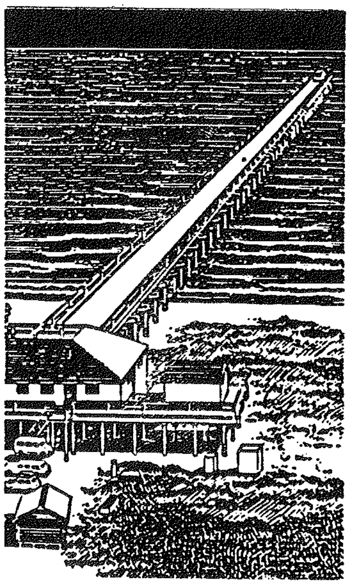
US Army Corps of Engineers



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COASTAL RESPONSE TO A DUAL JETTY SYSTEM AT LITTLE RIVER INLET, NORTH AND SOUTH CAROLINA

by

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13. ABSTRACT *(Maximum 200 words)*

Little River Inlet is a shallow coastal inlet located on the Atlantic Ocean along the North Carolina-South Carolina border. Construction by the US Army Engineer District, Charleston (SAC) of a dual jetty system at Little River Inlet began in March 1981 and was completed in July 1983.

An extensive monitoring program began in March 1981 to evaluate the performance of the jetty system and document its effect on local shorelines. The program included beach profile surveys, inlet hydrographic surveys, aerial photography, structural surveys, site inspections, and Littoral Environment Observation (LEO) data collection.

The Coastal Engineering Research Center has conducted an analysis of the monitoring data collected at Little River Inlet between 1978 and 1989. The objectives of this analysis were to summarize initial beach and nearshore response to the project, and assist SAC in developing dredged material management plans. Additionally, the option of opening the weir section of either jetty was evaluated, and recommendations were made on continued project monitoring.

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PREFACE

The investigation summarized in this report was conducted by the US Army Engineer Waterways Experiment Station's (WES's) Coastal Engineering Research Center (CERC) through a reimbursable study for the US Army Engineer District, Charleston (SAC). Messrs. James Joslin and Millard Dowd were the SAC representatives involved in this study. Funds were provided by SAC.

Work was performed at WES under the general supervision of Dr. Yen-hsi Chu, Chief, Engineering Applications Unit (EAU), Coastal Structures and Evaluation Branch (CSEB), CERC; Ms. Joan Pope, Chief, CSEB; Mr. Thomas W. Richardson, Chief, Engineering Development Division (EDD); Mr. Charles C. Calhoun, Jr., Assistant Chief, CERC; and Dr. James R. Houston, Chief, CERC.

This report was prepared by the Principal Investigator (PI) of the reimbursable study, Ms. Monica A. Chasten, EAU, CSEB. Mr. Don Ward, Wave Dynamics Division, conducted the RCPWAVE and longshore transport analyses. Technical assistance with the data analysis was provided by Mr. Bill Birkemeier, Chief, Field Research Facility; Mses. Kelly Lanier and Karen Pitchford and Messrs. Joseph Curro, III and Darryl Bishop, all of CSEB. Ms. Lanier, Mr. Bishop, and Ms. Janie Daughtry provided assistance in preparing the manuscript and figures. Technical reviewers of the report were Dr. Yen-hsi Chu and Dr. Douglas R. Levin, Assistant Professor of Science, Bryant College, formerly of CERC. The assistance of Mr. Millard Dowd, SAC, throughout the study is greatly appreciated.

A special acknowledgement is extended to Mr. Perry Reed, Civil Engineering Technician, EAU, CSEB who performed much of the bathymetry analysis. Mr. Reed passed away on 4 January 1991.

Dr. Robert W. Whalin was Director of WES. COL Leonard G. Hassell, EN, was Commander and Deputy Director.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
cubic yards	0.7645549	cubic meters
feet	0.3048	meters
inches	2.54	centimeters
miles	1.609347	kilometers

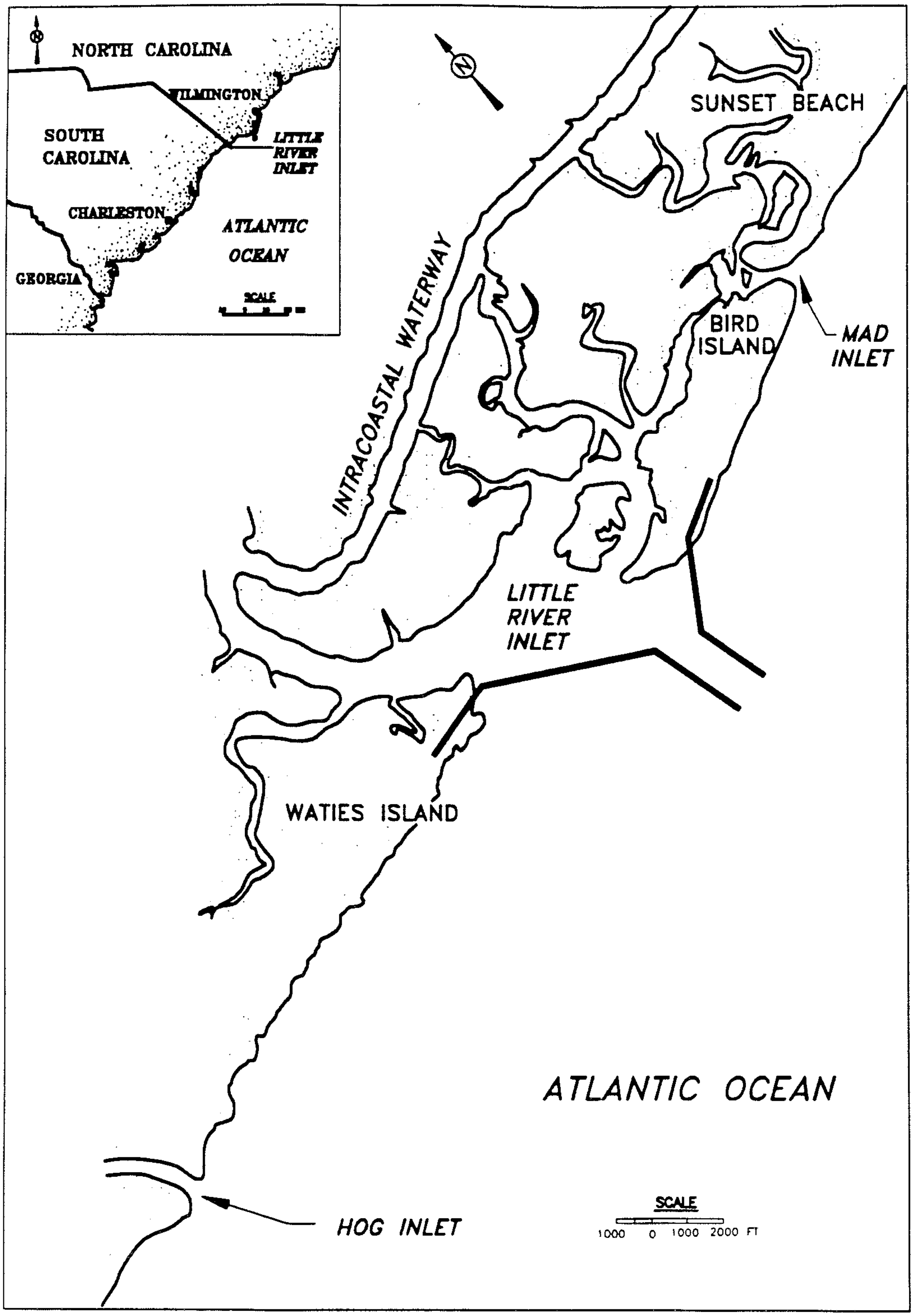

Figure 1. Study area location map

COASTAL RESPONSE TO A DUAL JETTY SYSTEM AT LITTLE RIVER INLET, NORTH AND SOUTH CAROLINA

PART I: INTRODUCTION

Purpose

1. The Waterways Experiment Station's (WES) Coastal Engineering Research Center (CERC) conducted an analysis for the U.S. Army Engineer District, Charleston (SAC) of the monitoring data collected at Little River Inlet, North and South Carolina from 1979 to 1989. The objectives of this analysis were to summarize initial beach and nearshore response to the Little River Inlet navigation project, and assist SAC in developing dredged material management plans. Additionally, the option of opening the weir section of either jetty was evaluated, and recommendations made on continued project monitoring.

Background

2. Little River Inlet is located on the Atlantic Ocean along the North Carolina-South Carolina border, approximately 23 miles* northeast of Myrtle Beach, South Carolina (Figure 1). The inlet is the ocean entrance to the towns of Little River and Calabash, the Atlantic Intracoastal Waterway (AIWW), and several tidal streams. The back bay serves as a safe coastal harbor for many private, recreational, and commercial fishing boats (US Army Corps of Engineers 1977). Little River Inlet is the only ocean outlet from the AIWW between Shallotte Inlet, NC and Georgetown, SC, a distance of 68 miles.

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*A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 3.

3. The inlet is part of the "Grand Strand," an area along South Carolina's northeastern shore consisting of 60 miles of resort beaches. Bird Island, an undeveloped privately-owned area lies to the northeast of the inlet. To the southwest is Waties Island, also privately owned and undeveloped.

4. Historical reviews of Little River Inlet are provided in Seabergh and Lane (1977) and Anders et al. (1990). The first survey of the area in 1735 noted that the inlet was just inside the South Carolina State line (U.S. Army Engineer District, Charleston 1971). Figure 2 indicates that the inlet remained relatively close to the State border (Seabergh and Lane 1977). The farthest known distance from the border was almost one mile west in 1873 (Figure 2). Subsequent shoreline configurations show an easterly migration of the inlet, and a post-1942 widening of the inlet. This increase in width may be due to a larger ebb tidal prism caused by the opening of the AIWW in the late 1930's (Seabergh and Lane 1977). Dynamic changes in the position of the main ebb channel and inlet shoals were historically experienced within the inlet opening. Frequent shifting and migration of the barred channel and extensive sand shoals made the inlet extremely dangerous for navigation. At times, controlling depth in the inlet was 3 ft or less at Mean Low Water (MLW). Due to the instability of the channel, sidecast dredge operations proved ineffective in providing safe navigation through the inlet.

5. Under Section 201 of the Flood Control Act of 1965, a project for the improvement and stabilization of Little River Inlet was authorized by Congress in 1972. Preconstruction planning began in 1974, and final plans and specifications were completed in 1980. Construction of a dual jetty system at the inlet began in March 1981 and was completed in July 1983.

Physical Setting

6. Little River Inlet is located within a geomorphic coastal zone termed the arcuate strand (Brown 1977). Landward,

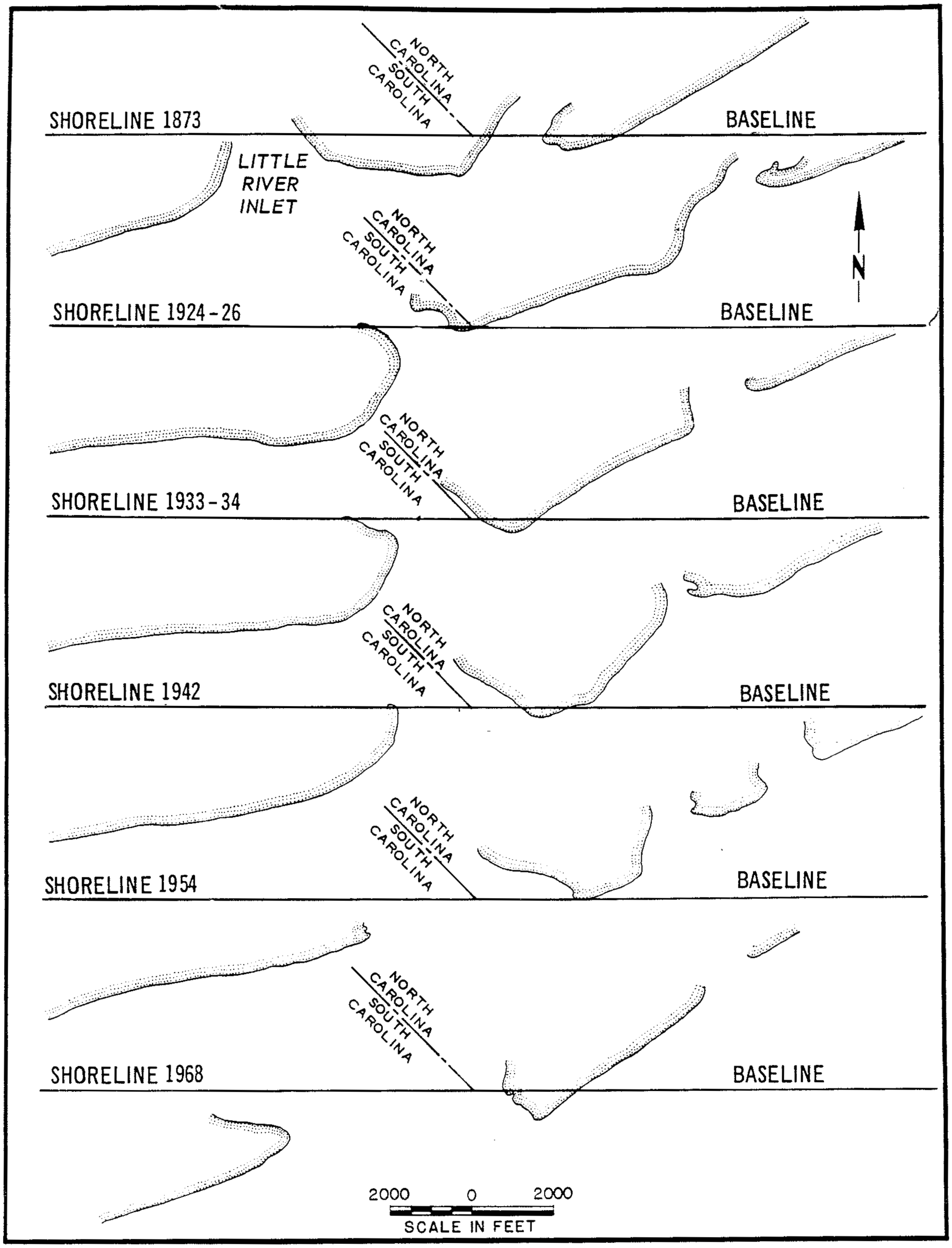


Figure 2. Historical high water shorelines and inlet locations (Seabergh and Lane 1977)

the strand abuts a mid-Pleistocene beach ridge deposit (Ward and Knowles 1987). The coastline is relatively straight and interrupted by few tidal inlets.

7. Tidal inlet morphology along this portion of the Carolina coast is characterized as mixed-energy (Hubbard et al. 1979) trending toward tide domination (Davis and Hayes 1984). In a mixed-energy inlet, shoals located near the throat are separated by channels of variable depth. Prior to stabilization, the shoals at Little River Inlet were located slightly seaward of the inlet throat.

8. The mean tidal range for this region is 5.0 ft. This range lies within the overlap between the upper end of the microtidal envelope and the beginning of the mesotidal range (Davies 1964). The average significant wave height for the vicinity is approximately 1.8 ft (Jensen 1983). Little River Inlet is somewhat protected from waves generated from the northeast by the Frying Pan Shoals at Cape Fear, NC.

9. Little River Inlet is connected with a marsh area and the AIWW, which in turn is joined to the Waccamaw River. Fresh water inflow from this source averages 1,200 cu ft per second, or 53.6 million cu ft per tidal cycle. The total pre-project tidal prism was 505 million cu ft (Seabergh and Lane 1977).

Project Description

10. The authorized stabilization project provides for an entrance channel 12-ft deep, 3,200-ft long, and 300-ft wide across the ocean bar, and an inner channel, 10-ft deep, 9,050-ft long, and 90-ft wide from the entrance channel to the AIWW. The channel is stabilized by two jetties, with sand transition dikes connecting the structures to the shore. A low weir section was built into each jetty, and then subsequently covered with armor stone (Figure 3).

11. Optimum design of the navigation project was determined through the use of a fixed-bed hydraulic model study (Seabergh

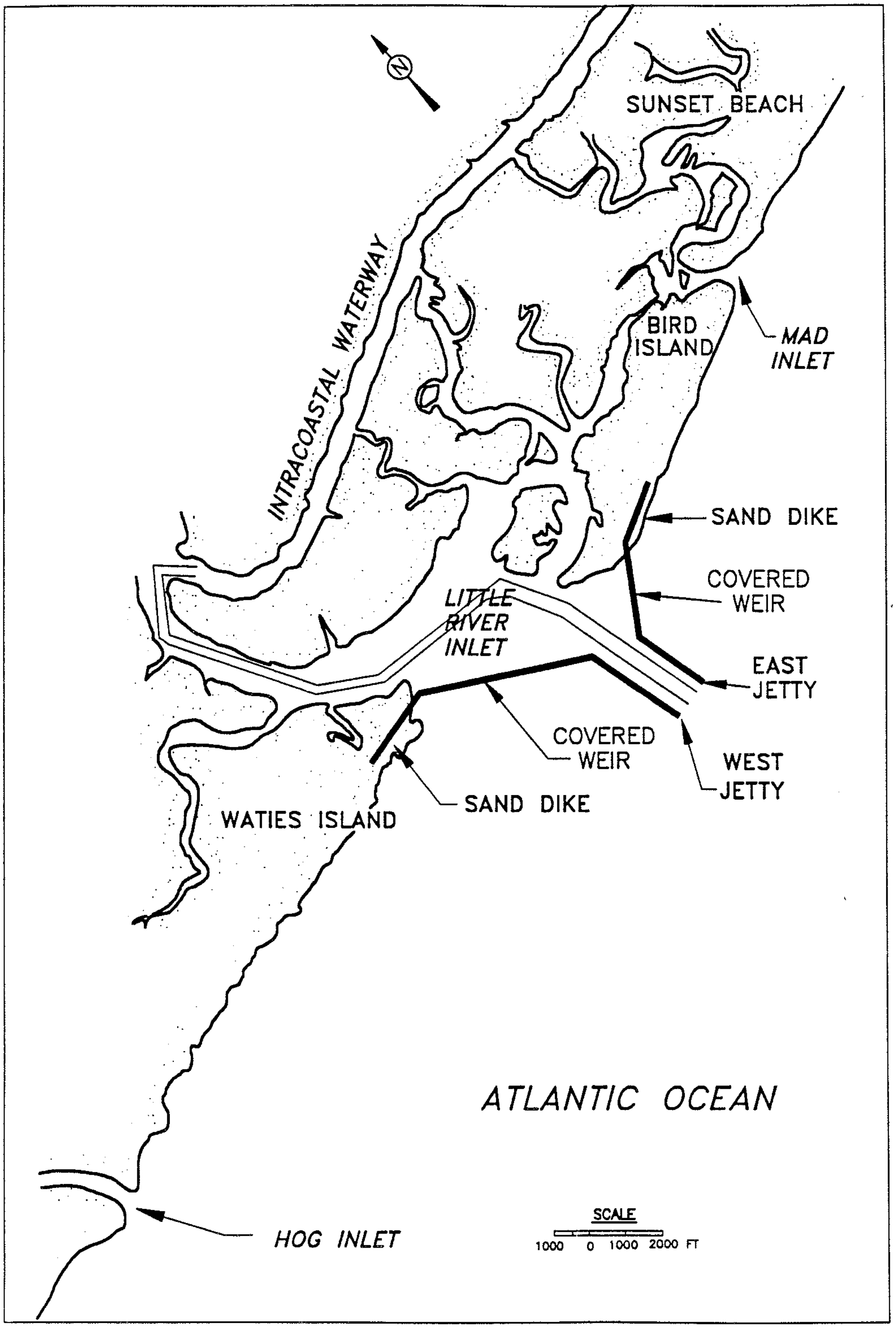


Figure 3. Little River Inlet navigation project and vicinity

and Lane 1977). This study examined alignment, length and spacing of the jetties, weir sections, current patterns and magnitudes, sediment movement patterns, effects on the tidal prism, and effects on bay salinities.

12. The two jetties are of typical quarrystone, rubble-mound construction. Seven various sizes of stone weighing between 2.5 pounds and 8 tons were used to construct the jetties. The east jetty is approximately 3,300-ft long, and the west jetty is approximately 3,800-ft long. Both jetties include a sand dike to anchor the structure to the shore, a weir, and a sand-tight section joining the weir to the sand dike.

13. The hydraulic model study determined that a 1,300-ft weir section at elevation +2.4 ft MLW backed by deposition basins would be the most feasible plan for both jetties. As constructed, this 1,300-ft section was divided into a 650-ft sand-tight section connected to the shore and a 650-ft weir, in order to provide more control of sand overtopping the weir. However, the weirs were subsequently covered with armor units to an elevation of +8 ft MLW. The deposition basins were never dredged.

Construction and Dredging History

14. The first stone was placed on the east jetty 28 July 1981 and the last one was set on 8 June 1982. Initial dredging of the entrance channel to a 300-ft width and 12-ft depth was performed between June and July 1982. This dredging effort removed 513,000 cu yds of material from the channel, which was subsequently used to construct the west sand dike. Upon completion of the east jetty, construction equipment was mobilized to Waties Island. Stone placement for the west jetty began in June 1982 and finished in early June 1983.

15. Little River Inlet has been dredged only one time since the initial dredging of the channel. This dredging effort was accomplished between December 1983 and February 1984. The total volume removed from the entrance and inner channels was

264,000 cu yds. Most of this material was placed adjacent to the inner side of the west jetty due to migration of the channel towards the jetty.

Monitoring Program

16. The SAC began collecting pre-project baseline data at the Little River Inlet project in 1979. A formal monitoring program was initiated by SAC and CERC in 1981. The primary objectives of this program were to evaluate the performance of the jetty system and document its effects on adjacent shorelines.

17. The first phase of the formal monitoring program began in March 1981 and continued through February 1986. A reduced monitoring effort will continue through 1991. The two phases are summarized below.

Phase I

18. Phase I of the monitoring program consisted of:

a. Beach profiles (quarterly, 58 lines through October 1983, then 48 lines)

b. Inlet hydrographic surveys (quarterly)

c. Aerial photography of shoreline (monthly during and one year after construction, then quarterly)

d. Structural surveys (quarterly)

e. Site inspections (annual, by SAC/CERC personnel)

f. Littoral Environment Observations (LEO) (three sites daily)

Phase II

19. The reduced monitoring program consisted of:

a. Beach profiles (semi-annual, 48 lines)

b. Inlet hydrographic surveys (semi-annual)

c. Aerial photography of shoreline (semi-annual)

d. Structural surveys (annual)

e. Site inspections (annual, SAC/CERC personnel)

f. Littoral Environment Observations (LEO) (three sites daily)

PART II: DATA ANALYSIS METHODS AND RESULTS

20. The CERC has analyzed monitoring data collected at Little River Inlet between 1979 and 1989. This chapter briefly describes the data and the analysis methods used in this investigation. Due to the large volume of data, most results are presented in separate appendices. Limitations of the data and results are discussed in each of the respective appendices.

Beach Profile and Inlet Hydrographic Data

21. Beach surveys were taken along 58 profile lines until October 1983, and 48 lines for the remainder of the program. The profile lines are spaced at 200-ft intervals to approximately 3500 ft from the channel centerline on either side of the inlet (Figure 4). From there, profiles are spaced at 500-ft intervals for a short distance, and then 1000-ft intervals to a distance of about 2.6 miles from the channel centerline. Coverage continues with 5000-ft spacing east to Tubbs Inlet, and west across Hog Inlet to North Myrtle Beach. Starting locations and alignments of the profile lines are provided in Appendix A (Table A-1).

22. Profile data was obtained from SAC and entered into the Interactive Survey Reduction Program (ISRP) (Birkemeier 1984). A description of ISRP, the techniques used to analyze the data, and the plotted results are presented in Appendix A.

23. Hurricane Hugo made landfall on September 21, 1989, just north of Charleston, SC. Post-Hugo profile data (December 1989) at Little River Inlet was plotted separately since the data represents profile changes during an extreme event. Comparison plots were made using surveys from 1988 (Appendix B).

24. Also computed from the profile data were estimations of MLW and Mean High Water (MHW) shoreline change (Appendix C) and calculations of above datum volume changes (Appendix D).

25. The ISRP beach profile and inlet hydrographic survey data for specified dates were input into Radian Corporation's

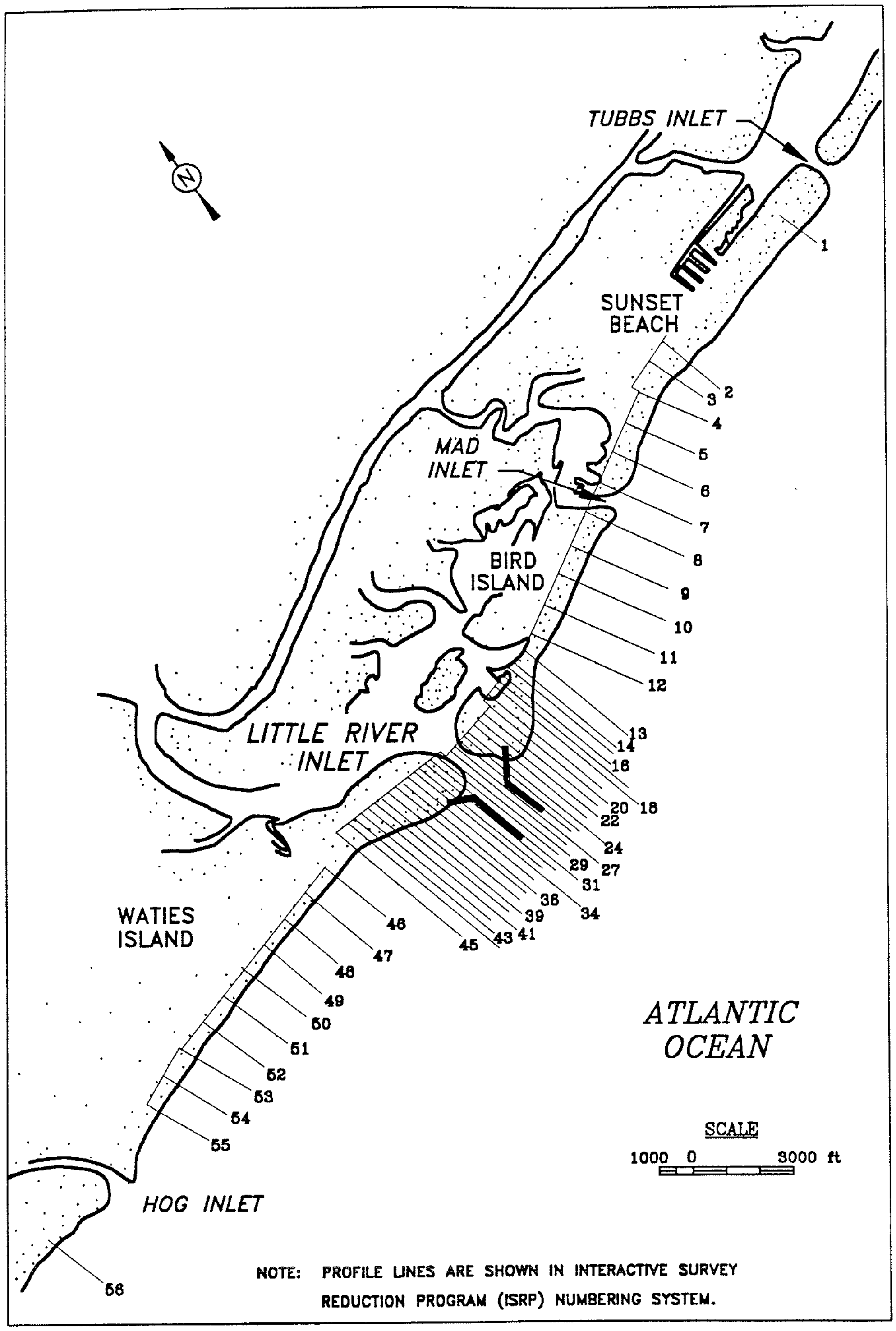


Figure 4. Beach profile survey lines

Contour Plotting System (CPS-3). Bathymetric contour maps were then generated for annual spring/summer surveys between April 1981 and July 1988 (Appendix E).

26. Shoal and fillet volumes were then computed from the bathymetric maps using CPS-3. Five volume polygons were designated covering the fillets to the west and east of the jetties, a central ebb shoal area, and the shoal areas on the inner side of each jetty (Figure 5). Table 1 and Figures 6 and 7 show the results for each volumetric determination. Additional volume computations were made for the shoal on the inner side of the east jetty (polygon denoted East Inside) to determine potential sources of the shoal's growth. Temporal changes in the shoal size were correlated to changes in other inlet sand bodies that may be sources of sediment supply.

Historical Shoreline Change Maps

27. Maps delineating the shoreline at various points in time (1873, 1924/26, 1933, 1962/63, 1969/70, and 1983) were prepared by the National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), and the South Carolina Division of Research and Statistical Services (DRSS). These maps were then used by Anders et. al (1990) to analyze changes in shoreline position along the South Carolina coast over the past 150 years.

28. A brief review was made of relative historical information found in Anders et al. (1990). Shoreline change measurements were made for map transects corresponding to ISRP Lines 49 through 53 (see Figure 4), a suspected erosional area on the western end of Waties Island. These ISRP profile lines correspond to survey Stations 81+00W to Stations 121+00W, respectively. In order to avoid potential scale distortions, measurements were made on the original mylars, and not on the maps published with Anders, et al. (1990).

29. Shoreline positions along the transects were digitized using a CALCOMP 9000 system, and shoreline changes between

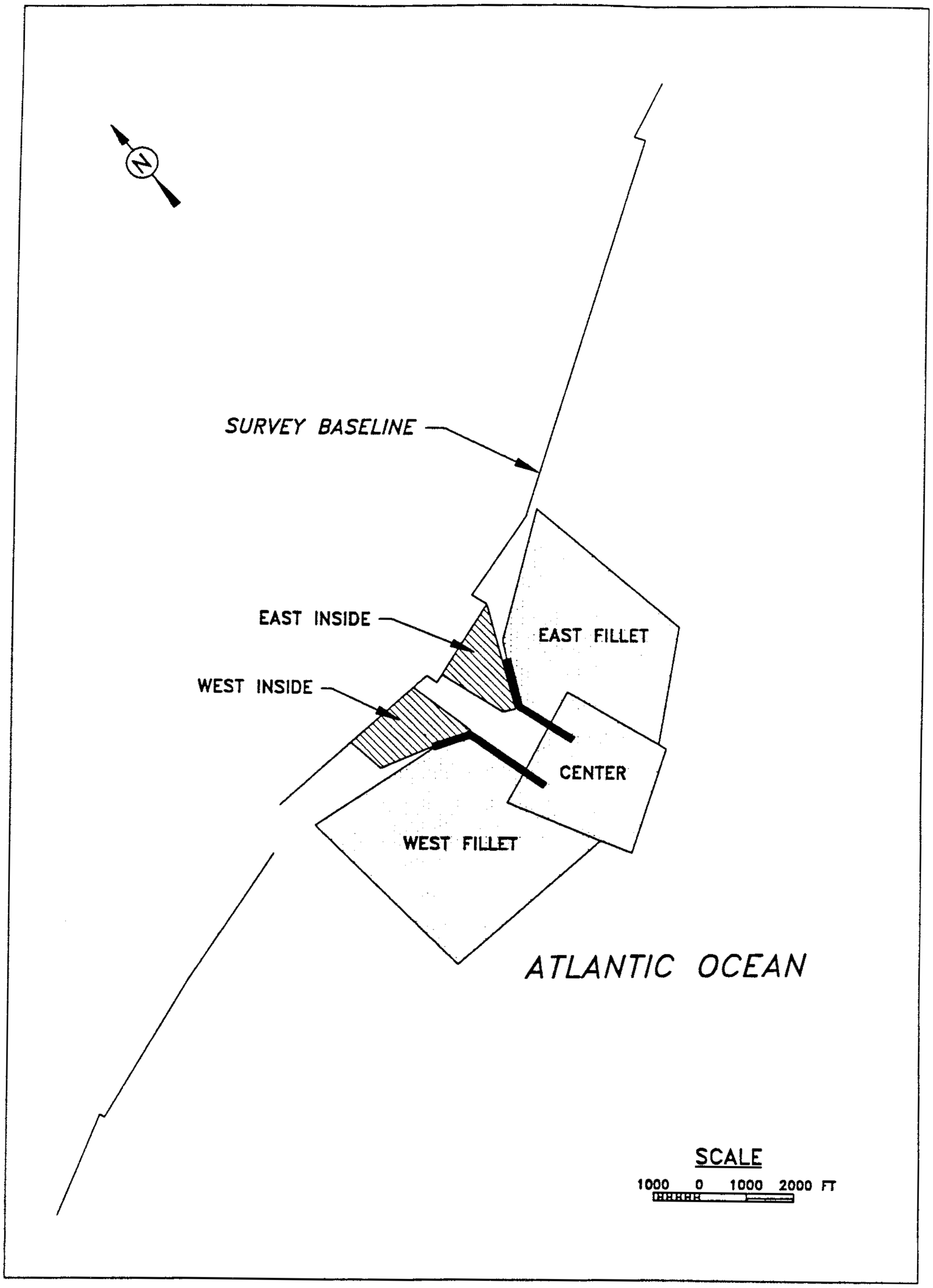


Figure 5. Polygons used in shoal and fillet volume calculations

Table 1

Shoal and Fillet Polygons

Total Volume, million yd^3

Date	West Fillet (1,173,100)*	East Fillet (1,319,100)*	Center Ebb (772,500)*	East Inside (203,700)*	West Inside (204,900)*
April 1981	6.2	4.8	3.3	2.7	1.8
May 1982	5.9	4.9	3.4	2.1	2.3
July 1982	5.5	4.8	3.4	2.3	3.0
May 1983	5.4	4.7	3.5	2.5	2.5
January 1984	4.6	4.5	2.6	2.4	2.4
May 1984	5.3	4.6	3.3	2.7	2.3
June 1985	5.0	4.7	3.1	2.8	2.4
June 1986	5.3	5.0	3.8	3.1	2.5
July 1987	5.5	4.6	3.3	4.1	2.5
July 1988	6.2	5.3	3.2	4.5	2.5

* ( ) = area, yd^2

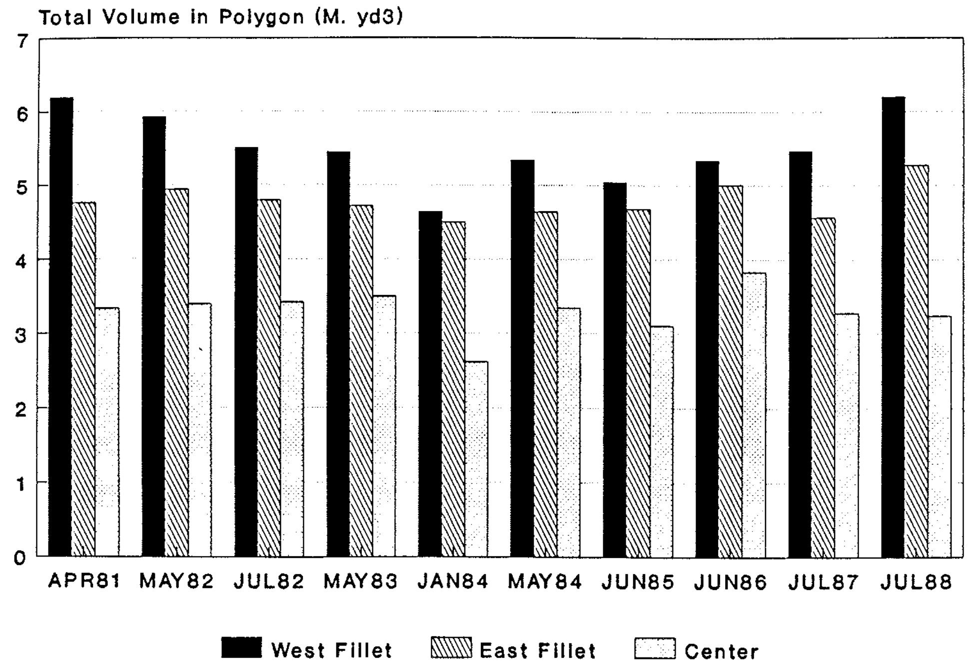


Figure 6. Ebb shoal and fillet polygon volumes

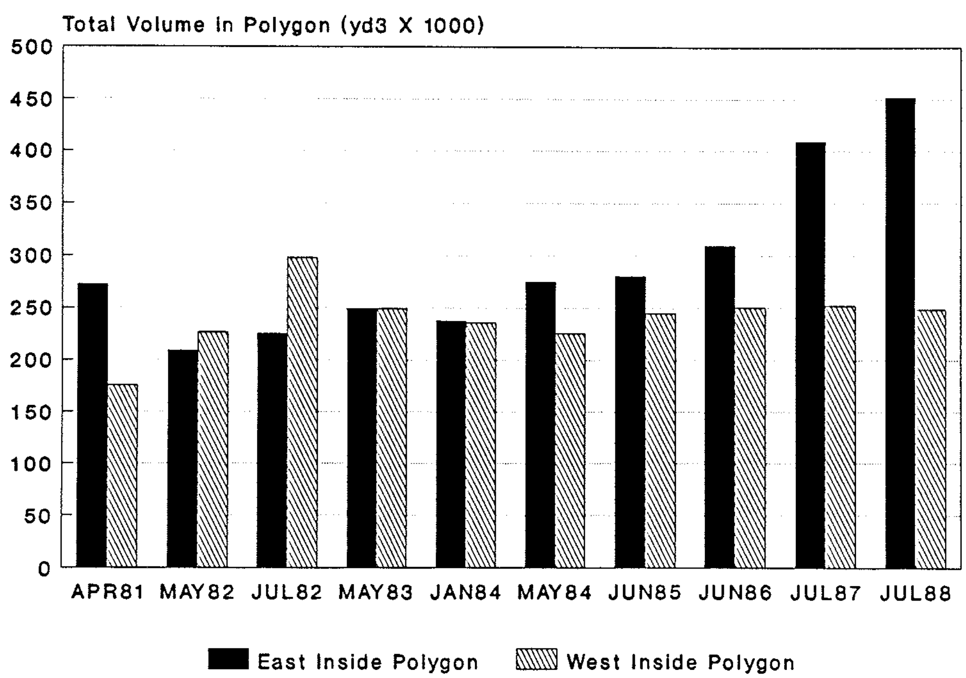


Figure 7. Inner shoal polygon volumes

historical dates were computed. This process was repeated several times to improve quantitative accuracy. Table 2 and Figure 8 provide historical shoreline change analysis results.

Aerial Photography

30. Aerial photography, at a scale of 1 in. = 400 ft, of Little River Inlet and the adjacent shorelines was collected monthly during and for one year after construction. Aerials were then taken quarterly for the remainder of the first phase of the monitoring program.

31. Mosaics of the spring photography from 1979 to 1988 were constructed (Figures 9a through 9j). Shoreline change measurements from both the full-size photographs and the mosaics were limited to qualitative analyses, since discrepancies within the photography prevented confident quantitative comparison of the shorelines.

32. Aerial photography of Hog Inlet was visually examined relative to changes on the western end of Waties Island. The inlet has historically demonstrated significant shoreline changes on this portion of Waties Island (Anders et al. 1990). The position of the inlet thalweg and volume of material contained in the ebb shoals were qualitatively evaluated in relation to the beach profile data collected for this area.

Wave Refraction Analysis

33. A pre- and post-project refraction analysis was conducted using the numerical model RCPWAVE (Ebersole et al. 1986). The primary objectives of this analysis were to examine the wave climate in the inlet's vicinity and evaluate longshore transport trends, for both pre- and post-jetty conditions.

34. The Wave Information Study (WIS) conducted a 20-yr wave hindcast study for the Atlantic coastlines (Jensen 1983). Phase III WIS data from Station A3108, Sunset Beach, was used along

Table 2

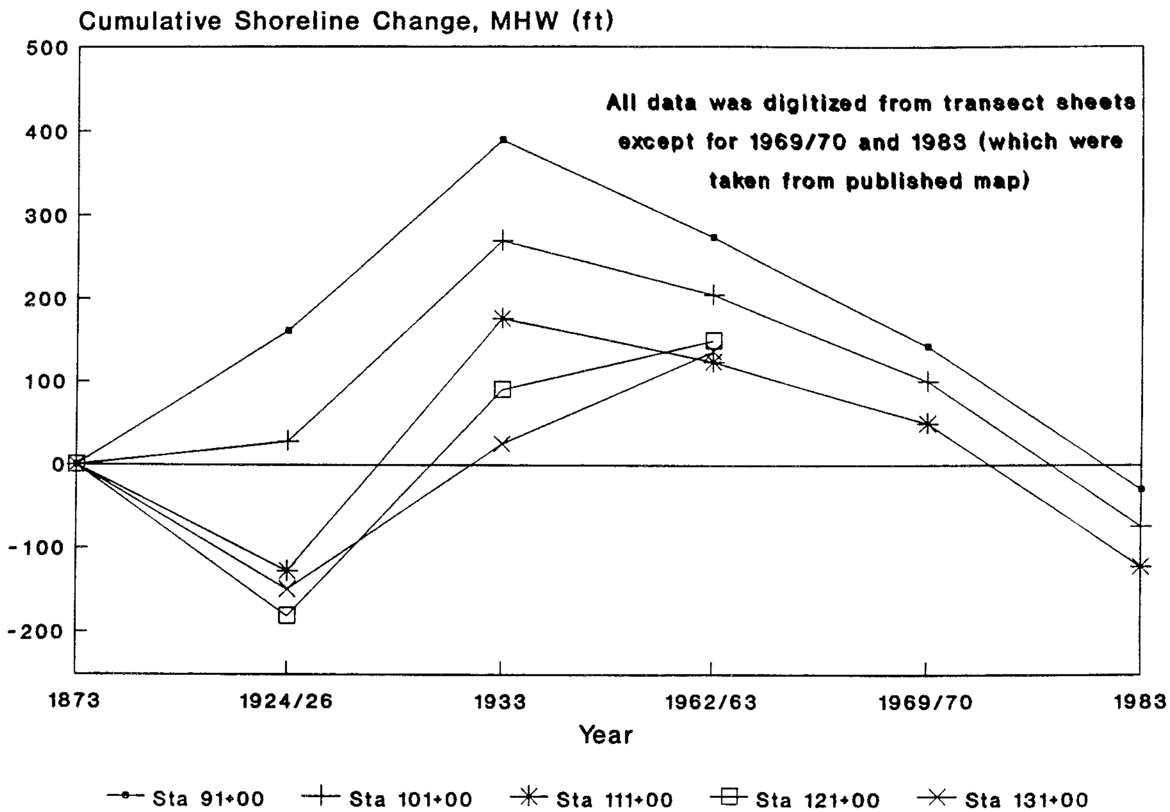
Historical Shoreline Change Measurements

(Taken from Mylars used for NOS/CERC/DRSS maps)

		Shoreline Change (ft)				
ISRP Line No.	Corresponding Station	1873-1925	1925-1934	1934-1962	1962-1970*	1970-1983*
54	131+00W	-150	+175	+110	E**	E
53	121+00W	-180	+270	+60	E	E
52	111+00W	-130	+300	-50	-75	-170
51	101+00W	+30	+240	-60	-100	-175
50	91+00W	+160	+230	-120	-130	-175
49	81+00W	+300	+230	-250	E	E

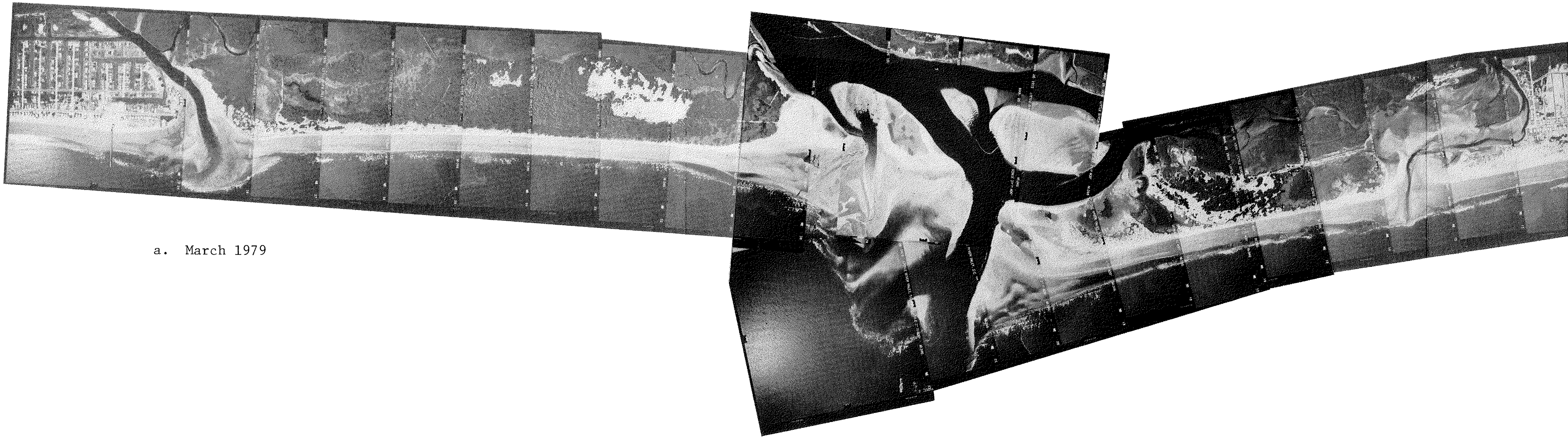
* Mylars of shorelines were not available, measurements were taken from the published maps (Anders et al. 1990). Because of the difference in source maps, quantitative comparisons of pre- and post-1962 values is cautioned.

** Measurements were not taken, general visual observations were made of the shoreline status (A = accreted, E = eroded, S= stable)



T-sheets/map from Anders et al. (1990)

Figure 8. Historical shoreline change for map transects corresponding to profiles on Waties Island



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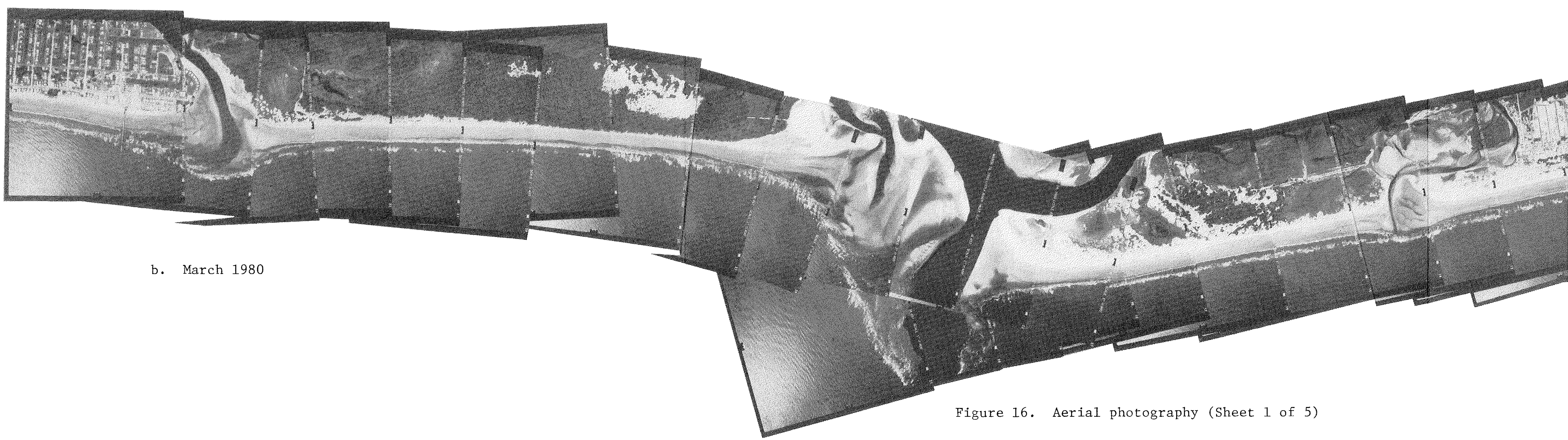


b. March 1980

Figure 16. Aerial photography (Sheet 1 of 5)

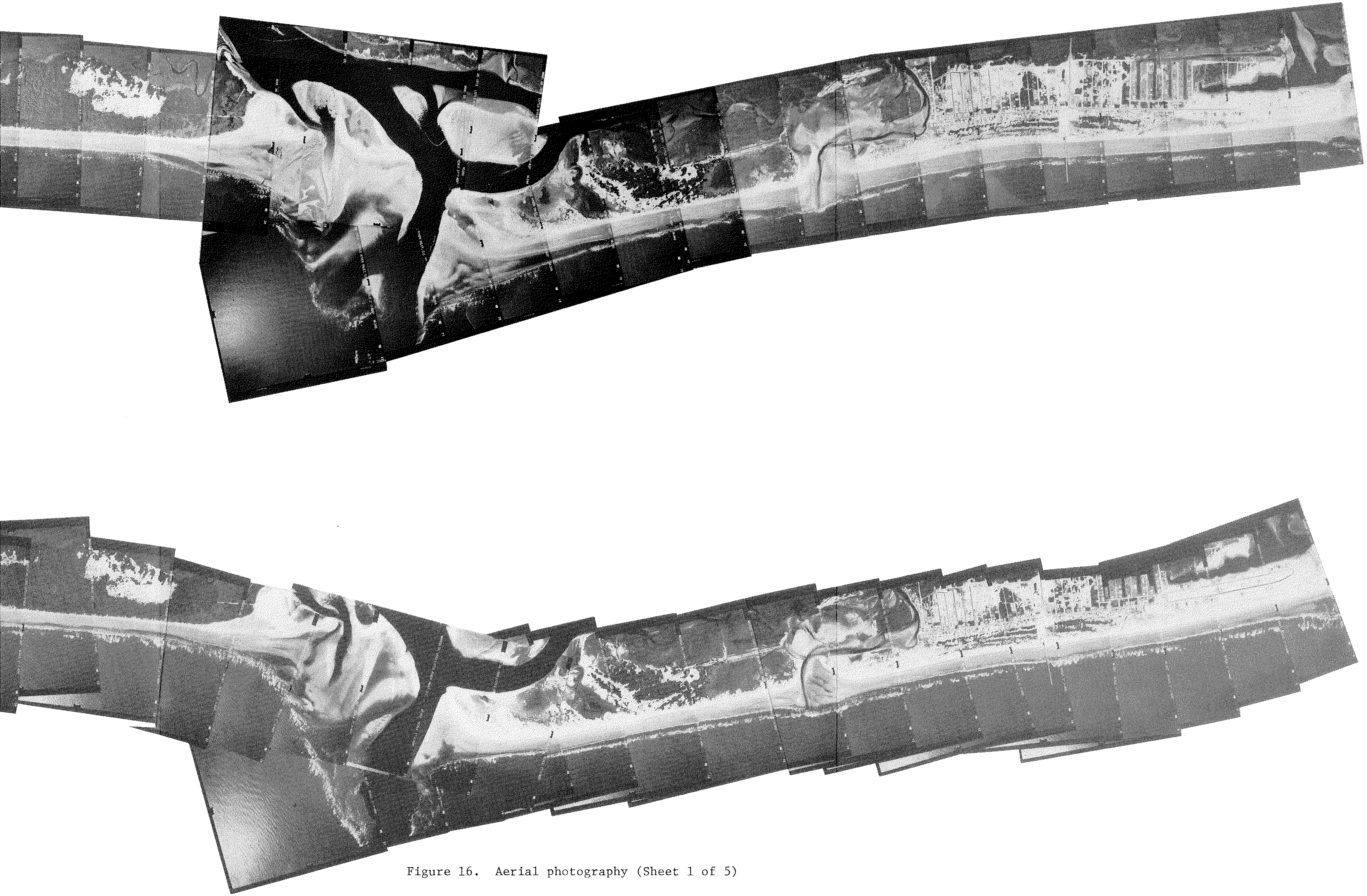
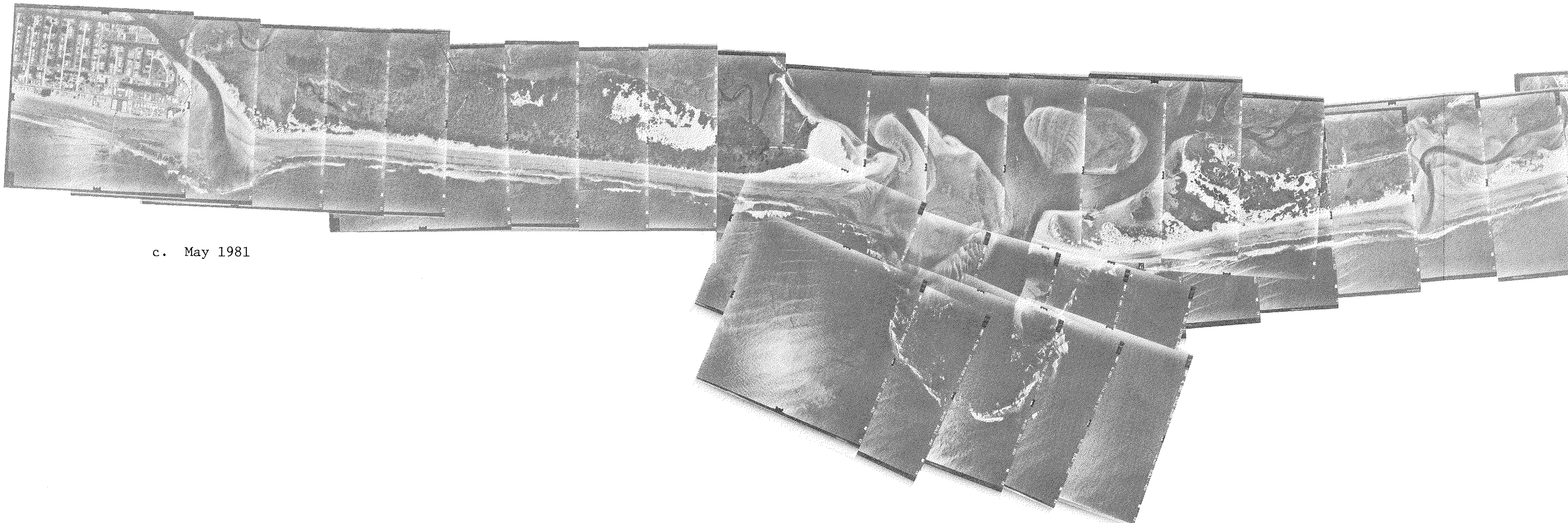
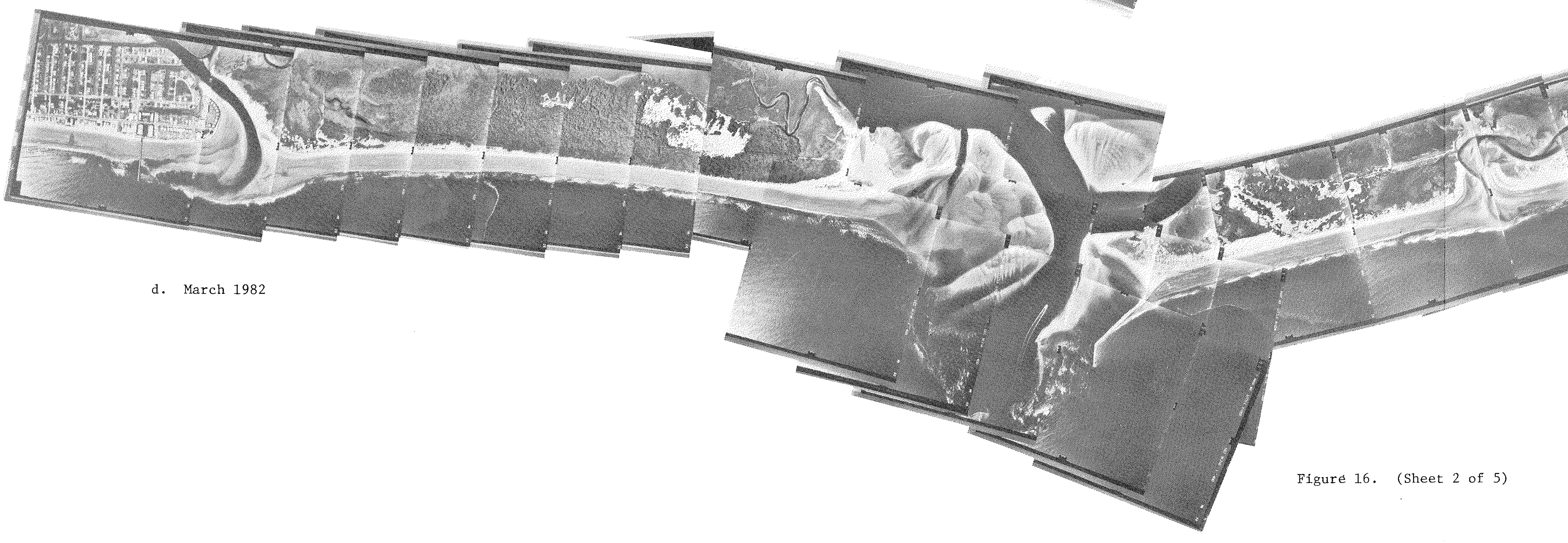


Figure 16. Aerial photography (Sheet 1 of 5)



c. May 1981



d. March 1982

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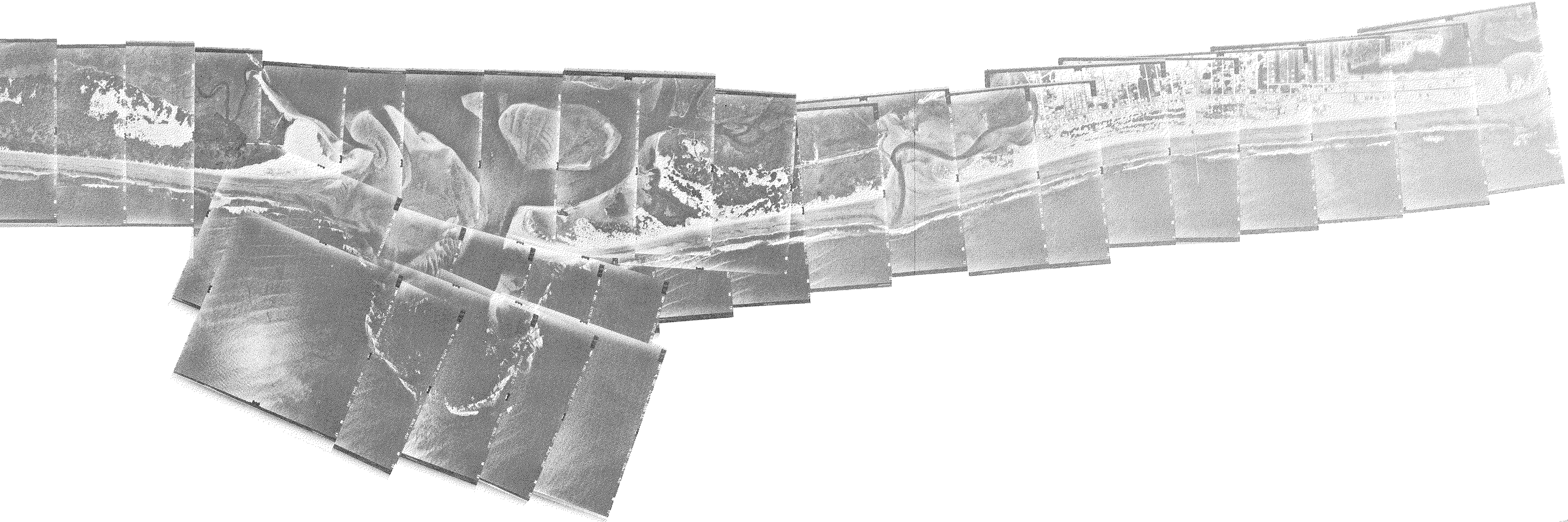

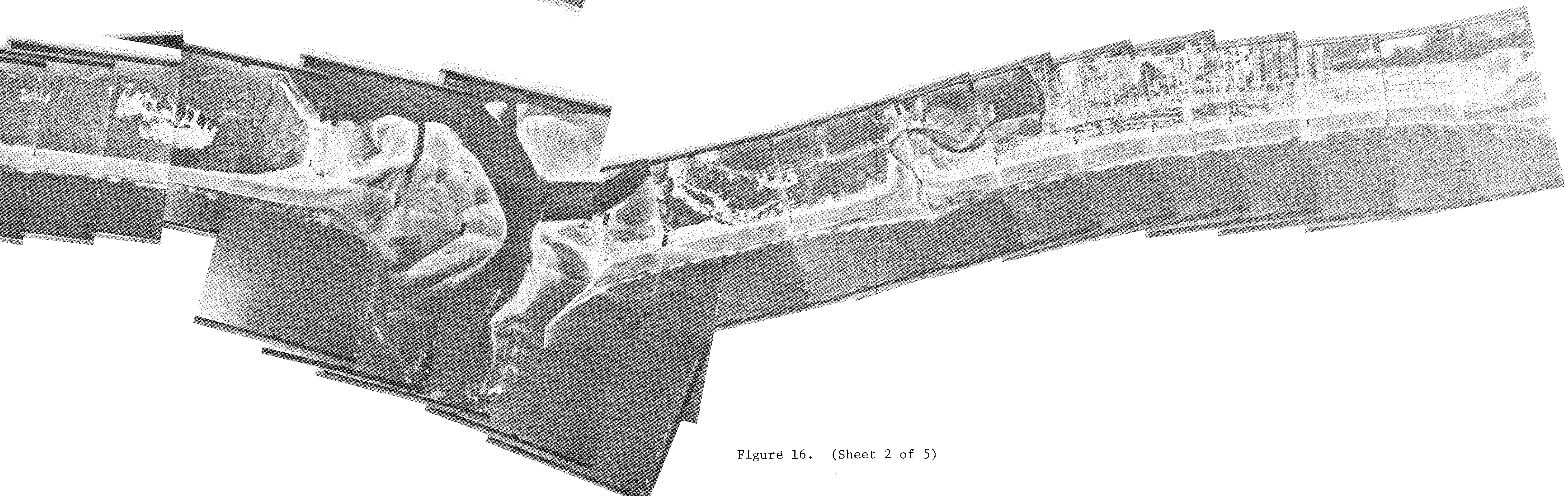

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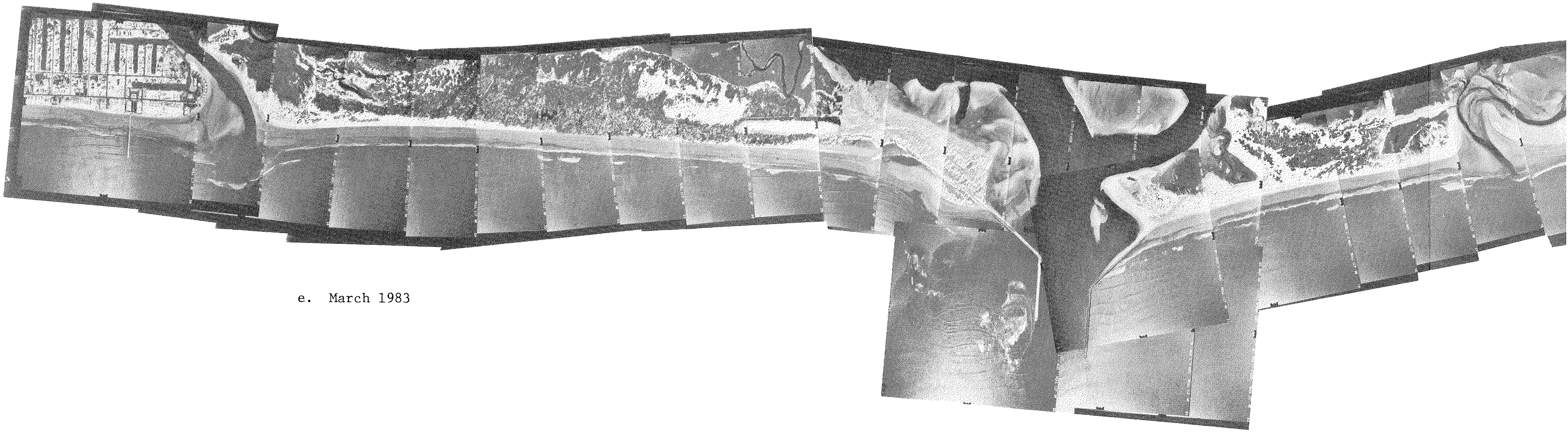
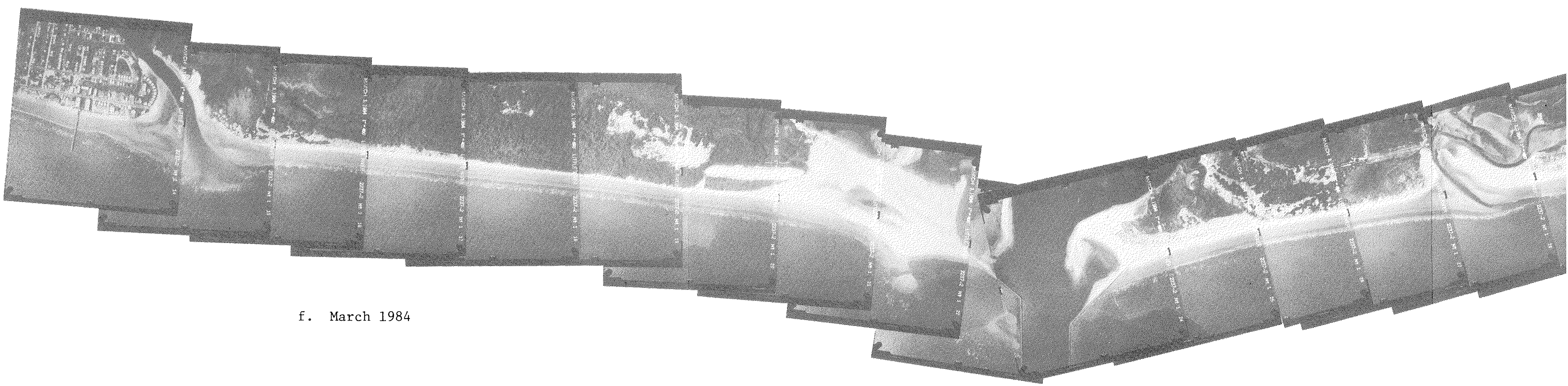


e. March 1983



f. March 1984

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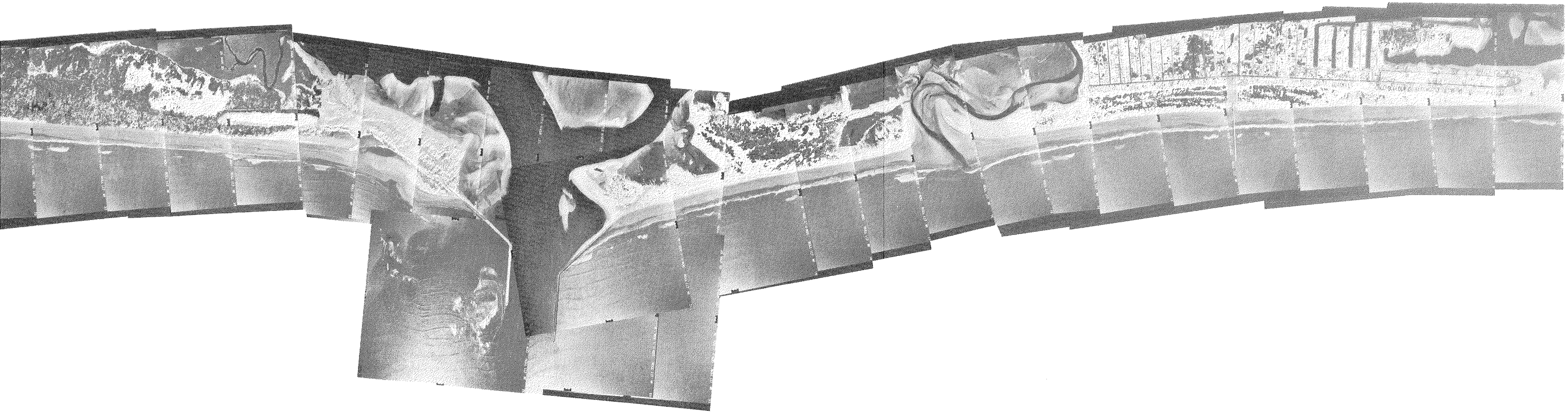

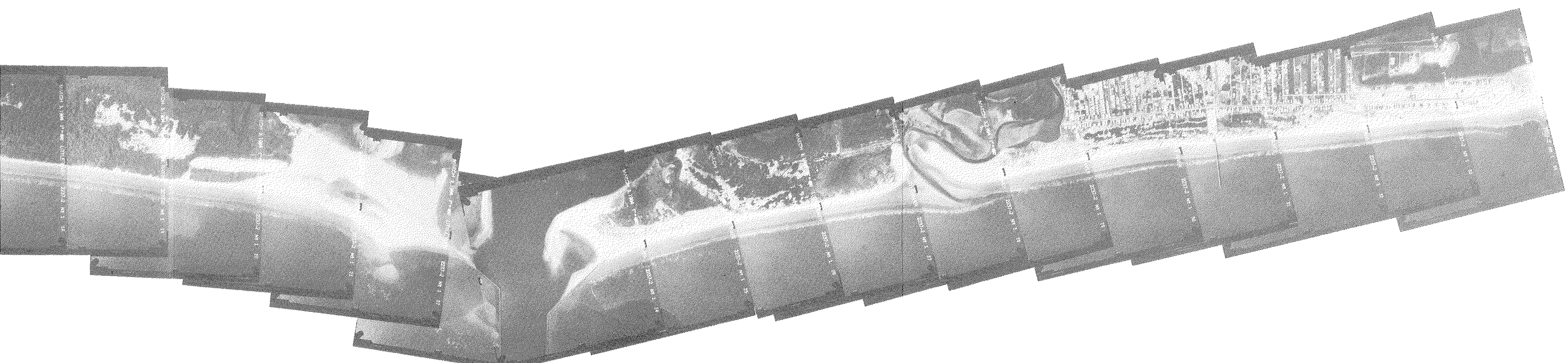

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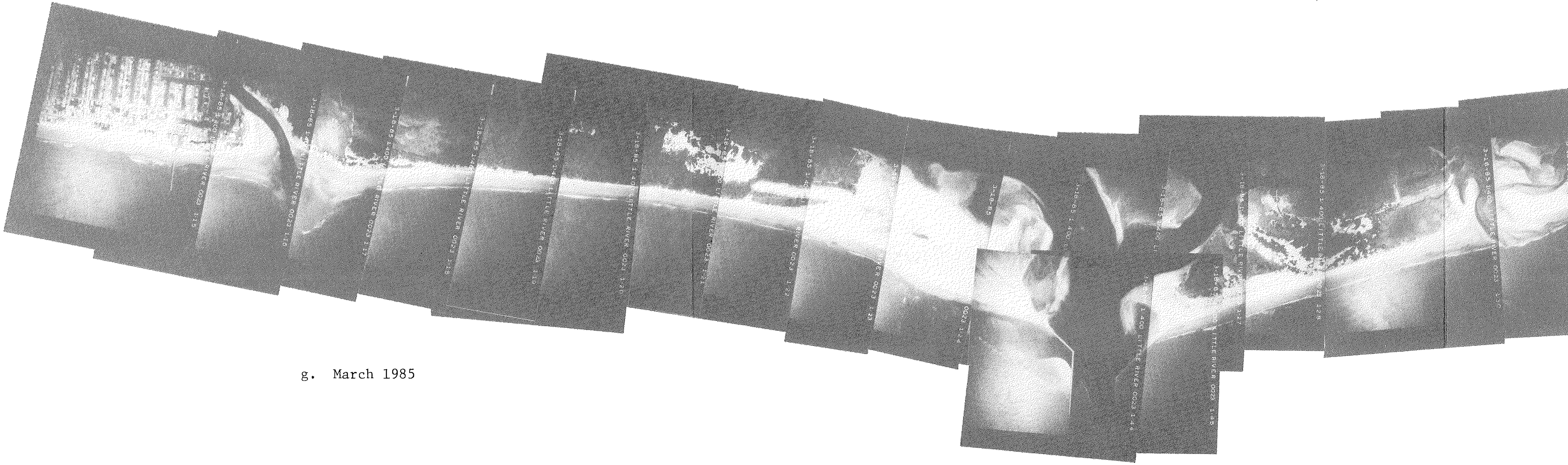

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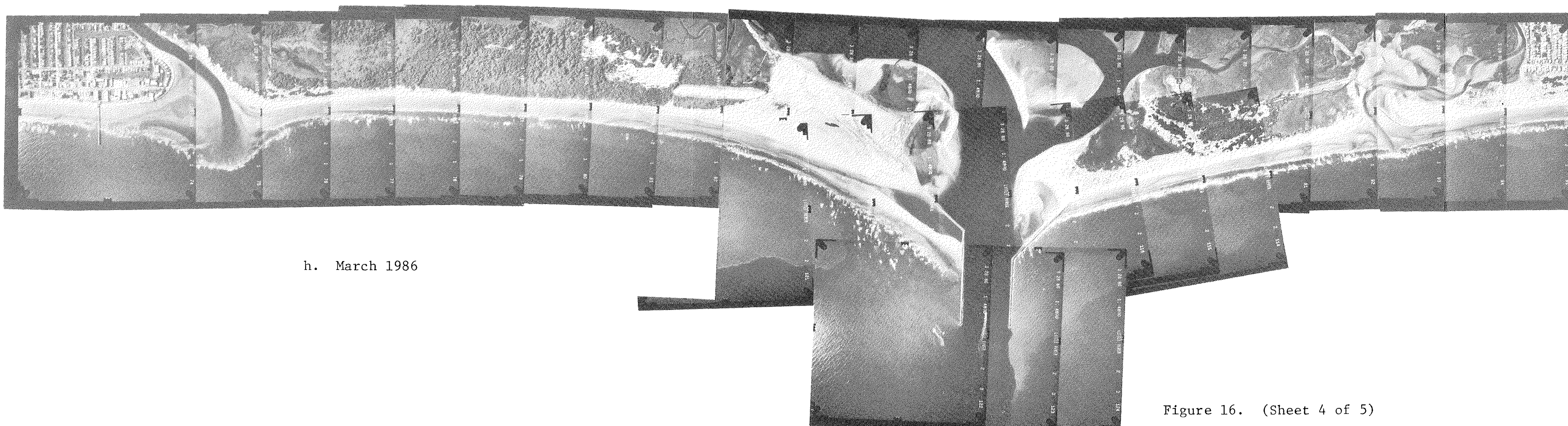

h. March 1986

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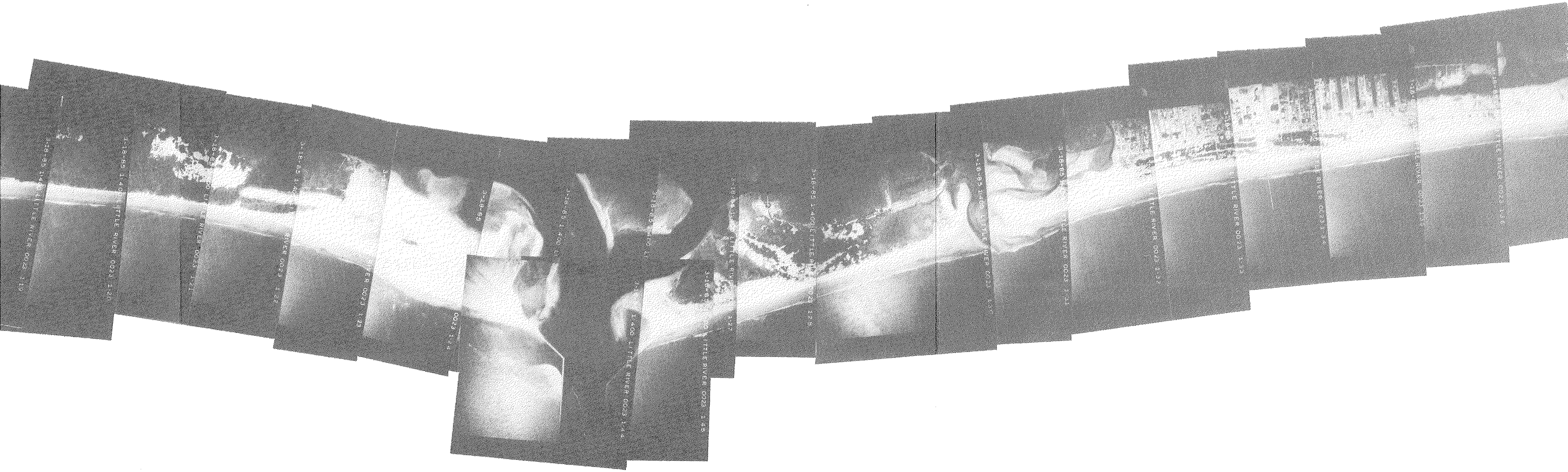

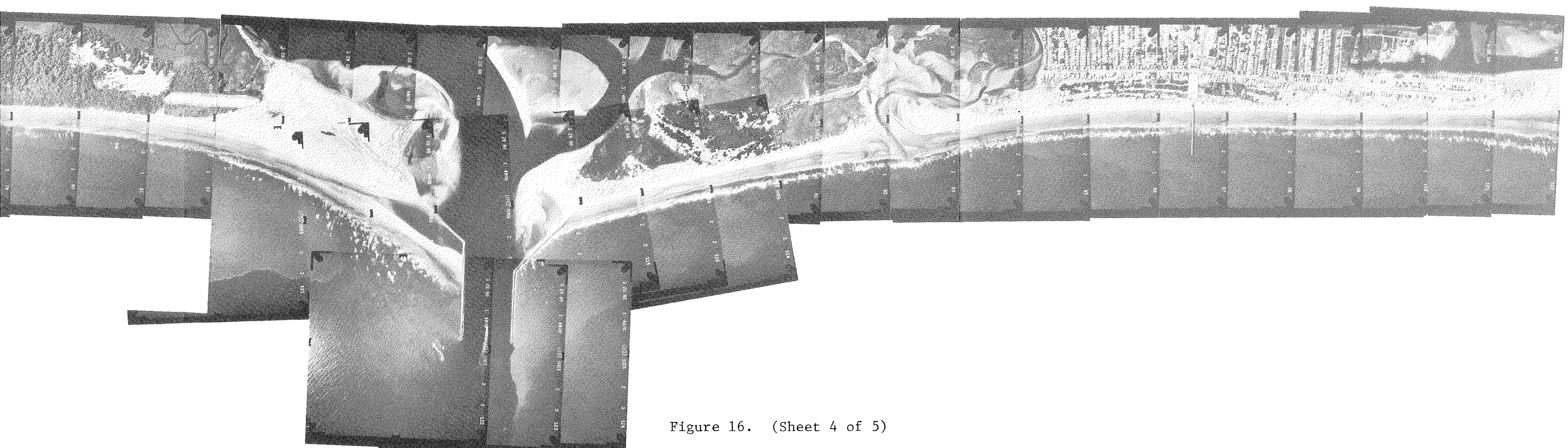

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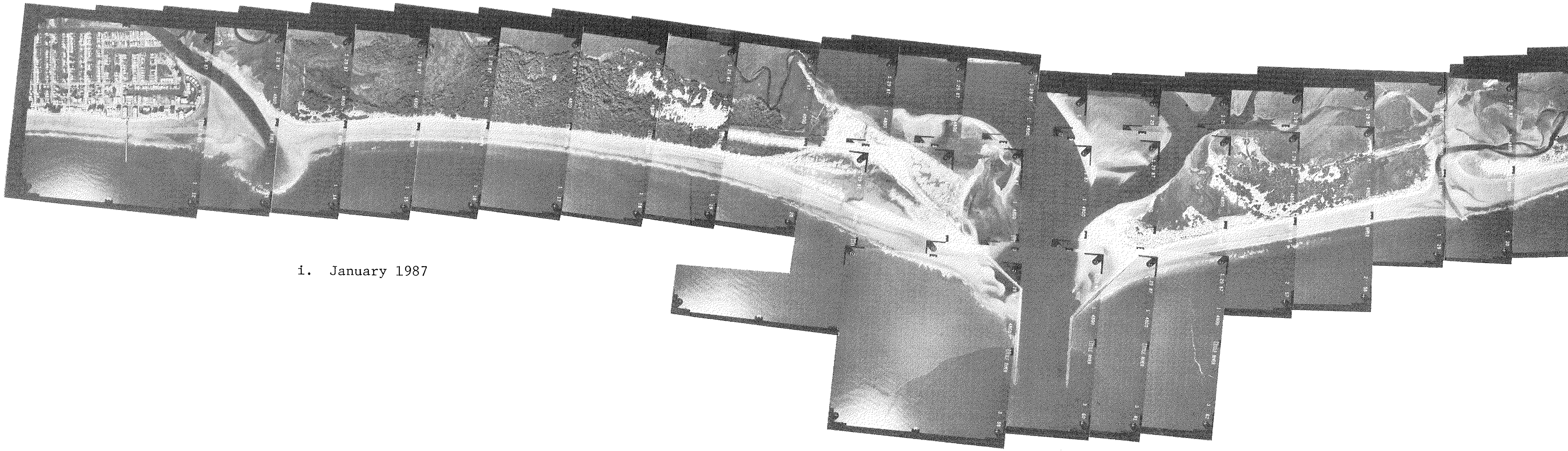

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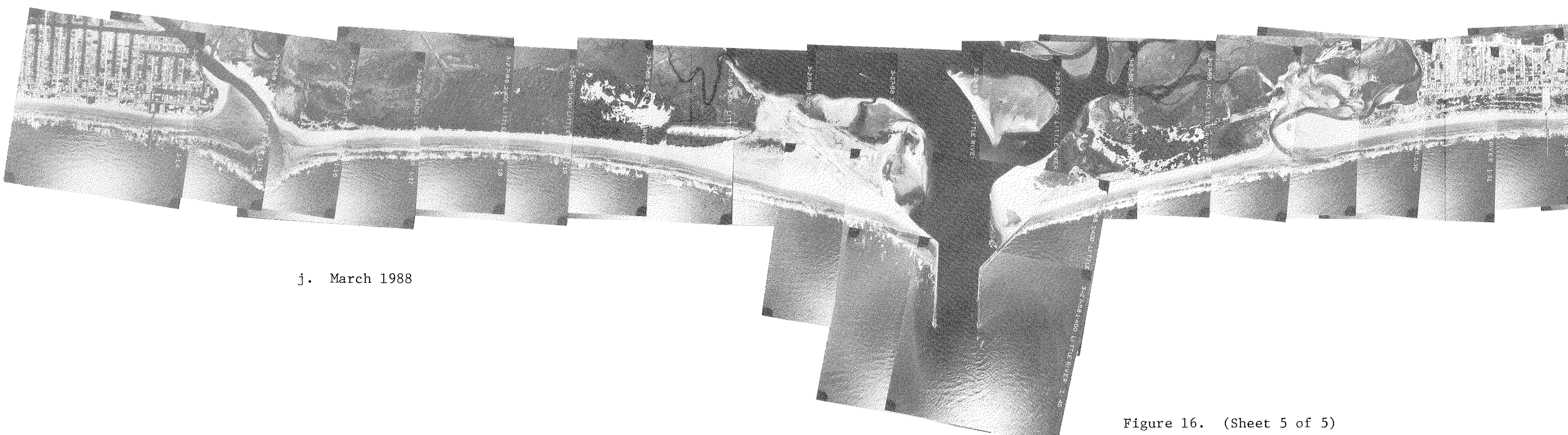

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Figure 16. (Sheet 5 of 5)

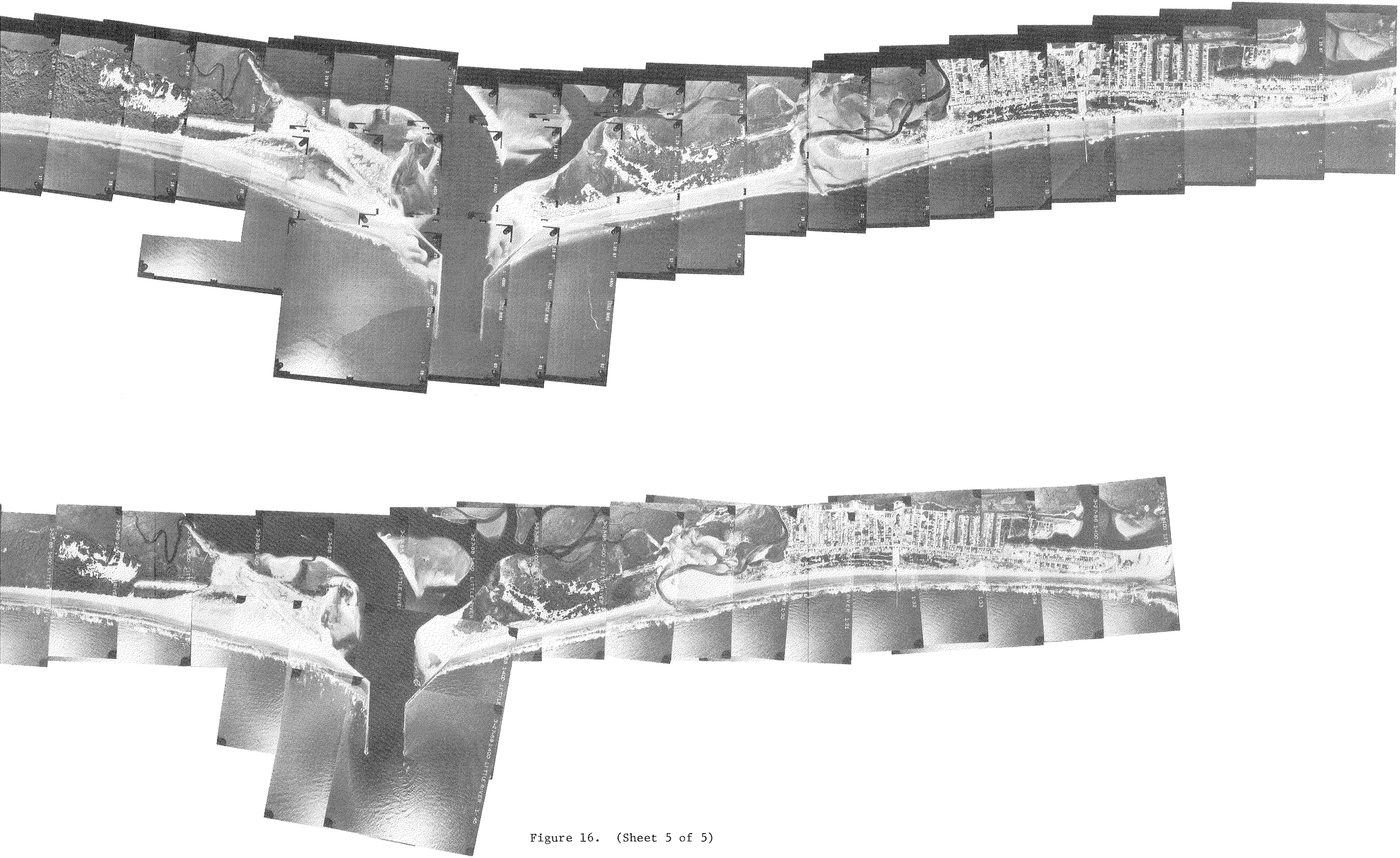


Figure 16. (Sheet 5 of 5)

with bathymetric data from 1981 (pre-project), 1985, and 1988. A summary of the methods used to run RCPWAVE is given in Appendix F. Potential longshore transport computations were then based on equations found in the Shore Protection Manual (1984). The methodology used to calculate sediment transport, along with plots of annual and monthly sediment transport trends for 1981, 1985, and 1988, are also located in Appendix F.

35. The grid used for Little River Inlet covers an area 5.7 miles alongshore and 1.2 miles offshore (Figure 10). The grid is dimensioned into 200 cells (150 ft wide) along the coast (grid lines i=1 to 201, numbered from west to east) by 154 cells (75 ft wide) (grid lines j=1 to 155, numbered from shore seaward). The jetties are located approximately between grid nodes i=94 and i=102.

36. The procedure used to calculate longshore transport in this analysis is considered more qualitative than quantitative. Due to the assumptions and limitations of the numerical model and methods used, results should be examined as a transport potential or trend over a range of cells. The jetties and local bathymetry in the vicinity of the inlets are not well interpreted by the model. Transport values in the immediate vicinity of these areas should be disregarded.

LEO Data

37. The LEO program was established by CERC to provide a means of daily monitoring of wave climate in a particular coastal region (Schneider 1981). Visual observations recorded for parameters such as breaking wave height, angle of wave approach, wave period, current direction and speed, and wind information.

38. LEO data was recorded almost daily by observers at three locations; Ocean Isle Beach, NC, Sunset Beach, NC, and Cherry Grove Beach, SC (Figure 11). Since access to both adjacent shorelines is difficult or restrictive, it was

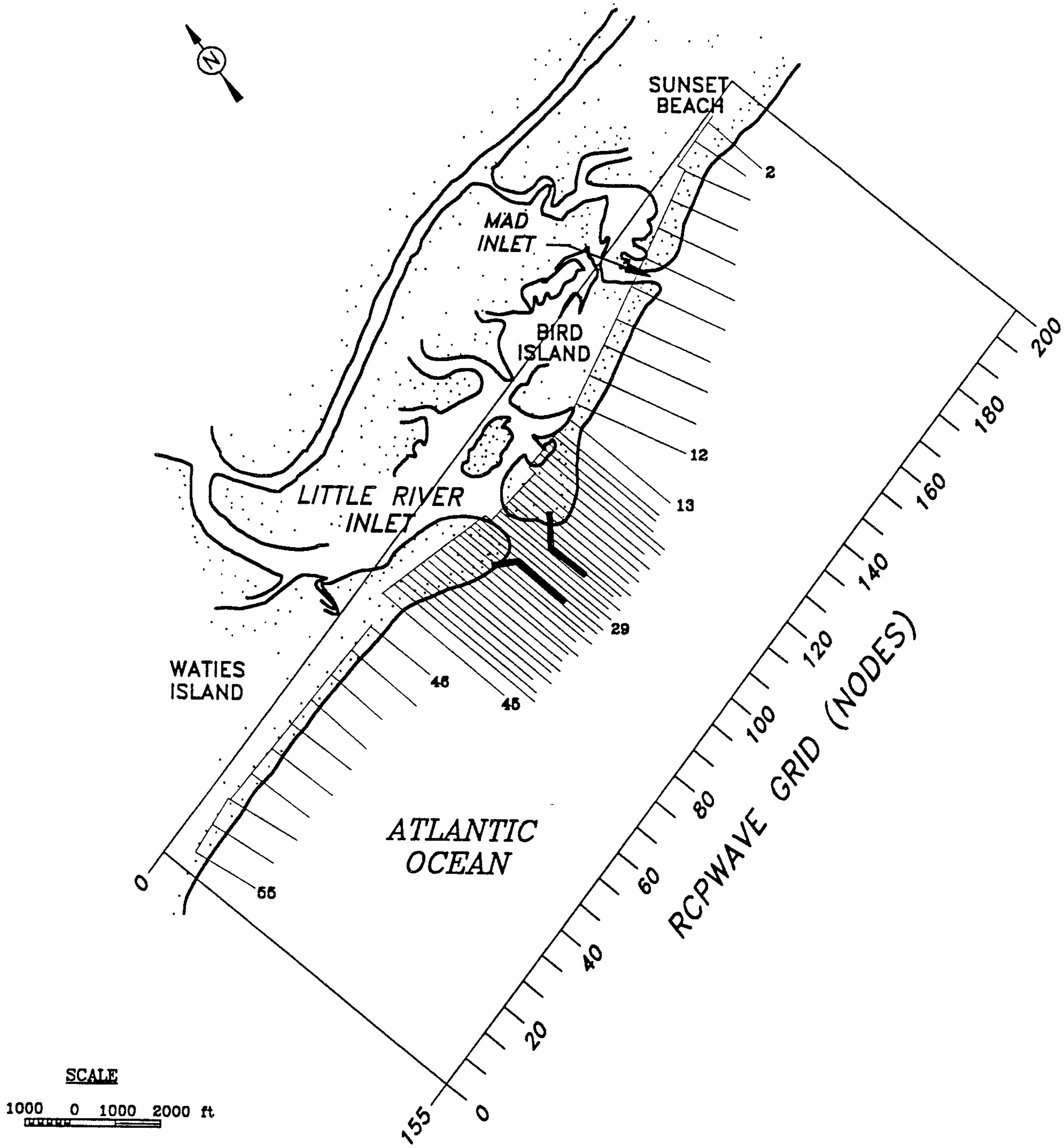


Figure 10. Numerical model grid utilized in RCPWAVE analysis

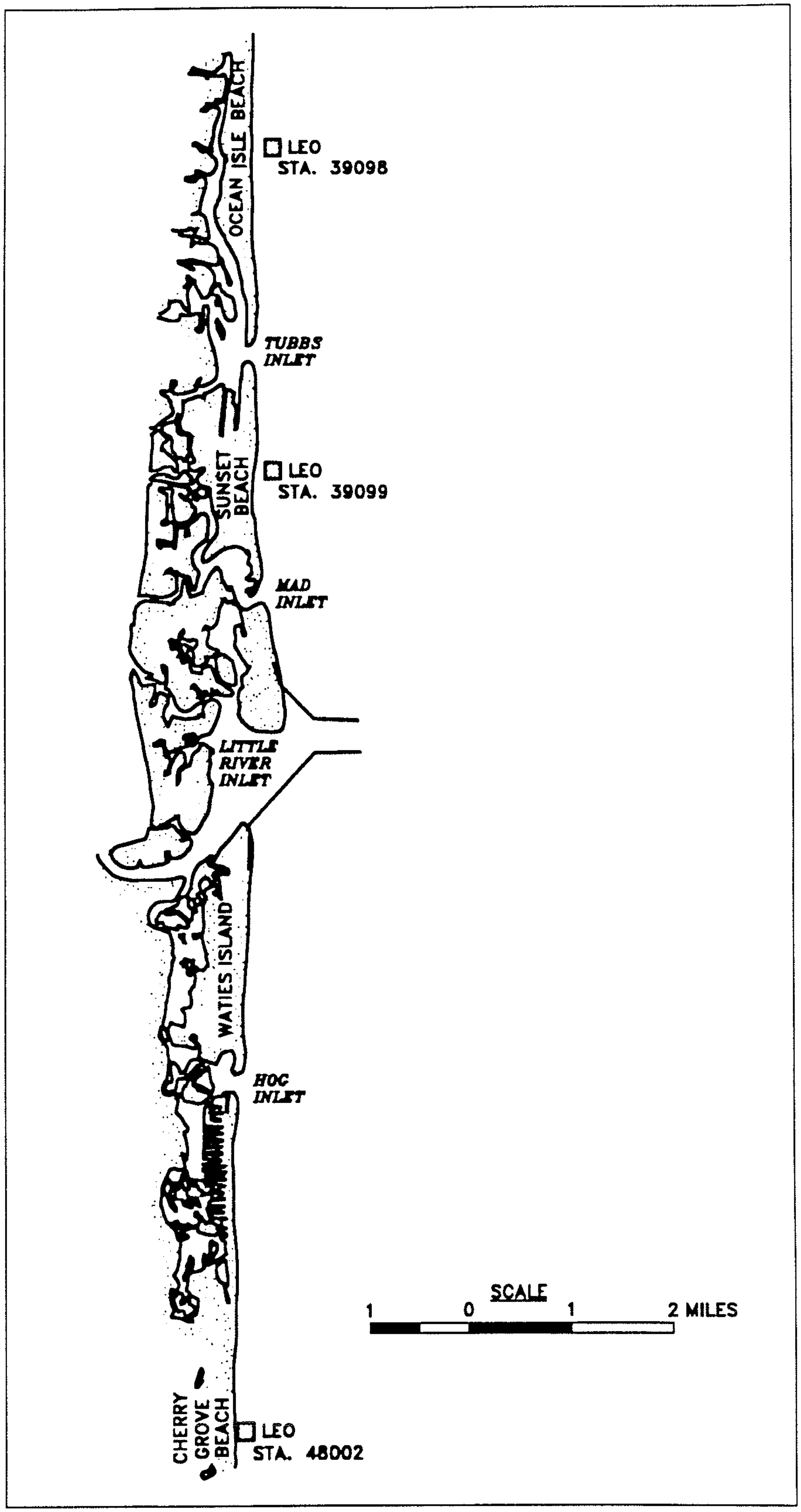


Figure 11. Littoral Environment Observation (LEO) sites in the vicinity of Little River Inlet

impossible to establish a LEO site in the immediate vicinity of the inlet.

39. The CERC utilizes specially developed computer programs to analyze LEO data and compute statistics of various coastal parameters. LEO data summaries for the stations in the vicinity of Little River Inlet are presented in Appendix G. Included in these summaries are calculations of longshore transport using two different methods; however, these values are considered only qualitative estimates of transport trends at the LEO site (Schneider and Weggel 1980). The LEO data analyzed in this report were examined comparatively to support other data results.

PART III: SUMMARY OF RESULTS AND DISCUSSION

Longshore Transport Trends

40. Historically, the direction of longshore transport in the vicinity of Little River Inlet has been highly variable making it difficult to define a dominant trend. Sediment transport rates and directions appear to vary both spatially and temporally in the vicinity of Little River Inlet. Local bathymetry and shoreline angle controlled drift reversals are common along the South Carolina coast; especially in the vicinity of tidal inlets.

41. A pre-project survey report (US Army Corps of Engineers 1977) estimated a gross transport rate of 300,000 cu yd/yr with both northeastward and southwestward moving drift balanced at 150,000 cu yd/yr. This estimation was based on maintenance dredging records at sites such as Georgetown Harbor, SC and Masonboro Inlet, NC.

42. Longshore transport estimations made during project design concluded a gross transport rate of 300,000 cu yd/yr with a net transport of 100,000 cu yd/yr to the west (US Army Corps of Engineers 1977). This estimate was based on the geomorphology and historical evolution of the inlet, and on calculations made using wave data and visual observations at Holden Beach, NC, a site located approximately 15 miles to the northeast of Little River Inlet. Although this was the best available data at the time, these calculations are based on limited assumptions. In addition, Mad, Tubbs, and Shallotte Inlets are located between Holden Beach and Little River Inlet, and probably affect the local calculated longshore transport rates significantly.

43. Pre-project longshore transport analyses for Little River Inlet were also conducted in 1979 and 1980 at the Waterways Experiment Station for the US Army Engineer Division, South Atlantic. Based on hindcast wave climatology for three years (US Army Engineer Waterways Experiment Station, unpublished) and

preliminary Wave Information Study data (Corson and Resio, unpublished), both analyses showed this to be an area with extremely variable transport; but, with a slight net transport to the northeast. An additional analysis conducted by CERC in 1984 (Pope, unpublished) using WIS data (Jensen 1983), also concluded a net northeasterly transport for Phase III stations A3108 (Sunset Beach, NC), A3109 (Crescent Beach, SC), and A3110 (Myrtle Beach, SC).

44. Due to inconsistent longshore transport information, the RCPWAVE analysis presented in Appendix F was conducted to specifically examine transport trends for the pre- and post-project conditions. Determination of longshore transport trends assisted with the examination of beach and nearshore response to the project, and in the evaluation of the weirs of both jetties.

45. Pre-project RCPWAVE results show an overall dominance of longshore sediment transport to the northeast on Waties Island and a slightly less dominant transport to the northeast on Bird Island. Transport on Bird Island is sometimes variable and appears, on occasion, to be opposite to the dominant trends. These reversals tend to occur in the vicinity of Mad and Tubbs Inlets, and are not considered representative of the regional trend of longshore sediment transport.

46. Post-project RCPWAVE analysis results continue to show a general northeasterly longshore transport trend. Figure 12 is a typical plot showing this northeasterly transport trend. Again, transport values should be examined as a qualitative potential or trend over a range of cells. Analysis results also indicate that minor seasonal (September-November) reversals to the southwest may occur on occasion. These reversals may be caused by seasonal waves encountering different shoreline orientations caused by the growth of the west fillet on Waties Island. Geographical variations such as a bulge in the shoreline or change in shoreline angle can cause localized transport reversals by transforming the incoming waves.

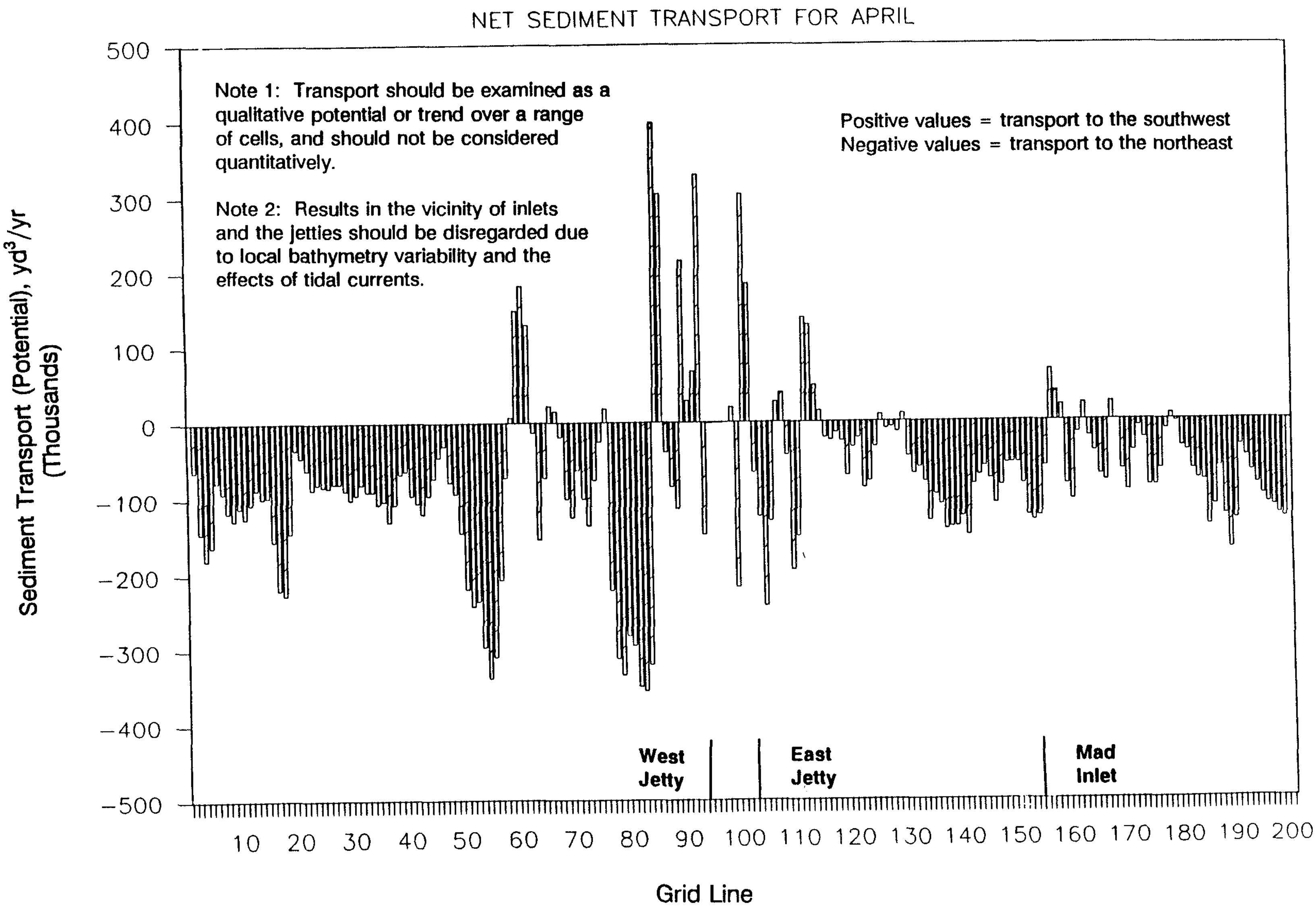


Figure 12. Post-project RCPWAVE analysis plot showing longshore transport trends for April (1988 bathymetry)

47. Methodologies used to quantify longshore sediment transport have been inconclusive. From the RCPWAVE results, fillet volumes, LEO summaries, and other pre-jetty analyses of littoral transport conducted by WES in 1979, 1980 and 1984, there is strong evidence that longshore transport is variable; but, slightly dominant to the northeast. The collection of inshore, directional wave gauge data would improve longshore transport information.

Shoreline Response

48. Beach response to the Little River Inlet jetties was examined through the analysis of beach profiles, bathymetric contour maps, and aerial photography. Due to the large amount of data, overall trends were examined initially. Specific areas were then examined to define trends in more detail.

49. It should be noted that the study area was examined with a data set of beach profiles spanning over an 8 year period. In addition to the construction of a navigation project within this 8 year period, the presence of 4 tidal inlets within less than 7 miles of shoreline (Tubbs, Mad, Little River and Hog Inlets), makes this study area especially vulnerable to cyclic trends and short-term fluctuations. An estimate of the long-term, equilibrium shoreline and rates of change at this point would most likely be premature, and is difficult to separate from the short-term "noise" and initial responses due to jetty construction. Therefore, overall trends and coastal responses to the jetties are examined, without quantitative rates of change or future extrapolations.

Bird Island

50. The Bird Island shoreline between the east jetty and Mad Inlet exhibited an overall accretion of between 50 and 100 ft, and the profiles appear to have steepened slightly since jetty construction. This section of shoreline accreted steadily

until middle to late 1984, and then either remained relatively stable or eroded slightly. This initial accretion could be due to the attachment of a portion of the pre-jetty ebb delta, onshore migration of the offshore bar due to wave sheltering by the jetties, and/or stabilization of the east sand dike area. The relative stability of this shoreline may also be attributed to wave sheltering by the jetties and the variability of littoral transport in the Bird Island vicinity.

51. The portion of shoreline between Mad and Tubbs Inlets appears also to have accreted slightly, but is more variable due to its proximity to both inlets. It should be noted that ISRP Profile Line 9 lies immediately to the west and Profile Line 8 immediately to the east of Mad Inlet, accounting for the often dramatic changes seen on these lines.

<u>Waties Island</u>

52. The shoreline to the west of the jetties in the vicinity of ISRP profile lines 49 through 53 has previously been identified as a potential area of project-related erosion (Figure 13), with profile line 52 experiencing the worst recession. This area was examined in detail.

53. Historical shoreline change measurements taken along map transects corresponding to ISRP lines 49 through 54 (Survey Stations 81+00W through 131+00W) show that the western end of Waties Island has naturally been unstable. Along these profile lines, the shoreline has exhibited an overall erosional trend since 1934 (Table 2 and Figure 8). According to Anders et al. (1990), the northeast side of Hog Inlet (western end of Waties Island) experienced 1,970 ft of accretion from 1873 to 1933/34, over 1,380 ft of erosion through 1969/70, and then accreted 200 ft from 1969/70 through 1983. This area has been historically dynamic in nature, experiencing alternating periods of erosion and accretion, and has exhibited periodic trapping and bypassing of significant quantities of material via Hog Inlet.

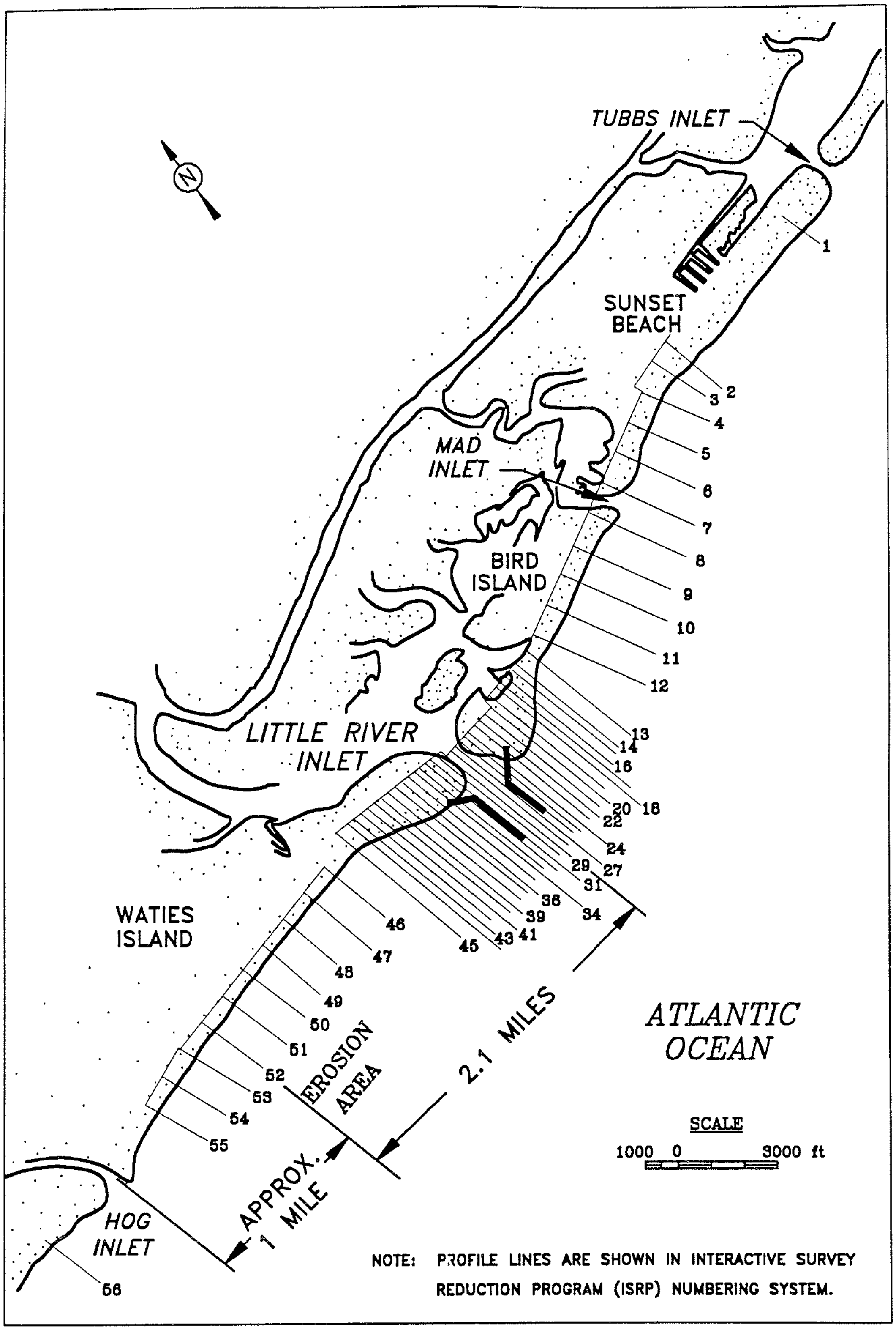


Figure 13. Suspected erosion area on Waties Island

54. Analysis of the profile data collected in the monitoring program, also shows a dynamic shoreline on this portion of Waties Island. Shoreline changes for the MLW, +3- and +5-ft (MHW) contours were computed to examine different portions of the profiles. The shoreline does not show a consistent erosional trend; but, appears to experience alternating periods of erosion and accretion (for example, see Figure 14). Each bar in Figure 14 represents the MHW shoreline change for ISRP profile line 52 (Station 111+00W) between the preceding survey date and the date where the bar is plotted. It should be noted that the major shoreline recessions are experienced during the fall and winter seasons. Cumulative shoreline change and above datum volume change plots (Appendices C and D) for several of the profile lines in this area tend to show a slight cumulative trend of erosion from approximately the winter of 1983 through the winter of 1987 (Figure 15). Although the beach experienced relative stability or periodic recovery during this three year period, it remained in a net eroded state relative to pre-winter 1983 conditions. The shoreline began to experience accretion from 1987 through the last regular survey date in 1988 (the survey in 1989 was post-hurricane). By 1988, the position of the shoreline in this area was approximately the same as the 1981 pre-project shoreline.

55. Tidal inlets strongly influence the dynamics of adjacent beaches and can cause significant fluctuations in these shorelines (Hayes et al. 1974; Fitzgerald et al. 1978; Fitzgerald 1988). Often, these fluctuations are periodic and associated with natural inlet bypassing of sediment. As evidenced by aerial photography and bar movement along the profile lines, the cyclic trapping and bypassing of large quantities of sediment by Hog Inlet, an unstabilized tidal inlet, appears to be significant to the trends of erosion and accretion on the western portion of Waties Island. This portion of the island appears to accrete periodically from the downdrift lobe of the Hog Inlet ebb delta welding to the beach face (Figure 16, also see Figure 9).

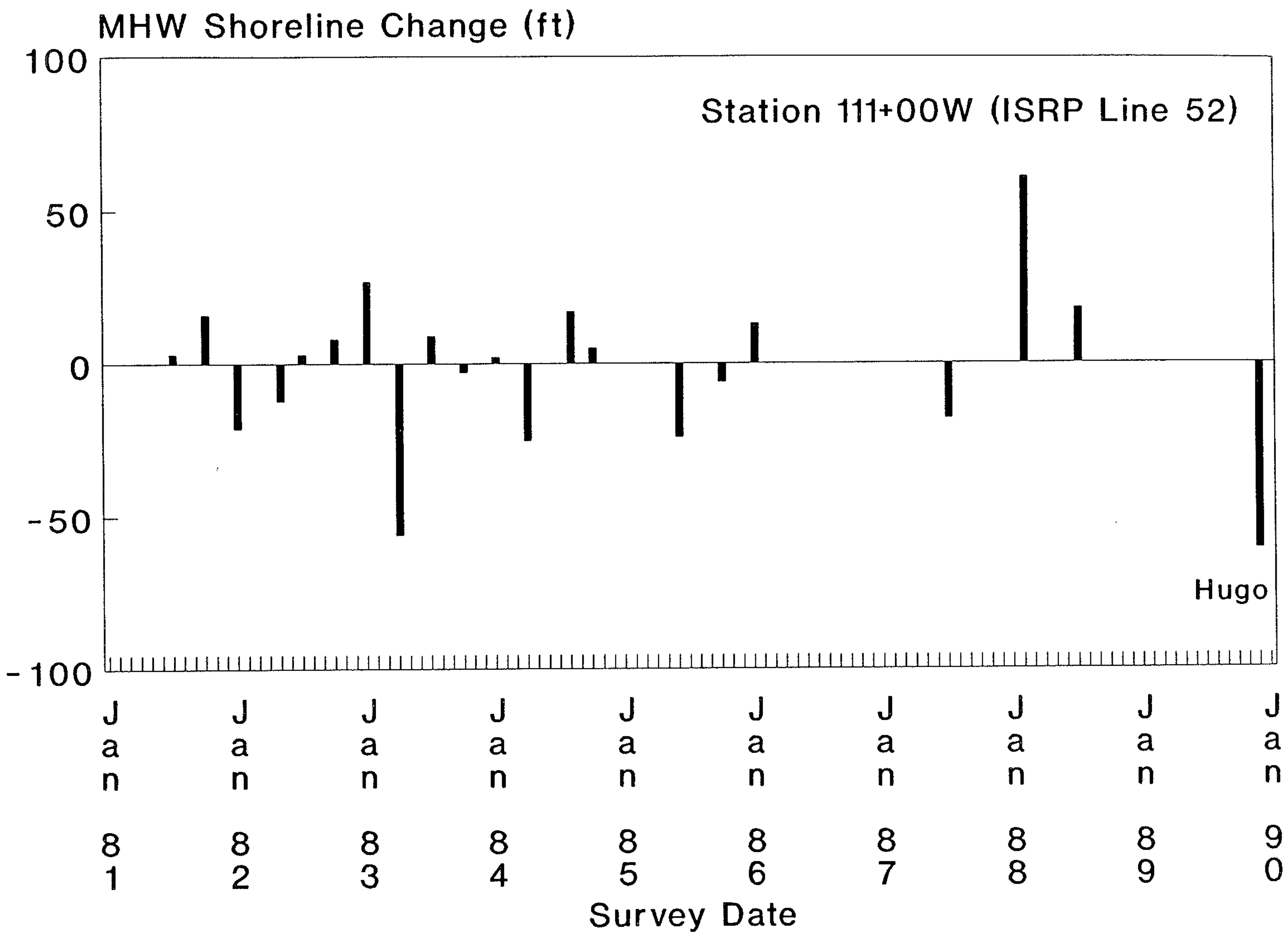
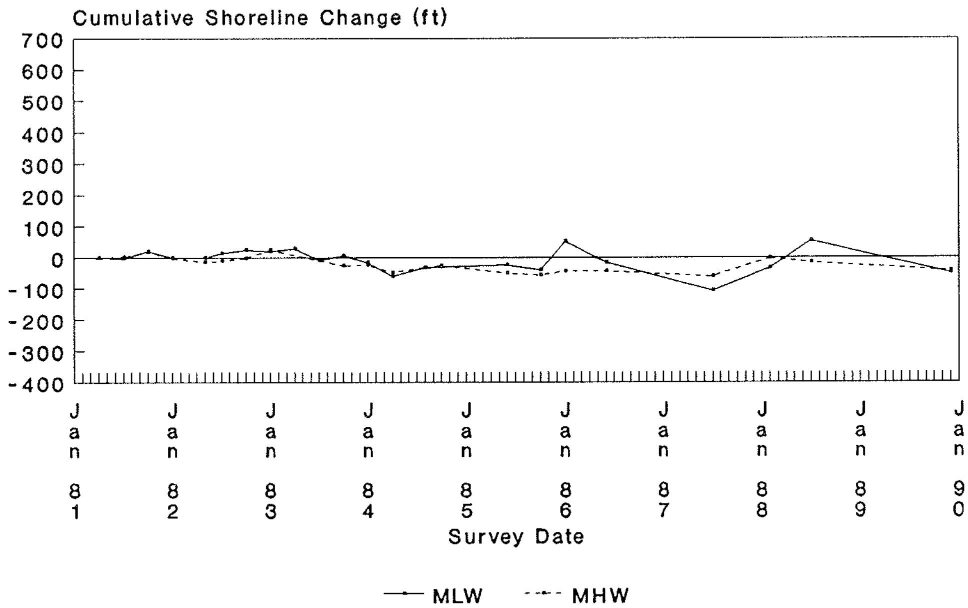


Figure 14. Mean high water shoreline change for ISRP Line 52 showing periodic fluctuations of erosion and accretion

Profile Line 52



Profile Line 53

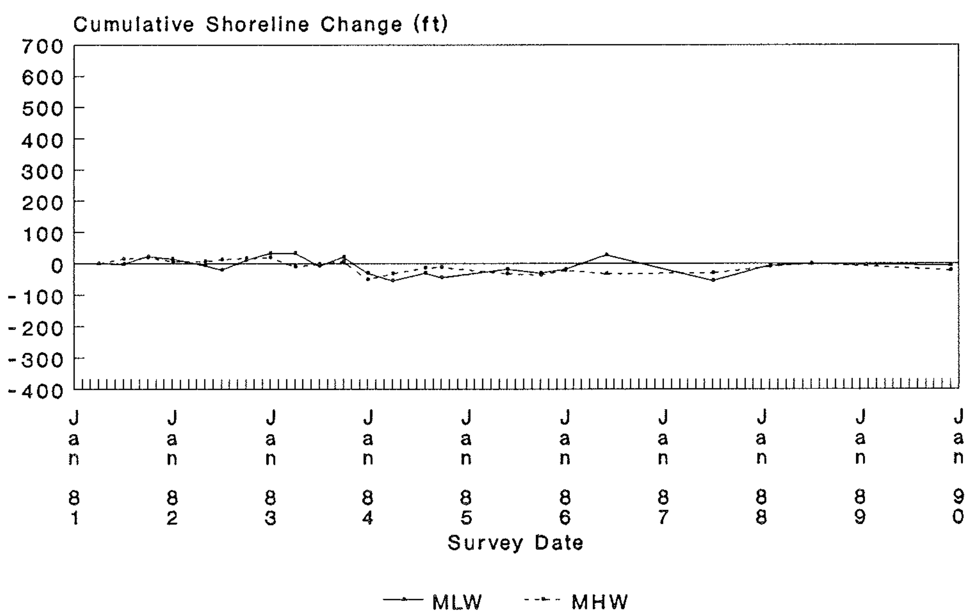


Figure 15. Cumulative shoreline change plots for two profiles on western end of Waties Island

Figure 16. Aerial photo showing ebb tidal delta system at Hog Inlet (February 1984)

Ebb tidal deltas represent a large sand reservoir, and slight changes in the size of the ebb delta can greatly affect the sand supply to nearby beaches (Fitzgerald 1988). From visual observations of aerial photography, wave transformations around the Hog Inlet shoals appear significant, and may also be a factor in the periodic erosion on Waties Island. Wave transformations due to the ebb shoal morphology may create a divergent nodal zone downdrift of Hog Inlet on the western end of Waties Island (possibly in the vicinity of ISRP profile line 52). Nodal zones downdrift of inlets have been observed to be regions of beach erosion (Ashley 1987; Farrell and Sinton 1983; Douglass 1991).

