PAP-52

PAP-52

Denver, Colorado
October 15, 1953

Memorandum

To: H. M. Martin

From: J. N. Bradley

Subject: Preliminary findings and operation of pilot fish screen structure and Pilot Canal model--Delta-Mendota Canal Headworks--Central Valley Project

The model of the existing pilot fish screen structure and Pilot Canal was completed and put into operation on October 1. Approximately a week was spent on making adjustments in the approach to the model, finding screens to simulate the approximate head loss through the fish screen structure, and stabilizing the banks of the Pilot Canal which were entirely of sand. The screens were so fine in the model that even with clear water it was not possible to hold a constant head loss for an extended length of time. Eleven vertical screens were used as the inclined screen was not used.

An over-all photograph of the model of the existing structure and canal, which was built on a scale of 1:15, is shown on Figure 1. The model was first operated at a discharge of 2,300 cfs to simulate the operation of 3 pumps. The head loss through the screens was held at 1/2 foot. Flow conditions were not particularly favorable but the operation could be considered satisfactory. The upstream channel appeared adequate but erosion was evident in the right bank of the downstream channel looking toward the pumping plant.

The discharge was next increased to approximately 3,800 cfs, or 5-pump operation, and the results are recorded pictorially. Figure 2 shows the flow in the upstream channel, Figure 3 depicts the flow at the screen structure, and Figure 4 records the flow in the downstream channel. Erosion of the left bank of the upstream channel is evident while a large eddy, rotating in a counterclockwise direction, is very evident at the left end of the fish screen structure.

The constriction of the downstream channel at the right side of the structure produced a backwater effect, causing the water surface at Bay 12 to be 6 inches higher than that at Bay 2.

Thus, the flow through the rack could not be uniform even if the resistance of the screens could be held constant.

Erosion of the right bank of the downstream channel occurred rapidly in the model. Figure 3 shows the flow in the vicinity of the screen structure.

Figures 5, 6, and 7, respectively, show the condition of the upstream channel, the downstream channel, and the gate structure after completion of the run. The bottom width of the upstream channel was widened by approximately 20 feet due to erosion. The change occurred entirely on the left bank. Figure 6 indicates the extent of the erosion which occurred to the right bank of the downstream channel and shows the resulting deposition in the channel for the 5-pump operation. Figure 7 shows that erosion in the vicinity of the fish screens was negligible as long as the screens were not disturbed. Localized erosion downstream from these bays in which the screens did not seal is evident in the photograph. This action would be aggravated and extended by flow under the screens during the cleaning operation.

The upstream and downstream channels were excavated to the limits shown on Field Drawing No. 214-208-1744 dated October 7, 1953. Figure 8 shows an over-all view of the model conforming to this scheme. Figures 9 and 10 show the model of a revised channel operating at 3,800 cfs. The flow was very satisfactory and the difficulties encountered in the existing lay-out were corrected. Although photographs are not included, there was no noticeable scouring of the banks after 8 hours of model operation.

Although it had not been proven as yet, it appears that the erosion resulting at the prototype fish rack did not occur during normal operation, but is directly related to the method of removing and replacing the screens. This phase of the problem will need further investigation, thus a sectional model of one screen on a larger scale is now under construction.

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(7-52)
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INFORMATIONAL ROUTING

Bradley

AUTHOR

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OCT 19 1953

Speedletter

Air Mail

To: Supervising Engineer, California Projects, Sacramento, California
Attention: CP-210

From: ACTING Chief, Engineering Laboratories Branch

Subject: Hydraulic model tests of pilot fish screen structure and pilot channel--Delta-Mendota Canal headworks--Central Valley Project

The hydraulic model of the pilot fish screen structure and pilot channel has been in operation for 2 weeks only. The hydraulic requirements of the structure and associated channels have not yet been developed. The review of the tentative new alinement dimensions and details of the approach and exit channels requested in the speedletter from Projects Engineer to Chief Engineer, subject as above, dated October 8, 1953, must necessarily be a cursory one.

The enclosed memorandum describes the testing accomplished to date and discusses the requirements as revealed by preliminary testing.

G. E. BURNETT

Enclosure (903)

HMMartin:mkf

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Interior - Reclamation - Denver, Colo.

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(7-52)
Bureau of Reclamation

INFORMATIONAL ROUTING

Bradley
Bradley
Bradley

AUTHOR

293

Air Mail

OCT 23 1953

Speedletter

To: Supervising Engineer, California Projects, Sacramento, California

Attention: CP-210

From: Chief, Engineering Laboratories Branch

Subject: Hydraulic model tests of pilot fish screen structure and pilot canal--Delta-Mendota Canal headworks--Central Valley Project

Enclosed is your Drawing No. 214-208-1744 showing bottom excavation lines (in red) as determined from hydraulic model tests, based on five-pump operation. Flow conditions were checked with six pumps operating to accentuate scouring tendencies. The lines indicate the minimum excavation for the purpose of issuing specifications and are subject to refinement by additional model tests.

The performance of each trial channel has been judged by observing and photographing the presence or absence of flow concentrations which would result in erosion. When time permits, the flow conditions and their significance will be developed in more detail by further testing.

The upstream channel is shown as widened 30 feet instead of the 60 feet shown in your drawing because flow conditions for the lesser change appeared to be very nearly as good as those for the greater widening. There is a definite concentration of flow at the right side of the entrance which would not be improved by further widening. The radius of this corner should be increased as much as possible along the lines indicated on the enclosed drawing. Further testing of this condition is planned.

The downstream channel is shown as widened considerably but represents less excavation than the change shown in your drawing although flow conditions are quite similar.

Attention is called to the manner in which the left bank of the downstream channel has been changed. It is essential that the bank at the downstream end be moved as close to the bridge as practical. This may necessitate lining the sharp turn with riprap.

