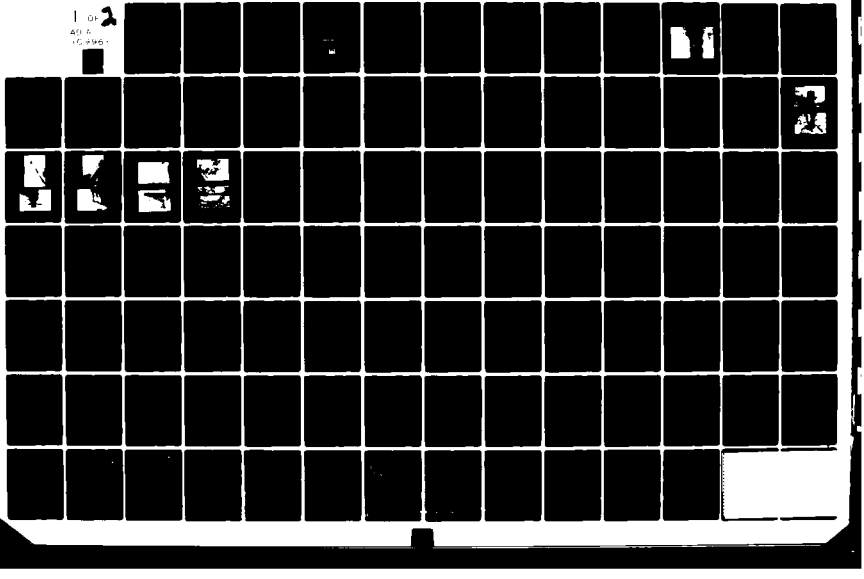
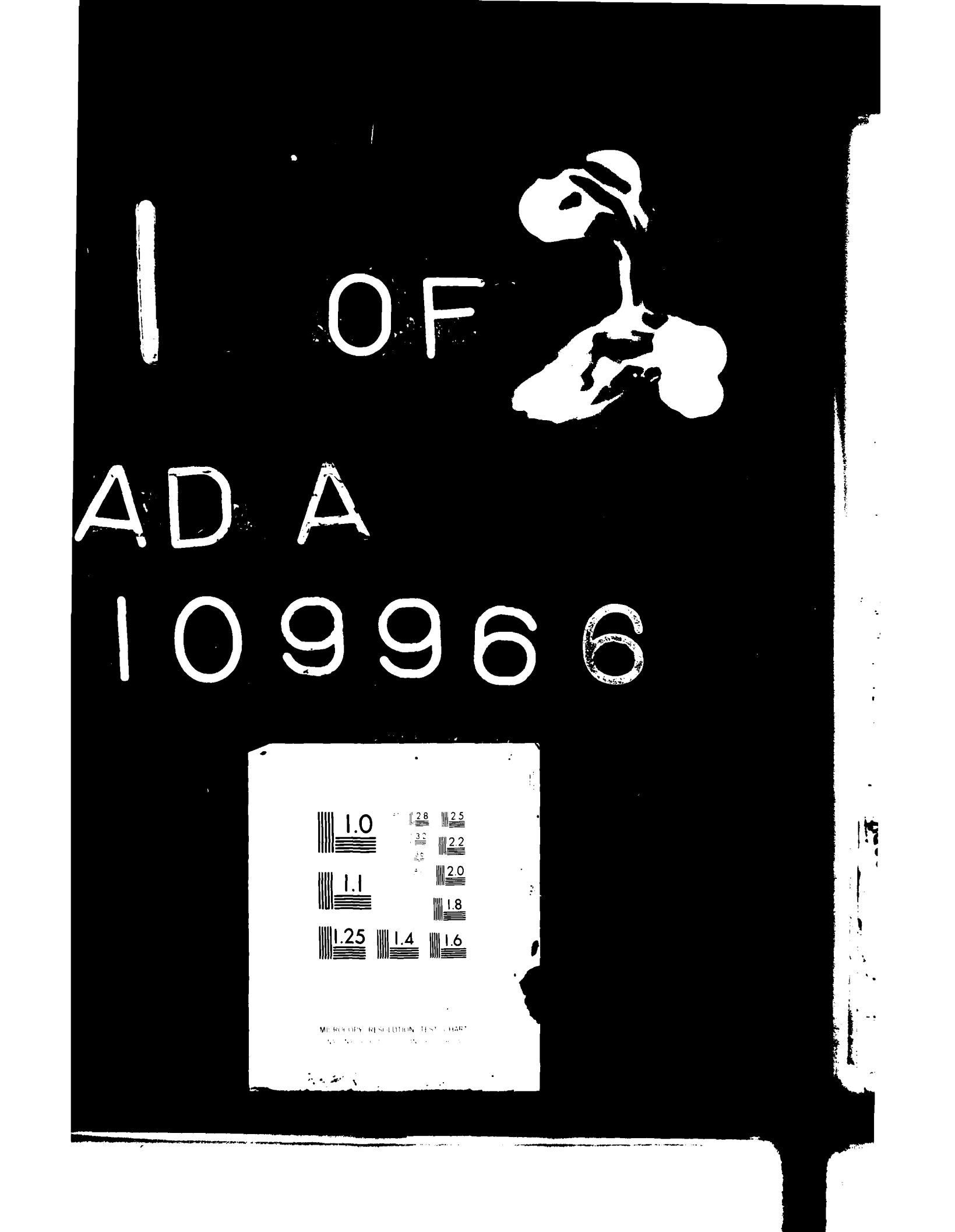
AD-A109 966 METCALF AND EDDY OF NEW YORK INC NY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. POTTERS FALLS DAM (INVENTORY NUMBE--ETC(U)
SEP 81 G P FULTON DACW51-81-C-0044
UNCLASSIFIED NL




1 OF
AD A
109966
1.0
1.1
1.25
1.4
1.6
2.0
1.8
2.2
2.5
2.8
3.2
3.6
MICROCOPY RESOLUTION TEST CHART

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	AD-A109966	

4. TITLE (and Subtitle)
Phase I Inspection Report
Potters Falls Dam
Oswego River Basin, Tompkins County, NY
Inventory No. 378

5. TYPE OF REPORT & PERIOD COVERED
Phase I Inspection Report
National Dam Safety Program

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
GEORGE P. FULTON

8. CONTRACT OR GRANT NUMBER(s)
DACW51-81-C-0044

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Metcalf and Eddy of New York, Inc.
60 East 42nd Street
New York, New York 100017

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
100

11. CONTROLLING OFFICE NAME AND ADDRESS
Department of the Army
26 Federal Plaza New York District, CofE
New York, New York 10287

12. REPORT DATE
23 September 1981

13. NUMBER OF PAGES

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)
Department of the Army
26 Federal Plaza New York District, CofE
New York, NY 10287

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for public release; Distribution unlimited.

17. DISTRIBUTION STATE [illegible] (if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Potter Falls Dam
Oswego River Basin
Tompkins County

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Visual inspection of this dam and engineering analysis which has been performed revealed that several deficiencies exist on this structure.

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

S/N 0102-LF-014-6601

The worst of these deficiencies was the localized spalling and erosion of the gunite covering the dam. This was observed in three areas on the downstream face and toe. A more thorough examination of the gunite when there there is no discharge over the spillway is needed to evaluate the extent and cause of this deterioration. If the gunite is not repaired, the interior concrete of the dam will become exposed to erosion.

Using the Corps of Engineer's Guidelines for the initial review of spillway adequacy, it has been determined that the structure would be overtopped by all storms exceeding 31 percent of the Probable Maximum Flood (PMF During a one-half PMF storm, the abutments of the dam would be overtopped by 3.4 feet. The dam is a concrete arch-gravity structure with bedrock at both abutments. While overtopping is not likely to induce failure from erosion, a stability analysis indicates that the factor of safety is below the recommended level during the one-half PMF storm. If the dam were to fail, it would increase the degree of flooding in downstream residential areas. Therefore, the spillway is assessed as seriously inadequate.

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

OSWEGO RIVER BASIN

POTTER'S FALLS DAM

TOMPKINS COUNTY, NEW YORK
INVENTORY NO. NY 378

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NEW YORK DISTRICT CORPS OF ENGINEERS

AUGUST 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, and Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hudrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
POTTER'S FALLS DAM
I.D. No. 378
75A-717
OSWEGO RIVER BASIN
TOMPKINS COUNTY, NEW YORK

TABLE OF CONTENTS

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Potter's Falls Dam (I.D. No. NY 378)
State Located:	New York
County:	Tompkins
Watershed:	Oswego River Basin
Stream:	Sixmile Creek
Date of Inspection:	July 8, 1981

ASSESSMENT

Visual inspection of this dam and engineering analyses which have been performed revealed that several deficiencies exist on this structure.

The worst of these deficiencies was the localized spalling and erosion of the gunite covering the dam. This was observed in three areas on the downstream face and toe. A more thorough examination of the gunite when there ~~there~~ is no discharge over the spillway is needed to evaluate the extent and cause of this deterioration. If the gunite is not repaired, the interior concrete of the dam will become exposed to erosion.

Using the Corps of Engineer's Guidelines for the initial review of spillway adequacy, it has been determined that the structure would be overtopped by all storms exceeding 31 percent of the Probable Maximum Flood (PMF). During a one-half PMF storm, the abutments of the dam would be overtopped by 3.4 feet. The dam is a concrete arch-gravity structure with bedrock at both abutments. While overtopping is not likely to induce failure from erosion, a stability analysis indicates that the factor of safety is below the recommended level during the one-half PMF storm. If the dam were to fail, it would increase the degree of flooding in downstream residential areas. Therefore, the spillway is assessed as seriously inadequate.

Within three months of the receipt of this report, the owner should commence a more detailed stability analysis. Further hydraulic/hydrologic studies are needed to accurately determine flood reservoir levels. Additional inspection and evaluation of the deteriorated gunite is also required. The owner should exercise the gate on the low-level outlet and maintain it in good operating condition. Remedial measures deemed necessary as a result of these studies should be completed within 18 months.

Other deficiencies as outlined below should be corrected within 12 months of the date of notification of the Owner:

1. The operating condition of the sluice gate on the low-level outlet should be tested and repaired as necessary for dependable operation.

2. The deteriorated concrete on the abutments should be repaired, and the brick facing replaced or repaired as necessary.

3. Vegetation growing on the abutment should be removed.

4. The concrete sill on the weir should be repaired to prevent further leakage beneath it.

5. Any open joints in the spillway should be repointed, particularly in the area of heavy efflorescence.

6. An emergency action plan should be developed for the notification and evacuation of downstream residents.

Edward M. Greco, P.E.
Project Manager
Metcalf & Eddy of New York, Inc.
New York Registration No. 47463

George P. Fulton, P.E.
Vice President
Metcalf & Eddy of New York, Inc.
New York Registration No. 22390

Approved By:

Col. W. M. Smith, Jr.
New York District Engineer

Date: 22 Sep 81

OVERVIEW
POTTER'S FALLS DAM
NY ID NO. 378

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
POTTER'S FALLS DAM
I.D. No. NY 378
75A-717
OSWEGO RIVER BASIN
TOMPKINS COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, fo fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection

This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam

Potter's Falls Dam, locally known as the 60 Foot Dam, impounds the Ithaca Reservoir used as a water supply for the City of Ithaca. The dam is a concrete gravity structure that is arch-shaped in plan view. A spillway weir is centrally located on the top of the dam, and a low-level outlet is located at the base. On the upstream side, there is a gatehouse containing mechanisms to operate valves on the water supply line and the low-level outlet.

The dam is 220 feet long with a maximum height of 70.5 feet. It is constructed of cyclopean concrete covered with gunite and mesh. The top width is 8.5 feet. The upstream face of the dam is vertical and the downstream face is 0.7 to 1 (horizontal to vertical).

The spillway is a 100-foot long, ungated ogee weir. Discharge flows onto the downstream face of the dam and into a 100-foot wide bedrock gorge.

A 72-inch cast iron pipe passes through the base of the dam and serves as the low-level outlet. The pipe is 45.5 feet long. Flow is controlled by a gate at the upstream end of the pipe. The gate is operated from the upper level of the gatehouse.

A 24-inch cast iron pipe passes through the right abutment of the dam and serves as the water supply line. The pipe extends from a wet well in the lower level of the gatehouse to the treatment plant 9,400 feet downstream. Flow is normally regulated at the treatment plant, however,

there are also two gates on the pipe in the gatehouse. One is at the upstream end of the pipe and the other is on the opening into the wet well. Both are operated from floor stands in the upper level of the gatehouse.

b. Location

The dam is located on Sixmile Creek about 2.5 miles southeast of downtown Ithaca. An unpaved road that leads to the dam is located off Route 79, 0.3 miles south of the junction with Route 174.

c. Size Classification

The dam is a maximum of 70.5 feet high and has a storage capacity of 1,290 acre-feet. Therefore, the dam is in the intermediate size category as defined by the "Recommended Guidelines for Safety Inspection of Dams".

d. Hazard Classification

The dam is classified as "high" hazard due to the presence of dense commercial and residential development adjacent to the stream bed in the City of Ithaca, about 2.5 miles downstream.

e. Ownership

The dam is owned by the City of Ithaca and operated by personnel from the Department of Public Works - Water and Sewer Division. Mr. Phillip Cox, City Engineer was contacted concerning the Phase I Inspection. His address is City Hall, 108 East Green Street, Ithaca, New York 14850.

f. Purpose of Dam

The dam is a water supply reservoir for the City of Ithaca.

g. Design and Construction History

The dam was constructed in 1911. Drawings were prepared in 1910 and signed by Donald F. McLeod, City Engineer. Specifications are not available, and the name of the construction contractor is unknown. By 1925, siltation had decreased the storage capacity of the dam by 12 percent. The Silt Dam was therefore constructed 3,500 feet upstream to control siltation. In 1939, a covering of gunite and mesh was placed over the entire dam. There are no drawings or construction data available for that work.

e. Normal Operating Procedures

There are no regular operating procedures at the dam. The gate on the low-level outlet has not been operated since 1959 when the reservoir was drained to inspect for siltation. The gates on the water supply pipe are operated once or twice a year to dewater the wet well and clean the screens in the gatehouse.

1.3 PERTINENT DATA

a. Drainage Area (sq. mi.)	45.6

b. Discharge at Dam (cfs)

Concrete Spillway-water surface at top of dam	10,450
72-inch Outlet-water surface at crest of spillway	1,044

c. Elevation (Plan Datum)

Top of Dam	715.5
Spillway Crest	705.0
Invert of 72-inch outlet pipe	647.0
Invert of 24-inch water pipe	665.0

d. Reservoir (Surface Area) (acres)

Top of Dam	47
Spillway Crest	47

e. Storage Capacity (acre-feet)

Top of Dam	1,290
Spillway Crest	800

f. Dam

Type: cyclopean concrete gravity dam, arch in plan, surface covering of gunite and mesh

Length (ft)	220
Slopes (V:H) Upstream	Vertical
Downstream	0.7:1
Crest Width (ft)	8.5

g. Spillway

Type: Concrete ogee overflow weir

Length of Weir (ft)	100

h. Low Level Outlet

Type: 72-inch cast iron pipe through dam, 45.5 feet long, gate controlling flow at upstream end of pipe, operating mechanism inside gatehouse

k. Appurtenant Structures

24-inch cast iron water supply pipe through dam at right abutment, 9,400 feet long, two gates at upstream end (gatehouse), but flow is controlled at downstream end (treatment plant)

SECTION 2: ENGINEERING DATA

2.1 GEOTECHNICAL DATA

a. Geology

Potter's Falls Dam is located in the Southern New York Section of the Appalachian Plateaus physiographic province. The bedrock in this area consists of shales, siltstones, and sandstones that have been uplifed and gently folded into regional basin structures. The bedrock at the dam is a dark gray, thin bedded shale with prominent vertical joints that form the steep walls of the gorge below the dam. A review of the "Geologic Map of New York" indicated that there are no faults in the vicinity of the dam.

Surficial soils in the area are the result of glaciations during the Pleistocene Epoch, the last of which was the Wisconsin glaciation.

b. Subsurface Investigations

There are no records of any subsurface investigation for Potter's Falls Dam. Continuous bedrock outcrops are visible at the abutments and along the base of the dam.

2.2 DESIGN RECORDS

Design plans were prepared in 1910 under the direction of the City Engineer for the City of Ithaca. These were the only design records available.

2.3 CONSTRUCTION RECORDS

This dam was constructed in 1911. The name of the contractor is unknown, and there are no as-built drawings available. There was some correspondence available concerning the construction. Personnel from the New York State Conservation Commission inspected the structure about halfway through construction. The principal comment made by the Conservation Commission was that the concrete was not of good quality, containing too much coarse aggregate (3/8 to 3/4 inch crushed shale) and not enough sand. The sand fraction was increased as a result of this comment. There were no records of significant changes made in the design of the dam during construction.

2.4 OPERATION RECORDS

The only operation records available are hydrographs of the height of the reservoir above the crest of the spillway for the years 1939 through 1944.

2.5 EVALUATION OF DATA

Information used for the preparation of this report was obtained from the Department of Environmental Conservation files and from the City of

Ithaca's Water and Sewer Division files. The information available appeared to be reasonably accurate. The plan datum agrees with elevation given on U.S. Geological Survey quadrangle maps.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of Potter's Falls Dam was conducted on July 8, 1981. The weather was sunny with the temperature around 90 degrees. The water level at the time of the inspection was slightly above the crest to the spillway.

b. Dam

Inspection of the dam was hampered by the flow of discharge over the spillway and by the lack of access to the abutments on the downstream side of the dam.

Spalling and erosion of the gunite and mesh covering the dam has occurred in the following areas on the downstream face:

1. left abutment - halfway down
2. bottom of face - from outlet opening to left abutment
3. downstream toe - right abutment

A large bulge in the gunite is also visible on the downstream face opposite the level of the water pipe. There are hairline cracks with slight efflorescence in many areas on the dam. This deterioration could be caused by flowing water, freezing and thawing, seepage through the dam, improper construction techniques or materials, or a combination of these factors.

Minor seepage indicated by wet areas on the bedrock face was observed at both abutments on the downstream face of the dam. At the left abutment, the wet area is larger, extending from the top to about halfway down. There is no visible flow in the wet areas, and the bedrock is intact. It is likely that this seepage is occurring along nearly horizontal bedding planes in the bedrock.

Brush and trees are growing on the upstream side of both abutments of the dam.

c. Spillway

The spillway weir is in satisfactory condition. No voids or cracks were visible. The crest is clear of obstructions.

d. Low-Level Outlet

The low-level outlet was partly submerged and only visible at the downstream end. This end of the pipe is clear of debris and silt. To inspect the pipe further, it should be dewatered and ventilated.

e. Water Supply Pipe

The water supply pipe is mostly embedded in concrete or in bedrock. The concrete around the pipe just downstream of the dam is moderately eroded. Where the pipe is visible farther downstream, it is in satisfactory condition.

f. Gatehouse

The gatehouse is in fair structural condition. There are some thin vertical cracks in the walls and localized spalling of the concrete at the water line. Inside, the floor stands for operating the gates on the low-level outlet and the water supply pipe are intact.

g. Reservoir

There were no indications of slope instability in the reservoir area.

h. Downstream Channel

The channel downstream of the dam is a bedrock gorge. There are no significant obstructions in the floor or sides of the channel.

3.2 EVALUATION OF OBSERVATIONS

Visual observations revealed several deficiencies on this structure. The following items were noted:

1. Localized spalling and erosion of the gunite surface.
2. Minor seepage at the dam abutments.
3. Brush and trees growing next to the upstream face.
4. Eroded concrete on the exterior of the gatehouse and around the water supply pipe downstream of the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 PROCEDURES

This reservoir is used as a water supply by the City of Ithaca. Flow through the water supply pipe is controlled downstream at the water treatment plant. The two gates on the water supply pipe at the dam are normally kept open. Once or twice a year, these gates are closed to dewater the wet well and clean the screens on the water supply pipe. The gate on the low-level outlet is normally kept closed. Its condition is unknown, since the last time it was operated was in 1959.

4.2 MAINTENANCE

Periodic visits are made to the dam to check on the condition of the facilities. The visits are made by personnel from the Ithaca Water and Sewer Division.

4.3 WARNING SYSTEM IN EFFECT

There is no apparent warning system for the notification and evacuation of downstream residents.

4.4 EVALUATION

The operation and maintenance procedures on this structure are not satisfactory. Additional maintenance efforts are required to correct some of the deficiencies noted in Section 3.2.

SECTION 5: HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

The delineation of the watershed contributing to this dam is indicated on the Vicinity Map (Appendix F). The irregularly shaped 45.6 square mile (29,184 acre) watershed is comprised of relatively undeveloped land consisting of open fields and woodland. The village of Brooktondale located near the center of the watershed is the largest developed area. Slopes along the primary drainage paths are flat (1.5 percent). However, the adjacent hillsides have steep (9 percent) slopes. The hills that form the watershed divide are 700 to 1,200 feet above the reservoir elevation. There are a few small ponds and wetlands in lowland areas of the watershed. The only upstream dam is Silt Dam which fills with debris flowing toward the reservoir.

5.2 ANALYSIS CRITERIA

No hydrologic/hydraulic information was available regarding the original design for this dam. Therefore, the analysis of the floodwater retarding capability of the dam was performed using the Corps of Engineers HEC-1 computer program, Dam Safety version. This program uses the Snyder Synthetic Unit hydrograph and the "Modified Puls" flood routing procedure. The spillway design flood selected for analysis was the Probable Maximum Flood (PMF), in accordance with the Recommended Guidelines of the U.S. Army Corps of Engineers.

5.3 SPILLWAY CAPACITY

A 100-foot long ogee-crested spillway is located at the center of the dam. Flow over the weir was analyzed using a discharge coefficient of 3.97. The computed discharge capacity of the spillway is 10,450 cfs with the reservoir level at the top of the dam. The flood analysis performed for this dam indicates that the spillway does not have sufficient capacity for discharging one-half the PMF. For this storm event, the peak inflow is 18,850 and the peak outflow is 18,830 cfs. The full PMF peak inflow and peak outflow are 37,700 cfs and 37,680 cfs respectively.

5.4 RESERVOIR CAPACITY

The normal water surface is at or near the spillway crest elevation of 705.0 (plan datum). The impounded capacity at this elevation is 800 acre-feet. Surcharge storage capacity to the top-of-dam (elev. 715.5) adds 490 acre-feet which is equivalent to a direct runoff depth of 0.2 inches over the watershed. The total storage capacity is 1,290 acre-feet.

5.5 FLOODS OF RECORD

The maximum flood at the dam site is reported to have been in 1935, but the reservoir level at that time is unknown. The highest level on record

occurred March 17, 1942 when the reservoir reached elevation 709.1. This elevation is 4.1 feet above the crest of the spillway and 6.4 feet below the top of the dam.

