SAND WEB INSTALLATION
NAPLES, FLORIDA

DAVID T. TACKNEY, P. E.

TACKNEY & ASSOCIATES, INC.
9385 N. 56TH STREET, SUITE 309
TEMPLE TERRACE, FL 33617

ISLAND WEB TEST INSTALLATION
NAPLES, FLORIDA

In late October 2001 an experimental project, involving the installation of 37 lines of fishnets referred to as sand webs, was undertaken along the beach in Naples, FL. The nets, which were about 160 feet in length, were installed in a configuration similar to a groin field and the spacing between lines was approximately 75 feet.

For six months the nets were maintained in place and monthly surveys were taken to monitor beach response. In addition control stations, north and south of the nets, were also surveyed.

For every month that the nets were in place the mean high water line (MHWL) in the net area advanced while the control stations showed recession of the MHWL. The monitoring surveys also showed accretion in the foreshore area (±140 feet seaward of the MHWL). This accretion, however, did not occur in the nearshore area (±140 to 300 feet seaward of the MHWL) and this area showed erosion losses more or less equivalent to the foreshore gains.

From the monitoring survey it was apparent that the presence of the nets resulted in a reshaping of the beach profiles, which persisted during the entire test period.

INTRODUCTION

In the early 1980's a commercial fisherman named Bill Parker made an observation that has had some rather interesting consequences. Mr. Parker used to catch bait fish along the beach using nets. Occasionally he left his nets unattended on the beach and he observed that they had a tendency to become partially buried in a relative short period.

Mr. Parker reasoned that, since the nets were not sinking into the beach, they must have been causing accretion. With this in mind he began to experiment and found that the most effective way to use the nets was to deploy them perpendicular to the shoreline from the edge of the berm to the nearshore bar.

Mr. Parker's tests suggested that the nets, in fact, caused a build up of sand. He therefore filed for and received a patent for his nets and began to promote them as a way of restoring eroded beaches. In addition it was suggested that since the nets did not cause recession of the adjacent shoreline, they were promoting the onshore movement of sand and therefore bringing in more sand into active profile.

In late 2000 the City of Naples sponsored a small-scale test over a 500 reach of shoreline and the test was completed in early 1988. This test showed that the nets built up the beach face and resulted in advance of the mean high water line. Some minor erosion however was noted downdrift of the nets. Since the monitoring surveys were limited and were not adequate to quantify the volume changes, this small-scale test was considered encouraging but inconclusive.

Mr. Parker continued to promote his nets and eventually two additional small-scale tests were undertaken in Louisiana and in the Bahamas. These tests also resulted in shoreline advance but again the monitoring surveys were limited.

In 2001 the City of Naples, in response to much local interest and some controversy, agreed to sponsor a larger scale test installation with adequate monitoring to allow the effects of the nets to be quantified. This test, which was undertaken in 2001 and 2002, is the subject of this presentation

It should be noted that before the test began Mr. Parker sold his patent to a company that retained his name, Parker Beach Restoration Inc., and the test was undertaken by this company.

TEST SITE

The location of the test was along the beach in Naples between 4th Avenue S. and 32nd Avenue S. This corresponds to the shoreline between DEP monuments 71 and 79.

This area was selected because the beach is not close to any inlets, is relatively straight in alignment and is free of groins, breakwaters or other structures that would bias the results.

The northern portion of the test area had been restored in 1996 but by the time of the test no significant discontinuity in beach alignment was noticeable. In addition by using control areas on both sides of the test area it was believed that possible effects from the restoration project could be identified.

Like most of the shoreline in southwest Florida the beach in the test area is subject of frequent reversal in the direction of longshore transport. Most studies, however, indicate that the direction of net transport in this area is toward the south and is of the general magnitude of 30,000 to 50,000 cubic yards per year.

For the test three different areas were used: North Control, Test and South Control. The two control areas were each 1,000 feet in length and were monitored with survey profiles at intervals of 200 feet. These control areas were separated from the installed nets by approximately 3,200 feet.

The nets, referred to as sand webs, were deployed in the central 2,700 feet of the 5,300 feet test area and the entire test area was monitored with profiles at 100 foot intervals. This left a surveyed shoreline of approximately 1,400 feet immediately north of the nets, which is referred to as the north adjacent segment. A similar segment of 1,200 feet was located south of the nets.

Due to concerns over nesting sea turtles the nets were installed in November 2001 and removed the first of May 2002.

SAND WEBS

A total of 37 nets were employed through out the test period. The spacing between the nets was 75 feet and, as a result, most of the nets were not located on profile lines.

The length of each net was 160 feet and they extended from approximately 40 feet upland of the pre-installation Mean High Water Line (MHW) to approximately 120 feet offshore.

The sand webs consisted of nylon fishing nets with openings of approximately 1 inch. Galvanized stanchions were spaced at intervals of approximately 20 feet and the nets were secured to these stanchions. Excess net material was collected and secured to the tops of the stanchions and chain was used to keep the bottoms of the nets in place. During the last month of the test period floats were used to keep the nets in place. These floats proved effective and reduced the maintenance required for the webs.

TEST CRITERIA

The criteria used to determine the success of the project included whether or not the sand webs were able to produce (to a level of 75% or more) average volumetric gain within the deployment areas of 4,000 cubic yards per month. In addition, for the project to be considered successful, accretion gains could not be accompanied by erosion of the adjacent shoreline above background levels as measured by the control areas.

Although not specifically stated, the criteria implied that, for the project to be considered successful, the system would have to promote the onshore migration of sand for the deeper, offshore portions of the beach profiles.

