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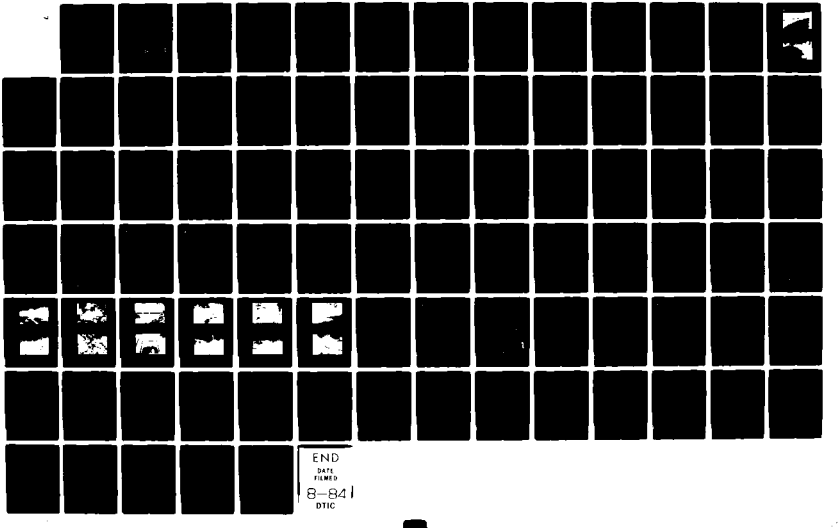
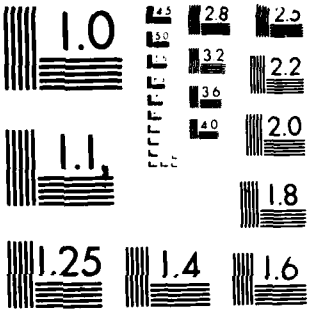
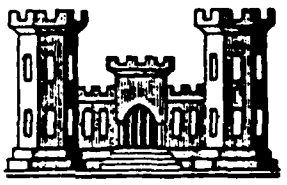




PARK RIVER BASIN
WEST HARTFORD, CONNECTICUT

HARTFORD RESERVOIR NO. 3 DAM
CT 00002

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

APRIL 1980

(1)

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

REPLY TO
ATTENTION OF
NEDED

MAY 30 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 Hartford Reservoir No. 3 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, Metropolitan District, Hartford, Connecticut 06101.

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

A-1

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Hartford Reservoir No.3 Dam; Park River Basin, Hartford, Connecticut; NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
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18. SUPPLEMENTARY NOTES

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)

DAMS, INSPECTION, DAM SAFETY, Hartford Ct., Park RiverBasin

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

Hartford Reservoir No.3 Dam is a 105-year old earth embankment approximately 500 ft. long with a maximum height of about 41 ft. The dam impounds water for use at the power generation facilities located 100 ft. downstream of Hartford Reservoir No.1 and for diversion to Hartfor Reservoir No.5 for eventual treatment and distribution in the City of Hartford water supply system. Normally, surplus water from Reservoir No.3 discharges through the spillway and flows downstream to Reservoir No.1. During periods of high demand, water may be diverted to Reservoir No. 5 by means of a 20-inch diameter pipe and an open channel at the Northern end of the Reservoir.

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HARTFORD RESERVOIR NO. 3 DAM

CT 00002

PARK RIVER BASIN
HARTFORD, CONNECTICUT

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No:	CT 00002
Name of Dam:	Hartford Reservoir No. 3 Dam
Town:	West Hartford
County and State:	Hartford County, Connecticut
Stream:	Unnamed Tributary of Spice Brook
Date of Inspection:	November 13, 1979

BRIEF ASSESSMENT

Hartford Reservoir No. 3 Dam is a 105-year old earth embankment approximately 500 feet long with a maximum height of about 41 feet. The dam impounds water for use at the power generation facilities located 100 feet downstream of Hartford Reservoir No. 1 and for diversion to Hartford Reservoir No. 5 for eventual treatment and distribution in the City of Hartford water supply system. Normally, surplus water from Reservoir No. 3 discharges through the spillway and flows downstream to Reservoir No. 1. During periods of high demand, water may be diverted to Reservoir No. 5 by means of a 20-inch diameter pipe and an open channel at the northern end of the reservoir.

The watershed for Hartford Reservoir No. 3 encompasses a 0.5-square mile area of forested, mountainous land. The normal pool reservoir surface area is approximately 28 acres, with a corresponding storage capacity of about 338 acre-feet. The maximum storage capacity of the reservoir is 487 acre-feet. Due to the 41-foot height of the dam, Hartford Reservoir No. 3 Dam is classified in the "Intermediate" size category. The potential hazard area that would be damaged by floodwaters in the event of a breaching of the dam is located about 2 miles downstream of Hartford Reservoir No. 3 Dam. A dam failure would result in excessive property damage and the possible loss of more than a few lives at the downstream hazard area. Therefore, the dam is classified in the "High" hazard potential category. The recommended test flood for an "Intermediate" size, "High" hazard dam is the full Probable Maximum Flood (PMF).

The test flood peak inflow to Hartford Reservoir No. 3 was computed as 1,370 cfs. The routed test flood outflow of 1,235 cfs overtops the embankment by 0.2 feet. The spillway is capable of discharging 946 cfs prior to overtopping of the embankment, which is about 77 percent of the routed test flood outflow. The spillway is capable of discharging one-half of the PMF with approximately 1.7 feet of freeboard.

On the date of the inspection, Hartford Reservoir No. 3 Dam generally appeared to be in fair condition. However, several deficiencies were observed during the inspection. A wet spot, apparently resulting from seepage through the embankment, extends along the downstream toe of the dam for a 50-foot distance. In addition, a section of the slope has failed above the wet area, leaving a one-foot high scarp approximately six feet above the downstream toe. Due to this condition, the dam is considered to be in poor condition. Animal burrow holes were also observed in the downstream face of the dam. Riprap has been displaced from the upstream slope and several trees are growing from the upstream face of the embankment.

Within one year after receipt of this Phase I inspection report, a qualified registered professional engineer should be retained by the Owner to: (1) investigate the source of the seepage at the downstream toe and recommend a method of seepage control; (2) perform slope stability analyses to assess the need for stabilizing the embankment; (3) direct the removal of trees from the upstream face of the dam and from the vicinity of the downstream toe; and (4) design and direct the installation of upstream controls for the high and low level outlet pipes.

In addition, the Owner should implement the following operation and maintenance procedures: (1) replace the missing riprap on the upstream face of the embankment; (2) backfill the animal burrows in the downstream face of the dam; (3) develop a formal surveiilance and flood warning plan; and (4) institute a program of annual periodic technical inspection. Within 90 days, the Owner should begin to monitor the area of slope failure at the downstream toe for further movement and continue monitoring until the condition is corrected.

O'BRIEN & GERE ENGINEERS, INC.

John J. Williams Date: 28 April 1980

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

This Phase I Inspection Report on Hartford Reservoir No. 3 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.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering 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 not 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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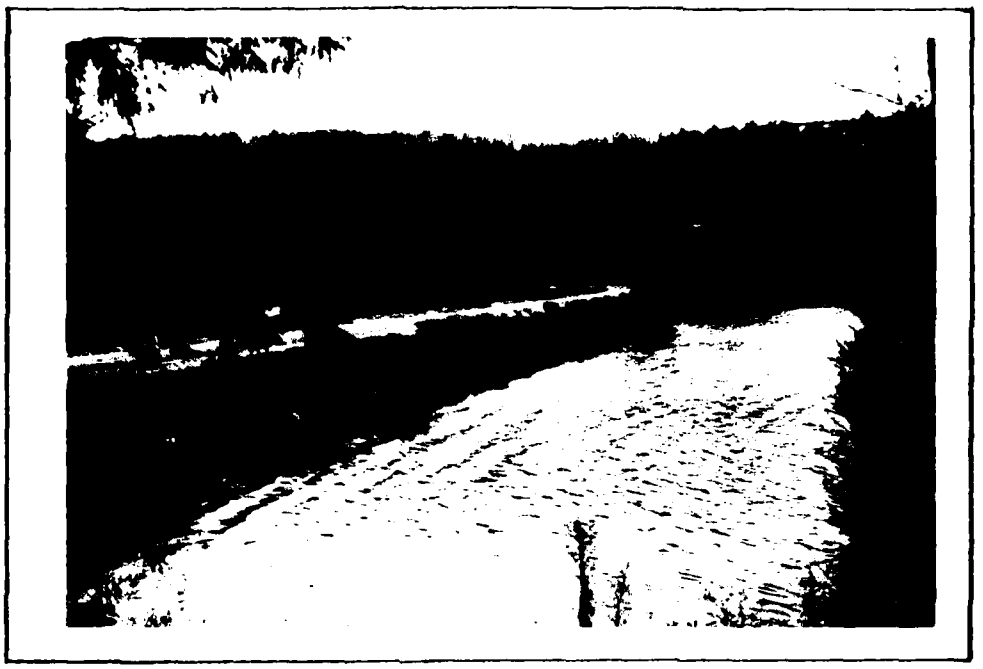
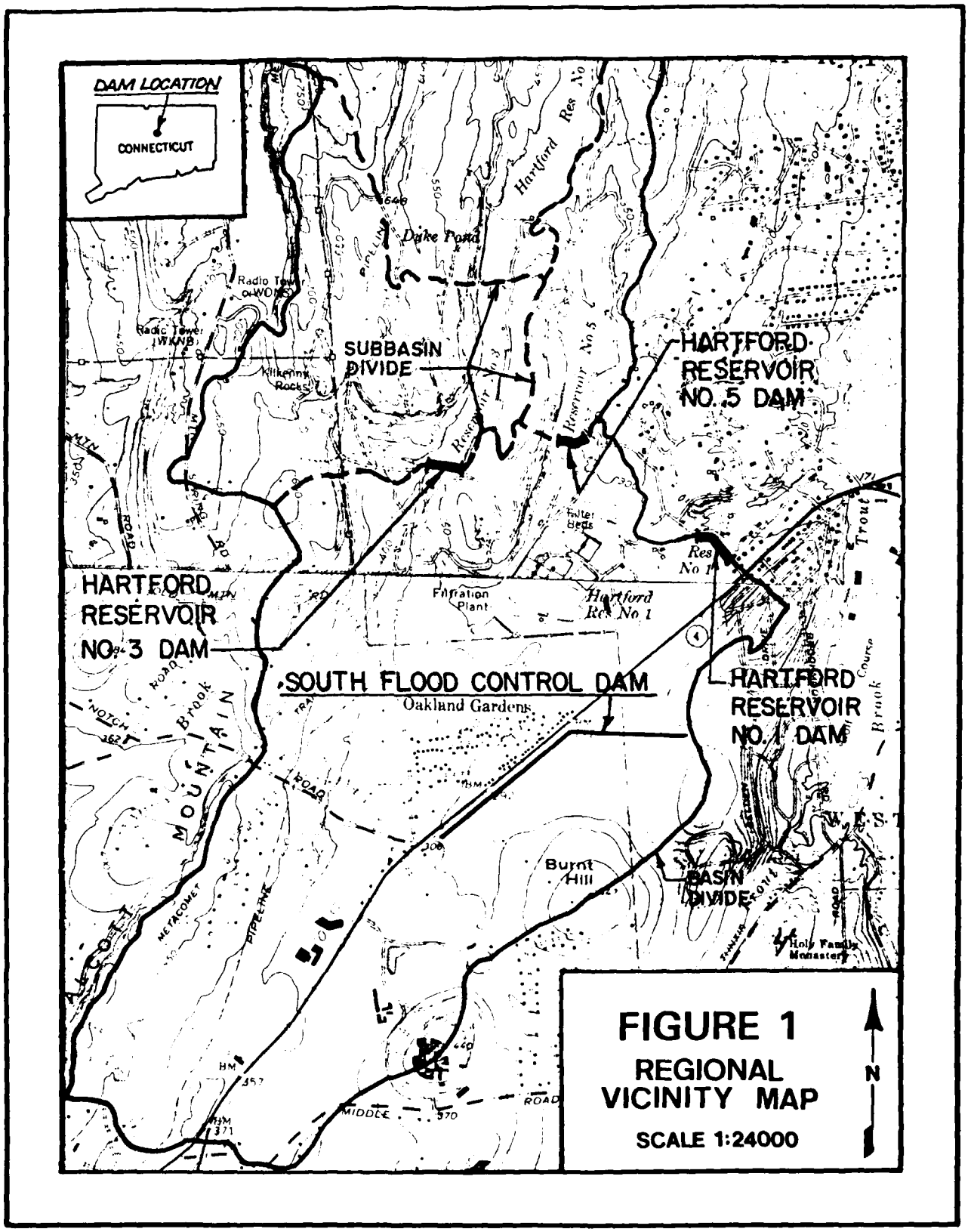
APPENDICES



UPSTREAM FACE OF THE DAM AS VIEWED FROM THE LEFT ABUTMENT.
(11/13/79)

DOWNSTREAM FACE OF THE DAM AS VIEWED FROM THE RIGHT ABUTMENT.
(11/13/79)


DAM LOCATION
CONNECTICUT
Dyke Pond
Hartford Res No 5
SUBBASIN DIVIDE
HARTFORD RESERVOIR NO. 5 DAM
HARTFORD RESERVOIR NO. 3 DAM
SOUTH FLOOD CONTROL DAM
Oakland Gardens
HARTFORD RESERVOIR NO. 1 DAM
Filtration Plant
Hartford Res No 1
Burnt Hill
BASIN DIVIDE
MOUNTAIN
Holy Family Monastery
FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24000
N

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
HARTFORD RESERVOIR NO. 3 DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The National Dam Inspection Act (Public Law 92-367), passed by Congress on August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate 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. The purpose of performing technical inspection and evaluation of non-federal dams is to:

1. Identify conditions which threaten public safety and make the Owner aware of any deficiencies to permit him to 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 this dam was obtained from the Hartford Metropolitan District)

a. Location. Hartford Reservoir No. 3 is located on an unnamed tributary of Spice Brook in the Town of West Hartford, Connecticut. To illustrate the location, portions of two USGS maps entitled "Avon, Conn." and "New Britain, Conn." have been included as Figure 1 on page vi of this report. USGS reference coordinates for this site are N $41^{o}45.2'$ and W $72^{o}47.5'$.

Outflow from Reservoir No. 3 normally flows through an open channel to Hartford Reservoir No. 1, located approximately 1.1 miles to the southeast of Reservoir No. 3. Discharge from Hartford Reservoir No. 1 flows into Spice Brook which outlets into Trout Brook about 4,000 feet downstream of Hartford Reservoir No. 1. Trout Brook discharges into the South Branch of Park River about 8 miles downstream of Hartford Reservoir No. 1.

The initial flood impact area consists of several residences located approximately 2,000 feet downstream of Hartford Reservoir No. 1 Dam. Many other residential flood impact areas are located in the ensuing miles along Trout Brook.

b. Description of Dam and Appurtenances. Hartford Reservoir No. 3 Dam is located at the southern end of the impoundment and consists of an earth embankment, approximately 500 feet long with a maximum height of 41 feet. The embankment has the following major features:

1. The upstream face of the embankment is built on a slope of approximately 1.5H:1V and it is protected with small stone riprap from an unknown depth below the normal pool elevation to about 2 feet above the normal pool surface. The remaining portion of the upstream face above the riprap protection is covered with grass.

2. The crest of the dam is approximately 24 feet wide and it is 4.8 feet above the spillway crest elevation. A 15-foot wide paved roadway, lined with large boulders on both sides, has been constructed along the entire length of the dam crest.

3. The downstream embankment face is grass-covered and built on a slope of approximately 2.5H:1V.

A section drawing and several photos of the features described above have been included in Appendix B and Appendix C, respectively.

The primary spillway is located approximately 700 feet north of the dam on the eastern shore of the reservoir. No control device exists at the spillway inlet; however, a very shallow weir extends across the 25-foot wide spillway channel, approximately 100 feet downstream of the reservoir.

Outlet works are available at the site which may be used to lower or drain the reservoir or provide a means for discharging water to an open channel for flow to Hartford Reservoir No. 5. Section 1.3b.1 presents details of the outlet works.

c. Size Classification. Hartford Reservoir No. 3 Dam has a maximum height of 41 feet and a maximum storage capacity of 487 acre-feet. Due to the 41-foot height of the dam, Hartford Reservoir No. 3 Dam is classified in the "Intermediate" size category for dams greater than 40 feet high but less than 100 feet high.

d. Hazard Classification. The initial downstream damage area consists of several homes located approximately 2,000 feet downstream of Hartford Reservoir No. 1 Dam. The sill elevation of the lowest houses at this location was estimated to be 2 feet above the channel banks of the stream. The failure analysis indicated that a breach of Hartford Reservoir No. 3 Dam with the reservoir surface at the top of the dam would result in a flow depth of 4.1 feet above the channel banks, or 2.1 feet above the sill elevation of the lowest houses at the downstream damage area. A flood of this magnitude would cause

excessive property damage and the possible loss of more than a few lives at this location. In addition, several other residential areas are located further downstream and could also be subjected to damage. The depth of flow at the hazard center immediately prior to failure was computed to be 1.8 feet below the low sill elevation with the reservoir surface at the top of the dam. Therefore, a significant increase in hazard to loss of life downstream would result from a failure of the dam. Due to the conditions described above, Hartford Reservoir No. 3 Dam is classified in the "High" hazard potential category.

e. Ownership. The dam is owned by the Metropolitan District; 555 Main Street; P.O. Box 800; Hartford, Connecticut; 06101. Telephone 203-278-7850.

f. Operator. Mr. Richard Allen, purification Engineer for the Hartford Metropolitan District, is responsible for operation of the West Hartford reservoir system.

g. Purpose of Dam. The dam was constructed in 1875 to impound water for the City of Hartford water distribution system. It is still used for water supply purposes as a reserve for Hartford Reservoir No. 5. The impounded water also is used at the power generation facilities located 100 feet downstream of Hartford Reservoir No. 1 Dam.

h. Design and Construction History. The dam was originally constructed in 1875. Since that time, there have been no major construction modifications of the dam. However, certain modifications to areas surrounding the reservoir have been made or are planned.

In 1964, the access road located along the northeastern corner of the reservoir was raised and a new 20-inch diameter outlet pipe was installed, approximately 6 feet below spillway crest elevation, to facilitate the transfer of water to Reservoir No. 5. A drawing, illustrating the dike installation and the installation of the new outlet, has been included in Appendix B.

Improvements to the primary spillway channel have also been designed and should be constructed in the near future. To date, only clearing operations have been performed. A sketch of the proposed widening has been included in Appendix B.

i. Normal Operating Procedures. According to Mr. Richard Allen, water from Reservoir No. 3 is occasionally diverted to Reservoir No. 5 for eventual treatment and use in the City water distribution system. Discharges are controlled at an outlet chamber, located at the northeastern corner of the reservoir, by adjusting the elevation of stop logs and/or operating a 20-inch sluice gate.