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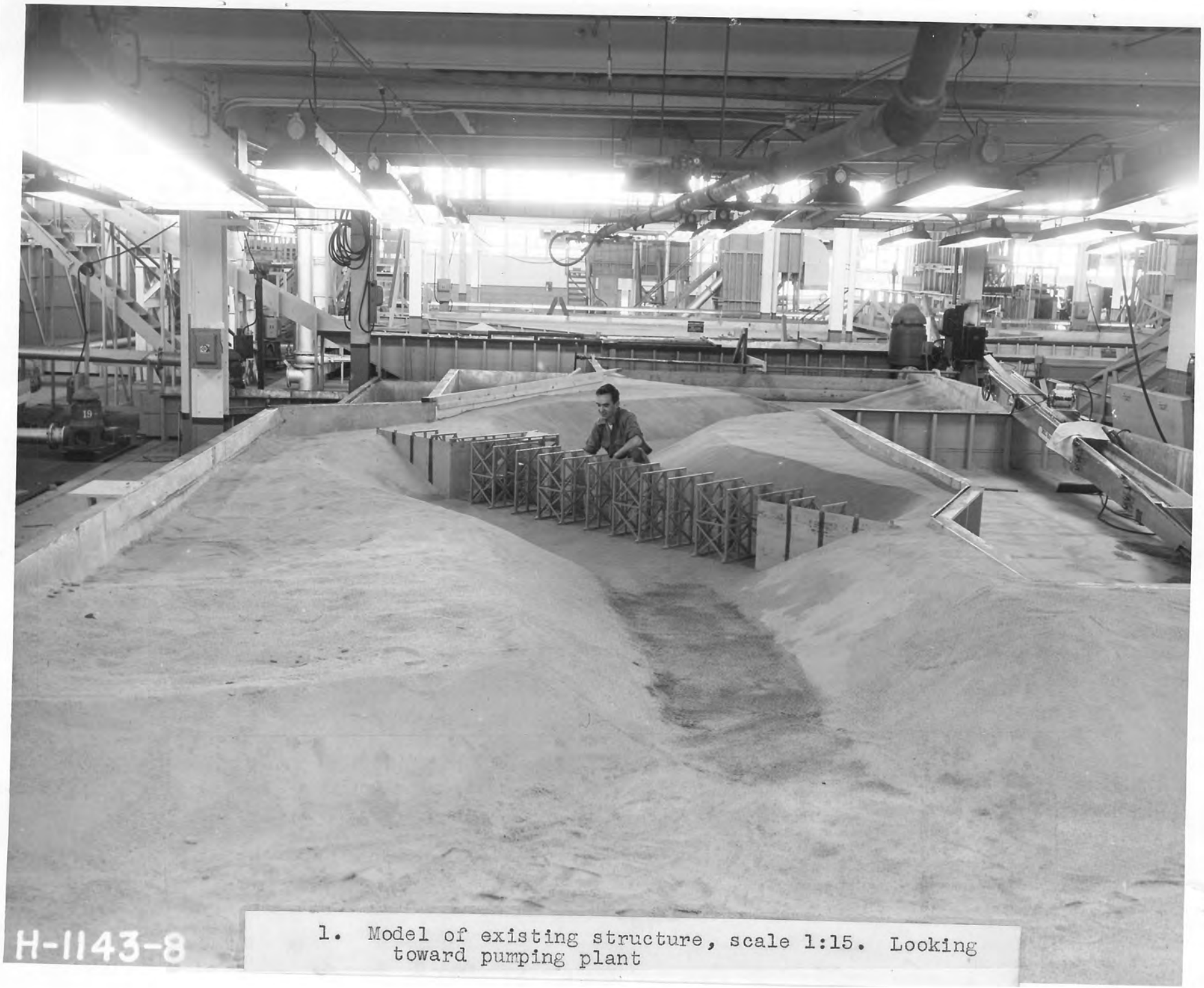
Record photographs showing the testing results to date will be transmitted to you within the next week. Movies showing the work to date will also be sent when processed.

W. H Price

AUTHOR

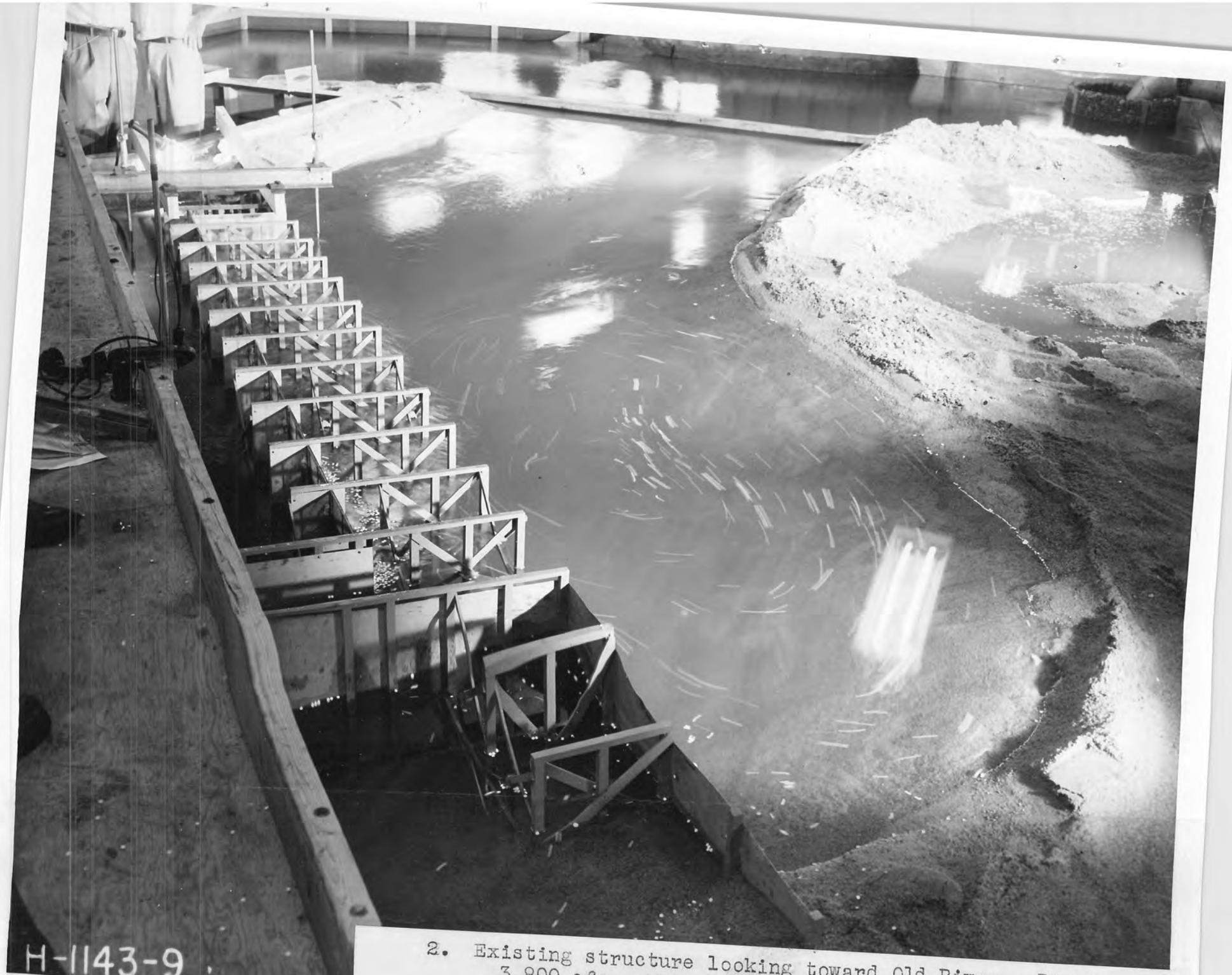
Enclosure (24104)