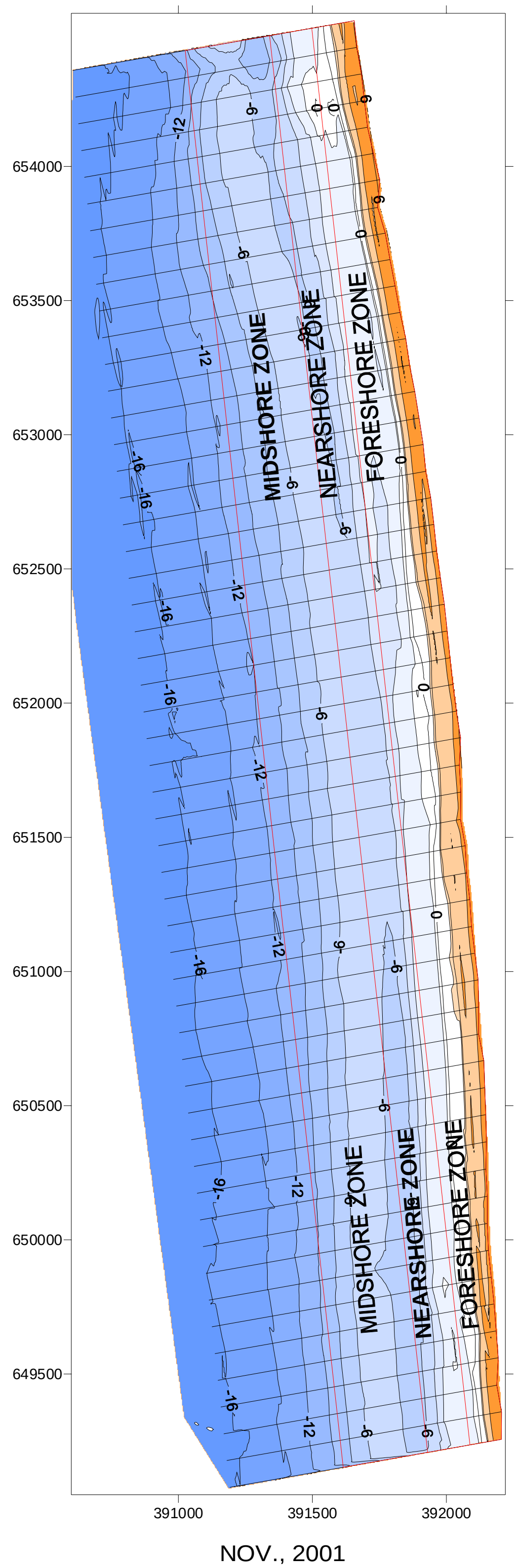


Fig. 1 Cross-Shore Zones

MONITORING PLAN

The primary purpose of the monitoring plan was to quantify shoreline changes resulting from the installation of the sand webs. This involved changes in the width of the upland beach (as referenced to the MHW Line) and volumetric changes in the various monitoring areas. The monitoring plan was also designed to identify the source of possible accretion gains and whether or not the webs caused erosion or other adverse impacts on the adjacent shoreline.

During the six month test period monthly profile surveys were taken for the control and test areas. These surveys extended approximately from the vegetation line to a distance of approximately 1,200 feet offshore. After the nets were removed the same profiles were surveyed at three month intervals for an additional 9 months.

To monitor cross-shore changes in the control and test areas the beach was divided into different zones (Figure 1). The first zone, which is referred to as the foreshore zone, extended for approximately 40 feet upland of the MHW Line to approximately 120 feet offshore. The second zone extended from the seaward limit of the foreshore zone an additional distance of 160 feet. During the first few months of the testing an anomaly, in the form of uncharacteristic accreting, was noted in the south control areas. To identify the cause of this anomaly a third crossshore zone was added. This zone, referred to as the midshore zone, extended from the seaward limit of the nearshore zone to an additional distance of 320 feet.

To identify the distributions of changes the control and test areas were divided into cells between the surveyed profiles. Therefore the cells for the two control areas were 200 feet wide while the cells in the test area were 100 feet wide.

For convention the cell numbers correspond to the largest (southern) profile number which bounded the cell. As a result the north and south control areas contained 5 cells whereas the test area contained 53 cells. The northern 14 of these cells represented the north adjacent segment; cells 15 through 41 comprised the net segment and cells 42 through 53 comprised the south adjacent segment.

MONITORING RESULTS

Figure 2 shows the six month history of mean high water (MHW) changes for the net segment and the two control areas. As may be noted the shoreline within the net segment, advanced consistently throughout the test period and similar advances did not occur for either of the control areas.

Figure 3 shows the volumetric changes within the foreshore zone during the same period of time. It should be noted that some caution is appropriate in interpreting the volumetric changes because the changes are small and even minor survey errors can significantly affect the results. This is particularly true of the deeper zone volumes. For the average gain of 4.1 cubic yd/ft the corresponding total gain was approximately 11,200 cubic yards. The pattern of volumetric gains within the net segment is very similar to that shown in the previous figure. In addition the control areas did not show similar gains.

