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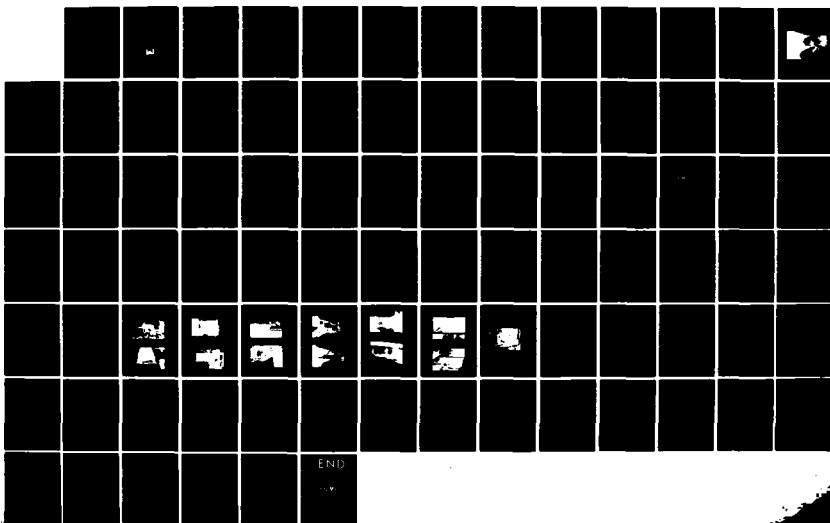
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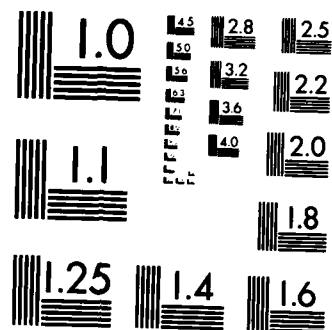
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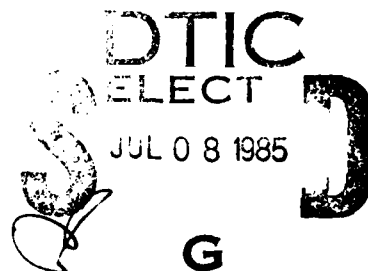
MASCOMA DAM NO. 2

NH 00156

NHWRB 134.11

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PHASE I INSPECTION REPORT
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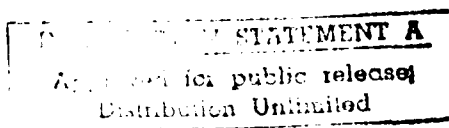


DEPARTMENT OF THE ARMY

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) -The dam is 120 ft. long with a height of about 21 ft. The dam is small in size with a significant hazard potential. The dam is in poor condition. Further investigations are recommended to evaluate rehabilitation of the spillway and the right end wall,		



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

REPLY TO
ATTENTION OF:
NEDED

SEP 9 1966

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Mascoma Dam No. 2 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 Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, City of Lebanon, New Hampshire 03766.

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 Water Resources Board for your cooperation in carrying out this program.

Sincerely,

Max B. Scheider

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.:	NH 00156
NHWRB No.:	134.11
Name of Dam:	Mascoma Dam No. 2
Town:	Lebanon
County and State:	Sullivan County, New Hampshire
Stream:	Mascoma River
Date of Inspection:	May 6, 1980

BRIEF ASSESSMENT

The Mascoma Dam No. 2 is located on the Mascoma River in Lebanon, New Hampshire approximately 2.2 miles upstream of its confluence with the Connecticut River. The dam consists of a rock filled timber crib spillway, a gate house, and a power house. The total length of the dam is approximately 120 feet and its height is approximately 21 feet. There are two waste gates which are each 3 feet 8 inches wide and 4 feet 2 inches high. The invert of these gates is 8 feet below the crest of the spillway. The power house has been partially demolished and is no longer usable.

The dam is owned by the City of Lebanon, New Hampshire. The purpose of the dam was to impound water for electric power generation, however, no power has been generated at this site since 1969.

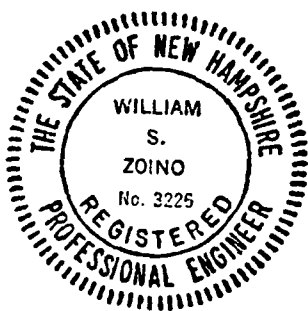
The drainage area of the dam covers 194 square miles and is made up of rolling woodland and development. The dam has a maximum impoundment of 400 acre feet. The dam is small in size and its hazard classification is SIGNIFICANT since appreciable economic loss and the potential for loss of life could result in the event of a dam failure.

Because of its small size and significant hazard classification, the test flood for this dam could range from the 100-year frequency flood to one-half of the Probable Maximum Flood. A 100-year flow of 7,000 cfs has been adopted as the test flood for this dam. Because of the insignificant surcharge storage, the resulting peak discharge is 7000 cfs compared to a total spillway capacity of 6300 cfs. The water surface would be at elevation 467.1 feet (msl) or 0.5 feet below the top of the left abutment and 0.2 feet above the top of the right abutment. The spillway is capable of passing 90 percent of the adopted test flood.

The dam is in POOR condition at the present time. Further investigations are recommended to evaluate rehabilitation of the spillway and the right end wall. Remedial measures to be undertaken by the owner include: implementing annual maintenance and inspection programs, developing a downstream warning system, removing debris from spillway and gates, checking operability of gates, filling

the abandoned power house, and repairing concrete.

The recommendations and remedial measures outlined above should be implemented within one year of receipt of this report by the owner.



William S. Zoino

William S. Zoino
N.H. Registration No. 3226



Nicholas A. Campagna, Jr.

Nicholas A. Campagna, Jr.
California Registration No. 21006

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This Phase I Inspection Report on Mascoma Dam No. 2 has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar
JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an 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.

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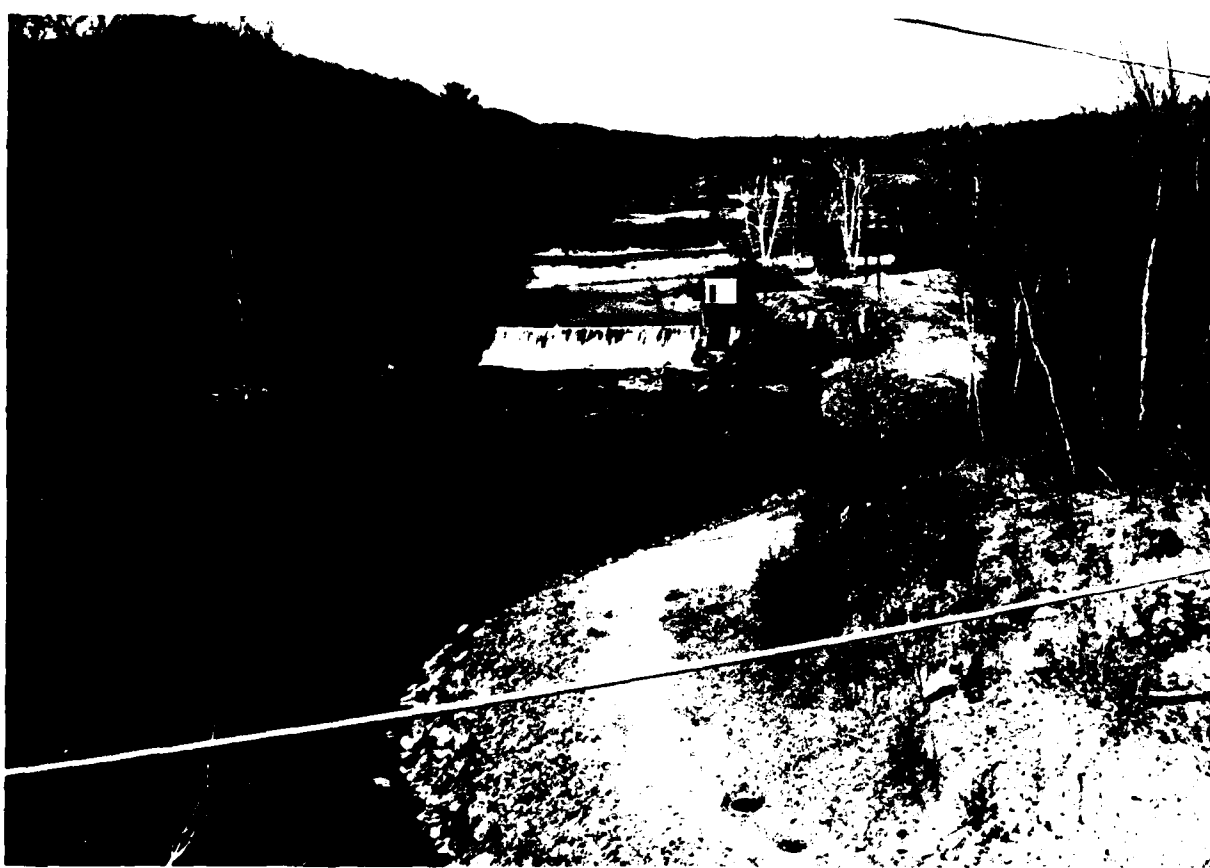
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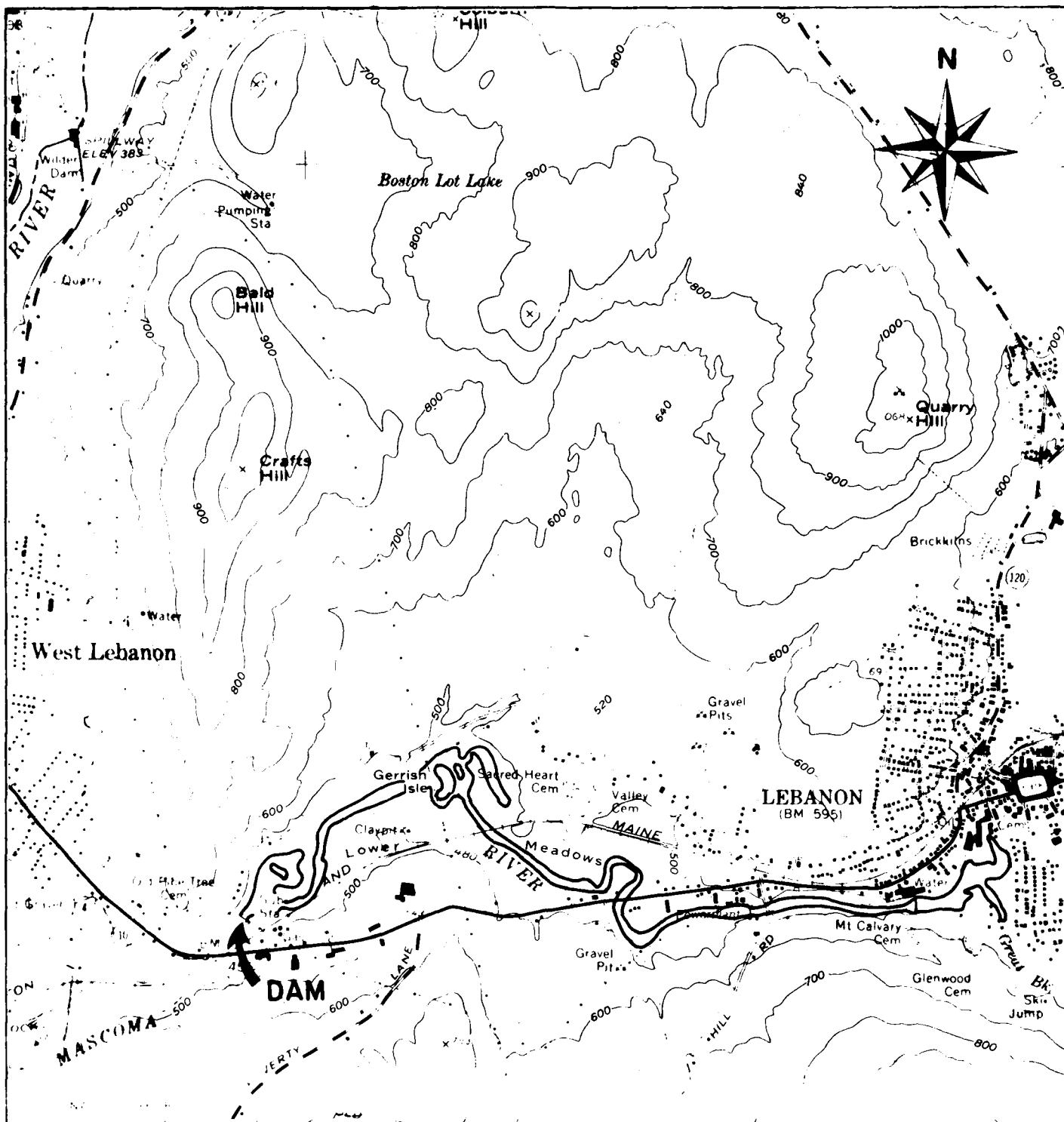
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Overview of Dam



0 1000 2000 4000 (FEET)

FROM USGS HANOVER-VT, N.H. QUADRANGLE MAP

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

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

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION PLAN

FILE No 2605

MASCOMA DAM No.2

LEBANON, NEW HAMPSHIRE

SCALE AS SHOWN

DATE

National Dam Inspection Program

Phase I Inspection Report

Mascoma Dam No. 2

Section I: 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. Goldberg-Zoino & Associates, Inc. (GZA) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to GZA under a letter of April 17, 1980 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW 33-80-C-0055 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.

