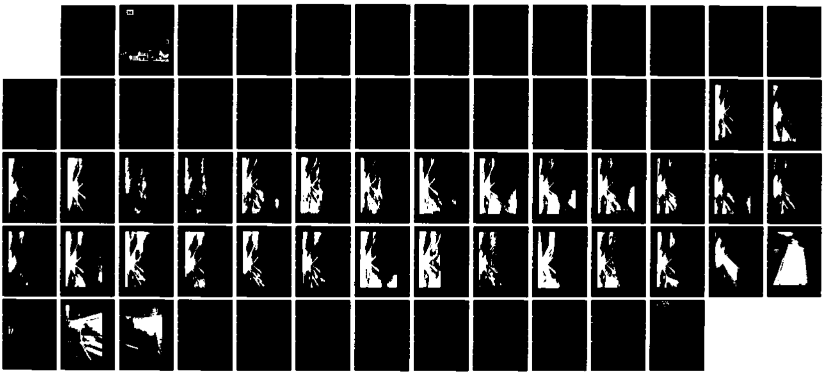
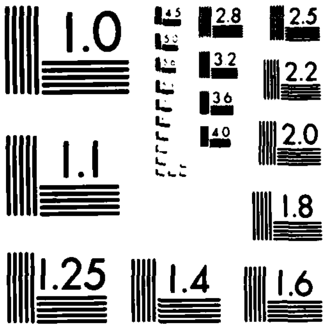
AD-A131 819 DESIGN FOR FLOOD CONTROL WAVE PROTECTION AND PREVENTION OF SHOALING ROGUE..(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS HYDRA.. R R BOTTIN 1/1

UNCLASSIFIED JUN 83 WES/TR/HL-82-18-APP-B F/G 13/2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

(12)

TECHNICAL REPORT HL-82-18

DESIGN FOR FLOOD CONTROL, WAVE PROTECTION, AND PREVENTION OF SHOALING, ROGUE RIVER, OREGON

APPENDIX B: RESULTS OF ADDITIONAL TESTS

Hydraulic Model Investigation

by

Robert R. Bottin, Jr.

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

June 1983

Final Report

Prepared for U. S. Army Engineer District, Portland
Portland, Oreg. 97208

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER Technical Report HL-82-18	2. GOVT ACCESSION NO. [illegible]	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (*and Subtitle*) DESIGN FOR FLOOD CONTROL, WAVE PROTECTION, AND PREVENTION OF SHOALING, ROGUE RIVER, OREGON: APPENDIX B: RESULTS OF ADDITIONAL TESTS; Hydraulic Model Investigation		5. TYPE OF REPORT & PERIOD COVERED Appendix B to final report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Robert R. Bottin, 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, Portland P. O. Box 2946 Portland, Oreg. 97208		12. REPORT DATE June 1983 13. NUMBER OF PAGES 61
14. MONITORING AGENCY NAME & ADDRESS(*if different from Controlling Office*)		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*)

18. SUPPLEMENTARY NOTES

Available from National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22161.

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

Flood control
Hydraulic models
Hydraulic structures
Rogue River (Ore.)

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

Additional tests were conducted in an existing 1:100-scale model of the entrance of Rogue River, Oregon, to determine shoaling patterns wave heights, water-surface elevations, and river current velocities in the lower reaches of the river. The improvement plans involved re-orienting the mouth of the river and decreasing the width of the entrance. Also included were the installation of weir sections in the

(Continued)

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

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

20. ABSTRACT (Continued)

north and south jetties. It was concluded from test results that:

a. The narrower, reoriented entrance of Plan 12 will generally result in smaller wave heights in the small-boat basin and lower reaches of the river than those obtained for existing conditions when the shoal is not present (Base Test 2). Wave heights will be substantially higher in the new entrance area, however, than in the existing entrance.

b. Sediment will move into the new jettied entrance of Plan 12 for waves from all directions and may eventually migrate upstream and form shoals adjacent to the new structures that could restrict or prohibit navigation.

c. The new entrance of Plan 12 will result in substantial increases in water-surface elevations (in excess of 7 ft for the higher discharges) in the lower reaches of the river when compared with stages obtained for existing conditions with the shoal removed (Base Test 2).

d. The weir section in the new south jetty of Plan 13 will reduce water-surface elevations in the lower reaches of the river to some extent, as opposed to the Plan 12 stages; however, when compared with a no-shoal existing condition (Base Test 2), elevations still increased in excess of 4 ft for the higher discharges.

e. The weir section and conveyance channel of Plan 13A will not reduce water-surface elevations in the lower reaches of the river significantly, as opposed to the Plan 13 stages. When compared with stages obtained for existing conditions when the shoal is not present (Base Test 2), elevations increased in excess of 3 ft for the higher discharges.

f. Sediment will move (upstream) over and/or through the weir section in the new south jetty of Plans 13 and 13A, particularly at the higher tidal stages, and result in a shoal that will extend into the small-boat basin entrance.

PREFACE

A request for additional testing on the Rogue River model was initiated by the District Engineer, U. S. Army Engineer District, Portland (NPP). The study was authorized by the Office, Chief of Engineers, U. S. Army, and funds for the U. S. Army Engineer Waterways Experiment Station (WES) to conduct the study were authorized on 5 October 1982 and 11 February 1983.

The investigation was conducted during the period November 1982-February 1983 by personnel of the Wave Dynamics, Hydraulics Laboratory, WES, under the direction of Messrs. H. B. Simmons, Chief of the Hydraulics Laboratory; F. A. Herrmann, Jr., Assistant Chief of the Hydraulics Laboratory; and C. E. Chatham, Jr., Acting Chief of the Wave Dynamics Division. Tests were conducted by Mr. H. F. Acuff, civil engineering technician, under the supervision of Mr. R. R. Bottin, Jr., Project Manager. This report was prepared by Mr. Bottin.

Mr. Bo Shindler, Port of Gold Beach, visited WES to observe model operation and participate in a conference during the course of the investigation.

The Rogue River model was initially tested during the period May 1980-July 1981. Test results were reported in WES Technical Report HL-82-18, "Design for Flood Control, Wave Protection, and Prevention of Shoaling, Rogue River, Oregon," dated August 1982. Test results reported herein supplement the basic report.

Commander and Director of WES during the conduct of this investigation and the preparation and publication of this report was COL Tilford C. Creel, CE. Technical Director was Mr. F. R. Brown.

CONTENTS

DESIGN FOR FLOOD CONTROL, WAVE PROTECTION, AND PREVENTION OF SHOALING, ROGUE RIVER, OREGON

APPENDIX B: RESULTS OF ADDITIONAL TESTS

Hydraulic Model Investigation

PART I: INTRODUCTION

1. A hydraulic model investigation of Rogue River, Oregon, was conducted to study the effects of proposed improvements at the mouth and in the lower reaches of the river. Existing conditions (both with and without a fixed-bed shoal in the entrance) were tested initially to establish a base from which to evaluate the effectiveness of the various proposals. Tests were conducted for 58 variations in the design elements of three basic remedial improvement plans. Dikes installed within the existing entrance, extensions of the existing jetties, and an alternate harbor entrance were tested with variations consisting of changes in the lengths, alignments, and/or cross sections of the various stuctures.

2. After the results of the above tests were published, additional tests were requested to determine the effectiveness of another entrance configuration with regard to shoaling, wave conditions, and passage of flood flows. The initial tests (see paragraph 1) and the report* presenting the results of these tests are referred to herein as the basic study (basic tests, basic report). This report constitutes an appendix to the basic report and presents the results of additional tests.

3. The 1:100-scale Rogue River model and its appurtenances, described in the basic study, were reactivated and used during the conduct of the additional tests.

---

* Robert R. Bottin Jr. 1982 (Aug). "Design for Flood Control, Wave Protection, and Prevention of Shoaling, Rogue River, Oregon; Hydraulic Model Investigation," Technical Report HL-82-18, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

PART II: THE TEST PROGRAM

Test Conditions

4. The test conditions used for the additional tests were selected from those listed in the basic study. In many cases, test conditions were limited only to representative and/or critical conditions as determined by the test results in the basic study.

5. Still-water levels (swl's) of 0.0 ft* mean lower low water (mllw**) and +6.7 ft mllw (representing mean higher high water) were used during the conduct of sediment tracer tests and while obtaining water-surface profiles and river current velocities. The +6.7 ft swl was also used while obtaining wave-height measurements. In addition, a swl of +4.3 ft mllw was used during long-term shoaling tests. Based on prototype data obtained at Rogue River, this swl (+4.3 ft) occurs during maximum flood tidal flow conditions.

6. The characteristics of waves selected for use during the conduct of testing are shown in the following tabulation:

Deepwater Direction	Selected Test Waves Period, sec	Selected Test Waves Height, ft
South-Southwest	9	27
	11	12
	13	7
Southwest	7	12, 20
	9	21, 27
	11	13, 21
	13	7, 27
	15	12, 25
	17	7, 18
West	9	7, 23, 31
	11	12
	13	7, 12, 21
	17	7, 12, 17, 25
North-Northwest	9	27
	11	12
	13	7

* Multiply feet by 0.3048 to obtain metres.
** All elevations cited herein are in feet referred to mean lower low water (mllw).

7. River discharges ranging from 50,000 - 350,000 cfs* were used while obtaining water-surface elevations and river current velocities at various stations in the lower reaches of the river.

Test Data

8. The relative merits of the test plans were evaluated by:

a. Comparisons of wave heights at various locations in the model.

b. Comparison of tracer movement and subsequent deposits.

c. Comparison of water-surface profiles and river current velocities.

d. Visual observations and wave pattern photographs.

Test results were compared with those obtained for base tests (existing conditions) reported in the basic study.

9. In analyzing the wave-height data, the average height of the highest one-third of the waves recorded at each gage location was selected. Wave heights thus selected were then adjusted to compensate for wave-height attenuation due to viscous bottom friction in the model. Water-surface profiles for various river discharges were determined by recording elevation changes on point gages located at various stations in the river. River current velocities were secured by timing a weighted float over a known distance in the river channel. It should be noted that the river channel downstream of the small-boat basin entrance was constructed as smooth as possible to minimize viscous friction effects during wave tests. Therefore the roughness in this area is less in the model than in the prototype and model velocities may be somewhat larger for riverflow tests than those to be expected in the prototype. Relative comparisons between various plans should be valid, however. During the conduct of tracer tests, material was introduced into the model south of the south jetty and north of the north jetty to represent sediment from those shorelines, respectively. In addition, material was

---

* Multiply cubic feet per second by 0.02831685 to obtain cubic metres per second.

introduced seaward of the river entrance to represent sediment washed out of the river and deposited by various discharges. Long-term shoaling tests were conducted by slowly introducing tracer material into the model between the jetties for test waves from the southwest or west until the material accumulated and formed a shoal. These tests were conducted assuming that an unlimited supply of sediment was available at the river entrance and were run long enough to ensure maximum penetration of the shoal upstream.

PART III: TEST PLANS AND RESULTS

Description of Plans

10. Model tests were conducted for an improvement plan which involved reorienting the mouth of the Rogue River toward the west and decreasing the width of its entrance. Variations of this plan entailed the installation of weir sections in the new north and south jetties and a conveyance channel through the north overbank. Brief descriptions of the test plans are presented in the following subparagraphs; dimensional details are presented in Plates B1 and B2.

- a. Plan 12 (Plate B1) consisted of a new 700-f ide entrance. The new north jetty originated at ·int approximately 2,100 ft shoreward from the head of e existing north jetty and extended about 2,100 ft on zimuth of 265 deg. The new south jetty originated at nt about 1,600 ft shoreward of the head of the existi south jetty. From this point it extended across the existing entrance channel toward the existing north jetty and then paralleled the new north jetty on the 265-deg azimuth. Total length of the new south jetty was approximately 2,400 ft. The existing north jetty between the new structures was removed and a 13-ft-deep, 300-ft-wide channel was installed that extended to the 13 ft contour in the Pacific Ocean. The area between the new jetties, other than the entrance channel, was dredged to 6 ft.
- b. Plan 13 (Plate B2) entailed the elements of Plan 12 with an 800-ft-long weir section installed in the new south jetty (that portion between the existing jetties) at an elevation of +5 ft.
- c. Plan 13A (Plate B2) included the elements of Plan 13 with an 800-ft-long weir section installed in the existing north jetty at an elevation of +5 ft and a 550-ft-wide conveyance channel installed also at a +5 ft elevation.

Test Results

11. In evaluating test results, the relative merits of various plans were based on the movement of tracer material and subsequent deposits, measured wave heights, water-surface elevations and/or river current velocities. Test results of the various plans were compared

with those obtained for existing conditions (as reported in the basic study report). Model wave heights (significant wave height or $H_{1/3}$), water-surface elevations, and river current velocities were tabulated to show measured values at selected locations. Water-surface elevations were plotted graphically to show water-surface profiles along the center line of the river and/or channel. The general movement of tracer material and subsequent deposits are shown in photographs. Arrows were superimposed onto these photographs to depict sediment movement patterns.

Plan 12

12. Results of wave-height tests for representative test waves from southwest and west with Plan 12 installed in the model using the +6.7 ft swl are presented in Table B1. Maximum wave heights obtained were 22.2 ft in the entrance at the seaward end of the new jetties (gage 2) for 17-sec, 18-ft test waves from southwest; 1.1 ft along the revetment on the north bank (gage 9) for 7-sec, 20-ft test waves from southwest; 0.9 ft upstream of the U. S. 101 Highway Bridge (gage 10) for 11-sec, 13-ft test waves and 17-sec, 18-ft test waves from southwest; 2.6 ft in the entrance to the small-boat basin (gage 12) for 11-sec, 13-ft test waves and 13-sec, 27-ft test waves from southwest; and 0.4 ft inside the small-boat basin (gages 13-15) for 7-sec, 12-ft test waves and 13-sec, 27-ft test waves from southwest. A comparison of wave data obtained for Plan 12 with data obtained for existing conditions in the basic study revealed that, in general, wave heights in the small-boat basin and lower reaches of the river (upstream of gage 4) were less for Plan 12 than for existing conditions when the shoal in the existing river mouth is not present (Base Test 2). In the entrance area, however, Plan 12 wave heights generally were substantially higher than those for Base Test 2. Typical wave patterns secured for representative test waves from the four test directions are presented in Photos B1-B4.

13. The general movement of tracer material and subsequent deposits obtained for Plan 12 for representative test waves from all four directions using the 0.0- and +6.7 ft swl's are shown in Photos B5-B28. For test waves from north-northwest, tracer material on the north shoreline generally moved around the head of the north jetty into the new

entrance. Some of the material seaward of the river mouth moved into the entrance and some moved southerly around the new south jetty. Material on the south shoreline also moved in a southerly direction. For test waves from west and southwest, tracer material on the north and south shorelines presented no problem with respect to shoaling in the new entrance; however, material seaward of the river mouth entered the entrance between the jetties. For test waves from south-southwest, tracer material on the south shoreline moved across the old (existing) entrance and into the new entrance for 11-sec, 12-ft test waves. Material on the north shoreline caused no shoaling problems, but material seaward of the river mouth entered the entrance between the new jetties. In summary, tracer material moved into the new jettied entrance for test waves from all four directions with both the 0.0 and +6.7 ft swl's.

14. Tracer material was introduced into the model between the new proposed jetties, and long-term shoaling tests were conducted for Plan 12 for 11-sec, 12-ft test waves from west using the +4.3 ft swl and the maximum flood tidal flow. Material moved upstream and shoals formed adjacent to the new north and south jetties as shown in Photos B29 and B30.