JNBradley:mlk-s



H-1143-8

1. Model of existing structure, scale 1:15. Looking toward pumping plant



2. Existing structure looking toward Old River. Discharge 3,800 cfs. Note counterclockwise eddy at right of picture

3. Flow near center of fish screen structure

4. Flow conditions in downstream channel of existing structure. Right bank is eroding rapidly

5. Condition of existing upstream channel after unwatering. The left bank (right bank in picture) eroded increasing the channel width by 20 feet

6. View of right bank of existing downstream channel showing erosion and resulting bar

7. Scour patterns downstream from fish screen structure after flow of 3,800 cfs through existing channels. The screens were removed prior to photography

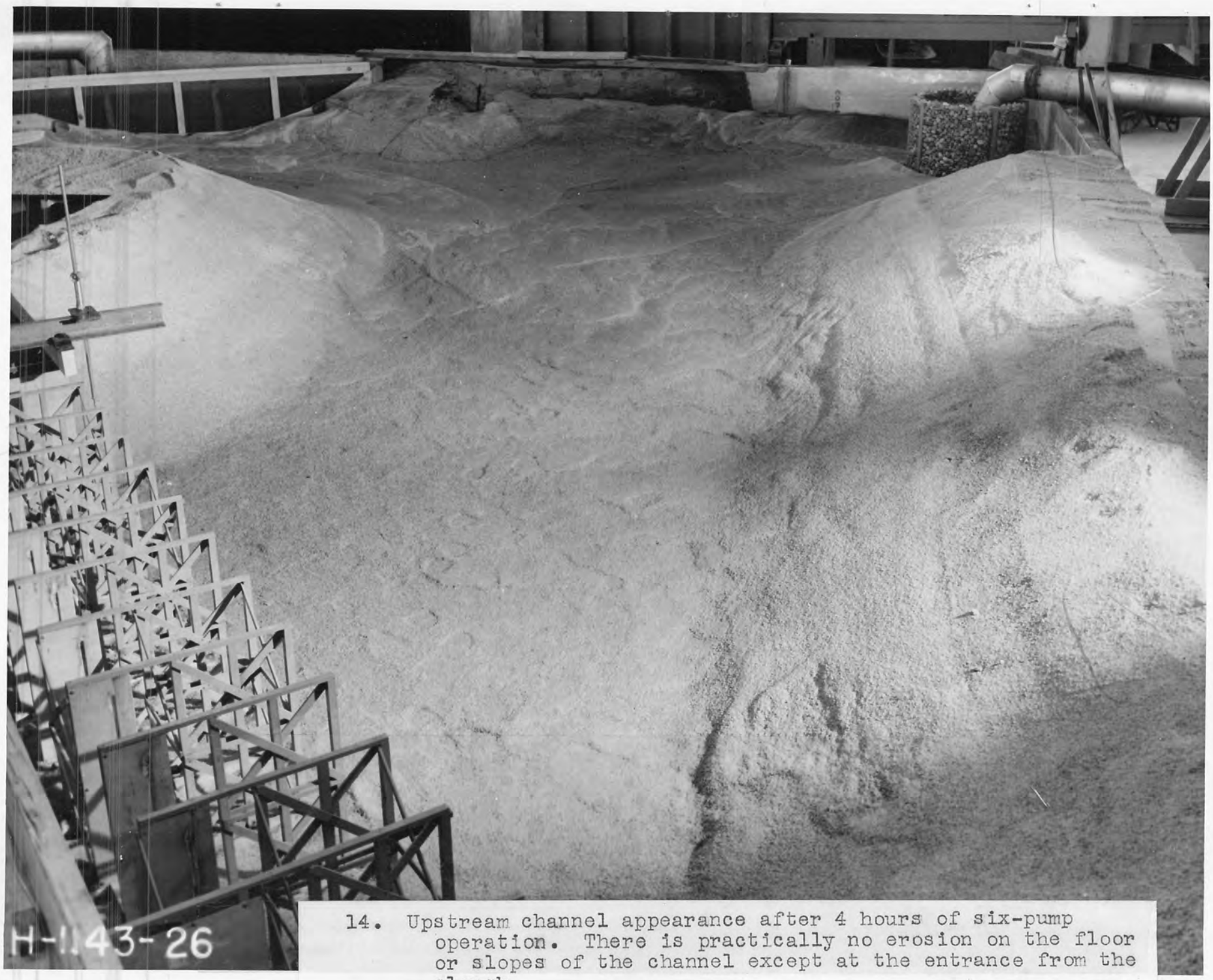
Figure ~~11~~ 8.--Over-all view of model showing channel changes as recommended by the project office. The white string shows the outline of the existing channel

9. Flow of 3,800 cfs with widened upstream channel. An eddy still forms at the left of the fish screen structure

10. Flow of 3,800 cfs in widened downstream channel. Flow is very satisfactory

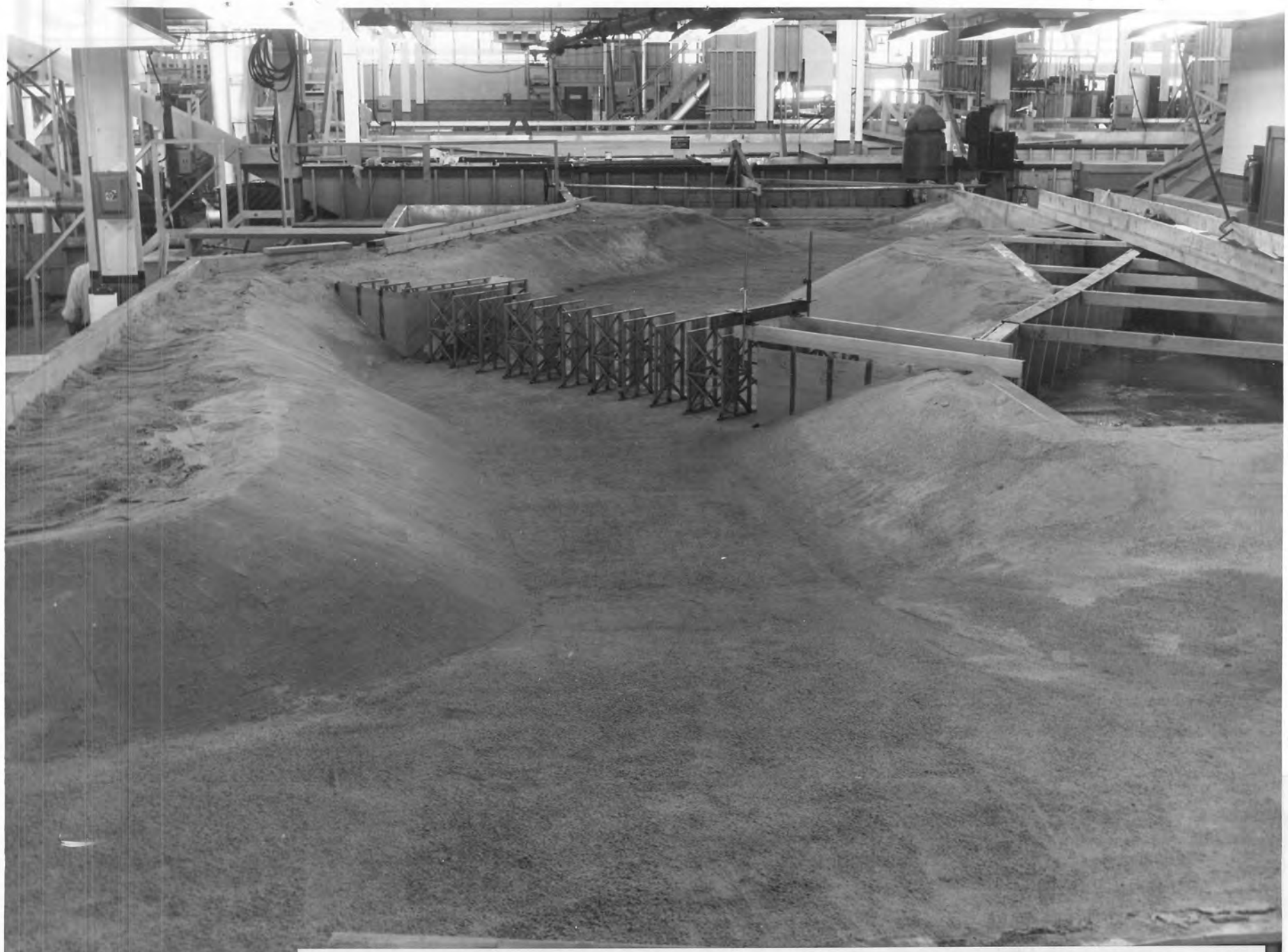
12. Flow appearance on upstream side of structure. Six-pump operation, Old River W.S. elevation = 5.0 feet. Note the eddy on right side of photograph

