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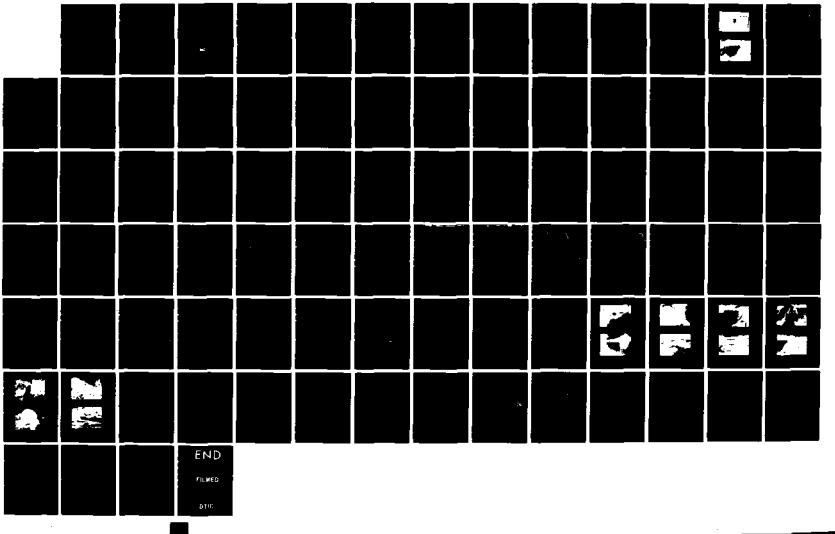

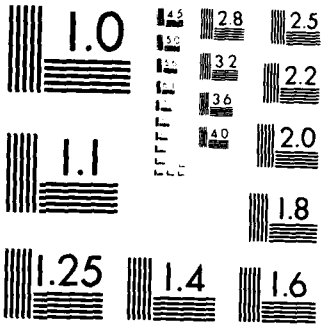

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

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WINDSOR UPPER DAM VT 00013

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WINDSOR, VERMONT

WINDSOR UPPER DAM

VT. 00013

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

SEPTEMBER 1978

REPRODUCED AT GOVERNMENT EXPENSE

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Identification No.:	-	VT 00013
Name of Dam:	-	Windsor Upper
Town:	-	Windsor
County and State:	-	Windsor, Vermont
Stream:	-	Mill Brook
Date of Inspection:	-	15 Dec 1977 & 8 Jun 1978

BRIEF ASSESSMENT

Based on the visual inspection, available records and past performance, the Windsor Upper Dam is considered to be in fair condition. The dam is believed to be safe under normal operating conditions. Its serviceability under the test flood load and ice forces is unknown. These peak loading conditions should be more fully investigated.

Based on size and hazard classifications in accordance with Corps guidelines, the test flood is the Probably Maximum Flood. A PMF outflow of 47,000 cfs (1073 csm) would overtop the dam by 5.3 feet. The spillway will pass about 16,700 cfs, or about 36 percent of the PMF outflow. A cursory analysis was performed to assess the downstream impact of a sudden dam failure. With the reservoir at top of dam, a failure would result in a 13-foot increase in the stage that would be occurring just prior to failure. This increase would be felt at Union Street, 600' downstream of the dam, which is the location of several residences.

Due to the potential for overtopping and the lack of formal stability analyses, it is recommended in Section 7 of this report that the owner engage the services of a qualified consultant to evaluate the stability of the dam. In addition, an analysis of the earth embankment at the left abutment must be performed. Further, a more detailed investigation should be made of the hydraulic and hydrologic aspects of the dam.

In addition to the long term recommendations, there are several remedial measures which should be implemented immediately.

a. The downstream face of the dam should be cleared of all brush and trees on an annual basis.

b. A periodic inspection program for Windsor Upper Dam should be established.

c. A formal warning program should be developed.

d. A formal plan for monitoring the structure during high flows should be developed.

These recommendations and remedial measures should be accomplished within 12 months after the receipt of this Phase I Report by the owner.

William H. Rodger

WILLIAM H. RODGER P.E.
Massachusetts Reg. # 29048

This Phase I Inspection Report on Windsor Upper Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with OCE's Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice.

CHARLES G. TIERSCH, Chairman
Chief, Foundations and Materials Branch
Engineering Division

FRED J. RAVENS, JR., Member
Chief, Design Branch
Engineering Division

SAUL C. COOPER, Member
Chief, Water Control Branch
Engineering Division

RECOMMEND APPROVAL:

JOE B. FRYAR
Chief, Engineering Division

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 continued care and inspection can there by any chance that unsafe conditions be detected.

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.

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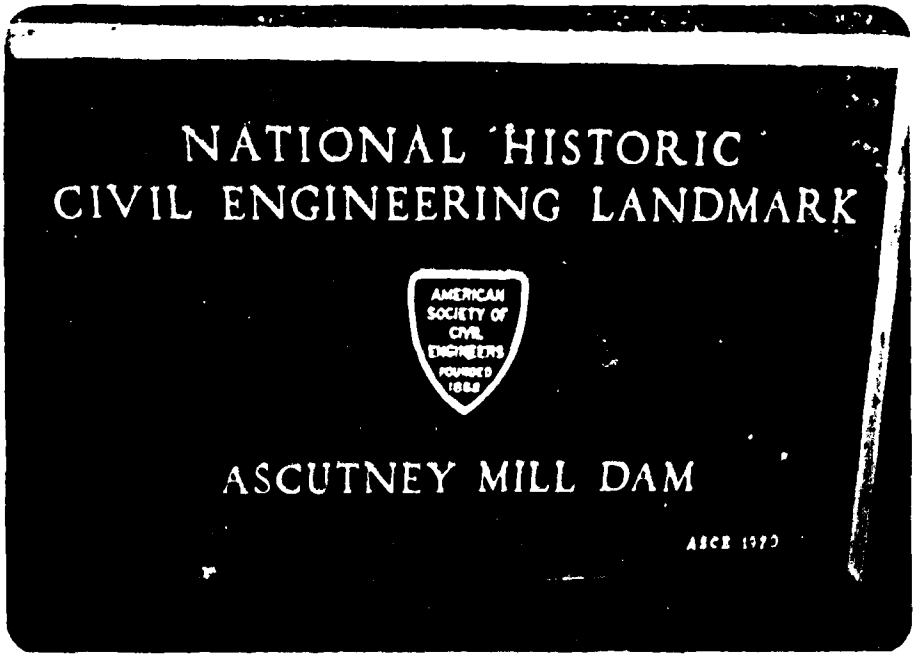

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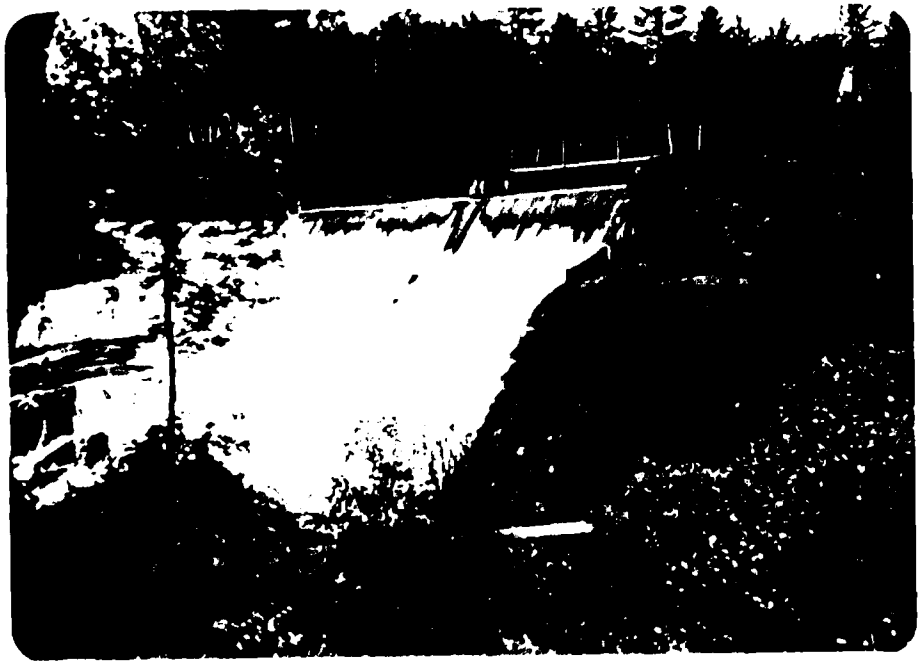
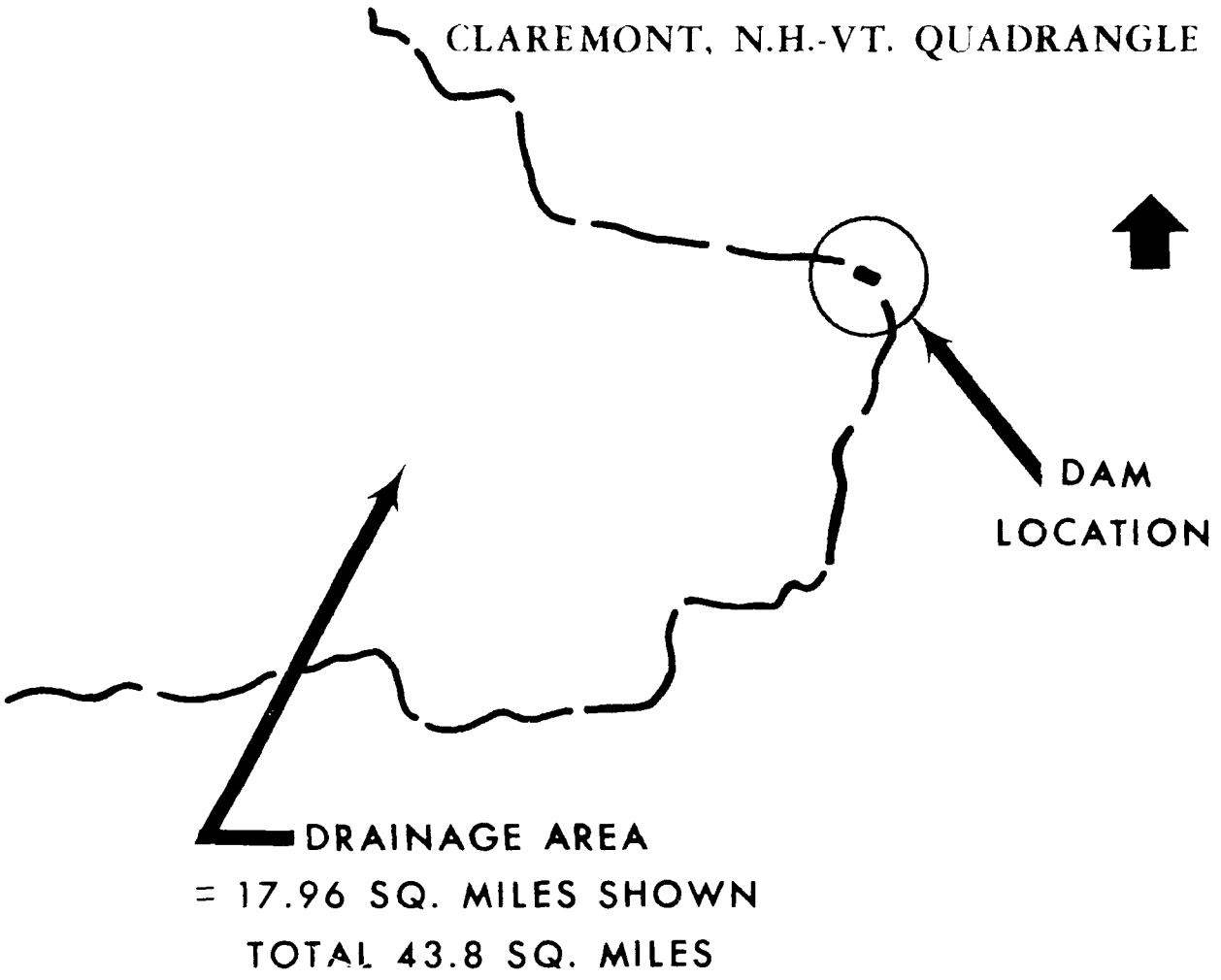


DOWNSTREAM FACE



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SCALE IN FEET

LOCATION MAP - WINDSOR UPPER DAM

b. Operation and Maintenance Procedures.

Operating procedures employed at Windsor Upper Dam are considered inadequate. However, the establishment of an effective annual maintenance and inspection program would significantly reduce the chance of a serious condition going undetected. It is therefore recommended the following items be performed.

(1) The downstream face of the dam should be cleared of all brush and trees on an annual basis.

(2) A biennial periodic technical inspection program for Windsor Upper Dam should be established.

(3) A formal warning program should be developed and implemented, along with a plan for monitoring the structure during periods of unusually high flow.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT.

a. Condition. Based on the visual inspection, available records and past performance, the Windsor Upper Dam is considered to be in fair condition.

b. Adequacy of Information. Information gathered during the search of the project files is considered to be inadequate to make a valid assessment of the Windsor Upper Dam.

c. Urgency. Recommendations and remedial measures made by this report should be accomplished within 12 months after the receipt of this Phase I report by the owner.

d. Need for Additional Investigation. As previously stated, Windsor Upper is considered to be in fair condition, and further study by a qualified consultant is recommended to cover the subjects listed in Para. 7.2 below.

7.2 RECOMMENDATIONS.

a. Since the spillway can pass about 36 percent of the test flood without overtopping the dam, a qualified consultant should be engaged to assess hydrological conditions and develop plans for any modification necessary to avoid overtopping.

Analysis of the structural stability of the spillway and non-overflow portions of the dam should be included in the consultant's scope of work. Stability of earth embankment at the left abutment should be investigated. This further investigation will require that Mill Pond be drawn down to allow inspection of the downstream face and a portion of the upstream face (to be determined by the consultant) under dry conditions.

7.3 REMEDIAL MEASURES.

a. Alternatives. Not Applicable - Alternative solutions to improve inadequate spillway capacity are beyond the scope of this report.

Based on the visual inspection and past performance, the Windsor Upper Dam is believed to be structurally stable during normal operating conditions. Stability during the projected test flood and ice forces cannot be determined by visual observations. Therefore, these peak loading conditions should be more fully investigated.

c. Operating Records.

There are no operating records which indicate a stability problem since the dam was built in 1834. There have been several major floods during the life of the structure. Therefore, the dam's performance with respect to stability has been adequate to date.

d. Post Construction Changes.

Repairs and modifications to Windsor Upper Dam were made in 1961. These modifications do not significantly change the stability of the dam. The 1961 modifications have been noted in SECTION 2 - ENGINEERING DATA.

e. Seismic Stability.

The dam is located in Seismic Zone No. 2 and in accordance with recommended Phase I guidelines does not warrant seismic analysis.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. No evidence was observed indicating structural instability of the dam at this time. However, several conditions which could affect the overall stability of the dam were noted.

(1) Evidence of erosion to the downstream face of the spillway was observed.

(2) It is not likely the earth embankment at the left abutment could sustain a possible overflow condition.

(3) Signs of past leakage were observed, indicating the possibility of cracks in the concrete liner on the upstream face.

(4) A granite masonry dam, such as Windsor Upper, is susceptible to localized failures on its faces or through weakened plans in the structure. It is very difficult to predict these localized pockets of failure analytically. The lack of maintaining the downstream face can significantly add to this problem. The undisturbed growth of brush and small trees on the downstream face was observed during the June 8 inspection.

These conditions could have an effect upon structural stability in the future and should be further investigated by a qualified consultant. In addition, a thorough annual inspection program, coupled with an effective maintenance program must be established to insure continued safe performance by the Windsor Upper Dam.

b. Design and Construction Data.

There is no design data available. In addition, no data pertaining to the original construction was found during the review of the project records.

The original stability analysis is not available. However, the past performance of the dam can be considered. This structure has performed for 143 years. It has not experienced a major failure. During its lifetime, the dam has had to resist significant loadings. The question of the present stability must include an accurate determination of the dam's existing condition. The years of service have generated significant wear and deterioration of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES.

a. Design Data. There is no design criteria or data available.

b. Experience Data. It was stated in Section 1.3 that the maximum flood or record for the site is estimated to be in excess of 160 csm. A summer flood during June-July 1973 produced flows averaging over 60 csm at USGS stations in the area.

c. Visual Observations. The reservoir area is essentially undeveloped. The town maintains a beach on the left (west) shore of the pond, and during the test flood, inundation can be expected. On the left shore just upstream of the dam, there is a private residence. The yard where it meets the foundation of the home, is about 7 (±) feet above the spillway crest elevation. Flooding of the first floor can be expected during the test flood.

The maximum downstream channel capacity of Mill Brook has not been determined. There is considerable streambank development between the dam and the center of town. The first grouping of homes close to the streambank is at Union Street, 600 feet downstream from the dam. For additional information see SECTION 3 - VISUAL INSPECTION of this report.

d. Overtopping Potential. Based on U. S. Geological Survey Water Supply Paper 1887, "Maximum Floodflows in the Conterminous United States," the Probable Maximum Flood for Mill Brook is estimated to be 47,000 cfs (1,073 csm). In designing the spillway at the Corps of Engineers' North Hartland Dam, on the Ottaquechee River, nine miles north of Windsor, the Probable Maximum Flood was computed to be 199,000 cfs (904 csm).

Due to the somewhat higher runoff-producing characteristics of the Mill Brook watershed, 47,000 cfs (1,073 csm) was selected as the Probable Maximum Flood (PMF).

Based on the size classification of the project (INTERMEDIATE), and the hazard potential classification (HIGH), the full PMF was selected as the test flood. It is estimated that a flow of this magnitude would result in a water surface elevation at the site of 112.6 feet (local datum), or a depth of 5.3 feet over the non-overflow section. This would cause a bypass flow to occur over the lawn and embankment to the left of the dam, reentering the main channel immediately downstream (refer to the photographs in Appendix C). One-half the PMF or 23,500 cfs, would result in a water surface of 109.8 feet, or 2.5 feet over the non-overflow section.

108.7 1.4

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES. As previously discussed, this is not a flood control structure, and the gates are kept closed unless the pool is being de-watered for maintenance. The pool is not prelowered in advance of impending runoff, and all flows are passed over the spillway.

4.2 MAINTENANCE OF DAM.

There is no formal annual maintenance program for the Windsor Upper Dam. Necessary minor repairs to the dam should be made by personnel of the town. Funds for major repairs must be appropriated by the Town of Windsor as part of their annual budget.

4.3 MAINTENANCE OF OPERATING FACILITIES.

Not applicable to the Windsor Upper Dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT.

The warning system is informal. According to the Town Manager, the police would probably patrol the structure periodically during flood periods. In the event of a danger of failure, they would notify affected residents downstream by cruiser-mounted loud speaker and by knocking on doors.

4.5 EVALUATION.

Periodic inspections of Windsor Upper by engineers from the town should be established. Minor deficencies must be corrected. Major repairs should be approved by the town.

A formal warning program should be developed and implemented, along with a plan for monitoring the structure during periods of unusually high flow.

3.2 EVALUATION. Our team was able to get a good overall view of the structure. A detailed inspection of the non-overflow portion of the dam was performed. No definitive evaluation of the condition of the spillway and the downstream face immediately below the spillway could be made.

There are signs of past leakage on the downstream face of the dam. These areas were dry during the June 8 inspection. A leak thru the spillway concrete splitter wall, where it intersects the non-overflow portion of the dam, was observed. At the present this condition does not appear to be serious.

In addition, the downstream face of the dam is overgrown with small bushes and trees. This condition could eventually cause leakage problems, if allowed to continue. The downstream face of the dam must be annually cleared of all brush.

As stated previously, the condition of the Windsor Upper Dam is considered to be fair. No major problems associated with either the serviceability or operation of the dam were discovered. There are, however, several areas which will require periodic maintenance to ensure continued serviceability. Furthermore, the condition of the concrete lining in the old penstocks should be more fully investigated.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS.

a. General. The Phase I inspection of the dam and Mill Pond was performed on 15 December 1977. The area adjacent to the dam was covered with 18 inches of snow. Water was passing over the full length of the spillway. The dam was reinspected on 8 June 1978. The area between the dam and the mouth of the Mill Brook is occupied by a complex of residential, commercial and mill buildings. The spring inspection allowed access to the downstream face of the dam and portions of the upstream face. A copy of the inspection report is included in Appendix A.

b. Dam.

The dam is considered to be in fair condition. There was no evidence of vertical or horizontal misalignment detected in the dam.

The non-overflow portion of the dam was inspected. No definite evaluation could be made during the December visit. During the spring follow-up visit, the section was reinspected and photographed. From the left abutment, a 2'-high grass-covered earth embankment extends out at elevation 107.3 for about 84 feet, where the crest drops 2.2 feet to elevation 105.1 and merges with an adjacent lawn. The lawn then slopes upward for a distance of 65 feet, where it meets the foundation of a home at elevation 107 (±). The grass cover on the embankment and lawn is excellently maintained. With the reservoir at top of dam (elev. 107.3), some flow will occur over the lawn.

c. Appurtenant Structures. The Ascutney Mill is immediately downstream of the dam. A penstock services this mill. The mill was not inspected.

d. Reservoir Area. The reservoir area is essentially undeveloped. The town maintains a beach on the left (west) shore of the pond, and during the test flood, inundation can be expected. On the left shore just upstream of the dam, there is a private residence. The yard where it meets the foundation of the home, is about 7 (±) feet above the spillway crest elevation. Flooding of the first floor can be expected during the test flood. A photograph of the home is included in Appendix C.

e. Downstream Channel. The maximum downstream channel capacity of Mill Brook has not been determined. There is considerable streambank development between the dam and the center of town. The first grouping of homes close to the streambank is at Union Street, 600 feet downstream from the dam. A stage discharge rating located in Appendix D, has been developed for this location, and the effects of a dam breach on the areas have been estimated.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN. There is no design data available.

