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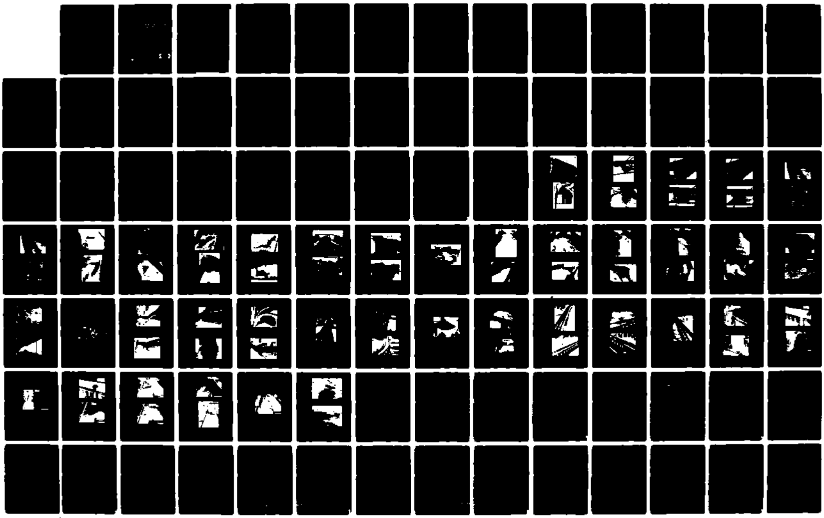

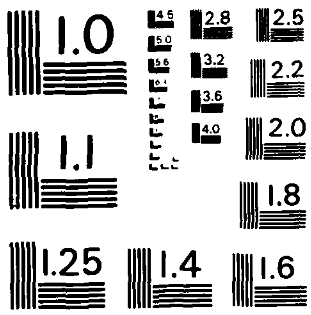

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TECHNICAL REPORT NO. 186-1

HYDRAULIC MODEL INVESTIGATION

Placer Creek High-Velocity Channel and Debris Basin at Wallace, Idaho

SPONSORED BY
U. S. ARMY CORPS OF ENGINEERS
SEATTLE DISTRICT

CONDUCTED BY
DIVISION HYDRAULIC LABORATORY
U. S. ARMY CORPS OF ENGINEERS
NORTH PACIFIC DIVISION
BONNEVILLE, OREGON

MARCH 1983

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

A 1:20 scale model of the Placer Creek high-velocity channel and debris basin was used to determine the adequacy of the proposed design. The model reproduced the entire 3,875-foot-long, concrete-lined channel; the 420-foot-long debris basin; and approximately 620 feet of the South Fork Coeur d'Alene River at the exit of Placer Creek.

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The original-design debris basin was ineffective. Satisfactory flow conditions in the basin were achieved when the basin was deepened and a 23-foot-high drop structure was added at the upstream end to dissipate energy of the incoming flow. The model verified that the basin design was effective in trapping debris in the basin.

The original channel design proved to be satisfactory except in one area where two short reverse curves caused unacceptable waves in the channel. This condition was remedied by realining the channel using a straight-line transition between the PC of one curve and the ST of the other curve.

Moveable bed studies showed that high Placer Creek discharges would develop a large scour hole in the South Fork Coeur d'Alene River at the exit of the high-velocity channel. Although not tested in the model, a grouted riprap section was included in the prototype to minimize the scour potential.

PREFACE

Model studies of the Placer Creek high velocity channel and debris basin were authorized by the Office, Chief of Engineers, on 27 December 1978 at the request of the U.S. Army Engineer District, Seattle (NPS). Studies were conducted at the Division Hydraulic Laboratory, U.S. Army Engineer Division, North Pacific, during the period July 1979 to October 1981.

The studies were conducted by Mr. R. L. Johnson under the supervision of Mr. P. M. Smith, Director of the Laboratory. This report was prepared by Mr. M. M. Kubo, Hydraulics Section, NPS.

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CONVERSION FACTORS, U.S. CUSTOMARY TO METRIC 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
feet	0.3048	metres
miles	1.609344	kilometres
feet per second	0.3048	metres per second
cubic feet per second	0.02832	cubic metres per second
pounds (mass)	0.4535924	kilograms

PLACER CREEK FLOOD CONTROL CHANNEL AND DEBRIS BASIN AT WALLACE, IDAHO

Hydraulic Model Investigations

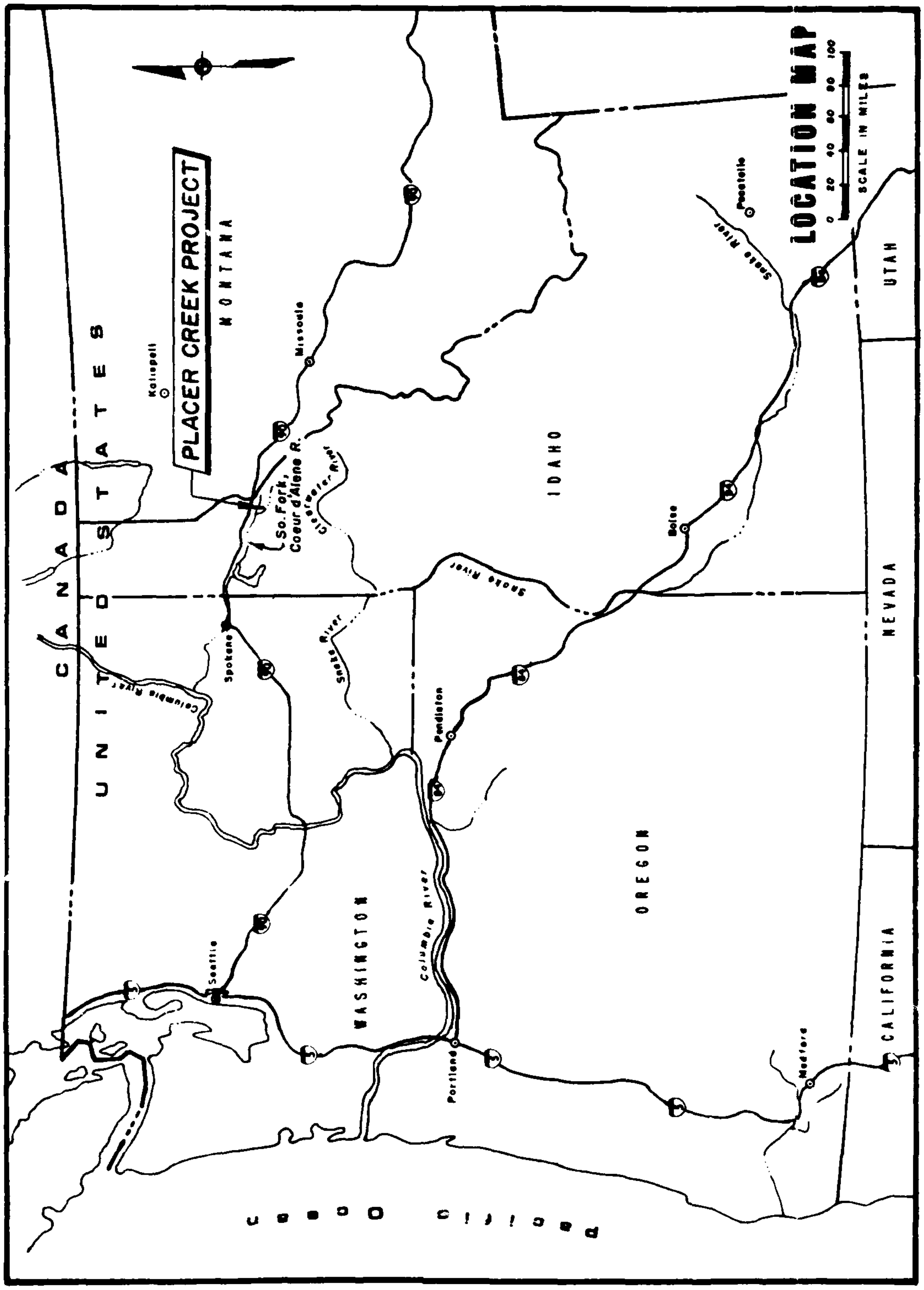
PART I: INTRODUCTION

The Project

1. The Placer Creek flood control channel project is located in the city of Wallace, Idaho, approximately 78 road miles east of Spokane, Washington (see figure 1). The project consists of a concrete-lined, high-velocity channel; channel entrance; and a debris basin upstream of the channel entrance (see plate 1). The channel exits into the South Fork Coeur d'Alene River.

2. The 3,875-foot-long, concrete-lined channel has an overall slope of approximately 0.023. Design discharge for the channel is 4,600 cubic feet per second (cfs); the 200-year thunderstorm flood. Channel geometry consists of 17- and 18-foot bottom width rectangular sections in the reach between stations 2+00 and 30+70 and a 17- to 20-foot-wide (top width) "V" bottom section having vertical walls in the reach between stations 32+10 and 38+95. A straight-line transition from the "V" bottom channel to the rectangular channel is located in the reach between stations 30+70 and 32+10. Curves are superelevated through spirals where required by rotating about the invert grade on the inner side of the curve. Curve data are shown in table 1.

3. The 420-foot-long debris basin is trapezoidal shaped with riprapped bottom and side slopes (1.0 vertical on 1.5 horizontal). A 23-foot-high drop structure is located at the basin entrance. The debris basin design capacity is 17,000 cubic yards (cu yd) and will be drained by a 3-foot-diameter pipe. An 88-foot-long riprapped section is used for transition from the natural channel to the debris basin drop structure.



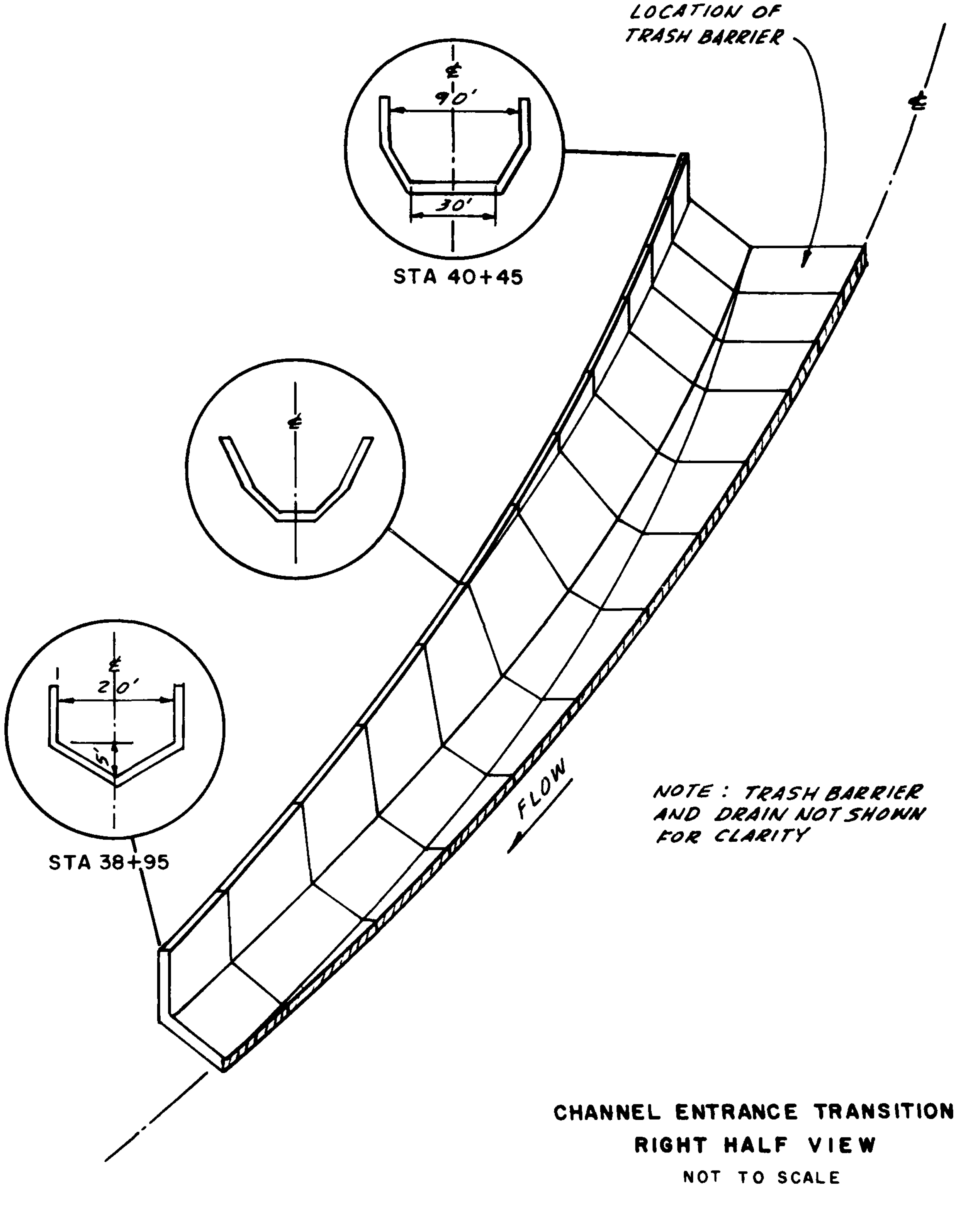
PLACER CREEK PROJECT
LOCATION MAP
0 20 40 60 80 100
SCALE IN MILES
CANADA
UNITED STATES
MONTANA
IDAHO
WASHINGTON
OREGON
NEVADA
UTAH
CALIFORNIA
Pacific Ocean
Kalispell
Missoula
Spokane
Seattle
Portland
Pendleton
Boise
Pocatello
Medford
So. Fork, Coeur d'Alene R.
Clearwater River
Columbia River
Snake River

Figure 1

4. The channel entrance is a 150-foot-long transition from the debris basin to the 20-foot-wide "V" bottom channel section (see figure 2). A 10-foot-high trash barrier is located at the 90-foot-wide channel entrance.

5. Numerous foot and vehicular traffic bridges cross the Placer Creek channel within the project area. Bridge obstructions were not a consideration for this study because local interests will raise all bridges as required to provide a minimum clearance of 2.5 feet above the design-condition water surface, as determined from the model study.

6. The channel improvements were designed in accordance with accepted practice and applicable results of hydraulic model tests of this and other similar projects. The design water surface profile used for project estimating purposes was based on a step-method energy balance computation. A Manning's friction factor value "n" of 0.015 was used to allow for an increase in roughness which would result from weathering of the channel and problems associated with concrete placement. Computed design water depth varies from 6.5 to 10.3 feet depending on location and channel width. Superelevations were computed using velocities based on a Manning's friction factor of 0.012.



CHANNEL ENTRANCE TRANSITION
RIGHT HALF VIEW
NOT TO SCALE

Figure 2

Need for Model Study

7. The design for channel improvement of Placer Creek was in accordance with sound engineering procedures; however, the need for a model study was considered essential to insure an adequate design of the high-velocity channel (25 to 30 feet per second (fps)) while attempting to minimize the real estate requirements in the city of Wallace. The entire reach was modeled because the proposed alinement of the improved channel essentially follows the existing Placer Creek channel which contains a large number of short radius curves, the cumulative effect of which could only be determined by a model study.

PART II: THE MODEL

Description

8. The model, constructed to a scale ratio of 1:20, reproduced the entire project area, including the concrete-lined channel, the debris basin, approximately 620 feet of the South Fork Coeur d'Alene River extending upstream and downstream from the Placer Creek exit, and 550 feet of the natural channel upstream from the debris basin. A 200-foot-long by 145-foot-wide movable bed section was included in the South Fork Coeur d'Alene River for observing and recording the scouring action of the Placer Creek exit. The model scale was chosen so that surface roughness (Manning's "n" value) and wave action in the curved sections will be properly reproduced.

9. The model was supported by wood or steel stringers between pipe and timber bents that could be adjusted vertically as required. The model channel was constructed with plywood surfaces that were fitted to formed wooden ribs mounted on a plywood base. The interior of the model channel was sanded to a smooth surface and finished with several coats of high-gloss enamel so that the model would have a Manning's "n" of 0.009 to simulate the channel design Manning's "n" value of 0.015. The debris basin, natural channel upstream of the basin, and South Fork Coeur d'Alene River were simulated by concrete molded between sheet metal templates to conform to field surveys and design plans. Crushed rock, cemented in place, was used to simulate riprap. Loosely placed crushed rock was used in the movable bed portion of the South Fork Coeur d'Alene River. Tailwater at the exit of the Placer Creek channel was controlled by an overflow tailgate at the downstream end of the South Fork Coeur d'Alene River model.

10. Water used in operation of the model was pumped through a recirculating system and was stilled in the head box, and all inflow was measured by a venturi meter.

Scale Relationships

11. The required similitude of the model to the prototype was obtained with the following scale relationship based on the Froude model law:

Dimension	Ratio	Scale Relationship
Length	L_r	1:20
Area	$A_r = L_r^2$	1:400
Volume	$V_r = L_r^3$	1:8000
Velocity	$U_r = L_r^{1/2}$	1:4.47
Time	$T_r = L_r^{1/2}$	1:4.47
Discharge	$Q_r = L_r^{5/2}$	1:1,789
Roughness	$N_r = L_r^{1/6}$	1:1.648

PART III: DEBRIS BASIN TESTS AND RESULTS

Original Design

12. Details of the original design are shown on plate 2. The debris basin consisted of a trapezoidal channel with improved bank protected by riprap with two debris barriers (plate 2 and photograph 1). Tests were conducted with discharges of 2,400 cfs, 3,300 cfs, and 4,600 cfs (design flow). Photograph 2 shows the design flow condition through the debris basin. The debris basin was ineffective, as all three discharges passed through the basin as a narrow, high-velocity stream with eddies on both sides of the basin between the debris barriers. At 4,600 cfs, impact on the upstream debris barrier was localized in the center where flow ride-up on the vertical beams overtopped the barriers (photograph 3). The entire downstream barrier was submerged, and the wall near station 40+00 (upstream of "V" bottom channel) was occasionally overtopped by the concentration of flow on the left bank (photograph 4).

Modified Designs

13. Several alternate modifications to the original design were devised and tested to alleviate the unacceptable hydraulic conditions which existed in the basin and at the upstream debris barrier. The Plan A design had a barrier consisting of fewer vertical beams in the upstream debris barrier (photograph 5) but resulted in conditions similar to the original design (photograph 6). The Plan B design had a barrier consisting of sloping braces on the upstream face of the barrier (photograph 7). The purpose of these braces was to streamline the beams and divide the flow to provide a major reduction in upwelling downstream from the barrier (photograph 8). Various schemes were tested in an attempt to reduce the high-velocity flow passing through the basin and uniformly distribute flow into the basin; however, no schemes were successful, and a complete redesign of the basin was considered a necessity.

14. The Plan C basin consisted of a deeper, shorter basin with a 23-foot-high drop structure at the upstream end (photograph 9) with a vertical training wall on the left bank and a single debris barrier at the downstream end near the channel entrance (photograph 10). The drop structure was provided to dissipate the energy of the incoming flow and to allow debris and bed material to settle out within the debris basin. Velocities in the Plan C basin, listed in table B, indicated that acceptable hydraulic conditions would be achieved using this scheme.

15. The large training wall on the left bank downstream of the drop structure would have been difficult to construct; therefore, several alternate plans were considered. Some plans had the training wall with a higher channel invert than the Plan C design and others included the left bank sloped to the bottom instead of the training wall.

Final Design

16. The final design debris basin (plate 3) had the left bank sloped to a flat invert at elevation 2784.0 feet. Although not constructed in the model, the prototype design incorporates a training wall extending along the right bank and 50 feet upstream to 60 feet downstream from the vertical drop structure to stabilize the hillside adjacent to the structure. The right training wall was not considered to significantly effect the hydraulic performance of the structure and, therefore, was not included in the model. Photographs 11 to 13 indicate the actual model geometry. Flow over the final design drop structure was satisfactory, as shown in photographs 14 to 16. Velocities were less than 8 fps through the downstream two thirds of the basin, indicating that debris deposition would occur. Plate 4 shows velocities in the basin with the design discharge of 4,600 cfs.

17. As the flow passed over the drop structure, the channel configuration forced the concentration of flow towards the right bank of the channel (photograph 17). Four directional fins were installed on top of the drop structure for better distribution of flow, but the fins were ineffective and not included in the final design.

18. Discharges in excess of about 1,500 cfs exceed the capacity of the existing arch culvert located about 500 feet upstream of the drop structure and overtopped Placer Creek road which parallels the left bank of the debris basin. Photograph 18 illustrates the condition at design discharge 4,600 cfs. Due to the natural topography and road gradient, this overflow would not be impeded and would continue to flow down the road into the city of Wallace, thereby outflanking the channel entrance. Although not model tested, this condition was remedied by resloping Placer Creek road to form a cutoff which would direct the overflow back into the debris basin over the grouted riprap sideslope downstream from the drop structure.

19. The effectiveness of the debris basin and trash barrier in collecting bedload and trash was observed in the model using flow conditions that simulated a 6-hour thunderstorm hydrograph (the 200-year design flood) and a continuous inflow of bed material. The material was sand (20 percent), small pea gravel comparable to 1- to 3-inch material (20 percent), small crushed rock simulating 3- to 6-inch material (40 percent), and medium crushed rock simulating 6- to 12-inch material with random rocks to 24 inches (20 percent). A scattering of trees and bushes was added during the period.

20. The general characteristic of the flood was a rapid increase from 14 to 4,600 cfs in slightly over 1 hour with a short 5-hour recession (see table C). Rock started to move with a discharge of approximately 600 cfs. A total of 16,000 cu yd of bed material was deposited in the debris basin with only a small amount of sand passing into the Placer

Creek channel. Initial fallout in the basin occurred between stations 42+50 and 43+00. As the velocities and volume of bed material increased, the deposition moved downstream. After the peak had passed, the material still moving was depositing more in the area of stations 43+00 to 44+00. Eventually the bed material filled the debris basin from bank to bank and from the drop structure to the trash barrier by slow continuous movement of material downstream. Trash formed a porous barrier on the racks, and bed material was deposited against it. Rock stopped moving at approximately 700 cfs. At the end of the flood, the top of the drop structure was under 4.2 feet of debris and the material had backed upstream as far as station 45+20. Velocities along the riprapped banks of the basin during the flood were 12 to 14 fps on the left bank and 17 fps on the right bank. Photographs 19 to 27 show the sequence of the test. A centerline profile of the deposited material is listed in table D.

21. A longer, 120-hour winter-rain flood hydrograph was also tested in the same manner. This flood had a maximum discharge of 3,050 cfs during the 28th hour (see table C). The test was begun at the 23rd hour with a discharge of 565 cfs and concluded after the 49th hour with a discharge of 760 cfs. The early difference between the two tests was that the bed material buildup started much farther upstream with the winter storm than with the thunderstorm flood. Initial fallout occurred just 40 feet downstream from the drop structures. Additional deposition of material was observed in downstream reaches. Flow was uniform across the top of the drop structure, but most of the bed material shifted towards the right bank. At a flow of 2,500 cfs (26-1/2 hours), rock had moved down to station 42+50 and the majority of rock was deposited on the right side. Maximum velocities along the left bank were 12 to 15 fps. The left end of the trash barrier was just starting to overtop. At the peak discharge of 3,050 cfs, rock had moved downstream to station 42+25 and had formed an exposed bar on the right side. Maximum velocities along the left bank had reduced to 10 to 12 fps. As the flow receded, bed material built up closer to the drop structure, and flow changed from

plunging to skimming which drew more rock in against the drop structure. At 1,700 cfs, rock had covered the top of the drop structure and was evenly distributed from bank to bank down to station 41+25. As the flow receded further, channels were cut through on one side and then the other and would change as the bed material slowly built up. At the end of the test, 5.1 feet of rock covered the top of the drop structure. A total of 17,600 cu yd had been deposited in the debris basin. Photographs 28 to 38 show the hydrograph sequence. A top-of-rock profile at the conclusion of the test is listed in table D.

PART IV: CHANNEL TESTS AND RESULTS

Original Design

22. Model layout and details of the original channel design are shown on plates 5 and 6. Photographs 39 to 44 show typical channel geometry. Tests were conducted with discharges of 1,000, 2,400, 3,300, and 4,600 cfs (design flow). Hydraulic conditions throughout the channel were acceptable for all discharges with the exception that downstream from curves 4 and 5 unacceptable standing waves were created which continued downstream (photograph 45). In the original design, curves 4 and 5 essentially formed a reverse curve which did not incorporate spirals or superelevation due to shortness of the curves and their close proximity.

Final Design

23. Model layout and design detail of the final channel design are shown on plates 7 and 8. The only change from the original design was the removal of curves 4 and 5 by straightening of the channel between the ST of curve 3 and the PC of curve 6 (photograph 46). This channel realinement was sufficient to prevent formation of unacceptable waves downstream from the curves (photograph 47). Flow conditions through the channel entrance between the debris basin and the "V" notch channel were acceptable (photograph 48).

24. Water surface profiles along both walls with the design discharge of 4,600 cfs are shown on plates 9 through 12. The model profiles were used in designing the prototype wall heights and determining minimum elevations for the bridges crossing the channel. A freeboard of 2.5 feet above the design discharge profile was used in setting wall heights for the prototype.

Miscellaneous

25. The model was used to isolate locations of initial channel wall overtopping with discharges in excess of design conditions. Initial wall overtopping occurred through the transition between the debris basin and "V" notch channel at a discharge of about 6,000 cfs. With a discharge of 9,000 cfs, both channel walls were overtopped along almost the entire length of the channel and the test was terminated. Table E defines locations and depths of wall overtopping for discharges of 6,000, 7,000, 8,000, and 9,000 cfs.

26. Relocation of a 6-inch-diameter sewer through the channel was suggested as an alternative by local interests. A test was conducted to illustrate the effects of the high-velocity water impingement on the pipe. When flow was allowed to strike the pipe, a maximum wave 15 feet high and 45 feet long resulted. The wave stayed within the channel, but spray 25 feet high spread over the sides. There were no detrimental waves further downstream. This alternative was discarded from further consideration.

PART V: EXIT TO SOUTH FORK COEUR D'ALENE RIVER

27. Movable bed studies were made to qualitatively evaluate the scouring effect at the Placer Creek exit to the South Fork Coeur d'Alene River. Existing channel scour data was not available; therefore, the model was used only to provide an indicator of scour potential. The extent and characteristics of erosion that might occur in the river were observed with two flood hydrographs in a movable bed section of the model (plate 13, photographs 49 and 50). Four gages, located as shown on plate 13, were used to monitor water surface elevations on the South Fork Coeur d'Alene River during the movable bed studies. The movable bed section of crushed rock reproduced 200 linear feet of the river channel and right overbank. Ninety-eight percent of the simulated bed and bank material consisted of 5- to 10-inch boulders of which 34 percent was 5 inches, 29 percent was 7.5 inches, and 35 percent was 10 inches.

Winter Rainflood

28. The simulated hydrological conditions for this observation were that flow in the South Fork Coeur d'Alene River was constant at 7,175 cfs, while flow from Placer Creek increased from 565 cfs at the 23rd hour of the storm to a maximum of 3,050 cfs at the 28th hour. When flow in Placer Creek receded to 790 cfs at the 48th hour, the test was concluded. The Placer Creek hydrograph is tabulated in table C.

29. The test commenced with approximately bankfull flow in the South Fork Coeur d'Alene River. No bed material was moved, and the high flow in the river caused the highway culvert located at the mouth of Placer Creek to flow full and a hydraulic jump to form in Placer Creek 500 feet upstream from the culvert. As flow in the creek increased to 1,175 cfs, the jump moved upstream 200 feet and then back 150 feet to a position 550 feet upstream from the confluence. The walls of Placer Creek were overtopped by 4 to 5 feet downstream from the jump. There was no erosion in the river. By the 26th hour of the flood, flow increased to 2,000 cfs

and pushed the hydraulic jump downstream another 150 feet. Walls were still overtopped at the upstream end of the culvert. No movement of bed material in the South Fork Coeur d'Alene River was observed. At the 28th hour when the flood peaked, the existing small scour hole in the river at the exit of Placer Creek was enlarged. The high flow in the river moved the scoured material downstream. An upwelling along the left bank wall deposited some of the smaller rock on top of the wall. The jump in Placer Creek was only 50 feet upstream from the highway culvert and caused a high impact on the culvert and significant overtopping of the walls (photographs 51 to 55).

30. As the flow reduced to 2,000 cfs in the 30th hour, the movement of bed material ceased. The jump in Placer Creek moved upstream 100 feet, and the extreme conditions at the culvert entrance were reduced. The erosion and final deposition of the scoured material are shown in photographs 56 and 57 and plate 14.

Thunderstorm Flood

31. The simulated hydrological conditions for this observation were the project design 200-year thunderstorm flood (table D). Flow in the South Fork Coeur d'Alene River was constant at 400 cfs, while flow in Placer Creek increased from 14 cfs during the 3rd hour of the storm to a maximum of 4,600 cfs shortly after the 4th hour and receded to constant at 400 cfs by the 9th hour. The movable bed section of the model reproduced 350 feet of the river invert and right bank (plate 15, photographs 58 and 59).

32. The test began at the 3rd hour of the storm when Placer Creek flow was increased from 14 to 500 cfs (3 hours and 15 minutes into the storm) and quickly scoured the right bank of the South Fork Coeur d'Alene River (photograph 60). By 3 hours and 30 minutes of the storm, the flow increased to 2,350 cfs and extensive scouring was occurring. The right

bank of the Coeur d'Alene was overtopped, and material was moving downstream on the bank. After 3 hours and 45 minutes with flow of 4,045 cfs, scour was continuous on the right bank and probably in the invert of the South Fork although observation of the invert was not made. Shooting flow from the creek extended over the top of the right bank of the river before turning downstream, and scoured material was carried in the same pattern.

33. The maximum flow of 4,600 cfs was reached shortly after the 4th hour of the storm (photographs 61 and 62). The volume of scouring increased with the bulk of the rock forming a berm beyond and downstream from the expanded scour area. Flow was still over the top of the South Fork Coeur d'Alene River bank. Scouring reduced sharply when flow dropped to 4,100 cfs after 4 hours and 30 minutes of the storm. The shooting flow was reduced, and the top of the newly formed berm of aggraded rock was exposed.

34. Only drifting and readjusting of bed material occurred at a flow of 3,500 cfs during the 5th hour of the storm. After 5 hours and 30 minutes flow receded to 3,000 cfs and most of the right bank was exposed again. Some rock still moved along the river bottom as flow settled back into the main channel. Photograph 63 shows how the 2,500 cfs discharge (6th hour) flowed against the left bank (wall). The flow moved some loose material but did not scour the existing invert.

35. At 2,000 cfs, after 6 hours and 30 minutes of the storm, shooting flow from Placer Creek was further reduced. Loose rock still moved along the invert but major scouring had ceased. Flow from Placer Creek started to turn downstream within the river during the 7th hour of the storm when the discharge was 1,500 cfs. All material had stopped moving, and the riverflow was confined to the left half of the channel by the deposited material. Flow was entirely downstream with a flow of 1,000 cfs (photograph 64). Riverflow was confined to a 25-foot-wide channel on the left. Just before the test was concluded with a minimum

flow of 500 cfs (after 8 hours and 30 minutes of the storm), bed material was observed to be deposited as far as 250 feet downstream from the movable bed section. Scour and deposition at the end of the flood are shown on plate 15 and in photographs 65 and 66. Flow through the highway culvert at the mouth of Placer Creek was open-channel flow at all times during the 200-year thunderstorm design flood.

36. The extensive scour which occurred near the exit of the highway culvert indicated a potential for undermining the channel exit and compromising the integrity of the project. Although not tested in the model, a grouted riprap pad utilizing 2,000 pound maximum size rock was incorporated in the final design of the prototype. The pad extends approximately 40 feet and 70 feet up and downstream respectively from the culvert centerline and across the river channel and will be overlaid with natural bed material.

37. Two test procedures were accomplished to evaluate the effect of Placer Creek induced bed movement in the South Fork Coeur d'Alene River on the South Fork Coeur d'Alene River water surface elevations. For the first test, water surface profiles in the South Fork Coeur d'Alene River with a discharge of 7,750 cfs were determined at the four gage locations under existing bed conditions and then following occurrence of the 200-year Placer Creek thunderstorm event. Following is a tabulation of pre- and post-flood water surface elevations on the South Fork Coeur d'Alene River:

	South Fork Coeur d'Alene River Water-Surface Elevation	
Gage No.	Pre-flood	Post-flood
1	2717.5	2721.0
2	2716.4	2717.4
3	2716.3	2716.2
4	2716.3	2716.3

38. The second test monitored South Fork Coeur d'Alene River water surface elevation at the four gage locations during two Placer Creek 200-year winter rainfloods, one prior to and one after a Placer Creek 200-year thunderstorm flood. The test was conducted to evaluate the self-cleansing capability of the South Fork Coeur d'Alene River. Table F illustrates water surface elevations following the two winter rainflood events. During the second winter flood, no major self-cleaning of the channel occurred, and only a small amount of the deposited material was disturbed or rearranged (photograph 67). The buildup of scour material in the channel below the confluence caused the water surface in the South Fork Coeur d'Alene upstream from the confluence to be higher during the second winter rainflood (5.4 feet at 565 cfs and 0.7 foot at 3,050 cfs, table F). Tests indicated that during the winter flood the highway culvert at the mouth of Placer Creek flowed full and a hydraulic jump formed upstream of the culvert.

PART VI: SUMMARY

39. A 1:20 scale model was used to verify design of the Placer Creek project. The project, which consists of a debris basin and a 3,900-foot-long high-velocity channel, was modeled in its entirety.

40. The original design debris basin proved to be ineffective and required redesign. The final design basin effectively dissipated the energy of the incoming flow and reduced velocities sufficiently to cause deposition of debris load. Tests were conducted by supplying debris load to both the 200-year winter rainflood hydrograph and the 200-year thunderstorm (design condition) hydrograph and demonstrated the effectiveness of the basin in collecting and trapping the debris and preventing debris from entering the channel. In February 1982, an approximate 10-year flood occurred and deposited about 3,000 cu yd of material in the basin which had been essentially completed. The basin prevented any debris from passing into the channel downstream, and material deposition in the prototype was very similar to that predicted by the model. Photographs 68 and 69 show the effectiveness of the debris basin in preventing debris from entering the concrete-lined flood control channel.

41. With one minor modification, the original channel design proved to be hydraulically acceptable. The modification consisted of replacing two short reverse curves with a straight-line transition which corrected the condition. The water surface elevations as determined from the model were used to design the prototype wall heights.

42. Movable bed tests at the channel exit into the South Fork Coeur d'Alene River indicated that extensive channel degradation/aggradation would occur downstream from the exit with large discharges. Although not model tested, a grouted riprap pad was provided in the prototype to prevent this scour from compromising the integrity of the project. The

tests showed that maintenance of the South Fork Coeur d'Alene channel would be required because the river would not be self-cleansing and bed material deposition downstream from the Placer Creek exit would cause an increase in existing South Fork Coeur d'Alene River water surface elevations.

TABLE A

CHANNEL CURVE DATA

Final Design in Model

Curve No.	Central Angle	Length of Main Curve in Feet	Radius of Main Curve in Feet	Spiral Length in Feet	Superelevation in Feet	Type of Channel Section
1	33°23'43.7"	123.20	280	40	3.7	Rectangular Banked
2	26°31'17.8"	96.87	300	42	3.7	Rectangular Banked
3	54°22'10.8"	243.68	300	41	3.6	Rectangular Banked
4	-	-	-	-	-	
5	-	-	-	-	-	
6	1°16'17.7"	13.30	600	-	-	Rectangular
7	14°49'13.6"	28.25	260	39	3.8	Rectangular Banked
8	11°50'17.0"	126.03	610	-	1.5	Rectangular Banked
9	15°34'35.1"	28.69	260	42	3.3	Rectangular Banked
10	59°26'56.6"	228.77	260	41	3.3	Rectangular Banked
11	10°30'40.6"	5.86	250	40	-	Transition
12	9°44'57.4"	195.68	1,150	-	-	"V" Bottom
13	38°35'35.1"	134.72	200	-	-	Trapezoidal (Debris Basin)

TABLE B

VELOCITIES IN DEBRIS BASIN

Plan C Debris Basin [1]
Placer Creek discharge 4600 cfs

Station	Original Left Bank Training Wall				Left-Bank Slope Extended to Invert[2]			
	Invert Elevation				Invert Elevation			
	2781.5[3]	2784.0	2786.5	2789.0	2781.5	2784.0	2786.5	2789.0
	Station Limits				Station Limits			
	43+51 to 44+14	43+51 to 44+14	43+51 to 44+14	42+89 to 44+14	43+51 to 44+14	43+51 to 44+14	43+51 to 44+14	42+89 to 44+14
	Velocities in Feet Per Second							
40+62	5	4	4	4	5	5	5	4
41+55	6	5	5	4	4	5	4	4
42+20	7	7	7	7	7	6	7	7
42+95	9	8	9	8	8	7-10	8	10
43+57	11	11	11	11	9	7-10	9	11-14

1 Plan C debris basin included a trash barrier at sta 40+40 and a drop structure at sta 44+14.

2 Eliminated training wall.

3 Original design.

NOTE: Two directional vanes were installed on top of the drop structure for these tests but later were considered not necessary and removed.

TABLE C

FLOOD HYDROGRAPHS

Winter Rain Flood *

Hour	Placer Creek Discharge in CFS
23	565
24	750
25	1175
26	2000
27	2950
28	3050
29	2250
30	2000
31	1775
32	1625
33	1500
34	1440
35	1335
36	1285
37	1235
38	1170
39	1125
40	1080
41	1040
42	1000
43	960
44	920
45	885
46	850
47	820
48	790

Thunderstorm Flood **

Hour	Placer Creek Discharge in CFS
3:00	14
3:15	583
3:30	2360
3:45	4045
4:00	4536
4:10	4600
4:15	4405
4:30	4100
4:45	3792
5:00	3513
5:15	3244
5:30	2979
5:45	2741
6:00	2530
6:15	2312
6:30	2049
6:45	1759
7:00	1497
7:15	1266
7:30	1073
7:45	910
8:00	722
8:15	640
8:30	560
8:45	480
9:00	400

* South Fork Coeur d'Alene River discharge 7175 cfs.

** South Fork Coeur d'Alene River discharge 400 cfs.

TABLE D

CENTER LINE PROFILE OF MATERIAL DEPOSITED IN DEBRIS BASIN

200-YEAR HYDROGRAPH

Thunderstorm Flood	
Station	Elevation
40+50	2800.1
41+00	2799.2
41+30	2800.9
41+60	2802.3
42+00	2803.7
42+30	2803.6
42+60	2805.9
43+00	2807.7
43+30	2808.9
43+60	2809.7
44+00	2810.8
44+30	2811.2
44+50	2810.7
45+00	2810.0

Winter Storm Flood	
Station	Elevation
40+50	2802.8
41+00	2802.3
41+30	2804.5
41+60	2805.3
42+00	2806.1
42+30	2807.1
42+60	2809.3
42+80	2810.7
43+00	2810.9
43+20	2812.1
43+40	2813.2
43+60	2813.9
44+00	2815.4
44+25	2812.1
44+50	2813.0
44+75	2816.0
45+00	2814.6
45+25	2815.7
45+50	2817.4
45+75	2817.3
46+00	2816.5
46+25	2817.3

NOTE: Trees, bushes, and trash collected on trash barrier at sta 40+40 and formed a porous blockade.