15. Results of water-surface elevation and depth-averaged river current velocity measurements for Plan 12 are shown in Tables B2 and B3. Water-surface profiles plotted from the data in Table B2 are shown in Plates B3 and B4. Elevations in the lower reaches of the river (sta 8800) ranged from 1.3 ft for the 50,000-cfs discharge to 15.6 ft for the 350,000-cfs discharge with the 0.0-ft swl. For the +6.7 ft swl, elevations ranged from 7.2 to 16.0 ft for the 50,000- to 350,000-cfs discharges. Maximum velocities between the jetties (sta 1700) at the entrance ranged from 5.2 fps* for the 50,000-cfs discharge to 30 fps for the 350,000-cfs discharge with the 0.0-ft swl. For the +6.7 ft swl, maximum velocities between the jetties (sta 2600) ranged from 3.6 to 20 fps for the 50,000- to 350,000-cfs discharges. When compared with Base Test 2 (existing conditions with the fixed-bed shoal removed from the entrance), the maximum elevation increases caused by Plan 12 in the

---

* Multiply feet per second by 0.3048 to obtain metres per second.

lower reaches of the river with the maximum 350,000-cfs river discharge occurred at sta 4800 and were 5.1 and 7.2 ft for the +6.7 and 0.0-ft swl's, respectively. Velocities in the existing river channel (1,000-ft-wide bank-to-bank portions) were generally lower for Plan 12 than for existing conditions (Base Test 2); however, velocities in the new 700-ft-wide entrance channel (bank-to-bank) of Plan 12 increased significantly (as opposed to comparable stations for Base Test 2 conditions).

Plan 13

16. Water-surface elevations and depth-averaged river current velocities for Plan 13 are shown in Tables B4 and B5. Water-surface profiles (obtained from Table B4) were plotted graphically and are shown in Plates B5 and B6. Elevations in the lower reaches of the river (sta 8800) ranged from 1.3 ft for the 50,000-cfs discharge to 13.8 ft for the 350,000-cfs discharge with the 0.0-ft swl. For the +6.7 ft swl, elevations ranged from 7.2 to 13.9 ft for the 50,000- to 350,000-cfs discharges. Maximum velocities between the jetties (sta 1700) at the entrance ranged from 5.4 fps for the 50,000-cfs discharge to 21.4 fps for the 350,000-cfs discharge with the 0.0-ft swl. For the +6.7 ft swl, maximum velocities between the jetties (sta 2600) ranged from 3.4 to 18.8 fps for the 50,000- to 350,000-cfs discharges. When compared with Base Test 2 (existing conditions with the fixed-bed shoal removed from the entrance), the maximum elevation increases caused by Plan 13 in the lower reaches of the river with the maximum 350,000-cfs river discharge occurred at sta 4800 and were 2.1 and 4.3 ft for the +6.7 and 0.0-ft swl's, respectively. Velocities in the new 700-ft-wide entrance of Plan 13 increased significantly as opposed to comparable stations for Base Test 2 conditions.

Plan 13A

17. Results of water-surface elevation and depth-averaged river current velocity measurements with Plan 13A installed are shown in Tables B6 and B7. Water-surface profiles plotted from the data in Table B6 are shown in Plates B7 and B8. Elevations in the lower reaches of the river (sta 8800) ranged from 1.4 ft for the 50,000-cfs discharge to

13.5 ft for the 350,000-cfs discharge with the 0.0-ft swl. For the +6.7 ft swl, elevations ranged from 6.9 to 13.5 ft for the 50,000- to 350,000-cfs discharges. Maximum velocities between the jetties at the entrance (sta 1700) ranged from 6.0 fps for the 50,000-cfs discharge to 23.1 fps for the 350,000-cfs discharge with the 0.0-ft swl. For the +6.7 ft swl, maximum velocities between the jetties (sta 2600) ranged from 3.4 to 20.0 fps for the 50,000- to 350,000-cfs discharges. When compared with existing conditions (Base Test 2), the maximum elevation increases caused by Plan 13A with the maximum 350,000-cfs river discharge occurred at sta 5600 and 6400 (1.5 ft) for the +6.7 swl and at sta 4800 and 5600 (3.5 ft) for the 0.0-ft swl. Velocities increased significantly in the new 700-ft-wide entrance of Plan 13A when compared with comparable stations for Base Test 2 conditions. A view of the conveyance channel and weir sections of Plan 13A with a 350,000-cfs river discharge is shown in Photo B31.

18. Tracer material was introduced into the model between the existing jetties, and long-term shoaling tests were conducted for Plan 13A for 13-sec, 27-ft test waves from southwest using the +4.3 ft swl and the maximum flood tidal flow. Tracer material moved upstream along the existing south jetty where a shoal formed against the new structure and weir section. Each wave crest then carried material over or through the structure, forming a shoal upstream of the weir section along the south jetty. This material eventually migrated to within about 200 ft of the small-boat basin entrance as shown in Photo B32. The +5 ft weir across the existing entrance dissipated enough wave energy to prevent the movement of the shoal into the basin entrance for the +4.3 ft swl. When the swl was raised to +6.7 ft (mhhw), however, the shoal formation migrated into the small-boat basin entrance as shown in Photo B33. This shoal was similar to the formation obtained for existing conditions (Base Test 2) and would have moved across the small-boat basin entrance provided sufficient time was allocated.

Discussion of riverine impacts

19. Water-surface profiles and velocity measurements indicate the potential of major amounts of riverine sediments being transported during

any major flood events. River current velocities also indicate that there is a high potential for loss of jetty structures due to removal of sediments between those structures. In addition, major shifts in the backwater profiles may occur from point to point as sediments are removed and deposited. Because of the potential for shifts in backwater profiles and the potential for loss of structures, increases or decreases in flood stages depict trends, but the degree of change cannot be quantified in the fixed-bed model. Introduction of overflow weirs also decreases the sediment transport capacity by dividing the flow, and these factors may have a significant effect on flood stages in the lower reaches of the river (sta 8000 to the entrance). The weir plans (Plans 13 and 13A) increase profiles relative to existing conditions (Base Test 2); however, they decrease water-surface profiles when compared with Plan 12 (where no weirs were used).

PART IV: CONCLUSIONS

20. Based on the results of the hydraulic model investigation reported herein, it is concluded that:

a. The narrower, reoriented entrance of Plan 12 will result, generally, in smaller wave heights in the small-boat basin and lower reaches of the river than those obtained for existing conditions when the shoal is not present (Base Test 2). On the other hand, wave heights will be substantially higher in the new entrance area than those in the existing entrance.

b. Sediment will move into the new jettied entrance of Plan 12 for waves from all directions and may eventually migrate upstream and form shoals adjacent to the new structures that could restrict or prohibit navigation.

c. The new entrance of Plan 12 will result in substantial increases in water-surface elevations (in excess of 7 ft for the higher discharges) in the lower reaches of the river when compared with stages obtained for existing conditions with the shoal removed (Base Test 2).

d. The weir section in the new south jetty of Plan 13 will reduce water-surface elevations in the lower reaches of the river to some extent, as opposed to the Plan 12 stages; however, when compared with a no-shoal existing condition (Base Test 2), elevations still increased in excess of 4 ft for the higher discharges.

e. The weir section and conveyance channel of Plan 13A will not reduce water-surface elevations in the lower reaches of the river significantly, as opposed to the Plan 13 stages. When compared with stages obtained for existing conditions when the shoal is not present (Base Test 2), elevations increased in excess of 3 ft for the higher discharges.

f. Sediment will move (upstream) over and/or through the weir section in the new south jetty of Plans 13 and 13A, particularly at the higher tidal stages, and result in a shoal that will extend into the small-boat basin entrance.

Table B1

Wave Heights for Plan 12 for Test Waves from Southwest and West, +6.7 ft swl

Test Wave Direction	Period sec	Height ft	Wave Height, ft, for Gage Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SW	7	12	8.1	9.3	4.4	3.4	2.0	0.7	0.5	0.5	0.7	0.5	1.1	0.4	0.4	0.3	0.1
		20	24.2	21.0	9.7	5.1	2.5	0.6	0.6	0.8	1.1	0.7	1.4	0.7	0.1	0.1	0.2
	9	27	29.8	18.5	8.8	3.1	1.4	0.7	0.7	0.6	0.5	0.5	1.1	1.7	0.2	0.1	0.2
	11	13	14.7	20.6	13.8	5.2	2.1	1.6	0.9	0.7	0.6	0.9	2.1	2.6	0.3	0.1	0.3
		21	21.8	15.3	10.7	4.9	1.9	1.1	0.8	0.5	0.6	0.5	1.4	2.1	0.3	0.1	0.3
	13	7	7.4	10.8	7.2	4.3	1.7	0.6	0.4	0.4	0.4	0.4	1.6	1.6	0.2	0.2	0.3
		27	33.5	19.1	12.6	5.9	2.1	1.4	0.7	0.7	0.6	0.7	1.7	2.6	0.3	0.3	0.4
	15	12	18.0	21.7	11.8	7.6	2.4	2.0	0.8	0.6	0.6	0.6	1.2	1.6	0.2	0.3	0.2
		25	29.2	19.7	10.6	5.5	2.2	1.4	0.8	0.7	0.7	0.7	1.3	1.8	0.3	0.3	0.3
	17	7	6.5	9.4	4.5	1.8	1.2	0.5	0.4	0.3	0.4	0.6	0.7	0.7	0.1	0.2	0.1
		18	19.5	22.2	9.1	3.9	2.2	1.3	0.9	0.7	0.6	0.9	1.3	1.7	0.2	0.2	0.2
West	9	7	6.1	8.2	7.4	2.6	1.4	0.4	0.4	0.2	0.6	0.3	1.2	1.0	0.1	0.1	0.2
		31	15.2	14.3	5.9	2.1	1.0	0.6	0.3	0.3	0.5	0.4	0.9	0.9	0.1	0.1	0.1
	13	12	20.6	19.8	8.2	3.5	1.6	1.0	0.3	0.4	0.4	0.4	1.1	1.1	0.2	0.2	0.2
		21	17.5	11.3	6.3	2.4	1.1	0.7	0.3	0.4	0.4	0.3	0.6	0.6	0.1	0.2	0.1
	17	7	9.9	10.7	9.3	5.3	1.3	1.1	0.5	0.3	0.4	0.4	0.8	1.0	0.2	0.2	0.1
		12	17.0	19.3	7.9	2.6	1.5	0.8	0.4	0.3	0.4	0.4	0.9	0.9	0.1	0.2	0.2
		17	25.2	13.8	7.9	2.4	1.4	0.8	0.5	0.3	0.3	0.4	0.7	0.7	0.1	0.1	0.1
		25	24.5	19.8	6.9	2.6	1.5	0.7	0.5	0.4	0.6	0.6	1.0	0.7	0.1	0.2	0.2

Table B2

Water-Surface Elevations, Plan 12

Discharge cfs	Water Surface Elevation, ft mllw, at Indicated Station								
	Sta 1700	Sta 2600	Sta 3600	Sta 4800	Sta 5600	Sta 6400	Sta 7100	Sta 7900	Sta 8800
				0.0-ft swl					
50,000	0.1	0.1	0.8	1.0	1.0	1.0	1.2	1.2	1.3
100,000	0.1	0.3	2.8	3.1	3.2	3.2	3.5	3.5	3.9
150,000	0.3	2.1	5.5	6.0	6.0	6.0	6.3	6.3	6.8
200,000	0.3	3.4	7.9	8.5	8.6	8.6	8.8	8.8	9.4
250,000	0.8	5.7	10.1	10.8	11.0	11.0	11.1	11.1	11.7
300,000	1.5	7.5	12.1	13.0	13.2	13.2	13.3	13.3	14.0
350,000	1.7	8.4	13.5	14.4	14.6	14.7	14.7	14.8	15.5
				+6.7 ft swl					
50,000	6.7	6.7	6.8	6.8	6.9	6.9	7.1	7.1	7.2
100,000	6.7	6.7	7.3	7.3	7.4	7.4	7.4	7.5	7.7
150,000	6.7	6.7	7.8	8.1	8.5	8.5	8.6	8.6	8.8
200,000	6.7	6.7	8.9	9.3	9.8	9.8	9.9	9.9	10.3
250,000	6.8	7.0	10.5	11.0	11.5	11.6	11.6	11.6	12.1
300,000	6.9	8.2	12.2	13.1	13.5	13.5	13.5	13.5	14.2
350,000	7.1	9.0	14.0	14.8	15.3	15.3	15.3	15.3	16.0

Table B3

River Current Velocities Obtained for Plan 12

Discharge cfs	Velocity, fps, at Indicated Station Sta 1700	Sta 2600	Sta 3600	Sta 4800	Sta 5600	Sta 6400	Sta 7100	Sta 7900	Sta 8800
				0.0-ft swl					
50,000	5.2	6.1	3.0	2.3	1.3	1.2	3.5	3.5	2.5
100,000	10.7	12.0	6.0	4.3	2.6	3.1	5.1	6.0	4.1
150,000	16.7	15.0	7.9	5.3	3.7	3.8	5.7	6.2	5.1
200,000	17.6	15.8	9.7	6.1	4.5	4.8	6.3	7.1	5.2
250,000	21.4	17.6	10.0	6.8	4.8	5.9	8.6	7.7	5.5
300,000	23.1	18.2	10.4	7.3	6.5	6.7	9.1	8.6	5.7
350,000	30.0	18.8	11.1	7.5	7.0	7.7	9.8	9.1	6.3
				+6.7 ft swl					
50,000	3.3	3.6	2.0	1.2	1.0	1.1	1.2	1.4	1.0
100,000	6.5	7.0	4.0	3.0	2.4	2.7	2.8	3.2	1.8
150,000	9.4	10.0	6.4	4.4	3.4	3.7	4.2	4.9	2.9
200,000	12.5	12.0	7.5	5.5	4.1	4.0	6.1	6.7	4.0
250,000	15.0	15.8	9.4	7.0	5.0	5.7	6.9	7.9	4.3
300,000	17.6	18.8	10.3	7.4	5.6	6.0	7.7	8.6	4.6
350,000	18.8	20.0	11.1	8.1	6.5	6.7	8.1	9.4	6.0

Table B4

Water-Surface Elevations, Plan 13

Discharge cfs	Sta 1700	Sta 2600	Sta 3600	Sta 4800	Sta 5600	Sta 6400	Sta 7100	Sta 7900	Sta 8800
	Water-Surface Elevation, ft mllw, at Indicated Station								
				0.0-ft swl					
50,000	0.0	0.0	0.6	0.7	0.8	0.8	0.9	1.2	1.3
100,000	0.0	0.3	2.3	2.6	2.7	2.7	2.9	3.4	3.9
150,000	0.0	1.9	4.7	5.2	5.4	5.4	5.5	5.8	6.6
200,000	0.0	3.6	6.7	7.3	7.6	7.6	7.6	8.0	8.9
250,000	0.3	4.7	8.5	9.1	9.6	9.6	9.6	9.9	10.9
300,000	0.2	5.8	9.8	10.5	10.8	10.8	10.8	11.3	12.5
350,000	0.0	6.7	10.7	11.6	12.0	12.0	12.0	12.5	13.8
				+6.7 ft swl					
50,000	6.7	6.7	6.8	6.9	6.9	6.9	7.2	7.2	7.2
100,000	6.7	6.7	7.3	7.3	7.4	7.4	7.4	7.5	7.7
150,000	6.7	6.7	7.8	8.1	8.3	8.3	8.5	8.5	8.7
200,000	6.7	6.7	8.7	9.1	9.3	9.1	9.4	9.7	10.2
250,000	6.7	7.1	9.4	10.0	10.2	10.2	10.3	10.7	11.5
300,000	6.7	7.4	10.4	11.0	11.3	11.3	11.4	11.9	12.9
350,000	7.0	7.4	10.9	11.8	12.1	12.1	12.3	12.7	13.9

Table B5

River Current Velocities Obtained for Plan 13

Discharge cfs	Velocity, fps, at Indicated Station Sta 1700	Sta 2600	Sta 3600	Sta 4800	Sta 5600	Sta 6400	Sta 7100	Sta 7900	Sta 8800	Sta A	Sta B
					0.0-ft swl						
50,000	5.4	6.0	3.5	2.9	1.8	1.8	4.6	4.8	3.0	0.0	0.0
100,000	10.0	11.5	6.0	5.0	2.9	3.4	5.5	5.1	4.2	3.4	0.7
150,000	15.0	13.0	7.5	5.7	4.1	5.3	6.7	7.5	5.3	4.3	1.1
200,000	16.7	15.8	9.1	6.7	4.8	5.7	7.5	8.6	5.8	5.2	2.3
250,000	18.8	17.6	9.4	8.3	5.4	6.0	8.3	10.0	6.1	6.0	3.3
300,000	21.4	18.2	10.4	8.3	7.1	7.5	10.0	10.3	6.5	7.1	5.6
350,000	21.4	18.8	11.1	9.4	7.7	8.6	10.3	11.1	7.5	8.6	6.7
					+6.7 ft swl						
50,000	3.1	3.4	2.2	1.9	1.5	1.5	1.7	2.5	1.2	1.4	0.5
100,000	6.1	6.5	4.8	3.5	2.9	2.8	4.2	5.2	2.2	2.7	1.0
150,000	9.1	9.4	6.5	5.2	4.1	3.8	6.0	6.7	3.6	3.9	1.4
200,000	11.5	12.0	8.3	6.3	5.6	5.4	7.5	8.1	4.5	4.7	2.2
250,000	15.0	15.0	9.4	7.1	6.7	6.0	8.3	10.0	6.0	6.0	3.9
300,000	17.6	17.6	10.7	8.6	7.9	7.5	10.0	10.7	6.8	6.8	4.6
350,000	18.8	18.8	11.5	9.4	8.8	8.6	10.7	11.5	7.9	8.1	5.4

