CHAPTER 252

The Reconstruction of Folly Beach

by

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ABSTRACT

Folly Beach is an island, nearly 10 km long, south of the entrance to Charleston Harbor. A large beach nourishment plan was planned and conducted to counter the large erosion rates the Island has suffered for several decades. Because of the limitation on operations dictated by the turtle nesting season in the local area, it was required that all construction be completed in one season and extending from November 1 until May 15, 1993. During the construction of the Project, which included 1,908,000 m^3 of material, two very significant winter storms caused some loss of material to the offshore and some damage to the pipeline system. The majority of the material moved by the storm has either migrated back onto the beach or stabilized in a lower part of the subaqueous profile. The success of the first phase of construction of this 50 year project is in many ways attributed to the excellent working relationship between the City of Folly Beach, the Charleston District of the Corps of Engineers and the contractor. The long term success of the project will depend upon the frequency and severity of the storms which attack the project.

BEACH NOURISHMENT AS AN EROSION CONTROL MEASURE

There have been many designs and attempts to halt erosion along the coast of the United States as well as other nations. In many instances the attempts have been ill conceived and did not perform as expected. One of the most successful approaches to dealing with eroding areas is to provide solutions which are in harmony with nature. The

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best solution known today for many of the severely eroding beaches is the addition of sand into the natural littoral system. Although this has been accomplished in rare circumstances by hauling sand from inland borrow pits, the most common methods employ dredging from riverine sources, inlets or from offshore sources. Normally these projects require not only initial reconstruction but periodic renourishment at five to eight year intervals.

According to the Corps of Engineers (1994), the total cost for beach nourishment over the 44 year period of record in 1993 dollars has been $1,150,000,000 or $26,100,000 per year. The federal share of beach nourishment costs has been approximately 60 per cent. This report estimates that over the next 54 years, another $505,000,000, in 1993 dollars, will be spent on future renourishment of these projects. Moreover if all of the other 26 shore protection and beach restoration projects which are awaiting authorization, construction or funding are approved then the total annual construction costs in 1993 dollars would be approximately $34,000,000. Currently, the United States spends considerably less on beach protection and nourishment than does Germany, Japan, The Netherlands or Spain. The amount invested by the United States in relation to the economic value of the beaches, rated in terms of the income from travel and tourism, is significantly less than that of the countries listed above.

The most well known and successful beach nourishment project in the United States is the Dade County Beach Project near Miami, Florida, where seven million cubic meters of sand were placed. There have been many other projects with nearly equal success save for the stability offered by the magnitude of the nourishment project. A recently completed project at Folly Beach, South Carolina is a good example of a long term erosional beach where the reconstruction of the beach by dredging in the back river has helped stabilize the beach, bolstered the local economy and helped the local environment.

FOLLY BEACH

Folly Beach is a barrier island near Charleston, South Carolina. The nearly 10 km long island has experienced large rates of erosion of approximately 1.4 m per year for over 100 years. The Island, as shown in Figure 1, is south of the entrance to Charleston Harbor with its deepened channel and jetties extending nearly 6 km seaward.

The Corps of Engineers (1987) estimated that as a result of the completion of the jetties a net southerly alongshore drift of approximately 122,00 to 152,000 m^3/year has been permanently blocked. They showed that in response to the channel stabilization begun in 1878, the offshore shoals have lost 199,000,000 m^3 of sand resulting in an increase of the wave energy of 100%. A further evaluation of the relationship of the erosion on Folly Island to the navigation project is given in Edge and Dean (1991). The barrier island provides significant public access with two county parks, 50 public accesses with dune walk overs, a fishing pier and both onstreet and public parking lots. The construction of the beach nourishment project was based on cost sharing of 85% Federal and 15% local participation. The local sponsor is the City of Folly Beach. As local sponsor, the City of Folly Beach was involved in the plan formulation, project

