Journal of Coastal Research	15	4	1100–1118	Royal Palm Beach, Florida	Fall 1999

Summary of Beach Nourishment Episodes on the U.S. East Coast Barrier Islands

Hugo R. Valverde§, Arthur C. Trembanis†, and Orrin H. Pilkey†

§Hampton Roads Planning District Commission
Chesapeake, VA, U.S.A.

†Program for the Study of Developed Shorelines
Duke University, Campus Box 90228
Durham, NC 27708, U.S.A.

ABSTRACT

VALVERDE, H.R.; TREMBANIS, C., and PILKEY, O.H., 1999. Summary of Beach Nourishment Episodes on the U.S. East Coast Barrier Islands. *Journal of Coastal Research*, 15(4), 1100–1118. Royal Palm Beach (Florida), ISSN 0749-0208.

This study documents that since 1923, approximately 350 million cubic yards of sand have been deposited on the US East Coast barrier island shoreline (from Long Island, New York to Fisher Island, Florida), by more than 573 beach nourishment episodes, at 154 locations. On East Coast barrier beaches, the use of beach nourishment to control coastal erosion has increased rapidly since the 1960's. Most of this volume (65%) has been placed by federally sponsored beach nourishment projects, either storm and erosion control projects or navigation projects with beach disposal of dredge spoil. However, the proportion of nourishment projects not involving federal funds (state/local and local/private nourishment projects) has been increasing.

ADDITIONAL INDEX WORDS: *Beach replenishment, East Coast erosion control, soft stabilization.*

INTRODUCTION

Beach nourishment is our nation's most widely used response to shoreline erosion. Despite its popularity, information documenting the extent to which beach nourishment has been used is fragmented and incomplete. This study attempts to fill this void by creating a database that documents open-ocean beach nourishment episodes which have occurred on the US East Coast barrier island shoreline (from Long Island, New York to Fisher Island, Florida) (Figure 1). It is hoped that the information presented by this study will be useful as a baseline database to coastal managers at all levels in evaluating and formulating policies involving beach nourishment. For example, in the current debate of the appropriate federal role in beach nourishment, this study provides a starting point by documenting the past.

Two other studies have attempted to establish a beach nourishment database for the East coast. The first study was performed by PILKEY and CLAYTON (1989), which documented East Coast open-ocean beach nourishment episodes through 1986. The most recent was a study by the US ARMY CORPS OF ENGINEERS (1994). The Corps study, however, only considered federal projects and did not assess the federal role in the larger picture of US beach nourishment. Our study is rather broad in scope and includes data on both federal and non-federal projects. This study adds to Pilkey and Clayton's work by bringing it up-to-date, to 1996. Additionally, where possible, Pilkey and Clayton's study was corrected by adding missing projects and replacing inaccurate information.

97069 received 28 September 1997; accepted in revision 19 July 1998.

METHODS

PILKEY and CLAYTON (1989) note in their study that data on beach nourishment "is difficult to come by." While it seems that this situation has improved somewhat, it is still very hard to obtain records on some types of beach nourishment, especially small or non-federal projects.

For the purposes of this study, beach nourishment was defined as the introduction of new sand, placed on the beach by hydraulic or mechanical means, which had the immediate effect of increasing the dry beach width. Thus, both engineered and non-engineered nourishments (such as beach disposal of dredge spoil) are included. The term *episode* is used to describe an individual application of sand to a beach, which may be part of a larger beach nourishment project, consisting of several episodes over decades of time.

The following information was sought for each beach nourishment episode: location, year, funding type, volume, length, and cost. These data were obtained from a variety of sources including conference proceedings, journal articles, newspaper articles, consultant reports, Corps of Engineers' documents, and state reports and files. A large part of this information was also obtained by personally communicating with federal, state, and local government officials. The first draft of the data table was sent to many of these individuals for comments and verification. Presently, we are still receiving feedback on the data table (see Table 1) and we invite any additional corrections. Our data table is available for examination at our website, http://www.geo.duke.edu/Research/psds.

Establishing our data table was a difficult and somewhat arbitrary process. In the process of collecting the data, we sometimes found several versions of the costs, lengths, and

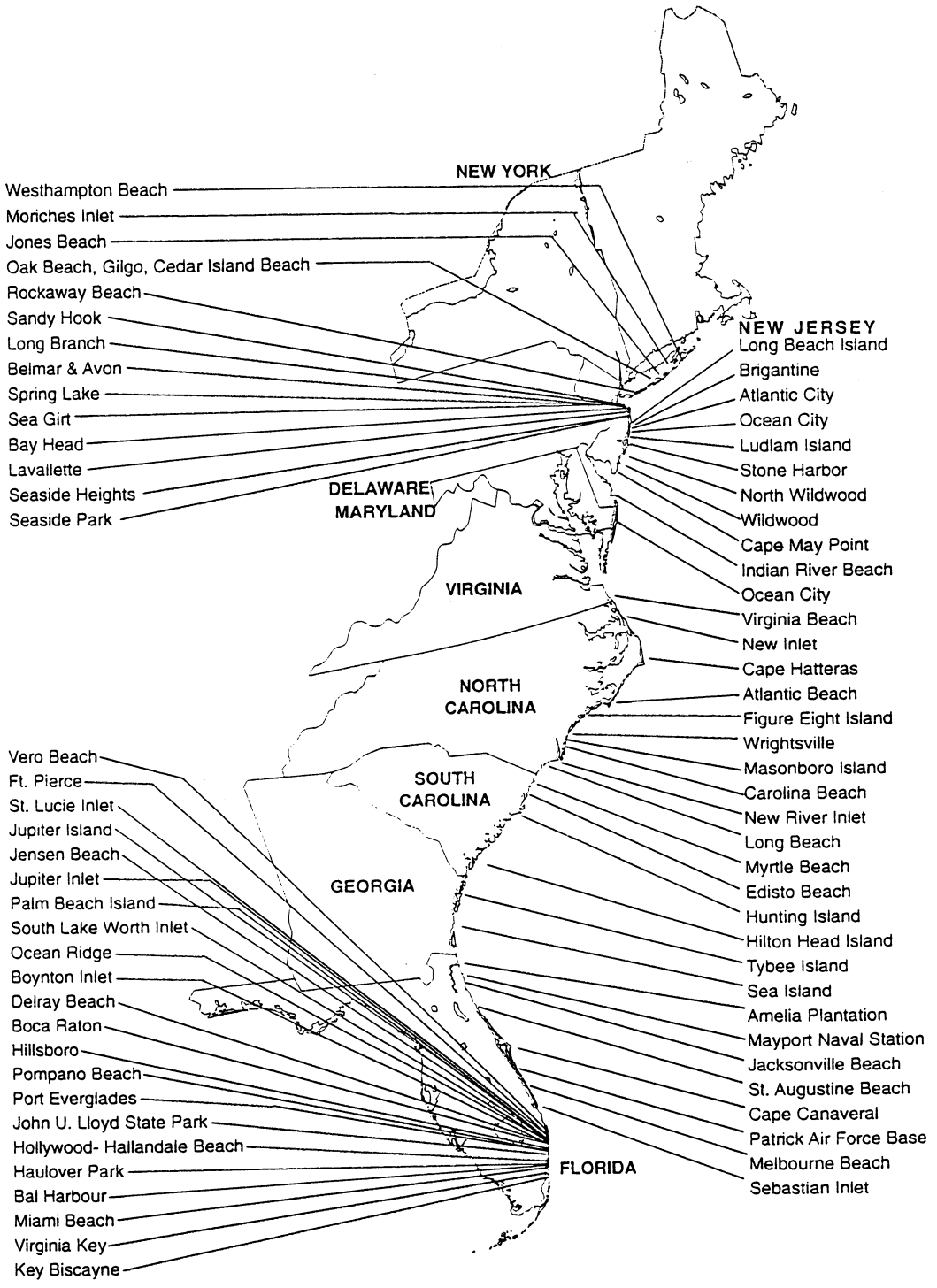

Figure 1. Index map showing the approximate location of 71 nourishment projects (for a complete list of projects see Table 1).

volumes for a single nourishment episode. For the table, we had to choose one source of information over another. However, in the reference list, we tried to include all the sources we found for an episode, not just the source that contained the figure we actually used in our table.

We are certain that the data presented by this study are not entirely complete or accurate. Out of 573, we found 62 (11%) episodes with no funding source information, 56 (10%) without information on volume, 299 (52%) without information on length, and 257 (45%) without cost information.

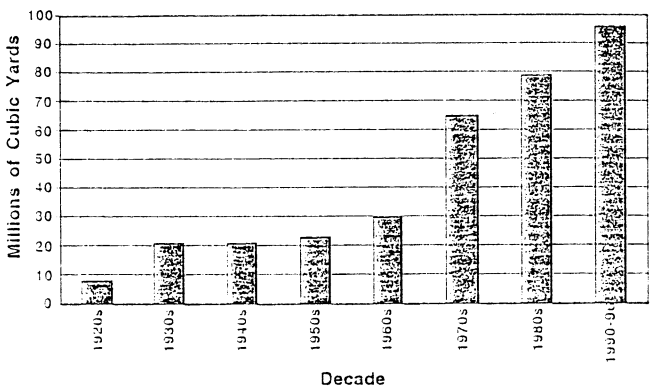

Figure 2. Total volume of nourishment sand placed on US East Coast barrier island beaches per decade.

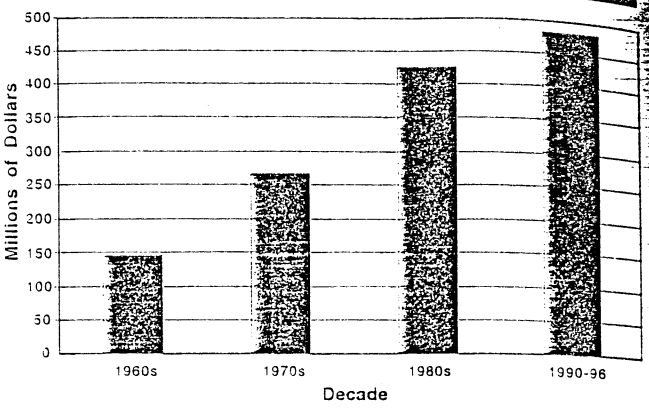

Figure 3. Total estimated cost of nourishing US East Coast barrier island beaches per decade. Costs are in 1996 dollars.

In order to arrive at an approximation of how much has been spent nourishing the East Coast barriers, we had to estimate missing costs. To do this, we first adjusted all documented costs for inflation and converted them to 1996 dollars, based upon cost update factors given by USACE (1996). Then, from those episodes with both a documented cost and volume, an average cost per cubic yard was calculated for each funding type. Finally, an episode's known volume was multiplied by the corresponding cost per cubic yard average for the appropriate funding type, in order to arrive at an estimated cost. If an episode's funding type was undocumented, then a median cost per cubic yard figure was used, such that 50% of the documented costs per cubic yard were higher and lower. If an episode had no volume (10% of the episodes had no volume), an estimated cost could not be obtained. Table 1 depicts only the documented costs expressed in project year dollars not including our estimated costs.

FUNDING TYPES

The beach nourishment episodes identified in this study were classified into one of six funding types, which are explained below. Some nourishment episodes, however, such as Wrightsville Beach, North Carolina were performed under a variety of funding categories for a single nourishment episode. For the purposes of simplifying the data table and analysis, we chose the dominant funding type. In some cases, to assign a funding type, we had to make assumptions or make an inference from available sources, where it was not explicitly available.

(1) Federal Storm and Erosion. These are nourishment episodes performed by federally sponsored beach erosion control, shore protection, or hurricane protection projects, where Congress authorizes up to 65 percent of the total cost. The remaining share is paid for by state and local governments. Of the six categories, these nourishments are the largest in cost and volume.

(2) Federal Navigation. These episodes involve federal navigation channel maintenance with beach disposal. Rather than dispose of dredged sand offshore or on an upland disposal area, sometimes it is less expensive and beneficial to dispose of the sand on a neighboring beach, at no cost to the local community. If beach disposal is not cost effective, in some cases, the local community will pay to have the dredge spoil placed on their beach.

(3) Federal Emergency. These are federally-funded nourishment episodes, which usually occur in response to a large loss of beach caused by major storms. For example, on the East Coast, the most widespread use of federal emergency projects was in response to the 1962 Ash Wednesday storm and the severe winter storm season of 1992–93.

(4) State. These are nourishment episodes which are paid for entirely by the state government.

(5) State/Local. This classification encompasses those beach nourishment episodes which were sponsored under a state and local government cost sharing agreement.

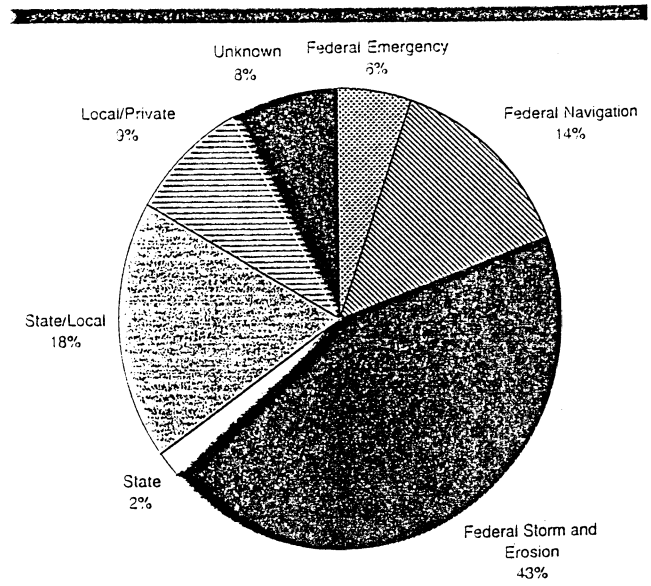

Figure 4. Funding sources of US East Coast barrier island nourishment episodes expressed as a percent of total sand volume (1923–1996).