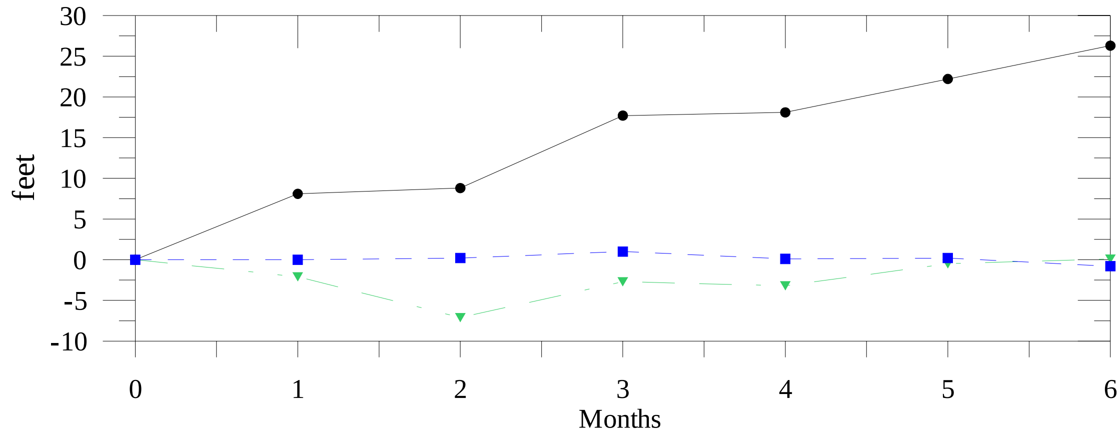
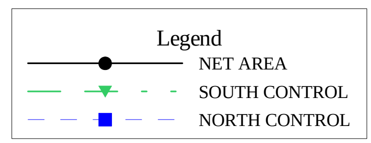


Fig. 2 Average M.H.W. Changes



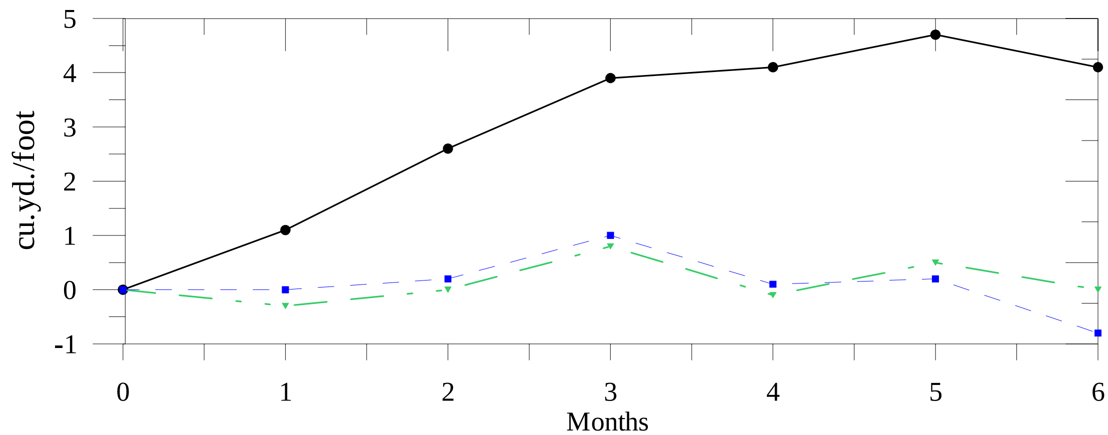


Fig. 3 Average Volumetric Changes

In Figures 4 through 9 the spatial distributions of MHW and foreshore volumetric gains are shown. These figures show the cumulative changes for 2 months, 4 months and 6 months. Again the patterns for shoreline advances and volumetric gains are very similar.

Based on these parameters a few general conclusions can be made. During the test period the sand web system produced modest but significant advance of the MHW and accretion in the zone closest to shore. In addition both the north and south adjacent segments showed, on average, advances in the MHW and volumetric gains in the foreshore zone.

This data, however, does not indicate the source of the accretion gains or whether the sand webs brought any additional sand into the active beach system. These questions can only be answered by examining the survey profiles farther offshore.

