with greater accumulations in the west and west center segments as well at the top of banks throughout as a dune for gradual release to the beach caused by tides and erosion. The Performance Criteria/Metrics intent therefore is to use Average Beach Sand Volume in order to be more representative and accurate for purposes of a comparison and assessment of unique and larger beach segments plus the overall Project Beach.

Project Area Average Beach Sand Volumes calculated from Table 2 data in square feet for a one foot wide strip of beach are indicated in Table 6.

There is no Previous Average Beach Sand Volume data for comparison.

Change and change rate indicated Table 6 are from the 4/15/10 pre-construction survey in square feet and over time respectively.

	Areas	Revet. Segmt.	West Segmt.	Center Segmt.	East Segmt.	Project Area Average	Project Beach Average
Survey	Transects	4 / 5	6 / 7	8 / 9	10 / 11	4 / 11	6 / 11
Winter 2010 - Pre-Construction							
4/15/10		136	386	489	253.5	316.5	376.17
Spring 2010 – Immediate Post-Construction							
7/1/10		152.5	373	354.5	200.5	270.12	309.33
Change		16.5	-13	-134.5	-53	-46.38	-66.84
Ch. Rate		1.50	-1.18	-12.23	-4.82	-4.22	-6.08
Summer - 2010							
8/9/10		149	451.5	381.5	279.5	315.37	370.83
Change		13	65.5	-107.5	26	-1.13	-5.34
Ch. Rate		0.81	4.09	-6.72	1.62	-0.07	-0.33
9/13/10		143.5	437	344.5	321	311.5	367.5
Change		7.5	51	-144.5	67.5	-5.0	8.67
Ch. Rate		0.35	2.43	- 6.88	3.21	-0.24	-0.41
Fall - 2010							
10/19/10		165.5	500	402	437.5	376.25	446.5
Change		29.5	114	-87	184	59.75	70.33
Ch. Rate		1.09	4.22	-3.22	6.81	2.21	2.60
11/16/10		155	494.5	414	379.5	360.75	429.33
Change		19	108.5	- 75	126	44.25	53.16
Ch. Rate		0.60	3.44	-2.38	4	1.40	1.68
12/16/10		142	503.5	409	395	362.37	435.83
Change		6	117.5	-81	141.5	45.87	59.67
Ch. Rate		0.17	3.38	-2.33	4.07	1.32	1.72
Winter 2011							
3/29/11		143.5	535.5	490.5	423	398.12	483
Change		7.5	149.5	1.5	169.5	81.62	106.83
Ch. Rate		0.15	2.99	0.03	8.46	1.63	2.14
Spring 2011							
6/28/11		177	636.5	420.5	400	408.5	411.33
Change		41	250.5	-68.5	146.5	92.0	74.33
Ch. Rate		0.66	4.04	-1.10	2.36	1.48	1.20
Summer 2011							
9/27/11		157.5	560.5	582	402.5	425.62	515

Change				21.5	174.5	93	149	109.12	138.83
Ch. Rate				0.29	2.39	1.27	2.04	2.00	1.50
Fall 2011/Winter 2012									
3/27/12				155.5	684.5	736.5	442.5	504.75	621.17
Change				19.5	298.5	247.5	189	188.62	245
Ch. Rate				0.19	2.87	2.37	1.82	1.81	2.36
Comparative									
As-Built B. Toe				152.5	373	354.5	200.5	270.12	309
DEBToe				99.1	242.4	230.4	1 30.3	175.6	201

Table 6 – Average Beach Sand Volume - Within the Project Area

Assessment: The significant changes during the 2011 fall/2012 winter seasons compared to the previous summer season are significant increases of Average Beach Sand Volume at all segments except for a slight decrease at the Revetment segment. Compared to the previous winter season, the 2011 fall/2012 winter seasons' Average Beach Sand Volume is also significantly greater.

To accurately compare pre-construction to post-construction survey data, two during-construction and one post-construction events need to be factored, which are not reflected in the pre- and post-construction survey data of Table 6, These factors are as follows:

1. Groin Fill Sand - During construction, approximately 856 cu. yds. of sand from the Project Beach was pumped to fill the four geotube groins, This amount is calculated based on the geotube manufacturer's estimate of the groins' Beach Sand Volume capacity, and this sand volume was not included in the post-construction survey data at transects between groins, but it remains on the Project Beach.

2. Beach Nourishment - During construction, approximately 2,886 cu. yds. of offshore sand nourishment, according to the Project's Daily Pumping Logs, was pumped and placed onto the Project Beach, and this amount is in addition to the pre-construction survey Beach Sand Volume data used for comparison with post-construction conditions.

3. Tsunami - During the 2011 winter, approximately 400 cu. yds. of Beach Sand Volume accreted during the 2011 early winter season was pushed off the Project Beach by the 11 March 2011 tsunami and not returned. The tsunami pushed sand from the Project Beach inland onto yards since there were no seawalls there to block the tsunami waves. From 50% of the yards, most sand was removed and placed back on the Project Beach as a dune; however, minimal sand was returned to the Project Beach from the other

yards. This amount is calculated from visual surveys (3" average depth x 75' inland width x 600' beach length).

The Beach Sand Volumes from these three events needs to be included with the post-construction survey data for Project Performance Assessment of Project Beach Sand Volume gain or loss when compared to the pre-construction survey data from Table 6, after conversion to cubic yards. Table 7 reflects adjustment of the three events for these purposes:

Season: Calculation Basis:	Winter 2010	Spring 2010	Summer 2010	Fall 2010	Winter 2011	Spring 2011	Summer 2011	Fall 11/ Wint. 12
ACTUAL AVERAGE BEACH SAND VOLUME IN CU. YDS.								
Table 6 Data in Cu. Yds. for 600 ft. Project Beach	8,359	6,874 .	8,179	9,685	10,733	9,141	11,444	13,800
Adjustment for Beach Sand Used to Fill Groins		+ 856	+ 856	+ 856	+ 856	+ 856	+ 856	+856
Adjustment for Offshore Sand Pumped onto Beach		-2,886 .	-2,886	-2,886	-2,886	-2,886	-2,886	-2,886
Adjustment for Tsunami Sand Loss		-	-	-	+ 400	+ 400	+ 400	+400
Adjusted Average Beach Sand Volume	8,359	4,844	6,149	7,655	9,103 .	7,511	9,814	12,170

Table 7 - Average Beach Sand Volume Seasonal Change at Project Beach Adjusted for During and Post-Construction Events Compared to Pre-Construction Survey Data

The adjustment for the beach sand fill for the groins is an increase since the post-construction survey data does not include it, although it remains on the Project Beach. The adjustment for offshore sand pumped and placed is a decrease since it was added to the beach and results in a greater loss than indicated when comparing Table 6 pre- to post-construction survey data. The adjustment for the tsunami effect is an increase since the sand was on the Project Beach before the tsunami, and it should be included for Project Performance assessment since its loss was not Project caused.

For example, there was a 744 cu. yd. gain of Average Beach Sand Volume at the Project Beach at the end of the 2011 winter season compared to the pre-construction survey data one year prior at the end of the 2010 winter season.

The adjustments occur during construction when there was a significant loss of Beach Sand Volume (winter to spring 2010) and from fall 2010 to winter 2011 when the tsunami would have otherwise caused a slight decrease in the trend of gained Beach Sand Volume (see Figure 10).

Table 7, also indicates non-adjusted values on the top line when comparing post-construction performance, and these actual values occur between spring, summer and fall 2010 plus between winter, spring and summer 2011.

The seasonal Project Beach sediment gain or loss is visually displayed in Figure 10. During the 2010 spring season, the Project Beach lost considerable Beach Sand Volume due to post-construction equilibrating process combined with the beginning of the spring season typical erosion cycle, despite pumping approximately 2,886 cu. yd. of offshore sand on to the beach; otherwise, the Project Beach has a trend of Beach Sand Volume gain during all other seasons totaling more than that pre-construction.

The increase of Average Beach Sand Volume is similar to the increase of Average Beach Width Within the Project Area but at a higher rate since the Average Beach Width is limited by the length of the groins. It is predicted the Average Beach Width Within the Project Area is or will also be limited by the groin length and resulting beach geometry.

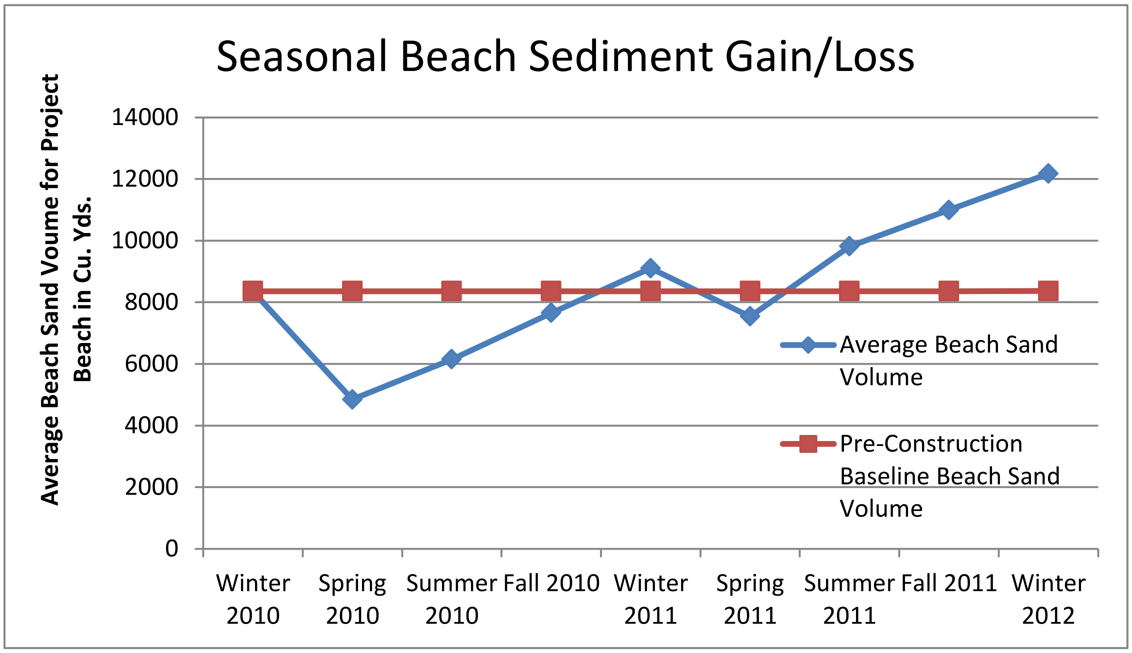


Figure 10 - Project Beach Seasonal Beach Sediment Gain/Loss

The Annual Sediment Budget for the Project Beach based on survey data calculations and adjustments when applicable, is the difference in Beach Sand Volume gained or lost over a one year period, which includes two accretion and two erosion seasons, measured in cubic yards (see Figure 10).

The Project's Annual Sediment Budget is positive as follows:

- 2010 to 2011 - First Year: + 744 cu. yd.
- 2011 to 2012 - Second Year: + 3,067 cu. yd.

Total over two years: + 3,811 cu. yd.

It is significant that the Project's Annual Sediment Budget is positive, which is indicative that the Project Beach is able to sustain itself without additional beach nourishment despite unusual weather conditions (see Section 8.3.1). This is due to the groin field performing properly to retain sand on the beach during the erosive spring/summer trade wind seasons, while still allowing the natural process of longshore sand transport along the nearshore to downdrift beaches, and to the beach's ability to gain sand during the fall/winter accretion seasons.

Overall for the two year monitoring period at the end of the 2011 fall/2012 winter seasons, when the groins have been in place during four each accretion and erosion seasons, compared to the pre-construction survey data, there was an increase of Average Beach Sand Volume Within the Project Beach post-construction at all beach segments and a 46% increase at the Project Beach between groins.

For the one year, post-construction equilibrating period, the Project Area and Project Beach Average Beach Sand Volume were greater than the DEBToe by 126% and 140% respectively.

Performance Criteria/Metrics Attainment: Based on the data from Table 6 for Within the Project Beach, the Average Beach Sand Volume for all the beach segments and the overall Project Beach post-construction is greater than the Design Equilibrium Beach Toe Average Beach Sand Volume; therefore, the Performance Criteria/Metrics was attained for Average Beach Sand Volume for Within the Project Area during the one year, post-construction equilibrating period as well, as during the two year monitoring period.

Action: None required.

6.1.3 Land Loss – Within Project Area: The Performance Criteria/Metrics is for the Annual Land Erosion Rate to be zero feet up to one year after construction Within the Project Area. All metrics allow a 10% variance for measurement accuracy. Beach Retreat causes Land Loss, and Figure 11 shows annual Beach Retreat Within the Project Area.

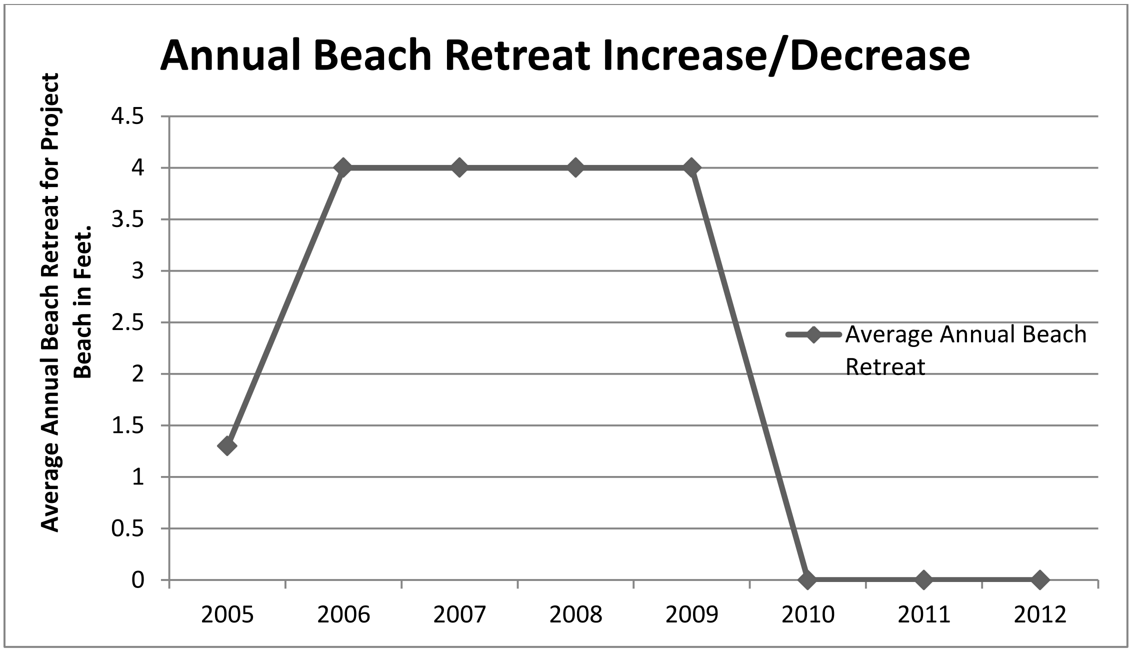


Figure 11 - Project Beach Annual Beach Retreat Increase/Decrease

<u>Assessment</u>: No Land Loss (Beach Retreat) occurred at the east end of the Project Beach during the erosive 2010 and 2011 spring/summer seasons; and this is a significant reduction from the past several years for the same period, which was averaging in excess of four feet of Land Loss inland per year by September (see Photos 1 and 3). No Land Loss (Beach Retreat) occurred at the west end of the Project Beach during the 2010 fall/2011 winter plus 2011 fall/2012 winter seasons, except from the tsunami; and this is also a significant reduction from the past several years for the same period, which was averaging in excess of four feet of Land Loss inland per year by March (see Photos 2 and 36).

Because the Project Beach had accumulated sand during the fall and winter cross shore sand transport seasons, the beach sand was at the same level as the land at the shoreline, except at the far west end. When the11 March 2011 tsunami waves hit the beach, the waves rolled over the land resulting in no land impact and thus no Land Loss, except at the far west end.

<u>Performance Criteria/Metrics Attainment</u>: Based on the data from observations and aerial photographs for the Project Area (see Appendix Photos 6 and 7), at all beach segments and overall Within the Project Area the post-construction Land Loss is zero feet, except at the far west end due to the tsunami; therefore, the Performance Criteria/Metrics was attained for Land Loss Within the Project Area during the one year, post-construction, equilibrating period, as well as during the two year monitoring period.

<u>Action</u>: None required.

6.1.4 Beach Shape - Within Project Area: There is no Performance Criteria/Metrics or Action for Project Area Beach Shape.

Assessment: The post-construction Beach Shape for the Project Area during the 2010 and 2011 spring/summer seasons was generally the same configuration to that anticipated by the Project coastal engineer/designer as indicated in his Equilibrium Beach Site Plan drawing (see Appendix Figure 8) where the immediate downdrift side of a groin has less Beach Width and Beach Sand Volume than that of the updrift side during these seasons due to localized downdrift scouring influenced by the groins. During the end of the 2010 fall/2011 winter and 2011 fall/2012 winter seasons, the curve of the Beach Toe during these seasons became more straight between groins, with the downdrift sides of the groins generally having increased Beach Width and Beach Sand Volume.

It appears that from the pre- to post-construction evaluation time, the location of the Ocean Hard Bottom has not changed based on site observations and aerial photographs. From the previous benthic surveys of the nearshore area, there is no indication that this line has changed, although the sand cover has increased a little between the Beach Toe and Ocean Hard Bottom in the nearshore ocean zone as described in the quarterly reports for Performance Monitoring and Metrics Guidelines for Benthic Habitat.

Action: None required.

6.2 Outside Project Area (Transects 1, 2, 3 and 12):

6.2.1 Beach Width and Beach Sand Volume - Outside Project Area: For Outside the Project Area, the Performance Criteria/Metrics is for the Dry Beach Width and Dry Beach Sand Volume post-construction to be greater than or equal to 100% of the Natural, Seasonal Dry Beach Width and Dry Beach Sand Volume, excluding seasonal changes and historical, average Beach Width and Beach Sand Volume losses. All metrics allow a 10% variance for measurement accuracy.

The Outside Project Areas monitored and assessed per the Guidelines include one updrift beach (transect 12) approximately 100 feet long with 70 feet of seawall and rock piles in front of the tennis court and a downdrift area (transects 1 through 3) which is approximately 560 feet long with a continuous seawall, several rock piles in front of the seawall and most of the fronting beach lost over time due to the erosive effect of seawalls.

With no beach and several rock piles in front of most of the downdrift seawalls Outside the Project Area, there is no beach at these locations to measure Beach Width, nor is there a need to measure beach toe for Beach Width as was used for Within the Project Area relative to the installation of temporary groins to extend the Project Beach to previous historical locations, so a Dry Beach survey measurement was used instead as a performance criteria/metrics measurement data basis. Dry Beach is the visible and useable beach above the maximum high tide level.

All transects Outside the Project Area are located at or near seawalls, and most locations (transects 2, 3 and 12) also have rock piles in front of the seawall for additional erosion and seawall protection. Per a 1940 aerial photograph (see Photo 9), the rock piles were once rock groins that have either been rearranged or neglected. Since the remaining beaches, or Dry Beaches, are unique and short sections near seawalls, the Dry Beach Width and Dry Beach Sand Volume measurements used for assessment are not averaged, as was done for Within the Project Area, since the segments are not long, not varied and without groins, plus there is no beach at most seawall locations.

Calculations of the Dry Beach Width and Dry Beach Sand Volume at each transect location where there are beaches Outside the Project Area (transects 1 and 12) generally correlate with their survey data seasonally; therefore, the Dry Beach Widths and Dry Beach Sand Volumes are assessed together at each transect location Outside the Project Area in this Section.

The Outside Project Area Dry Beach Width and Beach Sand Volumes data are indicated in feet or square feet per linear foot respectively and are located in Tables 3 and 4 in Section 5.2.2.

Figures 12 and 13 summarize and show graphically Outside Project Area Dry Beach Width and Dry Beach Sand Volume data from instrument survey measurements and calculations included in Tables 3 and 4 on a seasonal basis over time.

