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NATIONAL DAM SAFETY PROGRAM. COLD SPRING DAM (LOWER) (INVENTORY--ETC(U)
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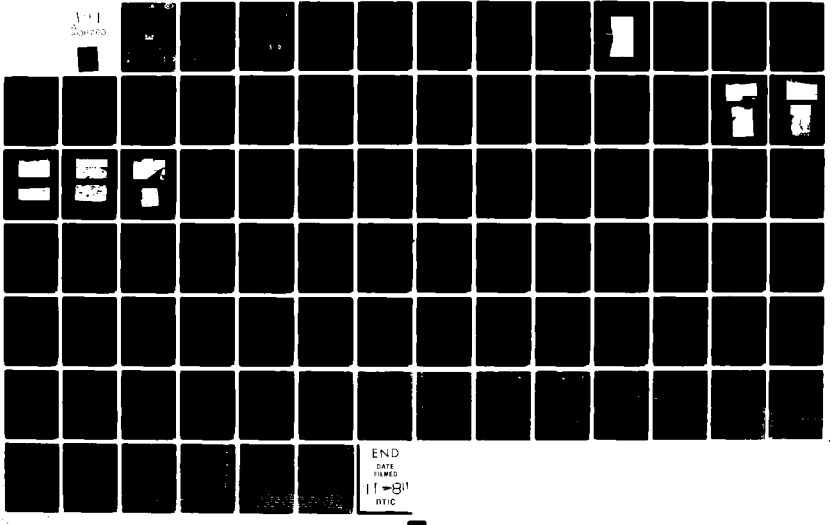

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LEVEL II

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LOWER HUDSON RIVER BASIN

COLD SPRING DAM (LOWER)

PUTNAM COUNTY, NEW YORK

INVENTORY NO. N.Y. 107

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

AD A106760

NEW YORK DISTRICT CORPS OF ENGINEERS

JUNE, 1981

135

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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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
Cold Spring Dam (Lower)
Putnam County
Lower Hudson River Basin

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 did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further engineering investigations.

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Structural stability analyses performed for this report indicate that the factors of safety are below recommended values for all conditions studied. In addition, there was a wet area noted at the downstream toe of the dam which extended for about 100 feet from the edge of the spillway channel toward the left end of the dam.

It is recommended that within 3 months of the date of notification of the owner, further investigations of the structural stability of the dam and of the wet area at the downstream toe should be commenced. These studies should include subsurface explorations to obtain information about the dam's foundation and about uplift forces. This data should then be incorporated into a detailed stability evaluation. Necessary remedial measures to correct both the stability deficiencies and the wet area should be completed within 18 months.

The hydrologic/hydraulic analysis performed indicates that the dam will be overtopped by all storms exceeding 31% of the Probable Maximum Flood (PMF). Stability analyses performed for this structure indicate that when the dam is subjected to the flow resulting from one-half the PMF, the factors of safety are below recommended values. Since the dam is only marginally stable under this loading condition, the spillway capacity has been rated as inadequate.

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, the 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 hydrologic 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
COLD SPRING DAM (LOWER)
I.D.NO. N.Y. 107
LOWER HUDSON RIVER BASIN
PUTNAM.COUNTY, NEW YORK

TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Cold Spring Dam (Lower) (I.D. No. NY-107)
State Located:..	New York
County:	Putnam
Watershed:	Lower Hudson River Basin
Stream:	Foundry Brook
Date of Inspection:	April 22, 1981

ASSESSMENT:

Visual inspection of this dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further engineering investigations.

Structural stability analyses performed for this report indicate that the factors of safety are below recommended values for all conditions studied. In addition, there was a wet area noted at the downstream toe of the dam which extended for about 100 feet from the edge of the spillway channel toward the left end of the dam.

It is recommended that within 3 months of the date of notification of the owner, further investigations of the structural stability of the dam and of the wet area at the downstream toe should be commenced. These studies should include subsurface explorations to obtain information about the dam's foundation and about uplift forces. This data should then be incorporated into a detailed stability evaluation. Necessary remedial measures to correct both the stability deficiencies and the wet area should be completed within 18 months.

The hydrologic/hydraulic analysis performed indicates that the dam will be overtopped by all storms exceeding 31% of the Probable Maximum Flood (PMF). Stability analyses performed for this structure indicate that when the dam is subjected to the flow resulting from one-half the PMF, the factors of safety are below recommended values. Since the dam is only marginally stable under this loading condition, the spillway capacity has been rated as inadequate.

Several other deficiencies were noted on this structure. These deficiencies should be corrected within 12 months of the date of notification of the owner. Among the required actions are the following:

1. Large trees growing along the downstream toe of the dam should be cut.

2. Deteriorated concrete and cracks on the crest should be repaired.

3. An emergency action plan for the notification of downstream residents should be developed and implemented.

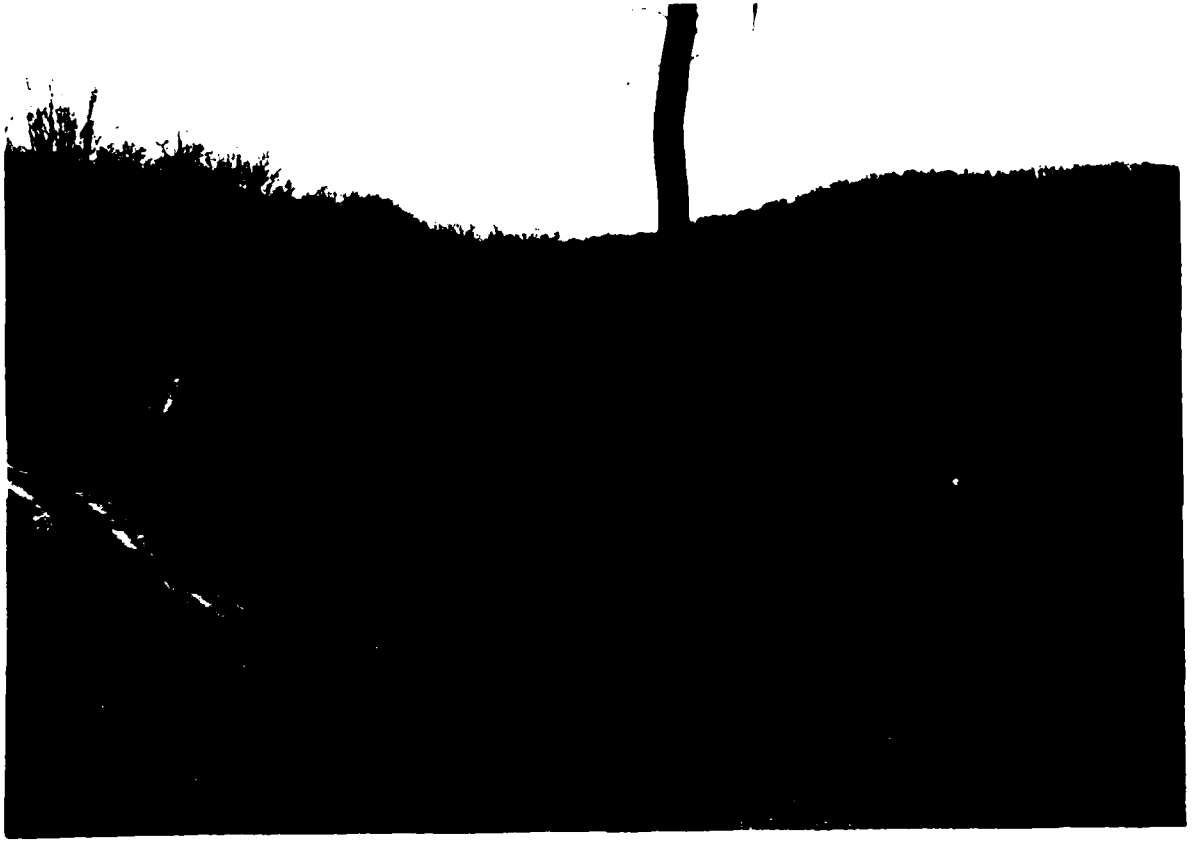
George Koch RW

George Koch
Chief, Dam Safety Section
New York State Department
of Environmental Conservation
NY License No. 45937

Approved By:

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

Date: 26 Aug 81



OVERVIEW
COLD SPRING DAM (LOWER)
I.D. NO. NY-107

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
COLD SPRING DAM (LOWER)
I.D. NO. NY 107
#213-1004L LOWER HUDSON RIVER BASIN
PUTNAM 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, to 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

Cold Spring Dam (Lower) is a laid up stone and concrete dam with an overflow spillway located near the right end of the dam. The dam is 330 feet long and about 20 feet high. The crest width of the dam is 15 feet.

The spillway consists of three openings each approximately 10 feet wide and 2.5 feet high. Openings are separated by concrete piers, each of which are 1.5 feet wide. These piers support a 5 inch thick concrete foot bridge across the top of the spillway.

The dam has a 12 inch diameter low level outlet pipe passing through a rectangular opening at the base of the spillway section. The valve for this pipe is located in a concrete manhole in the reservoir. A short concrete bridge provides access between the dam crest and this manhole. This pipe is used to discharge water from the reservoir when it is required by the water supply system .

b. Location

This dam is located off Lake Surprise Road in the Town of Philipstown. It is approximately one mile west of New York State Route 9 and about 3 miles north of the Village of Cold Spring. The Cold Spring Upper Reservoir is located immediately upstream of this reservoir.

c. Size Classification

This dam is 20 feet high and has a storage capacity of approximately 70 acre-feet. Therefore, the dam is in the small size category as defined by the "Recommended Guidelines for the Safety Inspection of Dams."

d. Hazard Classification

This dam is classified as "high" hazard due to the presence of two homes immediately downstream of the dam and several other residences located adjacent to the stream channel approximately 1 mile downstream of the dam.

e. Ownership

This dam is owned by the Village of Cold Spring whose mayor is Mr. Ronald A. McConville. His address is Cold Spring, New York 10516. His office telephone number is (914) 265-3611.

f. Purpose of Dam

This dam was originally constructed to impound water for the West Point Foundry. It was purchased by the Village of Cold Spring in about 1925 to provide an additional water supply. It continues to be used for this purpose.

g. Design and Construction History

This dam was reportedly constructed in about 1840. It was reconstructed in 1939. Mr. Allan Smith, Professional Engineer of Cold Spring, designed the modifications.

h. Normal Operating Procedures

There are no prescribed operating procedures for this structure. Water, when it is required by the water supply system, is discharged into Foundry Brook.

1.3 PERTINENT DATA

a. Drainage Area (acres)	496
b. Discharge at Dam (cfs)	
Spillway with Water Surface at Top of Dam	365
Low level outlet with water surface at spillway crest	13
c. Elevation (USGS Datum)	
Top of Dam	628.5
Spillway Crest	626.0

d. Reservoir - Surface Area (acres)

Top of Dam	12
Spillway Crest	9

e. Storage Capacity (acre-feet)

Top of Dam	70
Spillway Crest	54

f. Dam

Type: Laid up stone dam covered with concrete on crest and upstream face

Dam Length (ft)	330
Crest Width (ft)	15
Dam Height (ft)	20

g. Spillway

Type: Uncontrolled broad crested weir; divided into three sections which are separated by bridge piers, each section approximately 10 feet wide by 2.5 feet high.

Wier Length (ft)	31.25

h. Low Level Outlet

Type: 12 inch diameter pipe through rectangular opening in dam which outlets at downstream toe; concrete manhole at upstream face contains valve controlling flow through pipe; valve stem extends to top of manhole; access via bridge from dam crest.

Control: Valve is reportedly operational.

SECTION 2: ENGINEERING DATA

2.1 GEOTECHNICAL DATA

a. Geology

The Cold Spring Dam (Lower) is located in the Hudson Hills segment of the New England Uplands physiographic province of New York State. These hills, commonly known as the "Highlands of the Hudson" are composed of crystalline rocks similar to those in the Adirondacks. The highlands, which trend northeast-southwest, have been eroded to form very rugged terrain with summit levels reaching 1000 feet above sea level. Bedrock in the area consists of gneiss, quartzite, and marble from the Precambrian era (more than 570 million years ago). A review of the Brittle Structures Map of New York indicates that there are two faults within one mile of the dam. These are both fault traces, but no further information was available.

Surficial soils in the area consist of glacial drift from the Wisconsin glaciation.

b. Subsurface Investigations

No records of any subsurface investigations performed for this structure were available. An inspection report from 1939 provided some limited foundation information. The dam had been dewatered at the time of this inspection. The report stated that old concrete on rock formed the foundation at the north end of the structure and iron ore (cemented by oxidation) comprises the foundation at the south end.

2.2. DESIGN RECORDS

There were no records available concerning the original design of this structure. An application for reconstruction of the dam and one plan sheet (included in Appendix F) prepared in 1934 were available. The designer of these revisions was Allan Smith, professional engineer of Cold Spring, New York. The files also contained several letters from representatives of the New York State Department of Public Works, who reviewed the reconstruction plans, to the designer. Minor modifications to the design, such as providing a cutoff to impervious strata were suggested in these letters.

There were several discrepancies between the plan sheet and the as-built cross section of the dam. The most substantial revisions were made on the spillway section. A sketch of the existing spillway section was developed from measurements made at the time of the inspection and has been included in Appendix C.

2.3 CONSTRUCTION RECORDS

No construction records were available for this structure.

2.4 OPERATION RECORDS

No operation records were available for this structure.

2.5 EVALUATION OF DATA

Data used for the preparation of this report was obtained from the Department of Environmental Conservation files and from measurements taken during the visual inspection. The plans available did not accurately reflect the as-built conditions. Therefore, measurements made during the inspection were used to perform some of the analyses required for this report.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of the Cold Spring Dam (Lower) was conducted on April 22, 1981. The weather was clear and the temperature was in the fifties. The water level at the time of the inspection was slightly above the spillway crest elevation.

b. Dam

This dam is composed of laid up stone with concrete covering the crest and upstream face. The concrete was in satisfactory condition with only minor cracking and spalling at the joints. One crack was noted near the left end of the dam which extended across the entire width of the dam. There were a few stones which had been displaced on the downstream face but generally the face was in good condition. There were several large trees growing along the downstream toe of the dam.

A wet area was observed on the left end of the dam immediately beyond the downstream toe. This area began at the tree adjacent to the spillway channel and extended 100 feet along the toe toward the left end of the dam. While no flow was observed coming from beneath the dam, there were several places where the wet area extended up to or under the toe. The water from this wet area flowed away from the dam through an 18 inch diameter culvert pipe beneath the road near the left end of the wet area.

c. Spillway

The spillway section, having three openings, was in satisfactory condition. The concrete forming the spillway crest on the two outside openings was in good condition. There was some spalling and cracking in the middle opening. Some concrete deterioration was observed around the bases of the piers supporting the bridge over the spillway. The wingwalls separating the spillway channel from the remainder of the dam was also in good condition.

d. Low Level Outlet and Manhole

The manhole and low level outlet were in satisfactory condition. The valve on the 12 inch outlet pipe was reported to be operable. There was minor deterioration of concrete on the manhole. Inspection of the interior revealed several areas of minor leakage into the structure.

e. Reservoir

There were no signs of soil instability in the reservoir area. The Cold Spring Dam (Upper) formed the upstream limit of this reservoir.

f. Downstream Channel

The spillway discharges into a small pool downstream of the dam. Two 21 inch diameter corrugated metal pipes carried flows under the dirt

road downstream of the dam. Beyond the road, the natural channel meanders through woodlands.

3.2 EVALUATION OF OBSERVATIONS

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

1. A wet area at the downstream toe of the dam extending from the edge of the spillway channel about 100 feet toward the left end of the dam.

2. Several large trees growing along the downstream toe of the dam .

3. Several minor cracks in the concrete on the crest of the dam.

4. Deteriorated concrete in the middle opening of the spillway.

5. Minor deterioration and leakage through concrete on the manhole.

6. Limited discharge capacity of the two pipes under the road downstream of the dam.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

There are no prescribed operating procedures for this dam. The valve on the low level outlet pipe is opened when water is needed for the Village water supply. Water then flows in Foundry Brook to the treatment plant approximately 2.5 miles downstream of the dam.

4.2 MAINTENANCE OF DAM

This dam is maintained by the Village of Cold Spring. There is no established maintenance plan but work is performed as required by village personnel.

4.3 WARNING SYSTEM IN EFFECT

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

4.4 EVALUATION

The operations and maintenance procedures on this dam are generally satisfactory. Some increase in maintenance efforts is needed to correct minor deficiencies which exist on this structure.

SECTION 5: HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

Delineation of the watershed draining into the reservoir pool was made using the USGS 7.5 minute quadrangle sheet for West Point, New York. The 496 acre drainage area consists primarily of forested lands. The Cold Spring Upper Dam controls the upper 464 acres of the drainage area. Relief is relatively steep in the entire drainage area with slopes of up to 50 per cent. Hilltops within the drainage area rise to elevations of up to 475 feet above the normal lake level.

5.2 ANALYSIS CRITERIA

The analysis of the floodwater retarding capability of this dam was performed using the Corps of Engineers' HEC-1 computer program, Dam Safety version. This program used the Snyder Synthetic 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. The PMF event is that hypothetical storm event resulting from the most critical combination of rainfall, minimum soil retention, and direct runoff to a specific site that is considered reasonably possible for a particular watershed. Precipitation values used in the analysis were obtained from the Weather Bureau publication HMR33. Soil retention rates selected were an initial loss of 2.0 inches and a constant loss of 0.16 inches per hour

For the purposes of this analysis, the drainage area for the dam was divided into two sub-basins. The major portion of the watershed (464 acres) is controlled by the Cold Spring Upper Dam. This area was used as one sub-basin and outflows were routed over the dam. The second sub-basin consisted of the 32 acres downstream of the upper dam.

5.3 SPILLWAY CAPACITY

The dam has an ungated spillway near its right end. The spillway is composed of three openings separated by piers which support a concrete foot bridge across the top of the spillway. The spillway was analyzed as a broad crested weir with a discharge coefficient which varied according to head. The effective length of the spillway was reduced to account for turbulence caused by the piers. The computed spillway capacity for the water surface at the top of the dam is 365 cfs.

5.4 RESERVOIR CAPACITY

Surcharge storage capacity of the reservoir between the spillway crest and the top of the dam is estimated to be 16 acre-feet which is equivalent to a direct runoff depth of 0.39 inches over the drainage area. The total storage capacity of the dam is estimated to be 70 acre-feet.

5.5 FLOODS OF RECORD

No information was available regarding the maximum known flood.

5.6 OVERTOPPING POTENTIAL

Analysis using the PMF and one-half the PMF storm events indicates that the dam does not have sufficient spillway capacity. For the PMF, the peak inflow and outflow are both approximately 1225 cfs. The dam would be overtopped to a computed depth of 0.87 feet for this event. The peak inflow and outflow from one-half the PMF are both about 606 cfs and would result in a depth of overtopping of 0.34 ft. All storms exceeding 31% of the PMF will result in the dam being overtopped.

5.7 EVALUATION

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, it has been determined that the dam would be overtopped by all storms exceeding 31% of the PMF. Stability analyses performed indicate that the safety factors are less than desirable when the dam is subjected to storms of this magnitude. However, since the analysis does not indicate that the dam is unstable under these loading conditions, the spillway capacity has been rated as inadequate, rather than a more severe assessment.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual observations revealed no major deficiencies on this structure. Minor cracking and deterioration of concrete was noted on the dam and in the spillway section. There was a wet area which extended for approximately 100 feet along the downstream toe. While no flow was observed coming from beneath the dam, this appeared to be a likely source of the seepage.

b. Data Review and Stability Evaluation

Plans for the 1934 reconstruction of this dam were used in the stability evaluation. However, measurements made at the time of the inspection indicated that the plans do not accurately represent the existing structure. A revised cross section was developed for the structural stability analysis (see Appendix D).

The results of this stability analysis are as follows:

Case	Overturning Safety Factor	Resultant in Middle Third	Sliding Safety Factor
a. Normal conditions, water surface at spillway crest	2.21	Yes	1.89
b. Same as Case a. plus ice load of 5,000 #/ft	1.75	No	1.26
c. 1/2 PMF Flow; water surface 0.34 feet over the top of dam	1.87	No	1.36
d. PMF Flow; water surface 0.87 feet over top of dam	1.84	No	1.29
e. Normal conditions with seismic coefficient	2.15	Yes	1.12

While these analyses do not indicate that the dam is unstable (safety factors below 1.0), they do indicate that the factors of safety are below recommended values (factor of safety for sliding of 3.0 and for overturning resultant force in middle third)for all except normal conditions. A more detailed investigation of the structure is required to better assess the stability of the dam.

