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NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
CHESTNUT HILL RESERVO. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JAN 80

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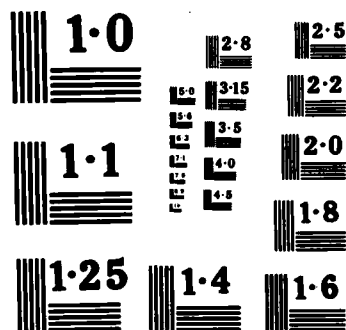
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NATIONAL BUREAU OF STANDARDS
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AD-A155 649

CHARLES RIVER BASIN
BOSTON, MASSACHUSETTS

CHESTNUT HILL RESERVOIR DAM
MA 01113

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The embankment is about 2000 ft. long with a maximum height of about 18 ft. It is intermediate in size with a high hazard potential classification. The dam is considered to be in fair condition. There are few remedial measures that the owner should undertake. | | |



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

REPLY TO
ATTENTION OF
NEDED

JUN 05 1980

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Chestnut Hill 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 Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition a copy of the report has also been furnished the owner, Commonwealth of Massachusetts, Metropolitan District Commission, Boston, MA 02108.

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 Quality Engineering for your cooperation in carrying out this program.

Sincerely,


MAX B. SCHEIDER

Colonel, Corps of Engineers
Division Engineer

Incl
As stated

CHESTNUT HILL RESERVOIR DAM

MA 01113

CHARLES RIVER BASIN

BOSTON, MASSACHUSETTS

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

| | |
|---------------------|-----------------------------|
| Identification No: | MA01113 |
| Name of Dam: | Chestnut Hill Reservoir Dam |
| Town: | Boston |
| County and State: | Suffolk, Massachusetts |
| Stream: | Charles River Basin |
| Date of Inspection: | October 23, 1979 |

BRIEF ASSESSMENT

Chestnut Hill Reservoir Dam is an 82-year old earth embankment structure used as a reserve source of water for the City of Boston water distribution system. The embankment is approximately 2,000 feet long with a maximum height of about 18 feet and a top width of 20 feet. The riprapped upstream face of the dam is on a slope of 1.5H:1V and the grass covered downstream face is on a slope of 2H:1V. Effluent Gatehouse No.1, near the north abutment, is a cut stone masonry structure about 40 feet by 50 feet in plan and Effluent Gatehouse No.2, near the south abutment, is a cut stone masonry structure about 16 feet by 28 feet in plan.

The normal pool surface area is 73 acres which is also the drainage area because the reservoir is not located on a stream. The maximum storage to the top of the dam is 1,270 acre-feet which places the structure in the "Intermediate" size classification. A breach of the dam would affect a municipal park, a business district and an urban residential neighborhood; therefore, the dam has been classified as having a "High" hazard potential. Based on the "Intermediate" size and "High" hazard potential, the test flood is the full Probable Maximum Flood (PMF). Since no inflow from the drainage area runoff occurs at Chestnut Hill Reservoir, the full Probable Maximum Precipitation(PMP) is considered the test flood and is applied directly to the normal pool surface area.

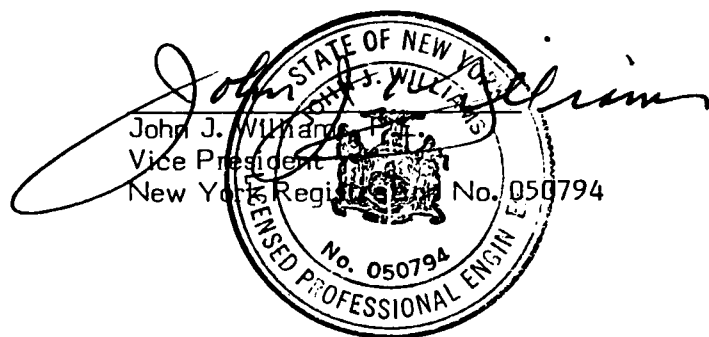
The dam is considered to be in fair condition. Saplings have been recently planted on the downstream face, it is not known if the gates and gate valves in Effluent Gatehouses 1 and 2 are operable, many animal burrows were observed on the downstream face and the catch basin system at the downstream toe of the embankment appears to be completely plugged.

The test flood for the facility is 22.9 inches of rainfall falling directly on the reservoir. Since the reservoir surface level is constantly maintained as close as possible to the normal level, which is 4 feet below the top of the dam, chances of the embankment being overtopped during the test flood event are extremely remote.

Within one year after receipt of this Phase I Inspection report, the Owner, the Metropolitan District Commission (MDC), should engage a qualified registered professional engineer to: 1) investigate the seismic stability of the dam; 2) supervise the removal of the saplings from the downstream face of the dam; and 3) determine the source of the water on the floor of Effluent Gatehouse No.1.

The MDC should implement the following operation and maintenance procedures: 1) check the operability of the gates and gate valves in Effluent Gatehouses 1 and 2 and, if necessary, repair them; 2) clean out and repair the catch basin system along the downstream toe of the dam; 3) backfill all animal burrows; 4) institute a program of annual periodic technical inspection; 5) develop and adhere to a comprehensive maintenance program; and 6) develop a formal surveillance and flood warning plan.

O'BRIEN & GERE ENGINEERS, INC.



Date 30 April 1980

This Phase I Inspection Report on Chestnut Hill 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.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

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

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

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there 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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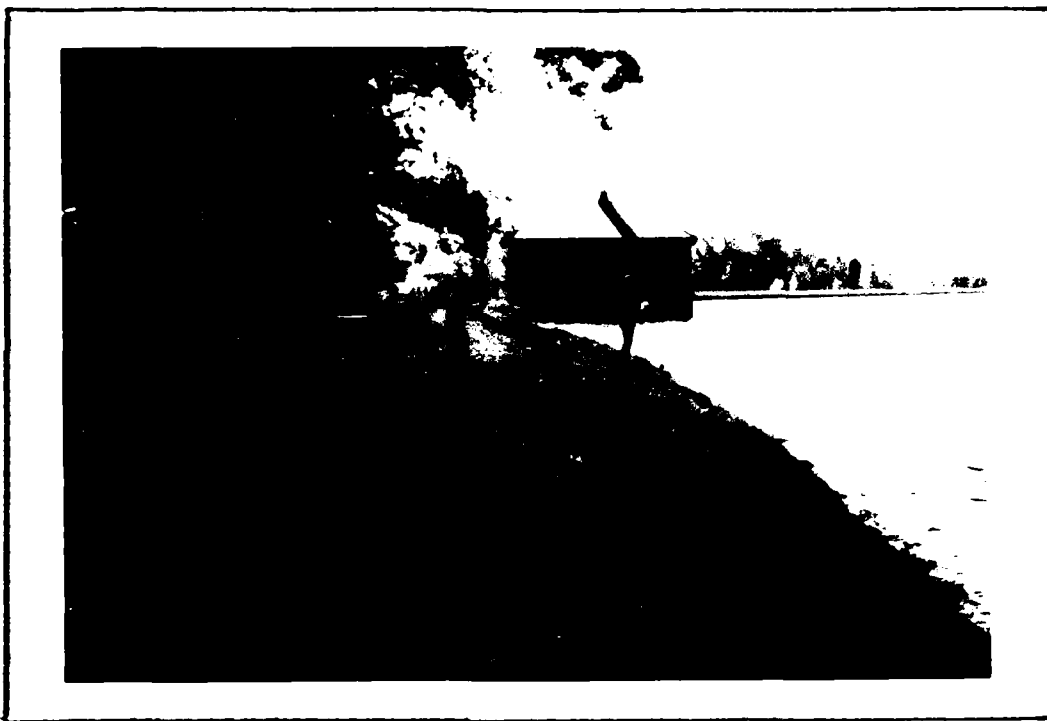
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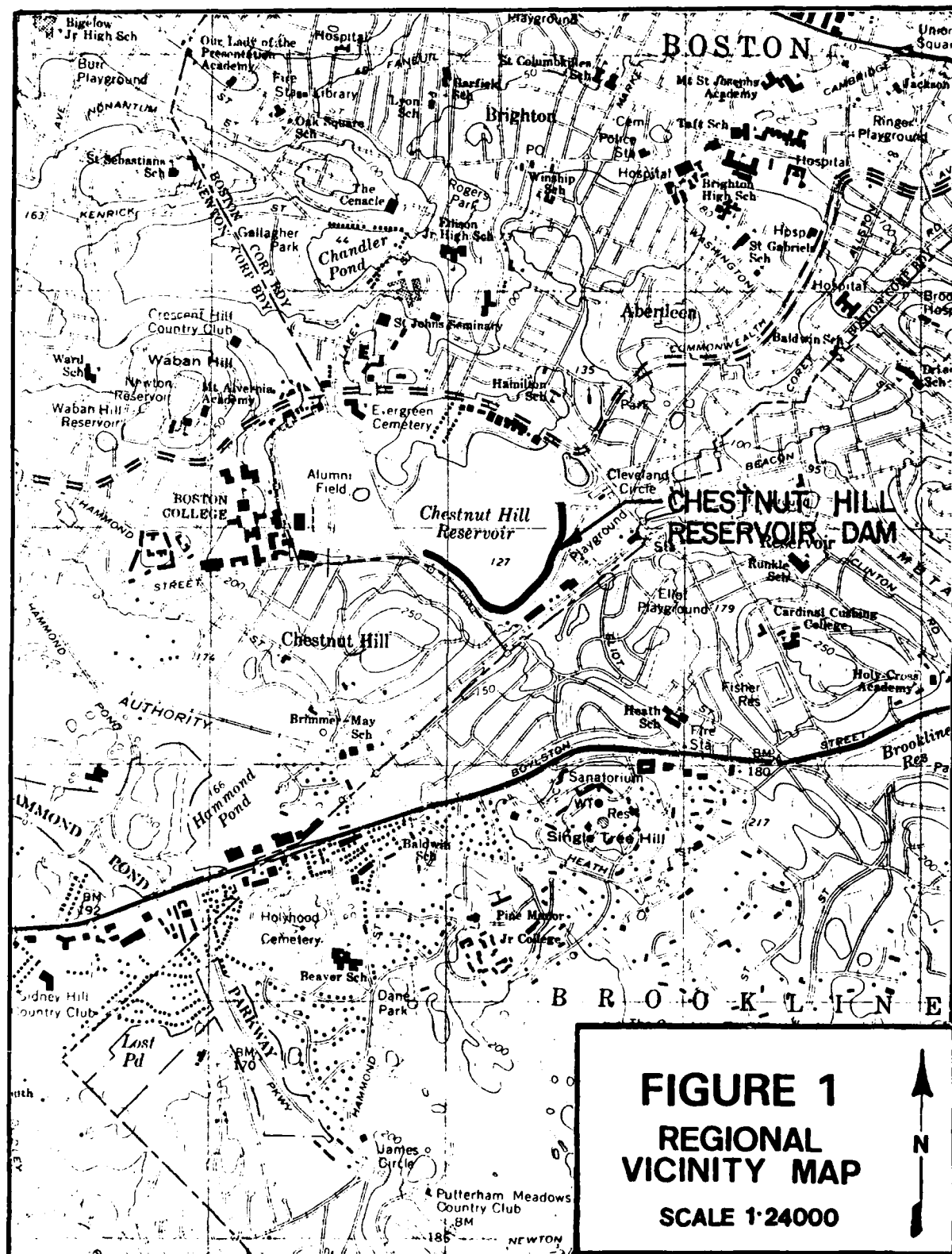
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OVERVIEW OF THE CHESTNUT HILL RESERVOIR DAM FROM THE NORTHERN
ABUTMENT WITH EFFLUENT GATEHOUSE NO. 1 IN THE BACKGROUND.
(10/23/79)