5.6 OVERTOPPING POTENTIAL

Analyses using the PMF and one-half PMF storm events indicate that the spillway does not have sufficient discharge capacity. The computed depths of overtopping for these two events are 9.6 feet and 3.4 feet respectively. All storm events exceeding 31 percent of the PMF will result in the dam being overtopped.

5.7 EVALUATION

The spillway is inadequate for the peak outflow from one-half the PMF. Due to the concrete construction of the dam and bedrock outcrops at both abutments, overtopping is unlikely to result in failure due to erosion. However, as discussed in the following section, a preliminary stability analysis indicates that the factor of safety is below the recommended value with the reservoir at the one-half PMF level. Dense residential and commercial development exists 2.5 miles downstream in the City of Ithaca. If the dam were to fail, it would increase the degree of flooding downstream from that which would exist prior to failure. Based on the capacity of the spillway, the low factor of safety, and the increased flooding as a result of failure, the spillway is assessed as seriously inadequate.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation

The dam is a combined arch and gravity design, constructed of concrete which was later covered with gunite and mesh. The reason for adding the gunite is unknown.

A close inspection of the downstream face of the dam was restricted by discharge over the spillway and a lack of access to the abutments. The downstream toe near the middle of the dam was submerged and could not be inspected. No major settlement was visible. The gunite covering the dam is locally spalled and bulging. Minor seepage was observed on the downstream face at both abutments.

b. Data Review and Stability Analysis

No design information concerning the stability of either the concrete dam or spillway sections was available. The design drawings provided cross sections used in the analyses. There are no as-built drawings or other construction data available for the dam.

A stability analysis was performed for this report in accordance with the "Recommended Guidelines for Safety Inspection of Dams". The analysis was performed using a section at the center of the dam perpendicular to the spillway weir. It was assumed that the structure is constructed of cyclopean concrete, as shown on the construction drawing dated August, 1910. The foundation material is horizontally bedded shale. No drainage system to relieve uplift pressures is shown on the drawings.

Due to the arch design of the dam, an overturning analysis was not performed for this structure. Therefore, only the safety factors against sliding were computed. The results of the analysis are as follows:

Case:	Sliding: Factors of Safety Spillway Section
a) Reservoir level at spillway crest	0.76
b) a) plus ice load of 5,000 lb./ft.	0.73
c) Reservoir level at top of dam	0.49
d) a) plus seismic coefficient of 0.10	0.57

c. Evaluation of Structural Stability

The analyses indicate that the factors of safety for the spillway are significantly below recommended levels. Due to the very low factors of safety for the spillway section, the non-overflow section of the dam was not analyzed.

Although the dam appears to be stable, the factors of safety are below acceptable values. If the dam were to fail during a storm or under other loading conditions, a significant amount of flooding would occur in downstream residential areas. Furthermore, failure would result in the loss of a public water supply reservoir.

A more detailed analysis is required to accurately evaluate the structural stability of the dam. Two features in its construction would provide stability and have not been taken into account in this analysis. One feature is the cut-off wall shown on the drawings as extending into bedrock under the entire length of the dam and the keying of the base of the dam into the bedrock. The second feature is the arched curvature of the dam which would resist lateral pressures from the reservoir. It is also known that the structure has withstood a reservoir level 4.1 feet above the spillway crest (6.4 feet below the top of the dam) without failure.

There is a lack of data concerning the concrete in the dam, the as-built construction of the cut-off wall, the physical properties of the bedrock, and seepage (uplift) conditions under the dam. Also, the condition of the downstream toe could not be evaluated during the visual inspection. Field investigations are required to obtain more information about the structure. This information should then be incorporated into a more detailed stability analysis. Based on this analysis, a design may be required to correct deficiencies in the stability of the dam.

d. Seismic Stability

This dam is located in Seismic Zone 1. However, a seismic stability analysis was performed in accordance with Corps of Engineer's Guidelines. The analysis is based on an assumed seismic coefficient of 0.10 and the reservoir level at the crest of the spillway. For the spillway section, the safety factor against sliding is 0.57. This low factor of safety further indicates that additional stability studies are needed.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

The Phase I inspection of Potter's Falls Dam revealed that the gunite surface is eroded in three areas on the downstream face and toe. A large bulge was also visible in the gunite on the downstream face as well as hairline cracks in other areas on the dam. Further deterioration will occur if the gunite is not repaired.

Outflows from all storms exceeding 31 percent of the Probable Maximum Flood will overtop the dam. During the one-half PMF, the abutments of the dam would be overtopped by 3.4 feet. The dam is a concrete structure that ties into bedrock at both abutments. However, a preliminary stability analysis of the spillway indicates that the factor of safety is less than 1.0 when the reservoir is at the one-half PMF level. A failure of the dam would increase the degree of flooding in downstream residential areas. Therefore, the spillway is assessed as seriously inadequate.

b. Adequacy of Information

The information which was available for the preparation of this report was limited. Drawings prepared during design of the dam were used for the stability analyses. No as-built drawings or detailed construction data is available.

c. Need for Additional Investigation

Investigation of the materials and as-built construction of the dam is required to conduct a detailed stability analysis. The investigation should develop accurate data on the construction of the cut-off wall, the nature and strength of concrete in the dam, the condition and strength of bedrock under the dam, and the uplift pressures acting on the base of the dam.

Additional hydraulic/hydrologic studies are required to more accurately determine reservoir levels that would occur during the full PMF. These levels are needed to evaluate the stability of the dam under maximum head conditions.

Additional investigation is required to determine the cause and extent of deterioration of the gunite covering the dam. This should include an inspection of the gunite when there is no flow over the spillway.

Evaluate the possibility that seepage is causing the gunite to spall. If this is the case, repairs such as sealing the upstream face or providing internal drainage may be necessary.

d. Urgency

The required investigations should be commenced within three months of the date of notification of the Owner. Within the same time, the gate on the low-level outlet should be exercised and maintained in good operating condition in the future.

Remedial measures deemed necessary as a result of the investigations and repairs required to correct other deficiencies which exist should be completed within 18 months of the date of final approval of this report.

7.2 RECOMMENDED MEASURES

a. After the structural stability analysis has been completed, perform necessary remedial work.
b. After the condition of the gunite has been evaluated, conduct necessary repairs.
c. Visually monitor wet areas at both abutments of the dam. If flowing water or spalling bedrock is evident, conduct an investigation and correct the seepage.
d. Repair the deteriorated concrete on the exterior of the gatehouse and around the water supply pipe downstream of the dam.
e. Clear brush and trees along the upstream face of both abutments of the dam.
f. Develop an emergency action plan for the notification and evacuation of downstream residents.

APPENDIX A

PHOTOGRAPHS

UPSTREAM VIEW OF DAM

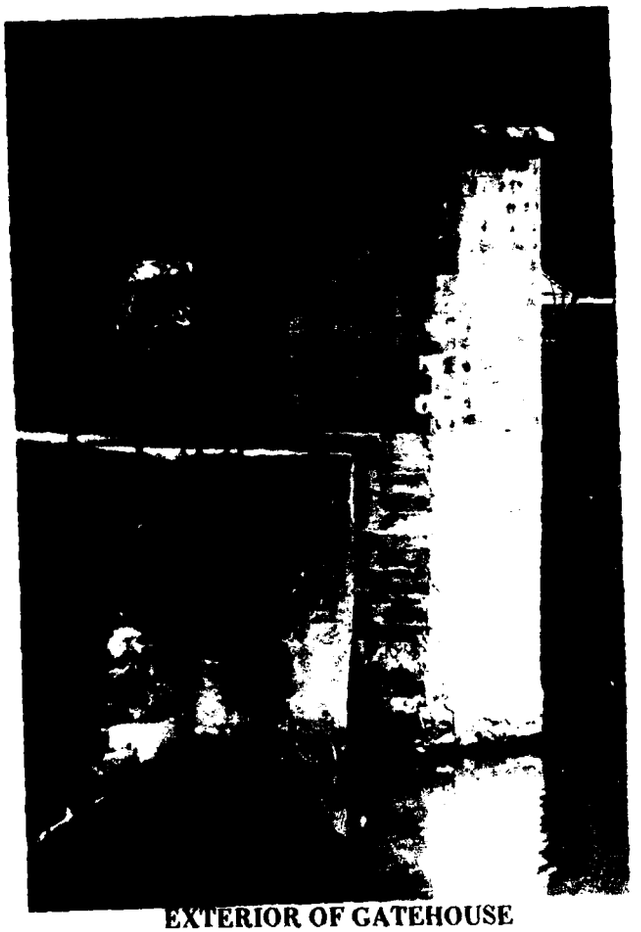
TOP OF DAM, RIGHT ABUTMENT

CREST OF SPILLWAY AND LEFT ABUTMENT

DOWNSTREAM TOE AT LEFT ABUTMENT (NOTE ERODED GUNITE ON DOWNSTREAM FACE BETWEEN OUTLET AND ABUTMENT)

GATEHOUSE AND RIGHT ABUTMENT

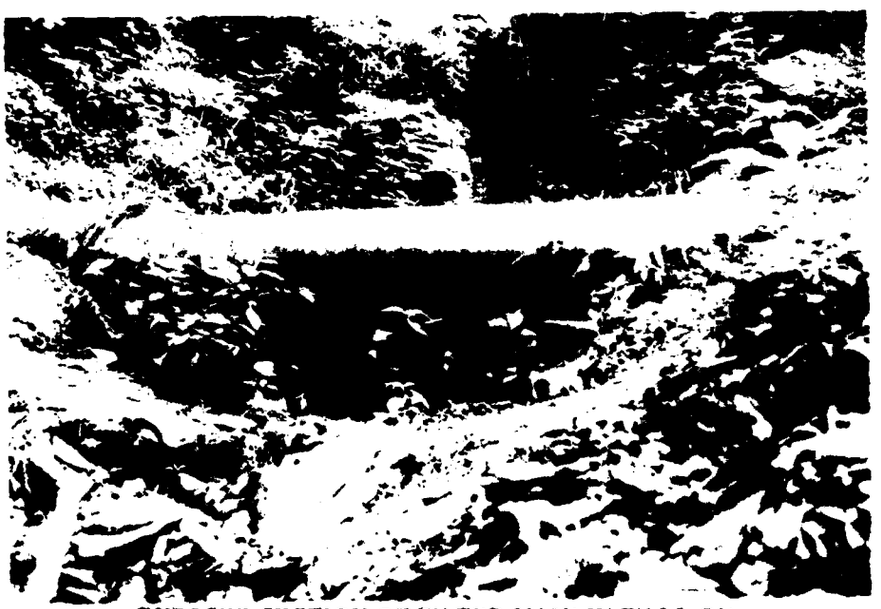
DOWNSTREAM TOE AT RIGHT ABUTMENT (NOTE BULGE ON DOWNSTREAM FACE AND EROSION OF GUNITE AT TOE)



EXTERIOR OF GATEHOUSE

INTERIOR OF GATEHOUSE

ERODED CONCRETE UNDER WATER MAIN IN WALL OF DOWNSTREAM CHANNEL



EXPOSED SECTION OF WATER MAIN IN WALL OF DOWNSTREAM CHANNEL

APPENDIX B

VISUAL INSPECTION CHECKLIST

93-15-3(9/80)

Potter's Falls Dam
NY-378

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Potter's Falls Dam / 60-Foot Dam

Fed. I.D. # NY 378 DEC Dam No. 75A-717

River Basin Oswego

Location: Town Ithaca County Tompkins

Stream Name Sixmile Creek

Tributary of Oswego River

Latitude (N) 42° 25.0' Longitude (W) 76° 27.7'

Type of Dam cyclopean concrete arch-gravity dam covered with gunite

Hazard Category high

Date(s) of Inspection July 8, 1981

Weather Conditions sunny + hot

Reservoir Level at Time of Inspection 705.1

b. Inspection Personnel Reginald Barron, Carol Sweet

c. Persons Contacted (Including Address & Phone No.)

Mr. Philip Cox, City Engineer
City Hall, 108 Green Street
Ithaca, New York 14850
(607) 272-1716

d. History:

Date Constructed 1911 Date(s) Reconstructed 1939-gunite added

Designer unknown

Constructed By unknown

Owner City of Ithaca - Dept. of Public Works - Sewer + Water Div.

2) Embankment

a. Characteristics

(1) Embankment Material cyclopean concrete covered with gunite

(2) Cutoff Type Key wall 10ft. thick into bedrock foundation

(3) Impervious Core concrete

(4) Internal Drainage System none shown on drawings

(5) Miscellaneous

b. Crest

(1) Vertical Alignment flat

(2) Horizontal Alignment curved upstream (arch)

(3) Surface Cracks hairline transverse cracks in gunite (oriented upstream → downstream)

(4) Miscellaneous

c. Upstream Slope

(1) Slope (Estimate) (V:H) vertical

(2) Undesirable Growth or Debris, Animal Burrows brush and a few trees growing along upstream face at both abutments

(3) Sloughing, Subsidence or Depressions none

(4) Slope Protection covered with gunite

(5) Surface Cracks or Movement at Toe some hairline cracks - one long horizontal crack from gatehouse to right abutment

d. Downstream Slope

(1) Slope (Estimate - V:H) battered 1:1.44 (0.7 percent)

(2) Undesirable Growth or Debris, Animal Burrows minor weed growth at right abutment

(3) Sloughing, Subsidence or Depressions eroded gunite: 1) midway down slope at left abutment, 2) between outlet and left abutment, 3) downstream toe at right abutment. Also large bulge in gunite on downstream face near water supply pipe.

(4) Surface Cracks or Movement at Toe not visible due to spillway discharge and tailwater

(5) Seepage wet areas on bedrock at both abutments, but no visible flow

(6) External Drainage System (Ditches, Trenches; Blanket) none

(7) Condition Around Outlet Structure eroded gunite to left of outlet opening

(8) Seepage Beyond Toe not visible - submerged

e. Abutments - Embankment Contact

dam ties into bedrock at both abutments - condition is satisfactory except for minor seepage noted above

93-15-3(9/80)

(1) Erosion at Contact eroded gunite at left abutment, midway on downstream slope

(2) Seepage Along Contact minor seepage (wet areas) at both abutments - bedrock is intact

3) Drainage System

a. Description of System none

b. Condition of System

c. Discharge from Drainage System

4) Instrumentation (Momumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) none

5) Reservoir

a. Slopes steep wooded slopes - shallow bedrock

b. Sedimentation conditions not visible, but siltation has been a problem in the past - Silt Dam built upstream to intercept sediment.

c. Unusual Conditions Which Affect Dam

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) 2.5 miles to downtown Ithaca - little attenuation of flood flow in gorge downstream of dam.

b. Seepage, Unusual Growth none in channel

c. Evidence of Movement Beyond Toe of Dam none visible

d. Condition of Downstream Channel steep bedrock walls, some loose blocks of rock in floor

7) Spillway(s) (Including Discharge Conveyance Channel)

ogee weir near top of dam - discharge flows onto downstream face and into bedrock channel

a. General condition is satisfactory except discharge is contributing to erosion of gunite on downstream face and toe of dam

b. Condition of Service Spillway good - no visible cracks or voids - crest is clear of debris and obstructions

c. Condition of Auxiliary Spillway none

d. Condition of Discharge Conveyance Channel good - shale bedrock on sides and in bottom - some loose rock could be picked up during flood flows

8) Reservoir Drain/Outlet

Type: Pipe ✓ Conduit _____ Other _____

Material: Concrete _____ Metal ✓cast iron Other _____

Size: 72-inch dia. Length 45.5 feet

Invert Elevations: Entrance 647.0 Exit 647.0

Physical Condition (Describe): Unobservable ✓

Material: _____

Joints: _____ Alignment _____

Structural Integrity: _____

Hydraulic Capability: _____

Means of Control: Gate ✓ Valve _____ Uncontrolled _____

Operation: Operable _____ Inoperable _____ Other not operated since 1959

Present Condition (Describe): submerged at the upstream end of the outlet

9) Structural

a. Concrete Surfaces concrete of dam covered with gunite which is eroded in places (see page 3) - also concrete on gatehouse is eroded at water line - concrete is eroded around water pipe downstream of dam

b. Structural Cracking hairline cracks in gunite visible on top and upstream face of dam - also around bulge on downstream face

c. Movement - Horizontal & Vertical Alignment (Settlement) none visible

d. Junctions with Abutments or Embankments generally satisfactory but close inspection not possible due to lack of access

e. Drains - Foundation, Joint, Face no drainage system visible

f. Water Passages, Conduits, Sluices outlet not inspected - visible sections of water supply pipe are in satisfactory condition, no significant corrosion, joints tight

g. Seepage or Leakage minor wet areas on bedrock at both abutments

h. Joints - Construction, etc. none visible

i. Foundation N/A - bedrock

j. Abutments N/A - bedrock

k. Control Gates submerged - not inspected

l. Approach & Outlet Channels N/A - natural channels

m. Energy Dissipators (Plunge Pool, etc.) none

n. Intake Structures none

o. Stability

p. Miscellaneous

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition

Gatehouse - foundation made of poured concrete, superstructure is concrete blocks - concrete on exterior is eroded at water line - minor vertical cracks in superstructure

11) Operation Procedures (Lake Level Regulation):

Reservoir is regulated downstream at water treatment plant.

APPENDIX C

HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS

Potter's Falls Dam
NY 378

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	715.5	47	1290
2) Design High Water (Max. Design Pool)	unKnown		
3) Auxiliary Spillway Crest	N/A		
4) Pool Level with Flashboards	N/A		
5) Service Spillway Crest	705.0	47	800

DISCHARGES

	Volume (cfs)
1) Average Daily	unKnown
2) Spillway @ Maximum High Water	10,450
3) Spillway @ Design High Water	N/A
4) Spillway @ Auxiliary Spillway Crest Elevation	N/A
5) Low Level Outlet (72"ϕ pipe, WS El. 705)	1,044
6) Total (of all facilities) @ Maximum High Water	11,494
7) Maximum Known Flood (reservoir El 709.1)	3,240
8) At Time of Inspection (reservoir El 705.1)	±10

Potter's Falls Dam
NY 378 2

CREST: ELEVATION: 715.5

Type: broad-crested; concrete with gunite surface

Width: 8.5 feet Length: 220 feet

Spillover service spillway

Location center of dam

SPILLWAY:

SERVICE		AUXILIARY
705.0	Elevation	
ungated ogee weir	Type	
100 feet	Width	
	Type of Control	
✓	Uncontrolled	
	Controlled:	
	Type (Flashboards; gate)	
	Number	
	Size/Length	
	Invert Material	
	Anticipated Length of operating service	
N/A	Chute Length	
vertical upstream face of dam	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

93-15-4(9/80)

HYDROMETEROLOGICAL GAGES:

Type : none

Location: _____

Records:

Date - _____

Max. Reading - _____

FLOOD WATER CONTROL SYSTEM:

Warning System: none

_____

Method of Controlled Releases (mechanisms):

72-inch ϕ low-level outlet-gate at upstream end-Inv. El. 647.0

_____

DRAINAGE AREA: 45.6 sq.mi. (29,184 acres)

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: relatively undeveloped w/ open fields, woodland

Terrain - Relief: drainways - flat slopes; hillsides - steep slopes

Surface - Soil: glacial till over shallow bedrock

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

runoff will flow downstream to Sixmile Creek Reservoir

Potential Sedimentation problem areas (natural or man-made; present or future)

sedimentation a problem in the past - Silt Dam built upstream in 1925 to control sedimentation

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

backwater will inundate Silt Dam located about 0.4 mi. upstream of Ithaca Reservoir

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: none

Elevation: _____

Reservoir:

Length @ Maximum Pool ± 0.4 (Miles)

Length of Shoreline (@ Spillway Crest) ± 1.2 (Miles)

Project NV CAFE PH 1 DAM INSP Acct. No. 7594 Page 1 of

Subject POTTER'S FALLS DAM Comptd. By M.Nowak Date 8-20-81

Detail Ck'd. By Date

DRAINAGE AREA = 45.6 SQ MI

Impervious areas include

reservoir surface 47 acres

The ratio of impervious area to total area is

$$\frac{47 \text{ ac} / 640 \text{ ac/sq mi}}{45.6 \text{ sq mi}} = 0.0016$$

WATERSHED PARAMETERS

Snyder Unit Hydrograph

Lag time

$$t_p = C_t (L L_c)^{0.3}$$

where $C_t = 2.0$

$L = 15.92$ mi

$L_c = 6.26$ mi

$$t_p = 2.0 (15.92 \cdot 6.26)^{0.3} = 7.95 \text{ hrs.}$$

Unit rainfall duration

$$t_r = t_p / 5.5$$

$$= 7.95 / 5.5 = 1.45 \text{ hrs}$$

adjusted $t_R = 0.5$ hr

Adjusted lag time

$$t_{pR} = t_p + 0.25 (t_R - t_p)$$

$$= 7.95 + 0.25 (0.5 - 1.45) = 7.71 \text{ hrs}$$

Peaking coefficient, $C_p = 0.6$

Project NY Cafe Pkl Dam Insp Acct. No. 7594 Page 2 of
Subject Potter's Falls Compld. By M. Nowak Date 8-20-81
Detail Ck'd. By Date

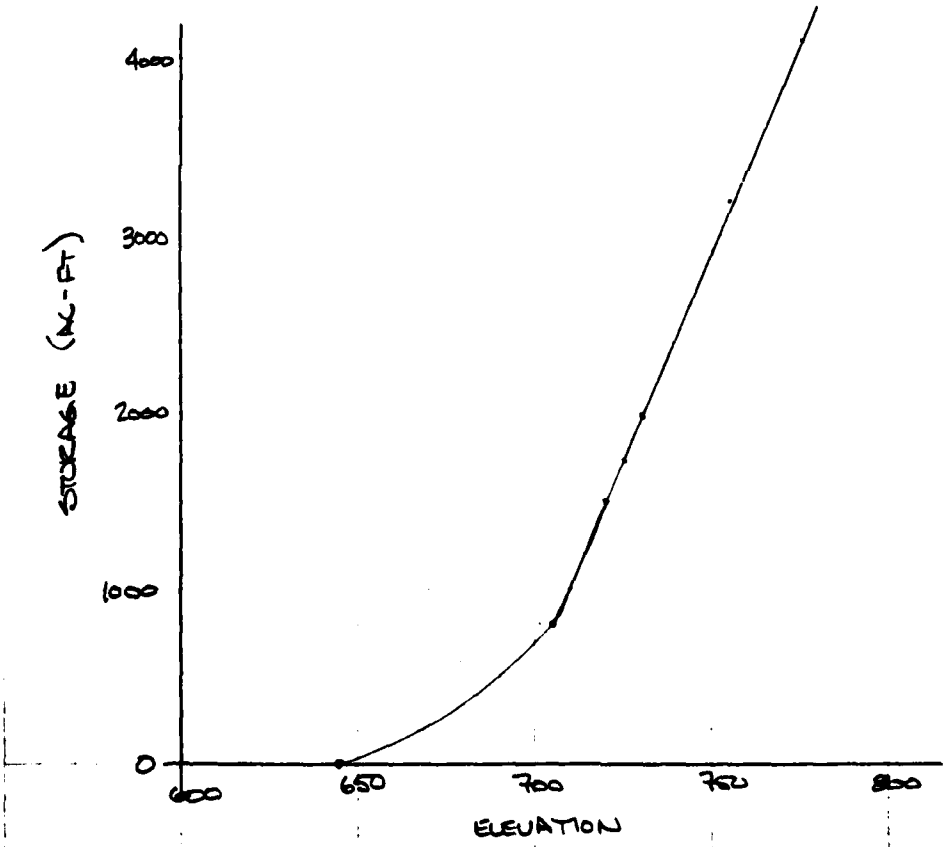
Base Flow

Based on Fall Creek at Ithaca 04234000, average August 1980 flow from 126 SQ Mi is 42.2 cfs
∴ at Ithaca reservoir

$$42.2 \text{ cfs} \left(\frac{45.6 \text{ SQ Mi}}{126 \text{ SQ Mi}} \right) = 15.3 \text{ cfs}$$

Using other dam inspection reports, RTIDR = 1.5 and QRCSN = 15%

Storage - Based on the assumption that the surface area will not significantly increase with changes in pool elevation above the spillway.