Table 1. *East Coast barrier island beach nourishment episodes (1923–1996)*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
EAST COAST BARRIERS							
New York							
1	Saganopack Pond area, NY	1962	Federal: Emergency	70,000	3,168	$133,400	2
2	Mecox Bay area, NY	1962	Federal: Emergency	175,000	6,864	$153,900	2
3	Southampton Beach, NY	1962	Federal: Emergency	200,000	5,280	$96,600	2
4	Tiana Beach, NY	1993	Federal: Navigation	500,000	3,000	$1,650,000	189
5	Westhampton Beach, NY	1962	Federal: Emergency	136,500	1,584	$93,600	2
6	Westhampton Beach, NY	1969	Federal: Storm and Erosion	750,000			2
7	Westhampton Beach, NY	1970	Federal: Storm and Erosion	1,100,000			2
8	Westhampton Beach, NY	1984	Federal: Storm and Erosion			$610,000	2
9	Westhampton Beach, NY	1993	Federal: Navigation	1,440,000		$5,364,030	150
10	Westhampton Beach, NY	1996	Federal: Storm and Erosion	4,000,000	12,000	$30,700,000	188
11	Moriches Inlet, NY	1966	Local/Private	677,900			189
12	Moriches Inlet, NY	1969	Local/Private	151,000			189
13	Moriches Inlet, NY	1973	Local/Private	135,000			189
14	Moriches Inlet, NY	1978	Local/Private	218,500			189
15	Great South Beach, NY	1962	Federal: Emergency	993,500	30,624	$844,100	2
16	Great South Beach, NY	1967	Local/Private	135,300			189
17	Great South Beach, NY	1960s	Local/Private	265,900			189
18	Great South Beach, NY	1973	Local/Private	174,100			189
19	Great South Beach, NY	1983	Local/Private	10,000			189
20	Great South Beach, NY	1991	Local/Private	3,000			189
21	Great Gunn Beach, NY	1969	Local/Private	62,400			189
22	Great Gunn Beach, NY	1995	Local/Private	40,000			189
23	Smith Point County Park, NY	1996	Local/Private	600,000			189
24	Brookhaven & Islip, NY	1962	Federal: Emergency	715,000	37,000	$528,600	2
25	Water Island, NY	1996	Local/Private	76,000	1,000	$470,000	189
26	Fire Island Pines, NY	1994	Local/Private	150,000	6,300	$900,000	189
27	Point o Woods, NY	1994	Local/Private	75,000	4,300	$450,000	189
28	Ocean Bay Park, NY	1994	Local/Private	140,000	2,600	$800,000	189
29	Seaview, NY	1994	Local/Private	55,000	3,000	$330,000	189
30	Saltaire/Fairharbor/Dunewood, NY	1994	Local/Private	550,000	8,500	$3,000,000	189
31	Oak Beach, NY	1946					60
32	Oak Beach, Gilgo Beach, Cedar Beach, NY	1946–1959		1,000,000			6
33	Hempstead Beach, NY	1990	Federal: Navigation	353,000	3,000	$2,403,000	189
34	Hempstead Beach, NY	1994	Federal: Navigation	560,000	3,000	$3,771,000	189
35	Hempstead Beach, NY	1995	Federal: Navigation	459,000	3,000	$2,915,000	189
36	Gilgo Beach, NY	1960	Federal: Navigation				7
37	Gilgo Beach, NY	1974	Federal: Navigation	954,000		$797,000	8,264
38	Gilgo Beach, NY	1975	Federal: Navigation	931,310	11,000	$3,335,000	8,9,264
39	Gilgo Beach, NY	1977	Federal: Navigation	2,271,457	11,000	$9,017,963	10,11,264
40	Gilgo Beach, NY	1987	Federal: Navigation				154
41	Gilgo Beach, NY	1989	Federal: Navigation	1,000,000	14,000	$7,348,000	154,189,264
42	Gilgo Beach, NY	1990	Federal: Navigation	797,000	14,000	$4,882,000	189,264
43	Gilgo Beach, NY	1992	Federal: Navigation	1,515,000	14,000	$10,225,000	189,264
44	Gilgo Beach, NY	1994	Federal: Navigation	1,500,000	18,000	$11,183,000	189
45	Jones Beach, NY	1927–1959	State/Local	40,000,000			5
46	Jones Beach, NY	1973	Federal: Navigation				151
47	Jones Beach, NY	1990	Federal: Navigation	388,000	1,000		189
48	Lido Beach, NY	1962	Federal: Emergency	200,000	4,224	$249,500	2
49	Rockaway Beach, NY	1926–1930		5,200,000			12,13
50	Rockaway Beach, NY	1930–1936		5,200,000			12
51	Rockaway Beach, NY	1939	State/Local	400,000	4,752	$60,000	12
52	Rockaway Beach, NY	1958		1,250,000			12
53	Rockaway Beach, NY	1962	Federal: Emergency	175,000	2,112	$135,500	2,12,15
54	Rockaway Beach, NY	1967	State/Local	300,000	3,696		15
55	Rockaway Beach, NY	1975	Federal: Storm and Erosion	3,668,700	15,840	$9,420,556	16,17,18,19
56	Rockaway Beach, NY	1976	Federal: Storm and Erosion	1,489,600	22,176	$2,204,467	17
57	Rockaway Beach, NY	1977	Federal: Storm and Erosion	1,000,000	10,560	$2,500,000	11,17
58	Rockaway Beach, NY	1978	Federal: Emergency	671,300	7,920	$1,200,000	20,21
59	Rockaway Beach, NY	1980	Federal: Storm and Erosion	466,000	3,696	$1,724,000	20,22,23
60	Rockaway Beach, NY	1982	Federal: Storm and Erosion	1,066,400	6,336	$2,716,750	20,24
61	Rockaway Beach, NY	1982	Federal: Storm and Erosion	163,000	1,500	$965,776	24
62	Rockaway Beach, NY	1984	Federal: Storm and Erosion	1,667,900	5,808	$9,732,204	19
63	Rockaway Beach, NY	1986	Federal: Storm and Erosion	1,345,000	6,336	$6,972,540	19,25

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
64	Rockaway Beach, NY	1988	Federal: Storm and Erosion	1,166,000	6,336	$3,406,906	199
65	Rockaway Beach, NY	1994	Federal: Navigation	153,000	3,000	$1,373,000	199
66	Rockaway Beach, NY	1996	Federal: Navigation	340,000	4,000	$2,400,000	199
67	Breezy Point/Roxbury beaches, NY	1994	Federal: Navigation	199,000	7,500	$1,288,000	189
68	Plumb Beach and Belt Parkway, NY	1992	Federal: Navigation	145,000	1,000	$1,329,000	189
69	Coney Island, NY	1923	Local/Private	1,700,000	8,750		152,153
70	Coney Island, NY	1926	Local/Private	850,000	2,500		152,153
71	Coney Island, NY	1941	Local/Private	500,000	12,500		152,153
72	Coney Island, NY	1961	State/Local	750,000	7,000		152,153
73	Coney Island, NY	1995	Federal: Storm and Erosion	2,800,000	18,340	$9,000,000	187,200
New Jersey							
74	Sandy Hook, NJ	1975	Federal: Storm and Erosion	191,447			26
75	Sandy Hook, NJ	1976	Federal: Storm and Erosion	198,276	3,168	$480,150	26,28
76	Sandy Hook, NJ	1977	Federal: Storm and Erosion	200,000	1,056	$770,500	27,28
77	Sandy Hook, NJ	1979	Federal: Storm and Erosion				28
78	Sandy Hook, NJ	1983	Federal: Storm and Erosion	2,370,766		$10,236,161	30,197
79	Sandy Hook, NJ	1984	Federal: Storm and Erosion	800,000		$3,968,965	31,197
80	Sandy Hook, NJ	1990	Federal: Storm and Erosion	3,302,273		$1,350,000	159,197
81	SeaBright-Monmouth Beach, NJ	1963	Federal: Emergency	1,433,000	26,928	$1,418,400	2
82	Sandy Hook-Deal, NJ	1995	Federal: Storm and Erosion	4,400,000	16,368	$19,100,000	149
83	Sandy Hook-Deal, NJ	1996	Federal: Storm and Erosion	4,100,000	12,672	$16,300,000	149
84	Shark River Inlet						6
85	Avon by the Sea, NJ	1950	Federal: Navigation	22,000			158
86	Avon by the Sea, NJ	1960		250,000			158
87	Avon by the Sea, NJ	1971	Federal: Navigation	120,000			158
88	Avon by the Sea, NJ	1982	Federal: Navigation	136,000		$352,240	158,197
89	Avon & Belmar, NJ	1958	State/Local			$226,544	32
90	Spring Lake, NJ	1969	State/Local			$112,728	32
91	Spring Lake/Belmar, NJ	1994	State/Local	70,000	1,180	$347,199	193,197
92	Sea Girt, NJ	1962	Federal: Emergency			$25,751	32
93	Sea Girt, NJ	1966	Federal: Storm and Erosion	425,211		$552,774	33
94	Bay Head, NJ	1963	Federal: Emergency			$217,551	32
95	Lavalette, NJ	1963	Federal: Emergency			$186,225	32
96	Seaside Heights, NJ	1963	Federal: Emergency			$154,498	32
97	Seaside Park, NJ	1963	Federal: Emergency			$99,443	32
98	Berkely Township, NJ	1962	Federal: Emergency			$12,628	32
99	Berkely Township, NJ	1968	State/Local			$71,566	32
100	South Seaside Park, NJ	1978	State/Local				34
101	Barnegat Light, NJ	1963	Federal: Emergency			$67,309	32
102	Barnegat Light, NJ	1966	State/Local			$65,481	32
103	Barnegat Light, NJ	1991	Federal: Navigation	75,000			197
104	Long Beach Island, NJ	pre-1963	Federal: Storm and Erosion	60,000			35
105	Long Beach Island, NJ	post-1972	Federal: Navigation				36
106	Long Beach Island, NJ	1979	Federal: Emergency	1,000,000	14,784	$4,600,000	37
107	Harvey Cedars, NJ	1962	Federal: Emergency	715,000	19,008	$759,700	2
108	Harvey Cedars, NJ	1963	Federal: Emergency			$282,770	32
109	Harvey Cedars, NJ	1967	State/Local			$39,484	32
110	Harvey Cedars, NJ	1990		27,300		$34,957	197
111	Harvey Cedars, NJ	1992		110,000			197
112	Harvey Cedars & Long Beach Township, NJ	1994	State/Local	660,000		$3,700,000	194,197
113	Surf City, NJ	1963	State/Local				32
114	Ship Bottom, NJ	1956	State/Local	182,000			38
115	Ship Bottom, NJ	1963	Federal: Emergency			$161,659	32
116	Brant Beach, NJ	1956	State/Local	115,000			38
117	Union Township, NJ	1966	State/Local			$12,142	32
118	Island Heights, NJ	1962	Federal: Emergency			$18,300	32
119	Long Beach, NJ	1959	State/Local			$72,025	32
120	Long Beach, NJ	1962	Federal: Emergency			$28,690	32
121	Long Beach, NJ	1963	Federal: Emergency			$1,008,050	32
122	Brigantine, NJ	1962	Federal: Emergency			$70,589	2
123	Brigantine, NJ	1963	Federal: Emergency	392,500	17,952	$503,700	39
124	Brigantine, NJ	1996	State/Local	1,200,000			195
125	Atlantic City, NJ	1936		792,000			14
126	Atlantic City, NJ	1937		900,000			14

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
127	Atlantic City, NJ	1938		500,000			14
128	Atlantic City, NJ	1942	Federal: Storm and Erosion	1,362,000			14
129	Atlantic City, NJ	1948	Federal: Storm and Erosion	1,073,684	5,808		14,40
130	Atlantic City, NJ	1963	Federal: Storm and Erosion	580,000	3,696		41,42,43
131	Atlantic City, NJ	1970	Federal: Emergency	830,000	4,752		41,43,44
132	Atlantic City, NJ	1979	State/Local	48,158			39,40
133	Atlantic City, NJ	1983		75,000		$358,250	197
134	Atlantic City, NJ	1986	State/Local	1,000,000		$7,000,000	45,46,47
135	Longport, NJ	1990	Federal: Navigation	250,000		$949,000	197
136	Ocean City, NJ	1952	Federal: Storm and Erosion	2,550,000	9,504	$1,912,500	48
137	Ocean City, NJ	1959	Federal: Storm and Erosion	1,618,000		$469,008	48,49
138	Ocean City, NJ	1962	Federal: Emergency				49
139	Ocean City, NJ	1966	State/Local				50
140	Ocean City, NJ	1970	State/Local	475,270			49
141	Ocean City, NJ	1971	State/Local	237,900			49
142	Ocean City, NJ	1972	State/Local	543,650			49
143	Ocean City, NJ	1973	State/Local	347,341			49
144	Ocean City, NJ	1974	State/Local	167,549			49
145	Ocean City, NJ	1975	State/Local	166,799			49
146	Ocean City, NJ	1976	State/Local	81,656			49
147	Ocean City, NJ	1977	State/Local	169,949			49
148	Ocean City, NJ	1978	State/Local	121,686			49
149	Ocean City, NJ	1979	State/Local	124,702			49
150	Ocean City, NJ	1980	State/Local	150,015		$647,147	49
151	Ocean City, NJ	1982	State/Local	1,200,000		$5,200,000	49,51
152	Ocean City, NJ	1992	Federal: Storm and Erosion	2,600,000	9,500	$10,915,970	196
153	Ocean City, NJ	1993	Federal: Storm and Erosion	2,800,000	9,500	$14,571,909	196
154	Ocean City, NJ	1993	Federal: Emergency	846,000		$2,915,131	196
155	Ocean City, NJ	1994	Federal: Storm and Erosion	606,000	6,336	$3,217,825	196
156	Ocean City, NJ	1995	Federal: Storm and Erosion	1,411,000	24,816	$5,749,776	196
157	Ocean City, NJ	1995	State/Local	360,000	10,560	$1,232,572	196
158	Ludlum Beach Island, NJ	1962	Federal: Emergency	905,082	35,376	$809,300	2
159	Upper Township, NJ	1966	State/Local				50
160	Upper Township, NJ	1981		36,000		$93,240	197
161	Upper Township, NJ	1984	State/Local	1,600,000			52,197
162	Upper Township, NJ	1984		120,000		$2,453,600	197
163	Upper Township, NJ	1992		23,000			197
164	Strathmere, NJ	1982	Local/Private	45,000		$90,000	53,197
165	Strathmere, NJ	1984		450,000		$2,986,679	197
166	Strathmere, NJ	1984		592,000		$3,929,142	197
167	Sea Isle City, NJ	1965	State/Local			$63,845	50
168	Sea Isle City, NJ	1981		20,880		$54,080	197
169	Sea Isle City, NJ	1983	State/Local	45,000		$194,294	197
170	Sea Isle City, NJ	1984	State/Local	800,000		$3,652,500	197
171	Sea Isle City, NJ	1987		158,000		$528,244	136,197
172	Avalon, NJ	1987	State/Local	1,305,000	6,000	$2,873,940	61,157, 192,197
173	Avalon, NJ	1990	Local/Private	404,000	2,500	$600,000	157,192
174	Avalon, NJ	1992	Local/Private	410,000	3,000	$1,188,000	192
175	Avalon, NJ	1993	Federal: Emergency	239,000	2,800	$1,777,193	192
176	Stone Harbor, NJ	1968	State/Local			$255,464	50
177	North Wildwood, NJ	1966	State/Local			$5,698	50
178	North Wildwood, NJ	1989	State/Local	190,000		$875,000	157,197
179	Wildwood, NJ	1963	Federal: Emergency			$24,298	50
180	Wildwood, NJ	1991	Federal: Navigation	100,000			157
181	Lower Township, NJ	1969	State/Local			$89,455	50
182	Lower Township, NJ	1986	State/Local	87,000			197
183	Cape May, NJ	1962	Federal: Emergency	156,656	8,448	$358,600	2
184	Cape May, NJ	1967	State/Local			$2,427	50
185	Cape May, NJ	1969	State/Local			$256,495	50
186	Cape May, NJ	1981		36,000		$93,000	197
187	Cape May, NJ	1989	Federal: Storm and Erosion	465,000	3,600	$3,158,000	198
188	Cape May, NJ	1991	Federal: Storm and Erosion	900,000	8,000	$4,380,000	198
189	Cape May, NJ	1992		500,000			197
190	Cape May, NJ	1993	Federal: Storm and Erosion	415,000	4,800	$4,561,000	198
191	Cape May, NJ	1993	Federal: Emergency	300,000		$2,135,000	198
192	Cape May, NJ	1995	Federal: Storm and Erosion	330,000	4,800	$2,605,000	198