13. Flow appearance on downstream side of structure. Note the slight eddy at lower part of photograph. This eddy was not apparent during operation of existing channel. There is no flow through the sloping screen bay



14. Upstream channel appearance after 4 hours of six-pump operation. There is practically no erosion on the floor or slopes of the channel except at the entrance from the slough

15. Downstream channel appearance after 4 hours of six-pump operation. No side slope erosion and very slight bed movement.

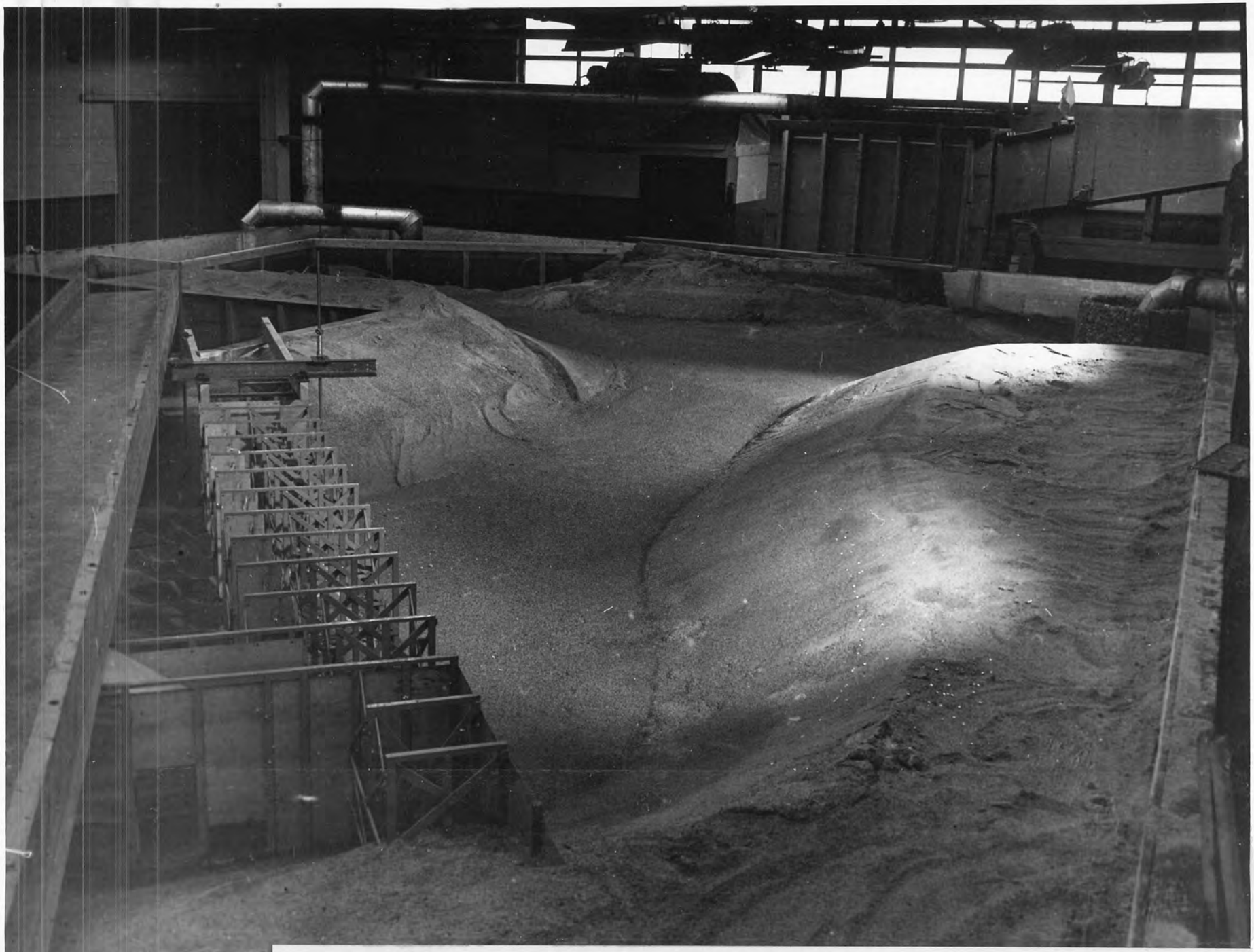


H-1143-30

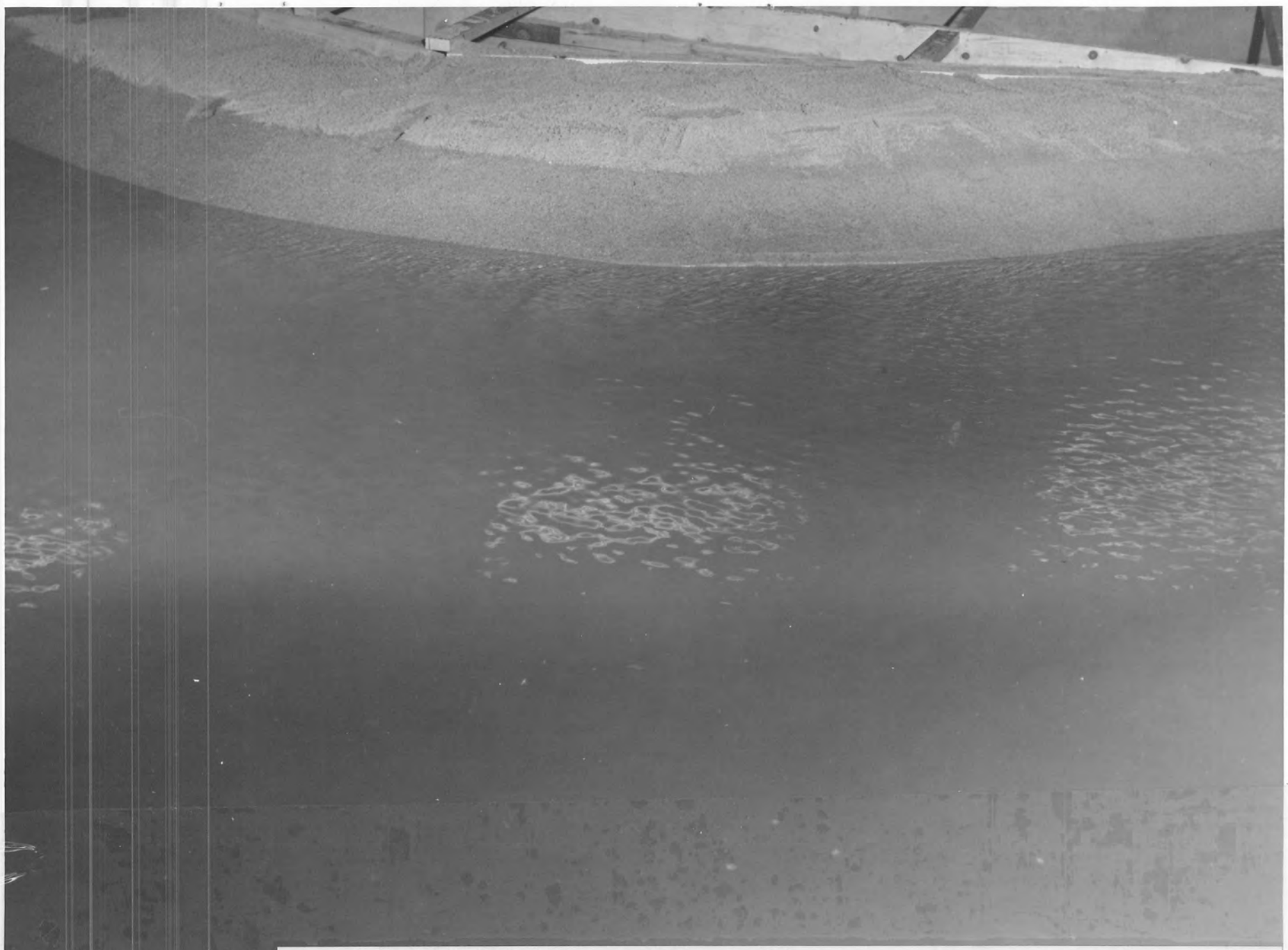