Project N.Y. C&E Ph 1 Dam Insp. Acct. No. 7594 Page 3 of
Subject Potter's Falls Comptd. By M. Nowak Date 8-20-81
Detail Ck'd. By Date

SPILLWAY The spillway is a concrete, ogee overflow weir. Discharge can be calculated using the equation

$$Q = CLH^{3/2}$$

where $C = 3.97$ → refer to "Open-Channel Flow" by Henderson.

LOW LEVEL OUTLET

Calculate discharge capacity of 72"ϕ outlet:

Water surface el	705	(spillway crest)
Downstream invert el	647	

Use the energy eqn to determine discharge

$$\frac{p_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + z_2 + h_{L_{1-2}}$$

$$705 = \frac{V_2^2}{2g} + 647 + \frac{V^2}{2g}\Sigma k$$

losses:

entrance	$k = 1.0$
exit	$k = 0.5$

Friction $\frac{\epsilon}{D} = \frac{.01}{6}$ $.0017 \therefore f = .023$

Substituting into eqn

$$58 = \frac{V^2}{2g}\left(1 + 1 + .5 + .023\left(\frac{45.5}{6}\right)\right)$$

$$58 = 2.6\,\frac{Q^2}{2gA^2}$$

$$Q = .62\,A\sqrt{2g(55)}$$

$$Q = .62\,\pi\,(3)^2\,(59.5)$$

$$Q = 1044\ cfs$$

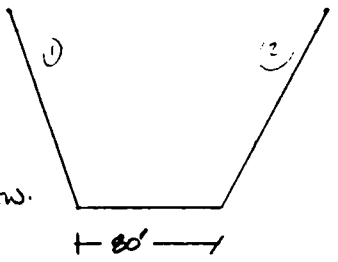
Project NY CoE PH 1 DAM INSP Acct. No. 7594 Page 4 of

Subject POTTER'S FALLS Comptd. By M. Nowak Date 8-20-81

Detail Ck'd. By Date

DISCHARGE - DOWNSTREAM CHANNEL

Channel is most narrow directly downstream of the dam. Calculate the discharge for the tail water elevation.



EL. 700

EL 645

$n = 0.04$

See 'Open Channel Hydraulics' V.T. Chow.

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Where $S = \frac{645-600}{1600} = 0.0281$

ELEV	Y	A	WP	$R^{2/3}$	$\frac{1.49}{n} S^{1/2}$	Q cfs
645	0	~	~	~	~	~
655	10	864	103.8	4.1	6.24	22,100
670	25	2398	139.4	6.7	6.24	100,300
680	35	3580	163.2	7.8	6.24	174,360

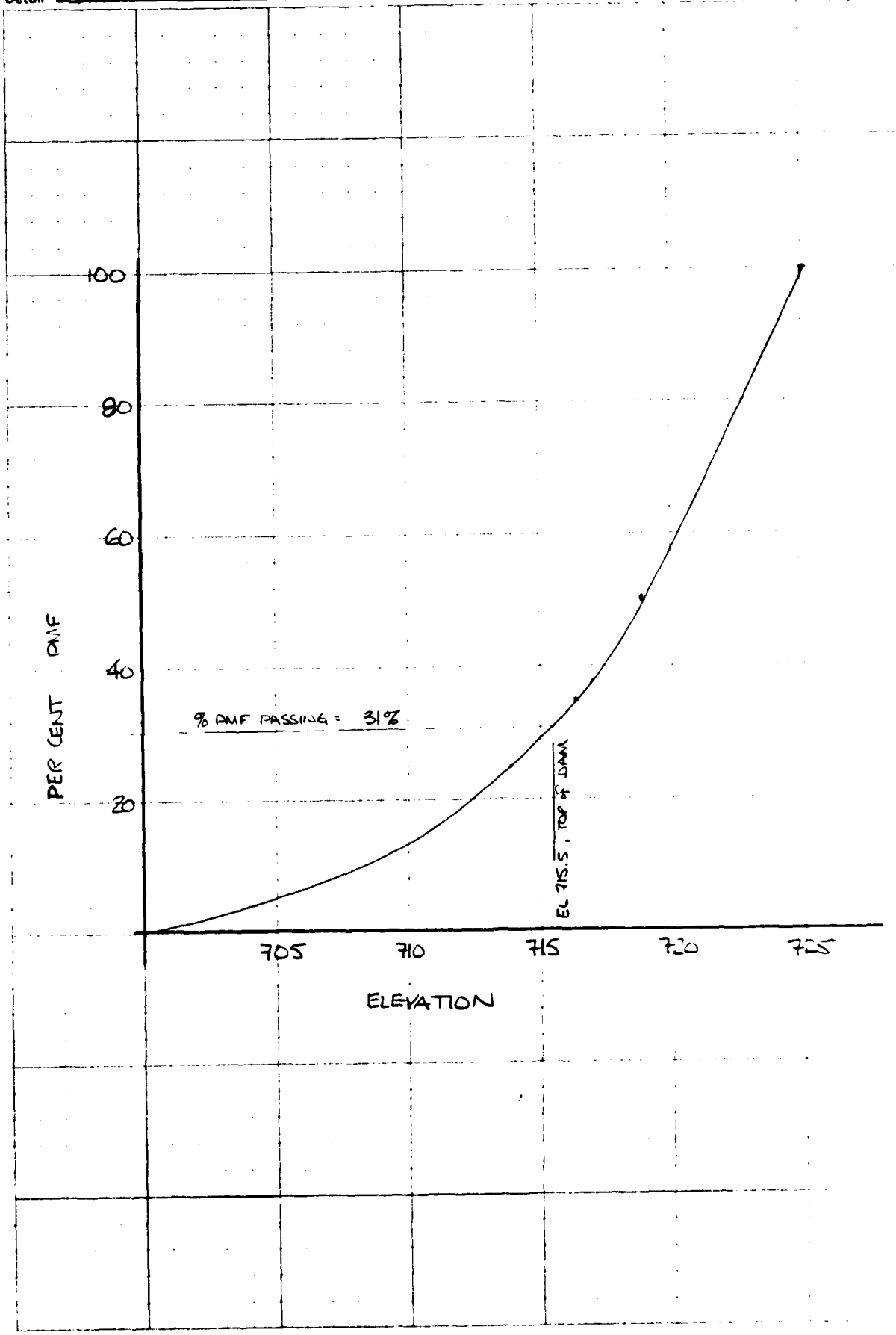
NONREPRODUCIBLE GRID FORM 123

METCALF & EDDY, ENGINEERS

Project NY CoE PH 1 DAM INSP Acct. No. 7594 Page ____ of ____

Subject POTTER'S FALLS DAM Compld. By M. NOWAK Date 8-25-81

Detail % PMF PASSING Ck'd. By ____ Date ____



```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  25 SEP 78
**********
```

1	A			NEW YORK C. OF E. PHASE 1 DAM INSPECTION								
2	A			POTTERS FALLS DAM - ITHICA RESERVOIR								
3	A			FULL AND HALF PMF FLOOD ANALYSIS								
4	B	100	0	30	0	0	0	0	0	0	0	
5	B1	5	0									
6	J	1	4	1								
7	J1	.25	.35	0.5	1.0							
8	K	0	1			0	0	1	0			
9	K1			INFLOW HYDROGRAPH								
10	M	1	1	45.6		0	0			1		
11	P	0	21	93	106	117	124					
12	T							1.0	0.1		0.002	
13	W	7.7	0.6									
14	X	15	-.15	1.5								
15	K	1	1			0	0	1	0			
16	K1			ROUTED HYDROGRAPH AT DAM NO BREACH								
17	Y				1	1						
18	Y1	20						-705.0	1			
19	SS	0	800	1035	1270	1505	1740	1975	4090			
20	SE	645	705	710	715	720	725	730	800			
21	SS	705.0	100	3.97	1.5	650.0	0.62	28.3	0.5			
22	SR	10	10	10								
23	SF	1	0	5	645	240	0	0.5	705.0			
24	ST	645	655	670	680							
25	SW	0	22100	100300	174360							
26	SD	715.5	2.7	1.5	120							
27	K	99										

