AD-A071 316 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 8/8

GEORGETOWN HARBOR, SOUTH CAROLINA. REPORT 2. EFFECTS OF VARIOUS--ETC(U)

MAY 79 M J TRAWLE, R A BOLAND

UNCLASSIFIED WES-MP-H-78-6-2 NL

1 OF 2

AD A071316

MISCELLANEOUS PAPER H-78-6

GEORGETOWN HARBOR, SOUTH CAROLINA

Report 2

EFFECTS OF VARIOUS CHANNEL SCHEMES ON TIDES, CURRENTS, AND SHOALING

Hydraulic Model Investigation

by

Michael J. Trawle, Robert A. Boland, Jr.

Hydraulics Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

May 1979

Report 2 of a Series

Approved For Public Release; Distribution Unlimited

Prepared for U. S. Army Engineer District, Charleston
Charleston, South Carolina 29402

When this report is no longer needed, return it to the originator.

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER Miscellaneous Paper, H-78-6	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) GEORGETOWN HARBOR, SOUTH CAROLINA; Report 2, EFFECTS OF VARIOUS CHANNEL SCHEMES ON TIDES, CURRENTS, AND SHOALING; Hydraulic Model Investigation		5. TYPE OF REPORT & PERIOD COVERED Report 2 of a series
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Michael J. Trawle Robert A. Boland, Jr		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Hydraulics Laboratory P. O. Box 631, Vicksburg, Miss. 39180		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineer District, Charleston P. O. Box 919 Charleston, South Carolina 29402		12. REPORT DATE May 1979
		13. NUMBER OF PAGES 126
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) (12) 131 p.		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

(14) WES-MP-H-78-6-2

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Fixed-bed models	Salt water intrusion
Georgetown, S. C. -- Harbor	Shoaling
Hydraulic models	Tidal currents
Navigation channels	Tides

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Georgetown Harbor model, a fixed-bed model constructed to linear scale ratios of 1:800 horizontally and 1:80 vertically, reproduced a portion of the Atlantic Ocean, Winyah Bay including Mud Bay, North Inlet and marshes between Winyah Bay and North Inlet, the Sampit River including Georgetown Harbor, and the lower portions of the Pee Dee, Black, and Waccamaw Rivers and adjacent marshes. The model was equipped with necessary appurtenances for the accurate reproduction and measurement of tides, tidal currents, salinity intrusion,

(Continued)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

038 100

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

20. ABSTRACT (Continued).

Cont

freshwater inflow, and shoaling distribution. The purposes of the model study were (a) to determine the effects on the hydraulic, salinity, and shoaling characteristics of a deepening from 27 to 35 ft of the main navigation channel to Georgetown Harbor and (b) to determine whether present maintenance dredging can be reduced by proposed plans involving channel revisions, sediment traps, and freshwater flow diversion.

This report presents and analyzes the results of the testing of the following schemes: Western Channel and Turning Basin scheme (Plans 1, 1A, and 2-6), Marsh Island Channel and Turning Basin scheme (Plan 7), Upper Winyah Bay Side Channel Trap scheme (Plans 8 and 9), Inflow Diversion scheme (Plan 10), and Deepened Channel scheme (Plan 11).

Western Channel and Turning Basin scheme, Plans 1 and 1A, reduced the overall annual shoaling (Western Channel plus Georgetown Harbor Channel) by 63 and 45 percent less than that for the existing channel, respectively. The effects of Plans 2, 3, 5, and 6 on shoaling when compared with Plan 1A were detrimental rather than beneficial and therefore cannot be recommended. The effects of Plan 4 on shoaling, when compared with Plan 1A, were definitely beneficial because of the much more even distribution of shoaling material along the Western Channel. Although the annual shoaling rate for Plan 4 is almost the same as that for Plan 1A, the elimination of the extremely high shoaling rate in one section (section WC3) should permit dredging to be performed on a less frequent basis. Since the overall annual shoaling rate was reduced to 43 percent of the existing rate and no unacceptably high shoaling rates occurred in any individual section, Plan 7 was an effective scheme for reducing the maintenance dredging requirements for the Georgetown Harbor project. Since the overall annual channel shoaling rate for Plans 8 and 9 was increased about 800,000-900,000 cu yd over the present shoaling rate and Georgetown Harbor (Sampit River) shoaling was reduced only about 350,000-450,000 cu yd, neither Plan 8 nor Plan 9 appears to be an effective solution to the existing maintenance dredging problem. Based on the assumption that the 90 percent reduction of the freshwater inflow to the bay would reduce the sediment supply by 90 percent, the overall annual channel shoaling rate for Plan 10 was 63 percent less than the existing rate. Plan 10 is an effective scheme for the reduction of maintenance dredging requirements for the Georgetown Harbor project. The overall annual channel shoaling rate for Plan 11 was 88 percent more than the existing shoaling rate.

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

PREFACE

This report is the second report to be published on the results of model tests on the Georgetown Harbor comprehensive model conducted for the U. S. Army Engineer District, Charleston. Report 1 covers the verification phase of the model investigation.

The studies were conducted in the Hydraulics Laboratory of the U. S. Army Engineer Waterways Experiment Station (WES) from January 1976 to March 1977 under the general supervision of Messrs. H. B. Simmons, Chief of the Hydraulics Laboratory; F. A. Herrmann, Jr., Assistant Chief of the Hydraulics Laboratory; and R. A. Sager, Chief of the Estuaries Division, and under the direct supervision of Messrs. R. A. Boland, Jr., Chief of the Interior Channel Branch, and M. J. Trawle, Project Engineer. Mr. A. J. Banchetti was senior techician for the study, assisted by Mr. D. M. Marzette. This report was prepared by Mr. Trawle with the assistance of Mr. Boland.

Directors of WES during the performance of this study and the preparation and publication of this report were COL G. H. Hilt, CE, and COL John L. Cannon, CE. Technical Director was Mr. F. R. Brown.

CONTENTS

CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI)
UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
cubic feet per second	0.02831685	cubic metres per second
cubic yards	0.7645549	cubic metres
feet	0.3048	metres
feet per second	0.3048	metres per second
inches	25.4	millimetres
miles (U. S. statute)	1.609344	kilometres
square feet	0.09290304	square metres
square miles (U. S. statute)	2.589988	square kilometres

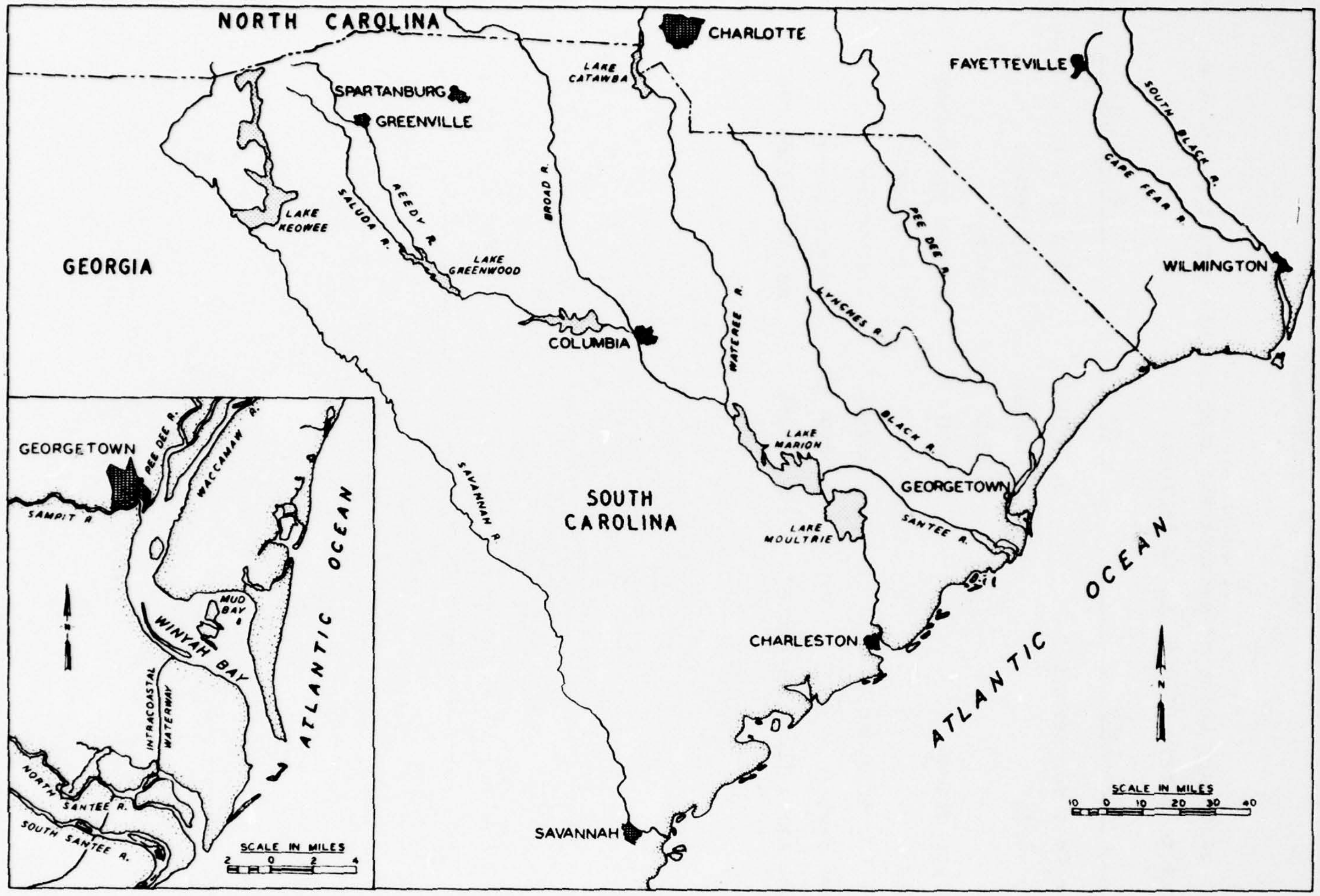


Figure 1. Vicinity map

GEORGETOWN HARBOR, SOUTH CAROLINA

EFFECTS OF VARIOUS CHANNEL SCHEMES ON TIDES, CURRENTS, AND SHOALING

Hydraulic Model Investigation

PART I: INTRODUCTION

The Problem

1. Georgetown Harbor is about 90 miles* northeast of Charleston, South Carolina, and 120 miles southwest of Wilmington, North Carolina (vicinity map, Figure 1). The harbor is about 18 miles from the Atlantic Ocean and is located at the mouth of the Sampit River near the head of Winyah Bay (Plate 1).

2. Winyah Bay is an irregular-shaped tidal estuary extending about 16 miles from the ocean to the confluence of the Pee Dee and Waccamaw Rivers near Georgetown, South Carolina. Bay width is about 0.75 mile at the entrance between North and South Islands, 4.5 miles in the middle section where it widens into a shallow expanse known as Mud Bay, and 1.25 miles in the upper section. Freshwater inflow to Winyah Bay, which averages 13,000 cfs, includes flow from the Pee Dee, Waccamaw, Black, and Sampit Rivers with a total drainage area of about 18,000 square miles. Under most conditions, Winyah Bay is a partially mixed estuary in which density currents are a significant factor with respect to shoaling.

3. The existing navigation project provides for a 27-ft-deep mean low water (mlw) channel from the ocean to the turning basin in the Sampit River, a distance of about 18 miles. The authorized channel is 600 ft wide across the outer bar and into Lower Winyah Bay, a distance of about 6 miles, then 400 ft wide to the Georgetown Harbor turning basin (Plate 1).

---

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

4. The route of the Atlantic Intracoastal Waterway passes through Winyah Bay, entering the bay from the north by way of the Waccamaw River and then southward through the Western Channel and the Esterville-Minion Creek Canal.

5. The original navigation project to Georgetown, authorized in 1882, provided for a 15-ft-deep channel aligned, as shown in Figure 2, generally the same as the existing channel. Annual maintenance dredging for the 15-ft project averaged about 200,000 cu yd. In 1913, a deepened channel of 18-ft depth, realigned along the western shore as shown in Figure 2, was constructed. Annual maintenance dredging for the 18-ft project averaged about 400,000 cu yd. In 1939 the 18-ft channel was realigned as shown in Figure 2 to the existing alignment (Eastern Channel). Annual maintenance dredging from 1938 to 1946 for the 18-ft project averaged about 280,000 cu yd. Generally, the channel was poorly maintained during this period, resulting in the small dredging volumes. Deepening of the channel from 18 ft to 27 ft was initiated in 1947 and completed in 1951. Annual maintenance dredging from 1947 to 1974 for the 27-ft project averaged about 1,460,000 cu yd. The average includes periods when the project was maintained at less than project depth or width. Annual maintenance dredging from 1972 to 1976 for the 27-ft project, not including entrance (jetty) dredging, averaged about 2,300,000 cu yd.

6. Since the need for a channel deeper than 27 ft has increased in recent years, one purpose of this model study was to determine the effects on the hydraulic, salinity, and shoaling characteristics of a deepening from 27 to 35 ft of the main navigation channel to Georgetown Harbor.

7. Because of the additional costs imposed on dredging activity by environmental considerations in recent years, maintenance dredging costs for the existing Georgetown Harbor project have become increasingly burdensome. Another purpose of this model study was to determine whether present maintenance dredging costs could be reduced by proposed schemes involving channel revisions, sediment traps, or freshwater inflow diversion.

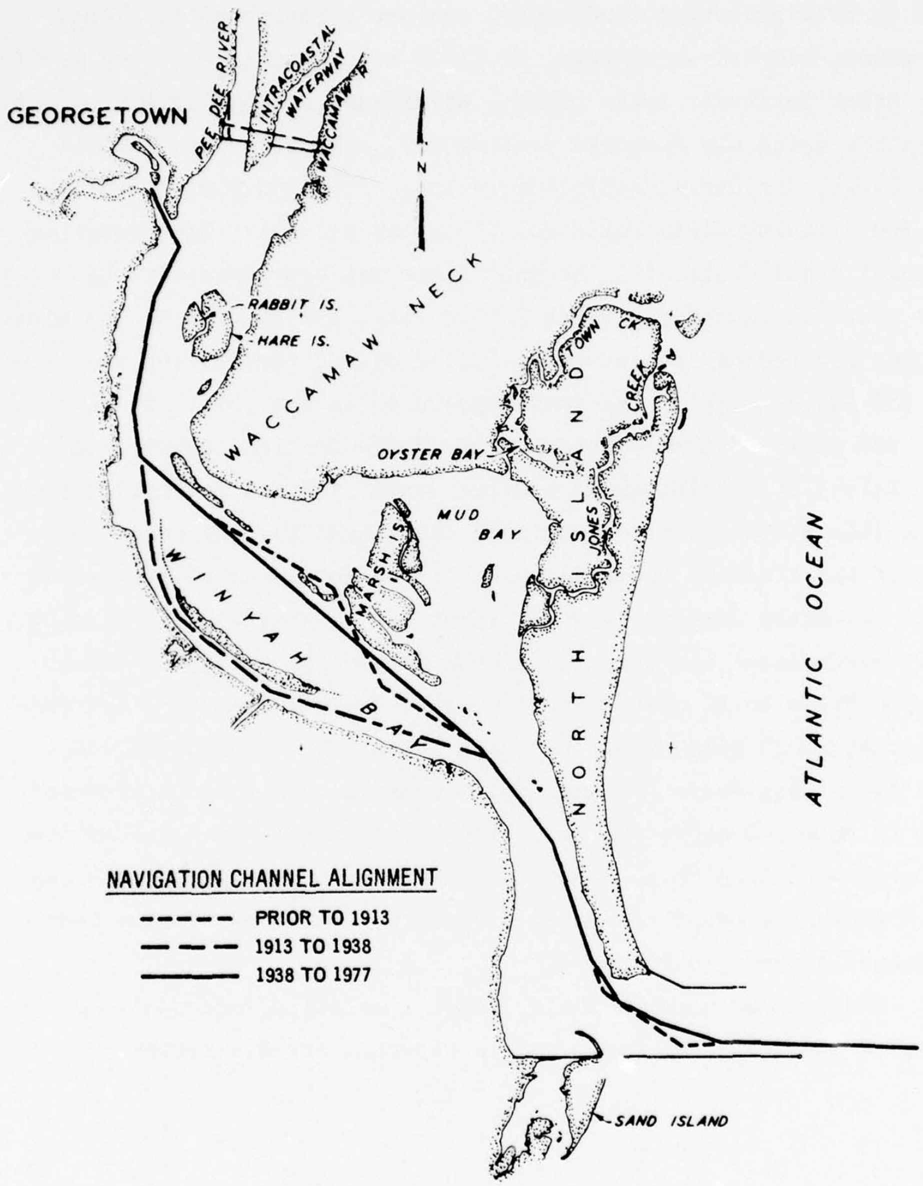


Figure 2. History of Georgetown Harbor Channel alignment

The Model

8. The model was of the fixed-bed type, molded in concrete to conform to 1972 prototype conditions, and was constructed to linear scale ratios, model-to-prototype, of 1:800 horizontally and 1:80 vertically. Other pertinent scale ratios, which were derived from the linear scale ratios using the Froudian scaling law, were velocity, 1:8.94; time, 1:89.44; discharge, 1:572,432; volume, 1:51,200,000; and slope 10:1. The salinity scale ratio for the study was 1:1. One prototype semidiurnal tidal cycle of 12 hr and 25 min was reproduced in the model in 8.33 min. The model was about 240 ft long, 130 ft wide at its widest point, and covered an area of about 17,000 sq ft, reproducing approximately 388 square miles. The area reproduced in the model is shown in Plate 1 and included that portion of the South Carolina coast from Debidue Island at a point about 8 miles north of North Inlet to a point on South Island about 5 miles south of the Winyah Bay entrance; the portion of the Atlantic Ocean adjacent to the above-mentioned coastal area and extending seaward about 9 miles; all of Winyah Bay including Mud Bay; North Inlet and marshes between Winyah Bay and North Inlet; the Sampit River to 12 miles above the bay; the Pee Dee River and adjacent marshes to 26 miles above the bay; the Black River and adjacent marshes to 9 miles above the bay; and the Waccamaw River and adjacent marshes to 30 miles above the bay. The topographical features of the model were reproduced to scale to the +10 ft mean sea level (msl) contour. A general view of the model viewed from the ocean toward Georgetown Harbor is shown in Figure 3.

9. Model appurtenances and hydraulic, salinity, and shoaling verification of the model are discussed in Report 1 of this series.

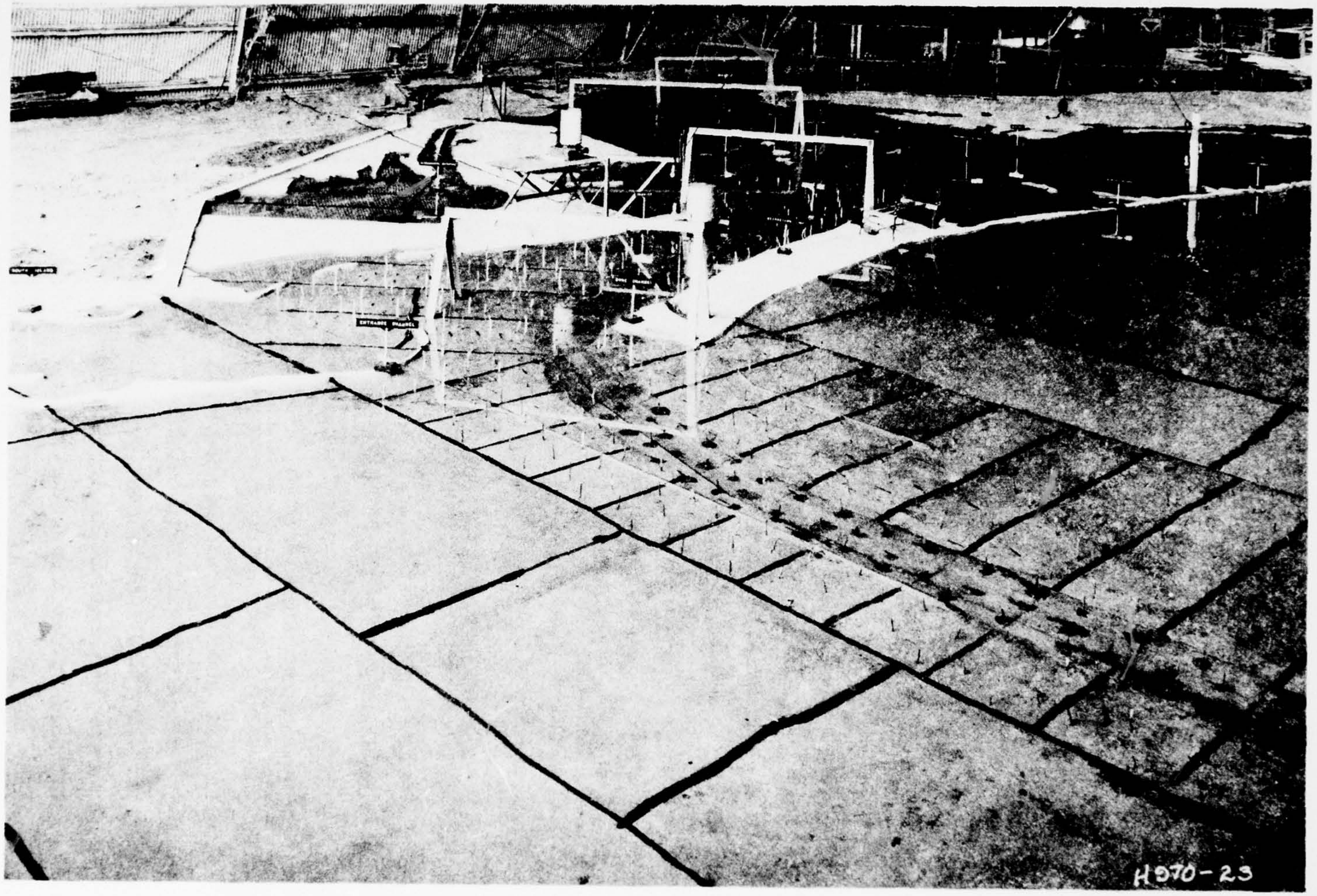


Figure 3. General view of model

PART II: WESTERN CHANNEL AND TURNING BASIN STUDY

Description of Tests

10. The Western Channel and Turning Basin scheme was designed to provide a reduction in the overall maintenance dredging requirements for the Georgetown Harbor project, while at the same time providing a deeper channel. The basic scheme consisted of deepening the lower portion of the Georgetown Harbor Channel from -27 ft mlw to -35 ft mlw and realigning and shortening the deep-draft channel so that it traversed the Lower Western Channel rather than the Eastern Channel and terminated in a turning basin located in the vicinity of the intersection of the Atlantic Intracoastal Waterway and the Western Channel (Plate 2). A shallow-draft -13 ft mlw barge channel would then continue above the turning basin through the Upper Western Channel and meet the existing alignment in Upper Winyah Bay. The existing Eastern Channel would be abandoned and allowed to shoal to natural depths. The depth of the shallow-draft channel in the Upper Western Channel (-13 ft mlw) would be less than the natural channel depth in that area, so no maintenance dredging should be required along the Upper Western Channel. After joining the existing alignment above the Western Channel, the shallow-draft channel would continue through Upper Winyah Bay and Sampit River along the existing alignment. A transfer facility would be provided at the Western Channel Turning Basin so that cargo could be transferred from deep-draft vessels to barges and vice versa. The present annual maintenance dredging requirement for Georgetown Harbor Channel, not including the entrance bar dredging, is about 2.3 cu yd, based on 1972-1976 dredging volumes. Implementation of this scheme should result in a significant reduction in the annual maintenance dredging requirements. It should be noted that all shoaling tests results include only the Winyah Bay Channel and Georgetown Harbor portions of the navigation project and not the entrance channel adjacent to the ocean jetties. The bay and harbor shoals consist mainly of cohesive sediments (clay-silt), whereas the entrance bar is primarily noncohesive sediment (sand). The original model

verification described in Report 1 of this series included only the bay and harbor shoaling distribution. To conduct entrance shoaling tests would first require verification of the entrance channel shoaling distribution.

11. The Western Channel and Turning Basin study involved testing of Plans 1, 1A, and 2-6. Plan 1 consisted of a 35-ft-deep and 300-ft-wide channel and turning basin located in the Western Channel, as shown in Plate 2. The existing channel below the junction of the Western Channel and existing channel was 35 ft deep by 400 ft wide and above the junction was 27 ft deep by 400 ft wide. Plan 1 represented the condition that would exist immediately after construction of the Western Channel and Turning Basin scheme, i.e., the portion of the Georgetown Harbor Channel upstream of the Western Channel would be near its current project depth, as would the abandoned Eastern Channel. Plan 1A, shown in Plate 2, was identical with Plan 1 except that the abandoned Eastern Channel was set at 13 ft deep to represent a shoaled condition that would develop naturally in the future and the Upper Winyah Bay and Sampit River Channels were reduced in depth to represent the -13 ft mlw depth barge channel. The purpose of Plans 2-6 was to investigate the possibilities of further reducing the maintenance dredging requirements by modifying the basic scheme represented by Plan 1A. Plan 2, elements of which are shown in Plate 3, was identical with Plan 1A, except that the Western Channel and Turning Basin were overdepth-dredged to 45-ft depth rather than dredged to project depth of 35 ft. Plan 3, elements of which are shown in Plate 4, was identical with Plan 1A, except that the lower end of the Western Channel was realigned slightly to result in a less abrupt angle at the junction with the existing channel and that a side channel sediment trap (35 ft deep by 600 ft wide by 8,000 ft long) was attached to the Western Channel. Plan 4, elements of which are shown in Plate 5, was identical with Plan 1A, except that an impermeable barrier (such as a lock and dam structure) was included above the turning basin. Plan 5, elements of which are shown in Plate 6, was identical with Plan 1A, except that the Western Channel was realigned slightly as in Plan 3 and a sediment trap (35 ft deep by 1,600 ft wide by 5,600 ft

long) was added below the junction. Plan 6, elements of which are shown in Plate 7, was identical with Plan 1A, except that an impermeable dike parallel to the Western Channel was constructed from the downstream tip of Western Channel Island to just above the channel junction.

12. For the collection of hydraulic and salinity data, Plan 1 was tested for a mean tide condition (3.88-ft range at Yawkies Dock) and total freshwater inflows of 5,000, 12,000, 35,000, and 60,000 cfs; and Plan 1A was tested for the same mean tide condition and total freshwater inflows of 12,000, 35,000, and 60,000 cfs. Plans 2-6 were not subjected to hydraulic or salinity testing. For collection of shoaling distribution data, all Western Channel plans (Plans 1-6) were tested for a 5.28-ft tide range and a step hydrograph of 5,000-25,000 cfs. The shoaling test procedure is described in paragraph 15, and the model shoaling verification is described in Report 1 of this series.

Description of Test Data and Results

Hydraulic and salinity tests

13. Data obtained to evaluate the effects of Plans 1 and 1A consisted of measurements of tidal elevations, current velocities, and salinities at numerous locations throughout the model (Plate 1) for existing and both plan conditions. Tidal elevations were measured at the Yawkies Dock, Jones Creek, South Island Road, Skinners Dock, Papermill Dock, Old Highway 17 Bridge, Sandy Island, Hasty Point, Wacca Wache, and Topsaw Landing (Plate 1). The elevations of high and low tides measured at each gage for existing conditions (base test) and Plans 1 and 1A are presented in Table 1. Current velocities were measured at 1-hr intervals over a complete tidal cycle at surface, middepth, and bottom at 11 stations in the existing Georgetown Harbor Channel, five stations along the Western Channel, and one station each at the mouths of the Waccamaw and Pee Dee Rivers (Plate 1). Maximum flood and ebb measurements observed at each station for the base test and Plans 1 and 1A are presented in Tables 2-5. Salinities were measured at 1-hr intervals over a complete tidal cycle at surface and bottom depths at

11 stations in the existing Georgetown Harbor Channel, 2 stations in the Sampit River above Georgetown Harbor, 5 stations along the Western Channel, 4 stations in the Pee Dee River, and 3 stations in the Waccamaw River (Plate 1). Maximum, minimum, and average salinities observed at each station for the various tests are presented in Tables 6-9.

14. The current measurements at both surface and bottom depths in the Georgetown Harbor Channel and the Western Channel were also analyzed to determine what percentage of the total flow over a complete tidal cycle was in a downstream direction at the locations of the various velocity stations. Percentages so determined and found to be greater than 50 indicate that flow was predominantly downstream at the point of measurement, and conversely, percentages less than 50 indicate the predominant flow direction to be upstream. The results of the predominance computations for surface and bottom depths for Plans 1 and 1A are presented in Plates 8-13 as curves of flow predominance along the length of the channel.

Shoaling tests

15. Tests to determine the probable annual dredging that would be required to maintain the proposed Western Channel and Turning Basin were made by injecting a mixture of 5 percent gilsonite, screened to pass a No. 35 screen and be retained on a No. 60 screen, and 95 percent water into the model through a 3/4-in. pipe suspended about 1.5 ft above the water along the center line of the Georgetown Harbor Channel between shoaling sections 1-27, then leaving the channel and continuing about 10 ft farther toward the Pee Dee River (Figure 4). After the model was operated for a sufficient time to become stable with a total freshwater inflow of 5,000 cfs, injection of shoal material was begun. Material was injected during flood tide for six consecutive tidal cycles with the freshwater inflow still at 5,000 cfs. After completion of gilsonite injection, the total freshwater inflow was increased to 25,000 cfs, and model operation was continued for 21 additional cycles to allow the currents ample time to disperse and deposit the material. Model operation was then stopped, the water in the model was pooled, and the material deposited in each channel shoaling section was retrieved and

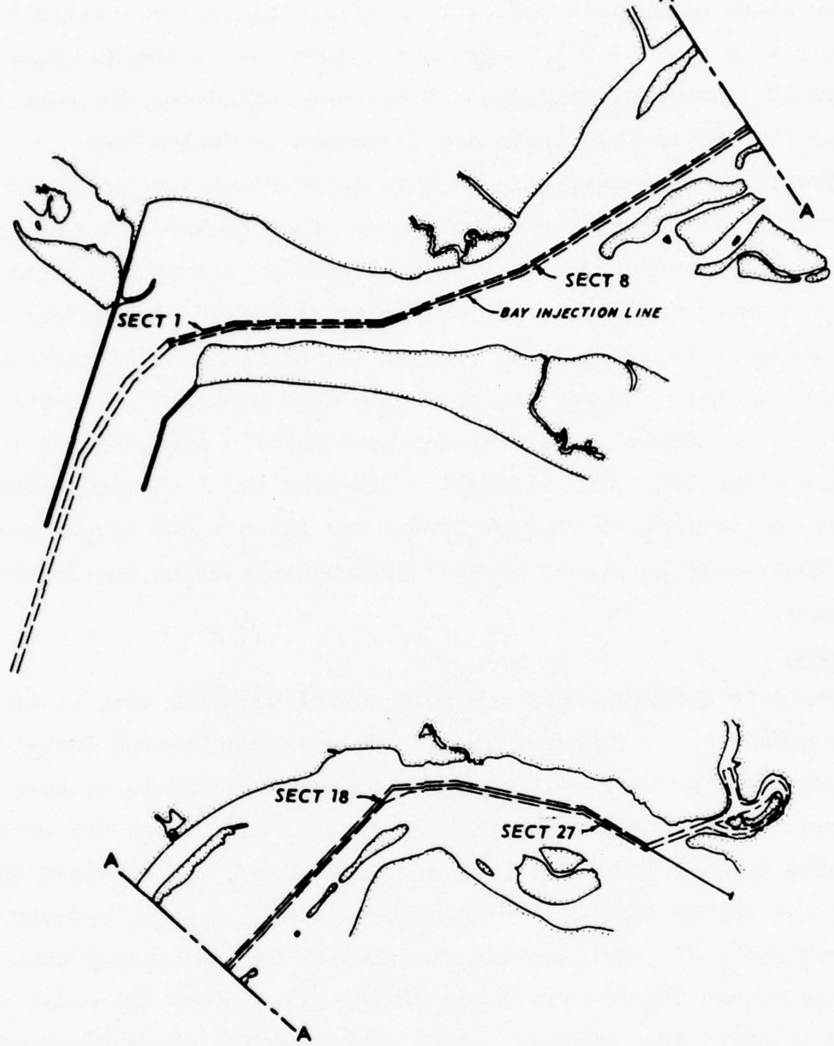


Figure 4. Location of gilsonite injection line for shoaling tests

measured. The shoaling test results for the base test and each plan are shown in Tables 10-15. Tests for the base and plans were conducted in an identical manner to assure comparable results. The results of the shoaling tests for Plans 1, 1A, and 2-6 are presented as shoaling volumes in cubic centimetres (cc) for base and plans and as indexes so that test results can be compared. A shoaling index for each particular area was determined by dividing the plan test volume by the base test volume; therefore, an index greater than 1.00 indicates that a larger volume of shoal material was deposited in an area during the test of the plan than was deposited in the same area for a test of existing conditions. An index less than 1.00 indicates that the plan would cause a decrease in shoaling in the respective area.

16. The shoaling indices for the plans in Tables 10-15 provide a good indication of the comparative shoaling rates of the plans if constructed in the prototype; however, the shoaling indices alone do not permit an evaluation of the probable quantities of dredging that will be required to maintain plan depths and dimensions. Where the prototype shoaling rate is known, as in the Georgetown Harbor Channel, the plan shoaling index, applied to the known prototype shoaling rate, provides a fair approximation of the new shoaling rate to be expected, if that particular plan is constructed. Since the shoaling characteristics in the Western Channel are not known, the standard method of evaluation described above is not applicable. It is believed that the best possible estimate of the quantities of maintenance dredging to be expected for the Western Channel plans can be arrived at using the following relationship:

$$WCP = \frac{WCM}{ECM} \times ECP$$

where

WCP = Western Channel prototype maintenance dredging requirement in cubic yards per year for the plan being tested

WCM = Western Channel model gilsonite volume in cubic centimetres for the plan being tested

ECM = Adjacent Eastern Channel (shoaling sections 8-18) model gilsonite volume for the base condition (110 cc)

ECP = Adjacent Eastern Channel (model sections 8-18; see Figure 4) prototype maintenance dredging requirement (283,000 cu yd/yr)

A similar procedure has been used in previous model studies, and it appears to be the only way to obtain a reasonable comparison between the effects of various plans.

Discussion of Results

Tides

17. As shown by the results in Table 1, Plan 1 had no major effect on tidal elevations. Plan 1A, however, raised low-water elevations in Winyah Bay and the lower portions of the Sampit, Pee Dee, and Waccamaw Rivers by 0.2 to 0.8 ft. For the 12,000- and 35,000-cfs inflows, Plan 1A caused the low-water elevations to be raised a maximum of 0.5 ft at the Sampit River and Old Highway 17 Bridge gages. For the 60,000-cfs inflow, Plan 1A caused the low-water elevations to be raised a maximum of 0.8 ft at the Sampit River gage. Since high-water elevations generally were unchanged, tidal ranges were decreased by approximately the amount of increase in the low-water elevation. For all inflows, no significant changes in tidal phasing were noted.

Velocities

18. For Plan 1 with the 5,000-cfs inflow (Table 2), maximum flood velocities (average of surface, middepth, and bottom) were slightly reduced at sta M3 and M12, slightly increased at sta WC0, and unchanged at all other stations. Maximum ebb velocities (average of surface, middepth, and bottom) were significantly reduced at sta WC2; slightly reduced at sta M5, M11, M13, M14, WC1, and WC3; slightly increased at sta M1; and unchanged at all other stations.

19. For Plan 1 with the 12,000-cfs inflow (Table 3), maximum flood velocities (average of surface, middepth, and bottom) were significantly reduced at sta M3, slightly reduced at sta M12 and M14, and unchanged at all other stations. Maximum ebb velocities (average of surface, middepth, and bottom) were significantly reduced at sta WC2; slightly reduced at sta M5, M13, and WC1; slightly increased at sta M1; and unchanged at all other stations.

20. For Plan 1 with the 35,000-cfs inflow (Table 4), maximum flood velocities (average of surface, middepth, and bottom) were significantly reduced at sta M3, slightly reduced at sta M1, and unchanged at all other stations. Maximum ebb velocities (average of surface, middepth, and bottom) were significantly reduced at sta M5 and WC2; slightly

reduced at sta WC1, WC3, and W2; slightly increased at sta M1; and unchanged at all other stations.

21. For Plan 1 with the 60,000-cfs inflow (Table 5), maximum flood velocities (average of surface, middepth, and bottom) were slightly reduced at sta M3, slightly increased at sta WC0, and unchanged at all other stations. Maximum ebb velocities (average of surface, middepth, and bottom) were significantly reduced at sta M5 and WC2; slightly reduced at sta M11, WC1, and W2; slightly increased at sta M1 and M5; and unchanged at all other stations.

22. For Plan 1A with the 12,000-cfs inflow (Table 7), maximum flood velocities (average of surface, middepth, and bottom) were significantly reduced at sta M3; slightly reduced at sta M1, M5, and M9; slightly increased at sta WC0 and WC3; and unchanged at all other stations. Maximum ebb velocities (average of surface, middepth, and bottom) were significantly reduced at sta WC2 and W2; slightly reduced at sta M5; slightly increased at sta M1, M9, and M12; significantly increased at sta M11; and unchanged at all other stations.

23. For Plan 1A with the 35,000-cfs inflow (Table 8), maximum flood velocities (average of surface, middepth, and bottom) were significantly reduced at sta M3; slightly reduced at sta M1, M9, and M11; slightly increased at sta WC0; and unchanged at all other stations. Maximum ebb velocities (average of surface, middepth, and bottom) were significantly reduced at sta M5, WC2, and W2; slightly reduced at sta M7; slightly increased at sta M11, M12, WC0, and WC4; significantly increased at sta M9; and unchanged at all other stations.

24. For Plan 1A with the 60,000-cfs inflow (Table 9), maximum flood velocities (average of surface, middepth, and bottom) were significantly reduced at sta M9; slightly reduced at sta M1, M3, and M7; slightly increased at sta WC0; and unchanged at all other stations. Maximum ebb velocities (average of surface, middepth, and bottom) were significantly reduced at sta M5 and W2; slightly reduced at sta M7, WC1, WC2, and WC3; slightly increased at sta M11 and WC4; and unchanged at all other stations.

Flow predominance

25. For existing conditions with the 12,000-cfs inflow, examination of the surface predominance data presented in Plate 8 shows that the surface flow in both the Georgetown Harbor Channel (sta M1-M15) and Western Channel (sta WC0-WC4) was predominantly downstream at all stations. The bottom flow (Plate 9) in the Georgetown Harbor Channel was predominantly downstream at sta M1, predominantly upstream at sta M3, M9, M11, M12, and M15, and about equally distributed at sta M5, M7, M13, and M14; and the bottom flow in the Western Channel was predominantly downstream at sta WC0, WC2, and WC3 and about equally distributed at sta WC1 and WC4.

26. For existing conditions with the 35,000-cfs inflow, the surface predominance data presented in Plate 10 show that the surface flow in the Georgetown Harbor Channel was predominantly downstream at all stations except sta M15, which was about equally distributed, and that the surface flow in the Western Channel was predominantly downstream at all stations. The bottom flow (Plate 11) in the Georgetown Harbor Channel was predominantly downstream at sta M5, M7, M13, and M14; predominantly upstream at sta M9 and M11; and about equally distributed at sta M1, M3, M12, and M15. The bottom flow in the Western Channel was predominantly downstream at all stations.

27. For existing conditions with the 60,000-cfs inflow, the surface predominance data presented in Plate 12 show that the surface flow in the Georgetown Harbor Channel was predominantly downstream at all stations except sta M15, which was equally distributed, and that the surface flow in the Western Channel was predominantly downstream at all stations. The bottom flow (Plate 13) in the Georgetown Harbor Channel was predominantly downstream at all stations except sta M15, which was equally distributed, and the bottom flow in the Western Channel was predominantly downstream at all stations.

28. For Plan 1 conditions with the 12,000-cfs inflow, no significant changes from existing conditions in surface flow predominance are noted in the Georgetown Harbor Channel or Western Channel, as evidenced by Plate 9. Bottom flow predominance (Plate 9) was also essentially

unchanged in the Georgetown Harbor Channel; however, in the Western Channel, sta WC1 changed from equally distributed to highly flood-predominant flow, sta WC2 changed from ebb-predominant to highly flood-predominant flow, and sta WCO, WC3, and WC4 remained unchanged. The changes in bottom flow predominance at sta WC1 and WC2 were caused by the deepening of the Western Channel from natural depth of about -15 ft mlw to -35 ft mlw. No large change in bottom flow predominance was noted at sta WCO, possibly because of its proximity to sta M5, where no significant change in bottom flow predominance was observed, and because the natural depth at sta WCO was relatively deep at about -25 ft mlw.

29. For Plan 1 conditions with the 35,000-cfs inflow, no significant changes from existing conditions in surface flow predominance occurred in either channel (Plate 10). Bottom flow predominance (Plate 11) was also essentially unchanged in the Georgetown Harbor Channel; however, in the Western Channel, sta WC1 changed from about equally distributed to highly flood-predominant flow, sta WC2 changed from ebb-predominant to highly flood-predominant flow, and sta WCO, WC3, and WC4 remained unchanged. Again, the changes in the bottom flow predominance at sta WC1 and WC2 were caused by the deepening of the channel from natural depths to -35 ft mlw.