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
193	Cape May Point, NJ	1992	State/Local	42,000			197
194	Cape May State Park, NJ	1986		15,000		$272,618	197
195	Cape May State Park, NJ	1992		200,000		$261,905	197
Delaware							
196	Fort Miles, DE	1962	Federal: Emergency	95,400	8,400	$46,300	271
197	North Shores, DE	1962	Federal: Emergency	69,400	4,900	$36,100	271
198	Rehoboth Beach, DE	1962	Federal: Emergency	216,200	5,000	$318,900	271
199	Dewey Beach, DE	1962	Federal: Emergency	82,000	3,550	$132,500	190
200	Dewey Beach, DE	1993	State/Local	5,755	1,900	$30,210	190
201	Dewey Beach, DE	1994	State/Local	573,874	6,000	$2,342,230	185,190
202	Dewey Beach, DE	1994	Federal: Storm and Erosion	14,004	1,385	$60,000	190
203	North Indian Beach, DE	1994	Private	21,000	403	$61,400	190
204	Indian Beach, DE	1962	Federal: Emergency	148,700	18,500	$94,700	271
205	Indian Beach, DE		Private	4,800	154	$20,435	271
206	North Indian River Inlet, DE	1957	Federal: Storm and Erosion	512,400		$316,500	271
207	North Indian River Inlet, DE	1961	Federal: Navigation	48,000			190
208	North Indian River Inlet, DE	1962	Federal: Emergency	290,000	8,400	$182,600	190
209	North Indian River Inlet, DE	1963	Federal: Storm and Erosion	590,300		$374,900	190
210	North Indian River Inlet, DE	1965	Federal: Navigation	90,000			190
211	North Indian River Inlet, DE	1972	Federal: Storm and Erosion	774,300	5,000	$637,200	190,201
212	North Indian River Inlet, DE	1974	Federal: Emergency				190
213	North Indian River Inlet, DE	1975	Federal: Storm and Erosion	142,500	5,000	$276,600	190,201
214	North Indian River Inlet, DE	1978	Federal: Emergency	535,400	5,000	$714,600	190,201
215	North Indian River Inlet, DE	1982	State	223,900			190
216	North Indian River Inlet, DE	1984	Federal: Emergency	540,000			190,201
217	North Indian River Inlet, DE	1990	State	175,000			190,200
218	North Indian River Inlet, DE	1991	State	68,900			200
219	North Indian River Inlet, DE	1992	State	40,000			190,200
220	Beach Cove-Bethany Beach, DE	1962	Federal: Emergency	37,100	9,504	$32,900	2
221	Bethany Beach, DE	1961	Federal: Storm and Erosion	100,000			190
222	Bethany Beach, DE	1962	Federal: Emergency	69,700		$138,400	190
223	Bethany Beach, DE	1989	State	284,500	5,138	$1,630,241	190
224	Bethany Beach, DE	1992	State	219,735	5,138	$1,037,303	190
225	Bethany Beach, DE	1994	State/Local	184,452	4,150	$838,953	190
226	South Bethany-York Beaches, DE	1962	Federal: Emergency	65,000	24,816	$119,000	2
227	South Bethany, DE	1989	State	231,600	4,158	$1,307,849	190
228	South Bethany, DE	1992	State	192,749	4,850	$905,786	190
229	South Bethany, DE	1994	State/Local	98,419	2,550	$452,165	190
230	York Beach-Fenwick Island, DE	1962	Federal: Emergency	297,700	15,200	$454,900	190
231	Fenwick Island, DE	1962	Federal: Emergency	67,600		$121,900	190
232	Fenwick Island, DE	1988	State	333,500	6,000	$1,572,993	190
233	Fenwick Island, DE	1991	Federal: Storm and Erosion	126,800	1,600	$443,603	190
234	Fenwick Island, DE	1992	Federal: Storm and Erosion	37,000	1,690	$269,234	190
235	Fenwick Island, DE	1992	State	144,900	4,150	$716,916	190
236	Fenwick Island, DE	1994	Federal: Emergency	68,236	2,300	$369,809	190
Maryland							
237	Ocean City, MD	1963	Federal: Emergency	1,050,000	42,240	$1,517,600	2
238	Ocean City, MD	1988	State/Local	2,700,000	36,960	$14,200,000	182
239	Ocean City, MD	1991	Federal: Storm and Erosion	3,800,000	36,960	$15,003,269	182
240	Ocean City, MD	1992	Federal: Emergency	1,221,388		$10,800,000	164,182
241	Ocean City, MD	1993	Federal: Emergency	223,515		$960,000	182
242	Ocean City, MD	1994	Federal: Emergency	1,300,000		$8,800,000	182
Virginia							
243	Virginia Beach, VA	1951	Federal: Storm and Erosion	20,000			59,175,178
244	Virginia Beach, VA	1952	Federal: Storm and Erosion	1,320,000			59,175,178
245	Virginia Beach, VA	1953	Federal: Storm and Erosion	94,000		$722,163	59,175,178,179
246	Virginia Beach, VA	1954	Local/Private	17,500			175,178
247	Virginia Beach, VA	1955	Local/Private	115,100			56,175,178
248	Virginia Beach, VA	1956	Local/Private	115,100			56,175,178
249	Virginia Beach, VA	1957	Local/Private	115,100			56,175,178
250	Virginia Beach, VA	1958	Local/Private	115,100			56,178
251	Virginia Beach, VA	1959	Local/Private	115,100			56,178
252	Virginia Beach, VA	1960	Local/Private	115,100			56,178
253	Virginia Beach, VA	1961	Local/Private	115,100			56,178
254	Virginia Beach, VA	1962	Federal: Emergency	472,000			59,178

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
255	Virginia Beach, VA	1963	Federal: Storm and Erosion	181,100	18,480	$168,000	56,175,178
256	Virginia Beach, VA	1964	Federal: Storm and Erosion	181,100	18,480	$166,000	56,175,178
257	Virginia Beach, VA	1965	Federal: Storm and Erosion	181,100	18,480	$176,439	56,175,178
258	Virginia Beach, VA	1966	Federal: Storm and Erosion	181,100	18,480	$178,256	56,57,178,180
259	Virginia Beach, VA	1967	Federal: Storm and Erosion	181,100	18,480	$205,664	56,57,178,180
260	Virginia Beach, VA	1968	Federal: Storm and Erosion	147,400	18,480	$209,030	56,57,178,180
261	Virginia Beach, VA	1969	Federal: Storm and Erosion	100,500	18,480	$232,757	56,178,180
262	Virginia Beach, VA	1970	Federal: Storm and Erosion	283,800	18,480	$211,951	56,178,180
263	Virginia Beach, VA	1971	Federal: Storm and Erosion	230,600	18,480	$363,892	56,178,180
264	Virginia Beach, VA	1972	Federal: Storm and Erosion	489,800	18,480	$427,097	56,58,178,180
265	Virginia Beach, VA	1973	Federal: Storm and Erosion	358,600	18,480		56,58,178,180
266	Virginia Beach, VA	1974	Federal: Storm and Erosion	165,500	18,480		56,178,180
267	Virginia Beach, VA	1975	Federal: Storm and Erosion	273,430	18,480	$1,979,376	56,178,180
268	Virginia Beach, VA	1976	Federal: Storm and Erosion	241,210	18,480		56,178,180
269	Virginia Beach, VA	1977	Federal: Storm and Erosion	289,488	18,480		59,178,180
270	Virginia Beach, VA	1978	Federal: Storm and Erosion	259,992	18,480		59,178,180
271	Virginia Beach, VA	1979	Federal: Storm and Erosion	295,040	18,480		59,178,180
272	Virginia Beach, VA	1980	Federal: Storm and Erosion	266,150	18,480	$1,866,140	59,178,180
273	Virginia Beach, VA	1981	Federal: Storm and Erosion	332,494	18,480		59,178,180
274	Virginia Beach, VA	1982	Federal: Storm and Erosion	319,578	18,480		59,178,180
275	Virginia Beach, VA	1983	Federal: Storm and Erosion	317,395	18,480		59,178,180
276	Virginia Beach, VA	1984	Federal: Storm and Erosion	351,399	18,480	$2,889,770	59,178,180
277	Virginia Beach, VA	1985	Federal: Storm and Erosion	384,453	18,480		59,178
278	Virginia Beach, VA	1986	Federal: Storm and Erosion	396,066	18,480		59,178
279	Virginia Beach, VA	1987	Local/Private	306,682	18,480	$1,271,000	178
280	Virginia Beach, VA	1988	Local/Private	160,071	18,480		178
281	Virginia Beach, VA	1989	Federal: Navigation	1,200,000	18,480		178
282	Virginia Beach, VA	1990	Local/Private	94,586	18,480		178
283	Virginia Beach, VA	1991	Local/Private	195,419	18,480		178
284	Virginia Beach, VA	1992	Local/Private	265,659	18,480		178
285	Virginia Beach, VA	1993	Local/Private	311,790	18,480		178
286	Virginia Beach, VA	1994	Local/Private	303,318	18,480	$800,000	178
287	Virginia Beach, VA	1995	Federal: Storm and Erosion	289,450	18,480	$962,000	176
288	Virginia Beach, VA	1996	Federal: Storm and Erosion	300,000	18,480	$1,100,000	177,178
289	Dam Neck Naval Base, VA	1996	Federal: Storm and Erosion	808,000	9,200	$3,800,000	184
290	Sandbridge, VA	1962	Federal: Emergency	262,000	11,088	$508,700	2
North Carolina							
291	Pea Island, NC	1990	Federal: Navigation	254,955	2,000		183
292	Pea Island, NC	1991	Federal: Navigation	282,600	2,500		183
293	Pea Island, NC	1992	Federal: Navigation	184,300	4,000		183
294	Pea Island, NC	1992	Federal: Navigation	1,078,000	5,400		183
295	Pea Island, NC	1993	Federal: Navigation	433,235	2,500		183
296	Pea Island, NC	1995	Federal: Navigation	250,000	2,000	$1,674,992	183
297	Hatteras Island, NC	1974	Federal: Navigation	135,293	1,353	$164,818	183
298	Hatteras Island, NC	1977	Federal: Navigation	97,029	970	$248,521	183
299	Hatteras Island, NC	1984	Federal: Navigation	29,972	300	$155,625	183
300	Hatteras Island, NC	1986	Federal: Navigation	90,114	901	$303,195	183
301	Hatteras Island, NC	1988	Federal: Navigation	74,646	746	$359,861	183
302	Hatteras Island, NC	1992	Federal: Navigation	18,147	1 81	$184,840	183
303	Cape Hatteras, NC	1966	Federal: Storm and Erosion	312,000			63
304	Cape Hatteras, NC	1972	Federal: Storm and Erosion	200,000			63
305	Cape Hatteras, NC	1973	Federal: Storm and Erosion	1,300,000	7,920	$4,000,000	64,65
306	Ocracoke Island, NC	1986	Federal: Navigation	167,755	1,678	$471,410	207
307	Ocracoke Island, NC	1988	Federal: Navigation	90,773	908	$420,821	207
308	Ocracoke Island, NC	1989	Federal: Navigation	113,229	1,132	$557,830	183
309	Ocracoke Island, NC	1992	Federal: Navigation	100,000	1,000	$653,748	183
310	Ocracoke Island, NC	1995	Federal: Navigation	44,305		$145,135	183
311	Fort Macon/Atlantic Beach, NC	1973	Federal: Navigation	504,266	5,043	$414,807	183
312	Fort Macon/Atlantic Beach, NC	1978	Federal: Navigation	1,179,739	11,797	$1,565,177	66
313	Fort Macon/Atlantic Beach, NC	1986	Federal: Navigation	1,912,894	39,129	$5,316,038	67
314	Fort Macon/Atlantic Beach, NC	1990	Federal: Navigation	312,522	4,000	$1,663,911	183
315	Fort Macon/Atlantic Beach, NC	1994	Federal: Navigation	2,473,727	24,737	$3,794,727	183
316	Emerald Isle, NC	1989	Federal: Navigation	45,399			207
317	West Onslow Beach, NC	1990	Federal: Navigation	101,653	4,000	$417,984	207
318	Topsail Island, NC	1982	Federal: Navigation	51,715			207
319	Topsail Island, NC	1988	Federal: Navigation	151,017		$423,256	207