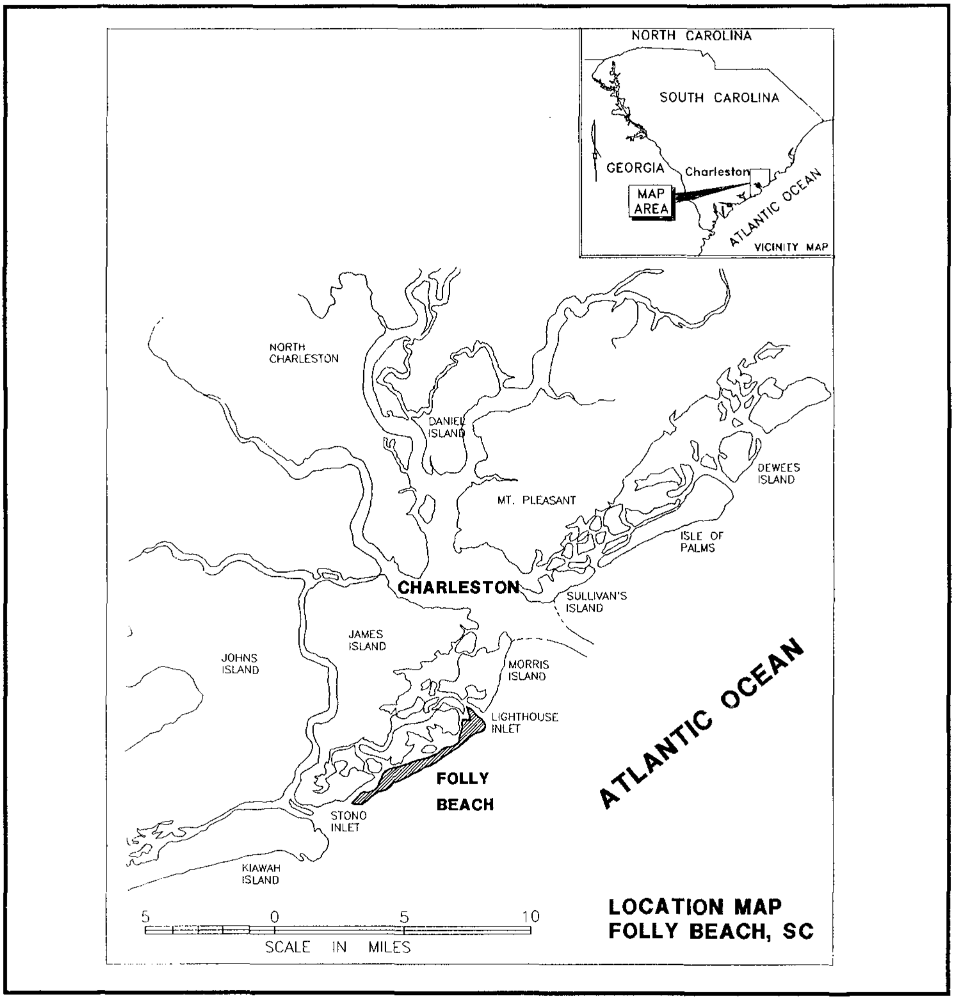

Figure 1. Location map of Folly Beach, South Carolina and the nearby jetties for Charleston Harbor

review and approvals and the City provided all lands, easements and rights of ways for the project. The City is responsible for maintenance of the project and providing the local share for all future renourishment requirements.

THE NOURISHMENT PLAN

The United States Congress authorized a beach erosion project at Folly Beach in 1979. The project was restudied pursuant to Section 501 of the 1986 Water Resources Development Act. In 1988 a Section 111 report was completed which found that 57 percent of the erosion was directly attributable to the Federal navigation project at Charleston harbor. An economic re-evaluation was completed in 1988 and again in 1989 after Hurricane Hugo; the final project was then developed.

The final project design provided for the initial reconstruction of approximately 8.6 km of shoreline and periodic renourishment for a period of 50 years. The plan called for the initial placement of 1,908,000 m^3 of material which would be obtained from the Folly River landward of the Island at the southern end. The design placement quantities ranged from 175 m^3/m to 250 m^3/m (70 yd^3/ft to 100 yd^3/ft .) The construction section included a storm berm at 2.7 m above MSL with a width of 4.6 m sloping down on a 1:10 grade to a berm at elevation 2.1 m which extended seaward from 18 to 40 m. The native beach sand had a mean grain size from 0.12 to 0.21 mm with a composite of 0.17 mm. Early measurements of the borrow site showed a composite mean grain size of 0.15 mm.

Final engineering plans were based upon the results of SBEACH and GENESIS simulations performed by the Coastal Engineering Research Center (U.S. Army Corps of Engineers, 1991). Two important results of the model studies indicated that (a) in the area of most severe erosion nine existing groins should be rebuilt to slow the unusually high erosion rate and (b) the project would require renourishment approximately every 5 to 8 years.

CONSTRUCTION

Because of the requirements that all construction be completed in one season between November 1 and May 15, the number of potential contractors who could meet these special requirements was limited. The limitation on operations was dictated by the turtle nesting season in the local area. Moreover, because of environmental concerns and the location of the borrow area, the contractor would have to pump up to a distance of approximately 12.5 km. There were only three contractors which bid on the project. In the Fall of 1993, a separate contract was let for grassing the dune at a cost of approximately $260,000. Engineering, land acquisition, environmental studies and other miscellaneous costs were estimated at $3,227,650. The 50-year cost of the project is estimated to be $115,000,000. During the initial construction, several winter storms occurred but two were significant and caused production to cease. Both storms caused major relocation of up to 6 km of pipeline and claims for loss of material and time. The second storm on March 12 - 14, 1993, was called the "Storm of the Century." That storm created hurricane force winds along much of the Atlantic seaboard.

THE SOLICITATION

As previously noted, the most limiting factor facing the potential contractor was the requirement that the total beach fill placement and groin construction be completed by May 15, 1993. This date represented the beginning of the nesting and hatching season of the Loggerhead Turtle. This requirement forced construction to be performed in the winter months thereby ensuring the most extreme weather conditions under which to do the dredging and other construction. The third factor was the entire issue of dredge pipeline; the length of line required to effect placement of the fill; the limited space available for maneuvering with and storage of more than 9.1 km of shorepipe; and requirements for transporting the shorepipe to the site by truck due to bathymetric conditions surrounding the shoreline of the island and the lack of commercial dockage available.

The bid opening was held on November 9, 1992, one month after the solicitation. A comparison of the bid amounts submitted by each contractor for the major features of the contract is shown in Table 1.