2.2 CONSTRUCTION. There is no data pertaining to the original construction, but modifications were made to the dam in 1961. A review of the repair contract drawings revealed discrepancies between the dam as it exists today and the intended changes as represented by the Fay, Spofford and Thorndike plans. These plans however, do give a good overall picture of the dam and its general features.

Sheets 1 and 2 of the original Fay, Spofford and Thorndike plans have been amended to show the existing conditions of the Windsor Upper Dam. These drawings are included in Appendix B of this report.

2.3 OPERATION. Information pertaining to the operation and operational procedures was not available.

2.4 EVALUATION. There is a limited amount of engineering data available for the project. It describes the general characteristics of the existing structures, sections and elevations. No insight to the engineering design parameters or assumptions were gained from this information.

i. Regulating Outlets. There are two outlets (a penstock and a sluice), and each is equipped with a 40-inch square, vertical lift gate on the upstream side of the dam. Both were reported to be functional, unobstructed, and are hand-operated from a walkway atop the spillway.

The sluiceway gate is located near the centerline of the structure, with invert at about elevation 52, or 48 feet below spillway crest, and has a free outfall into the channel downstream. The penstock gate is located on the left side of the structure, with invert at elevation 70, or 30 feet below spillway crest. Based on a visual inspection of the downstream ends of the conduits, the 40-inch gates appear to be the hydraulic controls of the outlets. With the pool at spillway crest, total gate capacity is computed to be 646 cfs, or 15 csm. The gates are therefore deemed to be of adequate size.

e. Storage

(1) Recreation Pool - approximately 344 acre-feet
(2) Top of Dam - approximately 645 acre-feet

(A capacity curve is located in Appendix D)

f. Reservoir Surface

(1) Top of Dam - estimated 115 acres
(2) Recreation Pool (spillway crest) - approximately 74 acres

g. Dam

Type - Stone Masonry & Concrete-Gravity
Length - Approximately 320 feet
Height - Varies, 55 feet (max.)
Top Width - Varies
Side Slopes - 6 hor. on 12 vert. upstream face
8 hor. on 12 vert. downstream face

h. Spillway(s). The total effective length of the main spillway is 198 feet; 108 feet of which is a modified ogee weir, and 90 feet of which is a broad-crested weir. The crest is at elevation 100.0 feet (local datum). There are no spillway gates. The spillway occupies the major portion of the dam, so the upstream channel is, in effect, the 77-acre recreation reservoir (i.e., no approach channel), and the downstream channel is the main river channel. The stilling basin consists of ledge outcroppings and boulders.

Immediately to the left of the main spillway there is a 45-foot section consisting of stone, capped and faced with concrete. For purposes of this report, this section may be classified as a broad-crested weir, and is termed "Auxiliary Spillway No. 1." The crest is at elevation 102.6.

Immediately to the left of Auxiliary Spillway No. 1, there is a 49-foot section, consisting of stone, faced and capped with concrete to elevation 104.4. For purposes of this report, this section may also be classified as a broad-crested weir, and is termed "Auxiliary Spillway No. 2."

The relationship of these overflow sections is shown in the contract drawings (Appendix B) and photographs (Appendix C). A spillway rating is located in Appendix D.

i. Normal Operational Procedure(s). A permanent recreation pool is maintained at elevation 100.0 (local datum) by the 198-foot main spillway. There are no flashboards. The two outlets at the base of the dam are used only to lower the pool for spring maintenance at the town beach. At the advice of the Vermont Department of Water Resources, there is no operation of the project for flood control purposes.

1.3 PERTINENT DATA

a. Drainage Area at damsite, 43.8 square miles.

b. Discharge at Damsite. There are no discharge records available for the site. The largest known floods of modern history in this region occurred in November 1927, March 1936, and September 1938. A flood insurance study conducted for the Twon of Windsor indicates the 1927 event was the worst of these. Examination of U. S. Geological Survey records for other streams in the area indicate Mill Brook probably sustained flows in excess of 160 cubic feet per second per square mile (csm).

Flows at the dam may be passed through the two 40-inch square gates near the base of the structure, over the 198-foot main spillway, or over the two auxiliary spillways. As mentioned in paragraph 1.2.i, the gates are normally left closed, even during floods, and all flows pass over the spillway(s). With the pool elevation 107.3 (top of dam), the total spillway capacity is about 16,600 cfs (380 csm). Section 5 contains further discharge information.

c. Elevations (feet, local datum)(100 feet local datum about equal to 283 feet msl, from USGS quadrangle).

(1) Top of Dam - 107.3
(2) Auxiliary Spillway (No. 1) - 102.6
(3) Auxiliary Spillway (No. 2) - 104.4
(4) Permanent (recreation) Pool - main spillway crest - 100.0
(5) Upstream invert, penstock gate - 70 (approximately)
(6) Upstream invert, sluice gate - 52 (approximately)
(7) Streambed at centerline of dam - 52 (approximately)

d. Reservoir

(1) Length of Maximum Pool (top of dam, elev. 107.3) - estimated 1.1 miles.

(2) Length of Recreation Pool (Elev. 100.0) - 0.83 mile.

The Windsor Upper Dam has several alternate titles which have been used through the years. They are Ascutney Mill Dam, Mill Pond Dam and Roger T. Mahar Dam. The structure has been listed in the Historic Register and named as a Civil Engineering Landmark under the name of Ascutney Mill Dam.

c. Size Classification. The structure is an intermediate dam, based on height.

d. Hazard Classification. High hazard potential, based on area of residential development at Union Street, 600 feet downstream.

e. Ownership. Town of Windsor, Vermont.

f. Operator.

Town of Windsor
Office of the Town Manager
Windsor, Vermont

TEL: (Area Code 802) 674-6786

All inquiries should be to the Office of the Town Manager. He will be able to answer the inquiry or direct one to the appropriate town department.

g. Purpose of Dam. To maintain a pool for recreational purposes.

h. Design and Construction History. The Windsor Upper Dam was completed in early nineteenth century. Best estimate on the completion date is 1834. There is no design or construction data available pertaining to the original structure.

The dam was partially renovated under a contract let by the Town of Windsor. Plans and Specifications, dated April 1961 for "The Repair and Alteration of Mill Pond Dam" were prepared by Fay, Spofford and Thorndike Inc. Engineers, Boston, Massachusetts. These repairs were based partly on the recommendations made in an inspection report, dated February 1961, prepared by Anderson-Nichols & Co., Engineers, Boston, Massachusetts for the Vermont Water Conservation Board. Plans of these modifications are attached to this report in Appendix B.

PHASE I INSPECTION REPORT

WINDSOR UPPER DAM, VERMONT 00013

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

b. Purpose.

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interest.

(2) Encourage and assist the States to initiate quickly effective dam inspection programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 DESCRIPTION OF PROJECT

a. Location. The dam is situated on the northern bank of Mill Road in the Town of Windsor, Vermont. It is approximately 0.9 miles upstream from the mouth of Mill Brook at the Connecticut River.

b. Description of Dam and Appurtenances. The Windsor Upper Dam is a stone masonry and concrete gravity dam founded on ledge. It has an overall length of approximately 320 feet, and a maximum height of about 55 feet. The dam is slightly convex upstream. It has one primary spillway at Elev. 100.00 (local datum), which has a total effective length of 198 feet. The dam has two other intermediate levels which act as auxiliary spillways. They are at Elevation 102.6 and 104.4 (local datum). The non-overflow section of the dam, a grass-covered earth embankment at Elev. 107.3, is at the left abutment. The structure has a gated sluice way and a gated penstock.

The upstream face of the dam has concrete facing that is estimated to be eight (8) inches thick.

APPENDIX A

APPENDIX A - WINDSOR UPPER

PHASE I
VISUAL INSPECTION

PARTY ORGANIZATION

PROJECT Windsor Upper

LOCATION Windsor, Vermont

STREAM Mill Brook

INVENTORY NO. VT #00013

DATE 6 June 1978

TIME 9:30

WEATHER

W.S. ELEV. U.S. DN.S.

PARTY:

1. W. Rodger
2. G. A. Laraway
3. J. McElroy
4.
5.
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Spillway (Fig. 5&6)	Laraway	Clear, but inadequate size.
2.	Outlets (Fig. 7&8)	"	Operable
3.	Berm (Fig. [illegible])	"	Excellent cond. but too low.
4.			
5.			
6.			
7.			
8.			
9.			
10.			

[illegible]

PART I

PERIODIC INSPECTION CHECK LIST

PROJECT Windsor Dam DATE October 19, [illegible]

PROJECT FEATURE Upstream Primary Dam TIME [illegible]

DISCIPLINE - NAME -

AREA EVALUATED	COMMENTS
DAM (Fig. 12.)	
Crest Elevation 100.00 (local datum)	(Spillway 1)
Current Pool Elevation 100.0	100.0
Maximum Impoundment to Date	Unknown
Surface Cracks	Unknown
Pavement Condition	N/A
Movement or Settlement of Crest	None observed
Lateral Movement	None
Vertical Alignment	Appears Good
Horizontal Alignment	Appears good, dam is slightly curved upstream
Condition of Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	N/A
Sloughing or Erosion of Slopes or Abutments	N/A
Rock Slope Protection - Riprap Failures	N/A
Unusual Movement or Cracking at or near Toes	None Observed
Unusual Embankment or Downstream Seepage	None Observed
Piping or Boils	N/A
Foundation Drainage Features	None
Toe Drains	N/A
Instrumentation System	None

PROJECT Windsor Dyer DATE 8 June 1978

PROJECT FEATURE Earth Embankment TEAM Inspection Team

DISCIPLINE _____ NAME _____

AREA EVALUATED	COMMENTS
DIKE EMBANKMENT (FEET)	
Crest Elevation 107.3	Grass-covered; excellent cond. but too low.
Current Pool Elevation 100.0	
Maximum Impoundment to Date	Unknown
Surface Cracks	N/A
Pavement Condition	N/A
Movement or Settlement of Crest	N/A
Lateral Movement	N/A
Vertical Alignment	N/A
Horizontal Alignment	N/A
Condition at Abutment and at Concrete Structures	N/A
Indications of Movement of Structural Items on Slopes	N/A
Trespassing on Slopes	N/A
Sloughing or Erosion of Slopes or Abutments	N/A
Rock Slope Protection - Riprap Failures	N/A
Unusual Movement or Cracking at or near Toes	N/A
Unusual Embankment or Downstream Seepage	N/A
Piping or Boils	N/A
Foundation Drainage Features	N/A
Toe Drains	N/A
Instrumentation System	None

ENCL 1

VISUAL INSPECTION CHECK LIST

PROJECT Windsor Upper DATE 8 June 1978

PROJECT FEATURE Outlets NAME Inspection Team

DISCIPLINE NAME

AREA EVALUATED	COMMENTS
OUTLET WORKS	
a. Concrete and Structural	N/A
General Condition	N/A
Condition of Joints	N/A
Spalling	N/A
Visible Reinforcing	N/A
Rusting or Staining of Concrete	N/A
Any Seepage or Efflorescence	N/A
Joint Alignment	N/A
Unusual Seepage or Leaks in Gate Chamber	N/A
Cracks	N/A
Rusting or Corrosion of Steel	N/A
b. Mechanical and Electrical	
Air Vents	None
Float Wells	None
Crane Hoist	None
Elevator	None
Hydraulic System	None
Service Gates (3)	Are operable (hand-operated)
Emergency Gates	None
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System in Gate Chamber	None

PROJECT Windsor Upper DATE 8 June 1978

PROJECT FEATURE Channel NAME Inspection Team

DISCIPLINE NAME

AREA EVALUATED	COMMENTS
OUTLET STRUCTURE AND/OR OUTLET CHANNEL	
General Condition of Concrete	N/A
Rust or Staining	N/A
Spalling	N/A
Erosion or Cavitation	N/A
Visible Reinforcing	N/A
Any Seepage or Efflorescence	N/A
Condition at Joints	N/A
Drain Holes	N/A
Channel	
Loose Rock or Trees overhanging Channel	No
Condition of Discharge Channel	Natural - good

APPENDIX B

Contents - Appendix B

A. All available records pertaining to Windsor Upper Dam are on file at the Vermont Department of Water Resources, Agency of Environmental Conservation, Montpelier, Vermont.

B. Information included in this report:

1. Inspection report prepared by Anderson - Nichols & Company for Vermont Water Conservation Board, dated February 1961.

2. Letter from Fay, Spofford & Thorndike, dated April 20, 1961.

3. Drawings included in this report:

   a. Plan & Elevation, Sheet No. 1/3.

   b. Cross-Sections & Details, Sheet No. 2/3.

   c. Existing Conditions and Demolition, Sheet No. 3/3.

INSPECTION OF

ROGER T. MAHER DAM

in

WINDSOR, VERMONT

for

The Vermont Water Conservation Board

Hollow Stone Walls

Prepared by

Anderson-Nichols & Company

ROGER T. MAHER DAM

1. General - History of major floods in Vermont indicates that loss of life and extensive property damage have been experienced. Structural failure of many existing dams has contributed significantly to peak flood flows and associated flood losses. In general, these failures resulted from inadequacies in spillway capacities, structural design and maintenance repair. To minimize flood damages associated with possible future dam failures, the Vermont Water Conservation Board is directed to undertake a program of period c inspection of existing dams. The Board has retained the engineering firm of Anderson-Nichols & Company to assist it in performing these inspections and evaluating the adequacy of the structures. A visual examination of the Roger T. Maher Dam site was made on November 16, 1960. The sluice gate at the bottom of the structure was open and only a small amount of water was impounded upstream of the dam. Photographs were taken, and are appended to this report.

2. Purpose - The purpose of this report is to

(a) Summarize the investigations of the Roger T. Maher Dam on Mill Brook in the Town of Windsor, Windsor County, Vermont.

(b) Evaluate the adequacy of the structure.

(c) Recommend to the Board appropriate action to be taken in view of any flood hazard associated with the existing dam.

3. Scope - The scope of this investigation includes a field inspection of the structure site to ascertain the physical characteristics and the condition of the dam, studies to determine the adequacy of the spillway and outlets to pass flood flows that might reasonable be anticipated, and a report summarizing the investigations.

4. Watershed Description - The watershed upstream of the dam has a drainage area of 43.8 square miles. Mill Brook is a tributary of the Connecticut River and flows in a general easterly direction. The main water course is fed by a series of steep gradient streams draining the hilly to mountainous topography of the watershed. The stream pattern, together with the rugged topography, is conducive to rapid runoff.

5. Site Description - The dam is located on Mill Brook in the southerly portion of the Town of Windsor at a point approximately 0.9 miles upstream of the Connecticut River. At spillway crest elevation, the pond created by the dam has a surface area of about 70 acres, and is presently used for recreational purposes. Between the dam and the mouth of the brook, the area adjacent to the stream is occupied by a complex of residential, commercial and mill buildings.

6. Structure Description - The dam is of stone masonry and concrete construction built on a foundation of sound ledge rock. It has an overall length of approximately 312 feet and a maximum height of about 50 feet. Exhibit I shows the principal features and approximate dimensions of the dam based on field measurements. The dam is slightly convex upstream and consists of two sections of primary spillway, two sections of auxiliary spillway at varying crest elevations, a gated sluiceway and a gated penstock through the dam. There are vertical steel I-beams set in the concrete crest for supporting fixed flashboards. A footbridge with steel frame and timber floor extends over the sections of spillway.

7. The upstream side of the dam is faced with concrete, while the downstream side, exclusive of the primary spillway chute, consists of rough cut stone. The piers, crests of all spillways and chute of the primary spillway are of concrete. The gated outlets consist of sluice gates with hand-operated geared hoists mounted in the concrete piers on the top of the dam.

8. The attached photographs of the structure, taken on 16 November 1960, show the following:

Photograph 1 - crest and upstream face of dam as viewed from left bank.

Photograph 2 - crest and upstream face of dam as viewed from right bank.

Photograph 3 - primary spillway chute and downstream face of dam as viewed from right bank.

Photograph 4 - upstream face of hand-operated sluice gate to penstock as viewed from left bank.

Photograph 5 - concrete chute and stone in downstream face of dam as viewed from left bank.

Photograph 6 - partial failure of downstream face of auxiliary spillway as viewed from right bank.

9. Structural Condition - The following observations are based solely on visual examination of the structure without benefit of detailed plans and design data:

(a) The concrete on the upstream face, piers and crest of the dam is in very poor condition (see photographs 1, 2 and 4).

(b) The concrete in the primary spillway chute is in fairly good condition, except for the end walls (see photograph 3).

(c) A section, 15 feet high by 20 feet deep and two to three feet thick, has fallen from the downstream face of the easterly portion of the dam (see photographs 3 and 6).

(d) The size and condition of the waste gate in the center of the dam and the penstock gate near the left abutment were not determinable. The

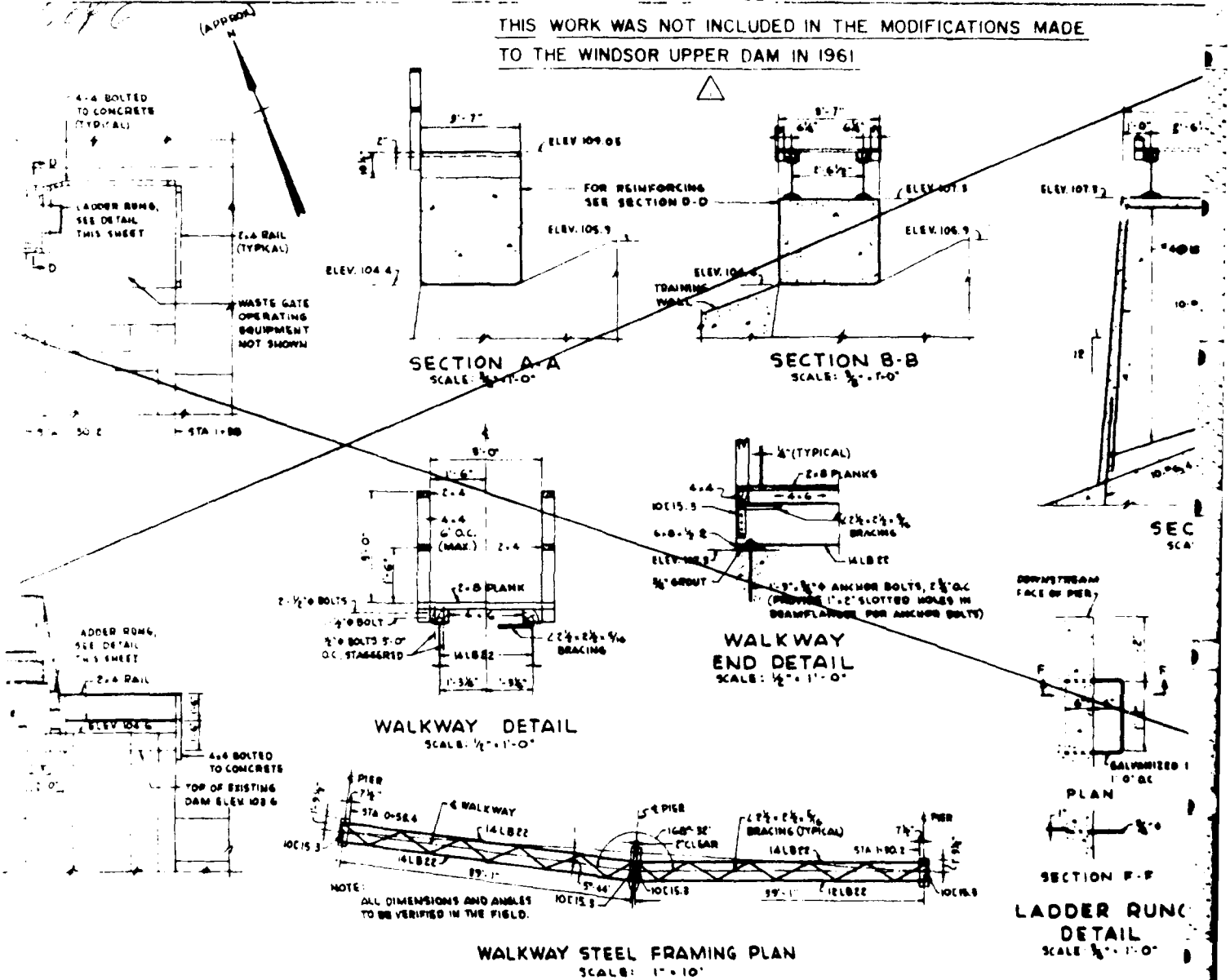
geared hoist for each of these gates appears to be in operable condition. The waste gate used to drain the pond is open carrying the flow of the stream through the dam. The penstock gate is in a closed position (see photographs 1 and 4).

(e) A considerable portion of the floor of the footbridge is missing and the hand railing is bent out of line (see photographs 2 and 3).

(f) The interior section of the dam consists of smaller stones set in mortar, as disclosed by the breach in the dam. The bottom width at the deep section of the dam, as shown on Exhibit I, is about 46 feet. On the basis of cursory examination, the dam appears to be designed with an adequate section.