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
320	Topsail Island, NC	1992	Federal: Navigation	75,519	755	$177,830	183
321	Topsail Island, NC	1993	Federal: Navigation	80,162	802	$269,659	183
322	Topsail Island, NC	1995	Federal: Navigation	38,883	389	$269,659	183
323	Figure Eight Island, NC	1979	Federal: Navigation				207
324	Figure Eight Island, NC	1985	Local/Private	46,300	2,000		68
325	Figure Eight Island, NC	1986	Local/Private	250,000	2,000		69
326	Figure Eight Island, NC	1993	Local/Private	275,000	3,000		205,208
327	Wrightsville Beach, NC	1939		700,000	13,728	$98,000	14,70
328	Wrightsville Beach, NC	1955		38,000			71
329	Wrightsville Beach, NC	1956	State/Local	35,000			71
330	Wrightsville Beach, NC	1957		304,000			71
331	Wrightsville Beach, NC	1959		100,000	7,920		71
332	Wrightsville Beach, NC	1965	Federal: Storm and Erosion	2,993,100	14,000	$739,339	36,72,73
333	Wrightsville Beach, NC	1966	Federal: Storm and Erosion	362,108	12,000	$255,941	72,74,75
334	Wrightsville Beach, NC	1970	Federal: Storm and Erosion	1,436,533	8,000	$578,545	76,77
335	Wrightsville Beach, NC	1980	Federal: Emergency	540,715	8,000	$1,030,736	78
336	Wrightsville Beach, NC	1980	Federal: Navigation	36,108			207
337	Wrightsville Beach, NC	1981	Federal: Storm and Erosion	1,249,699	8,000	$4,427,792	78
338	Wrightsville Beach, NC	1982	Federal: Navigation	124,533			207
339	Wrightsville Beach, NC	1983	Federal: Navigation	93,755			207
340	Wrightsville Beach, NC	1985	Federal: Navigation	19,399			207
341	Wrightsville Beach, NC	1986	Federal: Navigation	898,593	6,864	$1,331,715	79,80
342	Wrightsville Beach, NC	1987	Federal: Navigation	76,556			207
343	Wrightsville Beach, NC	1989	Federal: Navigation	96,771			207
344	Wrightsville Beach, NC	1991	Federal: Storm and Erosion	1,016,684	6,864	$2,682,412	183
345	Wrightsville Beach, NC	1994	Federal: Storm and Erosion	619,031	6,400	$1,973,591	183
346	Masonboro Island, NC	1986	Federal: Navigation	1,997,521	5,000		79
347	Masonboro Island, NC	1994	Federal: Navigation	362,009	2,400		208
348	Carolina Beach, NC	1955	Federal: Storm and Erosion	252,000		$50,000	81,82
349	Carolina Beach, NC	1956	State/Local	200,000			81,82
350	Carolina Beach, NC	1965	Federal: Storm and Erosion	3,597,362	10,032	$925,506	35
351	Carolina Beach, NC	1967	Federal: Storm and Erosion	389,959	4,224	$186,308	183
352	Carolina Beach, NC	1967	Federal: Navigation	115,000			207
353	Carolina Beach, NC	1968	Federal: Navigation	97,000			75
354	Carolina Beach, NC	1970	Federal: Emergency	282,423	4,224	$291,159	75,76,83
355	Carolina Beach, NC	1971	Federal: Storm and Erosion	734,140	11,600	$517,897	75,85
356	Carolina Beach, NC	1972	Federal: Navigation	18,816	182		207
357	Carolina Beach, NC	1973	Federal: Navigation	30,547			207
358	Carolina Beach, NC	1974	Federal: Navigation	66,687			207
359	Carolina Beach, NC	1975	Federal: Navigation	40,804			207
360	Carolina Beach, NC	1976	Federal: Navigation	119,971			207
361	Carolina Beach, NC	1977	Federal: Navigation	62,066			207
362	Carolina Beach, NC	1979	Federal: Navigation	230,866			207
363	Carolina Beach, NC	1980	Federal: Navigation	38,075			207
364	Carolina Beach, NC	1981	Federal: Navigation	109,176		$174,002	207
365	Carolina Beach, NC	1981	Federal: Emergency	406,352		$1,051,774	22,81
366	Carolina Beach, NC	1982	Federal: Storm and Erosion	3,662,181	14,256	$8,384,406	86,87
367	Carolina Beach, NC	1983	Federal: Navigation	119,244			207
368	Carolina Beach, NC	1985	Federal: Navigation	28,267			207
369	Carolina Beach, NC	1985	Federal: Storm and Erosion	764,162	6,000	$1,652,004	88
370	Carolina Beach, NC	1988	Federal: Storm and Erosion	950,913	5,700	$1,890,535	183
371	Carolina Beach, NC	1989	Federal: Navigation	98,843			208
372	Carolina Beach, NC	1991	Federal: Storm and Erosion	1,008,736	11,600	$2,450,286	183
373	Carolina Beach, NC	1995	Federal: Storm and Erosion	1,157,742	11,600	$3,185,642	183
374	Bald Head Island, NC	1992	Federal: Navigation	800,000	12,300	$900,000	203
375	Bald Head Island, NC	1996	Local/Private	715,000	13,000	$2,860,000	204,208
376	Long Beach, NC	1986	Federal: Navigation	130,000		$215,000	89,90,91
377	Long Beach, NC	1989	Federal: Navigation	104,803			208
378	Long Beach, NC	1993	Federal: Navigation	160,091	1,601	$1,389,987	208
379	Holden Beach, NC	1971	Federal: Navigation	108,802	1,088	$70,259	207
380	Holden Beach, NC	1973	Federal: Navigation	108,627			207
381	Holden Beach, NC	1974	Federal: Navigation	92,774			207
382	Holden Beach, NC	1975	Federal: Navigation	62,303			207
383	Holden Beach, NC	1977	Federal: Navigation	76,149			207
384	Holden Beach, NC	1984	Federal: Navigation	76,867			207
385	Holden Beach, NC	1986	Federal: Navigation	95,927			207

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
386	Holden Beach, NC	1987	Federal: Navigation	173,963			207
387	Ocean Isle, NC	1974	Federal: Navigation	82,831			207
388	Ocean Isle, NC	1976	Federal: Navigation	20,925			207
389	Ocean Isle, NC	1980	Federal: Navigation	37,325			207
390	Ocean Isle, NC	1983	Federal: Navigation	54,905			207
391	Ocean Isle, NC	1984	Federal: Navigation	38,880			207
392	Ocean Isle, NC	1986	Federal: Navigation	30,630			207
393	Ocean Isle, NC	1989	Federal: Navigation	48,614			207
South Carolina							
394	North Myrtle Beach, SC	1990	Federal: Emergency	377,200		$1,950,000	167,211,212,213,214
395	Myrtle Beach, SC	1987	State/Local	850,000	31,680	$4,500,000	92,214,215
396	Myrtle Beach, SC	1990	Federal: Emergency	380,000		$2,600,000	167,211,212,213,214
397	Huntington Beach, SC	1988	Federal: Navigation	450,000	10,000	$900,000	214,215
398	Surfside, SC	1990	Federal: Emergency	70,000	5,000	$581,250	167,211,212,213,214
399	Garden City, SC	1990	Federal: Emergency	163,500	13,500	$1,640,000	211,212,213,214
400	Pawleys Island, SC	1988	State/Local	60,000			211,212,213,214
401	Pawleys Island, SC	1990	Federal: Emergency	220,000	16,200	$612,000	167,211,212,213,214
402	Debidue Island, SC	1990		180,000	8,000	$900,000	215
403	Edisto Beach, SC	1954	State/Local	830,000	4,752		214,215
404	Edisto Beach, SC	1995	State/Local			$1,500,000	214,215
405	Isle of Palms, SC	1983	Local/Private	175,000	4,000	$175,000	214,215
406	Isle of Palms, SC	1984	Local/Private	350,000	5,000	$1,000,000	167,212,213
407	Folly Beach, SC	1982–1988	Federal: Storm and Erosion	305,560	1,000	$500,000	168
408	Folly Beach, SC	1990	Federal: Emergency			$350,000	214,215
409	Folly Beach, SC	1993	Federal: Storm and Erosion	2,641,818	28,215	$7,184,000	214,215
410	Seabrook Island, SC	1982	Local/Private	75,000	3,000		214,215
411	Seabrook Island, SC	1983	Local/Private	1,230,000	16,500		93
412	Seabrook Island, SC	1990	Local/Private	700,000	6,000	$1,500,000	209
413	Hunting Island, SC	1968	Federal: Storm and Erosion	750,000	9,850	$609,000	94,95,216
414	Hunting Island, SC	1971	Federal: Storm and Erosion	761,324	9,850	$534,000	95,216
415	Hunting Island, SC	1975	Federal: Storm and Erosion	613,000	8,860	$872,000	94,95,216
416	Hunting Island, SC	1980	Federal: Storm and Erosion	1,400,000	20,000	$2,107,053	96,97,214,215,216
417	Hunting Island, SC	1991	State/Local	757,644	7,800	$2,876,250	165,166
418	Hilton Head Island, SC	pre-1973	Local/Private	2,107,053			218
419	Hilton Head Island, SC	1980	Local/Private	550,000	15,000	$1,100,000	214,215
420	Hilton Head Island, SC	1982	Local/Private	800,000			98
421	Hilton Head Island, SC	1990	State/Local	2,340,000	35,000	$9,700,000	215,217,218
Georgia							
422	Tybee Island, GA	1976	Federal: Storm and Erosion	2,300,000	18,480	$3,600,000	99,100,101,219,220
423	Tybee Island, GA	1987	Federal: Storm and Erosion	1,360,000	14,500	$3,700,000	102,219,220
424	Tybee Island, GA	1994	Federal: Navigation	2,000,000			222
425	Tybee Island, GA	1995	Federal: Storm and Erosion	300,000		$1,860,000	221,222
426	Sea Island, GA	1964	Federal: Storm and Erosion	150,000	4,224	$175,000	103
427	Sea Island, GA	1977	Local/Private	100,000	400		223,224
428	Sea Island, GA	1986	Local/Private	250,000	2,640		223,224
429	Sea Island, GA	1990	Local/Private	2,000,000	10,560	$6,000,000	223,224
Florida							
430	Fernandina Beach, FL	1979	Federal: Navigation	1,000,000	9,000		174,228
431	Fernandina Beach, FL	1982	Federal: Navigation	395,000			174,231
432	Fernandina Beach, FL	1990	Federal: Navigation	147,693			231
433	Fernandina Beach, FL	1993	Federal: Navigation	654,000		$3,905,230	230,236
434	Fernandina Beach, FL	1996	Federal: Navigation	84,446			236
435	Amelia Island, FL	1983		76,000			229
436	Amelia Island, FL	1987	Federal: Navigation	1,000,000			174
437	Amelia Island, FL	1989	Federal: Navigation	750,000			229
438	Amelia Island, FL	1994	Local/Private	2,159,096	1,700	$3,500,000	225,226
439	Mayport/Kathryn Abby Hanna Park, FL	1966					227
440	Mayport/Kathryn Abby Hanna Park, FL	1972	Federal: Navigation	1,600,000			105,227
441	Mayport/Kathryn Abby Hanna Park, FL	1974	Federal: Navigation	400,000	7,920		105,227,233
442	Mayport/Kathryn Abby Hanna Park, FL	1980	Federal: Navigation	823,000			174

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
443	Mayport/Kathryn Abby Hanna Park, FL	1985	Federal: Navigation	1,284,000		$2,022,000	227,233,264
444	Mayport/Kathryn Abby Hanna Park, FL	1990	Federal: Navigation	422,000			233
445	Mayport/Kathryn Abby Hanna Park, FL	1994	Federal: Navigation	700,000			233
446	Jacksonville Beach, FL	1963	Federal: Emergency	320,000			93
447	Jacksonville Beach, FL	1974	Federal: Navigation				33
448	Jacksonville Beach, FL	1978	Federal: Storm and Erosion	1,268,000		$4,311,000	105,106,233,234
449	Jacksonville Beach, FL	1980	Federal: Storm and Erosion	1,218,000		$2,120,000	105,106,233,234
450	Jacksonville Beach, FL	1986	Federal: Storm and Erosion	309,000	26,400	$1,493,000	233,264
451	Jacksonville Beach, FL	1987	Federal: Storm and Erosion	850,000		$2,427,000	233,234,264
452	Jacksonville Beach, FL	1992	Federal: Storm and Erosion	370,000	8,800	$2,070,000	233,264
453	Jacksonville Beach, FL	1996	Federal: Storm and Erosion	1,240,000	39,600	$7,400,000	233
454	Anastasia State Park/ St Augustine, FL	1963	Federal: Emergency	50,000		$95,000	93
455	Anastasia State Park/ St Augustine, FL	1996	Federal: Storm and Erosion	292,000		$3,584,360	235
456	Ponce Inlet (North Beach), FL	1974	Federal: Storm and Erosion	89,167			236
457	Ponce Inlet (North Beach), FL	1978	Federal: Storm and Erosion	434,558			236
458	Ponce Inlet (North Beach), FL	1984	Federal: Storm and Erosion	82,212			236
459	Ponce Inlet (North Beach), FL	1985	Federal: Storm and Erosion	899,996			236
460	Ponce Inlet (North Beach), FL	1989	Federal: Storm and Erosion	868,967			236
461	Ponce Inlet (North Beach), FL	1996	Federal: Storm and Erosion				236
462	Cape Canaveral/Cocoa Beach, FL	1966	Federal: Navigation	120,000			265
463	Cape Canaveral/Cocoa Beach, FL	1972	Federal: Storm and Erosion	200,000			94
464	Cape Canaveral/Cocoa Beach, FL	1975	Federal: Navigation	2,715,000	11,088	$1,050,000	108,109,237
465	Cape Canaveral/Cocoa Beach, FL	1994	Federal: Storm and Erosion	100,000	5,100	$190,000	269
466	Cape Canaveral/Cocoa Beach, FL	1995	Federal: Navigation	742,000			238
467	Cocoa Beach, FL	1996	Federal: Storm and Erosion	40,000	2,500	$341,000	269
468	Patrick Air Force Base, FL	1985	Federal: Storm and Erosion	180,000	21,120		237
469	Patrick Air Force Base, FL	1996	Federal: Storm and Erosion	100,000	18,000	$1,300,000	269
470	Indialantic/Melbourne Beach, FL	1981	Federal: Storm and Erosion	540,000	11,088	$3,582,000	110,111
471	Indialantic/Melbourne Beach, FL	1985		180,000			237
472	Sebastian Inlet (South Beach), FL	1972	State/Local	423,684		$195,998	111,239
473	Sebastian Inlet (South Beach), FL	1978	State/Local	187,600		$599,900	239
474	Sebastian Inlet (South Beach), FL	1986	State/Local	110,038	3,168	$287,779	112,239
475	Sebastian Inlet (South Beach), FL	1989	State/Local	100,000		$174,500	239
476	Sebastian Inlet (South Beach), FL	1990	State/Local	235,000		$735,450	239
477	Sebastian Inlet (South Beach), FL	1993	State/Local	116,520		$675,093	239
478	Vero Beach, FL	1979	State/Local				114
479	Vero Beach, FL	1984	State/Local				115
480	Ft Pierce (South Beach), FL	1971	Federal: Storm and Erosion	718,000	6,864	$621,288	94,108
481	Ft Pierce (South Beach), FL	1974	Federal: Navigation	36,000			264
482	Ft Pierce (South Beach), FL	1978	Federal: Navigation	49,800	6,864	$315,591	240
483	Ft Pierce (South Beach), FL	1980	Federal: Storm and Erosion	426,000		$1,428,000	264
484	Ft Pierce (South Beach), FL	1983	Federal: Storm and Erosion	346,000	6,864	$1,559,431	267
485	Ft Pierce (South Beach), FL	1987	Federal: Navigation	29,800	6,864	$259,561	240
486	Ft Pierce (South Beach), FL	1989	Federal: Navigation	47,800	6,864	$394,400	240
487	Ft Pierce (South Beach), FL	1990	Federal: Navigation	55,700	6,864		240
488	Ft Pierce (South Beach), FL	1994	Federal: Navigation	7,190			236
489	Ft Pierce (South Beach), FL	1995	Federal: Navigation	166,650			236
490	Hutchinson Island, FL	1996	Federal: Storm and Erosion	1,340,000	21,648	$11,168,529	266
491	St Lucie Inlet, FL	1980					174
492	St Lucie Inlet, FL	1985					174
493	St Lucie Inlet, FL	1989					174
494	Jupiter Island, FL	1957	State/Local	250,000			93,173
495	Jupiter Island, FL	1961	Federal: Navigation	366,000			173
496	Jupiter Island, FL	1963		64,644	2,112		94,173
497	Jupiter Island, FL	1964		118,312			94,173
498	Jupiter Island, FL	1967		60,000		$30,000	94,117,173
499	Jupiter Island, FL	1970–72	Federal: Navigation	280,000			173
500	Jupiter Island, FL	1974	Local/Private	3,488,759	25,872	$4,046,960	117,118,173,249
501	Jupiter Island, FL	1978	Local/Private	1,327,289	26,400		118,119,120,173,249
502	Jupiter Island, FL	1983	Local/Private	1,000,000	26,400	$2,400,000	119,121,173,249
503	Jupiter Island, FL	1987	Local/Private	2,230,000	17,500	$3,500,000	147,148,249