30. For Plan 1 conditions with the 60,000-cfs inflow, no significant changes from existing conditions in surface flow predominance occurred in either channel (Plate 12). Bottom flow predominance (Plate 13) was also essentially unchanged in the Georgetown Harbor Channel; however, in the Western Channel, sta WC1 changed from ebb-predominant to flood-predominant flow, sta WC2 changed from ebb-predominant to about equally distributed flow, and sta WCO, WC3, and WC4 remained unchanged. Again the changes in the bottom flow predominance at sta WC1 and WC2 were caused by the deepening of the channel from natural depths to -35 ft mlw.

31. For Plan 1A with the 12,000-cfs inflow, no significant changes from existing conditions in surface flow predominance occurred in either channel (Plate 8). Bottom flow predominance (Plate 9) in the Georgetown

Harbor Channel was unchanged at sta M1, M3, M5, and M7; changed from highly flood-predominant to ebb-predominant flow at sta M9, M11, and M12; changed from about equally distributed to ebb-predominant flow at sta M13 and M14; and changed from highly flood-predominant to about equally distributed flow at sta M15. The changes in bottom predominance in the Georgetown Harbor Channel were caused by raising the bottom depth of the upper portion of the channel from -27 ft to -13 ft mlw. In the Western Channel, bottom flow changes for Plan 1A were identical with those that occurred for Plan 1.

32. For Plan 1A conditions with the 35,000-cfs inflow, no significant changes from existing conditions in surface flow predominance were noted in either channel (Plate 10). In the Georgetown Harbor Channel, bottom flow predominance (Plate 11) was essentially unchanged at sta M1, M3, M5, M7, M14, and M15; changed from flood-predominant to highly ebb-predominant flow at sta M9; changed from about equally distributed to highly ebb-predominant at sta M12; and changed from ebb-predominant to highly ebb-predominant flow at sta M13. As for the 12,000-cfs inflow, the changes in bottom predominance in the Georgetown Harbor Channel were caused by raising the bottom depth of the upper portion of the channel from -27 ft to -13 ft mlw. In the Western Channel, bottom flow changes for Plan 1A were identical with those that occurred for Plan 1.

33. For Plan 1A with the 60,000-cfs inflow, no significant changes from existing conditions in surface flow predominance were noted (Plate 12). In the Georgetown Harbor Channel, bottom flow predominance (Plate 13) was unchanged at sta M1, M3, M5, M7, M13, M14, and M15; and changed from ebb-predominant to highly ebb-predominant flow at sta M9, M11, and M12. As for the 12,000-cfs and 35,000-cfs inflows, the changes in bottom predominance in the Georgetown Harbor Channel were caused by raising the bottom depth of the upper portion of the channel from -27 ft to -13 ft mlw. In the Western Channel, bottom flow changes were identical with those that occurred for Plan 1.

Salinity

34. For Plan 1 with the 5,000-cfs inflow (Table 6 and Plate 14), Georgetown Harbor Channel maximum surface and bottom salinities,

compared with base conditions, were significantly decreased from sta M3 to S2 with maximum decreases on the surface at sta M9 and bottom at sta M13 of 3.6 ppt and 2.8 ppt, respectively. Minimum surface salinities in the Georgetown Harbor Channel appeared slightly decreased from sta M5 to M13 and unchanged elsewhere; minimum bottom salinities appeared unchanged overall. Average surface and average bottom salinities in the Georgetown Harbor Channel (sta M1-S2) were decreased by 1.1 ppt and 1.4 ppt, respectively. The tendency observed in both base and Plan 1 conditions for minimum salinities to increase at sta M15, TB, S1, and S2 compared with sta M14 results because sta M14 is located in Upper Winyah Bay directly below the confluence of the Pee Dee and Waccamaw Rivers; while sta M15, TB, S1, and S2 are located in Georgetown Harbor, protected from the direct influence of the Pee Dee and Waccamaw outflows. Consequently, since the Sampit River offers no significant freshwater inflow to Georgetown Harbor, minimum salinities tend to be higher than those in the vicinity at sta M14. Western Channel maximum surface and bottom salinities were significantly decreased at all stations (WC0-WC4), with maximum surface and bottom decreases of 3.1 ppt at sta WC2 and 3.8 ppt at sta WC4, respectively. Minimum surface salinities in the Western Channel were essentially unchanged, but minimum bottom salinities were significantly increased at sta WC0, WC1, and WC2 (maximum increase of 7.0 ppt at WC2) and unchanged at sta WC3 and WC4. Average surface salinities in the Western Channel were decreased by 1.1 ppt, and average bottom salinities were essentially unchanged since the decrease in maximums was balanced by the increase in minimums. Waccamaw River maximum surface salinities were slightly decreased at sta W2 and W5 and unchanged at W13 with a maximum decrease of 1.5 ppt at sta W2. Waccamaw River maximum bottom salinities were slightly decreased at all stations with a maximum decrease of 1.3 ppt at sta W2. Waccamaw River minimum surface and bottom salinities were essentially unchanged. Average surface salinities in the Waccamaw River were decreased by 0.3 ppt, and average bottom salinities were decreased by 0.5 ppt. Pee Dee River maximum surface and bottom salinities were slightly decreased at sta PD2, PD6, and PD8 and unchanged at sta PD16 with maximum surface and bottom decreases at sta PD2 of 2.5 ppt and 1.8 ppt, respectively. Pee Dee River minimum surface salinities were unchanged at sta PD2 and PD16 and slightly decreased at sta PD6 and PD8 with a maximum decrease of 0.8 ppt at sta PD6. Pee Dee River minimum bottom salinities were decreased at sta PD2, PD6, and PD8, and unchanged at PD16 with a maximum decrease of 0.8 ppt at sta PD6 and PD8. Average surface salinities in the Pee Dee River were decreased by 0.6 ppt, and average bottom salinities were decreased by 0.7 ppt.

35. For Plan 1 with the 12,000-cfs inflow (Table 7 and Plate 15), Georgetown Harbor Channel maximum surface salinities were slightly decreased compared with base conditions at sta M5, M13, and M14 and unchanged elsewhere; while maximum bottom salinities were significantly decreased from sta M5 to S2 with a maximum decrease of 2.2 ppt at sta M12. Minimum surface salinities in the Georgetown Harbor Channel were slightly decreased from sta M5 to M12 and unchanged elsewhere; minimum bottom salinities were unchanged overall. Average surface and average bottom salinities in the Georgetown Harbor Channel were decreased by 0.5 ppt and 1.2 ppt, respectively. Western Channel maximum surface salinities were unchanged overall; maximum bottom salinities were unchanged at sta WC0 and WC1 and significantly decreased at sta WC2, WC3, and WC4 with a maximum decrease of 1.6 ppt at sta WC4. Minimum surface salinities in the Western Channel were essentially unchanged, but minimum bottom salinities were greatly increased at sta WC0, WC1, and WC2 (maximum increase of 16.3 ppt at WC2) and unchanged at sta WC3 and WC4. Average surface salinities in the Western Channel (sta WC0-WC4) were unchanged, but average bottom salinities were increased by 2.7 ppt. There was essentially no change in salinities in the Pee Dee and Waccamaw Rivers.

36. For Plan 1 with the 35,000-cfs inflow (Table 8 and Plate 16), Georgetown Harbor Channel maximum surface salinities were significantly decreased from sta M5 to M13 (maximum decrease of 4.0 ppt at sta M11) and unchanged elsewhere; while maximum bottom salinities were significantly decreased from sta M5 to M14 (maximum decrease of 4.5 ppt at sta M11) and unchanged elsewhere. Minimum surface and bottom salinities

in the Georgetown Harbor Channel were essentially unchanged, except for reductions at the bottom of sta M1 and M3. Average surface salinities in the salinity zone of Georgetown Harbor Channel (sta M1-M14) were decreased by 0.3 ppt, and average bottom salinities were decreased by 1.5 ppt. Western Channel maximum surface salinities were increased at all stations except sta WC1, but maximum bottom salinities were significantly decreased at all stations with a maximum decrease of 4.1 ppt at sta WC3. Minimum surface salinities in the Western Channel were unchanged, but minimum bottom salinities were significantly increased at sta WC0, WC1, and WC2 (maximum increase of 17.2 ppt at WC2) and unchanged at sta WC3 and WC4. Average surface salinities in the Western Channel were increased by 0.8 ppt, and average bottom salinities were increased by 3.6 ppt.

37. For Plan 1 with the 60,000-cfs inflow (Table 9 and Plate 17), Georgetown Harbor Channel maximum surface salinities were significantly increased at sta M1 and M3 (maximum increase of 3.6 ppt at sta M3), but reduced at sta M5, M7, and M9; while maximum bottom salinities were significantly decreased at all stations where salt was measured (sta M1-M12) with a maximum decrease of 2.5 ppt at sta M7. Minimum surface and bottom salinities in the Georgetown Harbor Channel were essentially unchanged. Average surface salinities in the salinity zone of Georgetown Harbor Channel (sta M1-M12) were increased by 0.3 ppt, but average bottom salinities were decreased by 0.9 ppt. Western Channel maximum surface salinities were increased at sta WC0-WC2, but were unchanged at sta WC3 and WC4; while minimum surface salinities were unchanged. Maximum bottom salinities were reduced at sta WC0, WC1, and WC3, but were unchanged at sta WC2 and WC4; however, minimum bottom salinities were significantly increased at sta WC0, WC1, and WC2 (maximum increase of 9.8 ppt at sta WC2) and were unchanged at sta WC3 and WC4. Average surface salinities in the Western Channel were increased by 0.5 ppt, and average bottom salinities were increased by 3.9 ppt.

38. For Plan 1A with the 12,000-cfs inflow (Table 7 and Plate 15), Georgetown Harbor Channel maximum surface salinities were significantly decreased from sta M3 to S2 with a maximum decrease at sta M13 of

4.5 ppt; and maximum bottom salinities were significantly decreased from sta M7 to S2 with a maximum decrease at sta M15 of 11.3 ppt. Minimum surface salinities in the Georgetown Harbor Channel were significantly decreased from sta M3 to M11 and at sta S1 and S2 with a maximum decrease at sta M9 of 3.4 ppt; and minimum bottom salinities were significantly decreased from sta M1 to S2 with a maximum decrease at sta M9 of 15.3 ppt. Average surface and average bottom salinities in the Georgetown Harbor Channel were decreased by 1.9 ppt and 6.9 ppt, respectively. Western Channel maximum surface salinities were generally unchanged; but maximum bottom salinities were slightly increased at sta WC0 and slightly decreased at sta WC1-WC4. Minimum surface salinities in the Western Channel were significantly decreased at all stations with a maximum decrease of 3.1 ppt at WC2; minimum bottom salinities, however, were greatly increased at sta WC0-WC2 (maximum increase of 13.5 ppt at sta WC2) and were significantly decreased at sta WC3 and WC4 with a maximum decrease at sta WC3 of 3.8 ppt. Average surface salinities in the Western Channel were decreased by 1.6 ppt, but average bottom salinities were increased by 1.9 ppt. Maximum salinities in the salinity zones of the Pee Dee (sta PD2 and PD5) and Waccamaw (sta W2 and W5) Rivers were reduced by 1-5 ppt.

39. For Plan 1A with the 35,000-cfs inflow (Table 8 and Plate 16), Georgetown Harbor Channel maximum surface salinities were significantly decreased from sta M3-M13 with a maximum decrease of 5.3 ppt at sta M5; and maximum bottom salinities were significantly decreased from sta M7 to M14 with a maximum decrease of 21.5 ppt at M11. Minimum surface salinities in the Georgetown Harbor Channel were significantly decreased from sta M1 to M7 with a maximum decrease of 1.6 ppt at sta M3; and minimum bottom salinities were significantly decreased from sta M1 to M9 with a maximum decrease of 12.2 ppt at sta M7. Average surface salinities in the salinity zone of Georgetown Harbor Channel (sta M1-M14) were decreased by 0.7 ppt, and average bottom salinities were decreased by 6.0 ppt. Western Channel maximum surface salinities were reduced by 4.0 ppt at sta WC1, but were increased by about 4 ppt at sta WC2 and WC3; maximum bottom salinities were slightly decreased at

all stations (maximum decrease of 2.0 ppt at sta WC0). Minimum surface salinities in the Western Channel were essentially unchanged, but minimum bottom salinities were greatly increased at sta WC0, WC1, and WC2 (maximum increase of 16.3 ppt at WC2) and were unchanged at sta WC3 and WC4. Average surface salinities in the Western Channel were essentially unchanged, but average bottom salinities were increased by 2.0 ppt. The upstream extent of saltwater intrusion was significantly reduced in the main bay channel at both the surface and bottom depths (Plate 16).

40. For Plan 1A with the 60,000-cfs inflow (Table 9 and Plate 17), Georgetown Harbor Channel maximum surface salinities were significantly decreased at sta M1, M5, M7, and M9 (maximum decrease at M5 of 6.1 ppt) and were unchanged at sta M3; while maximum bottom salinities were unchanged at sta M1, M3, and M5 and greatly decreased at sta M7, M9, M11, and M12 with a maximum decrease at sta M9 of 21.8 ppt. Minimum surface and bottom salinities in the Georgetown Harbor Channel were slightly decreased at sta M1, but essentially unchanged at other stations where salt was measured (sta M3 and M5). Average surface salinities in the salinity zone of Georgetown Harbor Channel (sta M1-M9) were decreased by 0.6 ppt, and average bottom salinities were decreased by 4.0 ppt. In general, Western Channel maximum surface, maximum bottom, and minimum surface salinities were essentially unchanged. Minimum bottom salinities were significantly increased at sta WC0, WC1, and WC2 (maximum increase of 7.2 ppt at WC2) and were unchanged at sta WC3 and WC4. Average surface salinities in the Western Channel were essentially unchanged, but average bottom salinities were increased by 4.4 ppt. The upstream extent of saltwater intrusion was slightly reduced in the main bay channel at the surface and significantly reduced at the bottom (Plate 17).

<u>Shoaling</u>

41. Where the prototype shoaling rate is known, as in the Georgetown Harbor Channel, the plan shoaling index, applied to the known prototype shoaling rate, provides a fair approximation of the new shoaling rate to be expected, if that particular plan is constructed. Since the shoaling characteristics in the Western Channel are not known, the

standard method of evaluation described above is not applicable. The method used in the Western Channel (paragraph 16) has been successful on other studies, but the shoaling tests results are qualitative, not quantitative. The volumes reported are only intended to be indicators of relative rates and patterns for plans tested, and the accuracy with which the model duplicated identical tests is ±10 percent.

42. The results of the shoaling tests for Plan 1 are presented in Table 10. Channel section locations are shown in Plates 18 and 19. As evidenced by indexes for the three reaches of the Georgetown Harbor Channel (which are upstream of the proposed Western Channel), the shoaling rate for the three reaches of the Georgetown Harbor Channel was essentially unchanged by Plan 1 (index ≅ 0.96). The shoaling distribution among the three reaches was also unchanged.

43. As described in paragraph 16, the best possible estimate of the quantities of maintenance dredging to be expected in the Western Channel for Plan 1 can be arrived at in the following manner. The average annual shoaling for the Eastern Channel (model sections 8-18), which lies adjacent to the proposed Western Channel, is about 283,000 cu yd. The amount of material deposited (280 cc) in the Western Channel of Plan 1 during model shoaling tests was about 255 percent of the amount deposited (110 cc) in the Eastern Channel during the model base test (Table 10). Application of this percentage (255) to the known annual shoaling of the Eastern Channel (283,000 cu yd) would indicate the probable shoaling rate for Plan 1 to be on the order of 720,000 cu yd. Of the 280 cc (720,000 cu yd) of gilsonite deposited in the Western Channel for Plan 1, 10 cc (about 30,000 cu yd) deposited in section WC1, 30 cc (about 80,000 cu yd) deposited in section WC2, 210 cc (about 530,000 cu yd) deposited in section WC3, and 30 cc (about 80,000 cu yd) deposited in section WC4 (Table 10).

44. Based on the above results, annual Western Channel maintenance dredging for Plan 1 (interim period during which the Upper Winyah Bay and Sampit River Channels shoal from -27 ft mlw depth to -13 ft mlw depth) would be 720,000 cu yd, with the greatest dredging requirement occurring in section WC3 (530,000 cu yd).

45. The results of the shoaling tests for Plan 1A are presented in Table 10. Based on the indexes for the two reaches of the shallowed Georgetown Harbor Channel (-13 ft mlw), shoaling would be greatly reduced in the Upper Winyah Bay and Sampit River (sections 19-27 and 28-44) to 12 percent and 13 percent of base conditions, respectively. For the two reaches, the model results indicated an annual shoaling rate of about 250,000 cu yd (1,730,000 cu yd less than at present).

46. The amount of material deposited (375 cc) in the Western Channel of Plan 1A during model shoaling tests was about 341 percent of the amount deposited (110 cc) in the Eastern Channel during the model base test (Table 10). Application of this percentage to the known annual shoaling of the Eastern Channel (283,000 cu yd) would indicate the probable shoaling rate for Plan 1A to be on the order of 970,000 cu yd in the Western Channel. Of the 375 cc (970,000 cu yd) of gilsonite deposited in the Western Channel for Plan 1A, 10 cc (about 30,000 cu yd) deposited in section WC1, 35 cc (about 90,000 cu yd) deposited in section WC2, 300 cc (about 770,000 cu yd) deposited in section WC3, and 30 cc (about 80,000 cu yd) deposited in section WC4 (Table 10).

47. Based on the above results, annual Western Channel maintenance dredging for Plan 1A would be about 970,000 cu yd, with the greatest dredging requirement occurring in section WC3 (about 770,000 cu yd). The total annual dredging requirement in the Western Channel and the Georgetown Harbor Channel upstream of the Western Channel would be about 1,040,000 cu yd (46 percent) less than at present.

48. The results of the shoaling tests for Plan 2 are presented in Table 11. Based on the indexes for the two reaches of the shallowed Georgetown Harbor Channel, shoaling would be greatly reduced in the Upper Winyah Bay and Sampit River (sections 19-27 and 28-44) to 11 percent and 10 percent of base conditions, respectively. For the two reaches, the model results indicated an annual shoaling rate of about 200,000 cu yd (about 1,780,000 cu yd less than at present).

49. The amount of material deposited (765 cc) in the 45-ft-deep Western Channel of Plan 2 during the model shoaling tests was about

695 percent of the amount deposited (110 cc) in the Eastern Channel during the model base test (Table 11). Application of this percentage to the known annual shoaling of the Eastern Channel (283,000 cu yd) would indicate the probable shoaling rate in the Western Channel for Plan 2 to be on the order of 1,970,000 cu yd. Of the 765 cc (1,970,000 cu yd) of gilsonite deposited in the Western Channel for Plan 2, 5 cc (about 10,000 cu yd) deposited in section WC1, 50 cc (about 130,000 cu yd) deposited in section WC2, 570 cc (about 1,470,000 cu yd) deposited in section WC3, and 140 cc (about 360,000 cu yd) deposited in section WC4 (Table 11).

50. Based on the above results, annual Western Channel maintenance dredging for Plan 2 would be about 1,970,000 cu yd, with the greatest dredging requirement occurring in section WC3 (1,470,000 cu yd). The total annual dredging requirement in the Western Channel and the Georgetown Harbor Channel upstream from the Western Channel would be about 90,000 cu yd (4 percent) less than at present. Compared with Plan 1A, the overdepth dredging in the Western Channel would increase overall annual dredging requirements by about 950,000 cu yd (78 percent).

51. The results of the shoaling tests for Plan 3 are presented in Table 11. Based on the indexes for the two reaches of the shallowed Georgetown Harbor Channel, shoaling would be greatly reduced in the Upper Winyah Bay and Sampit River (sections 19-27 and 28-44) to 14 percent of base conditions. For the two reaches, the model results indicated an annual shoaling rate of about 280,000 cu yd (about 1,700,000 cu yd less than at present).

52. The side channel trap caused significant changes in the ebb flow pattern. Observation of the flow pattern during testing indicated that much of the ebb flow through the abandoned Eastern Channel was captured by the side channel trap and diverted through the Lower Western Channel, resulting in extremely large volumes of shoaling material in the Western Channel and the sediment trap. The amount of material deposited (795 cc) in the Western Channel of the Plan 3 during model shoaling tests was about 723 percent of the amount deposited (110 cc) in the Eastern Channel during the model base test (Table 11). Application of

this percentage to the known annual shoaling of the Eastern Channel (283,000 cu yd) would indicate the probable shoaling rate for the Western Channel of Plan 3 to be on the order of 2,050,000 cu yd. Of the 795 cc (2,050,000 cu yd) of gilsonite deposited in the Western Channel for Plan 3, 10 cc (about 30,000 cu yd) deposited in section WC1, 300 cc (about 770,000 cu yd) deposited in section WC2, 460 cc (about 1,190,000 cu yd) deposited in section WC3, and 25 cc (about 60,000 cu yd) deposited in section WC4 (Table 11). By use of the same analysis procedure as for the Western Channel, the 800 cc deposited in the side channel sediment trap would represent about 2,060,000 cu yd.

53. Based on the above results, annual Western Channel (including side channel sediment trap) maintenance dredging for Plan 3 would be about 4,110,000 cu yd, with the greatest dredging requirement occurring in the side channel sediment trap (2,060,000 cu yd). The total annual dredging requirement in the Western Channel (including the side channel sediment trap) and the Georgetown Harbor Channel upstream from the Western Channel would be about 2,130,000 cu yd (94 percent) more than at present. Compared with Plan 1A, the side channel sediment trap would increase overall annual dredging requirements by about 2,170,000 cu yd (260 percent).

54. The results of the shoaling tests for Plan 4 are presented in Table 12. Based on the indexes for the two reaches of the shallowed Georgetown Harbor Channel, shoaling would be greatly reduced in the Upper Winyah Bay and Sampit River (sections 19-27 and 28-44) to 24 percent and 23 percent of base conditions, respectively. For the two reaches, the model results indicated an annual shoaling rate of about 730,000 cu yd (about 1,530,000 cu yd less than at present).

55. The amount of material deposited (355 cc) in the Western Channel of Plan 4 during model shoaling tests was about 323 percent of the amount deposited (110 cc) in the Eastern Channel during the model base test (Table 12). Application of this percentage to the known annual shoaling of the Eastern Channel (283,000 cu yd) would indicate the probable shoaling rate for Plan 4 to be on the order of 910,000 cu yd. Of the 355 cc (about 910,000 cu yd) of gilsonite deposited in the

Western Channel for Plan 4, 85 cc (about 220,000 cu yd) deposited in section WC1, 90 cc (about 230,000 cu yd) deposited in section WC2, 135 cc (about 350,000 cu yd) deposited in section WC3, and 45 cc (about 110,000 cu yd) deposited in section WC4 (Table 12).

56. Based on the above results, annual Western Channel maintenance dredging for Plan 4 would be about 910,000 cu yd, with the greatest dredging requirement occurring in section WC3 (about 350,000 cu yd). The total annual dredging requirement in the Western Channel and the Georgetown Harbor Channel upstream of the Western Channel would be about 890,000 cu yd (39 percent) less than at present. Compared with Plan 1A, the Western Channel dam would increase overall annual dredging requirements by about 150,000 cu yd (12 percent).

57. The results of the shoaling tests for Plan 5 are presented in Table 12. Based on the indexes for the two reaches of the shallowed Georgetown Harbor Channel, shoaling would be greatly reduced in the Upper Winyah Bay and Sampit River (sections 19-27 and 28-44) to 13 percent of base conditions. For the two reaches, the model results indicated an annual shoaling rate of about 250,000 cu yd (about 1,730,000 cu yd less than at present). The sediment trap east of the Georgetown Harbor Channel was quite ineffective. Assuming that the model-to-prototype shoaling conversion for the Eastern Channel reach also is applicable to the sediment trap, the 40 cc deposited in the trap represents only 100,000 cu yd.

58. The amount of material deposited (610 cc) in the Western Channel of Plan 5 during model shoaling tests was about 555 percent of the amount deposited (110 cc) in the Eastern Channel during the model base test (Table 12). Application of this percentage to the known annual shoaling of the Eastern Channel (283,000 cu yd) would indicate the probable shoaling rate for Plan 5 to be on the order of 1,570,000 cu yd. Of the 610 cc (about 1,570,000 cu yd) of gilsonite deposited in the Western Channel for Plan 5, 15 cc (about 40,000 cu yd) deposited in section WC1, 140 cc (about 360,000 cu yd) deposited in section WC2, 440 cc (about 1,130,000 cu yd) deposited in section WC3, and 15 cc (about 40,000 cu yd) deposited in section WC4 (Table 12).

59. Based on the above results, annual Western Channel maintenance dredging for Plan 5 would be about 1,570,000 cu yd with the greatest dredging requirement occurring in section WC3 (about 1,130,000 cu yd). The total annual dredging requirement in the Western Channel and the Georgetown Harbor Channel (including the sediment trap) would be about 340,000 cu yd (15 percent) less than at present. Compared with Plan 1A, the sediment trap east of the Georgetown Harbor Channel would increase annual dredging requirements by about 700,000 cu yd (57 percent).

60. The results of the shoaling tests for Plan 6 are presented in Table 13. Based on the indexes for the two reaches of the shallowed Georgetown Harbor Channel, shoaling would be greatly reduced in the Upper Winyah Bay and Sampit River (sections 19-27 and 28-44) to 18 percent and 11 percent of base conditions, respectively. For the two reaches, the model results indicated an annual shoaling rate of about 270,000 cu yd (about 1,710,000 cu yd less than at present).

61. The amount of material deposited (405 cc) in the Western Channel of Plan 6 during model shoaling tests was about 368 percent of the amount deposited (110 cc) in the Eastern Channel during the model base test (Table 13). Application of this percentage to the known annual shoaling of the Eastern Channel (283,000 cu yd) would indicate the probable shoaling rate for Plan 6 to be on the order of 1,040,000 cu yd. Of the 405 cc (1,040,000 cu yd) of gilsonite deposited in the Western Channel for Plan 6, 85 cc (about 220,000 cu yd) deposited in section WC1, 275 cc (about 700,000 cu yd) deposited in section WC2, 35 cc (about 90,000 cu yd) deposited in section WC3, and 10 cc (about 30,000 cu yd) deposited in section WC4 (Table 13).

62. Based on the above results, annual Western Channel maintenance dredging for Plan 6 would be about 1,040,000 cu yd, with the greatest dredging requirement occurring in section WC2 (about 700,000 cu yd). The total annual dredging requirement in the Western Channel and the Georgetown Harbor Channel upstream from the Western Channel would be about 950,000 cu yd (42 percent) less than at present. Compared with Plan 1A, the impermeable dike between the Western Channel and the

Eastern Channel would increase overall annual dredging requirements by about 90,000 cu yd (7 percent).

Conclusions

63. Conclusions are as follows:

a. Plan 1 did not significantly affect the tidal heights or tidal phasing within the model area. Plan 1A raised low-water elevations and reduced tidal range by 0.2 to 0.8 ft in Winyah Bay and the lower portions of the Sampit, Pee Dee, and Waccamaw Rivers.

b. Plan 1 caused a slight reduction in maximum ebb velocities (average of surface, middepth, and bottom) at sta M1, M5, M11, M13, WC1, WC3, and W2 and a significant reduction in maximum ebb velocities (average of surface, middepth, and bottom) at sta WC2. Plan 1 caused a slight reduction in maximum ebb velocities (average of surface, middepth, and bottom) at sta M7, a significant reduction in maximum ebb velocities (average of surface, middepth, and bottom) at sta M5, WC2, and W2, and a slight increase in maximum ebb velocities at sta M9, M11, M12, and WC4. Plan 1A caused a slight reduction in maximum flood velocities at sta M1, M7, and M9; a significant reduction in maximum flood velocities at sta M3; and a slight increase in maximum flood velocities at sta WC0.

c. Plan 1 did not significantly affect either the surface or bottom flow predominance in the Georgetown Harbor Channel or the surface predominance in the Western Channel; however, bottom flow predominance in the proposed Western Channel and Turning Basin was significantly affected, changing from ebb-predominant to flood-predominant flow at sta WC1 and WC2. Plan 1A did not significantly affect the flow predominance in the Georgetown Harbor Channel, other than increasing the percent flow downstream at the bottom depth in the shallowed portion of the Georgetown Harbor Channel; however, in the Western Channel, the bottom flow predominance changes were essentially the same as those for Plan 1.

d. Plan 1 caused a slight but significant decrease in salinity within the region of saltwater intrusion (generally on the order of 1-4 ppt). Thus the extent of saltwater intrusion was reduced in the Georgetown Harbor Channel. Evidently, the deepened lower end of the Georgetown Harbor Channel caused an increase in the bay freshwater storage and a corresponding decrease in salinity within the bay. The only location that consistently indicated an increase in salinity (by an average of about 3 ppt) was the bottom depth of the proposed Western Channel and Turning Basin. Thus the extent of saltwater intrusion was increased in the Western Channel. Plan 1A caused a significant decrease in salinity within the saltwater intrusion zone (generally 1-7 ppt). As in Plan 1, the only location that consistently indicated an increase in salinity was the bottom depth of the proposed Western Channel (by an average of about 3 ppt).

e. The elements of Plans 1 and 1A were identical except that the abandoned Eastern Channel (sections 8-18), the Upper Winyah Bay Channel (sections 19-27), and the Sampit River Channel (sections 28-44) were -27 ft mlw deep for Plan 1 and -13 ft mlw deep for Plan 1A. Compared with Plan 1 (which assumed that no dredging would be performed in the existing Upper Winyah Bay and Sampit River Channels while these channels shoaled from -27 ft mlw depth toward -13 ft mlw depth), Western Channel shoaling for Plan 1A was increased significantly (about 35 percent) when the abandoned Eastern Channel, the Upper Winyah Bay Channel, and the Sampit River Channel were shallowed from -27 ft to -13 ft mlw to represent a shoaled condition. Overall annual shoaling (Western Channel plus Georgetown Harbor Channel) for Plan 1A was on the order of 45 percent less than in the existing channel. During the period in which the Georgetown Harbor Channel upstream from the Western Channel is allowed to shoal from its present depth of -27 ft to a depth of -13 ft mlw (Plan 1), the total annual dredging requirement would be about 68 percent less than for the existing channel.

f. Plans 2-6 were modifications of Plan 1A tested in an attempt to decrease Western Channel shoaling and more evenly distribute the shoaling along the channel length. Plan 2 annual shoaling was 78 percent more than Plan 1A shoaling with no improvement in shoaling distribution along the Western Channel, and overall annual shoaling for Plan 2 was 4 percent less than existing channel shoaling. Plan 3 annual shoaling was 260 percent more than Plan 1A shoaling (including a major maintenance dredging requirement for the side channel trap), with no improvement in distribution along the Western Channel, and overall annual shoaling (including the sediment trap) for Plan 3 was 94 percent more than existing channel shoaling. Plan 4 annual shoaling was only 12 percent more than Plan 1A shoaling with a significantly improved distribution of material along the Western Channel, and overall annual shoaling for Plan 4 was 39 percent less than existing channel shoaling. Plan 5 annual shoaling was 57 percent more than Plan 1A shoaling with no improvement in distribution along the Western Channel, and overall annual shoaling (including sediment trap) for Plan 5 was 15 percent less than existing channel shoaling. Plan 6 annual shoaling was 7 percent more than Plan 1A shoaling with no significant change in shoaling distribution along the Western Channel, and overall annual shoaling for Plan 6 was about 42 percent less than existing channel shoaling. Based on these results, the effects of Plans 2, 3, 5, and 6 on shoaling when compared with Plan 1A were detrimental rather than beneficial and therefore cannot be recommended. The effects of Plan 4 on shoaling, when compared to Plan 1A, were definitely beneficial because of the much more even distribution of shoaling material along the Western Channel. Although the annual shoaling rate for Plan 4 is almost the same as that for Plan 1A, the elimination of the extremely high shoaling rate in one section (section WC3) should permit dredging to be performed on a less frequent basis.

PART III: MARSH ISLAND CHANNEL AND TURNING BASIN STUDY

Description of Tests

64. The Marsh Island Channel and Turning Basin scheme (Plate 20) was designed to provide a reduction in the overall maintenance dredging requirements for the Georgetown Harbor Channel project. The scheme consisted of deepening the lower portion of the Georgetown Harbor Channel from -27 ft mlw to -35 ft mlw, terminating the deep-draft channel in a turning basin adjacent to Marsh Island, and reducing the channel depth upstream from the turning basin from -27 ft mlw to -13 ft mlw. A transfer facility would be provided at the turning basin so that cargo could be transferred from deep-draft vessel to barge and vice versa. The present annual maintenance dredging requirement for Georgetown Harbor (excluding the entrance channel) is about 2.3 million cu yd, based on 1972-1976 dredging volumes. Implementation of this scheme should result in a significant reduction in the annual maintenance dredging requirements.

65. The Marsh Island Channel and Turning Basin study involved testing of Plan 7, which consisted of the Marsh Island Channel (shoaling sections 1-11, see Plate 18) and turning basin constructed to -35 ft mlw, as shown in Plate 20. The Marsh Island Channel had the same alignment as the existing Georgetown Harbor Channel. The Georgetown Harbor Channel above the turning basin was constructed to -13 ft mlw, as was the harbor itself, to represent a shoaled condition (barge traffic only).

66. No hydraulic or salinity data were collected for the Marsh Island and Turning Basin scheme. For shoaling distribution data, Plan 7 was tested for a 5.28-ft tide range at the Yawkies Dock gage and a step hydrograph of 5,000-25,000 cfs (see Report 1 of this series for shoaling distribution verification procedure).

Description of Test Data and Results

Shoaling test

67. The shoaling test procedure was identical with that used for

the Western Channel and Turning Basin study described previously in paragraphs 41 and 43. The shoaling test results for Plan 7 are shown in Table 14. Tests of the base and Plan 7 were conducted in an identical manner to assure comparable results. The results of the shoaling test for Plan 7 are presented as shoaling volumes in cubic centimetres for base and plan and as indexes so that test results can be compared. A shoaling index for each particular area was determined by dividing the plan test volume by the base test volume; therefore, an index greater than 1.00 indicates that a larger volume of material deposited in an area during the plan test than deposited in the same area for the base test. An index less than 1.00 indicates that the plan would cause a decrease in shoaling in the respective area. Indicated changes less than ±10 percent (indexes between 0.90 and 1.10) are generally considered insignificant.

68. While the results of the model shoaling tests are qualitative rather than quantitative, it is believed that the test data are sufficiently reliable to show the overall effects of the proposed plan on shoaling throughout the study area.

Discussion of Results

69. As indicated in Table 14, the test results show that the overall annual channel shoaling (shallowed Georgetown Harbor Channel plus Marsh Island Channel) was reduced by about 1,290,000 cu yd (67 percent). Shoaling in the Marsh Island Channel and Turning Basin (sections 1-11), compared with existing conditions, increased from 66,000 to about 530,000 cu yd per year in shoaling volume, with a maximum shoaling rate of about 260,000 cu yd per year occurring in section 9.

Conclusions

70. Since the overall annual shoaling rate was reduced to 43 percent of the existing rate and no unacceptably high shoaling rates occurred in any individual section, Plan 7 was an effective scheme for reducing the maintenance dredging requirements for the Georgetown Harbor project.

PART IV: UPPER WINYAH BAY SIDE CHANNEL TRAP STUDY

Description of Tests

71. The Upper Winyah Bay Side Channel Trap scheme, designed to provide a reduction in the overall maintenance costs for the Georgetown Harbor project, consisted of constructing a side channel sediment trap adjacent to the upstream end of the Upper Winyah Bay Channel at the entrance to Georgetown Harbor, thereby trapping the shoaling material before it enters the harbor. The rationale behind this scheme is that for the same volume of sediment, the dredging and disposal are more expensive in the harbor itself than in the upper bay sediment trap. The present annual maintenance dredging requirement for the Georgetown Harbor project (excluding the entrance channel) is about 2.3 million cu yd based on 1972-1976 dredging volumes. It was anticipated that implementation of this scheme probably would not result in any significant reduction in present annual maintenance dredging volumes, but might induce a redistribution of shoaling material from the harbor to the sediment trap with an attendant reduction in maintenance costs.

72. The Upper Winyah Bay Side Channel Trap study included testing of Plans 8 and 9. Plan 8 involved the construction of a side channel trap (2,300 ft long by 600 ft wide by 27 ft deep) attached to the existing channel, as shown in Plate 21. In an effort to increase the efficiency of the side channel trap, Plan 9 consisted of realigning the existing channel and constructing a side channel trap (3,900 ft long by 600 ft wide by 27 ft deep), as shown in Plate 22.

73. No hydraulic or salinity data were collected for the Upper Winyah Bay Side Channel Trap scheme.

74. For shoaling distribution data, both Plans 8 and 9 were tested with a tide range of 5.28 ft at the Yawkies Dock gage and a step hydrograph of 5,000-25,000 cfs. (See Report 1 of this series for shoaling distribution verification procedure.)

Description of Test Data and Results

Shoaling tests

75. The shoaling test procedure was identical with that used for the Western Channel and Turning Basin study described previously in paragraphs 41 and 43. The shoaling test results for Plans 8 and 9 are shown in Table 15. Tests of the base and Plans 8 and 9 were conducted in an identical manner to assure comparable results. The results of the shoaling tests for Plans 8 and 9 are presented as shoaling volumes in cubic centimetres for base and plan and as indexes so that test results can be compared. A shoaling index for each particular area was determined by dividing the plan test volume by the base test volume; therefore, an index greater than 1.00 indicates that a larger volume of material deposited in an area during the plan test than deposited in the same area for the base test. An index less than 1.00 indicates that the plan would cause a decrease in shoaling in the respective area. Indicated changes less than ±10 percent (indexes between 0.90 and 1.10) are generally considered insignificant.

76. While the results of the model shoaling tests are qualitative rather than quantitative, it is believed that the test data are sufficiently reliable to show the overall effects of the proposed plan on shoaling throughout the study area.

Discussion of Results

77. Following the argument presented in paragraph 16, the prototype shoaling rate for the sediment trap can be determined approximately by applying the model-to-prototype shoaling ratio in Upper Winyah Bay (sections 18-27) to the model shoaling rate in the sediment trap. As indicated in Table 15, the test results show that the overall annual channel shoaling rates (Georgetown Harbor Channel plus sediment trap) for Plans 8 and 9 were increased by about 800,000 cu yd (35 percent) and 1,010,000 cu yd (47 percent), respectively. Sampit River shoaling for Plans 8 and 9 was reduced by 33 percent and 28 percent, respectively;

Upper Winyah Bay shoaling for Plans 8 and 9 was increased by 54 percent and 72 percent, respectively; and Eastern Channel shoaling for Plans 8 and 9 was increased by 27 percent and 18 percent, respectively. The annual shoaling rate in the sediment trap was about 810,000 and 880,000 cu yd for Plans 8 and 9, respectively.

Conclusions

78. Since the overall annual channel shoaling rate for Plans 8 and 9 was increased on the order of 800,000-900,000 cu yd over the present shoaling rate and Georgetown Harbor (Sampit River) shoaling was reduced only on the order of 350,000-450,000 cu yd, neither Plan 8 nor Plan 9 appears to be an effective solution to the existing maintenance dredging problem in the Georgetown Harbor project; however, an economic analysis is required to confirm this conclusion.

PART V: INFLOW DIVERSION STUDY

Description of Tests

79. The inflow diversion scheme was designed to provide a reduction in the overall maintenance dredging requirements for the existing Georgetown Harbor project. The scheme consisted of constructing a dam across the Pee Dee and Waccamaw Rivers and diverting all freshwater inflow less than 30,000 cfs through a canal bypassing Winyah Bay to the ocean. When inflows greater than 30,000 cfs occurred, 30,000 cfs would be diverted to the ocean and the remainder of the inflow allowed to pass over the dam into Winyah Bay. Based on inflow data for 1972, implementation of these schemes would result in a 90 percent reduction of fresh water entering the bay. For the purpose of model testing, it was assumed that upland sediment load into the bay would also be reduced by 90 percent. Unfortunately, insufficient data were available with which to define the amount of suspended sediment load as a function of freshwater inflow; thus it cannot be determined whether the assumed reduction in sediment supply is high or low. The present annual maintenance dredging requirement for the Georgetown Harbor Channel (excluding the entrance channel) is about 2.3 million cu yd, based on 1972-1976 dredging volumes. Implementation of this scheme should result in a significant reduction in annual maintenance dredging requirements, since the sediment load to Winyah Bay would be greatly reduced.

80. The inflow diversion study involved testing of Plan 10, elements of which are shown in Plate 23. For hydraulic and salinity data, Plan 10 was tested for a mean tide condition (3.88-ft range at Yawkies Dock) and total freshwater inflows of 12,000, 35,000, and 60,000 cfs. During model testing, no fresh water was actually diverted to the ocean; the selected inflow was simply reduced by 30,000 cfs to simulate the diversion. For example, the 12,000-cfs inflows were simulated by no flow over the dam, the 35,000-cfs inflow was simulated by 5,000-cfs flow over the dam, and the 60,000-cfs inflow was simulated by 30,000 cfs over the dam. For shoaling distribution data, Plan 10 was tested first

with a 5.28-ft tide range at Yawkies Dock and 0 cfs over the dam. A second test was conducted with a 5.28-ft tide range at Yawkies Dock and a step hydrograph of 5,000-25,000 cfs over the dam. For both tests, the gilsonite injection procedure was the same as in previous testing, except that the volume of gilsonite was reduced by 90 percent. To determine the overall shoaling characteristics of Plan 10, the results of the first and second tests were averaged. (See Report 1 of this series for shoaling distribution verification procedure.)