56. Based on an examination of profile data, aerial photography, longshore transport trends, and historical data from Anders et al. (1990), the periodic erosion occurring in this area is more likely due to the dynamic morphology of Hog Inlet and seasonal fluctuations, than due to effects caused by the construction of the Little River Inlet jetties. In most cases, the greatest beach recession is observed after the winter seasons, with periodic recoveries of the beach inbetween. Additionally, there has not been a significant increase in sediment in the updrift fillet on Bird Island. If the jetties were acting as a barrier to sediment supplying the western end of Waties Island, a larger accretion in the east fillet would be observed.

57. The shoreline reach closest to the west jetty (ISRP Lines 33 through 46) accreted dramatically since jetty construction. Most of this accretion is due to the onshore migration and welding of the abandoned (pre-jetty) ebb tidal delta. An additional sediment source for this area was the stabilization of the west sand dike area. These are discussed in the following section on shoal and fillet volumes.

58. Summarizing shoreline change over the study area, Figure 17 shows the net shoreline changes calculated between April 1981 (pre-jetty) through July 1988. Moving from left to right on Figure 17, the plot shows accretion immediately adjacent to Hog Inlet, relatively the same shoreline position on the

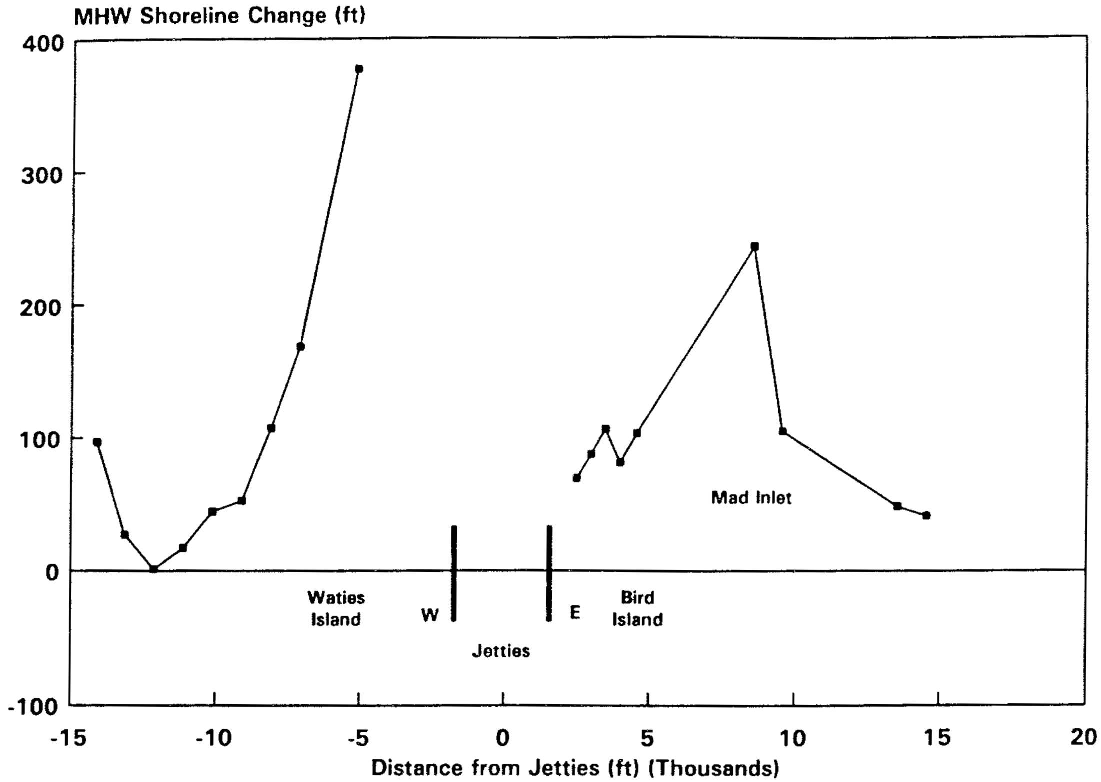


Figure 17. Mean high water shoreline change: April 1981 to July 1988.

western end of Waties Island, and then a major accretion in the fillet to the west of the jetties. East of the jetties, the shoreline appears to have accreted approximately 50 to 100 ft overall, with the exception of the profile line at Mad Inlet. This profile line showed major accretion, and is indicative more of a short-term fluctuation (shoal migration). Again, in only a 7 year time period, it is difficult to separate out the short-term fluctuations and "noise" from the long-term trends; however, this figure gives an indication of the initial shoreline responses experienced since jetty construction. The cumulative plots in Appendix C provide more detailed descriptions of shoreline changes occurring between April 1981 and July 1988.

Shoal and Fillet Volumes

59. Total volumes of material in the fillets and shoals were computed utilizing the Contour Plotting System. Two areas showing the most accretion were the fillet to the west of the jetties (Figure 6) and the inside jetty shoreline of Bird Island, labeled East Flood (Figure 7).

60. The landward migration of the relict ebb tidal delta and stabilization of the downcoast sand dike are the causes of a major portion of the accretion in the west fillet (see Figure 9d through 9j). Because ebb tidal deltas form due to a balance of tidal and wave forces, confinement of flow between the jetties causes wave dominance of the adjacent pre-jetty ebb tidal delta. Landward bar migration occurs due to wave induced sediment transport. This response of the ebb tidal delta has been observed at other southeast inlets, and is discussed in Hansen and Knowles (1988) and Pope (1991).

61. By 1985, a portion of the abandoned ebb delta which had been trapped between the jetties during construction, had welded onto the western portion of Bird Island inside of the jetties (polygon denoted East Inside). This extent of this sand shoal began to significantly increase from 1987 to 1989. This shoal is probably receiving some sediment deposits from the channel eroding material off of the centrally located flood delta. Additionally, although the jetties have been sand-tightened, a small portion of this increase may be due to sediment passing through or over the jetties. Supplementary volumes were computed for this area in an attempt to determine the sources of this growth, and show that the major volumetric increase is due to the attachment and molding by waves of the old ebb shoal onto this portion of Bird Island. During a field investigation in May 1991, this shoal had developed a significant scarp and appeared to be experiencing erosion due to currents and tidal flow.

62. The dominant direction of littoral drift is to the northeast. With the frequent drift reversals, there still does not appear to be a significant building up the east fillet. If

the jetties were acting as a barrier to sediment supplying the western end of Waties Island, a larger accretion in the east fillet and along would be observed. Aerial photography and supplementary volume calculations indicate that the buildup of the inner shoal within the jetties is mostly due to migration and attachment of a portion of the abandoned ebb shoal. Some of this accretion may be due to wind-blown sand or sand passing from the east fillet through the east jetty; however, this amount is not significant enough to be the major source of sediment for the inside shoal.

63. Examination of volume calculations and hydrographic surveys shows that the ebb tidal delta appears to be slowly rebuilding off of the tip of the east jetty. This shoal is not yet apparent in the aerial photography, and ranges in depth between 8- to 12-ft below MLW.

Jetty Scour and Channel Migration

64. Since the jetties were constructed, the channel has meandered and migrated relative to the constructed project channel. Scour holes have formed along the west jetty and at the east jetty tip (Figure 18), possibly due to the migrating channel. The scour hole along the west jetty has been documented to run within 50 ft of the toe of the structure to a depth of 25 ft MLW for approximately 2,000 ft (US Army Engineer District, Charleston 1990). The scour hole at the tip of the east jetty is also approximately 20 to 25 ft deep. Comparison of bathymetric contour maps (Appendix E) shows that these scour holes began to develop just after construction was completed. A deep area on the order of 25 to 30 ft also exists further back in the inlet throat near the shoal on the inner side of the east jetty. This scour could possibly be the relict inlet gorge or due to the confluence of the two bifurcating channels that feed the inlet (Kjerve et al. 1979).

65. The SAC is monitoring the erosion and slope steepening at these scour locations in order to evaluate the condition of

and potential risk to the structures. A stability analysis was completed for the west jetty in February 1990. The results indicated an average existing slope of 1 vertical on 2.5 horizontal, with a computed factor of safety of 1.7. The required factor of safety is 1.5; corresponding to a minimum acceptable slope of 1 vertical on 2 horizontal. If increased erosion towards the jetty occurs, remedial measures will be required to insure the integrity of the jetty structures (US Army Corps of Engineers 1990).

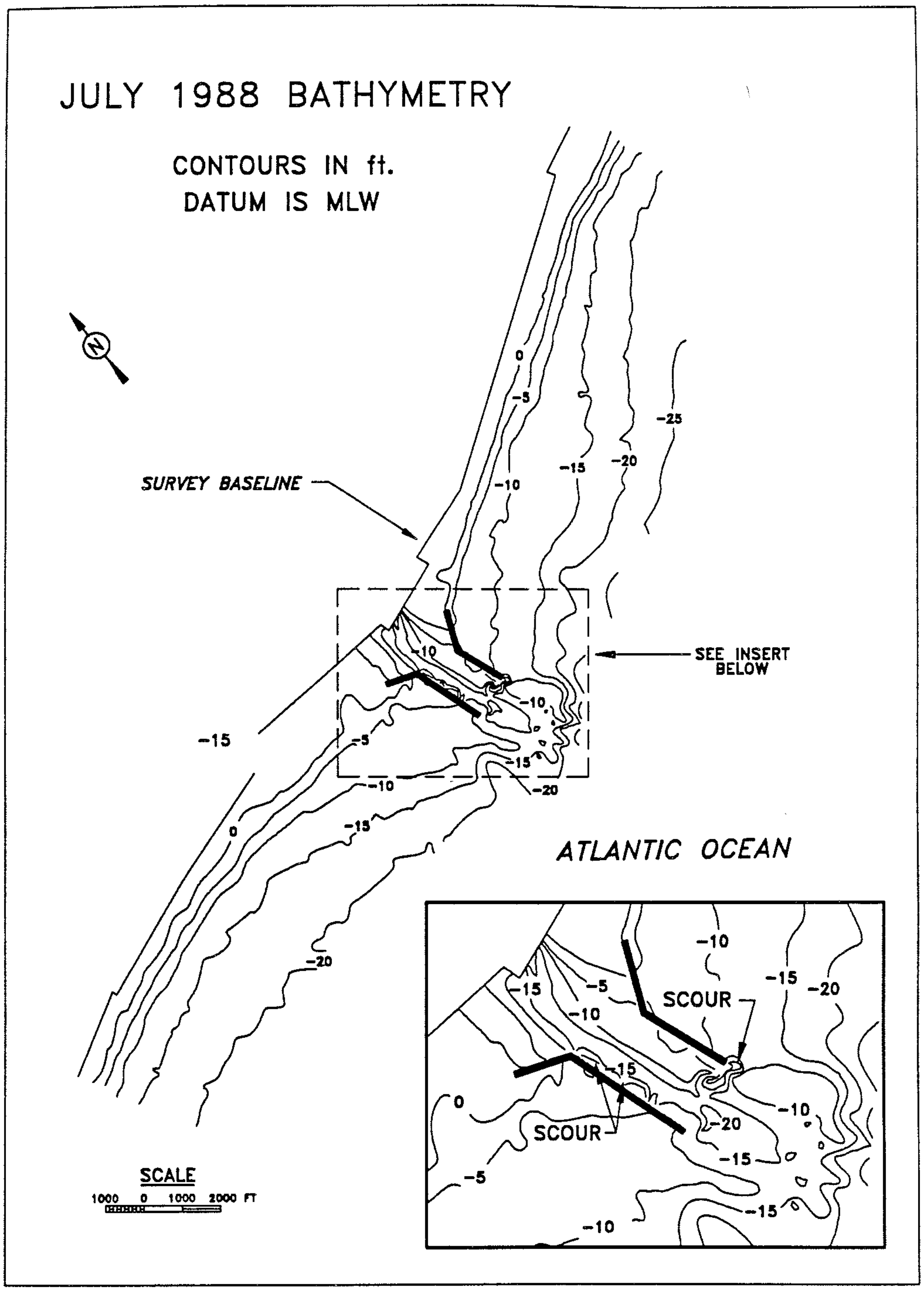


Figure 18. Locations of scour at the Little River Inlet jetties

PART IV: RECOMMENDATIONS

Dredged Material Disposal Options

66. The primary objectives of this analysis were to summarize beach and nearshore response to the Little River Inlet navigation project and assist SAC in developing disposal plans for maintenance material to be dredged from Little River Inlet.

67. From the most recent channel surveys, adequate navigable depths exist in the inlet; however the channel has migrated significantly. Based on depth alone, there does not appear to be a critical need for dredging operations within the inlet. If dredging of the inlet does proceed, several alternatives are available for disposal of the dredged material.

a. Beach nourishment for western portion of Waties Island (ISRP Lines 49 to 53 corresponding to survey stations 81+00 to 121+00 West). This analysis determined that the periodic erosion occurring at this section of shoreline was primarily caused by frequent trapping and bypassing of material by Hog Inlet and seasonal fluctuations. Placement of dredged material in this area is not an efficient method for disposal. Due to the dynamic nature of the area, the longevity and stability of the nourishment is at high risk. Due to the dominant northeasterly transport trend, this material may shift downdrift into the west fillet and may ultimately reenter the Little River Inlet channel. Also, dredging costs would be excessive since this area is approximately 2 miles to the west of the channel.

b. Placement of material directly to the east of the jetties on Bird Island. Although the direction of longshore transport in the study area is variable, it is slightly dominant to the northeast. However, the east fillet section of the Bird Island shoreline has in fact showed a net accretion over the entire monitoring period, therefore bypassing of the material or disposal of dredged material in this area does not appear to be necessary. Additionally, adding a significant quantity of material to this section of shoreline may effect the natural processes at Mad Inlet.

c. Placement of material in the scour hole at the east jetty tip and along the inner side of thewest jetty. The SAC performed a similar operation after the December 1983 dredging of the Little River Inlet channel; however, the material did not remain in the scour hole for very long. This option would be a temporary solution to the scour hole problem; but, would not have great longevity and could cause problems with shoaling in the channel.

d. A redirection or modulation of flow through the channel. The deep area that exists adjacent to the inside jetty shoreline of Bird Island could possibly be a factor in the channel meandering in that direction, and then swinging back along the west jetty. Several alternatives may exist for using the dredged material in an attempt to redirect the channel and alleviate scour along the west jetty. Measurement of currents within the inlet system was conducted in May 1991, and analysis of this data would be required before this alternative could be fully defined. Inlet hydrodynamics may be used to evaluate a more stable position for the channel.

e. Stockpiling of the material. The dredged material can be stored in the sand dike areas for future use.

68. Stockpiling the material inside the jetties on the west side of the inlet (in the sand dike area) is the recommended disposal alternative. This analysis has concluded that there is no immediate need for beach nourishment due to project-related erosion. Since a hydraulic pipeline dredge will be used for this operation, material can easily be pumped into this area and stored for future use if it should ever be required. The potential effects of a dredging operation on the inlet system's stability is further justification to stockpile the sand and continue monitoring the project. This aspect is under additional investigation in Phase II of this analysis.

Continued Monitoring Efforts

69. Additionally, this analysis examined if any action should be taken to open the weir sections of either jetty. Due to the relative balance in the fillet and shoal system, there do not appear to be any apparent benefits from uncovering either of the weirs at this time.

70. Continued monitoring of the project at a minimum level is recommended to better define the long-term equilibrium response to the jetty construction. Monitoring should include annual beach profiles, annual aerial photography coinciding with the beach surveys, and periodic structural inspections and hydrographic surveys of the inlet. Continuation of the LEO program at the three sites in the vicinity of Little River Inlet is not recommended. Ten years of LEO data have already been collected, providing an adequate database for this type of information.

71. In addition to routine project monitoring, the collection of wave gage data would improve the accuracy of longshore transport information. Tidal current monitoring and delineation of the inlet hydrodynamics will aid in defining the dynamics of the channel migration and scour problem.

Continued Analysis

72. Subsequent discussions between SAC, CERC, and U.S. Army Engineer, South Atlantic Division representatives have indicated that the channel migration and jetty scour problems are important project concerns relative to dredging and nourishment operations. Additional analyses of the post-jetty thalweg evolution and stability, relative inlet hydrodynamics, and jetty scour have been recommended and approved by SAC.

73. Phase II of this analysis is to perform a reconnaissance level review of the inlet thalweg stability, and develop recommendations for an inlet maintenance and/or monitoring plan which will assist with the proposed dredging of Little River Inlet. These recommendations will attempt to minimize dredging requirements and maximize inlet stability, in order to reduce or prevent scour-induced damage to the jetties due to natural thalweg migration. The field investigation of tidal currents at Little River Inlet and a side-scan sonar survey were conducted in May 1991. Results of these analyses will be available in a subsequent report.

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APPENDIX A:

BEACH PROFILES

APPENDIX A: BEACH PROFILES

1. Beach profile data was obtained from SAC periodically and entered into the Interactive Survey Reduction Program (ISRP). The ISRP is a Fortran program developed by CERC (Birkemeier 1984) which permits interactive reduction, editing, and plotting of field survey notes and the correction of previously entered data. The primary output from ISRP is a two-dimensional distance offshore and elevation data file.

2. The actual baseline survey stations were incorporated into an ISRP numbering system (Table A-1, Figure A-1). The profile data plotted in this appendix is labeled according to the ISRP numbering system. The ISRP also assigns a survey number to each survey date (Table A-2). For example, ISRP profile line 52, survey number 10 corresponds to Sta 111+00, surveyed in April 1983. Table A-3 denotes a number of ISRP line numbers of particular interest.

3. The program STCKPL (Birkemeier, unpublished) was used to plot the ISRP profile data on a VAX computer. The full length of the survey (horizontal scale, 0 - 6000 ft) and a windowed section (horizontal scale, 0 - 2500 ft) were plotted for each profile line. The STCKPL program takes the data for each profile through time and plots each survey (solid line) with the preceding survey (dashed line). The date is written to correspond with the end of the second survey (solid line).

4. Profile data considered questionable or insufficient were marked with an asterisk on the individual plots. Since there was such a large amount of data, if an entire profile line, portions of the line, or individual data points were considered questionable, the data was removed from the analysis. No smoothing was performed on the profiles. Since noisy fathometer data was frequently encountered, the intention of not smoothing the data was to average out the errors in the volume calculations. This was considered a better alternative than making erroneous assumptions of the smoothed profile.

Table A-1

Little River Inlet Beach Profiles

(East to West)

ISRP Profile No.	Baseline Station No.	State Plane Coordinates North	State Plane Coordinates East	Bearing
1	195+62	326,626.18	2,761,423.21	S 15°10'25" E
2	145+62	325,367.46	2,756,597.52	S 15°10'25" E
3	135+62	325,094.44	2,755,916.89	S 21°51'25" E
4	125+62	324,497.41	2,755,125.62	S 31°10'15" E
5	115+62	323,977.29	2,754,271.53	S 31°20'25" E
6	105+62	323,457.17	2,753,417.43	S 31°20'25" E
7	95+62	322,937.05	2,752,563.34	S 31°20'25" E
8	85+62	322,416.93	2,751,709.25	S 31°20'25" E
9	74+70	321,849.12	2,750,776.83	S 31°20'25" E
10	65+62	321,376.69	2,750,001.06	S 31°20'25" E
11	55+62	320,856.57	2,749,146.97	S 31°20'25" E
12	45+67	320,339.13	2,748,297.27	S 31°20'25" E
13	39+94	320,045.52	2,747,860.50	S 16°23'00" E
14	34+94	319,904.49	2,747,386.81	S 16°23'00" E
15*	32+50	319,835.67	2,747,152.71	S 16°23'00" E
16	29+94	319,763.46	2,746,907.11	S 16°23'00" E
17*	27+50	319,694.64	2,746,673.01	S 16°23'00" E
18	24+94	319,622.43	2,746,427.41	S 16°23'00" E
19*	22+50	319,553.61	2,746,193.32	S 16°23'00" E
20	19+94	319,481.40	2,745,947.71	S 16°23'00" E
21*	17+50	319,028.82	2,745,826.44	S 16°23'00" E
22	14+94	318,956.60	2,745,580.84	S 16°23'00" E
23*	12+50	318,887.79	2,745,346.75	S 16°23'00" E
24	9+94	318,815.58	2,745,101.14	S 16°23'00" E
25	8+00	318,760.86	2,744,915.02	S 16°23'00" E
26	6+00	318,704.45	2,744,723.14	S 16°23'00" E
27	4+00	318,648.03	2,744,531.26	S 16°23'00" E
28	2+00	318,591.62	2,744,339.32	S 16°23'00" E

(Continued)

* Profile line deleted after October 1983.

Table A-1 (Concluded)

ISRP Profile No.	Baseline Station No.	State Plane Coordinates North	East	Bearing
29	0+00	318,791.62	2,744,072.12	S 16°23'00" E
30	2+07	318,788.51	2,743,864.58	S 16°23'00" E
31	4+15	318,785.41	2,743,657.03	S 16°23'00" E
32	6+23	318,782.31	2,743,449.47	S 16°23'00" E
33	8+30	318,779.20	2,743,241.92	S 16°23'00" E
34	10+37	318,776.10	2,743,034.37	S 16°23'00" E
35*	12+97	318,772.27	2,742,774.93	S 16°23'00" E
36	15+56	318,768.33	2,742,515.48	S 16°23'00" E
37*	18+16	318,764.46	2,742,256.04	S 16°23'00" E
38	20+75	318,760.57	2,741,996.60	S 16°23'00" E
39*	23+35	318,756.69	2,741,737.16	S 16°23'00" E
40	25+94	318,752.81	2,741,477.72	S 16°23'00" E
41*	28+54	318,748.93	2,741,218.27	S 16°23'00" E
42	31+13	318,745.05	2,740,958.84	S 16°23'00" E
43*	33+73	318,741.17	2,740,699.39	S 16°23'00" E
44	36+33	318,737.29	2,740,439.96	S 16°23'00" E
45	41+51	318,729.53	2,739,921.07	S 16°23'00" E
46	51+00	318,047.58	2,739,124.68	S 15°02'25" E
47	61+00	317,788.08	2,738,158.94	S 15°02'25" E
48	71+00	317,528.58	2,737,193.19	S 15°02'25" E
49	81+00	317,269.08	2,736,227.45	S 15°02'25" E
50	91+00	316,959.73	2,735,277.09	S 19°15'08" E
51	101+00	316,629.99	2,734,338.01	S 19°15'08" E
52	111+00	316,300.29	2,733,383.94	S 19°15'08" E
53	121+00	316,041.41	2,732,412.13	S 23°57'46" E
54	131+00	315,543.89	2,731,538.93	S 23°57'46" E
55	141+00	315,137.7[illegible]	2,730,625.12	S 23°57'46" E
56	191+00	313,665.14	2,725,869.06	S 21°00'09" E
57	241+00	311,837.27	2,721,215.36	S 22°02'15" E
58	291+00	309,829.26	2,716,645.43	S 18°13'27" E

* Profile line deleted after October 1983.

Table A-2

Little River Inlet, SC

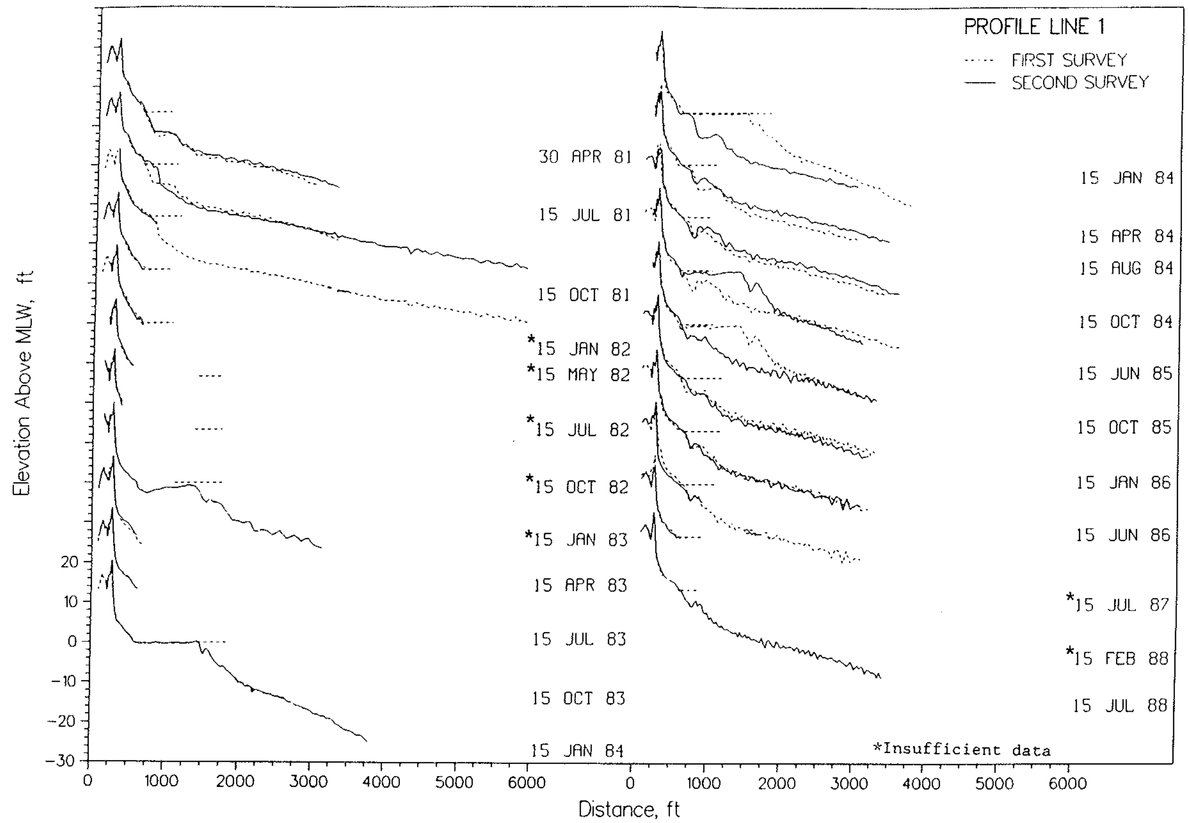
Beach Profile Survey Dates

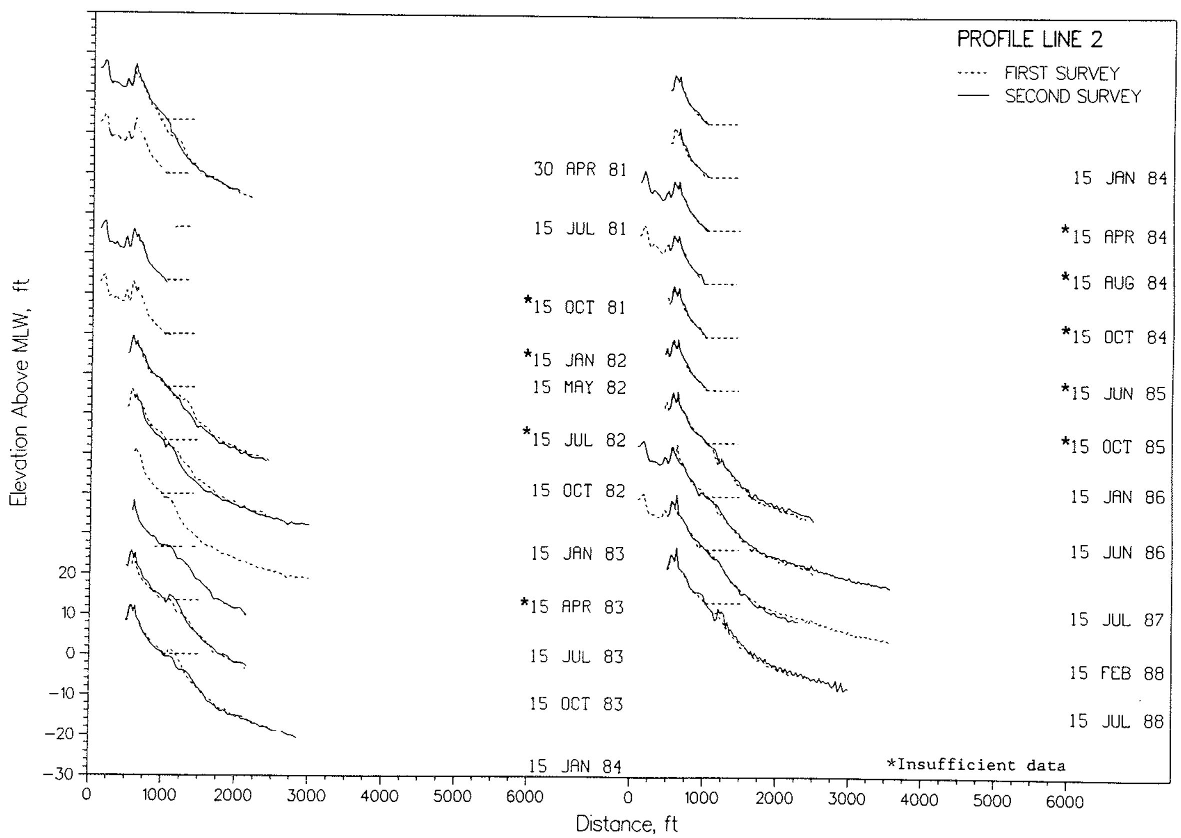
Survey Date	ISRP Survey Number
April 1981	2
July 1981	3
October 1981	4
January 1982	5
May 1982	6
July 1982	7
October 1982	8
January 1983	9
April 1983	10
July 1983	11
October 1983	12
January 1984	13
April 1984	14
August 1984	15
October 1984	16
June 1985	17
October 1985	18
January 1986	19
June 1986	20
July 1987	21
February 1988	22
July 1988	23
December 1989	25

Table A-3

Notation of Atypical Profile Lines

ISRP Profile No.	Description
1	Immediately adjacent to Tubbs Inlet
8	Immediately east of Mad Inlet
9	Immediately west of Mad Inlet
25-33	Immediately adjacent to and across Little River Inlet channel and jetties
29	Little River Inlet channel centerline
55	Immediately east of Hog Inlet


PROFILE LINE 1
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
*15 JAN 82
*15 MAY 82
*15 JUL 82
*15 OCT 82
*15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
*15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft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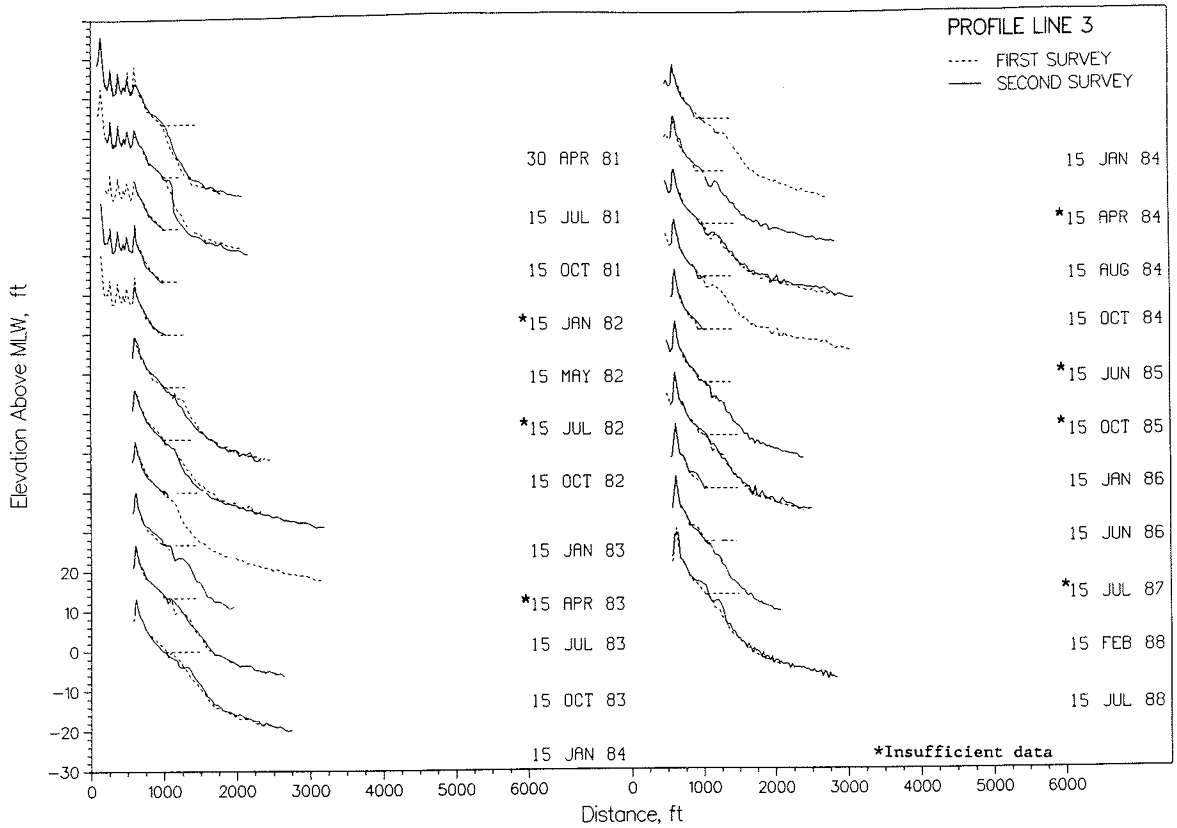
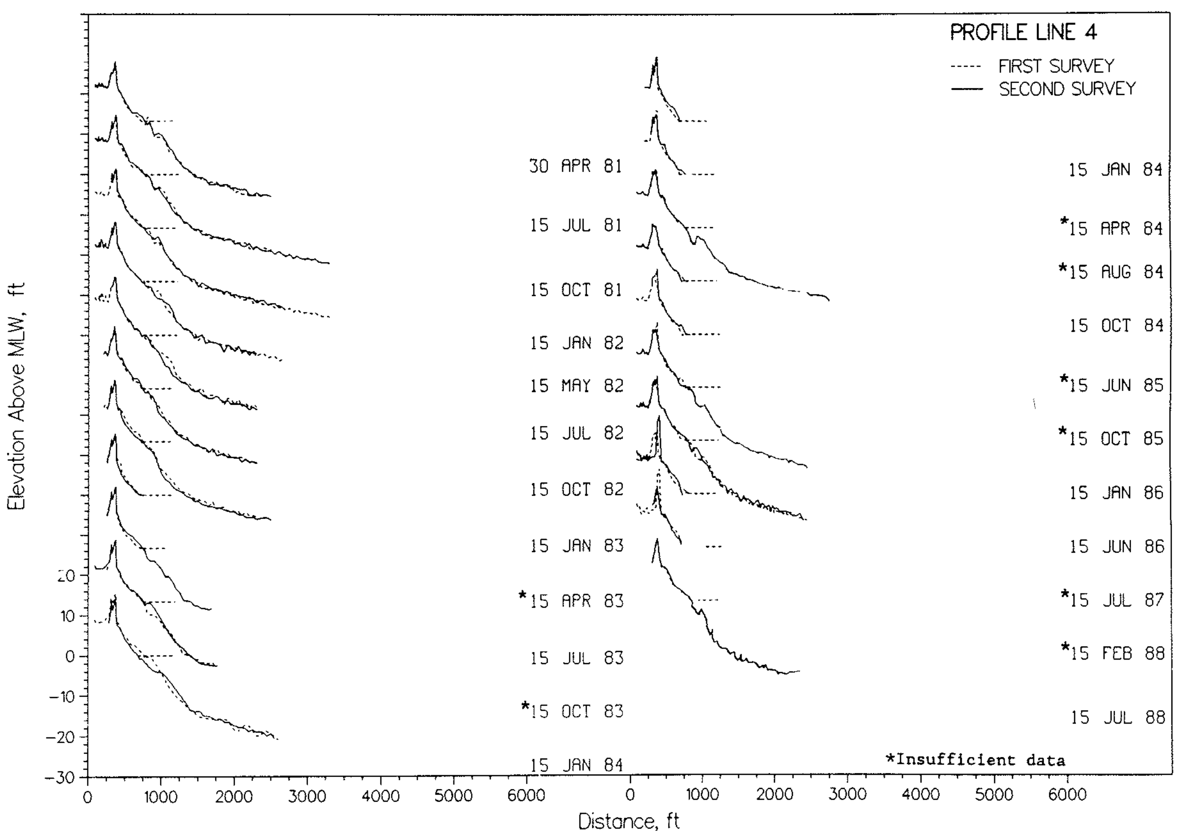
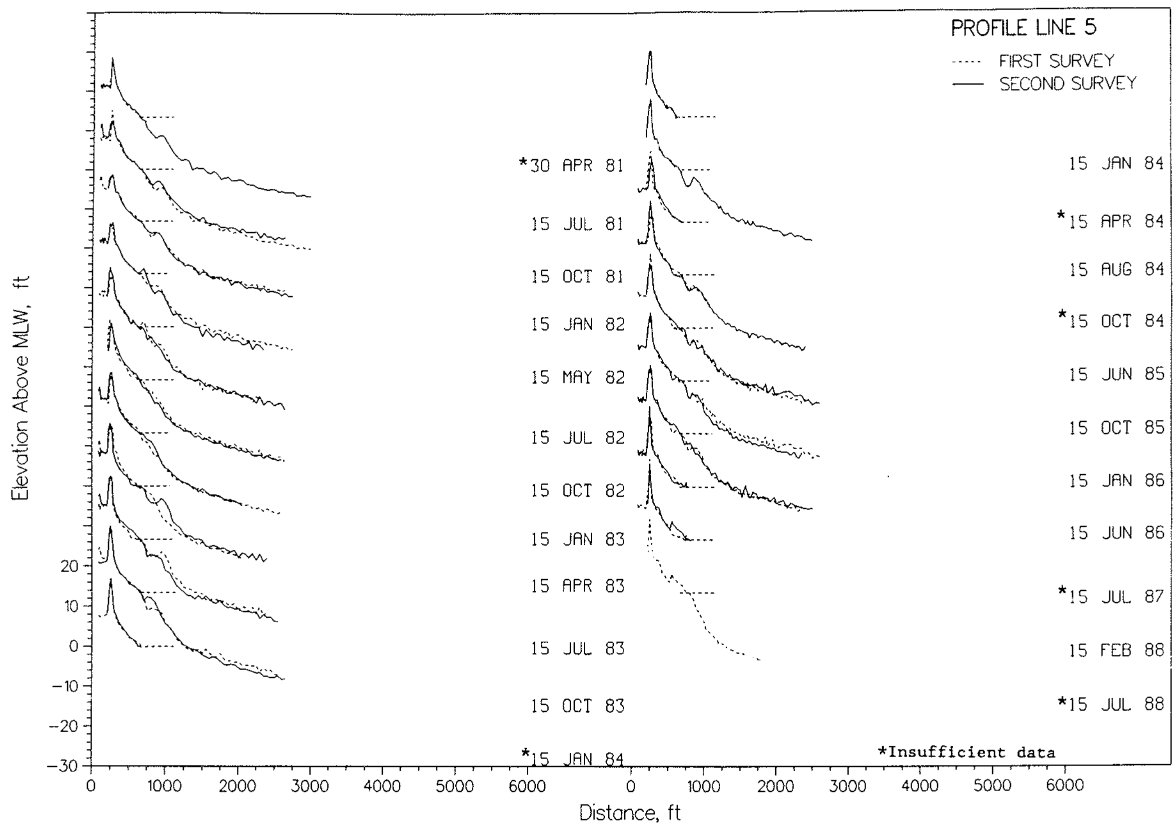
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
*15 OCT 81
*15 JAN 82
15 MAY 82
*15 JUL 82
15 OCT 82
15 JAN 83
*15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
*15 APR 84
*15 AUG 84
*15 OCT 84
*15 JUN 85
*15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft

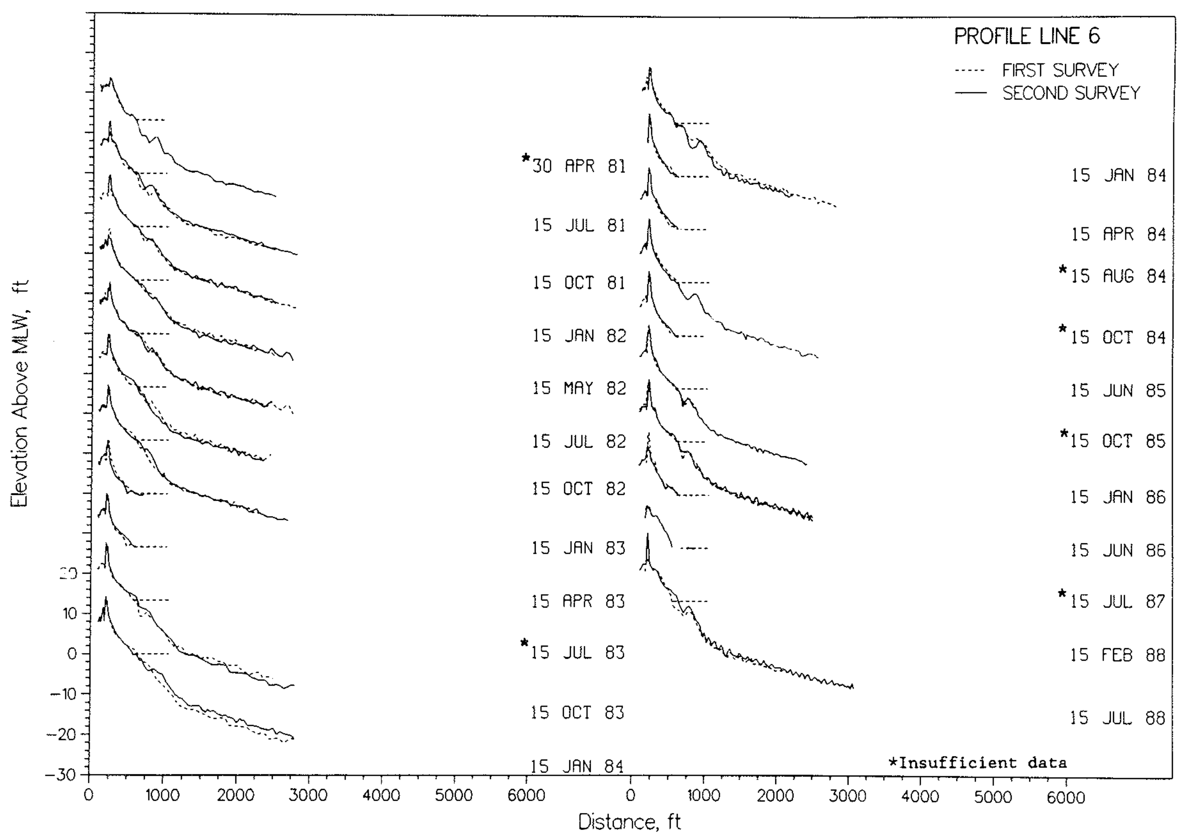


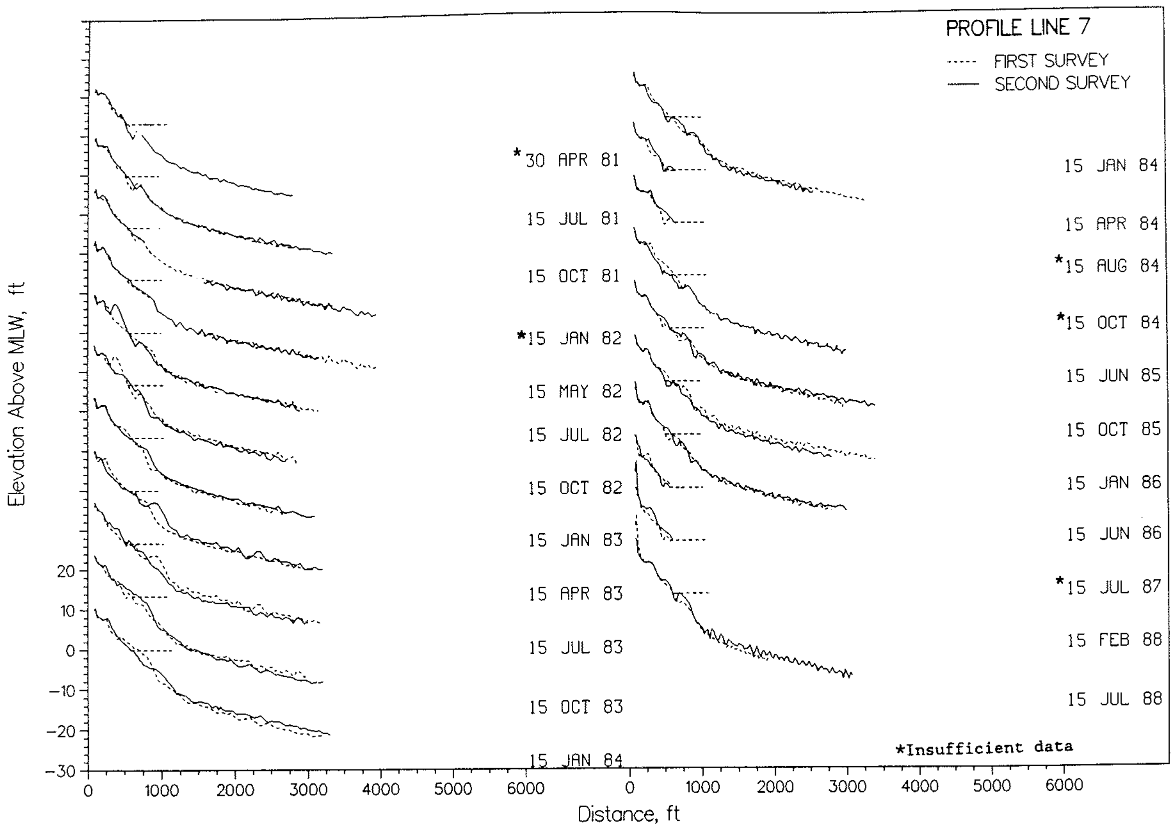
PROFILE LINE 3
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
*15 JAN 82
15 MAY 82
*15 JUL 82
15 OCT 82
15 JAN 83
*15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
*15 APR 84
15 AUG 84
15 OCT 84
*15 JUN 85
*15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft

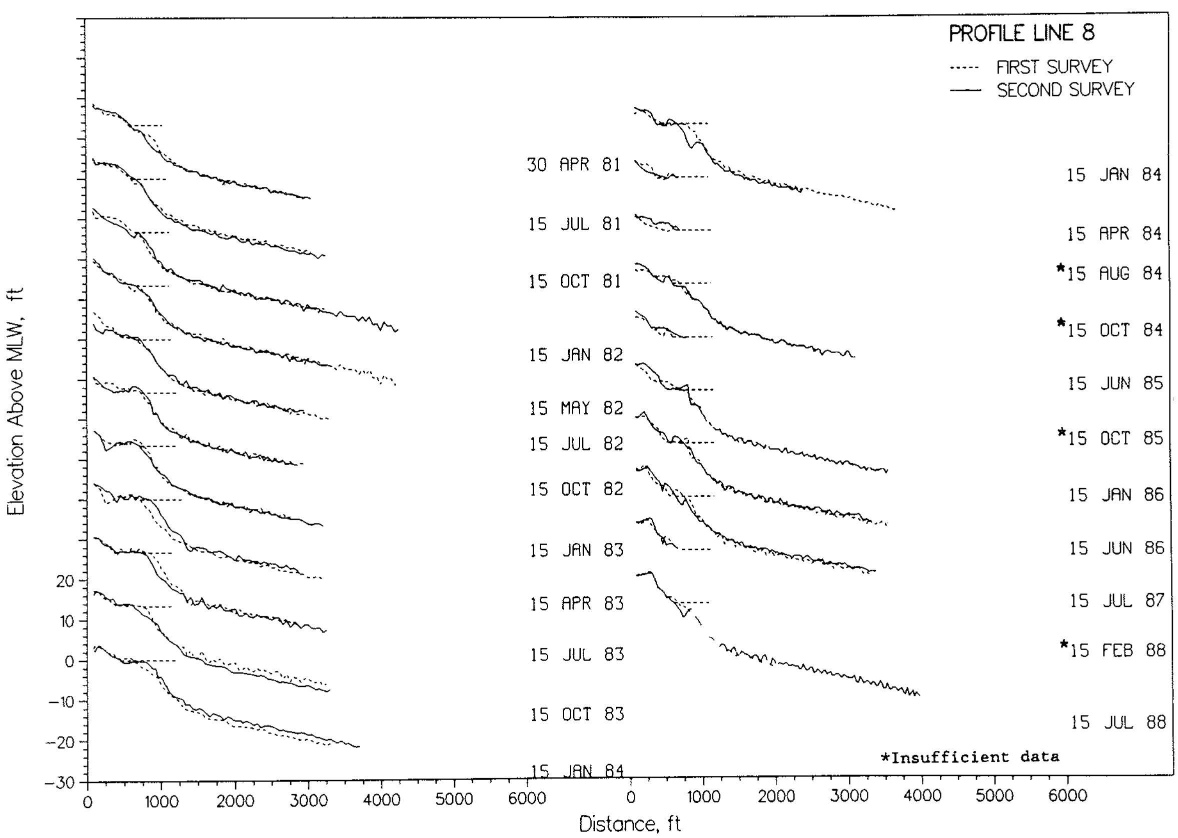


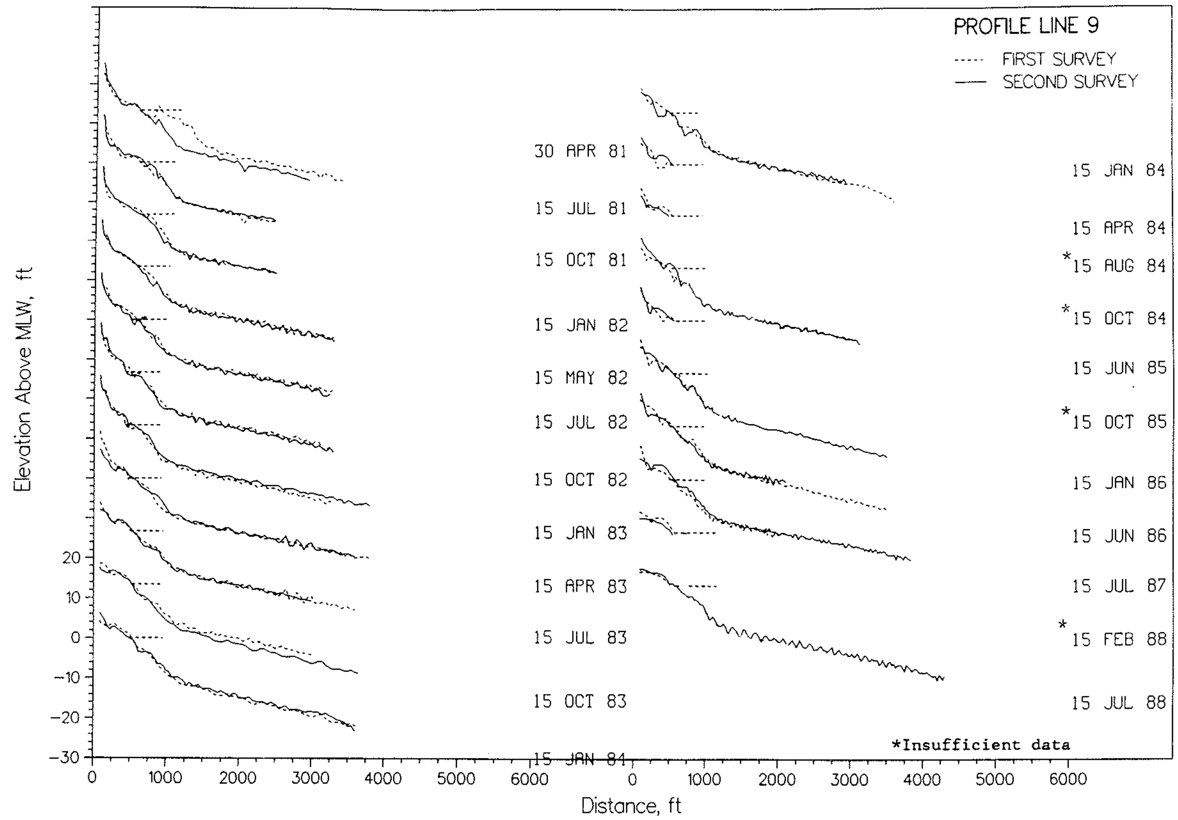
PROFILE LINE 4
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
*15 APR 83
15 JUL 83
*15 OCT 83
15 JAN 84
15 JAN 84
*15 APR 84
*15 AUG 84
15 OCT 84
*15 JUN 85
*15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
*15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft

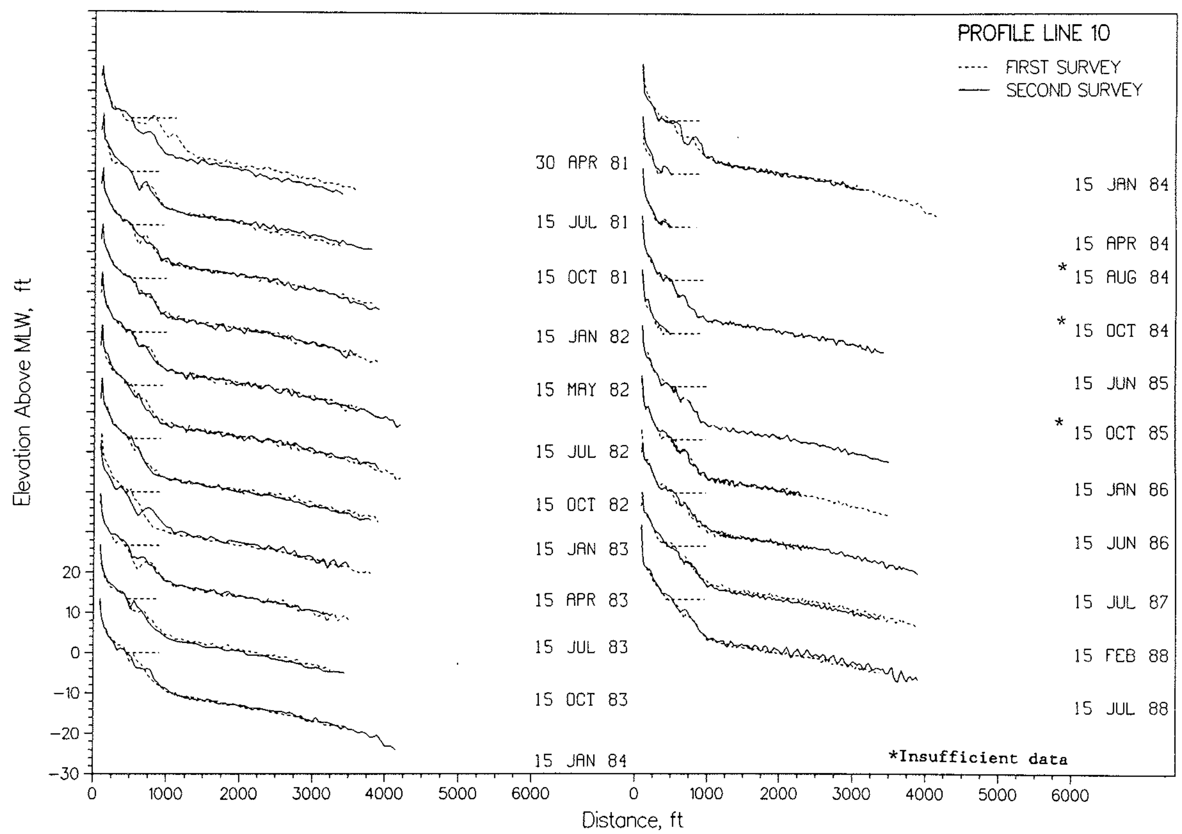

PROFILE LINE 5
FIRST SURVEY
SECOND SURVEY
*30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
*15 JAN 84
15 JAN 84
*15 APR 84
15 AUG 84
*15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
*15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 6
FIRST SURVEY
SECOND SURVEY
*30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
*15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
*15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 7
FIRST SURVEY
SECOND SURVEY
*30 APR 81
15 JUL 81
15 OCT 81
*15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 8
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
*15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
*15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 9
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
*15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
*15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 10
FIRST SURVEY
SECOND SURVEY
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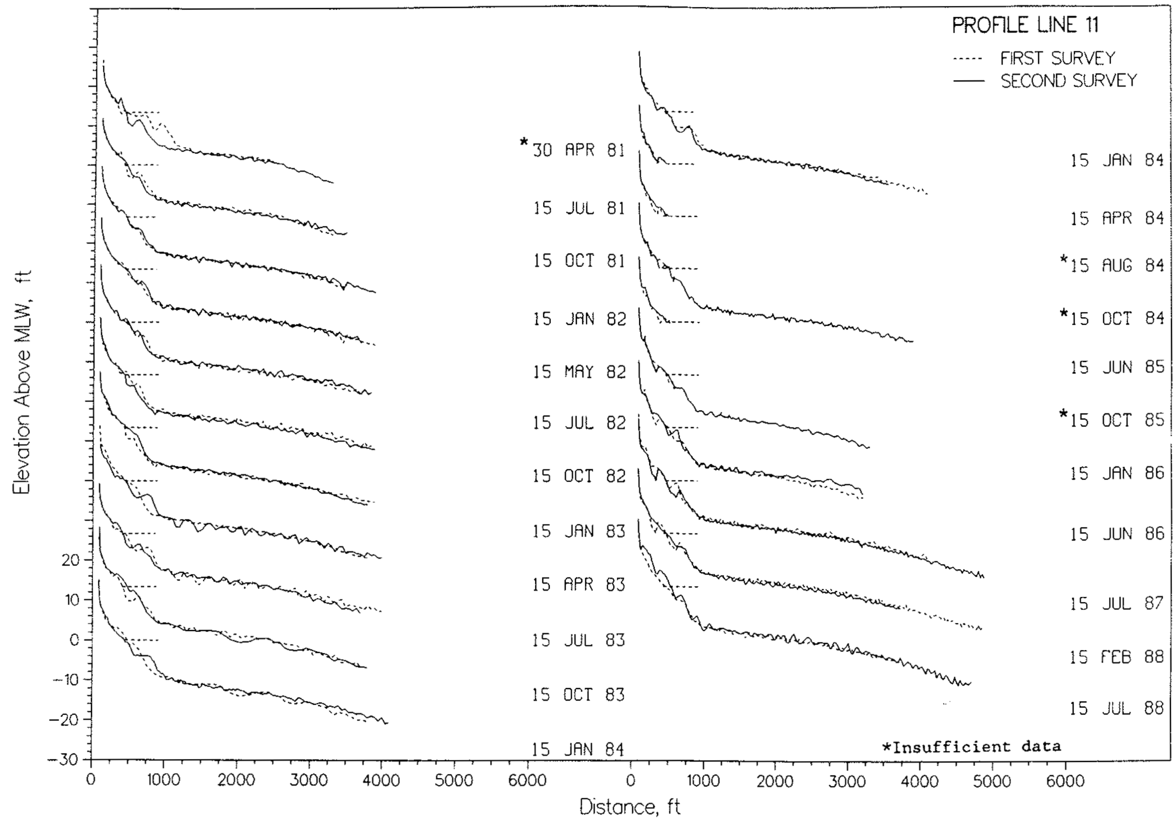
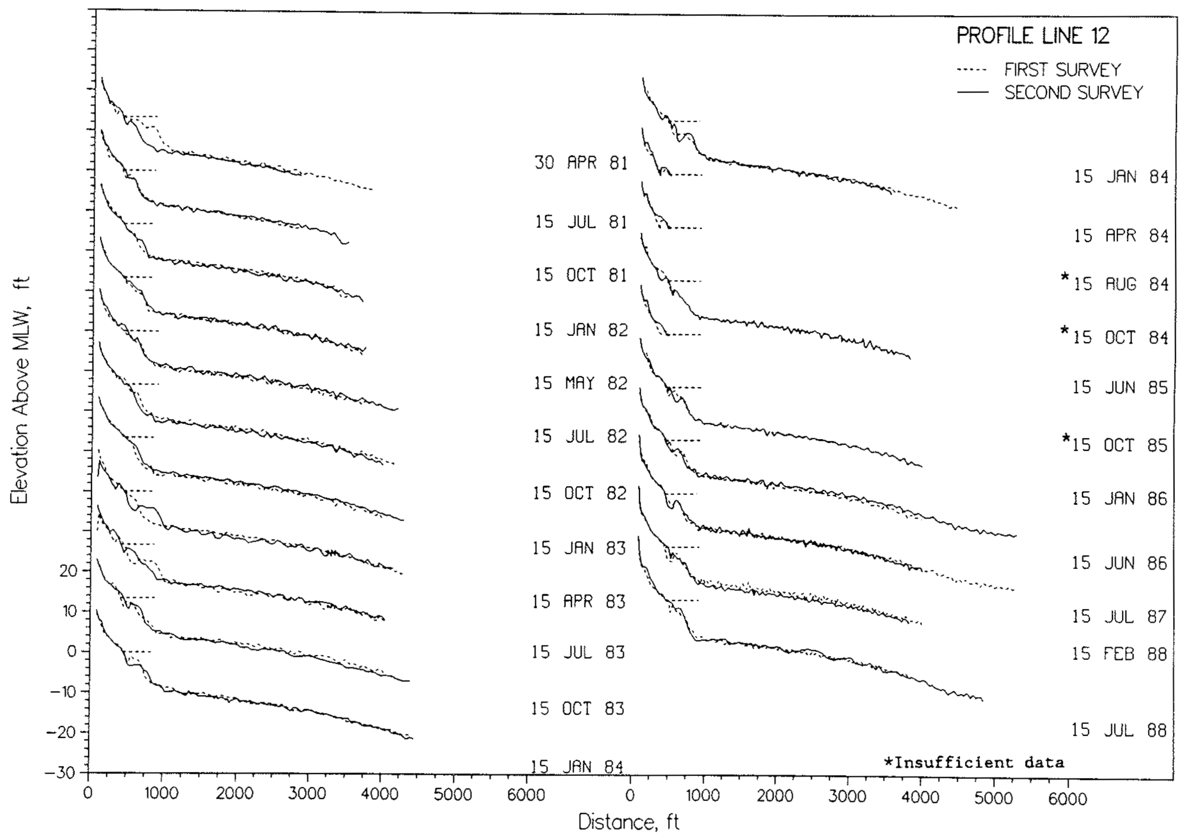
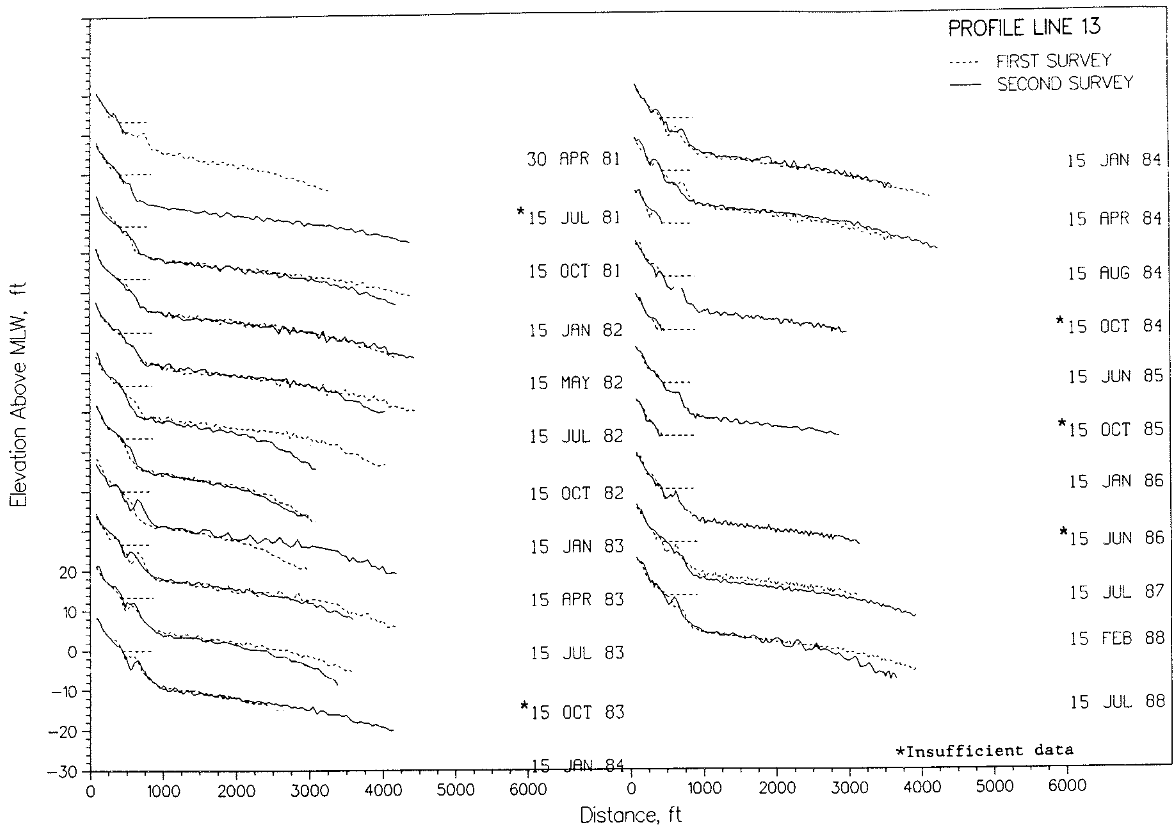
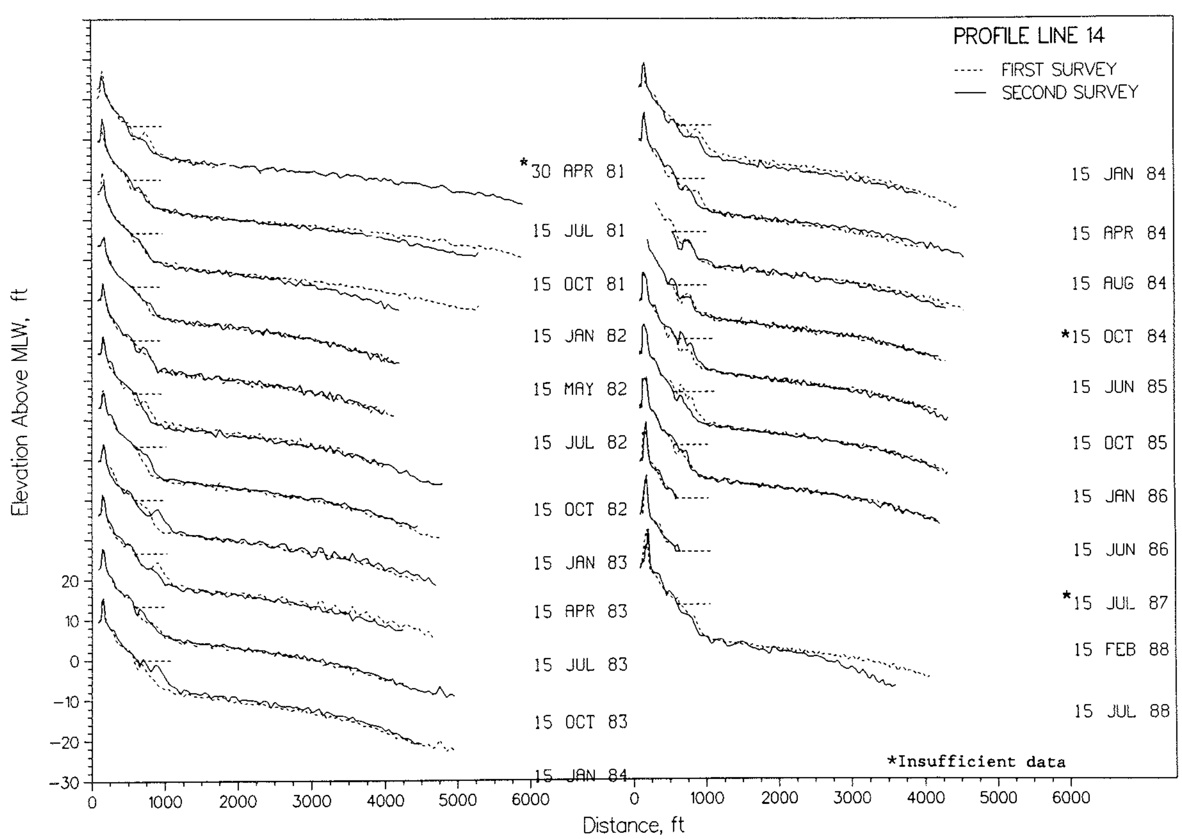
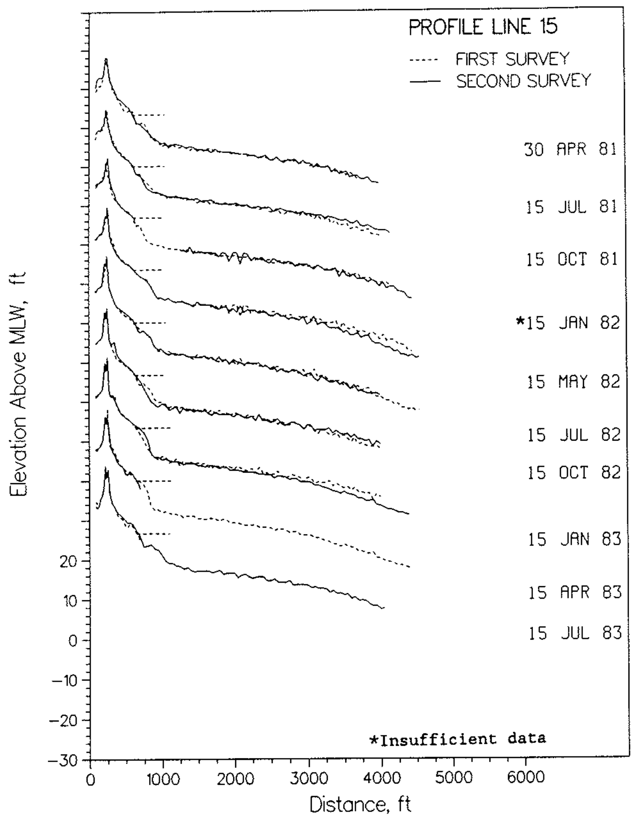
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
* 15 AUG 84
* 15 OCT 84
15 JUN 85
* 15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft

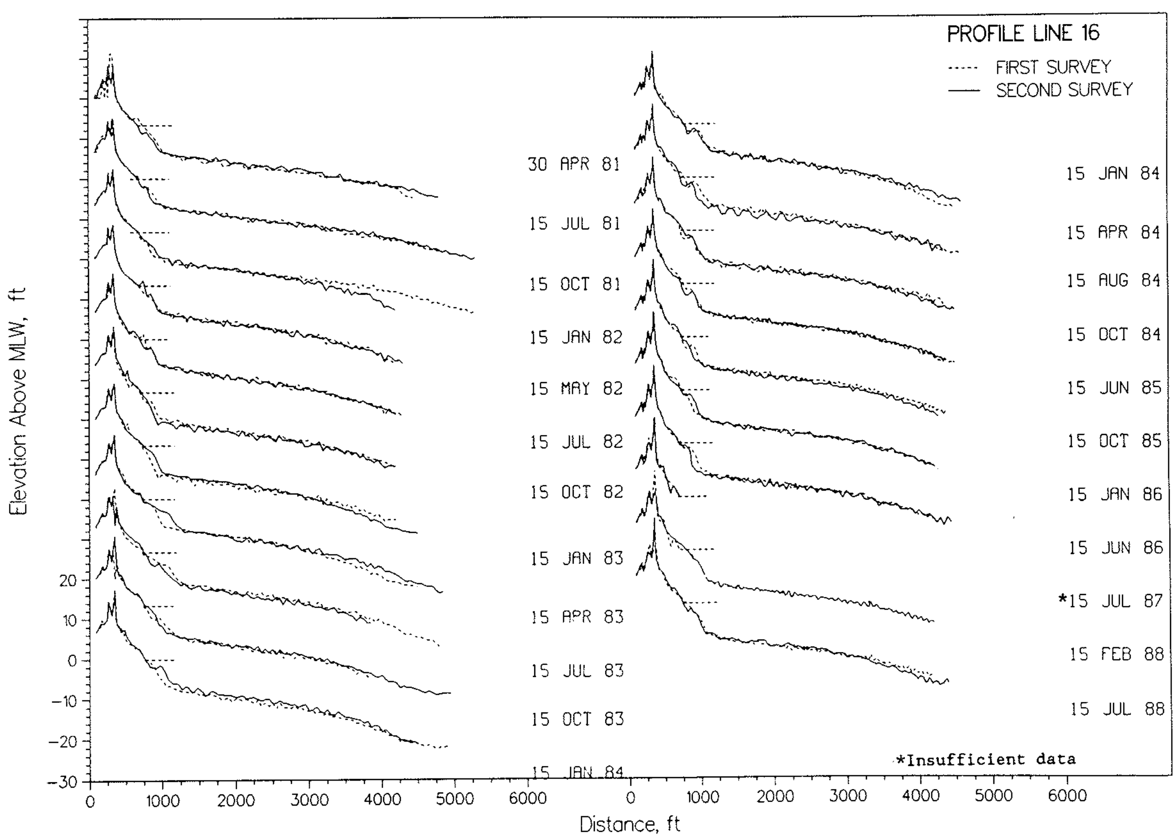

PROFILE LINE 11
FIRST SURVEY
SECOND SURVEY
Elevation Above MLW, ft
Distance, ft
*30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
*15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data

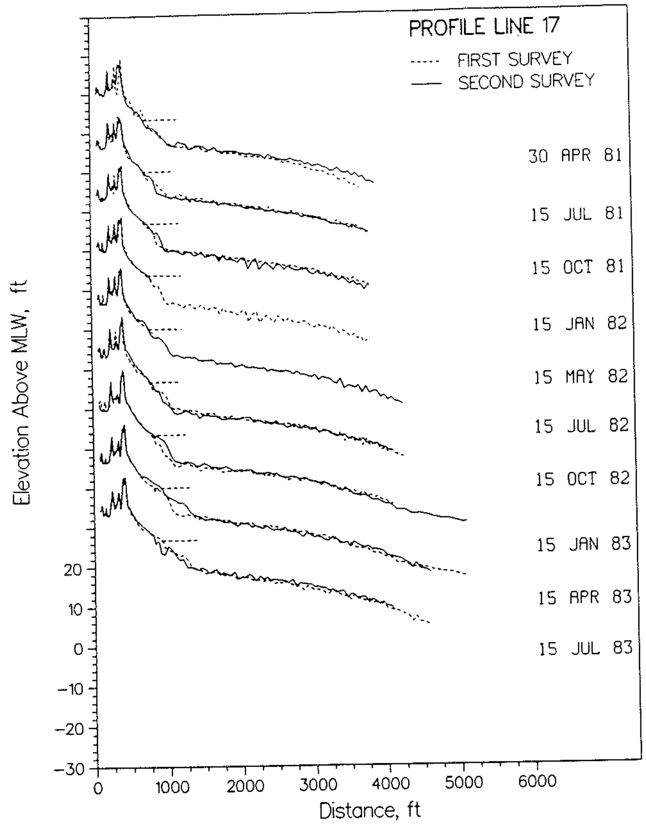

PROFILE LINE 12
FIRST SURVEY
SECOND SURVEY
Elevation Above MLW, ft
Distance, ft
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
*15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data

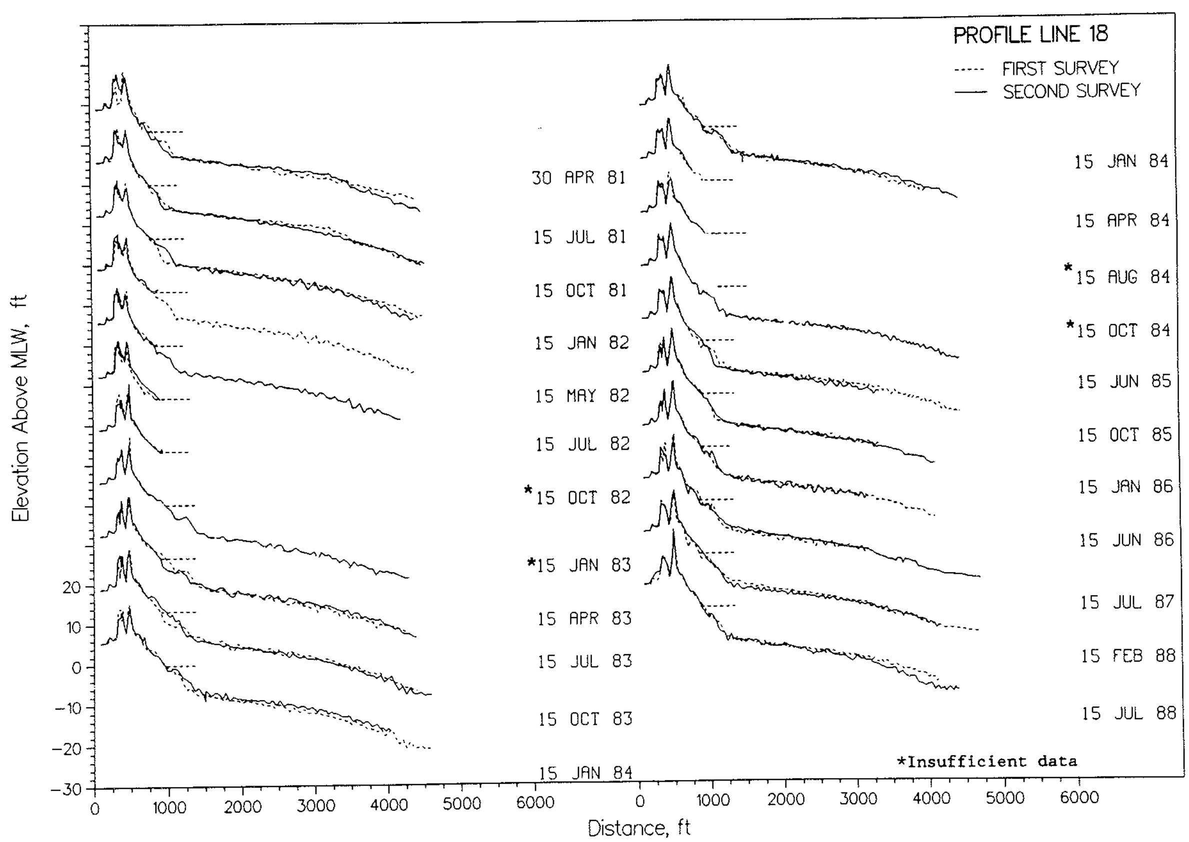

PROFILE LINE 13
FIRST SURVEY
SECOND SURVEY
30 APR 81
*15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
*15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
*15 OCT 84
15 JUN 85
*15 OCT 85
15 JAN 86
*15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft

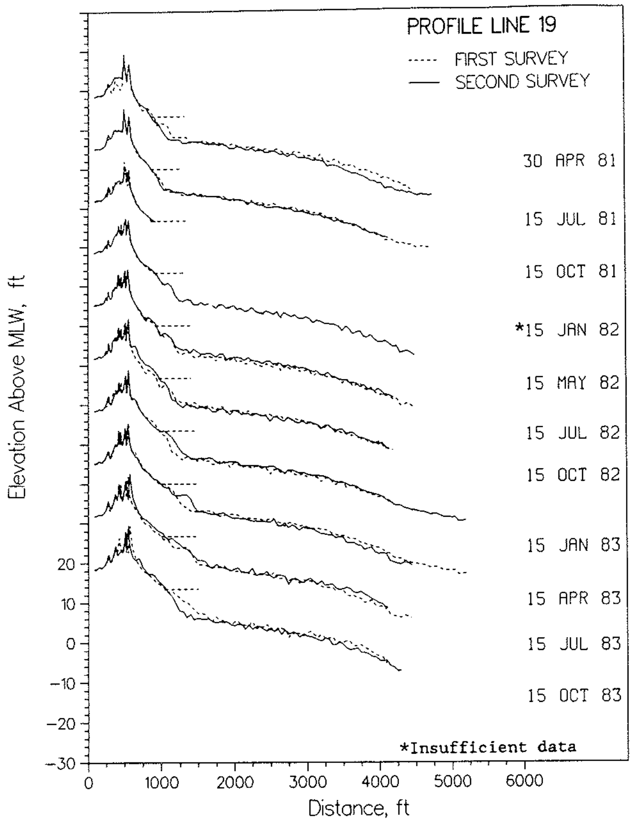

PROFILE LINE 14
FIRST SURVEY
SECOND SURVEY
*30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
*15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft

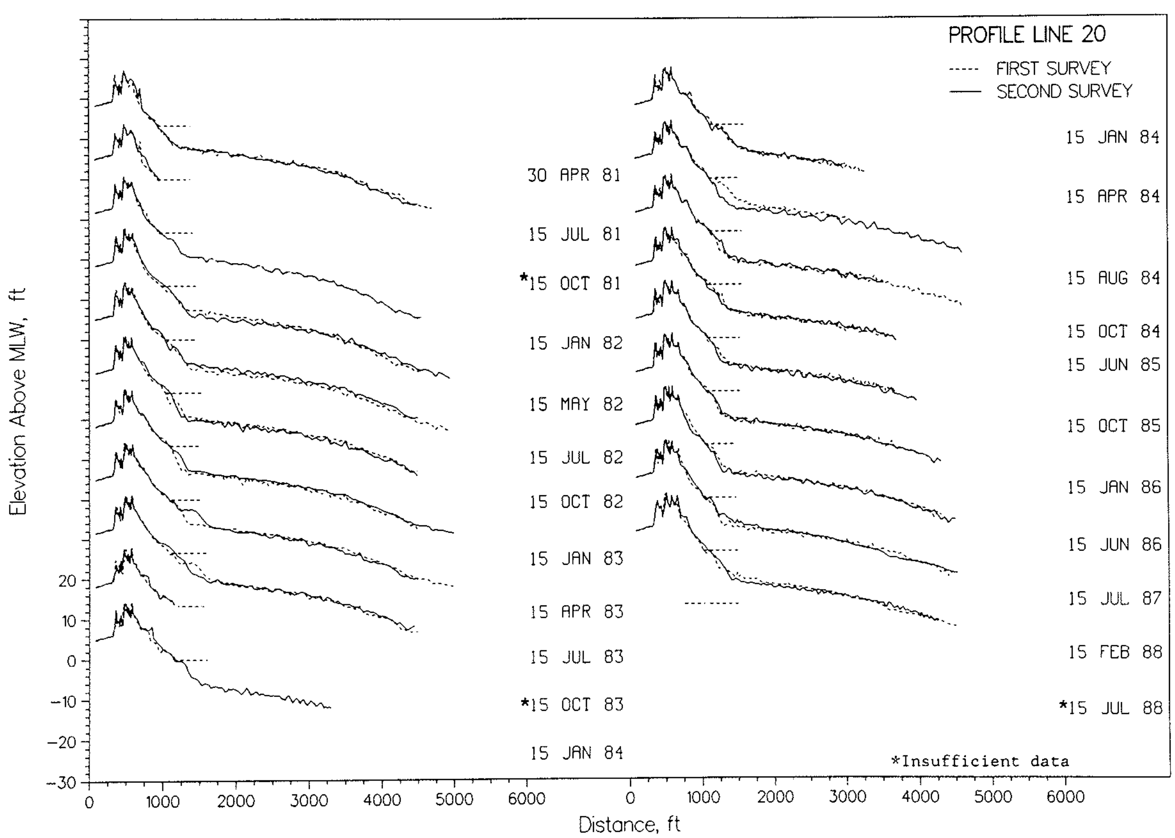

PROFILE LINE 15
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
*15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 16
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 17
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 18
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
*15 OCT 82
*15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 19
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
*15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
*Insufficient data
Elevation Above MLW, ft
Distance, ft
20
10
0
-10
-20
-30
0
1000
2000
3000
4000
5000
6000


PROFILE LINE 20
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
*15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
*15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
*15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft
20
10
0
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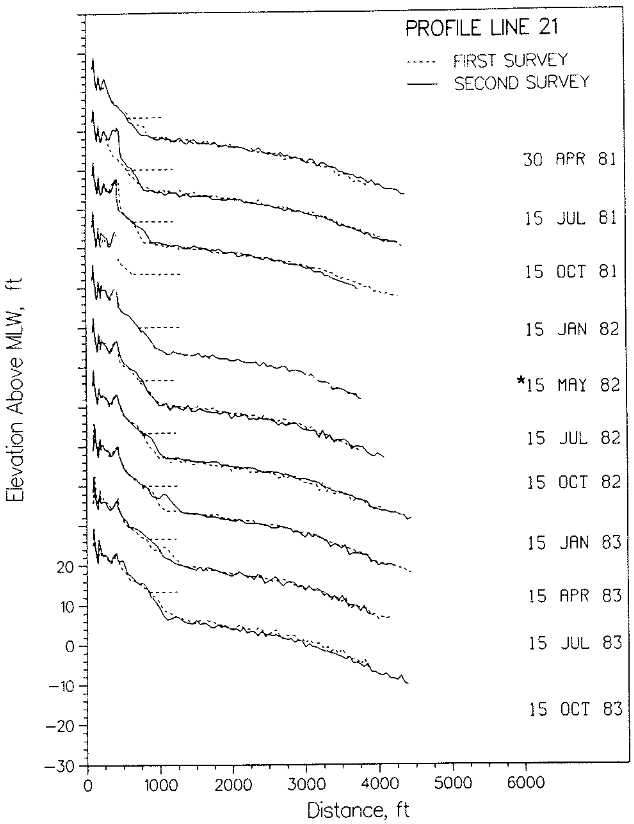
6000


PROFILE LINE 21
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SECOND SURVEY
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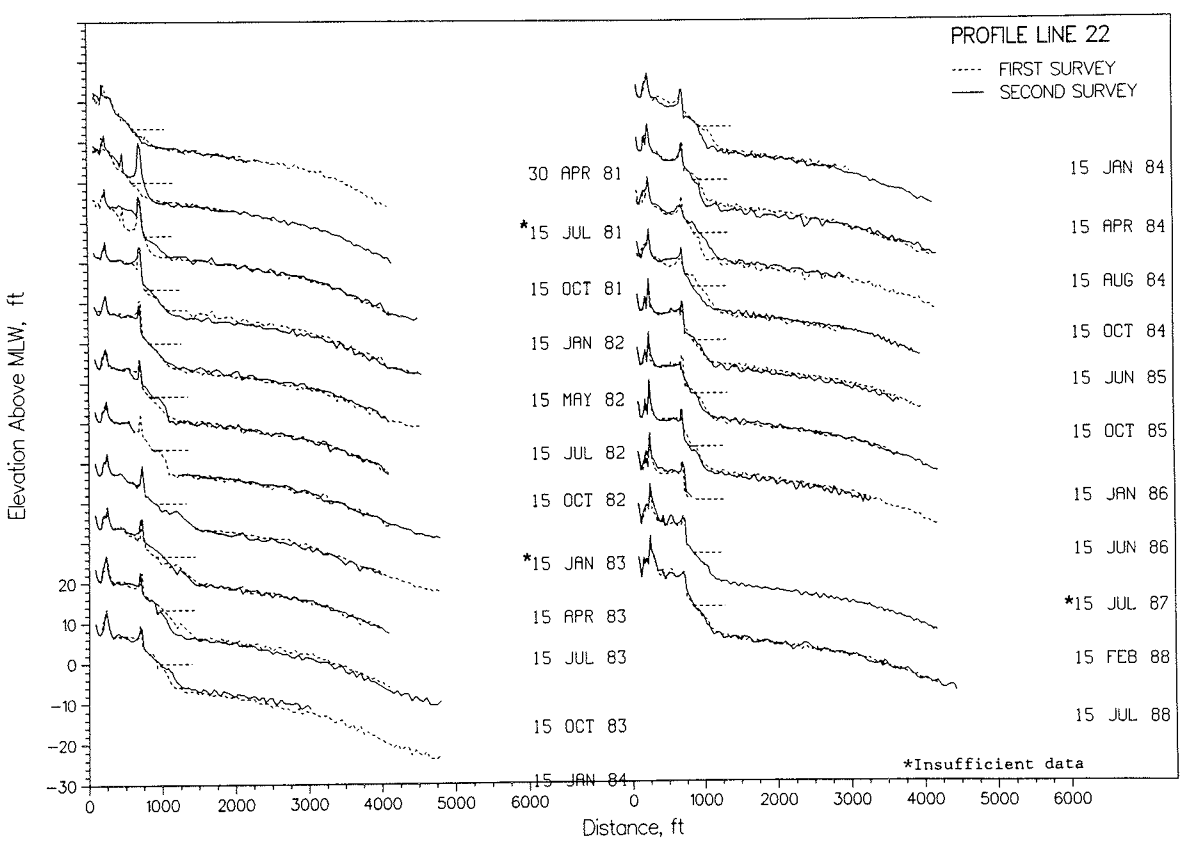
15 JUL 81
15 OCT 81
15 JAN 82
*15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
Elevation Above MLW, ft
20
10
0
−10
−20
−30
0
1000
2000
3000
4000
5000
6000
Distance, ft


PROFILE LINE 22
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SECOND SURVEY
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15 OCT 81
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15 MAY 82
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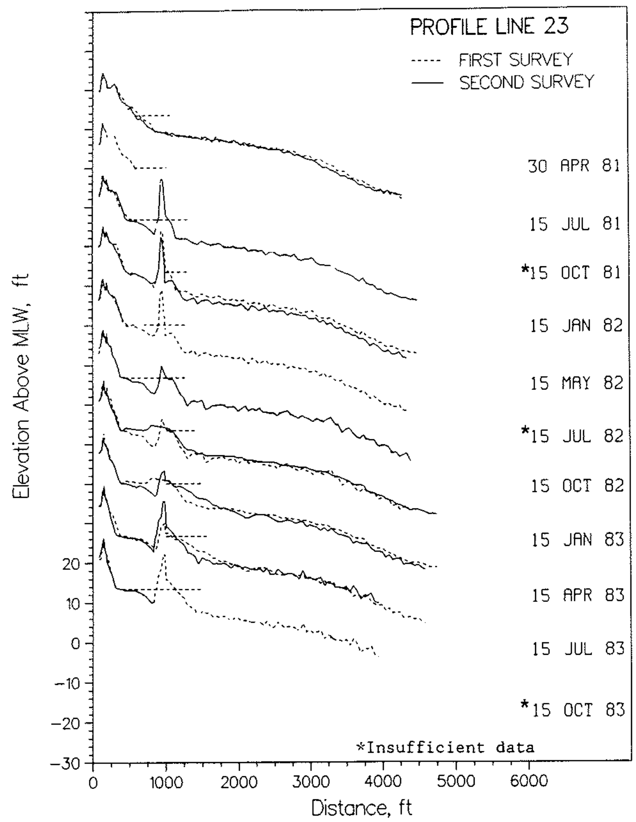
*15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
20
10
0
−10
−20
−30
0
1000
2000
3000
4000
5000
6000
Distance, ft


PROFILE LINE 23
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SECOND SURVEY
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*15 OCT 81
15 JAN 82
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15 OCT 82
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15 APR 83
15 JUL 83
*15 OCT 83
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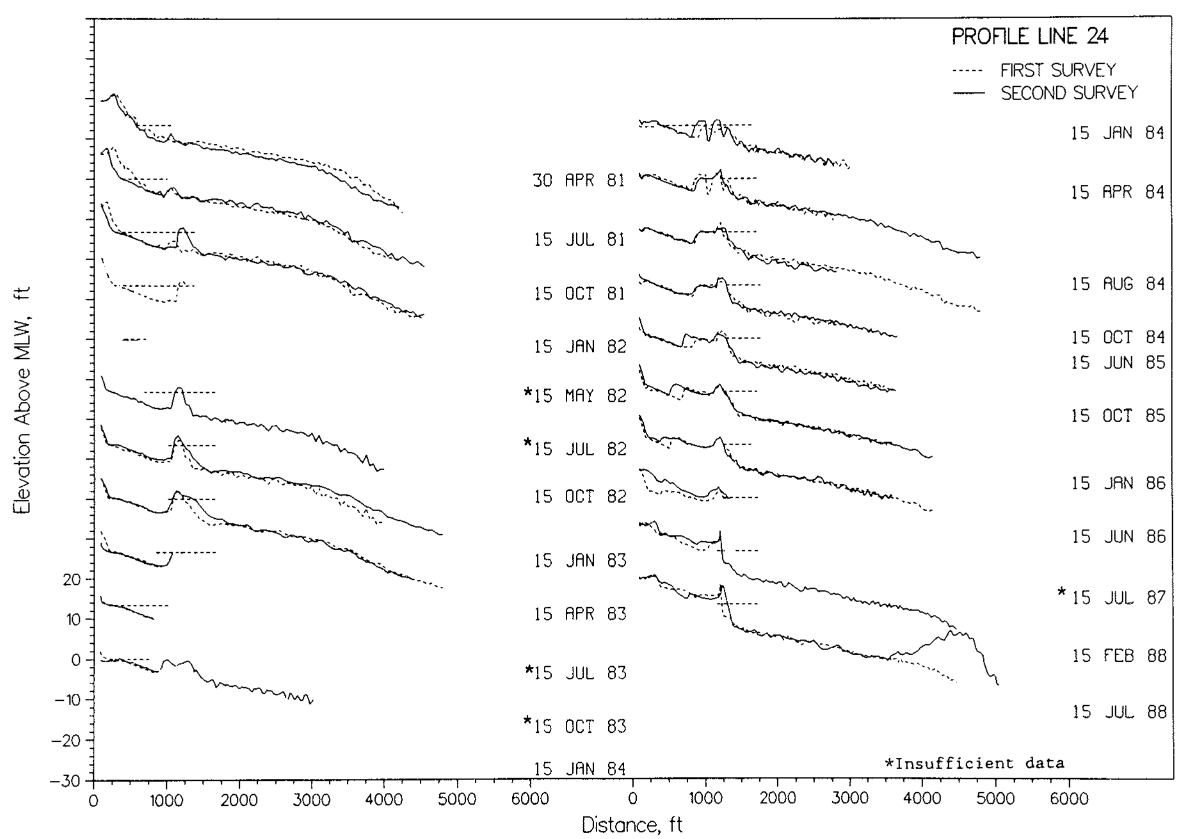
Elevation Above MLW, ft
Distance, ft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*15 JUL 82
15 OCT 82
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15 APR 83
*15 JUL 83
*15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
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15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
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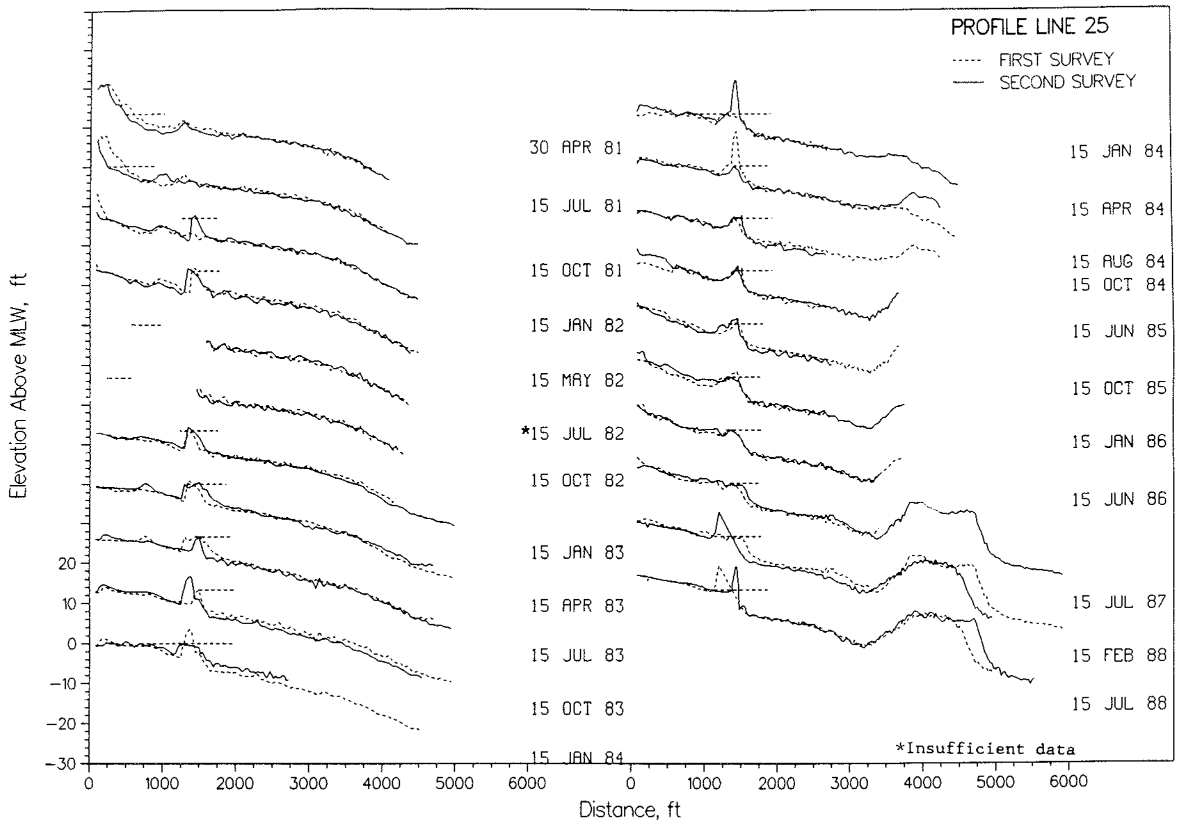
Elevation Above MLW, ft
Distance, ft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15 OCT 81
15 JAN 82
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*15 JUL 82
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15 JAN 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
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15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
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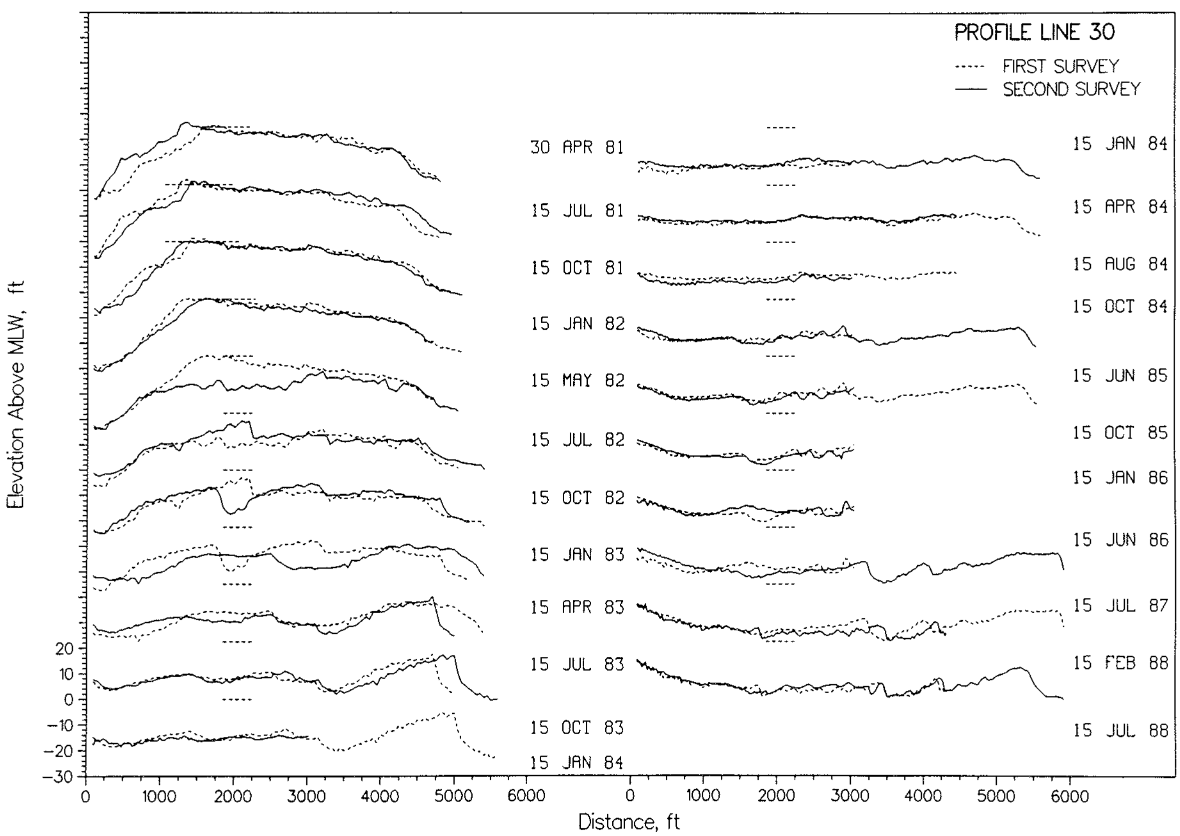
Elevation Above MLW, ft
Distance, ft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15 OCT 81
15 JAN 82
15 MAY 82
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15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
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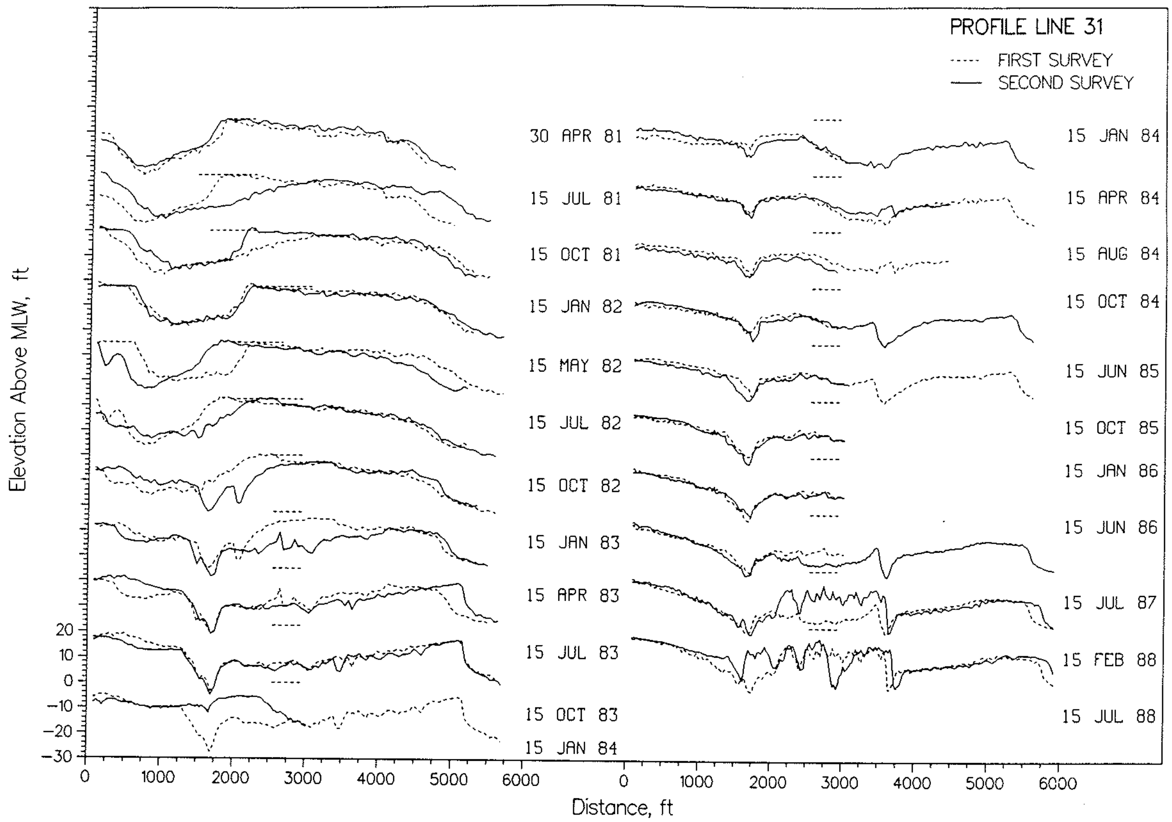
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 31
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15 OCT 82
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15 APR 83
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15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
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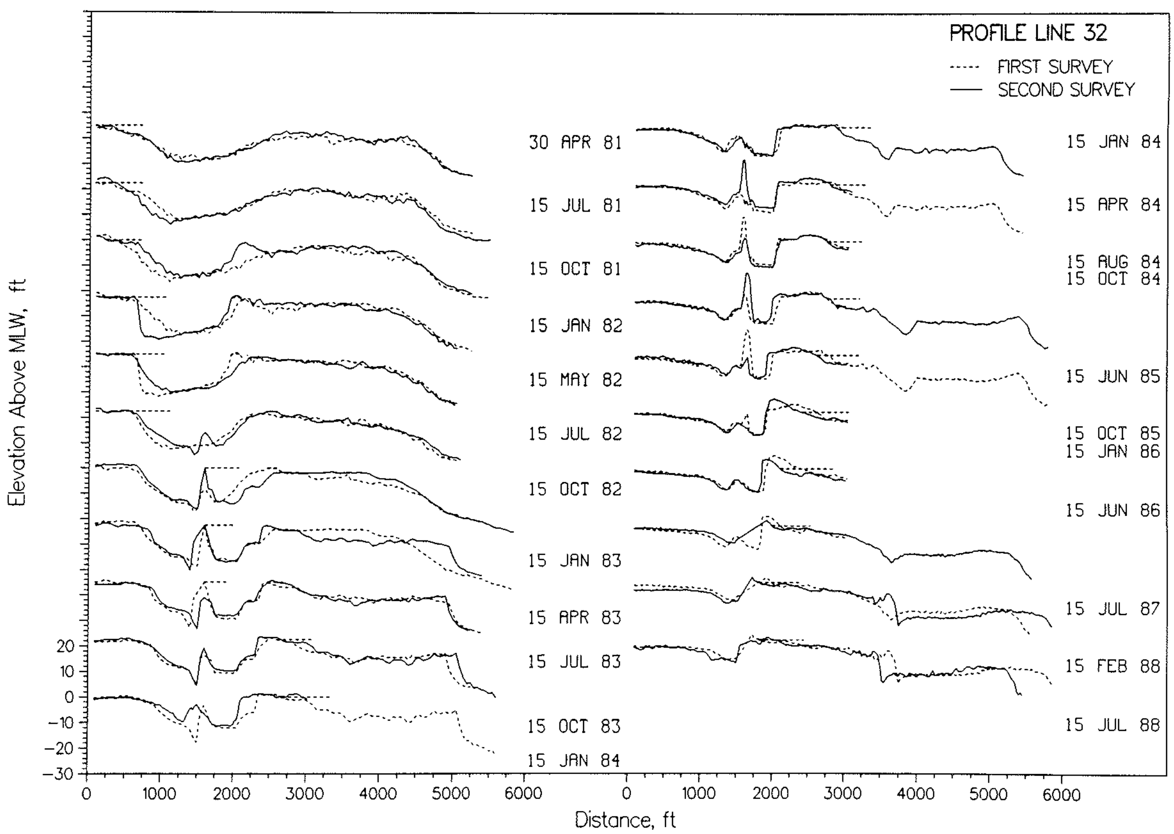
15 JUL 88
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 32
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15 OCT 82
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15 APR 83
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15 OCT 83
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15 JAN 84
15 APR 84
15 AUG 84
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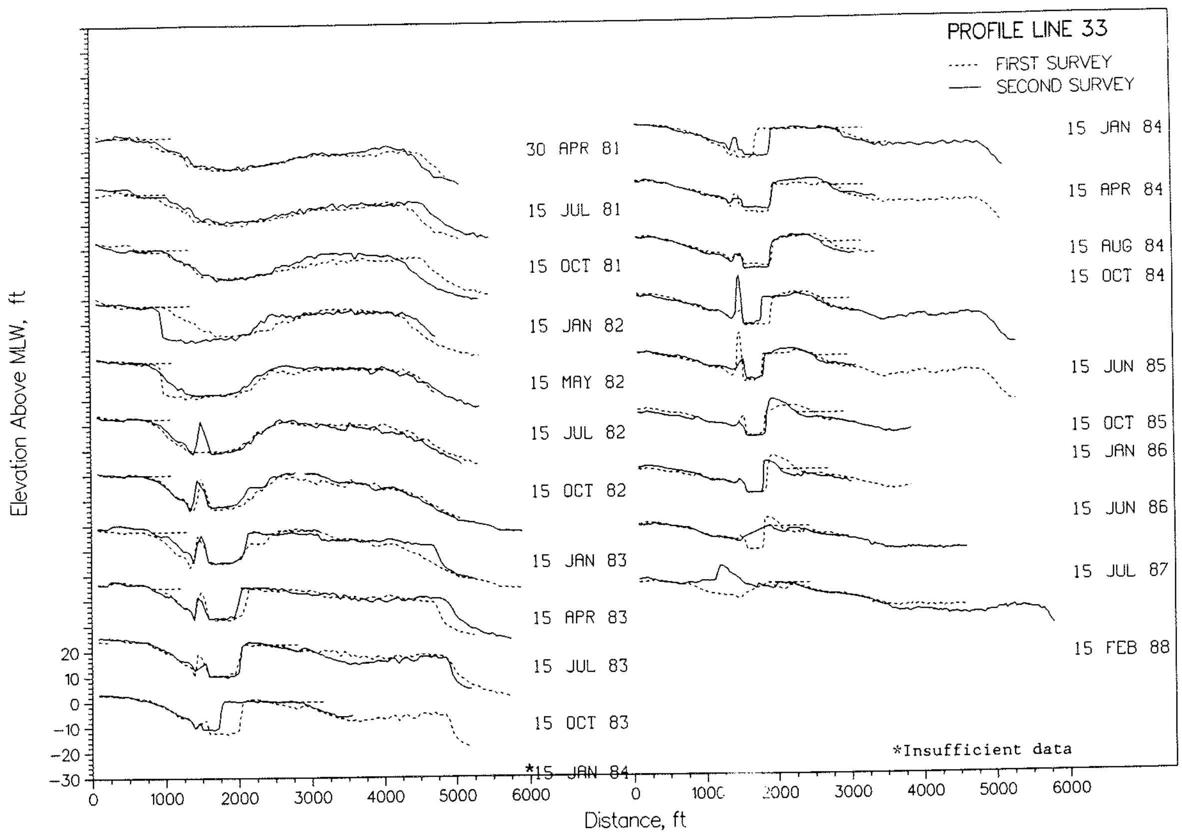
15 JUL 88
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 33
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15 OCT 82
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15 APR 83
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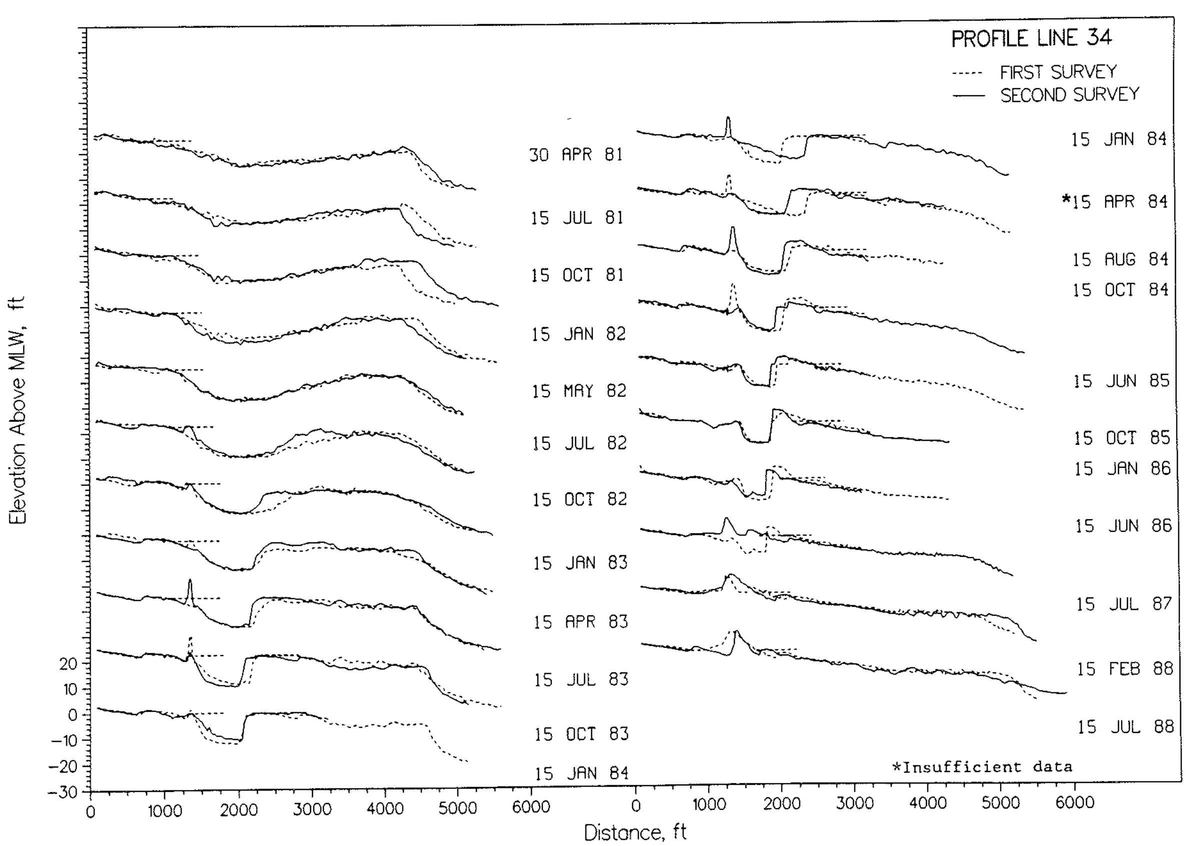
15 OCT 83
*15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 34
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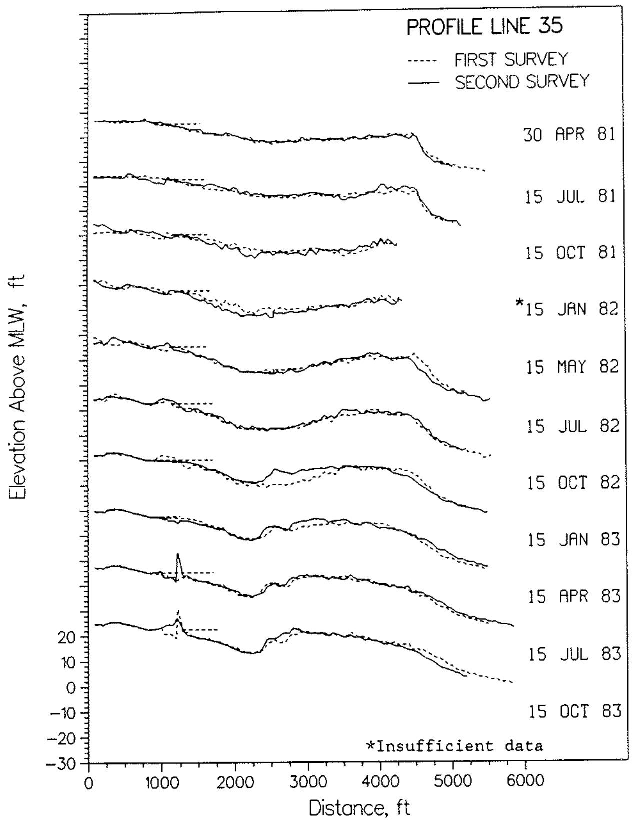
15 JAN 84
*15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 35
FIRST SURVEY
SECOND SURVEY
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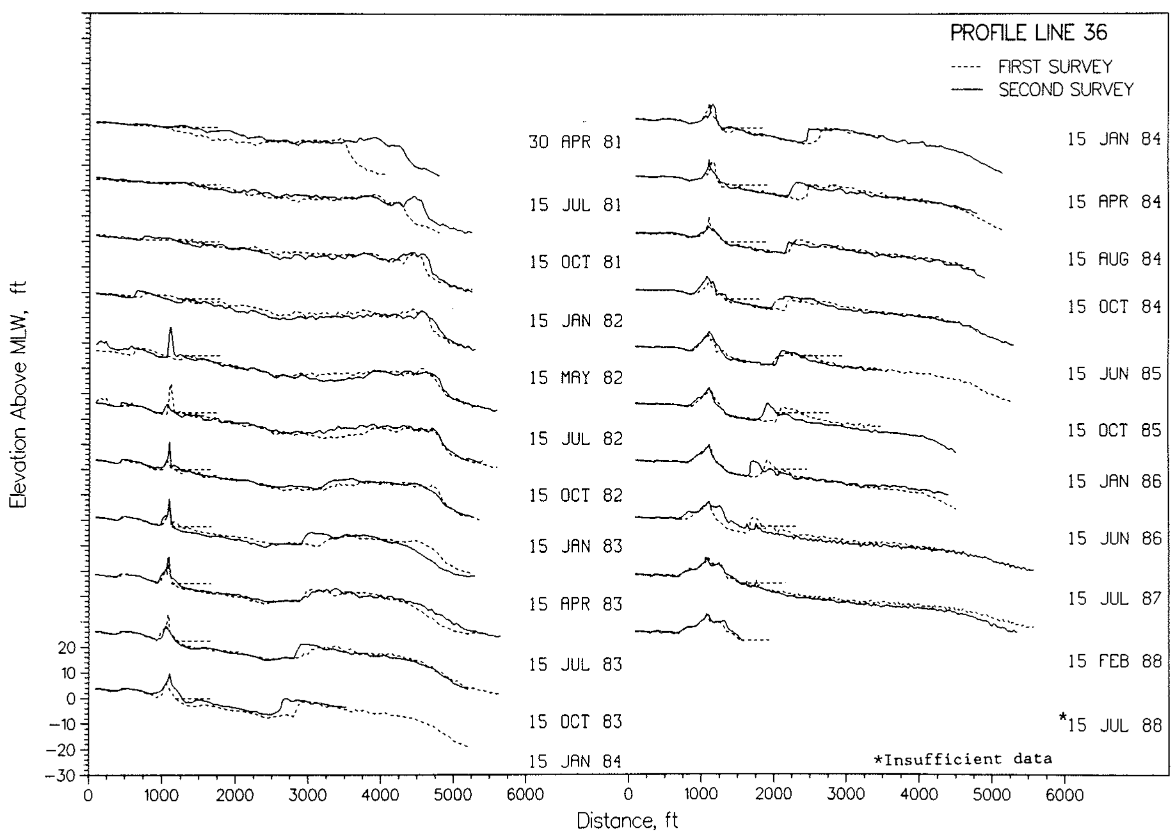
15 JUL 81
15 OCT 81
*15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
*Insufficient data
Elevation Above MLW, ft
20
10
0
-10
-20
-30
0
1000
2000
3000
4000
5000
6000
Distance, ft