OVERVIEW OF THE CHESTNUT HILL RESERVOIR DAM FROM THE WESTERN
ABUTMENT WITH THE EFFLUENT GATEHOUSE NO. 2 IN THE BACKGROUND.
(10/23/79)



NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
CHESTNUT HILL RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The National Dam Inspection Act of August 8, 1972 (Public Law 92-367), 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 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 Commonwealth of Massachusetts. Authorization and Notice to Proceed were issued to O'Brien & Gere by a letter dated November 6, 1979 and signed by Colonel William E. Hodgson, Jr. Contract No. DACW33-80-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 states to initiate effective dam safety programs for non-federal dams as soon as possible.

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

1.2 Description of Project (Information obtained from the Commonwealth of Massachusetts, Metropolitan District Commission (MDC)).

a. Location. Chestnut Hill Reservoir, which is not on a stream, is located adjacent to the Boston College campus along the western boundary of the City of Boston, Suffolk County, Massachusetts. The site is shown on the "Newton, Massachusetts" USGS Quadrangle at coordinates N 42°20.1', W 71° 9.3'. A regional location of Chestnut Hill Reservoir Dam is included as Figure 1, Page vi.

A municipal park, a business district and a residential neighborhood are located within the potential flood impact area beginning within a few hundred feet east of the dam.

b. Description of Dam and Appurtenances. Chestnut Hill Reservoir Dam is an earth embankment approximately 2,000 feet long with a maximum height of about 18 feet and a top width of 20 feet. The riprapped upstream face of the dam is on a slope of 1.5H:1V and the downstream face is grass covered on a slope of 2H:1V. The downstream face in the vicinity of Effluent Gatehouse No. 1 is provided with a 13-foot wide berm at the mid-height of the embankment. The berm, which is about 180 feet long, is symmetrical about the Effluent Gatehouse No.1 centerline and tapers into the prevailing embankment slope at each end.

Effluent Gatehouse No.1, near the north abutment, is a cut stone masonry structure about 40 feet by 50 feet in plan and is located at the crest of the upstream face of the dam. The structure contains four inlet portals of unknown dimensions which are provided with stoplog slots. Discharge from the intake chamber to the two 48-inch diameter cast iron water supply conduits is controlled by 2 four-foot square sluice gates. Downstream of the sluice gates are five 48-inch diameter manually operated non-rising stem gate valves located in a chamber within the embankment. Each of the two water supply conduits is equipped with two gate valves in series and the fifth valve is used to control flow in a 48-inch diameter cross-connecting conduit. This gatehouse has not been used for several years. Refer to pages B-1 and B-2.

Effluent Gatehouse No. 2, near the south abutment, is a cut stone masonry structure about 16 feet by 28 feet in plan constructed at the crest of the upstream face of the dam. The structure contains three inlet portals of unknown dimensions which are provided with screens and stoplog slots. Discharge from the intake chambers to the three 60-inch diameter connecting conduits is controlled by three manually operated gate valves. Pages B-1 and B-2 show the complex interconnections of these pipes with the MDC water supply system. This gatehouse has not been used for several years.

The Intermediate Gatehouse on the west side of the reservoir is a cut stone masonry structure which houses a 5-foot square gate used to maintain the impoundment level in Chestnut Hill Reservoir at Elevation 128.3 by allowing discharge to flow into an abandoned section of the Cochituate Aqueduct.

Chestnut Hill Reservoir Dam does not have a spillway.

c. Size Classification. The maximum storage capacity of 1,270 acre-feet, which is more than 1,000 acre-feet and less than 50,000 acre-feet, places Chestnut Hill Reservoir Dam in the "Intermediate" size category.

d. Hazard Classification. Chestnut Hill Reservoir is located within the City of Boston corporate boundary. Beacon Street, a major thoroughfare, parallels the downstream toe of the dam for nearly the entire length of the embankment. Two major pumping stations operated by the Metropolitan District Commission are located 200 feet southeast of the embankment. A municipal park, a business district and an urban residential neighborhood are located within the potential flood impact area beginning a few hundred feet east of the dam. The failure analysis indicates that the assumed breach of the dam would result in a 9.2 foot depth of water in the flood impact area. As a result, there would be at least 6 feet of water in the first floors of most of the buildings in the flood impact area.

Since flood waters resulting from a failure of Chestnut Hill Reservoir Dam would cause excessive property damage and the possible loss of more than a few lives, the dam is classified as "High" hazard.

e. Ownership. The dam is owned by the Commonwealth of Massachusetts, Metropolitan District Commission (MDC), 20 Somerset Street, Boston, Massachusetts 02108, Telephone (617) 727-5275.

f. Operator. The dam is operated by the MDC, Water Division. Mr. William R. Thompson, Superintendent, is in charge of dam operations. His address is 20 Somerset Street, Boston, Massachusetts 02108, Telephone (617) 396-4631.

g. Purpose of Dam. The dam was built to impound a water distribution reservoir. The reservoir has not been used on a regular basis since 1973 and is currently used as a reserve source of water supply only.

h. Design and Construction History. The construction of Chestnut Hill Reservoir (originally known as Bradlee Basin) Dam was completed in 1898. Further information is not available.

i. Normal Operating Procedures. According to the Owner's representative, Mr. Thompson, since 1973 the only operation relative to the Chestnut Hill Reservoir is the provision for discharge through a 5-foot square gate in the Intermediate Gatehouse (on the west side of Chestnut Hill Reservoir) into an abandoned section of the Conchituate Aqueduct to maintain the Chestnut Hill Reservoir level at Elevation 128.3. Elevation 128.3 is 4 feet below the top of the dam.

If it is necessary to use Chestnut Hill Reservoir, water would be supplied from the Sudbury Reservoir (about 20 miles west of Chestnut Hill Reservoir). Gates would be opened at Sudbury Reservoir and 16 hours later the discharge would reach Chestnut Hill Reservoir. No inlet controls are available at Chestnut Hill Reservoir. Both the high service and low service pumping stations, across Beacon Street from Chestnut Hill Reservoir, would be put into operation if Chestnut Hill Reservoir is restored to service.

1.3 Pertinent Data

a. Drainage Area. The area draining to Chestnut Hill Reservoir is equal to the reservoir surface area of 0.11 square miles.

b. Discharge at Damsite.

1. Outlet Works. As discussed in Section 1.2.i, since 1973 the only outlet functioning is the 5-foot square gate in the Intermediate Gatehouse, used to maintain the impoundment level in Chestnut Hill Reservoir at Elevation 128.3 by allowing discharge to flow into an abandoned section of the Cochituate Aqueduct. According to the Owner's representative, it is not known if the gates and gate valves in Effluent Gatehouses 1 and 2 are operable. If operable, they could be used to drawdown the entire impoundment.