This investigation should include subsurface explorations to obtain information about the foundation material and uplift forces. This information should then be incorporated into the stability analysis. Based on the results of this analysis, a determination should be made as to whether modifications to the structure are required.

c. Seismic Stability

This structure is located in Seismic Zone 1. However, a seismic stability analysis was performed in accordance with Corps of Engineer Guidelines. The seismic analysis was performed for normal conditions with the water level at the spillway crest. The results of this analysis (shown on page 11) indicate that the safety factors are below the recommended values although they are above 1.0.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

The Phase I inspection of the Cold Spring Dam (Lower) revealed several deficiencies. The structural stability analysis performed for this dam indicates that safety factors are below recommended values for all conditions studied. In addition, there was a wet area noted at the downstream toe of the dam which extended for about 100 feet from the edge of the spillway channel toward the left end of the dam. Other deficiencies noted, such as deteriorated concrete, were of a minor nature.

This dam will be overtopped by flows resulting from all storms exceeding 31% of the PMF. The stability analyses performed indicate that when the dam is subjected to flows resulting from one-half the PMF, the safety factors are below recommended values. However, the analysis does not indicate that the dam is unstable under these loading conditions. The spillway capacity has, therefore, been rated as inadequate.

b. Adequacy of Information

The information which was available did not accurately reflect all aspects of the structure as it exists. Field measurements made at the time of the inspection uncovered several discrepancies between the plans and the actual dimensions. Revised cross sections based on field measurements were used to perform the analyses for this report. Some of the data used for the hydrologic/hydraulic analysis was based on estimates as well.

c. Need for Additional Investigations

Further investigations of the structural stability of this dam are required. These studies should include subsurface explorations to obtain information about the dam's foundation and uplift forces. This data should then be incorporated into a detailed stability evaluation. Investigations are also required to determine the cause and severity of the wet area at the downstream toe of the dam.

d. Urgency

Investigations of the structural stability and of the wet area should be commenced within 3 months of the date of the notification of the owner. Remedial measures deemed necessary as a result of these investigations should be completed within 18 months. Other deficiencies noted in section 7.2 should be corrected within 12 months of the date of the notification of the owner.

7.2 RECOMMENDED MEASURES

1. After the structural stability analysis has been completed, appropriate remedial measures should be taken.

2. Based on the findings of the investigation into the wet area on the downstream toe, corrective actions should be taken.

3. Large trees growing along the downstream toe of the dam should be cut.

4. Deteriorated concrete and cracks on the crest should be repaired.

5. Minor deterioration and leakage through the concrete on the manhole should be kept under surveillance.

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

APPENDIX A

PHOTOGRAPHS

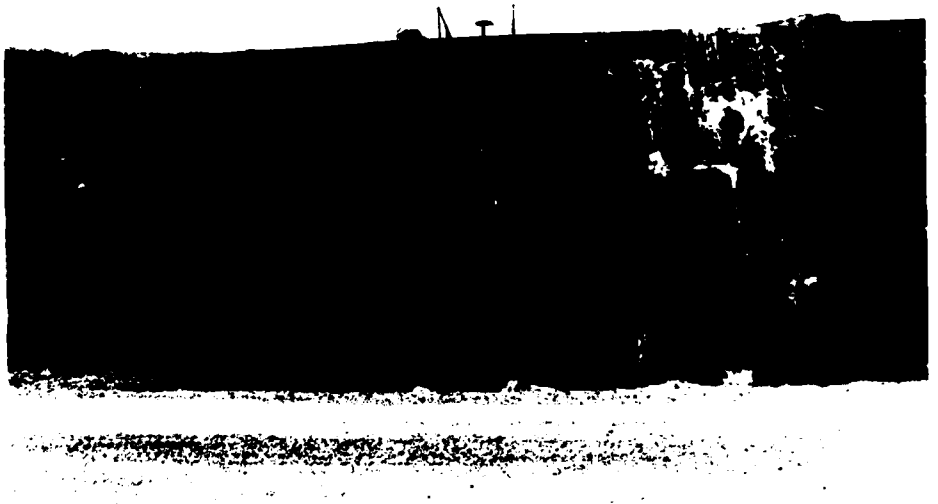
UPSTREAM FACE OF DAM

DOWNSTREAM FACE OF DAM
WET AREA AT TOE OF DAM

VIEW OF CREST FROM LEFT END OF DAM

CRACK IN CONCRETE ON CREST OF DAM

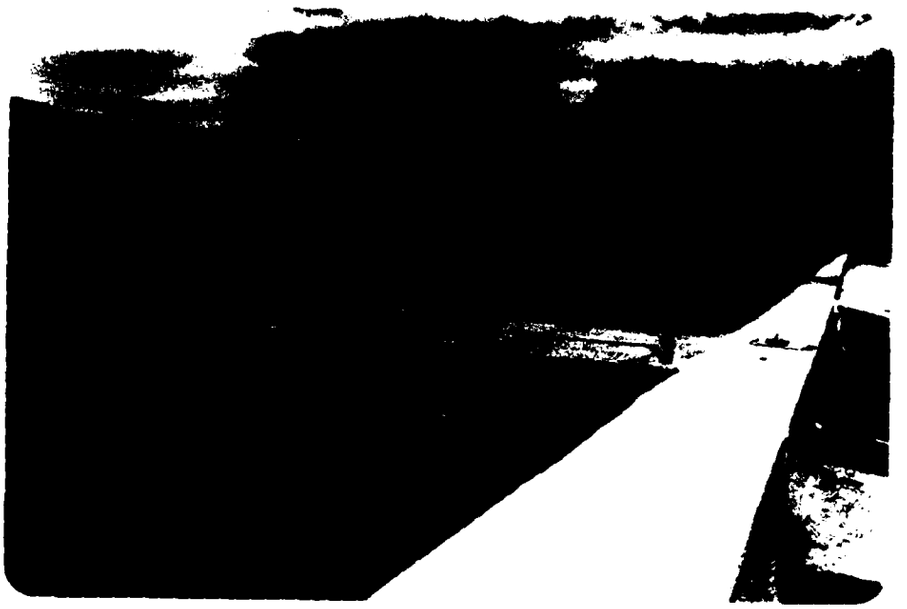
DOWNSTREAM FACE OF DAM; SPILLWAY SECTION
NEAR CENTER OF PICTURE



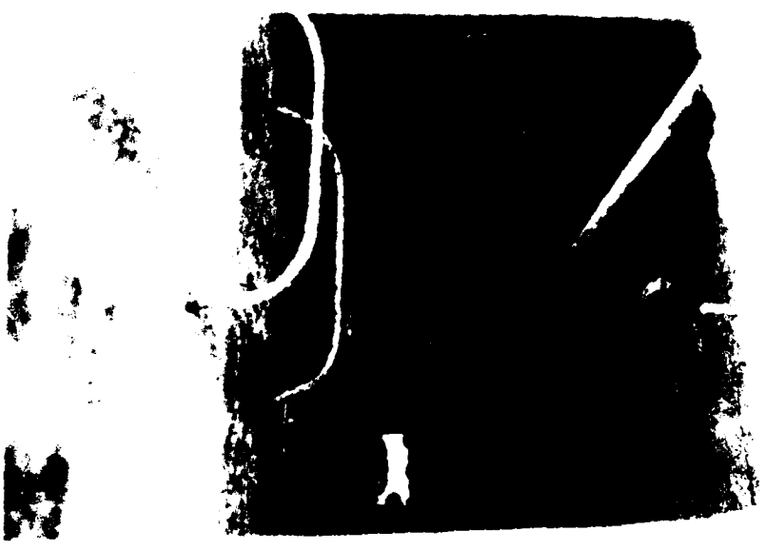
SPILLWAY SECTION; NOTE LOW LEVEL OUTLET PIPE AT
BASE OF DAM

SPILLWAY SECTION OF DAM
LOWER LEVEL OUTLET PIPE AND TWO
CULVERTS UNDER ROAD, DOWNSTREAM OF DAM

LOW LEVEL OUTLET PIPE AT BASE OF SPILLWAY SECTION
NOTE LARGER OPENING WHICH PIPE IS WITHIN



CONCRETE MANHOLE WITH GATE MECHANISM ON
UPSTREAM FACE OF DAM



INTERIOR OF MANHOLE, NOTE MINOR LEAKAGE

AT BASE

APPENDIX B

VISUAL INSPECTION CHECKLIST

93-15-3(9/80)

VISUAL INSPECTION CHECKLIST

1) **Basic Data**

a. General

Name of Dam COLD SPRING DAM (LOWER)

Fed. I.D. # 107 DEC Dam No. #213-1004L

River Basin LOWER HUDSON

Location: Town PHILIPSTOWN County PUTNAM

Stream Name FOUNDARY BROOK

Tributary of

Latitude (N) 41° 27.9′ Longitude (W) 73° 56.3′

Type of Dam MASONRY AND CONCRETE

Hazard Category C

Date(s) of Inspection 4/22/81

Weather Conditions 50° SUNNY

Reservoir Level at Time of Inspection 2.5′ BELOW CREST

b. Inspection Personnel R. WARRENDER W. LYNICK

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

MR. RONALD MC CONVILLE, MAYOR
COLD SPRING, N.Y. 10516
914-265-3611

JOHN BOYNES-CONSULTING ENG.
UPPER STA. ROAD
GARRISON, N.Y. 10524
914-424-3652

d. History:

Date Constructed ABOUT 1840 Date(s) Reconstructed 1939

Designer ALLAN SMITH

Constructed By

Owner VILLAGE OF COLD SPRING

93-15-3(9/80) NO EMBANKMENT - THEREFORE SECTION 2 NOT COMPLETED

(1) Erosion at Contact _____

(2) Seepage Along Contact _____

3) Drainage System

a. Description of System NONE

b. Condition of System _____

c. Discharge from Drainage System _____

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)

NONE

93-15-3(9/80)

5) Reservoir

a. Slopes SATISFACTORY

b. Sedimentation NO MAJOR DEPOSITS NOTED

c. Unusual Conditions Which Affect Dam UPPER DAM IS AT UPSTREAM END OF THIS RESERVOIR

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) 2 HOUSES IMMEDIATELY DOWNSTREAM - SEVERAL OTHERS FURTHER DOWNSTREAM

b. Seepage, Unusual Growth WET AREA ALONG TOE TO LEFT OF SPILLWAY CHANNEL

c. Evidence of Movement Beyond Toe of Dam NONE

d. Condition of Downstream Channel SATISFACTORY - TWO 21" CMP's CARRY FLOWS UNDER DIRT ROAD DOWNSTREAM OF DAM

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

UNCONTROLLED OVERFLOW SECTION

a. General SPILLWAY IN THREE SECTIONS DIVIDED BY CONCRETE PIERS - CONCRETE WALKWAY GOES ACROSS TOP

b. Condition of Service Spillway SATISFACTORY CONDITION WITH ONLY MINOR DETERIORATION - AROUND BASE OF PIERS.

CREST CONCRETE ON TWO OUTSIDE BAYS IN GOOD CONDITION; MIDDLE BAY CONCRETE IS SPALLED AND CRACKED WITH HOLES IN MIDDLE BAY

c. Condition of Auxiliary Spillway NONE

d. Condition of Discharge Conveyance Channel SATISFACTORY

8) Reservoir Drain/Outlet - LOW LEVEL OUTLET

Type: Pipe ✓ Conduit _____ Other _____

Material: Concrete _____ Metal ✓ Other _____

Size: 12" THROUGH RECTANGULAR OPENING Length _____

Invert Elevations: Entrance _____ Exit _____

Physical Condition (Describe): Unobservable ✓

Material: _____

Joints: _____ Alignment _____

Structural Integrity: _____

Hydraulic Capability: _____

Means of Control: Gate _____ Valve ✓ Uncontrolled _____

Operation: Operable ✓ Inoperable _____ Other _____

Present Condition (Describe): PIPE EXTENDS FROM GATEHOUSE ON U.S. FACE TO D.S. FACE OF DAM - SERVES AS WATER SUPPLY LINE

9) **Structural**

a. Concrete Surfaces SATISFACTORY OVERALL - MINOR CRACKING AND SPALLING AT JOINTS

b. Structural Cracking ONE NARROW CRACK EXTENDS ACROSS CREST & DOWN UPSTREAM FACE

c. Movement - Horizontal & Vertical Alignment (Settlement) ALIGNMENT SATISFACTORY WITH ONLY MINOR IRREGULARITIES

d. Junctions with Abutments or Embankments SATISFACTORY - LOW AREA AT LEFT END OF DAM WOULD PERMIT FLOW AROUND END FOR ABOUT 50' BEFORE DAM WAS OVERTOPPED

e. Drains - Foundation, Joint, Face NONE

f. Water Passages, Conduits, Sluices CONDUIT THROUGH RECTANGULAR OPENNING - SEE LOW LEVEL OUTLET SECTION

g. Seepage or Leakage WET AREA AT TOE ON LEFT END - EXTENDS FROM EDGE OF SPILLWAY CHANNEL TOWARD LEFT END FOR ABOUT 100 FEET. NO ACTUAL FLOWS FROM BENEATH DAM WERE NOTED, BUT THERE WERE SEVERAL PLACES WHERE WET AREA WENT NEAR OR UNDER TOE; AREA DRAINS THROUGH CULVERT PIPE UNDER ROAD

h. Joints - Construction, etc. SOME DETERIORATION ON JOINTS

i. Foundation SATISFACTORY

j. Abutments OKAY

k. Control Gates GATE FOR LOW LEVEL OUTLET PIPE IS IN GATE HOUSE ON U.S. FACE - SOME DETERIORATION OF CONCRETE ON GATEHOUSE SOME MINOR LEAKAGE INTO GATEHOUSE

l. Approach & Outlet Channels

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

n. Intake Structures

o. Stability

p. Miscellaneous 6 LARGE TREES IMMEDIATELY DOWNSTREAM OF TOE OF DAM

10) APPURTENANT STRUCTURES - NONE

APPENDIX C

HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS

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	628.5	12	70
2) Design High Water (Max. Design Pool)			
3) ~~Auxiliary~~ Spillway Crest	626.0	9.2	53.7
4) Pool Level with Flashboards			
5) Service Spillway Crest			

DISCHARGES

	Volume (cfs)
1) Average Daily	N/A
2) Spillway @ Maximum High Water	365
3) Spillway @ Design High Water	N/A
4) Spillway @ Auxiliary Spillway Crest Elevation	N/A
5) Low Level Outlet	13
6) Total (of all facilities) @ Maximum High Water	365
7) Maximum Known Flood	N/A
8) At Time of Inspection	N/A

CREST: ELEVATION: 628.5

Type: CONCRETE OVER LAID UP STONE

Width: 15 FT Length: 330 FT

Spillover CONCRETE CHANNEL

Location NEAR RIGHT END OF DAM

SPILLWAY:

SERVICE		AUXILIARY
626	Elevation	N/A
CONCRETE CHANNEL	Type	
31.25 FT	Width	
	Type of Control	
V	Uncontrolled	
	Controlled:	
	Type (Flashboards; gate)	
	Number	
	Size/Length	
	Invert Material	
	Anticipated Length of operating service	
	Chute Length	
	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

HYDROMETEROLOGICAL GAGES:

Type : NONE

Location: _____

Records:

Date - _____

Max. Reading - _____

FLOOD WATER CONTROL SYSTEM:

Warning System: NONE

_____

Method of Controlled Releases (mechanisms):

RELEASE THROUGH LOW LEVEL OUTLET PIPE NEAR BASE OF DAM

DRAINAGE AREA: 496 ACRES 0.77 Sq. Mi

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: FOREST

Terrain - Relief: VERY STEEP

Surface - Soil: ROCK & SHALLOW COVER SOIL

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

NONE

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

NONE

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

NONE

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

Location: NONE

Elevation: _____

Reservoir:

Length @ Maximum Pool _____ (Miles)

Length of Shoreline (@ Spillway Crest) _____ (Miles)

00-15-1 (3/78)
Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
COLD SPRING LOWER RESERVOIR DAM	1		
SUBJECT		**COMPUTED BY**	**DATE**
WATERSHED PARAMETERS		RLW	6/3/81

DRAINAGE AREA - USE 2 SUBBASINS

SUBBASIN No. 1 - DRAINAGE AREA FOR COLD SPRING (UPPER) NY 106

A_1 = 463.7 ACRES = .72 SQ. MI

SUB BASIN No. 2 - DOWNSTREAM OF UPPER DAM

A_2 = 32.2 ACRES = .05 SQ. MI

BASE FLOW:

INITIAL AT 1 CSM = 1 CFS

QRCSN = .1 (10% OF PEAK Q)

PTIOR = 1.5

LOSSES (SOIL INFILTRATION)

UPPER BASIN
INITIAL = 2.0
CONSTANT = 0.16
} FROM CORPS LOWER HUDSON STUDY USING FISHKILL CREEK

LOWER BASIN
INITIAL = 1.0
CONSTANT = 0.1

% IMPERVIOUS = $\frac{9.2 \text{ ACRES}}{32.2 \text{ ACRES}}$ = 0.28 ← % OF BASIN WHICH IS RESERVOIR & HA NO INFILTRATIO

RAINFALL - PMF

REF: HMR #33

ZONE 1

INDEX PMF = 21.4 (200 SQ MI / 24 HR)

ADJUSTMENT FOR TIME & DA	DURATION →	6	12	24	48
	% OF INDEX →	111	123	132	142

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
COLD SPRING LOWER RESERVOIR DAM	2		
SUBJECT		**COMPUTED BY**	**DATE**
WATERSHED PARAMETERS		RLW	6/3/81

SNYDER UNIT HYDROGRAPH PARAMETERS

SUB BASIN 1 - UPPER RESERVOIR

$L = 1.36 mi = 7181 ft$

$L_{CA} = 0.83 mi = 4387 ft$

USE $C_t = 2.4$ ← FROM CORPS LOWER HUDSON BASIN STUDY

LAG TIME (HRS):

$t_p = C_t (L \times L_{CA})^{0.3}$

$= 2.4 [1.36 \cdot 0.83]^{.3} = 2.49$ HRS

UNIT RAINFALL DURATION = $\frac{t_p}{5.5}$

$t_r = \frac{2.49}{5.5} = 0.45$ HRS

$t_r = .45$ hrs ← USE 0.50 HOURS

ADJUSTED LAG TIME (HOURS)

$TP = t_p + .25(t_R - t_r)$

$= 2.49 + .25(.50 - .45) = 2.50$

PEAKING COEFFICIENT

$C_p = 0.44$ - FROM SUB BASIN 5 FRANKLIN CREEK LOWER HUDSON BASIN STUDY

SNYDER COEFFICIENTS

TP = 2.50 CP = 0.44

SUBBASIN 2 - LOWER RESERVOIR

$L = 1400 ft = 0.26 mi$

$L_{CA} = 500 ft = 0.09 mi$

USE $C_t = 2.4$ FROM BASIN STUDY

LAG TIME (HRS):

$t_p = 2.4 [0.26 \cdot 0.09]^{.3} = 0.78$ HRS

UNIT RAINFALL DURATION

$t_r = \frac{0.78}{5.5} = 0.14$

$t_r = 0.14$ hrs ← USE .50 HOURS

ADJUSTED LAG TIME (HOURS)

$TP = 0.78 + .25(.50 - .14) = .87$

PEAKING COEFFICIENT

USE $C_p = 0.625$

SNYDER COEFFICIENTS

TP = 0.87 CP = 0.625

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Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
Cold Spring Lower Reservoir Dam	3		
SUBJECT		**COMPUTED BY**	**DATE**
Stage-Storage & Stage Discharge Data		RLW	6/3/81

Surface Area - (Based on USGS Sheet)

Normal Pool (Elev. 626) = 0.10 in² = 9.2 Acres

Elev 640 Contour Line = 0.15 in² = 13.8 Acres

Computed Storage Capacity

Height To Spillway Crest (Normal Water) = 17.5 ft

$$V = \frac{\text{Area}(\text{Height})}{3} = \frac{9.2 \text{ Acres}(17.5 \text{ ft})}{3} = 53.7 \text{ Ac·Ft}$$