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 1
END OF NETWORK

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  25 SEP 78
**********

RUN  DATE:25 AUG 1981
```

NEW YORK C. OF E. PHASE 1 DAM INSPECTION
POTTERS FALLS DAM - ITHICA RESERVOIR
FULL AND HALF PMF FLOOD ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	30	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1

RTIOS= 0.25 0.35 0.50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	45.60	0.0	45.60	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	21.00	93.00	106.00	117.00	124.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.847

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.10	0.0	0.00

UNIT HYDROGRAPH DATA
TP= 7.70 CP=0.60 NTA= 0

RECESSION DATA
STRTQ= 15.00 QRCSN= -0.15 RTIOR= 1.50

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=16.50 AND R=15.38 INTERVALS

UNIT HYDROGRAPH 91 END-OF-PERIOD ORDINATES, LAG= 7.66 HOURS, CP= 0.60 VOL= 1.00

39.	147.	302.	485.	688.	906.	1136.	1374.	1613.	1832.
2015.	2163.	2275.	2350.	2387.	2377.	2299.	2169.	2032.	1904.
1784.	1672.	1566.	1468.	1375.	1289.	1208.	1132.	1060.	994.

931.	872.	817.	766.	718.	672.	630.	590.	553.	518.
486.	455.	427.	400.	374.	351.	329.	308.	289.	271.
253.	238.	223.	209.	195.	183.	172.	161.	151.	141.

132. 124. 116. 109. 102. 96. 90. 84. 79. 74.
69. 65. 61. 57. 53. 50. 47. 44. 41. 38.
36. 34. 32. 30. 28. 26. 24. 23. 21. 20.
19.

O NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	0.30	1	0.00	0.00	0.00	14.	1.02	1.30	51	0.07	0.02	0.05	74.
1.01	1.00	2	0.00	0.00	0.00	14.	1.02	2.00	52	0.07	0.02	0.05	78.
1.01	1.30	3	0.00	0.00	0.00	13.	1.02	2.30	53	0.07	0.02	0.05	84.
1.01	2.00	4	0.00	0.00	0.00	13.	1.02	3.00	54	0.07	0.02	0.05	95.
1.01	2.30	5	0.00	0.00	0.00	12.	1.02	3.30	55	0.07	0.02	0.05	109.
1.01	3.00	6	0.00	0.00	0.00	12.	1.02	4.00	56	0.07	0.02	0.05	127.
1.01	3.30	7	0.00	0.00	0.00	11.	1.02	4.30	57	0.07	0.02	0.05	148.
1.01	4.00	8	0.00	0.00	0.00	11.	1.02	5.00	58	0.07	0.02	0.05	174.
1.01	4.30	9	0.00	0.00	0.00	10.	1.02	5.30	59	0.07	0.02	0.05	202.
1.01	5.00	10	0.00	0.00	0.00	10.	1.02	6.00	60	0.07	0.02	0.05	232.
1.01	5.30	11	0.00	0.00	0.00	10.	1.02	6.30	61	0.19	0.14	0.05	270.
1.01	6.00	12	0.00	0.00	0.00	9.	1.02	7.00	62	0.19	0.14	0.05	323.
1.01	6.30	13	0.01	0.00	0.01	9.	1.02	7.30	63	0.19	0.14	0.05	396.
1.01	7.00	14	0.01	0.00	0.01	9.	1.02	8.00	64	0.19	0.14	0.05	492.
1.01	7.30	15	0.01	0.00	0.01	8.	1.02	8.30	65	0.19	0.14	0.05	613.
1.01	8.00	16	0.01	0.00	0.01	8.	1.02	9.00	66	0.19	0.14	0.05	760.
1.01	8.30	17	0.01	0.00	0.01	8.	1.02	9.30	67	0.19	0.14	0.05	934.
1.01	9.00	18	0.01	0.00	0.01	7.	1.02	10.00	68	0.19	0.14	0.05	1137.
1.01	9.30	19	0.01	0.00	0.01	7.	1.02	10.30	69	0.19	0.14	0.05	1369.
1.01	10.00	20	0.01	0.00	0.01	7.	1.02	11.00	70	0.19	0.14	0.05	1627.
1.01	10.30	21	0.01	0.00	0.01	7.	1.02	11.30	71	0.19	0.14	0.05	1907.
1.01	11.00	22	0.01	0.00	0.01	7.	1.02	12.00	72	0.19	0.14	0.05	2208.
1.01	11.30	23	0.01	0.00	0.01	6.	1.02	12.30	73	0.83	0.78	0.05	2539.
1.01	12.00	24	0.01	0.00	0.01	6.	1.02	13.00	74	0.83	0.78	0.05	2950.
1.01	12.30	25	0.05	0.00	0.05	6.	1.02	13.30	75	0.99	0.94	0.05	3470.
1.01	13.00	26	0.05	0.00	0.05	6.	1.02	14.00	76	0.99	0.94	0.05	4122.
1.01	13.30	27	0.06	0.00	0.06	6.	1.02	14.30	77	1.24	1.19	0.05	4926.
1.01	14.00	28	0.06	0.00	0.06	6.	1.02	15.00	78	1.24	1.19	0.05	5909.
1.01	14.30	29	0.07	0.00	0.07	5.	1.02	15.30	79	1.51	1.46	0.05	7102.
1.01	15.00	30	0.07	0.00	0.07	5.	1.02	16.00	80	4.78	4.73	0.05	8667.
1.01	15.30	31	0.09	0.00	0.09	5.	1.02	16.30	81	1.16	1.11	0.05	10709.
1.01	16.00	32	0.29	0.00	0.29	5.	1.02	17.00	82	1.16	1.11	0.05	13132.
1.01	16.30	33	0.07	0.00	0.07	5.	1.02	17.30	83	0.91	0.86	0.05	15837.
1.01	17.00	34	0.07	0.02	0.05	6.	1.02	18.00	84	0.91	0.86	0.05	18751.
1.01	17.30	35	0.05	0.00	0.05	9.	1.02	18.30	85	0.10	0.05	0.05	21783.
1.01	18.00	36	0.05	0.00	0.05	12.	1.02	19.00	86	0.10	0.05	0.05	24821.
1.01	18.30	37	0.01	0.00	0.01	17.	1.02	19.30	87	0.10	0.05	0.05	27771.
1.01	19.00	38	0.01	0.00	0.01	23.	1.02	20.00	88	0.10	0.05	0.05	30528.
1.01	19.30	39	0.01	0.00	0.01	29.	1.02	20.30	89	0.10	0.05	0.05	32937.
1.01	20.00	40	0.01	0.00	0.01	35.	1.02	21.00	90	0.10	0.05	0.05	34882.
1.01	20.30	41	0.01	0.00	0.01	41.	1.02	21.30	91	0.10	0.05	0.05	36331.
1.01	21.00	42	0.01	0.00	0.01	48.	1.02	22.00	92	0.10	0.05	0.05	37272.
1.01	21.30	43	0.01	0.00	0.01	54.	1.02	22.30	93	0.10	0.05	0.05	37698.
1.01	22.00	44	0.01	0.00	0.01	60.	1.02	23.00	94	0.10	0.05	0.05	37621.
1.01	22.30	45	0.01	0.00	0.01	64.	1.02	23.30	95	0.10	0.05	0.05	37058.
1.01	23.00	46	0.01	0.00	0.01	67.	1.03	0.0	96	0.10	0.05	0.05	35983.
1.01	23.30	47	0.01	0.00	0.01	70.	1.03	0.30	97	0.0	0.0	0.0	34511.
1.02	0.0	48	0.01	0.00	0.01	71.	1.03	1.00	98	0.0	0.0	0.0	32863.
1.02	0.30	49	0.07	0.02	0.05	72.	1.03	1.30	99	0.0	0.0	0.0	31144.
1.02	1.00	50	0.07	0.02	0.05	72.	1.03	2.00	100	0.0	0.0	0.0	29405.
									SUM	22.06	18.45	3.61	635104.

(560.)(469.)(92.)(17984.17)

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

CFS	37698.	34856.	12901.	6204.	620394.
CMS	1067.	987.	365.	176.	17568.
INCHES		7.11	10.53	10.55	10.55
HR		180.61	267.39	267.88	267.88
AC-FT		17284.	25589.	25636.	25636.
THOUS CU M		21319.	31564.	31622.	31622.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

4.	3.	3.	3.	3.	3.	3.	3.	3.	3.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	2.	3.	4.	6.	7.	9.
10.	12.	14.	15.	16.	17.	17.	18.	18.	18.
19.	19.	21.	24.	27.	32.	37.	43.	50.	58.
67.	81.	99.	123.	153.	190.	234.	284.	342.	407.
477.	551.	635.	738.	868.	1030.	1232.	1477.	1775.	2167.
2677.	3283.	3959.	4688.	5446.	6205.	6943.	7632.	8234.	8720.
9083.	9318.	9425.	9405.	9265.	8996.	8628.	8216.	7786.	7351.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9425.	8714.	3225.	1551.	155098.
CMS	267.	247.	91.	44.	4392.
INCHES		1.78	2.63	2.64	2.64
HR		45.15	66.85	66.97	66.97
AC-FT		4321.	6397.	6409.	6409.
THOUS CU M		5330.	7891.	7905.	7905.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

5.	5.	5.	4.	4.	4.	4.	4.	4.	4.
3.	3.	3.	3.	3.	3.	3.	3.	3.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	4.	6.	8.	10.	12.
14.	17.	19.	21.	22.	24.	24.	25.	25.	25.
26.	27.	30.	33.	38.	44.	52.	61.	71.	81.
94.	113.	138.	172.	215.	266.	327.	398.	479.	569.
667.	771.	888.	1033.	1215.	1443.	1724.	2068.	2486.	3033.
3748.	4596.	5543.	6563.	7624.	8687.	9720.	10685.	11528.	12209.
12716.	13045.	13194.	13167.	12970.	12594.	12079.	11502.	10900.	10292.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13194.	12199.	4515.	2171.	217138.
CMS	374.	345.	128.	61.	6149.
INCHES		2.49	3.68	3.69	3.69
HR		63.21	93.59	93.76	93.76
AC-FT		6049.	8956.	8973.	8973.
THOUS CU M		7462.	11047.	11068.	11068.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

7.	7.	7.	6.	6.	6.	6.	5.	5.	5.
