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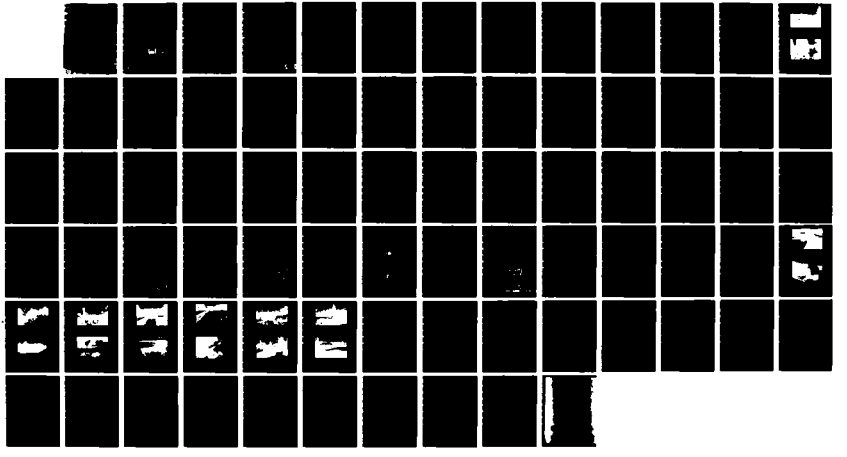

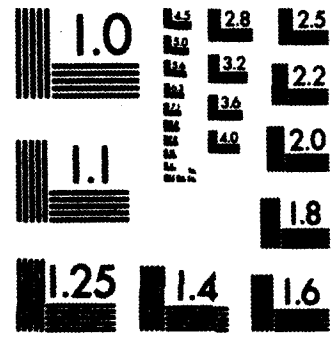

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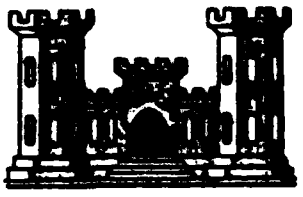
HOCKANUM RIVER BASIN
MANCHESTER, CONNECTICUT

PORTER RESERVOIR DAM
CT 00014

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

MAY 1980

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Hockanum River Basin
Porter Reservoir Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Porter Reservoir Dam is an earth embankment approximately 680 ft. long with a maximum height of about 32 ft. The upstream slope of the embankment is approximately 2H:1V and is riprap-lined to within 3 ft. of the top of the dam. The crest width of the dam is about 15 ft. The downstream slope is approximately 2.25 H:1V from the top of the dam to a 50 ft. wide berm located approximately 20 ft. below the dam crest. The lower portion of the slope, from the berm to the toe, feet downstream of the reservoir in a 20 ft. wide stone lined channel. The purpose of the dam, which is believed to have been constructed around is to impound a water supply for the City of Manchester water distribution.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

JUN 19 1980

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Porter Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, City of Manchester, Water & Sewer Department, Manchester, Connecticut 06040.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

PORTER RESERVOIR DAM

CT 00014

HOCKANUM RIVER BASIN
MANCHESTER, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.:	CT 00014
Name of Dam:	Porter Reservoir Dam
City:	Manchester
County and State:	Hartford County, Connecticut
Stream:	Porter Brook
Date of Inspection:	November 14, 1979

BRIEF ASSESSMENT

Porter Reservoir Dam is an earth embankment approximately 680 feet long with a maximum height of about 32 feet. The upstream slope of the embankment is approximately 2H:1V and is riprap-lined to within 3 feet of the top of the dam. The crest width of the dam is about 15 feet. The downstream slope is approximately 2.25 H:1V from the top of the dam to a 50-foot wide berm located approximately 20 feet below the dam crest. The lower portion of the slope, from the berm to the toe, is approximately 3H:1V. The spillway consists of a concrete weir located about 75 feet downstream of the reservoir in a 20-foot wide stone-lined channel. The purpose of the dam, which is believed to have been constructed around 1902, is to impound a water supply for the City of Manchester water distribution system.

Porter Reservoir Dam has a drainage area of approximately 0.6 square miles, with only about 0.15 square miles draining directly to the reservoir. The maximum storage capacity of the reservoir is 100 acre-feet. Based on this storage capacity and the maximum height of 32 feet, the dam is classified in the "Small" size category. A breach of the dam with the reservoir surface at the top of the dam would cause appreciable property damage but little or no loss of life. Therefore, the dam is classified in the "Significant" hazard potential category. The recommended test flood range for a "Small" size, "Significant" hazard dam is from the 100-year flood to one-half of the Probable Maximum Flood (PMF). Due to the potential for property damage at several residences downstream, the selected test flood is one-half of the PMF.

The peak inflow and outflow rates for the test flood at Porter Reservoir were computed to be 600 cfs and 570 cfs, respectively. The peak outflow corresponds to a stage of 4.2 feet above the spillway crest, or 1.8 feet below the top of dam elevation. The spillway is capable of discharging 970 cfs and can pass 100 percent of the test flood without overtopping of the embankment. The failure analysis indicated that a breach of the dam would result in a stream depth of 3.3 feet at the downstream damage center.

The dam appears to be in fair condition. The upstream and downstream slopes of the embankment are overgrown with brush and trees and the crest of the dam is unprotected from erosion. The masonry of the appurtenant structures is in need of minor repairs at several locations and seepage was observed during the inspection at the outlet structure. Several of the gate valves associated with operations of the dam were inoperable at the time of the inspection.

Within one year after receipt of this Phase I Inspection Report, the Owner, the City of Manchester Water and Sewer Department, should retain the services of a qualified registered professional engineer for the following purposes: 1) To investigate the source of the seepage observed at the outlet structure and recommend a means of treatment, and 2) to direct the removal of trees and their root systems from the downstream slope and the vicinity of the abutments.

The Owner should also implement the following operation and maintenance procedures: 1) Vegetation on the upstream and downstream slopes of the dam should be cut and vegetation growing between the riprap should be removed; 2) depressions on the crest of the dam should be filled and the crest should be provided with either a vegetative cover or a paved roadway; 3) deteriorated masonry on the appurtenant structures should be repaired; 4) inoperable gate valves should be repaired and exercised on a regular basis; and 5) a program of annual technical inspection should be instituted and, in conjunction, a regular maintenance program should be established.

O'BRIEN & GERE ENGINEERS, INC.

STATE OF NEW YORK
JOHN J. WILLIAMS
No. 050794
LICENSED PROFESSIONAL ENGINEER

John J. Williams, P.E.
Vice President
New York Registration No. 050794

Date: 16 May 1980

This Phase I Inspection Report on Porter Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

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 theses 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 be 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 aid 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.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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UPSTREAM OVERVIEW OF THE DAM AND GATEHOUSE AS OBSERVED FROM THE RIGHT SIDE OF THE RESERVOIR. (11/14/79)

OVERVIEW FROM THE LEFT ABUTMENT SHOWING LARGE TREES GROWING ON THE DOWNSTREAM FACE OF THE DAM. (11/14/79)

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
PORTER RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The National Dam Inspection Act (Public Law 92-367) was passed by Congress on August 8, 1972. Under this Act, the Secretary of the Army was authorized to initiate, through the Corps of Engineers, the National Program for Inspection of Dams throughout the United States. Responsibility for supervising inspection of dams in the New England Region has been assigned to the New England Division of the Army Corps of Engineers.

O'Brien & Gere Engineers, Inc. has been retained by the New England Division to inspect and report on selected non-federal dams in the State of Connecticut. Authorization and Notice to Proceed were issued to O'Brien & Gere by a letter dated November 6, 1979 and signed by Col. William E. Hodgson, Jr. Contract No. DACW 33-80-C-0014 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection. The purpose of inspecting and evaluating non-federal dams is to:

1. Identify conditions which threaten public safety and make the Owner aware of any deficiencies so that he may correct them in a timely manner.

2. Encourage and prepare the State to initiate an effective dam safety program for non-federal dams as soon as possible.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project (Information with regard to Porter Reservoir Dam was provided by the City of Manchester Water and Sewer Department.)

a. Location. Porter Reservoir Dam is located in the southeast corner of the City of Manchester, Connecticut. To illustrate the location, a portion of the USGS Quadrangle map entitled "Rockville, Conn." has been included as Figure 1 on page vi of this Report. USGS reference coordinates for this site are N 41°46.5' and W 72°29.2'.

Water flowing over the spillway at Porter Reservoir is conveyed westerly via Porter Brook approximately 5 miles to Laurel Lake. Here, the water flows into the Hockanum River and is again conveyed westerly approximately 4 river miles to the Connecticut River.

The initial flood impact area consists of several homes located approximately 2,000 feet downstream of Porter Reservoir Dam.

b. Description of Dam and Appurtenances. Porter Reservoir Dam is a 680-foot long earth embankment with a maximum height of 32 feet. The upstream slope of the embankment is approximately 2H:1V and is protected with random size riprap to within 3 feet of the top of the dam. The downstream slope of the dam is approximately 2.25 H:1V from the top of the dam to a 50-foot wide berm located about 20 feet below the dam crest. The remainder of the downstream slope is approximately 3H:1V from the berm to natural ground at the downstream toe. The crest of the dam is 15 feet wide.

According to a set of 1902 drawings, the dam is provided with a masonry corewall and is constructed in 5 zones. The corewall extends from an average depth of 5 feet below the original ground surface to 4 feet below the top of the dam. The embankment consists of a gravel layer and an impervious material zone upstream of the corewall and a coarse material zone, a pit gravel zone and a reservoir loam layer downstream of the corewall. For details of the corewall and zoning, see Page B-6.

The service spillway, which is located at the right abutment, consists of a 20-foot wide channel with stone masonry walls and a 1.5-foot high concrete weir located in the channel about 75 feet downstream of the reservoir. Photos of the spillway are included in Appendix C.

A gatehouse, equipped with 6 gate valves for performing a variety of operating functions, is located approximately 150 feet from the right abutment in the reservoir. An access bridge extends from the gatehouse to steps located on the upstream face of the dam. (See photos in Appendix C).

Outlet works consist of a 6-inch blowoff pipe, a 12-inch reservoir drain pipe, and a 12-inch bypass pipe. The pipe alignments are shown in schematic form on Page B-4. In addition to the outlets from the reservoir, a 10-inch diameter pipe allows discharge from an upstream flood control reservoir to bypass Porter Reservoir. The outlet to this 10-inch bypass pipe is a "Tee" section located in the spillway outlet channel about 300 feet downstream of the reservoir. The outlet works are described in more detail in Section 1.3 b.1.

c. Size Classification. Porter Reservoir Dam has a maximum height of approximately 32 feet, which is less than the 40-foot upper limit for "Small" size structures. Porter Reservoir has a maximum storage capacity of about 100 acre-feet, which is less that the 1,000 acre-foot upper limit for "Small" size dams. Therefore, Porter Reservoir Dam is classified in the "Small" size category.

d. Hazard Classification. The initial flood impact area consists of several homes located about 2,000 feet downstream of the dam. The breach analysis indicates that the failure of the dam with the reservoir surface at the top of the dam would result in a depth of flow of 1.3 feet above the channel banks at the downstream hazard area. The sill elevation of the lowest house in this vicinity was estimated to be about 2 feet above the channel banks. In addition, a highway bridge in this vicinity could be subjected to damage by breach floods. Therefore, appreciable property damage to basements and the highway bridge is likely to occur at this location but no loss of life would be expected. Several other potential damage areas located further downstream could also be subjected to property damage. Due to these considerations, Porter Reservoir Dam is classified in the "Significant" hazard potential category.

e. Ownership. The dam is owned by the City of Manchester; c/o Water & Sewer Department; Manchester, Connecticut; 06040. (Telephone: 203/647-3137).

f. Operator. Mr. John Bozio, Chief Operator at the Cooper Hill Water Treatment Plant, is responsible for operations at Porter Reservior. His address is: Cooper Hill Water Treatment Plant; 49 Cooper Hill Road; Manchester, Connecticut; 06040 (Telephone: 203/647-3208).

g. Purpose of Dam. The dam was constructed to impound water for the City of Manchester water distribution system and is still used for this purpose.

h. Design and Construction History. The only available information with regard to the original design and construction of the dam is a set of plans for Porter Brook Reseroir dated 1902. However, a number of discrepancies exist between the plan drawings and the field observations and it appears unlikely that the dam was constructed as originally designed. The 1902 plan drawings have been reproduced and included in Appendix B.

i. Normal Operating Procedures. Porter Reservoir functions as the primary source of water for a portion of Manchester. Water from the reservoir enters the gatehouse through a 16-inch diameter intake pipe (Elev. 403 NGVD), passes through a vertically mounted wire mesh screen, and is conveyed from the gatehouse via a 12-inch water supply main (see Page B-3). A short distance downstream of the dam, an 8-inch diameter line branches from the main to a chemical feed and pumping station, where the water is injected with chemicals and pumped to storage tanks located at Rock Ledge within the Town of Manchester. Still further downstream on the 12-inch main, there is a chemical feed station where the water is treated prior to flowing by gravity to the City distribution system.

A sluiceway is located near the left abutment which may be used to transfer water from Howard Reservoir to Porter Reservoir. When the water level at Porter Reservoir falls approximately two feet below the normal pool elevation, operating personnel will open a valve at Howard Reservoir which will permit water to flow by gravity via a 12-inch diameter pipeline to Porter Reservoir Approximately 350 feet from Porter Reservoir, the pipeline discharges into an open channel which conveys the flow the remainder of the distance. According to the operator, this procedure is performed on a seasonal basis, depending upon weather conditions.

Operating personnel also have the flexibility of discharging water directly from Howard Reservoir to the City distribution system. This may be accomplished by operating the appropriate valves located just downstream of Howard Reservoir to allow water to flow through a pressure reducing valve and into the 12-inch water supply main. The layout of the interconnecting piping is illustrated on Page B-4.

Further information with regard to the system operation is presented in Section 4.1a.

1.3 Pertinent Data

a. Drainage Area. The area draining to Porter Reservoir encompasses approximately 0.6 square miles to the east of the reservoir. The watershed topography ranges from Elevation 1000 in the upper reaches to Elevation 418 at the normal reservoir surface.

Approximately 700 feet upstream of Porter Reservoir, a dike has been constructed which prevents runoff from the upstream portion of the drainage basin (primarily residential) from draining directly to Porter Reservoir. This runoff bypasses Porter Reservoir by means of a 10-inch diameter pipe unless the water is urgently needed to build up the water supply. The dike drains approximately 0.45 square miles of the total watershed, reducing the effective drainage area of Porter Reservoir to approximately 0.15 square miles. However, in computing the test flood it was assumed that all the watershed runoff reaches Porter Reservoir.

b. Discharge at Damsite.

1. Outlet Works. Three conduits are located near the center of the dam which may be used to lower or drain the impoundment. Two of the conduits, a 12-inch diameter outlet and a 6-inch diameter blowoff, extend from the gatehouse and discharge just downstream of the dam at the outlet structure. The third pipe, a 12-inch diameter low level discharge pipe, extends from the reservoir directly to Porter Brook. The combined discharge capacity of these three outlet pipes is approximately 60 cfs.

In addition, there is a 10-inch diameter pipe which may be used to divert flows resulting from upstream runoff around the reservoir. This bypass pipe discharges the water approximately 300 feet downstream of the reservoir to the spillway channel. A photo of the "Tee" section located at the bypass pipe outlet is included in Appendix C.

2. Maximum Known Flood. Rainfall data and pool elevation records from 1960 to the present are available. However, it is known that larger storms occurred prior to 1960 and that runoff resulting from those storms did not overtop the dam.

3. Ungated Spillway Capacity at Top of Dam. The capacity of the service spillway at top of dam Elevation 424.0 NGVD is 970 cfs.

