Form DFC-11
(7-52)
Bureau of Reclamation

INFORMATIONAL ROUTING

Memorandum

Denver, Colorado
September 28, 1954

Chief, Dams Branch

Chief, Engineering Laboratories

Model demonstration of spillway bucket proposed for Klang Gates Dam, Malaya

1. Discussions among members of our respective staffs of the effects of imperfect information on tail-water elevations on the design of the spillway bucket for Klang Gates Dam developed the desirability of demonstrating the hydraulic action in a schematic model.

AUTHOR

2. A description of the model demonstration and a discussion of the results are contained in the attached memorandum from J. N. Bradley to H. M. Martin. Your attention is directed to the last paragraph of this memorandum, which discusses some of the shortcomings of this type of demonstration model.

Enclosure

Form DFC-11
(7-52)
Bureau of Reclamation

INFORMATIONAL ROUTING

Memorandum

Denver, Colorado
September 28, 1954

H. M. Martin

J. N. Bradley

Model demonstration of bucket proposed for Klang Gates Dam, Malaya

1. In designing the spillway bucket for Klang Gates Dam, Malaya (Figure 1), the size and elevation were established by computations based on the Hydraulic Laboratory's bucket research data. The computations showed the minimum size bucket required for satisfactorily handling the maximum discharge of 11,800 second-feet should have a radius of approximately 20 feet. The tail-water depth requirement was computed to range from a minimum of 30 feet above the bucket invert to a maximum of 34 feet. As the 34-foot depth would require more rock excavation than the 30-foot depth, the latter was preferable. However, in determining the bucket elevation for a 30-foot tail-water depth, the exact tail-water elevation was not known. Instead, an approximate maximum and minimum tail-water elevation was given together with an estimated tail-water rating curve as shown in Figure 2. The estimated tail-water elevation for the maximum discharge was used to determine the proposed bucket invert elevation. In discussion of this problem on June 30, 1954, with Louis Puls and members of his staff, the idea of assembling a rough model in an available 2-foot-wide test flume was developed. The purpose of the model was to demonstrate the performance of the bucket for tail-water elevations above and below the estimated value.