Table 1. Folly Beach Contract Bids

	Bidder 1		T. L. James & Co.		Bidder 3	
Item	**Unit price**	**Total $US**	**Unit price**	**Total $US**	**Unit Price**	**Total $US**
Mob & demob for dredging		1,038,500		1,500,000		800,000
Mob & demob for beach fill placement, groin demolition & new groin construction		100,000		13,050		16,000
Beach fill (m^3)	4.47	8,550,000	2.52	4,825,000	3.33	6,375,000
Groin demolition		15,000		18,000		21,000
Foundation blanket stone (ton)	35	164,500	56	263,200	45.35	213,145
Placement of existing armor stone		100,000		177,500		128,000
Steel sheet piling						
install sheet piling (m)	164	1,145,000	161	1,122,100	192	1,339,650
splicing	400	2,000	500	2,500	600	3,000
cutting	125	625	150	750	175	875
Geotextile installation (m^2)	1.5	10,500	1.75	12,250	2	14,000
Tilling (acre)	500	66,500	850	113,050	650	86,450
Mob & demob for drill rig for borings		2,500		3,000		3,500
Borings - drilling, sampling & testing	2,000	50,000	2,450	61,250	3,300	82,500
TOTAL		$11,245,125		$8,111,650		$9,083,120

THE CONSTRUCTION PLAN

Concerns were expressed relating to the issue of quantity, delivery, storage, and placement of the various types of pipeline necessary to transport the material from the borrow area to the beach. The lack of any moorage deep enough to serve a fully loaded pipe barge and the spatial constraints that existed on the island adjacent to the beach would force the Contractor to haul the 650 pieces of 15 m shorepipe to several small pipe laydown areas strategically placed along the beach. Unloading equipment capable of handling these pipes in such constrained conditions had not been included in the estimate, creating an unforeseen cost. Also the designated pipeline route from the borrow site to the beach required that over 600 m of shore pipeline be located in extremely shallow water through an existing marsh to a shore connection.

The hydraulic cutterhead dredge, *Tom James*, was used for the project. At the center of the pumping system of the *Tom James* is a 16 cylinder Enterprise diesel delivering up to 6000 shaft hp to a centrifugal pump. The pump has a 91 cm suction and a 76 cm discharge and could house impellers ranging from 210 to 240 cm. Based on hydraulic models of the dredge and booster system it was empirically determined and endorsed by historical performance that a 213 cm impeller could be used. The dredge had been dredging at depths of up to 15 m on the Mobile River and was equipped with a 30 m ladder. Based on the vertical limit of dredging allowed within the borrow area at Folly Beach, the decision was made to replace this ladder with the 20m ladder available in Houma, LA. Both ladders supported the 1800 hp ladder pump used to improve the pumping capacity of the main pump. The dredge was returned to the Houma Yard and the short ladder was installed in Mobile. On Dec. 18, 1992, refitted for the Folly Beach, the dredge and attendant plant, along with 700 m of floating pipeline began towing, via the Gulf Intracoastal Waterway, to Folly Beach.

The dredge arrived on site on December 30, 1992, and began preparations to begin dredging. The Plan of Operation submitted to the Corps indicated that dredging would begin at Station 0+00 proceeding in a northerly direction. The dredge was to make two 60 m cuts from Station 0+00 to Station 52+00, three 60 m cuts from Station 52+00 to Station 78+00, and four 60 m cuts from Station 78+00 to the limit of borrow at Station 115+00. (Note that stationing is in the original units of feet as specified in the contract plans.) As also dictated by the contract, the borrow site was to be excavated to a maximum depth of 5.5 m MLW in the first two designated reaches and 6.1 m MLW in the last reach.

A 3050 m submerged line was installed from the borrow area to the south end of the island where it connected with 9750 m of shorepipe. A shore connection was made at Station 91+00S. Starting at this location and pumping northerly conserved 500 m between Station 91+00S and the south limit of work at 107+00S to be used to prevent a shutdown in the event of damage to the pipeline on the beach or the installation of the booster. The flow from the 76 cm ID discharge pipes was trained by a 330 m levee located along the approximate break point of the berm. The trained flow of the effluent slurry served to maximize the retention of material, thereby increasing the efficiency of the dredging process while simultaneously minimizing the loss of the material placed in the surf zone. Stationing of the project and the location of the borrow area are shown in Figure 2.

Equipment for the beach fill operations was hauled by truck to the project. In accordance with the proposed plan of operations three bulldozers, two Caterpillar D6H LGP and a Cat D6D LGP were used to manage and dress the fill. Two Caterpillar 518S