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
504	Jupiter Island, FL	1991		414,812			246
505	Jupiter Island, FL	1993		203,736			246
506	Jupiter Island, FL	1996	Local/Private	1,800,000	17,600		246
507	Jupiter Inlet (South Beach), FL		Federal: Storm and Erosion	60,000			249
508	Jupiter/Carlin Beach, FL	1995	Federal: Storm and Erosion	603,000	5,702	$2,274,400	243,249,256
509	Juno Beach, FL	1996	Federal: Navigation	135,000	30,096	$1,455,000	235,249
510	Lake Worth Inlet (South Beach), FL	1944		280,000			241,246
511	Lake Worth Inlet (South Beach), FL	1948		2,335,300			241,246
512	Lake Worth Inlet (South Beach), FL	1949		480,000			241,246
513	Lake Worth Inlet (South Beach), FL	1953		463,000			241,246
514	Lake Worth Inlet (South Beach), FL	1970		61,949			241,246
515	Lake Worth Inlet (South Beach), FL	1972		131,538			241,246
516	Lake Worth Inlet (South Beach), FL	1973		145,498			241,246
517	Lake Worth Inlet (South Beach), FL	1975		68,090			241,246
518	Lake Worth Inlet (South Beach), FL	1978		43,559			241,246
519	Lake Worth Inlet (South Beach), FL	1984		110,799			241,246
520	Lake Worth Inlet (South Beach), FL	1985		130,803			241,246
521	Lake Worth Inlet (South Beach), FL	1987	Federal: Navigation	191,000			241,246
522	Lake Worth Inlet (South Beach), FL	1989	Federal: Navigation	105,756			241,246
523	Lake Worth Inlet (South Beach), FL	1990	Federal: Navigation	75,351			241,246
524	Lake Worth Inlet (South Beach), FL	1991	Federal: Navigation	87,335			241,246
525	Lake Worth Inlet (South Beach), FL	1994	Federal: Navigation	178,000			241
526	Lake Worth Inlet (South Beach), FL						246
527	Palm Beach, FL	1944	State/Local	300,000		$105,000	14
528	Palm Beach, FL	1948	State/Local	2,335,930		$478,659	14
529	Palm Beach, FL	1949	State/Local	480,000			14
530	Palm Beach, FL	1953		463,000			93
531	Palm Beach, FL	1975	State/Local		6,336		122
532	Palm Beach, FL	1976		100,000			250
533	Palm Beach, FL	1977		86,000			250
534	Palm Beach, FL	1987		34,000			250
535	Midtown Beach, FL	1996	Local/Private	800,000	5,400		241,242,251
536	Boynton Inlet, FL	1961–1973		1,366,229			268,249
537	Boynton Inlet, FL		State/Local				
538	Delray Beach, FL	1973	Federal: Storm and Erosion	1,634,513	14,256	$3,015,383	94,108,123,252
539	Delray Beach, FL	1978	Federal: Storm and Erosion	701,266	8,976	$1,660,584	116,124,125,252
540	Delray Beach, FL	1984	Federal: Storm and Erosion	821,551	13,728	$3,949,117	107,108,121,253
541	Delray Beach, FL	1992	Federal: Storm and Erosion	1,196,500	8,976	$4,862,000	254,255,264
542	Delray Beach, FL	1996	Federal: Storm and Erosion	1,020,000	14,260		244
543	Boca Raton North, FL	1988	Federal: Storm and Erosion	1,102,000	8,500	$3,547,000	257,258,264
544	Boca Raton South, FL	1985	State/Local	297,000	3,200		259
545	Boca Raton South, FL	1996	State/Local	252,000	4,170		249
546	Hillsboro Beach, FL	1972	Federal: Storm and Erosion	500,000	5,280		128,262
547	Hillsboro Inlet, FL		Local/Private				248
548	Pompano Beach/Lauderdale by the Sea, FL	1964	State/Local			$3,677	127
549	Pompano Beach/Lauderdale by the Sea, FL	1970	Federal: Storm and Erosion	1,076,000	16,896	$1,873,437	262
550	Pompano Beach/Lauderdale by the Sea, FL	1983	Federal: Storm and Erosion	1,909,000			262,264
551	John U Lloyd State Park, FL	1977	Federal: Storm and Erosion	1,090,000	7,920	$2,945,262	108,116,261,262,263
552	John U Lloyd State Park, FL	1989	Federal: Storm and Erosion	603,000	7,920	$2,945,262	260,262,263,264
553	Hallandale, FL	1971	Federal: Storm and Erosion	370,000	4,224	$779,977	108,128,262,263
554	Hollywood/Hallandale, FL	1979	Federal: Storm and Erosion	1,980,000	27,984	$7,743,376	108,129,262,263
555	Hollywood/Hallandale, FL	1991	Federal: Storm and Erosion	1,050,000		$9,186,444	169,263
556	Sunny Isles, FL	1988	Federal: Storm and Erosion	1,500,000		$15,600,000	170,263,264
557	Sunny Isles, FL	1990		30,000			263
558	Haulover Park, FL	1960	State/Local	180,000			93,263
559	Haulover Park, FL	1978	Federal: Storm and Erosion	300,000			130,263
560	Haulover Park, FL	1980	Federal: Navigation	80,000			131
561	Haulover Park, FL	1987		235,000			263
562	Bal Harbour, FL	1960	State/Local	86,000			93
563	Bal Harbour, FL	1961	State/Local	25,000			132
564	Bal Harbour, FL	1963–1973	State/Local	305,000			93
565	Bal Harbour, FL	1975	Federal: Storm and Erosion	1,700,000	4,224	$5,047,000	94
566	Bal Harbour, FL	1990	Federal: Storm and Erosion	230,000	4,488	$4,600,000	170

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost ($)	References
567	Miami Beach, FL	1978–1982	Federal: Storm and Erosion	12,000,000	55,440	$55,000,000	133,134
568	Miami Beach, FL	1987	Federal: Storm and Erosion	350,000		$5,000,000	170
569	Va. Key-Key Biscayne	1969	Federal: Storm and Erosion	373,000	13,200		94,108
570	Virginia Key, FL	1974	Federal: Storm and Erosion	500,000	6,864		116
571	Key Biscayne, FL	1987		360,000	12,672	$1,428,571	107,133,137
572	Fisher Island, FL	1991		30,263		$131,578	171
573	Key West, Smathers Beach, FL	1960		30,000		$23,697	172

(6) Local/Private. These are nourishments carried out at the local level, either by a municipality or local homeowners.

FINDINGS

Table 1 presents beach nourishment episodes, progressing from north to south geographically, which have occurred on the U.S. East Coast barrier island shoreline. In total, 573 beach nourishment episodes have occurred, at 154 locations (Figure 1). Three-hundred and fifty million cubic yards of sand have been placed, making the U.S. East Coast the most nourished shoreline in the country. Figure 2 indicates that since the 1960s, the sand placed on the East Coast barriers through beach nourishment has been increasing with time, especially in recent decades. Over 50% of the total sand used to nourish the East Coast has been placed within the last 16 years.

A dramatic increase in nourishment was found to have occurred in the 1970s (see Figure 2). This can be attributed in part to three factors: 1) legislation adopted around the 1970s, which increased the federal role in beach nourishment; 2) an increasing trend for federal navigation projects with beach disposal of dredged material, beginning in the 1970s; and 3) a shift in shore protection expenditures from hard stabilization to soft stabilization (USACE, 1994). These factors have continued to cause an increase in the use of beach nourishment in the 1980s and 1990s. In the 1990s, an increased number of relatively large nourishment projects were performed. Because of such projects, almost 30% of the total sand used to nourish the East Coast has been placed from 1990–96.

Figure 3 shows the estimated total amount (in 1996 dollars) that has been spent on nourishing the East Coast barriers since the 1960s. Because we are trying to establish a comprehensive view of beach nourishment, the costs presented include both federal and non-federal nourishment episodes. Since 1960, approximately $1.3 billion has been spent. In recent years, from 1990–96, we estimate that over $480 million dollars were spent on nourishing the East Coast. When this amount is distributed over the seven year time period, about $68 million a year is being spent. This amount has increased 62% from the previous decade, when an estimated $42 million a year was spent.

Figure 4 shows the distribution of funding expressed as percent of total sand volume placed on East Coast barrier island beaches. It is important to note that beaches listed in the Federal Storm and Erosion category will have been partially funded by state and local sources. Approximately, 65% of the sand placed on the East Coast has been through federal sponsorship. Forty-four percent has been placed by Federal Storm and Erosion projects, 14% by Federal Navigation projects, and 6% by Federal Emergency. Although most nourishment has occurred as a result of federal involvement, our data (Table 1) indicate that the frequency of non-federal nourishment episodes has been increasing in recent years.

CONCLUDING REMARKS

Our study finds a marked increase in the use of beach nourishment on the East Coast barrier island shoreline, especially in recent decades. A major factor contributing to this widespread use of beach nourishment has been the availability of federal funding. Recently, however, the availability of federal funds for beach nourishment projects has been reduced and threatened by the current administration. Additionally, in some areas, such as south Florida, suitable sand has become scarce, and legal disputes have arisen over the ownership of sand. Also in Florida, concern over the environmental impacts of beach nourishment has been increasing. For some communities, these factors may make the beach nourishment alternative less attractive or even unavailable in the future. In turn, this could cause an increased demand for non-federally funded nourishment episodes, importation of sand from outside areas (e.g. southeast Florida), and hard structures.

ACKNOWLEDGEMENTS

This study was funded by the Federal Emergency Management Agency (FEMA). We are also grateful for the support and assistance of Jamie Valverde, Michael O'Brien, and Tanya Haddad. Additionally, without the extensive cooperation from a large number of federal, state, and local officials, and consulting engineers this effort would not have been possible. We always received assistance when we requested it, and we are thankful to those individuals whom are too numerous to note here.

LITERATURE CITED

PILKEY and CLAYTON, 1989. Summary of Beach Replenishment Experience on U.S. East Coast Barrier Islands. *Journal of Coastal Research*, (5)1, pp. 147–159.

US ARMY CORPS OF ENGINEERS, 1994. Shoreline Protection and Beach Erosion Study: Yearly Cost Data for Constructed Projects (1950–1993). Accompaniment to *Shoreline Protection and Beach*

Erosion Control Study Phase I: Cost Comparison of Shoreline Protection Projects of the US Army Corps of Engineers, Institute of Water Resources Report, 94-PS-1, January 1994.

US ARMY CORPS OF ENGINEERS, 1996. *Shoreline Protection and Beach Erosion Control Study, Final Report: An Analysis of the U.S. Army Corps of Engineers Shore Protection Program,* Institute of Water Resources Report, 96-PS-1, January 1994.