2. Maximum Known Flood. Not applicable.
3. Ungated Spillway Capacity at Top of Dam. Not applicable.
4. Ungated Spillway Capacity at Test Flood Elevation. Not applicable.
5. Gated Spillway Capacity at Normal Pool. Not applicable.
6. Gated Spillway Capacity at Test Flood Elevation. Not applicable.
7. Total Project Discharge at Top of Dam. Not applicable.
8. Total Project Discharge at Test Flood Elevation. Not applicable.

c. Elevation. (NGVD)

| | |
|---------------------------------------|--------------------|
| 1. Streambed at Toe of Dam | 114.3 ⁺ |
| 2. Bottom of Cutoff | Unknown |
| 3. Maximum Tailwater | NA |
| 4. Normal Pool | 128.3 |
| 5. Full Flood Control Pool | NA |
| 6. Spillway Crest | NA |
| 7. Design Surcharge (Original Design) | Unknown |
| 8. Top of Dam | 132.3 |
| 9. Test Flood Surcharge | 130.2 |

d. Reservoir Length. (feet)

| | |
|------------------------|--------------------|
| 1. Normal Pool | 2,300 ⁺ |
| 2. Flood Control Pool | NA |
| 3. Spillway Crest Pool | NA |
| 4. Top of Dam | 2,300 ⁺ |
| 5. Test Flood Pool | 2,300 ⁺ |

e. Storage. (Acre-Feet)

| | |
|------------------------|-------|
| 1. Normal Pool | 970 |
| 2. Flood Control Pool | NA |
| 3. Spillway Crest Pool | NA |
| 4. Top of Dam | 1,270 |
| 5. Test Flood Pool | 1,120 |

f. Reservoir Surface. (Acres)

| | |
|------------------------|----|
| 1. Normal Pool | 73 |
| 2. Flood Control Pool | NA |
| 3. Spillway Crest Pool | NA |
| 4. Top of Dam | 73 |
| 5. Test Flood Pool | 73 |

g. Dam.

| | |
|---|--------------------|
| 1. Type | Earth Embankment |
| 2. Length | 2,000 feet |
| 3. Height | 18 feet |
| 4. Top Width | 20 feet |
| 5. Side Slopes (upstream) (downstream) | 1.5H:1V 2.0H:1V |
| 6. Zoning | Unknown |
| 7. Impervious Core | Unknown |
| 8. Cutoff | Unknown |
| 9. Grout Curtain | Unknown |

h. Diversion and Regulating Tunnel. Not Applicable

i. Spillway. Not Applicable

j. Regulating Outlets.

1. Effluent Gatehouse No.1

| | |
|----------------------|---|
| a. Invert Elevation | Unknown |
| b. Size | Two 48-inch diameter pipes |
| c. Description | Two 48-inch diameter gate valves on each 48-inch diameter pipe plus a 48-inch diameter gate valve on a 48-inch cross connecting pipe. |
| d. Control Mechanism | Hand Wheels |
| e. Other | According to the Owner's representative, it is not known if the gate valves are operable. |

2. Effluent Gatehouse No.2

| | |
|----------------------|---|
| a. Invert | Unknown |
| b. Size | Three 60-inch diameter pipes |
| c. Description | 60-inch diameter gate valve on each of the three 60-inch diameter pipes. |
| d. Control Mechanism | Hand Wheels |
| e. Other | According to the Owner's representative, it is not known if the gate valves are operable. |

SECTION 2

ENGINEERING DATA

2.1 Design

Drawings with limited information were made available for review of the Chestnut Hill Reservoir Dam. Reductions of the drawings are in Appendix B of this report. No design calculations are available for this site.

2.2 Construction

No information is available concerning the construction of Chestnut Hill Reservoir Dam.

2.3 Operation

The MDC, Water Division, maintains daily readings of reservoir pool elevations.

2.4 Evaluation

a. Availability. The information made available was obtained from the Commonwealth of Massachusetts, Metropolitan District Commission (MDC).

b. Adequacy. The drawings, visual inspection data and conversations with the Owner's representative are considered to be adequate for a Phase I investigation.

c. Validity. The data made available for this site investigation appears to be valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Chestnut Hill Reservoir Dam was performed on October 23, 1979. At the time of the inspection, the reservoir water surface was approximately 4.0 feet below the top of the dam. No underwater areas were inspected. The observations and comments of the field inspection team are in the checklist which is Appendix A of this report.

b. Dam. The dam appears to be in fair condition. The upstream face of the embankment is protected with large dumped riprap which extends to within two feet of the dam crest and is capped with 6-inch thick cut stone blocks. There is no evidence of displacement of the riprap. The crest of the dam is grass covered except for a 5-foot wide gravel walkway. The crest is constructed with a 2-foot differential between the upstream and downstream faces of the dam to provide drainage into the reservoir. The downstream face of the dam has a uniform slope of 2H:1V and is grass covered. About two dozen saplings have been planted in a random fashion on the downstream face between the gatehouses (refer to page C-2). The berm on the downstream face near Effluent Gatehouse No. 1 appears to have been constructed to accommodate a landing in the concrete steps leading from the downstream toe to the crest of the dam (refer to page C-1). No seepage was observed at the downstream toe or on the downstream face of the dam. Several rodent holes were observed on the downstream face at scattered locations (refer to page C-4). Four grated catch basins were observed at variable spacing along the downstream embankment toe. The basins were clogged with debris and were dry at the time of the inspection.

c. Appurtenant Structures. Effluent Gatehouse No. 1 has no indications of settlement or misalignments. Access to the valve chamber is through doors at the downstream toe of the dam. The wooden platform in the chamber is about five feet above the pipe invert and is severely deteriorated. The stairs leading to the gatehouse floor at the dam crest elevation were considered unsafe; therefore, the interior of the gatehouse at this elevation was not inspected. The operating wheels for the five 48-inch diameter gate valves were in place; however, according to the Owner's representative, three feet of standing water was noted on the floor of the chamber. The brick walls were wet but there was no evidence of a concentrated discharge into the chamber. No lighting fixtures were noted within the gate chamber.

Effluent Gatehouse No. 2 has no indications of settlement or misalignments. The gate valve operators within the gatehouse are enclosed (refer to page C-5). According to the Owner's representative, it is not known if the gate valves are operable. A reservoir stage recorder, consisting of a float and a graduated rod, is located within the gatehouse. The mechanical gate hoist and supporting beam for installation and removal of stoplogs appear to be in operating condition.

The Intermediate Gatehouse has no indications of settlement or misalignment. Within this gatehouse is the 5-foot square gate used to maintain the impoundment level in Chestnut Hill Reservoir at Elevation 128.3. The gate is operational.

d. Reservoir Area. The entire perimeter of the reservoir consists of MDC property which is primarily well maintained lawns and some wooded areas along the north and northeast sides of the reservoir. No indications of shoreline instability or excessive siltation were observed during the inspection.

e. Downstream Channel. Chestnut Hill Reservoir is not located on a stream and a spillway has not been incorporated into the structure. The local topography is such that flood waters would be directed to the east along Beacon Street, through Cleveland Circle and into the Muddy River approximately two miles to the east.

3.2 Evaluation. The dam and appurtenances appear to be in fair condition. Saplings have recently been planted on the downstream face and many animal burrows were observed in the downstream face. Three feet of standing water was observed on the floor of Effluent Gatehouse No. 1. It is not known if the gates and the gate valves in Effluent Gatehouses 1 and 2 are operable. The catch basin system at the downstream toe of the embankment appears to be completely plugged.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. According to Mr. Thompson, the reservoir is used only as a reserve source of water. Since 1973, the only outlet functioning is the 5-foot square gate in the Intermediate Gatehouse which is used to maintain the impoundment level at Elevation 128.3 by allowing discharge to flow into an abandoned section of the Cochituate Aqueduct.

b. Description of Any Warning System in Effect. According to Mr. Thompson, no flood warning system is in effect at this site.

4.2 Maintenance Procedures

a. General. According to Mr. Thompson, the grass on the embankment is cut twice a year.

b. Operating Facilities. According to Mr. Thompson, it is not known if the gates and gate valves in both gatehouses, which have not been used since 1973, are operable. The 5-foot square gate in the Intermediate Gatehouse is regularly maintained to insure that it can be used to hold the water level in the impoundment to Elevation 128.3.

4.3 Evaluation

The operational procedures of the outlet works, as described by Mr. Thompson, are considered to be satisfactory for the gate used in the Intermediate Gatehouse, but unsatisfactory for gates and gate valves in Effluent Gatehouses 1 and 2.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General.

Chestnut Hill Reservoir Dam is not located on a stream. Therefore, its drainage area is limited to the reservoir area.

5.2 Design Data

No hydraulic or hydrologic information is available relative to the original design.

5.3 Experience Data

No notable hydrologic events have occurred at this site. According to the Owner's representative, the embankment has never been overtopped.

5.4 Test Flood Analysis

Based on the "Intermediate" size and "High" hazard potential, the test flood is the full Probable Maximum Flood (PMF). Since no inflow from drainage area runoff occurs at Chestnut Hill Reservoir, the full Probable Maximum Precipitation (PMP) is considered the test flood and is applied directly to the normal pool surface area.

