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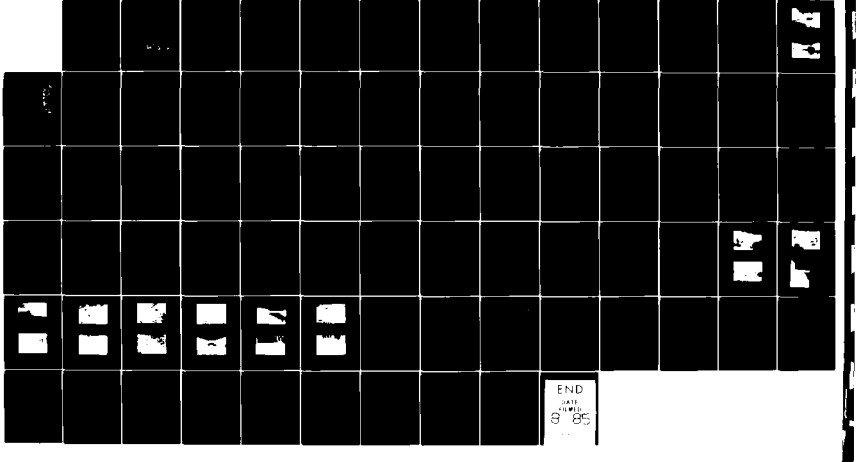

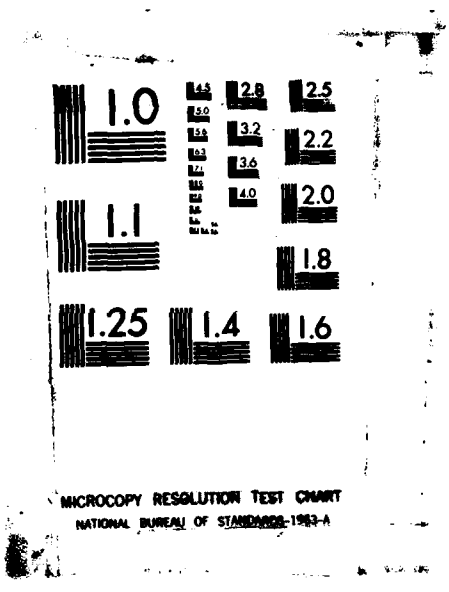
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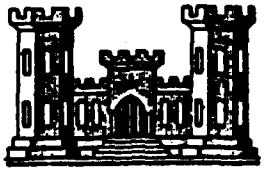
FINAL

CHARLES RIVER BASIN
WESTON, MASSACHUSETTS

WESTON RESERVOIR DAM
MA 00798

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

FEBRUARY 1980

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NEDED-E	Dam Safety Draft Report

TO: Chief, Design Branch
Chief, F&M Branch
Chief, Water Control Br.

FROM: Chairman, Dam Safety Review Board

DATE: 22 FEB 80 CMT 1

Attached for your review are two copies of the Architect-Engineer's draft report for WESTON RESERVOIR Dam, Identity No. MA 00798. The review board meeting date for this report is 5 MAR. Please present your comments in writing under the format shown below. Please return one copy with your comments. Cost code for this rewiew is ABAO 2070 2 000000 (FY80)

Incl (dupe)
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Yellow

NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS
DRAFT REPORT REVIEW COMMENTS
Weston Reservoir DAM, IDENTITY NO. MA 00798
F&M BRANCH

Page No.	Comments
Brief Assessment	1) Max dam height should be 32 feet. (Section 1)
Brief Assess. & 7-1 pam. 72	2) add "qualified" before registered prof. engineer
Appendix C	3) Show area of seepage on photo plan.

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4. TITLE (and Subtitle) Weston Reservoir Dam 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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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Charles River Basin
Weston, Massachusetts
Pine Brook

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

The dam is an earth embankment dam about 1000 ft. long with a maximum height of about 32 ft. It is intermediate in size with a high hazard potential. The dam appears to be in fair condition. The upstream slope appeared to be well maintained and in good condition.

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WESTON RESERVOIR DAM

MA 00798

CHARLES RIVER BASIN

WESTON, MASSACHUSETTS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.:	MA 00798
Name of Dam:	Weston Reservoir Dam
Town:	Weston
County and State:	Middlesex County, Massachusetts
Stream:	Pine Brook
Date of Inspection:	October 23, 1979

BRIEF ASSESSMENT

Weston Reservoir Dam is an earth embankment approximately 1,000 feet long with a maximum height of about 32 feet. The upstream slope of the embankment is approximately 2H:1V and is protected with heavy cut stone riprap to within two feet of the top of the dam. The downstream slope varies from 2H:1V to 2½H:1V along the length of the dam and the crest of the dam varies from 40 feet to 140 feet in width. The dam was constructed about 80 years ago and it is used as a stand pipe in the Weston Aqueduct which is a portion of the water supply source for the City of Boston and surrounding communities.

The reservoir is located adjacent to Pine Brook which bypasses the reservoir by means of a 36-inch diameter pipe. The bypass pipe conveys the Pine Brook discharge around the left abutment of the dam to a natural stream channel located approximately 200 feet downstream of the dam. The main inflow to the reservoir is from the Weston Aqueduct. The aqueduct terminates upstream of the reservoir and flow from the aqueduct is directed into the reservoir by means of a 100-foot wide, 0.25-mile long channel. Discharge from the reservoir is controlled by a system of 5 stop log bays, which are located in the stone masonry screen chamber and flow control building located about 50 feet to the right of the left abutment. The discharge flows back into the Weston Aqueduct immediately downstream of the screen chamber and flow control building. A 16-inch low level discharge pipe, located about 500 feet to the left of the right abutment, provides additional discharge capacity. No spillway exists for this structure.

Weston Reservoir has a maximum storage capacity of approximately 1,100 acre-feet, which places the dam in the "Intermediate" size category. Several houses are located within the flood plain of Pine Brook within one mile downstream of the dam. Excessive property damage and loss of life could result in these locations in the event of a dam failure. Therefore, Weston Reservoir 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 Weston Reservoir was computed to be 1,880 cfs. The routed test flood outflow was computed to be 1,100 cfs and would result in overtopping of the embankment by 0.5 feet. The reservoir is capable of storing approximately 60 percent of the test flood in surcharge storage prior to overtopping of the embankment.

On the date of the inspection, Weston Reservoir Dam appeared to be in fair condition. The upstream slope appeared to be well maintained and in good condition. However, the downstream slope and, to a lesser extent, the crest of the dam are overgrown with large trees, some as tall as 50 feet. Several roots are exposed along the crest of the dam, indicating the presence of extensive root systems throughout the embankment. In addition, a significant quantity of seepage (5 gpm) was observed approximately 20 feet downstream of the outlet of the 36-inch diameter bypass pipe within a few feet of the downstream toe of the embankment.

Within one year after the receipt of this Phase I inspection report, a qualified registered professional engineer, experienced in the design and construction of dams, should be retained by the Owner for the following purposes: 1) perform a detailed hydrologic and hydraulic study to assess the need for providing spillway discharge capacity; 2) investigate the cause of the seepage within a few feet of the downstream toe of the embankment along the right bank of the stream bypass outlet channel and assess the need for remedial action; 3) investigate the seismic stability of the dam; and 4) direct the removal of the trees from the downstream slope (to a distance of 20 feet downstream of the toe) and crest of the dam to minimize potential damage to the embankment. Voids left in the embankment by the removal of trees should be filled with suitable, thoroughly compacted material.

In addition, the Owner should implement the following operational and maintenance procedures: 1) operability of the low level outlet pipe (16-inch diameter) valve should be investigated, and the valve should be repaired if necessary; 2) develop and implement an ongoing operation and maintenance program; 3) institute a program of annual periodic technical inspection; 4) develop a formal surveillance and flood warning plan, including round-the-clock monitoring during heavy precipitation; and 5) install an upstream closure devise for emergency cutoff of aqueduct flow to the reservoir.

O'BRIEN & GERE ENGINEERS, INC.

John J. Williams

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

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

Date: 24 March 1980

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.

TABLE OF CONTENTS

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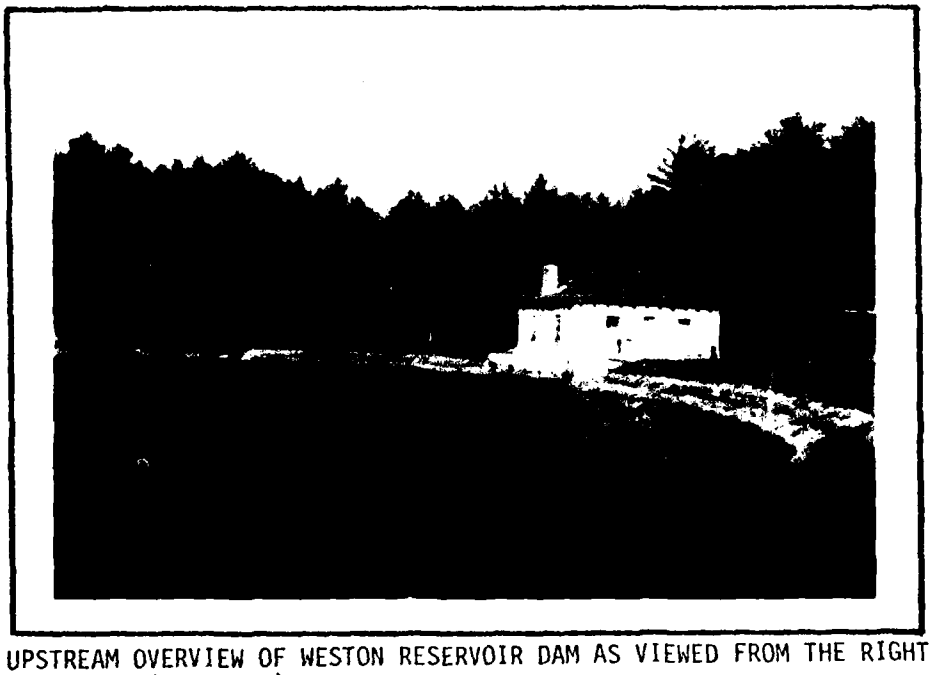
APPENDICES

UPSTREAM OVERVIEW OF WESTON RESERVOIR DAM AS VIEWED FROM THE LEFT ABUTMENT. (10/23/79)



UPSTREAM OVERVIEW OF WESTON RESERVOIR DAM AS VIEWED FROM THE RIGHT ABUTMENT. (10/23/79)

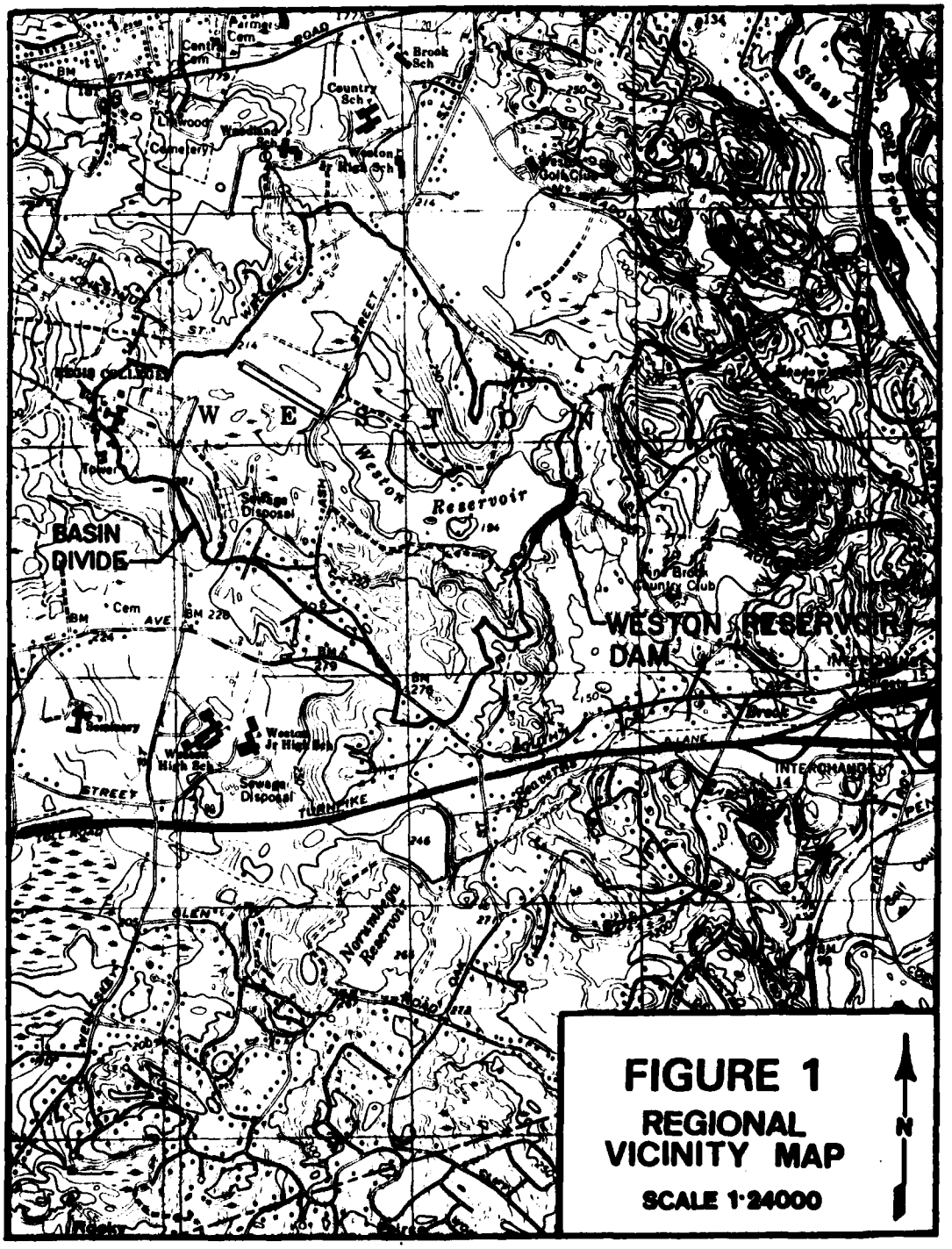


FIGURE 1

REGIONAL VICINITY MAP

SCALE 1:24000

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
WESTON RESERVOIR 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 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 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 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 with regard to this dam was obtained from Mr. Ray Gaumont, Metropolitan District Commission (MDC) Labor Foreman at Weston Reservoir; the Massachusetts Department of Environmental Quality Engineering (DEQE); and from Mr. Charles Y. Hitchcock, Director and Chief Engineer for the MDC).

a. Location. Weston Reservoir Dam is located adjacent to Pine Brook in the Town of Weston, Massachusetts. The brook bypasses the reservoir by means of a 36-inch diameter pipe which intercepts the flow from the natural channel upstream of the reservoir, conveys it around the left abutment of the dam and discharges it back to the brook about 200 feet downstream of the dam. Two homes are located on the banks of Pine Brook within a mile downstream of the embankment. Pine Brook flows into Seaverns Brook about a mile downstream of the dam. A portion of the USGS Quadrangle map entitled "Natick, Massachusetts" has been included as Figure 1 on page vi of this report to illustrate the location. USGS coordinates for this dam are N 42°20.3' and W 71°16.6'.

b. Description of Dam and Appurtenances. Weston Reservoir Dam is an earth embankment approximately 1,000 feet long with a maximum height of 32 feet. The embankment has the following features:

1. The upstream face of the embankment has a slope of approximately 2H:IV and is protected by heavy riprap extending from well below the water surface to within about 3 feet of the crest.