Description of Test Data and Results

Hydraulic and salinity tests

81. Data obtained to evaluate the effects of Plan 10 consisted of measurements of tidal elevations, current velocities, and salinities at numerous locations throughout the model. Tidal elevations were measured at Yawkies Dock, Jones Creek, South Island Road, Skinners Dock, Papermill Dock, and Old Highway 17 Bridge (see Plate 1). The elevations of high and low tides measured at each gage for Plan 10 are presented in Table 16. Current velocities were measured at 1-hr intervals over a complete tidal cycle at surface, middepth, and bottom at 11 stations in the existing Georgetown Harbor Channel, 5 stations along the Western Channel, and 1 station each at the mouths of the Waccamaw and Pee Dee Rivers. These constituted all model velocity stations located downstream of the Plan 10 dam (see Plate 1). Maximum flood and ebb measurements observed at each station for Plan 10 are presented in Tables 17-19. Salinities were measured at 1-hr intervals over a complete tidal cycle at surface and bottom depths at 11 stations in the existing Georgetown Harbor Channel, 2 stations in the Sampit River above Georgetown Harbor, 5 stations along the Western Channel, and 1 station each in the Pee Dee and Waccamaw Rivers. These constituted all model salinity stations located downstream of the Plan 10 dam (see Plate 1). Maximum, minimum, and average salinities observed at each station are presented in Tables 20-22. Since the location and design of the proposed diversion canal was not established at the time the model study was conducted, no

testing was conducted in the area above the dam. Drastic reduction in tidal amplitude, current velocities, and saltwater intrusion could be expected to result in the tidal areas upstream of the proposed dam. If and when the diversion plan is found to be economically justified by the Charleston District, further model studies are recommended to determine the effects of the dam and canal on the hydraulic and salinity conditions in the areas above the dam and in the canal proper.

Shoaling tests

82. The shoaling test procedure was identical with that used for the Western Channel and Turning Basin study in PART II, except that for Plan 10 testing the amount of gilsonite injected into the model was reduced to 10 percent of previous testing volume to simulate a 90 percent reduction in sediment load caused by the inflow diversion. The shoaling test results for Plan 10 are shown in Table 23. The results of the shoaling test for Plan 10 are presented as shoaling volumes in cubic centimetres for base and plan and as indexes so that test results can be compared. A shoaling index for each particular area was determined by dividing the plan test volume by the base test volume; therefore, an index greater than 1.00 indicates that a large volume of material deposited in an area during the plan test than deposited in the same area for the base test. An index less than 1.00 indicates that the plan would cause a decrease in shoaling in the respective area. Indicated changes less than ±10 percent (indexes between 0.90 and 1.10) are generally considered insignificant.

83. While the results of the model shoaling tests are qualitative rather than quantitative, it is believed that the test data are sufficiently reliable to show the overall effects of the proposed plan on shoaling throughout the study area.

Discussion of Results

Tides

84. As shown by the results in Table 16, Plan 10 significantly affected the water-surface elevations in Upper Winyah Bay and Georgetown Harbor. For the 12,000-cfs inflow, Plan 10 caused the low-water

elevations to be lowered a maximum of 0.6 ft at the Sampit River gage (Papermill Dock) and the high-water elevations to be raised a maximum of 0.4 ft at the Old Highway 17 Bridge gage; the tide range was increased a maximum of 0.9 ft at the Old Highway 17 Bridge gage. For the 35,000-cfs inflow, Plan 10 caused the low-water elevations to be lowered a maximum of 0.7 ft at the Sampit River gage and the high-water elevations to be raised a maximum of 0.4 ft at the Skinners Dock gage; the tide range was increased a maximum of 0.8 ft at the Sampit River and Old Highway 17 Bridge gages. For the 60,000-cfs inflow, Plan 10 caused the low-water elevations to be lowered a maximum of 0.5 ft at the Sampit River and Old Highway 17 Bridge gages, and the high-water elevations to be raised a maximum of 0.3 ft at the Skinners Dock, Sampit River, and Old Highway 17 Bridge gages; the tide range was increased a maximum of 0.8 ft at the Sampit River and Old Highway 17 Bridge gages. For all inflows, significant changes in tidal phasing were noted in the upper bay and harbor, as evidenced by the tidal plots for the Skinners Dock, Sampit River, and Old Highway 17 Bridge gages shown in Plate 24. The arrival times for low water were earlier by about 3/4-1 hr than for the base test. High water was earlier by about 1/2 hr at Old Highway 17 Bridge (essentially at the dam), but was unchanged at the other gages.

Velocities

85. As shown by Tables 17-19, the overall effect of Plan 10 was a significant decrease in the maximum flood and ebb velocities in Winyah Bay for all inflows tested (12,000, 35,000, and 60,000 cfs). This was to be expected because of the substantial reduction in tidal prism caused by the dam. For the 12,000-cfs inflow (Table 17), maximum flood velocities (average of surface, middepth, and bottom) were slightly decreased from sta M1 to M9, significantly decreased from sta M11 to M14, unchanged at sta M15 and TB, unchanged from sta WC0 to WC4, and significantly decreased at sta PD2 and W2; maximum ebb velocities (average of surface, middepth, and bottom) were unchanged at sta M1 and M3; significantly decreased from sta M5 to M14, unchanged at sta M15 and TB, slightly decreased at sta WC0 and WC1, significantly decreased at sta WC2 to WC4, and significantly decreased at sta PD2 and W2. For the

35,000-cfs inflow (Table 18), maximum flood velocities (average of surface, middepth, and bottom) were slightly decreased from sta M1 to M9, significantly decreased from sta M11 to M14, unchanged at sta M15 and TB, unchanged from sta WC0 to WC4, and significantly decreased at sta PD2 and W2; maximum ebb velocities (average of surface, middepth, and bottom) were unchanged at sta M1, slightly decreased at sta M3, significantly decreased from sta M5 to M14, slightly increased at sta M15 and TB, slightly decreased at sta WC0, significantly decreased at sta WC1 to WC4, and significantly decreased at sta PD2 and W2. For the 60,000-cfs inflow (Table 19), maximum flood velocities (average of surface, middepth, and bottom) were unchanged from sta M1 to M11, slightly reduced from sta M12 to M14, unchanged at sta M15 and TB, slightly increased from sta WC0 to WC3, unchanged at sta WC4, and significantly decreased at sta PD2 and W2; maximum ebb velocities (average of surface, middepth, and bottom) were significantly decreased from sta M1 to M14, slightly increased at sta M15 and TB, significantly decreased from sta WC0 to WC4, and significantly decreased at sta PD2 and W2.

Flow predominance

86. For Plan 10 conditions with the 12,000-cfs inflow, the surface flow predominance data presented in Plate 25 show that the surface flow predominance in the Georgetown Harbor Channel changed from highly ebb-predominant flow to equally distributed at sta M5 and M7 and changed from highly ebb-predominant flow to flood-predominant flow at sta M9 and M11. In the Western Channel the surface flow predominance changed from highly ebb-predominant flow to equally distributed. In the Georgetown Harbor Channel, bottom flow predominance (Plate 26) was changed from equally distributed to flood-predominant flow at sta M13 and M14 and was changed from highly flood-predominant flow to equally distributed at sta M15. In the Western Channel bottom flow predominance changed from ebb-predominant flow to flood-predominant flow at sta WC2 and WC3 and changed from equally distributed to flood-predominant flow at sta WC4.

87. For Plan 10 conditions with the 35,000-cfs inflow, the surface flow predominance data presented in Plate 27 show that the surface flow predominance in the Georgetown Harbor Channel changed from highly

ebb-predominant flow to equally distributed at sta M5, M7, and M9. In the Western Channel the surface flow predominance changed from highly ebb-predominant flow to slightly ebb-predominant flow at sta WC0, WC1, WC2, and WC3 and equally distributed at sta WC4. In the Georgetown Harbor Channel, bottom flow predominance (Plate 28) was changed from ebb-predominant flow to flood-predominant flow at sta M5, M7, M13, M14, and M15, changed from slightly flood-predominant flow to highly flood-predominant flow at sta M9 and M11. In the Western Channel bottom flow predominance was changed from ebb-predominant to flood-predominant flow at sta WC1-WC4 and was changed from highly ebb-predominant flow to equally distributed at sta WC0.

88. For Plan 10 conditions with the 60,000-cfs inflow, the surface flow predominance data presented in Plate 29 show that the surface flow predominance in the Georgetown Harbor Channel changed from highly ebb-predominant to slightly ebb-predominant flow at sta M1, M3, M5, M7, M9, and M11, and was unchanged at sta M12-M15. In the Western Channel the surface flow predominance changed from highly ebb-predominant to ebb-predominant flow at all stations. In the Georgetown Harbor Channel, bottom flow predominance (Plate 30) was changed from highly ebb-predominant to highly flood-predominant flow at sta M9, M11, M12, and M14, was changed from ebb-predominant flow to about equally distributed flow at sta M3, M5, and M7, and was changed from equally distributed to flood-predominant flow at sta M15. In the Western Channel, bottom flow predominance was changed from highly ebb-predominant to flood-predominant flow at sta M1 and about equally distributed flow at sta WC2 and WC3.

Salinities

89. As shown by Tables 20-22 and Plates 31-33, the overall effect of Plan 10 was a significant increase in the salt content of the bay for all inflows tested (12,000, 35,000, and 60,000 cfs). This was to be expected from the reduction in freshwater inflow. For the 12,000-cfs and 35,000-cfs inflows, average surface salinities and average bottom salinities were significantly increased at all stations. For the 60,000-cfs inflow, average surface salinities and average bottom salinities

were significantly increased at all stations except PD2 and W2, which were essentially salt-free for both base and Plan 10 conditions. For each of the inflows, average surface salinities were increased on the order of 5-15 ppt over substantial portions of the system, and average bottom salinities were increased on the order of 10-20 ppt over substantial areas.

Shoaling

90. As indicated in Table 23, the test results show that the overall annual channel shoaling was reduced by about 1,650,000 cu yd (63 percent). Shoaling in the Sampit River (sections 28-44) was decreased to 8 percent of the existing volume. Shoaling in the Upper Winyah Bay (sections 19-27) was decreased to 19 percent of the existing volume. Shoaling in the Eastern Channel (sections 8-18) was increased to 134 percent of the existing volume.

Conclusions

91. The conclusions are:

a. Plan 10 significantly affected the tide heights and phasing in Upper Winyah Bay and Georgetown Harbor for all inflows tested. The tide range in this area was increased by a slight lowering of low water and a slight raising of high water. Also, phasing was affected in the upper bay and harbor because low water tended to occur significantly earlier than for existing conditions.

b. Plan 10 significantly decreased maximum ebb and flood currents for all inflows tested, except in the harbor itself where velocities generally were unchanged.

c. Plan 10 caused a significant increase in salinity within the estuarine area downstream of the proposed dam for all inflows tested.

d. Based on the assumption that the 90 percent reduction of freshwater inflow to the bay would reduce the sediment supply by 90 percent, the overall annual channel shoaling rate for Plan 10 was 63 percent less than the existing rate. The Georgetown Harbor (Sampit River) shoaling rate was only 8 percent of the existing rate. Plan 10 is an effective scheme for the reduction of maintenance dredging requirements for the Georgetown Harbor project.

e. Although not subjected to model testing, it should be expected that the proposed dam and diversion canal would cause substantial changes to tidal, velocity, salinity, and shoaling characteristics in the Pee Dee and Waccamaw Rivers and in the North Inlet area.

PART VI: DEEPENED CHANNEL STUDY

Description of Tests

92. The deepening of the main navigation channel to Georgetown Harbor from -27 to -35 ft mlw would allow passage of larger vessels than presently use the channel to and from Georgetown Harbor, but probably at the cost of significantly increased maintenance dredging requirements. The present annual maintenance dredging requirement for the Georgetown Harbor Channel (excluding the entrance channel) is about 2.3 million cu yd based on 1972-1976 dredging volumes; any significant increase in dredging requirements caused by the deepening would severely affect the economic justification for the deepened project depth.

93. The deepened channel study involved testing of Plan 11, which consisted of deepening the existing Georgetown Harbor Channel from -27 to -35 ft mlw.

94. For hydraulic and salinity data, Plan 11 was tested for a mean tide condition (3.88-ft range at Yawkies Dock) and total freshwater inflows of 12,000 and 35,000 cfs. For shoaling distribution data, Plan 11 was tested with a 5.28-ft tide range of the Yawkies Dock gage and a step hydrograph of 5,000-25,000 cfs. (See Report 1 of this series for shoaling distribution verification procedure.)

Description of Test Data and Results

Hydraulic and salinity tests

95. Data obtained to evaluate the effects of Plan 11 consisted of measurements of tidal elevations, current velocities, and salinities at numerous locations throughout the model. Tidal elevations were measured at the Yawkies Dock, Jones Creek, South Island Road, Skinners Dock, Sampit River, Old Highway 17 Bridge, Sandy Island, Hasty Point, Wacca Wache, and Topsaw Landing (see Plate 1). The elevations of high and low tides measured at each gage for Plan 11 are presented in Table 24. Current velocities were measured at 1-hr intervals over a complete tidal

cycle at surface, middepth, and bottom at 11 stations in the existing Georgetown Harbor Channel, 5 stations along the Western Channel, and 1 station each at the mouths of the Waccamaw and Pee Dee Rivers (Plate 1). Maximum flood and ebb measurements observed at each station for Plan 11 are presented in Tables 25 and 26. Salinities were measured at 1-hr intervals over a complete tidal cycle at surface and bottom depths at 11 stations in the existing Georgetown Harbor Channel, 2 stations in the Sampit River above Georgetown Harbor, 5 stations along the Western Channel, 4 stations in the Pee Dee River, and 3 stations in the Waccamaw River (Plate 1). Maximum, minimum, and average salinities observed at each station for the two inflow conditions (12,000 and 35,000 cfs) are presented in Tables 27 and 28.

96. The current measurements at both surface and bottom depths in the Georgetown Harbor Channel and the Western Channel were also analyzed to determine what percentage of the total flow over a complete tidal cycle was in a downstream direction at the locations of the various velocity stations. Percentages so determined and found to be greater than 50 indicate that flow was predominantly downstream at the point of measurement, and conversely, percentages less than 50 indicate the predominant flow direction to be upstream. The results of the predominance computations for surface and bottom depths for Plan 11 are presented in Plates 34-37 as curves of predominance versus channel stations.

Shoaling tests

97. The shoaling test procedure was identical with that used for the Western Channel and Turning Basin study described previously in paragraphs 41 and 43. The shoaling test results for Plan 11 are shown in Table 29. Tests of the base and Plan 11 were conducted in an identical manner to assure comparable results. The results of the shoaling test for Plan 11 are presented as shoaling volumes in cubic centimetres for base and plan and as indexes so that test results can be compared. A shoaling index for each particular area was determined by dividing the plan test volume by the base test volume; therefore, an index greater than 1.00 indicates that a larger volume of material deposited in an area during the plan test than deposited in the same area for the base

test. An index less than 1.00 indicates that the plan would cause a decrease in shoaling in the respective area. Indicated changes less than ±10 percent (indexes between 0.90 and 1.10) are generally considered insignificant.

98. While the results of the model shoaling tests are qualitative rather than quantitative, it is believed that the test data are sufficiently reliable to show the overall effects of the proposed plan on shoaling throughout the study area.

Discussion of Results

Tides

99. As indicated by Table 24, Plan 11 had no major effects on tidal elevations in Winyah Bay, Georgetown Harbor, or the Waccamaw and Pee Dee Rivers; however, both high-water and low-water elevations were raised slightly (0.2 ft) in the Upper Winyah Bay and Georgetown Harbor areas. No significant changes in tidal phasing occurred.

Flow predominance

100. For existing conditions and the 12,000-cfs inflow, examination of the surface predominance data presented in Plate 34 shows that the surface flow in the Georgetown Harbor Channel (M1-M15) was predominantly downstream at all stations. Bottom predominance data for existing conditions and the 12,000-cfs inflow, presented in Plate 35, show that the bottom flow in the Georgetown Harbor Channel was predominantly downstream at sta M1, predominantly upstream at sta M3, M9, M11, M12, and M15, and equally distributed at sta M5, M7, M13, and M14.

101. For existing conditions and the 35,000-cfs inflow, the surface predominance data presented in Plate 36 show that the surface flow in the Georgetown Harbor Channel was predominantly downstream at all stations, except sta M15 where it was slightly upstream. Bottom predominance data for existing conditions and 35,000-cfs inflow, presented in Plate 37, show that the bottom flow in the Georgetown Harbor Channel was predominantly downstream at sta M5, M7, M13, and M14, predominantly upstream at sta M9 and M11, and equally distributed at sta M1, M3, M12, and M15.

102. For Plan 11 conditions and the 12,000-cfs inflow, no significant changes from existing conditions in surface flow predominance were noted in the Georgetown Harbor Channel, as evidenced by Plate 34. For bottom flow predominance in the Georgetown Harbor Channel, sta M1 changed from slightly ebb-predominant to ebb-predominant flow; sta M3 changed from slightly flood-predominant to slightly ebb-predominant flow; sta M9 changed from flood-predominant to highly flood-predominant flow; sta M13 changed from equally distributed to highly flood-predominant flow; sta M15 changed from highly flood-predominant flow to equally distributed; and sta M5, M7, M11, M12, and M14 were essentially unchanged (Plate 35).

103. For Plan 11 conditions and the 35,000-cfs inflow, no significant changes from existing conditions in surface flow predominance were noted in the Georgetown Harbor Channel, as evidenced by Plate 36. For bottom flow predominance in the Georgetown Harbor Channel, sta M1 changed from equally distributed to ebb-predominant flow; sta M3 changed from equally distributed to slightly ebb-predominant flow; sta M5 and M7 changed from ebb-predominant flow to equally distributed; sta M9 and M11 changed from slightly flood-predominant to flood-predominant flow; sta M12 was unchanged; sta M13 changed from ebb-predominant to flood-predominant flow; sta M14 changed from ebb-predominant flow to equally distributed; and sta M15 changed from equally distributed to flood-predominant flow (Plate 37).

<u>Salinity</u>

104. For Plan 11 and the 12,000-cfs inflow (Table 27 and Plate 38), Georgetown Harbor Channel maximum surface salinities, compared with base conditions, were significantly decreased from sta M1 to M7 and sta M13 to M15 (maximum reduction on the surface at sta M5 of 3.6 ppt), were unchanged at sta M9 and M12, and were significantly increased at sta M11 (4.0 ppt) and sta TB; minimum surface salinities were slightly increased (0.8 ppt) at sta M7 and unchanged from sta M1 to M5 and sta M9 to TB. Maximum bottom salinities, compared with base conditions, significantly decreased from sta M1 to M7 (maximum reduction of 2.2 ppt at sta M3), were unchanged at sta M9 and M11, and significantly increased from

sta M12 to TB (maximum increase of 5.1 ppt at sta TB); minimum bottom salinities were significantly decreased at sta M1, M3, and M7 (maximum reduction of 1.8 ppt at sta M3) and were significantly increased at sta M5 and sta M9 to TB (maximum increase of 13.6 ppt at sta M13). The upstream extent of saltwater intrusion on the bottom of the main channel was significantly increased (Plate 38).

105. For Plan 11 and the 35,000-cfs inflow (Table 28 and Plate 39), Georgetown Harbor Channel maximum surface salinities, compared with base conditions, were significantly increased at sta M1 (1.9 ppt), were significantly decreased from sta M3 to M13 (maximum reduction of 5.3 ppt at sta M5), and were unchanged at sta M14 to TB; minimum surface salinities were essentially unchanged at all stations along the channel. Maximum bottom salinities, compared with base conditions, were significantly decreased at sta M1 to M5 (maximum reduction of 3.0 ppt at sta M5), were unchanged at sta M7, and were significantly increased from sta M11 to TB (maximum increase of 14.9 ppt at sta TB); minimum bottom salinities were unchanged at sta M1 and significantly increased from sta M3 to TB (maximum increase of 16.2 ppt at sta M11). The upstream extent of saltwater intrusion on the bottom of the main channel was significantly increased (Plate 39).

Shoaling

106. As indicated in Table 29, the test results show that the overall annual channel shoaling was increased by about 1,980,000 cu yd (88 percent). The increase in shoaling volume for this plan is based on the assumption that the additional shoaling material is available to Winyah Bay and Georgetown Harbor. Thus, the results of the Plan 11 shoaling test indicate that if sufficient additional material is available, the deepened channel will alter the hydrodynamics of the system to allow a tremendous increase in the overall shoaling volume. Shoaling in the Sampit River (sections 28-44) was increased by 36 percent of the existing volume. Shoaling in the Upper Winyah Bay (sections 19-27) was increased by 138 percent of the existing volume. Shoaling in the Eastern Channel was increased by 14 percent of the existing volume.

Conclusions

107. Conclusions are as follows:

a. For the inflows tested, Plan 11 did not significantly affect the tide heights or phasing within the model area, other than a slight raising of low- and high-water elevations in Upper Winyah Bay and Georgetown Harbor.

b. For the inflows tested, Plan 11 did not significantly affect the surface flow predominance; however, bottom flow predominance was affected by a trend toward increased flood predominance or decreased ebb predominance in both Central and Upper Winyah Bay.

c. For the inflows tested, Plan 11 caused an overall significant increase in salinity in Winyah Bay and Georgetown Harbor; however, a decrease in average salinity for the 12,000- and 35,000-cfs flows was noted in Lower Winyah Bay.

d. Overall annual channel shoaling rate was 88 percent more than the existing shoaling rate. Georgetown Harbor (Sampit River) shoaling rate was 36 percent more than the existing rate. The Upper Winyah Bay shoaling rate was 138 percent more than the existing rate. The Eastern Channel shoaling rate was 214 percent more than the existing rate. These results are based on the assumption that the additional shoaling material required for such increases is available to the system.

PART VII: SUMMARY OF CONCLUSIONS

Tides

108. Plan 1 did not significantly affect the tidal heights or tidal phasing within the model area. Plan 1A raised low-water elevations and reduced tidal range by 0.2 to 0.8 ft in Winyah Bay and the lower portions of the Sampit, Pee Dee, and Waccamaw Rivers. Plan 10 significantly affected the tide heights and phasing in Upper Winyah Bay and Georgetown Harbor for all inflows tested. The tide range in this area was increased by a slight lowering of low water and a slight raising of high water. Also, phasing was affected in the upper bay and harbor because low water tended to occur significantly earlier than that for existing conditions. For the inflows tested, Plan 11 did not significantly affect the tide heights or phasing within the model area, other than a slight raising of low- and high-water elevations in Upper Winyah Bay and Georgetown Harbor.

Velocities

109. Plan 1 caused a slight reduction in maximum ebb velocities (average of surface, middepth, and bottom) at sta M1, M5, M11, M13, WC1, WC3, and W2 and a significant reduction in maximum ebb velocities (average of surface, middepth, and bottom) at sta WC2. Plan 1 caused a slight reduction in maximum ebb velocities (average of surface, middepth, and bottom) at sta M7, a significant reduction in maximum ebb velocities (average of surface, middepth, and bottom) at sta M5, WC2, and W2, and a slight increase in maximum ebb velocities at sta M9, M11, M12, and WC4. Plan 1A caused a slight reduction in maximum flood velocities at sta M1, M7, and M9; a significant reduction in maximum flood velocities at sta M3; and a slight increase in maximum flood velocities at sta WC0. Plan 10 significantly decreased maximum ebb and flood currents for all inflows tested, except in the harbor itself where velocities generally were unchanged.

Flow Predominance

110. Plan 1 did not significantly affect either the surface or bottom flow predominance in the Georgetown Harbor Channel or the surface predominance in the Western Channel; however, bottom flow predominance in the proposed Western Channel and Turning Basin was significantly affected, changing from ebb-predominant to flood-predominant flow at sta WC1 and WC2. Plan 1A did not significantly affect the flow predominance in the Georgetown Harbor Channel, other than increasing the percent flow downstream at the bottom depth in the shallowed portion of the Georgetown Harbor Channel; however, in the Western Channel, the bottom flow predominance changes were essentially the same as those for Plan 1. For the inflows tested, Plan 11 did not significantly affect the surface flow predominance; however, bottom flow predominance was affected by a trend toward increased flood predominance or decreased ebb predominance in both Central and Upper Winyah Bay.

Salinity

111. Plan 1 caused a slight but significant decrease in salinity within the region of saltwater intrusion (generally about 1-4 ppt); thus the extent of saltwater intrusion was reduced in the Georgetown Harbor Channel. Evidently, the deepened lower end of the Georgetown Harbor Channel caused an increase in the bay freshwater storage and a corresponding decrease in salinity within the bay. The only location that consistently indicated an increase in salinity (by an average of about 3 ppt) was the bottom depth of the proposed Western Channel and Turning Basin; thus the extent of saltwater intrusion was increased in the Western Channel. Plan 1A caused a significant decrease in salinity within the saltwater intrusion zone (generally 1-7 ppt). As in Plan 1, the only location that consistently indicated an increase in salinity was the bottom depth of the proposed Western Channel (by an average of about 3 ppt). Plan 10 caused a significant increase in salinity within the estuarine area downstream of the proposed dam for all inflows tested.

For the inflows tested, Plan 11 caused an overall significant increase in salinity in Winyah Bay and Georgetown Harbor; however, a decrease in average salinity for the 12,000- and 35,000-cfs flows was noted in Lower Winyah Bay.

Shoaling

112. The elements of Plans 1 and 1A were identical except that the abandoned Eastern Channel (sections 8-18), the Upper Winyah Bay Channel (sections 19-27), and the Sampit River Channel (sections 28-44) were -27 ft mlw for Plan 1 and -13 ft mlw for Plan 1A. Compared with Plan 1 (which assumed that no dredging would be performed in the existing Upper Winyah Bay and Sampit River Channels while these channels shoaled from the 27-ft mlw depth toward the 13-ft mlw depth), Western Channel shoaling for Plan 1A was increased significantly (about 35 percent) when the abandoned Eastern Channel, the Upper Winyah Bay Channel, and the Sampit River Channel were shallowed from -27 ft to -13 ft mlw to represent a shoaled condition. Overall annual shoaling (Western Channel plus Georgetown Harbor Channel) for Plan 1A was about 45 percent less than that in the existing channel. During the period in which the Georgetown Harbor Channel upstream from the Western Channel is allowed to shoal from its present depth of 27 ft to a depth of 13 ft mlw (Plan 1), the total annual dredging requirement would be about 68 percent less than that for the existing channel. Plans 2-6 were modifications of Plan 1A tested in an attempt to decrease Western Channel shoaling and more evenly distribute the shoaling along the channel length. Plan 2 annual shoaling was 78 percent more than Plan 1A shoaling with no improvement in shoaling distribution along the Western Channel, and overall annual shoaling for Plan 2 was 4 percent less than existing channel shoaling. Plan 3 annual shoaling was 260 percent more than Plan 1A shoaling (including a major maintenance dredging requirement for the side channel trap), with no improvement in distribution along the Western Channel; and overall annual shoaling (including the sediment trap) for Plan 3 was 94 percent more than existing channel shoaling. Plan 4

annual shoaling was only 12 percent more than Plan 1A shoaling with a significantly improved distribution of material along the Western Channel, and overall annual shoaling for Plan 4 was 39 percent less than existing channel shoaling. Plan 5 annual shoaling was 57 percent more than Plan 1A shoaling with no improvement in distribution along the Western Channel, and overall annual shoaling (including sediment trap) for Plan 5 was 15 percent less than existing channel shoaling. Plan 6 annual shoaling was 7 percent more than Plan 1A shoaling with no significant change in shoaling distribution along the Western Channel, and overall annual shoaling for Plan 6 was about 42 percent less than existing channel shoaling. Based on these results, the effects of Plans 2, 3, 5, and 6 on shoaling when compared with Plan 1A were detrimental rather than beneficial and therefore cannot be recommended. The effects of Plan 4 on shoaling, when compared with Plan 1A, were definitely beneficial because of the much more even distribution of shoaling material along the Western Channel. Although the annual shoaling rate for Plan 4 is almost the same as that for Plan 1A, the elimination of the extremely high shoaling rate in one section (section WC3) should permit dredging to be performed on a less frequent basis. Since the overall annual shoaling rate was reduced to 43 percent of the existing rate and no unacceptably high shoaling rates occurred in any individual section, Plan 7 was an effective scheme for reducing the maintenance dredging requirements for the Georgetown Harbor project. Since the overall annual shoaling rate for Plans 8 and 9 was increased on the order of 800,000-900,000 cu yd over the present shoaling rate and Georgetown Harbor (Sampit River) shoaling was reduced only on the order of 350,000-450,000 cu yd, neither Plan 8 nor Plan 9 appears to be an effective solution to the existing maintenance dredging problem in the Georgetown Harbor project; however, an economic analysis is required to confirm this conclusion. Based on the assumption that the 90 percent reduction of freshwater inflow to the bay would reduce the sediment supply by 90 percent, the overall annual shoaling rate for Plan 10 was 63 percent less than the existing rate. The Georgetown Harbor (Sampit River) shoaling rate was only 8 percent of the existing rate. Plan 10 is an effective scheme for the reduction of maintenance dredging requirements for the Georgetown Harbor project. Although not subjected to model testing, it should be expected that the proposed dam and diversion canal would cause substantial changes to tidal, velocity, salinity, and shoaling characteristics in the Pee Dee and Waccamaw Rivers and in the North Inlet area. Overall annual channel shoaling rate was 88 percent more than the existing shoaling rate. Georgetown Harbor (Sampit River) shoaling rate was 36 percent more than the existing rate. The Upper Winyah Bay shoaling rate was 138 percent more than the existing rate. The Eastern Channel shoaling rate was 214 percent more than the existing rate. These results are based on the assumption that the additional shoaling material required for such increases is available to the system.

Table 1

Effects of Plans 1 and 1A on Tide Heights*

Test	Yawkies Dock		Jones Creek		South Island Road		Skinners Dock		Papermill Dock		Old Hwy 17 Bridge		Sandy Island		Hasty Point		Wacca Wache		Topsaw Landing		Bucksport	
	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW
									Total Inflow 5,000 cfs													
Base	3.6	-0.2	3.5	-0.4	3.5	-0.3	3.6	-0.1	3.7	-0.2	3.5	-0.2	3.5	0.1	3.6	-0.5	3.5	0.4	3.6	0.9	3.6	0.4
Plan 1	3.5	-0.2	3.5	-0.4	3.5	-0.3	3.6	0.0	3.7	-0.2	3.5	-0.3	3.6	0.2	3.6	0.5	3.6	0.4	3.7	1.0	3.5	0.4
Plan 1A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
									Total Inflow 12,000 cfs													
Base	3.6	-0.2	3.6	-0.4	3.6	-0.2	3.6	-0.2	3.7	-0.3	3.6	-0.3	3.7	0.4	3.8	1.0	3.8	0.9	4.0	2.2	3.7	1.2
Plan 1	3.5	-0.2	3.6	-0.3	3.6	-0.2	3.7	0.0	3.8	-0.1	3.6	-0.2	3.7	0.4	3.8	1.0	3.7	0.8	4.1	2.2	3.7	1.0
Plan 1A	3.6	-0.2	3.7	-0.2	3.7	0.0	3.7	0.2	3.5	0.2	3.6	0.2	3.6	0.6	3.6	1.0	3.7	0.9	3.8	2.2	3.7	1.2
									Total Inflow 35,000 cfs													
Base	3.5	-0.2	3.6	-0.5	3.7	-0.3	3.6	-0.1	3.7	-0.2	3.7	-0.2	3.9	1.0	4.1	1.8	4.2	2.0	4.9	4.5	4.1	3.0
Plan 1	3.6	-0.2	3.7	-0.2	3.7	-0.2	3.6	-0.1	3.8	-0.1	3.7	-0.2	4.1	1.2	4.2	2.1	4.1	2.0	5.1	4.7	4.2	3.0
Plan 1A	3.6	-0.2	3.7	-0.2	3.6	0.0	3.8	0.3	3.7	0.3	3.6	0.3	4.0	1.3	4.0	2.1	4.1	2.2	5.0	4.6	4.1	3.1
									Total Inflow 60,000 cfs													
Base	3.5	-0.2	3.6	-0.4	3.6	-0.2	3.7	0.0	3.6	-0.2	3.8	0.0	4.3	1.9	4.6	3.2	4.8	3.7	6.4	6.2	5.8	5.5
Plan 1	3.6	-0.2	3.8	-0.2	3.8	-0.1	3.8	0.1	3.8	0.2	3.8	0.1	4.5	2.1	4.7	3.3	4.8	3.7	6.6	6.4	5.4	5.0
Plan 1A	3.6	-0.2	3.7	-0.2	3.7	0.1	3.8	0.6	3.8	0.6	3.8	0.6	4.4	2.3	4.5	3.2	4.9	3.9	6.4	6.2	5.4	5.1

* Tide heights are referred to mean sea level (msl) in prototype feet; HW is high water; LW is low water.

Table 2

Effects of Plans 1 and 1A on Maximum Current Velocities

Total Inflow 5,000 cfs

	Base						Plan 1						Plan 1A					
	Surface		Middepth		Bottom		Surface		Middepth		Bottom		Surface		Middepth		Bottom	
Station	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb
Georgetown Harbor Channel																		
M1	3.3	-4.5	2.8	-5.2	3.0	-5.1	2.8	-5.5	2.6	-5.8	3.0	-6.1	--	--	--	--	--	--
M3	4.5	-3.9	4.0	-3.2	3.4	-3.2	3.6	-4.1	3.2	-3.6	2.9	-3.5	--	--	--	--	--	--
M5	2.4	-4.5	2.6	-4.0	2.7	-3.3	3.0	-3.8	2.7	-2.8	2.7	-2.4	--	--	--	--	--	--
M7	3.2	-4.2	2.8	-4.1	2.9	-4.0	3.1	-4.2	3.0	-4.2	2.2	-3.4	--	--	--	--	--	--
M9	2.0	-3.9	2.9	-2.7	2.6	-1.9	2.4	-3.6	3.0	-2.4	2.9	-1.5	--	--	--	--	--	--
M11	1.7	-3.1	2.2	-2.8	3.1	-1.9	1.7	-2.5	2.3	-1.8	2.9	-1.7	--	--	--	--	--	--
M12	2.8	-3.5	2.8	-2.6	3.1	-1.6	1.9	-3.3	2.3	-2.2	2.6	-1.5	--	--	--	--	--	--
M13	1.5	-3.6	2.3	-2.7	2.1	-2.2	1.9	-2.9	1.7	-2.5	1.9	-1.6	--	--	--	--	--	--
M14	2.6	-3.9	2.5	-3.3	2.3	-3.0	2.2	-3.1	2.1	-2.6	1.8	-1.9	--	--	--	--	--	--
M15	1.5	-1.7	0.8	-1.1	1.1	-0.6	1.4	-1.4	1.2	-1.0	1.3	-0.4	--	--	--	--	--	--
TB	0.9	-1.8	0.8	-2.1	0.6	-0.6	0.8	-1.6	1.0	-1.5	0.7	-0.9	--	--	--	--	--	--
Western Channel																		
WC0	2.1	-2.6	1.6	-2.8	1.6	-3.1	2.5	-3.3	2.3	-3.0	2.1	-2.7	--	--	--	--	--	--
WC1	2.1	-3.3	2.1	-2.9	1.9	-2.1	1.8	-3.3	1.7	-2.1	1.8	-0.9	--	--	--	--	--	--
WC2	1.7	-3.3	1.9	-3.5	2.0	-3.5	0.8	-3.3	1.9	-3.2	1.8	-0.4	--	--	--	--	--	--
WC3	1.7	-4.4	1.7	-3.6	1.7	-2.9	2.1	-3.3	2.2	-3.0	2.0	-2.2	--	--	--	--	--	--
WC4	2.1	-2.9	2.1	-2.7	2.0	-2.1	2.0	-3.4	2.2	-2.8	2.2	-2.1	--	--	--	--	--	--
Pee Dee and Waccamaw Rivers																		
PD2	2.2	-3.6	2.2	-3.4	2.0	-2.7	2.1	-3.6	2.3	-3.4	2.4	-2.9	--	--	--	--	--	--
W2	1.9	-3.5	2.1	-2.9	2.3	-2.0	2.4	-3.8	2.6	-3.2	2.6	-1.9	--	--	--	--	--	--

Note: -- indicates no data obtained.