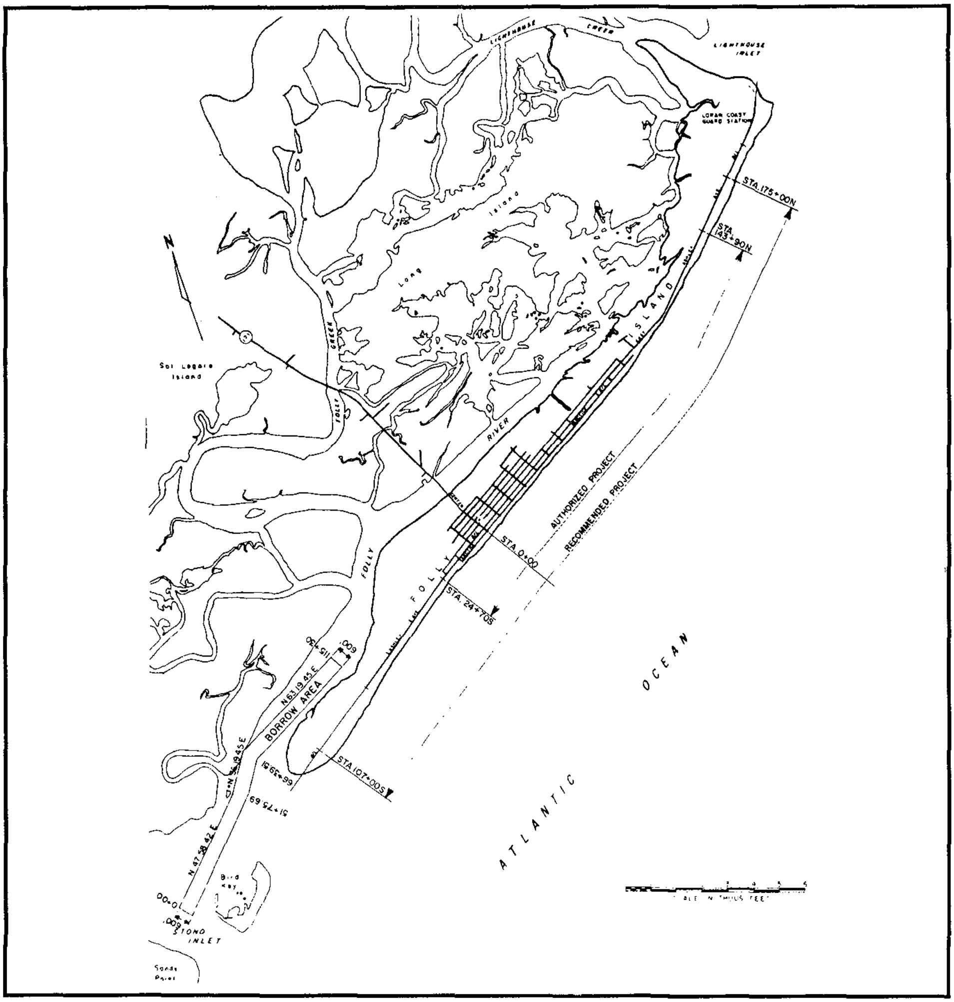

Figure 2. Project stationing and location of the borrow area.

logging skidders were delivered and used moving pipe, fuel, and equipment associated with the fill operation.

SURVEYING

The Folly Beach nourishment project required more detailed surveying than a normal dredge project. The most significant factor contributing to the elevated importance of field engineering on this project was largely due to the method by which the

Corps chose to control the quantity of required fill at any given point along the beach. Although design templates for various portions of the project were included in the project plans, these templates were not the conventional static geometry. The templates were instead, dynamic, holding constant the total number of cubic meters of fill for each linear meter of advance; adjustments in the width of the berm were made to compensate for changes in the required quantity. This approach, while rendering a more finite and predictable final fill quantity, substantially complicated both the placement of the fill and the computation of the pre- and post dredging volumes.

Specifications required that both pre and post dredging surveys be taken in the form of cross sections at a frequency of 30 m intervals, normal to the project baseline, with no more than 7.5 m between individual measurements. These cross sections were taken within five days prior to the time of placement of the fill and as soon as practical after the placement of the fill. The cross sections were taken by conventional leveling techniques beginning 15m landward of the project baseline and extending seaward until the -1.0 m NGVD[5]contour was reached.

Seaward from the -1.0 m contour to a point 460 m distant from the project baseline, cross sections were taken with echo sounding instrument. This task was complicated substantially as a result of the vertical oscillations of the survey vessel between the crests and troughs of the waves. Under these conditions conventional hydrographic survey procedures for correcting data for the effects of tide and draft would yield grossly unreliable and nonrepeatable measurements. The Contractor used a "surf boat" for data collection. The surf boat system consisted of a 6m, broad beam skiff equipped with a Del Norte DMU 547 Microwave Positioning System for horizontal positioning, an Odum Echotrac 3100 semi-portable fathometer using a dual frequency 24/208 Khz transducer for vertical measurement, and a 486DX laptop computer installed with data collection software developed by the Contractor.

The unique feature in the surf boat system was the method by which compensation for heave was made. A Spectra-physics Laserplane™ plane laser was placed above a point of known elevation, NGVD datum, and an height of instrument taken from the point to the infrared light beam. As a data collection event occurred, a differential measurement between the bottom of the receiver mast and the point at which the receiver mast was intersected by the beam was recorded. This differential measurement combined with the known distance from the bottom of the mast to the face of the transducer and the depth measurement, defined the vertical component of the measurement as an elevation relating to project datum.

DEMOLITION AND CONSTRUCTION OF GROINS

Prior to construction, the remains of nine timber groins existed just north of the Holiday Inn site from project Station 1+50N to 49+60N. The nine groins were from 100-150 m in length with a total of 100 m required to be moved. The removal of these groins and any other remains of old structures immediately adjacent was necessary for

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[5] NGVD represents approximately mean sea level.

driving new sheetpiles to replace the wooden groins. The removal of these structures required the handling of old creosote pilings.

