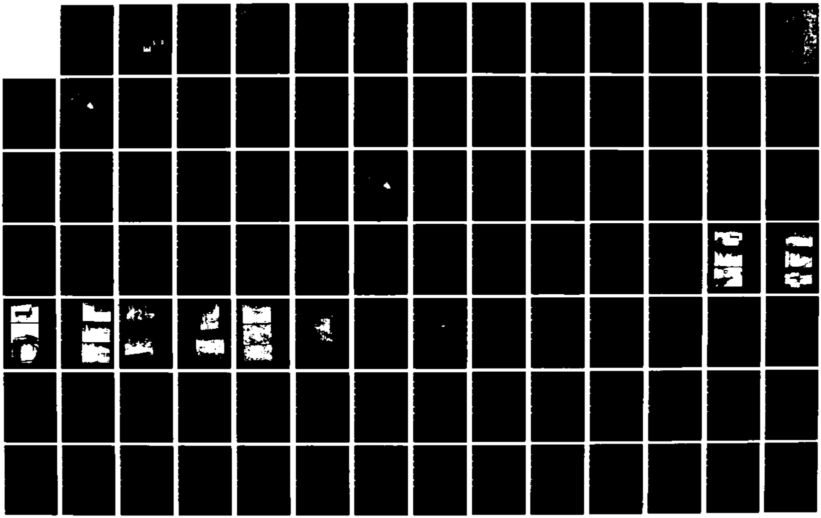
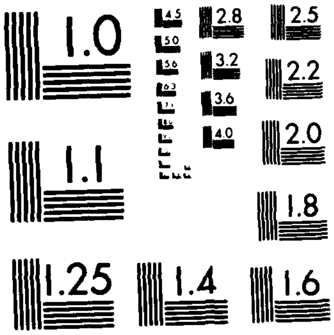
AD-A154 486 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
BELMONT RESERVOIR DAM. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV MAR 80

1/2

UNCLASSIFIED F/G 13/13 NL




1.0
4.5
5.0
5.6
6.3
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

2

HOUSATONIC RIVER BASIN
HINSDALE, MASSACHUSETTS

BELMONT RESERVOIR DAM
MA 00224

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

MARCH 1980

UNCLASSIFIED A154 486

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS
BEFORE COMPLETING FORM

1. REPORT NUMBER
MA 00224

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
Belmont Reservoir Dam
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS

5. TYPE OF REPORT & PERIOD COVERED
INSPECTION REPORT

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
DEPT. OF THE ARMY, CORPS OF ENGINEERS
NEW ENGLAND DIVISION, NEDED
424 TRAPELO ROAD, WALTHAM, MA. 02254

12. REPORT DATE
March 1980

13. NUMBER OF PAGES
72

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

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

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
DAMS, INSPECTION, DAM SAFETY,

Housatonic River Basin
Hinsdale, Massachusetts

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

The dam is an earthen dam with an emergency spillway cut into the right abutment. THe dam is about 440 ft. long and has a curve from the center to the emergency spillway. The dam is small in size and its hazard classification is high. The test flood for this dam is the Probable Maximum Flood. The dam is in poor condition at the present time. Remedial measures are to be undertaken by the owner.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

NOV 14 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 Belmont Reservoir Dam (MA-00224) 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, Town of Hinsdale, Hinsdale, Mass.

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,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

Incl
As stated

BELMONT RESERVOIR DAM

MA 00224

HOUSATONIC RIVER BASIN

HINSDALE, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPOFT

Identification No.:	MA 00224
Mass. D.P.W. No.:	1-2-132-2
Name of Dam:	Belmont Reservoir Dam
Town:	Hinsdale
County and State:	Berkshire County, Massachusetts
Stream:	No Name
Date of Inspection:	November 9, 1979

BRIEF ASSESSMENT

The Belmont Reservoir dam is located on the easterly end of Belmont Reservoir which is approximately 1.2 miles southwest of the Town of Hinsdale, Massachusetts. The dam was constructed as part of the water supply system for the Town of Hinsdale. The dam is an earthen dam with an emergency spillway cut into the right abutment. It is approximately 29 feet high at the center and its downstream channel is an unnamed stream which flows to Plunkett Reservoir. The facility has a gate house which is located to the left of the center of the dam. The water level is set by the level of the principal spillway. The principal spillway, which is part of the gate house foundation, is approximately thirteen (13) feet wide and four (4) feet high and its crest is four (4) feet below the top of the dam. The dam is approximately 440 feet long and has a curve from the center to the emergency spillway. The emergency spillway is a grass covered channel with stone retaining walls on each side. The spillway is 31 feet wide and discharges to a wooded area to the right of the dam.

The Town of Hinsdale owns the Belmont Reservoir dam and its Water Department is responsible for the operation of the facility. An employee visits the site on a regular basis, which is generally once every 2 weeks, to assure proper operation.

The drainage area affecting the Belmont Reservoir dam is approximately 0.44 square miles and is comprised of heavily wooded, mountainous terrain. The dam impounds approximately 90 acre feet at the normal pool elevation of 1692 feet MSL and 136 acre feet at the top of dam elevation of 1696 feet MSL. The dam is SMALL in size and its hazard classification is HIGH.

The test flood for this dam is the Probable Maximum Flood (PMF). For this drainage area the PMF is 1,350 cfs. When this flood is routed through the reservoir, the resulting outflow is 1,190 cfs. The principal and emergency spillways of the Belmont Reservoir dam cannot accommodate this flow and the dam will be overtopped by approximately 0.5 feet.

The combined spillways have a capacity of about 600 CFS with the water level at the top of te dam. This capacity is about 50% of the routed test flood outflow from the reservoir.

Failure of the dam would pose a serious threat to approximately seven buildings at a summer camp for youths, numerous boat docks on Plunket Reservoir and three roadway culverts.

The dam is in POOR condition at the present time. Remedial measures to be undertaken by the owner include: backfill animal holes, remove long grass and brush from the upstream and downstream faces of the dam and mow embankment slopes.

There are three areas that warrant further investigation. The area along the toe of the downstream slope of the dam from the emergency spillway to the principal spillway outlet channel is very wet and the source of this water should be determined. The discharge conduit is submerged in a small pool at the toe of the downstream slope. Also the discharge channel should be regraded to assure proper drainage from the downstream slope of the dam. Additional studies should be carried out to investigate the adequacy of the emergency spillway and the need for increased spillway capacity.

The recommendation for investigation of the wet condition along the downstream embankment toe should be initiated immediately, and all other recommendations and the remedial measures outlined above and listed in Section 7 should be implemented within one year of the receipt of this report by the Owner.

John W. Powers

John W. Powers
Massachusetts Registration 23106

This Phase I Inspection Report on Belmont 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.

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, CHAIRMAN
Water Control 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 aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

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

REPORT

APPENDICES

section. There is some minor cracking in the joints of the stone masonry riser section. There is a walkway to the gate house which is constructed of railroad track and wooden planking. The walkway extends into the foundation of the gate house and into the upstream face of the embankment. There is no handrail associated with this walkway.

Inside the gate house there are loose wooden planks that are laid across the openings to the basins. This planking comprises the floor of the gate house. Inspection of the basins is done by lifting one or more of the planks.

There are four wheel operated valves whch regulate the flow within the basins. These valves are exercised on a regular basis. The wooden slide gates to the opening of the basin are normally not in place.

During normal operation, the gate valves which drain each basin are closed. The gate valve allowing flow to pass from one basin to the second basin is open. And the gate valve allowing water to flow into the Town's distribution system is open. During the inspection, it was not possible to check the condition of these valves. However, the operator stated that all valves were in working condition and that all were exercised on a regular basis. There were no visible model numbers on any of the equipment.

2) Outlet Conduit (See photos 14 & 15)

The outlet conduit is a 16-inch diameter cast iron pipe. Due to the extent of ponding around the discharge end of the pipe inspection of the outlet conduit was not possible. The conduit was completely submerged in water approximately 1.5 feet above the top of the pipe.

(d) Reservoir Area (See photos 1,3&6)

The shore of the reservoir is generally shallow and is surrounded by gently sloping woodland. It appears stable and in good condition. There is no significant debris along the upstream slope of the embankment or along the upstream slope of the emergency spillway.

(e) Downstream Channel (See photo 15)

The downstream channel is a narrow unnamed brook which flows through a heavily wooded area. Downstream of this area the brook flows along a flat area and through a culvert under Persips Road (past Camp Romaca). Here, the brook enters a small pond which is connected to Plunkett Reservoir via a culvert under Plunkett Road.

Ponding of water around the outlet conduit is caused by poor grading of the downstream channel. Some debris was noted in the channel.

The soil along the toe of the downstream slope was primarily humus and was very soft and spongy. The soil composition of the embankment is unknown.

2) Riser Section (See Photos 1,3,6,7 & 9)

The riser section is located approximately 90 feet to the right of the left abutment and approximately 30 feet from the centerline of the embankment.

It is constructed of stone masonry and is the foundation upon which the gate house rests. The riser section is approximately 23 feet long and 21 feet wide and has a 13 foot by 4 foot rectangular weir in the southerly wall. This weir serves as the principal spillway for the reservoir.

The riser section is in relatively good condition, although there are a few minor cracks in the masonry. Photograph 9 shows the leakage through the joints on one wall.

The principal spillway has no provision for stoplogs and is completely self regulating.

3) Emergency Spillway (See photos 10, 11, 12 & 13)

The emergency spillway is located at the right abutment of the embankment. It is a grass lined channel approximately 31 feet wide with two stone masonry retaining walls along each side. There is a stone weir at grade across the channel.

The crest of the stone weir is about 3.4 feet below the top of the dam and the stone masonry retaining walls are about 4.6 feet high and extend about 1.2 feet above the top of the dam.

The grassed area of the emergency spillway is overgrown with long grass and weeds. The spillway is in good condition and shows no signs of erosion. The stone masonry retaining walls are in good condition although there is some minor cracking in the joints. The retaining wall on the right has some staining and a few trees are overhanging the channel. The area downstream of the emergency spillway is heavily wooded and the grading is done in such a manner that it might cause the flow to be diverted along the downstream toe of the embankment.

(c) Appurtenant Structure

1) Gate House (See photos 1,3,6,7,8,9)

The gate house is a 23 foot by 21 foot wooden structure which is located to the right of the left abutment. It is in relatively good condition for this type of structure. The foundation of the gate house is the stone masonry riser

SECTION 3 - VISUAL INSPECTION

3.1 Findings

(a) General

The Belmont Reservoir Dam in the Town of Hinsdale, Massachusetts (Dam No. MA 00224) is in POOR condition at the present time.

(b) Dam

1) Earth Embankment (See photos 1,2,3,4,5,16,17,18,19,& 20)

The upstream slope is partially protected by riprap and is in fair condition. The entire upstream slope is covered by long grass and weeds which have completely covered the riprap. There was no evidence of any significant debris along the upstream slope.

The top of dam varies between 8 to 10 feet in width and there are a few minor low spots along the top of the dam. The most severe depression is near the left abutment and that is approximately 0.4 feet lower than the remaining portions of the top of the dam.

There is no evidence of erosion on either the upstream or downstream slopes of the embankment. There is at least one animal hole on the downstream slope approximately 30 feet to the right of the gate house. The grass and weeds are so high that it was impossible to fully inspect the upstream and downstream slopes.

The downstream slope was quite steep and had a slight bulge approximately 130 feet to the right of the gate house. Since there were no plans available for this dam, it was impossible to determine if this bulge occurred after construction. There was no evidence of any cracks or leakage at this location.

The area immediately below the dam was wooded and was covered by tall grass and weeds, which prevented the identification of any toe drains which might exist.

The entire toe of the downstream slope between the emergency spillway and the discharge channel was very wet. Photographs 15 through 19 show the extent of the problem. Puddles were visable along the toe of the downstream slope and water was actually flowing along the toe of the downstream slope near the center of the embankment. Flowing seepage was clear, but the rate of flow was not measurable. The toe of the downstream slope near the left abutment showed no evidence of wetness, however, the area immediately surrounding the discharge channel was quite wet (Photo 20).

SECTON 2 - ENGINEERING DATA

2.1 Design Data

Design data for the Belmont Reservoir Dam is not available. Plans for the Belmont Reservoir Dam are not available. The designer of the Dam is not known.

2.2 Construction Data

Construction data is not available for the Belmont Reservoir Dam.

2.3 Operation Data

Since the dam is self regulating, there is no operational data available for the Belmont Reservoir Dam.

2.4 Evaluation of Data

a) Availability

As stated previously there are no known design records such as plans, computations, etc., and the designer of the dam is not known. Such data, therefore, is not available.

b) Adequacy

The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past-performance history and sound engineering judgment.

c) Validity

There is no design data for which validity can be assessed.

(2) Length of weir:

a) Principal Spillway: 13 feet

b) Emergency Spillway: 31 feet

(3) Crest elevation:

a) Principal Spillway inlet: 1,692±

b) Emergency Spillway: 1,692.6±

(4) Gates: None

(5) Upstream Channel:

a) Principal Spillway: Reservoir

b) Emergency Spillway: Reservoir

6) Downstream Channel:

a) Principal spillway: Ungated 16 inch cast iron pipe discharged to basin downstream of the earthen embankment.

b) Emergency spillway: Grass covered channel with wooded area downstream.

(j) Regulating Outlets (See gate house sketch page B-2)

1) Invert: Water Supply Intake 1668±
Pond Drain Valve 1670±

2) Size: 1 - 4 foot wide slide gate (Water Supply Intake and Pond Drain)
4 - 8 inch diameter gate valves

3) Description: One opening 4 feet wide, which can be closed by wooden slide gates, allows water from the pond to enter the upstream chamber on the north side of the gate house (Basin 1). Water normally flows through a valve into the downstream chamber (Basin 2) and then through another valve into the Town's water system. Each of the chambers can be completely closed off and drained into the principal spillway outlet (Basin 3) via separate 8-inch gate valves. The pond is self regulating and excess water is either stored within the impoundment or overflows the rectangular weir of the principal spillway depending upon the pond elevation. Water which overflows the principal spillway flows through a 16-inch cast iron pipe to the discharge channel.

- (2) Flood control pool: Not applicable
- (3) Spillway crest pool: 90±
- (4) Top of dam: 136±
- (5) Test flood pool: 145±

(f) Reservoir Surface (acres)

- (1) Normal pool: 10±
- (2) Flood-control pool: Not applicable
- (3) Spillway crest: 10±
- (4) Test flood pool: 13.5±
- (5) Top of dam: 13±

(g) Dam

- (1) Type: Earth embankment
- (2) Length: 440± ft.
- (3) Height: 29± ft.
- (4) Top Width: Varies between 8 to 10 feet
- (5) Side Slopes: Upstream: 3 to 1 (embankment)
  Downstream: 2 to 1 (embankment)
- (6) Zoning: Type of Material Not Known
- (7) Impervious Core: Unknown
- (8) Cutoff: Unknown
- (9) Grout curtain: Unknown

(h) Diversion and Regulating Tunnel

Not applicable

(i) Spillway

- (1) Type:
  - a) Principal Spillway: Rectangular weir in riser section
  - b) Emergency Spillway: Grass covered with stone masonry training walls

8) Total Project Discharge at Top of Dam

The total project discharge at top of dam (1,696 feet NGVD) is approximately 600 cfs. This is a combined discharge including 37 cfs for the principal spillway and 563 cfs for the flow through the emergency spillway.

9) Total Project Discharge at Test Flood Elevation

The total project discharge at test flood elevation (1,696.5 feet NGVD) is approximately 1,190 cfs. This is a combined discharge including 37 cfs for the principal spillway and 723 cfs for the flow through the emergency spillway and approximately 430 cfs which represents the flow overtopping the dam by approximately 0.5 feet.

(c) Elevation (ft. above NGVD)

(1) Streambed at toe of dam: 1,667±

(2) Bottom of cutoff: Unknown

(3) Maximum tailwater: Unknown

(4) Water supply pool: 1,692

(5) Full flood control pool: Not applicable

(6) Spillway crest: 1,692 (no gates)

(7) Design surcharge (Original Design): Unknown

(8) Top of dam: 1,696

(9) Test flood design surcharge: 1,696.5

(d) Reservoir (Length in feet)

(1) Normal pool: 1,000±

(2) Flood control pool: Not applicable

(3) Spillway crest pool: 1,000±

(4) Top of dam: 1,050±

(5) Test flood pool: 1,080±

(e) Storage (acre-feet)

(1) Normal pool: 90±

(b) Discharge at Dam Site

1) Outlet Works

Normal discharge at the site is through the 13 feet wide principal spillway in the base of the gate house at elevation 1,692±. Water overflowing this spillway discharges through a 16-inch pipe to the outlet channel at the downstream toe of the earthen embankment. In the event of severe flood flows, excess flow would discharge through the emergency spillway at elevation 1,692.6 feet (NGVD). It has been assumed that the normal pool elevation is at the crest of the principal spillway and that this elevation is 1,692 feet above mean sea level. The U.S.G.S. map shows the water level at this elevation and we have related all dam features to this datum.

2) Maximum Known Flood at Dam Site

There is no data available for the maximum known flood at this dam site.

3) Ungated Spillway Capacity at Top of Dam

With the water level at the top of the dam (elev. 1696 feet NGVD) spillway capacities are as follows:

principal spillway		37 CFS
emergency spillway		563 CFS
	Total	600 CFS

4) Ungated Spillway Capacity at Test Flood

With the water level at the test flood elevation (1696.5 feet NGVD) spillway capacities are as follows:

principal spillway		37 CFS
emergency spillway		723 CFS
	Total	760 CFS

5) Gated Spillway Capacity at Normal Pool Elevation

None.

6) Gated Spillway Capacity at Test Flood Elevation

None.

7) Total Spillway Capacity at Test Flood Elevation

The total spillway capacity at test flood elevation (1,696.5 feet NGVD) is approximately 600 cfs.

(d) Hazard Classification

The hazard potential classification for this dam is HIGH because of the economic losses and potential for loss of life downstream which may occur in the event of dam failure. There is a high potential for severely damaging about seven buildings at Camp Romaca with attendant probable loss of more than a few lives, as well as three roadway culverts and numerous dock facilities on Plunket Reservoir. Section 5 of this report presents more detailed discussion of the hazard potential.

(e) Ownership

The Belmont Reservoir dam is owned by the Town of Hinsdale acting through the Board of Selectmen. Their offices are at Town Hall, Maple Street, Hinsdale, Massachusetts.

(f) Operator

The Belmont Reservoir dam is operated by the Town of Hinsdale acting through its Highway Department. The Superintendent of the Highway Department is Mr. Art Moon, who can be reached by telephone at (413) 655-2245.

(g) Purpose of the Dam

The purpose of the dam is to provide a water supply for the Town of Hinsdale. Water is stored in Belmont reservoir, released through the 8-inch gate valve and enters the water distribution system of the Town of Hinsdale.

(h) Design and Construction History

The dam was constructed in 1889, however, there is no additional information available regarding the design and construction of the Belmont Reservoir Dam.

(i) Normal Operation Procedure

The dam is normally self regulating. The water supply intake pipe is normally fully open maintaining pressure within the distribution system. Flows in excess of water consumption are either stored within the reservoir or discharged via the spillways based on the stage vs discharge characteristics. There are no day-to-day operations of the water supply intake.

1.3 Pertinent Data

(a) Drainage Area

The drainage area for this dam covers about 0.44 square miles. It is primarily comprised of heavily wooded land with relatively steep hills sloping directly to Belmont Reservoir. There are no developed areas within the drainage area.

both the principal spillway, pond drain, and intake structure for the Town of Hinsdale water supply system.