1.2 Description of Dam

(a) Location

The Mascoma Dam No. 2 is located on the Mascoma River in Lebanon, New Hampshire approximately 2.2 miles upstream of the Connecticut River. It can be reached from State Route 10 in Lebanon. The dam is shown on USGS Hanover, New Hampshire quadrangle at approximate coordinates N4338.2, W7217.8 (see location map on page vi)

(b) Description of Dam and Appurtenances

The dam consists of a rock filled, timber crib spillway section, a

gate house structure, and a partially demolished power house structure.

1) Spillway (See Pages B-2, B-3, & B-10)

The spillway is a rock filled timber crib approximately 87 feet long and 16 feet high. The crest width is approximately 4 feet and the downstream face slopes at approximately 1-3/4 horizontal to 1 vertical. The upstream face reportedly slopes 1.4 horizontal to 1 vertical.

2) Gate House Structure (See Pages B-2, & B-3)

The gate house is a wood frame building supported on a concrete structure to the left of the spillway. It is approximately 15 feet wide and houses two wastegates each of which is 4 feet 2 inches high and 3 feet 8 inches wide. The invert of the wastegates is 3 feet below the crest of the spillway.

3) Power House (See Page B-2)

The powerhouse is located at the left abutment. This structure is presently in ruins.

(c) Size Classification

The dam's maximum impoundment of 400 acre feet and height of 23 feet place it in the SMALL size category according to the Corps of Engineer's Recommended Guidelines.

(d) Hazard Potential Classification

The hazard potential classification for this dam is SIGNIFICANT because of the major damage to a railroad bridge, a sewage pumping station and two industrial buildings downstream in the event of dam failure. Section 5 of this report presents more detailed discussion of the hazard potential.

(e) Ownership

The dam was originally owned by the Grafton County Electric Light and Power Company. Sometime between 1934 and 1937 Granite State Electric took over ownership. When power generation was stopped in 1969, the City of Lebanon, New Hampshire took over ownership and is the present owner. The City Engineer, Mr. Robert Pantell, can be reached at City Hall, Lebanon, New Hampshire 03766. He can be reached by telephone at (603) 448-4220.

(f) Operator

The operation of the dam is controlled by the City Engineer, Mr. Robert Pantell, of Lebanon, New Hampshire. He can be reached by telephone at (603) 448-4220.

(g) Purpose of the Dam

The purpose of the dam was to impound water for power generation, however, no power has been produced at this site since 1969.

(h) Design and Construction History

The original design and date of construction are unknown. A dam existed at this site in 1895, but there may have been a mill at this site as early as 1820. The dam was reconstructed in 1934 by Grafton County Electric Light and Power Company. The engineering for this work was accomplished by New England Power Engineering & Service Corporation of Boston, Massachusetts.

(i) Normal Operating Procedure

The dam is normally self regulating. The wastegates are operable but are used only on an as needed basis.

1.3 Pertinent Data

(a) Drainage Area

The drainage area for this dam covers 194 square miles. It is made up of approximately 50 percent development and 50 percent rolling woodland and pasture.

(b) Discharge at Dam Site

1) Outlet Works

The outlet works consist of two waste gates and a head gate. The waste gates are each 4 feet 2 inches high and 3 feet 8 inches wide. The head gate is inoperable. The invert of the waste gates is at elevation 450.3 feet (msl).

2) Maximum Known Flood

The maximum known flood at this dam site is approximately 7000 cfs, and occurred in March 1936.

3) Ungated Spillway Capacity at Top of Dam

The capacity of the spillway with the reservoir at top of dam elevation (466.6 feet msl) is 6300 cfs.

4) Ungated Spillway Capacity at Test Flood

The capacity of the spillway with the reservoir at test flood elevation (467.1 feet msl) is 6850 cfs.

5) Gated Spillway Capacity at Normal Pool

There are no gated spillways.

6) Gated Spillway Capacity at Test Flood

There are no gated spillways.

7) Total Spillway Capacity at Test Flood

The total spillway capacity at test flood elevation (467.1 feet msl) is 6850 cfs.

8) Total Project Discharge at Top of Dam

The total project discharge at top of dam elevation (466.6 feet msl) is 6300 cfs.

9) Total Project Discharge at Test Flood Elevation

The total project discharge at test flood elevation (467.1 feet msl) is 6850 cfs.

(c) Elevation (feet above msl)

- 1) Streambed at toe of dam: approximately 445.8
- 2) Bottom of cutoff: Unknown
- 3) Maximum tailwater: Unknown
- 4) Recreation Pool: Approximately 458.8
- 5) Full flood control pool: Not applicable
- 6) Spillway crest: Approximately 458.8
- 7) Design surcharge: Unknown

- 8) Top of dam: 466.6
- 9) Test flood surcharge: 467.1

(d) Reservoir (length in feet)

This is a run of the river dam. For analysis purposes assume 5000 feet.

(e) Storage (acre-feet)

- 1) Normal pool: 170
- 2) Flood control pool: Not applicable
- 3) Spillway crest pool: 170
- 4) Top of dam pool: 400
- 5) Test flood pool: 415

(f) Reservoir Surface (acres)

This is a run of the river dam. For analysis purposes, assume 30 acres.

(g) Dam

- 1) Type: Gravity, overflow, timber crib
- 2) Length: Approximately 120 feet
- 3) Height: Approximately 21 feet
- 4) Top width: Approximately 4 feet
- 5) Side slopes: Not applicable
- 6) Zoning: Not applicable
- 7) Impervious core: Unknown
- 8) Cutoff: Unknown
- 9) Grout curtain: Unknown

(h) Diversion and Regulating Tunnel

Not applicable

(i) Spillway

- 1) Type: Stone filled timber crib
- 2) Length of weir: 86 feet 9 inches
- 3) Crest elevation: 458.8 feet (msl)
- 4) Gates: Spillways not equipped with gates
- 5) Upstream channel: Mascoma river channel
- 6) Downstream channel: Mascoma river channel

(j) Regulating Outlets

The regulating outlet consists of two rectangular sluiceways, each of which is 3 feet 8 inches wide and 4 feet 2 inches high and equipped with a wheel operated sluice gate. The invert of these gates is at elevation 450.8 feet (msl).

Section 2: Engineering Data

2.1 Design Data

None of the original design drawings or calculations are available for this dam. Significantly lacking are data concerning the length and depth of any cutoff and the foundation conditions. An elevation and cross section drawing by New England Power Engineering & Service Corporation is available for the reconstruction which was accomplished in 1934.

2.2 Construction Records

No construction records are available for this dam.

2.3 Operational Records

No operational records are available for this dam.

2.4 Evaluation of Data

(a) Availability

The lack of detailed design and construction data warrants an unsatisfactory assessment for availability.

(b) Adequacy

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment of the dam is based primarily on the visual inspection, past performance and sound engineering judgement.

(c) Validity

Since the observations of the inspection team generally confirm the information contained in the records of the New Hampshire Water Resources Board, a satisfactory evaluation for validity is indicated.

Section 3: Visual Inspection

3.1 Findings

(a) General

The Mascoma Dam No. 2 is in POOR condition at the present time.

(b) Dam

1) Spillway (See Photos 1, 6, 11, 12, & overview)

The crest of this structure has settled, with the major settlement occurring at mid length. It is estimated that this settlement is in the range of 8 inches. The timber planking on the crest and downstream slope has been subjected to a high degree of decay. Portions of the downstream planking are dislodged. Approximately 20 feet of the crib work has been dislodged at the approximate mid point of the spillway. Portions of this grillage have splintered and crib stones have unravelled. Seepage is penetrating through the downstream side of the spillway approximately 2 feet below its crest.

2) Right End Wall (See Photos 5 & 6)

It was observed that this structure was constructed with cemented stone masonry. The mortar joints have eroded over its entire length from the spillway crest elevation up to 2 feet above. The upstream training wall has partially unravelled with heavy vegetative growth flourishing in masonry joints. The downstream portion of this wall is completely unravelled.

3) Left Abutment (See Photos 1 & 3)

This structure consists of a concrete wall which also serves as the right foundation of the sluice gate structure. The base of the downstream end of this wall, which is approximately at the spillway crest elevation, is eroded for a height of approximately 2 feet at its end. This erosion can be attributed to a combination of ice damage, cavitation and surface spalling induced by moisture intrusion subjected to alternate freezing and thaw cycles. Approximately 25 percent of its top surface has spalled up to depths of 8 inches and can be attributed to moisture intrusion subjected to alternate freeze and thaw cycles.

(c) Appurtenant Structures

1) Gate House Structure (See Photos 1, 2, 3, & 13)

This structure is founded on the left abutment and a concrete wall adjacent to the remains of the abandoned power house. This wall has deteriorated as described for the left abutment.

The outlet opening for the sluice gates is 8 feet wide. Discharge is through the gates outlets onto a concrete apron supported on timber cribbing. The downstream 3 feet of this apron has broken away from the remaining apron due to partial failure of the cribbing. The apron is completely eroded adjacent to the left wall.

The wood framed gate house is in good condition.

The twin sluice gates are equipped with a timber stem and rack gear. The left gate was partially open at the time of inspection. The gate operation gearing systems are manually operated by means of ratchets which can be supplemented by hand wheels. The equipment is well maintained and operable. At one time the gates were power operated; the power being generated by two 5HP, 220V, 3 phase motors which have been removed. Power has been disconnected to the structure.

The wood deck platform around the gate house is in good condition. However, the protective metal railing is a menace; portions being nonexistent above the forebay entrance to the sluice gates.

The access ladder to the sluice gate outlets is also a menace due to inadequate fastening.

The forebay entrance to both sluice gates is clogged with debris.

2) Abandoned Power Station (See Photos 1, 4, & 7)

The remains of this brick structure, which is founded on cemented stone masonry is completely destroyed. Two 60 inch penstock openings were observed penetrating the downstream brick masonry wall. The forebay entrance has been filled with rubble. A reinforced concrete slab, which is supported on steel stringers spans from the power station wall to the forebay entrance, is in deplorable condition and a menace. The voids under this slab are extensive. The remains of concrete foundation walls and a concrete wall are located at what appears to be a portion of the station immediately upstream of the tailrace. With the exception of the wall adjacent to the left bank, they are in ruins.

3) Tailrace (See Photo 7)

The left side of the tailrace consists of a dry stone masonry wall with a revetted slope extension whereas the right side consists of a dry stone masonry wall from what appears to be the downstream end of the abandoned power station. These walls are in fair condition. The right dry stone wall, which separates the tailrace from the dam overflow was extended by means of a concrete capped rubble wall. This wall has been undermined with numerous granite blocks being dislodged.

(d) Reservoir Area (see photos 3 & overview)

The reservoir area is the Mascoma River channel. It appears to be stable and in good condition.

(e) Downstream Channel (see photos 9, 10, & overview)

The outlet channel is the Mascoma River channel. It appears to be stable and in good condition.

3.2 Evaluation

The dam and its appurtenant structures are generally in poor condition. The problem areas noted during the visual inspection are listed as follows:

- (a) Unsafe condition of the remains of the power plant.
- (b) Settlement and general poor condition of the timber crib spillway section.
- (c) Debris caught in waste gates.
- (d) Unravelling of the right end wall.

Section 4: Operational and Maintenance Procedures

4.1 Operational Procedures

(a) General

No written operational procedures exist for this dam. The dam is normally self regulating. The waste gates are operated by the owner on an as-needed basis.

(b) Description of any Warning System in Effect

There is no warning system in effect.

4.2 Maintenance Procedures

(a) General

No maintenance program exists for the dam. Maintenance is accomplished on an as-needed basis.

(b) Operating Facilities

No maintenance program exists and maintenance is performed infrequently.

4.3 Evaluation

Additional emphasis on routine maintenance will assist the Owner in assuring the long-term safety of the dam and operating facilities. A formal, written, downstream emergency warning system should be developed for this dam.

Section 5: Evaluation of Hydraulic/Hydrologic Features

5.1 General

The Mascoma Dam No. 2 is a timber crib structure on the Mascoma River in Lebanon, New Hampshire.

The Mascoma River watershed is of rolling to mountainous terrain which is primarily forested but does include significant portions of pasture, field and urban development. There is substantial hydrologic storage in the watershed provided by numerous ponds and reservoirs, the most important of which is Mascoma Lake. The drainage area at the Mascoma Dam No. 2 is 194 square miles.

The Mascoma Dam No. 2 is a run of the river dam including an overflow spillway section, a waste gate structure, and the ruins of a power house.