The new groin design consisted of steel sheet pilings driven into the ground at ±0.3 cm vertical tolerance. The soils adjacent to the sheet piling were to be stabilized using a layer of geotextile covered by a layer of blanket stone and subsequent layer of armor stone. Much of the existing armor stone surrounding the existing timber groins was recovered and reused. The stones were laid so that they would interlock creating a surface less susceptible to movement by wave action. Lastly, a steel reinforced concrete cap was installed on top of the steel sheet pilings.

A vibratory hammer was used to drive the sheet pilings. The pile driving was vertically controlled by the use of a teflon-coated dual template allowing 6 m sections of piling to be driven at one time. When pile driving on an individual groin structure was completed, forming and pouring of the concrete cap was done. Finally the placement of the geotextile and stone work was performed using a 690LDC and a 890JD John Deere trackhoe and two John Deere 544 front end loaders. In addition to the problem of limited workspace and times available for working, the tidal and wave action created erosion problems adjacent to the groins far in excess of what the contractor expected for this type of construction.

DREDGING AND PLACEMENT OF BEACH FILL

In addition to the hydraulic dredge, *Tom James*, provision was made in the estimate to allow for the use of the *Atlas Booster* should the required line lengths on the north end of the project hinder production to such a level so as to jeopardize completion before the May 15 deadline. A comprehensive selection of peripheral equipment comprising the attendant plant was also delivered. Two 900 hp tenders and a smaller 600 hp tug were used to move and position the dredge within the borrow area, handle pipelines, and shift swing anchors as advance in the cut dictated. Also accompanying the dredge were two "skadgit" stiff leg derricks, a 10,000 lb. crane, and numerous barges employed in fuel and water storage, raw materials supply, welding, and pipe barges.

The dredge was placed in the southwest portion of the borrow area and was hooked onto the shortest length of pipeline for the project. A wye valve was placed at the end of the shore connection. This wye valve allowed the fill to proceed either north or south as needed. On January 12, 1993, the dredge began pumping material from the borrow site and placing it on the beach at Station 91+15S and advancing in a northerly direction. The dredge was positioned at Station 57+00 in the borrow area and began pumping through 2865 m of pipeline with a velocity of 3.4 m/s. Dredge positioning was performed by the Del Norte DMU 547 Microwave positioning system.

The dredge was equipped with a six blade serrated cutter ideal for the sandy conditions encountered in the borrow area. Although borings taken prior to dredging indicated that sufficient material of acceptable quality was available within the borrow area, as the dredge moved north several areas yielded high shell content. These shell deposits had a negative effect on production. Adjustments were made in dredge position as these areas were encountered.

Near the end of February, the contractor realized that using the *Tom James* alone to complete the project would jeopardize the timely completion of the contract. The decision was made to use the 3600 hp *Atlas Booster*. Arrangements were made and the booster was towed to the site. As pipe line length approached 7600 m, production continued to drop off at a progressively greater rate. On April 19, 1992, the booster was installed at a point 1220 m down line of the dredge. Though not immediate, the result was impressive. The production rate is shown in Figure 3. The upper line represents gross output at the borrow site and the lower line represents the net output on the beach. The booster pump was placed on line when the line reached about 7,300 m (24,000 ft). Small mechanical repairs and adjustments to the new hydraulic system improved the production from 1140 m^3/hr. to 2430 m^3/hr. This system was maintained until the terminus of the project, Station 175+00N, was reached on April 17, 1992. Once pumping was completed to the northern limits of the project, the pipeline was pulled back to refill the area between the newly constructed groins. Also remaining to be pumped was the 500m south of the initial starting point at Station 91+00S. On April 29, 1993, the dredging was completed and demobilization from the site was begun.

Dredge production on the project was estimated at 1,300 m^3/hr yielding 26,000 m^3 for each day of operation. The dredge operated a total of 72 days without a booster and twenty-nine days with the booster pump in operation. In the final analysis, the dredge pumped on the project 101 days for the original contract amount plus an additional 126,160 m^3. This represents a daily production of 20,300 m^3. Approximately 2.7M m^3 of borrow material was removed to place 2.0M m^3 of material on the beach. This represents an overfill ratio of 1.4.

The distribution of non effective time during production is given in Figure 4. It is obvious that a large amount of non-productive time was created by adding or moving beach pipelines and pipelines to the dredge. Weather was not a significant factor as was originally considered and did not cause appreciable down time.

As the end of the project approached preparations were made to commence tilling in areas where the fill had a compaction of greater than 500 psi. The compaction measurements were taken with a cone penetrometer between the seaward side of the storm berm at elevation 2.7 m NGVD and the high tide line. A total of five tests were taken at 61 m intervals for each 305m acceptance reach within five days of the placement of the fill. Areas not meeting the criteria defined above were required to be tilled to a depth of 0.9 m. On April 22, 1992, tilling of areas determined to be deficient commenced using a D8D equipped with a clearing rake. The tines on the rake were marked with paint at .9m to guide the operator. On May 8, 1993 tilling was completed.