The gate house is separated into three riser compartments. The 4-foot wide water supply intake and pond drain opening is into basin 1 which is in the northwest corner of the structure. Basin 2 is in the northeast corner of the structure and is connected to basin 1 by an 8-inch diameter pipe with a gate valve. The 8-inch diameter Town of Hinsdale water supply intake has its inlet end located in Basin 2 and is controlled by an 8-inch diameter gate valve. Basin 3 comprises the entire southern half of the structure and serves as the principal spillway. Both Basin 1 and Basin 2 are connected to Basin 3 for draining purposes by 8-inch diameter pipes each with an 8-inch gate valve at invert elevation 1670±.

The gating arrangement consists of a 4-foot wooden slide gate and 4 - 8-inch diameter gate valves. All of the gates are on the water supply and pond drain systems, and no gates are located in the principal spillway outlet pipe.

The 4 foot wooden slide gate can be used only to block off the intake opening into the gate house through the north corner of the upstream side. This opening has an invert elevation of 1668±. The 2 - 8-inch valves into the principal spillway section serve as the pond drain controls and as previously discussed are at invert elevation 1670±.

The 2 other 8-inch valves are on the water supply system; one connects Basin 1 to Basin 2 and the other controls the inlet to the water supply system pipe.

The pincipal spillway riser section outlet consists of an ungated 16-inch diameter pipe to the downstream channel from Basin 3.

Page B-2 of Appendix B illustrates the layout and gating arrangement of the gate house.

At the floor level of the superstructure the riser compartments are covered by wooden planks which span the openings. The gate valve operating stems are extended above the floor level. These valves are all of the manually operated type.

(c) Size Classification

The dam's maximum impoundment (computed to the top of dam) of approximately 136 acre feet and height of 29 feet places it in the SMALL size category according to the Corps of Engineers' Recommended Guidelines.

1.2 Description of Project

(a) Location

The Belmont Reservoir Dam is located on the easterly end of Belmont Reservoir, which is approximately 1.2 miles southwest of Hinsdale, Massachusetts. It can be reached from Hinsdale by taking Robinson Road to Plunkett Road. Follow Plunkett Road for approximately 0.2 miles. There is a dirt road on the right which leads to Belmont Reservoir. The dam is shown on the U.S.G.S. Pittsfield East Quadrangle Map. The dam is located at approximately N 42°-25'-52" latitude and W-73°-08'-53" longitude (see Locus Map).

(b) Description of Dam and Appurtenances

The dam consists of an earth embankment, an emergency spillway, and a wooden gate house with a principal spillway. The length of the earth embankment is approximately 440 feet and the emergency spillway is 31 feet wide. A sketch of the facility is included in Appendix B.

1) Earth Embankment (B-1)

The embankment is approximately 440 feet long and is a maximum of about 29 feet high. The upstream slope is approximately 3 horizontal to 1 vertical; the downstream slope of approximately 2 horizontal to 1 vertical; and the width at the top of the dam varies between 8 to 10 feet.

Since there are no plans or construction records available, the type of material used to construct the dam is not known.

Riprap covering most of the entire length of the upstream slope provides erosion protection. The riprap is approximately one foot diameter stone.

2) Principal Spillway (B-1 and B-2)

The principal spillway is located in the south side of the riser section which comprises the foundation of the gate house. The riser section consists of a stone masonry shaft which is divided into three sections. The principal spillway is approximately 13 feet wide and 4 feet high. There are no provisions for the use of stop logs in the structure and there are no means of regulating the amount of water entering the riser section. The outlet from the spillway riser section is a 16-inch diameter pipe.

3) Gate House (B-1 and B-2)

A gate house consisting of a 21 feet by 24 feet stone masonry foundation and wooden superstructure is located to the left of the center of the dam. The gate house serves as

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

BELMONT RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

(a) Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Tighe & Bond/SCI has been retained by the New England Division to inspect and report on selected dams in Massachusetts. Authorization and notice to proceed were issued to Tighe & Bond/SCI under a letter of October 24, 1979 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW 33-80-C-0005 has been assigned by the Corps of Engineers for this work.

(b) Purpose

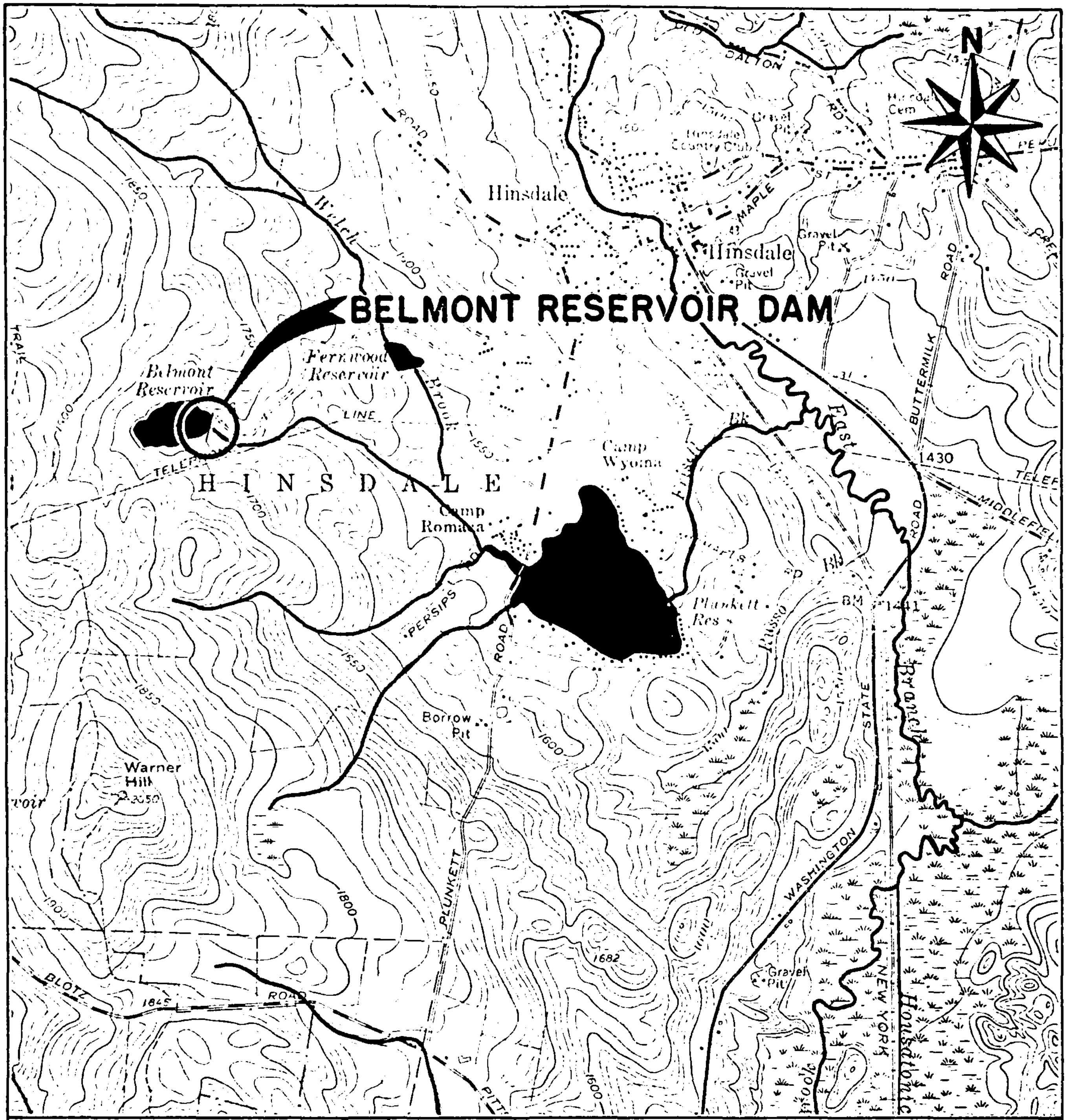
1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

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

(c) Scope

The program provides for the inspection of non-federal dams in the high hazard potential category based upon location of the dams, and those dams in the significant hazard potential category believed to represent an immediate danger based on condition of the dams.



-SCALE-

1000' 0 1000' 2000' 3000'

FROM: U.S.G.S. PITTSFIELD EAST, AND PERU, MASS. QUADRANGLE MAPS

QUADRANGLE LOCATION

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

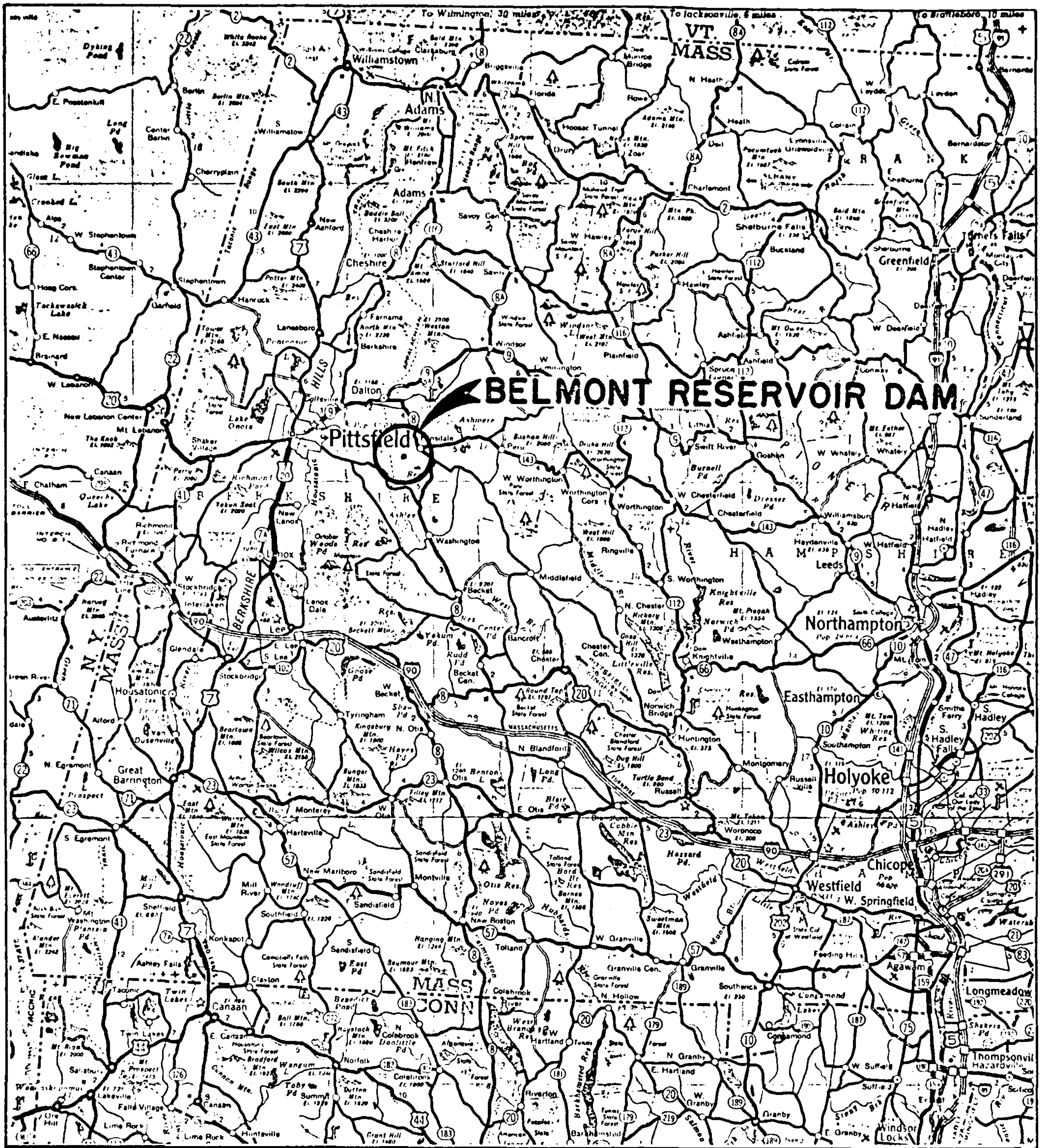
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCUS PLAN 2

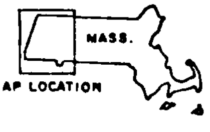
BELMONT RESERVOIR DAM (MA 00224) HINSDALE
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED

DATE: MARCH 1980



SCALE IN MILES



MAP LOCATION

TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

U.S.ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCUS PLAN I

BELMONT RESERVOIR DAM (MA 00224) HINSDALE
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED
DATE: MARCH 1980

3.2 Evaluation

The dam is generally in POOR condition. The potential problems noted during the visual inspection are listed below.

a) The area along the downstream toe of the embankment especially between the emergency spillway and the principal spillway outlet channel is very wet with ponding and some flowing water.

b) The upstream and downstream slopes of the embankment are completely covered by long grass, weeds, and brush.

c) The rip rap along the upstream slope of the embankment is completely overgrown by grass and weeds.

d) The roots of the trees along the toe of the downstream slope may be growing into the embankment.

e) There is a slight bulge in the embankment approximately 130 feet to the right of the gate house.

f) There are trees growing very close to the retaining wall along the right of the emergency spillway. These trees overhang the channel.

g) The heavily wooded area downstream of the emergency spillway and the grading of the channel may direct spillway flow along the toe of the downstream slope of the embankment.

h) There is an animal hole located on the downstream slope of the embankment approximately 30 feet to the right of the gate house.

i) There are many soft areas along the toe of the downstream slope of the embankment.

j) The outlet conduit is submerged in approximately 1.5 feet of ponded water.

k) The downstream channel is poorly graded and does not provide adequate drainage from the outlet conduit.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

(a) General

No written operational procedures are available for this Dam.

(b) Description of Any Warning System in Effect

There is no written warning system in effect.

4.2 Maintenance Procedures

(a) General

There is no evidence that any maintenance has been done on this dam in many years.

(b) Operating Facilities

Operation of the gate valve to regulate the water entering the distribution system is the only mechanical item that must be exercised on a regular basis. At this time, the Town of Hinsdale Highway Department inspects the water level of the Reservoir and checks the gate house on a regular basis which is about once every two weeks.

The pond could be drained by opening the first basin drain and removing all slide gates from the entrance to the first basin.

4.3 Evaluation

Detailed operating procedures are not considered necessary since the dam is normally self-regulating. Regular annual maintenance inspections should be performed.

A formal, written downstream emergency flood warning system should be developed.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Belmont Reservoir Dam in Hinsdale, Massachusetts is in the watershed of the Housatonic River. The dam is located approximately 1.4 miles upstream of Plunkett Reservoir. The upstream drainage area is approximately 0.44 square miles with mountainous topography.

The dam itself is an earthen embankment approximately 440 feet in length. The principal spillway is located to the left of the center of the dam and consists of a rectangular weir built into the riser section beneath the wooden gate house. The dam is self regulating and the overflow enters a 16 inch outlet conduit. It is discharged to an unnamed brook which flows through woodland into Plunkett Reservoir.

5.2 Design Data

There was no design data or plans available for this review and it was impossible to determine all hydraulic and hydrologic features of the Belmont Reservoir Dam. The designer of the dam is not known. Since the U.S.G.S. mapping shows an elevation of 1692 (MSL) for the water level, it has been assumed that this is the elevation of the crest of the rectangular weir and the normal pool elevation. All project features are related to this assumed datum.

5.3 Experience Data

No records of flow or stage are known to be available for the Belmont Reservoir Dam No. MA 00224.

5.4 Test Flood Analysis

The hydrologic conditions of interest in this Phase I investigation are those required to assess the dam's overtopping potential and its ability to safely allow an appropriately large flood to pass. This requires using the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. The original hydraulic and hydrologic design calculations are not available for inclusion in this Report.

Guidelines for establishing a recommended Test Flood based on the size and hazard classification of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of between 50 and 1,000 acre feet and the height between 25 and 40 feet classify this dam as a SMALL size structure.

The appropriate hazard classification for this dam is HIGH because of the economic losses and potential for loss of life downstream in the event of dam failure. As shown in the Dam Failure Analysis section, the increase in flooding caused by failure would pose a threat to life and property at various locations along the brook. Other impacts of dam failure include possible damage to several small roads, a heavily travelled road, and a railroad. (See Dam Failure Analysis section.)

As shown in Table 3 of the Corps of Engineers' "Recommended Guidelines," the appropriate Test Flood for a dam classified as SMALL in size with a HIGH hazard potential would be within a range of 50% of the Probable Maximum Flood (1/2 PMF) to the Probable Maximum Flood (PMF).

The downstream hazard area for this dam includes a summer camp for youths. Due to the potential for large numbers of children to be within the flood path of a dam failure, the Probable Maximum Flood has been selected as the test flood.

The Corps of Engineers "Maximum Probable Peak Flow Rates" guidance curve does not cover drainage areas which are less than 2 square miles. The drainage area for this dam is 0.44 square miles. Due to a lack of more specific data for small drainage areas within this region, an extrapolation of the Corps guidance curve has been utilized to determine the test flood. Extrapolating the guidance curve to a drainage area of 0.44 square miles using mountainous terrain results in a unit discharge of 3060 CFS/sq. mile and a PMF test flood of 1350 CFS for the Belmont Dam.

When this flood is routed through the reservoir, the resultant outflow is 1,190 cfs. The test flood would exceed the capacity of both the spillway and the pond drains. Therefore, the dam would be overtopped by approximately 0.5 feet.

The combined spillways have a capacity of about 600 CFS with the water level at the top of the dam. This capacity is about 50% of the routed test flood outflow from the reservoir.

5.5 Dam Failure Analysis

The peak outflow that would result from the failure of the Belmont Reservoir Dam is estimated using the procedure suggested in the Corps of Engineers New England Division's April 1978 "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs." This procedure is carried out with dam failure assumed to occur when the water surface reaches the top of the dam.

For an assumed breach width equal to 40 percent of the dam width at the half-height, the gap in the embankment due to failure would be 160 feet. The resulting dam failure flow would be about 40,000 cfs. The pre-failure spillway test flood outflow is 1,190 cfs.

The first damage area impacted by a dam failure flow is directly downstream of the dam. Prior to dam breach, the test flood flow is 1,190 cfs resulting in a river stage of about 3 feet. After the dam failure the flow is 42,000 cfs resulting in a river stage of about 10.6 feet. There are no structures or developed areas directly downstream of the dam, therefore, the damage incurred will not be significant.

The second damage area impaced by a dam failure flow is the crossing of Persips Road approximately 4,400 feet downstream of the dam. Prior to dam breach, the test flood flow is 1,190 cfs, which will result in overtopping Persips Road by about 0.9 feet. The dam failure attenuated flow is 16,300 cfs, which will result in overtopping Persips Road by about 4.1 feet. There are no structures endangered by either pre-failure or post-failure flows.

The third damage area impacted by dam failure flow is the crossing of Plunket Road and Camp Romaca approximately 5,100 feet downstream of the dam. Camp Romaca is a local summer camp which has about 24 buildings. Some of the buildings are overnight sleeping quarters. Prior to dam breach, the test flood flow is 1,190 cfs which will result in overtopping Plunket Road by about 1.3 feet. This will flood approximately seven buildings by about 2.0 feet. The dam failure attenuated flow is 14,500 cfs which will result in overtopping Plunket Road by about 6.0 feet. This will flood an additional 2 buildings. by about 1.0 feet and increase the flooding of the previously flooded 7 buildings to about 6.7 feet. If the failure occurred during a period of occupancy at the camp, then, there is a high potential for loss of life due to a dam failure.