A rock filled timber crib structure covered by a wood plank decking forms the main spillway section. The abutment walls are mortared rubble masonry. The waste gate structure to the left of the spillway includes two 3.7 foot wide by 4.5 foot high sluice gates.

Immediately downstream of the dam the Mascoma River channel broadens to form a pool approximately 200 feet wide and 200 feet long. Approximately 100 feet beyond the end of this pool, after the stream channel has become considerably narrower and steeper, U.S. Route 4 crosses the river on a high bridge with the B & M railroad passing beneath the highway on a low bridge. The railroad opening is roughly 10 feet high and 80 feet wide. Just downstream of the railroad bridge there is a small 3 ft. high concrete weir across the stream, creating a minimum tailwater condition at the dam. This weir is formed by the concrete casing of a sewer which crosses the stream at this point. There is a sewage pump station adjacent to the weir at the right bank. The pump house is elevated approximately 6 feet above the top of the weir.

The Mascoma River continues on a moderate to steep gradient in a channel roughly 80 feet wide with steep, confining banks 5-6 feet high. The valley slopes steadily away from the banks on both sides of the stream. Interstate 89 runs parallel to the stream, well elevated above the left bank, for much of the reach.

About 0.7 mile downstream of the Mascoma Dam No. 2 is the Glen Road Dam. This is a run-of-the-river timber crib dam similar to Mascoma Dam No. 2, though it impounds a considerably smaller volume of water. Glen Road Dam is approximately 15 feet high with a spillway length of 123 feet and is presently in poor condition. It is the subject of a separate inspection report dated February, 1979.

The B & M railroad crosses the stream twice near the Glen Road Dam, shortly upstream and shortly downstream. The bridge is well elevated above the river in both cases.

For the next 3000 foot reach, the stream channel properties are similar to those of the preceding reach. At the end of this reach the confining valley wall recedes and there is a sizeable floodplain extending from the left bank. There are two large, light industrial/warehouse structures in the floodplain here, each elevated approximately 7 feet above the streambed level. Further downstream, at South Main Street, there is a shopping center and other commercial buildings near the stream. These buildings are about 10 feet above the streambed.

The Mascoma River joins the Connecticut River about 1/2 mile downstream of South Main Street. This is about 2.2 miles downstream of the Mascoma Dam No. 2.

5.2 Design Data

Data sources available for the Mascoma Dam No. 2 include prior inventory and inspection reports. The New Hampshire Water Control Commission's "Data on Dams in New Hampshire" (3 January, 1939) and "Data on Water Power Developments in New Hampshire" (3 January, 1939) along with the New Hampshire Water Resources Board's "Inventory on Dams and Water Power Developments" (7 September, 1937) were utilized in this study.

Additionally, correspondence of the New Hampshire Public Service Commission and the New England Power Engineering and Service Corporation concerning the proposed reconstruction of the dam in 1934 provide some useful information. Included was a drawing of the dam prepared by the New England Power Engineering and Service Corp.

None of the original hydrologic and hydraulic design records are available.

5.3 Experience Data

A New Hampshire Water Control Commission questionnaire completed by the dam's owner concerning flood levels experienced during September 21 through 24, 1938 is available. The reported peak was roughly 7 feet above the spillway crest.

The U.S.G.S. operates a water stage recorder on the Mascoma River at Mascoma, New Hampshire, approximately 7.7 miles upstream of the Mascoma Dam No. 2. The record is continuous from August, 1923 to date. The maximum recorded flood at this gauge took place in March, 1936, with a peak discharge of 5840 cfs. After adjustment for the larger drainage area, the corresponding peak discharge at the Mascoma Dam No. 2 would be about 7000 cfs. The dam rating curve presented in Appendix D indicates that such a flood would overtop the left abutment. There is no evidence that this actually occurred during the 1936 flood.

In performing a Flood Insurance Study (FIS) of the city of Lebanon, the New England Division of the Corps of Engineers analyzed the Mascoma gauge to develop 10-, 50-, 100-, and 500-year peak discharges for the Mascoma River in

Lebanon. Water surface profiles for these discharges were also computed. These are available in an FIS report dated January, 1975.

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. None of the original hydraulic and hydrologic design records are available for use in this study.

Guidelines for establishing a recommended Test Flood based on the size and hazard classifications of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of less than 1000 acre feet and height of less than 40 feet classifies this as a SMALL structure.

The hazard potential for the Mascoma Dam No. 2 is considered to fall within the SIGNIFICANT category. This is based on the possibility of causing serious damage, and perhaps service interruption, to a sewage pump station and railroad bridge shortly downstream of the dam. Additionally, dam failure could cause some less severe flooding at two industrial/warehouse buildings approximately 1.3 miles downstream. There appears to be little threat of loss of life.

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 SIGNIFICANT hazard potential would be between the 100-year flood and one-half times the Probable Maximum Flood (PMF). Where a range of values is indicated for the Test Flood, the magnitude of the flood should be related to the hazard potential. Since the hazard is on the low side of significant, with little danger of loss of life and only a limited number of structures affected, a Test Flood equal to the 100-year flood is considered appropriate.

Previous Flood Insurance Study results for this river provide estimated values for the 10-, 50-, 100-, and 500-year discharges at the Mascoma Dam No. 2. These were computed using a log-Pearson Type III statistical analysis of peak discharges at a stream gauge 7.7 miles upstream of the dam. The resulting 100-year discharge of 7000 cfs is adopted as the applicable Test Flood. The surcharge storage volume for this dam is too small in relation to the size of the watershed to have a significant attenuating effect on the flood peak.

Using this stage-discharge curve, the peak Test Flood discharge of 7000 cfs would result in a maximum stage 8.3 feet above the spillway crest. This is 0.5 feet above the top of the left abutment and 0.2 feet below the top of the right abutment.

5.5 Dam Failure Analysis

The peak outflow at Mascoma Dam No. 2 that would result from dam failure was 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." Failure is assumed to occur with the pool at the level of the top of the left abutment. This is 20.8 feet above the natural streambed level. Just prior to failure, the normal outflow through the spillway would be 6240 cfs, with a tailwater level estimated to be 16.7 feet below the headwater. Assuming a 48 foot gap is opened in the dam, the peak failure outflow through this gap and over the remainder of the spillway would be 11750 cfs.

This outflow would result in a severe flooding condition and probable major damage to the railroad bridge and sewage pump station approximately 300 feet downstream of the dam. It is estimated that the peak water level would be 3-4 feet above the low chord of the bridge, while flooding at the pump station would be 4-5 feet deep.

The rate of flood wave attenuation in the 0.7 mile reach of the Mascoma River from the Mascoma Dam No. 2 to the Glen Road Dam would be small. The estimated peak flow at the Glen Road Dam would be 11340 cfs. This dam, already in poor condition, might be severely damaged by such a flood. If it were to fail, flood depths experienced downstream would be increased somewhat. However, the maximum impoundment capacity of the Glen Road Dam is quite small, approximately 60 acre-ft., and so this additional increment to flooding would be rapidly attenuated, adding little to the flood hazard at downstream locations.

Approximately 3000 feet downstream of the Glen Road Dam, two light manufacturing/warehouse buildings have been built near the stream in the floodplain. In this region, the estimated peak discharge would be about 7-8 feet, compared to a 5-6 foot depth prior to failure. As a result, perhaps 1 foot of flooding would be sustained at these buildings, whereas very little, if any would be expected without failure.

Further downstream, the dam failure flood wave would attenuate more rapidly as it spreads over the more extensive flood plain which adjoins the river there. Additional flood damage would be light, because structures near the last mile reach down to the Connecticut River are elevated roughly 10 feet or more above the streambed.

In summary, the results of the hydrologic and hydraulic calculations indicate that the spillway capacity is not sufficient to pass the recommended test flood without overtopping the wastegate structure, the power house remains, and the ground surface at the left abutment by about 0.5 feet.

Failure of this dam under assumed conditions would result in probable major flood damage to a railroad bridge and sewage pump station shortly downstream of the dam, and possible flood damage, less severe, at two industrial/warehouse buildings 1.3 miles downstream.

Section 6: Structural Stability

6.1 Visual Observations

(a) Visual Observations

1) Spillway

The field investigation revealed seepage flowing through the spillway. These seepage conditions warrant further investigation and the preparation of structural stability calculations.

The center section of the spillway has settled. Furthermore the timber planking on the crest and the downstream slope has been subjected to considerable decay. It has also been noted that the timber cribbing under the downstream timber apron has been dislodged and splintered. Stone fill has also been dislodged.

2) Right End Wall

Mortar has eroded from the joints of this wall. The upstream training wall has partially unravelled and the downstream wall has been completely unravelled.

3) Gate House

The gate house structure and its appurtenances are in good condition.

4) Power Station

The remains of the abandoned power station are in a deplorable condition and can be classified as a derelict and menace structure and is a contributory nuisance.

5) Left Abutment

The left abutment is essentially structurally sound. However, foundation conditions cannot be ascertained due to the lack of record drawings.

6) Tailrace

The concrete capped wall has been undermined and granite blocks have been dislodged.

6.2 Design and Construction Data

No records of structural stability analyses are available for this dam.

6.3 Post Construction Changes

The dam was rebuilt in 1934 by Grafton County Electric Light and Power.

6.4 Seismic Stability

The dam is located in seismic zone No. 2 and, in accordance with the recommended Phase I guidelines, does not warrant seismic analysis.

Section 7: Assessment, Recommendations and Remedial Measures

7.1 Dam Assessment

(a) Condition

The Mascoma Dam No. 2 is in POOR condition at the present time. The seepage through the rock filled timber crib spillway should be arrested. The decay of the timber planked crest and its downstream slope and the dislodgement and fracturing of cribbing should be repaired and/or replaced.

(b) Adequacy of Information

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment is based primarily on the visual inspection, past performance, and sound engineering judgement.

(c) Urgency

The engineering studies and improvements 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 services of a qualified registered professional engineer be retained to:

- (a) Draw down the impoundment pool and investigate the source and cause of seepage through the spillway and the extent of decay of the timber facing on the upstream face of the dam.
- (b) Evaluate the condition of the abandoned powerhouse structure and prepare recommendations for its rehabilitation.
- (c) Prepare plans for the complete rehabilitation of the spillway.
- (d) Prepare plans for the complete rehabilitation of the right end wall.

The owner should implement the findings of the above engineering studies.

7.3 Remedial Measures

It is recommended that the following remedial measures be undertaken by the owner:

- (a) Implement and intensify a program of diligent and periodic maintenance including but not limited to: clearing debris from spillway and waste gates and checking the operability of the waste gates.
- (b) Develop a downstream emergency, flood warning system.
- (c) Develop and implement a program of annual technical inspections.

7.4 Alternatives

One possible alternative to the above recommendations may be to lower the impoundment and remove the dam and its appurtenant structures.

APPENDIX A
VISUAL INSPECTION CHECKLIST

Inspection Team Organization

DATE: May 6, 1980
PROJECT: NH 00156
Mascoma Dam No. 2
Lebanon, New Hampshire
NHWRB No. 134.11
WEATHER: Clear, warm

Inspection Team

Nicholas A. Campagna	Goldberg Zoino & Associates, Inc.	Team Captain
William S. Zoino	Goldberg Zoino & Associates, Inc.	Soils
Jeffrey M. Hardin	Goldberg Zoino & Associates, Inc.	Soils
Andrew Christo	Andrew Christo Engineers	Structures
Paul Razgha	Andrew Christo Engineers	Structures
Carl Razgha	Andrew Christo Engineers	Structures

Robert Fitzgerald and Richard Laramie of Resource Analysis Inc. performed the hydrologic inspection of this dam on April 24, 1980.