2. The crest of the dam varies in width from approximately 40 feet at the longitudinal midpoint of the dam to approximately 140 feet at the location of the screen chamber and flow control building which is about 50 feet to the right of the left abutment.

3. The downstream slope of the embankment varies within a range of 2H:IV to 2.5H:IV along the length of the dam, with the steeper slope located near the low level discharge pipe.

Outlets from the reservoir include the 16-inch low level discharge pipe located approximately 500 feet left of the right abutment and the Weston Aqueduct which extends from the screen chamber and flow control building in an easterly direction. Page B-3 of Appendix B illustrates the locations of these outlets.

c. Size Classification. The maximum height of the dam and maximum storage capacity of the reservoir are 32 feet and 1,108 acre-feet, respectively. According to established guidelines, an "Intermediate" size dam is one which is more than 40 feet high (but less than 100 feet high) or has a maximum storage capacity of more than 1,000 acre-feet (but less than 50,000 acre-feet). Therefore, because the reservoir has a storage capacity in excess of 1,000 acre-feet, Weston Reservoir Dam is classified as an "Intermediate" size structure.

d. Hazard Classification. In general, the area immediately downstream of the dam is sparsely populated. However, there are several houses within one mile downstream of the dam which are within the flood plain. The breach analysis computed a stream depth of 7.3 feet (or 4.3 feet above the channel banks) at the initial damage center 0.6 miles downstream of the dam. This would result in at least 2 feet of water in the first floor of the house at this location. Therefore, loss of life is probable and excessive property damage would be expected. About 1.1 miles downstream, there is a major interchange of the Massachusetts Turnpike which would also be subject to flooding damage as a result of a dam failure. Therefore, Weston Reservoir Dam is classified as a "High" hazard structure.

e. Ownership. The dam is owned by the Metropolitan District Commission (MDC) located at 20 Somerset Street, Boston, Massachusetts 02109; Telephone 617-727-5275.

f. Operator. Mr. Ray Gaumont is employed by the MDC at the site to operate the outlet facilities and to maintain the dam.

g. Purpose of Dam. Weston Reservoir functions as a stand pipe in the Weston Aqueduct which is used as a water supply source for the City of Boston and the surrounding communities.

h. Design and Construction History: Little information with regard to the design and construction of Weston Reservoir Dam is available. However, a Record Plan dated February, 1905, shows the limits of the core of the dam. A portion of this plan has been included as page B-3 of Appendix B.

i. Normal Operating Procedures. According to Mr. Gaumont, discharge to the Weston Aqueduct is controlled by inserting or removing stop logs in the five sets of stop log slots located in the screen chamber and flow control building. In addition, debris collected at the screens is removed daily and the screens are cleaned and/or replaced as required.

1.3 Pertinent Data

a. Drainage Area. The area draining to Weston Reservoir encompasses a 0.9 square mile area to the northwest of the dam in the Town of Weston. The area is primarily wooded and ranges in elevation from 305 to 194 at normal pool level. Several large estates are scattered throughout the watershed.

b. Discharge at Damsite. (Refer to discharge calculations included in Appendix D).

1. Outlet Works. A 16-inch low level outlet is located approximately 500 feet left of the right abutment, as shown on page B-3 of Appendix B. If the low level discharge valve is operable, this outlet may be used to lower the water level in the reservoir. Outflow through the screen chamber and flow control building to the aqueduct downstream was assumed equal to the inflow to the reservoir from the aqueduct upstream.

2. Maximum Known Flood. Flood records are not kept for this site.

3. Ungated Spillway Capacity at Top of Dam. Not Applicable.

4. Ungated Spillway Capacity at Test Flood Elevation. Not Applicable.

5. Gated Spilway 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. Not Applicable.

8. Total Project Discharge at Top of Dam. No spillway has been provided for this structure. Therefore, the only discharge from the reservoir is through the screen chamber and flow control building and into the aqueduct (assumed equal to the inflow from the aqueduct) or through the low level blowoff pipe.

9. Total Project Discharge at Test Flood Elevation. At the test flood elevation of 201.5, the discharge over the top of the dam was computed as 1,100 cfs.

c. Elevation. (NGVD)

1. Streambed at Toe of Dam	169
2. Bottom of Cutoff	Unknown
3. Maximum Tailwater	NA
4. Normal Pool	194
5. Full Flood Control Pool	NA
6. Spillway Crest (Gated)	NA
7. Design Surcharge (Original Design)	Unknown
8. Top of Dam	201
9. Test Flood Design Surcharge	201.5

d. Reservoir Length. (Feet)

1. Normal Pool	4,000
2. Flood Control Pool	NA
3. Spillway Crest Pool	NA
4. Top of Dam	4,700
5. Test Flood Pool	4,750

e. Storage. (Acre-feet)

1. Normal Pool	486
2. Flood Control Pool	NA
3. Spillway Crest Pool	NA
4. Top of Dam	1,108
5. Test Flood Pool	1,174

f. Reservoir Surface. (Acres)

1. Normal Pool	61
2. Flood Control Pool	NA
3. Spillway Crest Pool	NA
4. Top of Dam	120
5. Test Flood Pool	122

g. Dam

1. Type	Earth Embankment
2. Length	1,000 feet
3. Height	32 feet
4. Top Width	Varies, 40 feet to 140 feet
5. Side Slopes	Upstream 2H:IV Downstream 2H:IV - 2½H:IV
6. Zoning	Unknown
7. Impervious Core	Unknown
8. Cutoff	Yes, but composition Unknown
9. Grout Curtain	Unknown

h. Diversion and Regulating Tunnel.

1. Type	36-inch diameter reinforced concrete pipe
2. Length	2,500 feet
3. Closure	None
4. Access	Manhole
5. Regulating Facilities	None

i. Spillway. None

j. Regulating Outlets.

1. Weston Aqueduct	
a) Invert	182.3
b) Size	9.25 feet high by 10 feet (minimum)
c) Description	Weston Aqueduct
d) Control Mechanism	Stop logs
2. Low Level Discharge Pipe	
a) Invert at Outlet	169.0±
b) Size	16 inches
c) Description	Cast iron pipe
d) Control Mechanism	Unknown

SECTION 2

ENGINEERING DATA

2.1 Design

No design information for Weston Reservoir Dam is available, according to Mr. Ray Gaumont, MDC Labor Foreman employed at the site.

2.2 Construction

Record drawings of the reservoir indicate that the dam was constructed about 1900. These same drawings indicate the presence of a core wall for the entire length of the dam. A portion of the drawings have been included in Appendix B.

2.3 Operation

Operating procedures include installation and removal of stop logs to control the amount of water discharged to the Weston Aqueduct. The stop logs are normally not used. Only when the MDC wants to shut down the Weston Aqueduct are the stop logs used.

2.4 Evaluation

a. Availability.

1. The record drawings, topographic plans, and information about the Weston Aqueduct were obtained from the MDC.

2. An inspection report for Weston Reservoir Dam, dated 1/17/74, was obtained from the Massachusetts DEQE, 100 Nashua Street, North Station, Room 532, Boston, Massachusetts, 02114.

3. In addition, operating information was obtained during the visual inspection and from subsequent telephone conversations with Mr. Ray Gaumont, the MDC Labor Foreman employed at the site (617-893-7499).

b. Adequacy. The information provided by MDC, DEQE, and Mr. Gaumont combined with the information obtained during the visual inspection is considered adequate for a Phase I evaluation.

c. Validity. The record drawings and other information obtained from the MDC appear to be valid. The DEQE inspection report, however, included inspection of only a small portion of the dam at the screen chamber and flow control building (referred to as the granite block pump station in the DEQE inspection report). Consequently, the DEQE report does not accurately define the dam, which is actually an estimated 1,000 feet long and 32 feet high with a top width varying between approximately 40 and 140 feet. The DEQE report states that the dam is 80 feet long, 27 feet high and has a top width of 3 feet. The possible consequences of a dam failure can not be accurately predicted using the information in the DEQE report. A copy of the DEQE inspection report has been included as pages B-6 through B-11 in Appendix B.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. Weston Reservoir Dam was inspected on October 23, 1979. At the time of inspection, the pool elevation was approximately 7 feet below the top of the dam. No underwater areas were inspected.

Observations and comments made during the field inspection appear on a checklist included as Appendix A of this report.

b. Dam. The upstream face of the embankment appears to be well maintained and in good condition. A 30-foot wide strip along the upstream edge of the dam crest is grass-covered and appears to be well maintained. However, the remainder of the crest of the embankment is covered with large trees, some as tall as 50 feet. The downstream face of the dam is overgrown with large trees with trunks up to 2 feet in diameter and heights up to 50 feet which partially obscure the condition of the embankment.

Clear seepage (estimated at 5 gpm) was observed discharging from the right channel bank of the stream approximately 20 feet downstream of the outlet of the bypass conduit within a few feet of the embankment toe.

Sections and photographs of the dam are included in Appendix B and Appendix C, respectively.

c. Appurtenant Structures. The screen chamber and flow control building located near the left abutment which contains chlorination facilities and provides access to the inlet screens appears to be in good condition. The five stop log bays located in the lower portion of the screen chamber and flow control building appear to be in good condition. Control of the discharge from Weston Reservoir to the Weston Aqueduct is provided through the insertion or removal of stop logs in the stop log bays.

The 16-inch pipe located about 500 feet left of the right abutment which functions as the low level outlet for the reservoir appears to have not been used in many years. The outlet and discharge channel for the low level outlet pipe are almost impossible to discern in the forest litter and underbrush. The Owner's representative could not give us any information concerning the control mechanism for the low level outlet.

d. Reservoir Area. The reservoir shoreline has slopes varying from 1 to 20 percent. The area draining to Weston reservoir is primarily comprised of forested and swampy land with several large residences within the Town of Weston. Evidence of slope instability or reservoir siltation was not observed.

e. Downstream Channel. A 36-inch concrete pipe intercepts Pine Brook to the north of the reservoir and conveys it around the left abutment of the dam and back to its natural stream channel about 200 feet downstream of the dam. From this point Pine Brook conveys the water southeasterly to Seaverns Brook about 1.0 miles downstream of the dam and ultimately to the Charles River about 1.5 miles downstream of the dam. Several homes are located within the flood plain within the first mile downstream of the dam.

The only direct discharge from the reservoir enters the Weston Aqueduct at the downstream end of the screen chamber and flow control building and is conveyed towards the Chesnut Hill Reservoir and eventual distribution in the City of Boston.

3.2 Evaluation

The upstream face of the embankment appears to be well maintained and is provided with heavy stone riprap for erosion protection. The upstream portion of the crest is also well maintained and grass-covered. However, the downstream face of the embankment and downstream portion of the crest are overgrown with large trees which hinder a detailed inspection of the embankment condition. In addition, the trees create a hazard to the integrity of the embankment by virtue of their apparently extensive root systems. The roots of the larger trees create potential seepage paths through the embankment and should any of these trees be uprooted during severe wind conditions, a significant amount of embankment material would be displaced.

Another matter of concern is the approximately 5 gpm of seepage observed on the right bank of the bypass outlet channel about 20 feet downstream of the outlet on the 36-inch pipe within a few feet of the embankment toe. Further investigation of this seepage is recommended.

Several photographs of the dam have been included in Appendix C to illustrate the conditions described above.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. The only operational procedure performed at the site is the infrequent insertion or removal of stop logs to regulate reservoir discharge to the aqueduct.

b. Description of Any Warning System in Effect. According to Mr. Gaumont, the Owner's representative, there is no downstream warning system in effect at this site.

4.2 Maintenance Procedures

a. General. According to the Owner's representative, other than daily removal of debris collected on the screens at the inlet to the screen chamber and flow control building and periodic mowing of the upstream side of the dam crest, no maintenance tasks are performed on a routine basis. Other maintenance tasks are performed, as the need arises, by a MDC crew employed at the site.

b. Operating Facilities. The screen chamber and flow control building contains chlorination facilities for the reservoir and provide access to the inlet screens and stop log slots. According to the Owner's representative, there are no routine maintenance procedures other than those discussed in the preceding subsection.