Table B6

Water-Surface Elevations, Plan 13A

Discharge cfs	Water-Surface Elevation, ft mllw, at Indicated Station								
	Sta 1700	Sta 2600	Sta 3600	Sta 4800	Sta 5600	Sta 6400	Sta 7100	Sta 7900	Sta 8800
				0.0-ft swl					
50,000	0.0	0.0	0.5	0.7	0.8	0.8	0.9	0.9	1.4
100,000	0.0	0.2	2.2	2.5	2.8	2.8	3.1	3.2	3.9
150,000	0.0	1.5	4.6	5.0	5.4	5.5	5.5	5.7	6.7
200,000	0.0	3.5	6.6	7.2	7.6	7.7	7.7	7.8	9.0
250,000	0.0	4.5	7.1	8.7	9.2	9.4	9.4	9.5	10.8
300,000	0.0	5.4	9.3	9.9	10.7	10.8	10.7	10.8	12.4
350,000	0.0	6.0	10.2	10.8	11.6	11.6	11.6	11.7	13.5
				+6.7 ft swl					
50,000	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.9	6.9
100,000	6.7	6.7	7.0	7.1	7.2	7.2	7.2	7.4	7.7
150,000	6.7	6.7	7.4	7.6	7.8	7.9	7.9	8.1	8.7
200,000	6.7	6.7	8.2	8.5	8.8	8.8	8.8	9.1	9.9
250,000	6.7	6.7	9.0	9.3	9.9	9.9	9.9	10.2	11.3
300,000	6.7	6.7	9.7	10.1	10.8	10.9	10.9	11.3	12.5
350,000	6.7	6.7	10.5	10.9	11.8	11.9	11.9	11.9	13.5

Table B7

River Current Velocities Obtained for Plan 13A

Discharge cfs	Velocity, fps, at Indicated Station Sta 1700	Sta 2600	Sta 3600	Sta 4800	Sta 5600	Sta 6400	Sta 7100	Sta 7900	Sta 8800	Sta A	Sta B	Sta C
					0.0-ft swl							
50,000	6.0	6.0	3.4	2.9	1.8	1.8	4.3	4.6	3.0	0.0	0.0	0.0
100,000	10.0	10.0	5.1	4.9	2.9	3.4	6.0	5.1	3.2	3.5	0.7	0.0
150,000	15.0	13.6	7.3	5.7	4.1	5.2	6.7	7.4	5.4	4.8	1.1	0.0
200,000	17.6	16.7	8.6	6.8	4.6	5.7	8.1	9.7	6.0	5.2	2.3	2.0
250,000	20.0	17.6	9.1	8.1	6.4	6.4	8.6	10.7	6.5	5.7	3.4	5.1
300,000	21.4	17.6	10.0	8.6	7.5	7.9	10.0	11.1	7.0	7.0	6.8	5.7
350,000	23.1	17.6	11.1	10.0	7.9	9.1	11.1	12.0	7.9	7.5	7.3	5.9
					+6.7 ft swl							
50,000	3.0	3.4	2.2	1.9	1.5	1.5	2.1	2.6	1.3	1.2	0.4	0.0
100,000	6.3	6.4	4.9	3.4	2.9	3.0	4.1	5.0	2.4	2.6	1.1	1.7
150,000	8.8	9.4	6.7	5.7	4.3	4.2	6.4	7.1	4.0	3.8	1.5	3.4
200,000	11.5	12.5	8.6	6.4	5.9	5.5	7.9	8.3	4.8	4.6	2.3	4.9
250,000	15.0	15.0	9.4	7.9	6.7	6.0	8.3	10.3	6.5	5.9	3.8	5.7
300,000	16.7	17.6	11.5	9.1	7.9	8.1	10.7	11.1	7.5	6.7	4.1	5.9
350,000	17.6	20.0	12.0	10.3	9.1	9.4	10.7	12.5	8.1	8.8	5.0	6.4

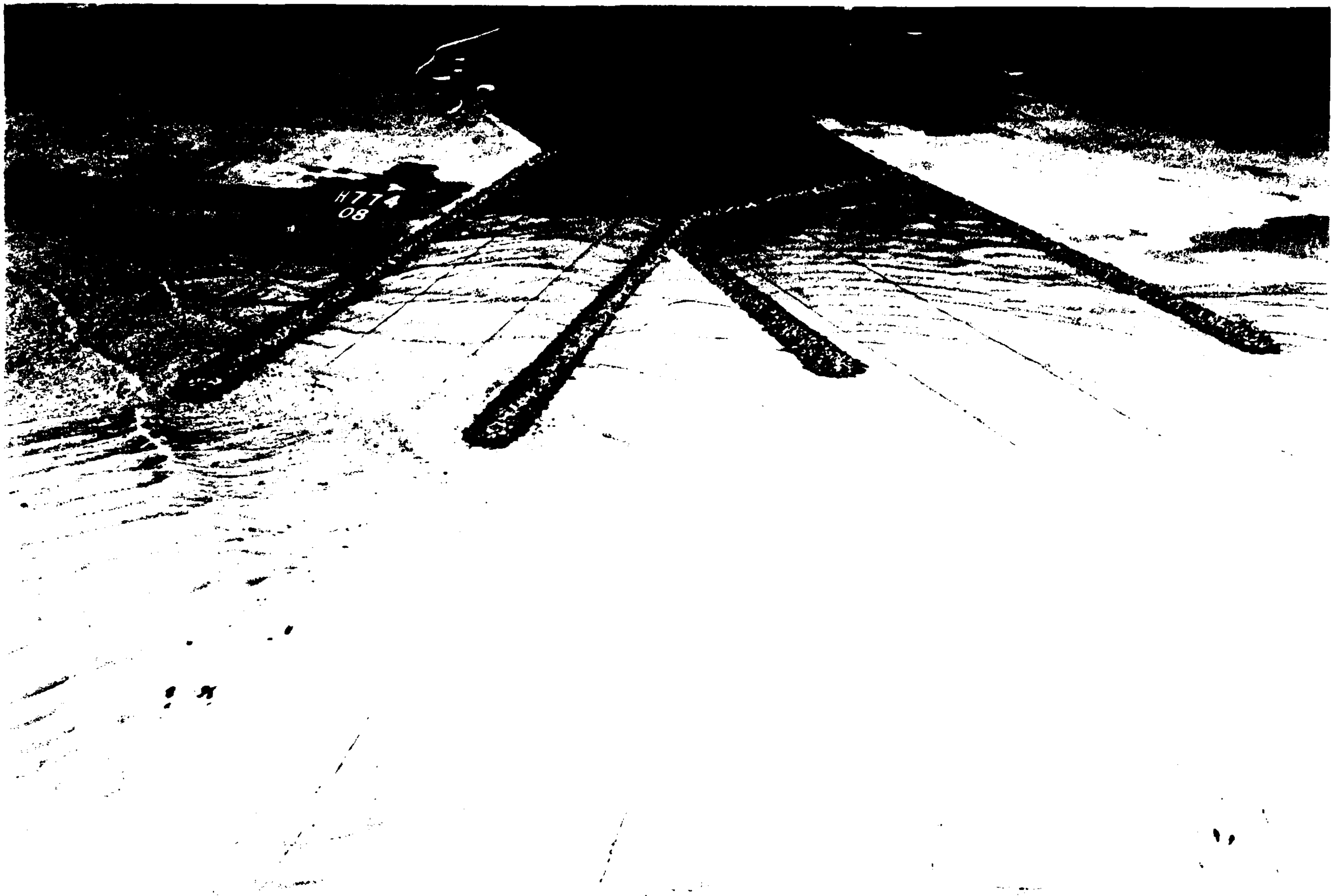


Photo B1. Typical wave patterns for Plan 12; 11-sec, 12-ft waves from NNW; +6.7 ft swl

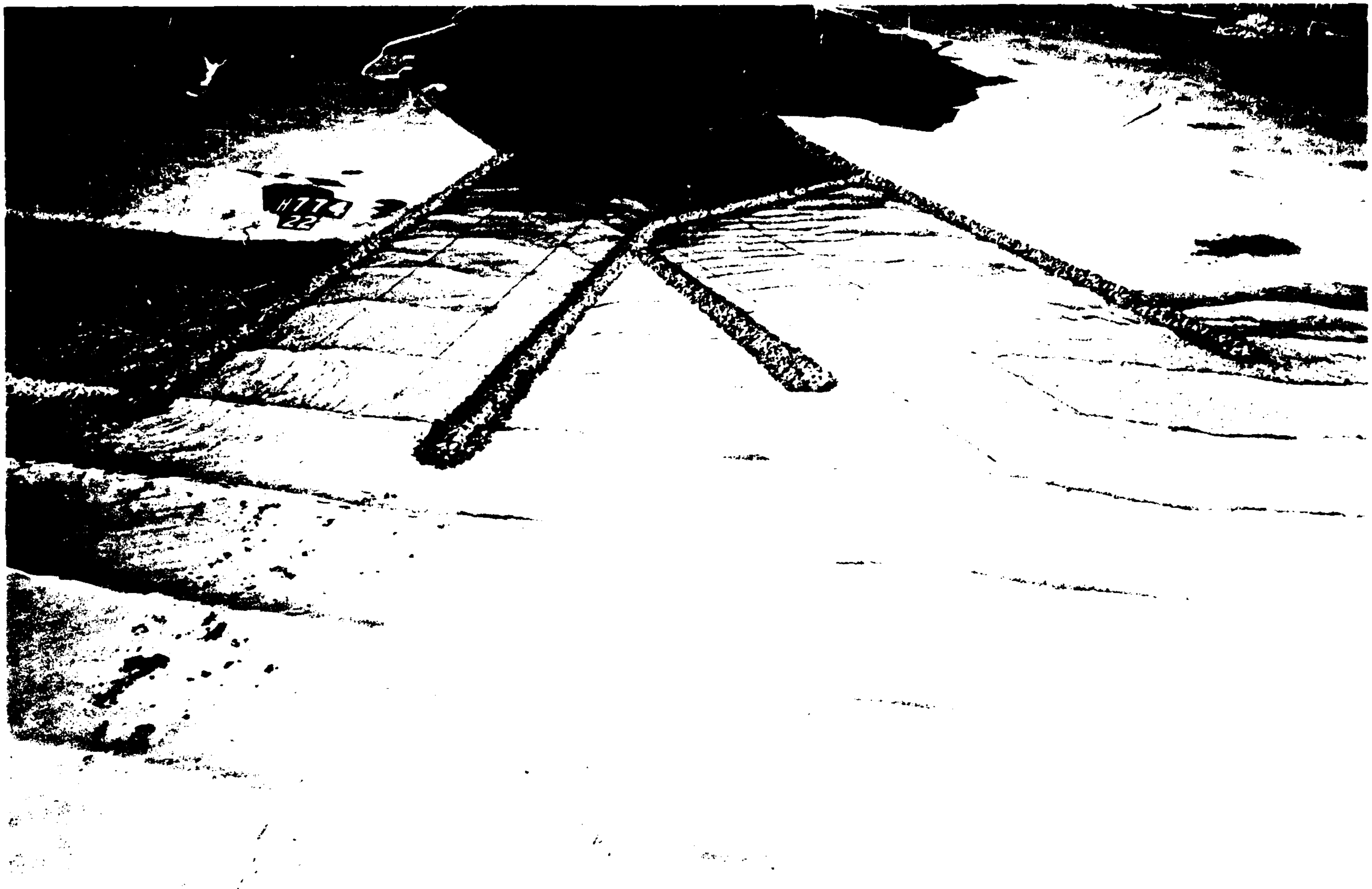


Photo B2. Typical wave patterns for Plan 12; 11-sec, 12-ft waves from west; +6.7 ft swl

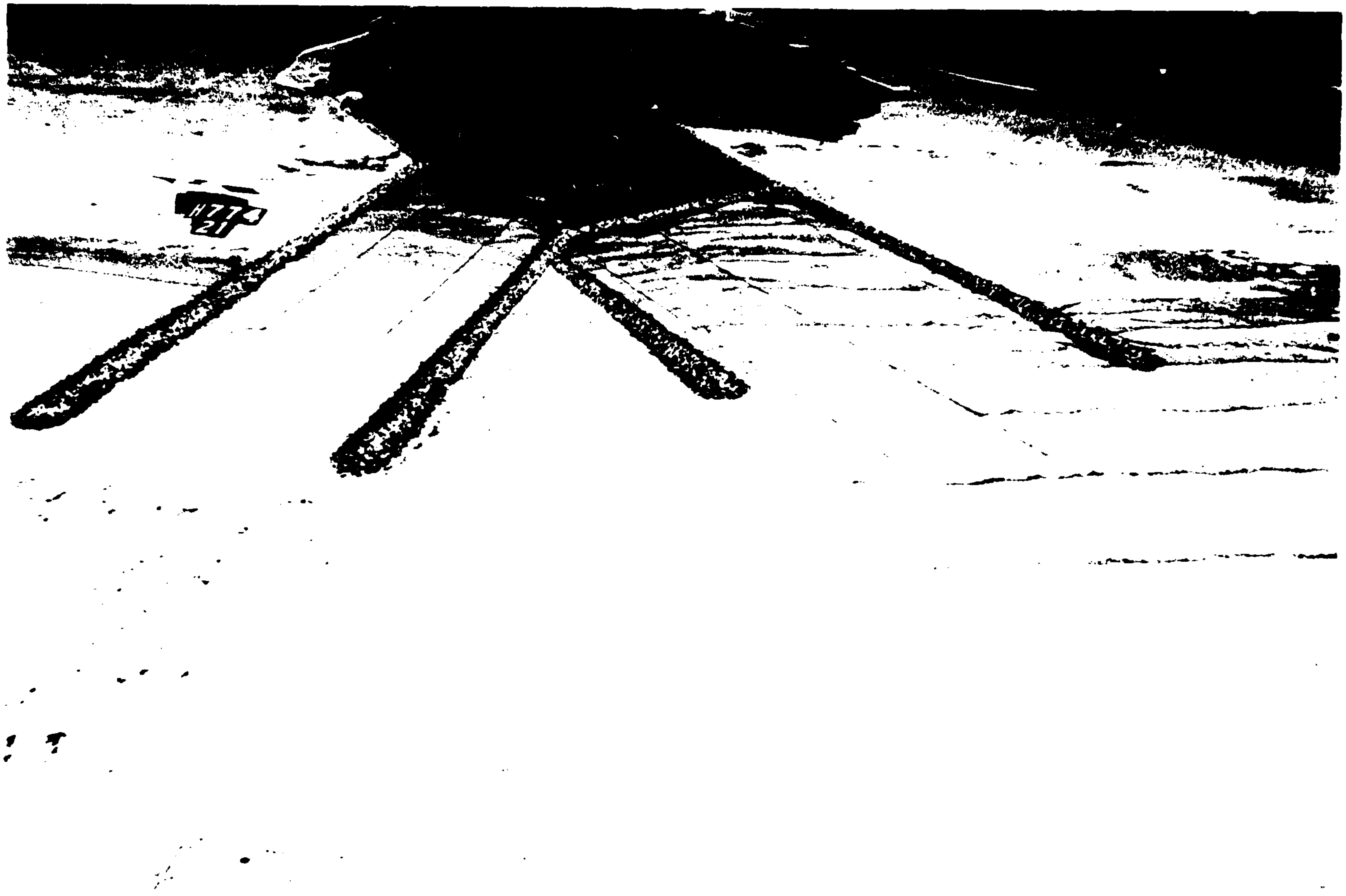


Photo B3. Typical wave patterns for Plan 12; 11-sec, 13-ft waves from SW; +6.7 ft swl