STORMS DURING CONSTRUCTION

After eighteen days of continuous production, a major winter storm occurred on 5-7 February 1993. The storm surge reached 1.5 m NGVD with waves of 1.5 to 2.4 m (Ebersole, Nielans and Dowd, 1995). The storm caused severe damage on property in the community and did considerable damage to the fill being placed on the beach. The fill operations were approaching the seawall fronting the Holiday Inn in the vicinity of

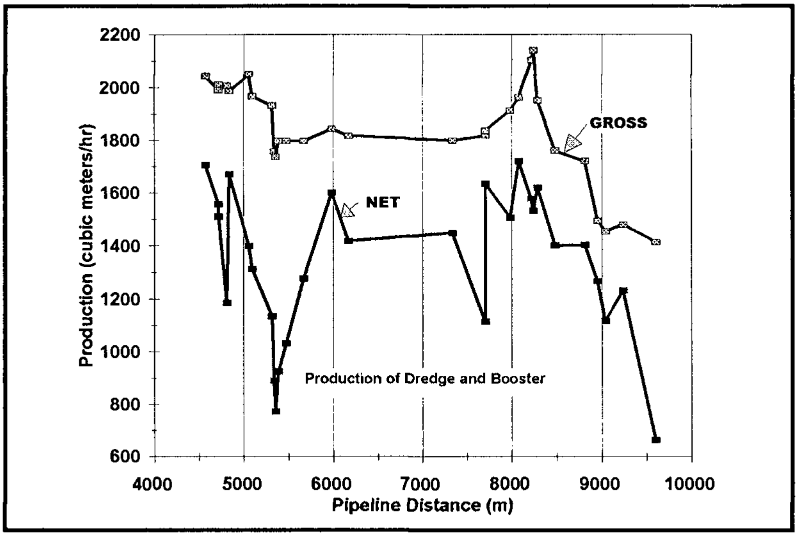

Figure 3. Production rate of *Tom James* versus length of pipeline.

Station 12+00S when the storm commenced. Contract specifications required that only 114 m^3/m be placed against the concrete seawall in front of the Holiday Inn in an area of severe erosion The resultant narrow berm width provided insufficient space to operate the equipment necessary to accomplish the fill operation. These contradicting requirements, one contractual and one practical, required that placement of a quantity of material far in excess of the design fill in order to create a berm with adequate width to facilitate the continued operation of the tractors.

As the storm built to full intensity, the waves began to severely erode the newly placed fill. By the next day conditions had worsened. The dredge continued to pump; however, the purpose was no longer to fill to required line and grade but to maintain the integrity of the pipeline. As the storm intensity increased these efforts were proven to be ineffective. In the afternoon of February 6 the shorepipe, now resting on bare rock, was broken apart by the pounding surf. Damage to the beach between Stations 11+50S and 6+50S was extensive. Pieces of 15 m shorepipe, dislocated and tossed in the surf, were strewn about on the beach. The portions of the pipeline not broken apart, once straight, now meandered up the beach. Shore crews recovered the loose pieces of pipeline and, at the direction of the Corps of Engineers removed the pipeline back to Station 11+50 and began refilling the area.

A second major storm occured on March 3 and 4 with a maximum storm surge of 1.4 m NGVD and waves of 1.5 to 2.1 m. This storm created additional losses with most located at the seawall in front of the Holiday Inn. The third and strongest storm occured on March 12-14 with wind gusts up to 35 m/s (Ebersole, Neilans and Dowd, 1995). This storm, called the "Storm of the Century," caused a storm surge of 1.4 m

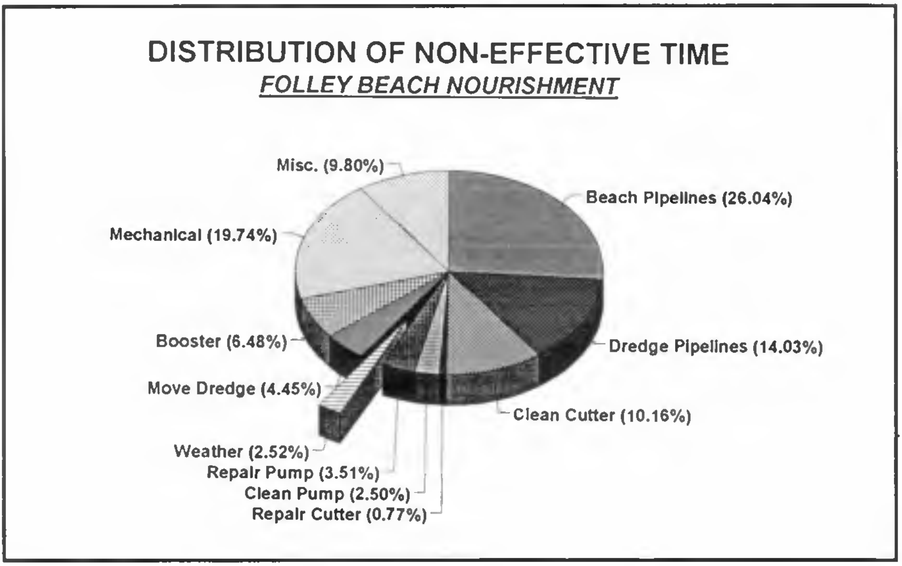

Figure 5. Distribution of non-effective time for *Tom James* during construction

above NGVD with large waves. The contractor continued pumping throughout the storm to keep the pipeline full of water. There was much erosion of the placed material because of this storm.