4.3 Evaluation

The current maintenance program has provided for care of the grounds and screening facilities. However, the program has not provided procedures for proper maintenance of the dam crest and the downstream face of the dam which should be kept clear of trees, brush, etc.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The drainage area to Weston Reservoir is approximately 0.9 square miles of relatively hilly, wooded, swampy terrain in the Town of Weston. The drainage area is sparsely populated, with only a small number of residences throughout the basin. The topography ranges from Elev. 305 in the upper reaches of the watershed to Elev. 194 at the normal pool water surface. A 36-inch bypass pipe intercepts the discharge of Pine Brook north of the reservoir and conveys it to Pine Brook about 200 feet downstream of the dam. Upstream of the reservoir, Weston Aqueduct discharge flow into a 100-foot wide, 0.25-mile long channel which directs the flow into Weston Reservoir. Discharge from the reservoir travels through the screen chamber and flow control building and into the aqueduct which resumes its course immediately downstream of the dam. No spillway is provided for this structure for additional discharge capacity.

5.2 Design Data

According to the Owner's representative, no hydraulic or hydrologic design data is available.

5.3 Experience Data

Reservoir pool elevation records have been maintained by the MDC and are available at the site and at their main office in Boston. According to MDC personnel, the embankment has never been overtopped.

5.4 Test Flood Analysis

The recommended test flood for an "Intermediate" size, "High" hazard dam is the full Probable Maximum Flood (PMF).

Hydrologic and hydraulic calculations were performed with the assistance of the HEC-1-DB computer program. The flood hydrographs were constructed from the Snyder unit hydrographs using average coefficients, an initial infiltration of zero and a constant loss rate of 0.05 inches per hour. The Hop Brook Adjustment Factor was used to reduce the Probable Maximum Precipitation (PMP) based on the drainage area. A Stage vs. Storage relationship was developed for Weston Reservoir. This relationship was utilized by the program to route the test flood through the dam. Inflow from the upstream aqueduct was assumed equal to outflow to the downstream aqueduct so that the only project discharge was due to flow over the top of the dam. The reservoir water surface was assumed to be at the normal pool elevation of 194 at the beginning of the storm event.

The test flood peak inflow to Weston Reservoir Dam was computed to be 1,880 cfs. The routed test flood outflow was computed to be 1,100 cfs which would result in overtopping of the embankment by 0.5 feet. The reservoir is capable of retaining approximately 60 percent of the test flood in surcharge storage prior to overtopping of the embankment.

5.5 Dam Failure Analysis

A failure of the embankment was simulated by the HEC-1-DB computer program assuming a 400-foot wide and 26-foot deep breach with vertical side slopes developing within 3 hours. The failure is assumed to occur with the reservoir surface at the top of dam elevation. The resulting outflow was routed to the potential damage center, which was assumed to be the first house approximately 0.6 miles downstream on the banks of Pine Brook. The channel cross-section at this point is shown on page D-3. The increase in stream depth at this location was computed to be 7.3 feet, or 4.3 feet above the banks of the channel with a maximum flow of 8,830 cfs. This would result in at least 2 feet of water in the house 0.6 miles downstream of the dam. Excessive property damage and possibly the loss of several lives could occur.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

At the time of inspection, no signs of settlement, cracking, or other structural movement were observed. The upstream face and crest of the dam are well maintained and appeared to be in good condition. The downstream face of the embankment and a portion of the dam crest are partially obscured by a heavy growth of trees, brush and forest litter; therefore, it is difficult to tell if the downstream face of the dam and the crest are free of structural deficiencies. The root systems of the trees create a potential hazard to the integrity of the embankment. Severe winds could uproot some of the trees, thereby dislodging portions of the embankment in the process. The root systems of the trees could also create seepage paths through the dam.

During the inspection, significant seepage (approximately 5 gpm) was observed about 20 feet downstream of the 36-inch bypass pipe outlet along the right side of the outlet channel within a few feet of the downstream embankment toe. Seepage of this magnitude could endanger the stability of the structure due to the possibility of migration of fine material through the embankment.

6.2 Design and Construction Data

Little information with regard to the original design and construction of the dam is available. A portion of the record plans are included in Appendix B. No indication of materials used in the construction of the dam or core wall is given on the plans and no specifications are available.

6.3 Post Construction Changes

There are no known modifications to the original construction of the dam.

6.4 Seismic Stability

Weston 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. Based upon the visual inspection, Weston Reservoir Dam appears to be in fair condition. The upstream face of the dam and the portion of the dam crest nearest the reservoir appear to be in good condition. Two conditions at the site, however, present some cause for concern. Trees and brush on the crest and downstream face of the embankment pose a potentially dangerous situation, as discussed in Sections 3.2 and 6.1, and seepage about 20 feet downstream of the outlet of the stream bypass pipe within a few feet of the downstream embankment toe.also poses a potentially dangerous situation.

b. Adequacy of Information. The information obtained from the MDC, DEQE, and Mr. Gaumont, combined with the information obtained during the field investigation, is considered adequate for a Phase I 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.

7.2 Recommendations

It is recommended that the Owner retain the services of a qualified registered professional engineer, experienced in the design and construction of dams, for the following purposes:

1. Perform a detailed hydrologic and hydraulic study to assess the need for providing spillway discharge capacity.

2. Investigate the cause of the seepage within a few feet of the downstream toe of the embankment along the right bank of the stream bypass outlet channel and assess the need for remedial action.

3. Investigate the seismic stability of the dam utilizing conventional equivalent static load methods.

4. Direct the removal of the trees from the downstream face (to a distance of 20 feet downstream of the toe) and crest of the dam to minimize damage to the embankment. Voids left in the embankment by the removal of trees should be filled with suitable, thoroughly compacted material.

7.3 Remedial Measures

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

1. Operability of the low level outlet pipe (16-inch diameter) valve should be investigated, and the valve should be repaired if necessary.

2. Develop and implement an ongoing operation and maintenance program to insure the future integrity of the dam.

3. Institute a program of annual periodic technical inspection.

4. Develop a formal surveillance and flood warning plan, including round-the-clock monitoring during heavy precipitation.

5. Install an upstream closure device for emergency cutoff of aqueduct flow to the reservoir.

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: Weston Reservoir Dam

National I.D. #: MA 00798

Location: Weston, Massachusetts

Type of Dam: Earth Embankment

Inspection Date(s): October 23, 1979

Weather: Partly Cloudy, 70

Pool Elevation: 194.0 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. Ray Gaumont, MDC Labor Foreman

VISUAL INSPECTION CHECK LIST

Project: Weston Reservoir Dam

National I.D. #: MA 00798

Date(s): October 23, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation (Ft. above MSL)	204±
Current Pool Elevation	197±
Maximum Impoundment to Date	Unknown
Surface Cracks	None Observed
Pavement Condition	N/A
Movement or Settlement of Crest	None Observed
Lateral Movement	None Observed
Vertical Alignment	Appears to be good
Horizontal Alignment	Appears to be good
Condition at Abutment and at Concrete Structures	Good
Indications of Movements of Structural Items on Slopes	None Observed
Trespassing on Slopes	Negligible
Vegetation on Slopes	Heavy growth on d/s slope u/s slope mowed
Sloughing or Erosion of Slopes or Abutments	Slight undulations @d/s toe
Rock Slope Protection - Riprap Failures	No failures Observed

VISUAL INSPECTION CHECK LIST

Project: Weston Reservoir Dam

National I.D. #: MA 00798

Date(s): October 23, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT (Con't)	
Unusual Movement or Cracking at or near Toes	Undulations
Unusual Embankment or Downstream Seepage	~5gpm Seepage @ toe near outlet of bypass
Piping or Boils	None Observed
Foundation Drainage Features	Unknown
Toe Drains	Unknown
Instrumentation System	N/A

VISUAL INSPECTION CHECK LIST

Project: Weston Reservoir Dam

National I.D. #: MA 00798

Date(s): October 23, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Not Applicable
General Condition	Not Applicable
Loose Rock Overhanging Channel	Not Applicable
Trees Overhanging Channel	Not Applicable
Floor of Approach Channel	Not Applicable
b. Weir and Training Walls	Not Applicable
General Condition of Concrete	Not Applicable
Rust or Staining	Not Applicable
Spalling	Not Applicable
Any Visible Reinforcing	Not Applicable
Any Seepage or Efflorescence	Not Applicable
Drain Holes	Not Applicable
c. Discharge Channel	
General Condition	Overgrown with brush $n \approx 0.045$

VISUAL INSPECTION CHECK LIST

Project: Weston Reservoir Dam

National I.D. #: MA 00798

Date(s): October 23, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (Con't)	
Loose Rock Overhanging Channel	In a few places
Trees Overhanging Channel	Several Small trees
Floor of Channel	Rough w/stones & debris
Other Obstructions	Downstream culvert

VISUAL INSPECTION CHECK LIST

Project: Weston Reservoir Dam

National I.D. #: MA 00798

Date(s): October 23,1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Not Applicable
Slope Conditions	Not Applicable
Bottom Conditions	Not Applicable
Rock Slides or Falls	Not Applicable
Log Boom	Not Applicable
Debris	Not Applicable
Condition of Concrete Lining	Not Applicable
Drains or Weep Holes	Not Applicable
b. Intake Structure	
Condition of Concrete	Good
Stop Logs and Slots	For (5) inlet gates - good condition

VISUAL INSPECTION CHECK LIST

Project: Weston Reservoir Dam

National I.D. #: MA 00798

Date(s): October 23,1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Good @ structure - Aqueduct Unknown
Rust or Staining	None Observed
Spalling	Slight
Erosion or Cavitation	None
Visible Reinforcing	None
Any Seepage or Efflorescence	None at Aqueduct
Condition at Joints	Unknown
Drain Holes	None Observed
Channel	N/A
Loose Rock or Trees Overhanging Channel	N/A
Condition of Discharge Channel	N/A

VISUAL INSPECTION CHECK LIST

Project: Weston Reservoir Dam

National I.D. #: MA 00798

Date(s): October 23, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Good
Rust or Staining on Concrete	None Observed
Spalling	Slight
Erosion or Cavitation	None
Cracking	None Observed
Alignment of Monoliths	Unknown
Alignment of Joints	Unknown
Numbering of Monoliths	Unknown