The PMP, if totally stored, would raise the reservoir pool level 22.9 inches (refer to Appendix D) above the normal pool and result in an estimated 2.10 feet of freeboard. Since the reservoir surface level is constantly maintained as close as possible to normal pool Elevation 128.3, chances of the embankment being overtopped during the PMP event are extremely remote.

5.5 Dam Failure Analysis

The dam failure analysis was performed using the HEC-1-DB computer program. The breach was performed with the reservoir at the PMP elevation of 130.2. The failure was assumed to progress to full breach width of about 200 feet in 2 hours. The assumed failure would be a result of piping of the embankment since the embankment would not be overtopped.

The downstream hazard area east of the reservoir is an urban neighborhood which contains very closely spaced multi-family dwellings and commercial establishments. Flood waters from the breach would probably be directed through this area along Beacon Street and into the Muddy River approximately 2 miles to the east. The potential flood impact area was taken at a natural constriction in the topography about 1,300 feet east of the dam. Due to the prevalence of man-made structures in the path of the flood, the Manning's roughness coefficient for the channel (Beacon Street) and overbanks was chosen to be 0.10 to reflect the considerable energy losses from buildings, automobiles and other obstructions.

Results of the breach of Chestnut Hill Reservoir Dam indicate that the maximum flood discharge at the impact area would be 11,530 cfs with a corresponding depth of 9.2 feet. As a result, there would be at least 6 feet of water in the first floor of most of the buildings in the flood impact area. Such a flood would cause excessive property damage and the possible loss of more than a few lives.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

At the time of the inspection, there were no indications of distortions or undulations of the embankment crest or slopes. The roots of trees on the downstream slope have a deleterious effect upon the compacted materials within the embankment and may provide seepage paths through the dam. The rodent holes may also increase the seepage potential which could lead to piping failure of the dam.

6.2 Design and Construction Data

The dam appears to have been constructed in general conformance with the record drawings shown on page B-1 and B-2.

6.3 Post-Construction Changes

No post-construction changes have been recorded at this site.

6.4 Seismic Stability

Chestnut Hill Reservoir Dam is located in Seismic Zone 3 on the "Seismic Zone Map of Contiguous States". Therefore, according to the recommended guidelines for Phase I Safety Inspection of Dams, a seismic stability analysis should be performed as recommended in Section 7.

SECTION 7

ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The dam and appurtenances appear to be in fair condition. The tree roots and rodent burrows in the downstream face of the dam may lead to the development of seepage paths through the embankment. The 3 feet of water on the floor of Effluent Gatehouse No. 1 could be indicative of a seepage problem. In case of an emergency, it is not known if the reservoir could be drawn down because of the uncertain condition of the gates and gate valves in Effluent Gatehouses 1 and 2. The catch basin system at the downstream toe of the embankment appears to be completely plugged.

b. Adequacy of Information. The drawings, visual inspection data and conversations with the Owner's representative are considered adequate for a Phase I assessment of the Chestnut Hill Reservoir Dam.

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

7.2 Recommendations

The Owner, the MDC, should engage a qualified registered professional engineer to:

1. Investigate the seismic stability of the dam.
2. Supervise the removal of trees from the downstream face of the dam.
3. Determine the source of the water on the floor of Effluent Gatehouse No. 1.

7.3 Remedial Measures

a. Operational and Maintenance Procedures. The MDC should implement the following operational and maintenance measures:

1. Check the operability of the gates and gate valves in Effluent Gatehouses 1 and 2 and, if necessary, repair them.
2. Clean out and repair the catch basin system along the downstream toe of the dam.
3. Backfill all animal burrows.

4. Institute a program of annual periodic technical inspection.
5. Develop and adhere to a comprehensive maintenance program.
6. Develop a formal surveillance and flood warning plan.

7.4 Alternatives

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

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST

INSPECTION TEAM ORGANIZATION

Project: CHESTNUT HILL RESERVOIR DAM

National I.D. #: MA 1113

Location: Boston, MA.

Type of Dam: Earth Embankment

Inspection Date(s): October 23, 1979

Weather: Clear, 64°

Pool Elevation: 134.0 MSL

Inspection Team

Leonard Beck
Steven Snider
Alan Hanscom
Rodney Georges

O'Brien & Gere
O'Brien & Gere
O'Brien & Gere
Bryant & Associates

Structures
Foundations & Materials
Structures
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. William R. Thompson, Superintendant, Water
Division, Metropolitan District Commission

VISUAL INSPECTION CHECK LIST

Project: CHESTNUT HILL RESERVOIR DAM

National I.D. #: MA 1113

Date(s): October 23, 1979

| AREA EVALUATED | CONDITIONS |
|--|----------------------------------|
| <u>DAM EMBANKMENT</u> | |
| Crest Elevation | 138.0 MSL |
| Current Pool Elevation | 134.0 MSL |
| Maximum Impoundment to Date | Unknown. |
| Surface Cracks | None. |
| Pavement Condition | N/A |
| Movement or Settlement of Crest | None. |
| Lateral Movement | None. |
| Vertical Alignment | Good. |
| Horizontal Alignment | Good. |
| Condition at Abutment and at Concrete Structures | No problems noted. |
| Indications of Movements of Structural Items on Slopes | None. |
| Trespassing on Slopes | None. |
| Vegetation on Slopes | Deciduous saplings on d/s slope. |
| Sloughing or Erosion of Slopes or Abutments | Rodent burrows on d/s slope. |
| Rock Slope Protection - Riprap Failures | None. |

VISUAL INSPECTION CHECK LIST

Project: CHESTNUT HILL RESERVOIR DAM

National I.D. #: MA 1113

Date(s): October 23, 1979

| AREA EVALUATED | CONDITIONS |
|--|-----------------|
| <u>DAM EMBANKMENT (Con't)</u> | |
| Unusual Movement or Cracking at or near Toes | <i>None.</i> |
| Unusual Embankment or Downstream Seepage | <i>None.</i> |
| Piping or Boils | <i>None.</i> |
| Foundation Drainage Features | <i>Unknown.</i> |
| Toe Drains | <i>None.</i> |
| Instrumentation System | <i>None.</i> |

VISUAL INSPECTION CHECK LIST

Project: CHESTNUT HILL RESERVOIR DAM

National I.D. #: MA 1113

Date(s): October 23, 1979

| AREA EVALUATED | CONDITIONS |
|--|---|
| <u>OUTLET WORKS - CONTROL TOWER</u> | <u>EFFLUENT GATEHOUSE NO. 1</u> |
| a. Concrete and Structural | |
| General Condition | Good. |
| Condition of Joints | Good. |
| Spalling | Slight loss of mortar. |
| Visible Reinforcing | None. |
| Rusting or Staining of Concrete | None. |
| Any Seepage or Efflorescence | Moist walls in gate chamber |
| Joint Alignment | Good. |
| Unusual Seepage or Leaks in Gate Chamber | None, but 3 feet of water on floor of gate chamber. |
| Cracks | None. |
| Rusting or Corrosion of Steel | None. |
| b. Mechanical and Electrical | |
| Air Vents | None. |
| Float Wells | None. |
| Crane Hoist | None. |

VISUAL INSPECTION CHECK LIST

Project: CHESTNUT HILL RESERVOIR DAM

National I.D. #: MA 1113

Date(s): October 23, 1979

| AREA EVALUATED | CONDITIONS |
|---|------------------------------------|
| <u>OUTLET WORKS - CONTROL TOWER (Con't)</u> | |
| Elevator | N/A |
| Hydraulic System | N/A |
| Service Gates | All 48" ϕ gates are operable. |
| Emergency Gates | N/A |
| Lighting Protection System | None. |
| Emergency Power System | N/A |
| Wiring and Lighting System in Gate Chamber | N/A |
| A-5 | |

VISUAL INSPECTION CHECK LIST

Project: CHESTNUT HILL RESERVOIR DAM

National I.D. #: MA 1113

Date(s): October 23, 1979

| AREA EVALUATED | CONDITIONS |
|--|---|
| <u>OUTLET WORKS - CONTROL TOWER</u> | <u>EFFLUENT GATEHOUSE NO. 2</u> |
| a. Concrete and Structural | |
| General Condition | Good. |
| Condition of Joints | Good. |
| Spalling | None. |
| Visible Reinforcing | None. |
| Rusting or Staining of Concrete | None. Stone masonry structure. |
| Any Seepage or Efflorescence | None. |
| Joint Alignment | Good. |
| Unusual Seepage or Leaks in Gate Chamber | None noted. |
| Cracks | None. |
| Rusting or Corrosion of Steel | Some corrosion of stop log hoist & support beam. |
| b. Mechanical and Electrical | |
| Air Vents | N/A |
| Float Wells | Stage recorder consisting of grad. rod and float. |
| Crane Hoist | Operable. |

VISUAL INSPECTION CHECK LIST

Project: CHESTNUT HILL RESERVOIR DAM

National I.D. #: N/A 1113

Date(s): October 23, 1979

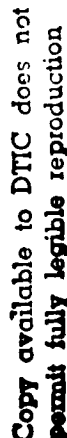
| AREA EVALUATED | CONDITIONS |
|---|---|
| <u>OUTLET WORKS - CONTROL TOWER (Con't)</u> | |
| Elevator | N/A |
| Hydraulic System | N/A |
| Service Gates | All 3- 60.5" ϕ gates are operable. |
| Emergency Gates | No stop logs at site. |
| Lighting Protection System | N/A |
| Emergency Power System | N/A |
| Wiring and Lighting System in Gate Chamber | N/A |