4. Ungated Spillway Capacity at Test Flood Elevation. At test flood Elevation 422.2 NGVD, the spillway capacity is 568 cfs.

5. Gated Spillway Capacity at Normal Pool Elevation. Not Applicable.

6. Gated Spillway Capacity at Test Flood Elevation. Not Applicable.

7. Total Spillway Capacity at Test Flood Elevation. (See 4 above).

8. Total Project Discharge at Top of Dam. The total project discharge capacity, including the outlet works, at top of dam Elev. 424.0 NGVD is approximately 1,030 cfs.

9. Total Project Discharge at Test Flood Elevation. The total project discharge capacity, including the outlet works, at test flood Elev. 422.2 NGVD is approximately 630 cfs.

c. Elevation.

Streambed at Toe of Dam	392±
Bottom of Cutoff	375±
Maximum Tailwater	Unknown
Recreation Pool	418
Full Flood Control Pool	N/A
Spillway Crest	418
Design Surcharge (Original Design)	Unknown
Top of Dam	424
Test Flood Surcharge	422.2

d. Reservoir Length. (Feet)

Normal Pool	800
Flood Control Pool	N/A
Spillway Crest Pool	800
Top of Dam Pool	1,400
Test Flood Pool	1,200

e. Storage. (Acre-feet)

Normal Pool	45
Flood Control Pool	N/A
Spillway Crest pool	45
Top of Dam Pool	100
Test Flood Pool	81

f. Reservoir Surface Area. (Acres)

Normal Pool	7
Flood Control Pool	N/A
Spillway Crest Pool	7
Top of Dam Pool	12
Test Flood Pool	10

g. Dam Data.

Type	Earth Embankment
Length	680 feet
Height	32 feet
Top Width	15 feet
Side Slopes (Upstream)	2H:1V
(Downstream)	2.25H:1V (Upper) 3H:1V (lower)
Zoning	5 zones, See Appendix B
Impervious Core	Masonry Corewall, See Appendix B
Cutoff	Sheetpiling, See Appendix B
Grout Curtain	None

h. Diversion and Regulating Tunnel.

There is a 10-inch diameter pipe which is normally used to direct upstream runoff around the reservoir so that water quality will not be affected.

i. Spillway.

Type	Concrete Weir
Length of Weir	20 feet
Crest Elevation	418
Gates	None
Upstream Channel	20-foot wide channel with masonry training walls
Downstream Channel	Discharge to Porter Brook

j. Regulating Outlets.

1) Main Outlet

Invert Elevation	398
Size	12-inch Diameter
Description	Cast Iron Pipe
Control Mechanism	Gate Valve

2) Low Level Discharge

Invert Elevation	398
Size	12-inch Diameter
Description	Cast Iron Pipe
Control Mechanism	Gate Valve

3) Blowoff Pipe

Invert Elevation	397.5
Size	6-inch Diameter
Description	Cast Iron Pipe
Control Mechanism	Gate Valve

SECTION 2

ENGINEERING DATA

2.1 Design

A set of original design drawings (dated 1902) have been obtained and are included in Appendix B. Several discrepancies between the design drawings and the existing structure were noted during the visual inspection.

2.2 Construction

No construction information is available. However, the dam does not appear to have been constructed in conformance with the original design drawings (See Section 2.4c.).

2.3 Operation

According to Mr. Norman McKee, the Owner's representative, rainfall and reservoir surface elevation records have been maintained since 1960. A number of gates are available for performing a variety of operating functions, however, no records of such operations are maintained.

2.4 Evaluation

a. Availability. The following information was furnished by the City of Manchester Water and Sewer Department:

1. Porter Brook Reservoir: Drawings of Dam (1902)
2. Porter Reservoir: Water Facilities Inventory
   - A. Porter Reservoir & Gatehouse
   - B. Outlet Facilities: Plan & Section
   - C. Outlet Facilities: Plan
   - D. Outlet Facilities: Schematic

All of the above information has been reproduced and included in Appendix B.

b. Adequacy. Sufficient information has been obtained during the field investigation, from available drawings, and through telephone conversations with City personnel to conduct a Phase I dam evaluation.

c. Validity. Several discrepancies exist between the original design drawings (1902) and the existing dam. The spillway crest length is greater and the freeboard is less than indicated on the original drawings. The gatehouse was constructed at the upstream toe of the embankment rather than in the dam and the pipes are sized differently. The downstream slope contains a berm which does not appear on the drawings. The height of the dam does not appear to be as great as designed and the datum base used for the design drawings is unknown. Therefore, it appears that the dam was not constructed in conformance with the original design drawings and may actually have been redesigned. The remainder of the information provided appears to be valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. Porter Reservoir Dam was inspected on November 14, 1979. At the time of the inspection, the pool elevation was approximately 1 foot below the spillway crest or about 7 feet below the top of the dam. Underwater areas were not inspected.

A checklist of observations and comments made during the inspection is included as Appendix A.

b. Dam. The dam appeared to be in fair condition on the date of the inspection. However, the following deficiencies were observed during the visual inspection. The upstream slope of the embankment (above the riprap) is overgrown with weeds and small bushes. The riprapped portion of the slope has settled slightly and vegetation is growing between some of the stones. The crest of the dam is bare earth, apparently due to traffic across the dam, and contains numerous depressions. The downstream slope of the embankment is partially obscured by a thick growth of vegetation. A path has been eroded along the slope between the top of the dam and the berm. A number of trees are growing from the lower section of the downstream slope and, to a lesser extent, from the berm. Large trees are growing at the downstream toe of the dam and in the vicinity of the abutments.

c. Appurtenant Structures. The masonry gatehouse and access bridge appeared to be in fair condition at the time of the inspection. The only deficiencies observed were cracks in the mortar between stone blocks near the water level.

A few loose stones were noted in the masonry spillway training walls. The concrete weir appears to be in good condition and the channel is kept relatively free of debris by a log boom located at the spillway inlet.

The masonry walls of the sluiceway located at the left abutment (for transfer of water from Howard Reservoir) appear to be in poor condition. Several stones have dislodged from the walls and have fallen into the sluiceway invert and numerous other stones are loose. Flow from Howard Reservoir is not significantly restricted by the dislodged stones, however.

The outlet structure at the downstream toe of the dam appears to be in fair condition, although some cracked or missing mortar was noted. A small amount of rust-colored seepage (about 0.25 gpm) was observed flowing from beneath the base of the outlet structure during the inspection.

d. Reservoir Area. The entire perimeter of the reservoir is bordered by a stone wall which extends approximately 3 feet above the normal pool elevation. No indications of reservoir slope instability or excessive siltation were apparent at the time of the inspection.

e. Downstream Channel. The spillway outlet channel, which becomes Porter Brook, extends approximately 300 feet downstream of the reservoir. At this point, flow is directed through twin 24-inch diameter culverts beneath the access road to chemical feed and pumping station and into the natural channel. At the time of the inspection, water was discharging into the channel from the outlet to the 10-inch diameter reservoir bypass pipe which is located immediately upstream of the twin culverts. The outlet consists of a 10-inch diameter tee section, with the side discharge pointing upward and a reducer section extending the straight run of the tee (see page C-5). The purpose of this configuration is unknown.

A small, poorly-defined channel extends from the outlet structure at the downstream toe of the dam to Porter Brook, a distance of about 400 feet.

3.2 Evaluation

Porter Reservoir Dam and its appurtenant structures are considered to be in fair condition. However, a number of conditions require further attention. These are:

1. The thick growth of vegetation on the upstream and downstream slopes hinders the early detection of structural deficiencies such as cracking or settlement. In addition, vegetation growing between riprap stones could cause displacement of the riprap.

2. The lack of vegetative cover or a paved surface on the crest of the dam could lead to further development of depressions which already exist or the erosion of the crest. Similar problems could result from the eroded path on the downstream slope.

3. The root systems of trees which are growing on the downstream face, at the downstream toe, and in the vicinity of the abutments present potential hazards to the structural integrity of the embankment. The roots could create seepage paths through the embankment and, in the event of uprooting, could remove significant portions of the embankment.

4. Dislodged stones and cracked mortar in the appurtenant structures should be repaired to prevent further deterioration.

5. The rust-colored seepage flowing from beneath the outlet structure is indicative of embankment erosion due to seepage. However, due to the presence of metal pipes in this vicinity the water could be rusty.

SECTION 4

OPERATION AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Mr. John Bozio, Chief Operator at the Cooper Hill Treatment Plant, is responsible for operations at Porter Reservoir. According to Mr. Bozio, appropriate operations are performed to ensure that an adequate supply of water is available to meet the needs of the area within the City of Manchester served by Porter and Howard Reservoirs. As a general guide, the pool elevation at Porter Reservoir is kept within two feet of the spillway crest at all times.

Normal operating procedures are dictated by weather conditions. If there is an adequate supply of water in the reservoir, there is no need for operating personnel to be concerned with anything other than the proper operation of chemical feed and pumping facilities located just downstream of the dam. When the water level falls more than two feet below spillway crest elevation, a gate valve is opened at Howard Reservoir to permit water to flow to Porter Reservoir. If the water supply becomes critical the water impounded at the upstream dike may be gradually "bled" into the reservoir to help build up the supply. This bleeding operation is performed by allowing water from the dike to flow through a 4-inch diameter pipe (which has a perforated outlet section to allow aeration of the lower quality water) to a holding pond, then through a 24-inch diameter culvert to Porter Reservoir. In order to obtain maximum flow through the 4-inch pipe, a valve on the 10-inch bypass pipe from the dike, which normally remains open, must be closed. Under normal operating conditions, water from the reservoir discharges through the 12-inch water supply main. In emergency cases or when maintenance is required, the reservoir may be drawn down by operating the gatehouse valves on a 6-inch diameter and/or a 12-inch diameter low level discharge pipe.

b. Description of Any Warning System In Effect. No formal warning system currently exists which would alert downstream property owners of an impending dam failure. However, there is a National Guard Emergency Plan, which would go into effect when necessary.

4.2 Maintenance Procedures

a. General. No routine maintenance program currently exists for Porter Reservoir Dam. During the summer of 1979, the City employed a crew of workers under the CETA program to remove the excess vegetation from the embankment. However, the dam is not mowed on a regular basis.

b. Operating Facilities. Due to the lack of periodic maintenance and exercising of the outlet facilities, several of the valves are not operable. According to the chief operator, only three of the six gate valves located in the gatehouse are operable: 1) The mid-level 16-inch intake pipe valve; 2) the 8-inch bypass pipe valve; and 3) the 6-inch low level discharge valve. Currently, the 12-inch valve on the outlet pipe is open with no reliable means of closing it in an emergency. The high-level and low-level 16-inch intake valves are not operable.

Information was also received with respect to outlet works located under the berm and lower portion of the downstream slope. The operator believes that all three of the valves located on the 12-inch low level discharge pipe and some of those located on the pipes interconnecting Howard and Porter Reservoirs are not operable.

In addition, there is an inoperable valve located on the 4-inch diameter pipe from the upstream dike which allows water to drain from the area upstream of the dike to Porter Reservoir. Consequently, since this 4-inch valve cannot be closed, runoff from the upstream residential areas cannot be completely prevented from entering the reservoir.

4.3 Evaluation

According to the Chief Operator, no regular operational or maintenance procedures are performed at this site. A periodic inspection and maintenance program, which would include operation of the gate valves, should be established. Additional remedial measures are described in Section 7.3.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The total drainage area for Porter Reservoir Dam is approximately 0.6 square miles. The watershed consists primarily of residential development in the upper reaches and low-lying swampland immediately upstream of the reservoir. The topography ranges from Elev. 1000 at the farthest upstream point in the drainage area to Elev. 418 at the normal reservoir surface level. Approximately 700 feet upstream of the reservoir, a dike has been constructed which prevents runoff from the developed portion of the watershed from draining directly to the reservoir. In effect, this dike reduces the Porter Reservoir drainage area to approximately 0.15 square miles immediately surrounding the reservoir since a 10-inch diameter bypass pipe at the dike diverts floodwaters downstream of the dam. However, a limited quantity of flow reaches Porter Reservoir from the dike by means of a 4-inch diameter pipe which aerates the water as it discharges into a holding pond which conveys water through a 24-inch diameter conduit to Porter Reservoir.

5.2 Design Data

According to Mr. Norman McKee, the Owner's representative, no hydrologic or hydraulic design data is available for Porter Reservoir.

5.3 Experience Data

According to the Owner's representative, rainfall and reservoir surface elevation records have been maintained since 1960. However, the flood of record in this region occurred during Hurricane Diane in 1955. According to Mr. McKee, the dam has never been overtopped.

5.4 Test Flood Analysis

The recommended test flood range for a "Small" size, "Significant" hazard dam is from the 100-year flood to one-half of the Probable Maximum Flood (PMF). Based upon the potential for appreciable property damage to several residences located along Porter Brook, the selected test flood is one-half of the PMF. Hydrologic and hydraulic calculations were performed with the assistance of the HEC-1-DB computer program. The flood hydrographs were constructed from the Snyder unit hydrographs using average coefficients, an initial infiltration of zero and a constant loss rate of 0.05 inches per hour. The Hop Brook adjustment factor was used to reduce the Probable Maximum Precipitation based on the drainage area. Stage vs. discharge and stage vs. storage relationships were developed for Porter Reservoir Dam. These relationships were utilized by the program to route the test flood through the dam. The reservoir water surface was assumed to be at the spillway crest elevation at the beginning of the storm event. Although the upstream dike diverts a great deal of the upstream runoff around the reservoir, the test flood was computed assuming that all the watershed runoff reaches Porter Reservoir.

The peak inflow and outflow rates for the test flood at Porter Reservoir were computed to be 600 cfs and 570 cfs, respectively. The peak outflow corresponds to a stage of 4.2 feet above the spillway crest, or 1.8 feet below the top of dam elevation. The spillway is capable of discharging 970 cfs and can pass 100 percent of the test flood without overtopping of the embankment.

5.5 Dam Failure Analysis

A failure of the embankment was simulated by the HEC-1-DB computer program assuming a 280-foot wide by 20-foot deep breach with vertical side slopes developing within 2 hours. The failure was assumed to occur with the reservoir surface at the top of dam elevation. The resulting breach outflow was routed to the initial damage center, which is considered to be several residences located about 2,000 feet downstream of the dam. The approximate channel cross-section at this point is shown on page D-5.

The failure analysis indicated that a breaching of the dam with the reservoir surface at the top of the dam would result in a stream depth of 3.3 feet, or 1.3 feet above the channel banks, with a corresponding flow of 1,020 cfs at the damage area. The estimated sill elevation of the lowest house in this area is 2 feet above the channel banks. Therefore, the breach flood would not reach the houses but would probably inundate a number of properties. In addition, a flow depth of greater than one foot could be expected over the highway which crosses the stream. A flood of this magnitude would result in appreciable property damage, but it is unlikely that any lives would be lost.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

No major structural deficiencies such as settlement, cracking, or slope instability were observed during the visual inspection. However, several conditions of potential structural instability were noted. The thick growth of vegetation on the embankment and the trees on the downstream slope present hazards to the structure. The exposed earth on the crest of the dam is subject to erosion and the masonry is in need of repair on several of the appurtenant structures. A small amount of seepage was observed flowing from beneath the outlet structure at the time of the inspection. These conditions are discussed in greater detail in Section 3.

6.2 Design and Construction Data

The only available design or construction data with regard to Porter Reservoir Dam is the set of original design drawings dated 1902. However, the dam does not appear to have been constructed as originally designed since several discrepancies between the existing structure and the design drawings were observed (See Section 2.4c.).

6.3 Post Construction Changes

According to the Owner's representative, there are no records of any post-construction changes to the dam. The only known modifications at the site are the construction of the upstream dike and appurtenances and the installation of piping in the downstream berm of the dam which allows water to flow directly from Howard Reservoir into the City of Manchester distribution system.