PROFILE LINE 36
FIRST SURVEY
SECOND SURVEY
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15 JUL 82
15 OCT 82
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15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
*15 JUL 88
*Insufficient data
Elevation Above MLW, ft
20
10
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-10
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-30
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1000
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3000
4000
5000
6000
0
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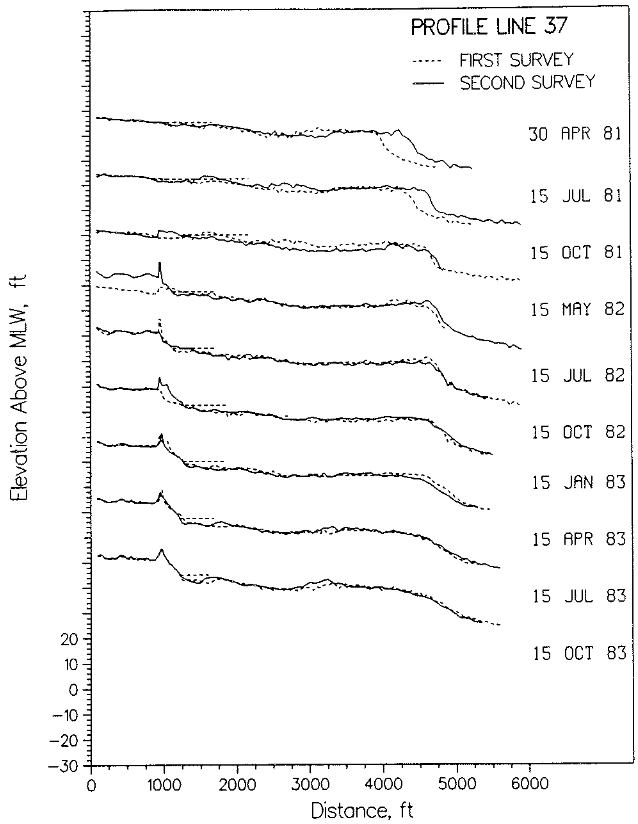
5000
6000
Distance, ft


PROFILE LINE 37
FIRST SURVEY
SECOND SURVEY
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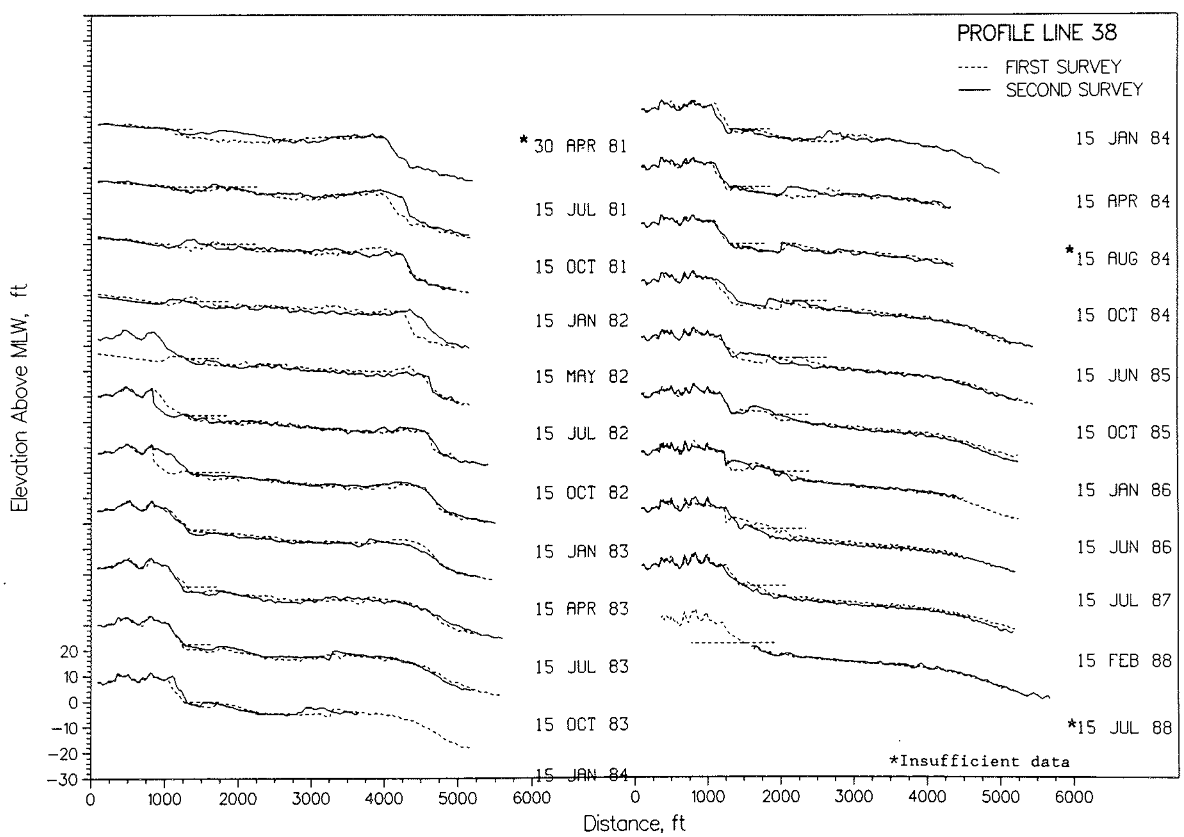
15 OCT 81
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 38
FIRST SURVEY
SECOND SURVEY
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15 MAY 82
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15 OCT 82
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15 APR 83
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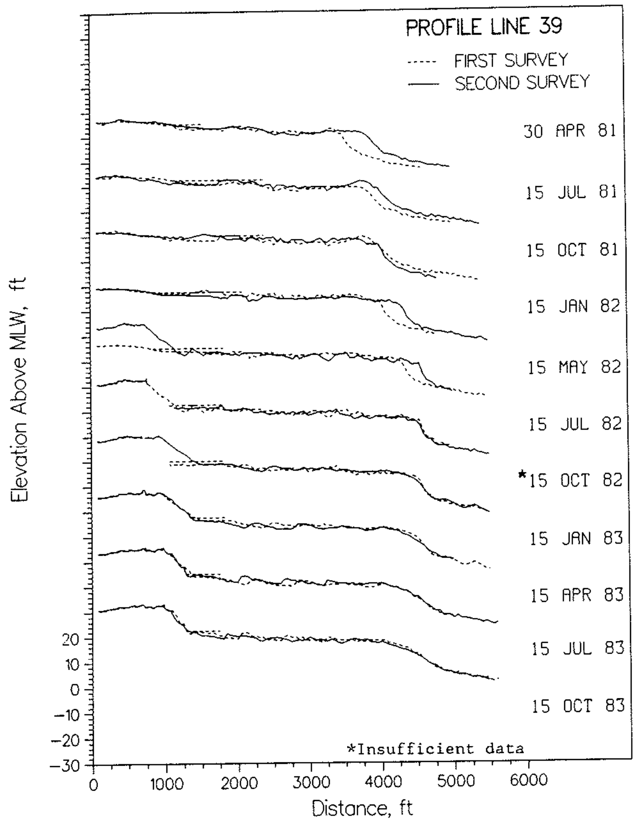
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
*15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 39
FIRST SURVEY
SECOND SURVEY
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15 JAN 82
15 MAY 82
15 JUL 82
*15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
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Elevation Above MLW, ft
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10
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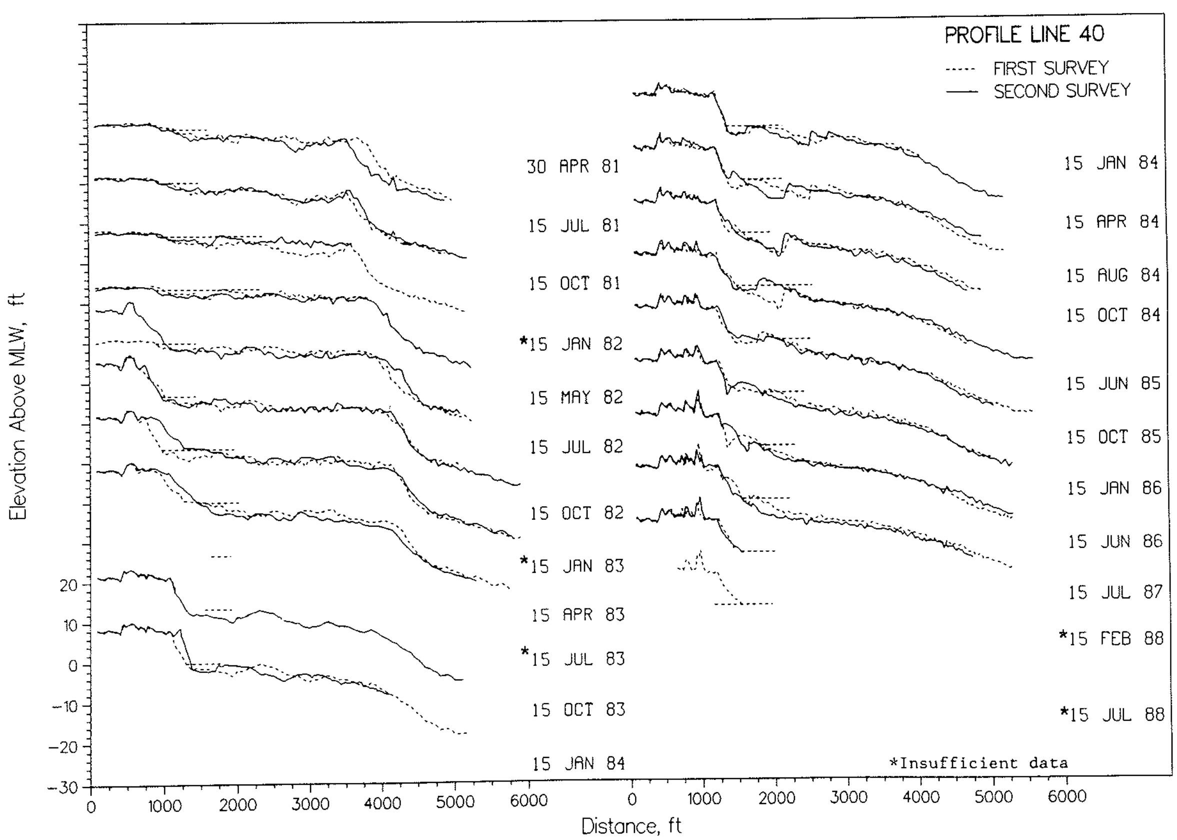
-10
-20
-30
0
1000
2000
3000
4000
5000
6000
Distance, ft


PROFILE LINE 40
FIRST SURVEY
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*15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
*15 JAN 83
15 APR 83
*15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
*15 FEB 88
*15 JUL 88
*Insufficient data
Elevation Above MLW, ft
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10
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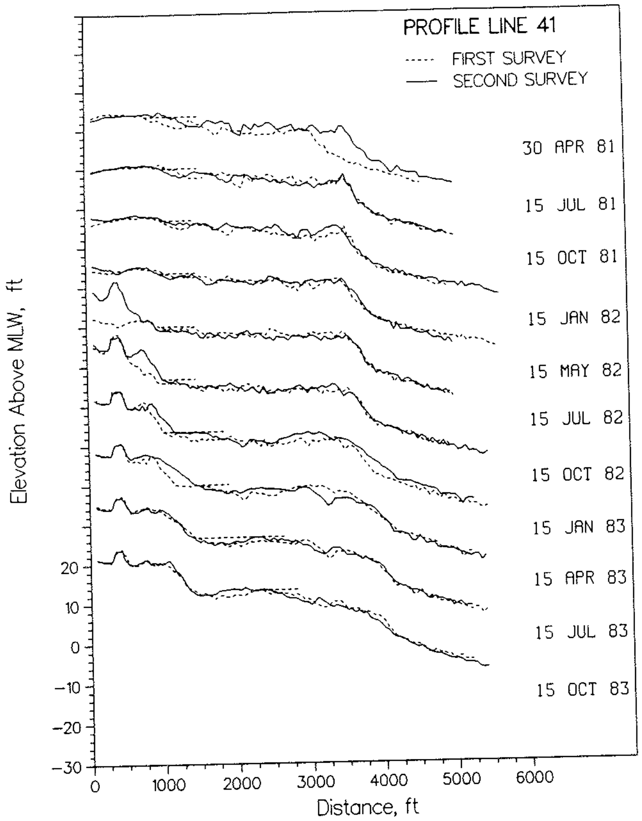
-10
-20
-30
0
1000
2000
3000
4000
5000
6000
Distance, ft


PROFILE LINE 41
FIRST SURVEY
SECOND SURVEY
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15 JUL 81
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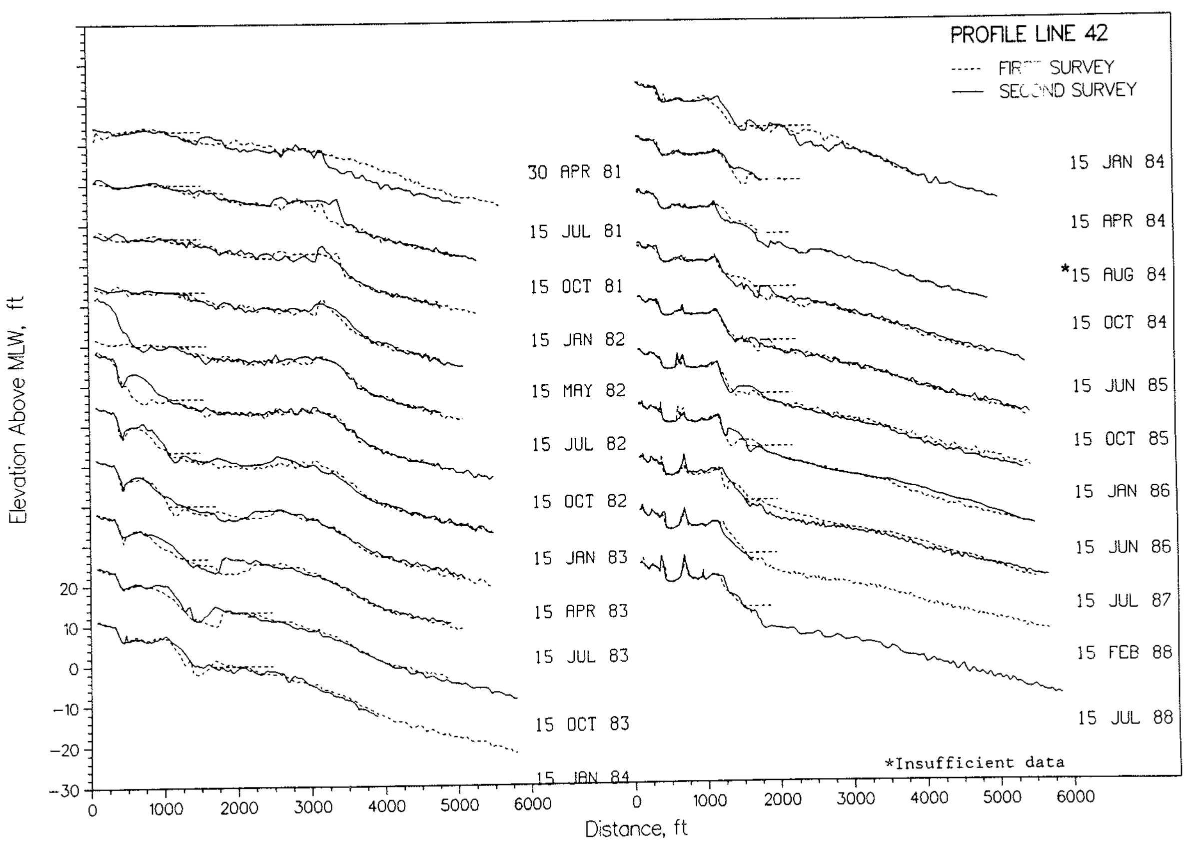
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 42
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SECOND SURVEY
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15 JAN 82
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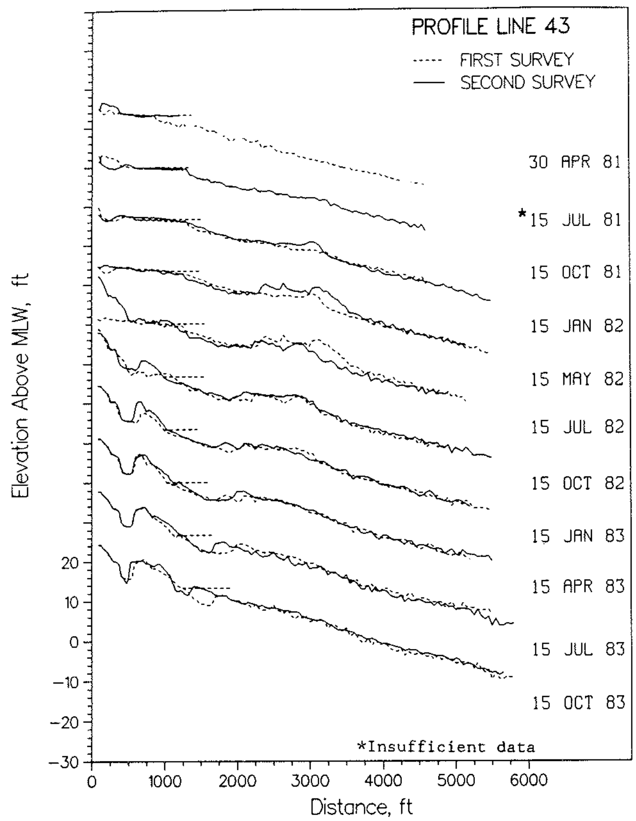
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 43
FIRST SURVEY
SECOND SURVEY
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15 OCT 81
15 JAN 82
15 MAY 82
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15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
*Insufficient data
Elevation Above MLW, ft
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-10
-20
-30
0
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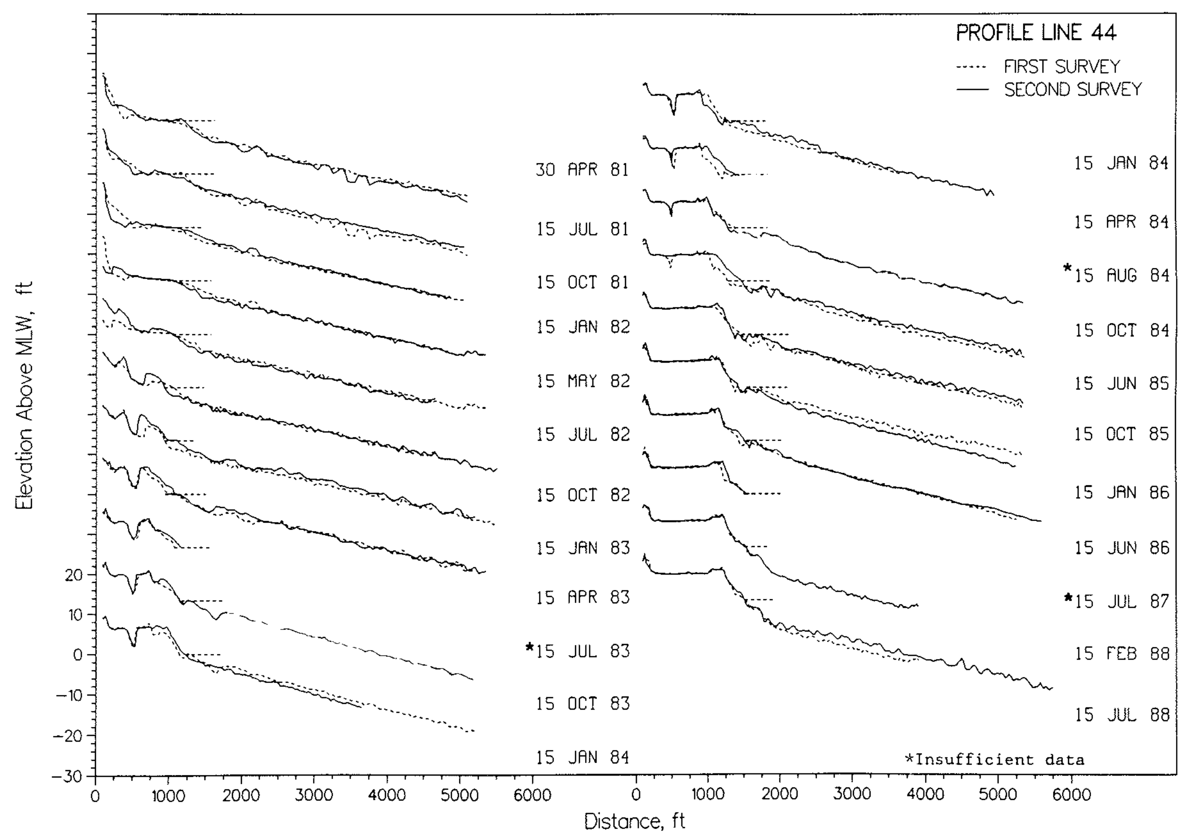
3000
4000
5000
6000
Distance, ft


PROFILE LINE 44
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SECOND SURVEY
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15 JUL 82
15 OCT 82
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15 APR 83
*15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
20
10
0
-10
-20
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1000
2000
3000
4000
5000
6000
0
1000
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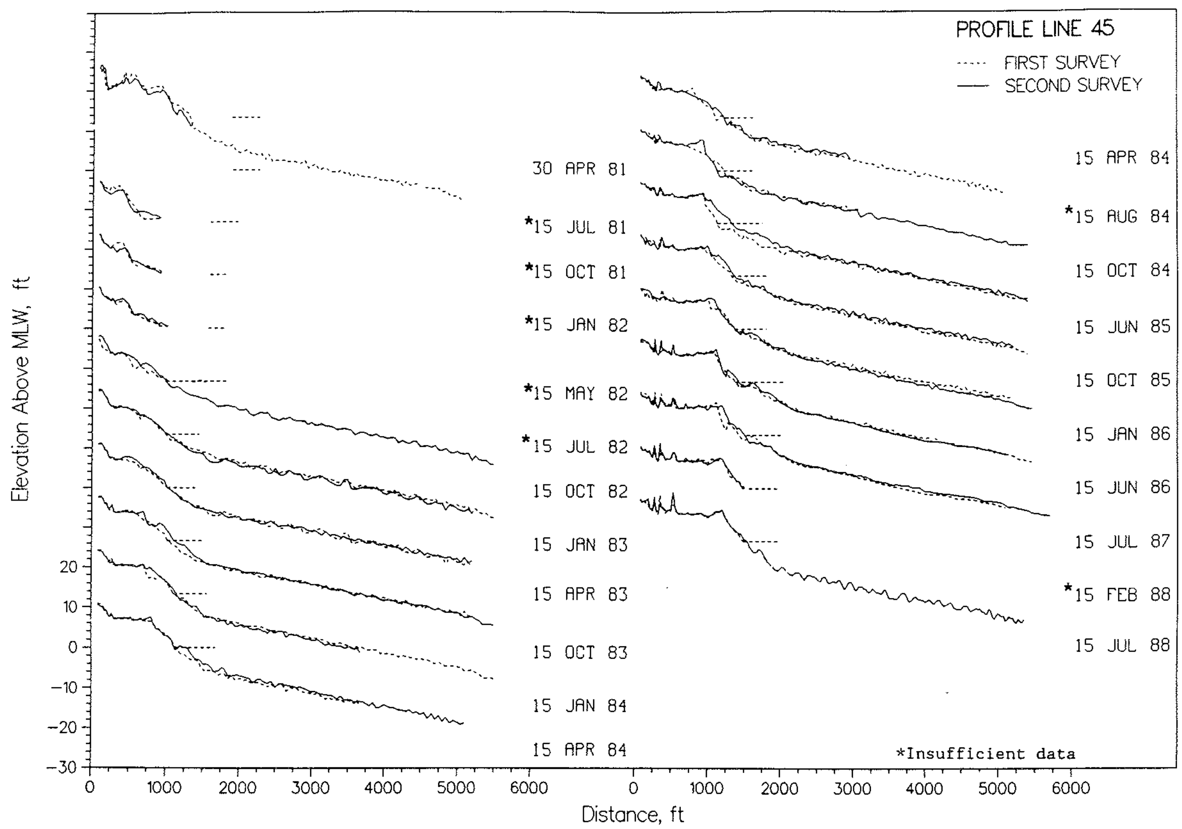
4000
5000
6000
Distance, ft


PROFILE LINE 45
FIRST SURVEY
SECOND SURVEY
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*15 OCT 81
*15 JAN 82
*15 MAY 82
*15 JUL 82
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15 JAN 84
15 APR 84
15 APR 84
*15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
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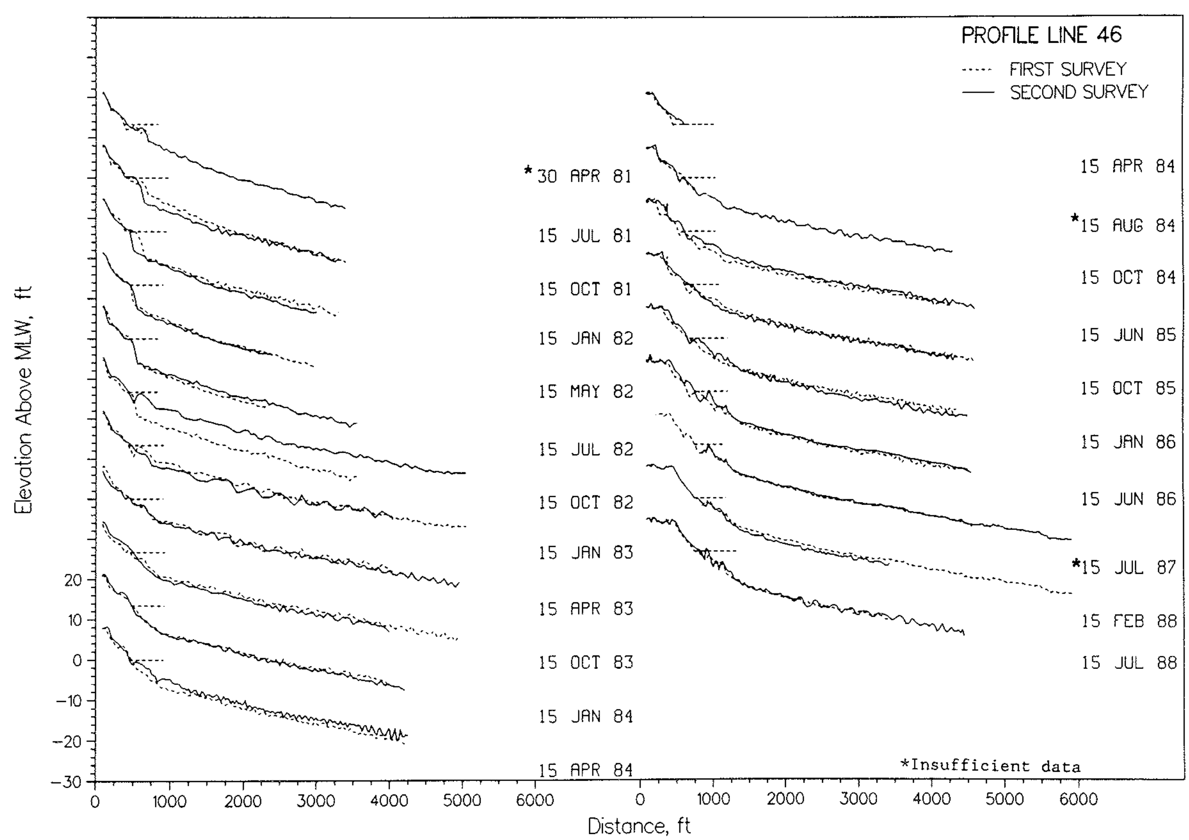
15 JUN 86
15 JUL 87
*15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 46
FIRST SURVEY
SECOND SURVEY
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15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
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15 APR 83
15 OCT 83
15 JAN 84
15 APR 84
15 APR 84
*15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
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15 JUN 86
*15 JUL 87
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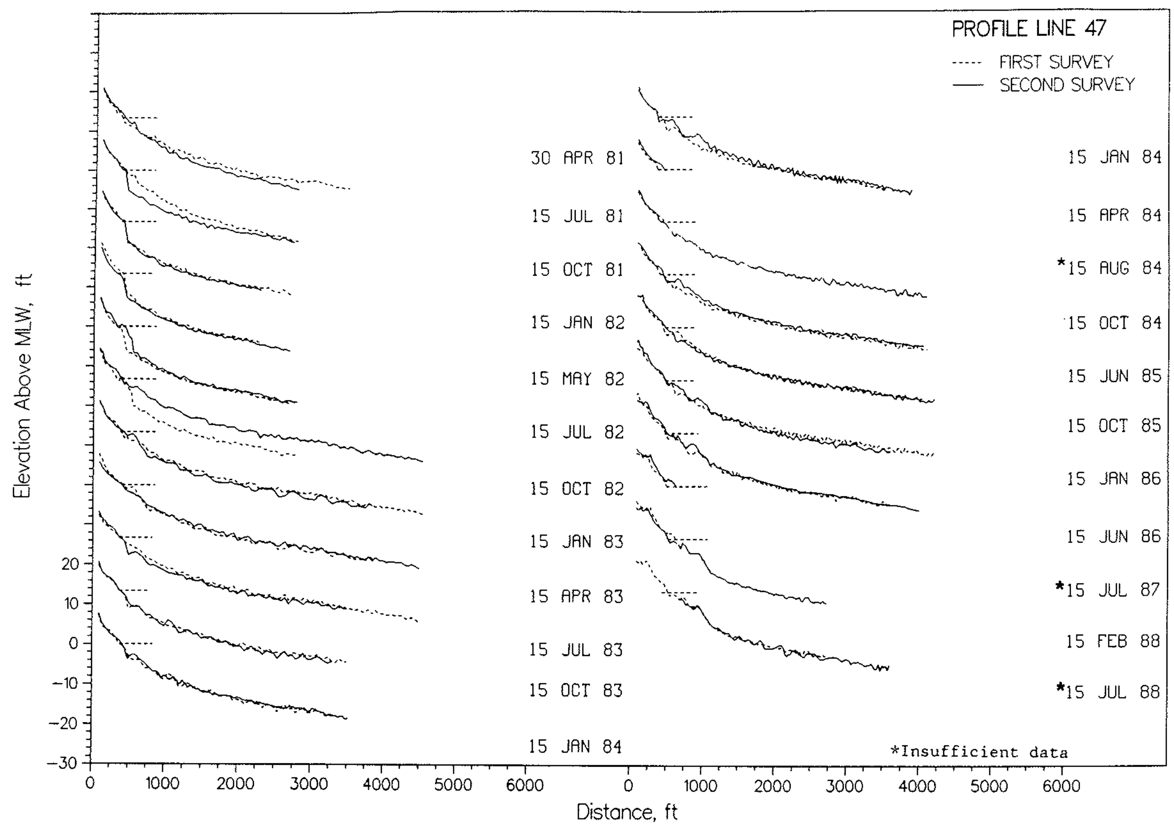
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 47
FIRST SURVEY
SECOND SURVEY
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15 JAN 82
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15 JUL 82
15 OCT 82
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15 JAN 84
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15 APR 84
*15 AUG 84
15 OCT 84
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*15 JUL 87
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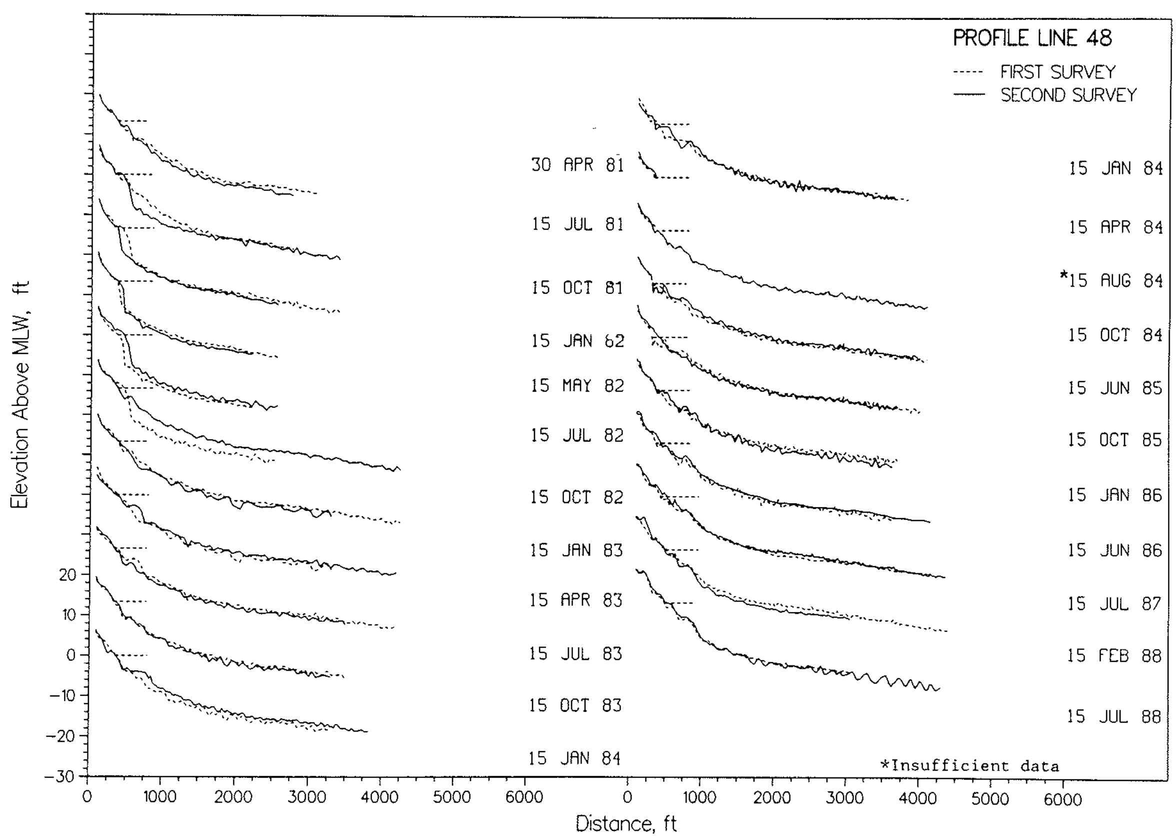
*15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 48
FIRST SURVEY
SECOND SURVEY
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15 OCT 81
15 JAN 62
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15 JUL 82
15 OCT 82
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15 APR 83
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15 JAN 84
15 APR 84
*15 AUG 84
15 OCT 84
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15 OCT 85
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15 JUN 86
15 JUL 87
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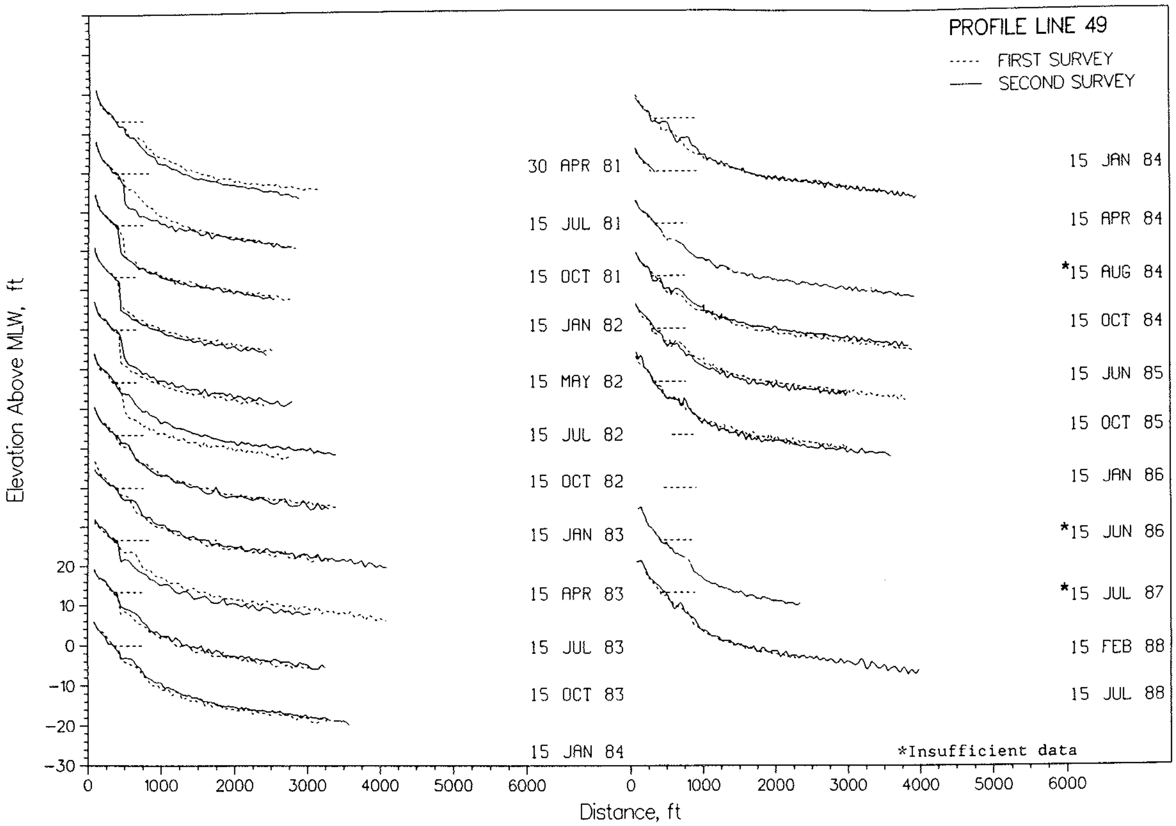
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 49
FIRST SURVEY
SECOND SURVEY
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15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
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15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
*15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
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10
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−10
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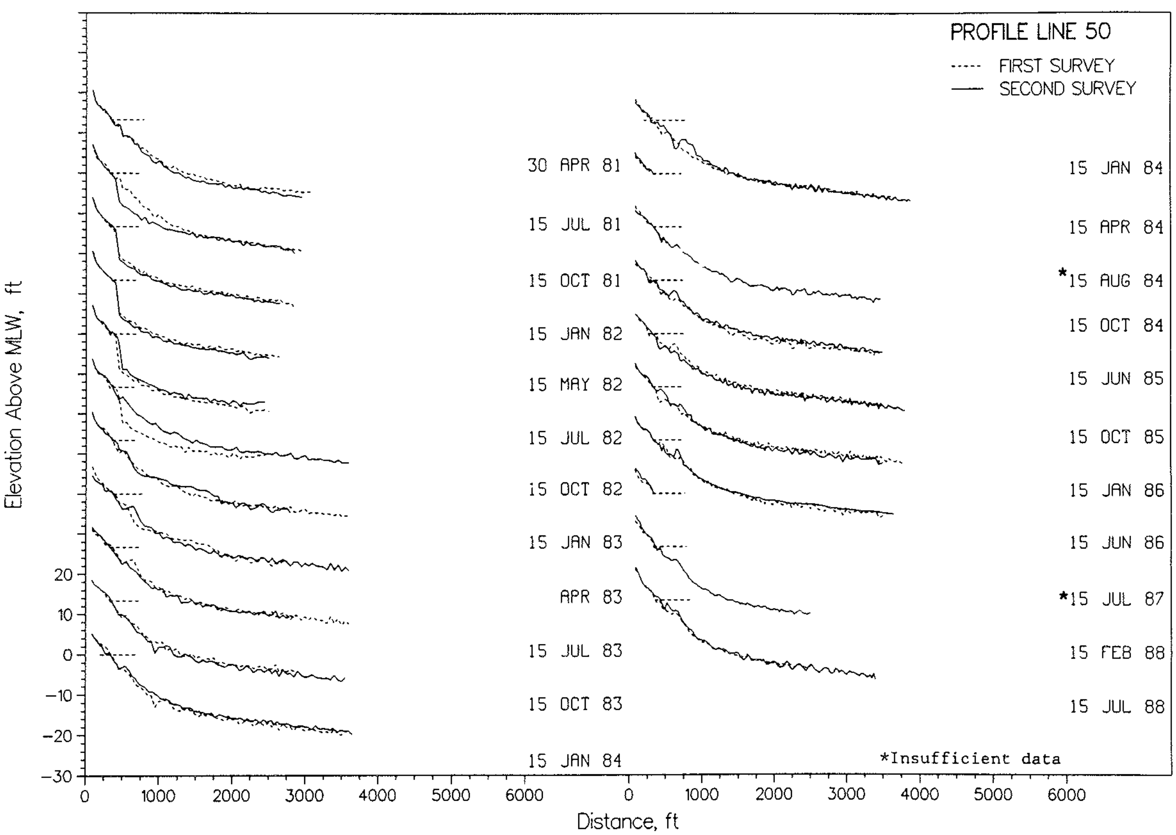
−30
0
1000
2000
3000
4000
5000
6000
Distance, ft


PROFILE LINE 50
FIRST SURVEY
SECOND SURVEY
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15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
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1000
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5000
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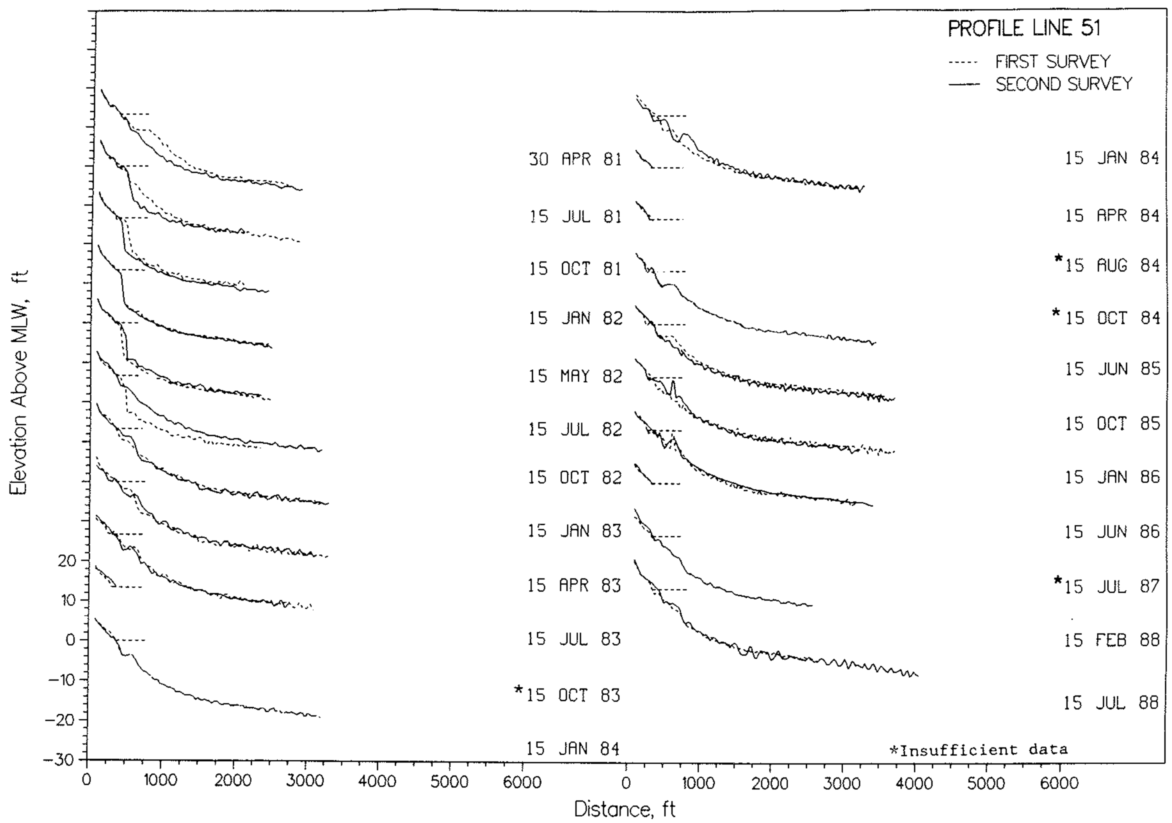
Distance, ft


PROFILE LINE 51
FIRST SURVEY
SECOND SURVEY
Elevation Above MLW, ft
Distance, ft
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15 OCT 81
15 JAN 82
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15 JAN 83
15 APR 83
15 JUL 83
*15 OCT 83
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15 JAN 84
15 APR 84
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*15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
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*15 JUL 87
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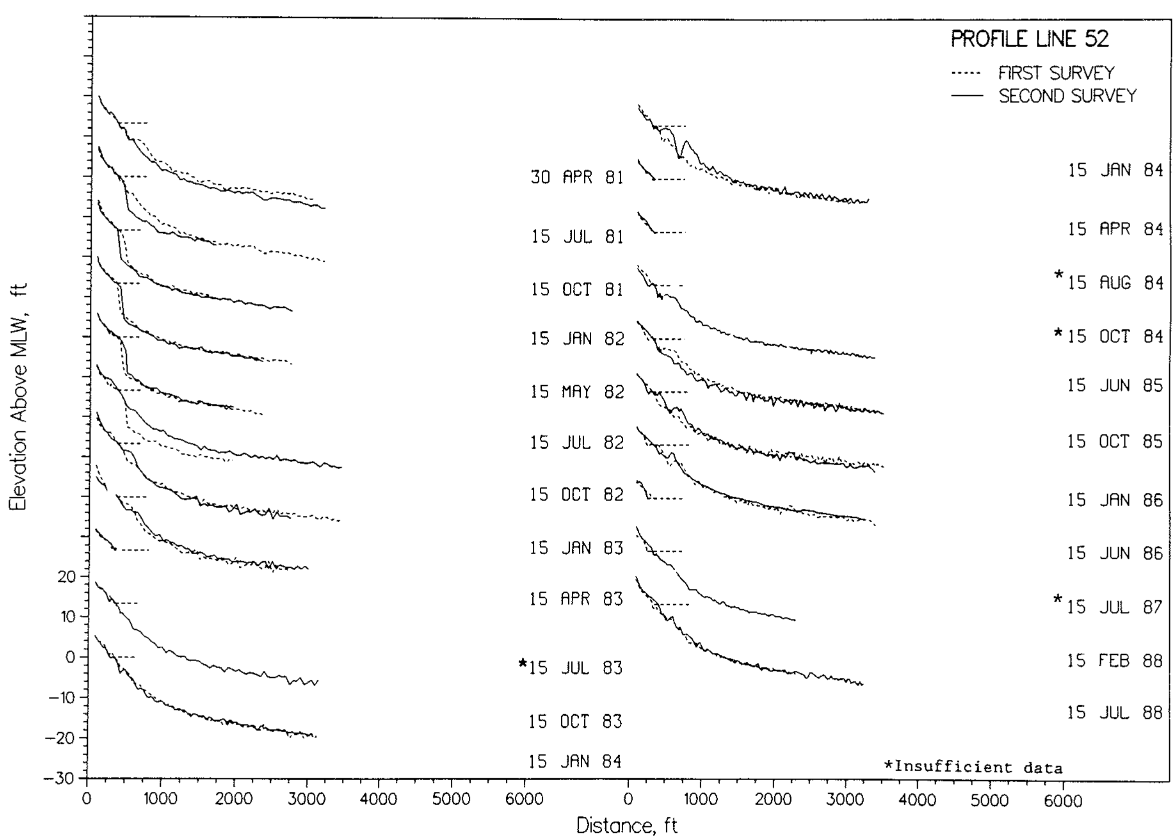
15 JUL 88
*Insufficient data


PROFILE LINE 52
FIRST SURVEY
SECOND SURVEY
Elevation Above MLW, ft
Distance, ft
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15 OCT 82
15 JAN 83
15 APR 83
*15 JUL 83
15 OCT 83
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15 APR 84
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15 JUN 86
*15 JUL 87
15 FEB 88
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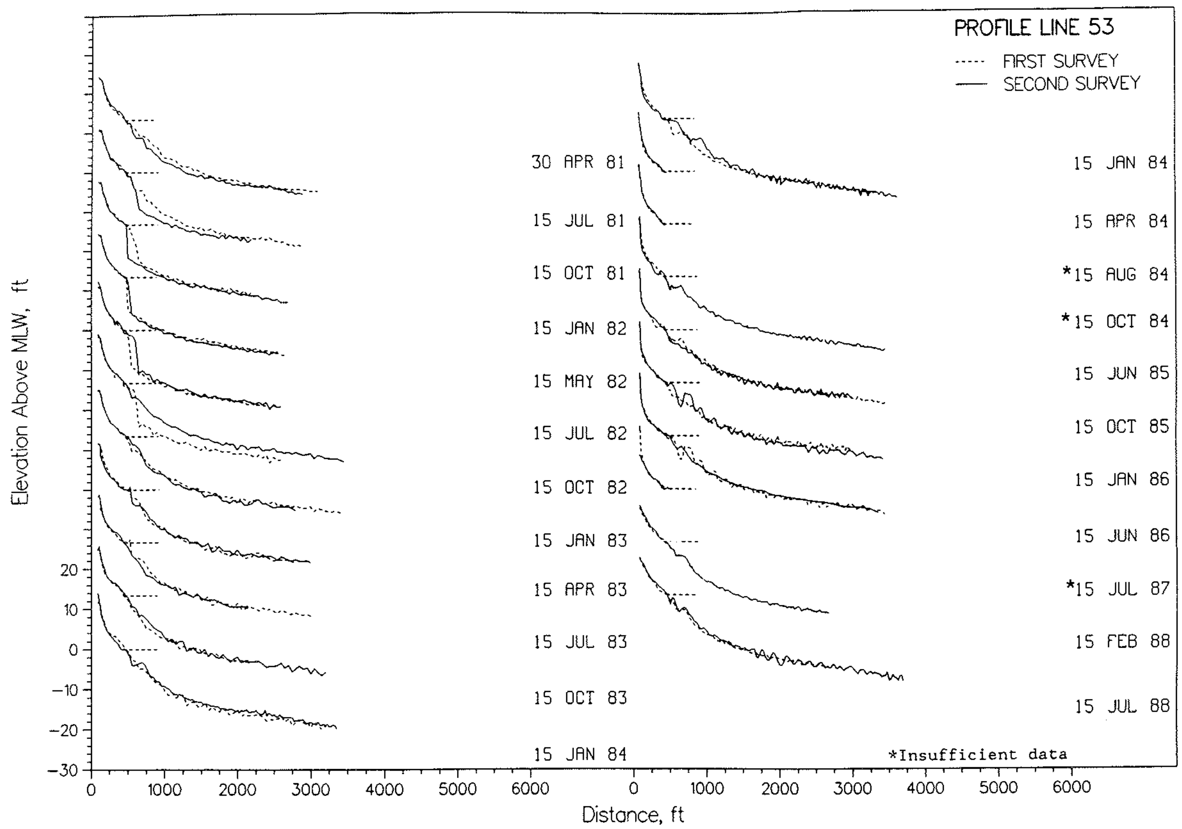
*Insufficient data


PROFILE LINE 53
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15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
15 OCT 85
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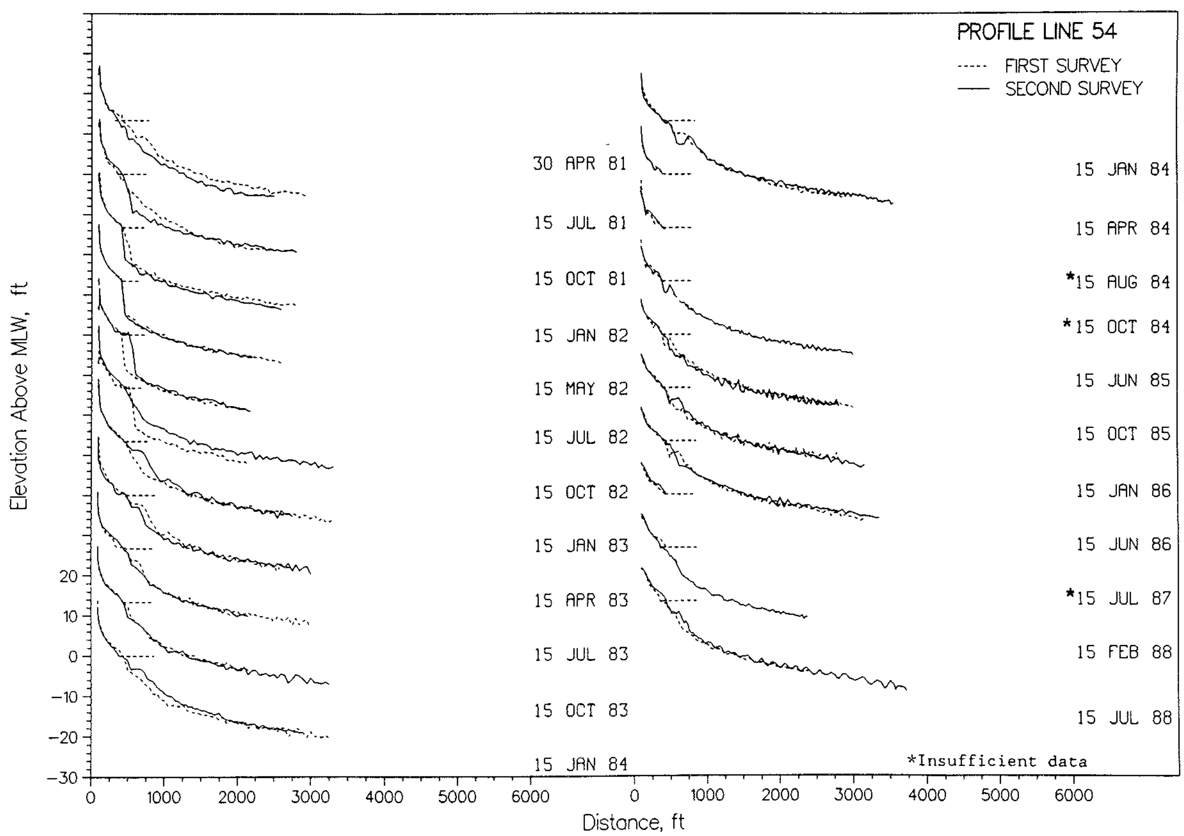
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 54
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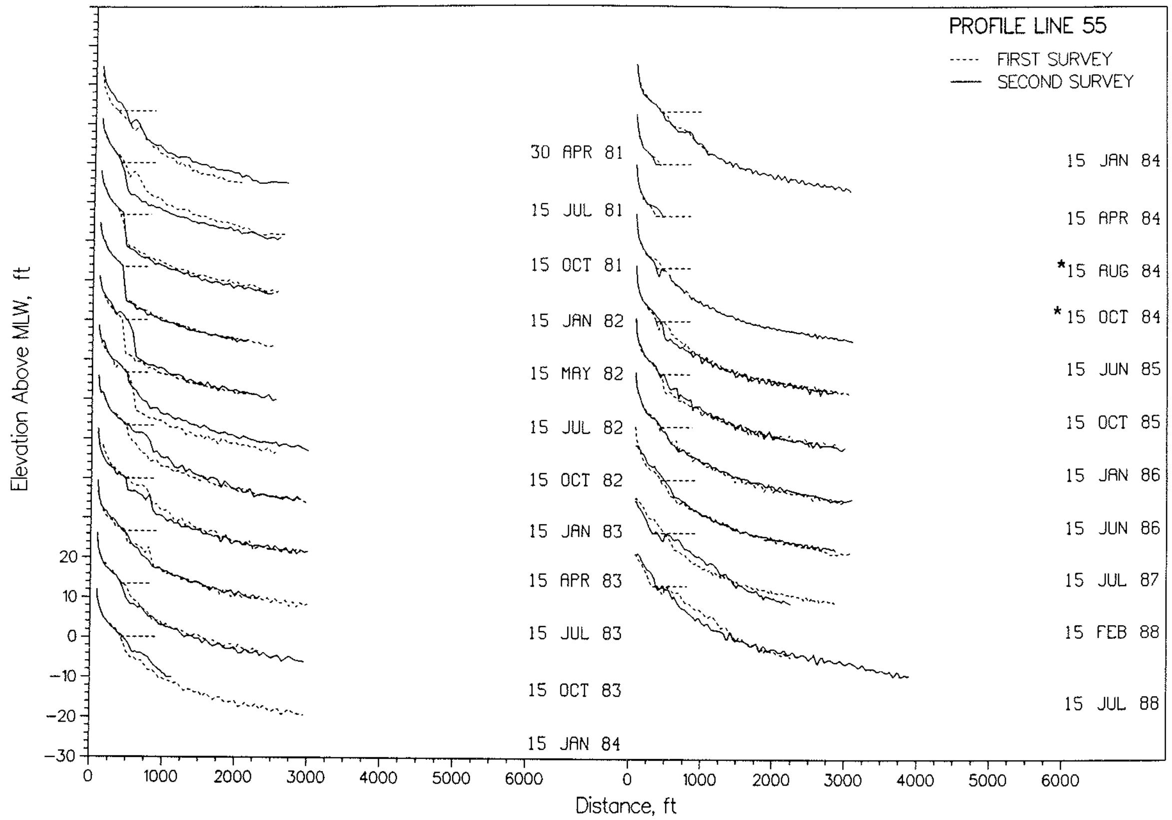
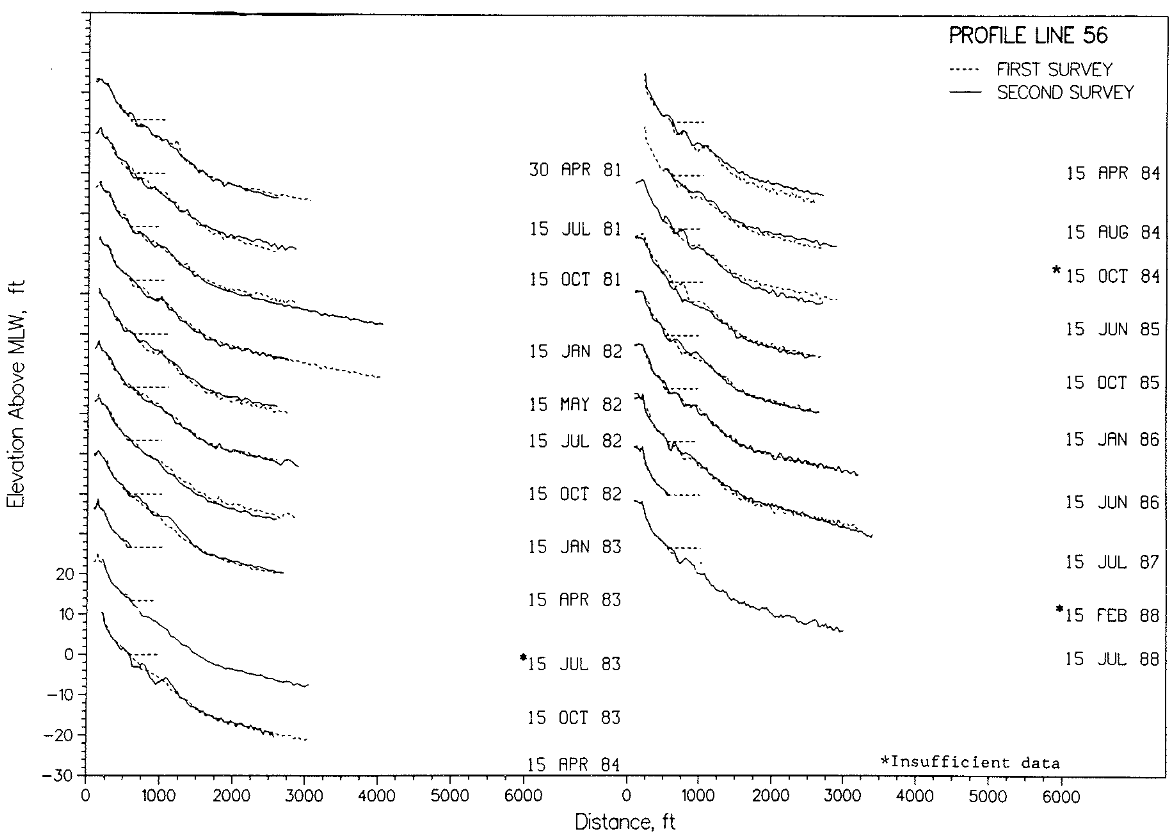
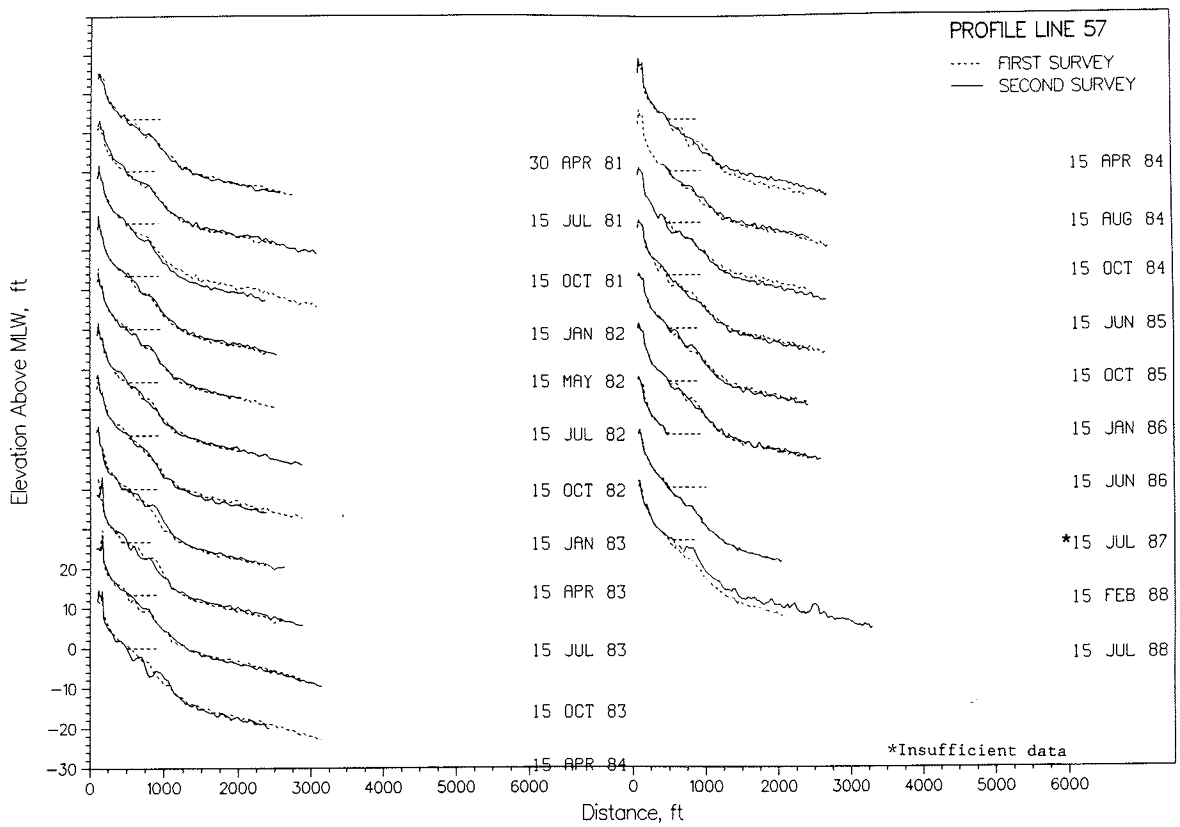
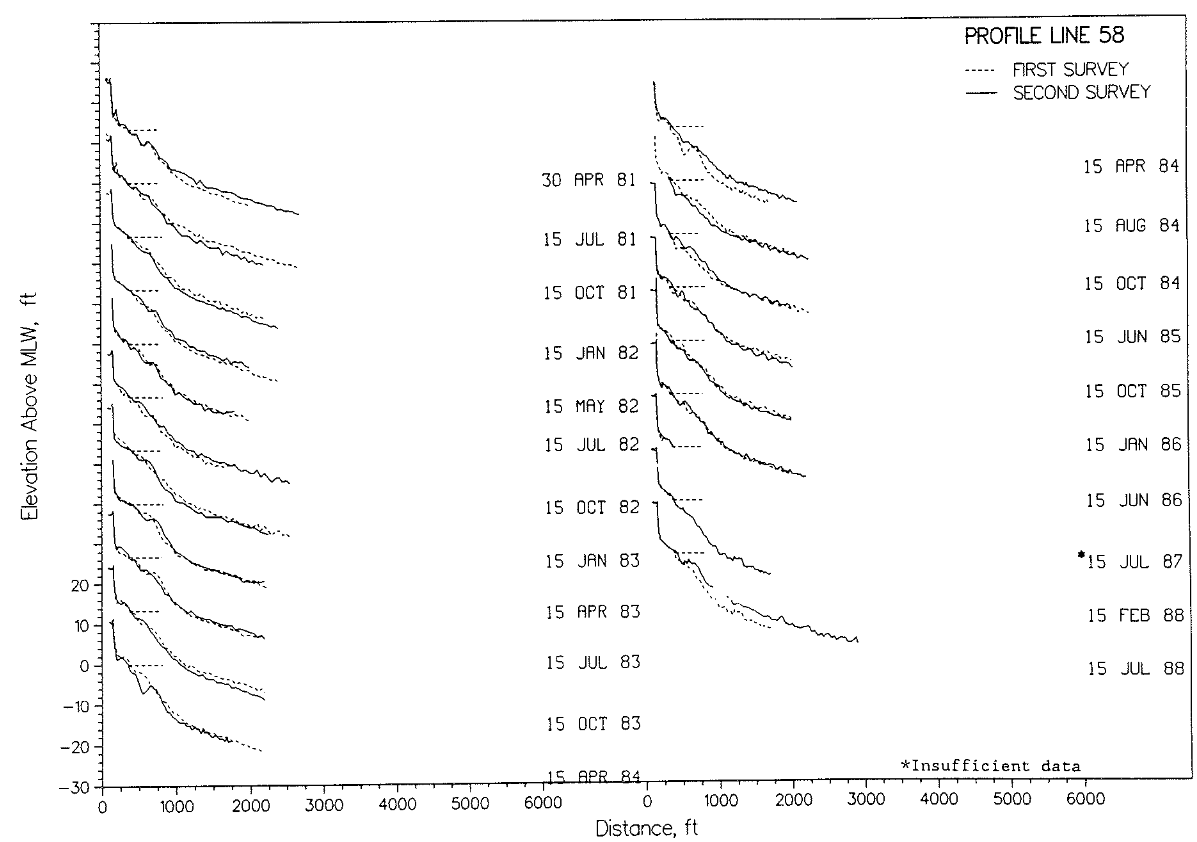
15 JAN 84
15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 55
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 JAN 84
15 JAN 84
15 APR 84
*15 AUG 84
*15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
15 FEB 88
15 JUL 88
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 56
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
*15 JUL 83
15 OCT 83
15 APR 84
15 APR 84
15 AUG 84
*15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
15 JUL 87
*15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 57
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 APR 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft


PROFILE LINE 58
FIRST SURVEY
SECOND SURVEY
30 APR 81
15 JUL 81
15 OCT 81
15 JAN 82
15 MAY 82
15 JUL 82
15 OCT 82
15 JAN 83
15 APR 83
15 JUL 83
15 OCT 83
15 APR 84
15 APR 84
15 AUG 84
15 OCT 84
15 JUN 85
15 OCT 85
15 JAN 86
15 JUN 86
*15 JUL 87
15 FEB 88
15 JUL 88
*Insufficient data
Elevation Above MLW, ft
Distance, ft

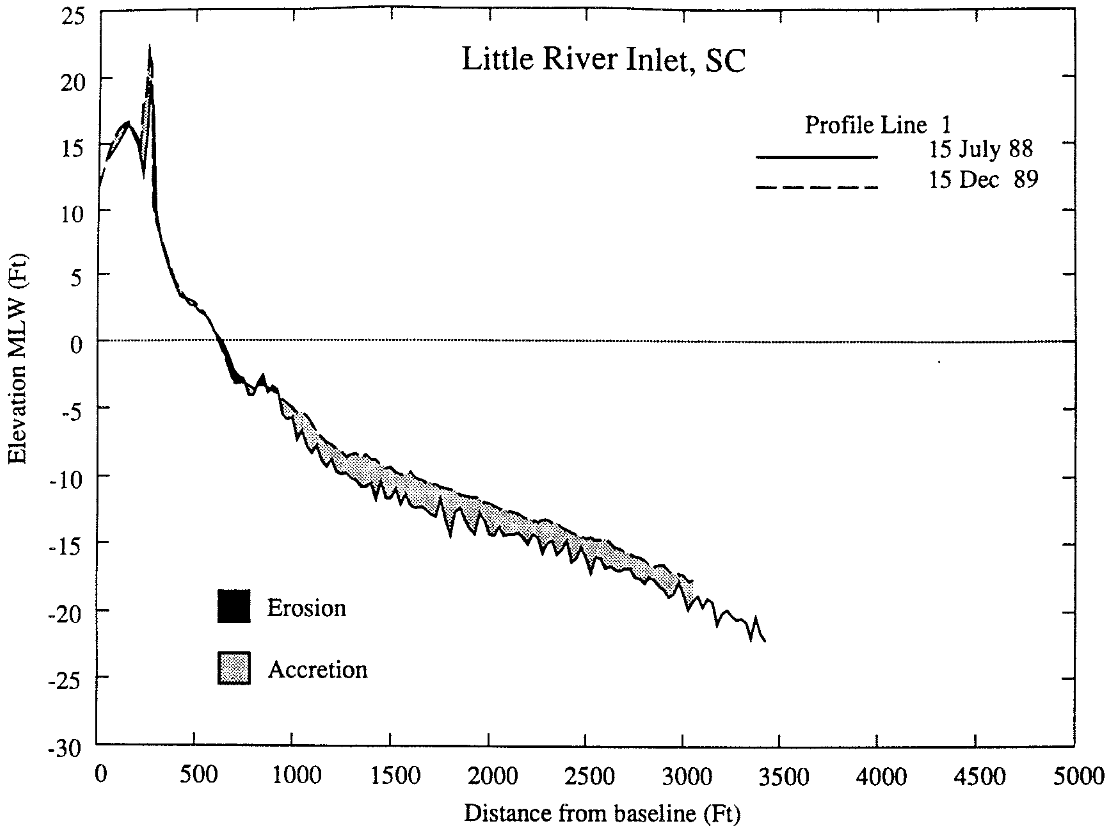
APPENDIX B:

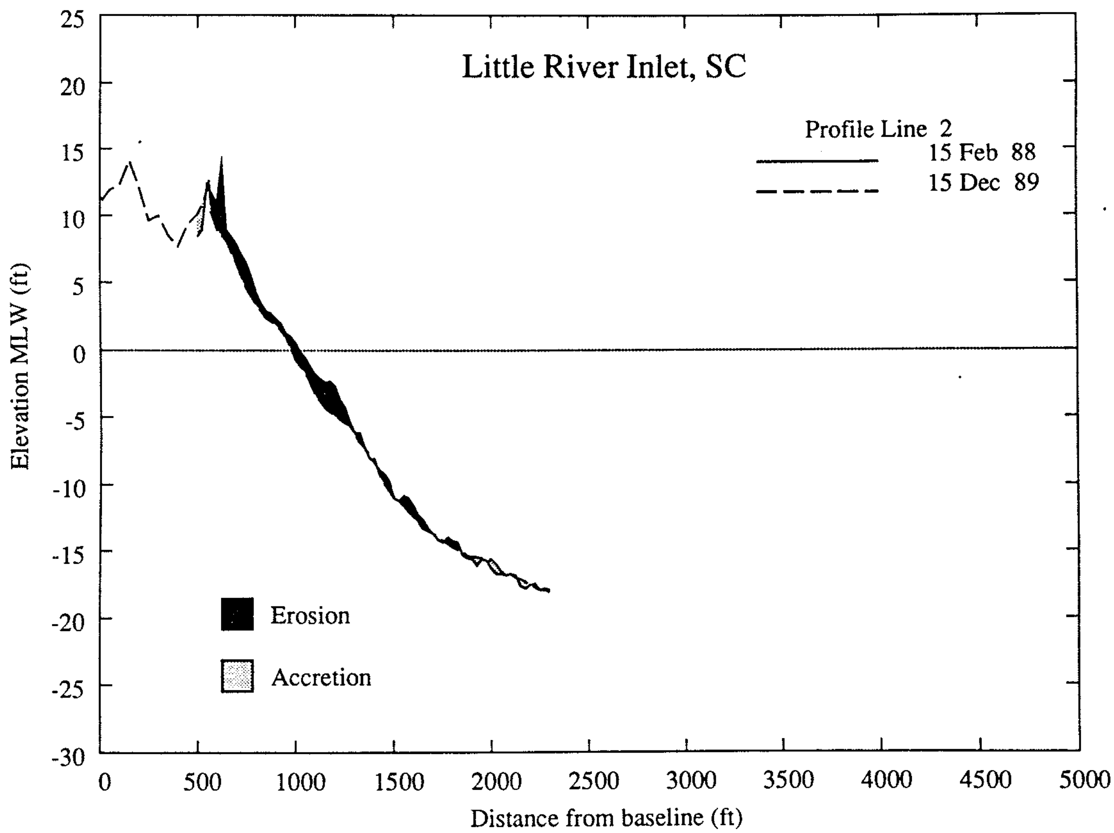
POST-HUGO BEACH PROFILES

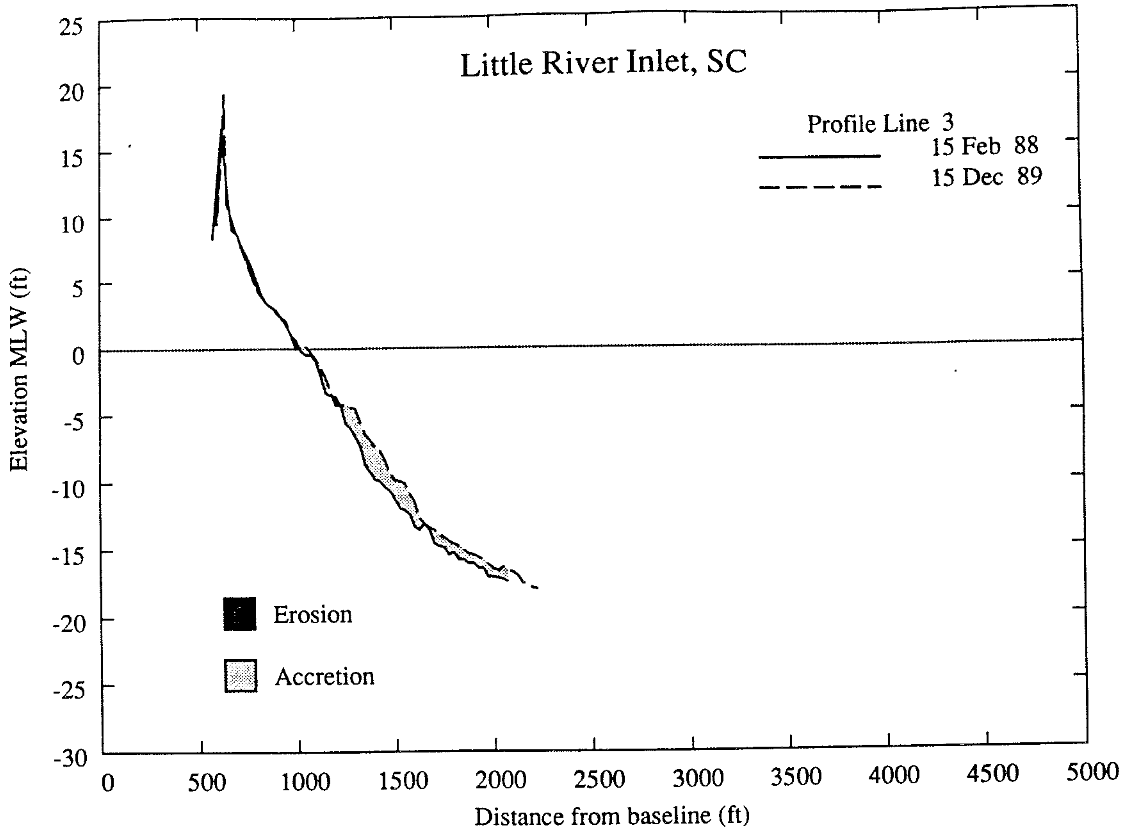
APPENDIX B: POST-HUGO BEACH PROFILES

1. The post-Hugo survey data (December 1989) was plotted separately since the survey data was collected after an extreme event, as opposed to a representative survey of beach response to the jetties.

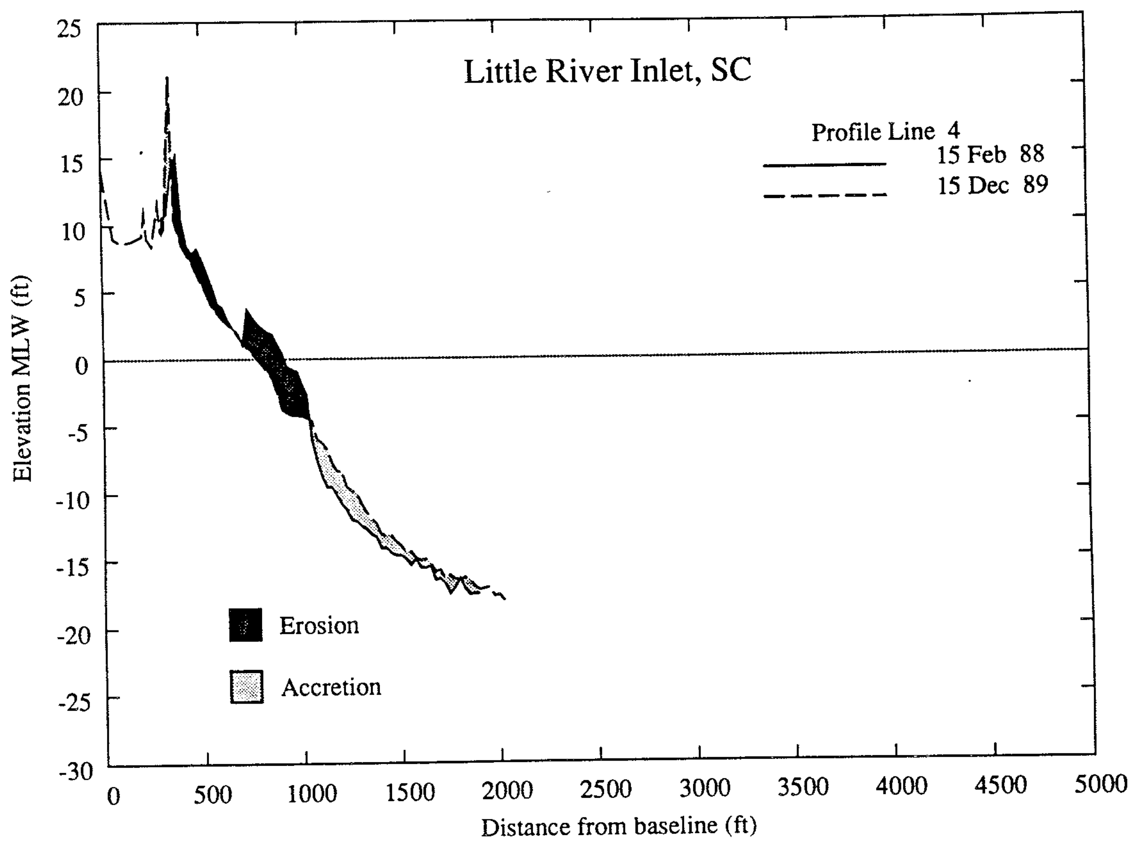
2. Similar to the data in Appendix A, the post-Hugo profile data was entered into the Interactive Survey Reduction Program. After correction of suspected erroneous points, the data was plotted using a Turbo-Pascal program. Comparison plots were made using the February 1988 survey; except for ISRP Profile Lines 1, 8, 9, 25-28, 45, and 56 which were compared with the July 1988 survey (due to insufficient data in the February 1988 surveys). Profile Line 46 was dropped because of questionable data on the post-Hugo survey.


Little River Inlet, SC
Profile Line 1
15 July 88
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)

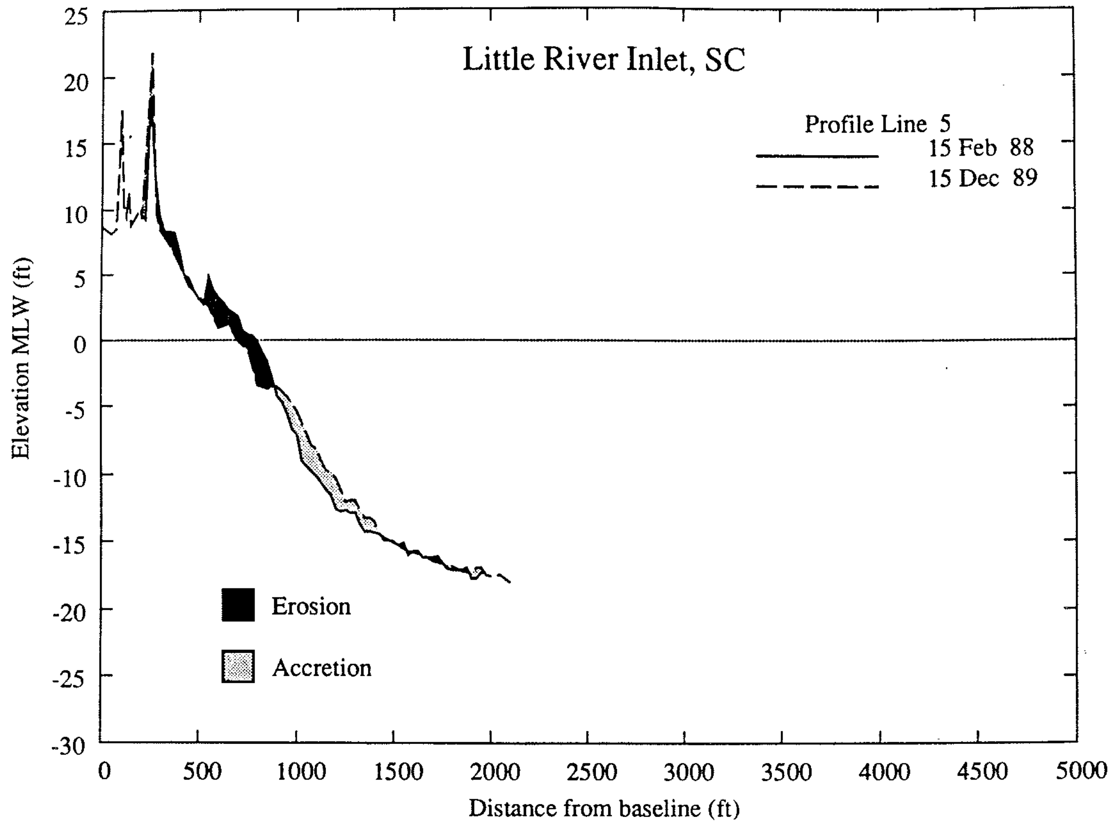

Little River Inlet, SC
Profile Line 2
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)

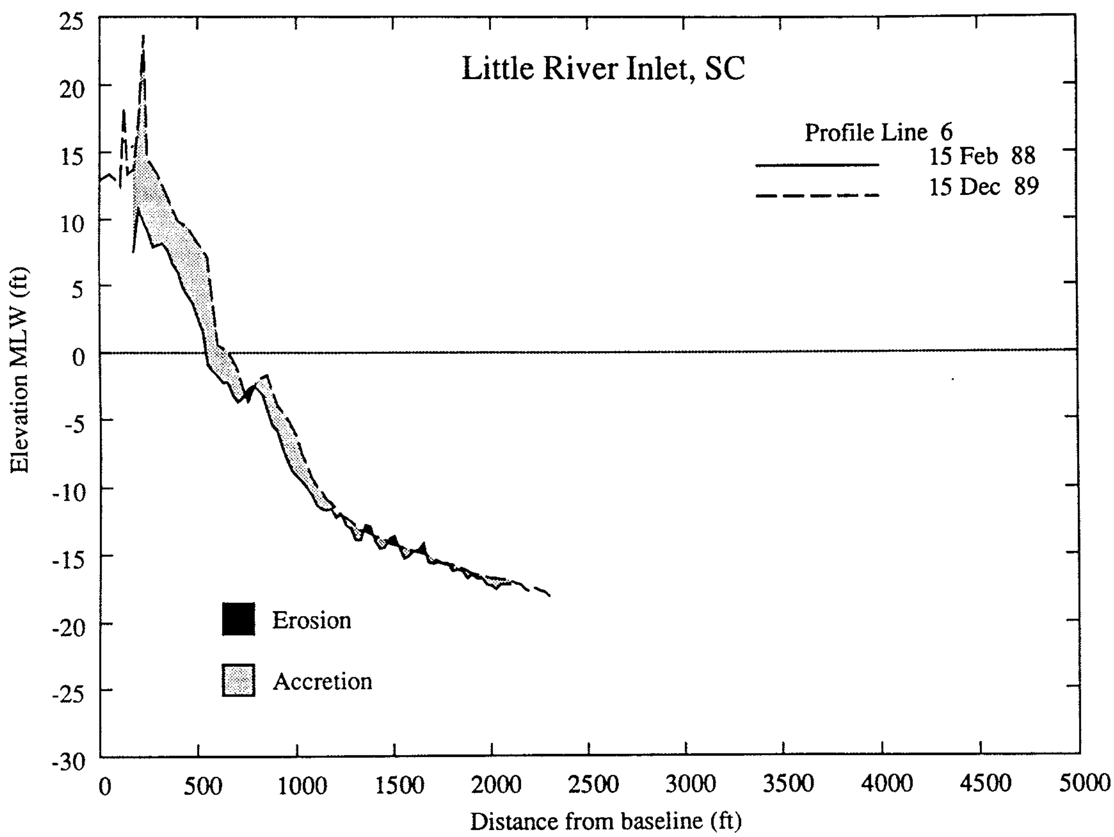


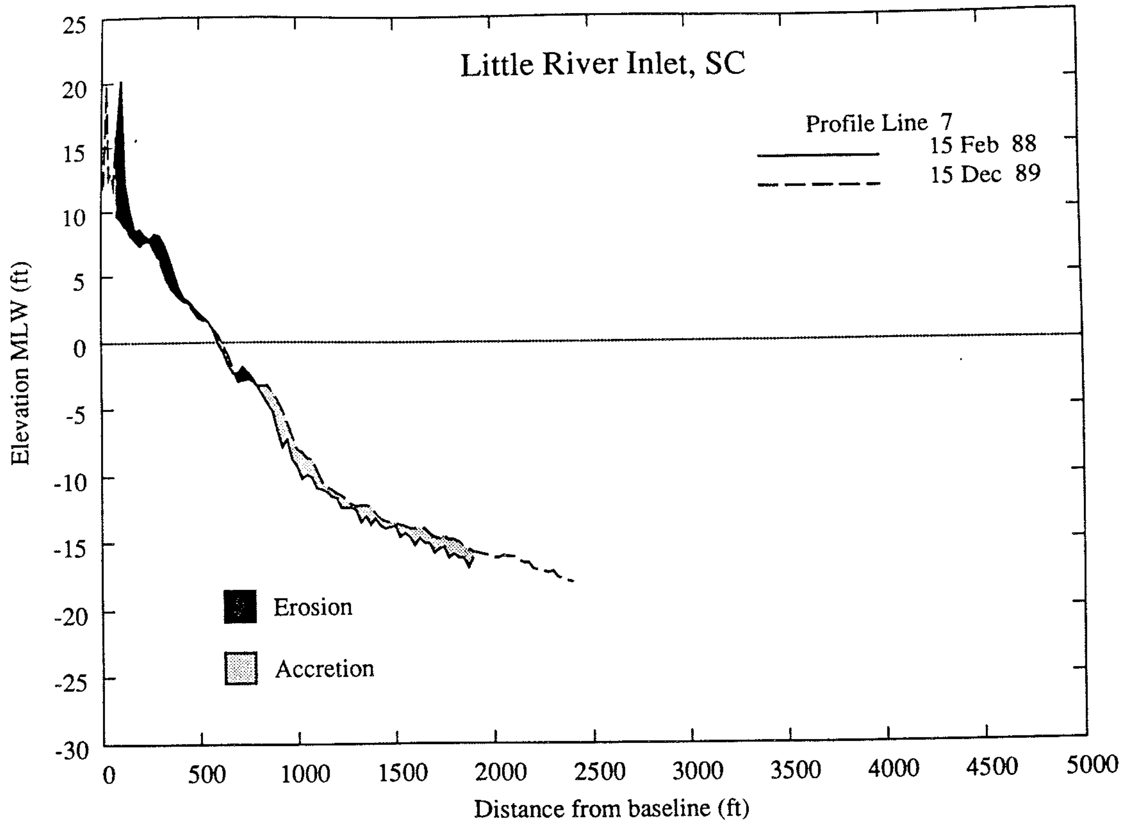
Little River Inlet, SC
Profile Line 3
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

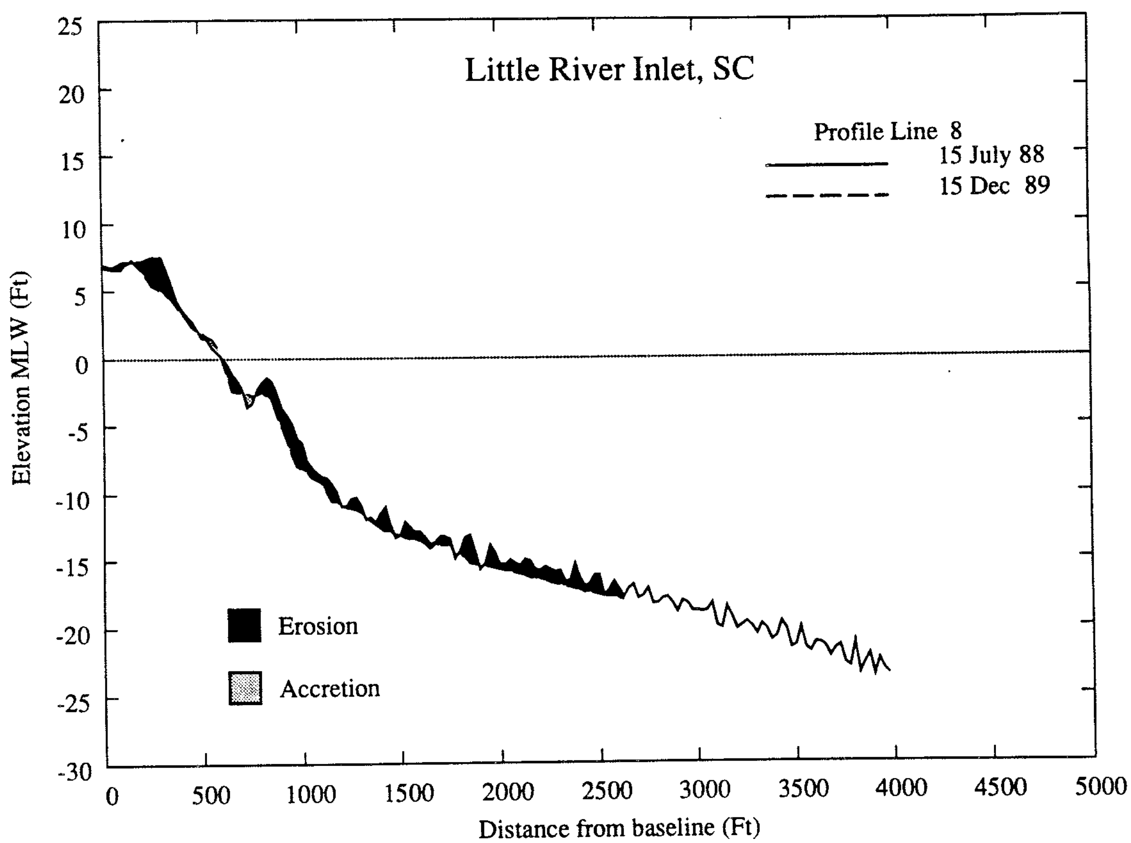


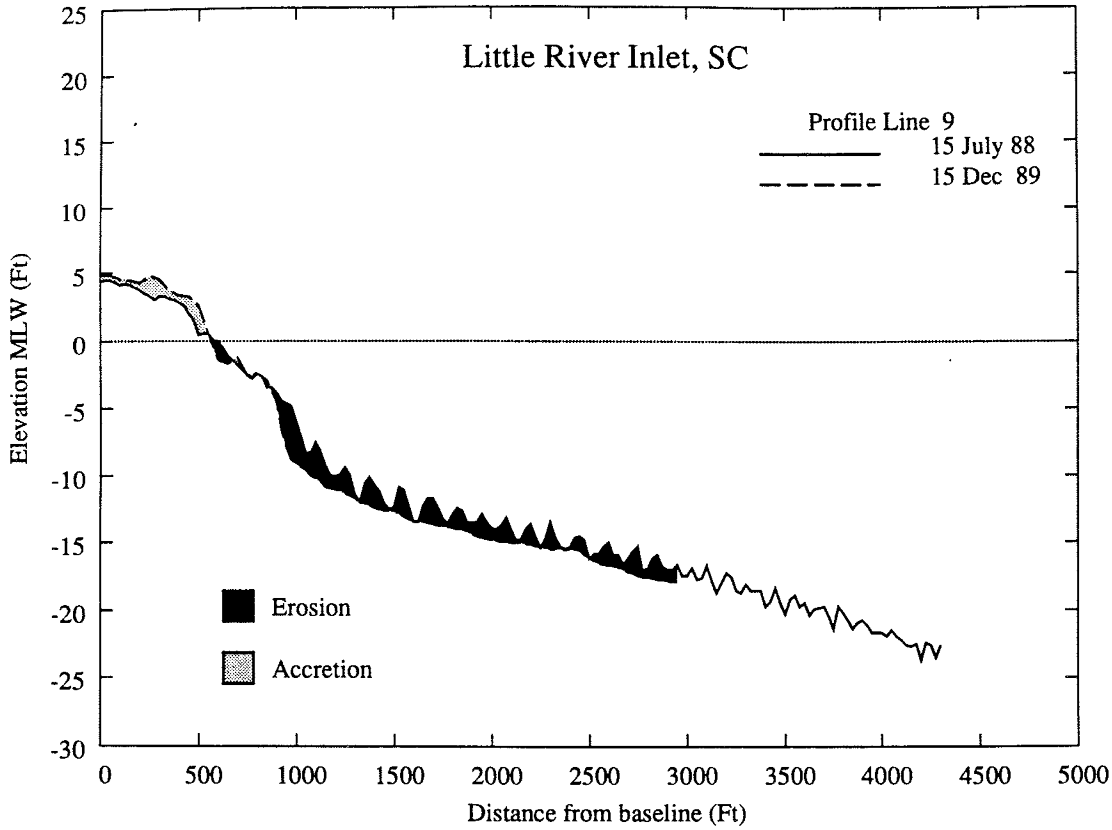
Little River Inlet, SC
Profile Line 4
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

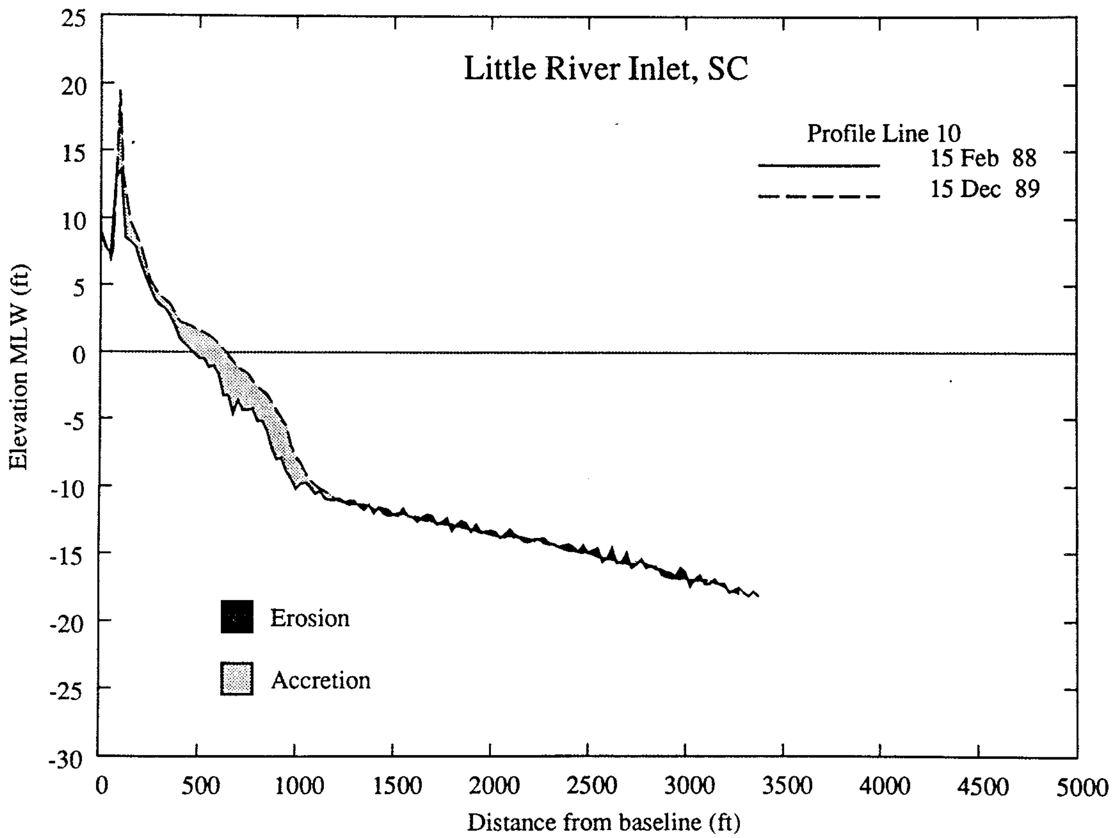

Little River Inlet, SC
Profile Line 5
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

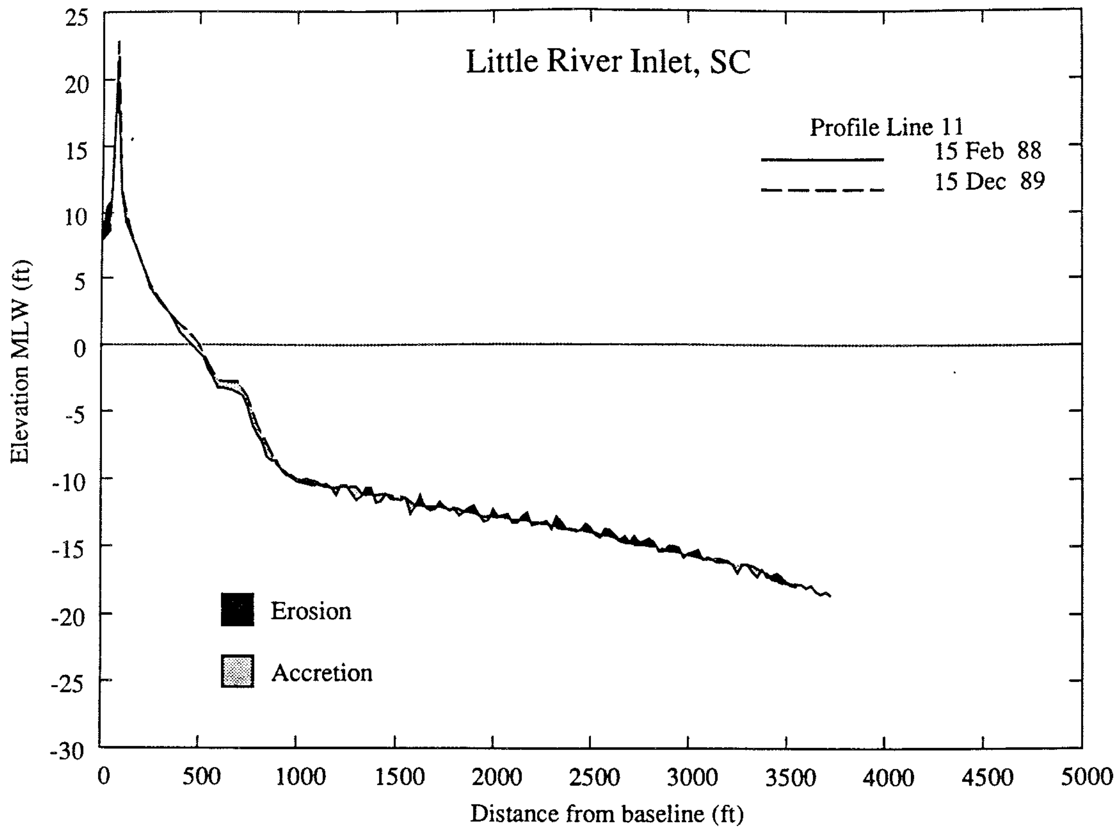

Little River Inlet, SC
Profile Line 6
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

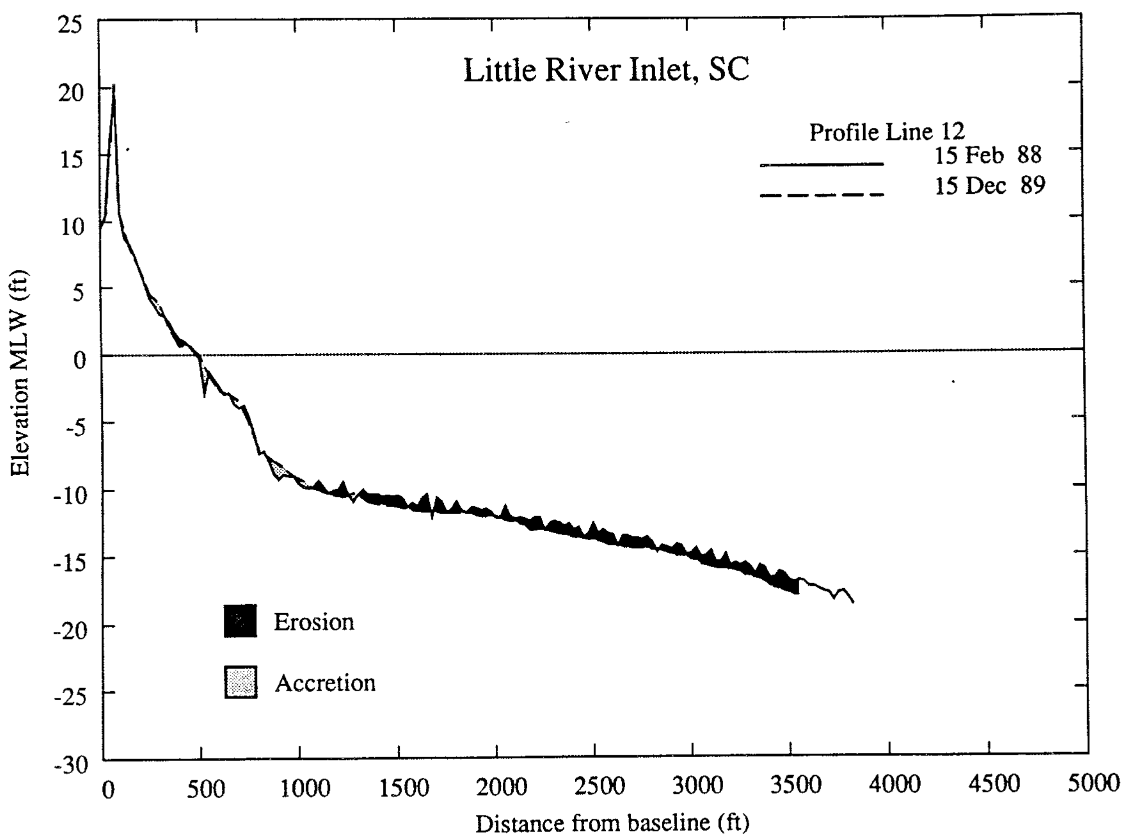

Little River Inlet, SC
Profile Line 7
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

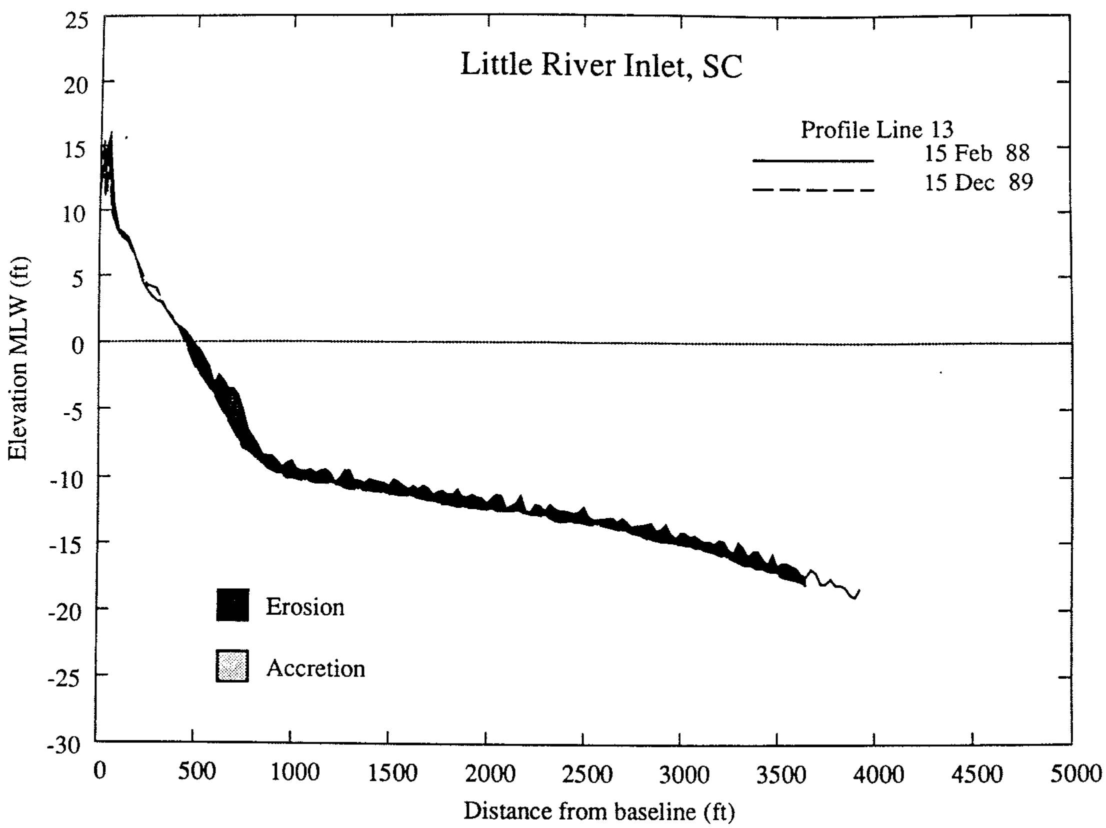

Little River Inlet, SC
Profile Line 8
15 July 88
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

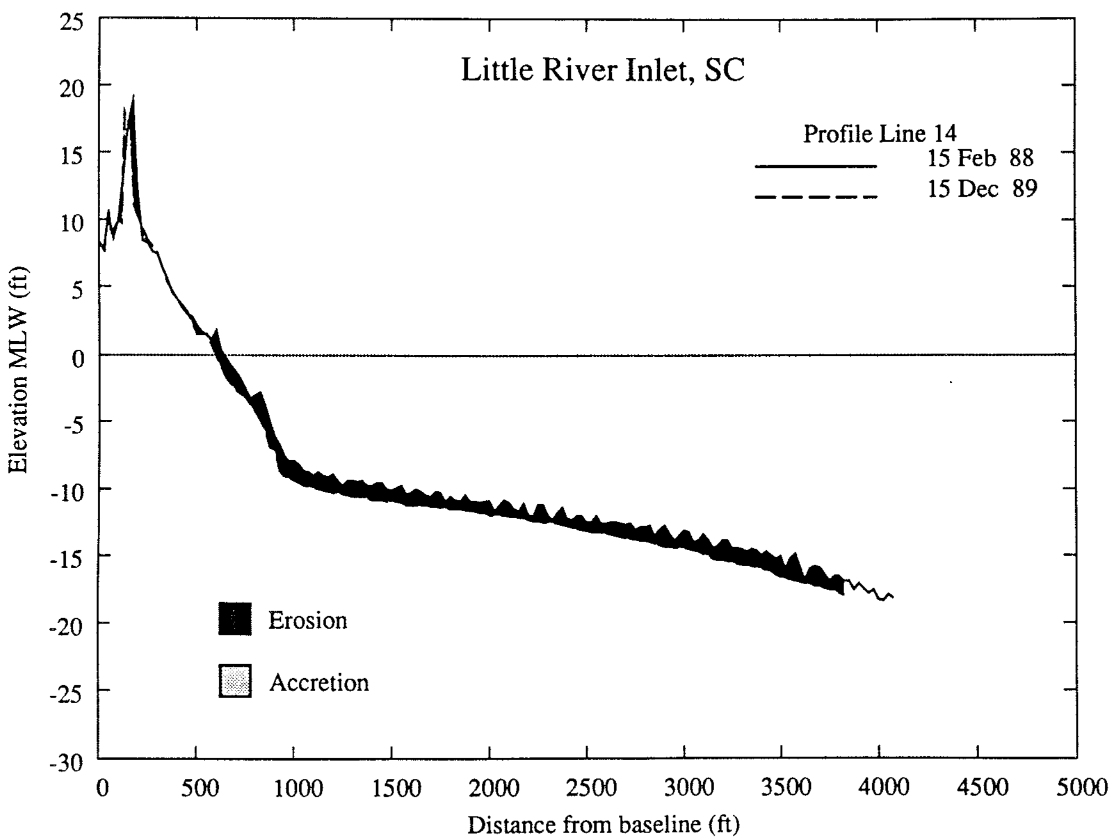

Little River Inlet, SC
Profile Line 9
15 July 88
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

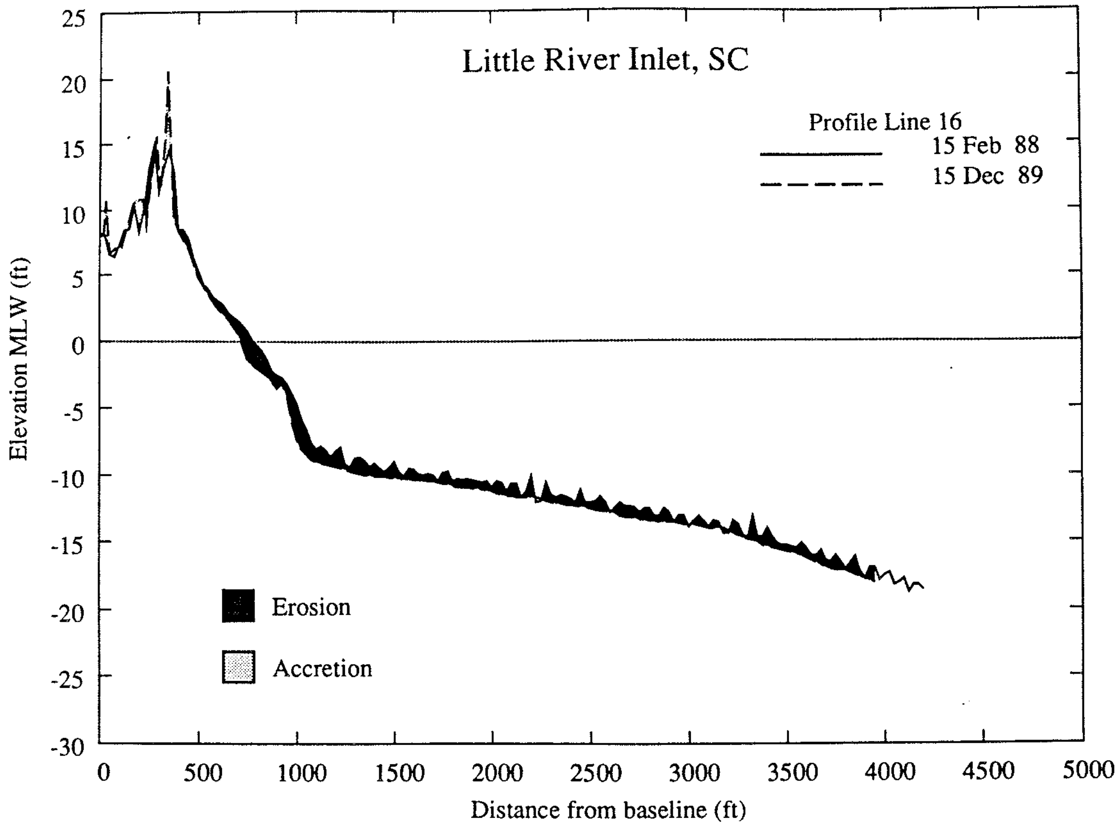

Little River Inlet, SC
Profile Line 10
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

