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CORPS OF ENGINEERS, U. S. ARMY

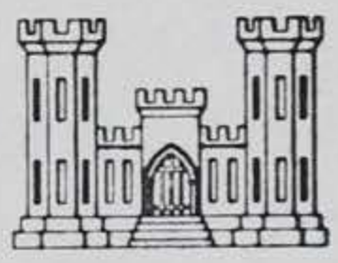
MISSISSIPPI RIVER COMMISSION

MODEL STUDY OF SPILLWAY

FOR

DEWEY DAM, JOHNS CREEK

KENTUCKY



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U. S. WATERWAYS EXPERIMENT STATION

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MODEL STUDY OF SPILLWAY

FOR DEWEY DAM, JOHNS CREEK, KENTUCKY

SYNOPSIS

1. This memorandum constitutes the final comprehensive report on the model study performed at the U. S. Waterways Experiment Station on the spillway for the Dewey Dam, Johns Creek, Kentucky. The general purpose of the study was to investigate the hydraulic performance of the proposed spillway structure and to determine the protective measures necessary to insure the safety of the dam and appurtenant structures during the occurrence of high discharges. All tests were conducted on a model built to the linear scale ratio, model to prototype, of 1 to 50.

2. Principal findings of the model study were as follows:

   a. The narrow hill jutting into the reservoir area upstream from the spillway approach channel did not affect flow entering the approach, nor did it affect the efficiency of the spillway.

   b. An ogee crest control was found to be more efficient than the flat crest control of original design, permitting the spillway width to be reduced by 12 ft (from 60 ft to 48 ft). The use of the ogee crest caused the flow downstream from the crest to be passed at subcritical depth, thus permitting a decrease in the height of the side walls.

   c. For the original stilling basin, tailwater depths were insufficient for the creation of a hydraulic jump, and at all discharges shooting flow existed in the basin and part of the exit channel. A revised stilling basin was developed, with floor lowered 27 ft, which was satisfactory for all discharges.

   d. There was no destructive eddy action along the downstream toe of the dam, thus obviating the need for the suggested steel-cell protection in this area.

PART I: INTRODUCTORY

Chronology

3. Authority to undertake the model study of the Dewey Dam spillway was requested by the District Engineer, U. S. Engineer Office, Huntington, West Virginia, in a letter dated December 23, 1940, to the Chief of Engineers, through the Division Engineer, Ohio River Division; authority was granted by the Chief of Engineers in an indorsement to the above letter, dated February 5, 1941. The study was conducted during the period from May 1941 to September 1941. The final comprehensive report (this memorandum) was published December 15, 1942; all the data from the tests, however, were supplied to the District Engineer as soon as obtained, in the form of interim reports.

Purpose

4. The general purpose of the model study was to examine the hydraulic performance of the proposed spillway for the Dewey Dam. Of particular interest was the development of a stilling-basin design which would dissipate the energy of flow from the spillway and also prevent the occurrence of destructive eddies which might erode the toe of the dam. Some doubt also existed as to the accuracy of the assumed spillway coefficient for the maximum discharge, due to the possible change in direction of flow caused by the hill opposite the spillway jutting into the approach area.

Liaison

5. During the course of the model study, close liaison was

maintained between the Experiment Station and the Huntington District Office. This liaison was accomplished by means of: (a) progress reports submitted every two weeks to the District Engineer; (b) preliminary reports on results of certain tests which were forwarded to the District Engineer after the completion of the tests; and (c) visits to the Experiment Station by the District Engineer and his technical assistant. These visits were so arranged as to permit inspection of the model during tests of the various plans.

Personnel

6. The model study was accomplished in Experiment Section No. 2 of the Hydraulics Division of the U. S. Waterways Experiment Station. Chief of the Hydraulics Division is Lieutenant J. M. Caldwell, C. E.; chief of Experiment Section No. 2 is Mr. F. R. Brown, Associate Engineer. The project engineer directly in charge of the model study was Mr. C. Kestenbaum, Junior Engineer. During the prosecution of the study, Lieutenant Colonel K. E. Fields, C. E., was Director of the Experiment Station, aided by Mr. J. B. Tiffany, Jr., Senior Engineer (formerly Civilian Executive Assistant), present Assistant Director. Director of the Experiment Station during the preparation of this memorandum was Mr. G. H. Matthes, Head Engineer.

7. Lieutenant Colonel F. H. Falkner, C. E., District Engineer, and Major Harry Pockras, C. E., of the Huntington District Office, visited the Experiment Station in an advisory capacity at intervals during the testing program.

PART II: DESCRIPTION OF THE PROTOTYPE*

General Features

8. The Dewey Dam is proposed for construction near Paintsville, Kentucky and is one unit in the general comprehensive plan for flood control in the Ohio River Basin (see plate 1). The dam will be a rolled-fill earth embankment and will contain approximately 900,000 cu yds of earth. The main section of the dam will be about 850 ft long and will rise to a maximum height of 118 ft above the bed of the stream. The reservoir created by the dam will have a total storage capacity of 88,000 acre-feet of water at spillway-crest elevation of 686; of the total storage capacity, 77,000 acre-feet are required for flood control; the 11,000 acre-feet remaining are for conservation.

Spillway

General

9. Reference is made to plates 2 and 3, showing the position and general outline of the spillway. The spillway structures will be located in the left abutment of the dam and are designed to pass a discharge of 22,800 cfs under a head of 25 ft; the maximum flood of record is 8,100 cfs. The spillway will be of the chute-type with uncontrolled crest. Both a 60-ft-wide flat-crested control section and a 48-ft-wide ogee control section were tested on the model. The chute,

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* Information on the prototype was obtained from the "Report on Dewey Reservoir Project, Johns Creek, Kentucky." The prototype description has been altered to accord with the modifications indicated by the model studies.

extending downstream from the crest section, will have an over-all length of about 637 ft. It will extend a distance of 246 ft on a slope of 0.005, a distance of 124 ft on a slope of 0.31, and a distance of 161.2 ft on a slope of 0.25. A 106-ft vertical curve will connect the 0.005 and 0.31 chute slopes (see plate 3). The upper portion of the chute will be curved in plan on a 530-ft radius and will have a width of 60 ft or 48 ft, depending on the crest control selected by the District Office; the portion of the chute below the vertical curve will have a straight alignment and a width of 40 ft. The most satisfactory stilling-basin design investigated consisted of a 108.8-ft horizontal apron at elevation 588.3 msl and a 11.7-ft end sill. No baffle piers were used.

Statistical data

10. Pertinent statistics pertaining to the dimensions of the spillway and most satisfactory stilling-basin design as indicated by model tests, are tabulated below:

a. Structural

Length of spillway	270 ft
Width of spillway (control section)	
Type A spillway	60 ft
Type B spillway	48 ft
Radius of horizontal curvature (on centerline)	530 ft
Elevation of crest	686 ft*
Length of chute	391.2 ft
Width of chute (bottom)	40 ft
Chute slope	1 on 200
	1 on 3.22
	1 on 4
Length of stilling basin	108.8 ft

* All elevations are in feet above mean sea level.

Width of stilling basin	40 ft
Elevation of stilling basin	588.3 ft

b. Hydraulic

Design discharge	22,800 cfs
Maximum flood of record	8,100 cfs
Design headwater elevation	711.0 ft
Design head on crest	25.0 ft
Minimum tailwater elevation at the stilling basin for design discharge	633.0 ft*
Maximum tailwater elevation at the stilling basin for design discharge	636.5 ft*
Range in tailwater depth at the stilling basin	48.2 ft*

Control Structures

11. Reference is made to plate 2 showing the position of the control structures and their general layout. These structures will be located in the left abutment ridge to the right of the spillway. The outlet structures are designed to serve the dual purpose of diverting flow during construction and controlling the outflow from the reservoir. Principal components of the control structures will be a three-gated intake structure, one 11.5-ft radius horseshoe-shaped tunnel with an over-all length of 500 ft, and a stilling basin. The stilling basin will discharge into an exit channel which will curve to the right to a junction with the original creek channel at station 9+50. A maximum diversion discharge of 3000 cfs through the outlet structures is contemplated. The capacity of the conduit at spillway-crest level (elevation 686) will be 5000 cfs. Only a few observation tests were conducted on the outlet structures in this study.

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* These data are from model results.

PART III: THE MODEL

Design Considerations

12. The accurate reproduction of hydraulic conditions in a small-scale model requires geometric and dynamic similarity of model and prototype. Geometric similitude is readily attained by carefully constructing the model to the linear scale ratio selected. Dynamic similitude is attained by consideration of the predominating forces involved and the reproduction of all hydraulic quantities in accordance with these forces. In models of overfall structures, such as the Dewey spillway, the force of gravity is dominant. Thus, all hydraulic quantities will vary according to the Froudian relationship. It is further required for practical dynamic similarity that the surface of the model have a roughness value in agreement with that of the corresponding prototype surface.

13. In meeting the requirements for complete dynamic similarity of model and prototype, the model representation of a prototype surface must be smoother as the scale ratio decreases. For the scale ratio of 1 to 50 adopted for the Dewey model, the roughness scale should be 1 to 1.919. Assuming the roughness of the prototype to be about 0.013, the model roughness should be about 0.0068. In the construction of the Dewey model, care was taken to make all spillway surfaces as smooth as possible, and a value of about 0.0085 was probably attained. The difference between this value and the theoretically correct value of 0.0068 has been found to be insignificant in the performance of the stilling basin. In the calibration of the spillway, however, the variation in roughness

might result in a slight reduction of indicated spillway efficiency.

14. Relationships for the transference of model data to prototype equivalents are presented in the following table:

Dimension	Scale Ratio
Length	1/50
Area	1/2,500
Time	1/7.07
Velocity	1/7.07
Rate of Discharge	1/17,677

Description of the Model

General

15. The model of the spillway for the Dewey Dam was built to the linear scale ratio, model to prototype, of 1 to 50. There were reproduced in the model 1400 ft of approach channel, the dam, the spillway, the stilling basin, the spillway exit channel, the outlet structures (schematically), and about 1000 ft of the Johns Creek area below the junction of the spillway outlet channel with Johns Creek. Reference is made to plate 2 which shows the area reproduced on the model. The dimensions of the model structures were in accordance with prototype plans and specifications prepared by the Huntington District Office.

Construction

16. That portion of the model representing the approach channel, the dam, the spillway, and the walls of the spillway exit channel, was molded in cement mortar to sheet-metal templets, and that portion of

the model below the dam, including the spillway exit channel, was molded in sand. For velocity observation tests, the sand bed was rendered immovable by the application of a thin coating of cement mortar. Care was exercised to obtain the proper shape of all surfaces.

Appurtenances

17. The water used in the model was supplied by a centrifugal pump. The water was pumped from a large sump and was measured by means of a venturi meter. The flow from the supply line spilled into a head-bay, where it was stilled by baffles prior to its passage into the model. After passing through the model, the water returned to the sump through an underground conduit. The tailwater in the lower end of the model was maintained at any desired depth by means of an adjustable tailgate. Steel rails set to grade on both sides of the model provided a datum for the use of measuring devices. Water-surface profiles were measured by means of a portable point gage mounted on an aluminum channel supported by the above-mentioned steel rails. Velocities were measured with a pitot tube and with a midget current meter also supported by the aluminum channel. Pressures over the spillway and chute were measured in manometers connected by tubes to piezometer openings in the model (see plate 5). Soundings over the sand bed below the dam were measured with a portable sounding rod.

Method of Operation

General

18. To accomplish the purpose of the model study (paragraph 4), it was necessary to conduct model tests which involved consideration

of (a) the relation of the pool elevation in the reservoir to the discharge; (b) profiles of the water surface and pressures over the spillway crest, in the chute, and stilling basin; (c) the depth and location of scour below the stilling basin and along the toe of the dam; (d) the magnitude of velocities in the approach channel, stilling basin, and exit area; and (e) observation of energy-dissipating characteristics of the stilling basin. In the operation of the model, all discharge and flow data were reproduced in accordance with computations supplied by the Huntington District Office. All tailwater elevations for both stilling-basin and exit-area tests were set in accordance with the computed rating curves, for either maximum or minimum tailwater, 0.5 mile below the axis of the dam. The computed rating curves were furnished by the Huntington District Office and were based on the assumptions that for maximum tailwater depths Levisa Fork would be in flood, and that for minimum tailwater depths no backwater would be expected from Levisa Fork (see plate 6).

Spillway calibration

19. The relation of the pool elevation in the reservoir to the discharge was determined at increments from a low flow of 4000 cfs to a maximum flow of 24,000 cfs. The pool elevation was obtained for each discharge, after the model was adjusted, by means of a hook gage located in a stilling well which was in turn connected to the headwater pool at a point beyond the influence of the velocity of approach. Data on the pool-discharge relation serve as a check on the computed rating curve, thus insuring the passage of the desired discharge through the spillway at about the predicted pool levels.

Water-surface and pressure profiles

20. Water-surface and pressure profiles were measured through the spillway and stilling basin for critical conditions of flow; these data were important in that they indicate the necessary heights of training walls and locations of low-pressure areas.

Scour

21. Prior to conducting a scour test, the sand bed was molded to conform to the contours shown on the survey of the Dewey Dam site as shown on plate 21. The spillway exit channel was molded flat to the elevation of the stilling basin or end sill when a sill was used. To obtain the required flow conditions for a test, the exit area was first flooded to prevent unnatural erosion before reaching stability of flow. The desired discharge was then introduced into the model. As the pool became stabilized, the tailgate was adjusted to obtain the required tailwater elevation. A scour test lasted one hour, during which time most of the scour had occurred and all data pertaining to basin action had been recorded. At the conclusion of a test, the exit area was drained, and the sand bed was cross-sectioned. Data on scour tendencies provide one basis for resolving the question as to the relative effectiveness of various types and arrangements of basin elements. These data do not indicate the absolute depth to which the prototype would be scoured.

Velocities

22. The magnitude of velocities in the approach channel, stilling basin, and exit area were measured at various ranges to indicate the distribution of flow and velocities to be expected in the prototype.

Such data below the stilling basin furnish indications from which the most effective arrangement of the stilling-basin elements can be determined. Study of the data on bottom velocities together with the characteristics of the prototype bed material will indicate the extent of scour to be expected in the latter.

Energy-dissipating characteristics

23. Observation of flow phenomena in the stilling basin and exit area show the general hydraulic performance of the basin and its effect on flow conditions in the exit area. Inasmuch as the model study is concerned mainly with the determination of a basin design to provide safe conditions at the toe of the dam, the investigation of the energy-dissipating characteristics of each basin tested is one of the most important parts of the study. Notes of basin performance during the observation tests were supplemented with still and motion pictures.

PART IV: DESCRIPTION OF THE MODEL TESTS

General

24. The initial model tests were conducted upon the spillway as originally designed (plate 3 and photographs 1 and 2). When all aspects of the original design had been investigated, tests were conducted upon various alterations in the original design of the spillway. The character of subsequent tests was dictated by the purpose of the model study (paragraph 4).

25. The major portion of the testing program concerned experiments on alternate designs for the spillway. In presenting the results of the tests, no attempt is made to present the test data according to the chronological order in which the tests were conducted. Instead, each element of the spillway is considered in turn, and all tests conducted thereon are described in detail.

Tests of Approach Channel

Description -- original design

26. The approach channel consists of that section of the spillway upstream from the crest of the spillway. It originally consisted of a rock cut 60 ft wide at the control section and had an adverse slope of 0.02 from the spillway control section to its intersection with the natural slope of the ground, 134 ft upstream. The walls of the channel were curved on a radius of 250 ft and became tangent to the spillway side walls at the control section (station 2+30). These walls had a batter of 4 on 1 (see plate 7).

Results -- original design

27. Some local disturbances in flow existed at the entrance to the approach channel (see photographs 3 and 7); these disturbances were caused by flow over the submerged side walls and decreased as flow through the spillway decreased. The small waves formed at the entrance, however, did not appear to affect the spillway efficiency. Neither did the narrow hill jutting into the reservoir area about 700 ft upstream from the approach channel have any effect on flow entering the spillway approach. Bottom velocities measured in the approach channel for discharges of 22,800 cfs and 8100 cfs indicated that velocities did not exceed 20 and 16 ft per sec, respectively (see plates 7 and 9). Velocities measured along the face of the dam to the right of the spillway approach did not exceed 1 ft per sec at the maximum discharge of 22,800 cfs. Water-surface profiles through the approach channel are shown on plate 8.

Description -- alternate designs

28. In the attempt to eliminate all disturbances at the entrance to the approach channel, various alterations to the left-bank curve of the entrance were tested. The curves tested varied from the 250-ft radius of the original design to a 160-ft radius; all curves were tangent to the spillway side walls at the control section (station 2+30) (see plate 7). No tests were conducted with a radius smaller than 160 ft, as it was believed that further widening of the spillway was impracticable. The variations were tested with the type A (original, flat-crest design) spillway section in place; this spillway design is discussed in detail in paragraphs 31-34. The 250-ft radius wall of

original design was also studied with the type B (ogee-crest) spillway described in paragraphs 35-38.

Results -- alternate designs

29. Results of the tests revealed that slight improvements in flow conditions were effected through revision of the left-bank wall curvature. Results of the tests also showed that the head-discharge relation of the type A spillway was not affected by the alterations to the entrance curve. For the maximum discharge (22,800 cfs), the elevation of the water surface at the pool gage was 710.5. Bottom velocities measured at the entrance to the channel for discharges of 22,800 cfs and 8100 cfs did not exceed 6 ft per sec for the type A spillway and 4 ft per sec for the type B spillway (see plate 7). Flow conditions at the entrance, with the type B spillway crest control installed and the curved entrance walls of original design, were approximately the same as those observed for the type A spillway.

Tests of Spillway Crest Control

Prefatory remarks

30. Reference is made to plates 3 and 4 showing centerline profiles of the two spillway designs which were tested in the model and a section of the ogee weir used as the type B spillway crest control. The type B spillway, suggested by the Division Engineer, Ohio River Division, was investigated with a view to increasing the efficiency of the spillway. The relative merits of the two spillway crest designs were investigated in tests involving (a) determination of the pool elevation-discharge relation, (b) observation of flow conditions, and

(c) measurements of water-surface and pressure profiles. In this memorandum and on the plates presenting the data, the use of the terms type A spillway or type B spillway refer to the type of crest control.

Description -- type A (original design)

31. The type A spillway crest control (see plate 3 and photograph 2) consisted of a broad-flat-crested weir 60 ft wide followed by a sloping chute, 270 ft long and 60 ft wide.

Results -- type A (original design)

32. Spillway calibration. Before the model study was undertaken, some question existed as to the accuracy of the assumed spillway coefficient. The basic formulas used in determining the spillway capacity were obtained from page 77 of "Low Dams," a National Resources Committee publication of 1938. These formulas are:

$$h_o = \frac{3(2ZD + b) - \sqrt{16Z^2 D^2 + 16ZDb + 9b^2}}{10Z}$$

and

$$Q = 8.03C\, h_o^{1/2} \left[D - h_o\right] \left[b + Z(D - h_o)\right]$$

where

h_o = velocity head

Z = side slopes, horizontal to vertical = 1/4

D = depth of water above channel bottom at entrance

b = width of channel bottom = 60 ft

C = coefficient of discharge

The spillway rating curve as determined on the model was in close agreement with the computed curve throughout the range in discharge (see plate 10). The pool elevation as indicated by the model at the maximum

discharge was about 0.5 ft below the computed curve. An inspection of the model coefficient-discharge relation curve, shown on the plate referred to above, shows the value of the coefficient, C, to be 0.948 for the design discharge as compared to the value of 0.92 assumed in the original computations.

33. Flow conditions. Flow conditions were observed over the flat-crested control section for discharges of 22,800 cfs and 8100 cfs. At all discharges subcritical velocities existed over the control section which, in conjunction with the flat slope of the chute downstream, caused small standing waves to exist downstream from the control section (see photograph 3). This condition is discussed more fully under the description of flow in the spillway chute (paragraph 41).

34. Water-surface and pressure profiles. Water-surface and pressure profiles in the area adjacent to the control section are shown on plates 8 and 16. Pressures in this area were positive for all discharges.

Description -- type B design

35. The type B crest control, proposed by the Ohio River Division office, consisted of a low ogee section located at the same station and elevation as the control section of original design (see plate 4 and photograph 15). The upstream face of the ogee weir was vertical from its intersection with the adverse slope of the entrance channel at elevation 679 to a point of intersection at elevation 682.6 with a circular curve having a radius of 8.4 ft. The circular curve was tangent at the weir crest (elevation 686) to a parabolic curve following the equation $Y = 0.0188X^2$, where X and Y are coordinates referred to

the crest as an origin. A 16-ft radius bucket makes the transition from the ogee section to the chute downstream. The 48-ft width of the ogee section was determined in the model and was based on the criterion that the maximum discharge of 22,800 cfs should be passed through the spillway at a pool elevation of about 711.

Results -- type B design

36. Spillway calibration. Reference is made to plate 11, showing the head-discharge curve for the type B crest control. The spillway rating curve as determined on the model was in close agreement with the computed curve of the type A crest control throughout the range in discharge. It will be noted from the plate that the model curve for type B lies 0.2 ft above the computed curve for type A at the design discharge of 22,800 cfs. It should be remembered, however, that the widths of the type B and type A spillway crests were 48 ft and 60 ft, respectively.

37. Flow conditions. Flow conditions over the type B crest control were observed for discharges of 22,800 cfs and 8100 cfs. Flow conditions were quite different from those observed with the original design crest control (paragraph 33), in that flow passing over the ogee section dropped below critical depth. Thus flow entered the spillway chute downstream at supercritical velocities which eliminated the standing waves in the chute section observed in the previous tests (see photograph 16). This in turn produced smaller depths of flow and thereby reduced the heights of walls required to contain the flow.

38. Water-surface and pressure profiles. Water-surface and pressure profiles over the spillway for discharges of 22,800 cfs and 8100 cfs are shown on plates 8 and 17. Pressures over the ogee crest

control were positive for all discharges.

Tests of Spillway Chute

Prefatory remarks

39. Reference is made to plate 3 showing centerline profiles of the chute designs tested in the model. The chute designs were designated types A and B. In connection with the tests of some of the stilling-basin designs the slope of the lower portion of the chute was changed to more nearly fit the underlying rock configuration. The change in slope, however, was too slight to have any effect on flow and therefore has not been designated as a new type design. The model investigations of the two types of chutes comprised (a) observations of flow conditions, and (b) measurements of water-surface and pressure profiles. No alterations were made to the chute designs in the course of the model study.

Description -- type A design

40. The type A chute design (see plate 3), used in conjunction with the type A (original) crest control, consisted of a concrete-lined channel 60 ft wide and 254.65 ft long on a slope of 0.005, a 100-ft-radius vertical curve, and a 40-ft-wide section 173.9 ft long on a slope of 0.31. The lower section of the chute was lengthened for basins of lower elevation; as mentioned previously the increased length changed the lower portion of the chute from a slope of 0.31 to 0.35 in order to more nearly follow the rock configuration. The transition from the 60-ft-wide chute to the 40-ft-wide chute was accomplished immediately upstream from the 100-ft vertical curve (station 4+58 to station 6+00).

The side walls of the entire chute section had a batter of 4 on 1. In plan the upstream portion of the chute was curved on a 530-ft radius from the crest control to about 45 ft upstream from the start of the 100-ft radius vertical curve.

Results -- type A design

41. Flow conditions. As a result of the low velocity of flow past the control section of original design and the flat slope of the chute immediately downstream, small standing waves (photograph 3) overtopped the side walls of the chute between stations 3+73 and 5+00 along the left wall and stations 4+50 and 5+00 along the right wall. The small standing waves disappeared as soon as flow entered the steep portion of the chute. Flow was distributed evenly in the lower portion of the chute, thus providing satisfactory distribution of flow into the stilling basin. The curvature of the spillway had no effect on flow through the spillway in that water-surface elevations in the curved portion were about the same along the left and right chute walls. The transition from the 60-ft chute section to the 40-ft section was also satisfactory in providing smooth flow conditions.

42. Water-surface and pressure profiles. Water-surface and pressure profiles were measured for discharges of 22,800 cfs and 8100 cfs (plate 16). These measurements indicated that the walls would be overtopped about 1 ft in the upper portion of the spillway for the maximum discharge. The spillway walls were of sufficient height to contain all flows in the lower and intermediate portions of the chute. Positive pressures obtained throughout the spillway chute.

43. Velocities. Under maximum discharge conditions, bottom

velocities ranged from 15 ft per sec at the upper portion of the chute to 73 ft per sec where flow entered the stilling basin; at a discharge of 8100 cfs, the corresponding velocities were 14 ft per sec to 70 ft per sec (see plates 9 and 24-27).

Description -- type B design

44. The type B design, used in conjunction with the type B (ogee) crest control, consisted of a concrete-lined channel 48 ft wide and 246 ft long on a slope of 0.005, a 106-ft-radius vertical curve, and a 40-ft-wide section 124 ft long on a slope of 0.31. As stated in paragraph 39, the lower portion of the chute had several different slopes depending on the elevation of the stilling basin. The transition from the 48-ft-wide chute to the 40-ft-wide chute was made immediately upstream from the vertical curve (station 4+58 to station 6+00). Alignment of the chute in plan is the same as in the original design.

Results -- type B design

45. Flow conditions. The depth of flow in the chute portion of the spillway immediately downstream from the ogee-crest section was much less than that observed in the case of the type A design as a result of supercritical velocities existing downstream from the crest control (see photograph 16). The 530-ft radius of horizontal curvature of that section of the spillway chute immediately downstream from the crest section had a noticeable effect on flow at the maximum discharge in that water-surface elevations in the upper portion of the chute were approximately 4 ft higher along the left wall of the spillway than on the right wall. For all ordinary discharges, however, a practically level water surface was maintained in the curved portion of the spillway. The

superelevation of the water surface in the curved portion of the chute did not affect the even distribution of flow entering the stilling basin.

46. Water-surface and pressure profiles. Water-surface and pressure profiles over the spillway for discharges of 22,800 cfs and 8100 cfs are shown on plates 6 and 17. At the maximum discharge of 22,800 cfs, the freeboard along the left chute wall between stations 1+90 and 2+80 was 9.8 ft, between stations 2+80 and 3+30 was 10.3 ft, and between stations 3+30 and 5+50 was 11.0 ft. Pressures over the chute were positive for all discharges.

47. Velocities. Under conditions of maximum discharge, bottom velocities in the chute area immediately downstream from the crest measured 35 ft per sec as compared to 18 ft per sec with the type A crest. Likewise, with a discharge of 8100 cfs, velocities in the same area for the type B crest were 29 ft per sec as compared to 14 ft per sec with the type A crest. Velocities entering the stilling basin were the same for types A and B chutes.

Tests of Stilling Basin

Prefatory remarks

48. The following four alternate schemes were proposed originally by the District Office to insure the safety of the dam and appurtenant structures during the occurrence of the spillway design flood:

a. Spillway with a stilling basin (type A design) designed merely to provide a transition from the spillway chute to the exit channel, and without protection of the toe of the dam from erosion.

b. Spillway with a stilling basin (type B design) as in a above but with steel-cell protection across or partially across the valley floor for protection of the toe of the

dam; location of proposed steel-cell protection is shown on plate 21.

c. Spillway with a stilling basin (type C design) designed to meet requirements as shown by model study.

d. Spillway with a stilling basin (type D design) to dissipate energy of spillway discharge under all predicted flow conditions.

Reference is made to plate 3, showing the types A, C, and D stilling-basin designs investigated in the Dewey Dam model; the model tests obviated the need for the investigation of the type B design. Investigations of the stilling basins consisted of (a) observations of flow conditions, (b) determinations of water-surface profiles, and (c) measurements of scour and velocities. Tailwater elevations for all tests were set in accordance with the curves forwarded by the District Office (plate 6).

Description -- type A design

49. As stated in subparagraph a above, the type A basin (see photograph 2 and plate 3) was intended merely to provide a transition from the spillway chute to the exit channel. This basin consisted of an 86-ft horizontal apron, 40 ft wide, at elevation 615 msl without baffle piers or end sill. The side walls of the basin were 25 ft high and had a batter of 4 on 1.

Results -- type A design

50. Flow conditions. Flow conditions in the stilling basin of original design were observed throughout the range in discharge and with maximum and minimum tailwater depths (see photographs 4, 6, 8, and 9). The results indicated that the stilling-basin action was not satisfactory. Flow passed down the spillway chute and through the

basin without reduction in velocity. Investigations of the hydraulic jump-tailwater depth relations indicated that a good jump would not form unless tailwater depths of 12 ft and 6 ft above the maximum depths for discharges of 22,800 cfs and 8100 cfs, respectively, were provided (see plate 6).

51. Water-surface profiles. Reference is made to plates 18 and 19 showing water-surface profiles along the centerline of the stilling basin for discharges of 22,800 cfs and 8100 cfs. The profiles show that a hydraulic jump did not occur over the apron for either discharge; a partial jump formed at the end of the apron or in the exit area with maximum tailwater conditions. The basin walls were sufficient to contain the spillway flow.

52. Scour. Scour tests conducted to reveal areas subject to erosive currents indicated that practically all scour was confined to the channel and left bank of the exit area downstream from the basin. The scour tests indicated further that no tendencies for erosion along the toe of the dam existed (see plates 21-23). Attention is directed to the fact that erosion tests indicated the areas subject to scouring attack rather than the actual depth of scour; actual scour depths should be predicted in the light of the velocities presented in the following paragraph.

53. Velocities. Reference is made to plates 18-20 and 24-27 showing bottom velocities in the stilling basin and downstream therefrom for flows of 22,800 cfs and 8100 cfs with conditions both of maximum and minimum tailwater. The maximum velocity over the end of the apron was in the range of 73 ft per sec for a discharge of 22,800

cfs with either maximum or minimum tailwater levels (see plates 18 and 24). Slightly lower velocities were obtained for the lesser discharges.

Description -- type B design

54. As stated in paragraph 48 the type B basin differed from the type A design only in the addition of a steel-cell protection across the toe of the dam. Inasmuch as the tests of the type A design indicated little erosion in the exit area adjacent to the dam, it was decided that the steel-cell protection was unnecessary. This feature of the tests is discussed in more detail in paragraphs 65-70. Accordingly it was decided that no tests should be conducted on this design.

Description -- type C design

55. As stated in paragraph 48 the type C basin was designed to meet requirements as shown by model study. The type C design involved the lowering of the apron of the types A and B designs to the maximum elevation that would still allow a good jump at ordinary discharges and fair jump action at the maximum discharge. The type C stilling basin consisted of a 131.6-ft horizontal apron at elevation 594 msl and a 6-ft sloped end sill. The side walls were 46 ft high and had a batter of 4 on 1. Attempts were made to improve the jump action at the maximum discharge by use of two rows of 4-ft baffle piers in addition to the 6-ft end sill. Inasmuch as the baffle piers did not add sufficient back pressure to improve the jump, they were omitted from the design (see plate 28).

Results -- type C design

56. Flow conditions. Flow conditions in the stilling basin of type C design were observed throughout the range in discharge and with

24551

maximum and minimum tailwater depths corresponding thereto. The performance of the basin was fair for high discharges and good for low discharges (see photograph 10). A hydraulic jump occurred in the stilling basin throughout the range in discharge.

57. Water-surface profiles. Reference is made to plates 29 and 30 showing water-surface profiles along the centerline of the stilling basin for discharges of 22,800 cfs and 8100 cfs. It will be noted that, for the lower discharge and maximum tailwater depth, the jump occurs well up on the chute. For all other conditions of discharge and tailwater depths, the jump occurs on the apron. The basin walls were sufficient to contain the maximum flow.

58. Velocities. Reference is made to plate 31, showing bottom velocities in the stilling basin and downstream therefrom for flows of 22,800 cfs and 8100 cfs with conditions both of maximum and minimum tailwater. For maximum tailwater conditions, the maximum velocity over the end sill was 22 ft per sec for a discharge of 22,800 cfs; maximum velocity for minimum tailwater conditions was found to be 24 ft per sec. Velocities measured at the toe of the chute with a flow of 22,800 cfs and minimum tailwater conditions were about 83 ft per sec, thus indicating a decrease in velocity of 54 ft per sec through the stilling basin. Correspondingly lower velocities were measured for the lesser discharges.

Description -- type D design

59. As stated in paragraph 48 the type D basin was designed to dissipate energy through the formation of a hydraulic jump. The basin was lowered 27 ft below the elevation of the type A basin to elevation

588.3 msl. The basin consisted of a 102.8-ft horizontal apron and an 11.7-ft sloped end sill. The side walls of the basin were 51.7 ft high and had a batter of 4 on 1.

Results -- type D design

60. Flow conditions. Observations of flow conditions revealed satisfactory basin performance for all discharge conditions. Sufficient tailwater depths obtained for the formation of a good jump at all discharges (see photographs 11, 13, and 14). For conditions of maximum tailwater the jump occurred well up on the spillway chute, while at minimum tailwater the jump occurred on the horizontal apron.

61. Water-surface profiles. Shown on plates 36 and 37 are water-surface profiles along the centerline of the stilling basin for discharges of 22,800 cfs and 8100 cfs. As will be noted, for low flows the water-surface profiles are practically horizontal, indicating excess tailwater depths and little disturbance in the basin. For the maximum discharge a good jump is evident at both high and low tailwater depths. The profiles further reveal the water surface below the jump to be unmarked by excessive turbulence. The side walls of the basin are sufficient to contain the spillway flow.

62. Scour. Scour tests conducted with the type D stilling basin in place revealed that a reduction in the amount of scour from that observed with the type A basin existed (compare plates 39 and 40 with plates 22 and 23). In either case, however, no scour along the toe of the dam was evident.

63. Velocities. The effectiveness of the hydraulic jump in dissipating the energy contained in flow from the spillway can be seen

from an inspection of plates 36-38 and 41-44, showing velocity distribution in the stilling basin and exit area. At a flow of 22,800 cfs the measured velocity of the water at the toe of the chute before entering the jump was 58 ft per sec; the velocity at the end of the stilling basin measured 8 ft per sec, indicating a decrease of 50 ft per sec through the stilling basin. The maximum velocity measured in the stilling basin exit channel was 10 ft per sec. Correspondingly lower velocities were obtained for the lesser discharges.

Tests of Exit Area

Prefatory remarks

64. Reference is made to plate 21 showing the bed configuration of the model in the exit area. The exit area is understood to include all the area immediately downstream from the dam except the stilling basin. Two points in this area were of particular concern: (a) the area immediately downstream from the stilling basin which is subject to the action of the high velocity flows leaving the stilling basin; and (b) the area along the downstream toe of the dam which would be subject to erosion from any high-velocity eddy that might be set up along the toe of the dam. Observations were made with both type A and type D stilling basins in place. Information as to current directions, location of eddies, erosion tendencies, and distribution of velocities was obtained for discharges of 22,800 cfs and 8100 cfs. For erosion tests the exit area was molded in sand. For the other tests the exit area was fixed in cement mortar to prevent sand particles from fouling the velocity-measuring instruments and to keep the bed from slumping and

causing unnatural velocities and current directions.