APPENDIX B

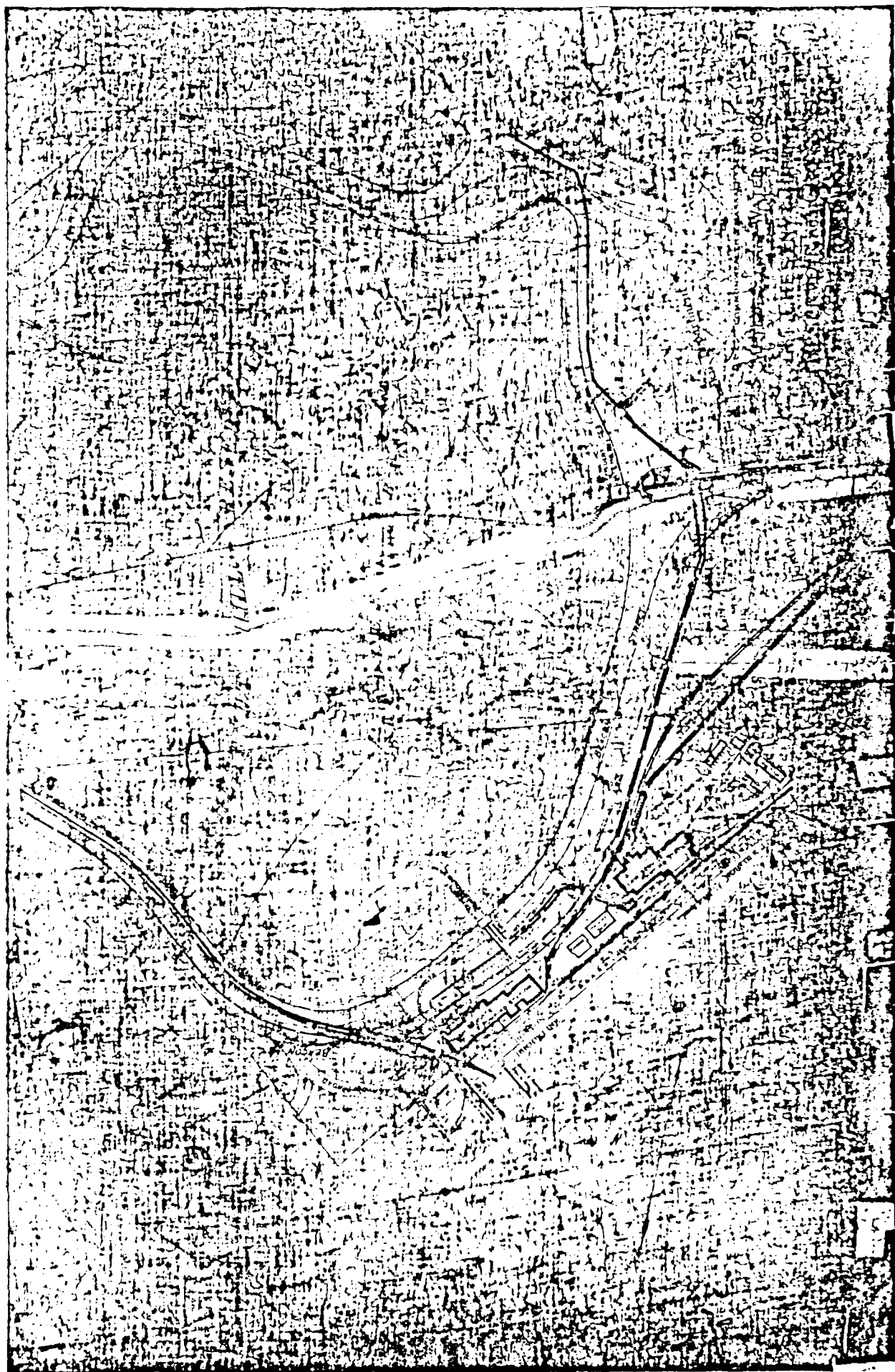
ENGINEERING DATA

APPENDIX B
ENGINEERING DATA
TABLE OF CONTENTS

| | <u>PAGE</u> |
|-----------------------------------|-------------|
| PLAN OF GATES | B-1 |
| RESERVOIR & GROUNDS, GENERAL PLAN | B-2 |



| SUPPLEMENTARY TABLE | | | MARCH 1900 | |
|---------------------|------|--------------------|------------|--|
| LUTATION | WIND | GATE | SIZE | |
| Small (1000) | 10 | 28 ft | 28 diam | |
| | 11 | Hydraulic Gates | 60 5/8 | |
| | 12 | 28 ft off by Drain | 12 | |
| | 13 | 28 ft off by Drain | 36 | |



APPENDIX C

PHOTOGRAPHS

APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT

LOCATION PLAN

Site Plan Sketch

Page
No.

A

PHOTOGRAPHS

No.

Page
No.

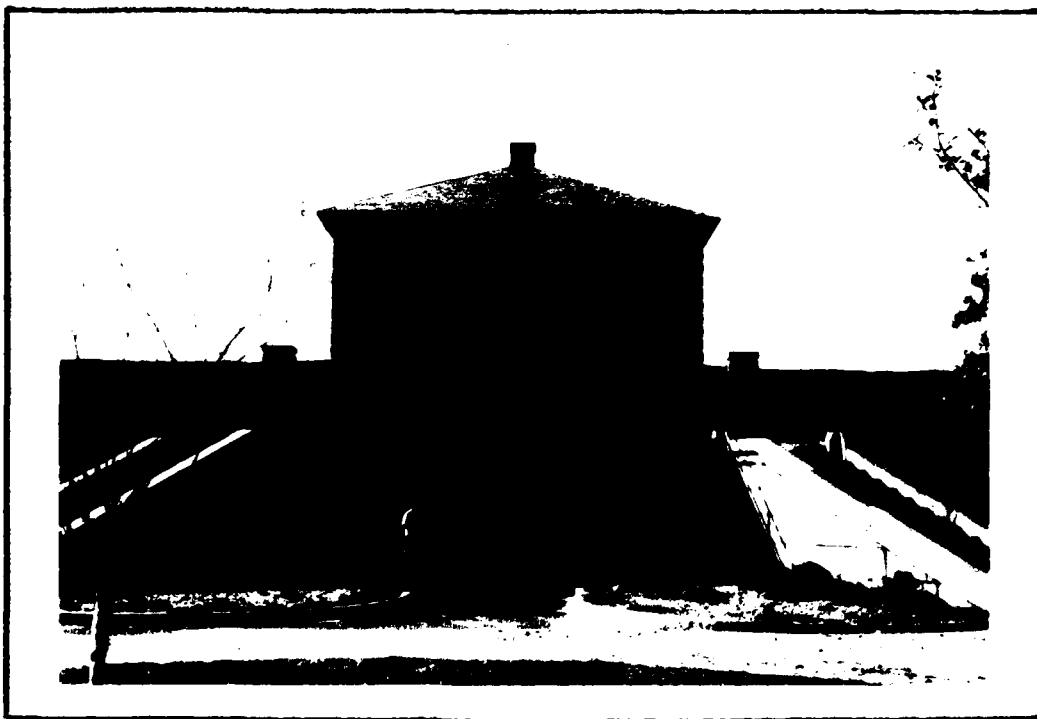
- | | | |
|-----|--|---|
| 1. | Downstream approach to effluent gatehouse No. 1 showing the potential hazard area in the background. | 1 |
| 2. | Effluent gatehouse No. 1 as viewed from downstream. | 1 |
| 3. | Downstream slope of the dam showing the berm and recently planted saplings looking north. | 2 |
| 4. | Downstream slope of the dam looking southwest showing the recently planted saplings on the embankment. | 2 |
| 5. | Effluent gatehouse No. 2 looking towards the western abutment. | 3 |
| 6. | Southeastern dam crest showing buildings and street of the potential hazard area in the background. | 3 |
| 7. | Chestnut Hill Reservoir showing Boston College in the western background. | 4 |
| 8. | Typical rodent hole in the downstream face of the dam. | 4 |
| 9. | Gate stems and hoists inside the effluent gatehouse No. 1. | 5 |
| 10. | Housing for the gate hoists inside the effluent gatehouse No. 2. | 5 |