New Hampshire Water Resources Board
Representative Present -- Mr. Pattu Kesavan

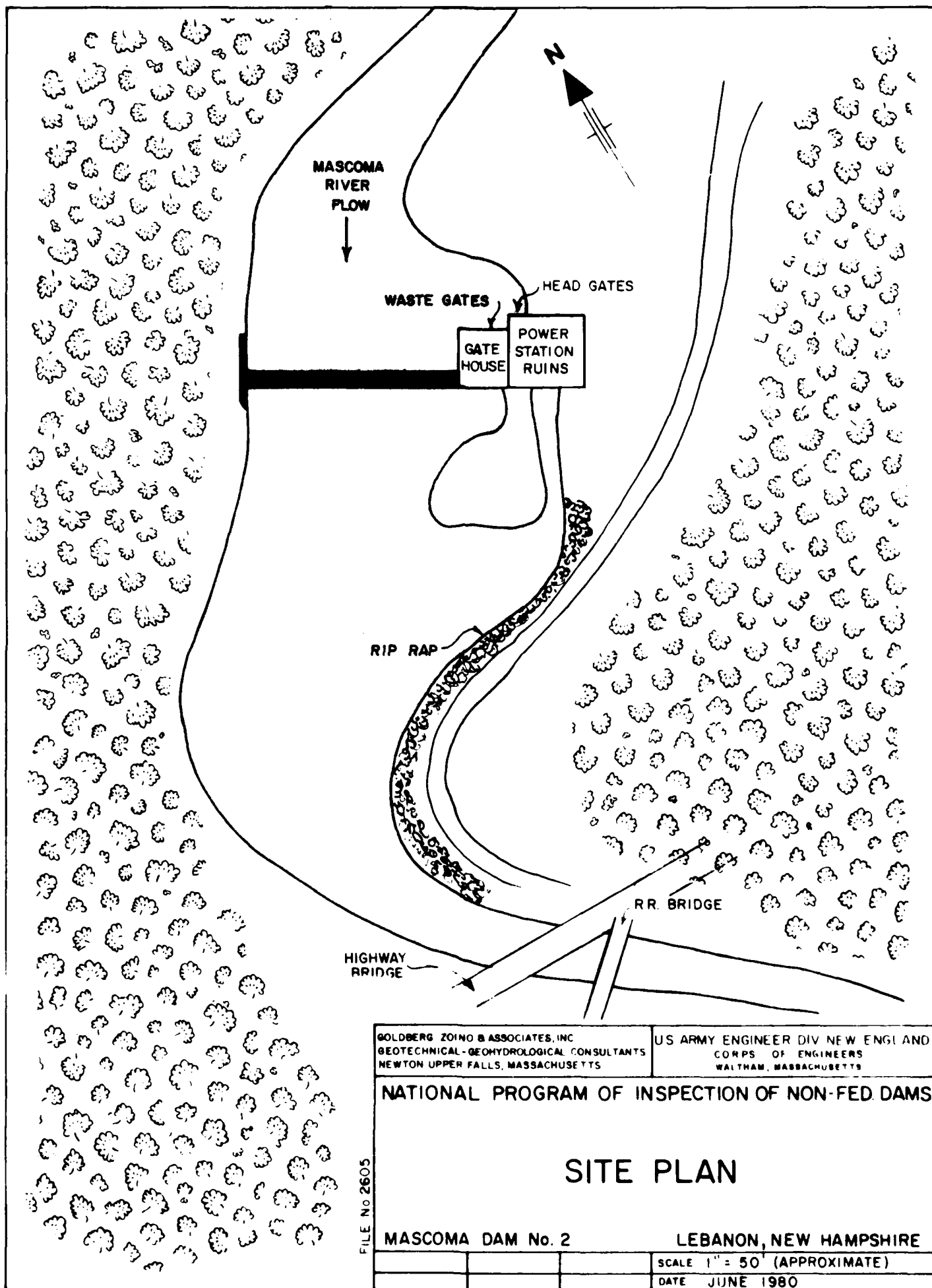
CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
<u>RIGHT END WALL</u>	PR	Mortar eroded from joints. Upstream training wall partially ravelled; dense vegetation active in joints. Downstream wall completely unravelled.
<u>SPILLWAY</u>		Crest settled 8 inches +. Timber planking on crest and downstream slope subjected to decay. Downstream planking dislodged. 20' + cribbing dislodged; portions splintered. Crib stones unravelled. Seepage 2' below crest.
<u>LEFT ABUTMENT</u>		
Condition of concrete		Fair
Erosion		2' in height at downstream end.
Spalling		25% of top surface spalled.
Cracking		Minor
Rusting or staining of concrete		None noted
Visible reinforcing		None noted
Efflorescence		Minor
<u>GATE HOUSE STRUCTURE</u>		
Concrete wall		Similar to left abutment.
Concrete apron		
Condition of concrete		Poor
Erosion	PR	Downstream end (3') broken away; partial failure of cribbing. Completely eroded adjacent to left wall.

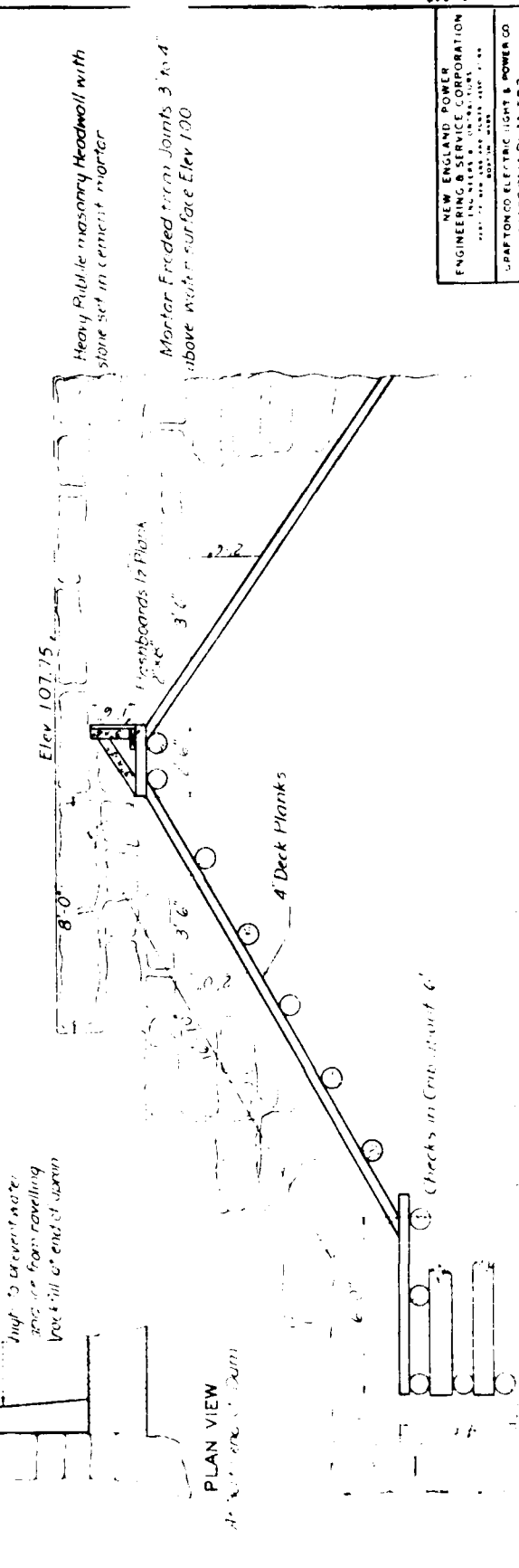
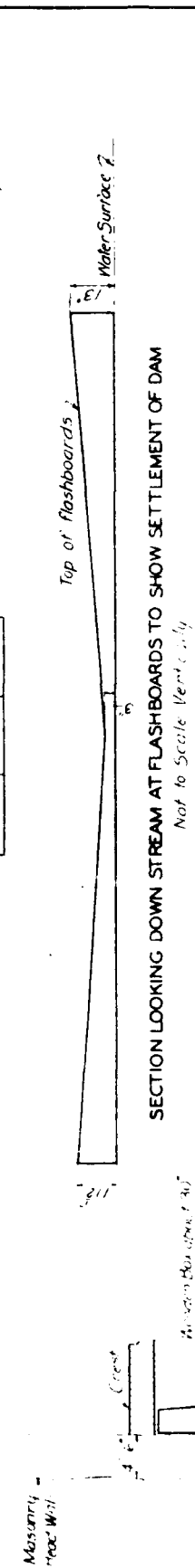
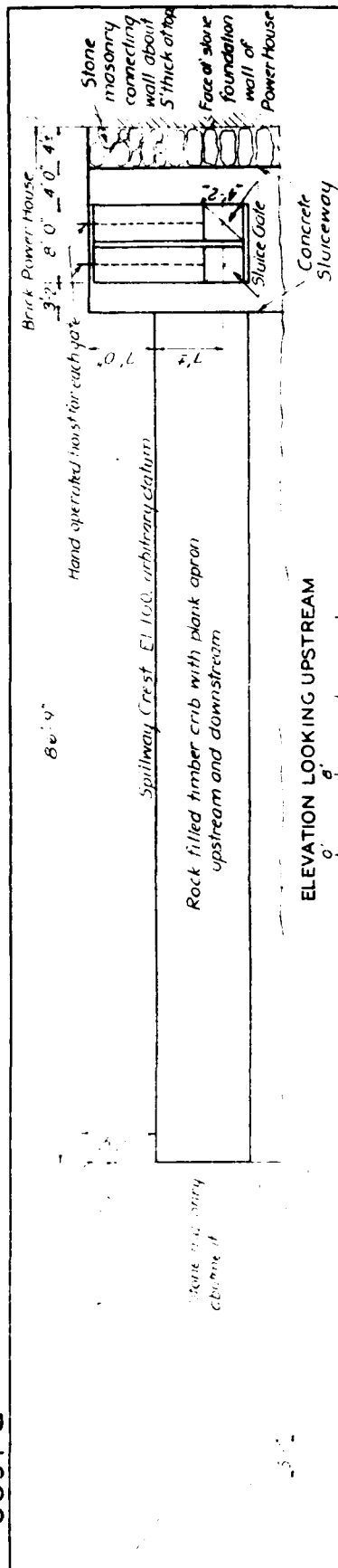
CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Visible reinforcing Gate House Sluice gate operating mechanisms Sluice gates Wood deck platform Protective metal railing Access ladder Forebay entrance	PR	None noted Good condition Good condition Not accessible Good condition Poor condition Poor condition Accumulated debris
<u>ABANDONED POWER STATION</u>		A derelict structure
<u>TAILRACE</u>		
Dry stone masonry walls		Good condition
Concrete capped wall	PR	Undermined. Stones displaced.

APPENDIX B
ENGINEERING DATA



-6691-D



NEW ENGLAND POWER
ENGINEERING & SERVICE CORPORATION
100 STATE STREET, SUITE 200
BOSTON, MASSACHUSETTS 02109
TELEPHONE: 617-552-1100
FAX: 617-552-1101
E-MAIL: NEWENGLAND@AOL.COM

UPATONCO ELECTRIC LIGHT & POWER CO.
MASSACHUSETTS PLANT #2

LONGITUDINAL ELEVATION & SECTION OF DAM

SECTION OF DAM LOOKING NORTH - SPILLWAY LENGTH 80'-9"

NEW HAMPSHIRE WATER RESOURCES BOARD

QUESTIONNAIRE

WATER POWER DEVELOPMENTS IN NEW HAMPSHIRE

Electric
Granite State ~~Co~~
Lebanon, N. H.

Gentlemen:

We maintain in this office a list of the water power installations in New Hampshire and are frequently receiving inquiries concerning these installations. We are, therefore, bringing this information up to date, and request your cooperation by filling in the questionnaire below with data on your development and return it to us in the enclosed stamped envelope.

If the ownership has changed, will you please forward this questionnaire to the present owners.

Very truly yours,

Hester G. White
Acting Chairman

Dam No. 134. 11 Location Lebanon, Brook
River at Musserma

1. Will you please check or correct:

Plant No. 2.

	Our Data	Your Corrections
Head - feet	17	16
Capacity		
Wheel - H.P.	300	279
Generator - K.W.	224	

2. Is the power plant in operation? Yes
3. If not, is the equipment in operable condition?
4. Is the dam in good repair? Yes

Signed: *W. B. B. B.*
Pres

Date 2-2-48

Capt. Bowen
State Planning & Development Commission
Concord, N. H.

Dear Capt. Bowen:

At our Precinct meeting recently here in Lebanon someone made a motion that a Committee be appointed to have the Federal Govt. look into the condition of Mascoma Dam here as this dam had caused them to lose a lot of sleep during the recent Flood.

You are no doubt familiar with such meetings and the motion carried and they appointed two Water Commissioners Harry Hanson and myself and another Mr. Edgar Moore to serve on this Committee. I bucked the thing to no avail, the people were aroused and would not listen to keeping the Federal people out of it.

From the enclosed article I note that there are several Army Engineers in Concord and I thought that if you would place this letter in the hands of the right parties perhaps these Engineers would come up and look over the Dam and make recommendations which we could turn in in our Report.

The Dam, as I understand it, belongs to N.E.P.A. as they control the Mascoma River Improvement Co. and the Conn. Conservation Co. If it is not too much trouble I wish you could pass this along or advise whether it is purely a State Function as I assumed it was in the Precinct Meeting.

Cordially yours,

E. R. Garrett.
20 Shaw Street. Lebanon. N.H.

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION

STATE NO. 134.11

Town Lebanon : County Sullivan
Stream Mascoma R.
Basin-Primary Connecticut : Secondary Mascoma R.
Local Name Plant #2
Coordinates—Lat. 43° 40' - 11300 : Long. 72° 20' - 10000

GENERAL DATA

Drainage area: Controlled.....Sq. Mi.: Uncontrolled.....Sq. Mi.: Total.....194.....Sq. Mi.
Overall length of dam.....120.....ft.: Date of Construction.....1895- rebuilt 1934
Height: Stream bed to highest elev.....22.5.....ft.: Max. Structure.....14.85.....ft.
Cost—Dam.....: Reservoir.....

DESCRIPTION

Waste Gates

Type.....
Number.....2.....: Size.....4.5.....ft. high x.....3.67.....ft. wide
Elevation Invert.....8.....: Total Area.....sq. ft.
Hoist.....