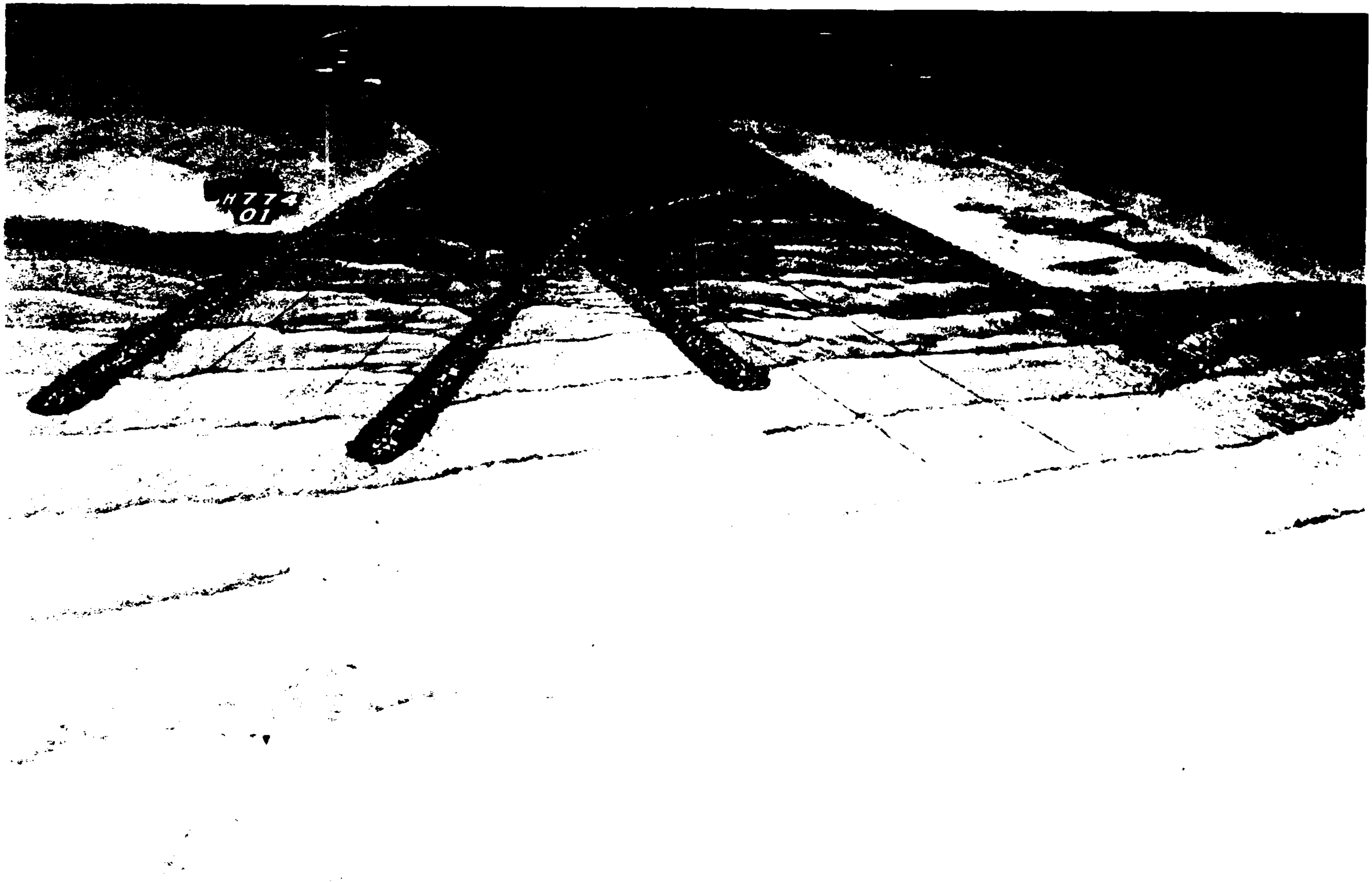


Photo B4. Typical wave patterns for Plan 12; 11-sec, 12-ft waves from SSW; +6.7 ft swl

Photo B5. General movement of tracer material and deposits resulting from 9-sec, 27-ft waves from NNW for Plan 12; 0.0-ft swl

Photo B6. General movement of tracer material and deposits resulting from 11-sec, 12-ft waves from NNW for Plan 12; 0.0-ft swl

Photo B7. General movement of tracer material and deposits resulting from 13-sec, 7-ft waves from NNW for Plan 12; 0.0-ft swl

Photo B8. General movement of tracer material and deposits resulting from 9-sec, 27-ft waves from NNW for Plan 12; +6.7 ft swl

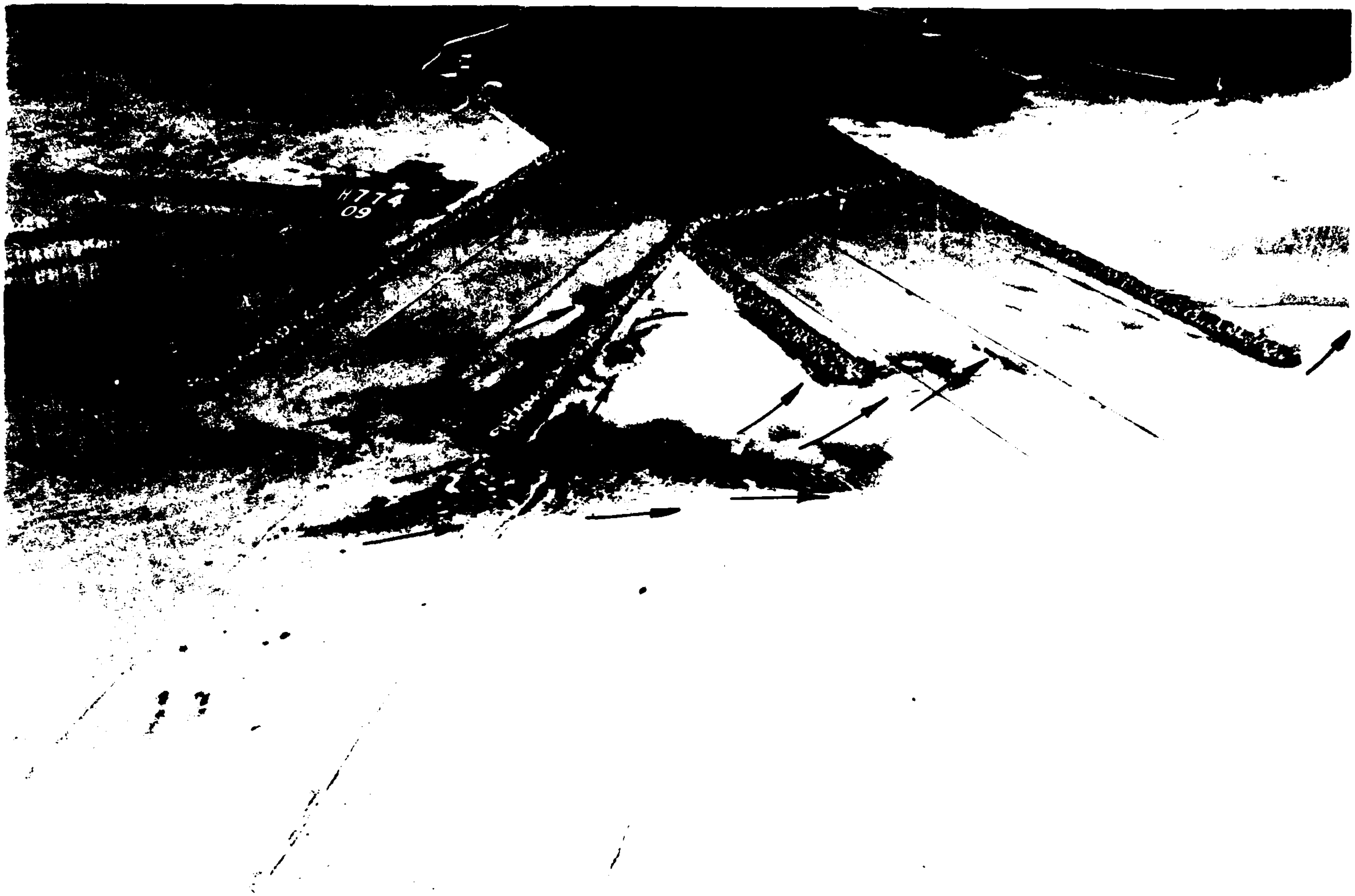


Photo B9. General movement of tracer material and deposits resulting from 11-sec, 12-ft waves from NNW for Plan 12; +6.7 ft swl

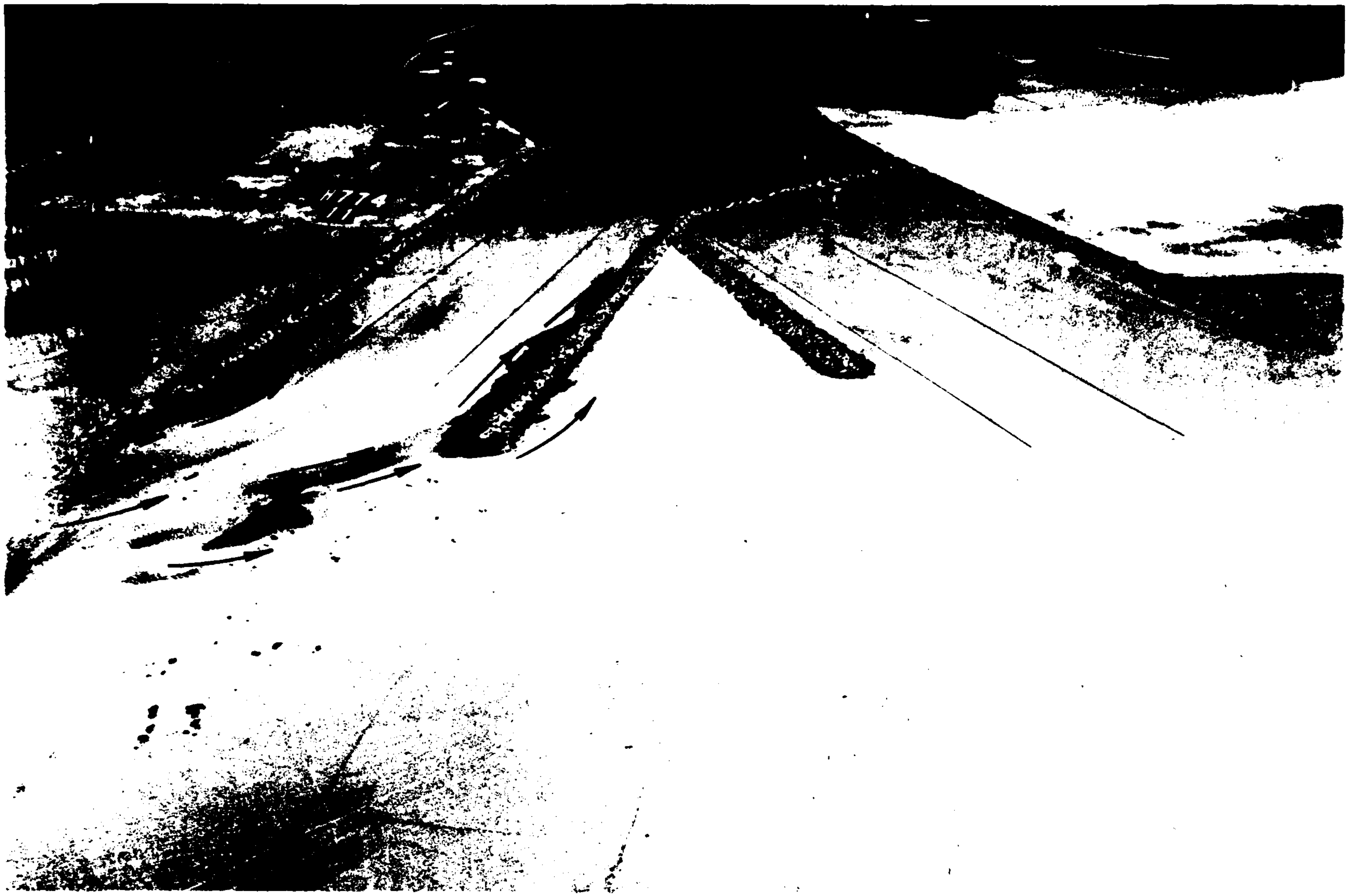


Photo B10. General movement of tracer material and deposits resulting from 13-sec, 7-ft waves from NNW for Plan 12; +6.7 ft swl

Photo B11. General movement of tracer material and deposits resulting from 9-sec, 23-ft waves from west for Plan 12; 0.0-ft swl

Photo B12. General movement of tracer material and deposits resulting from 11-sec, 12-ft waves from west for Plan 12; 0.0-ft swl

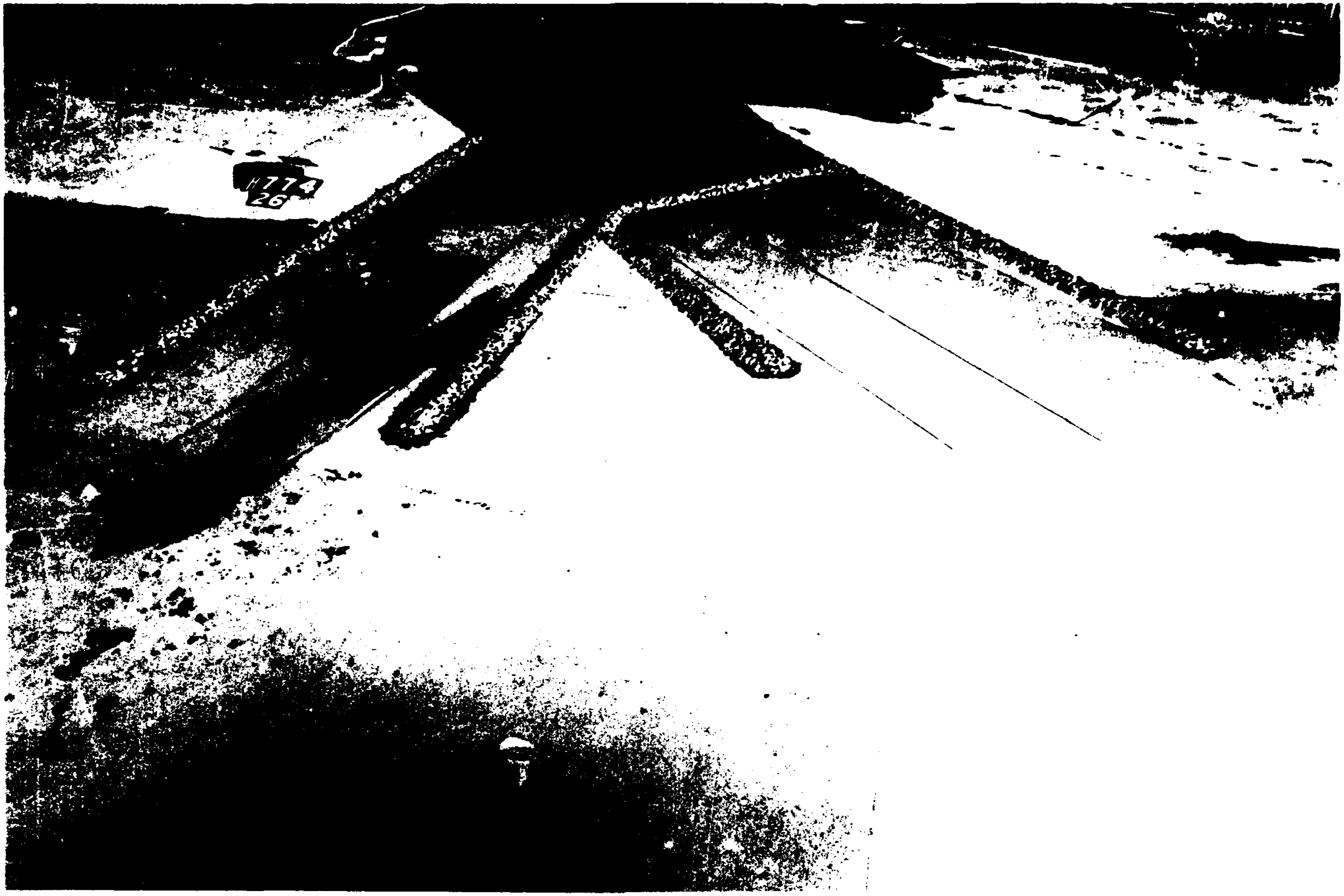


Photo B13. General movement of tracer material and deposits resulting from 13-sec, 7-ft waves from west for Plan 12; 0.0-ft swl