A





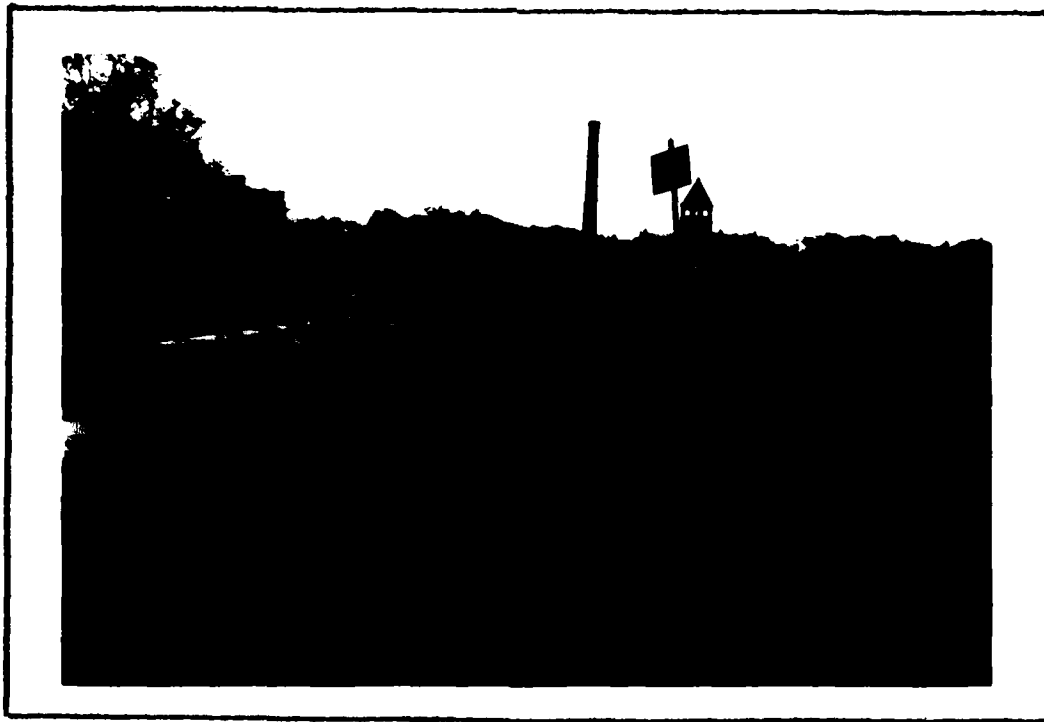
1. DOWNSTREAM APPROACH TO THE EFFLUENT GATEHOUSE NO. 1 SHOWING THE POTENTIAL HAZARD AREA IN THE BACKGROUND. (10/23/79)



2. EFFLUENT GATEHOUSE NO. 1 AS VIEWED FROM DOWNSTREAM. (10/23/79)



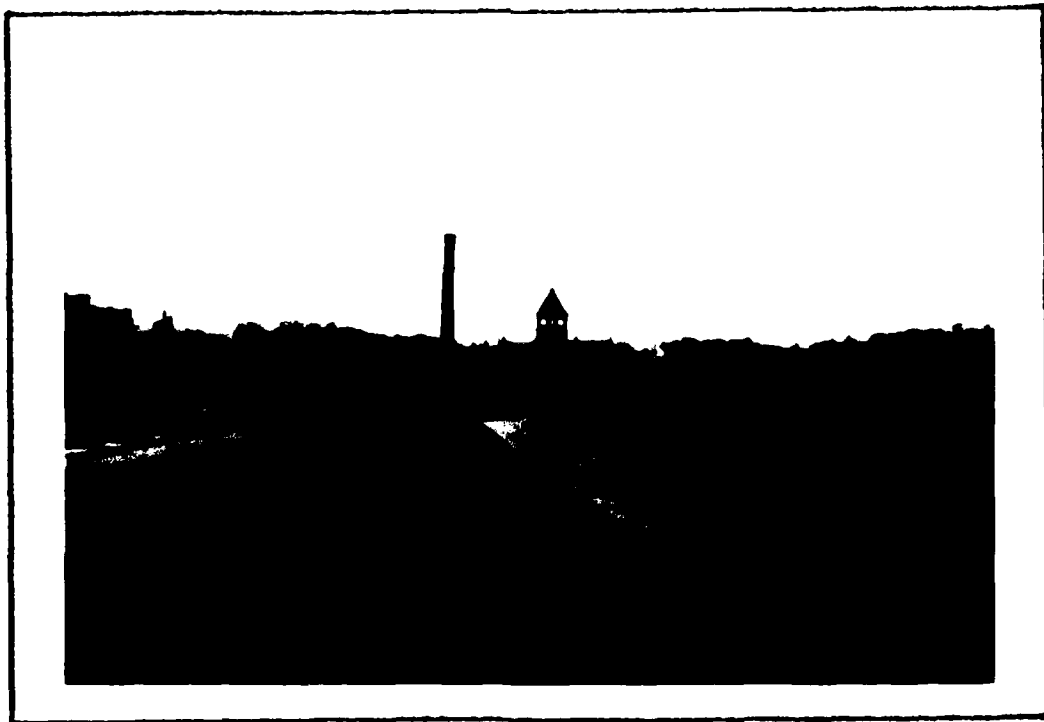
3. DOWNSTREAM SLOPE OF THE DAM SHOWING THE BERM AND RECENTLY PLANTED SAPLINGS LOOKING NORTH. (10/23/79)



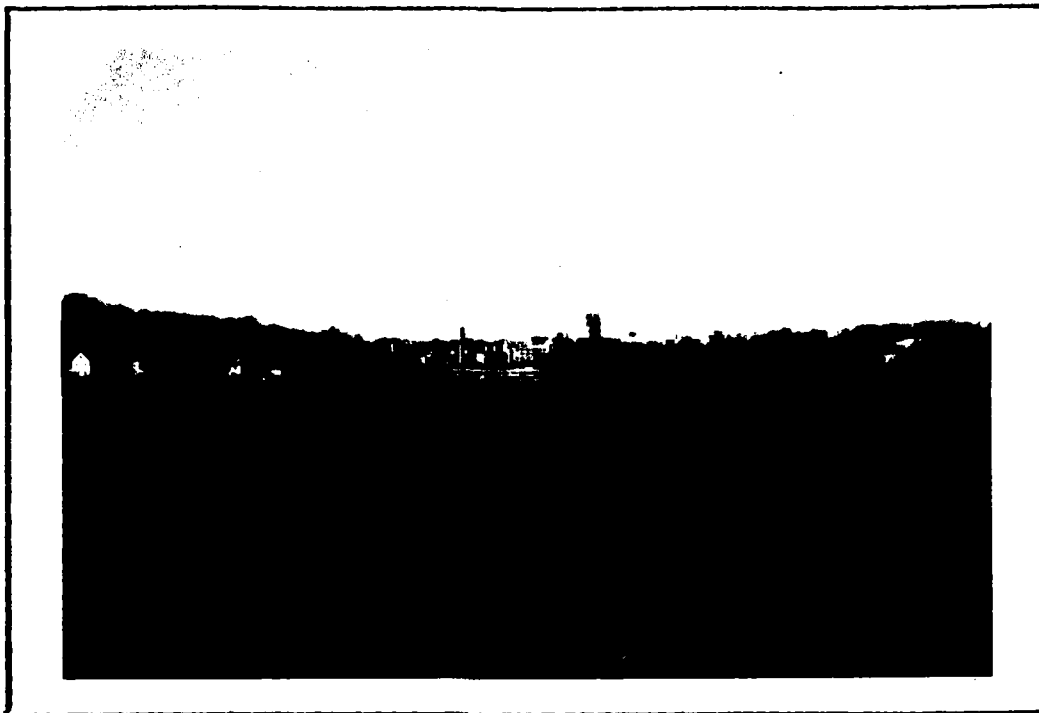
4. DOWNSTREAM SLOPE OF THE DAM LOOKING SOUTHWEST SHOWING THE RECENTLY PLANTED SAPLINGS ON THE EMBANKMENT. (10/23/79)



5. EFFLUENT GATEHOUSE NO. 2 LOOKING TOWARDS THE WESTERN ABUTMENT.
(10/23/79)



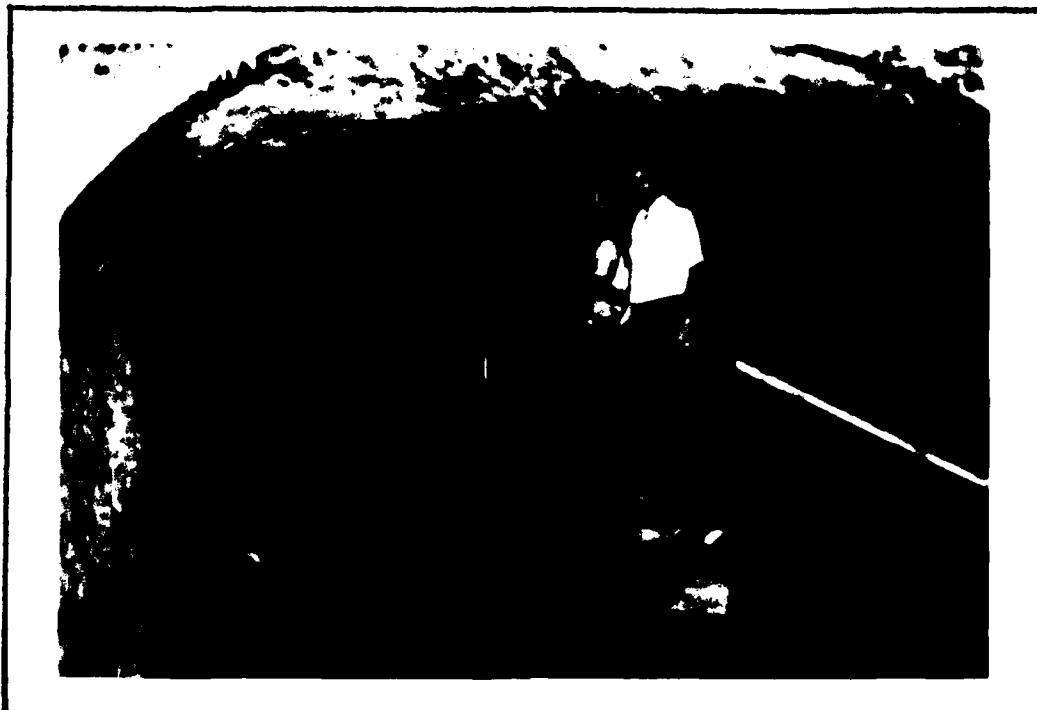
6. SOUTHEASTERN DAM CREST SHOWING BUILDINGS AND STREET OF THE
POTENTIAL HAZARD AREA IN THE BACKGROUND. (10/23/79)