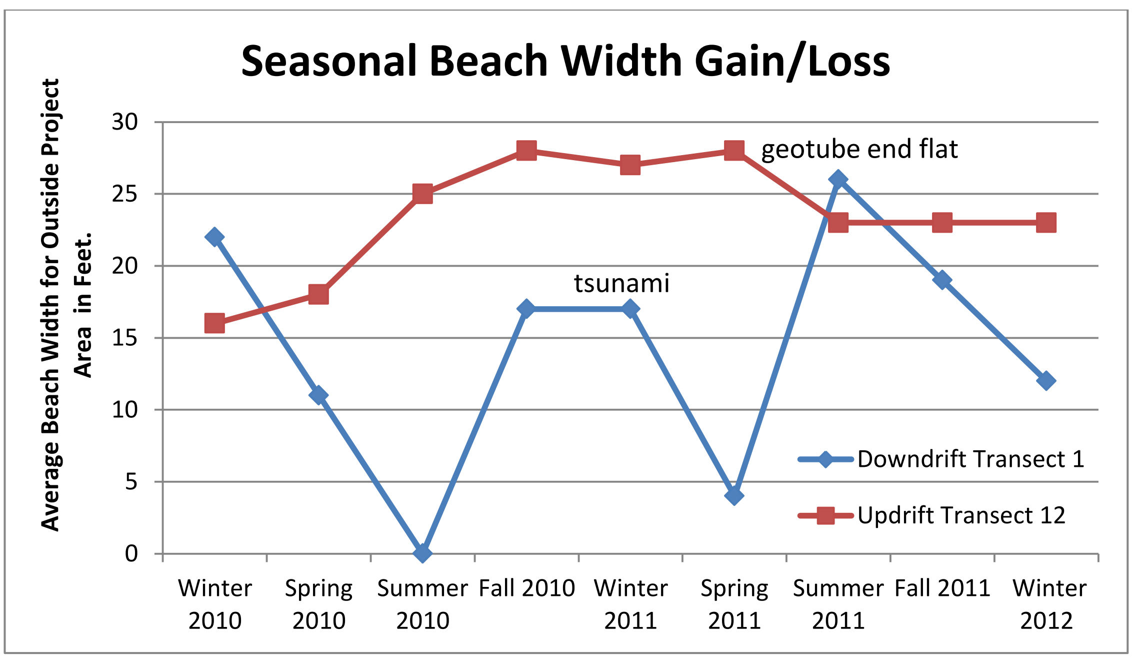


Figure 12 - Outside Project Area Seasonal Beach Width Gain/Loss

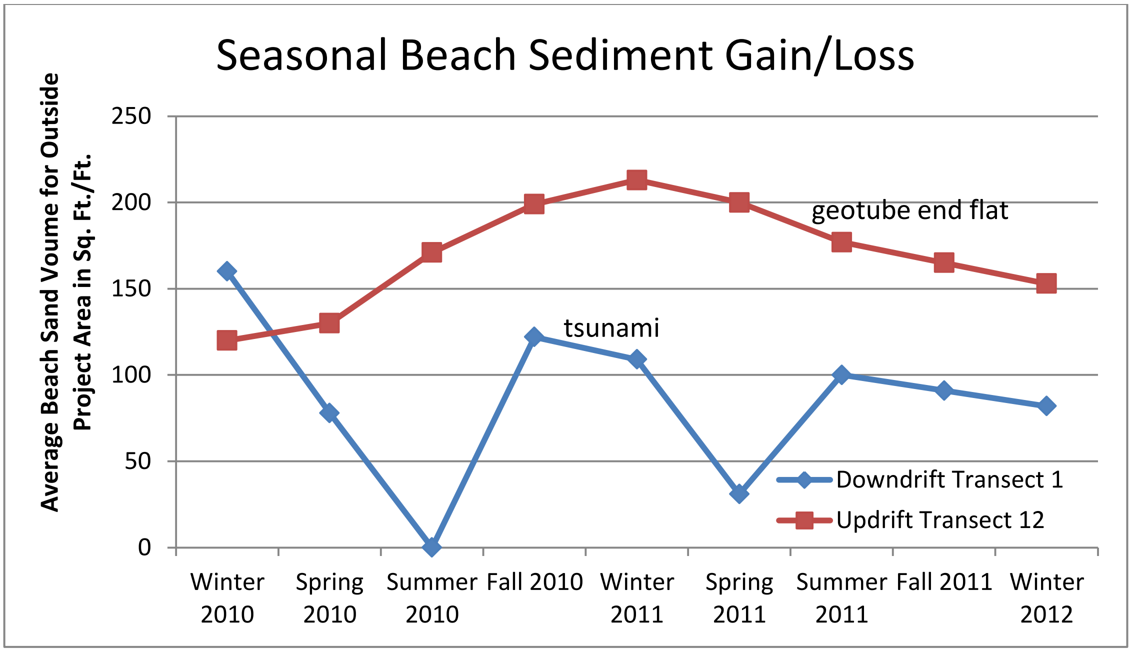


Figure 13 - Outside Project Area Seasonal Beach Sediment Gain/Loss

At downdrift transect 1. Dry Beach Width and Dry Beach Sand Volume have decreased on an annual basis from winter to winter, although their values have fluctuated seasonally in-between including similar increases during the 2010 fall and 2011 summer seasons. The two year trend is an increase in Dry Beach Width and a decrease in Dry Beach Sand Volume at downdrift transect 1.

At updrift transect 12, Dry Beach Width and Dry Beach Sand Volume increased to a peak during the 2011 winter, but did not increase during the 2011 fall/2012 winter seasons probably because the seaward end of the east end groin became flat during the 2011 summer and was not replaced until the 2012 winter. The two year trend is an increase of Dry Beach Width and Dry Beach Sand Volume during the first year and a leveling off during the second year at transect 12.

Changes in weather patterns affect wind and waves which cause changes in Dry Beach Width and Dry Beach Sand Volume, especially at these beaches with relatively narrow beaches and wave energy reflecting seawalls. Seasonal weather changes are evident in Figures 12 and 13. The 2011 fall/2012 winter seasons compared to the same seasons of the previous year had more high trade wind periods and less large north pacific swells. See Section 8 for discussion.

There is no historic Beach Width and Beach Sand Volume survey measurement data for Outside the Project Area except for the 4/15/10 pre-construction survey measurement, and since the post-construction assessment comparison is to consider seasonal changes and historical losses, historical photographs were also used as a Performance Criteria/Metrics data basis to visually assess pre-and post-construction, seasonal and historical conditions for the performance criteria/metrics assessments.

The photographs used for historical data Outside the Project Area include 1940, 1960, 1975, 1997, 2002, 2005 and 2007 aerial photographs by the University of Hawaii (see Appendix Photos 9 through15), 19 July 2009 aerial photograph (see Appendix Photo 16), 15 April 2010 aerial photographs (see Appendix Photos 4 and 5), 21 April 2010 aerial photograph (see Appendix Photo 17), 30 June 2010 aerial photograph (see Appendix Photo 6), 29 march 2012 aerial photographs (see Appendix Photos 7 and 8) plus 2010, 2011 and 2012 beach photographs (Photos 18 through 41) .

Also used for historical data to assess Outside Project Area performance criteria/metrics was the University of Hawaii Annual Erosion Hazard Map (see Figure 15). The erosion rates were determined from 1960 to 2002 based on aerial photographs. More recent data is not available.

Beach Width and Beach Sand Volume - Updrift Area at Transect 12: There is a 70 foot long seawall in front of the tennis court on Lot A with rock piles in front of the seawall (see Appendix Photo 4 and Photos 18 and 19). Typically during the spring and summer seasons, the seawall has no beach in front due to beach scouring and sand loss from northeasterly trade wind waves and longshore sand transport currents. During previous years, the bottom of the seawall footing became exposed and undermined during the spring/summer.

Photo 18 - Updrift Beach Area at Transect 12 Showing Seawall at Right and Rock Pile at Beach, 29 August 2010

Photo 19 - Updrift Beach Area at Transect 12 Showing Seawall at Left and Top of Rock Pile at Beach, 4 April 2012

The seawall has contributed to downdrift beach and land loss Within the Project Area during the spring and summer seasons. Typically during the fall and winter seasons, a downdrift beach returns in front of the seawall from the north Pacific swells' cross shore sand transport. The historical aerial photographs (see Appendix Photos 9 through 15) show a trend of Beach Width reduction this area over time. The pre-construction aerial photographs of this area show very little beach in front of the seawall and exposed rock pile (see Appendix Photos 4 and 16).

Assessment: The Dry Beach Width measurements and Dry Beach Sand Volume calculations at transect 12 have varied seasonally with a slight two year increase per Figures 12 and 13, which are also confirmed by Photos 18 and 19. In the last two years, there has been no exposed foundation and no significant erosion at transect 12; whereas the historic, Annual Erosion Hazard Rate from 1960 to 2001 at transect 12 was 1.5 feet per year (see Figure 15).

Performance Criteria/Metrics Attainment: Based on the data from Tables 3 and 4, the Outside Project Area Dry Beach Width and Dry Beach Sand Volume at updrift transect 12 post-construction are 44% and 28% greater than the Natural, Seasonal Dry Beach Width and Dry Beach Sand Volume; therefore, the Performance Criteria/Metrics was attained for Dry Beach

Width and Dry Beach Sand Volume at transect updrift 12 during the two year monitoring period.

<u>Action</u>: None required.

Beach Width and Beach Sand Volume - Downdrift Area at Transect 3: Transect 3 is located immediately downdrift of the Project Area and is approximately 160 feet from the nearest Project groin. Transect 3 is located approximately 20 feet west of the east end of a long seawall extending westerly, and there are rock piles in front, to the east and to the west of transect 3, which were formerly groins (see 1940 Appendix Photo 9). Immediately updrift of transect 3 to transect 4 is a small, sand beach cove approximately 50 feet wide with a perimeter seawall set back inland of the westerly seawall and the easterly revetment. This updrift beach cove did not significantly changed in its appearance of Beach Width and Beach Sand Volume during the 2010 summer and fall plus 2011 early winter seasons (see Photos 20 and 21), but it lost considerable Beach Sand Volume from the 11 March tsunami during the late 2011 winter season (see Photo 22). During the 2011 spring season, the beach cove re-gained considerable Dry Beach Width and Beach Sand Volume nearshore (see Photo 23); however, some ground under the perimeter seawall was still exposed, which was caused by the tsunami tidal waves undermining this wall upon impact and removing the sand below (see Photo 22). During the 2011 summer season, the beach cove gained sand initially and then lost sand in September with the return of a few north Pacific swells (see Photo 24). During the 2011 fall/ 2012 winter seasons, there was little change in the beach cove; however, sand returned to under the perimeter seawall (see Photos 25 and 26).

<u>Assessment</u>: There was no Dry Beach pre-construction at transect 3 (see Appendix Photo 5), and there is no Dry Beach Width and Dry Beach Sand Volume currently at transect 3 (see Appendix Photo 8) due to the seawall and rock piles, so there is no Dry Beach Width nor Dry Beach Sand Volume measurement/calculation data there. The 1997 aerial photograph (see Appendix Photo 12) indicates no Dry Beach then in front of the seawall at transect 3 nor does the 2002 aerial photograph (see Appendix Photo 13).

The historic Annual Erosion Hazard Rate at transect 3 from 1960 to 2002 was approximately .33 feet per year (see Figure 15).

Photo 20 - At Transect 3 Near Ends of Seawall and Updrift Beach Cove With Perimeter Seawall, 17 August 2010

Photo 21 - At Transect 3 Near Ends of Seawall and Updrift Beach Cove With Perimeter Seawall, 13 December 2010

Photo 22 - At Transect 3 Near Ends of Seawall and Updrift Beach Cove with Perimeter Seawall, 11 March 2011- Immediately Post-Tsunami

Photo 23 - At Transect 3 Near Ends of Seawall and Updrift Beach Cove with Perimeter Seawall, 29 June 2011

Photo 24 - At Transect 3 Near Ends of Seawall and Updrift Beach Cove with Perimeter Seawall, 1 October 2011

Photo 25 - At Transect 3 Near Ends of Seawall and Updrift Beach Cove with Perimeter Seawall, 4 April 2012

Photo 26 - At Transect 3 Near Ends of Seawall and Updrift Beach Cove with Perimeter Seawall, 4 April 2012

<u>Performance Criteria/Metrics Attainment</u>: Based on the data from historic, aerial photographs, the Outside Project Area Dry Beach Width and Dry Beach Sand Volume at downdrift transect 3 post-construction are unchanged from the Natural, Seasonal Dry Beach Width and Dry Beach Sand Volume; therefore, the Performance Criteria/Metrics was attained for Dry Beach Width and Dry Beach Sand Volume at transect 3 during the two year monitoring period.

<u>Action</u>: None required.

Beach Width and Beach Sand Volume - Downdrift Area at Transect 2:
Transect 2 is located approximately 160 feet downdrift and east of transect 3 and 180 feet west of the seawall end with a continuous seawall in between to the east. There is another 280 feet of seawall downdrift and west of transect 2 to Parcel 25 (see Appendix Photo 5 plus Photos 27 and 28), so transect 2 is near the middle of a 460 foot long, continuous seawall. There are several rock piles in front of the long seawall including large revetment type piles both sides of transect 2 (see Appendix Photos 5 and 8), and the rock plies were formerly rock groins per the 1940 aerial photograph (see Appendix Photo 9).

Photo 27 - Near Transect 3 Looking West Along Continuous Seawall with Large Rock Pile/Revetment at Transect 2 Beyond, 1 October 2011

Photo 28 - Near Transect 2 Looking East Along Continuous Seawall with Large Rock Pile/Revetment Toward Transect 3 Beyond, 13 December 2010.

<u>Assessment</u>: There has been no Dry Beach since 1997 (see Appendix Photo 12) nor is there a Dry Beach Width and Dry Beach Sand Volume currently at transect 2 (see Appendix Photo 8) due to the seawall and rock piles, so there is no Dry Beach Width and Dry Beach Sand Volume measurement/calculation data.

The 1997 and 2002 aerial photographs (see Appendix Photos 12 and 13) indicate no Dry Beach then in front of the seawall at transect 2.

The historic Annual Erosion Hazard Rate at transect 2 from 1960 to 2002 was approximately .6 feet per year and increasing from east to west that area over time (see Figure 15), most likely due to the erosive effects of the updrift seawall's hardened shoreline and advancing beach retreat.

<u>Performance Criteria/Metrics Attainment</u>: Based on the data from historic aerial photographs, the Outside the Project Area Dry Beach Width and Dry Beach Sand Volume at downdrift transect 2 post-construction are unchanged from the Natural, Seasonal Dry Beach Width and Dry Beach Sand Volume; therefore, the Performance Criteria/Metrics was attained for Dry Beach Width and Dry Beach Sand Volume at transect 2 the during the two year monitoring period.

<u>Action</u>: None required.

Beach Width and Beach Sand Volume - Downdrift Area at Transect 1:
Transect 1 is located the farthest from the Project Area approximately 460 feet downdrift and 600 feet from the nearest Project groin. This area also has an approximately 600 foot long hardened shoreline immediately updrift to the Project Area with rock revetments and a long, continuous seawall. In front of the seawall to the east of transect 1 there is a large rock pile revetment. There is a downdrift beach at transect 1 that extends approximately 120 feet updrift to the easterly rock pile revetment and downdrift approximately 120 feet to the westerly beginning of several rock groins along the shoreline (see Appendix Photos 5, 14 and 15).

<u>Assessment</u>: Immediately east of transect 1, the top of a rock groin on the beach became exposed in June 2010 as beach sand was lost (see Appendix Photo 6). Per the 19 July 2009 photograph (see Appendix Photo 16), the same top of rock groin was exposed to the same general extent one month later. Also during June 2010, the top of the seawall to the west of transect 1 began to become more exposed toward the west (see Appendix Photo 6).

<u>First Monitoring Year</u> - During the 2010 spring/summer seasons at transect 1, the Dry Beach Width decreased from 22 to 0 feet, and the Dry Beach Sand Volume decreased from 160 to 0 square feet/foot per Figures 12 and 13; however, during

the 2010 fall season, Dry Beach Width and Dry Beach Sand Volume increased due to the weather changing to light trade winds and dominant north Pacific waves causing cross shore transport resulting in accretion.

During the 2011 winter season, the same weather pattern continued, and the total recovery of the beach sand previously lost was anticipated by March 2011; however, the 29 March 2011 winter season survey data indicated the Dry Beach Width was unchanged, and that the Dry Beach Sand Volume decreased from 122 to 109 cubic feet/foot. The cause of the lack of additional sand was the 11 March tsunami. The 2011 winter survey was only 18 days after the tsunami and reflects the loss of sand by the tsunami at transect 1.

Photographic data visually shows the tsunami effect at transect 1. The most significant 2010 spring/summer beach sand loss at transect 1 in 2010 had occurred by mid-August, and the 17 August 2010 beach photograph (see Photo 29) shows 7 treads exposed at the lower stair located below the seawall at transect 1. Sand returned to this beach during the 2010 fall season, and as of 17 December 2010 only 2 treads were exposed at the same stair (see Photo 30). Also as of 17 December, sand was mostly covering the old rock groin immediately east of transect 1 as well as the seawall portion to the east. Sand also returned to this beach during the first two months of the 2011 winter season by 11 February when no lower stair treads were exposed (see Photo 31), and the average height of the seawall across Lot 1 was approximately .75 feet. The subsequent 11 March tsunami removed sand from this beach when 3 treads of the lower stair were exposed on March 11 (see Photo 32); however, a significant volume of sand returned to the beach after the tsunami a month later by 9 April (see Photo 33) when the top of the seawall west of transect 1 and the lower stair were no longer exposed. The tsunami did not push much sand from this beach onto the land at this location as it did Within the Project Area, so the sand removed from the beach by the tsunami was dispersed in the ocean.

<u>During the First Monitoring Year, it was apparent that were it not for the 11 March 2011 tsunami, the Dry Beach Width and Dry Beach Sand Volume at transect 1 would have been equal to or greater than that pre-construction one year earlier. The decrease of Dry Beach Sand Volume at transect 1 during the 2010 spring season is consistent with the decrease of Beach Sand Volume Within the Project Area at the same time.</u>

<u>Second Monitoring Year</u> - During the 2011 spring season, early, high trade winds eroded beach sand at transect 1 one month earlier than during the 2010 spring season, the Dry Beach Width decreased from 17 to 4 feet and the Dry Beach Sand Volume decreased from 109 to 31 square feet/foot per Figures 12 and 13. By 29 June 2011, 8 treads of the lower stair were exposed (see Photo 34); however, considerable sand returned during the 2011 summer season (see Photo 35) with only 1 lower stair tread exposed similar to the condition of the 17 December 2010 (see Photo 30).

It was anticipated that during the 2011 fall/2012 winter seasons, north Pacific waves would again dominate light trade wind weather as they did during the last two fall/winter seasons, and the beach would gain sand; however, the weather fluctuated between periods of high trade winds causing erosion and periods of north Pacific waves causing accretion resulting in the beach at transect 1 to be generally unchanged and not gain sand during the 2011 fall/2012 winter seasons from the 2011 summer condition (see Photos 35 and 36).

During the 2011 summer season, the downdrift beach located at transect 1 gained Dry Sand Volume; whereas, during the previous summer season it continued to lose sand. During the 2011 fall season, this beach lost Dry Beach Sand Volume; whereas, during the previous 2010 fall season it gained sand. At the end of the 2011 summer season, this beach gained Beach Width to exceed that pre-construction condition, yet during the previous summer season it lost Dry Beach Width.

During the Second Monitoring Year, it was apparent that the downdrift beach at transect 1 changes significantly during different seasons and weather conditions. If it were not for the unusual 2011 fall/2012 winter seasons' weather not increasing Dry Beach Width and Dry Beach Sand Volume as before during the same seasons, there may have been at least equal Dry beach Width and Dry Beach Sand Volume than that one year earlier. The decrease of Dry Beach Sand Volume at transect 1 during the 2011 spring season is consistent with the decrease of Beach Sand Volume Within the Project Area at the same time.

Photo 29 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 25 (in Foreground) Near Transect 1 (at Stair), 17 August 2010

Photo 30 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 25 (in Foreground) Near Transect 1 (at Stair), 17 December 2010

Photo 31 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 25 Near Transect 1 (at Stair), 11 February 2011 Pre-Tsunami

Photo 32 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 2
Near Transect 1 (at Stair), 11 March 2011 Immediately Post-Tsunami

Photo 33 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 25
Near Transect 1 (at Stair), 9 April 2011 Post-Tsunami

Photo 34 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 25
Near Transect 1 (at Stair), 29 June 2011

Photo 35 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 25
Near Transect 1 (at Stair), 1 October 2011

Photo 36 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 25
Near Transect 1 (at Stair), 29 December 2011

Photo 37 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 25
Near Transect 1 (at Stair), 18 February 2012

Photo 38 - Beach, Rock Groin and Seawall at West Half of Lot 1 and Parcel 25
Near Transect 1 (at Stair), 4 April 2012

Transect 1 is located at the west end of Lot 1 by the wooden stair (see Figure 1).

There is no historical and seasonal, instrument survey data of Dry Beach Width or Dry Beach Sand Volume at the downdrift beach located at transect 1, except immediately pre-construction at the end of the 2010 winter season; so there is no ability to quantitatively compare post-construction survey data to other pre-construction seasonal and historic conditions, except by visually comparing historic aerial photographs.

From the available historic aerial photographs (see Photos 9 through 15), it is difficult to determine the amount of other seasons' Dry Beach Width and Dry Beach Sand Volume; however, visually apparent over time is reduced Dry Beach Width in front of updrift Lot 2 and the east end of Lot 1, which indicates advancing beach retreat from the east toward transect 1.

The February 2002 aerial photograph (see Appendix Photo 13) taken at the end of the normal fall/winter accretion seasons, does show the exposure of the top of the seawall for its length across Lots 1 and 2 to Parcel 25 as evidenced by its shadow. The height of the seawall in front of easterly Lot 2 is approximately 7.2 feet above mean sea level. By comparing the scale of the height of the seawall shadow in front of Lot 1 to that of Lot 2, the seawall at Lot 1 was exposed approximately 1.5 to 2 feet in height during February 2002, which is historically and seasonally comparable to the beach condition post-construction during the 2011 and 2012 winter seasons in February (see Photos 31 and 37), especially considering the Annual Hazard Erosion Rate of .5 feet (see Figure 15). Exposure of the seawall indicates lower beach height and thus decreased Beach Sand Volume.

Recent photographs 29 through 31 show approximately 5 foot high, exposed roots of dead trees on the beach near transect 1 indicating a previously much higher beach with considerably more Dry Beach Width and Dry Beach Sand Volume historically in the past with a significant beach sand loss over time**.**

Based on Figures 12 and 13 plus from historic aerial photographs, it is apparent seasonal conditions at the beach located at transect 1 vary from season to season and year to year based on weather patterns and unique events, such as a tsunami. It is also evident this beach has had a short and long-term ability to recover lost beach sand during prior seasons and years.

<u>Performance Criteria/Metrics Attainment</u>: Based on the short-term data from Tables 3 and 4, the Outside the Project Area Dry Beach Width and Dry Beach Sand Volume at transect 1 decreased post-construction 45% and 48% from the pre-construction survey data two years prior; therefore, the assessment of one short-term data source pre-construction for Project Performance is that the Performance Criteria/Metrics were not attained for Dry Beach Width and Dry Beach Sand Volume at transect 1 during the two year monitoring period.

Based on the long-term data from the historic and seasonal February 2002 aerial photograph compared to the 11 February 2011 and 29 February 2012 beach photographs and considering the historic annual erosion rate of .5 feet over a 9 and 10 year interim, the Outside Project Area Dry Beach Width and Dry Beach Sand Volume at transect 1 are similar during the first and second year post-construction; therefore, the long-term assessment of the Project Performance Criteria/Metrics is that the Performance Criteria/Metrics were attained for Dry Beach Width and Dry Beach Sand Volume at transect 1 during the two year monitoring period.

<u>Action</u>: Despite comparable, long-term historic and seasonal pre- and post-construction conditions at downdrift transect 1, initially observed was a change in the downdrift beach condition during the 2010 spring season compared to the previous year at the same time. Per the Project's Performance Monitoring and Metric Guidelines for Beach Erosion, "the SRBRF and contractor representatives will immediate investigate the cause of the loss of significant sand volumes, beach width and land erosion rate. If the observed beach changes can be attributed to the Project's structures

taking into account seasonal and long-term trends, then the design flaws will be determined to correct the groins and/or sand placement". The Identification Action of several possible causes of the Initial and Seasonal Downdrift Beach Erosion started immediately after the 2010 spring/summer beach loss was first observed, and the initial investigation was included in the First Quarterly Monitoring Report for Beach Erosion dated 25 September 2010, which contained Possible and Probable Causes. Additional monthly survey monitoring was performed during the 2010 fall season as requested by the DLNR, OCCL. Each consecutive Beach Erosion Monitoring Report included additional investigation. See Sections 8 and 9 for Possible and Probable Causes.