Capacity At 640 Contour

$$V = \frac{(13.8 \text{ Acres})(31.5)}{3} = 144.9 \text{ Ac·Ft}$$

Spillway Discharge

Spillway Will Act As A Broad Crested Weir

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

$$L = L' + 2(NK_p + K_a)H \Rightarrow L = 31.25 - 2[0.04 + .2]H = 31.25 - .48H$$

$L' = 31.25$ $N = 2$ $K_p = 0.02$ $K_a = 0.20$

c → Varies With Head - Use Table 5-3 King & Brater

Take Breadth Of Crest = 2'

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
COLD SPRING LOWER RESERVOIR DAM	4		
SUBJECT		**COMPUTED BY**	**DATE**
SPILLWAY DISCHARGE CURVE		RLW	6/4/81

	ELEVATION	H	L	C	Q (cfs)
	626	0	—	—	—
		0.5	31.01	2.61	28.6
		1	30.77	2.66	81.8
		1.5	30.53	2.83	158.7
		2	30.29	2.85	244.2
TOP OF DAM	628.5	2.5	30.05	3.07	369.7
		3.0	29.81	3.20	495.7
		3.5	29.57	3.32	642.8
		4.0	29.33	3.32	779.0
		5.0	28.85	3.32	1070.9

COMPUTE DISCHARGE CAPACITY OF LOW LEVEL OUTLET PIPE

12 INCH DIAMETER CAST IRON PIPE $L = 30'$ $n = 0.015$ $A = .7854\ ft^2$
$S = 0.0425$

ASSUME INVERTS: INLET - 708.6

OUTLET - 707.5

PIPE FLOW

$$Z_1 + \frac{P_1}{\gamma} + \alpha\frac{V_1^2}{2g} = Z_2 + \frac{P_2}{\gamma} + \alpha\frac{V_2^2}{2g} + \sum h_L$$

$P_1 = 0$ $V_1 \approx 0$ $P_2 = 0$ $h_L = K\frac{V^2}{2g}$

$$Z_1 - Z_2 = \alpha\frac{V_2^2}{2g} + \sum K\frac{V_2^2}{2g}$$

CONTINUED ON NEXT PAGE

00-15-1 (3/78)
Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
COLD SPRING LOWER RESERVOIR DAM	5		
SUBJECT		**COMPUTED BY**	**DATE**
LOW LEVEL OUTLET DISCHARGE COMPUTATIONS		RLW	6/4/81

CALCULATE CAPACITY FOR WATER SURFACE AT SPILLWAY CREST (ELEV. 726)
(ASSUME GATE IS FULLY OPEN)

$$Z_1 - Z_2 = \alpha \frac{V_2^2}{2g} + \sum K \frac{V_2^2}{2g}$$

$$726 - 708.6 = \frac{V_2^2}{2g} + \left[\underset{\text{ENTRANCE}}{.5} + 1.28 + \underset{\text{VALVE}}{0.19} + \underset{\text{EXIT}}{1.0} \right] \frac{V_2^2}{2g}$$

$$17.4 = \left[1 + 2.97 \right] \frac{V_2^2}{2g}$$

$V = 16.8$ fps

$A = .7854$

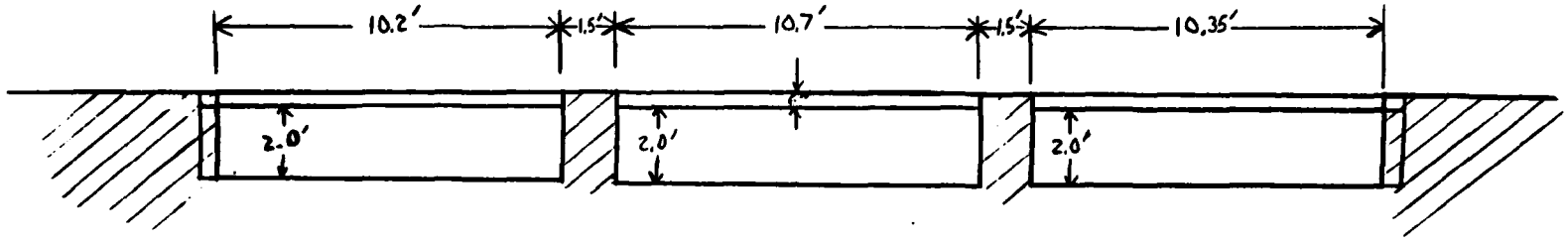
$Q = 13.2$ cfs

COLD SPRING DAM (LOWER)

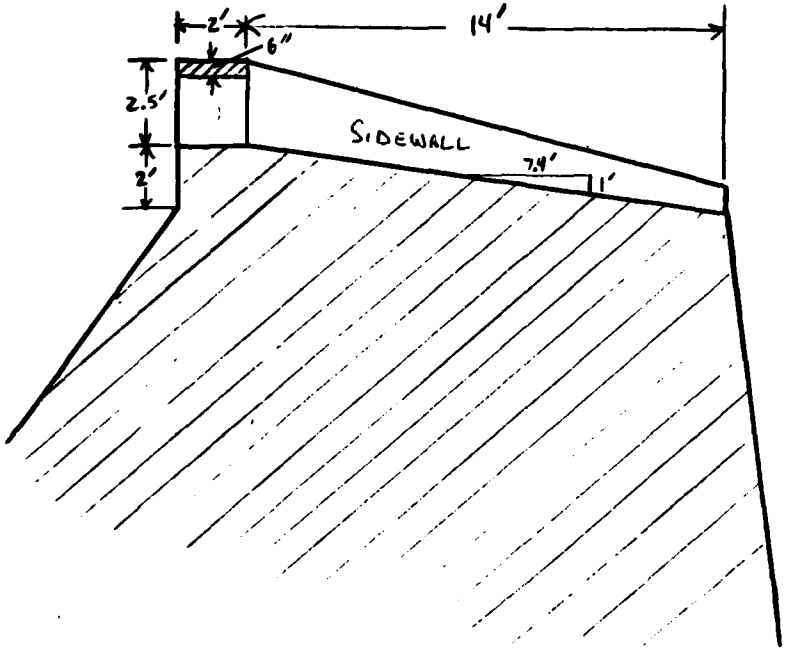
N.Y. 106

SPILLWAY SECTION

SCALE 1" = 5'



CROSS SECTION AT SPILLWAY



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**********                                                    **********
FLOOD HYDROGRAPH PACKAGE (HEC-1)                              NEW YORK STATE
DAM SAFETY VERSION      JULY 1978                             DEPT OF ENVIRONMENTAL CONSERVATION
  LAST MODIFICATION  26 FEB 79                                FLOOD PROTECTION BUREAU
  MODIFIED FOR HONEYWELL APR 79
**********                                                    **********
    1              A1 NY 107 COLD SPRING DAM LOWER
    2              A2 HEC-1 PMF WITH RATIOS
    3              A3 DATE
    4              B    150       0      30       0       0       0       0       0       0       0
    5              B1     5
    6              J      1       4       1
    7              J1   .31     .32     .50     1.0
    8              K      0       1                                       1
    9              K1  INFLOW HYDROGRAPH  UPPER RESERVOIR
   10              M      1      .1     .72                                                       1
   11              P             21.4     111     123     132     142
   12              T                                                     2.0    0.16
   13              W    2.5     .44
   14              X      1      -.1     1.5
   15              K      1   UPDAM                                       1
   16              K1     ROUTED HYDROGRAPH UPPER DAM
   17              Y                              1       1
   18              Y1     1                                             -647      -1
   19              Y4   647     647.5     648     648.5     649     649.4   650.5     652
   20              Y5     0      24.3    59.5     125.4   189.7     247.3   425.8   703.5
   21              $S     0      60.6     211
   22              $E627.25       647     660
   23              $$   647
   24              $D 649.4       2.6     1.5       233
   25              K      0       2                                       1
   26              K1 INFLOW HYDROGRAPH LOWER RESERVOIR                                          .
   27              M      1       1     .05                                                       1
   28              P             21.4     111     123     132     142
   29              T                                                     1.0    0.1     .28
   30              W    .87     .625
```

```
31              X       1     -.1     1.5
32              K       2    COMB                                    1
33              K1 COMBINE HYDROGRAPHS
34              K       1  LCWDAM                                    1
35              K1 ROUTED OUTFLOW LOWER DAM
36              Y                                  1       1
37              Y1      1                                          -626      -1
38              Y4    626   626.5   627.0   627.5   628.0   628.5   629.0   629.5   630.0   631.0
39              Y5      0    28.6    81.8   158.7   244.2   364.7   495.7   642.8   779.0  1070.9
40              $S      0    53.7   144.9
41              $E  608.5   626.0   640.0
42              $$    626
43              $D  628.5     2.6     1.5     296
44              K      99
45              A
46              A
47              A
48              A
49              A
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	UPDAM
RUNOFF HYDROGRAPH AT	2
COMBINE 2 HYDROGRAPHS AT	COMB
ROUTE HYDROGRAPH TO	LOWDAM
END OF NETWORK	

```
**********                                   **********
FLOOD HYDROGRAPH PACKAGE (HEC-1)             NEW YORK STATE
DAM SAFETY VERSION      JULY 1978            DEPT OF ENVIRONMENTAL CONSERVATION
  LAST MODIFICATION  26 FEB 79               FLOOD PRCTECTION BUREAU
  MODIFIED FOR HONEYWELL APR 79
**********                                   **********

RUN  DATE 08/12/81
                    NY 107 COLD SPRING DAM LOWER
                    HEC-1 PMF WITH RATIOS
                    DATE

                                  JOB SPECIFICATION
                 NQ      NHR     NMIN     IDAY     IHR     IMIN    METRC     IPLT     IPRT    NSTAN
                150        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=    0.31     0.32     0.50     1.00


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

                                SUB-AREA RUNOFF COMPUTATION

                    INFLOW HYDROGRAPH  UPPER RESERVOIR
                                 ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                     1       0       0       0       0       0       1       0       0

                                        HYDROGRAPH DATA
                    IHYDG     ILHG    TAREA     SNAP    TRSDA    TRSPC    RATIO   ISNOW   ISAME   LOCAL
                        1        1     0.72       0.     0.72       0.       0.       0       1       0

                                        PRECIP DATA
                              SPFE      PMS       R6      R12      R24      R48      R72      R96
                                0.    21.40   111.00   123.00   132.00   142.00     0.       0.
TRSPC COMPUTED BY THE PROGRAM IS 0.800

                                        LOSS DATA
                LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
                    0       0.       0.     1.00       0.       0.     1.00     2.00     0.16       0.       0.

                                    UNIT HYDROGRAPH DATA
                                TP=  2.50     CP=0.44     NTA=  0

                                    RECESSION DATA
                                STRTQ=    1.00     QRCSN=   -0.10     RTIOR= 1.50
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.40 AND R= 8.09 INTERVALS

                UNIT HYDROGRAPH 46 END-OF-PERIOD ORDINATES, LAG=   2.51 HOURS, CP= 0.44   VOL= 1.00
                    6.      23.      45.      57.      80.      81.      73.      64.      57.      50.
                   44.      39.      35.      31.      27.      24.      21.      19.      17.      15.
                   13.      11.      10.       9.       8.       7.       6.       5.       5.       4.
                    4.       3.       3.       3.       2.       2.       2.       2.       1.       1.
                    1.       1.       1.       1.       1.       1.

0                                   END-OF-PERIOD FLOW
```

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	0.30	1	0.00	0.	0.00	1.	1.02	14.00	76	1.14	1.06	0.08	183.
1.01	1.00	2	0.00	0.	0.00	1.	1.02	14.30	77	1.43	1.35	0.08	258.
1.01	1.30	3	0.00	0.	0.00	1.	1.02	15.00	78	1.43	1.35	0.08	342.
1.01	2.00	4	0.00	0.	0.00	1.	1.02	15.30	79	1.73	1.65	0.08	430.
1.01	2.30	5	0.00	0.	0.00	1.	1.02	16.00	80	5.49	5.41	0.08	546.
1.01	3.00	6	0.00	0.	0.00	1.	1.02	16.30	81	1.33	1.25	0.08	702.
1.01	3.30	7	0.00	0.	0.00	1.	1.02	17.00	82	1.33	1.25	0.08	874.
1.01	4.00	8	0.00	0.	0.00	1.	1.02	17.30	83	1.05	0.97	0.08	1027.
1.01	4.30	9	0.00	0.	0.00	1.	1.02	18.00	84	1.05	0.97	0.08	1128.
1.01	5.00	10	0.00	0.	0.00	1.	1.02	18.30	85	0.08	0.	0.08	1154.
1.01	5.30	11	0.00	0.	0.00	1.	1.02	19.00	86	0.08	0.	0.08	1117.
1.01	6.00	12	0.00	0.	0.00	1.	1.02	19.30	87	0.08	0.	0.08	1048.
1.01	6.30	13	0.01	0.	0.01	1.	1.02	20.00	88	0.08	0.	0.08	958.
1.01	7.00	14	0.01	0.	0.01	1.	1.02	20.30	89	0.08	0.	0.08	858.
1.01	7.30	15	0.01	0.	0.01	1.	1.02	21.00	90	0.08	0.	0.08	759.
1.01	8.00	16	0.01	0.	0.01	1.	1.02	21.30	91	0.08	0.	0.08	671.
1.01	8.30	17	0.01	0.	0.01	1.	1.02	22.00	92	0.08	0.	0.08	593.
1.01	9.00	18	0.01	0.	0.01	0.	1.02	22.30	93	0.08	0.	0.08	524.
1.01	9.30	19	0.01	0.	0.01	0.	1.02	23.00	94	0.08	0.	0.08	463.
1.01	10.00	20	0.01	0.	0.01	0.	1.02	23.30	95	0.08	0.	0.08	405.
1.01	10.30	21	0.01	0.	0.01	0.	1.03	0.	96	0.08	0.	0.08	361.
1.01	11.00	22	0.01	0.	0.01	0.	1.03	0.30	97	0.	0.	0.	319.
1.01	11.30	23	0.01	0.	0.01	0.	1.03	1.00	98	0.	0.	0.	282.
1.01	12.00	24	0.01	0.	0.01	0.	1.03	1.30	99	0.	0.	0.	249.
1.01	12.30	25	0.07	0.	0.07	0.	1.03	2.00	100	0.	0.	0.	220.
1.01	13.00	26	0.07	0.	0.07	0.	1.03	2.30	101	0.	0.	0.	195.
1.01	13.30	27	0.09	0.	0.09	0.	1.03	3.00	102	0.	0.	0.	172.
1.01	14.00	28	0.09	0.	0.09	0.	1.03	3.30	103	0.	0.	0.	152.
1.01	14.30	29	0.11	0.	0.11	0.	1.03	4.00	104	0.	0.	0.	134.
1.01	15.00	30	0.11	0.	0.11	0.	1.03	4.30	105	0.	0.	0.	119.
1.01	15.30	31	0.13	0.	0.13	0.	1.03	5.00	106	0.	0.	0.	112.
1.01	16.00	32	0.42	0.	0.42	0.	1.03	5.30	107	0.	0.	0.	107.
1.01	16.30	33	0.10	0.	0.10	0.	1.03	6.00	108	0.	0.	0.	103.
1.01	17.00	34	0.10	0.	0.10	0.	1.03	6.30	109	0.	0.	0.	99.
1.01	17.30	35	0.08	0.	0.08	0.	1.03	7.00	110	0.	0.	0.	95.
1.01	18.00	36	0.08	0.	0.08	0.	1.03	7.30	111	0.	0.	0.	91.
1.01	18.30	37	0.01	0.	0.01	0.	1.03	8.00	112	0.	0.	0.	88.
1.01	19.00	38	0.01	0.	0.01	0.	1.03	8.30	113	0.	0.	0.	84.
1.01	19.30	39	0.01	0.	0.01	0.	1.03	9.00	114	0.	0.	0.	81.
1.01	20.00	40	0.01	0.	0.01	0.	1.03	9.30	115	0.	0.	0.	78.
1.01	20.30	41	0.01	0.	0.01	0.	1.03	10.00	116	0.	0.	0.	75.
1.01	21.00	42	0.01	0.	0.01	0.	1.03	10.30	117	0.	0.	0.	72.
1.01	21.30	43	0.01	0.	0.01	0.	1.03	11.00	118	0.	0.	0.	69.
1.01	22.00	44	0.01	0.	0.01	0.	1.03	11.30	119	0.	0.	0.	66.
1.01	22.30	45	0.01	0.	0.01	0.	1.03	12.00	120	0.	0.	0.	63.
1.01	23.00	46	0.01	0.	0.01	0.	1.03	12.30	121	0.	0.	0.	61.
1.01	23.30	47	0.01	0.	0.01	0.	1.03	13.00	122	0.	0.	0.	58.
1.02	0.	48	0.01	0.	0.01	0.	1.03	13.30	123	0.	0.	0.	56.
1.02	0.30	49	0.05	0.	0.05	0.	1.03	14.00	124	0.	0.	0.	54.
1.02	1.00	50	0.05	0.	0.05	0.	1.03	14.30	125	0.	0.	0.	52.
1.02	1.30	51	0.05	0.	0.05	0.	1.03	15.00	126	0.	0.	0.	50.
1.02	2.00	52	0.05	0.	0.05	0.	1.03	15.30	127	0.	0.	0.	48.
1.02	2.30	53	0.05	0.	0.05	0.	1.03	16.00	128	0.	0.	0.	46.
1.02	3.00	54	0.05	0.	0.05	0.	1.03	16.30	129	0.	0.	0.	44.
1.02	3.30	55	0.05	0.	0.05	0.	1.03	17.00	130	0.	0.	0.	42.
1.02	4.00	56	0.05	0.	0.05	0.	1.03	17.30	131	0.	0.	0.	41.
1.02	4.30	57	0.05	0.	0.05	0.	1.03	18.00	132	0.	0.	0.	39.
1.02	5.00	58	0.05	0.	0.05	0.	1.03	18.30	133	0.	0.	0.	37.
1.02	5.30	59	0.05	0.	0.05	0.	1.03	19.00	134	0.	0.	0.	36.
1.02	6.00	60	0.05	0.	0.05	0.	1.03	19.30	135	0.	0.	0.	35.

1.02	6.30	61	0.17	0.09	0.08	1.	1.03	20.00	136	0.	0.	0.	33.
1.02	7.00	62	0.17	0.09	0.08	3.	1.03	20.30	137	0.	0.	0.	32.
1.02	7.30	63	0.17	0.09	0.08	7.	1.03	21.00	138	0.	0.	0.	31.
1.02	8.00	64	0.17	0.09	0.08	13.	1.03	21.30	139	0.	0.	0.	29.
1.02	8.30	65	0.17	0.09	0.08	20.	1.03	22.00	140	0.	0.	0.	28.
1.02	9.00	66	0.17	0.09	0.08	28.	1.03	22.30	141	0.	0.	0.	27.
1.02	9.30	67	0.17	0.09	0.08	34.	1.03	23.00	142	0.	0.	0.	26.
1.02	10.00	68	0.17	0.09	0.08	40.	1.03	23.30	143	0.	0.	0.	25.
1.02	10.30	69	0.17	0.09	0.08	45.	1.04	0.	144	0.	0.	0.	24.
1.02	11.00	70	0.17	0.09	0.08	50.	1.04	0.30	145	0.	0.	0.	23.
1.02	11.30	71	0.17	0.09	0.08	54.	1.04	1.00	146	0.	0.	0.	22.
1.02	12.00	72	0.17	0.09	0.08	58.	1.04	1.30	147	0.	0.	0.	21.
1.02	12.30	73	0.95	0.87	0.08	65.	1.04	2.00	148	0.	0.	0.	20.
1.02	13.00	74	0.95	0.87	0.08	86.	1.04	2.30	149	0.	0.	0.	20.
1.02	13.30	75	1.14	1.06	0.08	125.	1.04	3.00	150	0.	0.	0.	19.
									SUM	24.31	19.14	5.17	19255.
										(617.)	(486.)	(131.)	(545.24)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1154.	905.	371.	134.	19251.
CMS	33.	26.	11.	4.	545.
INCHES		11.70	19.17	20.72	20.73
MM		297.14	486.92	526.33	526.45
AC-FT		449.	736.	795.	795.
THOUS CU M		554.	908.	981.	981.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	2.	4.	6.	9.	11.	12.	14.	15.
17.	18.	20.	27.	39.	57.	80.	106.	133.	169.
218.	271.	318.	350.	358.	346.	325.	297.	266.	235.
208.	184.	162.	143.	127.	112.	99.	87.	77.	68.
60.	53.	47.	42.	37.	35.	33.	32.	31.	29.
28.	27.	26.	25.	24.	23.	22.	21.	20.	20.
19.	18.	17.	17.	16.	15.	15.	14.	14.	13.
13.	12.	12.	11.	11.	10.	10.	9.	9.	9.
8.	8.	8.	7.	7.	7.	7.	6.	6.	6.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	358.	291.	115.	41.	5968.
CMS	10.	8.	3.	1.	169.
INCHES		3.63	5.94	6.42	6.43
MM		92.11	150.95	163.16	163.20
AC-FT		139.	228.	247.	247.
THOUS CU M		172.	281.	304.	304.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1154.	905.	371.	134.	19251.
CMS	33.	26.	11.	4.	545.
INCHES		11.70	19.17	20.72	20.73
MM		297.14	486.92	526.33	526.45
AC-FT		449.	736.	795.	795.
THOUS CU M		554.	908.	981.	981.