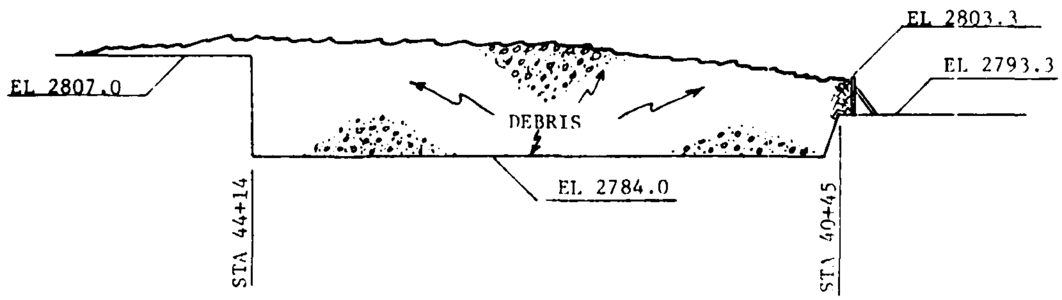


TABLE D

TABLE E

OVERTOPPING OF CHANNEL WALLS

Plan C Debris Basin

Left Wall		Right Wall	
Station Limits	Depth of Overtopping in Feet	Station Limits	Depth of Overtopping in Feet
Discharge 6000 cfs			
38+90 to 40+45	3.0	26+75 to 26+85	1.0
		27+75 to 27+90	1.0
		35+20 to 35+30	1.0
		35+70 to 36+10	1.0
		38+85 to 40+45	3.0
Discharge 7000 cfs			
2+00 to 2+30	0.5*	8+15 to 8+60	1.0
2+90 to 3+30	0.5	17+85 to 18+25	0.5
4+10 to 4+50	0.5	19+10 to 19+40	1.0
5+30 to 5+50	0.5	20+30 to 20+60	0.5
7+60 to 7+80	0.5	21+40 to 21+60	1.0
13+10 to 13+60	0.5	22+60 to 23+00	1.0
15+10 to 15+60	0.5	23+80 to 24+00	0.5
18+40 to 18+90	0.5	24+70 to 25+10	0.5
19+60 to 20+00	0.5	25+85 to 26+05	1.0
20+75 to 21+30	1.0	26+75 to 26+90	1.0
22+00 to 22+30	1.0	27+75 to 28+05	1.0
23+30 to 23+40	0.5	28+50 to 29+10	1.0
24+20 to 24+60	0.5	29+75 to 29+95	1.0
25+20 to 25+50	1.0	30+80 to 31+00	1.0
26+50 to 27+40	1.0	33+75 to 36+50	1.0
28+40 to 28+50	1.0	38+80 to 40+45	4.5
30+25 to 30+60	1.0		
31+25 to 31+75	1.0		
35+00 to 36+50	2.0		
38+85 to 40+45	5.0		
Discharge 8000 cfs			

7+60 to 7+80	0.5	[illegible] to 21+60	1.0
13+10 to 13+60	0.5	22+60 to 23+00	1.0
15+10 to 15+60	0.5	23+80 to 24+00	0.5
18+40 to 18+90	0.5	24+70 to 25+10	0.5
19+60 to 20+00	0.5	25+85 to 26+05	1.0
20+75 to 21+30	1.0	26+75 to 26+90	1.0
22+00 to 22+30	1.0	27+75 to 28+05	1.0
23+30 to 23+40	0.5	28+50 to 29+10	1.0
24+20 to 24+60	0.5	29+75 to 29+95	1.0
25+20 to 25+50	1.0	30+80 to 31+00	1.0
26+50 to 27+40	1.0	33+75 to 36+50	1.0
28+40 to 28+50	1.0	38+80 to 40+45	4.5
30+25 to 30+60	1.0		
31+25 to 31+75	1.0		
35+00 to 36+50	2.0		
38+85 to 40+45	5.0		
Discharge 8000 cfs			
2+00 to 2+25	1.0*	5+90 to 6+65	0.5
2+60 to 3+30	1.5	7+90 to 6+65	0.5
3+80 to 4+60	2.0	11+15 to 12+30	1.5
5+10 to 5+50	1.5	12+50 to 13+00	0.5
6+40 to 6+70	0.5	13+50 to 13+80	0.5
7+50 to 7+80	1.0	14+20 to 14+50	0.5
10+80 to 11+20	0.5	15+40 to 15+60	0.5
12+00 to 12+20	0.5	16+50 to 17+00	1.0
13+00 to 14+80	2.5	17+70 to 18+30	1.5
15+00 to 15+50	1.0	18+85 to 19+40	2.0
15+90 to 16+30	0.5	20+00 to 20+70	1.5
17+20 to 17+50	0.5	21+20 to 21+80	2.0
18+30 to 18+80	1.0	22+40 to 23+20	2.0
19+50 to 20+05	2.0	23+70 to 25+20	0.5
20+80 to 21+20	2.0	25+60 to 26+15	2.0
21+80 to 22+[illegible]	2.5	26+40 to 26+85	2.0
23+00 to 23+40	1.5	27+50 to 28+25	2.0
24+00 to 24+80	1.5	28+60 to 29+15	2.5
25+20 to 25+40	1.5	29+60 to 30+10	2.0
25+90 to 27+50	2.0	30+60 to 31+15	2.0
28+30 to 28+60	0.5	33+00 to 38+40	3.0
29+20 to 29+60	1.5	38+50 to 38+80	2.0
30+15 to 30+60	2.0	38+80 to 40+45	5.5
31+00 to 31+75	2.5		
33+00 to 37+25	4.0		
37+50 to 37+80	1.0		
38+00 to 38+20	1.0		
38+50 to 38+80	2.0		
38+80 to 40+45	6.5		

* Highway I-90 culvert removed (required for model operation at these large discharges).

TABLE E

TABLE F

WATER-SURFACE PROFILES
South Fork Coeur d'Alene River
Winter Rain Flood
Before and After Thunderstorm Flood

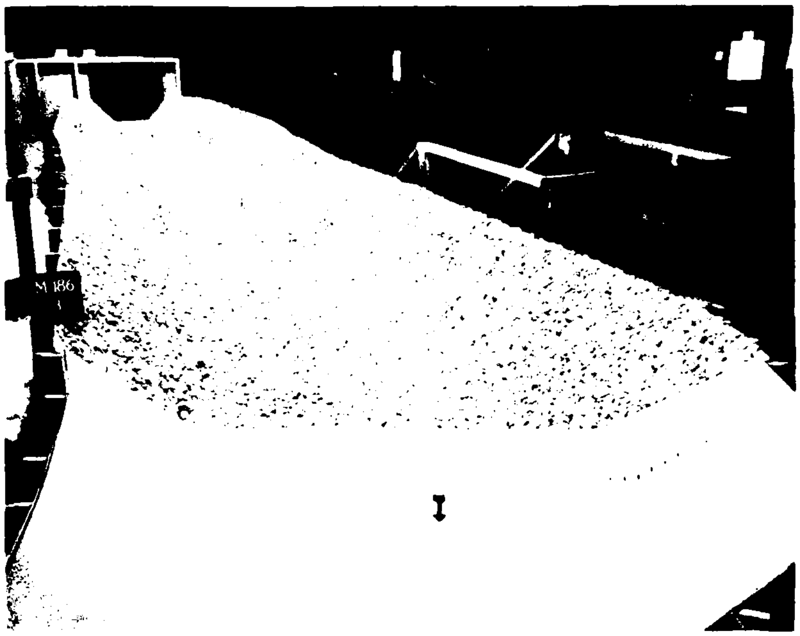
Existing Channel

Placer Creek Discharge CFS	Water-Surface Elevations			
	Gage *			
	1	2	3	4
565	2716.8	2716.7	2716.4	2716.3
1175	2720.2	2718.6	2718.3	2717.9
2000	2721.8	2719.7	2719.5	2719.0
3050	2722.8	2720.5	2720.4	2719.8
2000	2721.8	2719.6	2719.5	2719.0
1125	2721.0	2719.1	2719.0	2718.6
580	2720.0	2716.6	2717.1	2717.6

After Scouring of Thunderstorm Flood

Placer Creek Discharge CFS	Water-Surface Elevations			
	Gage *			
	1	2	3	4
565	2722.2	2716.5	2716.3	2716.3
1175	2722.8	2718.5	2718.2	2718.1
2000	2723.0	2719.3	2719.2	2719.0
3050	2723.5	2720.2	2720.0	2719.7
2000	2722.9	2719.2	2719.0	2718.9
1125	2722.7	2719.2	2718.7	2718.6
580	2722.0	2718.5	2716.5	2717.0

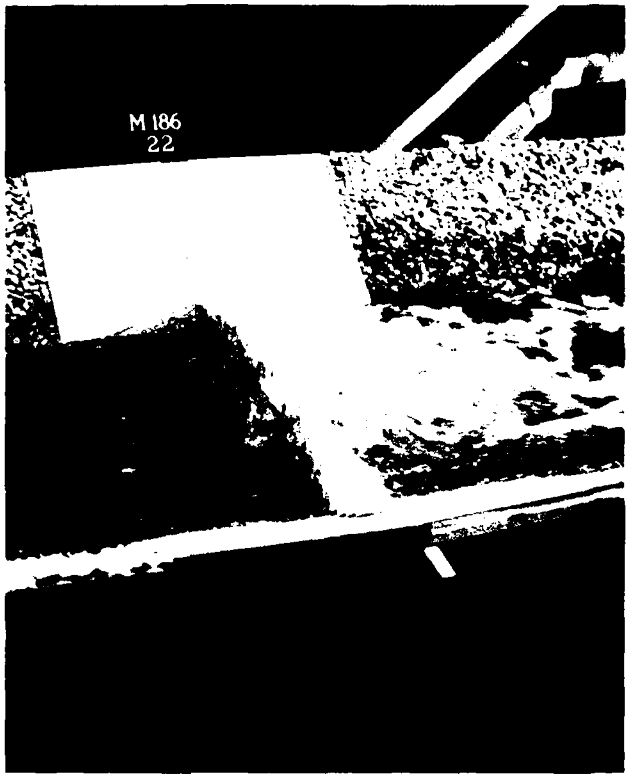
* See plate 13 for gage locations.



Photograph 1. Trash barriers and riprapped channel

Photograph 2. Flow through trash barriers; discharge 4,600 cfs

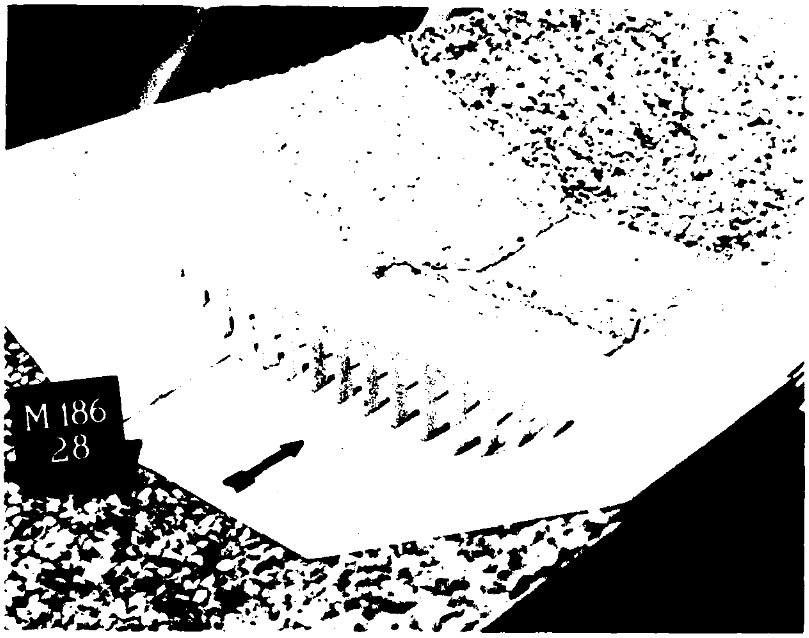
Original-Design Debris Basin



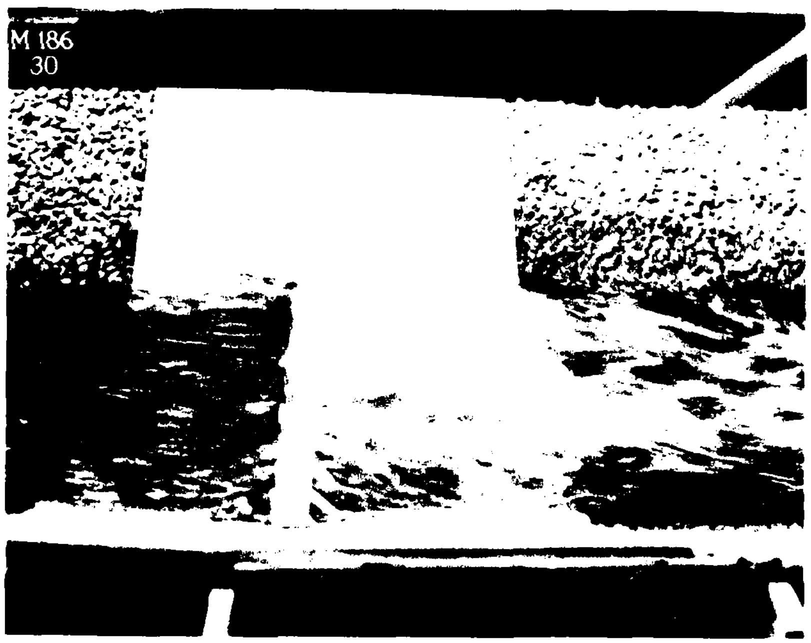
Photograph 3. Flow through upstream trash barrier

Photograph 4. Overbank flow downstream from submerged downstream trash barriers

Original-Design Debris Basin

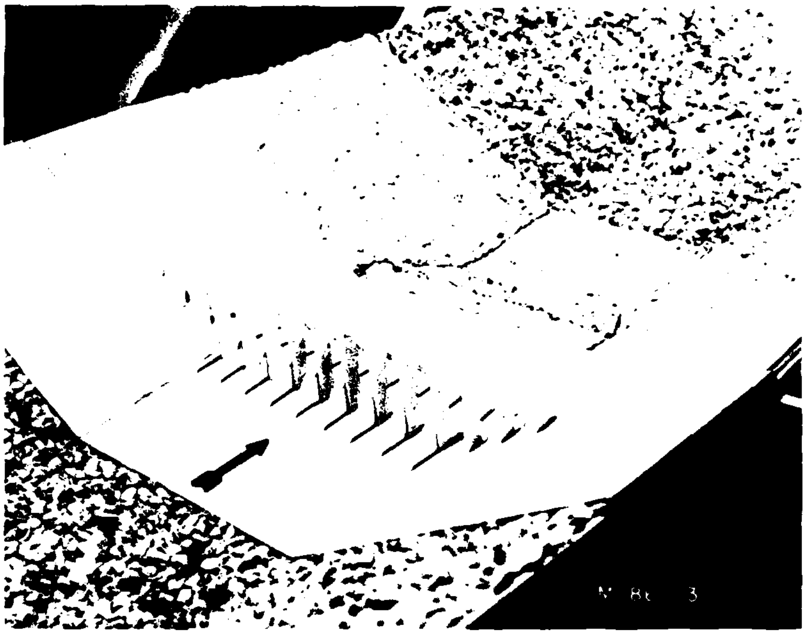


Photograph 5. Dry bed

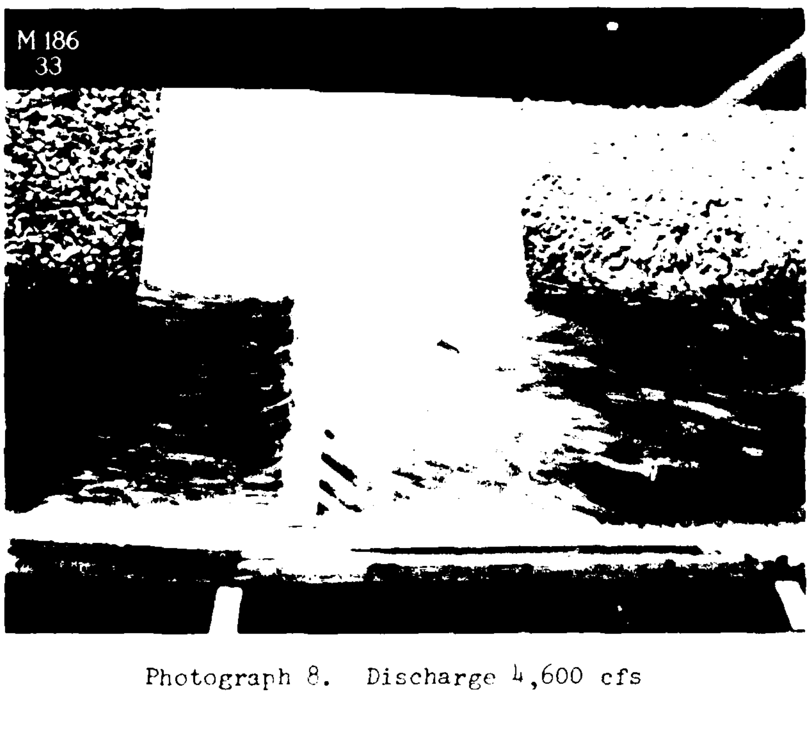


Photograph 6. Discharge 4,600 cfs

Plan A Upstream Trash Barrier

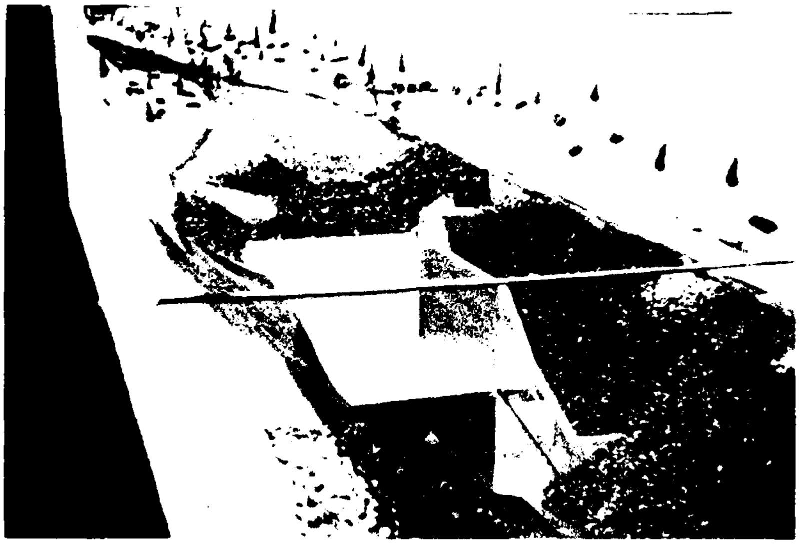


Photograph 7. Dry bed

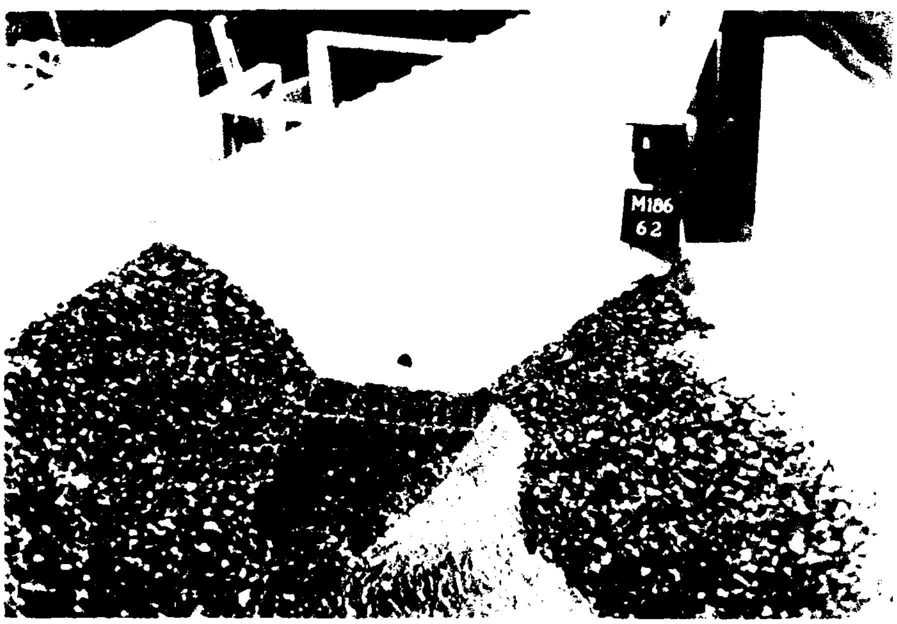


Photograph 8. Discharge 4,600 cfs

Plan B Upstream Trash Barrier

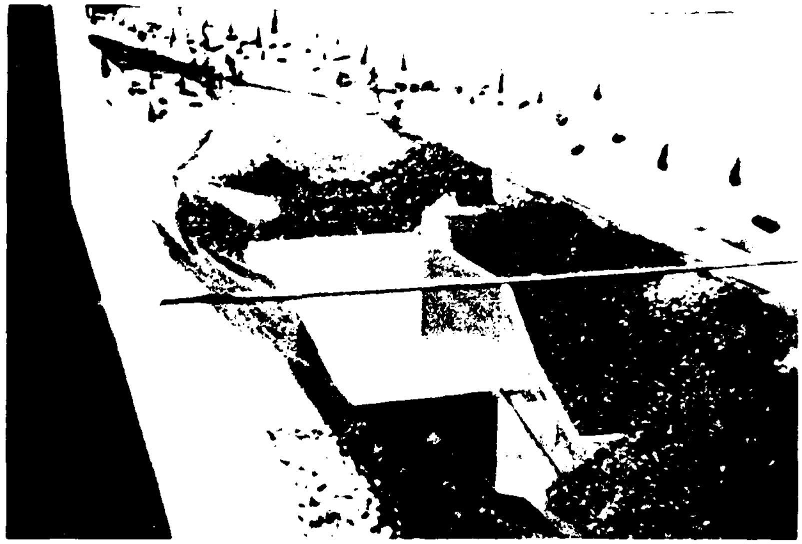


Photograph 9. Looking upstream at drop structure

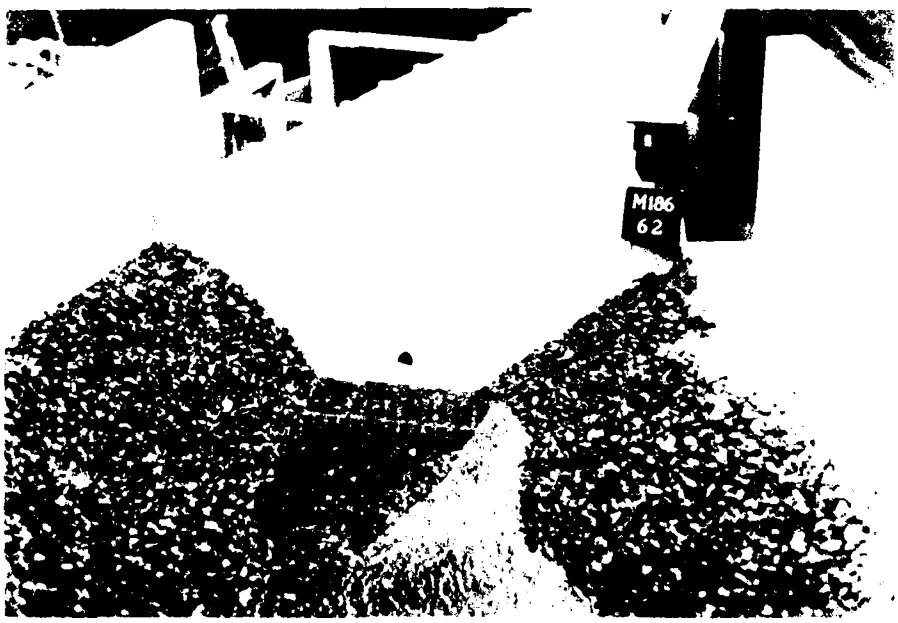


Photograph 10. Upstream view of trash barrier

Plan C Debris Basin and Drop Structure

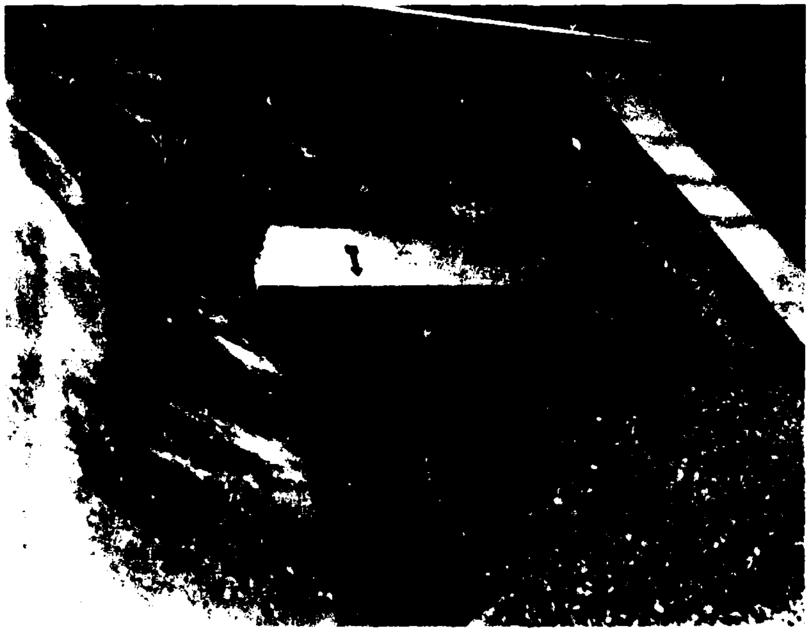


Photograph 9. Looking upstream at drop structure



Photograph 10. Upstream view of trash barrier

Plan C Debris Basin and Drop Structure



Photograph 11. Left bank

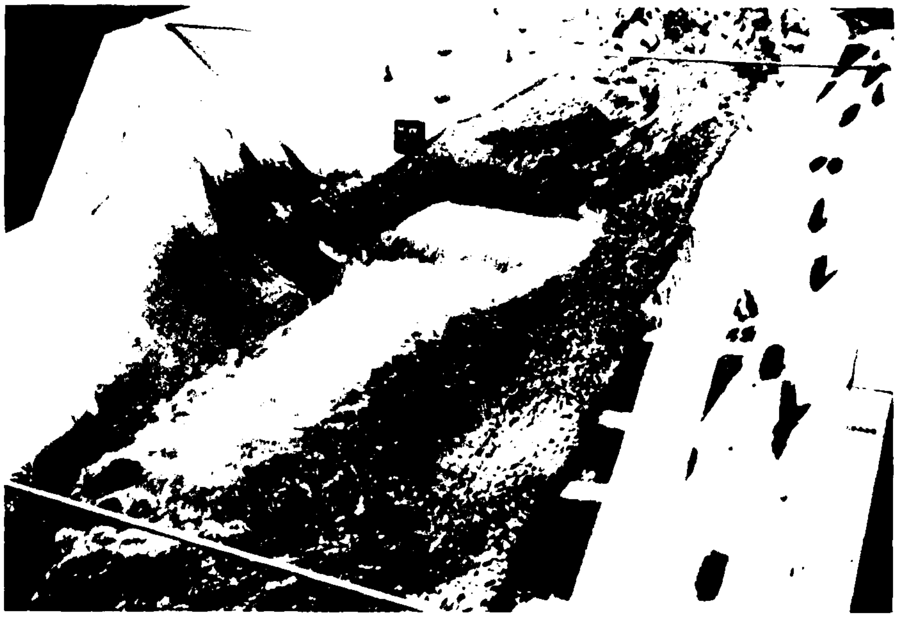
Photograph 12. Right bank

Final-Design Debris Basin and Drop Structure

Photograph 13. Dry bed

Photograph 14. Discharge 4,600 cfs

Final-Design Debris Basin and Drop Structure



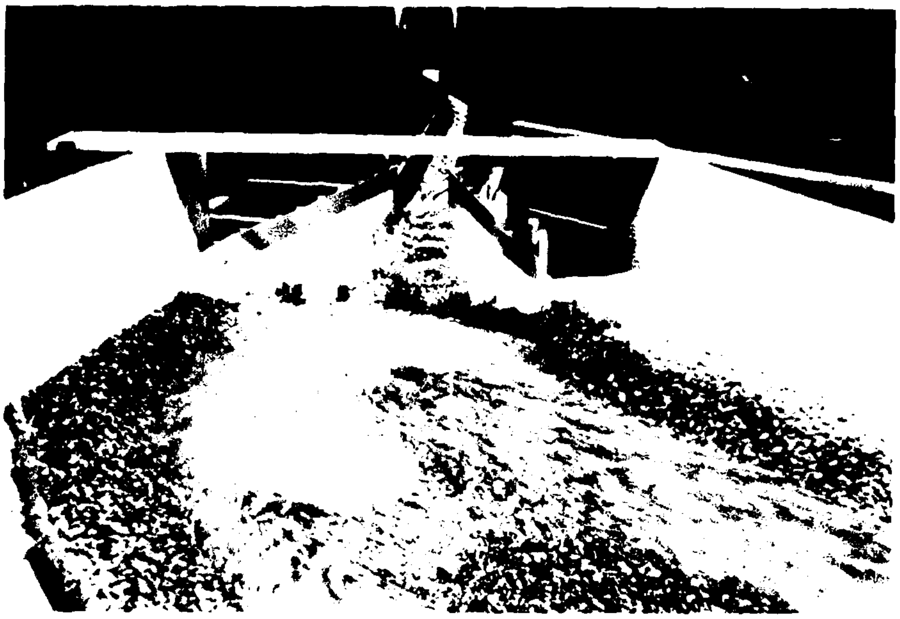
Photograph 15. Overhead view; discharge 4,600 cfs

Photograph 16. Upstream view; discharge 4,600 cfs

Final-Design Debris Basin and Drop Structure

Photograph 17. Flow condition downstream from Plan C drop structure; discharge 4,600 cfs

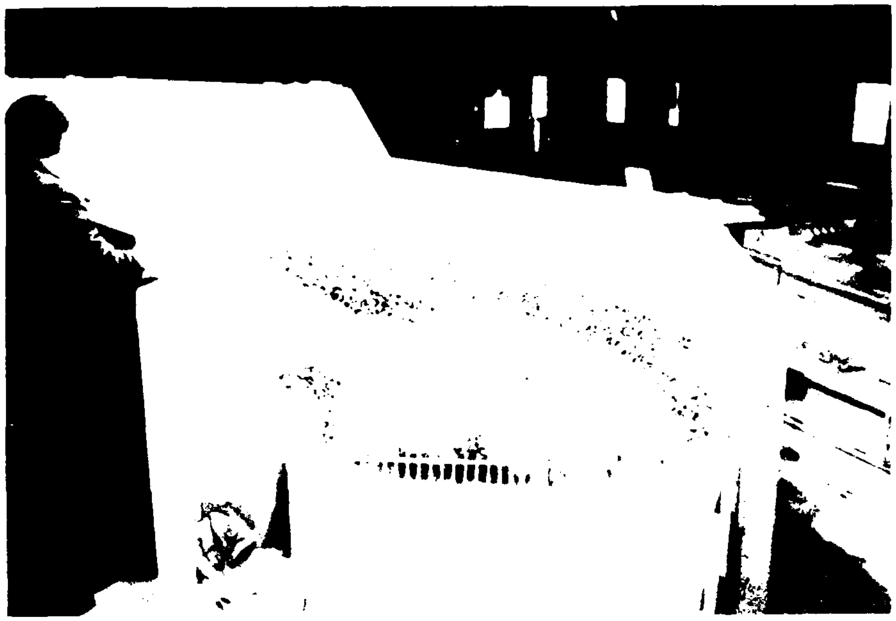
Photograph 18. Flow condition downstream from Placer Creek Road arch culvert; discharge 4,600 cfs



Photograph 19. Buildup at trash barrier

Photograph 20. Debris basin

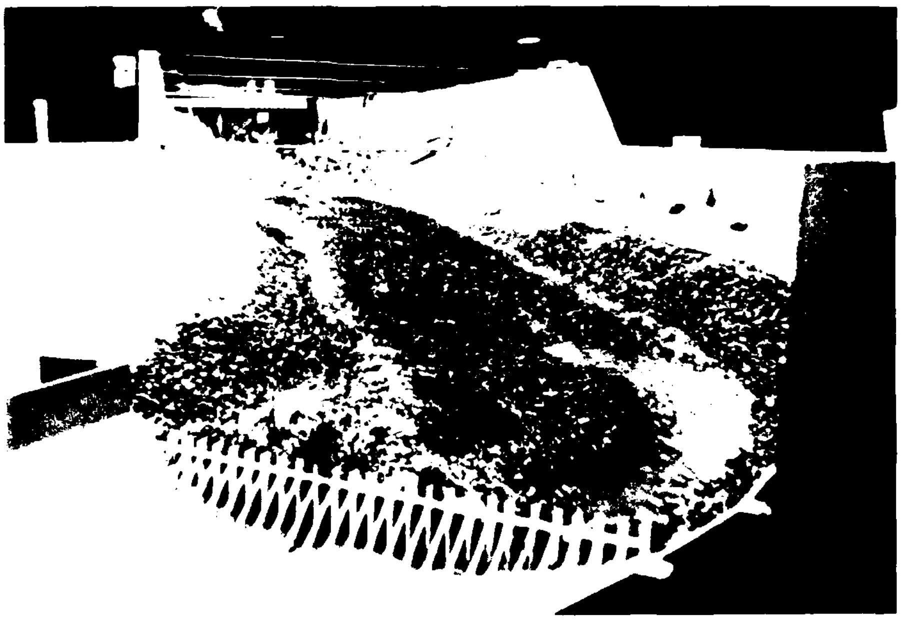
Final-Design Debris Basin
200-Year Thunderstorm Flood Hydrograph
3rd Hour; Discharge 2,530 cfs



Photograph 21. 4th hour; discharge 1,497 cfs

Photograph 22. After $4\frac{1}{2}$ hours; discharge 1,073 cfs

Final-Design Debris Basin
200-Year Thunderstorm Flood Hydrograph



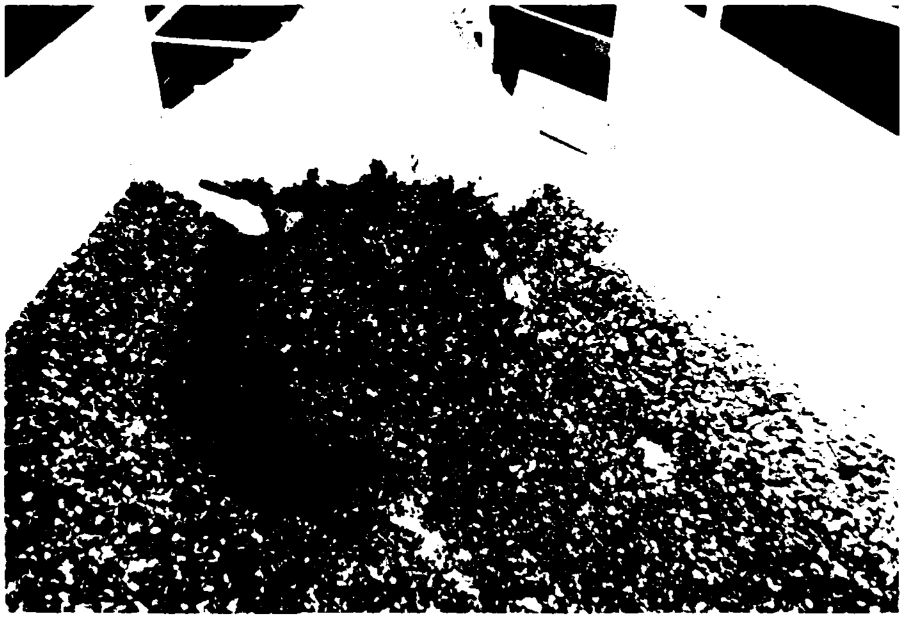
Photograph 23. 200-year thunderstorm flood hydrograph
5th hour; discharge 722 cfs

Final-Design Debris Basin

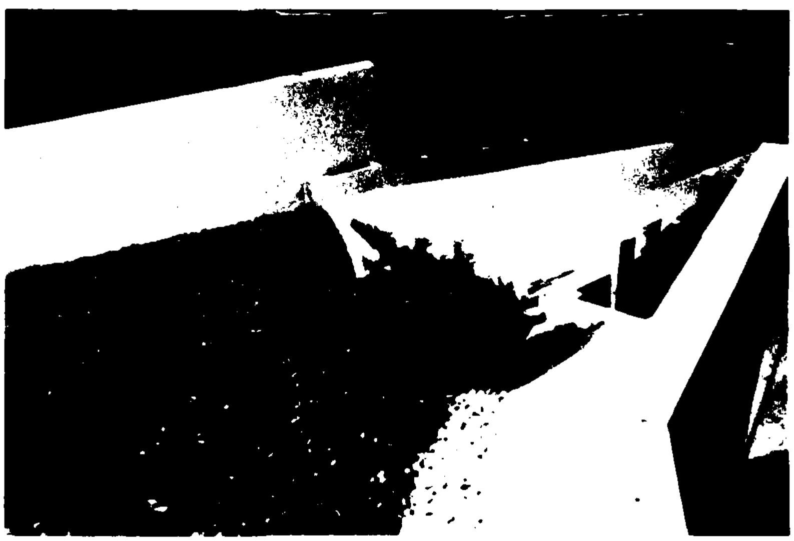
Photograph 24. Looking upstream at buildup in debris basin

Photograph 25. Upstream view of buildup at drop structure

Conclusion of 200-Year Thunderstorm Flood Hydrograph
16,000 Cubic Yards of Debris



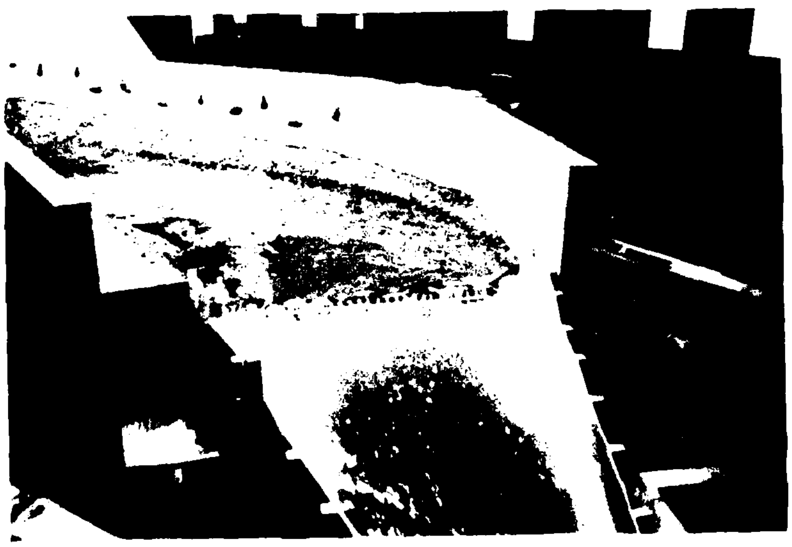
Photograph 26. Looking downstream at debris buildup on trash barrier



Photograph 27. View of debris buildup on trash barrier

Conclusion of 200-Year Thunderstorm Flood Hydrograph
16,000 Cubic Yards of Debris

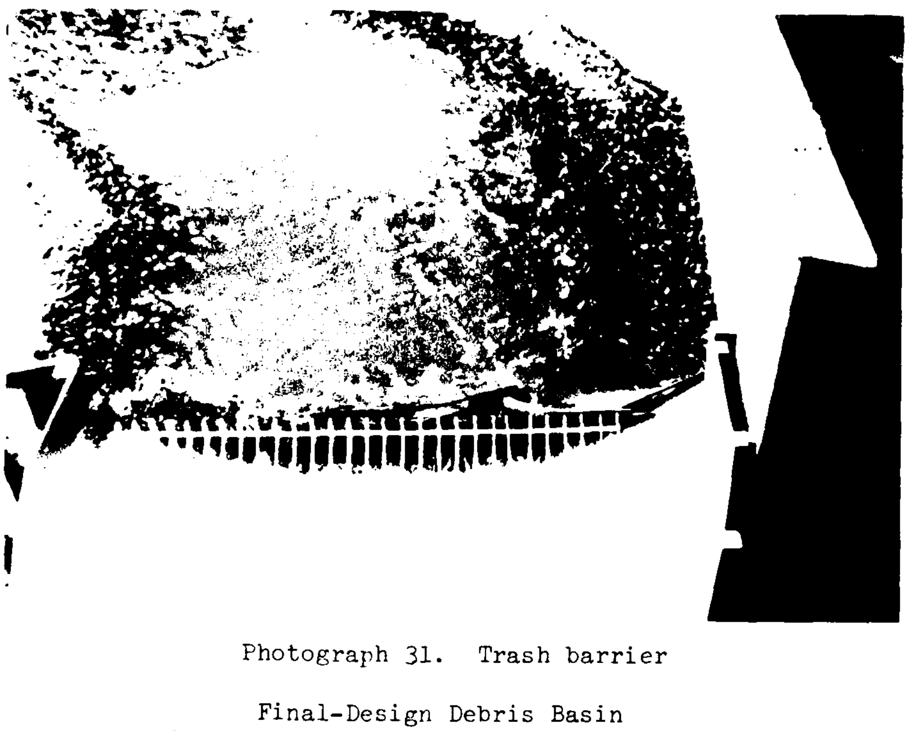
Photograph 28. Drop structure and debris basin



Photograph 29. Trash barrier

Final-Design Debris Basin
200-Year Winter Rainflood Hydrograph
1st Hour; Discharge 750 cfs

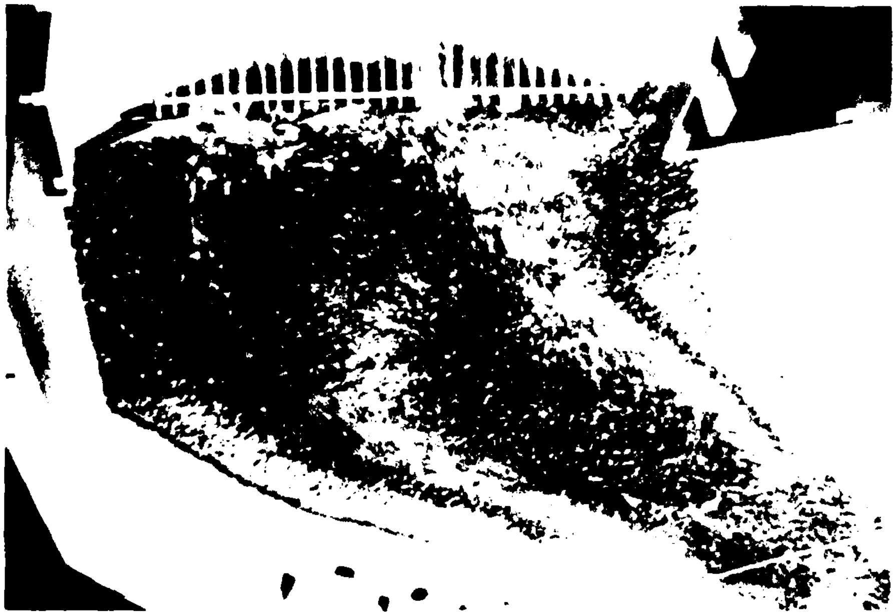
Photograph 30. Drop structure and debris basin