Table 3

Effects of Plans 1 and 1A on Maximum Current Velocities

Total Inflow 12,000 cfs

	Base						Plan 1						Plan 1A					
	Surface		Middepth		Bottom		Surface		Middepth		Bottom		Surface		Middepth		Bottom	
Station	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb
Georgetown Harbor Channel																		
M1	3.2	-4.7	2.9	-5.3	3.4	-5.0	2.7	-5.6	2.8	-6.1	3.0	-6.2	2.4	-5.7	2.4	-5.6	2.7	-5.4
M3	4.5	-4.5	4.3	-3.6	3.8	-3.5	3.4	-4.3	3.0	-3.6	3.1	-3.1	3.1	-3.9	2.6	-3.6	2.6	-3.1
M5	2.5	-4.5	2.9	-4.1	3.1	-3.1	2.6	-4.0	2.6	-2.6	2.6	-2.2	2.2	-3.3	2.3	-2.6	2.5	-3.2
M7	3.2	-5.0	2.9	-3.8	2.8	-3.8	2.9	-4.6	2.5	-4.1	2.6	-3.3	2.9	-4.2	2.8	-3.9	2.4	-3.5
M9	1.7	-4.1	2.9	-2.8	2.8	-1.8	2.1	-3.9	2.8	-2.7	3.0	-1.0	1.7	-3.8	2.1	-3.3	2.1	-3.2
M11	1.7	-3.3	2.8	-2.7	3.2	-1.3	1.7	-2.7	2.2	-2.2	2.7	-1.8	2.3	-3.9	2.3	-3.9	2.1	-3.3
M12	2.7	-3.4	2.9	-3.0	2.8	-1.6	2.0	-3.4	2.3	-2.2	1.5	-1.4	2.9	-4.1	2.9	-3.6	2.3	-3.2
M13	1.9	-3.8	2.3	-3.1	2.3	-2.5	1.7	-2.8	1.6	-2.5	1.6	-1.3	1.8	-3.4	1.7	-3.1	1.9	-2.3
M14	2.6	-3.5	2.3	-3.1	2.5	-2.6	2.3	-3.4	1.8	-2.8	1.7	-2.0	2.3	-3.6	2.3	-3.4	2.4	-3.0
M15	1.4	-1.6	1.1	-1.1	1.4	-0.5	1.3	-1.4	1.2	-1.4	1.3	-0.4	1.3	-1.5	1.3	-1.5	1.1	-1.5
TB	0.9	-1.7	0.8	-2.2	0.8	-0.7	0.7	-1.8	0.7	-1.6	0.6	-0.6	1.0	-2.2	1.1	-2.0	1.1	-1.4
Western Channel																		
WC0	1.8	-2.6	1.6	-3.1	1.7	-3.3	2.2	-3.4	2.3	-3.3	1.8	-2.7	2.6	-3.5	2.3	-3.6	1.9	-3.0
WC1	2.1	-3.1	2.2	-2.9	2.1	-2.0	1.7	-3.4	1.8	-1.9	2.2	-0.9	1.9	-3.4	2.0	-2.3	2.0	-1.4
WC2	1.7	-4.1	2.1	-4.1	2.1	-3.5	1.4	-3.8	1.9	-3.1	2.3	-0.5	1.2	-3.5	2.2	-3.2	2.7	-0.4
WC3	1.7	-4.3	1.9	-3.6	1.6	-2.6	1.8	-3.3	2.2	-3.2	1.8	-2.9	2.3	-3.9	2.4	-3.6	2.2	-3.1
WC4	2.1	-3.1	2.4	-3.0	2.2	-2.2	1.9	-3.3	2.2	-3.0	1.8	-2.2	2.2	-3.9	2.4	-3.2	2.0	-2.6
Pee Dee and Waccamaw Rivers																		
PD2	2.5	-3.6	2.2	-3.5	2.0	-3.0	2.3	-3.4	2.2	-3.2	2.1	-2.9	2.3	-3.2	1.9	-3.0	1.8	-2.5
W2	2.0	-3.3	2.0	-2.8	2.0	-2.6	2.1	-3.3	2.1	-2.9	2.0	-2.2	1.8	-1.8	2.0	-1.7	1.5	-2.0

Table 4

Effects of Plans 1 and 1A on Maximum Current Velocities

Total Inflow 35,000 cfs

	Base						Plan 1						Plan 1A					
	Surface		Middepth		Bottom		Surface		Middepth		Bottom		Surface		Middepth		Bottom	
Station	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb
									Georgetown Harbor Channel									
M1	2.8	-5.8	3.0	-5.8	3.7	-4.9	2.3	-6.4	2.7	-6.7	2.9	-5.7	2.1	-6.3	2.5	-6.1	2.4	-5.3
M3	3.9	-5.1	4.0	-4.0	3.5	-2.9	2.6	-5.1	2.6	-4.2	2.7	-3.4	2.5	-4.6	2.5	-3.9	2.6	-2.9
M5	2.0	-5.0	3.5	-4.3	2.9	-3.6	2.4	-4.0	2.5	-3.0	3.2	-2.9	1.8	-3.3	2.4	-3.1	3.4	-3.4
M7	2.6	-5.5	2.9	-4.4	3.2	-4.5	2.7	-5.0	2.3	-4.1	2.6	-3.9	2.3	-4.5	2.4	-4.2	2.5	-4.0
M9	1.7	-4.4	3.0	-3.6	2.5	-2.0	1.8	-4.1	2.6	-3.6	2.9	-1.7	1.6	-3.8	1.5	-3.4	1.4	-3.2
M11	1.7	-3.4	1.9	-3.1	3.3	-2.3	1.7	-2.9	1.5	-2.4	2.7	-2.3	1.7	-4.0	1.7	-3.9	1.7	-3.6
M12	2.6	-3.6	2.5	-3.1	2.2	-2.2	2.0	-3.5	2.1	-3.2	1.9	-2.6	2.5	-4.0	2.4	-3.8	2.0	-3.4
M13	1.6	-3.6	1.5	-3.6	1.4	-2.9	1.5	-3.6	1.4	-2.9	1.5	-2.3	1.5	-3.6	1.3	-3.4	1.3	-2.7
M14	2.3	-3.9	2.0	-3.5	2.0	-2.9	1.8	-3.6	1.5	-3.2	1.7	-2.7	2.0	-3.8	1.8	-3.4	1.9	-2.6
M15	1.1	-1.4	0.9	-1.3	0.7	-1.1	1.1	-1.1	1.0	-1.1	0.8	-1.1	1.5	-1.5	1.5	-1.5	1.2	-1.6
TB	0.8	-1.4	0.8	-1.4	0.9	-1.1	0.8	-1.4	0.8	-1.2	0.8	-1.0	1.2	-2.0	1.1	-1.8	1.1	-1.2
									Western Channel									
WC0	1.9	-2.7	1.6	-3.1	1.4	-3.0	2.3	-3.1	1.8	-3.3	1.8	-2.9	2.4	-3.8	2.1	-3.9	2.3	-3.1
WC1	1.9	-3.4	1.9	-3.3	1.6	-2.1	1.7	-3.6	1.8	-2.1	2.0	-0.7	1.7	-3.8	1.9	-2.7	2.1	-1.1
WC2	1.7	-3.9	1.8	-4.1	1.6	-3.8	1.1	-3.3	1.7	-3.3	1.8	-0.3	1.7	-3.5	1.5	-3.7	1.5	-0.6
WC3	1.6	-4.5	1.6	-4.4	1.6	-3.6	1.8	-3.6	1.8	-3.5	1.5	-3.4	2.0	-4.2	2.0	-3.6	1.5	-3.4
WC4	1.6	-3.1	1.6	-3.1	1.6	-2.4	1.7	-3.3	1.7	-3.1	1.5	-2.6	1.8	-3.9	1.8	-3.6	1.7	-3.0
									Pee Dee and Waccamaw Rivers									
PD2	2.2	-3.3	2.0	-3.4	1.7	-3.0	2.3	-3.5	2.2	-3.6	2.0	-3.3	2.0	-3.0	1.7	-2.9	1.8	-2.7
W2	1.5	-3.8	1.6	-3.7	1.2	-2.8	1.6	-3.2	1.6	-3.3	1.1	-2.3	1.4	-2.2	1.1	-1.8	0.9	-2.2

Table 5

Effects of Plans 1 and 1A on Maximum Current Velocities

Total Inflow 60,000 cfs

	Base						Plan 1						Plan 1A					
	Surface		Middepth		Bottom		Surface		Middepth		Bottom		Surface		Middepth		Bottom	
Station	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb
Georgetown Harbor Channel																		
M1	2.2	-7.4	2.8	-6.2	3.6	-5.7	2.0	-7.0	2.7	-7.6	3.0	-7.1	1.4	-6.8	2.4	-6.4	2.5	-5.8
M3	2.8	-4.7	3.4	-4.0	2.9	-2.9	2.3	-5.4	2.6	-4.9	2.7	-4.1	1.9	-4.8	2.4	-4.4	2.1	-3.6
M5	1.7	-5.2	2.5	-4.6	3.0	-4.0	2.0	-4.4	2.3	-3.4	3.3	-2.7	1.4	-3.4	2.1	-3.0	3.2	-3.6
M7	2.1	-5.7	2.1	-5.3	2.7	-4.5	2.1	-5.6	2.1	-5.0	1.9	-4.4	1.6	-4.5	1.7	-4.5	1.7	-4.3
M9	1.4	-4.5	2.2	-4.0	2.5	-3.3	1.4	-4.2	2.3	-4.0	2.7	-3.2	1.1	-4.3	1.0	-4.2	1.0	-4.2
M11	1.3	-3.8	1.2	-3.6	1.4	-2.8	1.4	-2.6	1.4	-2.6	1.0	-2.9	1.4	-4.5	1.4	-4.4	1.4	-3.9
M12	1.9	-3.6	1.9	-3.6	1.6	-3.2	1.4	-3.6	1.4	-3.4	1.5	-3.2	1.5	-4.2	1.6	-4.1	1.4	-3.5
M13	1.0	-3.7	1.0	-3.8	0.8	-3.4	1.2	-3.7	1.1	-3.2	0.7	-2.7	0.9	-3.8	0.8	-3.2	0.8	-2.9
M14	1.5	-4.2	1.2	-4.1	1.2	-3.5	1.6	-4.1	1.5	-3.3	1.0	-2.8	1.5	-4.1	1.4	-3.8	1.1	-3.2
M15	1.1	-1.2	1.0	-1.1	0.9	-0.9	1.0	-1.1	1.2	-1.0	1.1	-1.1	1.5	-1.3	1.5	-1.3	1.2	-1.5
TB	0.9	-1.5	0.9	-1.1	0.9	-0.9	0.8	-1.5	1.0	-1.2	1.0	-1.0	1.3	-1.7	1.4	-1.8	1.2	-1.4
Western Channel																		
WC0	1.4	-3.5	1.1	-3.7	1.4	-3.6	2.0	-3.3	1.9	-3.7	2.0	-3.4	1.8	-3.9	1.6	-3.9	2.0	-3.3
WC1	1.4	-3.4	1.4	-3.4	1.7	-2.6	1.4	-3.2	1.8	-2.3	1.6	-1.2	1.1	-3.5	1.8	-2.7	2.2	-1.5
WC2	1.1	-4.1	1.1	-4.1	1.2	-3.4	1.0	-3.9	1.0	-3.4	0.9	-0.7	1.0	-4.2	0.9	-4.2	1.7	-1.2
WC3	1.1	-4.7	1.2	-4.6	1.1	-3.5	1.4	-3.9	1.4	-3.9	1.3	-4.0	1.3	-4.2	1.4	-3.9	1.1	-3.1
WC4	1.4	-3.1	1.3	-3.2	1.3	-2.9	1.4	-3.6	1.3	-3.6	1.4	-2.9	1.3	-4.0	1.3	-3.7	1.3	-3.2
Pee Dee and Waccamaw Rivers																		
PD2	2.0	-3.5	1.9	-3.4	1.8	-3.3	2.2	-3.9	2.1	-3.5	2.0	-3.4	2.0	-3.3	1.9	-3.1	1.7	-2.7
W2	0.3	-4.0	0.3	-3.9	0.3	-3.4	0.4	-3.6	0.4	-3.5	0.3	-2.6	0.3	-2.0	0.0	-2.0	0.0	-2.2

Table 6

Effects of Plans 1 and 1A on Maximum, Minimum, and Average Salinities

Total Inflow 5,000 cfs

	Base						Plan 1						Plan 1A					
	Surface			Bottom			Surface			Bottom			Surface			Bottom		
Station	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
							Georgetown Harbor Channel											
M1	29.9	21.9	27.2	31.1	23.2	28.8	29.4	21.2	26.0	30.7	22.1	28.0	--	--	--	--	--	--
M3	29.8	19.1	25.1	30.1	22.1	27.4	28.9	19.0	24.8	29.4	20.3	26.0	--	--	--	--	--	--
M5	28.3	16.9	22.6	29.6	20.6	25.8	27.5	15.8	21.9	28.1	20.0	25.0	--	--	--	--	--	--
M7	28.7	13.3	20.3	29.5	20.7	25.8	27.3	12.2	19.0	27.6	19.5	24.2	--	--	--	--	--	--
M9	23.0	11.8	17.2	28.7	18.1	23.8	19.4	9.7	14.7	26.7	17.1	22.4	--	--	--	--	--	--
M11	17.1	9.3	13.1	26.9	12.8	20.2	16.0	8.2	11.9	24.6	14.2	19.3	--	--	--	--	--	--
M12	15.5	7.8	11.5	23.6	12.1	18.0	15.7	7.1	10.8	20.9	13.7	17.1	--	--	--	--	--	--
M13	16.1	6.7	10.9	20.7	10.7	15.9	14.2	5.7	9.7	17.9	8.4	14.6	--	--	--	--	--	--
M14	14.2	4.8	9.7	18.7	11.4	14.9	12.8	4.7	8.5	16.2	12.1	13.5	--	--	--	--	--	--
M15	10.3	4.9	8.5	17.9	15.5	17.1	9.3	5.4	8.0	15.7	12.5	14.6	--	--	--	--	--	--
TB	10.2	7.7	9.1	17.9	15.7	17.3	9.0	7.1	8.1	15.3	13.7	14.5	--	--	--	--	--	--
S1	10.1	8.6	9.4	16.5	11.7	14.5	9.0	7.8	8.4	13.7	9.1	11.6	--	--	--	--	--	--
S2	10.0	9.3	9.6	13.9	9.7	11.5	9.0	7.8	8.6	11.7	8.9	10.0	--	--	--	--	--	--
							Western Channel											
WC0	28.2	14.8	22.1	29.3	18.2	24.6	26.7	14.8	20.2	27.3	19.1	24.1	--	--	--	--	--	--
WC1	27.6	13.0	20.9	28.7	15.6	23.0	25.8	12.9	19.5	26.6	19.8	24.5	--	--	--	--	--	--
WC2	23.8	11.9	17.5	27.3	12.4	20.5	20.7	11.4	16.2	24.8	19.4	22.6	--	--	--	--	--	--
WC3	22.9	10.8	16.0	24.9	11.9	18.9	21.4	10.3	15.7	22.8	11.9	17.5	--	--	--	--	--	--
WC4	18.8	10.0	14.1	24.4	12.5	18.6	18.6	9.6	13.3	20.6	11.9	16.5	--	--	--	--	--	--
							Pee Dee and Waccamaw Rivers											
PD2	12.2	4.5	7.5	13.5	6.6	9.3	9.7	4.5	6.7	11.7	5.8	8.3	--	--	--	--	--	--
PD5	7.5	4.9	5.9	9.6	5.1	6.8	6.5	4.1	5.0	8.5	4.3	5.8	--	--	--	--	--	--
PD8	5.5	2.6	4.2	5.6	3.2	4.4	4.7	2.0	3.4	5.0	2.6	3.7	--	--	--	--	--	--
PD16	0.3	0.1	0.2	0.3	0.1	0.2	0.3	0.1	0.2	0.3	0.1	0.2	--	--	--	--	--	--
W2	12.3	2.1	7.4	14.5	4.3	10.2	10.8	1.9	6.6	13.2	4.0	9.2	--	--	--	--	--	--
W5	7.2	0.7	3.7	9.9	0.8	5.1	6.3	0.6	3.4	8.7	0.7	4.7	--	--	--	--	--	--
W13	0.4	0.1	0.2	0.5	0.1	0.3	0.4	0.1	0.3	0.4	0.1	0.2	--	--	--	--	--	--

Note: -- indicates no data obtained.

Table 7

Effects of Plans 1 and 1A on Maximum, Minimum, and Average Salinities

Total Inflow 12,000 cfs

	Base						Plan 1						Plan 1A					
	Surface			Bottom			Surface			Bottom			Surface			Bottom		
Station	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Georgetown Harbor Channel																		
M1	29.3	14.8	23.1	30.8	19.2	27.5	29.3	15.0	22.8	30.4	15.3	26.0	28.7	14.4	22.7	31.0	17.0	26.5
M3	28.6	12.7	20.8	30.0	18.9	25.7	28.3	12.9	20.9	29.6	16.7	24.3	27.2	11.5	19.8	30.4	15.3	24.8
M5	27.4	10.6	17.1	29.3	17.9	24.2	26.3	9.9	16.7	28.6	17.8	24.1	24.8	7.9	15.1	29.2	13.8	23.1
M7	26.0	6.4	13.9	28.3	20.0	23.1	25.8	5.4	13.6	27.0	16.2	22.1	25.4	3.1	14.1	26.7	6.1	17.7
M9	15.3	4.5	10.2	25.5	16.7	21.7	14.5	3.4	8.7	24.6	16.0	21.0	13.2	1.1	5.9	23.8	1.4	12.1
M11	9.8	2.2	5.7	23.7	5.8	16.5	10.1	1.7	5.3	22.9	9.6	16.6	7.9	0.7	3.4	12.6	0.9	5.4
M12	8.8	1.3	4.6	20.9	4.0	13.9	8.7	0.9	4.1	18.7	8.4	14.0	6.6	0.5	2.7	9.7	0.5	4.2
M13	9.7	0.8	5.3	16.5	2.5	9.9	7.9	0.7	3.8	15.7	4.6	12.1	5.2	0.3	1.8	7.8	0.4	3.6
M14	6.3	0.3	2.9	13.7	4.3	9.9	5.2	0.4	2.5	13.4	5.3	9.4	4.2	0.3	1.1	5.6	0.3	2.0
M15	3.6	0.4	2.1	12.8	11.6	12.3	3.4	0.5	2.0	11.3	9.3	10.7	0.9	0.5	0.6	1.5	0.5	0.8
TB	2.8	0.9	1.9	11.2	9.9	10.8	3.1	1.0	2.2	10.8	9.8	10.4	0.7	0.3	0.5	0.8	0.5	0.6
S1	3.7	1.5	2.8	11.0	7.4	9.8	3.1	1.2	2.3	9.3	3.1	6.4	0.6	0.5	0.5	0.6	0.5	0.5
S2	3.7	2.4	3.3	8.8	3.6	5.8	2.8	2.2	2.6	6.8	2.9	4.4	0.5	0.5	0.5	0.5	0.5	0.5
Western Channel																		
WC0	25.9	7.8	15.7	26.7	11.7	20.9	25.0	8.5	15.1	27.4	16.6	24.1	26.2	5.6	14.1	28.2	14.2	23.5
WC1	24.8	6.3	14.7	27.3	8.1	19.2	25.0	7.0	14.8	26.6	18.4	23.4	21.4	4.5	11.9	26.1	15.9	22.6
WC2	16.7	4.9	10.8	26.0	5.4	16.3	19.3	4.8	11.4	24.4	21.7	23.8	18.1	1.8	8.8	25.5	18.9	23.7
WC3	16.3	4.2	9.4	23.8	5.1	14.1	17.9	3.9	9.6	21.6	4.2	13.3	18.1	1.2	8.4	22.4	1.3	12.1
WC4	13.9	3.0	7.4	21.7	4.4	12.6	13.0	2.9	7.3	19.5	4.0	12.0	13.5	1.1	6.7	19.4	1.2	10.6
Pee Dee and Waccamaw Rivers																		
PD2	4.4	0.3	1.4	6.5	0.5	2.3	3.2	0.4	1.3	5.0	0.7	1.8	1.1	0.1	0.4	1.2	0.2	0.5
PD5	1.2	0.5	0.7	1.3	0.5	0.7	1.3	0.5	0.7	1.4	0.5	0.8	0.4	0.2	0.3	0.4	0.2	0.3
PD8	0.6	0.3	0.4	0.6	0.3	0.5	0.6	0.2	0.4	0.6	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2
PD16	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
W2	4.5	0.2	1.5	6.6	0.2	3.2	3.6	0.1	1.4	6.0	0.1	2.5	1.5	0.1	0.7	3.1	0.1	1.3
W5	1.2	0.1	0.5	1.4	0.1	0.6	1.0	0.1	0.4	1.3	0.1	0.5	0.5	0.1	0.2	0.5	0.1	0.3
W13	0.2	0.1	0.1	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Table 8

Effects of Plans 1 and 1A on Maximum, Minimum, and Average Salinities

Total Inflow 35,000 cfs

	Base						Plan 1						Plan 1A					
	Surface			Bottom			Surface			Bottom			Surface			Bottom		
Station	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Georgetown Harbor Channel																		
M1	25.0	6.0	16.2	30.4	12.6	25.8	25.2	6.3	15.6	30.1	8.2	24.7	25.3	4.5	14.6	30.3	6.6	24.0
M3	23.4	4.0	12.6	29.5	13.9	24.4	24.3	4.4	13.3	29.1	11.4	22.3	22.5	2.4	11.7	29.6	7.3	21.8
M5	23.2	2.4	8.7	28.1	12.3	22.1	20.1	1.9	8.9	26.8	12.1	20.6	17.9	1.0	6.0	27.9	6.2	19.4
M7	20.7	1.0	6.1	26.3	12.3	20.9	18.2	0.7	6.0	24.8	11.8	19.1	15.7	0.1	4.4	22.0	0.1	10.5
M9	6.0	0.2	3.0	24.6	5.8	16.6	4.0	0.2	1.5	21.5	5.7	15.3	2.4	0.1	0.6	16.5	0.1	3.4
M11	5.2	0.1	1.0	22.3	0.1	11.2	1.2	0.1	0.6	17.8	0.1	9.5	0.5	0.1	0.2	0.8	0.1	0.3
M12	4.6	0.1	0.9	18.9	0.1	7.7	1.1	0.1	0.4	15.3	0.1	5.3	0.4	0.1	0.2	0.6	0.1	0.2
M13	4.0	0.1	0.8	13.7	0.1	4.5	0.8	0.1	0.3	9.4	0.1	3.2	0.3	0.1	0.1	0.4	0.1	0.2
M14	0.6	0.1	0.2	3.8	0.1	0.7	0.4	0.1	0.2	0.6	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.1
M15	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TB	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S1	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1
S2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Western Channel																		
WC0	18.3	1.2	6.7	27.0	2.9	16.1	20.3	1.4	7.3	24.0	11.4	18.6	18.3	0.7	6.1	25.0	12.5	20.1
WC1	16.5	0.7	5.2	25.2	1.1	13.7	14.0	0.8	6.4	23.3	15.1	20.3	12.5	0.5	5.2	24.2	13.8	19.9
WC2	8.9	0.4	3.2	22.6	0.5	9.7	11.7	0.3	4.5	21.1	17.7	19.8	13.3	0.2	3.0	21.7	16.8	19.0
WC3	6.8	0.2	2.1	19.1	0.3	6.5	8.5	0.2	2.7	15.0	0.3	6.0	10.1	0.1	2.3	18.1	0.1	6.7
WC4	2.6	0.2	1.0	15.6	0.2	5.5	3.3	0.1	1.2	12.2	0.2	5.0	1.6	0.1	0.6	14.3	0.1	5.5
Pee Dee and Waccamaw Rivers																		
PD2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PD5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PD8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PD16	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
W2	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
W5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
W13	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Table 9

Effects of Plans 1 and 1A on Maximum, Minimum, and Average Salinities

Total Inflow 60,000 cfs

	Base						Plan 1						Plan 1A					
	Surface			Bottom			Surface			Bottom			Surface			Bottom		
Station	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Georgetown Harbor Channel																		
M1	18.6	1.6	8.5	30.6	3.7	24.0	21.9	1.9	10.6	28.8	2.8	21.1	15.8	0.8	8.0	30.4	1.6	22.0
M3	15.5	1.0	5.1	29.4	1.4	21.0	19.1	1.1	7.7	28.4	1.5	19.1	16.2	0.5	5.9	29.1	1.3	20.7
M5	13.7	0.3	4.4	27.4	1.0	16.4	11.4	0.5	2.8	25.8	2.3	16.3	7.6	0.2	1.3	27.2	0.6	16.1
M7	7.4	0.1	2.0	25.1	0.3	14.3	5.8	0.1	1.4	22.6	0.2	13.4	2.9	0.1	0.9	17.3	0.1	4.3
M9	2.4	0.1	0.7	22.4	0.1	10.7	1.2	0.1	0.4	20.7	0.1	10.2	0.3	0.1	0.2	0.6	0.1	0.3
M11	0.2	0.0	0.1	18.8	0.1	3.9	0.2	0.1	0.1	17.1	0.1	4.1	0.1	0.1	0.1	0.1	0.1	0.1
M12	0.2	0.1	0.1	10.9	0.1	1.1	0.1	0.1	0.1	8.3	0.1	0.8	0.1	0.1	0.1	0.1	0.1	0.1
M13	0.2	0.1	0.1	0.3	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
M14	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
M15	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TB	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S2	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Western Channel																		
WC0	7.9	0.1	1.6	25.2	0.4	12.1	11.6	0.4	3.0	23.1	5.8	16.3	6.8	0.3	1.8	24.4	3.2	15.7
WC1	4.3	0.1	1.5	23.2	0.1	10.1	4.6	0.3	1.7	21.5	9.6	16.0	2.9	0.3	1.5	23.5	6.7	17.1
WC2	1.1	0.1	0.5	19.4	0.1	4.7	5.6	0.2	1.2	19.0	9.9	15.1	2.9	0.1	0.9	21.2	7.3	15.6
WC3	1.3	0.1	0.4	15.5	0.1	2.6	1.1	0.1	0.4	10.7	0.1	1.7	1.3	0.1	0.3	16.5	0.1	3.2
WC4	0.3	0.1	0.1	0.6	0.1	0.2	0.5	0.1	0.2	0.5	0.1	0.2	0.3	0.1	0.2	0.4	0.1	0.2
Pee Dee and Waccamaw Rivers																		
PD2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PD5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PD8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PD16	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
W2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
W5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
W13	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Table 10

Effects of Plans 1 and 1A on Shoaling

Shoaling Section	Prototype cu yd*	Base cu cm	Plan 1 cu cm	Plan 1 Index	Plan 1 APD** cu yd	Plan 1A cu cm	Plan 1A Index	Plan 1A APD cu yd
Eastern Channel (sections 8-18)	283,000	110	105	--	0†	140	--	0†
Upper Winyah Bay (sections 19-27)	652,000	1,650	1,585	0.96	0††	205	0.12	80,000
Sampit River (sections 28-44)	1,323,400	830	795	0.96	0††	105	0.13	170,000
Subtotal	2,258,400	2,590	2,485		0††	450		250,000
Western Channel								
Section WC1	--	5	10	2.00	30,000	10	2.00	30,000
Section WC2	--	15	30	2.00	80,000	35	2.33	90,000
Section WC3	--	50	210	4.20	530,000	300	6.00	770,000
Section WC4	--	5	30	6.00	80,000	30	6.00	80,000
Subtotal	--	75	280		720,000	375		970,000
Total	2,258,400	2,665	2,765	0.32‡	720,000	825	0.54‡	1,220,000

* Yearly average (1969-1972) for sections 8-14; yearly average (1972-1976) for sections 15-44.

** Approximate prototype dredging.

† Under Plans 1 and 1A, Eastern Channel abandoned.

†† Based on assumption that no dredging would be accomplished during the period required for the channel to shoal naturally from 27 to 13 ft deep.

‡ Approximate prototype dredging divided by prototype.

Table 11

Effects of Plans 2 and 3 on Shoaling

Shoaling Section	Prototype cu yd*	Base cu cm	Plan 2 cu cm	Plan 2 Index	Plan 2 APD** cu yd	Plan 3 cu cm	Plan 3 Index	Plan 3 APD cu yd
Eastern Channel (sections 8-18)	283,000	110	190	--	0†	170	--	0†
Upper Winyah Bay (sections 19-27)	652,000	1,650	180	0.11	70,000	230	0.14	90,000
Sampit River (sections 28-44)	1,323,400	830	80	0.10	130,000	120	0.14	190,000
Subtotal	2,258,400	2,590	450		200,000	520		280,000
Western Channel								
Section WC1	--	5	5	1.00	10,000	10	2.00	30,000
Section WC2	--	15	50	3.33	130,000	300	20.00	770,000
Section WC3	--	60	570	11.40	1,470,000	460	9.20	1,190,000
Section WC4	--	5	140	28.00	360,000	25	5.00	60,000
Subtotal	--	75	765		1,970,000	795		2,050,000
Sediment Trap (Plan 3 only)	--	--	--	--	--	800	--	2,060,000
Total	2,258,400	2,665	1,215	0.96††	2,170,000		1.94††	4,390,000

* Yearly average (1969-1972) for sections 8-14; yearly average (1972-1976) for sections 15-44.
** Approximate prototype dredging.
† Under Plans 2 and 3, Eastern Channel abandoned.
†† Approximate prototype dredging divided by prototype.

Table 12

Effects of Plans 4 and 5 on Shoaling

Shoaling Section	Prototype cu yd*	Base cu cm	Plan 4 cu cm	Plan 4 Index	Plan 4 APD** cu yd	Plan 5 cu cm	Plan 5 Index	Plan 5 APD cu yd
Eastern Channel (sections 8-18)	283,000	110	105	--	0†	125	--	0†
Upper Winyah Bay (sections 19-27)	652,000	1,650	390	0.24	160,000	220	0.13	80,000
Sampit River (sections 28-44)	1,323,400	830	190	0.23	300,000	110	0.13	170,000
Subtotal	2,258,400	2,590	685		460,000	455		250,000
Western Channel								
Section WC1	--	5	85	17.00	220,000	15	3.00	40,000
Section WC2	--	15	90	6.00	230,000	140	9.33	360,000
Section WC3	--	50	135	2.70	350,000	440	8.80	1,130,000
Section WC4	--	5	45	9.00	110,000	15	3.00	40,000
Subtotal	--	75	355		910,000	610		1,570,000
Sediment Trap (Plan 5 only)	--	--	--		--	40	--	100,000
Total	2,258,400	2,665	1,040	0.61††	1,370,000	1,105	0.85††	1,920,000

* Yearly average (1969-1972) for sections 8-14; yearly average (1972-1976) for sections 15-44.
** Approximate prototype dredging.
† Under Plans 4 and 5, Eastern Channel abandoned.
†† Approximate prototype dredging divided by prototype.

Table 13

Effects of Plan 6 on Shoaling

Shoaling Section	Prototype cu yd*	Base cu cm	Plan 6 cu cm	Plan 6 Index	Plan 6 APD** cu yd
Eastern Channel (sections 8-18)	283,000	110	970	--	0†
Upper Winyah Bay (sections 19-27)	652,000	1,650	295	0.18	120,000
Sampit River (sections 28-44)	1,323,400	830	95	0.11	150,000
Subtotal	2,258,400	2,590	1,360		270,000
Western Channel					
Section WC1	--	5	85	17.00	220,000
Section WC2	--	15	275	18.33	700,000
Section WC3	--	50	35	0.70	90,000
Section WC4 (TB)	--	5	10	2.00	30,000
Subtotal	--	75	405		1,040,000
Total	2,258,400	2,665	1,765	0.58††	1,310,000

* Yearly average (1969-1972) for sections 8-14; yearly average (1972-1976) for sections 15-44.

** Approximate prototype dredging.

† Under Plan 6, Eastern Channel abandoned.

†† Approximate prototype dredging divided by prototype.

Table 14

Effects of Plan 7 on Shoaling

Shoaling Section	Prototype cu yd*	Base cu cm	Plan 7 cu cm	Plan 7 Index	Plan 7 APD** cu yd
Lower Eastern Channel - Marsh Island Channel and Turning Basin (sections 1-11)	66,000	25	200	8.00	530,000
Upper Eastern Channel (sections 12-18)	217,000	85	75	0.88	190,000
Upper Winyah Bay (sections 19-27)	652,000	1,650	220	0.13	80,000
Sampit River (sections 28-44)	1,323,400	830	110	0.13	170,000
Total	2,258,400	2,590	605	0.43†	970,000

* Yearly average (1969-1972) for sections 1-14; yearly average (1972-1976) for sections 15-44.

** Approximate prototype dredging.

† Approximate prototype dredging divided by prototype.

Table 15

Effects of Plans 8 and 9 on Shoaling

Shoaling Section	Prototype cu yd*	Base cu cm	Plan 8 cu cm	Plan 8 Index	Plan 8 APD** cu yd	Plan 9 cu cm	Plan 9 Index	Plan 9 APD** cu yd
Eastern Channel (sections 8-18)	283,000	110	140	1.27	360,000	130	1.18	330,000
Upper Winyah Bay (sections 18-27)	652,000	1,650	2,540	1.54	1,000,000	2,840	1.72	1,120,000
Sampit River (sections 28-44)	1,323,400	830	555	0.67	890,000	590	0.71	940,000
Subtotal	2,258,400	2,590	3,235		2,250,000	3,590		2,390,000
Sediment Trap	--	†	505	--	810,000	550	--	880,000
Total	2,258,400		3,740	1.35†	3,060,000	4,140	1.47††	3,270,000

* Yearly average (1969-1972) for sections 8-14; yearly average (1972-1976) for sections 15-44.
** Approximate prototype dredging.
† Small amount of material was deposited over the sediment trap site, but the material was not measured.
†† Approximate prototype dredging divided by prototype.

Table 16

Effects of Plan 10 on Tide Heights*

Test	Yawkies Dock HW	Yawkies Dock LW	Jones Creek HW	Jones Creek LW	South Island Rd HW	South Island Rd LW	Skinners Dock HW	Skinners Dock LW	Papermill Dock HW	Papermill Dock LW	Old Hwy 17 Bridge HW	Old Hwy 17 Bridge LW
Total Inflow 12,000 cfs (0 cfs over Dam)												
Base	3.6	-0.2	3.6	-0.4	3.6	-0.2	3.6	-0.2	3.7	-0.3	3.6	-0.3
Plan 10	3.6	-0.2	3.7	-0.2	3.8	-0.6	3.9	-0.5	3.8	-0.9	4.0	-0.8
Total Inflow 35,000 cfs (5,000 cfs over Dam)												
Base	3.5	-0.2	3.6	-0.5	3.7	-0.3	3.6	-0.1	3.7	-0.2	3.7	-0.2
Plan 10	3.6	-0.2	3.7	-0.2	3.7	-0.5	4.0	-0.4	3.8	-0.9	4.0	-0.7
Total Inflow 60,000 cfs (30,000 cfs over Dam)												
Base	3.5	-0.2	3.6	-0.4	3.6	-0.2	3.7	0.0	3.6	-0.2	3.8	0.0
Plan 10	3.6	-0.2	3.8	-0.2	3.8	-0.3	4.0	-0.2	3.9	-0.7	4.1	-0.5

* Tide heights are referred to mean sea level (msl) in prototype feet; HW is high water; LW is low water.

Table 17

Effects of Plan 10 on Maximum Current Velocities

Total Inflow 12,000 cfs (0 cfs over Dam)

Georgetown Harbor Channel

	Base						Plan 10					
	Surface		Middepth		Bottom		Surface		Middepth		Bottom	
Station	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb
Georgetown Harbor Channel												
M1	3.2	-4.7	2.9	-5.3	3.4	-5.0	2.6	-5.6	3.0	-5.5	2.7	-4.8
M3	4.5	-4.5	4.3	-3.6	3.8	-3.5	3.3	-4.2	3.1	-3.6	2.8	-3.1
M5	2.5	-4.5	2.9	-4.1	3.1	-3.1	2.2	-2.4	2.2	-2.3	1.9	-2.1
M7	3.2	-5.0	2.9	-3.8	2.8	-3.8	3.2	-3.3	2.9	-2.9	2.1	-2.9
M9	1.7	-4.1	2.9	-2.8	2.8	-1.8	2.3	-2.0	2.6	-1.4	2.1	-1.2
M11	1.7	-3.3	2.8	-2.7	3.2	-1.3	1.6	-1.3	1.6	-1.1	1.5	-1.2
M12	2.7	-3.4	2.9	-3.0	2.8	-1.6	1.2	-1.3	1.5	-1.1	1.1	-1.1
M13	1.9	-3.8	2.3	-3.1	2.3	-2.5	0.8	-1.1	0.9	-0.9	1.1	-0.6
M14	2.6	-3.5	2.3	-3.1	2.5	-2.6	0.9	-1.8	1.1	-1.4	1.1	-1.2
M15	1.4	-1.6	1.1	-1.1	1.4	-0.5	0.8	-1.5	0.9	-1.3	0.9	-1.8
TB	0.9	-1.7	0.8	-2.2	0.8	-0.7	0.8	-1.7	1.1	-1.9	1.3	-1.7
Western Channel												
WC0	1.8	-2.6	1.6	-3.1	1.7	-3.3	2.3	-2.5	2.3	-2.7	2.2	-2.6
WC1	2.1	-3.1	2.2	-2.9	2.1	-2.0	1.8	-2.3	1.9	-1.9	1.5	-1.8
WC2	1.7	-4.1	2.1	-4.1	2.1	-3.5	2.5	-2.0	2.6	-2.2	2.5	-2.2
WC3	1.7	-4.3	1.9	-3.6	1.6	-2.6	1.7	-1.7	1.8	-1.8	1.7	-1.6
WC4	2.1	-3.1	2.4	-3.0	2.2	-2.2	1.6	-1.6	1.7	-1.5	1.5	-1.2
Pee Dee and Waccamaw Rivers												
PD2	2.5	-3.6	2.2	-3.5	2.0	-3.0	0.8	-0.9	0.8	-0.9	0.5	-0.8
W2	2.0	-3.3	2.0	-2.8	2.0	-2.6	0.3	-0.4	0.8	-0.4	0.4	-0.3

Table 18

Effects of Plan 10 on Maximum Current Velocities

Total Inflow 35,000 cfs (5,000 cfs over Dam)

Georgetown Harbor Channel

	Base						Plan 10					
	Surface		Middepth		Bottom		Surface		Middepth		Bottom	
Station	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb
						Georgetown Harbor Channel						
M1	2.8	-5.8	3.0	-5.8	3.7	-4.9	2.9	-5.5	2.8	-5.6	2.8	-4.9
M3	3.9	-5.1	4.0	-4.0	3.5	-2.9	3.6	-3.8	3.3	-3.6	3.1	-3.0
M5	2.0	-5.0	3.5	-4.3	2.9	-3.6	2.1	-2.8	2.5	-2.1	2.3	-1.8
M7	2.6	-5.5	2.9	-4.4	3.2	-4.5	3.2	-3.2	2.6	-3.1	2.5	-2.6
M9	1.7	-4.4	3.0	-3.6	2.5	-2.0	2.2	-2.3	2.4	-1.2	2.5	-0.6
M11	1.7	-3.4	1.9	-3.1	3.3	-2.3	1.1	-1.9	2.0	-1.2	1.7	-0.6
M12	2.6	-3.6	2.5	-3.1	2.2	-2.2	1.1	-1.4	1.5	-1.1	1.1	-0.9
M13	1.6	-3.6	1.5	-3.6	1.4	-2.9	0.7	-1.1	0.9	-1.2	1.1	-0.8
M14	2.3	-3.9	2.0	-3.5	2.0	-2.9	0.9	-1.5	1.0	-1.6	1.1	-1.5
M15	1.1	-1.4	0.9	-1.3	0.7	-1.1	1.0	-2.0	0.9	-1.3	0.9	-1.3
TB	0.8	-1.4	0.8	-1.4	0.9	-1.1	0.8	-2.0	1.1	-1.7	0.9	-1.5
						Western Channel						
WC0	1.9	-2.7	1.6	-3.1	1.4	-3.0	2.0	-2.4	2.2	-2.5	2.0	-2.5
WC1	1.9	-3.4	1.9	-3.3	1.6	-2.1	1.7	-2.2	1.7	-1.9	1.4	-1.1
WC2	1.7	-3.9	1.8	-4.1	1.6	-3.8	2.3	-2.5	2.7	-2.5	2.4	-2.2
WC3	1.6	-4.5	1.6	-4.4	1.6	-3.6	1.5	-2.2	1.6	-1.9	1.7	-1.6
WC4	1.6	-3.1	1.6	-3.1	1.6	-2.4	1.7	-1.5	1.5	-1.4	1.2	-1.1
						Pee Dee and Waccamaw Rivers						
PD2	2.2	-3.3	2.0	-3.4	1.7	-3.0	0.2	-0.8	0.8	-1.0	0.8	-1.1
W2	1.5	-3.8	1.6	-3.7	1.2	-2.8	0.3	-0.4	0.8	-0.4	0.4	-0.3

Table 19

Effects of Plan 10 on Maximum Current Velocities

Total Inflow 60,000 cfs (30,000 cfs over Dam)

Georgetown Harbor Channel

	Base						Plan 10					
	Surface		Middepth		Bottom		Surface		Middepth		Bottom	
Station	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb
Georgetown Harbor Channel												
M1	2.2	-7.4	2.8	-6.2	3.6	-5.7	2.7	-6.3	2.7	-5.1	3.0	-4.8
M3	2.8	-4.7	3.4	-4.0	2.9	-2.9	3.1	-4.5	2.7	-3.2	2.6	-2.4
M5	1.7	-5.2	2.5	-4.6	3.0	-4.0	2.1	-3.3	2.3	-2.6	3.1	-2.6
M7	2.1	-5.7	2.1	-5.3	2.7	-4.5	2.7	-3.4	2.3	-2.9	2.1	-3.1
M9	1.4	-4.5	2.2	-4.0	2.5	-3.3	2.1	-2.8	2.4	-1.6	2.0	-1.0
M11	1.3	-3.8	1.2	-3.6	1.4	-2.8	1.2	-2.2	1.3	-1.4	1.4	-0.8
M12	1.9	-3.6	1.9	-3.6	1.6	-3.2	0.9	-1.9	0.9	-1.4	1.5	-0.9
M13	1.0	-3.7	1.0	-3.8	0.8	-3.4	0.4	-2.1	0.6	-1.6	1.1	-0.5
M14	1.5	-4.2	1.2	-4.1	1.2	-3.5	0.4	-2.0	0.6	-2.0	1.3	-1.3
M15	1.1	-1.2	1.0	-1.1	0.9	-0.9	1.1	-1.5	0.9	-1.8	1.4	-1.1
TB	0.9	-1.5	0.9	-1.1	0.9	-0.9	1.2	-2.0	0.8	-2.0	0.9	-1.1
Western Channel												
WC0	1.4	-3.5	1.1	-3.7	1.4	-3.6	2.5	-2.7	2.0	-2.5	1.2	-2.4
WC1	1.4	-3.4	1.4	-3.4	1.7	-2.6	2.1	-2.5	2.0	-2.1	1.4	-1.0
WC2	1.1	-4.1	1.1	-4.1	1.2	-3.4	2.0	-2.9	2.2	-2.7	1.8	-2.3
WC3	1.1	-4.7	1.2	-4.6	1.1	-3.5	1.3	-2.4	1.4	-2.3	1.4	-1.8
WC4	1.4	-3.1	1.3	-3.2	1.3	-2.9	1.4	-2.0	1.4	-1.8	0.6	-1.1
Pee Dee and Waccamaw Rivers												
PD2	2.0	-3.5	1.9	-3.4	1.8	-3.3	0.0	-1.7	0.0	-1.7	0.0	-1.4
W2	0.3	-4.0	0.3	-3.9	0.3	-3.4	0.0	-0.7	0.0	-0.4	0.0	-0.4

Table 20

Effects of Plan 10 on Maximum, Minimum, and Average Salinities

Total Inflow 12,000 cfs (0 cfs over Dam)

Georgetown Harbor Channel

Station	Base						Plan 10					
	Surface			Bottom			Surface			Bottom		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Georgetown Harbor Channel												
M1	29.3	14.8	23.1	30.8	19.2	27.5	30.2	25.9	28.4	31.2	26.0	29.2
M3	28.6	12.7	20.8	30.0	18.9	25.7	30.0	24.7	27.7	30.1	25.2	28.2
M5	27.4	10.6	17.1	29.3	17.9	24.2	29.0	23.4	26.2	29.8	25.1	27.4
M7	26.0	6.4	13.9	28.3	20.0	23.1	29.1	22.1	25.4	29.5	25.4	28.1
M9	15.3	4.5	10.2	25.5	16.7	21.7	26.4	19.8	23.0	28.8	25.5	27.6
M11	9.8	2.2	5.7	23.7	5.8	16.5	24.6	18.9	22.0	26.9	25.1	26.0
M12	8.8	1.3	4.6	20.9	4.0	13.9	24.2	18.6	21.0	25.7	24.7	25.2
M13	9.7	0.8	5.3	16.5	2.5	9.9	23.2	19.6	21.6	25.0	24.7	24.8
M14	6.3	0.3	2.9	13.7	4.3	9.9	21.4	17.3	19.3	24.3	22.3	23.6
M15	3.6	0.4	2.1	12.8	11.6	12.3	21.3	19.6	20.3	23.7	20.8	22.5
TB	2.8	0.9	1.9	11.2	9.9	10.8	20.7	18.7	19.7	23.4	21.4	22.4
S1	3.1	1.5	2.8	11.0	7.4	9.8	21.0	17.9	19.4	22.7	18.6	20.7
S2	3.7	2.4	3.3	8.8	3.6	5.8	20.7	16.4	18.4	21.6	17.9	19.8
Western Channel												
WC0	25.9	7.8	15.7	26.7	11.7	20.9	28.9	22.8	25.6	29.1	23.6	26.3
WC1	24.8	6.3	14.7	27.3	8.1	19.2	28.3	21.8	25.0	28.6	23.8	26.1
WC2	16.7	4.9	10.8	26.0	5.4	16.3	26.7	21.6	23.9	27.1	23.3	25.1
WC3	16.3	4.2	9.4	23.8	5.1	14.1	25.6	20.7	23.2	26.0	23.3	24.5
WC4	13.9	3.0	7.4	21.7	4.4	12.6	24.7	19.6	22.2	25.2	22.8	24.5
Pee Dee and Waccamaw Rivers												
PD2	4.4	0.3	1.4	6.5	0.5	2.3	21.0	15.8	18.3	22.8	21.9	22.4
W2	4.5	0.2	1.5	6.6	0.2	3.2	20.7	17.6	19.4	22.0	20.9	21.5

Table 21

Effects of Plan 10 on Maximum, Minimum, and Average Salinities

Total Inflow 35,000 cfs (5,000 cfs over Dam)

Georgetown Harbor Channel

	Base						Plan 10					
	Surface			Bottom			Surface			Bottom		
Station	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Georgetown Harbor Channel												
M1	25.0	6.0	16.2	30.4	12.6	25.8	30.3	22.7	27.3	31.2	22.4	28.0
M3	23.4	4.0	12.6	29.5	13.9	24.4	30.0	20.8	25.9	30.2	22.5	27.2
M5	23.2	2.4	8.7	28.1	12.3	22.1	28.9	18.2	23.6	29.7	23.6	26.8
M7	20.7	1.0	6.1	26.3	12.3	20.9	27.3	16.7	21.2	29.1	23.1	27.1
M9	6.0	0.2	3.0	24.6	5.8	16.6	20.9	11.5	17.5	28.2	22.9	26.6
M11	5.2	0.1	1.0	22.3	0.1	11.2	19.4	8.6	13.9	26.3	24.2	25.6
M12	4.6	0.1	0.9	18.9	0.1	7.7	17.4	5.3	10.6	25.8	24.0	25.1
M13	4.0	0.1	0.8	13.7	0.1	4.5	17.6	6.9	12.7	25.1	23.5	24.6
M14	0.6	0.1	0.2	3.8	0.1	0.7	15.2	4.2	9.9	24.0	20.3	22.6
M15	0.2	0.1	0.1	0.2	0.1	0.1	15.8	6.4	12.4	22.5	19.8	21.3
TB	0.2	0.1	0.2	0.2	0.1	0.2	16.6	15.1	16.1	20.8	18.7	19.7
S1	0.2	0.1	0.2	0.2	0.1	0.2	15.4	13.7	14.6	20.4	14.4	16.2
S2	0.2	0.2	0.2	0.2	0.2	0.2	17.2	14.7	15.9	19.6	14.4	16.9
Western Channel												
WC0	18.3	1.2	6.7	27.0	2.9	16.1	26.9	15.9	20.7	27.3	17.4	22.8
WC1	16.5	0.7	5.2	25.2	1.1	13.7	25.8	16.1	21.3	28.2	21.9	25.0
WC2	8.9	0.4	3.2	22.6	0.5	9.7	23.3	13.2	18.8	25.9	20.1	22.2
WC3	6.8	0.2	2.1	19.1	0.3	6.5	21.9	12.8	18.1	24.2	20.3	21.7
WC4	2.6	0.2	1.0	15.6	0.2	5.5	20.6	10.1	15.8	22.1	19.2	21.0
Pee Dee and Waccamaw Rivers												
PD2	0.1	0.1	0.1	0.1	0.1	0.1	13.0	2.3	5.3	19.0	17.4	18.4
W2	0.2	0.1	0.1	0.2	0.1	0.1	14.7	6.6	10.2	17.4	15.6	17.0

Table 22

Effects of Plan 10 on Maximum, Minimum, and Average Salinities

Total Inflow 60,000 cfs (30,000 cfs over Dam)

Georgetown Harbor Channel

Station	Base						Plan 10					
	Surface			Bottom			Surface			Bottom		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Georgetown Harbor Channel												
M1	18.6	1.6	8.5	30.6	3.7	24.0	24.3	6.8	16.0	30.7	13.9	25.5
M3	15.5	1.0	5.1	29.4	1.4	21.0	24.6	5.1	13.8	30.5	17.9	24.8
M5	13.7	0.3	4.4	27.4	1.0	16.4	22.4	4.0	10.0	28.0	16.9	23.1
M7	7.4	0.1	2.0	25.1	0.3	14.3	13.6	2.2	6.1	25.1	17.2	22.2
M9	2.4	0.1	0.7	22.4	0.1	10.7	5.7	0.8	2.3	22.9	20.0	21.5
M11	0.2	0.1	0.1	18.8	0.1	3.9	1.7	0.3	0.8	19.7	18.5	19.1
M12	0.2	0.1	0.1	10.9	0.1	1.1	0.8	0.2	0.4	19.0	16.9	18.5
M13	0.2	0.1	0.1	0.3	0.1	0.1	0.7	0.1	0.3	18.9	18.5	18.7
M14	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.2	18.8	15.4	17.5
M15	0.1	0.1	0.1	0.1	0.1	0.1	2.2	0.2	0.8	18.3	15.9	17.1
TB	0.1	0.1	0.1	0.1	0.1	0.1	4.5	0.6	2.5	17.4	15.1	16.3
S1	0.1	0.1	0.1	0.1	0.1	0.1	4.8	1.0	3.1	16.0	9.5	12.9
S2	0.2	0.1	0.1	0.2	0.1	0.1	4.6	1.9	3.7	14.7	4.5	8.4
Western Channel												
WC0	7.9	0.1	1.6	25.2	0.4	12.1	18.5	2.6	7.5	24.4	11.2	18.3
WC1	4.3	0.1	1.5	23.2	0.1	10.1	10.4	1.6	5.7	22.5	13.9	18.5
WC2	1.1	0.1	0.5	19.4	0.1	4.7	8.6	1.0	4.2	17.1	8.4	12.7
WC3	1.3	0.1	0.4	15.5	0.1	2.6	7.0	1.0	3.4	15.0	11.0	12.8
WC4	0.3	0.1	0.1	0.6	0.1	0.2	3.9	0.5	1.8	15.8	13.8	14.7
Pee Dee and Waccamaw Rivers												
PD2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
W2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1

Table 23

Effects of Plan 10 on Shoaling

Shoaling Section	Prototype cu yd*	Base cu cm	Plan 10** (0 cfs over Dam) cu cm	Plan 10** (0 cfs over Dam) Index	Plan 10** (25,000 cfs over Dam) cu cm	Plan 10** (25,000 cfs over Dam) Index	Plan 10 Average cu cm	Plan 10 Average Index	Plan 10 APD† cu yd
Eastern Channel (sections 8-18)	283,000	110	94	0.85	200	1.82	147	1.34	380,000
Upper Winyah Bay (sections 19-27)	652,000	1,650	270	0.16	368	0.22	319	0.19	120,000
Sampit River (sections 28-44)	1,323,400	830	63	0.08	66	0.08	65	0.08	110,000
Total	2,258,400	2,590	427		634		531	0.27††	610,000

* Yearly average (1969-1972) for sections 8-14; yearly average (1972-1976) for sections 15-44.
** Gilsonite injection 10 percent of base injection.
† Approximate prototype dredging.
†† Approximate prototype dredging divided by prototype.