Waste Gates Conduit

Number.....: Materials.....
Size.....ft.: Length.....ft.: Area.....sq. ft.

Embankment

Type.....
Height—Max. ft.: Min. ft.
Top—Width: Elev. ft.
Slopes—Upstream on: Downstream on
Length—Right of Spillway: Left of Spillway

Spillway

Materials of Construction.....
Length—Total.....9.....ft.: Net.....ft.
Height of permanent section—Max. 14.85.....ft.: Min. 14.....ft.
Flashboards—Type.....: Height.....2.5.....ft.
Elevation—Permanent Crest.....458.8.....U.S.G.S.....: Top of Flashboard.....
Flood Capacity.....7465.....cfs.:.....42.8.....cfs/sq. mi.

Abutments

Materials:.....
Freeboard: Max. 7.67.....ft.: Min. ft.

Headworks to Power Devel.—(See "Data on Power Development")

OWNER Granite State Electric Co.
Power for Public Utility

REMARKS

Tabulation By A.A.N. & R.L.T. Date Jan. 3, 1939

NEW HAMPSHIRE WATER CONTROL COMMISSION DATA ON WATER POWER DEVELOPMENTS IN NEW HAMPSHIRE

LOCATION

AT DAM NO. 134.11

Town Lebanon : County Sullivan
Stream Mascoma R.
Basin-Primary Connecticut : Secondary Mascoma
Local Name

GENERAL DATA

Head-Max. 17 ft. : Min. : Ave. ft.
Date of Construction : Use of Power
Pondage ac. ft. : Storage ac. ft.

DESCRIPTION

Racks

Size of Rack Opening
Size of Bar : Material
Area: Gross Sq. Ft.: Net sq. ft.

Head Gates

Type
Number : Size ft. high x ft. wide
Elevation of Invert : Total Area sq. ft.
Hoist

Penstock

Number : Material
Size : Length

Turbines

Number 1 : Makers 33" Rodney Hunt Horizontal
Rating HP. per unit 300 : Total Capacity HP.
Max. Dement C.F.S., per unit : Total 300 cfs

Drive

Type

Generator

Number 1
Make G E- 2300 V 70 A- 164 R P H
Rating KW., per unit 224 ; Total Capacity K. W.

Exciter

Number : Make
Rating-per unit : Total Capacity K. W.

OUTPUT—KWHRS

19.....	19.....
19.....	19.....
19.....	19.....
19.....	19.....
19.....	19.....

OWNER Granite State Electric Co.

Tabulation By A. A. N & R. L. T. Date Jan. 3, 1939

WATER CONTROL COMMISSION

Rec'd 11/9/38

Jacobson		
Holmgren	✓	✓
Salman	✓	
Return to		
Filed		
File No.		

STATE OF NEW HAMPSHIRE

Concord, New Hampshire

October 14, 1938.

#2 STATION

Granite State Elec Co.,
Lebanon N H

RE: Granite State Dam. W. C. C. No. 134.11

Gentlemen:

In order that we may determine the magnitude and extent of the flood of September 21-24 just passed, we are requesting the various dam owners in the State to supply us with the following information:

1. Was this dam injured? Ans. NO
2. If so, to what extent? Ans. -
3. Did all flashboards go out? Ans. YES
4. What was the maximum height of water over the permanent crest of spillway? Ans. 7 FT.
5. At what day and hour did the maximum flood height reach your dam? Ans. APPROX. 11 P.M., SEPT. 21

6. Any other interesting information regarding the flood or rain fall may be given on the back of this sheet, or attach sheets.

Will you please return this letter with as much information as you can give us as promptly as possible. A self-addressed envelope is attached hereto.

We thank you for your cooperation.

Very truly yours,

Richard S. Holmgren

Richard S. Holmgren
Chief Engineer

CDC:GMB
Enc.

7919

TOWN NO. 11 TOWN Lebanon, N. H. NO. 45 PAGE NO. 3
 NAME OF COMPANY Grafton County Electric Lt. & Pr. Co.
 HOME ADDRESS White River Jct. Vt.
 DRAINAGE AREA 195 sq. mi. HEAD 16 ft.
 RIVER Mascoma RATE SEC. FT. PER SQ. MI. 90% TIME 0.7

RESOURCES

FOR CENTRAL STATIONS		FOR ISOLATED INDUSTRIAL PLANTS
WHEEL CAP. H. P.	PRIMARY H. P. 90% TIME	WHEEL CAP. H. P.
270	198.52	PRIMARY H. P. 90% TIME

USES

FOR CENTRAL STATIONS		FOR ISOLATED INDUSTRIAL PLANTS
K. V. A. CAPACITY	ANNUAL KW. H. OUTPUT	K. V. A. CAPACITY
200		ANNUAL KW. H. PROD. AND CONS. MECH.

Granite State Elec. Co. Lebanon. 9/7/37 134.11
Dam #2

photos 445

Above Btmt.
Highway Bridge

Types..b
Timbers spaced

Stone
Wall

Stone
Wall

9' spill
flash boards
2.5'

10x10
Timbers

Apron

Waste gate
wheel
operate

Plan

Rods spaced @ 3'

30" flash.

2 1/2'

6'

8.5'

12'

Timber
crib

4" oak - 2x6

Section

8 1/2'

2.5' crest

LOOKING UP STREAM

Apron

7' 9"

4' 4"

4' 4"

4' 4"

4' 4"

GATE SILL

Elevation

photo

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Connecticut NO. 4-H 134.11 1890SCS
 RIVER Mascamun MILES FROM MOUTH 2.2 D.A.SQ. MI 192 193
 TOWN Lobanow OWNER Grafton Co. Elec. Light & Power
 LOCAL NAME OF DAM Plant #2 Little Embury Power Plant Granite State
 BUILT 1895 DESCRIPTION Timber Crib - stone abutment right Elec Co.
concrete abutment left, foundation ledge at left end boulders
+ gravel rest of way
 POND AREA-ACRES 43 DRAWDOWN FT. 12.27.5 POND CAPACITY-ACRE FT. MAX.
 HEIGHT-TOP TO BED OF STREAM-FT. 12.27.5 MAX. MIN.
 OVERALL LENGTH OF DAM-FT. 100-120 MAX. FLOOD HEIGHT ABOVE CREST-FT. MAX.
 PERMANENT CREST ELEV. U.S.G.S. 438.6 LOCAL GAGE MAX.
 TAILWATER ELEV. U.S.G.S. 424.2 LOCAL GAGE MAX.
 SPILLWAY LENGTHS-FT. 56-75 FREEBOARD-FT. 8.5 ft 767 left
 FLASHBOARDS-TYPE, HEIGHT ABOVE CREST 1-6 2.5
 WASTE GATES-NO. 2 WIDTH 3.67 MAX. OPENING 4.5 DEPTH SILL BELOW CREST 8

REMARKS Condition Fair
26

POWER DEVELOPMENT

UNITS	NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE
			<u>11.2</u>	<u>AE</u>		
		<u>270</u>	<u>16</u>	<u>pse</u>		
		<u>230</u>	<u>15</u>	<u>WGS</u>		
	<u>1</u>	<u>300</u>	<u>17</u>		<u>224</u>	<u>33" Rodney Hunt Horiz</u> <u>GE. 2300V 70AMP 164RPM</u>

USE Hydro Electric Power for Public Utility

REMARKS Primary to 90% of time 1925
Information from station attendant. Verified by S.I. Tupper
Sept. 2-60" steel tubes to turbine. May be twin. Concrete wall
separates tail race from dam overflow.

DATE 1922 pse 1921 AE

9/7/27 H & JAS.

134.

NEW ENGLAND POWER ENGINEERING & SERVICE CORPORATION

Part of New England Power Association



89 Broad Street
Boston, Massachusetts

June 22, 1934

RECEIVED

JUN 23 1934

N. H. Public Service Commission

S. J. Lord, Engineer
New Hampshire Public Service Commission
Concord, New Hampshire

Dear Mr. Lord:

In view of Mr. Pierce's conversation with you yesterday concerning Mascoma Dam #2, the following information concerning the present condition of that structure may be of interest.

It would seem that no plans of the structure are available but the power plant was built about 1895 and it is probable that the present dam was built at the same time.

This dam is a rock filled timber crib structure about 13 feet high to the crest. Above this crest 18" of flashboards are carried. This height was determined by measurements on the downstream side. The flat crest is about 2-1/2 feet wide. The upstream apron slope is 3.5 horizontal to 2.5 vertical. We do not know whether this slope extends to the bottom of the upstream side of the dam or whether it is met by a vertical face. Mr. Benjes was of the opinion that the slope continued to the bottom of the dam. On the downstream side a section of apron 16' 10" long measured on the slope extends down on a slope of about 3.5 horizontal to 2 vertical to a horizontal deck or apron section about 6' wide.

The crest length is 86' 9". At the north end of the dam there is a heavy rubble masonry abutment wall. The stones in this wall are fairly large and are laid in cement mortar. The top of the wall is about 7' 9" above the crest of the dam and it extends upstream a distance of about 45' from the downstream side of the crest. It also extends downstream to about the toe of the dam. The top of the downstream end of this wall is stepped at irregular steps.

At the south end the dam abuts against a concrete wall which separates the dam from the sluice in which the waste gates are set.

About 25% of the sloping part of the downstream apron has been carried away and 50% or more of the horizontal part of the apron and its supporting crib have also been carried away. Very little of the rock fill except that which may have been in cribwork under the horizontal deck has been carried out. The longitudinal timbers or stringers which supported the deck are broken in places and are worn and decayed. Some of the ends of the headers which are made of round timbers are also worn and decayed, although many of the larger ones are still in pretty fair shape.

S. J. Lord

- 2 -

June 22, 1934

The middle of the crest of the dam has settled about 8 or 10 inches below the ends. This may be due to foundation conditions. The south end of the dam is probably founded on a rock ledge as there appeared to be a fair sized outcrop of ledge on the downstream side of the south end. The remainder of the dam is probably founded on the original boulder strewn bed of the stream.

There is some leakage appearing along the entire length of the dam of an estimated amount of not over 5 cu. ft. per second. It is said that the upstream apron has been patched from time to time and that cinders have been dumped on the upstream deck to prevent leakage.

In repairing, it is proposed to remove as much as possible of the cinder fill from the upper apron, replace faulty deck plank with new plank and in places where there are small cracks or leaky knots patches would be placed over them. The upstream apron would then be reloaded with selected material. The crest and downstream apron, including the string pieces would be removed and replaced with new material. The new string pieces under the crest would be blocked up so that the crest will be level and as near as possible at the original grade. It will probably also be necessary to put in some new short headers on the downstream side in order to provide a suitable bearing surface and proper anchor for the string pieces. The crib under the flat part of the downstream apron would be largely rebuilt and loaded with rock. In raising the crest elevation at the center of the dam, it will be necessary to change the slope of the upper and lower aprons to some extent as the flat part of the crest should be not less than 2.5' wide to provide space for the flashboards and braces.

The mortar in the joints in the masonry abutment from an elevation of 3 or 4' above the crest of the dam to below the water surface has been eroded. During the general repair work these joints may be raked out and filled with mortar. No leaks in this wall or signs of settlement were apparent this spring.

At the south end of the dam at the bottom of the training wall and at a point 10 or 15' below the lower end of the dam, there is a hole a foot or more deep, several feet long and two or more feet wide. This hole will be filled with concrete during the general repair work.

Several pictures and a rough sketch are attached to enable you to follow the points brought up in this letter.

Very truly yours

NEW ENGLAND POWER ENGINEERING & SERVICE CORPORATION

C. R. Bliss
C. R. Bliss
Designing Engineer



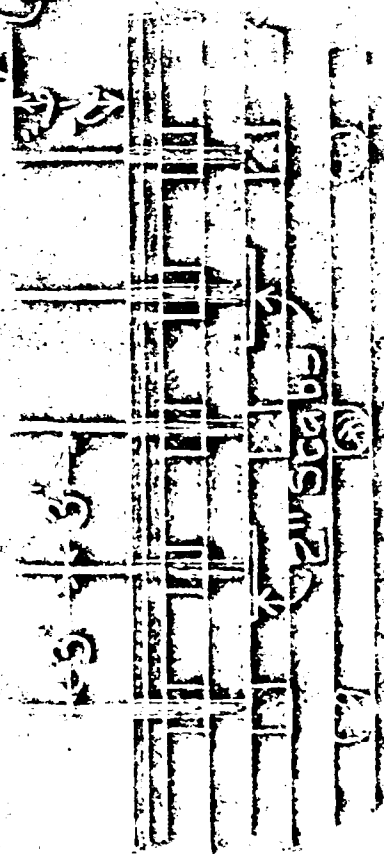
31-6" x 6" Pipe 5-0' long

31-3" x 6" Pipe 2-6' long

ORIGINAL



TRANS SECTION



LONG SECTION

Elev top of Flashboard same as at Base

MASSON DAM NO 2 REPAIRS

Co.