6.2.2 Land Loss - Outside Project Area: The Performance Criteria/Metrics require a comparison between the Annual Erosion Rate and the Average, Historical, Three Year Erosion Rate for Land Loss Outside the Project Area.

<u>Assessment</u>: **Per the visual data from the pre-construction aerial photographs (see Appendix Photos 4 and 5) compared to one and two year post-construction aerial photographs (see Photo 8), there has been no Land Loss at the updrift area (transect 12) nor at the downdrift area (transects 1 through 3), except from the 11 March tsunami which is not Project related.**

The Project related post-construction annual erosion rate Outside the Project Area is zero feet.

<u>Performance Criteria/Metrics Attainment</u>: Based on the data from beach and aerial photographs for the updrift and downdrift, Outside Project Areas, the Performance Criteria/Metrics was achieved regarding Land Loss Outside the Project Area during the two year monitoring period.

<u>Action</u>: None required.

6.2.3 Beach Shape - Outside Project Area: There are no Performance Criteria/Metrics or Action for Project Area Beach Shape.

<u>**Assessment**: The two year Beach Shape Outside the Project Area updrift and downdrift (see Appendix Photos 6 and 7), is generally the same configuration as the pre-construction Beach Shape (see Appendix Photos 4 and 5).</u>

<u>Action</u>: None required

7. PROJECT PERFORMANCE SUMMARY

7.1 Performance Criteria/Metrics Attainment

Table 8 is a summary of Project Performance for different areas and during different seasons of the two year monitoring period. Seasons marked with an asterisk (*) note when there was attainment of the Performance Criteria/Metrics, and those marked with a "pa" indicate when there was partial attainment based on short-term and long-term performance assessments in Section 6.

Area: Season:	Project Area	Updrift Transect 12	Downdrift Transect. 3	Downdrift Transect 2	Downdrift Transect 1
BEACH WIDTH					
Spring 2010	*	*	*	*	
Summer 2010	*	*	*	*	pa
Fall 2010	*	*	*	*	pa
Winter 2011	*	*	*	*	pa
Spring 2011	*	*	*	*	pa
Summer 2011	*	*	*	*	*
Fall 2011/Win 2012	*	*	*	*	pa
BEACH SAND VOLUME					
Spring 2010	*	*	*	*	pa
Summer 2010	*	*	*	*	pa
Fall 2010	*	*	*	*	pa
Winter 2011	*	*	*	*	pa
Spring 2011	*	*	*	*	pa
Summer 2011	*	*	*	*	pa
Fall 2011/Win 2012	*	*	*	*	pa
LAND LOSS					
Spring 2010	*	*	*	*	*
Summer 2010	*	*	*	*	*
Fall 2010	*	*	*	*	*
Winter 2011	*	*	*	*	*
Spring 2011	*	*	*	*	*
Summer 2011	*	*	*	*	*
Fall 2011/Win 2012	*	*	*	*	*
BEACH SHAPE					
Spring 2010	*	*	*	*	*
Summer 2010	*	*	*	*	*
Fall 2010	*	*	*	*	*
Winter 2011	*	*	*	*	*
Spring 2011	*	*	*	*	*
Summer 2011	*	*	*	*	*
Fall 2011/Win 2012	*	*	*	*	*

Table 8 – Project Performance Summary Table

7.1.1 Within Project Area: The Project's Performance Objectives were to increase Project Beach Width and Beach Sand Volume to historic levels, to reduce rates of future beach and land erosion and to not cause adverse impacts.

Photo 39 - East End of Project Beach, 4 August 2009

Photo 40 - East End of Project Beach, 1 October 2011

The Project Area pre-construction typically behaved as a littoral cell with spring/summer erosion starting at its east end from northeast trade winds (see pre-construction Photo 39), fall/winter erosion at its west end from north Pacific swells (see pre-construction Photo 2) and with sand migrating back and forth with seasonal weather changes. Post-construction during the 2010 and 2011 spring plus summer seasons, the east end of the Project Beach experienced minimal beach erosion and no land loss (see Photo 40), which is very unique compared to previous years of significant beach sand and land loss during the same time of year (see Photo 39).

Post-construction during the 2010 fall and 2011 winter seasons, the west end of the Project Beach experienced minimal beach erosion and no land loss, except a minor amount from the 11 March tsunami, which is very unique compared to previous years of significant beach sand and land loss for the same time of year (see pre-construction Photo 2); plus it gained windblown sand during the 2011 spring and summer seasons (see Photo 41).


Photo 41 - West End of Project Beach, 4 April 2012

The fact that Within the Project Area there has been only minimal beach erosion and no land loss during the two year monitoring period, except from the tsunami at the west end, indicates the Project has been highly successful and has attained its Performance Objectives and Performance Criteria/Metrics Within the Project Area for 32 of 32 performance assessments during 8 seasons for Beach Width, Beach Sand Volume, Land Loss and Beach Shape over the two year monitoring period.

7.1.2 Outside Project Area: Another Project Performance Objective was for the Project not to adversely affect Outside Project Updrift and Downdrift areas, especially by trapping sand Within the Project Area and thus stopping the normal, spring/summer longshore sand transport process, as well as not to cause erosion and land loss. As visually evident post-construction during all seasons, beach sand from the Project Area and from updrift beaches has been and continues to be naturally transported downdrift over and around all groins in the Project Area, particularly when trade winds occur, which creates nearshore turbidity, downdrift current and thus longshore sand transport.

The Project's monitoring data indicates the Project has attained its Performance Objectives and Performance Criteria/Metrics Outside Project Area for 113 of 128 performance assessments during 8 seasons for Beach Width, Beach Sand Volume, Land Loss and Beach Shape over the two year monitoring period at updrift transect 12 plus downdrift transects 1, 2 and 3, and with partial attainment (long-term) of 15 performance assessments for Beach Width and Beach Sand Volume at downdrift transect 1.

At the end of the 2010 spring season, the beach at transect 1 lost 50% of its Dry Beach Width and 51% of its Dry Beach Sand Volume; and during the 2010 summer season it lost 100% of both. During the 2010 fall season in three months, this beach had recovered 78% of its Dry Beach Width and 76% of its Dry Beach Sand Volume lost during the preceding toe seasons. The beach had recovered additional sand during the first two months of the 2011 winter season until the 11 March tsunami. The beach at transect 1 would have been in attainment with the Performance Criteria/Metrics at the end of the first year of monitoring during the 2011 winter season except for the March 2011 tsunami.

At the end of the 2011 summer season in three months, this beach had recovered 118% of its pre-construction Dry Beach Width and 92% of its Dry Beach Sand Volume loss during the 2011 spring season. With this rate of recovery, it was anticipated the normal fall and winter accretion seasons subsequently would have allowed the beach at transect 1 to have 100% recovery by the end of the second monitoring year. This did not happen.

There has been no land loss Outside the Project Area except for that caused by the 11 March 2011 tsunami.

What was the cause of the initial 2010 spring and summer plus 2011 spring seasons' beach sand loss at this downdrift beach located at transect 1? Was it Project related or a coincidental occurrence based on other factors?

8. POSSIBLE CAUSES OF INITIAL AND SEASONAL DOWNDRIFT BEACH EROSION

Per the Project Performance Summary Table (see Table 8), the Project has performed significantly well Within and Outside the Project Area over two years of monitoring with only one downdrift beach located at transect 1 noted as partial attainment (long-term) with the Project's Performance Criteria/Metrics.

Once the change in the downdrift beach condition during the 2010 spring season compared to the previous year at the same time was observed, immediate Action was taken by the SRBRF during the 2010 summer to identify and investigate several possible causes including Project related and natural causes. According to the Project's Performance Guidelines, Remedial Action by the SRBRF may be required regarding the loss of sand at the downdrift beach "if the observed beach changes can be attributed to the Project structures (groins) taking into account seasonal and long-term trends".

The initial Investigative Action was included in the First Quarterly Monitoring Report for Beach Erosion dated 25 September 2010, which contained Possible and Probable Causes. Each consecutive Beach Erosion Monitoring Report included additional investigation, and this Report contains Conclusions as to Probable Causes.

8.1 Setting: The downdrift beach at transect 1 is located the farthest from the Project Area in the area monitored. It is located at the west end of Lot 1, and transect 1 is located near the middle of the downdrift beach (see Figure 1). The beach is approximately 240 feet wide, and the beach is flanked at its east by a large rock pile/revetment and at its west by a rock groin (see Aerial Photo 8). There is a seawall along the beach which extends approximately 310 feet updrift to the east across the east half of Lot 1 and across Lot 2 to the Project Area. The updrift beaches along the seawall have been lost over time. The east end of the downdrift beach is approximately 460 feet from the Project's closest groin, and there is a continuous, hardened shoreline in-between with no beach (see Appendix Photo 5).

The Outside Project Area downdrift appears to be part of a littoral cell separate and distinct from the Project Area due to its northwest shoreline orientation, ocean current diverging from the shoreline and continuous hardened shoreline with seawalls reflecting wave energy from the northeast to the northwest; whereas, the Project Area shoreline orientation is facing the north/northwest, with a current parallel to the shoreline, a sand beach absorbing wave energy and flanked at both ends by hardened structures. Because it is a separate cell, the dynamics of beach erosion and beach loss at the downdrift beach are different from those of the Project Area.

8.2 Erosion History: The continuous seawall across downdrift Lots 1 and 2 is reported to have been constructed in 1925, and there are impressions of initials with a 1925 date on top of the wall. The 1940 aerial photograph (see Appendix Photo 9) shows the seawall across Lots 1 and 2 at that time, a wide sand beach in front of the entire seawall and four rock groins in front of the seawall on the beach. Presently, there is no beach in front of the seawall updrift of the west half of Lot 1 across the seawall at updrift Lot 2.

The long-term Annual Erosion Hazard Rate (see Figure 15) at Lot 2 from 1960 to 2002 was approximately .25 feet per year, and the rate at downdrift Lot 1 was greater at approximately .5 feet per year.

Beach erosion with beach loss immediately downdrift of the Project Area and at the downdrift beach is not a new phenomenon, and it started decades before the Project. This fact is well supported since it was deemed necessary or beneficial to construct the continuous seawall across Lots 1 and 2 and to install groins across its length before 1940 and probably in 1925, 87 years ago.

8.3 Investigative Action - Possible Causes of Initial and Seasonal Downdrift Beach Erosion: In accordance with the Project's Performance Guidelines, the SRBRF started an identification and investigation of several possible causes of the Beach Width and Beach Sand Volume loss at the downdrift beach located at transect 1 as soon as it was observed there was a change in the beach condition during the 2010 summer season compared to the previous year at the same time. Previous Quarterly Reports included identification and assessment of the following Possible Causes of the initial downdrift beach erosion at transect 1, which included both natural and Project related causes:

8.3.1 Unusually Early and High Trade Winds:

Project Construction History - The Project's construction schedule was established to perform the in-water work during the normally calmest time of the year after the winter, north Pacific swells in April and before the summer trade winds are strongest in July. The aerial photograph of 19 July 2009, one year before the Project (see Appendix Photo 16), shows the beginning of seasonal beach scouring and sand loss at the east end of the Project Beach and downdrift at the west half of Lot 1 in July 2009. The groins' installation occurred from 17 through 27 April 2010, and sand dredging/pumping occurred from 6 May through 8 June with several dredging/pumping work suspensions in May and June due to strong winds and high surf. The final pumped sand placement/beach shaping was completed on 25 June. The typical seasonal trend has been for trade winds to start with moderate strength in April and May and to increase to during July and August.

Wind History - Spring Season, 2010 - The Project Beach started to erode at its east end in April 2010 before construction started (see Appendix Photo 4), which reflected a seasonal trend change to one month earlier than the previous year. At the same time, there was no noticeable beach erosion at the downdrift beach (see Appendix Photo 5).

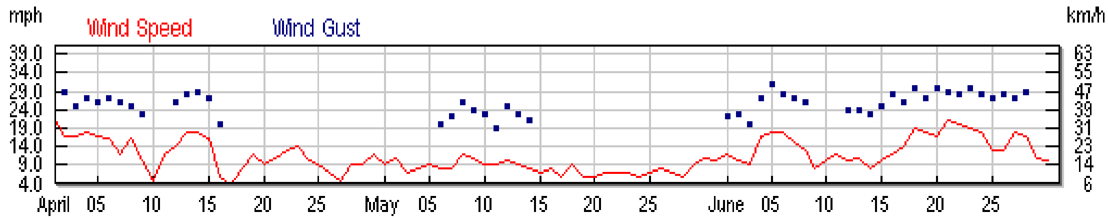
On 12 June, it was reported by one of the downdrift residents that beach sand loss downdrift in front of the seawall at Lot 2 and at the large rock pile/revetment in front of the seawall at the east half of Lot 1 started earlier than normal. Per the pre-construction aerial photo of 21 April 2010 (see Appendix Photo 17), there was no beach at these locations when the Project started. However, beach erosion had started at the east end of the downdrift beach by mid-June per the aerial photograph of 20 June 2010 (see Appendix Photo 6), and the amount of beach sand loss there in June was comparable to that indicated one month later in July of the previous year per the 19 July 2009 aerial photograph (see Photo 16).

What caused the initial beach erosion one month earlier than normal at the downdrift beach in 2010? During the 2010 spring season when Project construction occurred, there were approximately twice as many windy and high wind days plus four times as many high wind gusts days compared to the previous 2009 spring season per daily, wind history data from Weather Underground (wunderground.com) measured at Kahului Airport, which is near to the Project Area (see Table 9). Compared to the five year, pre-construction average, during the 2010 spring season there were approximately one and one half times as many windy days, twice as many high wind days plus seven times as many high wind gusts days. Notable in this data, is the substantial increase in the number of high wind days and especially days with high wind gusts in 2010.

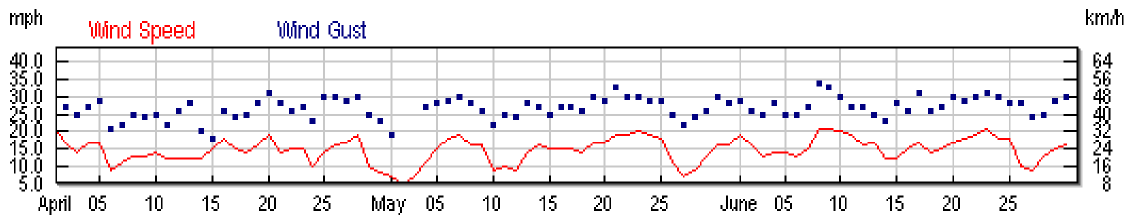
Spring Season April thru June	Windy Days 25 mph +	High Wind Days 30 mph+	High Wind Gust Days - 40 mph +
5 Year Average 2005 – 2009	48	14	3
2009	36	12	5
2010	66	27	20
2011	51	18	7

Table 9 - Wind History Data at Kahului Airport

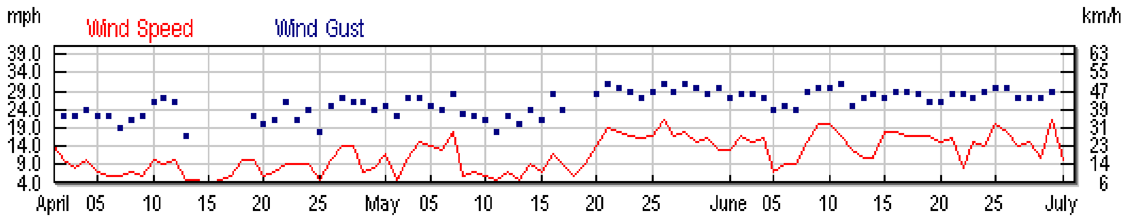
The photographic data of the seasonal change of beach erosion starting one month earlier during the 2010 spring season at the downdrift beach compared to photographic data of the previous year in July 2009, correlates to the data of Table 9 showing more windy, high wind and high wind gusts days during the 2010 spring season than during the previous year. Additionally, there were more early high wind days and sustained high wind days in the spring season of 2010 than in 2009 per the Wind History Charts (see Figure 11).



April, May and June 2009



April, May and June 2010



April, May and June 2011

Figure 11 – Spring Season Wind History Charts – 2009, 2010 and 2011

<u>Wind History - Spring Season, 2011</u> – Spring season beach erosion at the downdrift beach started one month earlier in early May 2011 than in 2010, when there were high winds and high tides, although the 2011 spring season windy weather pattern was similar to that during the 2010 spring season with numerous early season, high wind days and with periods of sustained high winds (see Table 9 and Figure 11).

What caused the earlier than normal initial beach erosion at the downdrift beach in 2011? Based on 2011 winter season Beach Sand Volume survey data, the Beach Sand Volume at the downdrift beach decreased during the winter season (see Table 4); whereas, normally there would an additional increase during the winter season due a continuation of similar weather conditions from the fall. The earlier than normal seasonal beach erosion in 2011 may be explained by the 11 March 2011 tsunami which removed considerable Beach Sand Volume at this downdrift beach as well as at the downdrift beach cove immediately downdrift of the Project Area, so when the initial, early spring season beach erosion started at these beaches at the same time due to a seasonal trend change of earlier and higher than normal trade winds, the beaches were deficient of sand compared to previous years.

La Niña Episode - According to the NOAA's 2011 winter forecast, "the sea surface temperatures across much of the equatorial Pacific entered a cooler than normal phase beginning in May 2010, signaling the onset of a La Niña episode.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2001	**-0.7**	**-0.6**	**-0.5**	-0.3	-0.2	-0.1	0.0	0.0	-0.1	-0.2	-0.2	-0.3
2002	-0.2	0.0	0.1	0.3	**0.5**	**0.7**	**0.8**	**0.8**	**0.9**	**1.2**	**1.3**	**1.3**
2003	**1.1**	**0.8**	0.4	0.0	-0.2	-0.1	0.2	0.4	0.4	0.4	0.4	0.3
2004	0.3	0.2	0.1	0.1	0.1	0.3	**0.5**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**
2005	**0.6**	0.4	0.3	0.3	0.3	0.3	0.2	0.1	0.0	-0.2	**-0.5**	**-0.8**
2006	**-0.9**	**-0.7**	**-0.5**	-0.3	0.0	0.1	0.2	0.3	**0.5**	**0.8**	**1.0**	**1.0**
2007	**0.7**	0.3	-0.1	-0.2	-0.3	-0.3	-0.3	**-0.6**	**-0.9**	**-1.1**	**-1.2**	**-1.4**
2008	**-1.5**	**-1.5**	**-1.2**	**-0.9**	**-0.7**	**-0.5**	-0.3	-0.2	-0.1	-0.2	-0.4	-0.7
2009	-0.9	-0.8	-0.6	-0.2	0.1	0.4	**0.5**	**0.6**	**0.7**	**1.0**	**1.4**	**1.6**
2010	**1.6**	**1.4**	**1.1**	**0.7**	0.2	-0.3	**-0.8**	**-1.2**	**-1.4**	**-1.5**	**-1.5**	**-1.5**
2011	**-1.4**	**-1.3**	**-1.0**	**-0.7**	-0.4	-0.2	-0.2	-0.3	**-0.6**	**-0.8**	**-1.0**	**-1.0**
2012	**-0.9**	**-0.7**										

Table 10 – Cold and Warm Water Episodes by Seasons, 2001 – 2012

NOAA information indicates for the period from May/June/July (M/J/J) 2010 through April/ May/June (A/M/J) 2011, there was an abrupt change from warm water (red) temperatures to a cold water (blue) period in the equatorial Pacific (see Table 10), which is a La Niña episode. During La Niña cycles, easterly trade winds strengthen per NOAA.

The shift to colder water and the beginning of the La Niña episode began in May 2010, which correlates with the beginning of the 2010 spring season beach erosion and sand loss at the downdrift beach and continuing during the 2010 summer. The La Niña episode continued uninterrupted through the winter and early spring of 2011 after which it decreased in intensity, and the beginning of earlier 2011 spring season beach erosion and sand loss at the downdrift beach correlates with the continuation of the episode.

The seasonal trend change of unusually early and higher than normal trade winds may be explained by the La Niña episode. Per Table 10, there were few La Niña episodes prior since 2000. Per NOAA long-term data, periods of multiple La Niña episodes occur approximately 10 years apart, so the 2009 -2010 and 2010-2011 episodes are unique in frequency and to previous seasons.

High Trade Winds Effect - High trade winds cause large wind swells which increase in height and frequency daily during periods of sustained high winds, which occurred numerous times during the 2010 and 2011 spring seasons (see Figure 11). High trade wind swells result in longshore waves and strong downdrift currents nearshore that scour and erode beaches on Maui's north shore, especially during high tides periods, which occur typically in the afternoon during the spring and summer seasons when the winds are also at their peak.

When the downdrift beach at transect 1 started to lose sand at its east end earlier and more rapidly than in recent years during the 2010 and 2011 spring seasons due to earlier than normal and sustained high wind periods, the seawall at the east end of this beach became more exposed in length and height as sand left the beach in front of the seawall due to the longshore waves and waves reflected by the exposed seawall during daily high tides. When the seawall became more exposed, it accelerated the rate of beach erosion and beach sand loss in front of it and at the downdrift beach, thus exposing more of the downdrift seawall.

When high trade winds and resultant beach erosion on Maui's north shore started one month earlier than previous years in the 2010 spring and 2011 summer, the duration of seasonal beach erosion was extended with increased erosion until fall, which resulted in greater total beach sand loss by mid-to late summer, when the winds are usually the strongest.

Because of the 2010 and 2011 seasonal trend change with initial, early season, sustained high trade winds and the seawall's reflected wave energy (see Section 8.3.3), the downdrift beach had an inability to become re-nourished by longshore transport with sand from updrift sources during the high wind summer season. The inability of this beach to be naturally re-nourished was also compounded by the fact that the locale is deficient in sand supply due to a history of updrift beach loss and sand supply (see Section 8.3.2), plus that the region is deficient in sand supply due to many years of sand mining for the Paia Lime Kiln and other uses per a recent Army Corps of Engineers' study (see Section 8.3.4).

8.3.2 Historic Trend of Local, Long-Term Beach Retreat:

<u>Local Beach Retreat Photographic Documentation</u> **-** The 1940, 1960, 1975, 1997, 2002, 2005 and 2007 aerial photographs (see Appendix Photos 9 through 15) show different rates of beach retreat updrift, within and downdrift of the Project Area as follows:

<u>Updrift Beach Retreat History</u> - From 1940 to 2007, the most beach retreat in the locale occurred this area west of Papaula Point as seen when comparing the shoreline location to the nearshore reef location. From 1940 to 1975, the sand beach was touching the reef, and the beach width increased significantly as the shoreline eroded and moved inland. By 1997, the sand beach was separated from the reef by a significant distance, and the beach retreated a much greater distance by 2007 due to continued land erosion. This is also evident when comparing the beach location relative to the approximate seaward property line location.