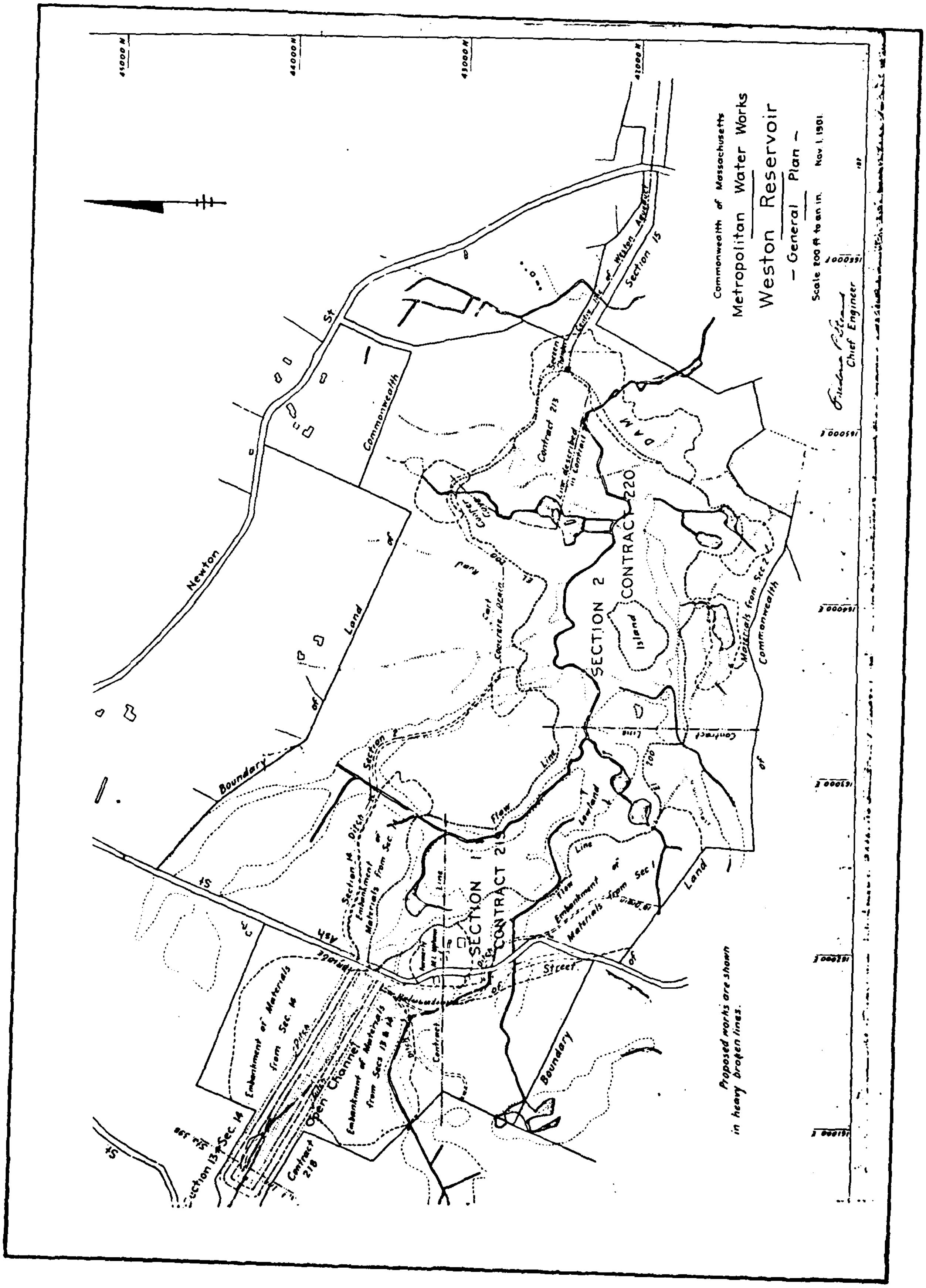
APPENDIX B

ENGINEERING DATA

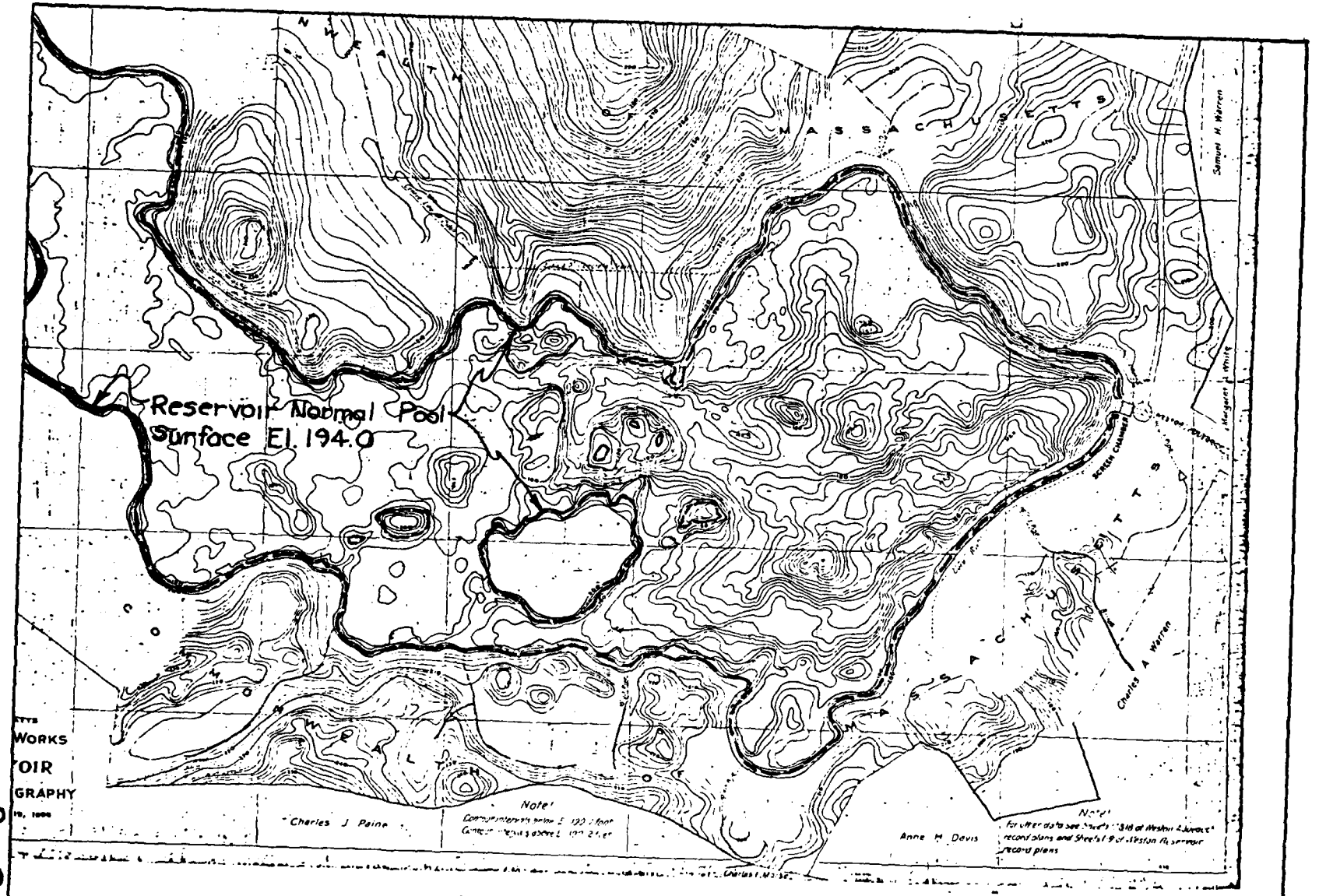
APPENDIX B

ENGINEERING DATA

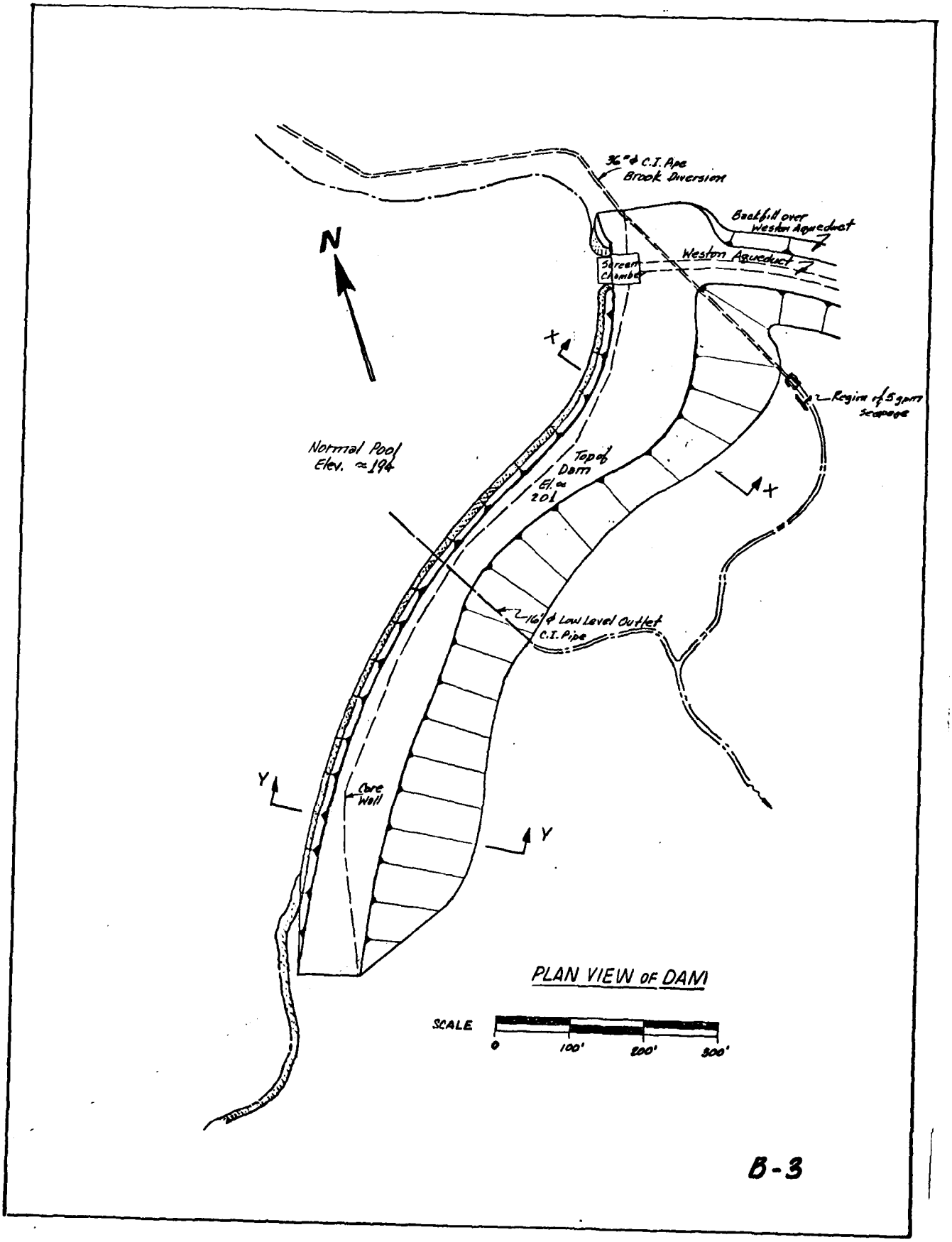
TABLE OF CONTENTS


Commonwealth of Massachusetts
Metropolitan Water Works
Weston Reservoir
– General Plan –
Scale 200 ft to an in.
Nov 1, 1901
Chief Engineer
Proposed works are shown in heavy broken lines.
SECTION 2
CONTRACT 220
SECTION 1
CONTRACT 219
Contract 218
Section 15
DAM
Island
Open Channel
Newton St
Boundary of Land of Commonwealth

B-1



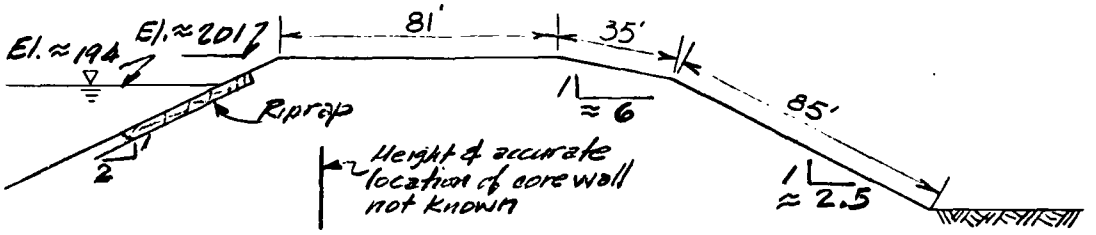
PLAN VIEW OF RESERVOIR


36" ϕ C.I. Pipe
Brook Diversion
Backfill over
Weston Aqueduct
N
Screen
Chamber
Weston Aqueduct
X
Region of Seepage
Normal Pool
Elev. ≈ 194
Top of
Dam
El. ≈
201
X
16" ϕ Low Level Outlet
C.I. Pipe
Y
Core
Wall
Y
PLAN VIEW OF DAM
SCALE
0
100'
200'
300'

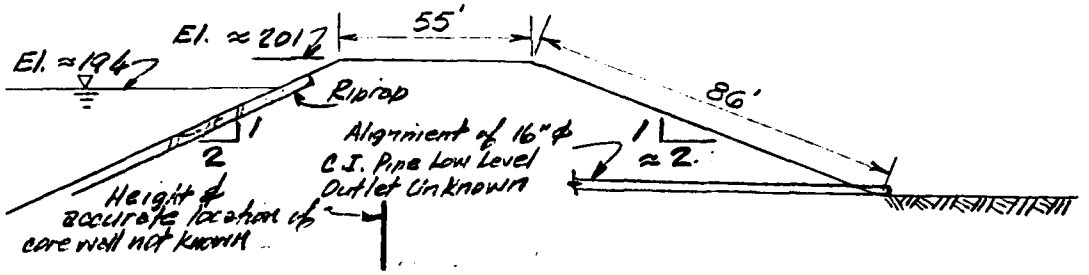
B-3

O'BRIEN & GERE
ENGINEERS, INC.

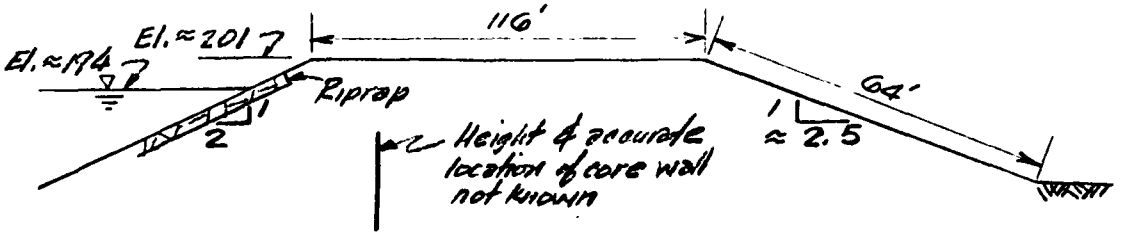
SUBJECT	SHEET	BY	DATE	JOB NO
WESTON RESERVOIR DAM			3/13/80	2060-001



SECTION Y-Y ≈ 200' NORTH OF SOUTH ABUTMENT



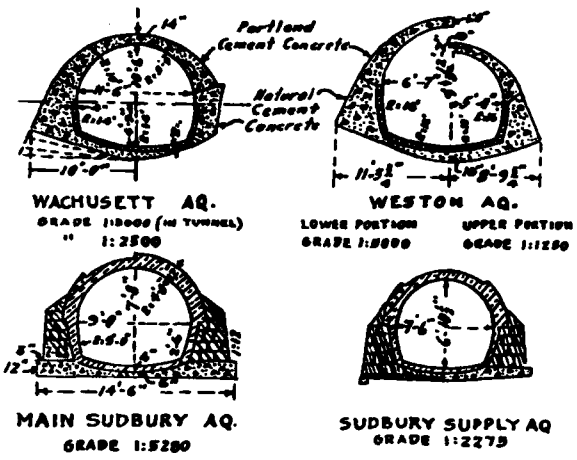
SECTION AT LOW LEVEL OUTLET



SECTION X-X ≈ 200' SOUTH OF NORTH ABUTMENT

EMBANKMENT SECTIONS

Scale: 1" = 50'



M.D.C.
WATER DIVISION
AQUEDUCTS

WESTON AQUEDUCT

Built by Metropolitan Water Works.
First used in December 1905.
Capacity, 300,000,000 gallons in 24 hours
Sudbury Dam to Head House: 4702' of 2 lines 60" C.I. Pipe
Head House to siphon under N.Y., N.H. & H.R.R. at Nobscot: concrete aqueduct, fall of 14.48' or 4.224' a mile, size 10'-0" wide at springing line x 9.2' high for 3.45 miles. S = 1:1250
Siphon under N.Y. N.H. & H.R.R. at Nobscot: 1382' long, fall 2.92'
Siphon at Nobscot to Channel Chamber: fall of 10.57' or 1.056' a mile, size 13.17' wide at springing line x 12.17' high for 7.79 miles S = 1:5000
Total length 15.42 miles.