16. Over-all view of Channel No. 3. The upstream channel has been narrowed 30 feet from the project recommendation. The width of the channel below the structure has also been reduced from the previous design

17. View looking toward right bank of Channel No. 3 downstream from the structure

18. Flow appearance for six-pump (4,600 cfs) operation, upstream W.S. elevation at approximately plus 1.0 foot. This is a more severe operating condition than was used in previous test. Note the presence of the slight eddy at right of photograph



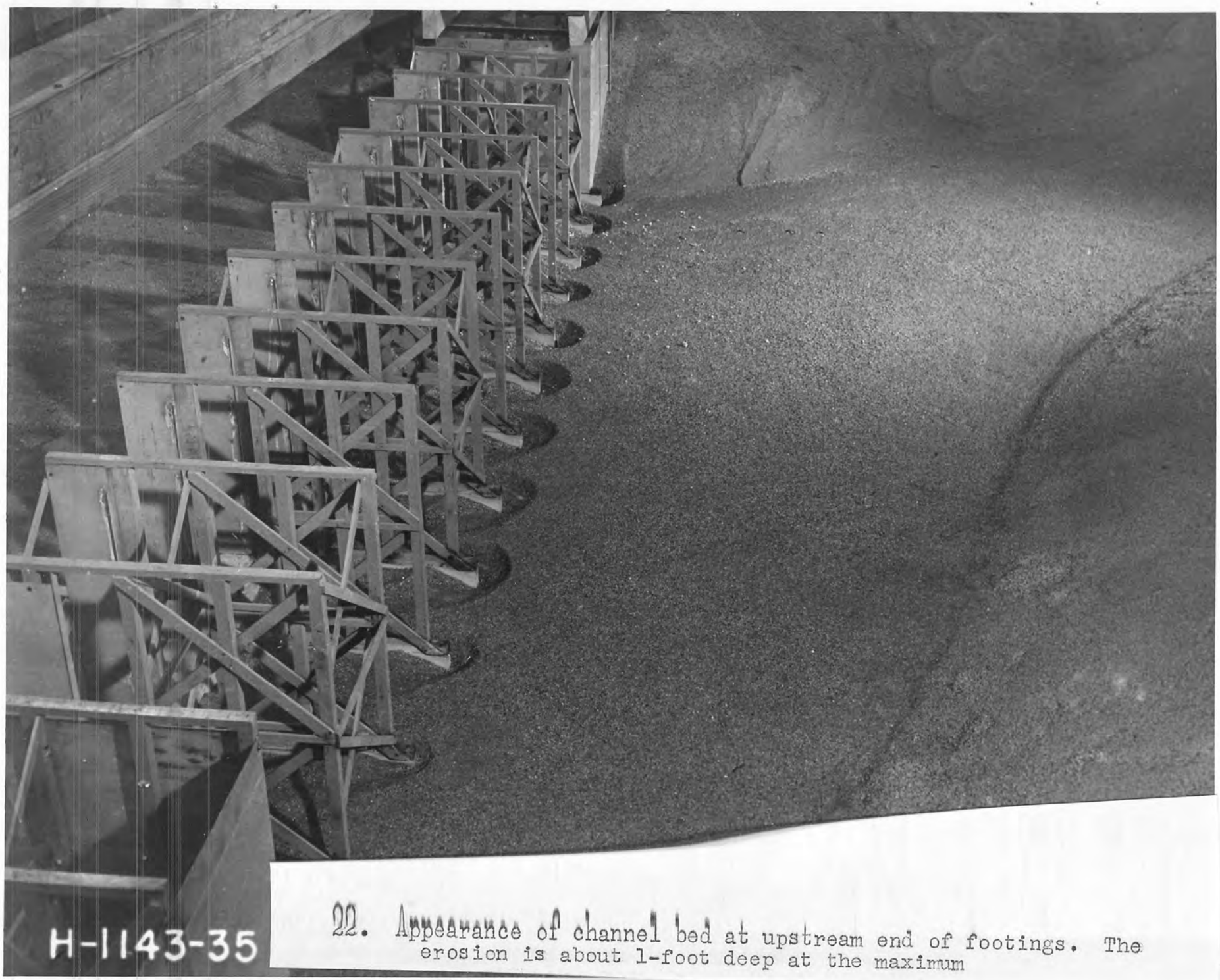
19. Appearance of upstream section of Channel No. 3 after 4 hours of six-pump operation. There was no erosion or bed movement except at the right side of the cha nnel entrance