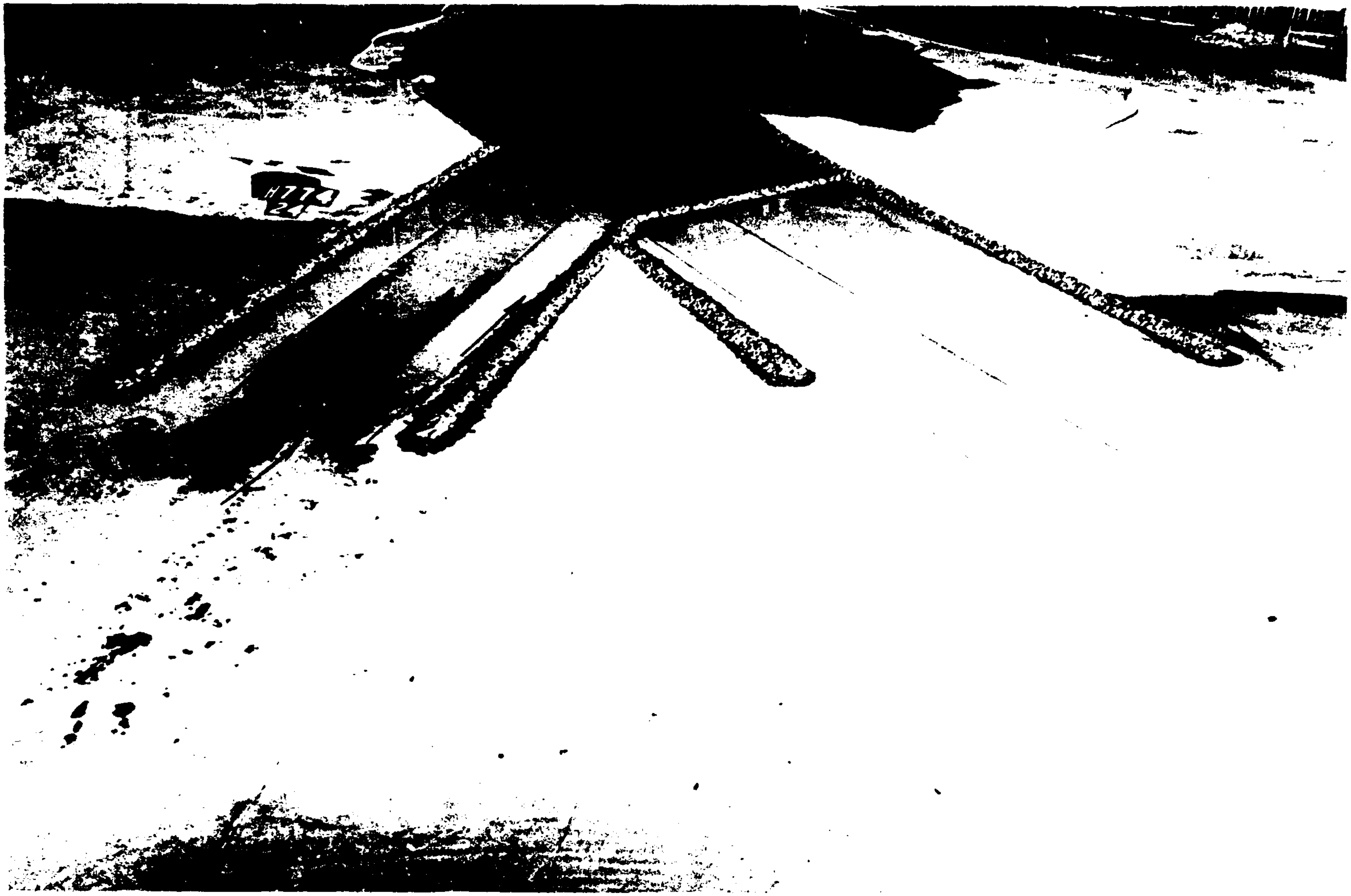


Photo B14. General movement of tracer material and deposits resulting from 9-sec, 23-ft waves from west for Plan 12; +6.7 ft swl

Photo B15. General movement of tracer material and deposits resulting from 11-sec, 12-ft waves from west for Plan 12; +6.7 ft swl

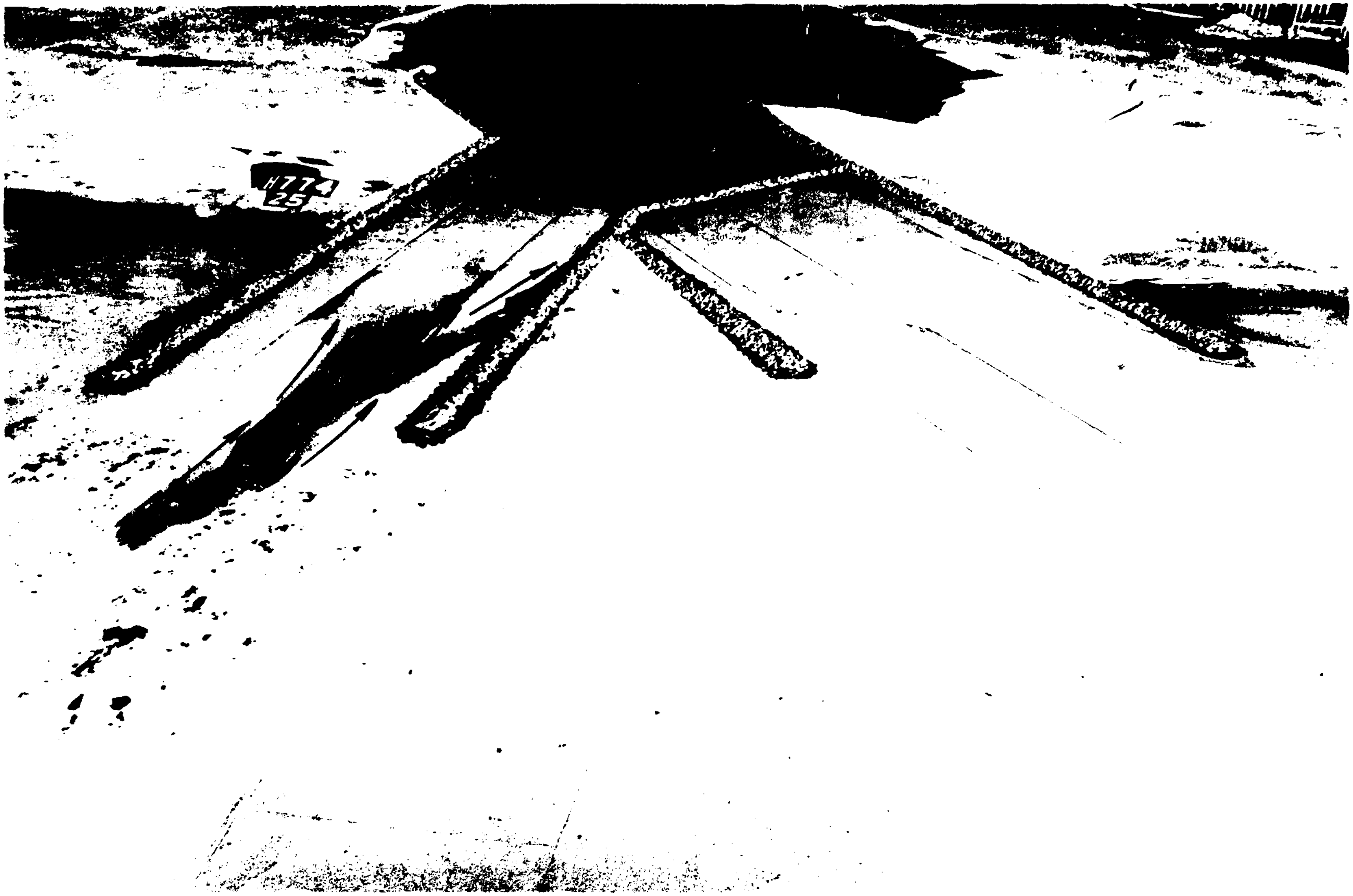


Photo B16. General movement of tracer material and deposits resulting from 13-sec, 7-ft waves from west for Plan 12; +6.7 ft swl

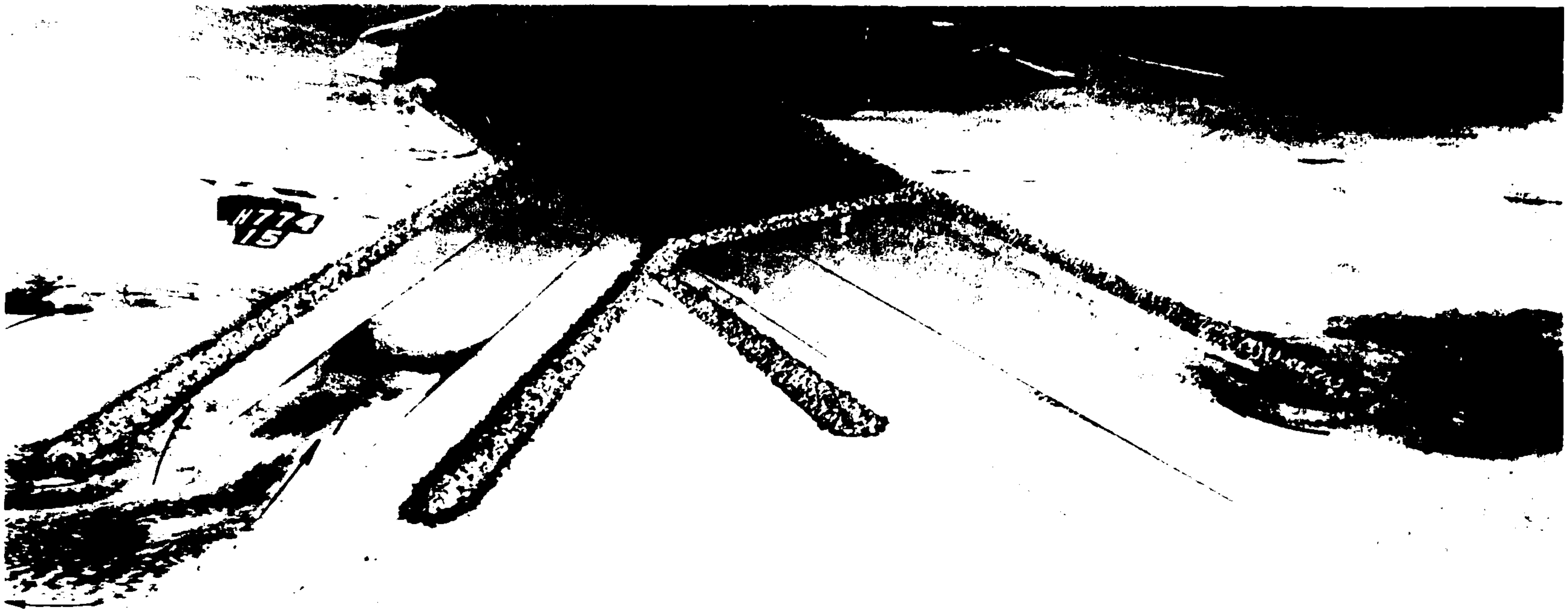


Photo B17. General movement of tracer material and deposits resulting from 9-sec, 21-ft waves from SW for Plan 12; 0.0-ft swl

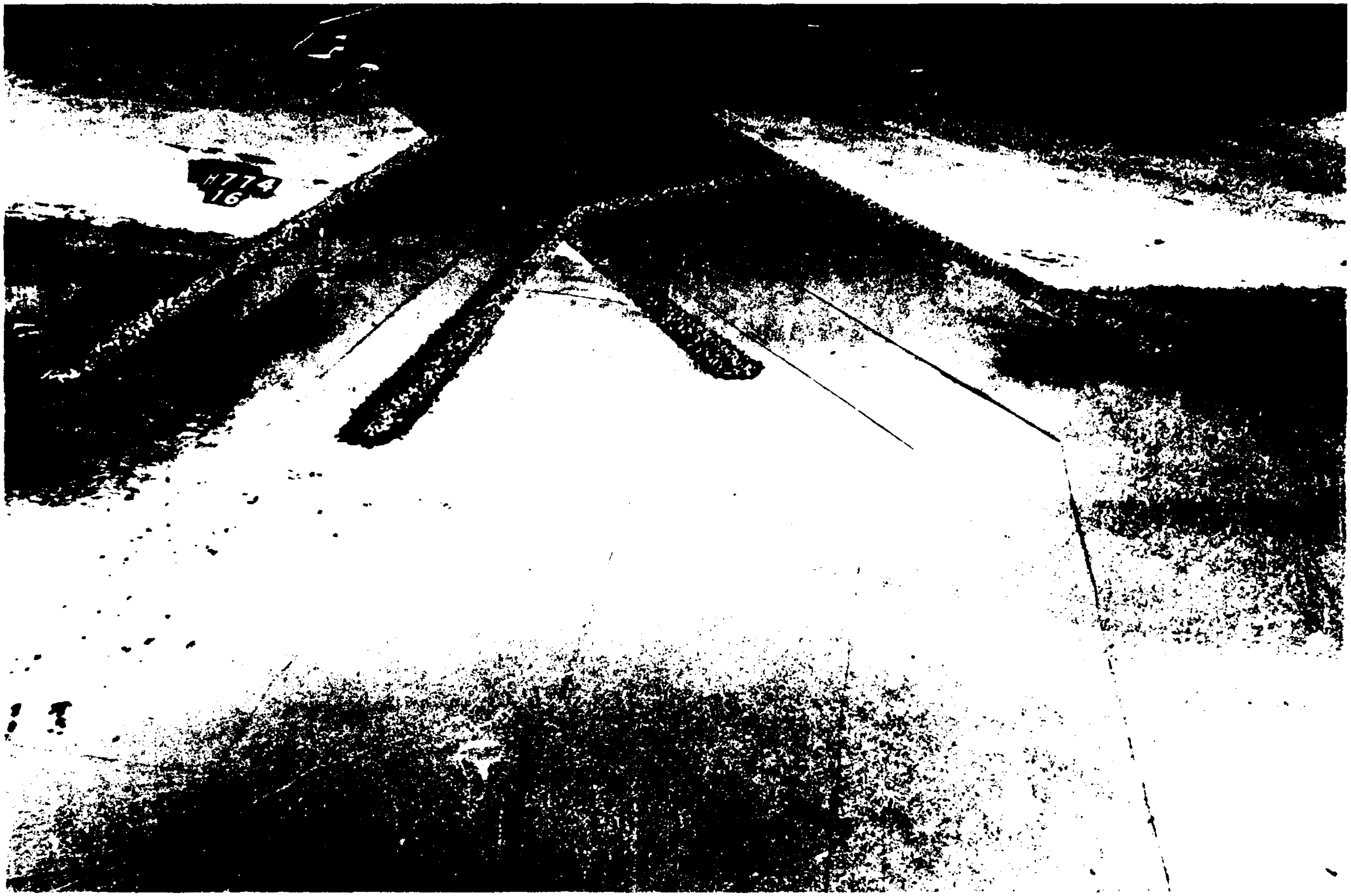


Photo B18. General movement of tracer material and deposits resulting from 11-sec, 13-ft waves from SW for Plan 12; 0.0-ft swl

Photo B19. General movement of tracer material and deposits resulting from 13-sec, 7-ft waves from SW for Plan 12; 0.0-ft swl

Photo B20. General movement of tracer material and deposits resulting from 9-sec, 21-ft waves from SW for Plan 12; +6.7 ft swl

Photo B21. General movement of tracer material and deposits resulting from 11-sec, 13-ft waves from SW for Plan 12; +6.7 ft swl

Photo B22. General movement of tracer material and deposits resulting from 13-sec, 7-ft waves from SW for Plan 12; +6.7 ft swl