Table 24

Effects of Plan 11 on Tide Heights*

Test	Yawkies Dock		Jones Creek		South Island Road		Skinners Dock		Papermill Dock		Old Hwy 17 Bridge		Sandy Island		Hasty Point		Wacca Wache		Topsaw Landing		Bucksport	
	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW
Total Inflow 12,000 cfs																						
Base	3.6	-0.2	3.6	-0.4	3.6	-0.2	3.6	-0.2	3.7	-0.3	3.6	-0.3	3.7	0.4	3.8	1.0	3.8	0.9	4.0	2.2	3.7	1.2
Plan 11	3.6	-0.2	3.8	-0.2	3.8	0.0	3.7	0.0	3.8	-0.1	3.8	0.0	3.7	0.3	3.8	1.0	3.8	0.6	4.1	2.1	3.8	0.9
Total Inflow 35,000 cfs																						
Base	3.5	-0.2	3.6	-0.5	3.7	-0.3	3.6	-0.1	3.7	-0.2	3.7	-0.2	3.9	1.0	4.1	1.8	4.2	2.0	4.9	4.5	4.1	3.0
Plan 11	3.6	-0.2	3.6	-0.3	3.8	-0.2	3.7	0.0	3.8	0.0	3.8	0.0	3.9	0.9	4.1	1.9	4.2	1.9	5.3	5.0	4.2	2.8

* Tide heights are referred to mean sea level (msl) in prototype feet; HW is high water; LW is low water.

Table 25

Effects of Plan 11 on Maximum Current Velocities

Total Inflow 12,000 cfs (0 cfs over Dam)

Georgetown Harbor Channel

	Base						Plan 11					
	Surface		Middepth		Bottom		Surface		Middepth		Bottom	
Station	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb
Georgetown Harbor Channel												
M1	3.2	-4.7	2.9	-5.3	3.4	-5.0	2.5	-5.4	2.4	-6.1	2.4	-6.1
M3	4.5	-4.5	4.3	-3.6	3.8	-3.5	3.2	-4.4	3.1	-4.1	2.6	-3.1
M5	2.5	-4.5	2.9	-4.1	3.1	-3.1	2.4	-3.6	2.9	-2.9	2.9	-2.5
M7	3.2	-5.0	2.9	-3.8	2.8	-3.8	3.2	-4.3	3.4	-4.3	2.6	-3.8
M9	1.7	-4.1	2.9	-2.8	2.8	-1.8	1.8	-3.2	2.9	-2.3	3.1	-0.8
M11	1.7	-3.3	2.8	-2.7	3.2	-1.3	1.6	-2.1	2.3	-2.1	2.9	-1.2
M12	2.7	-3.4	2.9	-3.0	2.8	-1.6	1.8	-2.7	2.0	-2.0	1.5	-1.3
M13	1.9	-3.8	2.3	-3.1	2.3	-2.5	1.4	-3.6	1.3	-2.5	1.5	-0.9
M14	2.6	-3.5	2.3	-3.1	2.5	-2.6	2.0	-3.0	2.0	-2.9	1.7	-2.0
M15	1.4	-1.6	1.1	-1.1	1.4	-0.5	1.2	-1.5	0.8	-0.8	0.7	-0.7
TB	0.9	-1.7	0.8	-2.2	0.8	-0.7	0.8	-1.2	0.5	-0.4	0.4	-0.4
Western Channel												
WC0	1.8	-2.6	1.6	-3.1	1.7	-3.3	2.5	-3.4	2.4	-3.5	2.0	-3.3
WC1	2.1	-3.1	2.2	-2.9	2.1	-2.0	2.7	-3.6	2.5	-3.0	1.9	-1.9
WC2	1.7	-4.1	2.1	-4.1	2.1	-3.5	2.7	-4.7	2.7	-4.4	3.0	-4.0
WC3	1.7	-4.3	1.9	-3.6	1.6	-2.6	2.2	-3.6	2.3	-3.0	2.2	-2.5
WC4	2.1	-3.1	2.4	-3.0	2.2	-2.2	1.7	-3.3	1.8	-2.4	1.9	-1.8
Pee Dee and Waccamaw Rivers												
PD2	2.5	-3.6	2.2	-3.5	2.0	-3.0	2.0	-2.9	2.1	-2.8	1.9	-2.2
W2	2.0	-3.3	2.0	-2.8	2.0	-2.6	1.9	-2.3	2.2	-2.0	2.0	-1.2

Table 26

Effects of Plan 11 on Maximum Current Velocities

Total Inflow 35,000 cfs (0 cfs over Dam)

Georgetown Harbor Channel

	Base						Plan 11					
	Surface		Middepth		Bottom		Surface		Middepth		Bottom	
Station	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb
Georgetown Harbor Channel												
M1	2.8	-5.8	3.0	-5.8	3.7	-4.9	2.4	-6.6	2.5	-6.5	2.4	-5.6
M3	3.9	-5.1	4.0	-4.0	3.5	-2.9	2.4	-4.7	2.8	-4.0	2.5	-3.1
M5	2.0	-5.0	3.5	-4.3	2.9	-3.6	2.3	-3.9	2.7	-2.9	2.8	-3.1
M7	2.6	-5.5	2.9	-4.4	3.2	-4.5	2.9	-4.5	3.1	-4.8	3.2	-4.1
M9	1.7	-4.4	3.0	-3.6	2.5	-2.0	2.1	-3.4	2.7	-2.6	3.0	-1.3
M11	1.7	-3.4	1.9	-3.1	3.3	-2.3	1.4	-2.3	2.0	-2.3	2.8	-1.5
M12	2.6	-3.6	2.5	-3.1	2.2	-2.2	1.5	-2.5	1.7	-2.7	1.5	-1.7
M13	1.6	-3.6	1.5	-3.6	1.4	-2.9	1.3	-3.6	1.0	-3.0	1.5	-1.0
M14	2.3	-3.9	2.0	-3.5	2.0	-2.9	1.5	-3.0	1.5	-2.5	1.2	-1.1
M15	1.1	-1.4	0.9	-1.3	0.7	-1.1	1.1	-1.1	0.9	-1.0	0.8	-0.5
TB	0.8	-1.4	0.8	-1.4	0.9	-1.1	0.8	-1.4	0.5	-0.9	0.3	-0.4
Western Channel												
WC0	1.9	-2.7	1.6	-3.1	1.4	-3.0	2.7	-3.6	2.3	-3.7	1.5	-3.0
WC1	1.9	-3.4	1.9	-3.3	1.6	-2.1	2.3	-3.9	2.3	-3.2	1.9	-2.5
WC2	1.7	-3.9	1.8	-4.1	1.6	-3.8	2.2	-5.2	2.3	-5.0	2.3	-4.6
WC3	1.6	-4.5	1.6	-4.4	1.6	-3.6	2.4	-3.6	2.2	-3.4	1.8	-2.4
WC4	1.6	-3.1	1.6	-3.1	1.6	-2.4	1.5	-2.9	1.5	-2.7	1.5	-2.4
Pee Dee and Waccamaw Rivers												
PD2	2.2	-3.3	2.0	-3.4	1.7	-3.0	1.7	-3.1	1.8	-3.0	1.7	-2.7
W2	1.5	-3.8	1.6	-3.7	1.2	-2.8	1.7	-3.1	1.4	-2.9	1.0	-2.0

Table 27

Deepened Channel Study

Effects of Plan 11 on Maximum, Minimum, and Average Salinities

Total Inflow 12,000 cfs

Georgetown Harbor Channel

	Base						Plan 11					
	Surface			Bottom			Surface			Bottom		
Station	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Georgetown Harbor Channel												
M1	29.3	14.8	23.1	30.8	19.2	27.5	28.0	15.3	22.4	29.1	17.6	25.7
M3	28.6	12.7	20.8	30.0	18.9	25.7	27.0	12.6	19.9	27.8	17.1	23.1
M5	27.4	10.6	17.1	29.3	17.9	24.2	23.8	10.5	16.1	27.6	18.9	23.7
M7	26.0	6.4	13.9	28.3	20.0	23.1	24.6	7.2	14.9	26.2	19.0	23.3
M9	15.3	4.5	10.2	25.5	16.7	21.7	15.4	4.7	11.1	25.3	19.6	23.0
M11	9.8	2.2	5.7	23.7	5.8	16.5	13.8	2.5	6.3	23.6	16.1	19.9
M12	8.8	1.3	4.6	20.9	4.0	13.9	8.9	1.7	5.0	21.4	16.1	18.2
M13	9.7	0.8	5.3	16.5	2.5	9.9	7.5	0.9	3.6	17.9	16.1	17.2
M14	6.3	0.3	2.9	13.7	4.3	9.9	5.6	0.4	2.6	17.7	14.0	16.1
M15	3.6	0.4	2.1	12.8	11.6	12.3	2.4	0.5	1.6	16.8	15.7	16.3
TB	2.8	0.9	1.9	11.2	9.9	10.8	3.9	1.0	2.2	16.3	14.8	15.7
S1	3.1	1.5	2.8	11.0	7.4	9.8	4.5	1.2	2.8	15.6	14.1	15.0
S2	3.7	2.4	3.3	8.8	3.6	5.8	5.4	3.5	4.5	15.0	13.3	14.3
Western Channel												
WC0	25.9	7.8	15.7	26.7	11.7	20.9	25.1	9.9	16.2	27.2	12.0	20.0
WC1	24.8	6.3	14.7	27.3	8.1	19.2	23.6	8.1	15.2	28.8	11.1	19.4
WC2	16.7	4.9	10.8	26.0	5.4	16.3	24.8	6.4	14.3	29.4	12.1	19.5
WC3	16.3	4.2	9.4	23.8	5.1	14.1	18.6	4.8	10.3	23.5	9.9	15.5
WC4	13.9	3.0	7.4	21.7	4.4	12.6	14.2	3.7	8.3	19.7	10.9	14.8
Pee Dee and Waccamaw Rivers												
PD2	4.4	0.3	1.4	6.5	0.5	2.3	5.8	0.9	2.4	10.1	1.1	4.1
W2	4.5	0.2	1.5	6.6	0.2	3.2	3.5	0.2	1.8	7.7	0.2	3.8

Table 28

Deepened Channel Study

Effects of Plan 11 on Maximum, Minimum, and Average Salinities

Total Inflow 35,000 cfs

Georgetown Harbor Channel

Station	Base						Plan 11					
	Surface			Bottom			Surface			Bottom		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Georgetown Harbor Channel												
M1	25.0	6.0	16.2	30.4	12.6	25.8	26.9	6.4	17.3	29.8	12.8	24.7
M3	23.4	4.0	12.6	29.5	13.9	24.4	21.9	4.8	12.2	28.9	17.2	24.7
M5	23.2	2.4	8.7	28.1	12.3	22.1	17.9	2.5	8.7	25.1	17.1	21.5
M7	20.7	1.0	6.1	26.3	12.3	20.9	15.6	1.2	6.7	26.4	18.3	22.8
M9	6.0	0.2	3.0	24.6	5.8	16.6	3.3	0.6	1.8	25.2	18.5	22.2
M11	5.2	0.1	1.0	22.3	0.1	11.2	2.8	0.3	1.2	23.5	16.3	20.3
M12	4.6	0.1	0.9	18.9	0.1	7.7	13.8	0.2	1.6	21.9	12.1	17.5
M13	4.0	0.1	0.8	13.7	0.1	4.5	1.1	0.1	0.6	18.1	12.5	15.9
M14	0.6	0.1	0.2	3.8	0.1	0.7	0.7	0.1	0.3	16.6	6.4	12.7
M15	0.2	0.1	0.1	0.2	0.1	0.1	0.7	0.2	0.4	14.8	14.3	14.6
TB	0.2	0.1	0.2	0.2	0.1	0.2	0.8	0.3	0.6	15.1	14.7	14.9
S1	0.2	0.1	0.2	0.2	0.1	0.2	0.9	0.4	0.7	12.2	7.9	10.0
S2	0.2	0.2	0.2	0.2	0.2	0.2	0.9	0.8	0.9	1.3	0.9	1.0
Western Channel												
WC0	18.3	1.2	6.7	27.0	2.9	16.1	18.7	1.6	7.0	23.6	3.1	12.6
WC1	16.5	0.7	5.2	25.2	1.1	13.7	16.8	1.0	6.9	21.7	1.6	11.7
WC2	8.9	0.4	3.2	22.6	0.5	9.7	12.0	0.8	4.5	21.4	1.0	9.9
WC3	6.8	0.2	2.1	19.1	0.3	6.5	9.2	0.6	3.8	16.5	0.7	6.5
WC4	2.6	0.2	1.0	15.6	0.2	5.5	3.7	0.4	1.5	9.6	0.7	4.5
Pee Dee and Waccamaw Rivers												
PD2	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	0.2	0.5	0.1	0.2
W2	0.2	0.1	0.1	0.2	0.1	0.1	0.4	0.1	0.2	0.5	0.1	0.2

Table 29

Deepened Channel Study Effects of

Plan 11 on Shoaling

Shoaling Section	Prototype cu yd*	Base cu cm	Plan 11 cu cm	Plan 11 Index	Plan 11 APD** cu yd
Eastern Channel (sections 8-18)	283,000	110	345	3.14	890,000
Upper Winyah Bay (sections 19-27)	652,000	1,650	3,935	2.38	1,550,000
Sampit River (sections 28-44)	1,323,400	830	1,125	1.36	1,800,000
Total	2,258,400	2,590	5,405	1.88†	4,240,000

* Yearly average (1969-1972) for sections 8-14; yearly average (1972-1976) for sections 15-44.

** Approximate prototype dredging.

† Approximate prototype dredging divided by prototype.

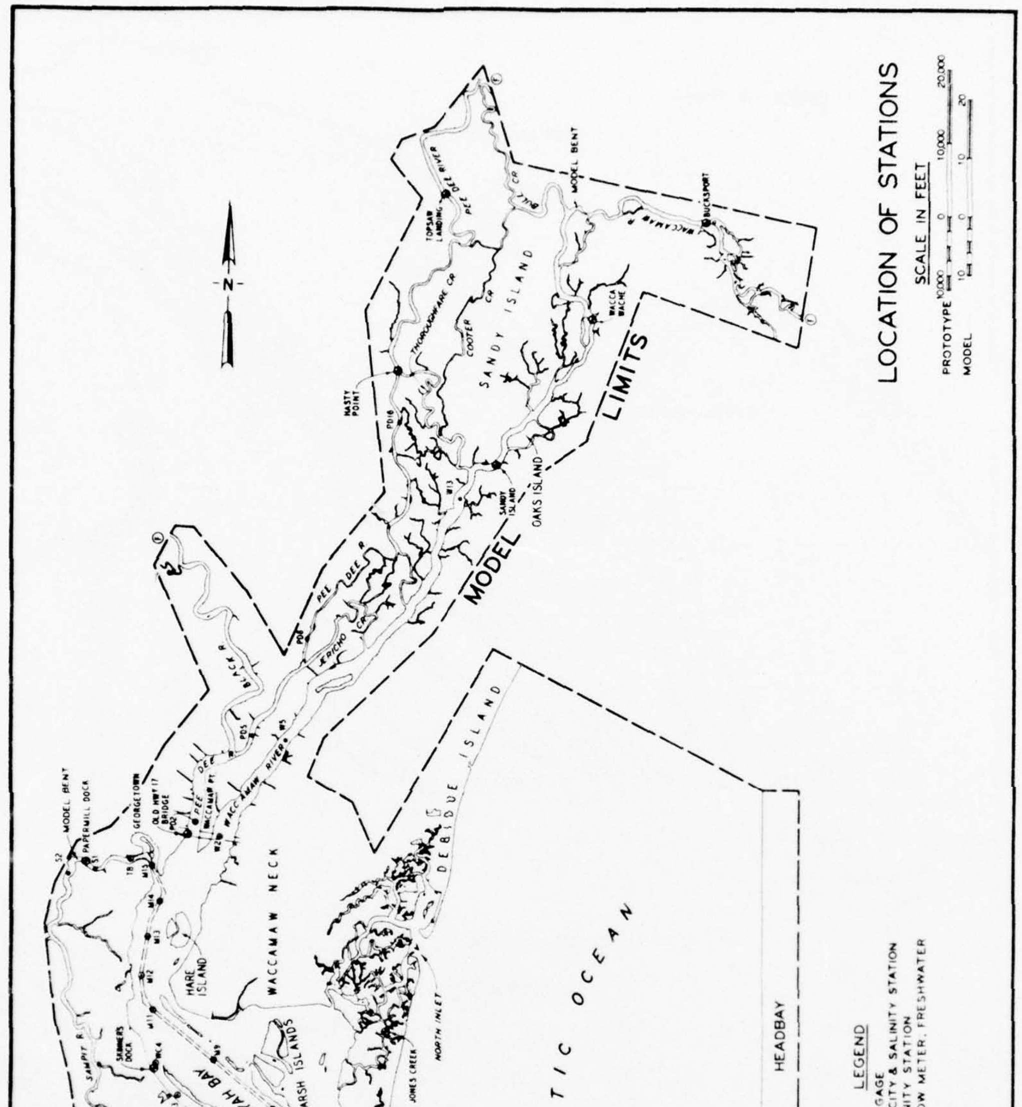
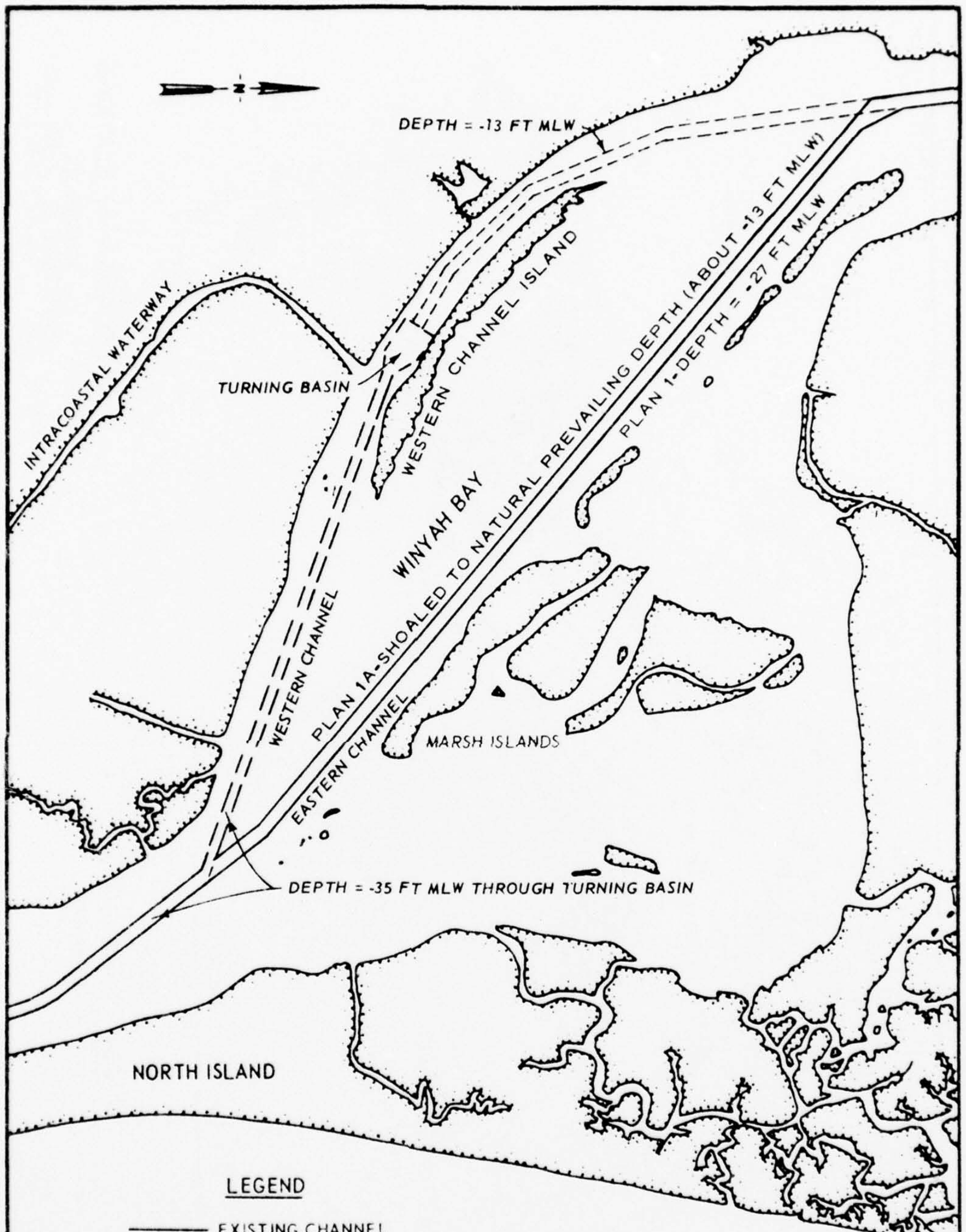

LOCATION OF STATIONS
SCALE IN FEET
PROTOTYPE
MODEL
LEGEND
TIDE GAGE
VELOCITY & SALINITY STATION
SALINITY STATION
INFLOW METER, FRESHWATER
MODEL LIMITS
ATLANTIC OCEAN
HEADBAY
WINYAH BAY
NORTH ISLAND
SOUTH ISLAND
SAND ISLAND
MARSH ISLANDS
WACCAMAW NECK
HARE ISLAND
DEBIDUE ISLAND
NORTH INLET
JONES CREEK
SANDY ISLAND
OAKS ISLAND
GEORGETOWN
PAPERMILL DOCK
MODEL BENT
BUCKSPORT
BLACK R
PEE DEE RIVER
WACCAMAW RIVER
SAMPIT R
YAWKEES DOCK
WINYAH BAY ENTRANCE

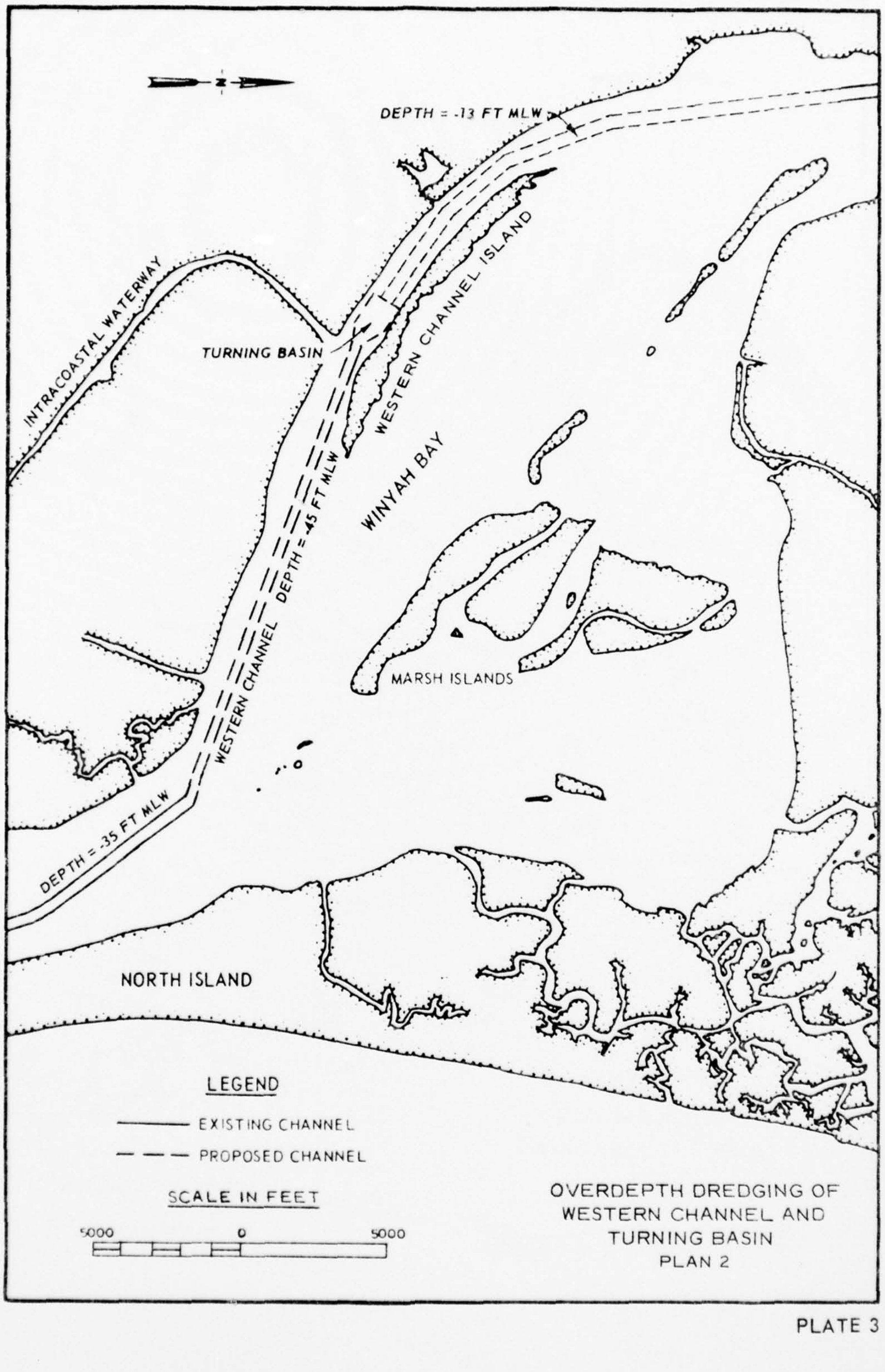
PLATE 1



WESTERN CHANNEL AND TURNING BASIN

PLANS 1 AND 1A

PLATE 2



OVERDEPTH DREDGING OF WESTERN CHANNEL AND TURNING BASIN PLAN 2

PLATE 3

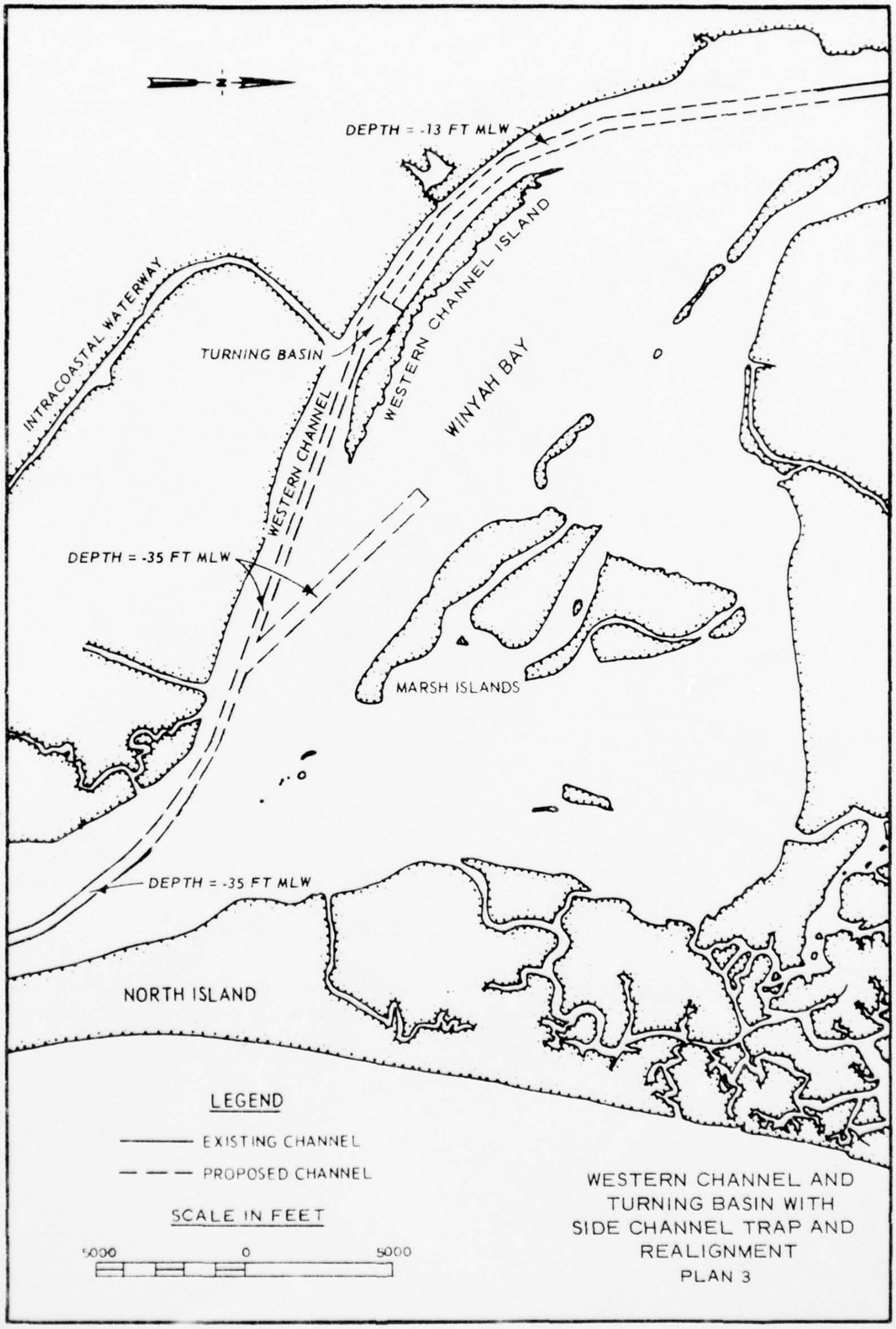
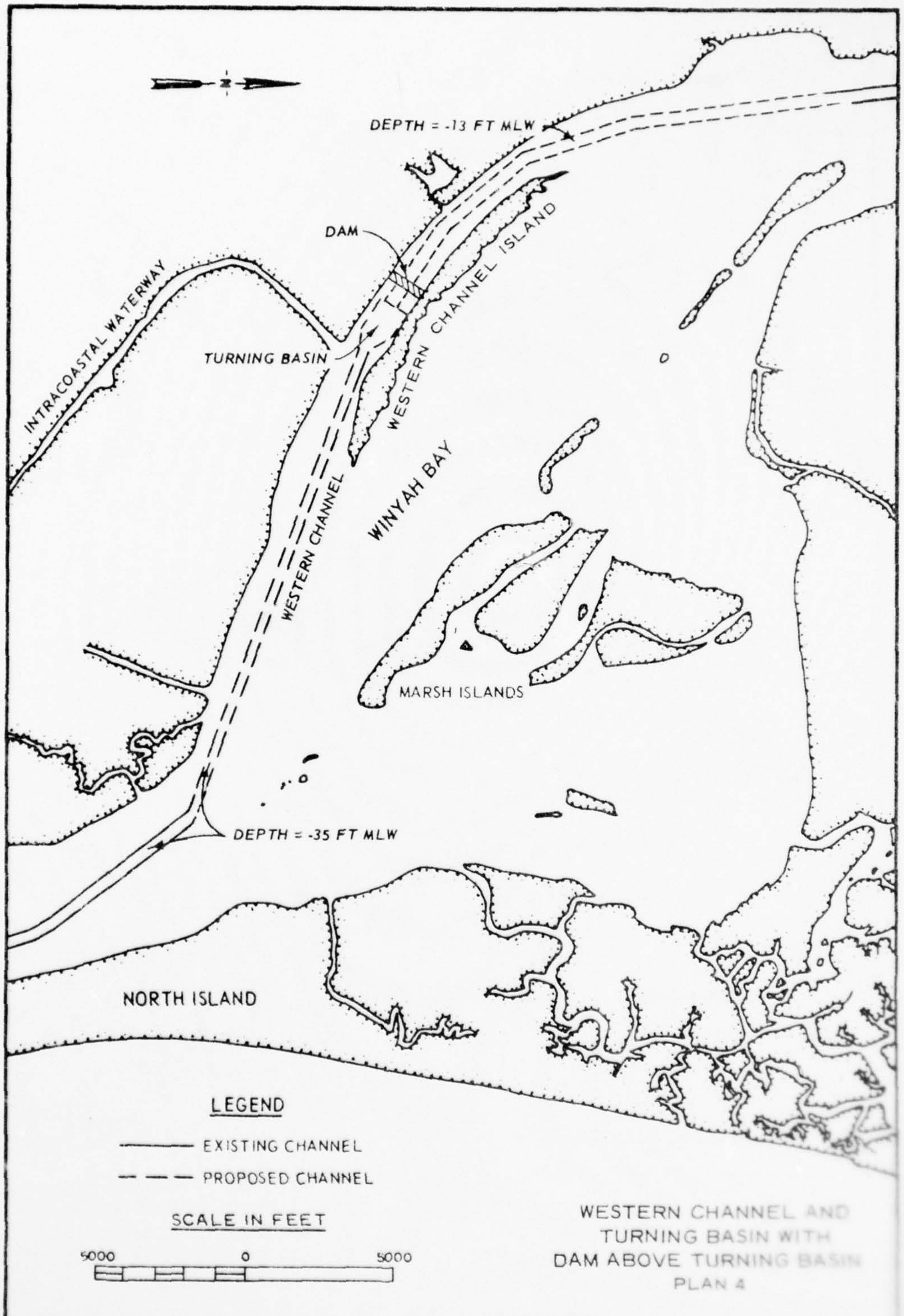

DEPTH = -13 FT MLW
INTRACOASTAL WATERWAY
WESTERN CHANNEL ISLAND
TURNING BASIN
WESTERN CHANNEL
WINYAH BAY
DEPTH = -35 FT MLW
MARSH ISLANDS
DEPTH = -35 FT MLW
NORTH ISLAND
LEGEND
EXISTING CHANNEL
PROPOSED CHANNEL
SCALE IN FEET
5000
0
5000
WESTERN CHANNEL AND TURNING BASIN WITH SIDE CHANNEL TRAP AND REALIGNMENT
PLAN 3