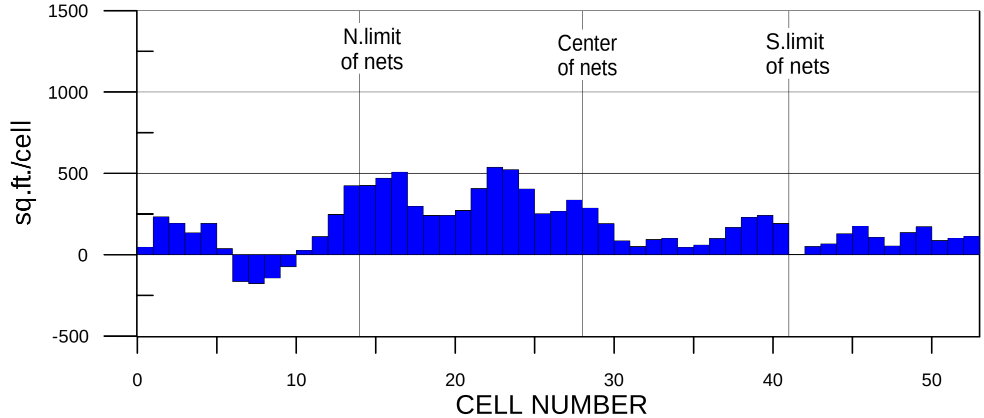


Fig. 4 Foreshore M.H.W. Changes Nov.,2001 to Jan.,2002

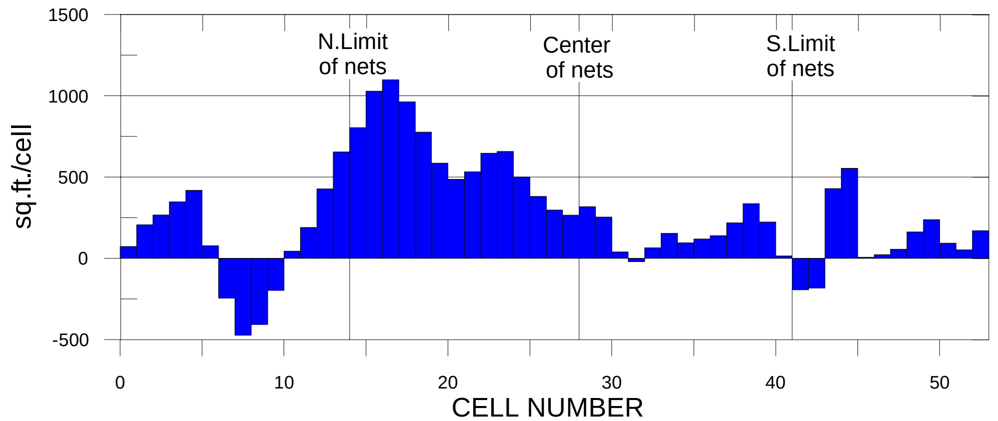


Fig. 5 Foreshore M.H.W Changes Nov.,2001 to Mar.,2002

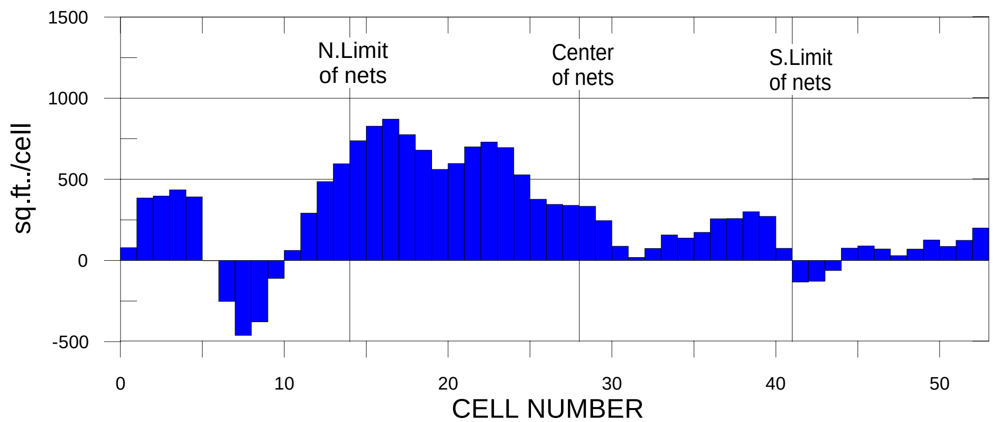


Fig. 6 Foreshore M.H.W. Changes Nov.,2001 to May,2002

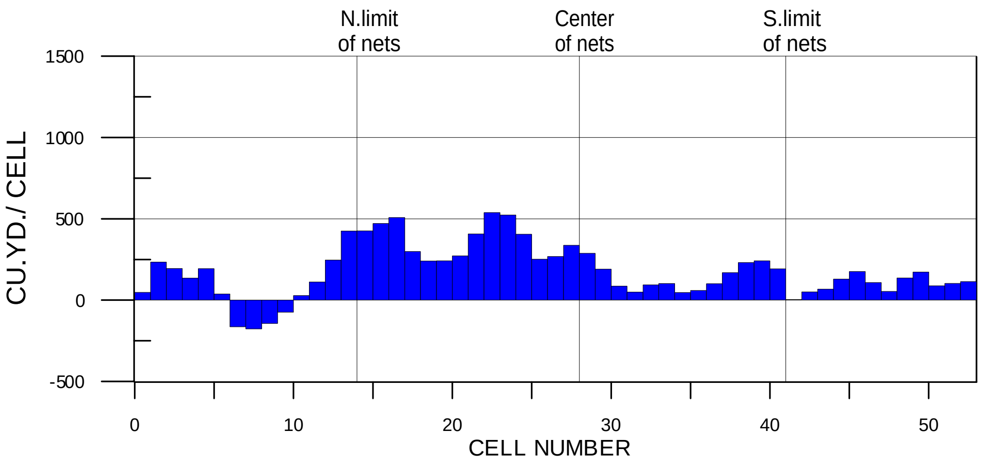


Fig. 7 Foreshore Volumetric Changes Nov.,2001 to Jan.,2002

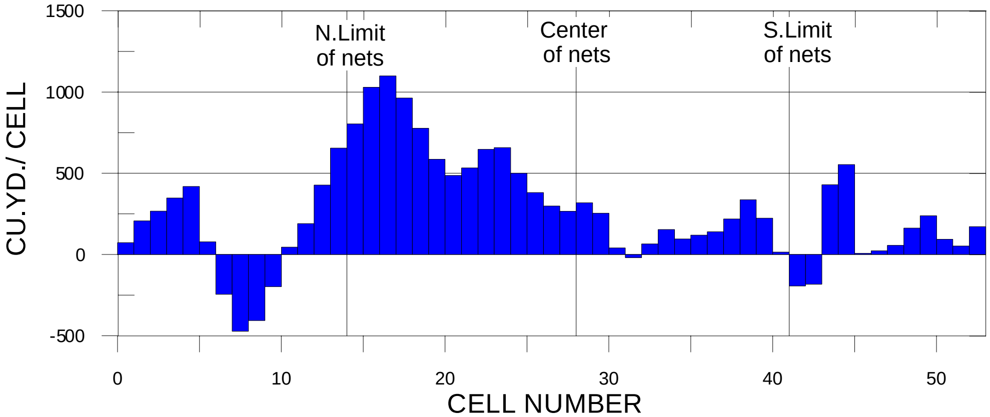


Fig. 8 Foreshore Volumetric Changes Nov.,2001 to Mar.,2002

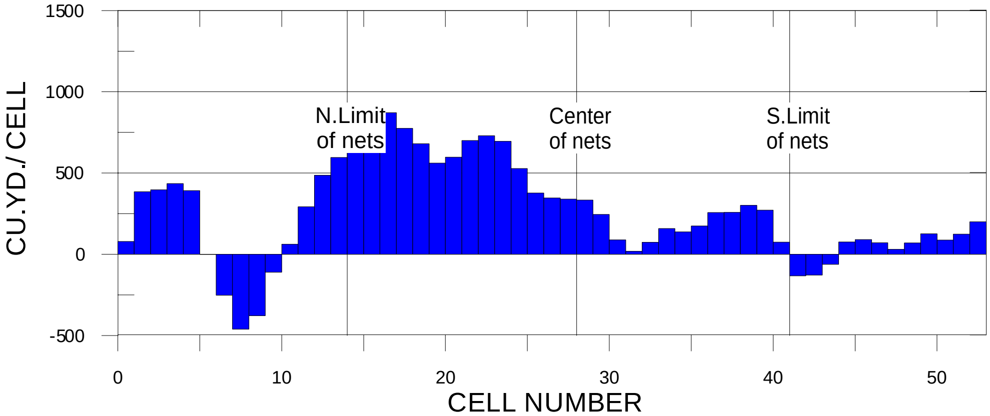


Fig. 9 Foreshore Volumetric Changes Nov.,2001 to May,2002

Figure 10 shows the time histories of volumetric changes in the foreshore, nearshore and midshore zones. Figure 11 shows the time histories of the foreshore, the combined foreshore and nearshore and the total (foreshore plus nearshore plus midshore) volume changes during the test period. This figure indicates that the foreshore gains are more or less offset by the losses in the offshore zones. Moreover this suggests that the sand webs did not bring any significant volume of additional sand into the active profiles.