The last storm resulted in the loss of 25,000 m^3 of material as well as the destruction and/or replacement of 200 m of pipeline. In addition to these losses the contractor also requested fair compensation for the additional 156,000 m^3 of fill required to create an adequate berm for sustaining the fill process.

MONITORING

As noted previously, surveys were conducted within one week prior to placement and immediately after the profile was constructed. Thus the total sand placed and remaining in the section out to -9 m NGVD was captured. Following the first and third winter storms, surveys were completed which showed the loss of some material and the redistribution of other material. After project completion, semiannual surveys have been conducted across the profile at 31 stations to closure depth. These surveys are part of the statewide monitoring program.

Figure 5 shows a comparison of the volume of sand which was placed on the beach with the design quantities specified in the construction plans. Note that the plans only allowed 114 m^3/m (45 yd^3/ft) at the seawall fronting the Holiday Inn in the center of the City. The Holiday Inn property had an existing seawall jutting seaward of the adjacent properties and the design was selected to only provide as much sand as necessary to carry the dredge pipe on the ocean side of the wall. Moreover, the project design considered that the primary objective was shoreline protection and the seawall at the Holiday Inn did not require any additional protection by the new beach. The Holiday Inn is located approximately between stations 15+00S and 5+00N. Center Street in the City of Folly Beach was used for the 0+00 in the construction stationing. The quality of the material obtained from the borrow area was compared with the native beach material and it was determined that the borrow material when placed on the beach had a d_{50} equal to or greater than the native beach material at the time it was sampled.

BEACH RESPONSE

The most obvious change in the beach profile since construction has been by the waves in the two large winter storms between the end of construction and January 1994. These storms caused the movement of sand from the dry sand beach to the offshore area. Surveys show that the sand did not disappear; where the contractor placed 225 m^3/m of sand initially, 225 m^3/m of sand remained in the section although some of it did move to between 1 and 4 m below mean sea level. This adjustment of the beach fill generally occurs more slowly over a period of 12 to 18 months with the resulting dry sand beach being about 45% as wide as the newly placed sand after the adjustment period. It is expected however, and the early data indicated this to be true, that the profile will

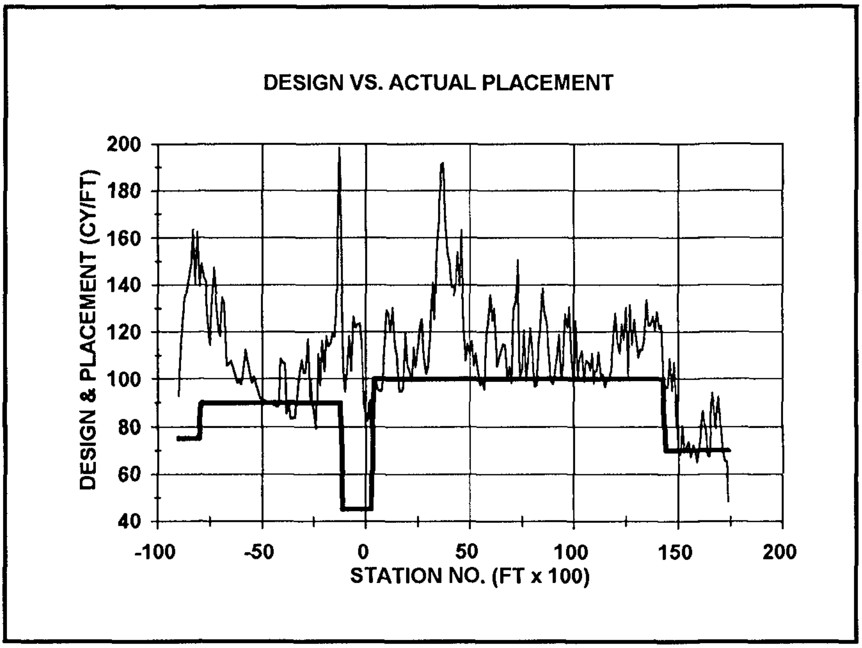

Figure 5. Comparison of the design (dark line) and the actual placement quantities.

continue to recover until by the end of the 1994 summer season it should have nearly 45% of the predicted initial equilibrium profile. As the beach fill ages there will be long-shore movement of the material as well. In fact the surveys and observations of 1994 indicate a movement of the material in the area of the "washout" to the northeast and somewhat to the southwest. As of July 1994, 95% of the placed material was accounted for within the limits of project construction according to Ebersole, Neilans and Dowd (1995).

Figure 7 is represents the movement of the mean high water line over the period of July 1993 until January 1994. Note that the stationing is taken from the most south-westerly end of the project. In the figure "HI" represents the location of the Holiday Inn. This figure shows the relationship of the shoreline position to the project baseline so the results of position are all relative to the baseline. It is interesting to note that there has been recession of the mean high-water line in general all along the beach and that two areas have particular features. The first area is the Holiday Inn area where after the first winter storm, the shoreline moved landward as far as the seawall where it cannot approach the baseline any closer. The second area of interest is at the "washout" where the sand moved both offshore and probably alongshore to the northeast between the first and second surveys.