10. Adequacy of Spillway - Assuming the structure is restored to its original condition, its total discharge capacity would be 3300 cubic feet per second, with one-foot of freeboard at the left or west abutment; and 5000 cubic feet per second with no freeboard. These discharges include an assumed additional 500 cfs flow passing through the sluice gate. The total discharges with and without freeboard correspond to unit rates of runoff of 75 and 115 cfs per square mile, respectively, from the drainage area. It is noted that the surcharge storage represents only 280 acre feet or about 0.1 inch of runoff from the drainage area, and would have an insignificant effect in reducing flood peaks.

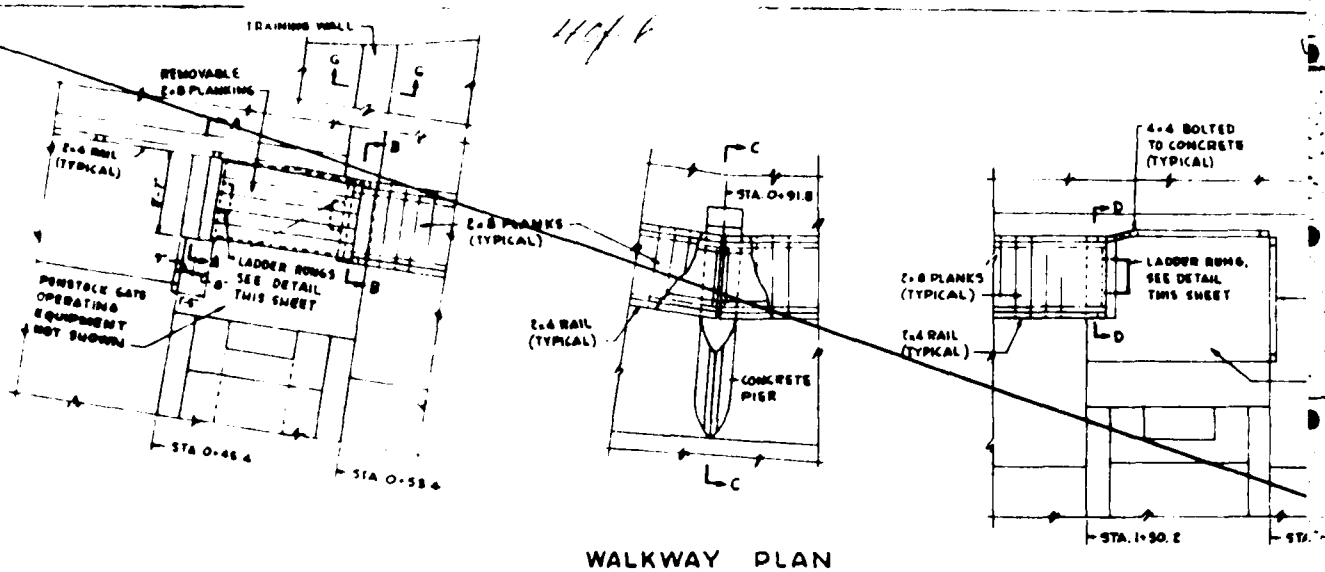
THIS WORK WAS NOT INCLUDED IN THE MODIFICATIONS MADE TO THE WINDSOR UPPER DAM IN 1961



THIS DRAWING

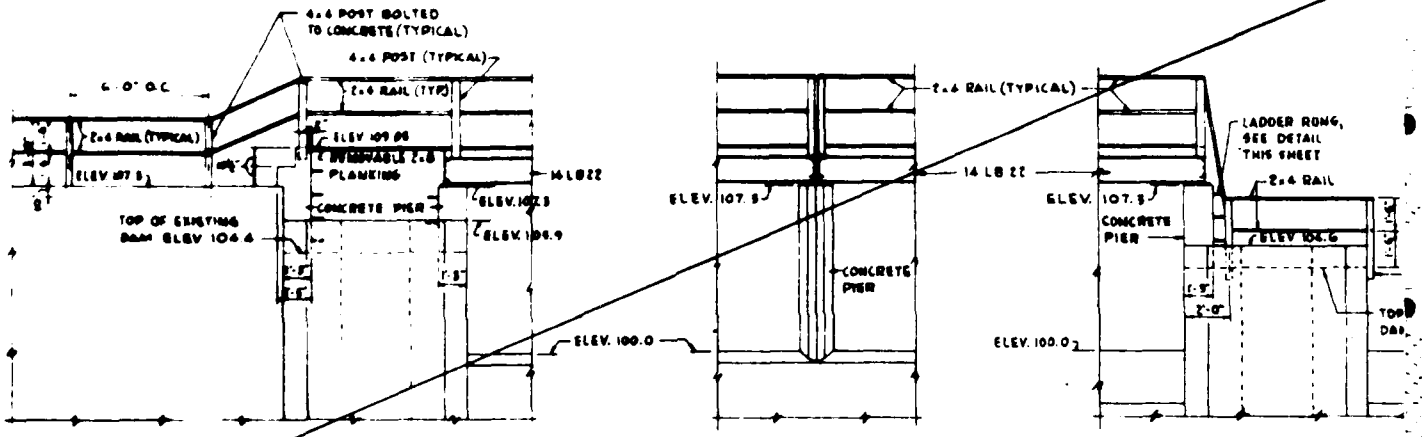
STA. 2+24 TO STA. 2+52.5

STA. 2+52.5 TO STA. 2+74



WALKWAY PLAN

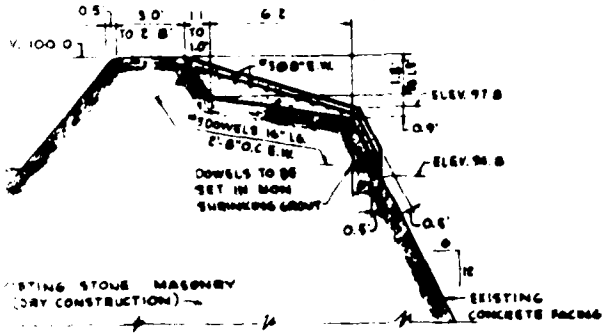
SCALE: ¼" = 1'-0"



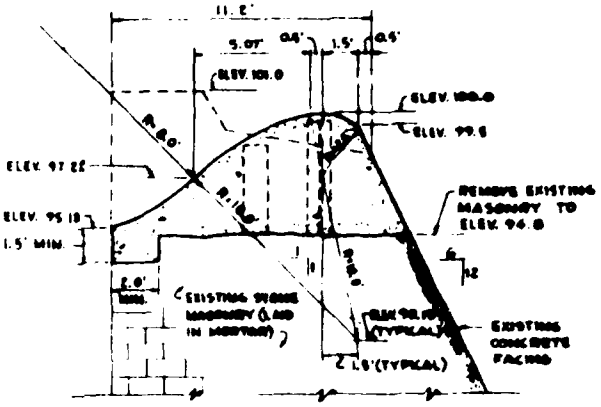
WALKWAY ELEVATION

SCALE: ¼" = 1'-0"

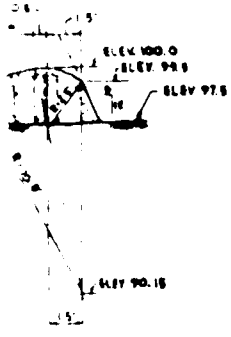
3076



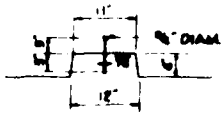
STA. 0+98.4 TO STA. 1+96.4



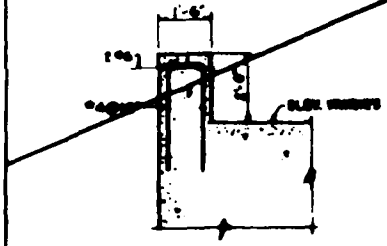
STA. 1+96.4 TO STA. 2+26.2



STA. 5+04.2

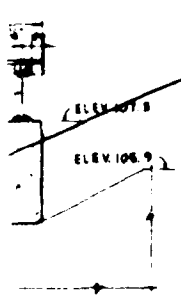


DETAIL - TYPICAL KEY & WATERSTOP AT VERTICAL CONST. JTS.
(WATERSTOP TO BE OF POLYVINYLCHLORIDE AS MANUFACTURED BY WALDRON WATERSTOP INC., OR EQUAL)

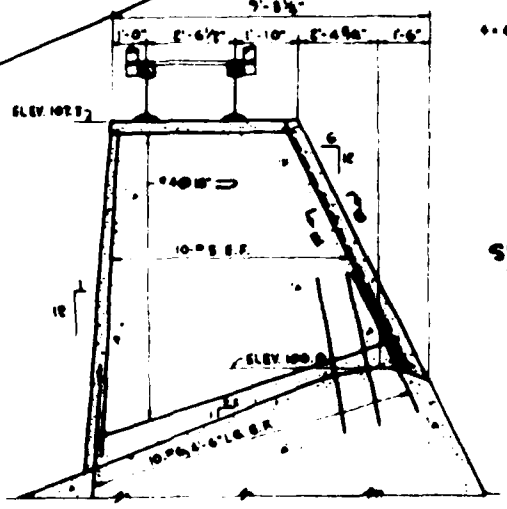


SECTION 6-6
SCALE: ¼"=1'-0"

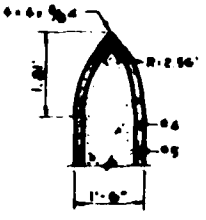
F MODIFICATIONS MADE



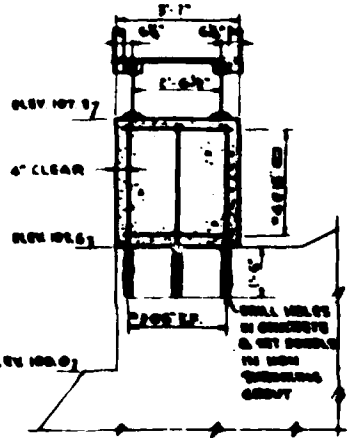
N 8-8
1"=1'-0"



SECTION C-C
SCALE: ¼"=1'-0"



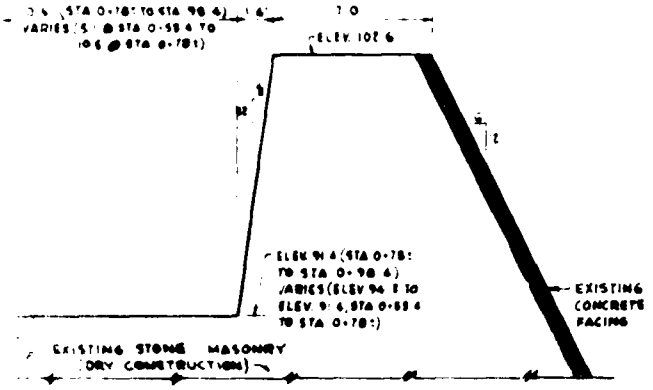
SECTION E-E
SCALE: ½"=1'-0"



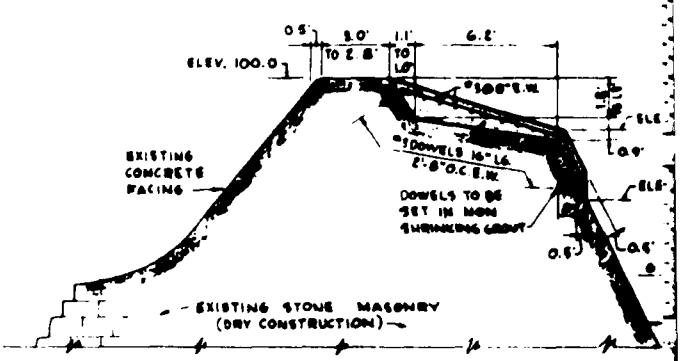
SECTION D-D
SCALE: ¼"=1'-0"

DOWNSTREAM FACE OF PIER

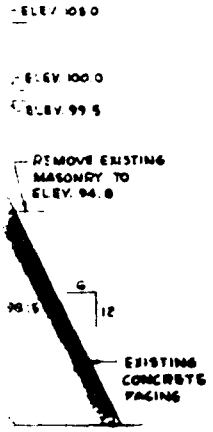
2 of 6

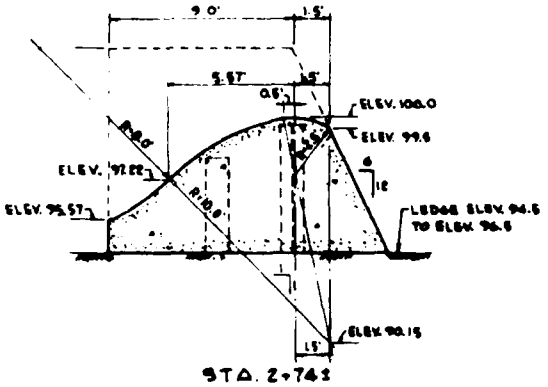


STA 0+53.4 TO STA. 0+98.4

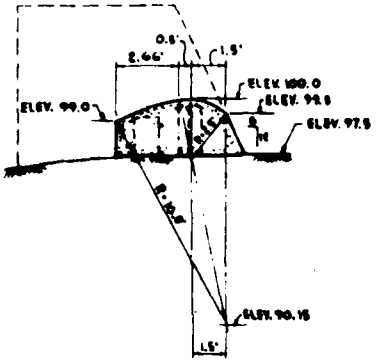


STA. 0+98.4 TO STA. 1+96.4





STA. 2+74.2



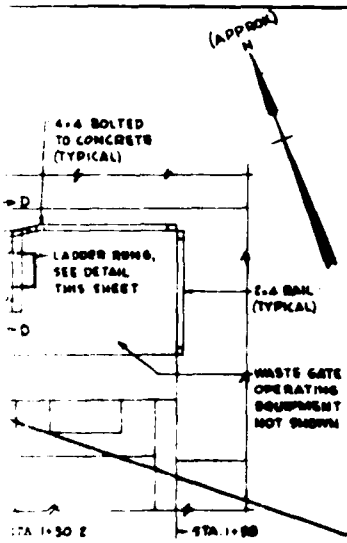
STA. 2+91.2 TO STA. 3+04.2

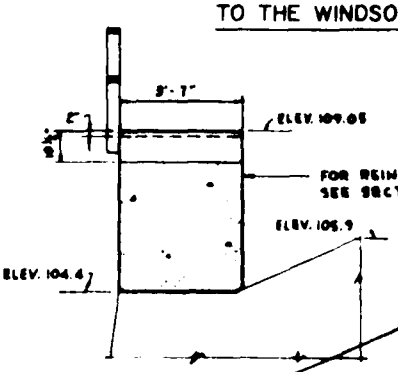
DETAIL - TYPICAL AT VERTICA
(WATERSTOP TO BE AS MANUFACTURED OR EQUAL)

CROSS SECTIONS

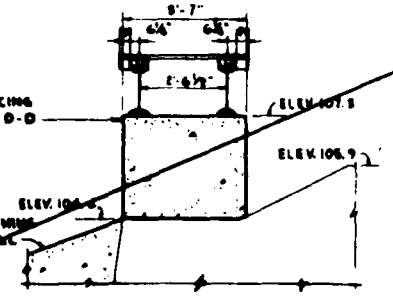
SCALE: 1/4" = 1'-0"

THIS WORK WAS NOT INCLUDED IN THE MODIFICATIONS MADE TO THE WINDSOR UPPER DAM IN 1961.

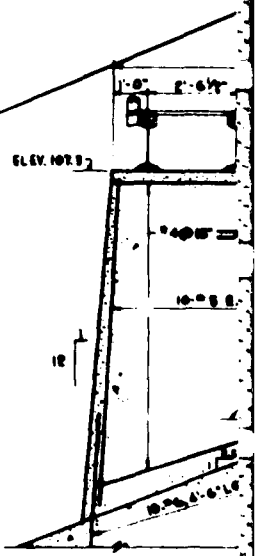




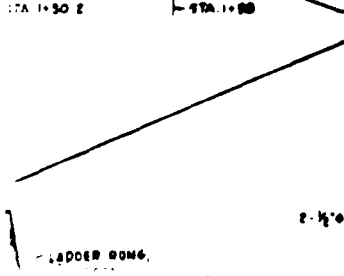
SECTION A-A
SCALE: 1/4" = 1'-0"

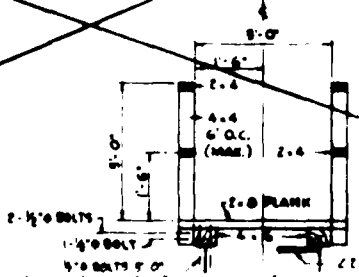


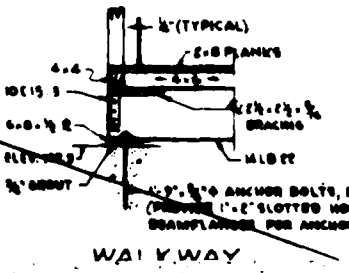
SECTION B-B
SCALE: 1/4" = 1'-0"



SECTIO
SCALE:



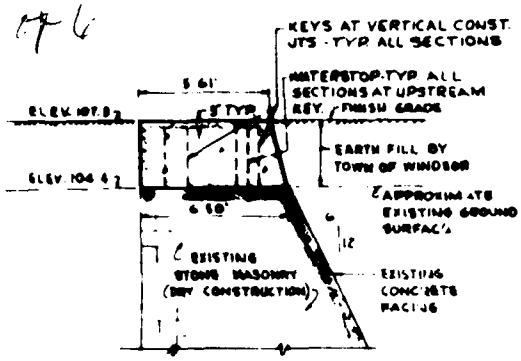




WALKWAY

DOWNSTREAM FACE OF PIER

1 of 6



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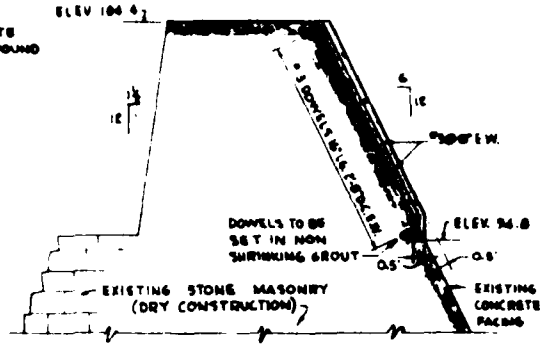
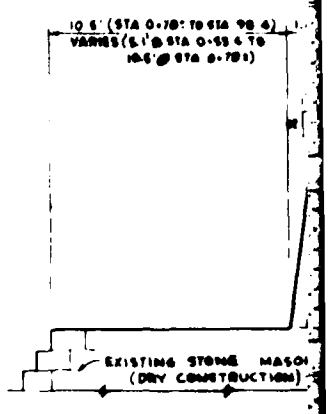
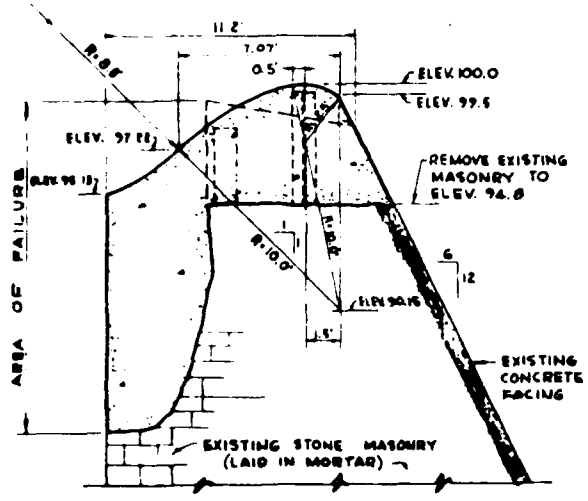