During periods of unusually high runoff, maintenance personnel from the Metropolitan District open valves on the high and low level discharge pipes to help draw down the pool elevation. However, due to the relatively small size of the discharge pipes, the Owner does not feel that such operations accomplish a great deal other than to exercise the valves.

1.3 Pertinent Data

a. Drainage Area. The area draining to Hartford Reservoir No. 3 encompasses 0.5 square miles of primarily mountainous, forested land to the west of the reservoir. The watershed topography rages from Elevation 800 along the Talcott Mountain Range to

Elevation 391.2 at the reservoir normal pool elevation. There has been no residential development within the drainage area.

b. Discharge at Damsite.

1. Outlet Works. Two outlet systems are available for Hartford Reservoir No. 3. The first is a 20-inch pipe, located at the northeastern end of the reservoir, which diverts water through an open channel to Hartford Reservoir No. 5. The sluice gate for this 20-inch diameter pipe is only operated during periods of high demand (summer months). The discharge capacity of this diversion pipe is estimated to be about 30 cfs with the reservoir surface at normal pool Elev. 391.2. The second is a high and low level pipe system which passes through the embankment. The low level pipe is 20 inches in diameter (reducing to 12 inches in diameter at its discharge point) and has an estimated discharge capacity of 22 cfs with the reservoir surface at normal pool (Elev. 391.2). The high level pipe is 16 inches in diameter with an estimated normal pool discharge capacity of 16 cfs. Discharge estimates were obtained from a 1956 Metropolitan District Report (see page B-9).

2. Maximum Known Flood. The flood of record at Hartford, Connecticut occurred over a three-day period in August, 1955 during Hurricane Diane. However, no records of maximum discharges or pool elevations are available for this site.

3. Ungated Spillway Capacity at Top of Dam. The spillway discharge capacity with the reservoir surface at the top of dam Elevation 396.0 is 946 cfs.

4. Ungated Spillway Capacity at Test Flood Elevation. The spillway discharge capacity with the reservoir surface at the test flood Elevation 396.2 is 1,006 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. The spillway discharge capacity with the reservoir surface at the test flood Elevation 396.2 is 1,006 cfs.

8. Total Project Discharge at Top of Dam. The total project discharge with the reservoir surface at the top of dam Elevation 396.0, including flow through the outlet works, is approximately 1,020 cfs.

9. Total Project Discharge at Test Flood Elevation. The total project discharge with the reservoir surface at the test flood Elevation 396.2 is approximately 1,310 cfs.

c. Elevation. (NGVD)

Streambed at Toe of Dam	355
Bottom of Cutoff	Unknown
Maximum Tailwater	N/A
Recreation Pool	391.2
Full Flood Control Pool	N/A
Spillway Crest	391.2
Design Surcharge (Original Design)	Unknown
Top of Dam	396.0
Test Flood Surcharge	396.2

d. Reservoir Length. (Feet)

Normal Pool	2620
Flood Control Pool	N/A
Spillway Crest Pool	2620
Top of Dam Pool	2700
Test Flood Pool	2720

e. Storage. (Acre-Feet)

Normal Pool	338
Flood Control Pool	N/A
Spillway Crest Pool	338
Top of Dam Pool	487
Test Flood Pool	493

f. Reservoir Surface Area. (Acres)

Normal Pool	28
Flood Control Pool	N/A
Spillway Crest Pool	28
Top of Dam Pool	34
Test Flood Pool	34

g. Dam Data.

Type	Earth Embankment
Length	500 feet
Height	41 feet
Top Width	25 feet
Side Slopes (upstream)	1.5H:1V
(downstream)	2.5H:1V
Zoning	Unknown
Impervious Core	Unknown
Cutoff	Unknown
Grout Curtain	Unknown

h. Diversion and Regulating Tunnel. — None

i. Spillway.

Type	Open channel with concrete weir
Length of Weir	25 feet
Crest Elevation	391.2
Gates	None
Upstream Channel	None
Downstream Channel	To be improved per Drawings B-2 and B-3, Appendix B

j. Regulating Outlets.

1. Low Level Outlet

Invert Elevation	354.6
Size	20-inch diameter reducing to 12-inch diameter at discharge point
Description	Cast Iron Pipe
Control Mechanisim	Gate Valve

2. High Level Outlet

Invert Elevation	382.5
Size	16-inch diameter
Description	Cast Iron Pipe
Control Mechanisim	Gate Valve

3. Diversion Outlet

Invert Elevation	378±
Size	20-inch diameter
Description	Cast Iron Pipe
Control Mechanism	Sluice Gate

SECTION 2

ENGINEERING DATA

2.1 Design

According to Mr. Peter Revill, Chief Design Engineer for the Hartford Metropolitan District, none of the original design information with respect to the construction of Hartford Reservoir No. 3 Dam is available. Design information for the construction of dikes and installation of the 20-inch outlet at the northeastern corner of the reservoir (1964), is available from the Metropolitan District. A drawing of the modifications is included in Appendix B.

2.2 Construction

According to Mr. Revill, original construction information for Hartford Reservoir No. 3 Dam is not available.

2.3 Operation

Under normal operating conditions, the pool elevation is at the spillway crest. During periods of high demand, water may be diverted to reservior No. 5 for eventual treatment and pumping to the City of Hartford water distribution system. Spillway overflow is routed to Reservoir No. 1 to be used for the generation of hydroelectric power. In anticipation of heavy precipitation and/or sustained snowmelt, valves at the dam may be opened to help lower the pool elevation. Further operating information is presented in Section 4.

2.4 Evaluation

a. Availability. Information obtained from the Metropolitan District has been included in Appendix B.

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

c. Validity. It appears that the information obtained from the Metropolitan District is valid except for the 2.1-foot elevation difference between Hartford Metropolitan District datum and NGVD.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. Hartford Reservoir No. 3 Dam was inspected on November 13, 1979. At the time of the inspection, the pool was at the spillway crest elevation, approximately 4.8 feet below the top of the dam. Underwater areas were not inspected. A checklist of observations and comments made during the field inspection is included as Appendix A of this report.

b. Dam. The dam consists of an earth embankment, approximately 500 feet long with a maximum height of 41 feet. The upstream face of the dam is on a slope of approximately 1.5H:1V. Riprap has been displaced in several locations above the pool surface. In addition, a few small trees are growing from the upstream face and the abutments.

A soft, wet area extends along the downstream toe of the dam for a distance of about 50 feet in the vicinity of the longitudinal center of the embankment. A one-foot vertical drop in the downstream face of the dam was observed about 6 feet above this saturated portion of the toe. A number of animal burrow holes were also observed in the downstream face of the dam.

Photos of conditions observed at the site have been included in Appendix C.

c. Appurtenant Structures. The spillway section appears to be in satisfactory condition. Improvements to the spillway outlet channel have been proposed which would widen and straighten the channel for a distance of 630 feet downstream of the weir.

Service boxes, which provide access to the high and low level outlet valves, are visible on the downstream face of the dam. The high level outlet valve is located near the left abutment, while the low level outlet valve is located approximately 180 feet to the right of the left abutment. The valves appear to be in good condition.

An outlet chamber houses the sluice gate for the diversion pipe which transfers water from Reservoir No. 3 to Reservoir No. 5. Access to this chamber is provided through two metal hinged doors as pictured on page C-3. The gate and outlet chamber appear to be in good condition.

d. Reservoir Area. The reservoir slopes are heavily wooded and mountainous to the west of the reservoir. No signs of reservoir slope instability or excessive siltation were observed on the date of the inspection.

e. Downstream Channel. The spillway outlet channel directs discharge for an approximate distance of 6,000 feet to Hartford Reservoir No. 1. Discharge from the high and low level outlet pipes is also directed into the channel and flows into Reservoir No. 1. This downstream channel has recently been cleared of major obstructions to flow, and plans have been made to improve the channel by widening it and removing high spots along the channel invert.

3.2 Evaluation

The wet area at the downstream toe of the dam appears to be a result of seepage through the embankment. In addition, the vertical drop in the downstream face of the dam appears to be a slope failure through the toe of the slope. Both of these conditions could potentially deteriorate into serious structural problems and should be remedied.

The upstream slope is relatively steep and the stability of the slope should be investigated. The root systems of the trees growing from the upstream face of the dam and in the vicinity of the downstream toe also present hazards to the structural integrity of the embankment. High winds could uproot the trees and dislodge portions of the embankment while the roots create potential seepage paths through the dam.

The control mechanisms for the high and low level outlet pipes are located at the downstream toe of the dam. Therefore, the pipes through the embankment are constantly under pressure and represent a potential danger to the dam.

Recommendations and remedial measures are discussed in Section 7.

SECTION 4

OPERATION AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Mr. Richard Allen, Purification Engineer for the Hartford Metropolitan District, is responsible for operation of the West Hartford reservoir system. According to Mr. Allen, Reservoir No. 3 is a reserve water supply reservoir and is generally used for water supply only during the summer months when demand exceeds the downstream supply. When such a demand exists, a sluice gate located at the northeastern corner of the reservoir is opened and water flows through the 20-inch diameter diversion pipe and through an open channel to Reservoir No. 5. Ultimately, the water is transferred to the filtration plant, treated, and pumped to the City of Hartford water distribution system.

Normally, surplus water overflows the spillway crest and is routed through the outlet channel to Reservoir No. 1 for use in the generation of hydroelectric power. In anticipation of large quantities of runoff, maintenance personnel will open two outlet valves to help lower the pool elevation.

b. Description of Any Warning System In effect. Currently, no formal warning system is in effect at this site. According to the Owner's representative, Mr. Peter Revill, a maintenance foreman monitors pool levels during periods of unusually high runoff.

4.2 Maintenance Procedures

a. General. According to the Owner's representative, the Metropolitan District employs a maintenance crew, headed by Mr. Rudy Wegscherder, who operate and maintain the West Hartford reservoir system. Maintenance of the grounds is performed on a routine basis.

b. Operating Facilities. According to the Owner's representative, gate valves at the dam and the sluice gate located at the northeastern corner of the reservoir, are kept in good operating condition. The outlet valves were last operated in April, 1979.

4.3 Evaluation

In general, maintenance of the dam and appurtenant structures is considered adequate. However, periodic technical inspections should be performed in order to detect such deficiencies as displaced riprap, slope failures at the toe, animal burrows, and seepage. Also, trees and brush should not be permitted to grow on the face of the embankment.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The drainage area for Hartford Reservoir No. 3 encompasses 0.5 square miles of primarily mountainous, forested land to the west of the reservoir. The watershed topography ranges from Elevation 800 along the Talcott Mountain Range to Elevation 391.2 at the reservoir normal pool elevation. There has been no residential development within the drainage area.

5.2 Design Data

According to the Owner's representative, hydraulic and hydrologic data from the original design of the dam is not available. Proposed improvements to the spillway outlet channel have been designed based upon the peak rate of runoff anticipated during a 34-hour, 18.25-inch rainfall.

5.3 Experience Data

The flood of record in Hartford occurred in August, 1955, as a result of rain which fell over a three-day period during Hurricane Diane. According to the Owner's representative, corresponding pool level records for Reservoir No. 3 are not available.

5.4 Test Flood Analysis

The recommended test flood for an "Intermediate" size, "High" hazard dam is the full Probable Maximum Flood (PMF). Hydraulic and hydrologic calculations were performed with the assistance of the HEC-1-DB computer program. The flood hydrographs were constructed from Snyder unit hydrographs using average coefficients, an initial infiltration of zero, and a constrant loss rate of 0.05 inches per hour. The Hop Brook Adjustment Factor was used to reduce the Probable Maximum Precipitation based upon the size of the drainage area.

Stage-discharge and stage-storage relationships were developed for Hartford Reservoir No. 3 Dam and input to the computer for the purpose of routing the test flood through the reservoir. The water surface elevation of the reservoir was assumed to be at the spillway crest at the beginning of the hypothetical storm event. The peak inflow and outflow rates for the test flood at Hartford Reservoir No. 3 Dam were computed to be 1,370 cfs and 1,235 cfs, respectively. The peak outflow corresponds to a reservoir stage of 5.0 feet above the spillway crest, or 0.2 feet above the top of the dam. The spillway discharge capacity is 946 cfs, which is about 77 percent of the routed test flood outflow. The spillway is capable of discharging one-half of the PMF with approximately 1.7 feet of freeboard.

5.5 Dam Failure Analysis

Failure of the embankment was simulated by the HEC-1-DB computer program assuming a 200-foot wide by 36-foot deep breach with vertical side slopes developing within 2 hours. Two failure conditions were assumed; with the reservoir surface at the top of dam elevation and with the reservoir surface at the spillway crest elevation. The resulting outflow for each condition was routed through Hartford Reservoir No. 1 and downstream to the potential damage center, located 2,000 feet downstream of Hartford Reservoir No. 1 Dam. The flow at the damage center immediately prior to failure of the embankment was 1.) computed by routing the spillway discharge downstream for the reservoir surface at top of dam case and 2.) was assumed to be equivalent to the flow observed during the visual inspection for the reservoir surface at spillway crest case. These flows were compared to the breach flows to assess the increase in hazard that would result from a failure of the embankment. 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 6.1 feet, or 4.1 feet above the channel banks, with a corresponding flow of 3,550 cfs at the damage area. The estimated sill elevation of the lowest houses in this area is 2 feet above the channel banks. Therefore, the breach flood would inundate the houses with 2.1 feet of water causing excessive property damage and the possible loss of more than a few lives. With the reservoir surface at the spillway crest, a breach flood would result in a stream depth of 4.8 feet and a corresponding flow of 2,100 cfs. This flood would also cause major property damage, but it is unlikely that any lives would be lost. The stream depth and quantity of flow at the hazard center immediately prior to failure of the dam were computed to be 2.2 feet and 360 cfs, respectively, with the reservoir surface at the top of the dam. A stream depth of 0.5 feet and flow of 35 cfs were estimated with the reservoir surface at the spillway crest. Therefore, a breach of the dam would result in a significant increase in downstream damage in both cases and in hazard to loss of life for the reservoir surface at top of dam case.

The maximum breach discharge from Hartford Reservoir No. 3 is approximately 5,600 cfs with the reservoir surface at the top of the dam and 4,650 cfs with the reservoir surface at the spillway crest elevation. The resulting peak discharge from Hartford Reservoir No. 1 for the two cases was computed to be 3,550 cfs and 2,110 cfs, respectively. The spillway system at Hartford Reservoir No. 1 is capable of discharging the maximum breach flood for both cases without overtopping of the dam.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

During the visual inspection, several indications of structural deficiencies were observed. The saturated toe of the downstream face of the dam appears to be the result of a seepage problem which has already caused a limited failure of the slope. The steepness of the upstream slope and the displaced riprap are conditions which indicate that the upstream face of the dam may not be stable. The tree roots and the animal burrow holes also pose potential hazards to the stability of the structure by creating seepage paths through the embankment. Photos of the dam are included in Appendix C.

6.2 Design and Construction Data

According to the Owner's representative, no design or construction data is available for Hartford Reservoir No. 3 Dam.

6.3 Post Construction Changes

No structural modifications have been performed subsequent to the original construction of the dam in 1875. However, spillway outlet channel improvements have been proposed.

6.4 Seismic Stability

Hartford Reservoir No. 3 Dam is located in Seismic Zone 1 on the Seismic Zone Map of Contiguous States. A dam located in Seismic Zone 1 need not be evaluated for seismic stability, according to the Recommended Guidelines for Phase I Dam Inspections.

SECTION 7

ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon the visual inspection, Hartford Reservoir No. 3 Dam generally appears to be in fair condition. However, due to seepage and stability problems which appear to exist in the vicinity of the downstream toe, the dam is considered to be in poor condition. The upstream face of the dam appears to be in fair condition. However, the steepness of the slope and the displaced riprap indicate that the stability of the slope may not be adequate and should be investigated. Trees on the upstream face and near the downstream toe and animal burrow holes in the downstream face also pose potential hazards to the structure. These conditions are discussed in further detail in Sections 3 and 6.

b. Adequacy of Information. Sufficient information has been obtained through field observations, from data supplied by the Metropolitan District, and through telephone conversations with Metropolitan District 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 from the date of receipt of this report, except as noted below.

7.2 Recommendations

It is recommended that the Owner retain the services of a qualified registered professional engineer for the following purposes:

1. To investigate the source of the seepage at the downstream toe and recommend a method of seepage control.

2. To perform slope stability analyses to assess the need for stabilizing the embankment.

3. To direct the removal of trees from the upstream face of the dam and from the vicinity of the downstream toe.

4. To design and direct the installation of upstream controls for the high and low level outlet pipes.

7.3 Remedial Measures

a. Operation and Maintenance Procedures. The following operation and maintenance procedures should be implemented by the Owner:

1. Replace the missing riprap on the upstream face of the embankment as required.

2. Backfill the animal burrows in the downstream face of the dam.

3. Develop a formal surveillance and flood warning plan.

4. Institute a program of annual periodic technical inspection.

5. Operate the gates periodically throughout the year.

6. Within 90 days, the Owner should begin to monitor the area of slope failure at the downstream toe for further movement and continue monitoring until the condition is corrected.

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: Hartford Reservoir No. 2 Dam

National I.D. #: CT 00002

Location: Hartford, Connecticut

Type of Dam: Earth Embankment

Inspection Date(s): November 13, 1979

Weather: Overcast, low 60's

Pool Elevation: 391.2 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. Peter Revill, Chief Design Engineer;
Metropolitan District; 555 Main Street;
P.O. Box 800; Hartford, Conn.; 06101

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 3 Dam

National I.D. #: CT 00002

Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	396.0 ±
Current Pool Elevation	391.2 ±
Maximum Impoundment to Date	Unknown
Surface Cracks	None Observed
Pavement Condition	Good
Movement or Settlement of Crest	None Observed
Lateral Movement	" "
Vertical Alignment	No Misalignment Observed
Horizontal Alignment	" " "
Condition at Abutment and at Concrete Structures	Trees growing @ abutments
Indications of Movements of Structural Items on Slopes	None Observed
Trespassing on Slopes	Negligible
Vegetation on Slopes	u/s slope - few trees, weeds d/s slope - grass & weeds
Sloughing or Erosion of Slopes or Abutments	Undulations & 1-ft scarp near toe of d/s slope
Rock Slope Protection - Riprap Failures	Several riprap stones displaced on 1.5:1 slope

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 3 Dam

National I.D. #: CT 00002

Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT (Con't)	
Unusual Movement or Cracking at or near Toes	Sloughing & 1-ft scarp formation
Unusual Embankment or Downstream Seepage	No flow observed - but very wet
Piping or Boils	None
Foundation Drainage Features	Unknown
Toe Drains	None
Instrumentation System	None
Miscellaneous	Animal burrows observed

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 3 Dam

National I.D. #: CT 00002

Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Clear of major debris
Loose Rock Overhanging Channel	Insignificant
Trees Overhanging Channel	"
Floor of Approach Channel	Clear
b. Weir and Training Walls	None
General Condition of Concrete	NA
Rust or Staining	NA
Spalling	NA
Any Visible Reinforcing	NA
Any Seepage or Efflorescence	NA
Drain Holes	NA
c. Discharge Channel	
General Condition	Flat slope, narrow w/ some restrictions:

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 3 Dam

National I.D. #: CT 00002

Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (Con't)	
Loose Rock Overhanging Channel	Not Significant
Trees Overhanging Channel	Few
Floor of Channel	Very rough
Other Obstructions	Brush & stones

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 3 Dam

National I.D. #: CT 00002

Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE - SLUICE GATE & STRUCTURE	
a. Approach Channel	
Slope Conditions	Submerged
Bottom Conditions	"
Rock Slides or Falls	Unknown
Log Boom	None
Debris	None Observed
Condition of Concrete Lining	Submerged
Drains or Weep Holes	None Observed
b. Intake Structure	
Condition of Concrete	Very Good
Stop Logs and Slots	Good, elevation of stop logs approx. 8" above pool.