Photo B23. General movement of tracer material and deposits resulting from 9-sec, 27-ft waves from SSW for Plan 12; 0.0-ft swl

Photo B24. General movement of tracer material and deposits resulting from 11-sec, 12-ft waves from SSW for Plan 12; 0.0-ft swl

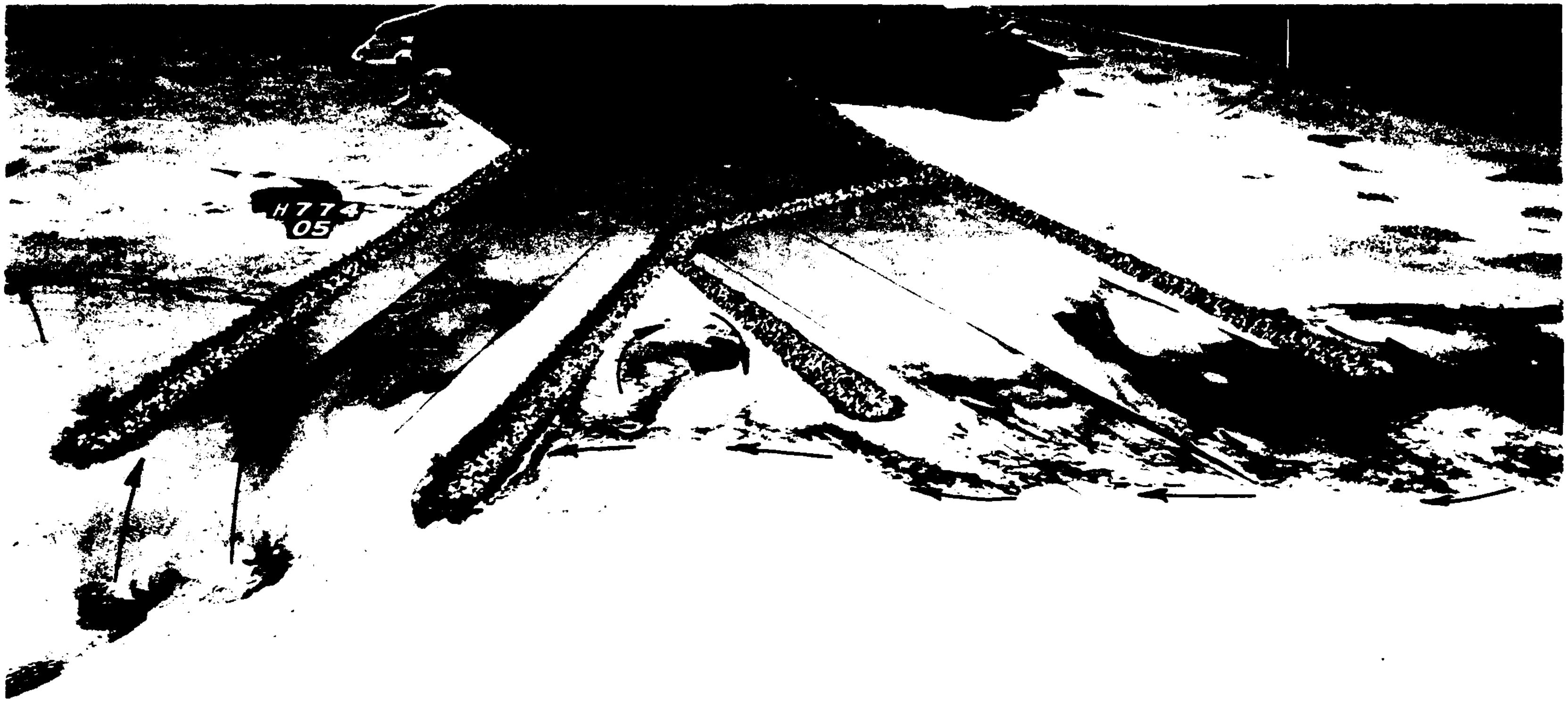


Photo B25. General movement of tracer material and deposits resulting from 13-sec, 7-ft waves from SSW for Plan 12; 0.0-ft swl

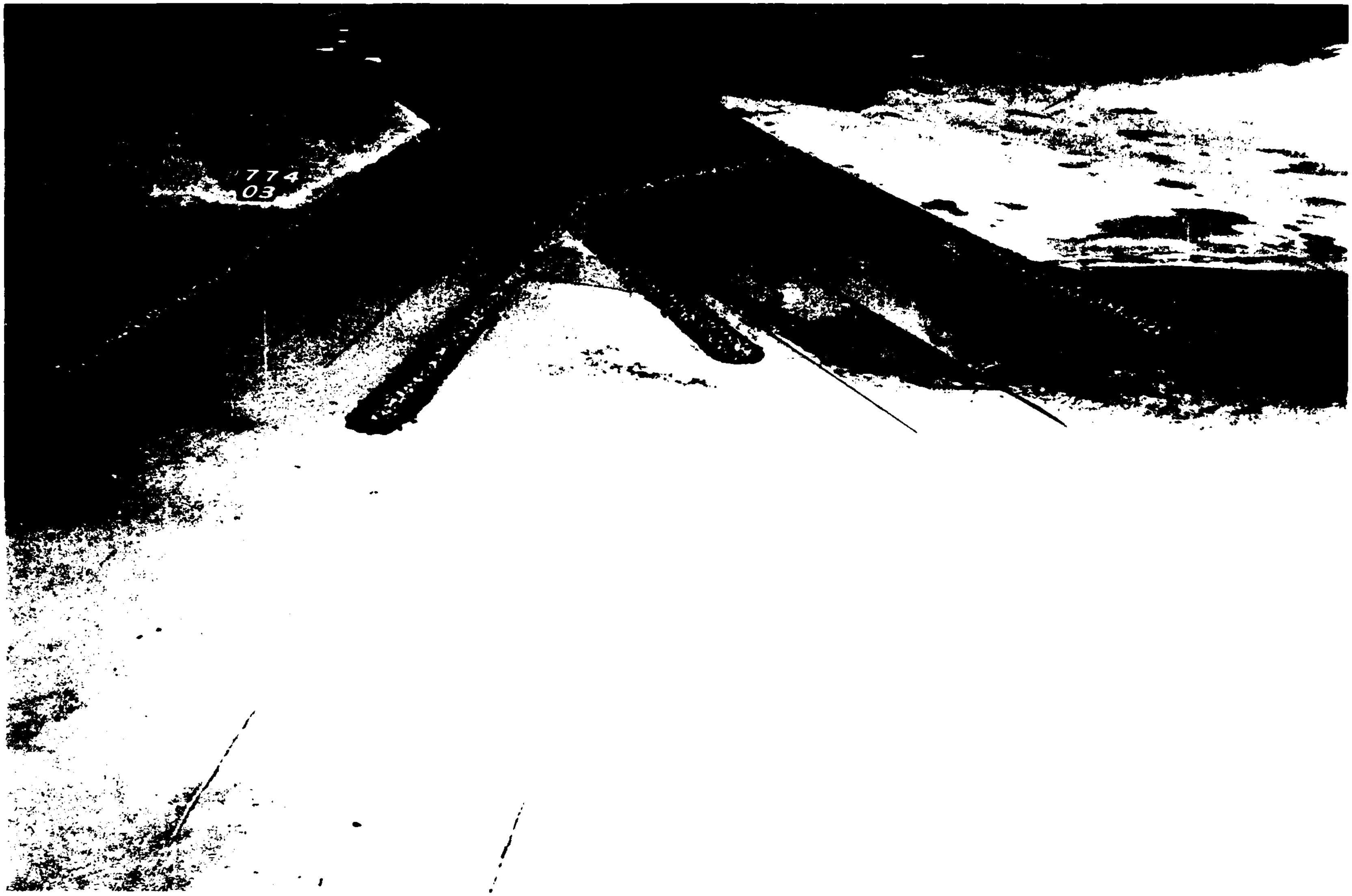


Photo B26. General movement of tracer material and deposits resulting from 9-sec, 27-ft waves from SSW for Plan 12; +6.7 ft swl

Photo B27. General movement of tracer material and deposits resulting from 11-sec, 12-ft waves from SSW for Plan 12; +6.7 ft swl

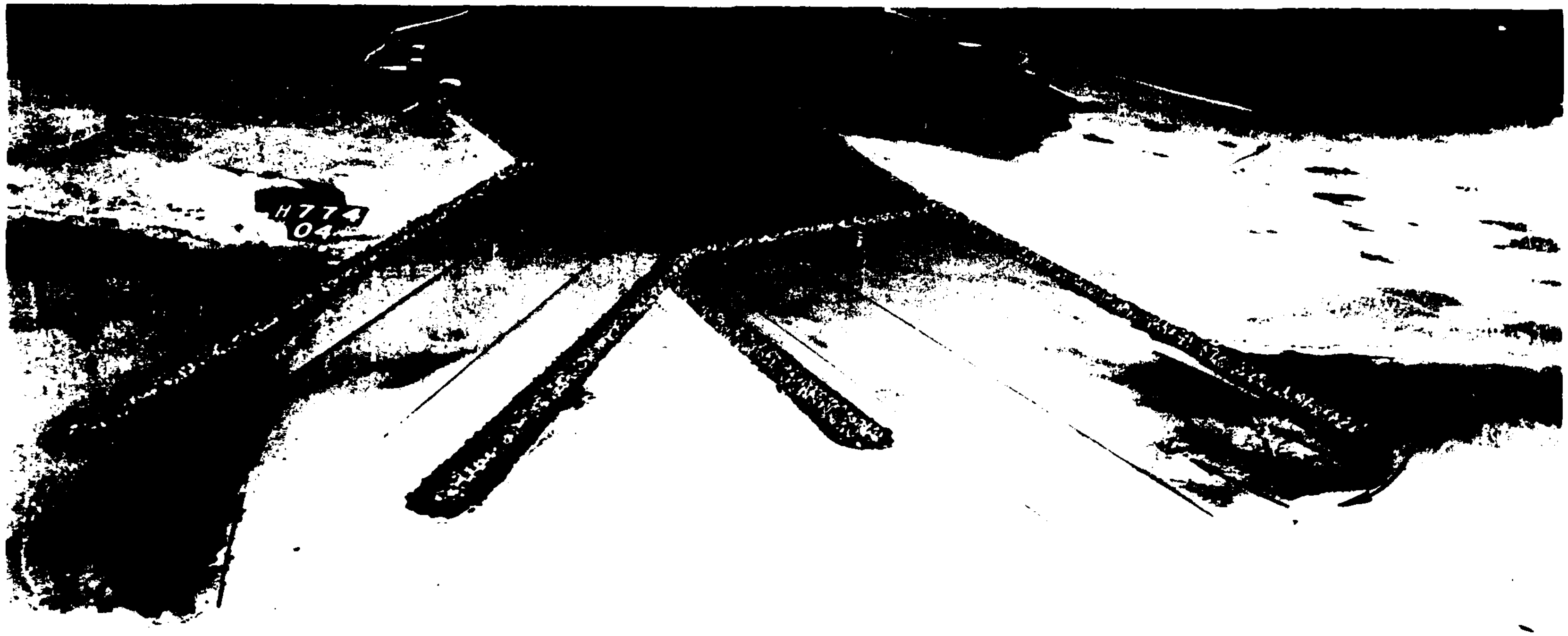


Photo B28. General movement of tracer material and deposits resulting from 13-sec, 7-ft waves from SSW for Plan 12; +6.7 ft swl

Photo B29. Shoal formed for Plan 12; 11-sec, 12-ft waves from west

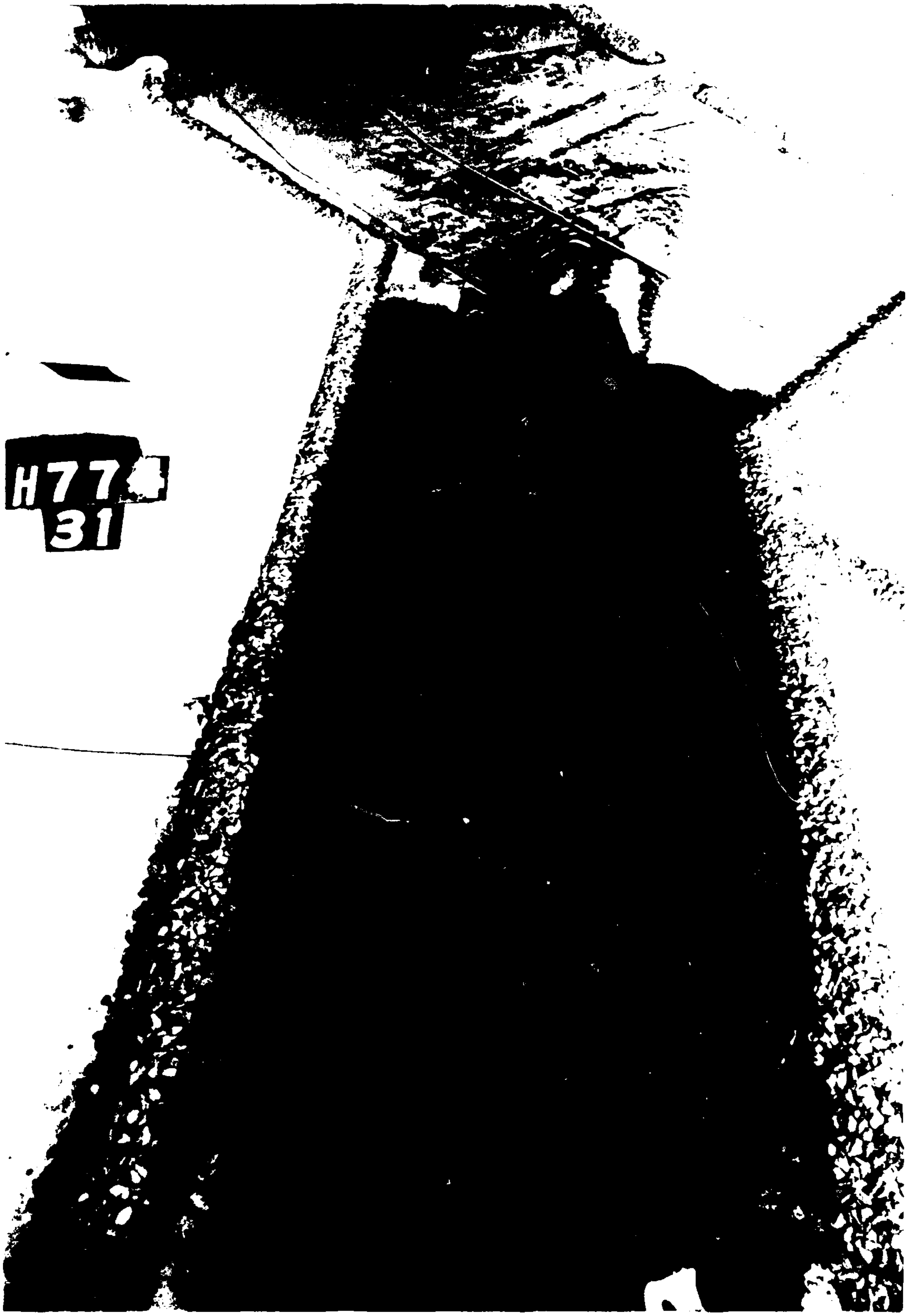


Photo B30. Closer view of shoal formed for Plan 12;
11-sec, 12-ft waves from west