Exit area with the type A stilling basin installed

65. Current directions and eddy locations. Reference is made to plates 12-15 and photograph 5, showing surface-current directions and the location of eddies in the exit area of the model with the type A stilling-basin design installed. As will be noted, for all discharges and tailwater conditions the main current followed the left of the exit area. At the toe of the dam there was an eddy flowing in a counter-clockwise direction for all discharge and tailwater conditions.

66. Scour. Erosion tests revealed (see plates 21-23) scour along the toe of the dam to be negligible for discharges of 22,800 cfs and 8100 cfs. It will be noted that a great amount of scour occurred in the stilling-basin exit channel for both maximum and minimum discharges.

67. Velocities. Shown on plates 24-27 are bottom velocities measured throughout the exit area. An inspection of the velocity distribution shown on these plates indicates that the main bottom velocities follow the same paths taken by surface currents. It will also be noted that 240 ft below the stilling basin, the hill on the left side of the exit area was exposed to velocities as high as 46 ft per sec. The greatest velocity along the toe of the dam was 3 ft per sec for a discharge of 22,800 cfs and maximum tailwater elevation.

Exit area with the type D stilling basin installed

68. Current directions and eddy locations. Reference is made to plates 32-35 and photograph 12, showing surface-current directions and the location of eddies in the exit area of the model with the type D stilling-basin design installed. A comparison of plates 32-35 and

plates 12-15 reveals no appreciable difference in the general current patterns and eddies in the exit area of the model, although there was a marked difference in the velocities below the stilling basin. Operation of the outlet works had no apparent effect on flow conditions in the exit channel.

69. Scour. Erosion tests revealed (see plates 39 and 40) scour in the stilling-basin exit channel to be moderate for a discharge of 22,800 cfs and negligible for a discharge of 8100 cfs. Scour along the toe of the dam was also negligible.

70. Velocities. Shown on plates 41-44 are bottom velocities measured throughout the exit area. A comparison of plates 41-44 and plates 24-27 reveals no appreciable difference in velocity along the toe of the dam. In the stilling-basin exit channel with the type D stilling basin in place the highest velocity below the end sill was 18 ft per sec, while the maximum velocity below the type A stilling basin was 70 ft per sec, thus showing the type D basin to be considerably more effective than the type A basin.

PART V: DISCUSSION OF RESULTS OF TESTS

71. The model study of the Dewey Dam served its purpose by providing the answers to questions arising in connection with the design of various elements of the spillway and dam. The tests showed what performances could be expected of alternate designs for these elements, which when viewed in the light of economical considerations provide the basis for establishment of the final design of the Dewey Dam structure. The most satisfactory design for the spillway, as finally developed from the model study, consisted of (a) a flared approach entrance to the chute spillway (curvature of original design); (b) either a flat crest or ogee weir control, depending upon which is the more economical design (types A or B spillway); (c) a chute curved in plan and trapezoidal in cross section (chute of original design); and (d) a stilling basin with a 108.8-ft horizontal apron at elevation 583.3 msl and an 11.7-ft end sill (stilling basin designated type D basin in this report).

72. The model tests indicated that the approach channel of original design was satisfactory, and that the knoll in the reservoir opposite the approach entrance was too far upstream to affect flow entering the approach. Alterations in the alignment of the left abutment wall to eliminate local disturbances were unsuccessful except when the entrance was widened more than is believed practicable.

73. The ogee crest control was found to be more efficient than the flat crest control, permitting the spillway width to be reduced by 12 ft (from 60 ft to 48 ft). It is desired to emphasize, however, that some added rock excavation is necessary to construct an ogee section at

the same elevation as the original flat-crested control.

74. The model demonstrated that under conditions of maximum discharges the use of the flat-crested spillway (type A) caused standing waves which overtopped the sidewalls in the upper portion of the chute; the use of the ogee crest control caused the flow downstream from the crest to be passed at subcritical depth, thus permitting a decrease in the height of the side walls.

75. The model demonstrated that from a hydraulic standpoint the type D basin, designed to create a good jump at all discharges, was most effective in the dissipation of energy and consequent protection of the bed and left bank of the exit channel downstream. Tailwater depths for the original (type A) stilling basin were insufficient for the creation of a hydraulic jump and at all discharges shooting flow existed in the basin and part of the exit channel with velocities in the order of 60 ft per sec. Such action could possibly cause the undermining of the basin slab and walls. However, if the rock bed of the exit channel is capable of withstanding the velocity of flow present with the type A basin, and if the land along the left bank of the exit channel is of little economic value, the use of the type A basin might be worthy of consideration from an economic standpoint.

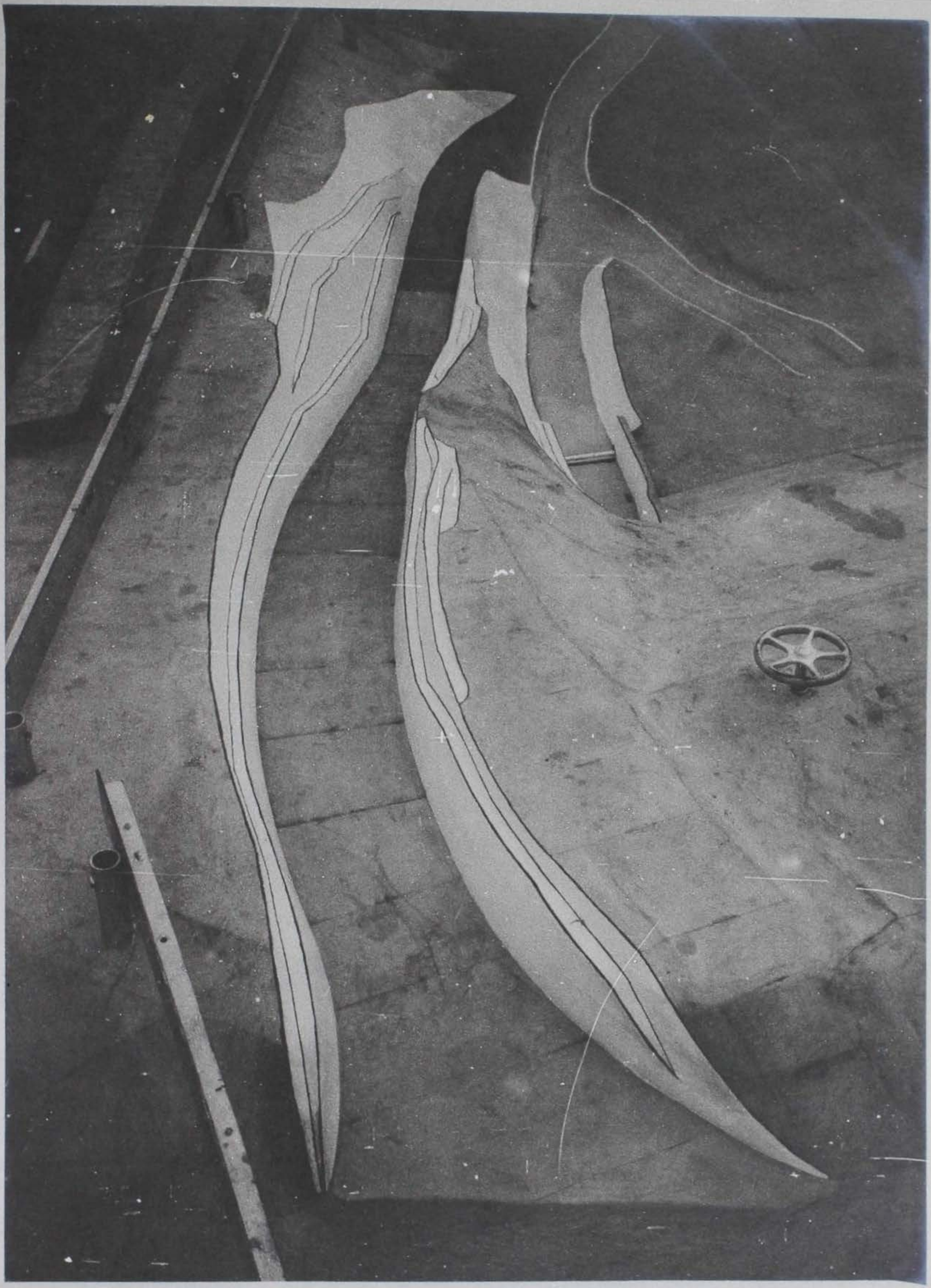
76. Regardless of the type basin used, the velocity of flow along the toe of the dam was not excessive; this will permit the omission of the suggested steel-cell protection in this area.

END OF REPORT PROPER

(Photographs and plates follow)

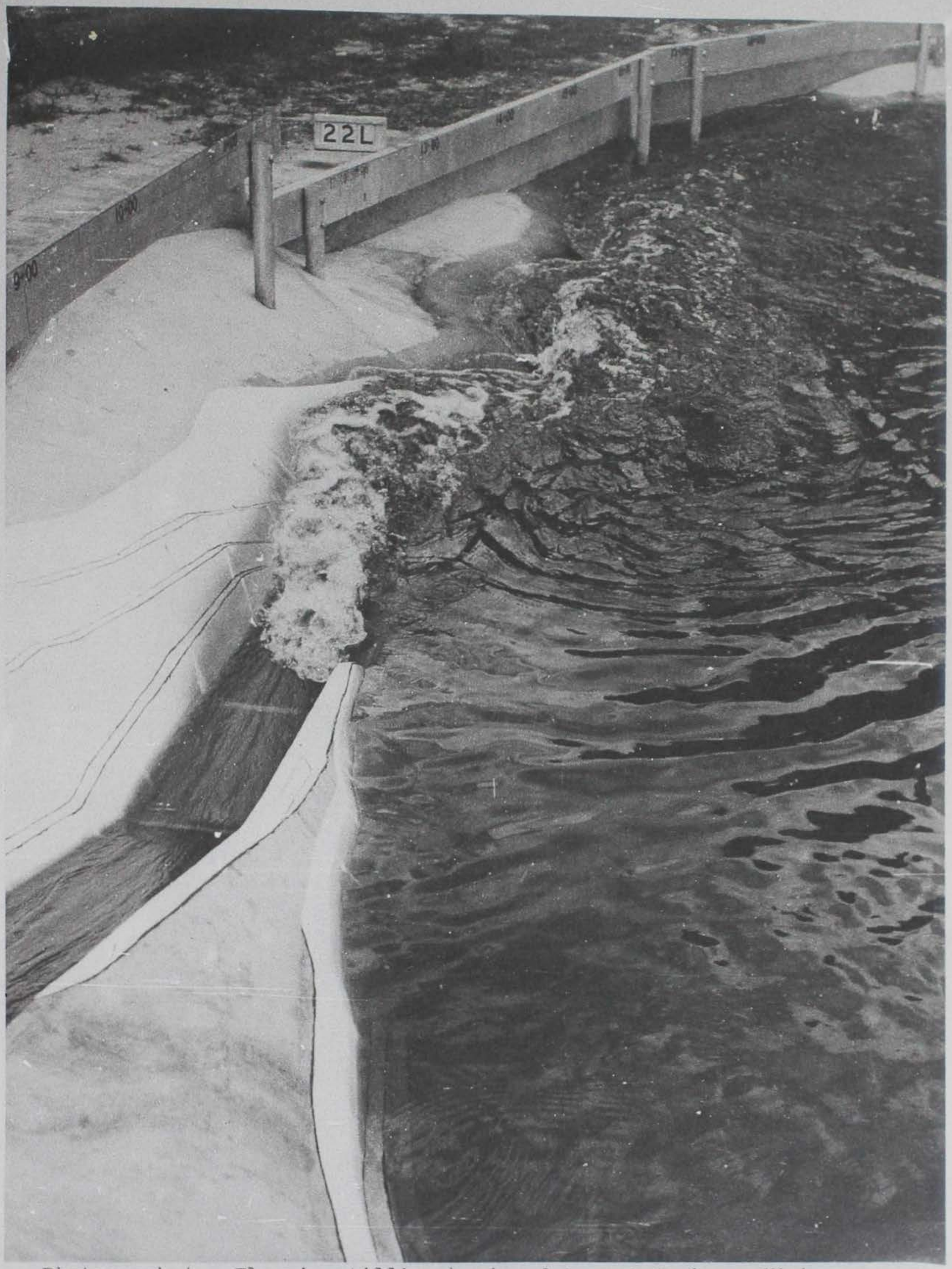
PHOTOGRAPHS

Photograph 1. General view looking upstream of the model of the Dewey Dam and appurtenant control structures.

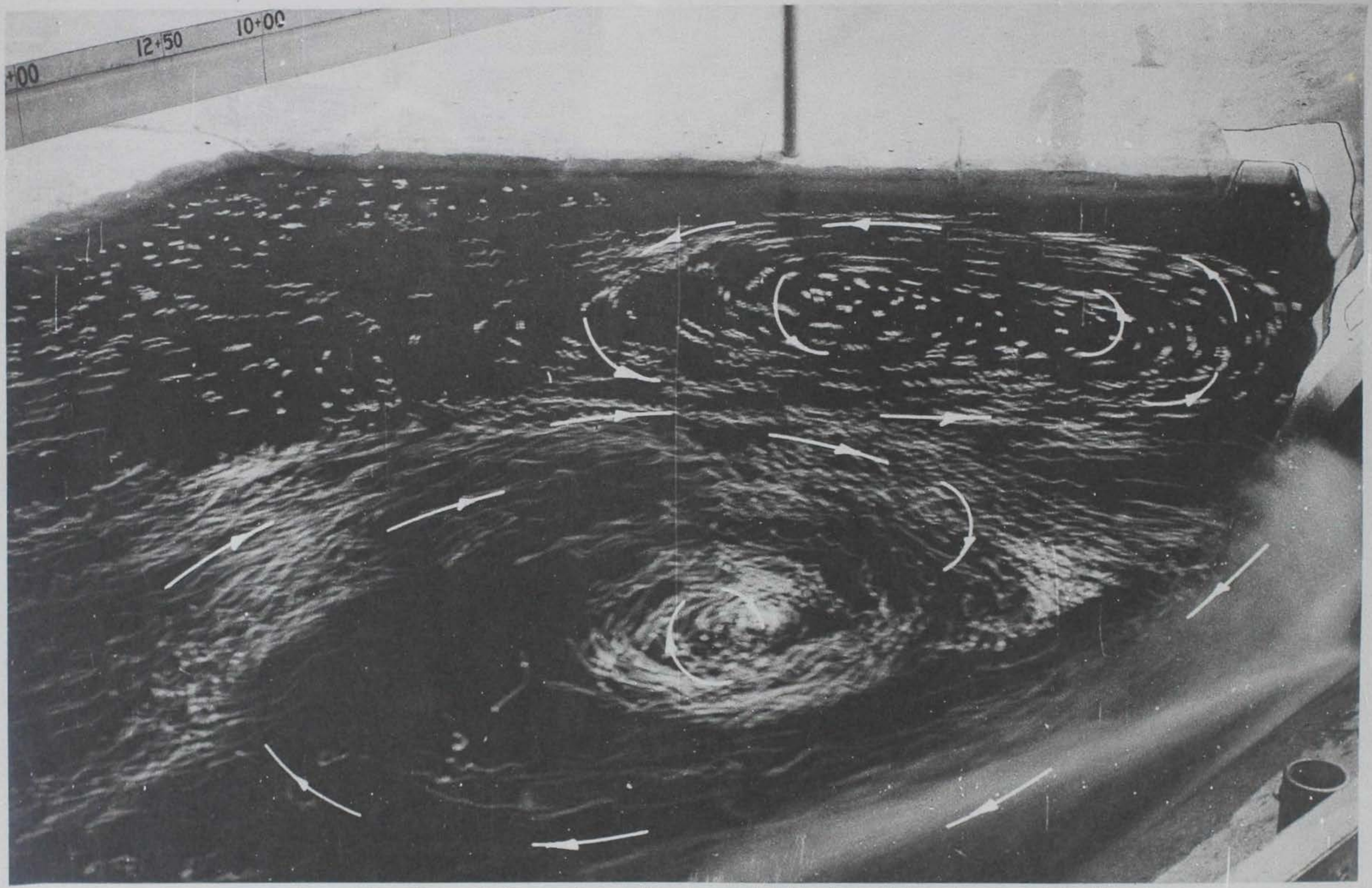


Photograph 2. View looking downstream showing spillway of original design. Type A crest control -- Type A stilling basin.

Photograph 3. Standing waves existed in the spillway chute downstream from the control section. Note flow at approach entrance and over spillway side walls in chute area. Discharge = 22,800 cfs Original alignment

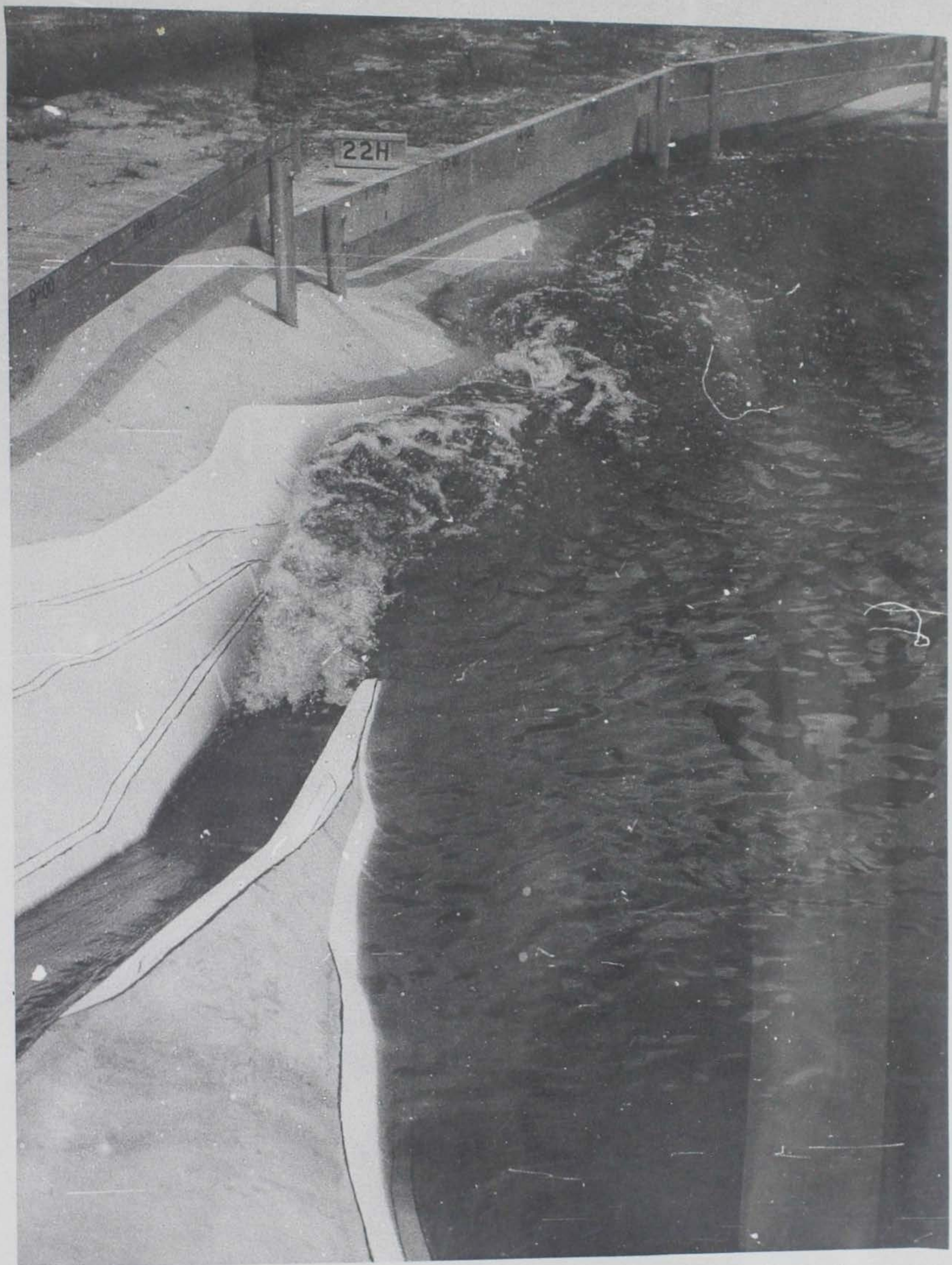


Photograph 4. Flow in stilling basin of type A design. High velocities existed at the end of the basin and along the left bank of the exit channel for minimum tailwater conditions. Discharge = 22,800 cfs Minimum tailwater elev. = 630.6

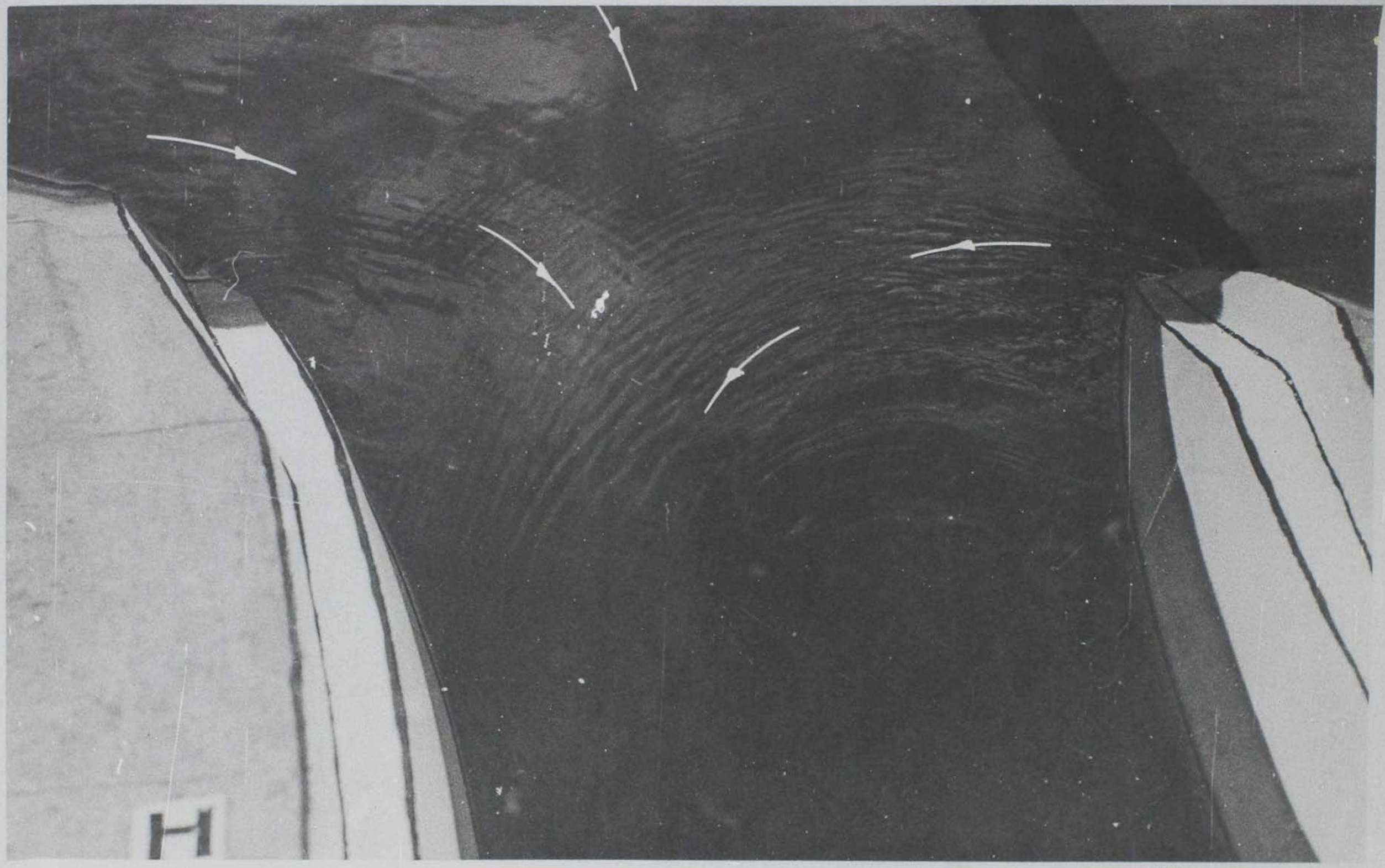


Photograph 5. Velocity of flow along the toe of the dam did not exceed 3 ft per sec. Type A stilling basin.

Discharge = 22,800 cfs Minimum tailwater elev. = 630.6

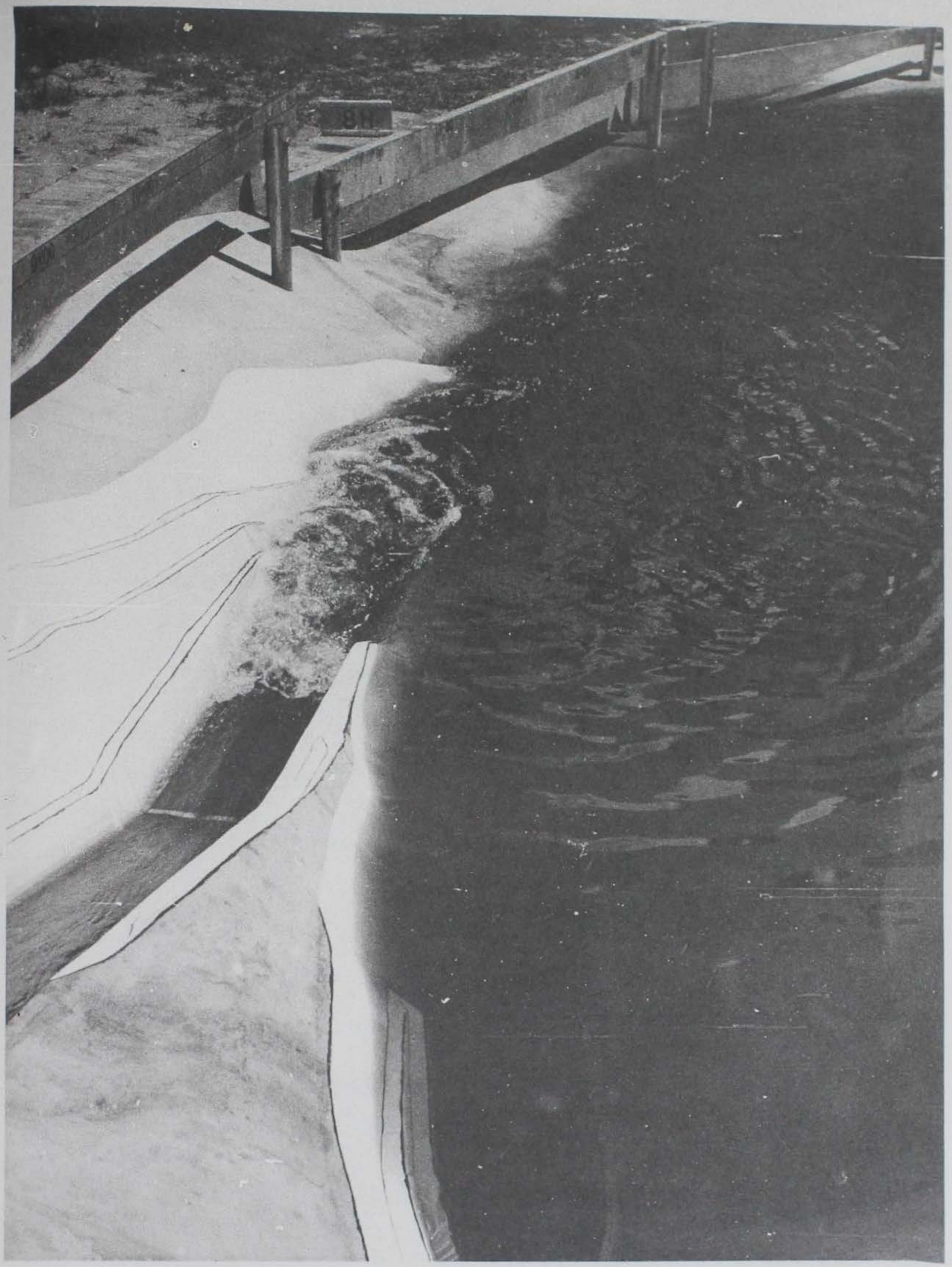


Photograph 6. Flow in the stilling basin of type A design. A partial jump occurred at the end of the basin for maximum tailwater conditions.
Discharge = 22,800 cfs Maximum tailwater elev. = 635.6

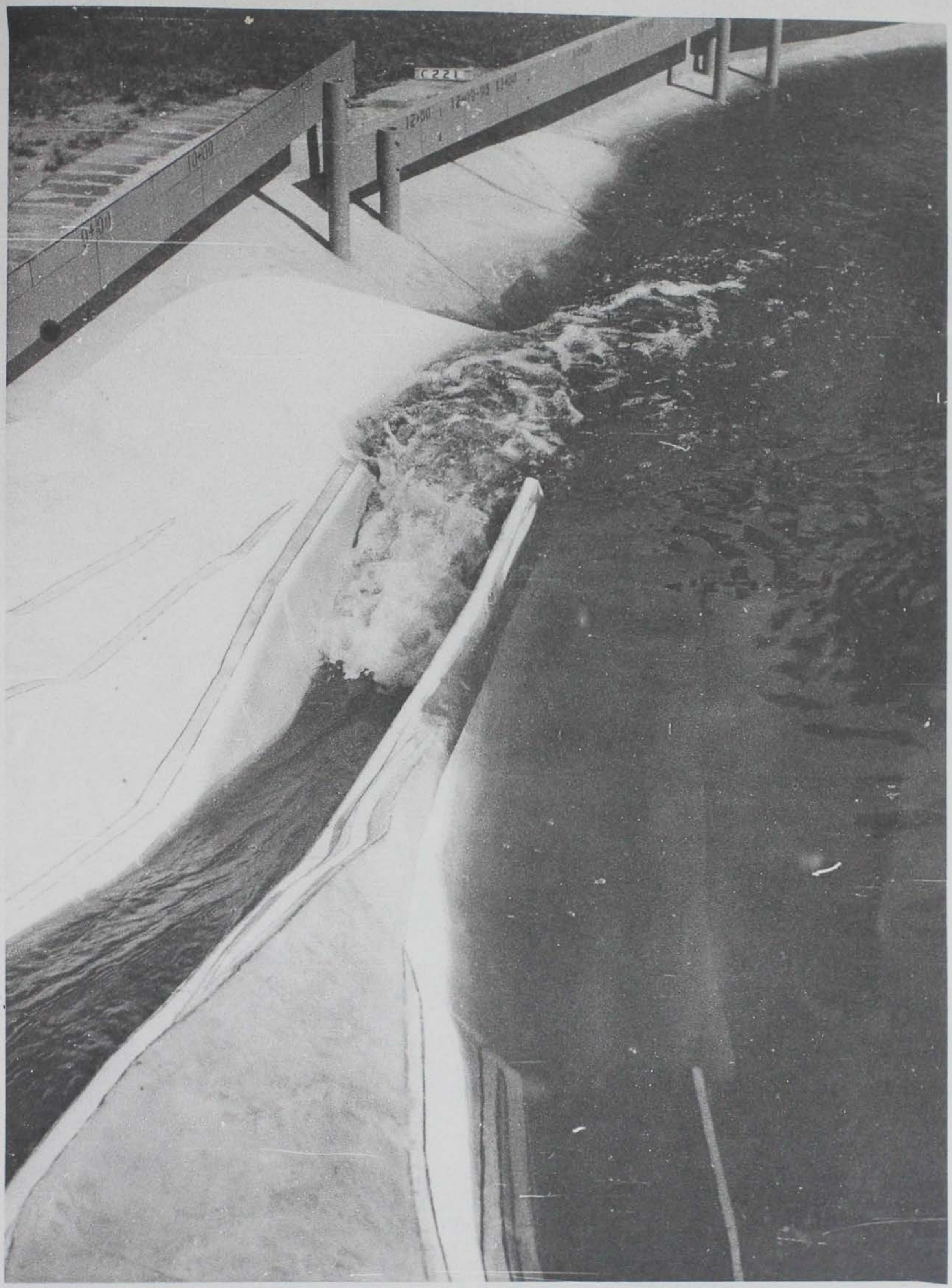


Photograph 7. View looking upstream showing flow entering the approach to the spillway. Note slight disturbance of flow that still existed along left wall of spillway for low discharges.
Discharge = 8,100 cfs Original alignment

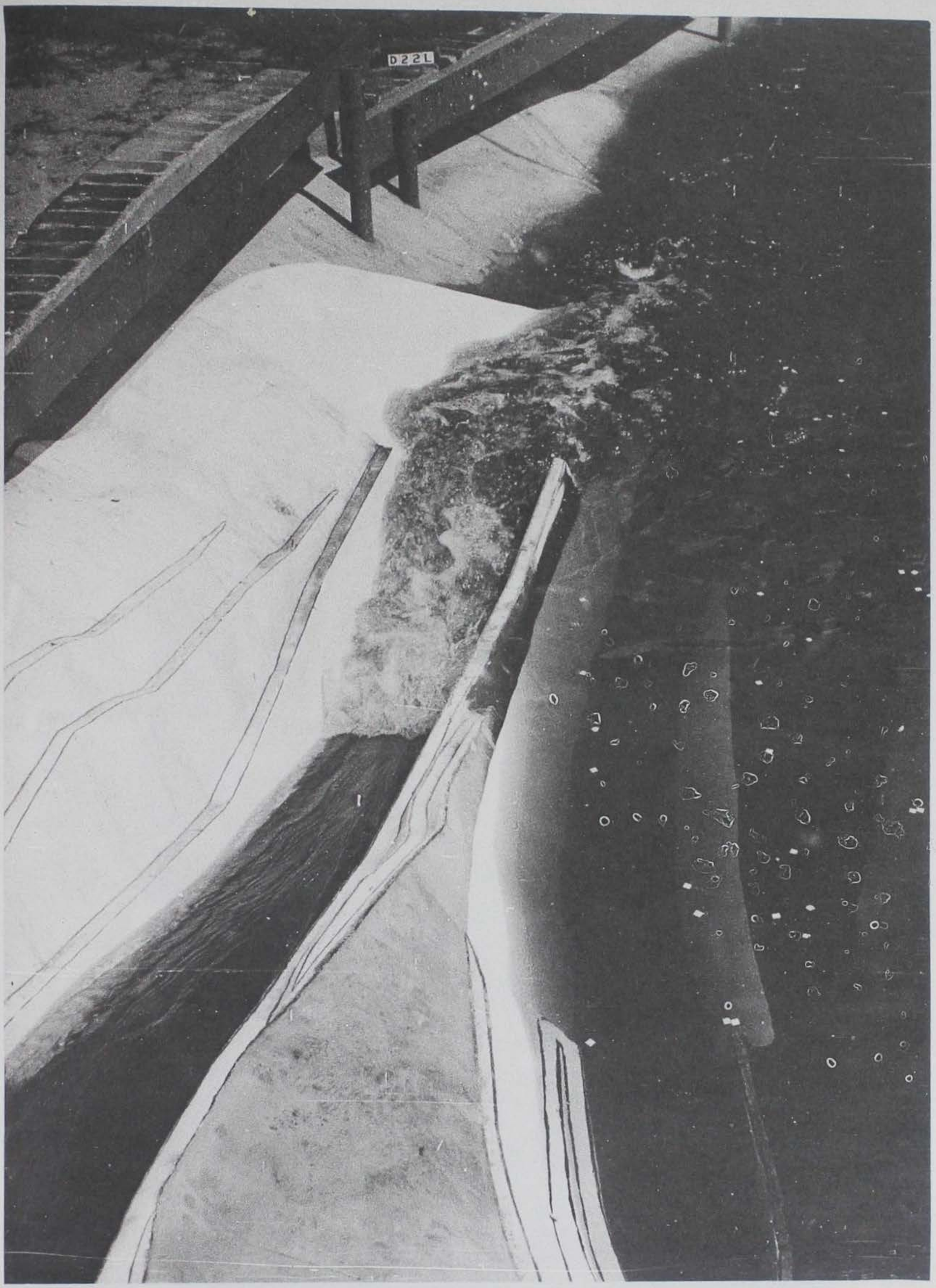
Photograph 8. Flow in the stilling basin of type A design. High velocities existed at the end of the basin and along the left bank of the exit channel for minimum tailwater conditions. Discharge = 8,100 cfs Minimum tailwater elev. = 620.6