PLATE 4

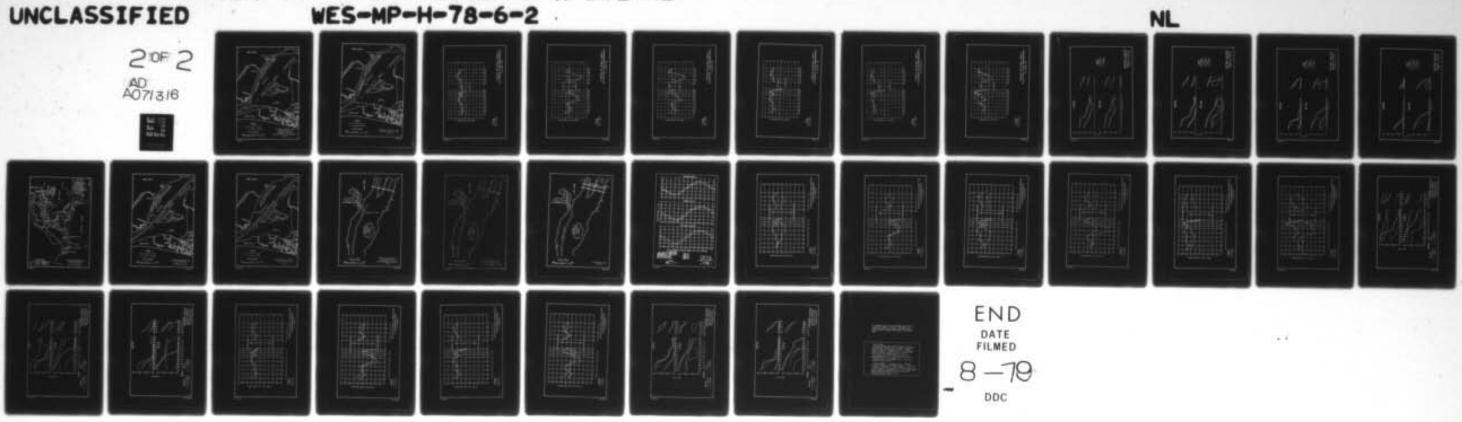


WESTERN CHANNEL AND
TURNING BASIN WITH
DAM ABOVE TURNING BASIN
PLAN 4

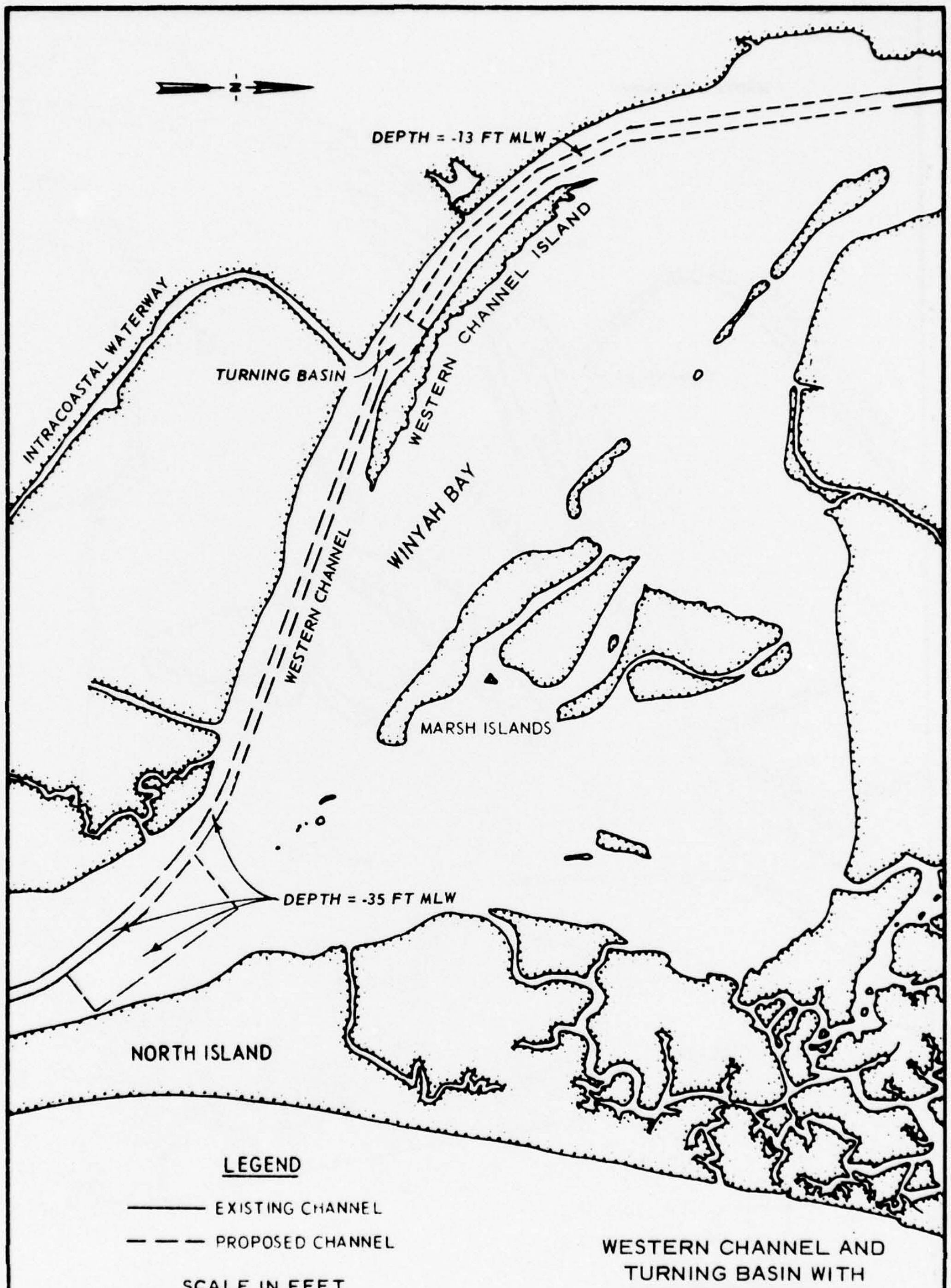
AD-A071 316 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 8/8
GEORGETOWN HARBOR, SOUTH CAROLINA. REPORT 2. EFFECTS OF VARIOUS--ETC(U)
MAY 79 M J TRAWLE, R A BOLAND

UNCLASSIFIED WES-MP-H-78-6-2 NL

2 OF 2
AD
A071316

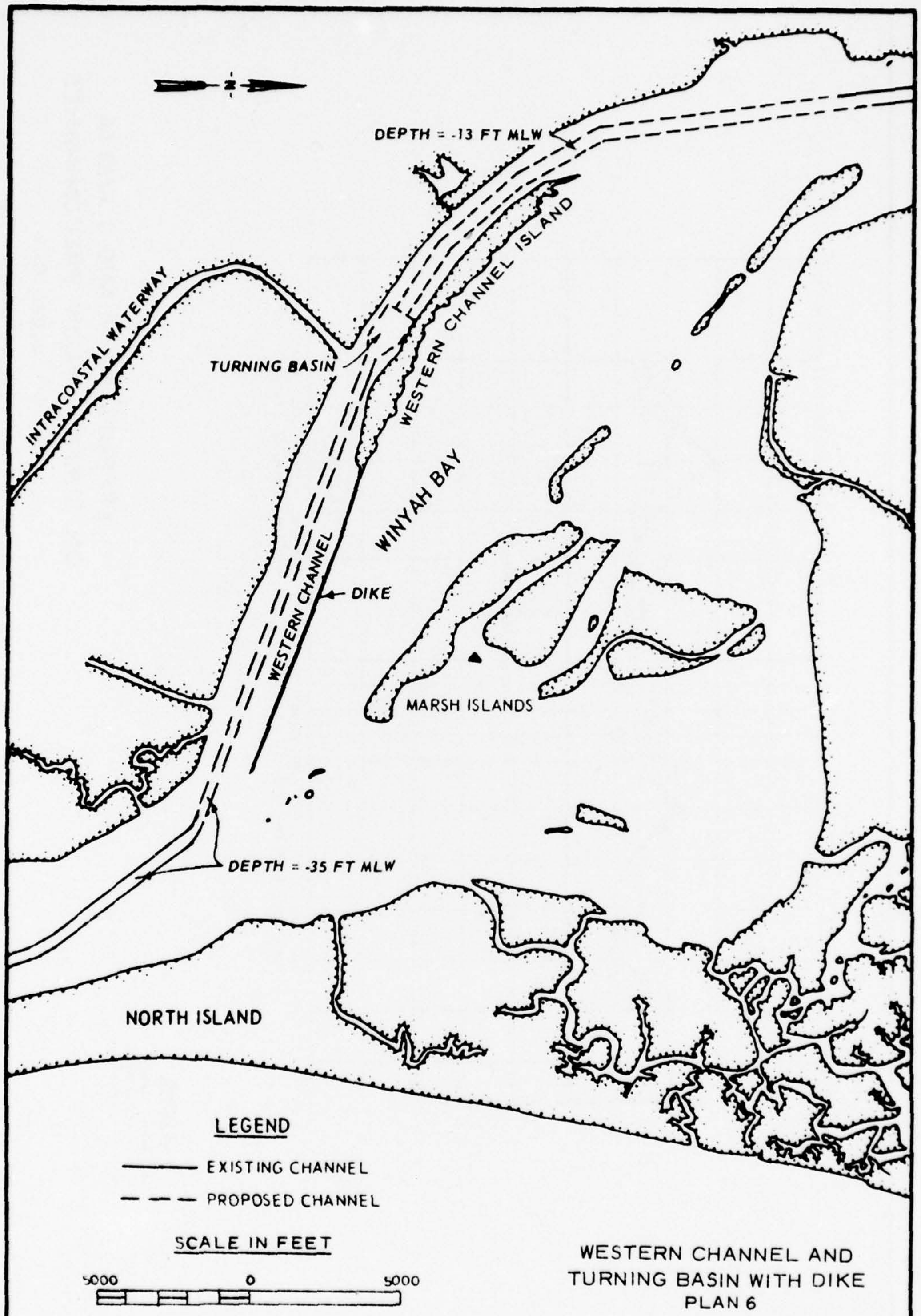


END
DATE
FILMED
8-79
DDC

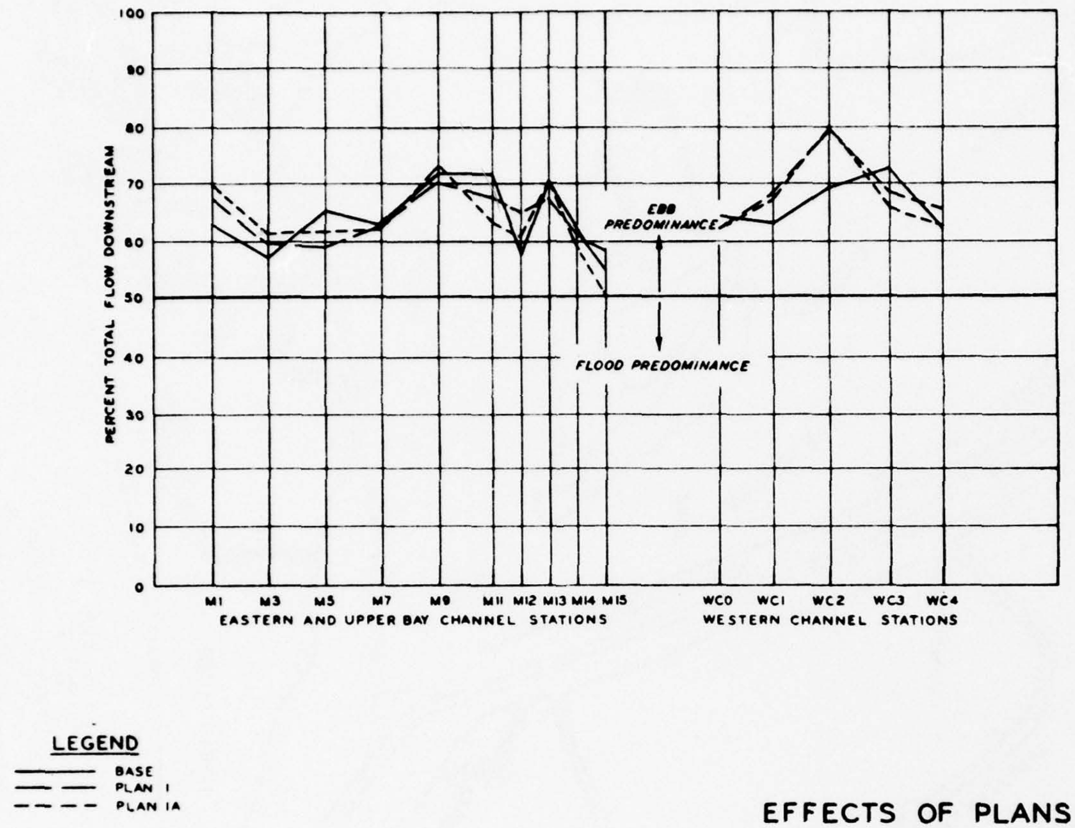


WESTERN CHANNEL AND TURNING BASIN WITH SEDIMENT TRAP AT JUNCTION AND REALIGNMENT
PLAN 5

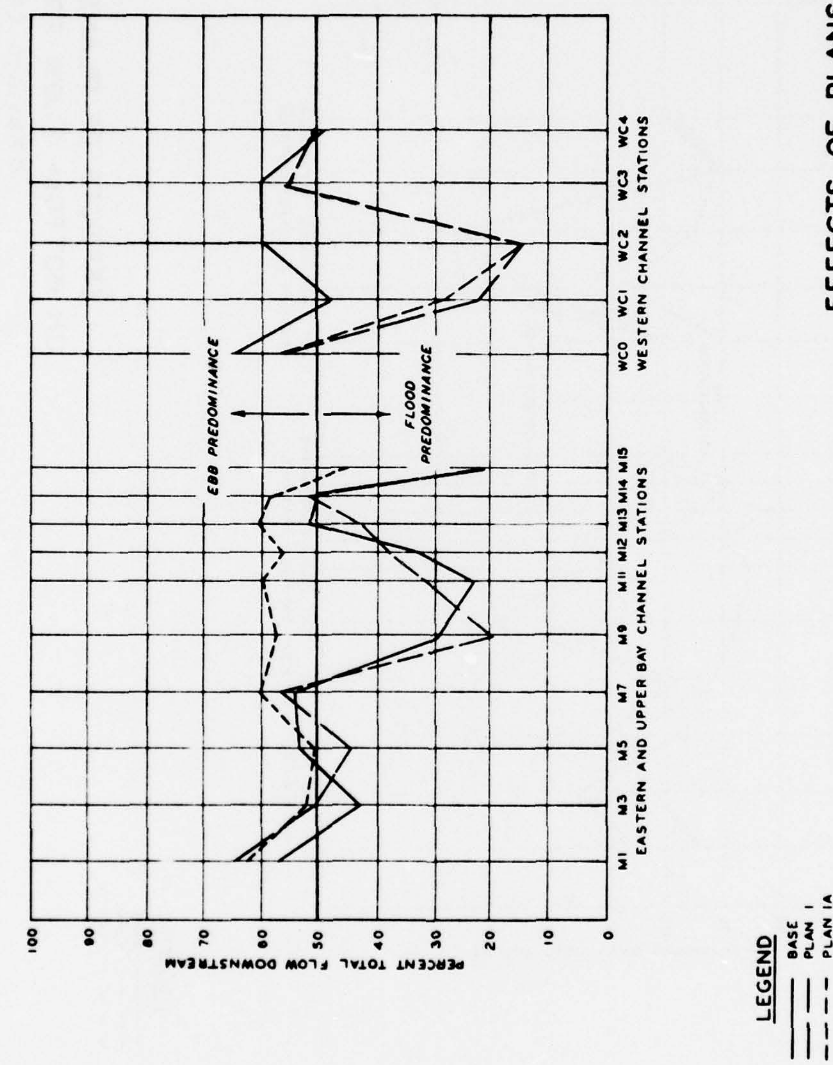
PLATE 6



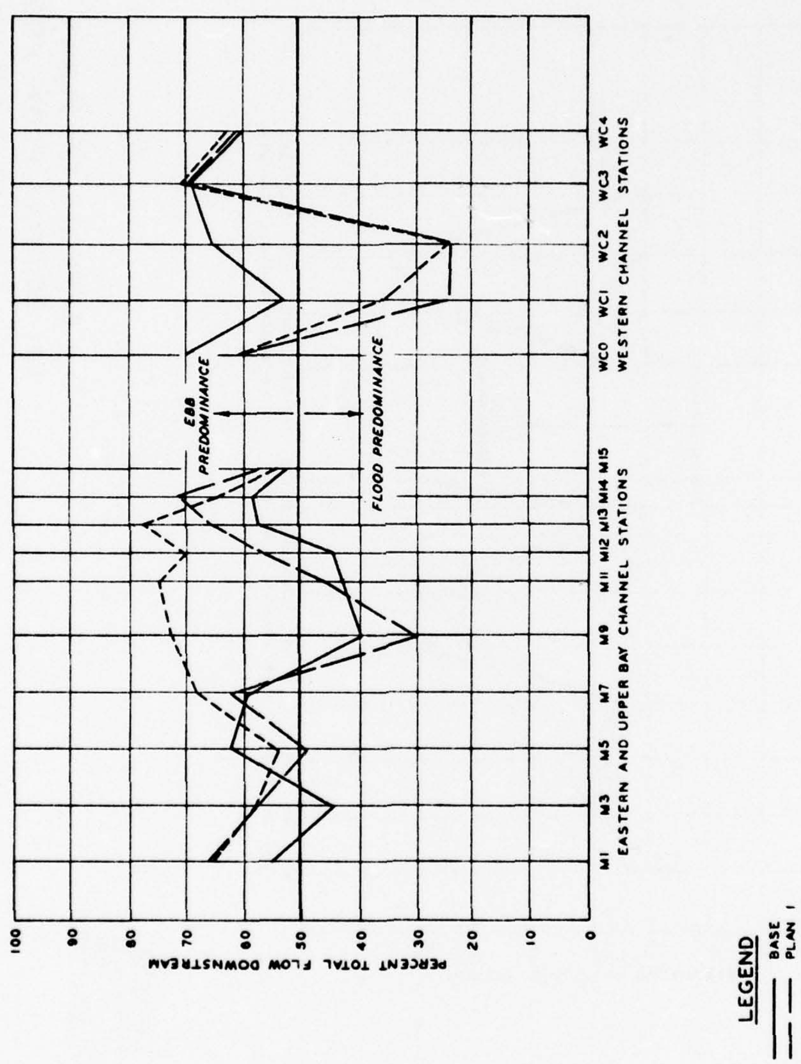
WESTERN CHANNEL AND
TURNING BASIN WITH DIKE
PLAN 6



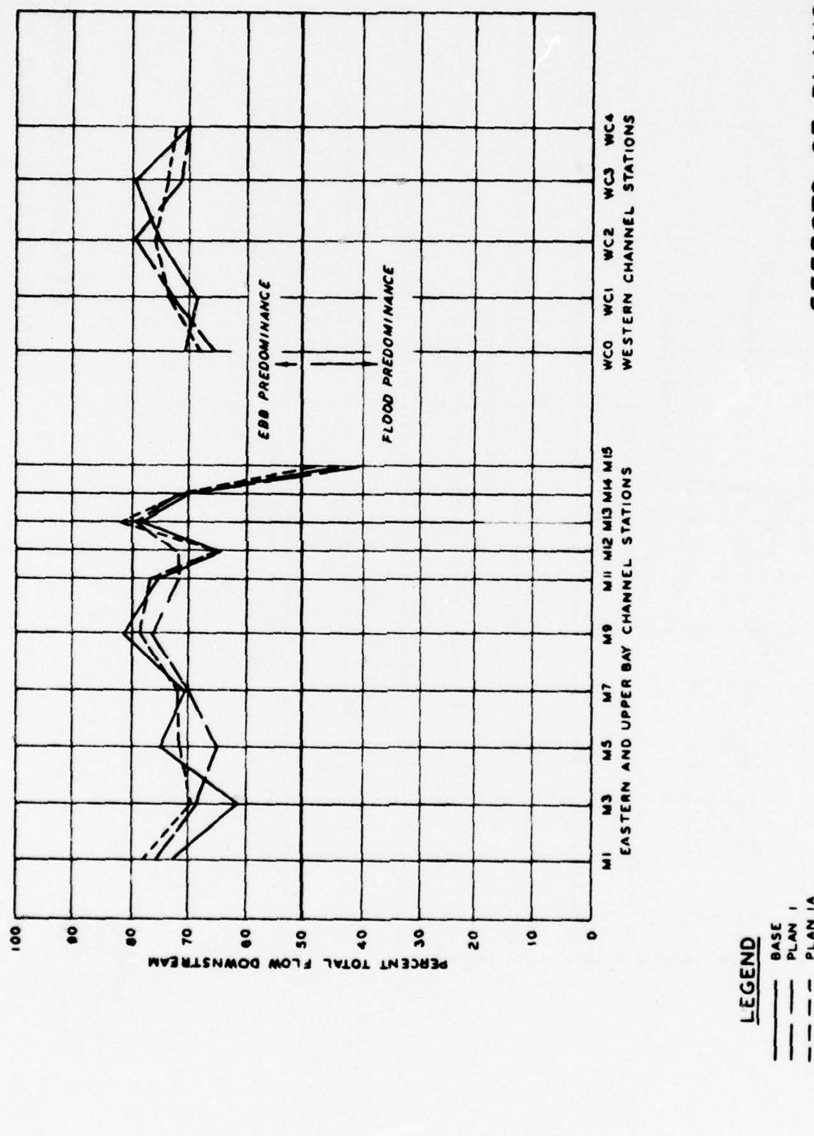
EFFECTS OF PLANS 1 AND 1A
ON SURFACE FLOW PREDOMINANCE
Q = 12,000 CFS



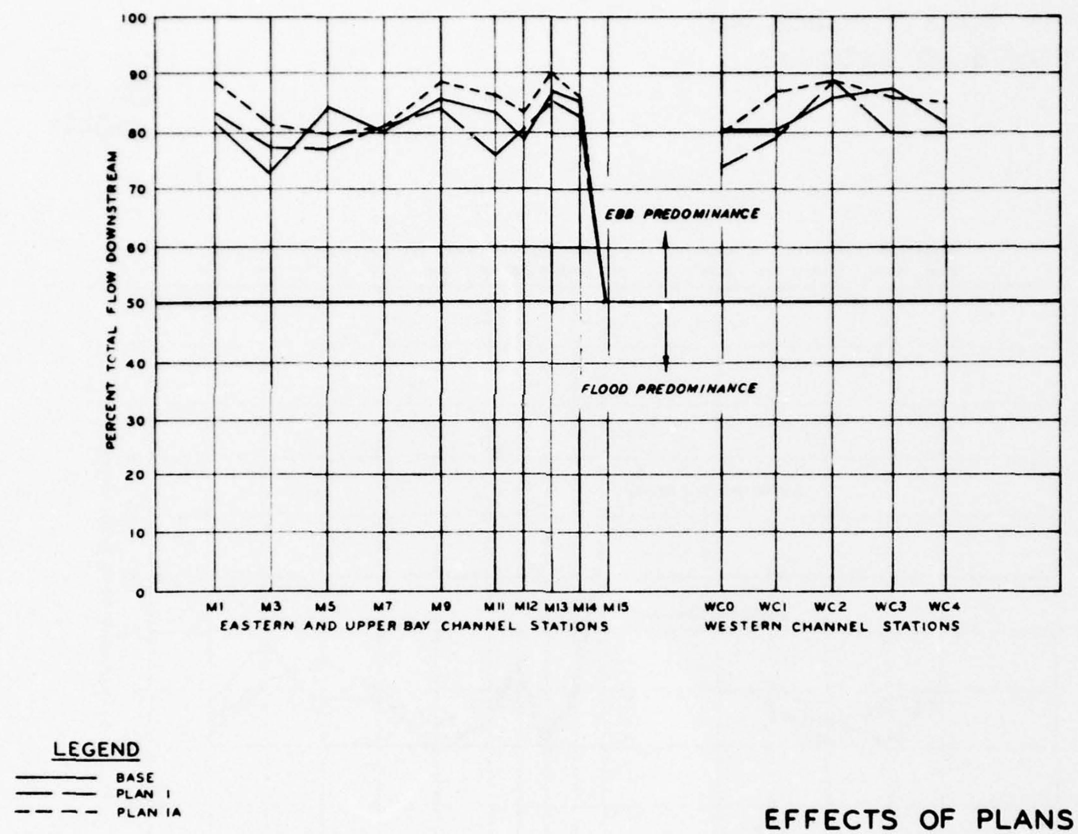
EFFECTS OF PLANS I AND IA
ON BOTTOM FLOW PREDOMINANCE
Q= 12,000 CFS



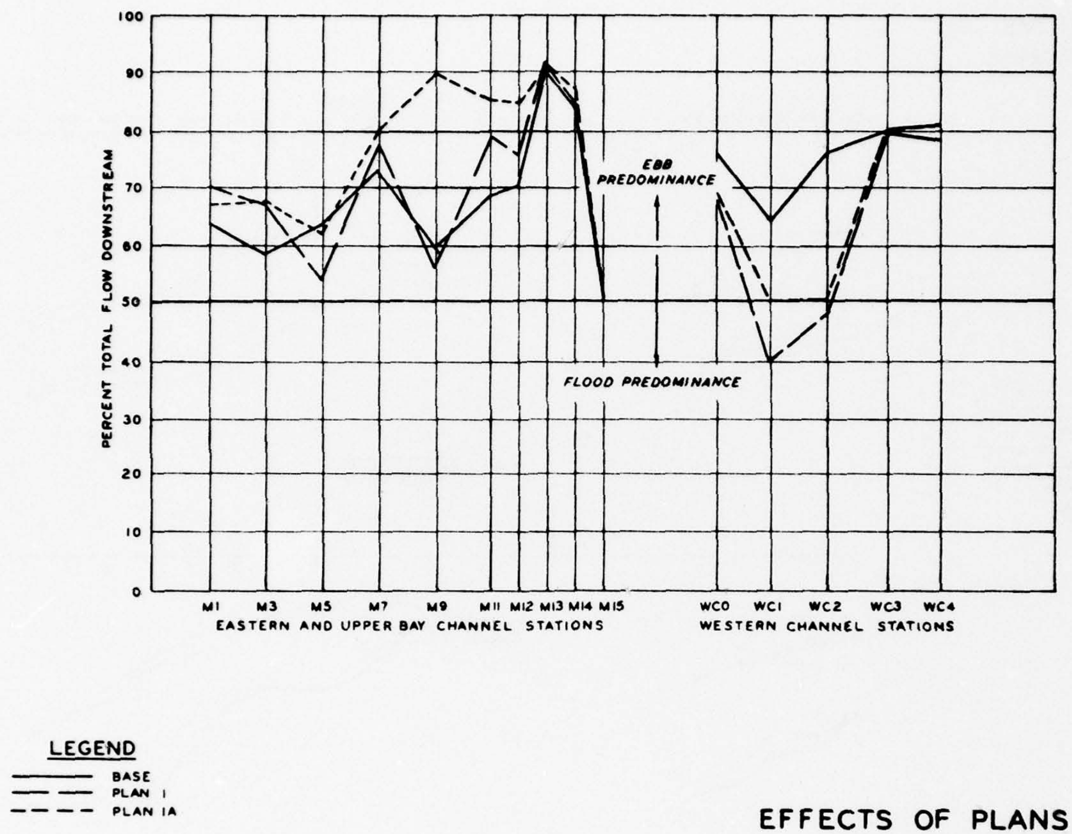
EFFECTS OF PLANS I AND IA
ON BOTTOM FLOW PREDOMINANCE
Q = 35,000 CFS



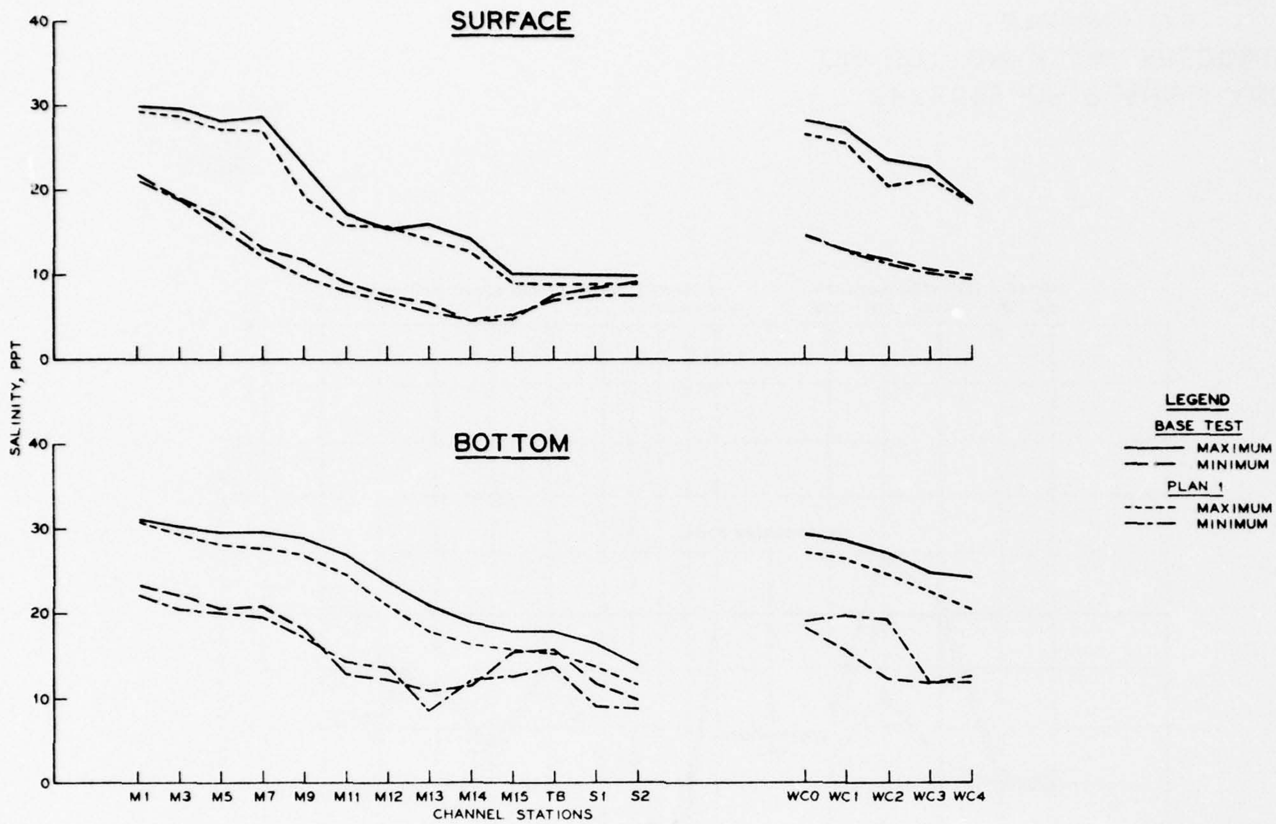
EFFECTS OF PLANS 1 AND 1A
ON SURFACE FLOW PREDOMINANCE
Q = 35,000 CFS