APPENDIX B

ENGINEERING DATA

O'BRIEN & GERE
ENGINEERS, INC.

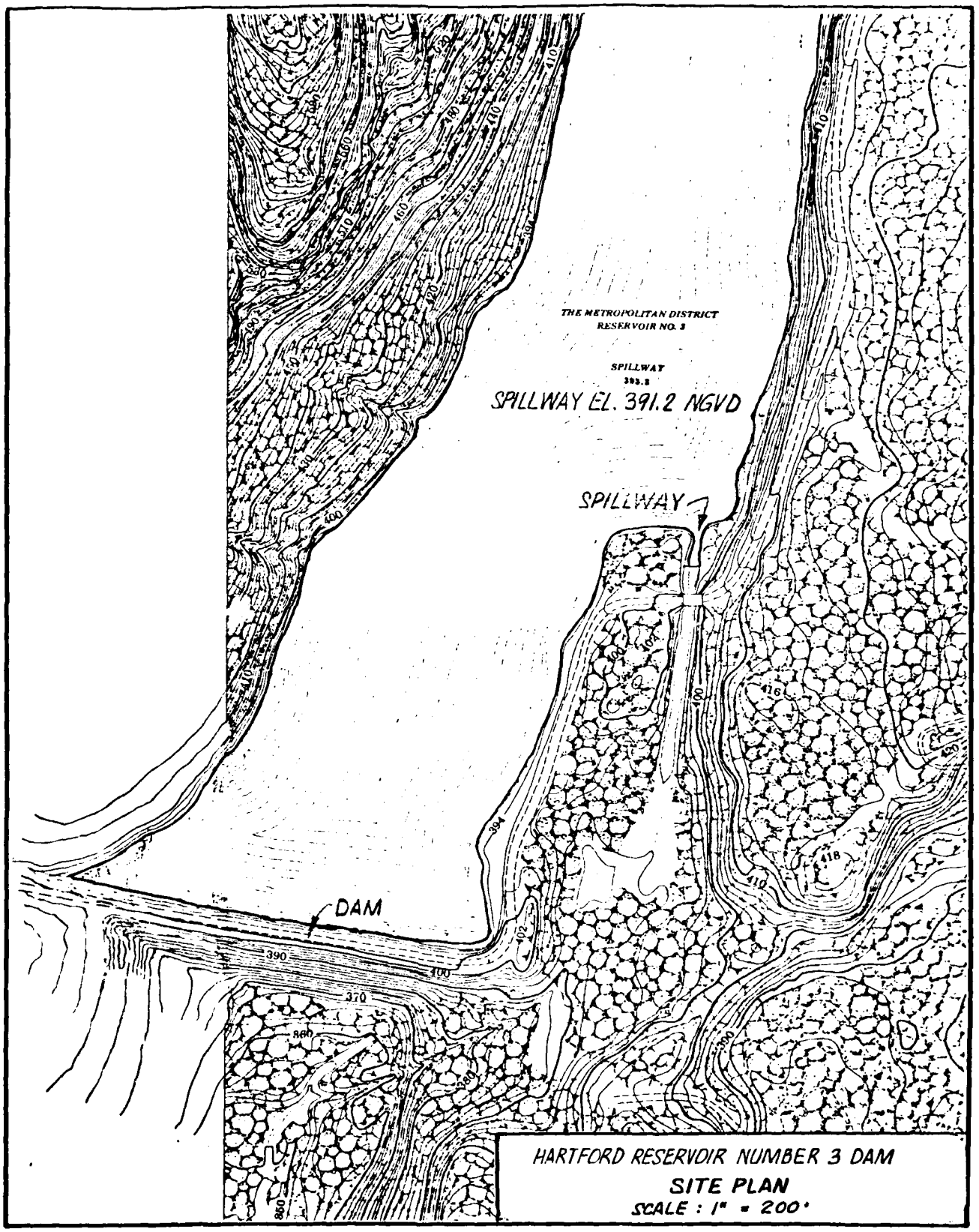
SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RESERVOIR NO. 3 DAM				

APPENDIX B

ENGINEERING DATA

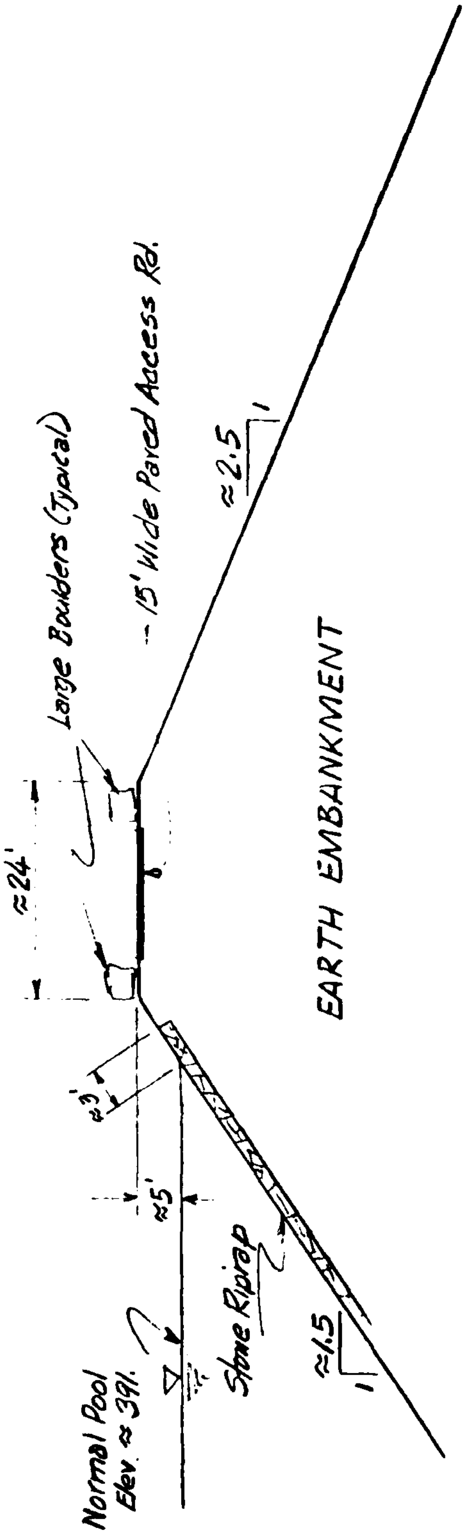
TABLE OF CONTENTS

NOTE: INFORMATION INCLUDED IN THIS APPENDIX WAS PROVIDED BY THE CITY OF HARTFORD METROPOLITAN DISTRICT. UNLESS OTHERWISE NOTED, ELEVATIONS REFER TO METROPOLITAN DISTRICT DATUM.


THE METROPOLITAN DISTRICT
RESERVOIR NO. 3
SPILLWAY
393.3
SPILLWAY EL. 391.2 NGVD
SPILLWAY
DAM
HARTFORD RESERVOIR NUMBER 3 DAM
SITE PLAN
SCALE : 1" = 200'

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RESERVOIR NO. 3 DAM	B-2			



TYPICAL SECTION OF THE DAM

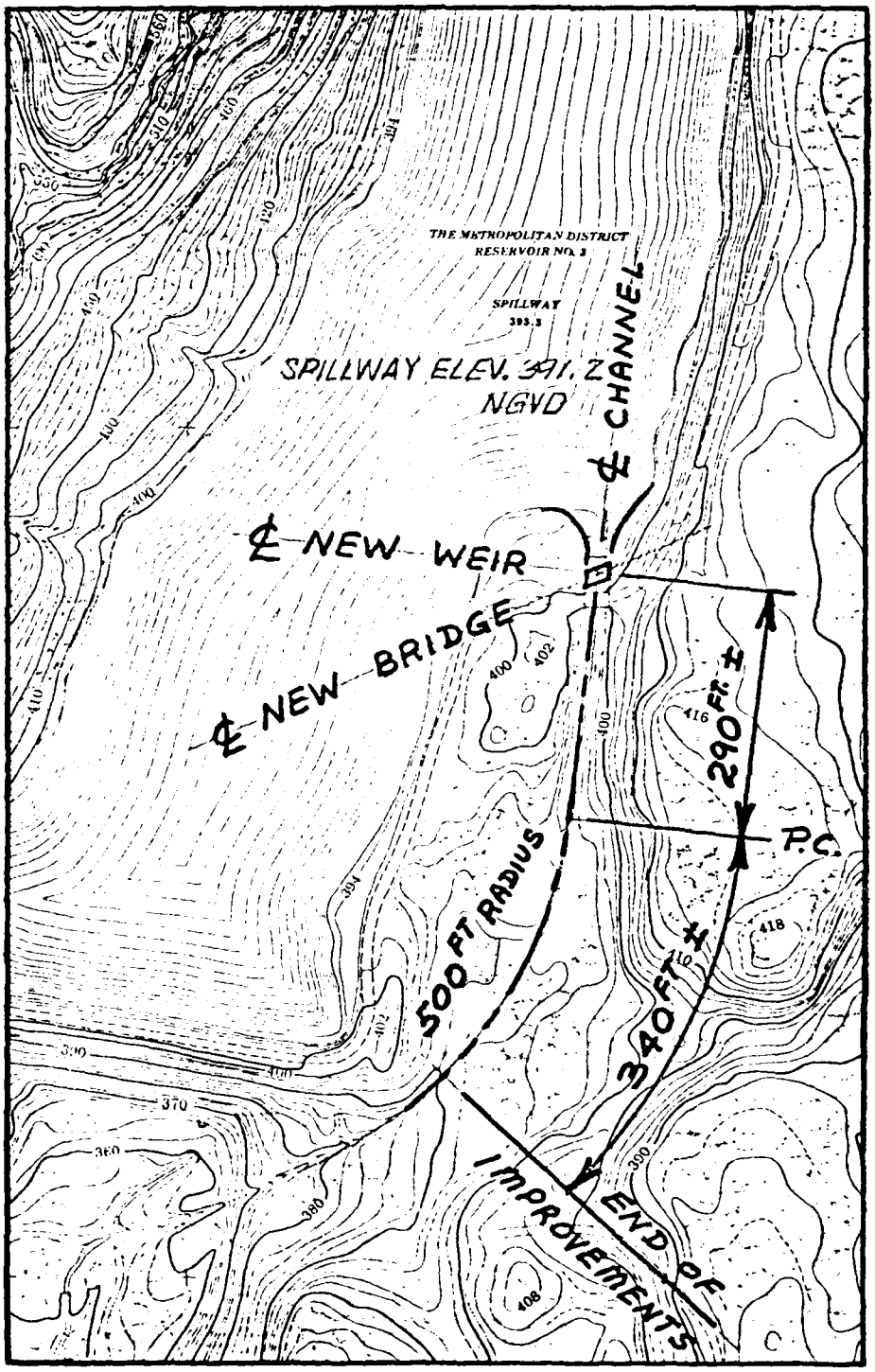
SCALE 1" = 20'

The Water Bureau of
The Metropolitan District
Engineering Office

Subject RESERVOIR NO. 3 SPILLWAY - SPILLWAY CHANNEL IMPROVEMENTS

File No.
Acc. No. H-4413.
Date Aug., 1975

Computer R. A. W. Checked by CAF



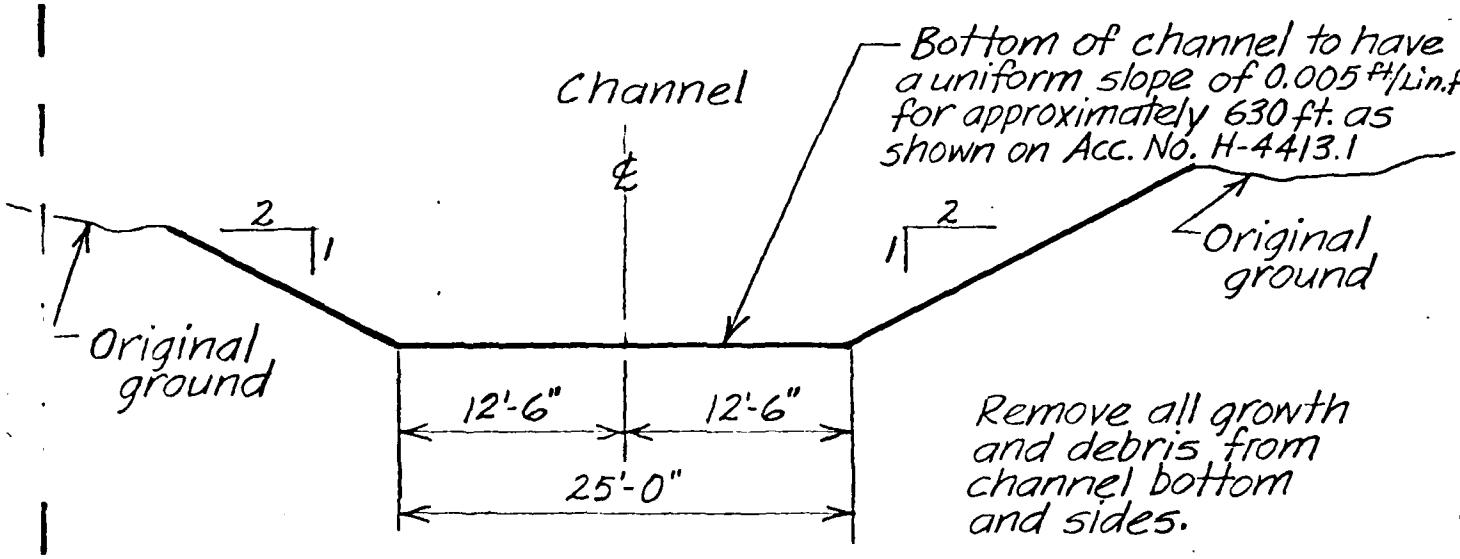
B-3

The Water Bureau of
The Metropolitan District
Engineering Office

Subject RESERVOIR NO.3 SPILLWAY-
SPILLWAY CHANNEL IMPROVEMENTS

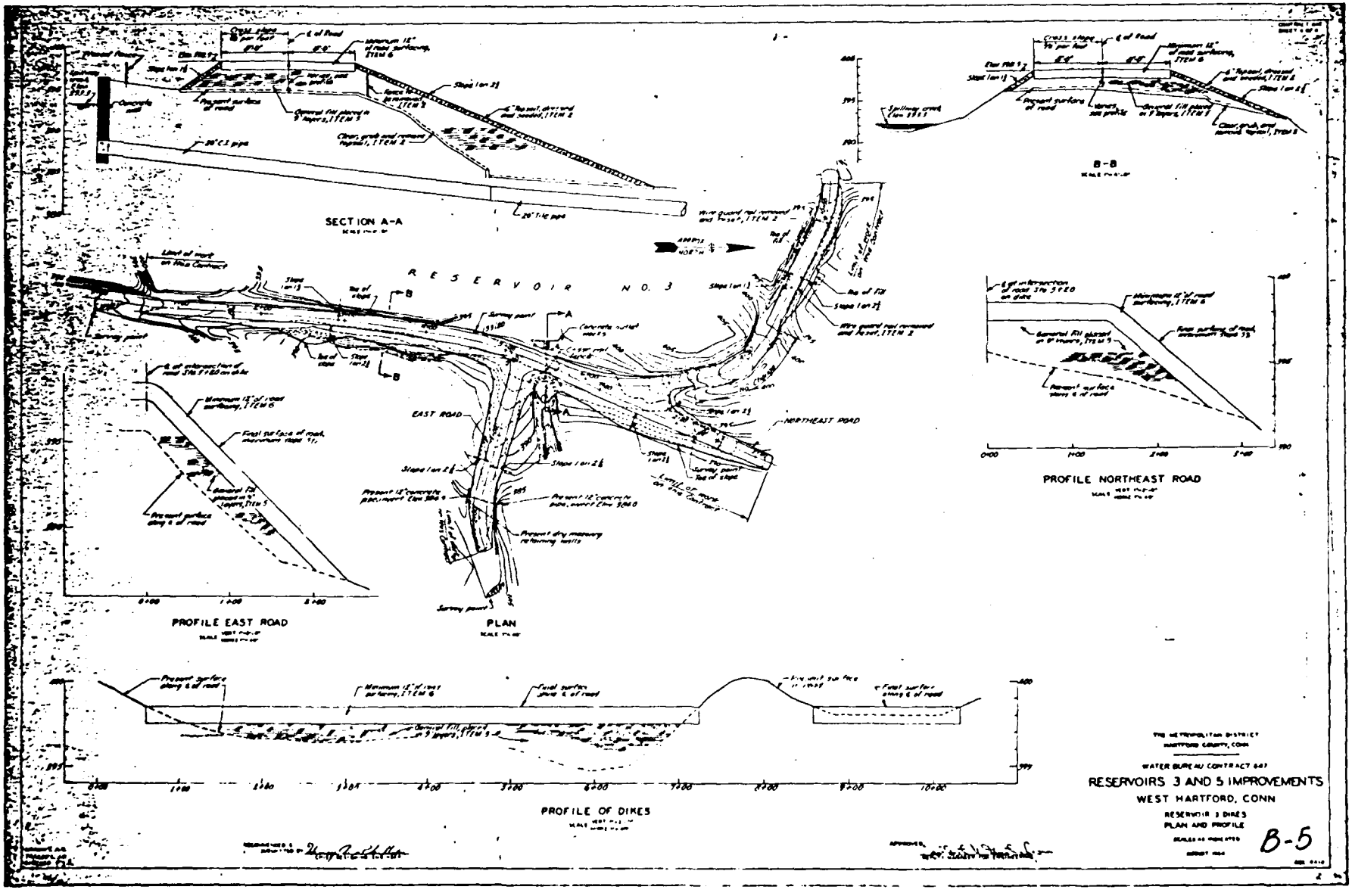
File No.
Acc. No: H-4413.2
Date Aug., 1975

Computer R.A.W. Checked by CAH



TYPICAL TRANSVERSE SECTION
Scale 1" = 10'-0"

Drawn by L.J.O.