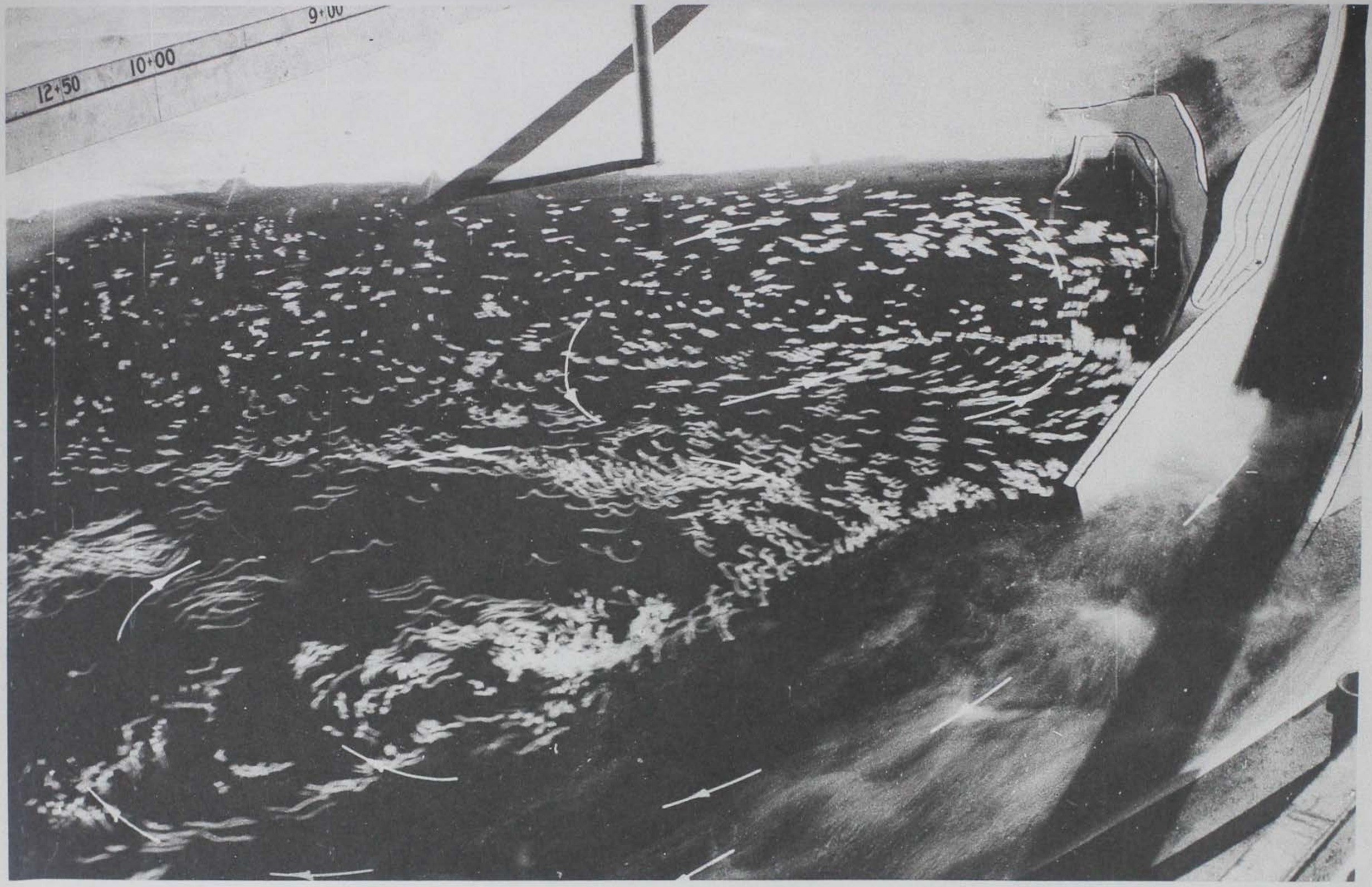
Photograph 9. Flow in the stilling basin of type A design. A partial jump occurred at the end of the basin for maximum tailwater conditions.
Discharge = 8,100 cfs Maximum tailwater elev. = 632.5



Photograph 10. Flow in the stilling basin of type C design. A fair hydraulic jump existed for minimum tailwater conditions. Discharge = 22,800 cfs Minimum tailwater elev. = 630.6

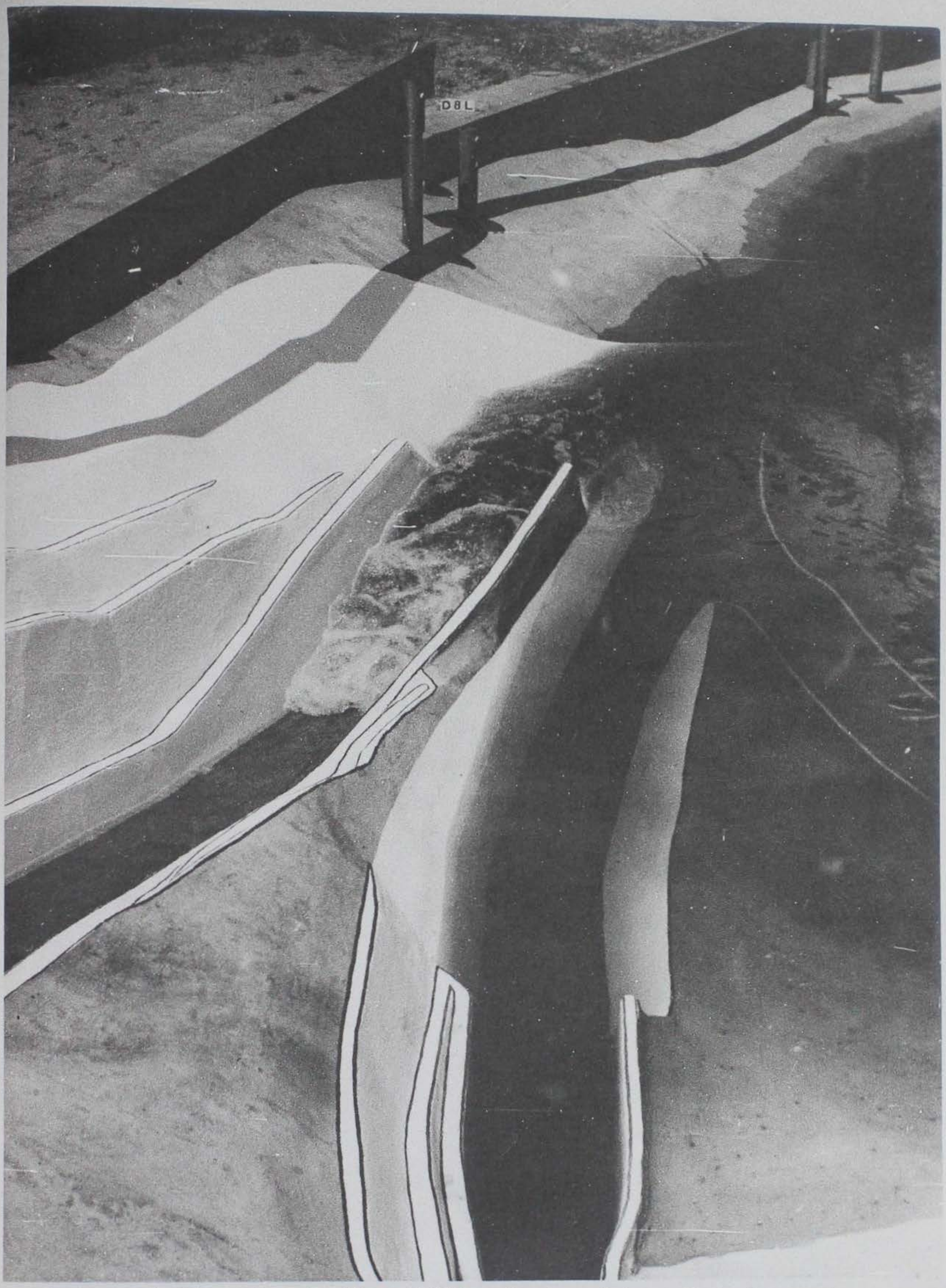


Photograph 11. Flow in the stilling basin of type D design. A good hydraulic jump existed for minimum tailwater conditions. Discharge = 22,800 cfs Minimum tailwater elev. = 630.6

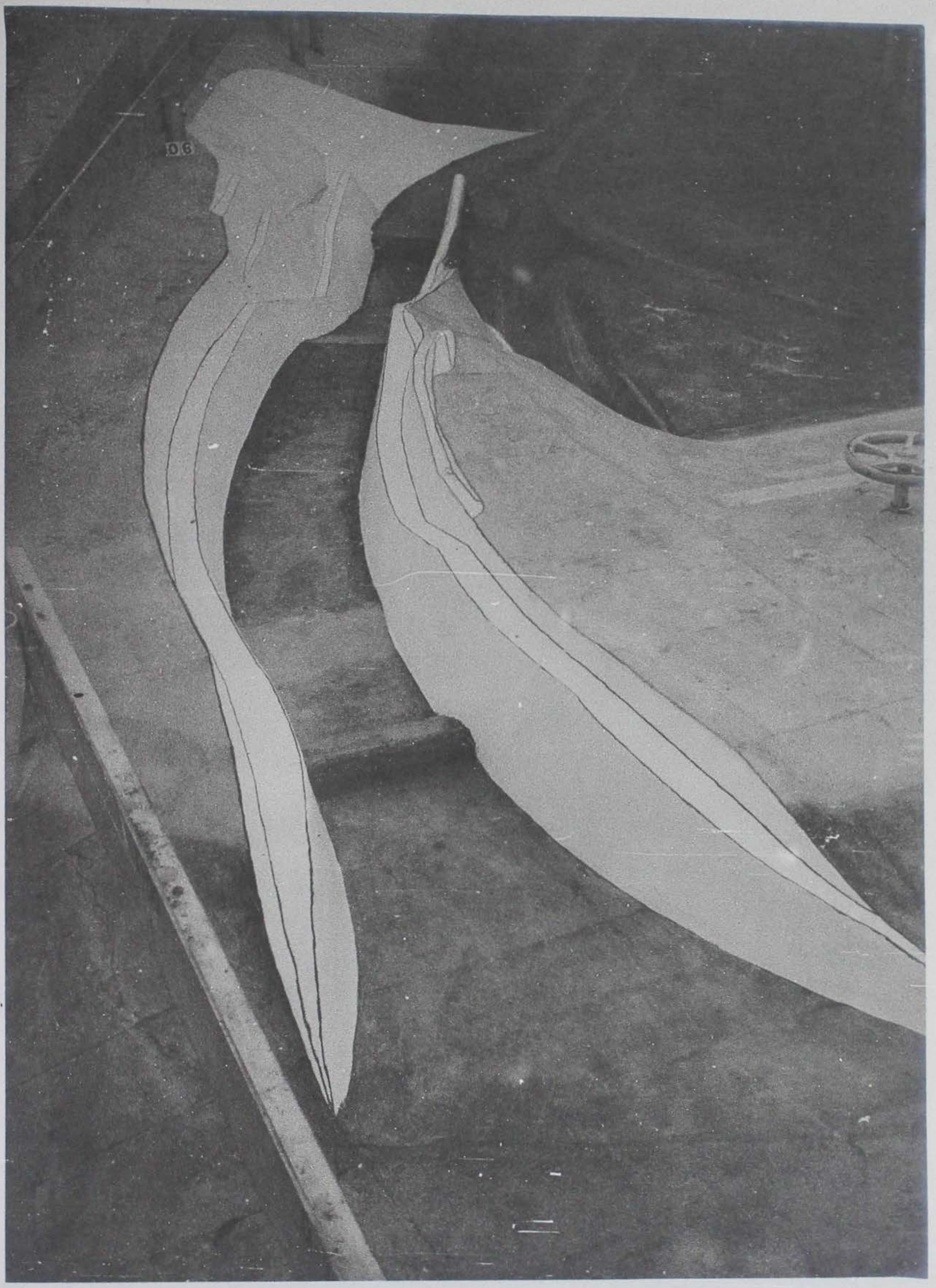


Photograph 12. Velocity of flow along the toe of the dam did not exceed 1 ft per sec.
Type D stilling basin.
Discharge = 22,800 cfs Minimum tailwater elev. = 630.6

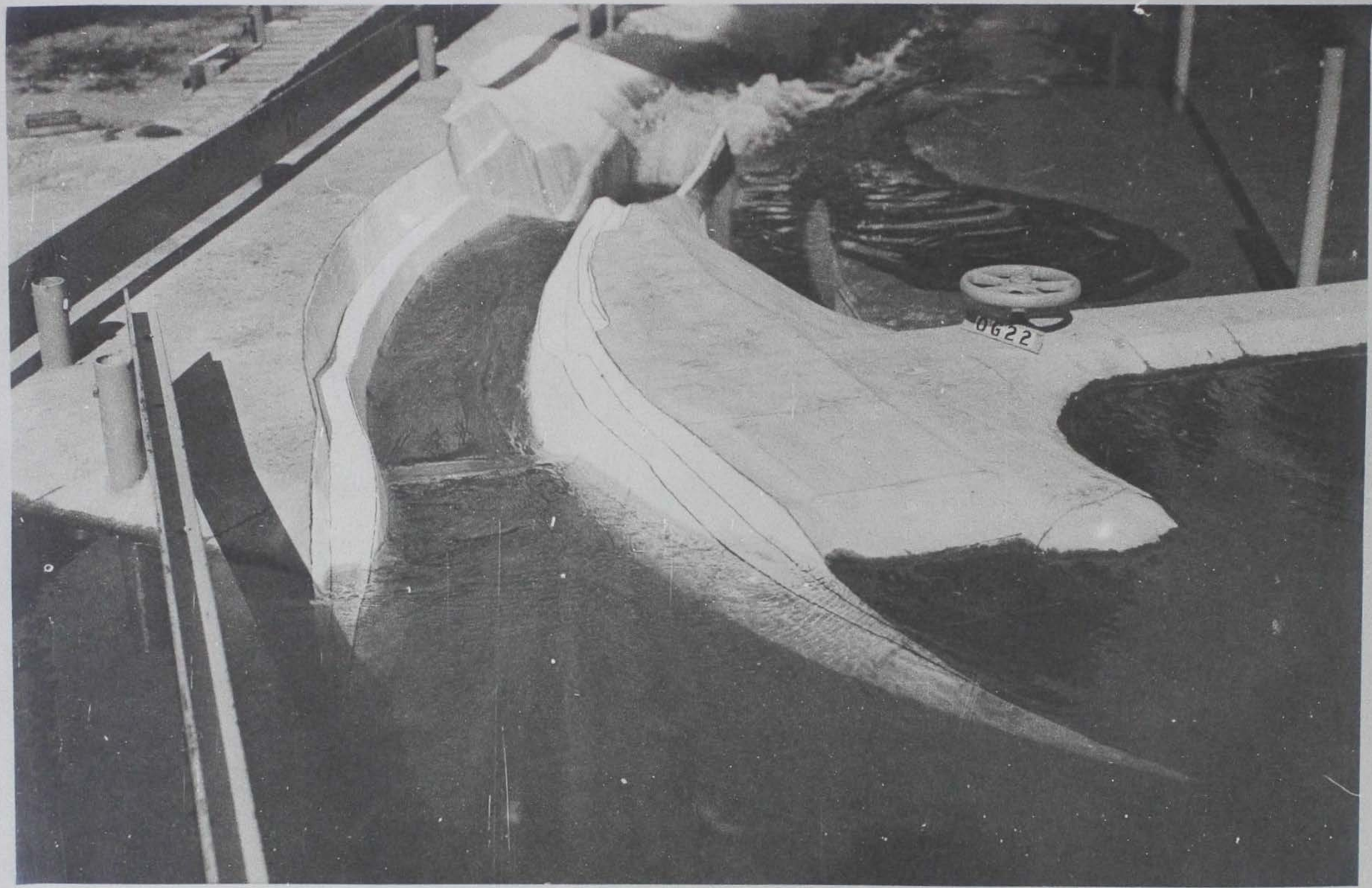
Photograph 13. Flow in the stilling basin of type D design. A good hydraulic jump existed for maximum tailwater conditions. Discharge = 22,800 cfs Maximum tailwater elev. = 635.6



Photograph 14. Flow in the stilling basin of type D design. A good hydraulic jump existed for minimum tailwater conditions. Discharge = 8,100 cfs Minimum tailwater elev. = 620.6



Photograph 15. View looking downstream showing spillway with the ogee crest control (type B). Type D stilling basin.



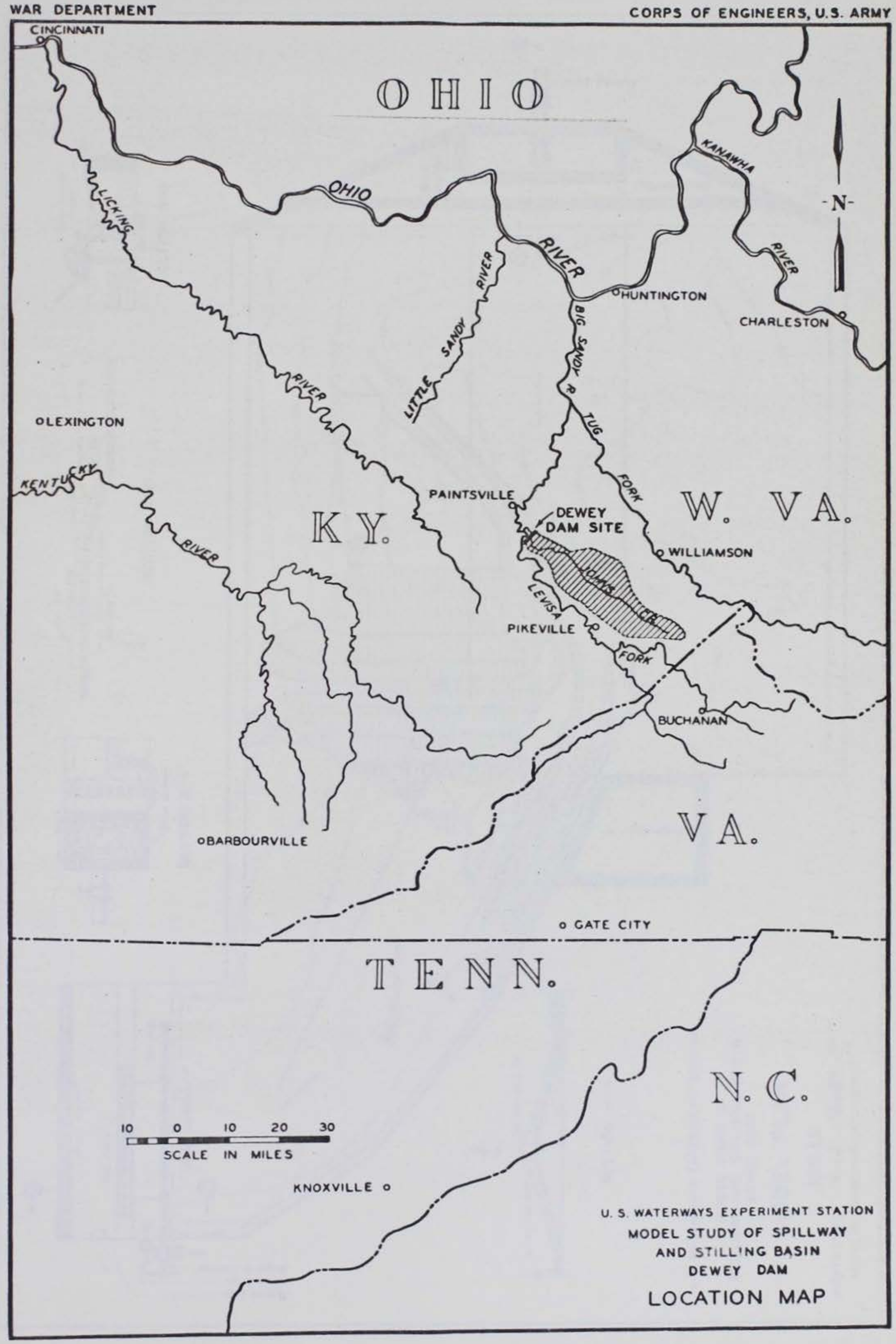
Photograph 16. View looking downstream showing flow over the ogee control section. Note freeboard downstream from crest.

Discharge = 22,800 cfs

PLATES

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY

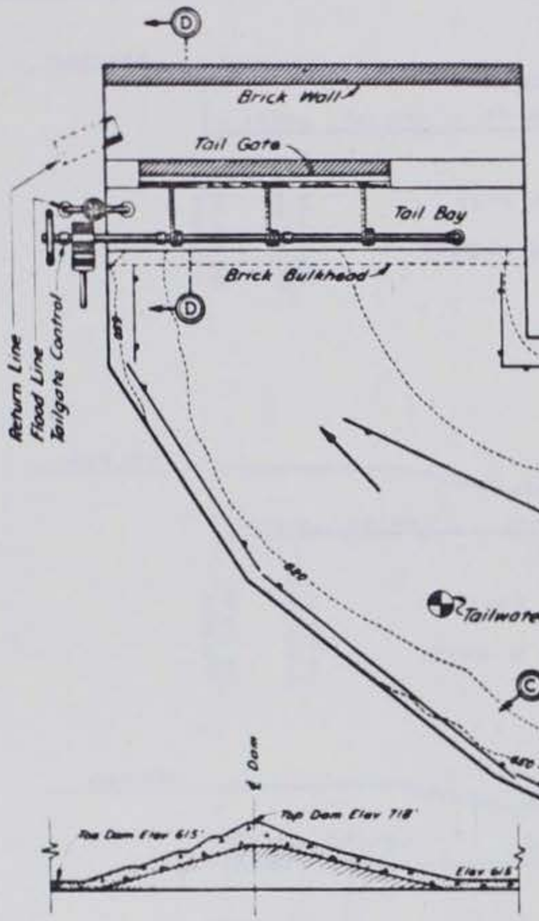


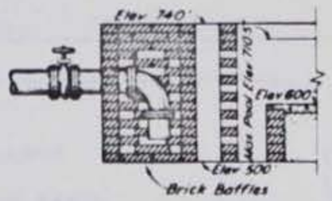
U. S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF SPILLWAY
AND STILLING BASIN
DEWEY DAM

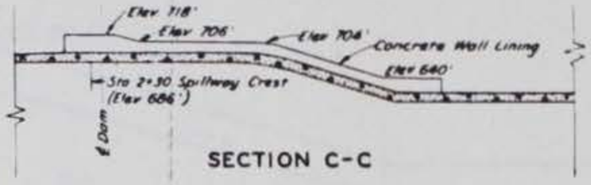
LOCATION MAP

PLATE 1





SECTION B-B



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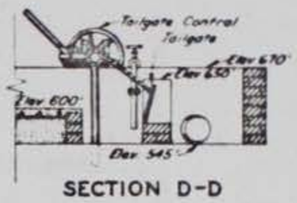
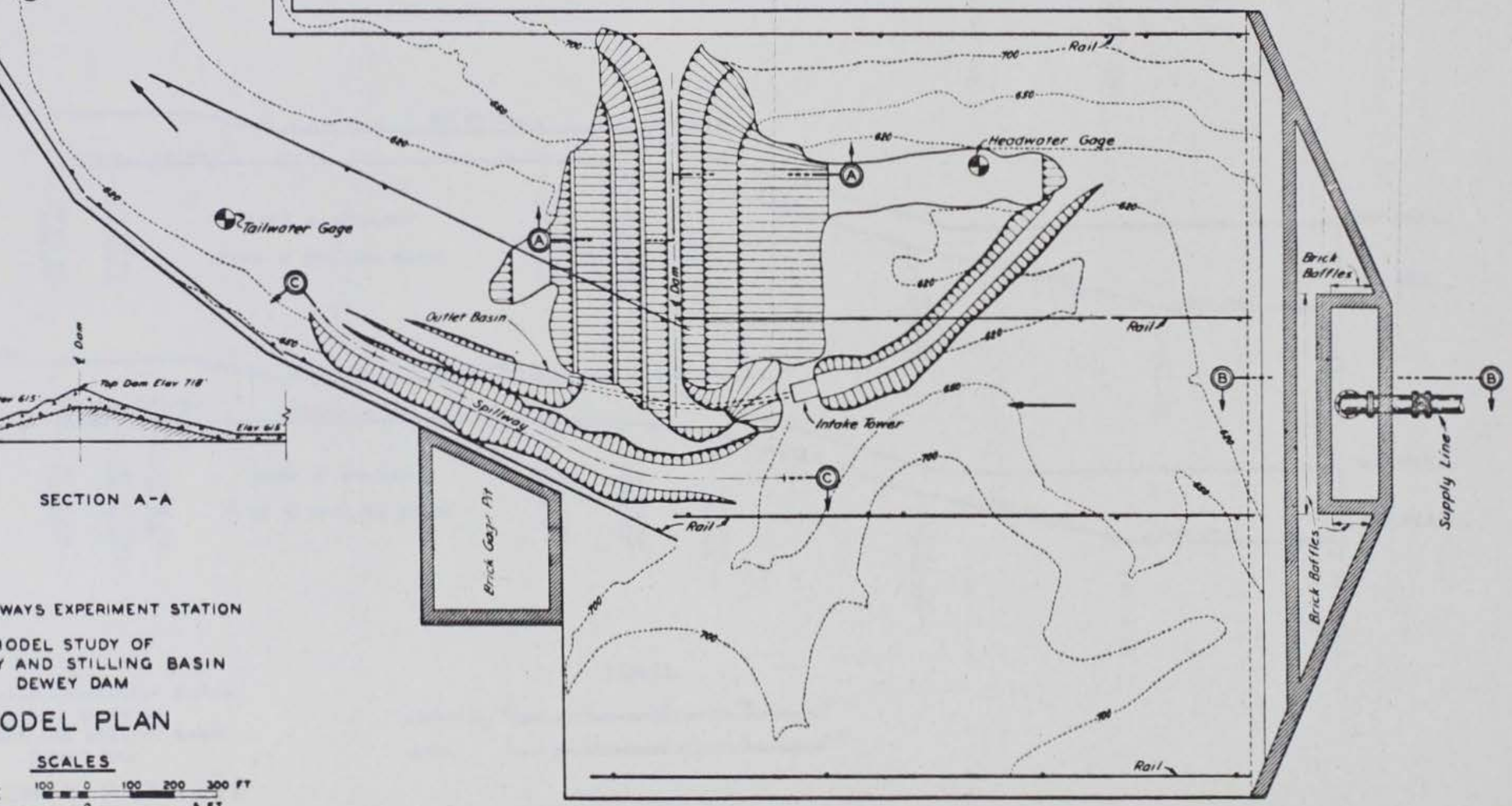


SECTION D-D

SECTION A-A



U.S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

MODEL PLAN

SCALES

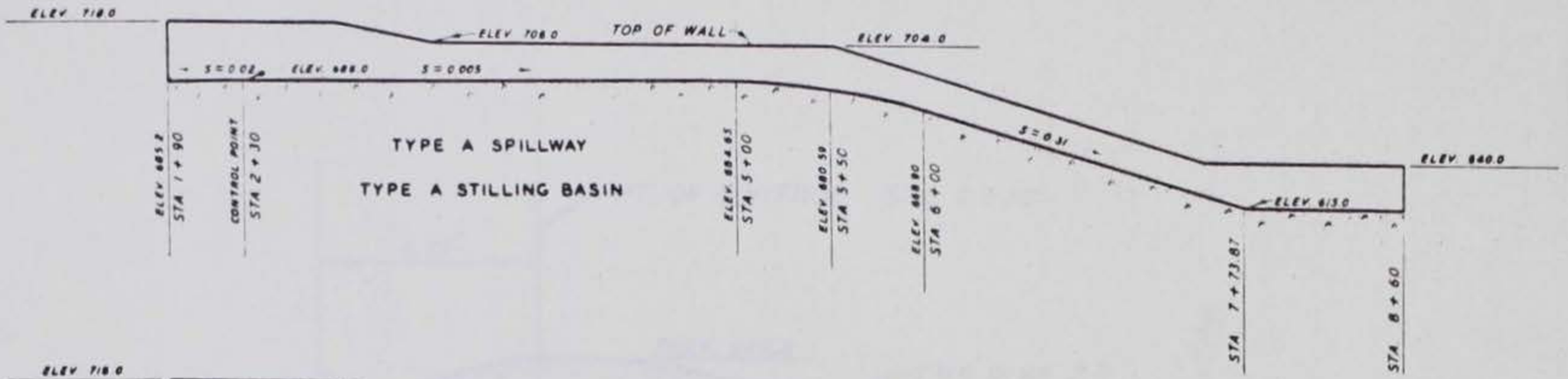
PROTOTYPE 100 0 100 200 300 FT

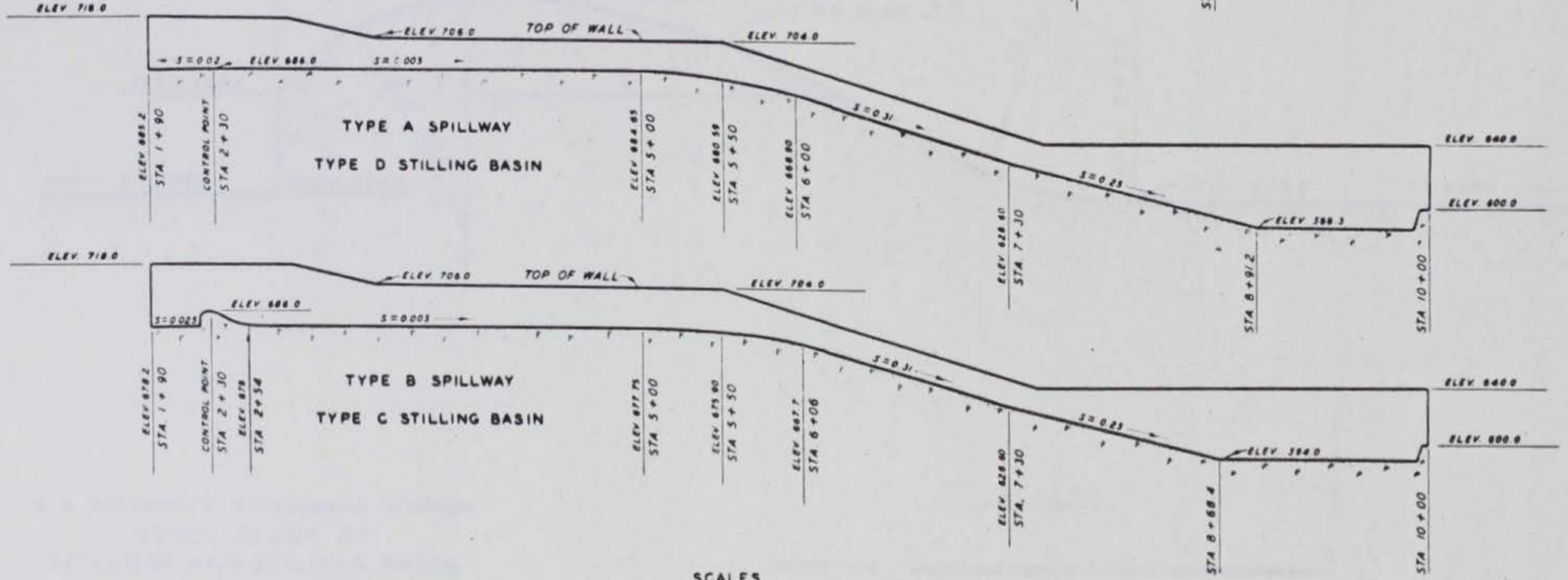
MODEL 5 0 5 FT

PLATE 2

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY





SCALES

PROTOTYPE 50 0 50 100 150 FT.