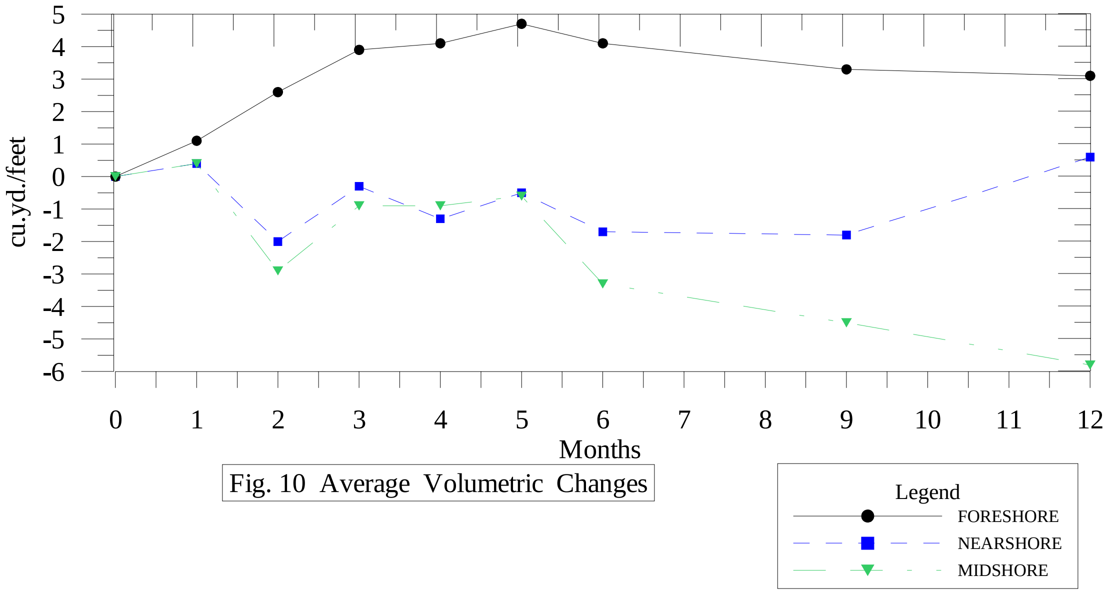


Fig. 10 Average Volumetric Changes

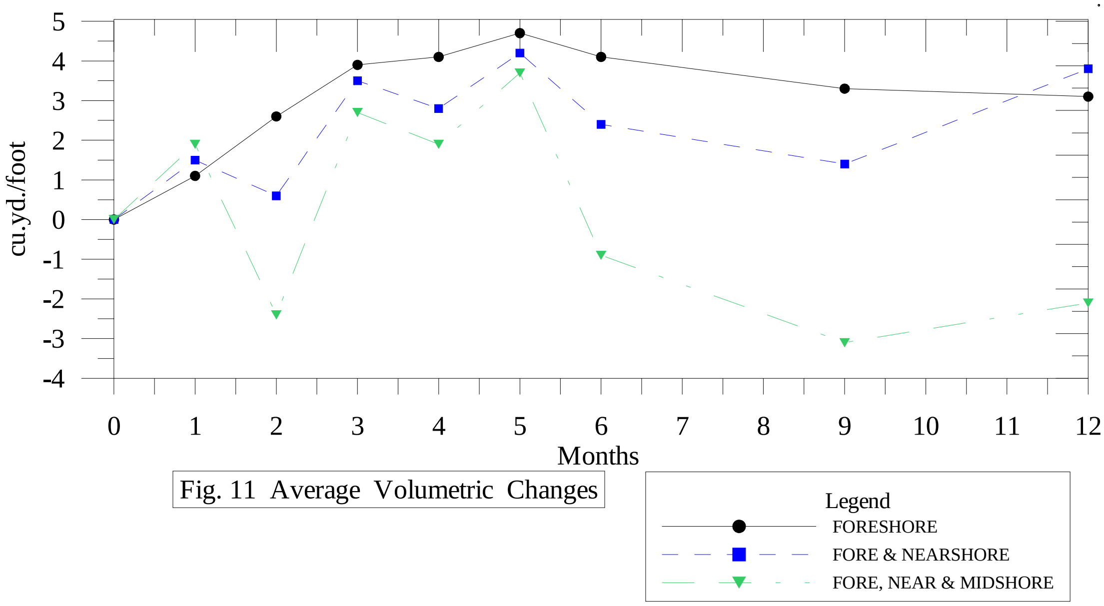


Fig. 11 Average Volumetric Changes

Surveys of the monitoring profiles were continued after the nets were removed and Figures 12 and 13 show average MHW line and foreshore volume changes through the first year after the nets were initially installed. During the six month period between the removal of the nets and the first anniversary survey the average MHW line advance had decreased from approximately 26 feet approximately 5 feet. The foreshore volume also decreased but the reduction was not as great as the reduction in shoreline advance.

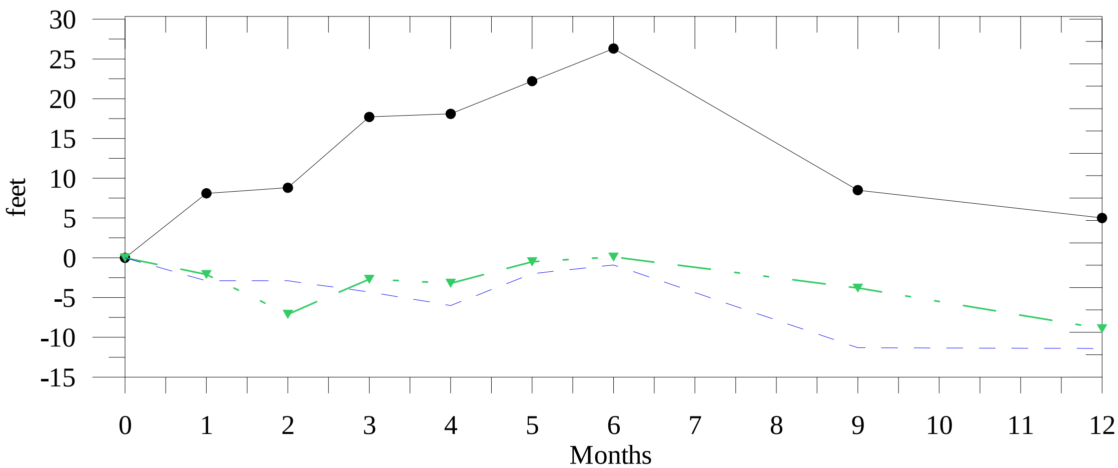


Fig. 12 Average M.H.W. Changes

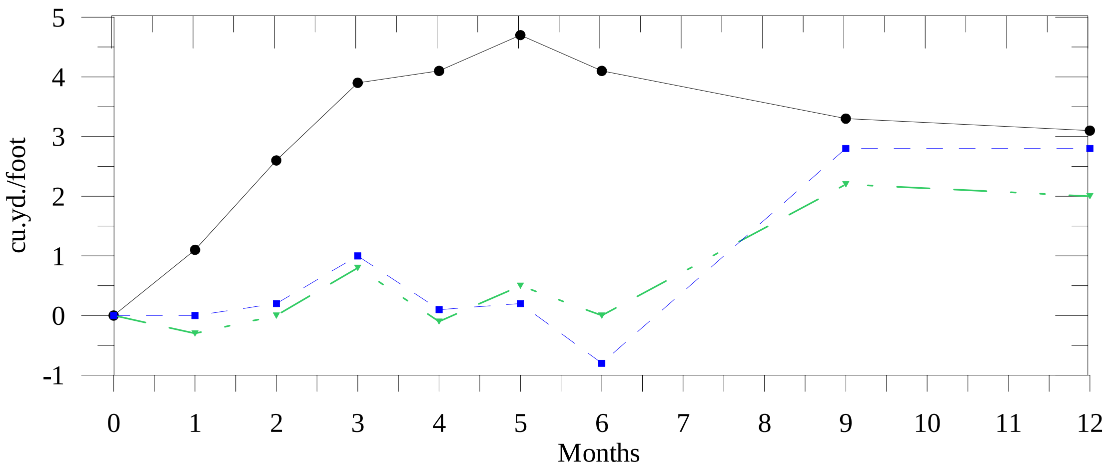
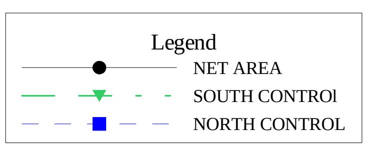


Fig. 13 Average Foreshore Volumetric Changes



To evaluate the patterns of shoreline advance and volumetric changes even/odd curves were calculated for the test area. These curves were prepared by combining the observed changes in each of the two cell pairs equal distance from the center of the test area. The even curves plot the sums of the two cell changes and the odd curves plot the difference between the cell changes. The even curves therefore represented the overall accretion/erosion changes with values greater than 0 representing gains. The odd curves represent the uniformity of the changes. Both curves show symmetry but they are of different types. The even curves show mirror image symmetry on both sides of the origin. For the odd curves the left sides represents a 180° rotation of the right side. As a result the odd curves pass through the origin.