REFERENCES

Numbers Refer to Table 1

1. PILKEY, O.H., and CLAYTON, T.D., 1987. Beach Replenishment: The National Solution? In: Magoon, D.T., *et al.* (ed.), *Coastal Zone '87.* New York: American Society of Civil Engineers, pp. 1408–1419.
2. U.S. ARMY CORPS OF ENGINEERS, NORTH ATLANTIC DIVISION, 1964. *Report on Operation Five-High: March 1962 Storm,* 2 volumes, variable paging.
3. U.S. ARMY CORPS OF ENGINEERS, 1984. *Annual Report of the Chief of Engineers on Civil Works Activities, Fiscal Year 1984.* Washington: U.S. Government Printing Office, variable paging.
4. MORRIS, R. and MARKS, P., 1987. $124M That Will Wash Away. *Long Island Newsday.* 47 (1501), 3, 23, 27.
5. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1964. *Review Report on Beach Erosion Control Cooperative Study, Atlantic Coast of Long Island, NY: Fire Island Inlet and the Shore Westerly to Jones Inlet.* House Document No. 115, 89th Congress, 1st Session. Washington: U.S. Government Printing Office.
6. YASSO, W.E., and HARTMAN, E.M., JR., 1976. *Beach Forms and Coastal Processes,* MESA New York Bight Atlas Monograph 11. Albany, NY: New York Sea Grant Institute, 50p.
7. U.S. ARMY CORPS OF ENGINEERS, 1972. *Annual Report of the Chief of Engineers on Civil Works Activities, Fiscal Year 1972.* Washington: U.S. Government Printing Office, variable paging.
8. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1975. *Fire Island Inlet to Jones Inlet, NY: Beach Erosion Control and Navigation Project.* Project map.
9. U.S. ARMY CORPS OF ENGINEERS, 1975. *Annual Report of the Chief of Engineers on Civil Works Activities: Fiscal Year 1975.* Washington, DC: U.S. Government Printing Office, variable paging.
10. U.S. ARMY CORPS OF ENGINEERS, 1976. *Annual Report of the Chief of Engineers on Civil Works Activities: Fiscal Year 1976.* Washington, DC: U.S. Government Printing Office, variable paging.
11. U.S. ARMY CORPS OF ENGINEERS, 1977. *Annual Report of the Chief of Engineers on Civil Works Activities: Fiscal Year 1977.* Washington, DC: U.S. Government Printing Office, variable paging.
12. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1965. *Atlantic Coast of New York City from East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, NY.* House Document No. 215, 89th Congress, 1st Session. Washington, DC: U.S. Government Printing Office, variable paging.
13. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1936. *Beach Erosion at Jacob Riis Park, Long Island, NY.* House Document No. 397, 74th Congress, 2nd Session. Washington, DC: U.S. Government Printing Office, variable printing.
14. HALL, J.V., JR., 1952. Artificially Constructed and Nourished Beaches. In: *Coastal Engineering: 1952 Proceedings.* New York: American Society of Civil Enginers, pp. 119–133.
15. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1974. *General Design Memorandum No. 1: East Rockaway Inlet and Jamaica Bay–Beach Erosion Control Phase,* 39p.
16. HOBSON, R.D., 1977. Sediment Handling and Beach Fill Design. In: *Coastal Sediments '77.* New York: American Society of Civil Engineers, pp. 167–180.
17. NERSESIAN, G.K., 1977. Beach Fill Design and Placement at Rockaway Beach, NY Using Offshore Ocean Borrow Sources. In: *Coastal Sediments '77.* New York: American Society of Civil Engineers, pp. 228–247.
18. U.S. ARMY CORPS OF ENGINEERS, 1976. *Annual Report of the Chief of Engineers on Civil Works Activities: Fiscal Year 1976.* Washington, DC: U.S. Government Printing Office, variable paging.
19. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1985. *East Rockaway to Rockaway Inlet and Jamaica Bay, NY, Beach Erosion Control Project, Yearly Data Report for Project Managing Program,* 23p.
20. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1984. *East Rockaway to Rockaway Inlet and Jamaica Bay, NY, Beach Erosion Control Project, Yearly Data Report for Project Monitoring Program, Main Report,* 14p.
21. U.S. ARMY CORPS OF ENGINEERS, 1979. *Annual Report of the Chief of Engineers on Civil Works Activities: Fiscal Year 1979.* Washington, DC: U.S. Government Printing Office, variable paging.
22. U.S. ARMY CORPS OF ENGINEERS, 1981. *Annual Report of the Chief of Engineers on Civil Works Activities: Fiscal Year 1981.* Washington, DC: U.S. Government Printing Office, variable paging.
23. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1982. *East Rockaway to Rockaway Inlet and Jamaica Bay, NY: Beach Erosion Control Project, Yearly Data Report for Project Monitoring Program,* 6p.
24. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1983. *East Rockaway to Rockaway Inlet and Jamaica Bay, NY: Beach Erosion Control Project, Yearly Data Report for Project Monitoring Program,* 13p.
25. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1985. *Annual Report of the Chief of Engineers on Civil Works Activities: Fiscal Year 1985, Extract Report of the New York District,* 36p.
26. PSUTY, N.P., NORDSTROM, K.F., and ALLEN, J.R., 1976. *Application of Coastal Geomorphology to Management of Beach Resources in Gateway National Recreation Area,* Contribution 76–1. New Brunswick, NJ: National Park Service Cooperative Research Unit, Center for Coastal and Environmental Studies, Rutgers University, 4p.
27. NORDSTROM, K.F., ALLEN, J.R., SHERMAN, D.J., and PSUTY, N.P., 1979. Management Considerations for Beach Nourishment at Sandy Hook, NJ, USA. In: *Coastal Engineering,* (2)215–236.
28. JOHNSON, H.L. INTO THE BREACH, 2–3, 32.
29. NORDSTROM, K.F., and ALLEN, J.R., 1980. Geomorphically compatible solutions to beach erosion. *Z. Geomorph. N.F.* Suppl.-Bd., (34)142–154.
30. PHILLIPS, J.D., PSUTY, N.P., and MCCLUSKEY, J.M., 1984. *The Impact of Beach Nourishment at South Beach, Sandy Hook, NJ: Final Report.* New Brunswick, NJ: Center for Coastal and Environmental Studies, Rutgers University, 30p.
31. PHILLIPS, J.D., and PSUTY, N.P., 1984. *A Geomorphic Assessment of Beach Nourishment at South Beach, Sandy Hook, NJ: Draft Final Report.* New Brunswick, NJ: Center for Coastal and Environmental Studies, Rutgers University, 24p.
32. PSUTY, N., Center for Coastal and Environmental Studies, Rutgers University, New Brunswick, NJ. "Monmouth County Shore Structures," 6pp and "ocean County Shore Structures," 3 pp., unpublished notes.
33. U.S. ARMY CORPS OF ENGINEERS, 1974. *Shore Protection and Restoration. Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1974.* Washington, DC: U.S. Government Printing Office, variable paging.
34. NORDSTROM, K.F., 1975. The Use of Dredged Spoil as Beach Fill on the New Jersey Beaches. *Proceedings, Middle States Division, Association of American Geographers,* (8) 89–93.
35. U.S. ARMY CORPS OF ENGINEERS, 1965. *Chief of Engineers Annual Report on Civil Works Activites: Fiscal Year 1965.* Washington, DC: U.S. Government Printing Office, variable paging.
36. MILLER, M.C., AUBREY, D.G., and KARPEN, J., 1980. *Beach Changes at Long Beach Island, NJ, 1962–73.* Miscellaneous Report 80–9. Vicksburg: Coastal Engineering Research Center, 289p.
37. ASHLEY, G.M., HALSEY, S.D., and FARRELL, S.C., 1987. A Study of Beachfill Longevity: Long Beach Island, NJ. In: N.C. Kraus (Ed.), *Coastal Sediments '87.* New York: American Society of Civil Engineers, 1188–1202.

38. U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT, 1985. Long Beach Island Beach Erosion Project, Condition of Improvement.
39. PSUTY, N., Center for Coastal and Environmental Studies, Rutgers University, New Brunswick, NJ. "Atlantic County Shore Structures," unpublished notes, 3p.
40. MCCANN, D.P., 1981. *Beach Changes at Atlantic City, NJ (1962–73).* Miscellaneous Report 81–3. Vicksburg: Coastal Engineering Research Center, 142p.
41. SORENSON, R.M., and WEGGEL, J.R., 1985. *Evaluation of Beach Behavior and Coastal Structure Effects at Atlantic City, NJ.* Fritz Engineering Laboratory Report No. 200.85.811.1. Fritz Engineering Laboratory, Lehigh University, Behtlehem, PA. Trenton: Division of Coastal Resources, New Jersey Department of Environmental protection, 66p.
42. EVERTS, C., DEWALL, A.E., and CZERNIAK, M.T., 1974. Behavior of Beach Fill at Atlantic City, NJ. In: *Proceedings of the Coastal Engineering Conference.* New York: American Society of Civil Engineers, pp. 1370–1388.
43. U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT, 1985. Atlantic City, NJ, Beach Erosion Control Project: Condition of Improvement.
44. U.S. ARMY CORPS OF ENGINEERS, 1970. *Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1970.* Washington, DC: U.S. Government Printing Office, variable paging.
45. PRICE, R.J., 1986. Atlantic City Engineer, "Atlantic City Beach/ 1st and 2nd, December 1986," Memorandum.
46. PETERSON, I., 1987. Battle to Save Jersey Shore Pits Nature Against the State. *New York Times,* 7 March 1987, L29-L30.
47. "Four States Hit Hardest By Storm," *USA Today,* 5 January 1987, 4A.
48. U.S. ARMY CORPS OF ENGINEERS, 1963. *Chief of Engineers Annual Report on Civil Works Activities, Fiscal Year 1963.* Washington, DC: U.S. Government Printing Office, variable paging.
49. U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT, 1985. *Great Egg Harbor and Peck Beach, Ocean City, NJ: Beach Erosion Control-Navigation Study,* 234p.
50. PSUTY, N., Center for Coastal and Environmental Studies, Rutgers University, New Brunswick, NJ, "Cape May County Shore Structures," unpublished notes, 4p.
51. BISHOP, G., 1986. Shore Growth Rising on Sand Despite Risks. *The Sunday Star-Ledger,* Newark, NJ, 73 (233), 1,22–23.
52. FARRELL, S.C., 1986. Division of Natural Sciences, Stockton State College, Pomona, NJ, pers. comm.
53. ALSOP, R., 1983. Beaches Eroded by Winter Storms Strain The Budget and Patience of Many Towns. *Wall Street Journal,* 9 June 1983, 35, 57.
54. U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT, 1985. Delaware Coast, Beach Erosion Control and Hurricane Protection: Condition of Improvement.
55. U.S. ARMY CORPS OF ENGINEERS, 1978. *Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1978.* Washington, DC: U.S. Government Printing Office, variable paging.
56. GOLDSMITH, V., STURM, S., and THOMAS, G., 1977. *Beach Erosion and Accretion of Virginia Beach, VA and Vicinity.* Miscellaneous Report 77–12. Vicksburg: Coastal Engineering Research Center, 185p.
57. BUNCH, J.W., 1970. Beach Nourishment at Virginia Beach, VA. In: *Coastal Engineering: Proceedings of the 12th Conference.* New York: American Society of Civil Engineers, pp. 967–973.
58. EDWARDS, P.G., 1973. Virginia Beach Needs Sand. *The Washington Post,* 16 July 1973, A16.
59. WATERWAY SURVEYS & ENGINEERING, LTD., 1986. *Annual Engineering and Operation Plan for Beach Nourishment: Virginia Beach, Virginia, 1986–1987.* Virginia Beach, VA: Waterway Surveys & Engineering, Ltd., 29p.
60. GOFSEYEFF, S., 1952. Case History of Fire Island Inlet, NY. *Coastal Engineering: 1952 Proceedings.* New York: American Society of Civil Engineers, pp. 272–305.
61. LANGFITT, F., 1987. Replacing the Sands of Time. *Philadelphia Inquirer,* 30 August 1987, 18–23.
62. FLAX, P., 1988. U.S. Army Corps of Engineers, New York District, pers. comm., 9 February 1988.
63. COASTAL RESEARCH ASSOCIATES, 1974. *1973 Buxton Beach Nourishment Project: An Annotated Photographic Atlas, Cape Hatteras National Seashore, NC.* Charlottesville, VA: Coastal Research Associates, 44p.
64. BEHN, R.D. and CLARK, M.A., 1976. *Termination II: How the National Park Service Annulled Its "Commitment" To A Beach Erosion Control Policy At the Cape Hatteras National Seashore.* Durham: Center for Policy Analysis, Institute of Policy Sciences and Public Affairs, Duke University, 120p.
65. LEATHERMAN, S.P., 1980. Non-structural Approach to Coastal Problems. In: *Barrier Island Forum and Workshop.* Boston: National Park Service, North Atlantic Region, pp. 139–147.
66. "Sand Put on Atlantic Beach Hardly a 'Bailout' By Corps," *The News and Observer,* Raleigh, NC, 27 July 1986.
67. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, 1986. *Chief of Engineers Annual Report on Civil Works Activities: Fiscal year 1986, Extract Report of the Wilmington District.*
68. File #11–85, Division of Coastal Management, North Carolina Department of Natural Resources and Community Development, Raleigh, NC.
69. File #23–86, Division of Coastal Management, North Carolina Department of Natural Resources and Community Development, Raleigh, NC.
70. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, 1983. *Feasibility Report and Environmental Assessment on Shore and Hurricane Wave Protection, Wrightsville Beach, NC,* 45p.
71. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, *Wrightsville Beach, NC.* House Document No. 511, 87th Congress, 2nd Session. Washington, DC: U.S. Government Printing Office.
72. U.S. ARMY CORPS OF ENGINEERS. 1966. *Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1966.* Washington, DC: U.S. Goverment Printing Office, variable paging.
73. JARRETT, J.T., 1977. Sediment Budget Analysis, Wrightsville Beach to Kure Beach, NC. In: *Coastal Sediments '77.* New York: American Society of Civil Engineers, 986–1005.
74. U.S. ARMY CORPS OF ENGINEERS, 1967. *Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1967.* Washington, DC: U.S. Government Printing Office, variable paging.
75. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, 1977. Appendix C: Shore Process Analysis. In: *Masonboro Inlet, NC South Jetty General Design Memorandum,* C1-C47.
76. U.S. ARMY CORPS OF ENGINEERS, 1970.*Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1970.* Washington DC: U.S. Government Printing Office, variable paging.
77. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, .1980. *Environmental Assesmetn, Wrightsville Beach, New Hanover County, NC,* 18p.
78. MANGUM, S. Wrightsville Beach, NC. Unpublished term paper, Department of Geology, Duke University, Durham, NC, 10p.
79. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, 1986. Public Notice: Sand Bypassing at Masonboro Inlet, Atlantic Intracoastal Waterway, 6 p.
80. "Wrightsville Expects County Refund," *Wilmington Morning Star,* Wilmington, NC, 21 August 1986.
81. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, 1984. *Monitoring Report: Carolina Beach, NC,* 52 p.
82. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, 1962. *Carolina Beach, NC.* House Document No. 418, 87th Congress, 2nd Session. Washingotn, DC: U.S. Goverment Printing Office, 194p.
83. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, 1981. *Final Environmental Impact Statement: Carolina each and Vicinity,* 72 p.
84. U.S. ARMY CORPS OF ENGINEERS, 1968. *Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1968.* Washington, DC: U.S. Government Printing Office, variable paging.
85. U.S. ARMY CORPS OF ENGINEERS, 1971. *Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1971.* Washington, DC: U.S. Goverment Printing Office, variable paging.
86. U.S. ARMY CORPS OF ENGINEERS, 1982. *Chief of Engineers Annual Report on Civil Works Activities: Fiscla Year 1982.* Washington, DC: U.S. Goverment Printing Office, variable paging.
87. FURUSETH, O.J. and IVES, S.M., 1987. Individual Attitudes Toward Coastal Erosion Policies: Carolina Beach, NC. In: *Cities*