	Station	Miles	Elev. of Invert
Head House (end of pipes, entrance to Head House)	5+06		215.89
Tunnel No. 1 (beginning)	7+00		
Gaging Chamber No. 1	17+00	0.2	214.97
Tunnel No. 2 (beginning)	42+30	0.7	212.96
Tunnel No. 3 (beginning)	113+20	2.0	
Nobscot Siphon (beginning)	186+50	3.4	201.41
Nobscot Siphon (end)	187+90	3.5	198.49
Gaging Chamber No. 2	214+21	3.9	197.97
Siphon Cham. No. 1 Begin. of Sud. Riv. Siphon)	284+30	5.3	196.56
Siphon Chamber No. 2 (end " " ")	328+74	6.0	194.15
Siphon Cham. No. 3 (begin. of Happy Hollow Siphon)	353+53	6.4	193.46
Siphon Cham. No. 4 (end " " ")	384+77	6.8	192.57
Tunnel No. 4 (beginning)	529+61	10.0	
End of Aqueduct, (Channel Chamber)	597+88	11.3	187.92
Ash St. Bridge, East End	611+47	11.6	187.59
Screen Chamber, West End	649+88	12.3	187.90
Terminal Chamber (end of aqueduct)	706+99	13.32	187.90
Entrance to Distributing Pipes	706+99.4		187.58

* Sudbury River Siphon crosses the river by arching the pipe to carry itself and the weight of the water; rise of pipe 5.5 ft; length between abutments 88.0 ft.
* Open Channel is 1½ miles from Sudbury Dam and is 1400' long, 12' deep & 18' wide of bottom, slope of sides 3:1
Double Station at 328+74 back and 328+89 ahead
" " " 416+55 " " 416+70 "

B-5

6 /

INSPECTION REPORT - DAMS AND RESERVOIRS WESTON

(2.) Location: ~~City~~/Town Weston. Dam No. 4-9-333-4

Name of Dam Weston Reservoir Dam. Inspected by: D. Kilpatrick

Date of Inspection 11/12/74

(2.) Owner/s: per: Assessors ____. Prev. Inspection ✓

Reg. of Deeds ____. Pers. Contact ____

	Name	St. & no.	City/Town	State	Tel. no.
1.	Kills M.D.C.		Framingham	Mass.	872-4388
2.					
3.					

(3.) Caretaker: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name	St. & no.	City/Town	State	Tel. no.
Kills	Newton St.	Weston	MASS	

M.D.C. caretaker

(4.) No. of Pictures taken None.

(5.) Degree of Hazard: (if dam should fail completely)*

1. Minor ✓. 2. Moderate ____.

3. Severe ____. 4. Disastrous ____.

* This rating may change as land use changes (future development)

(6.) Outlet Control: Automatic ✓. Manual ____.

Operative ____ yes ; ____ No.

Comments: M.D.C. water supply line is the outlet

(7.) Upstream Face of Dam: Condition:

1. Good ✓. 2. Minor Repairs ____

3. Major Repairs ____. 4. Urgent Repairs ____

Comments: ____

B-6

DAM NO. 4-9-333-4

(8) Downstream Face of Dam: Condition: 1. Good ✓ 2 Minor Repairs____

3. Major Repairs____ Urgent Repairs__

Comments:_____

(9) Emergency Spillway: Condition: 1. Good____ 2. Minor Repairs____

3. Major Repairs____ 4. Urgent Repairs____

Comments:_____

(10) Water level @ time of inspection 5 ft. above____ below ✓

top of dam ✓ Principal spillway____

other____

(11) Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment_____

Animal Burrows and Washouts_____

Damage to slopes or top of dam_____

Cracked or Damaged Masonry_____

Evidence of Seepage_____

Evidence of Piping_____

Erosion_____

Leaks_____

Trash and/or debris impeding flow_____

Clogged or blocked spillway_____

Other_____

DAM NO. 4-9-333-4

(12.) Remarks & Recommendations: (Fully Explain)

DAM IN GOOD CONDITION

(13.) Overall Condition:

1. Safe ✓
2. Minor repairs needed _____
3. Conditionally safe - major repairs needed _____
4. Unsafe _____.
5. Reservoir impoundment no longer exists (explain)

   Recommend removal from inspection list _____

DESCRIPTION OF DAM
DISTRICT 4

Submitted by D. Kilpatrick
Date JAN. 12 1978

Dam No. 4-9-333-4
~~City~~/Town Weston
Name of Dam Weston Reservoir Dam

1. Location: Topo Sheet No. 260
Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

2. Year built: _____ Year/s of subsequent repairs _____

3. Purpose of Dam: Water Supply V. Recreational _____
Irrigation _____ Other _____

4. Drainage Area: .743 Sq. mi. 475.66 acres.

5. Normal Ponding Area: 60 acres; Ave Depth 10 Ft.
Impoundment: 200 Mil gals; 600 acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir (i.e. summer homes etc. One block Pump House, 2 Block Storage Houses

7. Dimensions of Dam: Length 80 Ft. ± Max. Height 22 Ft.
Slopes: Upstream Face Vertical
Downstream Face Vertical
Width across top 3 Ft.

8. Classifications of Dam by Materials:
Earth _____. Conc Masonary V. Stone Masonary _____
Timber _____. Rockfill _____. Other _____

9. A. Description of present land usage downstream of dam: 95 % rural; 5 % [illegible]

B. Is there a storage area or flood plain downstream of dam which could be affected by impoundment in the event of a complete dam failure
Yes V

B-9

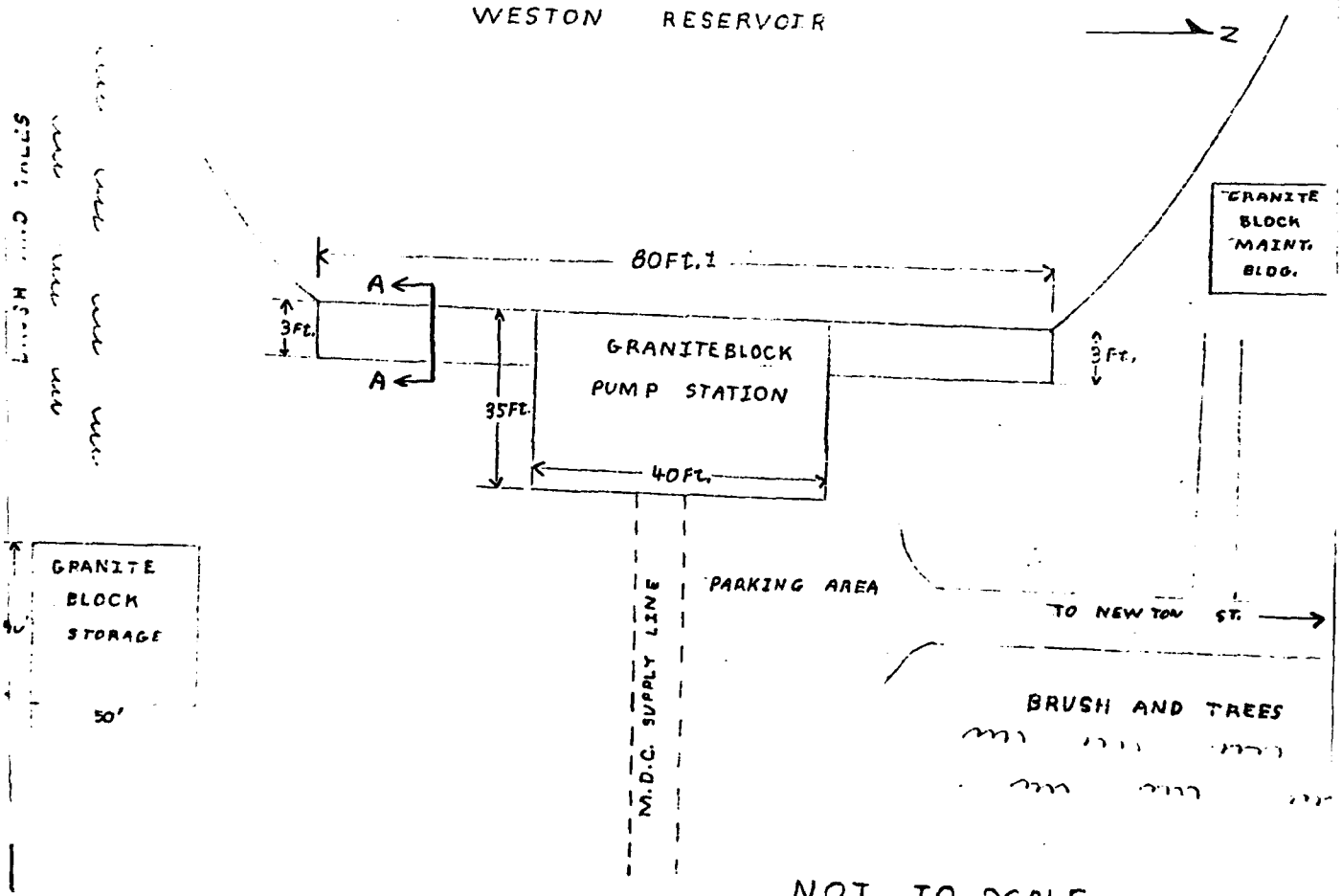
DAM NO. 4-9-333-4

10. Risk to life and property in event of complete failure.

No. of people NONE
No. of homes NONE
No. of businesses NONE
No. of industries NONE
No. of utilities ONE
Railroads NONE
Other dams NONE
Other

Type
Type M.D.C. water supply line to pump h

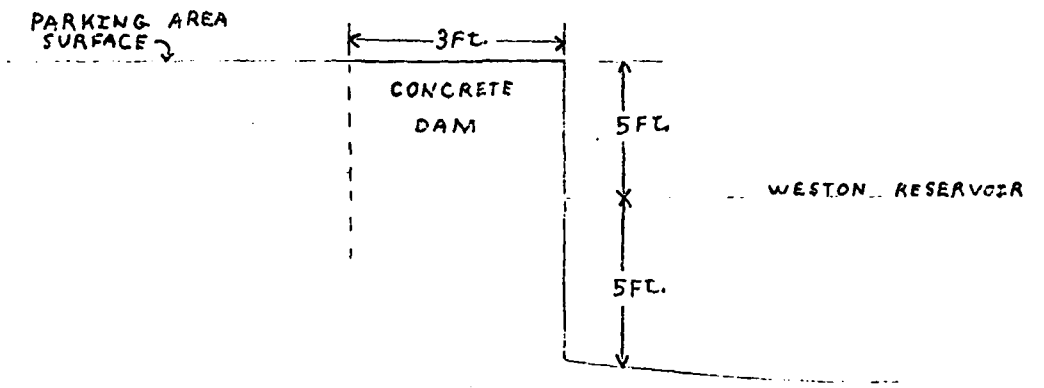
11. Attach sketch of dam to B's form showing section and plan 8½" x 11" Sheet.