One of the utilities of such curves is that they emphasize or exaggerate the filling pattern for structures that function as groins. As an example a simple groin that caused accretion on the updrift side, erosion on the downdrift side, but no net losses would show an even function of approximately zero and a steep slope for the odd function.

An ideal project response would show large uniform positives changes in the even functions and very small uniform changes in the odd functions.

Figures 14 and 15 show the even/odd curves for the MHW line and volumetric changes in the foreshore zone at the end of the 6 month installation period. As may be noted both curves show substantial net gains in the even functions and small but significant slopes for the odd functions. This pattern indicates that the installation did function as a groin field, and the magnitude of gains on the updrift (north) side was greater than on the downdraft (south) sides.

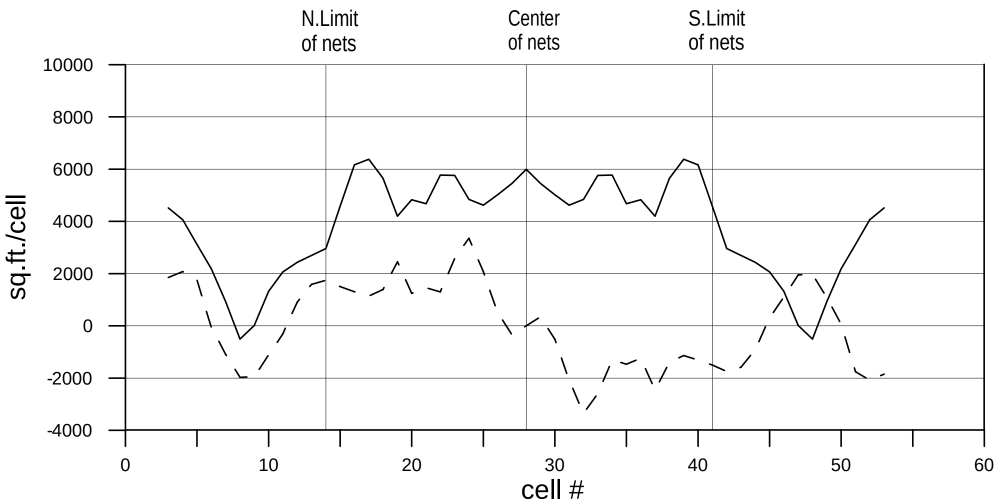
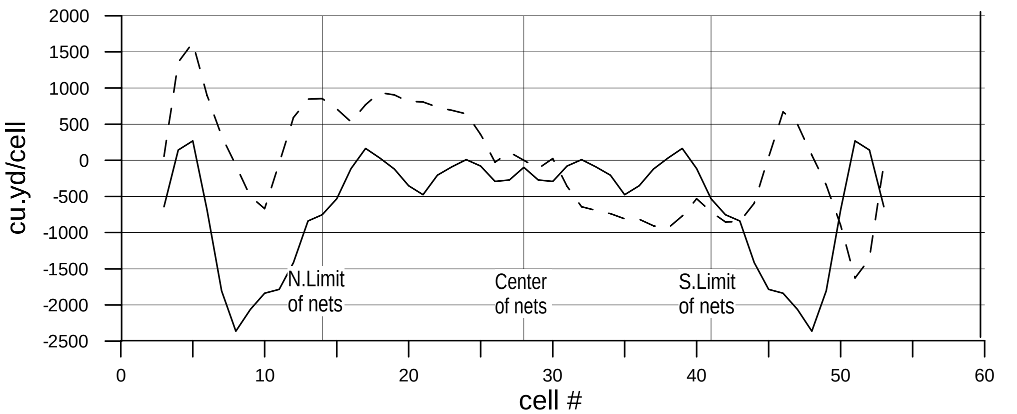


Fig. 14 Even/Odd M.H.W. Changes
May 2002



* Cell #N extends from profile
N-1 to Profile N
Cells are 100 ft. wide

Fig. 15 Even/Odd Volumetric Changes
May 2002

Figures 16 through 18 represents the even/odd curves for the combined (foreshore, nearshore and midshore) zones. As may be noted only the even functions for the foreshore zone showed positive values. In addition the slopes of the odd functions, within the net area, decreased with increasing distance off shore.