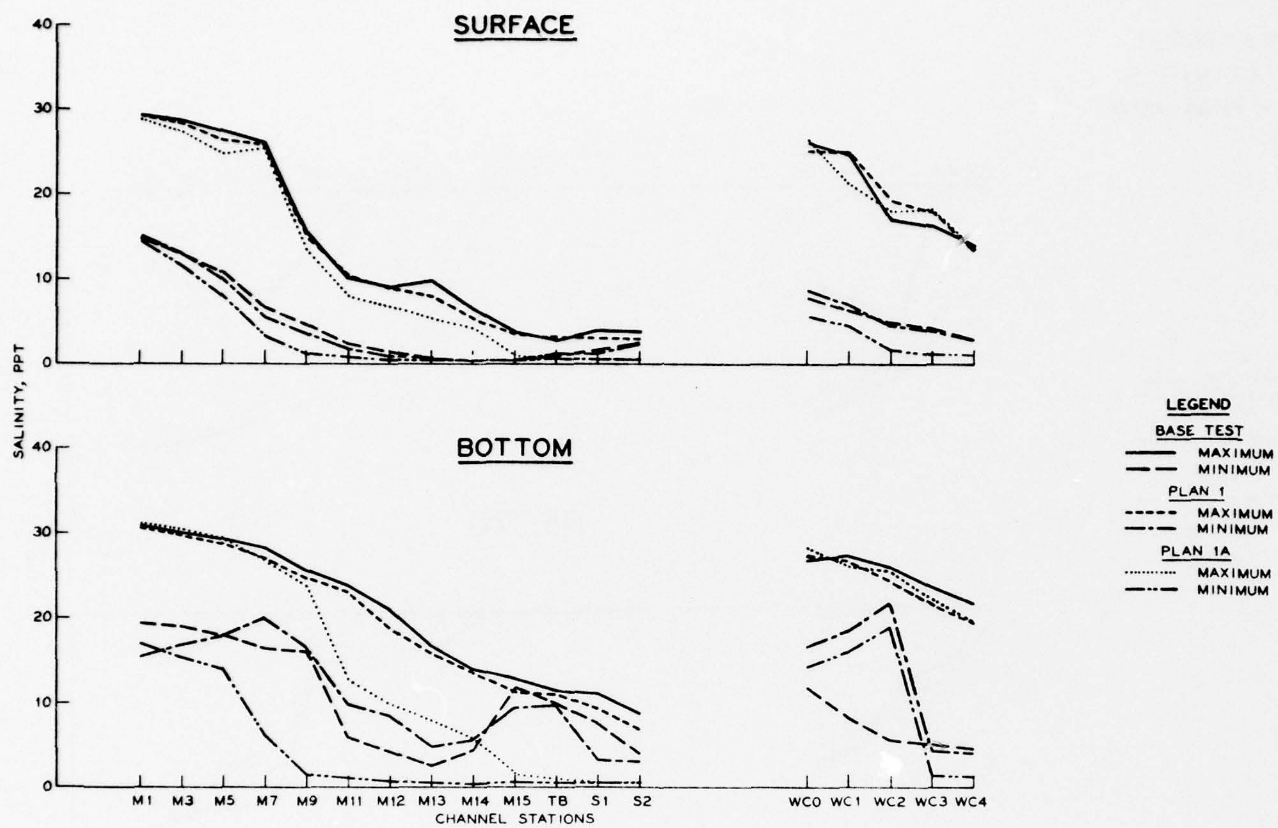
EFFECTS OF PLANS 1 AND 1A
ON SURFACE FLOW PREDOMINANCE
Q = 60,000 CFS



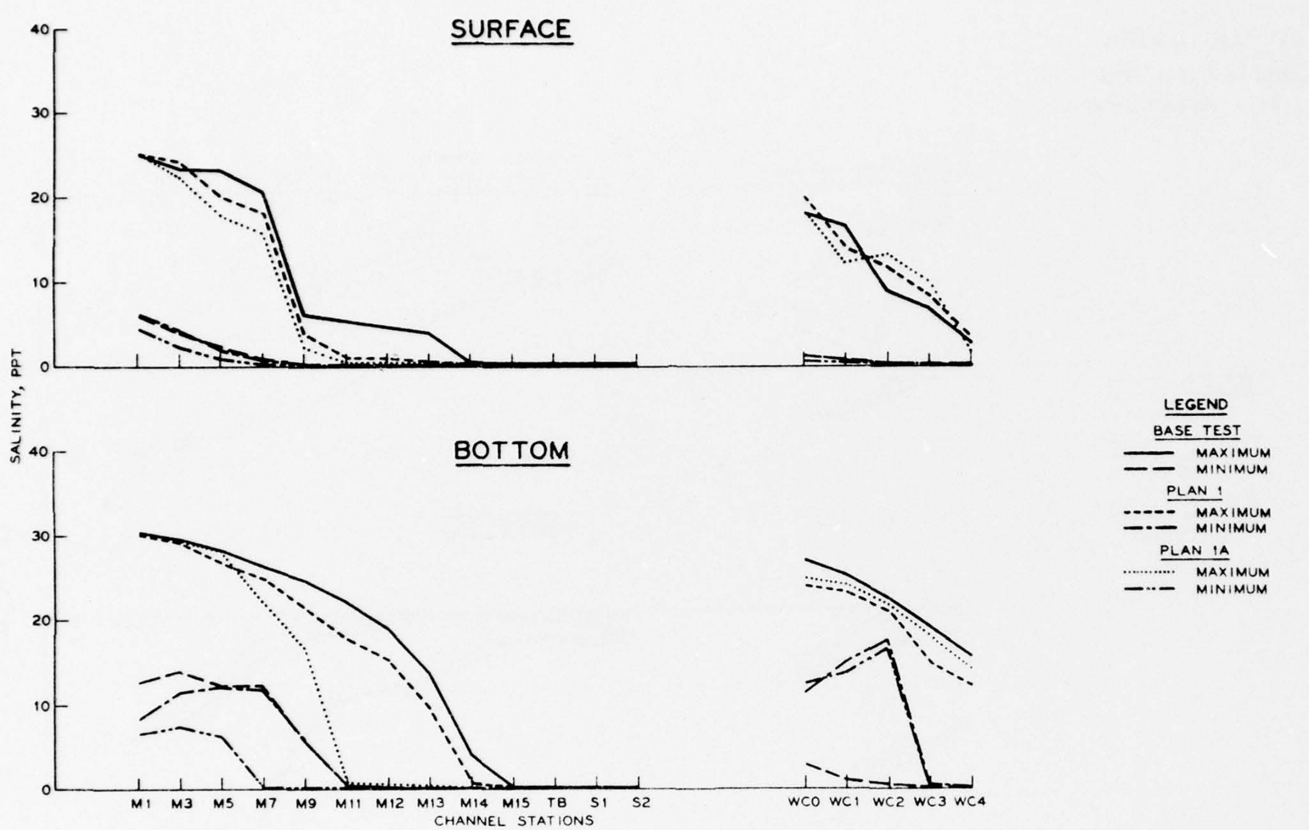
EFFECTS OF PLANS 1 AND 1A
ON BOTTOM FLOW PREDOMINANCE
Q = 60,000 CFS



MAXIMUM - MINIMUM
SALINITY PROFILE
5,000-CFS INFLOW

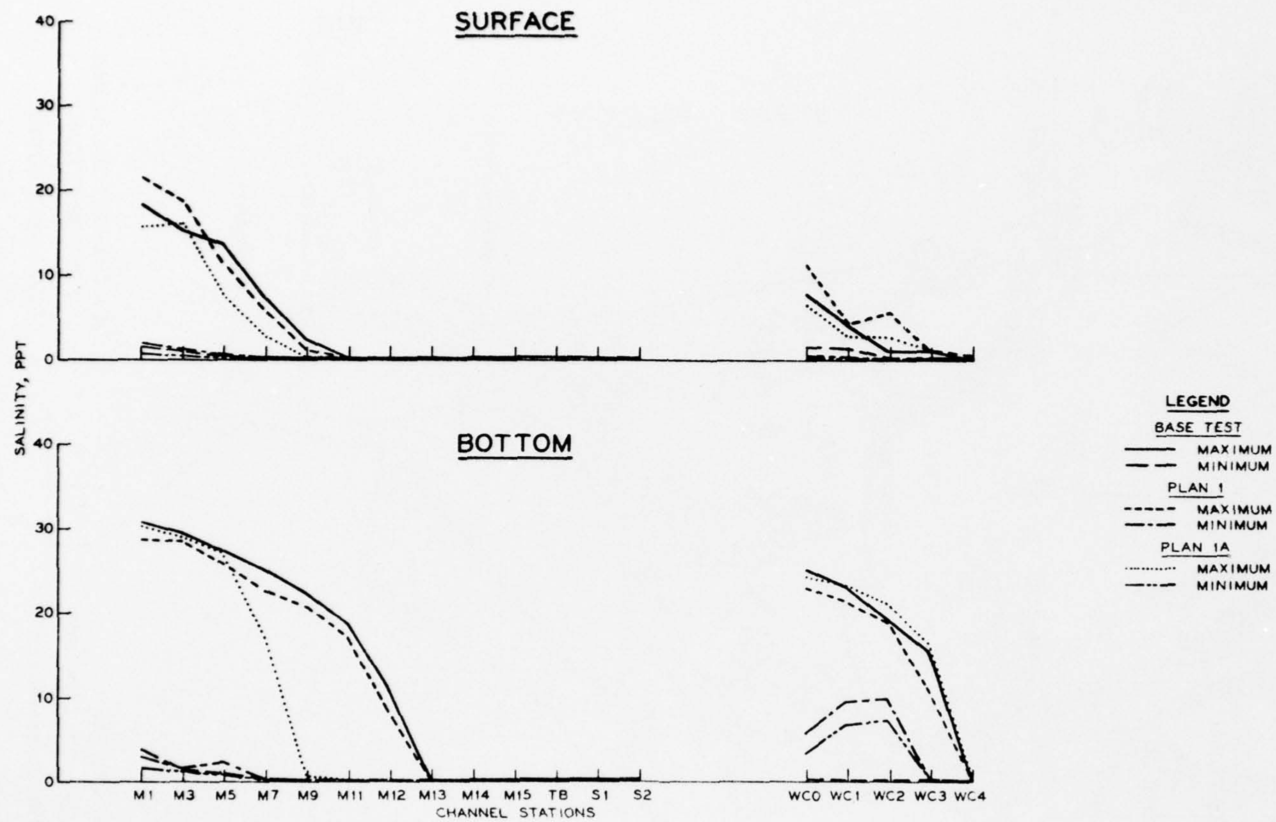


MAXIMUM - MINIMUM
SALINITY PROFILE
12,000-CFS INFLOW

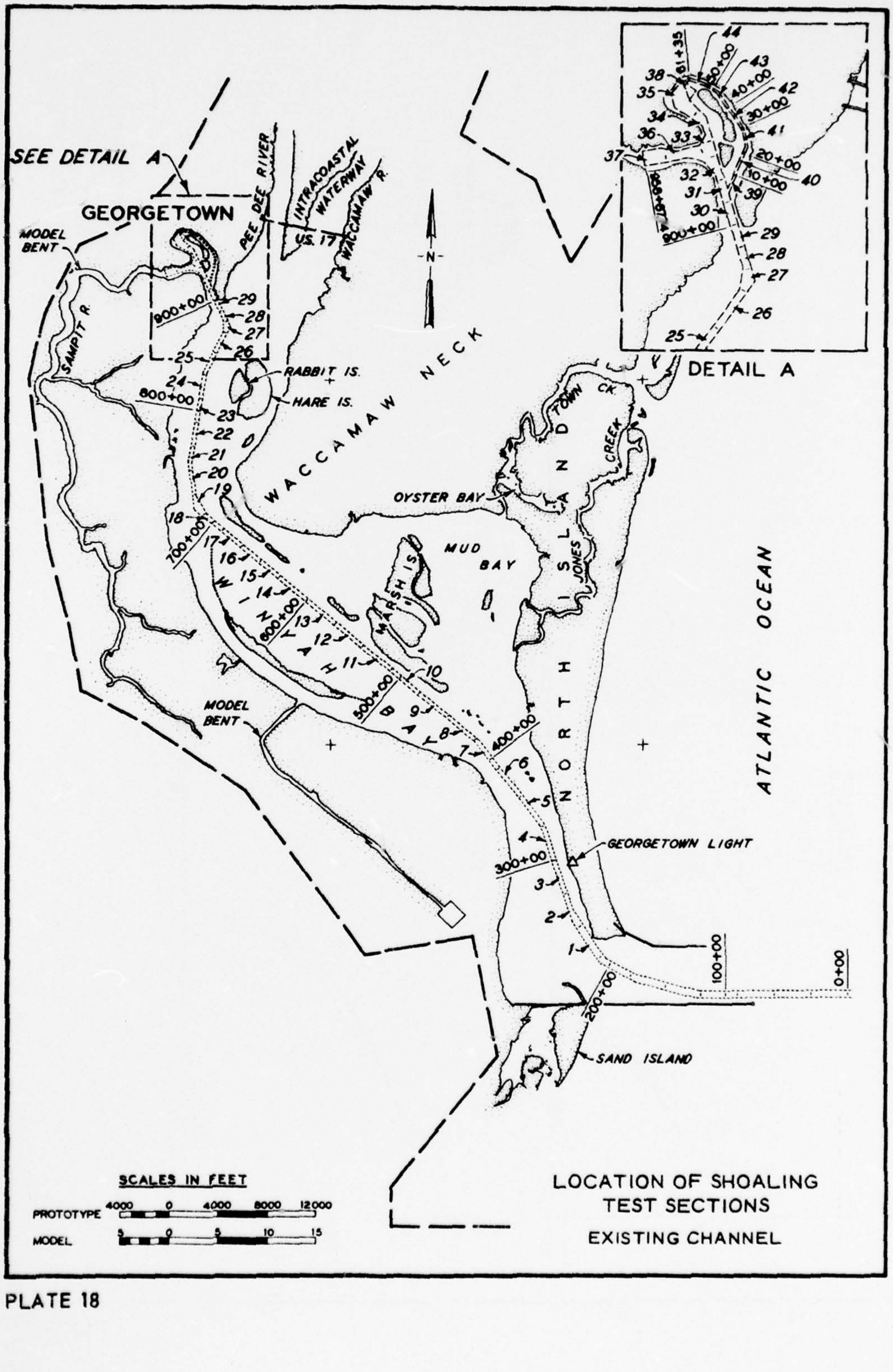


MAXIMUM - MINIMUM
SALINITY PROFILE
35,000-CFS INFLOW

PLATE 16

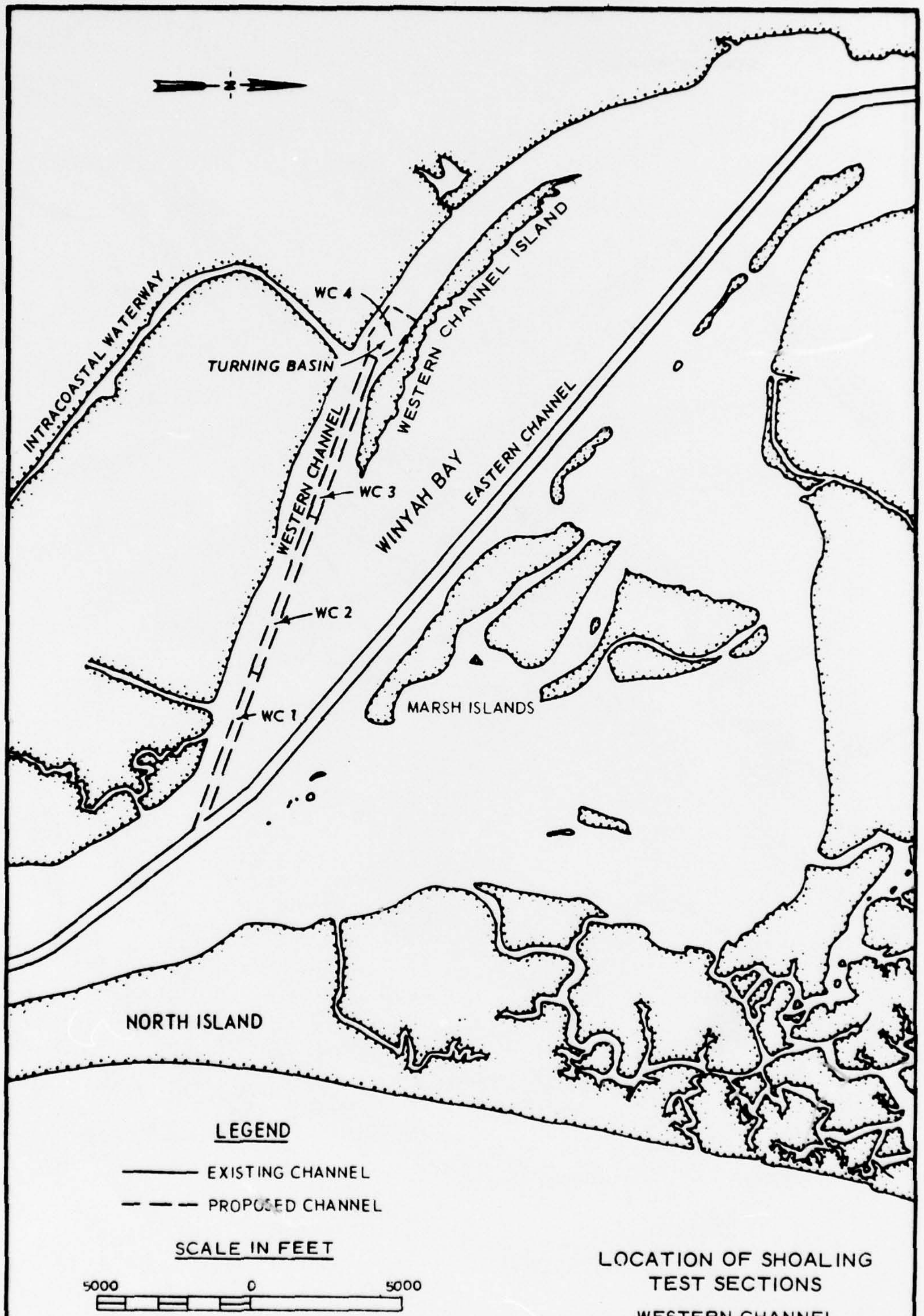


MAXIMUM - MINIMUM
SALINITY PROFILE
60,000-CFS INFLOW



LOCATION OF SHOALING
TEST SECTIONS
EXISTING CHANNEL

PLATE 18



LOCATION OF SHOALING TEST SECTIONS
WESTERN CHANNEL

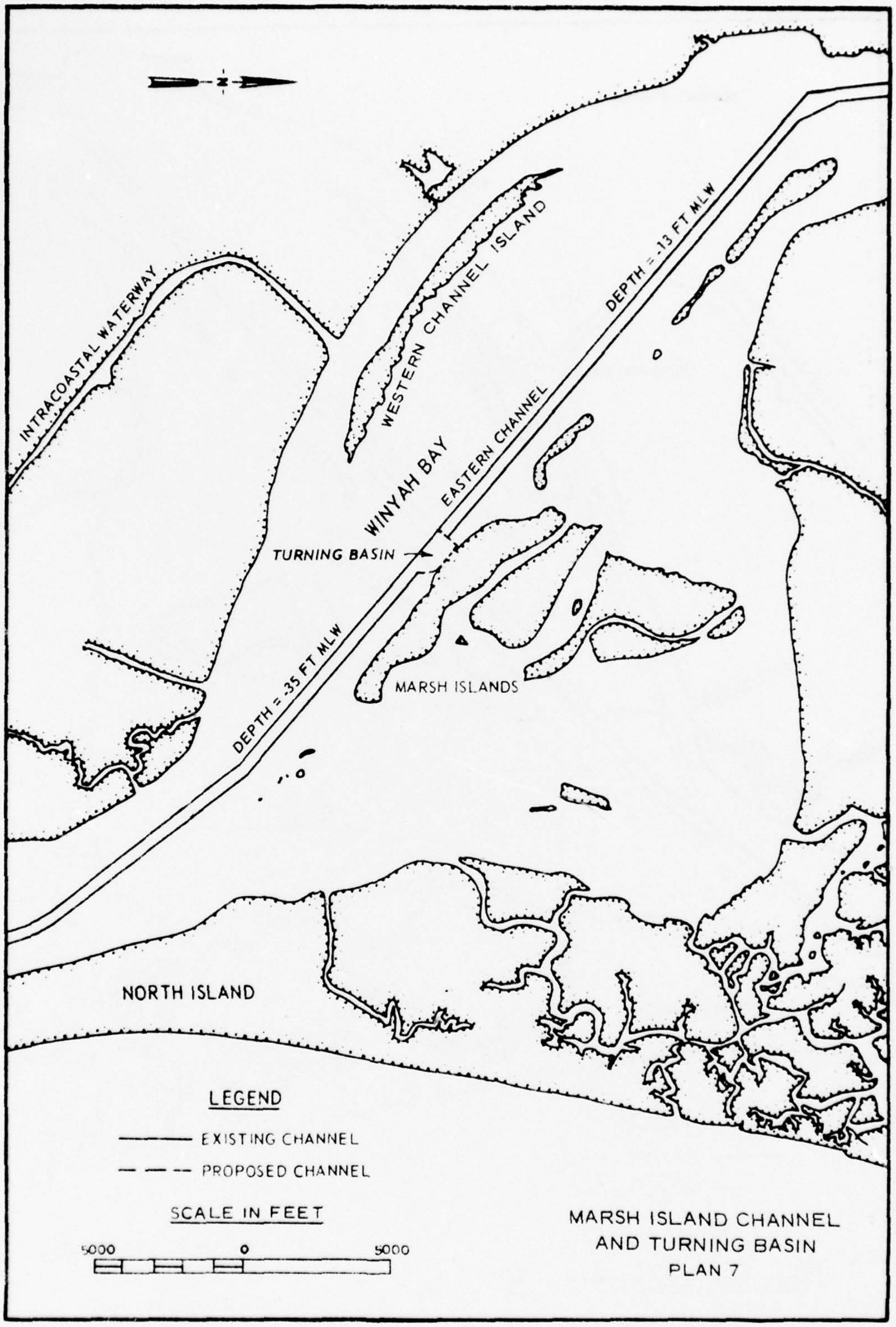
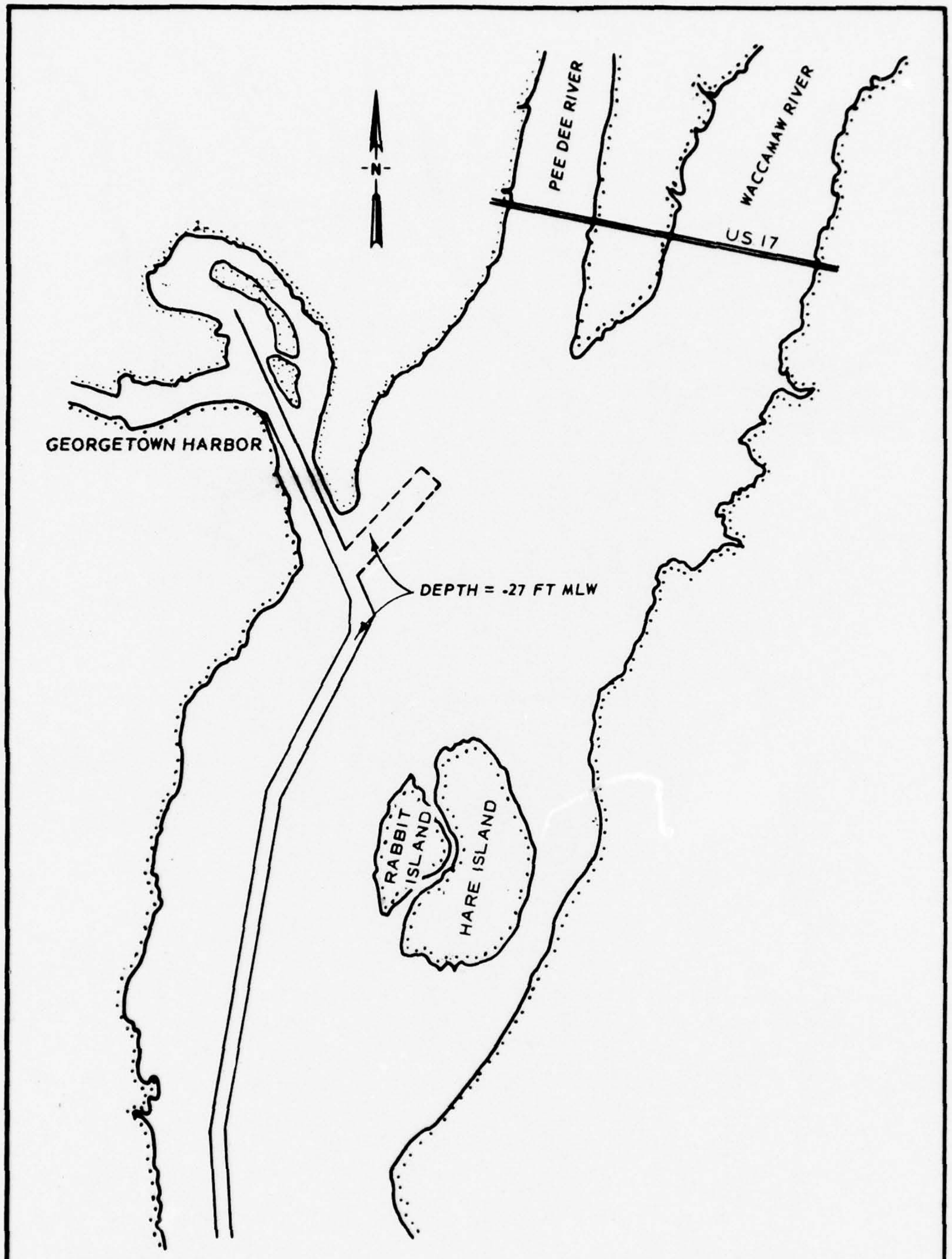
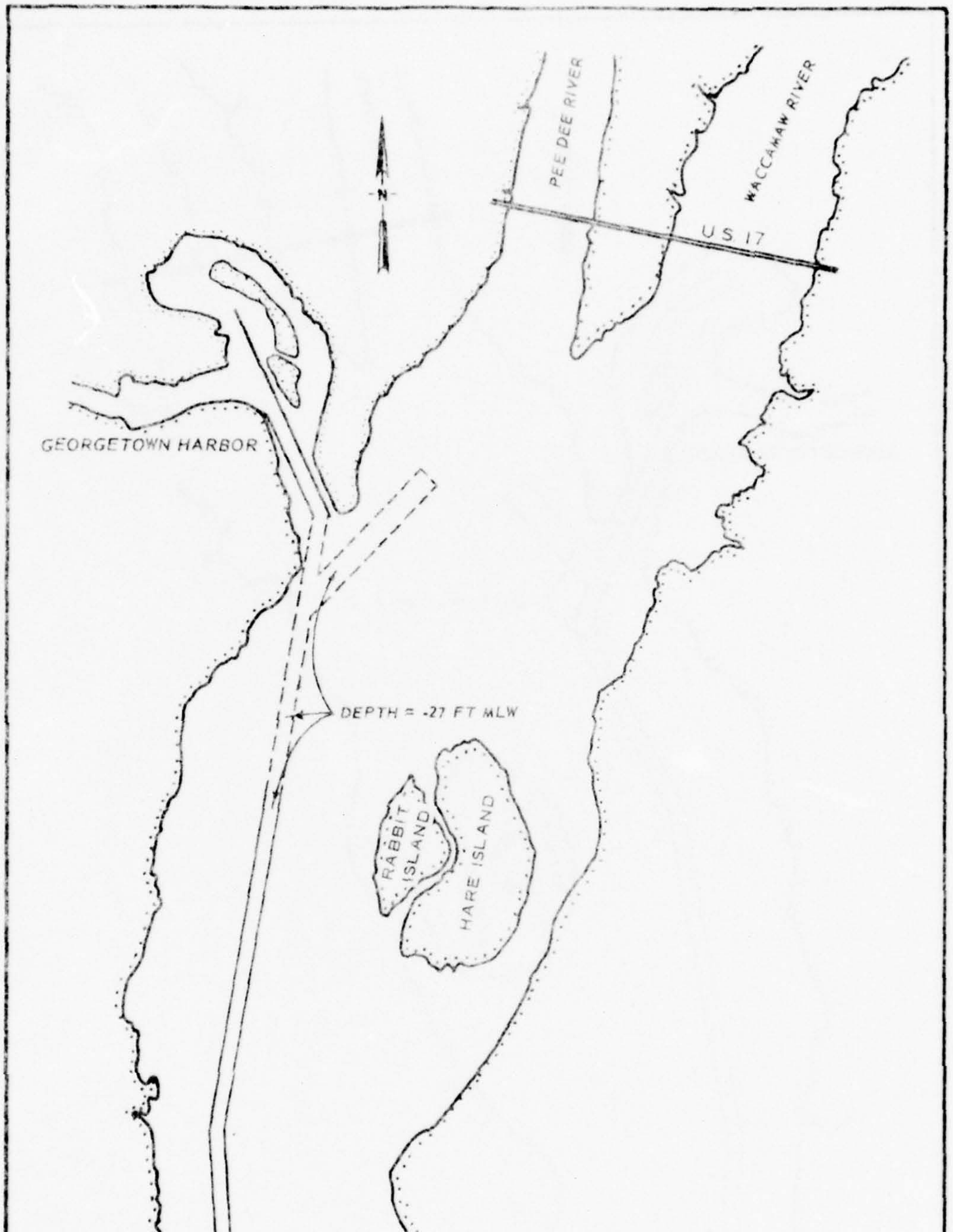

INTRACOASTAL WATERWAY
WESTERN CHANNEL ISLAND
DEPTH = -13 FT MLW
WINYAH BAY
EASTERN CHANNEL
TURNING BASIN
DEPTH = -35 FT MLW
MARSH ISLANDS
NORTH ISLAND
LEGEND
EXISTING CHANNEL
PROPOSED CHANNEL
SCALE IN FEET
5000
0
5000
MARSH ISLAND CHANNEL
AND TURNING BASIN
PLAN 7

PLATE 20

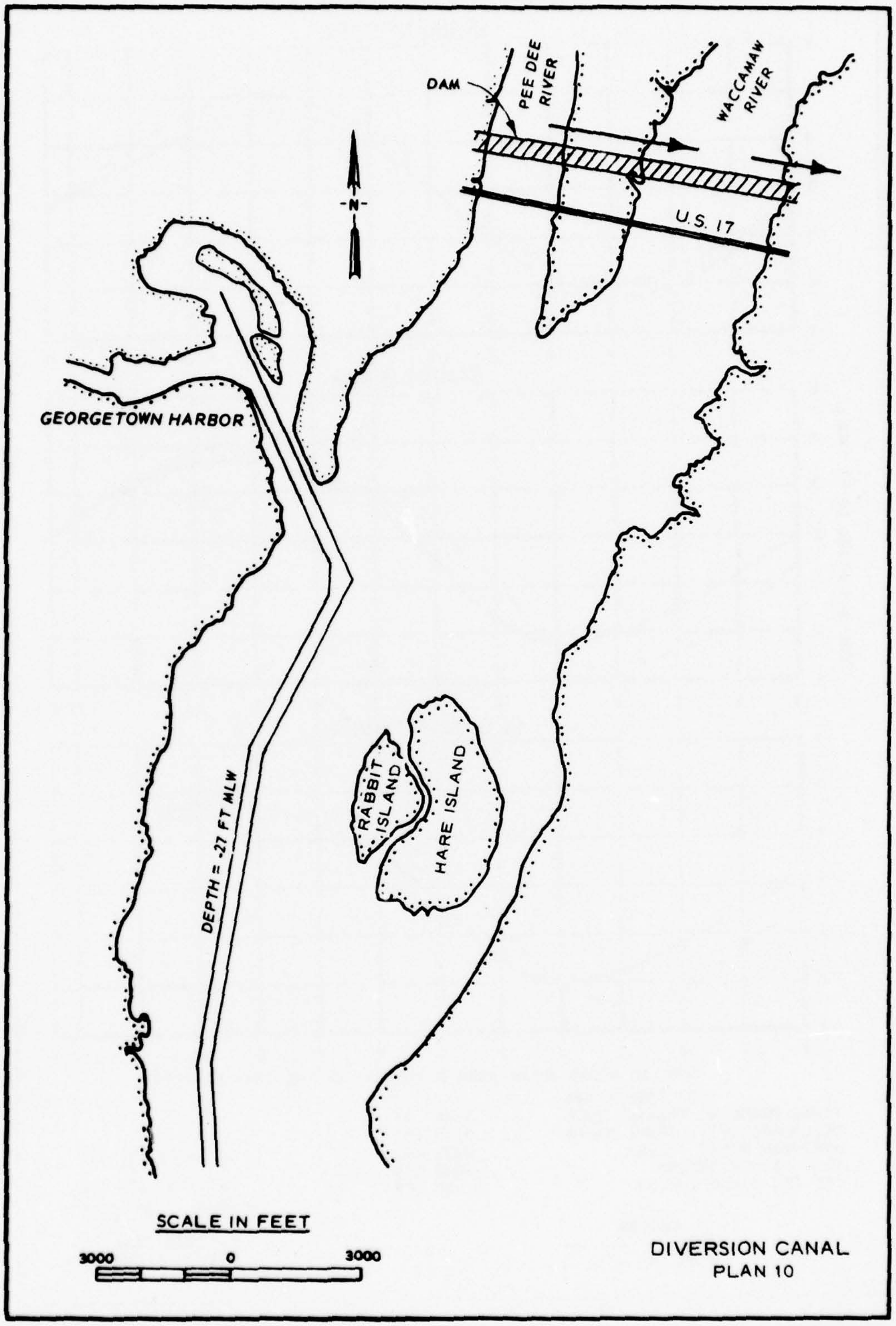


SIDE CHANNEL TRAP IN
UPPER WINYAH BAY
WITH EXISTING ALIGNMENT
PLAN 8

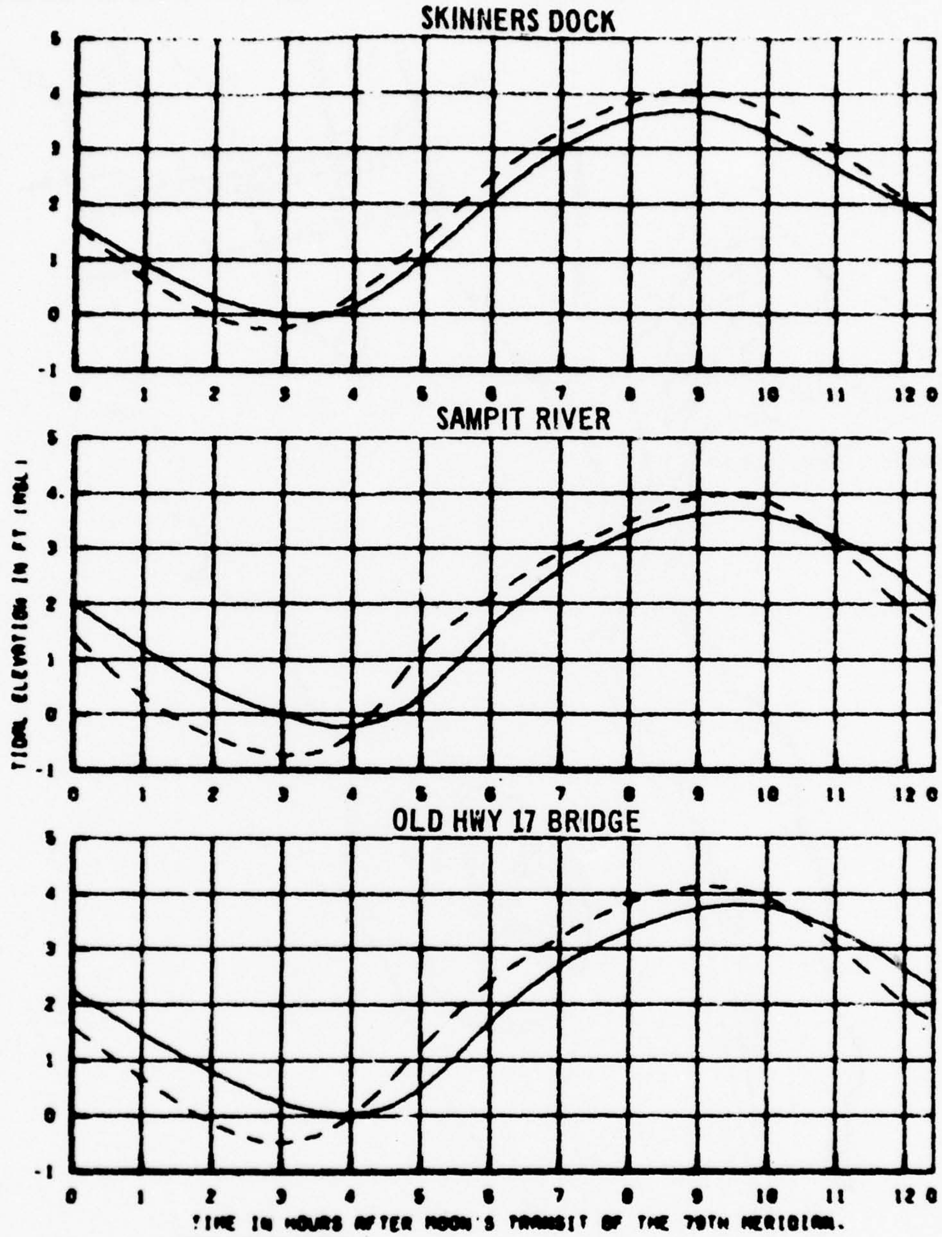


SIDE CHANNEL TRAP IN
UPPER WINYAH BAY
WITH REALIGNMENT CHANNEL
PLAN 9

PLATE 22



DAM
PEE DEE RIVER
WACCAMAW RIVER
N
U.S. 17
GEORGETOWN HARBOR
DEPTH = -27 FT MLW
RABBIT ISLAND
HARE ISLAND
SCALE IN FEET
3000
0
3000
DIVERSION CANAL
PLAN 10



TIME IN HOURS AFTER MOON'S TRANSIT OF THE 79TH MERIDIAN.

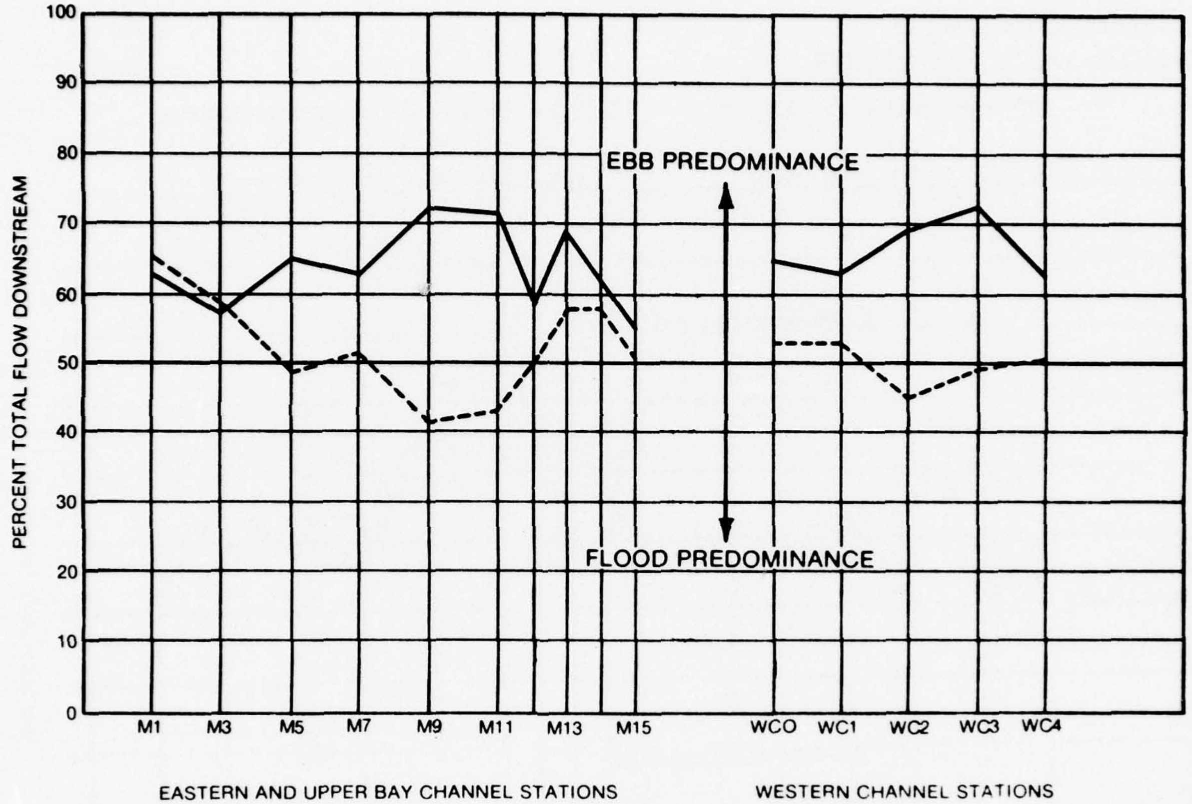
TEST CONDITIONS	
TIDAL RANGE AT YAWKIES DOCK	3.06 FT
OCEAN SALINITY (TOTAL SALTS)	31.5 PPT
WACCAMAW RIVER INFLOW	5822 CFS
BLACK RIVER INFLOW	3840 CFS
PEE DEE RIVER INFLOW	61930 CFS

LEGEND
BASE ———
PLAN 10 — — —

EFFECTS OF
PLAN 10 ON
TIDAL HEIGHTS

STATIONS
T2, T3, AND T4

PLATE 24



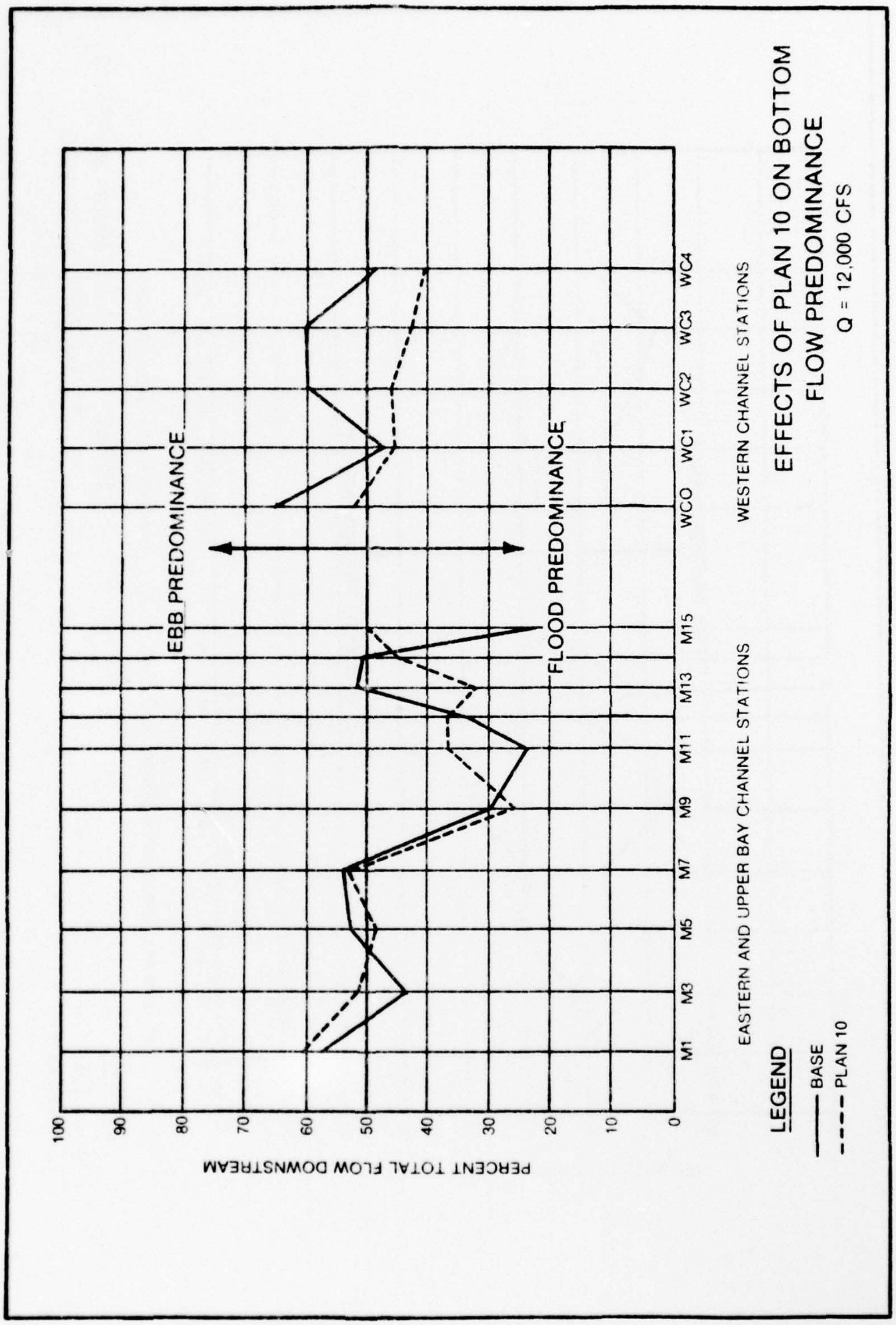
LEGEND

—— BASE

- - - - PLAN 10

EFFECTS OF PLAN 10 ON SURFACE FLOW PREDOMINANCE

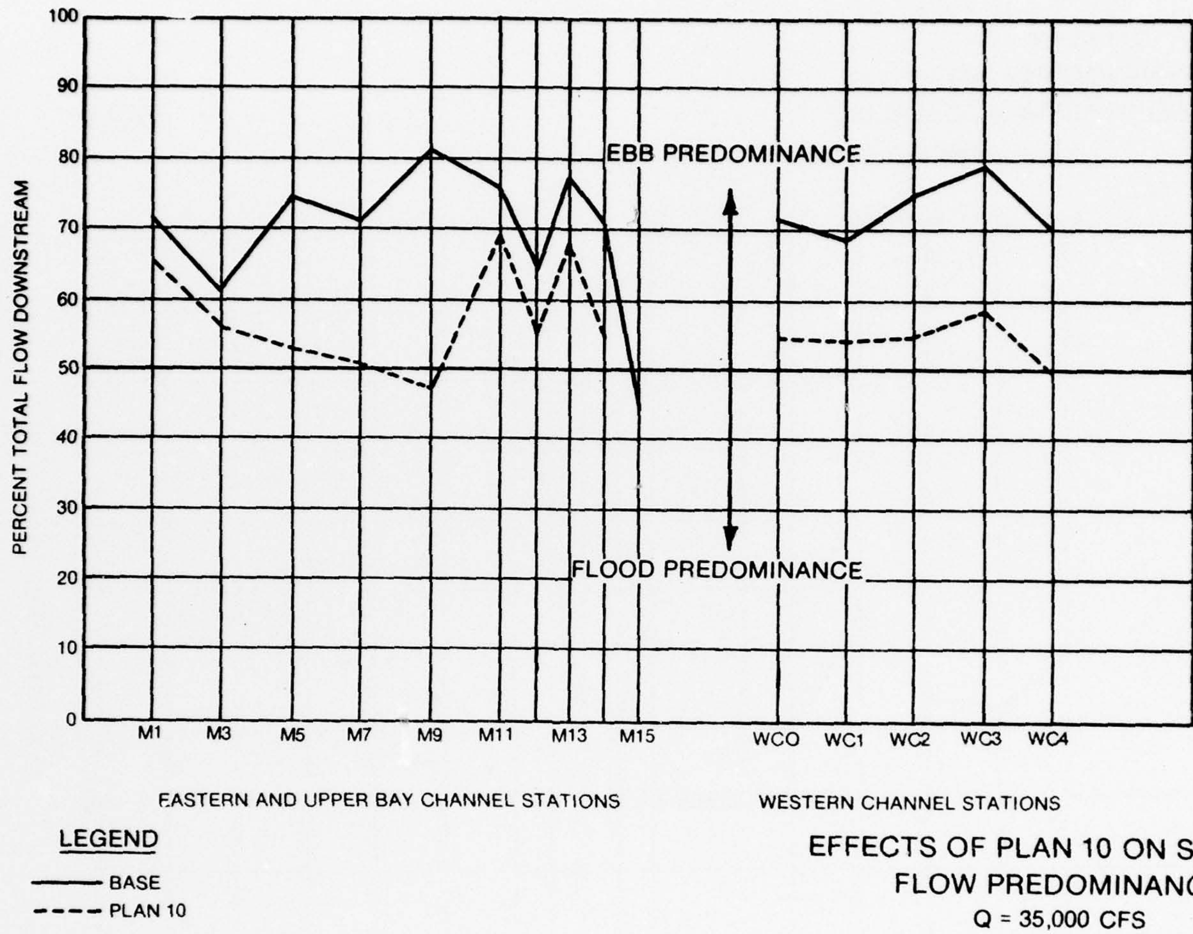
Q = 12,000 CFS



EFFECTS OF PLAN 10 ON BOTTOM FLOW PREDOMINANCE

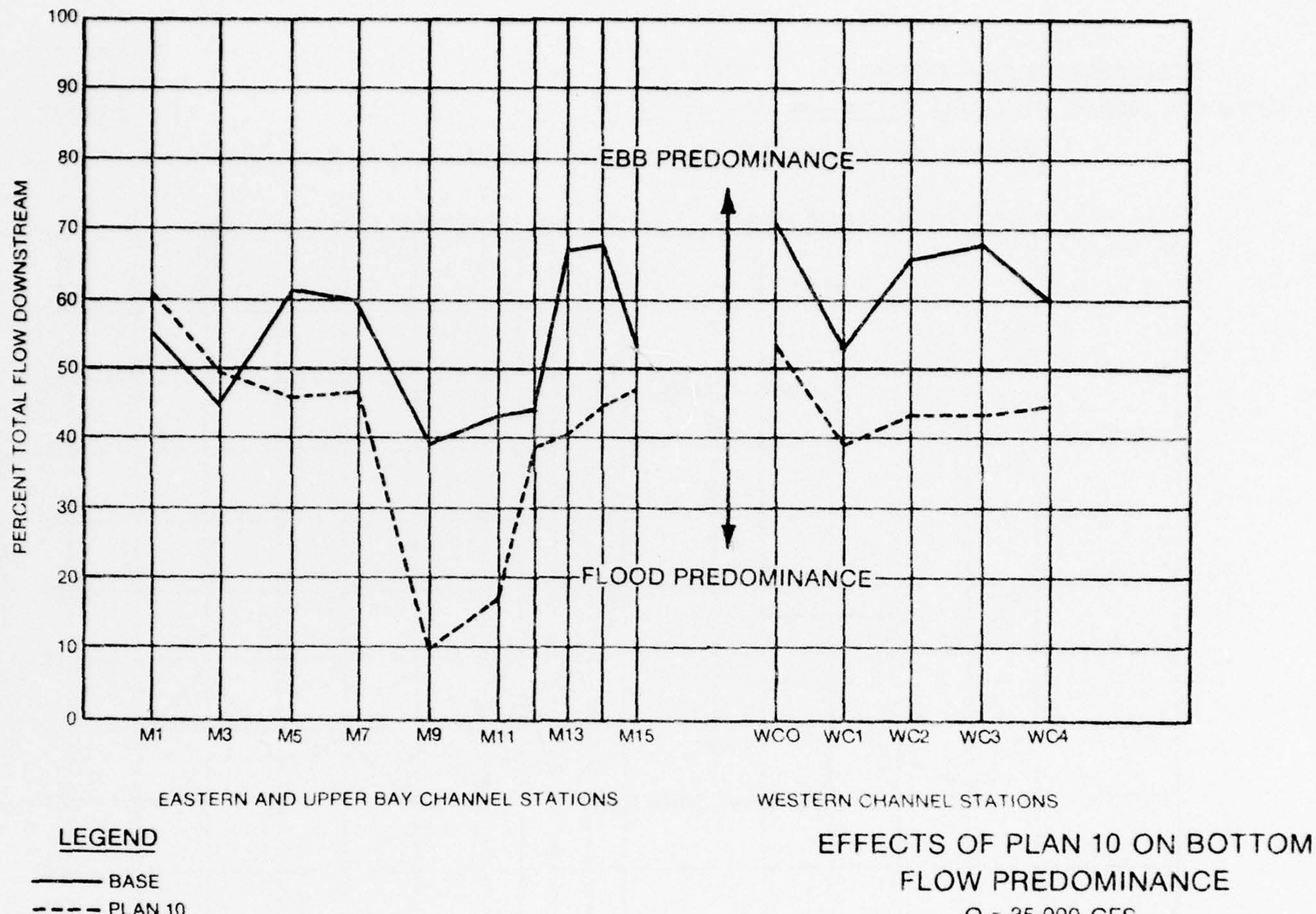
Q = 12,000 CFS

PLATE 26



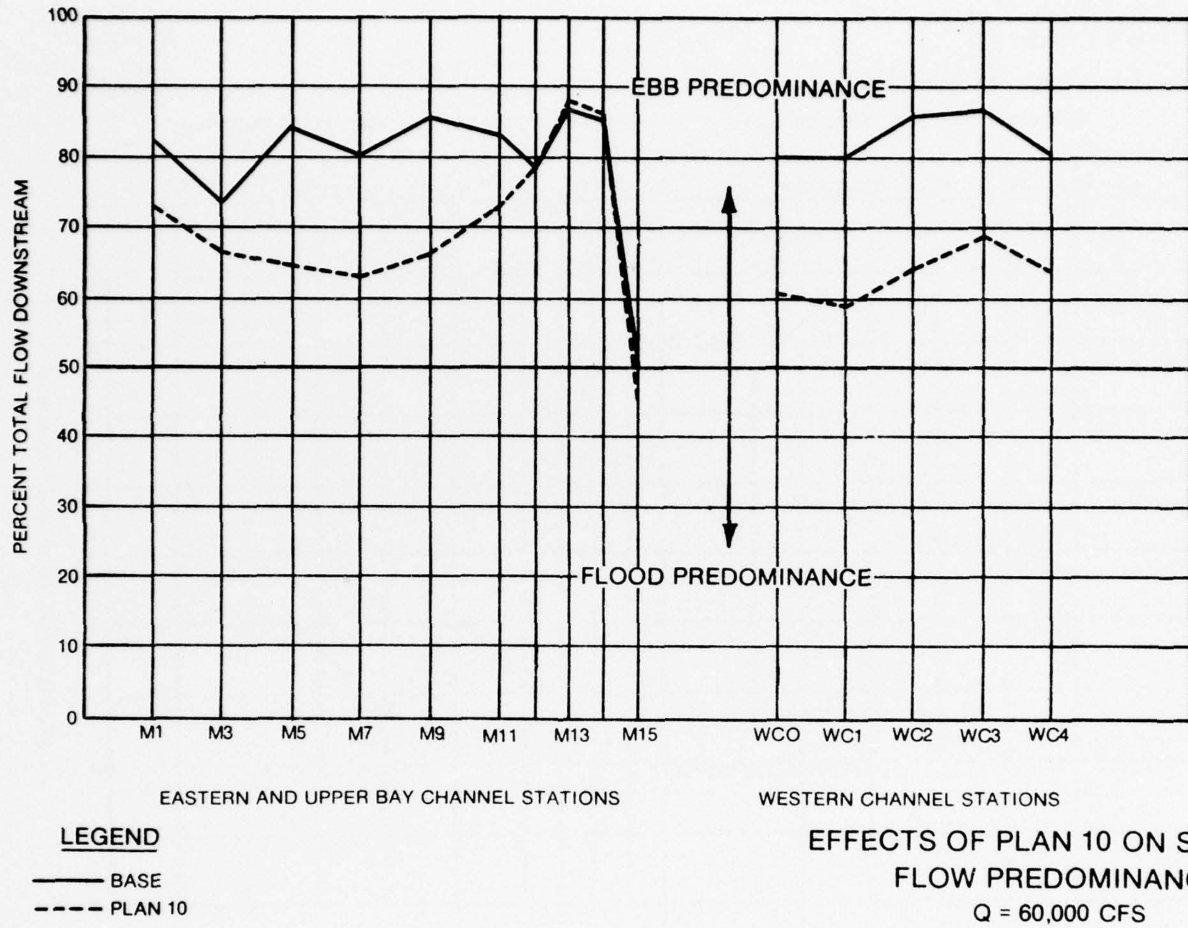
EFFECTS OF PLAN 10 ON SURFACE FLOW PREDOMINANCE