NOT TO SCALE

B-10

4-9-333-4



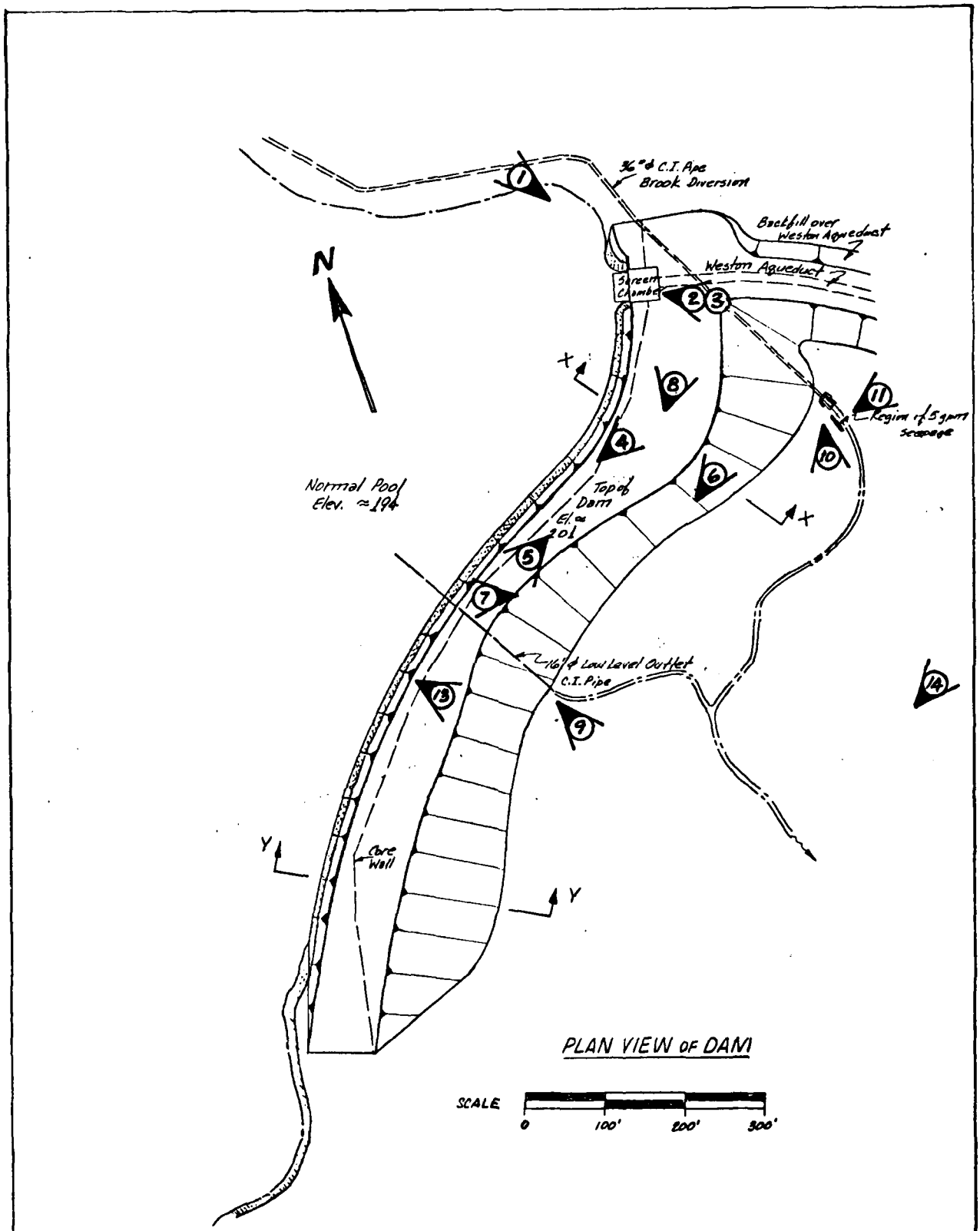
NOT TO SCALE

SECTION A-A

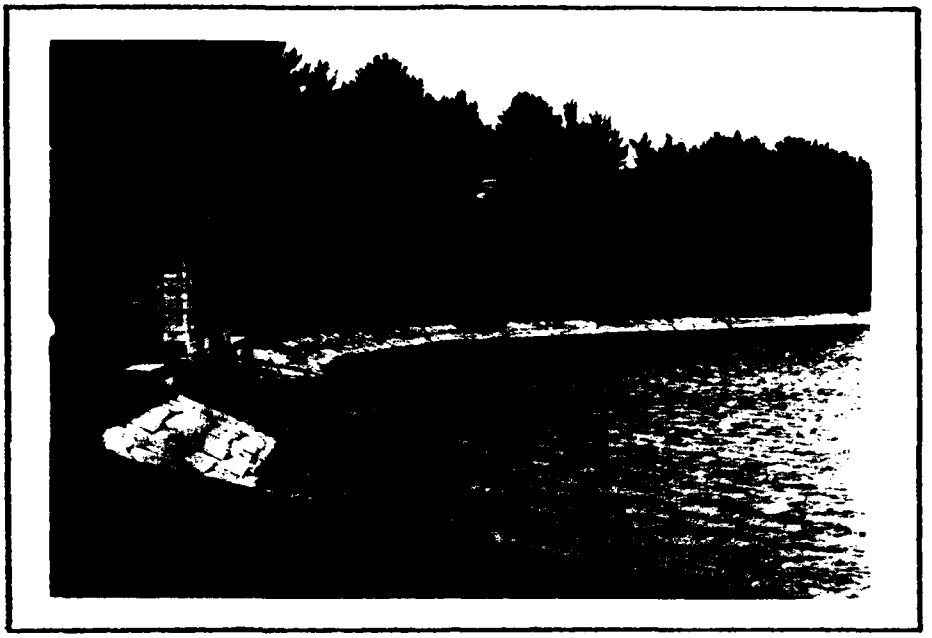
APPENDIX C

PHOTOGRAPHS

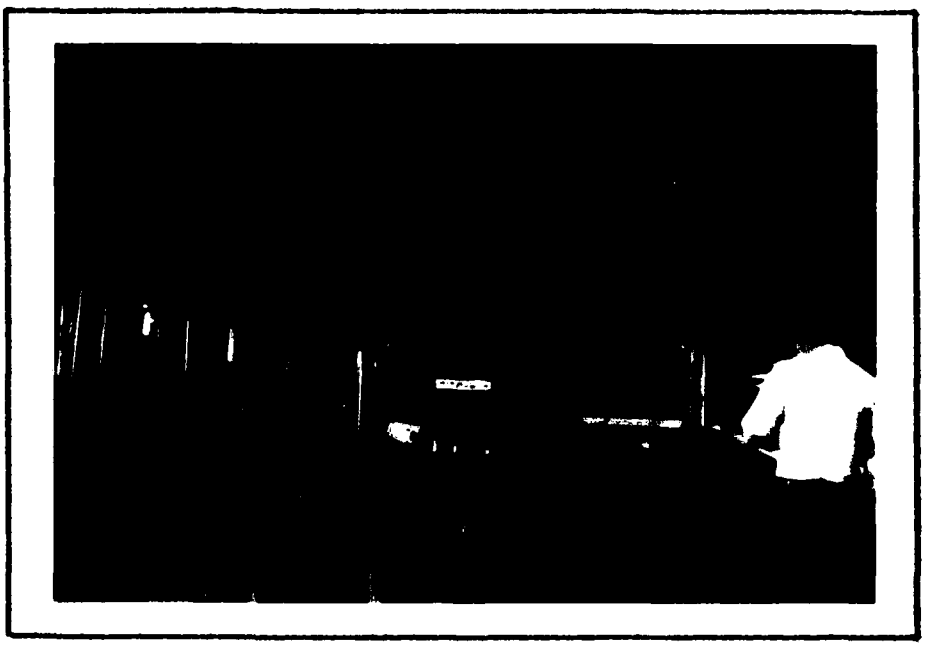
APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT


36"ϕ C.I. Pipe
Brook Diversion
Backfill over
Weston Aqueduct
Weston Aqueduct
Screen
Chamber
N
Normal Pool
Elev. ≈ 194
Top of
Dam
El. ≈
201
16"ϕ Low Level Outlet
C.I. Pipe
Core
Wall
Regim of Spring
seepage
X
Y
PLAN VIEW OF DAM
SCALE
0
100'
200'
300'
LEGEND
THE LOCATION AND DIRECTION IN WHICH EACH
PHOTO WAS TAKEN AND THE NUMBER OF THE PHOTO

PG. A

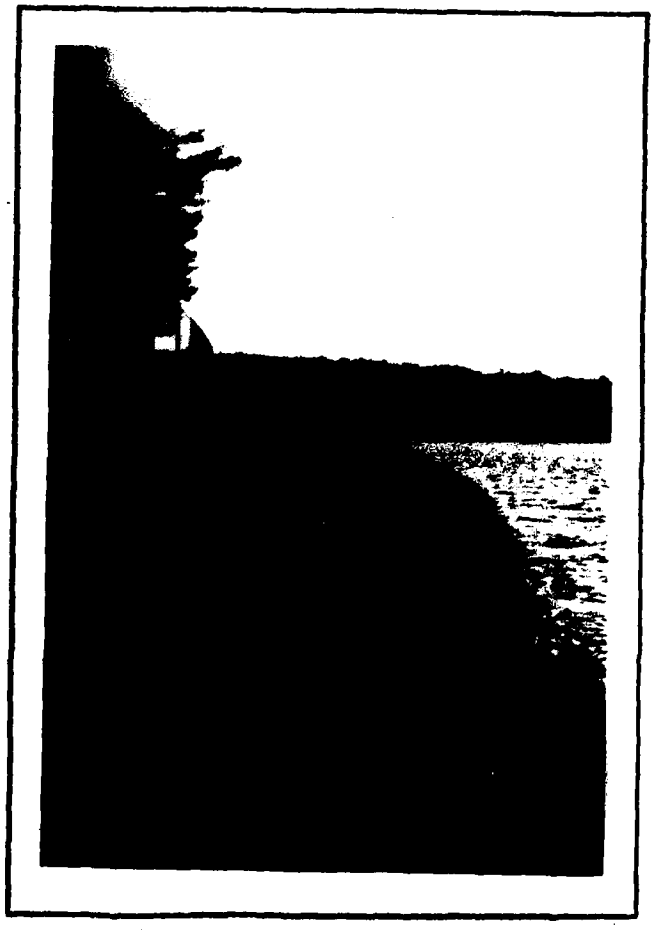


1. GATEHOUSE AND UPSTREAM SLOPE. (10/23/79)



2. GATEHOUSE INTERIOR SHOWING MECHANICAL STOP LOG HOIST. (10/23/79)

3. INLET PORTAL AND TRASH SCREEN IN GATEHOUSE. (10/23/79)

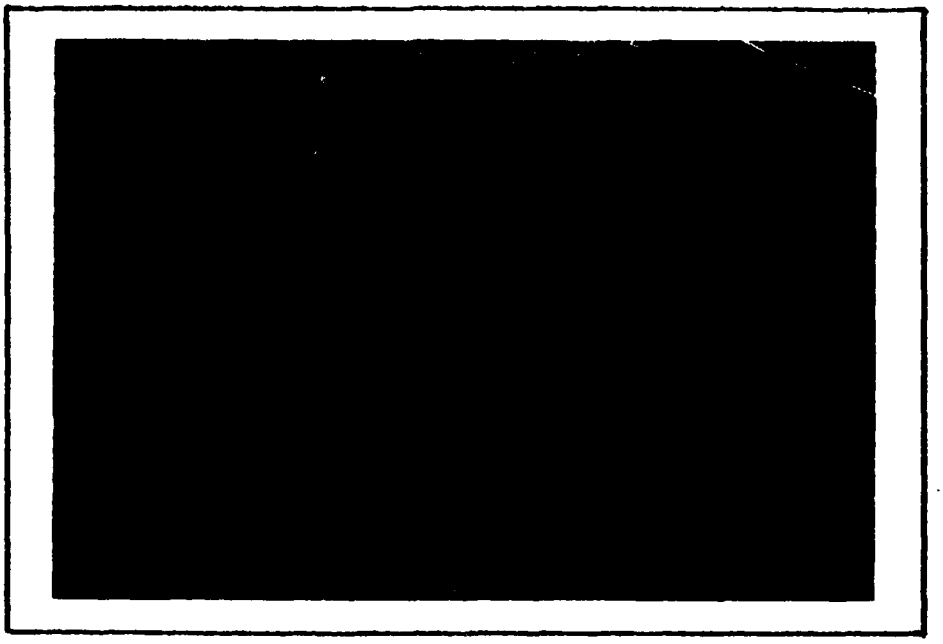


4. RIPRAP ON UPSTREAM SLOPE, GRASS COVER AND LARGE TREES ON THE DAM. (10/23/79)

5. CLOSE UP OF LARGE TREES GROWING ON THE DAM CREST AND DOWNSTREAM SLOPE. (10/23/79)

6. DOWNSTREAM SLOPE OF THE DAM SHOWING LARGE TREES AND UNDERGROWTH. (10/23/79)

7. 50 FOOT TALL TREES ON THE DAM CREST AND DOWNSTREAM SLOPE. (10/23/79)

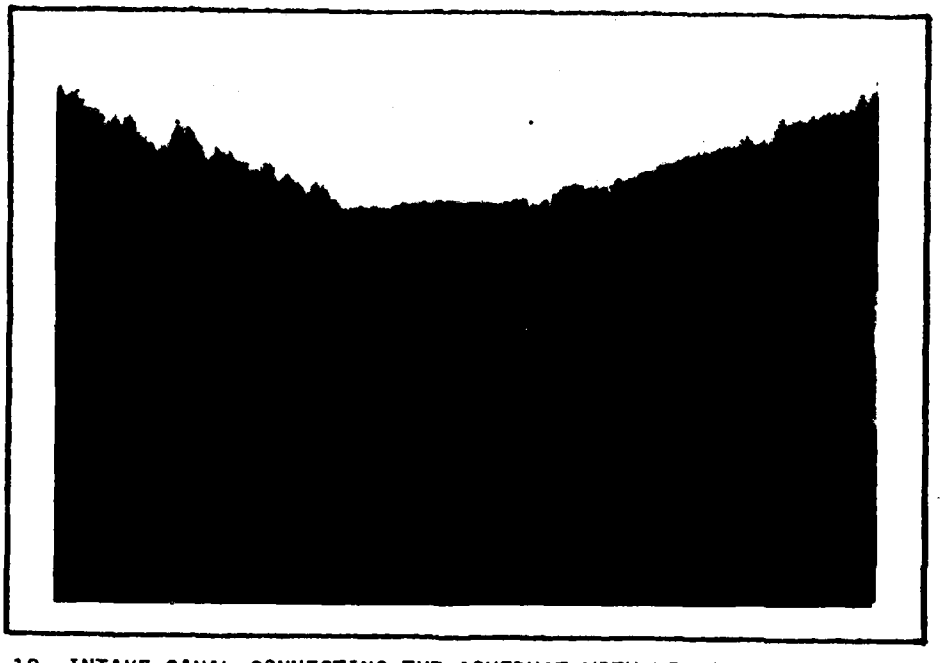


8. LARGE TREE ROOT ON THE DAM CREST. (10/23/79)

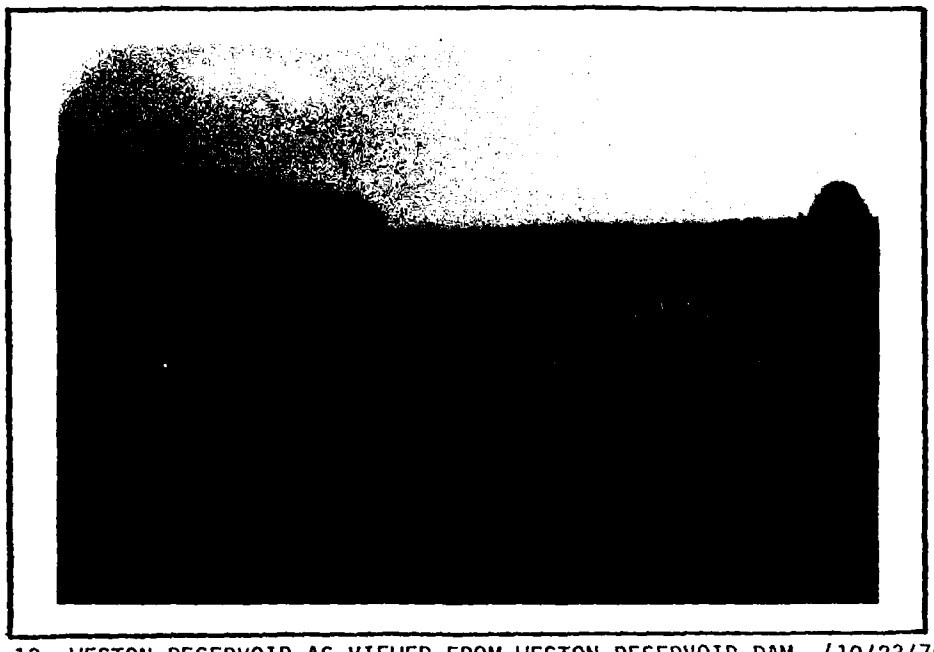
9. OUTLET OF 16 INCH DIAMETER CAST IRON PIPE RESERVOIR BLOW-OFF. (10/23/79)