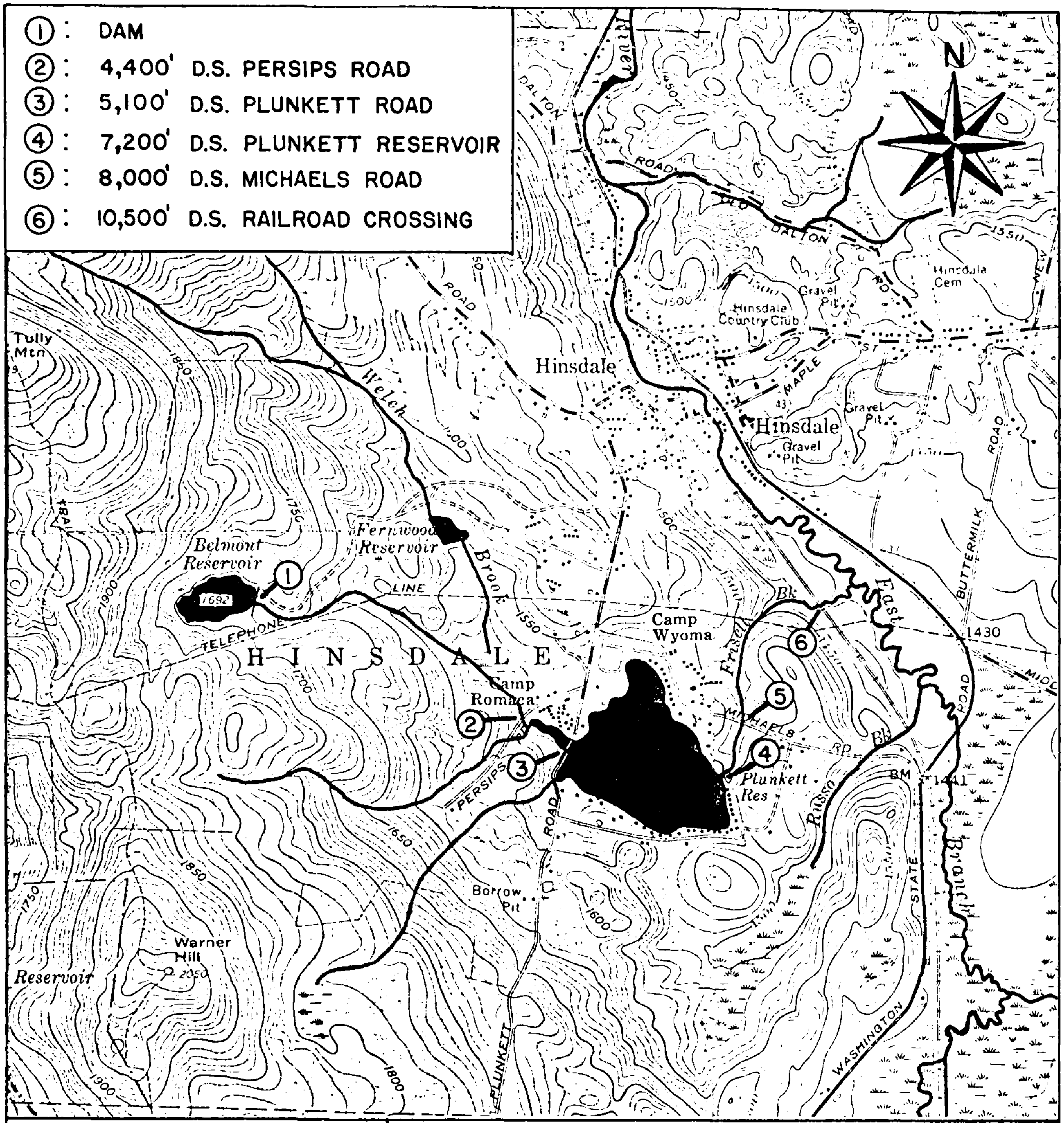
The fourth damage area impacted by dam failure flow is Plunket Reservoir approximately 7,200 feet downstream of the dam. Plunket Reservoir is a local recreational pond which covers approximately 62 acres and has about 42 cottages situated around its perimeter. Prior to dam breach, the test flood flow is 1,190 cfs which will raise the level of the pond less than 1.0 feet. This is not expected to cause significant damage to any of the cottage or docking facilities. The dam failure attenuated flow is 14,500 cfs entering the pond and is expected to raise the pond level by about 2.0 feet with a resulting 20% reduction in dam failure flow to 11,600 cfs. No structures are endangered by the dam failure flow.

The fifth damage area impacted by dam failure flow is the crossing of Michaels Road approximately 8,000 feet downstream of the dam. Prior to dam breach, the test flood flow is 1,190 cfs which will result in overtopping Michaels Road by about 1.1 feet. The dam failure attenuated flow is 11,600 cfs which will result in overtopping Michaels Road by about 4.0 feet. No structures are endangered by the flood or dam failure flows.

The sixth damage area impacted by dam failure flow is the crossing of the railroad tracks approximately 10,500 feet downstream of the dam. Prefailure test flood flow will result in overtopping the railroad embankment by about 0.2 feet. Post-failure flow will result in overtopping the railroad embankment by about 1.6 feet. No structures are endangered by the flood or dam failure flows.

Approximately 11,000 feet downstream of the dam the flow joins the East Branch of the Housatonic River. Pre-failure flows result in a river stage of about 3.0 feet and post-failure flows result in a river stage of about 7.0 feet. Downstream of the confluence the affects of a Belmont dam failure will not significantly add to the hazard potential.

In summary, the dam failure flow has a high potential for seriously damaging or destroying seven buildings at Camp Romaca, with attendant probable loss of more than a few lives. In addition, numerous boat docks on Plunket Reservoir, and three roadway culverts are seriously threatened.



-SCALE-

1000' 0 1000' 2000' 3000'

FROM: U.S.G.S. PITTSFIELD EAST, AND PERU, MASS. QUADRANGLE MAPS

QUADRANGLE LOCATION

TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

U.S.ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

BELMONT RESERVOIR DAM (MA 00224) HINSDALE
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED
DATE: MARCH 1980

PROBABLE DOWNSTREAM IMPACT OF DAM FAILURE

Belmont Reservoir Dam
MA 00224

Number	Location	Number of Houses Flooded	Other Damage	Flow Prior To Failure	Brook Stage	Flow After Failure	Brook Stage	Comments
1	Downstream Belmont Reservoir	---	---	1,190 c.f.s.	---	42,015 c.f.s.	---	No Significant Damage
2	Persips Road	---	Culvert	1,190 c.f.s.	7.6 ft.	16,274 c.f.s.	10.8	Prior to failure road flooded 0.9 ft.; after failure road flooded 4.1 ft.
3	Plunket Road	Camp Romaca 9	Culvert	1,190 c.f.s.	7.0 ft.	14,550 c.f.s.	11.7	Prior to failure road flooded 1.3 ft., 7 buildings flooded 2.0 ft; after failure road flooded 6.0 ft., 7 blgs. flooded 6.7 ft., 2 bldgs. 1.0 feet.
4	Plunket Reservoir	---	Boat Docks	1,190 c.f.s.	elev. 1502	14,550 c.f.s.	elev. 1507.5	Prior to failure no significant damage; after failure minor flooding to numerous boat docks.
5	Michaels Road	---	Culvert	1,190 c.f.s.	11± ft.	11,640 c.f.s.	14±	Prior to failure roadway flooded 1.1 feet; after failure roadway flooded 4.0 feet.

PROBABLE DOWNSTREAM IMPACT OF DAM FAILURE

Belmont Reservoir Dam
MA 00224

(Continued)

Number	Location	Number of Houses Flooded	Other Damage	Flow Prior To Failure	Brook Stage	Flow After Failure	Brook Stage	Comments
6	Railroad Crossing	---	Culvert	1,190 c.f.s.	---	11,640 c.f.s.		Prior to failure railroad embankment flooded 0.2 feet; after failure embankment flooded 1.6 ft.

Total number of buldings flooded before failure = 7

Total number of buildings flooded after failure = 9

Total number of buildings seriously damaged before failure = 0

Total number of buildings seriously damaged after failure = 7

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

There are no apparent signs of significant displacement or distress at this facility. The slight bulge noted during our visual inspection is not considered significant. However, since this is a high hazard dam, seepage and stability analyses comparable to the requirements of paragraph 4.4 of the "Recommended Guidelines for Safety Inspection of Dams" should be carried out.

6.2 Design and Construction Data

Seepage and stability analyses comparable to the requirements of paragraph 4.4 of the "Recommended Guidelines" are not available for the Belmont Reservoir Dam. Additional computations for seepage and stability analyses have not been developed for this report, since this is beyond the scope of the Phase I Inspection program.

6.3 Post Construction Changes

There have been no known modifications since the Dam was built in 1889.

6.4 Seismic Stability

The Belmont Reservoir Dam is located in seismic zone 1. According to the recommended Corps of Engineers guidelines, a seismic analysis is not warranted.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

(a) Condition

The Dam and its appurtenances are generally in POOR condition at the present time.

(b) Adequacy of Information

The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past-performance history and sound engineering judgment.

(c) Urgency

The recommendation for investigation of the source of the wet condition along the downstream toe of the embankment should be initiated immediately by the Owner upon receipt of this Phase I Inspection Report. All other recommendations and remedial measures described herein should be implemented by the owner within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

It is recommended that the following items be investigated under the supervision of a qualified registered professional engineer, and that the Owner implement the recommendations of the Engineer:

1. Investigate the source of the wet condition along the downstream toe of the embankment.
2. Regrade the downstream channel to assure proper drainage.
3. Investigate the adequacy of the emergency spillway and the advisability of increasing spillway capacity.

7.3 Remedial Measures

(a) Operation and Maintenance Procedures

It is recommended that the owner institute the following remedial, maintenance and operational measures:

1) Establish a maintenance program for the Belmont Reservoir Dam.

2) Trim all long grass and remove all brush and weeds from the upstream and downstream faces of the embankment including clearing the rip rap section.

3) Backfill all animal holes along the downstream face of the embankment.

4) Remove all debris from the downstream channel.

5) Fill all low spots on the crest of the dam.

6) Clear an area downstream of the emergency spillway to prevent water from flowing along the downstream slope of the dam.

7) Remove trees along the embankment toe and maintain an area of about 20 feet horizontally from the toe clear of trees.

8) Remove trees within 20 feet of the emergency spillway retaining walls.

9) Institute a program of annual technical inspections by a registered professional engineer qualified in dam design and inspection.

10. Develop an "Emergency Action Plan" that will include an effective preplanned downstream warning system, locations of emergency equipment, materials and manpower, authorities to contact and potential areas that require evacuation.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A

INSPECTION CHECKLIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Belmont Reservoir Dam
Hinsdale, Mass.

DATE Nov. 9, 1979

TIME 10:30

WEATHER Cloudy 50°+

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

PARTY: Tighe & Bond/SCI

1. J. W. Powers P. E. Project Manager
2. E. A. Moe P.E., Soils/Hydraulics
3. D. L. Lenart P.E., Civil
4. H. A. Koski, Civil
5. ______
6. ______
7. ______
8. ______
9. ______
10. ______

PROJECT FEATURE	INSPECTED BY	REMARKS
1. All Project features were inspected by all party members		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Also present was Mr. Art Moon of the Town of Hinsdale Highway Department.

[illegible]

Photo 5

Downstream face of dam looking southerly from toe of slope

[illegible]

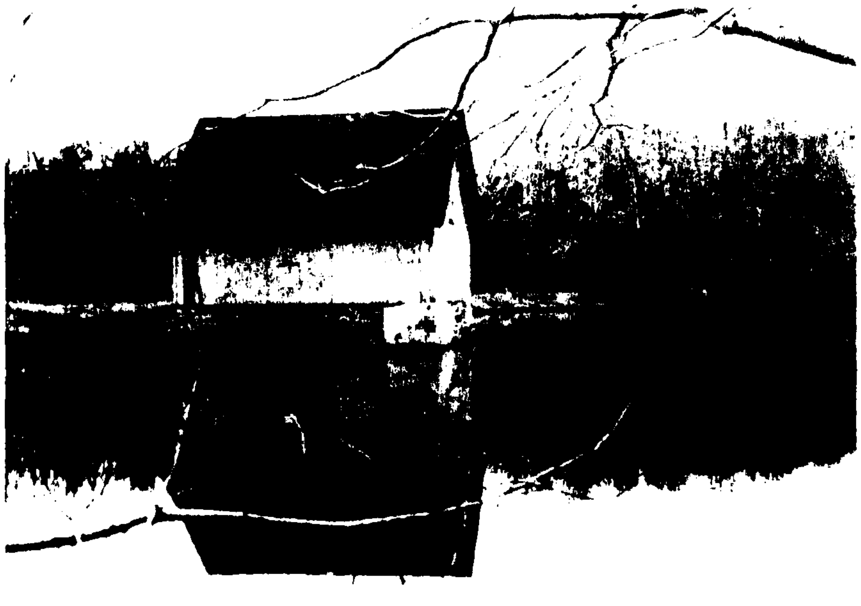


Photo 1

Dam overview looking southerly from left abutment

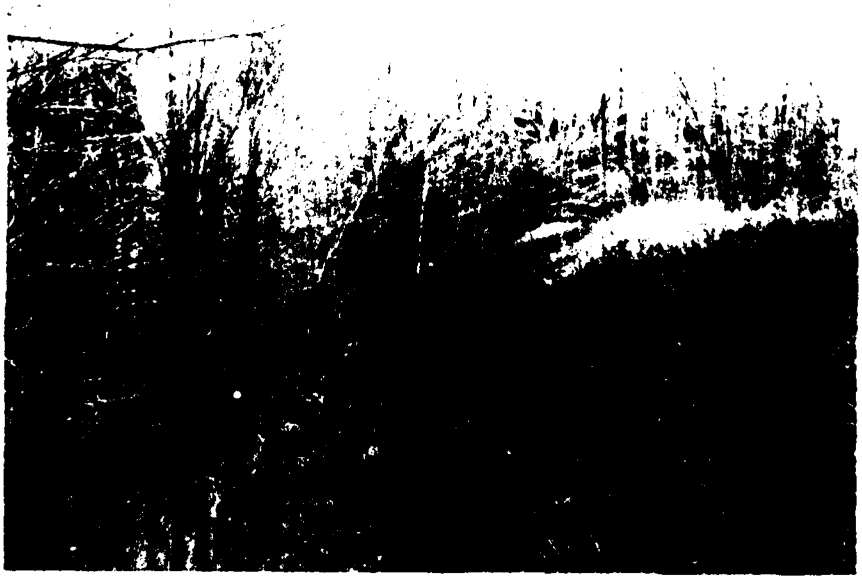


Photo 2

Downstream face of dam looking southerly from left abutment

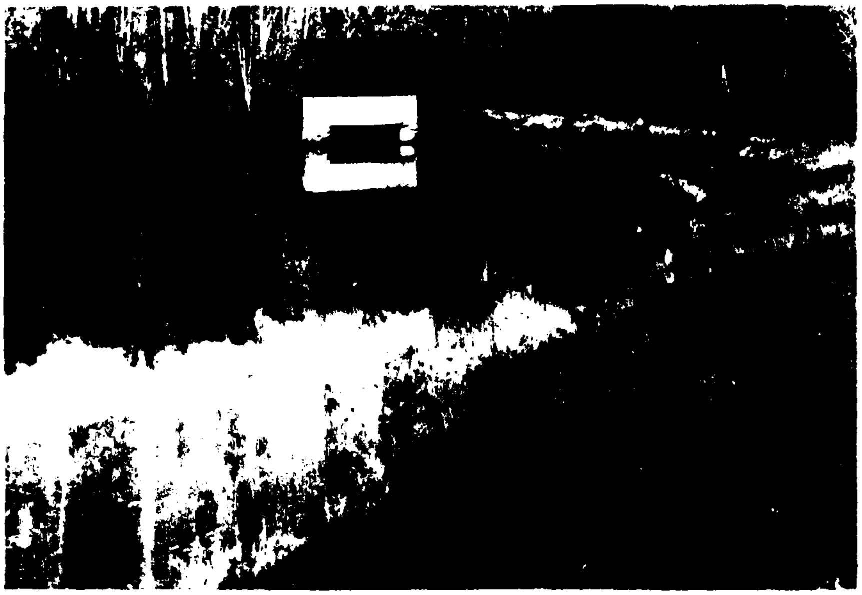
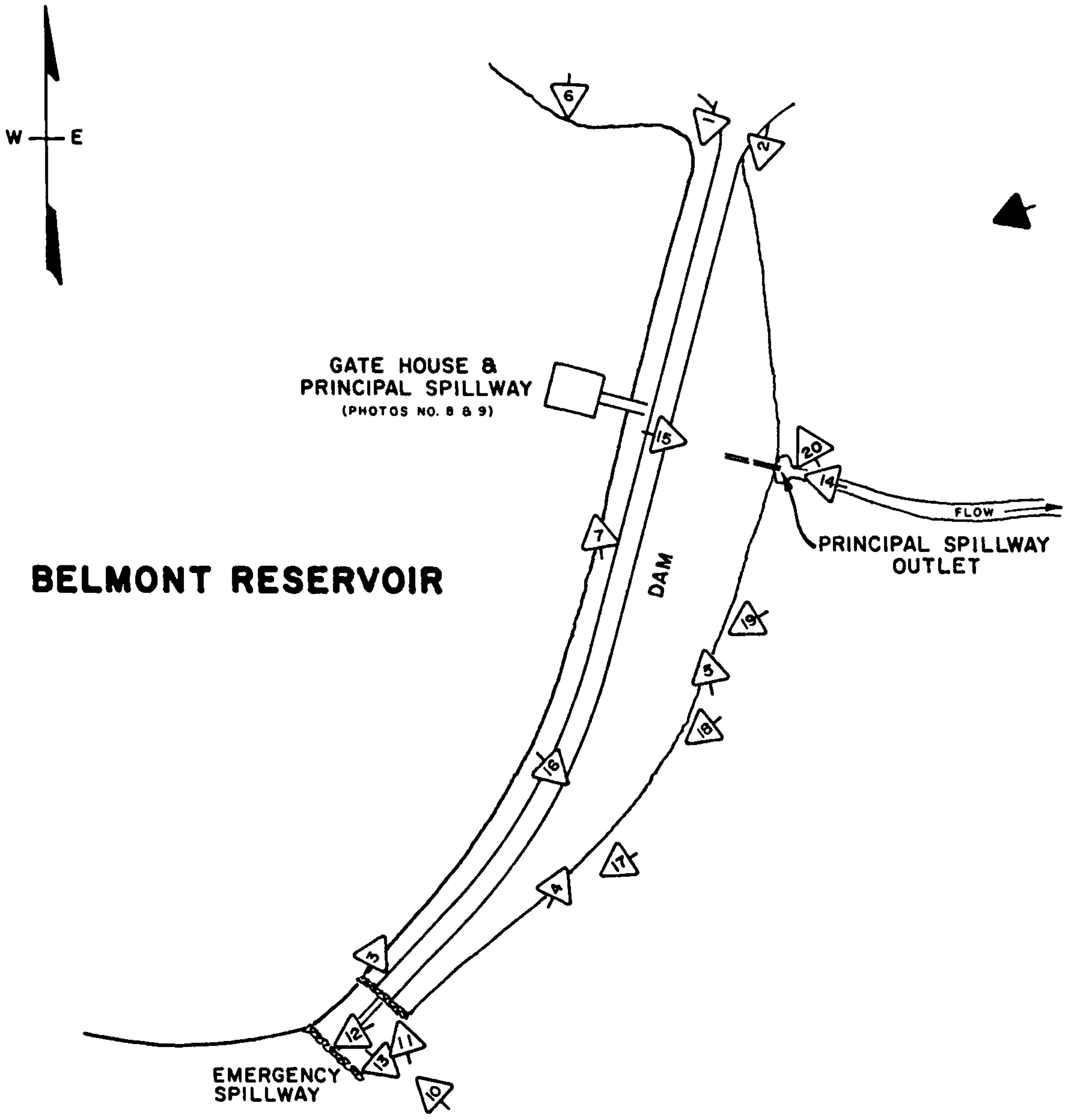