Within Project Area Beach Retreat History - From 1940 to 2007, this area experienced beach retreat at a slower rate than updrift. From 1940 to1975, the beach retreated little when comparing the beach location to the approximate property lines locations. By 1997, the sand beach had retreated inland of the seaward property lines by a significant distance, and the beach retreated to a much greater distance by 2007 to be mostly within the property boundaries due to continued land erosion. The most beach retreat occurred at the east end of the Project Area during this time.

Downdrift Beach Retreat History – The 1940 aerial photograph (see Photo 9) shows the seawall and several rock groins across Lots 1 and 2. The fact that the seawall at Lot 1 was built in 1925, and the rock groins and the seawalls at Lots 1 and 2 existed in 1940 indicates a concern about historic beach erosion and land loss 72 to 87 years ago at this area.

From 1940 to 1975, there was a wide sand beach in front of the seawall across Lots 1 and 2 immediately downdrift of the Project Area. By 1997, there was no sand beach in front of easterly Lot 2, and there was a reduction of Beach Width in front of the seawall at westerly Lot 1 at its east end. By 2005, there is less sand beach width in front of the seawall at Lot 1, with noticeable Beach Width narrowing at its updrift, east end and greater exposure of the rock pile/revetment there. This area did not have beach retreat as the other areas, because the land has been protected by a long seawall across Lots 1 and 2. The noticeable change across Lots 1 and 2 is Beach Width reduction and beach loss moving from east to west during this time, which is similar to the pattern of updrift and Project Area beach retreat there.

The long-term trend of beach retreat and beach loss is visually evident from historic aerial photographs and has beach retreat and beach loss have been advancing toward the downdrift beach at the west half of Lot 1 (transect 1) from east to west during this time. By 2005, the advancing beach retreat with a long and hardened shoreline immediately updrift of the downdrift beach put this downdrift beach in peril with it being the next in line for total beach loss, as well as resulting in a decreased updrift sediment supply to naturally nourish this beach via longshore sand transport during the erosive spring and summer seasons.

Local Annual Erosion Hazard Rate - The U.H. Annual Erosion Hazard Map (Figure 15) based on historic aerial photographs from 1912 to 2002 indicates at

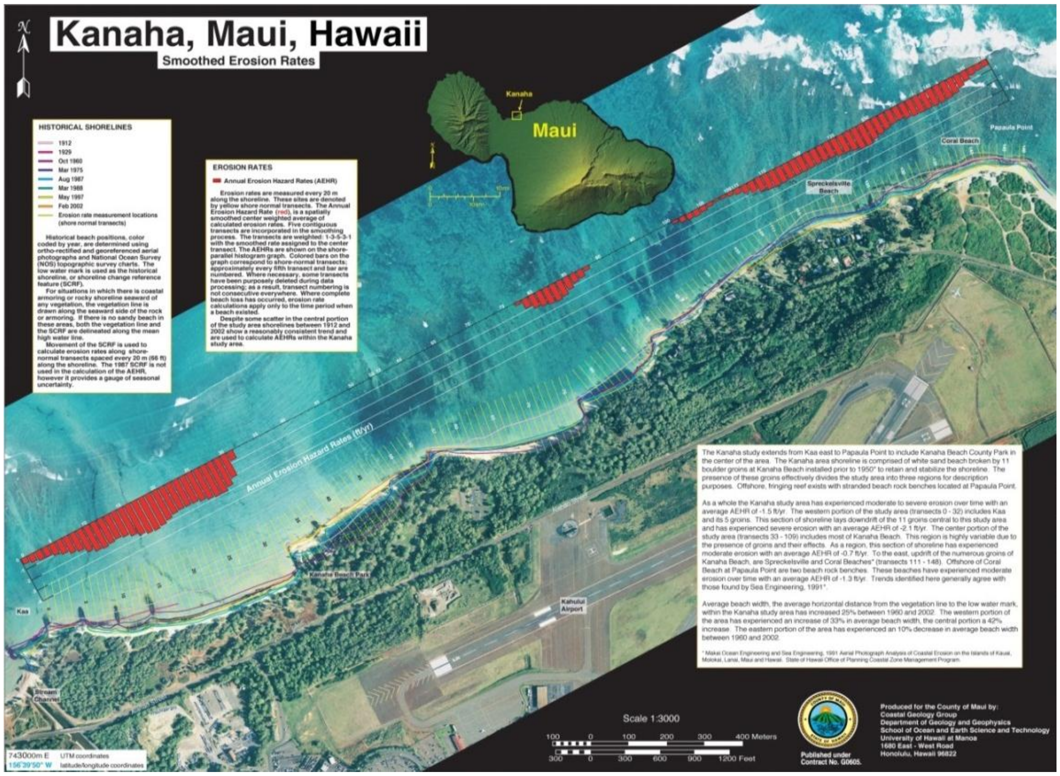


Figure 15 – Annual Erosion Hazard Map

each of its transects the annual rates of Beach Erosion and with different color Historical Shoreline locations the amount of beach loss over time. The rates and amount of historical shoreline retreat increase from west to east updrift of the downdrift beach from 1912 to 2002. The rates and amount of shoreline change across Lots 1 and 2 are less because the seawall there protects the shoreline from retreat; however, it is clear there is advancing beach loss and beach loss immediately updrift of Lot 2 and advancing toward Lot 1 over time.

<u>Local Annual Erosion Hazard Map</u> - The U.H. Annual Erosion Hazard Map (Figure 15) indicates in its text an increase of Beach Width from 1960 to 2002 at the west and central portions of the Kanaha area, but a 10% decrease of Average Beach Width at the east portion, which includes the Project Area east of the downdrift beach. It is evident beach width reduction has occurred immediately updrift of Lot 2, and there is advancing beach retreat toward Lot 1 from 1960 to 2002.

8.3.3 Seawall Effect on Beach Erosion:

<u>Seawall Effect on Beach Erosion in Front of Seawall</u> - Seawalls armoring a shoreline where there is long-term beach retreat halt erosion leading to land loss, and instead seawalls refocus the erosion onto the beach in front of the structure thus causing beach narrowing and beach loss there (Tait and Griggs,1990).

Seawalls cause a swash effect of creating backwash onto a receding beach, and thus seawalls interfere with the nearshore sediment processes if the shoreline retreats to the proximity of the structures. When waves wash up against seawalls, the waves reflect back towards the ocean with much more energy than if the wall were not there (Plant and Griggs, 1992).

<u>Seawall Effect on Beach Erosion Downdrift of Seawall</u> - Seawalls have an increased erosion effect on immediate, downdrift beaches undergoing beach retreat, and the effect is more pronounced on beaches undergoing long-term retreat, due partly to a diminished beach width in front of the seawall and thus a decreased supply of sand sediment immediately updrift that may be transported longshore to downdrift beaches. The effect of the long seawall downdrift of the Project Area to the beach in front and downdrift of the seawall is a loss of beach in front of the seawall and a narrowing of the beach immediately downdrift of the seawall (see Photo 42).

Photo 42 – Lot 2 Seawall Beach Loss and Beach Narrowing Immediately Downdrift atTransect 1, 5 October 2011

A contributing factor to downdrift beach loss is that the swash reflected by a seawall is directed seaward several seconds earlier than swash on the adjacent natural beach. This increases the backwash duration and velocity, which as a result increases the offshore transport of sand from the downdrift beach since the waves originate from updrift and reflect downdrift offshore (see Photo 43) (Tait and Griggs,1990) . “All seawalls produce ‘flanking’ a phenomena where the land next to a wall experiences accelerated erosion” (C. Fletcher).

Photo 43 - Lot 2 Seawall Reflected Waves toward Downdrift Beach at Transect 1, 10 June 2011

8.3.4 Regional Increase of Long-Term, Annual Beach Erosion Rate:

Increase of Historic Beach Erosion Rate at Project Area - During the last few years since 2006 until Project construction in 2010, the annual beach erosion rate and consequential land loss at the Project Area was significantly higher than the long-term, Annual Beach Erosion Rate from the U. H. Erosion Hazard Map (Figure 15), which is measured from 1960 to 2002 aerial photography, by a factor of three. This change of the long-term rate with a higher rate of beach erosion and land loss came abruptly to the Project Area in 2006, and perhaps the downdrift beach at transect 1 is experiencing a similar change of the long-term Annual Beach Erosion Rate last documented in 2002 based on natural causes. Other Maui north shore areas also experienced unusually high erosion rates and beach loss during the last 3 summer seasons, including updrift Baldwin and downdrift Kanaha Beach Parks.

Regional Sediment Management Study - At a Regional Sediment Management (RSM) Workshop on 19 January 2011, representatives of the U.S. Army Corps of Engineers stated that based on more recent 2007 aerial photographs, the long-term Annual Beach Erosion Rate for the Kanaha Littoral Cell, which includes the Within and Outside Project Areas, has significantly changed with an increase of the annual rate from the previous Annual Erosion Hazard Map, which is based on historic aerial photographs.

Figure 16 – Kanaha Littoral Cell Annual Beach Sand Volume Loss Map

The representatives also stated that there is a change in the long-term trend of the location of the most rapidly eroding zone in the RSM larger study region which extends from Hookipa Beach Park at the east and Paukukalo at the west on Maui's north shore, and the most rapidly eroding zone has shifted from east to west along the coastal region to the Kanaha Littoral Cell which has an annual loss of 10,550 cu. yd. of Beach Sand Volume (see Figure 16) based on 2007 aerial photographs.

One theory for the change of the long-term location of the region's most rapidly eroding zone is a change of the long-term location for sediment supply, which has been deficient in its ability to naturally nourish beaches updrift previously and now at the Kanaha cell, perhaps due to over 70 years of sand mining in the region for the updrift Paia Lime Kiln and other uses,

This significant increase of the long-term beach erosion rate and relocation of the highest rate of regional beach erosion from east to west in the RSM study area is based on 2007 aerial photographs, and it may indicate a new long-term trend at the Kanaha Littoral Cell which correlates with the significant increase of the annual beach erosion at the Project Area starting in 2006, and it may explain or contribute to the increased erosion at the downdrift beach starting in 2010.

8.3.5 Groin Field Effect on Downdrift Beach Erosion:

U.S. Army Corps of Engineers Groin Field Design Standard - The U.S. Army Corps of Engineers Shore Protection Manual (1984) recommends the design spacing between groins in a groin field should equal two to three times the groin length.

The reason is that a greater distance between groins results in the groin being ineffective beyond that distance, thus without influencing the direction and magnitude of downdrift waves and currents. The Project's groins have a maximum length of 100 feet and an in-water length of approximately 65 feet. Using a maximum distance factor of three times the closest groin's in-water length, the maximum, possible downdrift effect distance from the Project's closest west end groin is 195 feet (see Figure 17).

Figure 17 - Maximum Downdrift Effect of Project's Closest Groin

<u>Project Groin Field Effect Immediately Downdrift</u> - A possible adverse effect of a groin when there is longshore sand transport is localized erosion scouring immediately downdrift of the groin. There is no beach to scour immediately downdrift of the Project's closest, west end groin, but a rock revetment. The nearest downdrift beach and the only beach within the Area of Possible Influence of the Project's closest, west end groin at transect 5 is a small beach cove, which starts approximately 120 feet west of this groin at transect 4 and is approximately 50 feet wide to the west at transect 3 near where Lot 2's seawall starts.

There has been no Beach Width or Beach Sand Volume reduction post-construction at transects 3 and 4, and there has been an increase in Beach Width and Beach Sand Volume at transect 4 (see Tables 1 and 2). The beach cove lost considerable sand during the 11 March 2011 tsunami (see Photo 22), which was caused by cross shore tidal waves hitting the cove's perimeter seawall and reflecting back, thereby removing beach sand to the ocean in the process. The beach cove regained considerable sand volume during the normally erosive

2011 spring season (see Photo 23), thus indicating no adverse groin field effect on downdrift beach erosion.

Project Groin Field Effect Further Downdrift - The downdrift beach which lost sand early in the spring seasons of 2010 and 2011 is located approximately 460 feet west and downdrift of the Project's closest west end groin. The possibility of the closest groin, which is a significant distance updrift, and the updrift groin field further east of causing an effect of downdrift beach erosion at the small, downdrift beach is not possible, which is supported by the Corps' design recommendation basis, especially considering there is a hardened shoreline continuously between the groin and the downdrift beach. The seawall's swash effect with reflected and redirected waves drastically changes the nearshore currents which negates any effect and influence of this groin. Also, the orientation of the downdrift area is different and distinct from that of the Project Area. The hardened shoreline's seawall causes a swash effect and combined with the different coastal orientation, cause the nearshore current at the downdrift area to be divergent from its shoreline.

Groin Water Flow - After the Project's groins were installed late April 2010, the in-water ends of the groins were submerged at mean to high tides which allowed wave energy and water to move over as well as around the ends of the groins in the downdrift direction with the nearshore current during spring and summer seasons. A submerged groin end and water overflow reduces the possibility of scouring and beach erosion immediately downdrift of the groin.

Project Designer Post-Construction Observations - When the Project designer/coastal engineer visited the site to observe the early 2010 summer, post-construction beach erosion at the downdrift beach, he stated it is very doubtful the groin field had any effect to cause the Initial and Seasonal, Downdrift Beach Erosion.

8.3.6 Groin Field Effect on Longshore Sand Transport:

Project Construction History - The west end, terminal groin was installed on 27 April 2010. The sand dredging/pumping operation started on 6 May and extended twice as long as anticipated due to delays caused by rough weather and sea conditions, thus delaying the sand placement. The pumped sand that was stockpiled during pumping was finally placed and spread along the Project Beach by 25 June.

Sand Transport History - Spring Season, 2010 - During the 2010 spring season from the 15 April pre-construction survey to the 1 July immediate, post-construction survey, there was a 3,515 cu. yd. reduction of Average Beach Sand Volume from the Project Beach during the Project's construction period per Table 7 for the 600 foot long beach. This equates to a loss rate of approximately 5.86 cu. yd. of Beach Sand Volume per lineal foot of beach length. This large loss of

Beach Sand Volume can be explained since during the April, May and June construction period, there was sand lost from the Project Beach due to: seasonal beach erosion, outflow of sediment from the groins when being filled, outflow of sediment from the pumped sand dewatering basin overflow, high tides eroding the dewatering basin sand berm and stockpiled sand; plus from an unstable beach during construction caused by vehicle movement, beach grooming when work was temporarily suspended twice, erosion due to the beach reshaping after groins' installation and final sand placement.

The downdrift beach located at transect 1 experienced earlier and greater than the previous spring season erosion starting June, 2010 when it lost approximately 729 cu. yds. of Beach Sand Volume during the 2010 spring season per Table 4 for the 240 foot long beach. This equates to a loss rate of approximately 3.04 cu. yd. of Beach Sand Volume per lineal foot of beach length.

Therefore, during the 2010 spring season, the Project Beach lost approximately 4.82 times as much Beach Sand Volume than at the downdrift beach, plus the Project Beach had a loss rate of approximately twice that of the downdrift beach. The Beach Sand Volume lost from the Project Beach was transported longshore in the downdrift direction toward the downdrift beach by the nearshore current. Additionally, the Project Beach allowed considerable Beach Sand Volume to simultaneously move through the Project's groin field from updrift beaches to downdrift beaches after May via longshore sand transport.

<u>Sand Transport History - Summer Season, 2010</u> - During the 2010 summer season, sand continued to travel from and through the Project Beach and its groin field, which was visually evident in the afternoons when the wind and the tides were typically the highest; however, once the downdrift beach had lost 51% of its Beach Sand Volume during the previous spring season, the seawall at the west end of the downdrift beach became more exposed in length and height and the beach in front of it more narrow. During the summer, the strong trade winds continued, and the exposed seawall at the downdrift beach continued to accelerate Beach Sand Volume loss on the beach in front of it and immediately downdrift due its swash effect as Tait and Griggs recognized (see Section 8.3.3). These factors made it difficult for sand to accrete naturally on this beach from updrift beaches via longshore sand transport during the summer season.

<u>Sand Transport History - Spring Season, 2011</u> - During the 2011 spring season, there was a 1,603 cu. yd. reduction of Average Beach Sand Volume from the Project Beach per Table 6 for the 600 foot long beach. This equates to a loss rate of approximately 2.67 cu. yd. of Beach Sand Volume per lineal foot of beach length. By comparison, the downdrift beach lost approximately 693 cu. yd. of Beach Sand Volume during the same time per Table 4 for the 240 foot long beach. This equates to a loss rate of approximately 2.89 cu. yd. of Beach Sand Volume per lineal foot of beach length, which is slightly less than that during the spring of 2010.

Therefore, during the 2011 spring season, the Project Beach lost approximately 2.3 times as much Beach Sand Volume than at the downdrift beach, plus the Project Beach had a loss rate of approximately the same as that of the downdrift beach. The Beach Sand Volume lost from the Project Beach was transported longshore in the downdrift direction toward the downdrift beach by the nearshore current. Additionally, the Project Beach allowed considerable Beach Sand Volume to simultaneously move through the Project's groin field from updrift beaches to downdrift beaches via longshore sand transport.

When the 2011 trade wind season started early in March, visually obvious was a change of the Project Beach Shape where the straight line of the Beach Toe between groins from previous cross shore sand transport changed to a curved line due to the seasonal change to longshore sand transport. This change is a result of beach scouring immediately downdrift of the groins' seaward ends due to the longshore wave direction and current generated by the northeasterly trade winds. The scoured sand is then lost from the Project Beach as it moves downdrift via longshore sand transport.

<u>Water Flow and Sand Transport at Groins</u> - After the beach nourishment work was completed in June 2010, the in-water ends of the Project's groins were submerged at mean to high tides which allowed wave energy and longshore sand transport to move over as well as around the submerged ends of the groins

Photo 44 - Longshore Sand Transport Downdrift Over and Around Project's West End Groin, 10 June 2011 in a downdrift direction. Longshore sand transport from updrift and within the Project Area around and over the groins was visually obvious after May 2010.

One of the downdrift residents claimed on 2 June 2011, the Project's west end terminal groin was trapping sand on the Project Beach and thus stopping longshore sand transport during the summer to the downdrift beaches. A photograph taken on 10 June shortly thereafter (see Photo 44) shows this groin and longshore sand transport with nearshore sand suspended in the water around, at the end and immediately downdrift of the groin near the rocks; the beach sand the same level as the top of the groin at its updrift side allowing water and sand to overflow the top of the groin; and the groin's easterly angled, seaward end totally submerged at a mean tide level. This is similar to the condition at the same location during the 2010 spring and summer seasons.

Groin Field Capacity - It is documented by the U.S. Army Corps of Engineers that in some cases, a newly installed groin field may temporarily interrupt longshore sand transport to downdrift beaches until the groin field is filled to capacity with sand. One reason why the Project scope initially included beach nourishment was to fill the new groin field in order to counteract this possibility. The Project work occurred during the 2010 spring season which allowed the Project Beach to have benefitted from the previous fall and winter seasons' considerable sand accretion.

The Project's SSBN approval allowed a maximum of 10,000 cu. yds. of offshore sand to be pumped and placed annually on the Project Beach; however, as a result of the naturally accreted beach condition, only 6,000 cu. yds. of sand was calculated and contracted as necessary to fill the groin field. Approximately 2,886 of the 6,000 cu. yd. of offshore sand was able to be pumped and placed on the Project Beach due to unfavorable weather, so immediately the Project design was modified, and top sections of groins were removed during June 2010 in order to reduce the groin field height by 50% and thus its capacity similarly so the capacity would be commensurate with the Beach Sand Volume added by pumping. As a result the Project groin field was at or near capacity after construction.

At the beginning of the 2011 spring season, the Project's groin field was filled to capacity from the previous fall and winter seasons' natural accretion, and yet the Beach Sand Volume loss at the downdrift beach during the 2011 spring season was similar to that at the same time of the previous year immediately post-construction. Based on the similar loss rates during the 2010 and 2011 spring seasons at the downdrift beach, it is evident the newly installed groin field in 2010 did not temporarily interrupt longshore sand transport to downdrift beaches.

One Year Post-Construction - The one year, post-construction Project Beach equilibrating period passed, and the Project Beach was more stable as anticipated by the Project coastal engineer/designer, thus the Project Beach lost considerably less Beach Sand Volume during the 2011 spring season than during the 2010 spring season. The groin field now is not newly installed, and it was filled to capacity with sand, so the there is no further possibility of a newly installed groin field temporarily interrupting longshore sand transport to downdrift beaches.

9. CONCLUSIONS

9.1 Performance Objectives and Criteria/Metrics Attainment

9.1.1 Within Project Area:

Performance Objectives and Criteria/Metrics: To increase the Beach Width and Beach Sand Volume, to reduce the rate of future beach erosion and land loss post-construction with Beach Widths and Beach Sand Volumes equal or greater than Design Equilibrium Beach Widths and Beach Sand Volumes.

Performance Objectives and Criteria/Metrics Attainment: Positive

9.1.2 Outside Project Area:

Performance Objectives and Criteria/Metrics: To minimize adverse Project impacts to updrift and downdrift beaches.

Performance Objectives and Criteria/Metrics Attainment: Positive at updrift and immediate downdrift beaches. At furthest downdrift beach located at transect 1, the assessment of one short-term data source was non-attainment, but the long-term assessment was positive.

Were the initial and seasonal beach sand losses at the downdrift beach attributed to the Project or to natural causes that are coincidental in timing with the Project?

9.2 Probable Causes of Initial and Seasonal Downdrift Beach Erosion

Six Possible Causes of the Initial and Seasonal Downdrift Beach Erosion at the at transect 1 were identified, investigated and discussed in Section 8.3.

Possible Project Causes – Possible Project Causes of the Initial and Seasonal Downdrift Beach Erosion were investigated and assessed, and the conclusions are as follows:

9.2.1 Groin Field Effect on Downdrift Beach Erosion:

U.S. Army Corps of Engineers Groin Field Design Standard - Documented U.S. Army Corps of Engineers recommendation for groin field design indicates a distance of Maximum Downdrift Effect of Groin is 195 feet for this Project design.

Project Groin Field Effect Immediately Downdrift - The area immediately downdrift of the Project within the distance of Maximum Downdrift Effect of Groin has had no beach erosion and has accreted sand post-construction.