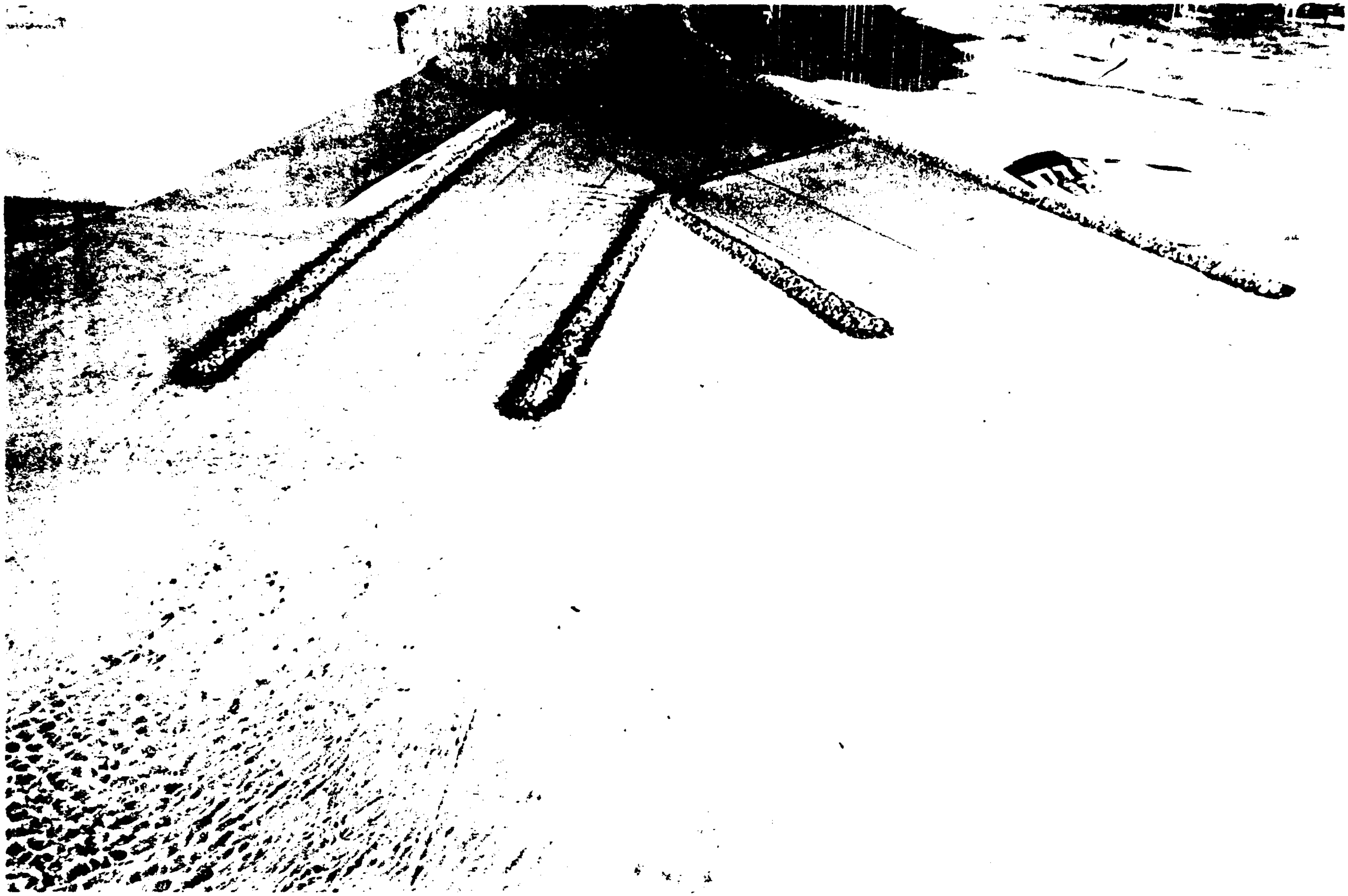
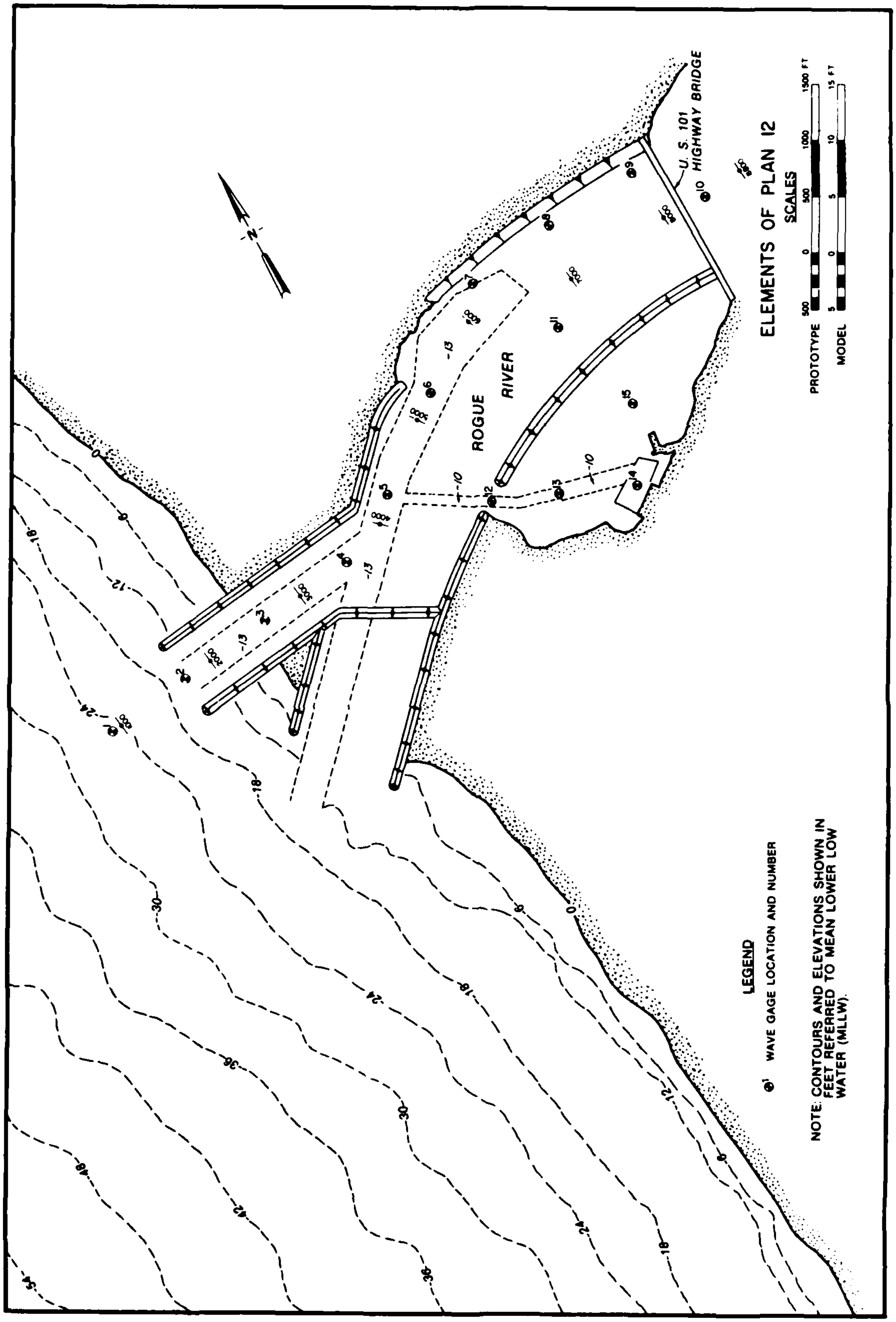


Photo B31. View of weir sections and conveyance channel of Plan 13A with a 350,000-cfs river discharge

Photo B32. Shoal formed for Plan 13A; 13-sec, 27-ft waves from southwest for maximum flood, +4.3 ft swl

Photo B33. Shoal formed for Plan 13A; 13-sec, 27-ft waves from southwest; +6.7 ft swl



ELEMENTS OF PLAN 12
SCALES
PROTOTYPE
MODEL
500 0 500 1000 1500 FT
5 0 5 10 15 FT
U. S. 101 HIGHWAY BRIDGE
ROGUE RIVER
N
LEGEND
WAVE GAGE LOCATION AND NUMBER
NOTE: CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW).

PLATE B1

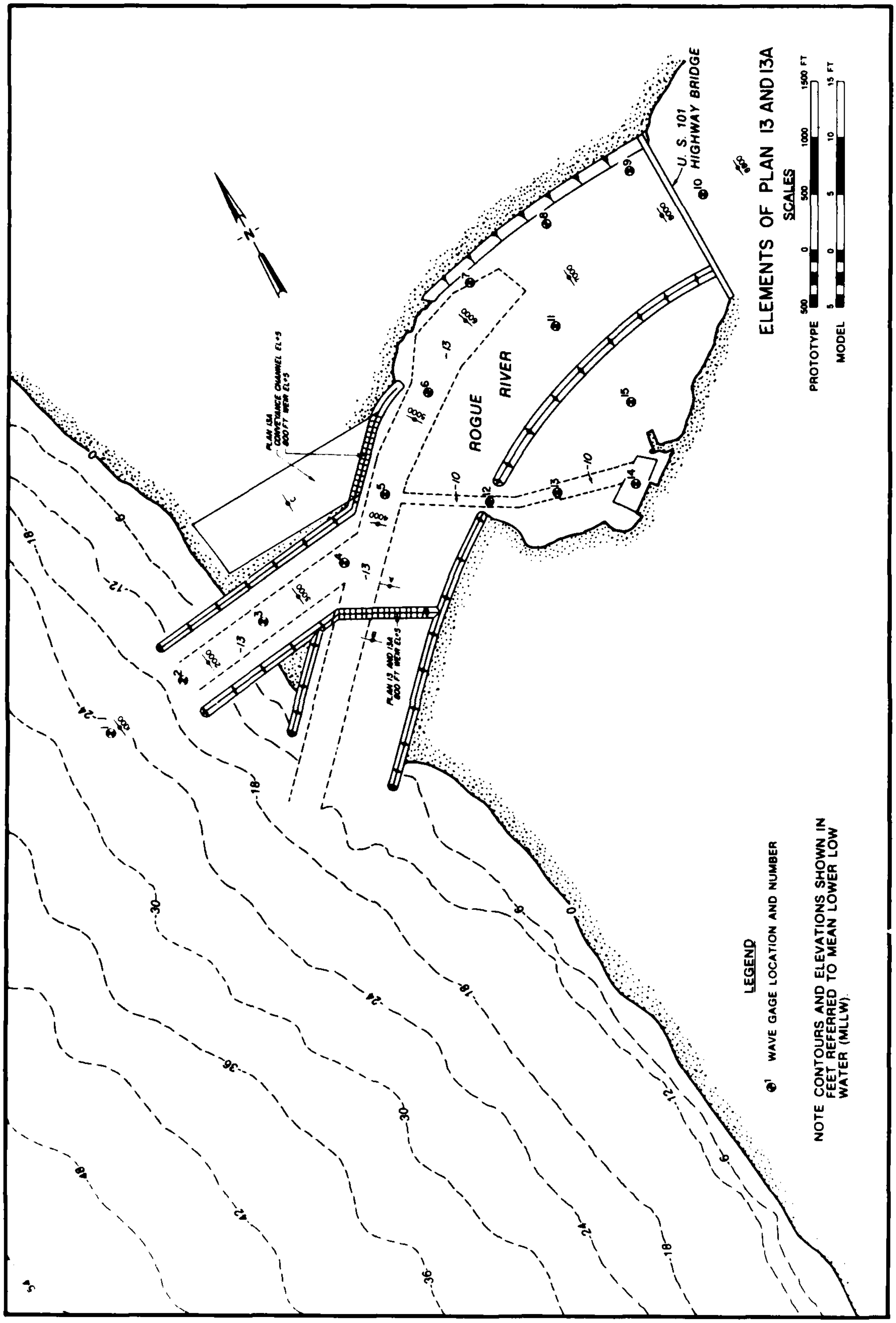
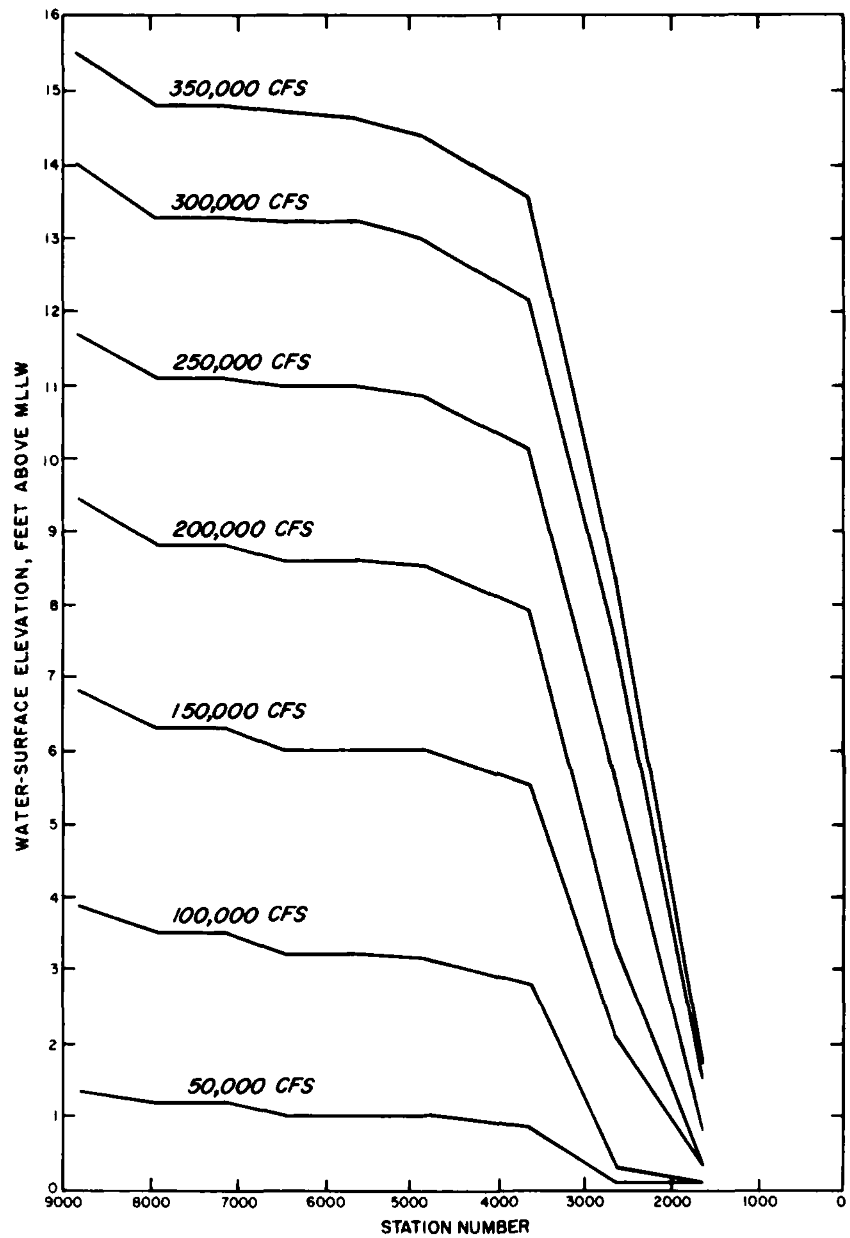
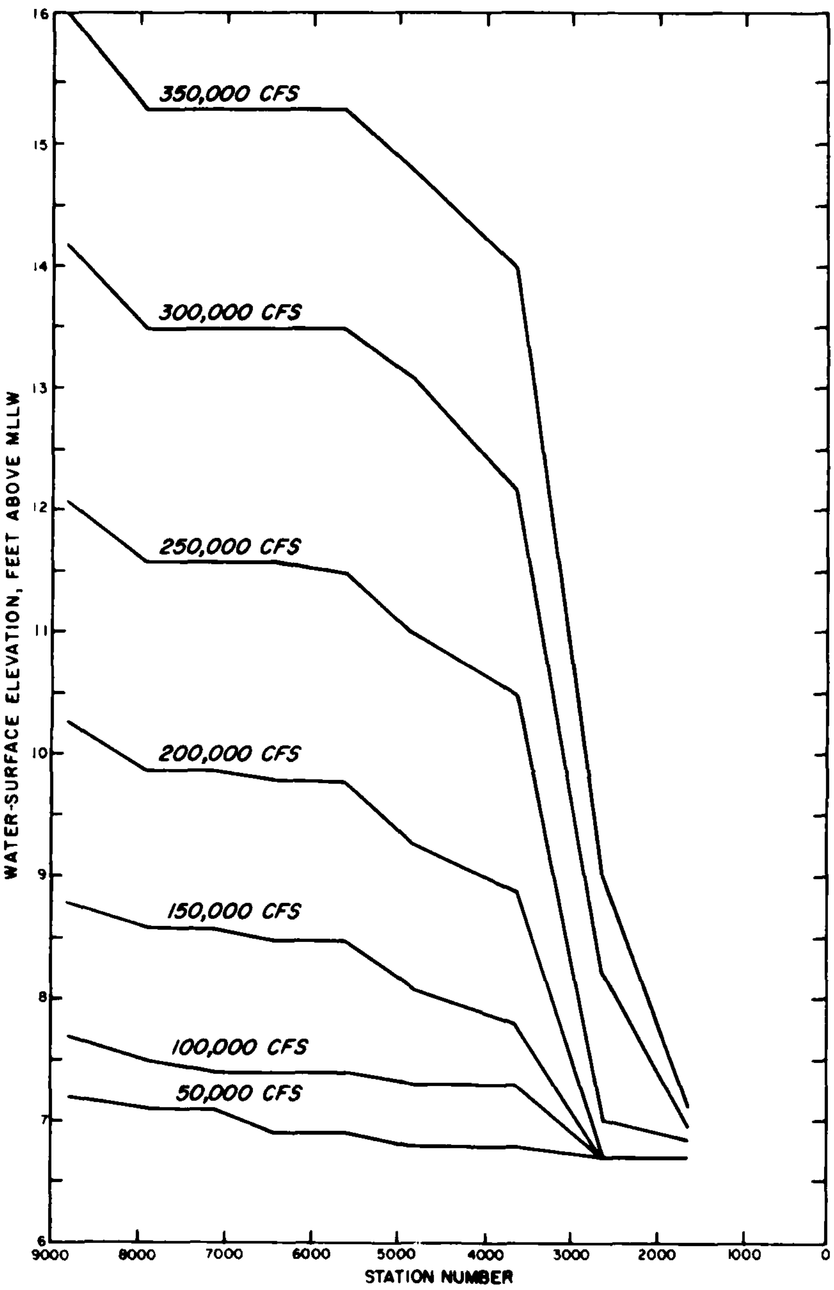

ELEMENTS OF PLAN 13 AND 13A
SCALES
PROTOTYPE
MODEL
500 0 500 1000 1500 FT
5 0 5 10 15 FT
U.S. 101 HIGHWAY BRIDGE
ROGUE RIVER
LEGEND
WAVE GAGE LOCATION AND NUMBER
NOTE CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW).