10. OUTLET OF 36 INCH DIAMETER STREAM BY-PASS CONDUIT AT THE DOWNSTREAM TOE OF SLOPE OF THE DAM. (10/23/79)

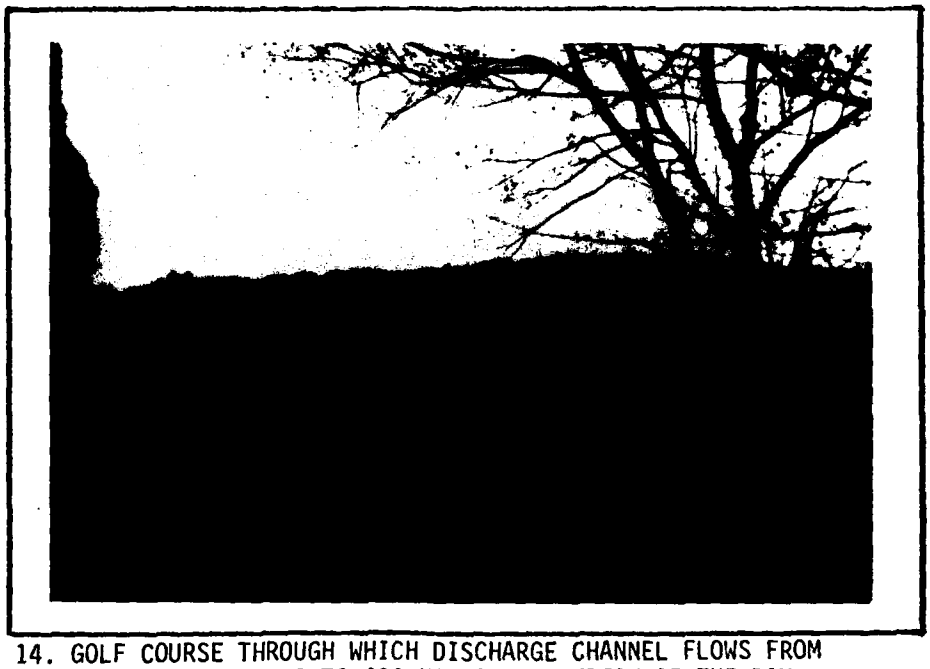
11. 5 G.P.M. SEEPAGE FROM THE DOWNSTREAM TOE OF SLOPE OF THE DAM ALONG THE STREAM BY-PASS OUTLET CHANNEL. (10/23/79)



12. INTAKE CANAL CONNECTING THE AQUEDUCT WITH WESTON RESERVOIR. (10/23/79)

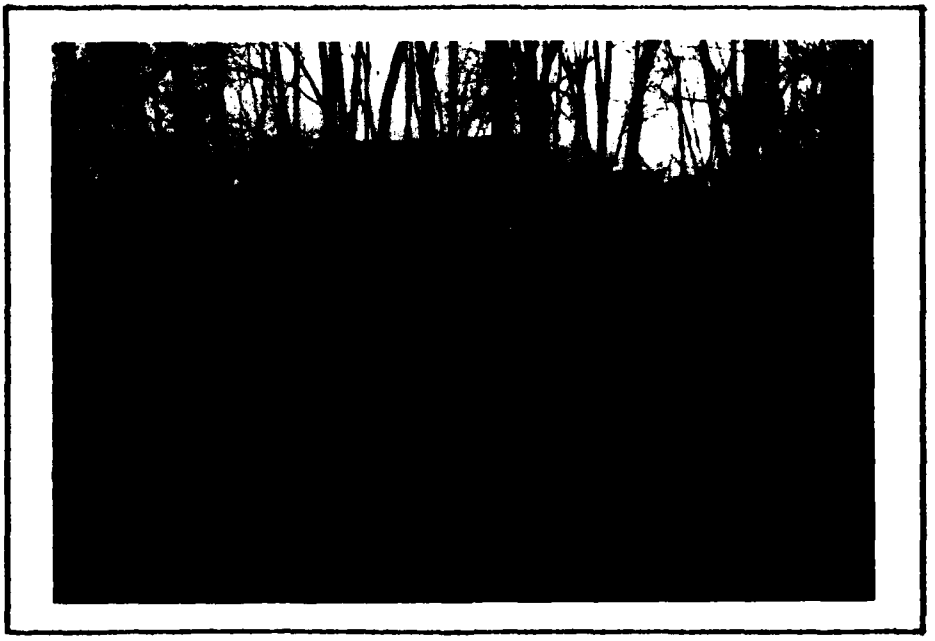


13. WESTON RESERVOIR AS VIEWED FROM WESTON RESERVOIR DAM. (10/23/79)



14. GOLF COURSE THROUGH WHICH DISCHARGE CHANNEL FLOWS FROM APPROXIMATELY 200 TO 900 YARDS DOWNSTREAM OF THE DAM. (10/23/79)

15. POTENTIAL HAZARD AREA ABOUT 1200 YARDS DOWNSTREAM FROM THE DAM. (10/23/79)



16. POTENTIAL HAZARD AREA ABOUT 1400 YARDS DOWNSTREAM FROM THE DAM. (10/23/79)

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

TABLE OF CONTENTS

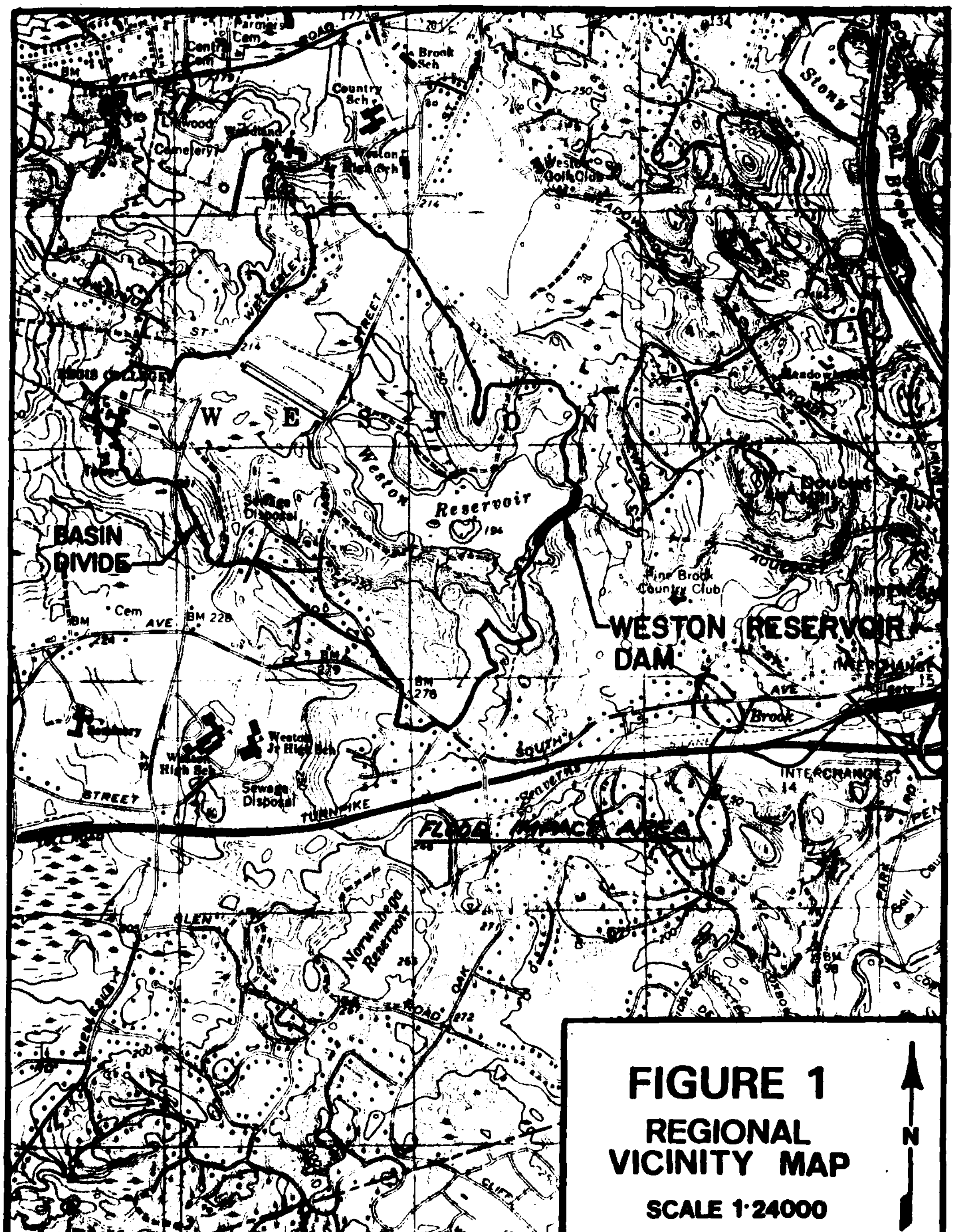


FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24000

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

JOB 2060-001
SHEET NO D-2 OF
CALCULATED BY RG DATE
CHECKED BY RRB DATE
SCALE

WESTON RESERVOIR DAM - H & H

DRAINAGE AREA = 0.9 Sq. Mi

SNYDER HYDROGRAPH COEFFICIENTS

$C_t = 2.0$ $C_p = 0.5$

T_p COMPUTATIONS

$L = 1.21$ MILES $L_{ca} = 0.61$ MILES

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

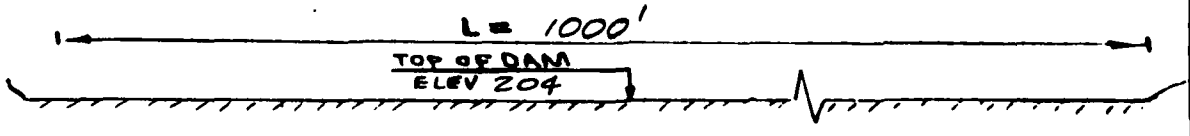
$T_p = 2.0 \times (1.21 \times .61)^{.3} \cong$ 2.0 HOURS

PMP DATA

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

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

DAM ELEVATION & LENGTH



C = 2.8 TOP OF DAM

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

JOB 2060-001
SHEET NO D-3 OF
CALCULATED BY RG DATE
CHECKED BY RRB DATE
SCALE

WESTON RESERVOIR DAM - H&H

H=0 @ TOP OF DAM CREST.— ELEVATION =204.0 MSL

TOP OF DAM. $C = 2.8$ $L = 1000'$ $Q = CLH^{1.5}$

STAGE-DISCHARGE

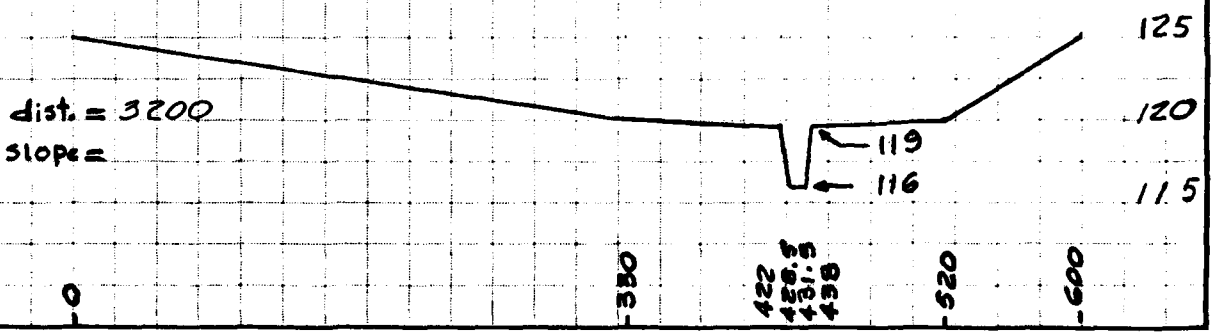
ELEVATION MSL	H Ft.	Q CFS
201	0	0
201.5	0.5	990
202	1.0	2800
202.5	1.5	5144
203	2.0	7920

STAGE - STORAGE

(CONIC METHOD BY COMPUTER)

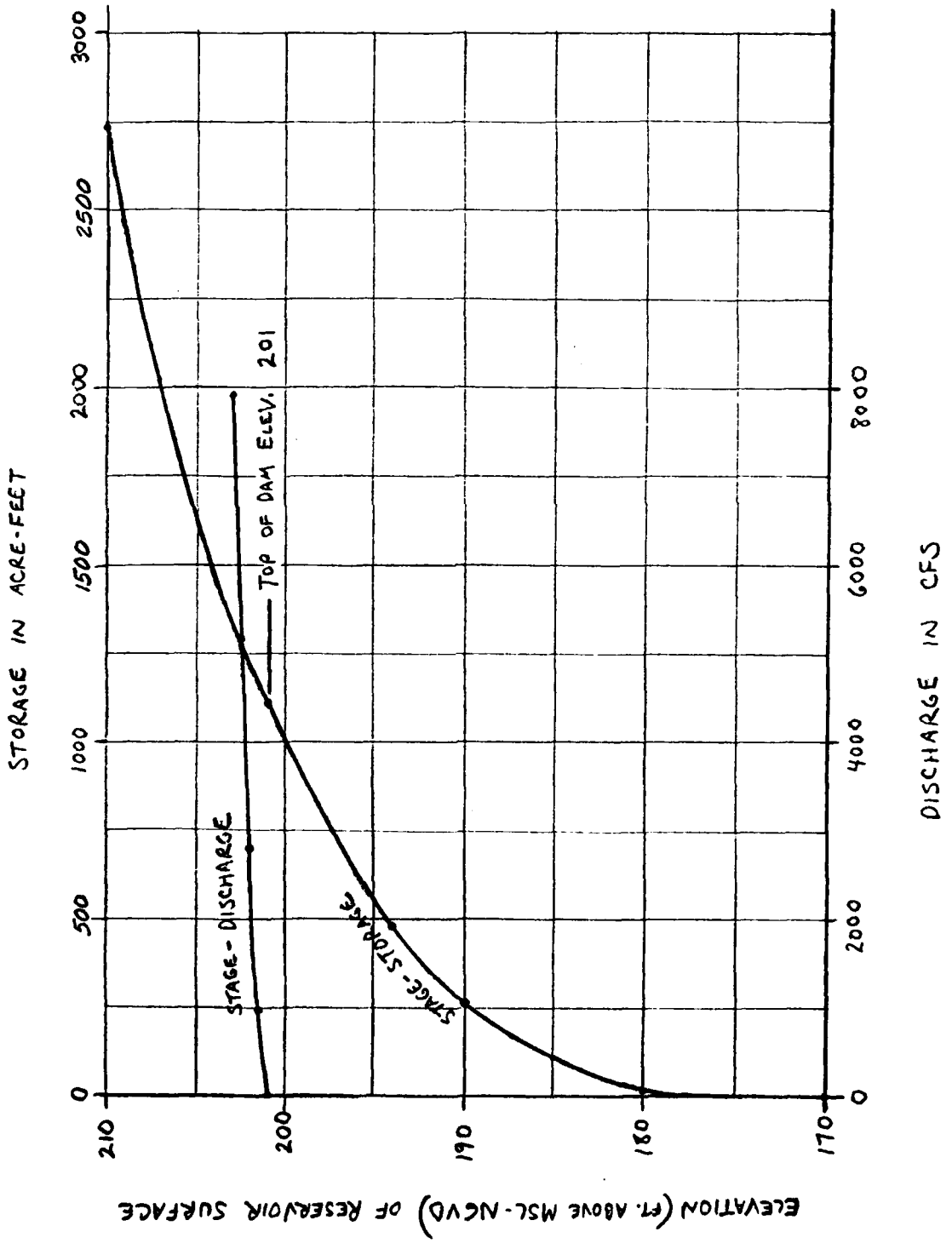
	ELEVATION MSL	AREA Ac.	STORAGE AC. FT.
	170	0	0
	180	5	17
	190	52	260
NORMAL POOL	194	61	486
TOP OF DAM	201	120	1108
	210	250	2738

HAZARD AREA (CROSS-SECTION)



O'BRIEN & GERE
ENGINEERS, INC.