5.	5.	4.	4.	4.	4.	4.	4.	4.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	4.	6.	9.	11.	14.	17.
21.	24.	27.	30.	32.	34.	35.	36.	36.	36.
37.	39.	42.	47.	54.	63.	74.	87.	101.	116.

135.	161.	198.	246.	307.	380.	467.	569.	685.	813.
953.	1102.	1269.	1475.	1735.	2061.	2463.	2955.	3551.	4333.
5354.	6566.	7918.	9375.	10891.	12411.	13885.	15264.	16468.	17441.

18166.	18636.	18849.	18811.	18529.	17991.	17255.	16431.	15572.	14703.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	18849.	17428.	6451.	3102.	310197.
CMS	534.	493.	183.	88.	8784.
INCHES		3.56	5.26	5.27	5.27
MM		90.30	133.70	133.94	133.94
AC-FT		8642.	12795.	12818.	12818.
THOUS CU M		10660.	15782.	15811.	15811.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

14.	14.	13.	13.	12.	12.	11.	11.	10.	10.
10.	9.	9.	9.	8.	8.	8.	7.	7.	7.
7.	7.	6.	6.	6.	6.	6.	6.	5.	5.
5.	5.	5.	6.	9.	12.	17.	23.	29.	35.
41.	48.	54.	60.	64.	67.	70.	71.	72.	72.
74.	78.	84.	95.	109.	127.	148.	174.	202.	232.
270.	323.	396.	492.	613.	760.	934.	1137.	1369.	1627.
1907.	2204.	2539.	2950.	3470.	4122.	4926.	5909.	7102.	8667.
10709.	13132.	15837.	18751.	21783.	24821.	27771.	30528.	32937.	34882.
36331.	37272.	37698.	37621.	37058.	35983.	34511.	32863.	31144.	29405.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	37698.	34856.	12901.	6204.	620394.
CMS	1067.	987.	365.	176.	17568.
INCHES		7.11	10.53	10.55	10.55
MM		180.61	267.39	267.88	267.88
AC-FT		17284.	25569.	25636.	25636.
THOUS CU M		21319.	31564.	31622.	31622.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED HYDROGRAPH AT DAM NO BREACH

ISTAQ	ICONP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPRP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
20	0	0	0.0	0.0	0.0	-705.	1

CAPACITY=	0.	800.	1035.	1270.	1505.	1740.	1975.	4090.
ELEVATION=	645.	705.	710.	715.	720.	725.	730.	800.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
705.0	100.0	4.0	1.5	650.0	0.6	28.3	0.5

IABCOA	ISPCTN	SS	NGATES	DESHD	APEL	APWID	APLOSS	PDPTH	ELTSUR
10	10	0.0	0.	5.0	645.0	240.0	0.0	0.5	705.0

	705.00	800.	0.	0.0	0.	1044.	0.0	1044.	1044.	1044.							
	710.00	1035.	3419.	648.3	3419.	1090.	645.5	1090.	4509.	4509.							
	715.00	1270.	9572.	651.7	9572.	1135.	645.5	1135.	10707.	10707.							

720.00	1505.	17406.	655.0	17406.	1177.	645.5	1177.	18583.	18583.
725.00	1740.	26522.	658.3	26522.	1219.	645.6	1219.	27741.	27741.
730.00	1975.	36680.	661.7	36680.	1259.	645.6	1259.	37938.	37938.
800.00	4090.	231665.	708.4	231665.	1723.	645.8	1723.	233389.	233389.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
715.5	2.7	1.5	120.

STATION 1, PLAN 1, RATIO 1

ITERATIVE SOLUTION DID NOT CONVERGE 52 1 0.0 6.500D+02 -5.345D+01 6.501D+02 8.794D+01

ITERATIVE SOLUTION DID NOT CONVERGE 54 1 0.0 6.500D+02 -5.341D+01 6.501D+02 8.787D+01

ITERATIVE SOLUTION DID NOT CONVERGE 61 1 0.0 6.500D+02 5.274D+01 6.500D+02 -8.612D+01

CONVERGENCE DOES NOT OCCUR WHEN RESERVOIR RUNS OUT OF WATER (DUE TO LOW LEVEL OUTLET)

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

989.	937.	888.	842.	798.	756.	717.	679.	644.	610.
578.	548.	519.	492.	466.	442.	419.	397.	376.	357.
338.	320.	304.	288.	273.	258.	245.	232.	220.	209.
198.	187.	178.	168.	160.	151.	144.	136.	130.	123.
117.	112.	106.	102.	97.	93.	89.	87.	0.	0.
0.	88.	0.	88.	0.	87.	0.	87.	0.	87.
0.	88.	88.	89.	92.	96.	102.	110.	121.	134.
150.	169.	192.	218.	248.	285.	329.	383.	448.	528.
628.	751.	902.	1381.	3102.	4374.	5857.	6866.	7619.	8224.
8702.	9054.	9278.	9375.	9347.	9194.	8924.	8570.	8168.	7745.

STORAGE

758.	718.	681.	645.	612.	580.	549.	521.	493.	468.
443.	420.	398.	377.	357.	339.	321.	304.	288.	273.
259.	246.	233.	221.	209.	198.	188.	178.	169.	160.
152.	144.	136.	129.	122.	116.	110.	105.	99.	94.
90.	86.	82.	78.	74.	71.	68.	67.	66.	66.
67.	67.	66.	67.	67.	67.	66.	67.	67.	67.
66.	67.	67.	68.	70.	73.	78.	84.	93.	103.
115.	130.	147.	167.	190.	219.	253.	294.	344.	405.
481.	576.	691.	823.	940.	1026.	1086.	1124.	1153.	1176.
1194.	1207.	1216.	1219.	1218.	1213.	1202.	1189.	1174.	1158.

STAGE

701.9	698.9	696.1	693.4	690.9	688.5	686.2	684.0	682.0	680.1
678.2	676.5	674.8	673.3	671.8	670.4	669.1	667.8	666.6	665.5
664.4	663.4	662.5	661.5	660.7	659.9	659.1	658.3	657.7	657.0
656.4	655.8	655.2	654.7	654.2	653.7	653.3	652.8	652.4	652.1
651.7	651.4	651.1	650.8	650.6	650.3	650.1	650.0	649.9	650.0
650.0	650.1	650.0	650.1	650.0	650.0	650.0	650.0	650.0	650.0
650.0	650.0	650.1	650.1	650.3	650.5	650.9	651.3	651.9	652.7
653.6	654.7	656.0	657.5	659.3	661.4	663.9	667.0	670.8	675.4
681.1	688.2	696.9	705.5	708.0	709.8	711.1	711.9	712.5	713.0
713.4	713.7	713.8	713.9	713.9	713.8	713.6	713.3	713.0	712.6

PEAK OUTFLOW IS 9375. AT TIME 47.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9375.	8647.	2676.	1455.	145520.
CMS	265.	245.	76.	41.	4121.
INCHES		1.76	2.18	2.47	2.47
MM		44.80	55.47	62.83	62.83
AC-FT		4288.	5308.	6013.	6013.
THOUS CU M		5289.	6547.	7417.	7417.

STATION 1, PLAN 1, RATIO 2

ITERATIVE SOLUTION DID NOT CONVERGE	50	1	0.0	6.500D+02	-5.359D+01	6.501D+02	8.816D+01
ITERATIVE SOLUTION DID NOT CONVERGE	55	1	0.0	6.500D+02	5.399D+01	6.499D+02	-8.594D+01
ITERATIVE SOLUTION DID NOT CONVERGE	56	1	0.0	6.500D+02	-5.359D+01	6.501D+02	8.816D+01
ITERATIVE SOLUTION DID NOT CONVERGE	57	1	0.0	6.500D+02	5.406D+01	6.499D+02	-8.606D+01
ITERATIVE SOLUTION DID NOT CONVERGE	59	1	0.0	6.500D+02	5.399D+01	6.499D+02	-8.595D+01

CONVERGENCE DOES NOT OCCUR WHEN RESERVOIR IS WITHOUT WATER (DUE TO LOW LEVEL OUTLET)

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

989.	937.	888.	842.	798.	756.	717.	680.	644.	610.
579.	548.	520.	493.	467.	443.	419.	398.	377.	357.
339.	321.	304.	288.	273.	259.	246.	233.	221.	209.
198.	188.	178.	169.	160.	152.	144.	137.	130.	124.
118.	113.	108.	103.	99.	95.	91.	88.	0.	88.
0.	0.	87.	0.	0.	88.	0.	87.	0.	88.
88.	89.	90.	94.	99.	107.	116.	129.	146.	166.
189.	217.	249.	287.	331.	383.	446.	522.	614.	727.
867.	1040.	2894.	4370.	6220.	7586.	8727.	9768.	10713.	11665.
12377.	12842.	13102.	13176.	13075.	12801.	12372.	11849.	11301.	10724.

STORAGE

758.	719.	681.	646.	612.	580.	550.	521.	494.	468.
444.	420.	398.	378.	358.	339.	322.	305.	289.	274.
260.	246.	233.	221.	210.	199.	188.	178.	169.	160.
152.	144.	137.	130.	123.	117.	111.	105.	100.	95.
91.	87.	83.	79.	76.	73.	70.	67.	67.	68.
67.	67.	67.	66.	66.	68.	66.	67.	66.	67.
67.	68.	69.	72.	76.	82.	89.	99.	112.	127.
145.	166.	191.	220.	253.	294.	342.	400.	471.	557.
664.	797.	926.	1026.	1100.	1152.	1195.	1234.	1270.	1298.
1317.	1328.	1334.	1336.	1333.	1327.	1316.	1303.	1288.	1271.

STAGE

701.9	698.9	696.1	693.4	690.9	688.5	686.2	684.1	682.0	680.1
678.3	676.5	674.9	673.3	671.8	670.4	669.1	667.9	666.7	665.5
664.5	663.5	662.5	661.6	660.7	659.9	659.1	658.4	657.7	657.0