Photograph 31. Trash barrier

Final-Design Debris Basin
200-Year Winter Rainflood Hydrograph
4th Hour; Discharge 2,950 cfs

Photograph 32. Drop structure and debris basin



Photograph 33. Trash barrier

Final-Design Debris Basin
200-Year Winter Rainflood Hydrograph
12th Hour; Discharge 1,335 cfs

Photograph 34. Debris basin upstream from trash barrier

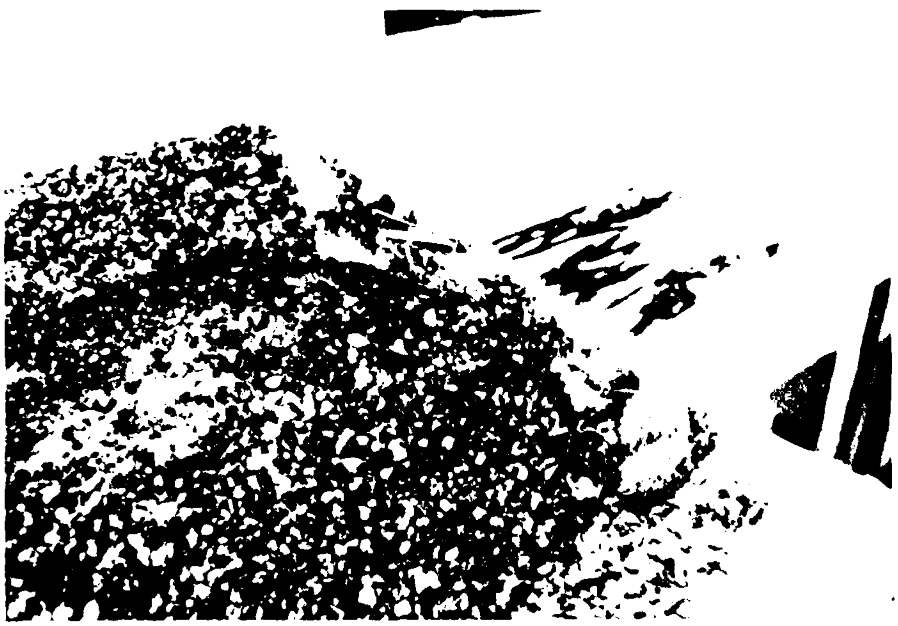
Photograph 35. View of trash barrier buildup

Final-Design Debris Basin
200-Year Winter Rainflood Hydrograph
23rd Hour; Discharge 850 cfs

Photograph 36. Looking upstream at drop structure (buried) and upper limit of bed material deposition

Photograph 37. Looking downstream at debris basin

Conclusion of 200-Year Winter Rainflood Hydrograph

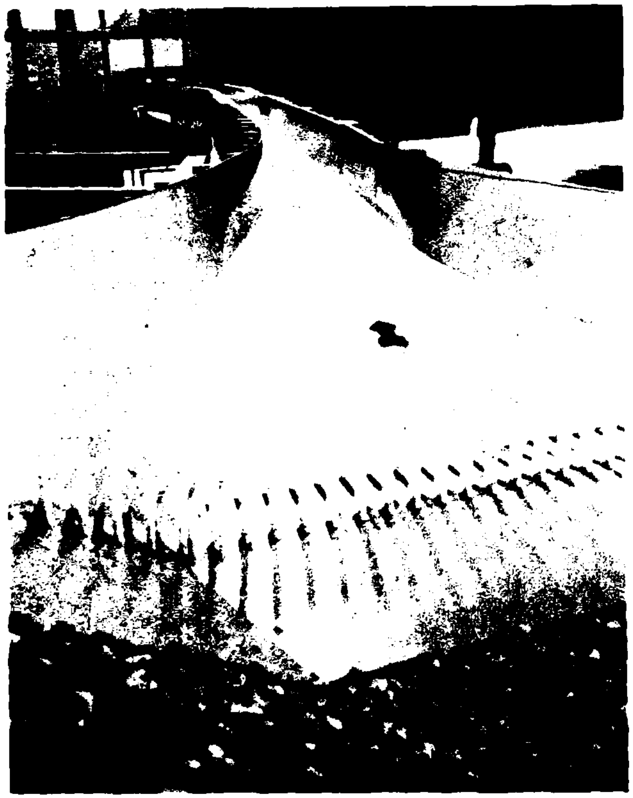


Photograph 38. Buildup on trash barrier

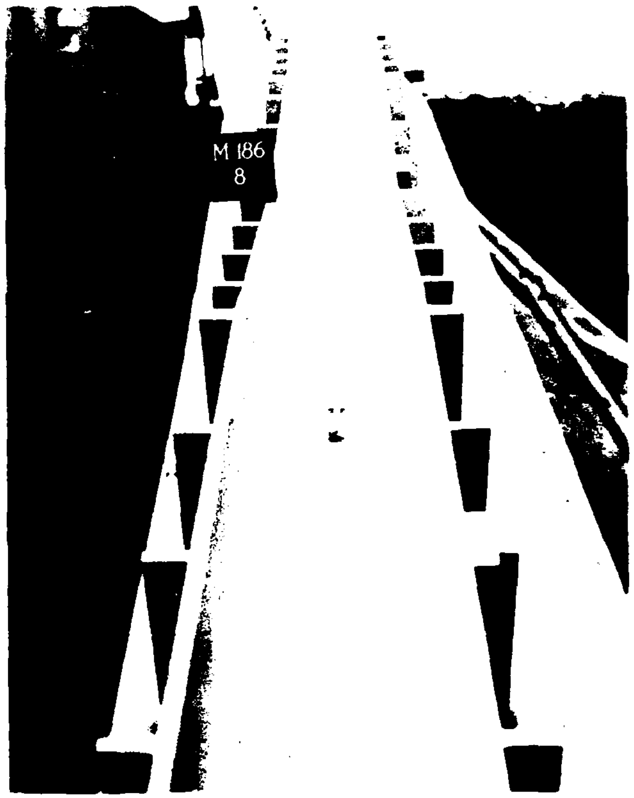
Conclusion of 200-Year Winter Rainflood Hydrograph

Photograph 39. Overall view of upstream section of model with original-design debris basin

Photograph 40. Overall view of downstream section of model

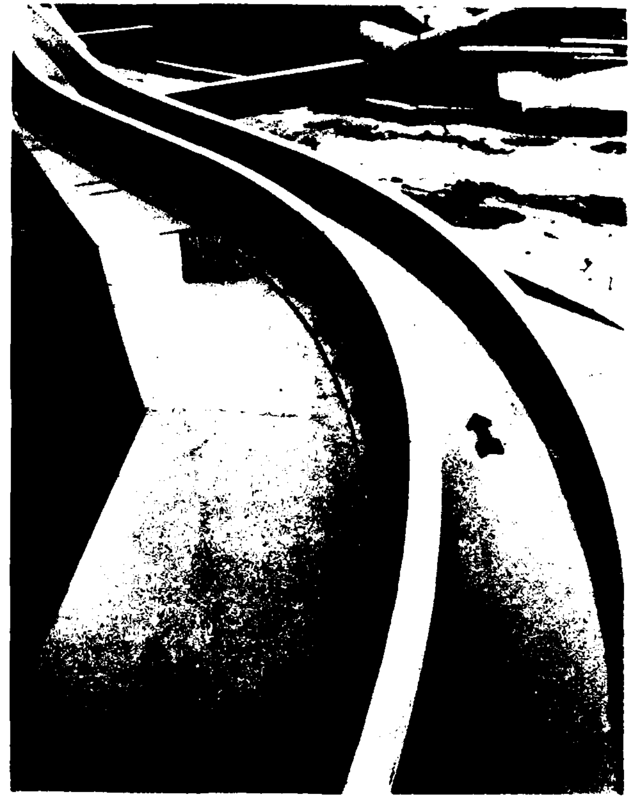


Photograph 41. Transition to V-bottom channel; Station 39+00 to 41+00



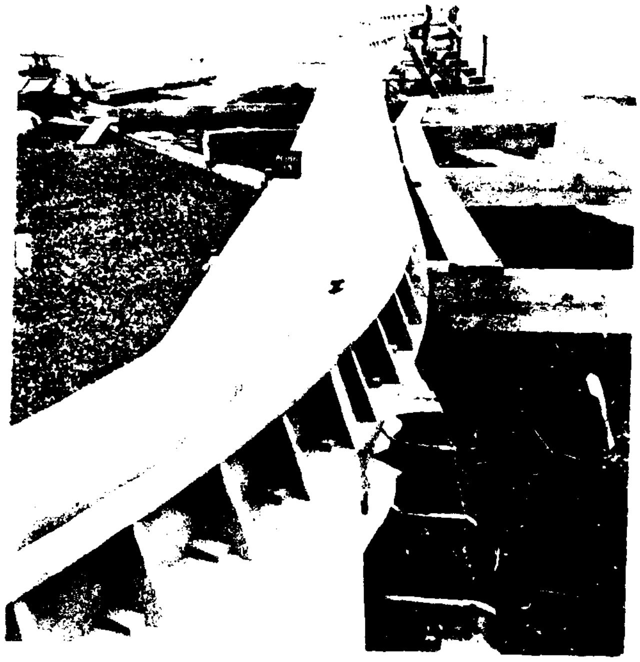
Photograph 42. Transition from 20-foot-wide to 17-foot-wide channel; Station 36+16 to 36+55

Photograph 43. Section of V-bottom channel downstream from Curve No. 12 near Station 33+00



Photograph 44. Typical superelevation at curves

Photograph 45. Looking upstream from Curve No. 3 (Station 15+00) at standing waves created by Curves No. 4 and 5; discharge 4,600 cfs



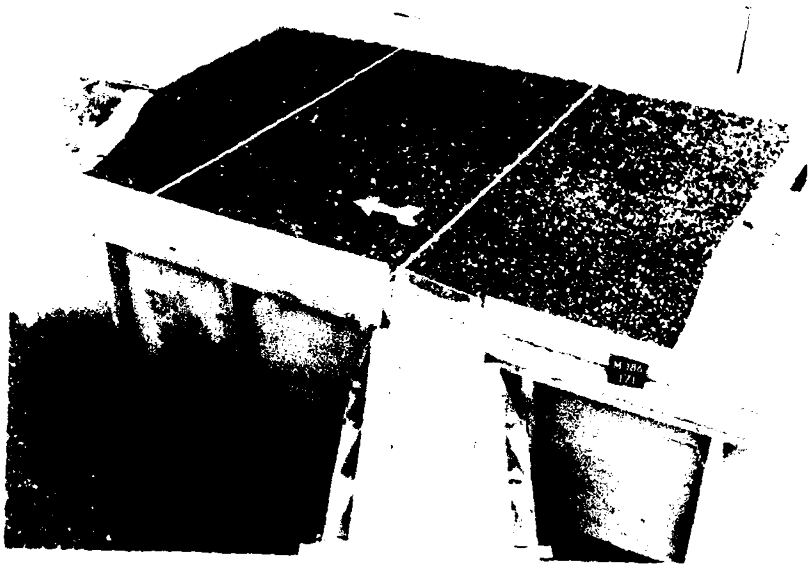
Photograph 46. Dry bed

Photograph 47. Discharge 4,600 cfs

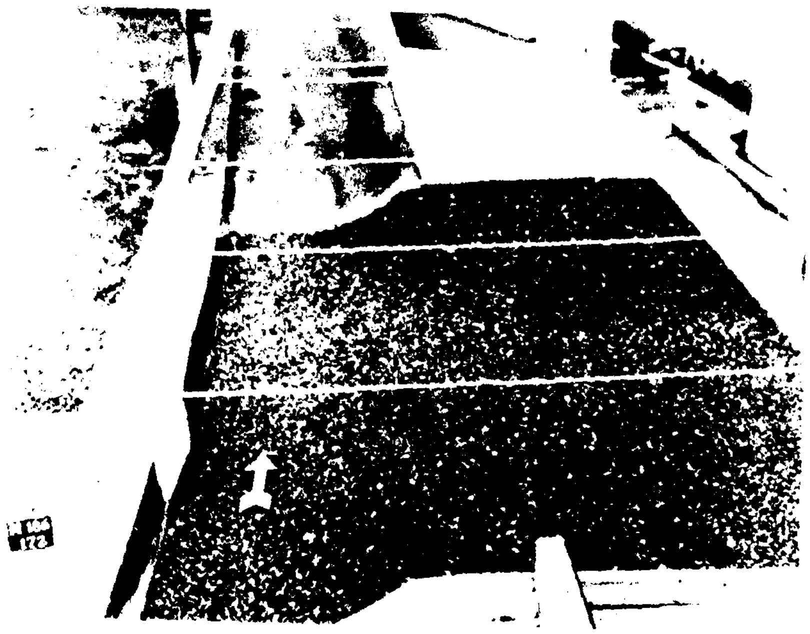
Looking Upstream From Curve No. 3
After Removal of Curves No. 4 and 5

Photograph 48. Looking downstream; discharge 4,600 cfs

Trash Barrier and Transition From
Sloping Banks to V-Bottom Channel

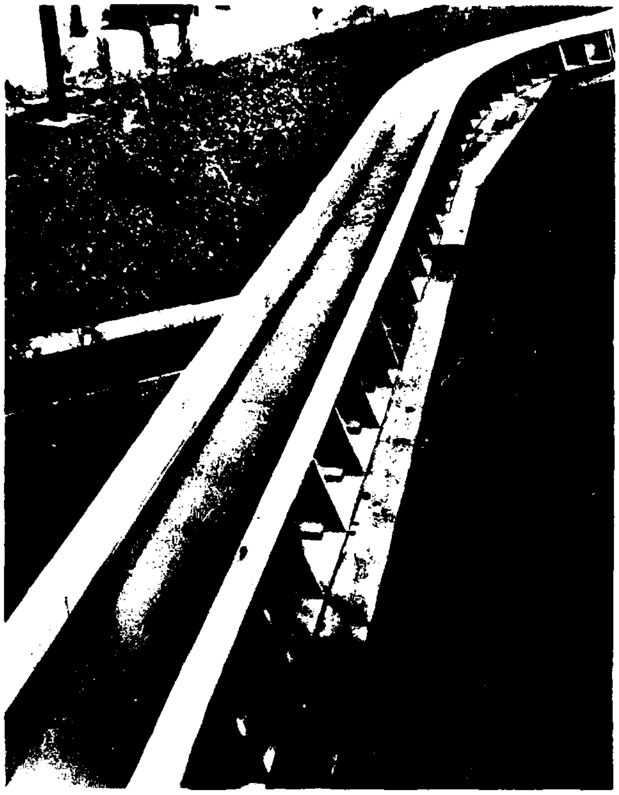


Photograph 49. View from Placer Creek

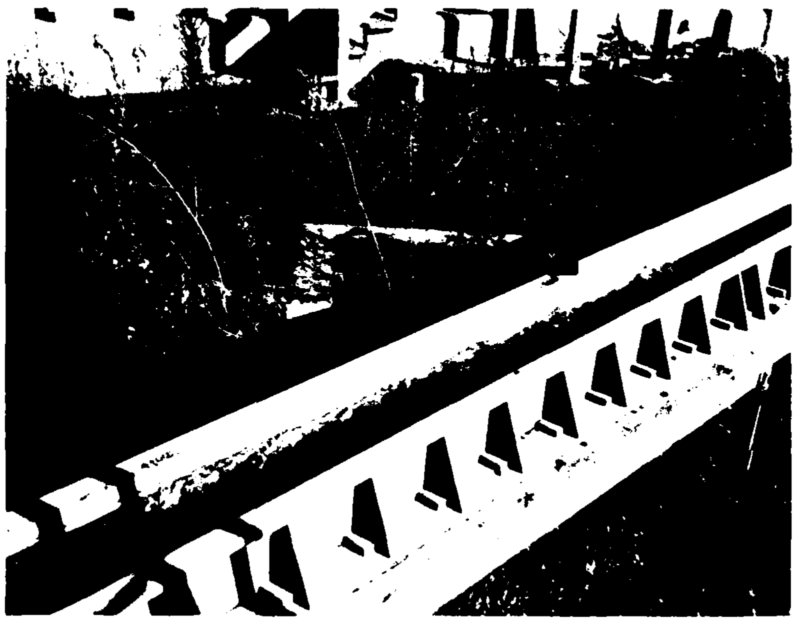


Photograph 50. View from South Fork Coeur d'Alene River

Movable-Bed Original Conditions
in South Fork Coeur d'Alene River

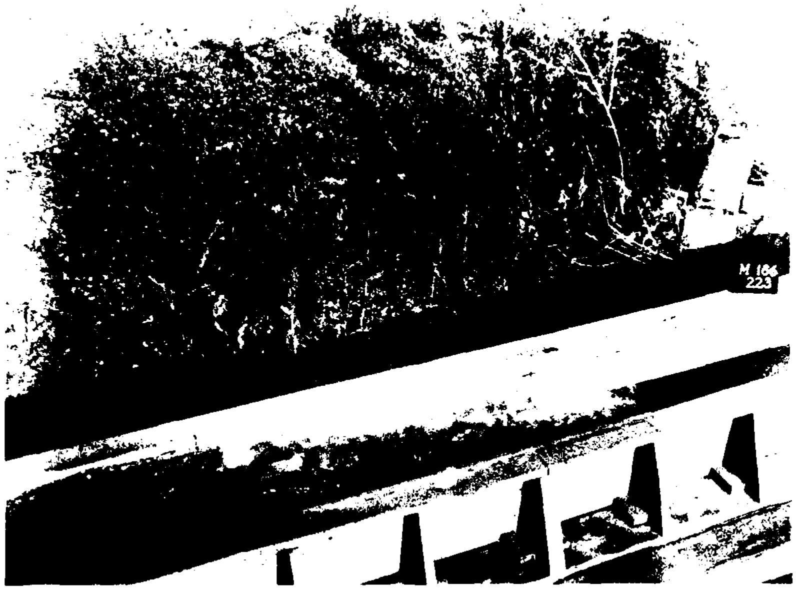


Photograph 51. Hydraulic jump at Station 7+00; Placer Creek discharge 565 cfs



Photograph 52. Hydraulic jump at Station 5+50; Placer Creek discharge 1,175 cfs

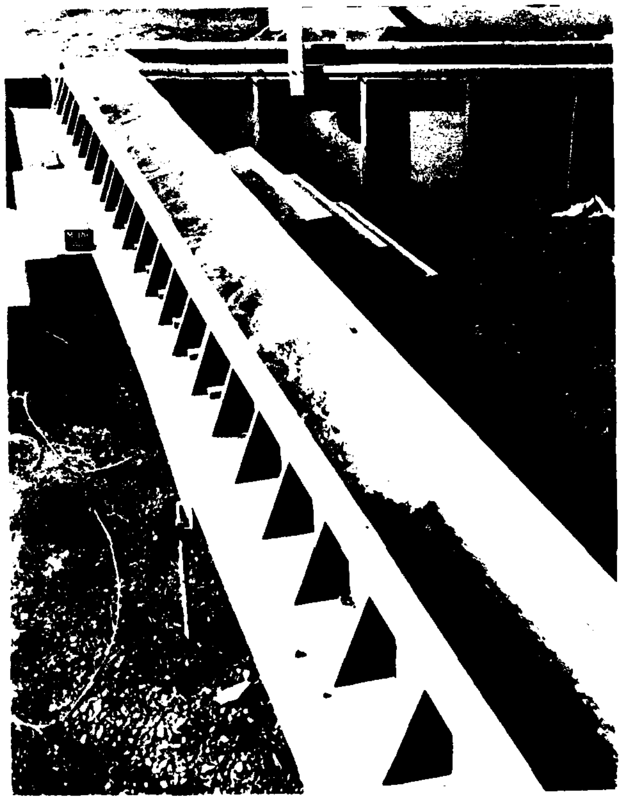
Winter Rainflood Hydrograph



Photograph 53. Hydraulic jump at Station 4+00;
Placer Creek discharge 2,000 cfs

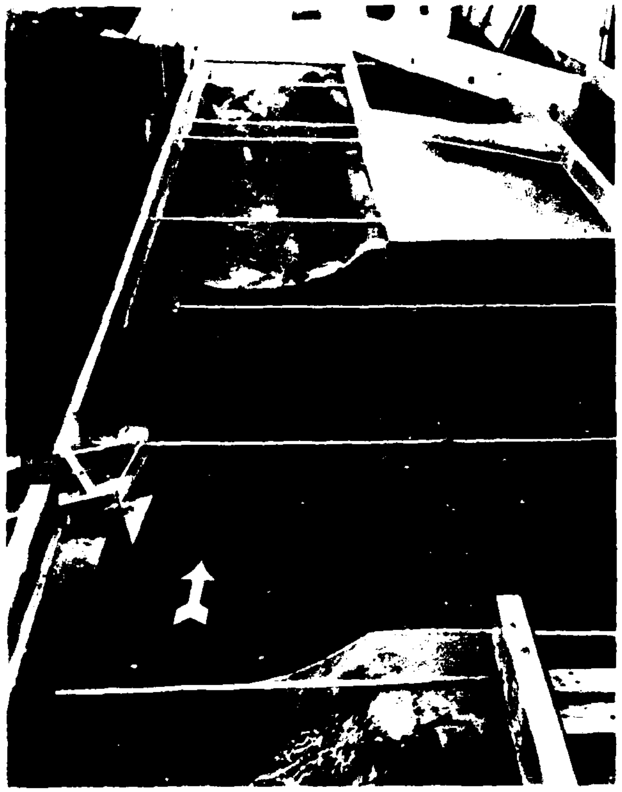
Photograph 54. Hydraulic jump at Station 2+50;
Placer Creek discharge 3,050 cfs

Winter Rainflood Hydrograph



Photograph 55. Hydraulic jump at Station 3+75;
Placer Creek discharge 2,000 cfs

Winter Rainflood Hydrograph

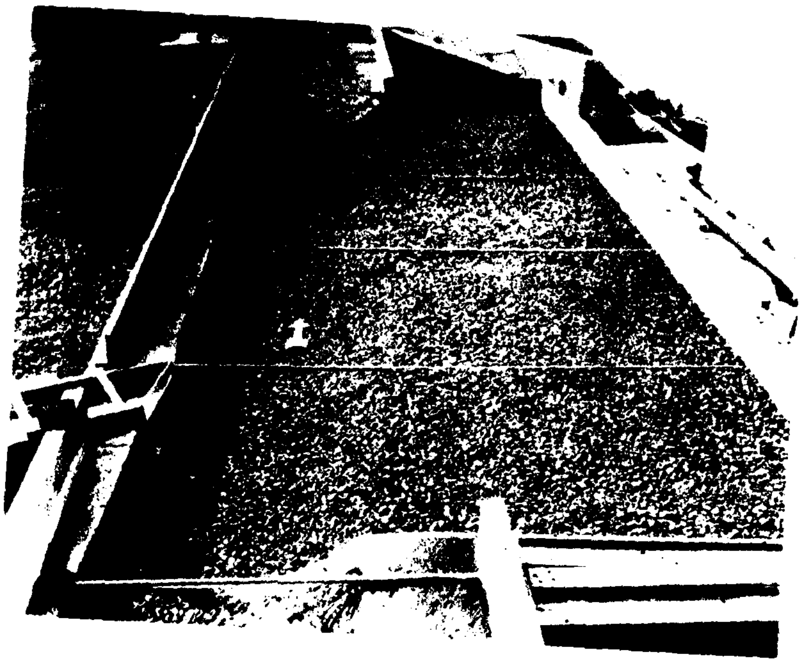


Photograph 56. View from South Fork Coeur d'Alene River looking downstream

Photograph 57. View from South Fork Coeur d'Alene River looking upstream

Winter Rainflood Hydrograph
Eroded Condition at End of Flood

Photograph 58. View from Placer Creek



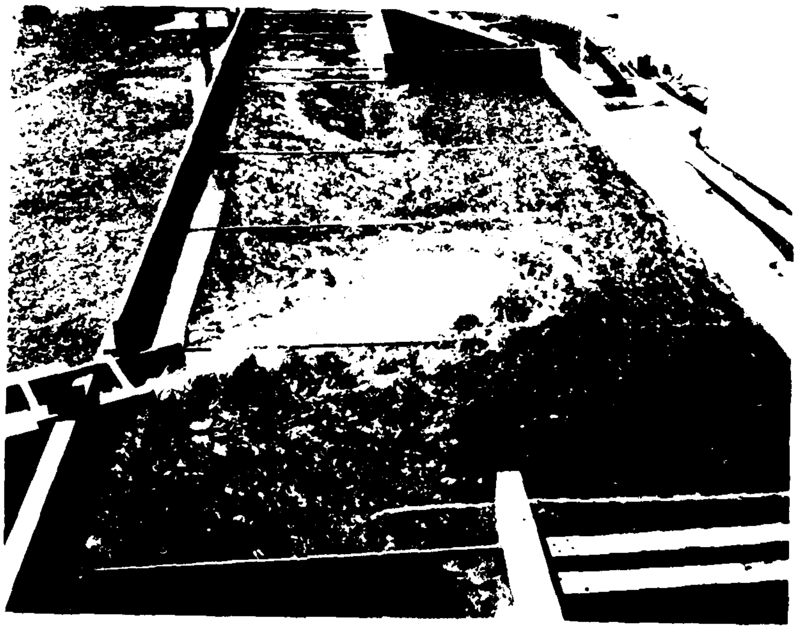
Photograph 59. View from South Fork Coeur d'Alene River

Movable-Bed Original Conditions
in South Fork Coeur d'Alene River

Photograph 60. View from South Fork Coeur d'Alene River

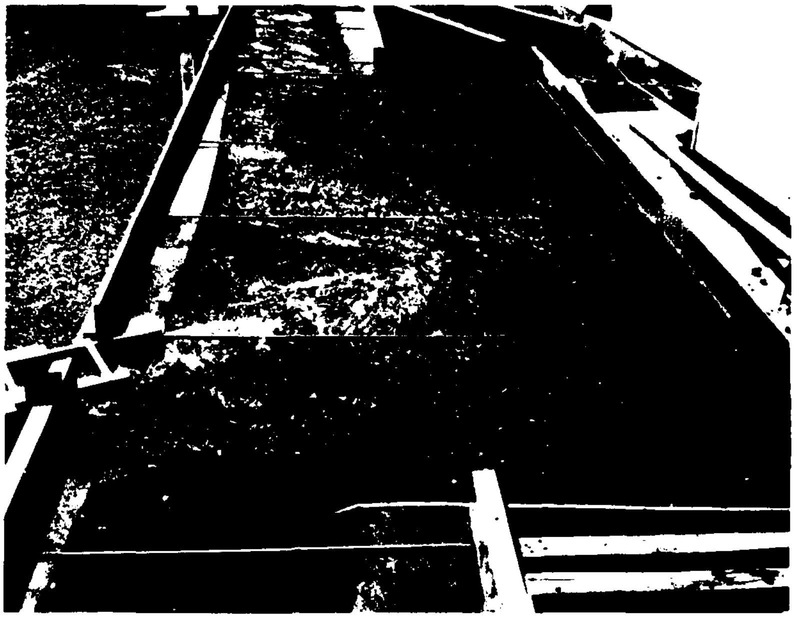
Thunderstorm Flood Hydrograph
Placer Creek Discharge 500 cfs
South Fork Coeur d'Alene River Discharge 400 cfs

Photograph 61. View from Placer Creek

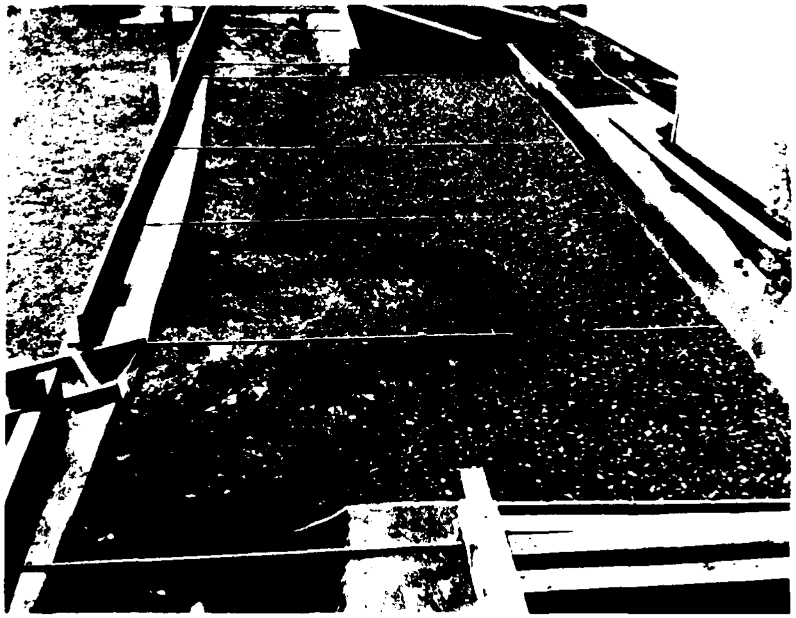


Photograph 62. View from South Fork Coeur d'Alene River

Thunderstorm Flood Hydrograph
Placer Creek Discharge 4,600 cfs
South Fork Coeur d'Alene River Discharge 400 cfs



Photograph 63. Placer Creek discharge 2,500 cfs

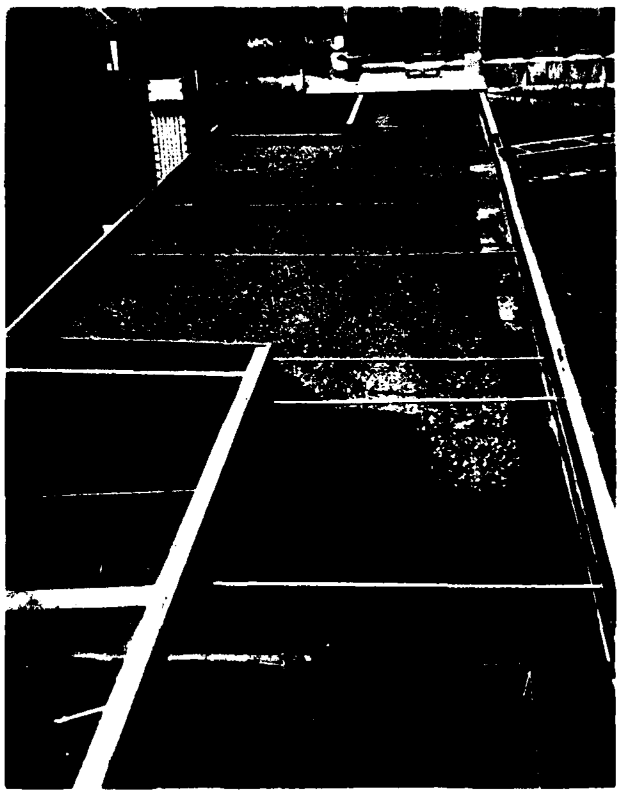


Photograph 64. Placer Creek discharge 1,000 cfs

Views From South Fork Coeur d'Alene River

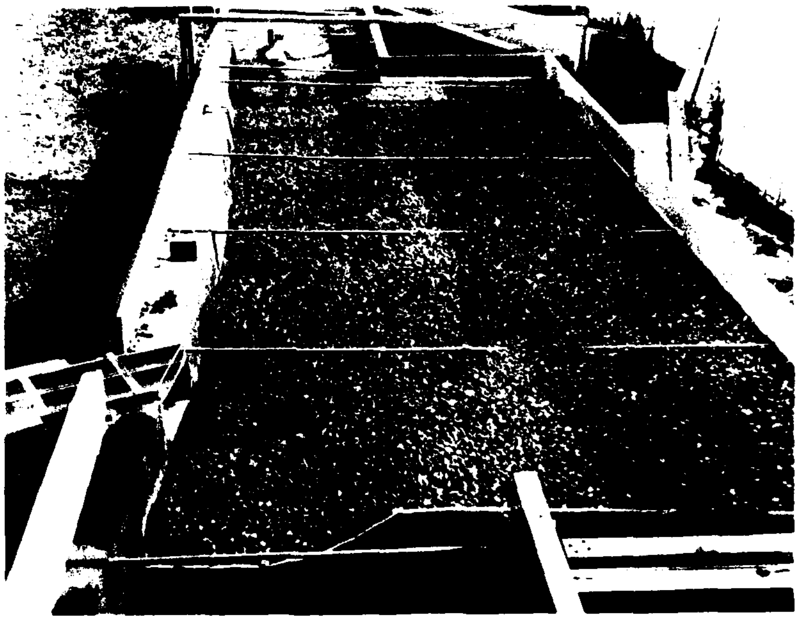
Thunderstorm Flood Hydrograph
South Fork Coeur d'Alene River Discharge 400 cfs

Photograph 65. View from upstream



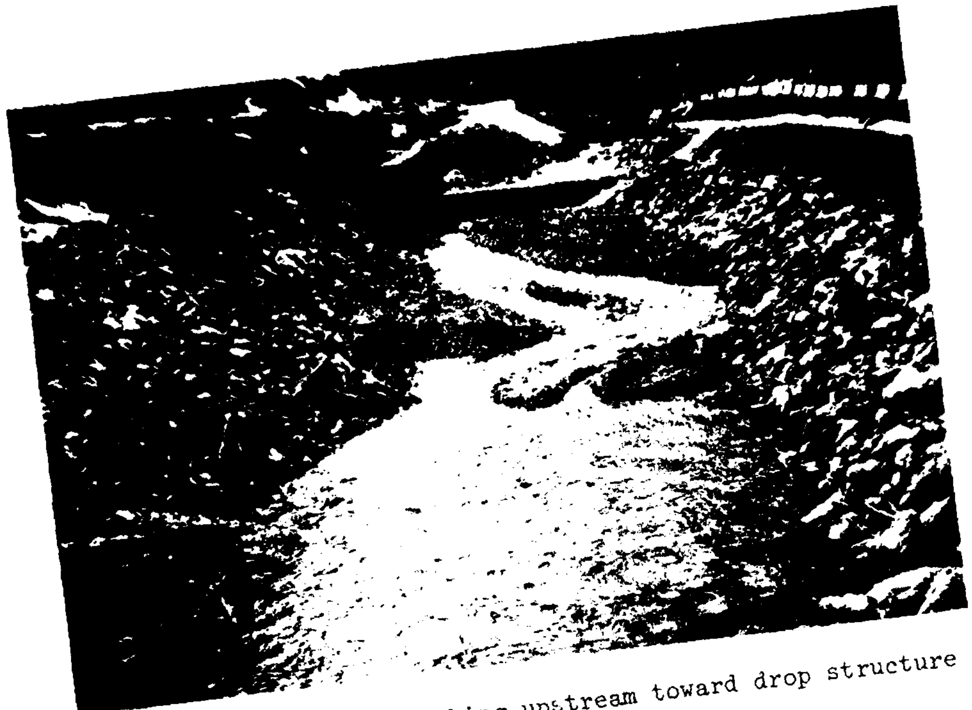
Photograph 66. View from downstream

Thunderstorm Flood Hydrograph
Eroded Condition at End of Flood

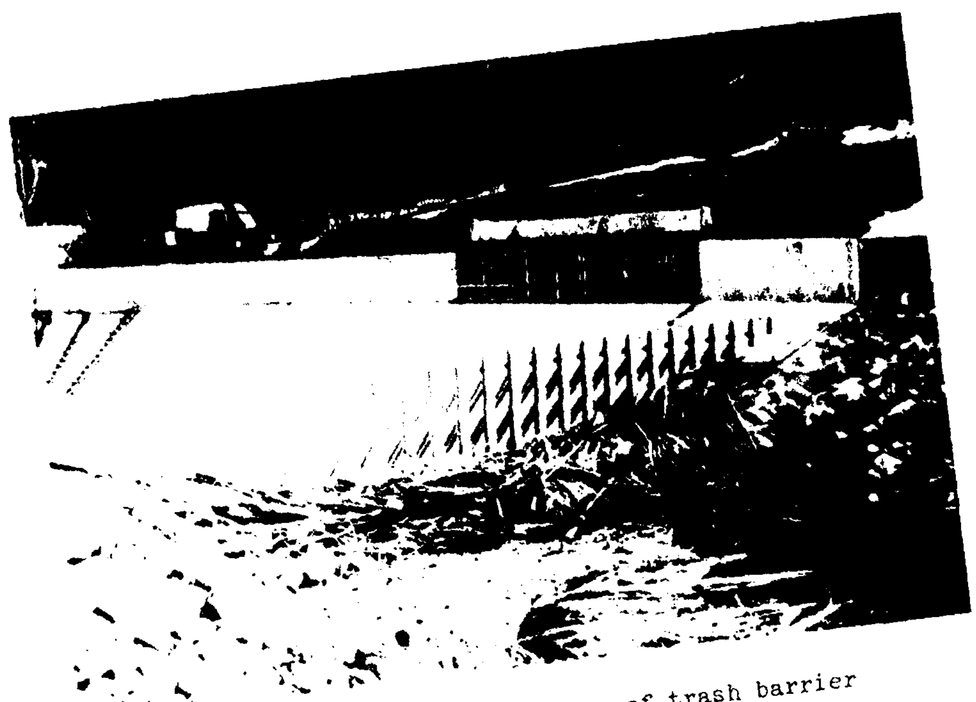


Photograph 67. Movable-bed section of South Fork Coeur d'Alene River

Eroded Condition at End of Winter Rainflood Hydrograph Following a Thunderstorm Flood Hydrograph