SECTION A-A
B-B
RESERVOIR NO. 3
EAST ROAD
NORTHEAST ROAD
PROFILE EAST ROAD
PLAN
PROFILE NORTHEAST ROAD
PROFILE OF DIKES
THE METROPOLITAN DISTRICT
HARTFORD COUNTY, CONN.
WATER BUREAU CONTRACT 647
RESERVOIRS 3 AND 5 IMPROVEMENTS
WEST HARTFORD, CONN
RESERVOIR 3 DIKES
PLAN AND PROFILE
B-5

O'BRIEN & GERE ENGINEERS, INC

SUBJECT	SHEET	BY	DATE	JOB NO
NE DAM INSPECTIONS	1/2			2060.001

HARTFORD RESERVOIRS 1, 3 & 5

PERTINENT DATA

	HARTFORD RESERVOIR NO: 1	3	5
I. GENERAL:			
Main River	Trout Brook & S. Branch Park River		
Use	Power pond Waste Pool	Reserve Water Supply	Water Supply Balancing
When Built	1864 - 1867 Rebuilt 1868	1875	1884
Commences	Improved 1967	Improved 1964	Improved 19[illegible]
II. ELEVATIONS & DATUMS:			
USGS: Flow Line	256.5'	391.2'	319.7'
MDC: Flow Line	258.6'	393.3'	321.8'
Const: Flow Line	259.0'	393.7'	322.3'
Const: Bottom	225.0'	357.0'	303.0'
III. CAPACITY (MG):			
Available for Stored Use	13.2	96	68
Below Avail Level	5.5	50	15
IV. MISCELLANEOUS:			
Flow Line Area (Ac)	27	28	25
Maximum Depth (Ft)	34	36	19
Watershed Area (Sq. Mi.)	4.3	0.6	1.4

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
NE DAM INSPECTIONS	2/2			2060.001

HARTFORD RESERVOIRS 1, 3 & 5

PERTINENT DATA (Cont.)

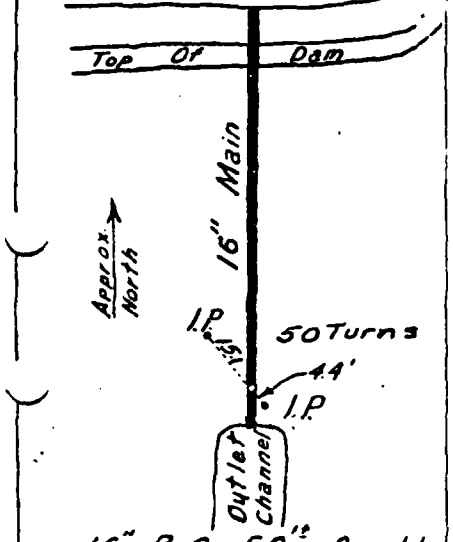
	HARTFORD RESERVOIR NO: 1	3	5
IV. MISCELLANEOUS (CONT.)			
Ave. Annual Rainfall	44.3" (61.4" Max. & 28.9 Min.)		
Ave. Annual Runoff	NA	1.9 Billion Gallons	
Design Fld. Runoff	1964 improvements: 18¼" in 34 hours		
V. SPILLWAY INFORMATION:			
Length (Feet)	45	23	62
Design Flow Head (Feet)	8.3*	3.9*	2.5
Design Flow (cfs)	4,000*	400*	700
Freeboard Above Crest (Feet)	8.8	5.2	5.2

* With Emergency Spillway.

From Water Bureau Gate Book F

#30/1

RESERVOIR NO. 3

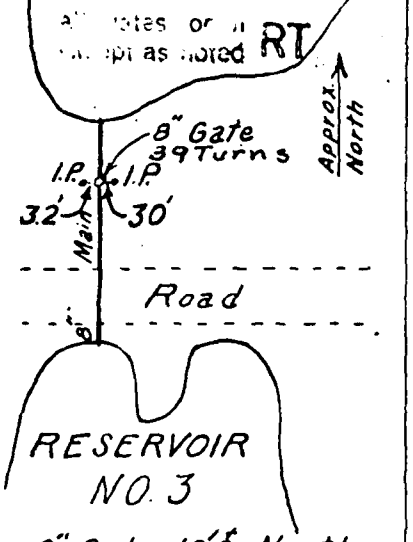


16" B.O. 50' South Of Top Of Dam

30

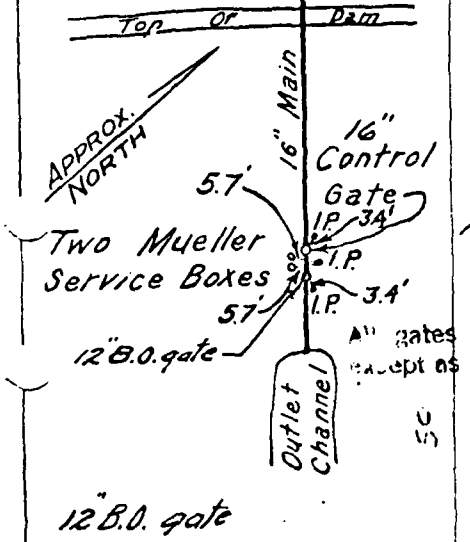
DYKE POND

All gates open except as noted RT



8" Gate 19' North of Road

RESERVOIR NO. 2

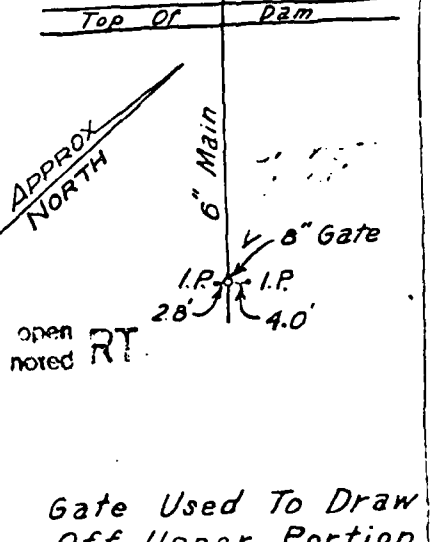


All gates open except as noted RT

12" B.O. gate

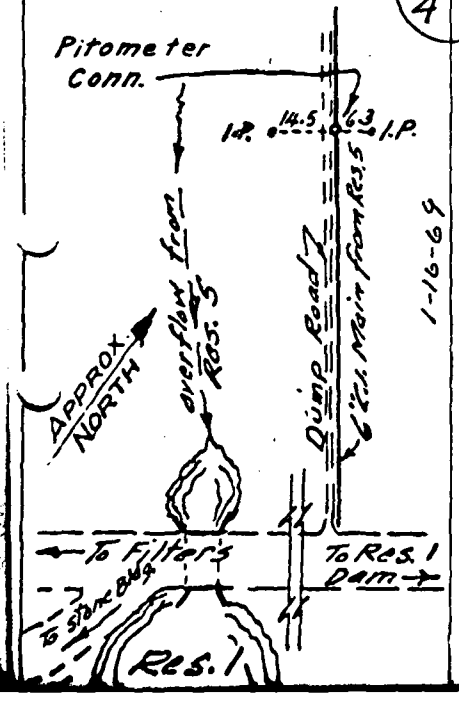
29

RESERVOIR NO. 2



Gate Used To Draw Off Upper Portion Of Reservoir

1 2
4 3

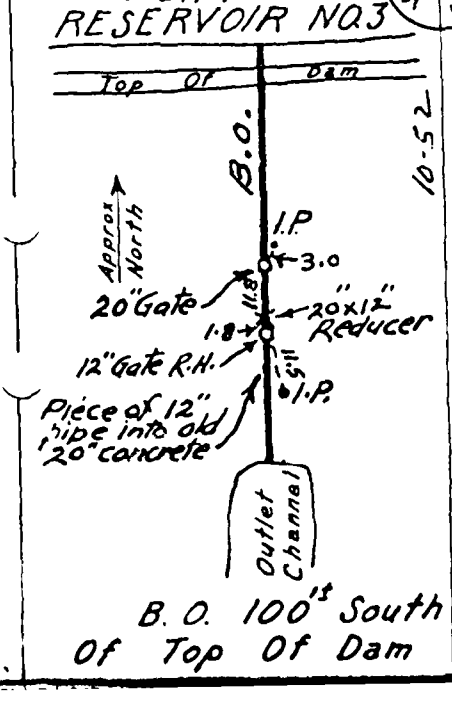


HARTFORD METROPOLITAN DISTRICT

RESERVOIR OUTLET SYSTEM INFORMATION

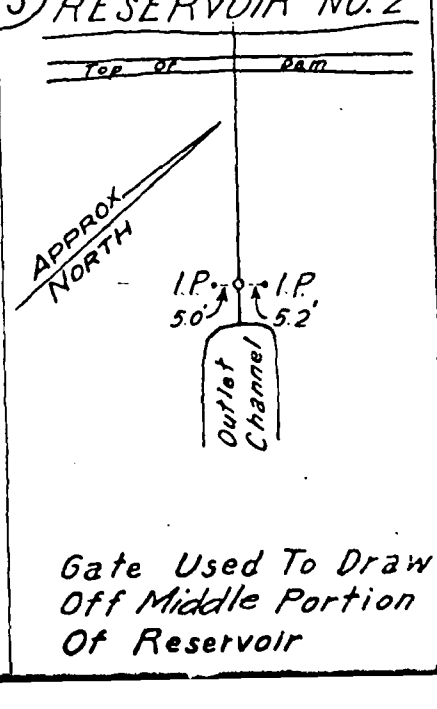
#29/1

RESERVOIR NO. 3



B. O. 100' South Of Top Of Dam

RESERVOIR NO. 2



Gate Used To Draw Off Middle Portion Of Reservoir

B-8

Form 5-E 7-1953

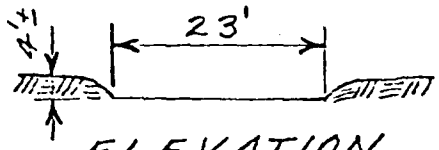
The Water Bureau of
The Metropolitan District
Office of the Manager

B-9

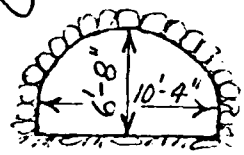
Subject WEST HARTFORD RESERVOIRS - Reservoir #3

File No.
Acc. No. H-2771.
Date June 195

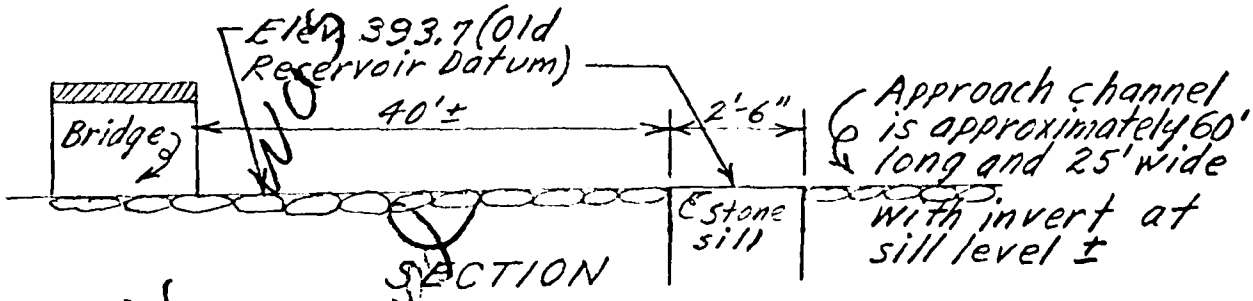
Computer T.E.M. Checked by



ELEVATION
1" = 20'



BRIDGE ELEV.
1" = 10'



SECTION
To Scale

WEIR

WEIR DETAILS

DAM DATA:

Present minimum freeboard is 2.2' at dike east of reservoir at northerly end and 3.0' on dam proper.
Maximum height of dam is 45'± (based on downstream toe)
Top width is 23'±
Downstream slope is 1 on 2±
Earth dam with "puddle" core down to rock

BLOW-OFF DATA (Based on approx. computation and reservoir at Elev. 393.7)

Invert Elev's from Acc H-2771.2

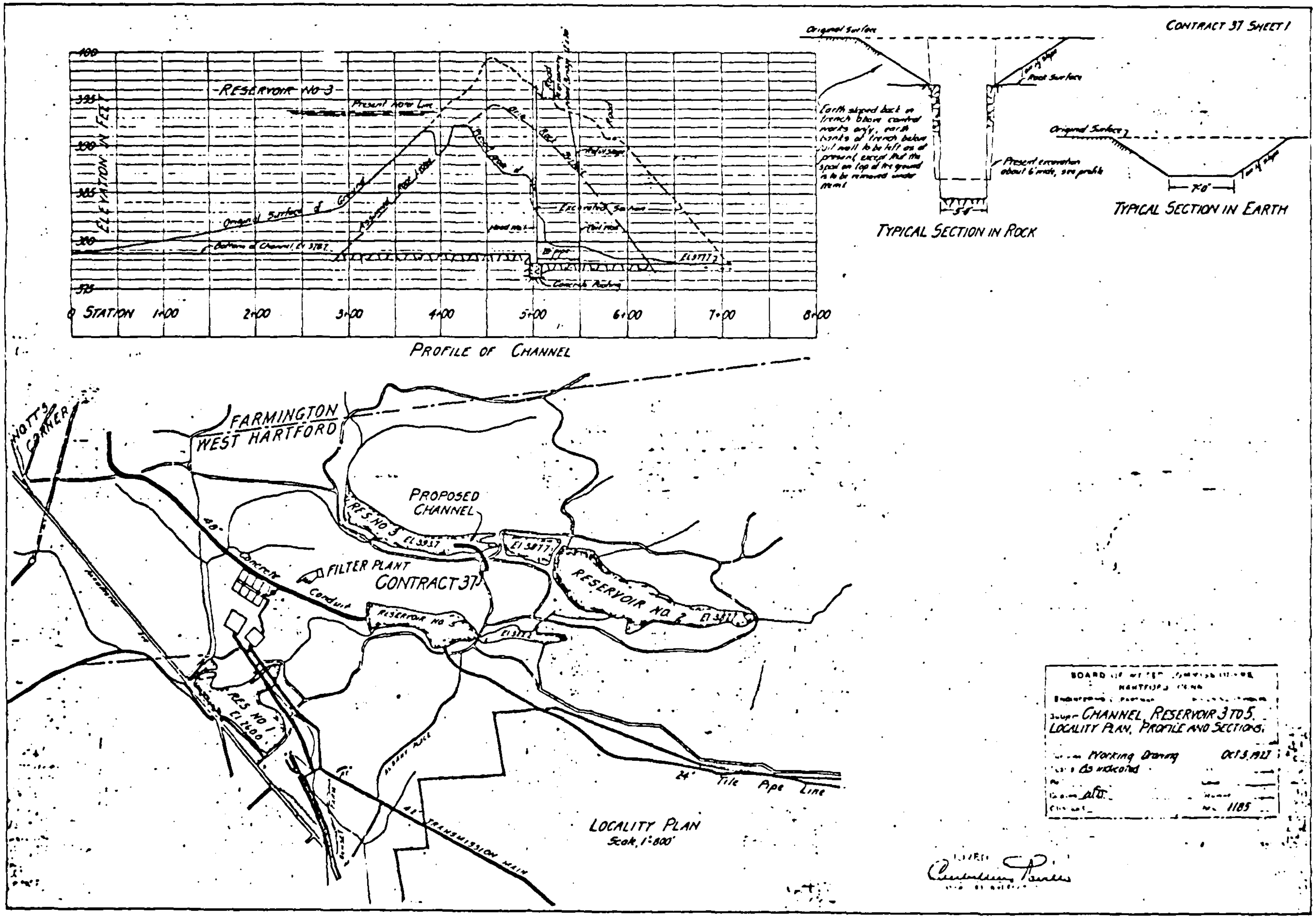
#29/4 - 20" Pipe will discharge 22±* c.f.s. (by Brock into Res. #1) 354.6'
#30/1 - 16" " " " 16±* c.f.s. (" " " " ") 382.5'
#40/2 - 20" " " " 31±* c.f.s. (" " " Res. #5) 378.±

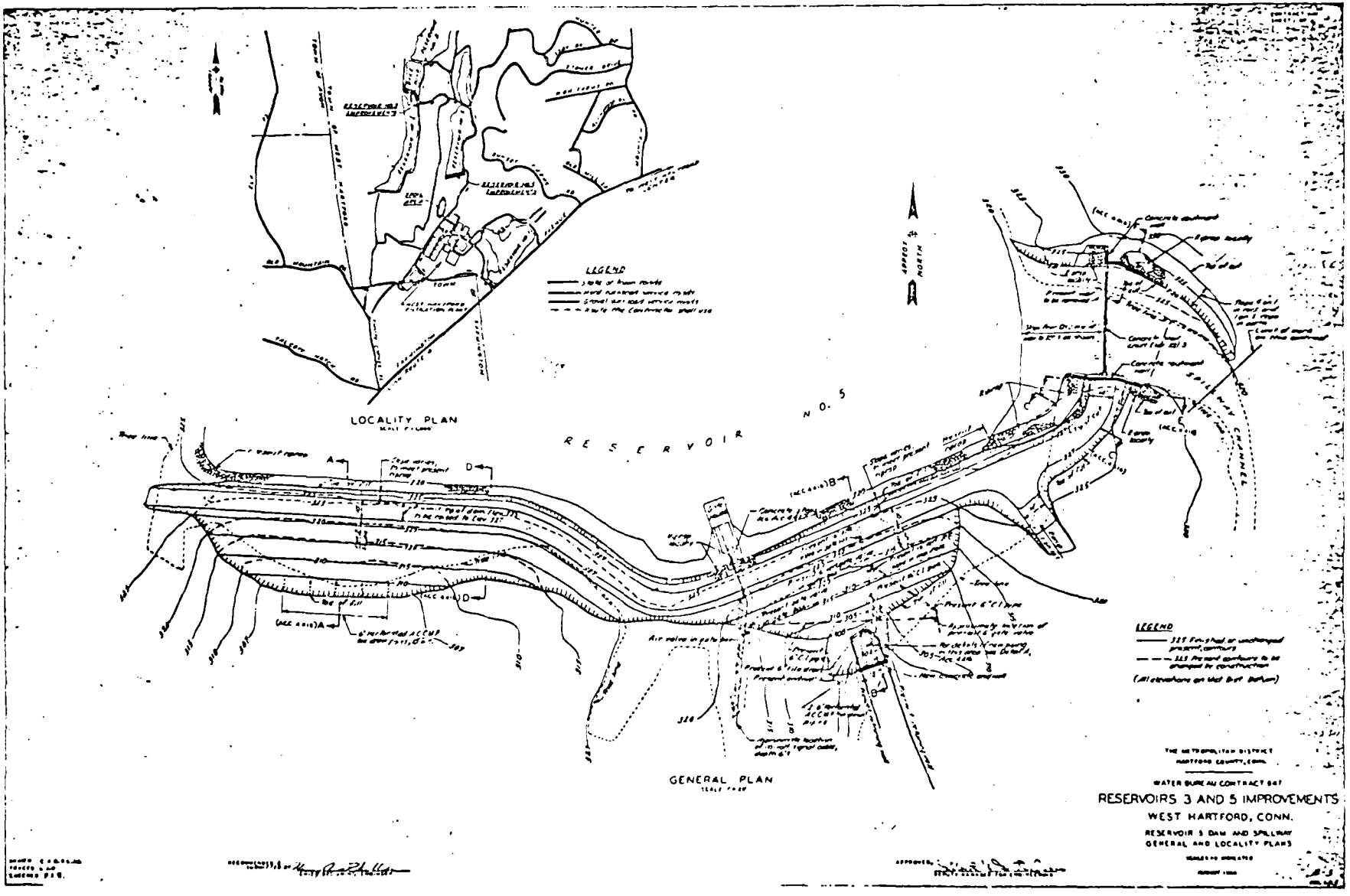
* Computations are noted very conservative.