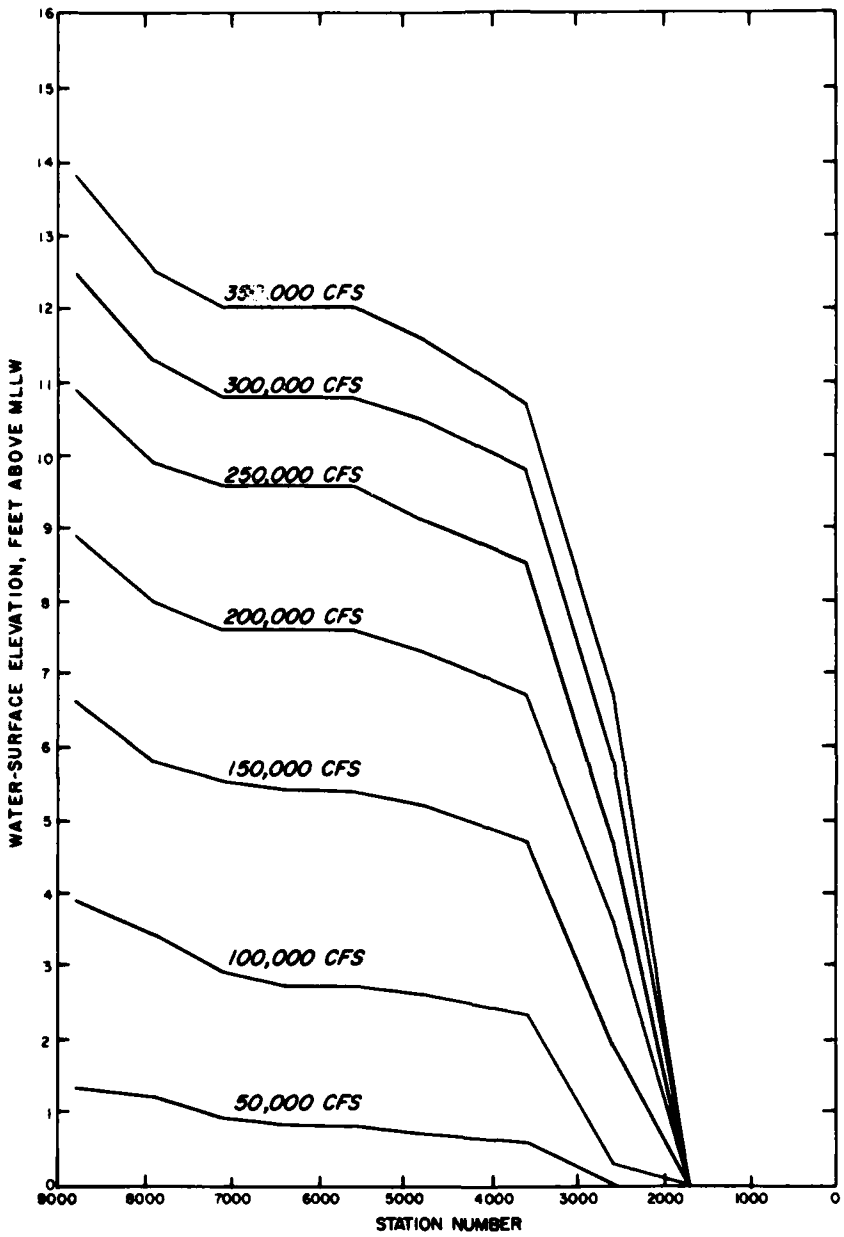
PLATE B2



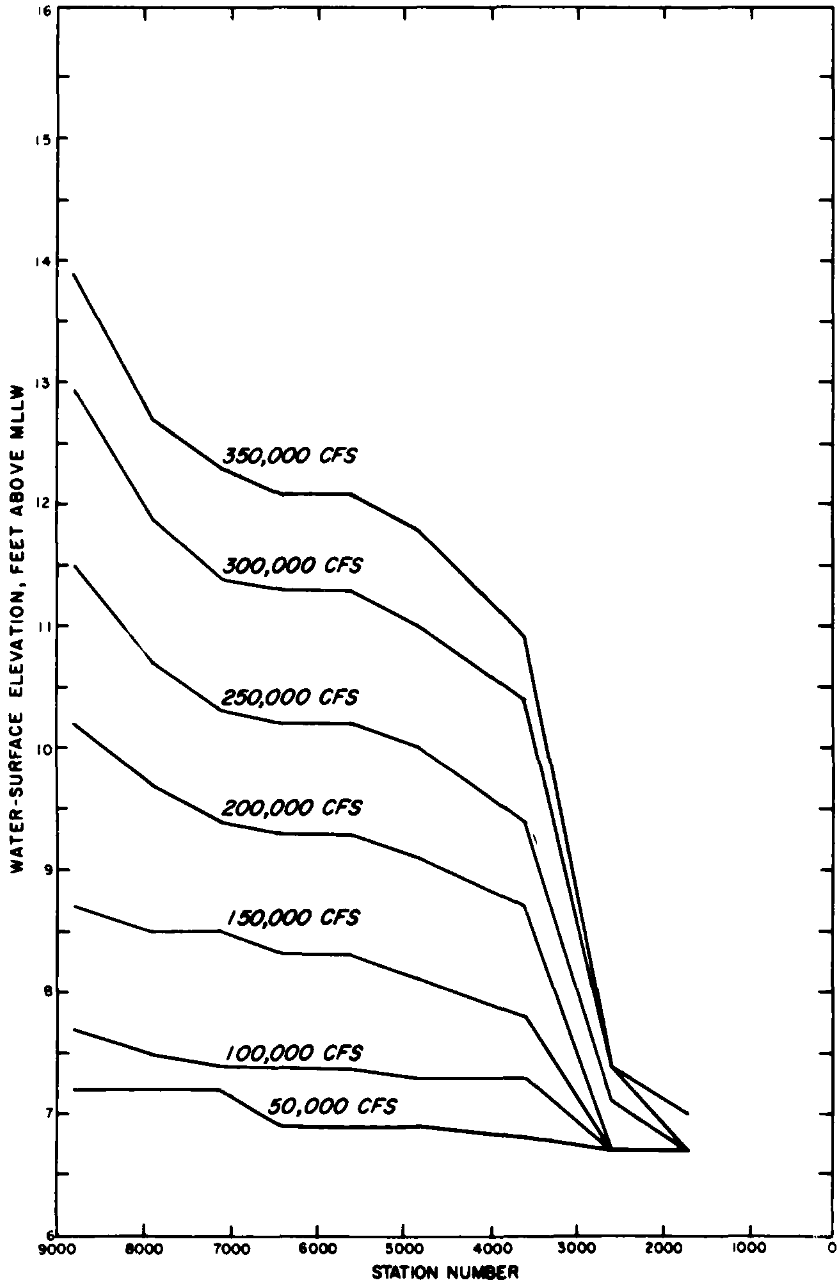
WATER-SURFACE PROFILES
PLAN 12
SWL = 0.0 FT



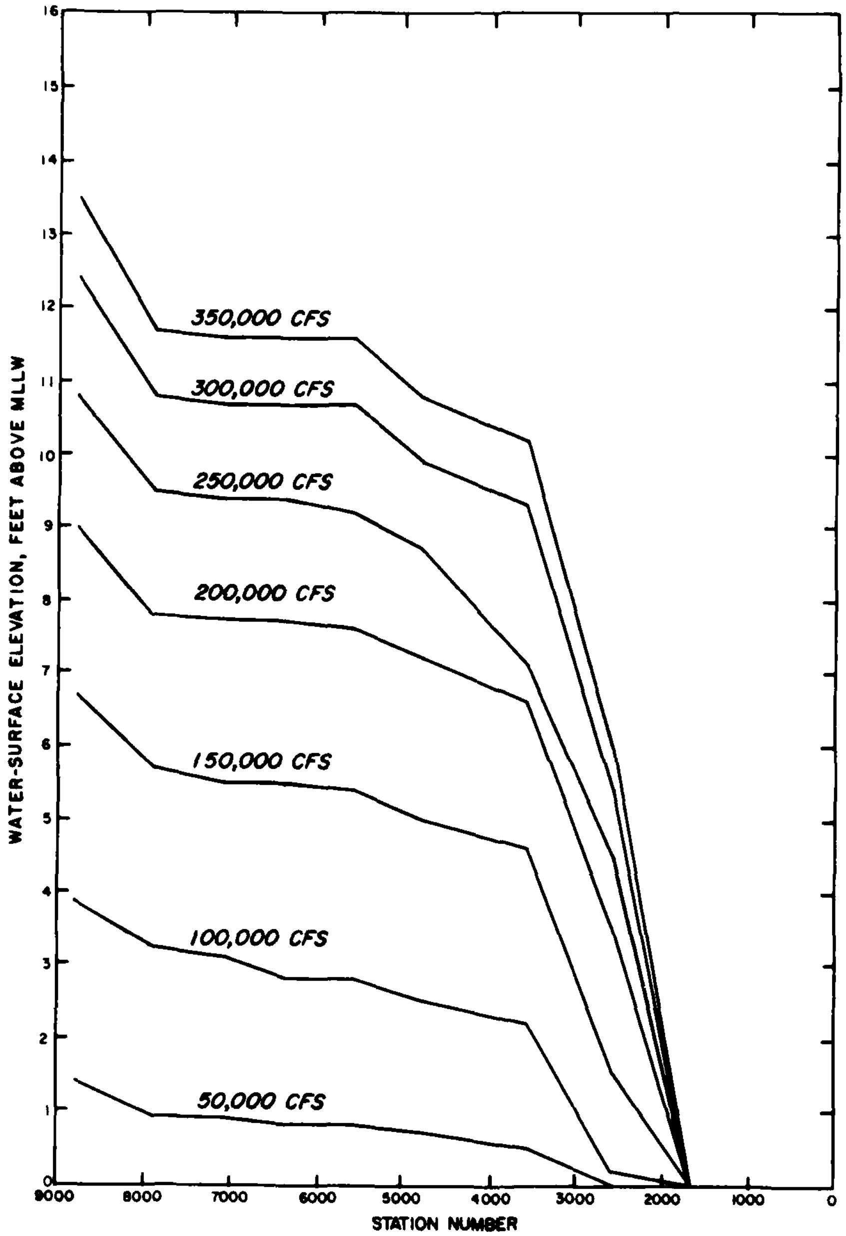
WATER-SURFACE PROFILES
PLAN 12
SWL = +6.7 FT



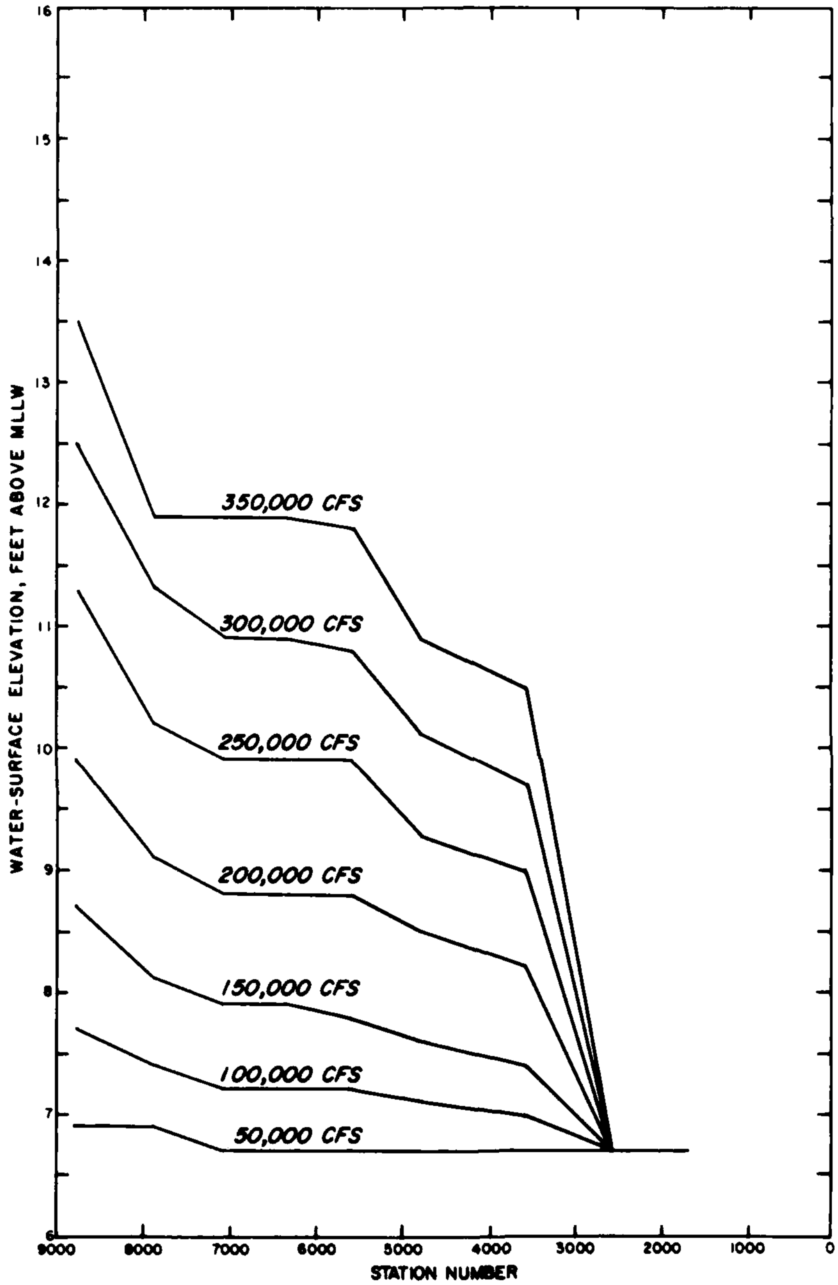
WATER-SURFACE PROFILES
PLAN 13
SWL = 0.0 FT



WATER-SURFACE PROFILES
PLAN 13
SWL = +6.7 FT



WATER-SURFACE PROFILES
PLAN 13A
SWL = 0.0 FT



WATER-SURFACE PROFILES
PLAN 13A
SWL = +6.7 FT

END

FILMED

9-83

DTIC