Project Groin Field Effect Further Downdrift – The only area of non-attainment is a downdrift beach of which its closest end is approximately 460 feet downdrift of the Project's closest groin. This distance is far beyond the distance of Maximum Downdrift Effect of Groin, plus the intervening seawall between the downdrift beach and the closest groin reflects and re-directs waves and currents to negate and overpower any possible groin field effect downdrift.

Documented by the U.S. Army Corps of Engineers and confirmed by the Project's Coastal Engineer, the Project's groin field effect downdrift a distance of 460 feet with a continuously intervening seawall is not a Possible Cause of the Initial and Seasonal, Downdrift Beach Erosion at the downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons.

9.2.2 Groin Field Effect on Longshore Sand Transport:

Sand Transport History – Spring and Summer Seasons, 2010 - Documented from Project survey monitoring during the 2010 spring season, the Project Beach lost approximately 4.82 times more Beach Sand Volume than the downdrift beach, and it had almost twice the loss rate per lineal foot of beach. Visually evident during the same period of time was longshore sand transport of sand from updrift beaches through the Project Area. The combined sand lost from the Project Beach and sand passing through the Project Area was transported downdrift toward the downdrift beach. By the 2010 summer season, the downdrift beach had lost so much sand that its seawall was exposed to the extent that its backwash prevented sand to accrete on this beach from updrift beaches.

Sand Transport History – Spring Season, 2011 - Documented from Project survey monitoring during the 2011 spring season, the Project Beach lost approximately 2.3 times more Beach Sand Volume than the downdrift beach, and it had a comparable loss rate per lineal foot of beach. Visually evident during the same period of time was longshore sand transport of sand from updrift beaches through the Project Area. The combined sand lost from the Project Beach and sand passing through the Project Area was transported downdrift toward the downdrift beach.

Water Flow and Sand Transport at Groins – Documented photographically is water flow and sand transport over and around the seaward ends of Project groins, which are submerged at mean to high tide periods and mostly buried at the beach.

Groin Field Capacity – During the erosive 2010 spring and summer seasons, the groin field was at or near capacity in June after sand placement and groin height reduction. After the 2010 fall and 2011 winter accretion seasons, the groin field was at capacity, which is photographically documented. There was no temporary or permanent groin field entrapment of sand to prevent longshore sand transport,

Documented by survey data and photographs, the Project's Groin Field Effect on Longshore Sand Transport is not a Possible Cause of the Initial and Seasonal, Downdrift Beach Erosion at the downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons.

Possible Natural Causes - Possible Natural Causes of the Initial and Seasonal Downdrift Beach Erosion were investigated and assessed, and the conclusions are as follows:

9.2.3 Historic Trend of Local, Long-Term Beach Retreat:

Beach Retreat History – Documented photographically is local, beach retreat as the land erodes and the beaches move inland historically within the Project area plus at updrift beaches. It is apparent the beach retreat has been advancing toward the downdrift beaches. There has been no historic beach retreat at the downdrift beaches because the seawall visible in 1940 photographs protects the land, which prevents beach retreat; however, the downdrift beaches have historically experienced beach width reduction and eventual beach loss in front of the majority of the seawall length.

The historic trend of local, long-term and advancing beach retreat plus beach width reduction and eventual beach loss downdrift is also documented by the University of Hawaii Annual Erosion Hazard Map from 2002 aerial photographs based on Historical Shorelines and Annual Erosion Rates. Due to this long-term trend, the next logical local area downdrift to occur beach loss is at the downdrift beach where the beach width has been relatively narrow over the last few years and where there are no beaches remaining for several hundred feet updrift.

The Historic Trend of Local, Long-Term Beach Retreat is at least a Contributing Cause of the Initial and Seasonal, Downdrift Beach Erosion at the downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons.

9.2.4 Seawall Effect on Beach Erosion:

Seawall Effect on Beach Erosion in Front of Seawall - Documented from studies by Tait and Griggs plus Plant and Griggs are the effects of seawalls to cause erosion and beach narrowing and beach loss in front of the seawall when longshore waves occur due to the seawall's reflected waves with a swash effect.

Seawall Effect on Beach Erosion Downdrift of Seawall - Documented from studies by Tait and Griggs are the effects of seawalls to cause erosion on immediate downdrift beaches and beach loss due to the seawall's reflected waves with a swash effect, especially to beaches experiencing long-term retreat.

The Seawall Effect on Beach Erosion causing reflected waves with a swash effect on the downdrift beach and immediately downdrift, both with long-term history of beach width reduction, is at least a Contributing Cause to the Initial and Seasonal Beach Erosion at the downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons.

9.2.5 Regional Increase of Historic Beach Erosion Rate:

Increase of Historic Beach Erosion Rate at Project Area - The sudden threefold increase in the Historic Beach Erosion Rate in 2006 at the Project Beach may be an indicator of a change of the local or regional, long-term erosion rate trend with an increase of the annual erosion rate last determined from 2002 aerial photographs.

Regional Sediment Management Study – Documented in this recent study for the U.S. Army Corps of Engineers there is a regional change in the long-term erosion trend with an increase of the annual erosion rate for the Kanaha littoral cell, of which the Project Area plus updrift and downdrift areas are a part, based on more recent 2007 aerial photographs.

The Regional Increase of the Historical Beach Erosion Rate is a change of the long-trend and a Possible Contributing Cause to the Initial and Seasonal Beach Erosion at the downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons.

9.2.6 Unusually Early and High Trade Winds:

Wind History - Documented are Unusually Early and High Trade Winds during the 2010 and 2011 spring seasons, which may have been caused by a La Niña episode. The earlier and higher than normal, seasonal trade winds accelerated beach erosion and sand loss at the downdrift beach as it started to do at the Project beach during the 2010 spring season.

High Trade Winds Effect - High trade winds produce large, frequent and sustained wind swells with side-shore waves that scour the beach with strong downdrift currents during moderate to high tides, which typically occur in the afternoons in the spring and summer seasons at the same time when the wind is the strongest. The early high trade winds increased the duration of beach erosion and thus the magnitude of beach erosion during the spring and summer seasons.

The Unusually Early and High Trade Winds during the 2010 and 2011 spring seasons is a Contributing Cause to the Initial and Seasonal Beach Erosion at the downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons

9.3 Causes of Initial and Seasonal Beach Erosion:

Project Causes – It is physically impossible that the Project's Groin Field caused Downdrift Beach Erosion and/or a temporary or permanent adverse effect on Longshore Sand Transport, which is supported by documentation.

Natural Causes – Identified and determined to be Contributing Causes are the following:

- **Historic Trend of Local, Long-Term Beach Retreat**
- **Seawall Effect on Beach Erosion**
- **Unusually Early and High Trade Winds**

Each of these three factors could have caused the Initial and Seasonal Beach Erosion at the downdrift beach; however, all three factors occurred simultaneously, and they collectively contributed to the cause, thus exacerbating the amount of Beach Width reduction and Beach Sand Volume initial and seasonal loss.

By 2010, the downdrift beach was at its tipping point of sustainability due to the Historic Trend of Local, Long-Term Beach Retreat immediately updrift and advancing downdrift toward the downdrift beach, of Beach Loss immediately updrift of the beach and of Reduced Beach Width at the downdrift beach.

The long, continuous seawall updrift at the downdrift beach and immediately downdrift with its documented Seawall Effect on Beach Erosion contributed to the cause of the downdrift beach being at its tipping point in 2010 and to the beach erosion sustained by the downdrift beach during the spring and summer plus 2011 spring seasons.

The Unusually Early and High Trade Winds were the catalyst to trigger the start of the early 2010 and 2011 seasonal beach erosion at the downdrift beach, which was at a tipping point of sustainability.

Another possible contributing cause is the Regional Increase of Long-term Annual Beach Erosion.

The increased exposure of the seawall and beach erosion at the downdrift beach located at transect 1 during the 2010 spring and summer plus 2011 spring seasons is not a new phenomenon. The fact that the seawall was most likely built in 1925, plus that the rock groins and seawall at this beach and immediately updrift to the Project Area appear in the 1940 aerial photograph indicates a concern about historic beach erosion and land loss 72 to 87 years ago at this stretch of beach.

<u>9.4 Remedial Action</u>: Remedial action is required by the SRBRF "if the observed beach changes can be attributed to the Project structures taking into account seasonal and long-term trends".

9.4.1 Within Project Area: No Remedial Action is required since the Performance Criteria/Metrics have been attained (see Section 6.1).

9.4.2 Outside Project Area: No Remedial Action by the SRBRF is required as follows:

<u>Updrift Area</u> - The Performance Criteria/Metrics have been attained.

<u>Downdrift Area</u> - The Performance Criteria/Metrics have been attained at transects 2 and 3. It is physically impossible that the 2010 spring and summer plus 2011 spring seasons' Initial and Seasonal Beach Erosion at the downdrift beach located at transect 1 are attributed to the Project, and documentation supports <u>no</u> Groin Field Effect on Downdrift Beach Erosion and/or Longshore Sand Transport.

The causes of the Initial and Seasonal, Downdrift Beach Erosion at the Downdrift beach located at transect 1 are natural and due to seasonal and long-term changes.

The SRBRF will continue to monitor and assess Beach Erosion Within and Outside the Project Area in conformance with the Project's Performance Monitoring and Metric Guidelines for Beach Erosion.

<u>9.5 General</u>: The north shore of Maui is described as an erosion hotspot with several sand beaches having been lost in the last few decades, including those at public parks and lands with public facilities in peril from erosion, and with private homeowners considering or illegally building seawalls or revetments. Because of this high rate of beach erosion, the U. S. Army Corps of Engineers is currently performing a Regional Sediment Management study of sand transport on Maui's north shore, the County of Maui is studying opportunities to protect its

Kahului Waste Water Treatment Facility from further beach erosion and several homeowners and groups of homeowners have or plan to implement beach preservation Projects.

One of the stated goals of the Stable Road Evaluation Project is to provide useful information regarding beach nourishment techniques and sand retention devices at an active north shore environment which may be applicable and beneficial to other possible, future beach restoration/preservation Projects in Hawaii and particularly at the unique environment of Maui's north shore. The more knowledge gained and shared will help produce an empirical and more successful approach to chronic beach erosion.