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HYDROGRAPH ROUTING

ROUTED HYDROGRAPH UPPER DAM

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

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.	0.	0.	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.	0.	0.	-647.	-1

STAGE	647.00	647.50	648.00	648.50	649.00	649.40	650.50	652.00
FLOW	0.	24.30	69.50	125.40	189.70	247.10	425.80	703.90
CAPACITY=	0.	61.	211.					
ELEVATION=	627.	647.	650.					

CREL	SPWID	COGW	EXPW	ELEVL	COQL	CAREA	EXPL
647.0	0.	0.	0.	0.	0.	0.	0.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
649.4	2.6	1.5	233.

STATION UPDAM, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	2.	4.	5.	6.	8.
9.	10.	12.	14.	17.	22.	33.	49.	69.	96.
129.	172.	221.	285.	352.	352.	335.	311.	283.	256.
239.	221.	202.	182.	165.	148.	132.	118.	106.	95.
85.	76.	68.	61.	55.	50.	45.	42.	39.	36.
34.	33.	31.	29.	28.	27.	26.	25.	24.	23.
23.	22.	21.	21.	20.	19.	19.	18.	17.	17.
16.	15.	15.	14.	14.	13.	13.	12.	12.	11.
11.	10.	10.	10.	9.	9.	9.	8.	8.	8.

X

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH LOWER RESERVOIR

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	ILHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	0.05	0.	0.05	0.	0.	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.	21.40	111.00	123.00	132.00	142.00	0.	0.

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.	0.	1.00	0.	0.	1.00	1.00	0.10	0.28	0.

UNIT HYDROGRAPH DATA

TP= 0.87 CP=0.63 NTA= 0

RECESSION DATA

STRTQ= 1.00 QRCSN= -0.10 RTIOR= 1.50

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 2.00 AND R= 1.38 INTERVALS

UNIT HYDROGRAPH 9 END-OF-PERIOD ORDINATES, LAG= 0.86 HOURS, CP= 0.62 VOL= 1.00

9. 21. 19. 9. 4. 2. 1. 0. 0.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	0.30	1	0.00	0.	0.00	1.	1.02	14.00	76	1.14	1.09	0.05	58.
1.01	1.00	2	0.00	0.	0.00	1.	1.02	14.30	77	1.43	1.38	0.05	67.
1.01	1.30	3	0.00	0.	0.00	1.	1.02	15.00	78	1.43	1.38	0.05	76.
1.01	2.00	4	0.00	0.	0.00	1.	1.02	15.30	79	1.73	1.68	0.05	85.
1.01	2.30	5	0.00	0.	0.00	1.	1.02	16.00	80	5.49	5.44	0.05	127.
1.01	3.00	6	0.00	0.	0.00	1.	1.02	16.30	81	1.33	1.28	0.05	178.
1.01	3.30	7	0.00	0.	0.00	1.	1.02	17.00	82	1.33	1.28	0.05	163.
1.01	4.00	8	0.00	0.	0.00	1.	1.02	17.30	83	1.05	1.00	0.05	118.
1.01	4.30	9	0.00	0.	0.00	1.	1.02	18.00	84	1.05	1.00	0.05	92.
1.01	5.00	10	0.00	0.	0.00	1.	1.02	18.30	85	0.08	0.03	0.05	69.
1.01	5.30	11	0.00	0.	0.00	1.	1.02	19.00	86	0.08	0.03	0.05	41.
1.01	6.00	12	0.00	0.	0.00	1.	1.02	19.30	87	0.08	0.03	0.05	20.
1.01	6.30	13	0.01	0.	0.01	1.	1.02	20.00	88	0.08	0.03	0.05	17.
1.01	7.00	14	0.01	0.	0.01	1.	1.02	20.30	89	0.08	0.03	0.05	17.
1.01	7.30	15	0.01	0.	0.01	1.	1.02	21.00	90	0.08	0.03	0.05	16.
1.01	8.00	16	0.01	0.	0.01	1.	1.02	21.30	91	0.08	0.03	0.05	15.
1.01	8.30	17	0.01	0.	0.01	1.	1.02	22.00	92	0.08	0.03	0.05	15.
1.01	9.00	18	0.01	0.	0.01	0.	1.02	22.30	93	0.08	0.03	0.05	14.
1.01	9.30	19	0.01	0.	0.01	0.	1.02	23.00	94	0.08	0.03	0.05	14.
1.01	10.00	20	0.01	0.	0.01	0.	1.02	23.30	95	0.08	0.03	0.05	13.
1.01	10.30	21	0.01	0.	0.01	0.	1.03	0.	96	0.08	0.03	0.05	12.
1.01	11.00	22	0.01	0.	0.01	0.	1.03	0.30	97	0.	0.	0.	12.
1.01	11.30	23	0.01	0.	0.01	0.	1.03	1.00	98	0.	0.	0.	12.
1.01	12.00	24	0.01	0.	0.01	0.	1.03	1.30	99	0.	0.	0.	11.
1.01	12.30	25	0.07	0.	0.07	0.	1.03	2.00	100	0.	0.	0.	11.
1.01	13.00	26	0.07	0.	0.07	0.	1.03	2.30	101	0.	0.	0.	10.

1.01	13.30	27	0.09	0.	0.09	0.	1.03	3.00	102	0.	0.	0.	10.
1.01	14.00	28	0.09	0.	0.09	0.	1.03	3.30	103	0.	0.	0.	9.
1.01	14.30	29	0.11	0.	0.11	0.	1.03	4.00	104	0.	0.	0.	9.
1.01	15.00	30	0.11	0.	0.11	0.	1.03	4.30	105	0.	0.	0.	9.
1.01	15.30	31	0.13	0.	0.13	0.	1.03	5.00	106	0.	0.	0.	8.
1.01	16.00	32	0.42	0.28	0.14	3.	1.03	5.30	107	0.	0.	0.	8.
1.01	16.30	33	0.10	0.05	0.05	7.	1.03	6.00	108	0.	0.	0.	8.
1.01	17.00	34	0.10	0.05	0.05	7.	1.03	6.30	109	0.	0.	0.	7.
1.01	17.30	35	0.08	0.03	0.05	5.	1.03	7.00	110	0.	0.	0.	7.
1.01	18.00	36	0.08	0.03	0.05	4.	1.03	7.30	111	0.	0.	0.	7.
1.01	18.30	37	0.01	0.	0.01	3.	1.03	8.00	112	0.	0.	0.	7.
1.01	19.00	38	0.01	0.	0.01	2.	1.03	8.30	113	0.	0.	0.	6.
1.01	19.30	39	0.01	0.	0.01	1.	1.03	9.00	114	0.	0.	0.	6.
1.01	20.00	40	0.01	0.	0.01	1.	1.03	9.30	115	0.	0.	0.	6.
1.01	20.30	41	0.01	0.	0.01	1.	1.03	10.00	116	0.	0.	0.	6.
1.01	21.00	42	0.01	0.	0.01	1.	1.03	10.30	117	0.	0.	0.	5.
1.01	21.30	43	0.01	0.	0.01	1.	1.03	11.00	118	0.	0.	0.	5.
1.01	22.00	44	0.01	0.	0.01	1.	1.03	11.30	119	0.	0.	0.	5.
1.01	22.30	45	0.01	0.	0.01	1.	1.03	12.00	120	0.	0.	0.	5.
1.01	23.00	46	0.01	0.	0.01	1.	1.03	12.30	121	0.	0.	0.	5.
1.01	23.30	47	0.01	0.	0.01	1.	1.03	13.00	122	0.	0.	0.	4.
1.02	0.	48	0.01	0.	0.01	0.	1.03	13.30	123	0.	0.	0.	4.
1.02	0.30	49	0.05	0.00	0.05	0.	1.03	14.00	124	0.	0.	0.	4.
1.02	1.00	50	0.05	0.00	0.05	0.	1.03	14.30	125	0.	0.	0.	4.
1.02	1.30	51	0.05	0.00	0.05	0.	1.03	15.00	126	0.	0.	0.	4.
1.02	2.00	52	0.05	0.00	0.05	0.	1.03	15.30	127	0.	0.	0.	4.
1.02	2.30	53	0.05	0.00	0.05	0.	1.03	16.00	128	0.	0.	0.	3.
1.02	3.00	54	0.05	0.00	0.05	0.	1.03	16.30	129	0.	0.	0.	3.
1.02	3.30	55	0.05	0.00	0.05	0.	1.03	17.00	130	0.	0.	0.	3.
1.02	4.00	56	0.05	0.00	0.05	0.	1.03	17.30	131	0.	0.	0.	3.
1.02	4.30	57	0.05	0.00	0.05	0.	1.03	18.00	132	0.	0.	0.	3.
1.02	5.00	58	0.05	0.00	0.05	0.	1.03	18.30	133	0.	0.	0.	3.
1.02	5.30	59	0.05	0.00	0.05	0.	1.03	19.00	134	0.	0.	0.	3.
1.02	6.00	60	0.05	0.00	0.05	0.	1.03	19.30	135	0.	0.	0.	3.
1.02	6.30	61	0.17	0.12	0.05	1.	1.03	20.00	136	0.	0.	0.	2.
1.02	7.00	62	0.17	0.12	0.05	4.	1.03	20.30	137	0.	0.	0.	2.
1.02	7.30	63	0.17	0.12	0.05	6.	1.03	21.00	138	0.	0.	0.	2.
1.02	8.00	64	0.17	0.12	0.05	7.	1.03	21.30	139	0.	0.	0.	2.
1.02	8.30	65	0.17	0.12	0.05	7.	1.03	22.00	140	0.	0.	0.	2.
1.02	9.00	66	0.17	0.12	0.05	8.	1.03	22.30	141	0.	0.	0.	2.
1.02	9.30	67	0.17	0.12	0.05	8.	1.03	23.00	142	0.	0.	0.	2.
1.02	10.00	68	0.17	0.12	0.05	8.	1.03	23.30	143	0.	0.	0.	2.
1.02	10.30	69	0.17	0.12	0.05	8.	1.04	0.	144	0.	0.	0.	2.
1.02	11.00	70	0.17	0.12	0.05	8.	1.04	0.30	145	0.	0.	0.	2.
1.02	11.30	71	0.17	0.12	0.05	8.	1.04	1.00	146	0.	0.	0.	2.
1.02	12.00	72	0.17	0.12	0.05	8.	1.04	1.30	147	0.	0.	0.	2.
1.02	12.30	73	0.95	0.90	0.05	15.	1.04	2.00	148	0.	0.	0.	2.
1.02	13.00	74	0.95	0.90	0.05	31.	1.04	2.30	149	0.	0.	0.	1.
1.02	13.30	75	1.14	1.09	0.05	47.	1.04	3.00	150	0.	0.	0.	1.
									SUM	24.31	20.63	3.68	1728.
										(617.)	(524.)	(93.)	(48.53)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	178.	93.	32.	12.	1723.
CMS	5.	3.	1.	0.	49.
INCHES		17.30	23.66	26.65	26.71
MM		439.45	601.03	676.84	678.56
AC-FT		46.	63.	71.	71.
THOUS CU M		57.	78.	88.	88.

37.	36.	34.	33.	32.	30.	29.	28.	27.	26.
25.	25.	24.	23.	22.	22.	21.	20.	20.	19.
18.	18.	17.	16.	16.	15.	14.	14.	13.	13.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	609.	472.	200.	72.	10417.
CMS	17.	13.	6.	2.	295.
INCHES		5.71	9.66	10.48	10.49
MM		144.95	245.33	266.30	266.39
AC-FT		234.	396.	430.	430.
THOUS CU M		289.	489.	531.	531.

SUM OF 2 HYDROGRAPHS AT COMB PLAN 1 RTIO 4

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	3.	7.	7.	5.	4.	3.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.
1.	4.	7.	9.	12.	15.	19.	23.	28.	32.
40.	46.	59.	84.	115.	154.	206.	276.	391.	629.
826.	986.	1105.	1197.	1221.	1172.	1087.	1000.	902.	803.
712.	632.	561.	498.	443.	394.	351.	313.	280.	256.
240.	221.	200.	182.	164.	149.	137.	128.	122.	116.
110.	105.	101.	97.	93.	89.	85.	82.	79.	75.
73.	70.	68.	65.	63.	60.	58.	56.	54.	51.
49.	47.	46.	44.	42.	40.	39.	37.	36.	34.
33.	32.	30.	29.	28.	27.	26.	25.	25.	24.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1221.	970.	401.	145.	20845.
CMS	35.	27.	11.	4.	590.
INCHES		11.72	19.37	20.98	20.99
MM		297.73	491.90	532.87	533.03
AC-FT		481.	795.	861.	861.
THOUS CU M		593.	980.	1062.	1062.

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HYDROGRAPH ROUTING

ROUTED OUTFLOW LOWER DAM

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LOWDAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.	0.	0.	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.	0.	0.	-626.	-1

STAGE	625.00	626.50	627.00	627.50	628.00	628.50	629.00	629.50	630.00	631.00
FLOW	0.	28.60	91.80	158.70	244.20	364.70	495.70	642.80	779.00	1070.90
CAPACITY=	0.	54.	145.							

ELEVATION= 609. 626. 640.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
626.0	0.	0.	0.	0.	0.	0.	0.

DAM DATA

TOPEL	COOD	EXPD	DAMWID
628.5	2.6	1.5	296.

STATION LOWDAM, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

CUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	2.	3.	3.	4.	6.	7.
8.	9.	11.	13.	18.	23.	31.	47.	66.	94.
137.	182.	223.	272.	334.	364.	355.	332.	307.	279.
255.	239.	223.	204.	185.	168.	151.	137.	123.	111.
99.	89.	80.	74.	67.	61.	56.	51.	47.	43.
40.	38.	36.	34.	32.	31.	29.	28.	28.	27.
26.	25.	25.	24.	23.	22.	22.	21.	20.	20.
19.	18.	18.	17.	16.	16.	15.	15.	14.	13.
13.	12.	12.	12.	11.	11.	10.	10.	9.	9.

STORAGE

54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
55.	55.	55.	55.	56.	56.	57.	58.	59.	61.
63.	64.	66.	67.	69.	70.	70.	69.	68.	68.
67.	67.	66.	65.	64.	64.	63.	63.	62.	61.
61.	61.	60.	60.	59.	59.	59.	58.	58.	58.
58.	58.	57.	57.	57.	57.	57.	57.	57.	57.
57.	57.	57.	56.	56.	56.	56.	56.	56.	56.
56.	56.	56.	56.	56.	55.	55.	55.	55.	55.
55.	55.	55.	55.	55.	55.	55.	55.	55.	55.

STAGE

626.0	626.0	626.0	625.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	625.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	625.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	625.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	626.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	625.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	625.0	626.0	626.0	626.1	625.1	626.1	626.1
626.1	626.2	626.2	625.2	626.3	626.4	626.5	625.7	626.9	627.1
627.4	627.6	627.9	628.1	628.4	628.5	628.5	628.4	628.3	628.1
628.0	628.0	627.5	627.8	627.7	627.6	627.5	627.4	627.3	627.2
627.1	627.0	627.0	626.9	626.9	626.8	626.8	625.7	626.7	626.6
626.6	626.6	626.6	625.6	626.5	626.5	626.5	625.5	626.5	626.5

626.1	626.2	626.2	626.2	626.3	626.4	626.5	626.7	626.9	627.1
627.4	627.7	627.9	628.2	628.4	628.5	628.5	628.4	628.3	628.2
628.1	628.0	627.9	627.8	627.7	627.6	627.5	627.4	627.3	627.2
627.1	627.1	627.0	626.9	626.9	626.8	626.8	626.7	626.7	626.7
626.6	626.6	626.6	626.6	626.5	626.5	626.5	626.5	626.5	626.5
626.5	626.5	626.4	626.4	626.4	626.4	626.4	626.4	626.4	626.4
626.3	626.3	626.3	626.3	626.3	626.3	626.3	626.3	626.3	626.2
626.2	626.2	626.2	626.2	626.2	626.2	626.2	626.2	626.2	626.2

PEAK OUTFLOW IS 382. AT TIME 43.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	382.	291.	127.	46.	6643.
CMS	11.	8.	4.	1.	188.
INCHES		3.52	6.14	6.69	6.69
MM		89.28	155.97	169.84	169.87
AC-FT		144.	252.	274.	275.
THOUS CU M		178.	311.	339.	339.

STATION LOWDAM, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	2.	3.	4.	6.	7.	9.	11.
13.	15.	17.	22.	29.	45.	64.	83.	127.	175.
244.	356.	530.	588.	606.	595.	554.	513.	467.	419.
376.	345.	311.	279.	255.	238.	222.	203.	185.	167.
151.	136.	123.	110.	99.	85.	81.	75.	71.	67.
63.	59.	57.	54.	51.	49.	47.	45.	43.	41.
40.	38.	36.	35.	34.	32.	31.	30.	29.	28.
27.	26.	26.	25.	24.	24.	23.	22.	22.	21.
20.	19.	19.	18.	17.	17.	16.	16.	15.	14.

STORAGE

54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	55.	55.	55.
55.	55.	56.	56.	57.	58.	59.	61.	62.	64.
67.	70.	72.	72.	72.	72.	72.	72.	71.	71.
70.	69.	69.	68.	67.	67.	66.	65.	64.	64.
63.	63.	62.	61.	61.	61.	60.	60.	60.	59.
59.	59.	59.	59.	58.	58.	58.	58.	58.	58.
58.	58.	57.	57.	57.	57.	57.	57.	57.	57.
57.	57.	57.	57.	56.	56.	56.	56.	56.	56.
56.	56.	56.	56.	56.	56.	56.	55.	55.	55.

STAGE

626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0
626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0

626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0
626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0
626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0
626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0	626.0
626.0	626.0	626.0	626.0	626.1	626.1	626.1	626.1	626.2	626.2
626.2	626.3	626.3	626.4	626.5	626.7	626.8	627.0	627.3	627.6
628.0	628.5	628.8	628.8	628.8	628.8	628.8	628.7	628.7	628.6
628.5	628.4	628.3	628.1	628.0	628.0	627.9	627.8	627.7	627.5
627.4	627.4	627.3	627.2	627.1	627.0	627.0	626.9	626.9	626.9
626.8	626.8	626.8	626.7	626.7	626.7	626.7	626.7	626.6	626.6
626.6	626.6	626.6	626.6	626.5	626.5	626.5	626.5	626.5	626.5
626.5	626.5	626.5	626.4	626.4	626.4	626.4	626.4	626.4	626.4
626.4	626.3	626.3	626.3	626.3	626.3	626.3	626.3	626.3	626.3

PEAK OUTFLOW IS 606. AT TIME 42.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	606.	469.	199.	72.	10379.
CMS	17.	13.	6.	2.	294.
INCHES		5.66	9.64	10.45	10.45
MM		143.83	244.81	265.35	265.40
AC-FT		232.	396.	429.	429.
THOUS CU M		287.	488.	529.	529.