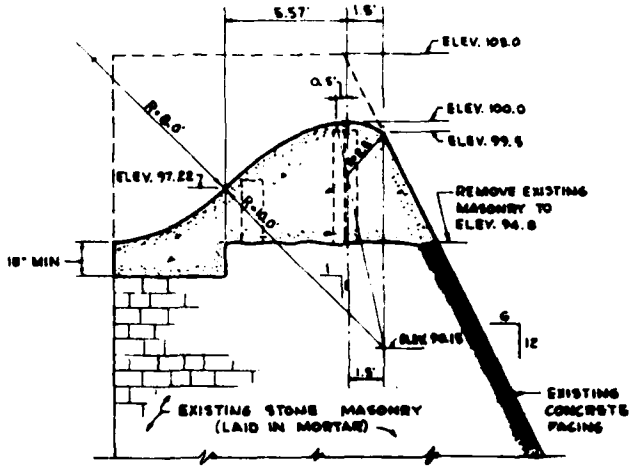


STA. 0+5

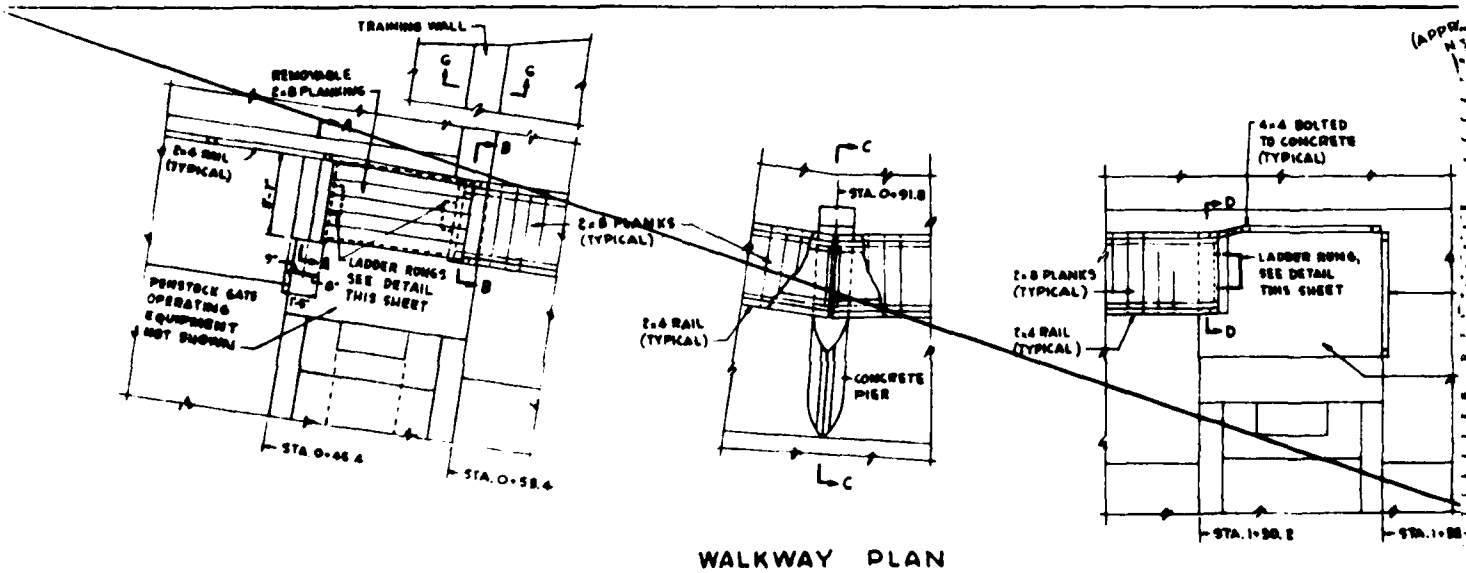
STA. 0+04 TO STA. 0+45.4



STA. 2+24± TO STA. 2+52.5

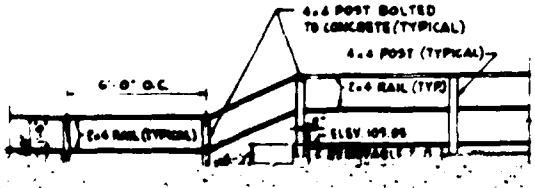


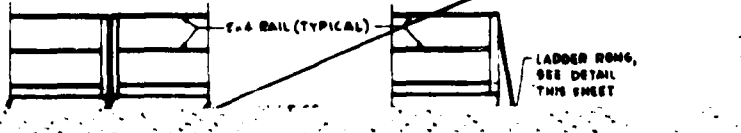
STA. 2+52.5 TO STA. 2+74±

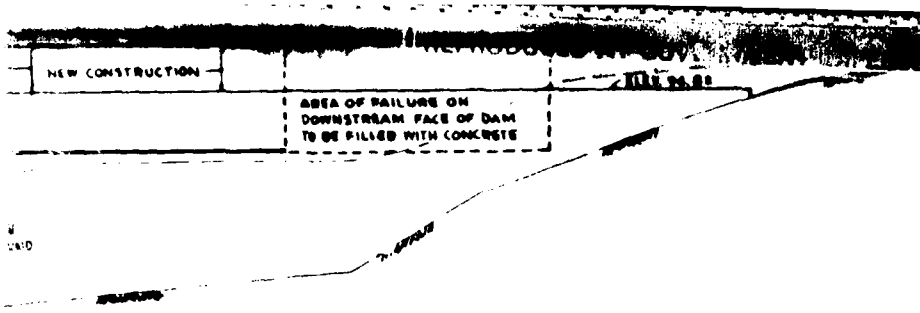


WALKWAY PLAN

SCALE: 1/4"=1'-0"







E LEDGE
KETCH BY CENTRAL
LIC SERVICE CORP.
SD, SHOWING LEDGE
AM FACE OF DAM)

DRAWINGS

SHEET NO.	
.....	1
.....	2
TION.....	3

AMENDED — 30 JUNE 1978 ⚠

WINDSOR, VERMONT

REPAIR AND ALTERATION OF MILL POND DAM

PLAN AND ELEVATION

SCALE AS NOTED APRIL 1981

FAY SPOFFORD & THORNDIKE INC. ENGINEERS BOSTON MASS

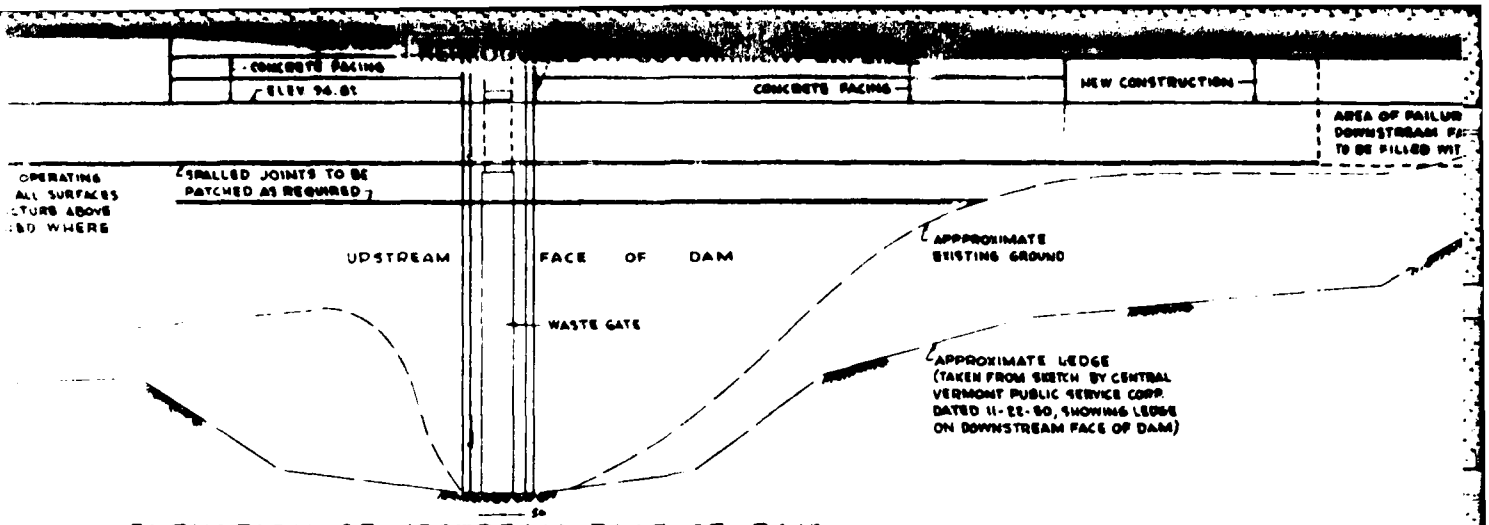
DES. B.C.F. DR. D.S.B.	CK. J.C.A. R.G.W.	D' Ew-7
APPROVED 7 M Calvely		D'' 1

SHEET NO. 1 OF 3

ABA06070000015

THIS DRAWING HAS BEEN REDUCED TO HALF SIZE

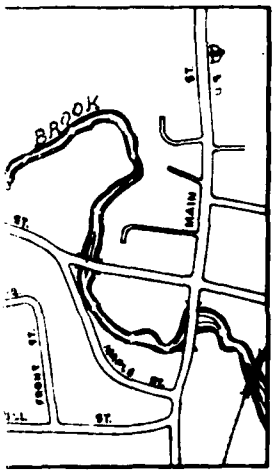
694



ELEVATION OF UPSTREAM FACE OF DAM

SCALE: 1"=10'

△1



AN

INDEX TO CONTRACT DRAWINGS

△2

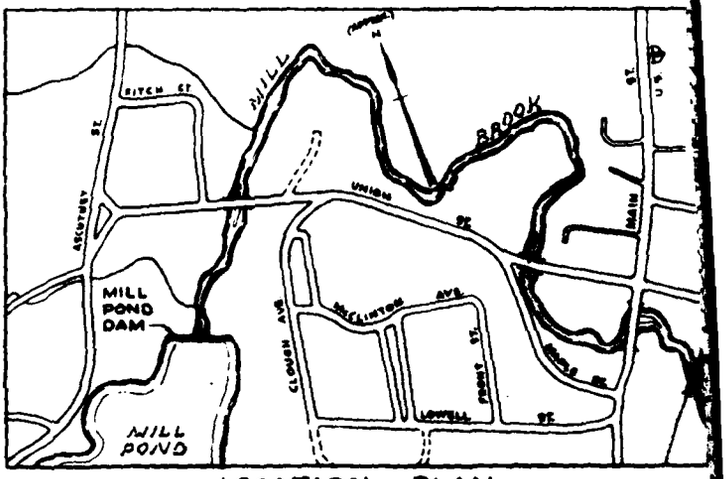
596

THIS DRAWING HAS BEE

PENSTOCK STRUCTURE & OPERATING EQUIPMENT TO REMAIN. ALL SURFACES OF PENSTOCK GATE STRUCTURE ABOVE ELEV. 94.8 TO BE PATCHED WHERE NECESSARY.

PENSTOCK GATE

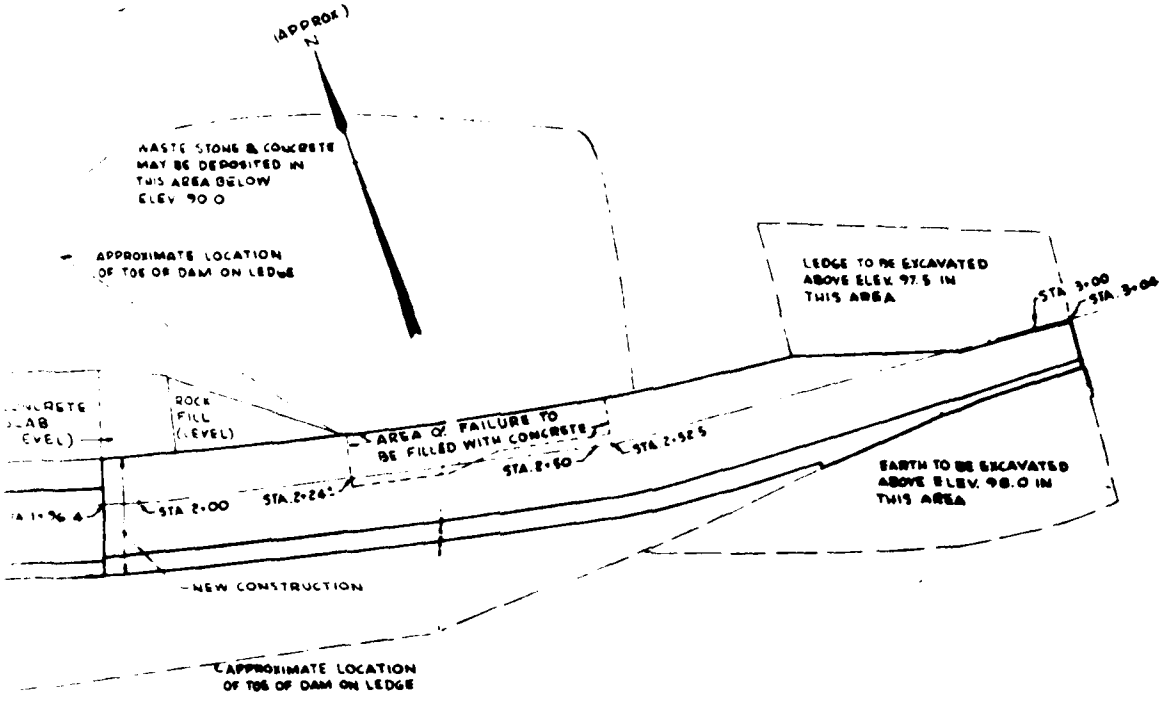
ELEVA

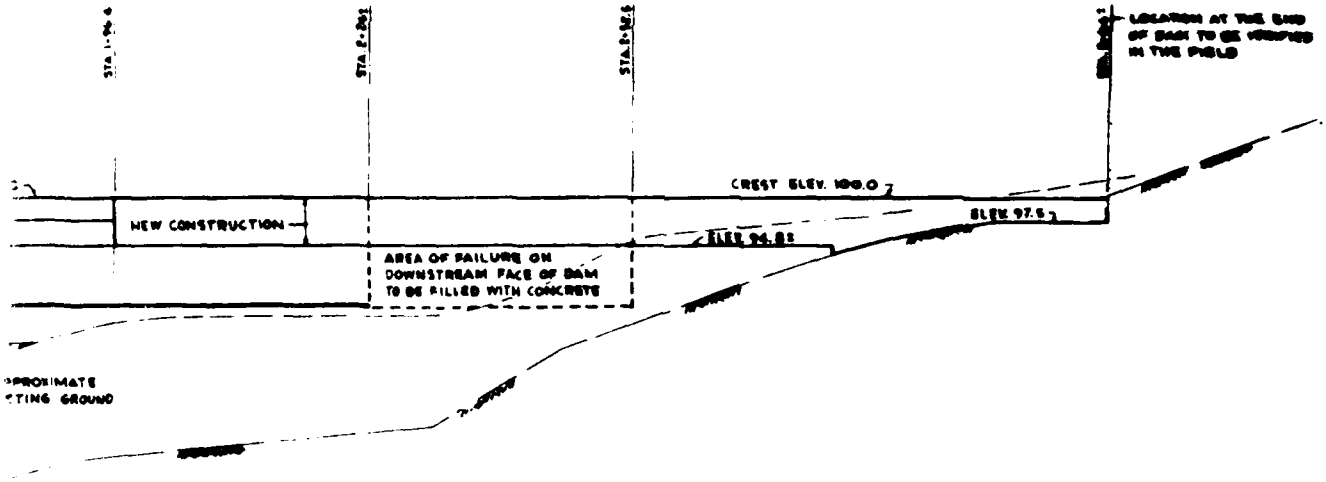


LOCATION PLAN
SCALE: 1" = 400'

496

3 of 6





PROXIMATE LEDGE
EN FROM SKETCH BY CENTRAL
MONT PUBLIC SERVICE CORP
ED 11-22-80, SHOWING LEDGE
DOWNSTREAM FACE OF DAM)

RACT DRAWINGS

	SHEET NO.
.....	1
AILS	2

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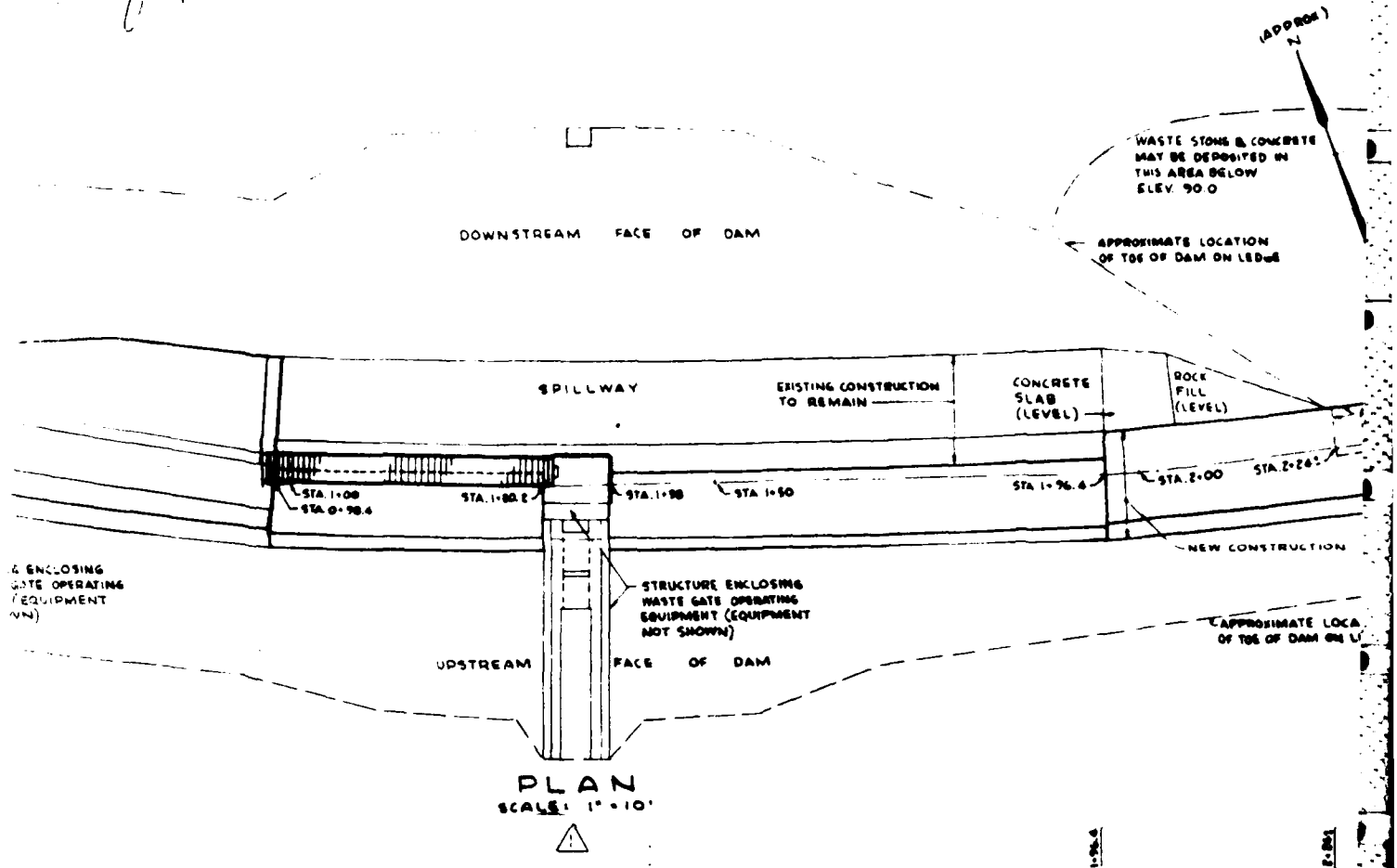
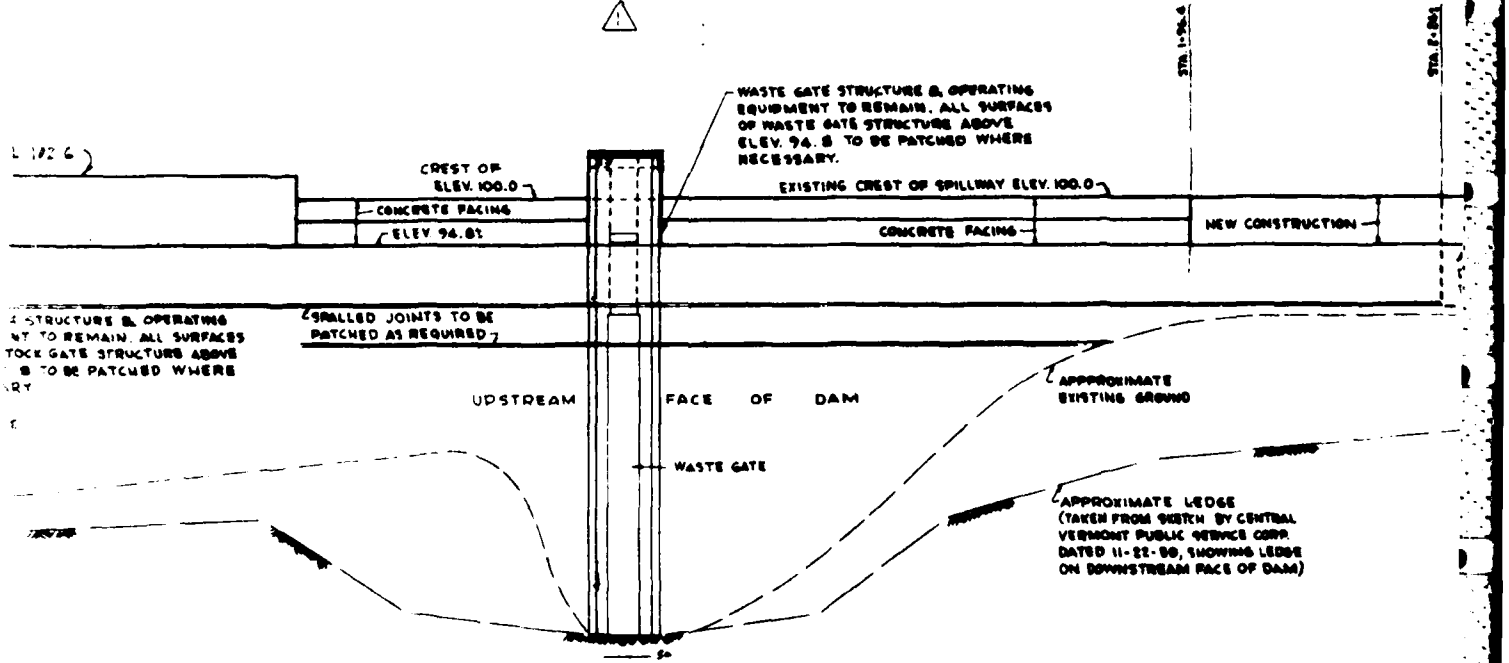


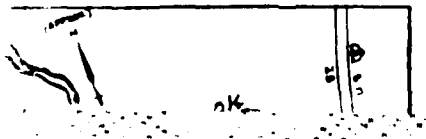
PLAN

SCALE: 1" = 10'



ELEVATION OF UPSTREAM FACE OF DAM

SCALE: 1" = 10'