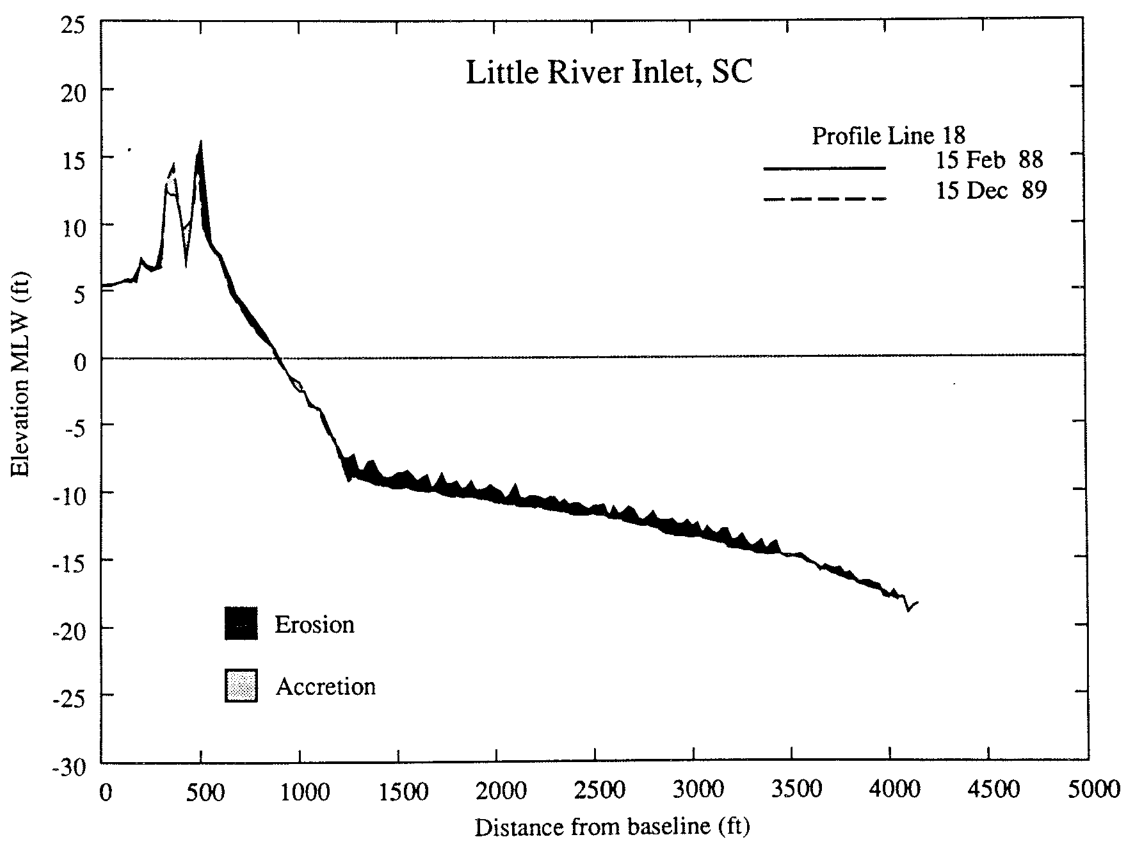

Little River Inlet, SC
Profile Line 11
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

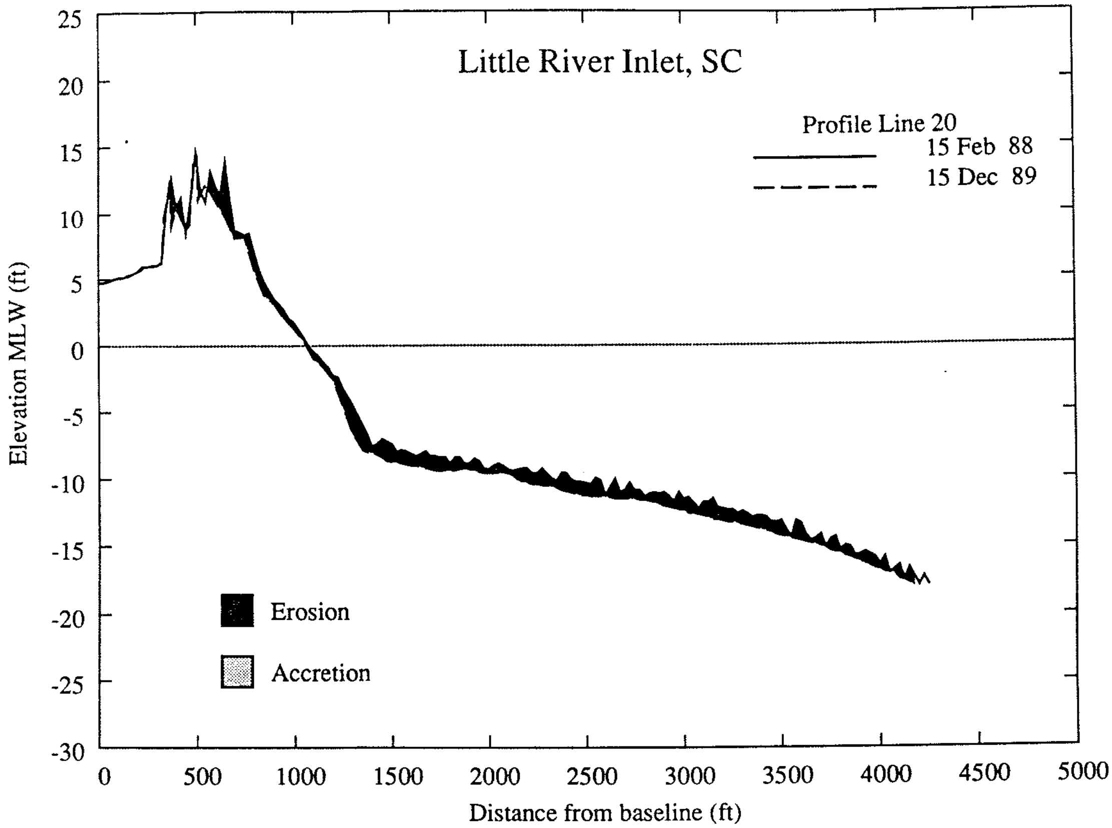

Little River Inlet, SC
Profile Line 12
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

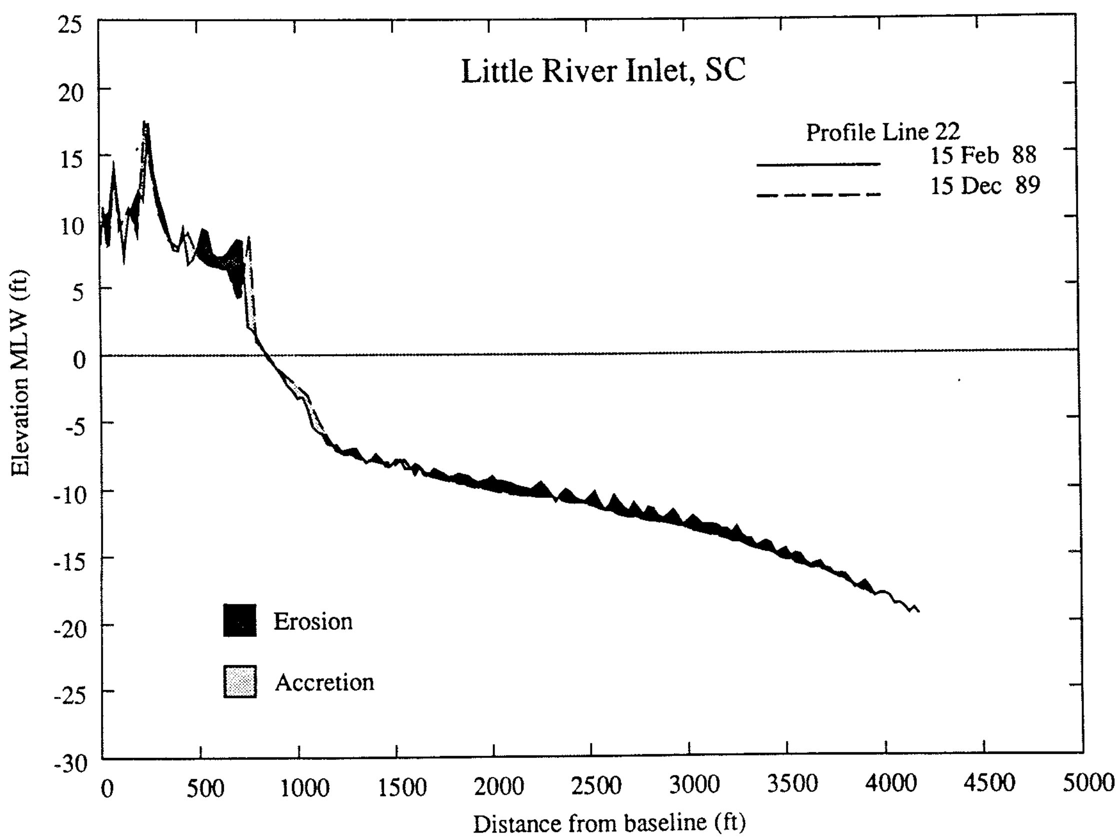

Little River Inlet, SC
Profile Line 13
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)

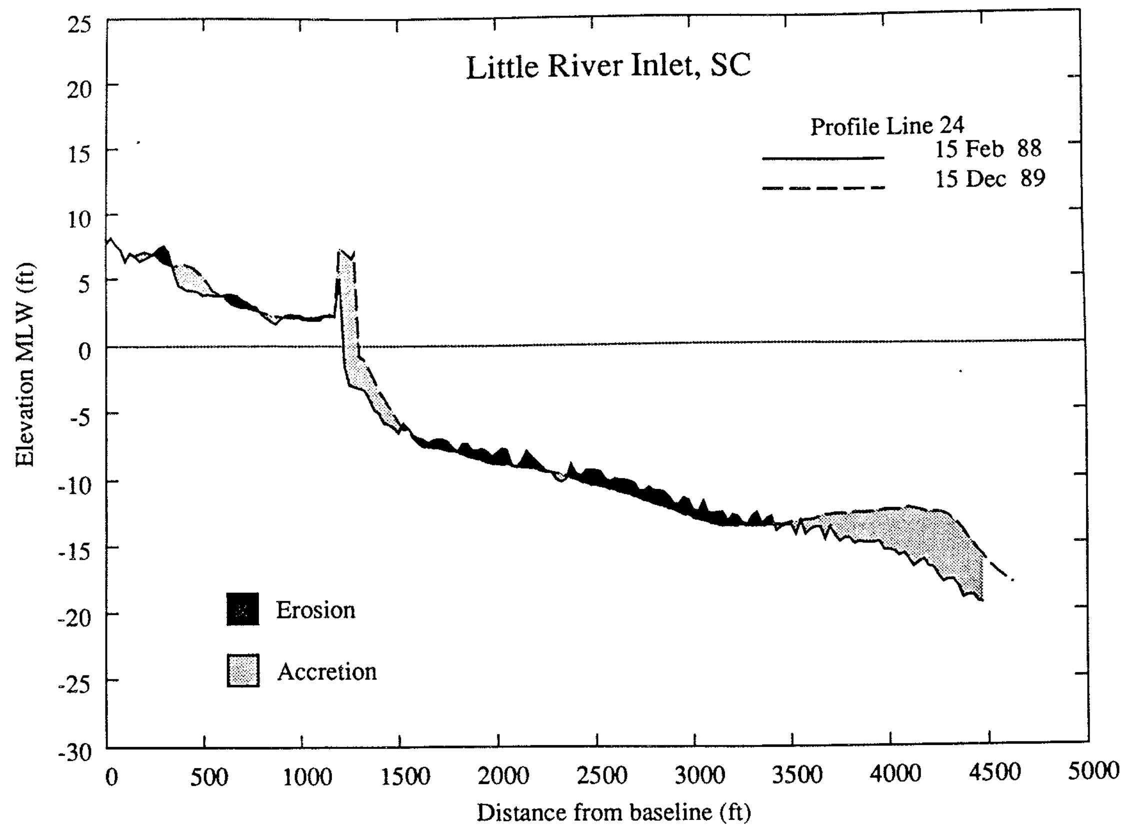

Little River Inlet, SC
Profile Line 14
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)


Little River Inlet, SC
Profile Line 16
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 18
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 20
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Distance from baseline (ft)


Little River Inlet, SC
Profile Line 22
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Distance from baseline (ft)


Little River Inlet, SC
Profile Line 24
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
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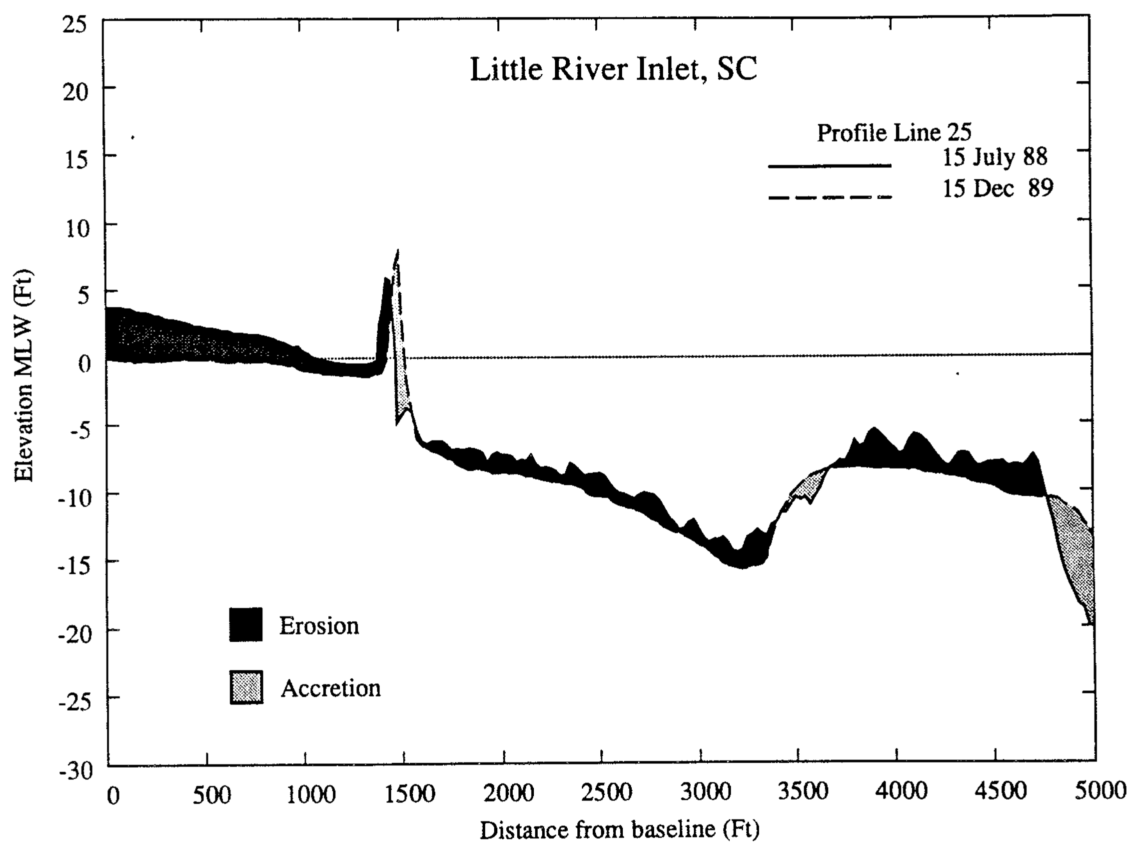
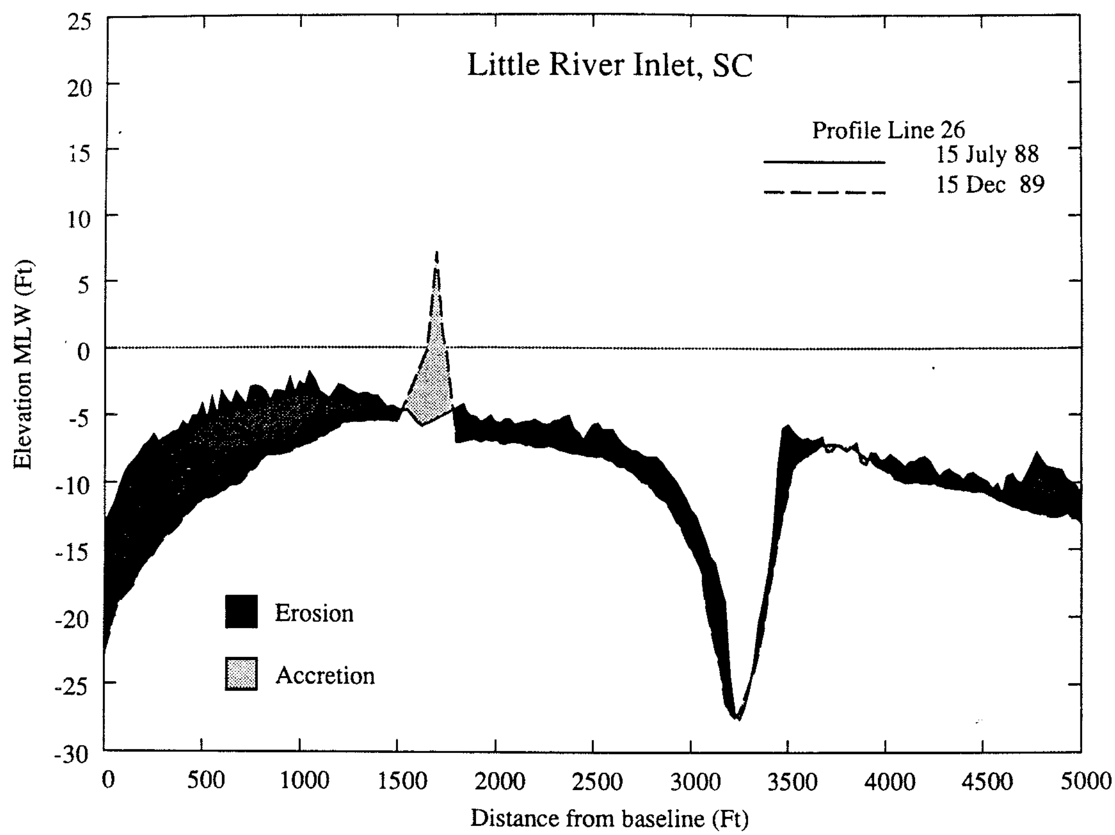
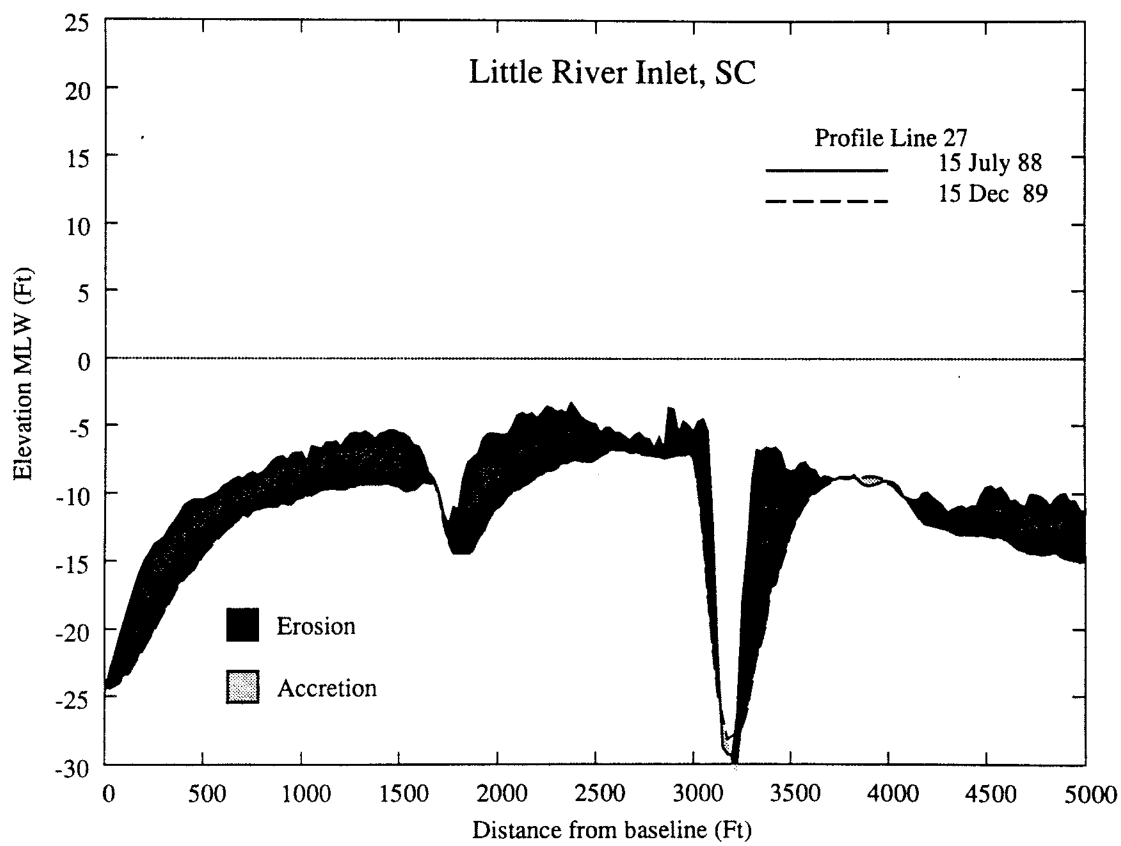
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

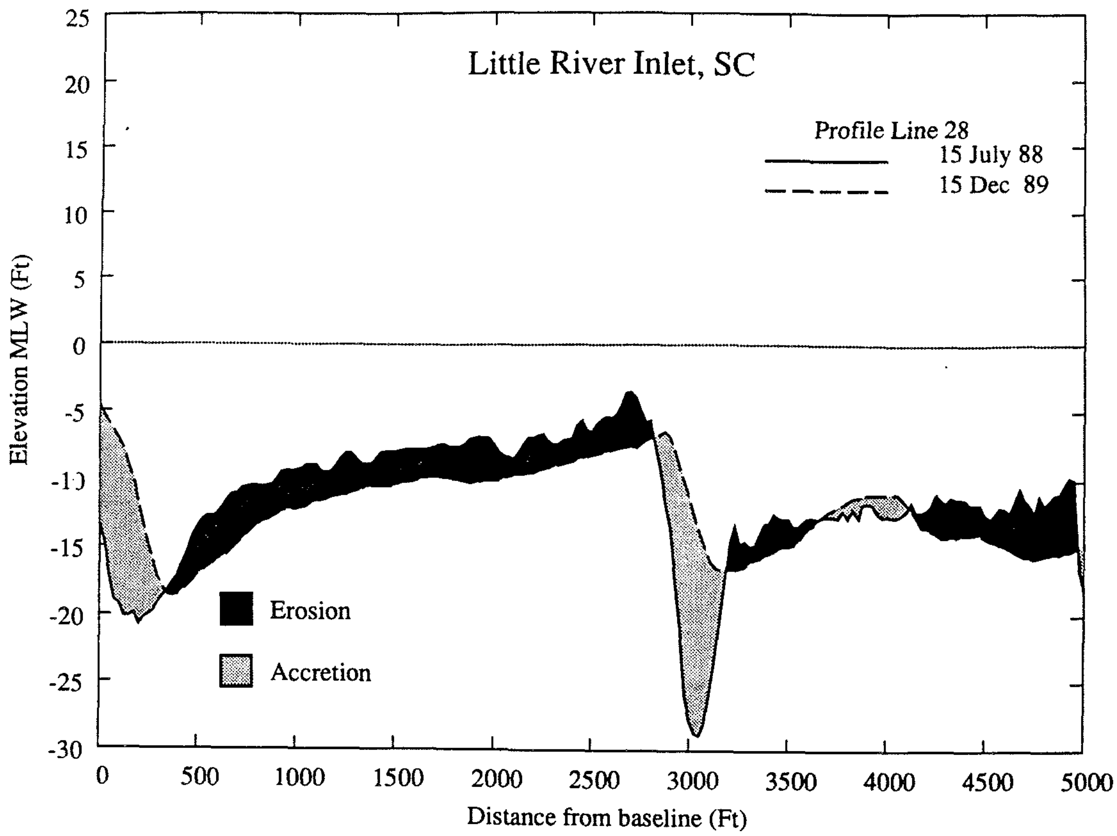

Little River Inlet, SC
Profile Line 25
15 July 88
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

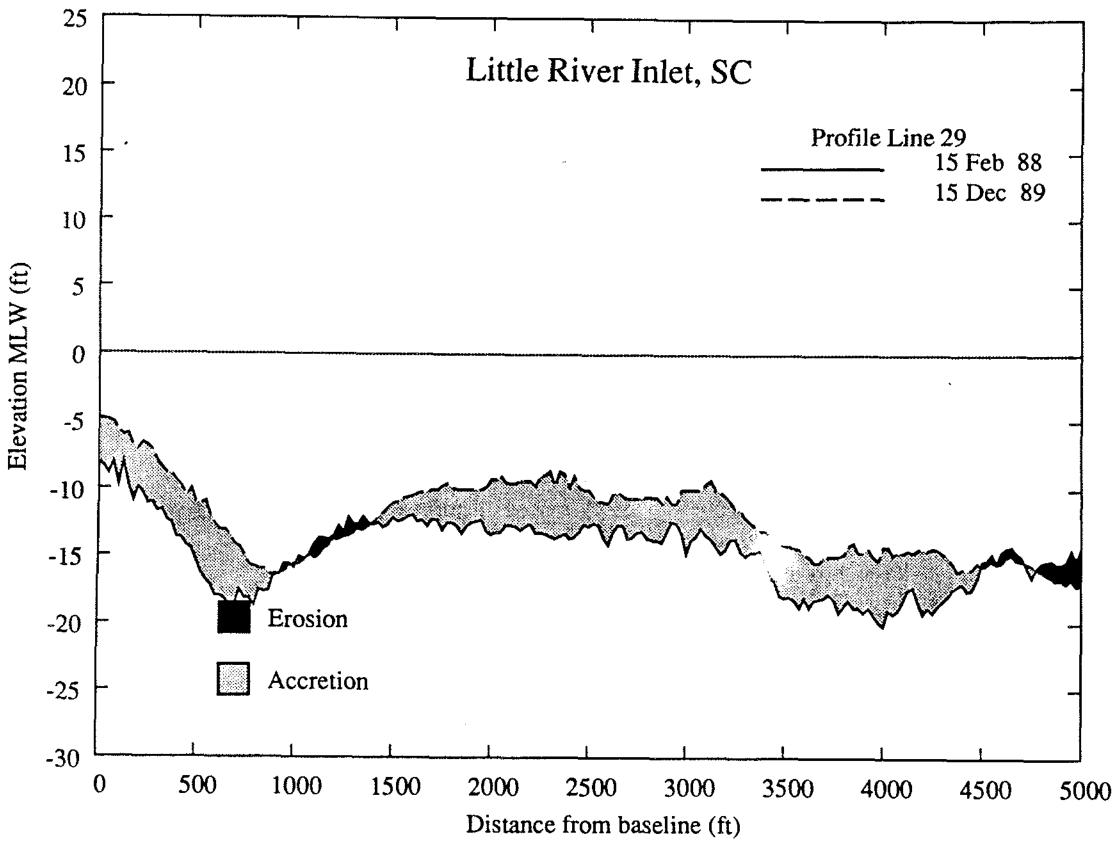


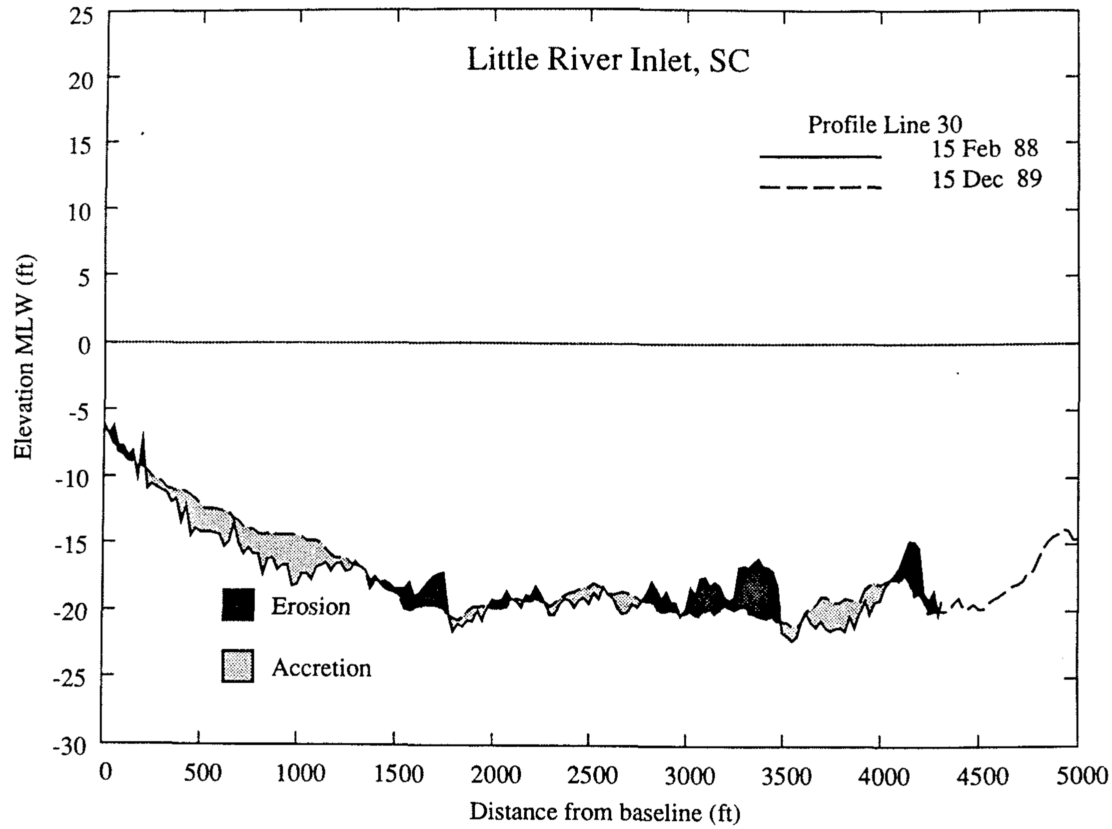
Little River Inlet, SC
Profile Line 26
15 July 88
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)



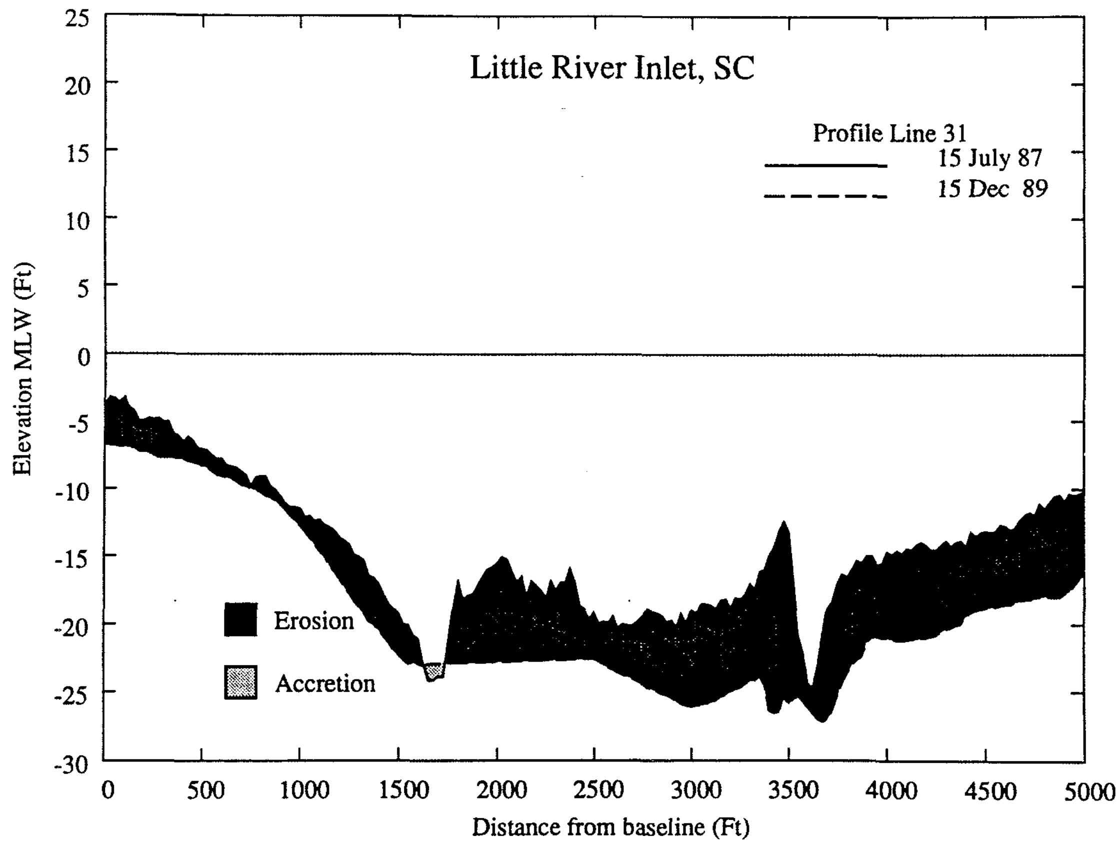
Little River Inlet, SC
Profile Line 27
15 July 88
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)


Little River Inlet, SC
Profile Line 28
15 July 88
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

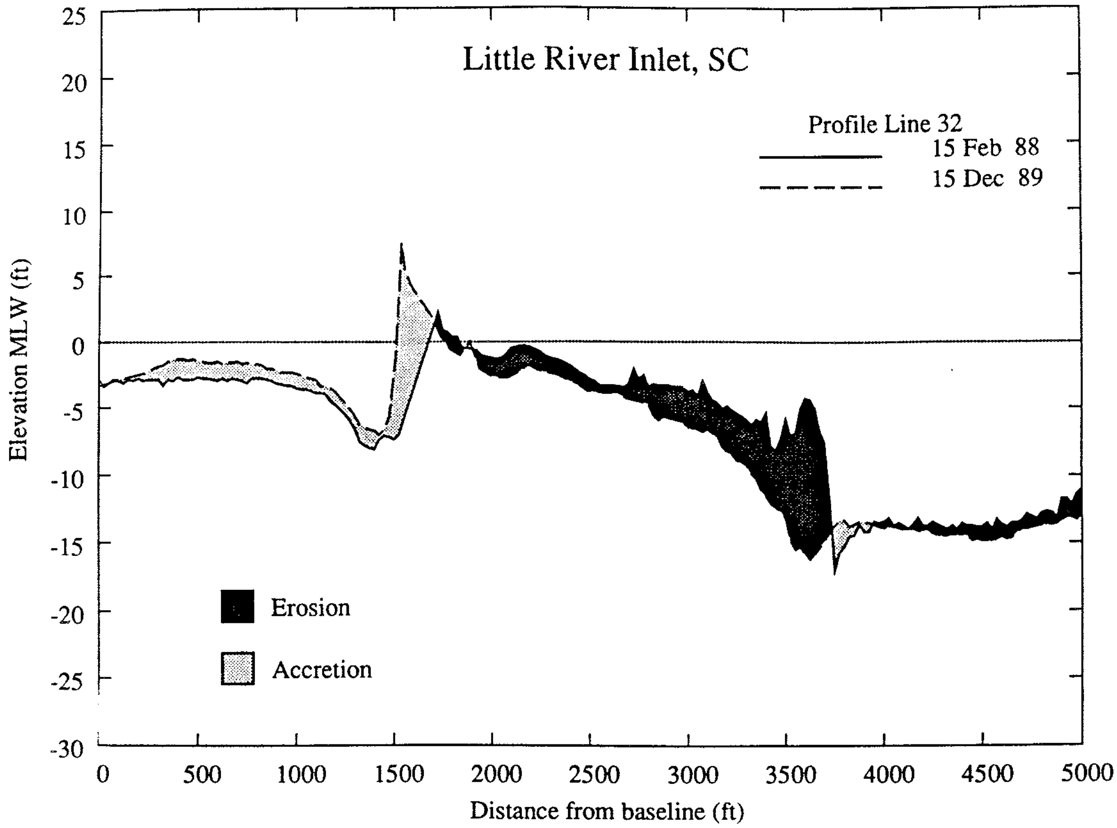

Little River Inlet, SC
Profile Line 29
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

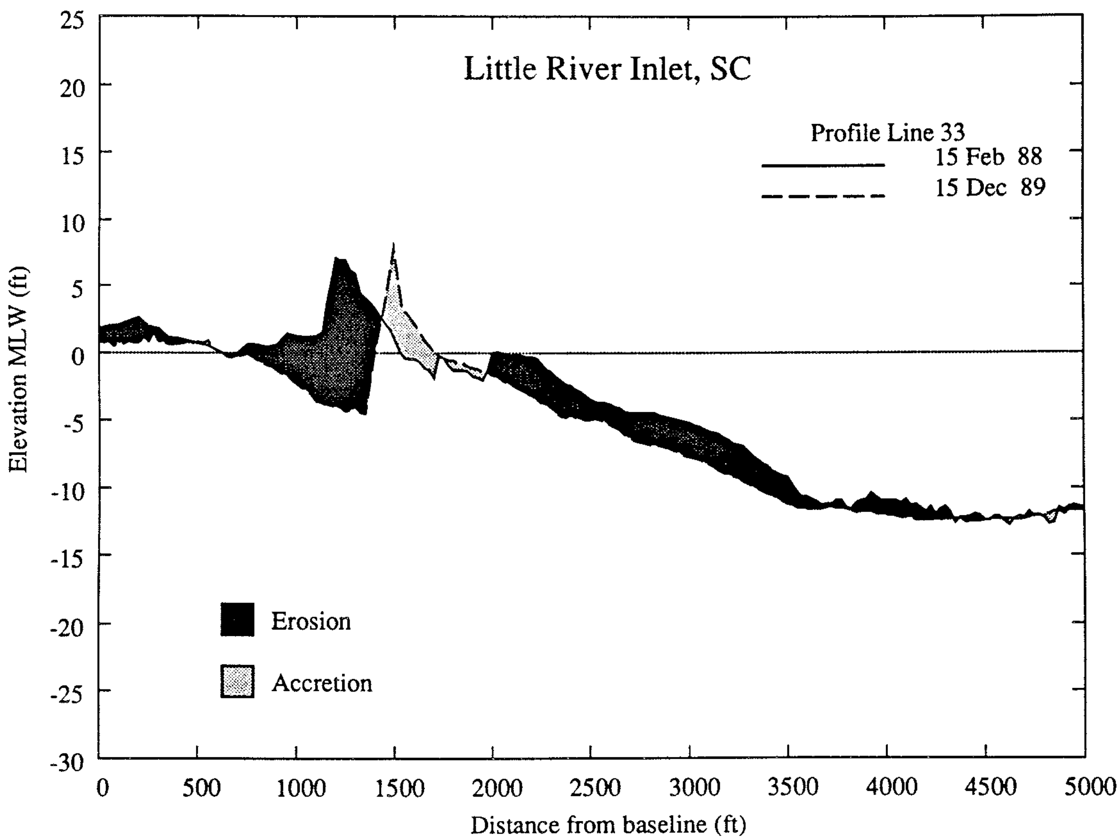


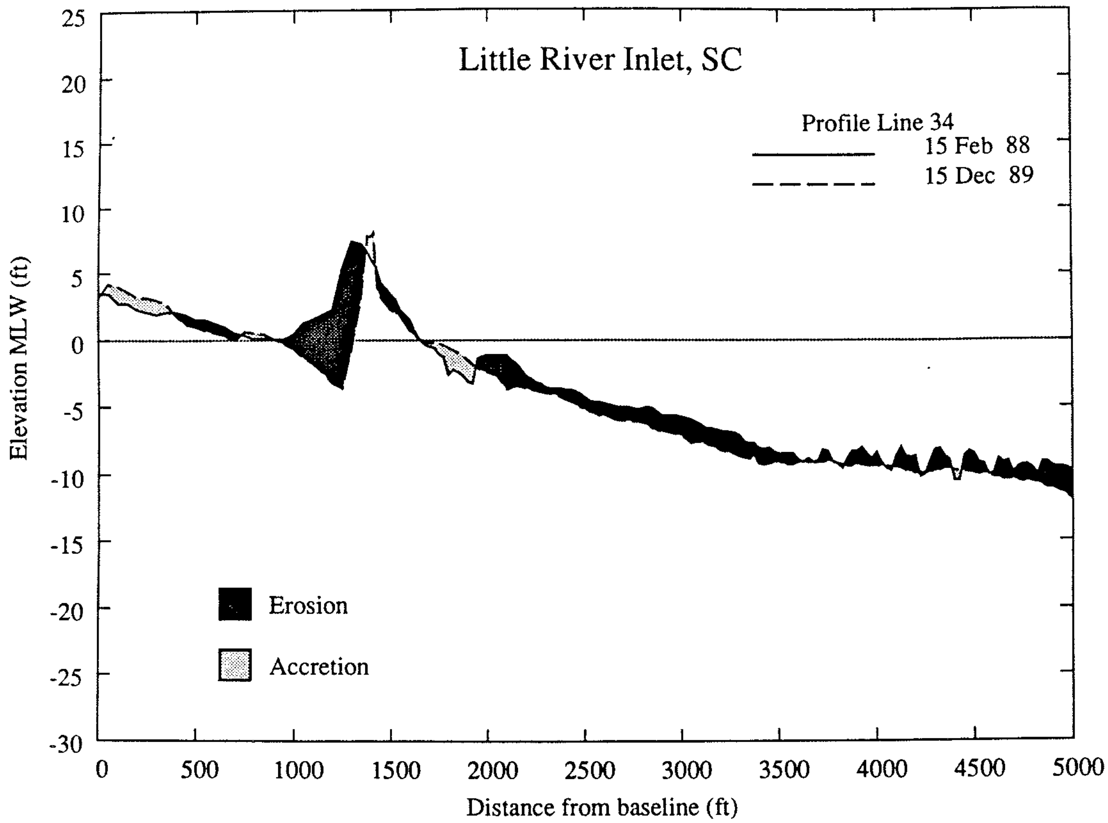
Little River Inlet, SC
Profile Line 30
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)

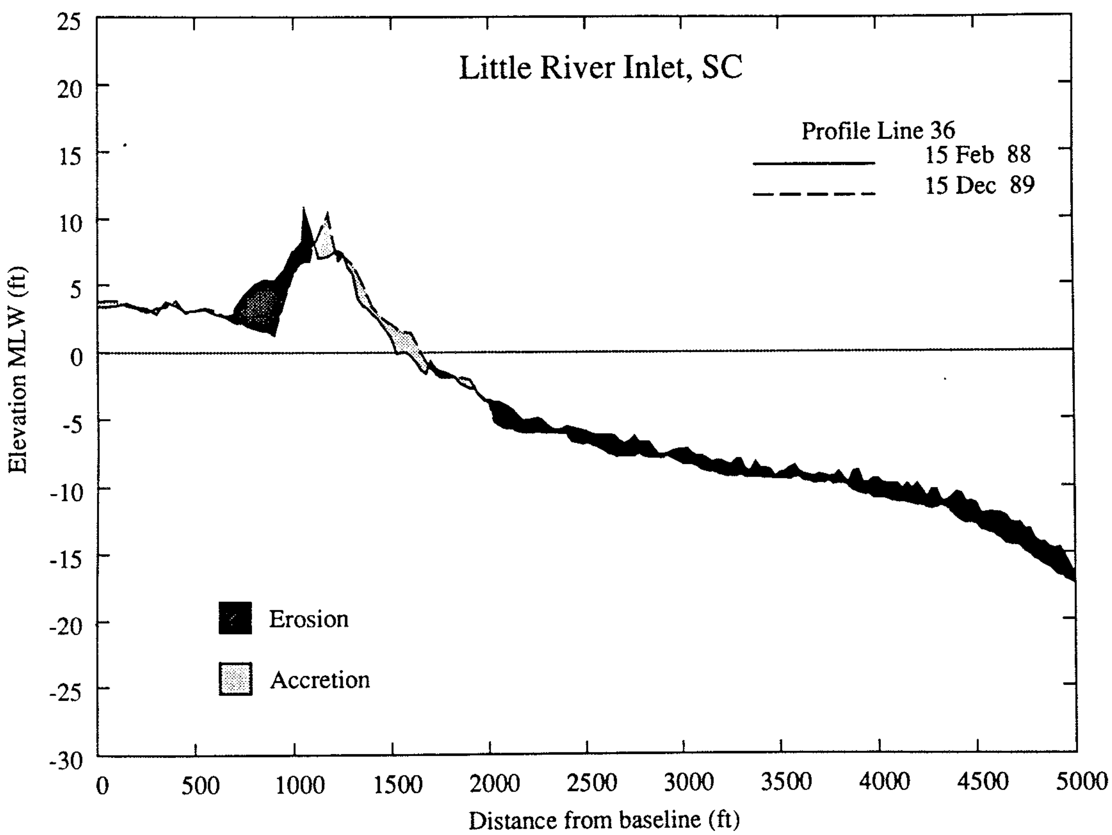


Little River Inlet, SC
Profile Line 31
15 July 87
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)


Little River Inlet, SC
Profile Line 32
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 33
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 34
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 36
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
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-5
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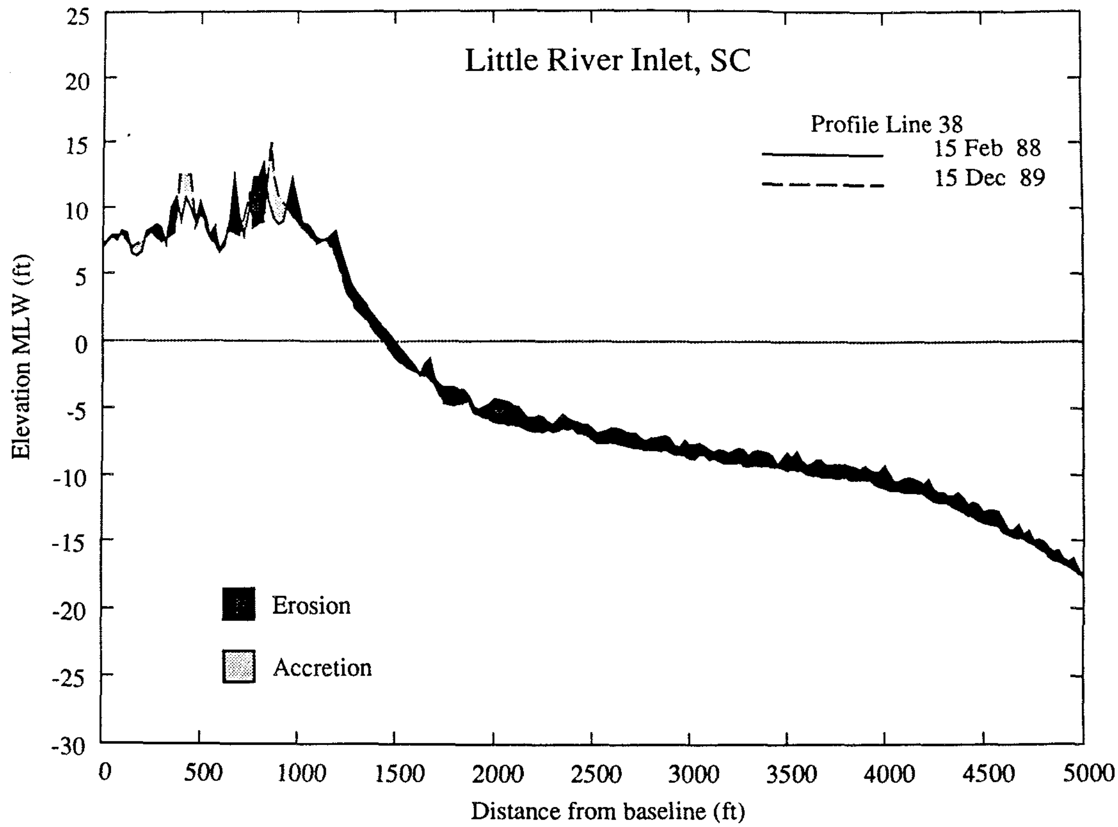
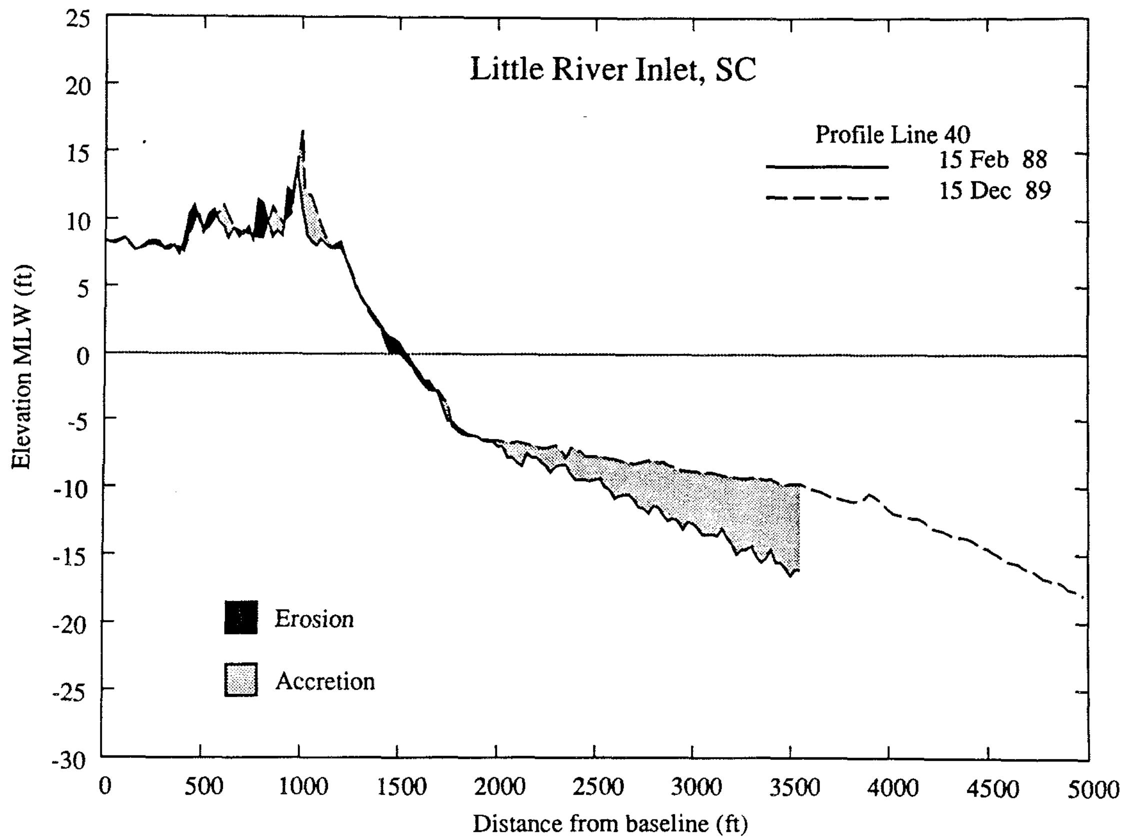
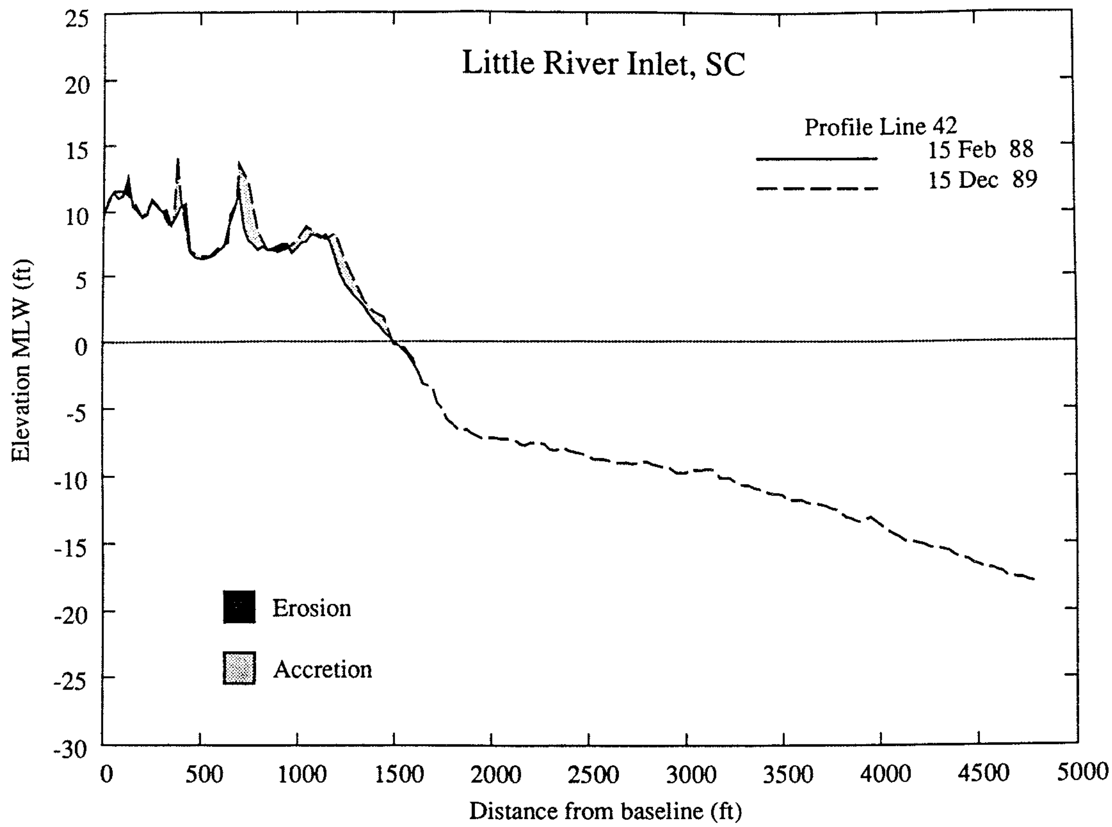
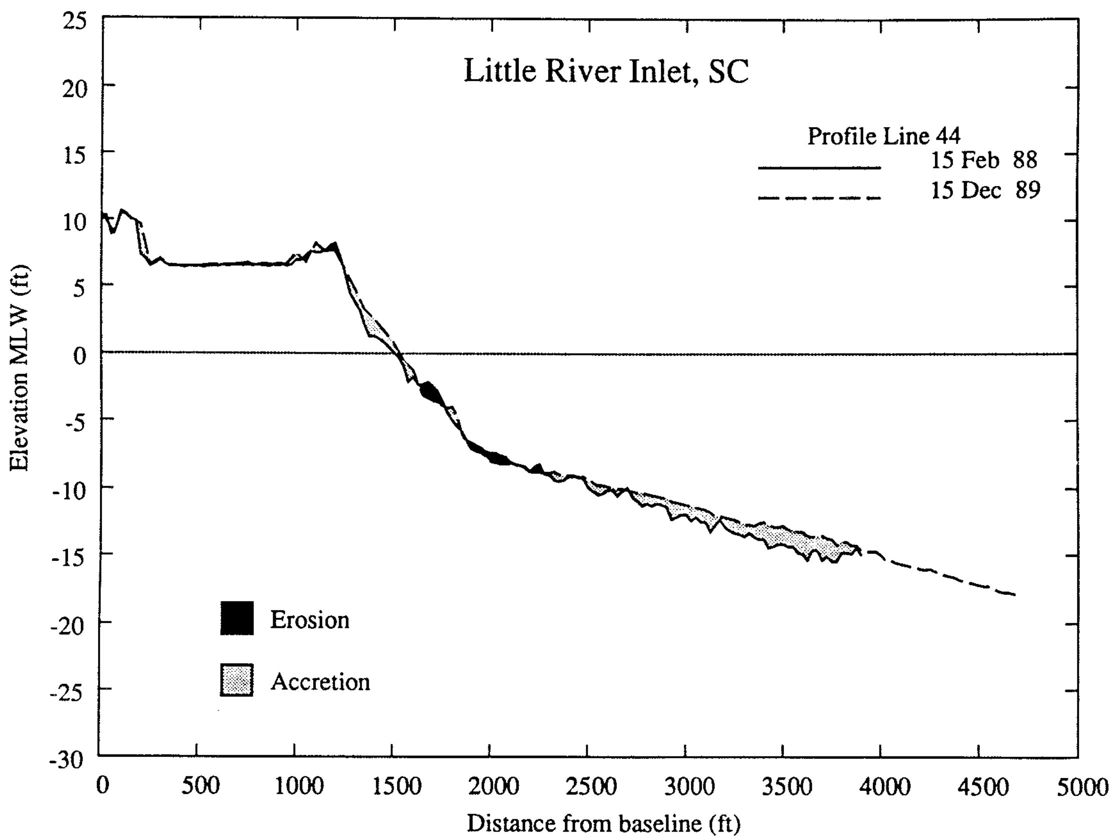
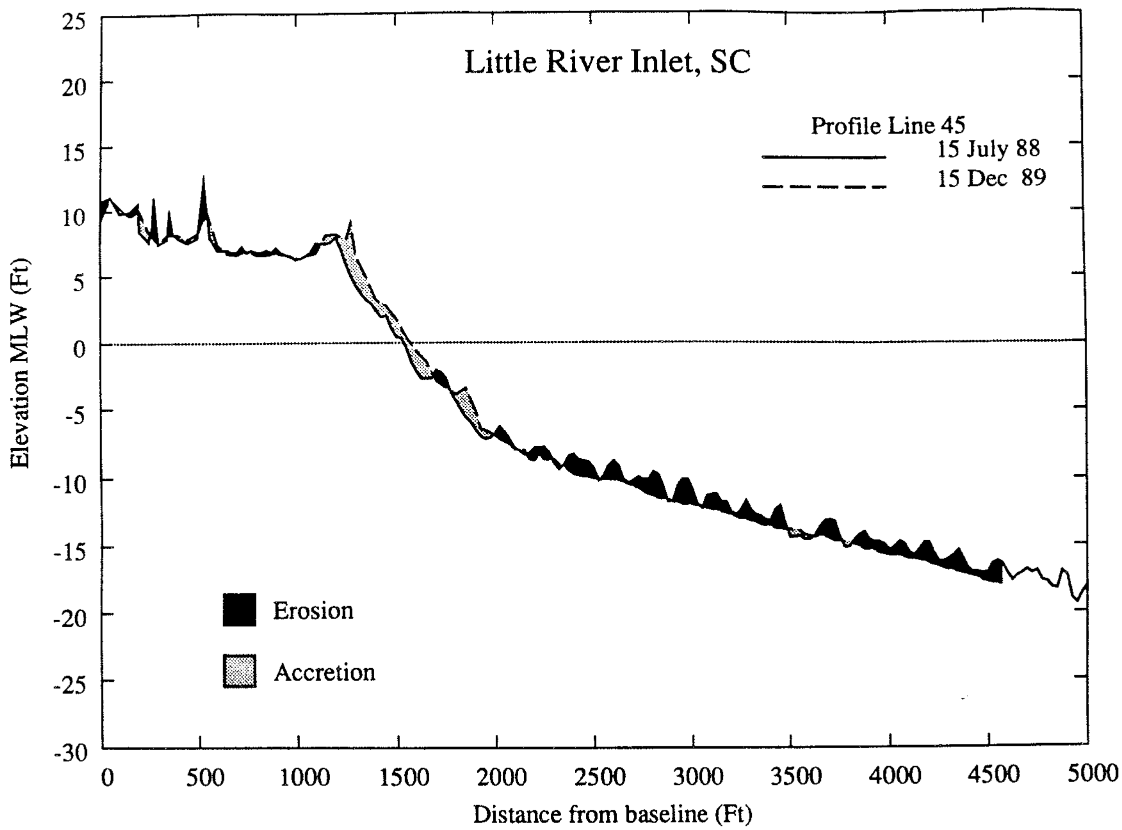
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

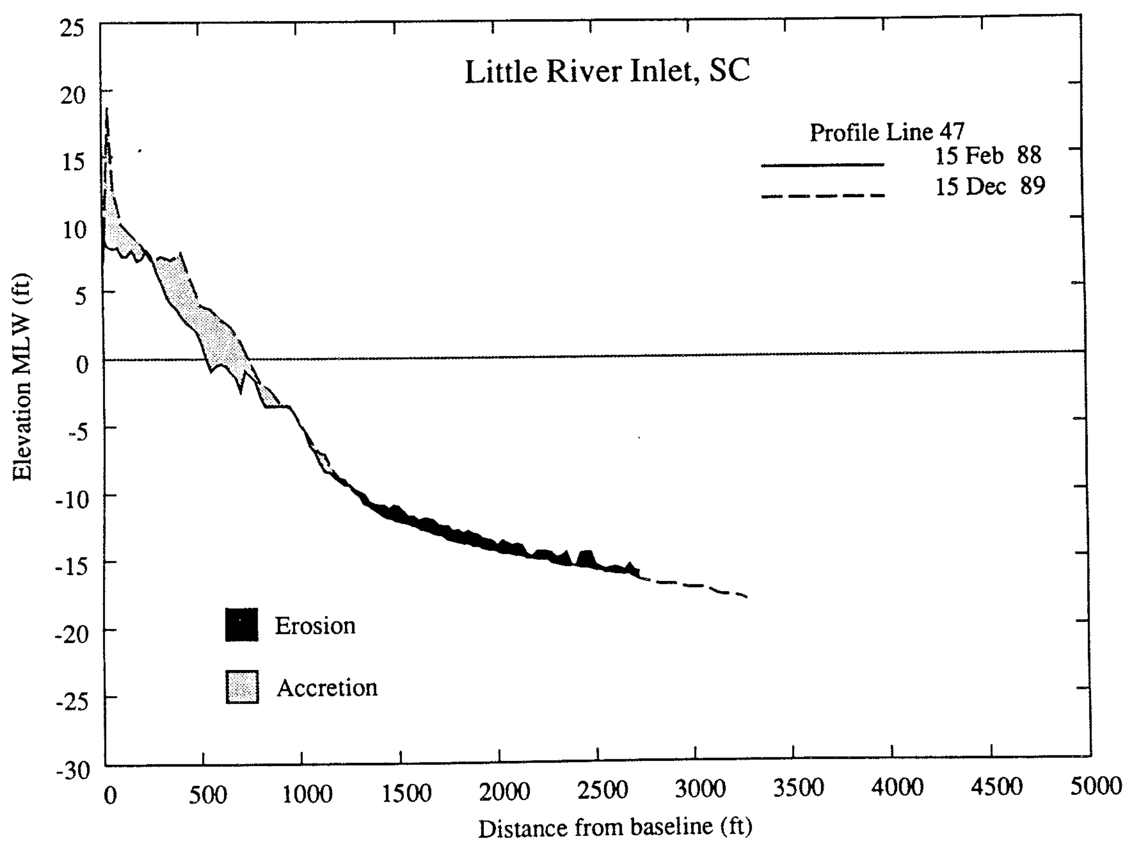

Little River Inlet, SC
Profile Line 38
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

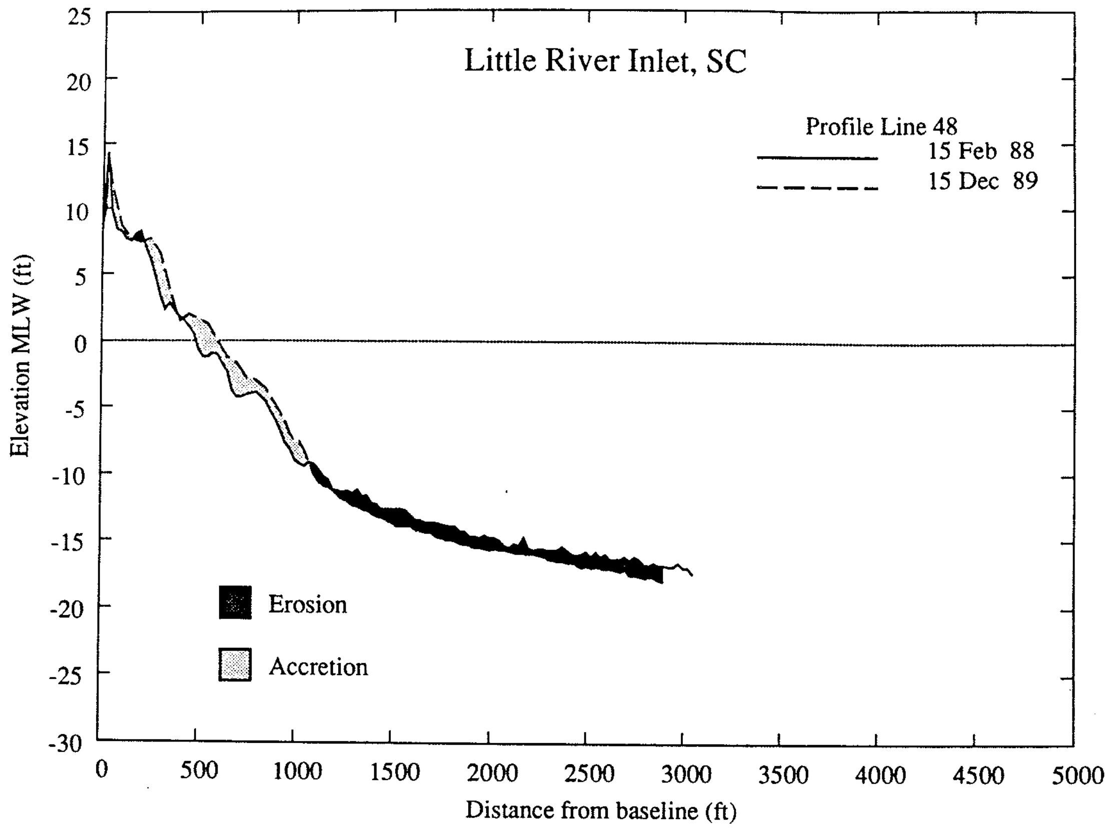

Little River Inlet, SC
Profile Line 40
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

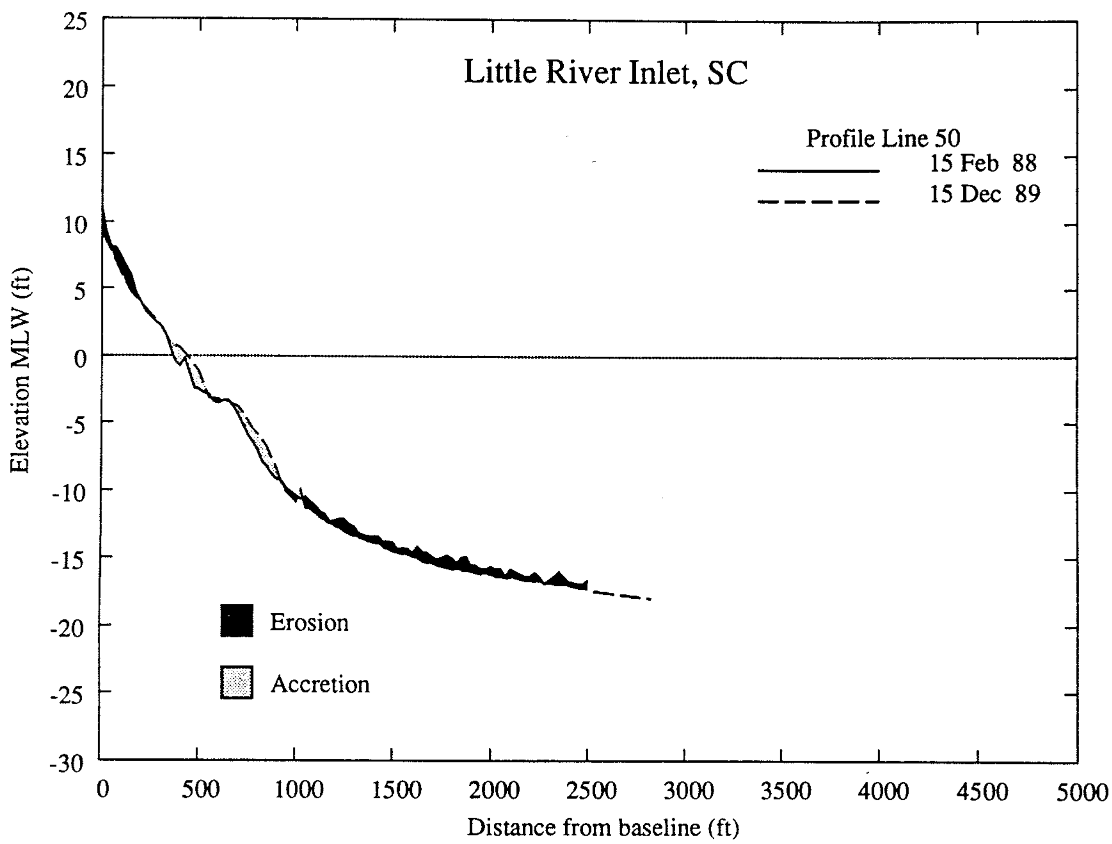

Little River Inlet, SC
Profile Line 42
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

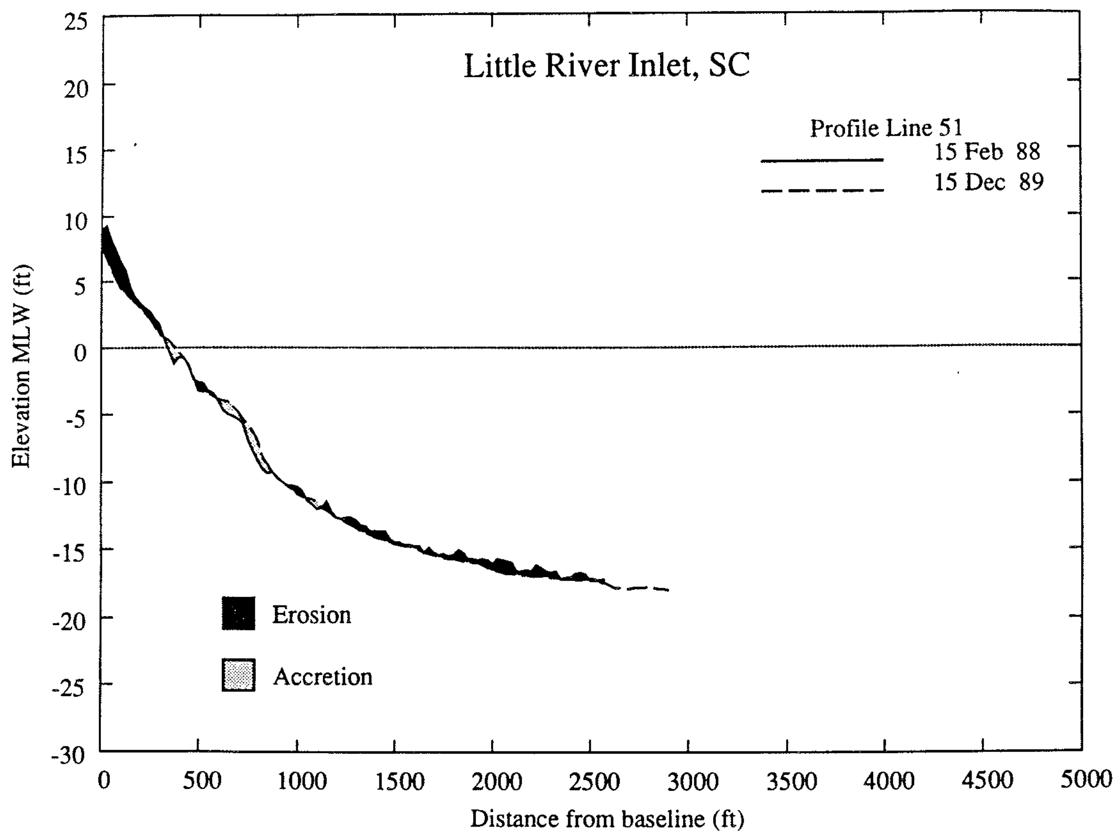

Little River Inlet, SC
Profile Line 44
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 45
15 July 88
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

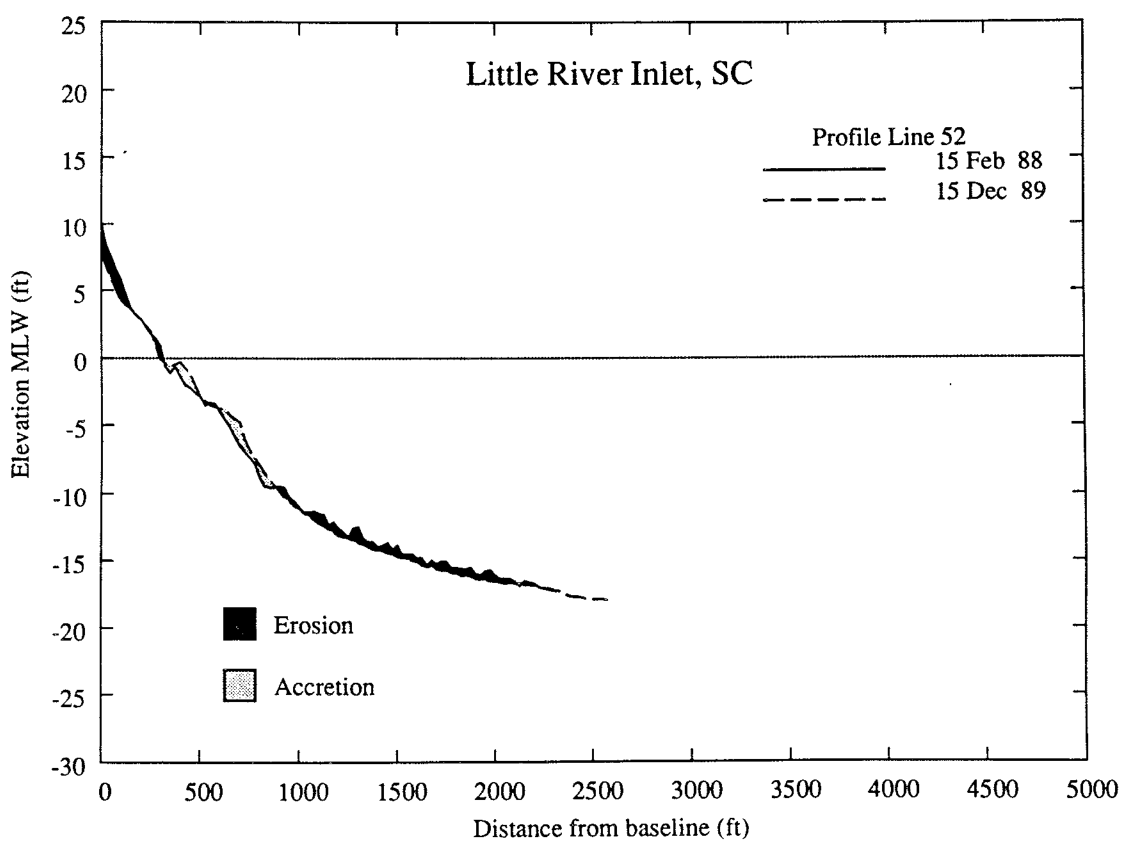

Little River Inlet, SC
Profile Line 47
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 48
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

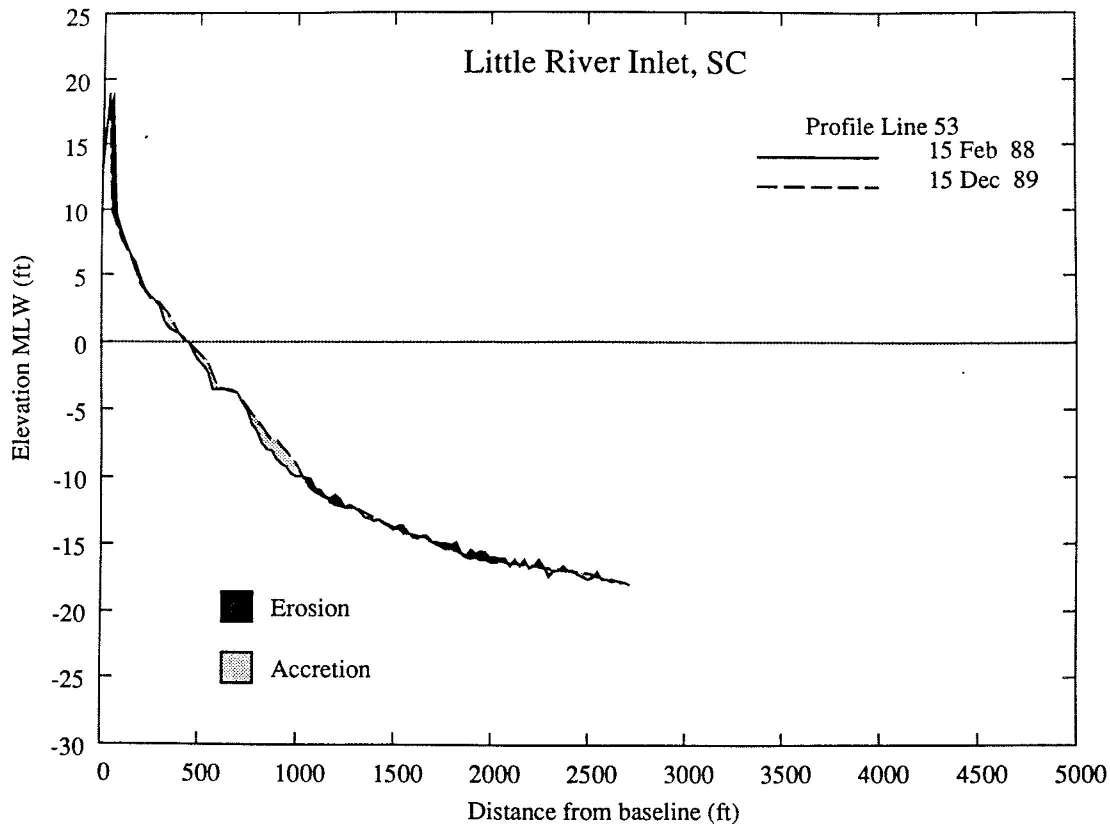

Little River Inlet, SC
Profile Line 50
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

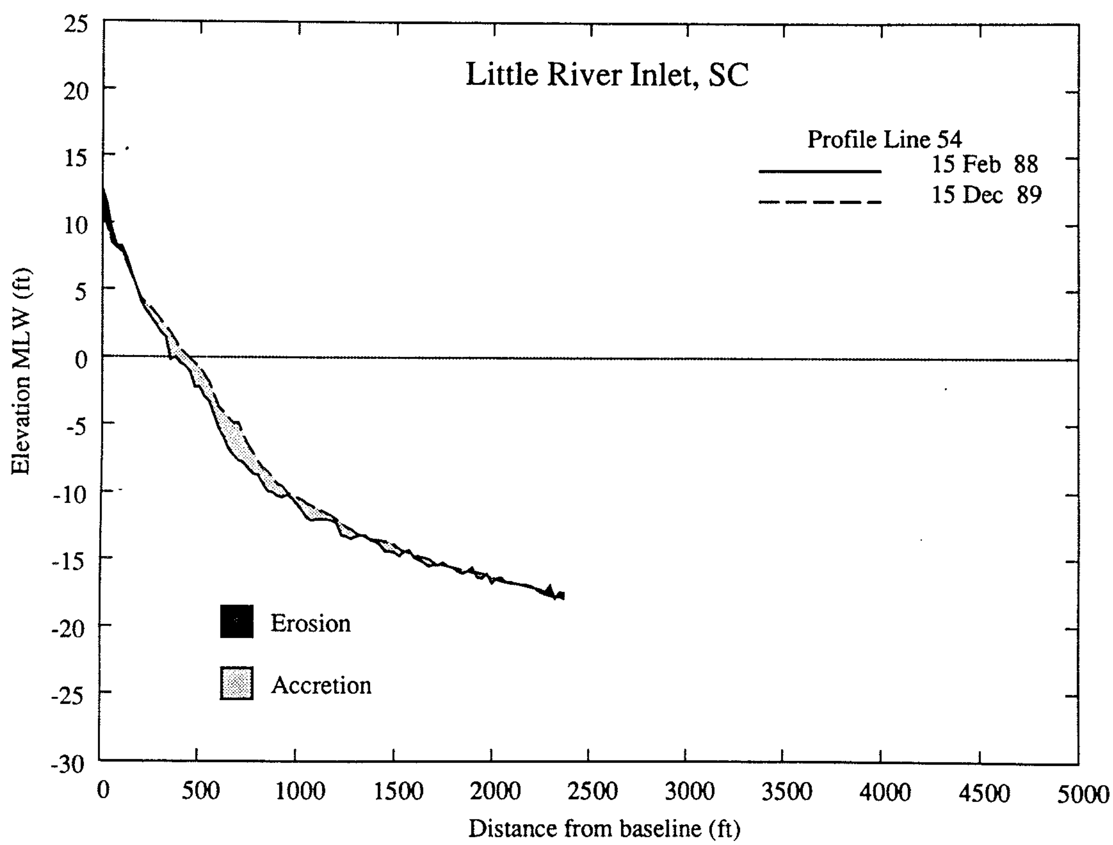


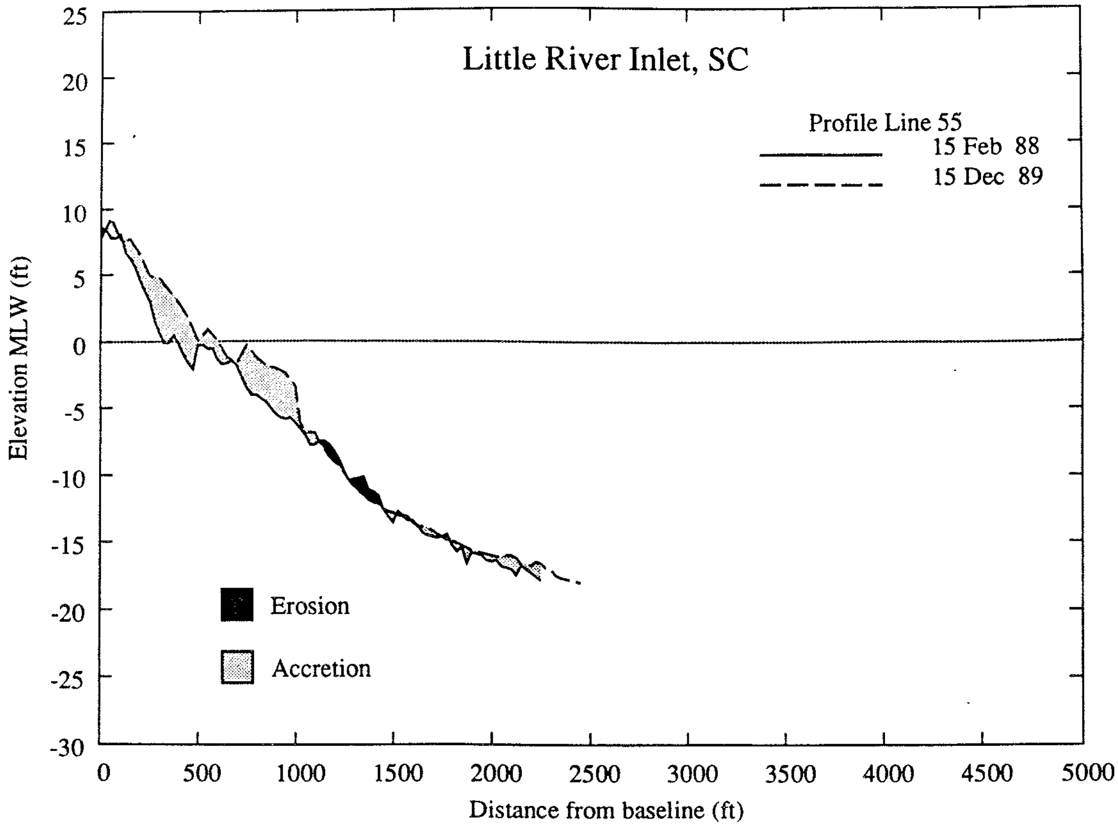
Little River Inlet, SC
Profile Line 51
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

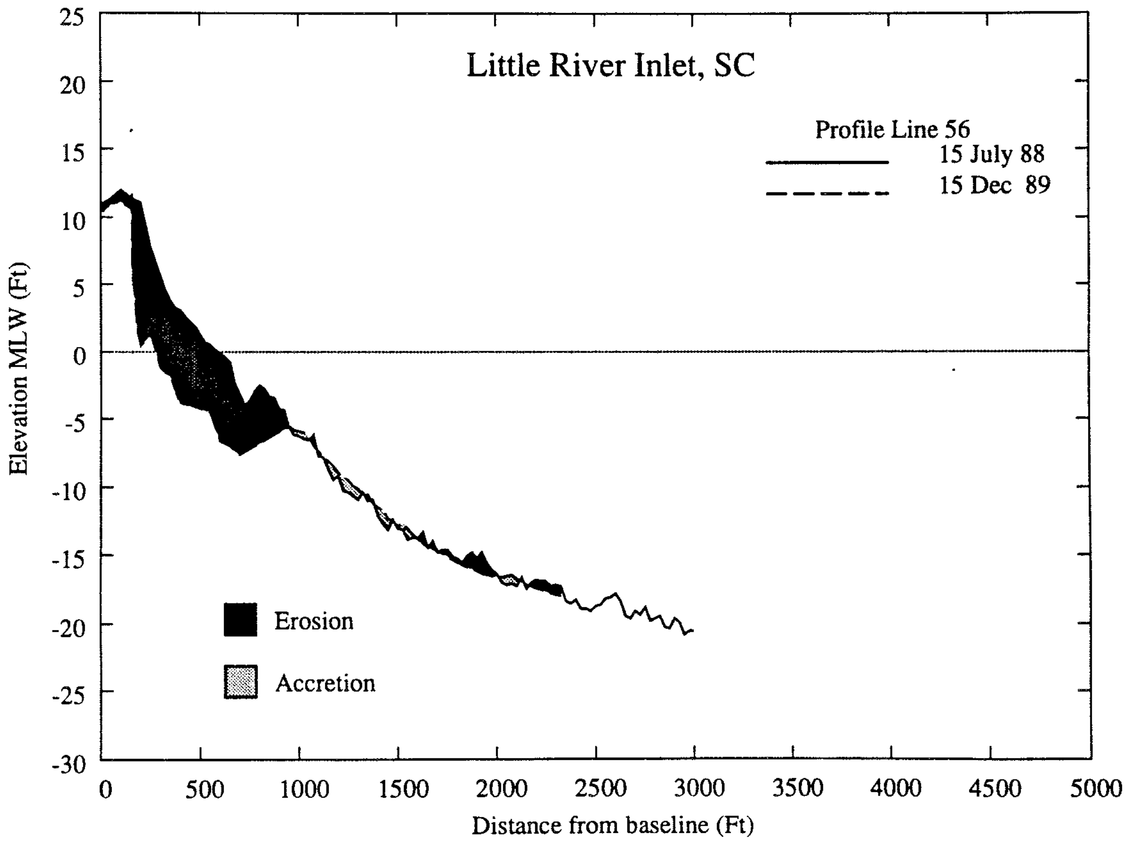


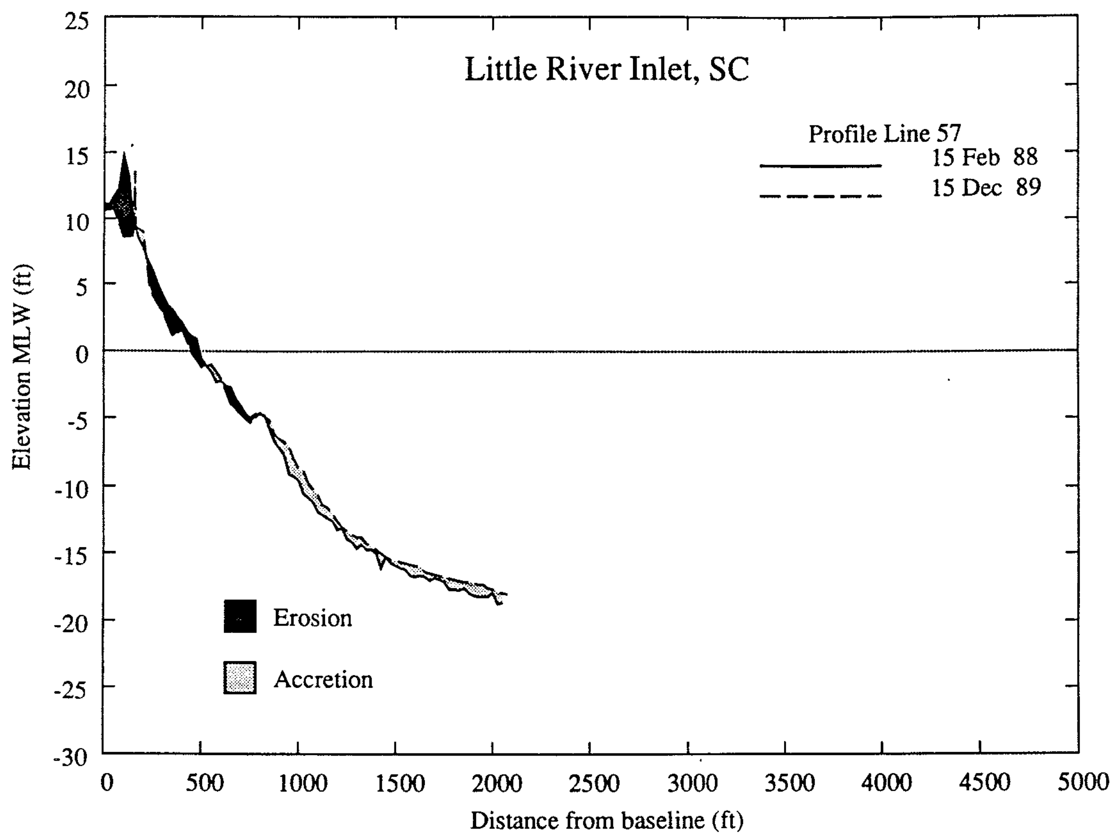
Little River Inlet, SC
Profile Line 52
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 53
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 54
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 55
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 56
15 July 88
15 Dec 89
Erosion
Accretion
Elevation MLW (Ft)
Distance from baseline (Ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


Little River Inlet, SC
Profile Line 57
15 Feb 88
15 Dec 89
Erosion
Accretion
Elevation MLW (ft)
Distance from baseline (ft)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

APPENDIX C:

CUMULATIVE SHORELINE CHANGE

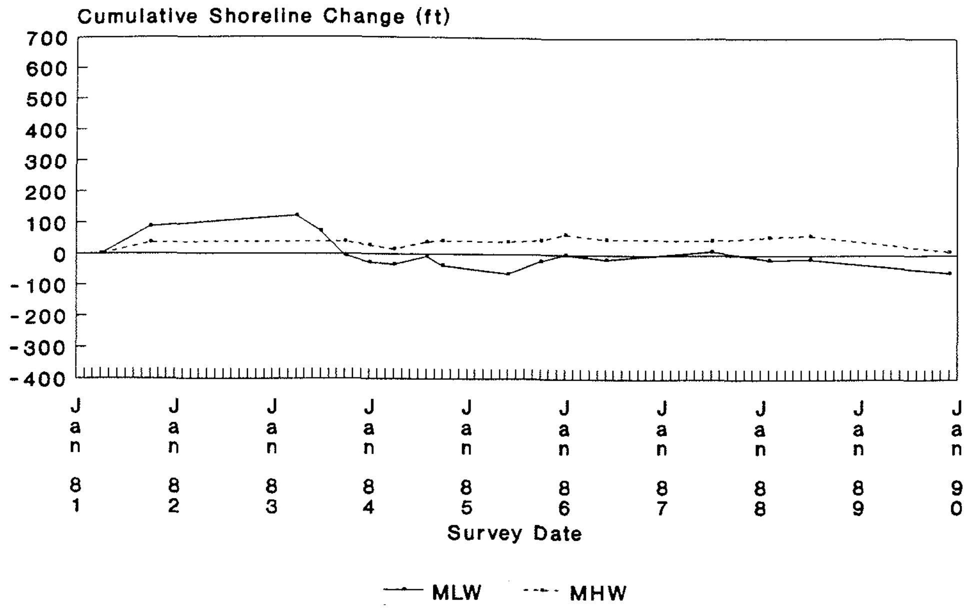
APPENDIX C: CUMULATIVE SHORELINE CHANGE

1. Mean Low Water (MLW) and Mean High Water (MHW) shoreline position data from the beach profile surveys were used to calculate shoreline change for each profile line. Changes were calculated between successive surveys through time, and were then added cumulatively. Because of the short time period between surveys, shoreline change was examined in units of feet, and not feet/year. Again, profile data that was considered insufficient was removed from the analysis.

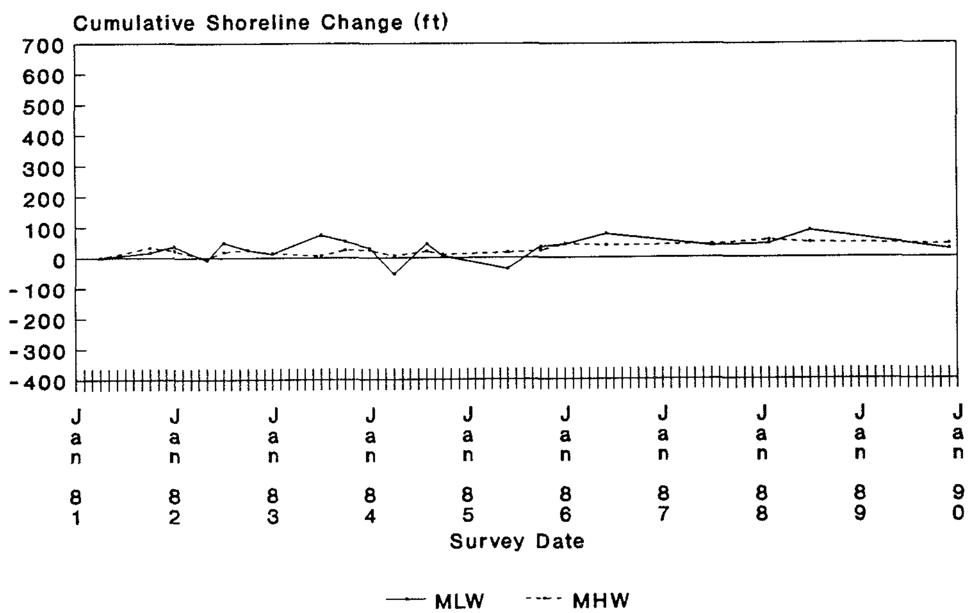
2. The data was plotted as cumulative MHW and MLW shoreline change for each ISRP profile line. Shoreline change was computed for ISRP profile lines 2 through 24 and 36 through 55. Profiles between 25 and 35 were omitted since they are taken along the channel between the jetties, or are immediately adjacent to the jetty, and do not provide an accurate measurement of natural beach change.

3. Some of the plotted results in the west fillet area show large variations in the shoreline. These are generally evident of the construction of the west sand dike and of the old ebb shoal welding onto this portion of the beach. The profiles adjacent to Little River, Tubbs, Mad, and Hog Inlets also tend to show large and erratic changes.

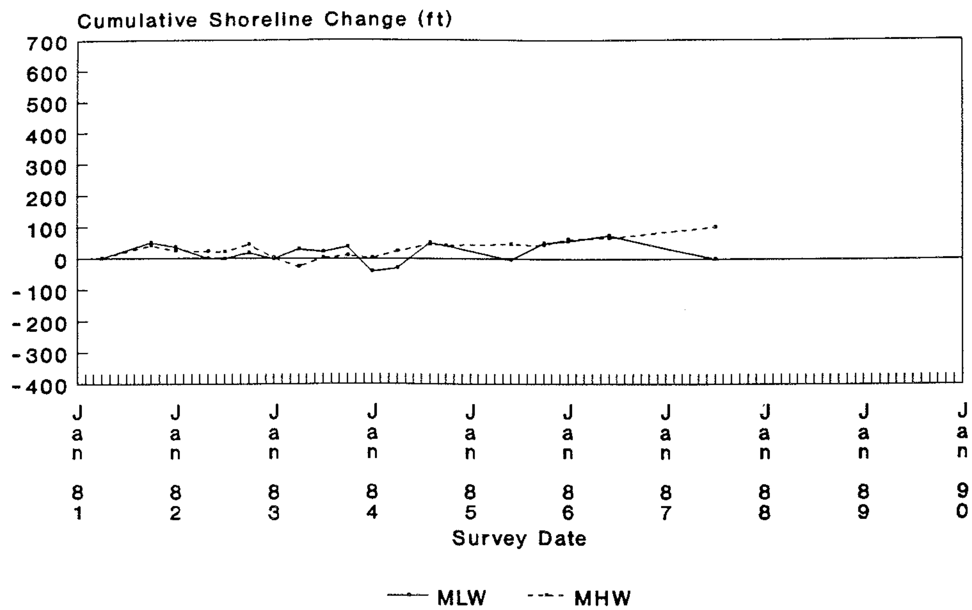
Profile Line 2



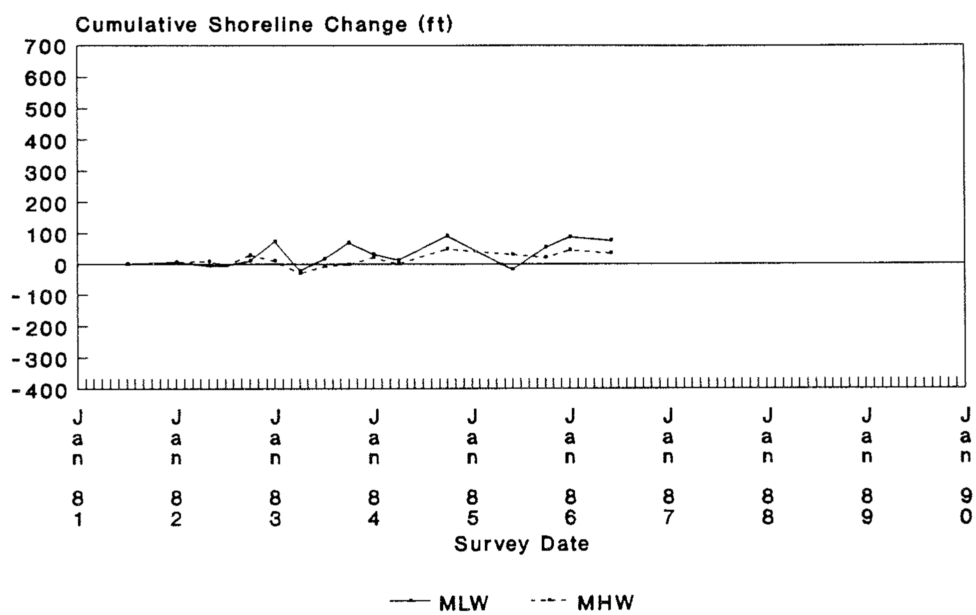
Profile Line 3



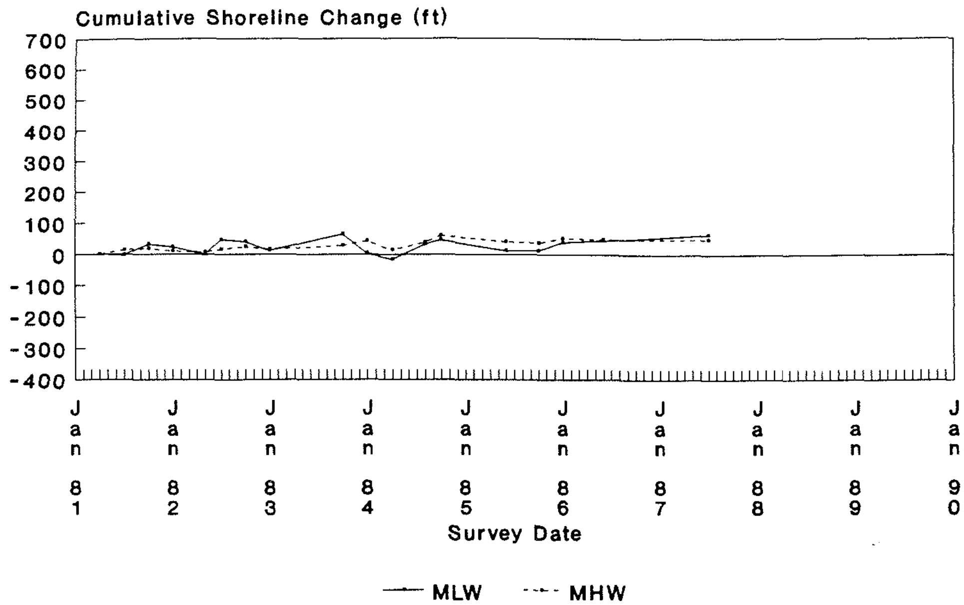
Profile Line 4



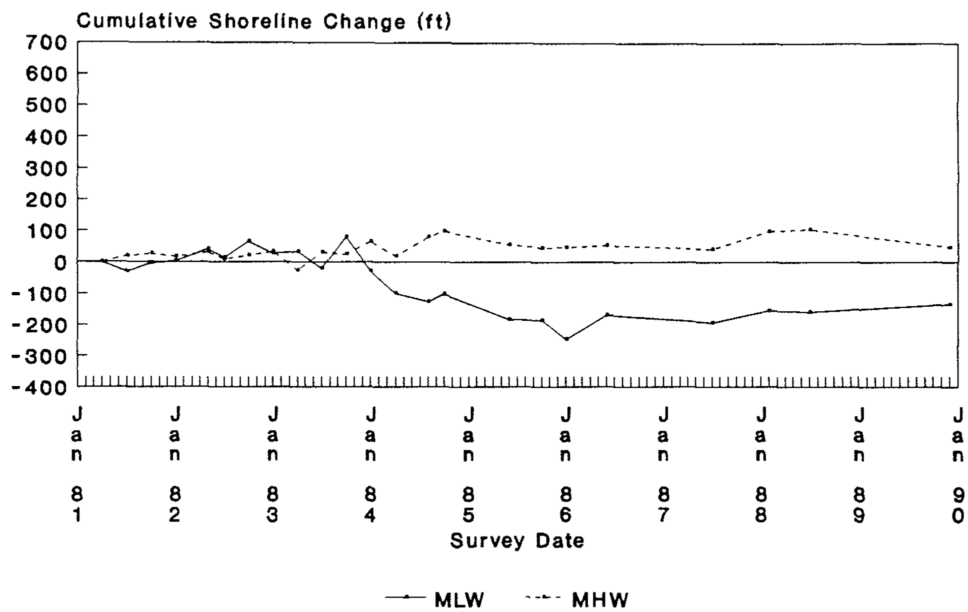
Profile Line 5



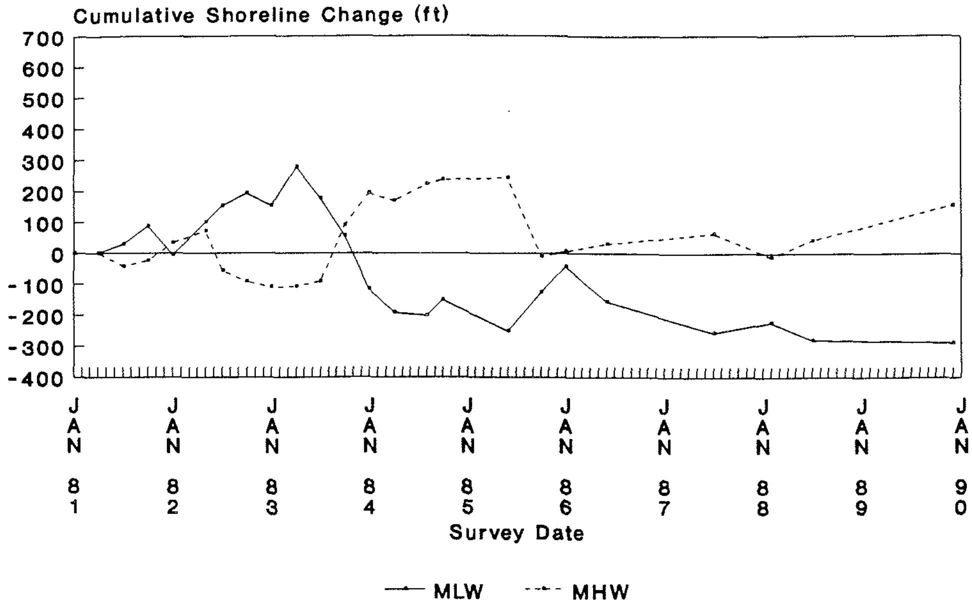
Profile Line 6



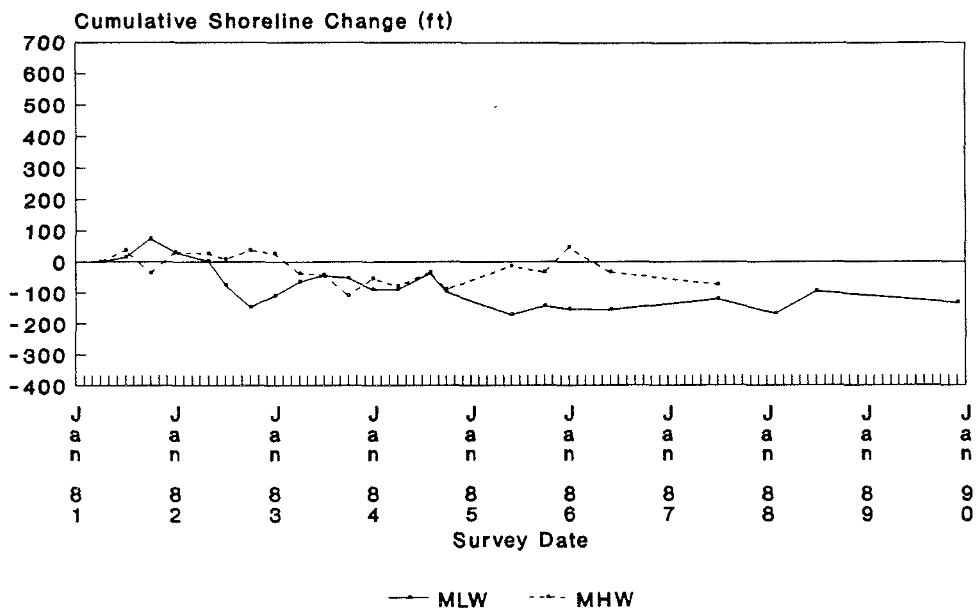
Profile Line 7



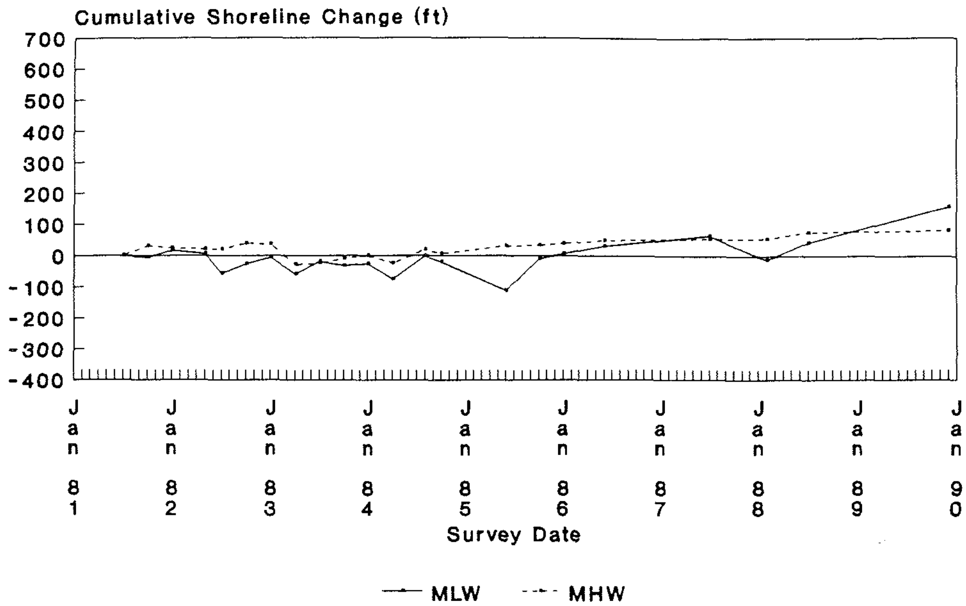
Profile Line 8



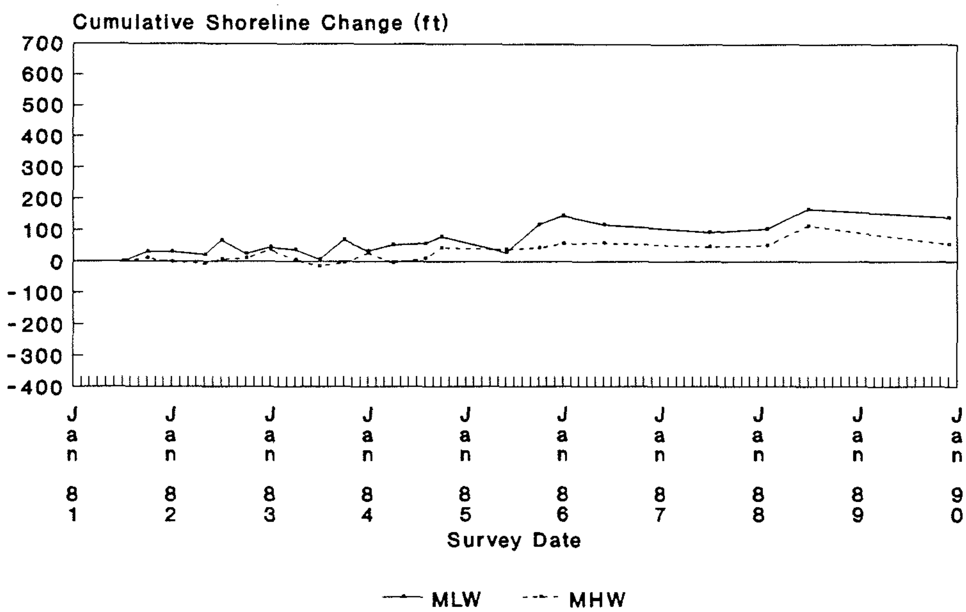
Profile Line 9



Profile Line 10



Profile Line 11



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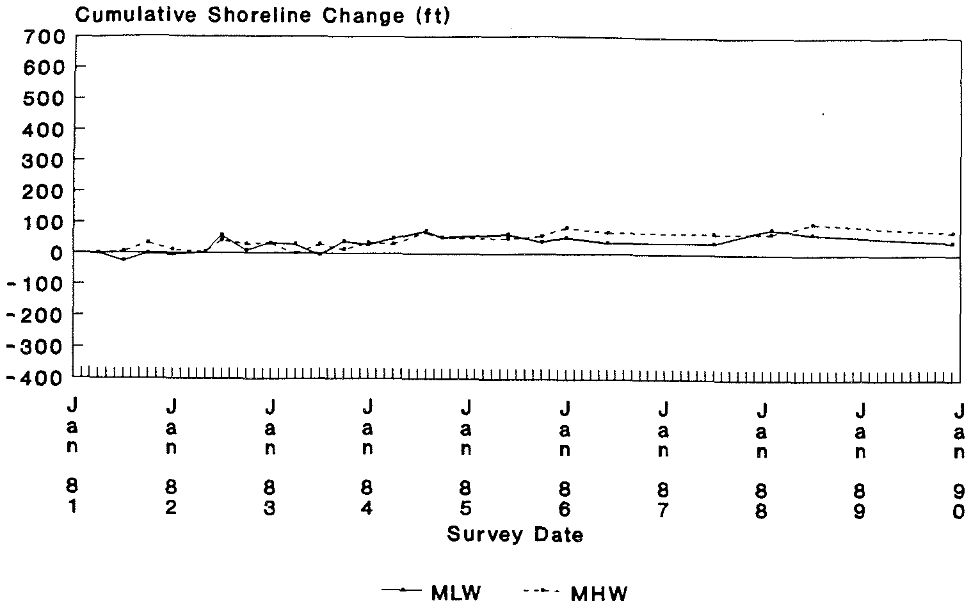
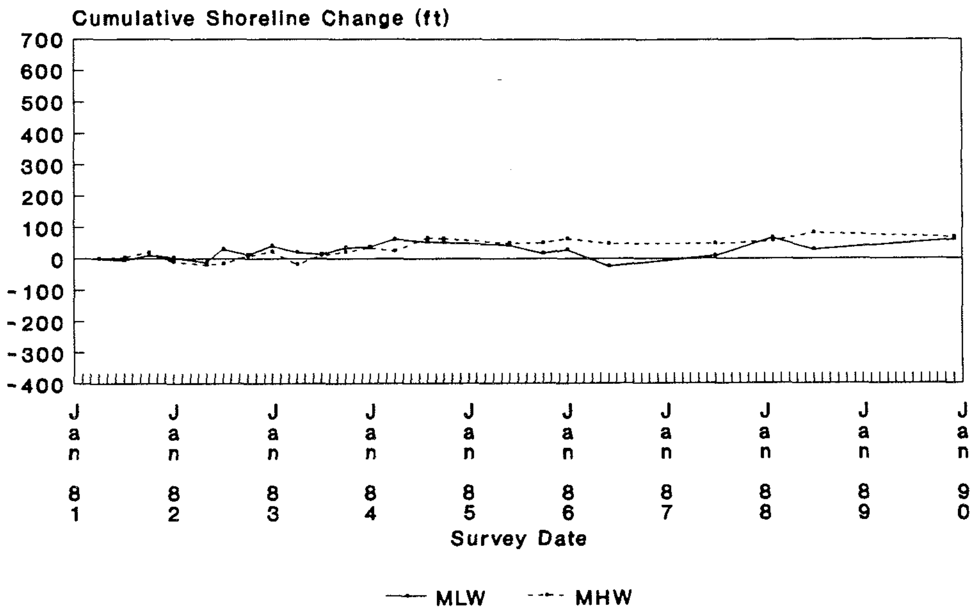
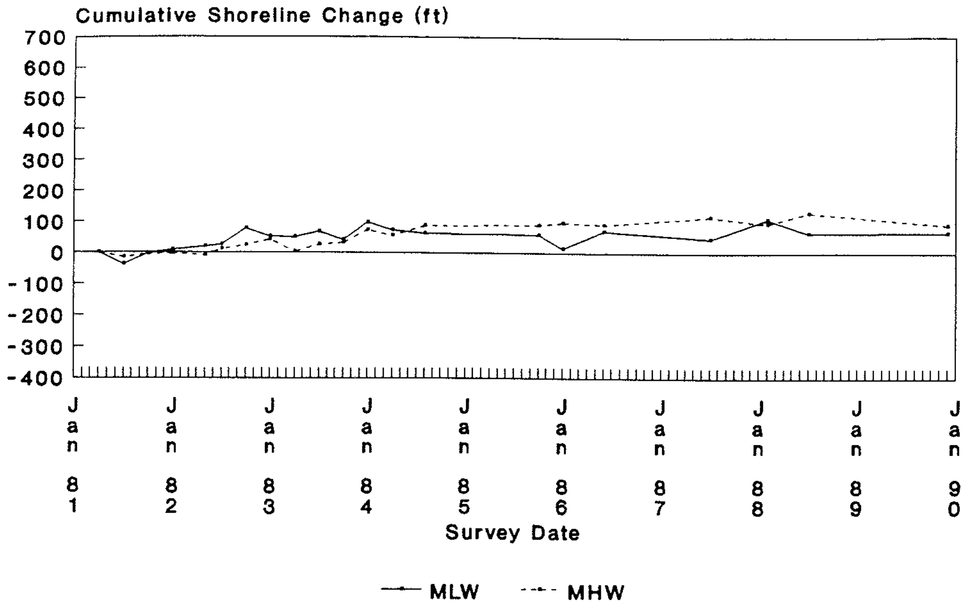