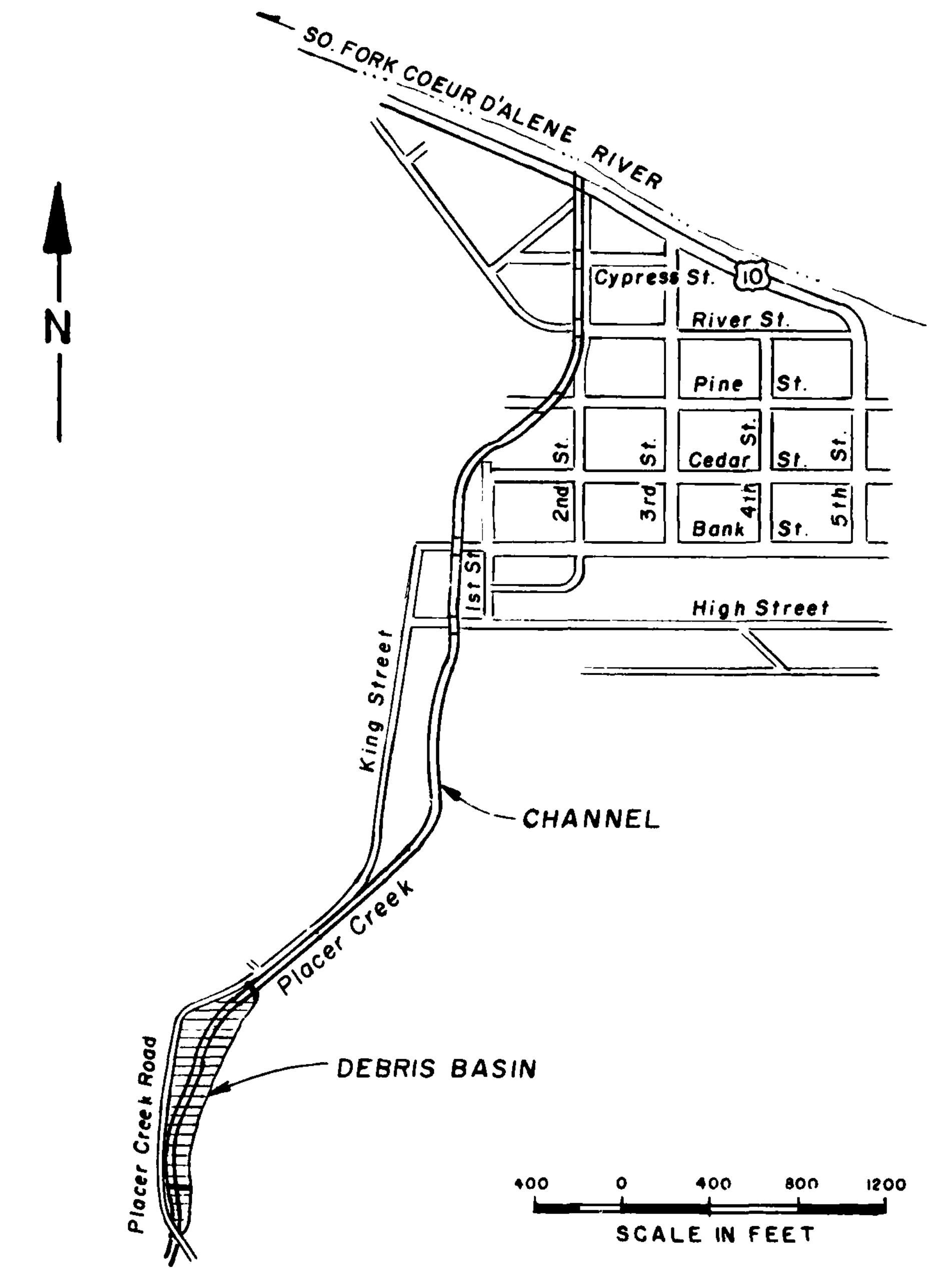


Photograph 68. View looking upstream toward drop structure



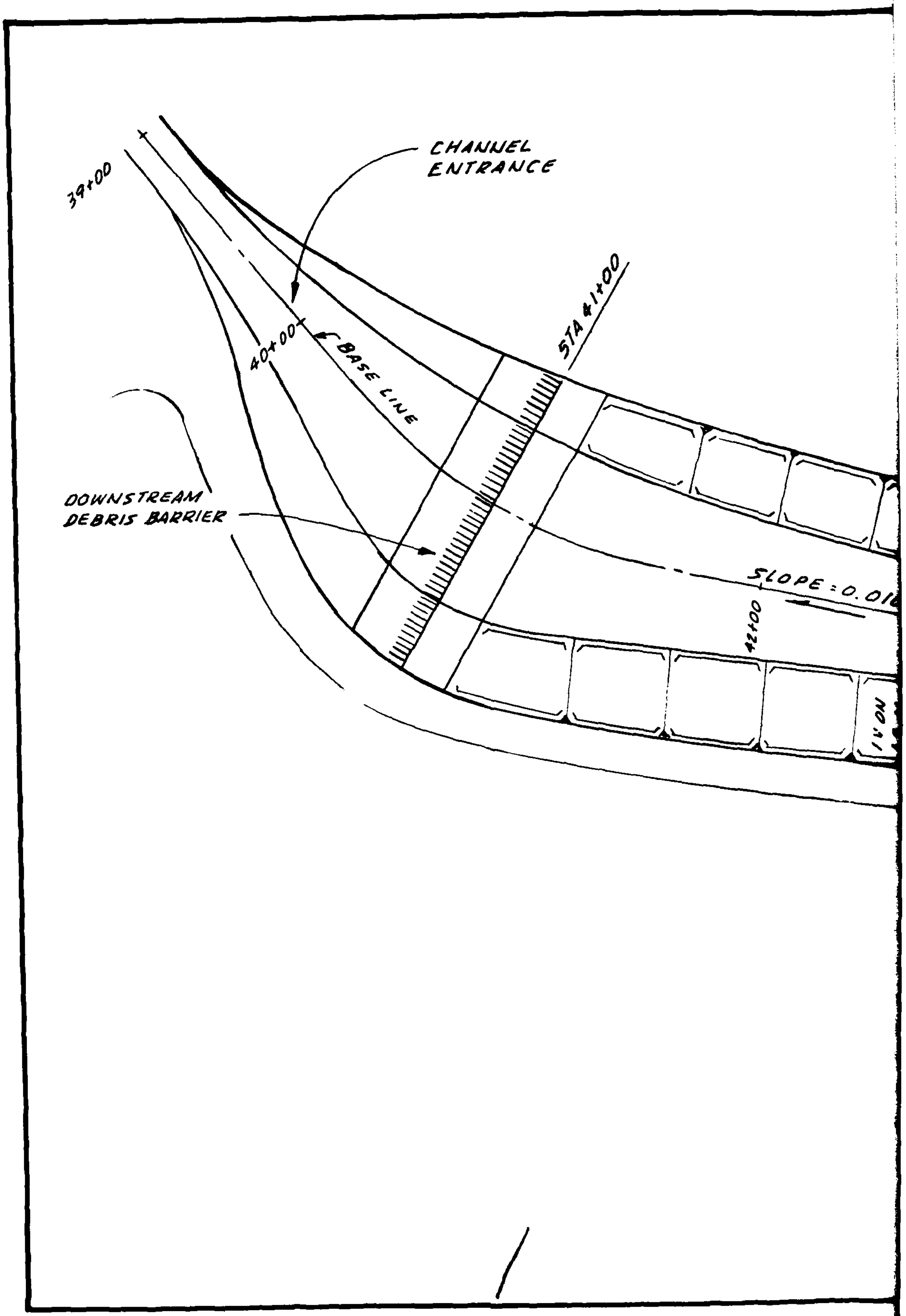
Photograph 69. Upstream face of trash barrier

Prototype Debris Basin Following February 1982 Flood

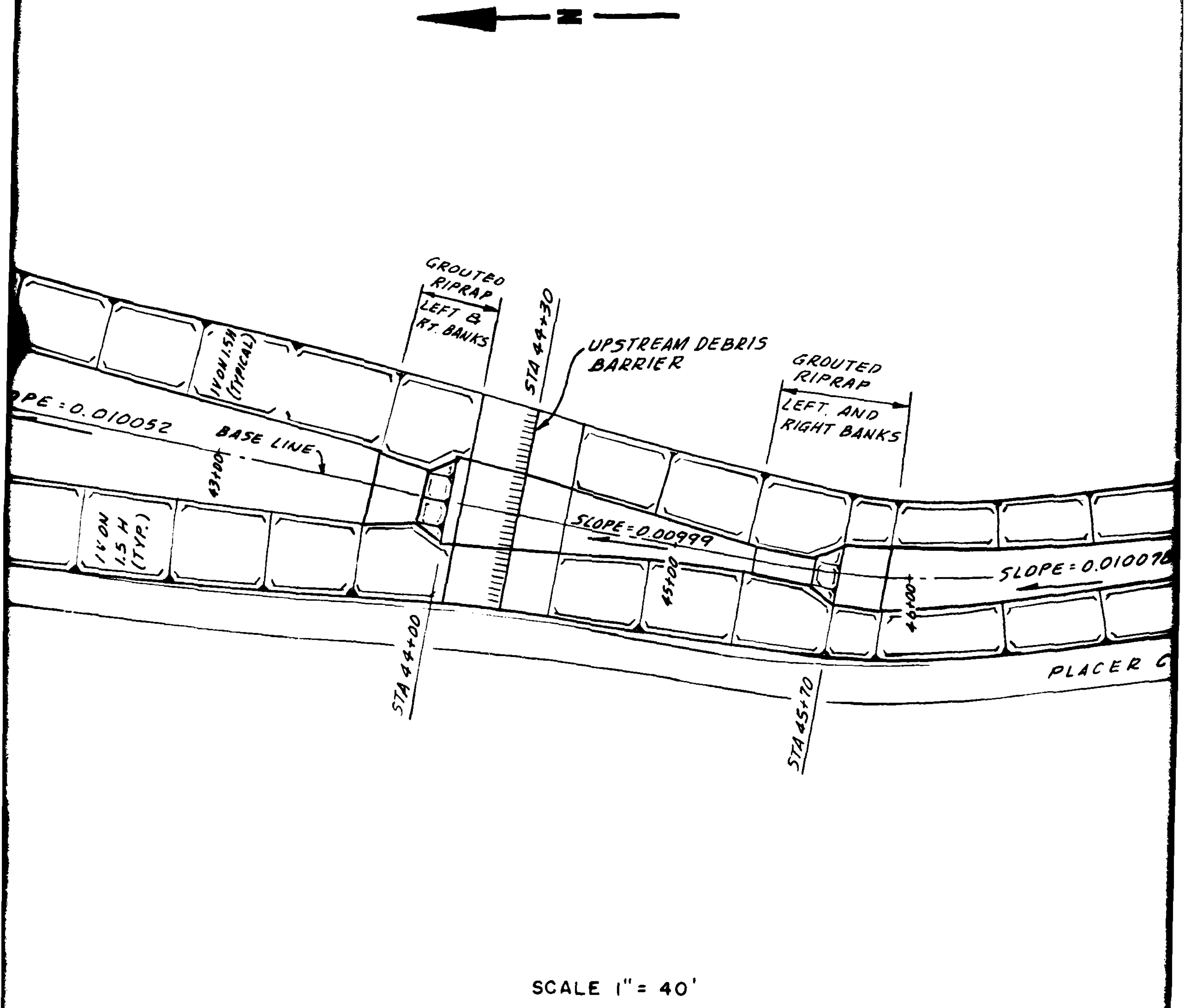


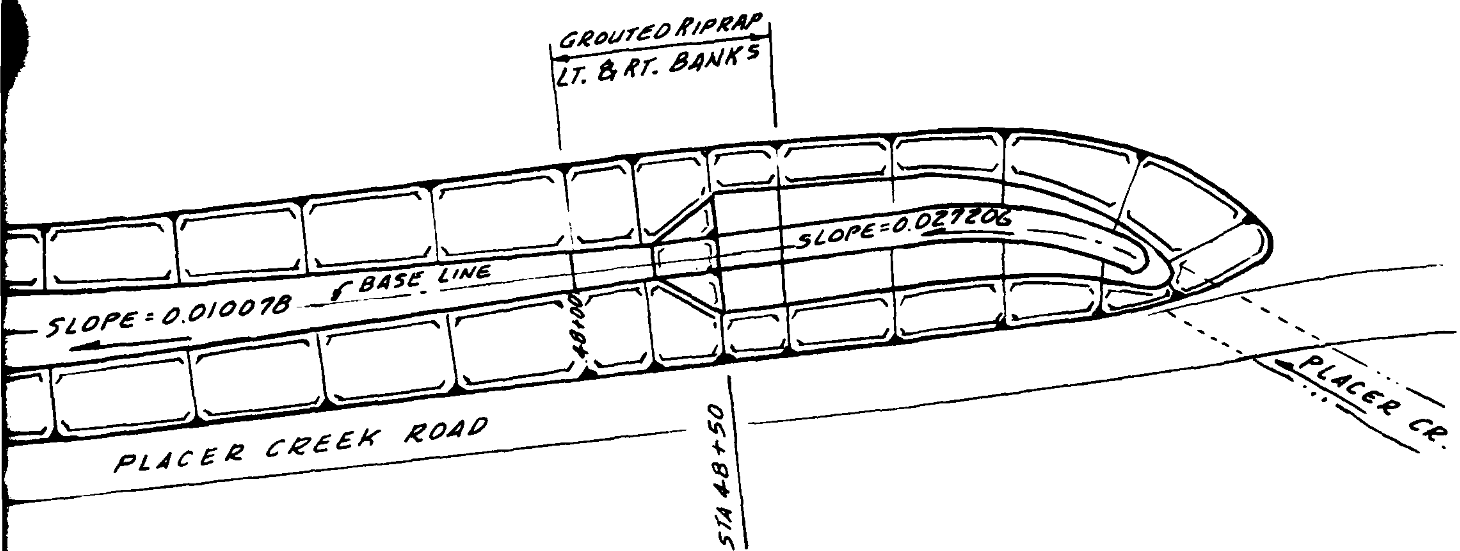
PROJECT PLAN

PLATE I

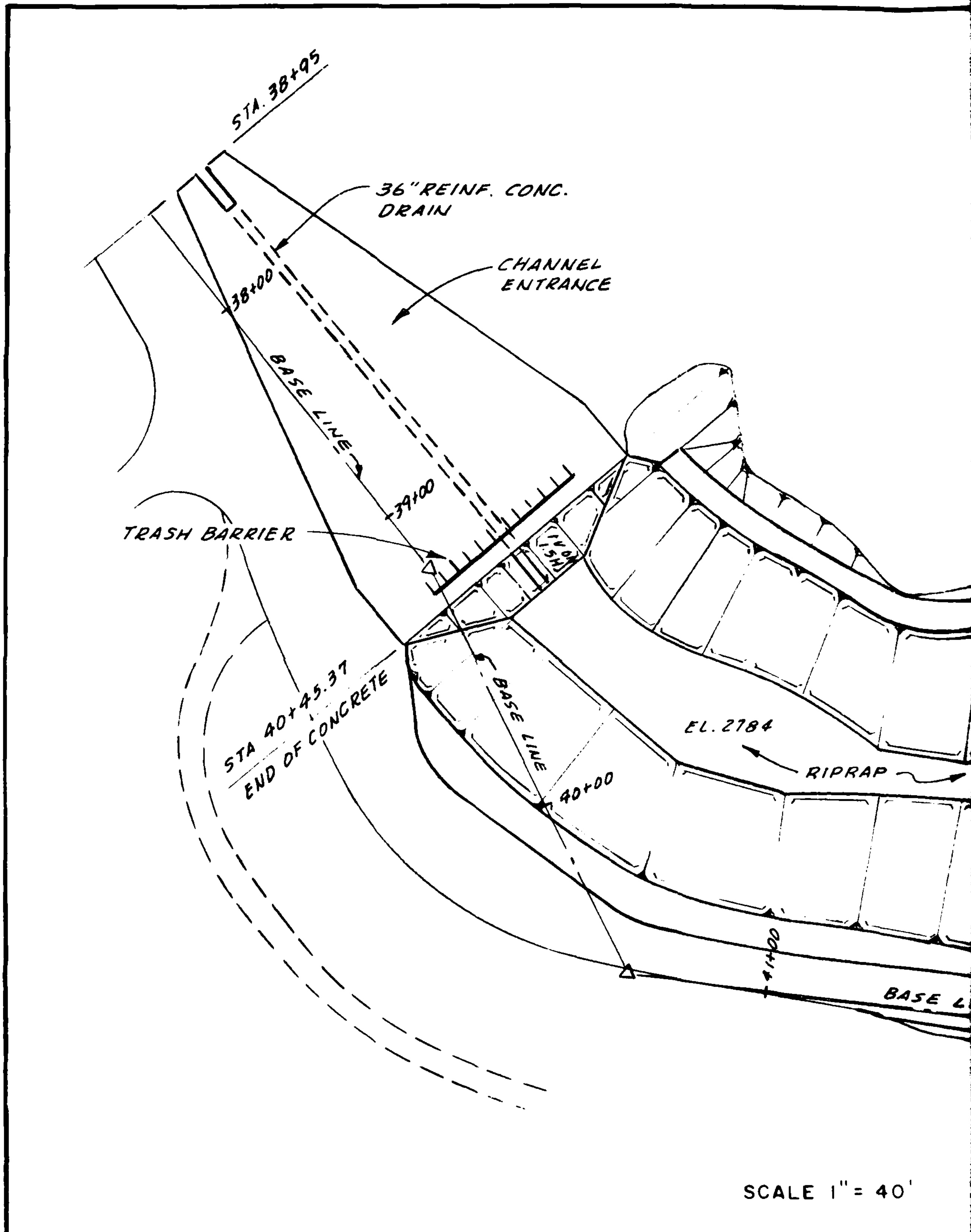


CHANNEL
ENTRANCE
39+00
40+00
BASE LINE
STA 41+00
DOWNSTREAM
DEBRIS BARRIER
SLOPE = 0.01
42+00


N
GROUTED RIPRAP
LEFT & RT. BANKS
STA 44+30
UPSTREAM DEBRIS BARRIER
GROUTED RIPRAP
LEFT. AND RIGHT BANKS
1V ON 1.5H (TYPICAL)
PE = 0.010052
BASE LINE
43+00
1V ON 1.5 H (TYP.)
SLOPE = 0.00999
45+00
SLOPE = 0.01007
46+00
STA 44+00
STA 45+70
PLACER C
SCALE 1" = 40'

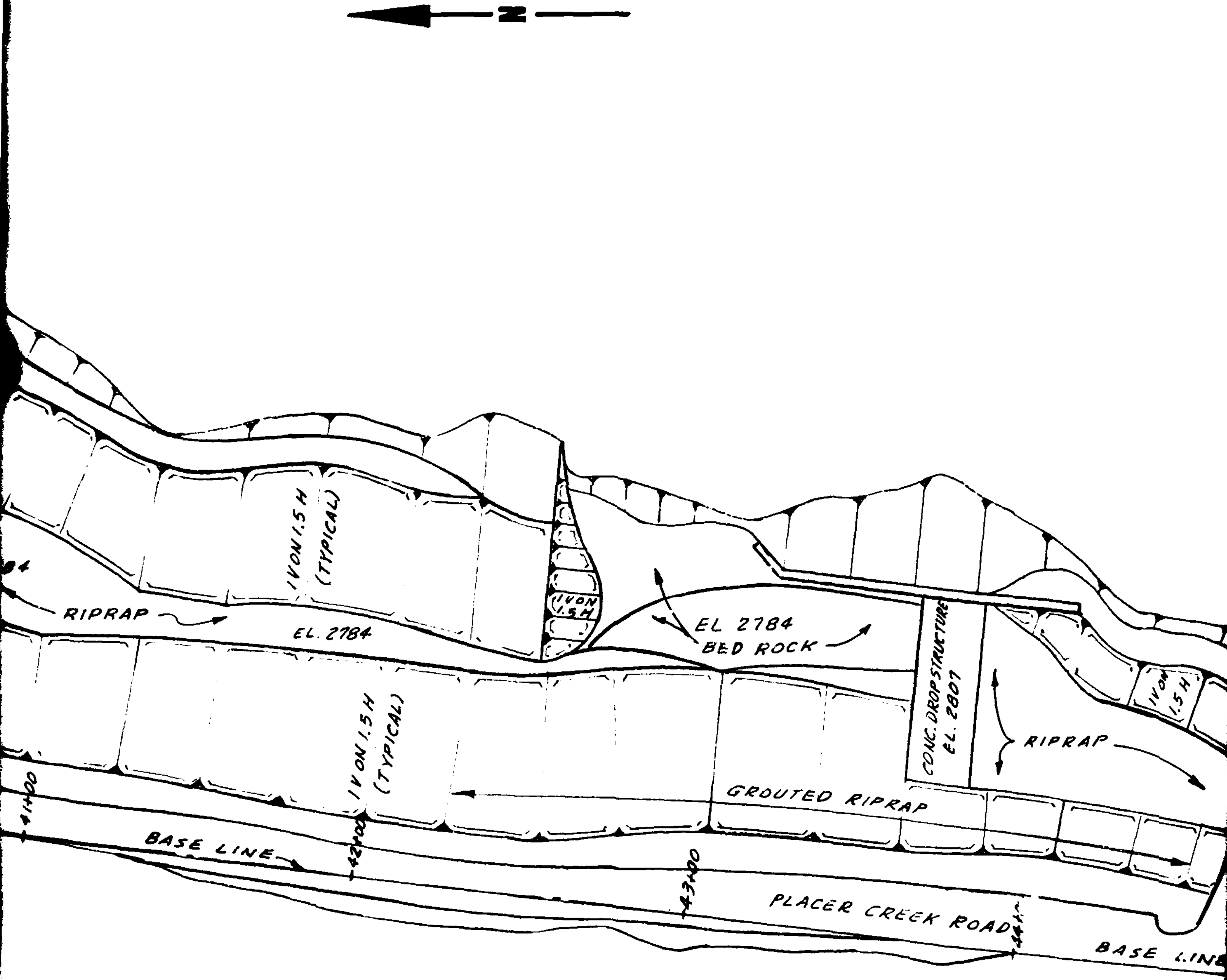


PLAN
DEBRIS BASIN
ORIGINAL DESIGN



STA. 38+95
36" REINF. CONC. DRAIN
CHANNEL ENTRANCE
38+00
BASE LINE
39+00
TRASH BARRIER
STA 40+45.37
END OF CONCRETE
BASE LINE
40+00
EL. 2784
RIPRAP
41+00
BASE LINE
SCALE 1" = 40'

1

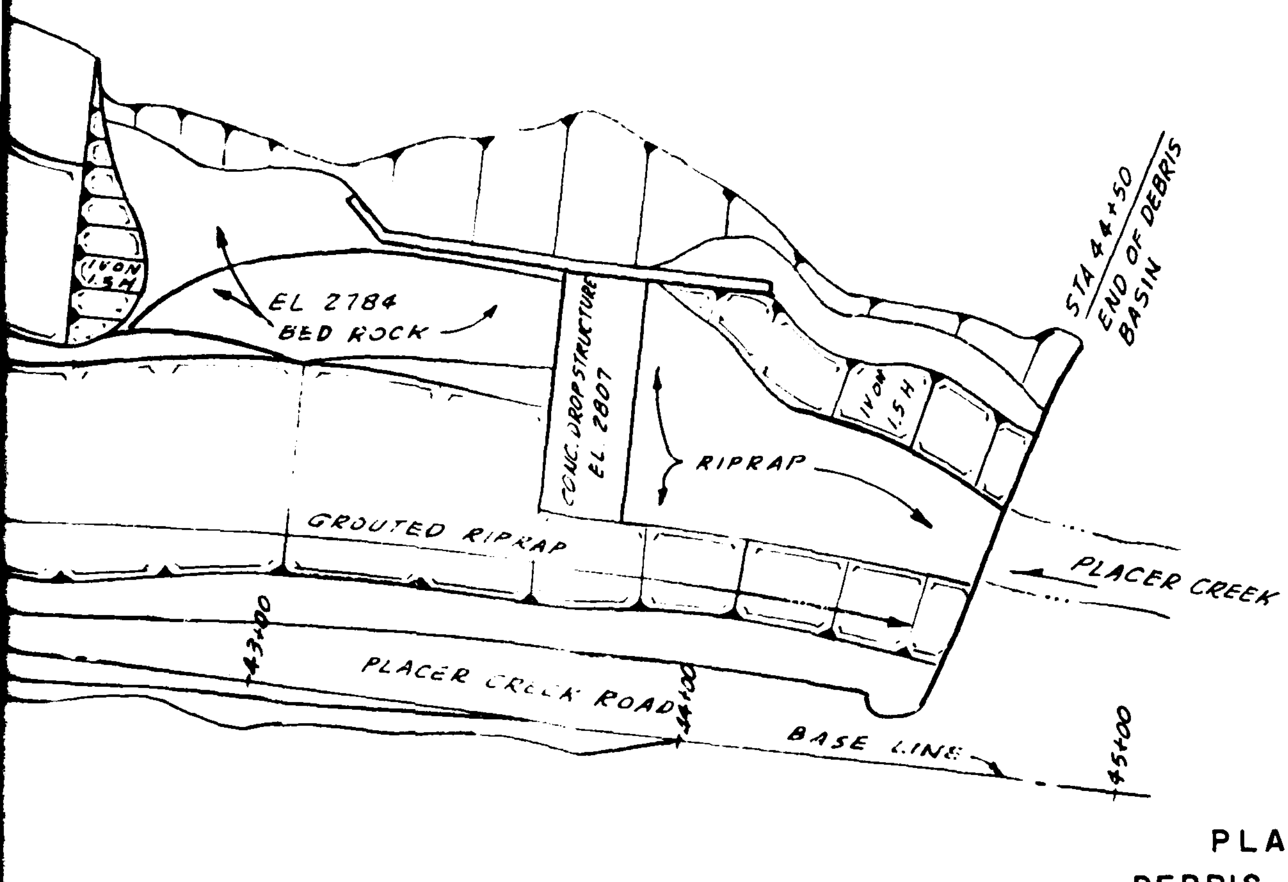


N
1 V ON 1.5 H (TYPICAL)
RIPRAP
EL. 2784
1 V ON 1.5 H
EL 2784 BED ROCK
CONC. DROP STRUCTURE EL. 2807
1 V ON 1.5 H
RIPRAP
GROUTED RIPRAP
1 V ON 1.5 H (TYPICAL)
41+00
42+00
43+00
BASE LINE
PLACER CREEK ROAD
BASE LINE

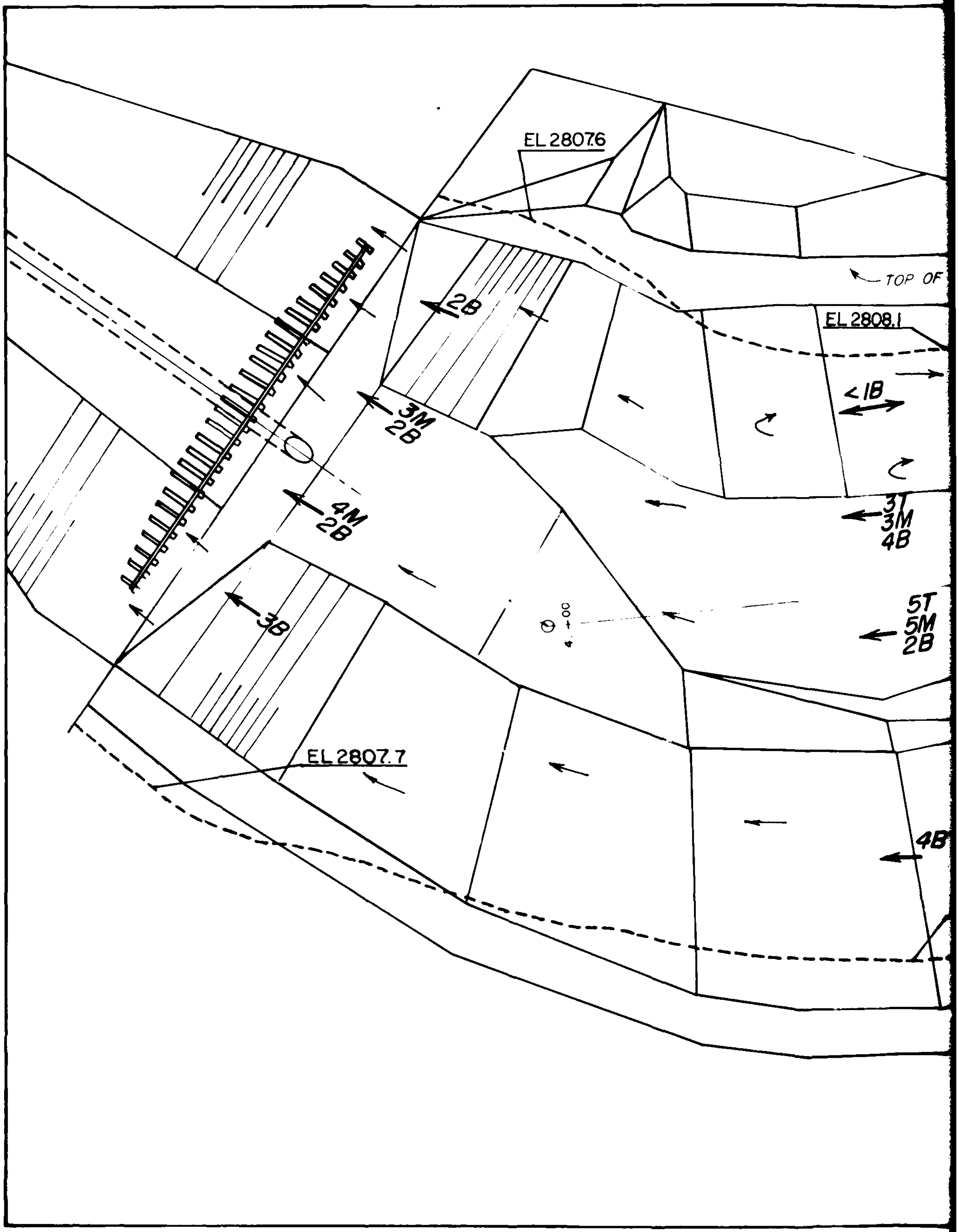
SCALE 1" = 40'

1

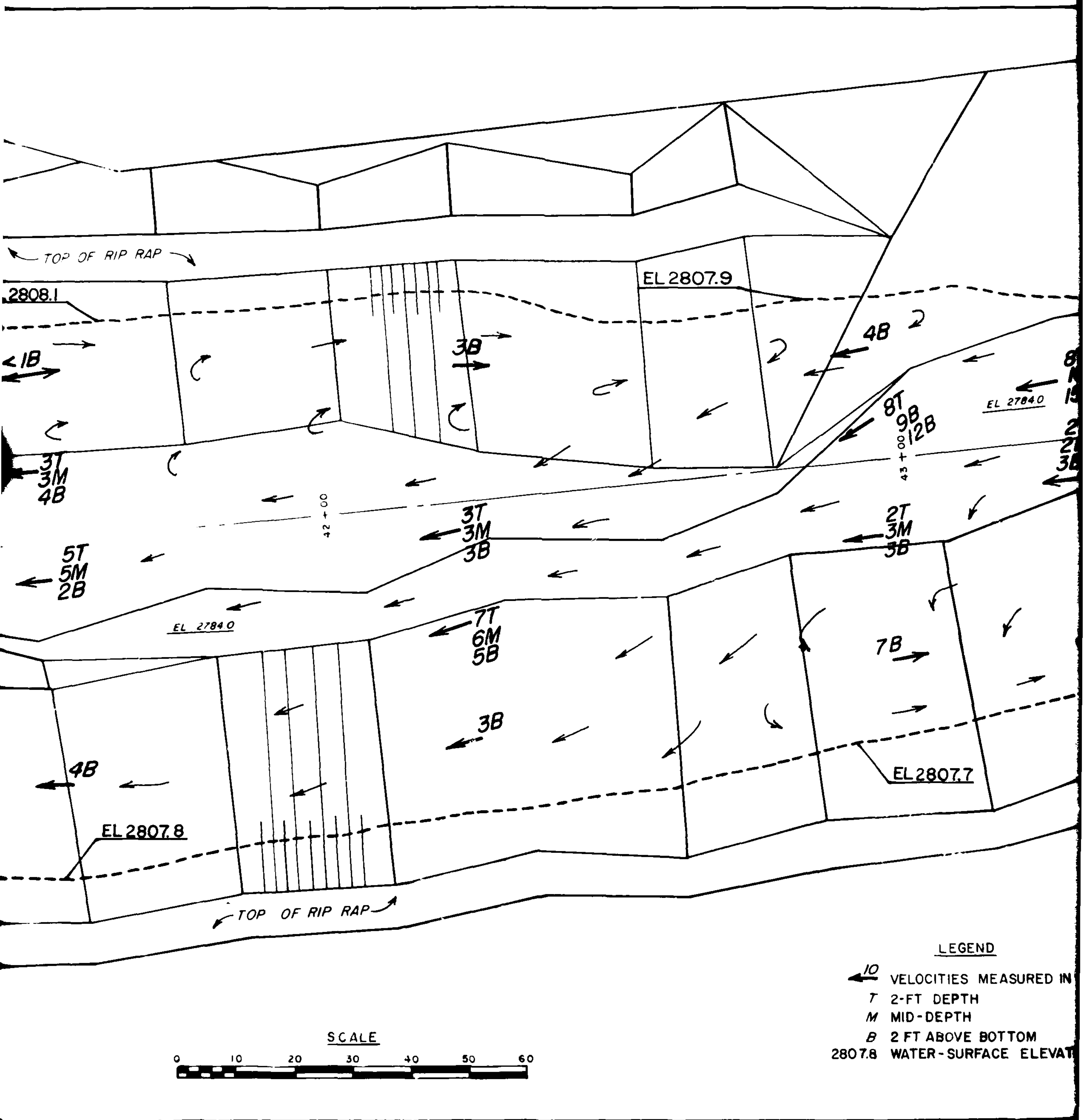
2



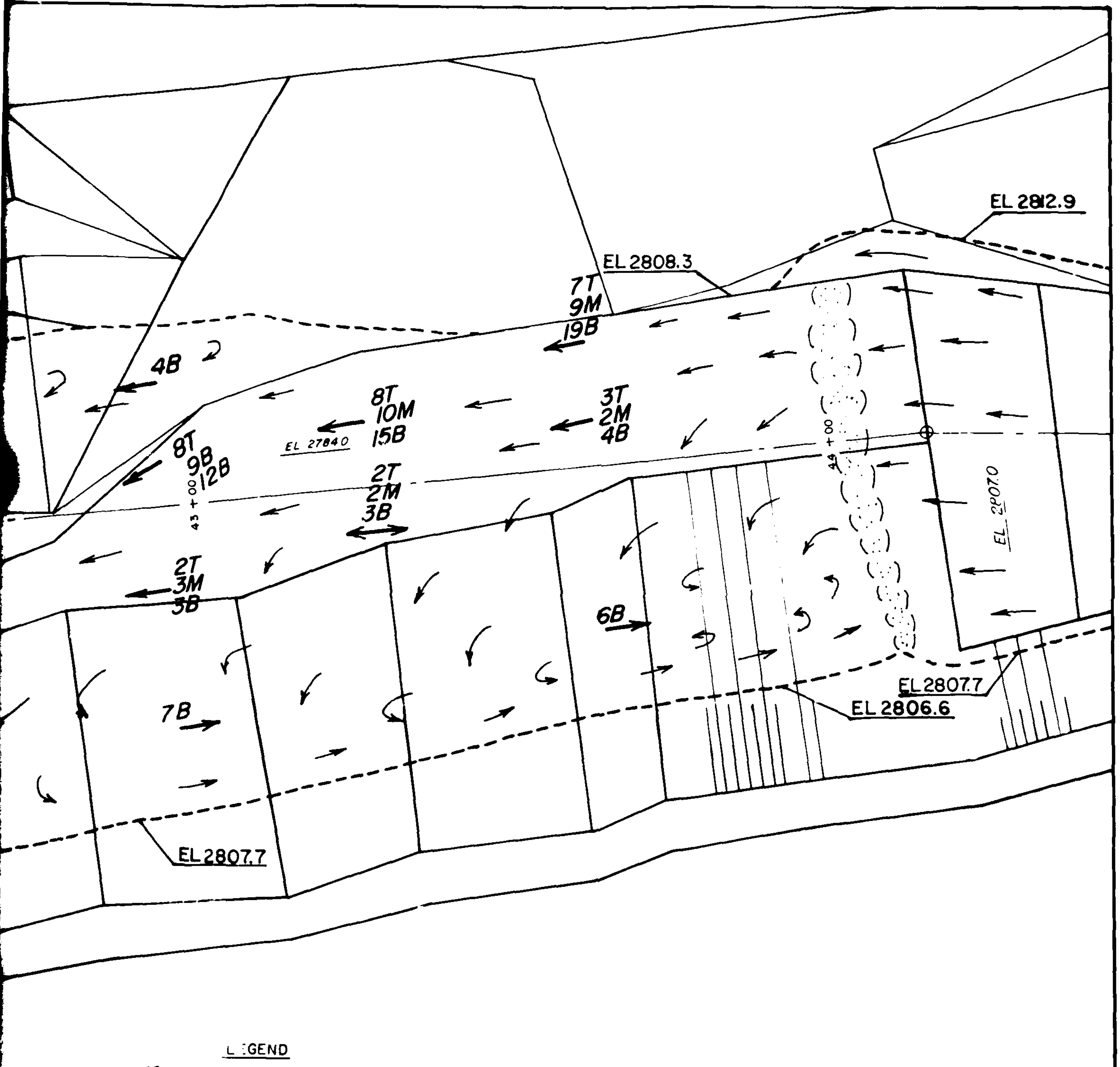
PLAN
DEBRIS BASIN
FINAL DESIGN



EL 2807.6
TOP OF
EL 2808.1
2B
3M
2B
4M
2B
<1B
3T
3M
4B
5T
5M
2B
3B
EL 2807.7
4B



TOP OF RIP RAP
2808.1
EL 2807.9
1B
3B
4B
3T
3M
4B
8T
9B
12B
43 + 00
EL 2784.0
42 + 00
5T
5M
2B
3T
3M
3B
2T
3M
3B
EL 2784.0
7T
6M
5B
7B
3B
4B
EL 2807.7
EL 2807.8
TOP OF RIP RAP
LEGEND
10 VELOCITIES MEASURED IN
T 2-FT DEPTH
M MID-DEPTH
B 2 FT ABOVE BOTTOM
2807.8 WATER-SURFACE ELEVAT
SCALE
0 10 20 30 40 50 60



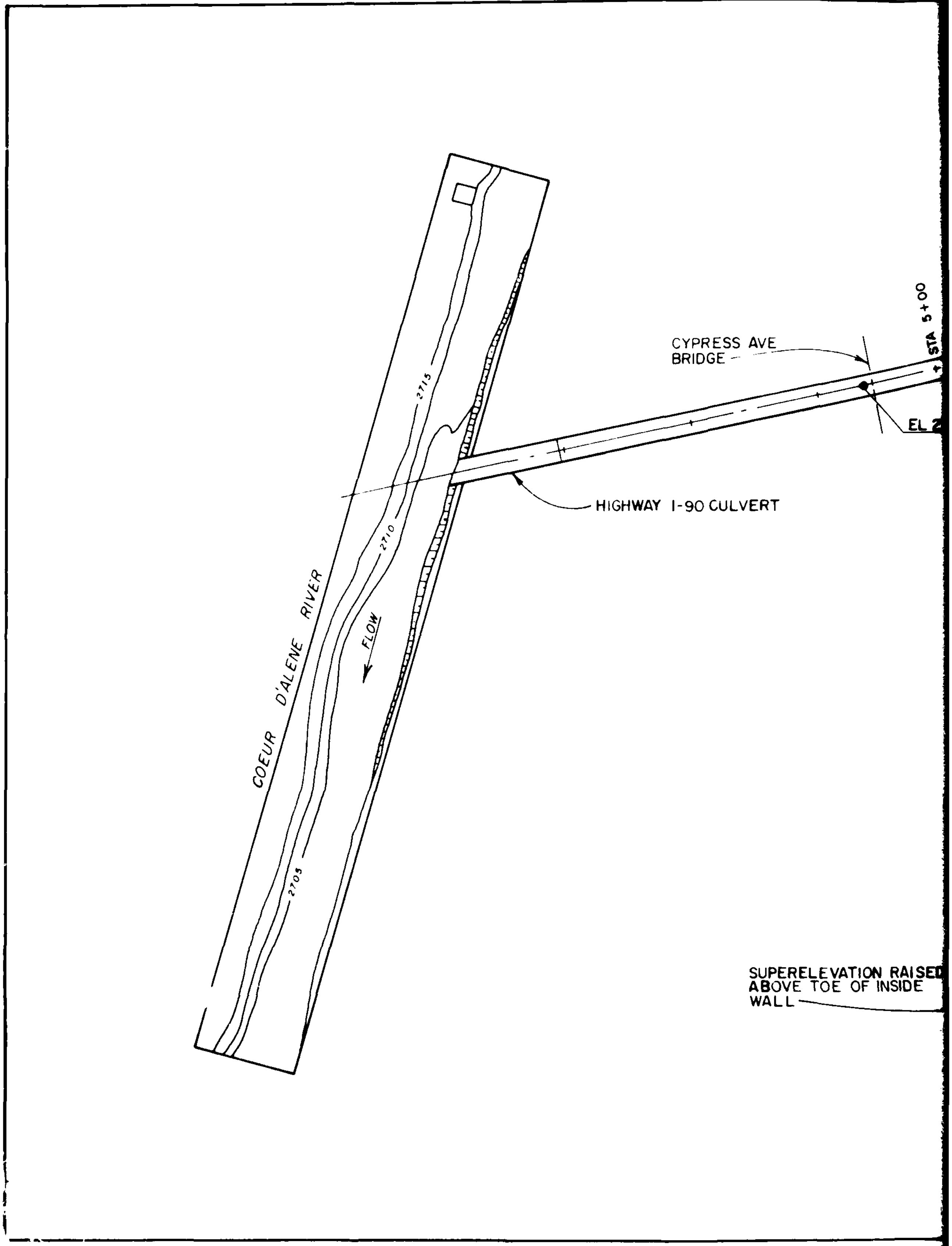
LEGEND

← 10	VELOCITIES MEASURED IN FPS
T	2-FT DEPTH
M	MID-DEPTH
B	2 FT ABOVE BOTTOM
2807.8	WATER-SURFACE ELEVATIONS

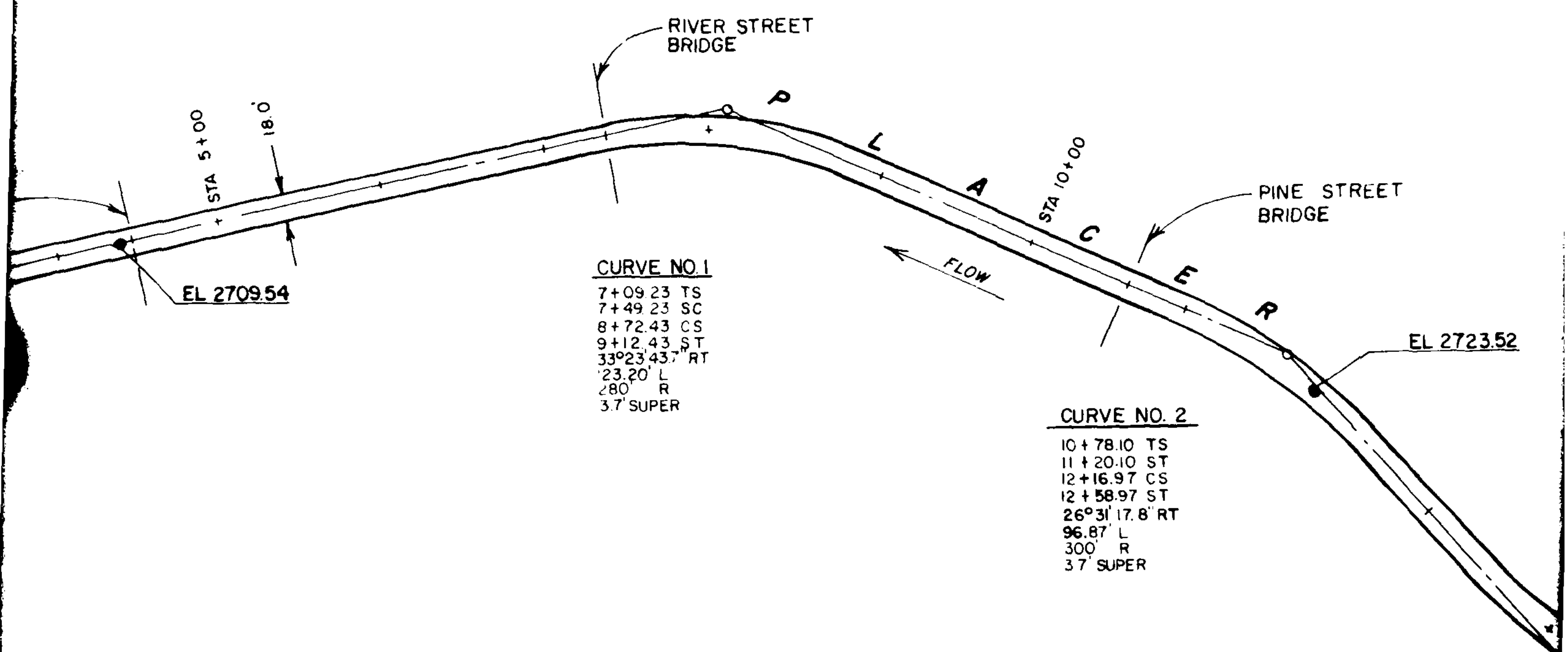
FINAL DESIGN DEBRIS BASIN

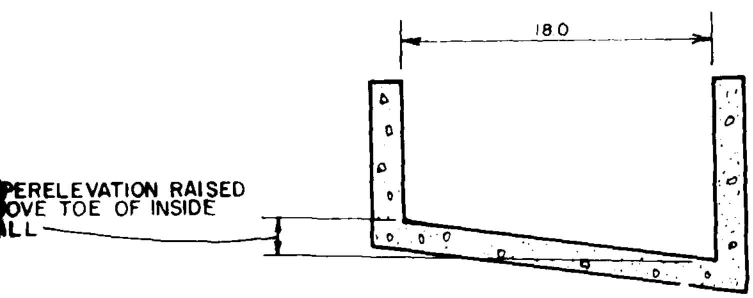
FLOW CONDITIONS

PLACER CREEK DISCHARGE 4600 CFS



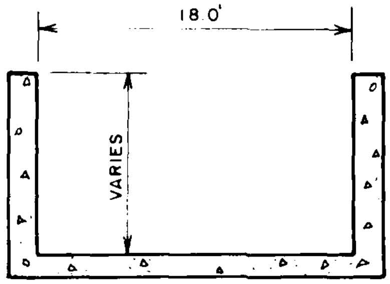
CYPRESS AVE BRIDGE
STA 5+00
EL 2
HIGHWAY I-90 CULVERT
COEUR D'ALENE RIVER
FLOW
2715
2710
2705
SUPERELEVATION RAISED ABOVE TOE OF INSIDE WALL