STATION LOWDAM, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	4.	4.	4.	4.	4.	3.	2.
2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.
1.	1.	3.	4.	6.	9.	11.	14.	18.	22.
28.	33.	43.	58.	79.	114.	158.	216.	312.	552.
820.	956.	1100.	1183.	1225.	1180.	1059.	1010.	916.	816.
725.	644.	573.	509.	454.	405.	365.	336.	302.	273.
251.	235.	218.	199.	181.	164.	150.	139.	130.	122.
115.	111.	106.	101.	97.	93.	89.	85.	82.	79.
77.	74.	71.	69.	66.	64.	62.	59.	57.	55.
53.	50.	45.	47.	45.	43.	41.	40.	38.	37.
35.	34.	32.	31.	30.	29.	28.	27.	27.	26.

STORAGE

54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
54.	54.	54.	54.	54.	55.	55.	55.	56.	56.
57.	57.	58.	59.	60.	62.	63.	66.	69.	72.
74.	74.	75.	75.	76.	75.	75.	75.	74.	74.
73.	72.	72.	71.	71.	71.	70.	69.	68.	68.
67.	66.	66.	65.	64.	64.	63.	63.	62.	62.
62.	61.	61.	61.	61.	61.	61.	60.	60.	60.
60.	60.	60.	59.	59.	59.	59.	59.	59.	59.
58.	58.	58.	58.	58.	58.	58.	58.	58.	57.

57.	57.	57.	57.	57.	57.	57.	57.	57.	57.
				STAGE					
626.0	626.0	626.0	625.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	626.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	625.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	626.1	626.1	626.1	626.1	625.1	626.1	626.0
626.0	626.0	626.0	626.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	626.0	626.0	626.0	626.0	625.0	626.0	626.0
626.0	626.0	626.0	626.1	626.1	626.2	626.2	625.3	626.3	626.4
626.5	626.5	626.6	625.8	627.0	627.2	627.5	627.8	628.3	628.8
629.0	629.2	629.3	629.3	629.4	629.3	629.3	629.2	629.1	629.0
629.0	628.9	628.8	628.7	628.7	628.6	628.5	628.4	628.2	628.1
628.0	627.9	627.8	627.7	627.6	627.5	627.4	627.4	627.3	627.3
627.2	627.2	627.2	627.1	627.1	627.1	627.0	627.0	627.0	627.0
627.0	626.9	626.9	626.9	626.9	626.8	626.8	626.8	626.8	626.7
626.7	626.7	626.7	626.7	626.7	626.6	626.6	625.6	626.6	626.6
626.6	626.5	626.5	625.5	626.5	626.5	626.5	625.5	626.5	626.5

PEAK OUTFLOW IS 1225. AT TIME 42.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1225.	969.	400.	144.	20776.
CMS	35.	27.	11.	4.	588.
INCHES		11.71	19.35	20.91	20.92
MM		297.33	491.39	531.16	531.27
AC-FT		480.	794.	858.	859.
THOUS CU M		593.	979.	1059.	1059.

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

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4
				RATIOS APPLIED TO FLOWS			
				0.31	0.32	0.50	1.00
HYDROGRAPH AT	1	0.72	1	338.	369.	577.	1154.
		(0.23E 18)		(10.13)(	10.46)(	16.34)(	32.69)(
ROUTED TO	UPDAM	0.72	1	352.	366.	574.	1152.
		(0.12E 25)		(9.97)(	10.35)(	16.26)(	32.63)(
HYDROGRAPH AT	2	0.05	1	55.	57.	89.	178.
		(0.42E 18)		(1.56)(	1.62)(	2.52)(	5.05)(
2 COMBINED	COMB	0.77	1	373.	388.	609.	1221.
		(0.00)		(10.57)(	10.97)(	17.23)(	34.58)(
ROUTED TO	LOWDAM	0.77	1	354.	382.	606.	1225.
		(0.12E 25)		(10.32)(	10.82)(	17.15)(	34.68)(

SUMMARY OF DAM SAFETY ANALYSIS

COLD SPRING UPPER DAM
NY 106

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	647.00	647.00	649.40
STORAGE	61.	61.	88.
OUTFLOW	0.	0.	247.

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
0.31	649.63	0.23	91.	352.	3.50	43.00	0.
0.32	649.65	0.25	91.	366.	3.50	42.50	0.
0.50	649.94	0.54	95.	574.	8.50	42.50	0.
1.00	650.52	1.12	101.	1152.	10.50	42.50	0.

COLD SPRING DAM (LOWER)
NY107

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	626.00	626.00	628.50
STORAGE	54.	54.	70.
OUTFLOW	0.	0.	365.

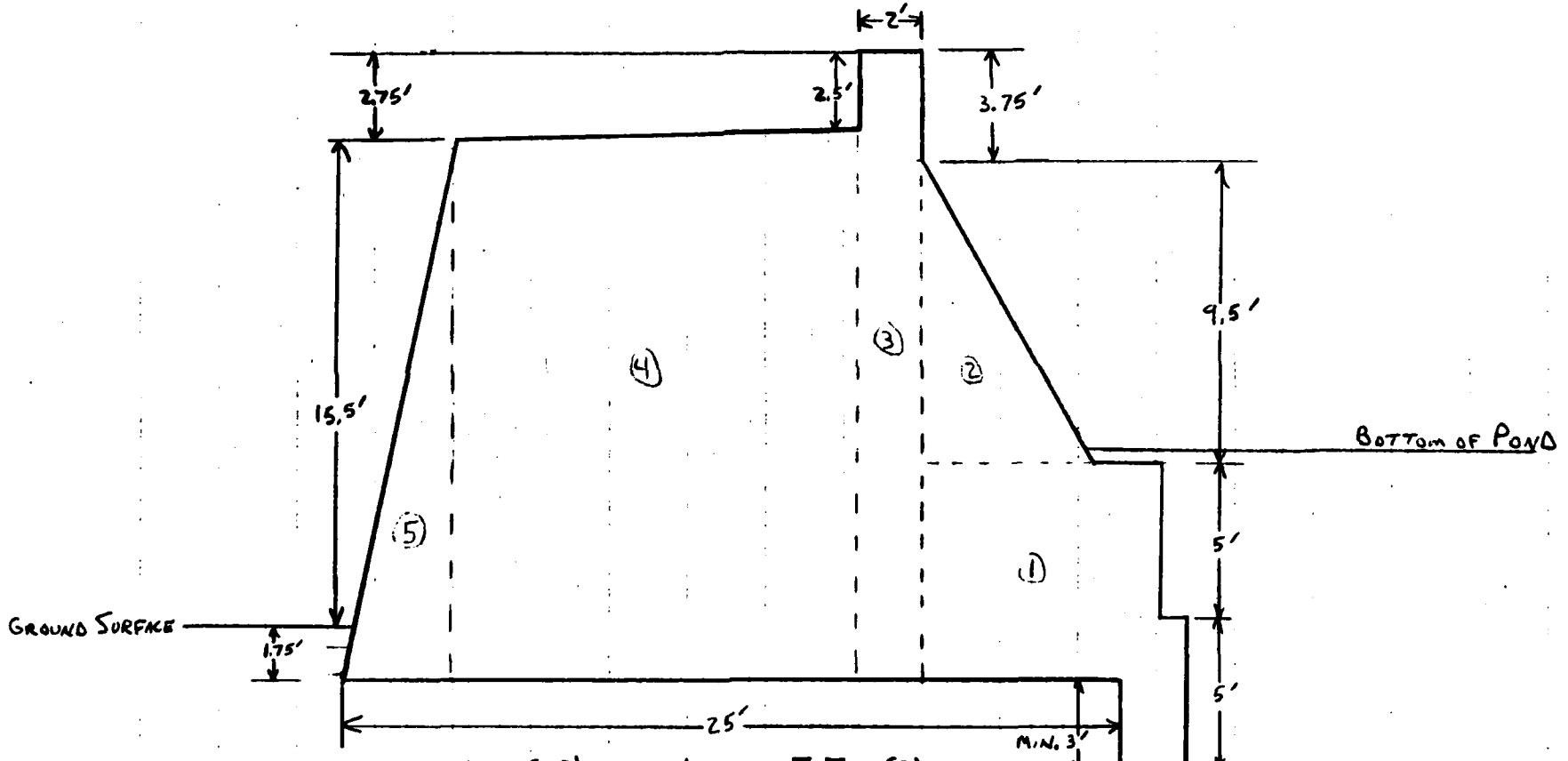
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.31	628.50	0.	70.	364.	0.	43.00	0.
0.32	628.54	0.04	70.	382.	0.50	43.00	0.
0.50	628.84	0.34	72.	606.	4.50	42.50	0.
1.00	629.37	0.87	76.	1225.	9.00	42.50	0.

APPENDIX D

STABILITY COMPUTATIONS

COLD SPRING LOWER RESERVOIR DAM

SCALE 1"=5'



SEGMENT	AREA (ft^2)	DISTANCE TO TOE (ft)
①	(7)(8.5) = 59.5	22.75
②	½(9.5)(5.5) = 26.1	20.33
③	(20.0)(2) = 40.0	17.5
④	(17.5)(13) = 227.5	10
⑤	½(17.25)(3.5) = 30.2	2.33

STRUCTURAL STABILITY ANALYSIS

Analysis was based on cross section shown on plans with minor modifications based on measurements made at time of the inspection. The cross section used is shown on the following page. A normal analysis was performed, including an overturning analysis, since the dam has a composite cross section consisting of both concrete and laid-up stone. Due to unknown foundation conditions, full uplift pressure was assumed at the upstream toe, decreasing to tailwater pressure at the downstream toe.

ANALYSIS CONDITIONS

1. Normal conditions, water surface at spillway crest.
2. Same as #1 plus ice load of 5,000 pounds per linear foot.
3. ½PMF Flow - water surface 0.34 feet above the top of the dam.
4. PMF Flow - water surface 0.87 feet above the top of the dam.
5. Normal conditions with seismic coefficient of 0.1.

COLD SPRING DAM (LOWER)

STABILITY ANALYSIS PROGRAM - WORK SHEET

INPUT ENTRY		ANALYSIS CONDITION 1	2	3	4	5
Unit Weight of Dam (K/ft^3)	0	0.15	0.15	0.15	0.15	0.15
Area of Segment No. 1 (ft^2)	1	59.5	59.5	59.5	59.5	59.5
Distance from Center of Gravity of Segment No. 1 to Downstream Toe (ft)	2	22.75	22.75	22.75	22.75	22.75
Area of Segment No. 2 (ft^2)	3	26.1	26.1	26.1	26.1	26.1
Distance from Center of Gravity of Segment No. 2 to Downstream Toe (ft)	4	20.33	20.33	20.33	20.33	20.33
Area of Segment No. 3 (ft^2)	5	40	40	40	40	40
Distance from Center of Gravity of Segment No. 3 to Downstream Toe (ft)	6	17.5	17.5	17.5	17.5	17.5
Base Width of Dam (Total) (ft)	7	27	27	27	27	27
Height of Dam (ft)	8	20	20	20	20	20
Ice Loading (K/L ft.)	9	—	5.0	—	—	—
Coefficient of Sliding	10	0.45	0.45	0.45	0.45	0.45
Unit Weight of Soil (K/ft^3) (deduct 18)	11	0.055	0.055	.055	.055	.055
Active Soil Coefficient - Ka	12	0.33	0.33	0.33	0.33	0.33
Passive Soil Coefficient - Kp	13	3.0	3.0	3.0	3.0	3.0
Height of Water over Top of Dam or Spillway (ft)	14	0	0	2.84	3.37	0
Height of Soil for Active Pressure (ft)	15	7.0	7.0	7.0	7.0	7.0
Height of Soil for Passive Pressure (ft)	16	1.75	1.75	1.75	1.75	1.75
Height of Water in Tailrace Channel (ft)	17	1.75	1.75	5.0	5.0	1.75
Weight of Water (K/ft^3)	18	0.0624	.0624	0624	.0624	.0624
Area of Segment No. 4 (ft^2)	19	227.5	227.5	227.5	227.5	227.5
Distance from Center of Gravity of Segment No. 4 to Downstream Toe (ft)	20	10	10	10	10	10
Height of Ice Load or Active Water (ft) (does not include 14)	46	17.5	17.5	17.5	17.5	17.5
Seismic Coefficient (g)	50	—	—	—	—	0.1
AREA OF SEGMENT 5	2	30.2	30.2	30.2	30.2	30.2
RESULTS OF ANALYSIS — DIST. TO CENTER OF GRAV SEG 5	22	2.33	2.33	2.33	2.33	2.33
Factor of Safety vs. Overturning		2.21	1.75	1.87	1.84	2.15
Distance From Toe to Resultant		9.79	7.67	8.96	8.79	9.60
Factor of Safety vs. Sliding		1.89	1.26	1.36	1.29	1.12

APPENDIX E

REFERENCES

APPENDIX E

REFERENCES

1) 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.

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

3) University of the State of New York, Geology of New York, Education Leaflet 20, Reprinted 1973.

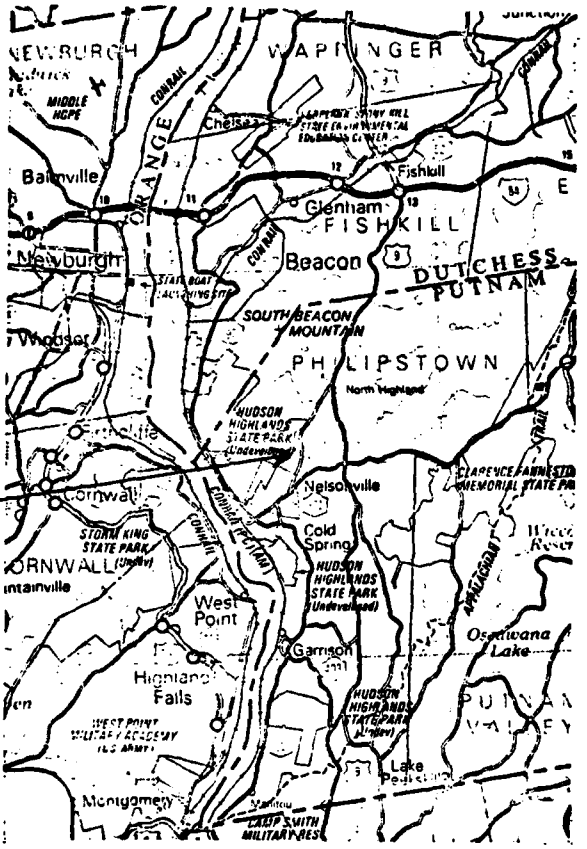
4) Elwyn E. Seelye, Design, 3rd edition, John Wiley and Sons, Inc.,1960.

5) U.S. Department of the Interior, Bureau of Reclamation ; Design of Small Dams, 2nd edition (rev.reprint), 1977.

6) T.S. George and R.S. Taylor; Lower Hudson River Basin Hydrologic Flood Routing Model; Department of the Army, New York District Corps of Engineers; Water Resources Engineers, Inc. January, 1977.

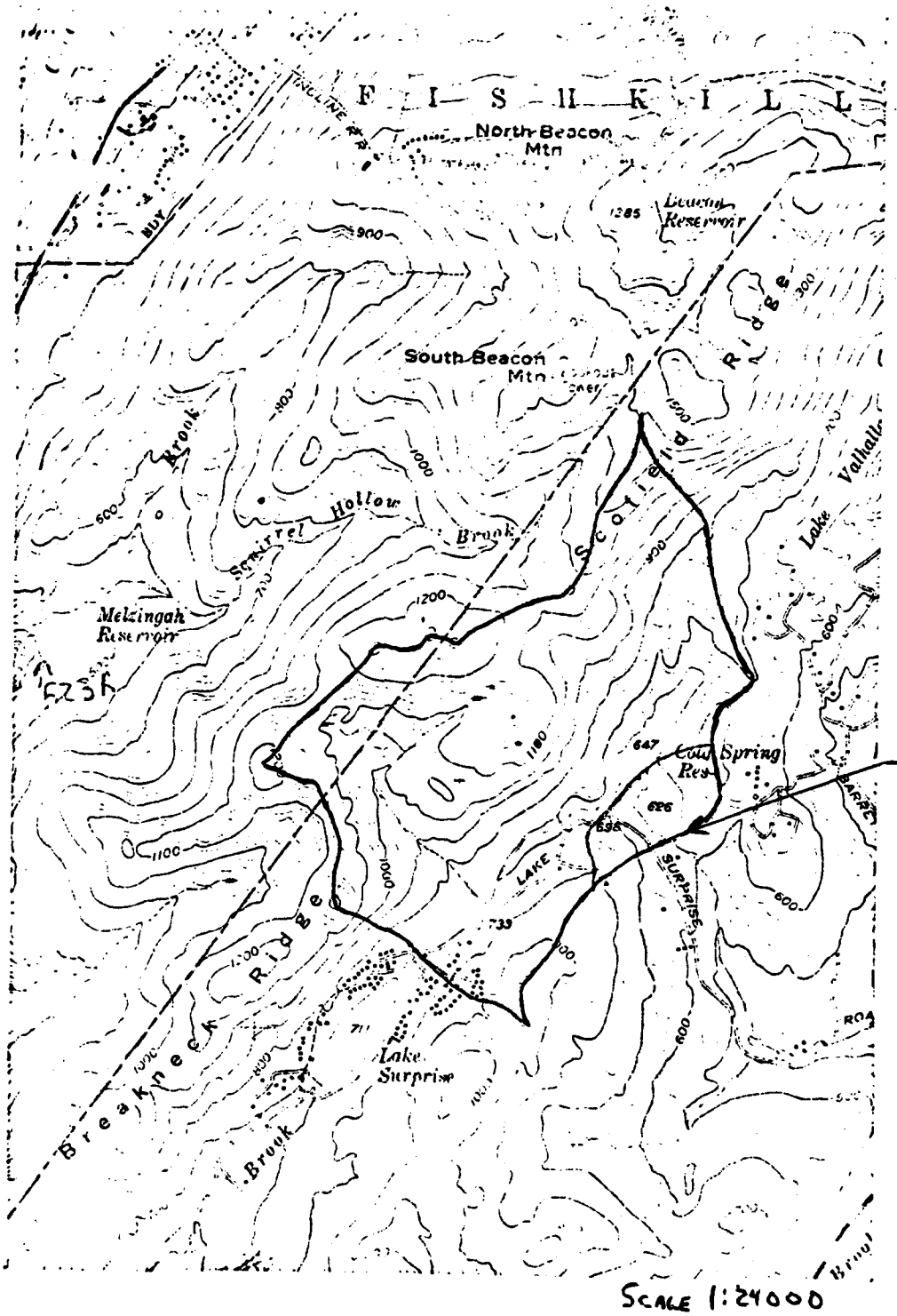
APPENDIX F

DRAWINGS



VICINITY MAP
COLD SPRING DAM (LOWER)