SUBMITTED BY William Dorenbaum
Chief Designing Engineer

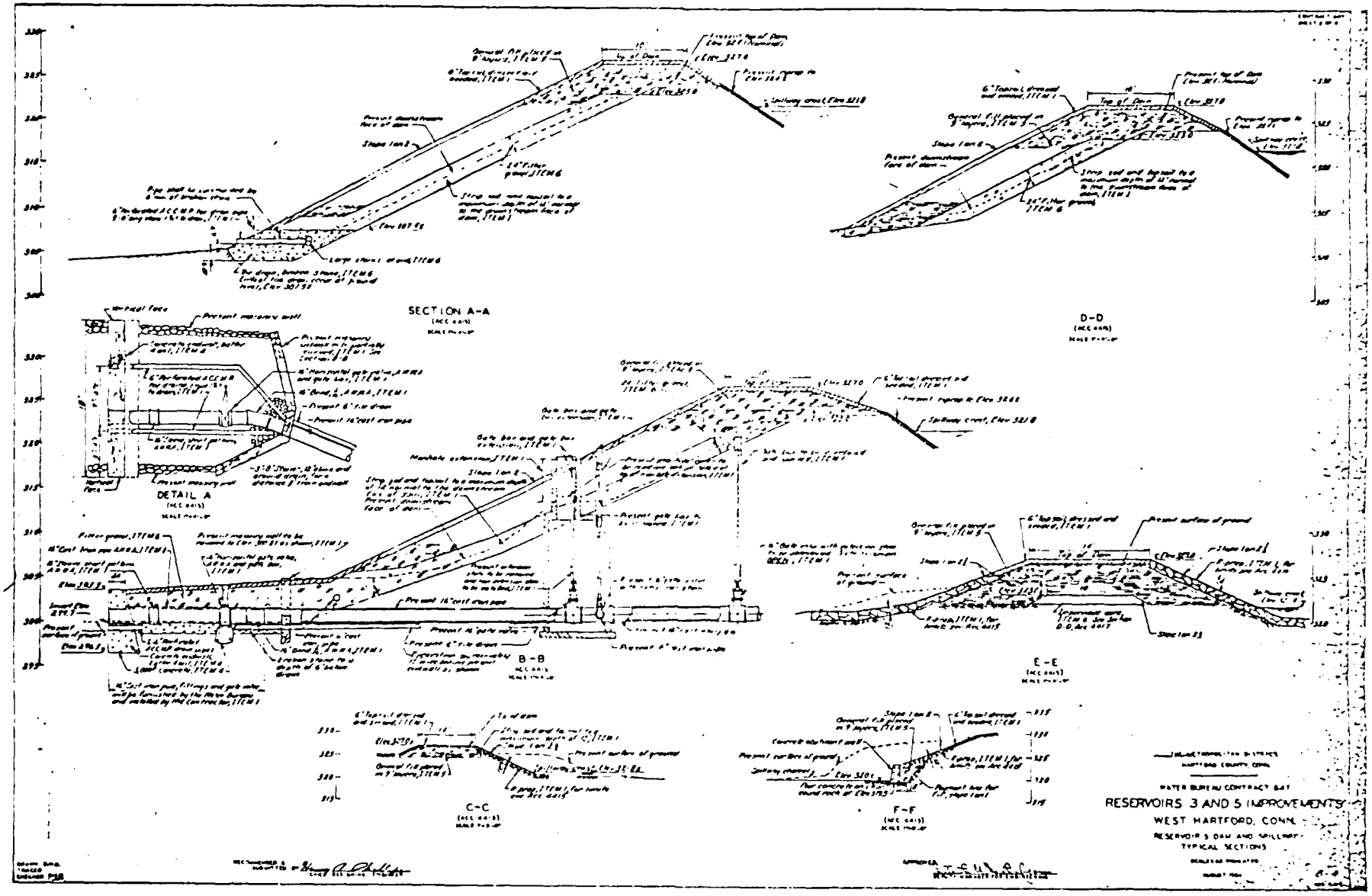
APPROVED
Walter A. Gentner
Deputy Manager and Chief Engineer

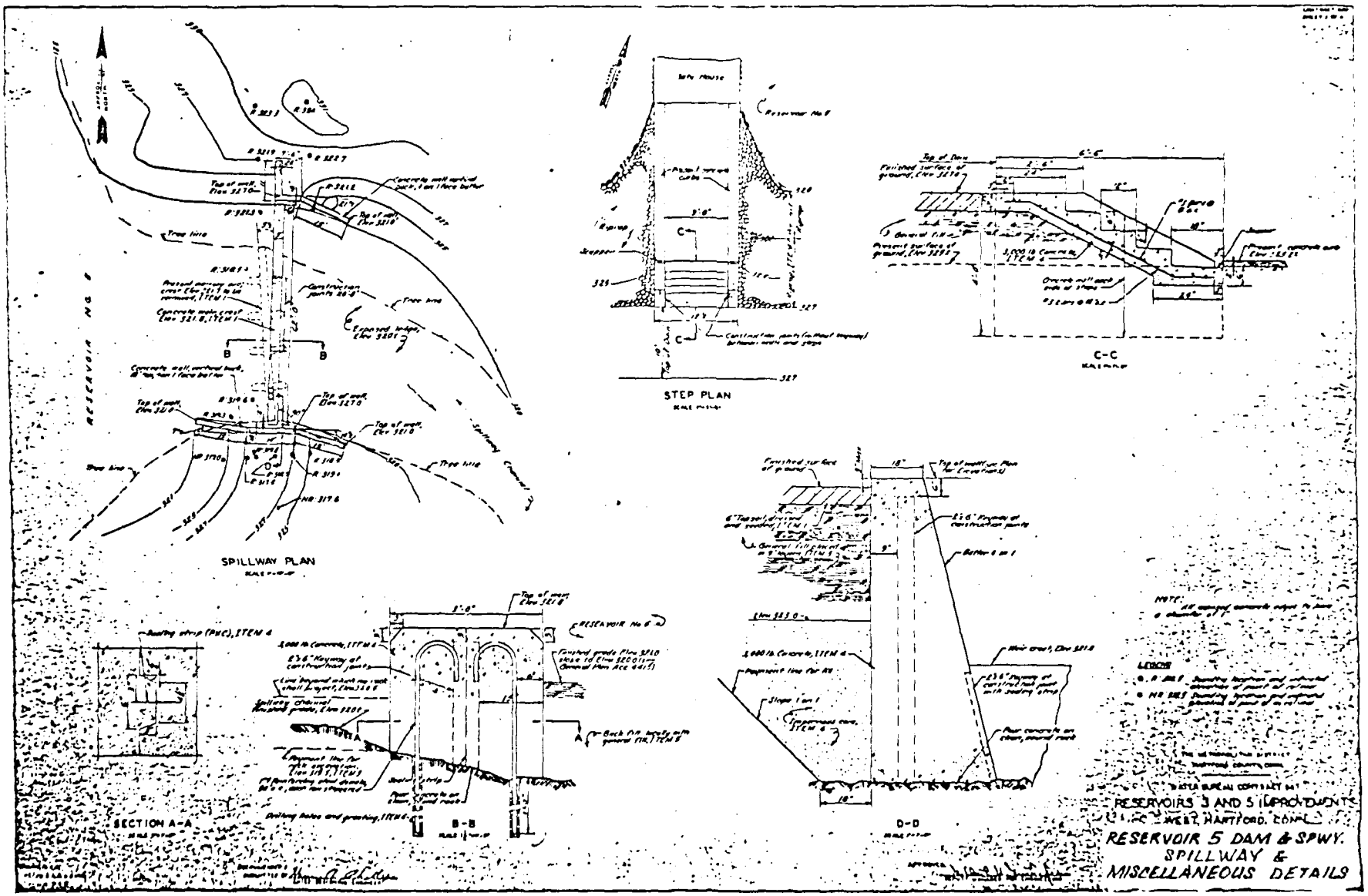
Joseph Merritt & Co.
1951 Albanene


CONTRACT 37 SHEET 1
RESERVOIR NO 3
Present Hole Line
ELEVATION IN FEET
Original Surface of Ground
Bottom of Channel
Excavated Surface
Concrete Footing
STATION 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00
PROFILE OF CHANNEL
Original Surface
Rock Surface
TYPICAL SECTION IN ROCK
Original Surface
7'0"
TYPICAL SECTION IN EARTH
NOTTS CORNER
FARMINGTON
WEST HARTFORD
PROPOSED CHANNEL
RES NO 3
FILTER PLANT
CONTRACT 37
Concrete Conduit
RESERVOIR NO 5
RESERVOIR NO 2
RES NO 1
24" Tile Pipe Line
48" TRANSMISSION MAIN
LOCALITY PLAN
Scale, 1"=800'
BOARD OF WATER COMMISSIONERS
HARTFORD, CONN.
CHANNEL, RESERVOIR 3 TO 5,
LOCALITY PLAN, PROFILE AND SECTIONS.
Working Drawing
As indicated
Oct 5, 1927
1185


LOCALITY PLAN
RESERVOIR NO. 5
GENERAL PLAN
LEGEND
THE METROPOLITAN DISTRICT
HARTFORD COUNTY, CONN.
WATER BUREAU CONTRACT 647
RESERVOIRS 3 AND 5 IMPROVEMENTS
WEST HARTFORD, CONN.
RESERVOIR 5 DAM AND SPILLWAY
GENERAL AND LOCALITY PLANS

B-11


SECTION A-A
D-D
DETAIL A
B-B
E-E
C-C
F-F
WATER BUREAU CONTRACT 647
RESERVOIRS 3 AND 5 IMPROVEMENTS
WEST HARTFORD, CONN.
RESERVOIR 5 DAM AND SPILLWAY
TYPICAL SECTIONS