10. APPENDIX

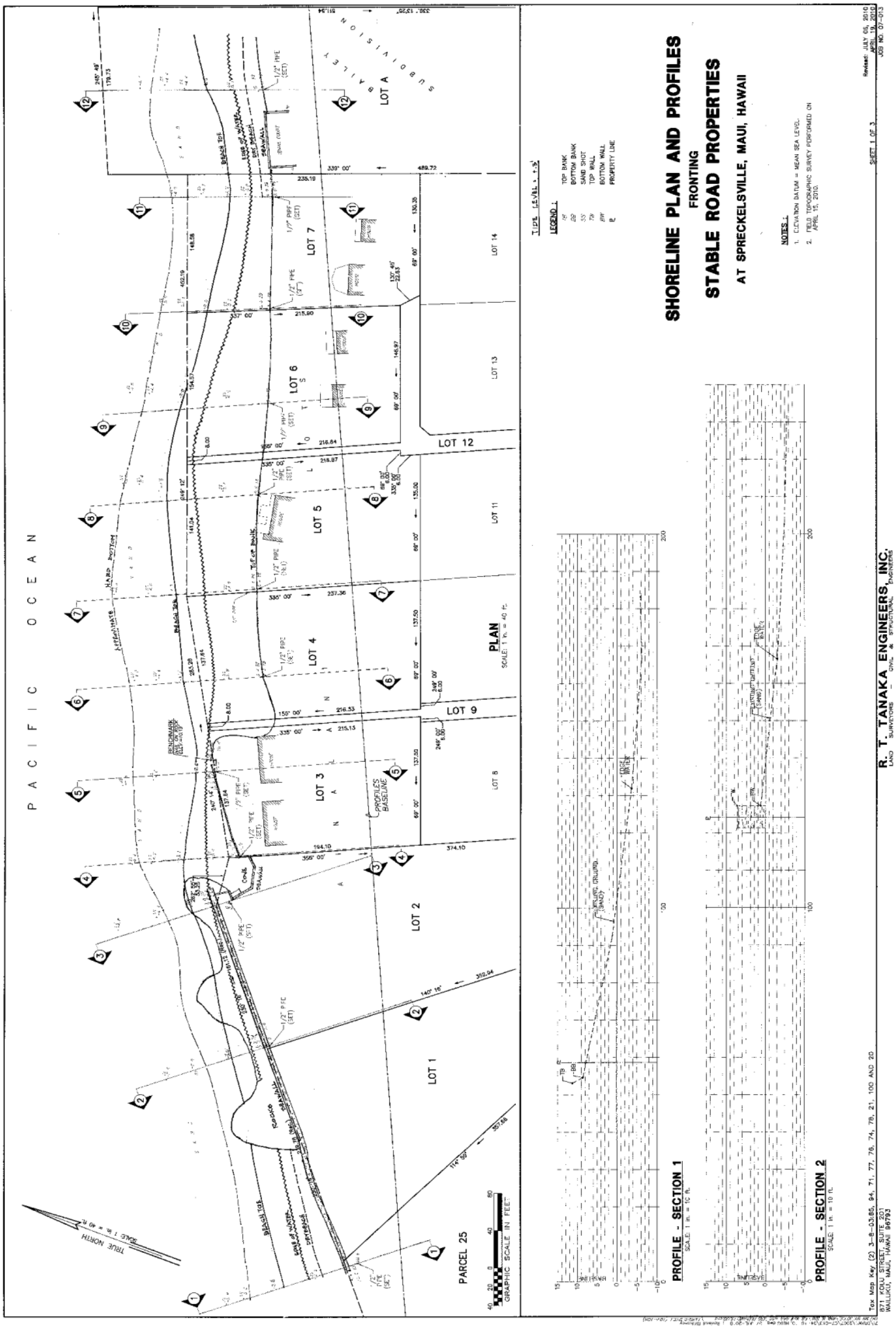


Figure 2 – Pre-Construction Site Plan and Beach Survey Profiles, 15 April 2010

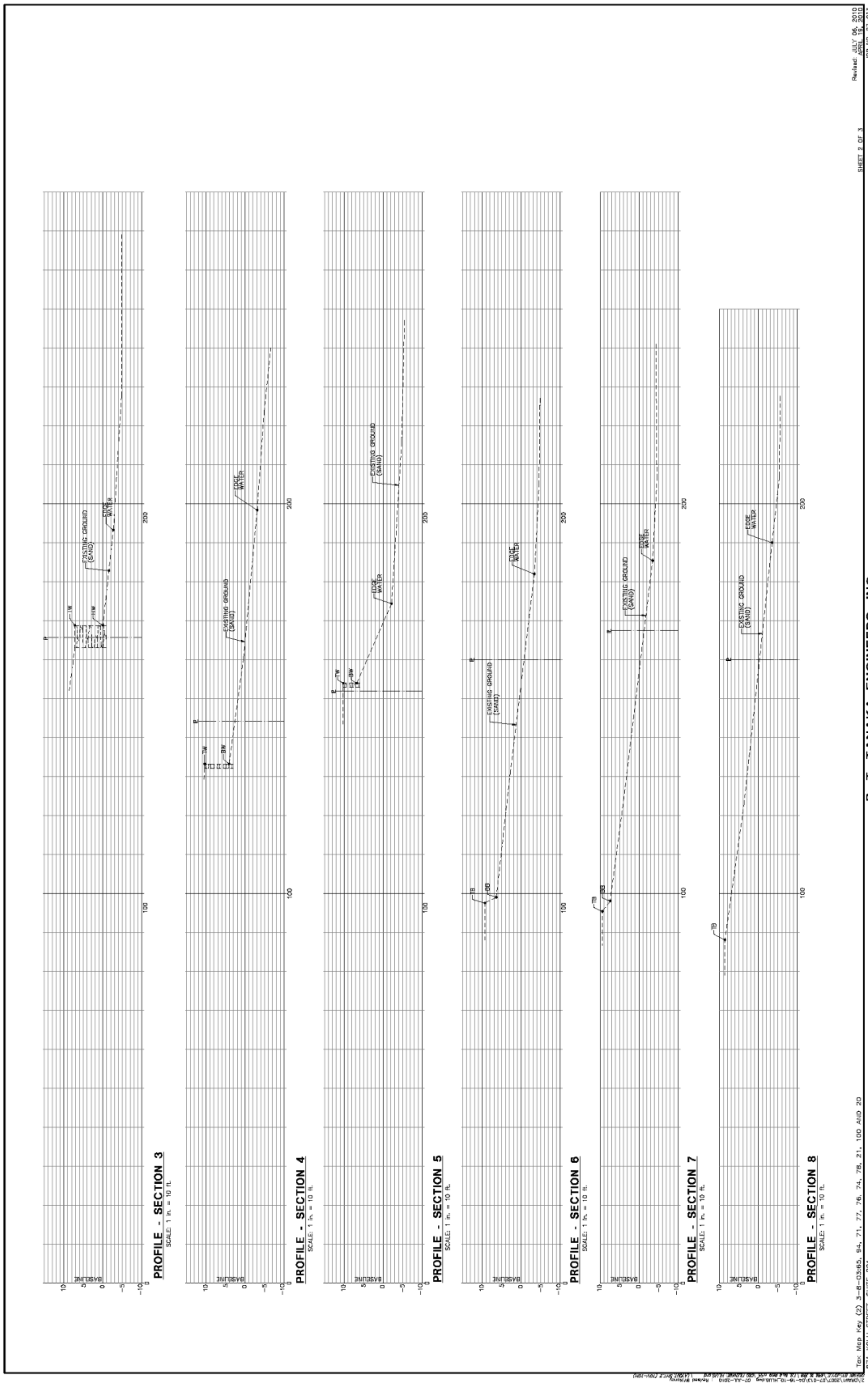


Figure 3 - Pre-Construction Beach Survey Profiles, 15 April 2010

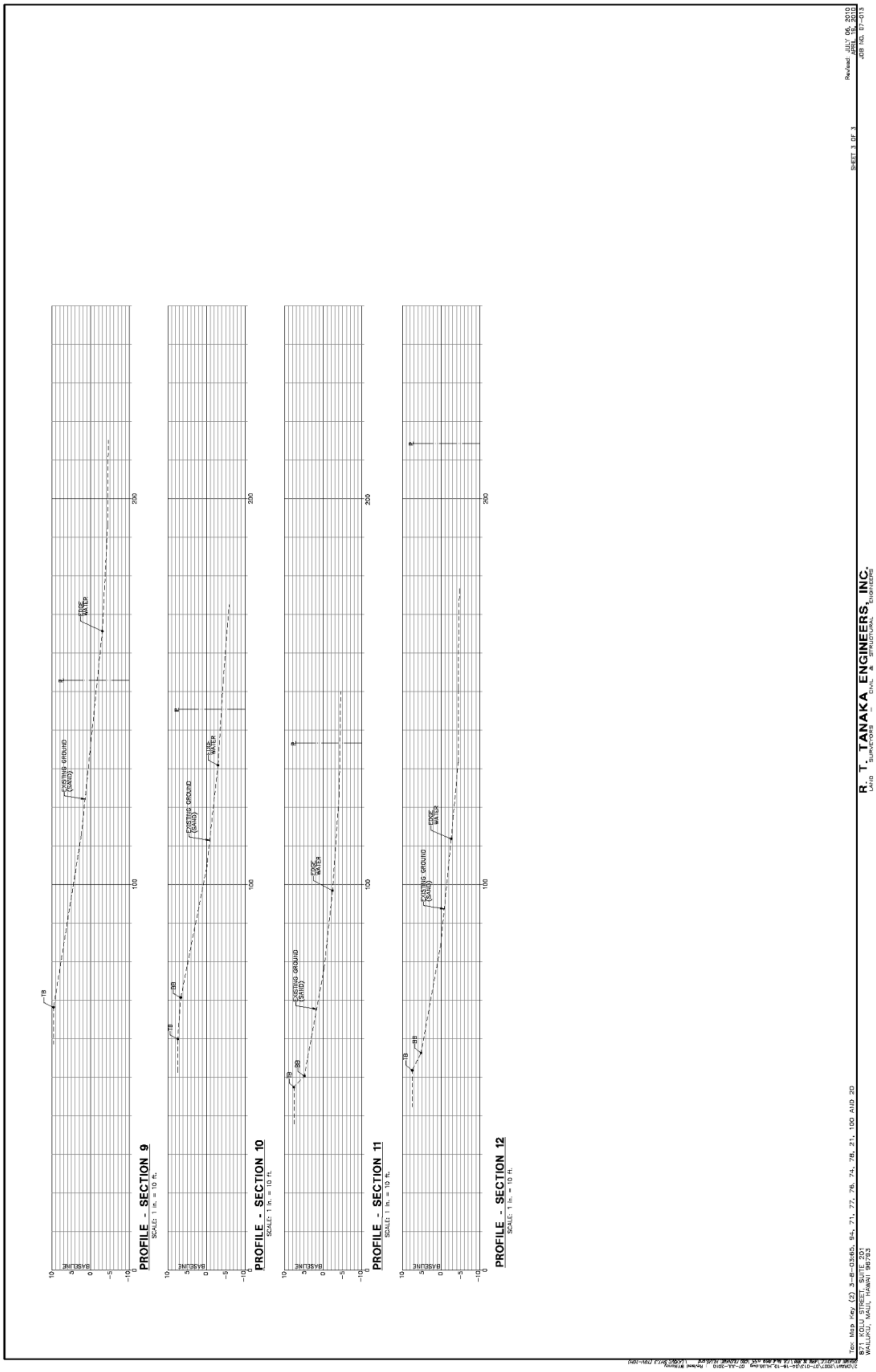


Figure 4 – Pre-Construction Beach Survey Profiles, 15 April 2010

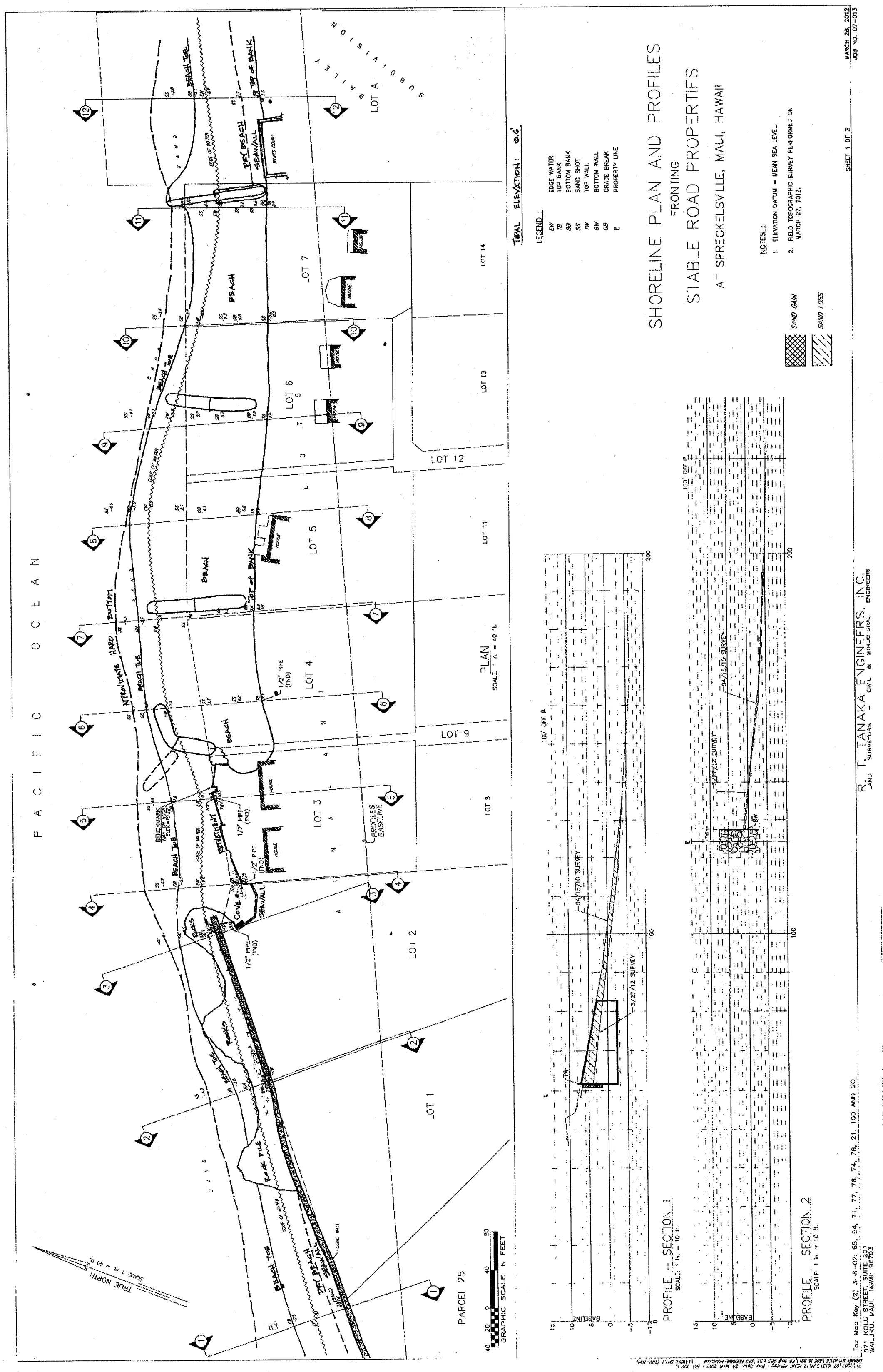


Figure 5 - Post-Construction Site Plan and Beach Survey Profiles, 27 March 2012

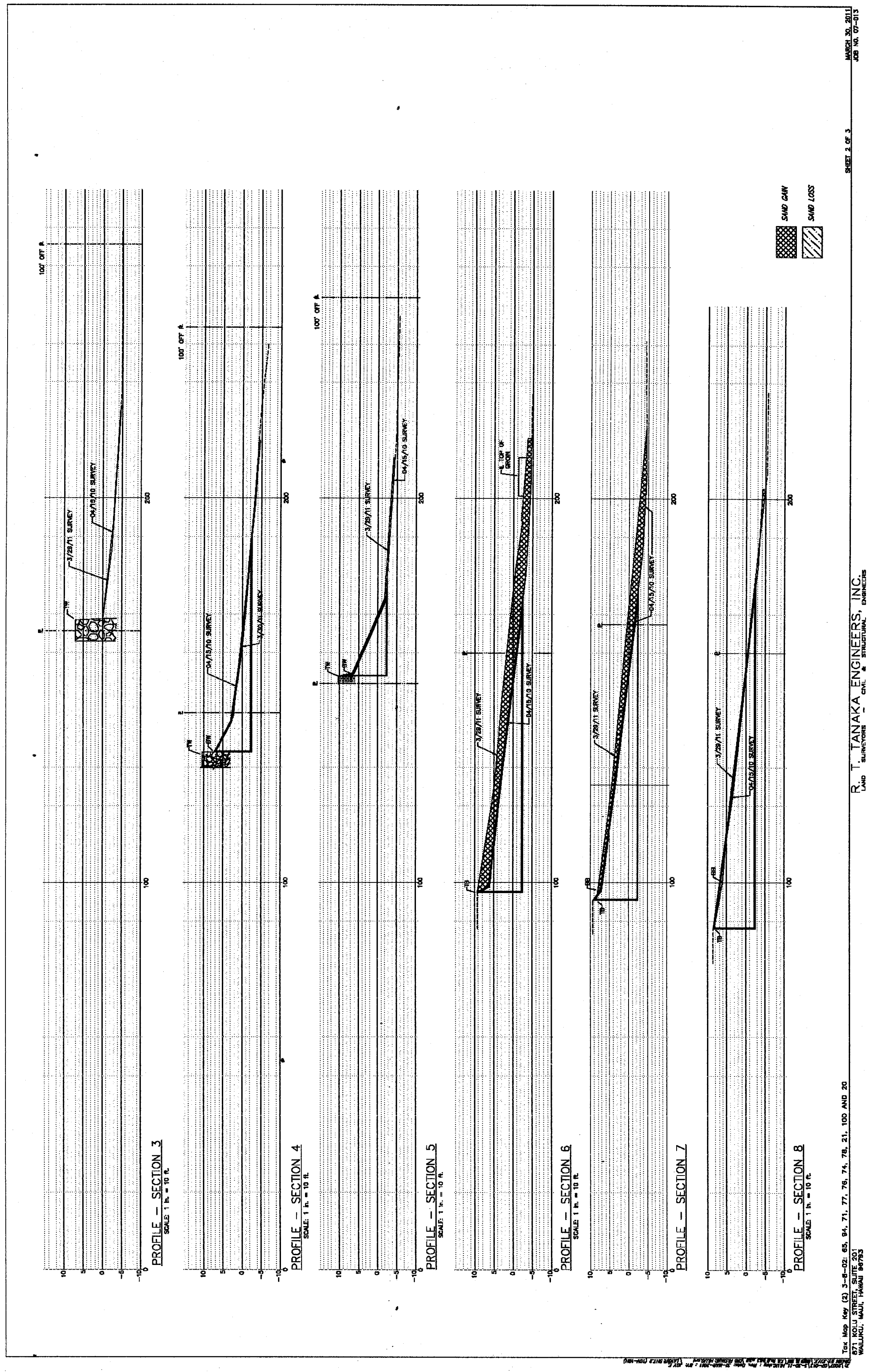


Figure 6 – Post-Construction Beach Survey Profiles, 27 March 2012

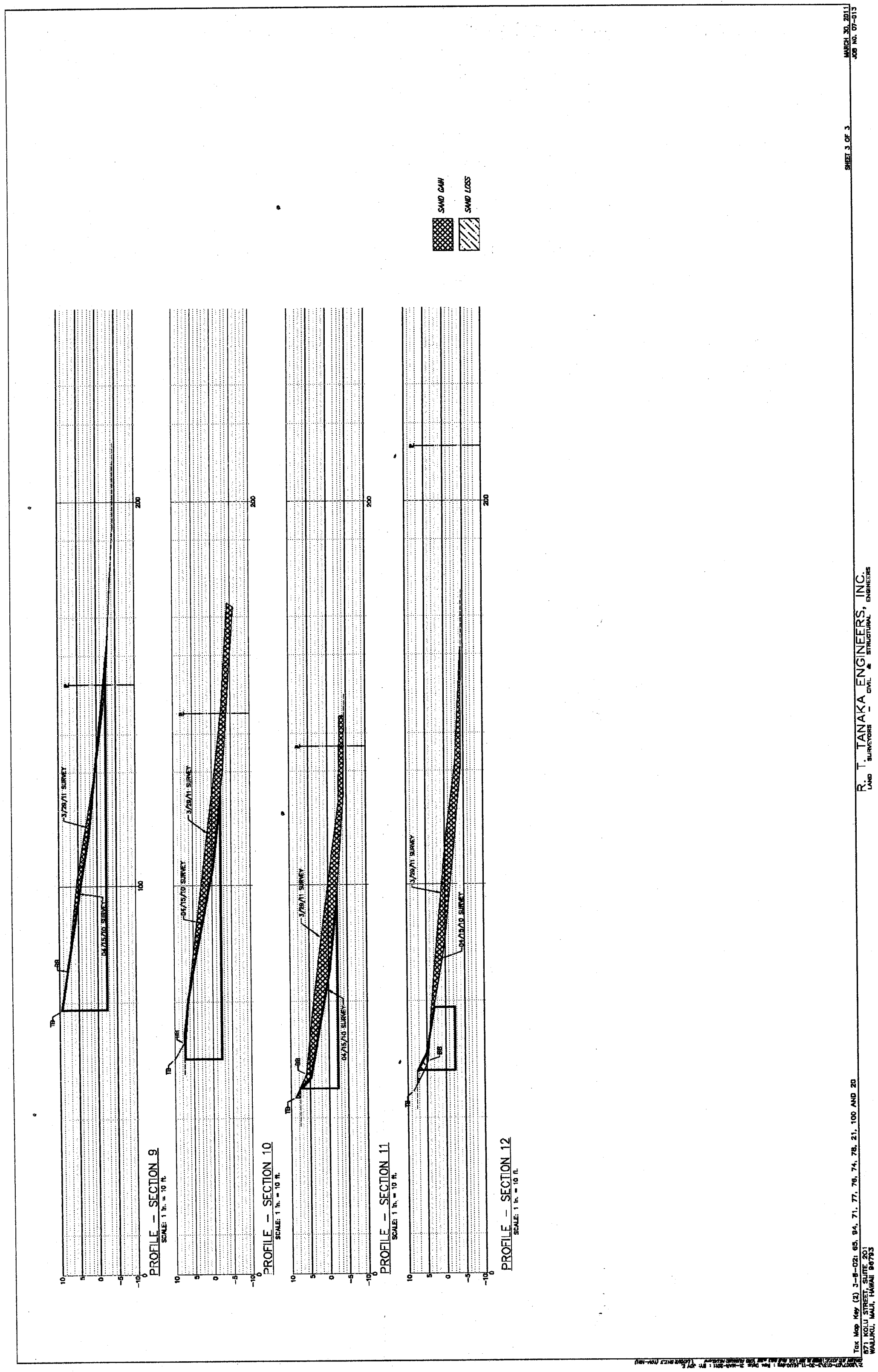


Figure 7- Post-Construction Beach Survey Profiles, 27 March 2012

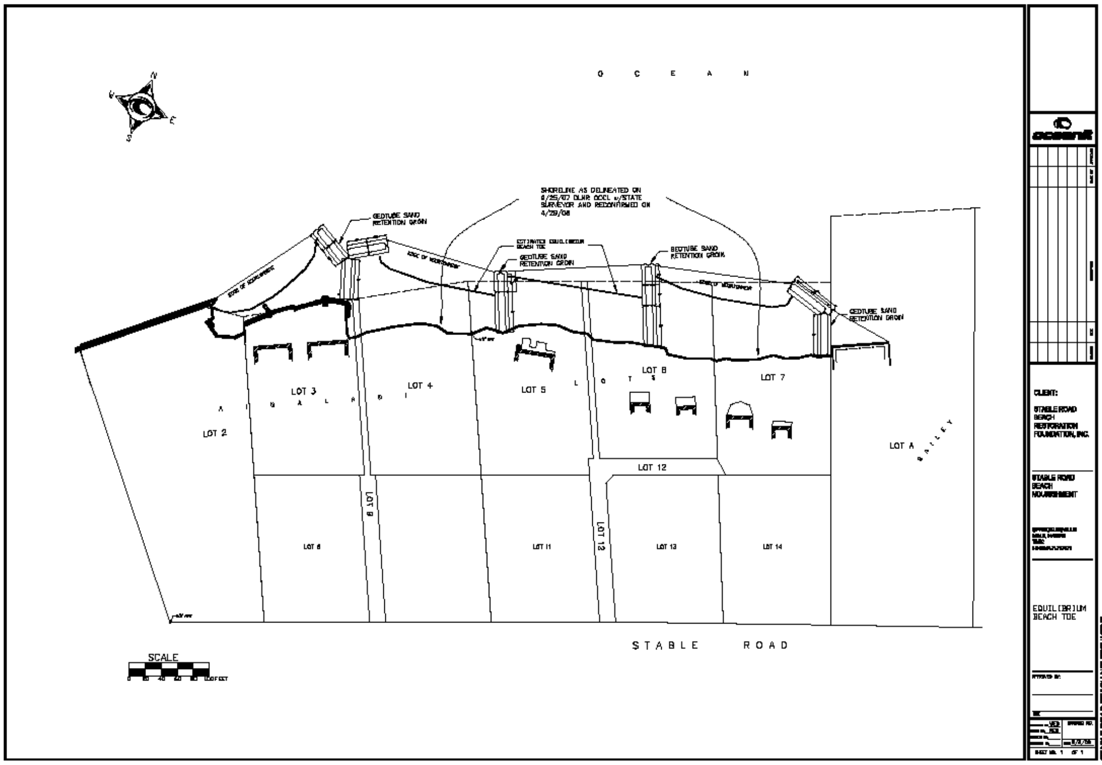


Figure 8 - Beach Equilibrium Site Plan Prepared By Coastal Engineer

Photo 4 – Aerial View of Project and Updrift Areas Pre-Construction Showing Rock Pile in Front of Updrift Seawall at Left, 15 April 2010

Photo 5 – Aerial View of Downdrift Area Pre-Construction Showing Lot 2 Seawall at Left and Lot 1 Seawall at Center with Rock Piles and at Right, 5 October 2010

Photo 6 – Aerial View of Project and Updrift Areas Post-Construction, 30 June 2010

Photo 7 – Aerial View of Project and Updrift Areas Post-Construction, 29 March 2012

Photo 8 – Aerial View of Downdrift Area Post-Construction, 29 March 2012

Photo 9 - Aerial View Showing Beaches, Seawall and Groins at Downdrift Lots 1 and 2, 1940

Photo 10 – Aerial View, October 1960

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Photo 12 – Aerial View Showing No Beach in Front of Downdrift Lot 2 Seawall, May 1997

Photo 13 - Aerial View Showing Exposed Seawall Length, Height and Shadow in Front of Downdrift Lots 1 and 2, February 2002

Photo 14 – Aerial View Showing No Beach at Downdrift Lot 2 and East Half of Lot 1, 2005

Photo 15 - Aerial View Showing No Beach at Downdrift Lot 2 and East Half of Lot 1, June 2007

Photo 16 – Aerial View Showing Beach Beginning of Summer Season Erosion, Scouring, Exposed Seawall Portion in Front of Downdrift Lot 1 at Right, 19 July 2009

Photo 17 - Aerial View Showing Rock Piles Without Sand in Front at Downdrift Lots 1 and 2 Beyond on Second Day of Project Construction, 21 April 2010

APPENDIX - 9.3 Performance Monitoring Criteria/Metrics Guidelines for Water Quality

Stable Road Beach
Groins Replacement Project

Performance Monitoring and Metric Guidelines for Water Quality Criteria

Prepared for:

Stable Road Beach
Restoration Foundation
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31 August 2011- Ian Horswill 4.2

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PREFACE

Water Quality Criteria - Performance Objectives and Metrics Guidelines

Definitions:

*A **Performance Objective** is by standard definition "a general statement of the desired achievement".* For the proposed Stable Road Beach Groins Replacement Project (SRBGRP or Project), the Performance Objectives are to minimize adverse impacts to the water quality of the nearshore environment fronting and downstream of the Project Area. Furthermore, the Performance Objectives include compliance with all terms, conditions and requirements of the DOH 401 WQC and specifically the applicable Water Quality Standards criteria in EPA 40 CFR and HAR Chapter 11-54 plus Existing Water Quality Conditions (EWQC)[1].

*A **Performance Metric** is by standard definition "a measurable quantity that indicates some aspect of performance".* In this case, water quality Performance Metrics seek to measure the Water Quality Criteria of the nearshore environment and evaluate if, how and why it may be changed within the shallow, sub-tidal zone fronting Project Area due to construction activities of the proposed Project. The Performance Metrics for Water Quality Criteria will employ the accepted seven-step Data Quality Objectives (DQO) process as well as proven monitoring techniques per the Water Quality Criteria Monitoring and Assessment Plan herein to provide a reliable evaluation of Existing Water Quality data pre-construction. This pre-construction Water Quality Criteria baseline will be used to compare with Water Quality Criteria data monitored and recorded during and immediately after construction activities. The Performance Metrics will provide Guidelines for this comparison and pre-approved Remedial Action plans if there is non-compliance with State Water Quality Standards or the Performance Metrics.

.

[1] Existing Water Quality Conditions (EWQC) are defined as pre-construction measurements of turbidity plotted using a log normal graph to create a representative background data set of Water Quality Criteria standards for the Project Area.

Purpose:

The purpose of Performance Monitoring and Metrics Guidelines for Water Quality Criteria are:

- To provide a systematic planning process to develop performance and acceptance criteria (or data quality objectives) for collecting water quality data and for improving the Project performance, if necessary. This process will clarify study objectives and define the appropriate quantity, quality and type of data collected. The analysis and decision process involved will allow the Project participants to modify the Project as required to improve overall performance related to Water Quality Criteria.

- To provide consistency in how water quality data is collected and evaluated. The intention is that data collection and analyses are accurate and not biased by using the EPA approved DQO process so that there is an accurate, standardized reporting of Water Quality Criteria performance data, thus allowing the comparison of "apples to apples".

- To identify if there are any adverse impacts to nearshore Water Quality Criteria and to define the short-term causes and effects that the proposed Project may have upon Water Quality Criteria during construction.

- To optimize the Project by specifying Action Levels and recommending Remedial Actions to eliminate ecological and environmental degradation attributed to Project construction, if necessary.

- To provide clear, consistent and accurate Performance Metrics to help the Stable Road Beach Restoration Foundation, plus State and County agencies better understand what drives Water Quality Criteria performance with this Project and other possible, future projects; to help designers and owners construct and manage more environmentally positive beach projects; and to help policy makers formulate meaningful performance goals and track progress toward those goals.

- To satisfy the Department of Health – Clean Water Branch (DOH – CWB) requirement to use Data Quality Objectives Process in the Project's Monitoring and Assessment Plans.

The following numbered outline for the systematic Performance Monitoring and Metric Guidelines is from the seven-step, Data Quality Objectives process developed by the Federal EPA.

1. Problem Statement

In order to preserve and sustain the recently stabilized portions of Stable Road Beach (Figure 1) as a result of the previously successful Small Scale Beach Nourishment (SSBN) Evaluation Project, the proposed Project seeks to remove four temporary, geotextile groins filled with sand and replace them with more durable rock groins. This activity could result in a temporary increase in nearshore turbidity during construction due to suspended sediment. This result could degrade water quality in the nearshore area around the groin removal and replacement activity. The recent SSBN project at the same site and groin locations evidenced very few nearshore turbidity plumes during construction. Furthermore, any turbidity was short lived since it was controlled by adhering to the SSBN project's Best Management Practices (BMP's). For example, construction was stopped, and the sediment barrier was improved to better retain turbid water. Those successful BMPs for the SSBN Evaluation Project and the lessons learned from their employment form the basis of the BMP's for the proposed Project. For both projects, the sediment being used and moved is clean beach sand, which has very little clay and fine particles. The relatively large particle size reduces the risk of generating large and persistently suspended plumes of turbidity.

There are existing rock groins updrift and downdrift of the Project Area that successfully retain sand to maintain pocket beaches that historically have significantly lesser rates of coastal retreat and beach erosion than the Project beach. The Project's rock groins are patterned to the length and scale of these existing rock groins, as well as to the temporary, geotextile groins (Figure 2). No persistent, negative water quality impacts were recorded from monitoring data during construction of the existing, temporary groins and during the post-construction beach equilibration; therefore, no adverse water quality impacts are anticipated to be caused by the removal of the temporary groins and placement of more durable rock groins.

The team responsible for planning and implementing the proposed Performance Monitoring and Assessment Plan for Water Quality Criteria includes the Stable Road Beach Restoration Foundation, a coastal engineer, a water quality specialist and an excavation contractor.

2. Monitoring and Metrics Goals

I. The Water Quality Criteria (WQC) monitoring goal is to determine whether water quality is affected by Project construction activity. To do this, water quality data will be monitored updrift, near and downdrift of the individual groin construction sites. This pre-, during and immediately post-construction data will be used to identify and assess any changes in water quality compared to the applicable Water Quality Standards criteria in EPA 40 CFR and HAR Chapter 11-54 plus to the Existing Water Quality Conditions[1].

II. The monitoring and assessment of Water Quality Criteria during construction will help determine if the Project's Best Management Practices (BMP's), such as sediment barriers, are working to minimize environmental impact outside the planned work areas. If the initial BMP's are not sufficient to meet the water quality standards, modifications to the BMP's will be made and/or the construction activity causing non-compliance of water quality will cease until the problem has been rectified with Remedial Action.

III. The continuation of monitoring and assessment of Water Quality Criteria post-construction is not included in the proposed Project's Monitoring and Assessment Plan as a requirement, as it was for the previous Small Scale Beach Nourishment Evaluation Project, since the previous similar but more complex SSBN project had shown that water quality was not affected adversely during or after its construction (see WQC Application, Appendix Section 5.2 - Summary Report & Conclusions - One Year, Post-Construction Performance Monitoring, 31 July 2011). The previous SSBN project had a larger scope and duration of construction disturbance including dredging, pumping, placing and moving offshore sand onto and around the Project beach, which the proposed Project does not.

3. Information Inputs

I. Type of Information Needed:

The waters off Stable Road, Maui are designated Class A with a bottom type II by the State of Hawaii HAR Chapter 11-54 Water Quality Standards for open coastal waters. The Project's water quality performance assessments will be made from information obtained by measuring Water Quality Criteria, namely turbidity measured in water sampled in and near the Project Area in Nephelometric Turbidity Units (NTU, dimensionless) and Total Suspended Solids (TSS in mg per liter).