No. 13411

CALCULATION SHEET

Date 8-10-34

Refers to 1-3463

Made By H

H

Mr. Belin telephoned from Lab, that
to lower the crest the fuel 12" would cut
it inches from the 12x12 timbers.
Wanted to know if there could raise
crest to obtain cutting. I told him
Q1 - but lower all possible.

CALCULATION SHEET

Refers to 1-3463

Date 6-29-34
Made By L

T-II

A

B

C

$$Q = \left(.405 + \frac{.00984}{H} \right) \left(1 + .55 \frac{H^2}{(p+H)^2} \right) L H \sqrt{2gH} \quad H = 7.$$

$$.405 + \frac{.00984}{7} = .4064 = A$$

$$\sqrt{2gH} = \sqrt{450.2} = 21.23$$

$$LH = 85.36 \times 7 = 597.45$$

$$b = 86.75 - 1.4 = 85.35$$

$$1 + .55 H^2 = 3.96$$

B

$$b \times \sqrt{2gH} = 85.35 \times 21.23$$

$$"a" (p+H)^2$$

$$H^2 = 49$$

$$"d"$$

$$B \times A =$$

$$= 12683.82 = C$$

$$p = p+H = (p+H)^2$$

$$.55 H^2 =$$

$$"c"$$

$$"D" \times C = \text{discharge}$$

1	8	64	26.95	1.421	.5774	7323.66
2	9	81	"	1.296	.5266	6679.32
3	10	100	"	1.269	.5157	6541.06
4	11	121	"	1.222	.4966	6298.80
5	12	144	"	1.187	.4823	6117.42
6	13	169	"	1.159	.4710	5979.09
7	14	196	"	1.137	.4620	5859.94
8	15	225	"	1.119	.4547	5737.35

Broad Chute 4173.61

Notes

Sharp " " 5263.53

p. Inflow as 4, then discharge 1.

The discharge = 6298.8

gals. 770.22

Total Discharge = 7069.02 cfs

Whichever allows 29.21 cfs

(2) 242 cfs from Reservoir

The Total Discharge = 195 cfs

$$= 29.2$$

$$16.58$$

$$A = 4 \times 4.16 = 16.64$$

$$Q = A V = 16.64 \times 28.03 = 481.39$$

$$C = 8$$

$$Q = C A V = 385.11$$

$$770.22 \text{ cfs}$$

Vancomas Lake must regulate the floods.

Q. when p = 4 & H = 9

Co. _____

CALCULATION SHEET

No. 157.11

Refers to 1-3463

Date 6-29-34

Made By R

 $D =$ when p is taken as 4 + $H = 9$

Table IV $111.13 \times .97 = 107.79 \times 85.35 = 10053.21$
 770
 10823

This just about covers for

The area up to Mureaux Lake,

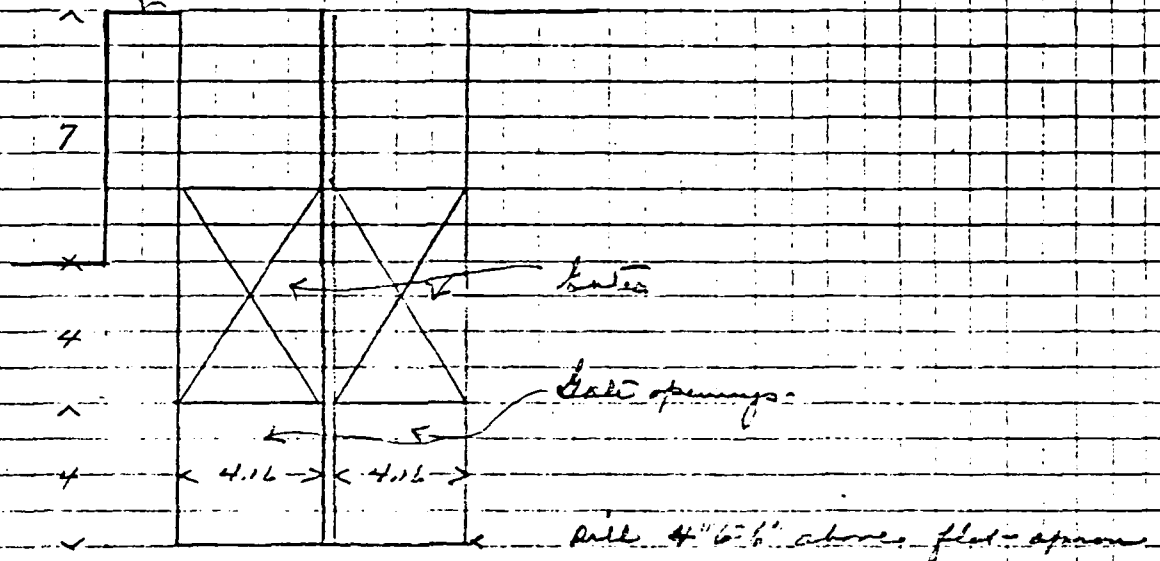
most 9" all rising 78' - leaving crest - 2'

Co. _____

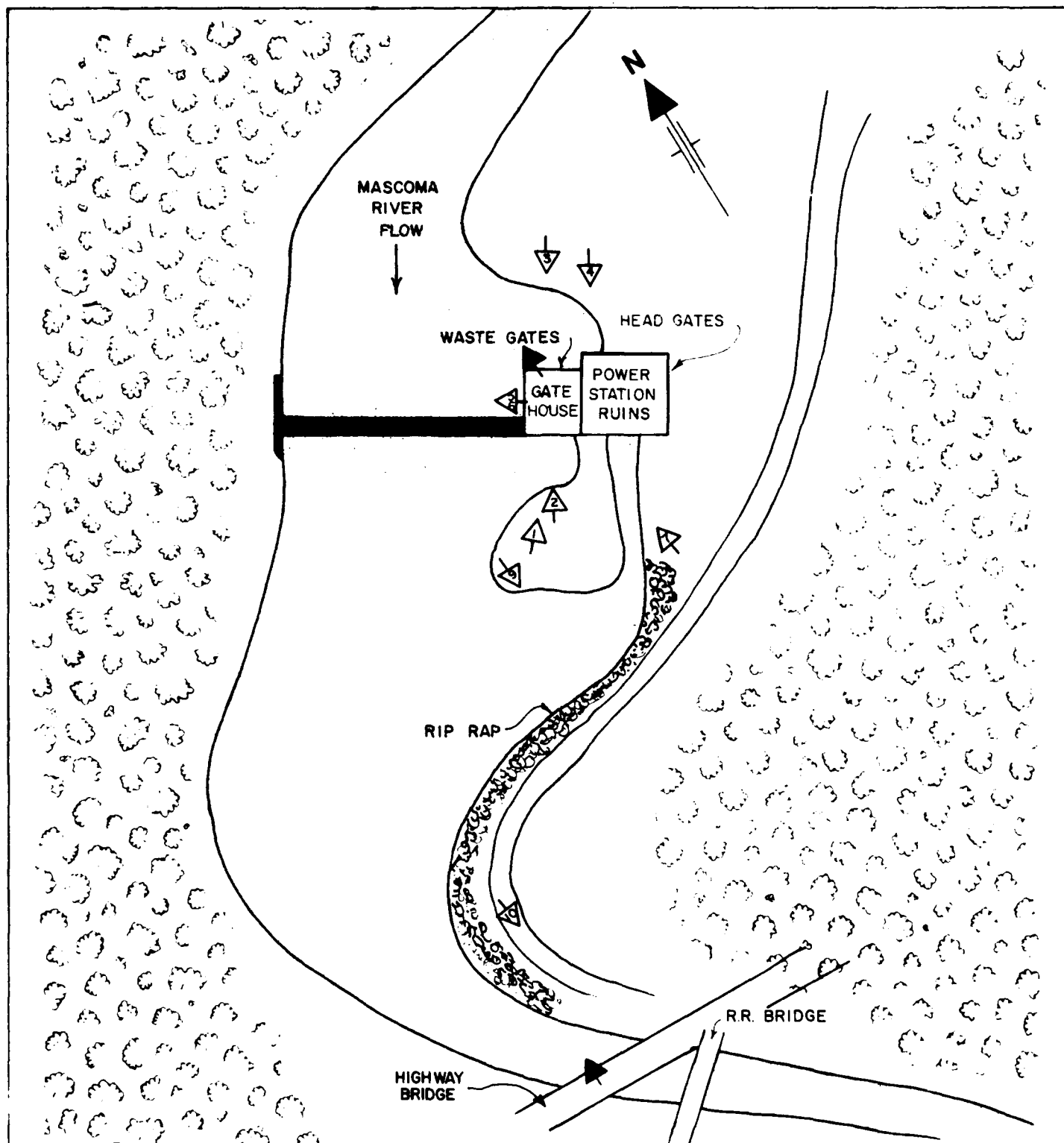
CALCULATION SHEET

No. 134.1
Date 6-29-34
Made By KRefers to 1-3463
12028

From Survey 7m 12 lines for information
(South 81-)



APPENDIX C
PHOTOGRAPHS



GOLDBERG ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

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

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND ORIENTATION OF PHOTOS

MASCOMA DAM No. 2

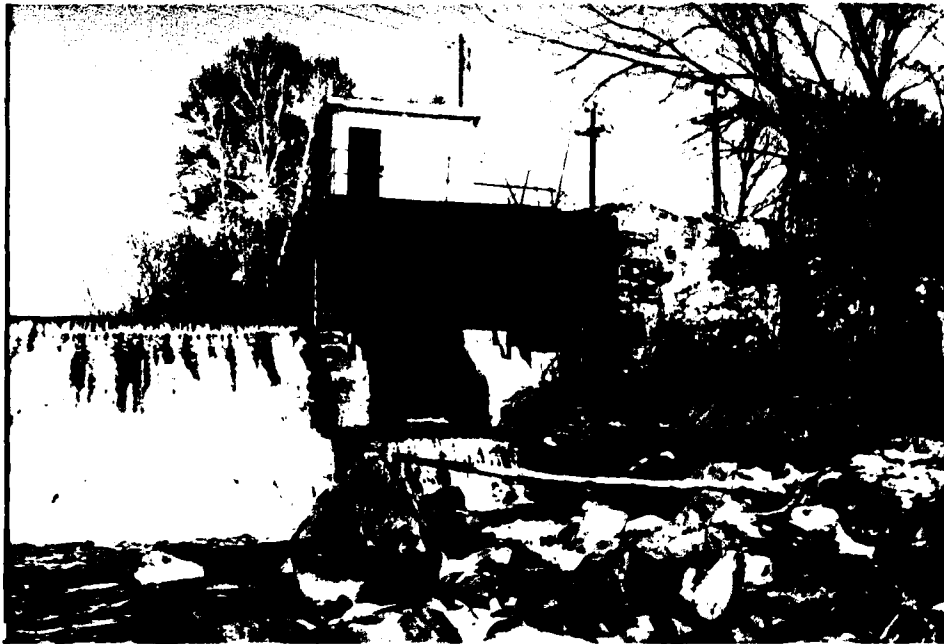
LEBANON, NEW HAMPSHIRE

SCALE 1" = 50' (APPROXIMATE)