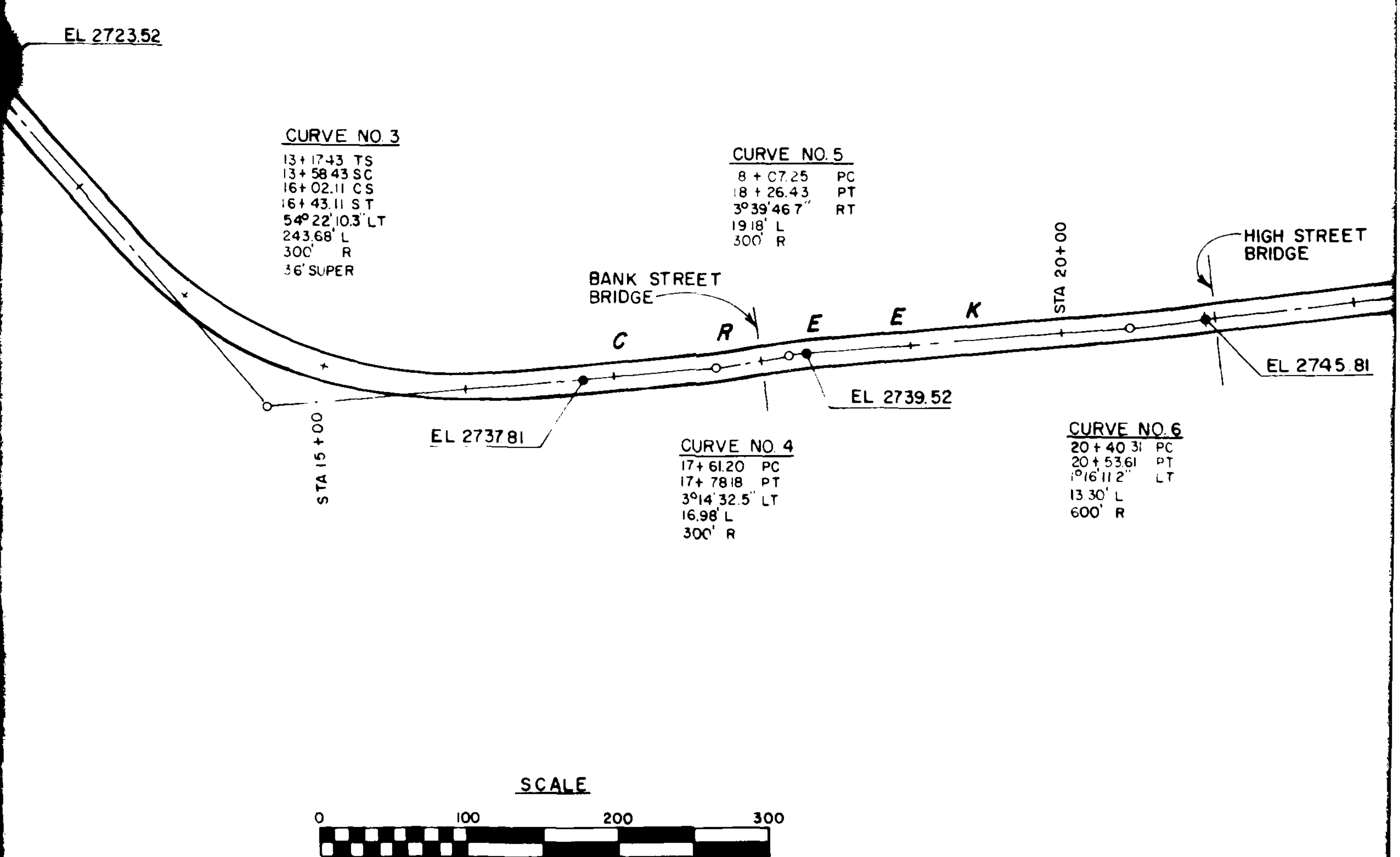


SECTION AT SUPERELEVATION

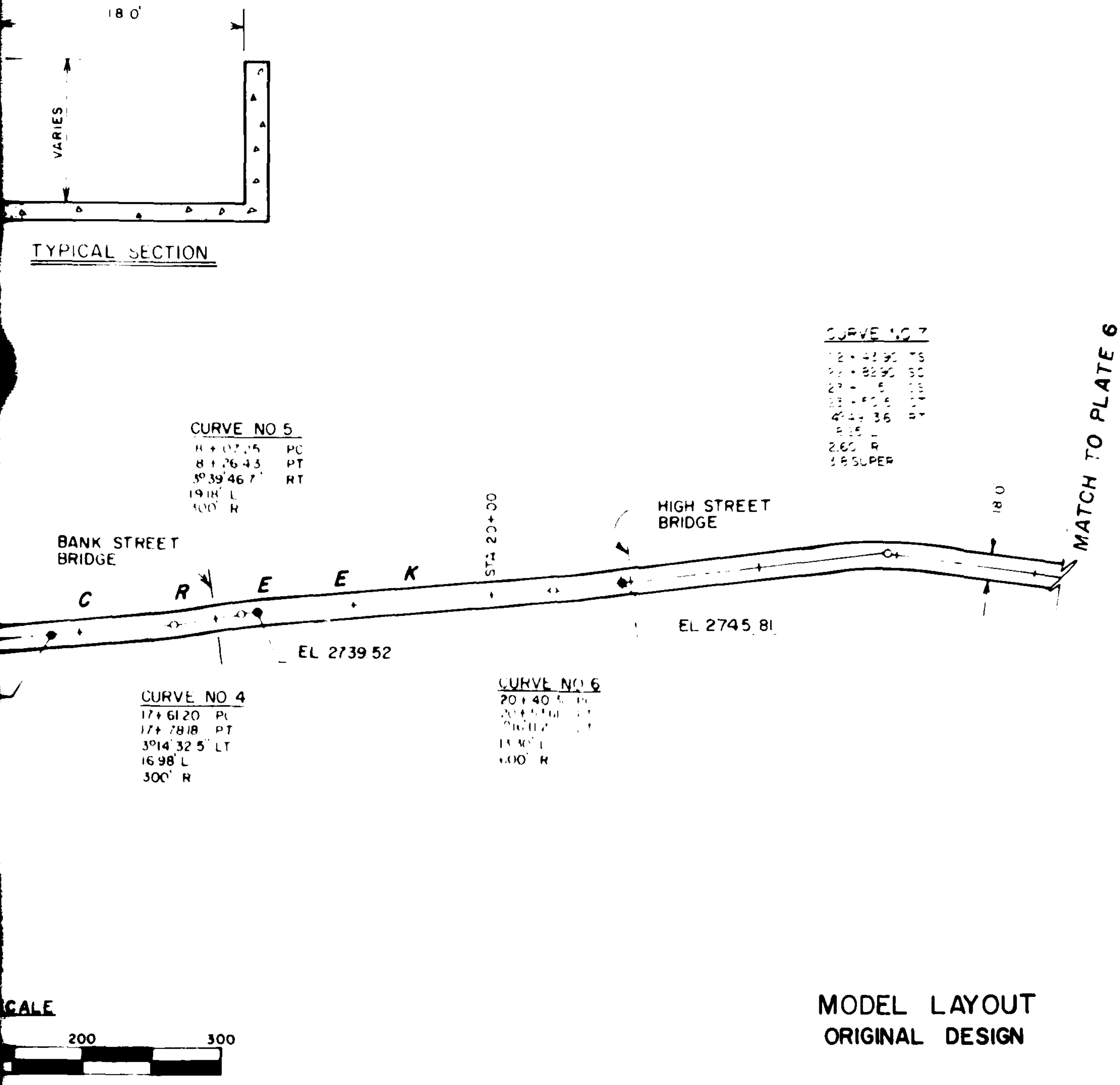
REET



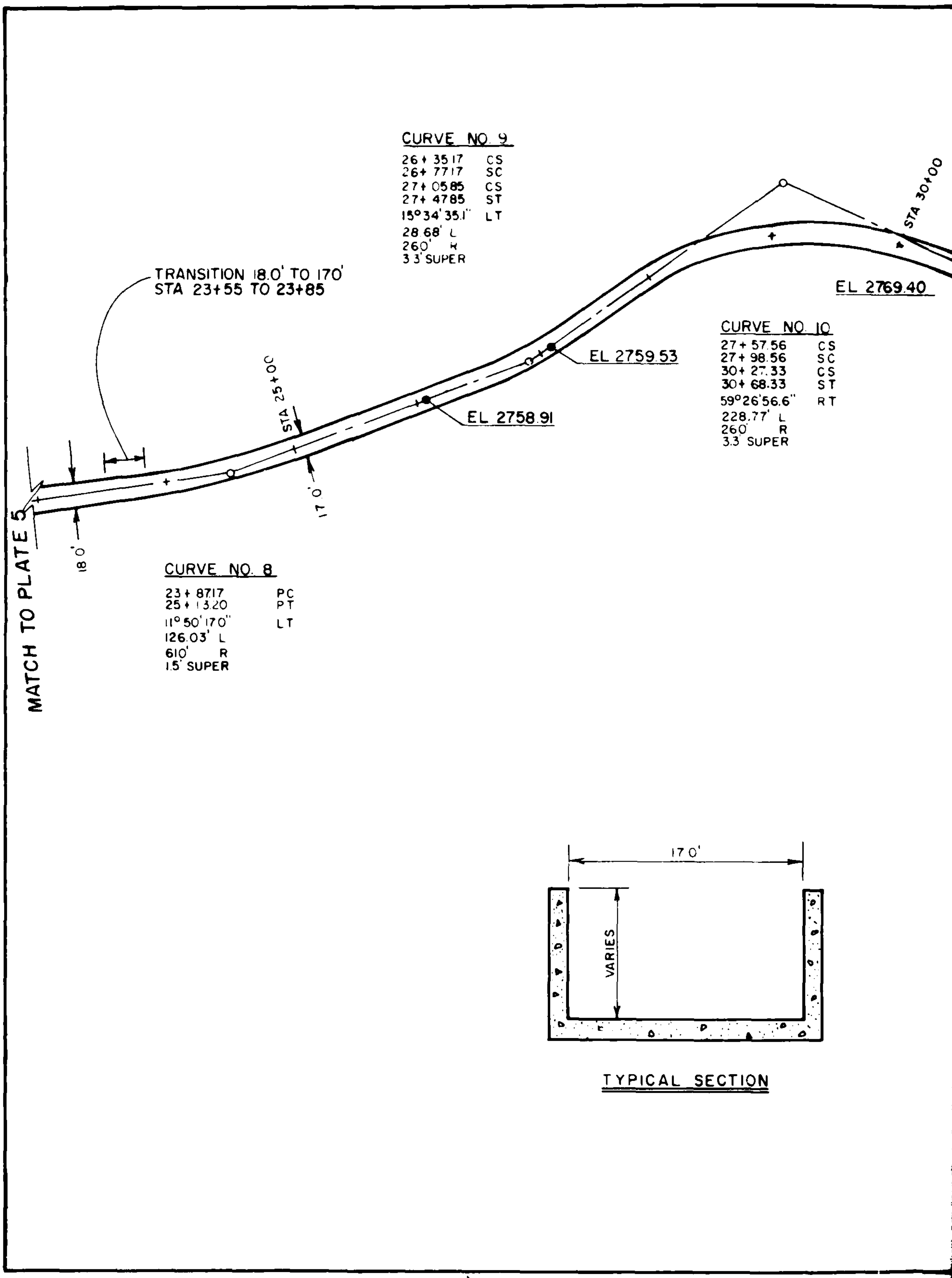
TYPICAL SECTION

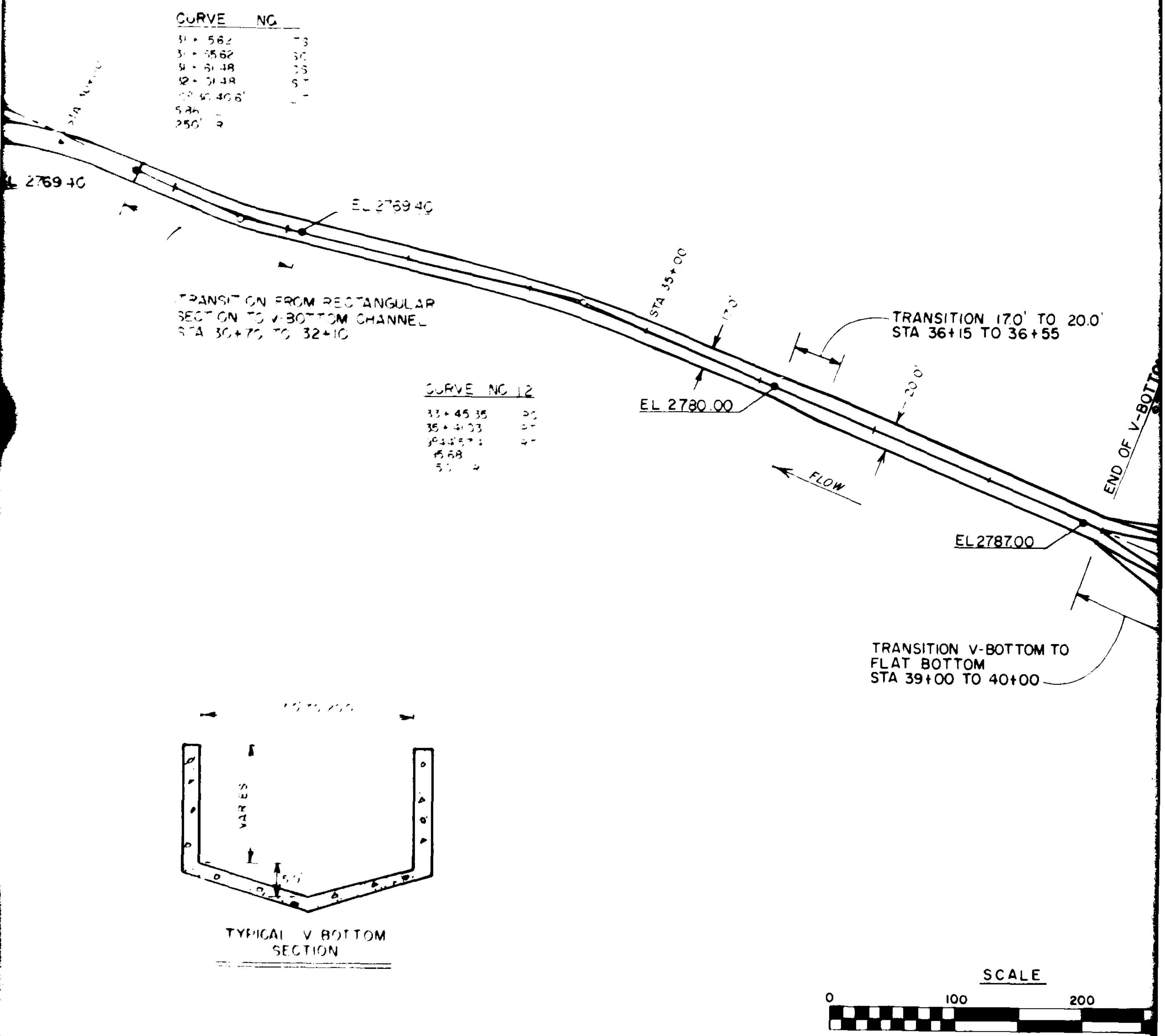


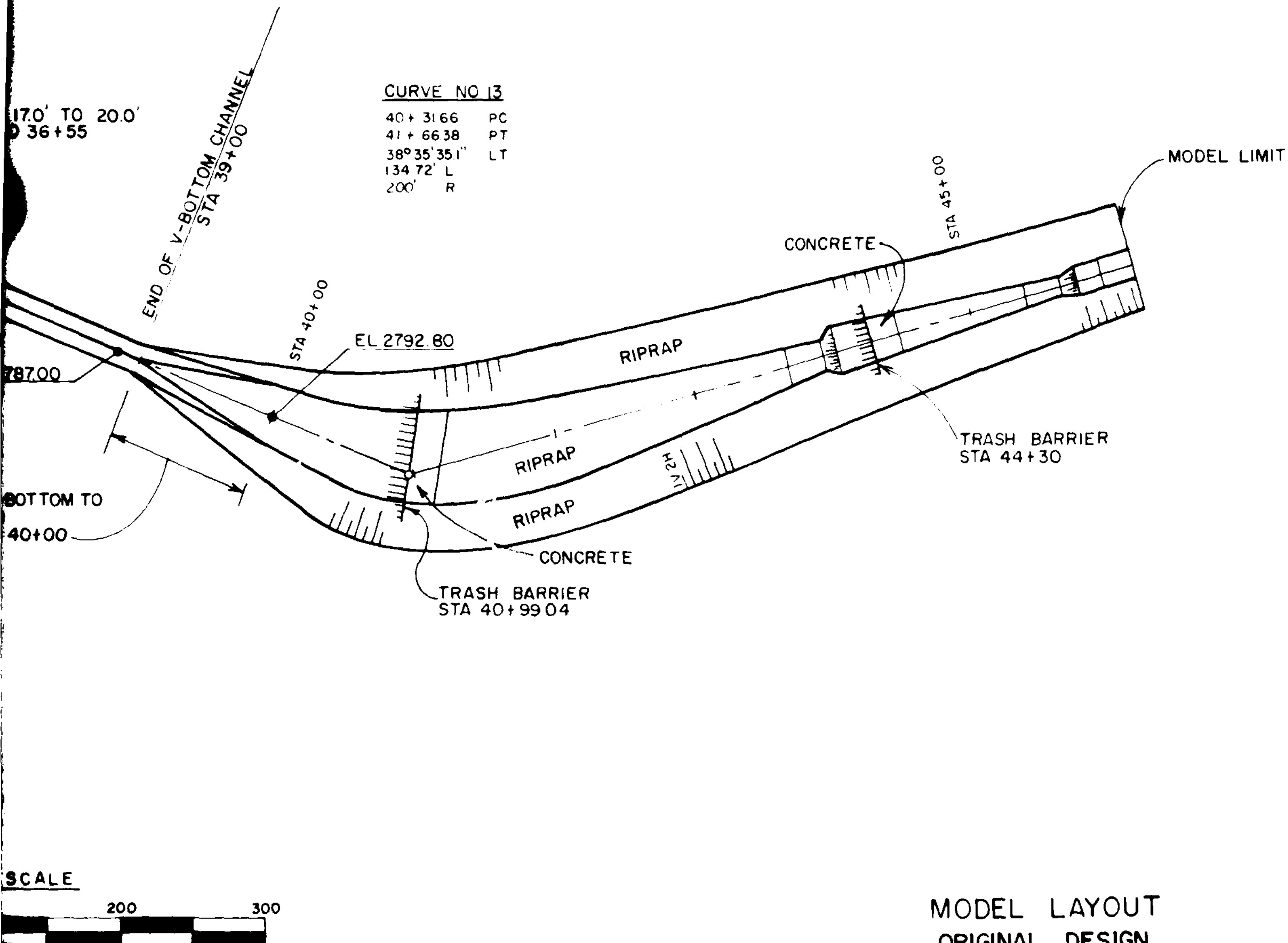
1 3



MODEL LAYOUT
ORIGINAL DESIGN

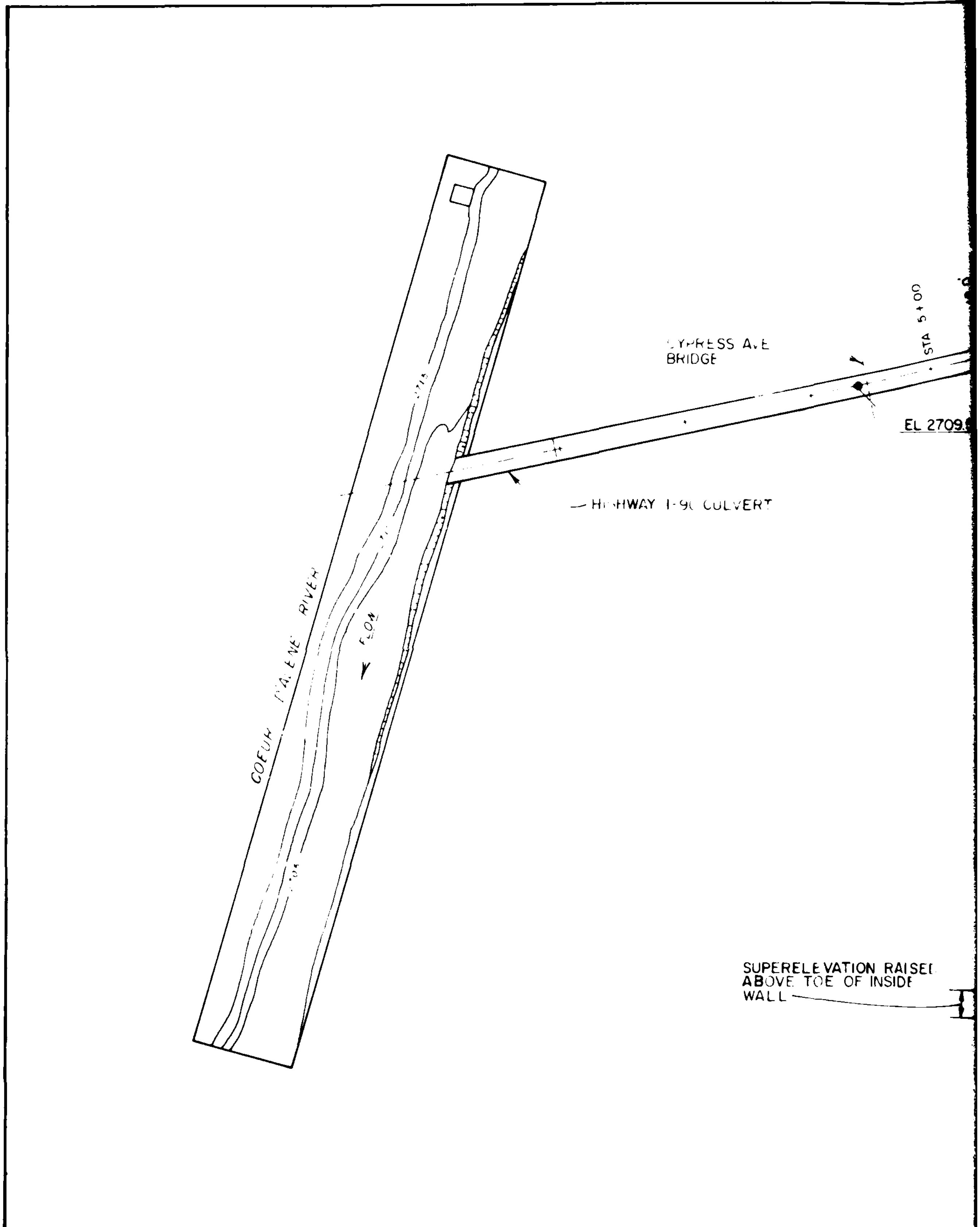

CURVE NO. 9
26+35.17 CS
26+77.17 SC
27+05.85 CS
27+47.85 ST
15°34'35.1" LT
28.68' L
260' R
3.3' SUPER
TRANSITION 18.0' TO 17.0'
STA 23+55 TO 23+85
STA 30+00
EL 2769.40
CURVE NO. 10
27+57.56 CS
27+98.56 SC
30+27.33 CS
30+68.33 ST
59°26'56.6" RT
228.77' L
260' R
3.3' SUPER
EL 2759.53
STA 25+00
EL 2758.91
17.0'
18.0'
MATCH TO PLATE 5
CURVE NO. 8
23+87.17 PC
25+13.20 PT
11°50'17.0" LT
126.03' L
610' R
1.5' SUPER
17.0'
VARIES
TYPICAL SECTION


CURVE NO
EL 2769.40
EL 2769.40
TRANSITION FROM RECTANGULAR SECTION TO V-BOTTOM CHANNEL STA 30+75 TO 32+10
CURVE NO 12
33+45.35
35+41.03
STA 35+00
17.0'
20.0'
EL 2780.00
TRANSITION 17.0' TO 20.0' STA 36+15 TO 36+55
FLOW
END OF V-BOTTO
EL 2787.00
TRANSITION V-BOTTOM TO FLAT BOTTOM STA 39+00 TO 40+00
VARIES
TYPICAL V BOTTOM SECTION
SCALE
0
100
200

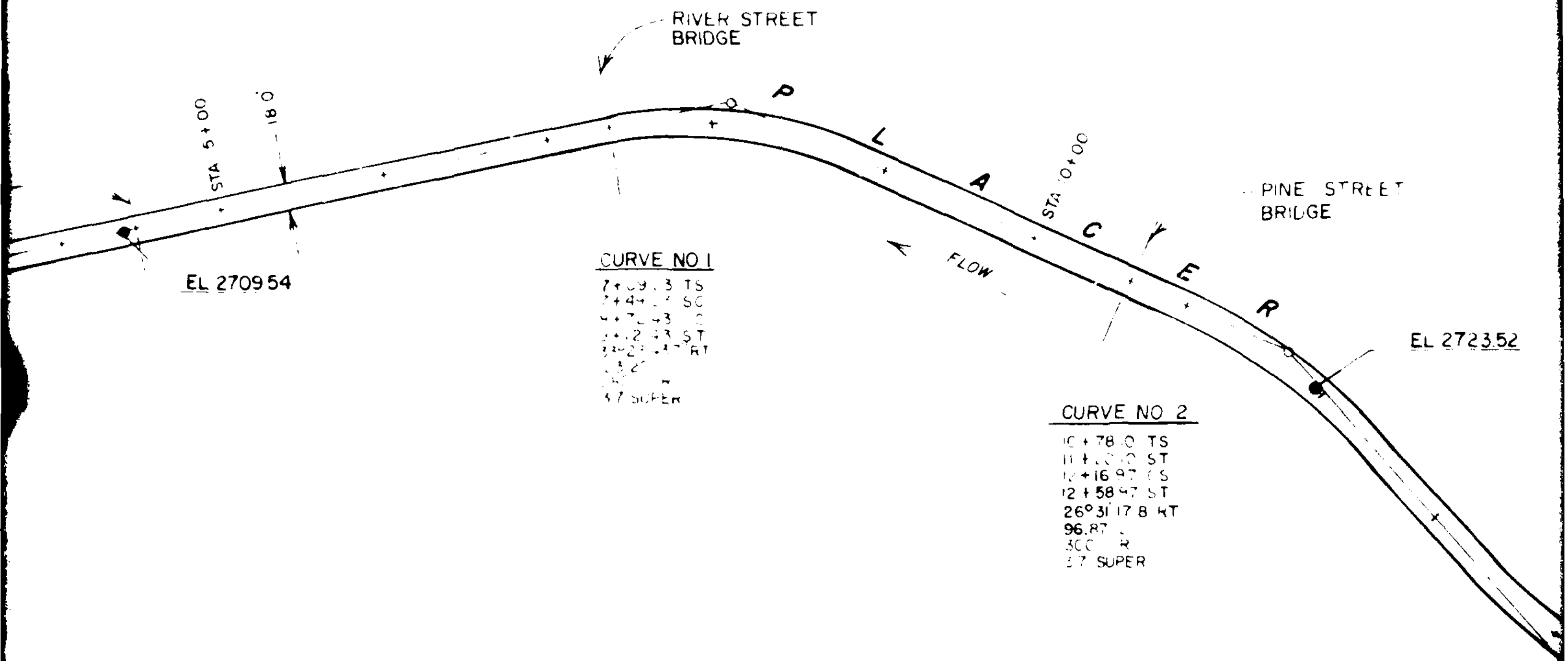


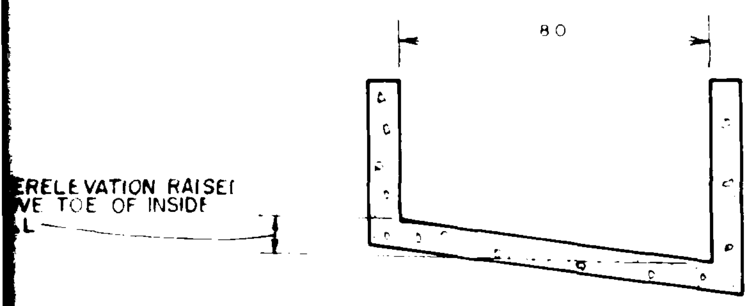
MODEL LAYOUT
ORIGINAL DESIGN

3



COEUR D'ALENE RIVER
FLOW
CYPRESS AVE BRIDGE
STA 5+00
EL 2709
HIGHWAY I-90 CULVERT
SUPERELEVATION RAISED ABOVE TOE OF INSIDE WALL

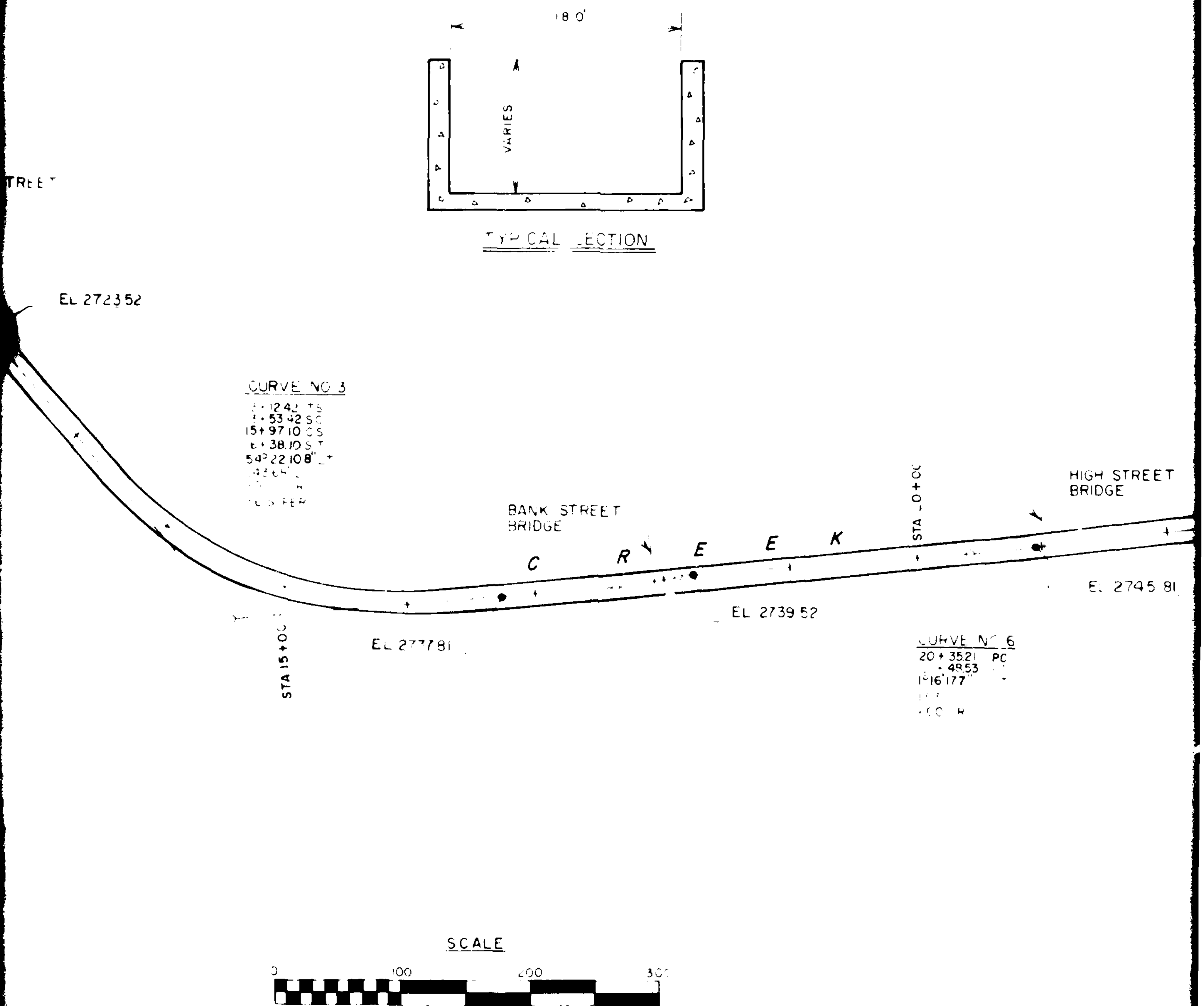




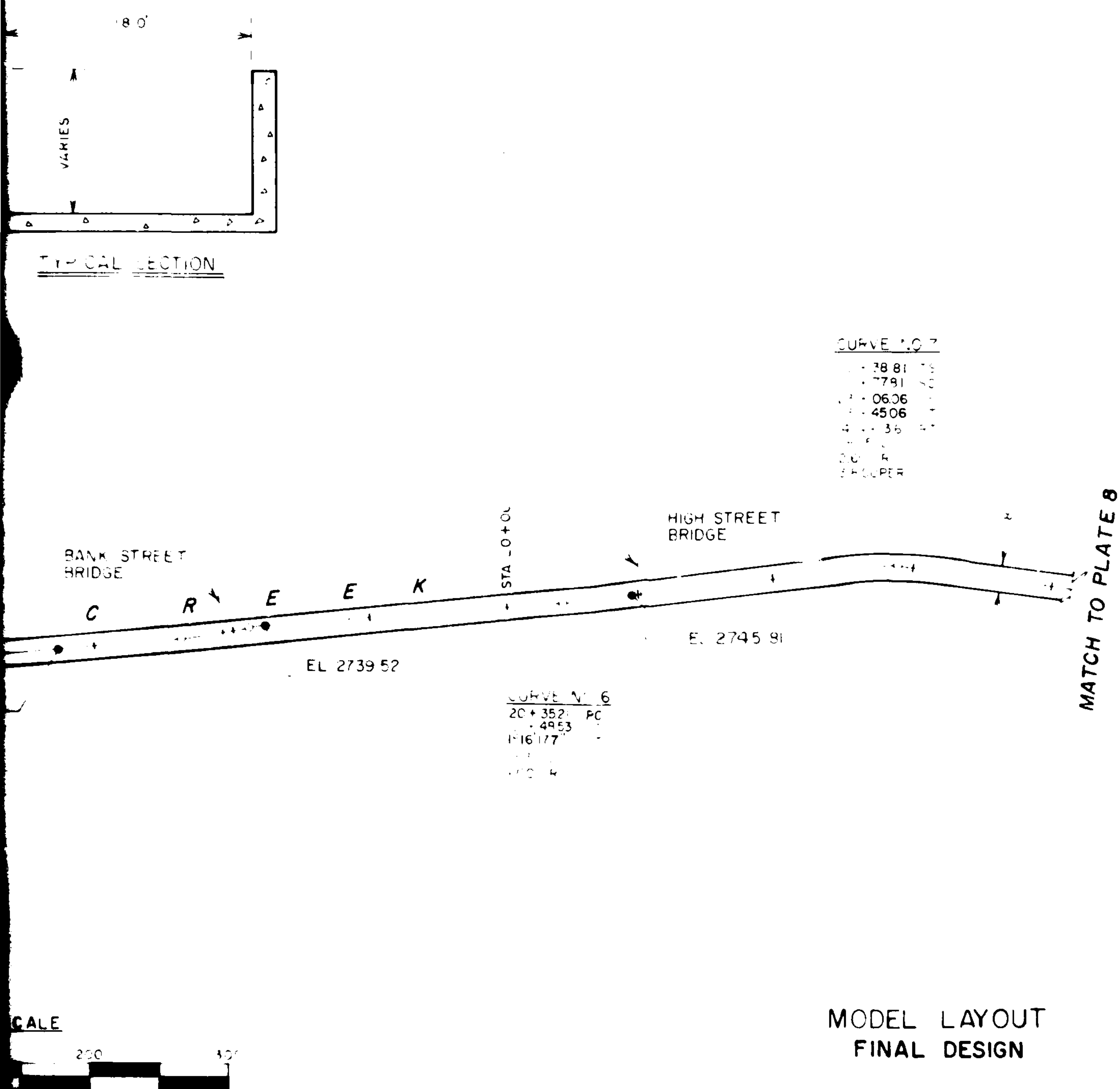
SECTION AT SUPERELEVATION

1

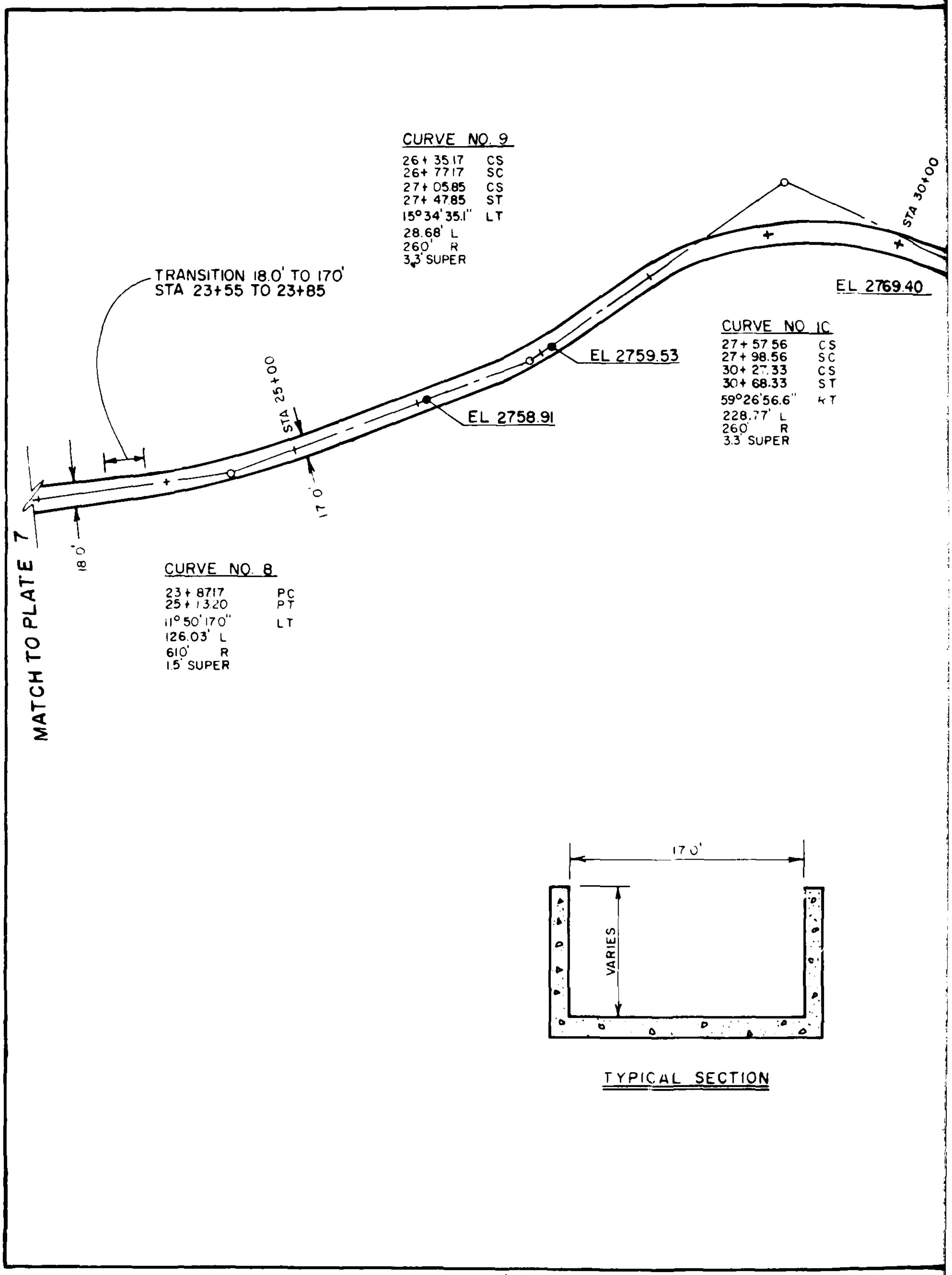
2



VARIES
EL 2723 52
CURVE NO 3
15+97 10 CS
BANK STREET
BRIDGE
C R E E K
HIGH STREET
BRIDGE
EL 2739 52
EL 2745 81
STA 15+00
CURVE NO 6
20+3521 PC
SCALE
100
200