A new water treatment facility is under design for future construction at Globe Hollow Reservoir. It is planned that water will flow by gravity from Porter and Howard Reservoirs to the new facility. Water will then be pumped to storage tanks for use in the City distribution system.

6.4 Seismic Stability

Porter Reservoir Dam is located in Sesmic Zone 1 on the "Seismic Zone Map of Contiguous States." Therefore, according to the Recommended Guidelines for Phase I dam inspections, the dam need not be evaluated for seismic stability.

SECTION 7

ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon the visual inspection of the site on November 14, 1979, the dam is considered to be in fair condition. No major structural deficiencies were noted during the inspection. Several conditions of potential structural instability are described in Sections 3 and 6. In addition, a number of gate valves are inoperable at this site, as described in Section 4. The spillway appears to be in fair condition and is hydraulically adequate.

b. Adequacy of Information. Sufficient information has been obtained through the field investigation, from data furnished by the Owner, and through telephone conversations with City of Manchester personnel to conduct a Phase I dam evaluation.

c. Urgency. The recommendations and remedial measures described in Sections 7.2 and 7.3 should be implemented within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

The Owner, the City of Manchester Water and Sewer Department, should retain the services of a qualified registered professional engineer for the following purposes:

1. To investigate the source and nature of the seepage observed at the outlet structure and recommend a means of treatment.

2. To direct the removal of trees and their root systems from the downstream slope and the vicinity of the abutments and to backfill any remaining voids with suitable, thoroughly compacted material.

7.3 Remedial Measures

a. Operation and Maintenance Procedures. The Owner should also implement the following operation and maintenance procedures:

1. Vegetation on the upstream and downstream slopes of the dam should be cut and vegetation growing between the riprap stones should be removed.

2. Depressions on the crest of the dam should be filled and the crest should be provided with a vegetative cover to prevent future erosion. If significant traffic along the top of the dam is anticipated, a paved roadway should be provided. The eroded path along the downstream slope should also be filled and reseeded.

3. Dislodged stones in the masonry appurtenant structures should be replaced and cracked mortar should be repaired.

4. All inlet and outlet valves associated with operations at Porter Reservoir Dam should be exercised on a regular basis. Any gate valves which are not currently operable should be repaired.

5. A program of annual technical inspection should be instituted. A regular maintenance program should be established in conjunction with the technical inspection.

6. A formal downstream warning system should be developed.

7.4 Alternatives

No valid alternatives to the recommendations and remedial measures described above are considered feasible for this site.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST

INSPECTION TEAM ORGANIZATION

Project: Porter Reservoir Dam

National I.D. #: CT 00014

Location: Manchester, Connecticut

Type of Dam: Earth Embankment

Inspection Date(s): November 14, 1979

Weather: Overcast, Mid-40's

Pool Elevation: 417+ MSL

Inspection Team

Leonard Beck	O'Brien & Gere	Structures
Steven Snider	O'Brien & Gere	Foundations & Materials
Alan Hanscom	O'Brien & Gere	Structures
Rodney Georges	Bryant & Associates	Hydrology/Hydraulics

*Mr. John J. Williams, Vice-President, O'Brien & Gere has visited the site but not necessarily in conjunction with the inspection team.

Owner's Representative

Mr. Frank Jodaitis, Chairman, Water & Sewer Commission; City of Manchester, Ct.

VISUAL INSPECTION CHECK LIST

Project: Porter Reservoir Dam

National I.D. #: CT 00014

Date(s): November 14, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	424.0
Current Pool Elevation	417.0
Maximum Impoundment to Date	100 acre-feet
Surface Cracks	None Observed
Pavement Condition	N/A
Movement or Settlement of Crest	Few potholes along access road
Lateral Movement	None Observed
Vertical Alignment	No misalignment observed
Horizontal Alignment	No misalignment observed
Condition at Abutment and at Concrete Structures	Abutments - several trees gatehouse - embankment is sound
Indications of Movements of Structural Items on Slopes	None Observed
Trespassing on Slopes	Well traveled path on d/s slope (berm to crest)
Vegetation on Slopes	Mostly grass covered - some brush and trees; heavy brush at toe
Sloughing or Erosion of Slopes or Abutments	No significant indications
Rock Slope Protection - Riprap Failures	Minor displacement of stones on 2H:IV slope

VISUAL INSPECTION CHECK LIST

Project: Porter Reservoir Dam

National I.D. #: CT 00014

Date(s): November 14, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT (Con't)	
Unusual Movement or Cracking at or near Toes	None Observed
Unusual Embankment or Downstream Seepage	¼ gpm rust colored seepage at d/s tailwall
Piping or Boils	None Observed
Foundation Drainage Features	Unknown*
Toe Drains	Unknown*
Instrumentation System	None

*Note: 1902 Drawings of the dam indicate that a toe drain was to be installed. However, since these are not record drawings and because several discrepancies between the drawings and actual conditions have been detected, they should not be considered reliable.

VISUAL INSPECTION CHECK LIST

Project: Porter Reservoir Dam

National I.D. #: CT 00014

Date(s): November 14, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Lined with stone rip-rap clear of debris
b. Weir and Training Walls	
General Condition of Concrete	Stone Masonry walls in good condition
Rust or Staining	None Observed
Spalling	Very slight
Any Visible Reinforcing	None Observed
Any Seepage or Efflorescence	None Observed
Drain Holes	None Observed
c. Discharge Channel	
General Condition	Good

VISUAL INSPECTION CHECK LIST

Project: Porter Reservoir Dam

National I.D. #: CT 00014

Date(s): November 14, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (Con't)	
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Several beyond access road to chemical feed and pumping station.
Floor of Channel	Clear for 150 feet, then natural channel
Other Obstructions	Twin 24-inch culverts under access road

VISUAL INSPECTION CHECK LIST

Project: Porter Reservoir Dam

National I.D. #: CT 00014

Date(s): November 14,1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Stone masonry - fair
Condition of Joints	Missing and cracked mortar
Spalling	Bricks deteriorating
Visible Reinforcing	N/A
Rusting or Staining of Concrete	N/A
Any Seepage or Efflorescense	None Observed
Joint Alignment	Good - No settlement suspected
Unusual Seepage or Leaks in Gate Chamber	Insignficant
Cracks	Between stone blocks in foundation
Rusting or Corrosion of Steel	None Observed
b. Mechanical and Electrical	
Air Vents	None Observed
Float Wells	No longer used
Crane Hoist	None

VISUAL INSPECTION CHECK LIST

Project: Porter Reservoir Dam

National I.D. #: CT 00014

Date(s): November 14, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER (Con't)	
Elevator	None
Hydraulic System	None
Service Gates (Valves)	Only one of three intake valves is operable
Emergency Gates (Valves)	12" outlet valve cannot be closed 6" blowoff and 8" bypass are operable.
Lighting Protection System	None
Emergency Power System	None
Wiring and Lighting System in Gate Chamber	Unknown

VISUAL INSPECTION CHECK LIST

Project: Porter Reservoir Dam

National I.D. #: CT 00014

Date(s): November 14, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Stone masonry - good
Rust or Staining	None Observed
Spalling	N/A
Erosion or Cavitation	None Observed
Visible Reinforcing	N/A
Any Seepage or Efflorescence	¼ gpm at base of tailwall
Condition at Joints	Cracks in Mortar
Drain Holes	None Observed
Channel	Standing water; ill-defined and overgrown
Loose Rock or Trees Overhanging Channel	Several trees, low stream banks
Condition of Discharge Channel	Poor - several constrictions

APPENDIX B

ENGINEERING DATA

APPENDIX B

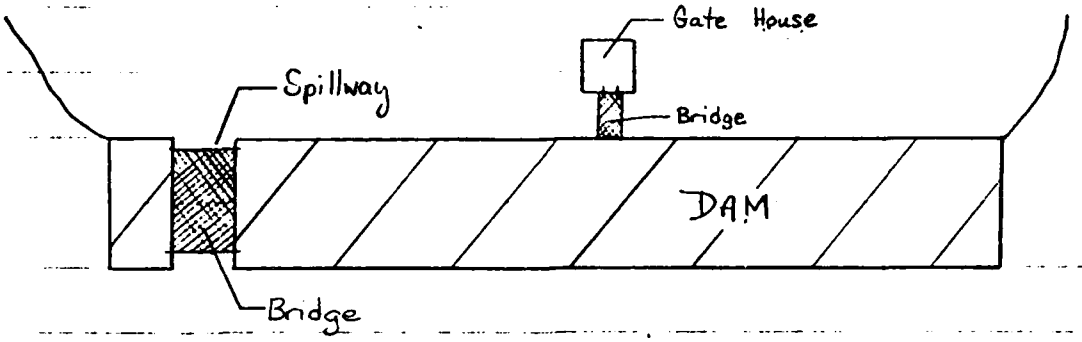
ENGINEERING DATA*

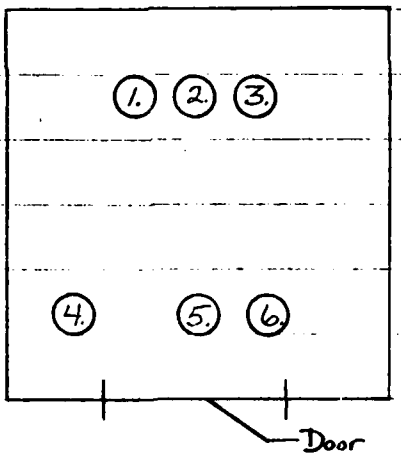
TABLE OF CONTENTS

*NOTE: Except for page B-10, information included in this Appendix was provided by the City of Manchester, Engineering Department. Elevations on pages B-1 through B-4 and page B-10 refer to NGVD Datum. The datum of the 1902 drawings is unknown.

Water Facilities Inventory

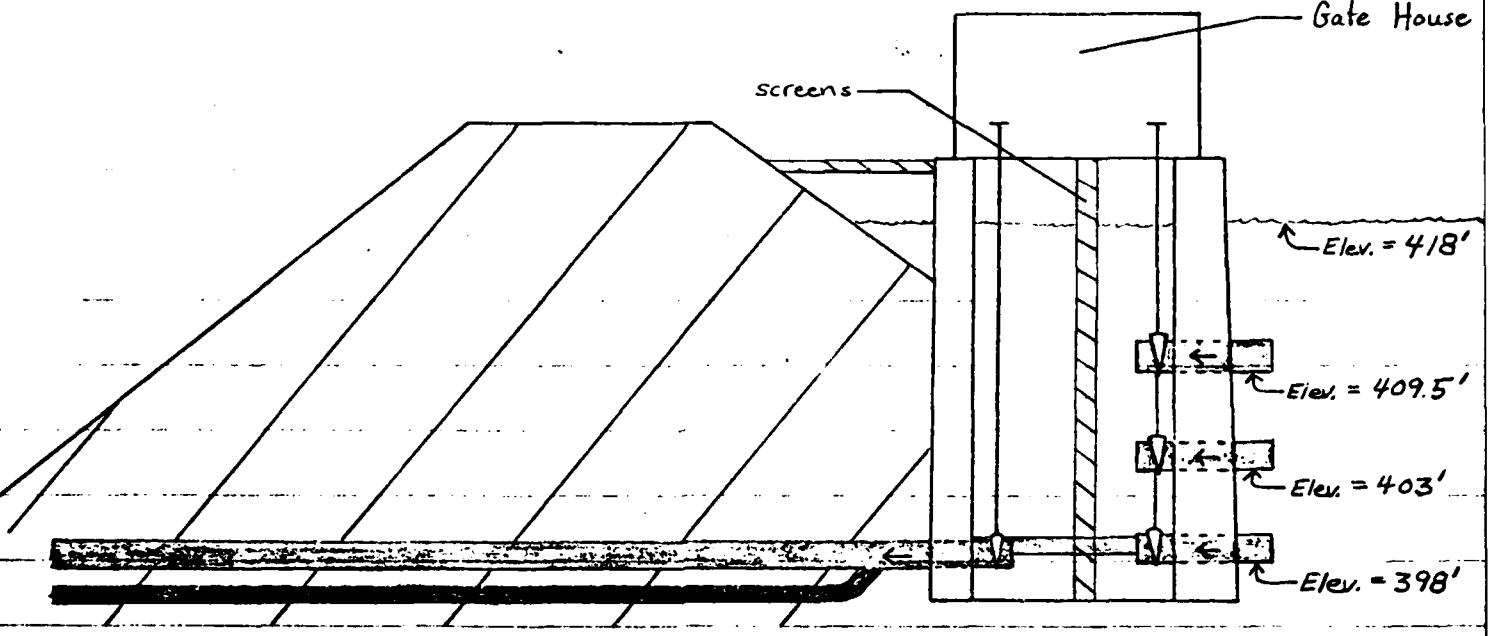
Porter Reservoir and Gate House: Capacity = 27 Million Gallons