DATE JUNE 1980

FILE No 2605

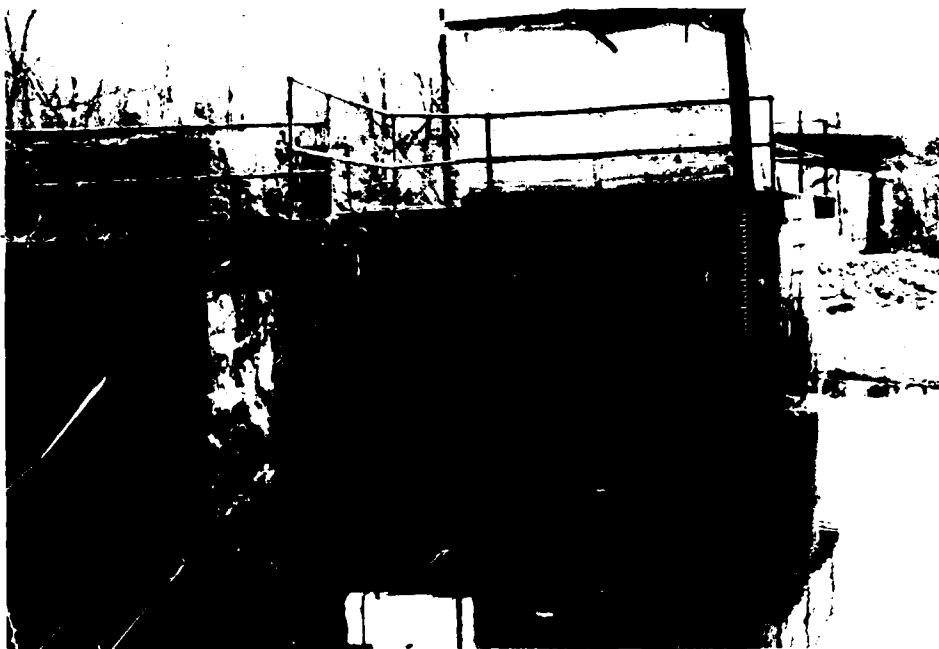
- OVERVIEW PHOTO
- △ APPENDIX C PHOTO



1. Gate House Structure from Downstream Side



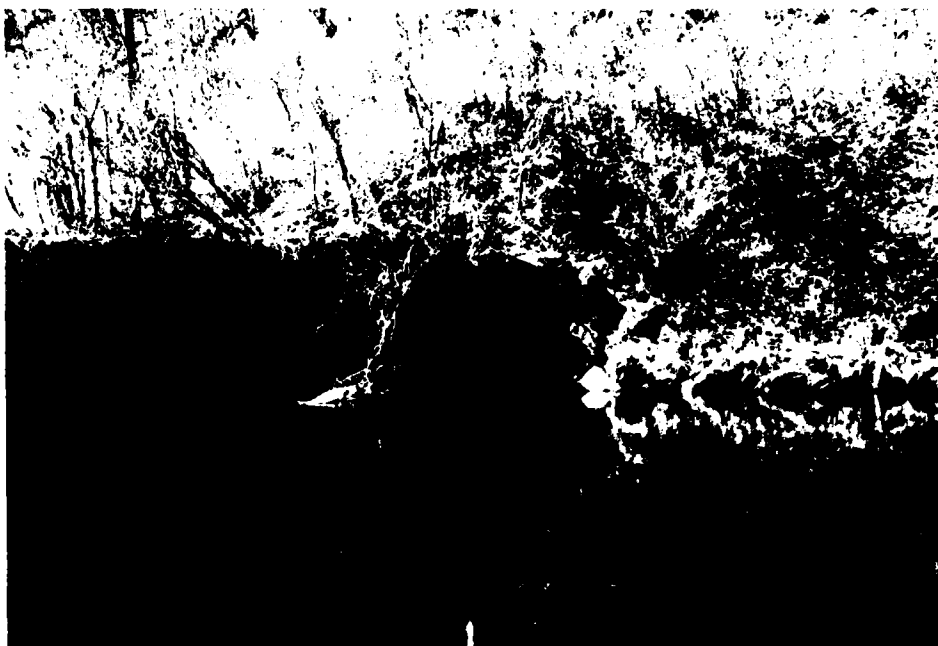
2. Downstream View of Waste Gates



3. Upstream View of Waste Gate Inlet Showing Accumulation of Debris



4. Upstream End of Power Plant Intake
This Intake Has Been Plugged With Earth



5. Upstream End of Right End Wall



6. Downstream End of Right End Wall



7. View of Tailrace and Power Plant Ruins



8. Upstream Reservoir Area



9. Downstream Channel



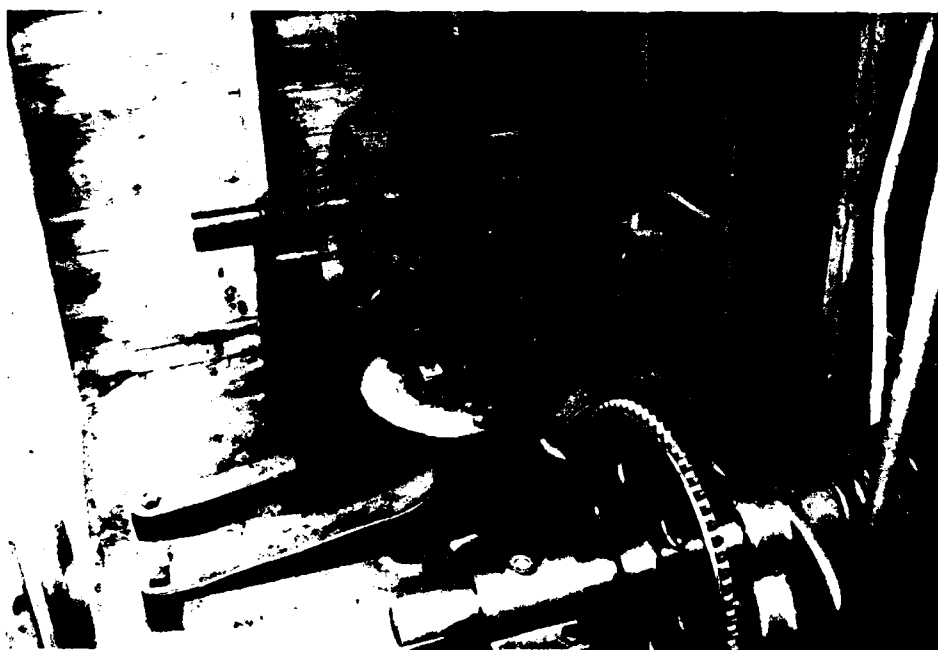
10. View Showing Relative Positions of Highway
and Railroad Bridges



11. Timber Facing on Downstream Side



12. Deterioration of Timber Cribbing



13. Waste Gate Operating Mechanism

APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MASCOMA DAM NO. 2

RHF
6/2/80Dam Rating Curve

A schematic sketch of the overflow section of this dam is shown on the next page. This sketch is based on the N.H.W.R.B. inventory (1937), N.E. Power & Service Corp. "Longitudinal Elevation & Cross Section of Dam" (1934), and recent field inspection. The dimensions may not be exact.

Spillway Discharge

$$Q_1 = C L H^{1.5}$$

$$C = 3.3$$

$$L = 86.8$$

$$H = \text{head on spillway crest (datum elev. 458.8 MSL)}$$

$$Q_1 = 3.3 \times 86.8 \times H^{1.5}$$

Abutment Overflow

$$Q_2 = Q_{\text{left abutment}} + Q_{\text{left side-slope}} + Q_{\text{right side-slope}}$$

Left Abutment

$$C = 3.1$$

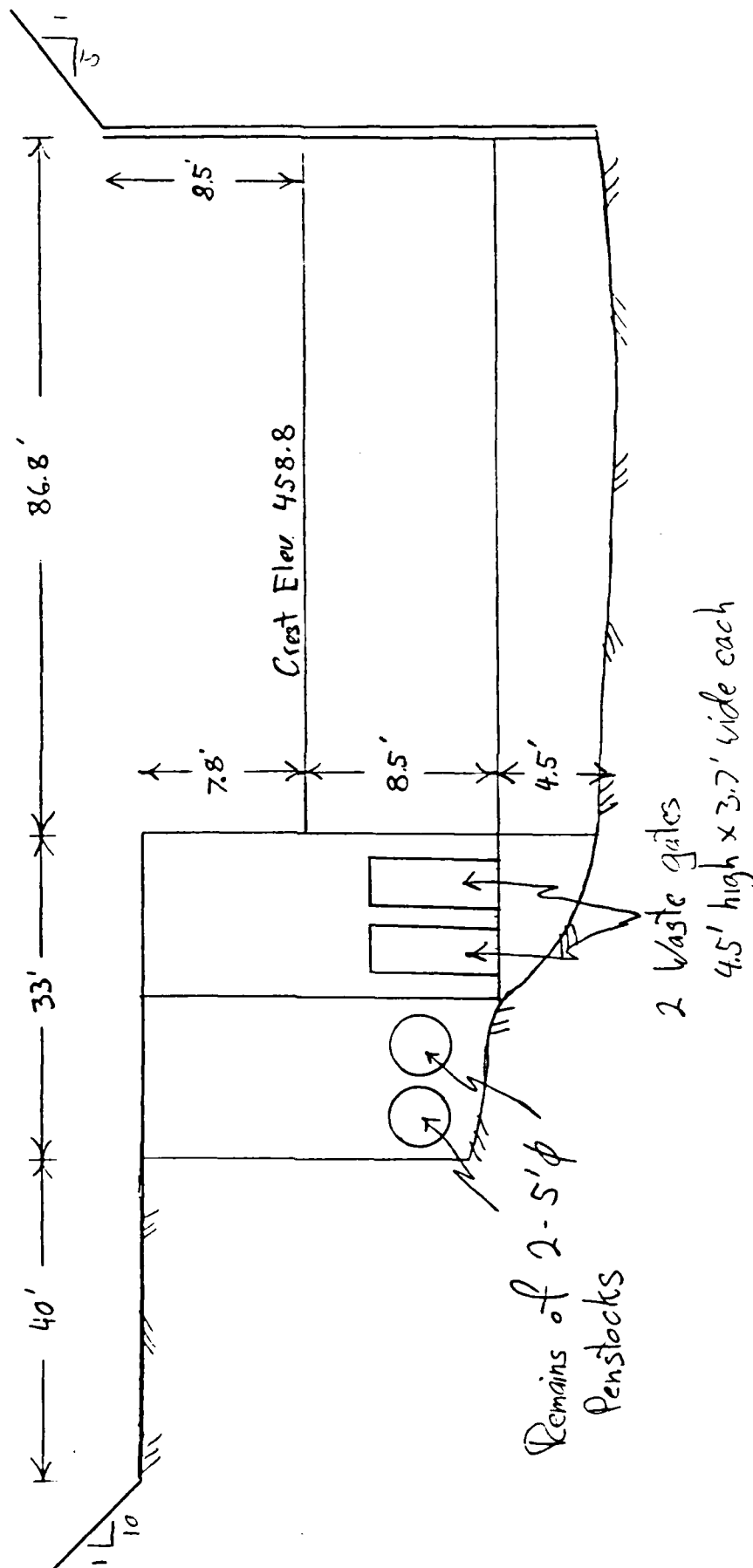
$$L = 73'$$

$$\text{head} = H - 7.8'$$

$$Q = 3.1 \times 73 \times (H - 7.8)^{1.5}$$



SCHEMATIC of MASCAMA DAM NO. 2 Not To Scale



MASCOMA DAM NO. 2

RHF
6/2/80

Left Side-Slope

$$C = 2.8$$

$$L = 10 \times (H - 7.8)$$

$$\text{head} = 0.5 \times (H - 7.8)$$

$$Q = 2.8 \times (10 \times (H - 7.8)) \times (0.5 \times (H - 7.8))^{1.5}$$

Right Side-Slope

$$C = 2.8$$

$$L = 5 \times (H - 8.5)$$

$$\text{head} = 0.5 \times (H - 8.5)$$

$$Q = 2.8 \times (5 \times (H - 8.5)) \times (0.5 \times (H - 8.5))^{1.5}$$

Total Abutment Overflow

$$\begin{aligned} Q_2 &= 3.1 \times 73 \times (H - 7.8)^{1.5} + 2.8 \times (10 \times (H - 7.8)) \\ &\quad \times (0.5 \times (H - 7.8))^{1.5} + 2.8 \times (5 \times (H - 8.5)) \\ &\quad \times (0.5 \times (H - 8.5))^{1.5} \end{aligned}$$

Waste Gates and Penstock Intake

$$Q_3 = 0$$

Although one gate was open at time of inspection, it was so blocked up with debris that outflow was negligible. Neither this gate nor the leaking penstock

MASCOMA DAM NO. 2

RHF
6/2/80

intake contribute materially to the dam's ability to pass flood flows safely.