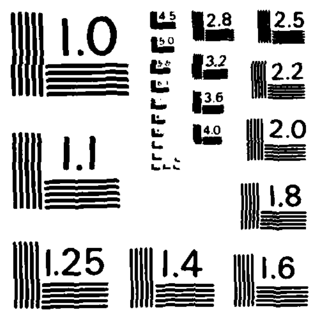
MODEL LAYOUT
FINAL DESIGN


CURVE NO. 9
26+ 35.17 CS
26+ 77.17 SC
27+ 05.85 CS
27+ 47.85 ST
15°34'35.1" LT
28.68' L
260' R
3.3' SUPER
TRANSITION 18.0' TO 17.0'
STA 23+55 TO 23+85
STA 30+00
EL 2769.40
CURVE NO. 10
27+ 57.56 CS
27+ 98.56 SC
30+ 27.33 CS
30+ 68.33 ST
59°26'56.6" RT
228.77' L
260' R
3.3' SUPER
EL 2759.53
STA 25+00
EL 2758.91
17.0'
18.0'
MATCH TO PLATE 7
CURVE NO. 8
23+ 87.17 PC
25+ 13.20 PT
11°50'17.0" LT
126.03' L
610' R
1.5' SUPER
17.0'
VARIES
TYPICAL SECTION

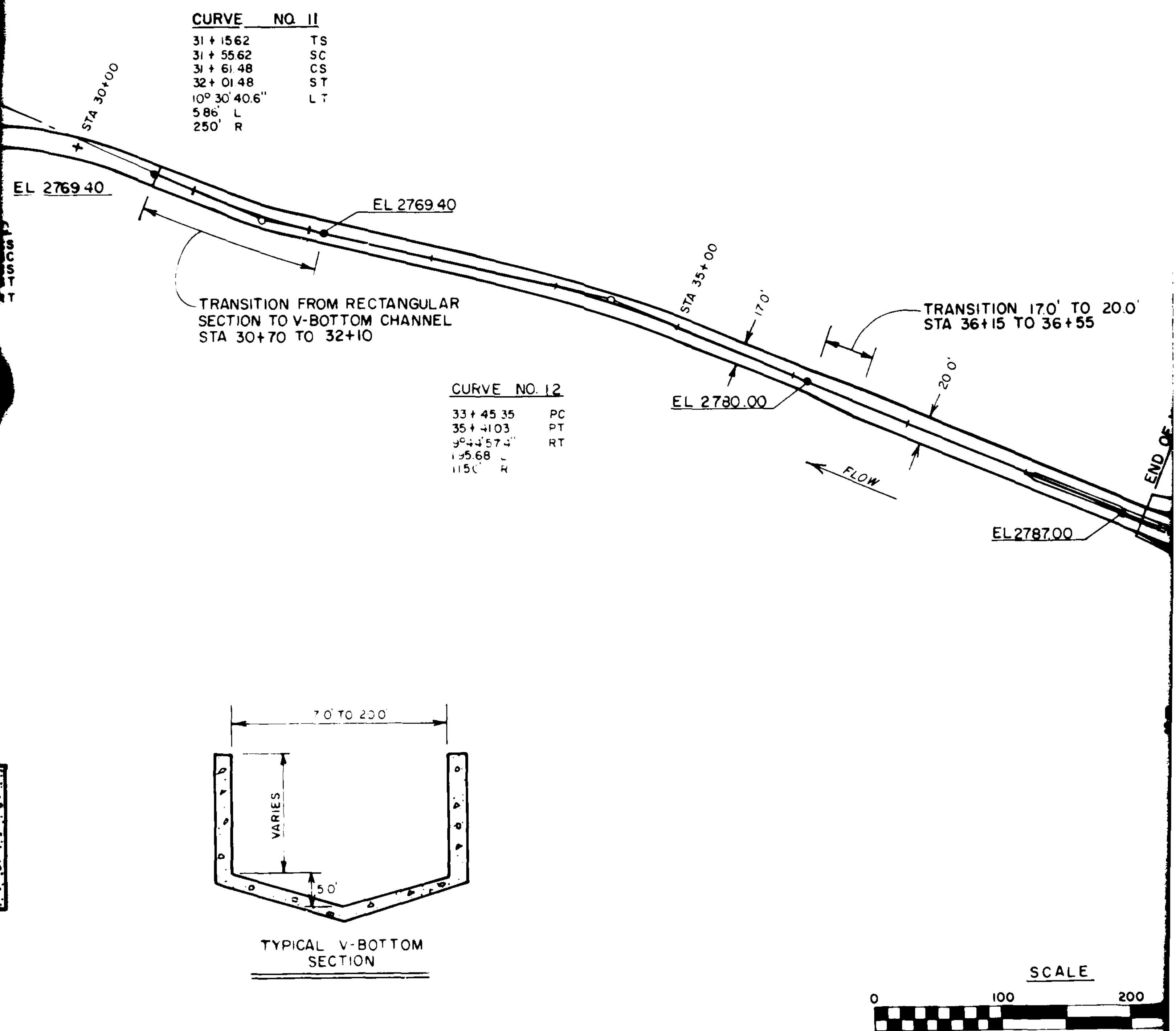
AD-A134 641 PLACER CREEK HIGH-VELOCITY CHANNEL AND DEBRIS BASIN AT WALLACE IDAHO HYDR..(U) ARMY ENGINEER DIV NORTH PACIFIC BONNEVILLE OR DIV HYDRAULIC L.. M M KUBO MAR 83 2/2

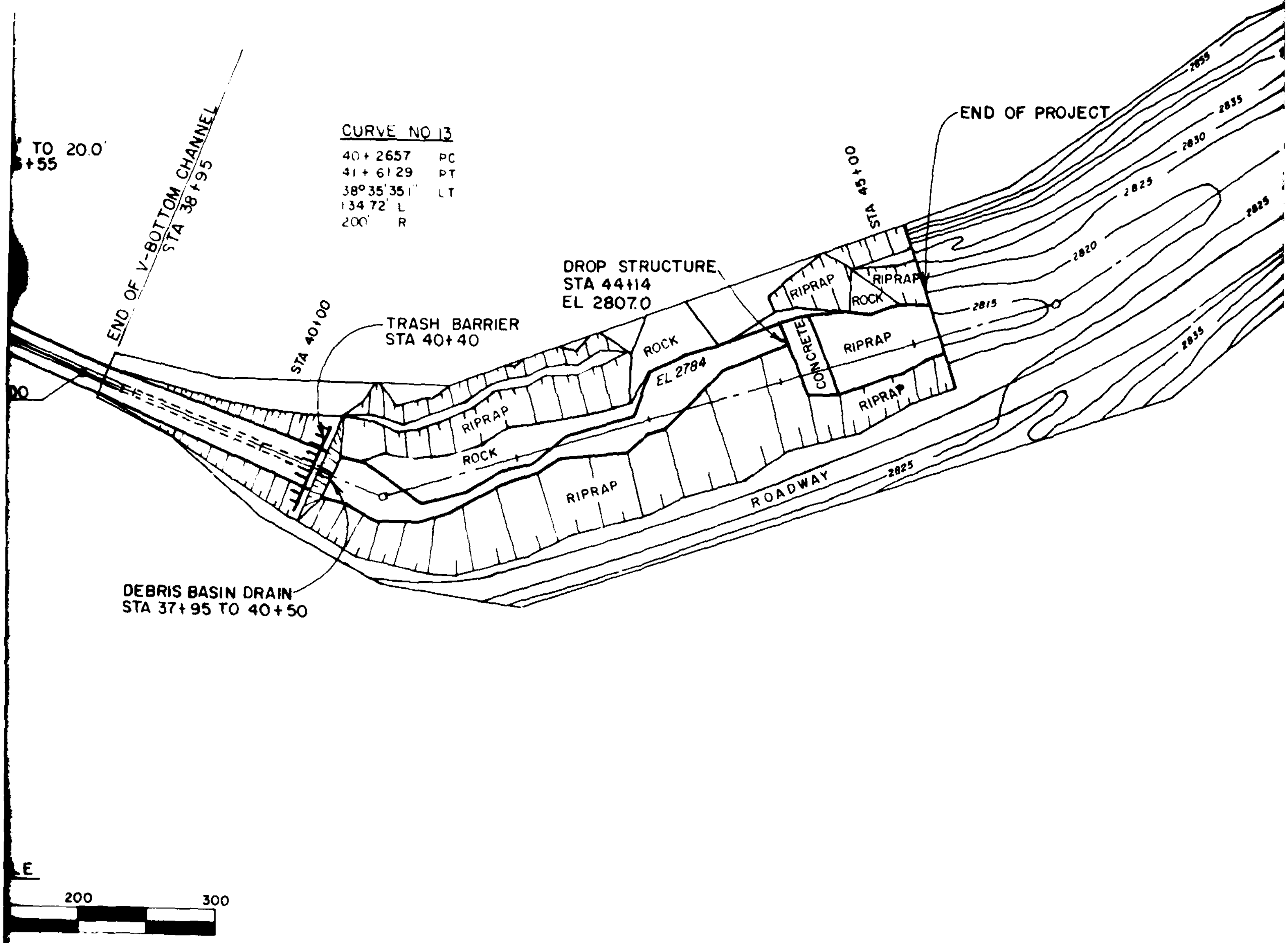
UNCLASSIFIED TR-186-1 F/G 13/2 NL

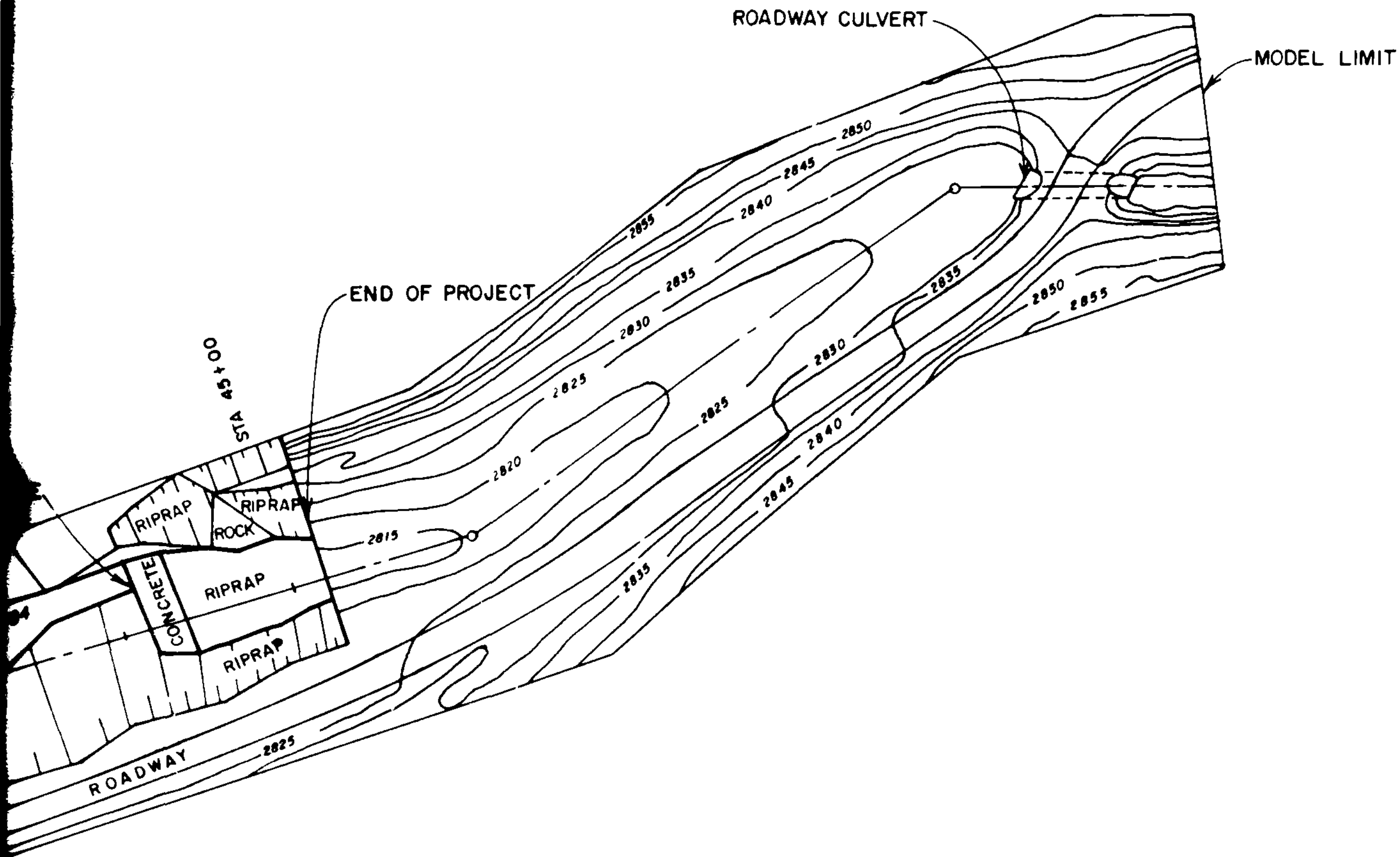
END
DATE FILMED
12 --
DTIC



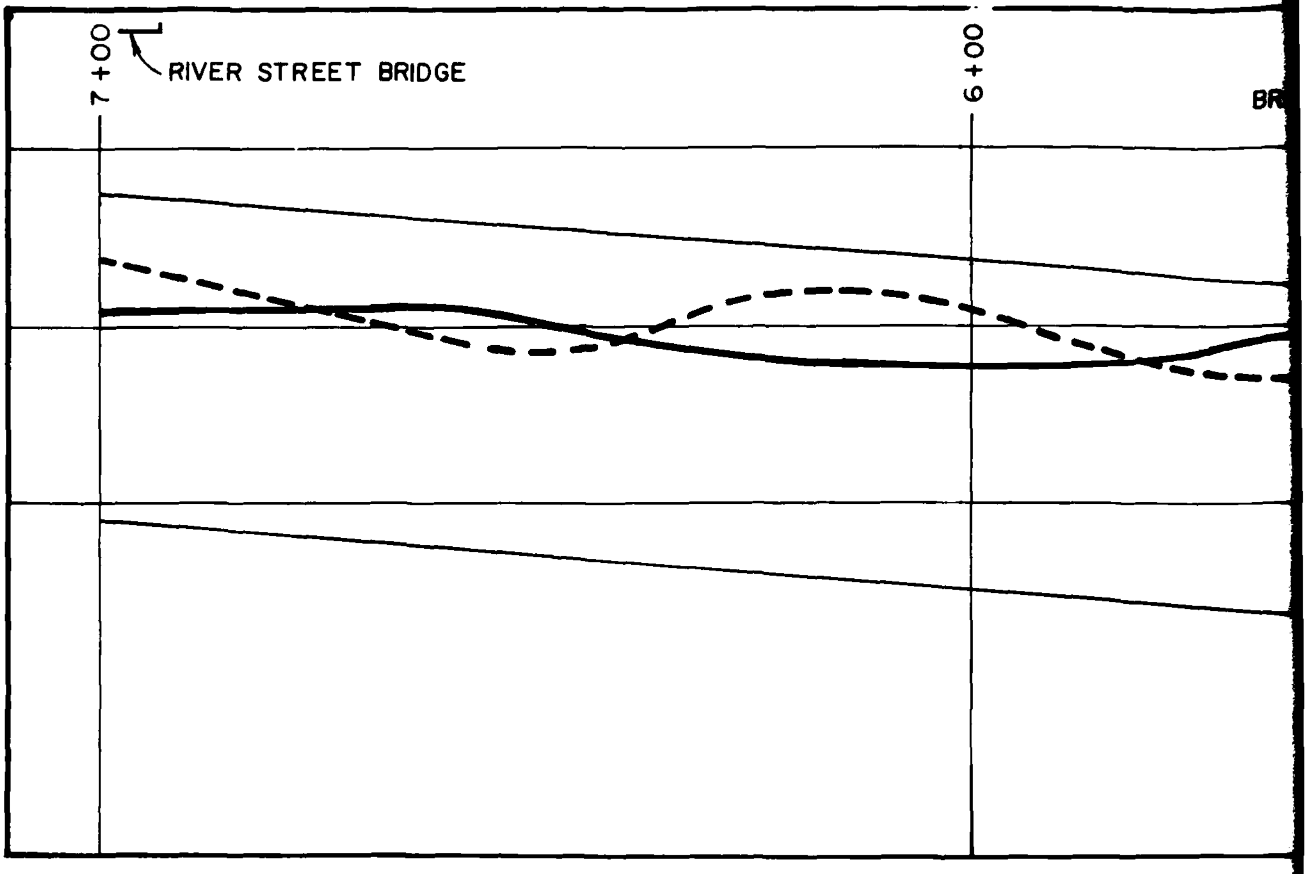
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A


CURVE NO. 11
31 + 15.62 TS
31 + 55.62 SC
31 + 61.48 CS
32 + 01.48 ST
10° 30' 40.6" LT
5.86' L
250' R
STA 30+00
EL 2769.40
EL 2769.40
TRANSITION FROM RECTANGULAR SECTION TO V-BOTTOM CHANNEL STA 30+70 TO 32+10
STA 35+00
17.0'
EL 2780.00
TRANSITION 17.0' TO 20.0' STA 36+15 TO 36+55
20.0'
CURVE NO. 12
33 + 45.35 PC
35 + 41.03 PT
9°44'57.4" RT
195.68 L
1150' R
FLOW
EL 2787.00
7.0' TO 20.0'
VARIES
5.0'
TYPICAL V-BOTTOM SECTION
SCALE
0 100 200

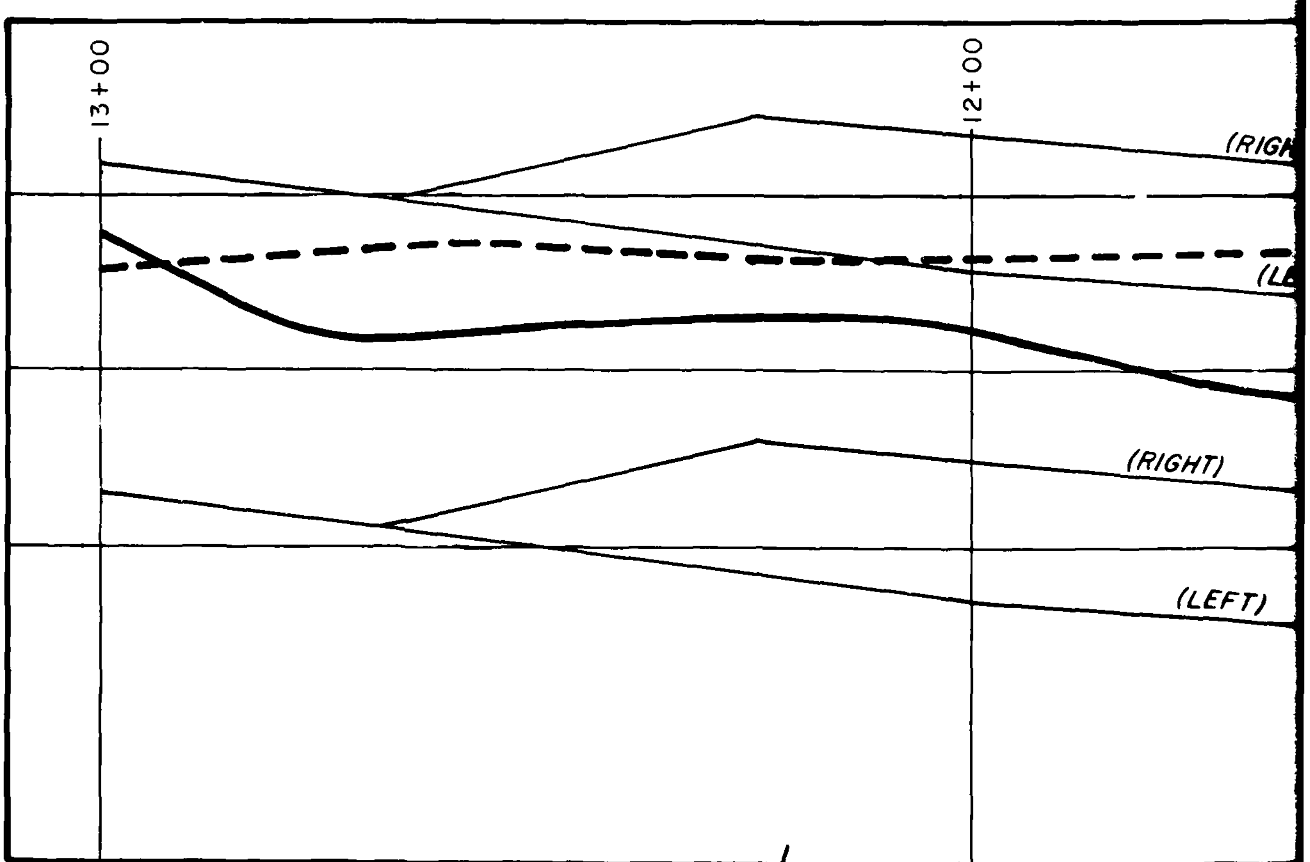

' TO 20.0'
+55
END OF V-BOTTOM CHANNEL
STA 38+95
CURVE NO 13
40+2657 PC
41+6129 PT
38°35'351" LT
134.72' L
200' R
STA 40+00
TRASH BARRIER
STA 40+40
RIPRAP
ROCK
EL 2784
DROP STRUCTURE
STA 44+14
EL 2807.0
STA 45+00
END OF PROJECT
CONCRETE
RIPRAP
ROCK
ROADWAY
2815
2820
2825
2830
2835
DEBRIS BASIN DRAIN
STA 37+95 TO 40+50
LE
200
300



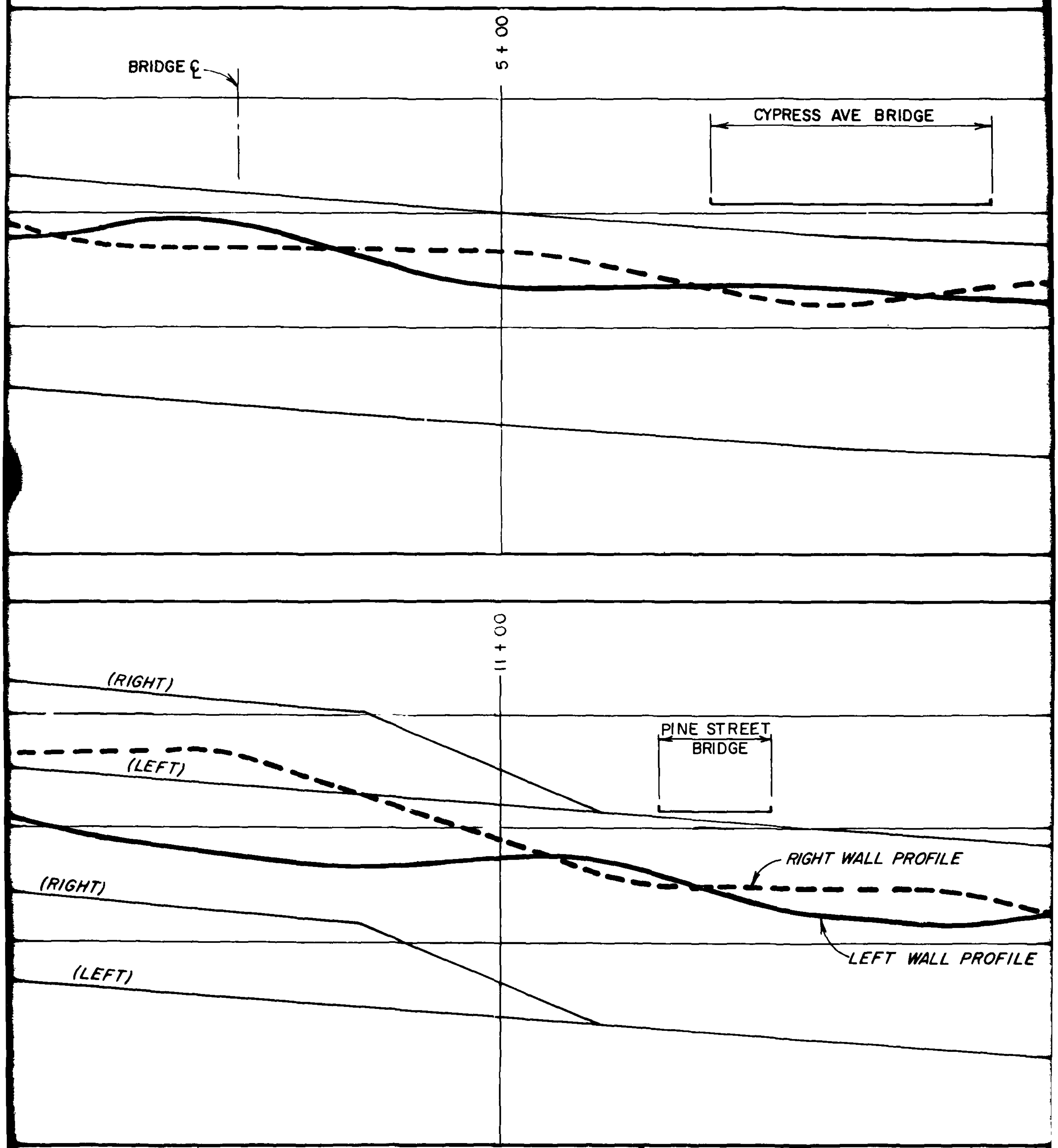
MODEL LAYOUT
FINAL DESIGN

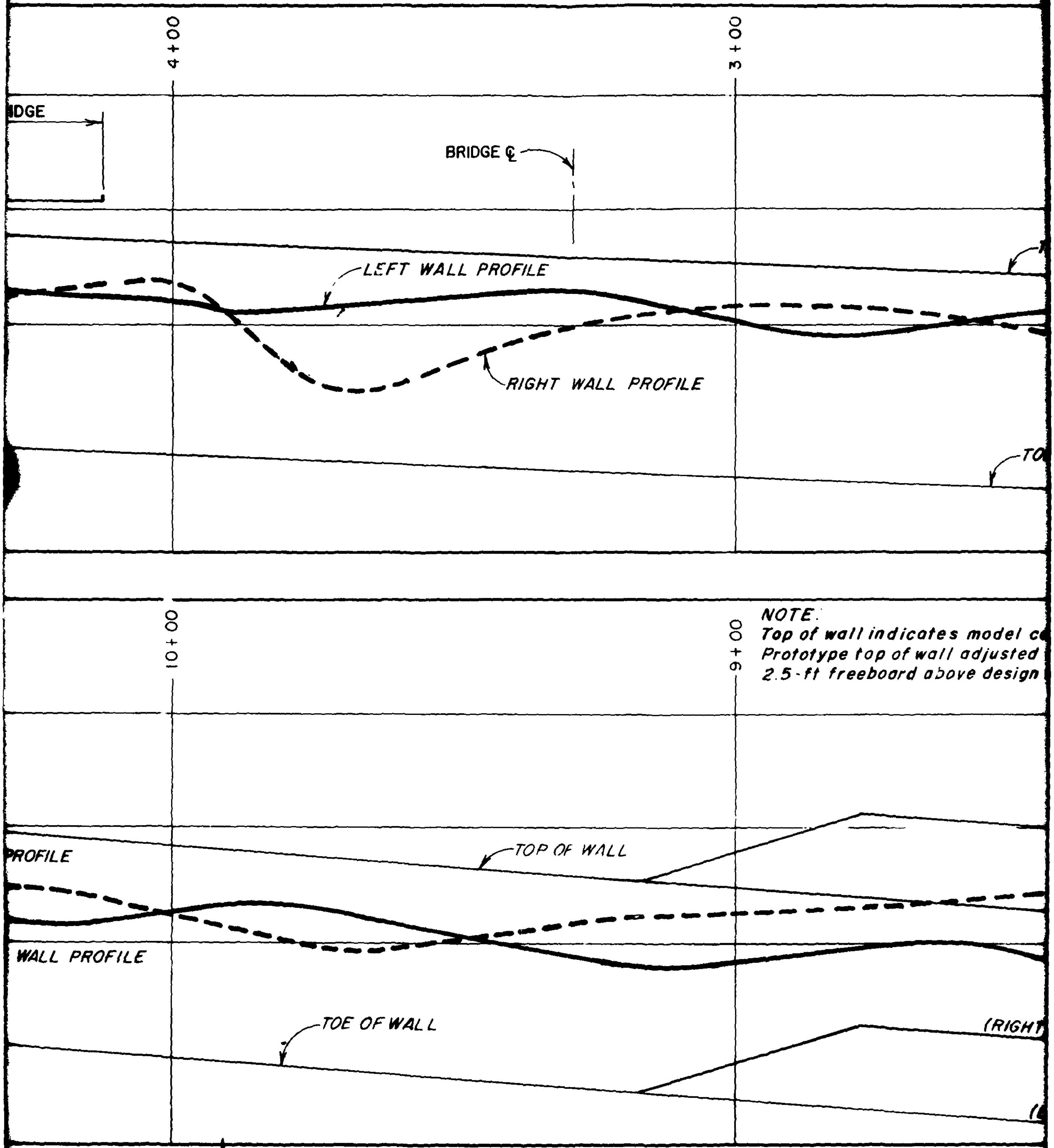


7+00
RIVER STREET BRIDGE
6+00
BR

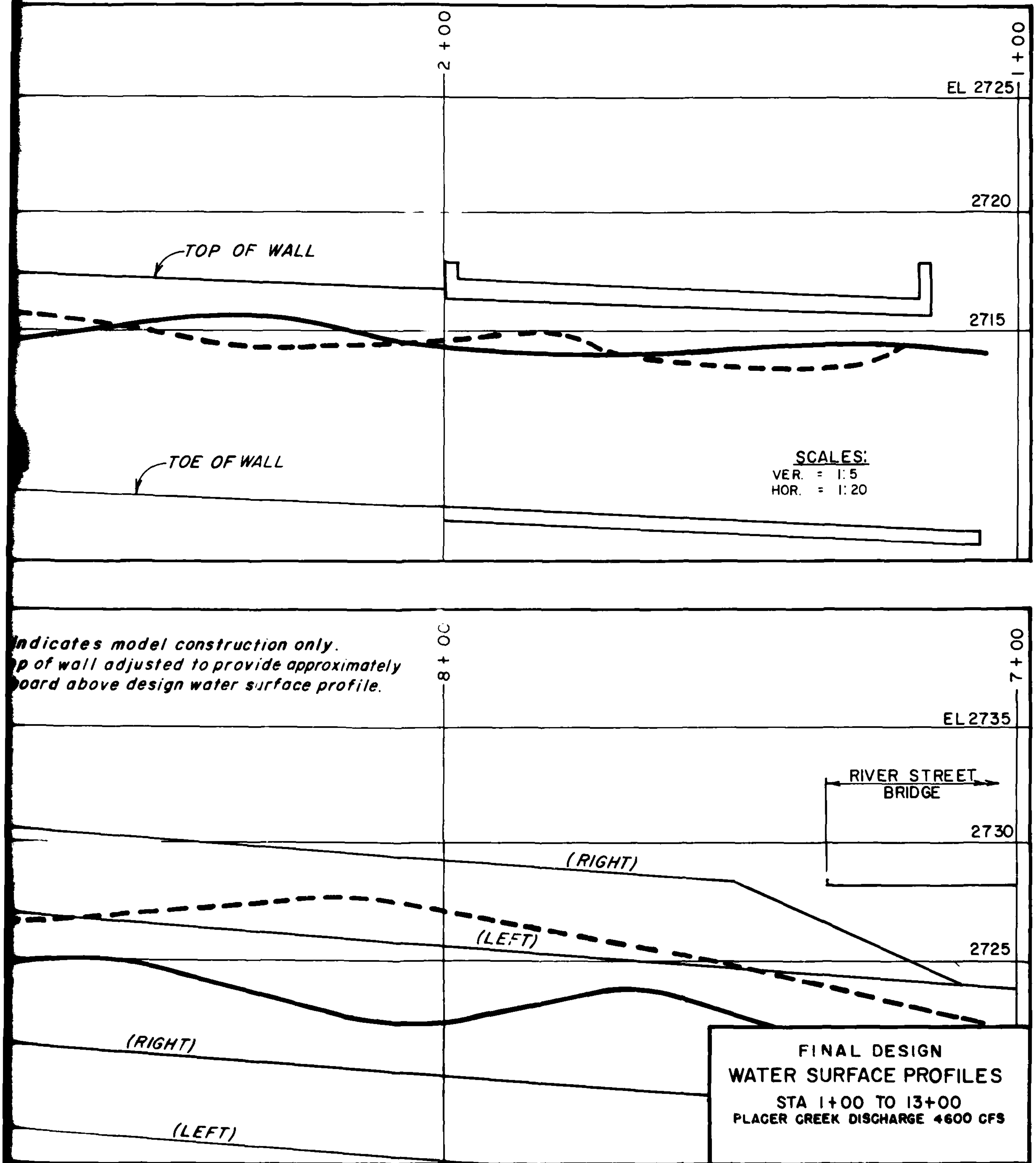


13+00
12+00
(RIGH
(LE
(RIGHT)
(LEFT)


5 + 00
BRIDGE ℄
CYPRESS AVE BRIDGE
11 + 00
(RIGHT)
(LEFT)
PINE STREET BRIDGE
(RIGHT)
(LEFT)
RIGHT WALL PROFILE
LEFT WALL PROFILE

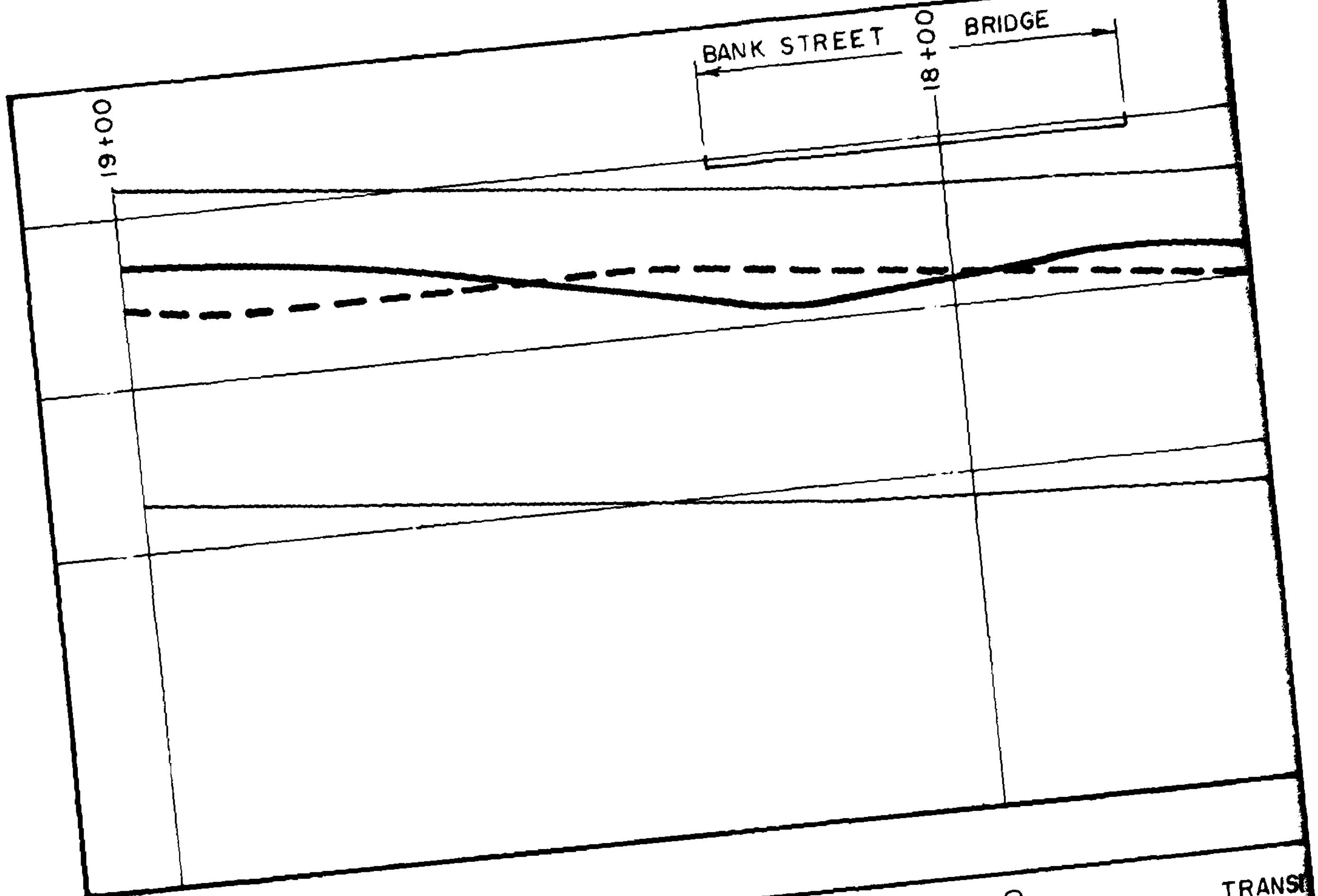


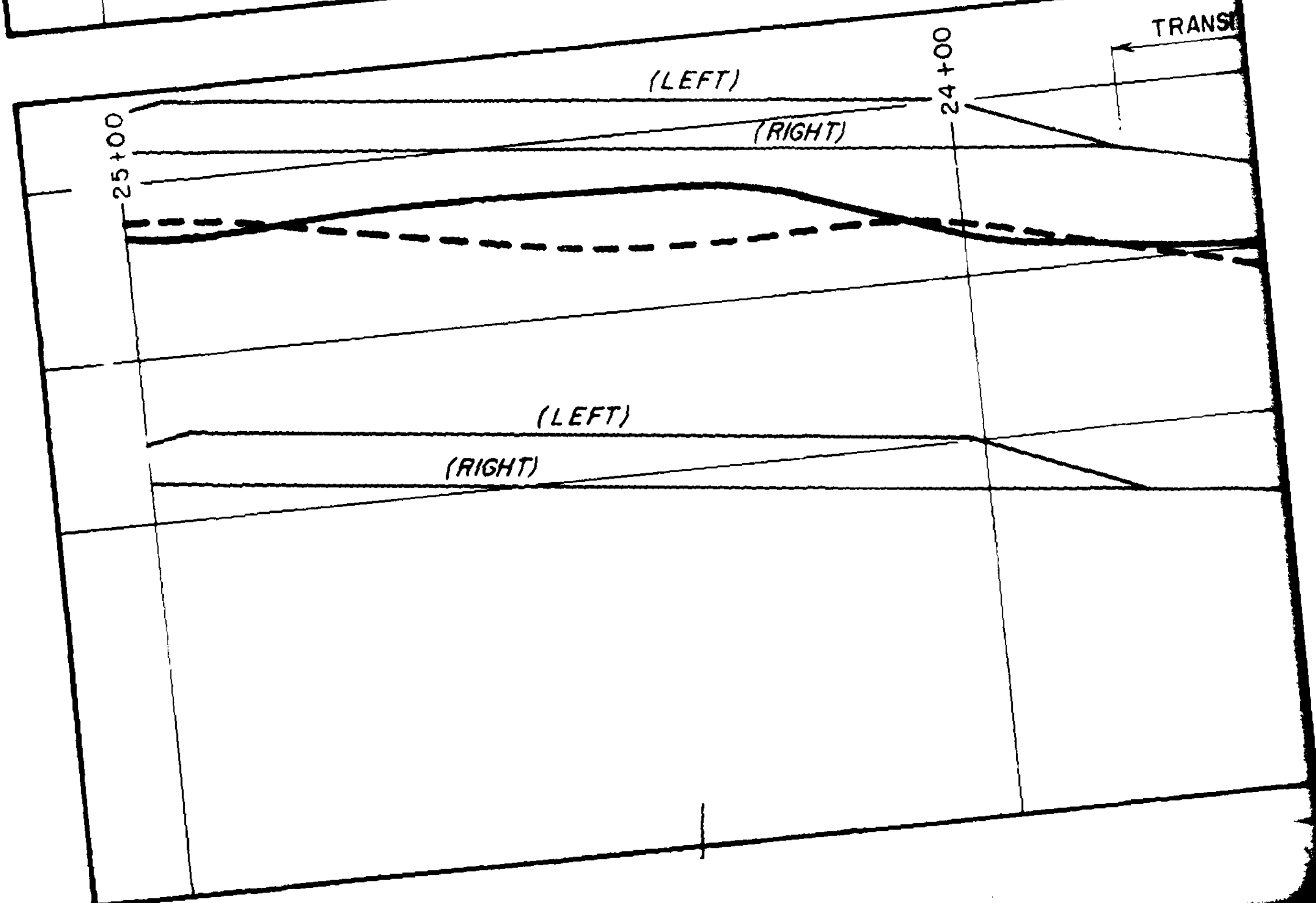
4+00
3+00
IDGE
BRIDGE ℄
LEFT WALL PROFILE
RIGHT WALL PROFILE
TO
10+00
9+00
NOTE:
Top of wall indicates model c
Prototype top of wall adjusted
2.5-ft freeboard above design
PROFILE
TOP OF WALL
WALL PROFILE
TOE OF WALL
(RIGHT