Q = 35,000 CFS



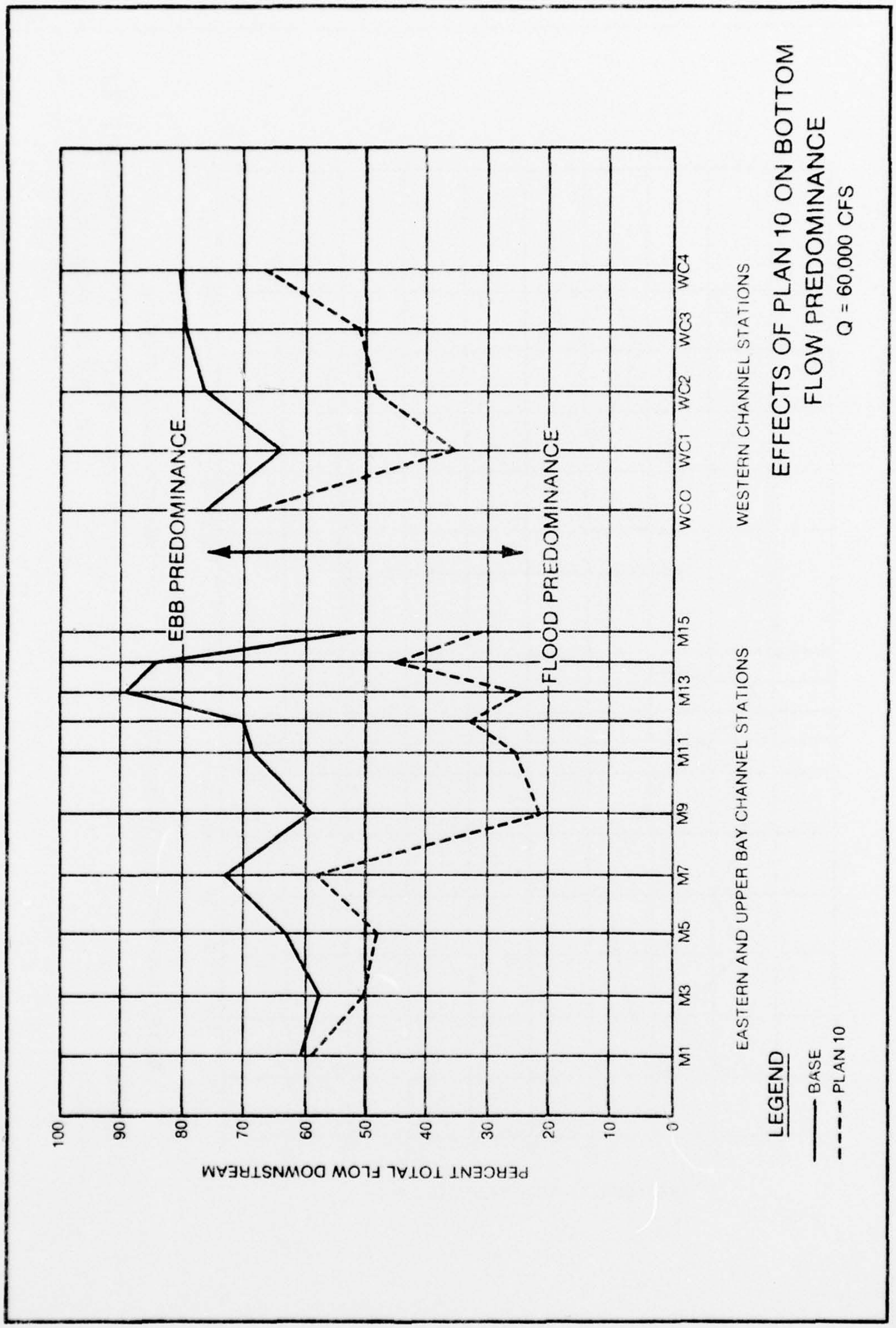
EFFECTS OF PLAN 10 ON BOTTOM FLOW PREDOMINANCE

Q = 35,000 CFS



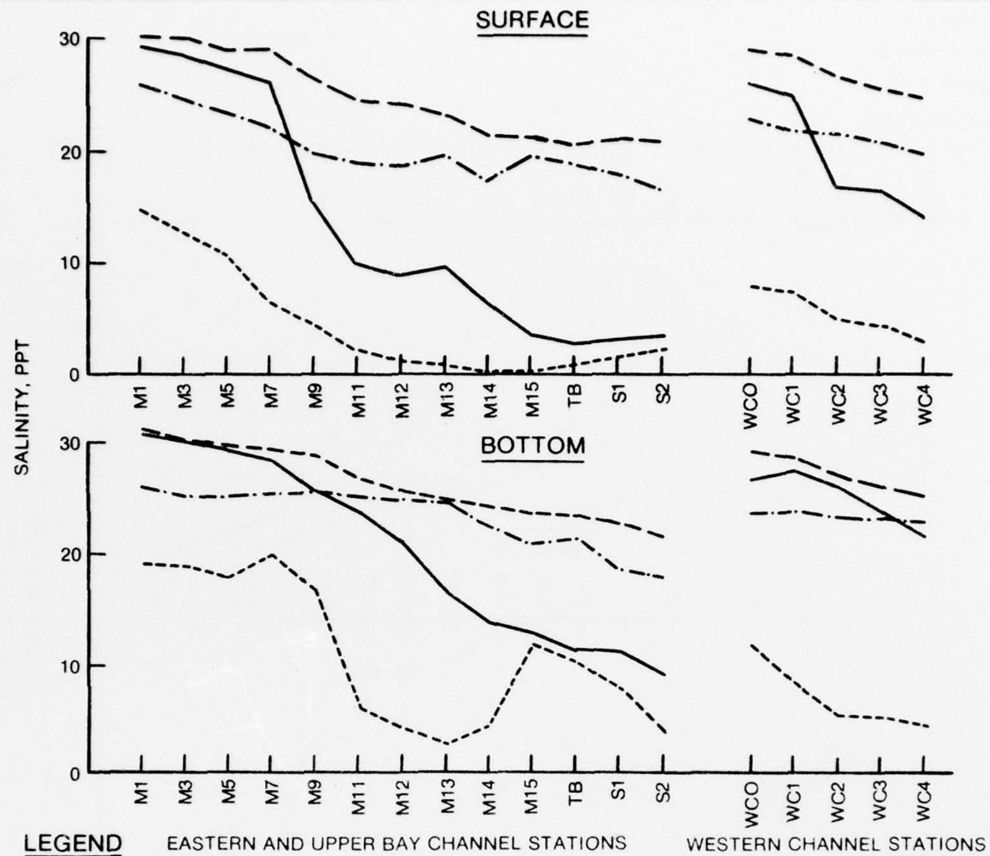
EFFECTS OF PLAN 10 ON SURFACE FLOW PREDOMINANCE

Q = 60,000 CFS



EFFECTS OF PLAN 10 ON BOTTOM FLOW PREDOMINANCE
Q = 60,000 CFS

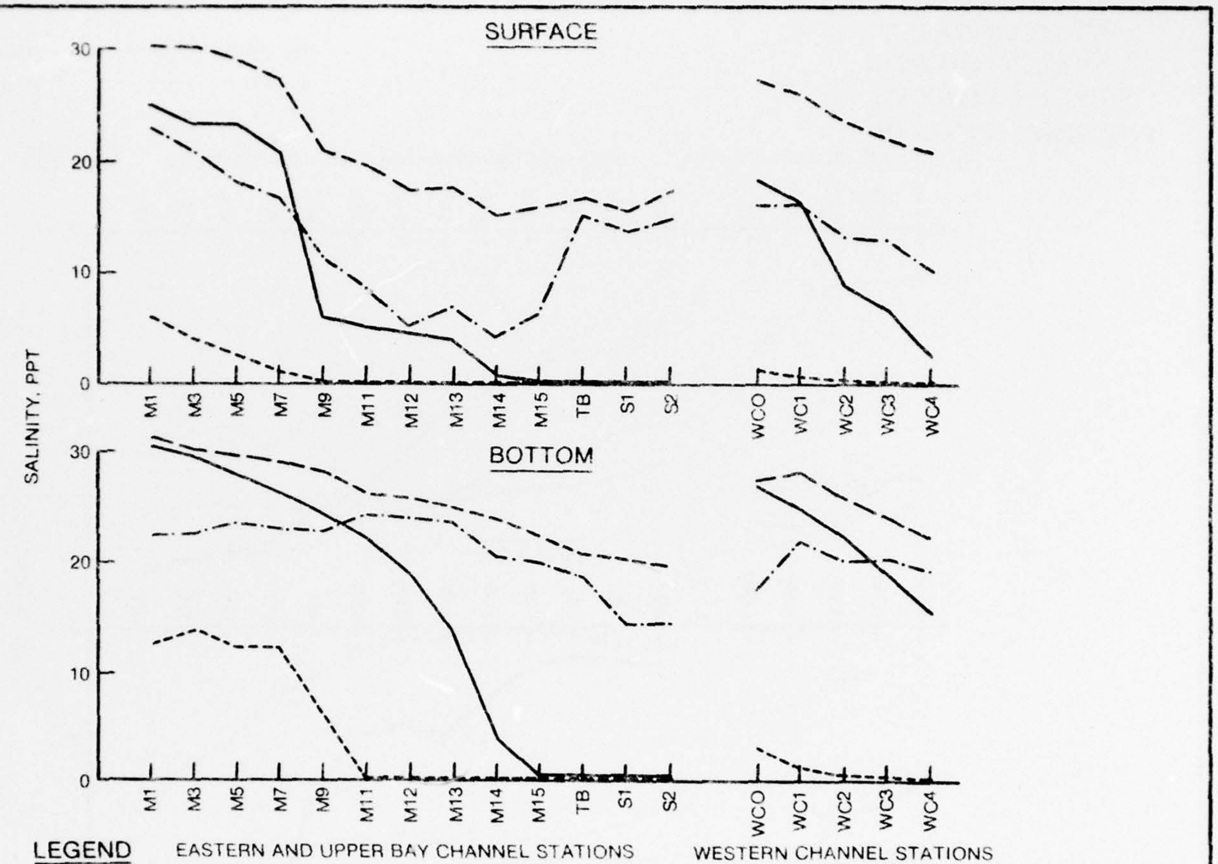
PLATE 30



LEGEND

BASE TEST	PLAN 10
——— MAXIMUM	— — — MAXIMUM
- - - - - MINIMUM	—·—·— MINIMUM

MAXIMUM—MINIMUM
SALINITY PROFILE
BASE TEST VS PLAN 10
12,000-CFS INFLOW



LEGEND

BASE TEST
——— MAXIMUM
-------- MINIMUM

PLAN 10
— — — MAXIMUM
—·—·— MINIMUM

MAXIMUM—MINIMUM
SALINITY PROFILE
BASE TEST VS PLAN 10
35,000-CFS INFLOW

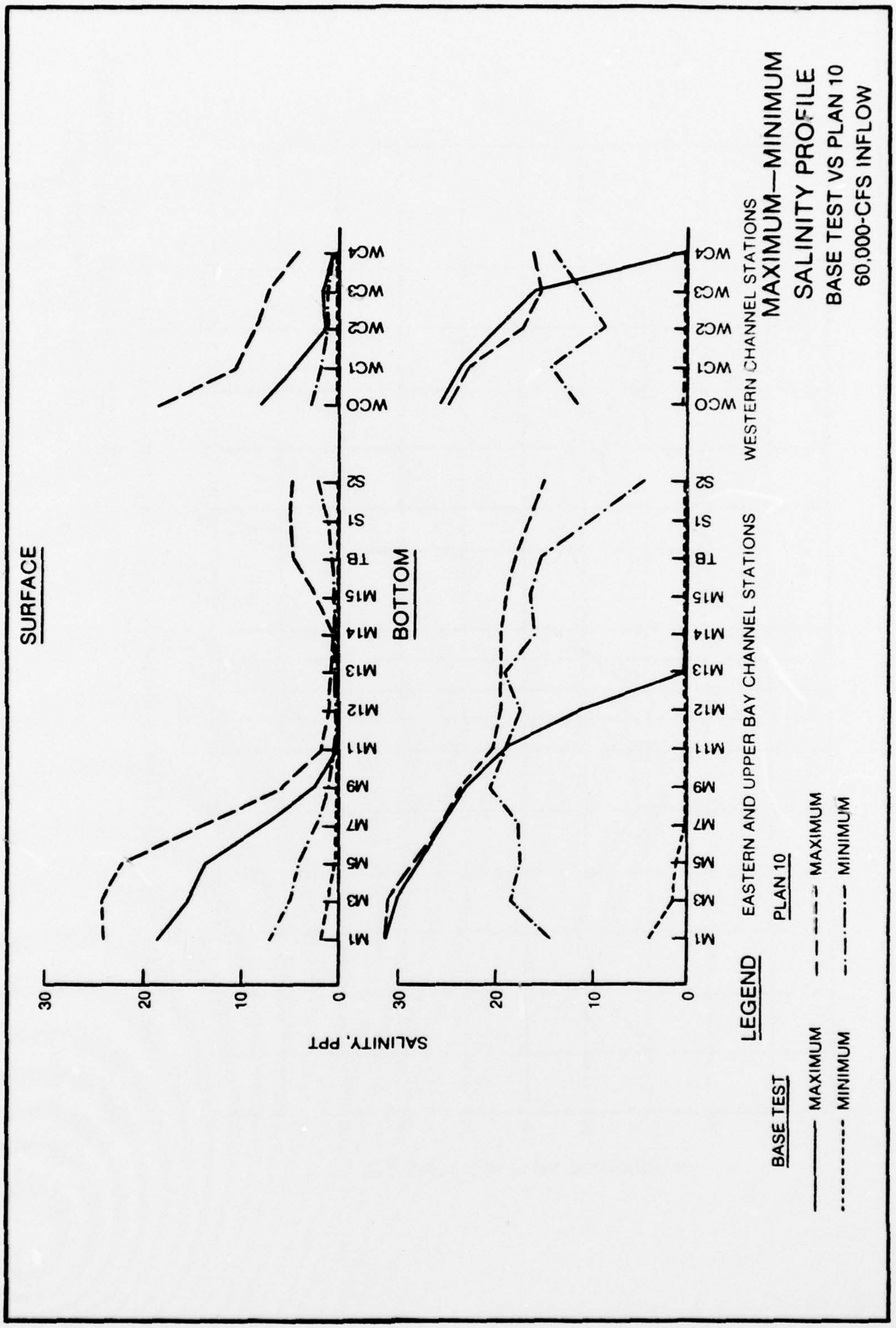
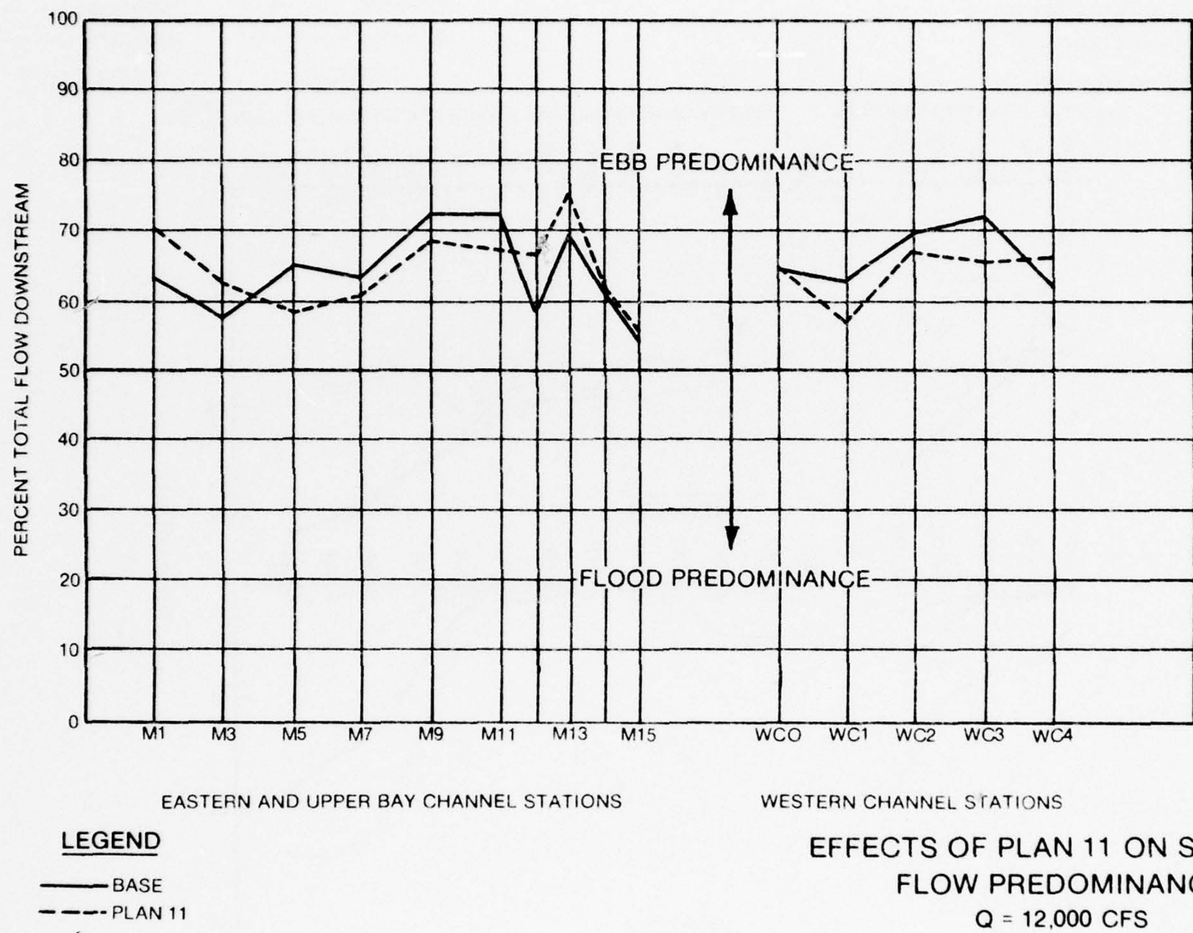
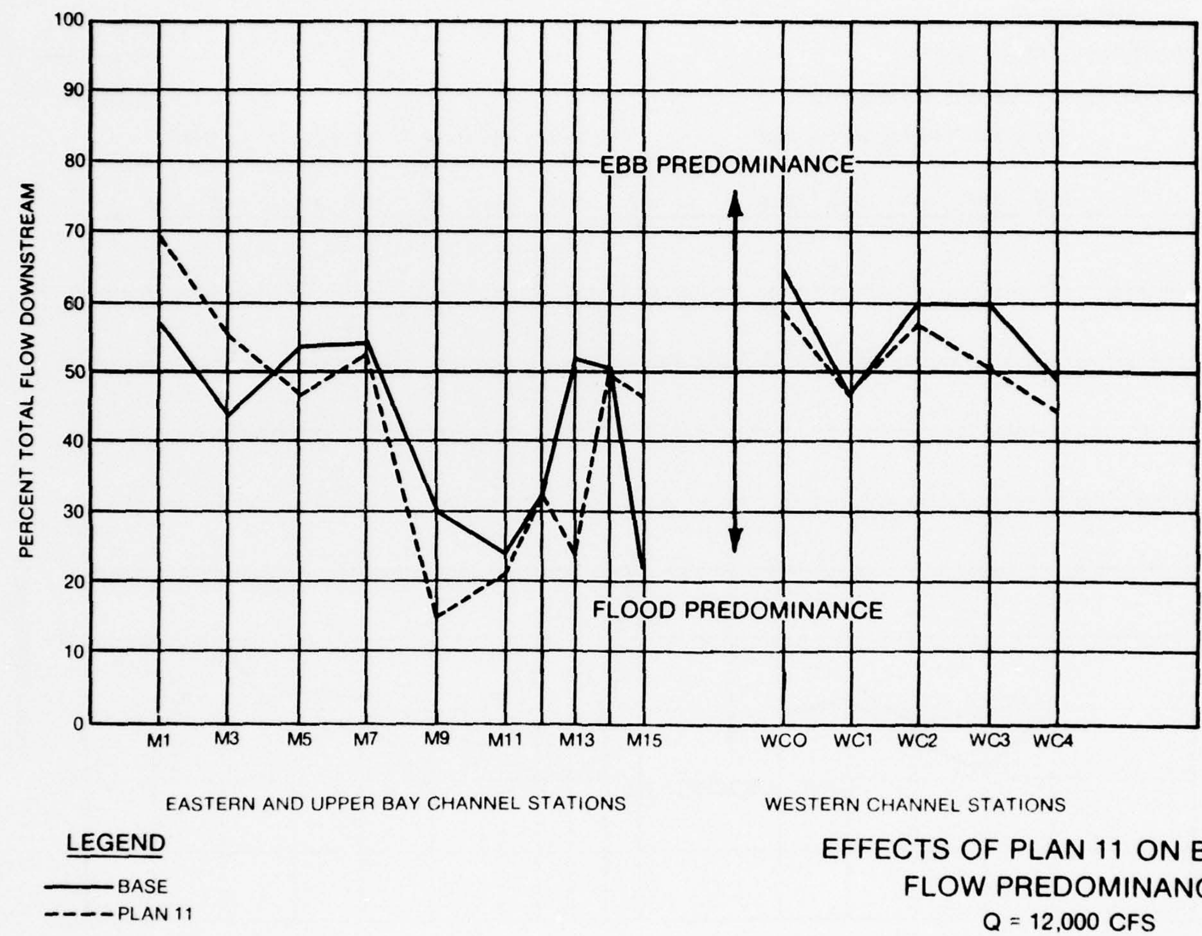

SURFACE
BOTTOM
SALINITY, PPT
30
20
10
0
M1 M3 M5 M7 M9 M11 M12 M13 M14 M15 TB S1 S2
WCO WC1 WC2 WC3 WC4
EASTERN AND UPPER BAY CHANNEL STATIONS
WESTERN CHANNEL STATIONS
LEGEND
BASE TEST
MAXIMUM
MINIMUM
PLAN 10
MAXIMUM
MINIMUM
MAXIMUM—MINIMUM
SALINITY PROFILE
BASE TEST VS PLAN 10
60,000-CFS INFLOW

PLATE 33



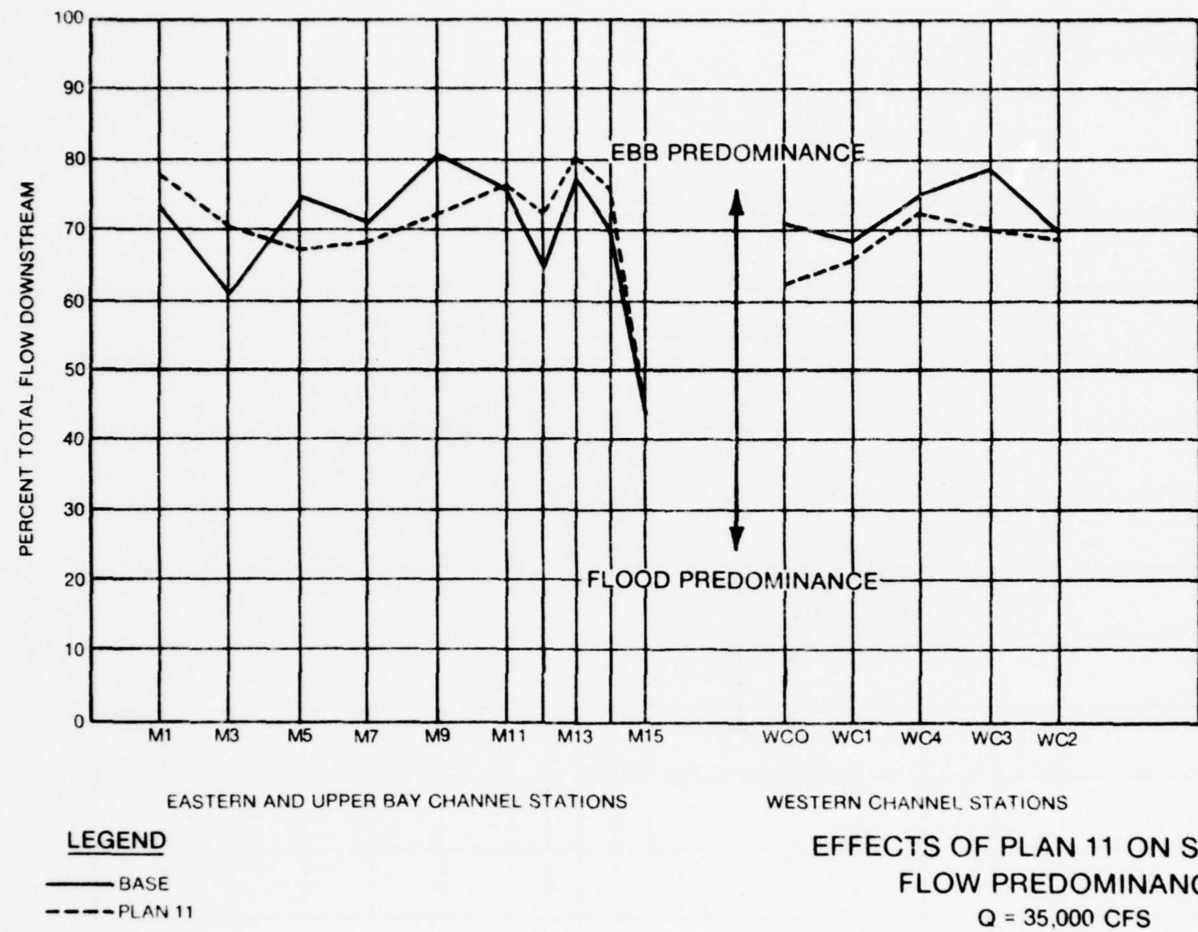
EFFECTS OF PLAN 11 ON SURFACE FLOW PREDOMINANCE

Q = 12,000 CFS



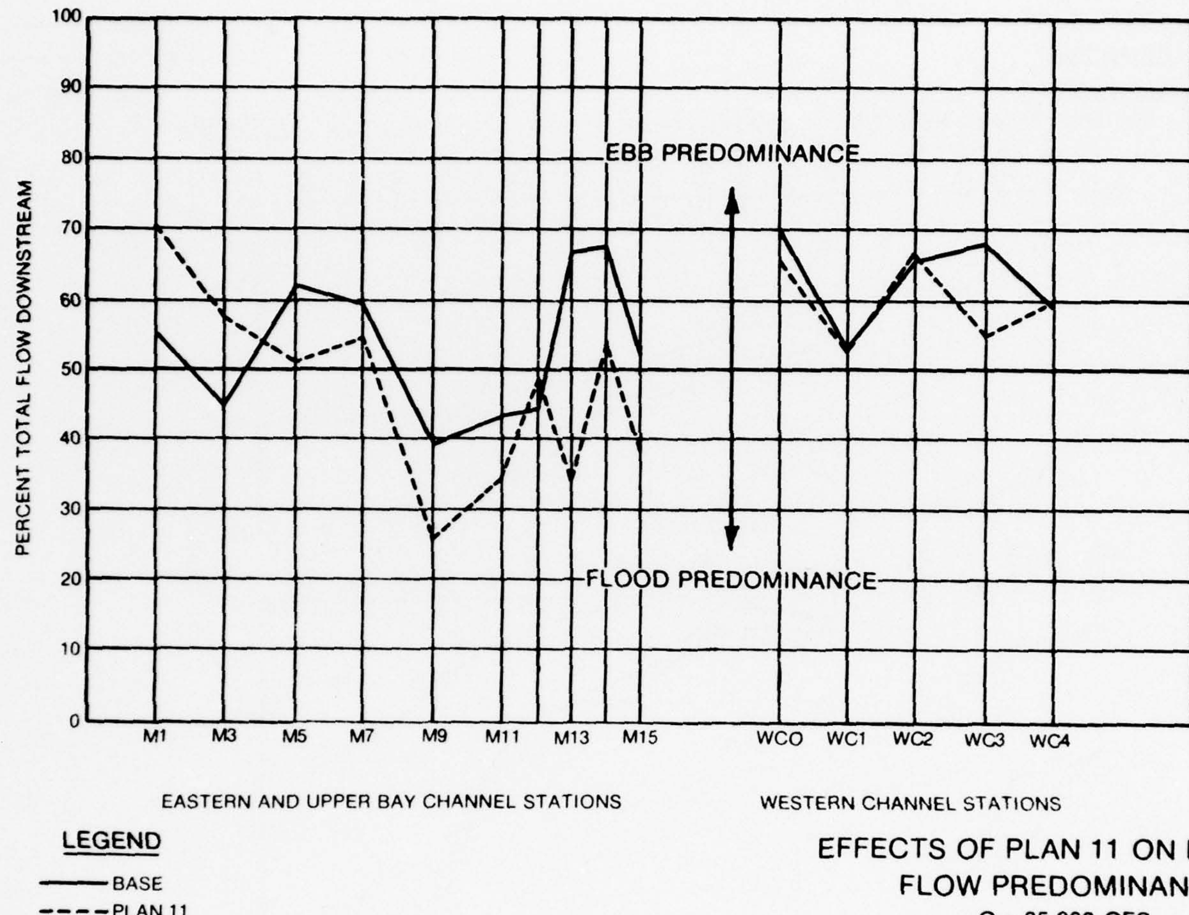
EFFECTS OF PLAN 11 ON BOTTOM FLOW PREDOMINANCE

Q = 12,000 CFS



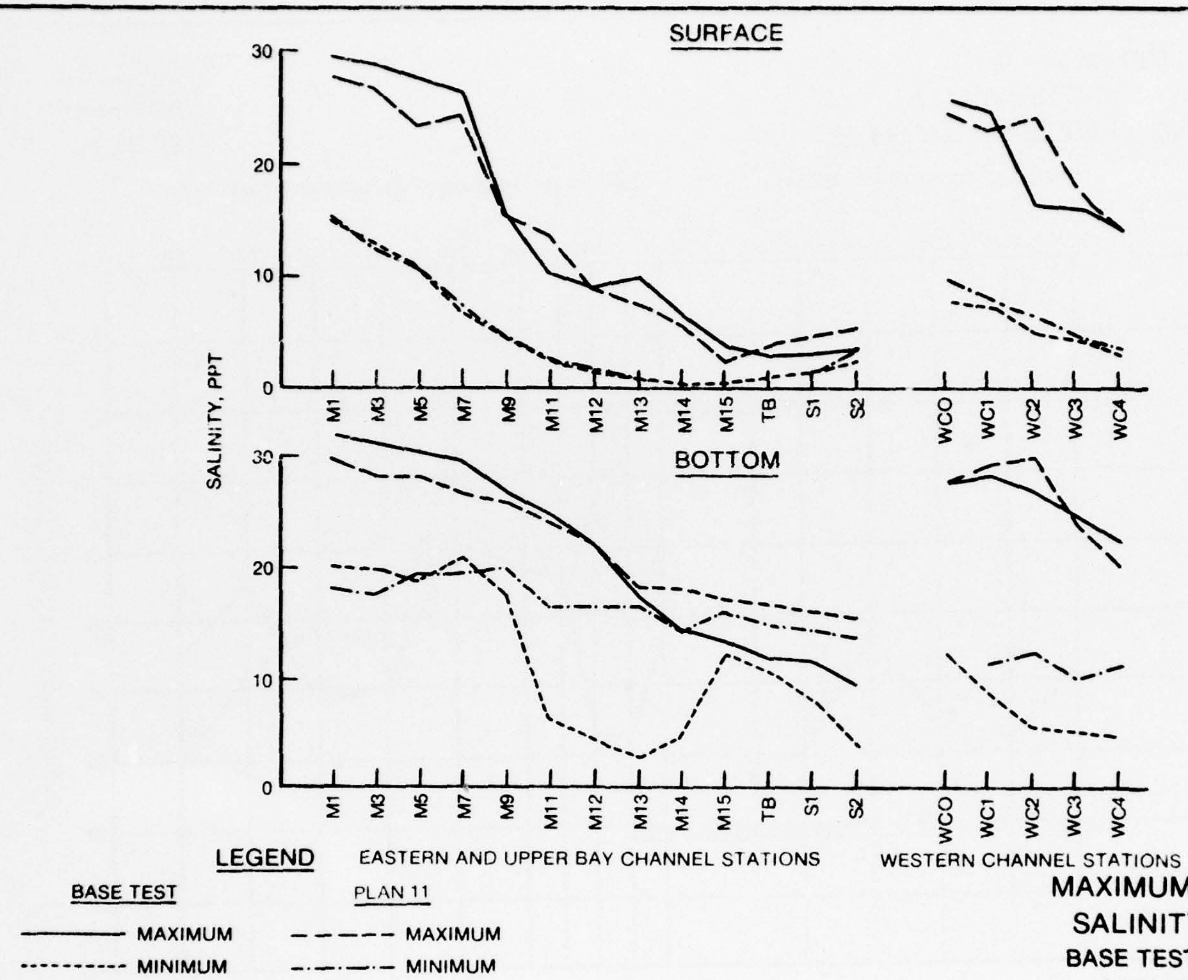
EFFECTS OF PLAN 11 ON SURFACE FLOW PREDOMINANCE
Q = 35,000 CFS

PLATE 36

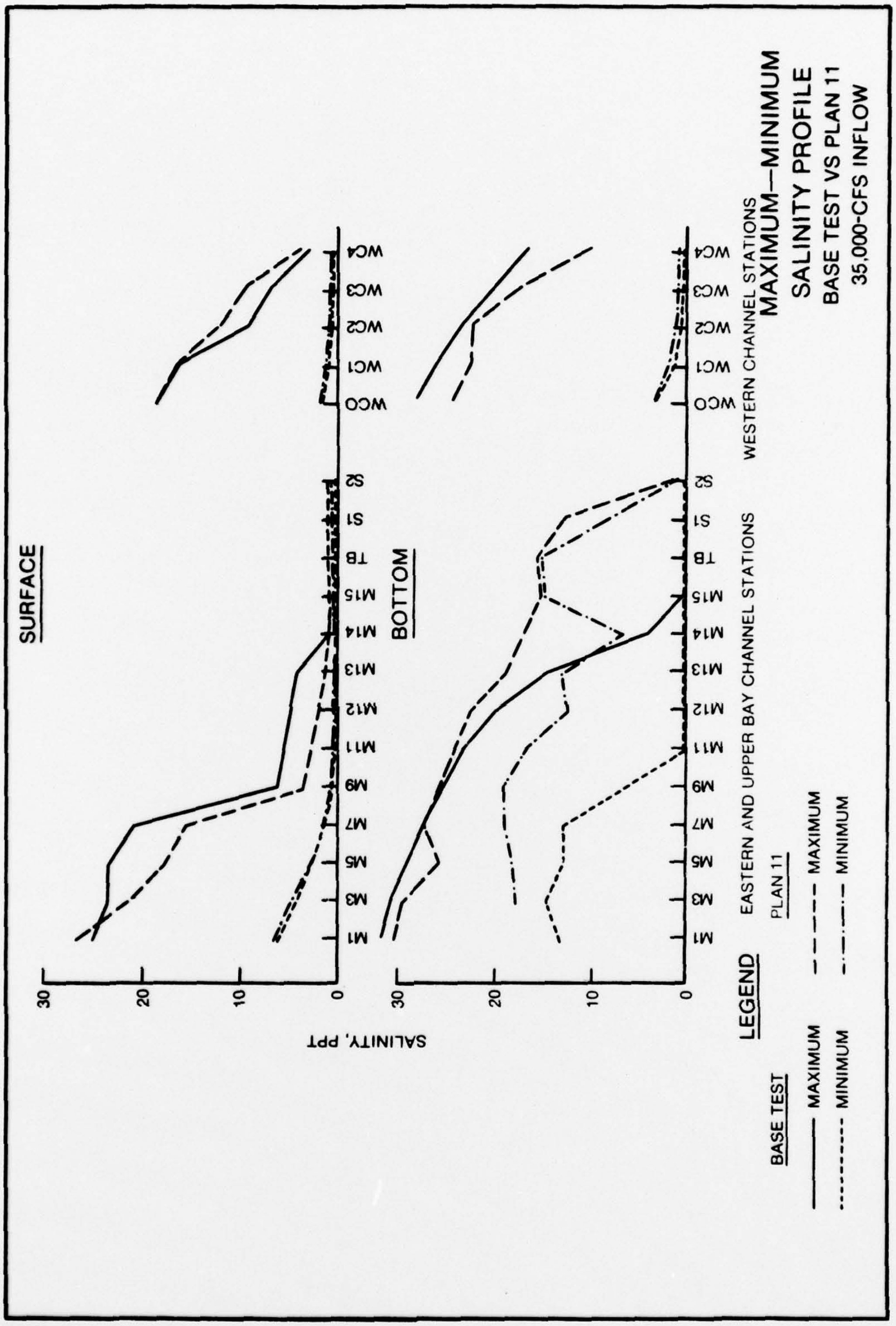


EFFECTS OF PLAN 11 ON BOTTOM FLOW PREDOMINANCE

Q = 35,000 CFS



MAXIMUM—MINIMUM SALINITY PROFILE
BASE TEST VS PLAN 11
12,000-CFS INFLOW


SURFACE
BOTTOM
SALINITY, PPT
30
20
10
0
M1
M3
M5
M7
M9
M11
M12
M13
M14
M15
TB
S1
S2
WCO
WC1
WC2
WC3
WC4
EASTERN AND UPPER BAY CHANNEL STATIONS
WESTERN CHANNEL STATIONS
LEGEND
BASE TEST
MAXIMUM
MINIMUM
PLAN 11
MAXIMUM
MINIMUM
MAXIMUM—MINIMUM
SALINITY PROFILE
BASE TEST VS PLAN 11
35,000-CFS INFLOW

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Trawle, Michael J
Georgetown Harbor, South Carolina; Report 2: Effects of various channel schemes on tides, currents, and shoaling; hydraulic model investigation / by Michael J. Trawle, Robert A. Boland, Jr. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1979.
58, [29] p., 39 leaves of plates : ill. ; 27 cm. (Miscellaneous paper - U. S. Army Engineer Waterways Experiment Station ; H-78-6, Report 2)
Prepared for U. S. Army Engineer District, Charleston, Charleston, South Carolina.

1. Fixed-bed models. 2. Georgetown, S. C. -- Harbor. 3. Hydraulic models. 4. Navigation channels. 5. Salt water intrusion. 6. Shoaling. 7. Tidal currents. 8. Tides. I. Boland, Robert A., joint author. II. United States. Army. Corps of Engineers. Charleston District. III. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Miscellaneous paper ; H-78-6, Report 2.
TA7.W34m no.H-78-6 Report 2