Photo 3

Dam overview looking northerly from emergency spillway



▶ OVERVIEW (AERIAL)

▷ APPENDIX C

TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND ORIENTATION OF PHOTOS

BELMONT RESERVOIR DAM (MA 00224)
BERKSHIRE COUNTY

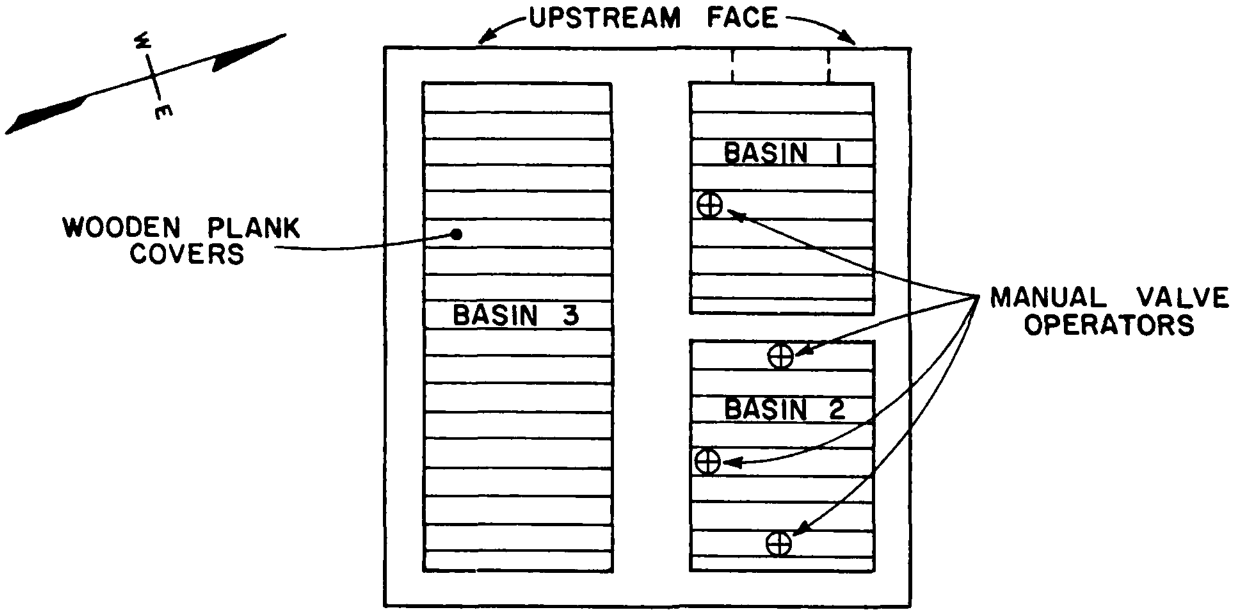
HINSDALE
MASSACHUSETTS

SCALE: NONE

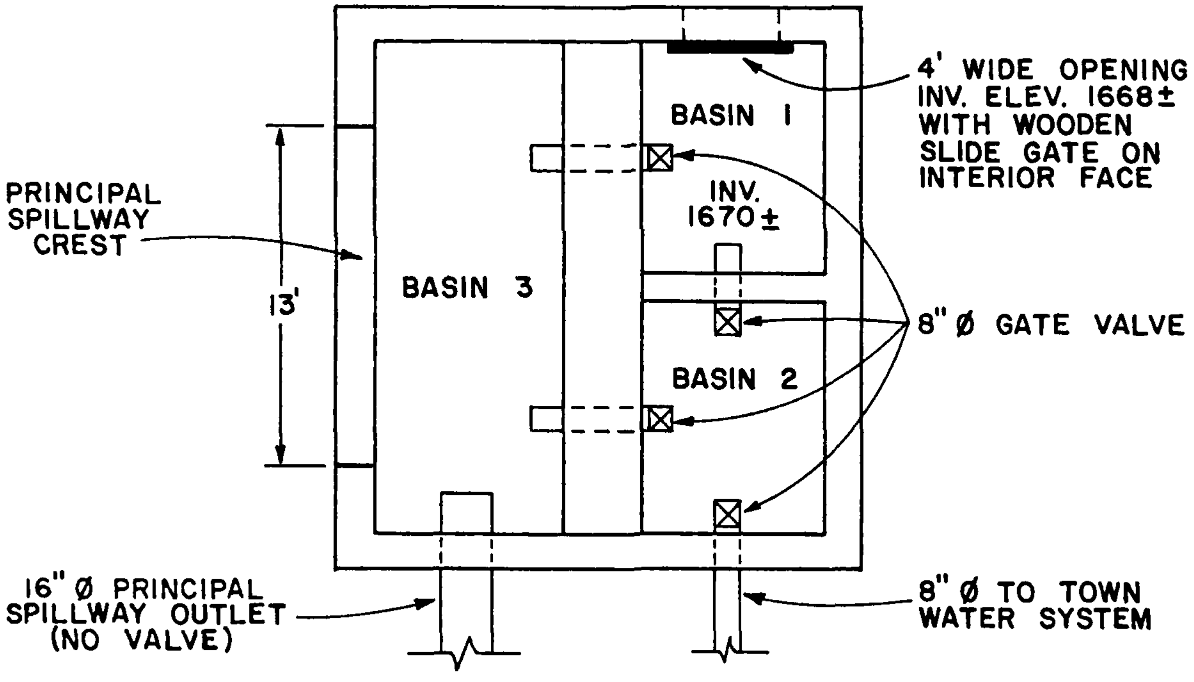
DATE: MARCH 1980

APPENDIX C

PHOTOGRAPHS



FLOOR PLAN ELEV. 1696±



BASIN PLAN ELEV. 1692±

TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

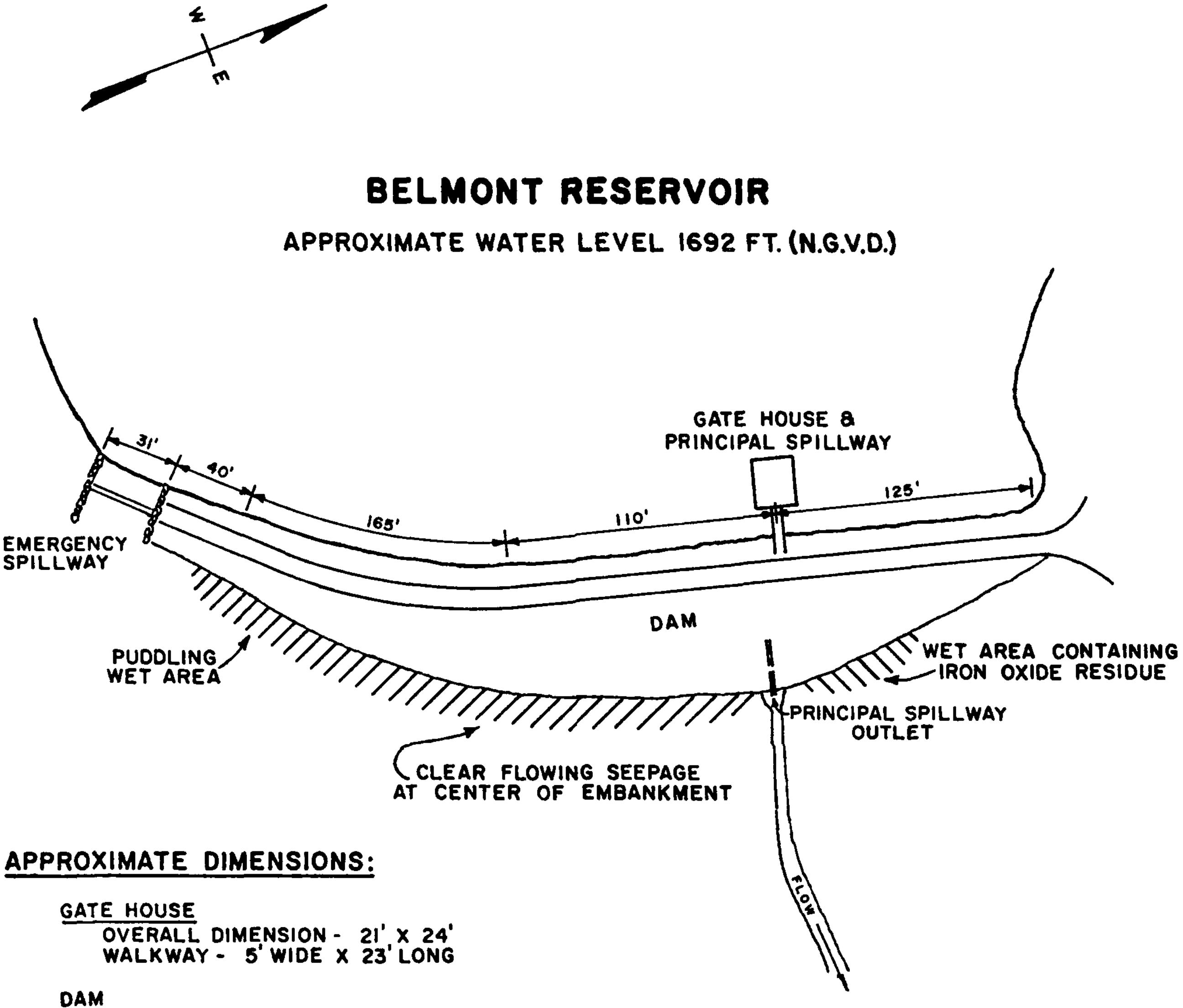
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SKETCH OF GATE HOUSE

BELMONT RESERVOIR DAM (MA 00224)
BERKSHIRE COUNTY

HINSDALE
MASSACHUSETTS

SCALE: NONE
DATE: MARCH 1980



APPROXIMATE DIMENSIONS:

GATE HOUSE
OVERALL DIMENSION - 21' X 24'
WALKWAY - 5' WIDE X 23' LONG

DAM
HEIGHT - 29 FEET
WIDTH AT TOP OF DAM - 8 TO 10 FEET
LENGTH - 440 FEET

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SKETCH OF DAM

BELMONT RESERVOIR DAM (MA 00224) HINSDALE
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: NONE
DATE: MARCH 1980

APPENDIX B

ENGINEERING DATA

INSPECTION CHECK LIST

PROJECT Belmont Reservoir Dam

DATE

PROJECT FEATURE

NAME

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	N/A
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	N/A
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	
	There is a walkway to the gate house which is constructed of railroad track and wood. The walkway extends into the foundation of the gate house and into the upstream face of the embankment.

INSPECTION CHECK LIST

PROJECT Belmont Reservoir Dam

DATE 11/9/79

PROJECT FEATURE

NAME

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	N/A
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	N/A
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

INSPECTION CHECK LIST

PROJECT Belmont Reseroir Dam
DATE 11/9/79
PROJECT FEATURE
NAME
DISCIPLINE
NAME

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	Measured 4.0' Above W.L. 1692 ± + 4.0 = 1696 ±
Current Pool Elevation	Observed at crest of spillway at Gate House (1692±)
Maximum Impoundment to Date	Unknown
Surface Cracks	None visible - heavy grass and weed cove
Pavement Condition	N/A
Movement or Settlement of Crest	None apparent
Lateral Movement	None apparent
Vertical Alignment	Good - one low spot near left abutment (approx 0.4' below crest)
Horizontal Alignment	Good - there is a slight bulge in slope Approx. 130' right of gate house
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None Apparent
Trespassing on Slopes	None Apparent
Vegitation on Slopes	Very long grass and weeds over all slopes
Sloughing or Erosion of Slopes or Abutments	None apparent - grass cover would conceal most sloughing or erosion
Rock Slope Protection - Riprap Failures	Grass overgrowth covering rip rap on upstream face, rip rap appears to extend 4' above W.L.
Unusual Movement or Cracking at or near Toes	None apparent
Unusual Embankment or Downstream Seepage	Very wet at toe of downstream slope with puddling
Piping or Boils	Water flowing at toe of down stream slope near center of dam
Foundation Drainage Features	None Found
Toe Drains	None Found
Instrumentation System	None

INSPECTION CHECK LIST

PROJECT Belmont Reservoir Dam

DATE 11/9/79

PROJECT FEATURE

NAME

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Emergency Spillway
General Condition	Good - has some long grass and weeds
Loose Rock Overhanging Channel	None apparent
Trees Overhanging Channel	Some trees along the right of the spillway are overhanging the channel
Floor of Approach Channel	Long grass and weeds
b. Weir and Training Walls	
General Condition of Concrete	Stone training walls are in relatively good condition, some cracking of joints, stone weir is in good condition
Rust or Staining	N/A
Spalling	N/A
Any Visible Reinforcing	N/A
Any Seepage or Efflorescence	Minor stain or right training wall
Drain Holes	None apparent
c. Discharge Channel	
General Condition	Good - has some long grass.
Loose Rock Overhanging Channel	None apparent
Trees Overhanging Channel	Trees along the right side of the channel are overhanging.
Floor of Channel	Grass
Other Obstructions	The area downstream of the maintained portion of the discharge channel is heavily wooded which might cause the flow to be routed along the toe of the embankment.

INSPECTION CHECK LIST

PROJECT Belmont Reservoir Dam DATE 11/9/79

PROJECT FEATURE ________ NAME ________

DISCIPLINE ________ NAME ________

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	N/A
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	
Channel	
Loose Rock or Trees Overhanging Channel	
Condition of Discharge Channel	

INSPECTION CHECK LIST

PROJECT Belmont Reservoir Dam

DATE 11/9/79

PROJECT FEATURE

NAME

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	There is a rough stone endwall, no concrete was visible.
Rust or Staining on Concrete	N/A
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	
	The 16 inch cast iron conduit discharges at the toe of downstream slope, near the conter of the embankment. The pipe is under approximately 1.5 feet of water, therefore conduit could not be inspected.

INSPECTION CHECK LIST

PROJECT Belmont Reservoir Dam

DATE 11/9/79

PROJECT FEATURE

NAME

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	Wooden Frame gate house with spillway and diversion basins within the foundation.
General Condition	Stone walls of gate house exterior are in good condition, some minor cracks are visible in concrete.
Condition of Joints	
Spalling	None apparent
Visible Reinforcing	N/A
Rusting or Staining of Concrete	None apparent
Any Seepage or Efflorescence	leakage through stone joints
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	Some leakage was observed through joints between stones in the structure
Cracks	Minor cracks in exterior concrete
Rusting or Corrosion of Steel	N/A
b. Mechanical and Electrical	N/A
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	8" Water main valve to water system and basin valves could not be inspected but operator says they are fully operational.
Emergency Gates	
Lightning Protection System	N/A
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