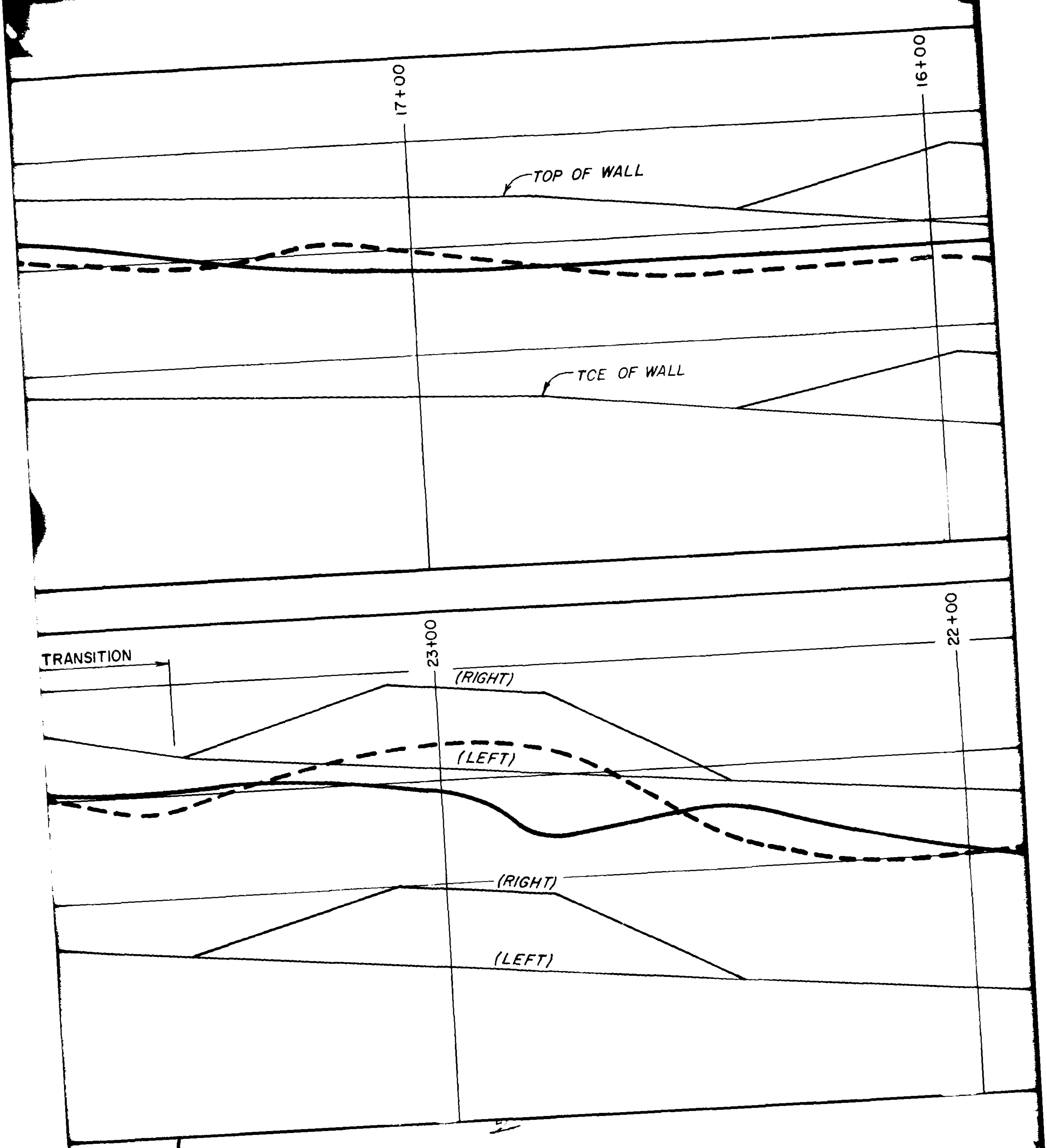


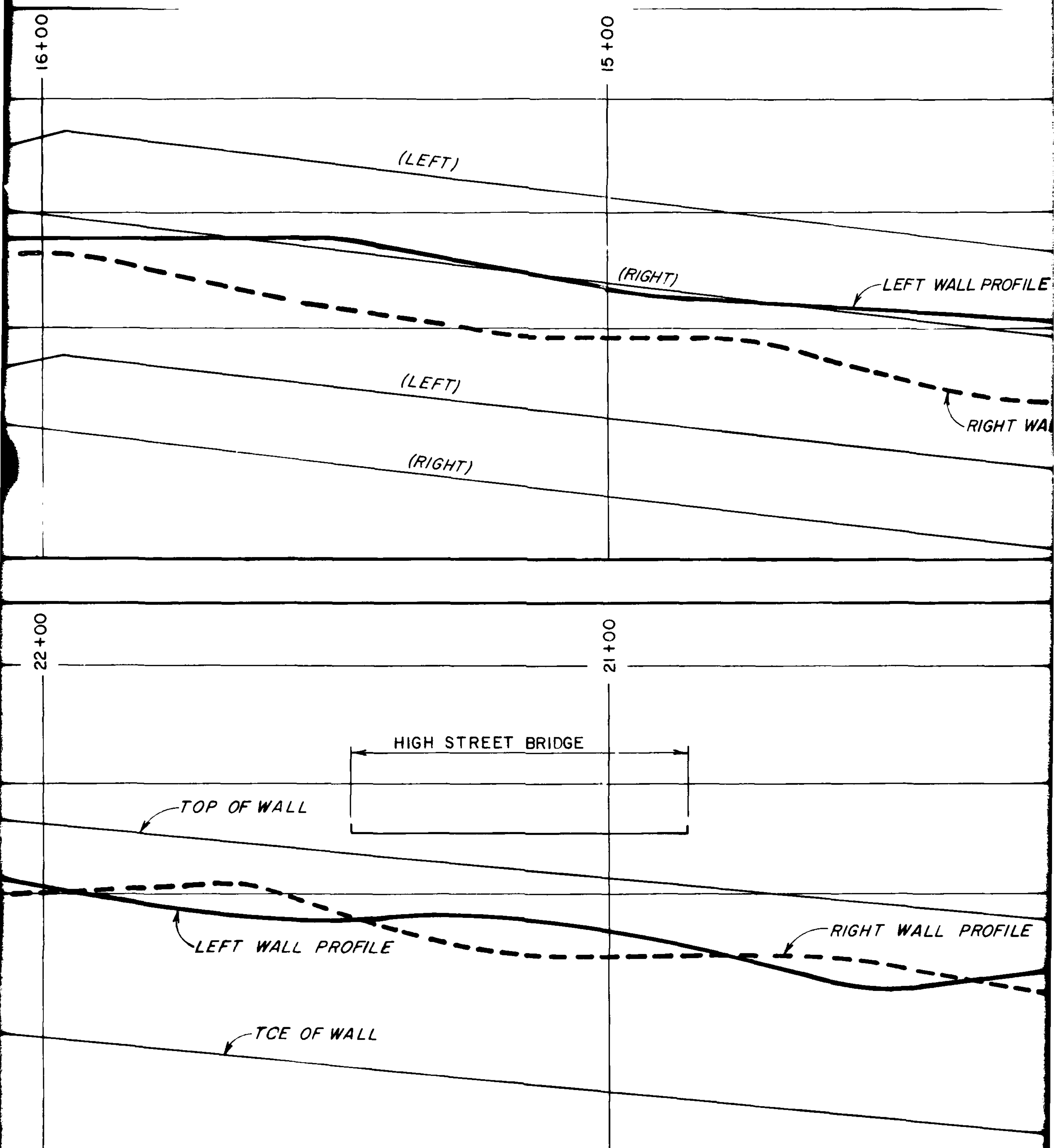
FINAL DESIGN
WATER SURFACE PROFILES
STA 1+00 TO 13+00
PLACER CREEK DISCHARGE 4600 CFS

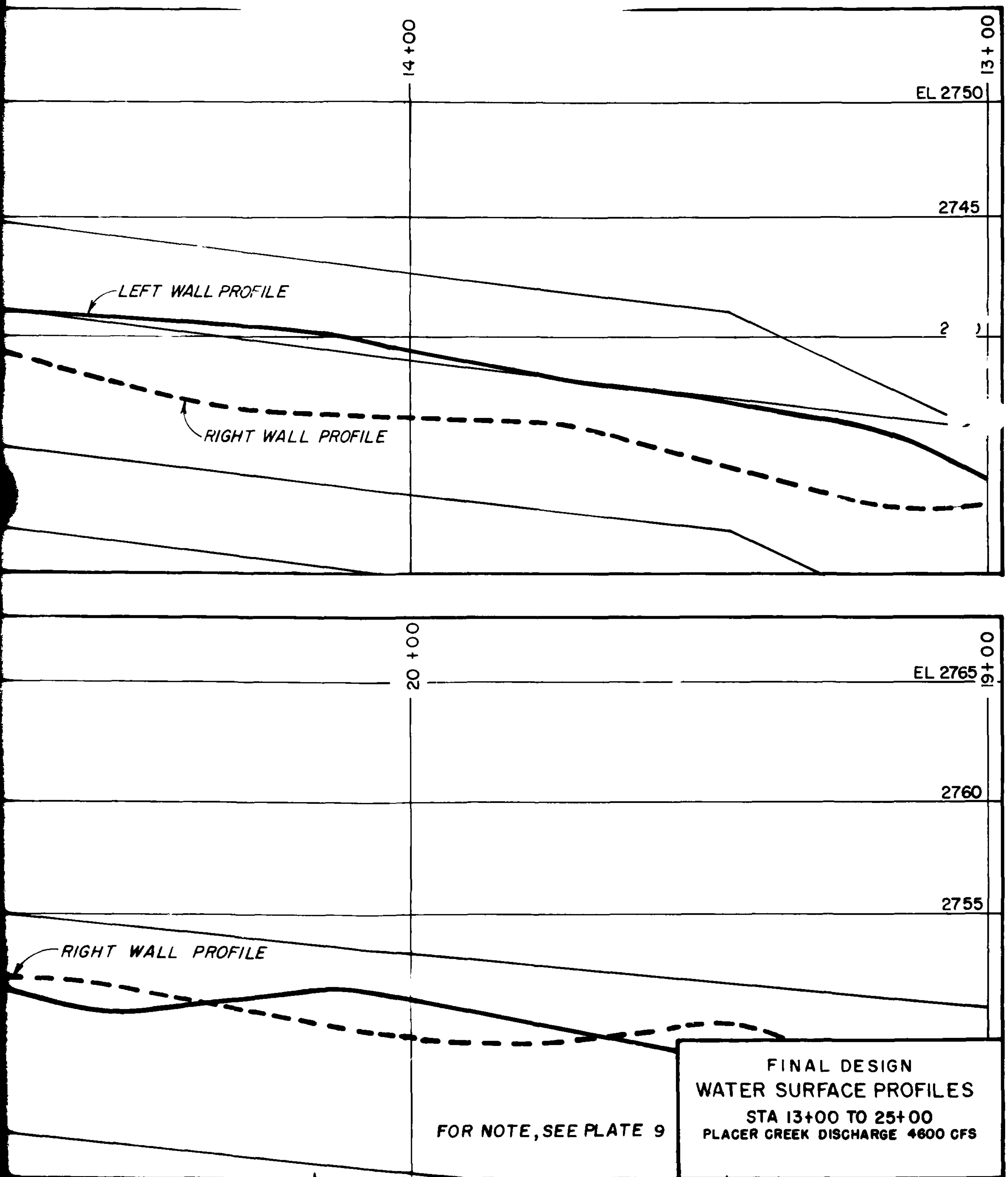
PLATE 9


BANK STREET
18+00
BRIDGE
19+00

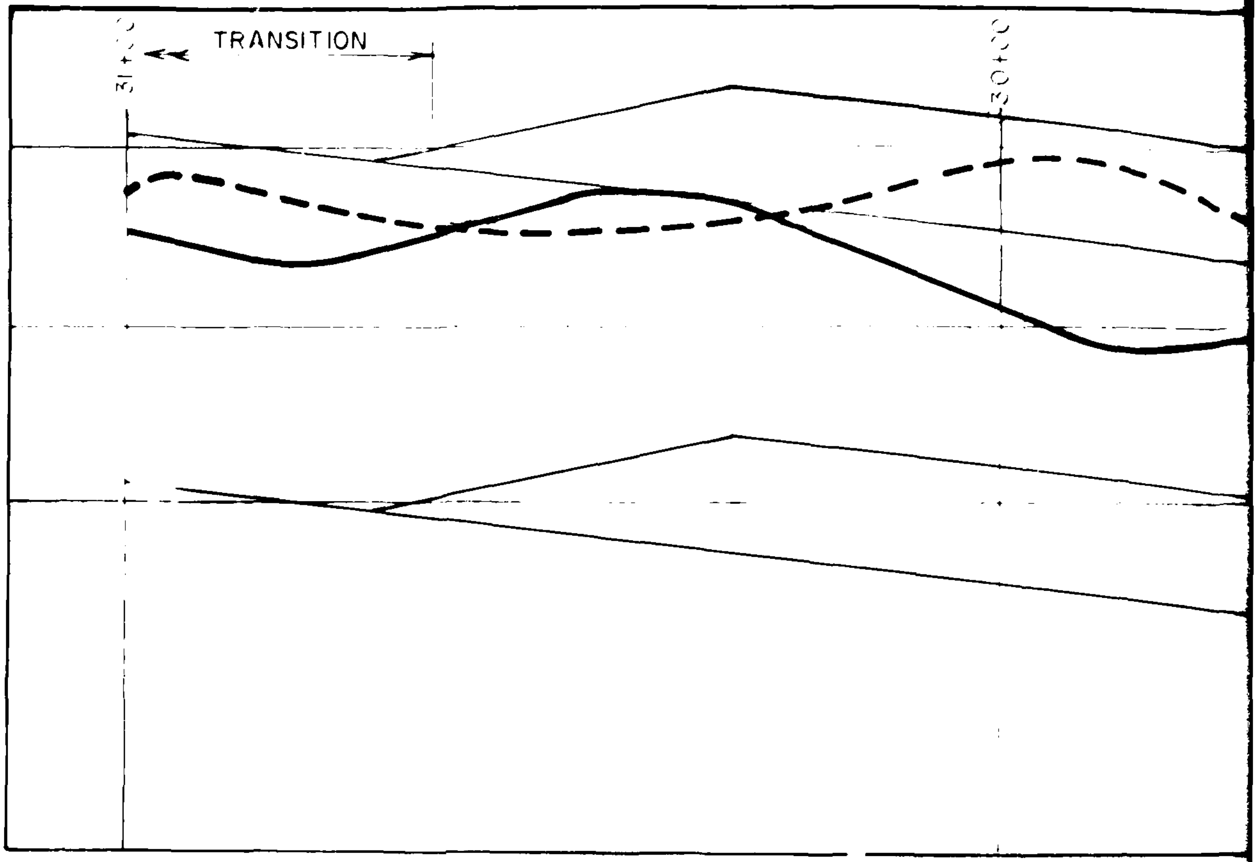

TRANS
24+00
(LEFT)
(RIGHT)
25+00
(LEFT)
(RIGHT)

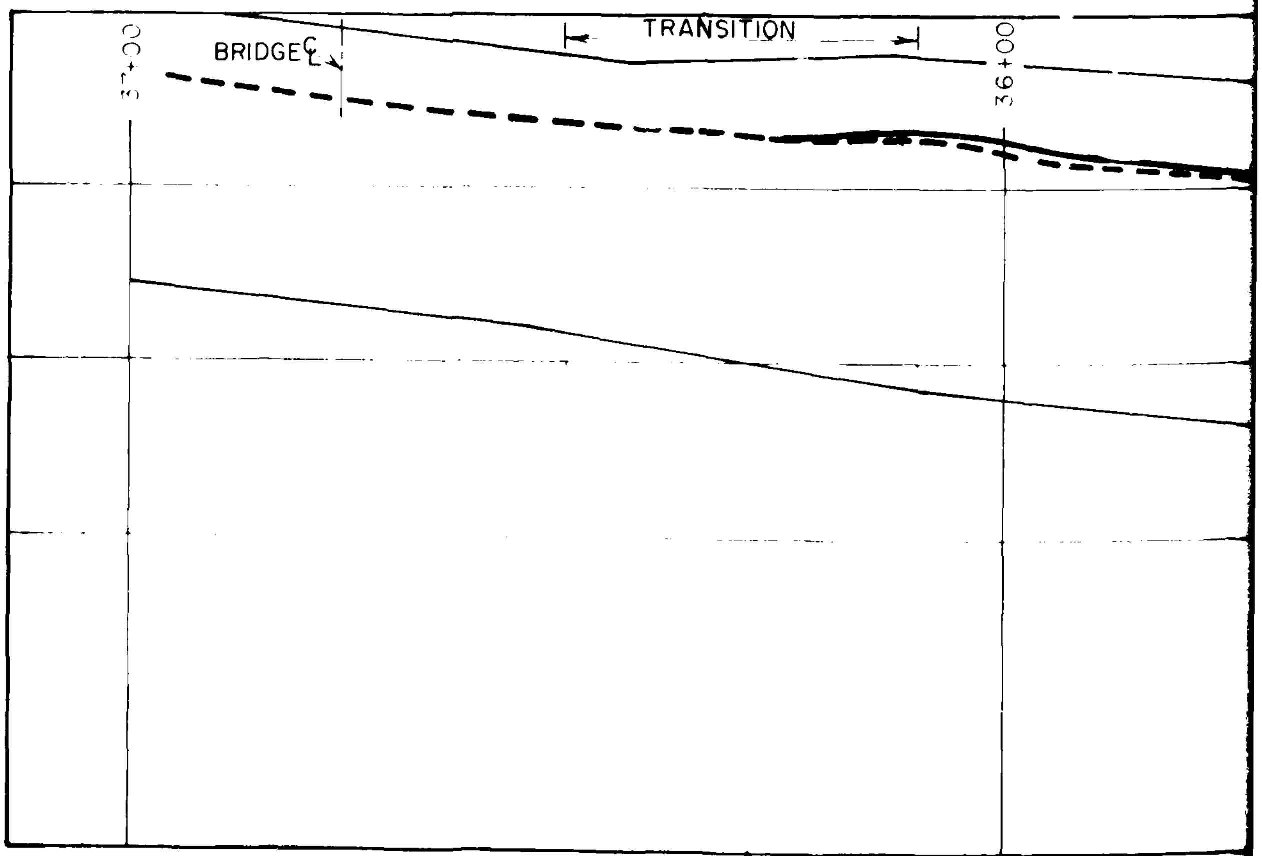

17+00
16+00
TOP OF WALL
TOE OF WALL
TRANSITION
23+00
22+00
(RIGHT)
(LEFT)
(RIGHT)
(LEFT)

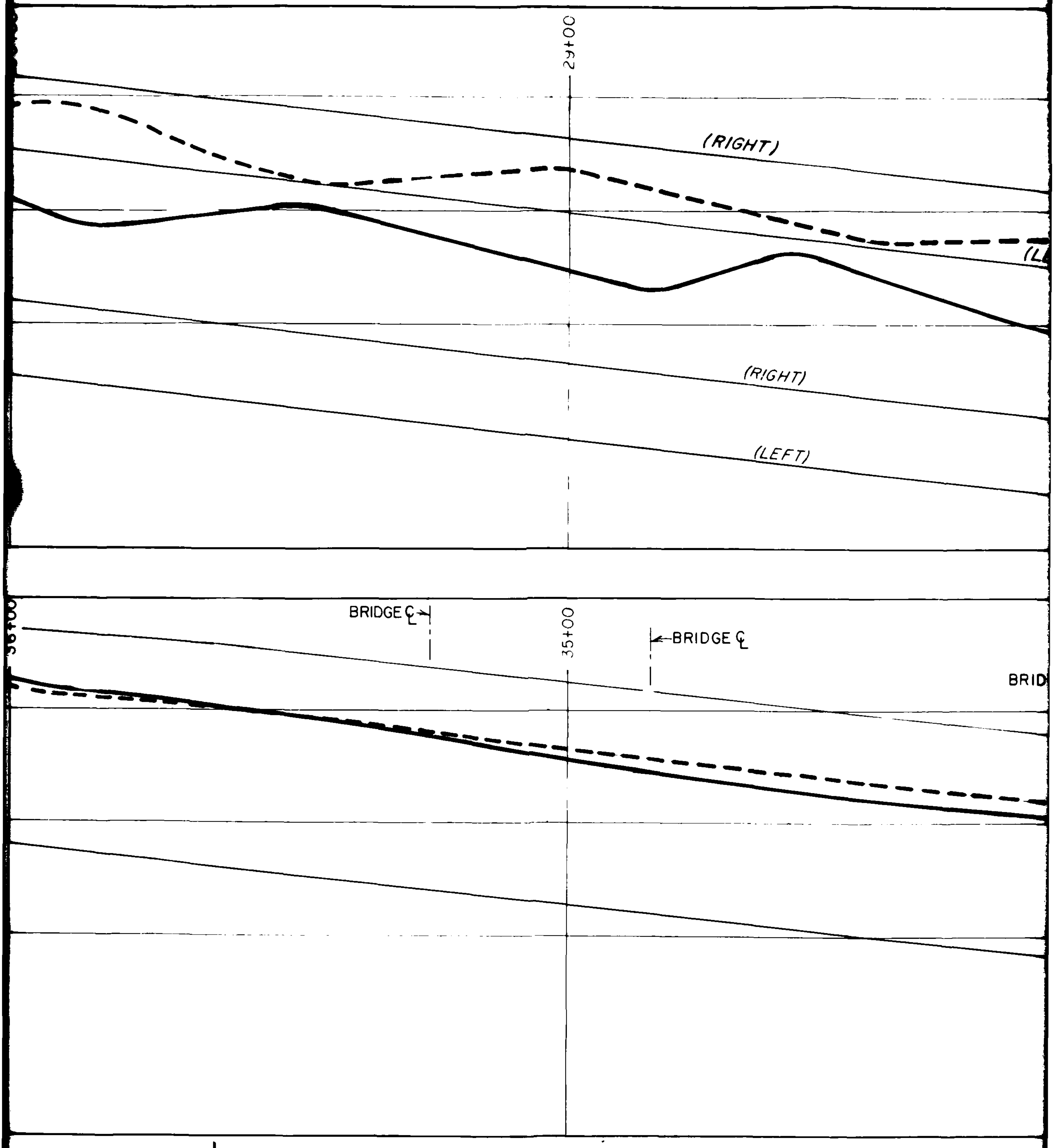

16+00
15+00
(LEFT)
(RIGHT)
LEFT WALL PROFILE
(LEFT)
RIGHT WA
(RIGHT)
22+00
21+00
HIGH STREET BRIDGE
TOP OF WALL
LEFT WALL PROFILE
RIGHT WALL PROFILE
TCE OF WALL

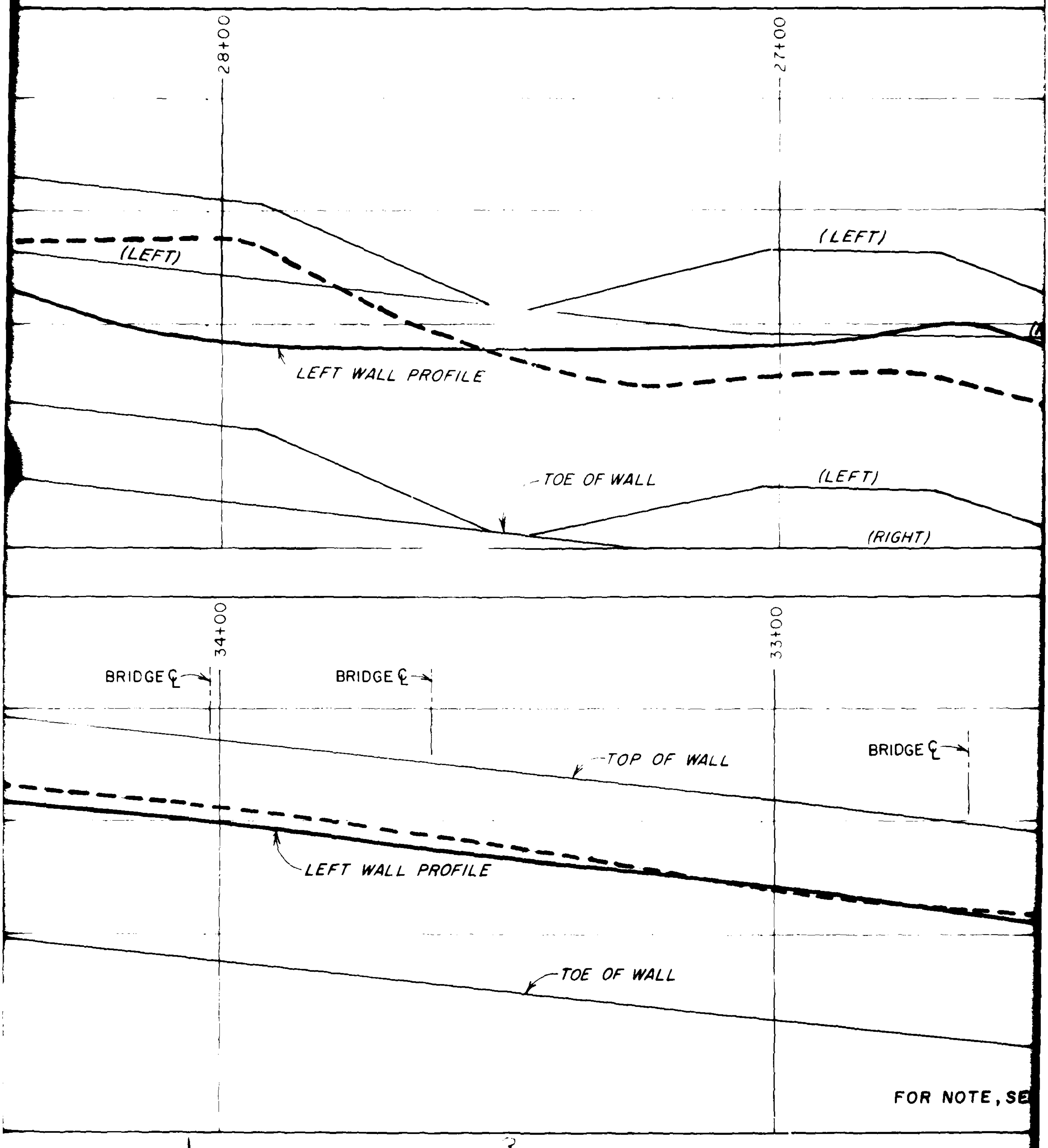


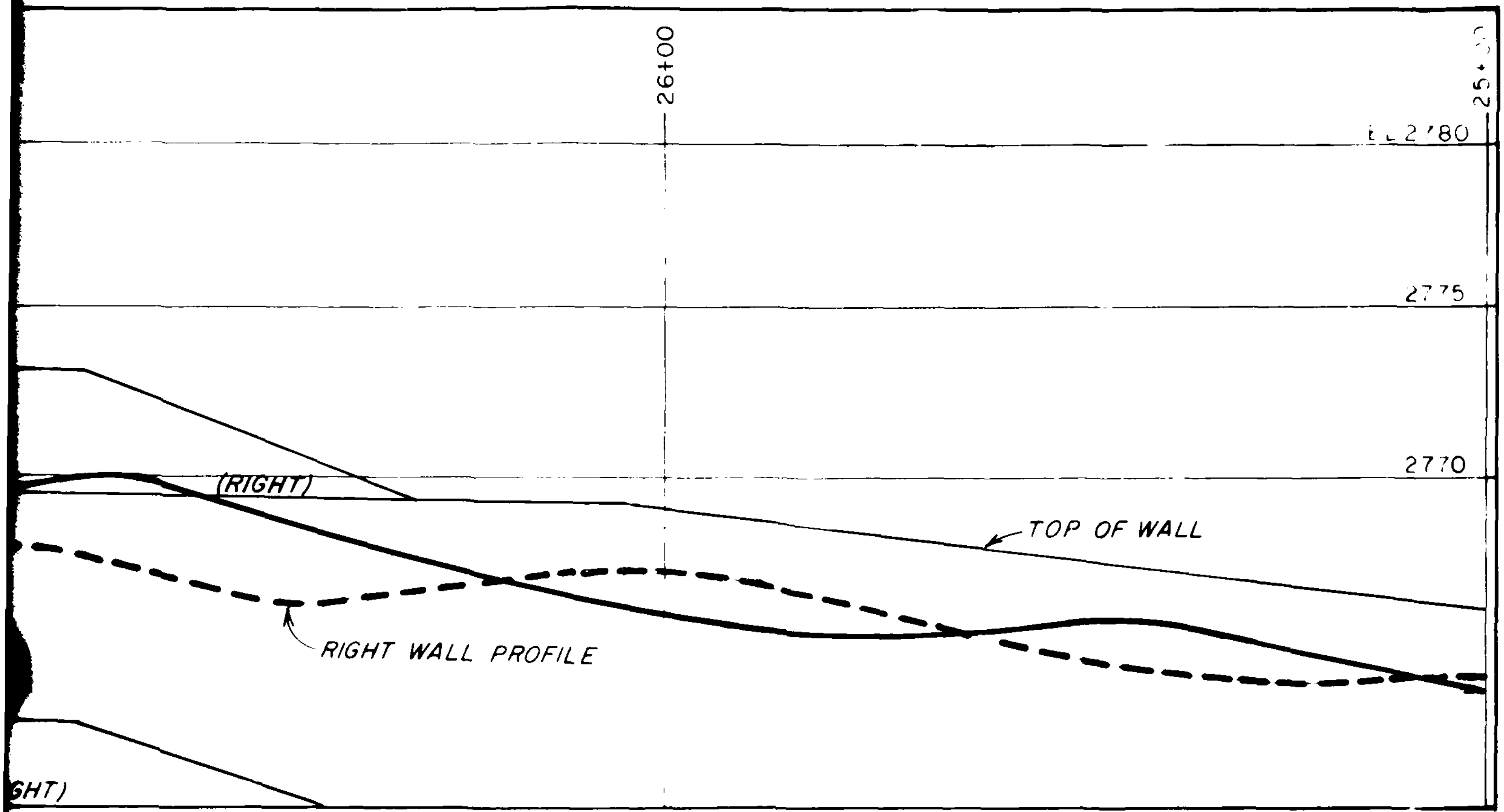
FINAL DESIGN
WATER SURFACE PROFILES
STA 13+00 TO 25+00
PLACER CREEK DISCHARGE 4600 CFS

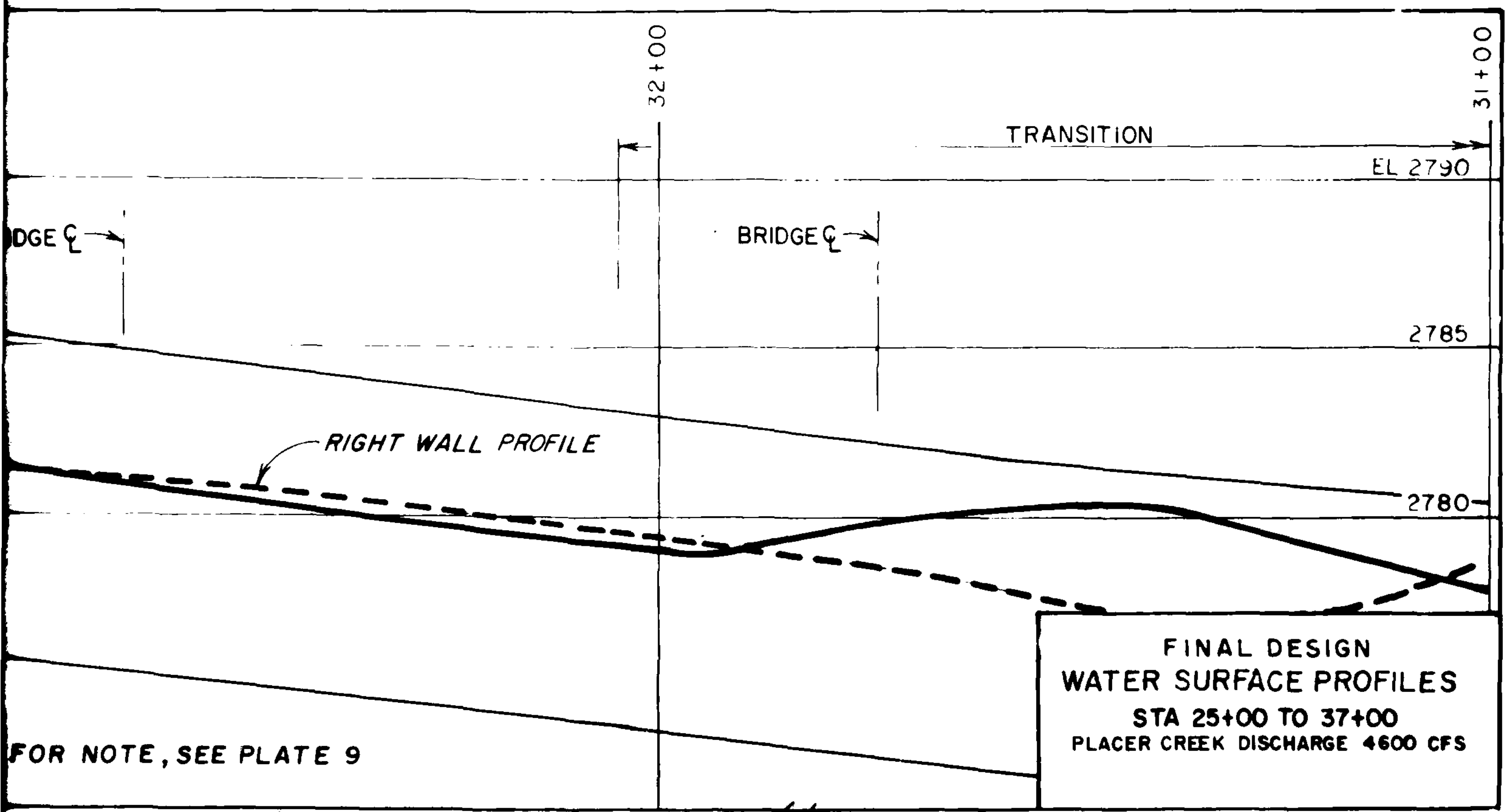

TRANSITION
31+00
30+00


37+00
BRIDGE ℄
TRANSITION
36+00

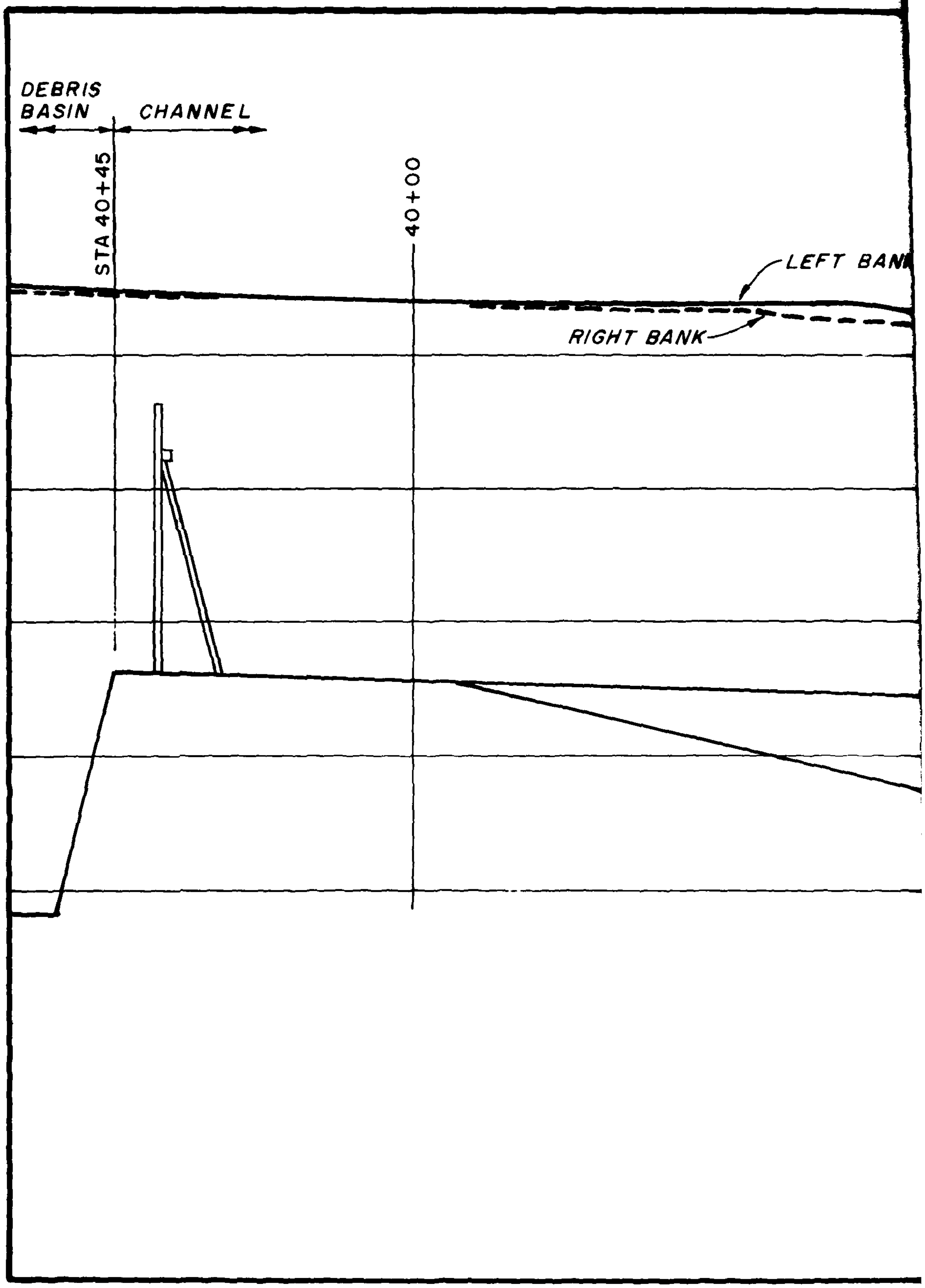

29+00
(RIGHT)
(RIGHT)
(LEFT)
BRIDGE ℄
35+00
BRIDGE ℄

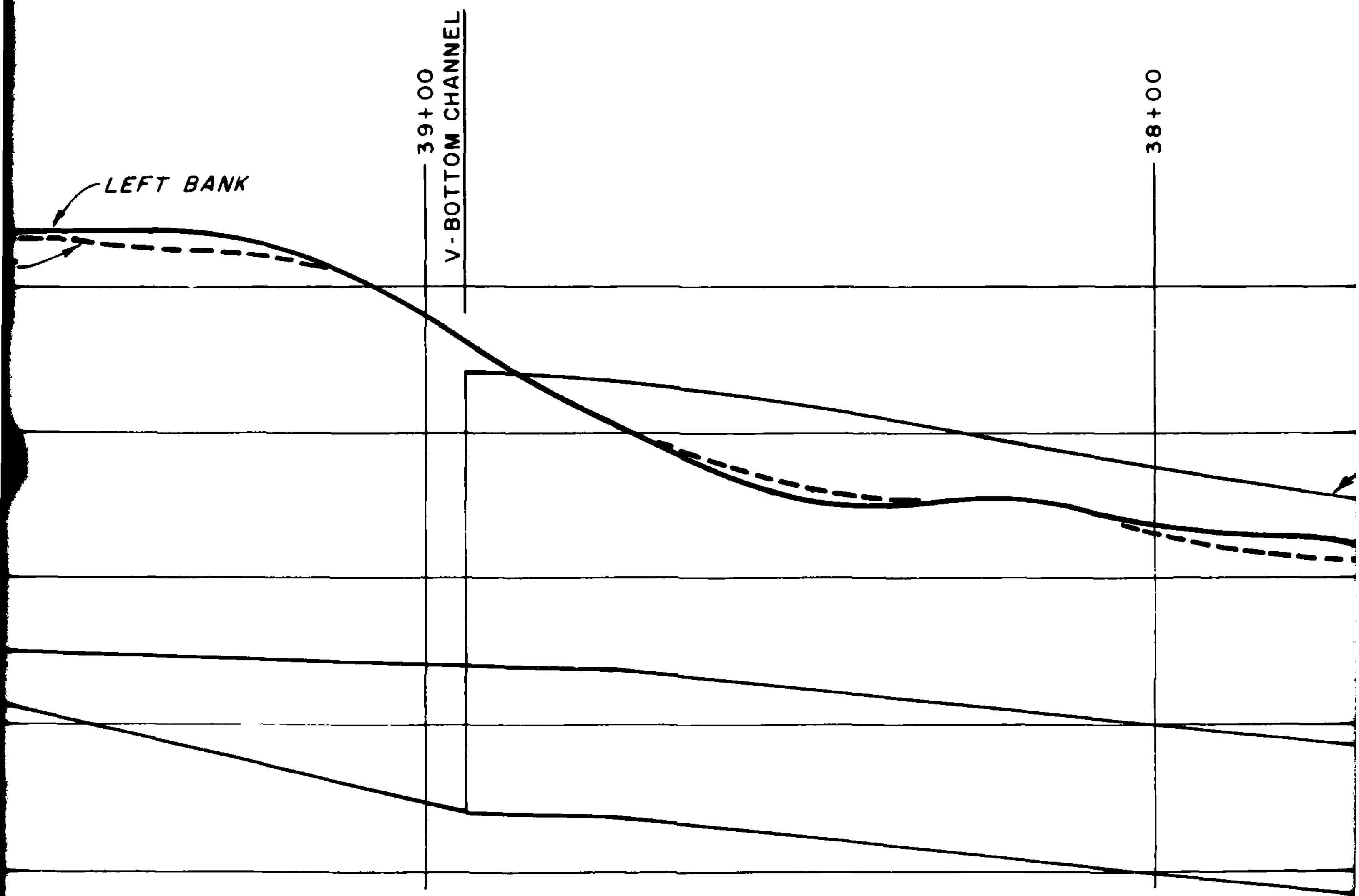

28+00
27+00
(LEFT)
(LEFT)
LEFT WALL PROFILE
TOE OF WALL
(LEFT)
(RIGHT)
34+00
33+00
BRIDGE ℄
BRIDGE ℄
BRIDGE ℄
TOP OF WALL
LEFT WALL PROFILE
TOE OF WALL
FOR NOTE, SE