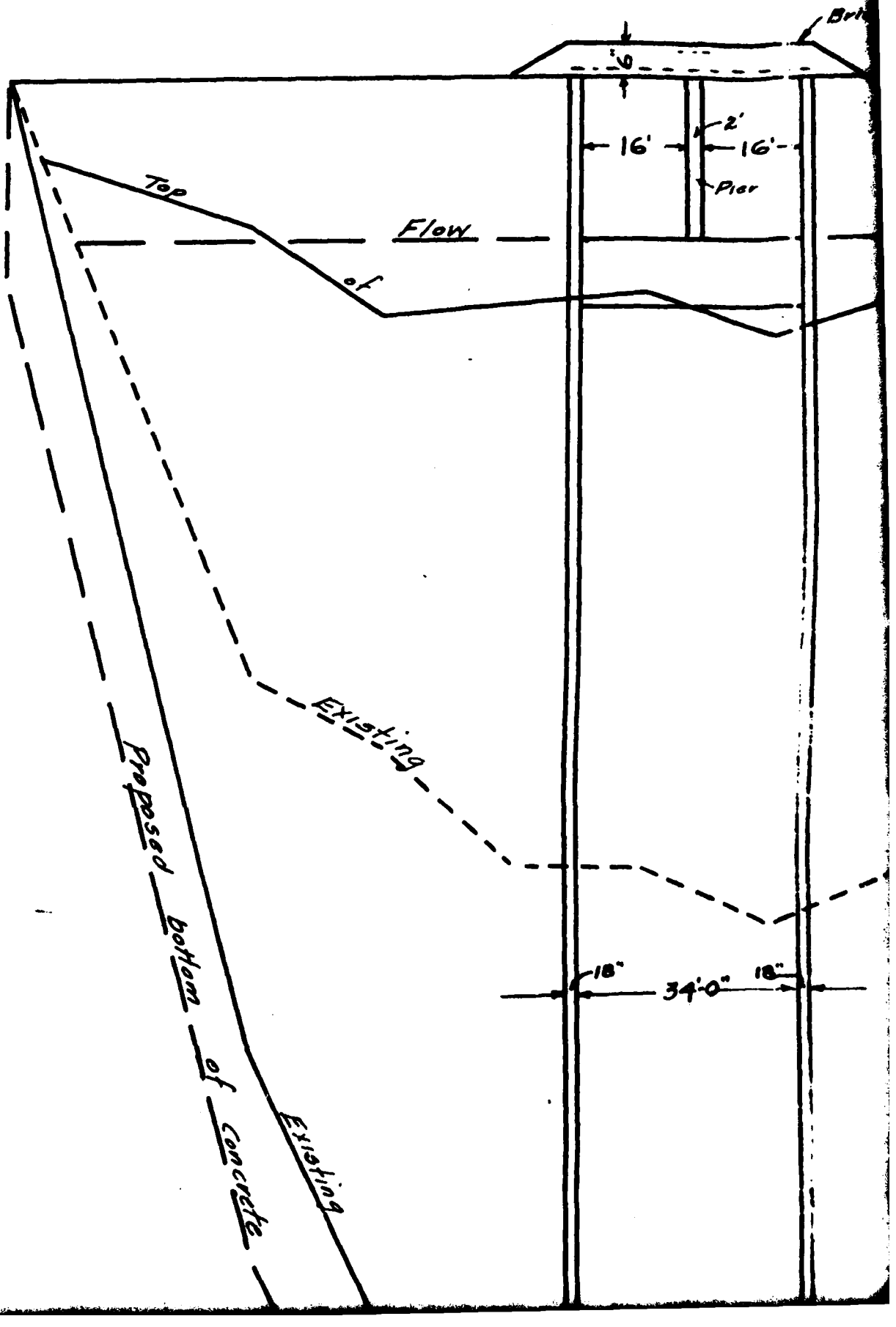
I.D.NO. NY-107

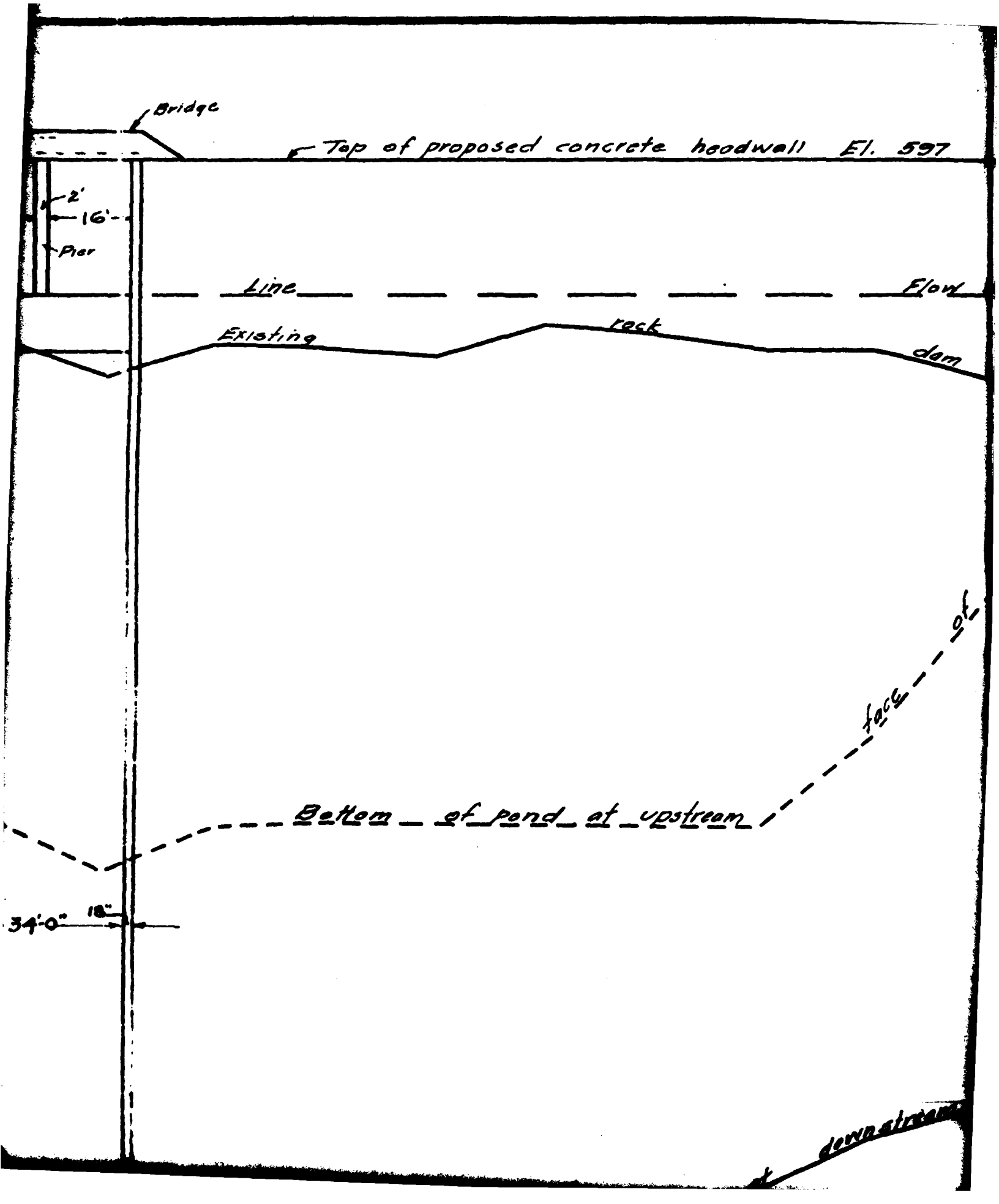


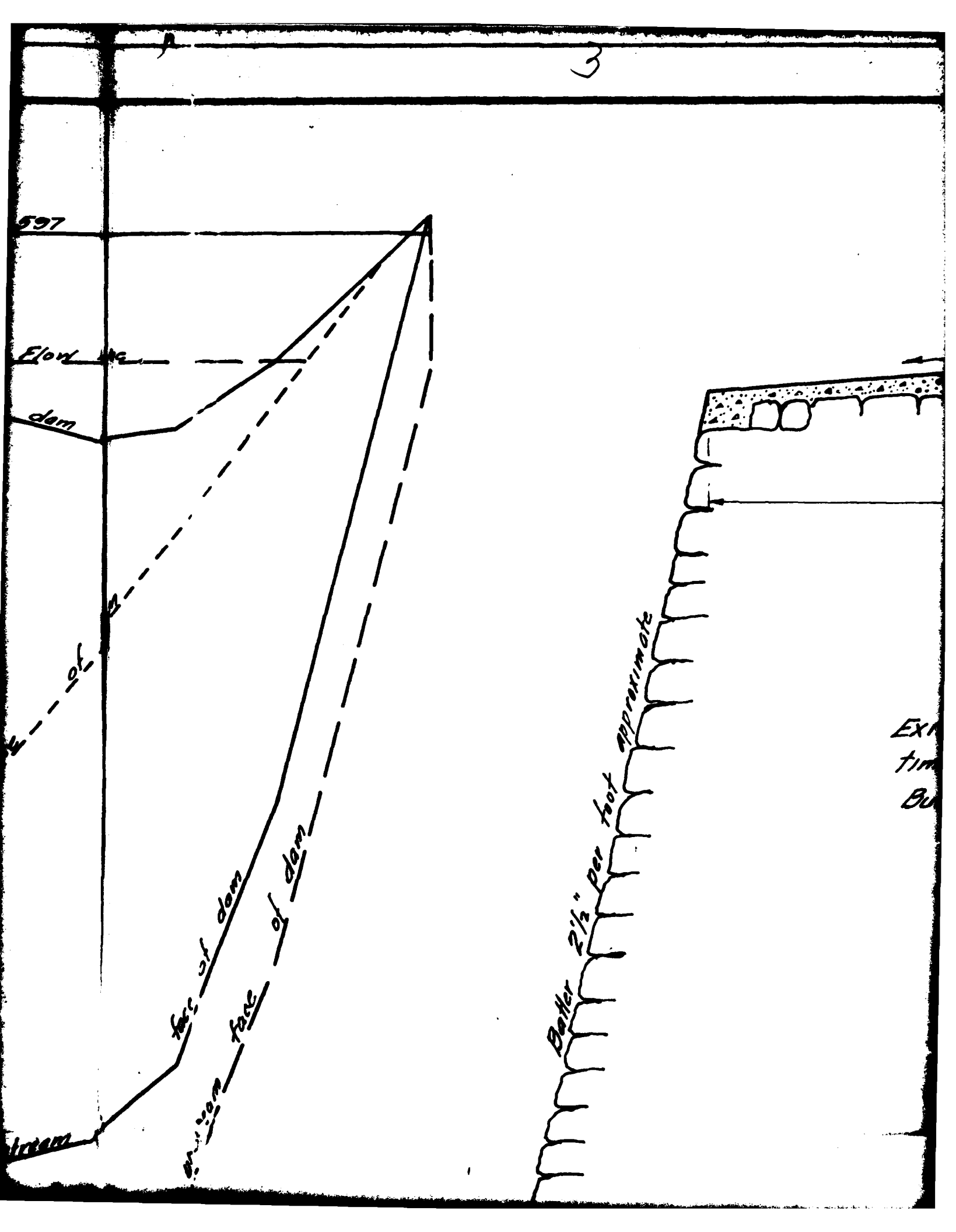
TOPOGRAPHIC MAP
COLD SPRING DAM (LOWER)

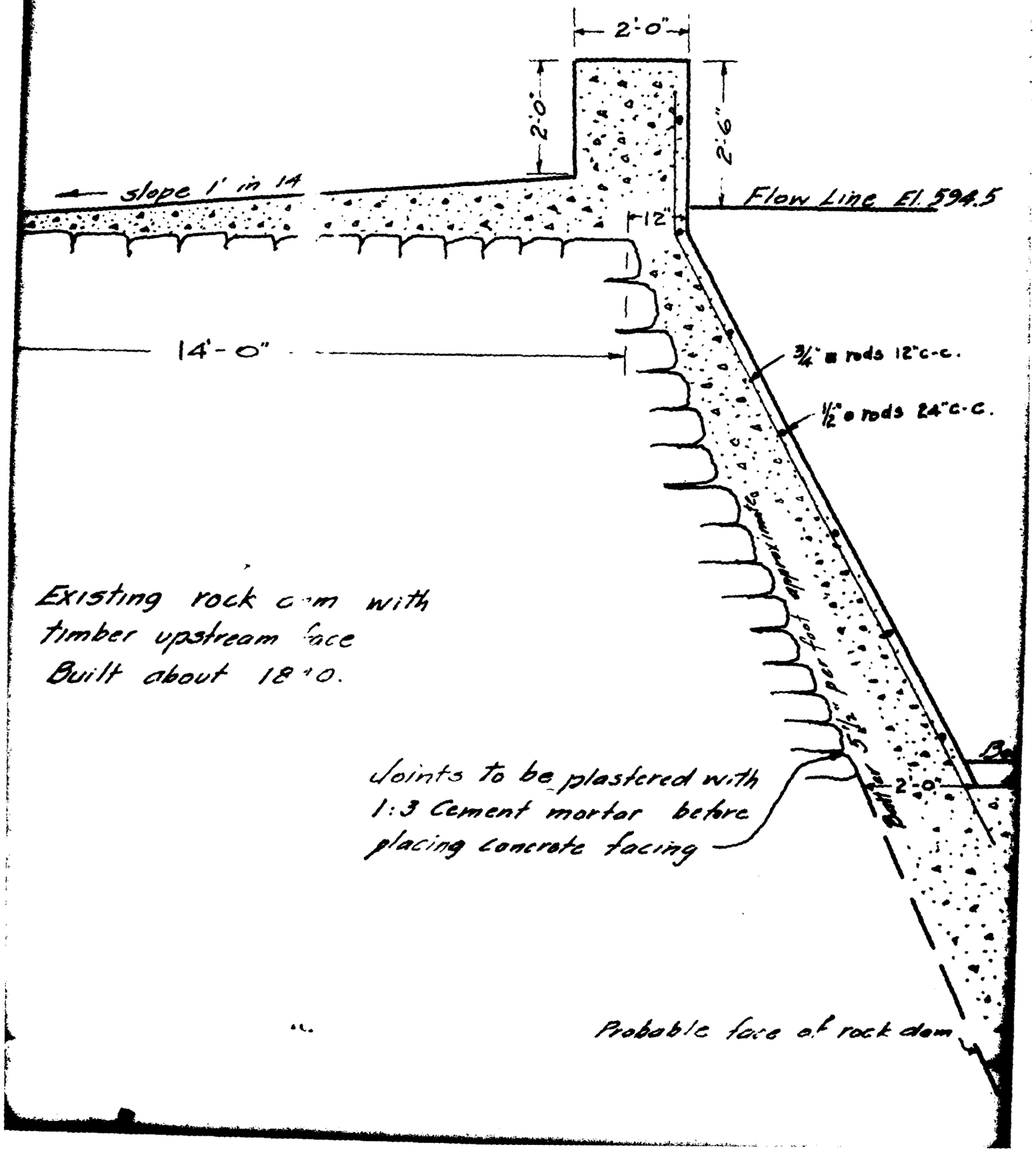
I.D. NO. NY-107

Allan Smith P.E.&L.S.
Cold Spring, N.Y.

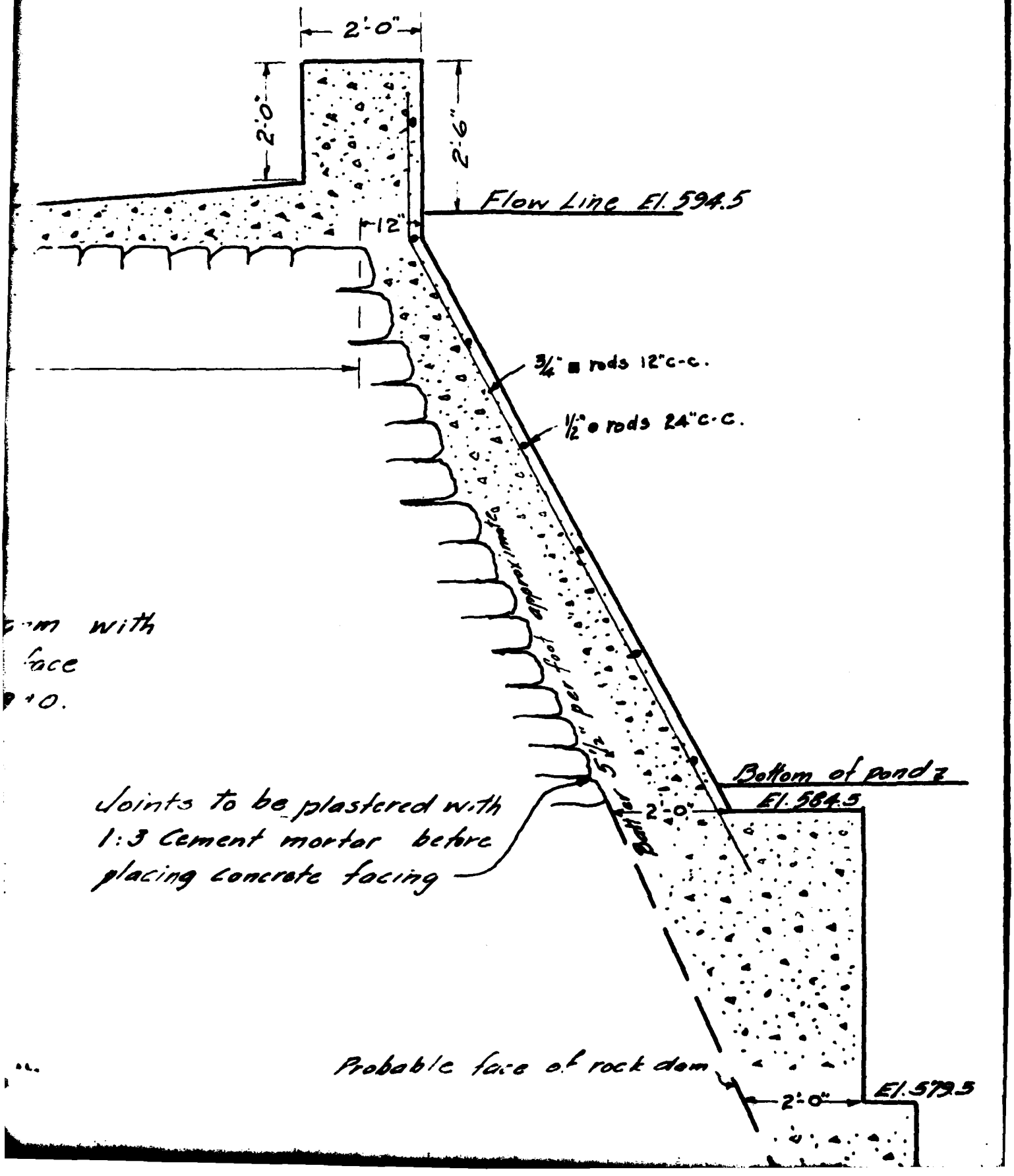


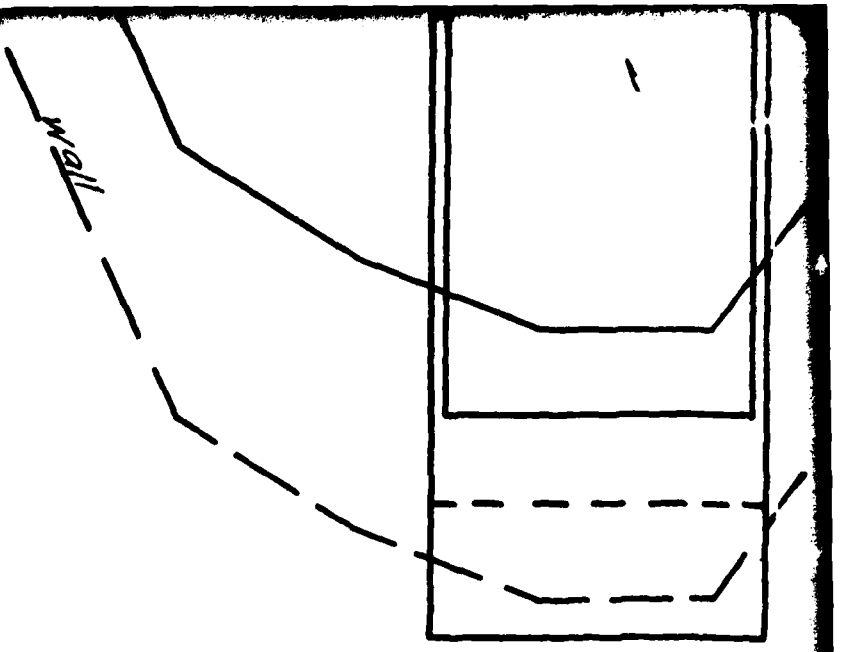

Bridge
Top of proposed concrete headwall El. 597
2'
16'-
Pier
Line
Flow
Existing
rock
dam
Bottom of pond at upstream
face of
34'-0"
18"
downstream


597
Elev
dam
of
face of dam
face of dam
stream
Batter 2½" per foot approximate


2'-0"
2'-0"
2'-6"
slope 1' in 14
Flow Line El. 594.5
12"
14'-0"
3/4" ø rods 12" c-c.
1/2" ø rods 24" c-c.
Existing rock dam with timber upstream face Built about 1810.
Joints to be plastered with 1:3 Cement mortar before placing concrete facing
2'-0"
Probable face of rock dam

Map No. 3403.