MODEL 1 0 1 2 3 FT

U.S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF

SPILLWAY AND STILLING BASIN

DEWEY DAM

SPILLWAY PROFILES

PLATE 3

WAR DEPARTMENT

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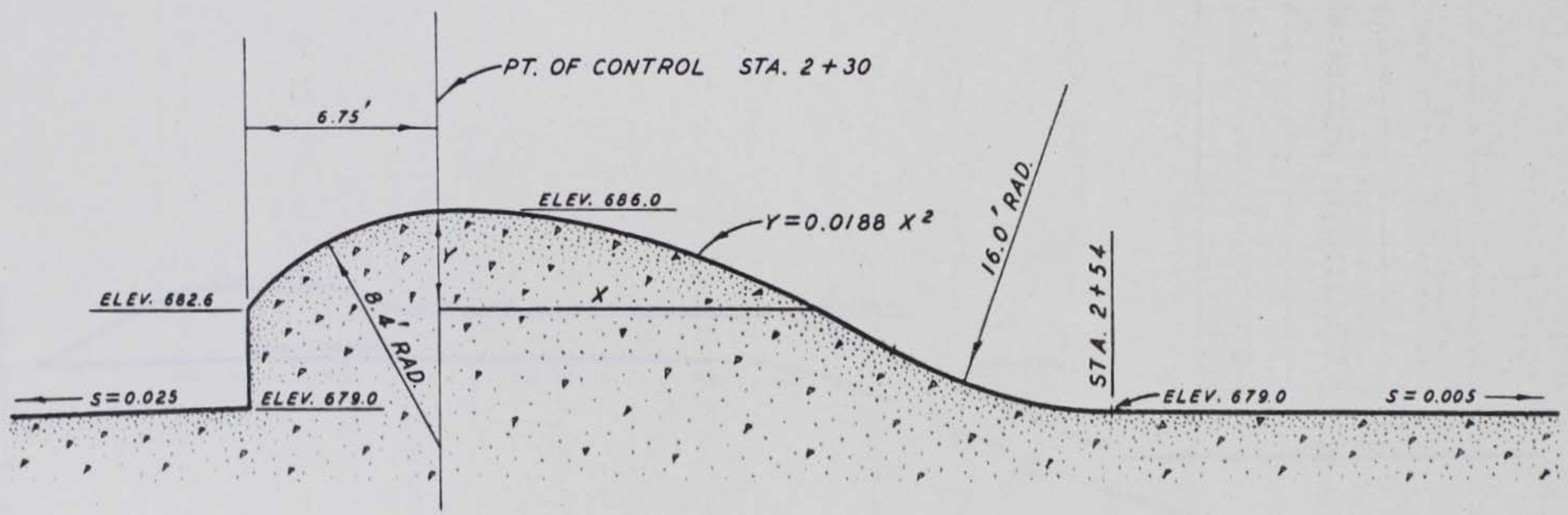


U. S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

DETAILS OF OGEE CREST

TYPE B SPILLWAY

SCALES

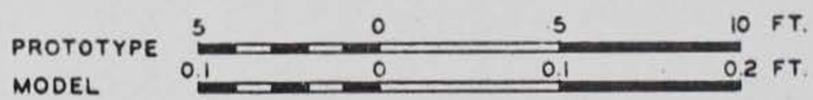
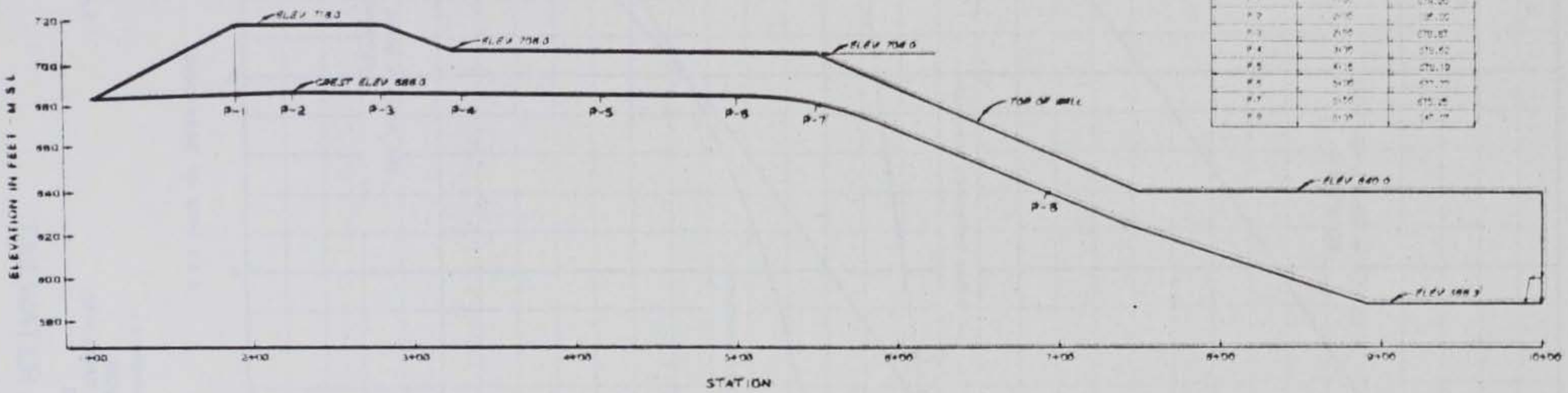


PLATE 4



TYPE A OR (1)		
PIEZOMETER NO.	PIEZOMETER STATION (FT.)	PIEZOMETER ELEVATION (FT. U.S.)
P-1	1+00	695.20
P-2	2+00	695.00
P-3	2+00	695.75
P-4	3+00	695.50
P-5	4+16	695.07
P-6	5+00	694.65
P-7	5+50	695.50
P-8	6+00	695.07

TYPE B OR (1)		
PIEZOMETER NO.	PIEZOMETER STATION (FT.)	PIEZOMETER ELEVATION (FT. U.S.)
P-1	1+00	679.20
P-2	2+00	678.00
P-3	2+00	678.87
P-4	3+00	679.62
P-5	4+16	678.19
P-6	5+00	677.77
P-7	5+50	675.25
P-8	6+00	647.07

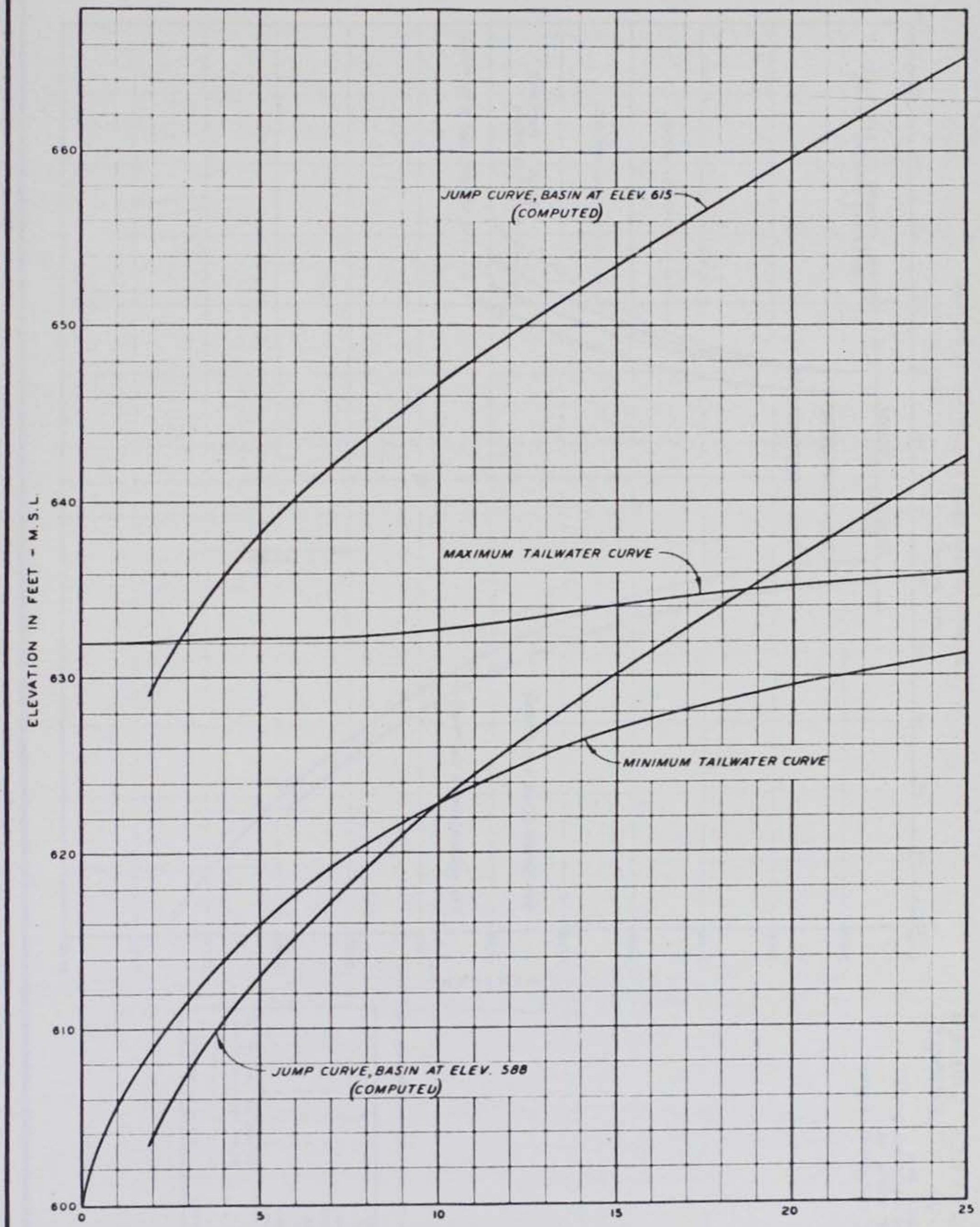
U. S. WATERWAYS EXPERIMENT STATION
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

PIEZOMETER LOCATIONS

PLATE 5

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



NOTE TAILWATER MEASURED 0.5 MILE BELOW AXIS OF DAM.

U. S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

TAILWATER AND JUMP CURVES

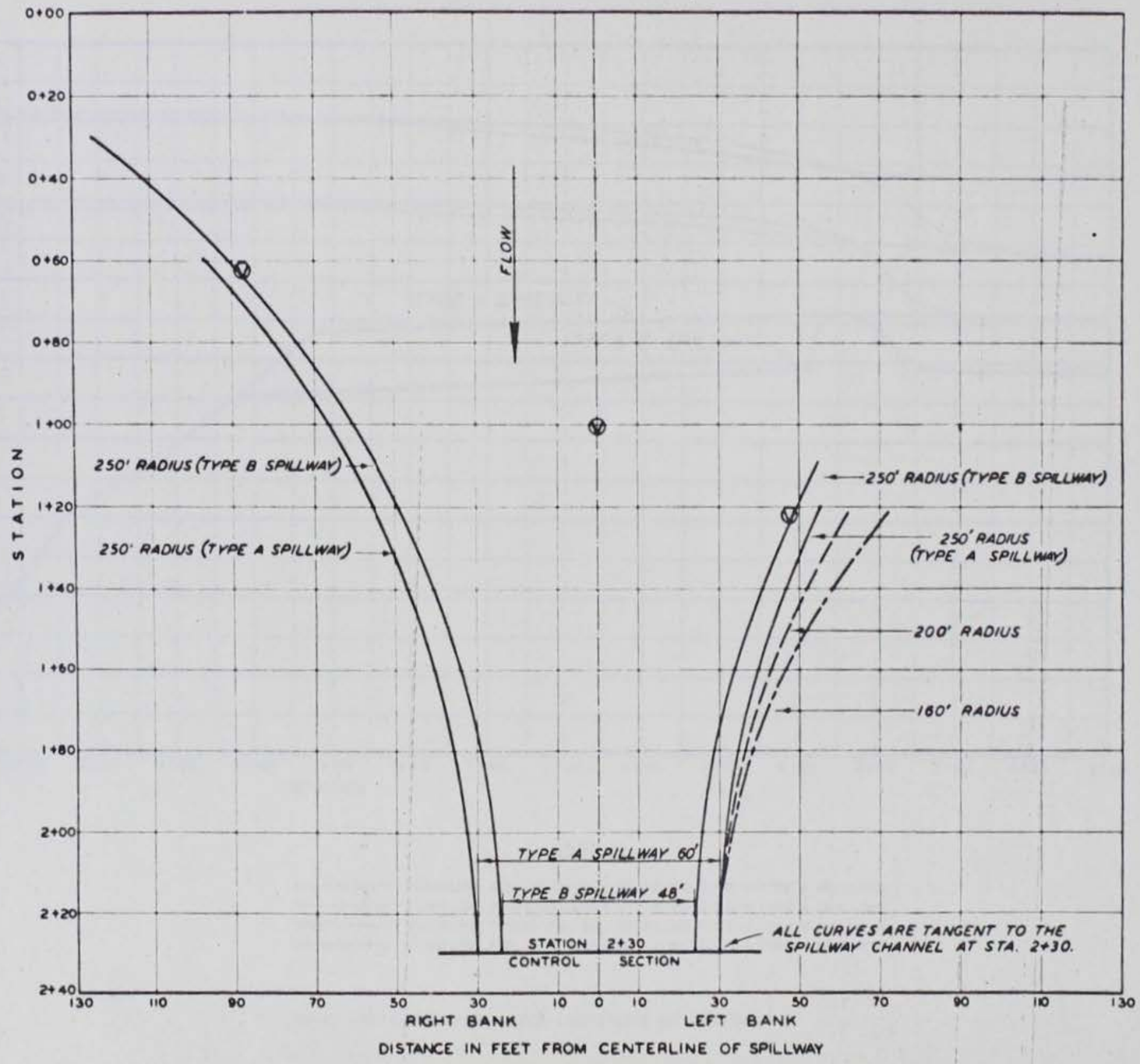
PLATE 6

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY

SPILLWAY ENTRANCE CURVE (LEFT BANK)	DISCHARGE C.F.S.	POOL ELEV.	VELOCITY (FT. PER SEC.)		
			Rt. Bank Sta. 0+62	Centerline Sta. 1+00	Lt. Bank Sta. 1+22
250 ft. Radius (TYPE A SPILLWAY)	22,800	710.50	4	8	2
	8,100	699.05	1	4	1
250 ft. Radius (TYPE B SPILLWAY)	22,800	711.20	1	4	4
	8,100	699.50	3	2	4
200 ft. Radius (TYPE A SPILLWAY)	22,800	710.45	3	5	5
	8,100	698.90	1	3	4
160 ft. Radius (TYPE A SPILLWAY)	22,800	710.45	---	---	---
	8,100	698.90	---	---	---

NOTE: Circle, ⓥ, indicates points at which velocity measurements were made.



U. S. WATERWAYS EXPERIMENT STATION
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

ALIGNMENT OF ALTERNATE SPILLWAY ENTRANCE CURVES

PLATE 7

LEGEND

- FLOWLINE FOR DISCHARGE OF 22,800 C.F.S. — TYPE A SPILLWAY
- FLOWLINE FOR DISCHARGE OF 8,100 C.F.S. — TYPE A SPILLWAY
- FLOWLINE FOR DISCHARGE OF 22,800 C.F.S. — TYPE B SPILLWAY
- FLOWLINE FOR DISCHARGE OF 8,100 C.F.S. — TYPE B SPILLWAY

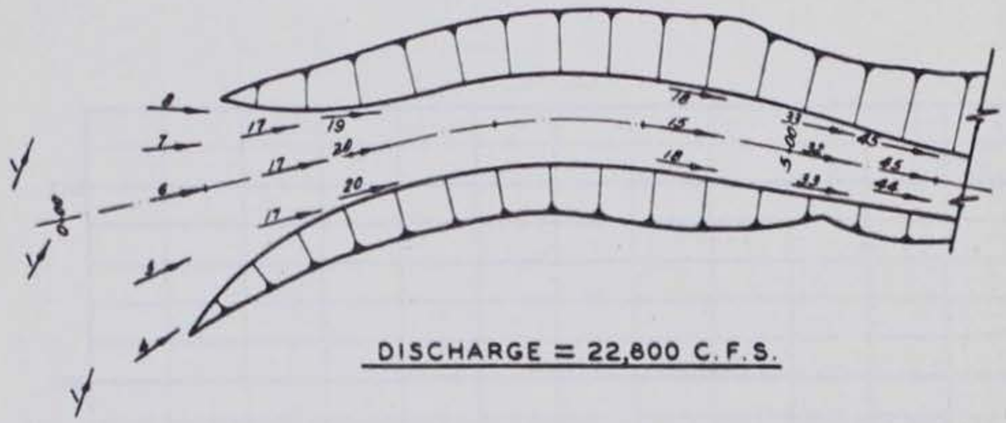
NOTE: PROFILES TAKEN ALONG CENTERLINE OF SPILLWAY

U. S. WATERWAYS EXPERIMENT STATION

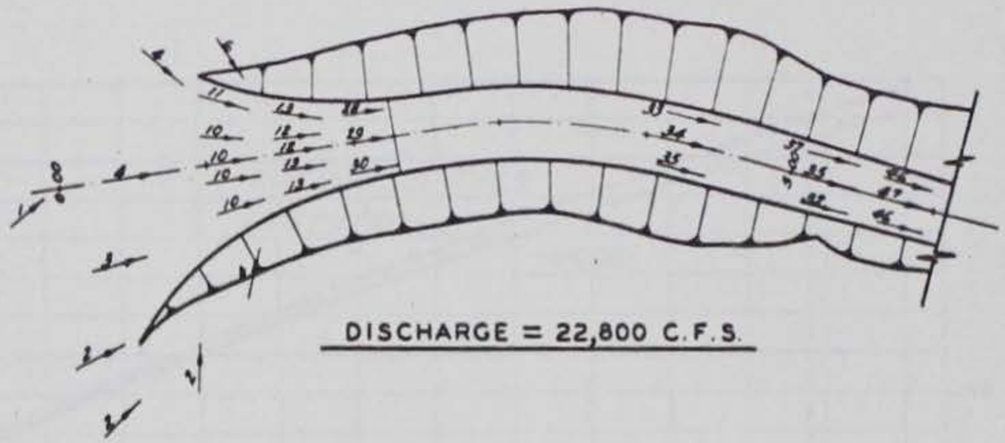
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

WATER-SURFACE PROFILES
TYPES A AND B SPILLWAYS

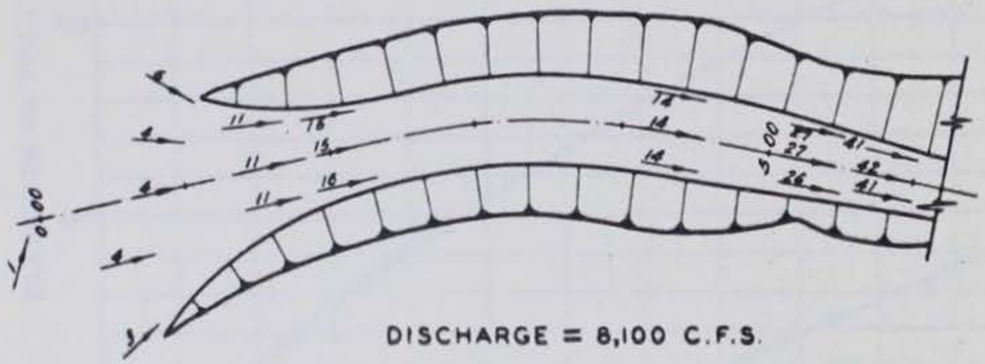
PLATE 8



DISCHARGE = 22,800 C.F.S.

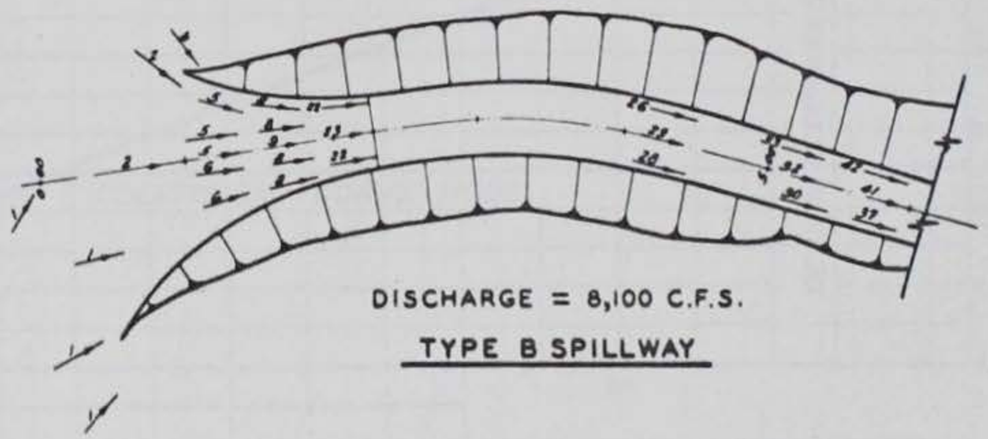


DISCHARGE = 22,800 C.F.S.



DISCHARGE = 8,100 C.F.S.

TYPE A SPILLWAY



DISCHARGE = 8,100 C.F.S.

TYPE B SPILLWAY

NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

U. S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPES A AND B SPILLWAYS

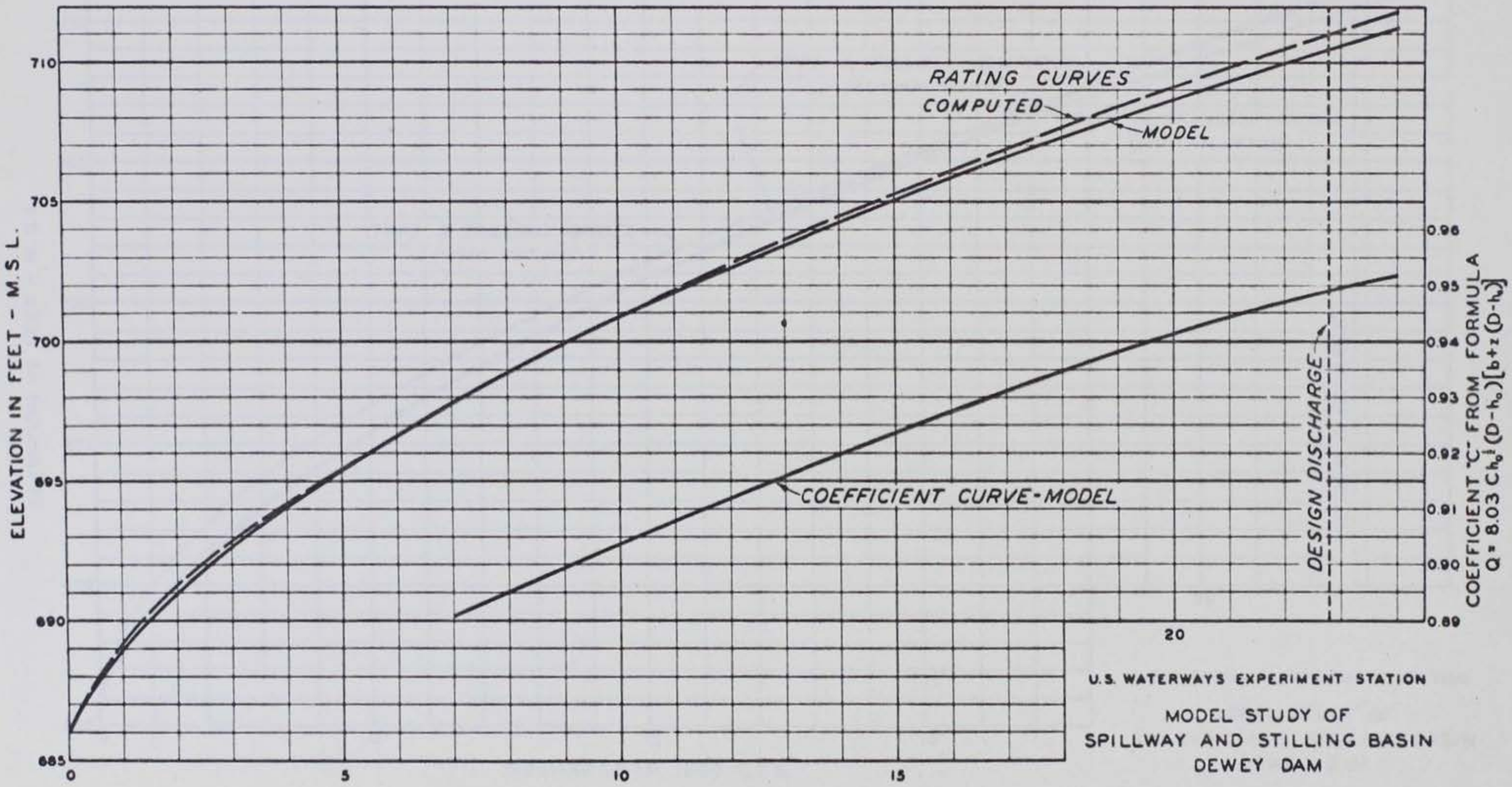
SCALES

PROTOTYPE	100	0	100	200	FT.
MODEL	2	0	2	4	FT.

PLATE 9

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U.S. WATERWAYS EXPERIMENT STATION

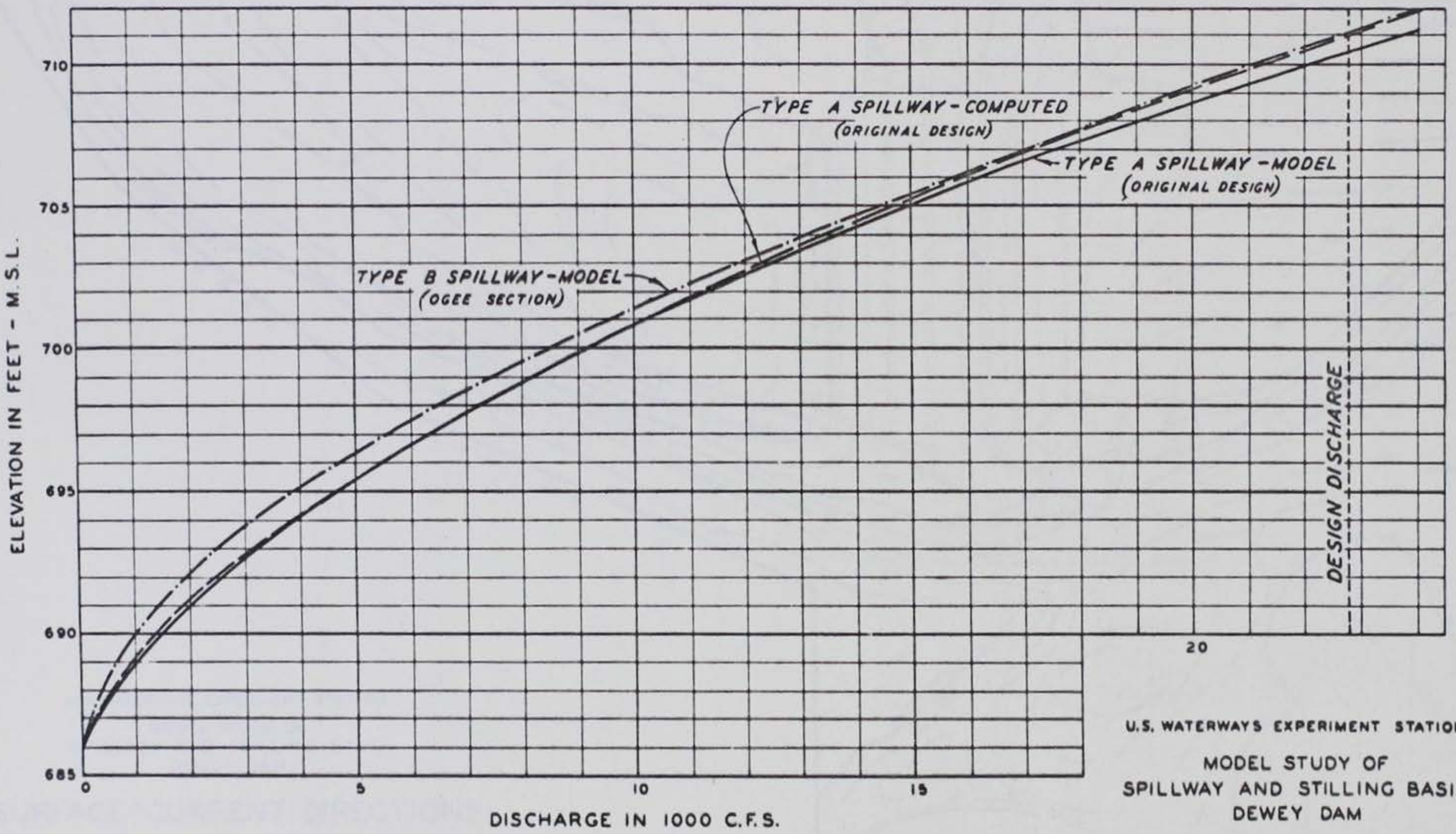
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

RATING CURVES
ORIGINAL DESIGN

PLATE 10

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U.S. WATERWAYS EXPERIMENT STATION

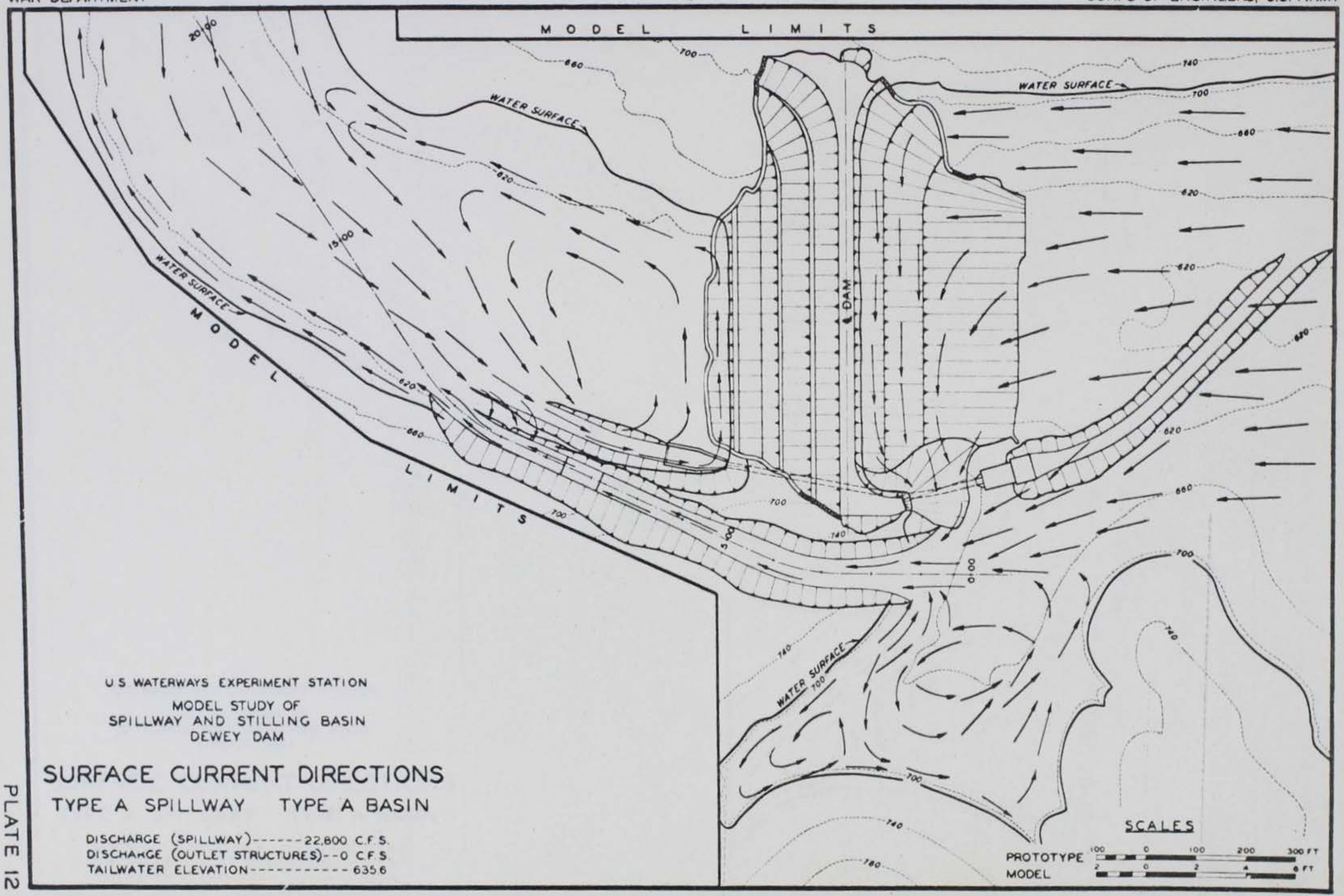
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

RATING CURVES

PLATE 11

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U.S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SURFACE CURRENT DIRECTIONS

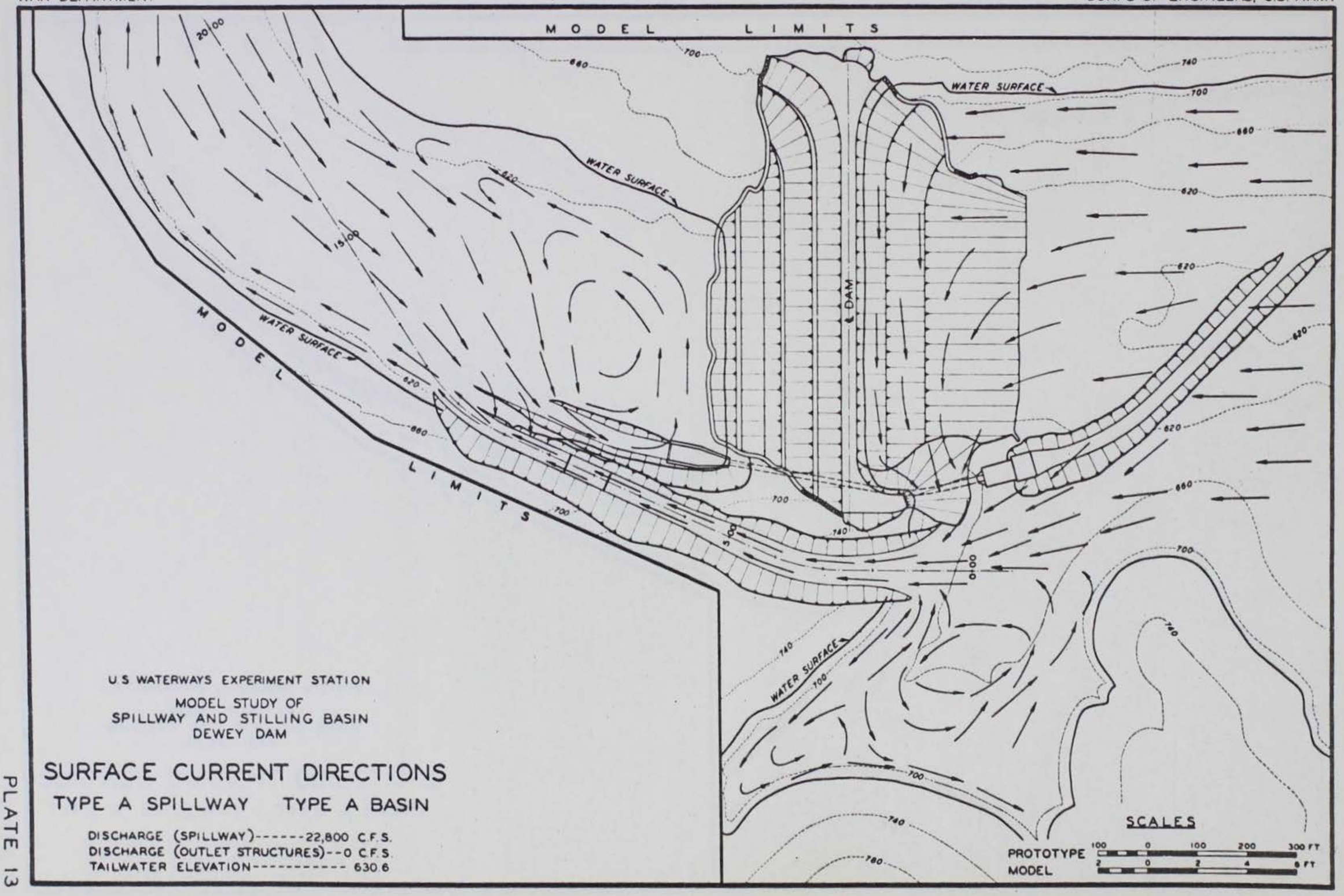
TYPE A SPILLWAY TYPE A BASIN

DISCHARGE (SPILLWAY)------22,800 C.F.S.
DISCHARGE (OUTLET STRUCTURES)--0 C.F.S
TAILWATER ELEVATION----------6356

PLATE 12

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U.S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SURFACE CURRENT DIRECTIONS