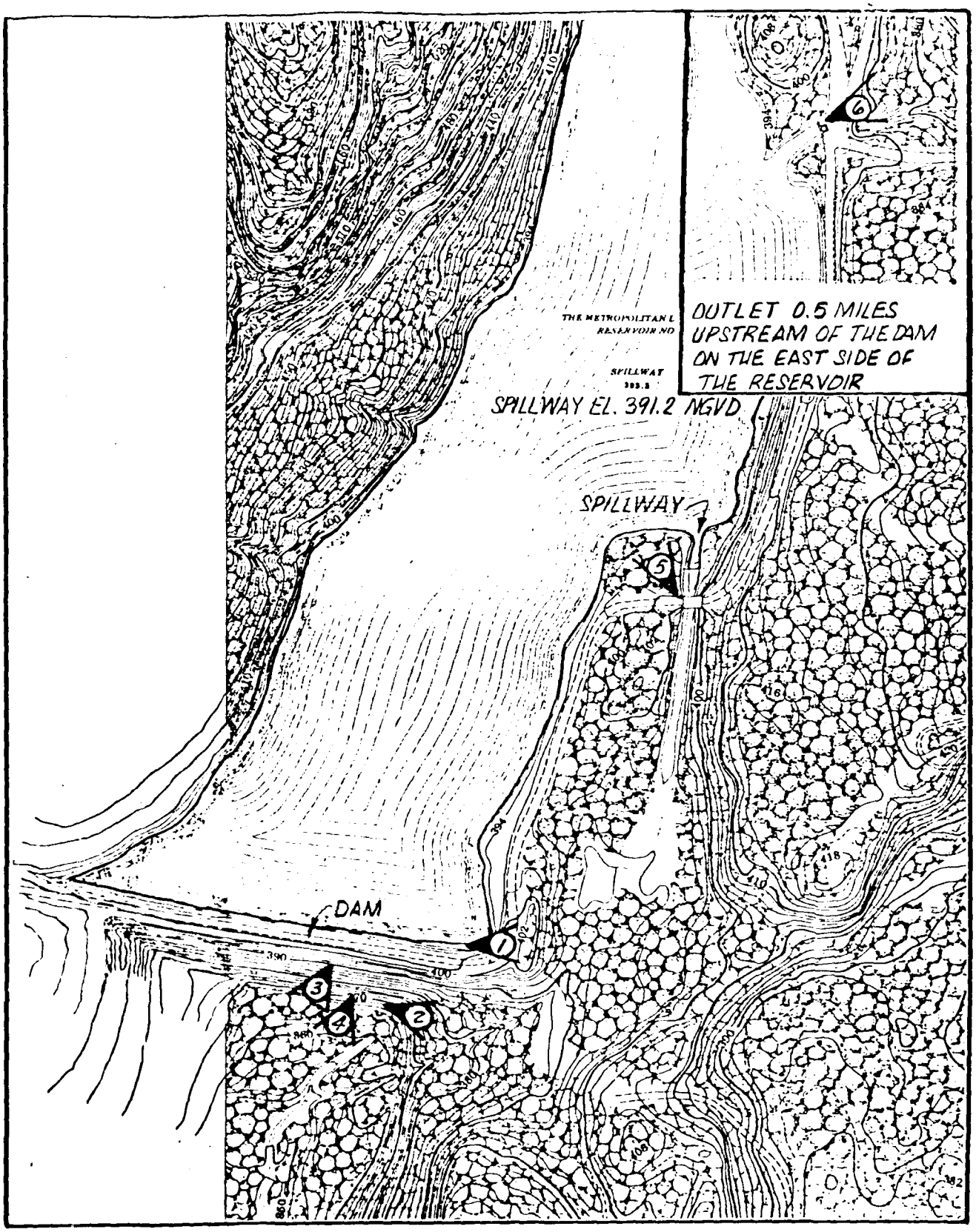

SPILLWAY PLAN
STEP PLAN
C-C
SECTION A-A
B-B
D-D
RESERVOIR 5 DAM & SPWY.
SPILLWAY &
MISCELLANEOUS DETAILS

B-13

APPENDIX C

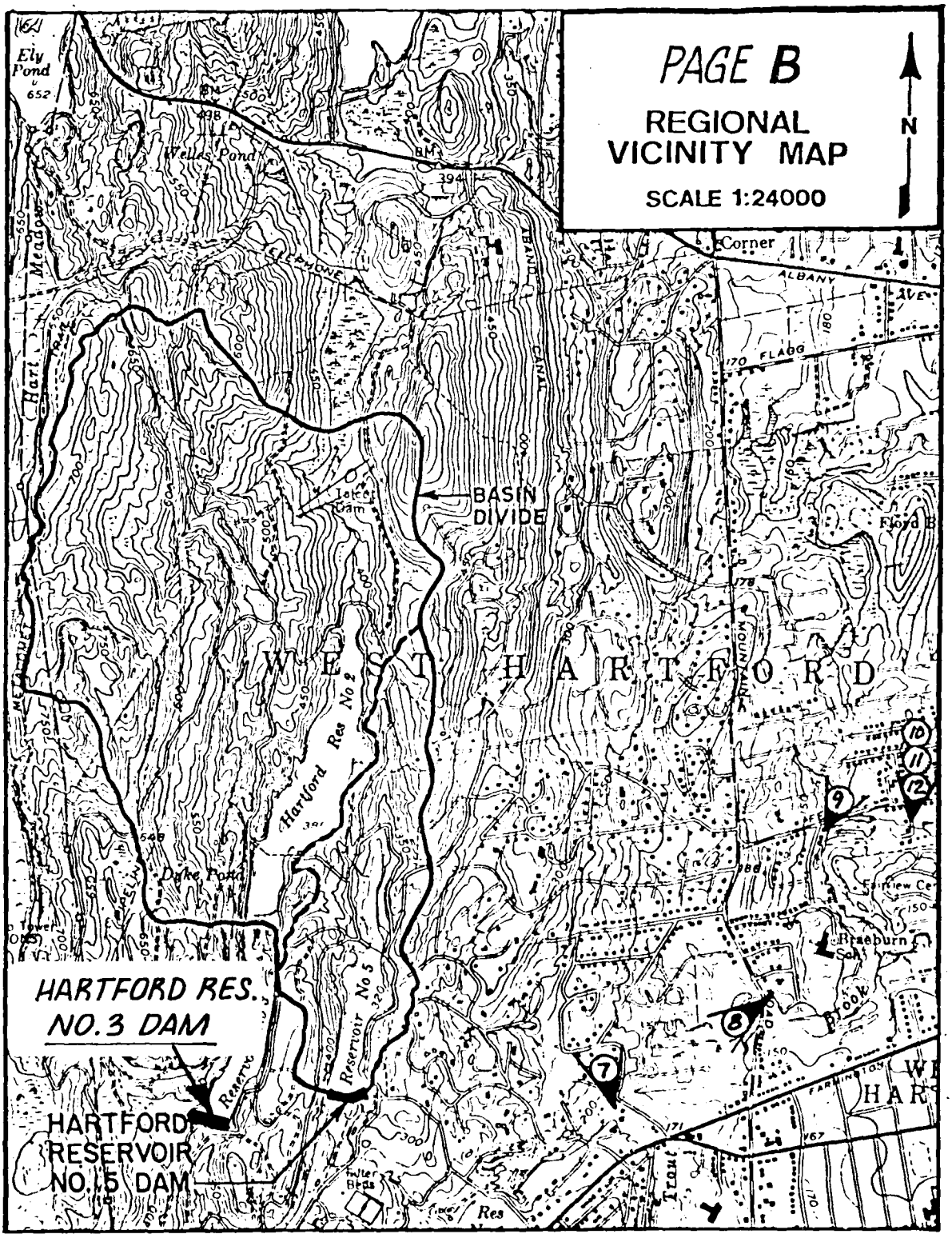
PHOTOGRAPHS

APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT

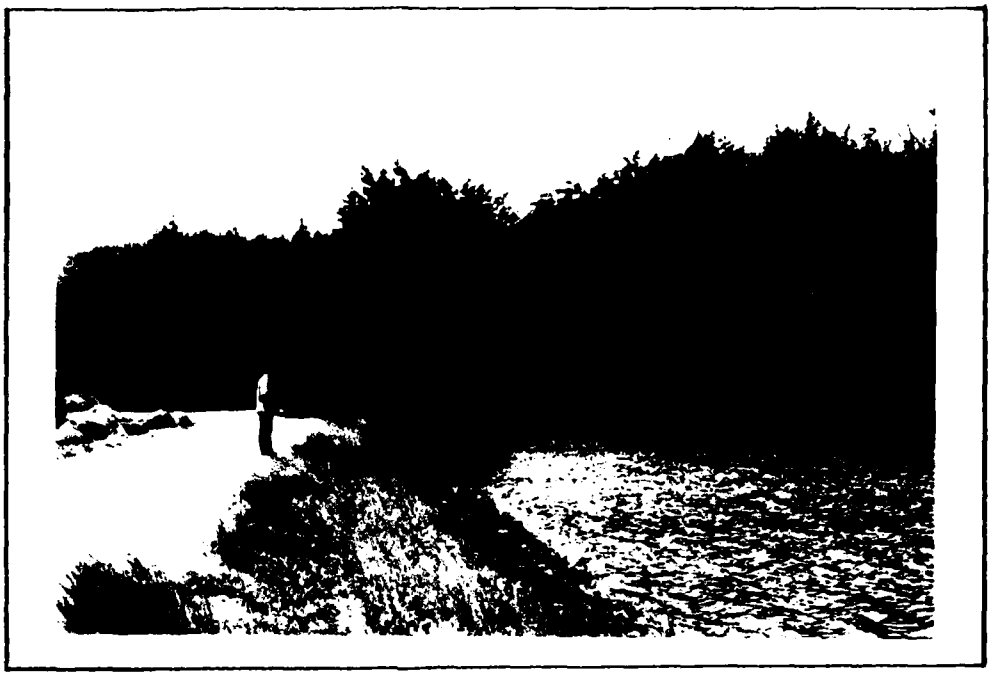


LEGEND (1) THE LOCATION AND DIRECTION IN WHICH PHOTO WAS TAKEN AND THE NUMBER OF THE PHOTO

PG. A



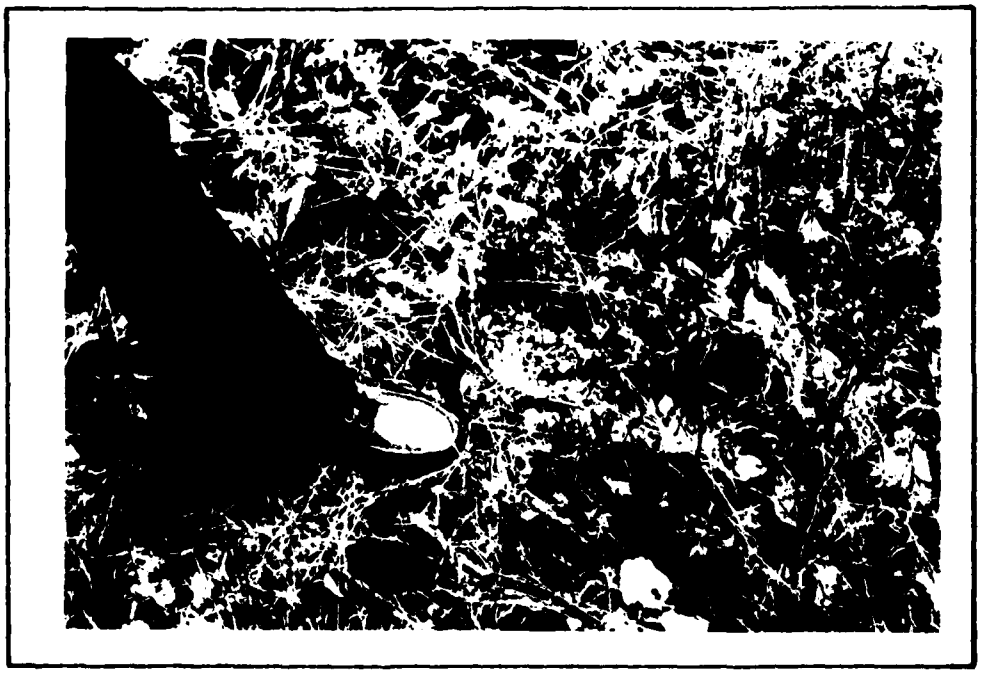
LEGEND (7) THE LOCATION AND DIRECTION IN WHICH EACH PHOTO WAS TAKEN AND THE NUMBER OF THE PHOTO



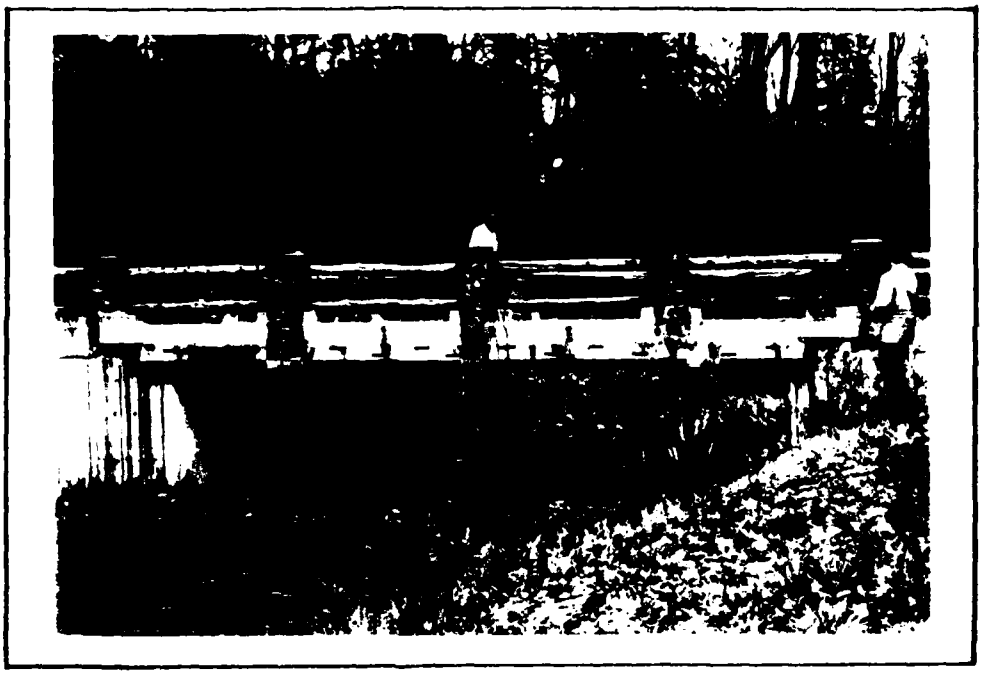
1. TREES AND VEGETATIVE COVER ON THE UPSTREAM FACE OF DAM. (11/13/79)

2. SLOUGHING ALONG DOWNSTREAM FACE OF THE DAM. (11/13/79)

3. TYPICAL RODENT HOLE IN THE DOWNSTREAM FACE OF THE DAM. (11/13/79)



4. SEEPAGE AT THE DOWNSTREAM TOE OF THE DAM. (11/13/79)

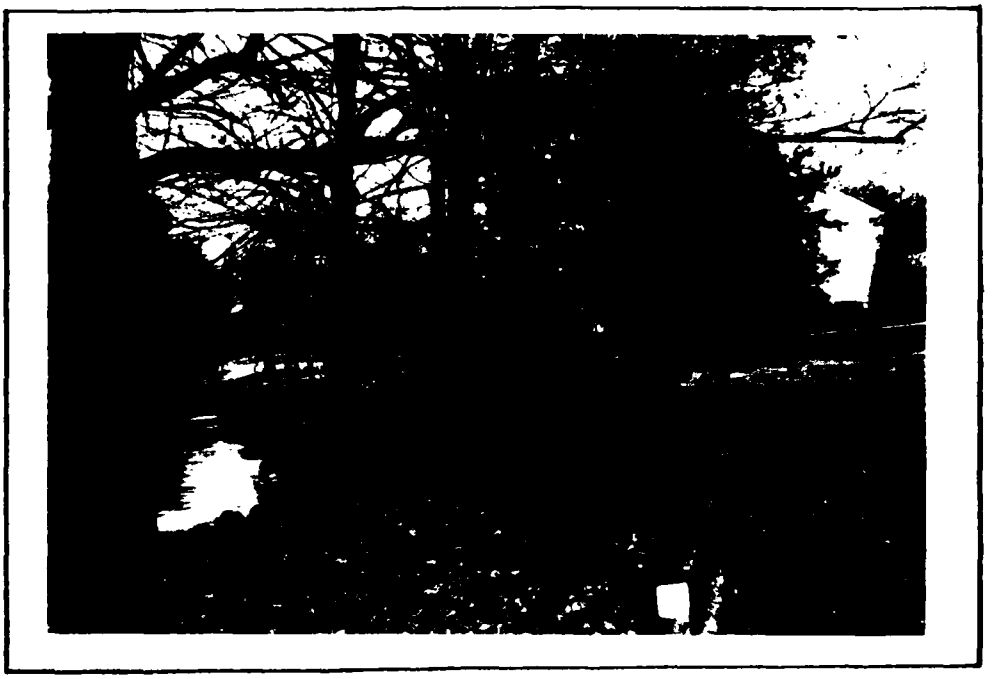


5. BRIDGE OVER SPILLWAY FOR RESERVOIR 3.
(11/13/79)

6. ENCLOSURE FOR GATE SYSTEM WHICH CONTROLS DIVERSION DISCHARGE TO RESERVOIR 5.
(11/13/79)

7. POTENTIAL DAMAGE AREA ABOUT 2 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

8. POTENTIAL DAMAGE AREA ABOUT 2.5 MILES DOWNSTREAM FROM THE DAM. (11/13/79)



9. POTENTIAL DAMAGE AREA ABOUT 3.4 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

10. POTENTIAL DAMAGE AREA ABOUT 3.6 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

11. POTENTIAL DAMAGE AREA ABOUT 3.6 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

12. POTENTIAL DAMAGE AREA ABOUT 3.6 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RESERVOIR NO. 3 DAM				

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

TABLE OF CONTENTS

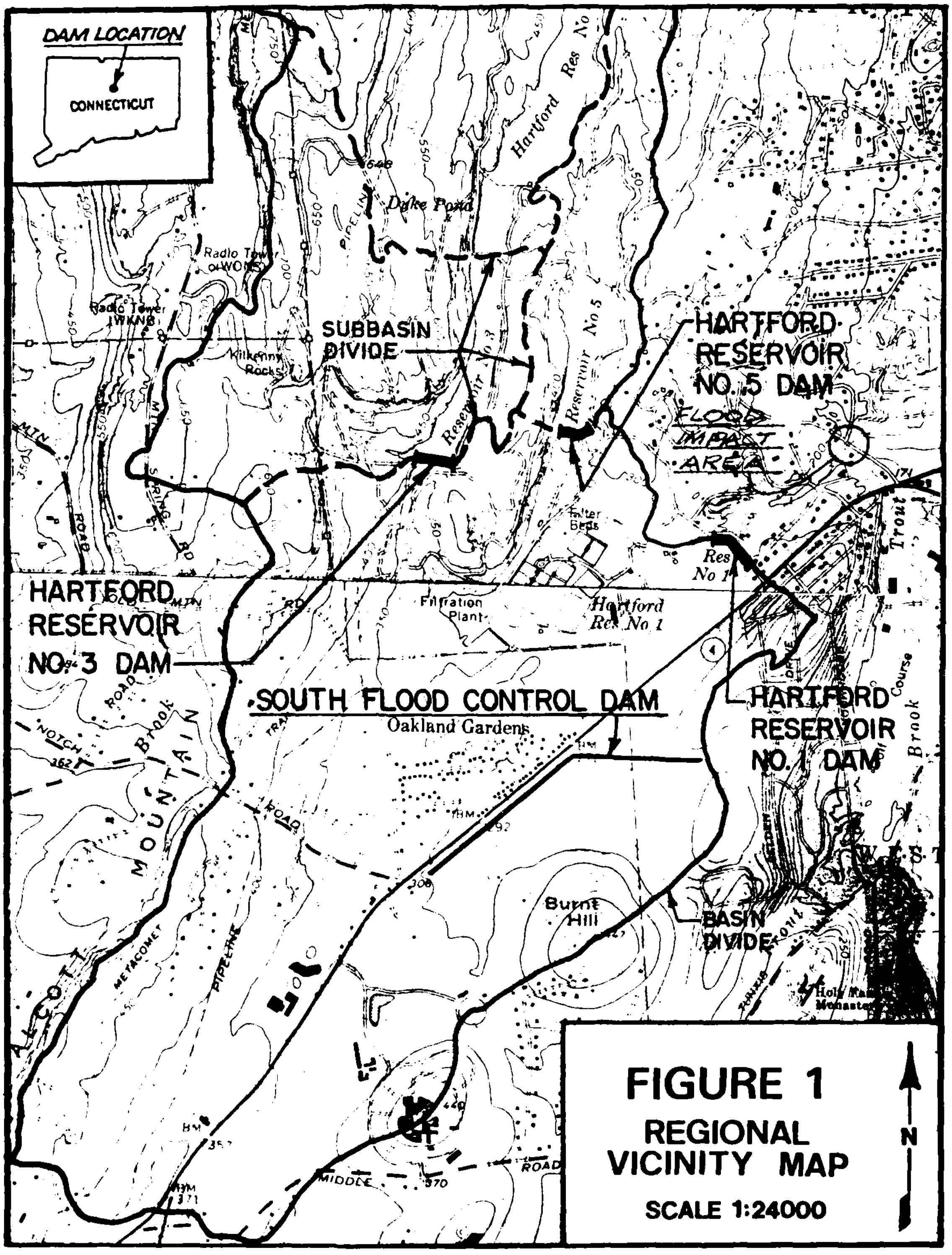


FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24000

N

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

JOB 2060-001
SHEET NO D-2 OF D-22
CALCULATED BY E.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE

HARTFORD RESERVOIR DAM # 3 H&H

SUB-BASIN DRAINAGE AREA = 0.58 Sq.Mi

TOTAL WATERSHED = 3.89 SQUARE MILES

SNYDER HYDROGRAPH COEFFICIENTS

$C_t = 2.0$ $C_p = 0.5$

T_p COMPUTATIONS

$L = 1.21$ Mi. $L_{ca} = 0.40$ Mi.

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

$$T_p = 2 \times (1.21 \times 0.40)^{.3} \simeq 1.60 \text{ HOURS}$$

PMP DATA

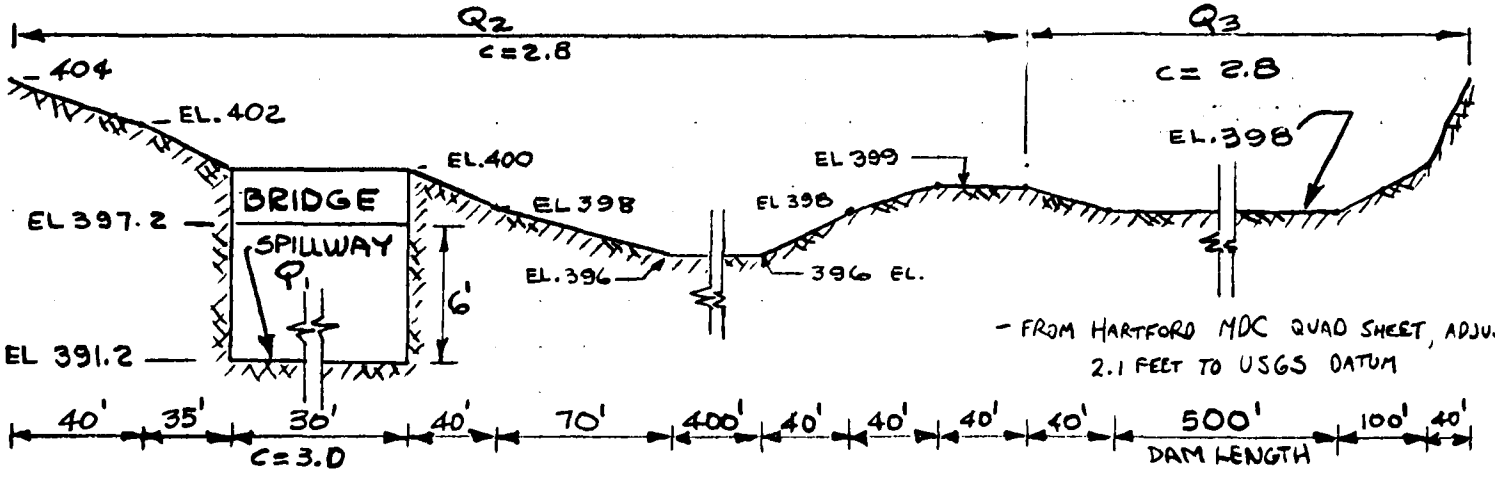
FROM HMS # 33 THE 24 HOUR 200 Sq.Mi. INDEX RAINFALL IS 21.5

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

STAGE STORAGE

	ELEV. (NGVD)	AREA (AC.)	STORAGE (Ac.Ft.) (COMPUTED BY HEC-1 PROGRAM)
	355	0	0
NORMAL POOL -	391.2	28	338
	400	40	636

HARTFORD RESERVOIR DAM # 3 H&H



STAGE DISCHARGE

$Q = CLH^{1.5}$ FOR DAM AND SURROUNDING AREAS; $Q_1 = CLH^{1.5}$ FOR $0 < H \leq 6$; $Q_1 = .65 \times 180\sqrt{2g}(H-3)^{1/2}$ FOR $H > 6$

N=0 @ CORRESPONDING CREST

ELEVATION NGVD	H FT.	Q_1 CFS.	H Ft.	Q_2 CFS.		Q_3 CFS.	EQ CFS
391.2	0	0					0
393.2	2	255					255
395.2	4	720					720
396.0	4.8	946	0	0			946
397.2	6.0	1,323	1.2	1,508			2,831
398.0	6.8	1,596	2.0	3,294	0	0	4,890
399.0	7.8	1,961	3.0	6,200	1	1,526	9,687
400.0	8.8	2,349	4.0	9,778	2	4,356	16,483
402.0	10.8	2,622	6.0	18,848	4	12,320	33,790
404.0	12.8	2,939	8.0	30,428	6	22,633	56,000