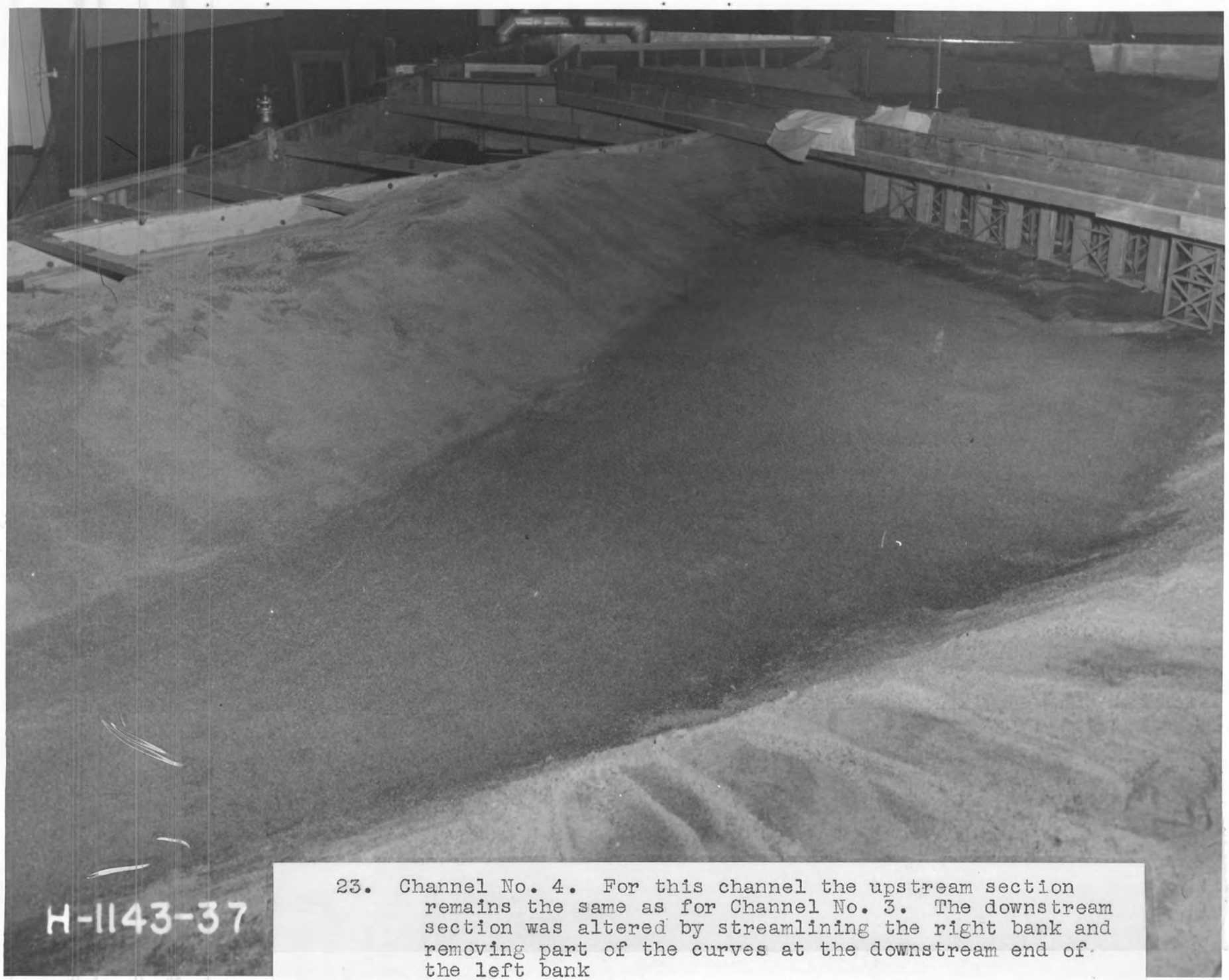
H-1143-33

20. Flow appearance in downstream section of Channel No. 3. The flow condition is good except at the center of the curve along the right bank. The slight water surface roughness indicates that the curve might be too sharp

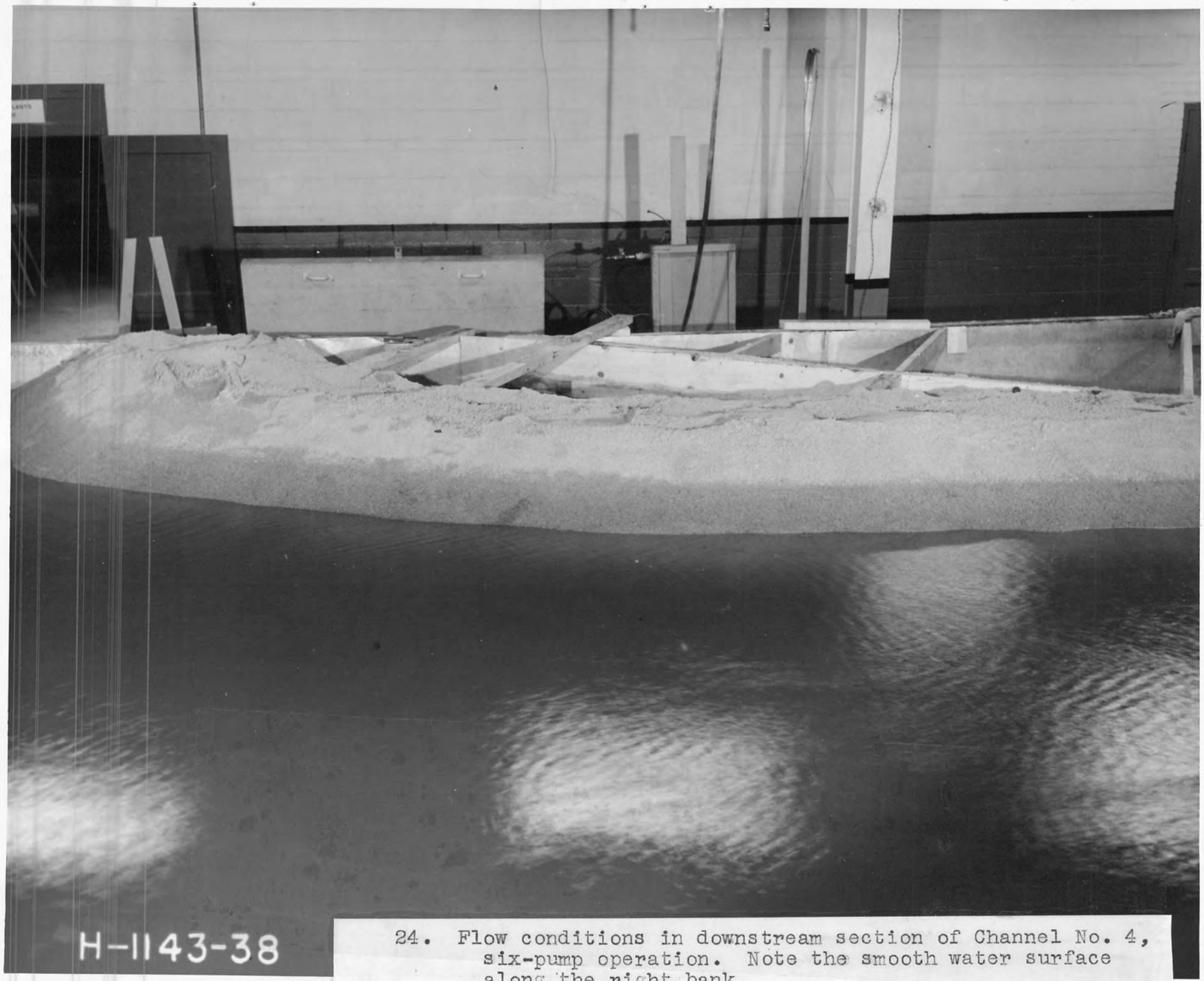
21. Downstream channel appearance after 4 hours of six-pump operation. Note the erosion along the right bank