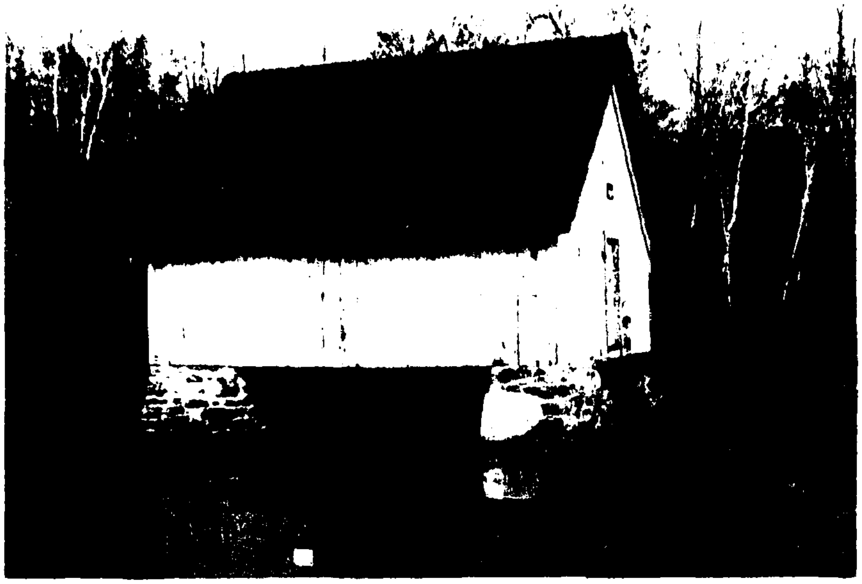


Photo 7

Gate house looking northerly from crest of dam

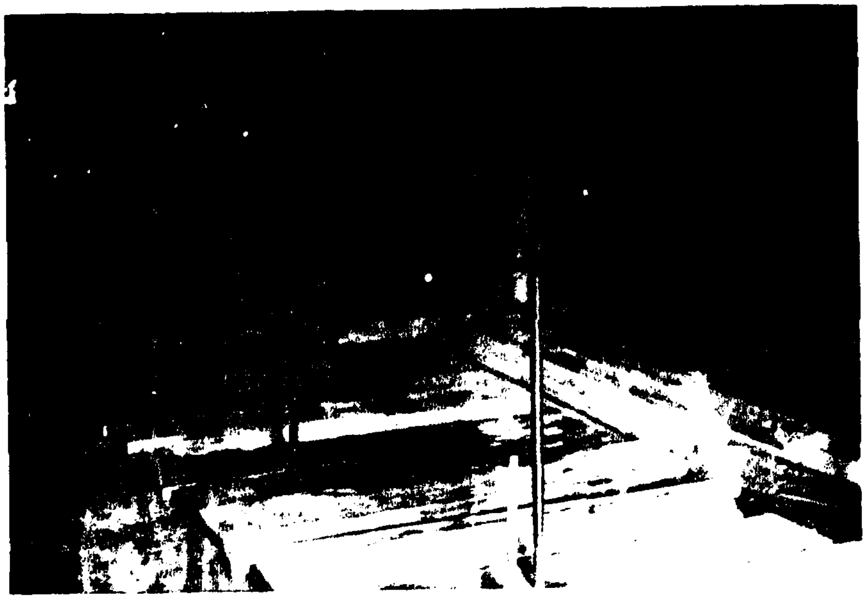


Photo 8

Inside of gatehouse

Photo 9

Gatehouse foundation

Photo 10

Emergency spillway looking westerly from spillway channel

Photo 11

Left abutment of emergency spillway

Photo 12

Right abutment of emergency spillway

Photo 13

Downstream of emergency spillway

Photo 14

Outlet of principle spillway discharge conduit

Photo 15

Principle spillway discharge channel, looking downstream from crest of dam

Photo 16

Wet conditions along downstream toe of the embankment

Photo 17

Wet conditions along the toe of the embankment

Photo 18

Wet conditions along the toe of the embankment

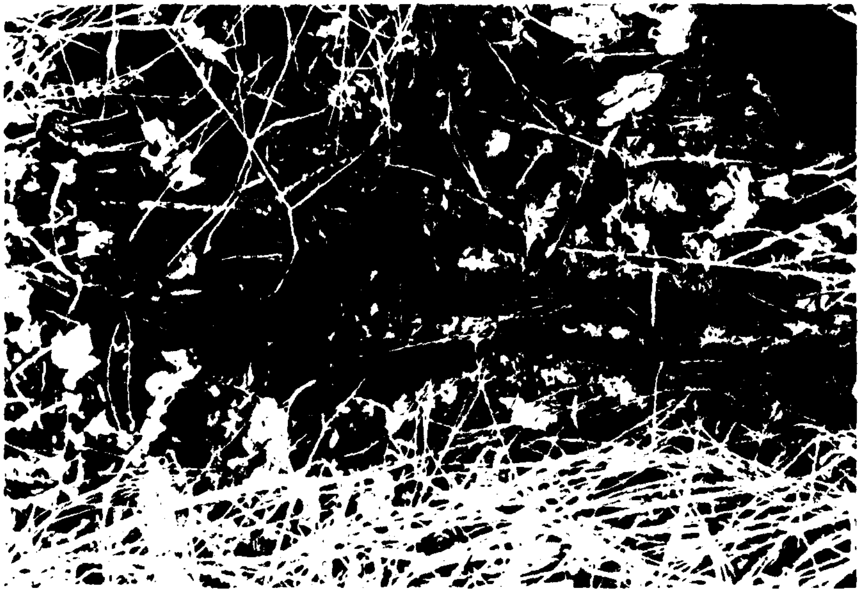


Photo 19

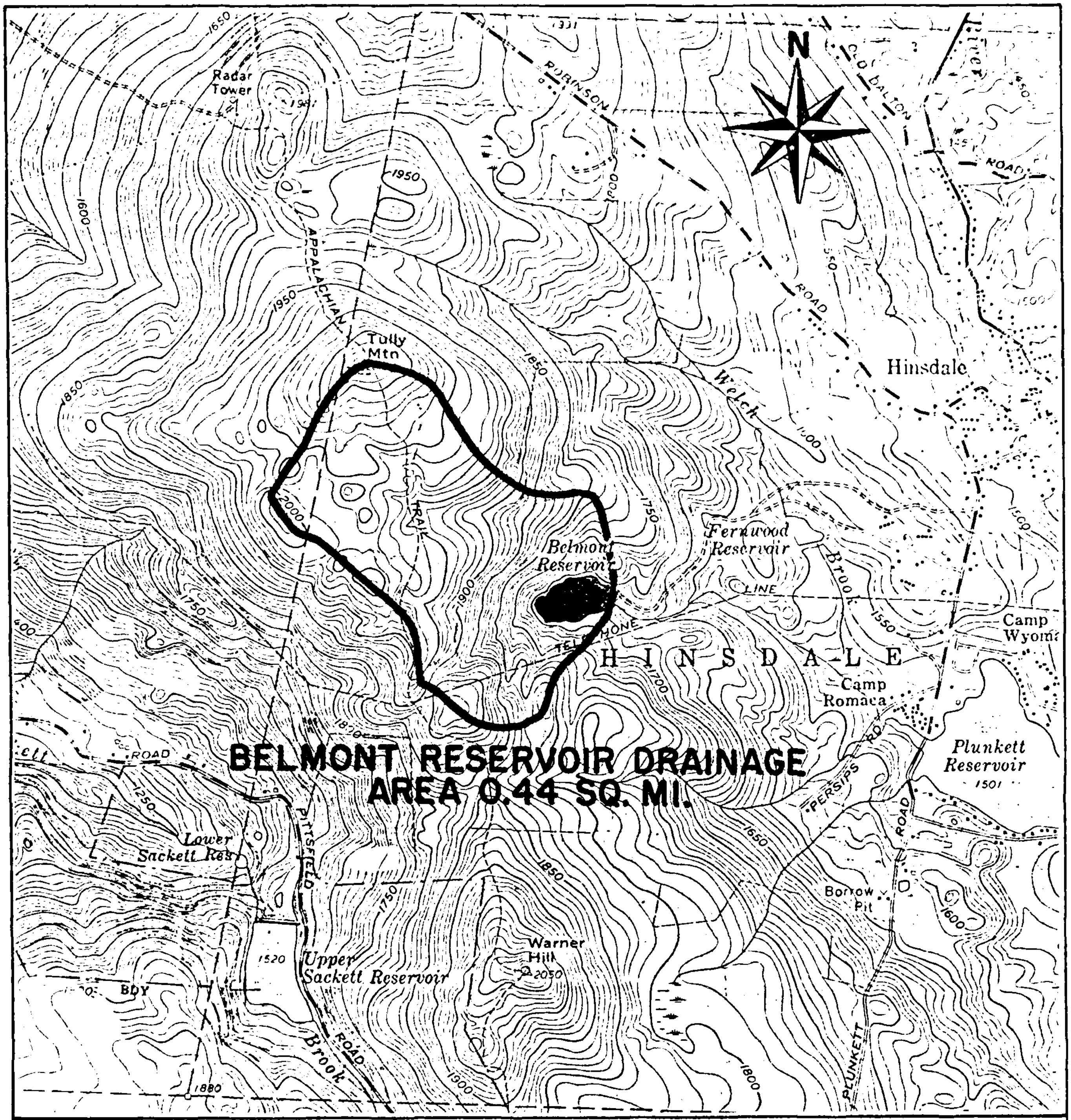
Flow along toe of embankment (possible toe drain)

Photo 20

Wet conditions along toe of embankment

APPENDIX D

HYDROLOGIC & HYRAULIC COMPUTATIONS



-SCALE-

1000' 0 1000' 2000' 3000'

FROM: U.S.G.S. PITTSFIELD EAST, MASS. QUADRANGLE MAP

QUADRANGLE LOCATION

TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

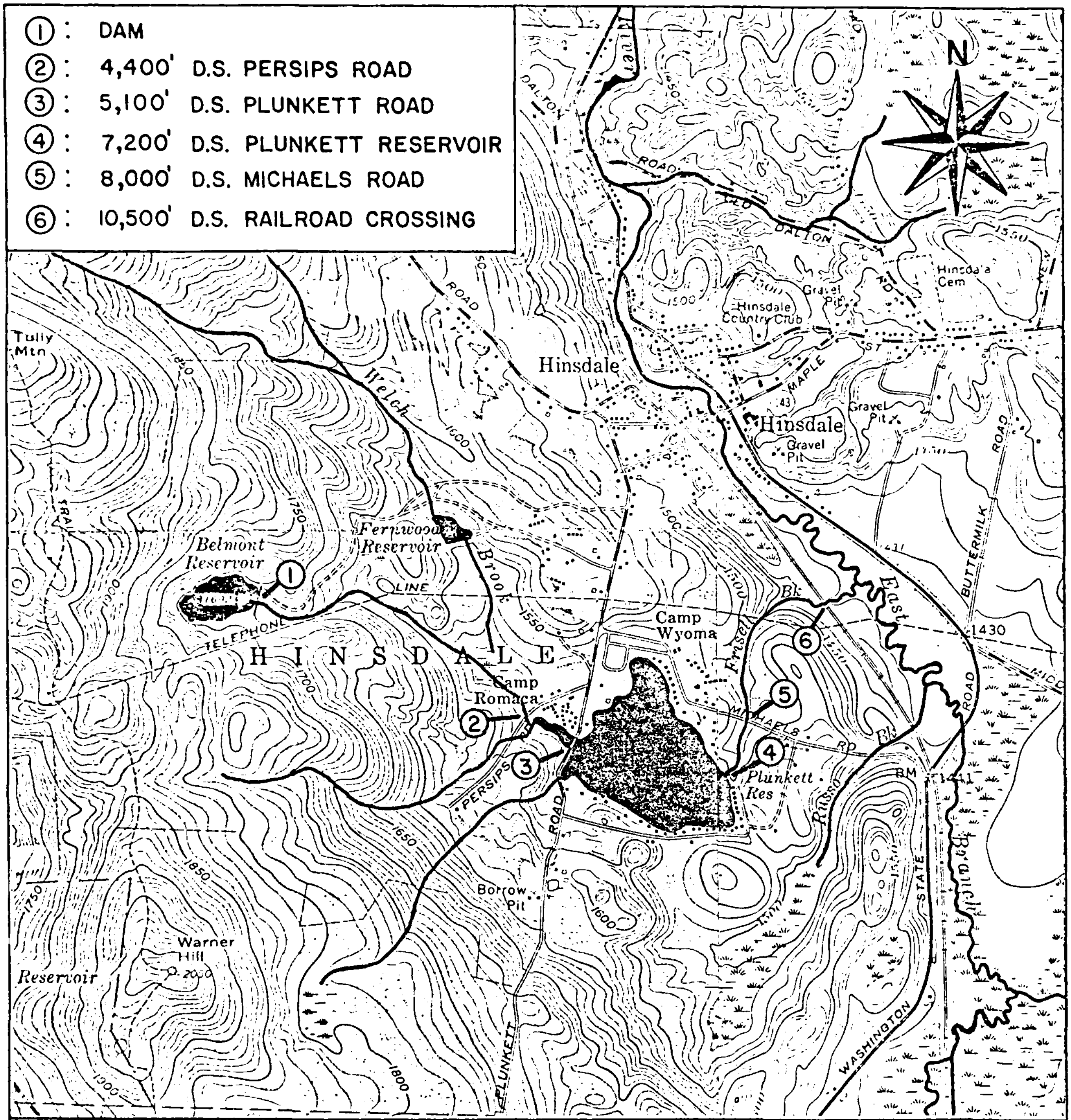
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

DRAINAGE AREA MAP

BELMONT RESERVOIR DAM (MA 00224) HINSDALE
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED
DATE: MARCH 1980



①: DAM
②: 4,400' D.S. PERSIPS ROAD
③: 5,100' D.S. PLUNKETT ROAD
④: 7,200' D.S. PLUNKETT RESERVOIR
⑤: 8,000' D.S. MICHAELS ROAD
⑥: 10,500' D.S. RAILROAD CROSSING

-SCALE-
1000' 0 1000' 2000' 3000'

FROM: U.S.G.S. PITTSFIELD EAST, AND PERU, MASS. QUADRANGLE MAPS

QUADRANGLE LOCATION

TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

U.S.ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

BELMONT RESERVOIR DAM (MA 00224) HINSDALE
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED
DATE: MARCH 1980

Calculations based on information from U.S.G.S. Map - Pittsfield East, Mass. . Normal pool elevation is assumed to be 1692(MSL) per. U.S.G.S. map.

Scale 1" = 2000'

1 sq. in = 91.83 Acres or 0.143 sq. miles

Drainage Area

By planimeter = 3.10 sq. in × 91.83 Acres/sq. in. = 285 Acres

3.10 sq. in × 0.143 sq. mi/sq. in. = 0.44 Sq. miles

Surface Area of Reservoir

By planimeter

1. @ Elevation 1692 (Normal Pool Elevation)

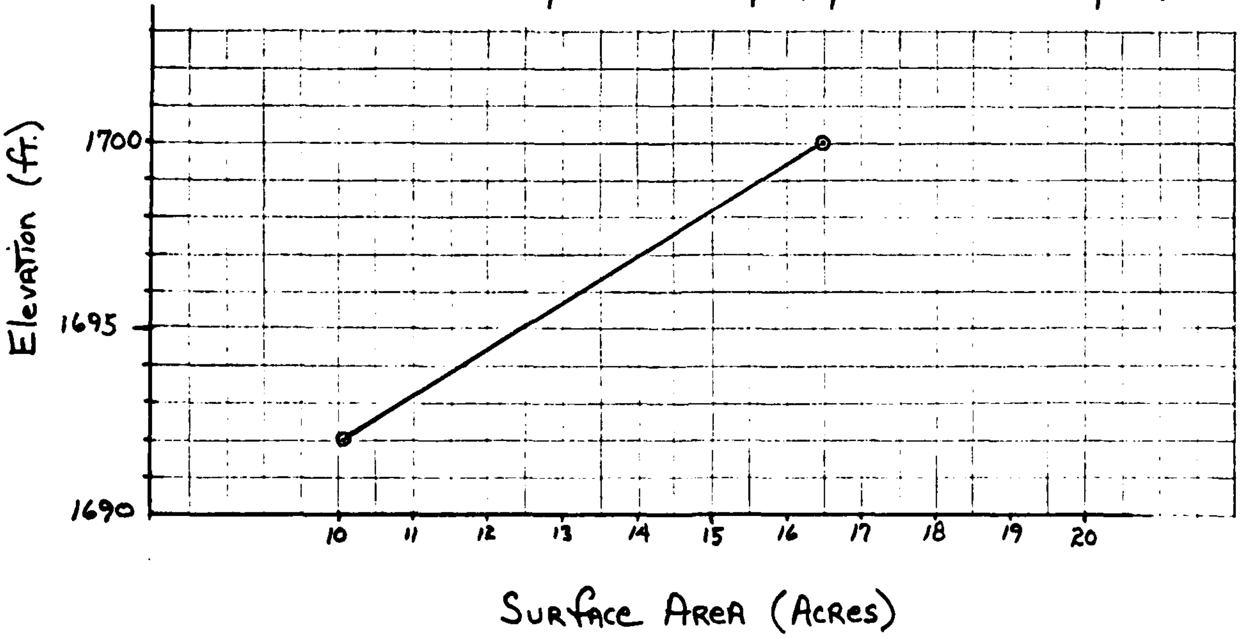
0.11 sq. in. × 91.83 Acres/sq. in. = 10.1 Acres

0.11 sq. in. × 0.143 sq. mi/sq. in. = 0.0157 sq. mi

2. @ Elevation 1700

0.18 sq. in. × 91.83 Acres/sq. in. = 16.5 Acres

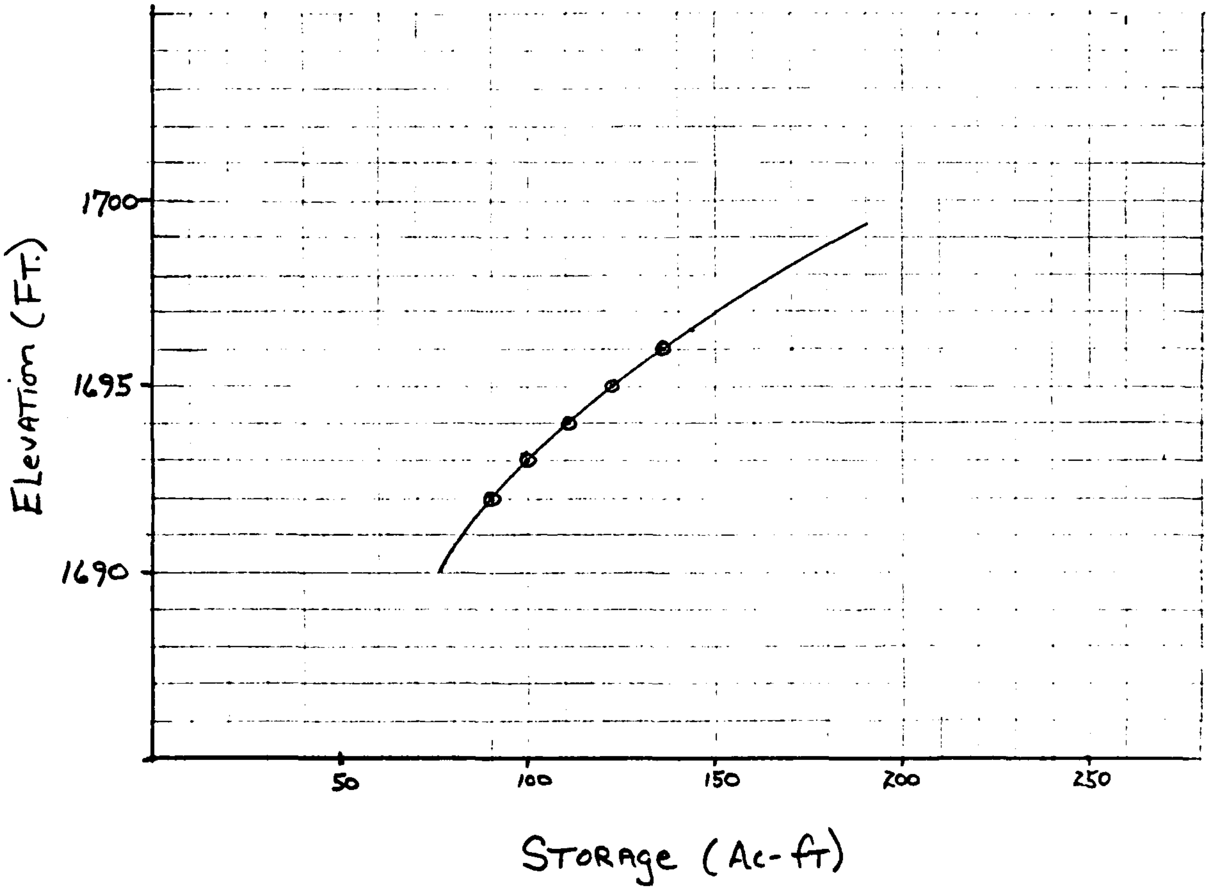
0.18 sq. in × 0.143 sq. mi/sq. in. = 0.0257 sq. mi.



Storage

Assume average depth of Pond = 9ft @ 1692

	Elevation	Surface Area	Height above Normal Pool Elev.	Storage (Approx.)
Water Level & Principal Spillway	1692 (M.S.L)	10.1 Acres	—	90 Ac-ft
	1693 "	10.7 "	1 ft.	100 Ac-ft
	1694 "	11.6 "	2 "	111 Ac-ft
	1695 "	12.4 "	3 "	123 Ac-ft
Top of dam	1696 "	13.3 "	4 "	136 Ac-ft
Crest of Emergency Spillway.	1692.6 "	10.5 "	0.6 "	96 Ac-ft



Size Classification

Height of Dam = 29 ft - between 25' & 40' ∴ Small

Storage = 90± Ac-ft
@ normal pool

136± Ac-ft - between 50 & 1000 Ac-ft ∴ Small
@ Top of Dam

Classification: Small

Hazard Potential

Camp Romaca is located approximately 4,400 feet downstream of the Belmont Reservoir Dam. The camp has approximately 24 buildings and during the season would house many children. There are approximately 40 homes along the shore of Plunkett Reservoir which is a summer recreation area. Therefore, the danger of loss of life would be HIGH and economic loss to these residences would also be High

∴ Use HIGH Classification for Hazard Potential

Test Flood

Recommended Spillway Design Flood - 1/2 PMF to PMF

∴ Use PMF

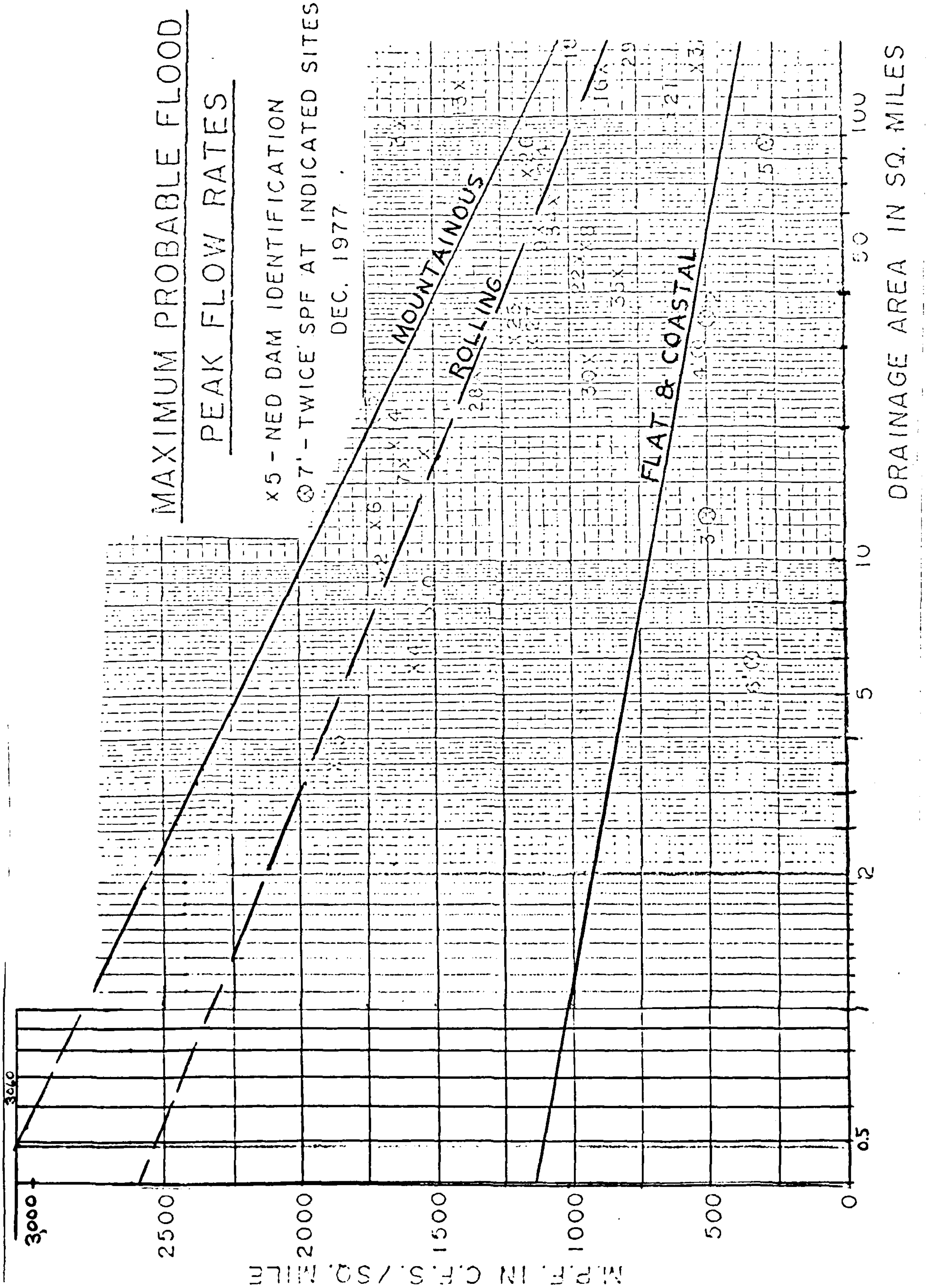
Classification of Terrain in Drainage Area

The area is primarily mountainous with steep slopes rising above the reservoir. The area is heavily wooded and has no development anywhere in the drainage basin. The MOUNTAINOUS graph will be used to determine the Peak Flow Rates.