Nearshore turbidity is naturally influenced by water depth, wave size and frequency plus by current speed; and thus nearshore turbidity varies with astronomical (tidal cycles) and meteorological (wind, wave) parameters. Additional information the planning team will include in assessments are:

- Significant wave height and direction (from offshore)
- Tidal amplitude
- Wind speed and direction
- Turbidity data from previous monitoring efforts at Stable Road
- Turbidity data from DOH monitored beaches near Stable Road (Figure 3)
- Photographic documentation of the Project Area construction activity

II. Sources of Information:

The primary sources of new information of actionable data at the Project Area will be from data-logging water quality probes and laboratory analysis of hand drawn water quality samples. Information in addition to the collection of new water quality data from the Project Area will include:

1.) Water quality data from two sites monitored by DOH (Spreckelsville Beach and Kanaha Beach; Figure 3) which are close to the Project Area and have extensive data histories. At these sites, typically samples are collected in a period of less than 1 week and are relatively complete for more than 4 years.

2.) Meteorological Data (sustained wind speed, gust wind speed, wind direction, tidal amplitude) from the Kahului Harbor NOAA weather station (KLIH1).

3.) Oceanographic Data (significant wave height, wave direction) from NOAA buoy (51201) at Waimea Bay, Oahu, a similarly oriented north facing shore.

III. Appropriate Water Quality Sampling and Analysis Methods:

Water Quality sampling and analytical specifications must be appropriate to ensure that measurements can be quantified accurately at levels below the Water Quality Criteria that the DOH, CWB issued under HAR Chapter 11-54 and Existing Water Quality Conditions. Sampling methods will include in-situ turbidity recorders or probes (YSI Data Sondes, see Table 1) and hand-drawn water samples.

	Sensor Type	Range	Resolution	Accuracy
Depth	Strain gauge	0 to 30 ft,- 9.1 m	0.001 ft, - 0.001 m	±0.06 ft,- ±0.02 m
Water Temperature	Thermistor	5 to +50°C	0.01°C	±0.15°C
Turbidity	Optical, 90° scatter	0 to 1,000 NTU	0.1 NTU	±2% of reading or 0.3 NTU

Table 1 – YSI Sonde Sensor Specifications

The Table 1 water quality parameters are only available when using the in-situ probes. The in-situ probes take sample measurements of the Water Quality Criteria at arbitrary intervals (the previous SSBN Evaluation Project monitoring used 15 minute intervals to optimize probe memory and data resolution). Calibration of the probes will be performed prior to deployment. Vertical localization of the probes will be mid-water column height at each monitoring site.

In addition to the use of in-situ probes, bottles will be used to collect and store hand-drawn water samples. A 1000 ml sample collected at each sample site will be comprised of two replicate 500 ml bottles of seawater collected 30 cm beneath the water surface. Samples will be stored cold and shipped on ice to the laboratory. Analysis will be conducted by Aecos Laboratory (Kaneohe, Oahu, HI), which will analyze the samples and report two turbidity measures: nephelometric turbidity units (NTU; dimensionless) and total suspended solids (TSS; mg/l).

Meteorological, oceanographic and water quality (DOH) data will be collected as verified data become available and are posted on the web (NOAA data buoy center and Maui DOH).

Digital, high resolution photos of the Project Area and construction activities will be taken daily from various reference locations to provide an accurate qualitative picture of the work area and any turbidity plumes.

Due to a large number of turbidity and other Water Quality Criteria data points, the not-to-exceed percent from a series of measurements can be evaluated with log normal statistics and compared to the State WQS and EWQC data. Other summary statistics such as the geometric mean can be compared directly with State and EWQC.

4. Boundaries of the Study

I. Target Population:

The target population of interest is the nearshore ocean waters fronting the Project construction area where any turbidity plumes may originate during construction activity. Specifically, the nearshore water quality monitoring locations are near the active groin construction area and seaward of the sediment barrier surrounding the groin under removal and replacement to determine if the sediment barrier and construction techniques are performing as intended. The monitoring area also includes ocean waters updrift and downdrift of the Project Area (Figure 2).

II. Spatial Boundaries:

The Project's Study area (Figure 2) includes:

- Updrift Control Site: Located approximately 75 feet updrift of the Project Area and Lot 7.
- Project Area Construction Zones: Located at the approximately 600 foot-long sandy beach along Stable Road fronting properties with TMK (2) 3-8-002:94, 71, 77, 74 & 78 and with Lot 3, 4, 5, 6 and 7 designations.
- Downdrift Site: Located approximately 450 feet downdrift of the Project Area in front of Lot 1.

The Project's nearshore monitoring program study area covers an area approximately 1,125 feet along the shoreline. Water depth in the nearshore area varies from 0 to 5 feet.

III. Temporal Boundaries:

Monitoring will be conducted before, during and after excavation activities and will rely on turbidity, measured in NTU and TSS as a good indicator of the effectiveness of BMP's for Water Quality Criteria and sediment control. Early, pre-construction point sampling will be conducted pre-construction to record existing, seasonal conditions. During-construction daily sampling will occur for approximately 4 to 5 weeks based on the estimated construction period. Post-construction daily sampling will occur for two weeks or less if there is no change of condition from pre-construction (Table 2).

Pre-Construction -	1 month prior for trial
Pre-Construction -	Weeks -1 through - 2, daily for EWQC
During Construction -	Weeks 1 through 4, daily
Post- Construction -	Weeks 5 and 6, daily

Table 2 - Water Quality Criteria Monitoring Schedule

IV. Practical Constraints:

- Laboratory analyses turnaround time: 3-4 weeks before data are verified and available for managers.
- A limited availability of probes: Only 2 sites can be simultaneously monitored.
- Limited access to monitoring due to weather and operations.
- Natural variability of water quality conditions: Turbidity will naturally vary greatly over the time scale encompassed by the Project.

5. Analytic Approach to Performance Evaluation and Decisions

I. Population Parameters:

The most likely effect of the groins' replacement work to water quality is the temporary increase in turbidity. Turbidity can sometimes be visually observed as well as measured. The lack of turbidity is a good indicator of the Project's BMP's effectiveness during construction plus of optimal Project design and implementation.

By using in-situ probes for Water Quality Criteria (WQC) sampling there will be a sufficient population of data collected pre-, during and immediately post-construction. This data will allow a series of turbidity measurements to be evaluated using log normal statistics and be compared with the State Water Quality standards (HAR Chapter 11-54) and the Existing Water Quality Conditions (EWQC). Other statistics such as geometric mean can be compared directly with State standards and EWQC. The collected and normalized turbidity measurements will be compared with the higher of the State WQS and EWQC as well as to the updrift "Control Site" data to determine compliance or non-compliance for Action Level decision making purposes. The rationale for this approach is that the existing Water Quality Criteria in the Project Area pre-construction may vary significantly from the State WQS, and the Water Quality Criteria during or immediately post-construction may vary from State WQS or even the EWQC data if there are unusual sea conditions.

II. Action Levels:

Predetermined Action Levels will be triggered if the visual observations and/or sampling data during construction indicate Project related turbidity levels exceeding the highest of the State Water Quality Standard, the EWQC, other DOH sampling sites' data or the Control Site data.

Investigation of specific Action Levels will be determined by visual observations and followed up with digital photos taken during the construction period to identify any turbidity plumes.

III. Decision Rules - Performance Metrics:

A. Measurements of Existing Water Quality - Pre-Construction Period:

During the month prior to construction activity, two calibrated data probes will be deployed at mid-water depth to record turbidity (NTU) at 15 minute intervals. One will be installed updrift of future Project activity at the Control Site. The other will be installed near the middle of the Project area. Also, hand-drawn water samples will be collected at least twice during the same period at the six water sampling stations (Figure 2) and analyzed by a laboratory for turbidity (NTU and TSS). The geometric mean and variance for probe and laboratory data will be calculated. Variance (here standard deviation; SD) in these data sets will be used to construct Existing Water Quality Conditions (EWQC) or standards parallel to State WQS. Thresholds not to be exceeded by 10% and 2% of samples will be calculated as GM + 1.24 SD and GM+1.96 SD respectively. The probe and laboratory analyses are not expected to be identical due to methodology and handling, thus these standards are calculated independently.

Historic data sets from DOH monitored nearby beaches also will be used to calculate a third Water Quality Standard for qualitative comparison. Monthly GM and SD will be calculated for each beach, and 10% and 2% standards will be calculated as above.

B. Measurements of Water Turbidity – Construction Period:

Measurements of turbidity will be recorded daily during construction at the monitoring locations outside of each sediment barrier where construction activity is occurring using an in-situ probe (Figure 2). These turbidity measurements will be compared to: the pre-construction measurements (EWQC), the State WQS turbidity standards, water quality conditions at nearby DOH monitored beaches and the Control Site data. The highest value of the comparable data will be used to determine compliance or non-compliance with the Water Quality Criteria.

C. Evaluation:

Evaluation Criterion: The removal of the existing, temporary groins plus excavation and placement of the rock groins is successful if:

The GM from each monitoring period is less than or equal to: the GM of State Water Quality Standard, the EWQC standard, other DOH sites' data and the Control Site data (whichever is greatest). Compliance further requires 10% or fewer of recorded samples to exceed the 10% rule, and 2% or fewer to exceed the 2% rule of the same standard. *The frequency and locations of monitoring are as discussed in the Water Quality Criteria Monitoring and Assessment Plan (Section 7).*

D. Remedial Action:

Remedial Action Required:

I. If evaluation is successful ,no further evaluation and action is required.

II. If evaluation is unsuccessful, the construction activity responsible for the non-compliant turbidity will stop until:

- *The turbidity levels return to within the normal range or;*
- *SRBRF and contractor representatives immediately review the cause of the non-compliant turbidity and correct the activity so that the turbidity returns to normal levels as soon as possible.*

6. Performance Criteria

State Water Quality Standards (WQS) and Existing Water Quality Conditions (EWQC) will be used to determine if the Project's Best Management Practices (BMP's) during construction are performing properly. The waters off Stable Road Beach are Class A with a Class II bottom. The State Water Quality Standard for turbidity in Class A waters are per Table 3:

Parameter	Geometric Mean not to exceed the given value	Not to exceed the given value more than ten percent of the time	Not to exceed the given value more than two percent of the time
Turbidity (NTU)(wet)	0.50	1.35	2.0
(dry)	0.20	0.5	1.0

Table 3 – State Water Quality Standards for Turbidity

Existing Water Quality Conditions (EWQC) for turbidity in the Project Area will be determined as the seasonal mean as sampled from pre-construction probe measurements and bottle sample laboratory analyses, as well as by nearby DOH monitoring sites (Figure 3). Ongoing sampling at the Control Site will serve as a reference for any dynamic changes in water quality driven by ambient conditions.

The geometric mean and variance for probe and laboratory data will be calculated. Variance (here standard deviation; SD) in these data sets will be used to construct Water Quality Standards parallel to State WQS. Thresholds not to be exceeded by 10% and 2% of samples will be calculated as GM + 1.24 SD and GM+1.96 SD respectively. Probe measurements and laboratory analyses data are not expected to be identical due to methodology and handling, thus these standards are calculated independently.

7. Water Quality Criteria Monitoring and Assessment Plan

Water Quality Criteria monitoring will follow the Department of Health, Clean Water Branch's - General Monitoring Guideline for Section 401 Water Quality Certification Projects applicable to this Groin Replacement Project which are detailed in this Plan.

The most resource-effective method of sampling turbidity is with an in-situ probe. The YSI 6920 data sonde or probe will be used and has the specifications shown in Table 1, Section 3. These probes can either be anchored in place or submerged at various locations by the person taking samples. The data can be obtained near-real time if necessary. Laboratory analysis is not needed. The in-situ probes will measure and record sample measurements of Water Quality Criteria every15 minutes. Calibration of the probes will be checked before placement in the water.

The primary location of each monitoring probe in the Project Area will be in front and slightly downdrift of the sediment barrier/silt curtain surrounding the active groin construction and relocated as the active construction area with sediment barrier/silt curtain are relocated. The second probe will be stationary and deployed continuously updrift of all Project construction activity at the Control Site

In addition to the in-situ probes, a 1 liter volume of bottle water quality samples will be used and laboratory analyses performed. Two replicate 0.5 liter bottles will be collected at each of the six monitoring locations to provide 1 liter of a filterable sample for analysis. Bottles will be filled with ocean water such that water enters the bottle at a mid-depth below the surface of the water. This depth correlates with the in-situ probe depth. The planning team indicated that it would be desirable for the laboratory to process, measure and report the total suspended solids measurements for all samples collected on a given day within one week, if possible.

In-situ probe water quality monitoring will commence one month pre-construction with a 24 hour trial run for Water Quality Criteria monitoring near the middle of the Project Area. The determination of Existing Water Quality Conditions (EWQC) as defined in Section 1 will be measured near the middle of the Project area for 10 days by the probe and commence within a 25 day pre-construction period (see Table 3, Section 6). This amount of data gathering at the nearshore site will provide enough statistical data to account for site specific weather, tidal, current and in-situ conditions to create a representative baseline set of EWQC data. This information will be compared with the data gathered during the previous SSBN monitoring period.

During the same pre-construction period, at least two sets of bottle samples will be collected at the six designated bottle sample locations described below (Figure 2). Samples will be collected at morning low-tide if possible. Within the two week post-construction period, turbidity will be measured by at least two sets of bottle samples collected at the six monitoring locations to establish the baseline for EWQC.

During construction, including the removal of the temporary, geotube groins; excavation of sand from the geotubes; plus excavation and placement of the rock groins, turbidity will be measured by in-situ probes at the following locations, as well as immediately post-construction for two weeks (Figure 2):

1. Updrift "Control site" - At mid-depth, 50 feet offshore, 75 feet east of the Lot 7 groin.
2. East End Groin - At mid-depth, approx.50 feet offshore, 10 feet outside the sediment barrier.
3. East Center Groin - At mid-depth, approx.50 feet offshore, 10 feet outside the sediment barrier.
4. West Center Groin - At mid-depth, approx.50 feet offshore, 10 feet outside the sediment barrier.
5. West End Groin - At mid-depth, approx.50 feet offshore, 10 feet outside the sediment barrier.
6. Downdrift approx. 450 feet west of Project Area - At mid-depth, approx.100 feet offshore.

Monitoring photos of the Project Area and activities will be digital, high resolution and will be taken daily from various reference locations to provide an accurate qualitative picture of any turbidity plumes.

Data will be analyzed statistically as stated in previous Section 5. Analyses of data taken during construction will help determine if there has been any release of turbidity from the work site and if water quality standards have been exceeded. Initially, there will not be sufficient data for meaningful statistical analysis; however, the geometric mean of all daily samples near the work site can be calculated and compared with the pre-construction measurements and Control Site data. Based on results, the Project team can decide if Remedial Action is needed (see Section 5). Due to a large number of turbidity and other Water Quality Criteria data points, the not to exceed percent of a series of measurements can be evaluated with log normal statistics and compared to the State WQS and EWQC data. Other statistics such as geometric mean can be compared directly with State and EWQC.

A Water Quality Monitoring Report will be submitted to the SRBRF and then to the Department of Health, Clean Water Branch and to DLNR within two weeks of the sampling date or within one week of receiving laboratory data, whichever is sooner after the completion of the Project. Reports will be transmitted by e-mail or fax as soon as the data results are available. Tide, waves, weather conditions (wind, rainfall, recent storms, etc.), construction activity, and visual observations will be included in each report. (See Attached Example Water Quality Monitoring Report).

ATTACHMENTS AND FIGURES

Figure 1 – Project Site Map Showing Reef Flat, Fringing Reef and Wave Patterns

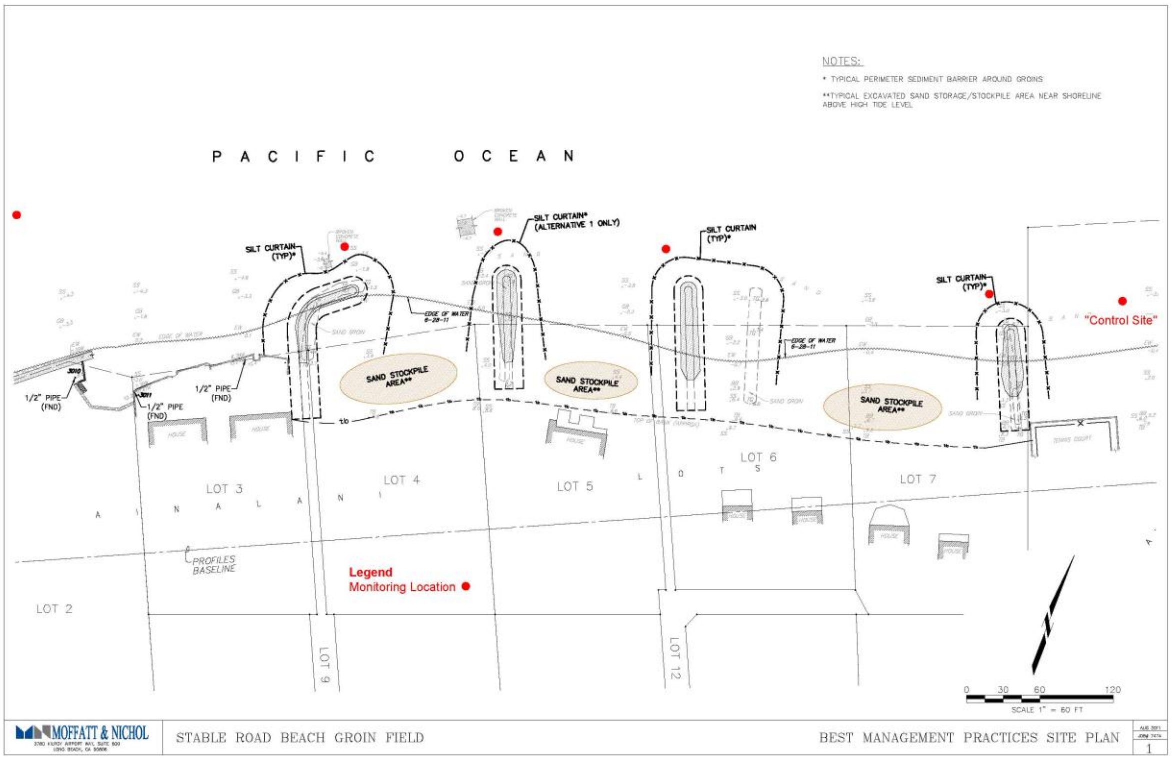

Figure 2 – Water Quality Monitoring Locations Map

Note: Monitoring locations for the three groin design are in similar locations – 10 feet outside of the sediment barrier/silt curtain. The Control Site and downdrift locations are the same for each design.

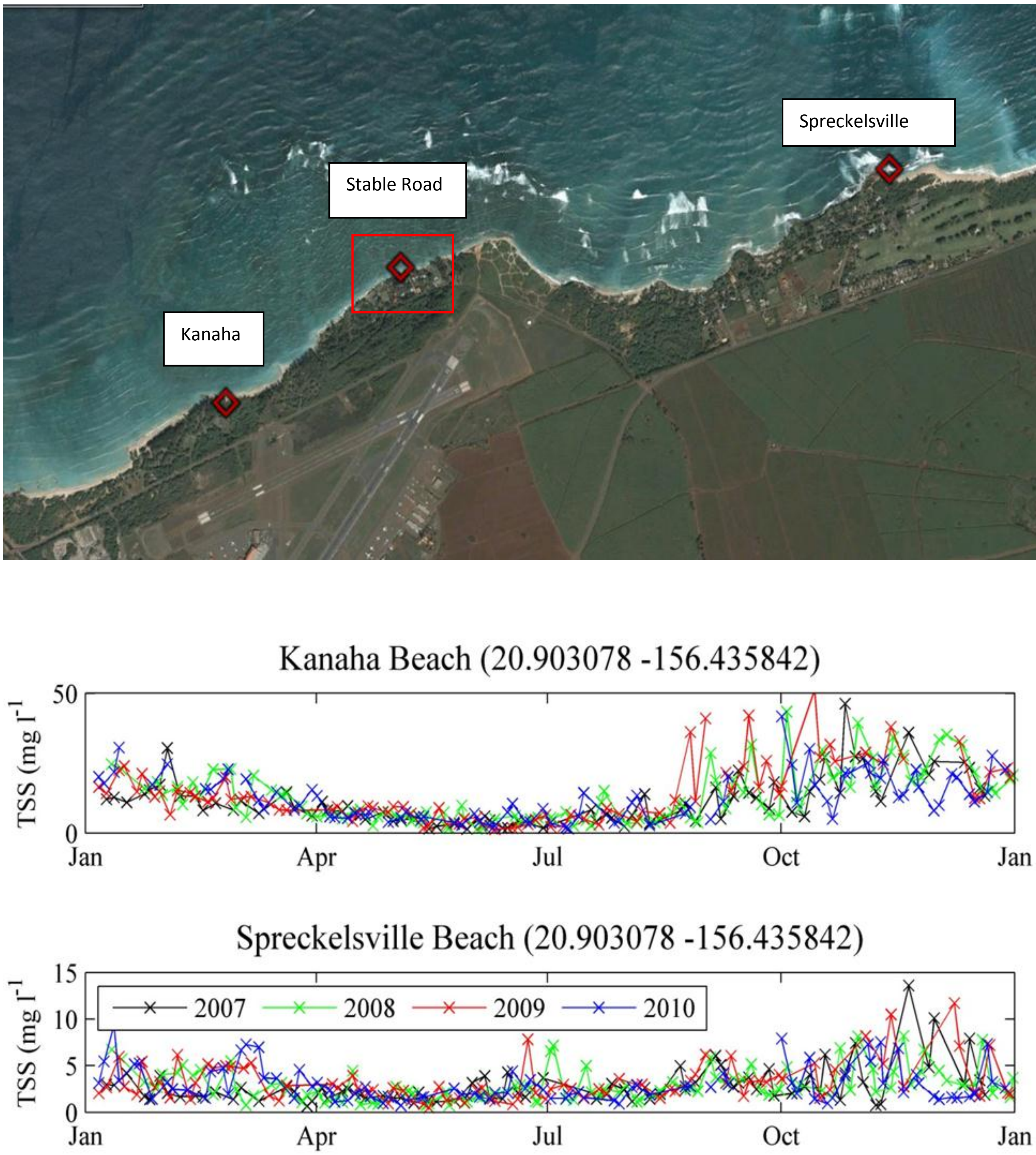

Figure 3 - Upper Panel - Hawaii Department of Heath Water Quality Monitoring Sites
Lower Panels - Turbidity Data for 2007-2010 at DOH Monitoring Sites

ATTACHMENT 1 - EXAMPLE WATER QUALITY MONITORING REPORT (FROM PREVIOUS REPORT). NEW REPORTS WILL NOT INCLUDE SAND PUMPING SCOPE

OCEAN WATERS AT STABLE ROAD BEACH NOURISHMENT PROJECT
FINAL WATER QUALITY MONITORING REPORT

Week 3 through 10, April 27 – June 25, 2010

Executive Summary:

Previously submitted was a similar report for weeks 1 and 2, for which the work consisted of sediment barrier/silt curtain installation plus geotube placement and filling from 17 to 26 April.