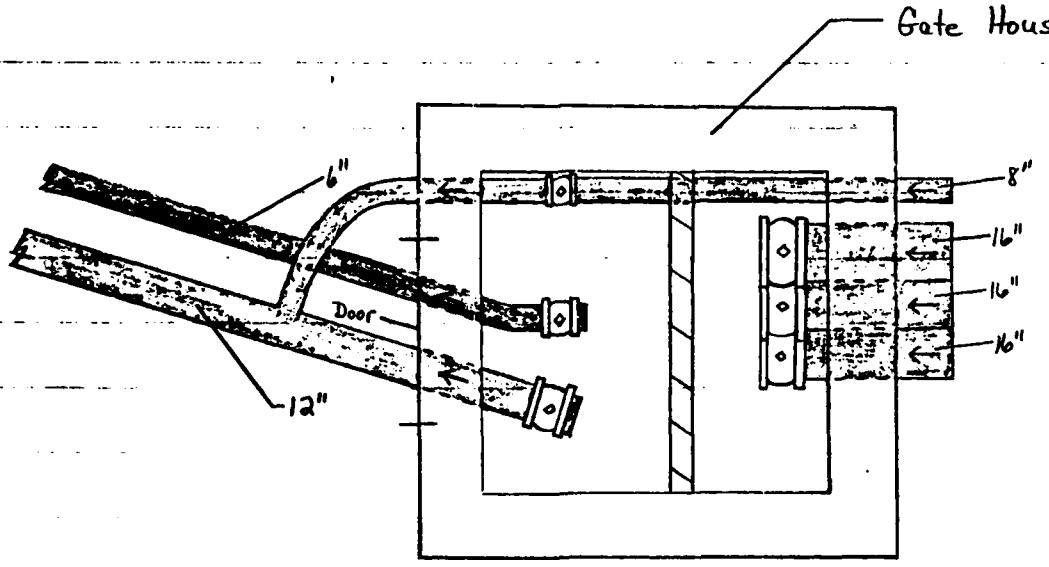




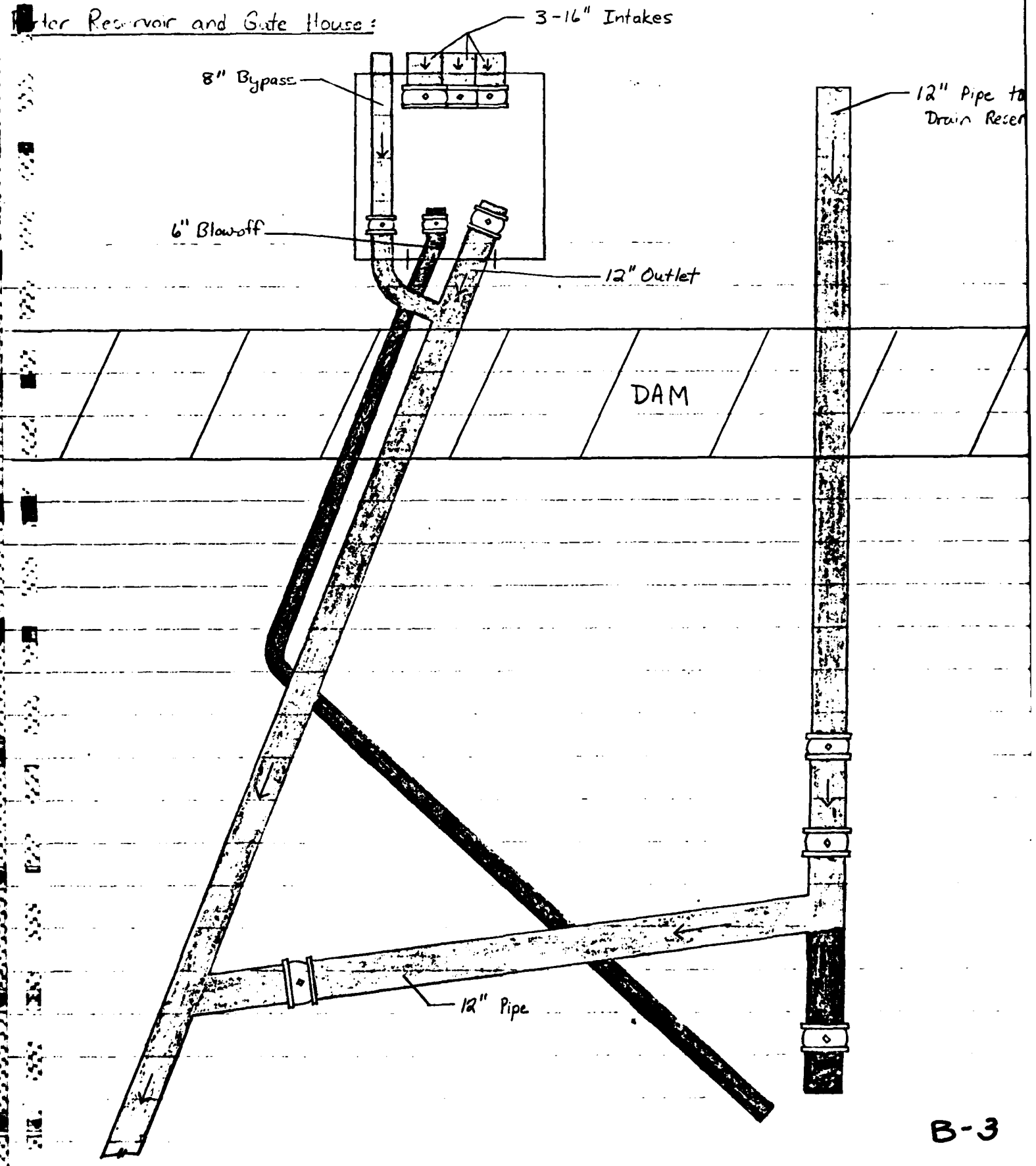
1. 16" Influent pipe, Elevation = 409.5 feet NGVD
2. 16" Influent pipe, Elevation = 403.0 feet NGVD
3. 16" Influent pipe, Elevation = 398.0 feet NGVD
4. 8" Bypass pipe, Elevation = 398.5 feet NGVD
5. 6" Blow-off pipe.
6. 12" Effluent pipe.

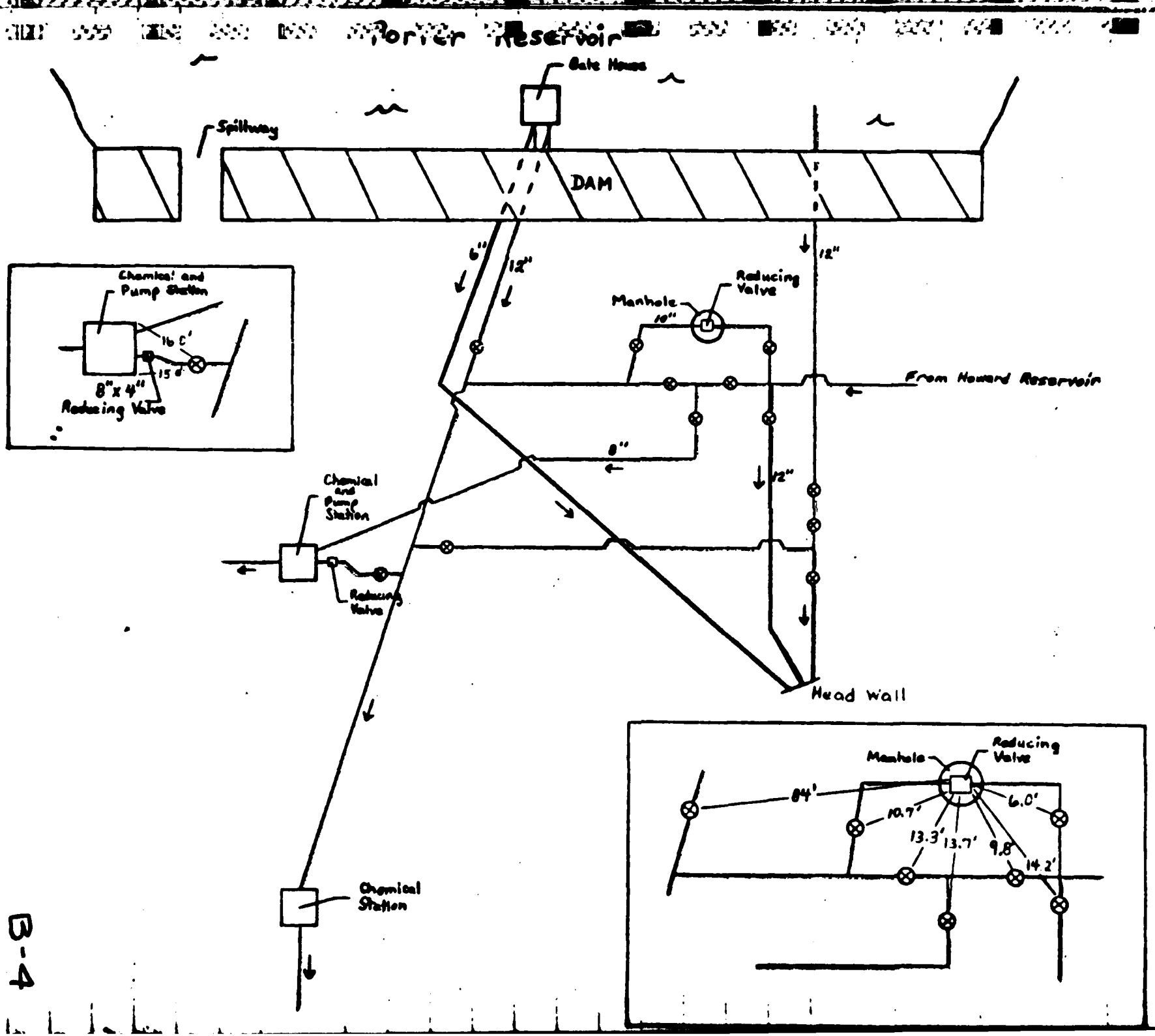
orter Reservoir and Gate House:



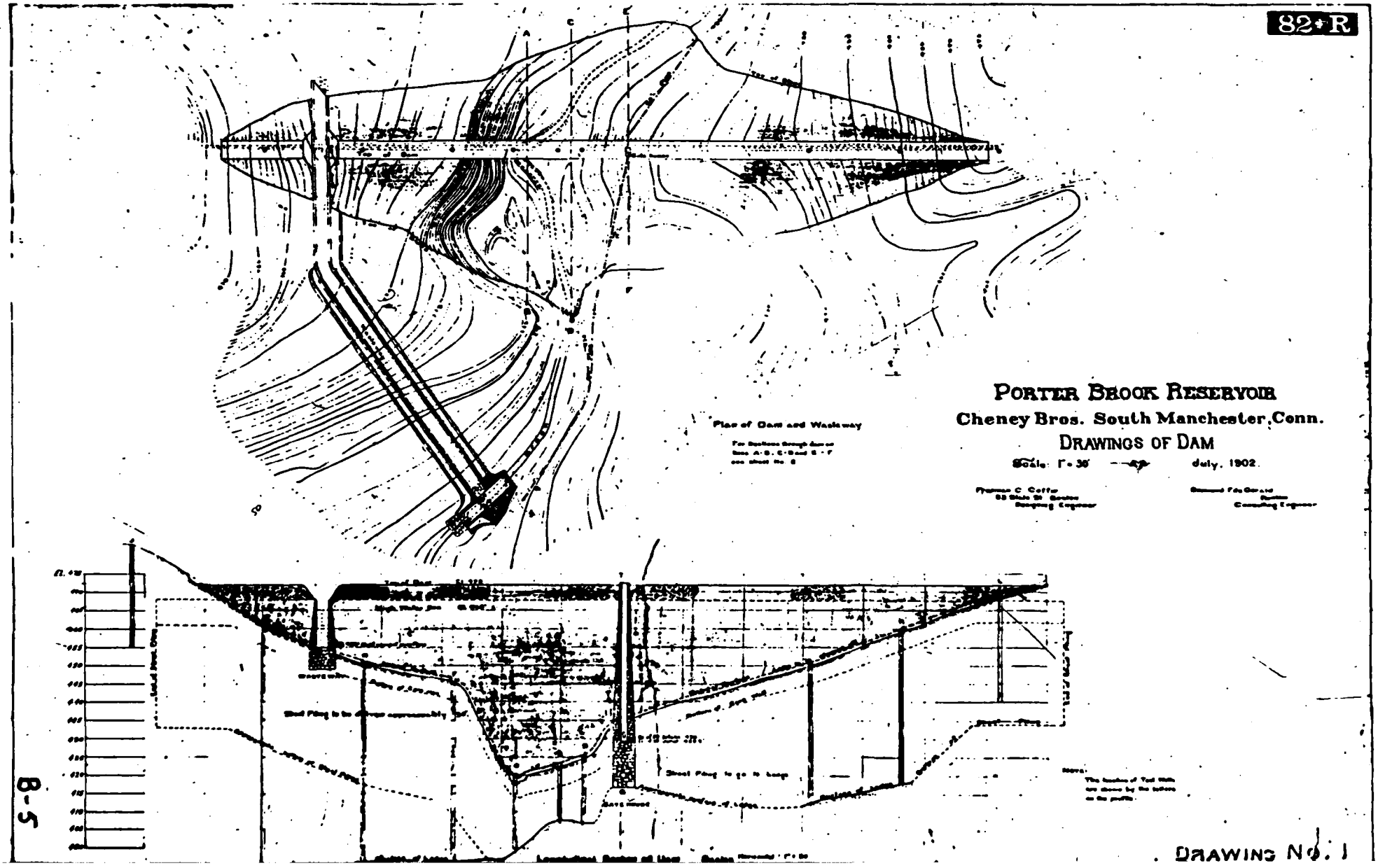


ter Reservoir and Gate House:




Porter Reservoir
Gate House
Spillway
DAM
6"
12"
12"
Manhole
10"
Reducing Valve
From Howard Reservoir
8"
12"
Chemical and Pump Station
Reducing Valve
Head Wall
Chemical Station
Chemical and Pump Station
16.0'
15.0'
8" x 4"
Reducing Valve
Manhole
Reducing Valve
84'
10.7'
13.3'
13.7'
9.8'
6.0'
14.2'

82-R



Plan of Dam and Washway

PORTER BROOK RESERVOIR

Cheney Bros. South Manchester, Conn.

DRAWINGS OF DAM

Scale: 1" = 30' July, 1902.

DRAWING No. 1

8-5

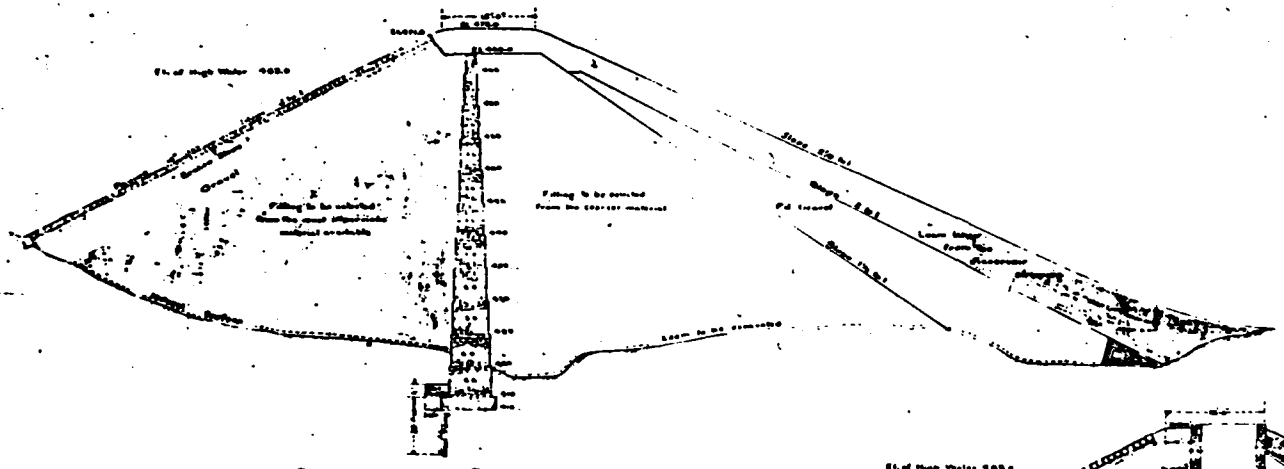
82 Q

PORTER BROOK RESERVOIR

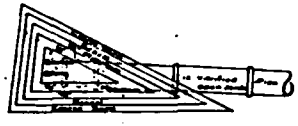
Cheney Bros. South Manchester, Conn.