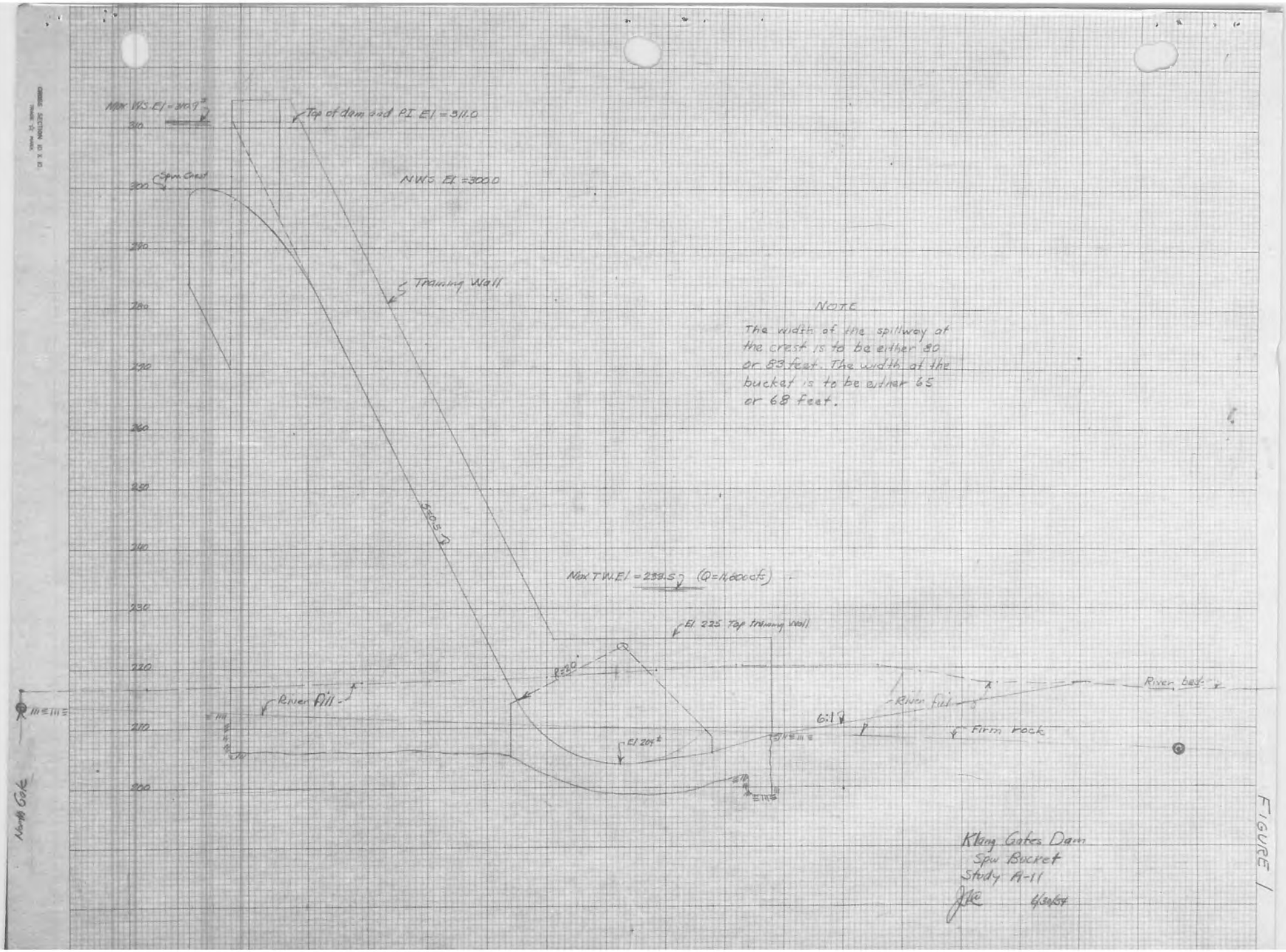
AUTHOR

2. A 5-foot-high spillway section, from bucket invert to crest, with a 12-inch-radius bucket was available in the laboratory's 2-foot-wide flume. This section of spillway and bucket (Figure 3) was used for the Klang Gates test since it approximated very closely a 1:20 scale model of the prototype. One marked difference between the model and the prototype was that the slope of the spillway face of the model was 0.7 instead of 0.5 as required for the prototype. However, it was believed that the 0.7 slope would provide higher minimum usable tail-water depths than would the 0.5 slope and, therefore, be on the safe side.

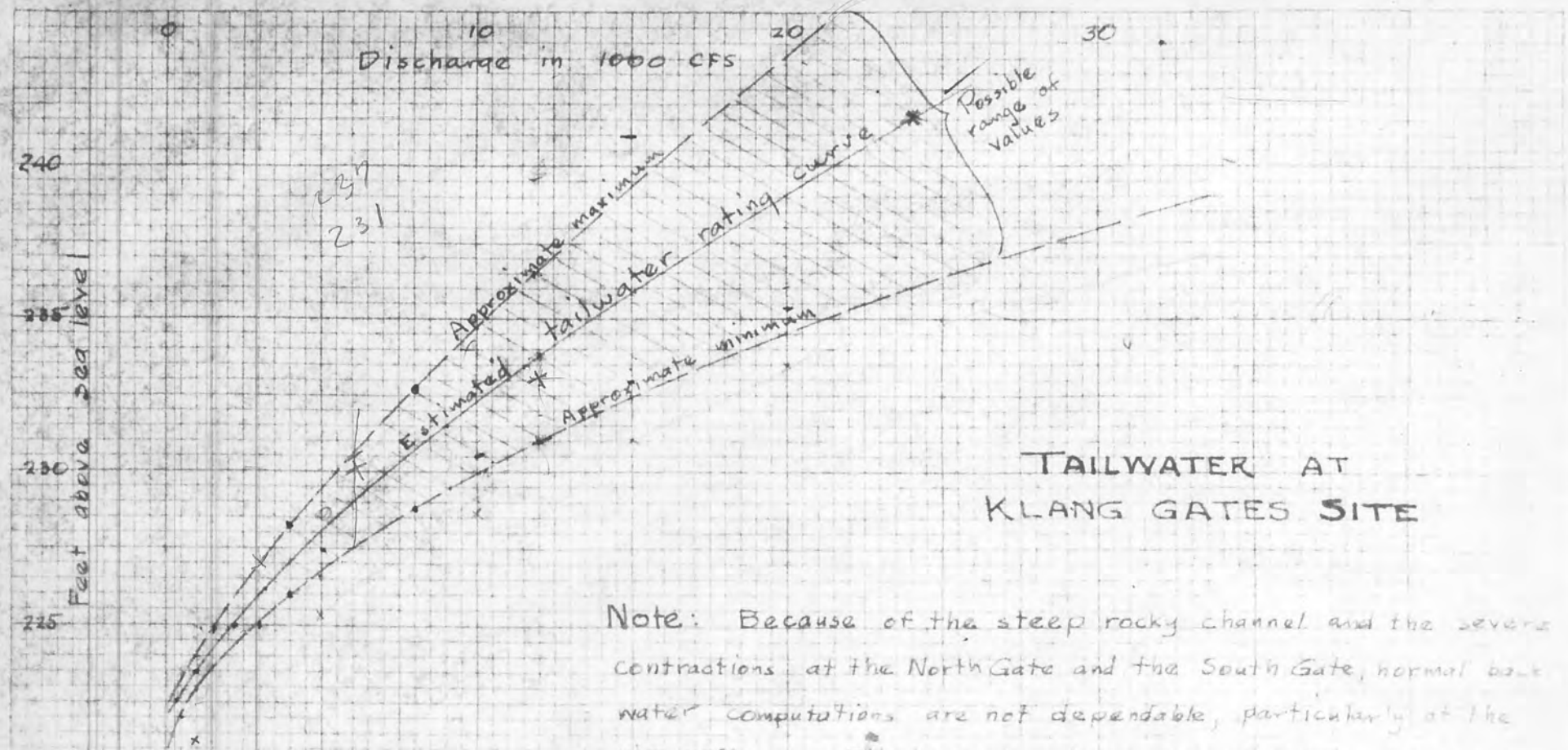
3. The width of the prototype spillway was to be either 80 or 83 feet at the crest and either 65 or 68 feet at the invert of the bucket. The 24-inch-wide model represented 40 feet of this width. In the prototype the elevation of the solid rock layer and the elevation of the river bed varied across the width of the channel immediately downstream from the bucket, but in the model an average section shown in Figure 1 was represented across the 40-foot width. The solid rock elevation as shown in Figure 1 was represented in the model with a board floor. The erodible bed material above this layer was represented with 3/4-inch gravel.