INDEX TO CONTRACT DRAWINGS

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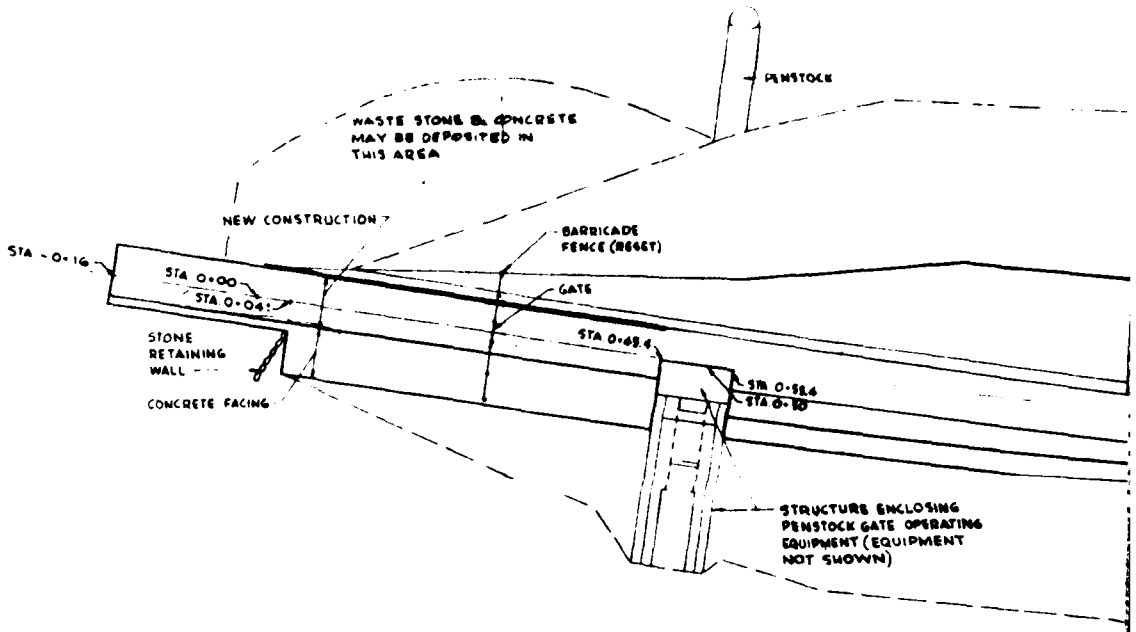
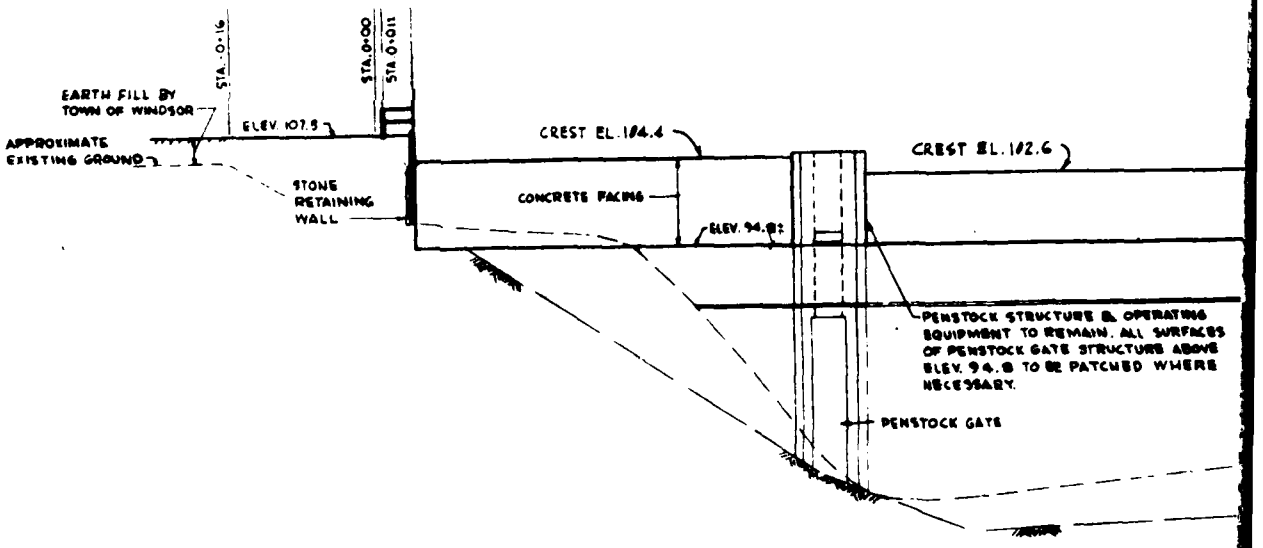
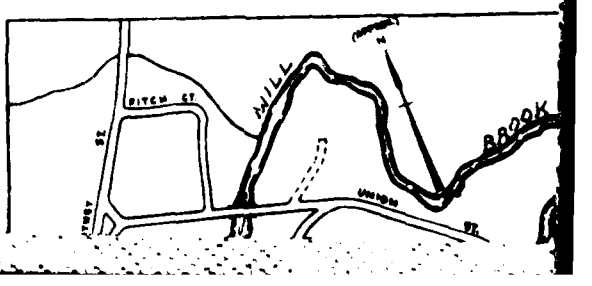






2.

FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS
11 BEACON STREET, BOSTON 8, MASS
TELEPHONE LAFAYETTE 3-8300

April 20, 1961

State of Vermont
Water Conservation Board
Montpelier, Vermont

Attention: Mr. John E. Cerutti
Hydraulic Engineer

Subject: Repair and Alteration of
Mill Pond Dam
Windsor, Vermont

Dear Sir:

We are forwarding herewith two copies each of our Preliminary Plans and Specifications for the subject work. We are also enclosing one copy of our computation sheet 1, showing the spillway flow computations.

These data are being forwarded to you, at the direction of Mr. William E. Blaisdell, Municipal Manager, Windsor, Vt., for your comments or approval. Mr. Blaisdell further requests that, if there are features that you desire to change or if more information is required, you contact this office by telephone as soon as possible, to avoid delay in advertising this work for bids.

You will note that it has been necessary to raise the non-overflow section of the dam higher than was estimated at our conference in Windsor on March 28, 1961, in order to pass the specified flood flow of 13,000 cfs.

Very truly yours,

FAY, SPOFFORD & THORNDIKE, INC.
By

RCFlanders:jb
Ew-7
Enclosures
cc: Mr. W. E. Blaisdell

(c) The vertical steel I-beam should be removed to preclude the future use of flashboards or the collection of debris.

(d) Structural repair and reconstruction of the dam should be made to provide a minimum spillway discharge capacity of 13,000 cubic feet per second with a minimum freeboard of one-and-one-half feet at the left or westerly abutment.

Harry M. Nelson
Harry M. Nelson
Project Engineer

Registered Professional
Engineer - Vermont #120

Herman J. Kropper
Herman J. Kropper
Vice President
Anderson-Nichols & Company, Inc.

Registered Professional
Engineer - Vermont #773

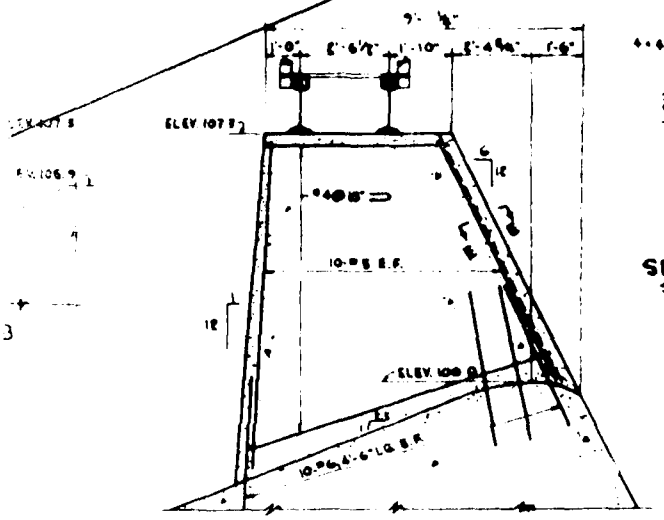
11. As flood records were not available for Mill Brook, an analysis was made of the maximum floods of record on nearby watersheds with similar hydrologic characteristics. The unit rates of runoff for the 1927 and 1938 flood peaks were plotted against drainage area on logarithmic paper and an envelope curve was developed. The resulting rate of runoff for a 43.8 square mile drainage area was about 300 cfs per square mile, which is nearly three times the unit rate of discharge capacity of the structure (paragraph 10). Since floods of similar magnitude to the floods of record can reasonably be anticipated to recur, it is concluded that the present spillway discharge capacity at the dam is highly inadequate.

12. Recommendations - In view of the hazards associated with the present state of disrepair, and the inadequate spillway discharge capacity of the dam, our recommendations are as follows:

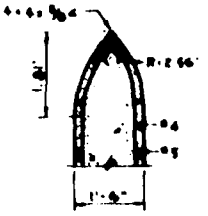
(a) No water should be impounded by the structure in its present state.

(b) At the point of the existing failure near the east auxiliary spillway, all rock and concrete masonry should be removed from the bottom of the failure to the top of dam for the width of the gap. This will permit the spring runoff to flow freely through the gap, and greatly reduce the hazard of structural failure resulting from water impounded by the limited capacity of the gated outlets.

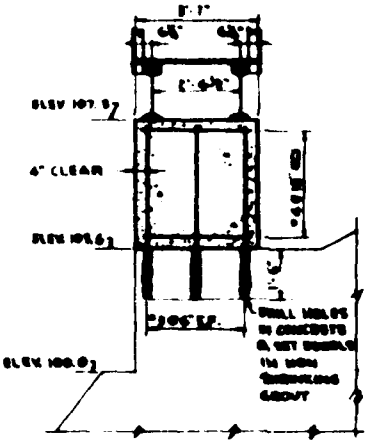
SECTION 6-6



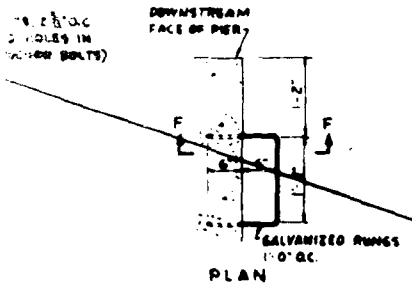
SECTION C-C
SCALE: 3/8" = 1'-0"



SECTION E-E
SCALE: 1/2" = 1'-0"



SECTION D-D
SCALE: 3/8" = 1'-0"



PLAN

SECTION F-F

LADDER RUNG DETAIL
SCALE: 3/8" = 1'-0"

AMENDED — 30 JUNE 1978 ⚠

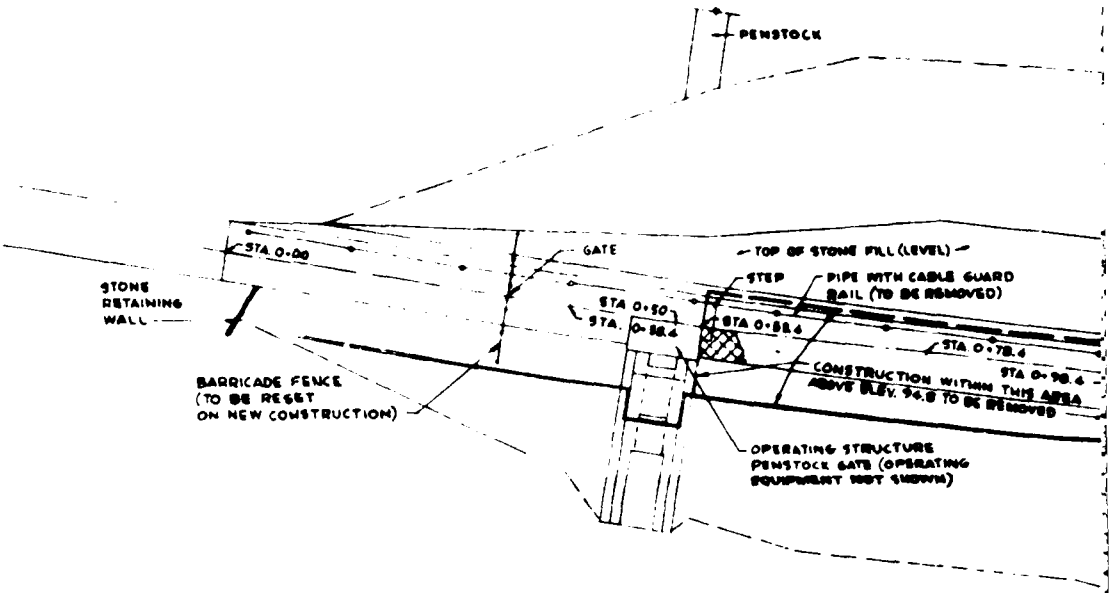
WINDSOR, VERMONT		
REPAIR AND ALTERATION OF MILL POND DAM		
CROSS SECTIONS AND DETAILS		
SCALE AS NOTED		APRIL, 1969
FAY SPOFFORD & THORNDIKE INC ENGINEERS BOSTON MASS		
DES. R.C.B. DR. B.G.B.	CK. A.S.B. B.G.B.	NO. EW-7
APPROVED: F.H. Caleb		SH. 2

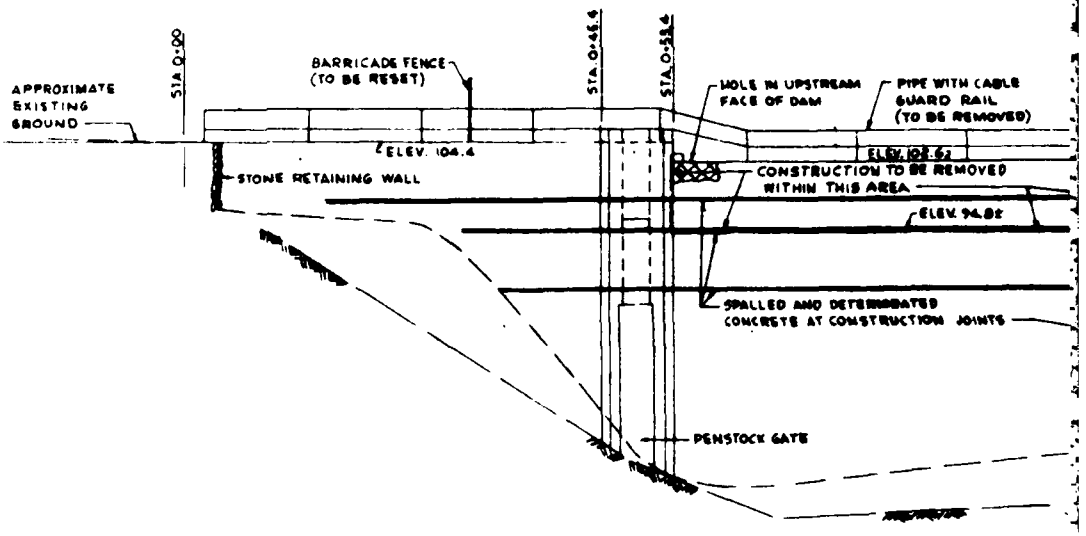
SHEET NO. 2 OF 3

ARA 760700000013

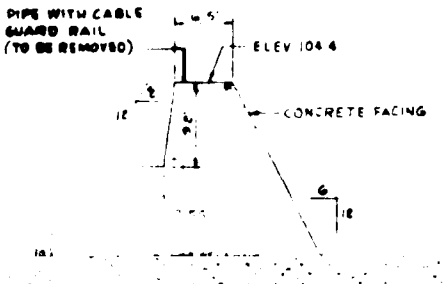
THIS DRAWING HAS BEEN REDUCED TO HALF SIZE

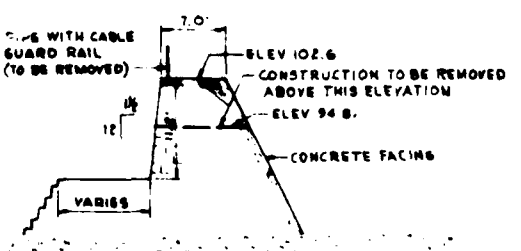
1976



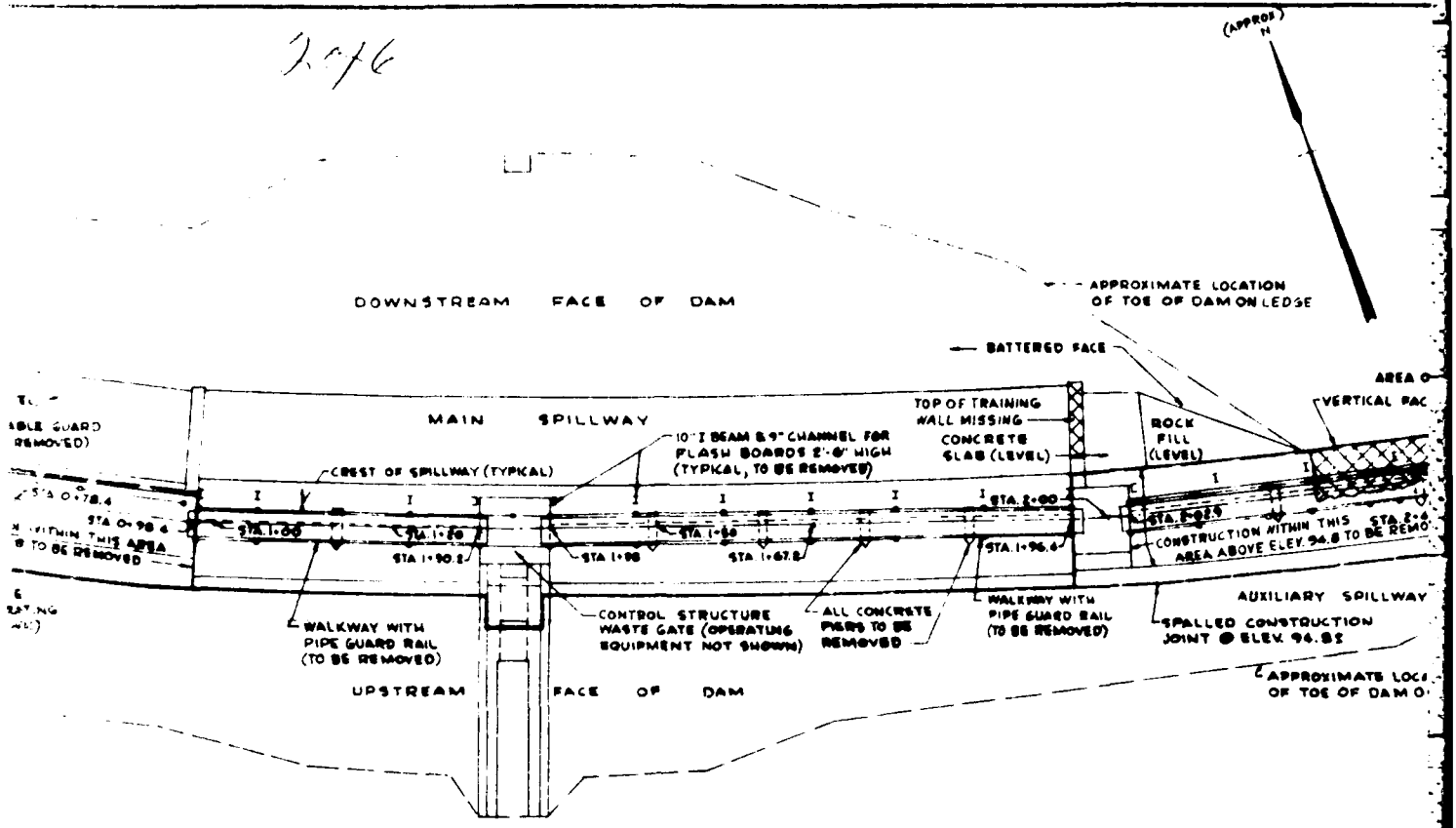


ELEV



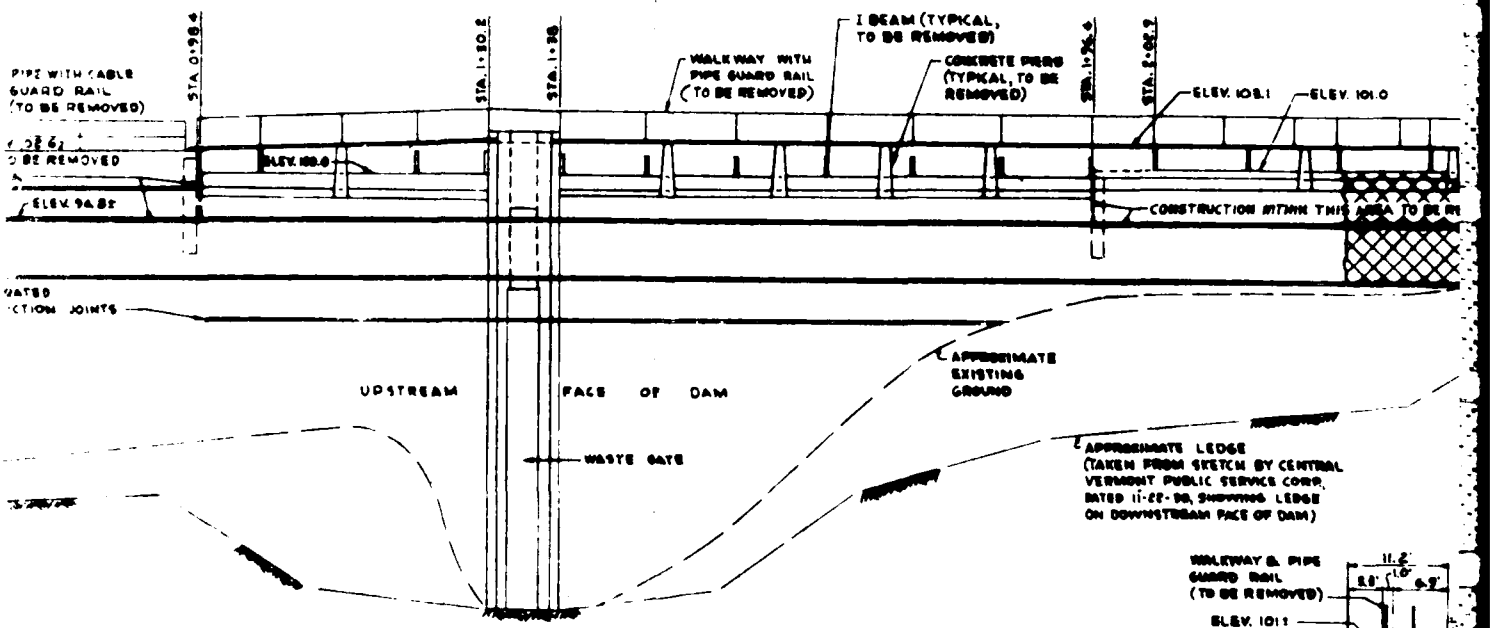


2-76



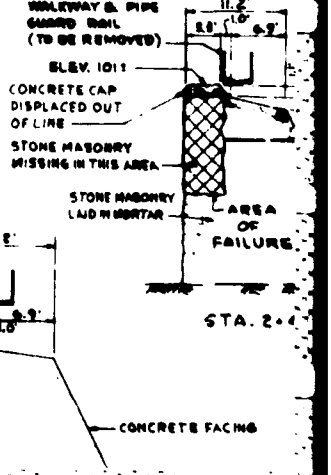
PLAN

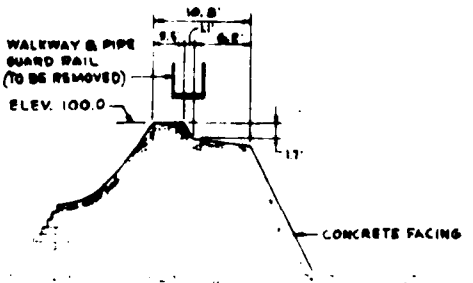
SCALE: 1" = 10'