7. CHESTNUT HILL RESERVOIR SHOWING BOSTON COLLEGE IN THE WESTERN BACKGROUND. (10/23/79)



8. TYPICAL RODENT HOLE IN THE DOWNSTREAM FACE OF THE DAM. (10/23/79)



9. GATE STEMS AND HOISTS INSIDE EFFLUENT GATEHOUSE NO. 1.(10/23/79)



10. HOUSING FOR THE GATE
HOISTS INSIDE EFFLUENT
GATEHOUSE NO. 2. (10/23/79)

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

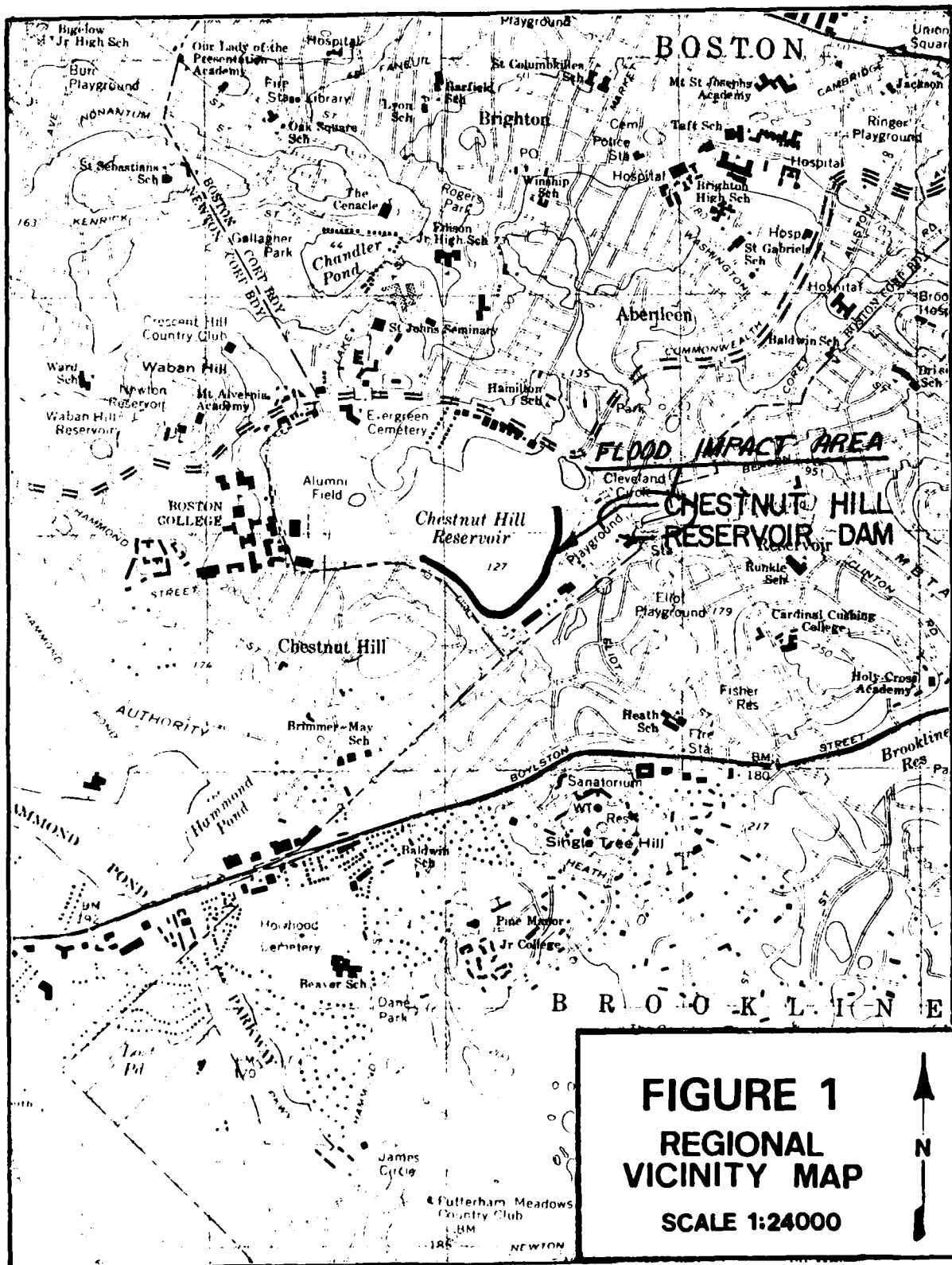
| | | | | |
|------------------------------------|-------|----|------|--------|
| SUBJECT | SHEET | BY | DATE | JOB NO |
| <i>CHESTNUT HILL RESERVOIR DAM</i> | | | | |

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

TABLE OF CONTENTS

| | <u>PAGE</u> |
|---|-----------------|
| <i>REGIONAL VICINITY MAP, FIGURE 1, SHOWING FLOOD IMPACT AREA</i> | <i>D-1</i> |
| <i>STAGE-AREA, STAGE-STORAGE, & HAZARD AREA INFORMATION</i> | <i>D-2</i> |
| <i>HEC-1 DAM SAFETY VERSION, BREACH ANALYSIS, COMPUTER OUTPUT</i> | <i>D-3</i> |
| | <i>thru D-6</i> |



JOB NED-COE, CHESTNUT HILL RES. DAM

SHEET NO D-2 OF

CALCULATED BY RG DATE

CHECKED BY SHS DATE

SCALE _____

CHESTNUT HILL RESERVOIR DAM - H&H

PMP CALCS. (TEST FLOOD):

FROM HMS # 33 → 24 HR., 200 SQ. MI. INDEX RAINFALL = 21.5 INCHES

INDEX % FOR < 10 SQ. MI. AREA (FOR 24 HR STORM) = 133%, HOP BROOK
FACTOR (FOR PROBABILITY OF IMPERFECT FIT OF STORM OVER BASIN) = 0.8.

TEST FLOOD \rightarrow 24 HR. PMP = $(1.33)(0.8)(21.5) = 22.9$ INCHES

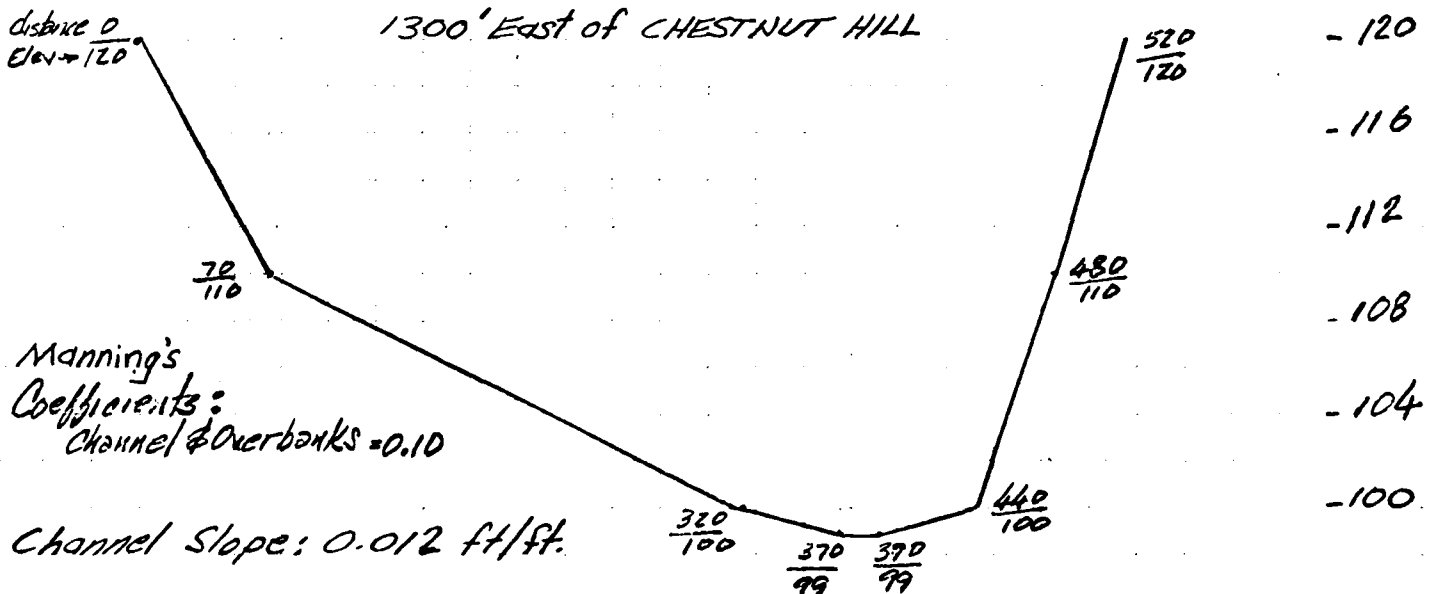
APPLYING THE TEST FLOOD DIRECTLY TO THE NORMAL POOL RESERVOIR SURFACE YIELDS A TEST FLOOD ELEV. OF $128.3 + 1.9 = \underline{130.2}$. THE TOP OF THE DAM IS AT ELEVATION 132.3 AND, THEREFORE, IT IS EXTREMELY UNLIKELY THAT THE EMBANKMENT WOULD EVER BE OVERTOPPED.