Feb. 22, 1980

Belmont Res. Dam

Done by: H.K.
Checked by: Moe



Spillway Rating

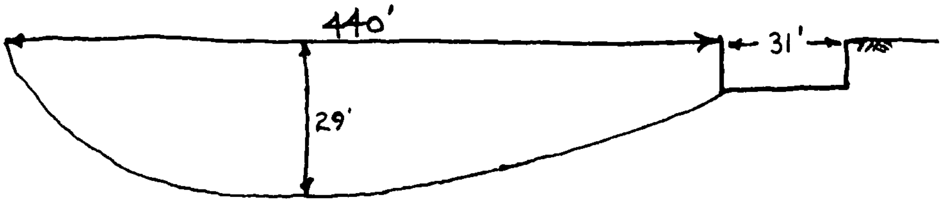
1. Use P.M.F.
2. Assume Mountainous Terrain
3. Drainage Area = 0.44 sq. miles
4. Use the "Maximum Probable Flood Peak Flow Rates" curves and extrapolate for a drainage area of 0.44 sq. miles. (See previous sheet.)

From curve on page 4, Maximum Probable Flood for D.A. of 0.44 sq. mi. is 3,060 c.f.s/sq. mi

3,060 c.f.s./sq. mi × 0.44 sq. mi = 1,346 say 1,350 c.f.s.

The Belmont Reservoir dam is located on the easterly side of the reservoir and is comprised of the dam (29 ft. high), emergency spillway (31 ft wide - grass lined with stone walls) and a gate house which regulates the water level of the reservoir. There is an 8" main which connects to the Town water system and a 16" C.I. discharge pipe. The gate house has an opening (4' high × 13' wide) in its foundation which allows water to be diverted between the water system and the discharge pipe.

For these calculations we are assuming that both the 8 inch water main and the 16 inch discharge pipe will be fully utilized and that only the excess flow will pass through the emergency spillway.



for additional 700 feet of Reach

$Q = 16,869$ c.f.s.

from graph on page 17 $y = 6.9$ feet

$$Vol = (700)\left(\frac{27.5\,(6.9)^2}{43,560}\right) - \left(\frac{700}{2100}\right)(3.4) = 19.9 \text{ ac. ft.}$$

$S: 136$ Ac-ft

$$Q_{P_2}\,(\text{TRIAL}) = Q_{P_1}\left(1 - \frac{V_1}{S}\right)$$

$$= 18,869\left(1 - \frac{19.9}{136}\right)$$

Q_{P_2} (TRIAL) = 16,108 c.f.s.

from graph on page 17, $y = 6.5$ feet

$$V_2 = (700)\left(\frac{27.5\,(6.5)^2}{43,560}\right) - 1.1 = 17.6 \text{ ac. ft.}$$

$$V_{AVG} = \frac{V_1 + V_2}{2} = \frac{19.9 + 17.6}{2} = 18.7 \text{ Ac-ft}$$

$$\therefore\ Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{S}\right)$$

$$= 18,869\left(1 - \frac{18.7}{136}\right)$$

$Q_{P_2} = \underline{16,274 \text{ c.f.s.}}$

from graph on page 17, $\underline{y = 6.6 \text{ feet}}$

Flow over the top of Persips Road

Flow thru culvert

6' diam pipe 19 ft long

Inlet loss $= 0.9\ v^2/2g$

Outlet loss $= 1.0\ v^2/2g$

Pipe loss $= 0.1\ v^2/2g$ $\left(h_L = f \frac{L}{d} \frac{v^2}{2g}\right)$ where $f = 0.02$, $L = 19'$, $d = 6'$

$H = 2.0\ v^2/2g$

B) Calculate the stage after dam failure

$Q = 27{,}834$ cfs

Channel Vol = Reach × Area

from graph on page 17, $y = 7.8$ ft

$$Vol = (2100)\left(\frac{27.5\,(7.8)^2}{43{,}560}\right) - 3.4 = 77.2 \text{ ac. ft.}$$

$S = 136$ Ac-ft $\quad \frac{V_1}{S} > 50\%$ ∴ use shorter reach

Assume X-section is typical of entire reach and storm runoff occurs in upper section.

Compute Reach of 1400 ft and reach of 700 ft.

$$Vol = (1400)\left(\frac{27.5\,(7.8)^2}{43{,}560}\right) - \left(\frac{1400}{2100}\right)(3.4) = 51.5 \text{ ac. ft}$$

$S = 136$ Ac-ft

$$Q_{P_2} \text{ (TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{S}\right)$$

$$= 27{,}834\left(1 - \frac{51.5}{136}\right)$$

Q_{P_2} (TRIAL) = 17,293 c.f.s.

from graph on page 17, $y = 6.6$ ft

$$V_2 = (1{,}400)\left(\frac{27.5\,(6.6)^2}{43{,}560}\right) - 2.3 = 36.2 \text{ ac. ft.}$$

$V_2 = 36.2$ Ac-ft

$$V_{AVG} = \frac{V_1 + V_2}{2} = \frac{51.5 + 36.2}{2} = 43.8 \text{ Ac-ft}$$

$$\therefore \quad Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{S}\right)$$

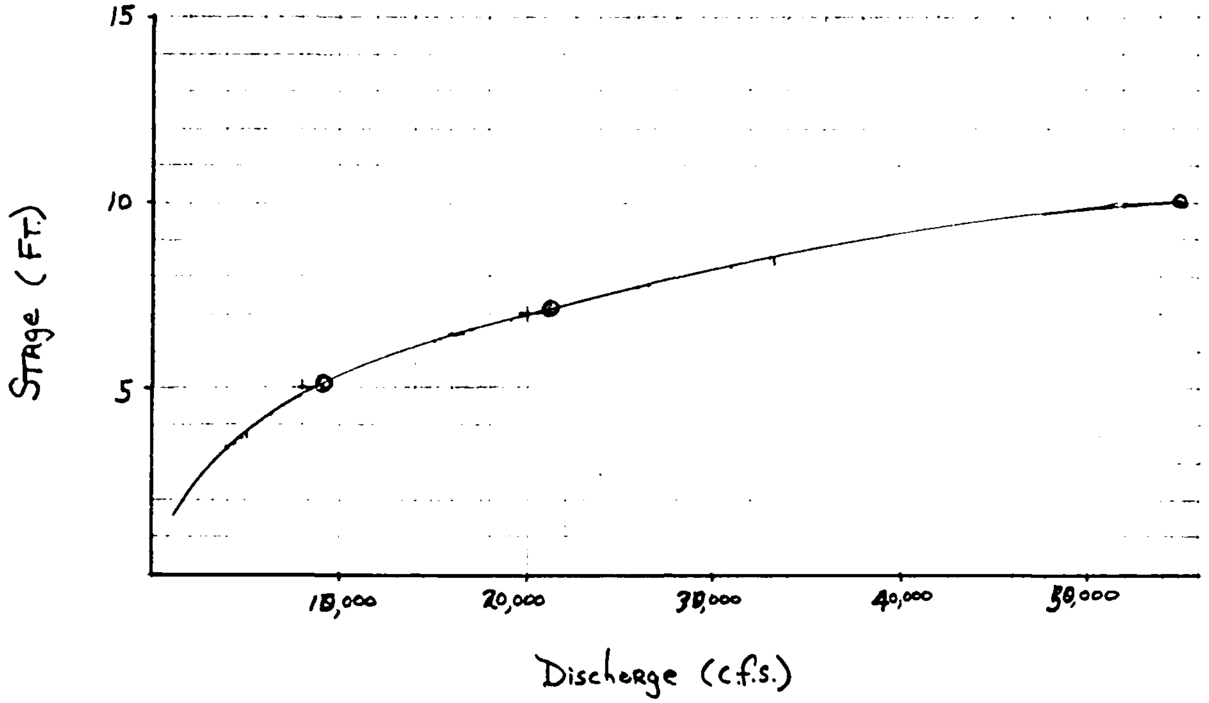
$$= 27{,}834\left(1 - \frac{43.8}{136}\right)$$

Q_{P_2} = 18,869 c.f.s.

from graph on pp.17 y = 6.9 ft

Feb. 28, 1980 Belmont Res. Dam

Done by: H.K.
Checked by: Moe
REVISED BY: OHD



A) Calculate the stage of the brook prior to dam failure

Flow prior to dam failure = 1190 cfs

From graph above, stage = 1.6 ft.

Storage Volume = $(2100)\left(\frac{(27.5)(1.6)^2}{43560}\right) = 3.4$ ac-ft

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 5'$

$A = 27.5y^2 = 27.5(5)^2 = 687.5$ s.f.

$R = 0.499y = 0.499(5) = 2.495$

$S = 0.019$

$$Q = \frac{1.486}{0.03}(687.5)(2.495)^{2/3}(0.019)^{1/2}$$

$$= (49.5333)(687.5)(1.845)(0.138)$$

$Q = 8,671$ c.f.s.

Assume $y = 10'$

$A = 27.5y^2 = 27.5(10)^2 = 2,750$ s.f.

$R = 0.499y = 0.499(10) = 4.99$

$S = 0.019$

$$Q = \frac{1.486}{0.03}(2,750)(4.99)^{2/3}(0.019)^{1/2}$$

$$= (49.5333)(2,750)(2.936)(0.138)$$

$Q = 55,191$ c.f.s.

Assume $y = 7'$

$A = 27.5y^2 = 27.5(7)^2 = 1,347.5$

$R = 0.499y = 0.499(7) = 3.493$

$S = 0.019$

$$Q = \frac{1.486}{0.03}(1,347.5)(3.493)^{2/3}(0.019)^{1/2}$$

$$= (49.5333)(1,347.5)(2.312)(0.138)$$

$Q = 21,296$ c.f.s.

B) Calculate the stage of the stream after dam failure

Channel Vol = Reach × Area

$Q = 42,015$ c.f.s.

from graph on page 14, $y = 12.3'$

$Vol = (2,300)\left(\frac{7.25\,(12.3)^2}{43,560}\right) - 3.4 = 54.5$ ac-ft

$S = 136$ Ac-ft.

$Q_{P_2}\,(\text{TRIAL}) = Q_{P_1}\left(1 - \frac{V_1}{S}\right)$

$= 42,015\left(1 - \frac{54.5}{136}\right)$

$Q_{P_2}\,(\text{TRIAL}) = 25,178$ c.f.s.

Using Q_{P_2} (TRIAL) = 25,178 c.f.s.

from graph on page 14 $y = 10.3$ ft

$V_2 = (2,300)\left(\frac{7.25\,(10.3)^2}{43,560}\right) - 3.4 = 37.2$ ac-ft

$V_2 = 37.2$ Ac.-ft

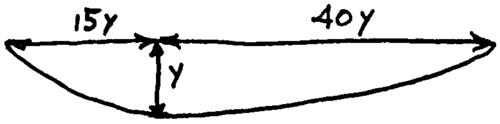
$V_{AVG} = \frac{V_1 + V_2}{2} = \frac{54.5 + 37.2}{2} = \frac{91.7}{2} = 45.9$ Ac-ft

$\therefore\ Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{S}\right) = 42,015\left(1 - \frac{45.9}{136}\right) = \underline{\underline{27,834\text{ c.f.s.}}}$

from graph on pp. 14 $y = \underline{\underline{10.6\text{ ft}}}$

3) Compute effect at point 3 - just upstream of Persips Road

Reach = 2,100



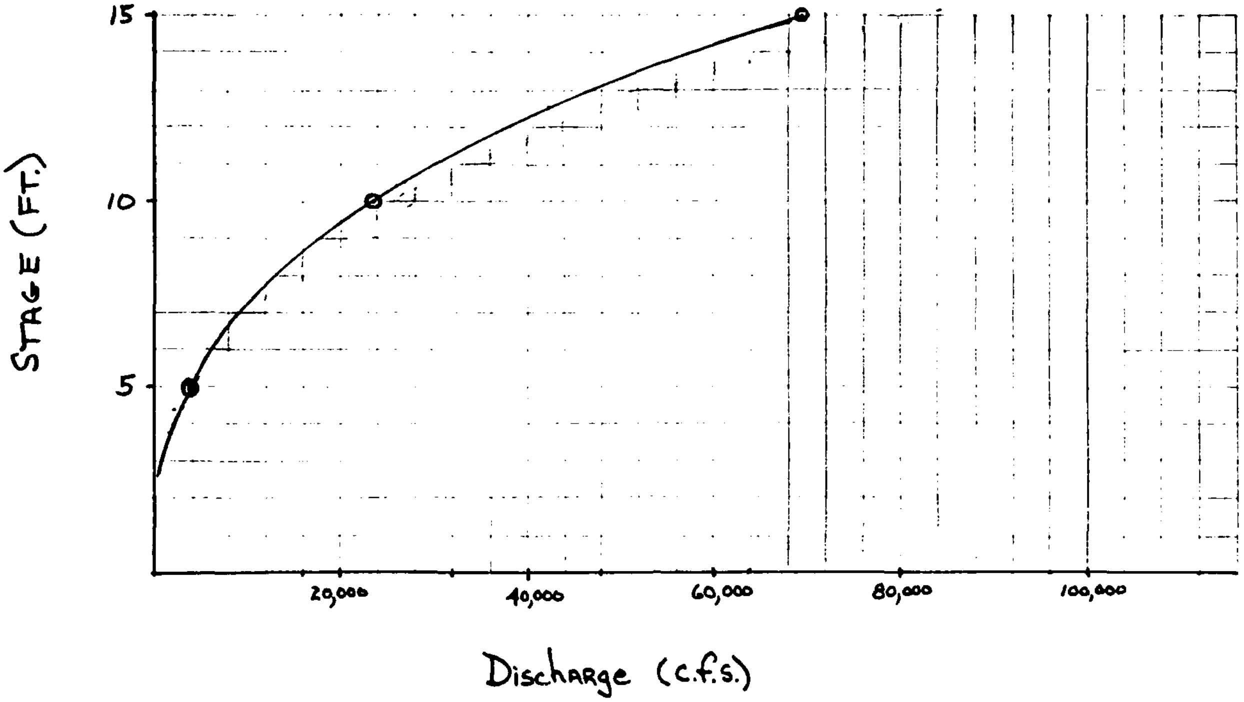
$n = 0.03$

$Area = \frac{15y^2}{2} + \frac{40y^2}{2} = 27.5y^2$

$S = \frac{1545 - 1505}{2,100} = 0.019$

$W.P. \approx 55.1y$

$R = A/W.P. = 27.5y^2/55.1y = 0.499y$



A) Calculate the stage of the brook prior to dam failure

Flow prior to dam failure = 1190 cfs

From graph above, stage = 3.0 ft.

$$\text{Storage Volume} = (2,300)\left(\frac{(7.25)(3.0)^2}{43,560}\right) = 3.4 \text{ ac.-ft.}$$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 5'$

$A = 7.25 y^2 = 7.25(5)^2 = 181.25$

$R = 0.493y = 0.493(5) = 2.465$

$S = 0.051$

$Q = \frac{1.486}{0.03}(181.25)(2.465)^{2/3}(0.051)^{1/2}$

$Q = (49.5333)(181.25)(1.83)(0.226)$

$Q = 3{,}713$ c.f.s.

Assume $y = 10'$

$A = 7.25y^2 = 7.25(10^2) = 725$

$R = 0.493y = 0.493(10) = 4.93$

$S = 0.051$

$Q = \frac{1.486}{0.03}(725)(4.93)^{2/3}(0.051)^{1/2}$

$Q = (49.5333)(725)(2.912)(0.226)$

$Q = 23{,}635$ c.f.s.

Assume $y = 15'$

$A = 7.25 y^2 = 7.25(15)^2 = 1{,}631.25$

$R = 0.493y = 0.493(15) = 7.395$

$S = 0.051$

$Q = \frac{1.486}{0.03}(1{,}631.25)(7.395)^{2/3}(0.051)^{1/2}$

$Q = 49.5333(1{,}631.25)(3.821)(0.226)$

$Q = 69{,}776$ c.f.s.

Dam Failure Analysis - Belmont Reservoir Dam - Hinsdale, Mass.

$$Q_{P_1} = 8/27\ W_b \sqrt{g}\ y_o^{3/2}$$

where,

W_b = Breach Width (40% of dam length @ Mid height)

y_o = Total height from River Bed to Pool Level at failure

Q_{P_1} = Peak Failure Outflow

g = 32.2 ft/sec.

$W_b = 400\ ft \times 40\% = 160\ ft.$

$y_o = 29\ ft$ (Assume that water will be at top of dam when failure occurs)

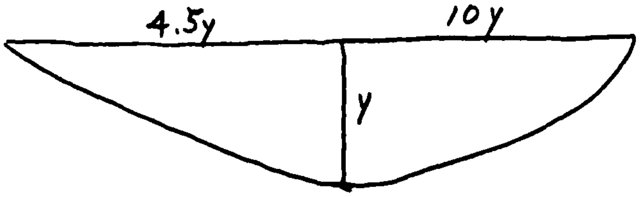
$$Q_{P_1} = 8/27 \times 160 \times (32.2)^{1/2} \times (29)^{3/2}$$

$$= 8/27 \times 160 \times 5.675 \times 156.17$$

$$Q_{P_1} = 42{,}015\ c.f.s.$$

2) Compute effect at the first downstream section - Approximately 2,300 ft downstream of the Belmont Reservoir Dam.