DRAWINGS OF DAM

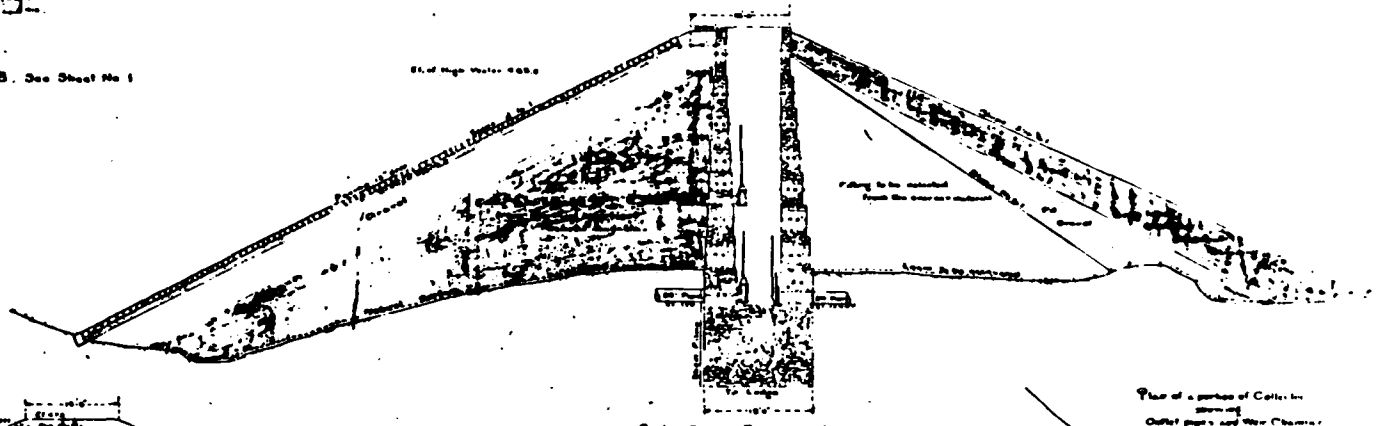
Scale: 1/8"=1' — July, 1902



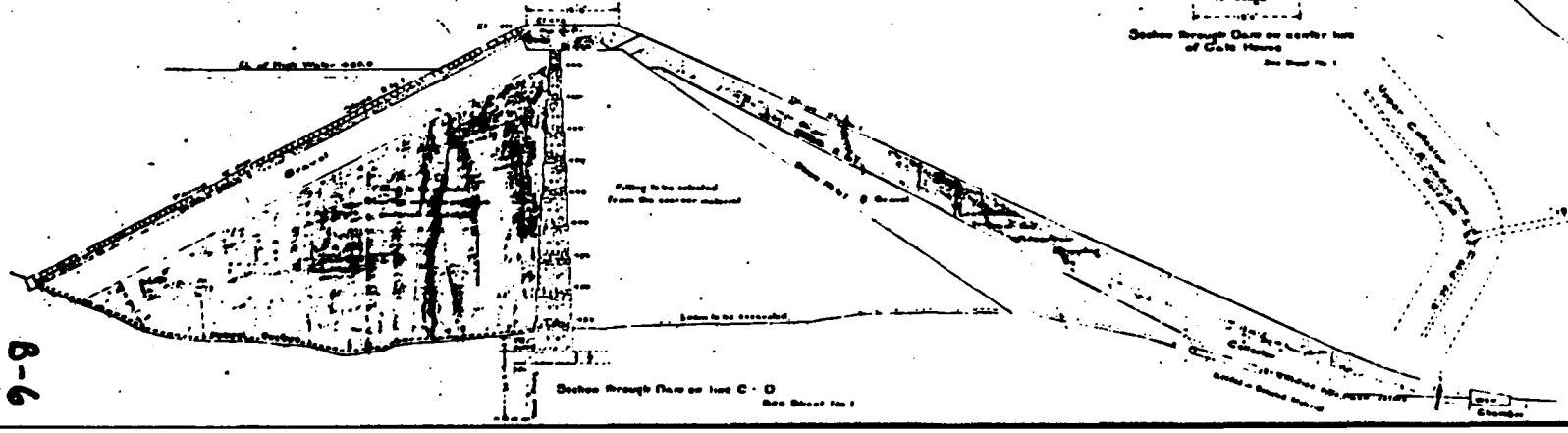
Section on line A - B. See Sheet No 1



Section through Collector around the toe of dam. Scale: 1/8"=1'



Section through Dam on center line of Core Wall. See Sheet No 1

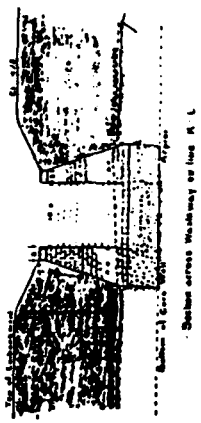


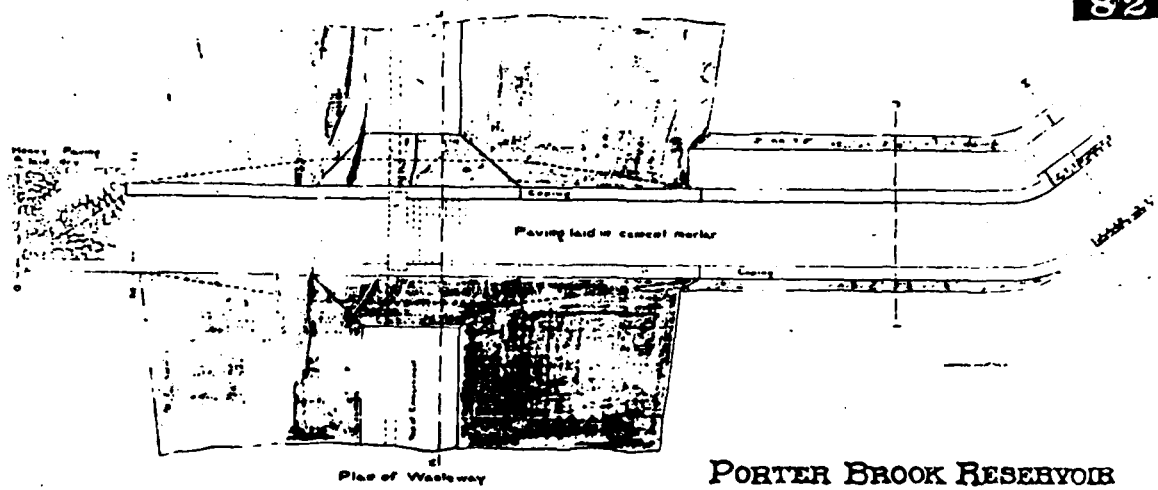
Section through Dam on line C - D. See Sheet No 1

DRAWING NO. 2

B-6

82P





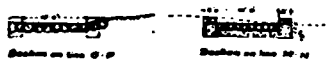
PORTER BROOK RESERVOIR

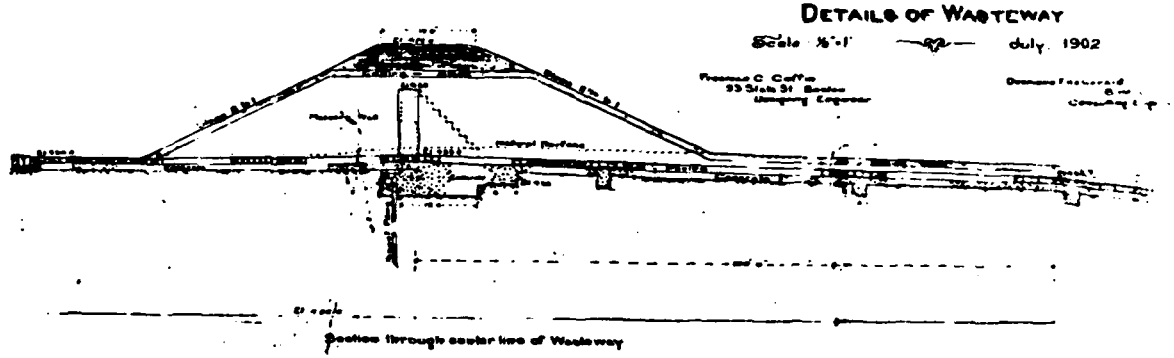
Cheney Bros. South Manchester, Conn.

DRAWINGS OF DAM

DETAILS OF WASTEWAY

Scale ½"-1' July 1902

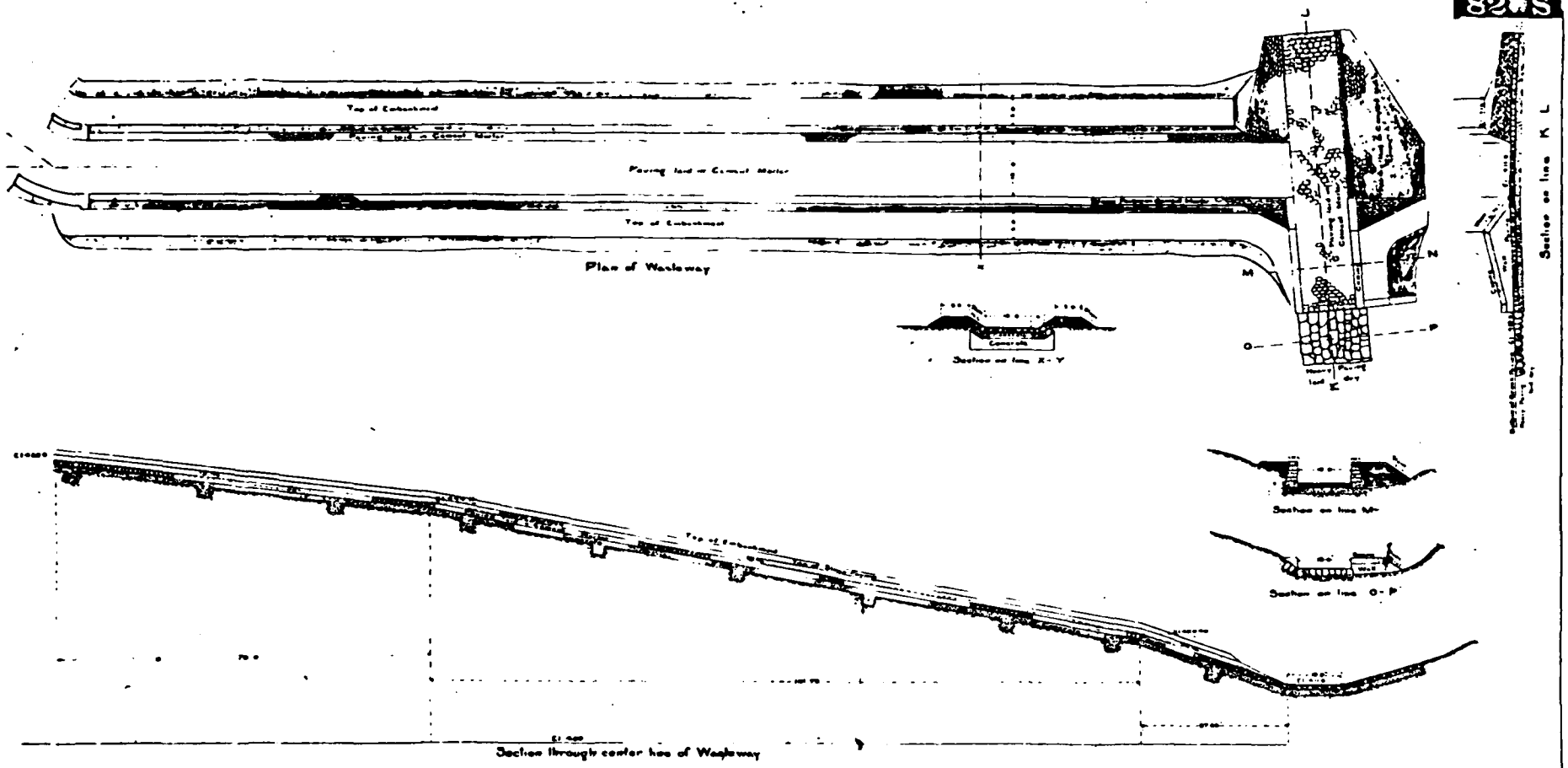




8-7.

DRAWING No. 3

82 S



PORTER BROOK RESERVOIR

Chency Bros. South Manchester, Conn.

DRAWINGS OF DAM

DETAILS OF WASTEWAY

Scale : 1/8"-1' — July . 1902

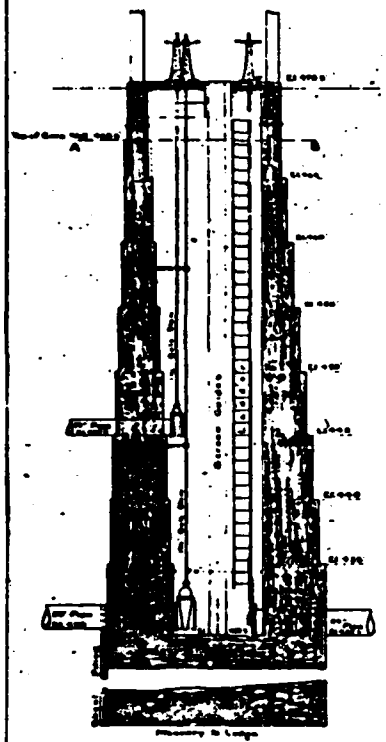
Frederic C. Coffin
93 State St. Boston
Designing Engineer

Desmond FitzGerald
Boston
Consulting Engineer

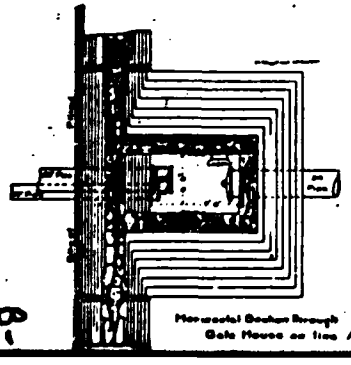
DRAWING No. 3^

6-8

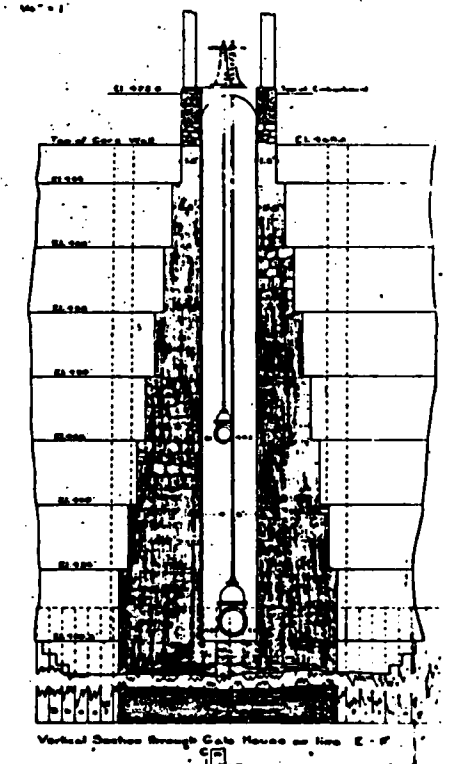
GATE HOUSE



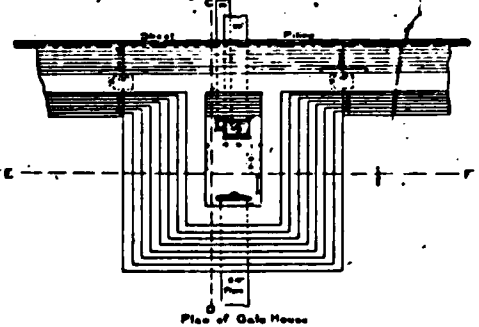
Vertical Section through Gate House on line C-D



Horizontal Section through Gate House on line A-B

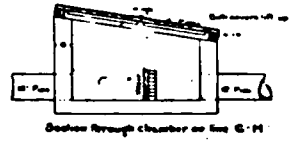


Vertical Section through Gate House on line E-F

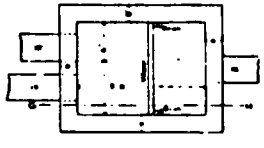


Plan of Gate House

WEIR CHAMBER



Section through chamber on line G-H



Plan of Weir Chamber

PORTER BROOK RESERVOIR

Cheney Bros. South Manchester, Conn.