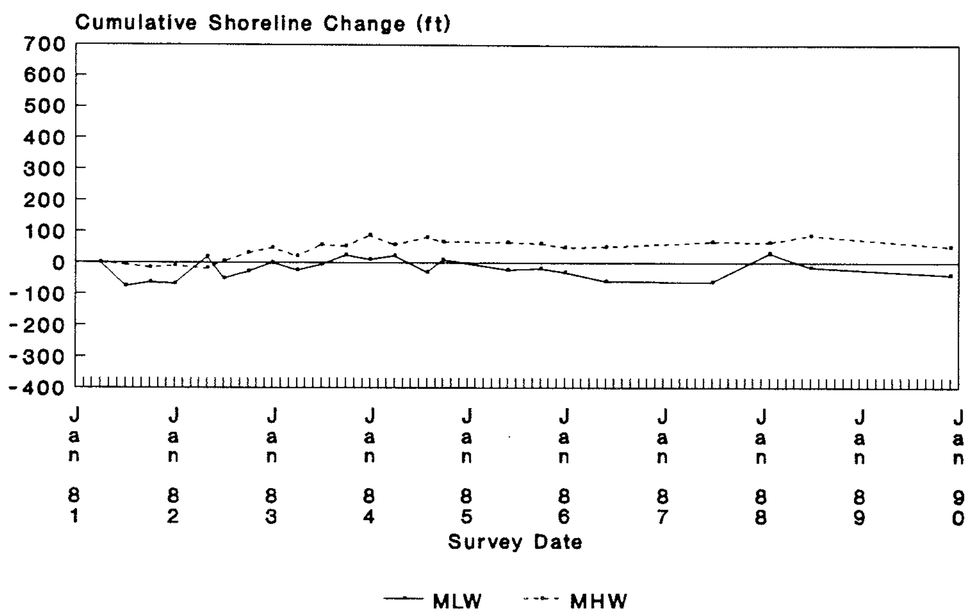
Profile Line 13



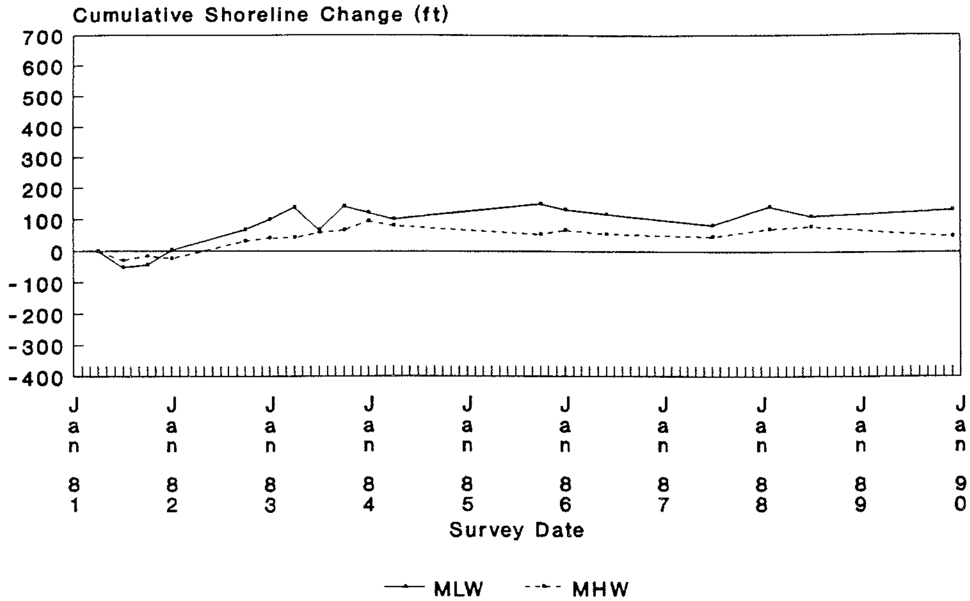
Profile Line 14



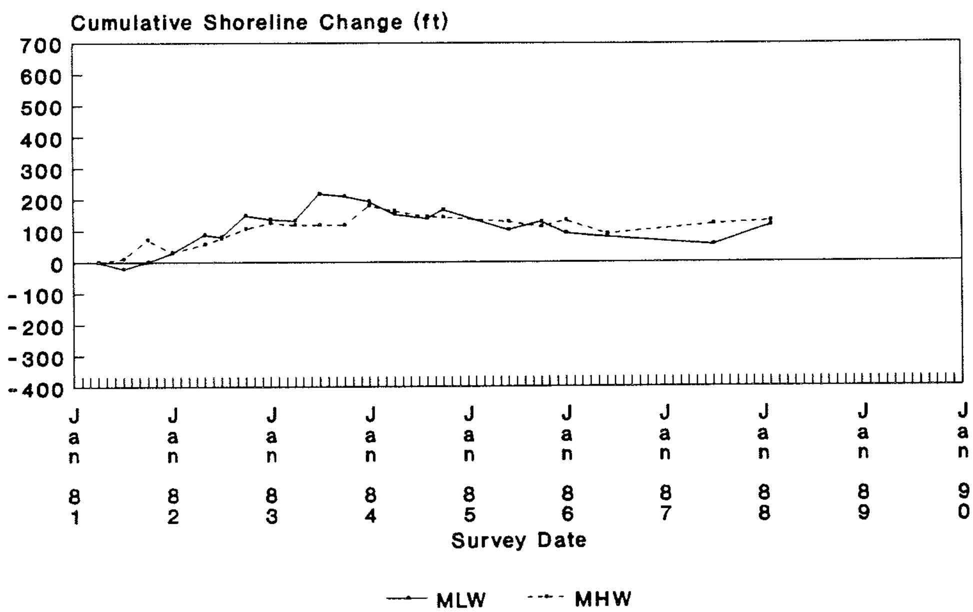
Profile Line 16



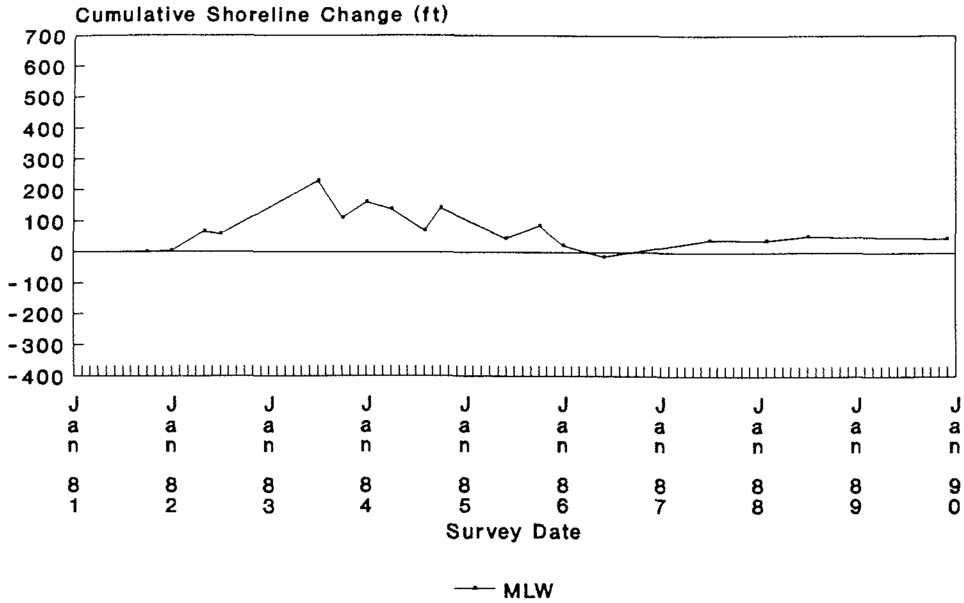
Profile Line 18



Profile Line 20



Profile Line 22



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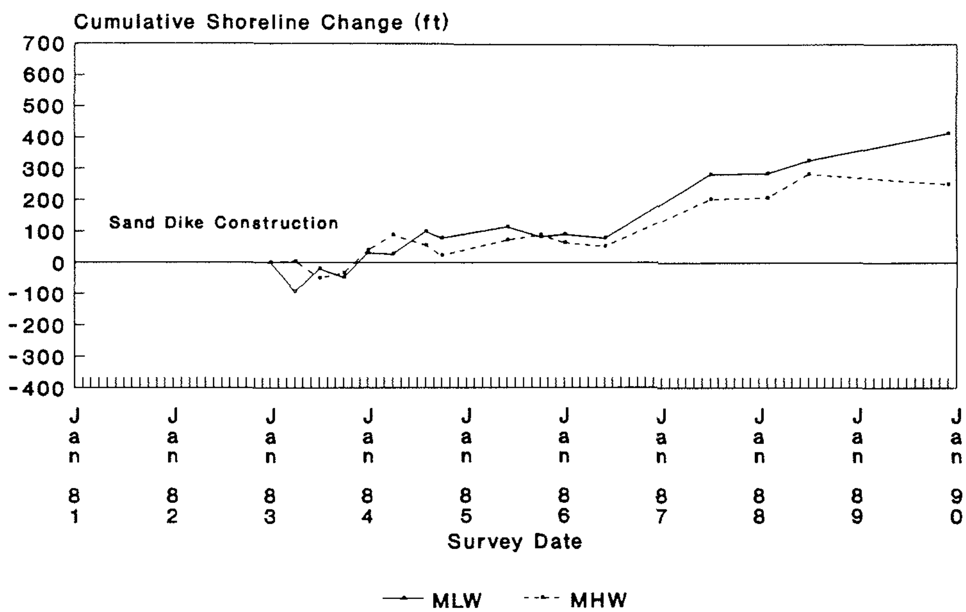

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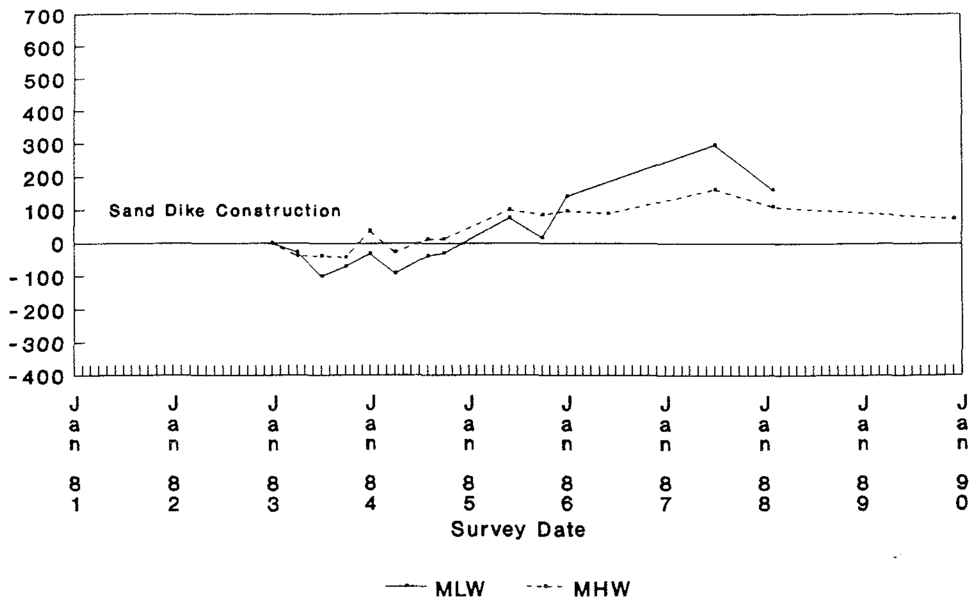
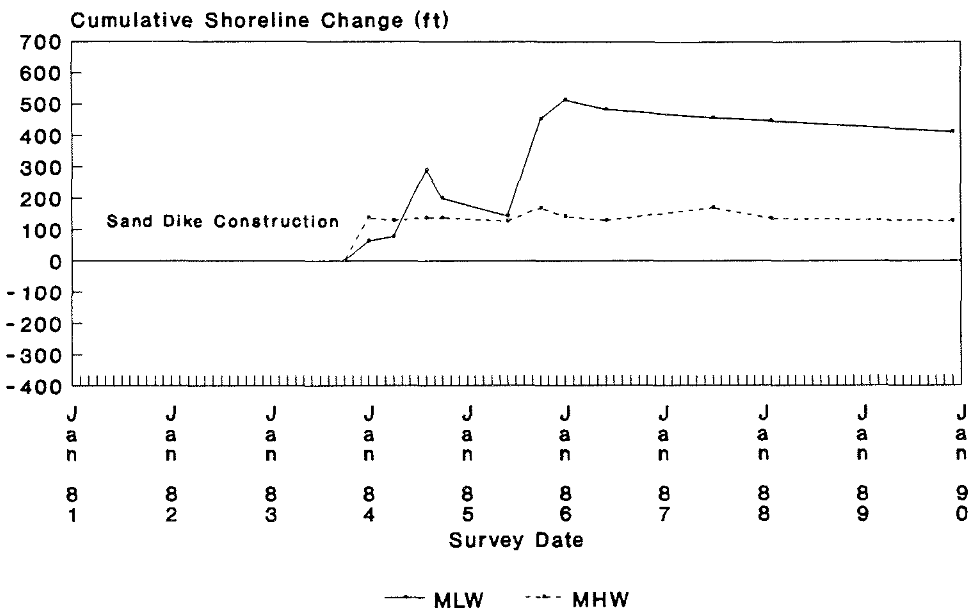
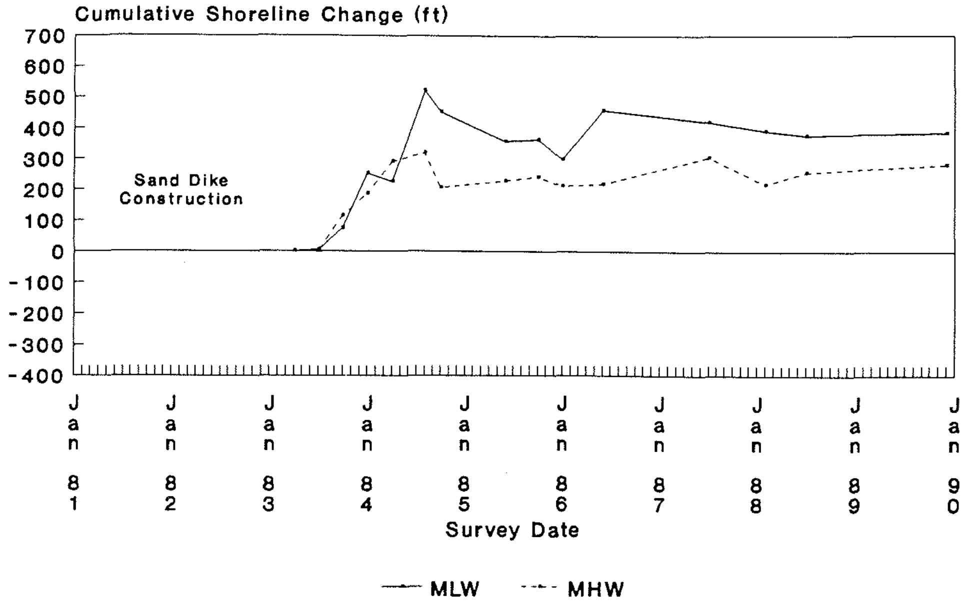


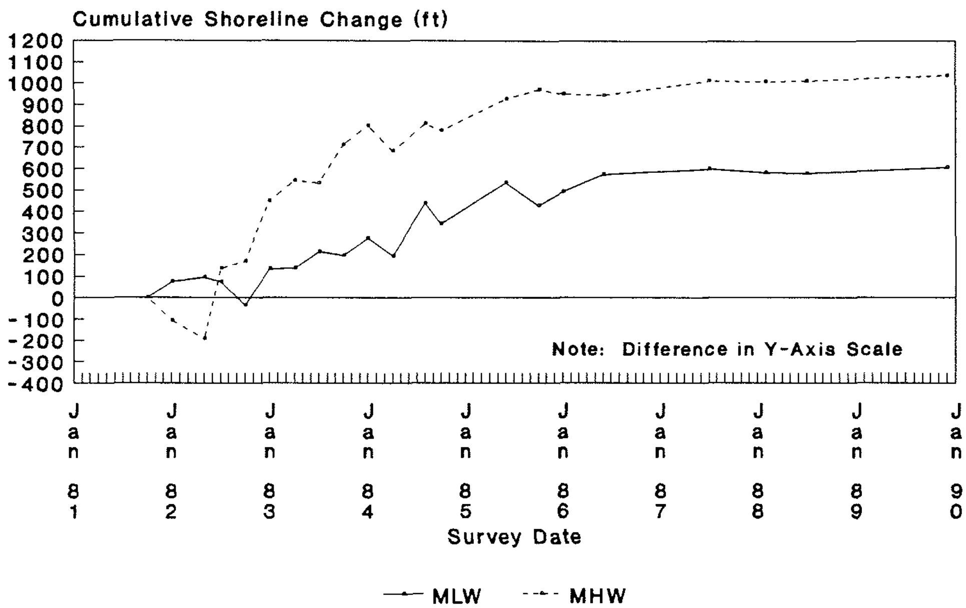
Profile Line 40



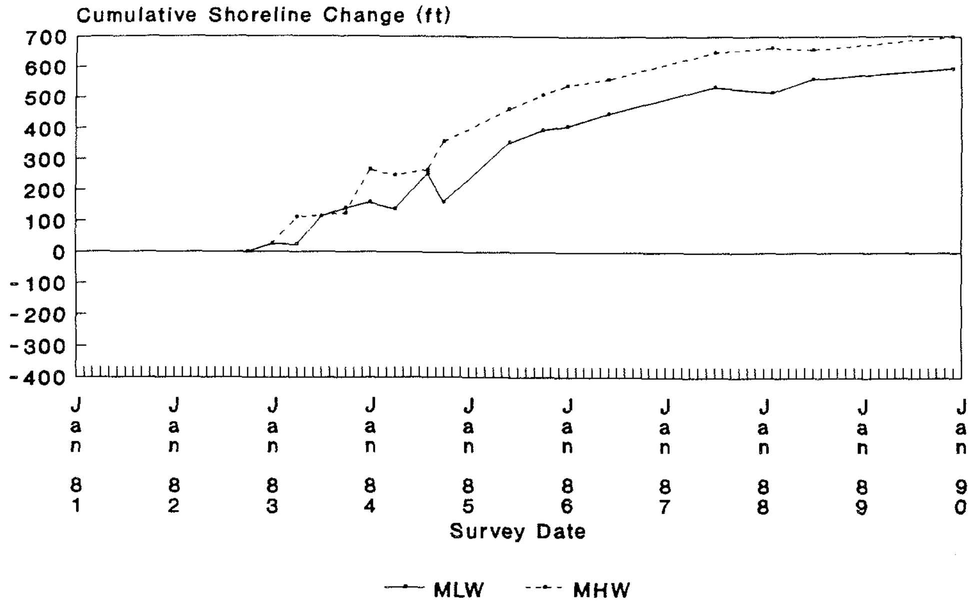
Profile Line 42



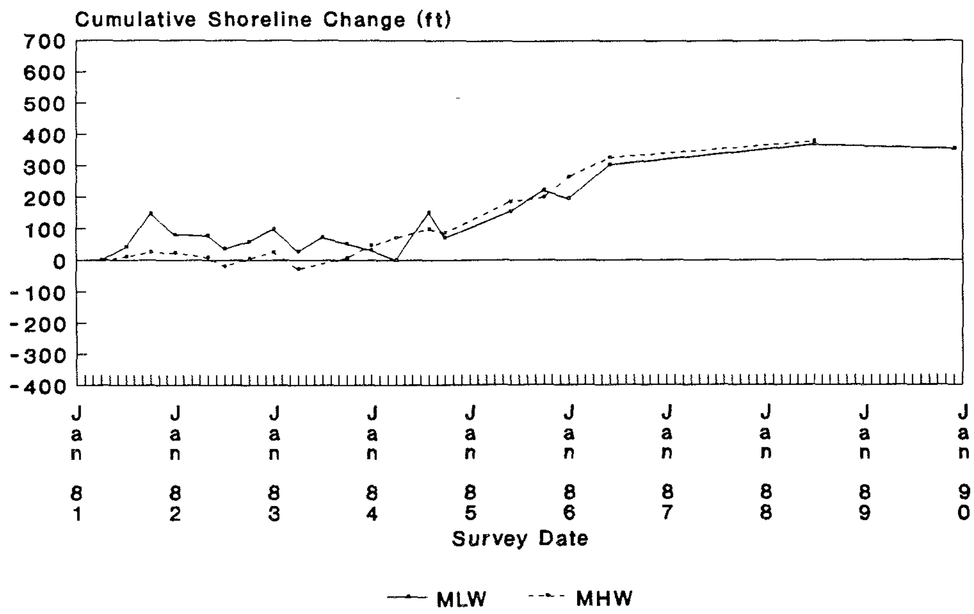
Profile Line 44



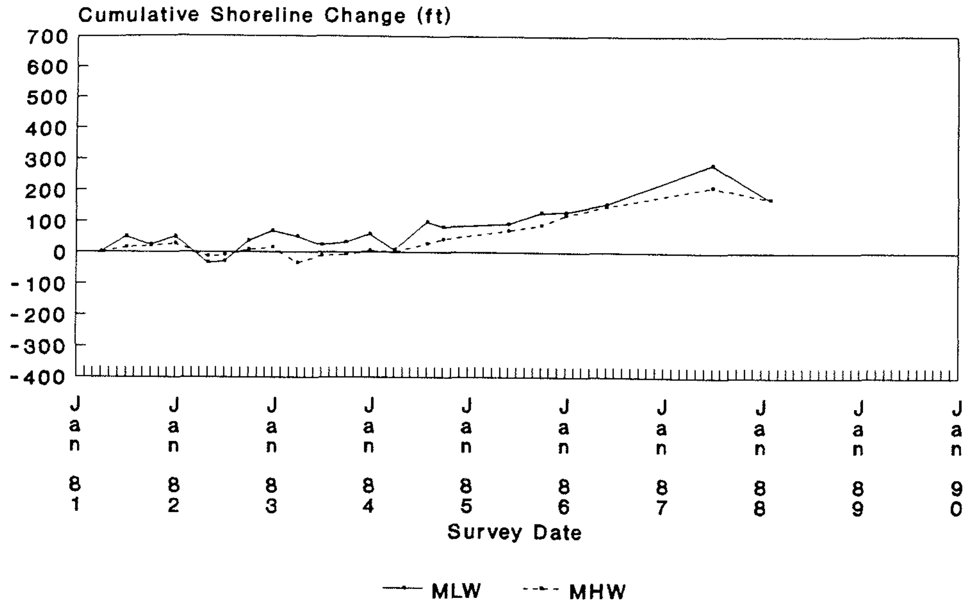
Profile Line 45



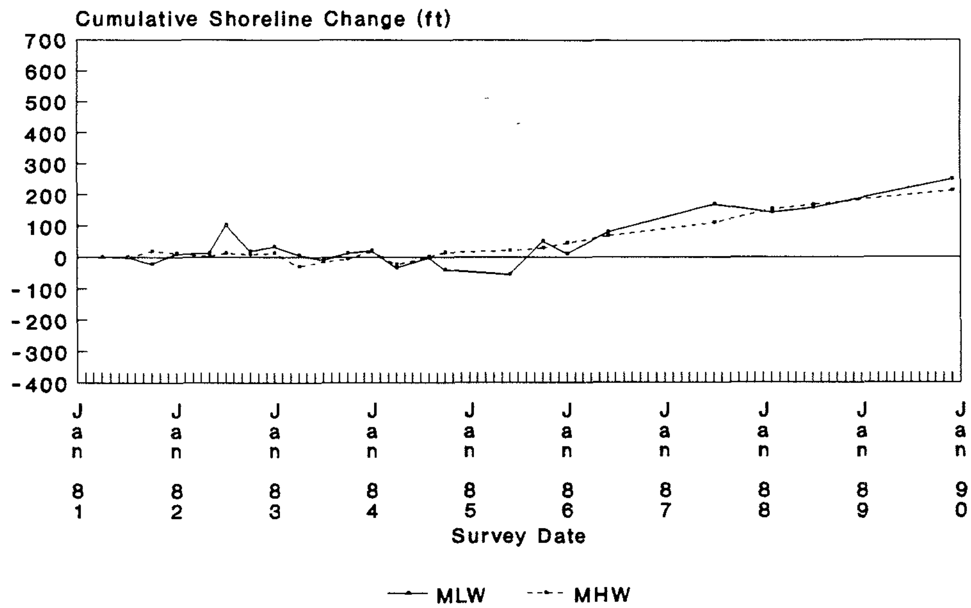
Profile Line 46



Profile Line 47



Profile Line 48



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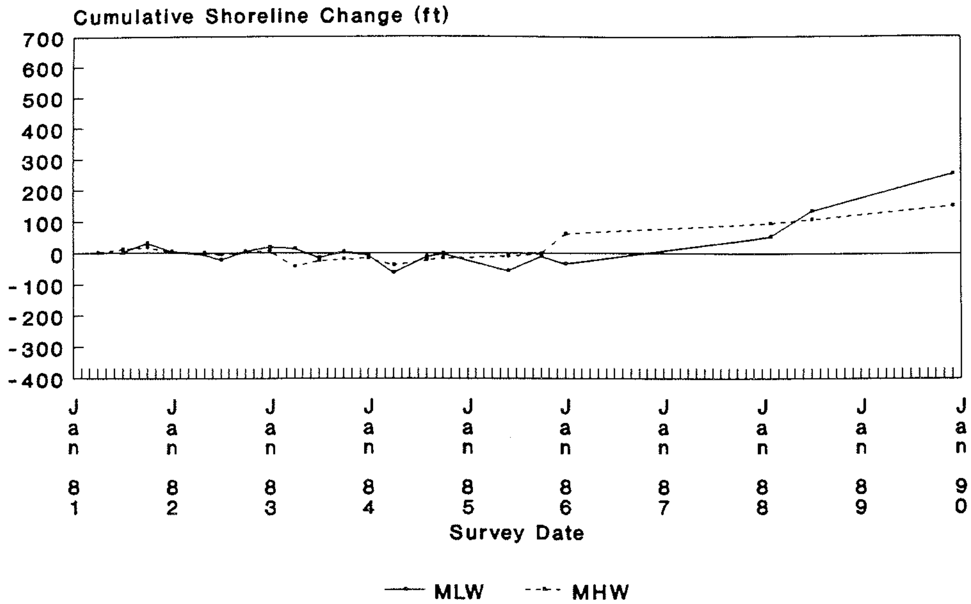

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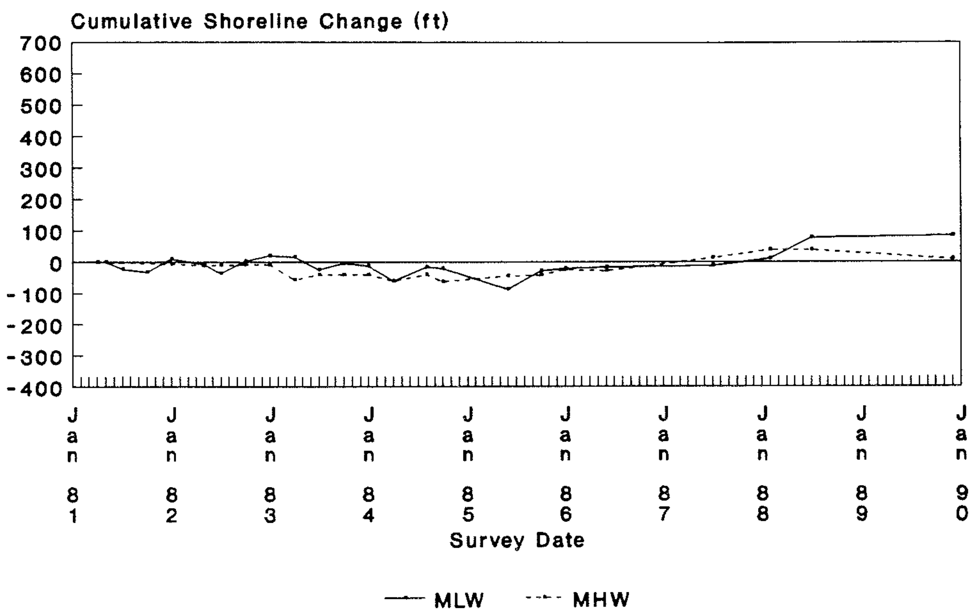
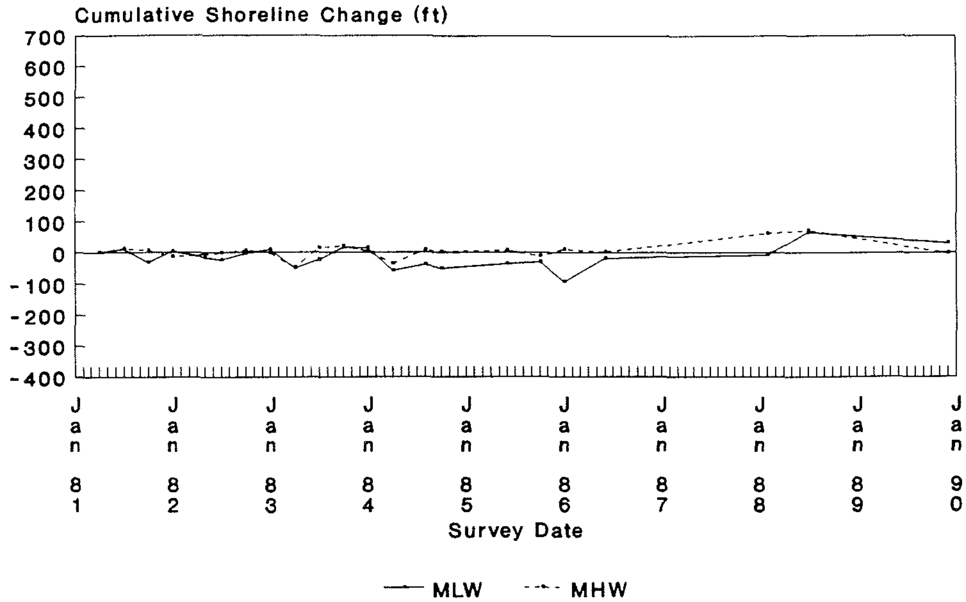
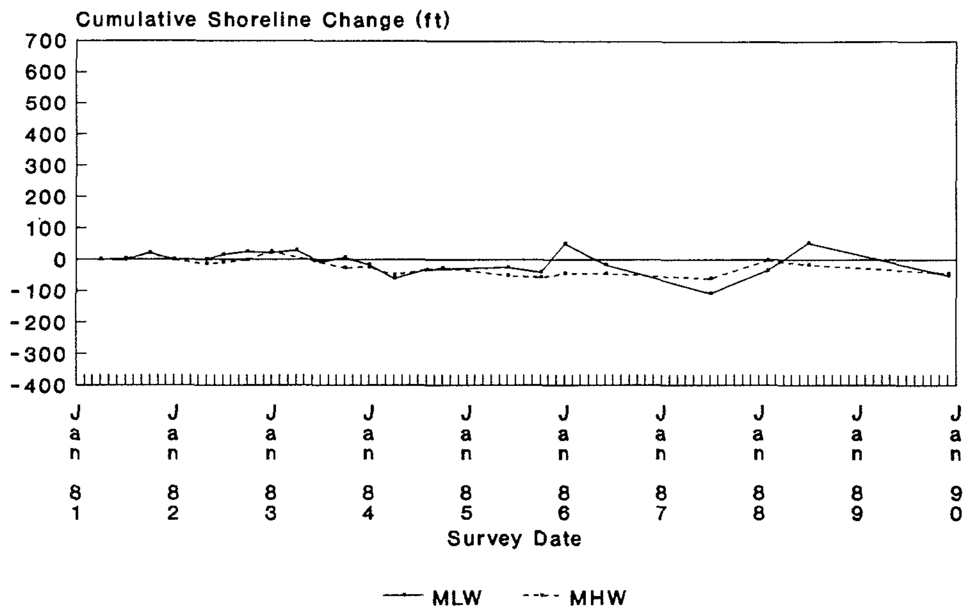


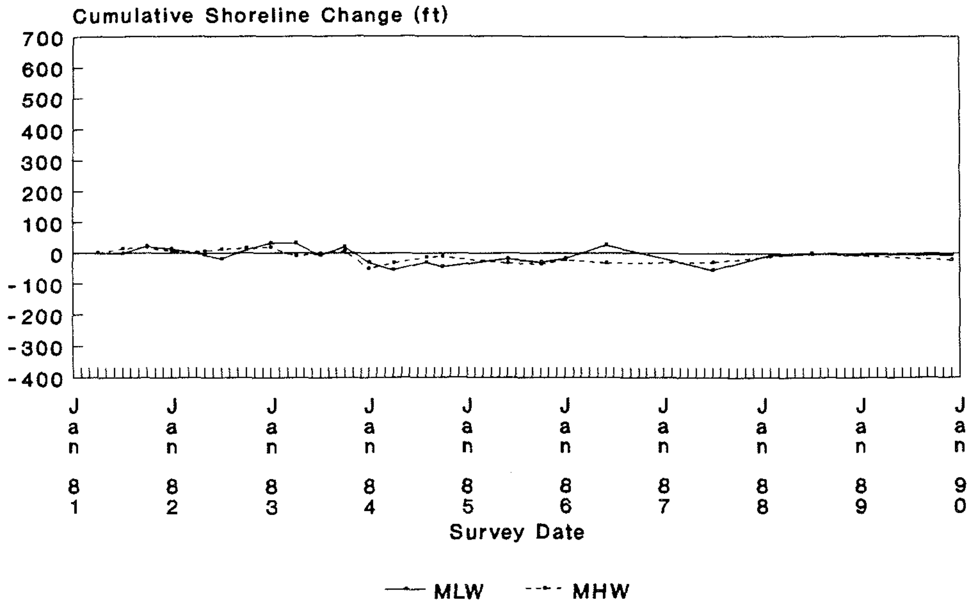
Profile Line 51



Profile Line 52



Profile Line 53



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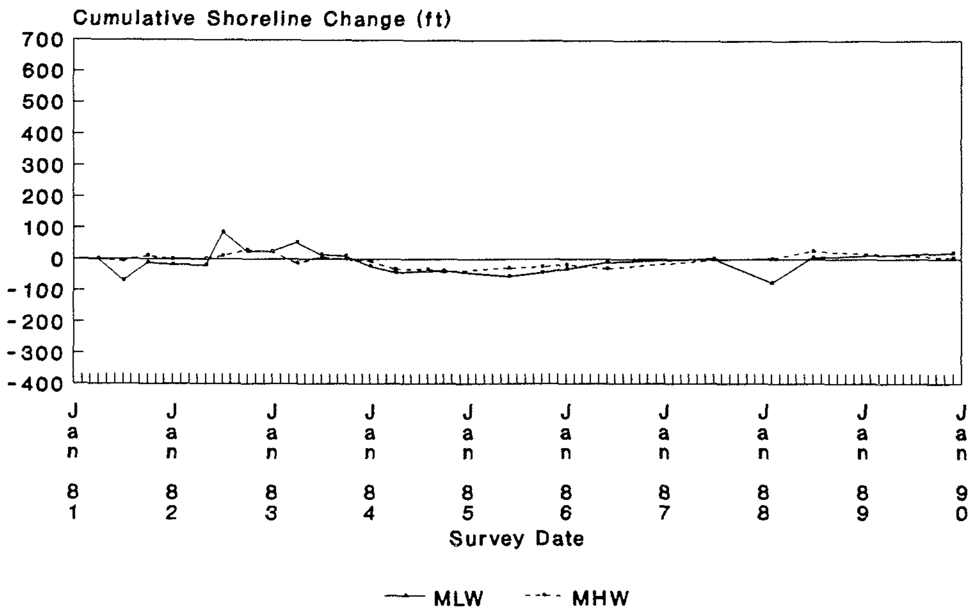
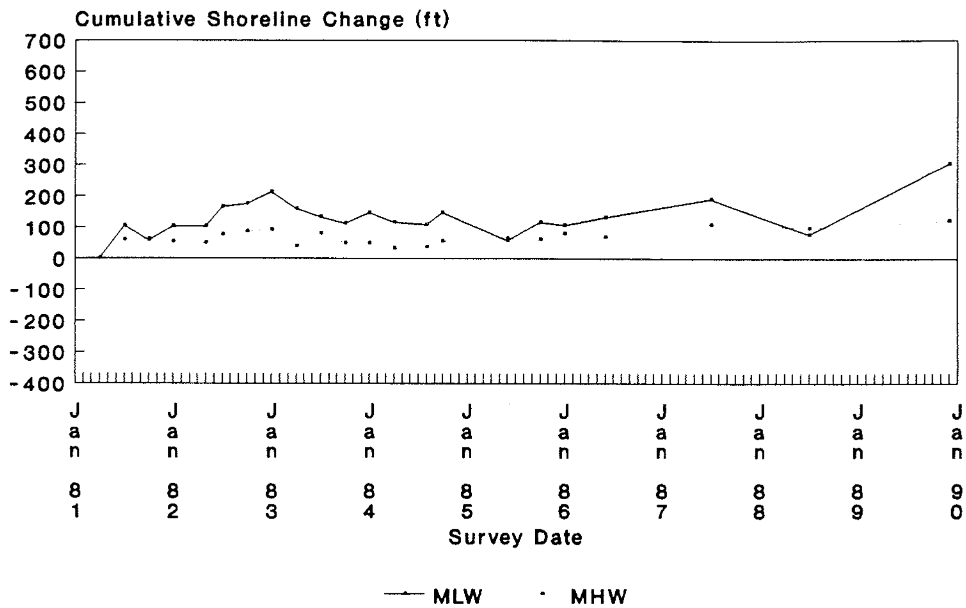


Profile Line 55



APPENDIX D:

ABOVE-DATUM VOLUME CHANGE

APPENDIX D: ABOVE-DATUM VOLUME CHANGE

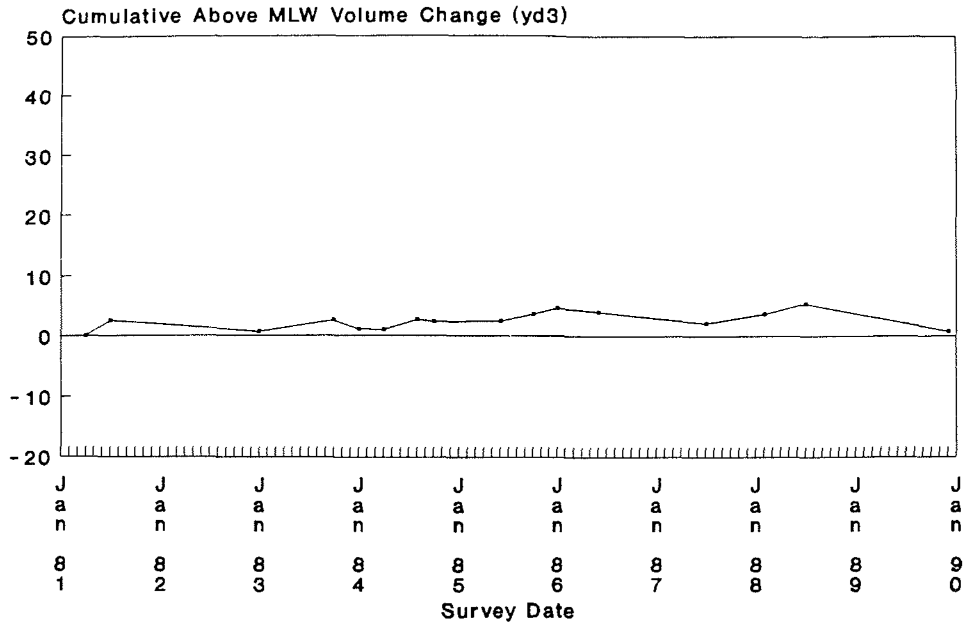
1. The program VOLUME-PC was used to calculate above- and below-datum volume changes along each profile line. VOLUME-PC is a program for processing beach and nearshore survey data on an IBM compatible microcomputer, and is a complementary program to ISRP-PC and ISRPSORT.

2. The "shoreline" is defined as the horizontal intercept of the profile data with the datum (in this case, MLW). Although the program actually computes changes in cross-sectional area, changes are presented as volumes based on a uniform length of beach (yd^3/ft). These volumes were then linearly interpolated by multiplying over a normalized distance interval of 250 ft to produce a volume in yd^3 over that "cell."

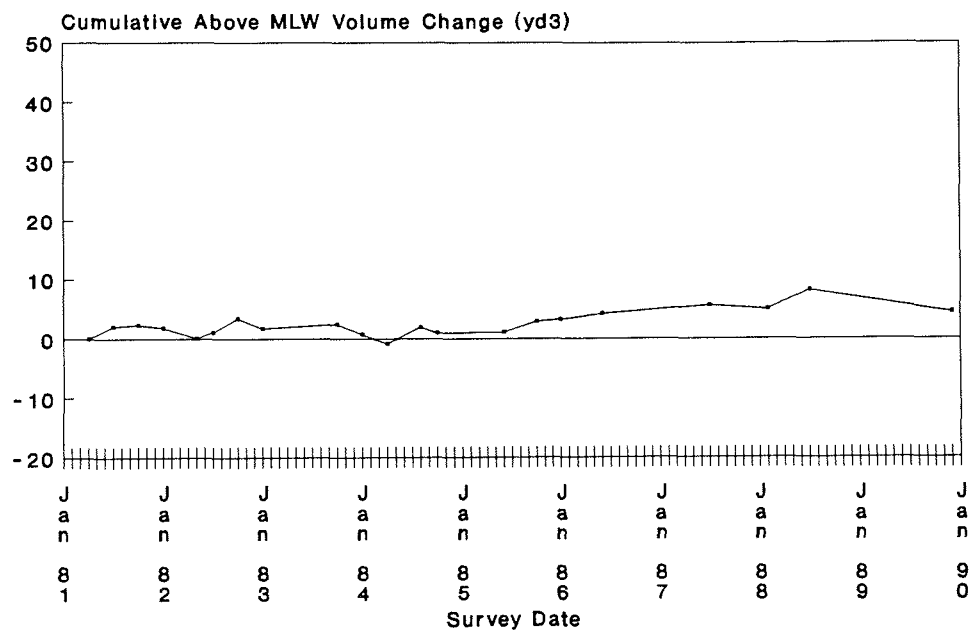
3. Similar to the shoreline change plots, volume changes were calculated between successive surveys for each profile line through time. Plots were made for cumulative above datum volume changes. Below datum volume changes were computed; however, due to insufficient offshore data on a large number of profile lines, these results were not considered in the final analysis.

4. Again, some of the plotted results in the west fillet area show dramatic increases in volume, which are generally evident of the construction of the west sand dike and of the old ebb shoal welding onto this portion of the beach. The profiles adjacent to Little River, Tubbs, Mad, and Hog Inlets also tend to show large and erratic volume changes due to dynamic inlet morphologies.

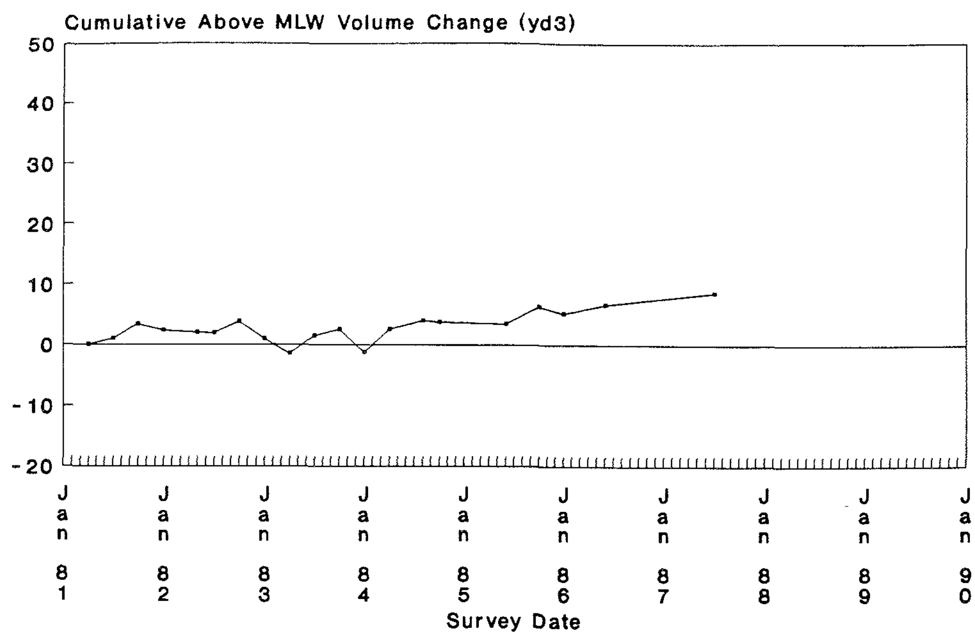
Profile Line 2



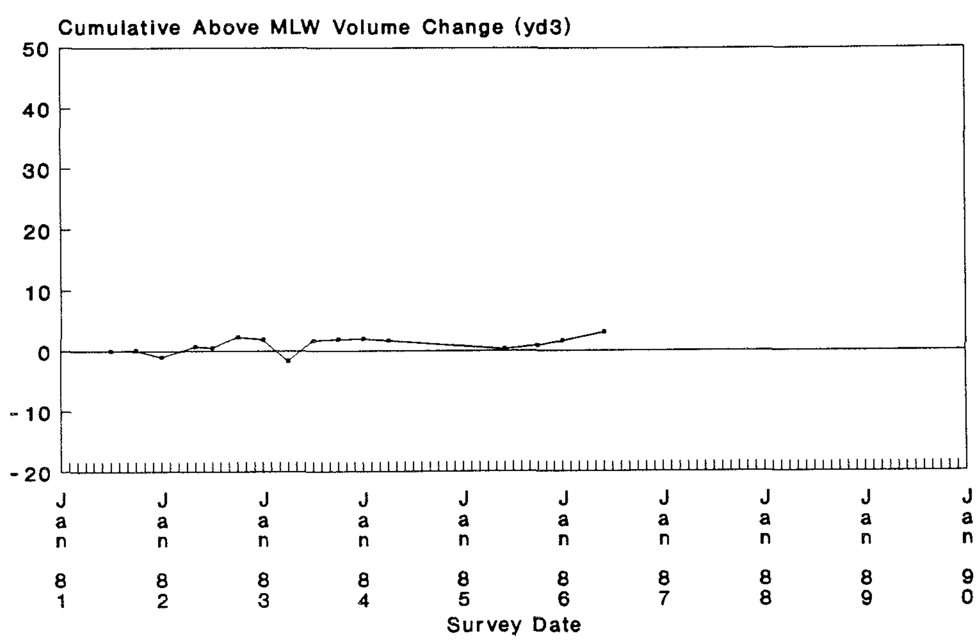
Profile Line 3



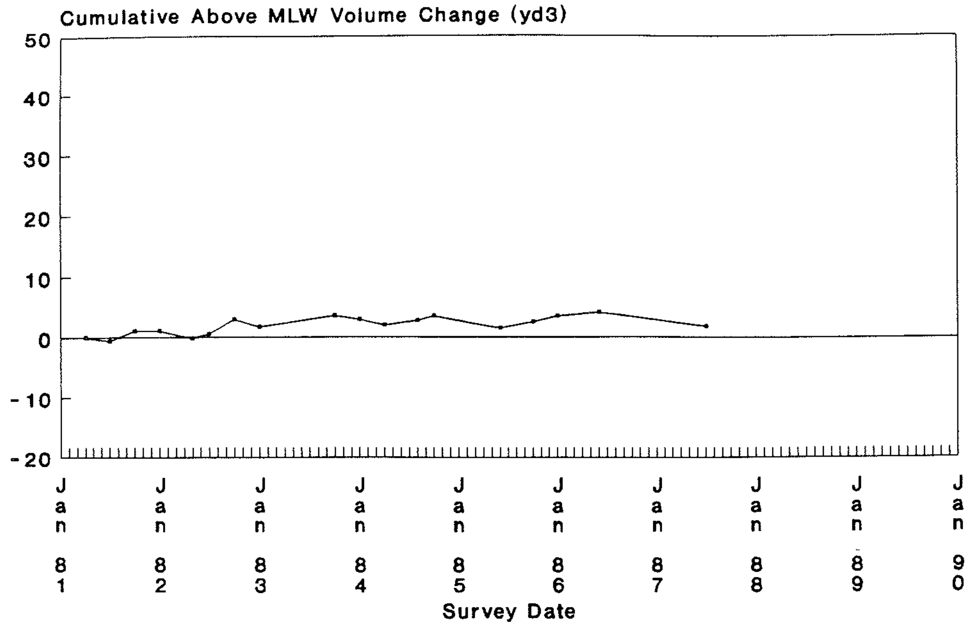
Profile Line 4



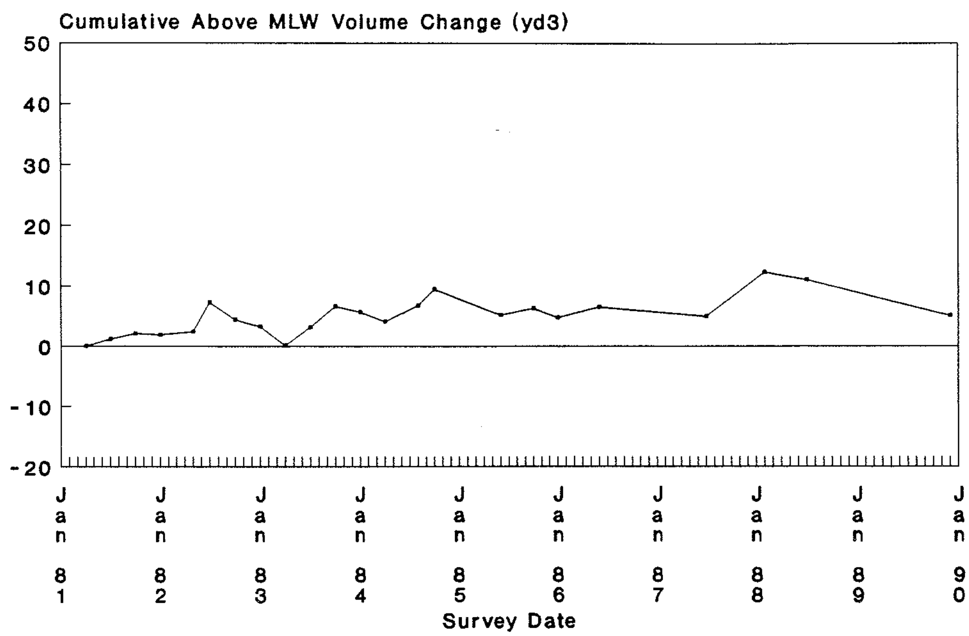
Profile Line 5



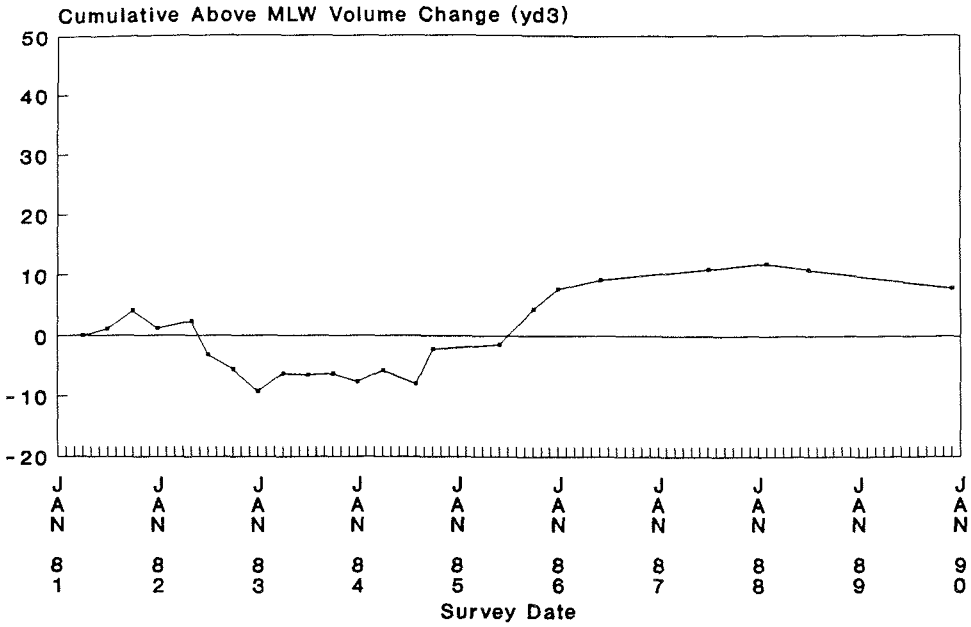
Profile Line 6



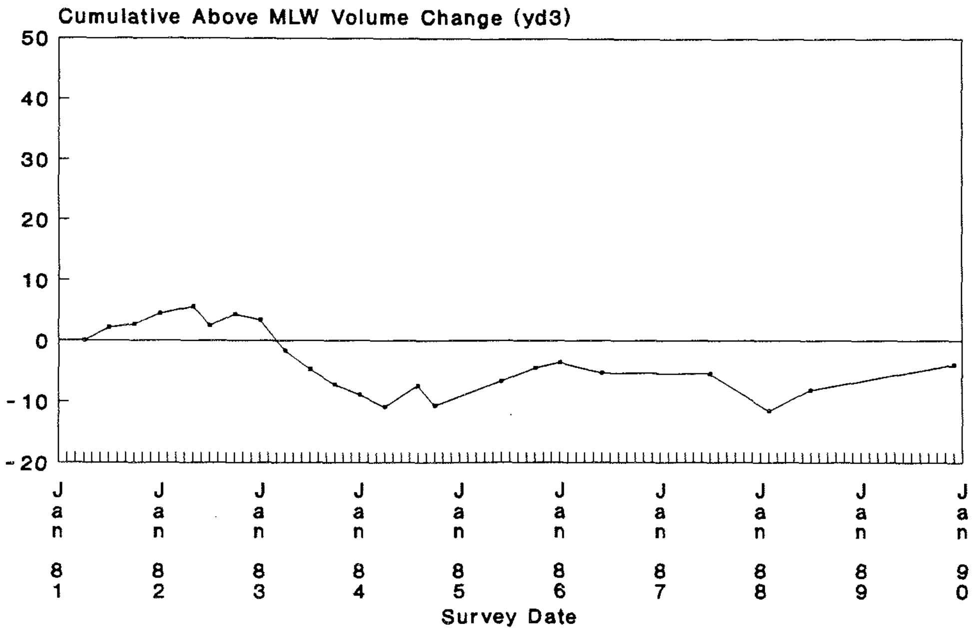
Profile Line 7



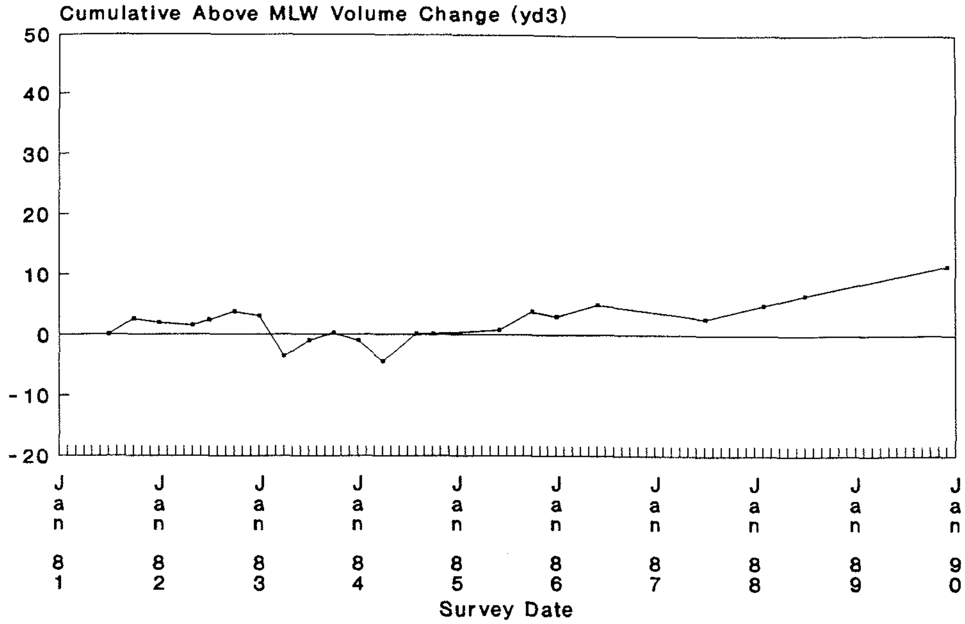
Profile Line 8



Profile Line 9



Profile Line 10



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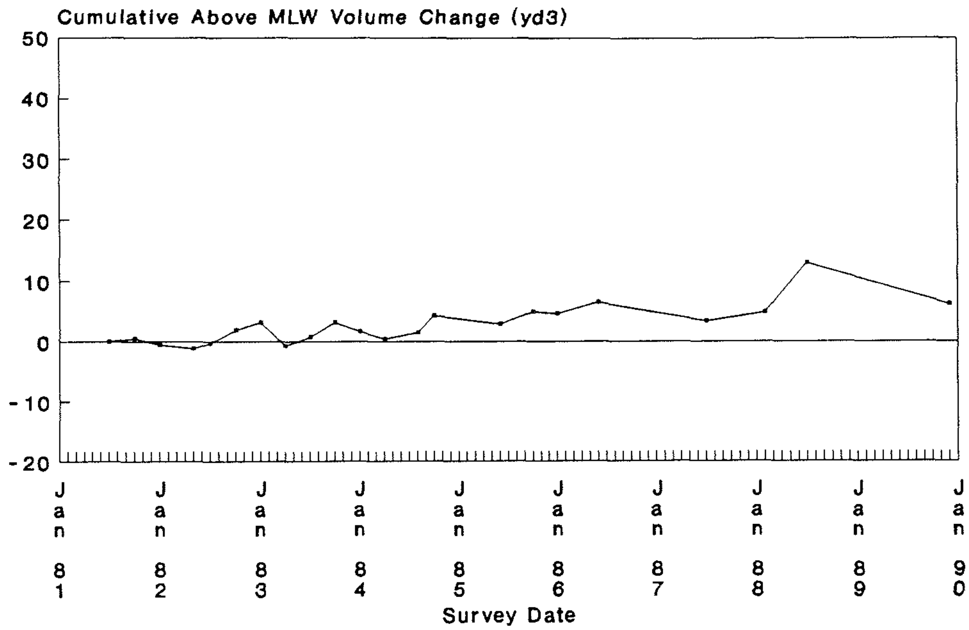

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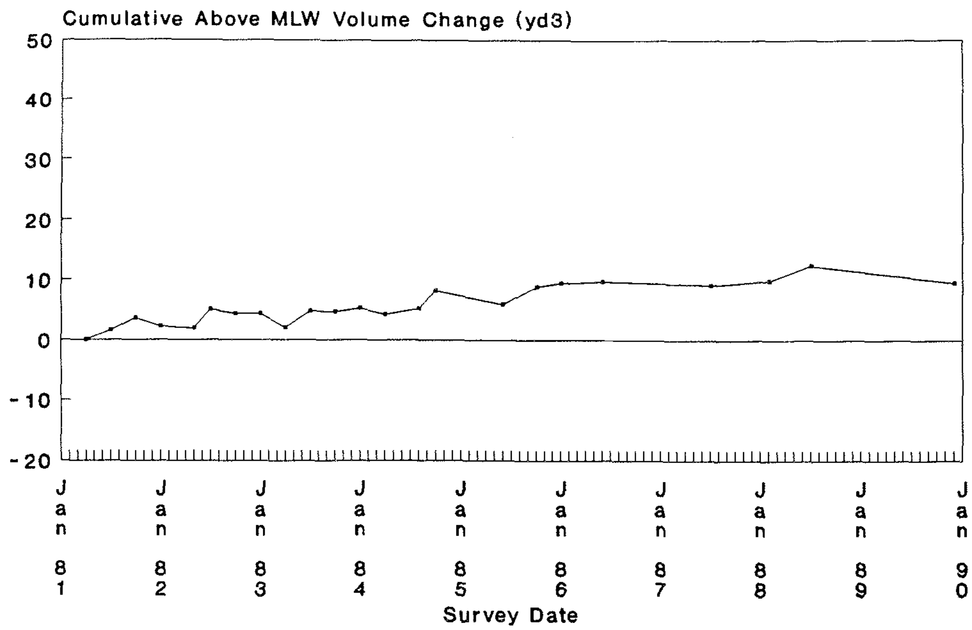

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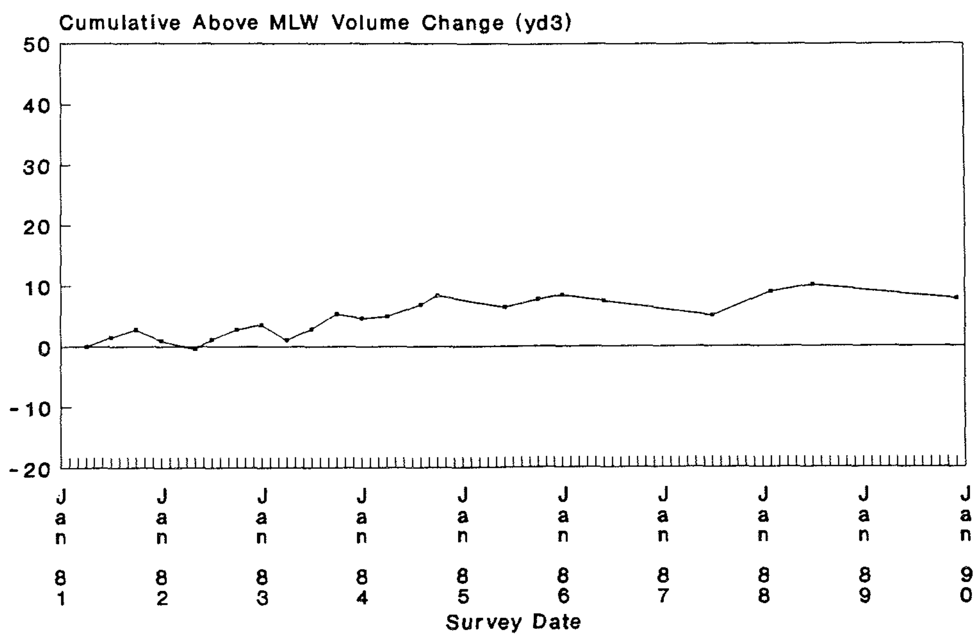

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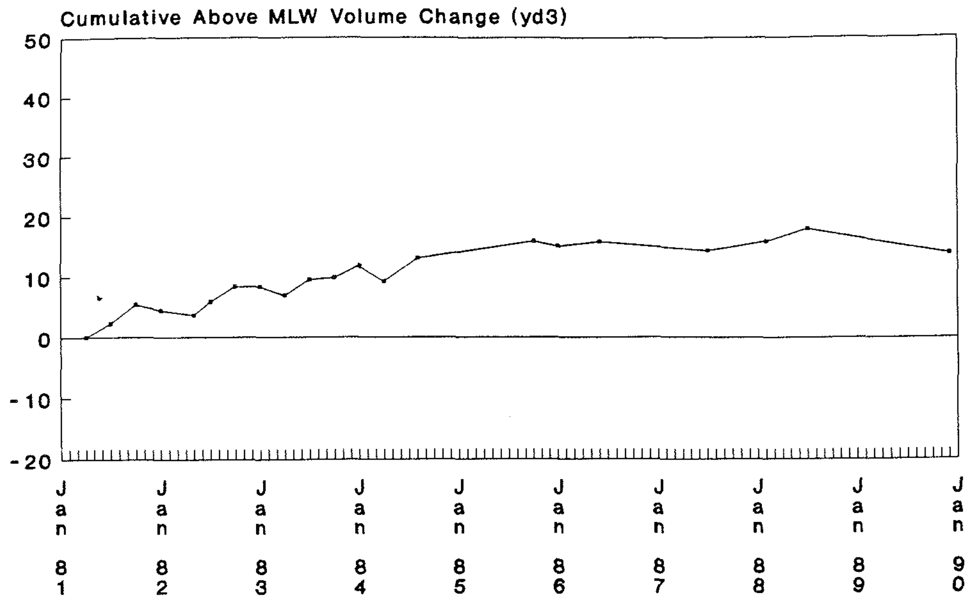

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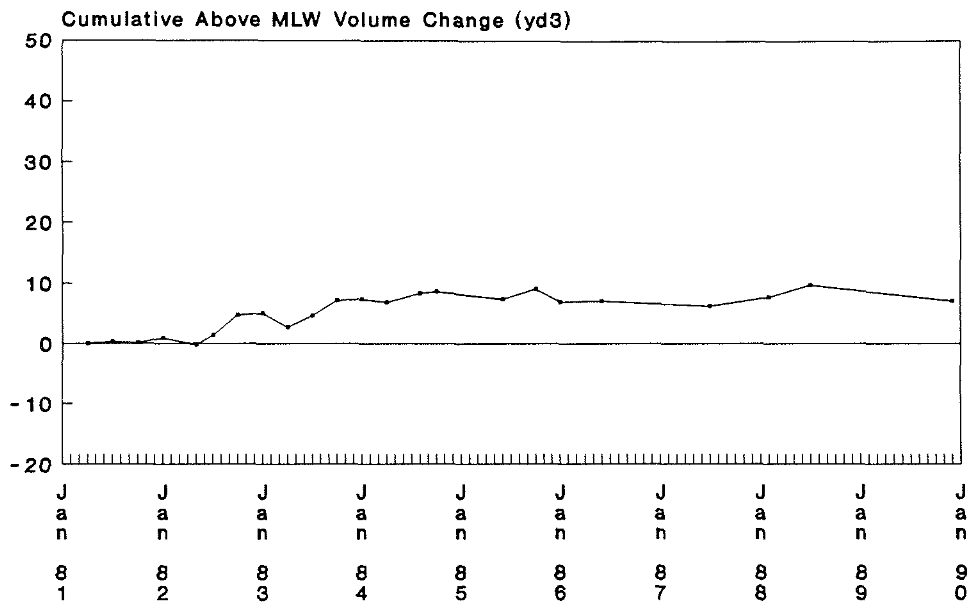

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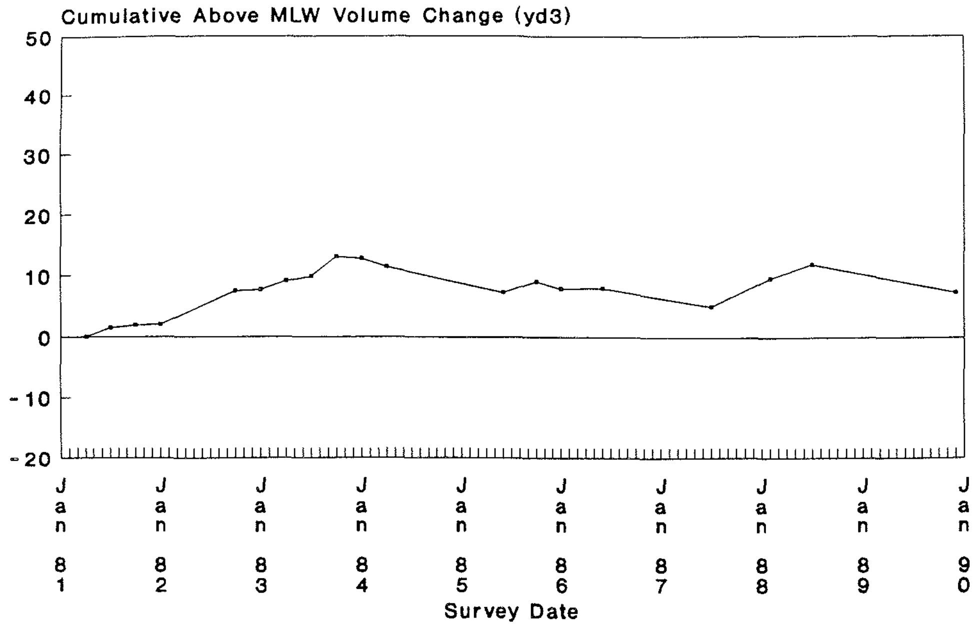

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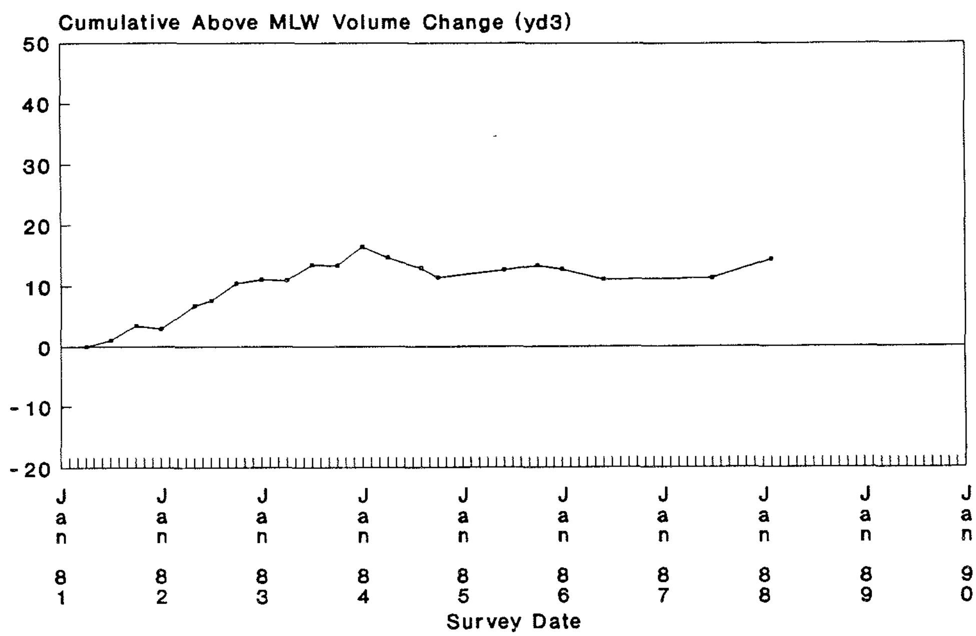

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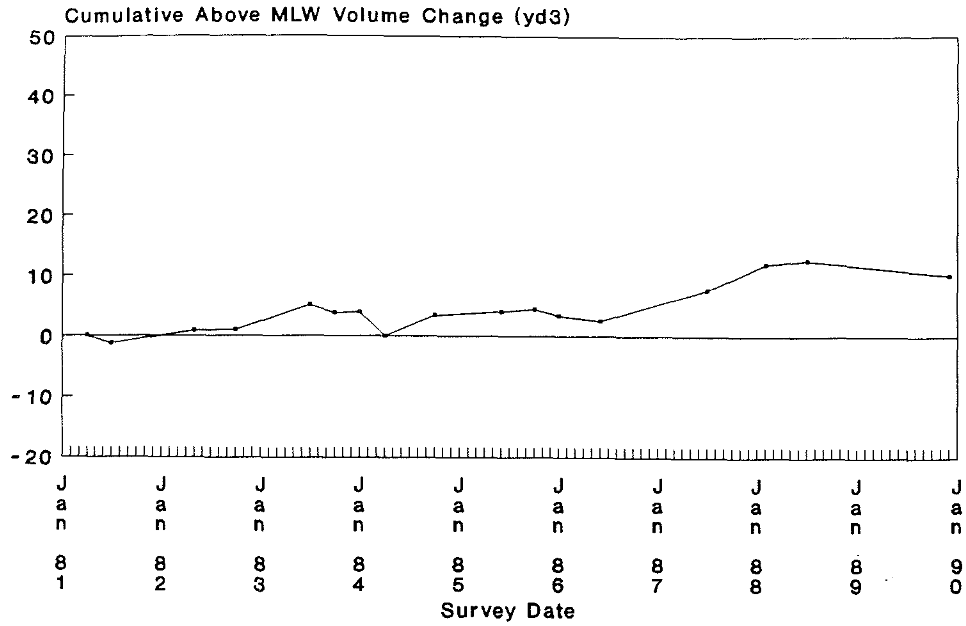

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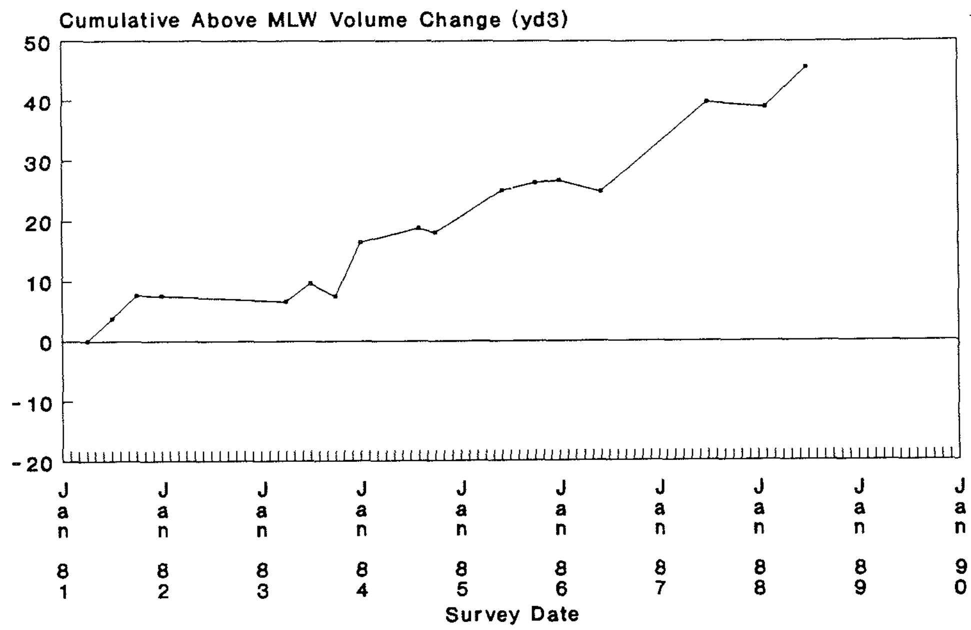

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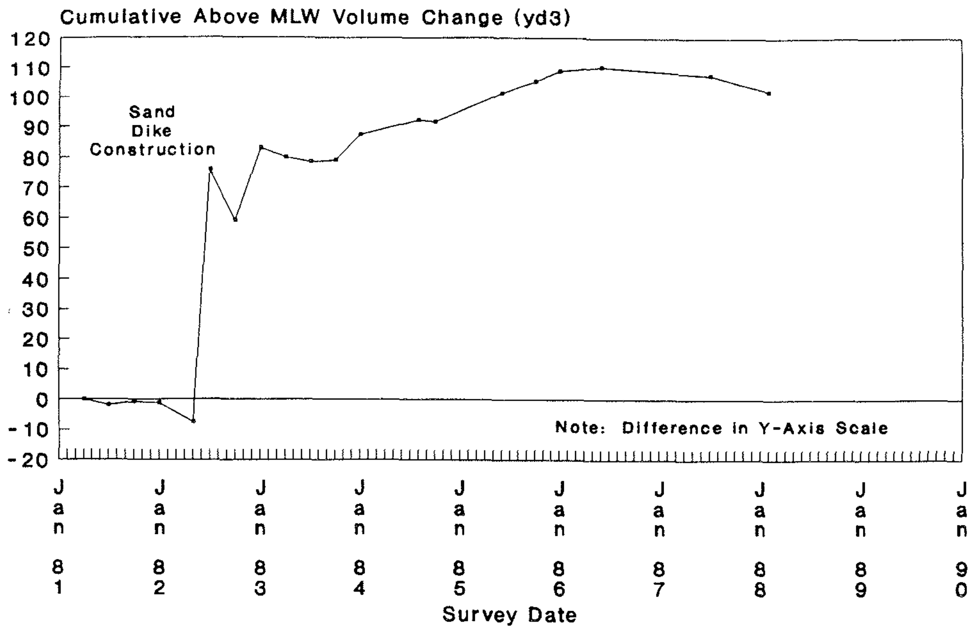

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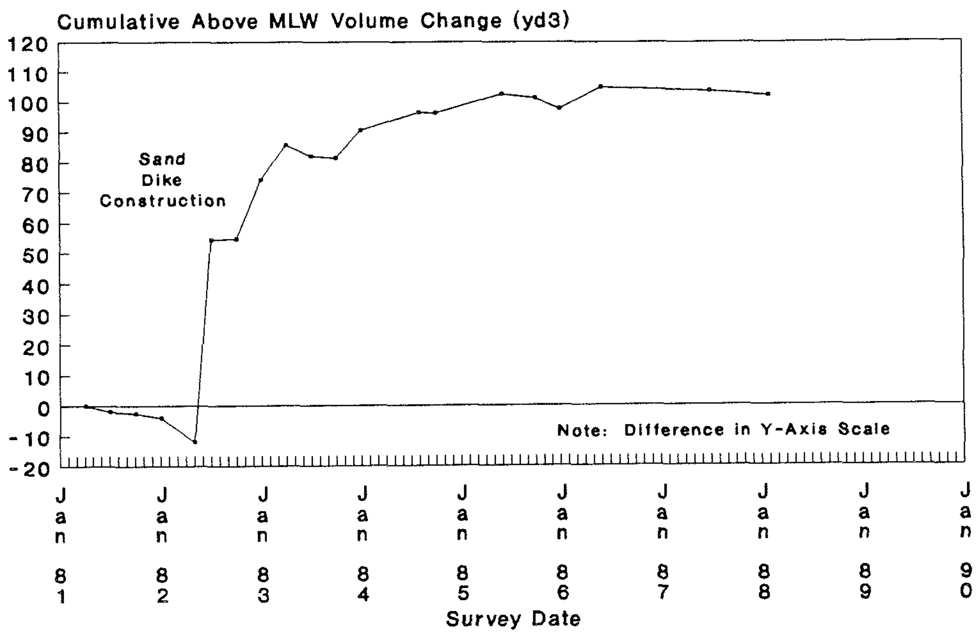

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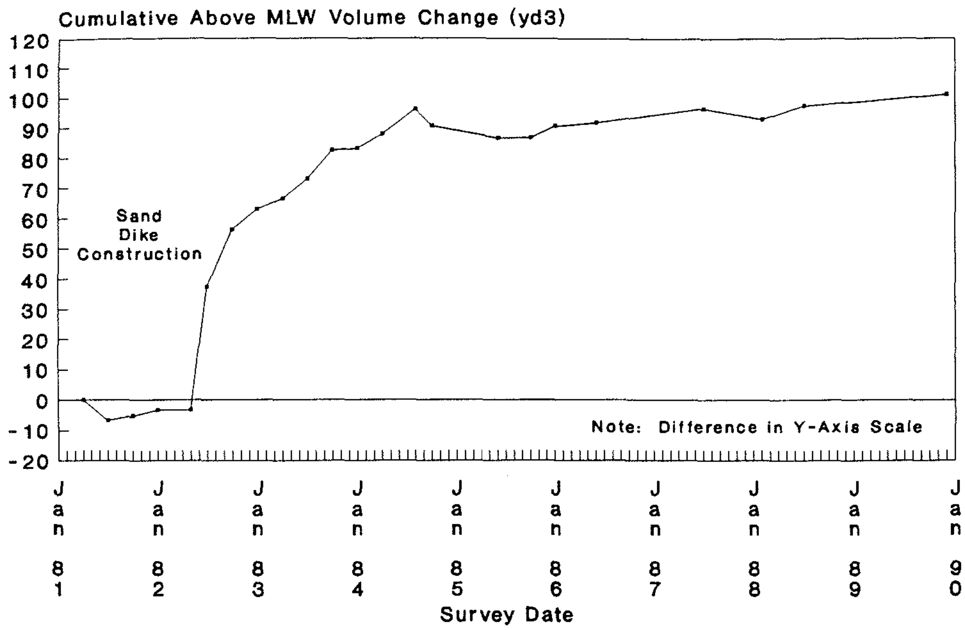

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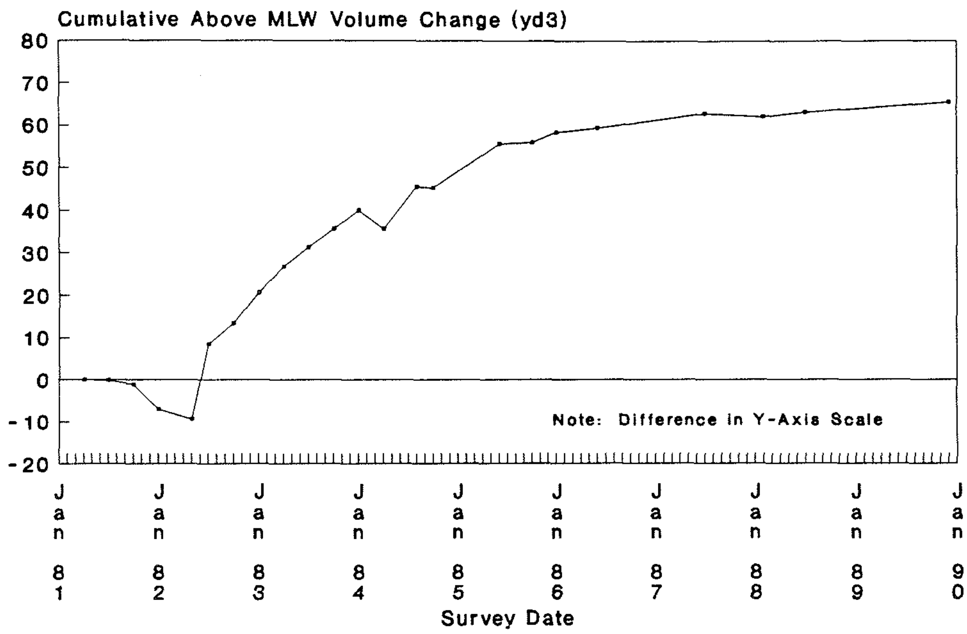

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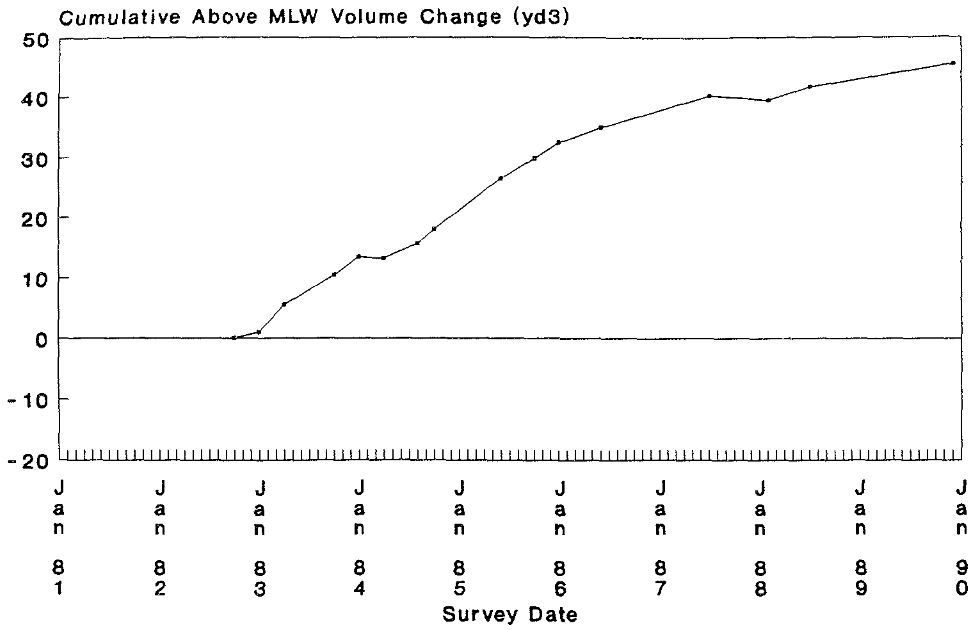

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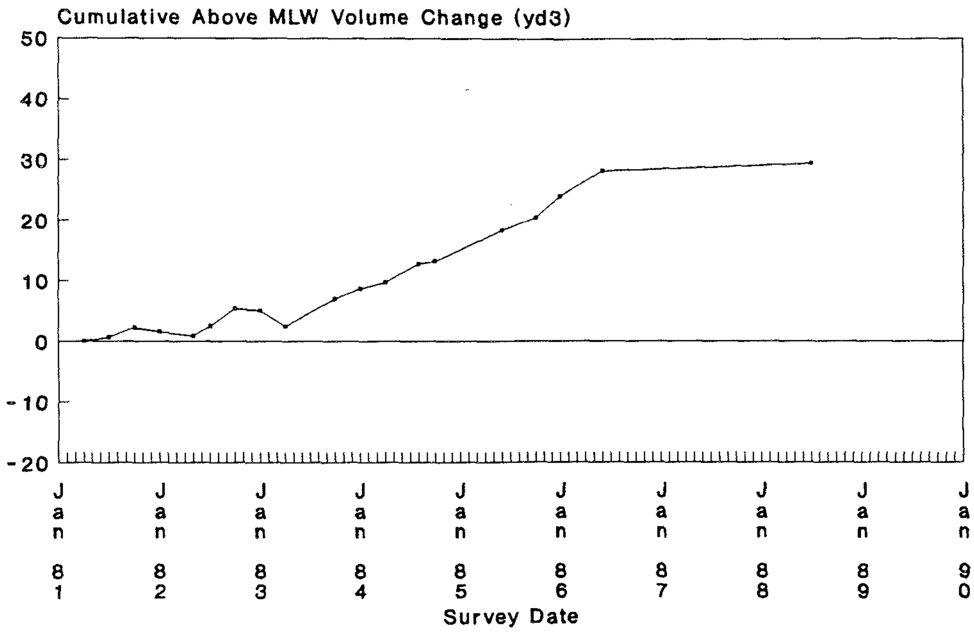

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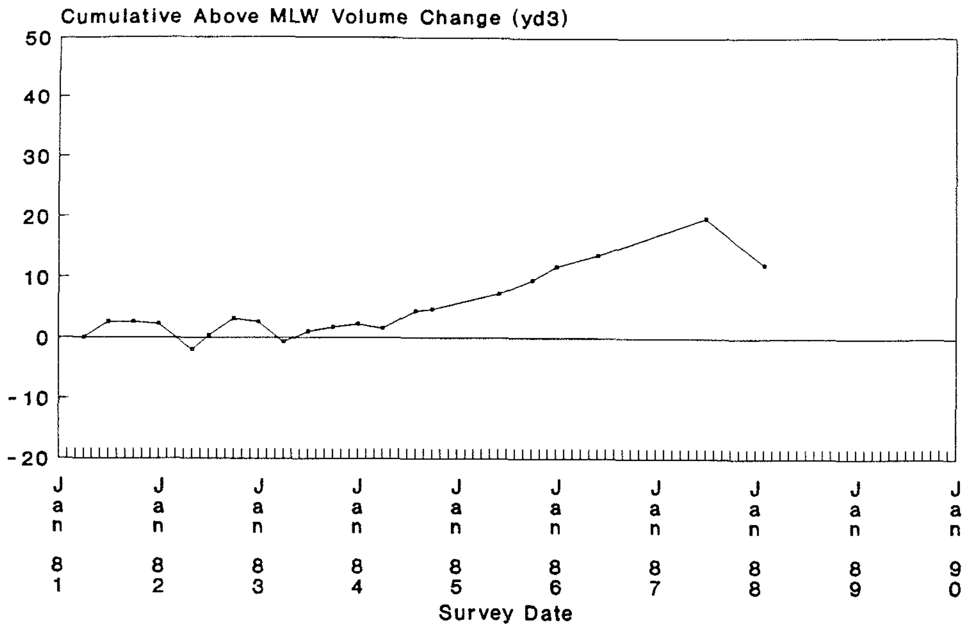

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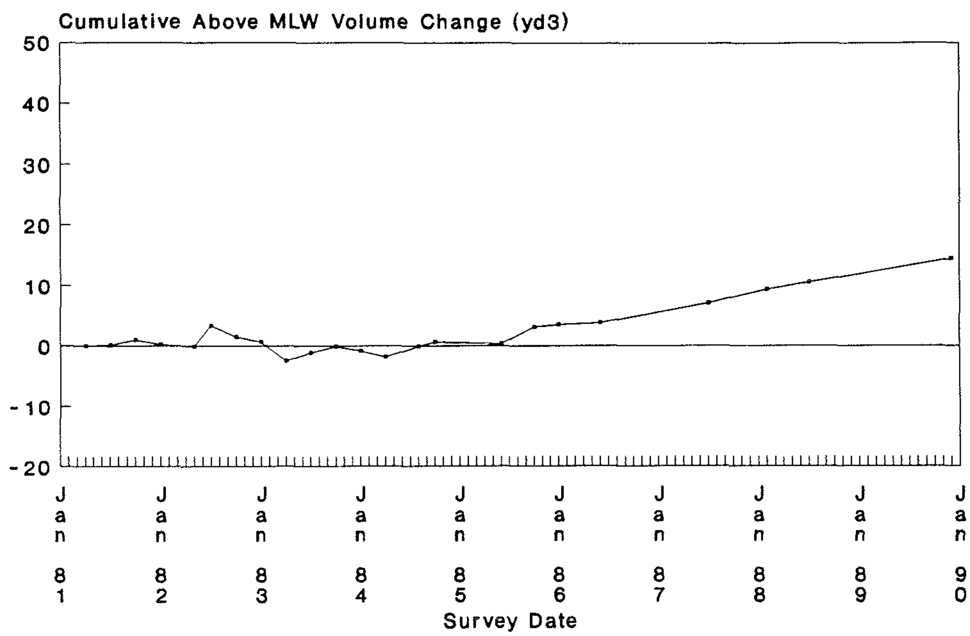

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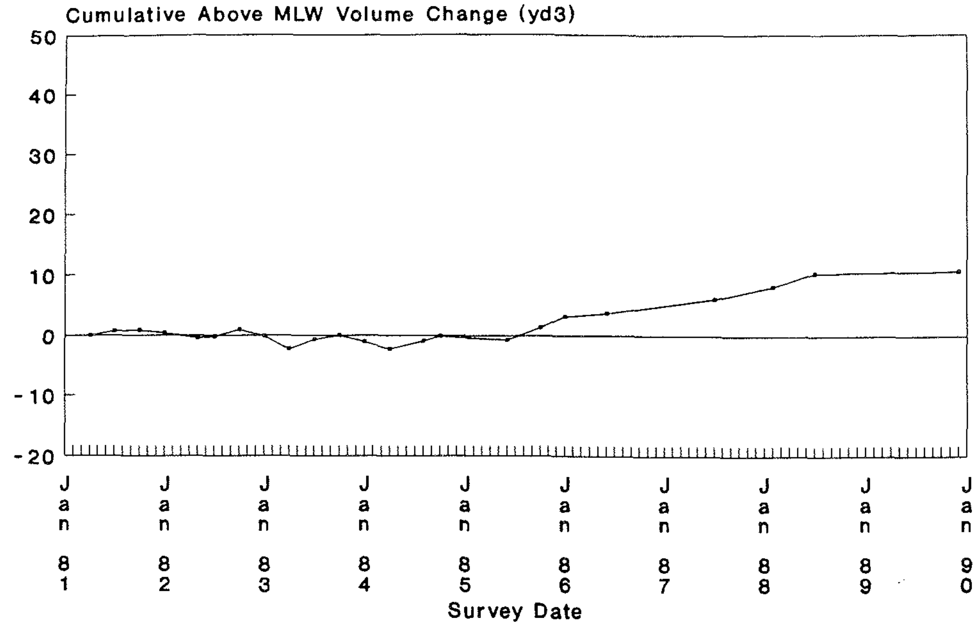

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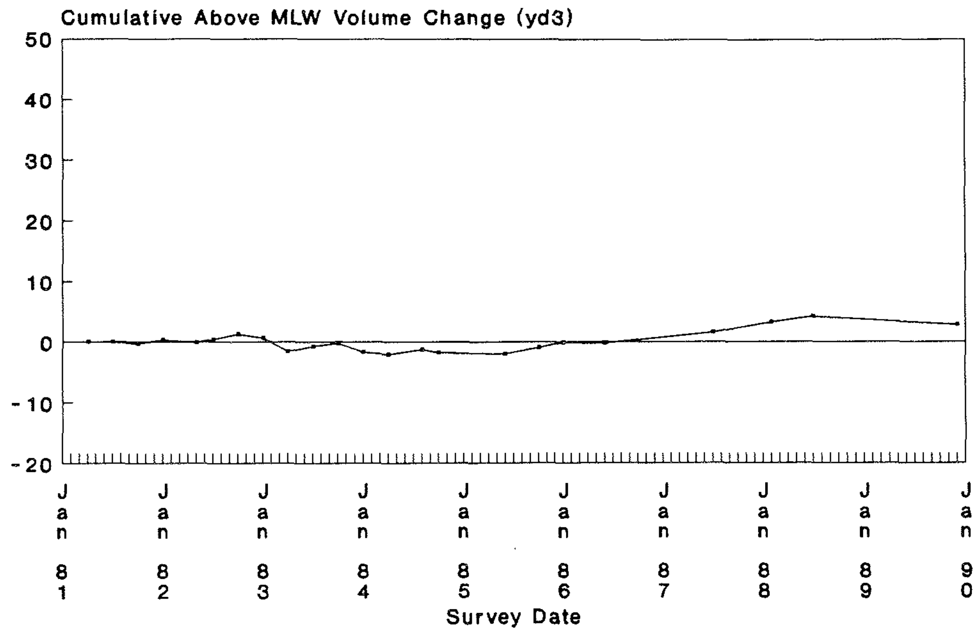

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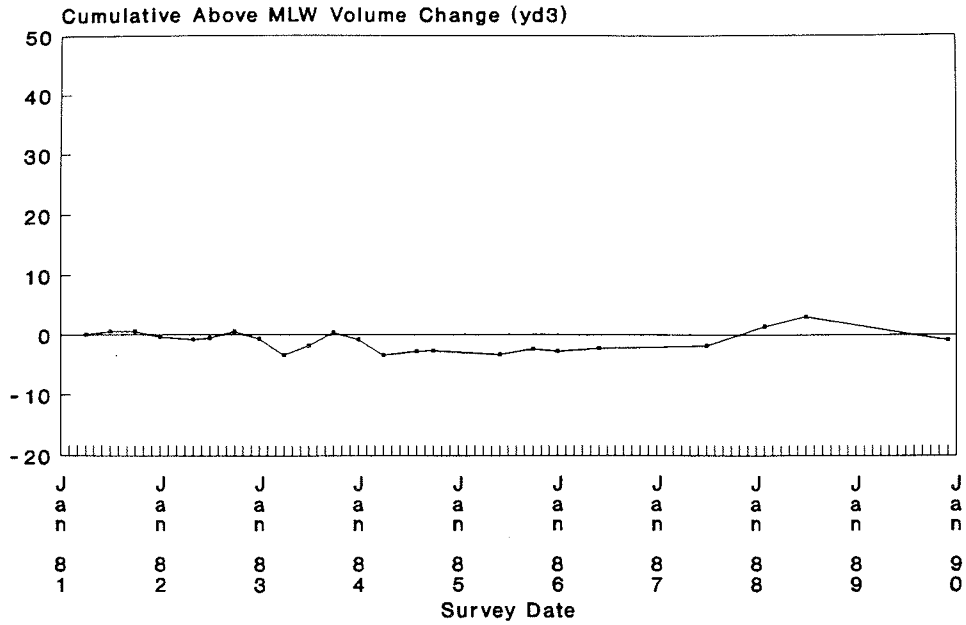

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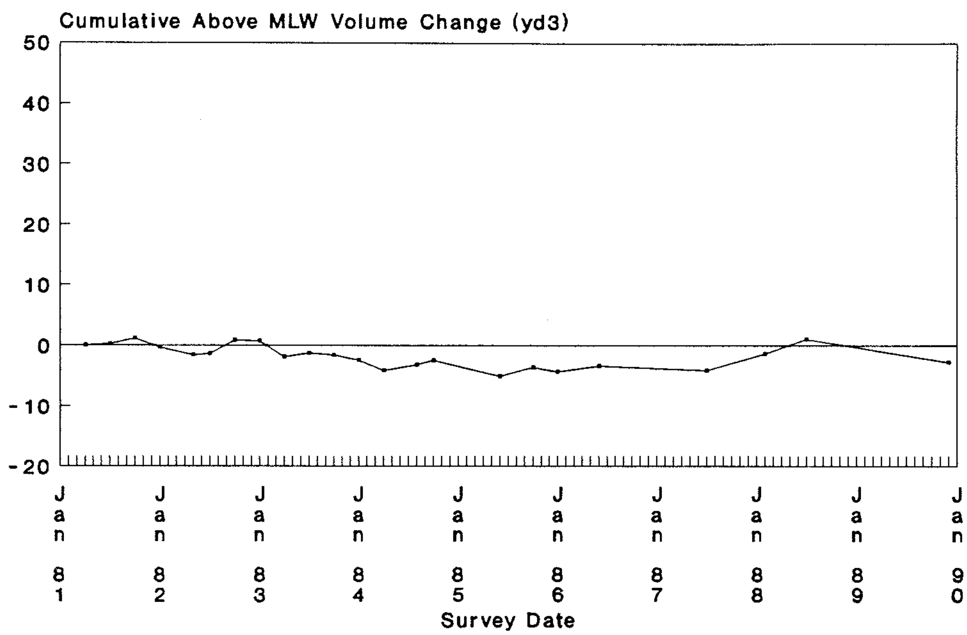

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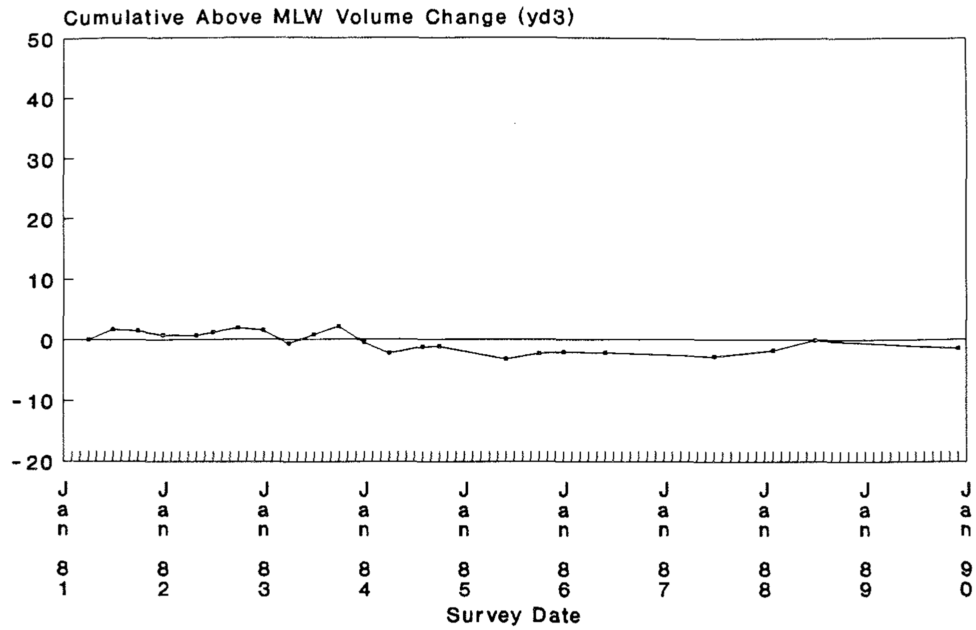

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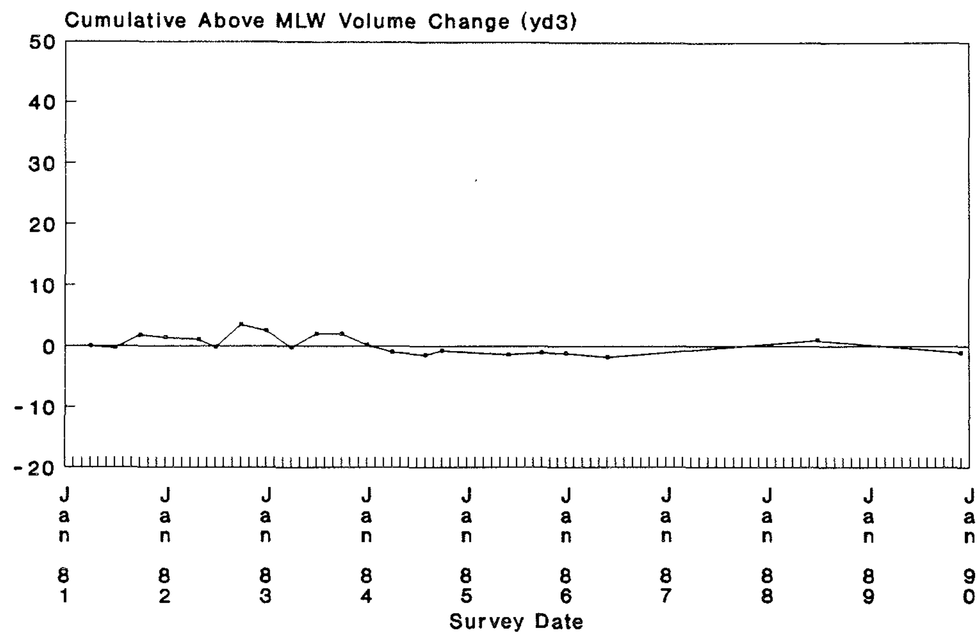

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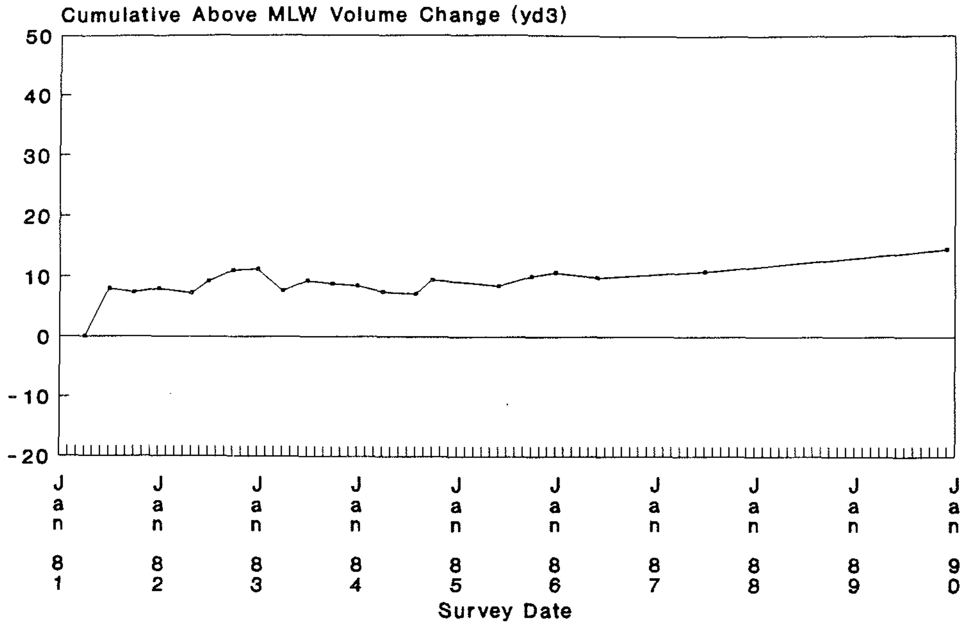

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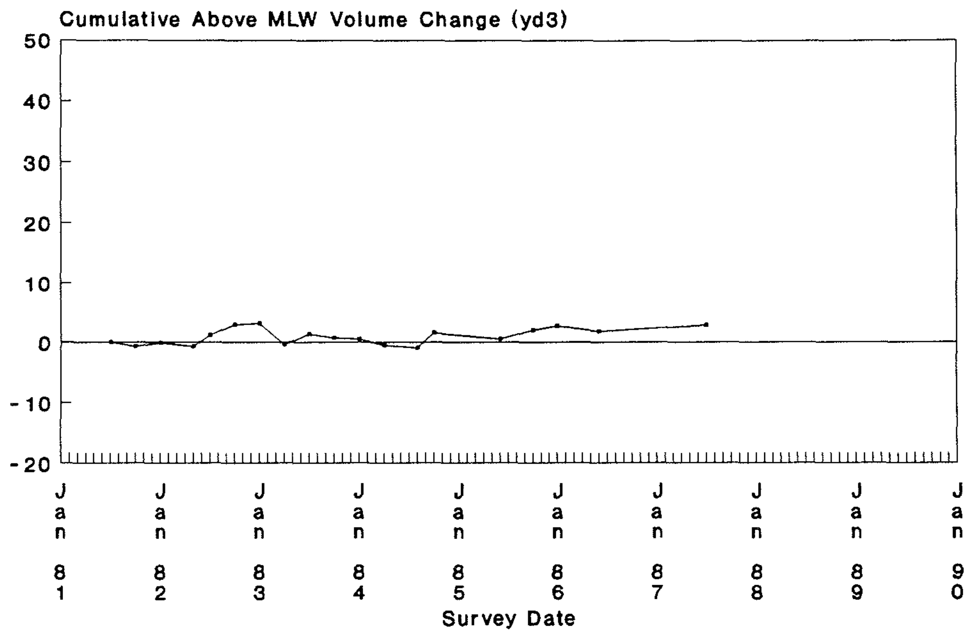
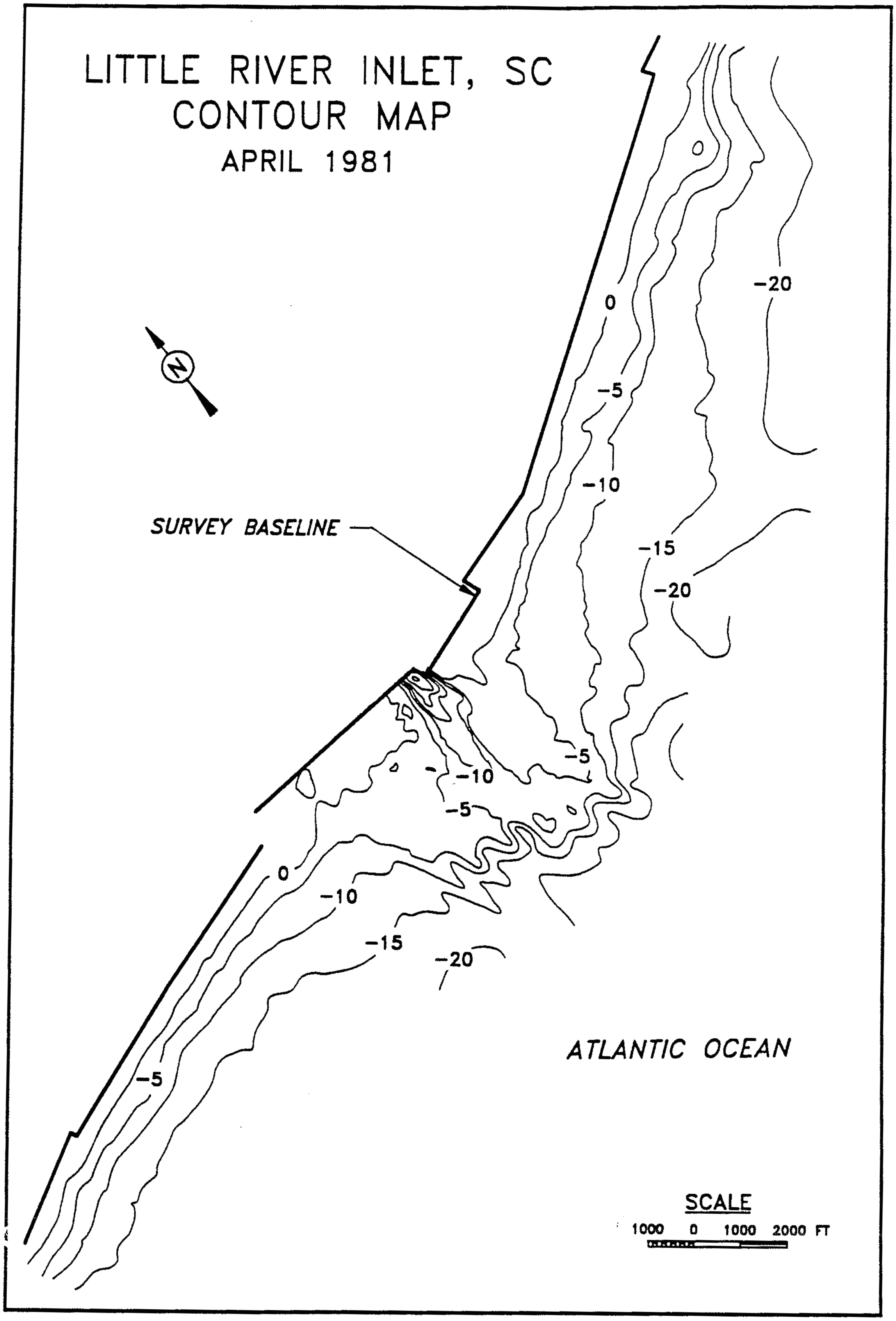
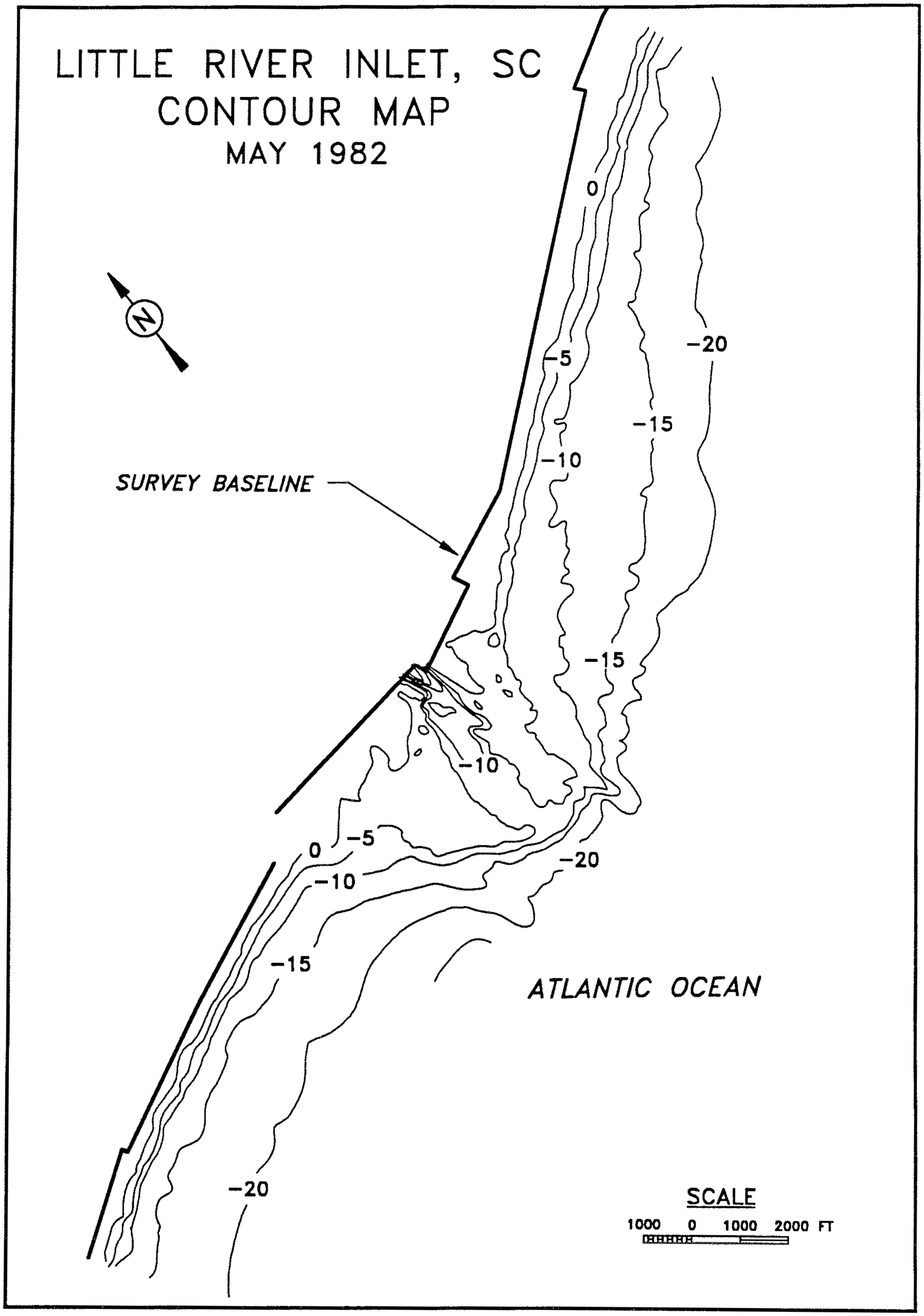


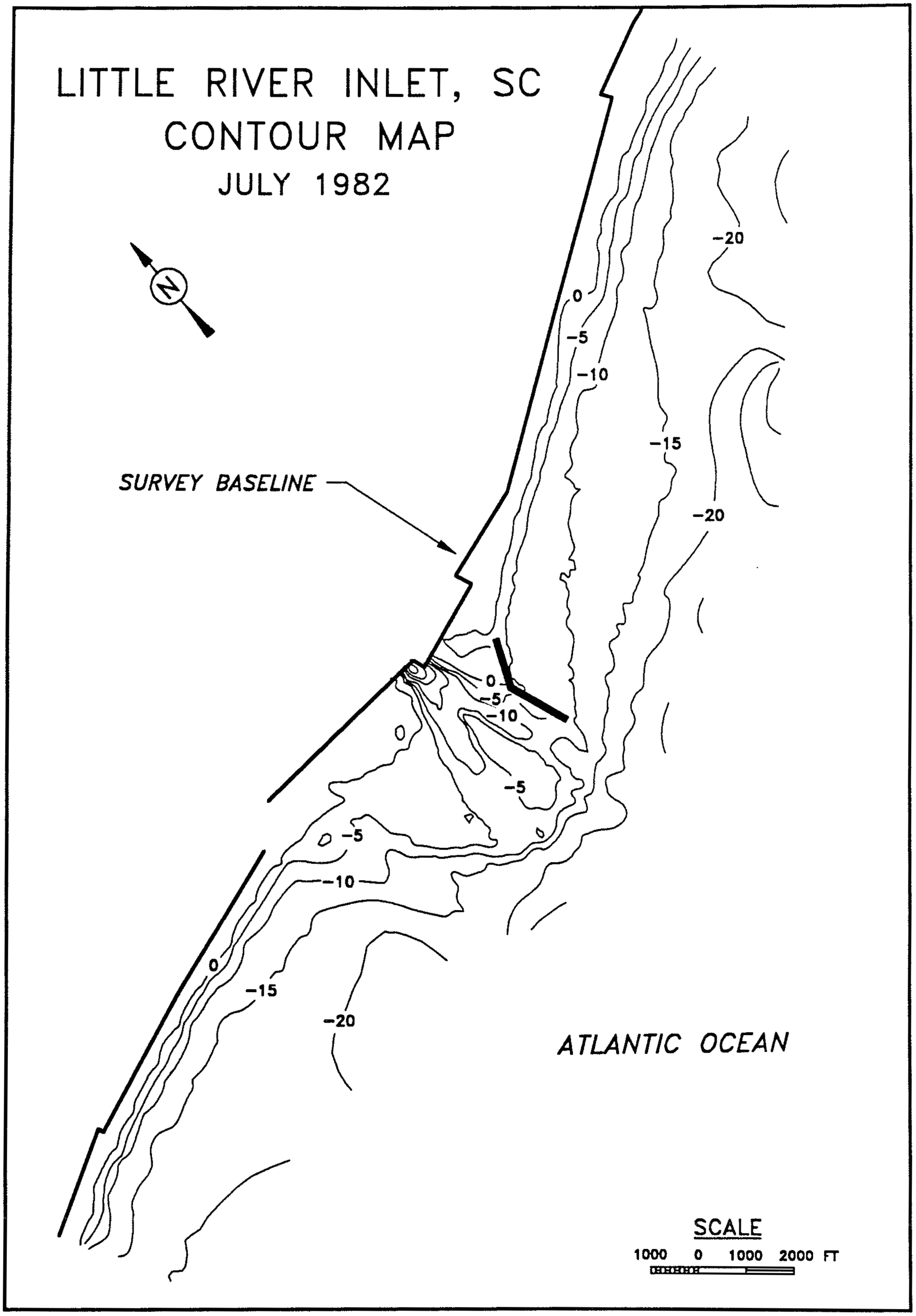
APPENDIX E:

BATHYMETRIC CONTOUR MAPS

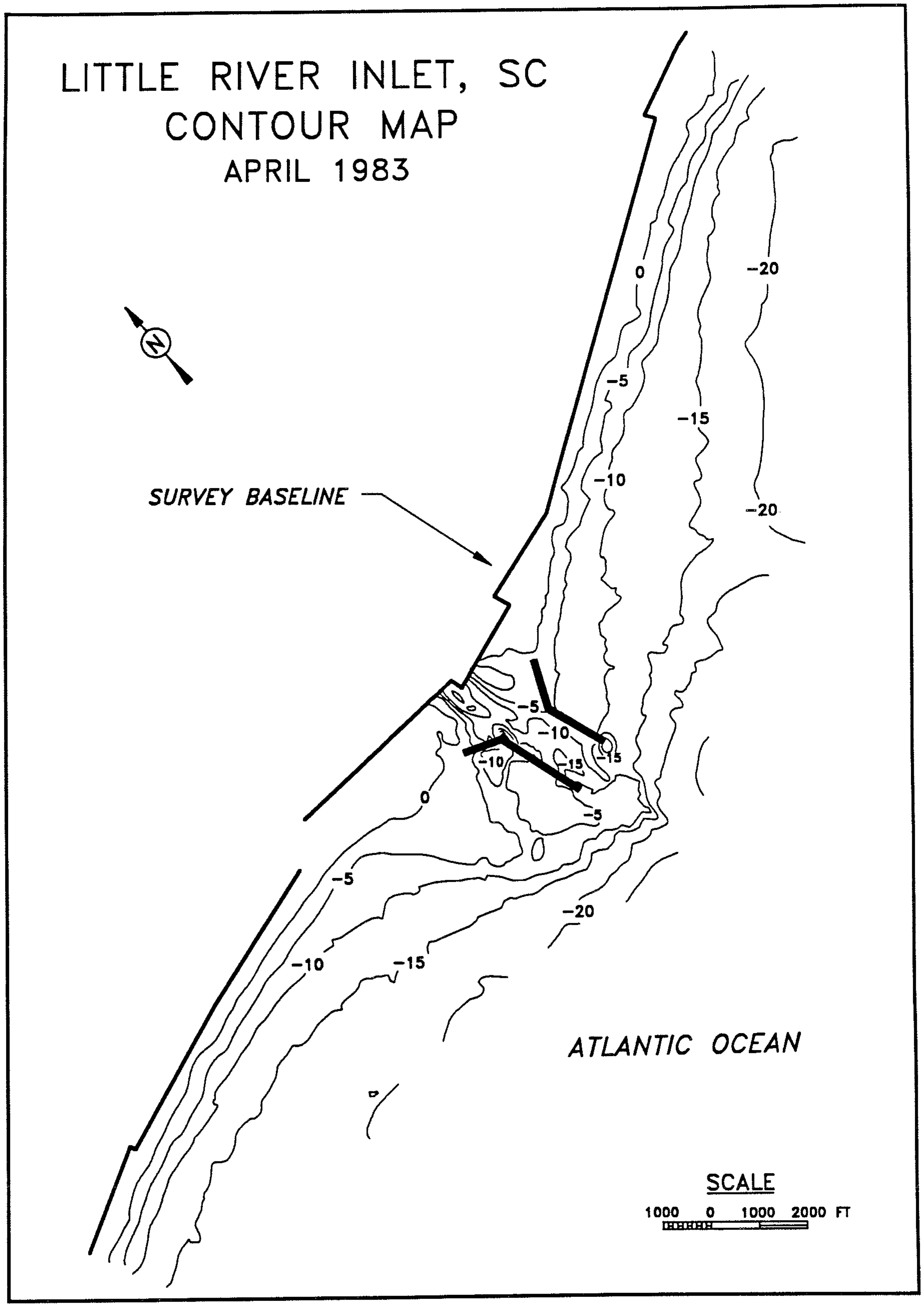

LITTLE RIVER INLET, SC
CONTOUR MAP
APRIL 1981
SURVEY BASELINE
0
-5
-10
-15
-20
-20
-5
-10
-5
0
-10
-15
-20
-5
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT

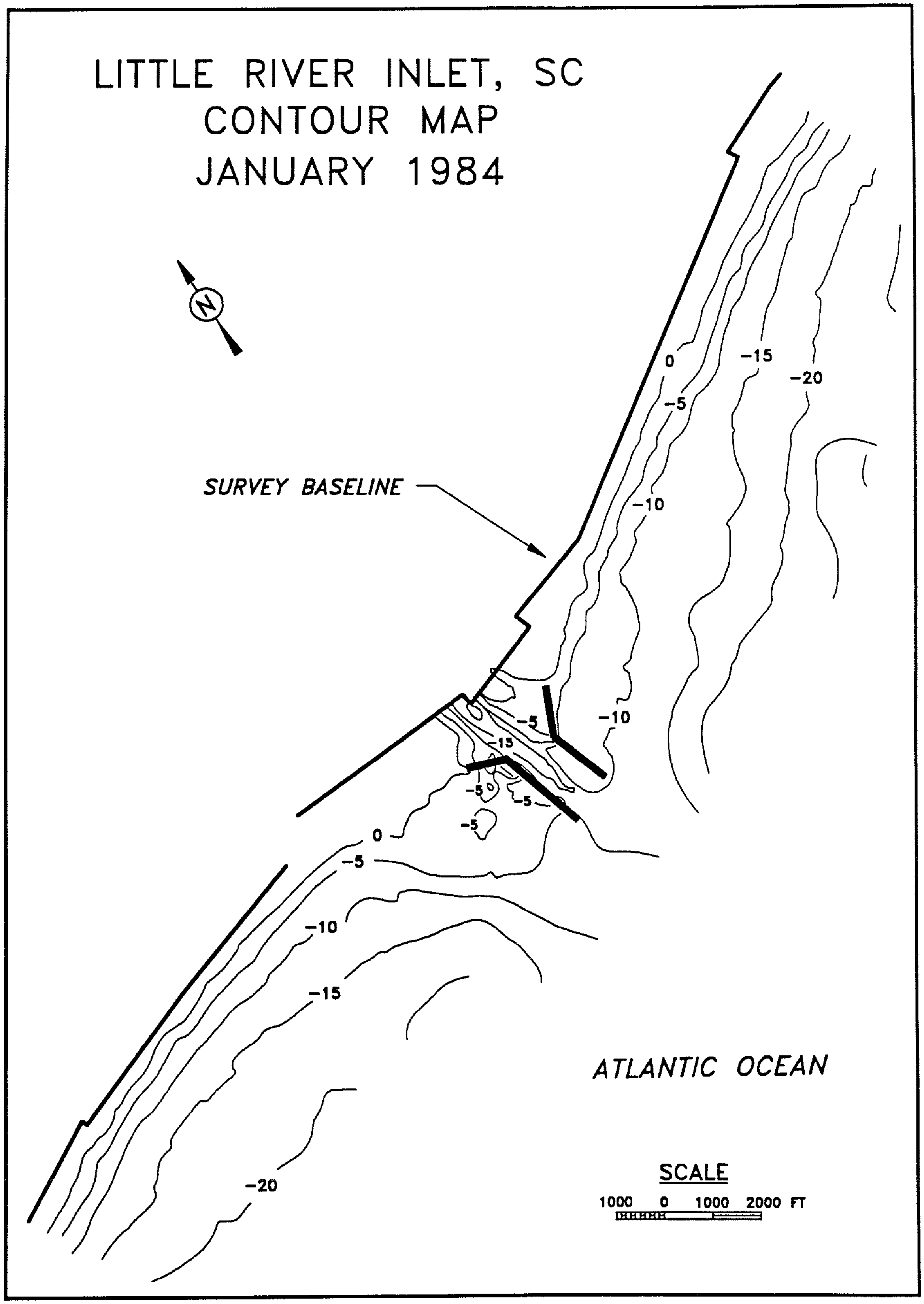


LITTLE RIVER INLET, SC
CONTOUR MAP
MAY 1982
N
SURVEY BASELINE
0
-5
-10
-15
-20
-15
-10
0
-5
-10
-15
-20
-20
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT

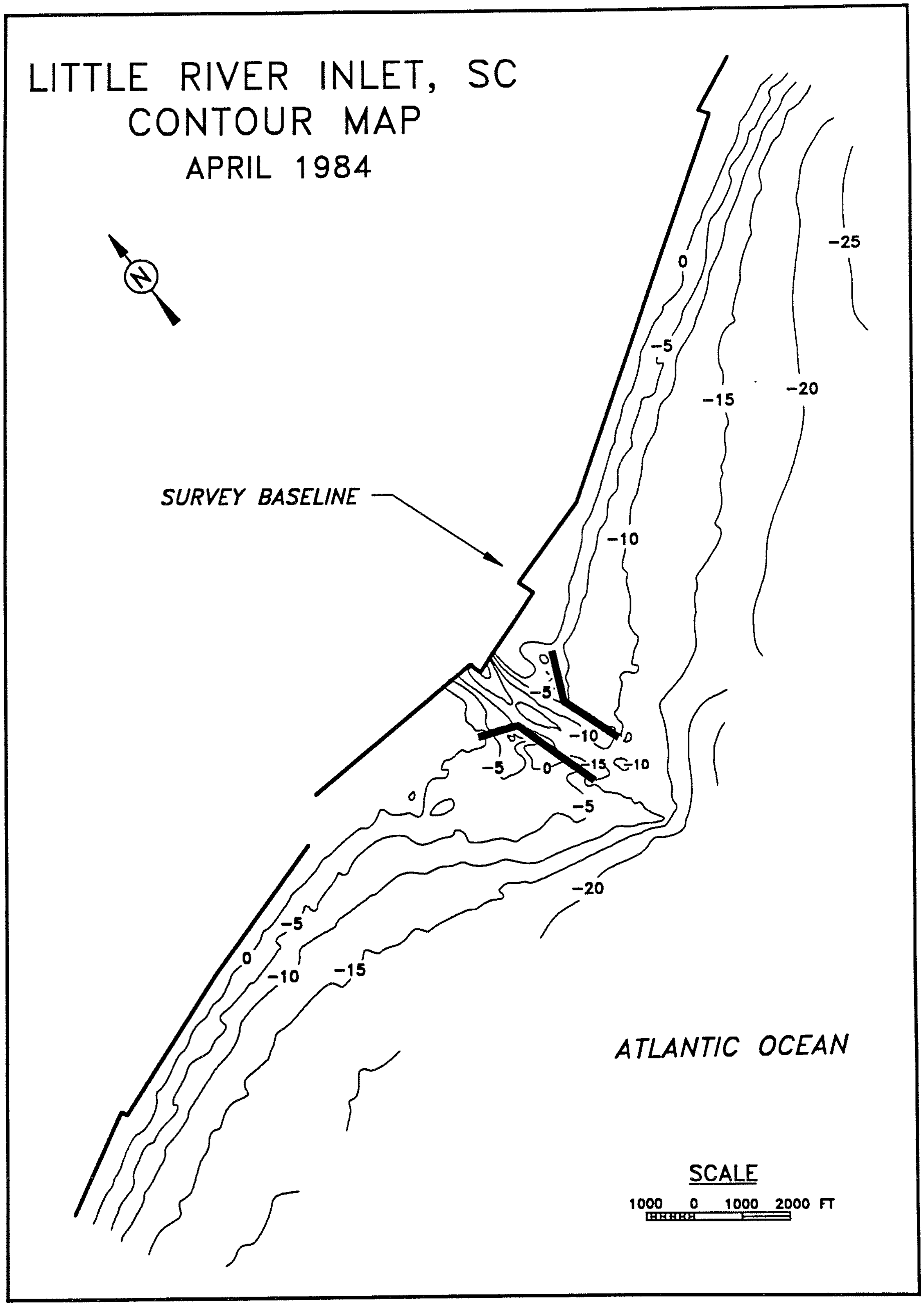


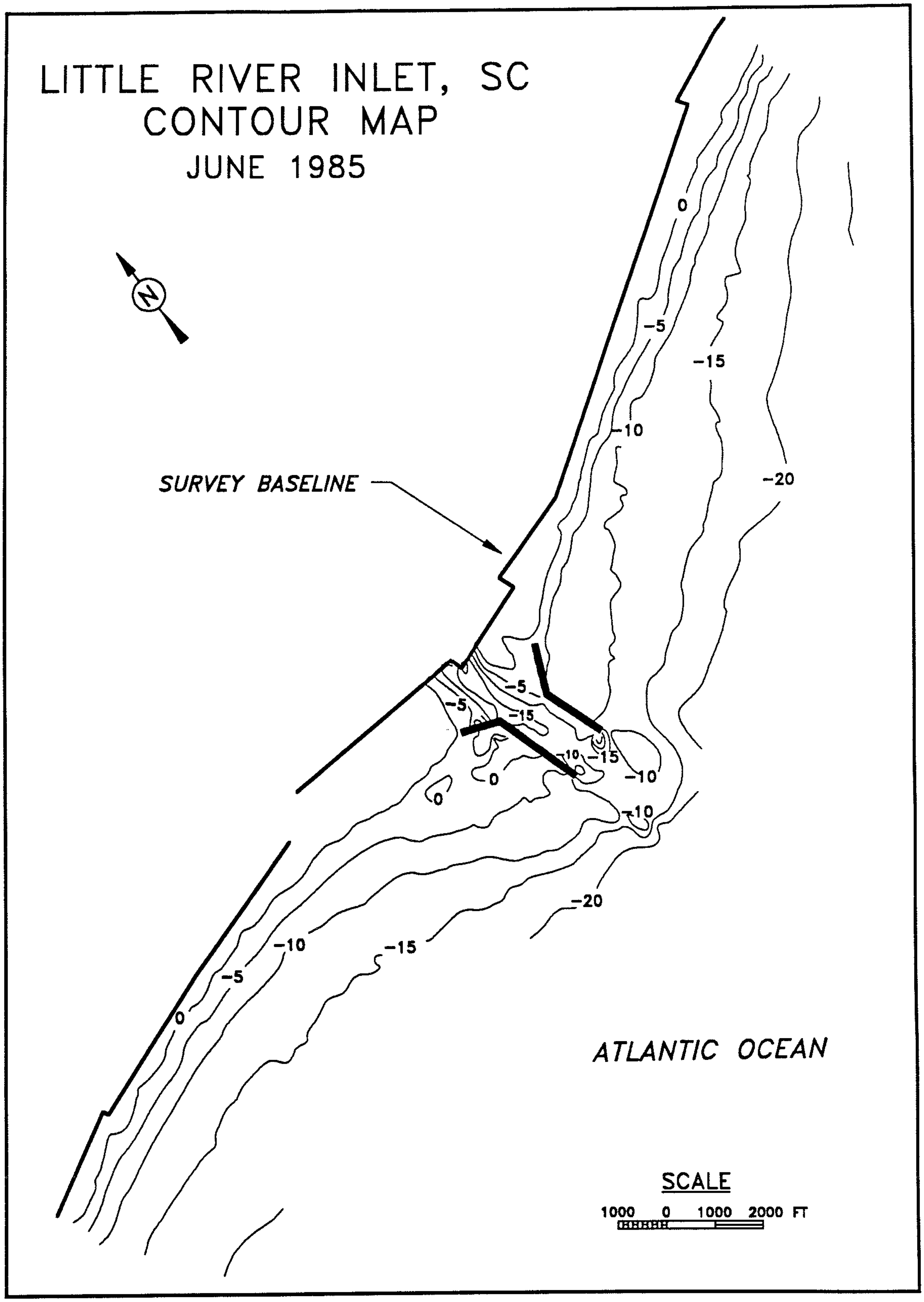
LITTLE RIVER INLET, SC
CONTOUR MAP
JULY 1982
N
SURVEY BASELINE
0
−5
−10
−15
−20
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT

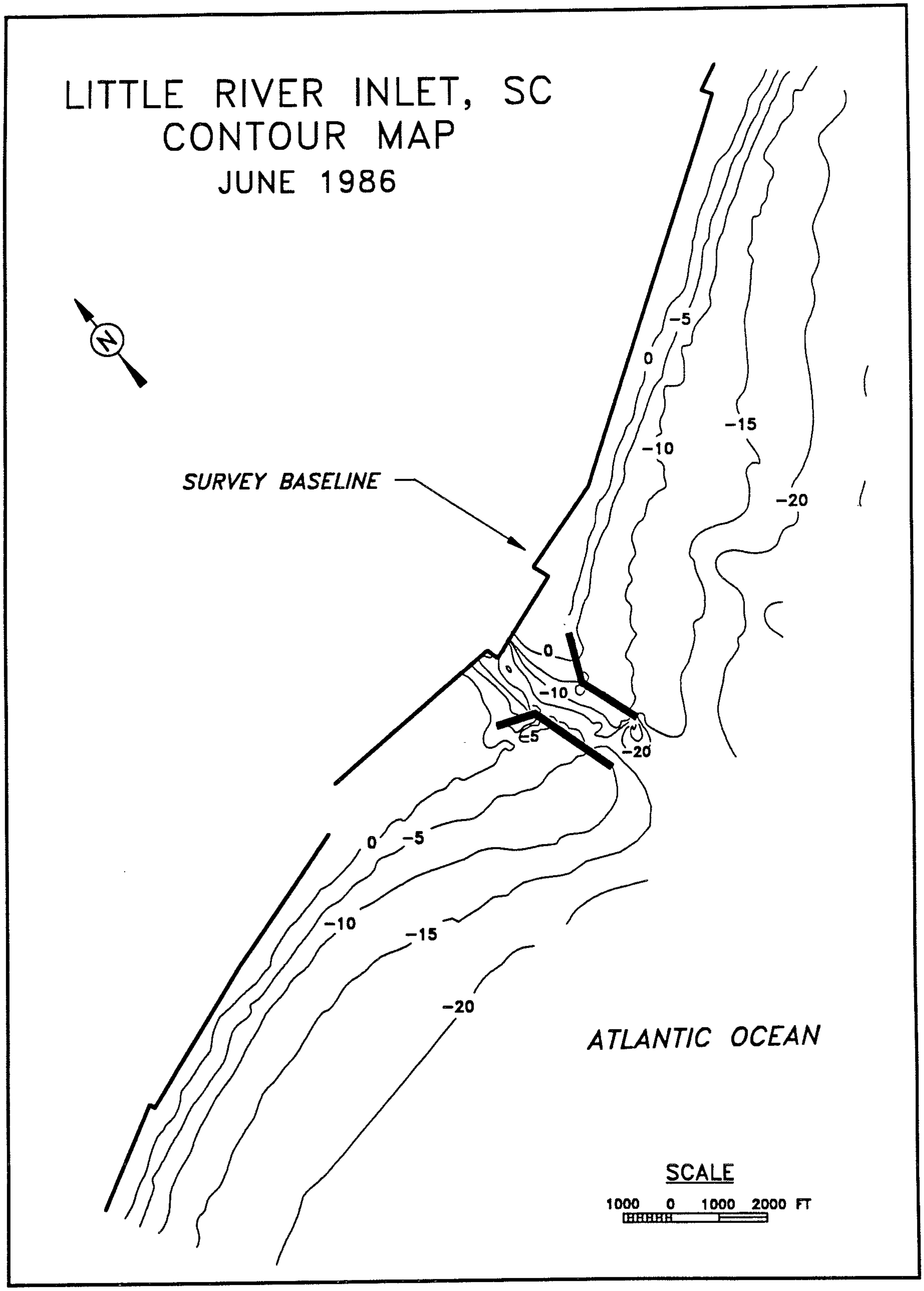

LITTLE RIVER INLET, SC
CONTOUR MAP
APRIL 1983
N
SURVEY BASELINE
0
-5
-10
-15
-20
-5
-10
-15
-10
-15
-5
0
-5
-20
-10
-15
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT



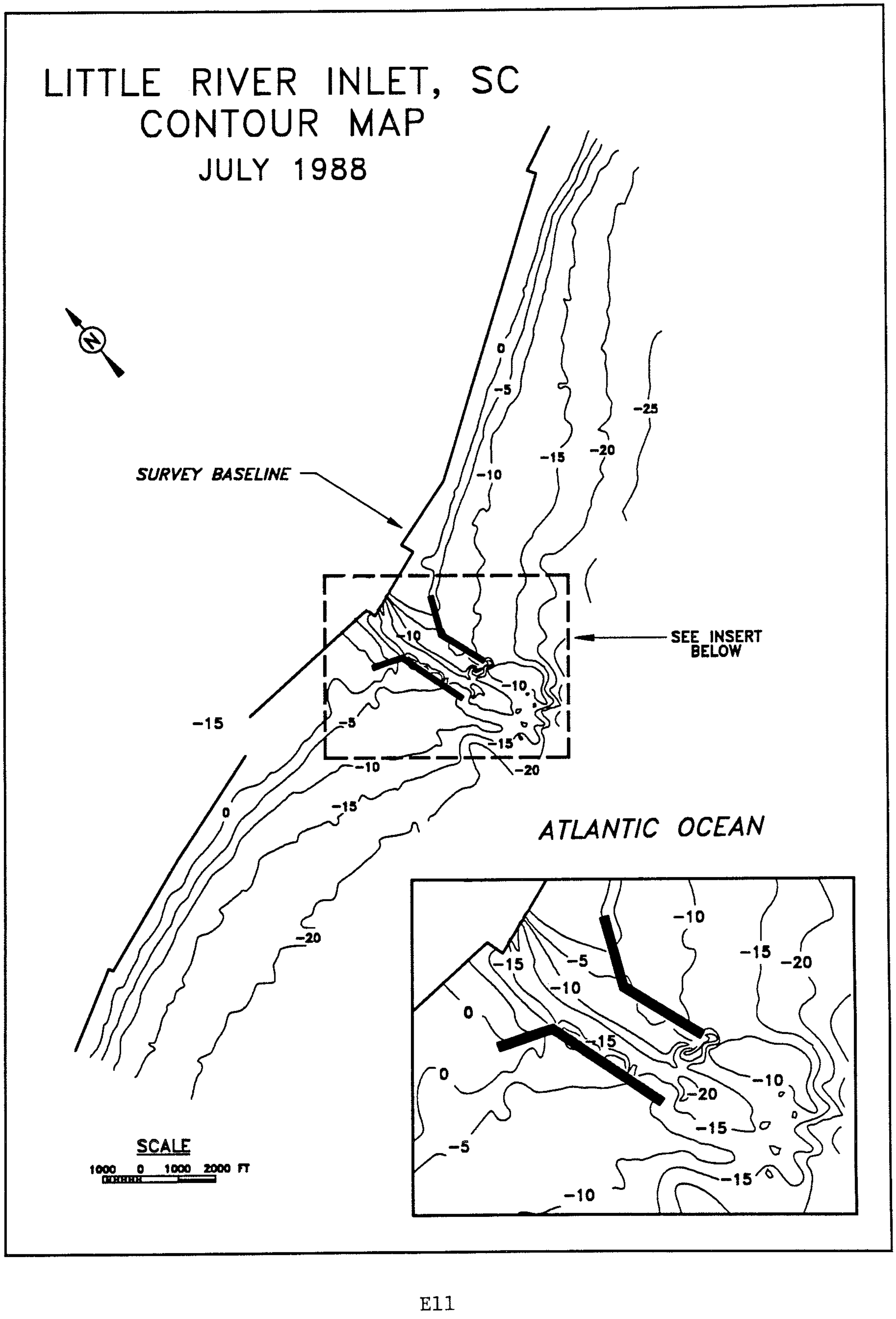
LITTLE RIVER INLET, SC
CONTOUR MAP
JANUARY 1984
N
SURVEY BASELINE
0
-5
-10
-15
-20
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT

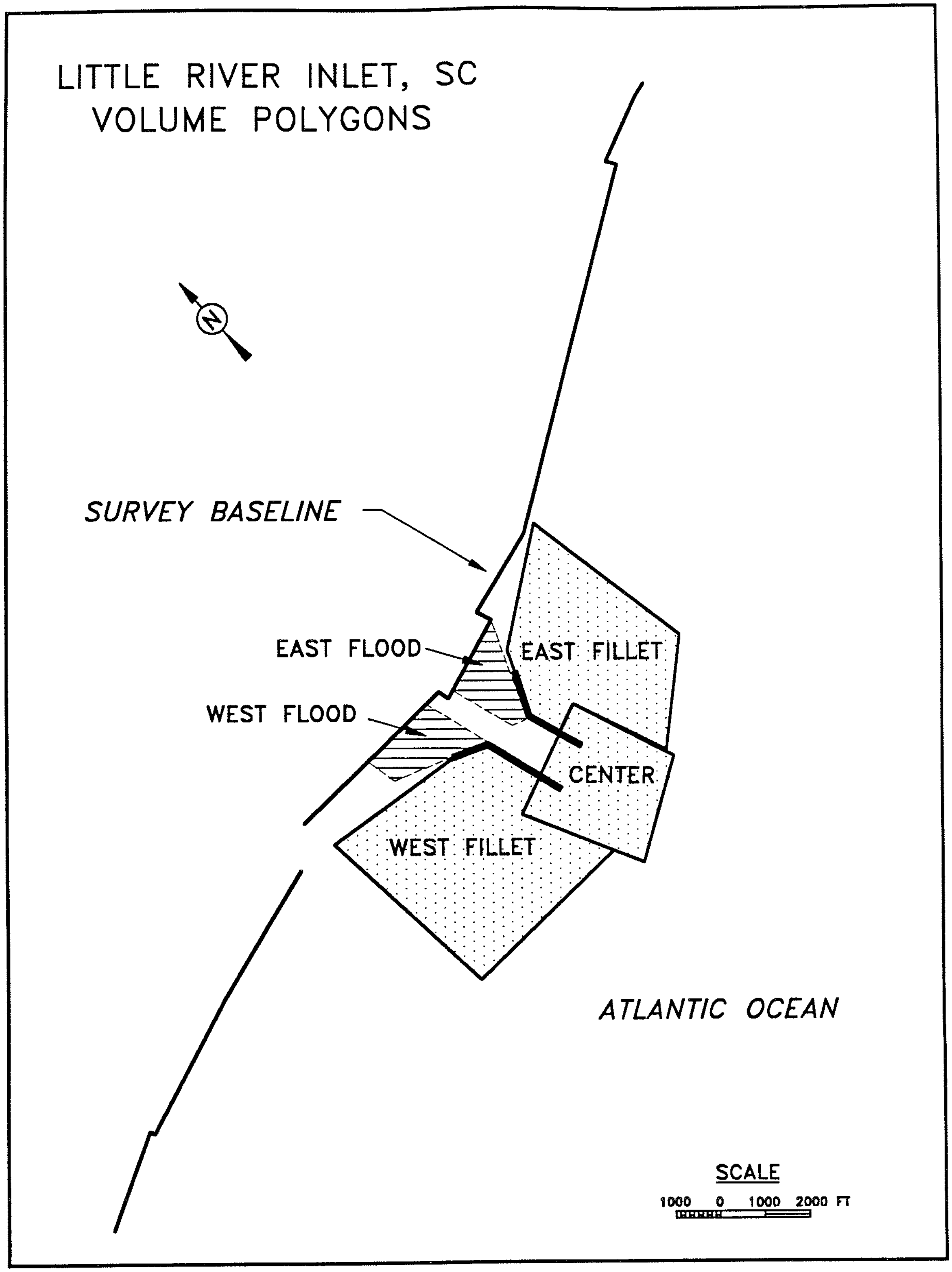

LITTLE RIVER INLET, SC
CONTOUR MAP
APRIL 1984
N
SURVEY BASELINE
0
-5
-10
-15
-20
-25
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT


LITTLE RIVER INLET, SC
CONTOUR MAP
JUNE 1985
N
SURVEY BASELINE
0
-5
-15
-10
-20
-5
-5
-15
-10
-15
-10
0
0
-10
-20
-10
-15
-5
0
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT

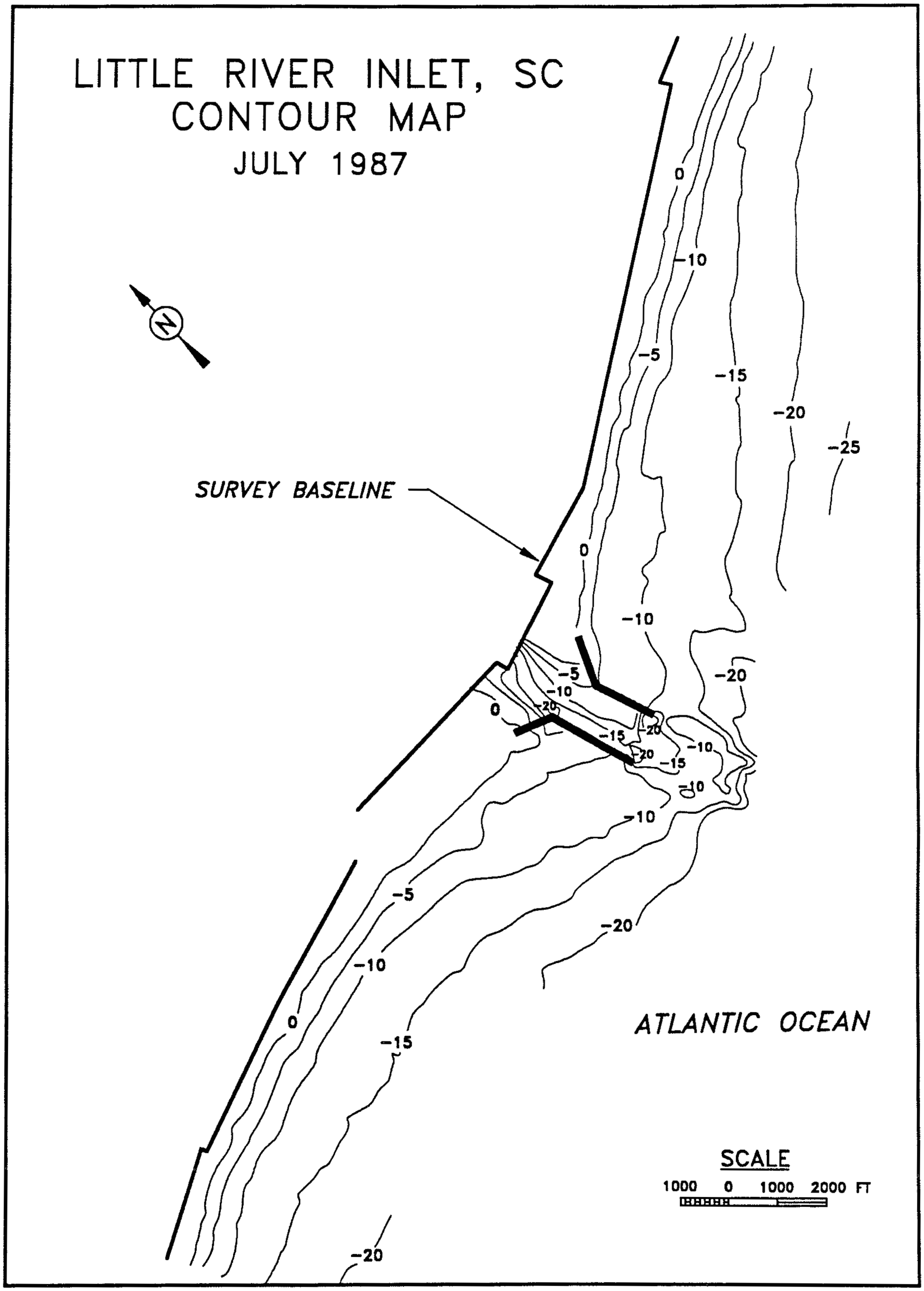


LITTLE RIVER INLET, SC
CONTOUR MAP
JUNE 1986
N
SURVEY BASELINE
-5
0
-15
-10
-20
0
-10
-5
-20
0
-5
-10
-15
-20
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT

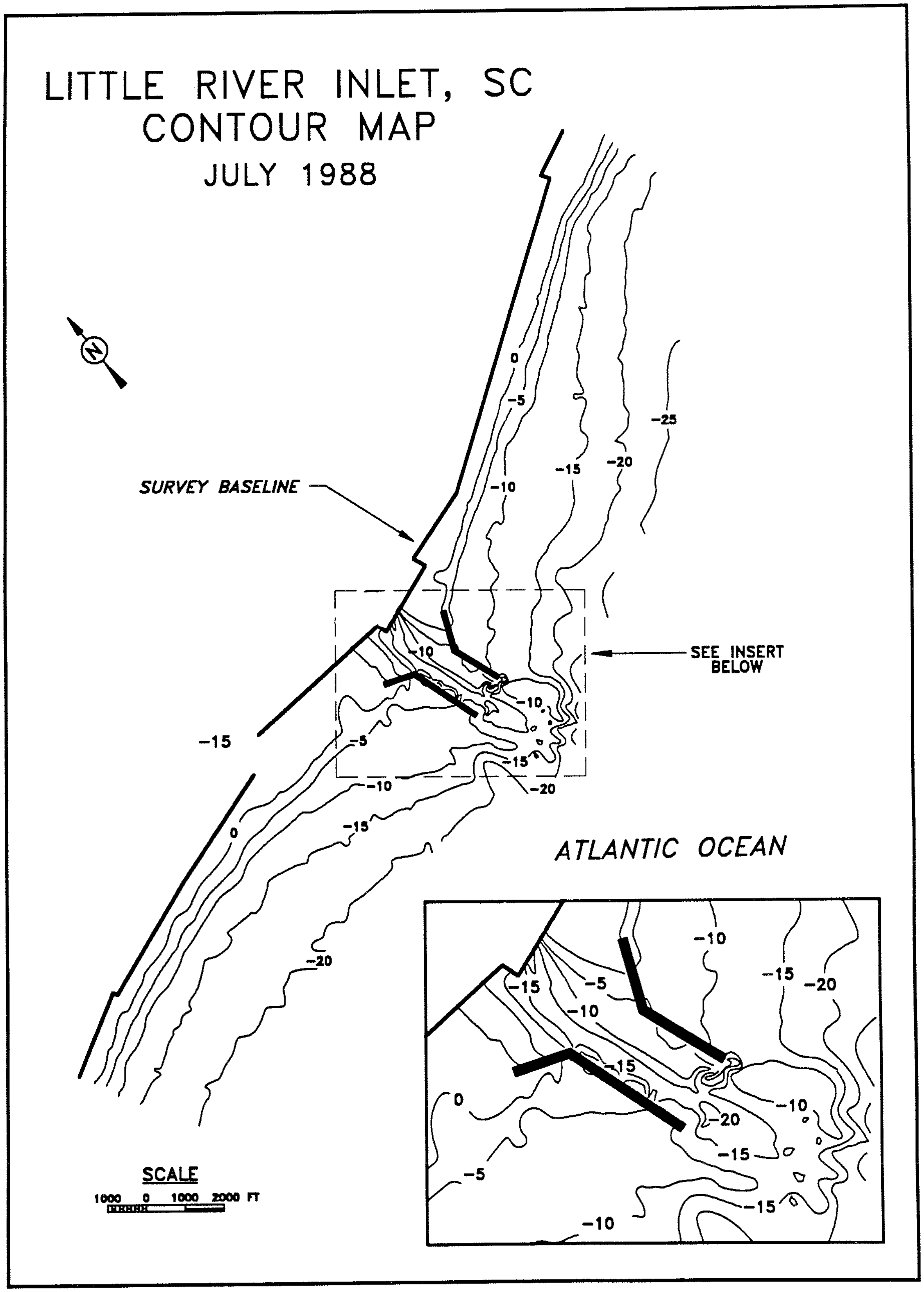

LITTLE RIVER INLET, SC
CONTOUR MAP
JULY 1988
SURVEY BASELINE
SEE INSERT BELOW
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT
0
-5
-10
-15
-20
-25



LITTLE RIVER INLET, SC
VOLUME POLYGONS
N
SURVEY BASELINE
EAST FLOOD
WEST FLOOD
EAST FILLET
CENTER
WEST FILLET
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT



LITTLE RIVER INLET, SC
CONTOUR MAP
JULY 1987
SURVEY BASELINE
ATLANTIC OCEAN
SCALE
1000 0 1000 2000 FT
0
-5
-10
-15
-20
-25


LITTLE RIVER INLET, SC
CONTOUR MAP
JULY 1988
SURVEY BASELINE
SEE INSERT BELOW
ATLANTIC OCEAN
0
-5
-10
-15
-20
-25
SCALE
1000 0 1000 2000 FT

APPENDIX F:

NUMERICAL MODEL METHODOLOGY AND LONGSHORE TRANSPORT PLOTS

(Pages F12-F23 represent pre-project longshore transport plots, 1981 bathymetry; pages F24-F36 represent post-project longshore transport plots, 1985 bathymetry; pages F37-F49 represent post-project longshore transport plots, 1988 bathymetry.)

APPENDIX F: NUMERICAL MODEL METHODOLOGY AND LONGSHORE TRANSPORT PLOTS

Selection of Wave Inputs to RCPWAVE Model

1. Selection of wave height, period, and incident angle to define the wave climate in the numerical model RCPWAVE is crucial to obtaining satisfactory results from the program. This appendix describes the rationale used in this study for selection of these criteria.

2. A wave hindcast study has been conducted for the US coastlines through the Wave Information Study (WIS) for the 20-yr period from 1956 to 1975 (Jensen 1983). Using barometric information, the program determined both seas and swells at three-hour intervals at several deepwater locations, then brought the waves shoreward to the a depth of 10 m (32.81 ft). A separate nearshore station was determined for each 10-mi stretch of shoreline along the Atlantic coast. Station A3108 is the Atlantic coast nearshore station for Sunset Beach on the northeast side of Little River Inlet (Figure F-1); inputs to RCPWAVE were determined from WIS data for station A3108.

3. At each 3-hr interval, WIS provides the significant wave height, period, and incident angle relative to the shore of both the seas and the swell. Thus, for the 20 years of the study there are 58,480 wave conditions for seas, plus 58,480 wave conditions for swell, for a total of 116,960 wave conditions. Because time and cost considerations dictate that only a limited number of wave cases could be run through RCPWAVE, it was necessary to select wave conditions that would produce representative results.

4. A common means of selecting representative wave conditions is to group the data into bands of wave height, period, and angle, determine the percent occurrence of waves falling within the bands, and select the midpoint of the band as representative of those waves. For example, for WIS station

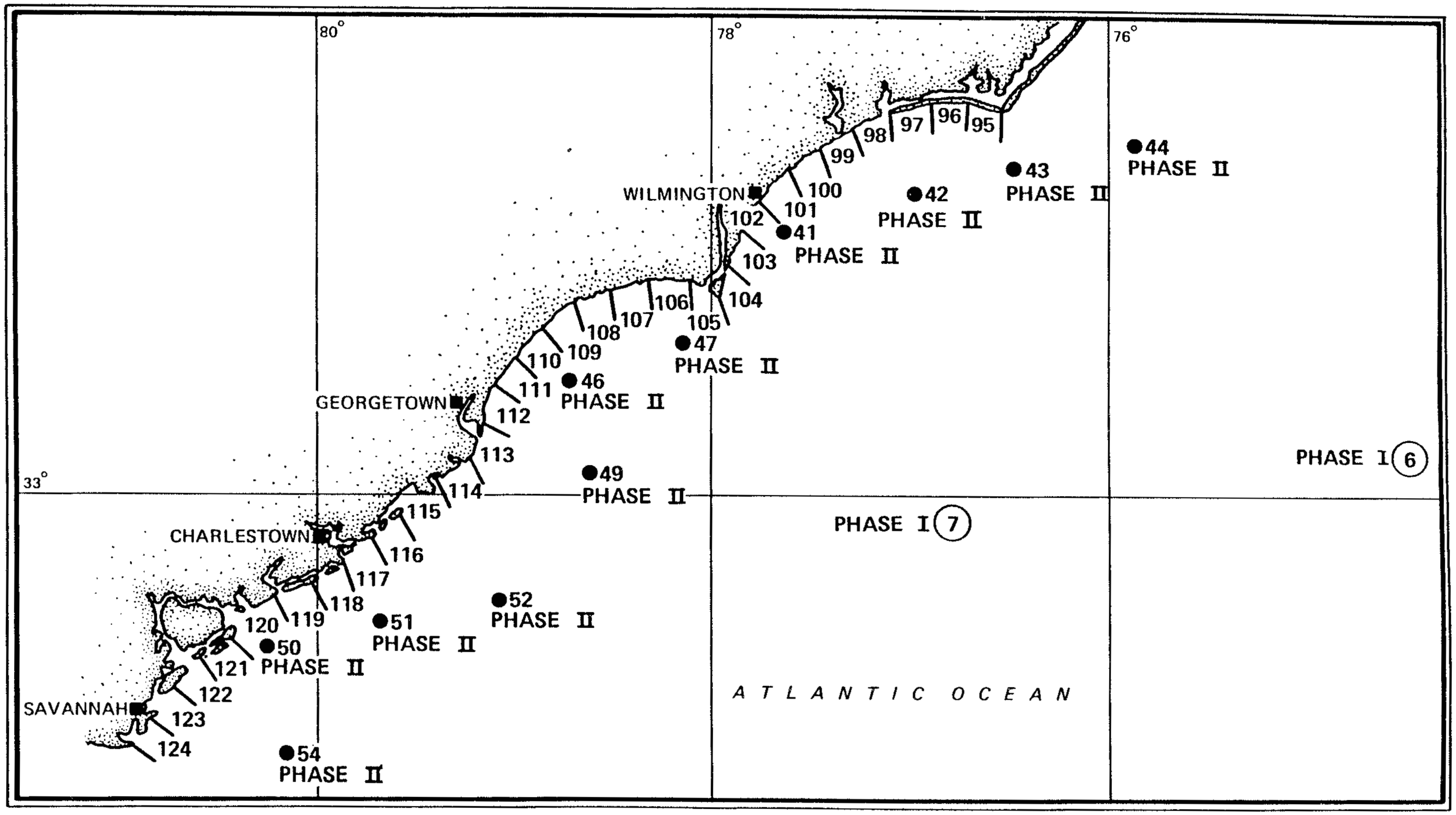


Figure F-1. Locations of Phase III stations for shallow-water wave information along the Atlantic Coast, region 4 (Jensen, 1983)

A3108, 2.061 percent of the waves were predicted to have an angle between 30 and 59.9 degrees with a wave height between 0.50 and 0.99 m, and a period between 7.0 and 7.9 sec (Jensen 1983). Information of this type has been compiled and is presented in Jensen (1983) for the Atlantic coast WIS stations. This listing provides data based on 6 ranges of wave approach angle, 11 ranges of wave height, and 10 ranges of wave period for a total of 660 bands, with waves at station A3108 occurring in about one-third of the bands. This information may then be grouped into larger bands to reduce the number of wave conditions to input into RCPWAVE.

5. While banding of this type is very useful for wave data, it cannot used for sediment transport calculations without biasing the results. As an example, consider using the wave banding to determine wave energy. As wave energy is a function of wave height squared, using the midpoint of a band would underestimate wave energy from the larger waves in the band. While wave energy from smaller waves would be overestimated, calculated energy for the band (assuming an even distribution of wave heights within the band) would always be too low.

6. While it is possible to group wave data based on the square of the wave height to eliminate this bias, sediment transport is a function of the energy flux in the surf zone. This is considerably more complex than a simple function of wave height squared, and includes a function of wave period and angle of incidence. Thus bias is induced in the sediment transport calculations by banding of wave heights, periods, or incident angles. As an added complication, banding typically assumes a uniform distribution across the band, which will seldom be the case in practice.

7. In an attempt to minimize the potential bias, an alternate means of selecting the wave inputs to RCPWAVE was employed. The potential sediment transport for each of the 116,960 wave conditions was determined using standard equations, assuming straight and parallel bottom contours. Wave conditions were then determined that reproduced the average transport rates.

Wave information was then grouped based on potential sediment transport rather than wave height, period or angle. Selected wave conditions were then entered into RCPWAVE to determine the effects of the actual bathymetry in the area. In this manner a reasonable number of inputs for RCPWAVE were determined while minimizing any inherent bias.

8. The first step was to determine the potential sediment transport for each of the 116,960 wave conditions using equations in the Automated Coastal Engineering System (ACES) (Leenknecht and Szuwalski 1990) and in the Shore Protection Manual (1984). These equations solve for the energy flux factor at the surf zone based on known breaking or deepwater significant wave conditions, then determine the longshore transport rate based on an empirical equation with the energy flux factor. Derivation of the equations may be found in either of these references and will not be repeated here, but the equations themselves are written below for reference.

a. Energy flux factor based on breaking wave conditions:

$$P_{ls} = (\rho g/16) H_{sb}^2 C_{gb} \sin(2\alpha_b) \quad (1)$$

b. Energy flux factor based on deepwater wave conditions:

$$P_{ls} = (\rho g/16) H_{so}^2 C_{gb} \sin(2\alpha_o) \quad (2)$$

c. Longshore sediment transport rate:

$$Q = K \, P_{ls} \quad (3)$$

where P_{ls} is the energy flux factor, ρ is the mass density of water, g is the acceleration of gravity, H_{sb} is the significant breaking wave height, C_{gb} is wave group celerity at breaking, α_b is the angle of wave advance at breaking, H_{so} is the significant deepwater wave height, α_o is the angle of deepwater wave advance, Q is the potential sediment transport rate, and K is an empirical coefficient. In non-SSI units, K is equal to 7500 (yd^3-sec)/(lb-yr), P_{ls} is calculated in units of (ft-lb)/(ft-sec), yielding potential sediment transport in terms of yd^3/yr.

9. Because WIS information is presented at a depth of 32.81 ft, equations 2 and 3 were used to estimate potential sediment transport based on deepwater wave conditions. Snell's Law was used to refract the wave conditions from 32.81 ft to deepwater conditions, and the potential sediment transport rate was determined for each of the 116,960 wave conditions.

10. To minimize bias which may be induced by the bathymetry, seas and swell conditions were stored separately, and wave conditions causing sediment transport to the left was stored separately from wave conditions causing sediment transport to the right. This created four main groups of data: seas left, seas right, swell left, and swell right.

11. To reduce the number of RCPWAVE inputs to a reasonable number, it was then decided to average the 20-yrs of sediment transport information by month. As no banding of wave conditions had been employed, the transport rates could be grouped or averaged in any manner, but it was hoped that averaging by month would provide seasonal information. Each month therefore included wave conditions for that month from each of the 20 yrs of data. Thus the WIS information was separated into 48 groups (12 months times 4 main groups).

12. For each group of waves, a single wave condition was sought to input into RCPWAVE. This was determined by finding the average potential sediment transport rate for all wave conditions in a group, then selecting a wave condition that reproduced the average rate. The average potential transport rate was calculated only from those wave conditions that produced sediment transport. Wave conditions with a perpendicular angle of incidence at breaking or with a wave height or period of zero were excluded from the calculations.

13. Rather than randomly select a set of wave conditions to reproduce the average transport rate, it was preferable to select a wave closely represented the actual wave conditions in each group. Therefore, wave conditions in each group were averaged for all wave conditions that produced a potential sediment transport rate within ten percent of the average transport rate. This "average wave" did not reproduce the average transport rate for the same reasons that banding the wave data will bias the transport rates. However, given the average wave period and angle of incidence it was possible to adjust the wave height to determine a "representative wave" that reproduced the average potential sediment transport rate and closely reflected actual wave conditions in the group.

14. Inputs to RCPWAVE were thus reduced to 48 wave conditions, one for each of the 48 groups. Sediment transport was then recalculated with output from RCPWAVE, at which time the frequency of occurrence of wave conditions in each group was taken into account.

15. For the simplified case of uniform sediment characteristics, no currents, and no aeolian transport, sediment transport will be affected by the deepwater wave height, period, and incident angle, and by the bathymetry. Using the equations given above for each wave condition minimized bias from wave height, period, and incident angle. Processing seas and swell information separately, and transport to the east separately from transport to the west, was done to minimize bias caused by bathymetry.

Calculation of Sediment Transport Based on RCPWAVE Output

16. Output at each nodal point from the numerical model RCPWAVE includes water depth, wave angle, wave height, wave period, and an indicator of whether or not the wave has broken. This appendix describes the process used to determine sediment transport at Little River Inlet based on this information and the input bathymetry. The grid used at Little River Inlet was

200 cells 150 ft wide along the coast (grid lines i=1 to 201, numbered from west to east) by 154 cells 75 ft wide (grid lines j=1 to 155, numbered from shore seaward), and thus included 30,800 cells covering 5.7 miles along the coast and 1.2 miles in the offshore direction.

17. Shoreline location was determined by reading the bathymetry input file shoreward along each grid line from the offshore edge of the grid. The shoreline was defined as the first location where the zero datum was reached. For the input bathymetry used here, the zero datum was mean low water. Linear interpolation was used to determine the location of the zero crossing between nodal points. Note that depths at each nodal point were determined from the input grid to RCPWAVE rather than from the output. RCPWAVE defaults to a depth of one foot for all depths less than a foot and all positive elevations. This default is reflected in the output, thus no shoreline is indicated in the output file.

18. Shoreline angle was determined by averaging the angle between the shoreline location along a grid line and the shoreline location along both adjacent grid lines. This gave the angle of the shoreline relative to the grid at each grid line.

19. Location of the wave at breaking was determined by first reading the RCPWAVE output file shoreward along each grid line until the first breaker index was encountered. Wave height, period, and angle were then determined at the grid point previous to the one with the breaker index, that is, the next grid point seaward of the one with the breaker index. The wave was then "marched" shoreward in small increments through the cell to more accurately determine the breaking point.

20. The marching algorithm began by determining the bottom slope from the depth at the starting cell (one cell seaward of the breaker index) and the depth at, and distance to, either the next cell shoreward along the grid line or either of the cells adjacent to the next cell shoreward, depending on the incident angle of the wave. That is, the depth was determined for cell (i,j) then, depending on the angle of the wave at the cell, the

depth at cell (i-1,j), (i-1,j-1), or (i-1,j+1) and the distance to the appropriate cell were used to determine the bottom slope. This next cell was termed the "target cell."

21. Each step in the marching algorithm advanced the wave one-tenth the distance between the starting cell and the target cell. At each step, the wave was refracted and shoaled and compared to a breaking criteria. Due to refraction at each step, it was possible that a wave would require more than ten steps to traverse the distance to the target cell, therefore fifteen steps were allowed. If the wave had not met the breaking criteria within fifteen steps, the location of the target cell was taken as the breaking point.

22. With the breaking point determined, the depth, breaking wave height, and wave angle at the point were also known. The angle between the wave and the shoreline was then determined, and the sediment transport could then be calculated by equations 1 and 3, above.

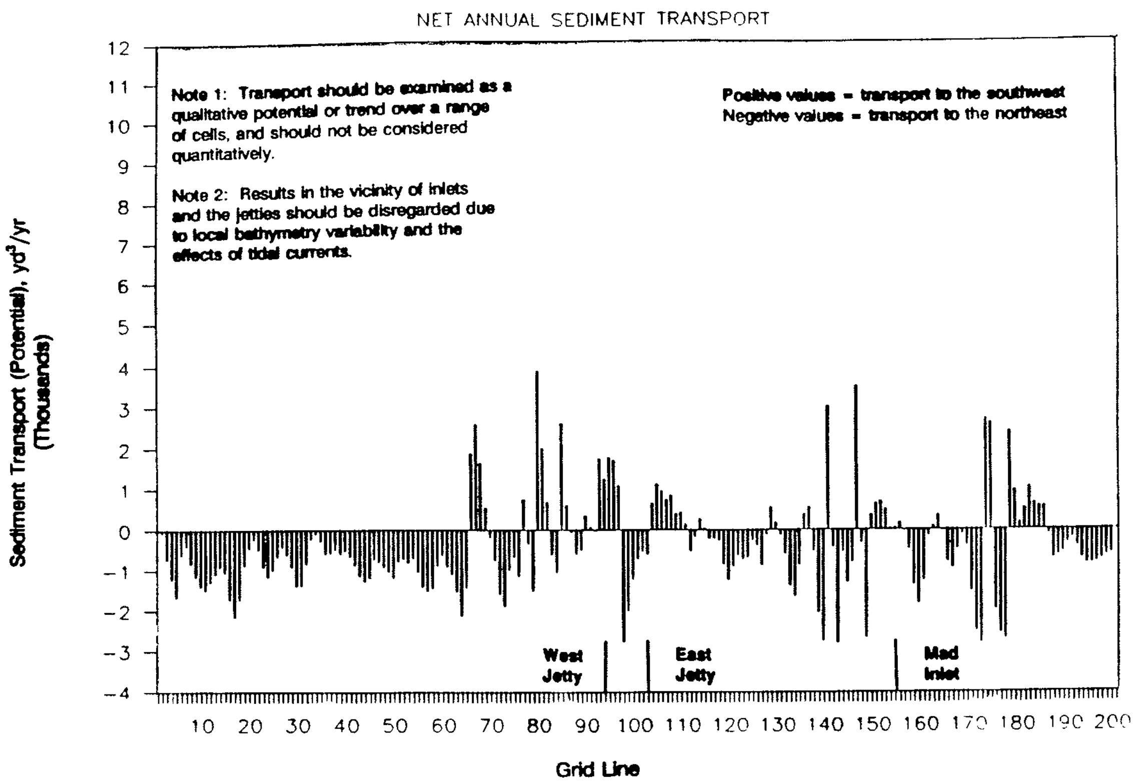
23. It should be noted that numerous offshore bars were located in the ebb tidal delta at Little River Inlet. By stepping shoreward along a grid line, it was very possible to cross an offshore bar along one grid line and miss the bar on the adjacent grid line. In these cases, the shoreline locations differed significantly causing a very steep shoreline angle. This then had a significant effect on the sediment transport calculations at that location. Thus at a given cell, or small group of adjacent cells, a significant change or reversal in the calculated sediment transport might be seen. This is misleading and does not reflect the actual sediment transport at that point. It is important to realize that due to this and other effects, the sediment transport calculations should be averaged over a range of cells and used only to determine trends in the transport. The procedure described herein is considered more qualitative than quantitative, and any individual numbers should be used with caution.

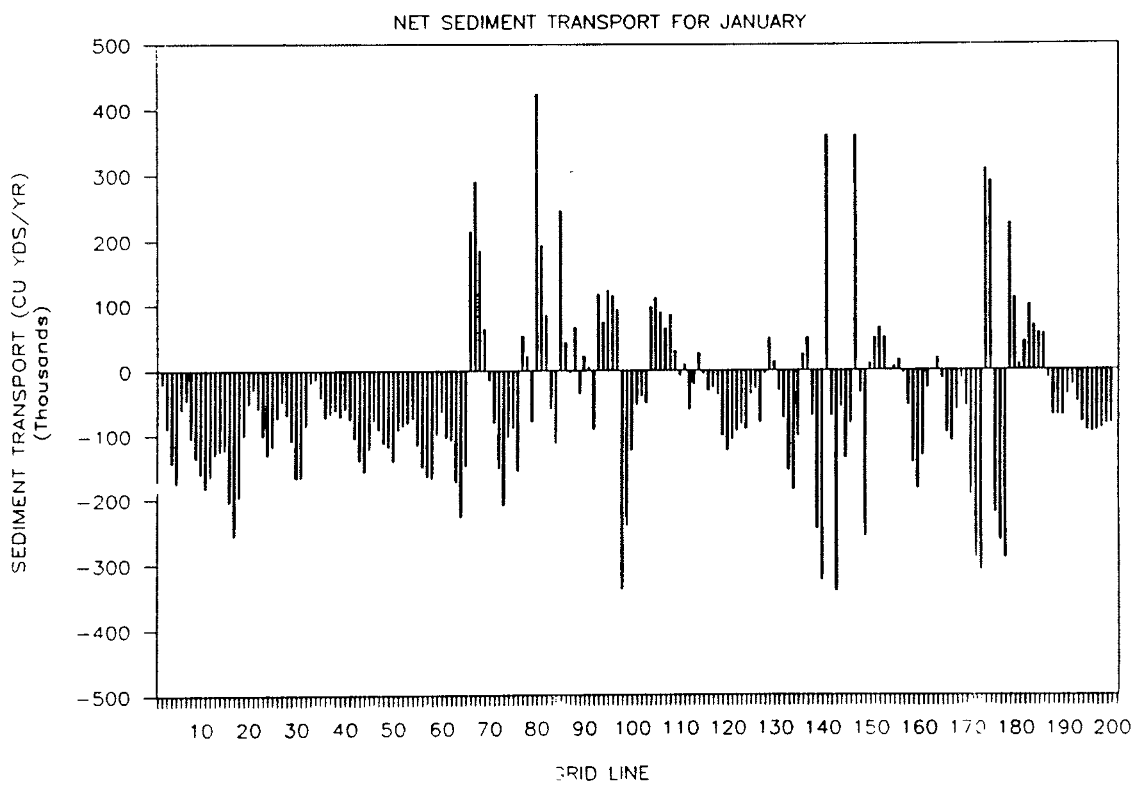
REFERENCES

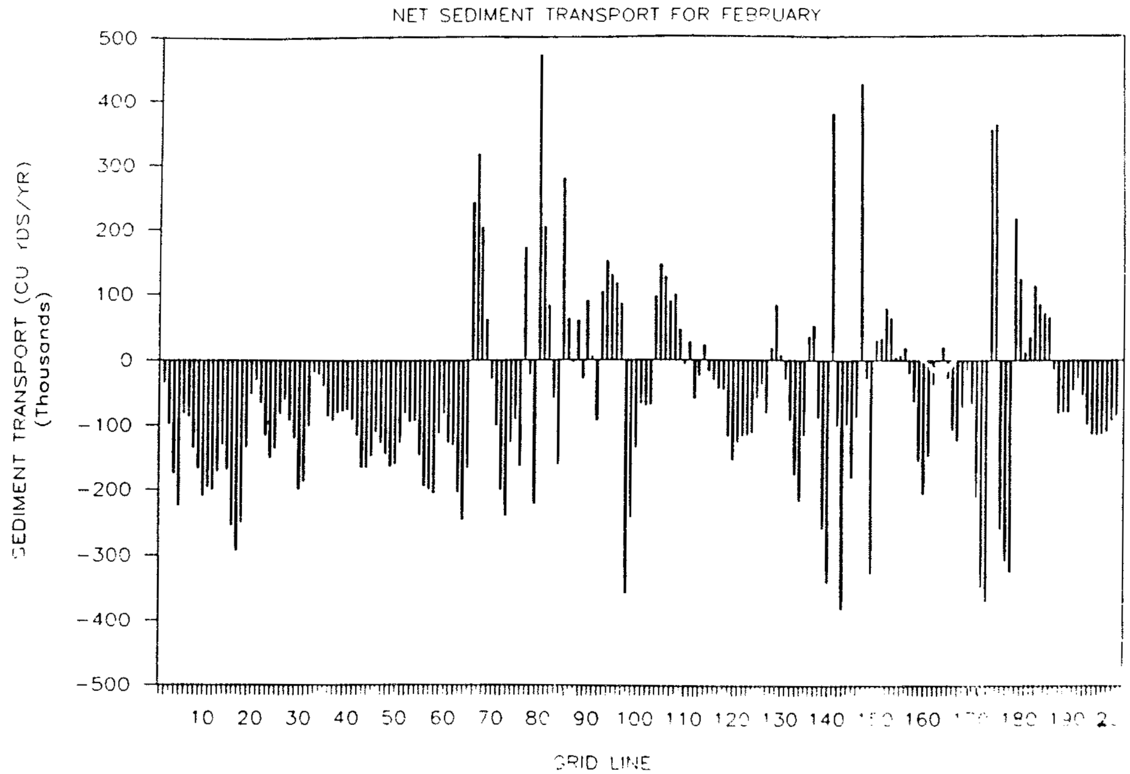
Jensen, R. E. 1983. "Atlantic Coast Hindcast, Shallow Water, Significant Wave Information," WIS Report 9, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

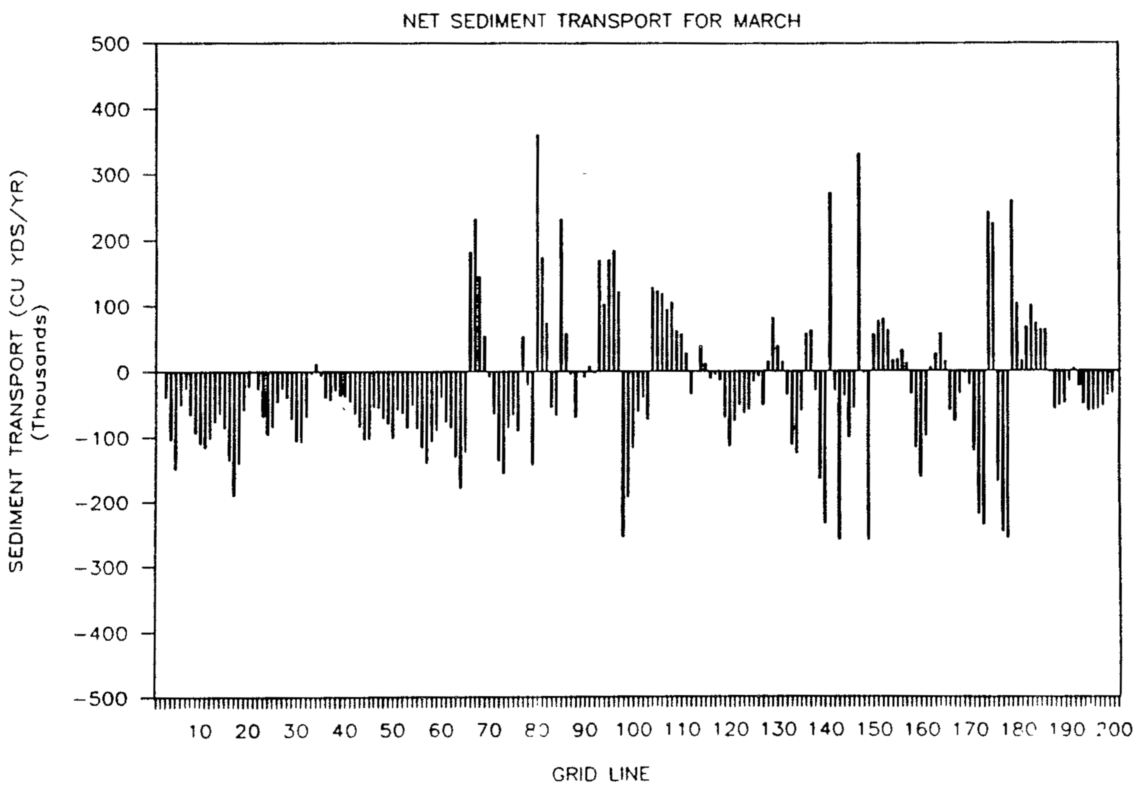
Leenknecht, D. A., and A. Szuwalski. 1990. "Automated Coastal Engineering System, Technical Reference, Version 1.05," US Army Engineer Waterways Experiment Station, Vicksburg, MS.

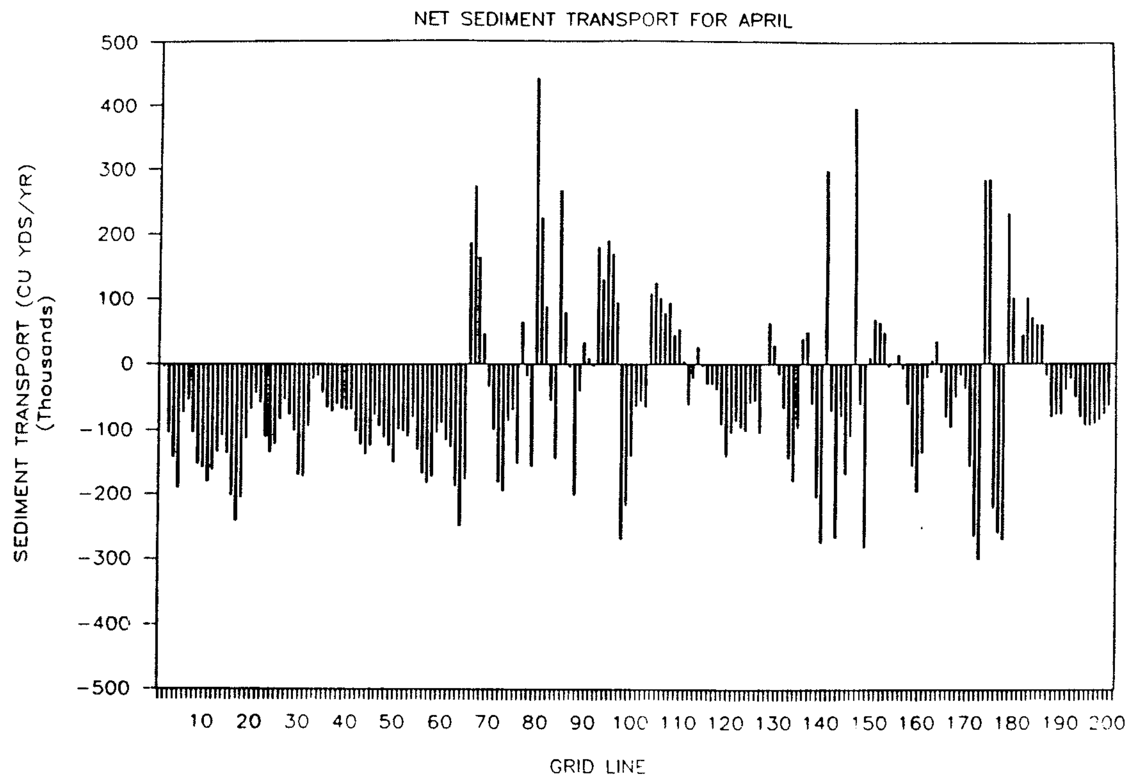
Shore Protection Manual. 1984. 4th ed., 2 vols. US Army Engineer Waterways Experiment Station, Vicksburg, MS.

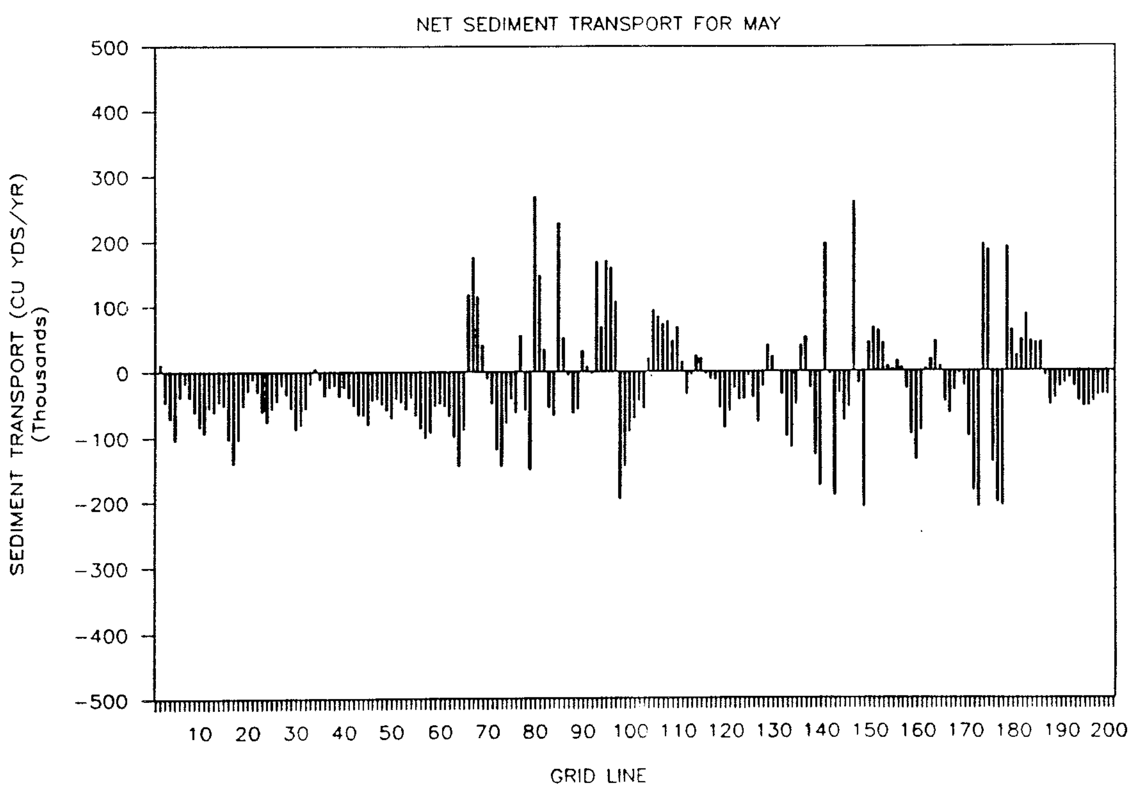

NET ANNUAL SEDIMENT TRANSPORT
Note 1: Transport should be examined as a qualitative potential or trend over a range of cells, and should not be considered quantitatively.
Note 2: Results in the vicinity of inlets and the jetties should be disregarded due to local bathymetry variability and the effects of tidal currents.
Positive values = transport to the southwest
Negative values = transport to the northeast
Sediment Transport (Potential), yd³/yr (Thousands)
West Jetty
East Jetty
Mad Inlet
Grid Line

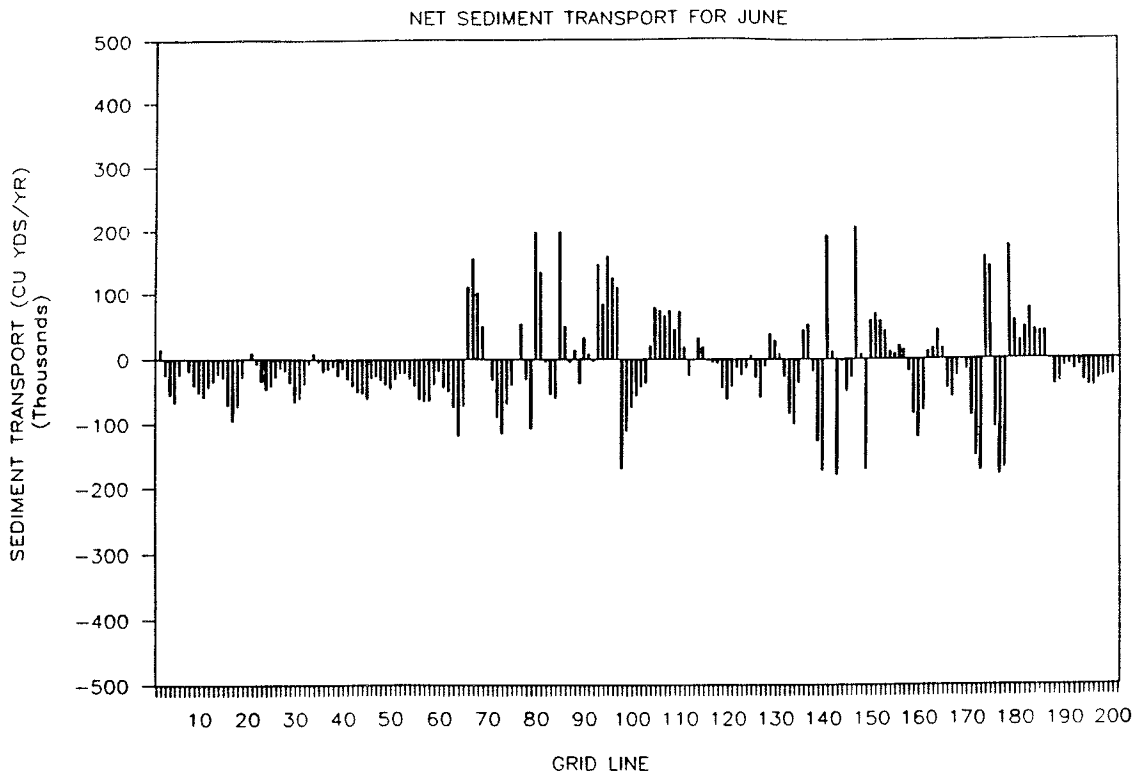

NET SEDIMENT TRANSPORT FOR JANUARY
SEDIMENT TRANSPORT (CU YDS/YR) (Thousands)
GRID LINE

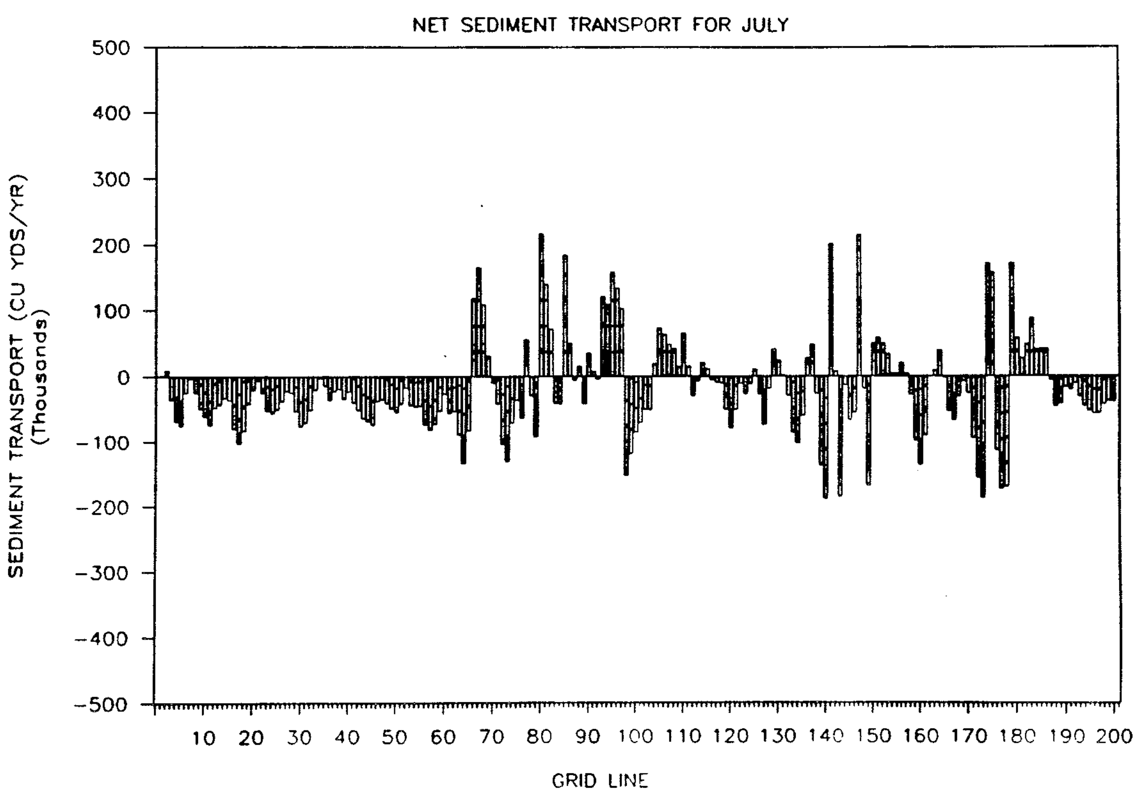

NET SEDIMENT TRANSPORT FOR FEBRUARY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
GRID LINE

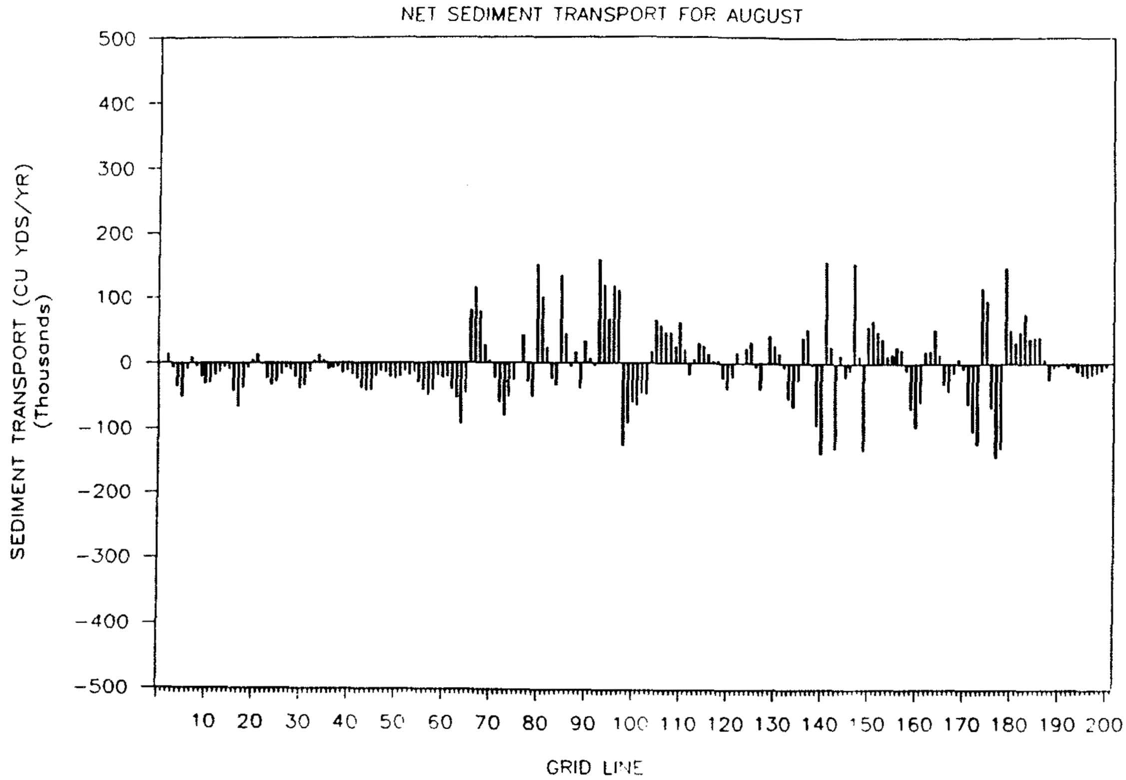

NET SEDIMENT TRANSPORT FOR MARCH
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
GRID LINE


NET SEDIMENT TRANSPORT FOR APRIL
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

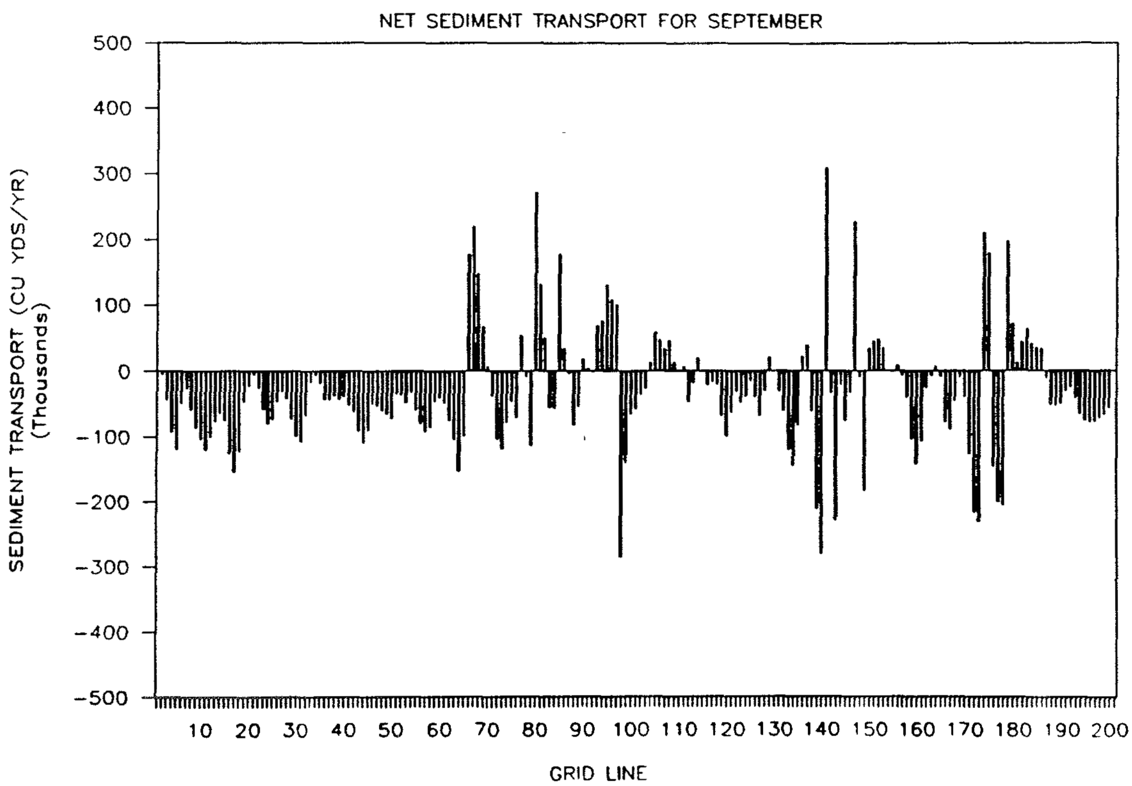

NET SEDIMENT TRANSPORT FOR MAY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR JUNE
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
−100
−200
−300
−400
−500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR JULY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
−100
−200
−300
−400
−500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE



NET SEDIMENT TRANSPORT FOR AUGUST
SEDIMENT TRANSPORT (CU YDS/YR) (Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE



NET SEDIMENT TRANSPORT FOR SEPTEMBER
SEDIMENT TRANSPORT (CU YDS/YR) (Thousands)
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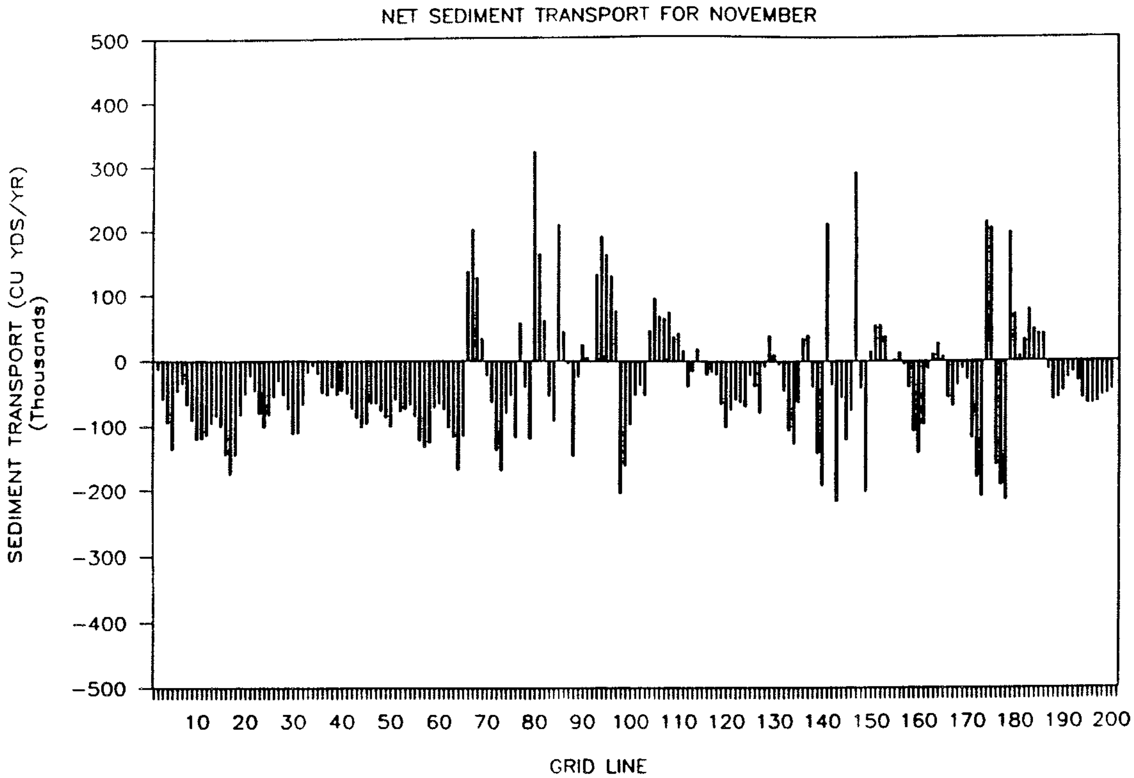
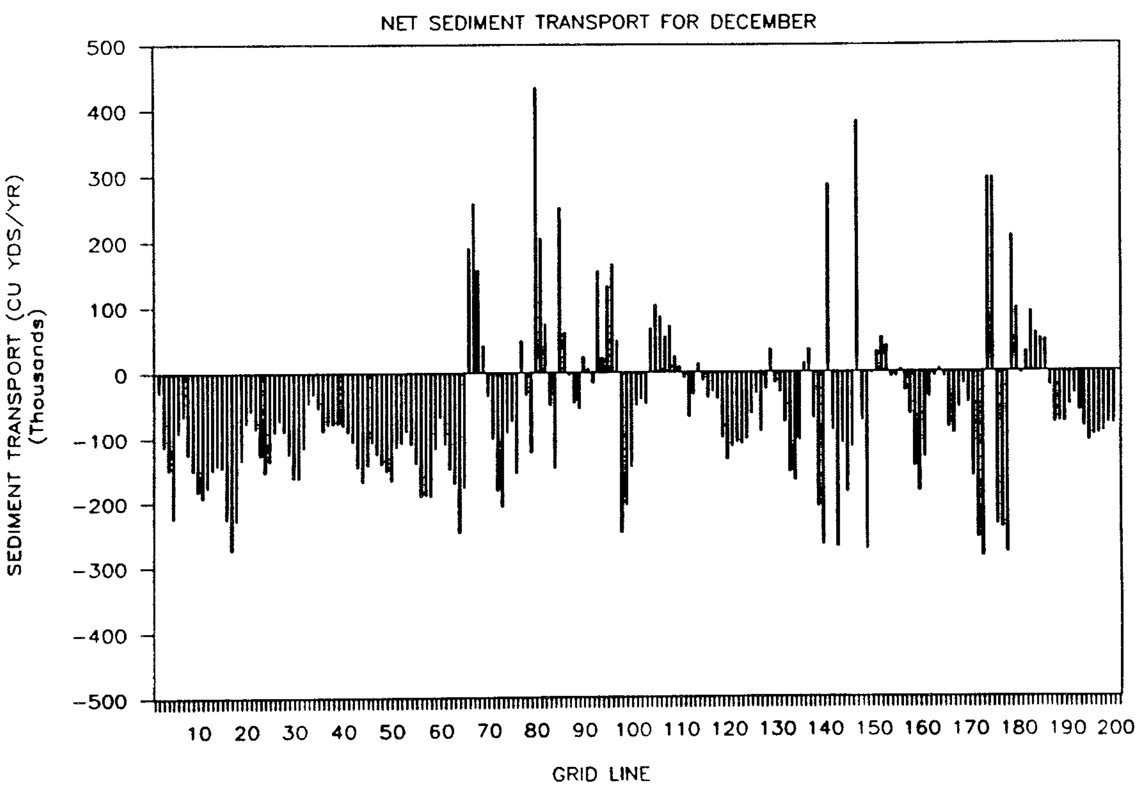
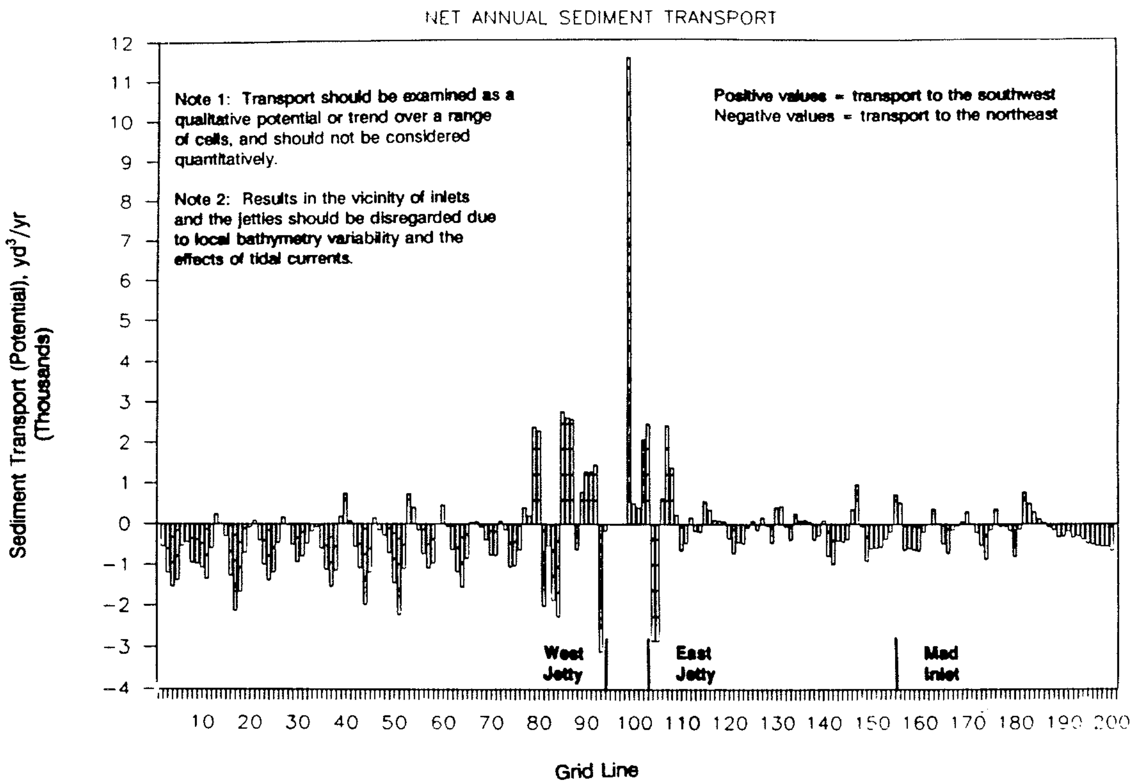
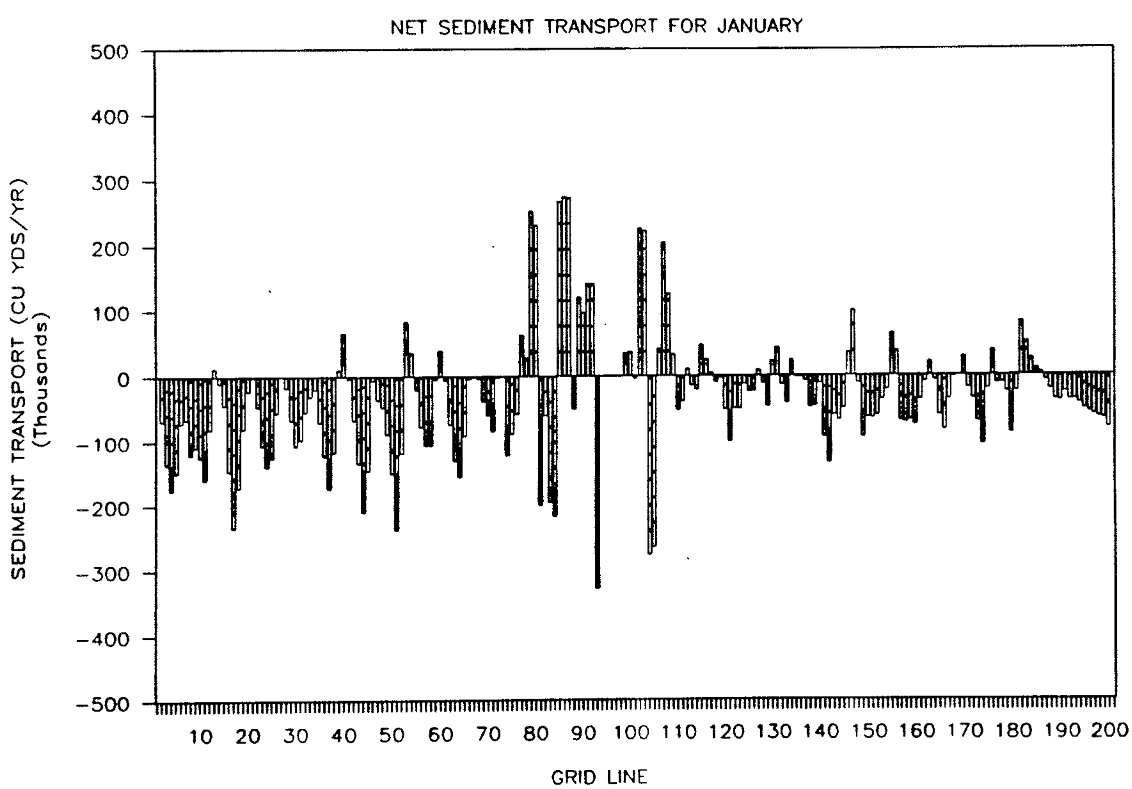
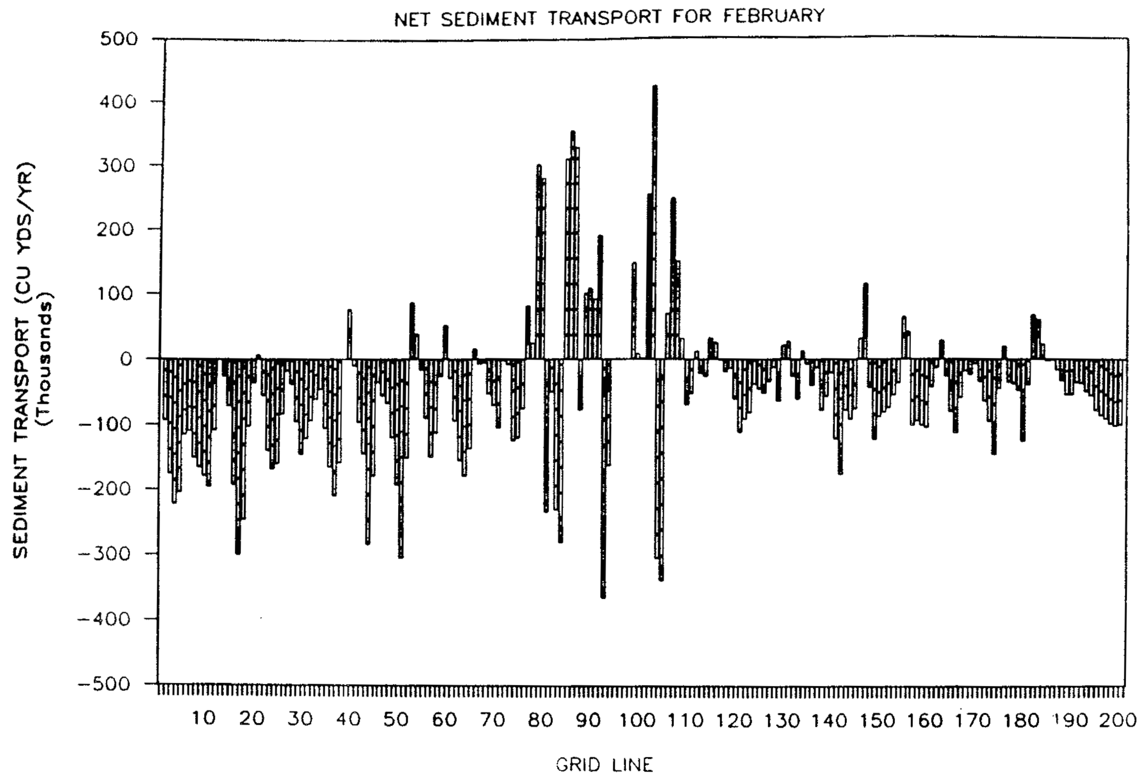
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

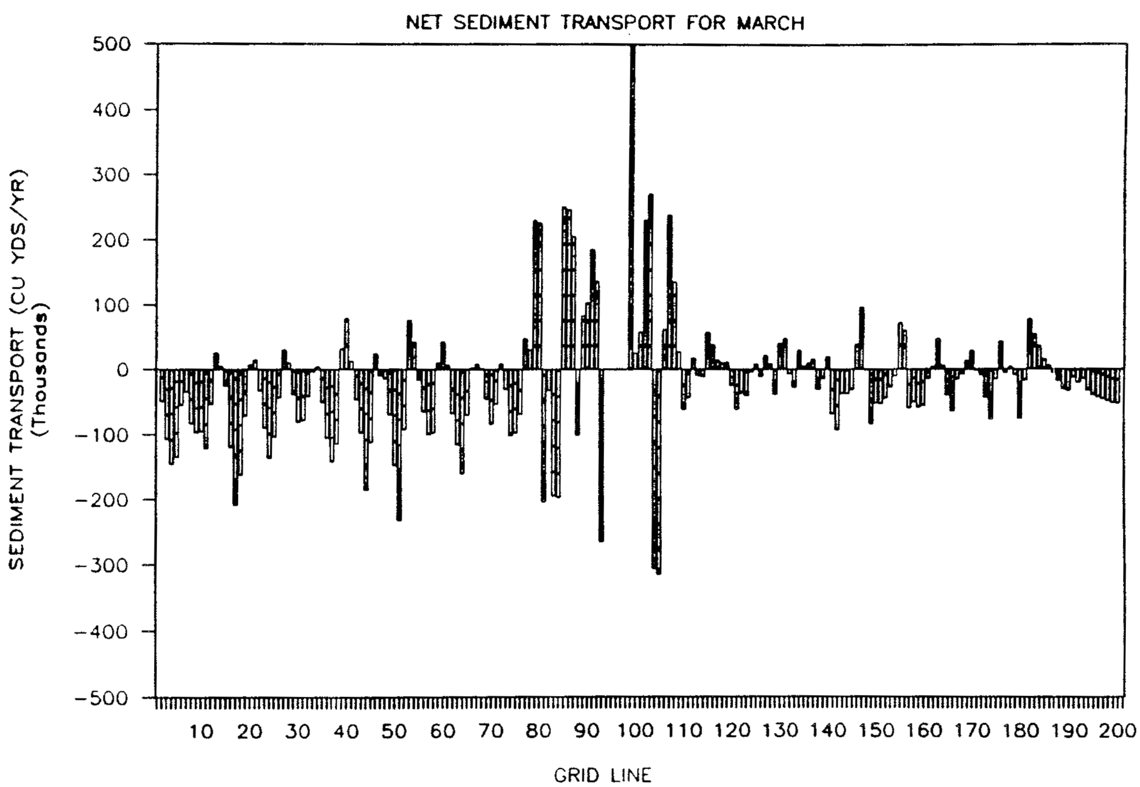

NET SEDIMENT TRANSPORT FOR NOVEMBER
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
−100
−200
−300
−400
−500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

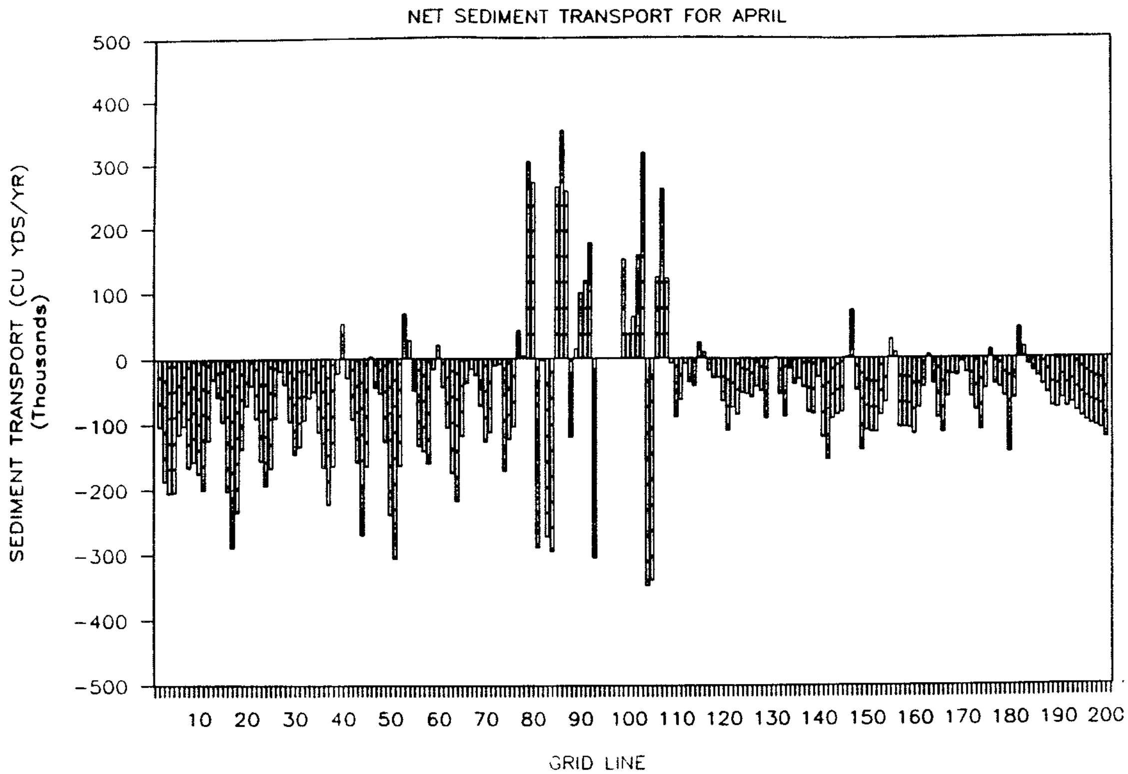

NET SEDIMENT TRANSPORT FOR DECEMBER
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
−100
−200
−300
−400
−500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET ANNUAL SEDIMENT TRANSPORT
Note 1: Transport should be examined as a qualitative potential or trend over a range of cells, and should not be considered quantitatively.
Note 2: Results in the vicinity of inlets and the jetties should be disregarded due to local bathymetry variability and the effects of tidal currents.
Positive values = transport to the southwest
Negative values = transport to the northeast
West Jetty
East Jetty
Mad Inlet
Sediment Transport (Potential), yd³/yr (Thousands)
Grid Line


NET SEDIMENT TRANSPORT FOR JANUARY
SEDIMENT TRANSPORT (CU YDS/YR) (Thousands)
GRID LINE


NET SEDIMENT TRANSPORT FOR FEBRUARY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR MARCH
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE



NET SEDIMENT TRANSPORT FOR APRIL
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
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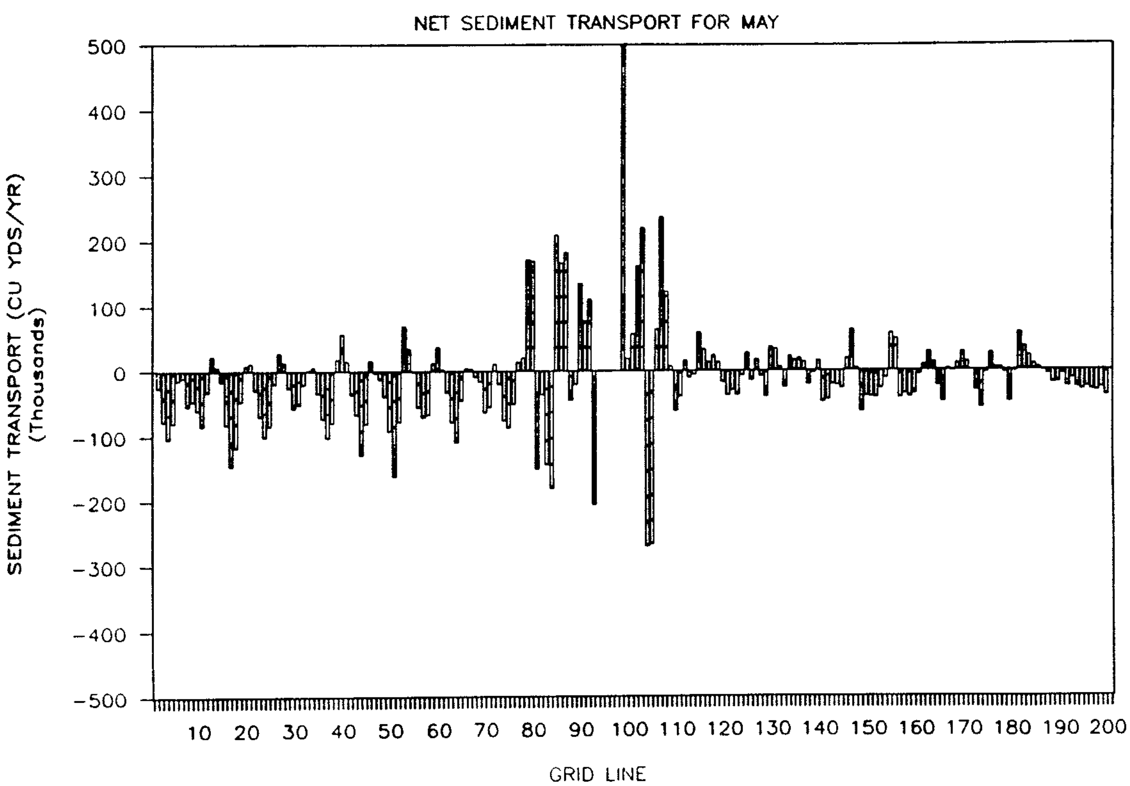
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE



NET SEDIMENT TRANSPORT FOR MAY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
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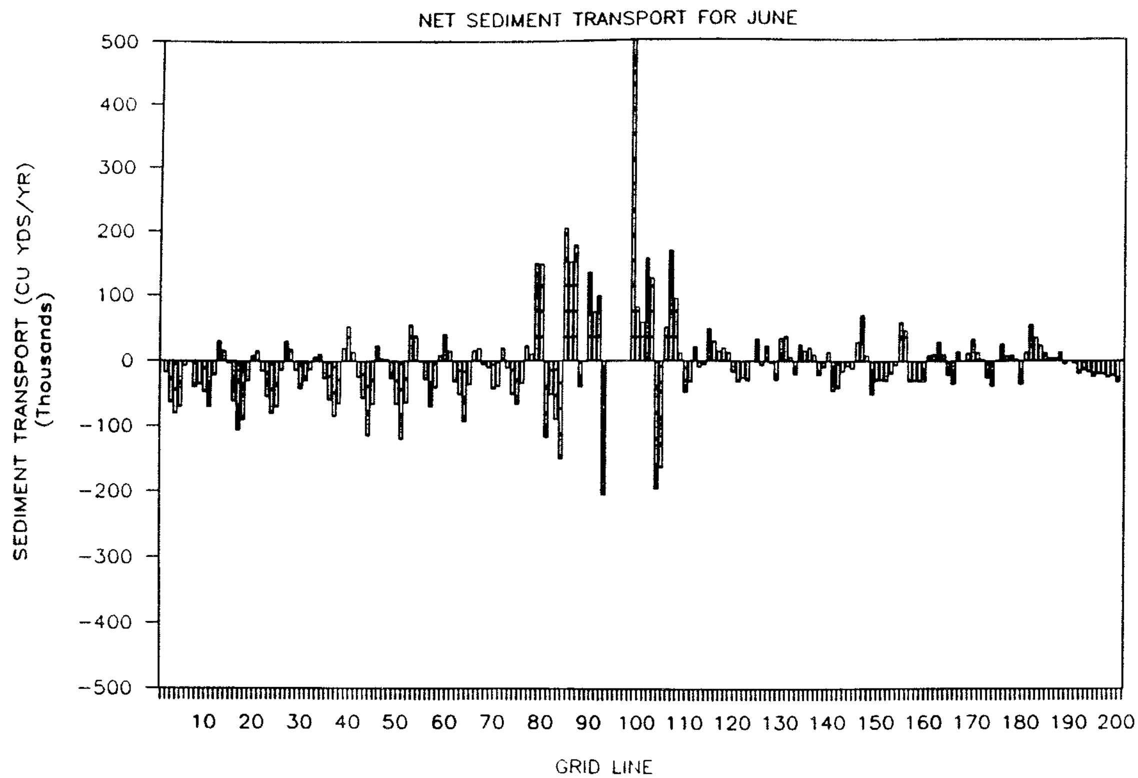
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR JUNE
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
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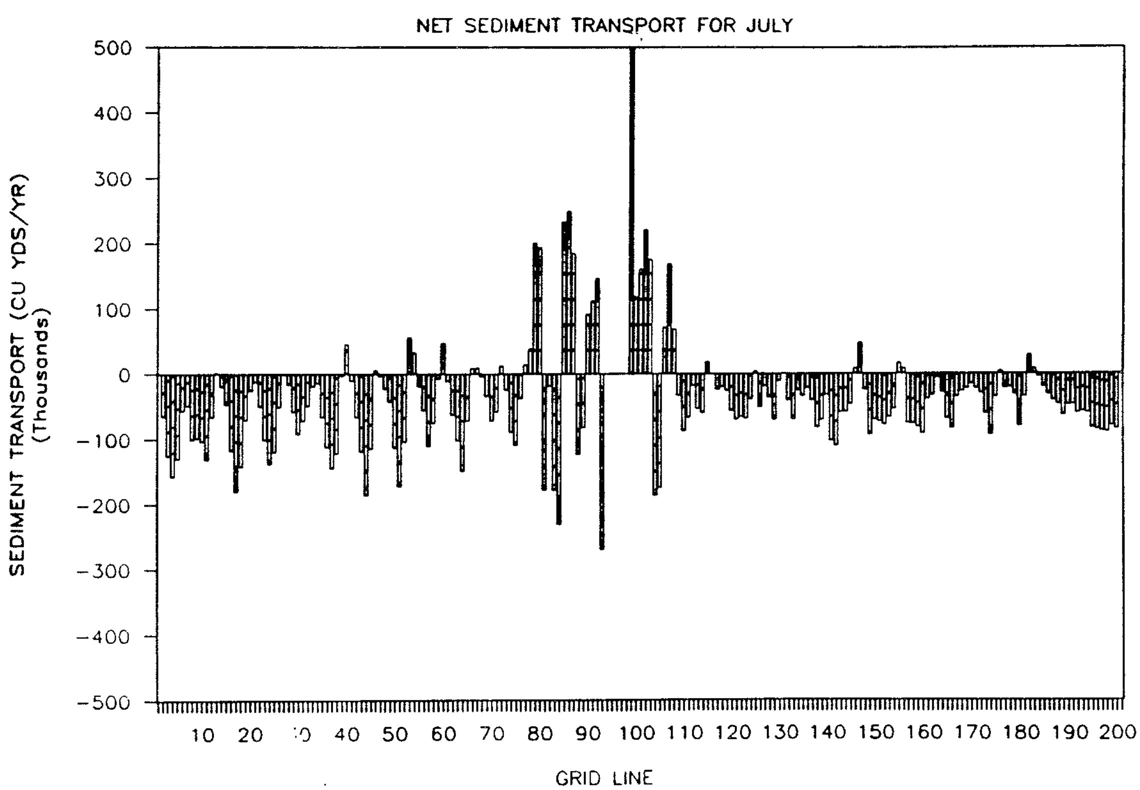
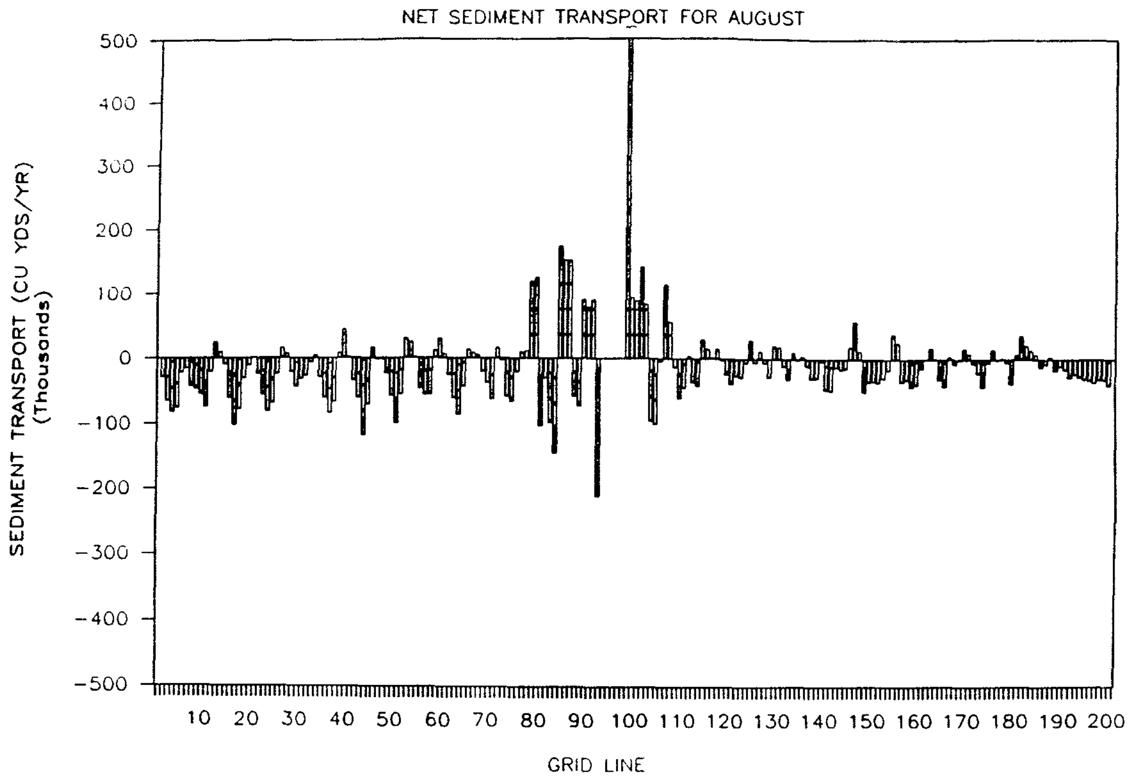
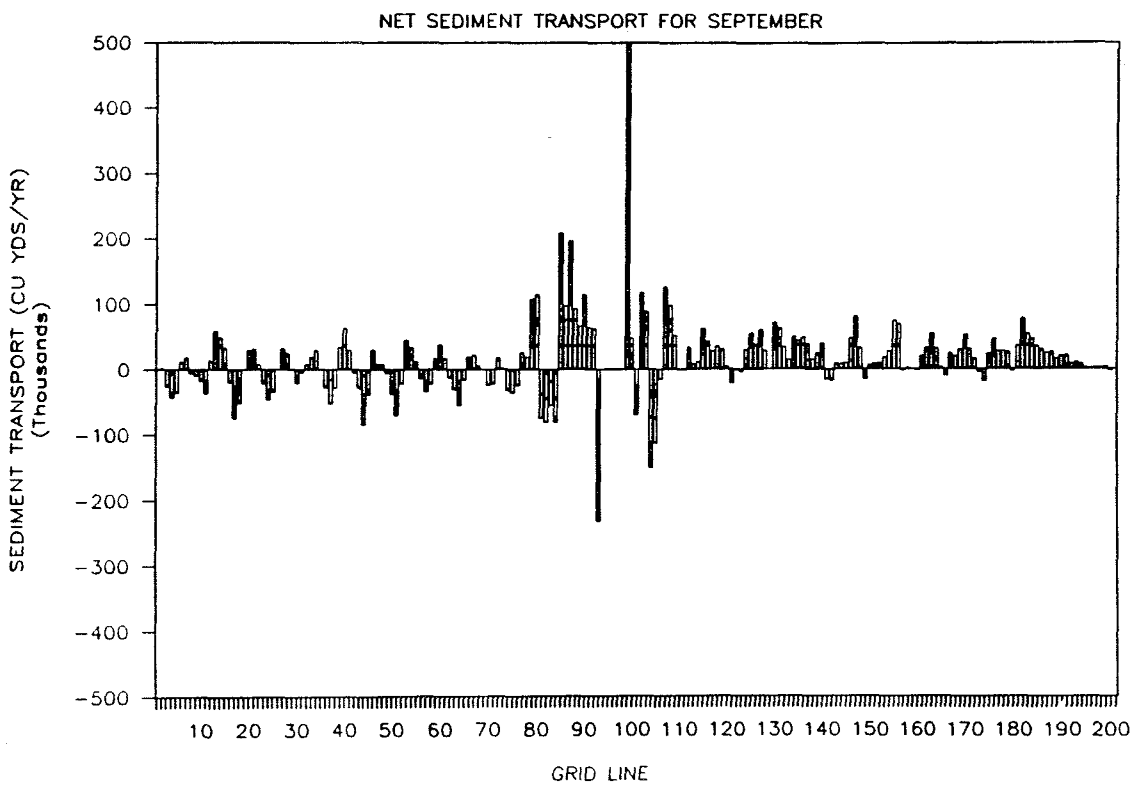
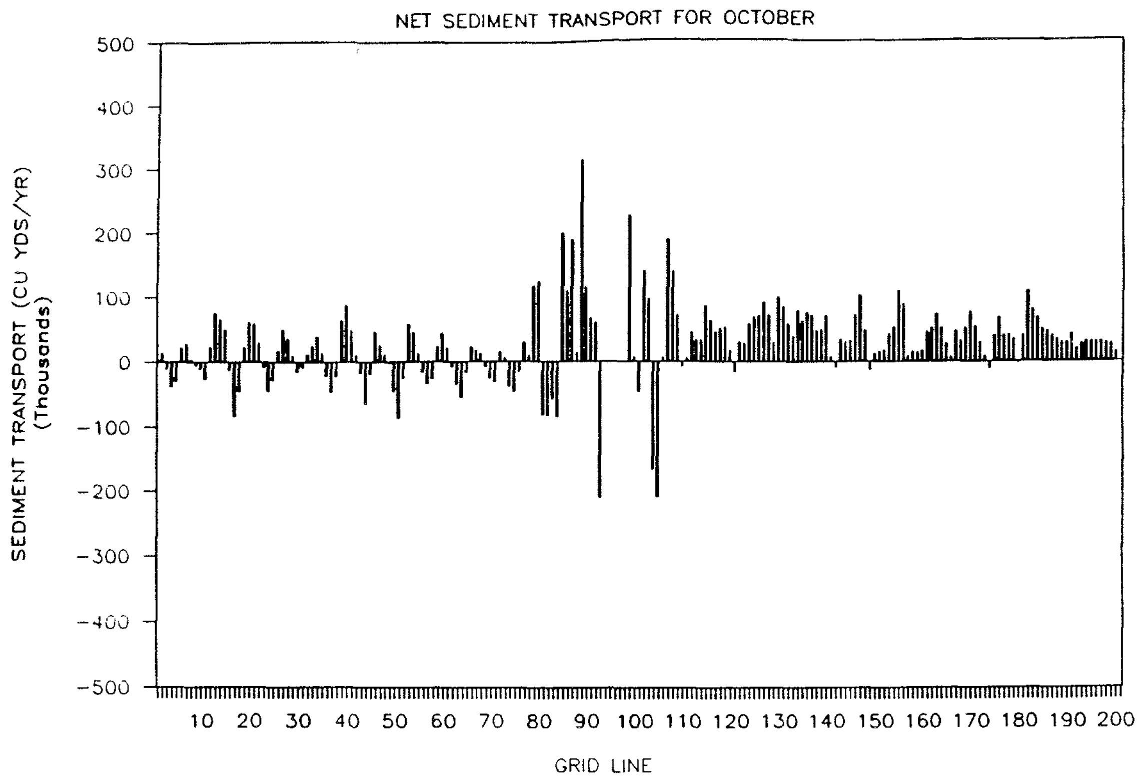
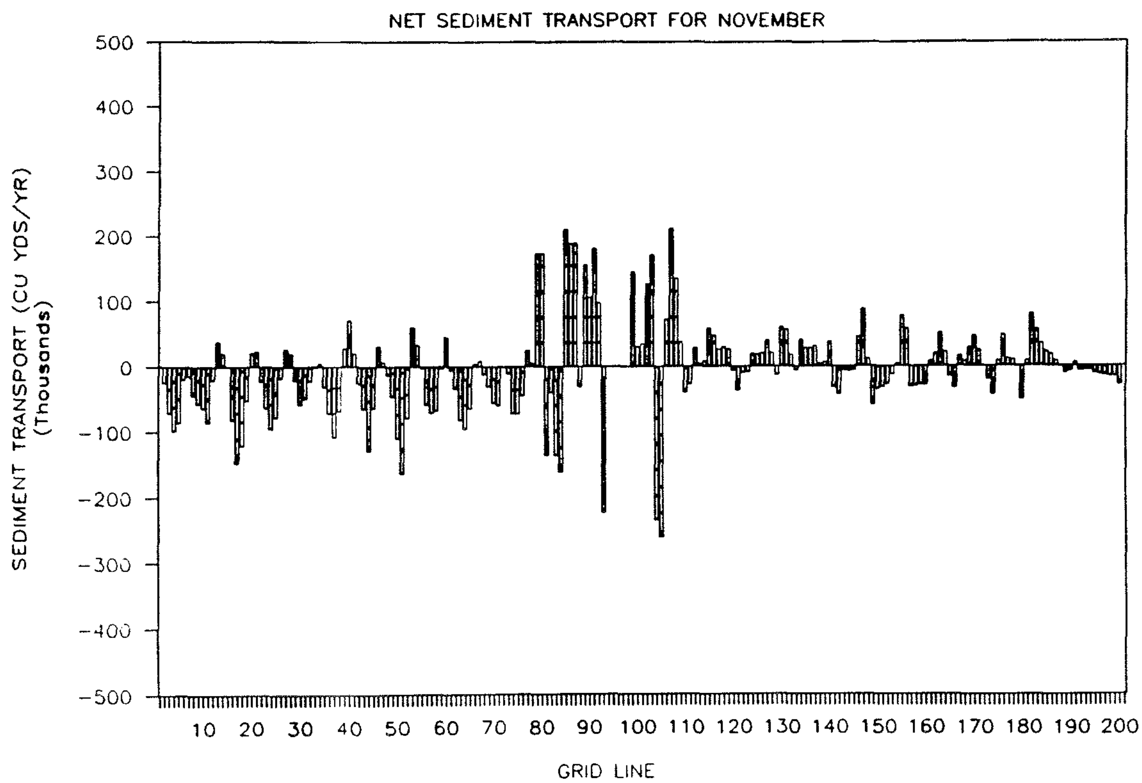
GRID LINE