TYPE A SPILLWAY TYPE A BASIN

DISCHARGE (SPILLWAY)------22,800 C.F.S.
DISCHARGE (OUTLET STRUCTURES)--0 C.F.S.
TAILWATER ELEVATION---------- 630.6

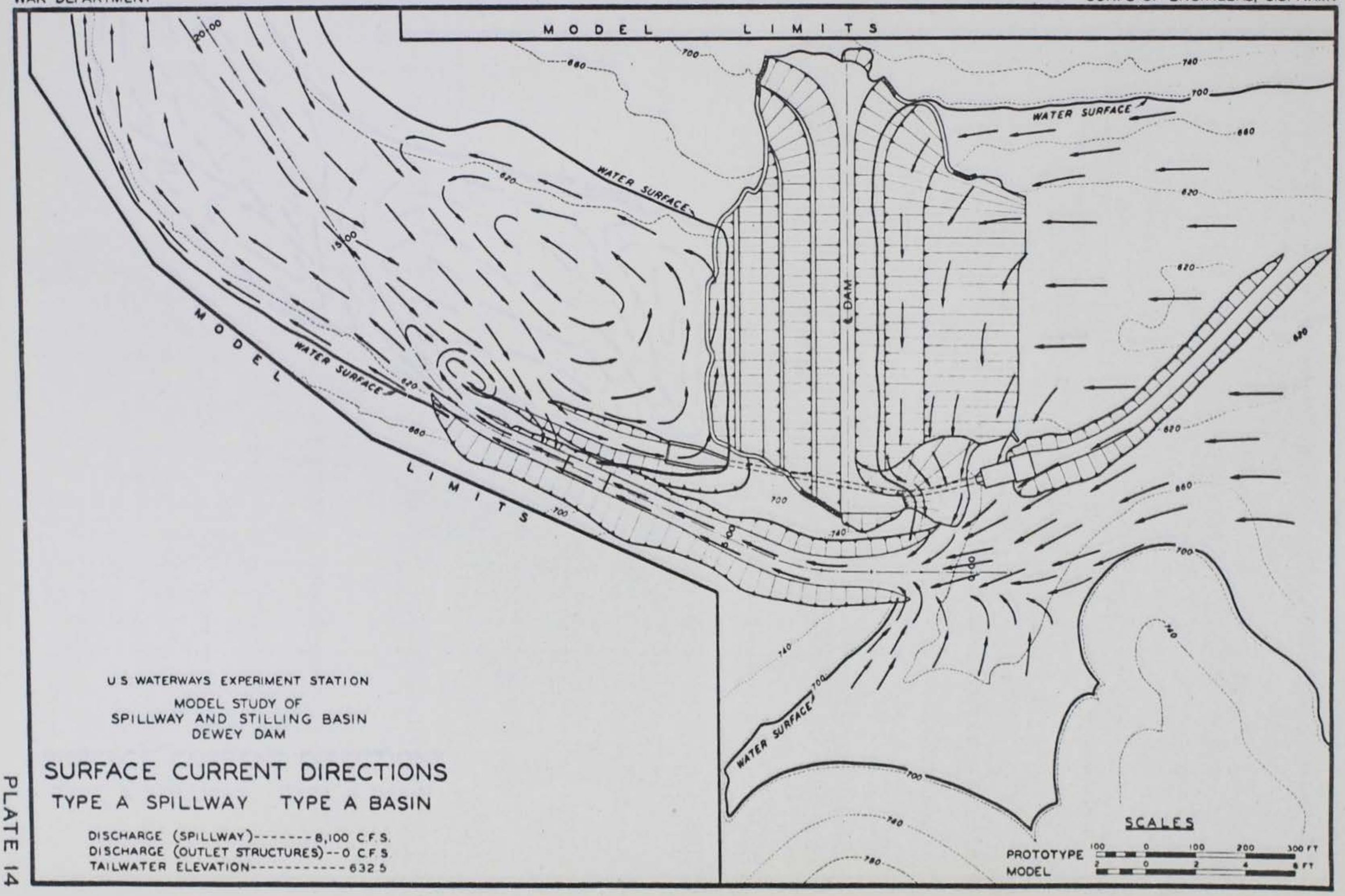
SCALES

PROTOTYPE 100 0 100 200 300 FT
MODEL 2 0 2 4 6 FT

PLATE 13

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SURFACE CURRENT DIRECTIONS

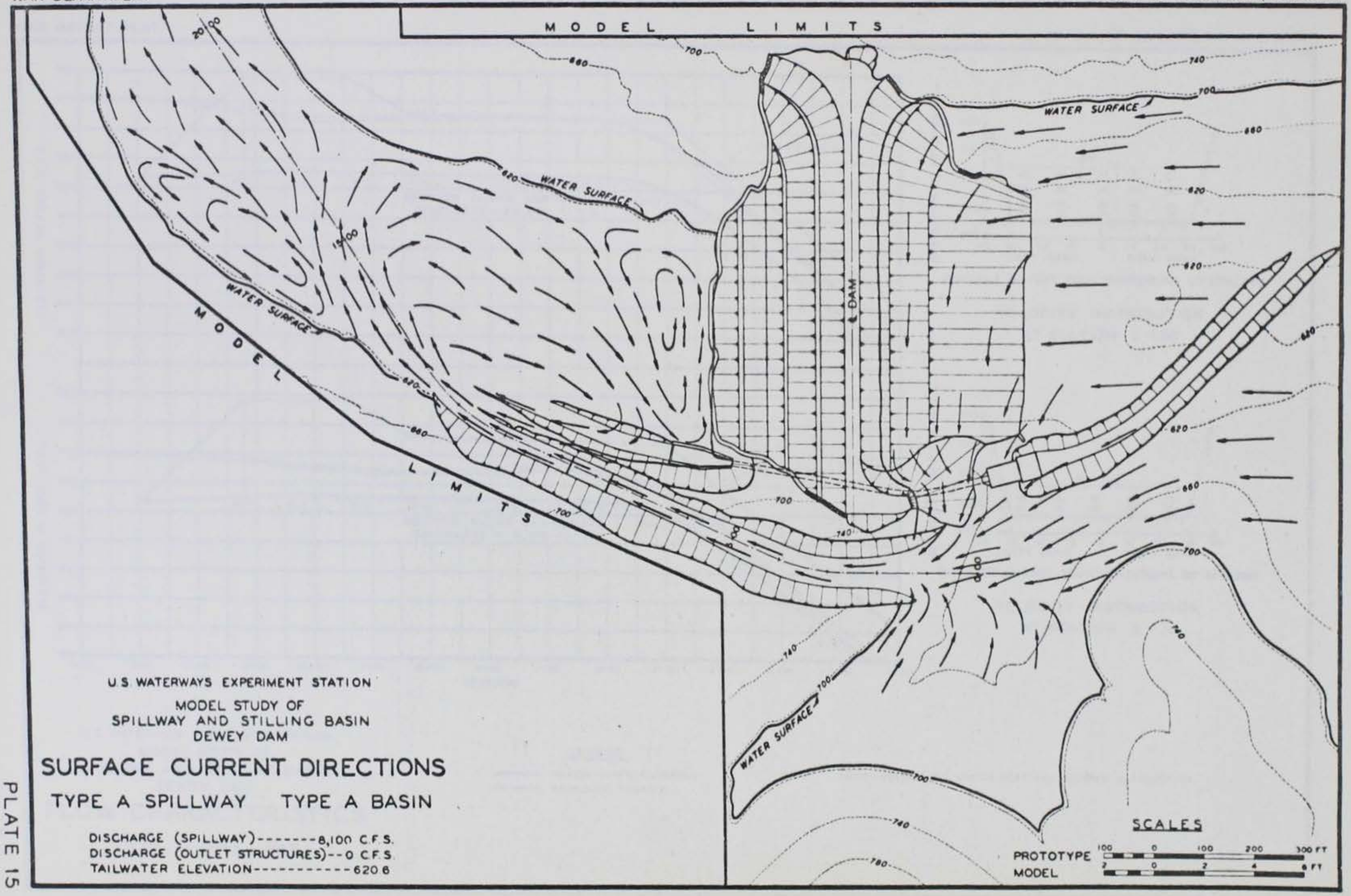
TYPE A SPILLWAY TYPE A BASIN

DISCHARGE (SPILLWAY)-------8,100 C.F.S.
DISCHARGE (OUTLET STRUCTURES)--0 C.F.S.
TAILWATER ELEVATION----------632.5

PLATE 14

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U.S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SURFACE CURRENT DIRECTIONS

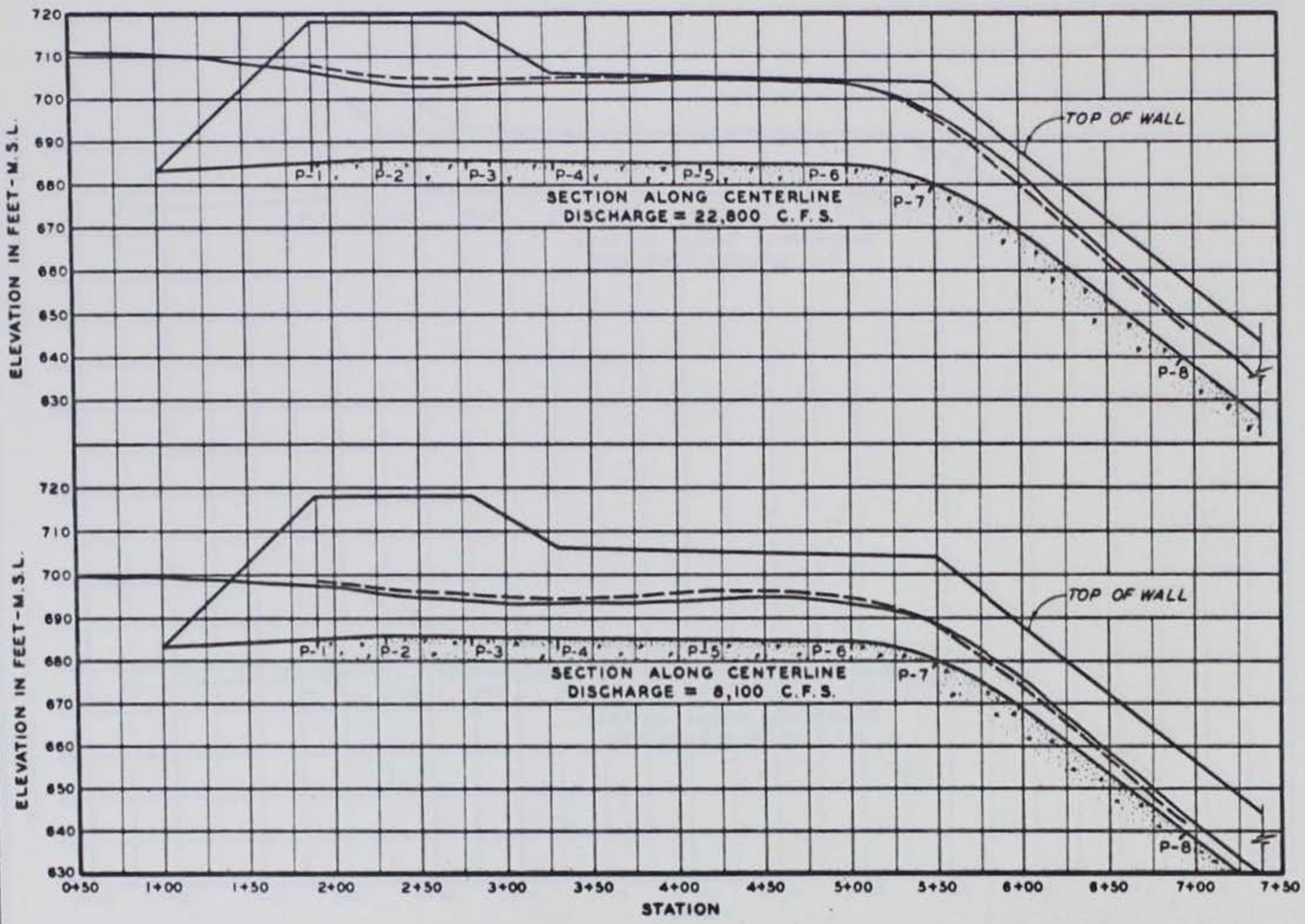
TYPE A SPILLWAY TYPE A BASIN

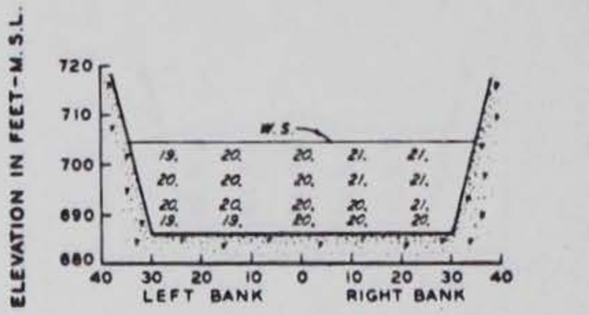
DISCHARGE (SPILLWAY)-------8,100 C.F.S.
DISCHARGE (OUTLET STRUCTURES)--0 C.F.S.
TAILWATER ELEVATION----------620.6

PLATE 15

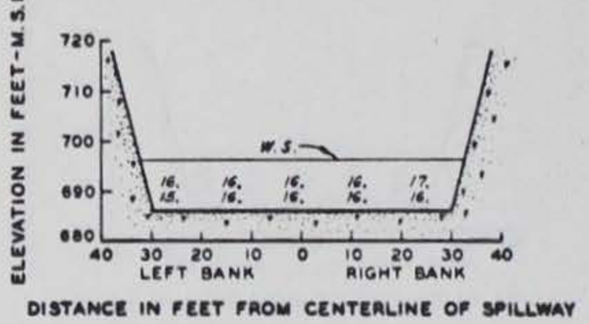
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY





VELOCITY DISTRIBUTION
AT STATION 2+30



VELOCITY DISTRIBUTION
AT STATION 2+30

U. S. WATERWAYS EXPERIMENT STATION
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

FLOW CHARACTERISTICS

TYPE A SPILLWAY

LEGEND

——— WATER-SURFACE PROFILE

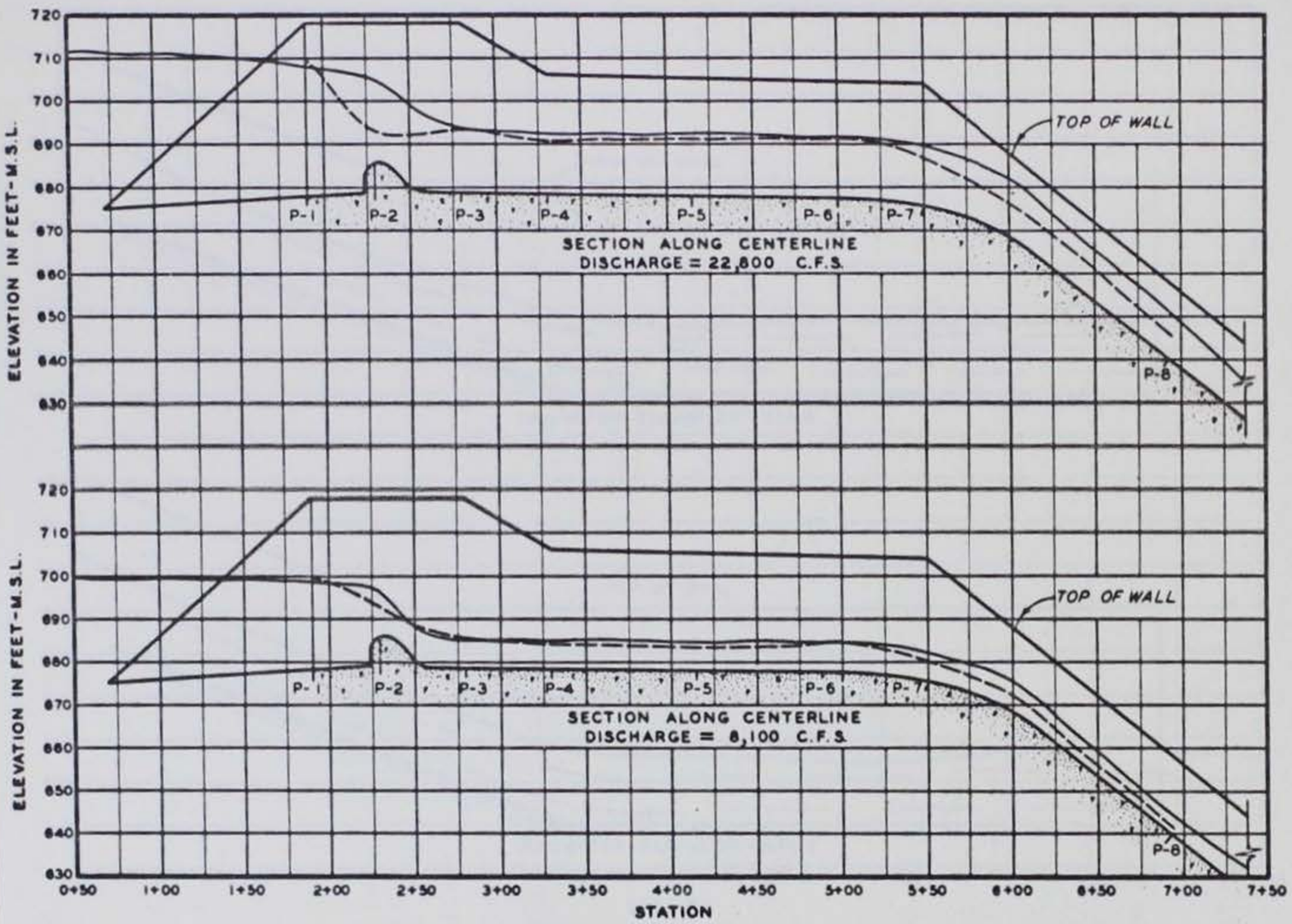
— — — PRESSURE PROFILE

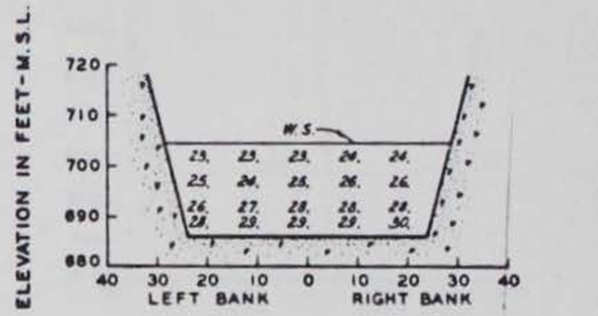
NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

PLATE 16

WAR DEPARTMENT

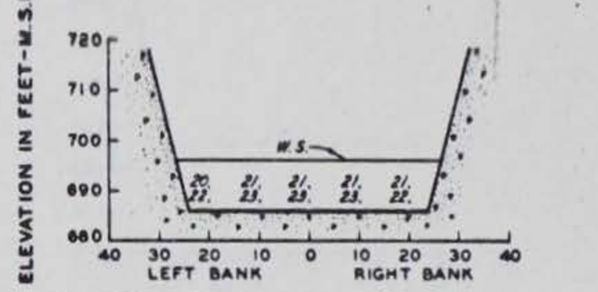
CORPS OF ENGINEERS, U. S. ARMY





DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 2+30



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 2+30

U. S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

FLOW CHARACTERISTICS

TYPE B SPILLWAY

LEGEND

——— WATER-SURFACE PROFILE

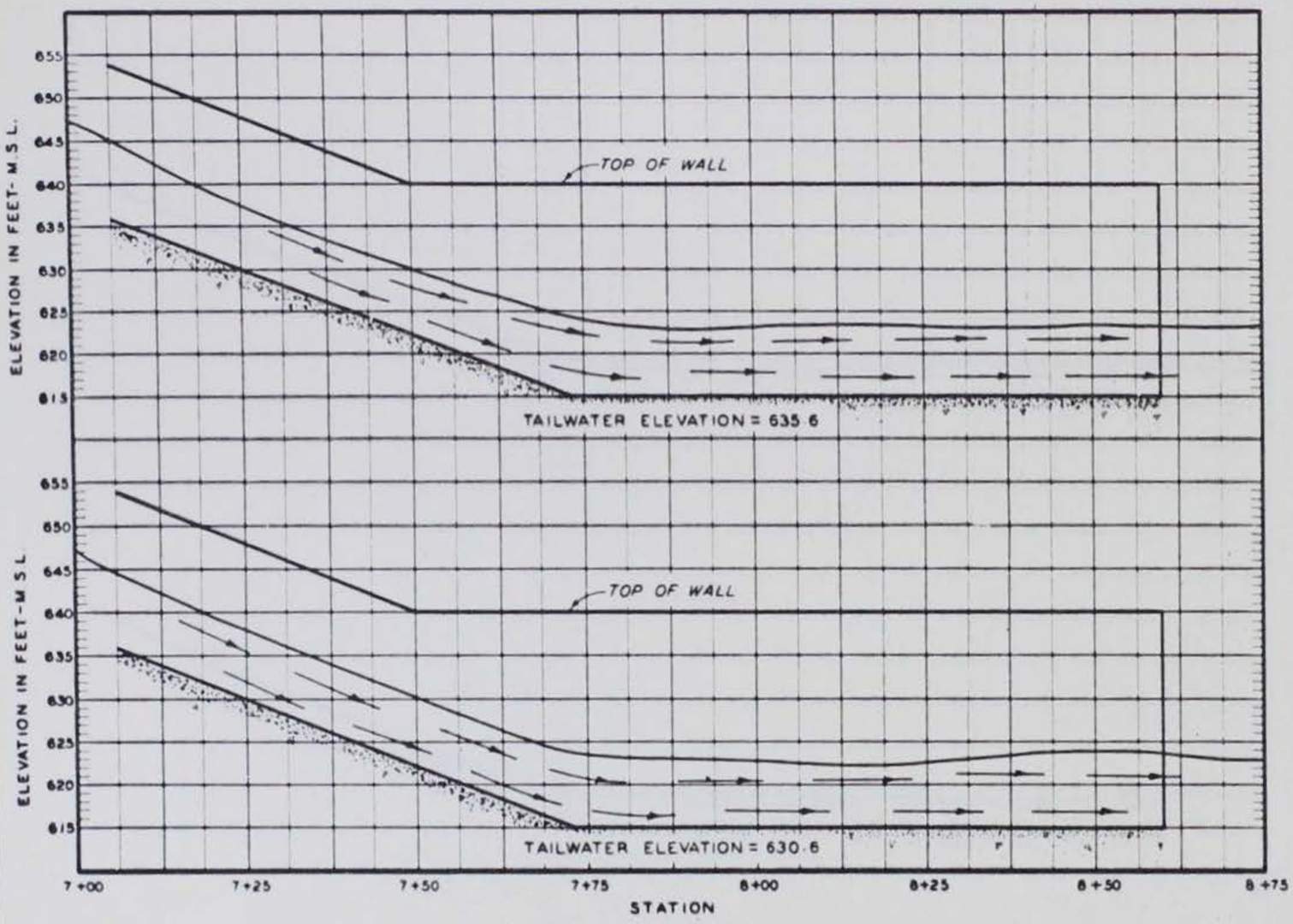
— — — PRESSURE PROFILE

NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

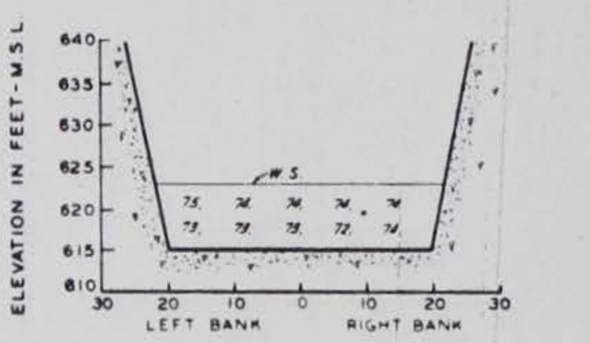
PLATE 17

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

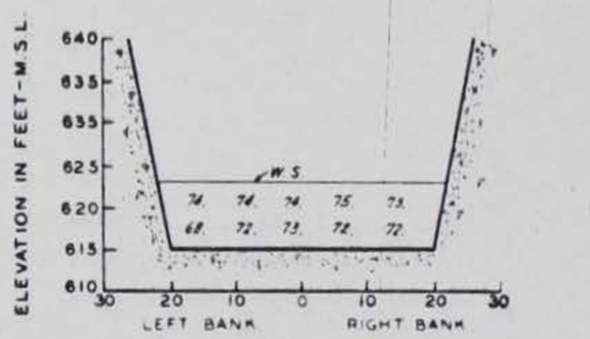


WATER-SURFACE PROFILES



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 8+60



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 8+60

U. S. WATERWAYS EXPERIMENT STATION

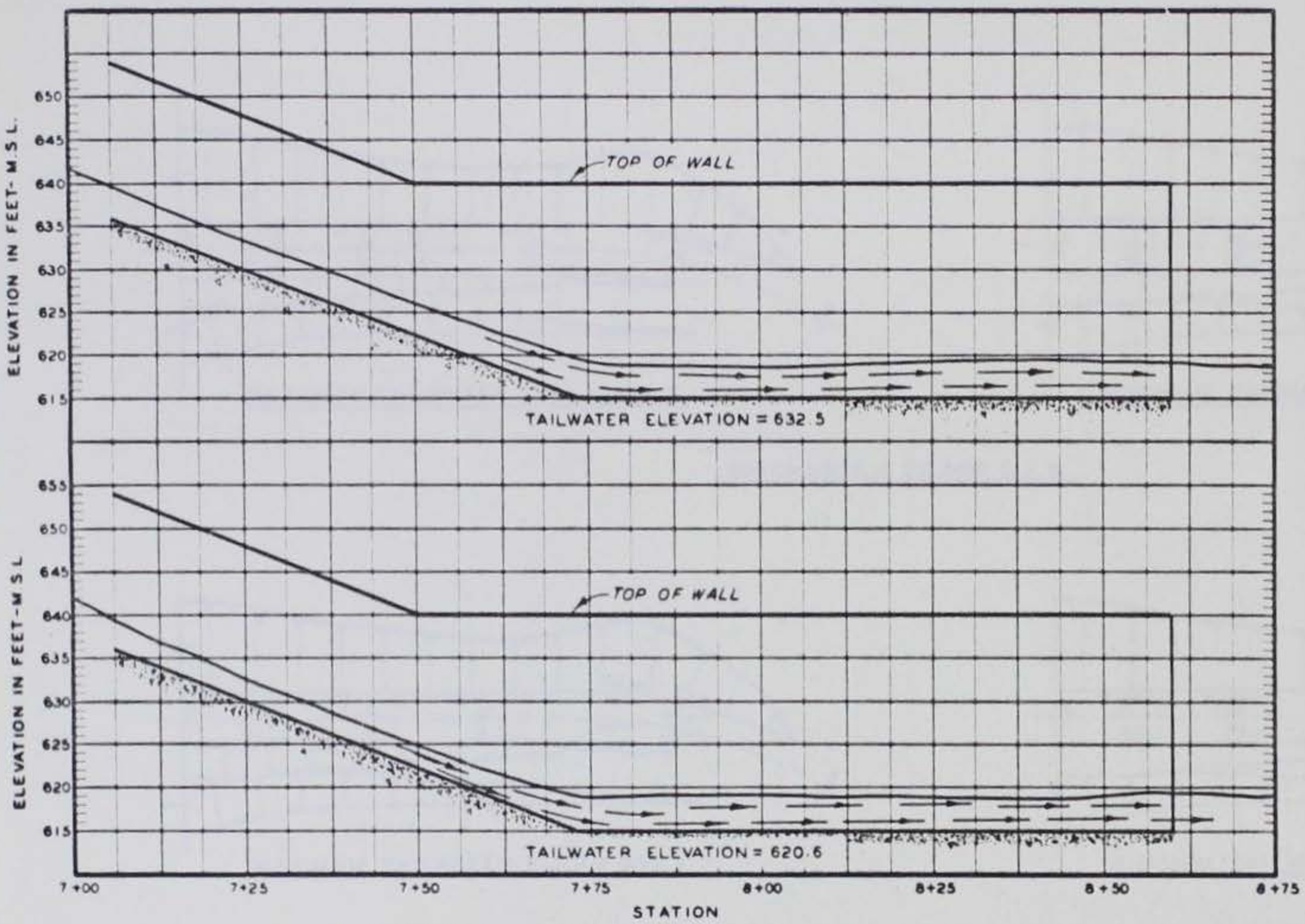
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

FLOW CHARACTERISTICS
TYPE A BASIN

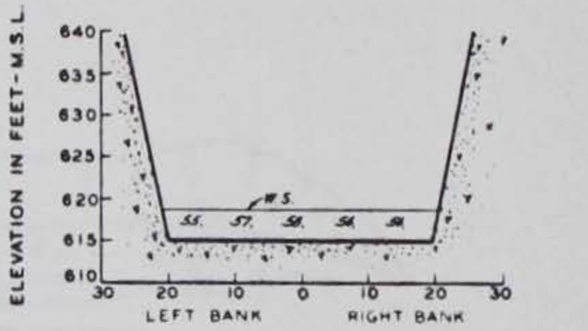
DISCHARGE (SPILLWAY)..... 22,800 C.F.S.
DISCHARGE (OUTLET STRUCTURES).. 0 C.F.S.

NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE.

PLATE 18

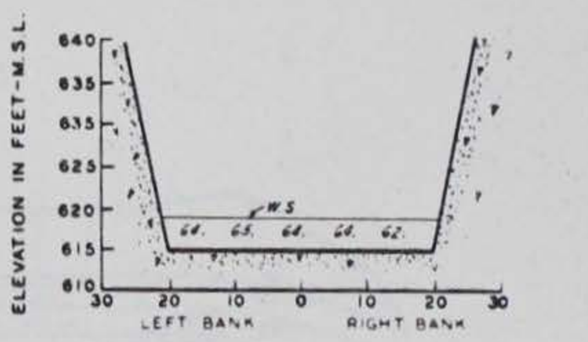


WATER-SURFACE PROFILES



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 8+60



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 8+60

U. S. WATERWAYS EXPERIMENT STATION

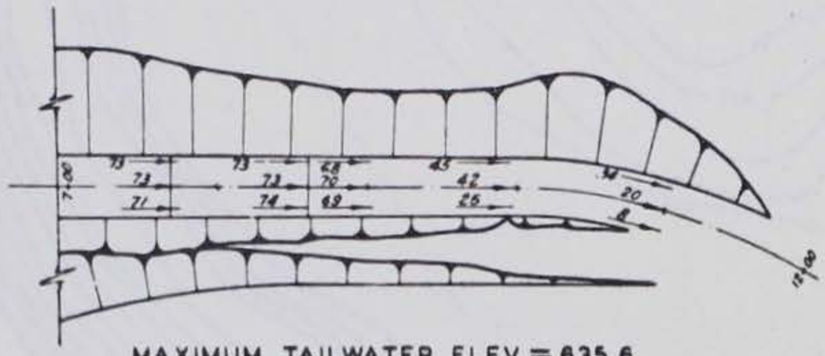
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

FLOW CHARACTERISTICS
TYPE A BASIN

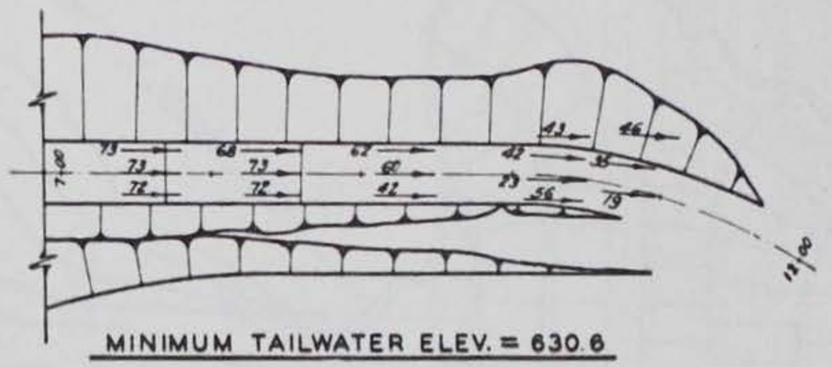
DISCHARGE (SPILLWAY)..... 8,100 CFS
DISCHARGE (OUTLET STRUCTURES).. 0 CFS

NOTE VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE.

PLATE 19

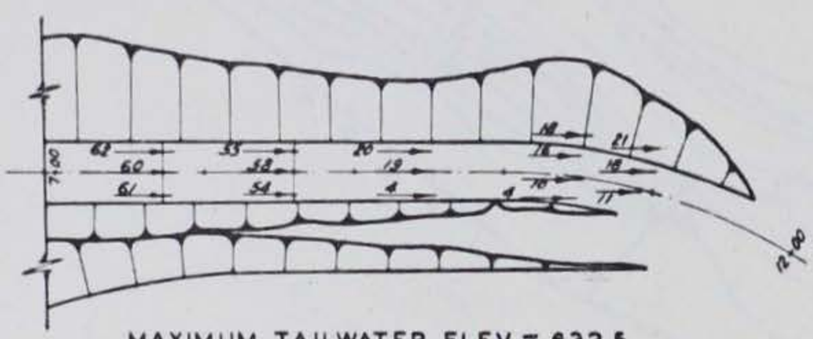


MAXIMUM TAILWATER ELEV. = 635.6

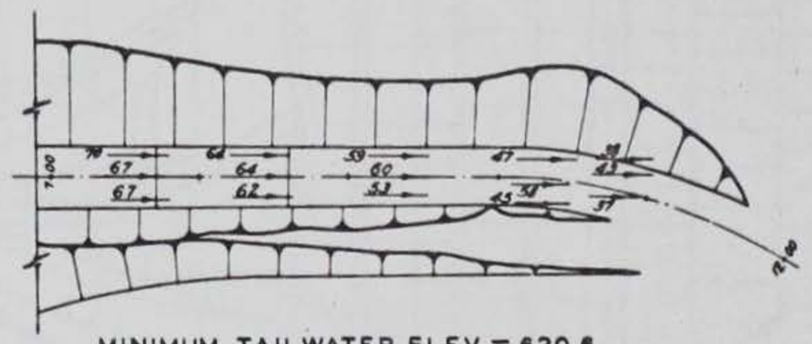


MINIMUM TAILWATER ELEV. = 630.6

DISCHARGE = 22,800 C.F.S.