on the Beach, Research Paper No. 224. Chicago: Department of Geography, University of Chicago, pp. 185–198.
88. U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, 1985. *Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1985, Extract Report of the Wilmington District,* 31p.
89. KOME, H., 1987. Beach Sand Won't Receive Federal Funds. *Wilmington Morning Star,* Wilmington, NC, 24 January 1987.
90. SANDMAN DELAYS BEACH TRIP. *Wilmington Morning Star,* 21 December 1986.
91. Too Late, Dredge Comes to the Rescue. *Wilmington Morning Star.* Wilmington, NC, 6 December 1986.
92. KANA, T.W., 1986. Coastal Science and Engineering, Inc., Pers. Comm.
93. U.S. ARMY CORPS OF ENGINEERS, 1971 and 1973. Various districts and volumes. *National Shoreline Study.* Washington, DC: Government Printing Office.
94. WALTON, T., 1977. *Beach Nourishment in Florida and on the Lower Atlantic and Gulf Coast.* Technical Paper TP-2. Gainesville: Florida Sea Grant, 66p.
95. U.S. ARMY CORPS OF ENGINEERS, CHARLESTON DISTRICT, 1975. *Final Environmental Impact Statement, Hunting Island, SC,* 26p.
96. NEAL, W.J., BLAKENEY, W.C., JR., PILKEY, O.H., JR., and PILKEY, O.H., SR., 1984. *Living with the South Carolina Shore.* Durham: Duke University Press, 205p.
97. SCOVILLE, M., 1987. Beach Renourishment of Hunting Island State Park: A Case Study. Unpublished term paper, Department of Geology, Duke University, 13p.
98. BRUUN, P., 1986. The Design and Construction of Mounds for Breakwaters and Coastal Protection. *Papers Presented at Annual Conferences on Beach Preservation,* [1984 and 1985]. Tallahassee: Florida Shore and Beach Preservation Association, Inc., pp. 20–24.
99. U.S. ARMY CORPS OF ENGINEERS, 1983. *Chief of Engineers Annual Report on Civil Works Activities: Fiscal Year 1983.* Washington, DC: U.S. Government Printing Office, variable paging.
100. OERTEL, G.F., CHAMBERLAIN, C.F., LARSEN, M., and SCHAAF, W., 1977. Monitoring the Tybee Beach Nourishment Project. In: *Coastal Sediments '77.* New York: American Scoeity of Civil Engineers, 1049–1056.
101. CORAM, R., 1981. Georgia Beaches Vanish as Nature Isn't Fooled. *The Atlanta Journal-Constitution,* 7 November 1981, 1-B, 4-B.
102. CORVETTE, D., 1987. A Losing Battle Against Beach Erosion. *Atlanta Journal-Constitution,* 28 February 1987, 1-B, 6-B.
103. U.S. ARMY CORPS OF ENGINEERS, SAVANNAH DISTRICT, 1968. *Beach Erosion Control Study on Sea Island and St. Simons Island, GA,* 16p.
104. GEORGIA SHORE ASSISTANCE COMMITTEE, GEORGIA DEPARTMENT OF NATURAL RESOURCES, 1986. Permit to Sea Island Company. Permit no. 149.
105. ADAMS, J., 1979. Rebuilding the Beaches of Florida. *Shore & Beach,* 47(2).
106. U.S. ARMY CORPS OF ENGINEERS, JACKSONVILLE DISTRICT, 1979. Duval County, Florida Beach Erosion Control. Project map.
107. MYERS, C.T., III, 1986. Florida Erosion Control Update. In: *Papers Presented at Annual Conferences on Beach Preservation,* [1984 and 1985]. Tallahassee: Florida Shore and Beach Preservation Association, Inc., 45–56.
108. Florida Division of Beaches and Shores, with the assistance of RESTORE OUR COAST TASK FORCE, 1985. *Beach Restoration: A State Initiative.* Tallahassee: Florida Department of Natural Resources, variable paging.
109. *Report on Monitoring of a Beach Fill South of Canaveral Jetties, Brevard County, FL,* 1976. Report No. 76/010. Gainesville: Coastal and Oceanographic Engineering Laboratory, University of Florida, 59p.
110. STAUBLE, D.K., SAINSBURY, J.C., and KNIGHT, J.M., 1984. *Erosion Control/Permit Monitoring Program,* Report No. CZM-84–1. Tallahassee: Division of Beaches and Shores, Florida Department of Natural Resources, 125p.
111. HUSHLA, F.L., 1982. *Evaluating the Performance of Beach Nourishment in Brevard County, FL Through the Use of Aerial Photography.* Unpublished M.S. Thesis, Florida Institute of Technology, Melbourne, FL, 80p.
112. File Nos. BBS 82–40 and Bbs 75–11, Division of Beaches and Shores, Florida Department of Natural Resources, Tallahassee, FL.
113. U.S. ARMY CORPS OF ENGINEERS, JACKSONVILLE DISTRICT, 1984. *Indian County, FL.* House Document No. 154, 98th Congress, 2nd Session. Washington, DC: U.S. Government Printing Office, 455 p.
114. ADAMS, J.W.R., 1979. David and the Beaches. *Papers Presented at Annual Conference on Beach Preservation, October 3–5, 1979,* Technical Paper No. 16. Gainesville: Florida Sea Grant, 115–128.
115. JONES, E. and KENEAGY, B., 1984. Group: Renourish More Beach. *Today,* 28 November 1984.
116. *Beach Restoration: An Historical Overview,* 1984. Tallahassee: Office of Beach Erosion Control, Division of Beaches and Shores, Florida Department of Natural Resources, 19p.
117. STROCK, A.V. & ASSOCIATES, INC., 1974. *Town of Jupiter Island Beach Restoration Project: Follow-up Report No. 1.* Deerfield Beach, FL: A.V. Strock & Associates, Inc., 25p.
118. STROCK, A.V. & ASSOCIATES, INC., 1975. *Town of Jupiter Island Beach Restoration Project: Construction Report.* Deerfield Beach, FL: A.V. Strock & Associates, Inc., 23p.
119. COASTAL PLANNING AND ENGINEERING, 1987. Pers. comm.
120. STROCK, A.V. & ASSOCIATES, INC., 1981. *Town of Jupiter Island Beach Follow-up Study.* Deerfield Beach, FL: A.V. Strock & Associates, Inc., 10p.
121. COASTAL PLANNING AND ENGINEERING, 1986. Business resume.
122. SALLAN, M., 1982. 'Renourishment' is Not Solution. *Palm Beach Daily News,* 15 November 1982.
123. STROCK, A.V. & ASSOCIATES, INC., 1976. *City of Delray Beach Follow-up Report No. 4 (34 Mo.). 1.* Deerfield Beach, FL: A.V. Strock & Associates, Inc.
124. STROCK, A.V. & ASSOCIATES, INC., 1984. *City of Delray Beach 60-Month Follow-Up Report.* Deerfield Beach, FL: A.V. Strock & Associates, Inc.
125. STROCK, A.V. & ASSOCIATES, INC., 1983. *City of Delray Beach General Design Memorandum: Beach Maintenance Nourishment.* Deerfield Beach, FL: A.V. Strock & Associates, Inc.
126. CARROLL, J.H., and SPADONI, R.H., 1986. Maximizing Inlet Sand Transfer for Successful Beach Nourishment and Navigation Maintenance: The Boca Raton Story. In: *Papers Presented at Annual Conference on Beach Preservation,* [1984 and 1985]. Tallahassee: Florida Shore and Beach Preservation Association, Inc., pp. 145–155.
127. WALKER, S., 1972. Beach Preservaion in Southeast Florida. Winter study project for Dr. T.W. Fox, Available at Coastal and Oceanographic Engineering Laboratory Archives, University of Florida, Gainesville, 69p.
128. SOMERVILLE, S., 1984. Environmental Planning, Permitting and Monitoring of the Pompano Beach/Lauderdale-by-the-Sea Beach Nourishment Project. *The New Threat to Beach Preservation.* Tallahassee: Florida Shore and Beach Preservation Association, Inc., pp 157–167.
129. STAUBLE, D.K., and HOEL, J., 1986. *Guidelines for Beach Restoration Projects: Part II-Engineering.* Report #77. Gainesville: Florida Sea Grant, 10p.
130. U.S. ARMY CORPS OF ENGINEERING, JACKSONVILLE DISTRICT, 1978. Dade County, Beach Erosion Control and Hurricane Protection. Project map.
131. File #BBS 80–5, Division of Beaches and Shores, Florida Department of Natural Resources, Tallahassee, FL.
132. U.S. ARMY CORPS OF ENGINEERING, JACKSONVILLE DISTRICT, 1968. *Dade County, FL.* House Document No. 335, 90th Congress, 2nd Session. Washington, DC: U.S. Government Printing Office, 103p.
133. CLEMENTE, A.J., 1986. The Need to Streamline the Erosion Control Process: A Decade of Experience at Key Biscayne, FL. *Papers Presented at Annual Conferences on Beach Preservation,* [1984 and 1985]. Tallahassee: Florida Shore and Beach Preservation Association, Inc., pp. 1–10.
134. FROHLING, N.M., 1986. The New Beach in Dade County: Its Impact on the Community. *Papers Presented at Annual Conferences on Beach Preservation,* [1984 and 1985]. Tallahassee: Florida Shore and Beach Preservation Association, Inc., 114–121.

135. U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT, 1962. *Review of Report on Cooperative Beach Erosion Control Study at Atlantic City, NJ,* 29p.
136. PREVETTI, A., 1987. Prevetti Associates, Ocean City, NJ. Pers. comm.
137. ANDERSON, P., 1985. State Oks Key Biscayne Beach Plan. *Miami Herald.*
138. PILKEY, O.H., 1988. A "Thumbnail Method" for Beach Communities: Estimation of Long-Term Replentishment Requirements. *Shore & Beach,* 56, 23–31.
139. U.S. ARMY CORPS OF ENGINEERS, 1987. *Annual Report of the Chief of Engineers on Civil Works Activities: Fiscal Year 1987, Extract Report of the New York, NY District,* 38p.
140. MEYER, E.L., 1988. Ocean City Declares War on Nature, *The Washington Post,* 11 May 1988, D1, D7.
141. RUBIN, R., 1987. Storms of Public Opinion Batter Beach Renourishment Projects, *Sunday Star-News,* Wilmington, NC, 12 July 1987, 1A, 7A.
142. LONG, D., 1988. Beach Recieves its Quota of Sand, and Then Some, *Wilmington Morning Star,* Wilmington, NC, 14 April 1988.
143. FOSTER, P., 1988. Figure Eight Island Resident, pers. comm., April 1988.
144. SCHWARTZ, R.K., and MUSIALOWSKI, F.R., 1977. Nearshore Disposal: Onshore Sediment Transport. In: *Coastal Sediment '77.* New York: American Society of Civil Engineers, pp. 85–101.
145. RAUCH, H.G., 1988. American Coastal Engineering, Inc., pers. comm., 9 February 1988.
146. U.S. ARMY CORPS OF ENGINEERS, SAVANNAH DISTRICT, 1987. *Annual Report of the Chief of Engineers on Civil Works Activities: Fiscal Year 1987,* Extract Report of the Savannah District, 17p.
147. CARMEN, V., 1987. Palm Beach County Health Department, pers. comm., September, 1987.
148. BRYANT, C., 1987. Continental Shelf Associates, pers. comm., September, 1987.
149. CIORRA, A., 1996. US Army Corps of Engineers, New York District, pers. comm., September, 1996.
150. TERCHUNIAN, A.V., and COVELLO, D.M., 1994. Winter Storms of 1992–1993, Their Impacts and Remediation, Long Island, New York. in *Proceedings of the 6th National Conference on Beach Preservation Technology,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp.594–607.
151. BLACK, J.A., 1987. Barrier Beach Management: The Long Island Experience, in *Proceedings of Coastal Zone '87,* pp. 3209–3220.
152. DORNHELM, R.B., 1995. The Coney Island Public Beach and Boardwalk Improvement of 1923, in *Shore and Beach,* January 1995, pp. 7–11.
153. EMMET, B.K., COCCHIERI, L.J., and LESNICK, J.R., 1995. Coney Island Storm Damage Reduction Plan, in *Shore and Beach,* January 1995, pp. 5–10.
154. BOKUNIEWICZ, H., 1989. Charactersitics of New York's Beach Erosion, in *Proceedings of the 2nd National Conference on Beach Preservation Technology,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 161–166.
155. BEUMEL, N.H., and BOCAMOZO, L.B., 1989. Rebuilding the New Jersey Shoreline, in *Proceedings of Coastal Zone '89,* pp. 2060–2075.
156. BEUMEL, N.H., and CAMPBELL, T.J., 1988. Restoring the New Jersey Shoreline. *Proceedings of the 1st Annual Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, pp. 241–248.
157. MAURIELLO, M.N., 1991. Beach Nourishment and Dredgng: New Jersey's Policies, in *Shore and Beach,* July 1991, pp. 25–28.
158. SORENSEN, R.M., 1990. Beach Behavior and Effect of Coastal Structures: Bradley Beach, New Jersey., in *Shore and Beach,* July 1991, pp. 25–28.
159. PSUTY, N.P., and NAMIKAS, S.L., 1991. Beach Nourishment Episodes at Sandy Hook Unit, Gateway National Recreation Area, New Jersey, USA: A Preliminary Comparison, in *Proceedings of Coastal Sediments '91,* pp. 2116–2129.
160. KELLY, G.P., 1990. Keynote Address: American Shore and Beach Preservation Association Annual Meeting, October 17, 1990, Atlantic City New Jersey, in *Shore and Beach,* July 1991, pp. 25–28.
161. WEGGEL, J.R., MORREALE, M., and GIEGENGACK, R., 1995. The Ocean City, New Jersey, Beach Nourishment Project: Monitoring its Early Performance, in *Shore and Beach,* pp. 25–31.
162. GROSSKOPF, W.G., and STAUBLE, D.K., 1993. Atlantic Coast of Maryland (Ocean City) Shoreline Protection Project, in *Shore and Beach,* January 1993, pp. 3–7.
163. GROSSKOPF, W.G., and BEHNKE, D.L., 1993. An Emergency Remedial Beach Fill Design For Ocean City Maryland, in *Shore and Beach,* January 1993, pp. 8–12.
164. CHATRY, S., and SMITH, R., 1993. T.L. James Marine Group Beach Nourishment Projects, in *Proceedings of Coastal Zone '93,* pp. 1490–1504.
165. KANA, T.W., and ANDRASSY, C.J., 1994. Beach Profile Spacing: Practical Guide for Monitoring Nourishment Projects, in *Proceedings of Coastal Engineering 1994,* pp. 2100–2114.
166. WIEGEL, R.L., 1993. Lecture notes from NRC panel on Hunting Island, South Carolina.
167. KANA, T.W., and STEVENS, F.D., 1990. Beach and Dune Restoration Following Hugo, in *Shore and Beach,* October 1990, pp. 57–63.
168. EDGE, B.L., DOWD, M., DEAN, R.G., and JOHNSON, P., 1994. The Reconstruction of Folly Beach, in *Proceedings of Coastal Engineering 1994,* pp. 3491–3506.
169. BEACHLER, K.E., and HIGGINS, S.H., 1992. Hollywood/Hallandale Building Florida's Beaches in the 1990's, in *Shore and Beach,* July 1992, pp. 15–22.
170. WIEGEL, R.L., 1992. Dade County, Florida, Beach Nourishment and Hurricane Surge Protection Project, in *Shore and Beach,* October 1992, pp. 2–28.
171. BODGE, K.R., and OLSEN, E.J., 1992. Aragonite beachfill at Fisher Island, Florida, in *Shore and Beach,* January 1992, pp. 3–8.
172. WIEGEL, R.L., 1993. Artificial Beach Construction with Sand/Gravel Made by Crushing Rock, in *Shore and Beach,* October 1993, pp. 28–29.
173. AUBREY, D.G., and DEKIMPE, N.M., 1989. Performance of Beach Nourishment at Jupiter Island, Florida, in *Proceedings of the 2nd Annual Beach Preservation Technology Conference.* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 409–420.
174. BODGE, K.R., and ROSEN, D.S., 1989. Offshore Sand Sources for Beach Nourishment in Florida: Part 1: Atlantic Coast, in *Proceedings of the 2nd Annual Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 175–189.
175. CHURCH, E. H., 1957. Comments on the Beach Restoration and Maintenance Program at Virginia Beach, Virginia, 1951 to 1957, *Shore and Beach* 25(1): pp.11–17.
176. MESSINA, D., 1995. Annual Replenishment of Sand Under Way on Ocean Beach 15,000 Truckloads from Lynnhaven Inlet Will be Spread from Rudee Inlet to 49th Street. *The Virginian Pilot,* 10 March 1995, in Virginia Beach Beacon, p. 11.
177. MESSINA, D., 1996. Sand replenishment to work around visitors. *The Virginian Pilot,* 10 March 1996, in Virginia Beach Beacon, p. 4.
178. ROEHRS, P., Office Of Beach Management, City of Virginia Beach, Department of Public Works, 1995. pers. comm., October 1995.
179. U.S. ARMY CORPS OF ENGINEERS, 1962. *Virginia Beach, Virginia Cooperative Beach Erosion Control Study,* Washington D.C.: U.S. Government Printing Office, variable paging.
180. U.S. ARMY CORPS OF ENGINEERS, NORFOLK DISTRICT, VIRGINIA BEACH EROSION COMMISSION, AND CITY OF VIRGINIA BEACH, 1972. *Beach Maintenance Virginia Beach, Virginia: Interim Report of an Ad Hoc Committee for Long Range Requirements.*
181. U.S. ARMY CORPS OF ENGINEERS, NORFOLK DISTRICT, 1987. *Evaluation Report: Virginia Beach Nourishment; Virginia Beach, Virginia.*
182. VON FAUSSEN, J., 1996. U.S. Army Corps Of Engineers, Baltimore District, pers. comm., June 1996.
183. JARRET, T., 1996. U.S. Army Corps Of Engineers, Wilmington District, pers. comm., May 1996.
184. HARPER, SCOTT, 1996. Sand from ocean floor to be used to replenish beach at Dam Neck, *The Virginian Pilot.*