22. Appearance of channel bed at upstream end of footings. The erosion is about 1-foot deep at the maximum



23. Channel No. 4. For this channel the upstream section remains the same as for Channel No. 3. The downstream section was altered by streamlining the right bank and removing part of the curves at the downstream end of the left bank



24. Flow conditions in downstream section of Channel No. 4, six-pump operation. Note the smooth water surface along the right bank

25. Appearance of Channel No. 4 after 4 hours of six-pump operation. The very slight bank erosion and bed movement shows that the channel is adequate for the expected operating conditions.

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(7-52)
Bureau of Reclamation

INFORMATIONAL ROUTING

Memorandum

Denver, Colorado
November 10, 1953

A. W. Kidder, Canals Branch

Through: Head, Hydraulic Laboratory Section

T. J. Rhone, Hydraulic Laboratory Section

Summary of tests performed to determine an effective method of preventing the erosion downstream from the fish screen structure

The tests were made in a glass-sided flume in which one bay of the fish screen structure had been constructed to a scale of 1:10.

AUTHOR

The tests were performed under the same discharge conditions which were as follows: Six-pump operation assuming the sloping screen bay was not open. The upstream water surface was held at approximately elevation +5.0, with about a 1-1/2-foot head loss across the screen. When two screens were used, the second screen was assumed to be clean with only a slight head loss.

In the summation the dimensions that are given are the prototype figures, but the times are the actual operating times of the model.

1. Preliminary test. In order to have a basic scale for comparison, the model was operated to duplicate the assumed existing conditions; that is, one screen raised about 2 feet above the apron with the sand placed at the same elevation as the apron, see Photograph H-1143-45. The model was then operated for 10 minutes and a picture taken of the resulting erosion, see Photograph H-1143-42

2. 2-1/2- to 3-3/4-inch riprap. The riprap was placed to a depth of 1 foot for 10 feet downstream from the apron. Photograph H-1143-40 shows the bed movement after 10 minutes' operation at the 2-foot opening. The screen was next dropped to a 1-foot opening;and since this seemed to produce a more rapid bed movement, the model was allowed to operate for an additional 20 minutes, the resulting bed movement is shown in Photograph H-1143-41

3. 6-inch sill and riprap. The next alteration was to place a 6-inch sill on the end of the apron, see attached sketch; the riprap was placed the same as for the previous test. Photograph H-1143-44 shows the bed prior to raising the fish screen. The screen was raised in increments of 1 foot to determine the opening that resulted in the severest bed movement. The 2-foot opening was the most severe and Photograph H-1143-43 shows the erosion after 30 minutes' operation

4. 12-inch sill and riprap. For this test a 12-inch high end sill was used, see attached sketch, and the riprap placed as in previous tests. A 3-foot opening was the most damaging for this combination. At the end of 30 minutes the erosion was as shown in Photograph H-1143-47. Photograph H-1143-49 shows the bed after 4 hours' operation. Note that the gravel has sunk beneath the sand, and the sand has moved toward the end sill and formed a protective layer

5. Two screens. For this test two screens were used, the screens were about 1-1/2 feet apart with the dirty screen on the upstream side. When the clean screen was lowered to the apron and the dirty screen raised about 2 feet, there was very slight bed movement; if the clean screen was also raised, the bed movement was again very severe, Photograph H-1143-48 shows the bed after 10 minutes' operation with both screens raised

6. The position of the two screens were reversed, (no photographs). With the clean screen on the upstream side, the erosive action was very severe when the dirty screen was raised H-1143-54