656.4	655.8	655.2	654.7	654.2	653.7	653.3	652.9	652.5	652.1
651.8	651.5	651.2	650.9	650.7	650.5	650.3	650.0	650.0	650.1
650.0	650.0	650.0	650.0	649.9	650.1	649.9	650.0	649.9	650.0

650.0	650.1	650.2	650.4	650.7	651.1	651.7	652.4	653.4	654.5
655.9	657.5	659.3	661.5	664.0	667.0	670.6	675.0	680.3	686.8
694.8	704.8	707.7	709.8	711.4	712.5	713.4	714.2	715.0	715.6

716.0 716.2 716.4 716.4 716.3 716.2 716.0 715.7 715.4 715.0

PEAK OUTFLOW IS 13176. AT TIME 47.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13176.	12127.	3907.	2047.	204691.
CMS	373.	343.	111.	58.	5796.
INCHES		2.47	3.19	3.48	3.48
MM		62.83	80.98	88.38	88.38
AC-FT		6013.	7750.	8458.	8458.
THOUS CU M		7417.	9559.	10433.	10433.

STATION 1, PLAN 1, RATIO 3

ITERATIVE SOLUTION DID NOT CONVERGE 50 1 0.0 6.500D+02 5.274D+01 6.500D+02 -8.612D+01

ITERATIVE SOLUTION DID NOT CONVERGE 51 1 0.0 6.500D+02 -5.355D+01 6.501D+02 8.809D+01

DUE TO LOW LEVEL OUTLET RESERVOIR DRAINED COMPLETELY AT T: 50.5L

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

989.	938.	889.	842.	799.	757.	718.	680.	645.	611.
579.	549.	521.	494.	468.	443.	420.	399.	378.	358.
340.	322.	305.	289.	274.	260.	247.	234.	222.	210.
199.	189.	179.	170.	161.	153.	145.	138.	132.	126.
120.	115.	110.	106.	102.	98.	95.	92.	89.	0.
88.	87.	0.	87.	0.	88.	87.	87.	87.	89.
91.	94.	98.	105.	114.	126.	141.	161.	185.	215.
250.	291.	338.	392.	456.	532.	622.	732.	864.	1026.
2668.	4206.	6193.	7924.	9483.	11061.	12894.	14504.	15853.	16966.
17823.	18420.	18755.	18833.	18663.	18246.	17605.	16827.	15993.	15140.

STORAGE

758.	719.	681.	646.	612.	580.	550.	521.	494.	469.
444.	421.	399.	378.	359.	340.	322.	306.	290.	275.
260.	247.	234.	222.	210.	199.	189.	179.	170.	161.
153.	145.	137.	130.	124.	117.	111.	106.	101.	96.
92.	88.	84.	81.	78.	75.	73.	70.	68.	66.
68.	67.	67.	67.	67.	67.	67.	67.	67.	68.
69.	72.	75.	80.	87.	96.	108.	123.	142.	165.
192.	223.	259.	301.	349.	407.	477.	561.	662.	786.
910.	1014.	1099.	1164.	1224.	1281.	1329.	1365.	1394.	1416.
1433.	1444.	1451.	1452.	1449.	1441.	1429.	1413.	1396.	1379.

STAGE

701.9	698.9	696.1	693.4	690.9	688.5	686.3	684.1	682.1	680.1
678.3	676.6	674.9	673.4	671.9	670.5	669.2	667.9	666.7	665.6
664.5	663.5	662.5	661.6	660.8	660.0	659.2	658.4	657.7	657.1
656.5	655.9	655.3	654.8	654.3	653.8	653.4	652.9	652.6	652.2
651.9	651.6	651.3	651.1	650.9	650.7	650.5	650.3	650.1	650.0
650.1	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.1
650.2	650.4	650.6	651.0	651.5	652.2	653.1	654.3	655.7	657.4
659.4	661.7	664.4	667.5	671.2	675.6	680.8	687.1	694.7	704.0
707.3	709.6	711.4	712.8	714.0	715.2	716.3	717.0	717.6	718.1
718.5	718.7	718.8	718.9	718.8	718.6	718.4	718.0	717.7	717.3

PEAK OUTFLOW IS 18833. AT TIME 47.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	18833.	17400.	5789.	2952.	295221.
CMS	533.	493.	164.	84.	8360.
INCHES		3.55	4.72	5.02	5.02
MM		90.16	119.99	127.48	127.48
AC-FT		8628.	11483.	12199.	12199.
THOUS CU M		10643.	14164.	15048.	15048.

STATION 1, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

990.	938.	890.	844.	800.	759.	720.	682.	647.	614.
582.	552.	523.	496.	471.	447.	424.	402.	381.	361.
343.	325.	308.	293.	277.	263.	250.	237.	225.	213.
202.	192.	182.	173.	164.	156.	149.	142.	136.	130.
126.	121.	118.	114.	112.	109.	107.	105.	103.	102.
100.	99.	98.	98.	98.	99.	101.	104.	108.	114.
121.	131.	143.	158.	179.	206.	239.	281.	332.	393.
465.	549.	645.	755.	884.	1037.	2609.	3921.	5444.	7165.
8945.	11098.	14177.	17290.	20387.	23583.	26664.	29525.	32094.	34228.
35856.	36977.	37589.	37675.	37267.	36380.	35039.	33447.	31756.	30031.

STORAGE

759.	719.	682.	647.	613.	582.	552.	523.	496.	470.
446.	423.	401.	381.	361.	342.	325.	308.	292.	277.
263.	249.	236.	224.	213.	202.	191.	182.	172.	163.
155.	147.	140.	133.	126.	120.	114.	109.	104.	100.
96.	93.	90.	88.	86.	84.	82.	81.	79.	78.
77.	76.	75.	75.	75.	76.	77.	80.	83.	88.
93.	100.	109.	121.	137.	158.	183.	216.	255.	302.
357.	421.	494.	579.	677.	795.	906.	995.	1070.	1136.
1203.	1282.	1358.	1422.	1481.	1536.	1584.	1628.	1666.	1697.
1721.	1736.	1745.	1746.	1741.	1728.	1709.	1686.	1661.	1636.

STAGE

701.9	699.0	696.2	693.5	691.0	688.6	686.4	684.2	682.2	680.3
678.5	676.7	675.1	673.5	672.1	670.7	669.3	668.1	666.9	665.8
664.7	663.7	662.7	661.8	661.0	660.1	659.4	658.6	657.9	657.3
656.6	656.0	655.5	654.9	654.4	654.0	653.6	653.2	652.8	652.5
652.2	652.0	651.8	651.6	651.4	651.3	651.2	651.1	650.9	650.9
650.8	650.7	650.6	650.6	650.6	650.7	650.8	651.0	651.2	651.6
652.0	652.5	653.2	654.1	655.3	656.8	658.8	661.2	664.1	667.6
671.8	676.6	682.1	688.4	695.8	704.6	707.3	709.2	710.8	712.1
713.6	715.2	716.9	718.2	719.5	720.7	721.7	722.6	723.4	724.1
724.6	724.9	725.1	725.1	725.0	724.7	724.3	723.8	723.3	722.8

PEAK OUTFLOW IS 37675. AT TIME 47.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	37675.	34840.	12115.	5992.	599171.
CMS	1067.	987.	343.	170.	16967.
INCHES		7.11	9.89	10.19	10.19
MM		180.53	251.10	258.72	258.72
AC-FT		17276.	24030.	24759.	24759.

THOUS CU M	21310.	29640.	30540.	30540.	

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 0.25	RATIO 2 0.35	RATIO 3 0.50	RATIO 4 1.00
HYDROGRAPH AT	1	45.60	1	9425.	13194.	18849.	37698.
		(118.10)		(266.87)(	373.62)(	533.75)(	1067.49)(
ROUTED TO	1	45.60	1	9375.	13176.	18833.	37675.
		(118.10)		(265.46)(	373.11)(	533.29)(	1066.84)(

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	705.00	705.00	715.50
STORAGE	800.	800.	1293.
OUTFLOW	1044.	1044.	11494.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.25	713.93	0.0	1219.	9375.	0.0	47.00	0.0
0.35	716.39	0.89	1336.	13176.	4.50	47.00	0.0
0.50	718.88	3.38	1452.	18833.	7.00	47.00	0.0
1.00	725.13	9.63	1746.	37675.	9.00	47.00	0.0

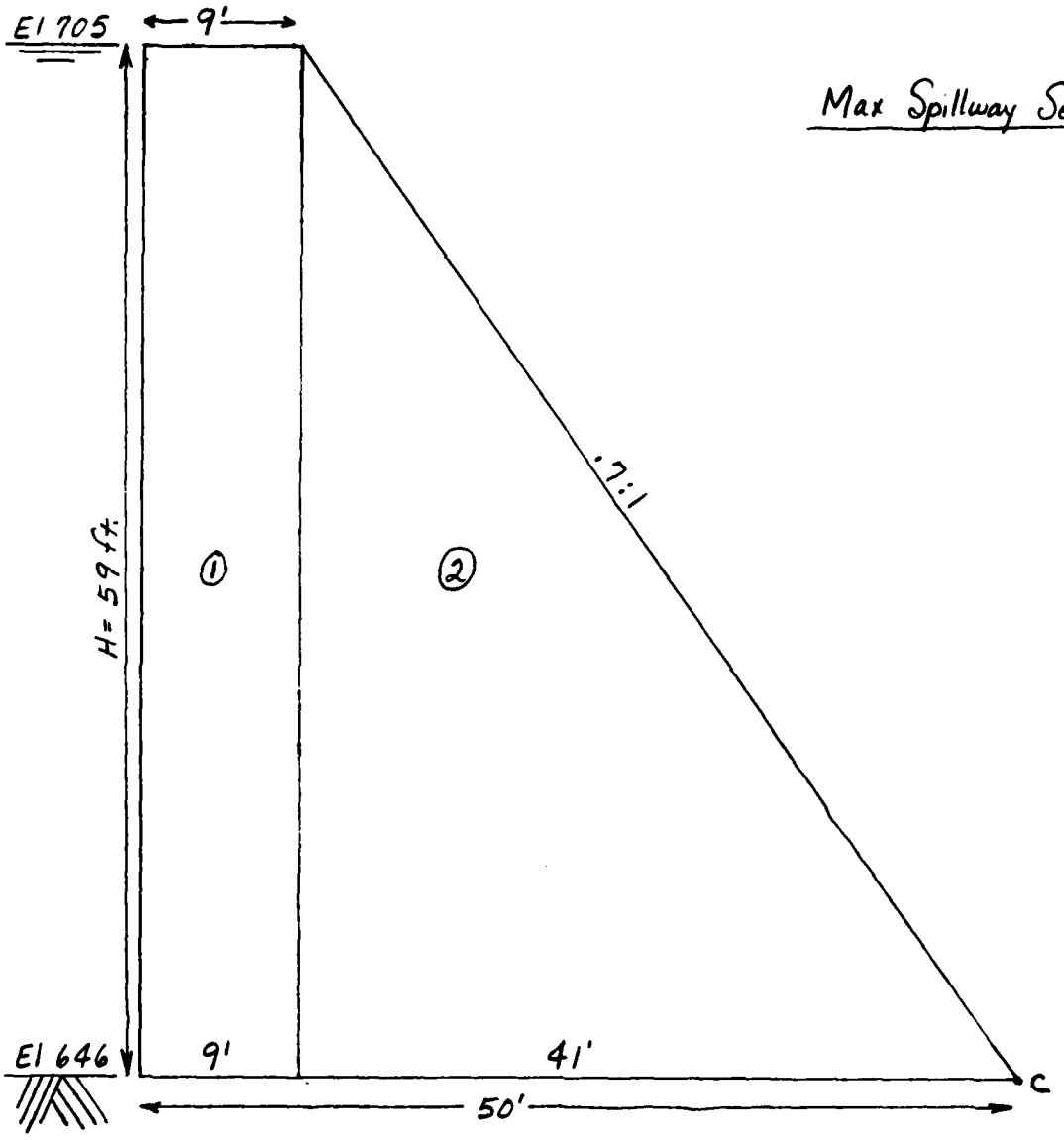
APPENDIX D

STRUCTURAL STABILITY

Project Phase I - N.Y. Acct. No. 7594 Page 1 of 5

Subject Potters Falls Dam Comptd. By CMG Date 7/29/81

Detail Stability Anal Ck'd. By CFS Date



Segment	Area	Centroid to pt. C
①	9x59 = 531	45.5
②	½(41)59 = 1210	27.3

Project Phase I - NY Dams Acct. No. 7594 Page 2 of 5
Subject Potters Falls Dam Comptd. By Sweet Date
Detail Stability Analysis Ck'd. By EMG Date

Analysis Conditions

1. Normal conditions:
   water surface at crest of spillway

2. Winter conditions:
   level at crest of spillway with
   ice 2 feet thick

3. Flood Conditions:
   water surface at top
   of dam.

4. Normal Conditions with seismic
   coefficient of 0.1

SPILLWAY SECTION
Potters Fall Dam

STABILITY ANALYSIS PROGRAM - WORK SHEET

INPUT ENTRY		ANALYSIS CONDITION 1	2	3	4	5
Unit Weight of Dam (K/ft^3)	0	0.14	0.14	0.14	0.14	
Area of Segment No. 1 (ft^2)	1	531	531	531	531	
Distance from Center of Gravity of Segment No. 1 to Downstream Toe (ft)	2	45.5	45.5	45.5	45.5	