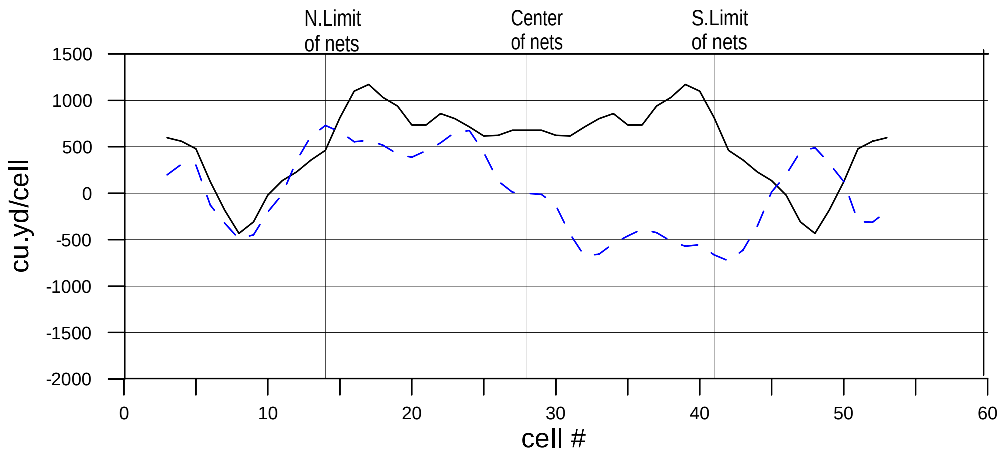


Fig. 16 Even/Odd Foreshore Volumetric Changes
May 2002

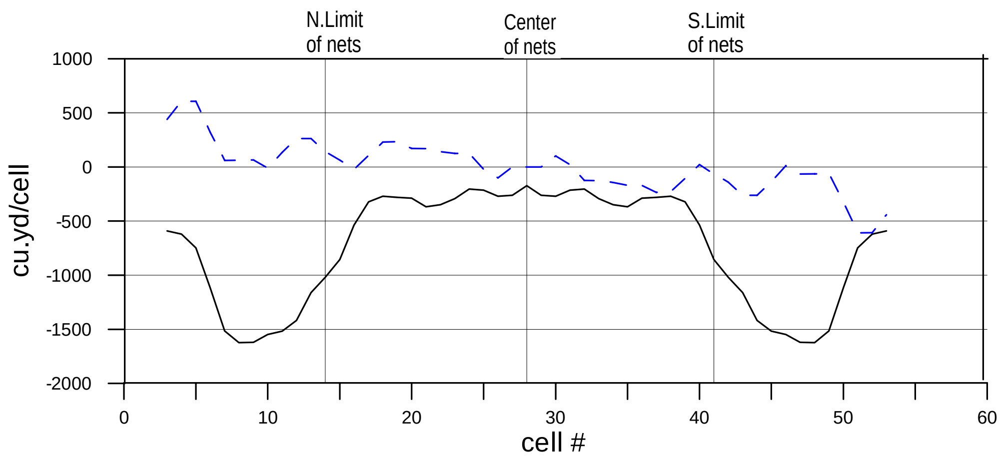


Fig. 17 Even/Odd Nearshore Volumetric Changes
May 2002

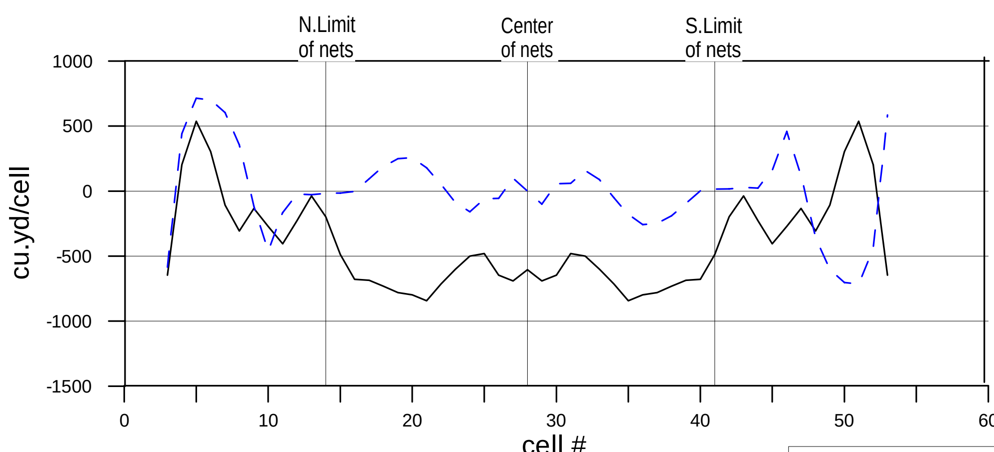


Fig. 18 Even/Odd Midshore Volumetric Changes
May 2002

Legend
Even Function
Odd Function

* Cell #N extends from profile
N-1 to Profile N
Cells are 100 ft. wide

GENERAL OBSERVATION

Before starting the test there was some skepticism as to whether fish nets could produce any significant change in the beach system. The nets were extremely flexible and porous and therefore would not be expected to produce significant reductions in nearshore wave energy. Therefore a clearly defined mechanism of operations was not apparent. The test, however, showed that the nets effected substantial changes well beyond their physical limits.

Observations during the test period showed that the webs had a tendency to collect small layers of cobble and shell. These layers then acted as low level groins while resulting in accretion on their updraft sides. This mechanism, however does not fully explain the performance of the nets since many of the nets, which had accretion gains, did not show such layers of shell and cobble.

Another interesting observation was that the webs did not produce a well defined series of cusps at the nets. Instead the shoreline was relatively smooth within the net area.

CONCLUSION

Although the Sand Web system did produce continued advance of the MHW Line and accretion within the foreshore zone during the six month test period, most of the gains were offset by losses within the nearshore and midshore zones. The noted gains therefore resulted from reshaping of the beach profiles rather than bringing more sand into the active system. In addition the shoreline advance within the test area persisted only while the webs were in place and within six months following web removal most of the gains had been lost.

The system did function as a groin field and gains within the north net areas were significantly larger than those in the south net area. In addition the combined volumetric changes for the foreshore and nearshore zones showed losses within the two segments adjacent to the net segment.

Since the installation did not meet the test criteria it was not considered successful.