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



FLOOD ROUTINGS THROUGH WESTON RESERVOIR WITHOUT BREACHING

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

INPUT

```
     1                A1                HYDROLOGIC ANALYSIS OF WESTON RESERVOIR DAM
     2                A2                     NATIONAL DAM INSPECTION PROGRAM
     3                A3                     NEW ENGLAND DIVISION - CORPS OF ENGINEERS
     4                B    200       0      15       0       0       0       0       0      -4       0
     5                B1     5
     6                J      1       9       1
     7                J1    .2      .3      .4      .5      .6      .7      .8      .9     1.0
     8                K      0  WESTON                                       1
     9                K1                          INFLOW TO WESTON RESERVOIR
    10                M      1       1     0.9                                                    1
    11                P      0    21.5     111     124     133
    12                T                                                     0    0.05
    13                W    2.0     0.5
    14                X   -1.7    -0.1       2
    15                K      1  WESTON                                       1
    16                K1                    ROUTED OUTFLOW FROM WESTON RESERVOIR DAM OVERTOPPED
    17                Y                                 1       1
    18                Y1     1                                                -194      -1
    19                Y4   201   201.5     202   202.5     203
    20                Y5     0     990    2800    5144    7920
    21                $A   0.0     5.0      52      61     120     250
    22                $E   170     180     190     194     201     210
    23                $S   201
    24                $D   201
    25                K     99
```

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

RUN  DATE0 01/08/80.
     TIME0 10.18.51.
```

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

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
200	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

PERCENTAGES OF PMF ROUTED

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

RTIOS= .20 .30 .40 .50 .60 .70 .80 .90 1.00

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

SUB-AREA RUNOFF COMPUTATION

INFLOW TO WESTON RESERVOIR

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.90	0.00	.90	0.00	0.000	0	1	0

PRECIP DATA

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

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

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

UNIT HYDROGRAPH DATA
TP= 2.00 CP= .50 NTA= 0

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

UNIT HYDROGRAPH 62 END-OF-PERIOD ORDINATES, LAG= 2.02 HOURS, CP= .50 VOL= 1.00

6.	21.	43.	69.	96.	120.	137.	147.	146.	136.
124.	113.	103.	94.	86.	78.	71.	65.	59.	54.
49.	45.	41.	37.	34.	31.	28.	26.	23.	21.
19.	18.	16.	15.	13.	12.	11.	10.	9.	8.
8.	7.	6.	6.	5.	5.	4.	4.	4.	3.
3.	3.	3.	2.	2.	2.	2.	2.	1.	1.
1.	1.								

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	22.68	21.68	1.20	51017.
										(581.)	(551.)	(30.)	(1444.64)

9-0

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM WESTON RESERVOIR DAM OVERTOPPED

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
WESTON	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	-194.	-1

STAGE	201.00	201.50	202.00	202.50	203.00	} STAGE-DISCHARGE DATA
FLOW	0.00	990.00	2800.00	5144.00	7920.00	
SURFACE AREA=	0.	5.	52.	61.	120.	250. } STAGE-STORAGE DATA
CAPACITY=	0.	17.	260.	486.	1108.	2738.
ELEVATION=	170.	180.	190.	194.	201.	210.

CREL	SPWID	COOW	EXPW	ELEVL	COQL	CAREA	EXPL
201.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

IOPEL	COQD	EXPD	DAMWID
201.0	0.0	0.0	0.

PEAK OUTFLOW IS 0. AT TIME 0.00 HOURS
PEAK OUTFLOW IS 0. AT TIME 0.00 HOURS
PEAK OUTFLOW IS 0. AT TIME 0.00 HOURS
PEAK OUTFLOW IS 0. AT TIME 0.00 HOURS
PEAK OUTFLOW IS 18. AT TIME 32.25 HOURS
PEAK OUTFLOW IS 271. AT TIME 23.50 HOURS
PEAK OUTFLOW IS 535. AT TIME 21.75 HOURS
PEAK OUTFLOW IS 803. AT TIME 21.00 HOURS
PEAK OUTFLOW IS 1105. AT TIME 20.25 HOURS

} ROUTED OUTFLOWS

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	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
PERCENTAGES OF PMF →				.20	.30	.40	.50	.60	.70	.80	.90	1.00
PEAK INFLOWS → HYDROGRAPH AT	WESTON	.90	1	377.	566.	754.	943.	1131.	1320.	1508.	1697.	1885.
		(2.33)	(	10.68)(	16.01)(	21.35)(	26.69)(	32.03)(	37.37)(	42.70)(	48.04)(	53.38)
ROUTED OUTFLOWS → ROUTED TO	WESTON	.90	1	0.	0.	0.	0.	18.	271.	535.	803.	1105.
		(2.33)	(	0.00)(	0.00)(	0.00)(	0.00)(	.50)(	7.69)(	15.16)(	22.74)(	31.28)

RESULTS OF VARIOUS FLOODS
AT WESTON RESERVOIR DAM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	194.00	201.00	201.00
STORAGE	486.	1106.	1108.
OUTFLOW	0.	0.	0.

1108. → MAXIMUM STORAGE 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	196.93	0.00	696.	0.	0.00	0.00	0.00
	.30	198.12	0.00	802.	0.	0.00	0.00	0.00
	.40	199.20	0.00	907.	0.	0.00	0.00	0.00
	.50	200.18	0.00	1013.	0.	0.00	0.00	0.00
	.60	201.01	.01	1109.	18.	19.25	32.25	0.00
	.70	201.14	.14	1125.	271.	28.00	23.50	0.00
	.80	201.27	.27	1141.	535.	29.75	21.75	0.00
	.90	201.41	.41	1158.	803.	30.50	21.00	0.00
TEST FLOOD →	1.00	201.53	.53	1174.	1105.	31.25	20.25	0.00

201.53 → TEST FLOOD ELEVATION

1105. → ROUTED TEST FLOOD OUTFLOW

WESTON RESERVOIR DAM BREACH OUTFLOW
ROUTED TO DOWNSTREAM DAMAGE AREA

INPUT

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************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
************************************
  1      A1          HYDROLOGIC ANALYSIS OF WESTON RESERVOIR DAM
  2      A2                NATIONAL DAM INSPECTION PROGRAM
  3      A3                NEW ENGLAND DIVISION - CORPS OF ENGINEERS
  4      B     200      0     15      0      0      0      0      0     -4      0
  5      B1      5
  6      J       2      1      1
  7      J1  .0001
  8      K       1  WESTON                                1
  9      K1          ROUTED OUTFLOW FROM WESTON RESERVOIR DAM OVERTOPPED
 10      Y                           1      1
 11      Y1      1                                     -201      -1
 12      Y4    201  201.5    202  202.5    203
 13      Y5      0    990   2600   5144   7920
 14      $A    0.0    5.0     52     61    120    250
 15      $E    170    180    190    194    201    210
 16      $S    201
 17      $D    201
 18      $B    400   0.01    175      3    201  201.5
 19      $B    400   0.01    175      3    201    201
 20      K       1   05-2                                 1
 21      K1                 CHANNEL ROUTING TO HAZARD CENTER
 22      Y                           1      1
 23      Y1      1                                             -1
 24      Y6   0.06   0.06   0.06    116    125   3200   0.02
 25      Y7      0    125    330    120    422    119  428.5    116  431.5    116
 26      Y7    438    119    520    120    400    125
 27      K      99
```

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 FEB 79
**********************************

RUN  DATE= 01/29/80.
     TIME= 10.14.21.
```

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

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
200	0	15	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= .00

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM WESTON RESERVOIR DAM OVERTOPPED

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

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IPES	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	-201.	-1

STAGE	201.00	201.50	202.00	202.50	203.00	} STAGE-DISCHARGE DATA
FLOW	0.00	990.00	2800.00	5144.00	7920.00	
SURFACE AREA=	0.	5.	32.	61.	120.	250. } STAGE-STORAGE DATA
CAPACITY=	0.	17.	260.	486.	1108.	2738.
ELEVATION=	170.	180.	190.	196.	201.	210.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
201.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
201.0	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
400.	.01	175.00	3.00	201.00	201.50

} BREACH DIMENSIONS - NO FAILURE OCCURS

PEAK OUTFLOW IS 0. AT TIME 0.00 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
400.	.01	175.00	3.00	201.00	201.00

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

BEGIN DAM FAILURE AT 0.00 HOURS

PEAK OUTFLOW IS 8938. AT TIME .88 HOURS

HYDROGRAPH ROUTING

CHANNEL ROUTING TO HAZARD CENTER

ISTAQ	ICOMP	IECON	ITYPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DS-2	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	0.	-1

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELEVT	ELMAX	RLNTH	SEL
.0600	.0400	.0600	116.0	125.0	3200.	.02000

} DOWNSTREAM CHANNEL CHARACTERISTICS

CHANNEL CROSS-SECTION AT DOWNSTREAM DAMAGE CENTER

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

→ 0.00 125.00 330.00 120.00 422.00 119.00 428.50 116.00 431.50 116.00
438.00 119.00 520.00 120.00 600.00 125.00

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

STORAGE	0.00	.14	.35	.63	.99	1.41	1.91	3.10	.01	13.54
	21.58	30.97	41.71	53.80	67.25	82.05	98.19	115.69	13 .54	154.75
OUTFLOW	0.00	5.11	18.66	41.09	76.39	123.71	185.32	283.60	48 .19	884.98
	1495.74	2316.56	3361.77	4646.90	6187.72	7999.98	10099.23	12500.75	1521 .61	18270.56
STAGE	116.00	116.47	116.95	117.42	117.89	118.37	118.84	119.32	11 .79	120.26
	120.74	121.21	121.68	122.16	122.63	123.11	123.58	124.05	12 .53	125.00
FLOW	0.00	5.11	18.66	41.09	76.39	123.71	185.32	283.60	48 .19	884.98
	1495.74	2316.56	3361.77	4646.90	6187.72	7999.98	10099.23	12500.75	1521 .61	18270.56

MAXIMUM STAGE IS 116.0

MAXIMUM STAGE IS 123.3

WESTON RESERVOIR DAM WITHOUT BREACH

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	201.00	201.00	201.00
STORAGE	1108.	1108.	1108.
OUTFLOW	0.	0.	0.

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
.00	201.00	0.00	1108.	0.	0.00	0.00	0.00

WESTON RESERVOIR DAM WITH BREACH

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	201.00	201.00	201.00
STORAGE	1108.	1108.	1108.
OUTFLOW	0.	0.	0.

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
.00	200.99	0.00	1108.	8936.	0.00	.84	0.00

DOWNSTREAM DAMAGE AREA WITHOUT BREACH → PLAN 1 STATION DS-2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.00	0.	116.0	.25

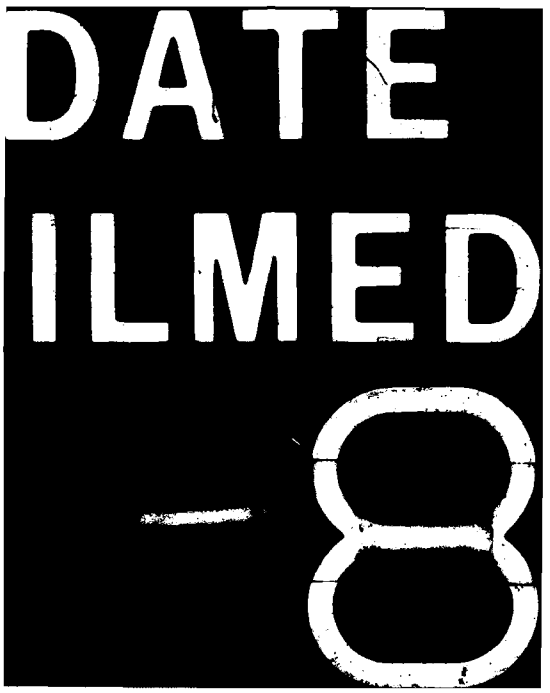
DOWNSTREAM DAMAGE AREA WITH BREACH → PLAN 2 STATION DS-2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.00	8831.	123.3	1.00

→ STREAM ELEVATION AT DAMAGE AREA

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS


DATE
ILMED
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