ELEVATION OF UPSTREAM FACE OF DAM

SCALE: 1" = 10'





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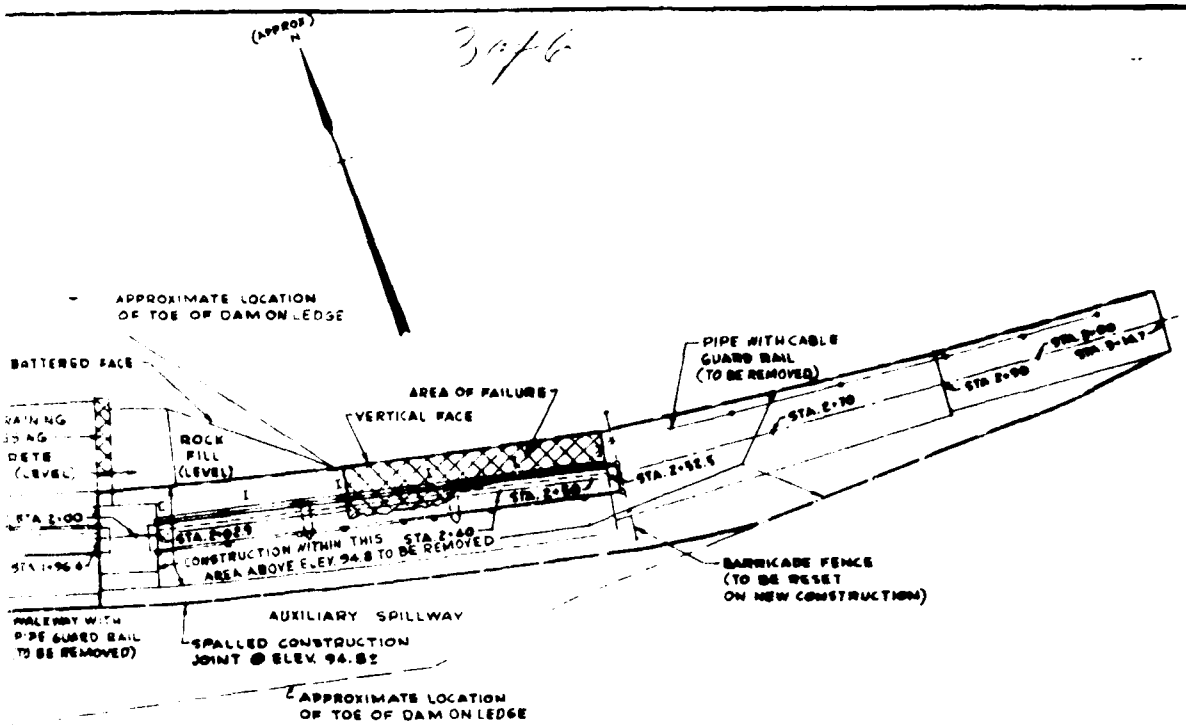
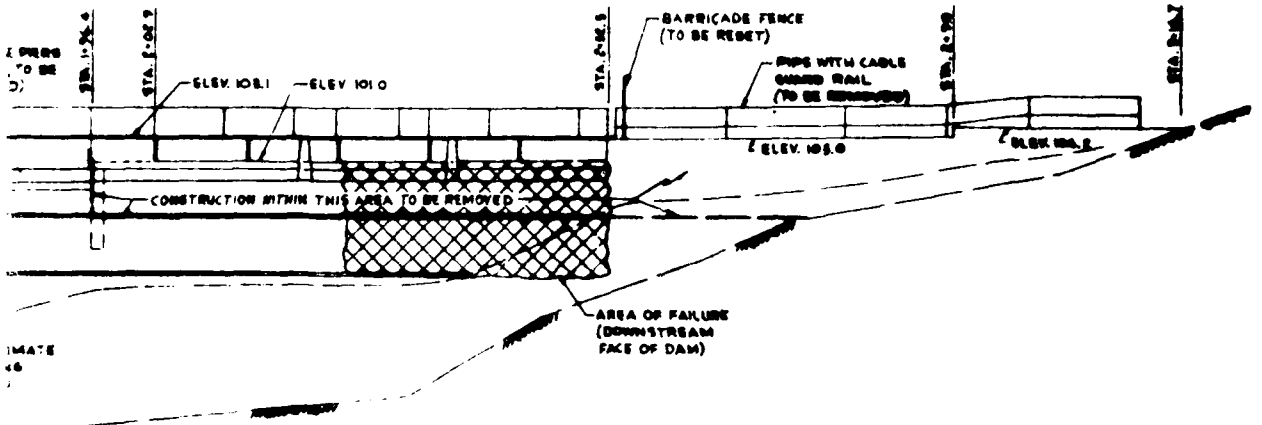
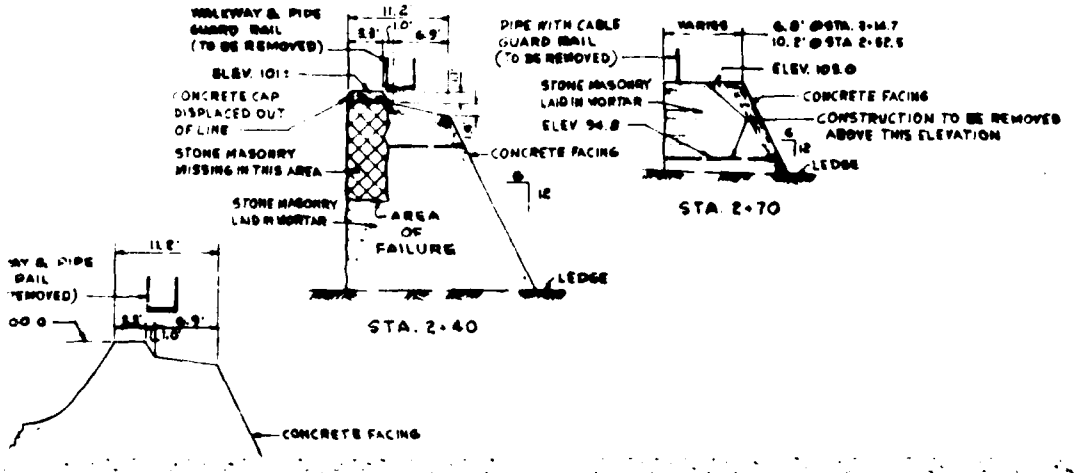
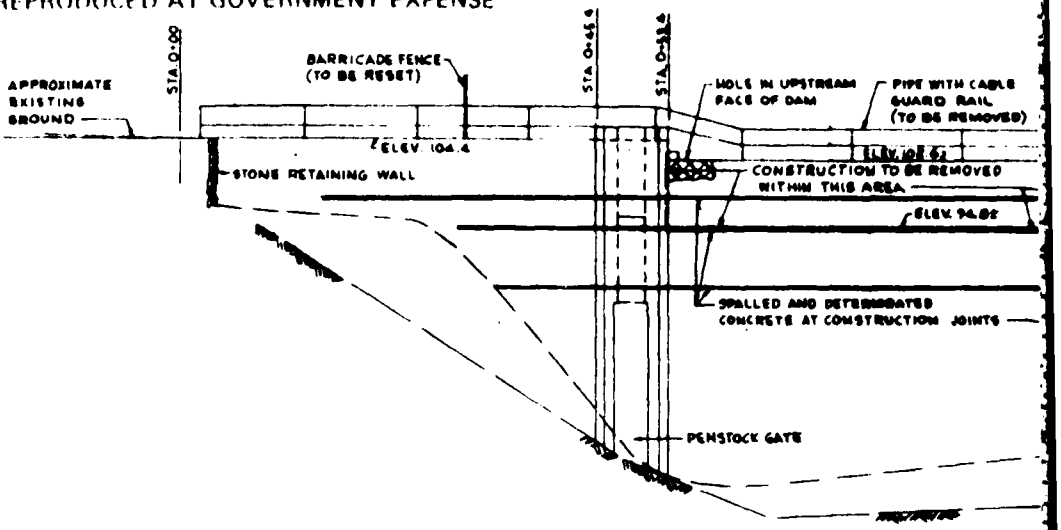






4 of 6



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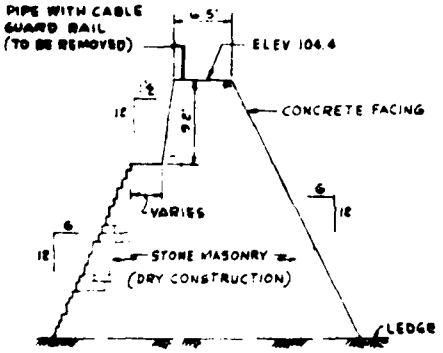
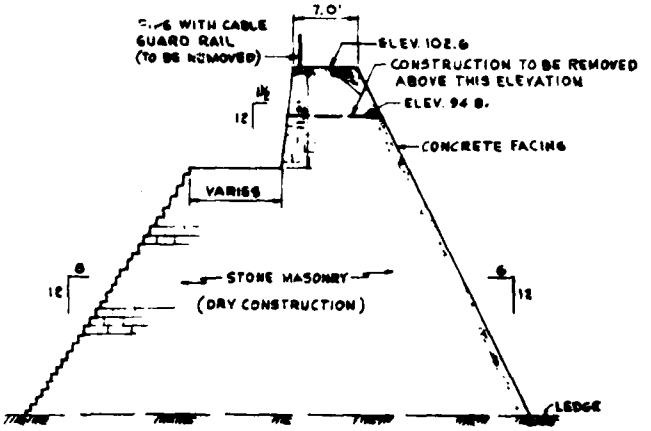
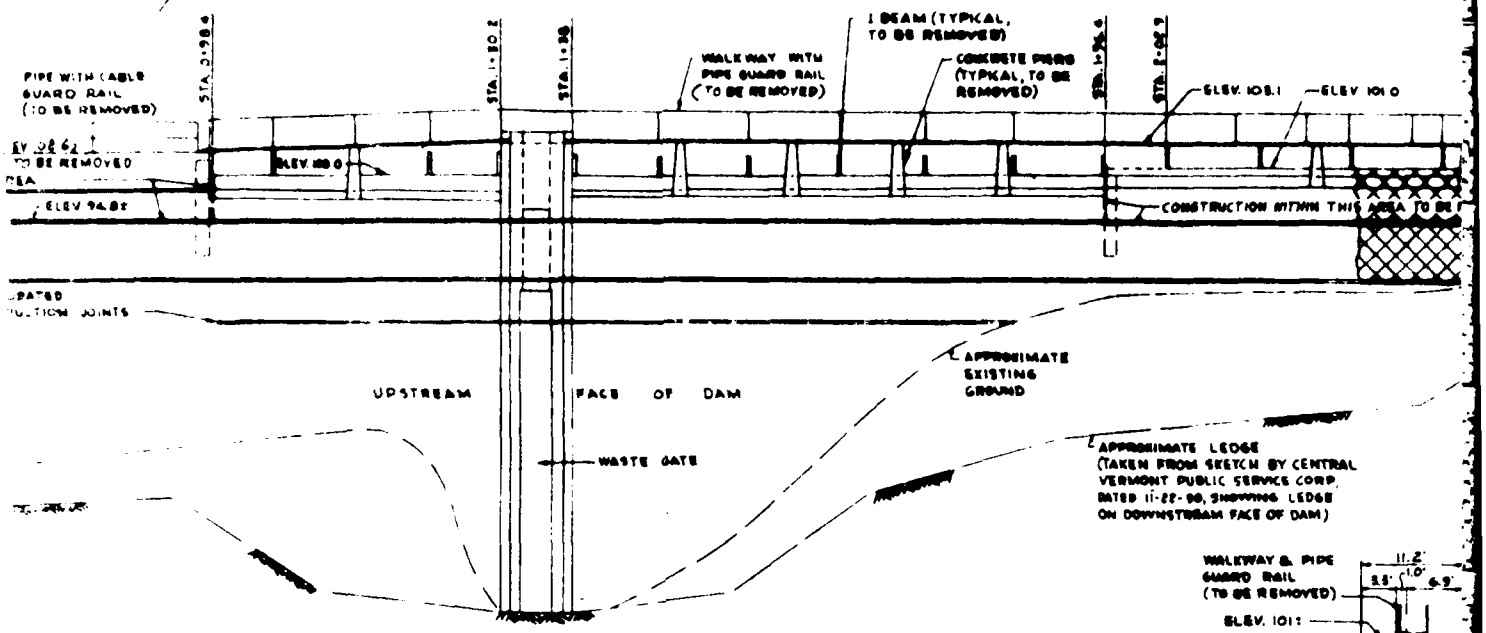


STA. 0+38.4



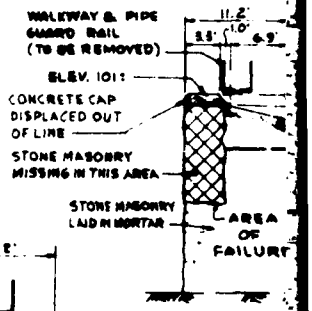
STA. 0+78.4

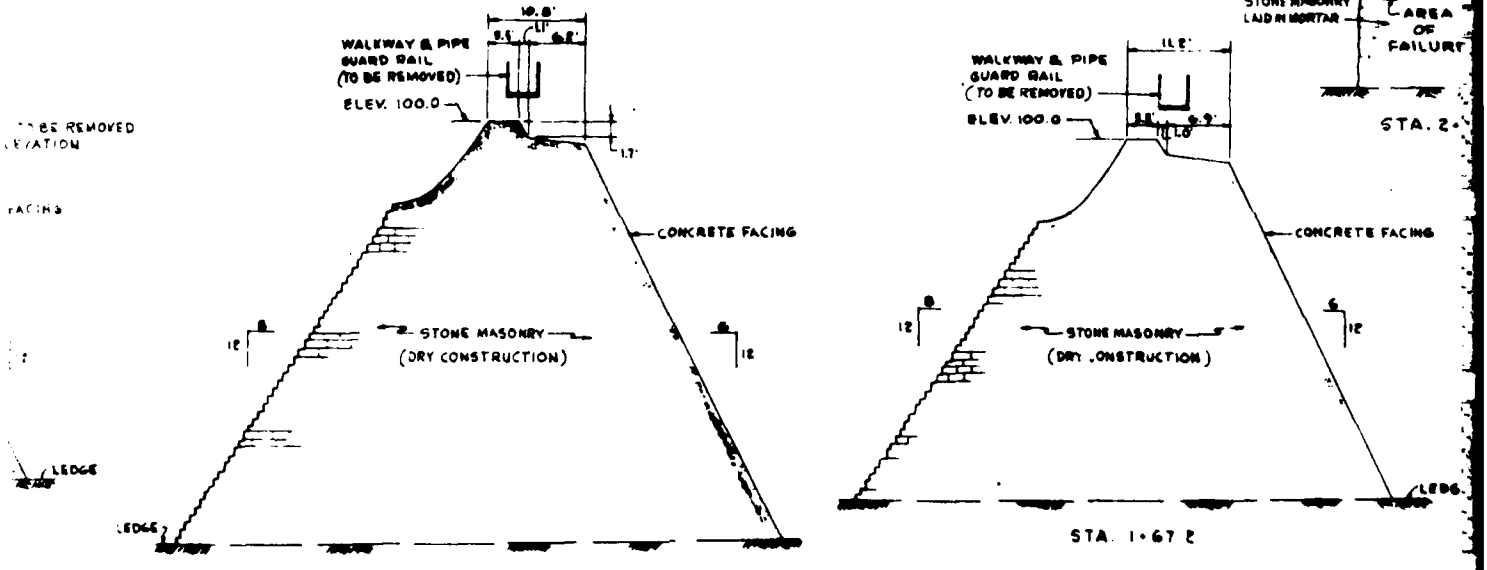
LEDGE



ELEVATION OF UPSTREAM FACE OF DAM

SCALE: 1" = 10'





CROSS SECTIONS

SCALE: 1" = 10'

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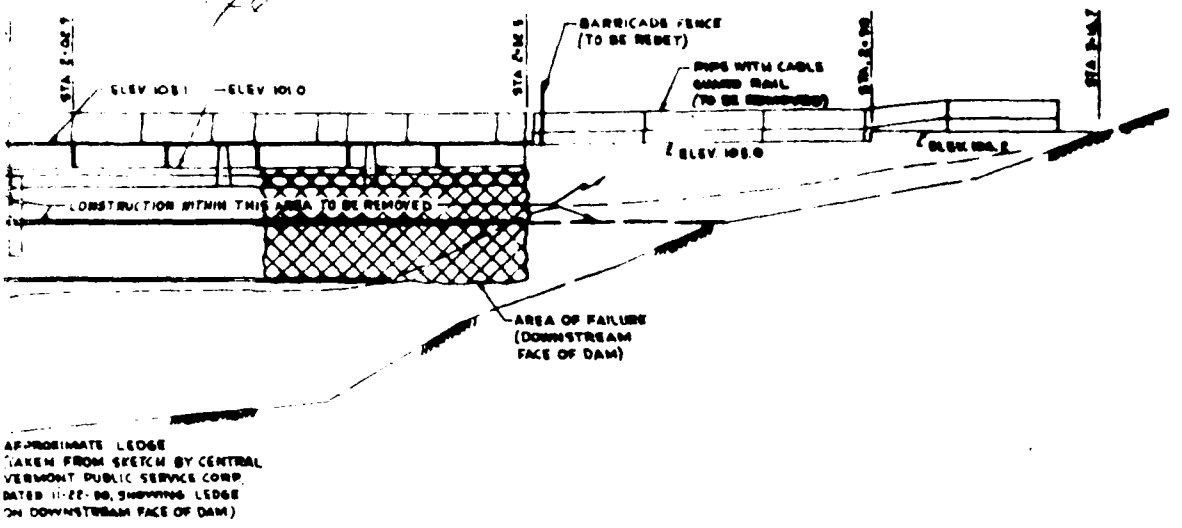
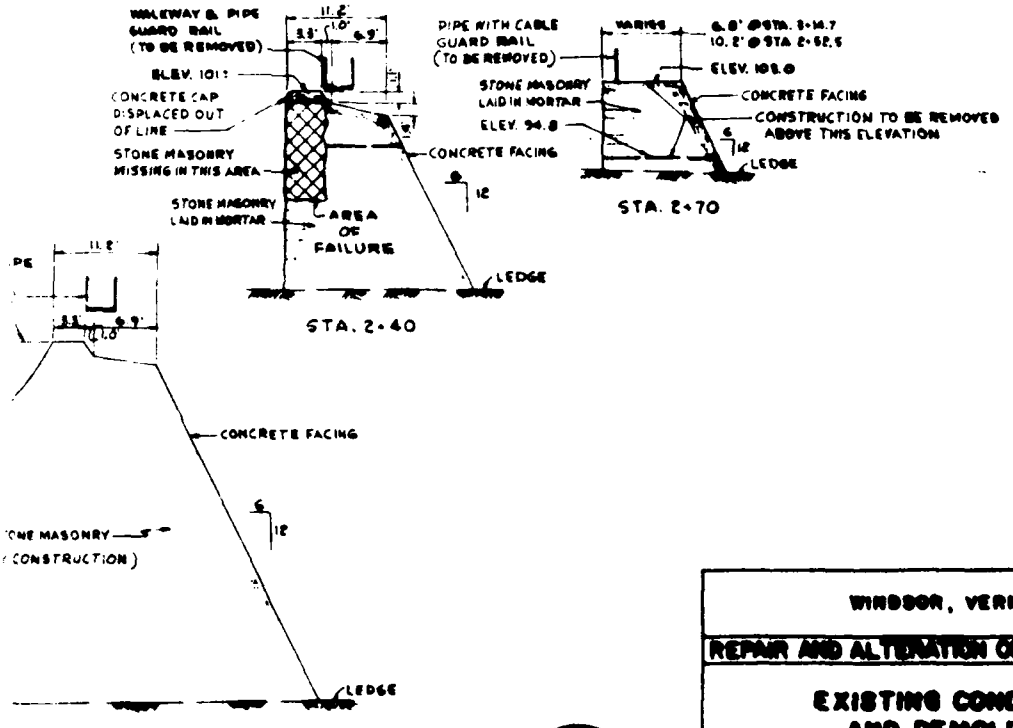