2'-0"
2'-0"
2'-6"
Flow Line El. 594.5
12"
3/4" ■ rods 12" c-c.
1/2" ● rods 24" c-c.
5 1/2" per foot approximately
Joints to be plastered with 1:3 Cement mortar before placing concrete facing
Bottom of pond
El. 584.5
2'-0"
Probable face of rock dam
2'-0"
El. 579.5

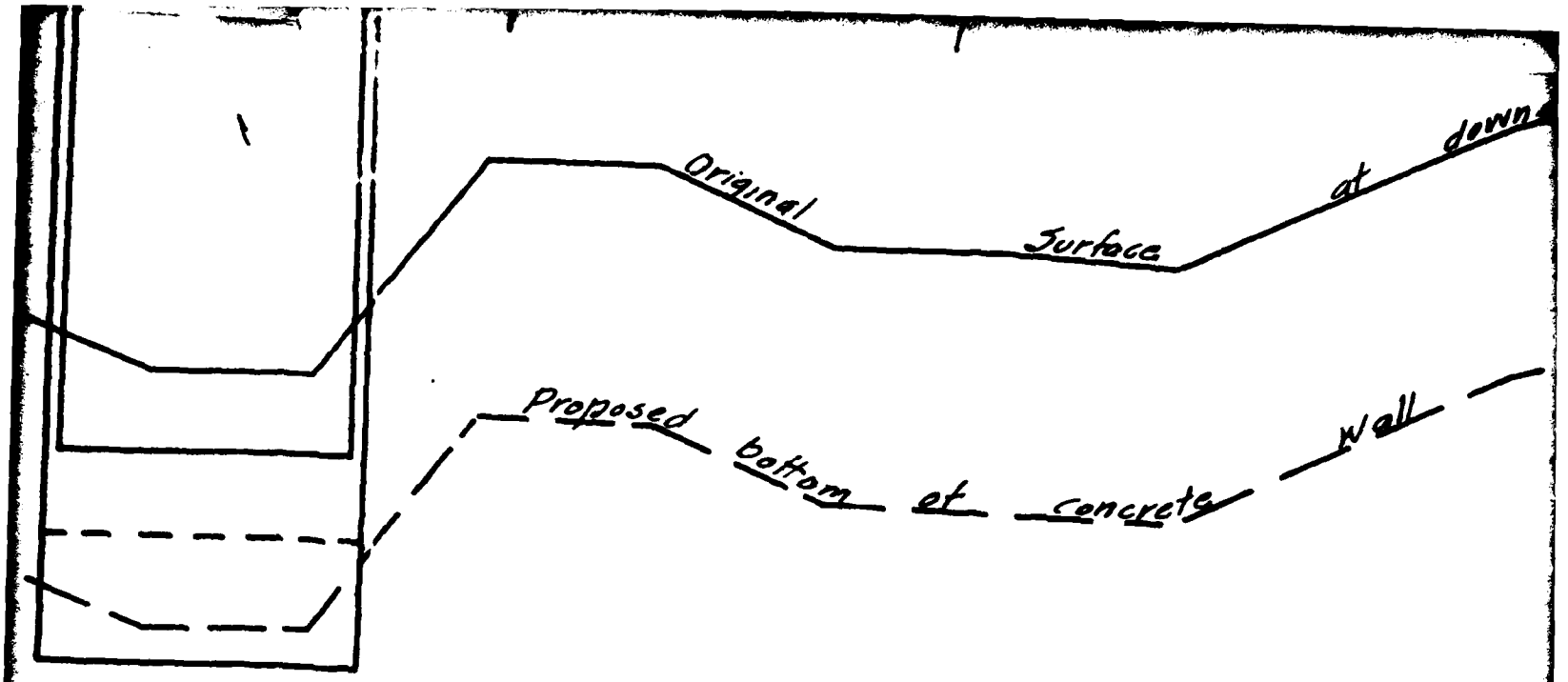


PROFILE

Scales { Hor. 1"=2
Vert. 1"=2

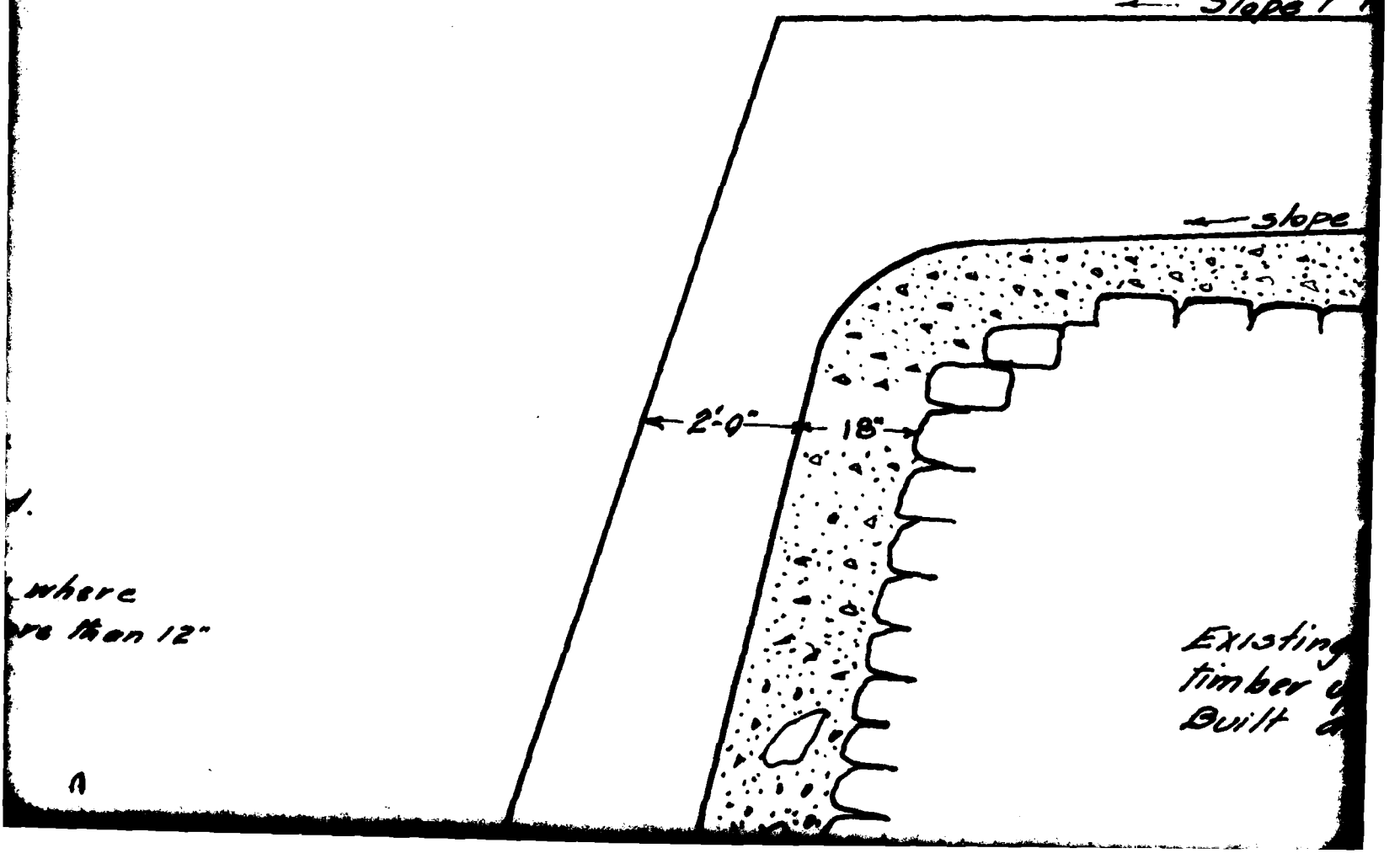
Concrete

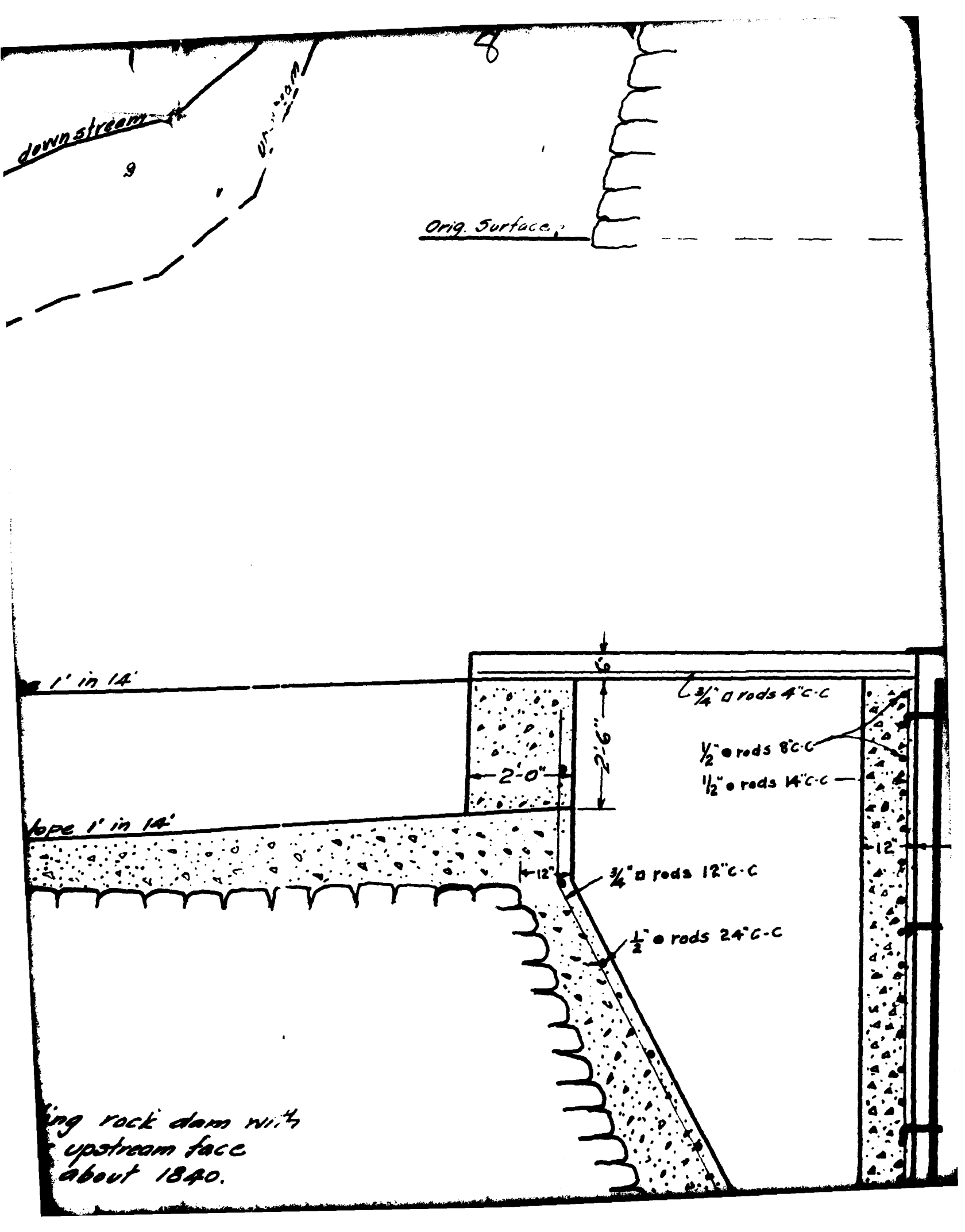
1 part portland cement.
2 parts clean sharp sand.
4 parts broken stone.
Large stones to be used where thickness of concrete more than 12"



PROFILE

Scales { Hor. 1" = 20'
Vert. 1" = 2'

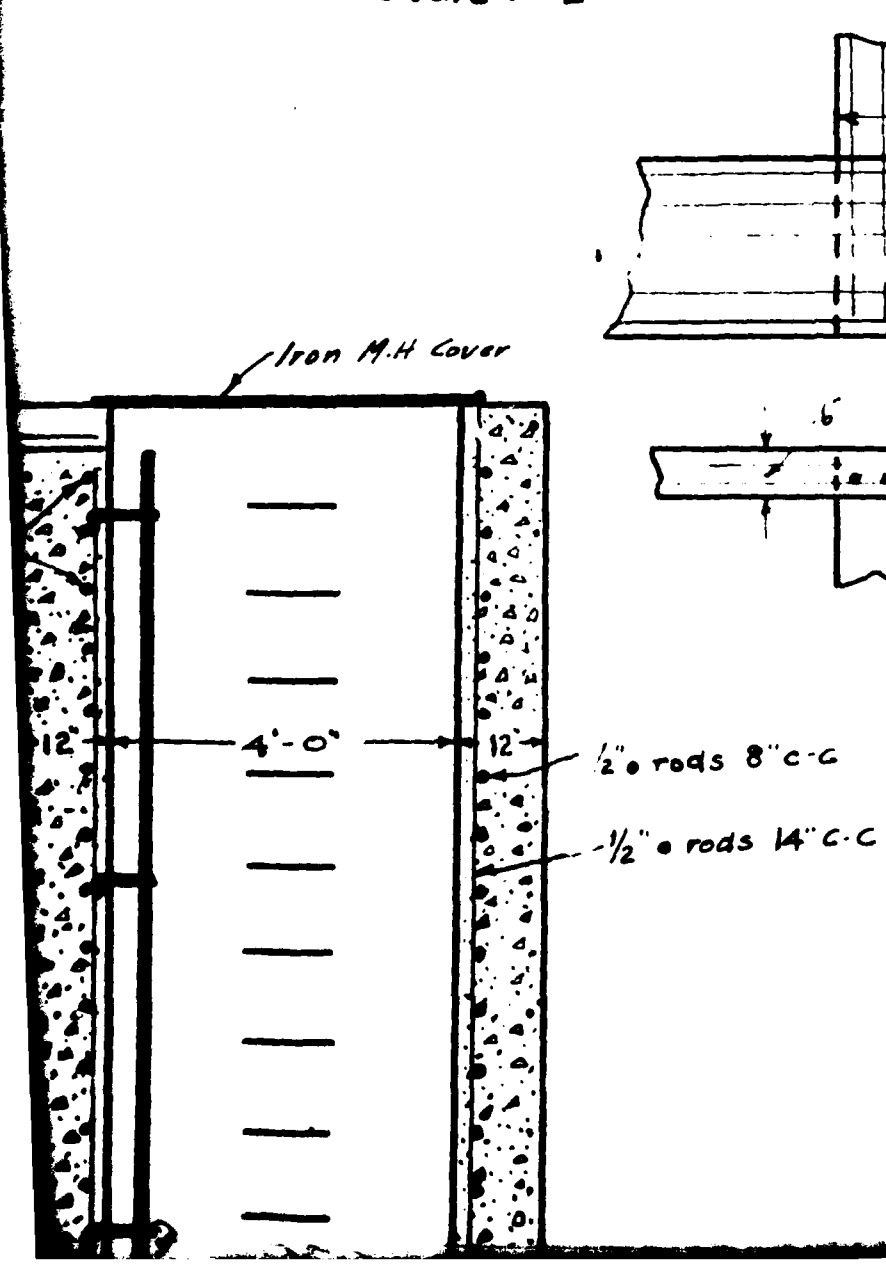


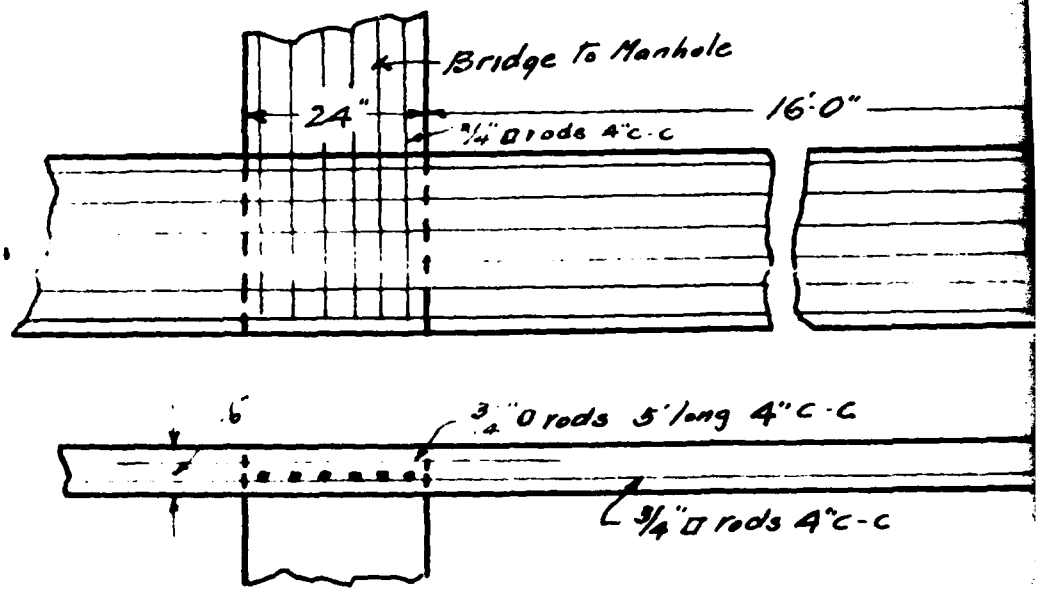

downstream
Orig. Surface
1' in 14'
2'-6"
2'-0"
3/4" □ rods 4"c-c
1/2" ● rods 8"c-c
1 1/2" ● rods 14"c-c
lope 1' in 14'
12"
12"
3/4" □ rods 12"c-c
1/2" ● rods 24"c-c
ing rock dam with
upstream face
about 1840.