AREA & STORAGE

| ELEV. | AREA (AC) | | |
|---------------------|-----------|-------------|---------|
| 114.3 (BOTTOM) | 68.4 | TOP OF DAM | 1273 AF |
| 128.3 (NORMAL POOL) | 73 | TEST FLOOD | 1120 AF |
| 132.3 (TOP OF DAM) | 73 | (EL. 130.2) | |

SECTION @ HAZARD AREA

1300' East of CHESTNUT HILL



.....
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 20 FEB 79
.....

HYDRAULIC ANALYSIS OF CHESTNUT HILL RESERVOIR DAM

NATIONAL DAM SAFETY PROGRAM
NEW ENGLAND DIVISION COMPS OF ENGINEERS
10 0 0 0 0 0 0 0

HYDROLOGIC ANALYSIS OF CHESTNUT HILL WESERVUIN DAM
NATIONAL DAM SAFETY PROGRAM
NEW ENGLAND DIVISION CORPS OF ENGINEERS
10 0 0 0 0 0 0 0

-132.3 -1

134.3 139.3
15948-103600-

| | |
|-------|-------|
| 72 | 73 |
| 128.3 | 132.3 |

100

0.01 116.3
HAZARD

CHANNEL ROUTING

0.1
120

100-400

100

| Year | Number of cases | Rate per 100,000 | Rate per 100,000 (95% CI) |
|------|-----------------|------------------|---------------------------|
| 1990 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 1991 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 1992 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 1993 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 1994 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 1995 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 1996 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 1997 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 1998 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 1999 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2000 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2001 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2002 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2003 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2004 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2005 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2006 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2007 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2008 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2009 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2010 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2011 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2012 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2013 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2014 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2015 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2016 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2017 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2018 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2019 | 10 | 0.0 | 0.0 (0.0-0.0) |
| 2020 | 10 | 0.0 | 0.0 (0.0-0.0) |

PREVIEW OF SEQU

ROUTE 110

END OF

100

1

OVERVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

ROUTE HYDROGRAPH TO
ROUTE HYDROGRAPH TO
END OF NETWORK

RUN DATE 02/12/80.
TIME 10.18.57.

HYDROLOGIC ANALYSIS OF CHESTNUT HILL RESERVOIR DAM
NATIONAL DAM SAFETY PROGRAM
NEW ENGLAND DIVISION CORPS OF ENGINEERS

| JUH SPECIFICATION | | | | | | | | | | | |
|-------------------|-----|------|-------|-----|-------|-------|------|------|--------|--|--|
| NO | QHH | NMIN | IDAY | IMH | IMIN | MEINC | IPLI | IPRI | INSTAN | | |
| 300 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | JUPEM | NWT | LROPT | TRACE | | | | | |
| | | | 5 | 0 | 0 | 0 | | | | | |

MULTI-PLAN ANALYSES TO BE PERFORMED
--PLAN--RATION--RATION--

NO INFLOW \rightarrow $\pi_{1105} = 0.00$

HYDROGRAPH ROUTING

HRFACH ROUTING CHESTNUT HILL RES. CAM

| ISTAU | ICOMP | IFCON | ITAPE | JPLT | INAME | ISTAGE | IAUTO |
|--------------|-------|-------|-------|-------|-------|--------|-------|
| CHESM | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| ROUTING DATA | | | | | | | |
| | | IMES | ISAME | IUPT | IPMP | LSTR | |
| NULOSS | CLOSS | AVG | | | | | |
| 0.0 | 0.000 | 0.00 | 1 | 0 | 0 | 0 | |
| NSIPS | | | | | | | |
| NSIDL | LAG | ANSKK | X | TSK | STORA | ISPHAT | |
| 1 | 0 | 0 | 0 | 0.000 | 132 | 1 | |

STAGE- DISCHARGE DATA

| | | | |
|-------|--------|----------|-----------|
| STAGE | 132.30 | 134.30 | 139.30 |
| FLOW | 0.00 | 15848.00 | 103600.00 |

SURFACE-AREA = 60.72.

STAGE-STORAGE DATA

| | | | |
|------------|------|------|-------|
| CAPACITY= | 0. | 983. | 1213. |
| ELEVATION= | 114. | 128. | 152. |

SPILLWAY CREST ELEVATION → 132.3

NAME DATA -

| TOPEL | COND | EXPI | DAMWID |
|-------|------|------|--------|
| 132.3 | 0.0 | 0.0 | 0. |

UAM BMEACH IATA

Z ELHM TFAL
:01-116:30-1:00-

WSEL FAILED } BREACH DATA - FAILURE BEGINS
0:20-130:20 IMMEDIATELY WITH RESERVOIR
SURFACE AT TEST FLOOD ELEVATION

BEGIN DAM FAILURE AT 0.00 HOURS

PEAK OUTFLOW IS 1111A. AT TIME 1-00 HOURS

PEAK BREACH DISCHARGE

HYDROGRAPH ROUTING

CHANNEL ROUTING TO HAZARD CENTER

| ISLAG | ICOMP | IFCON | ITAPE | JPLT | JPRI | INAME | ISAGE | IAUTO |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|
| HAZARD | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| ROUTING DATA | | | | | | | | |
| GLUSS | CLUSS | AVG | JMES | ISAME | JOPT | IPW | ESTR | |
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 | |
| NSIPS | | | | | | | | |
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| LAG | | | | | | | | |
| 0 | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| AMSAK | | | | | | | | |
| 0 | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |
| ISPRAT | | | | | | | | |
| 0 | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 |

NORMAL DEPTH CHANNEL ROUTING

| UN(1) | UN(2) | UN(3) | ELNVT | FLMAX | MLNTH | SET |
|-------|--------|--------|-------|-------|-------|---------|
| 0.000 | 0.1000 | 0.1000 | 99.0 | 120.0 | 1300. | 0.01200 |

| CROSS SECTION COORDINATES--STA+ELEV+STA+ELEV--FTC | 370.00 | 49.00 | 340.00 | 99.00 |
|---|--------|-------|--------|-------|
| 0.00 120.00 70.00 110.00 320.00 100.00 | | | | |
| 440.00 100.00 440.00 110.00 520.00 120.00 | | | | |

STAGE-STORAGE AND
STAGE-DISCHARGE
DATA FOR THE FLOW
AREA AT THE DAMAGE
CENTER

| STORAGE | 0.00 | 2.47 | 7.06 | 12.70 | 19.41 | 27.16 | 35.98 | 45.86 | 56.79 | 68.77 |
|------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| OUTFLOW | 81.82 | 95.56 | 109.71 | 124.25 | 139.20 | 154.55 | 170.30 | 186.45 | 203.00 | 219.95 |
| STAGE | 17084.32 | 21431.61 | 26247.51 | 31525.74 | 37262.43 | 43455.46 | 50104.03 | 57208.36 | 64769.43 | 72788.90 |
| FLOW | 99.00 | 100.11 | 101.21 | 102.32 | 103.42 | 104.53 | 105.63 | 106.74 | 107.84 | 108.95 |
| MAXIMUM STAGE IS | 17084.32 | 21431.61 | 26247.51 | 31525.74 | 37262.43 | 43455.46 | 50104.03 | 57208.36 | 64769.43 | 72788.90 |

WATER ELEVATION AT DAMAGE AREA

**CHESTNUT HILL RESERVOIR DAM -
BREACH ROUTED TO DAMAGE CENTER**

SUMMARY OF DAM SAFETY ANALYSIS

| INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---------------|----------------|------------|
| 130.20 | 132.30 | 132.30 |
| 1120. | 1273. | 1273. |
| 0. | 0. | 0. |

| PLAN 1 | ELEVATION | STORAGE | OUTFLOW |
|--------|-----------|---------|---------|
| 0.00 | 130.20 | 1120. | 0. |

| MAXIMUM OF PMF | 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 | 0.00 | 1120. | 11814. | 0.00 | 1.00 | 0.00 |

TEST FLOOD ELEVATION
PLAN 1 STATION HAZARD

| NATLO | FLOW+CFS | MAXIMUM STAGE+FT | TIME HOURS |
|-------|----------|---------------------|---------------|
| 0.00 | 11526. | 108.22 | 1.00 |

ROUTED OUTFLOW
FLOW THROUGH DAMAGE AREA
FLOW ELEVATION AT DAMAGE AREA

6.1

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

FILMED

7-85

DTIC