APPROXIMATE LEDGE
TAKEN FROM SKETCH BY CENTRAL
VERMONT PUBLIC SERVICE CORP.
DATED 11-22-80, SHOWING LEDGE
ON DOWNSTREAM FACE OF DAM)



WINDSOR, VERMONT		
REPAIR AND ALTERATION OF MILL POND DAM		
EXISTING CONDITIONS AND DEMOLITION		
SCALE AS NOTED		APRIL, 1981
FAY SPOFFORD & THORNDIKE INC. ENGINEERS BOSTON MASS		
JOB C & P on B.G.D.	TO cm J.C.R. B.G.D.	21' EW-7
APPROVED F.M. Cahalan		24" 3

SHEET NO. 3 OF 3

APPENDIX C

APPENDIX C

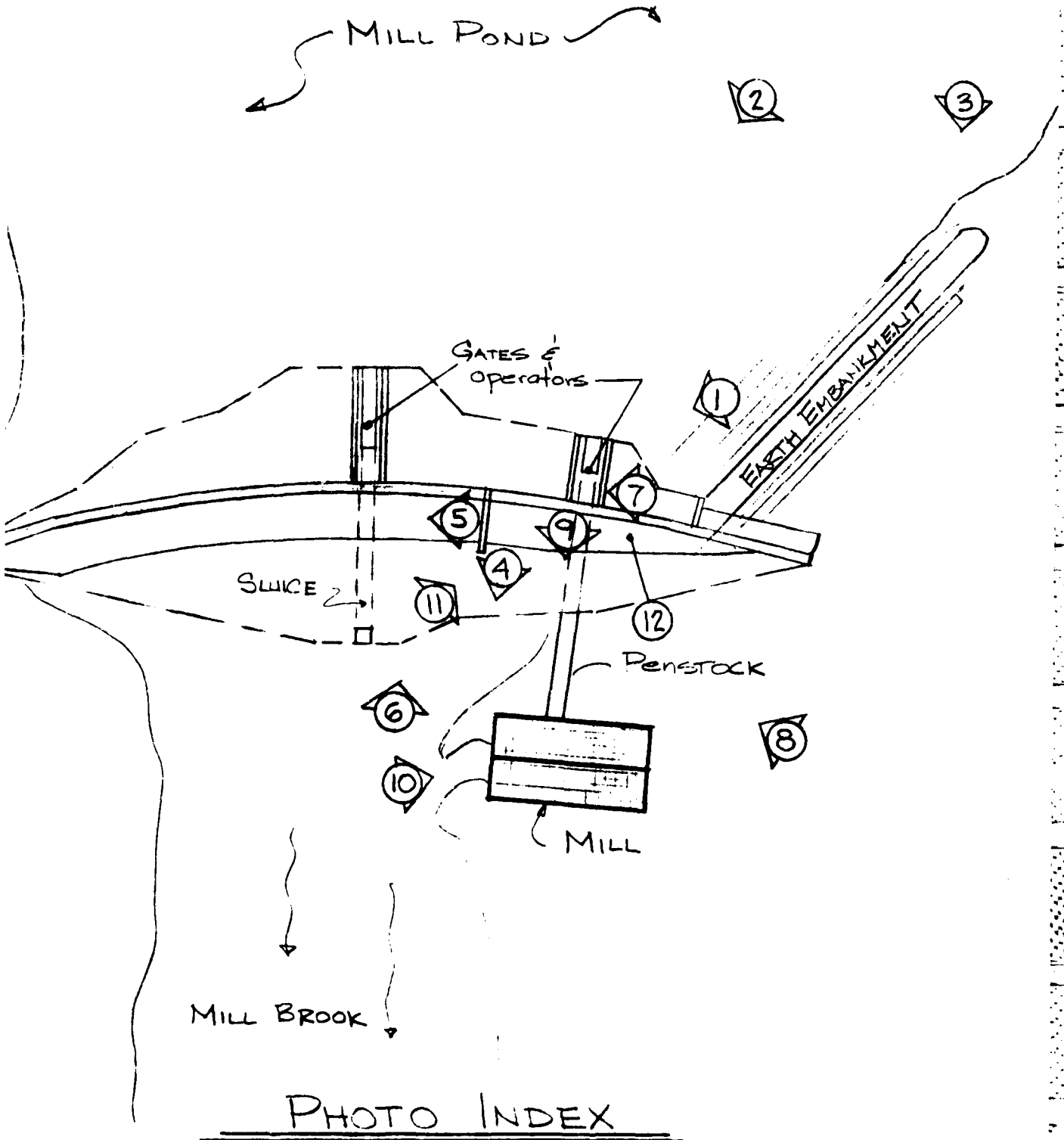


PHOTO INDEX

WINDSOR UPPER

FIG. 1

Upstream face of dam as viewed from left abutment.

FIG. 2

Windsor Upper Dam as viewed from upstream.

FIG. 3

Grass-covered embankment and lawn at left abutment.

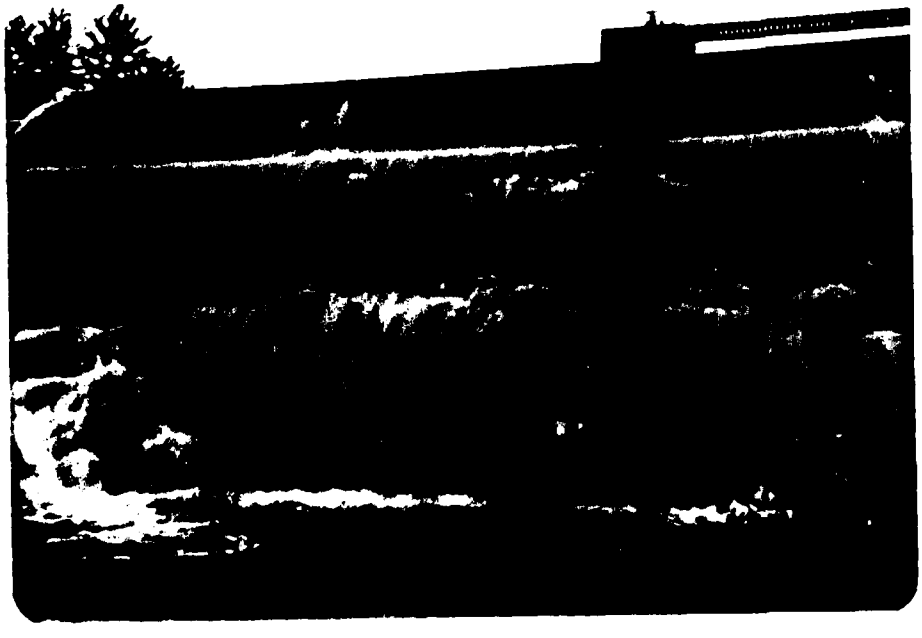
FIG. 4

Downstream as viewed from top of dam.

FIG. 5

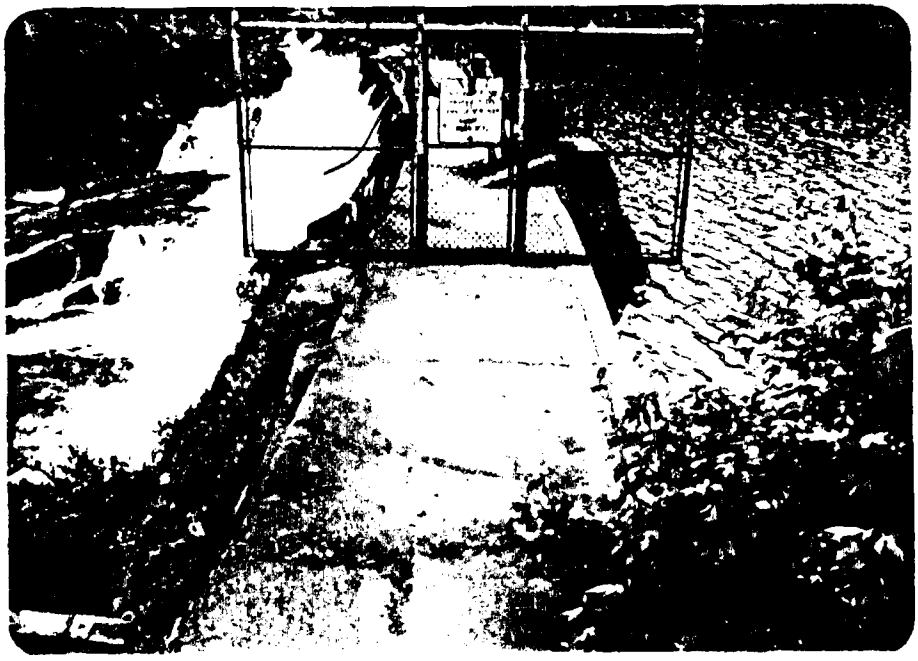
Longitudinal view of spillway.

FIG. 6



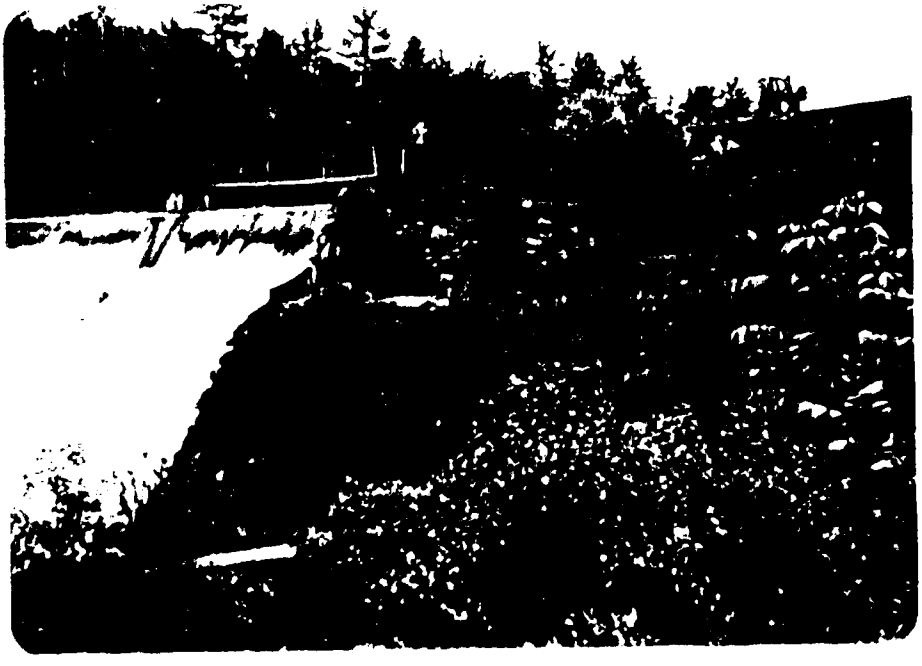
Downstream face of dam.
(Note discontinuity of white water along the spillway)

FIG. 7



Operators for penstock and sluice gates.
(Penstock operator in foreground).

FIG. 8



Main spillway and auxiliary spillways as viewed from downstream. (Note vegetation on downstream face).

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U S ARMY

SUBJECT Windsor, Vermont – Upper Dam
COMPUTATION Failure Analysis
COMPUTED BY Laraway CHECKED BY DATE 6/78

Reservoir Stage at time of failure: 107.3' local datum
= 645 ACRE-FEET

Peak Outflow (of failure):

$$Q_{p_1} = \frac{8}{27} W_b \sqrt{g} y_o^{3/2}$$

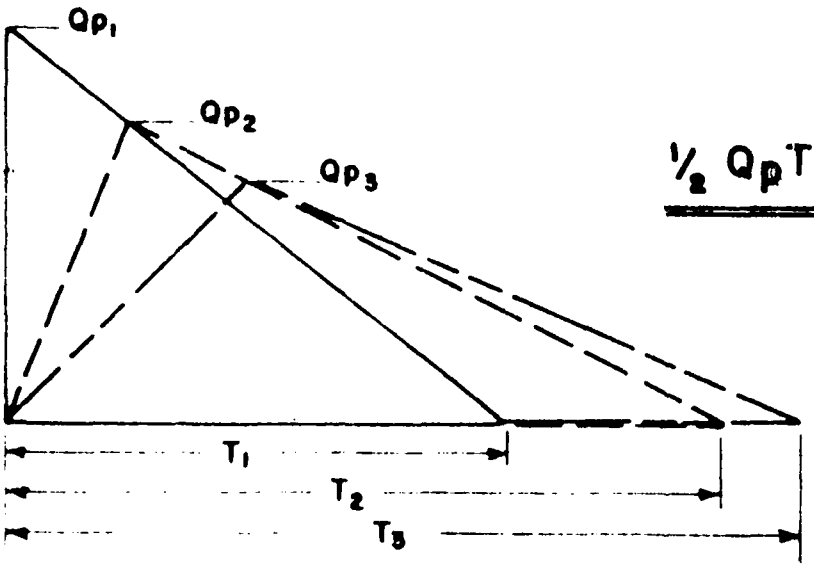
$$= \frac{8}{27} (80)(5.66)(55.3)^{3/2}$$

$\underline{Q_{p_1} = 55{,}172 \text{ cfs}}$ (= 368.5' msl @ first Union St. bridge)

Spillway Q just prior to failure = 16,600 cfs
(= 355.4' msl @ Union St.)

∴ failure wave = 13' fall

"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12 S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Qp_1 = \frac{8}{27} W_b \sqrt{g} Y_o^{3/2}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Qp_2(TRIAL) = Qp_1 (1 - \frac{V_1}{S})$$

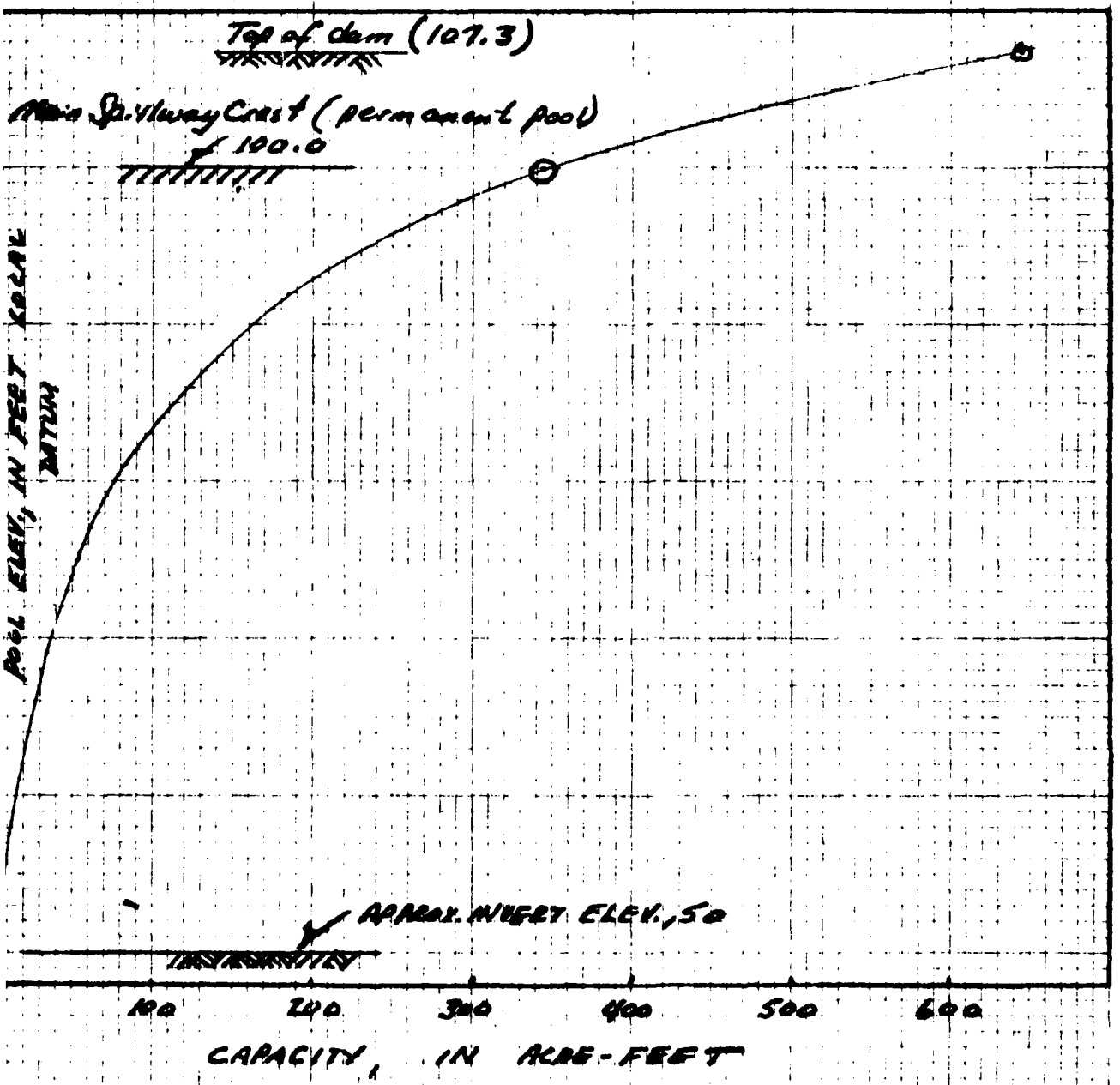
C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Qp_2 = Qp_1 (1 - \frac{V_{AVG}}{S})$$

STEP 5: FOR [illegible] REACH - REPEAT STEPS 3 AND 4.

APRIL 1978



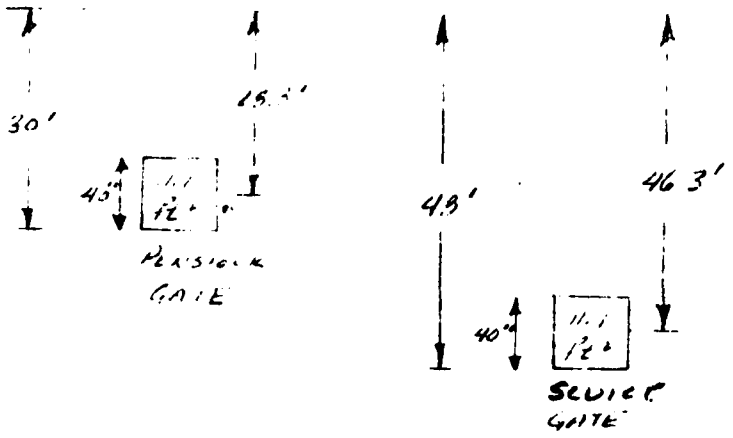
MILL ROAD DAM
WINDSOR, VERMONT

CAPACITY CURVE

DECEMBER, 1977

NEW ENGLAND DIVISION

Dec 28, 1977



$Q = C A \sqrt{2gh}$

(use $C = .6$)

(TOP of dam = 101.3)

AT TOP OF S.C.E. (102)

PERISTOCK: $Q = (.6)(11.1)\sqrt{64.4 \times 1.3}$

$= 284$ cfs

SLUICE $Q = (.6)(11.1)\sqrt{64.4 \times 46.3}$

$= 362$ cfs

TOTAL Q

646 cfs

= 15 csm

AT TOP OF DAM (103.3)

PERISTOCK: $Q = (.6)(11.1)\sqrt{64.4 \times 3.3}$

$= 319$ cfs

SLUICE $Q = (.6)(11.1)\sqrt{64.4 \times 53.6}$

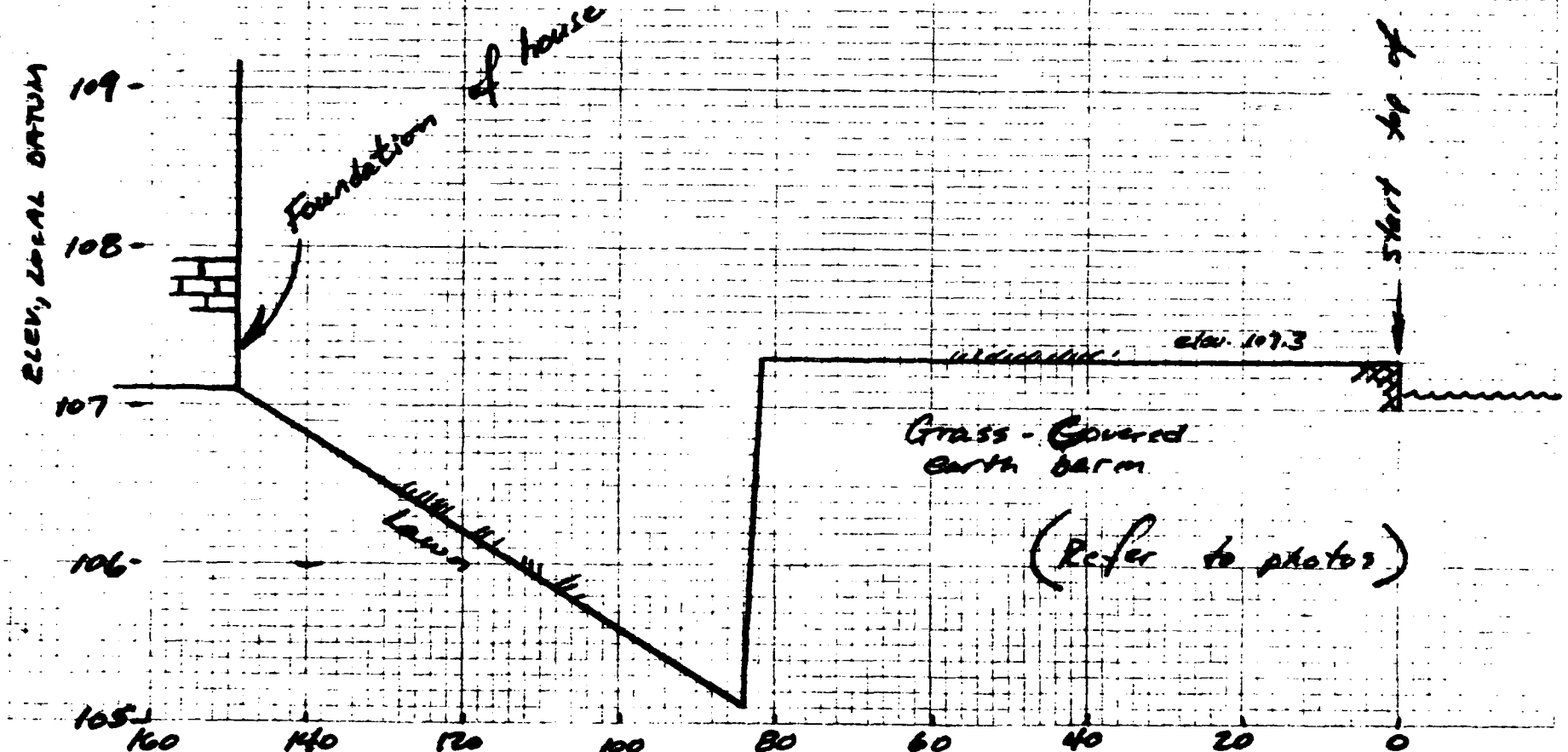
$= 391$ cfs

TOTAL Q =

710 cfs

= 16 csm

Cross Section of earth berm & lawn (left bank) as viewed from upstream.