DRAWINGS OF DAM

DETAILS OF GATE HOUSE

Scale as drawings — 1/2" — July, 1902

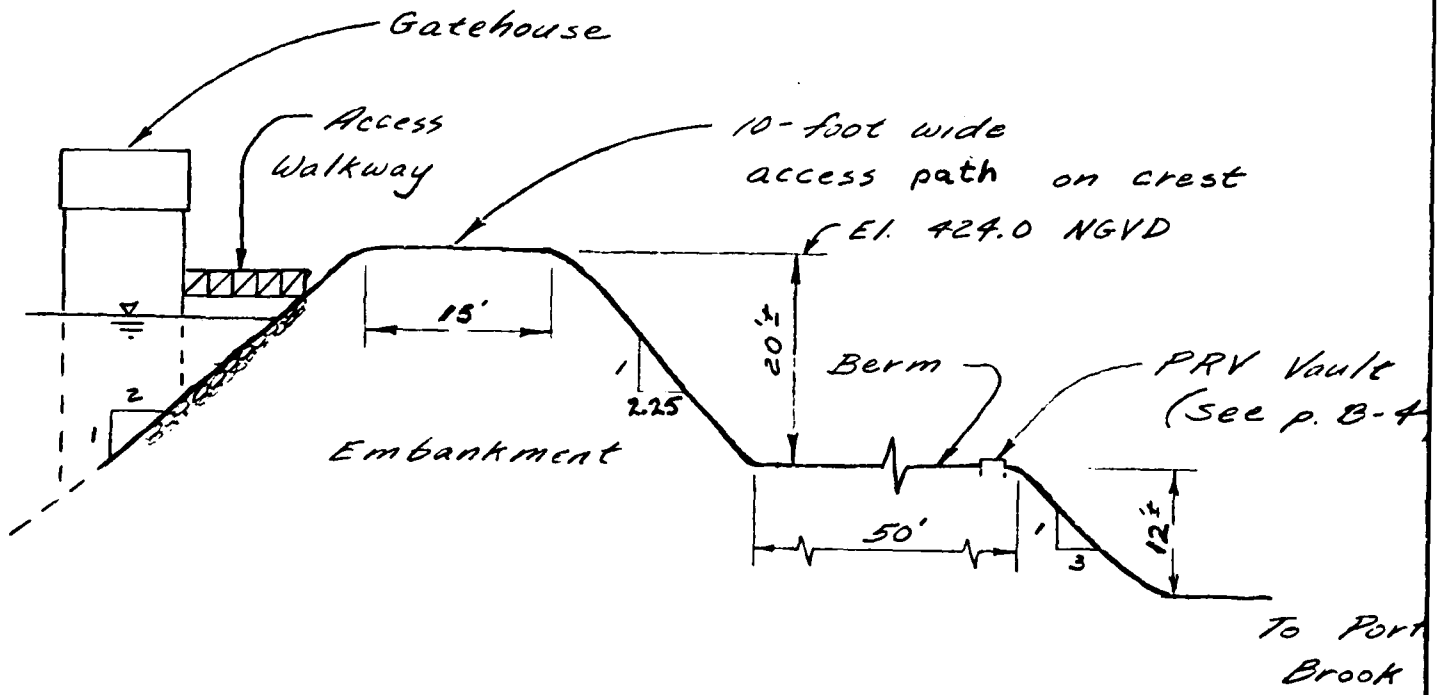
Frederic C. Coffin
53 State St. Boston
Designing Engineer

Desmond FitzGerald
Boston
Consulting Engineer

DRAWING No. 4

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
Porter Reservoir Dam				



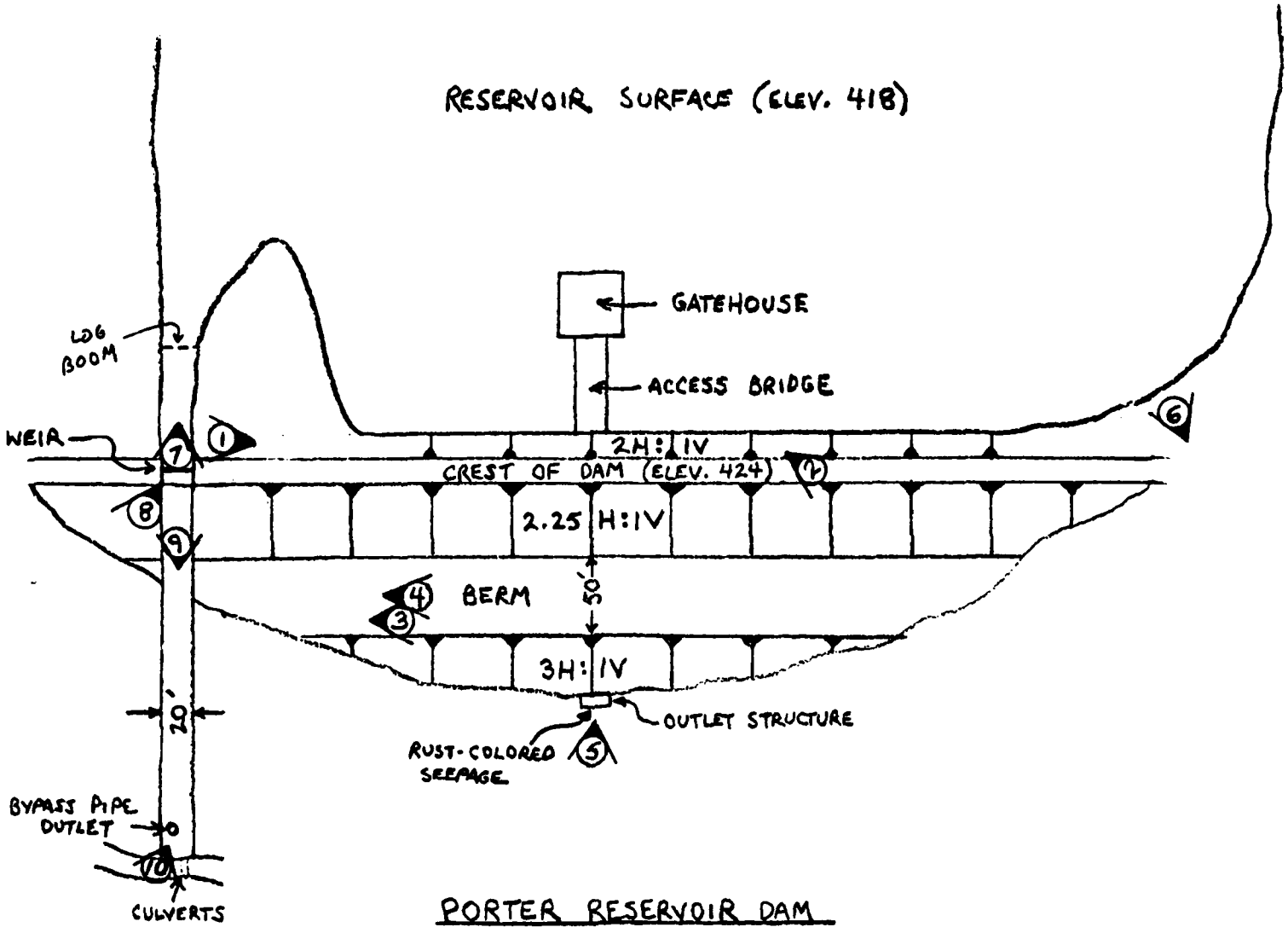
EMBANKMENT SECTION AT GATEHOUSE

(Not To Scale)