Area of Segment No. 2 (ft^2)	3	1210	1210	1210	1210	
Distance from Center of Gravity of Segment No. 2 to Downstream Toe (ft)	4	27.3	27.3	27.3	27.3	
Area of Segment No. 3 (ft^2)	5	—	—	—	—	
Distance from Center of Gravity of Segment No. 3 to Downstream Toe (ft)	6	—	—	—	—	
Base Width of Dam (Total) (ft)	7	50	50	50	50	
Height of Dam (ft)	8	59	59	59	59	
Ice Loading (K/L ft.)	9	—	5	—	—	
Coefficient of Sliding	10	0.55	0.55	0.55	0.55	
Unit Weight of Soil (K/ft^3) (deduct 18)	11	—	—	—	—	
Active Soil Coefficient - Ka	12	—	—	—	—	
Passive Soil Coefficient - Kp	13	—	—	—	—	
Height of Water over Top of Dam or Spillway (ft)	14	—	—	10.5'	—	
Height of Soil for Active Pressure (ft)	15	—	—	—	—	
Height of Soil for Passive Pressure (ft)	16	—	—	—	—	
Height of Water in Tailrace Channel (ft)	17	—	—	—	—	
Weight of Water (K/ft^3)	18	.0625	.0625	.0625	.0625	
Area of Segment No. 4 (ft^2)	19	—	—	—	—	
Distance from Center of Gravity of Segment No. 4 to Downstream Toe (ft)	20	—	—	—	—	
Height of Ice Load or Active Water (ft) (does not include 14)	46	59'	59'	69.5	59'	
Seismic Coefficient (g)	50	—	—	—	0.1	
RESULTS OF ANALYSIS						
Factor of Safety vs. Overturning						
Distance From Toe to Resultant						
Factor of Safety vs. Sliding		0.76	0.73	0.49	0.57	

Condition 1

Uplift

$\frac{(59)(.0625)(50)}{2} = 92.2$ Kips

Total Wt. (Area 1 + Area 2)

$(531 + 1210)(.14) = 243.7$ Kips

Total Net Force

$= 243.7 - 92.2 = 151.5$ Kips

Sliding Resistance

$= (151.5)(.55) = 83.3$ Kips

Water Pressure on Face Dam

$= (1/2)(59)^2(.0625) = 108.8$ Kips

$F.S. = \frac{83.3}{108.8} = 0.76$

Condition 2

$F.S. = \frac{83.3}{108.8 + 5.0} = 0.73$

Project Phase I Acct. No. 7594 Page 5 of 5

Subject Potters Falls Comptd. By EMG Date 7/29/81

Detail Stabil. Anal. Ck'd. By CES Date

Condition 3

Uplift

$$\frac{(69.5)(.0625)(50)}{2} = 108.6$$

Total Net Force

$$243.7 - 108.6 = 135.1$$

Sliding Resist.

$$= 135.1\ (.55) = 74.3$$

Water Pressure

$$= (1/2)(69.5)^2(.0625) = 150.9$$

$$F.S. = \frac{74.3}{150.9} = 0.49$$

Condition 4 - Earthquake (0.1g)

$$W_H = (243.7)(.1) = 24.4 \text{ kips} \quad (\text{Horiz Force})$$

$$\text{Polynomic water pressure} = \frac{7}{12}(h^2)(\delta_w)(k_h)$$

$$= \frac{7}{12}(59)^2(.0625)(.1) = 12.7 \text{ kips}$$

$$F.S. = \frac{83.3}{\underbrace{108.8 + 24.4 + 12.7}_{175.9}} = 0.57$$

APPENDIX E

REFERENCES

LIST OF REFERENCES

GENERAL

Harris, Dorothy, History of Ithaca's Water & Sewer Systems, Reprinted August 1956.

University of the State of New York, Geologic Map of New York, Map and Chart Series No. 5, 1962.

University of the State of New York, Geology of New York, Education Leaflet 20, Reprinted 1972.

HYDRAULICS

Chow, Ven Te, 1959, Open Channel Hydraulics, McGraw Hill.

King, H.W. and E.F. Brater, 1963, Handbook of Hydraulics, 5th Edition, McGraw-Hill

U.S. Army Corps of Engineers:

HEC-1 Flood Hydrograph Package - Dam Safety Version, September 1978.

Engineering Manual 1110-2-1405; Flood-Hydrograph Analyses and Computations, August 1959.

U.S. Department of Agriculture, Soil Conservation Service:

National Engineering Handbook; Section 4 - Hydrology, August 1972.

U.S. Department of Commerce; Weather Bureau:

Hydrometeorological Report No. 33: Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6,12,24, and 48 Hours, April 1956.

U.S. Department of the Interior:

BUREC, 1977, Design of Small Dams, 2nd Ed. (rev. reprint).

USGS, 1980, Water Resources Data For New York, Western New York, USGS Water Data Report NY-80-3.

37-1 (7/76)

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DAM INSPECTION REPORT
(By Visual Inspection)

CITY OF ITHACA

Dam Number	River Basin	Town	County	Hazard Class*	Date & Inspector
717	Oswego	ITHACA	Tompkins	C	11/21/76 B.C.

Type of Construction

- ☐ Earth w/concrete spillway
- ☐ Earth w/drop inlet pipe
- ☐ Earth w/stone or riprap spillway
- ☒ Concrete
- ☐ Stone
- ☐ Timber

Use

- ☒ Water Supply
- ☐ Power
- ☐ Recreation
- ☐ Fish and Wildlife
- ☐ Farm Pond
- ☐ No Apparent Use-Abandoned

Estimated Impoundment Size

- ☐ 1-5 acres
- ☐ 5-10 acres
- ☒ Over 10 acres (15 ACRES)

260,000,000 Gals.

Estimated Height of Dam above Streambed

- ☐ Under 10 feet
- ☐ 10-25 feet
- ☒ Over 25 feet 64 FT.

Condition of Spillway

- ☒ Service satisfactory
- ☐ In need of repair or maintenance
- ☐ Auxiliary satisfactory
- ☐ In need of repair or maintenance

Explain: With 4" of water going over spillway there are some surface cracks
Should reinspect at low flows to see if there are any bad cracks or leaks

Condition of Non-Overflow Section

- ☒ Satisfactory
- ☐ In need of repair or maintenance Explain: _____

Condition of Mechanical Equipment

- ☒ Satisfactory
- ☐ In need of repair or maintenance Explain: _____

Reinspected 7/30/79 KOH
OK

Evaluation (From Visual Inspection)

- ☐ No defects observed beyond normal maintenance
- ☐ Repairs required beyond normal maintenance

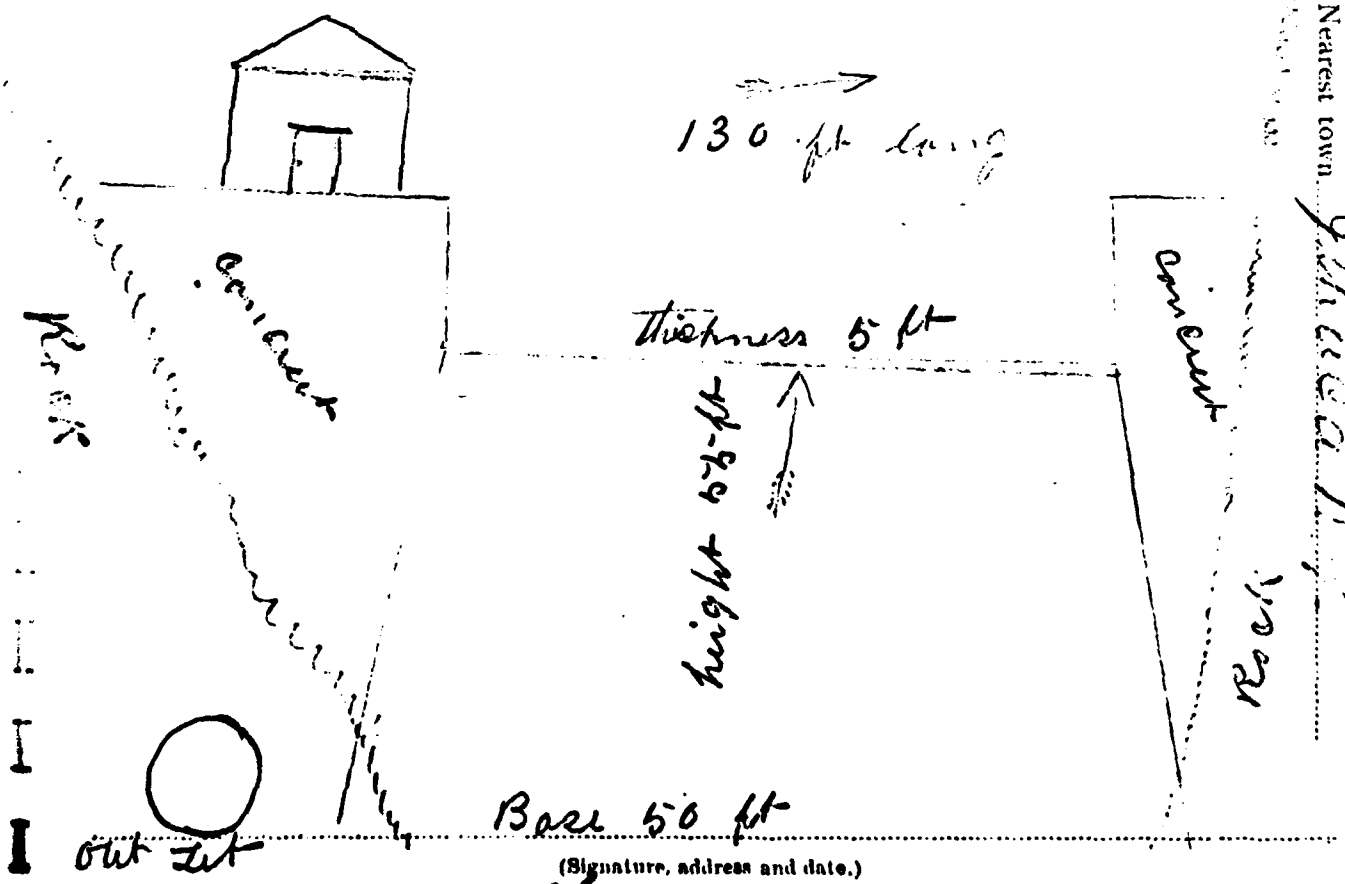
*Explain Hazard Class, if Necessary Reinspect summer '79 during low flows
"C" HAZARD. Lowland business & homes in ITHACA would be flooded if dam went out

Potters Falls Dam.

Fill out a form as complete as possible for each dam in your district and send to State Conservation Commission, Albany, N. Y.

1. Name and address of owners Ithaca Water Works Co. Ithaca N.Y.
2. Date of construction June 1913.
3. Uses of impounded water City Water Main.
4. Character of foundation bed Rock.
5. Material of waste spill Concrete.
6. Length of waste and depth below dam Waste 100ft. Depth below dam 6ft.
7. Total length of dam including waste 130ft.
8. Material of dam Concrete and Steel.
9. Discharges, size and location Iron pipe at bottom of Dam 3ft. in diamater. Two miles to City Filter plant.

Below sketch section of waste and section of dam, with greatest heights and top thickness and bottom thickness. On opposite side sketch general plan of dam and give distance from a bridge or from a tributary stream.



Nearest town

(Signature, address and date.)

John B Vann
Ithaca N.Y.
Feb 12 th 1913

October 31,,1911.

In re Potters Falls Dam
#722 Oswego-Seneca Watershed.

Donald F. McLeod, Esq.,

City Engineer,

Ithaca, N.Y.

717 Oswego

Dear Sir:-

I visited the above dam on October 26th and it appeared to be of good proportions and run well into the rock at the side. I regretted, however, to see it built up at an angle of about 45 degrees for the entire length instead of keeping the top of work horizontal. The sand was not a good quality, one-half being composed of 3/8 to 3/4 inch stones and the other half of poorly washed screenings. I suggest that this be washed better and a test be made to be sure that the voids are filled; if not additional sand should be added.