Probable face of rock

TYPICAL SECTION

Scale 1" = 2



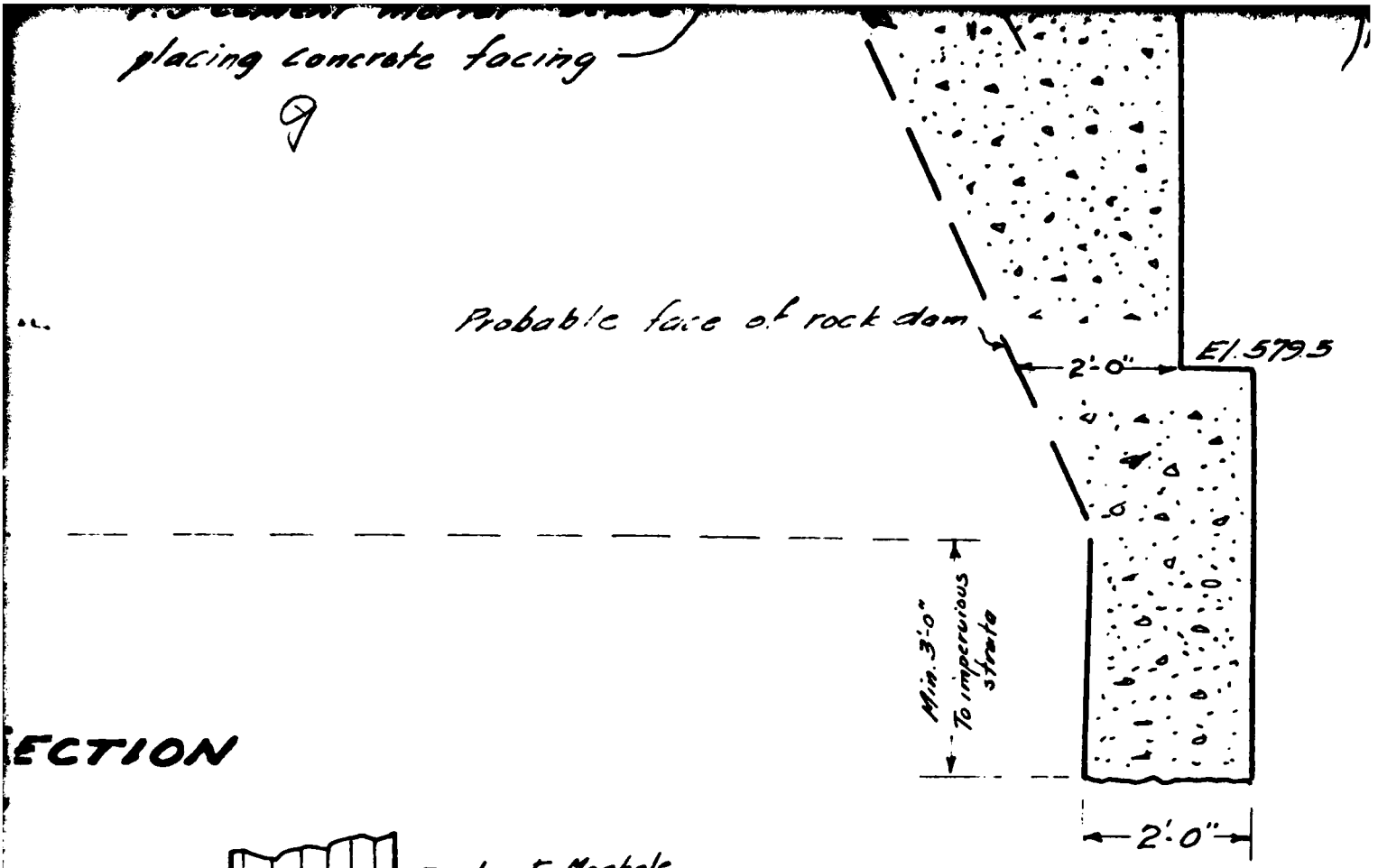


BRIDGE AT SPILLW

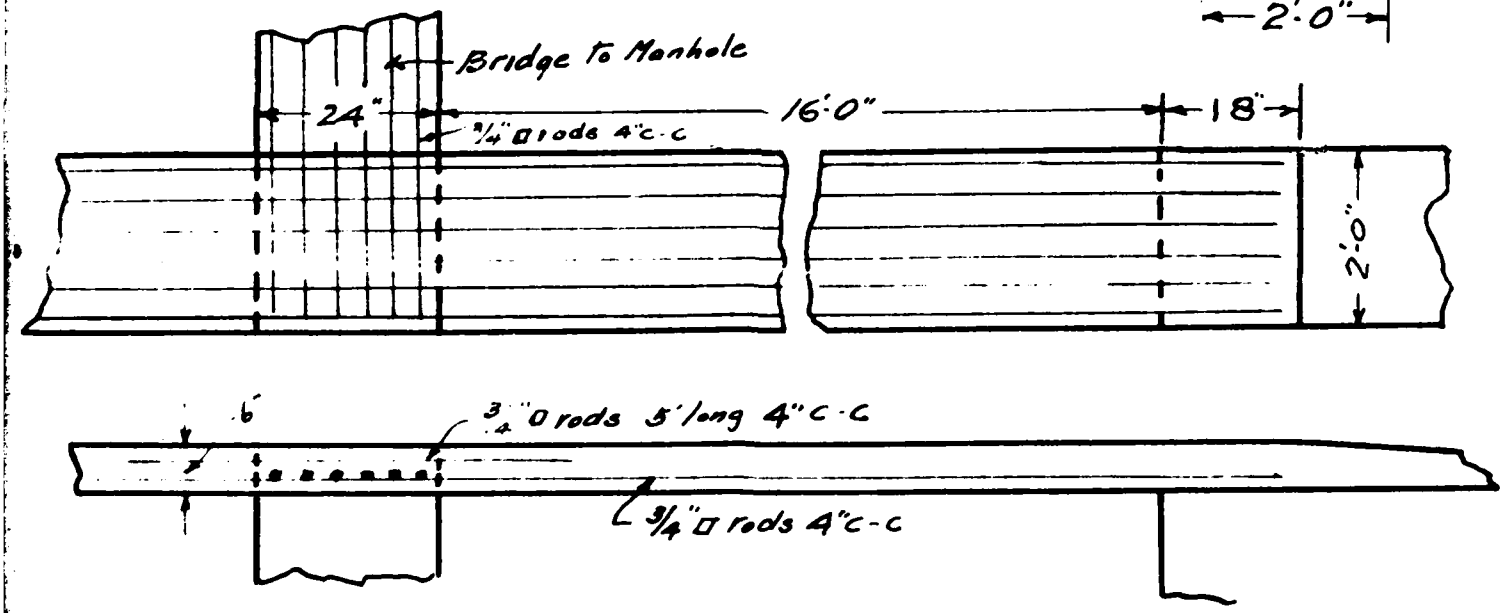
Scale 1" = 2'

placing concrete facing

9



ECTION



BRIDGE AT SPILLWAY

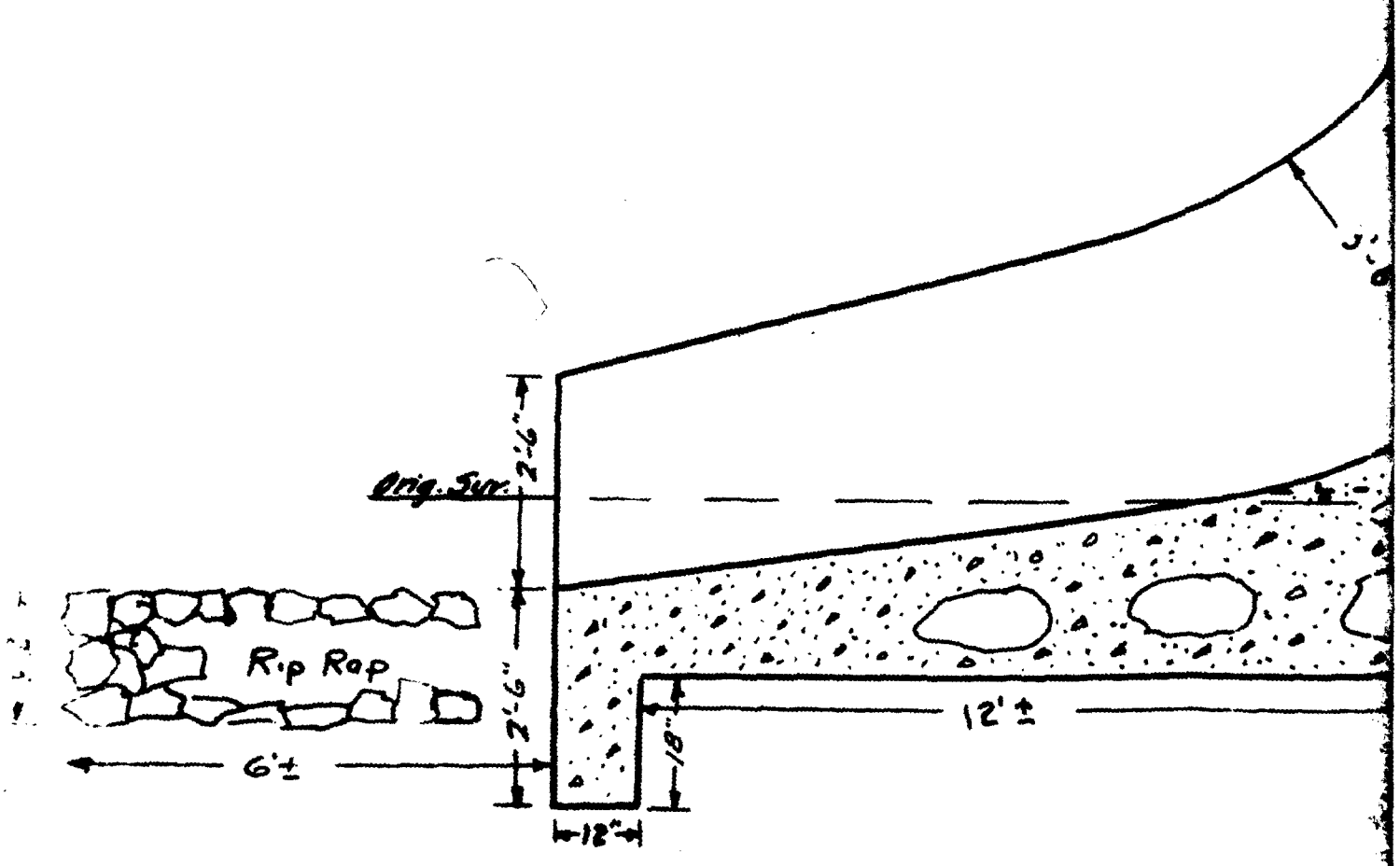
Scale 1" = 2'

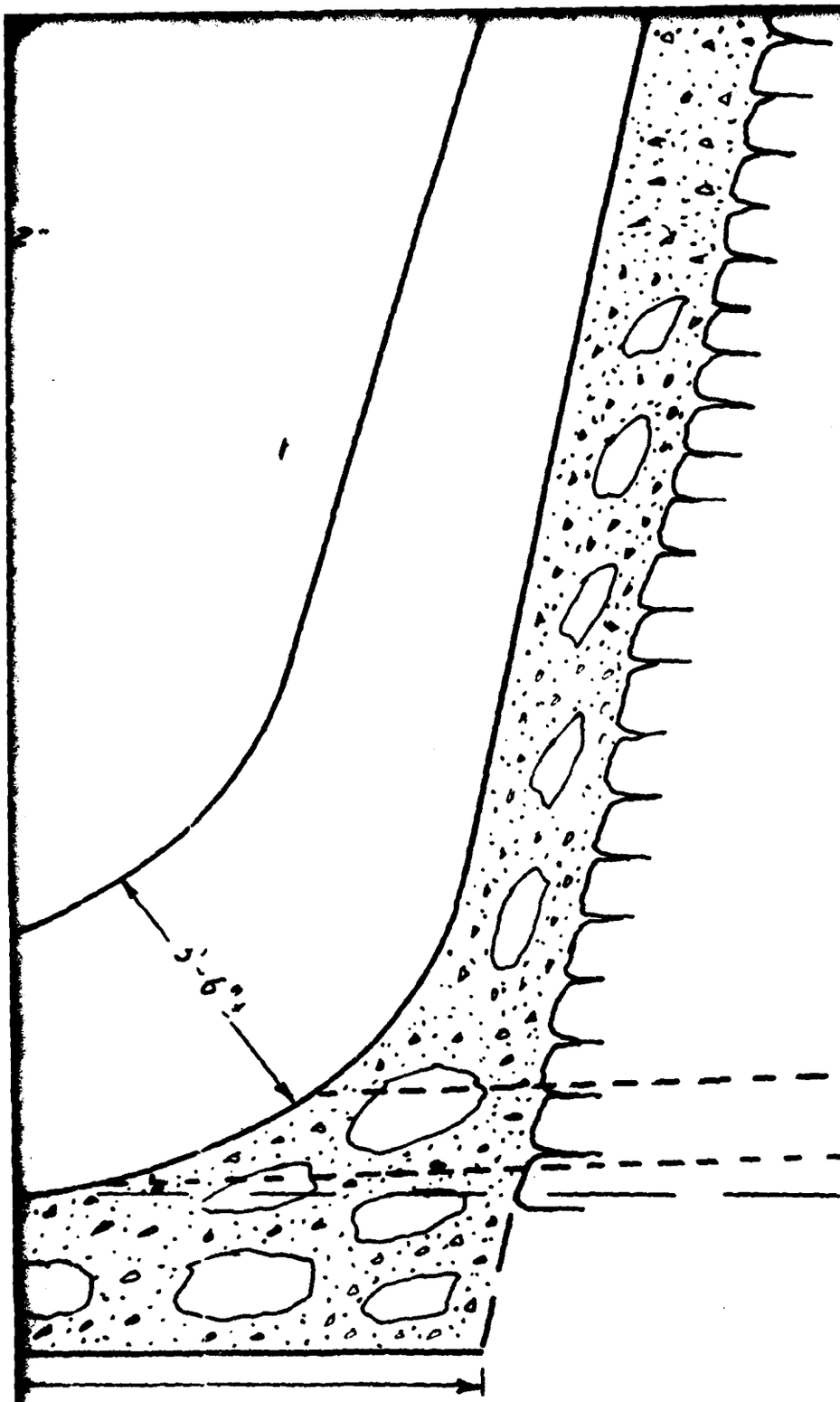
½" ø rods 8" c-c

½" ø rods 14" c-c

Concrete

1 part portland cement.
2 parts clean sharp sand.
4 parts broken stone.
Large stones to be used where thickness of concrete more than 12"





Existing rock da
timber upstream
Built about 184

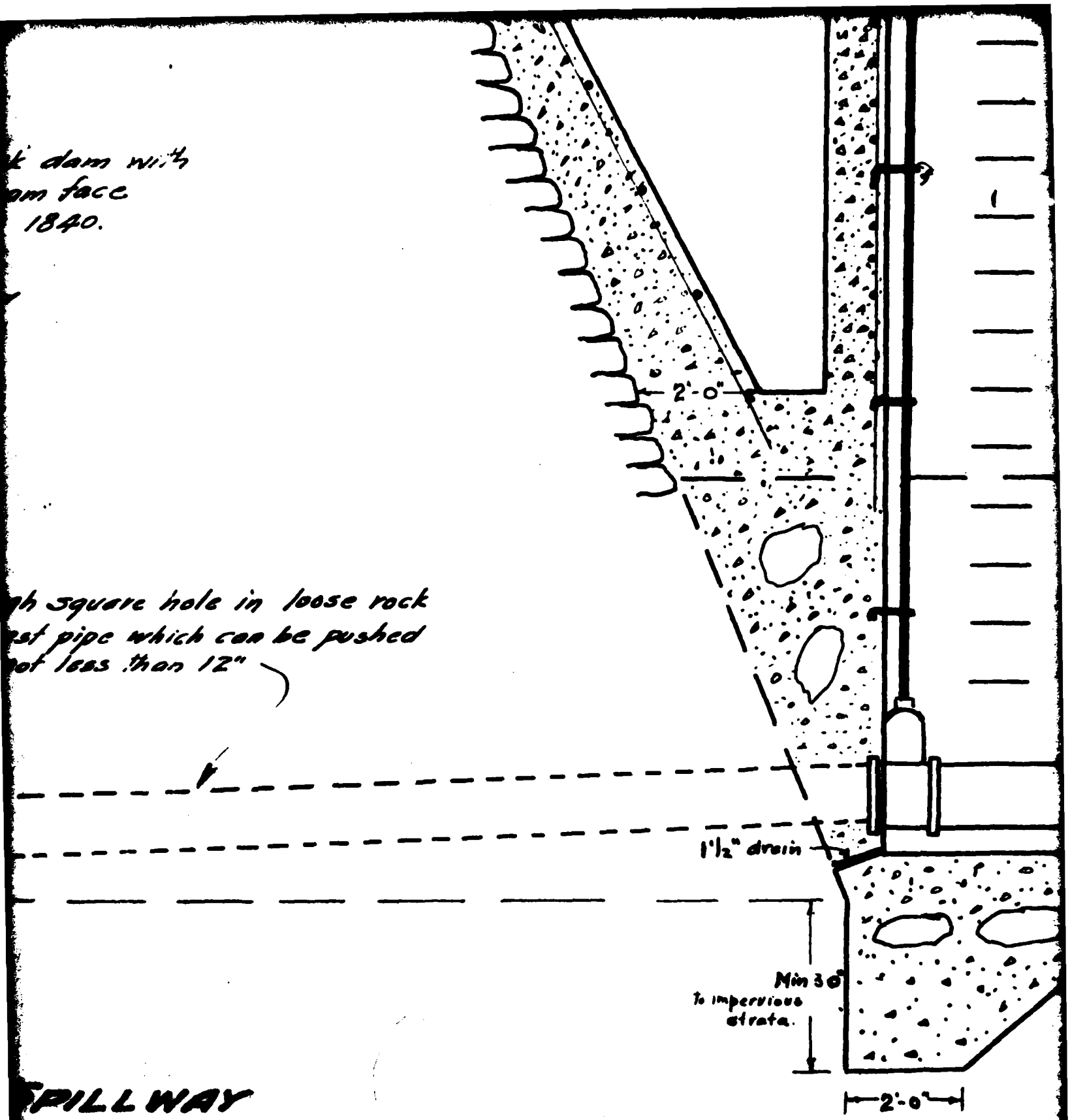
Present blowoff through 3
Proposed blowoff largest p
through hole in dam, not l

SECTION AT SP

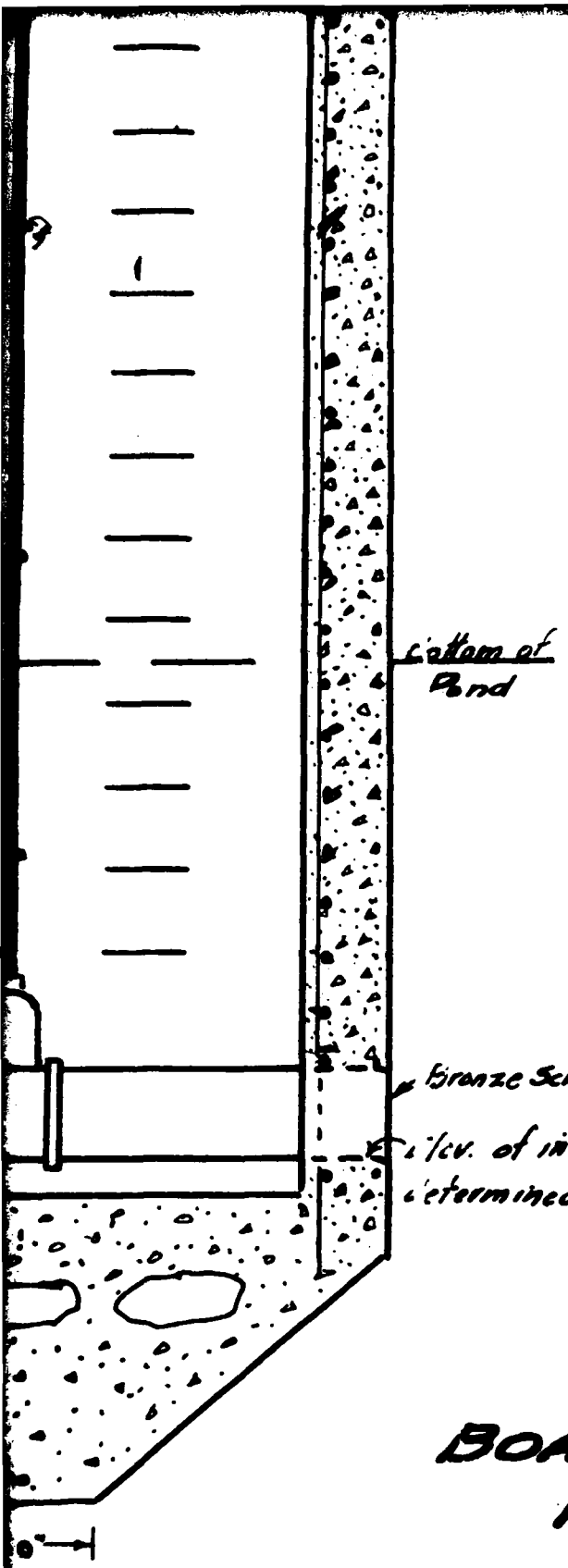
Scale 1" = 2'

k dam with
om face
1840.

gh square hole in loose rock
est pipe which can be pushed
not less than 12"



SPILLWAY
: 2'



Approved by Board of Water Com
of the Village of Cold Spring Fe

Presid

Clerk

Revised April 3, 1934 to show reinforcement
upstream concrete facing and valve chamber
Revised April 19, 1934 reinforcing " "

VILLAGE OF COLD SPRI
BOARD OF WATER COMMISSI
PROPOSED RECONSTRU
LOWER FOUNDRY DA
PHILIPSTOWN PUTNAM
SCALE - AS SHOWN JAN.

Approved by Board of Water Commissioners
of the Village of Cold Spring Feb. 1934.

_____ President

_____ Clerk

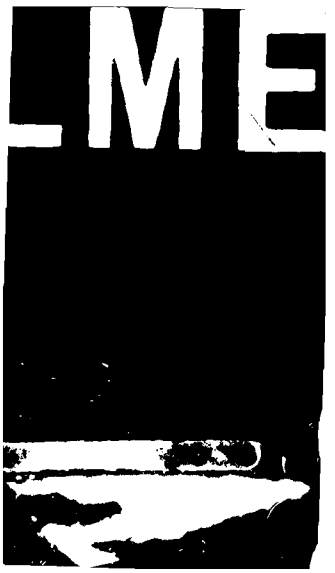
of

Revised April 3, 1934 to show reinforcement of upstream concrete facing and valve chamber walls.
Revised April 19, 1934 reinforcing " " " .

e Screen.

f intake to be
ined in field.

VILLAGE OF COLD SPRING
OARD OF WATER COMMISSIONERS
PROPOSED RECONSTRUCTION
LOWER FOUNDRY DAM
LIPSTOWN PUTNAM CO., N.Y.
LE-AS SHOWN JAN. 31, 1934.


LME