APPENDIX C

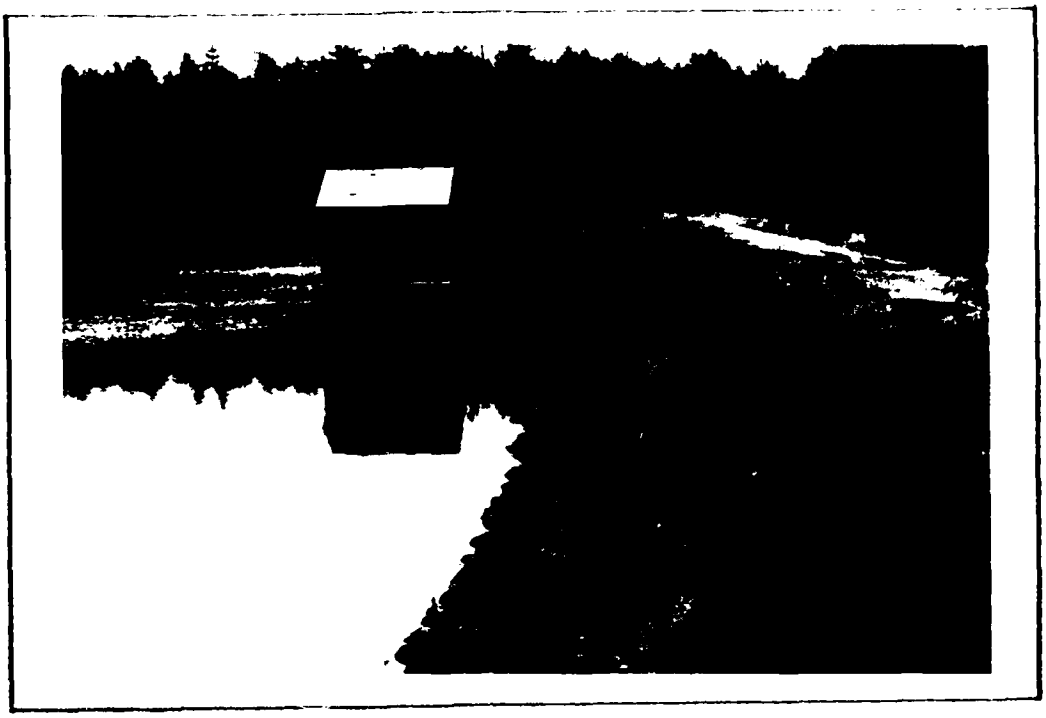
PHOTOGRAPHS

APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT

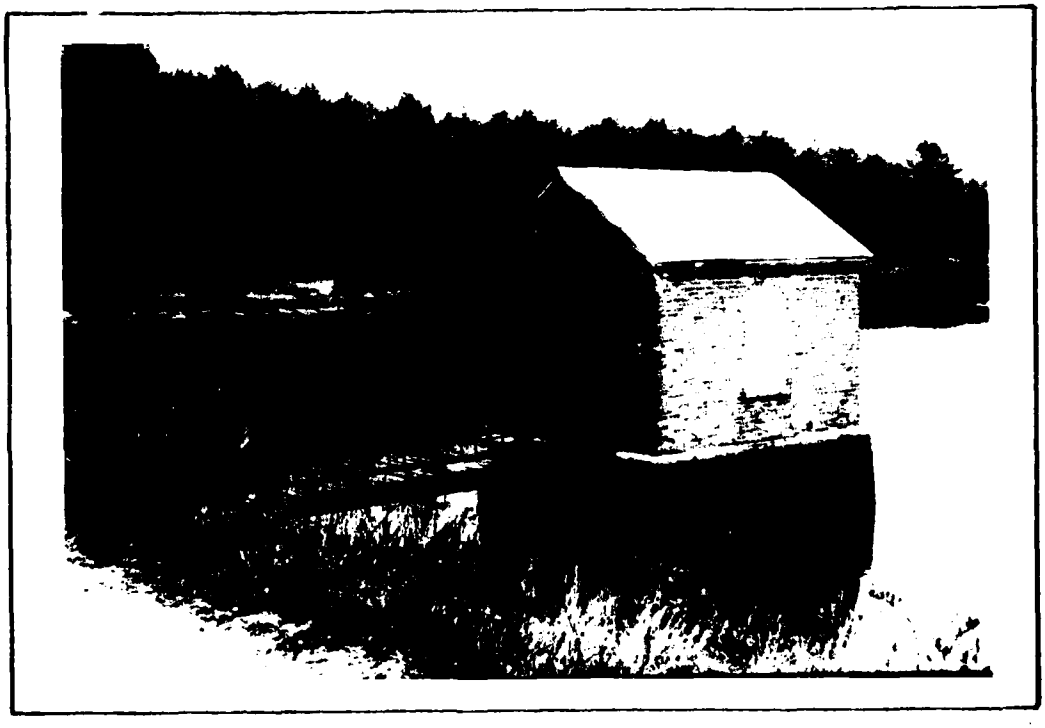


PORTER RESERVOIR DAM

LEGEND ① THE LOCATION AND DIRECTION IN WHICH EACH PHOTO WAS TAKEN AND THE NUMBER OF THE PHOTO

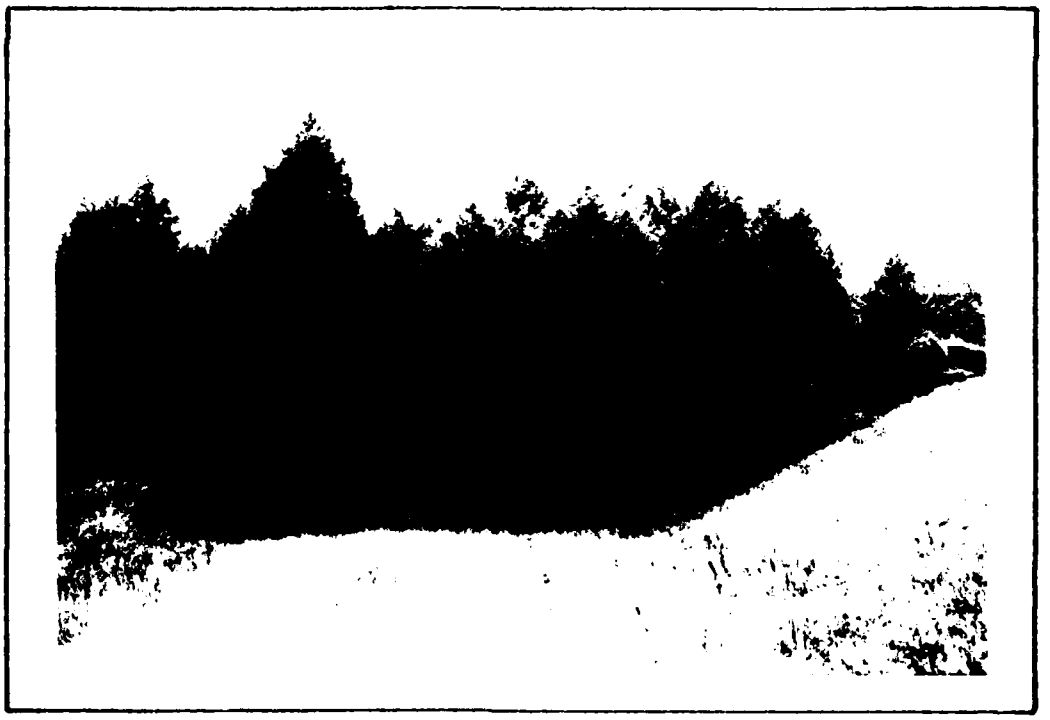


1. DETAILS OF THE UPSTREAM FACE AND TOP FACE OF THE DAM WITH THE GATEHOUSE AND CATWALK IN THE BACKGROUND. (11/14/79)

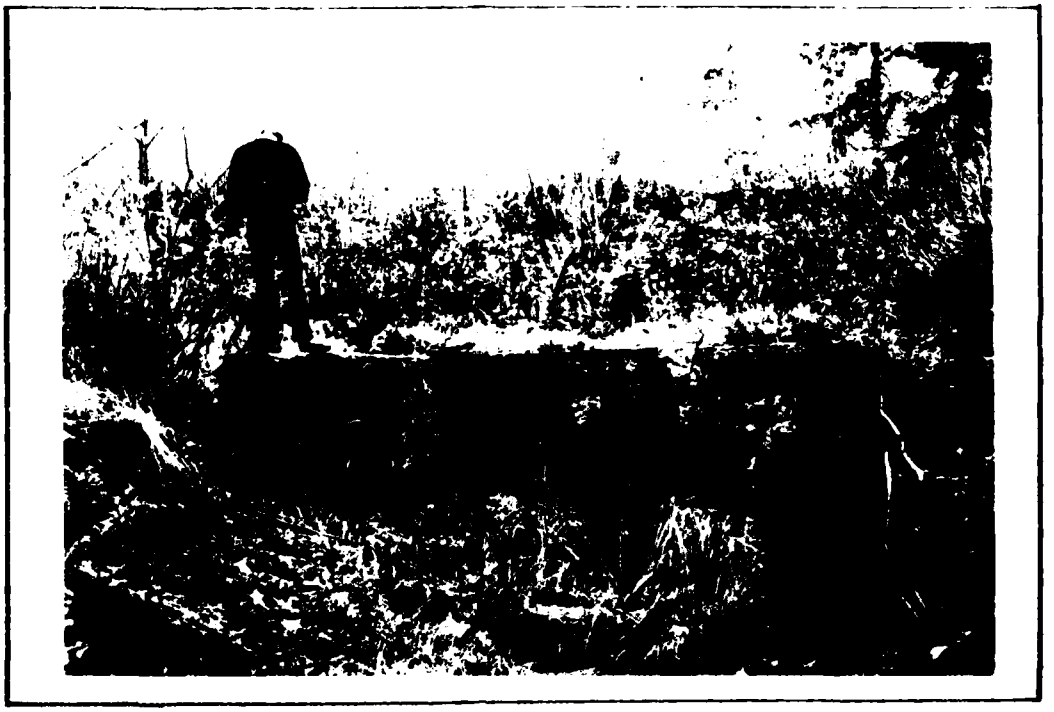


2. GATEHOUSE AND CATWALK WITH THE RIGHT SHORELINE IN THE BACKGROUND. (11/14/79)

3. HEAVY WEED COVER, TREES AND UTILITY POLE ON THE DOWNSTREAM FACE OF THE DAM. (11/14/79)

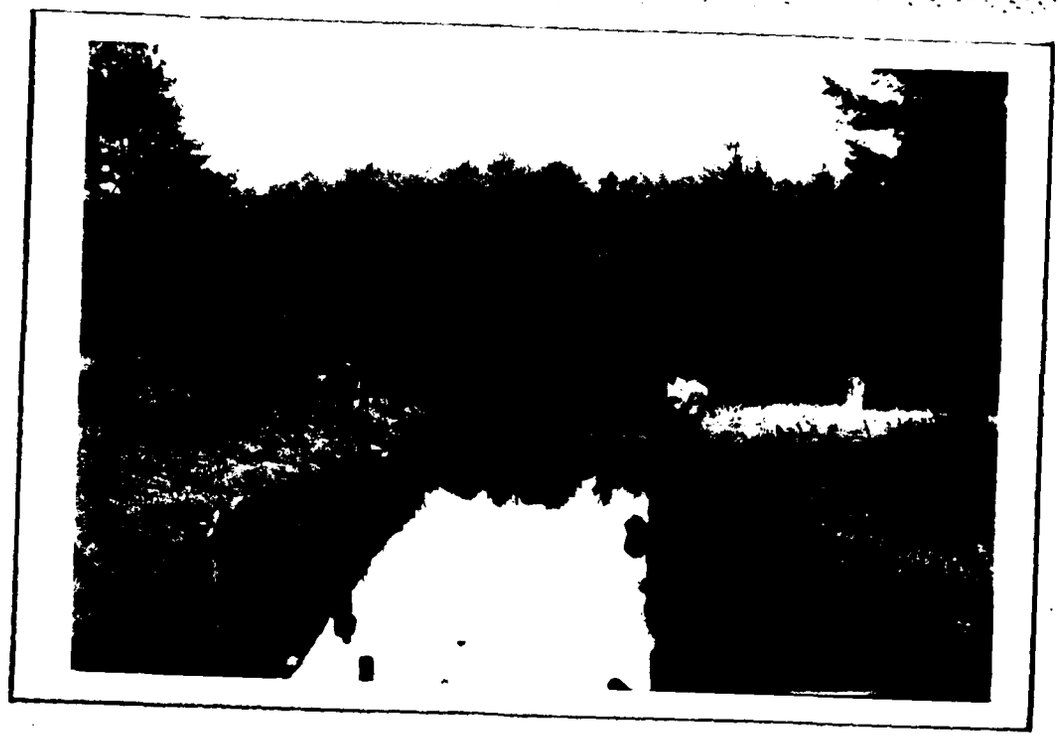


4. HEAVY TREE COVER ON THE DOWNSTREAM FACE OF THE DAM. (11/14/79)



5. DOWNSTREAM RESERVOIR DRAIN OUTLET. (11/14/79)

6. INFLOW INTO PORTER RESERVOIR FROM HOWARD RESERVOIR APPROXIMATELY 2,200 FEET TO THE SOUTHEAST. (11/14/79)



7. INLET TO THE "WASTEWATER" SPILLWAY CONSTRUCTED IN THE RIGHT ABUTMENT. (11/14/79)

8. WEIR IN THE "WASTEWATER" SPILLWAY CHANNEL ABOUT 75 FEET DOWNSTREAM FROM THE RESERVOIR. (11/14/79)

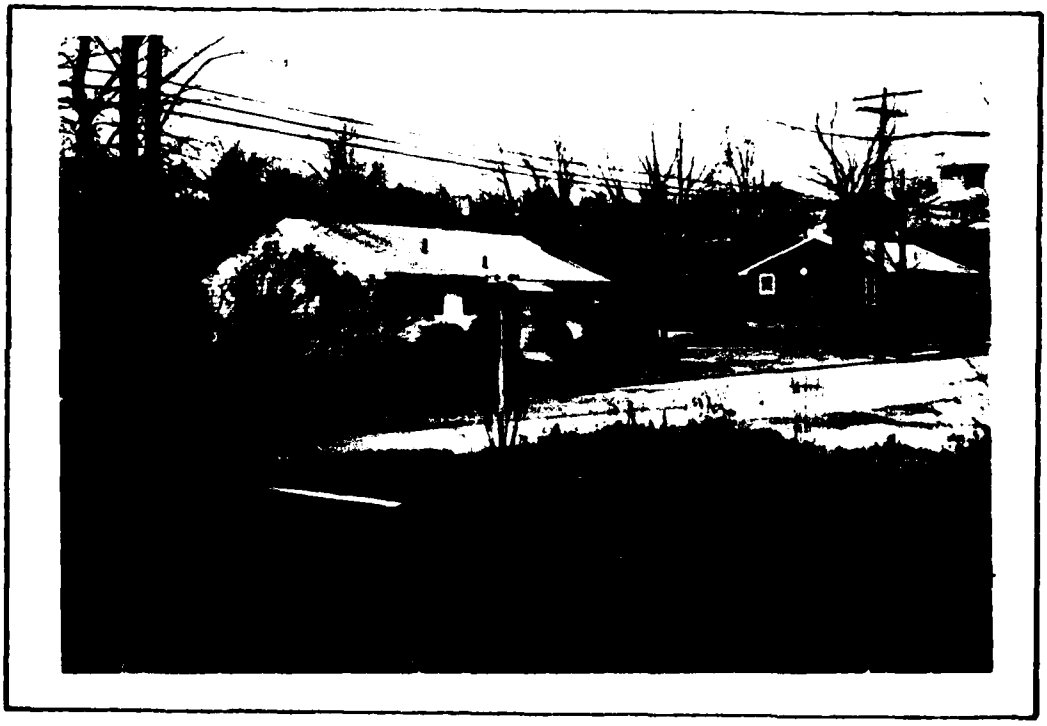
9. "WASTEWATER" SPILLWAY OUTLET CHANNEL AS VIEWED FROM THE BRIDGE OVER THE CHANNEL. (11/14/79)

10. OUTLET OF CONDUIT IN THE "WASTEWATER" SPILLWAY OUTLET CHANNEL DISCHARGING EXCESS WATER FROM THE RESERVOIR. (11/14/79)

11. POTENTIAL DAMAGE AREA ONE HALF MILE DOWNSTREAM FROM THE DAM. (11/14/79)

12. POTENTIAL DAMAGE AREA ONE HALF MILE DOWNSTREAM FROM THE DAM. (11/14/79)

13. POTENTIAL DAMAGE AREA 1.2 MILES DOWNSTREAM FROM THE DAM. (11/14/79)



14. POTENTIAL DAMAGE AREA 1.2 MILES DOWNSTREAM FROM THE DAM. (11/14/79)

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

PORTER RESERVOIR DAM - APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

TABLE OF CONTENTS

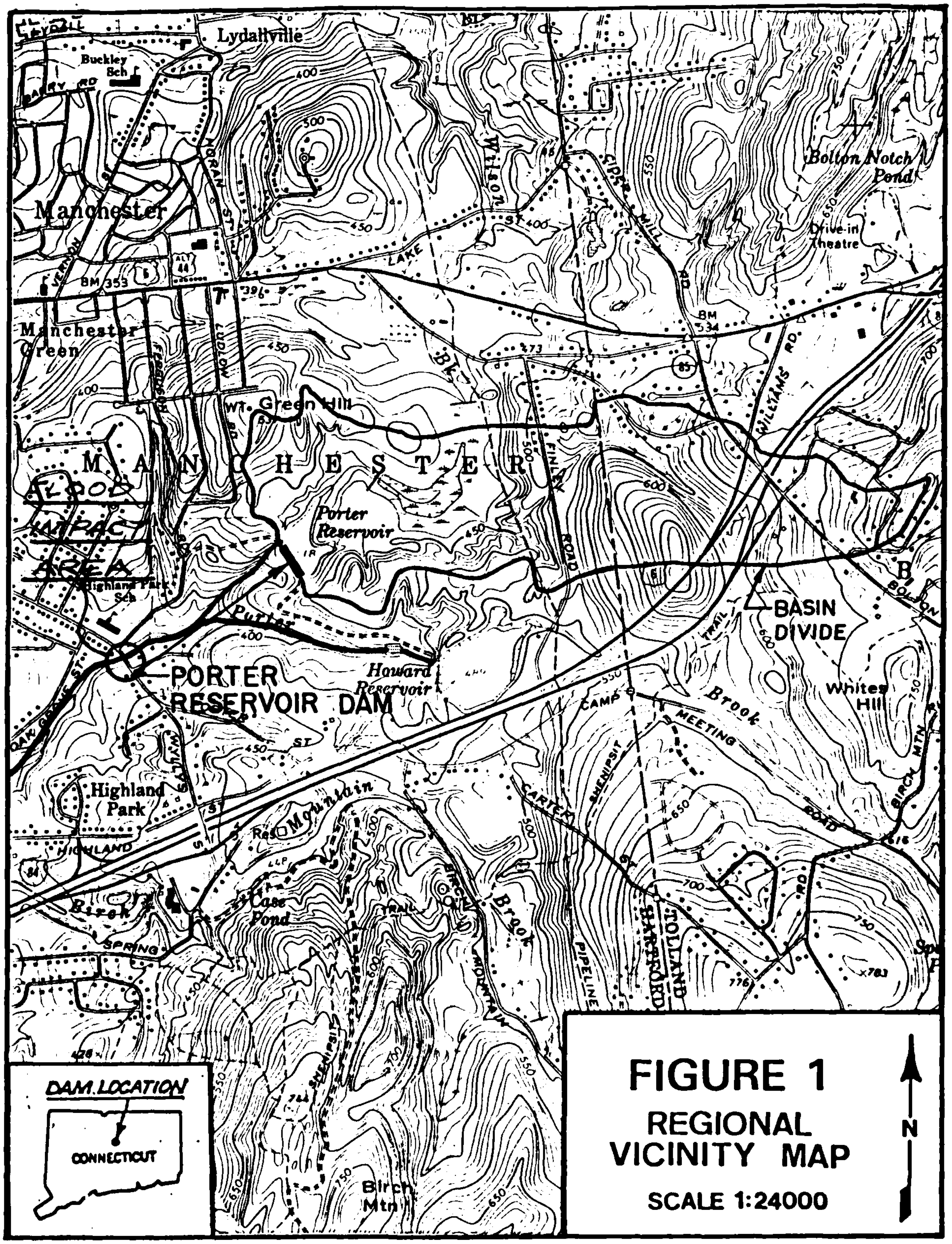


FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24000

BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB
SHEET NO. D-2 OF
CALCULATED BY E.G. DATE
CHECKED BY DATE
SCALE

PORTER RESERVOIR DAM - H & H

1/

DRAINAGE AREA = 0.61 Sq. Mi

SNYDER HYDROGRAPH COEFFICIENTS

$C_t = 2.0$ $C_p = 0.5$

T_p COMPUTATIONS

$L = 1.85$ MILES $L_{ca} = 0.8$ MILES

$T_p = C_t \cdot (L \times L_{ca})^{.3}$

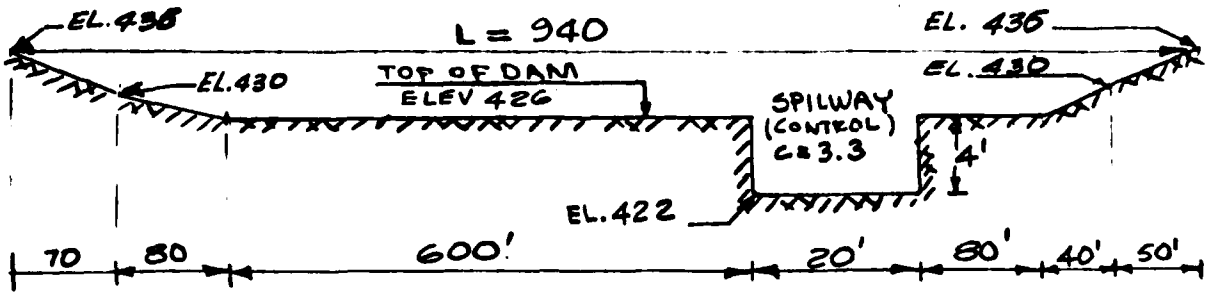
$T_p = 2.0 \times (1.85 \times 0.8)^{.3} \cong$ 2.25 HOURS

PMP DATA

FROM HMS #33 THE 24 HOUR 200 SqMi INDEX RAINFALL IS 21.5

6hr. % OF INDEX FOR THIS BASIN = 111
12hr. % " " " " " = 124
24hr. % " " " " " = 133

DAM ELEVATION & LENGTH and SPILLWAY DIMENSIONS SKETCH



C = 2.8 TOP OF DAM

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
	D-3	RRB		

PORTER RESERVOIR DAM H&H

STAGE - DISCHARGE

H = 0 @ CORRESPONDING CREST — $Q = CLH^{1.5}$

SPILLWAY CREST ELEV. = 418 (NGVD) — Q_1

C = 3.3 L = 20'

TOP OF DAM ELEV. = 424 (NGVD) — Q_2

C = 2.8 L = 680'