MAXIMUM TAILWATER ELEV. = 632.5



MINIMUM TAILWATER ELEV. = 620.6

DISCHARGE = 8,100 C.F.S.

U. S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE A BASIN

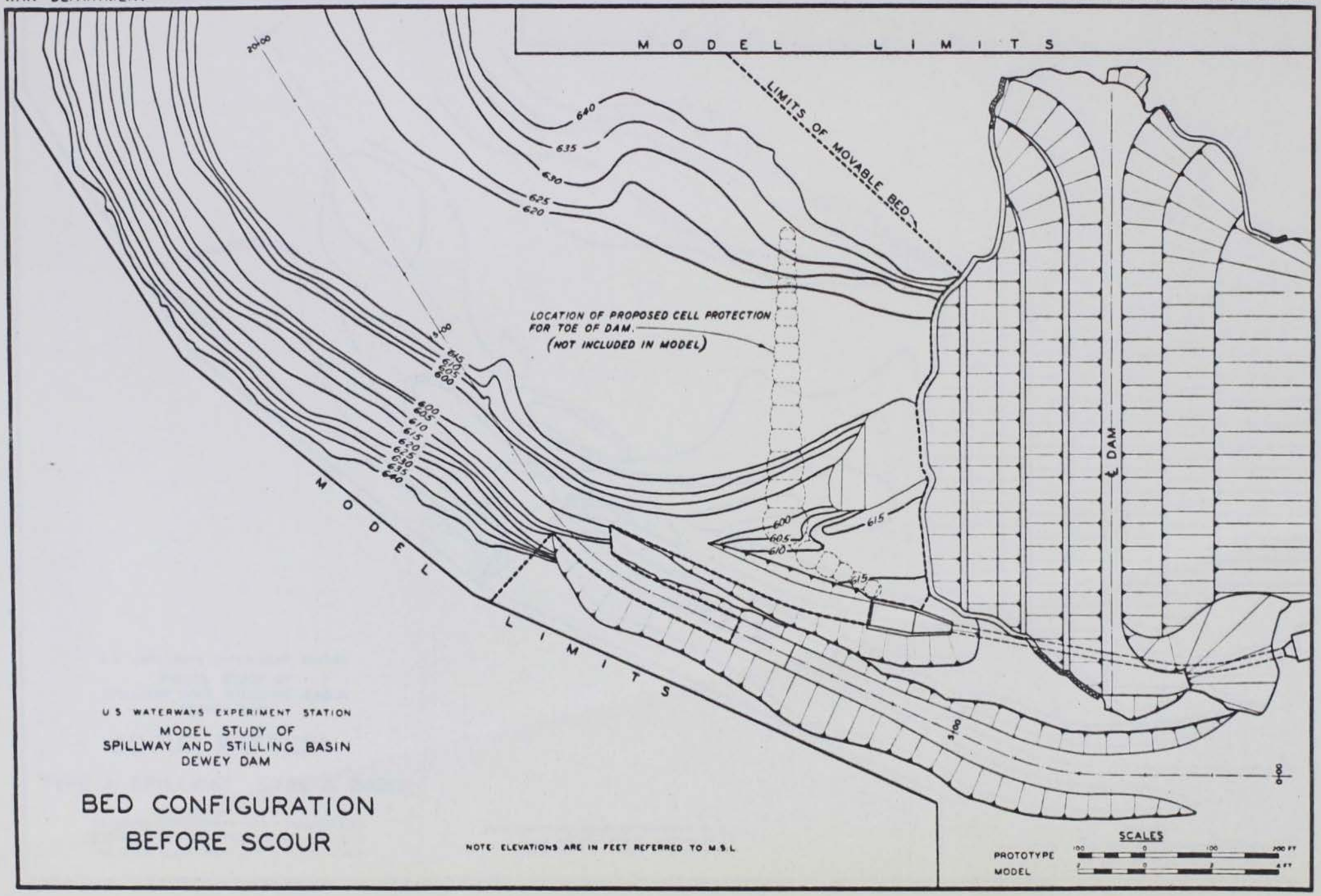
NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

SCALES

PLATE 20

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

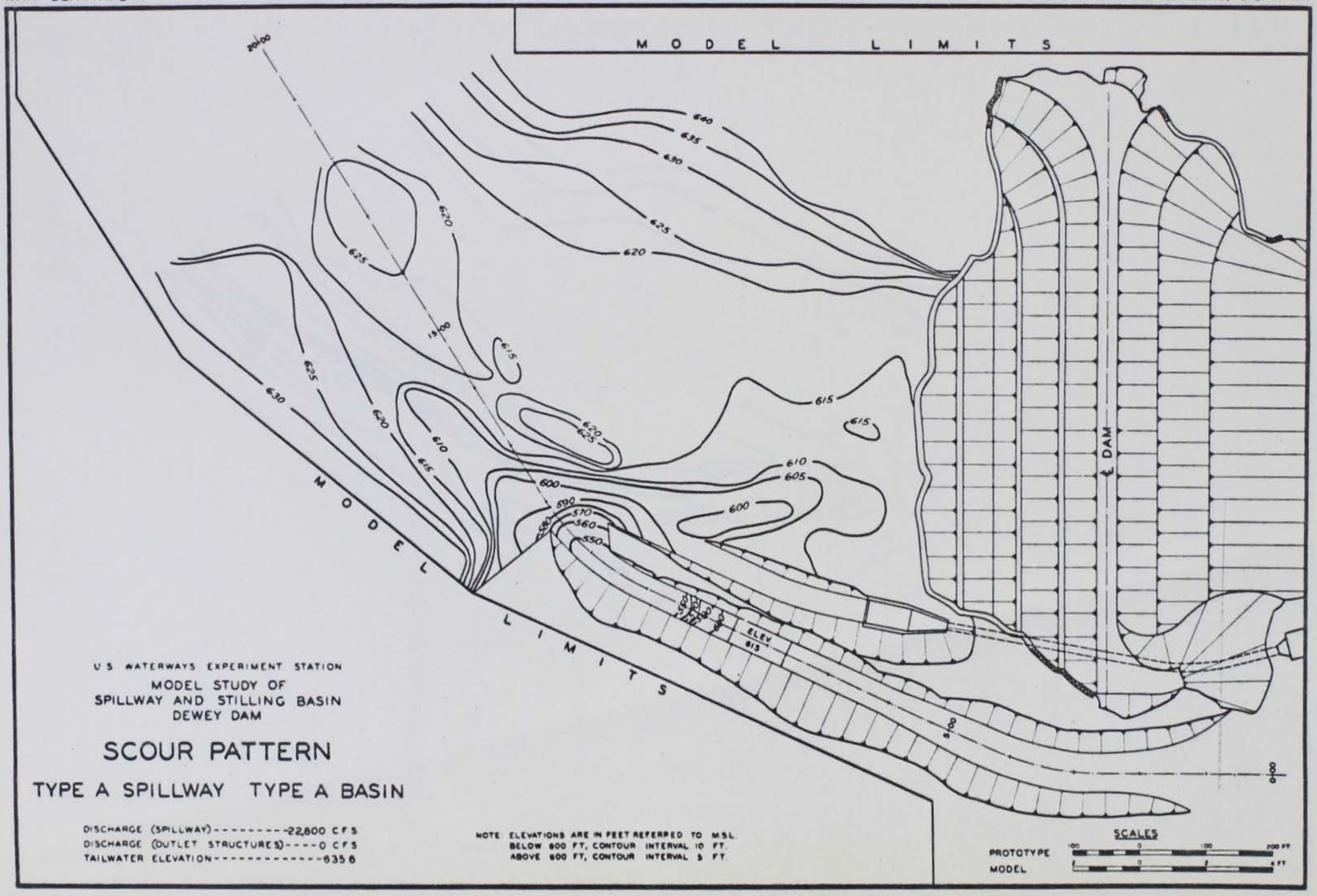
BED CONFIGURATION BEFORE SCOUR

NOTE ELEVATIONS ARE IN FEET REFERRED TO M.S.L.

PLATE 21

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SCOUR PATTERN

TYPE A SPILLWAY TYPE A BASIN

DISCHARGE (SPILLWAY)--------22,800 C F S
DISCHARGE (OUTLET STRUCTURES)----0 C F S
TAILWATER ELEVATION----------6356

NOTE ELEVATIONS ARE IN FEET REFERRED TO M.S.L.
BELOW 600 FT, CONTOUR INTERVAL 10 FT.
ABOVE 600 FT, CONTOUR INTERVAL 5 FT.

SCALES

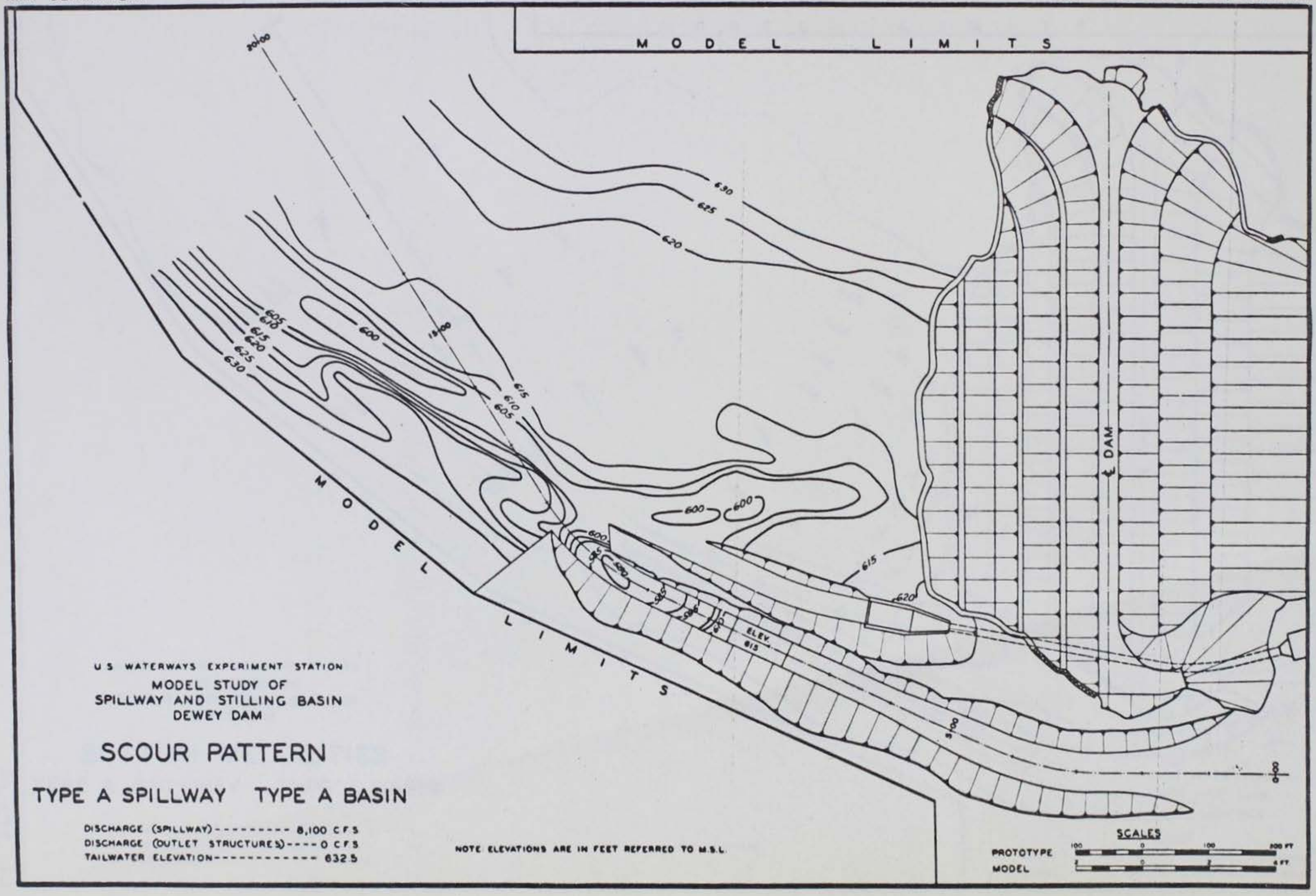
PROTOTYPE 100 0 100 200 FT

MODEL 2 0 2 4 FT

PLATE 22

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SCOUR PATTERN

TYPE A SPILLWAY TYPE A BASIN

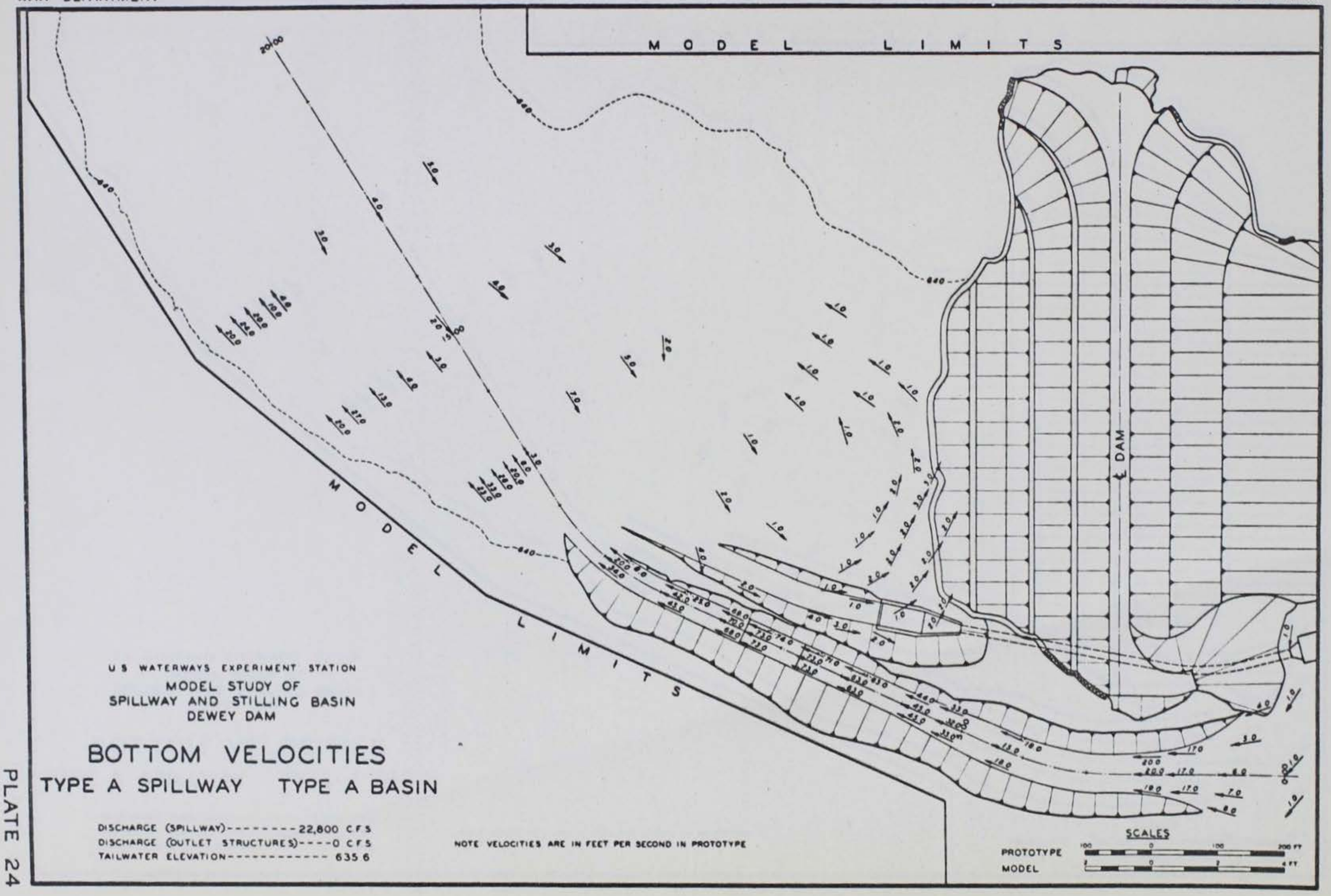
DISCHARGE (SPILLWAY)--------- 8,100 C F S
DISCHARGE (OUTLET STRUCTURES)---- 0 C F S
TAILWATER ELEVATION---------- 632.5

NOTE ELEVATIONS ARE IN FEET REFERRED TO M.S.L.

PLATE 23

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE A SPILLWAY TYPE A BASIN

DISCHARGE (SPILLWAY)--------22,800 C F S
DISCHARGE (OUTLET STRUCTURES)----0 C F S
TAILWATER ELEVATION---------- 635 6

NOTE VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

SCALES

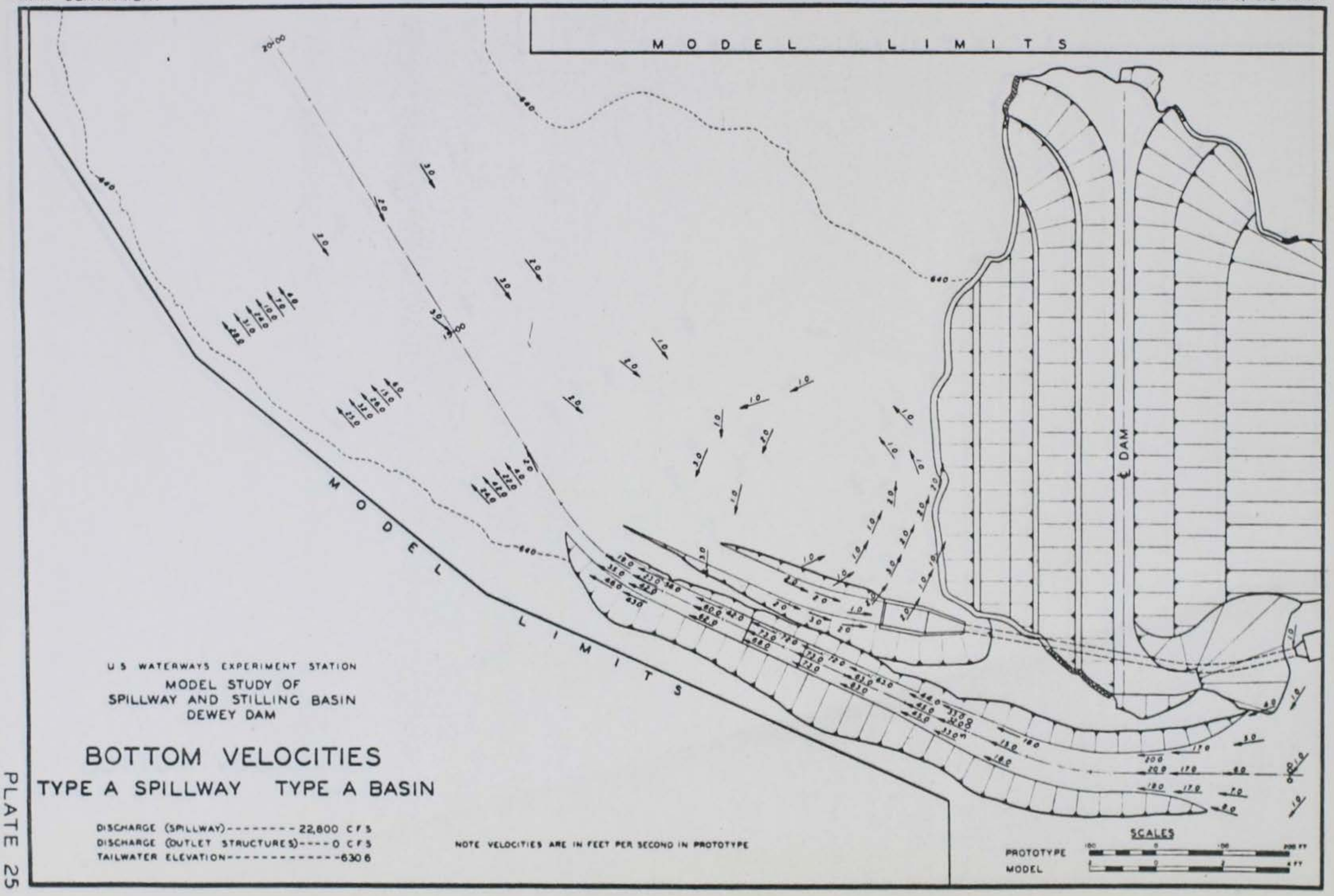
PROTOTYPE 100 0 100 200 FT

MODEL 2 0 2 4 FT

PLATE 24

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE A SPILLWAY TYPE A BASIN

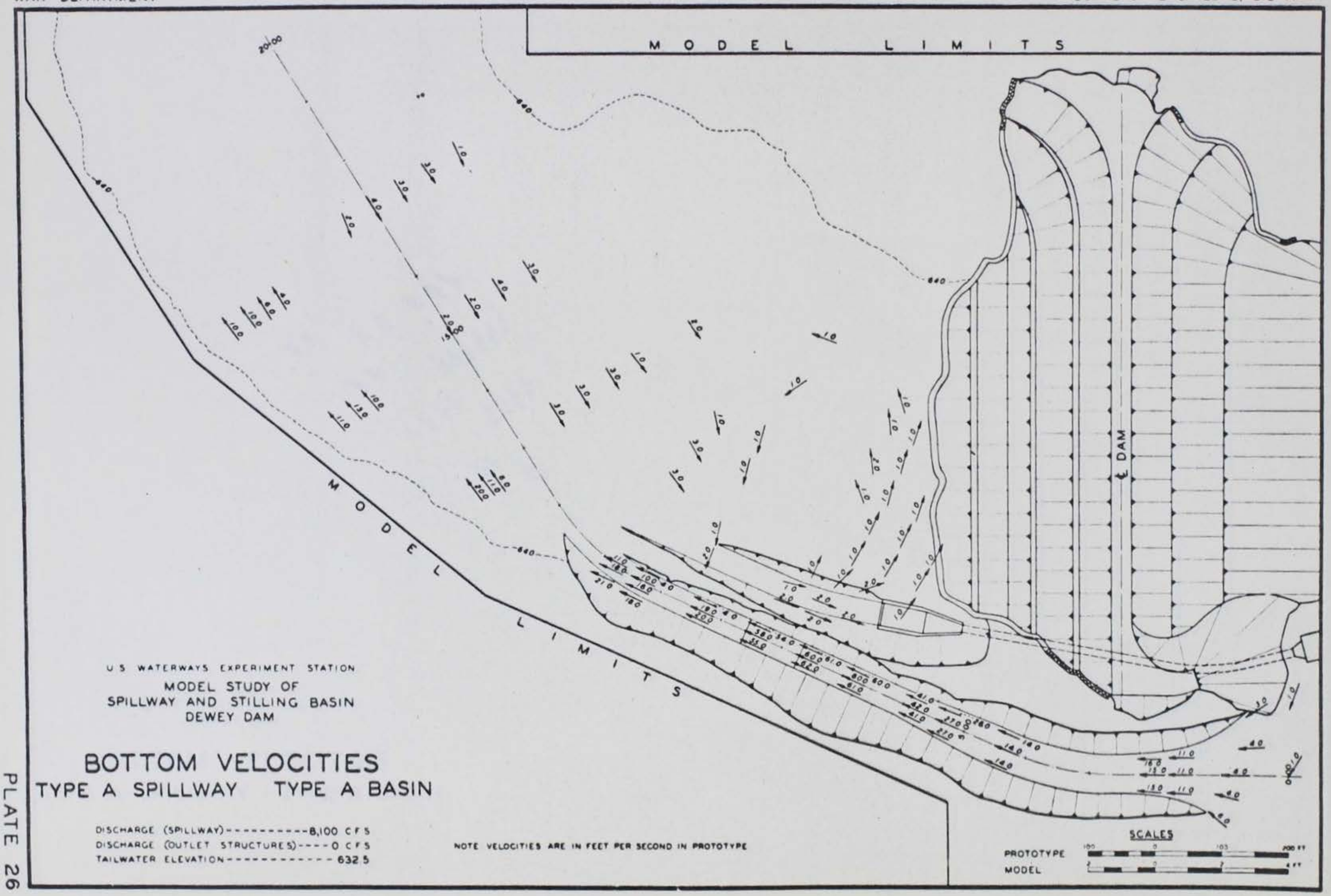
DISCHARGE (SPILLWAY)--------22,800 C F S
DISCHARGE (OUTLET STRUCTURES)----0 C F S
TAILWATER ELEVATION----------6306

NOTE VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

PLATE 25

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES
TYPE A SPILLWAY TYPE A BASIN

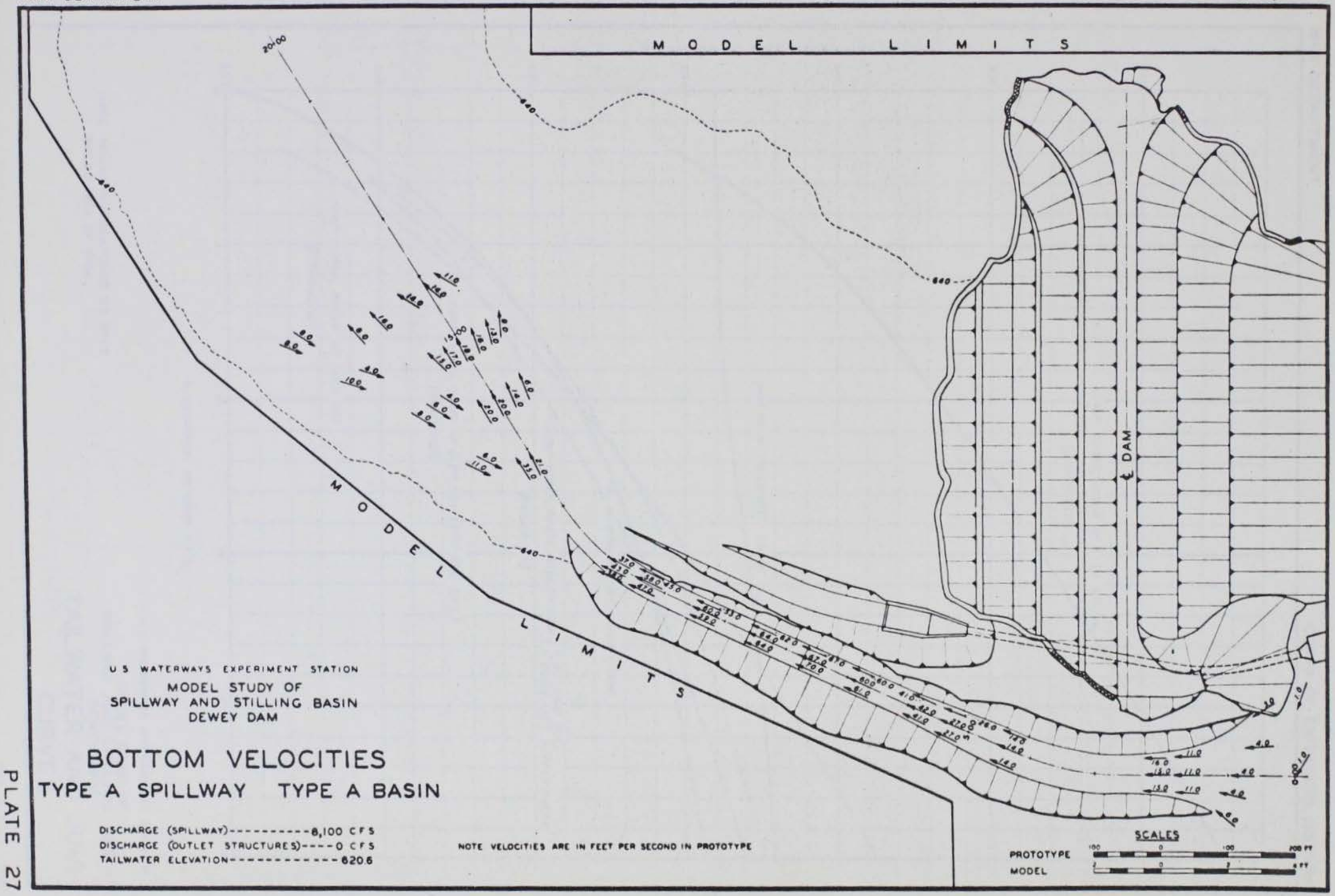
DISCHARGE (SPILLWAY)----------8,100 CFS
DISCHARGE (OUTLET STRUCTURES)----0 CFS
TAILWATER ELEVATION----------6325

NOTE VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

PLATE 26

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE A SPILLWAY TYPE A BASIN

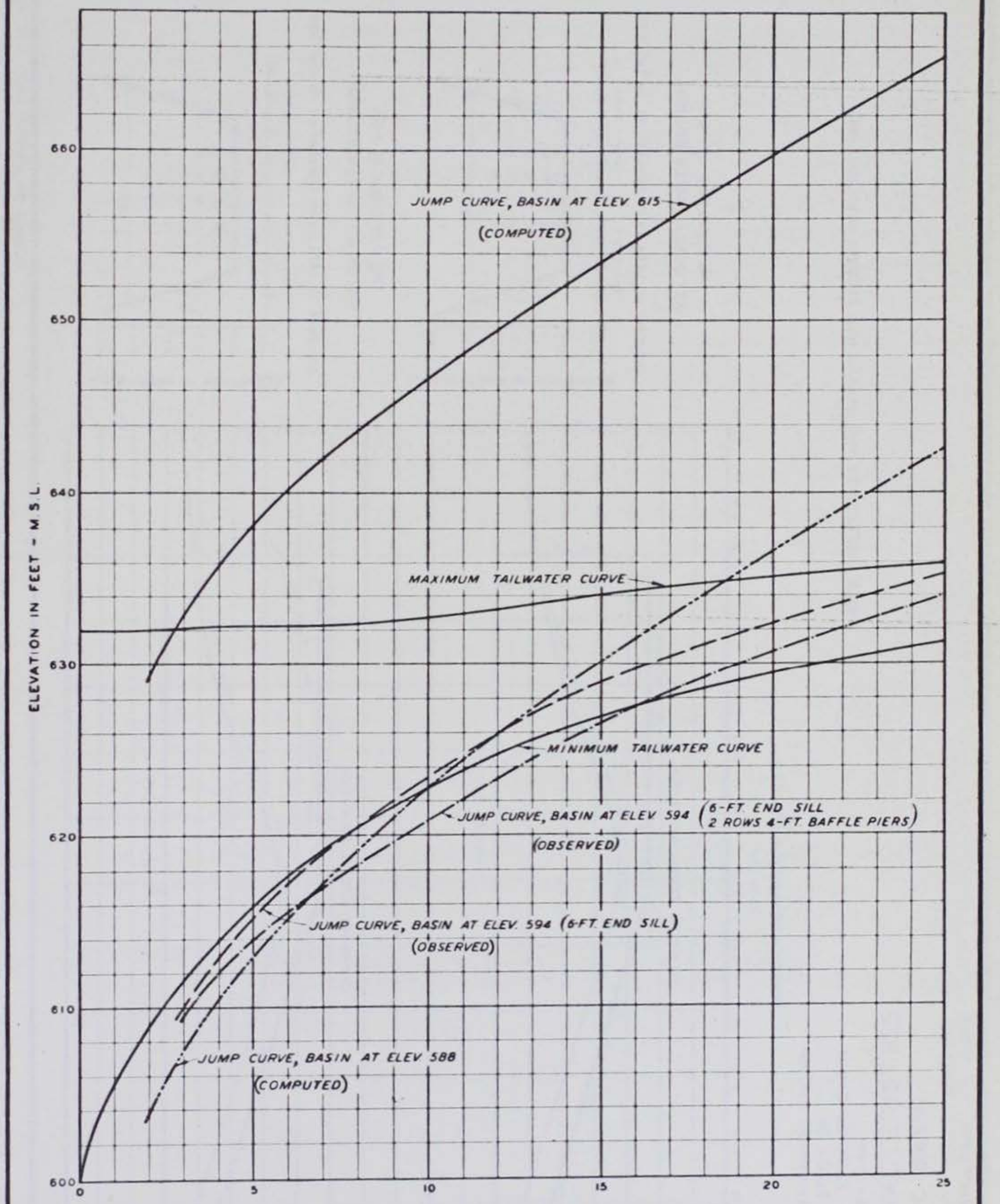
DISCHARGE (SPILLWAY)----------8,100 CFS
DISCHARGE (OUTLET STRUCTURES)----0 CFS
TAILWATER ELEVATION----------820.6

NOTE VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

PLATE 27

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



NOTE TAILWATER MEASURED 0.5 MILE BELOW AXIS OF DAM.