I further suggest to bond each day's work to the preceding days by longitudinal and vertical grooves formed by 6 x 6 joist smoothed and battered built into the concrete.

We should like to receive, for the files of this office, plans, sections and elevations of this dam and of all other dams owned or controlled by the City.

Very truly yours,

Inspector of Dams and Docks.

WcK/C.

Oswego - Ithaca

Potters Falls dam situated on Six Mile Creek.

Used for water supply purposes for the City of Ithaca.

Built of reinforced concrete 9 feet top width, 46 feet bottom width, 64 feet high, 197 feet long.

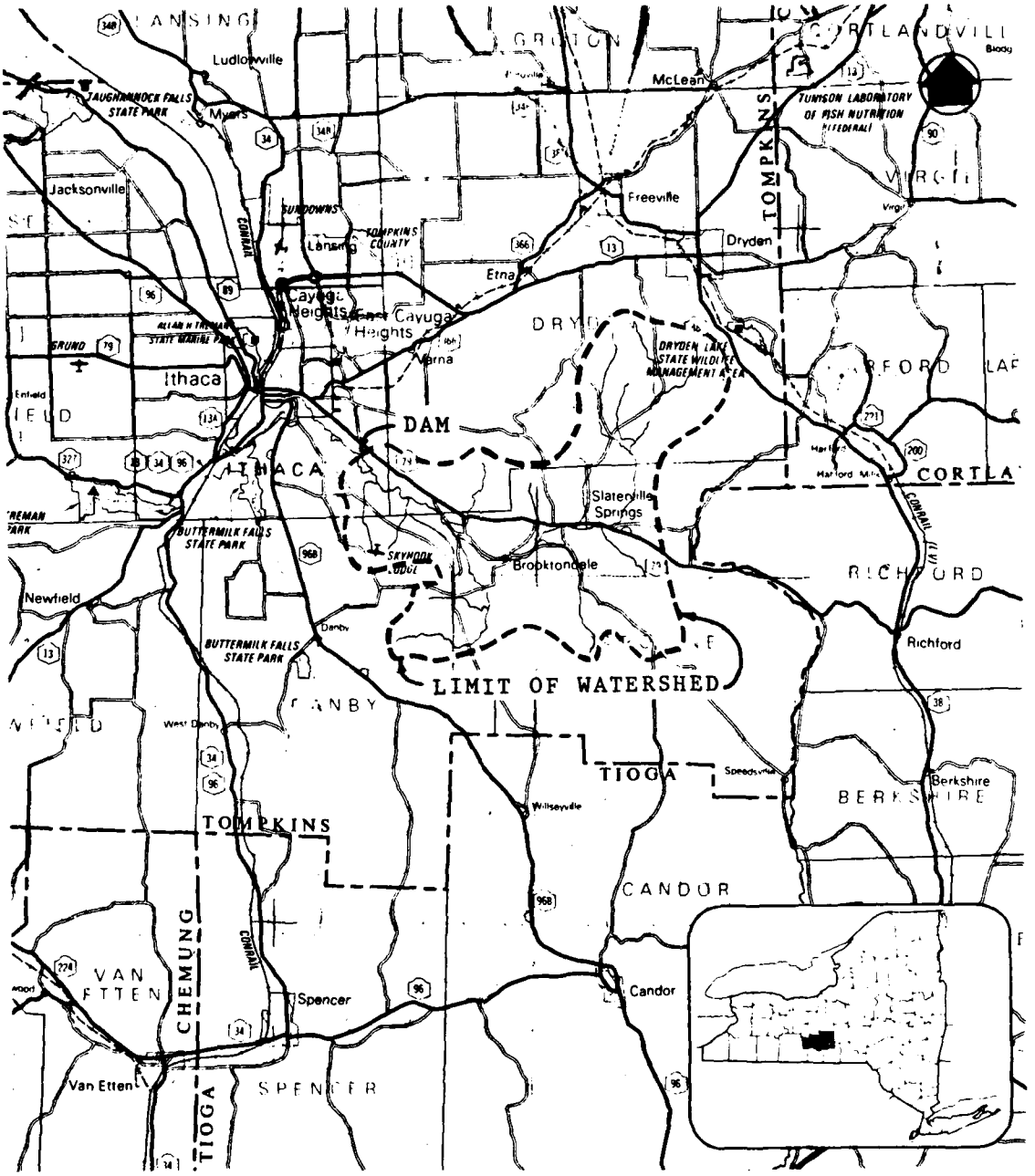
Inspected October 26, 1911.

Concrete work about half finished.

Comment:- The concrete work was built up at about an angle of 43 degrees for the entire length of the dam instead of building same up in horizontal layers. Sand was not a good quality 1/2 being composed of 3/8 to 3/4 inch stones and the other half of poorly washed screenings; the portions of concrete being 2 of cement, 4 of sand and 7 of broken stone about 2 1/2 inch size.

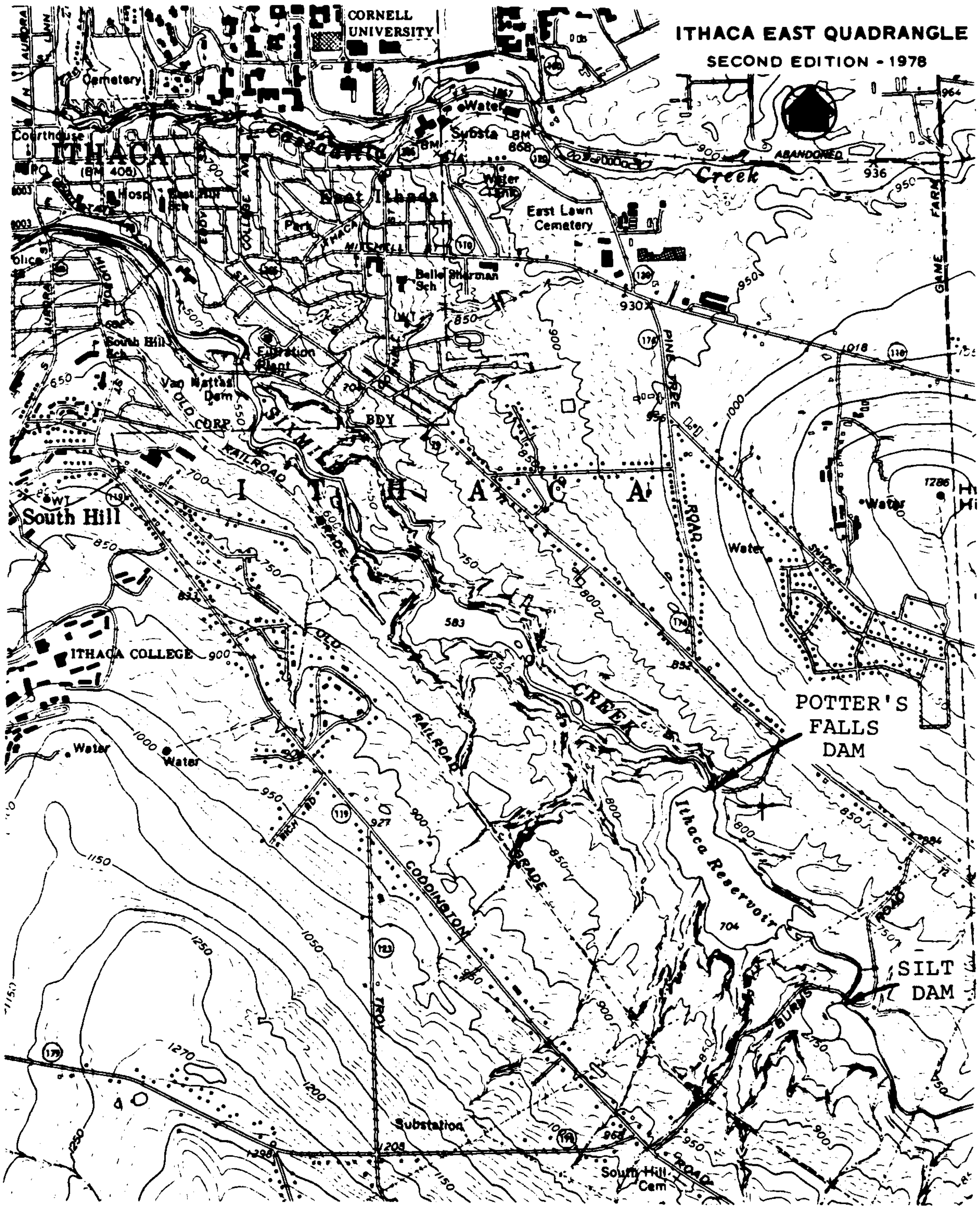
As at present mixed the sand would be better washed. Where necessary to fill the voids a large proportion of sand should be added. Also there should be better bonding between the different day's work longitudinally - horizontally and vertically by grooves.

APPENDIX G
DRAWINGS



VICINITY MAP

POTTER'S FALLS DAM
ID No. NY 378

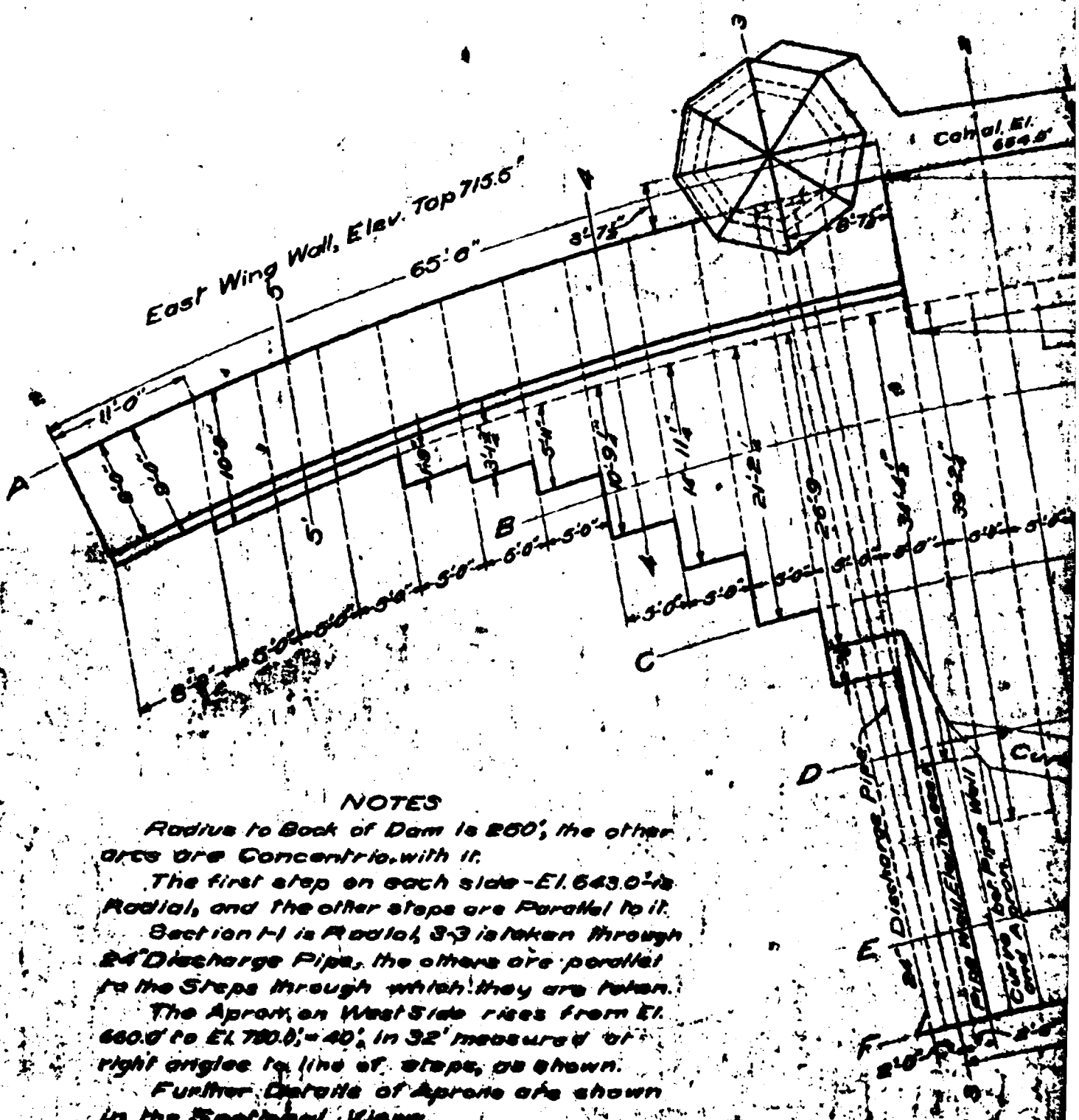


SCALE 1:24000

0 1000 2000 3000 4000 5000 6000 7000 FEET

TOPOGRAPHIC MAP

POTTER'S FALLS DAM
ID No. NY 378



NOTES

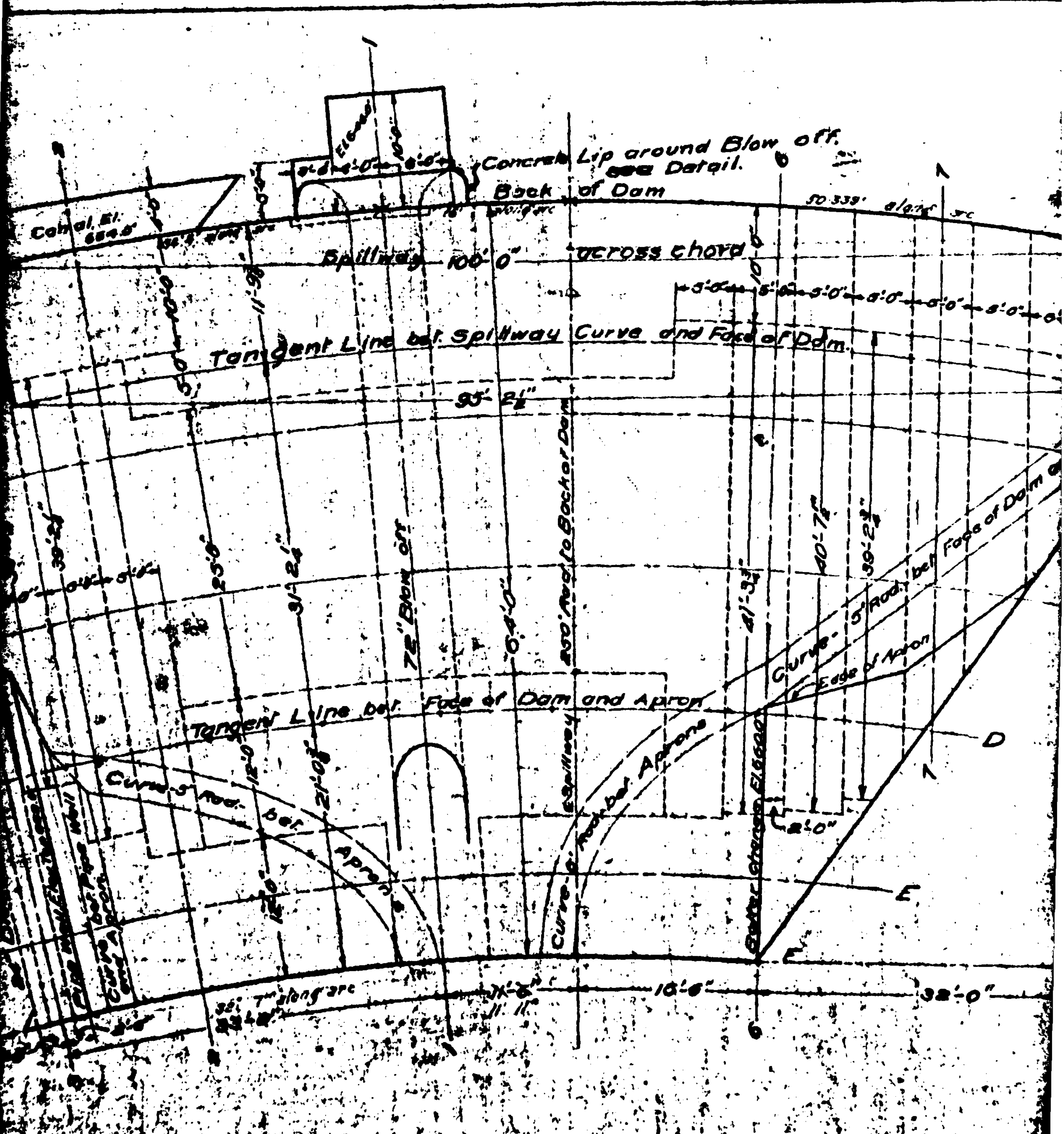
Radius to Back of Dam is 200', the other arcs are Concentric with it.

The first step on each side - El. 643.0' - is Radial, and the other steps are Parallel to it.

Section 1-1 is Radial, 3-3 is taken through 24" Discharge Pipe, the others are parallel to the Steps through which they are taken.

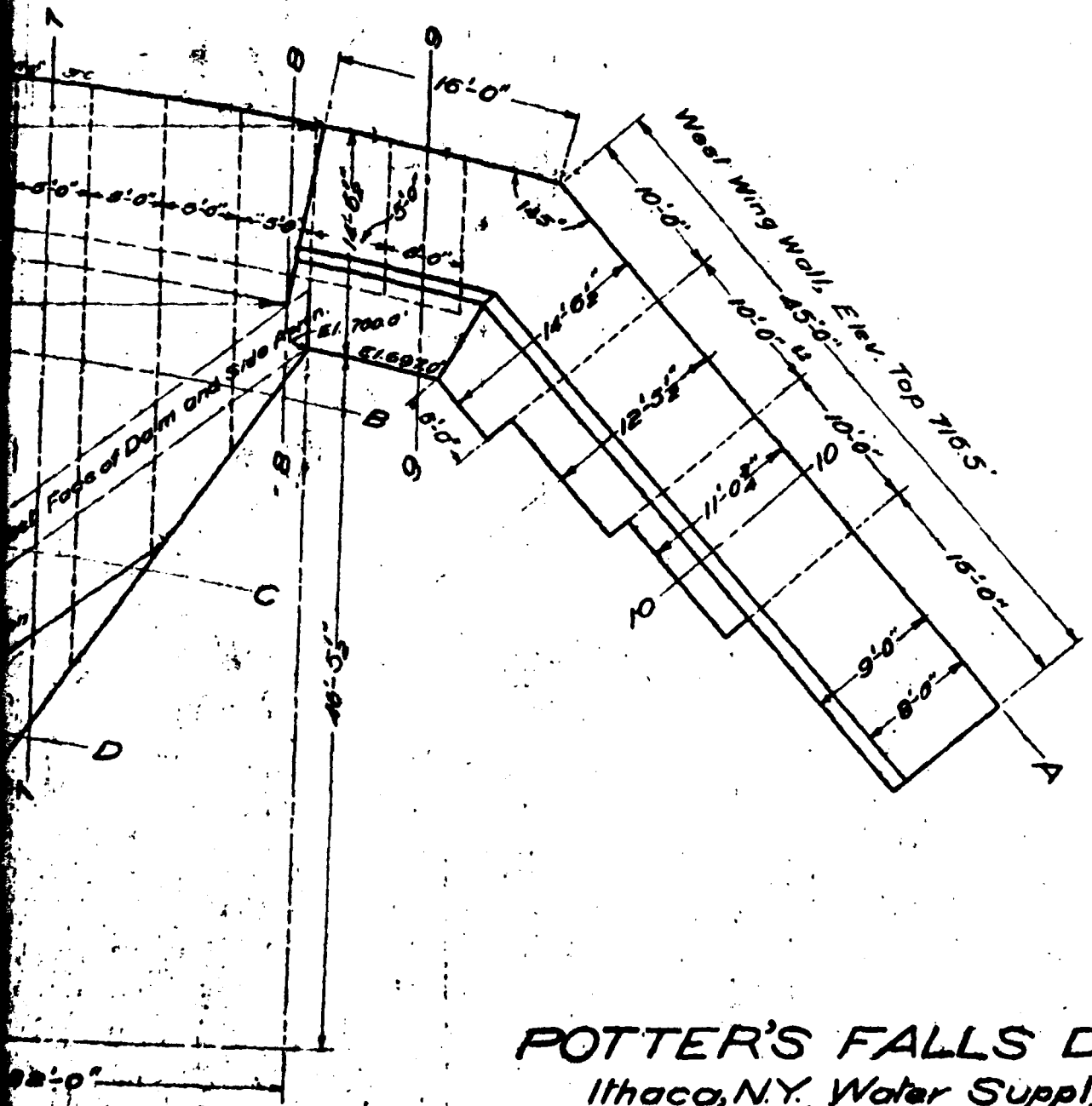
The Apron on West Side rises from El. 660.0' to El. 710.0', - 40', in 32' measured at right angles to line of steps, as shown.

Further Details of Aprons are shown in the Sectional Views.



Concrete Lip around Blow off.
see Detail.
Back of Dam
50.339' along arc
Conal El. 654.5'
Spillway 100'-0" across chord
Tangent Line bet. Spillway Curve and Face of Dam.
95'-2½"
72" Blow off
250' Rad. to Back of Dam
41'-3¾"
40'-7⅞"
39'-2⅜"
Curve - 5' Rad. bet. Face of Dam and
Edge of Apron
Tangent Line bet. Face of Dam and Apron
D
Curve 5' Rad. bet. Aprons
Curve 5' Rad. bet. Apron
℄ Spillway
Batter change El. 660.0
2'-0"
E
F
10'-6"
32'-0"
6

Alterations from Contract Drawings are in Red



POTTER'S FALLS DAM

Ithaca, N.Y. Water Supply

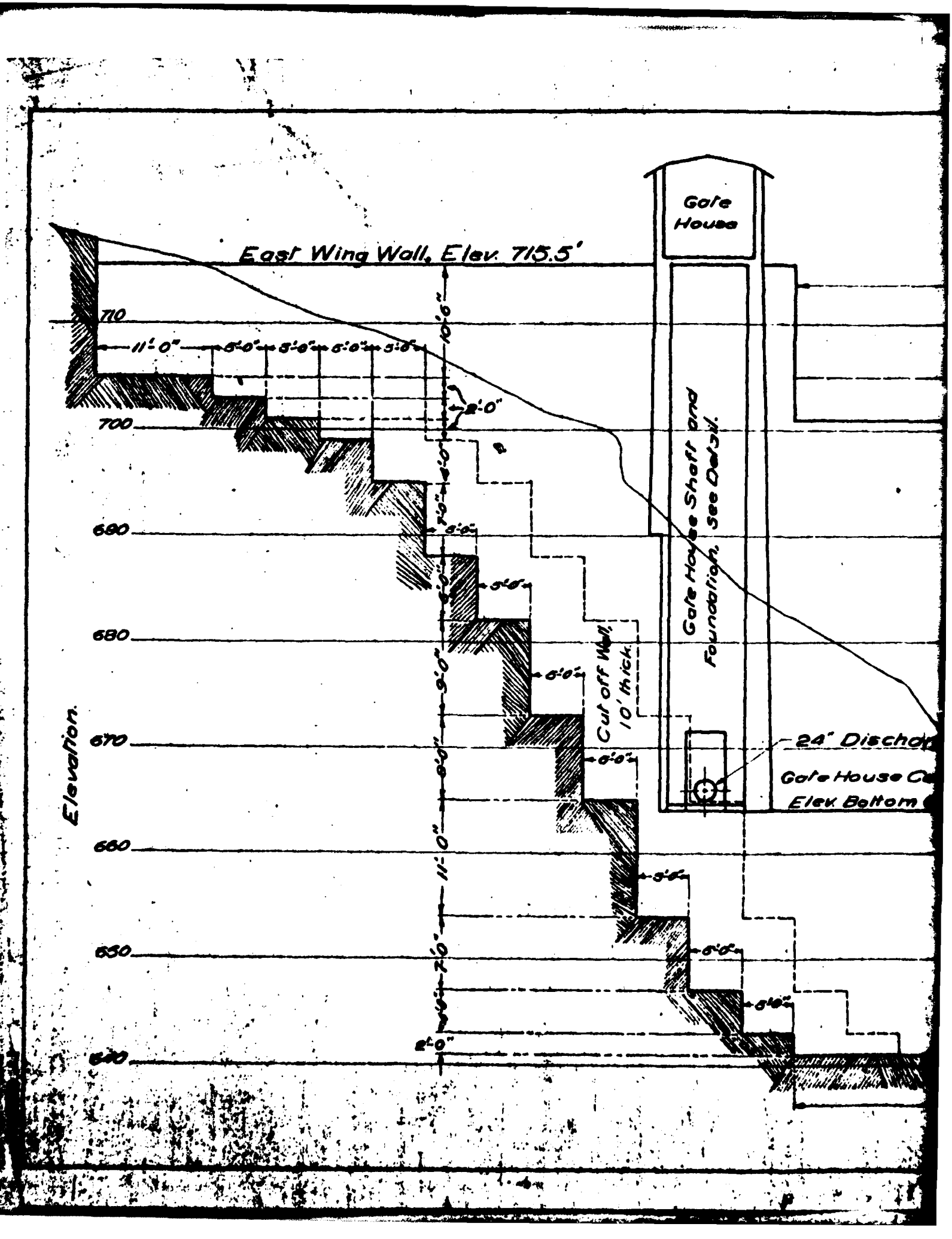
FINISHED CONCRETE PLAN

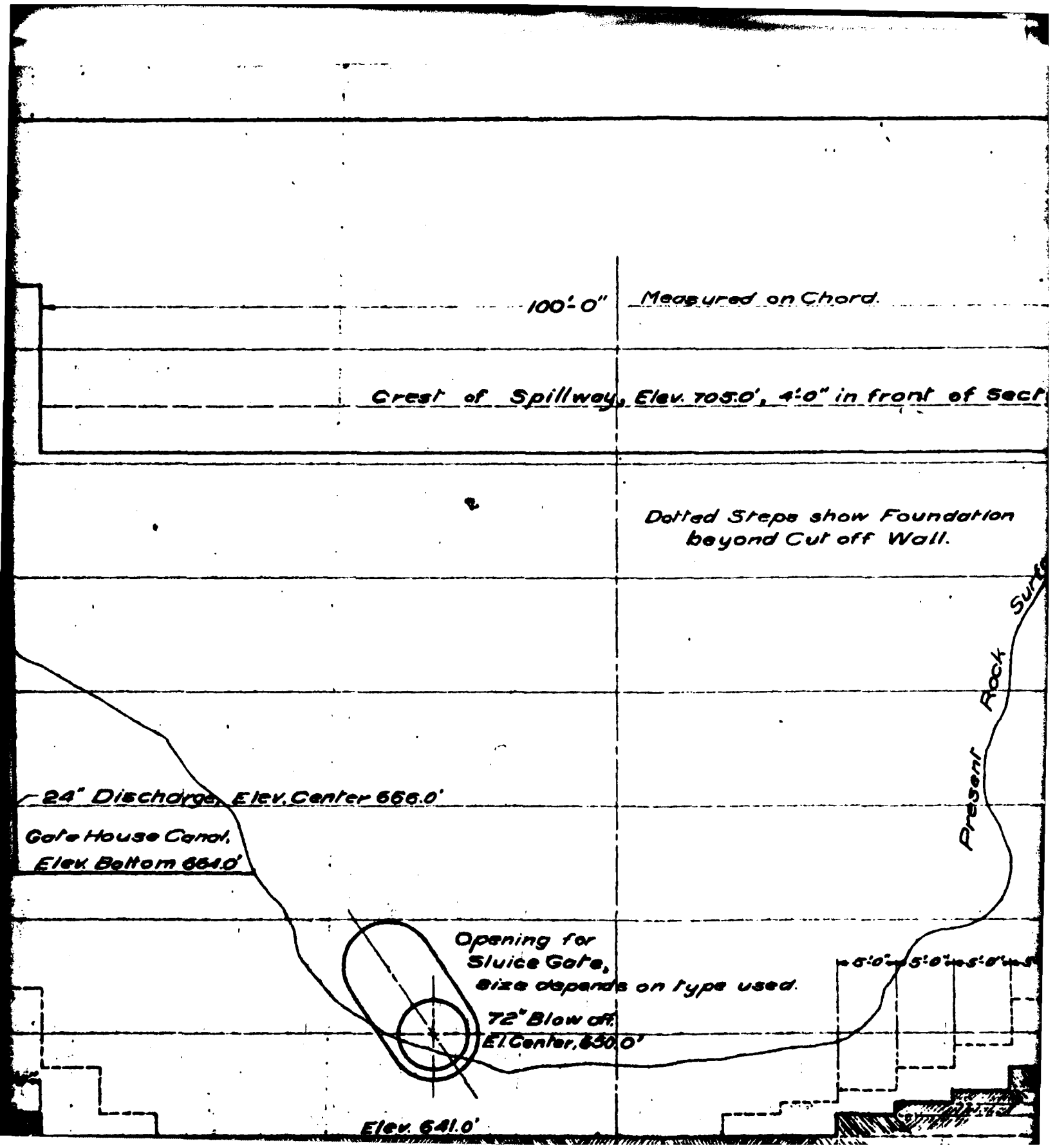
Scale: 1in. = 10ft.

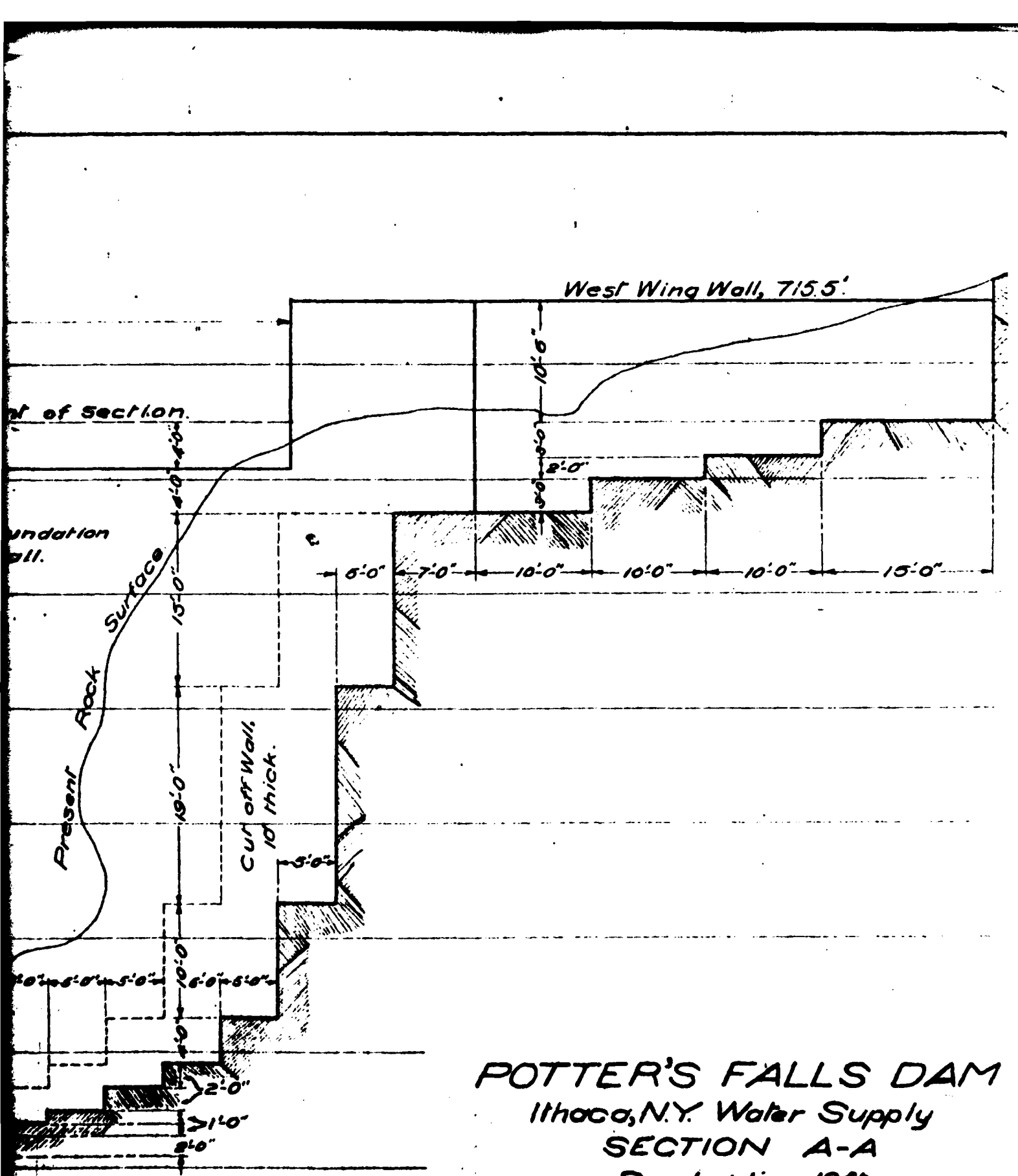
Wesley J. Weld, City Engineer.

August, 1910.

O-9


Gate House
East Wing Wall, Elev. 715.5'
710
700
690
680
670
660
650
640
Elevation.
11'-0"
5'-0"
5'-0"
5'-0"
5'-0"
10'-6"
2'-0"
7'-0"
5'-0"
5'-0"
5'-0"
5'-0"
5'-0"
5'-0"
5'-0"
5'-0"
5'-0"
11'-0"
7'-0"
2'-0"
Cut off Wall, 10' thick.
Gate House Shaft and Foundation, see Detail.
24" Discha
Gate House C
Elev. Bottom


100'-0"
Measured on Chord.
Crest of Spillway, Elev. 705.0', 4'-0" in front of Secf
Dotted Steps show Foundation beyond Cut off Wall.
Present Rock Surf
24" Discharge, Elev. Center 666.0'
Gate House Canal, Elev. Bottom 664.0'
Opening for Sluice Gate, size depends on type used.
72" Blow off, El. Center, 630.0'
5'-0"
5'-0"
5'-0"
Elev. 641.0'



POTTER'S FALLS DAM

Ithaca, N.Y. Water Supply

SECTION A-A

Scale : 1in. = 10ft.

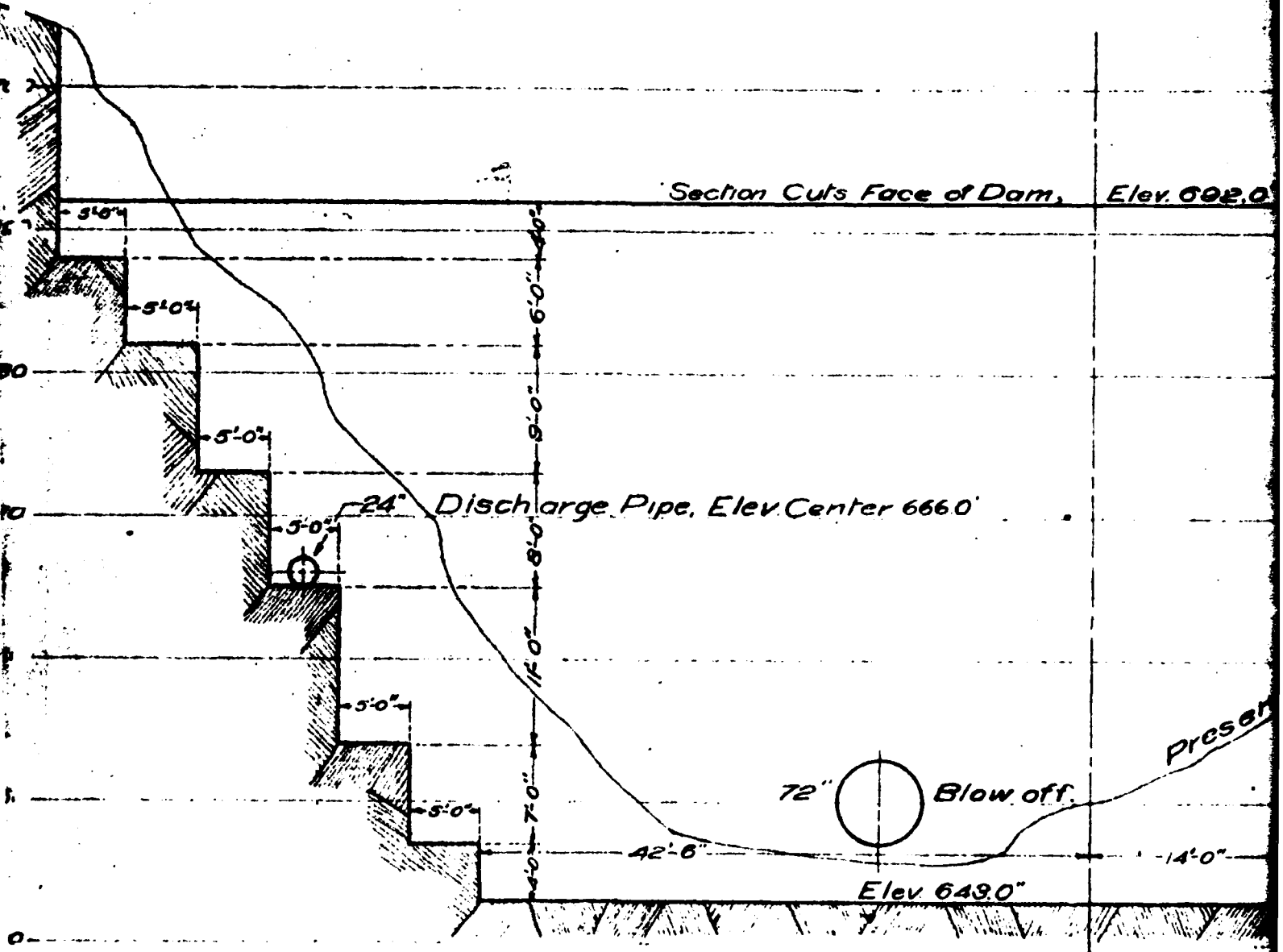
Donald F. McLeod, City Engineer.

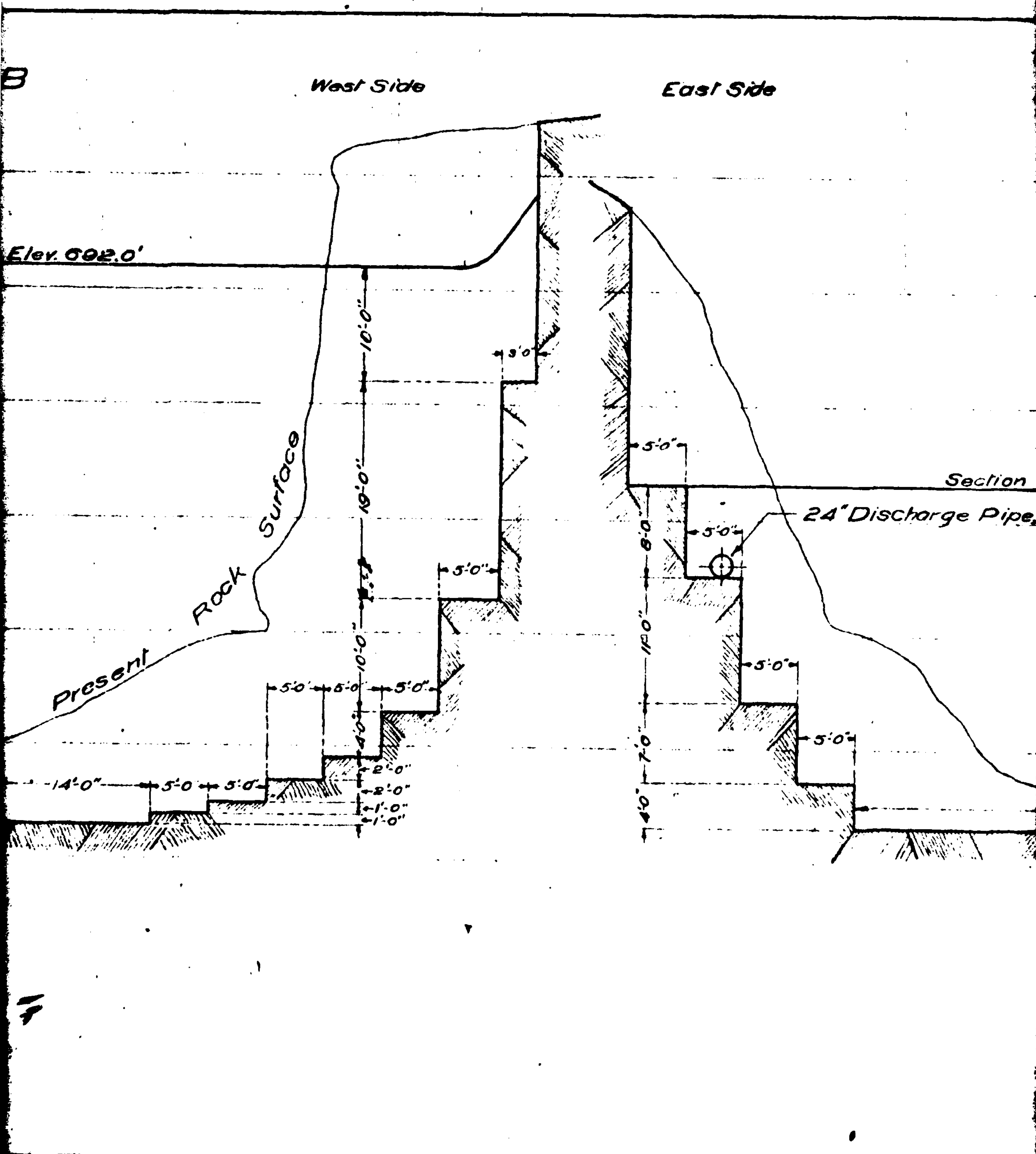
August, 1910.

C

East Side

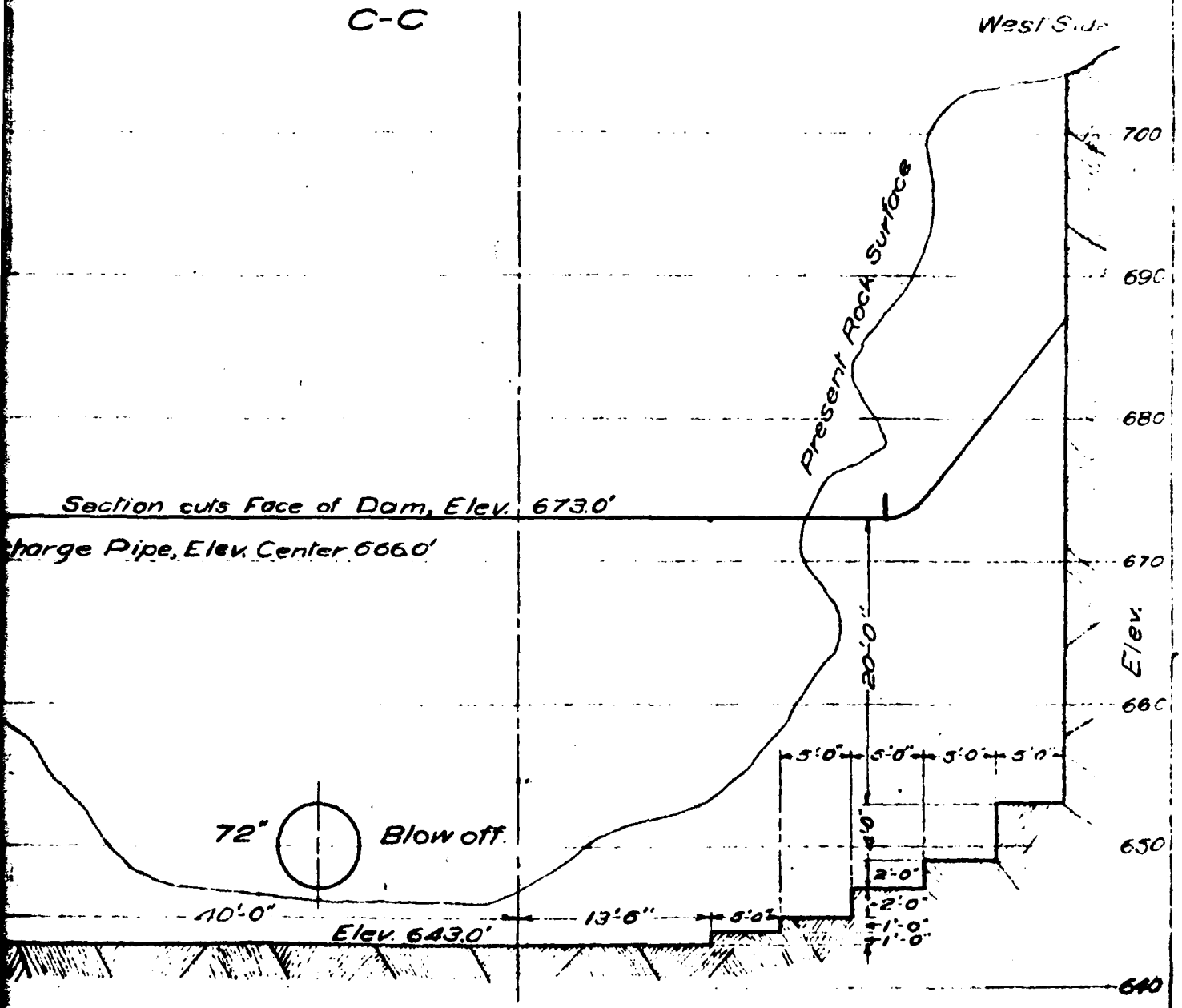
B-B


Section Cuts Face of Dam, Elev. 692.0'
5'-0"
5'-0"
5'-0"
5'-0"
5'-0"
5'-0"
24" Discharge Pipe, Elev. Center 666.0'
6'-0"
8'-0"
11'-0"
7'-0"
72" Blow off.
42'-6"
14'-0"
Elev 643.0"



West Side
East Side
Elev. 692.0'
Present Rock Surface
Section
24" Discharge Pipe
10'-0"
19'-0"
10'-0"
4'-0"
3'-0"
5'-0"
14'-0"
2'-0"
1'-0"
6'-0"
11'-0"
7'-0"

12



POTTER'S FALLS DAM

Ithaca, N.Y. Water Supply

SECTIONS B-B AND C-C

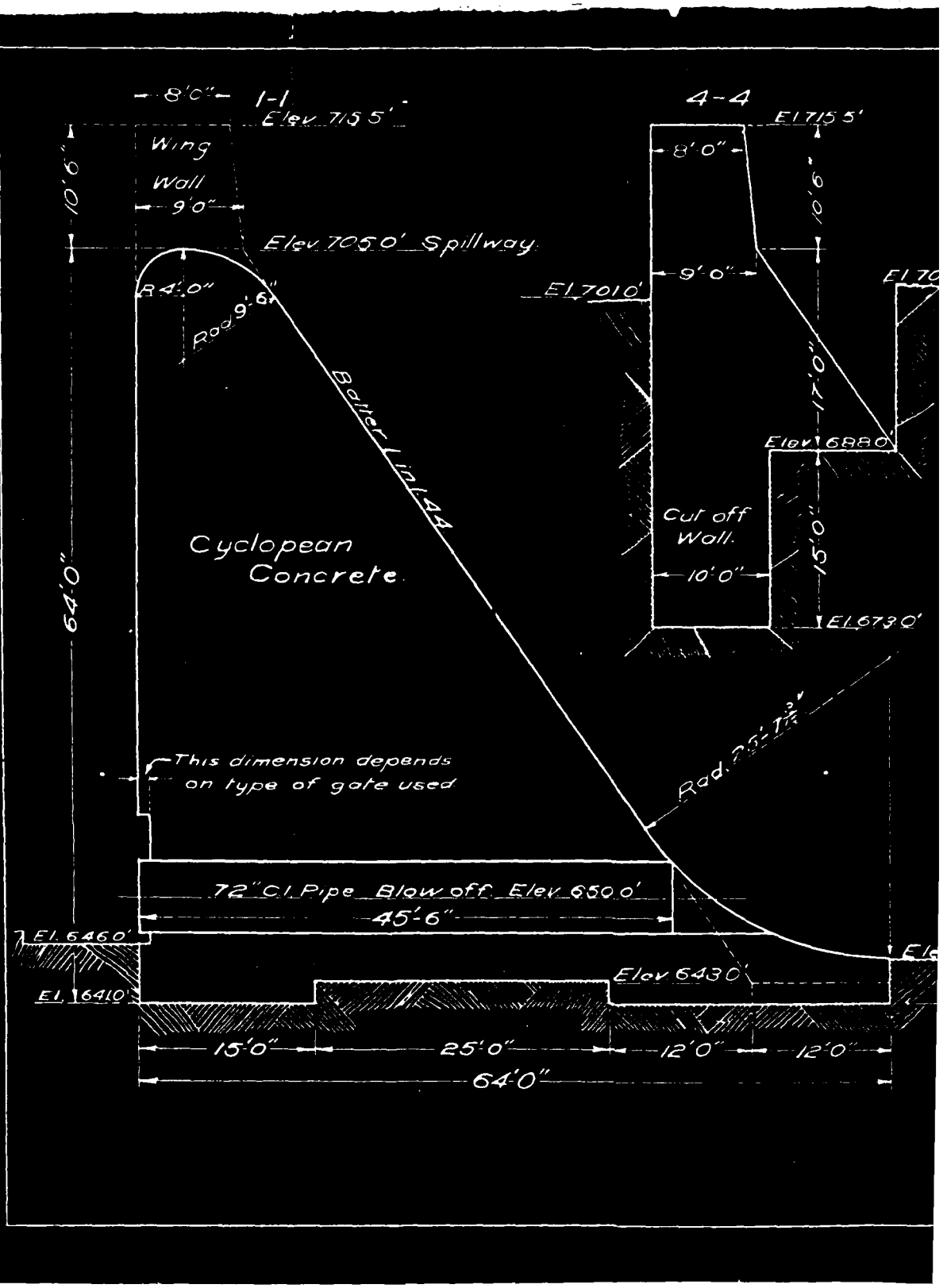
Scale: 1in. = 10ft.

Donald L. McLeod, City Engineer.

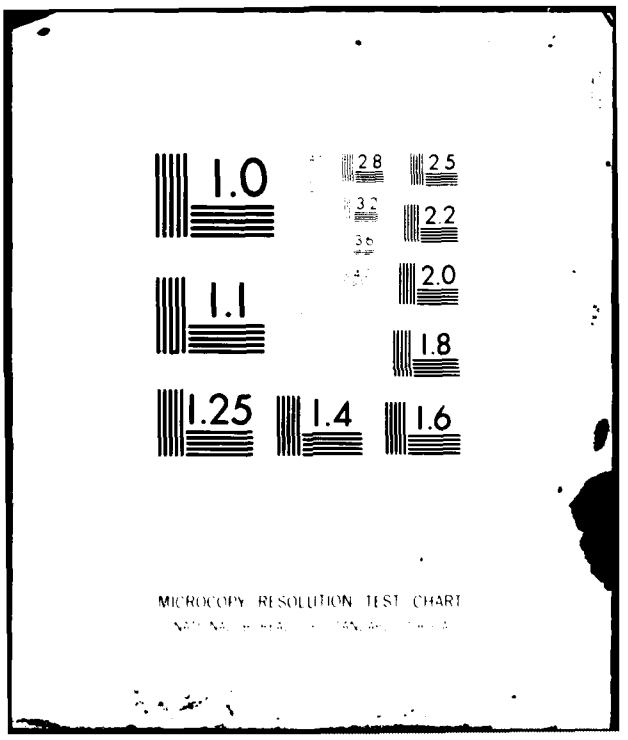
August, 1910.

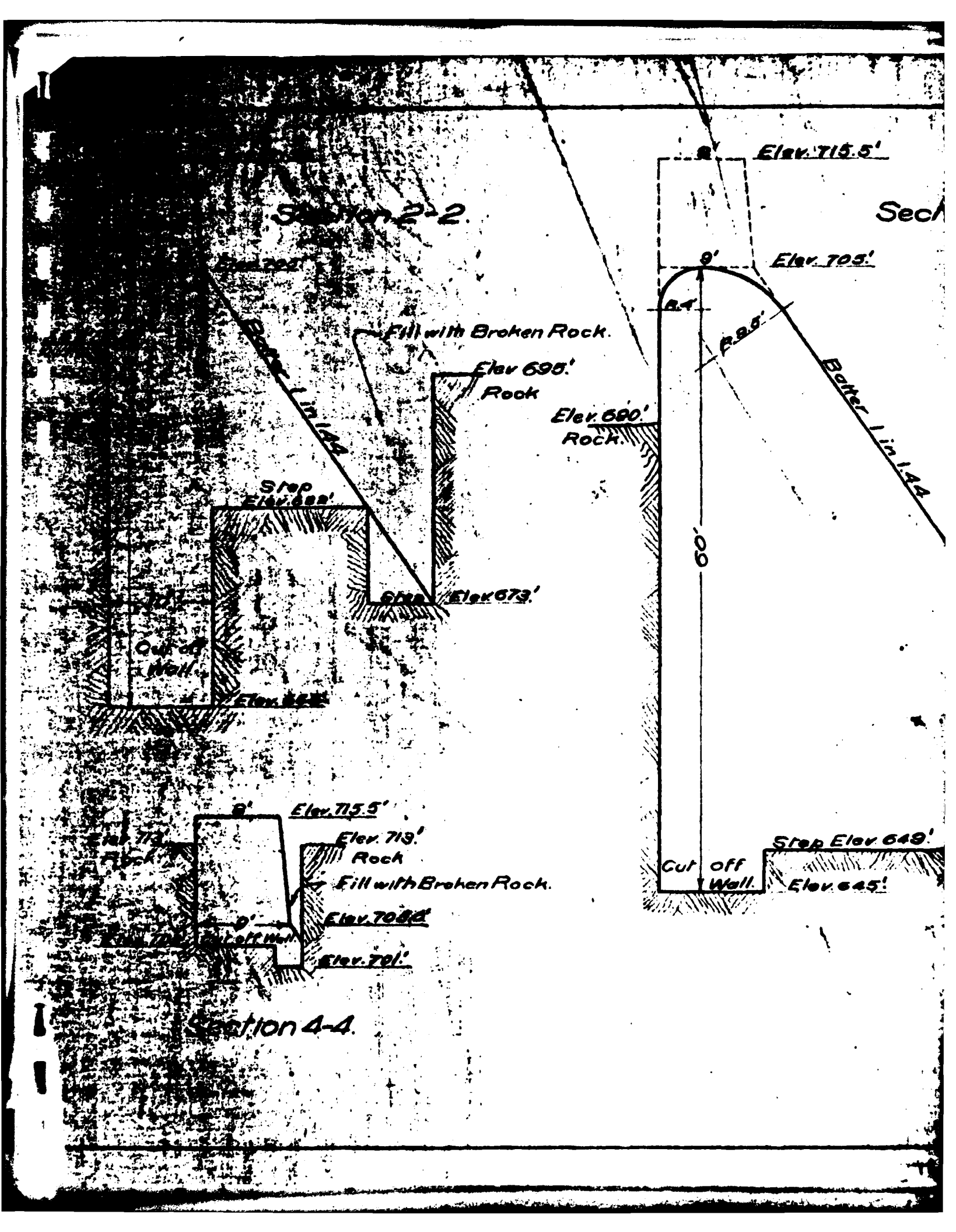
O-12

13


8'0" 1-1
Elev 715 5'
Wing Wall
9'0"
10'6"
Elev 705 0' Spillway
R 4'0"
Rad 9'6"
Batter 1 in 4
Cyclopean Concrete
64'0"
This dimension depends on type of gate used
72" C.I. Pipe Blow off Elev 650 0'
45'6"
El 6460'
El 16410'
Elev 643 0'
15'0"
25'0"
12'0"
12'0"
64'0"
4-4
El 715 5'
8'0"
10'6"
9'0"
El 7010'
17'0"
Elev 688 0'
Cut off Wall.
15'0"
10'0"
EL 673 0'
Rad 29'1 3/4"

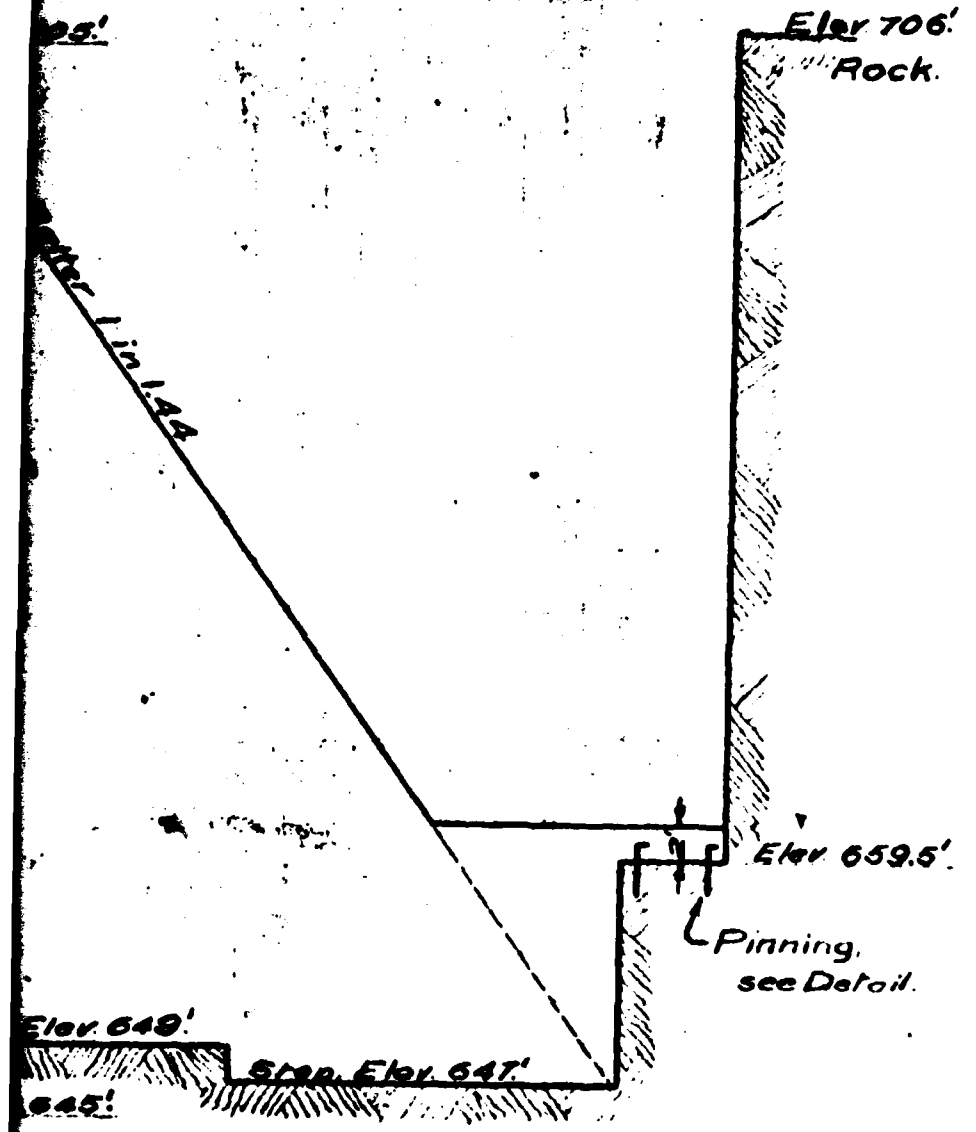
AD-A109 966 METCALF AND EDDY OF NEW YORK INC NY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. POTTERS FALLS DAM (INVENTORY NUMBE--ETC(U)
SEP 81 G P FULTON DACW51-81-C-0044
UNCLASSIFIED NL

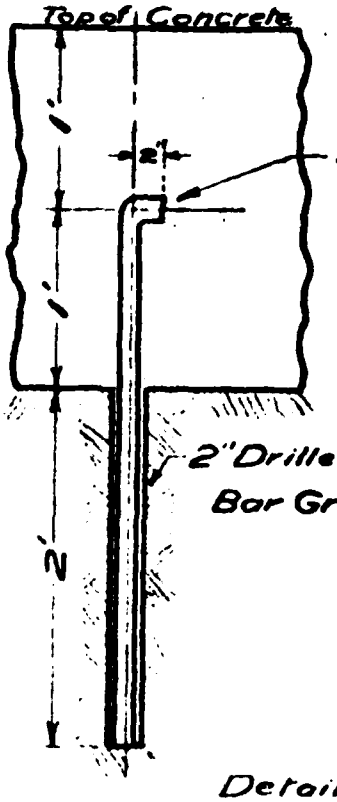

1.0
2.8
2.5
3.2
2.2
3.6
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART


Section 2-2.
Batter 1 in 1.44
Fill with Broken Rock.
Elev 695'
Rock
Step
Elev. 688'
Cut off
Wall
Elev. 673'
Elev. 715.5'
9'
Elev. 705'
8.4'
8.96'
Batter 1 in 1.44
60'
Elev. 690'
Rock.
Cut off
Wall
Step Elev 649'
Elev. 645'
9'
Elev. 715.5'
Elev. 713'
Rock
Fill with Broken Rock.
Elev. 708.4'
Elev. 701'
Section 4-4.

.5'

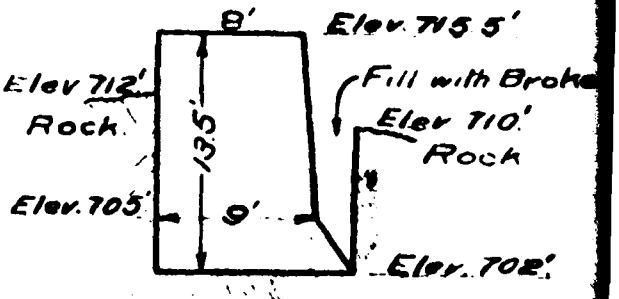
Section 3-3.





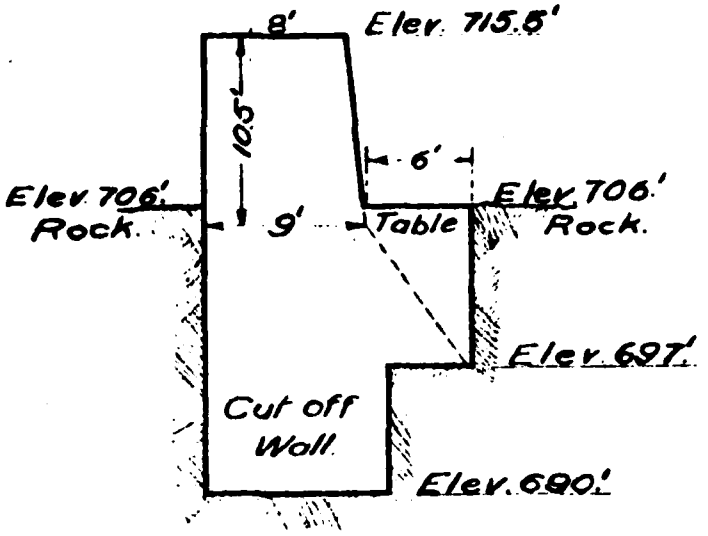
Detail of Pinning

Used where Concrete is but
Scale: 1" = 1 ft.



Section 7-7.

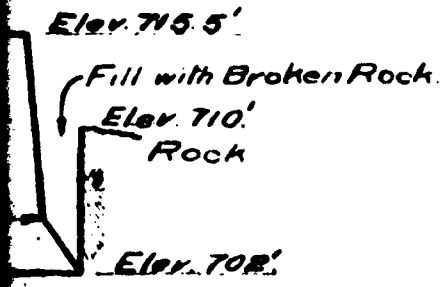
1½" W.I. Round Bar,
3'-2" Long.



Section 5-5.

illed Hole,
Grouted in.

tail of Pinning
· Concrete is but 2' thick.
cale: 1"=1ft.



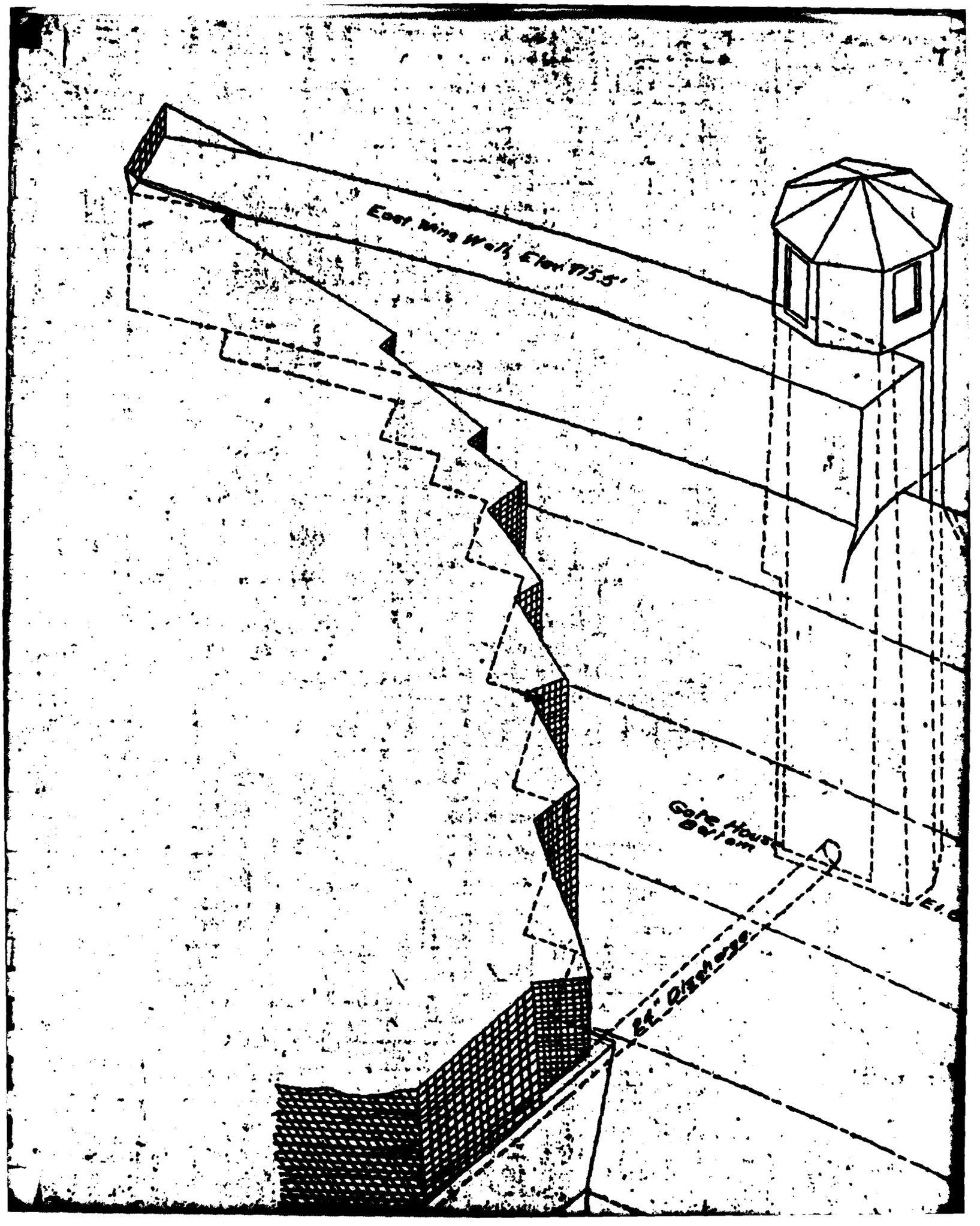
POTTER'S FALLS DAM

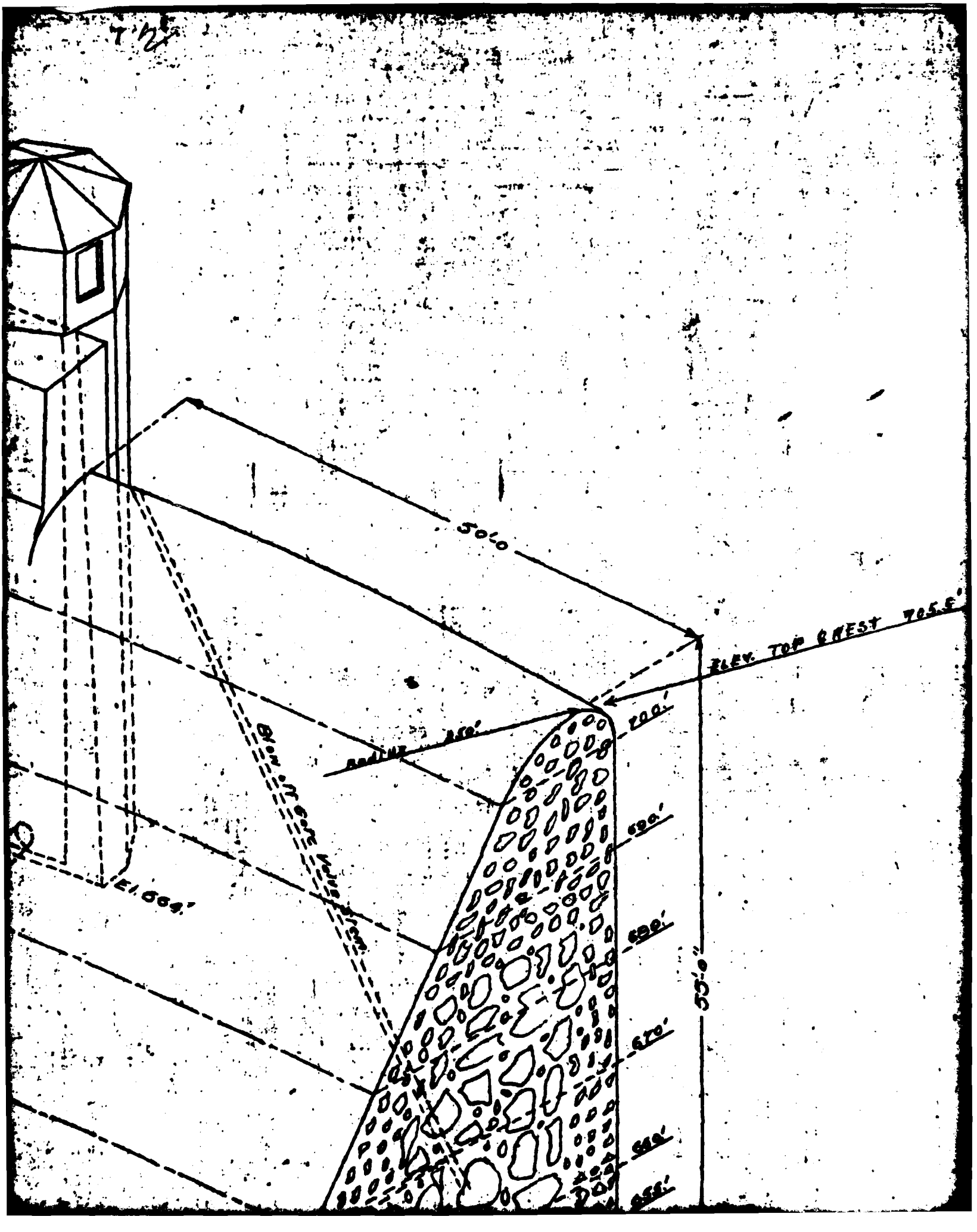
DETAIL OF SECTIONS AND PINNING.

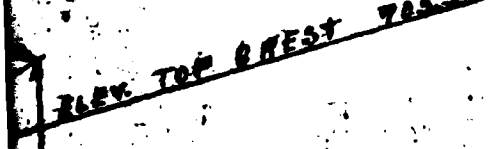
Scales: 1"=10ft. and 1"=1ft. July, 1910.

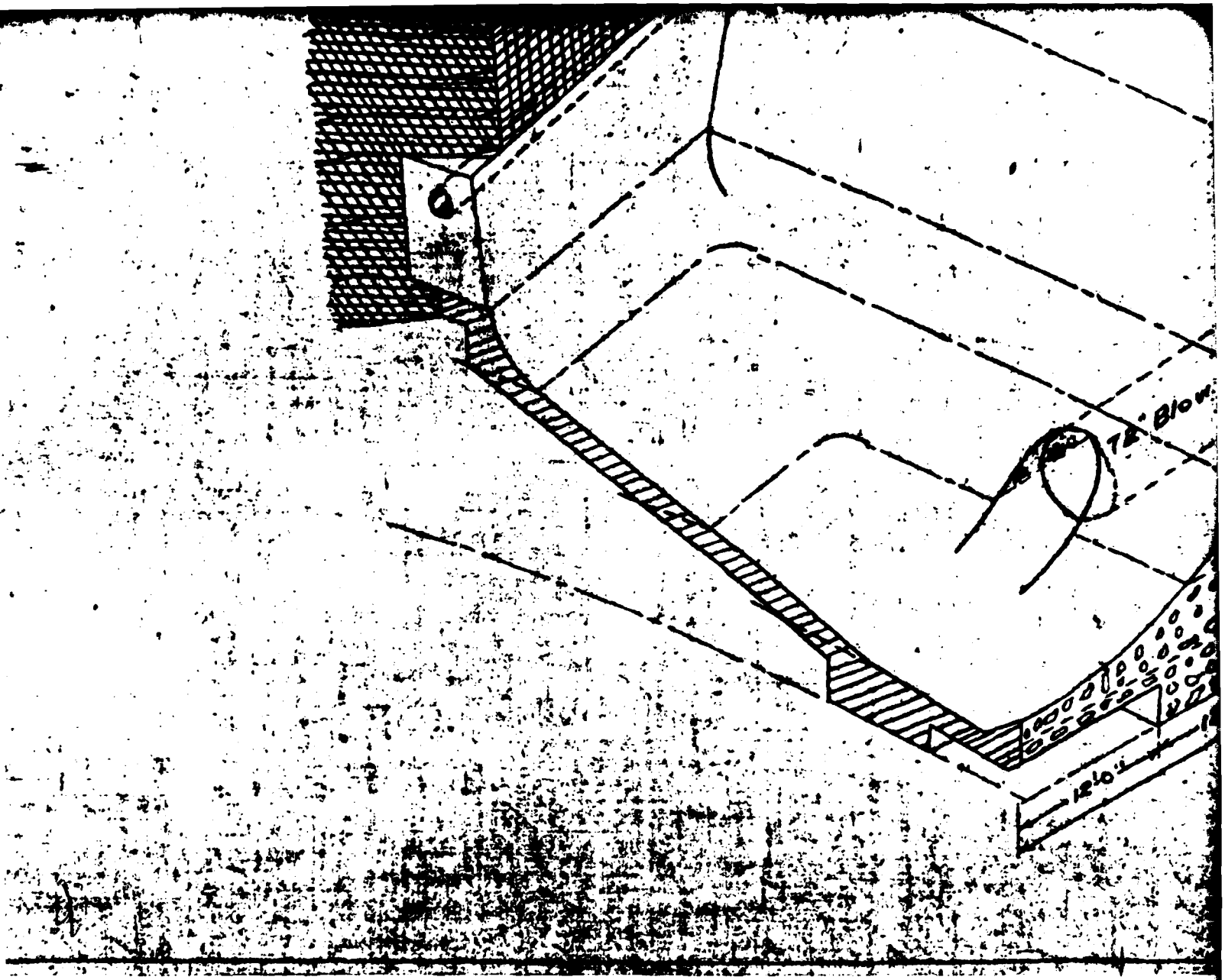
City Engineer.

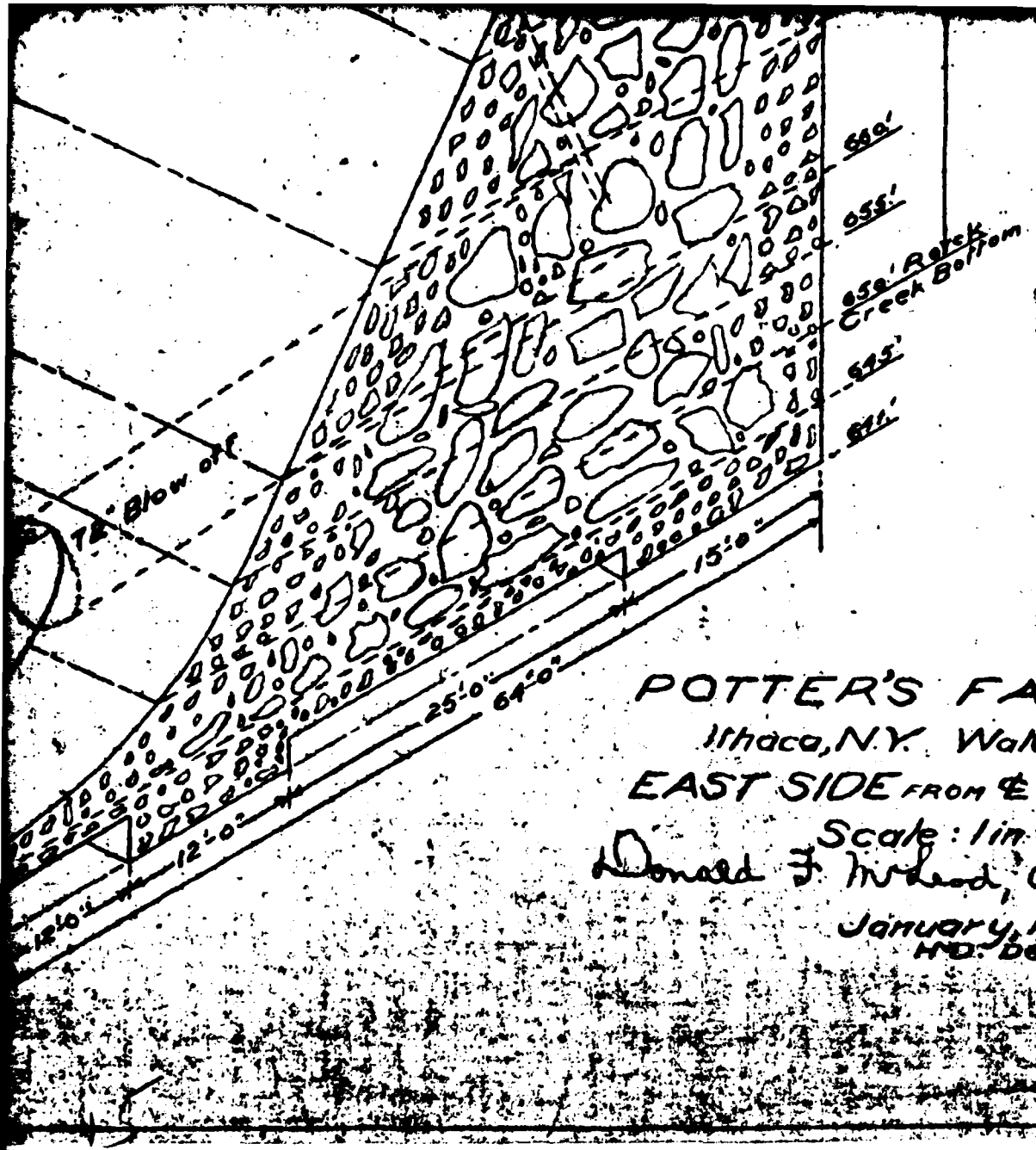
7-7.


East Wing Walk Elev 775.5'
Gate House Bottom
El. Discharge


T 2
50'-0
ELEV. TOP CREST 705.5'
700'
600'
500'
400'
55'-0"


FLEX TOP CREST TOP


12'-0"



POTTER'S FALLS DAM

Ithaca, N.Y. Water Supply

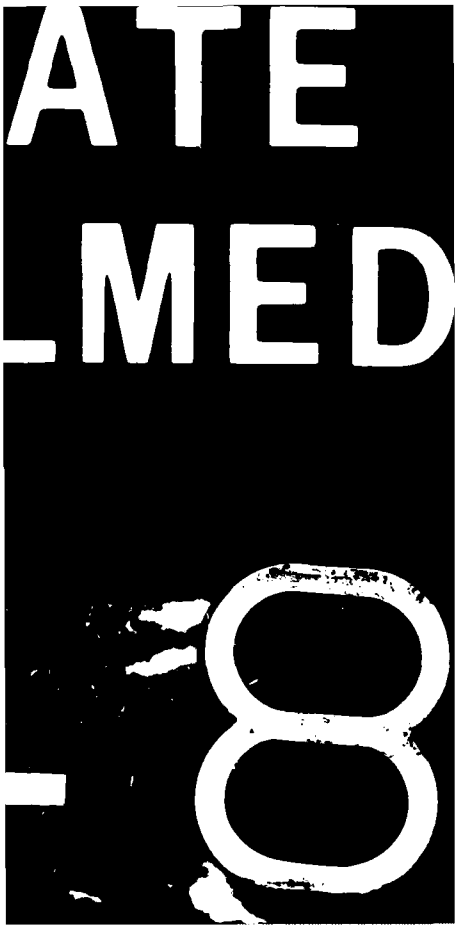
EAST SIDE FROM ℄ OF SPILLWAY

Scale: 1 in. = 10 ft.

Donald F. McLeod, City Engineer.

January, 1911.

H.D. Del. BK 1934


ATE
LMED
8