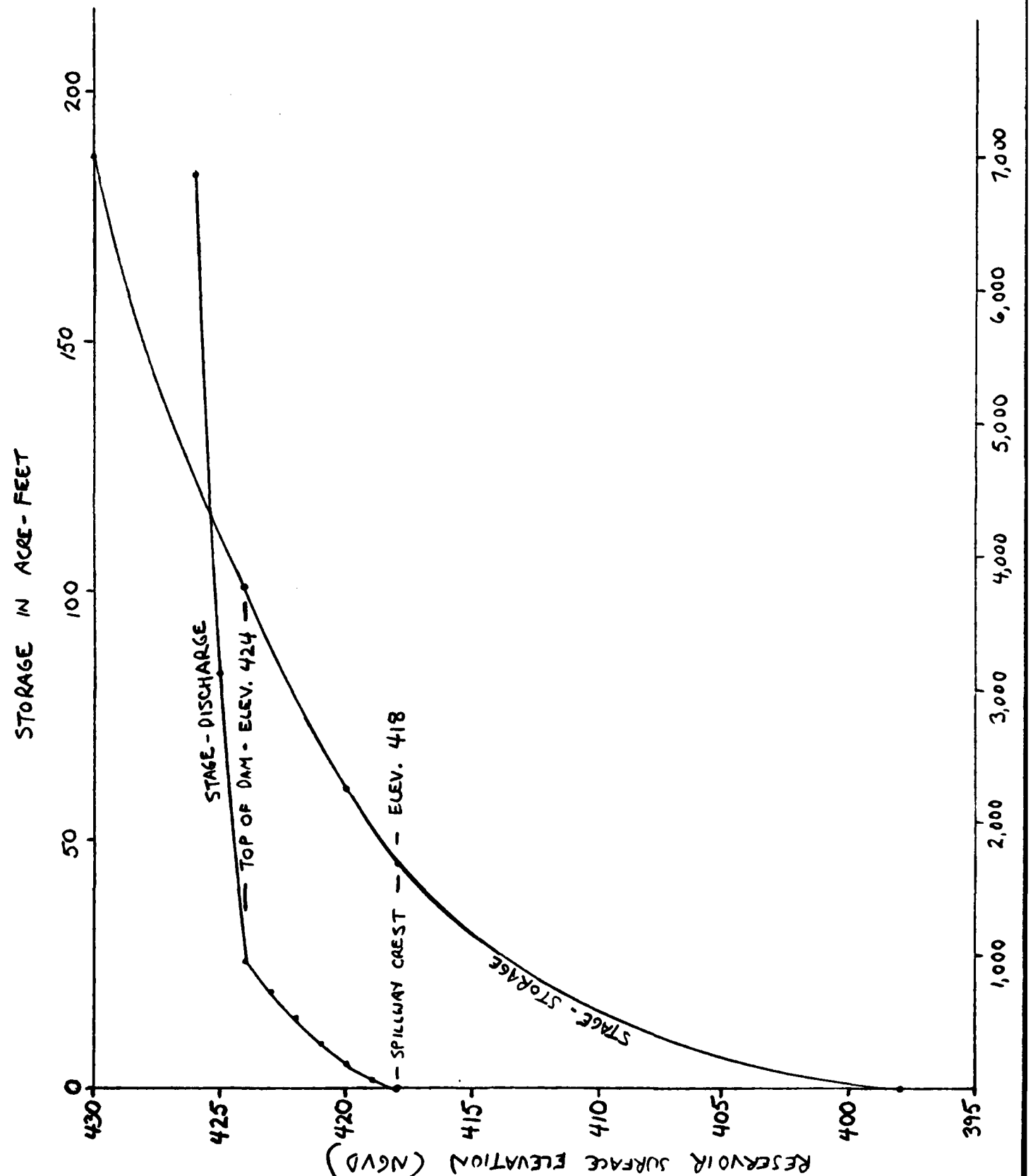
ELEVATION (NGVD)	H_1 (FT.)	Q_1 (CFS)	H_2 (FT.)	Q_2 (CFS)	ΣQ (CFS)
418 (SPWY. CREST)	0	0			0
419	1	66			66
420	2	187			187
421	3	343			343
422	4	528			528
423	5	738			738
424 (TOP OF DAM)	6	970	0	0	970
425	7	1,222	1	1,904	3,126
426	8	1,493	2	5,385	6,878

STAGE - STORAGE

ELEVATION (NGVD)	AREA (ACRES)	STORAGE (ACRE-FEET) (COMPUTED BY HEC-1 PROGRAM)
398	0	0
418	6.7	45
420	8.6	60
430	17.4	187

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
STAGE - STORAGE AND STAGE - DISCHARGE CURVES	D-4	RRB		



BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB _____

SHEET NO D-5 OF _____

CALCULATED BY R.G. DATE _____

CHECKED BY _____ DATE _____

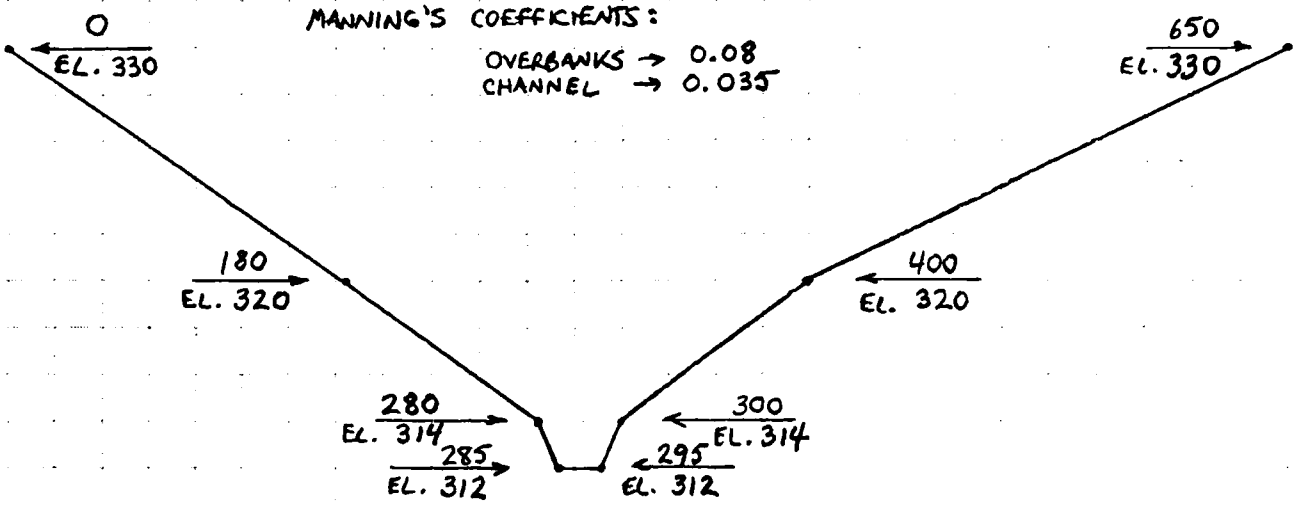
SCALE _____

PORTER RESERVOIR DAM - H&H Cont'd.

CROSS-SECTION AT HAZARD AREA 2,700' DOWNSTREAM OF PORTER RESERVOIR DAM

SLOPE = 0.04

MANNING'S COEFFICIENTS:
OVERBANKS → 0.08
CHANNEL → 0.035



FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

FLOOD ROUTINGS THROUGH PORTER RESERVOIR DAM

INPUT

```
     1              A1
     2              A2
     3              A3
     4              B     300       0      15       0       0       0       0       0      -4       0
     5              B1      5
     6              J       1       9       1
     7              J1     .2      .3      .4      .5      .6      .7      .8      .9     1.0
     8              K       0   PORTR                                       1
     9              K1        INFLOW TO PORTER RESERVOIR
    10              M       1       1    0.61                                                   1
    11              P       0    21.5     111     124     133
    12              T                                                       0    0.05
    13              W    2.25     0.5
    14              X    -1.7    -0.1       2
    15              K       1   PORTR                                       1
    16              K1        ROUTED OUTFLOW FROM PORTER RESERVOIR
    17              Y                                       1       1
    18              Y1      1                                       -418.0      -1
    19              Y4    418     419     420     421     422     423     424     425     426
    20              Y5      0      66     187     343     528     738     970    3126    6878
    21              $A      0     6.7     8.6    17.4
    22              $E    398     418     420     430
    23              $S    418
    24              $D    424
    25              K      99
```

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE= 03/17/80.
TIME= 14.47.43.

HYDROLOGIC ANALYSIS OF PORTER RESERVOIR DAM
NATIONAL DAM INSPECTION PROGRAM
NEW ENGLAND DIVISION - CORPS OF ENGINEERS

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

PERCENTAGES OF PMF → RTIOS= .20 .30 .40 .50 .60 .70 .80 .90 1.00

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH DEVELOPMENT

INFLOW TO PORTER RESERVOIR

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.61	0.00	.61	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.50	111.00	124.00	133.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 2.25 CP= .50 NTA= 0

RECESSION DATA
STRTQ= -1.70 QRCSN= -.10 RTIOR= 2.00

UNIT HYDROGRAPH 70 END-OF-PERIOD ORDINATES, LAG= 2.27 HOURS, CP= .50 VOL= 1.00

3.	11.	22.	36.	50.	65.	76.	84.	89.	88.
83.	76.	70.	65.	60.	55.	51.	47.	43.	40.
36.	34.	31.	28.	26.	24.	22.	21.	19.	17.
16.	15.	14.	13.	12.	11.	10.	9.	8.	8.
7.	7.	6.	6.	5.	5.	4.	4.	4.	3.

3.	3.	3.	2.	2.	2.	2.	2.	2.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM PORTER RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
PORTR	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-418.	-1

STAGE	418.00	419.00	420.00	421.00	422.00	423.00	424.00	425.00	426.00
FLOW	0.00	66.00	187.00	343.00	528.00	738.00	970.00	3126.00	6878.00

STAGE - DISCHARGE DATA

SURFACE AREA=	0.	7.	9.	17.
CAPACITY=	0.	45.	60.	147.
ELEVATION=	398.	418.	420.	430.

STAGE - STORAGE DATA

SPILLWAY CREST ELEVATION →

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
418.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOP OF DAM ELEVATION →

TOPEL	COOD	EXPD	DAMWID
424.0	0.0	0.0	0.

PEAK OUTFLOW IS 224. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 337. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 453. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 568. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 683. AT TIME 18.50 HOURS

PEAK OUTFLOW IS 798. AT TIME 18.50 HOURS

MAXIMUM DISCHARGE FOR VARIOUS FLOODS

PEAK OUTFLOW IS 913. AT TIME 18.50 HOURS

PEAK OUTFLOW IS 1043. AT TIME 18.25 HOURS

PEAK OUTFLOW IS 1225. AT TIME 17.75 HOURS

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

OPERATION	STATION	AREA	PLAN	RATIO 1 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 .60	RATIO 6 .70	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	PORTR	.61	1	239.	359.	478.	598.	717.	837.	956.	1076.	1196.
		(1.58)		(6.77)	(10.16)	(13.54)	(16.93)	(20.31)	(23.70)	(27.08)	(30.47)	(33.85)
ROUTED TO	PORTR	.61	1	224.	337.	453.	568.	683.	798.	913.	1083.	1225.
		(1.58)		(6.35)	(9.55)	(12.84)	(16.08)	(19.33)	(22.60)	(25.84)	(30.68)	(34.69)

PEAK INFLOW FOR VARIOUS FLOODS

ROUTED OUTFLOW FOR VARIOUS FLOODS

TEST FLOOD PEAK INFLOW

ROUTED TEST FLOOD OUTFLOW

RESULTS OF ROUTED FLOODS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	418.00	418.00	424.00
STORAGE	45.	45.	100.
OUTFLOW	0.	0.	970.

SPILLWAY DISCHARGE CAPACITY

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
.20	420.24	0.00	62.	224.	0.00	18.75	0.00
.30	420.96	0.00	69.	337.	0.00	18.75	0.00
.40	421.60	0.00	75.	453.	0.00	18.75	0.00
.50	422.17	0.00	81.	568.	0.00	18.75	0.00
.60	422.74	0.00	86.	683.	0.00	18.50	0.00
.70	423.26	0.00	92.	798.	0.00	18.50	0.00
.80	423.75	0.00	98.	913.	0.00	18.50	0.00
.90	424.05	.05	101.	1083.	1.25	18.25	0.00
1.00	424.12	.12	102.	1225.	2.25	17.75	0.00

TEST FLOOD ELEVATION

ROUTED TEST FLOOD OUTFLOW

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

PORTER RESERVOIR DAM BREACH OUTFLOW
ROUTED TO DOWNSTREAM DAMAGE CENTER

INPUT

```
    1  A1
    2  A2
    3  A3
    4  R    300      0      5      0      0      0      0      0     -4      0
    5  R1     5
    6  J      1      1      1
    7  J1     0
    8  K      1  PORTR                                          1
    9  K1
   10  Y                                          1      1
   11  Y1     1                                                -424.0     -1
   12  Y4   418    419    420    421    422    423    424    425    426
   13  Y5     0     66    187    343    528    738    970   3126   6878
   14  SA     0    6.7    8.6   17.4
   15  SF   398    418    420    430
   16  SS   418
   17  SD   424
   18  SR   280    .01    404      2    424    424
   19  K      1  DS-1                                          1
   20  K1
   21  Y                                          1      1
   22  Y1     1                                                -1
   23  YA 0.08  0.035   0.08    312    330   2700  0.040
   24  Y7     0    330    180    320    280    314    285    312    295    312
   25  Y7   300    314    400    320    650    330
   26  K     99
```

ROUTED OUTFLOW FROM PORTER RESERVOIR

HYDROLOGIC ANALYSIS OF PORTER RESERVOIR DAM
NATIONAL DAM INSPECTION PROGRAM
NEW ENGLAND DIVISION - CORPS OF ENGINEERS

CHANNEL ROUTING THROUGH HAZARD CENTER

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE= 03/24/80.
TIME= 14.49.14.

HYDROLOGIC ANALYSIS OF PORTER RESERVOIR DAM
NATIONAL DAM INSPECTION PROGRAM
NEW ENGLAND DIVISION - CORPS OF ENGINEERS

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	5	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

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

NO INFLOW → RTIOS= 0.00

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM PORTER RESERVOIR

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-424.	-1

STAGE	418.00	419.00	420.00	421.00	422.00	423.00	424.00	425.00	426.00
FLOW	0.00	66.00	187.00	343.00	528.00	738.00	970.00	3126.00	6878.00

} STAGE-DISCHARGE DATA

SURFACE AREA=	0.	7.	9.	17.
CAPACITY=	0.	45.	60.	187.
ELEVATION=	398.	418.	420.	430.

} STAGE-STORAGE DATA

SPILLWAY CREST ELEVATION →

CREL	SPWID	COOL	EXPW	ELEVL	COOL	CAREA	EXPL
418.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOP OF DAM ELEVATION →

TOPEL	COOD	EXPD	DAMWID
424.0	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
240.	.01	404.00	2.00	424.00	424.00

} BREACH DIMENSIONS - FAILURE BEGINS IMMEDIATELY WITH RESERVOIR SURFACE AT TOP OF DAM

BEGIN DAM FAILURE AT 0.00 HOURS

UNITED COMPUTING SYSTEMS, INC.

BREACH FLOOD ROUTED TO DOWNSTREAM DAMAGE CENTER

HYDROGRAPH ROUTING

CHANNEL ROUTING THROUGH HAZARD CENTER

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0900	.0350	.0800	312.0	330.0	2700.	.04000

} CHANNEL CHARACTERISTICS

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 330.00 180.00 320.00 280.00 314.00 285.00 312.00 295.00 312.00
300.00 314.00 400.00 320.00 650.00 330.00

} CHANNEL CROSS-SECTION AT DOWNSTREAM DAMAGE AREA

STORAGE	0.00	.73	1.73	3.64	7.39	12.99	20.45	29.76	40.93	54.03
	69.48	87.31	107.54	130.16	155.17	182.58	212.37	244.56	279.14	316.12
OUTFLOW	0.00	84.24	294.98	710.58	1392.50	2414.56	3843.33	5739.14	8158.11	11083.40
	14628.47	18924.96	24036.27	30024.26	36949.03	44868.93	53840.70	63919.57	75159.39	87612.81
STAGE	312.00	312.95	313.89	314.84	315.79	316.74	317.68	318.63	319.58	320.53
	321.47	322.42	323.37	324.32	325.26	326.21	327.16	328.11	329.05	330.00
FLOW	0.00	84.24	294.98	710.58	1392.50	2414.56	3843.33	5739.14	8158.11	11083.40
	14628.47	18924.96	24036.27	30024.26	36949.03	44868.93	53840.70	63919.57	75159.39	87612.81

} STAGE-STORAGE AND STAGE-DISCHARGE DATA FOR THE DOWNSTREAM CHANNEL

MAXIMUM STAGE IS 315.3

→ MAXIMUM STREAM ELEVATION DUE TO BREACH OUTFLOW AT HAZARD CENTER

BREACH OUTFLOW RESULTS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	424.00	418.00	424.00
STORAGE	100.	45.	100.
OUTFLOW	970.	0.	970.

→ SPILLWAY DISCHARGE CAPACITY

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
0.00	423.72	0.00	100.	1026.	0.00	.29	0.00

→ PEAK BREACH DISCHARGE

PLAN 1 STATION OS-1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	1018.	315.3	.33

→ STREAM ELEVATION DUE TO BREACH AT DAMAGE AREA

→ PEAK FLOW DUE TO BREACH AT DAMAGE AREA

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

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