185. HANRAHAN, S., DEPASQUALE, A., HENRY, R., ALLEN, S., and SWANDA, M., 1995. Sand resources off the ocean coast of Delaware, in *Proceedings of the 8th Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 383–398.
186. SKRABAL, T.E., RAMSEY, K.A., and HENRY, R., 1990. Monitoring results of a replenishment project at Fenwick Island, Delaware, in *Proceedings of the Third Annual Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 36–51.
187. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1996. Fact Sheet: Atlantic Coast of New York City Rockaway Inlet to Norton Point (Coney Island Area) Shore Protection Project, 2 pp.
188. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1996. Fact Sheet: Fire Island Inlet to Montauk Point New York, (Reach 2: Moriches Inlet to Shinnecock Inlet), Westhampton Interim Project, 1p.
189. HERRMAN, R., 1996. Part of research for unpublished Master's Project for Town of Southampton, Duke University, Nicholas School of the Environment, pers. comm., September 1996.
190. PRATT, A.P., 1996. Delaware Department of Natural Resources and Environmental Control, pers. comm., August 1996.
191. BODGE, K.R., 1994. Performance of 1992 Nearshore berm disposal at Port Canaveral, Florida, in *Proceedings of the 5th Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 285–301.
192. FARRELL, S., 1995. Beach Nourishment at Avalon, New Jersey: A Comparison of Fill Performance with and without Submerged Breakwaters. in *Proceedings of the 8th Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 149–164.
193. New Jersey Department of Environmental Protection, Project file # 4009.
194. New Jersey Department of Environmental Protection, Project file # 4005–3.
195. NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, Project file #4058.
196. U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT, 1996. Fact Sheet: Great Egg Harbor Inlet and Peck Beach, NJ., 4pp.
197. INSTITUTE OF MARINE AND COASTAL SCIENCES, 1996. Unpublished Draft of *Coastal Hazard Management Plan: New Jersey's Shoreline Future, Preparing Tomorrow.* N.P.Psuty (ed.), Rutgers the State University of New Jersey.
198. U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT, 1995. Fact Sheet: Cape Inlet to Lower Township, N.J., June 1995, 2pp.
199. U.S. ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT, 1993. *Atlantic Coast of New York City, East Rockaway Inlet to Rockaway Inlet and Jamiaca Bay, NY, Final Reevaluation Report (Section 934 of WRDA 1986).,* 89pp.
200. WATSON, K.D., CLAUSNER, JE., and HENRY, R.D., 1993. Beach Response to Sand Bypassing at Indian River Inlet, Delaware. in *Proceedings of the Hilton Head Island South Carolina U.S.A. International Coastal Symposium June 6–9, 1993,* P. Bruun (ed.), pp. 651–656.
201. ANDERS, F.J., LILLYCROP, W.J., and GEBERT, J., 1990. Effects of Natural and Man-Made Changes at Indian River Inlet, Delaware. in *Proceedings of the 3rd Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 280–294.
202. Permit # 152–87, Division of Coastal Management, North Carolina Department of Environment, Health, and Natural Resources, Raleigh, NC.
203. Permit # 9–95, Division of Coastal Management, North Carolina Department of Environment, Health, and Natural Resources, Raleigh, NC.
204. Permit # 26–92, Division of Coastal Management, North Carolina Department of Environment, Health, and Natural Resources, Raleigh, NC.
205. Permit # 46–94, Division of Coastal Management, North Carolina Department of Environment, Health, and Natural Resources, Raleigh, NC.
206. Permit # 26–92, Division of Coastal Management, North Carolina Department of Environment, Health, and Natural Resources, Raleigh, NC.
207. VARNUM, H., 1996. U.S. Army Corps of Engineers, Wilmington District, pers. Comm., June 1996.
208. YELVERTON, F., 1995. Beach Disposal Activity in North Carolina (1984–1995), U.S. Army Corps of Engineers, Wilmington District internal document.
209. BEHRE, R., 1995. Edisto Beach Ends Sand Project. *The Post and Courier,* 16 May 1995, p. A11.
210. RHODES, P.E., 1990. Federal Emergency Work on South Carolina Beaches Following Hurricane Hugo. in *Proceedings of the 3rd Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 26–35.
211. KANA, T.W., STEVENS, F.D., and LENNON, G., 1991. Post-Hugo Beach Restoration in South Carolina. in *Proceedings of the Fourth Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 412–425.
212. KANA, T.W., and LENNON, G., 1991. Emergency Beach and Dune Restoration Following Hurricane Hugo. in *Proceedings of the Fourth Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 1–13.
213. KANA, T.W., STEVENS, D., and LENNON, G., 1991. Post-Hugo Beach Restoration in South Carolina. in Proceedings of *Coastal Sediments '91,* pp. 1697–1711.
214. KANA, T.W., 1990. *Conserving South Carolina Beaches through the 1990s: A Case for Beach Nourishment.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, printed December 1990, 30 pp.
215. KANA, T.W., 1991. An Estimate of South Carolina Beach Nourishment Requirements Through the 1990s. in *Proceedings of the Fourth Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 102–115.
216. KANA, T.W., 1993. South Carolina Beach Nourishment Projects: Successes and Failures. in *Proceedings of the Hilton Head Island South Carolina U.S.A.. International Coastal Symposium June 6–9, 1993,* P. Bruun (ed.), pp. 255–260.
217. OLSEN, E.J., BODGE, K.R., and CREED, C.G., 1993. Performance of Beach Nourishment at Hilton Head Island, South Carolina. in *Proceedings of the Hilton Head Island South Carolina U.S.A.. International Coastal Symposium June 6–9, 1993,* P. Bruun (ed.), pp. 145–150.
218. OLSEN ASSOCIATES, INC., 1992. *Hilton Head Island Beach Restoration Project Monitoring Report.* Jacksonville, Florida: Olsen Associates, Inc.
219. HU, Y.H., and POSEY, F.H., 1989?. Beach Erosion Protection and Beach Nourishment at Tybee Island, Georgia. in *Proceedings of the 2nd? Annual Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 102–115.
220. POSEY, F.H., DICK, J.A., and SHAY, C.H., 1989. Initial Apparent Failure Appears to be A Success at Tybee Island, Georgia. in *Proceedings of Coastal Zone '89,* pp. 848–858.
221. DOUGLAS, B.D., PHLEGAR, W.S., and SEMMES, R.H., 1996. Shallow Water Dredging for Beach Nourishment: Tybee Island, Georgia. in *Proceedings of the 1996 National Conference on Beach Preservation Technology,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 369–379.
222. OLSEN, E.J., 1996. Tybee Island South Beach Stabilization Project. in *Proceedings of the 1996 National Conference on Beach Preservation Technology,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 5–15.
223. OERTEL, G.F., FOSTER, W.G., and GRAHAM, W.R., 1996. Elements of a Successful Beach Management Plan. in *Proceedings*

of the 1996 National Conference on Beach Preservation Technology, L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 27–42.
224. GRAHAM, W.R., 1996. Sea Island Properties, pers. comm., August 1996.
225. RAICHLE, A.W., 1994. *1994 South Amelia Island Beach Nourishment Physical Monitoring: Post-Dredging Borrow Site Analysis.* Jacksonville, FL: Olsen Associates, Inc.
226. OLSEN ASSOCIATES, INC., 1995. *Amelia Island, Florida SAIS-SA Beach Restoration Project Monitoring Report No. 1.* Jacksonville, FL: Olsen Associates, Inc, p. i.
227. DEAN, R.G., and LIN, L., 1995. *Beneficial Uses of Dredged Materials in the Lower St. John's River.* Coastal and Oceanographic Engineering Department, University of Florida.
228. OLSEN ASSOCIATES, INC., 1990. *Feasibility Study for Comprehensive Beach and Dune Preservation Amelia Island, Florida.* Jacksonville, FL: Olsen Associates, Inc., pp. 16–20.
229. NASSAU COUNTY BEACH RESTORATION MANAGEMENT PLAN. Florida Department of Environmental Protection, Division of Beaches and Coastal Systems.
230. WOLF, M., 1996. U.S. Army Corps of Engineers, Jacksonville District, Construction and Operations., pers. comm. by Art Trembanis, June 1996.
231. FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF BEACHES and COASTAL SYSTEMS, state files.
232. FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF BEACHES and COASTAL SYSTEMS, state files.
233. File # DU-94-4. Florida Department Of Environmental Protection. Bureau Of Beaches And Coastal Systems.
234. U.S. ARMY CORPS OF ENGINEERS, JACKSONVILLE DISTRICT, 1989. *Duval County Beaches, Florida General Design Memorandum Addendum II Reach 2 Beach Nourishment,* p. 4.
235. FLOOD, P., 1996. Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems, personal files.
236. FLOOD, P., 1996. Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems, pers. comm., July 1996.
237. BREVARD COUNTY BEACH RESTORATION MANAGEMENT PLAN. Florida Department of Environmental Protection, Division of Beaches and Coastal Systems.
238. Permit File # DBS9A-316BE, Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems.
239. LEROUX, R.K., 1996. Sebastian Inlet Tax District, pers. comm., November 1996.
240. FORT PIERCE INLET MANAGEMENT PLAN. Florida Department of Environmental Protection, Division of Beaches and Coastal Systems.
241. File # PB-91–1-BR, Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems.
242. Permit file # 50–2739539, Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems.
243. File # PB-90–1, Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems.
244. Permit file # PB -91–4, Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems.
245. Permit file # DBS 91–275 MI &MI-M2, Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems.
246. APPLIED TECHNOLOGY AND MANAGEMENT, INC., 1995. *Lake Worth Inlet Management Plan* Draft. West Palm Beach, FL: Applied Technology and Management.
247. FORE, D., 1996. US Army Corps of Engineers, Jacksonville District, Construction and Operations., pers. comm. by Art Trembanis, June 1996.
248. RYSAVY, F., 1996. Hillsboro Inlet District, Chairman. pers. comm., November 1996.
249. CLINGER, R., 1996. Palm Beach County, Dept. of Evironmental Resources Management, Engineering Coordinator. pers. comm., December 1996.
250. OLSEN ASSOCIATES, INC., 1987. *Palm Beach County Atlas Shoreline Management Plan.* Jacksonville, FL: Olsen Associates, Inc.
251. DEAN, R.G., 1996. *Midtown Beach Nourishment Program: Sedimentation Monitoring.* University of Florida, Coastal and Oceanographic Engineering Department, Gainseville, FL, p.1.
252. ARTHUR V. STROCK and ASSOCIATES, INC., 1984. *City of Delray Beach Maintenance Nourishment Project.* Deerfield Beach, FL: Arthur V. Strock and Associates, Inc., pp. 3–7.
253. COASTAL PLANNING and ENGINEERING, INC., 1988. *City of Delray Beach, Florida Second Periodic Beach Nourishment Project.* Boca Raton, FL.: Coastal Planning and Engineering, Inc., p. 4.
254. BEACHLER, K.E., 1993. The Positive Impacts to Neighboring Beaches from the Delray Beach Nourishment Program., in *Proceedings of the Sixth Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 223–238.
255. COASTAL PLANNING and ENGINEERING, INC., 1994. *City of Delray Beach, Florida Third Periodic Beach Nourishment Project 12-Month Follow-Up Study.* Boca Raton, FL.: Coastal Planning and Engineering, Inc., p. 4.
256. COASTAL PLANNING and ENGINEERING, INC., 1995. *Jupiter/Carlin Shore Protection Project 6-Month Follow-up Study.* Boca Raton, FL: Coastal Planning and Engineering, Inc., p. 3.
257. File # PB-89-5. Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems.
258. COASTAL PLANNING AND ENGINEERING, INC., 1991. *City of Boca Raton Boca Raton Beach Restoration Monitoring Study 1 Year Follow-Up Report.* Boca Raton, FL: Coastal Planning and Engineering, Inc., p.i.
259. COASTAL PLANNING AND ENGINEERING, INC., 1995. *Boca Raton Inlet and Adjacent Beaches 1993 Monitoring Program.* Boca Raton, FL: Coastal Planning and Engineering, Inc., p. 7.
260. PORT EVERGLADES INLET MANAGEMENT PLAN. Florida Department of Environmental Protection, Division of Beaches and Coastal Systems.
261. HIGGINS, S. H., 1990. The John U. Lloyd Beach Renourishment and Jetty Grouting Project: A Local Success Story. in *Proceedings of the Third Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 53–68.
262. U.S. ARMY CORPS OF ENGINEERS, JACKSONVILLE DISTRICT, 1991. *Broward County, Florida Port Everglades to the South County Line (Segment III) Shore Protection Project Reevaluation Report Section 934 Study with Environmental Assessment.*
263. LIN, P.C.P., HANSEN, I.E., and SASSO, H., 1994. Regional Sand Movement and Performance of Successive Beach Nourishment Projects. in *Proceedings of the Seventh Annual National Beach Preservation Technology Conference,* L.S. Tait (ed.), Florida Shore and Beach Preservation Association, Tallahassee, Florida, pp. 217–228.
264. U.S. ARMY CORPS OF ENGINEERS, 1994. Shoreline Protection and Beach Erosion Study: Yearly Cost Data for Constructed Projects (1950–1993). Accompaniment to *Shoreline Protection and Beach Erosion Control Study Phase I: Cost Comparison of Shoreline Protection Projects of the US Army Corps of Engineers,* Institute of Water Resources Report, 94-PS-1, January 1994.
265. PORT CANAVERAL MANAGEMENT PLAN, Florida Department of Environmental Protection, Division of Beaches and Coastal Systems.
266. Monroe County Beach Restoration Management Plan, Florida Department of Environmental Protection, Division of Beaches and Coastal Systems.
267. Fort Pierce Inlet Management Plan, Florida Department of Environmental Protection, Division of Beaches and Coastal Systems.
268. PALM BEACH COUNTY BEACH RESTORATION MANAGEMENT PLAN, Florida Department of Environmental Protection, Division of Beaches and Coastal Systems.
269. BODGE, K., 1996. Olsen Associates, Inc., pers. comm., October 1996.
270. PILKEY and CLAYTON, 1989. Summary of Beach Replenishment Experience on U.S. East Coast Barrier Islands. *Journal of Coastal Research,* (5)1, pp. 147–159.
271. HENRY, R.D., 1997. Delaware Department of Natural Resources. Program Administrator Shoreline and Waterway Management Section. pers. comm. by Art Trembanis, August 1997.