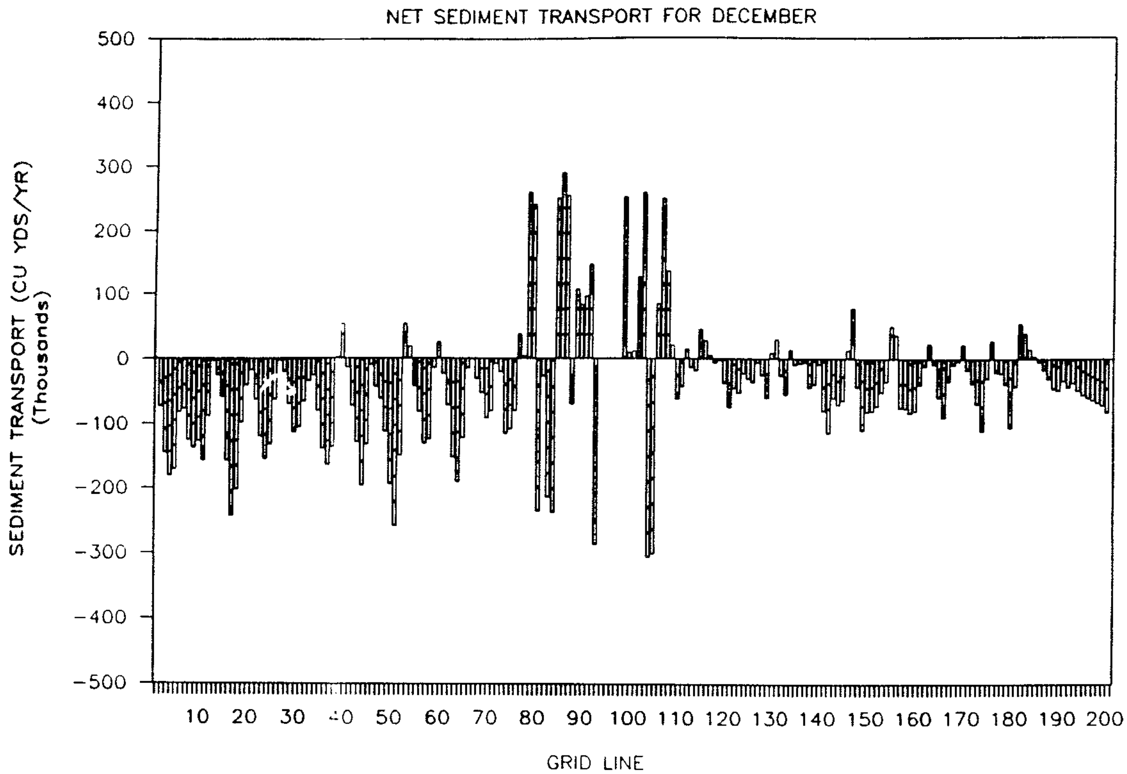

NET SEDIMENT TRANSPORT FOR JULY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

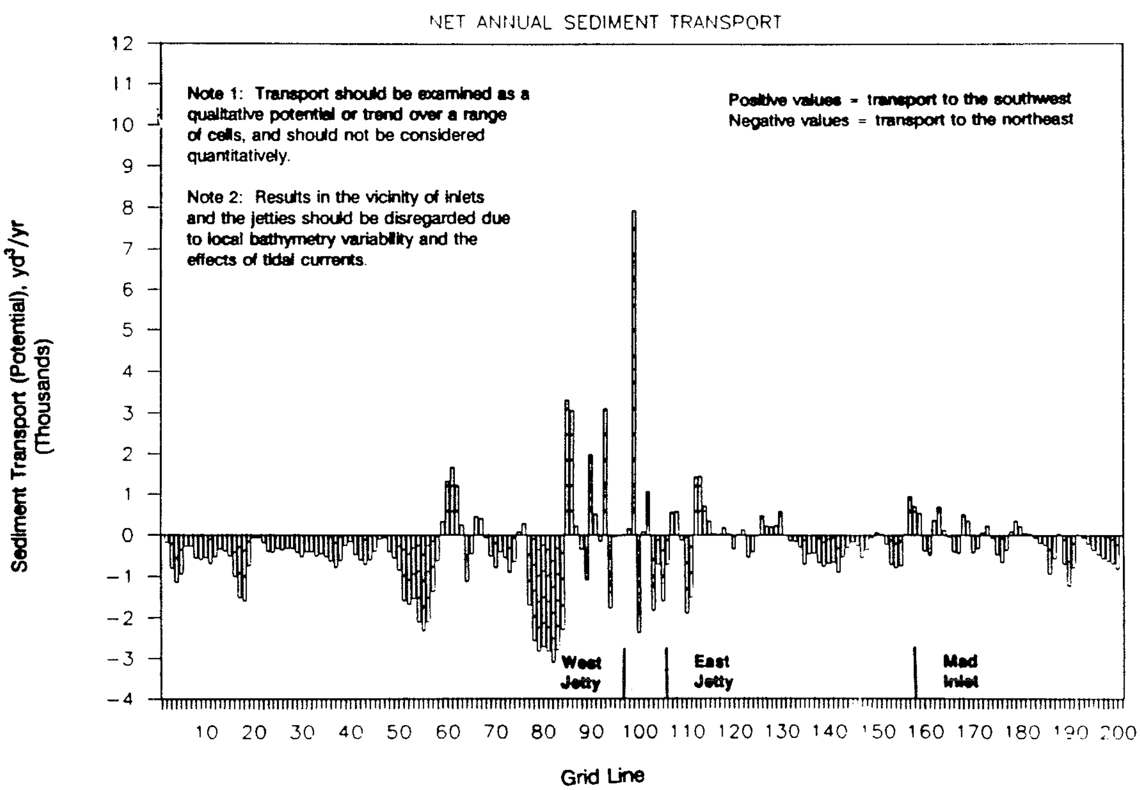

NET SEDIMENT TRANSPORT FOR AUGUST
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

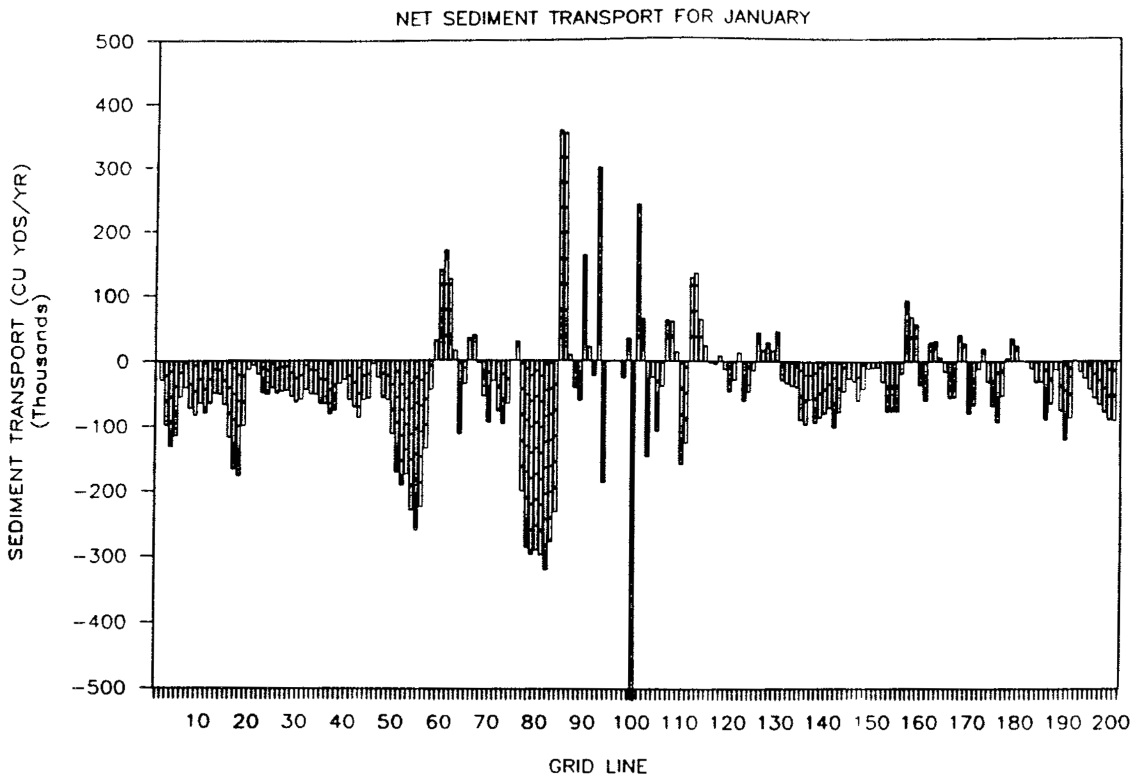

NET SEDIMENT TRANSPORT FOR SEPTEMBER
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

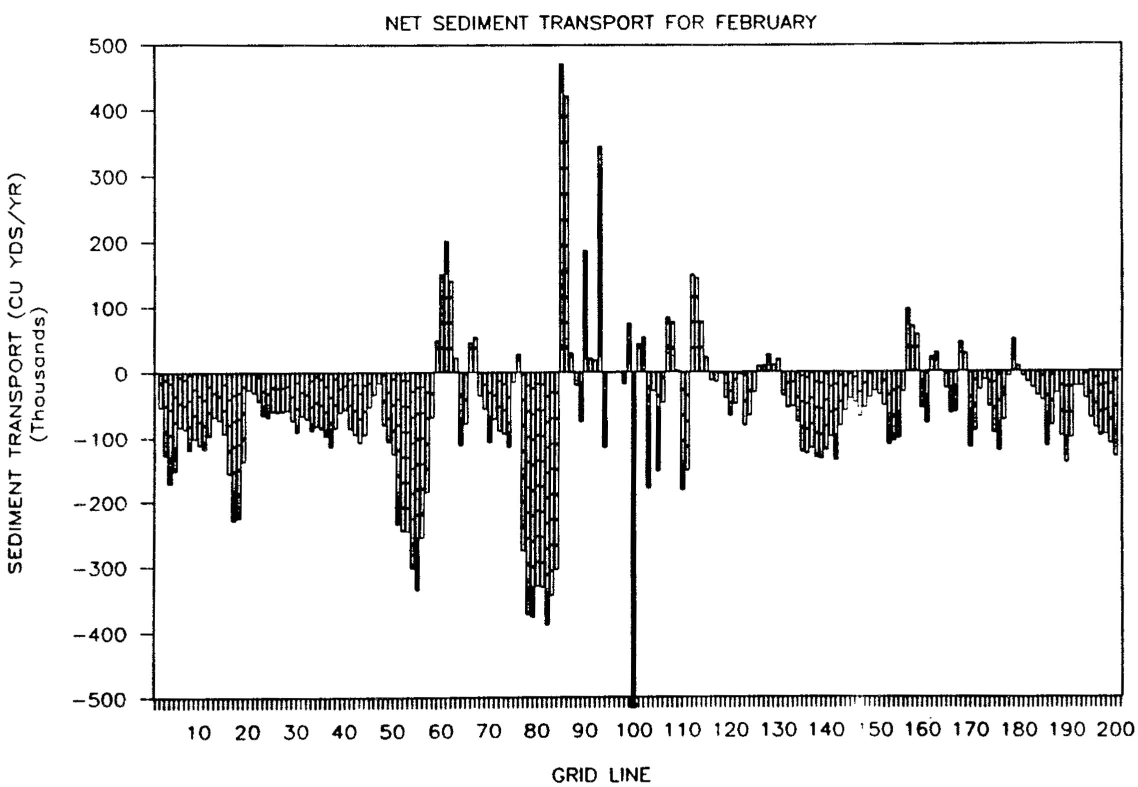

NET SEDIMENT TRANSPORT FOR OCTOBER
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

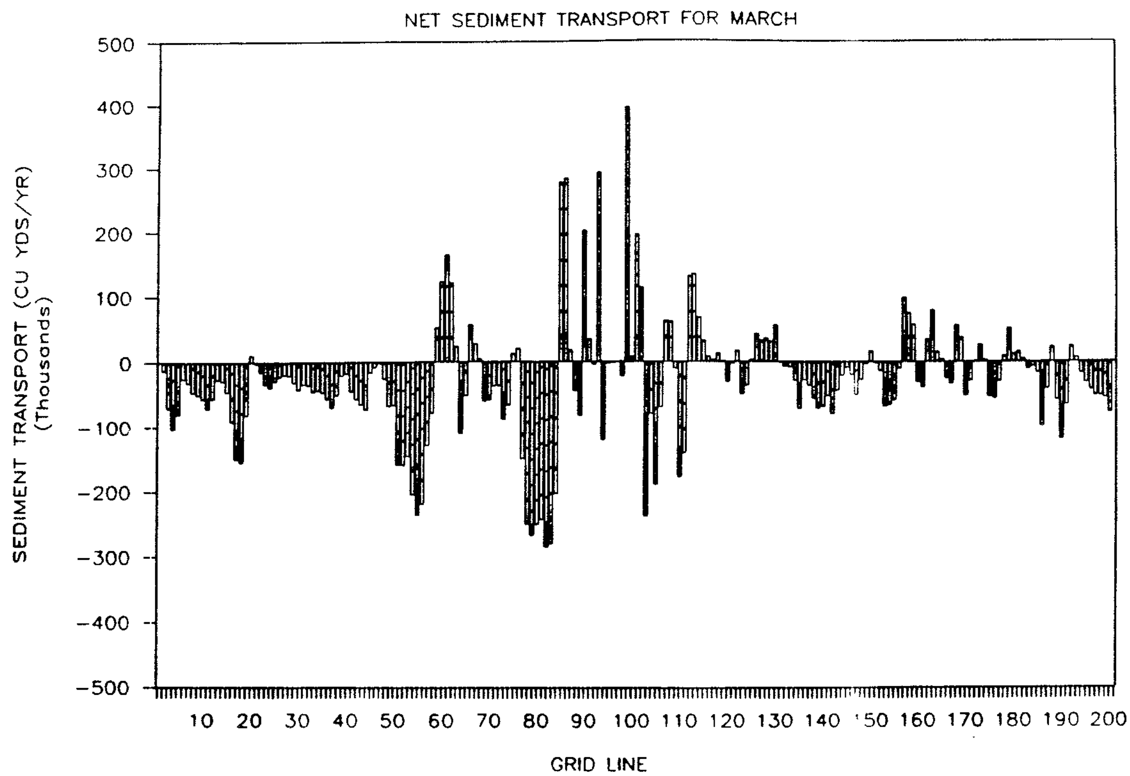

NET SEDIMENT TRANSPORT FOR NOVEMBER
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

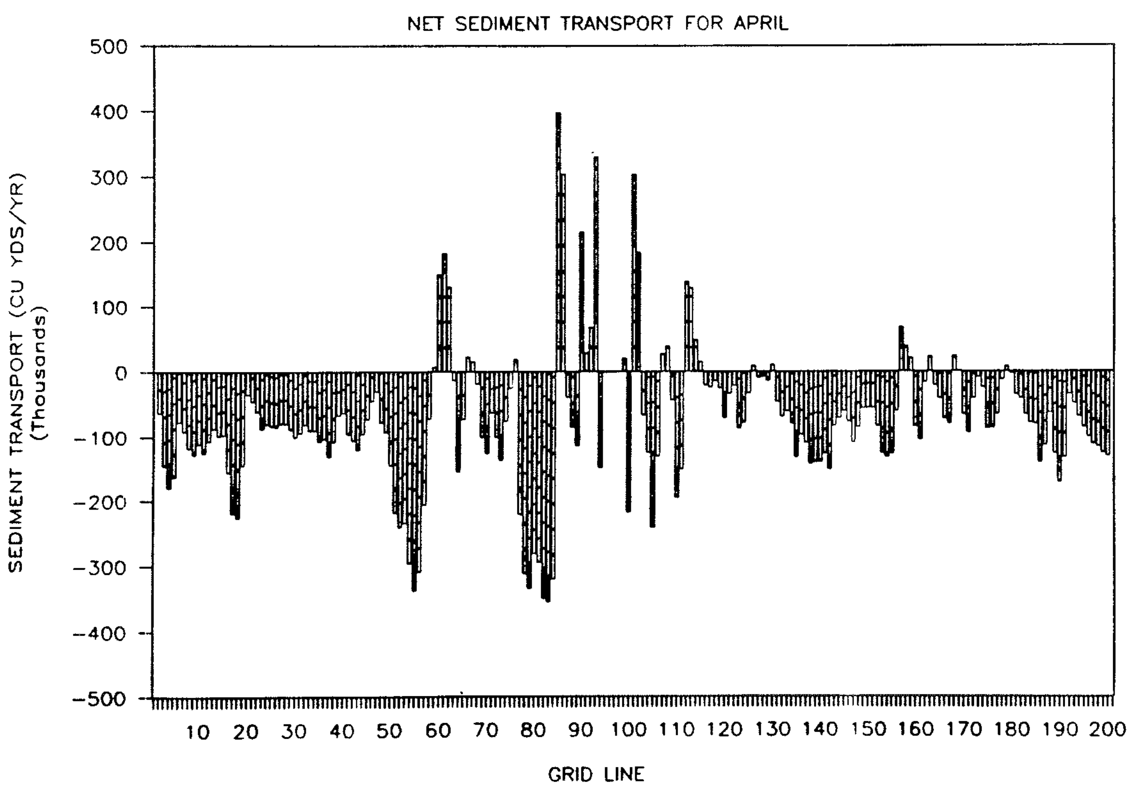

NET SEDIMENT TRANSPORT FOR DECEMBER
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
−100
−200
−300
−400
−500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

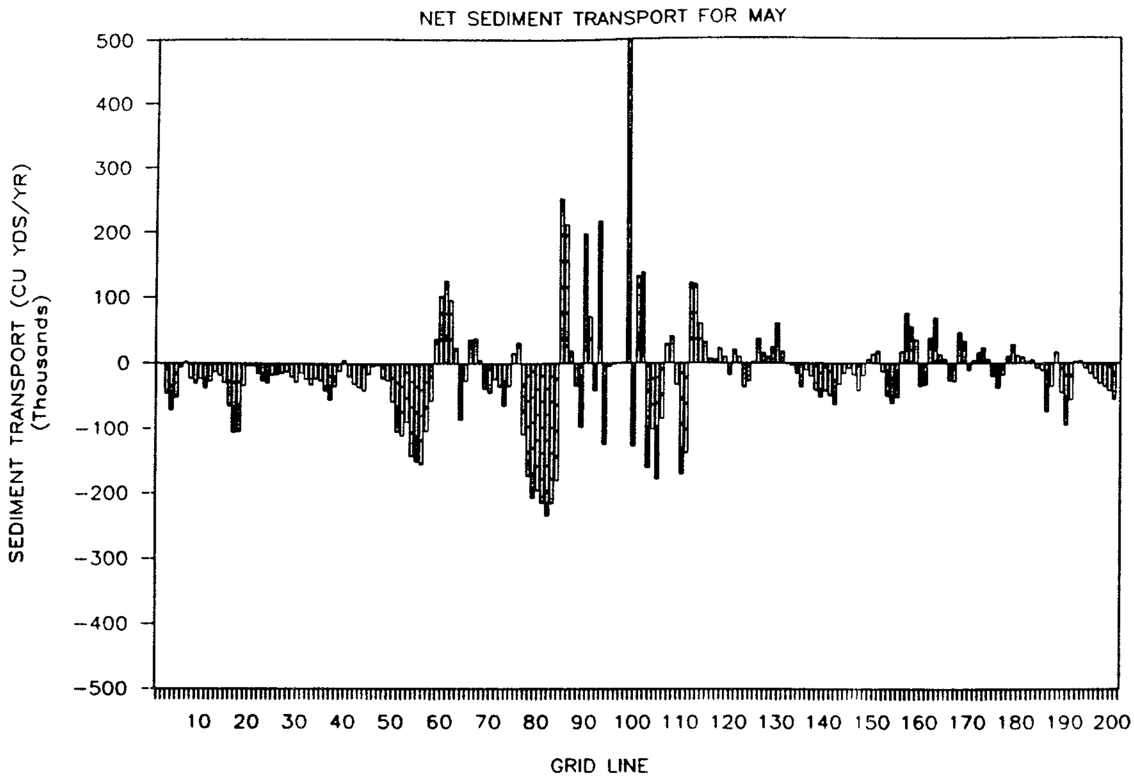

NET ANNUAL SEDIMENT TRANSPORT
Note 1: Transport should be examined as a qualitative potential or trend over a range of cells, and should not be considered quantitatively.
Note 2: Results in the vicinity of inlets and the jetties should be disregarded due to local bathymetry variability and the effects of tidal currents.
Positive values = transport to the southwest
Negative values = transport to the northeast
Sediment Transport (Potential), yd³/yr
(Thousands)
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
−4
West Jetty
East Jetty
Mad Inlet
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Grid Line

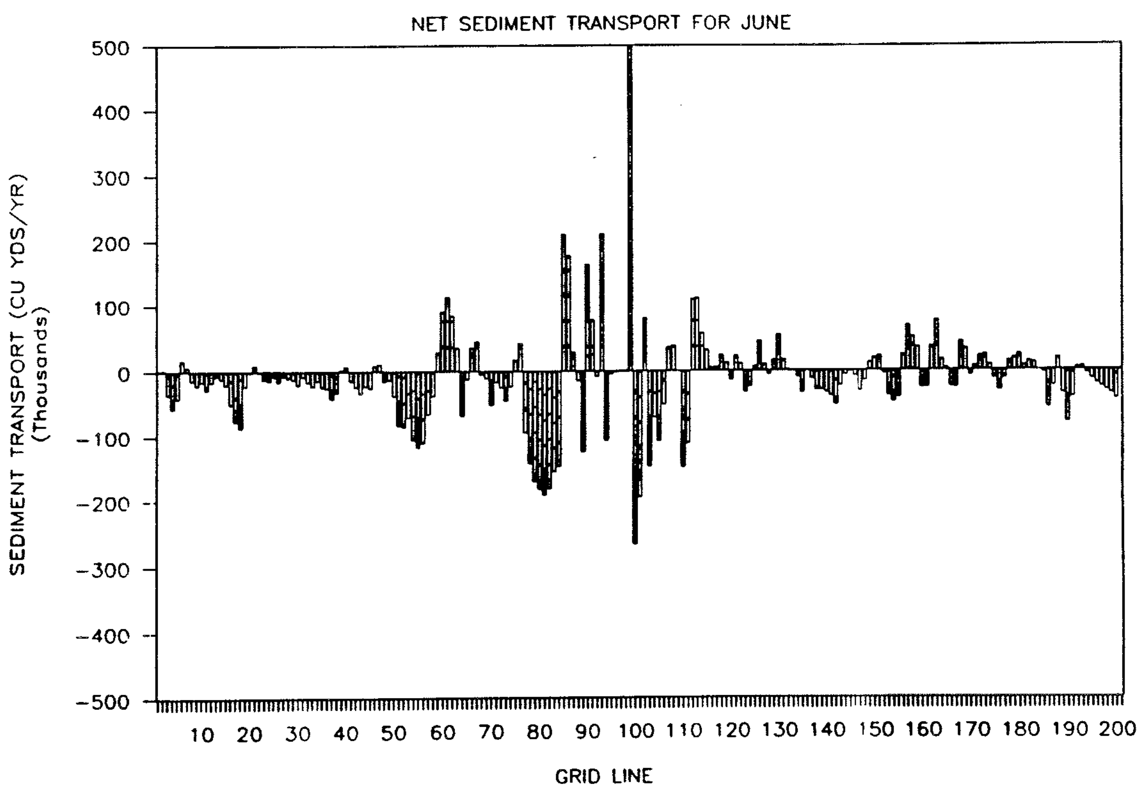

NET SEDIMENT TRANSPORT FOR JANUARY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

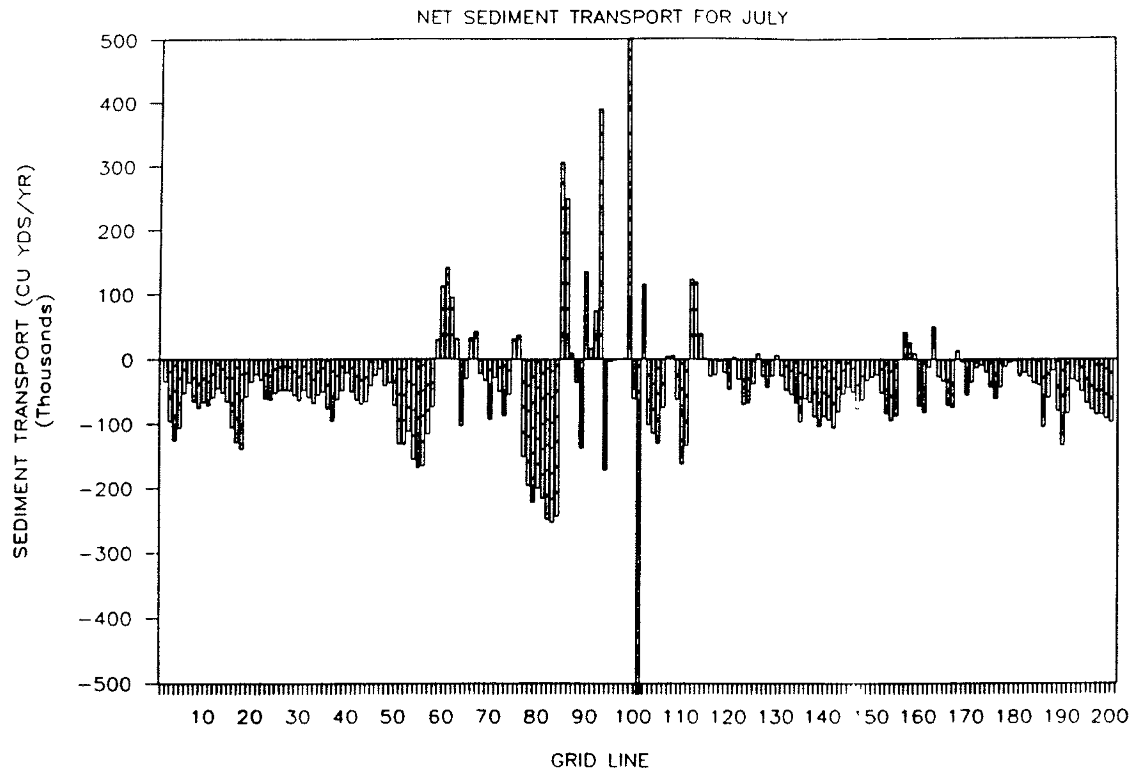

NET SEDIMENT TRANSPORT FOR FEBRUARY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR MARCH
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
−100
−200
−300
−400
−500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

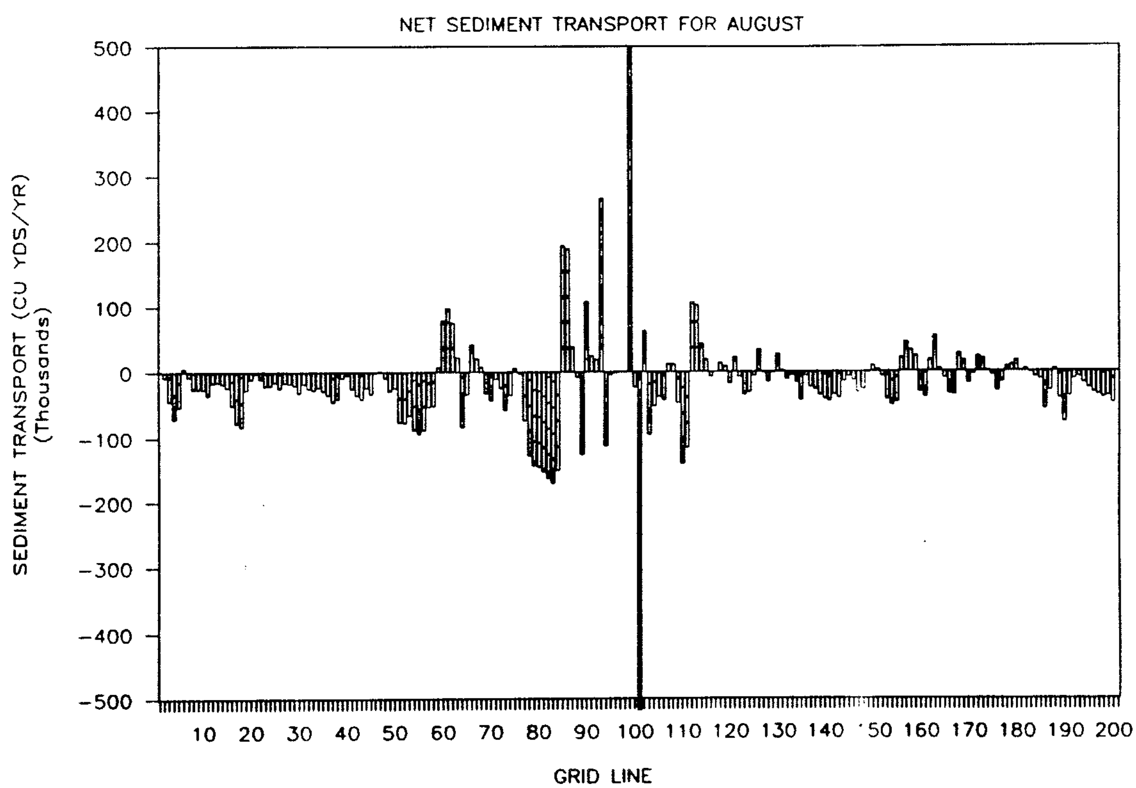

NET SEDIMENT TRANSPORT FOR APRIL
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
−100
−200
−300
−400
−500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR MAY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

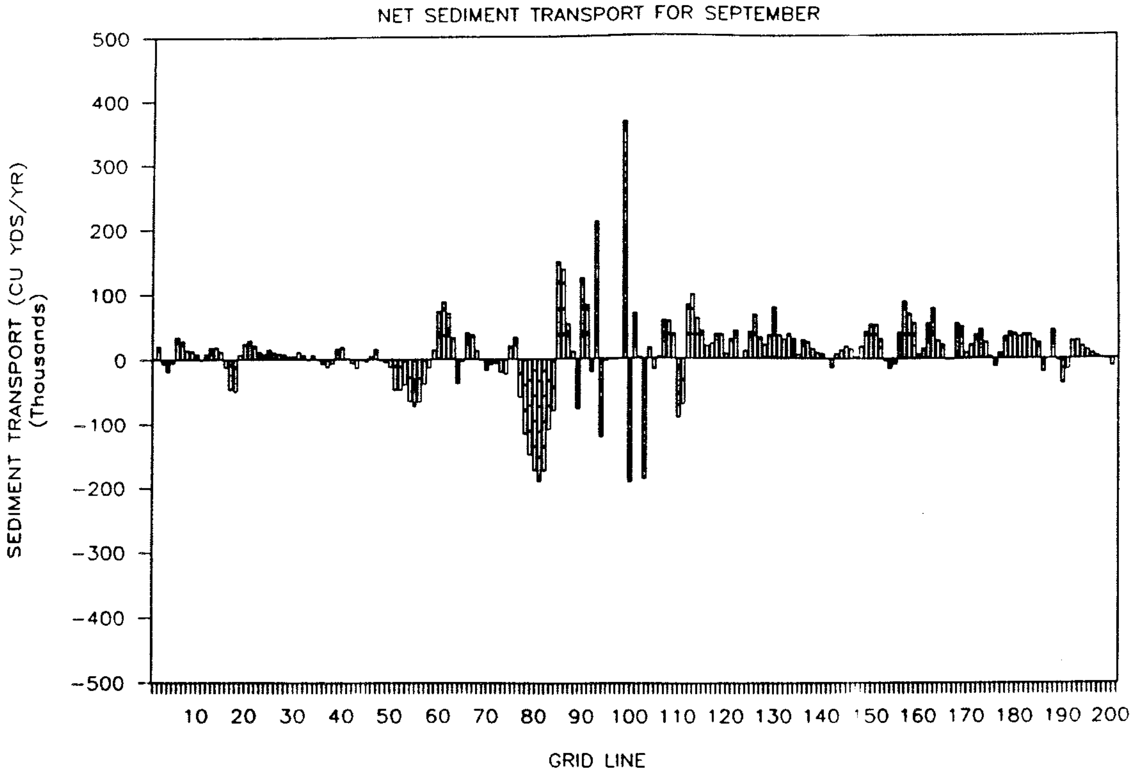

NET SEDIMENT TRANSPORT FOR JUNE
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

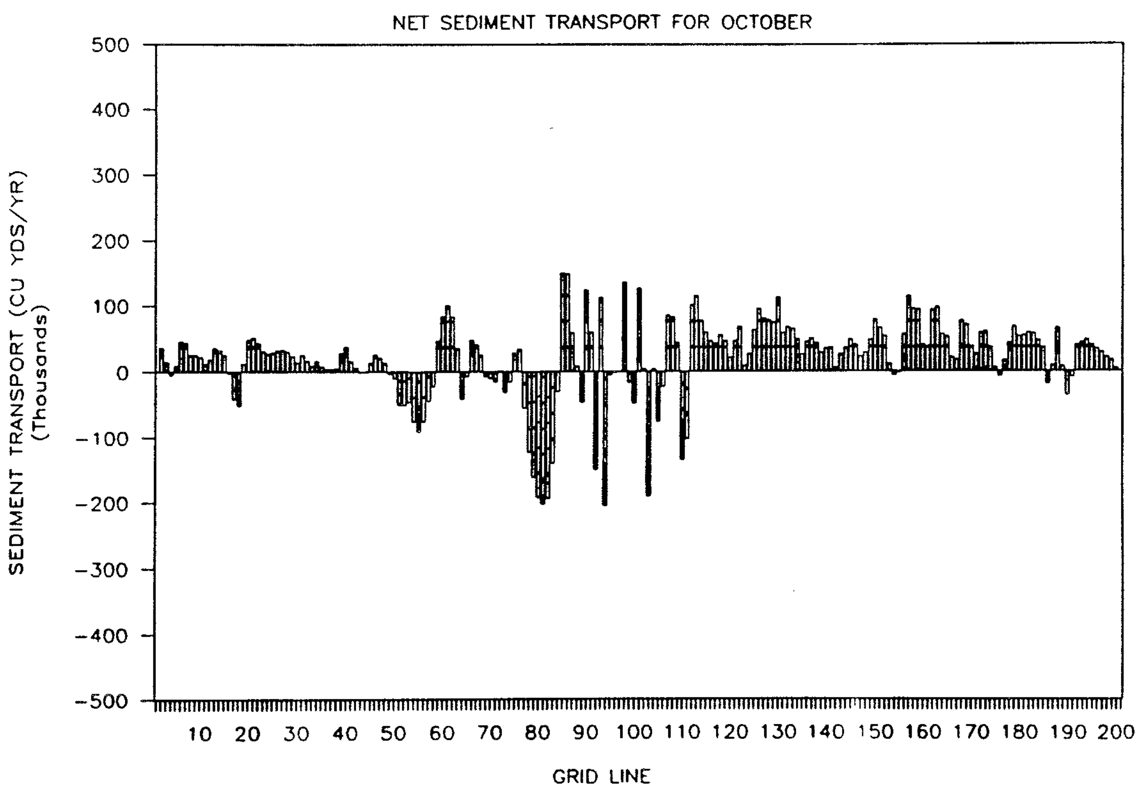


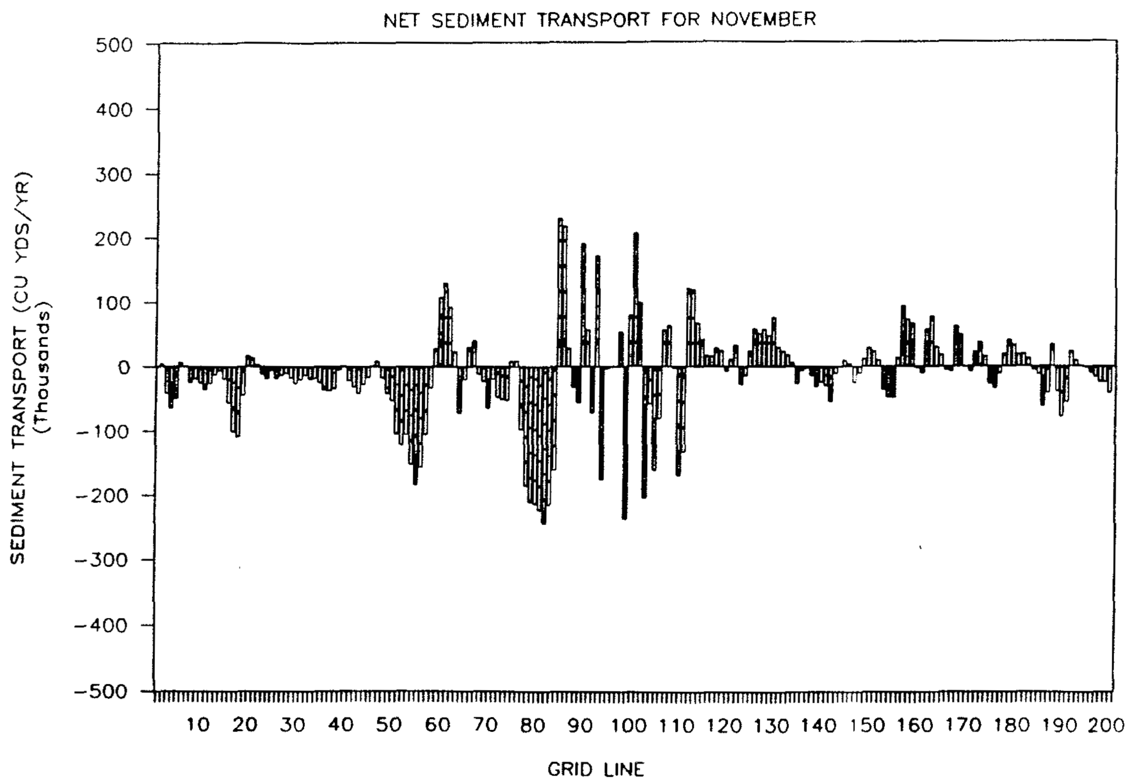
NET SEDIMENT TRANSPORT FOR JULY
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

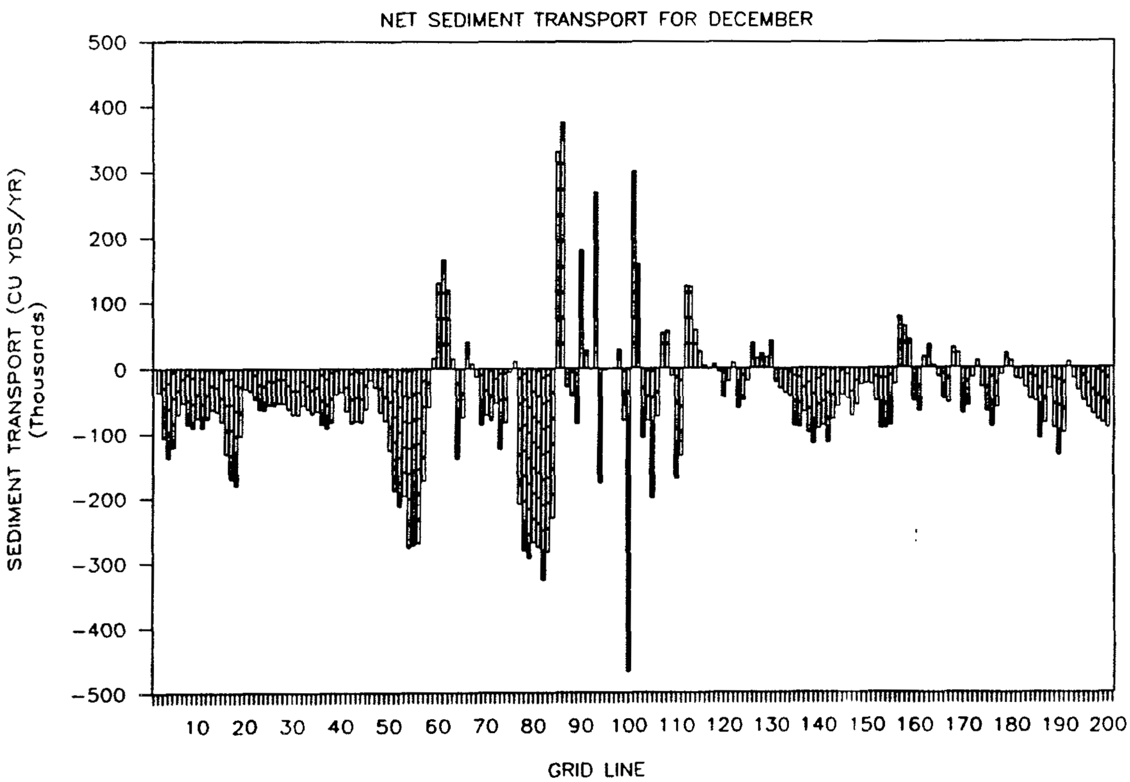


NET SEDIMENT TRANSPORT FOR AUGUST
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR SEPTEMBER
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR OCTOBER
SEDIMENT TRANSPORT (CU YDS/YR)
(Thousands)
500
400
300
200
100
0
-100
-200
-300
-400
-500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR NOVEMBER
SEDIMENT TRANSPORT (CU YDS/YR) (Thousands)
500
400
300
200
100
0
−100
−200
−300
−400
−500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE


NET SEDIMENT TRANSPORT FOR DECEMBER
SEDIMENT TRANSPORT (CU YDS/YR) (Thousands)
500
400
300
200
100
0
−100
−200
−300
−400
−500
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
GRID LINE

APPENDIX G:
LITTORAL ENVIRONMENT OBSERVATIONS

(Pages G3-G22 represent data for LEO Station 39098, Ocean Isle Beach, NC; pages G23-G42 represent data for LEO Station 39099, Sunset Beach, NC; pages G43-62 represent data for LEO Station 48002, Cherry Grove Beach, SC)

LEO Data Summary: Sta 39098, Ocean Isle Beach, North Carolina

Latitude 33°51'10.8", Longitude 78°26'7.8",

Data Collected from 29 Jul 80 to 31 Dec 80

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	0	0	0	0	0	0	2	28	30	29	30	31	150
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	2	0	0	2
HIGHEST WAVE RECORDED	.00	.00	.00	.00	.00	.00	1.50	3.00	2.00	4.50	4.50	5.00	5.00
AVG. WAVE HEIGHT(FT) (1)	.00	.00	.00	.00	.00	.00	1.25	1.14	1.08	1.62	2.27	2.29	1.69
STANDARD DEVIATION	.00	.00	.00	.00	.00	.00	.25	.54	.23	1.15	1.14	1.20	1.07
LONGEST PERIOD RECORDED	.00	.00	.00	.00	.00	.00	6.00	12.80	10.00	13.50	16.40	12.00	16.40
AVG WAVE PERIOD(SEC) (1)	.00	.00	.00	.00	.00	.00	6.00	7.74	7.27	6.27	6.07	5.13	6.46
STANDARD DEVIATION	.00	.00	.00	.00	.00	.00	.00	2.28	1.27	3.30	3.37	2.14	2.73
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	0	0	0	0	0	0	2	28	30	27	30	31	148
PERCENT OCCURRENCE >90	.0	.0	.0	.0	.0	.0	50.0	67.9	66.7	33.3	13.3	19.4	39.9
=90	.0	.0	.0	.0	.0	.0	.0	21.4	20.0	14.8	6.7	.0	12.2
<90	.0	.0	.0	.0	.0	.0	50.0	10.7	13.3	51.9	80.0	80.6	48.0
AVG. ZONE WIDTH (FT) (2)	0	0	0	0	0	0	15	34	22	168	210	208	129
NUMBER OF OBSERVATIONS	0	0	0	0	0	0	2	27	29	27	30	31	146
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	.0	.0	.0	.0	.0	.0	7.0	13.0	10.0	13.0	10.0	13.0	13.0
AVG. WIND SPEED(MPH) (1)	.0	.0	.0	.0	.0	.0	6.0	7.0	6.0	7.0	6.8	5.9	6.5
STANDARD DEVIATION	.0	.0	.0	.0	.0	.0	1.0	2.3	1.6	2.2	2.7	3.2	2.5
NUMBER OF OBSERVATIONS	0	0	0	0	0	0	2	28	29	30	30	31	150
PERCENT OCCURRENCE FROM													
NORTH	.0	.0	.0	.0	.0	.0	.0	.0	.0	10.0	16.7	41.9	14.0
NORTHEAST	.0	.0	.0	.0	.0	.0	.0	.0	.0	10.0	10.0	3.2	4.7
EAST	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.7	3.2	2.0
SOUTHEAST	.0	.0	.0	.0	.0	.0	.0	.0	.0	20.0	16.7	.0	7.3
SOUTH	.0	.0	.0	.0	.0	.0	.0	.0	.0	23.3	10.0	9.7	8.7
SOUTHWEST	.0	.0	.0	.0	.0	.0	100.0	100.0	100.0	30.0	16.7	29.0	54.7
WEST	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.3	6.7	3.2	2.7
NORTHWEST	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.3	16.7	3.2	4.7
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.5	1.3
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	.00	.00	.00	.00	.00	.00	-.12	-.61	-.79	-.90	-.73	-1.26	-.79
STANDARD DEVIATION	.00	.00	.00	.00	.00	.00	.00	.58	.41	.28	.30	.53	.50
NUM. OF OBS. (TO LEFT)	0	0	0	0	0	0	1	26	30	10	13	10	90
AVG TO RIGHT(FT/SEC) (2)	.00	.00	.00	.00	.00	.00	.00	1.00	.00	1.06	1.20	1.06	1.09
STANDARD DEVIATION	.00	.00	.00	.00	.00	.00	.00	.67	.00	.46	.79	.48	.58
NUM. OF OBS. (TO RIGHT)	0	0	0	0	0	0	0	2	0	18	14	19	53
AVG. NET CURRENT (2)(3)	.00	.00	.00	.00	.00	.00	.00	-.50	-.79	.36	.27	.26	-.09
NUMBER OF OBSERVATIONS	0	0	0	0	0	0	1	28	30	28	27	29	143
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	2	0	2	4

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	0	0	0	0	0	0	4	14	4	5	4	6	14
MINIMUM SLOPE	0	0	0	0	0	0	4	1	2	1	1	1	1
AVERAGE SLOPE (2)	.0	.0	.0	.0	.0	.0	4.0	3.5	3.0	2.0	2.0	2.3	2.6
NUMBER OF OBSERVATIONS	0	0	0	0	0	0	2	28	30	24	30	31	145
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	0	0	0	0	0	0	1770	-9179	-1591	6357	66046	82114	145517
NUM OF OBSERVATIONS	0	0	0	0	0	0	2	28	30	27	30	31	148
TOTAL LEFT CUBIC YDS	0	0	0	0	0	0	-565	-9415	-2244	-30602	-11002	-17597	-71425
NUM OF OBS TO LEFT	0	0	0	0	0	0	1	19	20	9	4	6	59
TOTAL RGHT CUBIC YDS	0	0	0	0	0	0	2336	235	653	36959	77049	99711	216943
NUM OF OBS TO RIGHT	0	0	0	0	0	0	1	3	4	14	24	25	71
METHOD 2													
NET CUBIC YARDS	0	0	0	0	0	0	-164	-2255	-1708	25685	-17385	-80761	-76588
NUM OF OBSERVATIONS	0	0	0	0	0	0	1	27	29	26	27	29	139
TOTAL LEFT CUBIC YDS	0	0	0	0	0	0	-164	-2790	-1708	-36118	-79809	-188778	-309367
NUM OF OBS TO LEFT	0	0	0	0	0	0	1	25	29	10	13	10	88
TOTAL RGHT CUBIC YDS	0	0	0	0	0	0	0	534	0	61803	62424	108017	232778
NUM OF OBS TO RIGHT	0	0	0	0	0	0	0	2	0	16	14	19	51

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39098, Ocean Isle Beach, North Carolina
Latitude 33°51'10.8", Longitude 78°26'7.8",
Data Collected from 1 Jan 81 to 31 Dec 81

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	27	31	30	31	30	31	30	30	30	30	31	362
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.00	5.00	3.50	4.00	3.50	3.00	3.00	5.00	3.50	3.50	4.50	4.50	5.00
AVG. WAVE HEIGHT(FT) (1)	2.02	2.30	1.92	2.20	2.21	2.02	1.84	1.85	1.87	2.05	2.10	2.35	2.06
STANDARD DEVIATION	.87	1.20	.77	.73	.70	.50	.54	.83	.53	.73	1.02	.92	.82
LONGEST PERIOD RECORDED	9.00	9.50	8.50	16.50	8.60	8.00	6.90	8.60	9.80	8.60	8.60	8.60	16.50
AVG WAVE PERIOD(SEC) (1)	5.11	4.98	4.74	5.18	5.66	5.12	5.14	5.88	6.13	5.63	5.74	5.56	5.41
STANDARD DEVIATION	1.97	1.95	1.87	2.26	1.32	.83	.58	1.25	1.32	1.11	1.20	1.14	1.53
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	27	31	30	31	30	31	30	30	30	30	31	362
PERCENT OCCURRENCE >90	.0	11.1	22.6	60.0	45.2	60.0	58.1	36.7	56.7	33.3	50.0	58.1	41.2
=90	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
<90	100.0	88.9	77.4	40.0	54.8	40.0	41.9	63.3	43.3	66.7	50.0	41.9	58.8
AVG. ZONE WIDTH (FT) (2)	251	323	322	304	279	297	313	309	300	314	289	318	301
NUMBER OF OBSERVATIONS	31	28	31	29	30	29	31	31	30	31	30	31	362
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	12.0	10.0	20.0	20.0	20.0	21.0	16.0	20.0	15.0	18.0	20.0	18.0	21.0
AVG. WIND SPEED(MPH) (1)	4.9	6.2	9.5	10.9	9.3	8.1	8.9	9.7	10.0	11.5	9.1	10.4	9.0
STANDARD DEVIATION	3.7	2.6	4.5	4.9	3.7	3.5	3.0	4.3	2.4	3.5	4.4	4.0	4.2
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
PERCENT OCCURRENCE FROM													
NORTH	3.2	7.1	6.5	3.3	6.5	3.3	.0	.0	6.7	12.9	13.3	6.5	5.8
NORTHEAST	19.4	10.7	6.5	3.3	12.9	.0	9.7	32.3	33.3	38.7	20.0	16.1	17.0
EAST	.0	17.9	.0	.0	3.2	16.7	6.5	3.2	6.7	6.5	6.7	.0	5.5
SOUTHEAST	.0	7.1	6.5	33.3	16.1	6.7	16.1	9.7	6.7	12.9	.0	6.5	10.1
SOUTH	.0	10.7	12.9	13.3	9.7	10.0	25.8	.0	16.7	.0	13.3	9.7	10.1
SOUTHWEST	29.0	17.9	41.9	30.0	38.7	60.0	35.5	41.9	23.3	19.4	23.3	19.4	31.8
WEST	3.2	7.1	6.5	13.3	12.9	3.3	3.2	.0	.0	6.5	6.7	9.7	6.0
NORTHWEST	16.1	14.3	19.4	3.3	.0	.0	3.2	3.2	6.7	3.2	13.3	29.0	9.3
CALM	29.0	7.1	.0	.0	.0	.0	.0	9.7	.0	.0	3.3	3.2	4.4
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	.00	-1.18	-1.00	-1.00	-1.21	-.95	-1.08	-1.27	-1.11	-1.33	-1.34	-1.19	-1.15
STANDARD DEVIATION	.00	.41	.22	.29	.31	.24	.39	.59	.40	.45	.44	.39	.41
NUM. OF OBS. (TO LEFT)	0	4	8	16	15	12	20	10	15	13	15	18	146
AVG TO RIGHT(FT/SEC) (2)	.94	.91	.85	1.19	1.24	.98	1.06	1.10	1.46	1.36	1.09	1.19	1.10
STANDARD DEVIATION	.39	.39	.37	.71	.24	.32	.37	.39	.43	.35	.40	.42	.44
NUM. OF OBS. (TO RIGHT)	27	17	20	14	16	17	11	21	15	18	14	13	203
AVG. NET CURRENT (2)(3)	.94	.51	.32	.02	.05	.18	-.32	.33	.17	.23	-.16	-.19	.16
NUMBER OF OBSERVATIONS	27	21	28	30	31	29	31	31	30	31	29	31	349
NUMBER OF CALM OBS.	4	7	2	0	0	1	0	0	0	0	1	0	15

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	5	5	5	4	3	3	10	3	4	4	3	10
MINIMUM SLOPE	1	1	1	1	1	1	1	1	1	1	1	2	1
AVERAGE SLOPE (2)	2.1	2.0	1.9	2.4	2.3	2.1	1.9	2.3	1.9	2.0	2.1	2.0	2.1
NUMBER OF OBSERVATIONS	31	27	29	30	31	30	31	31	30	31	30	31	362
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	77467	110539	23442	-27495	-32312	-33617	-22807	6451	-14503	-3367	-53216	-35715	-5133
NUM OF OBSERVATIONS	31	27	31	30	31	30	31	31	30	30	30	31	363
TOTAL LEFT CUBIC YDS	0	-4379	-25894	-52849	-52520	-45212	-34238	-19406	-29372	-29269	-68269	-63007	-424415
NUM OF OBS TO LEFT	0	3	7	18	14	18	18	12	17	10	15	18	150
TOTAL RGHT CUBIC YDS	77467	114918	49336	25354	20207	11595	11430	25858	14869	25901	15053	27292	419280
NUM OF OBS TO RIGHT	31	24	24	12	17	12	13	19	13	20	15	13	213
METHOD 2													
NET CUBIC YARDS	240202	342067	52777	-60330	-94711	-16609	-75062	75778	21925	-72799	-246274	9001	175965
NUM OF OBSERVATIONS	27	21	28	29	30	28	31	31	30	31	29	31	346
TOTAL LEFT CUBIC YDS	0	-53588	-138067	-188350	-192430	-114254	-159710	-152527	-135342	-254184	-356864	-232023	-1977339
NUM OF OBS TO LEFT	0	4	8	15	15	12	20	10	15	13	15	18	145
TOTAL RGHT CUBIC YDS	240202	395655	190845	128019	97719	97644	84648	228306	157267	181384	110589	241025	2153303
NUM OF OBS TO RIGHT	27	17	20	14	15	16	11	21	15	18	14	13	201

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39098, Ocean Isle Beach, North Carolina

Latitude 33°51'10.8", Longitude 78°26'7.8",

Data Collected from 1 Jan 82 to 31 Dec 82

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	27	31	30	30	29	31	30	30	30	30	31	360
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	3.50	3.50	4.50	3.50	3.50	5.00	3.50	4.00	3.50	3.50	3.50	3.50	5.00
AVG. WAVE HEIGHT(FT) (1)	2.02	2.11	2.18	2.27	2.20	2.67	2.32	1.76	1.82	1.88	1.88	2.26	2.11
STANDARD DEVIATION	.91	.71	.93	.69	.86	.94	.71	.67	.77	.78	.72	.86	.84
LONGEST PERIOD RECORDED	8.60	6.80	8.60	8.60	8.60	7.80	8.60	8.60	8.60	8.60	8.60	7.60	8.60
AVG WAVE PERIOD(SEC) (1)	5.87	5.47	5.80	5.66	5.56	5.47	5.72	5.71	6.00	5.94	5.88	5.48	5.72
STANDARD DEVIATION	1.27	.77	1.00	1.08	1.05	.72	.90	.98	1.19	1.01	1.13	.73	1.02
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	27	31	30	30	29	31	30	30	30	30	31	360
PERCENT OCCURRENCE >90	54.8	40.7	38.7	36.7	40.0	34.5	48.4	46.7	33.3	20.0	23.3	41.9	38.3
=90	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
<90	45.2	59.3	61.3	63.3	60.0	65.5	51.6	53.3	66.7	80.0	76.7	58.1	61.7
AVG. ZONE WIDTH (FT) (2)	325	339	289	309	323	360	302	239	251	248	275	317	298
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	30	29	31	363
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	16.0	16.0	14.0	18.0	16.0	18.0	16.0	16.0	16.0	18.0	16.0	16.0	18.0
AVG. WIND SPEED(MPH) (1)	8.9	10.7	9.1	10.2	8.4	8.8	9.4	8.5	8.7	8.8	9.0	10.0	9.2
STANDARD DEVIATION	3.8	2.6	3.2	3.1	3.2	2.9	4.1	3.5	3.5	4.5	3.3	3.4	3.5
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
PERCENT OCCURRENCE FROM													
NORTH	9.7	14.3	3.2	13.3	.0	.0	.0	.0	.0	12.9	23.3	12.9	7.4
NORTHEAST	25.8	35.7	22.6	26.7	16.1	6.7	3.2	19.4	36.7	51.6	43.3	22.6	25.8
EAST	9.7	3.6	3.2	16.7	.0	6.7	.0	3.2	3.3	.0	6.7	.0	4.4
SOUTHEAST	3.2	3.6	12.9	6.7	12.9	23.3	6.5	29.0	13.3	6.5	10.0	19.4	12.3
SOUTH	6.5	7.1	12.9	6.7	25.8	13.3	19.4	12.9	3.3	.0	10.0	32.3	12.6
SOUTHWEST	19.4	17.9	19.4	3.3	35.5	43.3	54.8	25.8	16.7	9.7	6.7	.0	21.1
WEST	6.5	7.1	6.5	13.3	3.2	.0	12.9	3.2	6.7	.0	.0	6.5	5.5
NORTHWEST	16.1	10.7	12.9	13.3	6.5	6.7	.0	.0	13.3	16.1	.0	6.5	8.5
CALM	3.2	.0	6.5	.0	.0	.0	3.2	6.5	6.7	3.2	.0	.0	2.5
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-1.42	-1.06	-1.32	-1.30	-1.39	-1.58	-1.55	-1.19	-1.39	-1.20	-1.20	-1.43	-1.35
STANDARD DEVIATION	.38	.41	.39	.36	.37	.19	.27	.35	.35	.41	.45	.22	.38
NUM. OF OBS. (TO LEFT)	17	11	12	11	13	11	15	15	9	6	7	12	139
AVG TO RIGHT(FT/SEC) (2)	.98	1.13	1.11	1.18	1.23	1.21	.90	.92	.85	1.02	.98	.94	1.04
STANDARD DEVIATION	.35	.40	.35	.37	.36	.34	.26	.30	.24	.38	.32	.32	.36
NUM. OF OBS. (TO RIGHT)	13	16	19	19	18	19	16	16	20	25	22	18	221
AVG. NET CURRENT (2)(3)	-.33	.24	.17	.27	.13	.19	-.29	-.10	.15	.59	.45	-.01	.12
NUMBER OF OBSERVATIONS	30	27	31	30	31	30	31	31	29	31	29	30	360
NUMBER OF CALM OBS.	1	1	0	0	0	0	0	0	0	0	1	1	4

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	3	3	2	2	2	3	2	2	4	2	2	4
MINIMUM SLOPE	1	2	2	1	1	1	2	2	1	2	2	2	1
AVERAGE SLOPE (2)	2.0	2.0	2.0	2.0	1.9	2.0	2.0	2.0	2.0	2.2	2.0	2.0	2.0
NUMBER OF OBSERVATIONS	31	28	31	30	31	28	31	31	30	31	30	31	363
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-47359	-1565	-27075	-9076	-9348	-37422	-55556	-26265	-25522	1315	4512	-48075	-281436
NUM OF OBSERVATIONS	31	28	31	30	30	29	31	31	30	30	30	31	362
TOTAL LEFT CUBIC YDS	-60016	-29959	-52133	-38852	-39497	-76950	-71316	-36046	-38354	-22634	-19576	-66668	-552001
NUM OF OBS TO LEFT	17	11	12	11	12	10	15	15	10	6	7	13	139
TOTAL RGHT CUBIC YDS	12657	28394	25057	29775	30148	39528	15760	9780	12832	23949	24089	18593	270562
NUM OF OBS TO RIGHT	14	17	19	19	18	19	16	16	20	24	23	18	223
METHOD 2													
NET CUBIC YARDS	-260212	100726	-49205	37704	-663923	-1165672	-302877	-88302	-130562	158259	50749	-125008	-2438323
NUM OF OBSERVATIONS	30	27	31	30	31	29	31	31	29	30	28	30	357
TOTAL LEFT CUBIC YDS	-378939	-129398	-214282	-182249	-897038	-1465130	-363637	-139133	-191042	-58718	-106237	-252304	-4378107
NUM OF OBS TO LEFT	17	11	12	11	13	11	15	15	9	5	7	12	138
TOTAL RGHT CUBIC YDS	118726	230125	165076	219954	233115	299457	60760	50830	60479	216978	156986	127296	1939782
NUM OF OBS TO RIGHT	13	16	19	19	18	18	16	16	20	25	21	18	219

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39098, Ocean Isle Beach, North Carolina

Latitude 33°51'10.8", Longitude 78°26'7.8",

Data Collected from 1 Jan 83 to 31 Dec 83

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	29	31	364
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	3.50	4.00	4.00	3.50	3.50	3.00	2.50	3.00	3.50	4.00	3.50	3.50	4.00
AVG. WAVE HEIGHT(FT) (1)	1.87	1.96	2.53	2.13	2.44	2.00	2.02	2.00	1.88	1.98	1.93	2.21	2.08
STANDARD DEVIATION	.72	.95	.91	.78	.67	.47	.45	.44	.64	.82	.78	.80	.75
LONGEST PERIOD RECORDED	8.60	8.60	7.60	7.60	6.80	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60
AVG WAVE PERIOD(SEC) (1)	6.05	5.96	5.45	5.44	5.69	5.98	6.10	5.53	5.66	5.86	6.12	5.60	5.78
STANDARD DEVIATION	1.01	1.09	.86	.35	.83	1.11	.76	.85	.91	1.21	1.36	1.07	1.03
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	29	31	364
PERCENT OCCURRENCE >90	19.4	21.4	51.6	50.0	32.3	20.0	29.0	25.8	23.3	19.4	24.1	51.6	30.8
=90	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
<90	80.6	78.6	48.4	50.0	67.7	80.0	71.0	74.2	76.7	80.6	75.9	48.4	69.2
AVG. ZONE WIDTH (FT) (2)	241	275	372	331	350	274	297	319	295	305	281	320	305
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	29	31	30	30	30	31	362
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	18.0	18.0	20.0	18.0	18.0	18.0	14.0	12.0	18.0	18.0	18.0	18.0	20.0
AVG. WIND SPEED(MPH) (1)	9.4	10.9	11.7	10.9	11.5	9.3	9.1	8.9	9.3	9.5	8.9	10.7	10.0
STANDARD DEVIATION	3.8	4.3	4.2	3.8	4.0	2.8	3.1	3.2	4.1	4.1	4.0	4.2	4.0
NUMBER OF OBSERVATIONS	31	28	31	29	31	30	31	31	30	31	30	31	364
PERCENT OCCURRENCE FROM													
NORTH	19.4	17.9	3.2	.0	.0	3.3	6.5	3.2	3.3	6.5	6.7	19.4	7.4
NORTHEAST	25.8	32.1	22.6	.0	6.5	13.3	16.1	16.1	33.3	29.0	16.7	12.9	18.7
EAST	3.2	7.1	.0	3.4	3.2	3.3	3.2	.0	.0	.0	.0	9.7	2.7
SOUTHEAST	6.5	7.1	9.7	6.9	16.1	43.3	.0	9.7	3.3	25.8	13.3	.0	11.8
SOUTH	3.2	.0	16.1	37.9	41.9	10.0	29.0	12.9	16.7	6.5	6.7	9.7	15.9
SOUTHWEST	9.7	7.1	9.7	20.7	22.6	16.7	38.7	51.6	36.7	12.9	33.3	29.0	24.2
WEST	6.5	7.1	16.1	10.3	9.7	3.3	3.2	.0	.0	6.5	10.0	9.7	6.9
NORTHWEST	25.8	21.4	22.6	20.7	.0	6.7	.0	3.2	3.3	9.7	6.7	6.5	10.4
CALM	.0	.0	.0	.0	.0	.0	3.2	3.2	3.3	3.2	6.7	3.2	1.9
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-1.15	-1.14	-1.31	-1.37	-1.19	-1.28	-1.10	-1.06	-1.50	-1.03	-1.23	-1.18	-1.23
STANDARD DEVIATION	.34	.34	.39	.26	.34	.37	.25	.31	.24	.41	.42	.42	.37
NUM. OF OBS. (TO LEFT)	5	6	16	15	9	5	11	3	7	6	7	16	111
AVG TO RIGHT(FT/SEC) (2)	.92	.96	1.30	1.18	1.04	1.03	.87	1.07	.94	1.06	.96	1.01	1.02
STANDARD DEVIATION	.34	.42	.40	.40	.42	.34	.27	.32	.37	.39	.43	.39	.39
NUM. OF OBS. (TO RIGHT)	26	22	15	15	21	25	20	21	23	25	22	15	250
AVG. NET CURRENT (2)(3)	.59	.51	-.05	-.10	.37	.64	.17	.49	.37	.65	.43	-.12	.33
NUMBER OF OBSERVATIONS	31	28	31	30	30	30	31	29	30	31	29	31	361
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	2	2	2	2	4	2	2	4	2	2	2	2	4
MINIMUM SLOPE	1	2	2	2	2	2	2	2	2	2	2	2	1
AVERAGE SLOPE (2)	2.0	2.0	2.0	2.0	2.1	2.0	2.0	2.1	2.0	2.0	2.0	2.0	2.0
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	29	31	30	31	364
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	13262	-4217	-33854	-26688	-8552	6634	-2721	4420	-11545	5707	-1062	-37442	-96058
NUM OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	29	31	364
TOTAL LEFT CUBIC YDS	-13634	-31331	-67766	-47681	-43827	-18183	-24672	-19450	-29106	-22428	-25423	-57215	-400716
NUM OF OBS TO LEFT	6	6	16	15	10	6	9	8	7	6	7	16	112
TOTAL RGHT CUBIC YDS	26896	27113	33912	20993	35274	24818	21951	23871	17560	28135	24360	19773	304656
NUM OF OBS TO RIGHT	25	22	15	15	21	24	22	23	23	25	22	15	252
METHOD 2													
NET CUBIC YARDS	97195	90080	8602	-83225	92379	106006	-12079	91008	-58965	154566	114837	-143947	456457
NUM OF OBSERVATIONS	31	28	31	30	30	30	29	28	30	30	29	31	357
TOTAL LEFT CUBIC YDS	-45834	-124769	-332345	-266573	-181340	-53408	-120397	-93702	-193121	-93692	-101687	-296998	-1903866
NUM OF OBS TO LEFT	5	6	16	15	9	5	11	8	7	6	7	16	111
TOTAL RGHT CUBIC YDS	143029	214849	340948	183347	273720	159415	108317	184710	134155	248259	216524	153051	2360324
NUM OF OBS TO RIGHT	26	22	15	15	21	25	18	20	23	24	22	15	246

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39098, Ocean Isle Beach, North Carolina

Latitude 33°51'10.8", Longitude 78°26'7.8",

Data Collected from 1 Jan 84 to 31 Dec 84

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	29	31	30	31	28	30	29	29	31	30	31	360
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	3.50	3.50	3.50	4.50	3.50	3.00	3.50	3.00	5.00	4.50	4.00	3.50	5.00
AVG. WAVE HEIGHT(FT) (1)	1.82	2.12	2.00	2.32	2.26	1.82	1.98	1.64	2.02	2.03	2.12	1.95	2.01
STANDARD DEVIATION	.69	.93	.85	.82	.75	.57	.69	.60	.90	.78	.96	.92	.82
LONGEST PERIOD RECORDED	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.80	8.60	8.60	8.80
AVG WAVE PERIOD(SEC) (1)	6.06	6.02	6.01	6.16	6.05	6.43	6.15	6.99	6.50	6.77	6.49	6.36	6.33
STANDARD DEVIATION	1.11	1.34	1.12	1.37	1.08	.91	.90	1.27	1.49	1.35	1.47	1.24	1.27
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	29	31	30	31	28	30	29	29	31	30	31	360
PERCENT OCCURRENCE >90	32.3	41.4	51.6	43.3	38.7	35.7	53.3	37.9	24.1	29.0	33.3	35.5	38.1
=90	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
<90	67.7	58.6	48.4	56.7	61.3	64.3	46.7	62.1	75.9	71.0	66.7	64.5	61.9
AVG. ZONE WIDTH (FT) (2)	244	305	275	319	309	233	255	207	262	263	285	258	268
NUMBER OF OBSERVATIONS	31	29	31	31	31	30	30	30	28	31	29	31	362
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	18.0	18.0	18.0	20.0	20.0	12.0	18.0	12.0	20.0	18.0	18.0	18.0	20.0
AVG. WIND SPEED(MPH) (1)	10.1	8.9	12.1	11.4	12.0	9.3	10.7	7.8	9.7	7.7	8.5	8.0	9.7
STANDARD DEVIATION	4.4	4.7	4.6	5.0	3.7	2.3	2.8	3.4	5.3	4.8	5.6	4.0	4.6
NUMBER OF OBSERVATIONS	31	29	31	31	31	30	30	30	29	31	30	31	364
PERCENT OCCURRENCE FROM													
NORTH	29.0	6.9	22.6	.0	6.5	.0	.0	3.3	6.9	3.2	10.0	9.7	8.2
NORTHEAST	19.4	17.2	9.7	12.9	3.2	3.3	6.7	6.7	24.1	12.9	26.7	22.6	13.7
EAST	3.2	3.4	3.2	6.5	.0	3.3	.0	.0	.0	3.2	.0	.0	1.9
SOUTHEAST	.0	13.8	9.7	16.1	3.2	16.7	16.7	6.7	20.7	22.6	.0	.0	10.4
SOUTH	6.5	13.8	25.8	6.5	38.7	13.3	23.3	10.0	20.7	19.4	10.0	12.9	16.8
SOUTHWEST	16.1	6.9	6.5	29.0	32.3	60.0	53.3	46.7	17.2	16.1	16.7	19.4	26.6
WEST	9.7	13.8	6.5	25.8	9.7	3.3	.0	3.3	3.4	3.2	6.7	19.4	8.8
NORTHWEST	12.9	13.8	12.9	.0	6.5	.0	.0	13.3	3.4	6.5	10.0	9.7	7.4
CALM	3.2	10.3	3.2	3.2	.0	.0	.0	10.0	3.4	12.9	20.0	6.5	6.0
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.92	-1.04	-1.00	-.95	-.90	-.75	-.82	-.73	-.69	-.97	-.98	-.79	-.89
STANDARD DEVIATION	.29	.36	.35	.32	.27	.17	.27	.20	.10	.34	.31	.25	.31
NUM. OF OBS. (TO LEFT)	10	11	17	12	12	9	18	11	7	9	10	10	136
AVG TO RIGHT(FT/SEC) (2)	.82	.85	.69	.78	.73	.68	.67	.69	.92	.76	.84	.77	.77
STANDARD DEVIATION	.25	.36	.15	.23	.19	.17	.15	.10	.30	.19	.29	.23	.24
NUM. OF OBS. (TO RIGHT)	20	17	14	18	19	19	13	18	22	22	20	20	222
AVG. NET CURRENT (2)(3)	.24	.11	-.24	.09	.10	.22	-.19	.15	.53	.26	.23	.25	.14
NUMBER OF OBSERVATIONS	30	28	31	30	31	28	31	29	29	31	30	30	358
NUMBER OF CALM OBS.	1	0	0	0	0	0	0	0	0	0	0	1	2

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	2	2	2	2	2	2	12	2	2	2	4	2	12
MINIMUM SLOPE	2	2	2	2	2	2	2	2	2	2	2	2	2
AVERAGE SLOPE (2)	2.0	2.0	2.0	2.0	2.0	2.0	2.3	2.0	2.0	2.0	2.1	2.0	2.0
NUMBER OF OBSERVATIONS	31	29	31	31	31	30	30	29	29	31	30	31	363
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-192	-13335	-47351	-8697	-15746	-13450	-42051	1031	28291	-20842	-8712	-434	-141538
NUM OF OBSERVATIONS	31	29	31	31	31	30	31	30	29	31	30	31	365
TOTAL LEFT CUBIC YDS	-20861	-41062	-58657	-43828	-43764	-28290	-51678	-14665	-10796	-41124	-38790	-27614	-421129
NUM OF OBS TO LEFT	10	12	16	13	12	11	17	11	7	9	10	11	139
TOTAL RGHT CUBIC YDS	20669	27676	11305	35131	28018	14840	9627	15696	39088	20281	30077	27179	279587
NUM OF OBS TO RIGHT	21	17	15	18	19	19	14	19	22	22	20	20	226
METHOD 2													
NET CUBIC YARDS	17898	94795	-205501	17218	-14700	17607	-127182	24915	250770	-55029	9321	103410	133522
NUM OF OBSERVATIONS	30	28	31	30	31	28	30	29	28	31	29	30	355
TOTAL LEFT CUBIC YDS	-81802	-147181	-257425	-147609	-150961	-50310	-158160	-32599	-11521	-138647	-160515	-69865	-1406595
NUM OF OBS TO LEFT	10	11	17	12	12	9	17	11	6	9	10	10	134
TOTAL RGHT CUBIC YDS	99701	241976	51924	164828	136260	67918	30977	57515	262292	83618	169836	173275	1540120
NUM OF OBS TO RIGHT	20	17	14	18	19	19	13	18	22	22	19	20	221

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION

(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION

(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT

(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 39098, Ocean Isle Beach, North Carolina

Latitude 33°51'10.8", Longitude 78°26'7.8",

Data Collected from 1 Jan 85 to 31 Dec 85

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	28	31	30	30	30	31	31	30	30	29	31	362
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.50	4.50	4.50	3.50	3.50	3.50	3.50	3.50	5.50	3.50	3.50	3.50	5.50
AVG. WAVE HEIGHT(FT) (1)	2.08	2.30	2.26	2.15	2.32	1.92	2.31	2.05	2.35	2.23	1.67	1.83	2.12
STANDARD DEVIATION	.93	.92	.88	.75	.79	.75	.69	.72	1.07	.73	.61	.76	.84
LONGEST PERIOD RECORDED	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.80	8.60	8.60	8.60	8.80
AVG WAVE PERIOD(SEC) (1)	6.52	6.41	6.02	6.33	5.92	6.62	5.95	6.74	6.25	5.99	7.02	6.68	6.37
STANDARD DEVIATION	1.33	1.26	1.12	1.35	1.23	1.28	1.05	1.28	1.34	1.05	1.38	1.41	1.31
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	28	31	30	30	30	31	31	30	30	29	31	362
PERCENT OCCURRENCE >90	45.2	39.3	35.5	26.7	40.0	26.7	51.6	35.5	26.7	10.0	41.4	54.8	36.2
=90	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
<90	54.8	60.7	64.5	73.3	60.0	73.3	48.4	64.5	73.3	90.0	58.6	45.2	63.8
AVG. ZONE WIDTH (FT) (2)	271	294	296	286	309	221	300	259	271	273	186	226	266
NUMBER OF OBSERVATIONS	31	28	31	30	30	30	31	31	30	31	29	31	363
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	18.0	18.0	16.0	18.0	18.0	20.0	18.0	18.0	18.0	18.0	16.0	16.0	20.0
AVG. WIND SPEED(MPH) (1)	11.2	9.7	9.7	10.5	10.3	8.7	10.8	9.8	9.9	10.0	8.5	8.3	9.8
STANDARD DEVIATION	3.2	4.5	3.3	4.6	3.8	4.3	3.3	4.0	3.6	3.8	4.3	3.9	4.0
NUMBER OF OBSERVATIONS	31	28	30	30	30	30	31	30	30	31	29	31	361
PERCENT OCCURRENCE FROM													
NORTH	12.9	14.3	10.0	10.0	.0	.0	6.5	10.0	6.7	9.7	.0	12.9	7.8
NORTHEAST	6.5	3.6	6.7	6.7	23.3	3.3	6.5	10.0	33.3	54.8	24.1	16.1	16.3
EAST	.0	.0	10.0	13.3	13.3	.0	3.2	10.0	3.3	6.5	6.9	3.2	5.8
SOUTHEAST	6.5	3.6	3.3	6.7	3.3	16.7	3.2	13.3	16.7	3.2	13.8	3.2	7.8
SOUTH	3.2	17.9	3.3	3.3	10.0	13.3	16.1	.0	.0	6.5	.0	3.2	6.4
SOUTHWEST	22.6	25.0	30.0	26.7	40.0	46.7	51.6	46.7	26.7	12.9	34.5	19.4	31.9
WEST	16.1	21.4	30.0	23.3	.0	6.7	.0	3.3	3.3	.0	6.9	16.1	10.5
NORTHWEST	32.3	7.1	3.3	6.7	3.3	3.3	6.5	6.7	6.7	.0	.0	19.4	8.0
CALM	.0	7.1	3.3	3.3	6.7	10.0	6.5	.0	3.3	6.5	13.8	6.5	5.5
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-1.03	-1.02	-1.16	-1.15	-1.11	-1.10	-1.17	-1.11	-.87	-1.01	-.88	-.95	-1.05
STANDARD DEVIATION	.26	.34	.29	.22	.27	.32	.19	.29	.32	.30	.30	.34	.30
NUM. OF OBS. (TO LEFT)	13	11	11	3	12	8	16	12	7	3	11	17	129
AVG TO RIGHT(FT/SEC) (2)	.80	.91	.92	.85	.90	.87	.93	.73	.99	.99	.72	.76	.87
STANDARD DEVIATION	.30	.32	.27	.29	.34	.27	.38	.23	.31	.34	.20	.20	.31
NUM. OF OBS. (TO RIGHT)	17	17	20	22	18	21	15	19	22	28	18	14	231
AVG. NET CURRENT (2)(3)	.01	.15	.18	.32	.10	.32	-.15	.02	.54	.79	.12	-.18	.18
NUMBER OF OBSERVATIONS	30	28	31	30	30	29	31	31	29	31	29	31	360
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	2	2	2	2	2	2	2	2	2	2	2	4
MINIMUM SLOPE	2	2	2	2	2	2	2	2	2	2	2	2	2
AVERAGE SLOPE (2)	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
NUMBER OF OBSERVATIONS	30	27	31	30	30	30	31	31	30	30	29	30	359
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-32892	-17032	-22151	-11925	-20667	-7020	-26295	-17763	23304	36941	-11733	-39034	-146267
NUM OF OBSERVATIONS	31	28	31	30	30	30	31	31	30	31	29	31	363
TOTAL LEFT CUBIC YDS	-53057	-49231	-50235	-38024	-49467	-28494	-51346	-38521	-28395	-7573	-24196	-47430	-465969
NUM OF OBS TO LEFT	14	11	11	8	12	8	16	11	8	3	12	17	131
TOTAL RGHT CUBIC YDS	20164	32198	28083	26098	28800	21474	25050	20758	51699	44515	12463	8396	319698
NUM OF OBS TO RIGHT	17	17	20	22	18	22	15	20	22	28	17	14	232
METHOD 2													
NET CUBIC YARDS	-56855	14188	-17849	722	-49312	-11162	34961	-101194	234704	268934	-37548	-124907	154682
NUM OF OBSERVATIONS	30	28	31	30	30	29	31	31	29	31	29	31	360
TOTAL LEFT CUBIC YDS	-192850	-182221	-174610	-152257	-206095	-99109	-155364	-173542	-23633	-17189	-74554	-153882	-1605306
NUM OF OBS TO LEFT	13	11	11	8	12	8	16	12	7	3	11	17	129
TOTAL RGHT CUBIC YDS	135995	196410	156760	152979	156783	87947	190325	72347	258337	286124	37005	28974	1759986
NUM OF OBS TO RIGHT	17	17	20	22	18	21	15	19	22	28	18	14	231

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 39098, Ocean Isle Beach, North Carolina

Latitude 33°51'10.8", Longitude 78°26'7.8",

Data Collected from 1 Jan 86 to 31 Dec 86

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	27	31	30	31	31	31	31	29	31	30	31	364
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	3.50	4.00	3.50	3.50	3.00	3.50	3.00	3.50	3.50	3.50	3.50	5.00	5.00
AVG. WAVE HEIGHT(FT) (1)	1.89	2.04	2.10	1.68	1.87	2.37	1.73	1.86	1.97	1.67	1.74	1.90	1.90
STANDARD DEVIATION	.69	.87	.80	.60	.55	.79	.54	.68	.66	.65	.69	1.17	.77
LONGEST PERIOD RECORDED	8.80	8.60	8.60	8.60	8.60	6.60	8.60	8.60	8.60	8.60	8.60	8.60	8.80
AVG WAVE PERIOD(SEC) (1)	6.52	6.70	6.45	6.63	6.44	5.83	6.16	6.28	6.32	6.86	7.09	7.28	6.54
STANDARD DEVIATION	1.32	1.43	1.16	1.17	1.14	.42	1.10	.89	1.01	1.41	1.41	1.40	1.25
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	27	31	30	31	31	31	31	29	31	30	31	364
PERCENT OCCURRENCE >90	61.3	48.1	32.3	36.7	51.6	51.6	45.2	38.7	13.8	22.6	6.7	12.9	35.2
=90	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
<90	38.7	51.9	67.7	63.3	48.4	48.4	54.8	61.3	86.2	77.4	93.3	87.1	64.8
AVG. ZONE WIDTH (FT) (2)	233	248	238	173	189	256	166	187	189	160	173	179	199
NUMBER OF OBSERVATIONS	31	27	31	30	31	31	31	31	29	31	28	31	362
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	18.0	16.0	18.0	18.0	18.0	16.0	16.0	14.0	18.0	16.0	18.0	22.0	22.0
AVG. WIND SPEED(MPH) (1)	9.5	9.0	10.2	10.3	8.6	10.8	9.2	10.0	11.0	8.5	9.5	7.7	9.5
STANDARD DEVIATION	3.6	3.3	3.0	4.2	4.0	3.4	3.4	3.0	3.2	4.7	4.6	4.6	3.9
NUMBER OF OBSERVATIONS	30	27	30	30	31	31	31	31	30	31	30	31	363
PERCENT OCCURRENCE FROM													
NORTH	10.0	3.7	13.3	.0	3.2	.0	.0	.0	20.0	3.2	3.3	12.9	5.8
NORTHEAST	16.7	3.7	10.0	.0	6.5	6.5	3.2	16.1	20.0	19.4	26.7	32.3	13.5
EAST	3.3	18.5	3.3	.0	6.5	3.2	.0	3.2	10.0	.0	3.3	3.2	4.4
SOUTHEAST	.0	3.7	16.7	10.0	25.8	9.7	3.2	19.4	6.7	9.7	33.3	9.7	12.4
SOUTH	6.7	14.8	3.3	3.3	.0	.0	.0	.0	6.7	12.9	.0	3.2	4.1
SOUTHWEST	30.0	33.3	26.7	40.0	45.2	77.4	71.0	19.4	26.7	16.1	10.0	6.5	33.6
WEST	26.7	7.4	.0	6.7	.0	.0	9.7	25.8	6.7	22.6	3.3	.0	9.1
NORTHWEST	6.7	11.1	26.7	36.7	9.7	.0	9.7	16.1	.0	9.7	13.3	22.6	13.5
CALM	.0	3.7	.0	3.3	3.2	3.2	3.2	.0	3.3	6.5	6.7	9.7	3.6
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.96	-.97	-1.01	-.99	-.84	-.95	-.82	-.74	-.96	-.79	-.70	-.83	-.90
STANDARD DEVIATION	.24	.24	.27	.26	.22	.24	.21	.16	.27	.18	.10	.29	.25
NUM. OF OBS. (TO LEFT)	18	13	10	11	14	16	14	11	4	6	2	4	123
AVG TO RIGHT(FT/SEC) (2)	.71	.70	.78	.65	.80	.85	.76	.85	.86	.76	.88	.78	.79
STANDARD DEVIATION	.18	.22	.25	.13	.21	.26	.20	.25	.26	.22	.29	.32	.25
NUM. OF OBS. (TO RIGHT)	13	14	21	19	16	14	16	20	25	24	28	26	236
AVG. NET CURRENT (2)(3)	-.26	-.10	.20	.05	.04	-.11	.02	.29	.61	.45	.78	.57	.21
NUMBER OF OBSERVATIONS	31	27	31	30	30	30	30	31	29	30	30	30	359
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	2	2	2	4	2	2	4	2	2	2	2	2	4
MINIMUM SLOPE	2	2	2	2	2	2	2	2	2	2	2	2	2
AVERAGE SLOPE (2)	2.0	2.0	2.0	2.1	2.0	2.0	2.1	2.0	2.0	2.0	2.0	2.0	2.0
NUMBER OF OBSERVATIONS	31	27	31	30	31	31	31	29	30	30	30	31	362
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-38941	-54211	-13620	-14783	-14389	-25243	-24245	8179	23668	8852	26148	35970	-87620
NUM OF OBSERVATIONS	31	27	31	30	31	31	31	31	30	31	30	31	365
TOTAL LEFT CUBIC YDS	-47742	-64366	-41594	-26344	-29594	-54433	-32647	-16300	-8783	-11075	-1915	-9307	-344100
NUM OF OBS TO LEFT	19	13	10	11	16	16	14	12	4	7	2	4	128
TOTAL RGHT CUBIC YDS	8800	10154	22973	11555	15204	29190	8401	24479	32452	19928	28063	45277	256476
NUM OF OBS TO RIGHT	12	14	21	19	15	15	17	19	26	24	28	27	237
METHOD 2													
NET CUBIC YARDS	-108068	-164633	-18566	-47215	10981	-22702	-33961	87684	65366	46716	101646	114822	32065
NUM OF OBSERVATIONS	31	27	31	30	30	30	30	31	28	30	28	30	356
TOTAL LEFT CUBIC YDS	-141705	-196251	-114393	-70480	-44264	-143738	-50706	-16703	-13618	-13689	-639	-29829	-836015
NUM OF OBS TO LEFT	18	13	10	11	14	16	14	11	4	6	1	4	122
TOTAL RGHT CUBIC YDS	33636	31613	95826	23264	55246	121036	16744	104387	78984	60405	102286	144651	868078
NUM OF OBS TO RIGHT	13	14	21	19	16	14	16	20	24	24	27	26	234

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.
METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.
METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39098, Ocean Isle Beach, North Carolina

Latitude 33°51'10.8", Longitude 78°26'7.8",

Data Collected from 1 Jan 87 to 31 Dec 87

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	29	31	30	31	364
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	1	0	0	0	1
HIGHEST WAVE RECORDED	3.50	4.50	3.50	3.50	3.50	3.50	3.50	3.50	4.50	2.50	4.50	3.50	4.50
AVG. WAVE HEIGHT(FT) (1)	2.06	2.34	1.68	1.93	1.71	1.75	1.97	1.82	1.76	1.48	2.17	2.00	1.89
STANDARD DEVIATION	.88	.95	.79	.75	.67	.63	.61	.72	.93	.43	.97	.89	.81
LONGEST PERIOD RECORDED	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60
AVG WAVE PERIOD(SEC) (1)	6.47	6.17	6.86	6.20	6.54	6.50	6.25	6.34	6.23	6.66	6.33	6.63	6.44
STANDARD DEVIATION	1.21	.94	1.27	.92	1.11	1.04	.78	.88	1.66	1.22	1.09	1.23	1.15
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	28	31	30	31	363
PERCENT OCCURRENCE >90	64.5	39.3	19.4	46.7	32.3	76.7	61.3	32.3	39.3	22.6	30.0	45.2	42.4
=90	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
<90	35.5	60.7	80.6	53.3	67.7	23.3	38.7	67.7	60.7	77.4	70.0	54.8	57.6
AVG. ZONE WIDTH (FT) (2)	220	256	172	192	162	167	188	178	175	125	221	204	188
NUMBER OF OBSERVATIONS	31	28	31	30	31	29	31	31	29	31	30	31	363
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	20.0	18.0	18.0	18.0	18.0	22.0	12.0	18.0	18.0	16.0	18.0	18.0	22.0
AVG. WIND SPEED(MPH) (1)	10.1	9.6	7.9	11.1	7.5	11.2	8.7	10.1	8.0	9.0	7.2	7.6	9.0
STANDARD DEVIATION	6.5	4.9	4.4	4.5	4.9	4.2	2.2	3.9	4.6	4.1	4.3	5.1	4.8
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
PERCENT OCCURRENCE FROM													
NORTH	12.9	7.1	19.4	.0	.0	.0	.0	.0	.0	.0	.0	3.2	3.6
NORTHEAST	16.1	28.6	12.9	6.7	6.5	6.7	3.2	.0	13.3	29.0	10.0	12.9	12.1
EAST	6.5	10.7	.0	20.0	.0	6.7	.0	6.5	3.3	.0	.0	.0	4.4
SOUTHEAST	9.7	21.4	12.9	16.7	29.0	23.3	9.7	22.6	30.0	22.6	33.3	6.5	19.7
SOUTH	3.2	.0	.0	.0	6.5	13.3	.0	12.9	.0	3.2	.0	.0	3.3
SOUTHWEST	9.7	17.9	19.4	26.7	29.0	33.3	71.0	29.0	16.7	3.2	6.7	16.1	23.3
WEST	6.5	.0	3.2	16.7	3.2	10.0	.0	9.7	6.7	.0	3.3	12.9	6.0
NORTHWEST	19.4	3.6	16.1	10.0	9.7	6.7	12.9	12.9	16.7	29.0	30.0	32.3	16.7
CALM	16.1	10.7	16.1	3.3	16.1	.0	3.2	6.5	13.3	12.9	16.7	16.1	11.0
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.98	-.86	-.84	-.84	-.73	-.83	-.88	-.82	-.86	-.93	-.74	-1.04	-.87
STANDARD DEVIATION	.35	.28	.22	.32	.16	.26	.25	.25	.25	.30	.23	.34	.29
NUM. OF OBS. (TO LEFT)	20	11	6	14	10	23	19	10	11	8	8	14	154
AVG TO RIGHT(FT/SEC) (2)	.92	.97	.71	.75	.79	.73	.93	.84	.89	.73	.92	.75	.82
STANDARD DEVIATION	.34	.30	.19	.23	.23	.19	.27	.28	.34	.20	.29	.27	.28
NUM. OF OBS. (TO RIGHT)	11	17	25	16	21	7	11	20	18	22	20	16	204
AVG. NET CURRENT (2)(3)	-.30	.25	.41	.01	.30	-.46	-.21	.29	.23	.29	.45	-.08	.09
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	30	30	29	30	28	30	358
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	1	0	0	1	2

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	2	2	8	2	2	2	2	2	2	4	4	2	8
MINIMUM SLOPE	2	2	2	2	2	2	2	2	2	2	2	2	2
AVERAGE SLOPE (2)	2.0	2.0	2.2	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.0	2.0
NUMBER OF OBSERVATIONS	31	28	30	29	31	30	31	31	29	31	30	30	361
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-32086	6621	103	-15002	17137	-35524	-23564	15804	4010	4616	29232	-29982	-58635
NUM OF OBSERVATIONS	31	28	31	30	31	30	31	31	28	31	30	31	363
TOTAL LEFT CUBIC YDS	-50836	-35301	-19054	-34240	-6905	-41402	-38710	-11074	-21486	-8293	-15661	-47913	-330875
NUM OF OBS TO LEFT	20	11	6	14	10	23	19	10	11	7	9	14	154
TOTAL RGHT CUBIC YDS	18749	41922	19158	19238	24043	5877	15145	26878	25497	12910	44894	17931	272242
NUM OF OBS TO RIGHT	11	17	25	16	21	7	12	21	17	24	21	17	209
METHOD 2													
NET CUBIC YARDS	-28350	143892	23218	-10782	77146	-61407	-5648	98410	70042	9459	173560	-71615	417925
NUM OF OBSERVATIONS	31	28	31	30	31	29	30	30	29	30	28	30	357
TOTAL LEFT CUBIC YDS	-132686	-84472	-48484	-83865	-6779	-73283	-53212	-14102	-41122	-13399	-11246	-146685	-709335
NUM OF OBS TO LEFT	20	11	6	14	10	22	19	10	11	8	8	14	153
TOTAL RGHT CUBIC YDS	104336	228365	71702	73083	83926	11875	47564	112513	111164	22859	184807	75069	1127263
NUM OF OBS TO RIGHT	11	17	25	16	21	7	11	20	18	22	20	16	204

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39098, Ocean Isle Beach, North Carolina

Latitude 33°51'10.8", Longitude 78°26'7.8",

Data Collected from 1 Jan 88 to 31 Dec 88

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.50	4.50	3.50	4.50	3.50	3.50	3.50	4.50	3.50	3.50	3.50	3.50	4.50
AVG. WAVE HEIGHT(FT) (1)	2.06	2.16	2.19	2.27	1.85	1.90	2.18	2.70	1.92	2.21	2.12	1.77	2.11
STANDARD DEVIATION	.94	.90	.93	.94	.77	.70	.64	.87	.63	.72	.79	1.02	.86
LONGEST PERIOD RECORDED	8.60	8.60	8.60	8.60	8.60	15.60	6.60	8.60	8.60	8.60	8.60	8.60	15.60
AVG WAVE PERIOD(SEC) (1)	6.47	6.46	6.15	6.10	6.37	6.87	5.92	6.08	6.38	6.18	6.37	6.89	6.35
STANDARD DEVIATION	.94	1.07	1.01	.81	1.07	1.97	.47	.67	.70	.91	1.17	1.25	1.10
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
PERCENT OCCURRENCE >90	29.0	44.8	45.2	50.0	38.7	30.0	51.6	45.2	33.3	32.3	30.0	32.3	38.5
=90	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
<90	71.0	55.2	54.8	50.0	61.3	70.0	48.4	54.8	66.7	67.7	70.0	67.7	61.5
AVG. ZONE WIDTH (FT) (2)	208	222	232	232	181	183	216	301	183	227	214	188	216
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	18.0	20.0	18.0	20.0	14.0	18.0	18.0	25.0	18.0	16.0	18.0	18.0	25.0
AVG. WIND SPEED(MPH) (1)	8.3	8.1	8.3	11.3	7.4	8.4	9.5	8.2	8.9	9.7	8.7	7.4	8.7
STANDARD DEVIATION	4.9	5.5	5.0	6.0	3.8	4.1	2.4	5.1	3.4	4.1	5.7	4.4	4.8
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
PERCENT OCCURRENCE FROM													
NORTH	6.5	13.8	.0	.0	9.7	3.3	.0	.0	.0	6.5	3.3	.0	3.6
NORTHEAST	25.8	10.3	3.2	3.3	3.2	.0	.0	.0	20.0	.0	13.3	19.4	8.2
EAST	.0	.0	3.2	6.7	.0	.0	.0	.0	.0	3.2	3.3	.0	1.4
SOUTHEAST	16.1	10.3	29.0	16.7	3.2	16.7	.0	29.0	33.3	12.9	20.0	16.1	16.9
SOUTH	3.2	3.4	9.7	6.7	6.5	10.0	.0	.0	3.3	.0	.0	.0	3.6
SOUTHWEST	3.2	27.6	6.5	30.0	38.7	13.3	96.8	54.8	30.0	29.0	23.3	16.1	30.9
WEST	6.5	6.9	9.7	6.7	3.2	6.7	.0	3.2	.0	3.2	.0	3.2	4.1
NORTHWEST	22.6	10.3	22.6	20.0	19.4	36.7	3.2	.0	10.0	32.3	16.7	29.0	18.6
CALM	16.1	17.2	16.1	10.0	16.1	13.3	.0	12.9	3.3	12.9	20.0	16.1	12.8
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.98	-1.02	-.87	-1.22	-.86	-.90	-.89	-1.20	-.85	-1.21	-1.18	-1.03	-1.02
STANDARD DEVIATION	.26	.27	.29	.25	.24	.29	.27	.29	.28	.33	.35	.33	.32
NUM. OF OBS. (TO LEFT)	9	12	13	15	12	9	16	14	10	10	9	10	139
AVG TO RIGHT(FT/SEC) (2)	.78	.64	.73	.69	.68	.85	.84	.33	.81	.80	.73	.70	.76
STANDARD DEVIATION	.28	.08	.25	.18	.17	.35	.35	.33	.31	.26	.22	.19	.27
NUM. OF OBS. (TO RIGHT)	21	16	17	15	19	21	15	16	20	21	21	19	221
AVG. NET CURRENT (2)(3)	.25	-.07	.03	-.26	.08	.33	-.06	-.12	.25	.15	.16	.10	.07
NUMBER OF OBSERVATIONS	30	28	30	30	31	30	31	30	30	31	30	29	360
NUMBER OF CALM OBS.	0	1	0	0	0	0	0	0	0	0	0	1	2

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	2	2	2	2	2	2	2	2	2	2	2	2	2
MINIMUM SLOPE	2	2	2	2	2	2	2	2	2	2	2	2	2
AVERAGE SLOPE (2)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
NUMBER OF OBSERVATIONS	31	29	31	30	31	29	31	31	30	31	30	31	365
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-6283	-44743	-20420	-69539	-20505	-924	-24587	-27822	9158	-5056	-24680	-13299	-248700
NUM OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
TOTAL LEFT CUBIC YDS	-35464	-62506	-47913	-82573	-36257	-23478	-45576	-70027	-16396	-34813	-45942	-33536	-534481
NUM OF OBS TO LEFT	9	13	14	15	12	9	16	14	10	10	9	10	141
TOTAL RGHT CUBIC YDS	29180	17763	27492	13033	15751	22554	20989	42205	25554	29756	21262	20236	285775
NUM OF OBS TO RIGHT	22	16	17	15	19	21	15	17	20	21	21	21	225
METHOD 2													
NET CUBIC YARDS	-18272	-74139	-2567	-199714	-42186	65869	-2670	-61799	67692	12391	-91937	-42076	-389408
NUM OF OBSERVATIONS	30	28	30	30	31	30	31	30	30	31	30	29	360
TOTAL LEFT CUBIC YDS	-109334	-116824	-118881	-233412	-82753	-36332	-77118	-231347	-22374	-94743	-142314	-104676	-1370108
NUM OF OBS TO LEFT	9	12	13	15	12	9	16	14	10	10	9	10	139
TOTAL RGHT CUBIC YDS	91062	42684	116314	33697	40566	102202	74448	169547	90067	107135	50376	62600	980698
NUM OF OBS TO RIGHT	21	16	17	15	19	21	15	16	20	21	21	19	221

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 39098, Ocean Isle Beach, North Carolina

Latitude 33°51'10.8", Longitude 78°26'7.8",

Data Collected from 29 Jul 80 to 31 Dec 88

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	248	223	248	240	246	238	249	272	267	274	268	279	3052
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	1	2	0	0	3
HIGHEST WAVE RECORDED	4.50	5.00	4.50	4.50	3.50	5.00	3.50	5.00	5.50	4.50	4.50	5.00	5.50
AVG. WAVE HEIGHT(FT) (1)	1.98	2.17	2.11	2.12	2.11	2.06	2.04	1.88	1.85	1.91	2.00	2.06	2.02
STANDARD DEVIATION	.84	.94	.89	.79	.77	.74	.65	.79	.81	.81	.89	.98	.84
LONGEST PERIOD RECORDED	9.00	9.50	8.60	16.50	8.60	15.60	8.60	12.80	10.00	13.50	16.40	12.00	16.50
AVG WAVE PERIOD(SEC) (1)	6.13	6.03	5.93	5.96	6.03	6.10	5.92	6.35	6.30	6.24	6.34	6.18	6.13
STANDARD DEVIATION	1.38	1.38	1.35	1.38	1.17	1.26	.90	1.38	1.31	1.60	1.71	1.51	1.39
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	248	223	248	240	246	238	249	272	266	272	268	279	3049
PERCENT OCCURRENCE >90	38.3	35.9	37.1	43.8	39.8	42.0	49.8	40.4	35.3	24.6	28.0	39.1	37.7
=90	.0	.0	.0	.0	.0	.0	.0	2.2	2.3	1.5	.7	.0	.6
<90	61.7	64.1	62.9	56.3	60.2	58.0	50.2	57.4	62.4	73.9	71.3	60.9	61.7
AVG. ZONE WIDTH (FT) (2)	249	283	275	268	262	249	252	229	217	232	237	246	249
NUMBER OF OBSERVATIONS	248	225	248	240	246	239	247	274	265	273	265	279	3049
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	20.0	20.0	20.0	20.0	20.0	22.0	18.0	25.0	20.0	18.0	20.0	22.0	25.0
AVG. WIND SPEED(MPH) (1)	9.1	9.1	9.8	10.8	9.4	9.3	9.5	8.9	9.1	9.1	8.4	8.5	9.2
STANDARD DEVIATION	4.7	4.4	4.3	4.6	4.2	3.7	3.2	3.9	3.9	4.2	4.5	4.4	4.2
NUMBER OF OBSERVATIONS	247	225	246	240	247	241	249	274	268	278	269	279	3063
PERCENT OCCURRENCE FROM													
NORTH	14.8	15.0	9.8	3.3	5.9	2.2	1.6	1.8	4.9	8.8	9.4	13.3	7.5
NORTHEAST	26.6	21.0	12.7	8.5	10.6	5.0	6.0	11.3	29.1	27.3	24.7	22.3	17.4
EAST	3.2	7.6	3.8	10.3	3.2	5.0	1.6	2.9	3.0	3.0	4.6	2.2	4.1
SOUTHEAST	9.8	12.2	20.7	19.0	14.7	24.3	6.8	23.0	23.3	18.3	20.8	10.8	17.1
SOUTH	4.9	9.5	13.3	11.5	19.2	13.3	14.1	5.5	8.3	7.9	5.6	9.0	10.0
SOUTHWEST	18.3	27.8	21.7	34.6	46.0	47.9	86.3	59.4	40.3	23.8	25.0	21.2	37.6
WEST	11.9	11.1	12.5	16.5	6.2	6.1	3.6	6.3	3.0	5.8	4.8	9.8	8.0
NORTHWEST	25.3	14.8	23.4	19.6	12.3	18.1	5.3	6.2	9.3	20.2	16.2	24.7	16.3
CALM	13.0	12.6	10.2	5.8	9.8	7.2	2.4	8.7	5.0	9.7	14.9	11.5	9.2
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-1.07	-1.02	-1.09	-1.10	-1.04	-1.00	-1.02	-.94	-.96	-1.07	-1.03	-1.10	-1.03
STANDARD DEVIATION	.36	.34	.37	.34	.35	.35	.36	.47	.42	.39	.42	.40	.39
NUM. OF OBS. (TO LEFT)	92	79	93	102	97	93	130	117	100	71	82	111	1167
AVG TO RIGHT(FT/SEC) (2)	.86	.89	.87	.90	.92	.92	.86	.89	.95	.94	.91	.87	.90
STANDARD DEVIATION	.33	.36	.35	.41	.35	.34	.31	.33	.36	.37	.39	.36	.36
NUM. OF OBS. (TO RIGHT)	148	136	151	138	148	143	117	153	165	203	179	160	1841
AVG. NET CURRENT (2)(3)	.12	.19	.13	.05	.15	.16	-.13	.10	.23	.42	.30	.06	.15
NUMBER OF OBSERVATIONS	240	215	244	240	245	236	247	270	265	274	261	271	3008
NUMBER OF CALM OBS.	6	9	2	0	0	1	0	0	1	2	2	6	29

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	5	8	5	4	3	12	14	4	5	4	6	14
MINIMUM SLOPE	1	1	1	1	1	1	1	1	1	1	1	1	1
AVERAGE SLOPE (2)	2.0	2.0	2.0	2.1	2.0	2.0	2.1	2.2	2.1	2.0	2.0	2.0	2.0
NUMBER OF OBSERVATIONS	247	223	245	240	247	238	249	272	267	270	269	277	3044
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS X 1000)(4)													
METHOD 1													
NET CUBIC YARDS	-8	-3	-18	-23	-13	-18	-27	-5	4	4	3	-10	-114
NUM OF OBSERVATIONS	248	224	243	241	246	240	250	275	267	273	268	279	3059
TOTAL LEFT CUBIC YDS	-35	-40	-45	-46	-38	-39	-43	-26	-21	-23	-28	-41	-425
NUM OF OBS TO LEFT	95	80	92	105	98	101	125	112	94	67	75	109	1153
TOTAL RGHT CUBIC YDS	27	37	27	23	25	21	16	21	24	27	31	32	311
NUM OF OBS TO RIGHT	153	144	156	136	148	139	125	157	167	202	191	170	1888
METHOD 2													
NET CUBIC YARDS	-18	60	-27	-43	-87	-135	-66	13	56	61	5	-40	-221
NUM OF OBSERVATIONS	240	215	244	239	244	233	244	268	262	270	257	271	2987
TOTAL LEFT CUBIC YDS	-137	-131	-175	-166	-221	-254	-143	-97	-71	-81	-116	-165	-1757
NUM OF OBS TO LEFT	92	79	93	101	97	92	129	116	98	70	81	111	1159
TOTAL RGHT CUBIC YDS	119	192	148	122	134	119	77	110	128	142	121	124	1536
NUM OF OBS TO RIGHT	148	136	151	138	147	141	115	152	164	200	176	160	1828

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 39099, Sunset Beach, North Carolina

Latitude 33°52'.6", Longitude 78°30'28.8",

Data Collected from 19 May 80 to 31 Dec 80

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	0	0	0	0	11	19	30	30	25	26	18	31	190
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	1	0	0	1
HIGHEST WAVE RECORDED	.00	.00	.00	.00	2.50	2.50	3.00	2.50	2.50	2.50	2.00	3.00	3.00
AVG. WAVE HEIGHT(FT) (1)	.00	.00	.00	.00	1.73	1.65	1.38	1.23	1.30	1.23	1.44	1.10	1.33
STANDARD DEVIATION	.00	.00	.00	.00	.30	.48	.64	.59	.49	.62	.47	.60	.59
LONGEST PERIOD RECORDED	.00	.00	.00	.00	15.20	8.20	8.20	8.20	7.20	8.70	7.40	12.00	15.20
AVG WAVE PERIOD(SEC) (1)	.00	.00	.00	.00	9.30	6.59	6.20	5.84	5.64	6.12	6.04	7.66	6.50
STANDARD DEVIATION	.00	.00	.00	.00	3.35	.93	.57	.69	.76	1.56	.78	2.18	1.73
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	0	0	0	0	11	19	30	30	25	25	18	31	189
PERCENT OCCURRENCE >90	.0	.0	.0	.0	18.2	15.8	6.7	20.0	8.0	.0	16.7	22.6	13.2
=90	.0	.0	.0	.0	63.6	47.4	76.7	43.3	68.0	84.0	66.7	22.6	57.7
<90	.0	.0	.0	.0	18.2	36.8	16.7	36.7	24.0	16.0	16.7	54.8	29.1
AVG. ZONE WIDTH (FT) (2)	0	0	0	0	200	171	149	144	125	125	104	78	131
NUMBER OF OBSERVATIONS	0	0	0	0	11	19	30	30	25	25	18	31	189
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	.0	.0	.0	.0	9.0	18.0	18.0	18.0	14.0	16.0	14.0	19.0	19.0
AVG. WIND SPEED(MPH) (1)	.0	.0	.0	.0	6.5	10.7	10.6	9.5	6.7	5.1	7.1	6.7	7.9
STANDARD DEVIATION	.0	.0	.0	.0	1.8	3.3	4.5	4.3	3.1	3.4	2.9	3.4	4.1
NUMBER OF OBSERVATIONS	0	0	0	0	11	19	30	30	26	27	18	31	192
PERCENT OCCURRENCE FROM													
NORTH	.0	.0	.0	.0	.0	.0	3.3	.0	.0	18.5	5.6	32.3	8.9
NORTHEAST	.0	.0	.0	.0	9.1	10.5	6.7	6.7	7.7	33.3	22.2	22.6	15.1
EAST	.0	.0	.0	.0	9.1	10.5	.0	.0	.0	7.4	5.6	.0	3.1
SOUTHEAST	.0	.0	.0	.0	.0	.0	6.7	23.3	34.6	7.4	33.3	.0	13.5
SOUTH	.0	.0	.0	.0	18.2	.0	.0	13.3	19.2	11.1	.0	3.2	7.8
SOUTHWEST	.0	.0	.0	.0	54.5	78.9	76.7	50.0	26.9	3.7	33.3	38.7	44.3
WEST	.0	.0	.0	.0	9.1	.0	.0	.0	.0	.0	.0	3.2	1.0
NORTHWEST	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
CALM	.0	.0	.0	.0	.0	.0	6.7	6.7	11.5	18.5	.0	.0	6.3
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	.00	.00	.00	.00	-.23	-.38	-.78	-.80	-.78	-.58	-.78	-.34	-.60
STANDARD DEVIATION	.00	.00	.00	.00	.21	.21	.43	.19	.16	.12	.31	.19	.35
NUM. OF OBS. (TO LEFT)	0	0	0	0	8	9	11	14	3	3	6	6	60
AVG TO RIGHT(FT/SEC) (2)	.00	.00	.00	.00	.77	.67	.70	.90	.89	.76	.77	.38	.71
STANDARD DEVIATION	.00	.00	.00	.00	.27	.20	.34	.35	.28	.20	.25	.27	.33
NUM. OF OBS. (TO RIGHT)	0	0	0	0	2	9	18	15	21	18	11	24	118
AVG. NET CURRENT (2)(3)	.00	.00	.00	.00	-.03	.14	.14	.08	.68	.57	.22	.24	.27
NUMBER OF OBSERVATIONS	0	0	0	0	10	18	29	29	24	21	17	30	178
NUMBER OF CALM OBS.	0	0	0	0	1	1	1	1	2	5	0	1	12

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	0	0	0	0	3	3	3	3	3	2	2	2	3
MINIMUM SLOPE	0	0	0	0	3	3	3	3	2	2	2	1	1
AVERAGE SLOPE (2)	.0	.0	.0	.0	3.0	3.0	3.0	3.0	2.2	2.0	2.0	2.0	2.5
NUMBER OF OBSERVATIONS	0	0	0	0	11	19	30	30	26	27	18	31	192
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	0	0	0	0	2743	-3894	1303	373	846	306	-616	4559	5620
NUM OF OBSERVATIONS	0	0	0	0	11	19	30	30	26	25	18	31	190
TOTAL LEFT CUBIC YDS	0	0	0	0	-1560	-6179	-131	-999	-67	0	-889	-722	-10547
NUM OF OBS TO LEFT	0	0	0	0	2	3	2	6	2	0	3	7	25
TOTAL RGHT CUBIC YDS	0	0	0	0	4303	2284	1434	1373	914	306	272	5281	16167
NUM OF OBS TO RIGHT	C	0	0	0	2	7	5	11	6	4	3	17	55
METHOD 2													
NET CUBIC YARDS	0	0	0	0	-12145	8978	6702	-5805	23566	18491	-1352	5045	43480
NUM OF OBSERVATIONS	0	0	0	0	10	18	29	29	24	20	17	30	177
TOTAL LEFT CUBIC YDS	0	0	0	0	-18981	-10125	-10261	-18263	-2186	-3548	-10597	-574	-74535
NUM OF OBS TO LEFT	0	0	0	0	8	9	11	14	3	3	6	6	60
TOTAL RGHT CUBIC YDS	0	0	0	0	6835	19104	16963	12458	25752	22040	9245	5619	118016
NUM OF OBS TO RIGHT	0	0	0	0	2	9	18	15	21	17	11	24	117

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 39099, Sunset Beach, North Carolina

Latitude 33°52'.6", Longitude 78°30'28.8",

Data Collected from 1 Jan 81 to 31 Dec 81

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	30	27	31	23	30	30	31	31	30	30	30	24	347
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	2.50	3.00	4.50	2.50	3.50	3.00	4.00	4.00	3.50	4.00	3.00	3.50	4.50
AVG. WAVE HEIGHT(FT) (1)	1.33	2.07	2.00	1.87	2.18	1.73	2.39	2.26	2.30	2.40	2.25	2.23	2.09
STANDARD DEVIATION	.65	.74	.79	.54	.65	.56	.66	.75	.60	.85	.59	.84	.76
LONGEST PERIOD RECORDED	15.00	11.80	16.00	11.00	12.50	9.20	8.80	10.00	9.00	8.80	8.70	15.20	16.00
AVG WAVE PERIOD(SEC) (1)	8.66	7.66	7.39	7.50	7.10	6.21	6.46	7.00	7.30	6.87	6.94	7.64	7.21
STANDARD DEVIATION	2.61	2.03	2.18	1.64	1.52	.94	1.06	1.13	1.01	.62	.85	2.12	1.70
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	30	27	31	23	30	30	31	31	30	30	30	24	347
PERCENT OCCURRENCE >90	40.0	25.9	25.8	30.4	30.0	63.3	61.3	25.8	20.0	16.7	43.3	45.8	35.7
=90	20.0	18.5	29.0	26.1	40.0	13.3	16.1	22.6	40.0	30.0	30.0	25.0	25.9
<90	40.0	55.6	45.2	43.5	30.0	23.3	22.6	51.6	40.0	53.3	26.7	29.2	38.3
AVG. ZONE WIDTH (FT) (2)	87	70	71	78	68	67	85	83	83	99	77	66	78
NUMBER OF OBSERVATIONS	30	25	31	24	31	30	31	29	29	30	29	24	343
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	10.0	10.0	16.0	18.0	20.0	18.0	14.0	16.0	14.0	12.0	12.0	20.0	20.0
AVG. WIND SPEED(MPH) (1)	5.4	4.6	8.1	8.5	9.0	7.7	7.2	7.1	5.7	6.3	5.7	7.3	6.9
STANDARD DEVIATION	2.8	2.4	3.6	4.1	4.2	4.2	2.9	3.5	2.8	2.9	3.0	4.6	3.7
NUMBER OF OBSERVATIONS	30	28	31	24	31	30	31	31	30	31	30	25	352
PERCENT OCCURRENCE FROM													
NORTH	36.7	21.4	22.6	4.2	25.8	3.3	3.2	9.7	16.7	12.9	3.3	12.0	14.5
NORTHEAST	3.3	7.1	6.5	.0	6.5	.0	16.1	32.3	23.3	45.2	26.7	28.0	16.5
EAST	3.3	10.7	6.5	8.3	.0	13.3	9.7	9.7	10.0	6.5	13.3	.0	7.7
SOUTHEAST	.0	10.7	.0	25.0	16.1	10.0	12.9	.0	6.7	.0	3.3	8.0	7.4
SOUTH	.0	10.7	19.4	16.7	6.5	16.7	3.2	12.9	23.3	9.7	3.3	.0	10.2
SOUTHWEST	36.7	28.6	32.3	37.5	38.7	53.3	54.8	29.0	13.3	16.1	20.0	24.0	32.1
WEST	6.7	7.1	6.5	4.2	.0	.0	.0	.0	.0	3.2	10.0	4.0	3.4
NORTHWEST	3.3	.0	3.2	4.2	6.5	.0	.0	.0	3.3	6.5	16.7	16.0	4.8
CALM	10.0	3.6	3.2	.0	.0	3.3	.0	6.5	3.3	.0	3.3	8.0	3.4
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.53	-.35	-.34	-.32	-.28	-.33	-.44	-.46	-.28	-.40	-.36	-.41	-.39
STANDARD DEVIATION	.19	.14	.15	.29	.16	.24	.31	.24	.25	.33	.24	.23	.25
NUM. OF OBS. (TO LEFT)	17	7	13	11	8	15	16	10	6	5	13	9	130
AVG TO RIGHT(FT/SEC) (2)	.40	.35	.35	.33	.31	.45	.42	.48	.37	.40	.61	.50	.40
STANDARD DEVIATION	.36	.18	.18	.16	.17	.34	.35	.39	.32	.36	.54	.25	.32
NUM. OF OBS. (TO RIGHT)	13	15	13	11	14	11	10	16	21	20	8	7	159
AVG. NET CURRENT (2)(3)	-.13	.13	.00	.00	.10	.00	-.11	.12	.22	.24	.01	-.01	.05
NUMBER OF OBSERVATIONS	30	22	26	22	22	26	26	26	27	25	21	16	289
NUMBER OF CALM OBS.	1	6	5	2	9	4	5	5	3	5	9	9	63

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	3	2	2	2	2	1	1	1	1	1	1	1	3
MINIMUM SLOPE	1	1	2	1	1	1	1	1	1	1	1	1	1
AVERAGE SLOPE (2)	1.2	1.1	2.0	1.4	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.2
NUMBER OF OBSERVATIONS	29	27	31	24	31	30	31	31	30	31	29	25	349
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	199	18341	10588	13099	2662	-3250	-3052	7602	2444	13488	-2202	-53	59866
NUM OF OBSERVATIONS	30	27	31	23	30	30	31	31	30	31	30	25	349
TOTAL LEFT CUBIC YDS	-3999	-5268	-3628	-3453	-3618	-7665	-17087	-9505	-3749	-3442	-10675	-10569	-82658
NUM OF OBS TO LEFT	12	7	8	7	9	19	19	8	6	5	13	12	125
TOTAL RGHT CUBIC YDS	4199	23610	14217	16553	6280	4414	14034	17108	6193	16931	8473	10515	142527
NUM OF OBS TO RIGHT	12	15	14	10	9	7	7	16	12	17	8	7	134
METHOD 2													
NET CUBIC YARDS	28122	14796	730	13151	5917	-2118	-6743	1688	6269	21427	4304	227	87770
NUM OF OBSERVATIONS	29	20	26	22	22	25	26	24	27	24	21	16	282
TOTAL LEFT CUBIC YDS	-9171	-1825	-3631	-3223	-2429	-4174	-13473	-5150	-1235	-1054	-5715	-7501	-58581
NUM OF OBS TO LEFT	17	7	13	11	8	14	16	9	6	4	13	9	127
TOTAL RGHT CUBIC YDS	37293	16621	4361	16374	8347	2056	6730	6839	7504	22481	10019	7728	146353
NUM OF OBS TO RIGHT	12	13	13	11	14	11	10	15	21	20	8	7	155