4. On July 20 the model was operated with Messrs. Puls, Houck, and Conrad from Concrete Dams Section, and Messrs. Bradley and Beichley from the Hydraulic Laboratory present. The spillway was observed discharging the maximum flow and smaller flows as shown in Figures 3 and 4, each with maximum and minimum expected tail-water elevations. For the maximum discharge the loose bed material was eroded from the solid rock bed immediately downstream from the bucket, particularly for the higher tail-water elevations. This eroded material deposited downstream and formed a bar which increased the tail-water depth and prevented the jet from sweeping out of the bucket for the estimated minimum elevation or even lower tail-water depths. The sharp bend in the river channel a short distance downstream from the spillway and a narrow gap between the walls of the channel, from which the site derives its name (Klang Gates), might also aid in maintaining the tail-water elevation high enough to prevent flow sweep-out in the bucket. The designers considered the performance of the proposed bucket satisfactory for all discharges with any tail-water depth between maximum and minimum limits.

5. Although the model test observations are indicative for the spillway section tested, more reliable data could be obtained from a model of the complete spillway structure including a short length of the river topography downstream. The elevation of the solid rock layer and the erodible bed affect the flow pattern leaving the bucket. Side eddies are another factor that cannot be analyzed in a sectional model.


Max NWS El = 310.9±
Top of dam and PI El = 311.0
Spw Crest
NWS El = 300.0
Training Wall
S=0.5
Max T.W. El = 239.5 (Q=11,000 cfs)
El 225 Top training wall
R=30'
River Fill
El 204±
6:1
River fill
River bed
Firm rock
310
300
290
280
270
260
250
240
230
220
210
200
NOTE
The width of the spillway at the crest is to be either 80 or 83 feet. The width of the bucket is to be either 65 or 68 feet.
Kleny Gates Dam
Spw Bucket
Study A-11
6/30/64
FIGURE 1

Meyers
23 Apr 54



TAILWATER AT
KLANG GATES SITE

Note: Because of the steep rocky channel and the severe contractions at the North Gate and the South Gate, normal back water computations are not dependable, particularly at the higher flows. Eddy losses are large and uncertain, and velocities approach or exceed the critical at several points, so the turbulent flow conditions assumed for backwater computations are not valid.

The estimated tailwater rating curve has therefore been sketched in rather than computed in the usual sense. Since the values are very approximate, supplemental curves have been shown above and below the main curve to indicate the range in values that may be expected.

FIGURE 2.

20-foot radius Angostura type slotted bucket--
Average river bed section

4,000 cfs--Max. T.W.--Elev. 228.2

4,000 cfs--Min. T.W.--Elev. 226.0

KLANG GATES DAM
Spillway Bucket Operating
1:20 Scale Model

8,000 cfs--Min. T.W.--Elev. 228.8

8,000 cfs--Max. T.W.--Elev. 232.7

11,800 cfs--Min. T.W.--Elev. 231.0

11,800 cfs--Max. T.W.--Elev. 236.5

KLANG GATES DAM
Spillway Bucket Operating
1:20 Scale Model

Figure 4