Reach = 2,300 ft.



$n = 0.03$

$$\text{Area} = \frac{4.5y^2}{2} + \frac{10y^2}{2} = 7.25y^2 \qquad W.P. \approx 14.7y$$

$$S = \frac{1663 - 1545}{2{,}300} = \frac{118}{2{,}300} = 0.051 \qquad R = A/_{W.P.} = \frac{7.25y^2}{14.7y} = 0.493y$$

Reservoir Routing

Normal Pool Elevation = 1692 (MSL)

Height to pass PMF (1,350 c.f.s.) = 0.6 feet over Top of dam ($1696.6^{\pm}$)

This is approximately 4.9 feet above normal pool elevation

Surface area @ Elev. 1696.6 = 13.8 Acres (from graph on page 1)

$$\text{Volume of Surcharge Storage} = \left(\frac{13.8+10.1}{2}\right)(4.6) = 55 \text{ Acre-ft}$$

Drainage Area = 0.44 Square miles = 285 Acres

$$\text{Runoff} = \frac{\text{Storage}}{\text{Drainage Area}} = \text{STOR}_1 = \frac{55 \text{ Ac-ft}}{285 \text{ Acres}} = 0.193 \text{ ft} = 2.32 \text{ inches}$$

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{\text{STOR}_1}{19}\right) = 1{,}350\left(1 - \frac{2.32}{19}\right) = 1185 \text{ c.f.s.}$$

Surcharge height for Q_{P_2} is 1696.5 ft (from graph on page 10)

Surface area @ Elev. 1696.5 = 13.7 Acres (from graph on page 1)

$$\text{Runoff} = \frac{\text{Storage}}{\text{D.A.}} = \frac{\left(\frac{13.7+10.1}{2}\right)(4.5)}{285} = \frac{53.6}{285} \text{ Ac-ft.} = 0.188' = 2.25''$$

$$\text{Avg. STOR} = \frac{\text{STOR}_1 + \text{STOR}_2}{2} = \frac{2.32+2.25}{2} = \frac{4.57}{2} = 2.29 \text{ inches}$$

$$Q_{P_3} = Q_{P_1}\left(1 - \frac{\text{STOR}_{AVG}}{19}\right) = 1{,}350\left(1 - \frac{2.29}{19}\right) = \underline{\underline{1{,}187 \text{ c.f.s.}}}$$

Surcharge height for Q_{P_3} = 1696.5 (MSL)

Surface area @ 1696.5 = 13.7 Acres

∴ H = 0.5 ft over the top of the dam or 4.5 ft above the normal pool elevation and Q = 1,187 c.f.s. say 1,190 c.f.s.

The routing of the Test Flood (P.M.F.) lowers the flow from 1,350 c.f.s. to approximately 1,190 c.f.s. and also lowers the overtopping of the dam from about 0.9 feet to 0.5 feet. Either way the dam will be overtopped.

Compute flow over the top of the dam

Assume that this case is the same as flow over a broad crested weir.

$Q = CLH^{3/2}$ where $C = 3.0$ & $L = 470'$

for $H = 1'$; $Q = CLH^{3/2}$

$Q = (3.0)(470)(1)^{3/2}$

$Q =$ 1,410 c.f.s.

for $H = 0.8$; $Q = CLH^{3/2}$

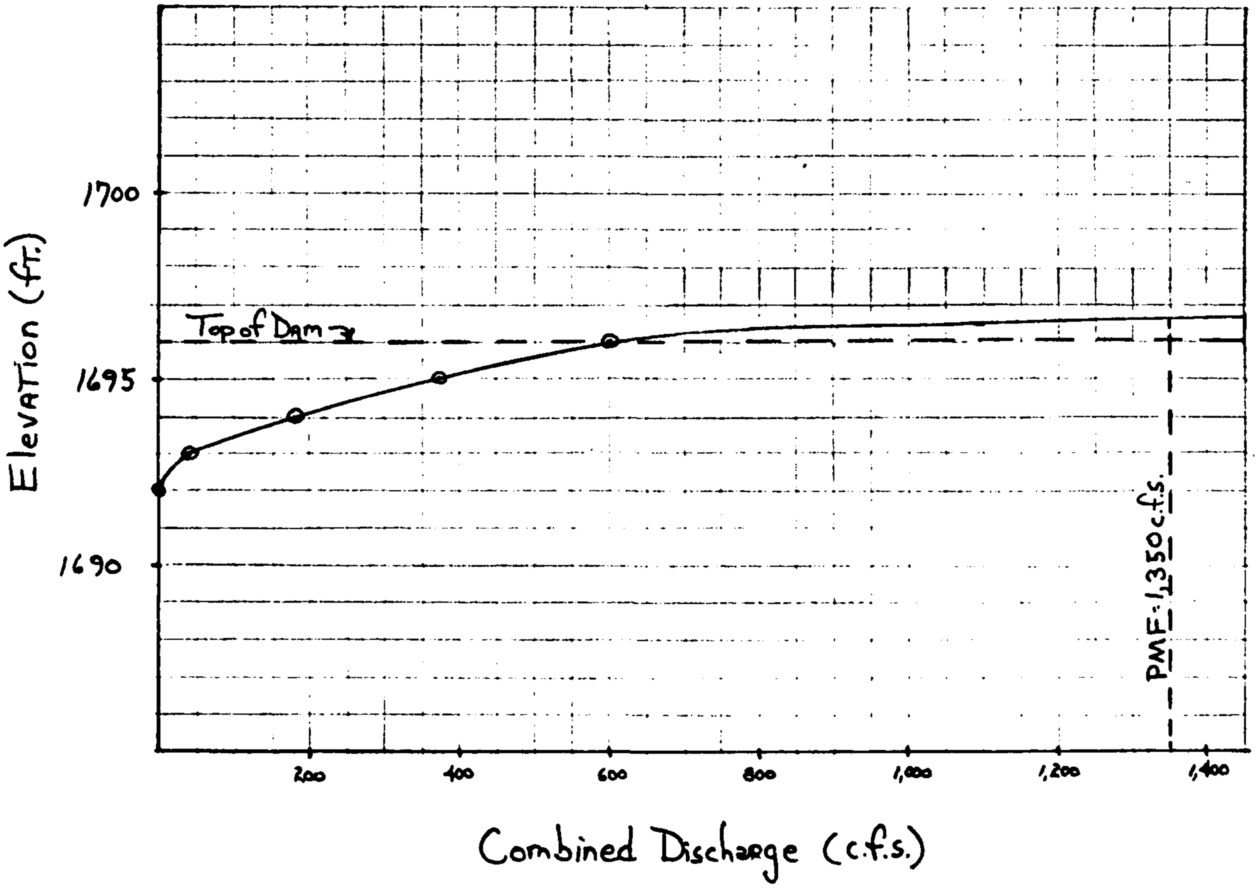
$Q = (3.0)(470)(0.8)^{3/2}$

$Q =$ 1,009 c.f.s.

for $H = 0.5$; $Q = CLH^{3/2}$

$Q = (3.0)(470)(0.5)^{3/2}$

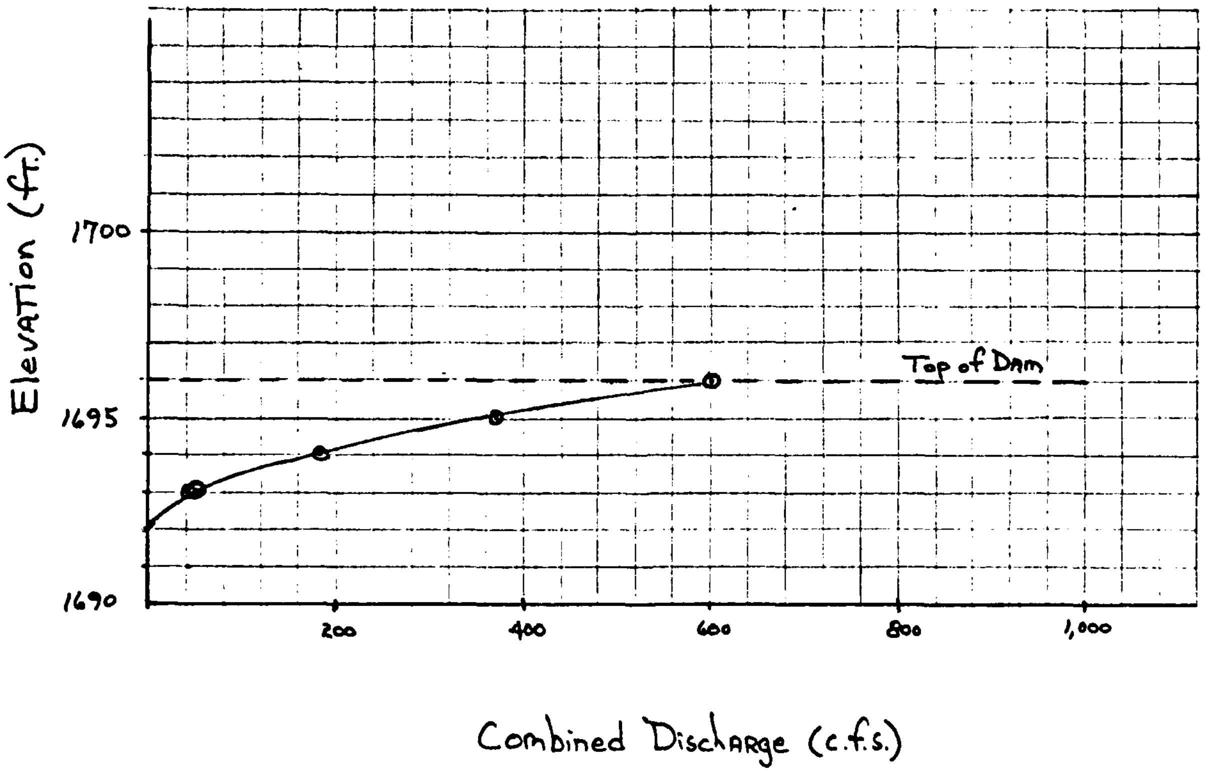
$Q =$ 499 c.f.s.



Feb. 26, 1980	Belmont Res. Dam	Done by: H.K. checked by: Moe

Total Discharge

	Elev	$Q_{16\text{" pipe}}$	$Q_{\text{emergency spillway}}$	Q_{combined}
	1692	—	—	—
	1692.6	19.9	—	19.9 c.f.s.
	1693	34.8	22.7	57.5 c.f.s.
	1694	35.5	148.9	184.4 c.f.s.
	1695	36.2	334.3	370.5 c.f.s.
Top of dam	1696	36.9	563.6	600.5 c.f.s.



Discharge from Principal Spillway (neglecting flow through 8" water main)

Elev. (MSL)	Q (cfs.)
1692	—
1692.6	19.9
1693	34.8
1694	35.5
1695	36.2
1696	36.9
1697	37.4
1698	38.1
1699	38.7
1700	39.4

Discharge through Emergency Spillway

Assume Broad Crested Weir for Emergency Spillway

$Q = CLH^{3/2}$ where $C = 2.9$
$L = 31$ ft

	Elev(MSL)	H (ft)	Q (c.f.s)
Crest	1692.6	—	—
	1693.0	0.4	22.7
	1694.0	1.4	148.9
	1695.0	2.4	334.3
Top of Dam	1696.0	3.4	563.6

For 8" pipe to water distribution system

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$Q = \frac{1.486}{0.013}(0.349)(0.167)^{2/3}(0.005)^{1/2}$$

$$Q = (114.3)(0.349)(0.301)(0.0707)$$

$$\underline{Q = 0.85 \text{ c.f.s.}}$$

$R = D/4 = \frac{8/12}{4} = 0.167$

$A = \pi R^2 = \pi(0.333)^2 = 0.349$ s.f.

$S = 25/5000 = 0.005$

This flow is negligible in comparison with any Test Flood flows, therefore we will neglect the 8" pipe in all further calculations.

For 16" pipe:

$$H_L = f \frac{L}{d}\frac{V^2}{2g}$$ where f = 0.02 (from Moody Diagram)

$$H_L = 0.5\frac{V^2}{2g} + 1.0\frac{V^2}{2g} + 1.1\frac{V^2}{2g} = 2.6\frac{V^2}{2g}$$ (H varies from 24' to 32')

$$H_L = 2.6\frac{V^2}{2g} \qquad V^2 = \frac{2gH_L}{2.6} \qquad V = \sqrt{\frac{2gH_L}{2.6}}$$

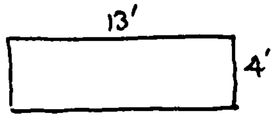
$$V = \sqrt{24.8 H}$$ $Q = VA$ where $A = \pi R^2 = \pi(\frac{8}{12})^2 = 1.396$

Elev.	H	V	Q	Elev	H	V	Q
1692	24	24.4	34.1	1697	29	26.8	37.4
1693	25	24.9	34.8	1698	30	27.3	38.1
1694	26	25.4	35.5	1699	31	27.7	38.7
1695	27	25.9	36.2	1700	32	28.2	39.4
1696	28	26.4	36.9				

Spillway Rating (cont.)

Stage - Discharge

1) Compute flow thru Principal Spillway



Rectangular Weir: $Q = 3.33(L - 0.2H)H^{1.5}$

Orifice: $Q = CA\sqrt{2gH}$ $C = 0.65$
$A = 52$ s.f.

Assume Rectangular weir to top of opening then compute as an orifice

	Elev	H	Q
	1692	–	–
	1692.6	0.6	19.9 c.f.s.
	1693	1	42.6 c.f.s.
	1694	2	118.7 c.f.s.
	1695	3	214.6 c.f.s.
Top of dam	1696	4	325.0 c.f.s.
	1697	5 (3)	469.8 c.f.s.
	1698	6 (4)	542.5 c.f.s.
	1699	7 (5)	606.5 c.f.s.
	1700	8 (6)	664.4 c.f.s.

Compute flow through 8" water pipe and 16" discharge pipe.

Darcy Equation: $h_L = f \frac{l}{d} \frac{V^2}{2g}$ where $f = 0.02$ (from Moody Diagram)

Head Losses: Inlet losses $= 0.5 \frac{V^2}{2g}$ Outlet losses $= 1.0 \frac{V^2}{2g}$

for 8" pipe: Normal Pond elevation = 1692; ℄ Pipe = 1668±; s = 15/1000 L = 3,000'±

for 16" pipe: Normal Pond elevation = 1692; ℄ Pipe = 1668±; S: 10/1000±; L: 70'±

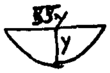
for $H = 6'$, $V = 13.9$ fps $Q = 393$ c.f.s. (Assume no surcharge)

For dam failure flow

$Q = 16{,}274 - 393 = 15{,}881$ c.f.s.

Broad-crested weir flow over road:

$$H = \left(\frac{Q}{3.0\,L}\right)^{2/3}$$



$L = 55y = 55(6.5) = 357.5$ ft

$$H = \left(\frac{15{,}881}{(3.0)(357.5)}\right)^{2/3} = (14.8 \text{ ft})^{2/3} = 6.1 \text{ ft}$$

Depth over Road $\approx \frac{2}{3}(6.1) = \underline{4.1 \text{ ft}}$

$\therefore$ The road will be overtopped by approximately $\underline{4.1 \text{ ft}}$

For flow prior to dam failure

$Q = 1190 - 393 = 797$ cfs

Broad-crested weir flow over road:

$$H = \left(\frac{Q}{3.0\,L}\right)^{2/3}$$

$L = 55y = 55(3.4) = 187$ ft.

$$H = \left(\frac{797}{3.0\,(187)}\right)^{2/3} = (1.4)^{2/3} = 1.3 \text{ ft}$$

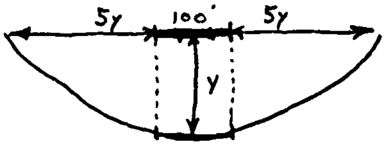
Depth over Road $\approx \frac{2}{3}(1.3) = 0.9$ ft

$\therefore$ The road will be overtopped by approximately $\underline{0.9 \text{ ft}}$

4) Compute effect AT Plunkett Road

Reach = 700 ft.

Typical Section



$$\text{Area} = \frac{5y^2}{2} + \frac{5y^2}{2} + 100y = 5y^2+100y$$

$$\text{W.P.} \approx 10.1y+100$$

$$R = A/_{\text{W.P}} = \frac{5y^2+100y}{10.1y+100}$$

$$S = \frac{1505-1501}{700} = 0.006$$

There are 1.6 Acres available for storage between Persips Road and Plunkett Road

Compute various points for y to attain Q

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 2$ ft

$A = 5y^2 + 100y = (5 \times 4) + 200 = 220$

$R = \frac{5y^2 + 100y}{10.1y + 100} = \frac{220}{120.2} = 1.830$

$S = 0.006$

$Q = \frac{1.486}{0.03} (220)(1.830)^{2/3}(0.006)^{1/2}$

$= (49.5333)(220)(1.499)(0.077)$

$Q = 1{,}258$ c.f.s.

Assume $y = 5$ ft

$A = 5y^2 + 100y = 125 + 500 = 625$

$R = \frac{5y^2 + 100y}{10.1y + 100} = \frac{625}{150.5} = 4.153$

$S = 0.006$

$Q = \frac{1.486}{0.03} (625)(4.153)^{2/3}(0.006)^{1/2}$

$= (49.5333)(625)(2.596)(0.077)$

$Q = 6{,}188$ c.f.s.

Assume $y = 10$ ft

$A = 5y^2 + 100y = 1{,}500$

$R = \frac{5y^2 + 100y}{10.1y + 100} = \frac{1{,}500}{201} = 7.463$

$S = 0.006$

$Q = \frac{1.486}{0.03} (1{,}500)(7.463)^{2/3}(0.006)^{1/2}$

$= (49.5333)(1{,}500)(3.845)(0.077)$

$Q = 21{,}998$ c.f.s.