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NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
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METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 39099, Sunset Beach, North Carolina

Latitude 33°52'.6", Longitude 78°30'28.8",

Data Collected from 1 Jan 82 to 31 Dec 82

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	29	29	30	30	30	28	30	31	30	30	15	31	343
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.00	3.50	3.00	3.50	2.50	2.00	2.50	2.50	3.00	4.00	3.00	3.50	4.00
AVG. WAVE HEIGHT(FT) (1)	2.24	2.17	1.80	1.82	1.43	1.30	1.40	1.40	1.82	1.82	1.73	2.02	1.75
STANDARD DEVIATION	.70	.63	.67	.72	.50	.45	.51	.65	.58	.88	.65	.86	.73
LONGEST PERIOD RECORDED	11.00	12.00	11.90	10.00	9.40	9.70	8.40	7.80	7.80	7.20	7.40	10.10	12.00
AVG WAVE PERIOD(SEC) (1)	7.23	8.52	7.90	7.04	7.84	7.09	7.21	6.80	6.75	6.36	6.45	6.23	7.14
STANDARD DEVIATION	1.46	1.88	1.73	.91	.96	1.12	.85	.65	.63	.43	.47	1.36	1.32
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	29	29	30	30	30	28	30	31	30	30	15	31	343
PERCENT OCCURRENCE >90	44.8	17.2	13.3	40.0	46.7	42.9	56.7	32.3	16.7	3.3	13.3	19.4	29.4
=90	13.8	20.7	16.7	13.3	40.0	14.3	23.3	12.9	16.7	36.7	20.0	35.5	22.2
<90	41.4	62.1	70.0	46.7	13.3	42.9	20.0	54.8	66.7	60.0	66.7	45.2	48.4
AVG. ZONE WIDTH (FT) (2)	101	70	63	71	70	77	84	80	67	59	63	76	74
NUMBER OF OBSERVATIONS	30	28	31	29	31	27	30	31	29	31	15	31	343
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	12.0	12.0	12.0	16.0	12.0	15.0	16.0	12.0	12.0	18.0	6.0	20.0	20.0
AVG. WIND SPEED(MPH) (1)	6.1	6.0	6.0	5.5	5.5	5.7	5.6	5.3	5.2	4.7	3.9	4.9	5.4
STANDARD DEVIATION	3.1	3.3	2.7	3.0	2.4	3.2	3.8	2.4	2.7	3.7	2.0	4.8	3.3
NUMBER OF OBSERVATIONS	30	29	31	30	30	27	30	30	30	31	14	30	342
PERCENT OCCURRENCE FROM													
NORTH	13.3	27.6	3.2	3.3	3.3	7.4	3.3	.0	16.7	25.8	7.1	23.3	11.4
NORTHEAST	16.7	20.7	9.7	13.3	.0	11.1	6.7	6.7	20.0	29.0	57.1	20.0	15.8
EAST	6.7	.0	12.9	.0	3.3	11.1	3.3	6.7	10.0	9.7	7.1	13.3	7.0
SOUTHEAST	3.3	.0	16.1	46.7	36.7	14.8	6.7	30.0	16.7	9.7	.0	.0	15.8
SOUTH	16.7	3.4	12.9	10.0	20.0	29.6	30.0	13.3	10.0	.0	.0	10.0	13.5
SOUTHWEST	10.0	13.8	35.5	10.0	26.7	14.8	43.3	40.0	20.0	9.7	14.3	13.3	21.3
WEST	16.7	3.4	.0	.0	6.7	.0	3.3	.0	.0	.0	.0	.0	2.6
NORTHWEST	10.0	20.7	6.5	13.3	3.3	3.7	.0	.0	3.3	3.2	.0	3.3	5.8
CALM	6.7	10.3	3.2	3.3	.0	7.4	3.3	3.3	3.3	12.9	14.3	16.7	6.7
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.56	-.30	-.47	-.35	-.27	-.29	-.54	-.30	-.14	-.33	-.31	-.27	-.37
STANDARD DEVIATION	.36	.16	.26	.26	.15	.18	.31	.15	.04	.00	.07	.03	.26
NUM. OF OBS. (TO LEFT)	12	5	6	8	11	12	13	9	3	1	4	5	89
AVG TO RIGHT(FT/SEC) (2)	.35	.33	.35	.41	.27	.47	.26	.38	.34	.45	.49	.42	.38
STANDARD DEVIATION	.21	.23	.19	.24	.06	.30	.13	.16	.12	.20	.17	.19	.21
NUM. OF OBS. (TO RIGHT)	12	17	22	15	5	11	7	15	20	20	8	21	173
AVG. NET CURRENT (2)(3)	-.10	.18	.17	.14	-.10	.07	-.26	.13	.28	.42	.22	.29	.13
NUMBER OF OBSERVATIONS	24	22	28	23	16	23	20	24	23	21	12	26	262
NUMBER OF CALM OBS.	6	6	3	7	15	4	10	6	6	10	2	5	80

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	3	3	2	1	1	1	2	1	1	1	1	4
MINIMUM SLOPE	1	2	2	1	1	1	1	1	1	1	1	1	1
AVERAGE SLOPE (2)	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.4
NUMBER OF OBSERVATIONS	30	29	31	30	31	28	30	31	30	31	15	31	347
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	1516	8617	6470	1675	-688	-232	-5195	127	8668	8627	8834	7598	46017
NUM OF OBSERVATIONS	30	29	30	30	31	28	30	31	30	30	15	31	345
TOTAL LEFT CUBIC YDS	-8201	-2720	-870	-4521	-2210	-3119	-5397	-4149	-1201	-207	-1913	-1779	-36787
NUM OF OBS TO LEFT	13	5	4	12	14	12	17	10	5	1	2	6	101
TOTAL RGHT CUBIC YDS	9717	11338	7341	6196	1521	2886	701	4277	9869	8835	10747	9377	82805
NUM OF OBS TO RIGHT	13	18	21	14	5	12	6	17	20	18	10	14	168
METHOD 2													
NET CUBIC YARDS	-8691	4666	15849	2596	-1791	-407	-6966	256	4713	7442	1148	5881	24696
NUM OF OBSERVATIONS	24	21	28	23	16	22	20	24	22	21	12	26	259
TOTAL LEFT CUBIC YDS	-14605	-1211	-1688	-2500	-2932	-3294	-8018	-2330	-192	-86	-1991	-1522	-40419
NUM OF OBS TO LEFT	12	5	6	8	11	12	13	9	2	1	4	5	88
TOTAL RGHT CUBIC YDS	5914	5377	17538	5096	1140	2887	1051	2636	4906	7528	3139	7404	65116
NUM OF OBS TO RIGHT	12	16	22	15	5	10	7	15	20	20	8	21	171

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
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NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39099, Sunset Beach, North Carolina

Latitude 33°52'.6", Longitude 78°30'28.8",

Data Collected from 1 Jan 83 to 31 Dec 83

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	28	31	30	15	30	31	31	29	30	29	30	345
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	3.50	4.00	4.00	3.50	2.00	3.00	3.00	3.00	3.00	3.50	3.50	4.00	4.00
AVG. WAVE HEIGHT(FT) (1)	2.06	1.80	2.24	1.77	1.67	1.83	2.02	1.77	1.57	1.92	1.51	1.83	1.84
STANDARD DEVIATION	.62	.81	.83	.79	.51	.51	.65	.57	.64	.80	.83	.86	.75
LONGEST PERIOD RECORDED	12.80	8.70	12.50	10.20	9.30	10.20	8.20	8.80	7.80	7.10	7.10	6.60	12.80
AVG WAVE PERIOD(SEC) (1)	7.11	6.33	7.05	6.92	6.42	6.93	6.67	6.92	6.48	6.36	6.12	5.78	6.65
STANDARD DEVIATION	1.63	.95	1.95	1.09	.96	1.03	.67	.77	.51	.39	.50	.58	1.11
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	28	31	30	15	30	31	31	29	30	29	30	345
PERCENT OCCURRENCE >90	12.9	10.7	29.0	50.0	40.0	16.7	41.9	45.2	37.9	30.0	55.2	20.0	32.2
=90	16.1	21.4	41.9	26.7	26.7	26.7	19.4	25.8	24.1	3.3	31.0	30.0	24.3
<90	71.0	67.9	29.0	23.3	33.3	56.7	38.7	29.0	37.9	66.7	13.8	50.0	43.5
AVG. ZONE WIDTH (FT) (2)	106	96	96	65	55	46	42	42	35	32	29	30	56
NUMBER OF OBSERVATIONS	31	27	31	30	15	30	31	31	30	30	29	30	345
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	12.0	12.0	20.0	14.0	12.0	10.0	10.0	12.0	10.0	10.0	10.0	34.0	34.0
AVG. WIND SPEED(MPH) (1)	5.5	6.2	5.6	5.7	5.8	5.1	5.5	4.9	5.3	5.4	4.0	6.4	5.4
STANDARD DEVIATION	3.2	3.1	4.4	3.2	2.6	2.3	2.0	2.3	1.9	2.1	2.9	5.9	3.3
NUMBER OF OBSERVATIONS	31	27	31	30	14	30	31	29	30	30	29	31	343
PERCENT OCCURRENCE FROM													
NORTH	35.5	44.4	16.1	6.7	.0	6.7	6.5	3.4	10.0	10.0	17.2	16.1	14.9
NORTHEAST	9.7	14.8	9.7	.0	7.1	6.7	12.9	20.7	16.7	53.3	3.4	19.4	14.9
EAST	3.2	11.1	6.5	20.0	14.3	33.3	9.7	.0	16.7	6.7	.0	12.9	11.1
SOUTHEAST	.0	3.7	3.2	6.7	21.4	3.3	3.2	3.4	3.3	3.3	6.9	6.5	4.7
SOUTH	3.2	3.7	9.7	16.7	50.0	36.7	45.2	31.0	20.0	3.3	6.9	3.2	17.8
SOUTHWEST	29.0	3.7	35.5	23.3	7.1	6.7	19.4	34.5	30.0	13.3	41.4	29.0	23.6
WEST	.0	7.4	.0	6.7	.0	.0	.0	.0	.0	.0	.0	3.2	1.5
NORTHWEST	12.9	7.4	9.7	10.0	.0	.0	3.2	.0	.0	3.3	.0	3.2	4.4
CALM	6.5	3.7	9.7	10.0	.0	6.7	.0	6.9	3.3	6.7	24.1	6.5	7.3
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.60	-.36	-.26	-.28	-.35	-.40	-.26	-.32	-.40	-.31	-.28	-.27	-.32
STANDARD DEVIATION	.25	.10	.13	.13	.15	.19	.07	.17	.17	.12	.14	.12	.17
NUM. OF OBS. (TO LEFT)	4	3	9	15	4	6	11	14	9	6	13	7	101
AVG TO RIGHT(FT/SEC) (2)	.41	.44	.46	.42	.32	.42	.47	.37	.35	.38	.42	.28	.40
STANDARD DEVIATION	.20	.24	.30	.26	.13	.12	.11	.10	.09	.16	.16	.16	.19
NUM. OF OBS. (TO RIGHT)	22	19	11	7	5	17	14	9	12	21	4	14	155
AVG. NET CURRENT (2)(3)	.26	.33	.14	-.06	.02	.21	.15	-.05	.03	.23	-.11	.10	.12
NUMBER OF OBSERVATIONS	26	22	20	22	9	23	25	23	21	27	17	21	256
NUMBER OF CALM OBS.	4	5	11	8	6	7	5	8	9	3	12	8	86

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	1	1	0	0	0	0	0	0	0	1	1	2	2
MINIMUM SLOPE	1	1	0	0	0	0	0	0	0	1	1	1	1
AVERAGE SLOPE (2)	1.0	1.0	.0	.0	.0	.0	.0	.0	.0	1.0	1.0	1.5	1.1
NUMBER OF OBSERVATIONS	31	25	0	0	0	0	0	0	0	22	29	31	138
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	8728	7532	13926	-470	-5962	11774	-1484	894	3544	12677	-732	7000	57427
NUM OF OBSERVATIONS	31	28	31	30	15	30	31	31	29	30	29	30	345
TOTAL LEFT CUBIC YDS	-1893	-1776	-5290	-9216	-7592	-2308	-8334	-6350	-2717	-3948	-4102	-2302	-55818
NUM OF OBS TO LEFT	4	3	9	15	6	5	13	14	11	9	16	6	111
TOTAL RGHT CUBIC YDS	10622	9309	19206	8746	1630	14082	6849	7245	6262	16625	3369	9303	113248
NUM OF OBS TO RIGHT	22	19	9	7	5	17	12	9	11	20	4	15	150
METHOD 2													
NET CUBIC YARDS	6599	9693	18604	-581	-2026	1667	877	-325	536	1824	61	-1703	35226
NUM OF OBSERVATIONS	26	21	20	22	9	23	25	23	21	27	17	20	254
TOTAL LEFT CUBIC YDS	-4447	-2091	-1644	-3482	-2833	-1051	-866	-1578	-742	-241	-734	-2624	-22333
NUM OF OBS TO LEFT	4	3	9	15	4	6	11	14	9	6	13	7	101
TOTAL RGHT CUBIC YDS	11046	11785	20249	2901	806	2719	1743	1253	1278	2066	796	921	57563
NUM OF OBS TO RIGHT	22	18	11	7	5	17	14	9	12	21	4	13	153

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METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39099, Sunset Beach, North Carolina

Latitude 33°52'.6", Longitude 78°30'28.8",

Data Collected from 1 Jan 84 to 31 Dec 84

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	29	31	30	31	27	31	31	29	31	30	21	352
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	3.50	3.50	3.50	3.50	3.00	3.00	2.00	3.00	4.50	3.00	4.00	3.50	4.50
AVG. WAVE HEIGHT(FT) (1)	1.85	1.86	1.79	1.85	1.66	1.33	1.13	1.42	1.74	1.77	2.12	2.14	1.71
STANDARD DEVIATION	.66	.85	.70	.67	.63	.59	.43	.57	.81	.65	.80	.62	.73
LONGEST PERIOD RECORDED	7.10	6.90	6.80	7.20	6.90	6.90	6.70	6.80	6.70	6.80	6.70	6.50	7.20
AVG WAVE PERIOD(SEC) (1)	6.05	6.08	5.97	6.11	6.10	6.27	6.12	6.22	6.07	6.04	5.99	5.97	6.08
STANDARD DEVIATION	.54	.50	.43	.40	.35	.31	.35	.25	.32	.38	.38	.26	.39
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	29	31	30	31	27	31	31	29	31	30	21	352
PERCENT OCCURRENCE >90	29.0	27.6	45.2	50.0	54.8	44.4	74.2	64.5	34.5	35.5	40.0	61.9	46.6
=90	35.5	41.4	16.1	26.7	19.4	18.5	6.5	6.5	27.6	38.7	26.7	14.3	23.3
<90	35.5	31.0	38.7	23.3	25.8	37.0	19.4	29.0	37.9	25.8	33.3	23.8	30.1
AVG. ZONE WIDTH (FT) (2)	27	27	26	29	27	25	21	18	25	24	25	27	25
NUMBER OF OBSERVATIONS	31	29	31	29	31	27	31	31	28	31	30	21	350
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	22.0	18.0	18.0	15.0	10.0	10.0	12.0	99.0	12.0	8.0	12.0	12.0	99.0
AVG. WIND SPEED(MPH) (1)	4.4	4.8	6.0	7.1	5.1	4.9	5.7	7.6	5.7	3.7	4.2	4.3	5.3
STANDARD DEVIATION	4.0	3.8	3.6	3.0	2.4	2.3	2.0	16.8	2.9	2.1	3.1	3.2	5.9
NUMBER OF OBSERVATIONS	31	29	31	29	30	27	31	31	29	31	29	21	349
PERCENT OCCURRENCE FROM													
NORTH	35.5	6.9	16.1	3.4	20.0	.0	.0	6.5	20.7	16.1	37.9	23.8	15.5
NORTHEAST	19.4	3.4	9.7	10.3	.0	7.4	.0	16.1	17.2	9.7	6.9	9.5	9.2
EAST	.0	13.8	6.5	10.3	3.3	3.7	6.5	6.5	10.3	12.9	10.3	4.8	7.4
SOUTHEAST	3.2	13.8	16.1	13.8	.0	14.8	16.1	.0	.0	.0	.0	.0	6.6
SOUTH	6.5	13.8	6.5	24.1	26.7	40.7	19.4	6.5	6.9	25.8	6.9	4.8	15.8
SOUTHWEST	12.9	27.6	25.8	24.1	26.7	25.9	51.6	45.2	24.1	19.4	10.3	23.8	26.6
WEST	.0	3.4	9.7	.0	.0	.0	.0	.0	3.4	.0	3.4	4.8	2.0
NORTHWEST	3.2	6.9	3.2	3.4	3.3	.0	.0	3.2	13.8	.0	3.4	4.8	3.7
CALM	19.4	10.3	6.5	10.3	20.0	7.4	6.5	16.1	3.4	16.1	20.7	23.8	13.2
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.30	-.31	-.22	-.25	-.23	-.22	-.32	-.23	-.21	-.14	-.27	-.19	-.25
STANDARD DEVIATION	.24	.16	.07	.10	.10	.08	.18	.08	.17	.04	.25	.07	.15
NUM. OF OBS. (TO LEFT)	7	12	12	17	15	12	20	20	9	7	10	10	151
AVG TO RIGHT(FT/SEC) (2)	.29	.32	.29	.27	.23	.31	.26	.26	.35	.32	.27	.30	.29
STANDARD DEVIATION	.16	.17	.10	.12	.09	.17	.06	.10	.12	.21	.10	.12	.14
NUM. OF OBS. (TO RIGHT)	13	10	14	7	7	8	6	9	11	10	11	8	114
AVG. NET CURRENT (2)(3)	.09	-.03	.06	-.10	-.09	.00	-.19	-.08	.10	.13	.01	.03	-.01
NUMBER OF OBSERVATIONS	20	22	26	24	22	20	26	29	20	17	21	18	265
NUMBER OF CALM OBS.	11	7	4	6	8	6	5	2	9	11	8	2	79

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	2	2	2	2	2	2	2	2	2	1	1	1	2
MINIMUM SLOPE	2	2	2	2	2	2	2	2	1	1	1	1	1
AVERAGE SLOPE (2)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.4	1.0	1.0	1.0	1.7
NUMBER OF OBSERVATIONS	31	29	31	30	31	27	31	31	29	31	30	21	352
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	3837	-650	-432	-6773	-2080	2693	-2817	-2720	5597	220	-1219	-1603	-5997
NUM OF OBSERVATIONS	31	29	31	30	31	27	31	31	29	31	30	21	352
TOTAL LEFT CUBIC YDS	-2919	-6591	-4842	-10077	-4092	-1200	-3614	-5239	-1763	-1588	-6354	-5847	-54126
NUM OF OBS TO LEFT	9	8	14	15	17	12	23	20	10	11	12	13	164
TOTAL RGHT CUBIC YDS	6757	5940	4359	3303	2011	3893	796	2518	7361	1809	5135	4244	48126
NUM OF OBS TO RIGHT	11	9	12	7	8	10	6	9	11	8	10	5	106
METHOD 2													
NET CUBIC YARDS	702	-151	353	-577	-356	50	-489	-305	343	1046	-33	280	863
NUM OF OBSERVATIONS	20	22	26	23	22	20	26	29	19	17	21	18	263
TOTAL LEFT CUBIC YDS	-606	-1145	-477	-1018	-661	-490	-689	-511	-635	-215	-913	-468	-7828
NUM OF OBS TO LEFT	7	12	12	16	15	12	20	20	9	7	10	10	150
TOTAL RGHT CUBIC YDS	1309	994	831	441	305	541	199	205	979	1262	879	748	8693
NUM OF OBS TO RIGHT	13	10	14	7	7	8	6	9	10	10	11	8	113

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(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 39099, Sunset Beach, North Carolina

Latitude 33°52'.6", Longitude 78°30'28.8",

Data Collected from 1 Jan 85 to 31 Dec 85

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	21	31	30	31	30	31	31	30	31	28	31	356
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	3.50	6.00	5.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	3.00	6.00
AVG. WAVE HEIGHT(FT) (1)	2.11	2.29	2.37	1.77	1.63	1.50	1.48	1.53	1.75	2.24	1.73	1.56	1.82
STANDARD DEVIATION	.74	.98	.87	.73	.58	.62	.57	.80	.85	.91	.97	.62	.84
LONGEST PERIOD RECORDED	6.80	6.50	6.60	6.40	6.30	6.40	6.20	6.20	6.00	5.80	6.30	6.10	6.80
AVG WAVE PERIOD(SEC) (1)	5.99	5.92	5.81	5.76	5.71	5.76	5.56	5.50	5.38	5.22	5.48	5.42	5.62
STANDARD DEVIATION	.33	.31	.36	.43	.30	.39	.25	.35	.25	.27	.40	.33	.40
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	21	31	30	31	30	31	31	30	31	28	31	356
PERCENT OCCURRENCE >90	80.6	33.3	54.8	50.0	71.0	63.3	83.9	45.2	50.0	35.5	42.9	51.6	55.9
=90	9.7	42.9	22.6	13.3	22.6	10.0	3.2	3.2	6.7	22.6	39.3	22.6	17.4
<90	9.7	23.8	22.6	36.7	6.5	26.7	12.9	51.6	43.3	41.9	17.9	25.8	26.7
AVG. ZONE WIDTH (FT) (2)	28	30	34	36	32	31	33	33	28	34	38	34	32
NUMBER OF OBSERVATIONS	31	21	31	29	31	30	31	31	30	31	28	31	355
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	12.0	20.0	12.0	12.0	10.0	10.0	12.0	13.0	10.0	12.0	12.0	14.0	20.0
AVG. WIND SPEED(MPH) (1)	6.0	5.2	5.0	4.8	4.4	4.7	5.3	5.6	6.1	5.2	3.1	4.6	5.0
STANDARD DEVIATION	3.0	4.7	3.2	2.7	2.0	2.5	2.4	2.6	2.9	3.1	3.2	3.5	3.1
NUMBER OF OBSERVATIONS	31	21	31	30	31	30	31	30	30	31	27	31	354
PERCENT OCCURRENCE FROM													
NORTH	22.6	33.3	9.7	3.3	12.9	3.3	.0	10.0	16.7	16.1	.0	19.4	11.9
NORTHEAST	3.2	.0	12.9	3.3	6.5	6.7	.0	16.7	26.7	12.9	7.4	3.2	8.5
EAST	.0	14.3	6.5	16.7	9.7	6.7	3.2	.0	20.0	12.9	3.7	.0	7.6
SOUTHEAST	.0	.0	.0	3.3	12.9	23.3	6.5	23.3	6.7	9.7	11.1	.0	8.2
SOUTH	9.7	9.5	12.9	33.3	19.4	20.0	9.7	6.7	3.3	19.4	11.1	.0	13.0
SOUTHWEST	22.6	14.3	29.0	20.0	22.6	16.7	67.7	40.0	20.0	9.7	25.9	35.5	27.4
WEST	9.7	.0	.0	10.0	9.7	10.0	3.2	.0	.0	.0	.0	.0	3.7
NORTHWEST	25.8	4.8	12.9	3.3	3.2	.0	.0	.0	.0	.0	3.7	22.6	6.5
CALM	6.5	23.8	16.1	6.7	3.2	13.3	9.7	3.3	6.7	19.4	37.0	19.4	13.3
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.28	-.44	-.44	-.33	-.31	-.26	-.28	-.28	-.20	-.25	-.32	-.38	-.31
STANDARD DEVIATION	.15	.36	.21	.16	.20	.14	.10	.10	.05	.12	.15	.13	.16
NUM. OF OBS. (TO LEFT)	24	4	13	13	17	17	24	17	11	7	11	10	168
AVG TO RIGHT(FT/SEC) (2)	.38	.24	.29	.33	.29	.34	.22	.34	.45	.26	.23	.25	.30
STANDARD DEVIATION	.07	.11	.15	.20	.14	.10	.06	.13	.17	.15	.06	.09	.15
NUM. OF OBS. (TO RIGHT)	5	12	14	14	9	8	6	14	16	17	8	17	140
AVG. NET CURRENT (2)(3)	-.17	.07	-.06	.01	-.10	-.07	-.18	.00	.19	.11	-.09	.02	-.03
NUMBER OF OBSERVATIONS	29	16	27	27	26	25	30	31	27	24	19	27	308
NUMBER OF CALM OBS.	1	5	4	3	5	4	1	0	3	7	9	4	46

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	1	1	1	1	1	1	1	1	1	11	1	1	11
MINIMUM SLOPE	1	1	1	1	1	1	1	1	1	1	1	1	1
AVERAGE SLOPE (2)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.0	1.0	1.0
NUMBER OF OBSERVATIONS	30	20	31	30	31	30	31	31	30	31	28	31	354
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-17493	-19852	-1842	1750	-6882	-6452	-8795	-3312	4423	8089	-6669	-6970	-64005
NUM OF OBSERVATIONS	31	21	31	30	31	30	31	31	30	31	28	31	356
TOTAL LEFT CUBIC YDS	-17893	-22875	-10483	-6365	-7183	-7320	-8957	-6977	-6141	-4658	-7087	-9282	-115221
NUM OF OBS TO LEFT	25	7	17	15	22	19	26	14	15	11	12	16	199
TOTAL RGHT CUBIC YDS	400	3022	8640	8116	300	867	161	3664	10564	12748	417	2311	51210
NUM OF OBS TO RIGHT	3	5	7	11	2	8	4	16	13	13	5	8	95
METHOD 2													
NET CUBIC YARDS	-1140	-1287	-808	164	-564	-717	-902	-728	1277	1134	-1259	-456	-5286
NUM OF OBSERVATIONS	29	16	27	26	26	25	30	31	27	24	19	27	307
TOTAL LEFT CUBIC YDS	-1456	-2163	-1807	-1180	-1065	-1074	-1070	-1158	-330	-407	-1656	-1178	-14544
NUM OF OBS TO LEFT	24	4	13	13	17	17	24	17	11	7	11	10	168
TOTAL RGHT CUBIC YDS	316	875	998	1344	501	356	168	429	1607	1541	396	722	9253
NUM OF OBS TO RIGHT	5	12	14	13	9	8	6	14	16	17	8	17	139

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 39099, Sunset Beach, North Carolina
Latitude 33°52'.6", Longitude 78°30'28.8",
Data Collected from 1 Jan 86 to 31 Dec 86

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	30	28	27	30	31	30	29	31	28	31	23	31	349
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	3.50	3.50	4.00	3.00	3.00	3.50	3.00	3.00	2.50	3.00	4.00	4.00	4.00
AVG. WAVE HEIGHT(FT) (1)	2.12	1.80	1.54	1.42	1.21	1.58	1.64	1.61	1.25	1.85	1.76	1.84	1.63
STANDARD DEVIATION	.61	.54	.69	.63	.58	.75	.63	.66	.53	.64	.69	.77	.70
LONGEST PERIOD RECORDED	5.80	5.70	5.60	5.70	5.80	5.80	5.70	5.90	5.70	5.90	5.50	6.00	6.00
AVG WAVE PERIOD(SEC) (1)	5.25	5.23	5.33	5.27	5.23	5.13	5.27	5.25	5.40	5.37	5.25	5.41	5.28
STANDARD DEVIATION	.21	.20	.19	.23	.25	.24	.24	.26	.24	.26	.17	.26	.25
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	30	28	27	30	31	30	29	31	28	31	23	31	349
PERCENT OCCURRENCE >90	56.7	46.4	40.7	63.3	45.2	43.3	62.1	29.0	17.9	22.6	21.7	22.6	39.5
=90	26.7	46.4	18.5	23.3	25.8	26.7	31.0	35.5	28.6	22.6	34.8	41.9	30.1
<90	16.7	7.1	40.7	13.3	29.0	30.0	6.9	35.5	53.6	54.8	43.5	35.5	30.4
AVG. ZONE WIDTH (FT) (2)	35	34	30	31	34	34	36	37	35	34	35	34	34
NUMBER OF OBSERVATIONS	31	28	28	30	31	30	29	31	27	31	21	31	348
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	14.0	12.0	14.0	14.0	15.0	14.0	16.0	12.0	8.0	12.0	8.0	14.0	16.0
AVG. WIND SPEED(MPH) (1)	4.6	4.2	4.8	5.9	5.9	6.7	7.0	6.3	4.1	5.1	3.2	3.8	5.2
STANDARD DEVIATION	3.7	3.1	3.6	3.6	3.0	2.8	2.9	2.7	1.9	3.5	2.6	3.0	3.3
NUMBER OF OBSERVATIONS	30	23	28	30	31	29	29	31	28	31	23	31	349
PERCENT OCCURRENCE FROM													
NORTH	6.7	10.7	7.1	10.0	9.7	3.4	3.4	3.2	.0	9.7	21.7	19.4	8.6
NORTHEAST	16.7	3.6	10.7	6.7	9.7	13.8	.0	12.9	10.7	19.4	21.7	32.3	13.2
EAST	3.3	3.6	7.1	3.3	3.2	10.3	10.3	16.1	10.7	.0	4.3	12.9	7.2
SOUTHEAST	6.7	10.7	7.1	3.3	12.9	10.3	.0	16.1	7.1	6.5	8.7	.0	7.4
SOUTH	3.3	10.7	3.6	23.3	9.7	17.2	27.6	19.4	10.7	12.9	4.3	12.9	13.2
SOUTHWEST	23.3	35.7	39.3	36.7	48.4	41.4	51.7	25.8	50.0	22.6	4.3	3.2	32.1
WEST	6.7	3.6	.0	.0	3.2	3.4	3.4	.0	.0	3.2	.0	.0	2.0
NORTHWEST	13.3	3.6	7.1	10.0	.0	.0	3.4	.0	.0	.0	.0	.0	3.2
CALM	20.0	17.9	17.9	6.7	3.2	.0	.0	6.5	10.7	25.8	34.8	19.4	13.2
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.26	-.15	-.20	-.23	-.23	-.27	-.29	-.20	-.18	-.25	-.21	-.25	-.23
STANDARD DEVIATION	.12	.06	.07	.07	.09	.11	.09	.08	.08	.08	.04	.06	.09
NUM. OF OBS. (TO LEFT)	13	12	9	17	9	7	14	9	5	7	2	4	108
AVG TO RIGHT(FT/SEC) (2)	.24	.17	.21	.16	.25	.24	.21	.25	.23	.28	.26	.30	.24
STANDARD DEVIATION	.07	.08	.07	.05	.12	.09	.05	.08	.09	.09	.08	.11	.09
NUM. OF OBS. (TO RIGHT)	15	9	18	9	17	19	12	13	19	22	18	22	198
AVG. NET CURRENT (2)(3)	.01	-.02	.07	-.10	.09	.10	-.06	.10	.14	.16	.22	.21	.08
NUMBER OF OBSERVATIONS	28	21	27	26	26	26	26	27	24	29	20	26	306
NUMBER OF CALM OBS.	3	7	1	4	5	3	3	4	2	2	2	5	41

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	1	1	1	1	1	20	1	1	1	1	1	1	20
MINIMUM SLOPE	1	1	1	1	1	1	1	1	1	1	1	1	1
AVERAGE SLOPE (2)	1.0	1.0	1.0	1.0	1.0	1.6	1.0	1.0	1.0	1.0	1.0	1.0	1.1
NUMBER OF OBSERVATIONS	31	28	27	30	31	30	29	31	28	31	23	31	350
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-3552	-4129	1302	-6188	-808	1326	-1854	6231	12586	28434	8789	2322	44459
NUM OF OBSERVATIONS	30	28	27	30	31	30	29	31	28	31	23	31	349
TOTAL LEFT CUBIC YDS	-8243	-4842	-3398	-6602	-2153	-1722	-2624	-603	-5681	-1967	-1876	-1489	-41200
NUM OF OBS TO LEFT	17	13	11	19	14	13	18	9	5	7	5	7	138
TOTAL RGHT CUBIC YDS	4691	712	4700	413	1344	3049	770	6835	18268	30402	10665	3812	85661
NUM OF OBS TO RIGHT	5	2	11	4	9	9	2	11	15	17	10	11	106
METHOD 2													
NET CUBIC YARDS	1560	-113	3345	-688	166	623	-201	947	729	1304	1339	1474	10485
NUM OF OBSERVATIONS	28	21	27	26	26	26	26	27	23	29	18	26	303
TOTAL LEFT CUBIC YDS	-834	-486	-233	-843	-416	-399	-746	-265	-135	-275	-117	-301	-5050
NUM OF OBS TO LEFT	13	12	9	17	9	7	14	9	5	7	2	4	108
TOTAL RGHT CUBIC YDS	2394	373	3579	155	582	1022	545	1213	864	1580	1457	1776	15540
NUM OF OBS TO RIGHT	15	9	18	9	17	19	12	18	18	22	16	22	195

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
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(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 39099, Sunset Beach, North Carolina

Latitude 33°52'.6", Longitude 78°30'28.8",

Data Collected from 1 Jan 87 to 31 Dec 87

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	25	31	30	26	25	31	31	24	28	27	28	337
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.00	4.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	3.50	4.00	4.00	4.00
AVG. WAVE HEIGHT(FT) (1)	2.19	1.76	1.58	1.22	1.13	1.48	1.24	1.61	1.44	1.89	1.96	1.72	1.61
STANDARD DEVIATION	.90	.91	.75	.40	.43	.56	.42	.59	.70	.62	.95	.99	.78
LONGEST PERIOD RECORDED	6.00	6.20	6.20	6.10	6.00	5.90	5.90	5.80	6.00	6.00	6.20	5.90	6.20
AVG WAVE PERIOD(SEC) (1)	5.48	5.57	5.65	5.65	5.61	5.50	5.51	5.40	5.42	5.61	5.50	5.47	5.53
STANDARD DEVIATION	.32	.33	.31	.19	.18	.25	.19	.24	.24	.16	.26	.20	.26
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	25	31	30	26	25	31	31	24	28	27	28	337
PERCENT OCCURRENCE >90	41.9	20.0	6.5	30.0	38.5	68.0	45.2	61.3	37.5	21.4	18.5	25.0	34.4
=90	35.5	32.0	58.1	50.0	30.8	28.0	45.2	29.0	41.7	35.7	63.0	50.0	41.8
<90	22.6	48.0	35.5	20.0	30.8	4.0	9.7	9.7	20.8	42.9	18.5	25.0	23.7
AVG. ZONE WIDTH (FT) (2)	36	35	33	35	36	34	34	36	31	33	33	32	34
NUMBER OF OBSERVATIONS	31	25	30	30	26	25	31	31	24	28	27	28	336
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	14.0	16.0	12.0	12.0	10.0	12.0	12.0	12.0	10.0	12.0	14.0	14.0	16.0
AVG. WIND SPEED(MPH) (1)	5.8	5.8	4.1	4.9	5.2	6.2	4.9	6.2	5.0	5.1	4.7	4.6	5.3
STANDARD DEVIATION	4.2	3.7	3.0	2.7	1.8	3.0	2.8	3.2	2.6	2.7	3.5	3.6	3.2
NUMBER OF OBSERVATIONS	30	25	31	30	26	25	31	29	24	27	27	28	333
PERCENT OCCURRENCE FROM													
NORTH	20.0	12.0	6.5	13.3	3.8	.0	6.5	13.3	.0	25.9	11.1	25.0	11.7
NORTHEAST	16.7	28.0	16.1	16.7	3.8	4.0	12.9	10.3	8.3	33.3	14.8	14.3	15.0
EAST	.0	16.0	9.7	6.7	11.5	.0	9.7	3.4	29.2	11.1	14.8	.0	9.0
SOUTHEAST	3.3	.0	19.4	16.7	23.1	20.0	.0	6.9	12.5	3.7	7.4	3.6	9.6
SOUTH	6.7	.0	6.5	10.0	19.2	24.0	12.9	13.8	12.5	3.7	3.7	3.6	9.6
SOUTHWEST	16.7	32.0	22.6	20.0	38.5	48.0	51.6	41.4	29.2	.0	7.4	25.0	27.6
WEST	3.3	.0	.0	6.7	.0	.0	.0	.0	.0	.0	7.4	.0	1.5
NORTHWEST	6.7	4.0	3.2	3.3	.0	.0	.0	.0	4.2	14.8	11.1	14.3	5.1
CALM	26.7	3.0	16.1	6.7	.0	4.0	6.5	10.3	4.2	7.4	22.2	14.3	10.8
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.30	-.33	.00	-.17	-.21	-.24	-.29	-.33	-.21	.00	-.22	-.27	-.26
STANDARD DEVIATION	.08	.14	.00	.00	.04	.05	.07	.12	.04	.00	.04	.07	.09
NUM. OF OBS. (TO LEFT)	10	3	0	4	2	8	4	3	2	0	3	7	46
AVG TO RIGHT(FT/SEC) (2)	.34	.34	.25	.21	.22	.25	.23	.27	.27	.27	.24	.26	.26
STANDARD DEVIATION	.14	.09	.10	.05	.07	.09	.07	.09	.10	.06	.11	.08	.10
NUM. OF OBS. (TO RIGHT)	21	21	25	18	16	11	19	22	14	24	19	18	228
AVG. NET CURRENT (2)(3)	.14	.25	.25	.14	.17	.04	.14	.19	.21	.27	.18	.11	.18
NUMBER OF OBSERVATIONS	31	24	25	22	18	19	23	25	16	24	22	25	274
NUMBER OF CALM OBS.	0	1	6	8	8	6	8	6	8	3	5	3	62

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	1	1	1	1	1	1	1	1	1	1	1	1	1
MINIMUM SLOPE	1	1	1	1	1	1	1	1	1	1	1	1	1
AVERAGE SLOPE (2)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
NUMBER OF OBSERVATIONS	31	25	31	30	26	25	31	31	24	28	27	28	337
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-3697	6735	3396	-314	326	-7919	-3783	-8769	2135	1227	13815	4056	7208
NUM OF OBSERVATIONS	31	25	31	30	26	25	31	31	24	28	27	28	337
TOTAL LEFT CUBIC YDS	-12002	-2594	-307	-847	-1129	-7965	-4117	-12340	-7421	-2870	-1306	-6908	-59806
NUM OF OBS TO LEFT	13	5	2	9	10	17	14	19	9	6	5	7	116
TOTAL RGHT CUBIC YDS	8304	9330	3703	533	1455	45	334	3571	9557	4098	15122	10964	67016
NUM OF OBS TO RIGHT	7	12	11	6	8	1	3	3	5	12	5	7	80
METHOD 2													
NET CUBIC YARDS	1435	1737	1426	464	860	373	351	884	1036	1648	1391	503	12108
NUM OF OBSERVATIONS	31	24	24	22	18	19	23	25	16	24	22	25	273
TOTAL LEFT CUBIC YDS	-724	-331	0	-164	-100	-447	-324	-372	-107	0	-212	-555	-3336
NUM OF OBS TO LEFT	10	3	0	4	2	8	4	3	2	0	3	7	46
TOTAL RGHT CUBIC YDS	2159	2068	1426	628	961	821	675	1257	1144	1648	1604	1059	15450
NUM OF OBS TO RIGHT	21	21	24	13	16	11	19	22	14	24	19	18	227

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39099, Sunset Beach, North Carolina

Latitude 33°52'.6", Longitude 78°30'28.8",

Data Collected from 1 Jan 88 to 30 Sep 88

	JAN	FE3	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	26	26	24	26	24	28	15	28	0	0	0	228
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.50	2.50	2.50	3.00	2.50	3.00	1.50	3.00	3.50	.00	.00	.00	4.50
AVG. WAVE HEIGHT(FT) (1)	1.89	1.54	1.21	1.15	1.25	1.38	1.25	1.27	1.88	.00	.00	.00	1.45
STANDARD DEVIATION	.90	.59	.52	.55	.50	.58	.25	.63	.66	.00	.00	.00	.67
LONGEST PERIOD RECORDED	6.30	6.20	6.30	6.20	6.00	5.90	5.70	5.70	5.80	.00	.00	.00	6.30
AVG WAVE PERIOD(SEC) (1)	5.62	5.59	5.49	5.49	5.44	5.45	5.38	5.42	5.40	.00	.00	.00	5.48
STANDARD DEVIATION	.27	.27	.33	.23	.27	.29	.18	.18	.26	.00	.00	.00	.27
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	26	26	24	26	24	28	15	28	0	0	0	228
PERCENT OCCURRENCE >90	12.9	30.8	11.5	29.2	15.4	29.2	53.6	53.3	25.0	.0	.0	.0	27.6
=90	67.7	61.5	65.4	62.5	69.2	62.5	46.4	40.0	64.3	.0	.0	.0	61.0
<90	19.4	7.7	23.1	8.3	15.4	8.3	.0	6.7	10.7	.0	.0	.0	11.4
AVG. ZONE WIDTH (FT) (2)	32	33	31	31	30	30	30	31	28	0	0	0	30
NUMBER OF OBSERVATIONS	31	26	26	24	26	23	27	15	27	0	0	0	225
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	14.0	9.0	12.0	12.0	8.0	10.0	14.0	10.0	8.0	.0	.0	.0	14.0
AVG. WIND SPEED(MPH) (1)	6.3	4.4	5.8	5.1	4.5	4.9	6.3	5.5	4.3	.0	.0	.0	5.2
STANDARD DEVIATION	4.0	2.3	3.3	2.7	1.9	2.0	2.3	2.1	2.4	.0	.0	.0	2.8
NUMBER OF OBSERVATIONS	31	26	27	24	26	24	26	15	28	0	0	0	227
PERCENT OCCURRENCE FROM													
NORTH	35.5	23.1	7.4	8.3	7.7	4.2	.0	.0	.0	.0	.0	.0	10.6
NORTHEAST	16.1	.0	3.7	4.2	3.8	.0	.0	.0	14.3	.0	.0	.0	5.3
EAST	6.5	11.5	11.1	8.3	3.8	8.3	7.7	.0	.0	.0	.0	.0	6.6
SOUTHEAST	.0	.0	11.1	25.0	11.5	4.2	.0	33.3	17.9	.0	.0	.0	10.1
SOUTH	.0	.0	11.1	4.2	3.8	33.3	30.8	13.3	7.1	.0	.0	.0	11.0
SOUTHWEST	16.1	19.2	25.9	33.3	53.8	37.5	61.5	46.7	28.6	.0	.0	.0	34.8
WEST	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
NORTHWEST	9.7	34.6	14.8	8.3	7.7	8.3	.0	.0	14.3	.0	.0	.0	11.5
CALM	16.1	11.5	14.8	8.3	7.7	4.2	.0	6.7	17.9	.0	.0	.0	10.1
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.33	-.32	.00	-.21	.00	.00	-.21	.00	-.17	.00	.00	.00	-.26
STANDARD DEVIATION	.12	.02	.00	.04	.00	.00	.04	.00	.00	.00	.00	.00	.10
NUM. OF OBS. (TO LEFT)	3	2	0	2	0	0	2	0	1	0	0	0	10
AVG TO RIGHT(FT/SEC) (2)	.31	.28	.26	.26	.22	.24	.23	.26	.26	.00	.00	.00	.26
STANDARD DEVIATION	.11	.08	.06	.06	.06	.08	.08	.06	.09	.00	.00	.00	.08
NUM. OF OBS. (TO RIGHT)	23	20	18	14	19	15	13	13	18	0	0	0	153
AVG. NET CURRENT (2)(3)	.24	.23	.26	.20	.22	.24	.17	.26	.24	.00	.00	.00	.23
NUMBER OF OBSERVATIONS	26	22	18	16	19	15	15	13	19	0	0	0	163
NUMBER OF CALM OBS.	5	4	8	8	7	9	12	2	9	0	0	0	64

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	1	1	1	1	1	1	1	1	1	0	0	0	1
MINIMUM SLOPE	1	1	1	1	1	1	1	1	1	0	0	0	1
AVERAGE SLOPE (2)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	.0	.0	.0	1.0
NUMBER OF OBSERVATIONS	31	26	27	24	26	24	28	14	28	0	0	0	228
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-1402	-2783	-179	-1302	-759	263	-2672	-1221	-1757	0	0	0	-11812
NUM OF OBSERVATIONS	31	26	26	24	26	24	28	15	28	0	0	0	228
TOTAL LEFT CUBIC YDS	-3755	-3361	-664	-1692	-1398	-1613	-2672	-1648	-4732	0	0	0	-21535
NUM OF OBS TO LEFT	4	8	3	7	4	7	15	8	7	0	0	0	63
TOTAL RGHT CUBIC YDS	2353	577	484	389	639	1876	0	426	2974	0	0	0	9718
NUM OF OBS TO RIGHT	6	2	6	2	4	2	0	1	3	0	0	0	26
METHOD 2													
NET CUBIC YARDS	1875	1109	6476	684	704	989	636	812	1166	0	0	0	14451
NUM OF OBSERVATIONS	25	22	16	16	19	15	15	13	18	0	0	0	159
TOTAL LEFT CUBIC YDS	-205	-163	0	-112	0	0	-103	0	-61	0	0	0	-644
NUM OF OBS TO LEFT	3	2	0	2	0	0	2	0	1	0	0	0	10
TOTAL RGHT CUBIC YDS	2080	1273	6476	797	704	989	739	812	1227	0	0	0	15097
NUM OF OBS TO RIGHT	22	20	16	14	19	15	13	13	17	0	0	0	149

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
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NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 39099, Sunset Beach, North Carolina

Latitude 33°52'.6", Longitude 78°30'28.8",

Data Collected from 19 May 80 to 30 Sep 88

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	244	213	238	227	231	243	272	262	253	237	200	227	2847
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	1	0	0	1
HIGHEST WAVE RECORDED	4.50	6.00	5.00	3.50	3.50	3.50	4.00	4.00	4.50	4.00	4.00	4.00	6.00
AVG. WAVE HEIGHT(FT) (1)	1.98	1.91	1.83	1.61	1.53	1.54	1.55	1.59	1.69	1.90	1.84	1.78	1.72
STANDARD DEVIATION	.78	.79	.83	.70	.64	.60	.67	.71	.73	.82	.82	.85	.76
LONGEST PERIOD RECORDED	15.00	12.00	16.00	11.00	15.20	10.20	8.80	10.00	9.00	8.80	8.70	15.20	16.00
AVG WAVE PERIOD(SEC) (1)	6.41	6.47	6.35	6.20	6.33	6.10	6.05	6.08	6.01	5.99	5.97	6.18	6.17
STANDARD DEVIATION	1.63	1.55	1.55	1.08	1.49	.97	.85	.90	.87	.82	.75	1.49	1.21
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	244	213	238	227	231	243	272	262	253	236	200	227	2846
PERCENT OCCURRENCE >90	39.8	26.3	28.6	43.6	42.4	44.0	54.0	41.2	27.7	21.2	34.0	32.2	36.6
=90	28.3	35.2	33.2	29.5	35.5	25.9	29.4	23.3	34.4	33.1	38.5	30.8	31.2
<90	32.0	38.5	38.2	26.9	22.1	30.0	16.5	35.5	37.9	45.8	27.5	37.0	32.2
AVG. ZONE WIDTH (FT) (2)	56	50	48	47	51	53	57	57	50	53	47	48	52
NUMBER OF OBSERVATIONS	246	209	239	225	233	241	271	260	249	237	197	227	2834
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	22.0	20.0	20.0	18.0	20.0	18.0	18.0	99.0	14.0	18.0	14.0	34.0	99.0
AVG. WIND SPEED(MPH) (1)	5.5	5.1	5.7	5.9	5.7	6.1	6.4	6.5	5.3	5.2	4.5	5.3	5.6
STANDARD DEVIATION	3.6	3.4	3.6	3.4	3.0	3.4	3.4	6.6	2.7	3.1	3.2	4.3	3.8
NUMBER OF OBSERVATIONS	244	213	241	227	230	241	270	256	255	239	197	228	2841
PERCENT OCCURRENCE FROM													
NORTH	35.9	30.1	13.4	9.4	13.3	4.6	3.0	5.5	9.4	16.7	13.7	21.5	14.4
NORTHEAST	17.3	9.9	11.1	8.4	6.0	6.6	6.3	14.5	20.5	29.3	17.3	18.9	13.8
EAST	4.7	13.9	11.7	12.0	6.9	13.8	8.8	5.1	11.8	8.4	7.6	5.7	9.2
SOUTHEAST	2.0	5.2	12.5	25.6	19.4	12.9	5.9	25.1	16.4	5.0	8.1	2.2	11.8
SOUTH	5.7	6.6	13.7	19.0	18.6	35.4	28.1	18.9	14.6	10.9	5.1	4.8	15.5
SOUTHWEST	25.5	28.7	38.6	36.3	52.5	45.9	69.8	54.2	34.7	12.1	19.8	24.1	37.6
WEST	5.3	3.3	2.1	3.5	3.0	1.7	1.1	.0	.4	.8	3.0	1.8	2.1
NORTHWEST	13.4	22.4	12.0	9.8	5.5	3.9	.7	.4	8.3	3.3	5.1	7.9	7.5
CALM	18.5	14.8	15.3	9.4	6.8	6.7	3.7	9.6	12.1	13.4	20.3	13.2	11.8
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.38	-.29	-.32	-.28	-.26	-.29	-.39	-.36	-.28	-.29	-.35	-.30	-.32
STANDARD DEVIATION	.24	.18	.19	.18	.16	.18	.27	.24	.21	.19	.25	.15	.22
NUM. OF OBS. (TO LEFT)	90	48	62	87	74	86	115	96	49	36	62	58	863
AVG TO RIGHT(FT/SEC) (2)	.34	.32	.30	.29	.27	.36	.36	.39	.40	.39	.38	.33	.35
STANDARD DEVIATION	.19	.18	.17	.18	.14	.22	.26	.28	.28	.25	.28	.19	.23
NUM. OF OBS. (TO RIGHT)	124	123	135	95	94	109	105	131	152	152	87	131	1438
AVG. NET CURRENT (2)(3)	.04	.15	.10	.02	.03	.07	-.03	.07	.24	.26	.08	.14	.10
NUMBER OF OBSERVATIONS	214	171	197	182	168	195	220	227	201	188	149	189	2301
NUMBER OF CALM OBS.	31	41	42	46	64	44	50	34	51	46	47	37	533

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	3	3	2	3	20	3	3	3	11	2	2	20
MINIMUM SLOPE	1	1	1	1	1	1	1	1	1	1	1	1	1
AVERAGE SLOPE (2)	1.3	1.3	1.4	1.3	1.3	1.4	1.4	1.4	1.2	1.2	1.1	1.2	1.3
NUMBER OF OBSERVATIONS	244	209	209	198	218	213	241	230	225	232	199	229	2647

SEDIMENT TRANSPORT VOLUME (CUBIC YARDS X 1000)(4)	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
METHOD 1													
NET CUBIC YARDS	-1	2	4	0	-1	0	-3	0	4	9	2	2	18
NUM OF OBSERVATIONS	245	213	238	227	232	243	272	262	254	237	200	228	2851
TOTAL LEFT CUBIC YDS	-7	-6	-4	-6	-3	-4	-6	-6	-4	-2	-5	-5	-58
NUM OF OBS TO LEFT	97	56	68	99	98	107	147	108	70	50	68	74	1042
TOTAL RGHT CUBIC YDS	6	8	8	5	2	4	3	6	8	12	7	7	76
NUM OF OBS TO RIGHT	79	82	91	61	52	73	45	93	96	109	55	84	920
METHOD 2													
NET CUBIC YARDS	4	4	5	2	0	1	-1	0	5	7	1	2	30
NUM OF OBSERVATIONS	212	167	194	180	168	193	220	225	197	186	147	188	2277
TOTAL LEFT CUBIC YDS	-4	-1	-1	-2	-2	-2	-4	-4	-1	-1	-3	-2	-27
NUM OF OBS TO LEFT	90	48	62	86	74	85	115	95	48	35	62	58	858
TOTAL RGHT CUBIC YDS	8	5	7	3	2	3	4	3	5	7	3	3	53
NUM OF OBS TO RIGHT	122	119	132	94	94	108	105	130	149	151	85	130	1419

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 48002, Cherry Grove Beach, South Carolina

Latitude 33°49'43.8", Longitude 78°37'58.2",

Data Collected from 20 May 80 to 31 Dec 80

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	0	0	0	0	12	26	22	20	30	22	24	26	182
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	.00	.00	.00	.00	3.00	6.00	3.50	4.00	2.50	4.50	5.00	4.50	6.00
AVG. WAVE HEIGHT(FT) (1)	.00	.00	.00	.00	1.67	1.87	1.55	1.60	1.15	1.52	1.65	1.38	1.53
STANDARD DEVIATION	.00	.00	.00	.00	.61	1.15	.71	.90	.59	.89	1.06	.85	.90
LONGEST PERIOD RECORDED	.00	.00	.00	.00	6.00	6.00	5.50	5.00	4.50	4.60	4.50	5.00	6.00
AVG WAVE PERIOD(SEC) (1)	.00	.00	.00	.00	4.55	4.86	4.41	4.25	4.22	4.23	4.00	4.35	4.35
STANDARD DEVIATION	.00	.00	.00	.00	1.13	.69	.49	.30	.25	.33	.60	.27	.58
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	0	0	0	0	12	26	22	20	30	22	24	26	182
PERCENT OCCURRENCE >90	.0	.0	.0	.0	16.7	88.5	63.6	50.0	30.0	22.7	33.3	30.8	43.4
=90	.0	.0	.0	.0	33.3	3.8	27.3	25.0	43.3	54.5	29.2	38.5	31.9
<90	.0	.0	.0	.0	50.0	7.7	9.1	25.0	26.7	22.7	37.5	30.8	24.7
AVG. ZONE WIDTH (FT) (2)	0	0	0	0	165	108	115	120	108	118	103	82	111
NUMBER OF OBSERVATIONS	0	0	0	0	12	24	21	20	26	24	24	26	177
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	.0	.0	.0	.0	8.0	15.0	9.0	8.0	10.0	10.0	18.0	14.0	18.0
AVG. WIND SPEED(MPH) (1)	.0	.0	.0	.0	3.4	6.2	2.3	2.3	2.4	2.4	5.1	4.5	3.5
STANDARD DEVIATION	.0	.0	.0	.0	2.9	3.8	2.7	2.6	2.8	2.9	3.6	3.9	3.5
NUMBER OF OBSERVATIONS	0	0	0	0	12	29	31	30	30	31	24	31	218
PERCENT OCCURRENCE FROM													
NORTH	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	16.1	2.3
NORTHEAST	.0	.0	.0	.0	.0	3.4	.0	.0	10.0	12.9	25.0	22.6	9.6
EAST	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
SOUTHEAST	.0	.0	.0	.0	8.3	17.2	6.5	13.3	16.7	25.8	25.0	.0	14.2
SOUTH	.0	.0	.0	.0	41.7	13.8	9.7	6.7	6.7	6.5	25.0	9.7	12.4
SOUTHWEST	.0	.0	.0	.0	16.7	51.7	32.3	30.0	20.0	6.5	20.8	25.8	26.1
WEST	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	.0	.5
NORTHWEST	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
CALM	.0	.0	.0	.0	33.3	13.8	51.6	50.0	46.7	48.4	.0	25.8	34.9
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	.00	.00	.00	.00	-.24	-.48	-.33	-.29	-.32	-.42	-.53	-.41	-.38
STANDARD DEVIATION	.00	.00	.00	.00	.19	.21	.16	.15	.15	.18	.17	.13	.20
NUM. OF OBS. (TO LEFT)	0	0	0	0	10	21	12	9	7	5	6	9	79
AVG TO RIGHT(FT/SEC) (2)	.00	.00	.00	.00	.17	.90	.58	.38	.29	.46	.44	.40	.42
STANDARD DEVIATION	.00	.00	.00	.00	.03	.64	.00	.15	.13	.37	.21	.22	.30
NUM. OF OBS. (TO RIGHT)	0	0	0	0	2	3	1	5	8	7	12	11	49
AVG. NET CURRENT (2)(3)	.00	.00	.00	.00	-.18	-.31	-.26	-.05	.01	.10	.12	.04	-.07
NUMBER OF OBSERVATIONS	0	0	0	0	12	24	13	14	15	12	18	20	128
NUMBER OF CALM OBS.	0	0	0	0	0	4	17	15	15	19	0	11	81

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	0	0	0	0	3	3	9	2	2	2	2	2	9
MINIMUM SLOPE	0	0	0	0	1	1	1	1	1	1	1	1	1
AVERAGE SLOPE (2)	.0	.0	.0	.0	1.7	1.6	1.5	1.5	1.4	1.4	1.3	1.3	1.4
NUMBER OF OBSERVATIONS	0	0	0	0	12	29	31	30	30	30	30	31	223
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	0	0	0	0	27551	-96814	-1776	-328	-4587	11373	22466	15309	-26806
NUM OF OBSERVATIONS	0	0	0	0	12	29	30	29	30	22	27	27	206
TOTAL LEFT CUBIC YDS	0	0	0	0	-8420	-104024	-17527	-9719	-8226	-10670	-9029	-5904	-173519
NUM OF OBS TO LEFT	0	0	0	0	2	24	14	11	9	5	8	9	82
TOTAL RGHT CUBIC YDS	0	0	0	0	35971	7210	15751	9390	3639	22043	31496	21214	146714
NUM OF OBS TO RIGHT	0	0	0	0	6	2	2	5	8	5	9	8	45
METHOD 2													
NET CUBIC YARDS	0	0	0	0	-7134	-32829	-17137	3741	-1603	24769	8171	7607	-14415
NUM OF OBSERVATIONS	0	0	0	0	10	23	13	14	15	12	18	20	125
TOTAL LEFT CUBIC YDS	0	0	0	0	-7315	-39826	-23389	-5044	-6166	-6964	-5487	-2312	-96503
NUM OF OBS TO LEFT	0	0	0	0	9	20	12	9	7	5	6	9	77
TOTAL RGHT CUBIC YDS	0	0	0	0	181	6996	6252	8786	4563	31734	13659	9920	82091
NUM OF OBS TO RIGHT	0	0	0	0	1	3	1	5	8	7	12	11	48

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
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METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 48002, Cherry Grove Beach, South Carolina

Latitude 33°49'43.8", Longitude 78°37'58.2",

Data Collected from 1 Jan 81 to 31 Dec 81

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	23	22	30	30	31	29	29	30	30	30	30	30	344
NUMBER OF CALM OBS.	0	0	0	0	1	0	1	0	0	0	1	2	5
HIGHEST WAVE RECORDED	1.50	4.50	5.50	2.50	3.50	1.50	2.50	3.50	4.50	3.50	4.50	4.50	5.50
AVG. WAVE HEIGHT(FT) (1)	.80	1.23	1.10	1.01	.83	.94	1.27	1.36	1.15	1.43	1.43	1.53	1.18
STANDARD DEVIATION	.32	.96	1.04	.55	.63	.37	.62	.67	1.05	.78	1.05	.99	.83
LONGEST PERIOD RECORDED	4.50	4.60	4.50	4.50	4.50	4.50	4.50	5.00	4.70	4.50	4.50	4.50	5.00
AVG WAVE PERIOD(SEC) (1)	4.28	4.34	4.31	4.33	4.18	4.33	4.28	4.42	4.32	4.33	4.10	3.93	4.26
STANDARD DEVIATION	.25	.23	.24	.32	.82	.24	.33	.23	.25	.24	.80	1.09	.58
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	23	22	30	30	30	29	28	30	30	30	29	28	339
PERCENT OCCURRENCE >90	34.8	9.1	26.7	26.7	33.3	27.6	53.6	16.7	10.0	13.3	20.7	28.6	25.1
=90	56.5	63.6	60.0	63.3	60.0	58.6	35.7	20.0	60.0	46.7	48.3	50.0	51.6
<90	8.7	27.3	13.3	10.0	6.7	13.8	10.7	63.3	30.0	40.0	31.0	21.4	23.3
AVG. ZONE WIDTH (FT) (2)	62	76	80	88	80	100	138	150	124	158	169	184	119
NUMBER OF OBSERVATIONS	23	24	30	30	30	30	28	30	30	30	29	28	342
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	12.0	15.0	15.0	10.0	18.0	8.0	11.0	18.0	14.0	16.0	29.0	11.0	29.0
AVG. WIND SPEED(MPH) (1)	3.7	4.9	3.1	3.5	3.0	3.5	4.6	5.9	3.2	6.3	3.9	4.8	4.2
STANDARD DEVIATION	3.8	4.4	4.5	3.1	4.7	2.4	3.5	4.5	4.1	4.7	5.8	3.4	4.3
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	30	30	31	30	31	364
PERCENT OCCURRENCE FROM													
NORTH	6.5	10.7	.0	3.3	.0	.0	.0	.0	.0	3.2	.0	6.5	2.5
NORTHEAST	29.0	32.1	12.9	3.3	3.2	.0	3.2	46.7	23.3	35.5	30.0	32.3	20.9
EAST	.0	7.1	.0	.0	.0	3.3	.0	3.3	.0	.0	.0	.0	1.1
SOUTHEAST	.0	10.7	6.5	10.0	19.4	10.0	6.5	16.7	16.7	12.9	6.7	3.2	9.9
SOUTH	.0	.0	6.5	23.3	3.2	50.0	25.8	3.3	3.3	19.4	.0	.0	11.3
SOUTHWEST	22.6	7.1	19.4	23.3	22.6	16.7	48.4	13.3	6.7	9.7	16.7	12.9	18.4
WEST	.0	.0	6.5	.0	.0	3.3	.0	3.3	.0	.0	.0	.0	1.1
NORTHWEST	6.5	3.6	.0	6.7	.0	.0	.0	.0	.0	.0	.0	25.8	3.6
CALM	35.5	28.6	48.4	30.0	51.6	16.7	16.1	13.3	50.0	19.4	46.7	19.4	31.3
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.28	-.33	-.39	-.49	-.33	-.27	-.39	-.44	-.44	-.20	-.25	-.22	-.33
STANDARD DEVIATION	.10	.12	.23	.44	.20	.08	.13	.12	.20	.06	.15	.11	.20
NUM. OF OBS. (TO LEFT)	9	3	8	7	8	8	15	5	3	4	8	9	87
AVG TO RIGHT(FT/SEC) (2)	.25	.34	.33	.27	.25	.33	.25	.25	.20	.35	.26	.23	.28
STANDARD DEVIATION	.06	.11	.25	.14	.05	.06	.12	.11	.05	.08	.16	.14	.13
NUM. OF OBS. (TO RIGHT)	4	13	4	7	5	4	3	20	11	13	9	9	102
AVG. NET CURRENT (2)(3)	-.12	.21	-.14	-.11	-.11	-.07	-.29	.11	.06	.22	.02	.00	.00
NUMBER OF OBSERVATIONS	13	16	12	14	13	12	18	25	14	17	17	18	189
NUMBER OF CALM OBS.	18	12	19	16	18	18	12	5	16	14	13	13	174

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	2	2	2	2	2	2	2	2	3	3	3	3	3
MINIMUM SLOPE	1	1	1	1	1	1	1	1	1	2	3	3	1
AVERAGE SLOPE (2)	1.2	1.4	1.2	1.9	1.4	1.1	1.5	1.5	2.1	2.6	3.0	3.0	1.8
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	30	30	31	30	31	364
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-1165	13237	5776	-1157	-7376	-786	-6273	163	-9827	4880	3739	-3175	-1964
NUM OF OBSERVATIONS	25	22	30	30	30	29	26	30	30	30	29	28	341
TOTAL LEFT CUBIC YDS	-1426	-504	-7728	-2434	-7564	-1887	-8786	-6310	-11583	-2615	-7695	-7054	-65586
NUM OF OBS TO LEFT	9	2	8	8	10	8	15	5	3	4	6	8	86
TOTAL RGHT CUBIC YDS	261	13741	13504	1277	187	1101	2512	6474	1756	7496	11435	3879	63623
NUM OF OBS TO RIGHT	2	6	4	3	2	4	3	19	9	12	9	6	79
METHOD 2													
NET CUBIC YARDS	-615	6432	5720	-492	-18014	-1553	-17044	555	-16171	15798	20650	-1424	-6158
NUM OF OBSERVATIONS	13	16	12	14	13	12	18	25	14	17	17	18	189
TOTAL LEFT CUBIC YDS	-1091	-485	-8880	-3974	-18782	-3030	-18591	-9342	-23580	-2167	-18310	-11406	-119638
NUM OF OBS TO LEFT	9	3	8	7	8	8	15	5	3	4	8	9	87
TOTAL RGHT CUBIC YDS	475	6917	14600	3481	767	1477	1547	9898	7408	17966	38961	9982	113479
NUM OF OBS TO RIGHT	4	13	4	7	5	4	3	20	11	13	9	9	102

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Latitude 33°49'43.8", Longitude 78°37'58.2",

Data Collected from 1 Jan 82 to 31 Dec 82

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	30	28	29	30	31	29	29	31	30	31	30	31	359
NUMBER OF CALM OBS.	1	0	0	0	1	0	0	1	0	1	0	0	4
HIGHEST WAVE RECORDED	4.50	3.50	3.00	4.50	3.00	5.00	6.00	4.00	3.00	6.50	4.00	4.50	6.50
AVG. WAVE HEIGHT(FT) (1)	1.56	2.05	1.50	2.00	1.19	1.88	1.69	1.68	1.37	2.16	2.22	2.42	1.81
STANDARD DEVIATION	1.02	.79	.68	1.19	.60	1.17	1.27	.86	.55	1.44	.78	.81	1.04
LONGEST PERIOD RECORDED	5.00	4.50	4.50	5.00	4.80	5.00	5.00	4.50	4.50	5.00	5.00	4.50	5.00
AVG WAVE PERIOD(SEC) (1)	4.12	4.34	4.14	4.32	4.27	4.43	4.26	4.21	4.23	4.32	4.47	4.29	4.28
STANDARD DEVIATION	.82	.23	.26	.27	.81	.25	.28	.80	.25	.84	.26	.25	.53
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	29	28	29	30	30	29	29	30	30	30	30	31	355
PERCENT OCCURRENCE >90	20.7	17.9	6.9	16.7	33.3	37.9	48.3	23.3	6.7	6.7	3.3	22.6	20.3
=90	51.7	50.0	62.1	53.3	53.3	44.8	44.8	46.7	63.3	60.0	36.7	41.9	50.7
<90	27.6	32.1	31.0	30.0	13.3	17.2	6.9	30.0	30.0	33.3	60.0	35.5	29.0
AVG. ZONE WIDTH (FT) (2)	175	218	166	243	158	222	220	224	169	279	271	296	220
NUMBER OF OBSERVATIONS	29	28	29	30	30	29	29	30	30	30	30	31	355
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	17.0	15.0	13.0	22.0	10.0	22.0	25.0	16.0	10.0	22.0	18.0	12.0	25.0
AVG. WIND SPEED(MPH) (1)	4.0	5.4	4.0	6.6	3.4	6.4	5.6	4.6	3.7	6.1	5.1	5.1	5.0
STANDARD DEVIATION	3.8	4.4	3.6	7.7	3.1	6.4	6.3	4.2	3.0	7.1	5.1	4.1	5.2
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
PERCENT OCCURRENCE FROM													
NORTH	.0	10.7	.0	.0	.0	.0	.0	.0	3.3	6.5	.0	.0	1.6
NORTHEAST	45.2	35.7	35.5	3.3	9.7	.0	3.2	19.4	50.0	32.3	43.3	48.4	27.1
EAST	.0	.0	.0	.0	.0	3.3	.0	.0	6.7	.0	.0	.0	.8
SOUTHEAST	3.2	.0	3.2	23.3	12.9	23.3	6.5	12.9	.0	3.2	6.7	6.5	8.5
SOUTH	.0	.0	.0	10.0	19.4	10.0	19.4	16.1	3.3	3.2	.0	6.5	7.4
SOUTHWEST	9.7	10.7	12.9	13.3	19.4	33.3	35.5	16.1	6.7	6.5	6.7	9.7	15.1
WEST	9.7	.0	.0	.0	3.2	.0	.0	.0	.0	.0	.0	.0	1.1
NORTHWEST	.0	17.9	16.1	6.7	.0	.0	.0	.0	.0	.0	.0	.0	3.3
CALM	32.3	25.0	32.3	43.3	35.5	30.0	35.5	35.5	30.0	48.4	43.3	29.0	35.1
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.16	-.20	-.14	-.35	-.15	-.41	-.28	-.21	-.27	-.23	-.42	-.21	-.25
STANDARD DEVIATION	.05	.01	.03	.16	.02	.28	.21	.13	.05	.13	.00	.07	.18
NUM. OF OBS. (TO LEFT)	6	4	4	7	9	11	15	8	2	2	1	11	80
AVG TO RIGHT(FT/SEC) (2)	.13	.20	.16	.28	.13	.28	.15	.26	.16	.26	.24	.21	.21
STANDARD DEVIATION	.07	.12	.06	.17	.01	.08	.02	.09	.06	.17	.07	.05	.11
NUM. OF OBS. (TO RIGHT)	11	11	9	7	4	6	2	8	16	15	17	11	117
AVG. NET CURRENT (2)(3)	.03	.09	.07	-.03	-.07	-.17	-.23	.02	.11	.21	.21	.00	.02
NUMBER OF OBSERVATIONS	17	15	13	14	13	17	17	16	18	17	18	22	197
NUMBER OF CALM OBS.	14	13	18	16	18	13	14	15	12	14	12	9	168

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	3	3	3	2	2	2	3	3	4	6	6	4	6
MINIMUM SLOPE	3	3	1	2	2	2	2	3	3	3	4	4	1
AVERAGE SLOPE (2)	3.0	3.0	2.4	2.0	2.0	2.0	2.9	3.0	3.2	4.3	4.7	4.0	3.0
NUMBER OF OBSERVATIONS	31	23	31	30	31	30	31	31	30	31	30	31	365
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-99	6726	4396	-1924	950	-32182	-26273	1774	2823	18685	16557	1005	-7567
NUM OF OBSERVATIONS	29	28	29	30	30	29	29	30	30	30	30	31	355
TOTAL LEFT CUBIC YDS	-4328	-4076	-317	-13767	-1793	-35446	-26643	-7133	-1139	-19035	-2151	-10575	-127403
NUM OF OBS TO LEFT	6	5	2	5	10	11	14	7	2	2	1	7	72
TOTAL RGHT CUBIC YDS	4729	10303	5213	11642	2743	3263	364	8908	3963	37721	18708	11580	119837
NUM OF OBS TO RIGHT	8	9	9	9	4	5	2	9	9	10	18	11	103
METHOD 2													
NET CUBIC YARDS	-3175	16473	4254	-17842	1263	-120928	-145601	2449	4897	139502	29635	-6865	-95938
NUM OF OBSERVATIONS	17	15	13	14	13	16	17	16	18	17	18	22	196
TOTAL LEFT CUBIC YDS	-8990	-5885	-1793	-61505	-3057	-127996	-146357	-19319	-1809	-11260	-7278	-20765	-416014
NUM OF OBS TO LEFT	6	4	4	7	9	10	15	8	2	2	1	11	79
TOTAL RGHT CUBIC YDS	5814	22358	6047	43662	4321	7067	755	21768	6706	150762	36913	13900	320073
NUM OF OBS TO RIGHT	11	11	9	7	4	6	2	8	16	15	17	11	117

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 48002, Cherry Grove Beach, South Carolina

Latitude 33°49'43.8", Longitude 78°37'58.2",

Data Collected from 1 Jan 83 to 31 Dec 83

	JAN	FEB	MAPCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
NUMBER OF CALM OBS.	0	1	0	0	0	0	0	0	0	0	0	0	1
HIGHEST WAVE PECORDED	5.00	6.00	6.50	5.00	4.50	4.50	4.00	3.00	4.00	4.00	4.00	5.50	6.50
AVG. WAVE HEIGHT(FT) (1)	2.60	2.73	2.47	2.32	2.81	2.43	2.10	1.92	2.27	2.66	2.95	2.81	2.50
STANDARD DEVIATION	1.20	1.40	1.42	1.08	.76	1.01	.75	.66	.78	.80	.70	1.09	1.05
LONGEST PERIOD RECORDED	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50
AVG WAVE PERIOD(SEC) (1)	4.40	4.21	4.45	4.43	4.44	4.35	4.32	4.32	4.37	4.35	4.33	4.37	4.36
STANDARD DEVIATION	.39	.88	.39	.31	.33	.39	.30	.27	.29	.29	.27	.34	.40
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	27	31	30	31	30	31	31	30	31	30	31	364
PERCENT OCCURRENCE >90	9.7	11.1	19.4	36.7	54.8	20.0	48.4	41.9	26.7	32.3	46.7	41.9	32.7
=90	38.7	55.6	61.3	43.3	19.4	40.0	51.6	54.8	43.3	45.2	46.7	35.5	44.5
<90	51.6	33.3	19.4	20.0	25.8	40.0	.0	3.2	30.0	22.6	6.7	22.6	22.8
AVG. ZONE WIDTH (FT) (2)	316	322	316	300	340	290	256	226	272	308	349	324	301
NUMBER OF OBSERVATIONS	31	27	31	30	31	30	31	31	30	31	30	31	364
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	14.0	12.0	16.0	19.0	16.0	13.0	11.0	11.0	9.0	11.0	8.0	16.0	19.0
AVG. WIND SPEED(MPH) (1)	6.1	5.7	5.7	5.9	7.1	4.5	3.7	3.5	3.1	4.3	3.9	5.1	4.9
STANDARD DEVIATION	4.3	4.1	4.1	5.0	4.3	3.7	3.5	3.6	2.6	3.2	2.3	3.9	4.0
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
PERCENT OCCURRENCE FROM													
NORTH	.0	3.6	.0	.0	6.5	.0	.0	3.2	.0	.0	.0	.0	1.1
NORTHEAST	58.1	46.4	32.3	10.0	9.7	13.3	3.2	3.2	20.0	58.1	56.7	25.8	27.9
EAST	.0	.0	.0	.0	.0	13.3	.0	.0	.0	.0	.0	.0	1.1
SOUTHEAST	.0	7.1	9.7	10.0	12.9	13.3	3.2	12.9	6.7	3.2	.0	3.2	6.8
SOUTH	.0	.0	3.2	6.7	6.5	3.3	6.5	3.2	.0	.0	.0	3.2	2.7
SOUTHWEST	16.1	10.7	22.6	50.0	48.4	26.7	41.9	22.6	23.3	9.7	16.7	35.5	27.1
WEST	.0	.0	6.5	.0	.0	.0	6.5	9.7	.0	.0	.0	.0	1.9
NORTHWEST	3.2	3.6	6.5	.0	.0	.0	.0	.0	20.0	.0	10.0	6.5	4.1
CALM	22.6	28.6	19.4	23.3	16.1	30.0	38.7	45.2	30.0	29.0	16.7	25.8	27.1
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.25	-.15	-.27	-.26	-.39	-.41	-.29	-.28	-.28	-.20	-.34	-.36	-.31
STANDARD DEVIATION	.04	.01	.13	.14	.14	.13	.13	.10	.12	.03	.09	.12	.13
NUM. OF OBS. (TO LEFT)	3	3	11	14	18	7	15	11	9	2	8	13	114
AVG TO RIGHT(FT/SEC) (2)	.25	.33	.36	.25	.33	.25	.00	.30	.25	.39	.38	.37	.31
STANDARD DEVIATION	.09	.17	.17	.09	.12	.13	.00	.00	.08	.13	.11	.11	.14
NUM. OF OBS. (TO RIGHT)	15	11	7	7	9	13	0	1	9	15	9	7	103
AVG. NET CURRENT (2)(3)	.17	.23	-.03	-.09	-.15	.02	-.29	-.23	-.01	.32	.04	-.11	-.01
NUMBER OF OBSERVATIONS	18	14	18	21	27	20	15	12	18	17	17	20	217
NUMBER OF CALM OBS.	13	14	13	9	4	10	16	19	12	14	13	10	147

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	3	3	3	4	4	5	5	5	5	4	5	5
MINIMUM SLOPE	3	1	1	1	3	4	4	4	4	4	4	4	1
AVERAGE SLOPE (2)	3.8	1.7	1.6	2.2	3.6	4.0	4.1	4.5	4.8	4.2	4.0	4.0	3.6
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	30377	40499	3709	-6396	-17889	3696	-15110	-9339	-1982	-9299	-24840	-17290	-18864
NUM OF OBSERVATIONS	31	27	31	30	31	30	31	31	30	31	30	31	364
TOTAL LEFT CUBIC YDS	-3678	-4606	-17340	-19381	-30809	-9402	-15110	-10755	-10192	-18476	-28456	-31162	-199367
NUM OF OBS TO LEFT	3	3	6	11	17	6	15	13	8	10	14	13	119
TOTAL RGHT CUBIC YDS	34055	45106	21049	12984	12919	18099	0	1416	8209	9177	3615	13871	180500
NUM OF OBS TO RIGHT	16	9	6	6	8	12	0	1	9	7	2	7	83
METHOD 2													
NET CUBIC YARDS	56055	179879	7507	-53275	-58610	-1609	-57355	-23256	-7050	55808	6131	-21694	82531
NUM OF OBSERVATIONS	18	14	18	21	27	20	15	12	18	17	17	20	217
TOTAL LEFT CUBIC YDS	-5846	-5786	-70108	-73837	-83056	-51771	-57355	-26793	-19705	-2262	-31385	-53805	-481709
NUM OF OBS TO LEFT	3	3	11	14	18	7	15	11	9	2	8	13	114
TOTAL RGHT CUBIC YDS	61902	185666	77615	20561	24445	50161	0	3537	12655	58070	37517	32110	564239
NUM OF OBS TO RIGHT	15	11	7	7	9	13	0	1	9	15	9	7	103

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NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 48002, Cherry Grove Beach, South Carolina

Latitude 33°49'43.8", Longitude 78°37'58.2",

Data Collected from 1 Jan 84 to 31 Dec 84

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.50	4.50	8.50	5.50	6.00	3.00	4.50	3.50	8.50	5.50	5.00	3.50	8.50
AVG. WAVE HEIGHT(FT) (1)	2.76	2.48	2.77	2.93	2.85	2.02	2.98	2.63	3.32	2.35	3.15	2.21	2.71
STANDARD DEVIATION	.83	1.12	1.55	1.07	.93	.64	.56	.67	1.80	1.04	.72	.72	1.10
LONGEST PERIOD RECORDED	5.00	5.00	4.50	4.50	4.50	4.50	4.50	4.50	4.50	5.00	4.50	4.50	5.00
AVG WAVE PERIOD(SEC) (1)	4.34	4.53	4.10	4.02	4.21	4.48	4.35	4.42	4.08	4.24	4.13	4.40	4.28
STANDARD DEVIATION	.27	.41	.37	.35	.35	.09	.23	.18	.45	.31	.22	.20	.34
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
PERCENT OCCURRENCE >90	41.9	20.7	38.7	13.3	35.5	10.0	54.8	32.3	6.7	12.9	30.0	41.9	28.4
=90	48.4	48.3	32.3	70.0	38.7	70.0	41.9	61.3	40.0	45.2	50.0	58.1	50.3
<90	9.7	31.0	29.0	16.7	25.8	20.0	3.2	6.5	53.3	41.9	20.0	.0	21.3
AVG. ZONE WIDTH (FT) (2)	324	303	325	348	327	238	338	274	375	283	355	256	312
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	13.0	14.0	19.0	12.0	16.0	8.0	14.0	6.0	32.0	12.0	12.0	8.0	32.0
AVG. WIND SPEED(MPH) (1)	4.1	3.7	4.1	3.5	4.0	2.1	4.4	1.6	5.8	3.2	5.7	2.4	3.7
STANDARD DEVIATION	3.5	4.7	4.9	3.8	3.9	2.6	3.5	2.2	6.8	3.6	3.7	2.8	4.2
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
PERCENT OCCURRENCE FROM													
NORTH	3.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3
NORTHEAST	16.1	6.9	19.4	20.0	12.9	.0	3.2	6.5	36.7	35.5	16.7	22.6	16.4
EAST	.0	.0	3.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3
SOUTHEAST	.0	3.4	.0	.0	9.7	10.0	16.1	.0	26.7	6.5	.0	.0	6.0
SOUTH	.0	.0	.0	.0	6.5	23.3	9.7	12.9	.0	3.2	3.3	.0	4.9
SOUTHWEST	16.1	27.6	32.3	33.3	35.5	13.3	45.2	19.4	3.3	3.2	26.7	22.6	23.2
WEST	.0	.0	3.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3
NORTHWEST	32.3	10.3	.0	3.3	.0	.0	.0	.0	.0	3.2	33.3	.0	6.8
CALM	32.3	51.7	41.9	43.3	35.5	53.3	25.8	61.3	33.3	48.4	20.0	54.8	41.8
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.26	-.43	-.33	-.22	-.33	-.23	-.26	-.18	-.19	-.20	-.36	-.26	-.29
STANDARD DEVIATION	.03	.20	.16	.05	.15	.08	.10	.04	.04	.02	.11	.06	.13
NUM. OF OBS. (TO LEFT)	4	6	13	6	12	3	21	7	2	3	9	6	92
AVG TO RIGHT(FT/SEC) (2)	.24	.30	.28	.41	.18	.23	.20	.20	.40	.28	.37	.30	.30
STANDARD DEVIATION	.05	.09	.11	.16	.05	.07	.00	.04	.20	.10	.12	.05	.14
NUM. OF OBS. (TO RIGHT)	16	10	9	6	9	6	1	5	20	13	7	7	109
AVG. NET CURRENT (2)(3)	.14	.02	-.08	.10	-.11	.08	-.23	-.02	.34	.19	-.04	.04	.03
NUMBER OF OBSERVATIONS	20	16	22	12	21	9	22	12	22	16	16	13	201
NUMBER OF CALM OBS.	11	13	9	18	10	21	9	19	8	15	14	18	165

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	5	5	5	5	5	5	5	5	6	4	5	4	6
MINIMUM SLOPE	4	4	4	3	3	5	5	4	3	3	3	4	3
AVERAGE SLOPE (2)	4.1	4.5	4.7	4.2	4.5	5.0	5.0	4.5	4.5	3.0	4.0	4.0	4.3
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-16378	2413	-30904	12936	-21470	1017	-24405	-8756	90154	17768	-11765	-16267	-5657
NUM OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
TOTAL LEFT CUBIC YDS	-19590	-16863	-42662	-5313	-28793	-3854	-27312	-12255	-2927	-3228	-24809	-16267	-203878
NUM OF OBS TO LEFT	13	6	12	4	11	3	17	10	2	4	9	13	104
TOTAL RGHT CUBIC YDS	3211	19276	11757	18255	7322	4871	2907	3498	93081	20996	13043	0	198217
NUM OF OBS TO RIGHT	3	9	9	5	8	6	1	2	16	13	6	0	78
METHOD 2													
NET CUBIC YARDS	22121	790	-78061	47039	-56580	3406	-42903	-820	225186	33651	4426	11974	170229
NUM OF OBSERVATIONS	20	16	21	12	21	9	22	12	22	16	16	13	200
TOTAL LEFT CUBIC YDS	-7186	-38110	-94442	-15867	-63304	-8948	-45450	-10520	-2465	-4196	-34279	-11078	-335845
NUM OF OBS TO LEFT	4	6	12	6	12	3	21	7	2	3	9	6	91
TOTAL RGHT CUBIC YDS	29308	38901	16381	62907	6724	12355	2547	9700	227651	37848	38706	23053	506081
NUM OF OBS TO RIGHT	16	10	9	6	9	6	1	5	20	13	7	7	109

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(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 48002, Cherry Grove Beach, South Carolina

Latitude 33°49'43.8", Longitude 78°37'58.2",

Data Collected from 1 Jan 85 to 31 Dec 85

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.00	5.50	4.00	4.50	3.50	3.50	6.00	3.50	4.50	4.00	3.50	3.50	6.00
AVG. WAVE HEIGHT(FT) (1)	2.79	2.73	2.73	2.00	2.16	2.37	2.66	2.02	2.10	2.65	2.68	2.32	2.43
STANDARD DEVIATION	.77	1.14	.68	1.07	.69	.74	.89	.70	.87	.72	.38	.53	.84
LONGEST PERIOD RECORDED	4.50	4.50	4.50	5.00	4.50	4.50	4.50	5.00	5.00	4.50	4.50	5.00	5.00
AVG WAVE PERIOD(SEC) (1)	4.27	4.32	4.34	4.50	4.42	4.42	4.34	4.61	4.52	4.35	4.43	4.48	4.42
STANDARD DEVIATION	.25	.27	.23	.37	.18	.19	.27	.24	.27	.23	.17	.15	.26
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
PERCENT OCCURRENCE >90	54.8	57.1	35.5	36.7	25.8	40.0	45.2	22.6	10.0	9.7	13.3	25.8	31.2
=90	38.7	28.6	48.4	53.3	61.3	46.7	45.2	45.2	26.7	38.7	56.7	58.1	45.8
<90	6.5	14.3	16.1	10.0	12.9	13.3	9.7	32.3	63.3	51.6	30.0	16.1	23.0
AVG. ZONE WIDTH (FT) (2)	319	301	304	221	243	271	300	245	241	308	302	258	276
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	11.0	18.0	11.0	18.0	11.0	9.0	19.0	8.0	9.0	11.0	8.0	9.0	19.0
AVG. WIND SPEED(MPH) (1)	6.2	6.7	3.9	2.0	2.3	2.8	3.1	2.1	2.5	3.0	2.3	2.9	3.3
STANDARD DEVIATION	3.0	4.9	3.2	3.8	2.9	2.8	3.8	2.3	2.4	3.4	2.7	2.8	3.5
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
PERCENT OCCURRENCE FROM													
NORTH	16.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.4
NORTHEAST	22.6	17.9	25.8	6.7	12.9	13.3	.0	3.2	50.0	41.9	36.7	19.4	20.8
EAST	.0	3.6	.0	.0	.0	3.3	.0	.0	.0	.0	.0	.0	.5
SOUTHEAST	.0	.0	.0	.0	3.2	.0	6.5	25.9	.0	3.2	.0	.0	3.3
SOUTH	.0	.0	.0	3.3	.0	6.7	6.5	.0	.0	3.2	3.3	.0	1.9
SOUTHWEST	12.9	28.6	38.7	23.3	29.0	33.3	45.2	22.6	6.7	3.2	10.0	25.8	23.3
WEST	3.2	7.1	3.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.1
NORTHWEST	32.3	21.4	3.2	.0	.0	3.3	.0	.0	.0	.0	.0	16.1	6.3
CALM	12.9	21.4	29.0	66.7	54.8	40.0	41.9	48.4	43.3	48.4	50.0	38.7	41.4
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.35	-.39	-.30	-.33	-.28	-.26	-.27	-.34	-.18	-.25	-.30	-.23	-.31
STANDARD DEVIATION	.08	.16	.10	.13	.09	.07	.13	.09	.00	.04	.06	.06	.12
NUM. OF OBS. (TO LEFT)	16	18	12	11	7	12	16	8	1	3	4	9	117
AVG TO RIGHT(FT/SEC) (2)	.25	.24	.37	.37	.32	.30	.22	.23	.29	.37	.27	.18	.29
STANDARD DEVIATION	.02	.04	.15	.02	.12	.08	.02	.03	.09	.14	.06	.04	.11
NUM. OF OBS. (TO RIGHT)	4	4	7	3	4	4	3	10	19	16	11	6	91
AVG. NET CURRENT (2)(3)	-.26	-.27	-.05	-.18	-.06	-.12	-.19	-.02	.27	.27	.12	-.07	-.05
NUMBER OF OBSERVATIONS	20	22	19	14	11	16	19	18	20	19	15	15	208
NUMBER OF CALM OBS.	11	6	12	16	20	14	12	13	10	12	15	16	157

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	5	4	4	4	4	4	4	5	4	4	4	5
MINIMUM SLOPE	4	4	4	3	3	3	3	3	4	3	3	3	3
AVERAGE SLOPE (2)	4.0	4.6	4.0	3.3	3.5	3.4	3.7	3.6	4.6	3.3	3.9	4.0	3.8
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-36051	-44077	-1954	-16351	1245	-9704	-23697	-580	25049	21675	6934	-222	-77733
NUM OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
TOTAL LEFT CUBIC YDS	-37463	-46487	-15503	-20893	-7104	-15466	-25622	-7885	-776	-2309	-5318	-7451	-192277
NUM OF OBS TO LEFT	17	16	11	11	8	12	14	7	3	3	4	8	114
TOTAL RGHT CUBIC YDS	1411	2409	13548	4542	8350	5762	1925	7305	25825	23985	12252	7228	114542
NUM OF OBS TO RIGHT	2	4	5	3	4	4	3	10	19	16	9	5	84
METHOD 2													
NET CUBIC YARDS	-53122	-74682	2065	-31963	1124	-8599	-51728	-8727	33794	52049	14100	-5376	-131065
NUM OF OBSERVATIONS	20	22	19	14	11	15	19	18	20	19	15	15	207
TOTAL LEFT CUBIC YDS	-57074	-77344	-25959	-43733	-17658	-21948	-54146	-18621	-192	-3258	-10565	-13543	-344041
NUM OF OBS TO LEFT	16	18	12	11	7	11	16	8	1	3	4	9	116
TOTAL RGHT CUBIC YDS	3951	2661	28025	11769	18782	13348	2418	9893	33987	55308	24666	8167	212975
NUM OF OBS TO RIGHT	4	4	7	3	4	4	3	10	19	16	11	6	91

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 48002, Cherry Grove Beach, South Carolina

Latitude 33°49'43.8", Longitude 78°37'58.2",

Data Collected from 1 Jan 86 to 31 Dec 86

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	28	32	30	31	30	31	31	30	30	29	31	364
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.50	3.50	3.50	4.00	3.50	3.50	3.50	4.00	3.50	4.00	4.50	6.50	6.50
AVG. WAVE HEIGHT(FT) (1)	2.44	2.23	2.19	2.18	2.10	2.28	2.26	2.53	2.23	2.40	2.98	2.48	2.36
STANDARD DEVIATION	.80	.57	.65	.86	.69	.74	.72	.54	.68	.64	.66	.94	.75
LONGEST PERIOD RECORDED	4.50	4.50	5.00	5.00	4.50	5.00	4.50	4.50	4.50	4.50	4.50	4.50	5.00
AVG WAVE PERIOD(SEC) (1)	4.34	4.41	4.41	4.45	4.39	4.32	4.39	4.39	4.43	4.45	4.36	4.44	4.40
STANDARD DEVIATION	.23	.19	.23	.24	.21	.74	.21	.21	.17	.15	.22	.21	.29
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	28	32	30	31	30	31	31	30	30	29	31	364
PERCENT OCCURRENCE >90	45.2	17.9	9.4	63.3	48.4	36.7	64.5	35.5	3.3	10.0	6.9	6.5	29.1
=90	41.9	60.7	62.5	33.3	38.7	40.0	32.3	48.4	50.0	43.3	27.6	71.0	45.9
<90	12.9	21.4	28.1	3.3	12.9	23.3	3.2	16.1	46.7	46.7	65.5	22.6	25.0
AVG. ZONE WIDTH (FT) (2)	256	246	239	243	238	256	254	269	253	266	336	283	262
NUMBER OF OBSERVATIONS	31	28	32	30	31	30	31	31	30	31	30	31	366
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	10.0	11.0	9.0	16.0	11.0	12.0	11.0	8.0	7.0	11.0	8.0	9.0	16.0
AVG. WIND SPEED(MPH) (1)	4.2	2.6	2.7	3.9	3.5	4.5	3.7	2.9	2.4	3.0	2.8	1.4	3.1
STANDARD DEVIATION	3.4	3.1	2.7	3.9	3.6	3.6	3.4	2.4	2.4	3.1	2.9	2.7	3.2
NUMBER OF OBSERVATIONS	31	28	32	30	31	30	31	31	30	31	30	31	366
PERCENT OCCURRENCE FROM													
NORTH	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.2	.3
NORTHEAST	3.2	28.6	15.6	6.7	3.2	.0	.0	12.9	46.7	41.9	43.3	16.1	18.0
EAST	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
SOUTHEAST	.0	.0	21.9	3.3	.0	20.0	.0	.0	.0	.0	.0	3.2	4.1
SOUTH	9.7	.0	.0	.0	3.2	16.7	12.9	12.9	3.3	9.7	.0	3.2	6.0
SOUTHWEST	29.0	14.3	15.6	33.3	38.7	30.0	54.8	38.7	3.3	6.5	6.7	.0	22.7
WEST	.0	.0	.0	.0	3.2	.0	3.2	.0	.0	.0	.0	.0	.5
NORTHWEST	25.8	7.1	.0	20.0	9.7	3.3	.0	.0	.0	3.2	3.3	.0	6.0
CALM	32.3	50.0	46.9	36.7	41.9	30.0	29.0	35.5	46.7	38.7	46.7	74.2	42.3
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.29	-.18	-.24	-.25	-.26	-.30	-.28	-.24	-.18	-.19	-.27	-.18	-.26
STANDARD DEVIATION	.08	.05	.08	.11	.09	.10	.10	.06	.00	.03	.03	.00	.10
NUM. OF OBS. (TO LEFT)	14	5	6	19	15	11	19	11	1	3	2	1	108
AVG TO RIGHT(FT/SEC) (2)	.22	.18	.26	.18	.23	.26	.28	.28	.23	.19	.24	.21	.23
STANDARD DEVIATION	.06	.05	.06	.01	.10	.07	.00	.03	.05	.06	.09	.13	.08
NUM. OF OBS. (TO RIGHT)	5	6	9	2	4	6	1	5	14	15	19	9	95
AVG. NET CURRENT (2)(3)	-.15	.00	.06	-.21	-.16	-.10	-.25	-.03	.20	.13	.20	.17	-.03
NUMBER OF OBSERVATIONS	19	12	15	21	19	17	20	16	15	18	21	10	203
NUMBER OF CALM OBS.	12	16	17	9	12	13	11	15	15	13	9	21	163

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	5	5	4	4	5	4	4	5	5	4	4	4	5
MINIMUM SLOPE	4	4	3	3	4	3	3	4	3	3	3	2	2
AVERAGE SLOPE (2)	4.5	4.7	3.9	3.9	4.3	3.7	3.3	4.5	3.6	3.6	3.7	2.1	3.8
NUMBER OF OBSERVATIONS	31	28	32	30	31	29	31	31	30	31	30	31	365
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	-18153	-1034	5366	-19720	-11376	-3605	-18851	-3883	17723	13869	30426	27125	17887
NUM OF OBSERVATIONS	31	28	32	30	31	30	31	31	30	30	29	31	364
TOTAL LEFT CUBIC YDS	-22014	-6579	-4116	-20251	-14455	-11726	-20933	-11700	-531	-2386	-4451	-1713	-120855
NUM OF OBS TO LEFT	14	5	3	19	15	11	20	11	1	3	2	2	106
TOTAL RGHT CUBIC YDS	3860	5545	9483	531	3078	3120	2082	7817	13254	16256	34877	23839	138742
NUM OF OBS TO RIGHT	4	6	9	1	4	7	1	5	14	14	19	7	91
METHOD 2													
NET CUBIC YARDS	-22009	-1446	3396	-29860	-18016	-12235	-25738	-3932	25944	15557	37782	59686	29129
NUM OF OBSERVATIONS	19	12	15	21	19	17	20	16	15	18	21	10	203
TOTAL LEFT CUBIC YDS	-28082	-9711	-11558	-31094	-22378	-22394	-28619	-16792	-377	-2713	-4618	-1706	-180042
NUM OF OBS TO LEFT	14	6	6	19	15	11	19	11	1	3	2	1	108
TOTAL RGHT CUBIC YDS	6072	8265	14955	1233	4362	10158	2881	12860	26321	18270	42400	61392	209169
NUM OF OBS TO RIGHT	5	6	9	2	4	6	1	5	14	15	19	9	95

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION
(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION
(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 48002, Cherry Grove Beach, South Carolina
Latitude 33°49'43.8", Longitude 78°37'58.2",
Data Collected from 1 Jan 87 to 31 Dec 87

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	28	31	30	31	31	31	31	30	31	30	31	366
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	8.00	6.00	6.50	4.50	4.00	5.50	4.00	4.50	5.50	3.00	4.00	4.50	8.00
AVG. WAVE HEIGHT(FT) (1)	3.42	2.83	3.23	2.95	2.58	3.08	2.32	2.71	2.38	1.68	2.57	2.35	2.73
STANDARD DEVIATION	1.20	1.12	.87	.72	.74	.89	.99	1.06	.91	.74	.81	1.08	1.04
LONGEST PERIOD RECORDED	4.50	5.00	4.50	4.50	4.50	5.00	5.00	5.00	4.50	5.00	5.00	5.50	5.50
AVG WAVE PERIOD(SEC) (1)	4.24	4.36	4.34	4.40	4.40	4.44	4.44	4.37	4.40	4.63	4.47	4.53	4.42
STANDARD DEVIATION	.28	.22	.27	.20	.20	.25	.25	.28	.20	.25	.22	.31	.27
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	23	31	30	31	31	31	31	30	31	30	31	366
PERCENT OCCURRENCE >90	29.0	.0	19.4	60.0	29.0	54.8	3.2	32.3	6.7	.0	.0	12.9	20.8
=90	41.9	71.4	16.1	20.0	41.9	35.5	64.5	48.4	80.0	77.4	50.0	45.2	49.2
<90	29.0	28.6	64.5	20.0	29.0	9.7	32.3	19.4	13.3	22.6	50.0	41.9	30.1
AVG. ZONE WIDTH (FT) (2)	366	330	359	308	282	337	251	296	318	183	295	254	298
NUMBER OF OBSERVATIONS	31	23	31	30	31	31	31	31	30	31	30	31	366
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	13.0	21.0	12.0	12.0	9.0	15.0	13.0	12.0	11.0	11.0	10.0	16.0	21.0
AVG. WIND SPEED(MPH) (1)	5.2	4.5	6.1	6.1	3.6	5.4	2.2	3.4	2.0	1.6	3.0	3.9	3.9
STANDARD DEVIATION	4.3	5.6	3.8	3.4	3.2	4.5	3.1	3.8	3.5	3.0	3.5	4.0	4.1
NUMBER OF OBSERVATIONS	31	28	31	30	31	31	31	31	30	31	30	31	366
PERCENT OCCURRENCE FROM													
NORTH	.0	.0	6.5	.0	.0	.0	.0	.0	.0	.0	3.3	.0	.8
NORTHEAST	25.8	17.9	35.5	20.0	3.2	.0	6.5	.0	10.0	19.4	36.7	9.7	15.3
EAST	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
SOUTHEAST	.0	.0	3.2	.0	25.8	9.7	22.6	16.1	6.7	.0	.0	3.2	7.4
SOUTH	.0	.0	.0	6.7	3.2	3.2	6.5	3.2	6.7	3.2	.0	.0	2.7
SOUTHWEST	22.6	3.6	12.9	60.0	32.3	58.1	6.5	32.3	6.7	3.2	.0	6.5	20.5
WEST	.0	3.6	.0	.0	.0	.0	.0	.0	.0	.0	.0	25.8	2.5
NORTHWEST	16.1	21.4	22.6	.0	.0	.0	.0	.0	.0	.0	6.7	12.9	6.6
CALM	35.5	53.6	19.4	13.3	35.5	29.0	58.1	48.4	70.0	74.2	53.3	41.9	44.3
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.31	-.18	-.29	-.31	-.26	-.31	-.18	-.23	-.23	.00	.00	-.27	-.28
STANDARD DEVIATION	.08	.00	.12	.11	.07	.11	.00	.08	.07	.00	.00	.08	.10
NUM. OF OBS. (TO LEFT)	9	1	6	18	10	16	2	12	3	0	0	4	81
AVG TO RIGHT(FT/SEC) (2)	.31	.35	.28	.29	.18	.20	.22	.26	.34	.22	.27	.24	.26
STANDARD DEVIATION	.14	.08	.08	.11	.04	.06	.06	.07	.11	.04	.07	.04	.09
NUM. OF OBS. (TO RIGHT)	10	3	20	6	10	4	10	6	5	7	14	11	111
AVG. NET CURRENT (2)(3)	.01	.29	.15	-.16	-.04	-.21	.16	-.07	.13	.22	.27	.10	.03
NUMBER OF OBSERVATIONS	19	9	26	24	20	20	12	18	8	7	14	15	192
NUMBER OF CALM OBS.	12	19	5	6	11	11	19	13	22	24	16	14	172

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	4	5	5	4	4	4	4	4	3	4	4	5
MINIMUM SLOPE	2	4	4	3	2	4	3	3	3	3	3	4	2
AVERAGE SLOPE (2)	2.8	4.0	4.1	3.9	2.7	4.0	3.3	3.3	3.8	3.0	3.8	4.0	3.6
NUMBER OF OBSERVATIONS	31	28	31	30	31	30	31	31	30	31	30	31	365
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	33667	30328	13225	-19719	-1107	-36158	15615	-7799	11220	7207	27184	13230	86893
NUM OF OBSERVATIONS	31	28	31	30	31	31	31	31	30	31	30	31	366
TOTAL LEFT CUBIC YDS	-21345	0	-17691	-30194	-13246	-40171	-897	-20422	-5155	0	0	-8299	-159420
NUM OF OBS TO LEFT	9	0	6	18	9	17	1	10	2	0	0	4	76
TOTAL RGHT CUBIC YDS	55012	30328	32916	10474	12139	4012	16512	12622	16376	7207	27184	21529	246311
NUM OF OBS TO RIGHT	9	8	20	6	9	3	10	6	4	7	15	13	110
METHOD 2													
NET CUBIC YARDS	50190	117543	9440	-27268	-6878	-60537	24356	-8487	69716	22943	48224	13279	252521
NUM OF OBSERVATIONS	19	9	25	24	20	20	11	18	8	7	14	15	190
TOTAL LEFT CUBIC YDS	-34299	-2882	-27978	-39406	-17339	-65621	-3412	-28361	-17656	0	0	-13956	-250910
NUM OF OBS TO LEFT	9	1	5	18	10	16	2	12	3	0	0	4	80
TOTAL RGHT CUBIC YDS	84490	120425	37418	12137	10460	5083	27768	19873	87372	22943	48224	27236	503429
NUM OF OBS TO RIGHT	10	8	20	6	10	4	9	6	5	7	14	11	110

(1) CALMS, IF ANY, INCLUDED IN AVERAGE CALCULATION

(2) CALMS NOT INCLUDED IN AVERAGE CALCULATION

(3) A MINUS SIGN (-) INDICATES CURRENT MOVEMENT TO THE LEFT
NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT

(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary: Sta 48002, Cherry Grove Beach, South Carolina

Latitude 33°49'43.8", Longitude 78°37'58.2",

Data Collected from 1 Jan 88 to 31 Dec 88

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
NUMBER OF CALM OBS.	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGHEST WAVE RECORDED	4.00	4.00	4.50	4.50	4.00	4.00	4.50	6.00	3.50	4.00	4.50	3.50	6.00
AVG. WAVE HEIGHT(FT) (1)	2.65	2.26	2.05	2.20	2.39	2.22	2.50	2.32	2.08	2.31	2.25	2.16	2.28
STANDARD DEVIATION	.80	.83	1.15	.88	.79	.80	.97	1.07	.72	.80	.92	.78	.90
LONGEST PERIOD RECORDED	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
AVG WAVE PERIOD(SEC) (1)	4.50	4.49	4.60	4.52	4.47	4.53	4.47	4.45	4.50	4.48	4.48	4.56	4.50
STANDARD DEVIATION	.22	.21	.35	.20	.25	.26	.28	.27	.13	.20	.24	.17	.24
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
PERCENT OCCURRENCE >90	.0	20.7	6.5	20.0	16.1	16.7	51.6	16.1	10.0	19.4	10.0	29.0	18.0
=90	51.6	62.1	74.2	40.0	67.7	60.0	48.4	61.3	53.3	54.8	50.0	35.5	54.9
<90	48.4	17.2	19.4	40.0	16.1	23.3	.0	22.6	36.7	25.8	40.0	35.5	27.0
AVG. ZONE WIDTH (FT) (2)	300	251	220	253	262	235	275	259	245	248	256	238	254
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	9.0	9.0	9.0	16.0	11.0	10.0	13.0	13.0	11.0	9.0	14.0	9.0	16.0
AVG. WIND SPEED(MPH) (1)	3.6	2.8	1.6	3.4	2.2	1.7	4.1	3.0	2.4	2.7	2.7	3.2	2.8
STANDARD DEVIATION	2.9	3.1	2.9	4.3	3.8	2.9	4.1	3.9	3.1	3.0	3.9	3.1	3.5
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
PERCENT OCCURRENCE FROM													
NORTH	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
NORTHEAST	29.0	6.9	3.2	13.3	3.2	.0	.0	6.5	13.3	12.9	20.0	12.9	10.1
EAST	.0	.0	.0	3.3	.0	.0	.0	.0	.0	.0	.0	3.2	.5
SOUTHEAST	.0	.0	.0	6.7	9.7	3.3	.0	12.9	10.0	.0	3.3	.0	3.8
SOUTH	.0	.0	3.2	3.3	3.2	.0	3.2	9.7	3.3	3.2	.0	6.5	3.0
SOUTHWEST	.0	10.3	9.7	13.3	12.9	16.7	51.6	16.1	16.7	12.9	10.0	19.4	15.8
WEST	12.9	17.2	3.2	.0	.0	3.3	.0	.0	.0	6.5	.0	.0	3.6
NORTHWEST	25.8	17.2	6.5	10.0	.0	6.7	.0	.0	.0	12.9	6.7	19.4	8.7
CALM	32.3	48.3	74.2	50.0	71.0	70.0	45.2	54.8	56.7	51.6	60.0	38.7	54.4
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	.00	-.27	-.25	-.24	-.29	-.16	-.28	-.29	-.23	-.21	-.28	-.15	-.24
STANDARD DEVIATION	.00	.08	.09	.04	.07	.04	.06	.14	.09	.05	.11	.05	.09
NUM. OF OBS. (TO LEFT)	0	2	4	6	5	6	15	5	5	6	3	9	66
AVG TO RIGHT(FT/SEC) (2)	.23	.25	.29	.27	.29	.14	.00	.20	.23	.22	.23	.18	.23
STANDARD DEVIATION	.06	.06	.13	.11	.14	.04	.00	.06	.07	.09	.07	.07	.09
NUM. OF OBS. (TO RIGHT)	18	10	6	12	5	6	0	7	11	8	12	11	106
AVG. NET CURRENT (2)(3)	.23	.16	.08	.10	.00	-.01	-.28	.00	.08	.04	.12	.03	.05
NUMBER OF OBSERVATIONS	18	12	10	18	10	12	15	12	16	14	15	20	172
NUMBER OF CALM OBS.	13	17	21	12	21	18	16	19	14	17	15	11	194

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	4	4	4	4	4	4	5	5	4	4	2	3	5
MINIMUM SLOPE	3	3	3	3	3	4	4	4	4	2	2	2	2
AVERAGE SLOPE (2)	3.7	3.8	3.5	3.6	3.8	4.0	4.7	4.1	4.0	3.0	2.0	2.3	3.6
NUMBER OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	30	365
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS)(4)													
METHOD 1													
NET CUBIC YARDS	26082	-294	5642	10433	-1420	2524	-28694	-5772	9704	5661	15430	6817	46118
NUM OF OBSERVATIONS	31	29	31	30	31	30	31	31	30	31	30	31	366
TOTAL LEFT CUBIC YDS	0	-8323	-4323	-5844	-9238	-2507	-28694	-14413	-3213	-5521	-4146	-6368	-92590
NUM OF OBS TO LEFT	0	6	2	6	5	5	16	5	3	6	3	9	66
TOTAL RGHT CUBIC YDS	26082	8028	9965	16283	7817	5031	0	8640	12917	11182	19576	13185	138706
NUM OF OBS TO RIGHT	15	5	6	12	5	7	0	7	11	8	12	11	99
METHOD 2													
NET CUBIC YARDS	37847	28787	17744	21943	-3884	128	-53164	-33552	9027	12092	22842	7489	67299
NUM OF OBSERVATIONS	18	12	10	18	10	12	15	12	16	14	15	20	172
TOTAL LEFT CUBIC YDS	0	-4598	-15103	-7386	-29376	-4443	-53164	-48261	-8708	-3790	-8245	-4895	-192969
NUM OF OBS TO LEFT	0	2	4	6	5	6	15	5	5	6	3	9	66
TOTAL RGHT CUBIC YDS	37847	33335	32848	29330	25492	4572	0	14708	17735	20883	31087	12385	260272
NUM OF OBS TO RIGHT	18	10	6	12	5	6	0	7	11	8	12	11	106

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NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
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METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.

LEO Data Summary; Sta 48002, Cherry Grove Beach, South Carolina

Latitude 33°49'43.8", Longitude 78°37'58.2",

Data Collected from 20 May 80 to 31 Dec 88

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
SURF OBSERVATIONS													
NUMBER OF OBSERVATIONS	239	220	246	240	260	265	266	267	270	268	263	273	3077
NUMBER OF CALM OBS.	1	1	0	0	2	0	1	1	0	1	1	2	10
HIGHEST WAVE RECORDED	8.00	6.00	8.50	5.50	6.00	6.00	6.00	6.00	8.50	6.50	5.00	6.50	8.50
AVG. WAVE HEIGHT(FT) (1)	2.43	2.35	2.26	2.20	2.10	2.13	2.18	2.11	2.07	2.15	2.45	2.20	2.22
STANDARD DEVIATION	1.17	1.12	1.24	1.11	.99	1.02	.99	.93	1.19	1.00	.98	.97	1.07
LONGEST PERIOD RECORDED	5.00	5.00	5.50	5.00	6.00	6.00	5.50	5.00	5.00	5.00	5.00	5.50	6.00
AVG WAVE PERIOD(SEC) (1)	4.31	4.38	4.34	4.37	4.36	4.46	4.36	4.39	4.34	4.38	4.32	4.38	4.36
STANDARD DEVIATION	.40	.42	.33	.33	.53	.42	.39	.38	.30	.39	.42	.46	.40
WAVE DIRECTON													
NUMBER OF OBSERVATIONS	238	219	246	240	253	265	265	266	270	267	262	271	3067
PERCENT OCCURRENCE >90	29.4	19.6	20.3	34.2	33.7	36.2	47.5	29.3	12.2	13.9	17.9	26.6	26.8
=90	45.8	54.8	52.0	47.1	46.9	44.9	44.2	46.6	51.1	51.7	44.3	48.3	48.1
<90	24.8	25.6	27.6	18.8	19.4	18.9	8.3	24.1	36.7	34.5	37.8	25.1	25.2
AVG. ZONE WIDTH (FT) (2)	272	259	253	250	239	232	245	234	236	242	275	245	248
NUMBER OF OBSERVATIONS	238	221	246	240	258	264	264	266	266	270	263	271	3067
WIND OBSERVATIONS													
HIGHEST WIND RECORDED	17.0	21.0	19.0	22.0	18.0	22.0	25.0	18.0	32.0	22.0	29.0	16.0	32.0
AVG. WIND SPEED(MPH) (1)	4.6	4.5	3.9	4.4	3.6	4.1	3.7	3.2	3.1	3.6	3.8	3.7	3.8
STANDARD DEVIATION	3.8	4.5	4.0	4.8	4.0	4.1	4.0	3.6	3.8	4.3	4.0	3.7	4.1
NUMBER OF OBSERVATIONS	248	226	249	240	260	270	279	277	270	279	264	279	3141
PERCENT OCCURRENCE FROM													
NORTH	3.2	3.1	.3	.4	.8	.0	.0	.4	.4	1.1	.4	2.9	1.1
NORTHEAST	36.7	26.1	23.4	14.3	7.8	3.3	2.2	12.4	32.3	35.4	39.8	26.5	21.6
EAST	.0	1.3	.4	1.4	.0	2.6	.0	.4	.7	.0	.0	1.2	.7
SOUTHEAST	.4	2.7	5.6	8.6	14.1	12.7	7.5	15.5	11.9	6.1	5.1	2.2	7.8
SOUTH	1.2	.0	2.5	7.6	8.2	14.1	11.9	10.0	3.8	6.5	3.0	4.8	6.3
SOUTHWEST	16.1	17.4	23.2	35.1	32.7	35.4	52.9	27.5	14.7	10.0	15.2	22.3	25.3
WEST	6.8	9.0	3.7	.0	.8	1.6	1.1	1.4	.0	2.3	.4	2.9	2.4
NORTHWEST	24.9	13.2	8.6	8.8	1.2	3.2	.0	.0	2.2	5.3	8.6	13.7	7.6
CALM	38.4	53.7	59.5	52.9	61.1	53.0	49.2	57.3	59.9	57.9	54.2	48.3	53.8
CURRENT OBSERVATIONS													
AVG TO LEFT (FT/SEC) (2)	-.30	-.32	-.29	-.30	-.29	-.34	-.29	-.27	-.28	-.25	-.34	-.27	-.30
STANDARD DEVIATION	.10	.17	.15	.18	.14	.18	.14	.12	.14	.12	.15	.13	.15
NUM. OF OBS. (TO LEFT)	61	43	64	88	94	95	130	76	33	28	41	71	824
AVG TO RIGHT(FT/SEC) (2)	.23	.28	.28	.29	.23	.28	.24	.25	.27	.31	.29	.26	.27
STANDARD DEVIATION	.09	.12	.13	.14	.11	.24	.10	.10	.14	.17	.13	.14	.14
NUM. OF OBS. (TO RIGHT)	83	73	71	50	52	52	21	67	113	109	110	82	883
AVG. NET CURRENT (2)(3)	.01	.06	.01	-.09	-.10	-.12	-.22	-.02	.14	.19	.12	.01	.00
NUMBER OF OBSERVATIONS	144	116	135	138	146	147	151	143	146	137	151	153	1707
NUMBER OF CALM OBS.	104	110	114	102	114	122	126	133	124	142	107	123	1421

(Continued)

(Concluded)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
FORESHORE SLOPE OBSERVATNS													
MAXIMUM SLOPE	5	5	5	5	5	5	9	5	6	6	6	5	9
MINIMUM SLOPE	1	1	1	1	1	1	1	1	1	1	1	1	1
AVERAGE SLOPE (2)	3.4	3.5	3.2	3.1	3.2	3.2	3.3	3.4	3.6	3.2	3.4	3.2	3.3
NUMBER OF OBSERVATIONS	243	226	249	240	260	268	279	277	270	278	270	278	3143
SEDIMENT TRANSPORT VOLUME (CUBIC YARDS X 1000)(4)													
METHOD 1													
NET CUBIC YARDS	2	6	1	-5	-6	-18	-14	-4	16	10	9	3	0
NUM OF OBSERVATIONS	240	219	246	240	258	268	273	275	270	267	265	272	3093
TOTAL LEFT CUBIC YDS	-14	-11	-14	-15	-14	-25	-19	-11	-5	-7	-10	-11	-156
NUM OF OBS TO LEFT	71	43	50	82	87	97	126	79	33	37	47	73	825
TOTAL RGHT CUBIC YDS	17	17	15	10	8	6	5	7	20	17	19	13	154
NUM OF OBS TO RIGHT	59	56	68	45	50	50	22	64	99	92	99	68	772
METHOD 2													
NET CUBIC YARDS	11	23	-7	-16	-25	-30	-46	-7	44	44	21	4	16
NUM OF OBSERVATIONS	144	116	133	138	144	144	150	143	146	137	151	153	1699
TOTAL LEFT CUBIC YDS	-19	-23	-37	-36	-36	-43	-49	-19	-8	-5	-13	-16	-304
NUM OF OBS TO LEFT	61	43	62	88	93	92	130	76	33	28	41	71	818
TOTAL RGHT CUBIC YDS	30	46	30	21	11	13	4	13	52	49	35	20	324
NUM OF OBS TO RIGHT	83	73	71	50	51	52	20	67	113	109	110	82	881

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NO SIGN INDICATES CURRENT MOVEMENT TO THE RIGHT
(4) ESTIMATED SEDIMENT TRANSPORT VOLUMES ARE GIVEN IN CUBIC YARDS. TWO METHODS (DESCRIBED IN SECTION 4 OF THE "SHORE PROTECTION MANUAL" (SPM)) ARE USED TO CALCULATE THE TRANSPORT VOLUME. NEGATIVE VALUES INDICATE TRANSPORT TO THE LEFT.

METHOD 1. THIS METHOD IS BASED ON EQUATIONS 4-38 AND 4-50B FROM THE SPM. A LONGSHORE ENERGY FLUX (EQUATION 4-38) IS FIRST CALCULATED FOR ONLY THE DAYS OF THE MONTH WHERE WAVE HEIGHT AND ANGLE OF APPROACH HAVE BEEN RECORDED, THEN AN AVERAGE FLUX FOR EACH MONTH IS CALCULATED, AND FINALLY THESE MONTHLY VALUES OF FLUX ARE SUBSTITUTED INTO EQUATION 4-50B AND DIVIDED BY 12 TO GET THE NET MONTHLY SEDIMENT TRANSPORT VOLUMES. THE YEARLY SEDIMENT TRANSPORT VOLUME IS CALCULATED BY SUMMING THE MONTHLY VALUES.

METHOD 2. THIS METHOD IS BASED ON EQUATIONS 4-51, 4-52, AND 4-50B FROM THE SPM, USING RECORDED OBSERVATIONS OF WAVE HEIGHT, WIDTH OF SURF ZONE, LONGSHORE CURRENT, AND DISTANCE TO DYE PATCH FROM SHORELINE AND FOLLOWING THE SAME PROCEDURE AS METHOD 1. NOTE: RECENT FINDINGS INDICATE A FRICTION FACTOR OF .006 SHOULD BE USED IN EQUATION 4-52.