U.S. WATERWAYS EXPERIMENT STATION

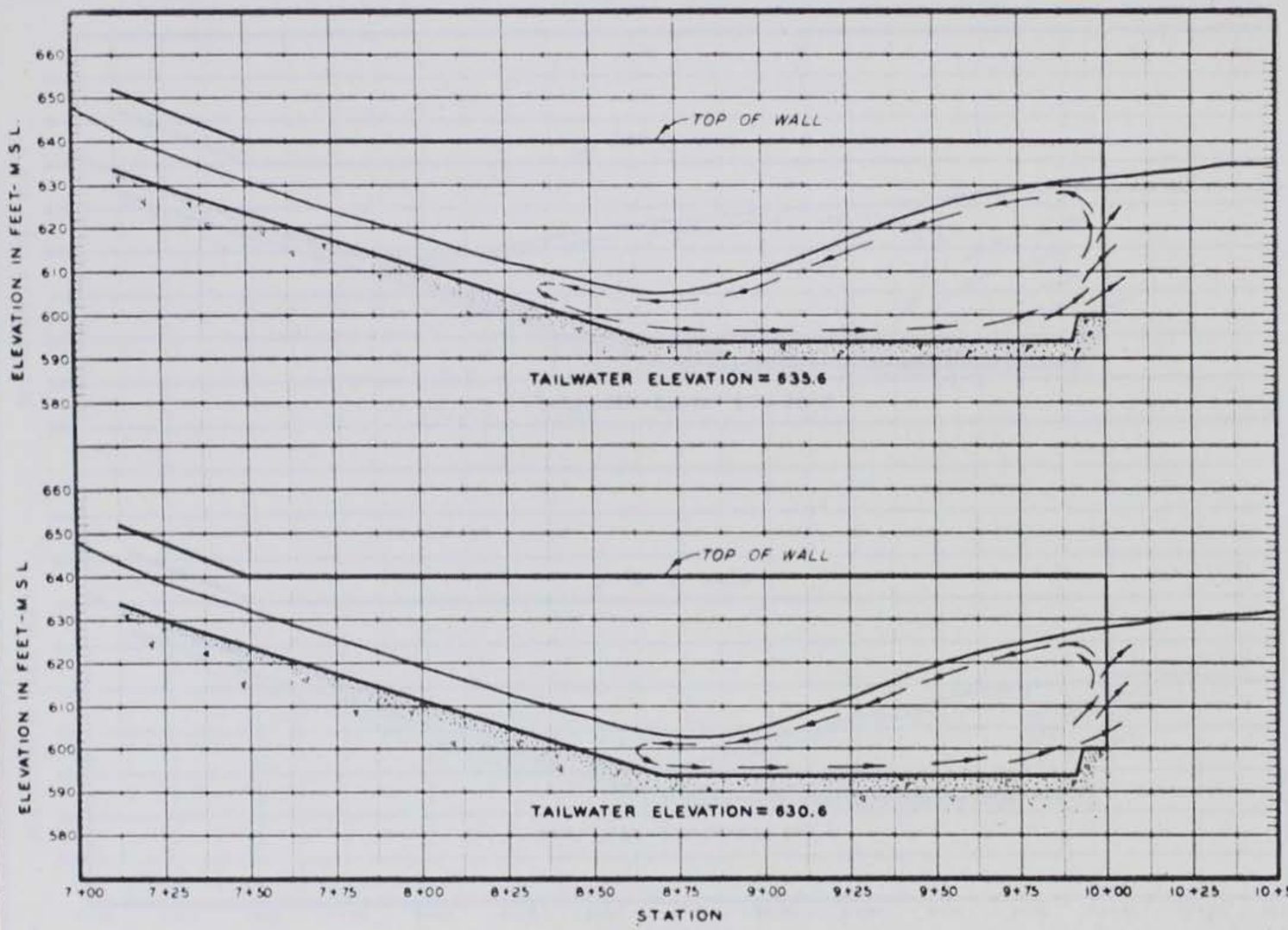
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

TAILWATER AND JUMP CURVES

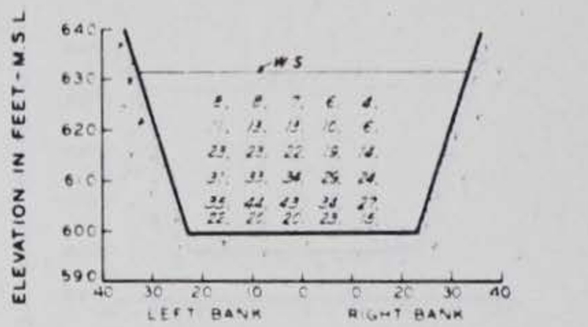
PLATE 28

WAR DEPARTMENT

CORPS OF ENGINEERS, U S. ARMY

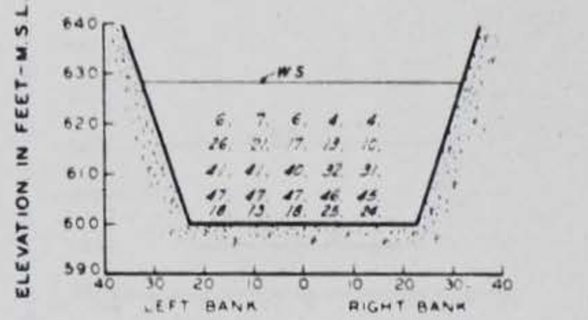


WATER-SURFACE PROFILES



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 10+00



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 10+00

U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

FLOW CHARACTERISTICS
TYPE C BASIN

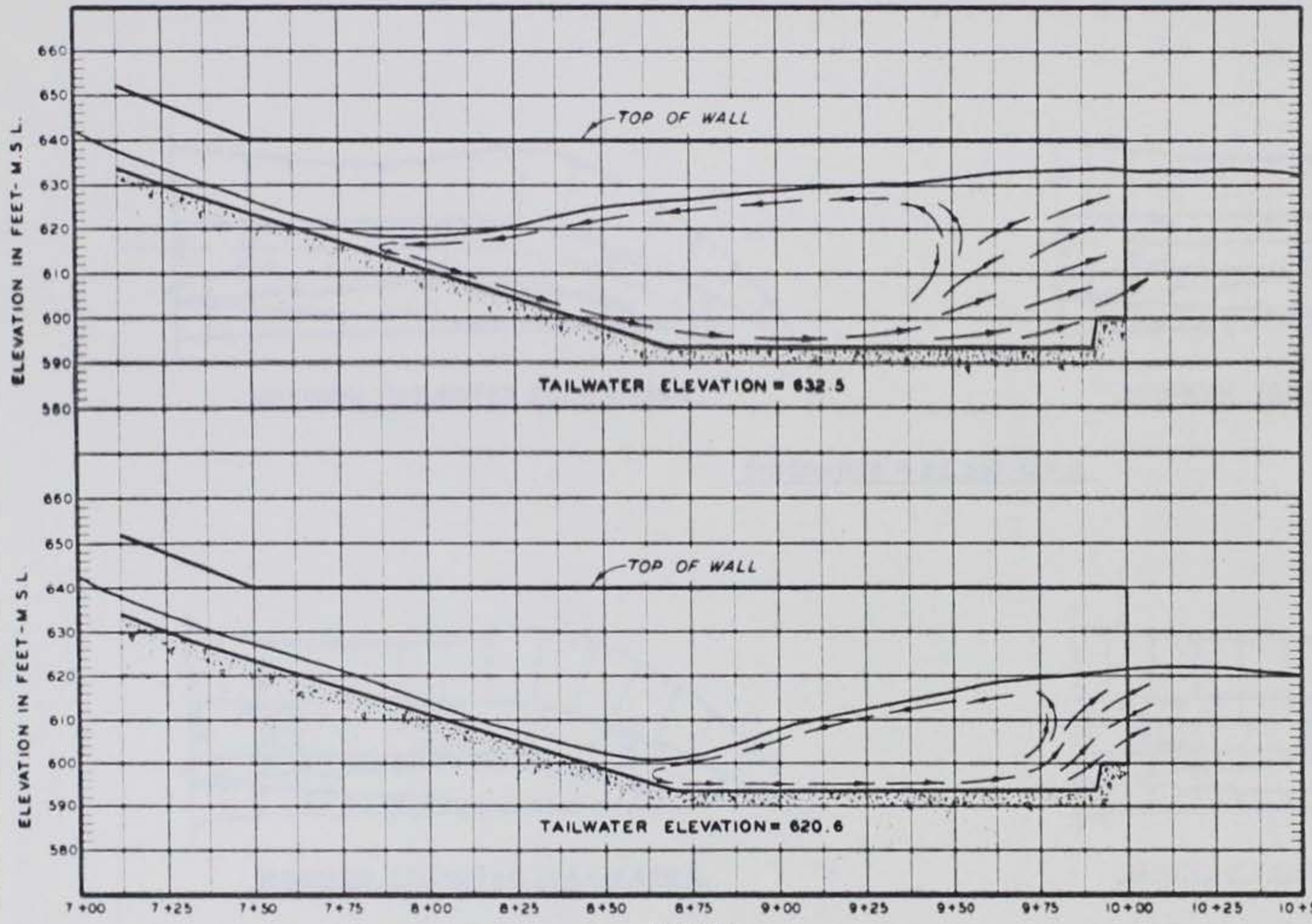
DISCHARGE (SPILLWAY)..... 22,800 C F S
DISCHARGE (OUTLET STRUCTURES).. 0 C F S

NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE.

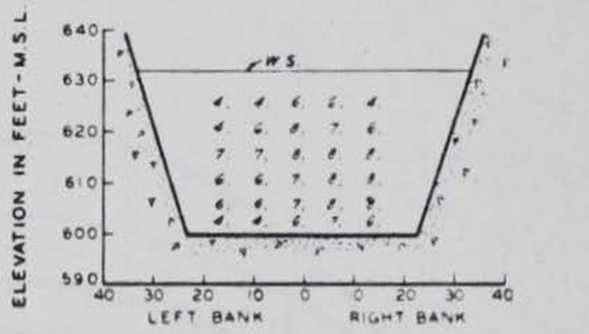
PLATE 29

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

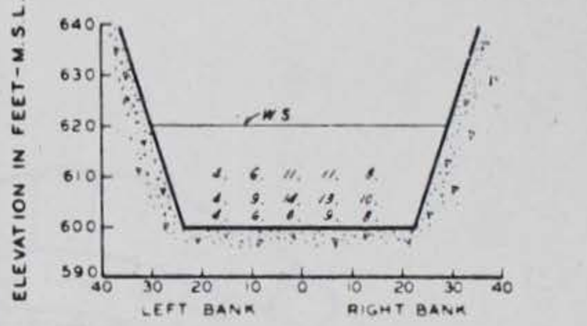


WATER-SURFACE PROFILES



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 10+00



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 10+00

U. S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

FLOW CHARACTERISTICS
TYPE C BASIN

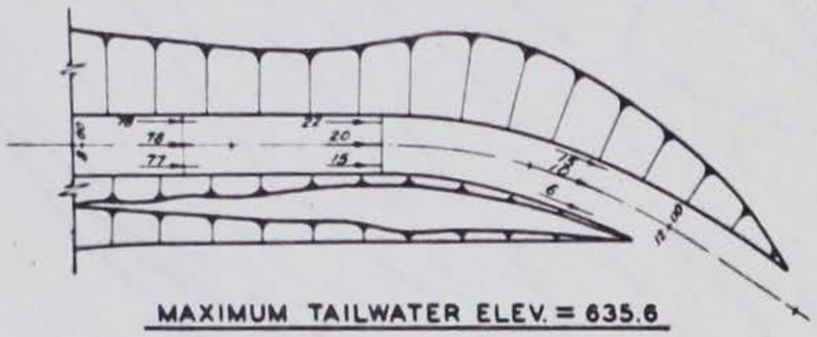
DISCHARGE (SPILLWAY)..... 8,100 CFS
DISCHARGE (OUTLET STRUCTURES).. 0 CFS

NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE.

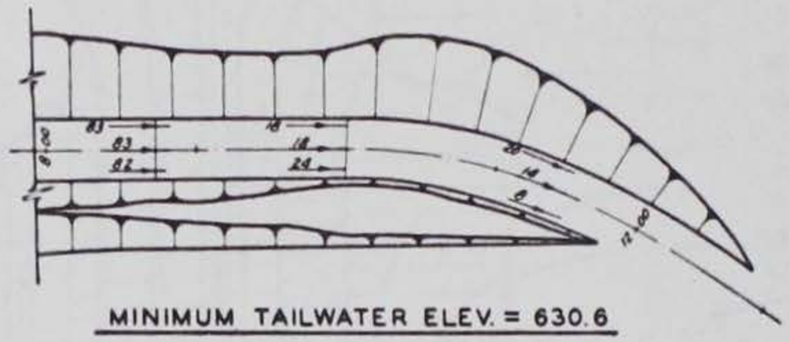
PLATE 30

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

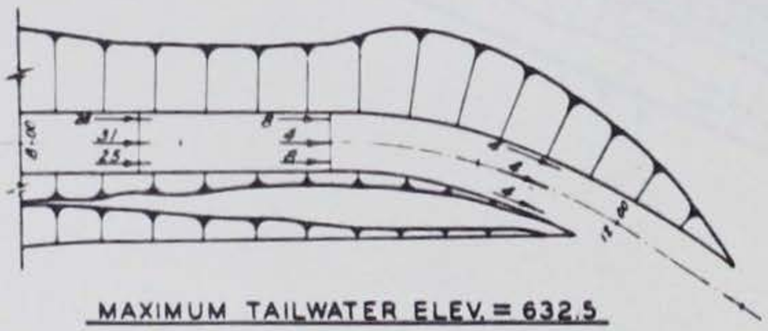


MAXIMUM TAILWATER ELEV. = 635.6

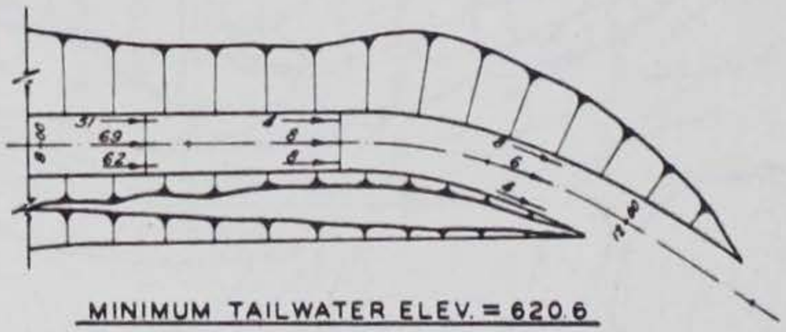


MINIMUM TAILWATER ELEV. = 630.6

DISCHARGE = 22,800 C.F.S.



MAXIMUM TAILWATER ELEV. = 632.5



MINIMUM TAILWATER ELEV. = 620.6

DISCHARGE = 8,100 C.F.S.

U. S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE C BASIN

NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

SCALES

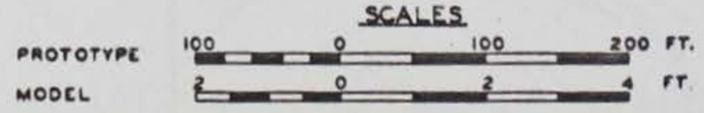
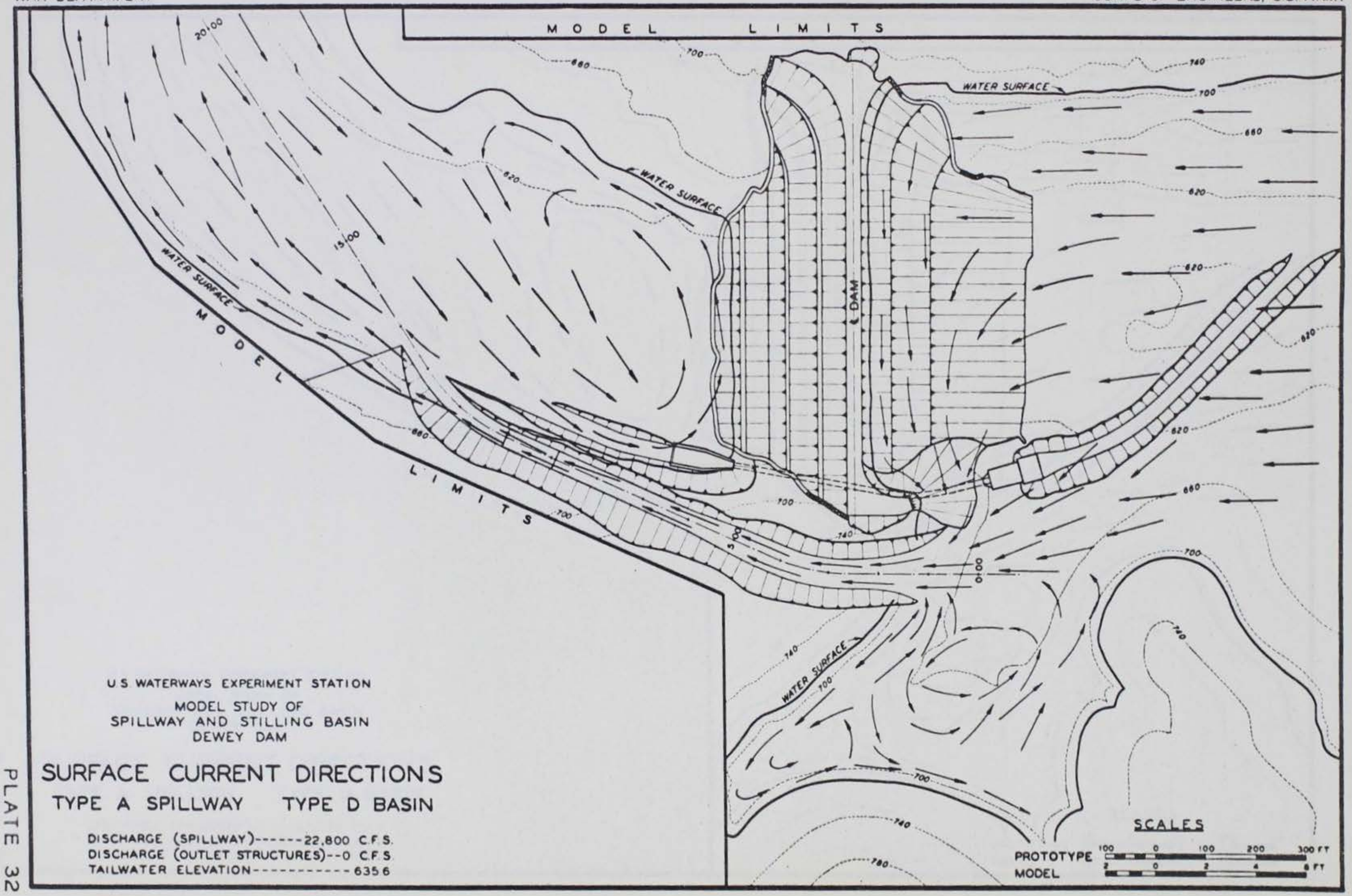


PLATE 31

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U.S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SURFACE CURRENT DIRECTIONS

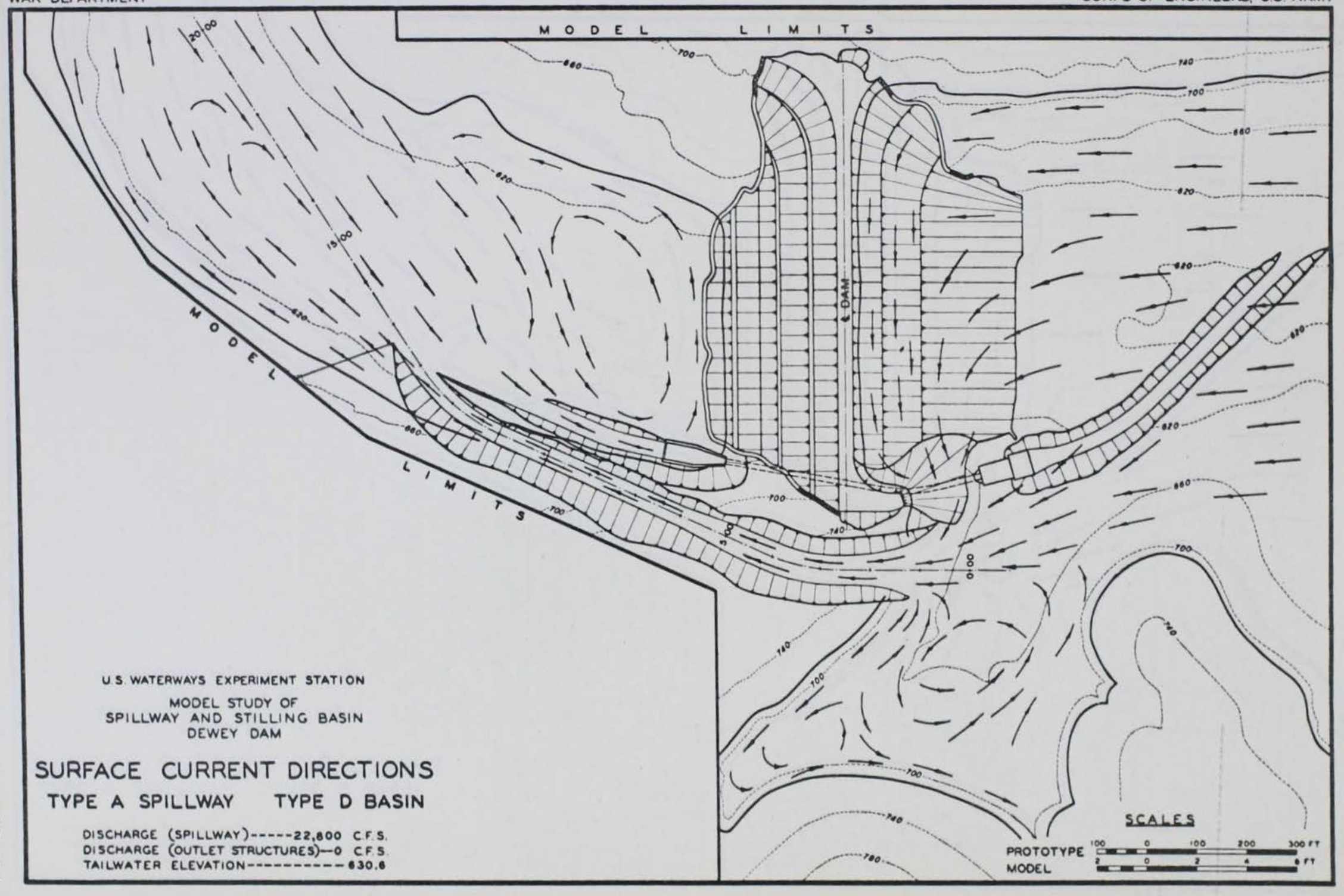
TYPE A SPILLWAY TYPE D BASIN

DISCHARGE (SPILLWAY)------22,800 C.F.S.
DISCHARGE (OUTLET STRUCTURES)--0 C.F.S.
TAILWATER ELEVATION----------6356

PLATE 32

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U.S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SURFACE CURRENT DIRECTIONS

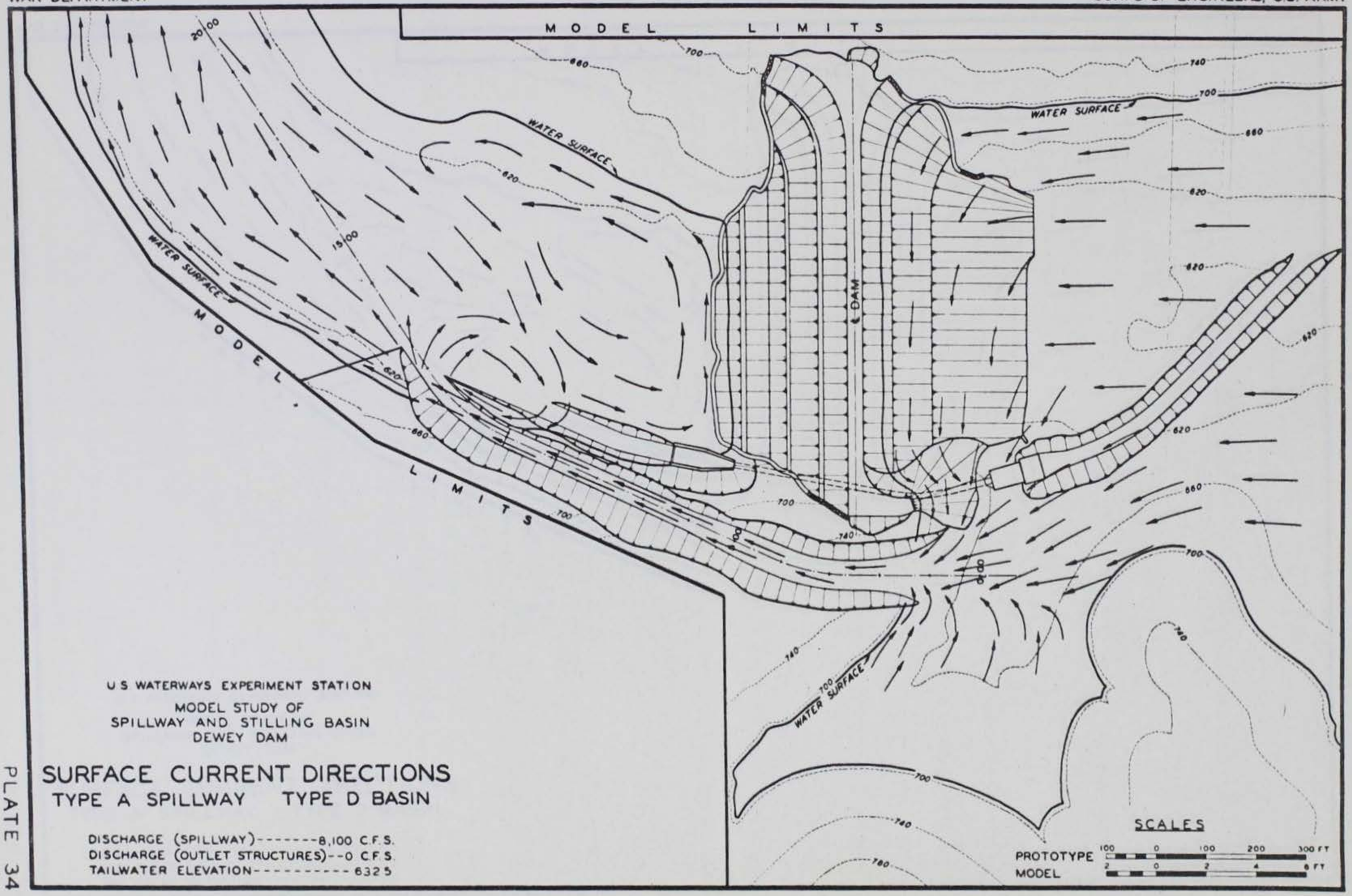
TYPE A SPILLWAY TYPE D BASIN

DISCHARGE (SPILLWAY)-----22,800 C.F.S.
DISCHARGE (OUTLET STRUCTURES)--0 C.F.S.
TAILWATER ELEVATION----------630.6

PLATE 33

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

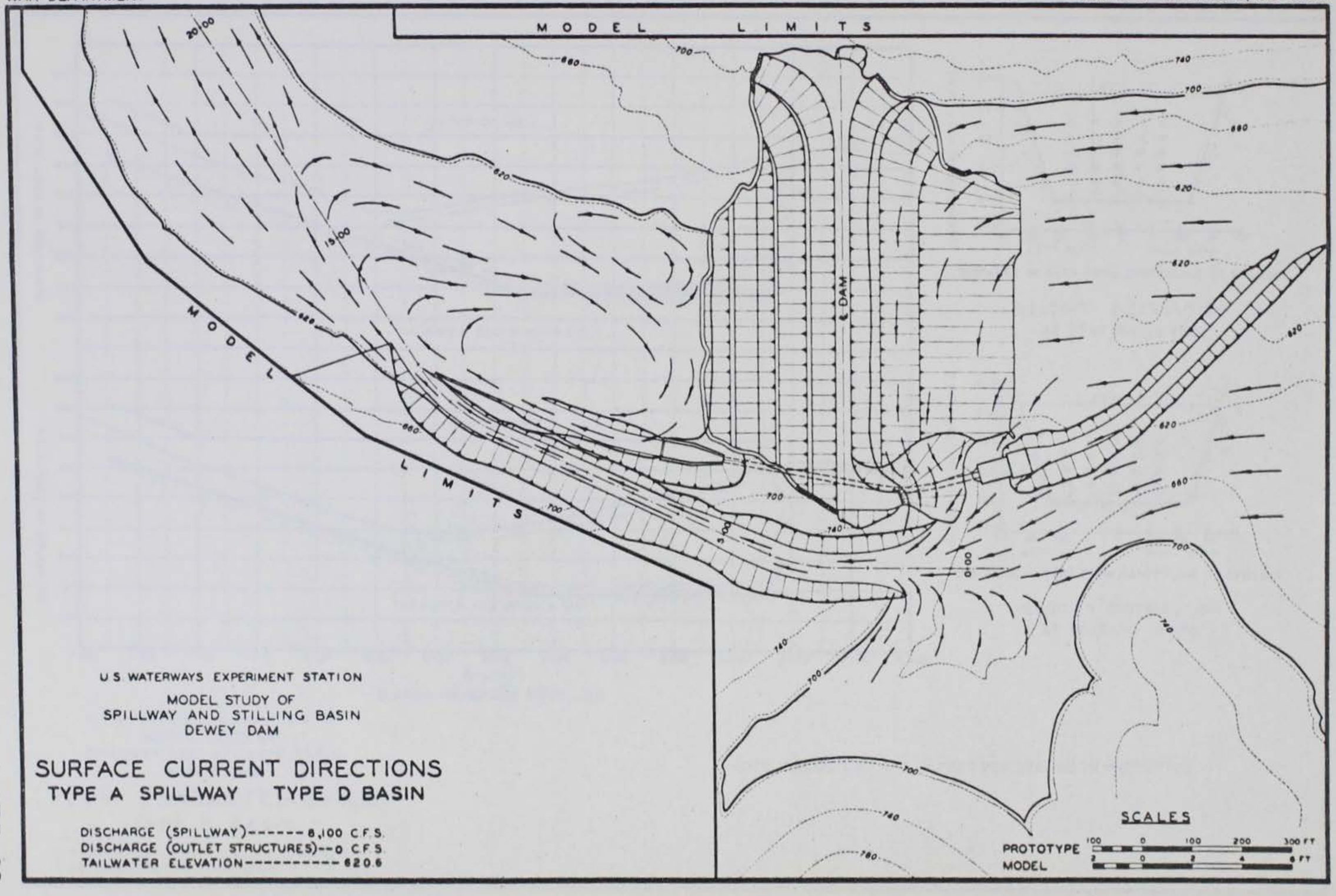
SURFACE CURRENT DIRECTIONS
TYPE A SPILLWAY TYPE D BASIN

DISCHARGE (SPILLWAY)-------8,100 C.F.S.
DISCHARGE (OUTLET STRUCTURES)--0 C.F.S.
TAILWATER ELEVATION----------6325

PLATE 34

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U.S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

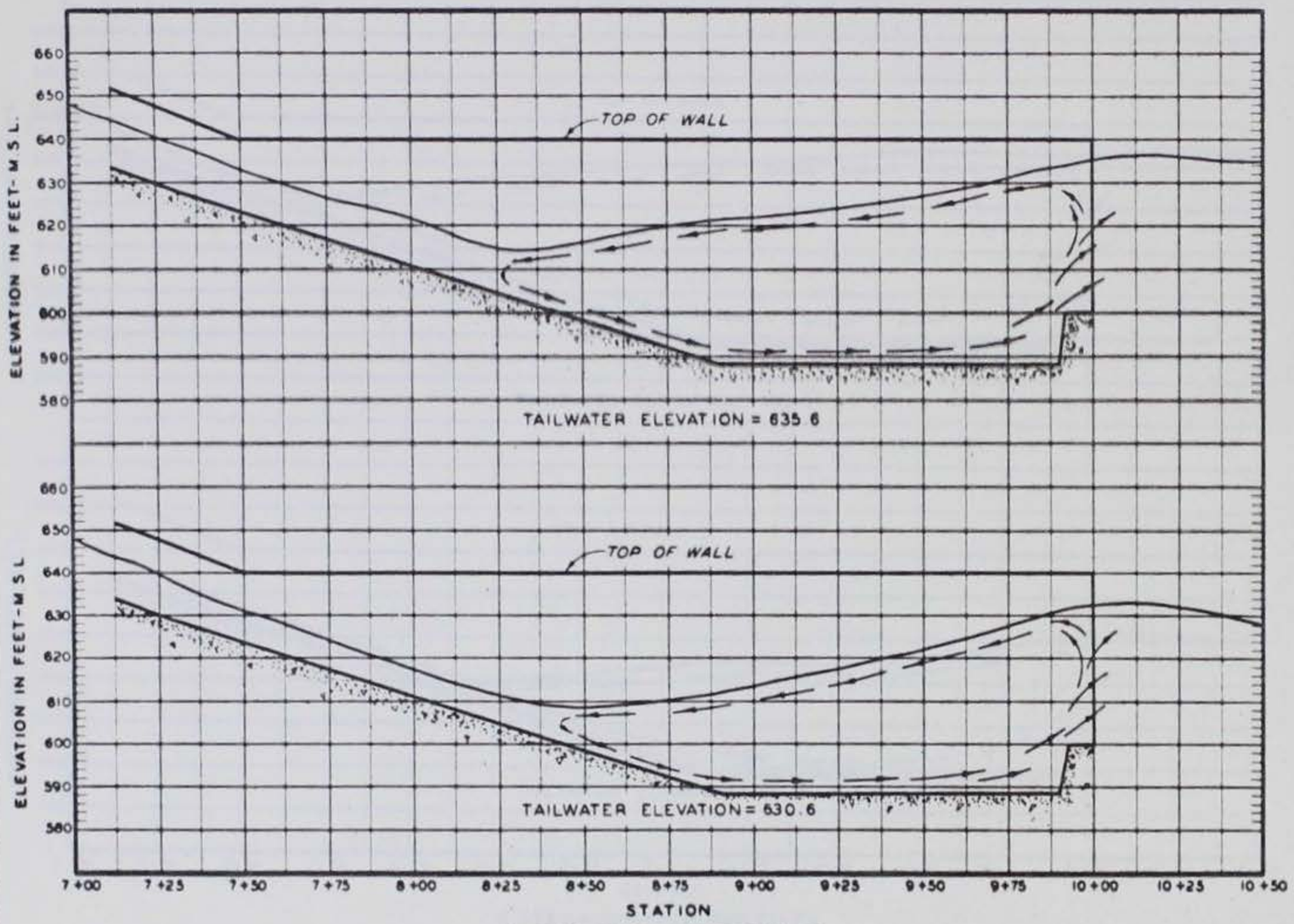
SURFACE CURRENT DIRECTIONS
TYPE A SPILLWAY TYPE D BASIN

DISCHARGE (SPILLWAY)------8,100 C.F.S.
DISCHARGE (OUTLET STRUCTURES)--0 C.F.S.
TAILWATER ELEVATION----------620.6

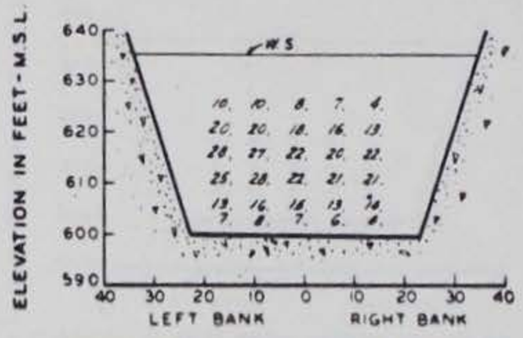
SCALES

PROTOTYPE 100 0 100 200 300 FT
MODEL 2 0 2 4 6 FT

PLATE 35

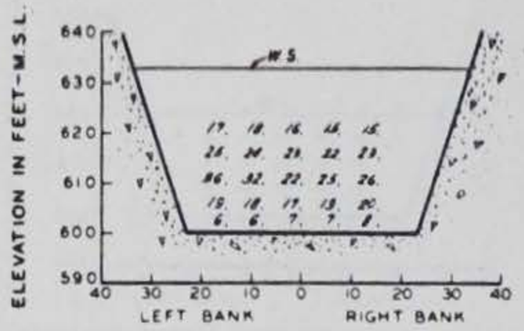


WATER-SURFACE PROFILES



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 10+00



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 10+00

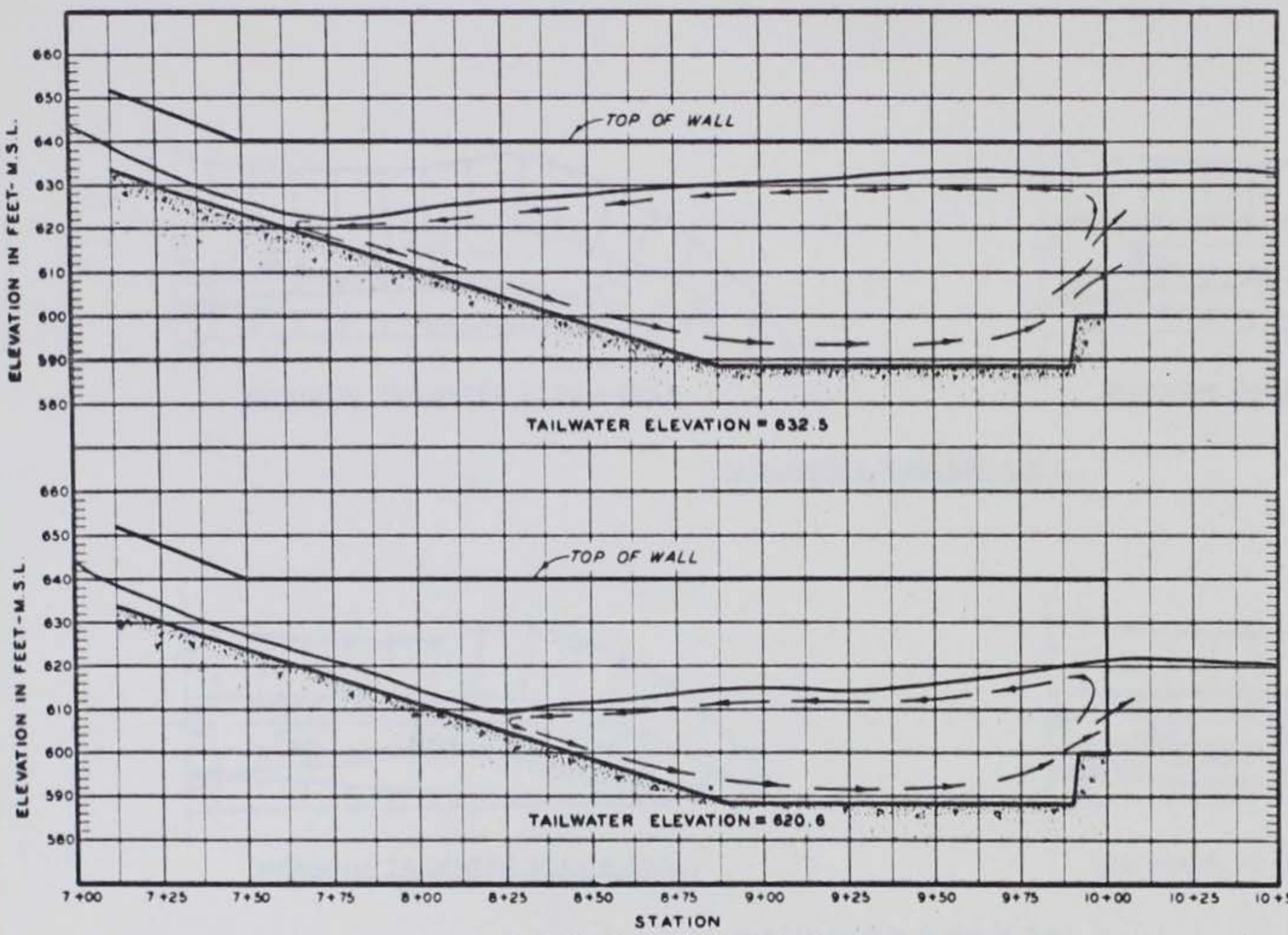
U. S. WATERWAYS EXPERIMENT STATION
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

FLOW CHARACTERISTICS
TYPE D BASIN

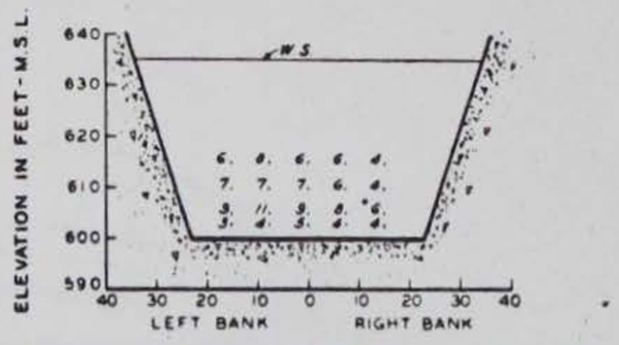
DISCHARGE (SPILLWAY)..... 22,800 C.F.S.
DISCHARGE (OUTLET STRUCTURES).. 0 C.F.S.

NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE.

PLATE 36

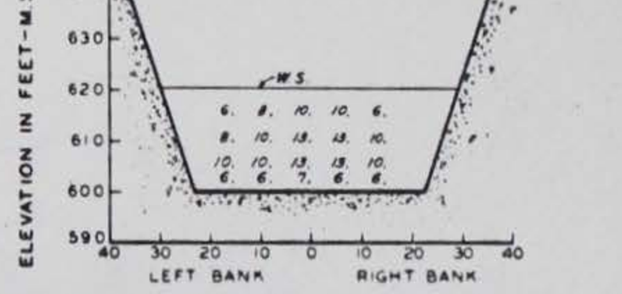


WATER-SURFACE PROFILES



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 10+00



DISTANCE IN FEET FROM CENTERLINE OF SPILLWAY

VELOCITY DISTRIBUTION
AT STATION 10+00

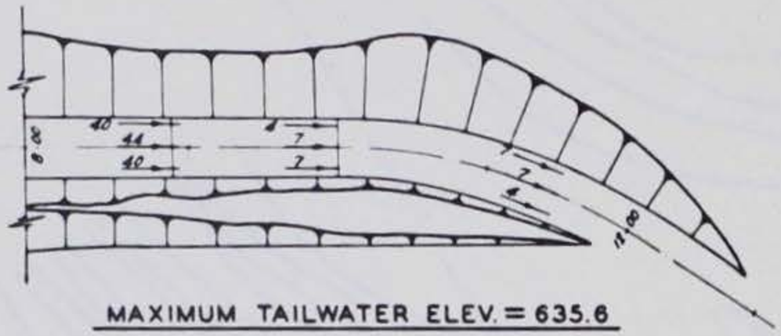
U. S. WATERWAYS EXPERIMENT STATION
MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

FLOW CHARACTERISTICS
TYPE D BASIN

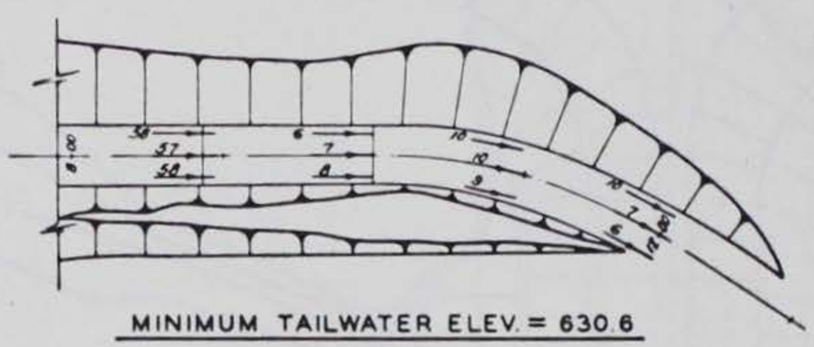
DISCHARGE (SPILLWAY)---------- 8,100 C.F.S.
DISCHARGE (OUTLET STRUCTURES)-- 0 C.F.S.

NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE.

PLATE 37

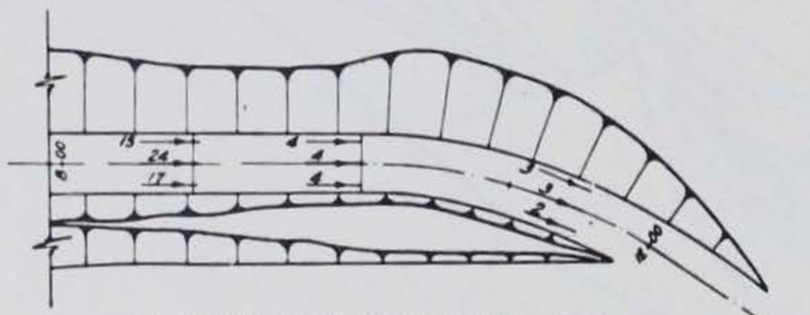


MAXIMUM TAILWATER ELEV. = 635.6

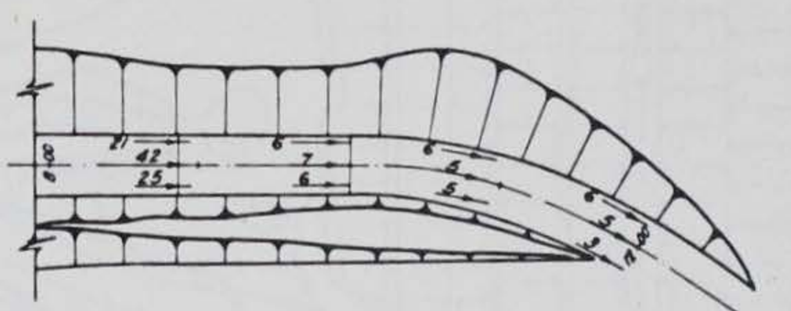


MINIMUM TAILWATER ELEV. = 630.6

DISCHARGE = 22,800 C.F.S.



MAXIMUM TAILWATER ELEV. = 632.5



MINIMUM TAILWATER ELEV. = 620.6

DISCHARGE = 8,100 C.F.S.

TYPE B SPILLWAY

U. S. WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE D BASIN

NOTE: VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

SCALES

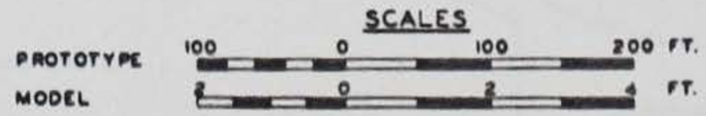
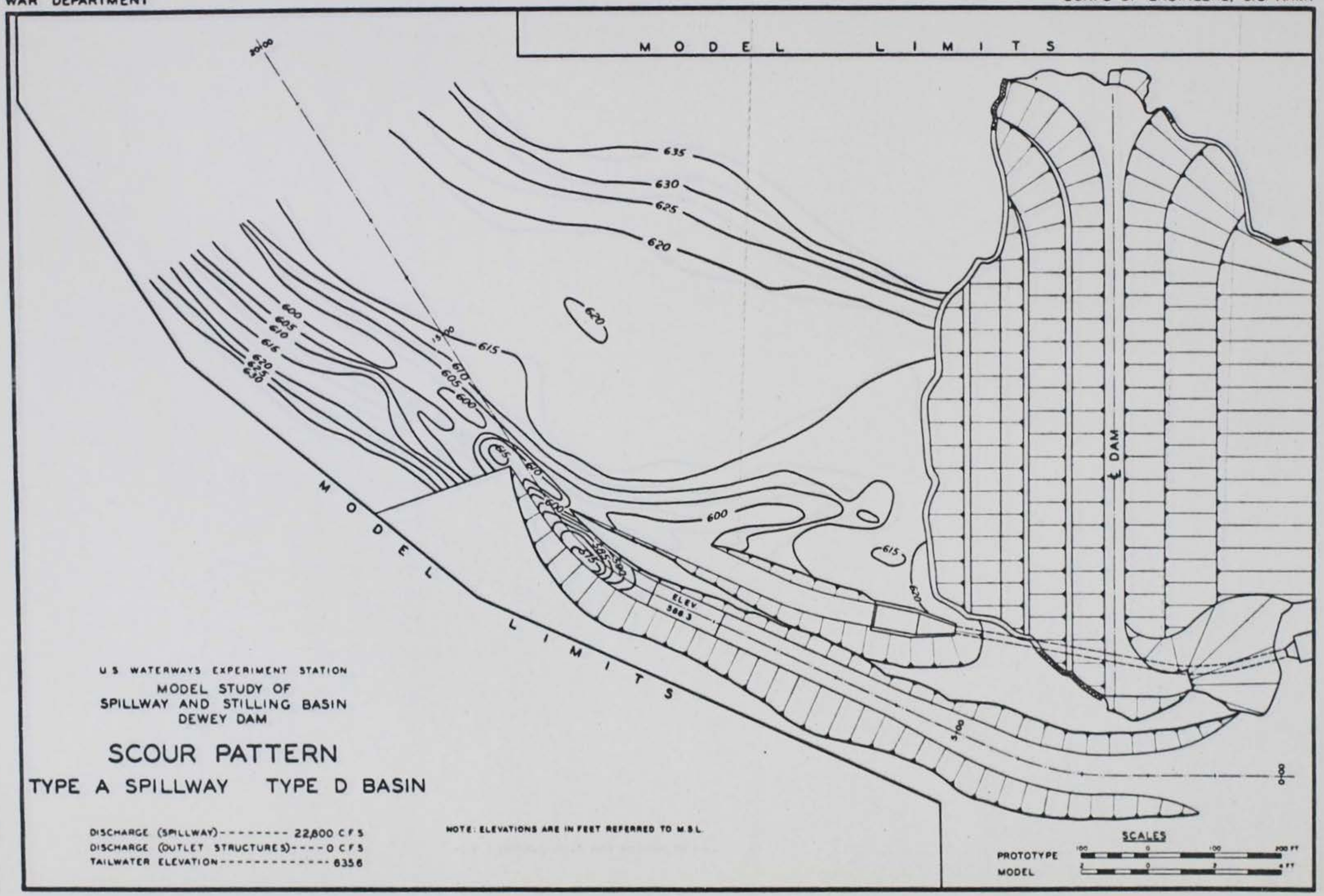


PLATE 38

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SCOUR PATTERN

TYPE A SPILLWAY TYPE D BASIN

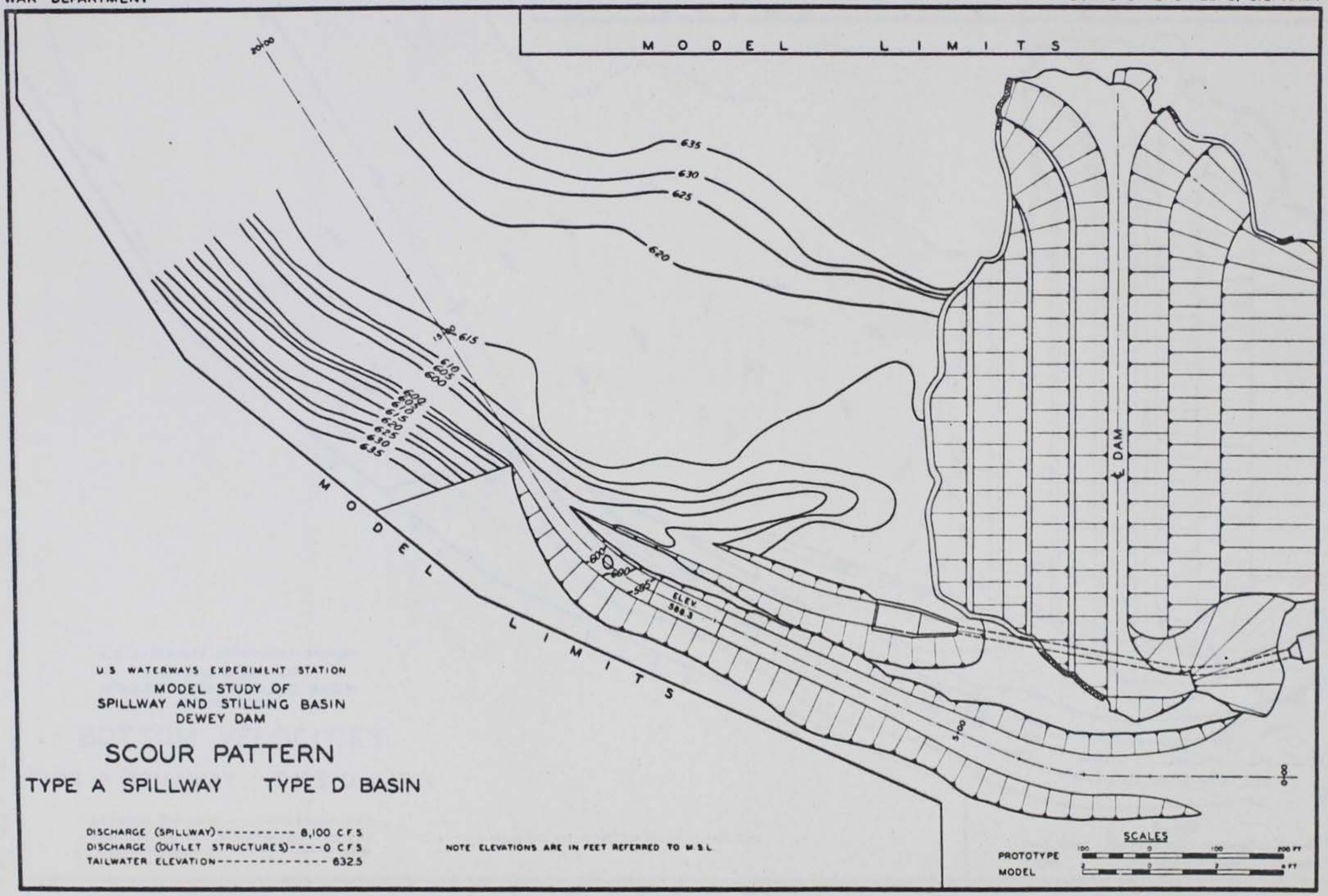
DISCHARGE (SPILLWAY)-------- 22,800 C F S
DISCHARGE (OUTLET STRUCTURES)---- 0 C F S
TAILWATER ELEVATION---------- 635.6

NOTE: ELEVATIONS ARE IN FEET REFERRED TO M.S.L.

PLATE 39

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

SCOUR PATTERN

TYPE A SPILLWAY TYPE D BASIN

DISCHARGE (SPILLWAY)---------- 8,100 C F S
DISCHARGE (OUTLET STRUCTURES)---- 0 C F S
TAILWATER ELEVATION---------- 632.5

NOTE ELEVATIONS ARE IN FEET REFERRED TO M.S.L.

SCALES

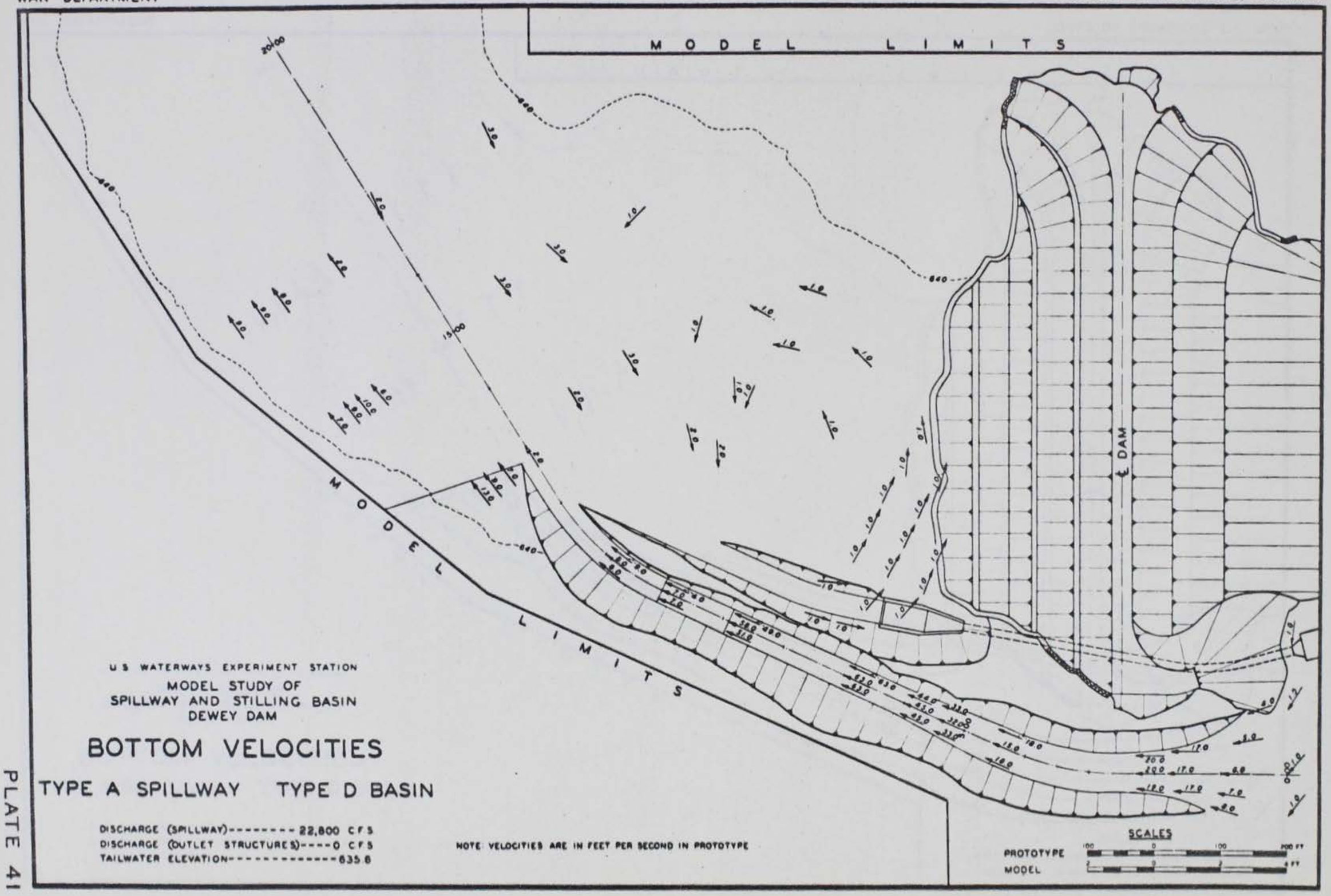
PROTOTYPE 100 0 100 200 FT

MODEL 2 0 2 4 FT

PLATE 40

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE A SPILLWAY TYPE D BASIN

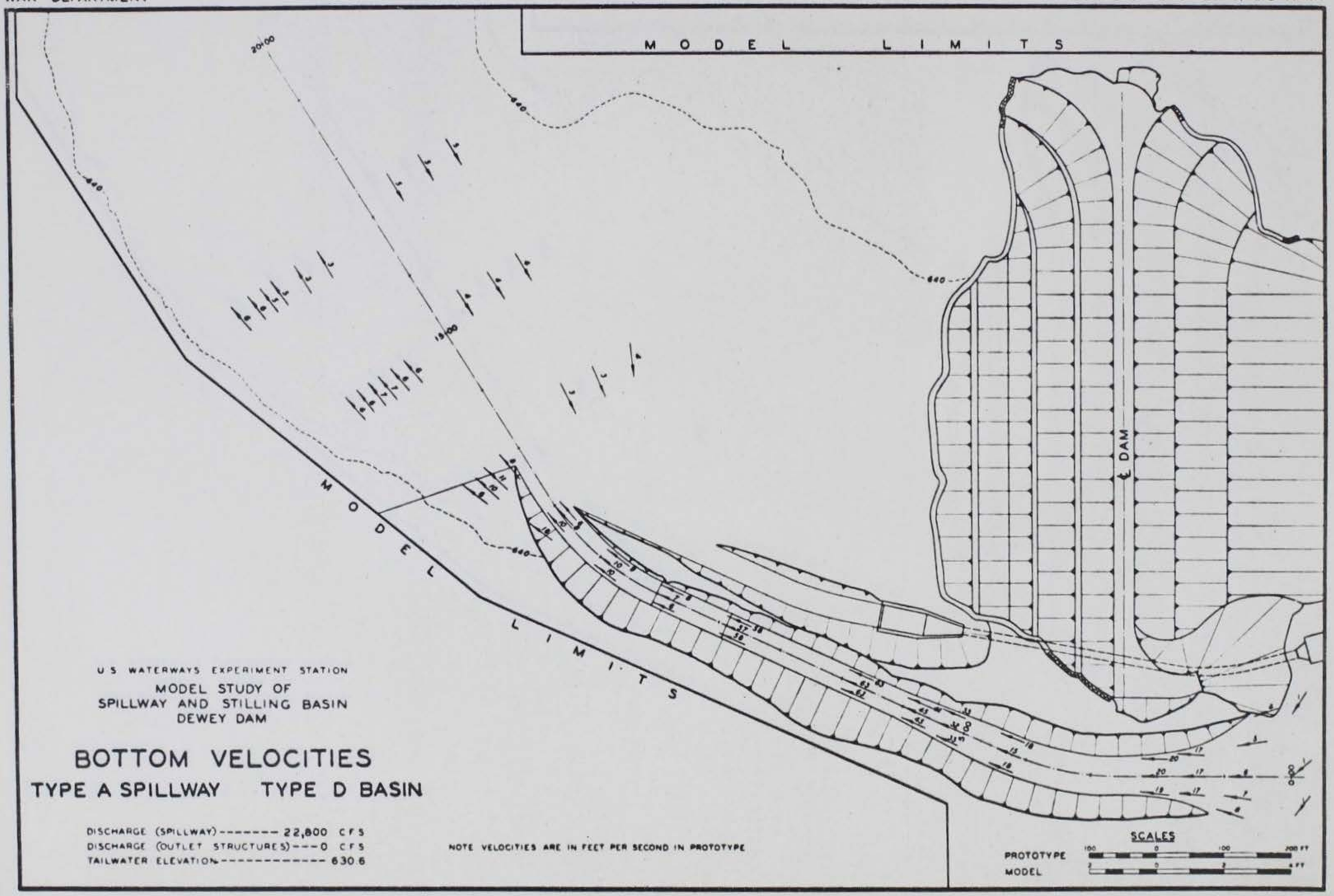
DISCHARGE (SPILLWAY)-------- 22,800 CFS
DISCHARGE (OUTLET STRUCTURES)----0 CFS
TAILWATER ELEVATION----------635.8

NOTE VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

PLATE 41

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE A SPILLWAY TYPE D BASIN

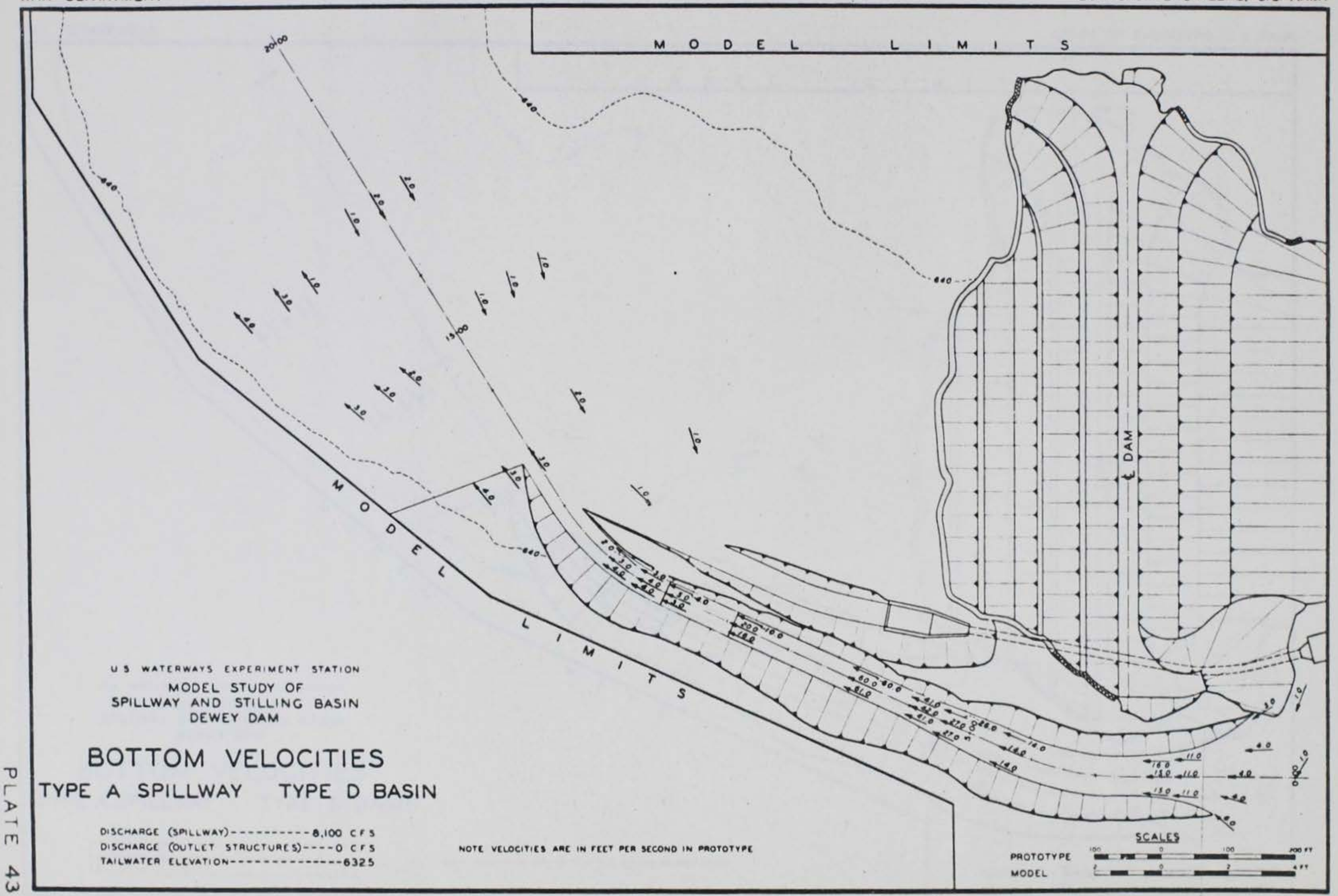
DISCHARGE (SPILLWAY)------- 22,800 CFS
DISCHARGE (OUTLET STRUCTURES)---0 CFS
TAILWATER ELEVATION---------- 630.6

NOTE VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

PLATE 42

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE A SPILLWAY TYPE D BASIN

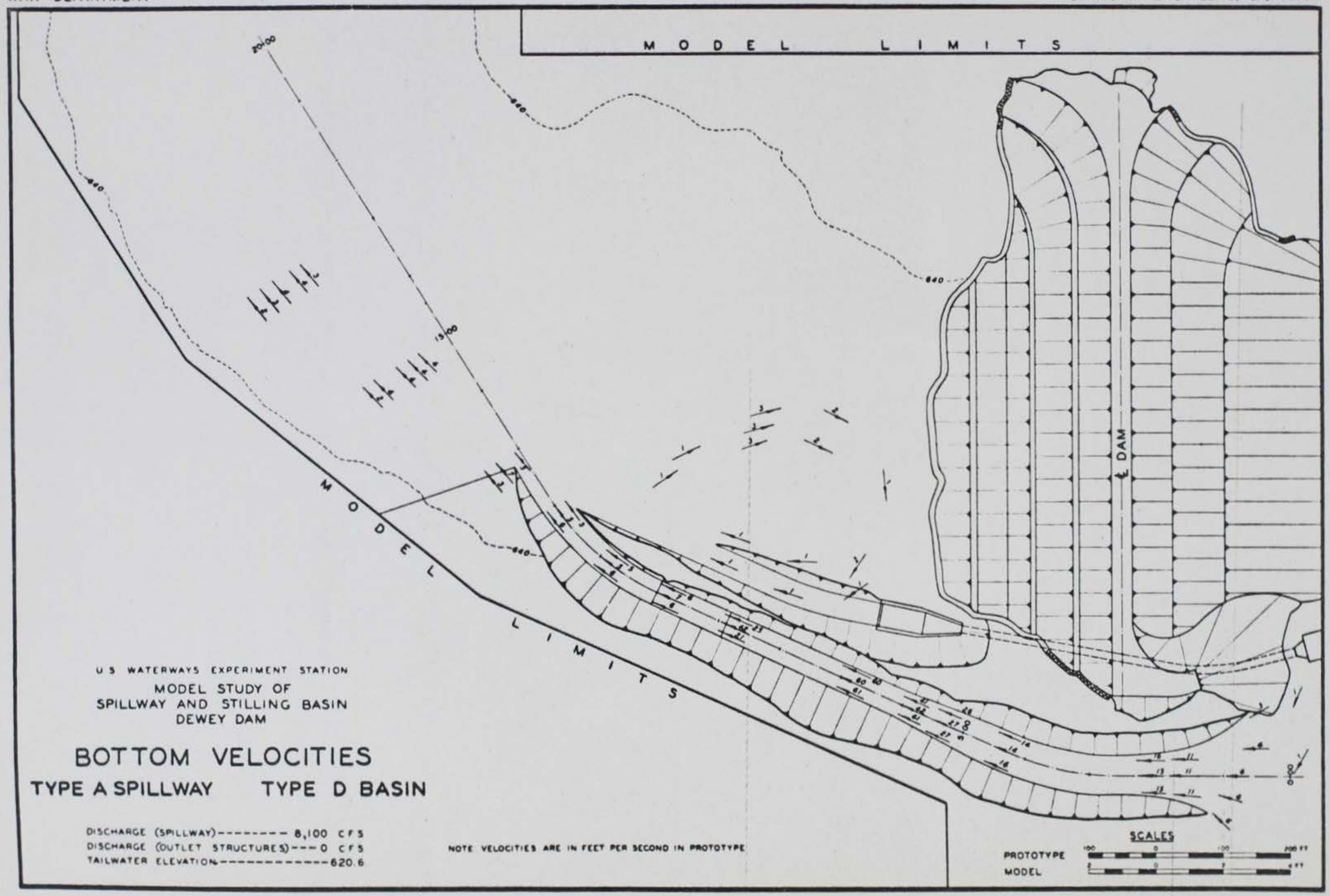
DISCHARGE (SPILLWAY)----------8,100 C F S
DISCHARGE (OUTLET STRUCTURES)----0 C F S
TAILWATER ELEVATION----------6325

NOTE VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

PLATE 43

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S ARMY



U S WATERWAYS EXPERIMENT STATION

MODEL STUDY OF
SPILLWAY AND STILLING BASIN
DEWEY DAM

BOTTOM VELOCITIES

TYPE A SPILLWAY TYPE D BASIN

DISCHARGE (SPILLWAY)-------- 8,100 CFS
DISCHARGE (OUTLET STRUCTURES)--- 0 CFS
TAILWATER ELEVATION----------620.6

NOTE VELOCITIES ARE IN FEET PER SECOND IN PROTOTYPE

PLATE 44