Section

WS. ELEV.	(1)	(2)	(3)	(4)	(6)	(7)		TOTAL Q
100.0	0	0	[illegible]		0	0	0	
101.0	0	[illegible]	[illegible]	0	410	5	703	
102.6	0	[illegible]	[illegible]	0	1719	50	2976	
103	[illegible]	[illegible]	[illegible]	0	2130	76	3736	
104.4	0	32[illegible]	[illegible]	0	3764	7[illegible]	696[illegible]	
105	[illegible]	[illegible]	[illegible]	10	4584	276	8660	plus left bank overflow
106	2[illegible]	8[illegible]	[illegible]	45	6026	43[illegible]	11878	22/11,900
107.3	[illegible]	[illegible]	[illegible]	[illegible]	8087	7[illegible]	16,[illegible]90	248/16,938
108	[illegible]	16[illegible]	[illegible]	[illegible]53	9277	[illegible]	19,485	490/19,97[illegible]
109	14[illegible]	[illegible]	[illegible]	221	11670	11[illegible]	23,553	1216/25,069
112	3[illegible]	[illegible]	11972	4[illegible]	17013	2210	38,666	4417/43,08[illegible]

NEL FORM 225
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

revised

PAGE

SUBJECT: Windsor Locks
COMPUTATION: Overflow Section Discharges (Left bank)
COMPUTED BY: [illegible] CHECKED BY: DATE:

WS @ 105.1 — Q = 0

WS @ 106 — coc. # = .44

C = 2.5 ±

L = 30'

$Q = 2.5(30)(.44)^{3/2} = 22$ cfs

WS @ 107.3 — one H = 2.74

C = 2.5 ±

L = 67

$Q = 2.5(67)(1.13)^{3/2} = 248$ cfs

WS @ 108 — one H = 1.2

C = 2.5 ±

L = 149'

$Q = 2.5(149)(1.2)^{3/2} = 490$ cfs

WS @ 109 — one H = 2.2

C = 2.5 ±

L = 149

$Q = 2.5(149)(2.2)^{3/2} = 1216$ cfs

WS @ 112 — $Q = 2.5(149)(5.2)^{3/2} = 4417$ cfs

NED FORM 205
27 Sept 54

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT

COMPUTATION

COMPUTED BY

CHECKED BY

DATE

Section (7)

use Q = AV

will assume that V is about equal
to that on the spillway adjacent.

El. 100 Q = 0

101 Q = (1.25)(30) = 5 cfs

102.6 Q = 50 cfs

103 Q = 11.7(6.5) = 76

104.4 200 cfs

105 Q = 32.5(8.5) = 276

106 Q = 46.5 (9.3) = 430

107.3 Q = 69.3 (10.2) = 710

108 Q = 890 cfs

109 Q = 1150 cfs

112 Q = 2210 cfs

SUBJECT

COMPUTATION

COMPUTED BY

CHECKED BY

DATE

Sec (4)

ws = 104.4

TW	104.4	$Q = 0$
	105	$Q = 2.8(8)(.6)^{3/2} = 10$ c/s
	106	$Q = 22.4(1.6)^{3/2} = 45$
TW	107.3	$Q = 22.4(2.9)^{3/2} = 111$
	108	$Q = 22.4(3.6)^{3/2} = 153$
	109	$Q = 22.4(4.6)^{3/2} = 221$
	112	$Q = 22.4(7.6)^{3/2} = 470$

Sec (6)

TW	100	$Q = 0$
	101	$Q = 3.8(108)(1)^{3/2} = 410$ c/s
	102.6	$Q = 410(2.6)^{3/2} = 1719$
	103	$Q = 410(3)^{3/2} = 2130$
	104.4	$Q = 410(4.4)^{3/2} = 3784$
	105	$Q = 410(5)^{3/2} = 4584$
	106	$Q = 410(6)^{3/2} = 6026$
TW	107.3	$Q = 410(7.3)^{3/2} = 8087$
	108	$Q = 410(8)^{3/2} = 9217$
	109	$Q = 410(9)^{3/2} = 11070$
	112	$Q = 410(12)^{3/2} = 17043$

NED FORM 225
27 Sept 40

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT [illegible]
COMPUTATION
COMPUTED BY [illegible] CHECKED BY DATE

Section ② ("aux sp[illegible] No. 1")

ms 102.6	$Q = 0$
103	$Q = 3.0(45)(.4)^{3/2} = 34$ cfs
104.4	$Q = 3.0(45)(1.8)^{3/2} = 326$ cfs
105	$Q = 3.0(45)(2.4)^{3/2} = 502$ cfs
106	$Q = 3.0(45)(3.4)^{3/2} = 846$ cfs
ms 107.3	$Q = 3.0(45)(4.7)^{3/2} = 1376$ cfs
108	$Q = 3.0(45)(5.4)^{3/2} = 1694$ cfs
109	$Q = 3.0(45)(6.4)^{3/2} = 2186$ cfs
112	$Q = 3.0(45)(9.4)^{3/2} = 3891$

Section ③ ⑤

ms 100	$Q = 0$
101	$Q = 3.2(90)(1)^{3/2} = 288$ cfs
102.6	$Q = 288(2.6)^{3/2} = 1207$ cfs
103	$Q = 288(3)^{3/2} = 1496$ cfs
104.4	$Q = 288(4.4)^{3/2} = 2658$ cfs
105	$Q = 288(5)^{3/2} = 3220$ cfs
106	$Q = 288(6)^{3/2} = 4233$ cfs
ms 107.3	$Q = 288(7.3)^{3/2} = 5600$ cfs
108	$Q = 288(8)^{3/2} = 6517$ cfs
109	$Q = 288(9)^{3/2} = 7776$ cfs
112	$Q = 288(12)^{3/2} = 11972$ cfs

NED FORM 213
27 Sept 49

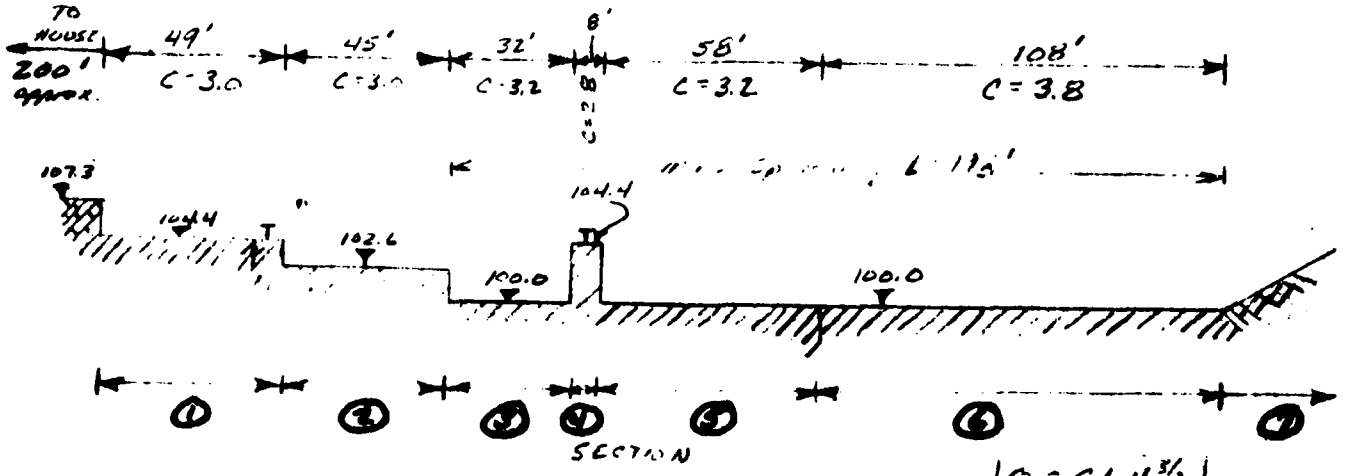
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U S ARMY

PAGE 1/5

SUBJECT [illegible]

COMPUTATION [illegible]

COMPUTED BY [illegible] CHECKED BY DATE Dec. 29, 1977



$Q = CLH^{3/2}$

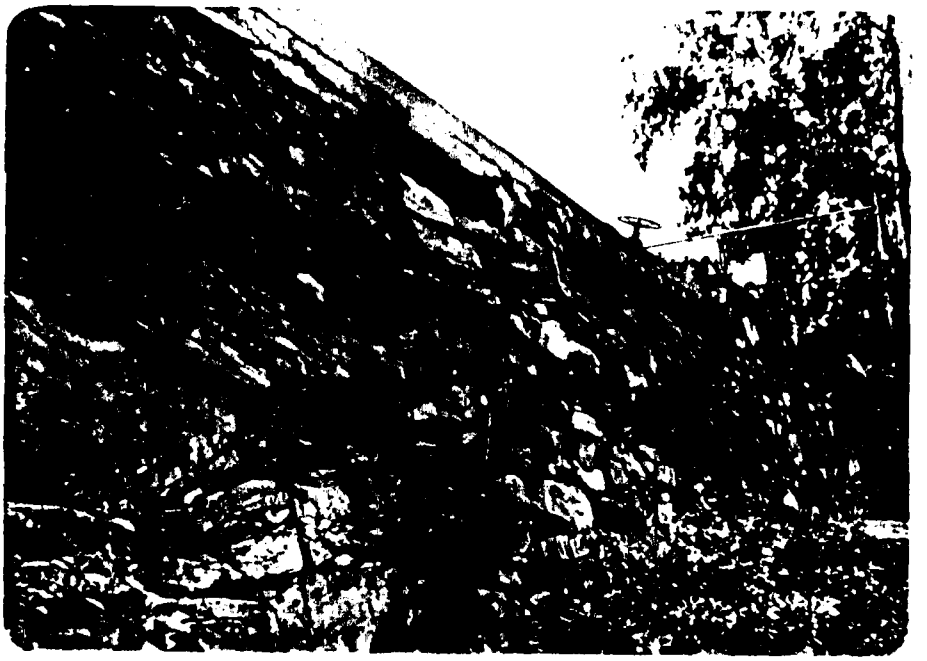
Section ① (Max. spillway ht. 2')

WS elev.	
100.0	$Q = 0$
↓	
104.4	$Q = 0$
105.0	$Q = 3.0(49)(.6)^{3/2} = 65$ cfs
106.0	$Q = 3.0(49)(1.6)^{3/2} = 298$ cfs
107.3	$Q = 3.0(49)(2.9)^{3/2} = 726$ cfs
108	$Q = 3.0(49)(3.6)^{3/2} = 1064$ cfs
109	$Q = 3.0(49)(4.6)^{3/2} = 1450$ cfs
112	$Q = 3.0(49)(7.6)^{3/2} = 3080$ cfs

APPENDIX D

HYDRAULIC COMPUTATIONS

FIG. 11



Downstream face at left abutment.
(Note void near concrete cap).

FIG. 12

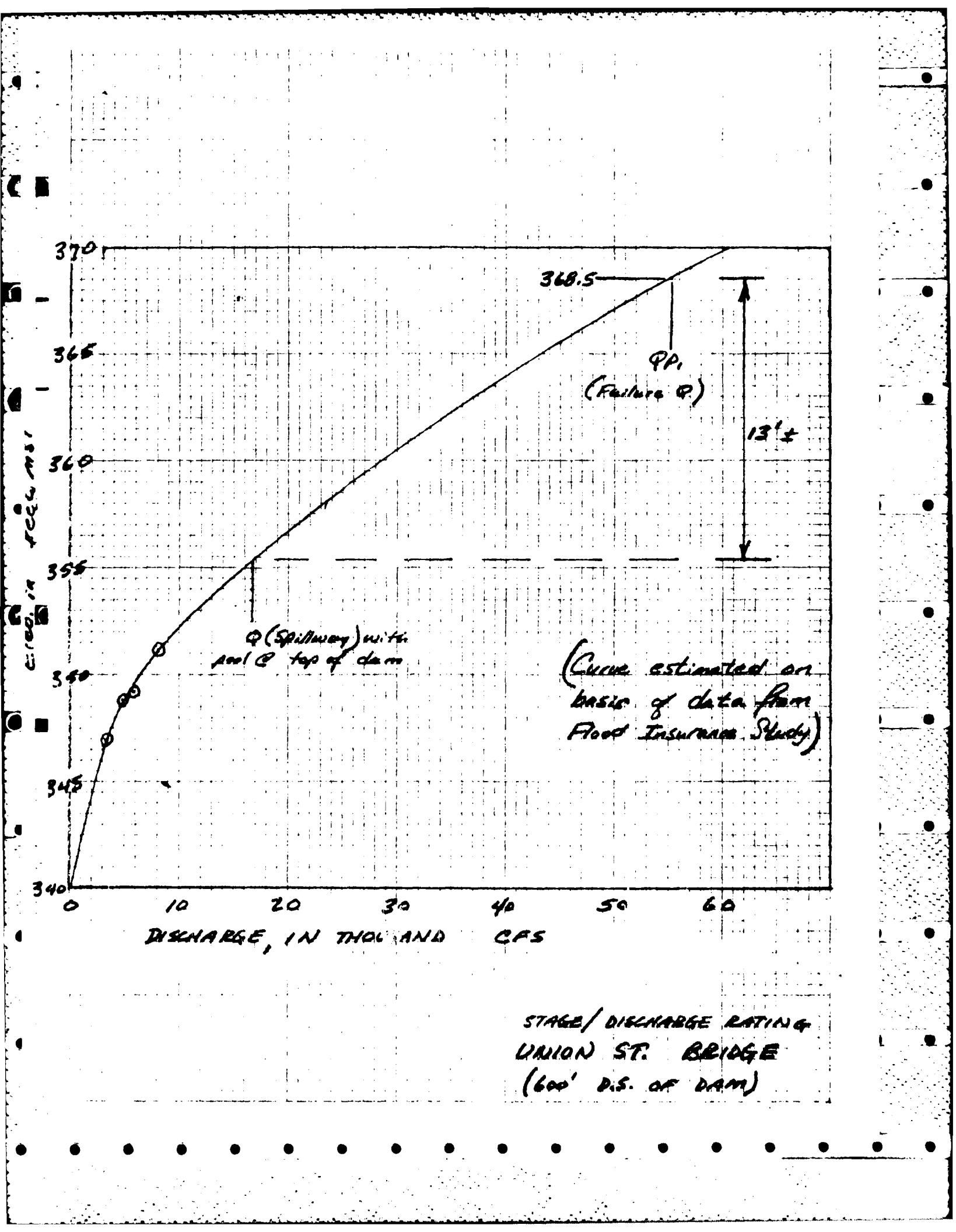
Detail view of granite masonry construction.

FIG. 9

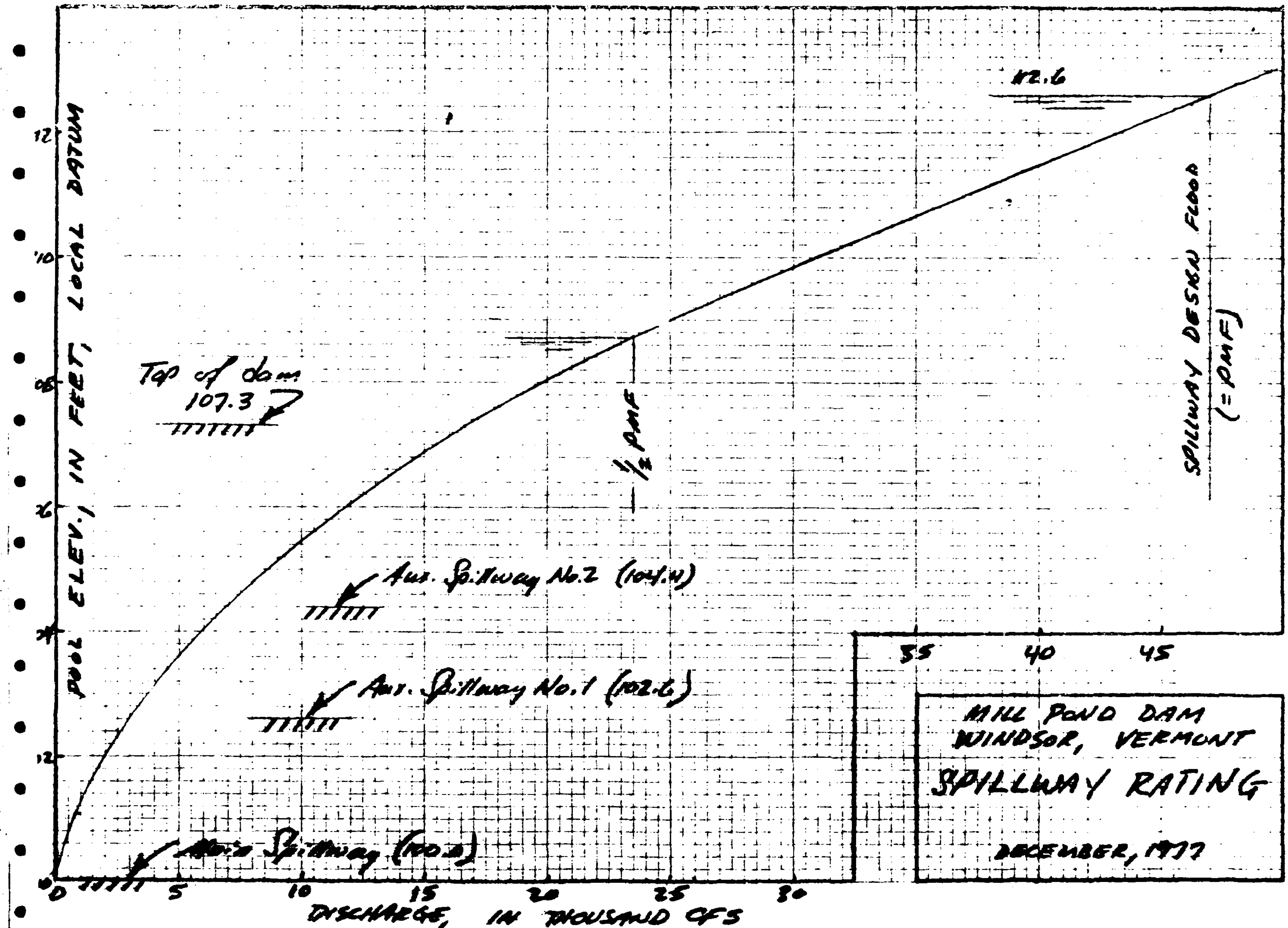
Penstock (breeched area has been repaired) to mill downstream.

FIG. 10

Outlet from mill downstream from dam.



STAGE / DISCHARGE RATING
UNION ST. BRIDGE
(600' D.S. OF DAM)



MILL POND DAM
WINDSOR, VERMONT
SPILLWAY RATING
DECEMBER, 1977
POOL ELEV., IN FEET, LOCAL DATUM
DISCHARGE, IN THOUSAND CFS
Top of dam 107.3
Aux. Spillway No.2 (104.4)
Aux. Spillway No.1 (102.6)
Main Spillway (100.0)
½ PMF
SPILLWAY DESIGN FLOOD (=PMF)
112.6
0
5
10
15
20
25
30
35
40
45

APPENDIX E

END

FILMED

8-85

DTIC