The work of weeks 3 through 10 included laying the pipeline to the offshore sand source, excavating the dewatering basin, installing the sediment barrier/silt curtain for the stilling basin, and offshore dredging/pumping with pipeline laying from 28 April – 5 May and sand dredging/pumping from 6 May-8 June (Daily Field Reports) and sand spreading and project clean up from June 18 to 25 June. The dredging pipeline was active for a total of 12 days during this window of time, depositing approximately 2,886 cubic yards of offshore sand at the Stable Road Beach Nourishment construction site. Throughout the project, sporadic large swells and strong currents from high winds complicated each stage of the operation.

The purpose of the daily water quality monitoring is to maintain the water quality by sampling using two installed water quality probes to continuously monitor conditions, and by collecting supplementary water samples for laboratory analysis. Stable Road Beach Restoration Foundation Inc. (SRBRFI) staff and monitoring personnel were on site every day. The Best Management Practices were fully adhered to resulting in compliant turbidity measurements and with occasional procedural adjustments to adapt to the site and weather conditions to improve results.

This report describes conditions, activities and findings of the SRBRFI during pipeline setting and offshore dredging through the months of April, May and June. All terms and conditions of the WQC751.FNL.10 permit and WQC751 application were adhered to during the construction of this project. This is the second of two water quality reports, and concludes the water quality monitoring for the construction and immediately after construction phases of the beach nourishment project.

Pumping Activity Log:

Sand dredging/pumping proceeded as weather and equipment serviceability allowed (Table 1), and was marked by several periods free of dredging activity.

Site Conditions - Weather:

During the construction period the weather was characterized by moderate to high trade winds, cooler temperatures, and late winter swells, and spanned a full lunar tidal cycle

(Table 2). The winter swells and wind swell combined to make for challenging conditions for geotube filling and maintaining the dewatering basin, silt curtains and sediment barrier. The silt curtains/sediment barriers (Photo 1) were adjusted as necessary to minimize project related water column turbidity, and meet the criteria specified in the environmental water quality standards.

Water Quality Monitoring:

Initial monitoring of water quality (turbidity) for the Stable Road Beach Nourishment Project began in March of 2009. After approval of the DLNR Right of Entry and Revocable Permits April 8, SRBRFI acquired pre-construction data starting April 12, 2010 following the approved Performance Monitoring and Metrics Guidelines for Water Quality Criteria. Yellow Springs Instrument Company (YSI) data sondes equipped with turbidity sensors were deployed at approximately 40cm above the substratum at each monitoring station (Photo 2) and (Figure 1). Turbidity measurements were logged at 15 minute intervals for the duration of each instrument deployment. Samples were also collected manually at nearshore and offshore locations prior to the commencement of construction activity (see Figure 1 for bottle sample locations and table 2 for laboratory analysis). The values reported in the initial water quality report established a water quality (turbidity) baseline for both methodologies (i.e. data sonde, and laboratory analyzed bottle samples), describing Existing Water Quality Conditions in the nearshore and offshore environments. Laboratory analysis of hand drawn bottle water samples yielded measurements of Nephelometric Turbidity Units (NTU a dimensionless quantity) and Total Suspended Solids (TSS in units of mg l-1), whereas the YSI data sonde only reported NTU. The geometric mean + and – one standard deviation from that mean establishes the range for normal turbidity measurements in hand drawn samples from the project area (NTU gm = 1.11, +std = 3.48 , -std = 0.45; TSS: gm = 6.95, +std = 9.34, -std = 5.35) , and at the offshore sand source (NTU gm = 0.78, +std = 1.36, -std = 0.42; TSS: gm = 2.61, -+std = 5.78, -std = 1.18). To establish a baseline water quality metric for the YSI data, a week's worth of turbidity observations were pooled for the calculation of a geometric mean, and standard deviation in the nearshore (NTU: gm = 9.70 +std = 12.40 -std = 9.65), and offshore (NTU gm: = 9.83, +std = 12.89, -std = 9.1).). Turbidity in the project site was characterized by strong tidal forcing with peaks in turbidity during high tides, and turbidity minima at low tides. Thus, while figures representing these data show all collected points, turbidity metrics are calculated on a daily basis to account for the variability. In brief, habitat existing water quality conditions are characterized by moderate turbidity, with wide standard deviation (see, for example Figure 2) Initial stages of construction showed no increase in turbidity with increased construction activity (see initial report).

Laboratory analyses of hand drawn bottle water samples reported qualitatively less turbidity than YSI instruments. The YSI instruments provide a continuous record that verifies qualitative changes in the water quality at the construction site that may not be captured by periodic water quality samples collected manually. Procedural differences between field and laboratory measurements of turbidity prevent direct comparison of these data (in situ monitoring yielded higher values, at least in part because of their relative proximity to the substratum), however they provide meaningful and complementary information about patterns in changing water quality conditions.

Results:

Nearshore:
Hand drawn bottle samples: Hand drawn water samples met or exceeded the water quality criteria established from baseline site monitoring for NTU and TSS at all sites (Table 3). The highest TSS and NTU values were observed at the nearshore site 4 on May 1 2010, before construction activity began. During construction samples indicated no increase in turbidity.

YSI samples: Continuously collected turbidity data (NTU) indicated that through most of the construction period there were no obvious effects of project activities on water quality (Figure 3, Table 4). Beginning June 8th, daily water quality summaries exceeded baseline water quality expectations. This coincided with the final day of pumping. These conditions are due to the phase of high tides (new moon June 12), very high wind conditions of 40+ knots June 8 – 13 and the resulting increased wave action (refer to Table 2) causing increased native sediment transport and turbidity. Turbidity was greatest on June 13th and appears to have subsequently declined.

Offshore:
Hand drawn bottle samples: Hand drawn bottle water samples fell within the water quality standards established from baseline site monitoring for NTU and TSS at all sites (Table 3).

YSI samples: Offshore turbidity measurements reflected the positioning of the instrument in two ways. During the initial deployment, 100 feet downstream of Sand Source A, average daily turbidity was low, and met water standards until the 18th of May. The sensor appears to have been overturned around this date, causing both salinity and turbidity readings to become spikey. When the instrument was collected on the 23rd of May, it was found on its side, dozens of meters from its initial deployment site.

The instrument was redeployed on June 3, 2010 100 feet downstream of Sand Source B, where dredging was to commence that day. Turbidity readings were lower at this location, and remained within established water quality standards through completion of dredging (June 9, 2010). The instrument was again overturned in late June, and was found on its side at the date of retrieval (June 19, 2010).

Other Potential Construction Discharges:
No fueling spills occurred during the construction project including diesel and gasoline. Hydraulic fluids used were Chevron Clarity vegetable oil. The equipment was properly inspected and maintained. All waste products from construction have been properly disposed of and the construction site has been cleared of construction equipment and materials and returned to its original state.

Interpretation and Conclusions:
Potential Construction Discharge - Turbidity
Neither hand drawn bottle water samples nor YSI turbidity meter data indicated that construction activity caused significant increases in turbidity at either end of the project site.

Construction activity at the Stable Road site did not appear to result in increases in nearshore or offshore turbidity. Nevertheless, a general increase in near shore turbidity was observed with increasing tidal amplitude during the full moon and high swell and high winds during mid-June. This is likely a natural phenomenon and is typical for this time of year. Offshore monitoring showed minor signs of construction related turbidity, evidenced by sporadic high values over short periods, nevertheless daily mean values did not exceed those stipulated in the EWQC baseline.

The use of hand operated suction dredging provided a more efficient and cost effective means of dredging the thin sand source sites in the Project area. More importantly, this technique had minimal impact on the water quality offshore with minimum turbidity caused during operations (Photo 3). It is recommended that the need for any future monitoring of the offshore sites be terminated due to a lack of any visual or measureable changes in turbidity.

Best Management Practices per the approved WQC751 application Attachment E2 and other Attachments E1 – E8 were adhered to.

Other Potential Construction Discharges:
There was no other construction activity related pollution. Best Management Practices per the approved WQC751 application Attachment E2 were adhered to.

Benthic Habitat Monitoring:

The post construction benthic habitat monitoring was conducted by Oceanit's marine biologist Bob Bourke and SRBRFI marine biologist Kyle Aveni – Deforge during June 18 - 19 2010 nearshore (Photo 4) and offshore plus along the pipeline route. Visual inspection of the offshore sand sites was made and it was determined that this was sufficient due to no changes encountered. A total of 42 nearshore and the pipeline route were monitored following the methodology approved in the Performance Monitoring and Metrics Guidelines for Benthic Habitat. The benthic habitat monitoring report is to follow.
Beach Erosion Monitoring

The post construction beach erosion monitoring was conducted by RK Tanaka Surveys on 1 July, 2010 following the methodology approved in the Performance Monitoring and Metrics Guidelines for Beach Erosion. Twelve transects were surveyed to establish a pre-and post-construction beach profiles. The beach erosion monitoring report is to follow.

Table 1 - DAILY PUMPING LOG
Stable Road Beach Restoration Evaluation Project - 2010

Date	Hours	Average Rate (cy/h)	Quantity (cy)	Cumulative Quantity (cy)	Remarks:
6 May	5	10	50	50	Test pumping
7 May	13	20	260	310	Stopped due to weather
16 May	2.5	20	50	360	Resumed pumping
17 May	8.25	25	206	566	Activated booster pump

18 May	7	34	238	804	Pack shut off
19 May	5	37.5	188	922	Added booster pump
21 May	7.5	37.5	281	1273	Work stopped due to power pack shut off
3 June	6.75	37.5	253	1526	Resumed pumping
4 June	9.75	37.5	366	1892	
5 June	7	37.5	263	2155	
6 June	11.25	37.5	422	2577	
7 June	2.25	37.5	84	2661	
8 June	6	37.5	225	2886	

Work stopped due to remaining sand in the sand sites containing poor quality sand with large, dead coral segments resulting in lower sand pumping rates and less dredging time at boat relocations, plus contributing factors of very high winds causing increasing fatigue and risk of damage to equipment posing a safety and environmental threat resulted in the decision to stop pumping sand.

Table 2 - WEATHER CONDITIONS FOR STABLE ROAD REGION:
Hourly summaries of wave swell, wind speed and direction are predictions given by www.windguru.com.

United States - Maui (north shore), Lat: 20.935, Lon: -156.36, Timezone: GMT-10
[Detail / Map], archive available: 28.10.2009 - 02.07.2010
GFS Wind speed (knots) Wind direction Temperature (°C)

	01h 13h	04h 16h	07h 19h	10h 22h	13h 01h	16h 04h	19h 07h	22h 10h	01h 13h	04h 16h	07h 19h	10h 22h
01.06.2010		16	15	15	16	15	16	14	15			
					24	24	23	24	24	24	24	24
02.06.2010		10	14	8	12	11	13	13	14			
					24	24	24	24	24	24	24	24
03.06.2010		7	12	7	12	11	12	13	10			
					24	23	23	23	24	24	24	24
04.06.2010		4	9	6	10	12	14	11	13			
					24	24	24	24	24	24	24	24
05.06.2010		9	12	8	12	12	12	12	12			
					24	24	24	24	24	24	24	24
06.06.2010		9	11	6	11	12	12	12	12			
					24	24	24	24	25	25	24	24
07.06.2010		7	11	12	13	13	14	14	16			
					24	24	24	24	24	24	24	24
08.06.2010		16	15	8	16	18	19	17	19			
					24	24	24	24	25	24	24	24
09.06.2010		18	17	10	17	20	20	15	19			
					24	24	25	24	25	25	25	25
10.06.2010		14	16	11	16	17	16	15	16			
					24	24	25	25	25	25	24	24

11.06.2010	13	14	7	13	13	15	13	17			
				24	24	24	24	24	24	24	24
12.06.2010	10	13	8	15	14	14	13	14			
				24	24	24	24	24	24	25	25
13.06.2010	9	11	7	13	11	12	10	11			
				25	25	25	25	25	24	24	24
14.06.2010	7	8	3	8	9	11	8	10			
				24	24	24	24	25	25	24	24
15.06.2010	5	9	6	10	11	12	11	13			
				24	24	24	24	25	25	25	24
16.06.2010	7	11	6	12	12	12	13	13			
				24	24	24	24	24	24	24	24
17.06.2010	14	13	7	11	12	13	11	13			
				24	24	24	24	24	24	24	24
18.06.2010	7	11	5	10	10	11	9	12			
				24	24	24	24	25	24	24	24
19.06.2010	7	11	11	10	10	13	12	14			
				24	24	24	24	25	25	24	24
20.06.2010	15	15	15	15	16	16	14	15			
				24	24	24	24	25	25	24	24
21.06.2010	9	15	15	14	15	15	15	16			
				24	24	24	24	24	25	24	24
22.06.2010	10	16	9	15	13	17	13	17			
				24	24	25	25	25	25	25	24
23.06.2010	9	15	9	15	17	18	18	18			
				24	25	25	25	25	24	24	24
24.06.2010	16	16	15	16	17	16	16	16			
				24	24	23	24	24	24	24	24
25.06.2010	14	14	13	10	10	12	13	12			
				24	24	24	24	24	24	24	24
26.06.2010	10	10	9	7	5	6	8	11			
				24	24	24	24	24	24	24	24
27.06.2010	4	6	5	9	7	10	5	10			
				24	24	24	24	25	25	25	24
28.06.2010	4	9	7	11	10	12	8	12			
				24	24	24	24	25	25	24	24
29.06.2010	7	12	6	13	13	14	12	14			
				24	24	24	24	25	25	24	24
30.06.2010	7	13	7	14	15	15	9	14			
				24	24	24	25	25	25	25	24
01.07.2010	8	13	9	14	14	18	12	16			
				24	25	25	25	25	24	24	24
02.07.2010	9	13	-	-	-	-	-	-			-
-	-	-	-	-	24	24	-	-	-	-	-
-											

Table 3 - HAND DRAWN BOTTLE WATER SAMPLE ANALYSIS REPORTED BY AECOS LABORATORYORATORIES

(Chain of custody data are in appendix A). Nephelometric turbidity units (NTU) and total suspended solids (TSS) are reported for nearshore (NS) and offshore (OS) at each sample date. TSS 1NS was omitted from geometric mean (gm) calculation because it was a statistical outlier.

Sample Date 4/16 - 4/20 2010 4/23-4/24 2010 5/1/2010 6/3/2010
AECOS report # 26205 26205 26221 26332
analyte (units)

	NTU	TSS	NTU	TSS	NTU	TSS	NTU	TSS	NTU
1NS	1.78	24.20	1.60	5.80	1.38	7.30	0.60	4.20	
2NS	1.70	6.90	1.10	6.30	1.36	8.40	0.60	4.70	
3NS	1.30	6.80	1.00	5.50	1.37	6.20	0.56	5.80	
4NS	2.10	8.20	1.48	3.90	2.48	9.00	0.74	5.20	
5NS	2.04	9.10	1.00	5.90	1.34	7.20	0.98	4.30	
6NS	0.11	4.60	0.62	6.60	1.36	5.80	0.54	3.60	
NS gm		1.11	6.94	1.08	5.59	1.51	7.23	0.65	4.58
NS gm+std		3.48	9.00	1.52	6.74	1.92	8.56	0.82	5.42
NS gm-std		0.35	5.35	0.77	4.63	1.18	6.11	0.52	3.87
OS	1.48	5.20	0.46	1.10			0.24	3.20	
OS			0.64	3.1					
OS gm				0.76	2.61				
OS gm+std				1.38	5.75				
OS gm-std				0.42	1.18				

<u>Table 4. - DATA SUMMARIZED FROM TURBIDITY METERS LOCATED NEAR THE PROJECT AREA (NEARSHORE) AND NEAR THE SAND SOURCE (OFFSHORE).</u>

Daily summaries of geometric mean (gm), and the range of 1 standard deviation (+/- STD), where n is the number of observations used in the calculation and %b indicates the percentage of observations that exceeded the established water quality standard. Construction activity is indicted by a + symbol in the pumping column.

		nearshore			offshore								
date	pumping		gm	+STD	-STD	n	% b		gm	+STD	- STD	n	% b
5/5/2010			8.4	9.1	7.6	48	0		9.4	11.1	8.0	56	0
5/6/2010		+	7.9	8.7	7.2	96	1		9.9	11.4	8.6	96	0
5/7/2010			7.9	8.4	7.5	96	0		9.3	9.5	9.0	96	0
5/8/2010			8.0	8.4	7.5	96	0		9.2	9.4	9.0	96	1
5/9/2010		+	8.2	9.5	7.0	96	3		9.3	9.6	9.1	96	

											0
5/10/2010		8.0	8.7	7.3	96	0	9.6	10.6	8.8	96	0
5/11/2010		8.5	9.8	7.4	96	3	9.2	9.4	9.0	96	0
5/12/2010		8.8	10.5	7.4	96	2	9.1	9.3	8.9	96	0
5/13/2010		9.1	11.1	7.5	96	5	9.1	9.3	8.8	96	3
5/14/2010		8.6	10.6	7.0	96	3	9.3	9.7	8.9	96	1
5/15/2010		8.4	10.0	7.0	95	2	9.5	10.8	8.4	96	0
5/16/2010	+	8.4	10.1	7.0	96	3	9.2	9.8	8.7	96	2
5/17/2010	+	8.7	11.6	6.5	95	7	9.0	9.2	8.8	96	2
5/18/2010	+	8.5	10.8	6.7	95	3	9.2	10.2	8.3	96	19
5/19/2010		8.5	10.5	6.9	95	5	9.6	12.9	7.1	96	26
5/20/2010		8.4	9.8	7.2	96	2	13.2	30.0	5.8	94	34
5/21/2010	+	8.9	10.7	7.4	96	3	14.1	29.4	6.7	95	40
5/22/2010		9.6	12.0	7.6	96	7	16.3	39.4	6.7	94	72
5/23/2010		9.5	10.9	8.3	96	3	30.1	124.5	7.3	89	74
5/24/2010		10.0	13.0	7.8	96	9					
5/25/2010		10.7	15.0	7.7	95	16					
5/26/2010		10.2	13.7	7.6	93	11					
5/27/2010		9.2	11.9	7.1	95	3					
5/28/2010		9.4	12.1	7.4	96	12					
5/29/2010		9.5	12.7	7.1	95	10					
5/30/2010		9.8	13.6	7.1	96	17					
5/31/2010		10.0	13.7	7.3	95	23					
6/1/2010		8.9	10.7	7.3	95	5					
6/2/2010		8.7	11.1	6.8	95	2	8.2	15.1	4.4	54	14
6/3/2010	+	9.3	13.3	6.5	95	11	5.9	6.1	5.7	96	0
6/4/2010	+	9.0	13.2	6.1	96	7	6.0	6.2	5.9	96	0
6/5/2010	+	9.8	14.8	6.5	95	10	6.2	6.9	5.6	96	1
6/6/2010	+	9.9	14.2	6.9	96	14	6.2	6.9	5.6	96	1
6/7/2010	+	10.8	16.6	7.0	96	17	6.3	6.8	5.8	96	

	1											
6/8/2010		+	12.5	19.9	7.9	92	33		6.3	6.8	5.8	96
	1											
6/9/2010			13.5	23.3	7.8	94	38		6.4	7.5	5.5	96
	1											
6/10/2010			13.1	20.2	8.5	93	36		6.2	6.4	6.1	96
	0											
6/11/2010			14.6	24.7	8.6	95	47		6.4	7.3	5.6	96
	2											
6/12/2010			14.1	21.2	9.4	94	50		6.7	10.6	4.2	96
	1											
6/13/2010			16.8	29.8	9.4	90	49		7.0	7.9	6.2	96
	2											
6/14/2010			13.8	21.9	8.6	94	38		9.0	12.2	6.6	96
	9											
6/15/2010			15.8	24.8	10.1	91	52		7.6	9.0	6.3	96
	2											

Figure 1: A.) Google Earth map of Stable Road Beach Nourishment Project site, Kahului Maui. The square in the center of the left frame indicates the project area, expanded at right. B.) NS2 circle indicates location of near shore YSI deployment, while stars (s1-s6) indicate the location of hand drawn water samples.

Figure 2: Example of YSI nearshore background data. In the upper panel, black '+' symbols represent observations from the sensor, and the smooth green line shows a 12 point sliding average. The middle panel shows tidal amplitude, and the bottom panel shows wind speed (black line) and gusts (red) reported by the nearby NOAA meteorological station 1615680.

Figure 3: Nearshore turbidity measurements from YSI probe. In the upper panel, black '+' symbols represent observations from the sensor, and the smooth green line shows a 12 point sliding average. The red horizontal bars indicate an active dredging day, and blue horizontal bars indicate daily mean turbidity measurements (see table 4 for these values). The middle panel shows tidal amplitude, and the bottom panel shows wind speed (black line) and gusts (red) reported by the nearby NOAA meteorological station 1615680.

Figure 4: Offshore turbidity measurements from YSI probe. In the upper panel, black '+' symbols represent observations from the sensor, and the smooth green line shows a 12 point sliding average. The red horizontal bars indicate an active dredging day, and blue horizontal bars indicate daily mean turbidity measurements (see table 4 for these values). Missing data from late May corresponds with signal degradation due to sensor dislodgement. The middle panel shows tidal amplitude, and the bottom panel shows wind speed (black line) and gusts (red) reported by the nearby NOAA meteorological station 1615680.

Photo 1 – Construction turbidity BMP – placement of two sediment/silt curtains outside of the stilling basin while sand pumping.

Photo 2 – YSI probe monitoring water quality continuously – at NS2 site

Photo 3 – Hand operated suction dredging at Sand Source A – note the clarity of the water and lack of turbidity caused by the dredging operations.

Photo 4 – Marine biologist monitoring benthic habitat site.

Note: Figures and Photos not Included for brevity.

DAILY FIELD REPORT EXAMPLE OF SEVERAL PAGES OF REPORTS

Stable Road Beach Restoration

Date: 27 April 2010

Weather:
Wind: Moderate
Surf: Minimal north swell
Tide: High in afternoon

Work Activity:
1. Installed silt curtain at lot 5 makai groin.
2. Placed and filled scour apron and tube at lot 5 groin end.
3. Removed silt curtain.

Monitoring:
1. Water quality probes in place.

Remedial Actions:

Design Modifications:

Remarks:
1. All initial groins in place.