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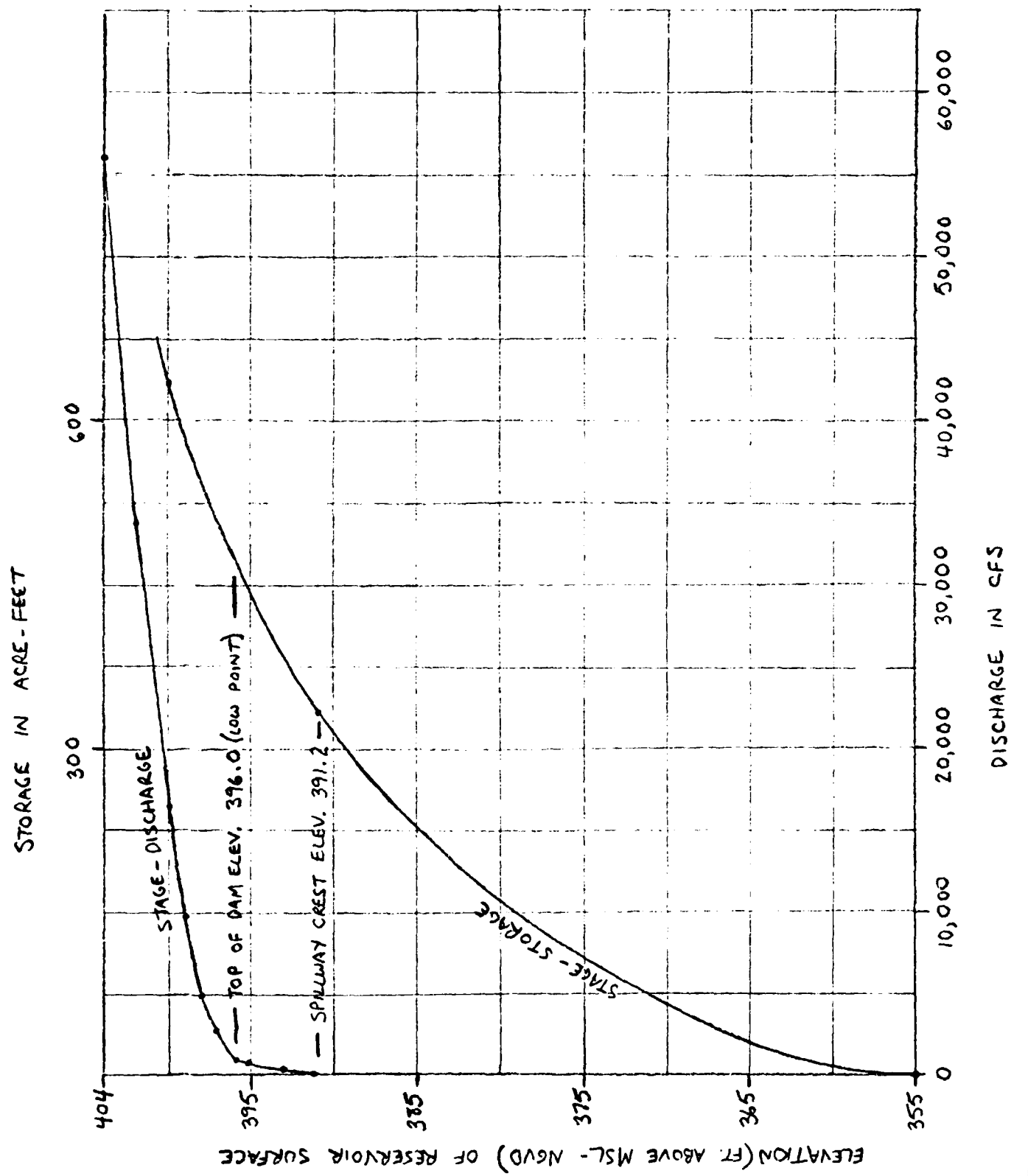
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB 2060.001
SHEET NO D-3 OF D-22
CALCULATED BY E.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
STAGE - STORAGE & STAGE - DISCHARGE CURVES	D-4	RRB	2/80	2060-001



O'BRIEN & GERE ENGINEERS, INC.

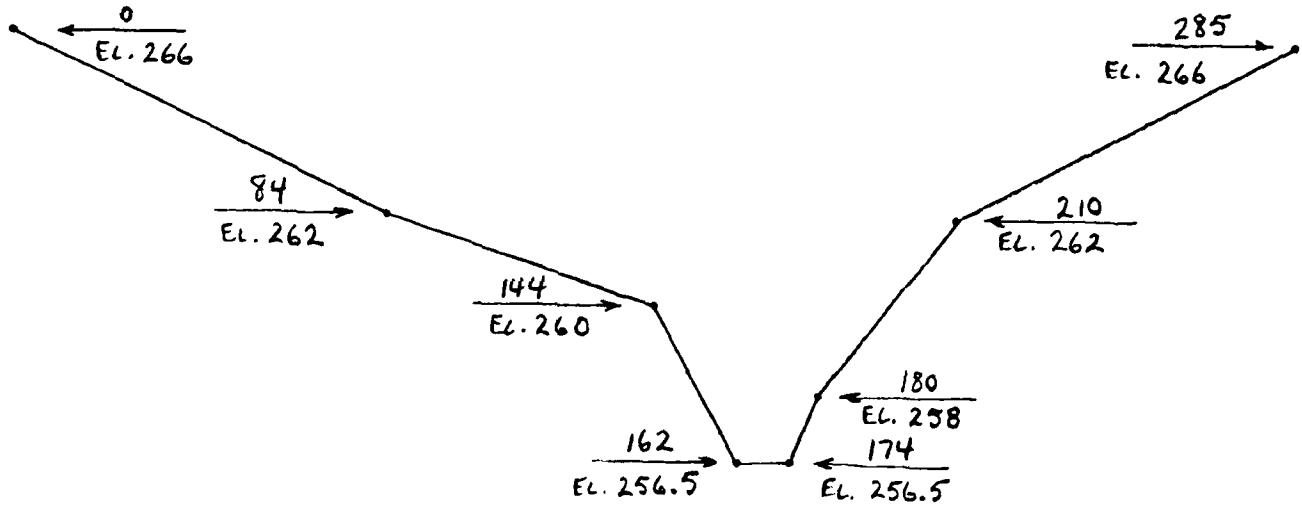
SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RESERVOIR DAM # 3	D-5	RRB	3/80	2060-001

DOWNSTREAM CROSS-SECTIONS FOR BREACHED OUTFLOW

1) CHANNEL CROSS-SECTION AT RESERVOIR # 1 (ROUTED FROM RESERVOIR # 3):

CHANNEL LENGTH = 6,000'
SLOPE = .025 FT/FT.

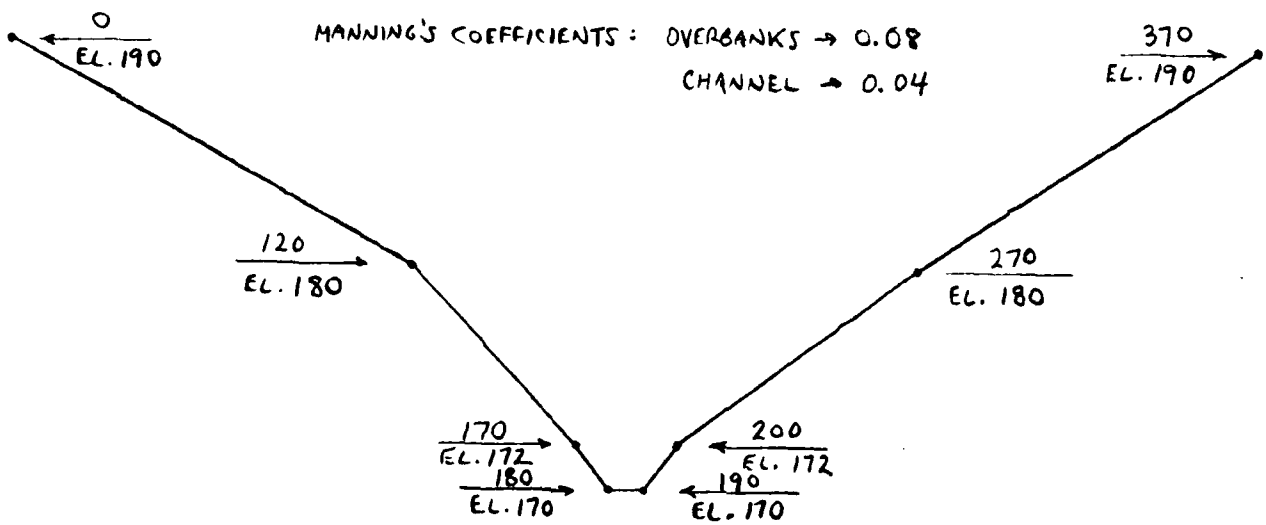
MANNING'S VALUES → OVERBANKS : 0.08
CHANNEL : 0.04



2) CHANNEL CROSS-SECTION AT HAZARD AREA DOWNSTREAM OF DAM # 1:

CHANNEL LENGTH : 2,000' INITIAL HAZARD AREA
SLOPE = 0.025

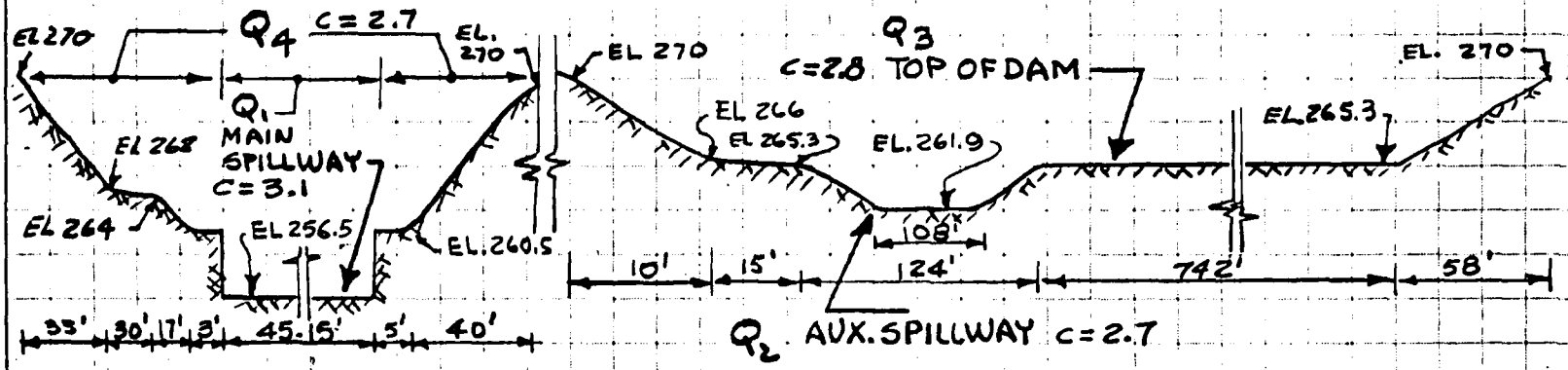
MANNING'S COEFFICIENTS : OVERBANKS → 0.08
CHANNEL → 0.04



INFORMATION FOR DOWNSTREAM BREACH ROUTING THROUGH HARTFORD RESERVOIR # 1

HARTFORD RESERVOIR DAM #1 H&H

TOP OF DAM & SPILLWAYS ELEVATION. H=0 @ CORRESPONDING CREST



STAGE DISCHARGE

$Q = CLH^{1.5}$

ELEVATION NGVD	H Ft.	Q_1 CFS	H	Q_2 CFS	H	Q_3 CFS	H	Q_4 CFS	E.Q CFS
256.5	0	0							0
257.5	1	140							140
258.5	2	396							396
259.5	3	727							727
260.5	4	1,120					0	0	1,120
261.9	5.4	1,756	0	0			1.4	48	1,804
265.3	8.8	3,654	3.4	1,871	0	0	4.8	604	6,129
266.0	9.5	4,098	4.1	2,490	0.7	1,236	5.5	702	8,526
268.0	11.5	5,458	6.1	4,595	2.7		7.5	11,375	20,832
270.0	13.5	6,942	8.1	7,149	4.7		9.5	12,330	38,018

STAGE - STORAGE DATA	ELEV. (NGVD)	225	256.5	260	270
	AREA (ACRES)	0	27	35	68
	STORAGE (A-FT. - COMP. BY HEC-1 PROGRAM)	0	284	392	898

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

JOB 2060-001
SHEET NO D-6 OF D-22
CALCULATED BY E.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 197H
LAST MODIFICATION 26 FEB 79

HARTFORD RESERVOIR #3 DAM FLOOD ROUTINGS
WITHOUT BREACH

INPUT

```
     1 A1   HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR NO. 3
     2 A2   NATIONAL DAM INSPECTION PROGRAM
     3 A3   NEW ENGLAND DIVISION - CORPS OF ENGINEERS
     4 H    300       0       15        0        0        0        0        0       -4        0
     5 H1   5
     6 J    1         4        1
     7 J1   .2       .3       .4       .5       .6       .7       .8       .9      1.0
     8 K    0    HAD-3                                              1
     9 A1       INFLOW TO HARTFORD NO 3
    10 M    1         1     0.56                3.89                                    1
    11 P    0      21.5      111      124      133
    12 T                                                            0     0.05
    13 H    1.60    0.5
    14 K   -1.7    -0.1        2
    15 K    1    HAD-3                                              1
    16 A1      ROUTED OUTFLOW FROM HARTFORD RESERVOIR NO 3
    17 Y                                    1        1
    18 Y1   1                                                   -391.2      -1
    19 Y4 391.2    393.2    395.2    396.0    397.2    398.0    399.0    400.0    402.0    404.0
    20 Y5   0      255      720      946     2831     4890     9687    16483    33790    56000
    21 X8   0       28       40
    22 XE   355    391.2     400
    23 XS 391.2
    24 X0 398.0
    25 K   99
```

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

RUN  DATED 02/25/80.
     TIMED 10.44.25.

                    HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR NO. 3
                          NATIONAL DAM INSPECTION PROGRAM
                     NEW ENGLAND DIVISION - CORPS OF ENGINEERS

                                 JOB SPECIFICATION
          NQ     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

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

INFLOW HYDROGRAPH
  DEVELOPMENT                     SUB-AREA RUNOFF COMPUTATION

                 INFLOW TO HARTFORD NO 3

                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                   HAD-3       0       0       0       0       0       1       0       0

                                   HYDROGRAPH DATA
          IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1      1     .58    0.00    3.89    0.00   0.000       0       1       0

                                    PRECIP DATA
                SPFE     PMS      R6     R12     R24     R48     R72     R96
                0.00   21.50  11[illegible]  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=  1.60     CP= .50     NTA=  0

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

          UNIT HYDROGRAPH 50 END-OF-PERIOD ORDINATES, LAG=   1.61 HOURS, CP=  .50  VOL= 1.00
         6.      23.      47.      74.      98.     113.     118.     112.      99.      88.
        79.      70.      62.      55.      49.      44.      39.      35.      31.      28.
        25.      22.      20.      17.      15.      14.      12.      11.      10.       9.
         8.       7.       6.       5.       5.       4.       4.       3.       3.       3.
         2.       2.       2.       2.       2.       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

                                                                  SUM  22.88  21.68   1.20   33095.
                                                                     ( 581.)( 551.)(  30.)( 937.15)
```

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM HARTFORD RESERVOIR NO 3

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
HAD-3	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	-391.	-1

STAGE	391.20	393.20	395.20	396.00	397.20	398.00	399.00	400.00	402.00	404.00
FLOW	0.00	255.00	720.00	946.00	2831.00	4890.00	9687.00	16483.00	33790.00	56000.00

STAGE-DISCHARGE DATA

SURFACE AREA=	0.	28.	40.
CAPACITY=	0.	338.	636.
ELEVATION=	355.	391.	400.

STAGE-STORAGE DATA

SPILLWAY CREST ELEVATION →

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
391.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOP OF DAM ELEVATION →

TOPEL	COOD	EXPD	DAMWID
396.0	0.0	0.0	0.

PEAK OUTFLOW IS 185. AT TIME 19.25 HOURS

PEAK OUTFLOW IS 286. AT TIME 19.25 HOURS

PEAK OUTFLOW IS 407. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 521. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 632. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 744. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 864. AT TIME 18.75 HOURS

ROUTED OUTFLOWS FROM HARTFORD RESERVOIR # 3 FOR VARIOUS FLOODS

PEAK OUTFLOW IS 1038. AT TIME 18.50 HOURS

PEAK OUTFLOW IS 1235. AT TIME 18.00 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	HAD-3	.58	1	274.	412.	549.	686.	823.	961.	1098.	1235.	1372.
		(1.50)		(7.77)	(11.66)	(15.54)	(19.43)	(23.32)	(27.20)	(31.09)	(34.97)	(38.86)
ROUTED TO	HAD-3	.58	1	145.	286.	407.	521.	632.	744.	864.	1038.	1235.
		(1.50)		(5.23)	(8.10)	(11.53)	(14.75)	(17.88)	(21.07)	(24.46)	(29.39)	(34.97)

PEAK INFLOWS

ROUTED OUTFLOWS

HARTFORD RESERVOIR #3
FLOOD ROUTING RESULTS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	391.20	391.20	396.00
STORAGE	338.	338.	487.
OUTFLOW	0.	0.	946.

→ 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	392.65	0.00	380.	185.	0.00	19.25	0.00
.30	393.33	0.00	400.	286.	0.00	19.25	0.00
.40	393.96	0.00	417.	407.	0.00	19.00	0.00
.50	394.54	0.00	432.	521.	0.00	19.00	0.00
.60	394.92	0.00	448.	632.	0.00	18.75	0.00
.70	395.28	0.00	463.	744.	0.00	18.75	0.00
.80	395.71	0.00	477.	864.	0.00	18.75	0.00
.90	396.05	.05	489.	1038.	1.00	18.50	0.00
1.00	396.14	.14	493.	1235.	1.75	18.00	0.00

→ TEST FLOOD ELEVATION

→ ROUTED TEST FLOOD OUTFLOW

10-10

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

HARTFORD RESERVOIR # 3 DAM BREACH (WITH RESERVOIR SURFACE AT TOP OF DAM)
OUTFLOW ROUTED TO DOWNSTREAM DAMAGE CENTER

INPUT