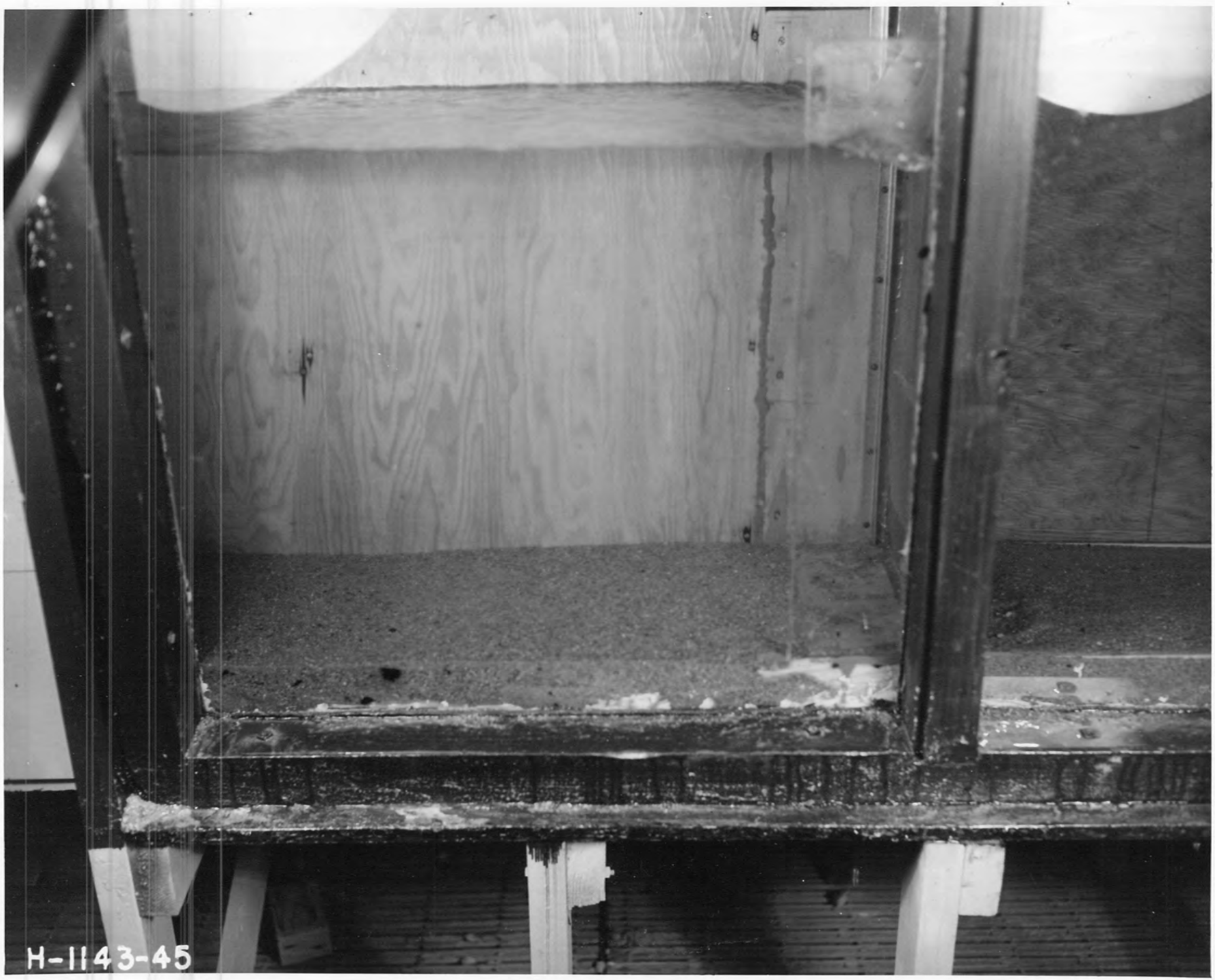
7. Two screens. The screens were adjacent, that is, separated by about 7 inches rather than 1-1/2 feet. With the clean screen downstream, the erosive action was still very slight when the dirty screen was raised; with the dirty screen on the downstream side the erosive action was very severe when the dirty screen was raised H-1143-55 H-1143-50

8. The lower 2-1/4 feet of both screens were blocked off with sheet metal shields. With dirty screen on upstream side, there was very slight movement as the dirty screen was raised. With the dirty screen on the downstream side, there was very rough erosive action as the dirty screen was raised. The screens for this test were placed about 7 inches apart

~~Note: Still photographs were made for Tests 6, 7, and 8, but were not available at the time this memorandum was prepared.~~

Motion pictures were taken for Tests 1 through 8, but they have not been returned from the processing plant.

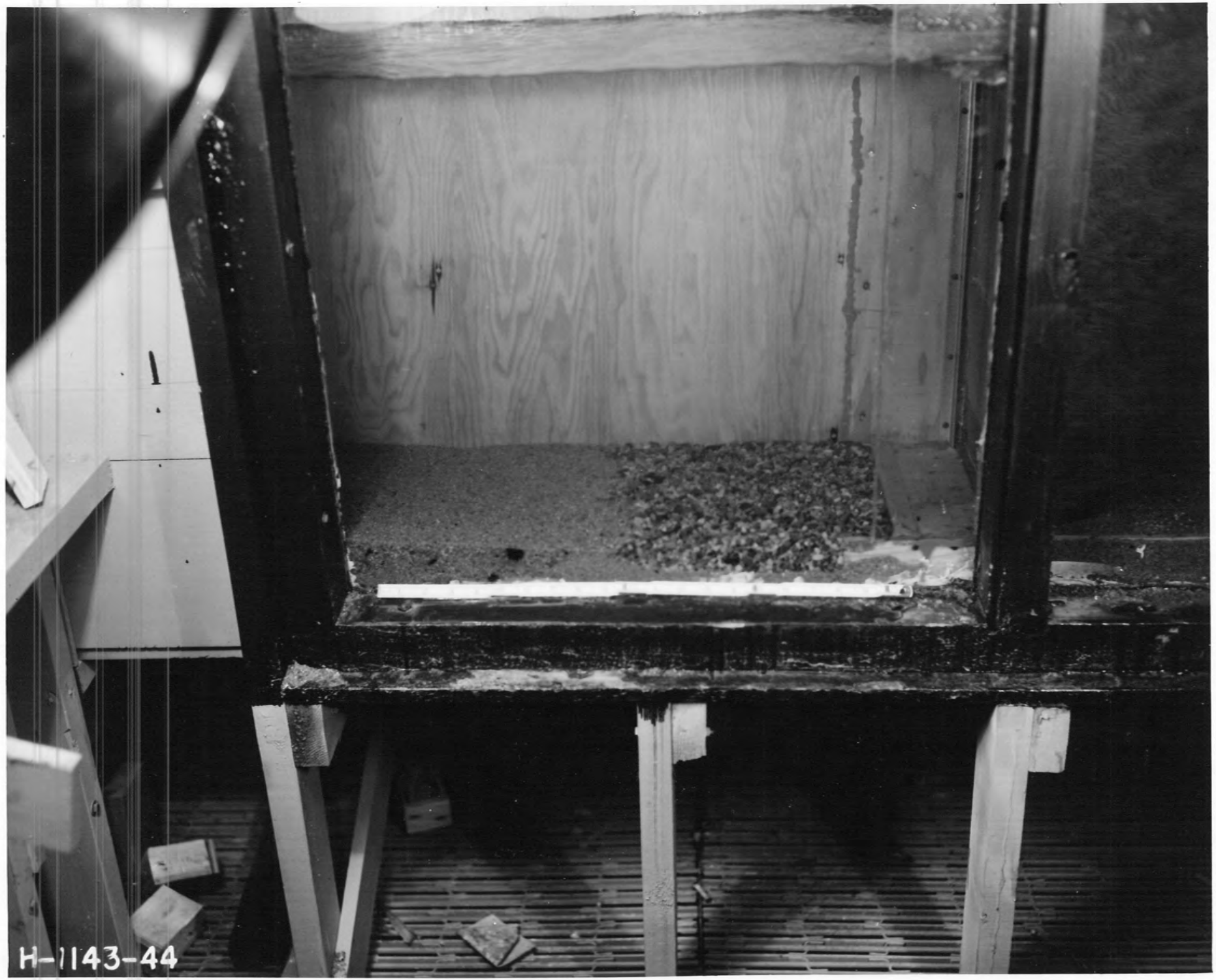
TJRhone:reo-s


H-1143-45


H-1143-42


H-1143-40


H-1143-41


H-1143-44


H-1143-43


H-1143-47


H-1143-49


H-1143-48


H-1143-54


H-1143-50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