Figure 8 shows the same information in the form of shoreline advance/erosion over the period of record. Although the general trend is toward erosion it must be remembered that these surveys only show the response of the summer post nourished beach to the winter storm season. As noted previously, the beach is adjusting and "hot spots" are appearing as the sediment moves alongshore and equilibrates by moving out into the equilibrium profile further from the baseline. Surveys are being taken quarterly to track the movement of the sediment. The quarterly surveys are being correlated with tide and wave records.

PERFORMANCE PREDICTION

The performance of a beach nourishment project is dependent upon the quality and quantity of sand placed, presence of stabilization structures, project length, the wave climate that tends to spread out the sand along the beach and the background erosion rate, which in this case, is primarily due to the interruption of the longshore sediment transport by the Charleston Entrance jetties and navigational channel. Project performance may be considered in terms of: (1) the equilibrium beach profile formed and the associated dry beach width, and (2) the spreading out of the sand in the longshore direction. Based on equilibrium beach profile concepts, the equilibrium additional dry beach width would be less than 10 m compared to 22 m if the native and borrow sand sizes had been equal. Considering a representative wave height of 0.9 m, based on the Wave Information Study (Hubertz, et al., 1993), the time required for the project to lose 50% of the material placed is approximately 4 years. Of course, the losses near the ends of the project at any one time will be much greater than the average. The monitoring results will be compared to the predicted profiles after the first annual surveys are completed.

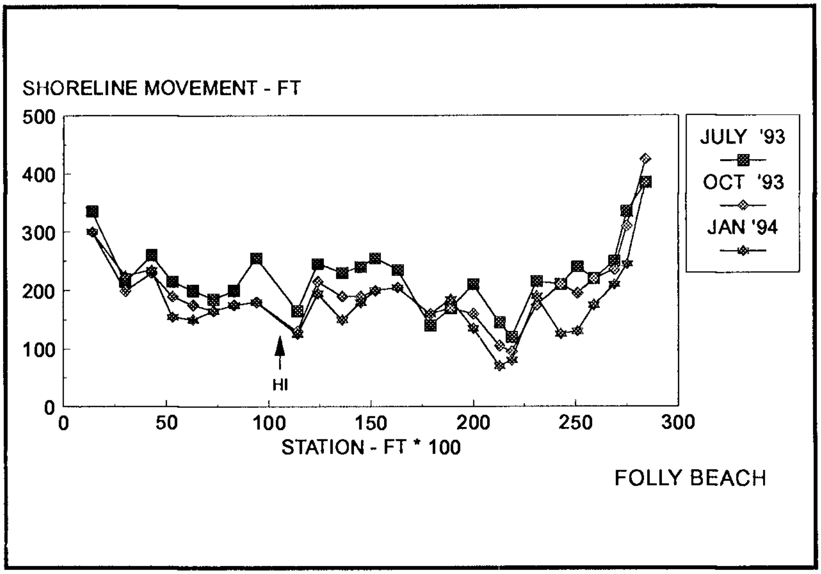

Figure 7. Shoreline position relative to the project baseline showing response to winter storms.

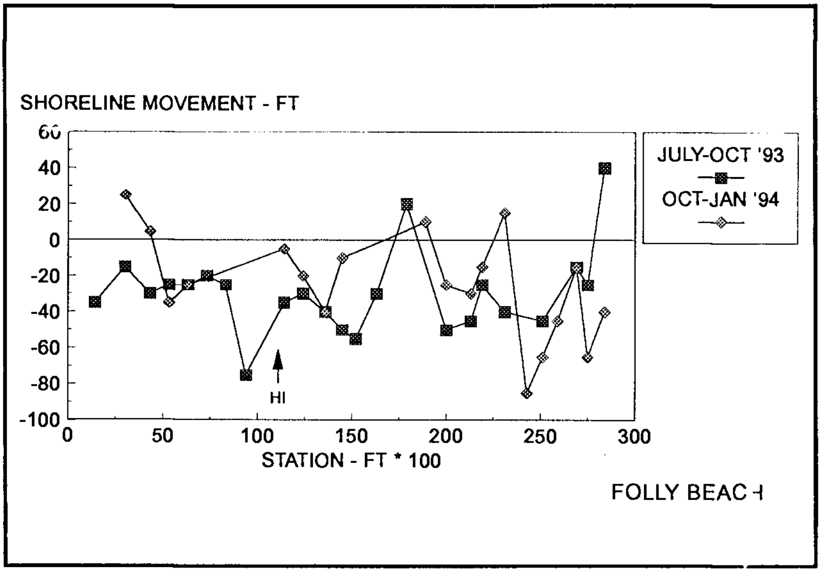

Figure 8. Change in shoreline position between the periods of July-Oct '93 and Oct-Jan '94.

SUMMARY

The reconstruction of Folly Beach is an example of the success of a dredging - beach nourishment - project which was successfully completed within the environmental constraints of winter conditions, very short time windows, and large pumping requirements. The success of the project is in many ways attributed to the excellent working relationship between the City of Folly Beach, the Charleston District of the Corps of Engineers and the personnel of T. L. James & Company. The long term success of the project will depend upon the frequency and severity of the storms which attack the project.

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