```
A1         HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR DAM NO. 3
A2              NATIONAL DAM INSPECTION PROGRAM
A3           NEW ENGLAND DIVISION - CORPS OF ENGINEERS
B     300      0      5      0      0      0      0      0     -4      0
B1      5
J       2      1      1
J1      0
K       1  HAD=3                                 1
K1      ROUTED OUTFLOW FROM HARTFORD RESERVOIR NO 3
Y                            1      1
Y1      1                                     -396     -1
Y4  391.2  393.2  395.2  396.0  397.2  398.0  399.0  400.0  402.0  404.0
Y5      0    255    720    946   2831   4890   9687  16483  33790  56000
$A      0     28     40
$E    355  391.2    400
$$  391.2
$D  396.0
$B    200    .01    360      2    396    396
$B    200    .01    350      2    396    400
K       1  DS=4                                  1
K1      CHANNEL ROUTING FROM RES. 3 TO RES. 1
Y                            1      1
Y1                                               -1
Y6   0.04   0.04   0.08  256.5    266   6000   .025
Y7      0    266     84    262    144    260    162  256.5    174  256.5
Y7    180    258    210    262    285    266
K       1  HAD-1                                 1
K1      ROUTED OUTFLOW FROM RESERVOIR 1
Y                            1      1
Y1      1                                   -256.5     -1
Y4  256.5  257.5  258.5  259.5  260.5  261.9  265.3  266.0  268.0  270.0
Y5      0    140    375    727   1120   1804   6129   8526  20832  38018
$A      0     27     35     68
$E    225  256.5    260    270
$$  256.5
$D  265.3
K       1  HAZARD                                1
K1      CHANNEL ROUTING  TO HAZARD CENTER 1
Y                            1      1
Y1      1                                        -1
Y6   0.06   0.04   0.08    170    190   2000   .025
Y7      0    190    120    180    170    172    180    170    190    170
Y7    200    172    270    140    370    190
K      99
```


UNITED COMPUTING SYSTEMS, INC.

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

RUN DATED 06/01/80.
TIME 09.50.23.

HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR DAM NO. 3
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= 2 NRTIO= 1 LRTIO= 1

NO INFLOW → RTIOS= 0.00

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM HARTFORD RESERVOIR NO 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
HAD-3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME 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	-396.	-1

STAGE	391.20	391.27	395.20	396.00	397.20	398.00	399.00	400.00	402.00	404.00
FLOW	0.00	255.00	720.00	946.00	2931.00	4890.00	9687.00	16493.00	33790.00	56000.00

STAGE-DISCHARGE DATA FOR H.R. # 3

SURFACE AREA=	0.	28.	40.
CAPACITY=	0.	338.	636.
ELEVATION=	355.	391.	400.

STAGE-STORAGE DATA FOR H.R. # 3

SPILLWAY CREST ELEVATION →

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
391.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
396.0	0.0	0.0	0.

TOP OF DAM ELEVATION →

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	MSEL	FAILEL
200.	.01	360.00	2.00	396.00	396.00

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

UNITED COMPUTING SYSTEMS, INC.

BEGIN DAM FAILURE AT 0.00 HOURS

PEAK OUTFLOW IS 5595. AT TIME .58 HOURS

→ MAXIMUM BREACH DISCHARGE

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	MSEL	FAILEL
200.	.01	360.00	2.00	396.00	400.00

BREACH DIMENSIONS - NO FAILURE OCCURS

PEAK OUTFLOW IS 946. AT TIME 0.00 HOURS → MAXIMUM SPILLWAY DISCHARGE PRIOR TO FAILURE

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

ROUTING FLOWS INTO HARTFORD RESERVOIR # 1

HYDROGRAPH ROUTING

CHANNEL ROUTING FROM RES. 3 TO RES. 1

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	DS=4	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME 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

	SN(1)	SN(2)	SN(3)	ELINVT	ELMAX	RLNTH	SEL
	.0400	.0400	.0400	256.5	266.0	6000.	.02500

CHANNEL CHARACTERISTICS

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

0.00 266.00 84.00 262.00 144.00 260.00 162.00 256.50 174.00 256.50
180.00 258.00 210.00 262.00 285.00 266.00

CHANNEL CROSS-SECTION AT UPSTREAM END OF H.R. # 1

STORAGE	0.00	.04	2.28	3.90	5.88	8.31	11.17	14.46	18.62	24.07
	30.81	38.84	48.21	58.94	71.04	84.50	99.34	115.55	133.12	152.07
OUTFLOW	0.00	23.90	82.40	176.03	317.51	501.48	731.49	1011.00	1394.50	1851.68
	2394.05	3031.31	3752.94	4595.42	5563.94	6665.09	7905.89	9293.46	10834.84	12537.02
STAGE	256.50	257.00	257.50	258.00	258.50	259.00	259.50	260.00	260.50	261.00
	261.50	262.00	262.50	263.00	263.50	264.00	264.50	265.00	265.50	266.00
FLOW	0.00	23.90	82.40	176.03	317.51	501.48	731.49	1011.00	1394.50	1851.68
	2394.05	3031.31	3752.94	4595.42	5563.94	6665.09	7905.89	9293.46	10834.84	12537.02

STAGE-STORAGE AND STAGE-DISCHARGE DATA FOR THE CHANNEL BETWEEN RESERVOIRS # 1 AND # 3

MAXIMUM STAGE IS 263.4 → STREAM ELEVATION AT H.R. # 1 DUE TO BREACH OUTFLOW

MAXIMUM STAGE IS 259.8 → STREAM ELEVATION AT H.R. # 1 DUE TO SPILLWAY OVERFLOW

FLOWS ROUTED THROUGH RESERVOIR # 1

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM RESERVOIR 1

	ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	MAU=1	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

	NSTPS	ITSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
	1	0	0	0.000	0.000	0.000	-257.	-1

STAGE	256.50	257.50	258.50	259.50	260.50	261.90	265.30	266.00	268.00	270.00
FLOW	0.00	140.00	396.00	727.00	1120.00	1804.00	6129.00	8526.00	20932.00	38018.00

STAGE-DISCHARGE DATA FOR H.R. # 1

SURFACE AREA=	0.	27.	35.	68.
CAPACITY=	0.	284.	392.	898.
ELEVATION=	225.	257.	260.	270.

STAGE-STORAGE DATA FOR H.R. # 1

SPILLWAY CREST ELEVATION → 256.5

	CREL	SPWID	COOW	EXPW	FLEVL	COOL	CAREA	EXPL
	256.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOP OF DAM ELEVATION → 265.3

TOPEL	COOD	EXPD	DAMWID
265.3	0.0	0.0	0.

PEAK OUTFLOW IS 3550. AT TIME 1.17 HOURS

→ MAXIMUM DISCHARGE FROM H.R. # 1 DUE TO H.R. # 3 BREACH OUTFLOW

PEAK OUTFLOW IS 359. AT TIME 1.75 HOURS

→ MAXIMUM DISCHARGE FROM H.R. # 1 DUE TO H.R. # 3 SPILLWAY DISCHARGE

FLOWS ROUTED TO DOWNSTREAM DAMAGE AREA

HYDROGRAPH ROUTING

CHANNEL ROUTING TO HAZARD CENTER 1

ISTAU	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
HAZARD	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME 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	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QMIN	QMAX	QINCR	ELEVL	ELMAX	WIDTH	SEL
.0800	.0400	.0800	170.0	190.0	2000.	.02500

} DOWNSTREAM CHANNEL CHARACTERISTICS

UNITED COMPUTING SYSTEMS, INC.

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

0.00 190.00 120.00 180.00 170.00 172.00 180.00 170.00 190.00 170.00
200.00 172.00 270.00 180.00 370.00 190.00

} CHANNEL CROSS-SECTION AT HAZARD AREA

STORAGE	0.00	.74	1.99	3.89	6.56	10.00	14.20	19.16	24.88	31.37
	38.66	47.03	56.52	67.12	78.85	91.70	105.66	120.74	136.95	154.27
OUTFLOW	0.00	79.43	321.14	822.33	1557.50	2549.67	3821.33	5394.56	7290.94	9531.51
	12072.80	14978.34	18352.22	22223.78	26623.11	31580.21	37124.56	43285.11	50090.16	57567.45
STAGE	170.00	171.05	172.11	173.16	174.21	175.26	176.32	177.37	178.42	179.47
	180.53	181.58	182.63	183.68	184.74	185.79	186.84	187.89	188.95	190.00
FLOW	0.00	79.43	321.14	822.33	1557.50	2549.67	3821.33	5394.56	7290.94	9531.51
	12072.80	14978.34	18352.22	22223.78	26623.11	31580.21	37124.56	43285.11	50090.16	57567.45

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

ST-0

MAXIMUM STAGE IS 176.1 → STREAM ELEVATION AT DAMAGE CENTER DUE TO H.R.# 3 BREACH OUTFLOW

MAXIMUM STAGE IS 172.2 → STREAM ELEVATION AT DAMAGE CENTER DUE TO H.R.# 3 SPILLWAY OVERFLOW

HARTFORD RESERVOIR #3 DAM BREACH FLOOD ROUTING RESULTS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	396.00	391.20	396.00
STORAGE	487.	338.	487.
OUTFLOW	946.	0.	946. → SPILLWAY DISCHARGE CAPACITY FOR H.R. #3

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	395.89	0.00	487.	5595. → PEAK BREACH DISCHARGE	0.00	.58	0.00

SPILLWAY OVERFLOW ROUTING RESULTS

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	396.00	391.20	396.00
STORAGE	487.	338.	487.
OUTFLOW	946.	0.	946.

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	395.81	0.00	487.	946.	0.00	0.00	0.00

CHANNEL BETWEEN RESERVOIRS #1 AND #3 WITH FLOOD ROUTINGS

PLAN 1 STATION OS-A

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	5281.	263.4	.75

PLAN 2 STATION OS-A

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	894.	259.8	.08

H.R. #3 BREACH FLOOD ROUTING
THROUGH RESERVOIR # 1 RESULTS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	256.50	256.50	265.30
STORAGE	284.	284.	619.
OUTFLOW	0.	0.	6129.

→ SPILLWAY DISCHARGE CAPACITY FOR H.R. # 1

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	263.27	0.00	522.	3550.	0.00	1.17	0.00

→ PEAK DISCHARGE DUE TO H.R. # 3 BREACH

SPILLWAY DISCHARGE ROUTING THROUGH H.R. # 1

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	256.50	256.50	265.30
STORAGE	284.	284.	619.
OUTFLOW	0.	0.	6129.

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	254.36	0.00	337.	359.	0.00	1.75	0.00

→ PEAK DISCHARGE DUE TO H.R. # 3 SPILLWAY DISCHARGE

BREACH FLOOD ROUTED TO DOWNSTREAM HAZARD AREA → PLAN 1 STATION HAZARD

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	3544.	176.1	1.25

→ PEAK FLOW AT DAMAGE AREA DUE TO H.R. # 3 BREACH

SPILLWAY OVERFLOW ROUTED TO DOWNSTREAM HAZARD AREA → PLAN 2 STATION HAZARD

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	359.	172.2	1.75

→ PEAK FLOW AT DAMAGE AREA DUE TO H.R. # 3 SPILLWAY DISCHARGE

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
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HARTFORD RESERVOIR # 3 DAM BREACH (WITH RESERVOIR SURFACE AT SPILLWAY CREST)
OUTFLOW ROUTED TO DAMAGE AREA

INPUT

```
  1      A1            HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR NO. 3
  2      A2                NATIONAL DAM INSPECTION PROGRAM
  3      A3             NEW ENGLAND DIVISION - CORPS OF ENGINEERS
  4      B    300      0      5      0      0      0      0      0     -4      0
  5      B1     5
  6      J      1      1      1
  7      J1     0
  8      K      1   HAD-3                                    1
  9      K1        ROUTED OUTFLOW FROM HARTFORD RESERVOIR NO 3
 10      Y                           1      1
 11      Y1     1                                      -391.2     -1
 12      Y4 391.2  393.2  395.2  396.0  397.2  398.0   399.0   400.0  402.0  404.0
 13      Y5     0    255    720    946   2431   4440    9687   16483  33790  56000
 14      $A     0     28     40
 15      $E   355  391.2    400
 16      $S 391.2
 17      $D 396.0
 18      $B   200    .01    300      2  391.2  391.2
 19      K      1   DS-A                                     1
 20      K1        CHANNEL ROUTING FROM RES. 3 TO RES. 1
 21      Y                           1      1
 22      Y1     1                                       -1
 23      Y6  0.08   0.04   0.08  256.5    266   6000    .025
 24      Y7     0    266     44    262    144    260     162   256.5    174  256.5
 25      Y7   140    258    210    262    285    266
 26      K      1   HAD-1                                    1
 27      K1        RESERVOIR 3  ROUTING THROUGH RESERVOIR 1
 28      Y                           1      1
 29      Y1     1                                      -256.5     -1
 30      Y4 256.5  257.5  258.5  259.5  260.5  261.9   265.3   266.0  268.0  270.0
 31      Y5     0    140    396    727   1120   1804    6129    8526  20832  38018
 32      $A     0     27     35     68
 33      $F   225  256.5    260    270
 34      $S 256.5
 35      $D 265.3
 36      K      1   HAZARD                                   1
 37      K1        CHANNEL ROUTING  TO HAZARD CENTER 1
 38      Y                           1      1
 39      Y1     1                                       -1
 40      Y6  0.08   0.04   0.08    178    190   2000    .025
 41      Y7     0    190    120    180    170    172     180     170    190    170
 42      Y7   200    172    270    180    370    190
 43      K     99
```

DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

TIME= 13.32.23.

HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR NO. 3
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	NRT	LRGRT	IBACH
5	0	0	0

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

NO INFLOW → UNITGS= 0.00

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM HARTFORD RESERVOIR NO 3

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
MAU-3	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	-391.	-1

STAGE	391.20	393.20	395.20	396.00	397.20	398.00	399.00	400.00	402.00	404.00
FLOW	0.00	255.00	729.00	946.00	2831.00	4894.00	9687.00	16483.00	33790.00	56000.00

STAGE - DISCHARGE DATA FOR H.R. # 3

SURFACE AREA=	0.	28.	40.
CAPACITY=	0.	334.	636.
ELEVATION=	365.	381.	400.

STAGE - STORAGE DATA FOR H.R. # 3

SPILLWAY CREST ELEVATION →

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
391.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOP OF DAM ELEVATION →

TOPEL	COQD	EXPD	DAMWID
396.0	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	FLAM	TFAIL	MSEL	FAILEL
200.	.01	360.00	2.00	391.20	391.20

BREACH DIMENSIONS - FAILURE BEGINS IMMEDIATELY WITH RESERVOIR SURFACE AT SPILLWAY CREST

BEGIN DAM FAILURE AT 0.00 HOURS

PEAK OUTFLOW IS 4654. AT TIME .75 HOURS

→ MAXIMUM - BREACH - DISCHARGE

61-0

BREACH OUTFLOW ROUTED TO HARTFORD RESERVOIR # 1

HYDROGRAPH ROUTING

CHANNEL ROUTING FROM RES. 3 TO RES. 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DS-A	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	ISPHAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QNTIO	QNTIO	QNTIO	ELEVI	ELEVA	RENTH	SEL
.0400	.0400	.0400	256.5	266.0	6000.	.02500

} CHANNEL CHARACTERISTICS

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

0.00	256.00	44.00	252.00	144.00	260.00	162.00	256.50	174.00	256.50	
180.00	258.00	210.00	262.00	245.00	266.00					

} CHANNEL CROSS-SECTION AT THE UPSTREAM END OF HARTFORD RESERVOIR # 1

STORAGE	0.00	.08	2.28	3.48	5.88	8.31	11.17	14.46	18.62	24.07
	30.41	38.84	48.21	58.94	71.04	84.50	99.34	115.55	133.12	152.07
OUTFLOW	0.00	23.00	82.00	176.03	317.51	501.48	731.49	1011.00	1394.50	1851.68
	2394.05	3031.31	3752.94	4595.42	5563.94	6665.09	7905.89	9293.46	10834.84	12537.02
STAGE	256.50	257.00	257.50	258.00	258.50	259.00	259.50	260.00	260.50	261.00
	261.50	262.00	262.50	263.00	263.50	264.00	264.50	265.00	265.50	266.00
FLOW	0.00	23.00	82.00	176.03	317.51	501.48	731.49	1011.00	1394.50	1851.68
	2394.05	3031.31	3752.94	4595.42	5563.94	6665.09	7905.89	9293.46	10834.84	12537.02

} STAGE-STORAGE AND STAGE-DISCHARGE DATA FOR THE CHANNEL BETWEEN RESERVOIRS # 1 AND # 3

MAXIMUM STAGE 19 PAR 4

→ STREAM ELEVATION AT H.R. # 1

BREACH OUTFLOW ROUTING THROUGH RESERVOIR # 1

HYDROGRAPH ROUTING

RESERVOIR 3 ROUTING THROUGH RESERVOIR 1

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

ROUTING DATA

OLOSS	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	-257.	-1

STAGE	256.50	257.50	258.50	259.50	260.50	261.00	265.30	266.00	268.00	270.00
FLOW	0.00	140.00	396.00	727.00	1120.00	1804.00	6129.00	8526.00	20832.00	38018.00

STAGE - DISCHARGE DATA FOR H.R. # 1

SURFACE AREA=	0.	27.	35.	68.
CAPACITY=	0.	244.	342.	998.
ELEVATION=	225.	257.	260.	270.

STAGE-STORAGE DATA FOR H.R. # 1

SPILLWAY CREST ELEVATION → 256.5

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
256.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
TOP OF DAM ELEVATION → 265.3	0.0	0.0	0.

PEAK OUTFLOW IS 2112. AT TIME 1.50 HOURS

→ MAXIMUM DISCHARGE FROM ROUTED BREACH OUTFLOW

BREACH FLOOD ROUTING TO DAMAGE CENTER

~~HYDROGRAPH ROUTING~~ CHANNEL ROUTING TO HAZARD CENTER 1

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	HAZARD	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	.0400	.0400	170.0	190.0	2000.	.02500

} DOWNSTREAM CHANNEL CHARACTERISTICS

~~CROSS SECTION COMBINATES STA,ELEV,STA,ELEV--ETC~~

	0.00	190.00	120.00	180.00	170.00	172.00	180.00	170.00	190.00	170.00
	200.00	172.00	270.00	180.00	370.00	190.00				

} CHANNEL CROSS-SECTION AT HAZARD AREA

STORAGE	0.00	.74	1.99	3.89	6.56	10.00	14.20	19.16	24.88	31.37
	38.66	47.03	56.52	67.12	78.85	91.70	105.66	120.74	136.95	154.27
OUTFLOW	0.00	19.83	321.14	822.33	1557.50	2549.67	3821.33	5394.56	7290.94	9531.51
	12072.80	14978.34	18352.22	22223.78	26623.11	31580.21	37124.56	43285.11	50090.16	57567.45
STAGE	170.00	171.05	172.11	173.16	174.21	175.26	176.32	177.37	178.42	179.47
	180.53	181.58	182.63	183.68	184.74	185.79	186.84	187.89	188.95	190.00
FLOW	0.00	19.83	321.14	822.33	1557.50	2549.67	3821.33	5394.56	7290.94	9531.51
	12072.80	14978.34	18352.22	22223.78	26623.11	31580.21	37124.56	43285.11	50090.16	57567.45

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

MAXIMUM STAGE IS 174.4 → STREAM ELEVATION AT DAMAGE CENTER

HARTFORD RESERVOIR # 3 DAM BREACH
OUTFLOW RESULTS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	391.20	391.20	396.00
~~STORAGE~~	~~339.~~	~~338.~~	~~487.~~
OUTFLOW	0.	0.	966.

966. → H.R. # 3 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	391.20	0.00	338.	4654.	0.00	.75	0.00

CHANNEL BETWEEN RESERVOIRS # 1 & # 3 → PLAN 1 STATION DS-A

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	4239.	262.8	.92

4239. → MAXIMUM FLOW INTO RESERVOIR # 1

ROUTED BREACH OUTFLOW RESULTS
AT HARTFORD RESERVOIR # 1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	256.50	256.50	265.30
~~STORAGE~~	~~284.~~	~~284.~~	~~619.~~
OUTFLOW	0.	0.	6129.

6129. → H.R. # 1 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	262.14	0.00	473.	2112.	0.00	1.50	0.00

DOWNSTREAM CHANNEL → PLAN 1 STATION HAZARD

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	2102.	174.8	1.50

174.8 → STREAM ELEVATION AT HAZARD CENTER

2102. → MAXIMUM FLOW AT HAZARD CENTER

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME


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DATE
ILME