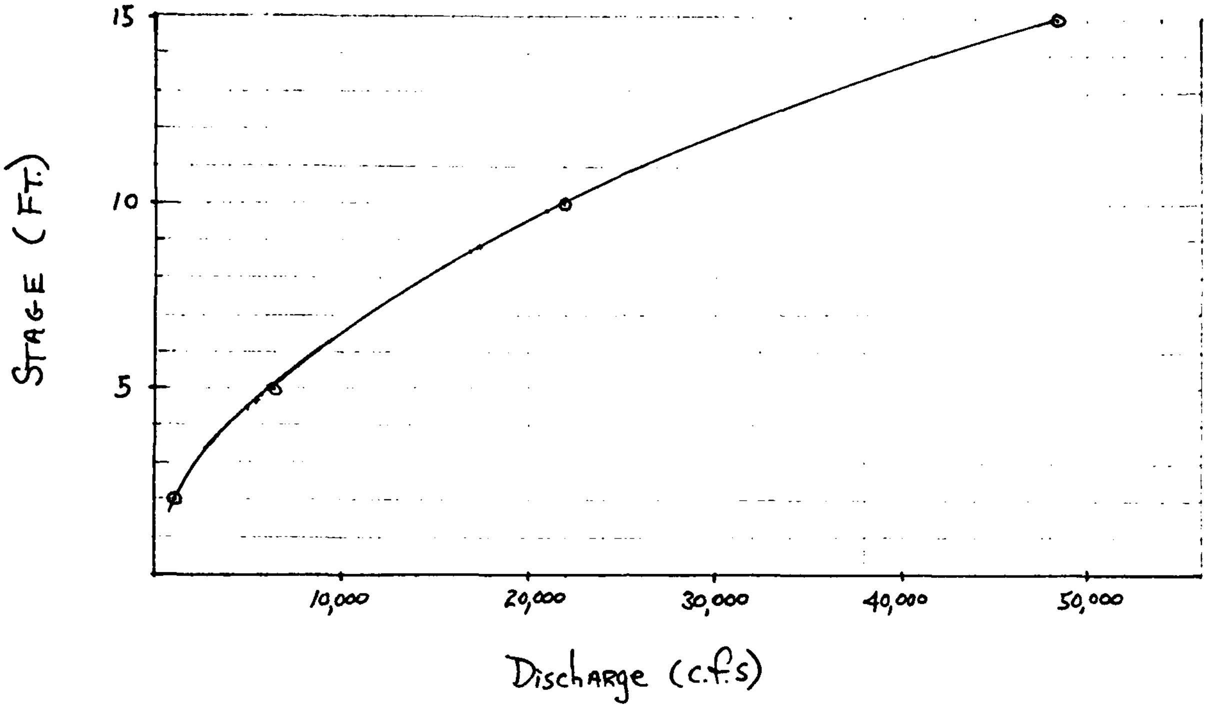
Assume $y = 15$ ft

$A = 5y^2 + 100y = 2{,}625$ $R = \frac{5y^2 + 100y}{10.1y + 100} = \frac{2{,}625}{251.5} = 10.437$ $S = 0.006$

$Q = \frac{1.486}{0.03} (2{,}625)(10.437)^{2/3}(0.006)^{1/2}$

$= (49.5333)(2{,}625)(4.813)(0.077)$

$Q = 48{,}192$ c.f.s.



A) Calculate the stage of the pond prior to dam failure

Flow Prior to dam failure = 1190 CFS

From graph above, stage = 2.5 ft.

Storage Volume = $(700)\left(\frac{(5)(2.5)^2+(100)(2.5)}{43,560}\right)$ = 4.5 ac.ft.

B) Calculate the stage of the stream after dam failure

$Q = 16,274$ cfs.

Channel Vol = Reach × Area

from graph on pp. 23, $y = 8.6$ feet

$$Vol = (700)\left(\frac{5(8.6)^2 + 100(8.6)}{43,560}\right) - 4.5 = 15.3 \text{ ac. ft}$$

$S = 136$ Ac-ft

$$Q_{p_2}(\text{TRIAL}) = Q_{p_1}\left(1 - \frac{V_1}{S}\right)$$

$$= 16,274\left(1 - \frac{15.3}{136}\right)$$

Q_{p_2} (TRIAL) = 14,443 c.f.s.

from graph on pp 23, $y = 8.0$ ft

$$V_2 = (700)\left(\frac{5(8.0)^2 + 100(8.0)}{43,560}\right) - 4.5 = 13.5 \text{ ac. ft}$$

$V_2 = 13.5$ Ac-ft $\qquad V_{AVG} = \frac{15.3 + 13.5}{2} = 14.4$ Ac-ft

$$\therefore Q_{p_2} = Q_{p_1}\left(1 - \frac{V_{AVG}}{S}\right)$$

$$= 16,274\left(1 - \frac{14.4}{136}\right)$$

$Q_{p_2} = 14,550$ c.f.s.

from graph on pp. 23 $y = 8.1$ ft

Flow over the top of Plunkett Road

Flow thru culvert
4' diameter 33 ft long

Inlet loss $= 0.9\ V^2/2g$

Outlet loss $= 1.0\ V^2/2g$

Pipe loss $= \underline{0.2\ V^2/2g}$ $\quad \left(h_L = f\frac{L}{d}\frac{V^2}{2g}\right)$ where $f = 0.02$, $l = 33'$, $d = 4'$

$H = 2.1\ V^2/2g$

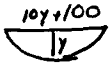
for $H = 4'$ $V = 11.1$ fps $Q = 139$ c.f.s. (Assume no surcharge)

FOR dam failure flow

$Q = 14{,}550 - 139 = 14{,}411$ c.f.s.

Broad crested weir flow over road:

$$H = \left(\frac{Q}{3.0(L)}\right)^{2/3}$$



$L = 10y + 100 = 188'$

$$H = \left(\frac{14{,}411}{3.0(188)}\right)^{2/3} = 8.8 \text{ ft.}$$

Depth over Road $\approx \frac{2}{3}(8.8) = 6.0$ ft

∴ The Road will be overtopped by 6.0 ft

FOR flow prior to dam failure

$Q = 1190$ cfs

Broad crested weir flow over road:

$$H = \left(\frac{Q}{3.0(L)}\right)^{2/3}$$

$L = 10y + 100 = 146'$.

$$H = \left(\frac{1190}{3.0(146)}\right)^{2/3} = 1.9 \text{ ft}$$

Depth over Road $\approx \frac{2}{3}(1.9) = 1.3$ ft

∴ The Road will be overtopped by 1.3 ft

5) Determine the effect on Plunkett Reservoir

The impact on Plunkett Reservoir can only be estimated since we do not have sufficient information on the discharge capacities of this reservoir nor do we have sufficient information to determine the actual volumes related to the calculated discharges entering the reservoir. Therefore, by experience we estimate that there will be approximately 20% to 30% reduction in flow due to the effect of the reservoir. For these calculations, we assume a 20% reduction. Also, the stage of the Plunkett Reservoir is estimated to increase less than 1 foot for the flow prior to dam failure and approximately 2 feet after dam failure.

Surface Area of Plunkett Reservoir @ normal pool (1501) ≈ 62 Acres

Reach = 2,100 ft

∴ with no discharge
136 ac.ft. ÷ 62 acres = 2.2 ft

There will be some discharge ∴ use 2.0 ft. as reservoir stage increase.

A) Flow Prior To Dam Failure = 1190 cfs

REVISED BY: OHD

B) Flow after dam failure

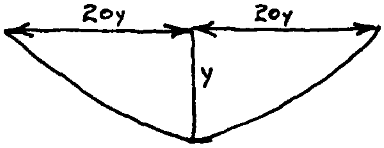
$Q = 14{,}550$ cfs

Less 20% for storage on Plunkett Res. = $\underline{2910}$

11,640 c.f.s. Total flow at Point 5 after dam failure.

6) Determine flow over Michaels Road

800 ft downstream of Plunkett Reservoir (Assume no additional drainage area)



Area: $\frac{20y^2}{2} + \frac{20y^2}{2} = 20y^2$

W.P. $\simeq 20.1y$

$R = A/\text{W.P.} = 20y^2/40.1y = 0.499y$

$S = \frac{20}{800} = 0.025$

Compute various points for y to attain Q

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 2$ ft

$A = 20y^2 = 20(2)^2 = 80$ s.f.

$R = 0.499y = 0.499(2) = 0.998$

$S = 0.025$

$Q = \frac{1.486}{0.03}(80)(0.998)^{2/3}(0.025)^{1/2}$

$Q = (49.5333)(80)(0.999)(0.158)$

$Q = 625$ c.f.s.

Assume $y = 5$ ft

$A = 20y^2 = 20(5)^2 = 500$ s.f.

$R = 0.499y = 0.499(5) = 2.495$

$S = 0.025$

$Q = \frac{1.486}{0.03}(500)(2.495)^{2/3}(0.025)^{1/2}$

$Q = (49.5333)(500)(1.845)(0.158)$

$Q = 7{,}220$ c.f.s.

Assume $y = 10$ ft

$A = 20y^2 = 20(10)^2 = 2{,}000$ s.f.

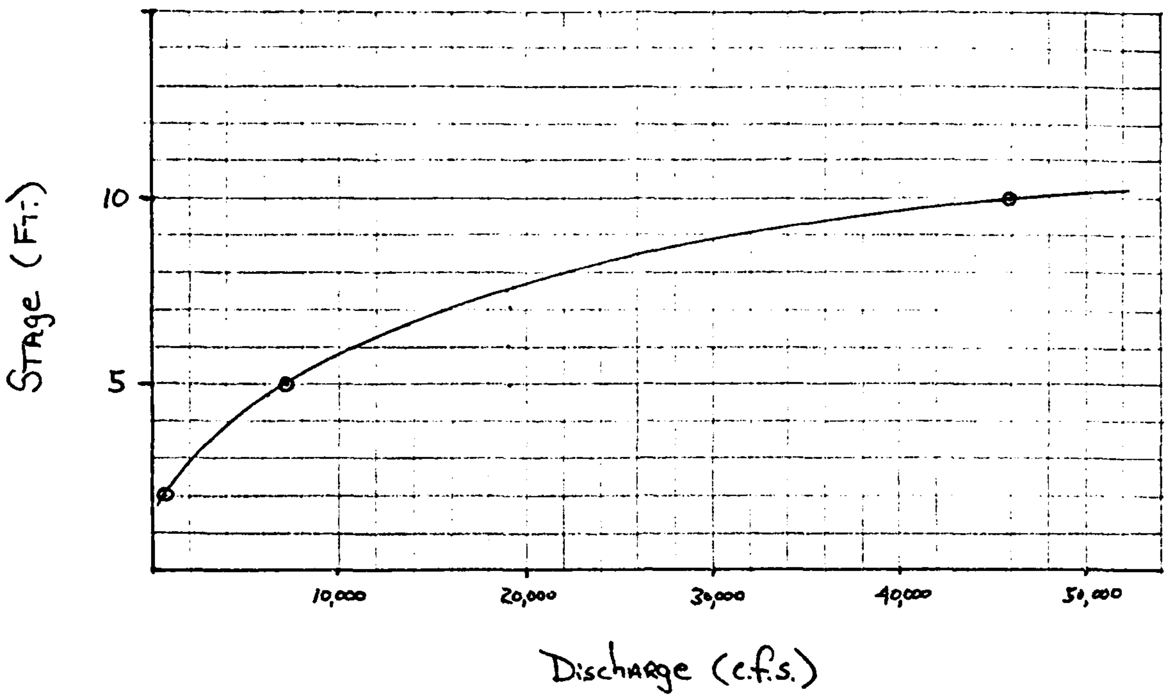
$R = 0.499y = 0.499(10) = 4.99$

$S = 0.025$

$Q = \frac{1.486}{0.03}(2{,}000)(4.99)^{2/3}(0.025)^{1/2}$

$Q = (49.5333)(2{,}000)(2.936)(0.158)$

$Q = 45{,}956$ c.f.s.



A) Flow prior to dam failure

$Q = 1190$ cfs

Broad-crested weir flow over road:

$H = \left(\frac{Q}{3.0L}\right)^{2/3} = \left(\frac{1190.}{(3)(188)}\right)^{2/3} = 1.6$ ft.   Depth over Road $\approx \frac{2}{3}(1.6) = 1.1$ ft

$L = 40y = 40(4.7) = 188$

Road will be overtopped by about 1.1 ft prior to failure

B) Flow after dam failure

$Q = 11{,}640$ c.f.s.

Broad-crested weir flow over road:

$H = \left(\frac{Q}{3.0L}\right)^{2/3} = \left(\frac{11{,}640}{(3.0)(252)}\right)^{2/3} = 6.2$ ft

$L = 40y = 40(6.2) = 252$ Depth over Road $\approx \frac{2}{3}(6.2) = 4.1$ ft

Road will be overtopped by about 4.1 ft after dam failure

7) Railroad crossing Frisell Brook

A) Flow prior to dam failure

$$Q = 1190 \text{ cfs.}$$

B) Flow after dam failure

neglect effect of storage thru this reach

$$Q = 11,640 \text{ cfs}$$

C) Flow over Railroad (neglect flow thru culvert)

Prior to dam failure the flow would overtop the railroad by:

$$H = \left(\frac{Q}{3.0(L)}\right)^{2/3} = \left(\frac{1190}{(3.0)(2,000)}\right)^{2/3} = 0.3 \text{ ft}$$

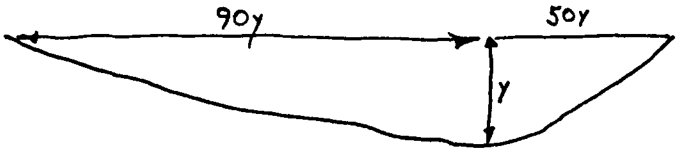
$$\text{depth over railroad} \approx \frac{2}{3}(0.3) = 0.2 \text{ ft.}$$

After dam failure the flow would overtop the railroad by:

$$H = \left(\frac{Q}{(3.0)L}\right)^{2/3} \left(\frac{11,640}{3.0(2,000)}\right)^{2/3} = 1.6 \text{ ft}$$

$$\text{depth over railroad} \approx 2/3\,(1.6) = 1.0 \text{ ft.}$$

8) Confluence with the East Branch of the Housatonic River
Section taken just downstream



Area = $\frac{90y^2}{2} + \frac{50y^2}{2} = 70y^2$

W.P. ≈ 140.1y

S = 0.001

R = A/W.P. = $70y^2/140.1y$ = 0.5y

n = 0.03

Compute various points for y to attain Q

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume y = 2 ft

$A = 70y^2 = 70(2)^2 = 280$

$R = 0.5y = 0.5(2) = 1$

$S = 0.001$

$Q = \frac{1.486}{0.03}(280)(1)^{2/3}(0.001)^{1/2}$

$= 49.5333(280)(1)(0.316)$

Q = 438 c.f.s.

Assume y = 5 ft

$A = 70y^2 = 70(5)^2 = 1750$

$R = 0.5y = 0.5(5) = 2.5$

$S = 0.001$

$Q = \frac{1.486}{0.03}(1750)(2.5)^{2/3}(0.001)^{1/2}$

$= 49.5333(1750)(1.848)(0.316)$

Q = 5,062 c.f.s.

Assume y = 3 ft

$A = 70y^2 = 70(3)^2 = 630$

$R = 0.5y = 0.5(3) = 1.5$

$S = 0.001$

$Q = \frac{1.486}{0.03}(630)(1.5)^{2/3}(0.001)^{1/2}$

$= (49.5333)(630)(1.312)(0.316)$

Q = 1,294 c.f.s.

Assume y = 4 ft

$A = 70y^2 = 70(4)^2 = 1120$

$R = 0.5y = 0.5(4) = 2.0$

$S = 0.001$

$Q = \frac{1.486}{0.03}(1120)(2.0)^{2/3}(0.001)^{1/2}$

$Q = (49.5333)(1120)(1.591)(0.316)$

Q = 2,789 c.f.s.

Assume y = 10 ft

$A = 70y^2 = 70(10)^2 = 7000$

$R = 0.5y = 0.5(10) = 5$

$S = 0.001$

$Q = \frac{1.486}{0.03}(7000)(5)^{2/3}(0.0316)$

$Q = 49.5333(7000)(2.94)(0.0316)$

Q = 32,213 c.f.s.

Assume y = 14 ft

$A = 70y^2 = 70(14)^2 = 13{,}720$

$R = 0.5y = 0.5(14) = 7$

$S = 0.001$

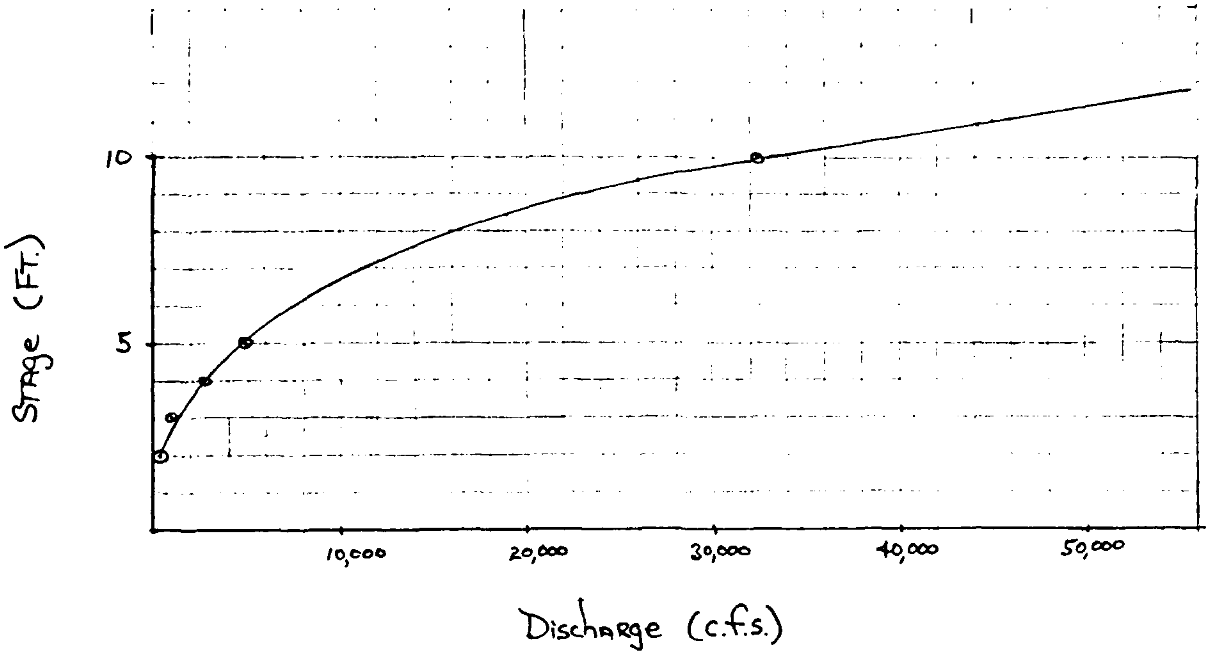
$Q = \frac{1.486}{0.03}(13{,}720)(7)^{2/3}(0.001)^{1/2}$

$Q = 49.5333(13{,}720)(3.683)(0.0316)$

Q = 79,093 c.f.s.

MARCH 3, 1980 Belmont Res. Dam

Done by: H.K.
checked by: Moe
REVISED BY: OHD



A) Calculate the stage of the River prior to dam failure

$Q = 1190$ cfs

From graph above, stage = 3.0 ft

B) After Dam Failure:

$Q = 11,640$ cfs (neglect effects of storage)

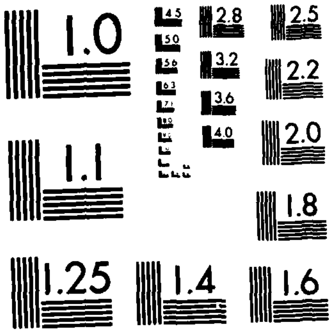
From graph above, stage = 7.0

Downstream of the confluence with the East Branch of the Housatonic River, the effects of a dam failure will not significantly add to the hazard potential

End of Calculations

AD-A154 486 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
BELMONT RESERVOIR DAM. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV MAR 80
UNCLASSIFIED F/G 13/13 NL

END
FILMED
DTIC


1.0
4.5
5.0
5.6
6.3
7.1
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
	224	NED	MA	003	01				BELMONT RESERVOIR DAM	4225.9	7308.9	28MAR80

POPULAR NAME	NAME OF IMPOUNDMENT
BELMONT RESERVOIR DAM	BELMONT RESERVOIR

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	10	TR EAST BRANCH HOUSATONIC RIV	HINSDALE	1	1600

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REPG	1889	S	29	29	140	90	NED	N	N	N	N	

REMARKS
2. 25 26 ARE TOP OF DAM

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	440	U	31	600												

OWNER	ENGINEERING BY	CONSTRUCTION BY
TOWN OF HINSDALE	UNKNOWN	UNKNOWN

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	MASS DEQE	MASS DEQE

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
TIGHE & BOND DIV SCI	09NOV79	PUBLIC LAW 92-367

REMARKS
35 AT TOP OF DAM