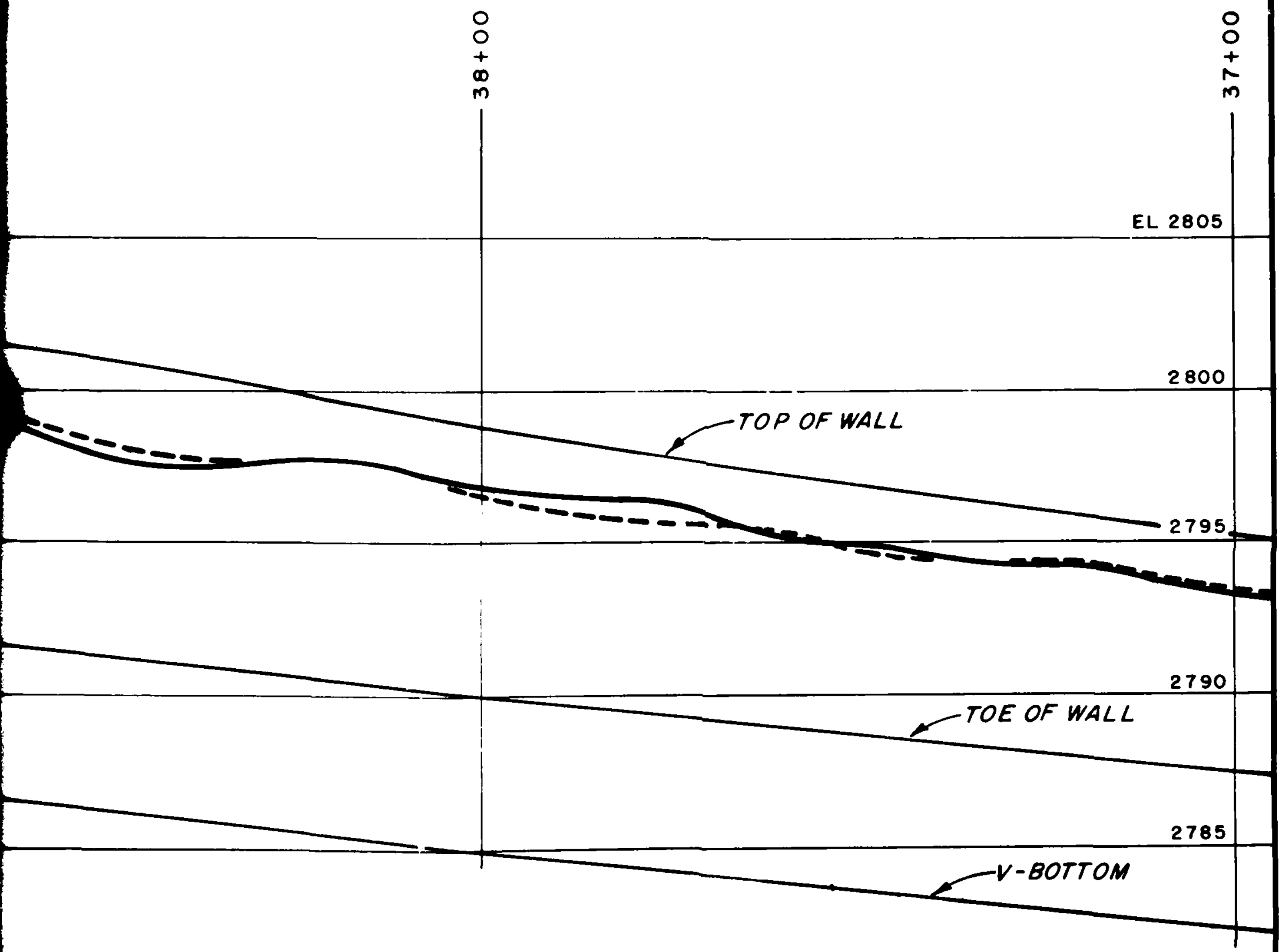


FINAL DESIGN
WATER SURFACE PROFILES
STA 25+00 TO 37+00
PLACER CREEK DISCHARGE 4600 CFS


DEBRIS BASIN
CHANNEL
STA 40+45
40+00
LEFT BAN
RIGHT BANK

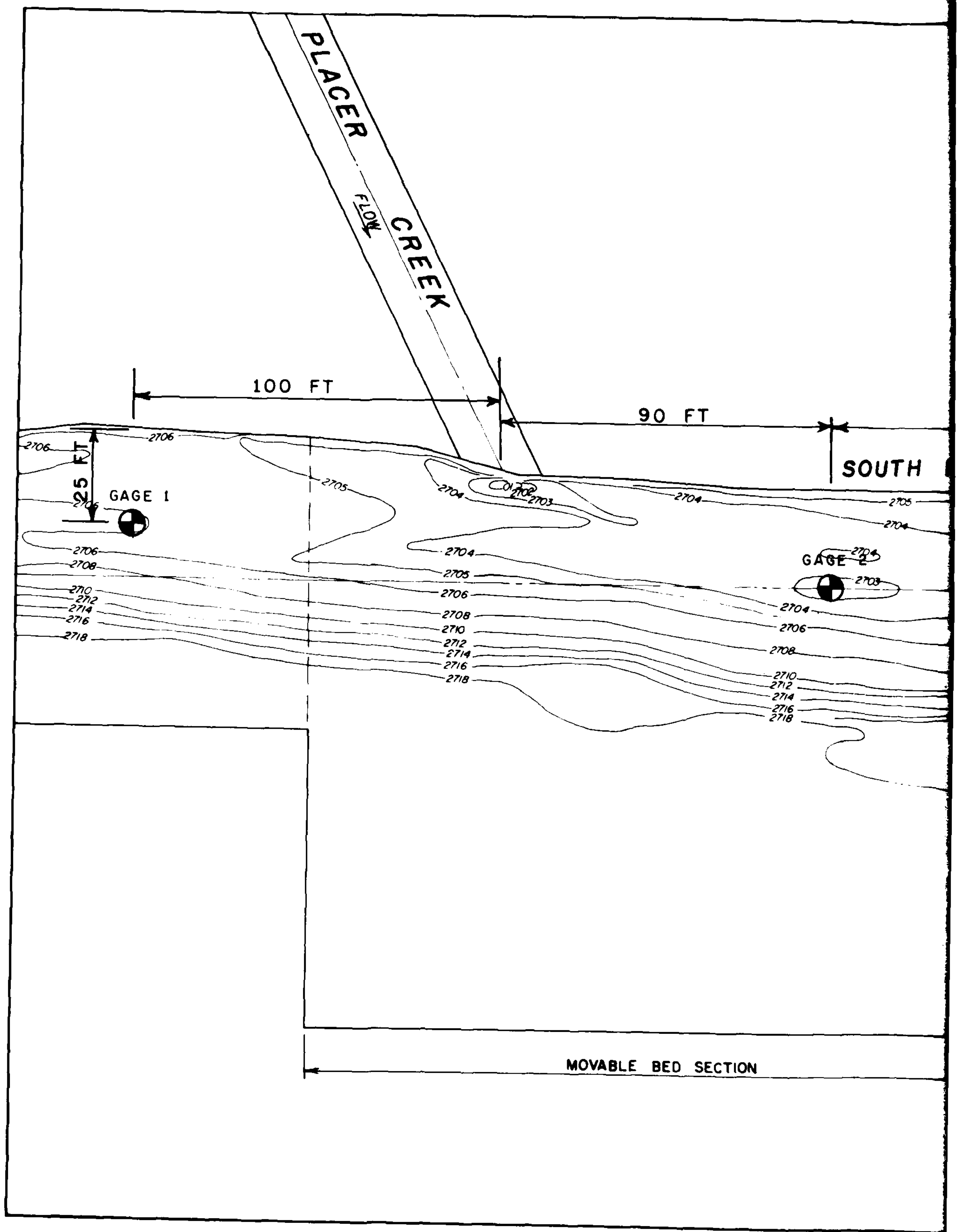


FOR NOTE, SEE PLATE 9

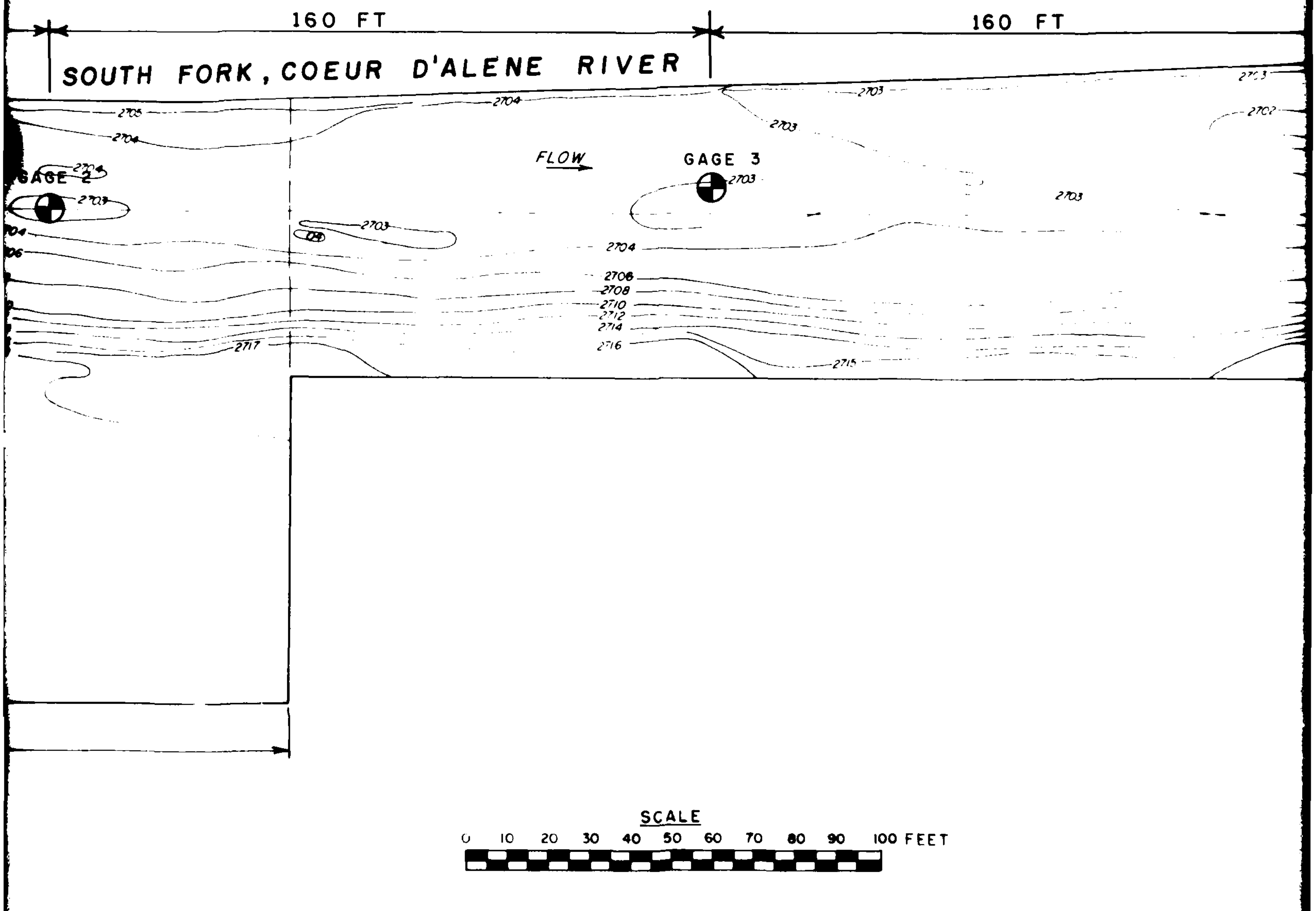


FOR NOTE, SEE PLATE 9

FINAL DESIGN
WATER SURFACE PROFILES
STA 37+00 TO 40+45
PLACER CREEK DISCHARGE 4600 CFS

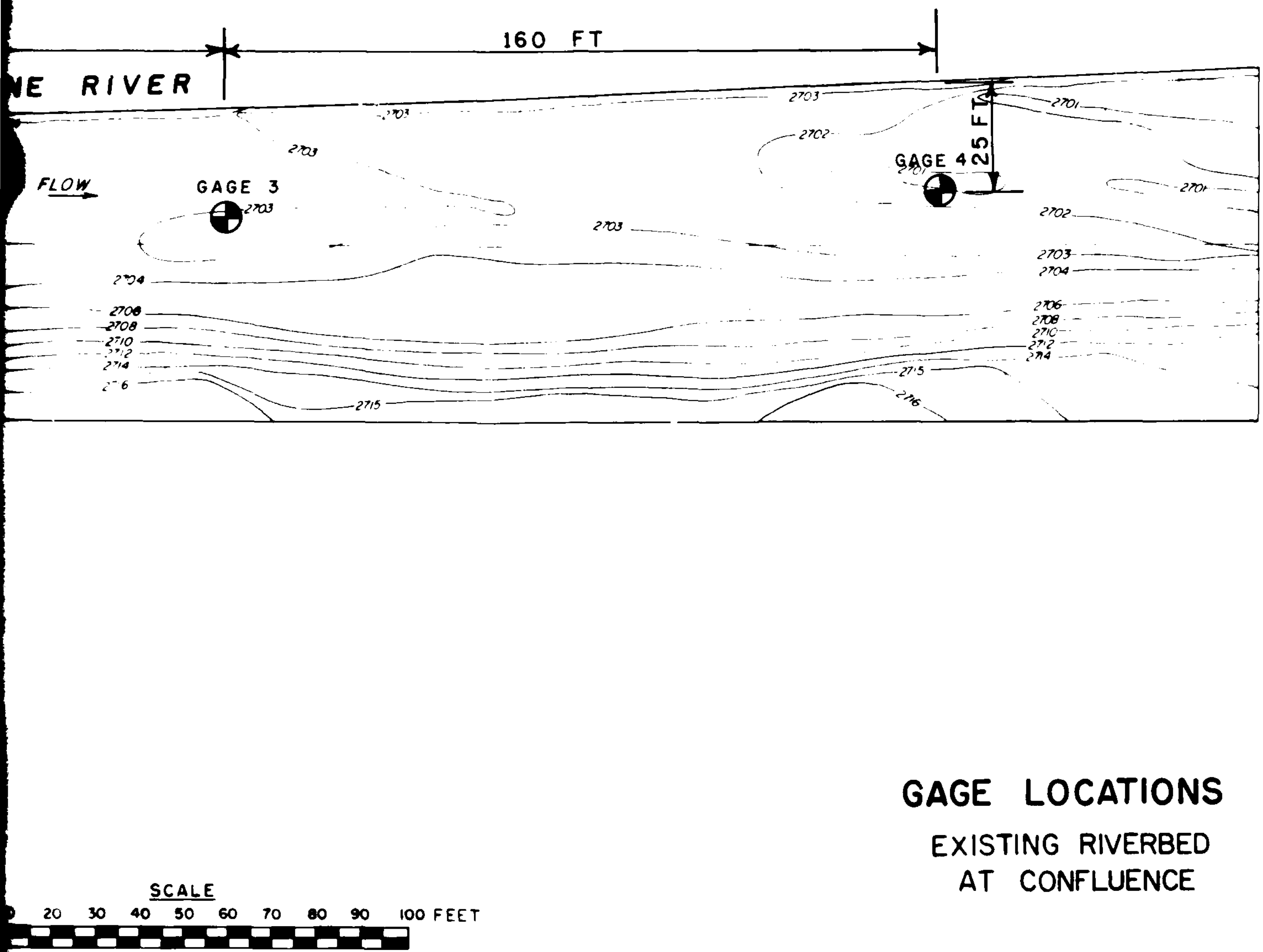


PLACER CREEK
FLOW
100 FT
90 FT
25 FT
SOUTH
GAGE 1
GAGE 2
2703
2704
2705
2706
2708
2710
2712
2714
2716
2718
MOVABLE BED SECTION


160 FT
160 FT
SOUTH FORK, COEUR D'ALENE RIVER
FLOW
GAGE 3
GAGE 2
2703
2704
2705
2706
2708
2710
2712
2714
2715
2716
2717
2702
SCALE
0 10 20 30 40 50 60 70 80 90 100 FEET

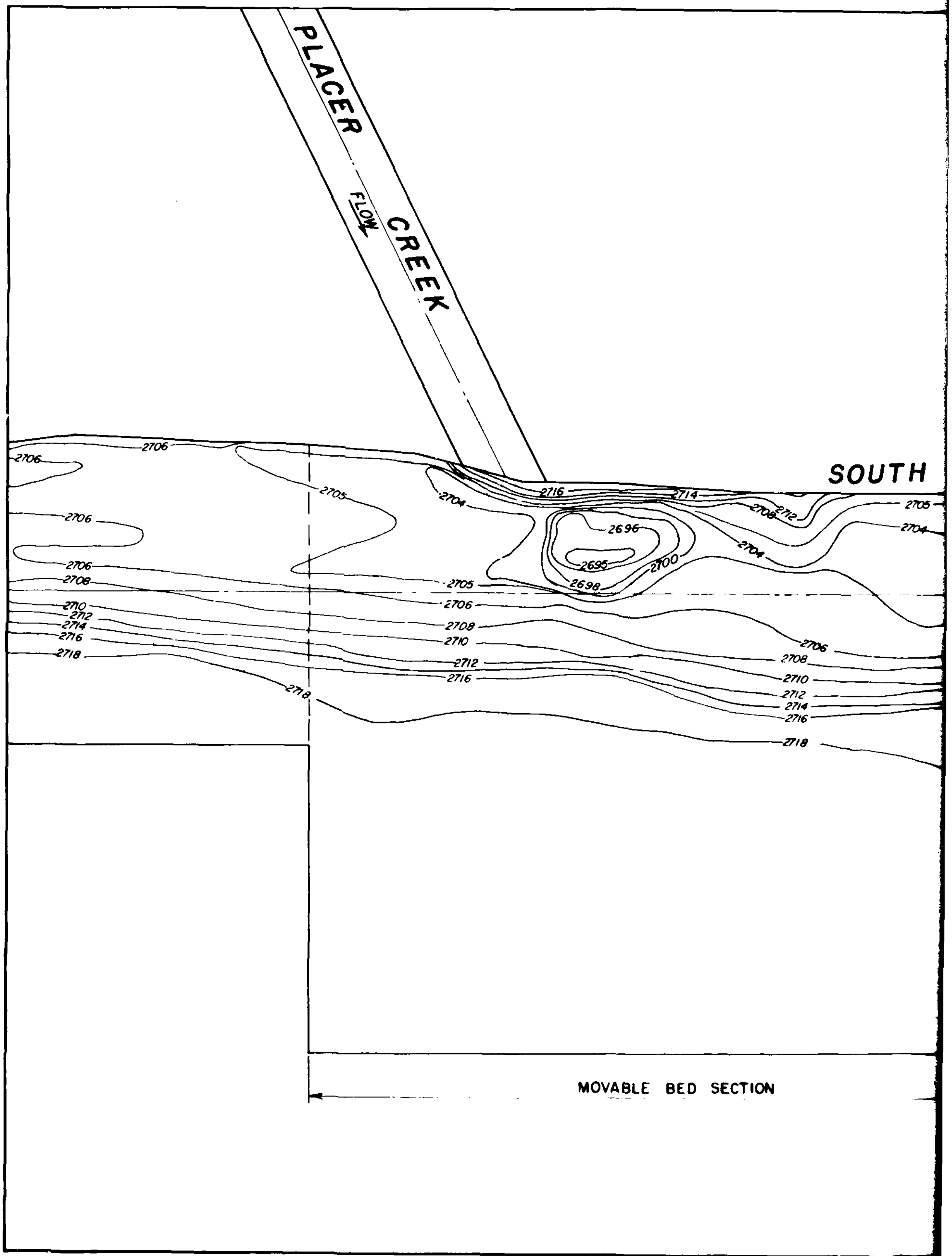
1

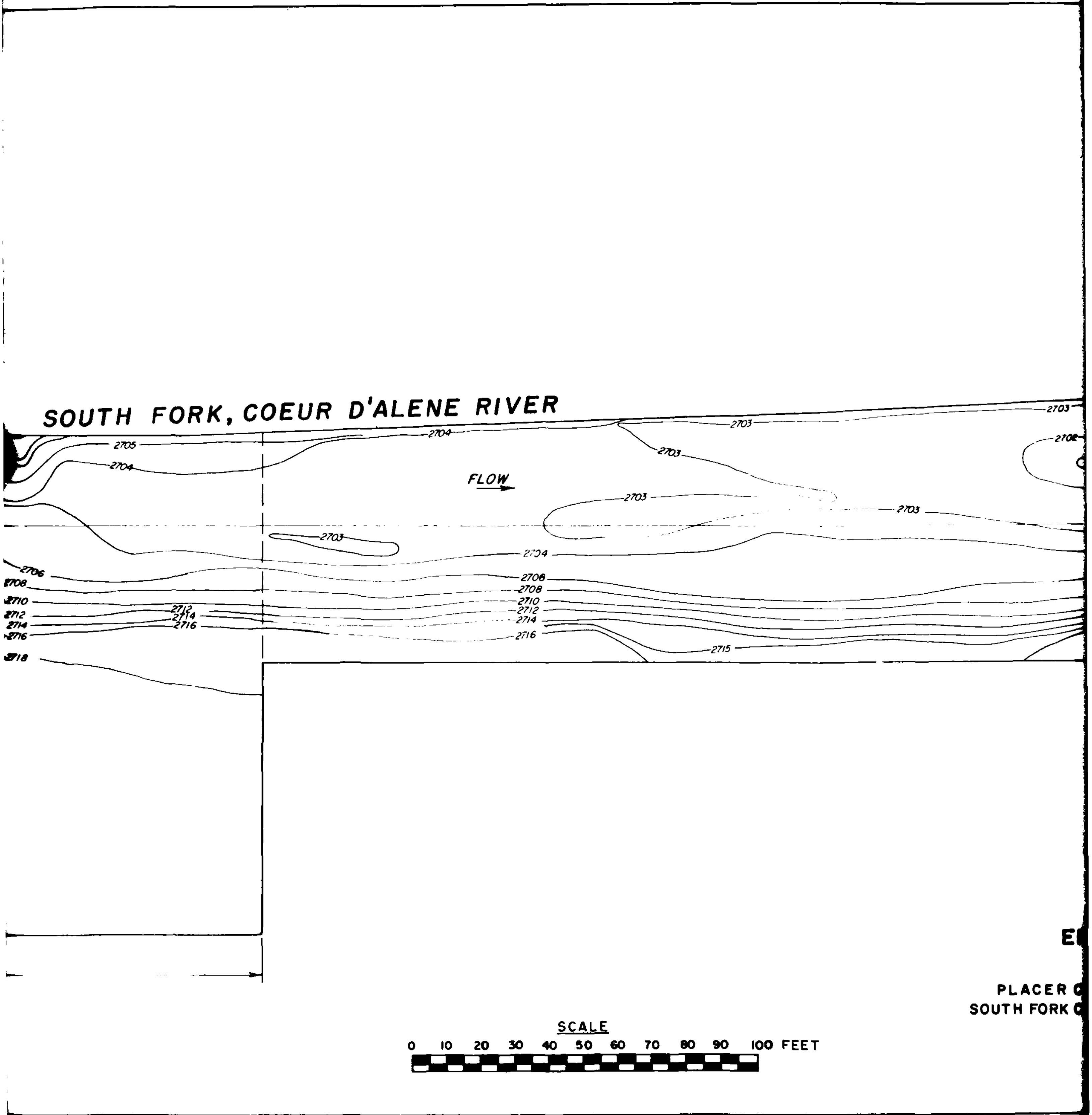
2

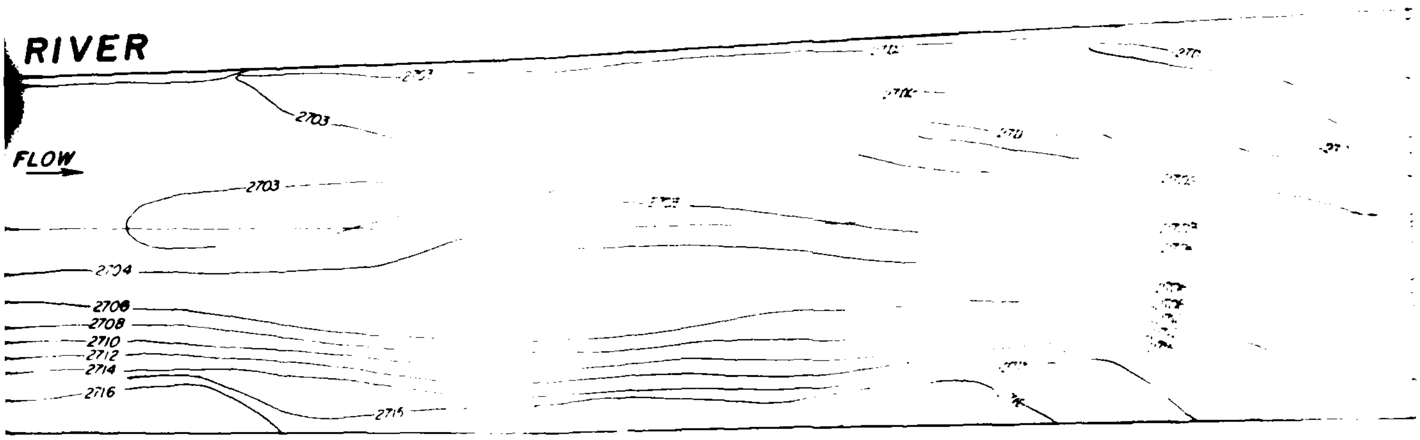


GAGE LOCATIONS

EXISTING RIVERBED
AT CONFLUENCE


PLACER CREEK
FLOW
SOUTH
2706
2705
2704
2716
2714
2712
2708
2706
2696
2695
2700
2698
2710
2718
MOVABLE BED SECTION


SOUTH FORK, COEUR D'ALENE RIVER
FLOW
2703
2704
2705
2706
2708
2710
2712
2714
2715
2716
2718
SCALE
0 10 20 30 40 50 60 70 80 90 100 FEET
PLACER C
SOUTH FORK C



EROSION AT CONFLUENCE

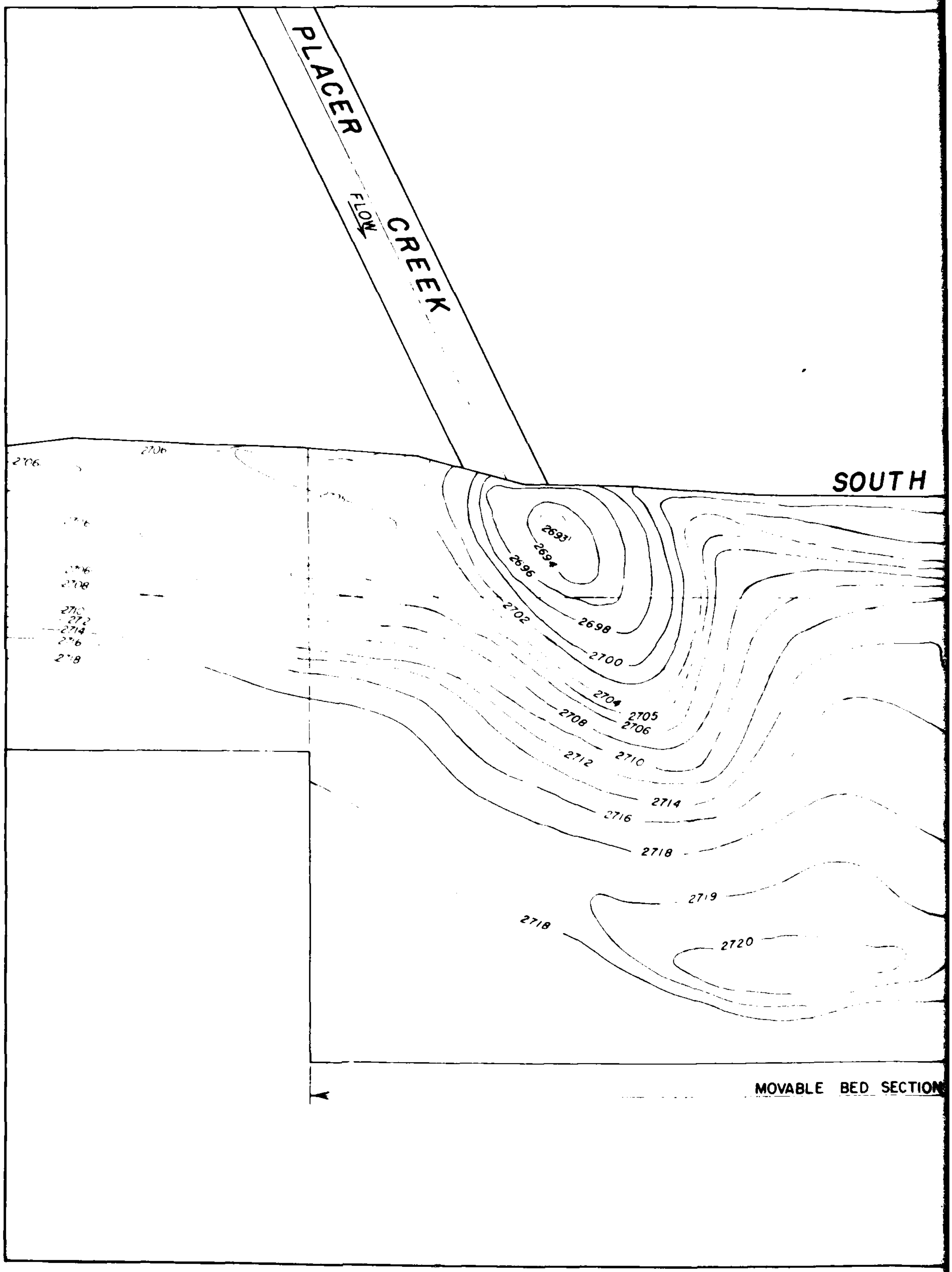
WINTER RAIN FLOOD

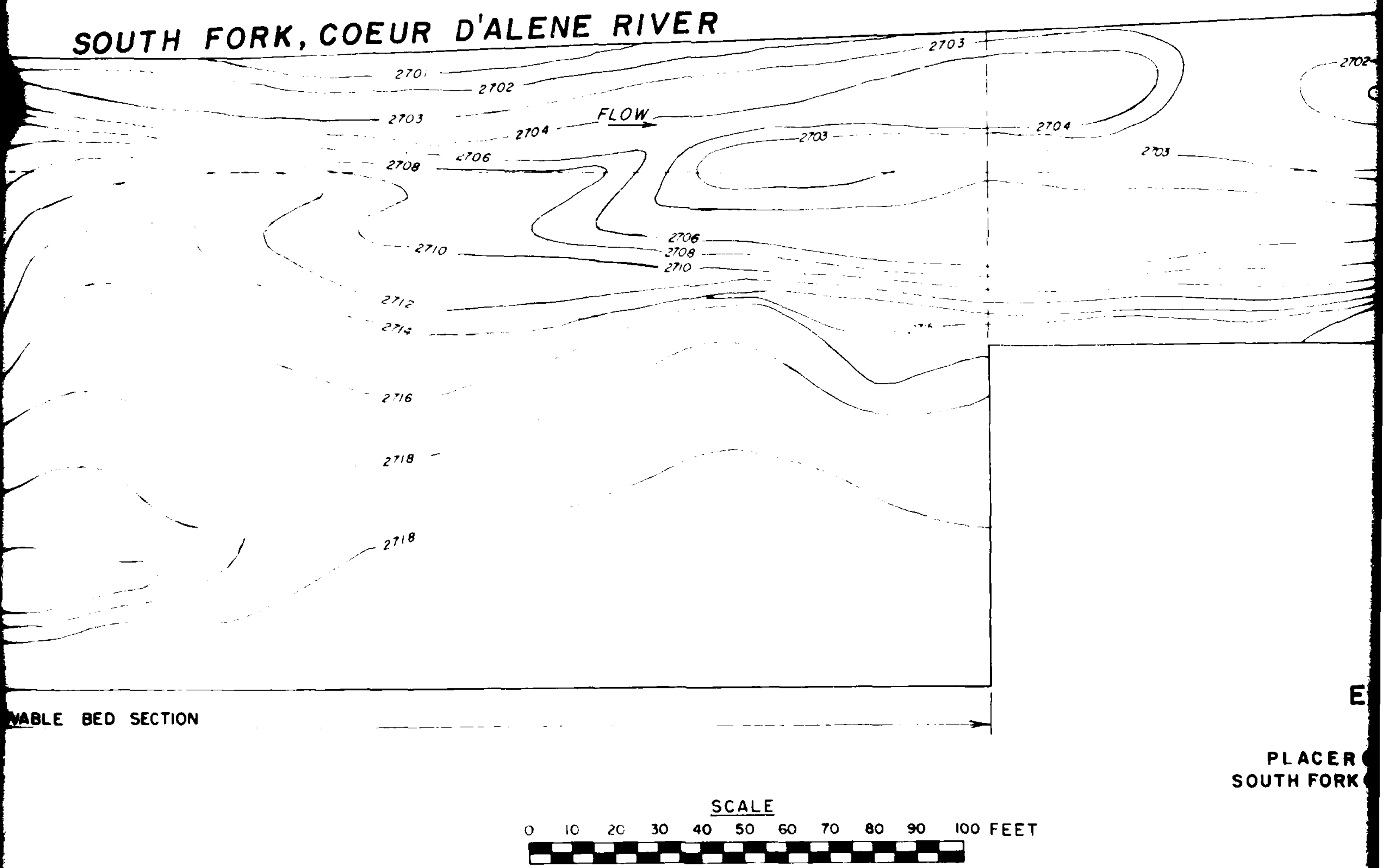
PLACER CREEK MAXIMUM DISCHARGE 3050 CFS
SOUTH FORK COEUR D'ALENE RIVER DISCHARGE 7175 CFS

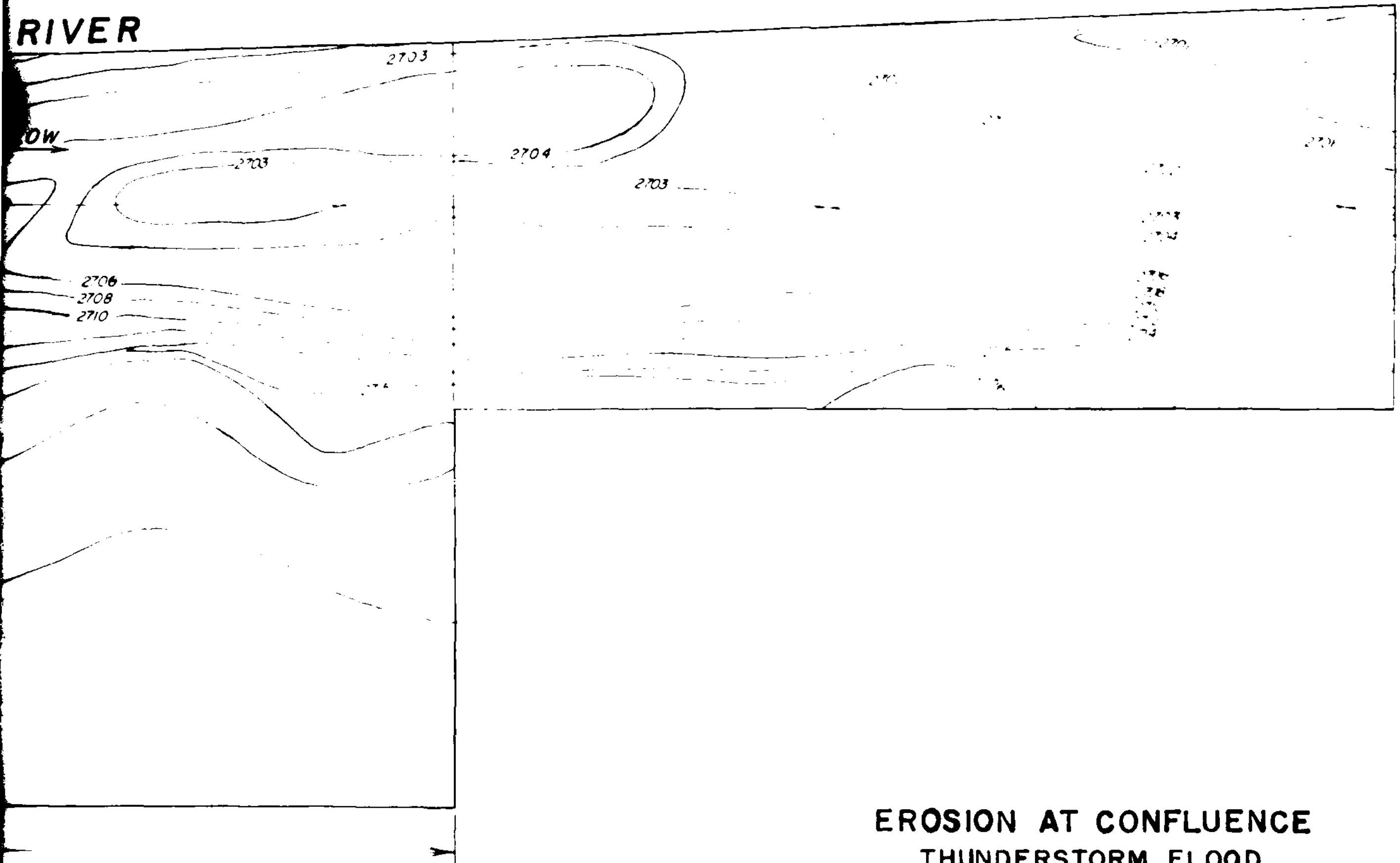
SCALE

20 30 40 50 60 70 80 90 100 FEET

PLATE 1.
3


PLACER CREEK
FLOW
SOUTH
2693'
2694
2696
2698
2700
2702
2704
2705
2706
2708
2710
2712
2714
2716
2718
2719
2720
MOVABLE BED SECTION


SOUTH FORK, COEUR D'ALENE RIVER
FLOW
2701
2702
2703
2704
2706
2708
2710
2712
2714
2716
2718
2718
2703
2704
2703
2703
2702
2706
2708
2710
ABLE BED SECTION
E
PLACER
SOUTH FORK
SCALE
0 10 20 30 40 50 60 70 80 90 100 FEET



EROSION AT CONFLUENCE
THUNDERSTORM FLOOD
PLACER CREEK MAXIMUM DISCHARGE 4600 CFS
SOUTH FORK COEUR D'ALENE RIVER DISCHARGE 400 CFS

SCALE
20 30 40 50 60 70 80 90 100 FEET

PLATE 15