A BASIC program was written to calculate the head-discharge function at the dam. A listing of this program is shown on the next page, followed by tabulated output and a plotted curve.

```

100 REM - HEAD-DISCHARGE CURVE FOR MASCOMA DAM NO. 2
110 REM - STORED ON TAPE 18 FILE 53
120 PAGE
130 PRINT USING 140,
140 IMAGE 20T"HEAD VS. DISCHARGE FOR MASCOMA DAM NO. 2"
150 PRINT USING 160,
160 IMAGE //12T"HEAD" 35T"DISCHARGE"
170 PRINT USING 180,
180 IMAGE 11T"(FEET)" 37T"(CFS)"
190 PRINT USING 200:
200 IMAGE 23T"TOTAL      SPILLWAY  ABUTMENTS  GATES"
210 PRINT " "
220 FOR H=0 TO 12 STEP 0.5
230 01=3.3*86.8*H↑1.5
240 02=0
250 03=0
260 IF H<7.8 THEN 310
270 02=3.1*73*(H-7.8)↑1.5
280 02=02+2.8*(10*(H-7.8))*(0.5*(H-7.8))↑1.5
290 IF H<8.5 THEN 310
300 02=02+2.8*(5*(H-8.5))*(0.5*(H-8.5))↑1.5
310 T1=01+02+03
320 PRINT USING 330:H,T1,01,02,03
330 IMAGE 12T,20.10, 120,120,100,100
340 NEXT H
350 END

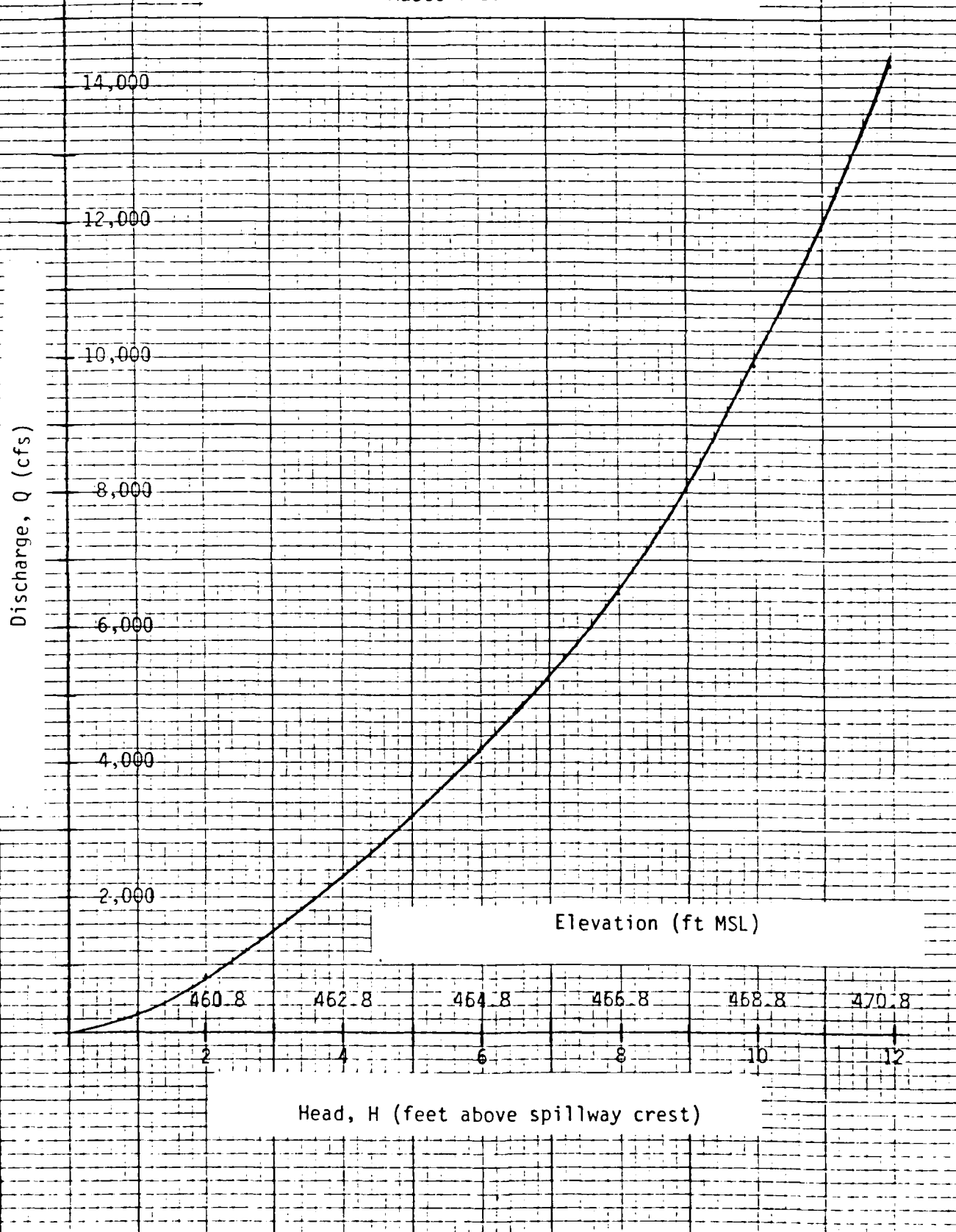
```

HEAD VS. DISCHARGE FOR MASCOMA DAM NO. 2

HEAD (FEET)	TOTAL	DISCHARGE (CFS)	ABUTMENTS	GATES
0.0	0	0	0	0
0.5	101	101	0	0
1.0	286	286	0	0
1.5	526	526	0	0
2.0	810	810	0	0
2.5	1132	1132	0	0
3.0	1488	1488	0	0
3.5	1876	1876	0	0
4.0	2292	2292	0	0
4.5	2734	2734	0	0
5.0	3202	3202	0	0
5.5	3695	3695	0	0
6.0	4210	4210	0	0
6.5	4747	4747	0	0
7.0	5305	5305	0	0
7.5	5883	5883	0	0
8.0	6502	6481	20	0
8.5	7235	7098	137	0
9.0	8048	7734	314	0
9.5	8931	8387	544	0
10.0	9881	9058	823	0
10.5	10896	9746	1151	0
11.0	11976	10450	1526	0
11.5	13119	11171	1948	0
12.0	14326	11907	2419	0

PIETZEN CORPORATION
PAPER
10 X 10 PER INCH

HEAD-DISCHARGE CURVE Mascoma Dam



MASCOMA DAM NO. 2

RHF
6/2/80

Dam Failure Analysis

Assume that the dam fails with the pool at the level of the top of the left abutment.

7.8' above the spillway crest and
20.8' above the streambed

Normal Outflow at Failure

$Q = \underline{6240}$ cfs (from Dam Rating, $H = 7.8$)

Tailwater Level at Failure

Estimate using FIS discharges and profiles at the dam.

T.W. 9.3' below spillway crest with $Q = 5900$

T.W. 8' below spillway crest with $Q = 7000$

Use T.W. level = 8.9' below spillway crest or 16.7' below headwater level.

Breach Outflow

$$Q_{p1} = 8/27 \times W_b \times \sqrt{g} \times Y_o^{3/2}$$

$W_b \leq$ width of breach

$\leq 0.4 \times$ (width of dam at 1/2 height)

$\leq 0.4 \times 120$

MASCOMA DAM NO. 2

RHF
6/2/80Use $W_b = 48'$ $Y_o = \text{pool elev.} - \text{T.W. Elev.} = 16.7'$

$$Q_{p1} = 8/27 \times 48 \times \sqrt{g} \times 16.7^{3/2} = \underline{5507} \text{ cfs}$$

Total Outflow

$$Q_{\text{tot}} = 6240 + 5510 = \underline{11750} \text{ cfs}$$

Volume Impounded by Dam (from COE inventory)

$$\text{Vol} = \underline{400} \text{ acre-ft.}$$

Downstream Flooding

Approx. 300' downstream of the dam the B&M railroad crosses the river on a bridge with low chord about 7' above normal water surface and 10' above streambed (minimum water depth provided by small weir just downstream of the bridge).

From FIS profile, $Q = 10000$ cfs causes water to impinge on bridge ~ 2' above low chord.

Extrapolate, water surface 3'-4' above low chord with $Q = 11,750$ cfs.

MASCOMA DAM NO. 2

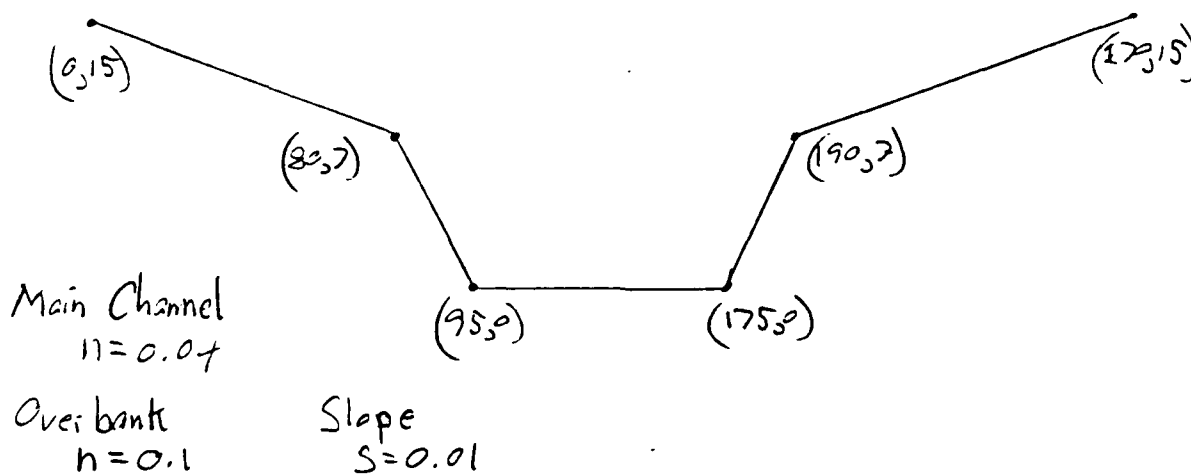
RHF
6/2/80

Just beyond the bridge is a sewage pump station at a level
~ 1' below the bridge low chord. The pump station will sustain
flooding 4'-5' deep.

Estimate Peak Dam Break Flow at Glen Road Dam ~ 0.7 mile
Downstream of the Dam

Follow (essentially) COE "Rule of Thumb Guidance for Estimating
Downstream Dam Failure Hydrographs."

A uniform flow rating table for this reach based on the approxi-
mate section sketched below is shown on the next page. This was
calculated using a simple BASIC program.



Mascoma R. d/s of Mascoma Dam No. 2

The calculated rating table agrees reasonably with the FIS profiles
for this reach.

===== DATA FOR THE COMBINED SYSTEM =====

DEPTH f1.	ELEV f1.	AREA f1f2	WPER f1.	HYD-R f1.	AR2/3	O cfs
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	82.1	84.7	1.0	80.5	239.8
2.00	2.0	168.6	89.5	1.9	257.2	766.4
3.00	3.0	259.3	94.2	2.8	509.3	1517.7
4.00	4.0	354.3	98.9	3.6	829.4	2471.6
5.00	5.0	453.6	103.6	4.4	1213.5	3616.4
6.00	6.0	557.1	108.4	5.1	1659.5	4945.7
7.00	7.0	665.0	113.1	5.9	2166.3	6455.9
8.00	8.0	785.0	133.2	5.9	2561.2	8341.5
9.00	9.0	925.0	153.3	6.0	3065.7	10454.5
10.00	10.0	1085.0	173.4	6.3	3684.2	12811.7
11.00	11.0	1265.0	193.5	6.5	4422.7	15427.0
12.00	12.0	1465.0	213.6	6.9	5288.4	18312.6
13.00	13.0	1685.0	233.7	7.2	6288.7	21480.4
14.00	14.0	1925.0	253.8	7.6	7431.1	24941.4
15.00	15.0	2185.0	273.9	8.0	8723.5	28706.5

MASCOMA DAM NO. 2

RHF
6/2/80

Storage in Reach vs. Outflow

Assume channel storage of the flood wave equal to the reach length times the average of the upstream flow area minus normal (pre-failure) flow area and the downstream flow area minus normal flow area.

$$Vol = \left(\left(\frac{A_1 + A_2}{2} \right) - A_{norm} \right) \times L / 43560$$

where:

$$A_1 = 1010^{ft^2} \text{ (upstream flow area from stream rating w/Q = 11750)}$$

$$A_2 = f(Q_2) \text{ (downstream flow area from stream rating)}$$

$$A_{norm} = 650^{ft^2} \text{ (normal flow area, Q = 6240)}$$

$$L = 0.7 \times 5280 = 3700' \text{ (length of reach)}$$

The flood wave peak outflow from the reach is equal to the total peak outflow minus the normal flow.

$$Q_{p2} = Q_2 - Q_{normal} \text{ (downstream flood wave peak discharge)}$$

$$Q_2 = \text{total downstream peak discharge}$$

$$Q_{normal} = 6240 \text{ (normal discharge)}$$

MASCOMA DAM NO. 2

RHF
6/2/80

Channel Storage vs. Downstream Discharge Table (computed from the relationships outlined above)

$\underline{Q_2}$	$\underline{D_2}$	$\underline{A_2}$	$\underline{Vol}$	$\underline{Q_{p2}}$
6456	7	665	15.9	216
8342	8	785	21.0	2100
10455	9	925	27.0	4215
11750	9.5	1010	30.6	5510

Attenuated Peak Outflow from Reach

$$Q_{p2} = Q_{p1} \left(1 - \frac{Vol}{S} \right)$$

$$Q_{p2} = Q_2 - Q_{normal} \text{ (flood wave outflow)}$$

$$Q_{p1} = Q_1 - Q_{normal} = 11750 - 6240 = 5510 \text{ cfs}$$

$$S = 400 \text{ AF (storage behind dam)}$$

$$Q_{p2} = 5510 \left(1 - \frac{Vol}{400} \right)$$

Volume Required for Attenuation

$$Vol = 400 \left(1 - \frac{Q_{p2}}{5510} \right)$$

MASCOME DAM NO. 2

RHF
6/2/80

Trial and Error Solution of Q_{p2}

Storage in reach at correct value of Q_{p2} equals volume required for attenuation to that value.

Guess $Q_{p2} = 4215$ cfs

$$Vol = 400 \left(1 - \frac{4215}{5510}\right) = 94 \text{ AF}$$

Guess $Q_{p2} = 5000$

$$Vol = 37$$

$$Q_{p2} = \underline{5100}$$

$$Vol = 29.8 \quad \text{OK}$$

$$Q_2 = 6240 + 5100 = \underline{11340} \text{ cfs}$$

Estimate Peak Dam Break Flow 3000' Downstream of Glen Rd. Dam

Assume the same channel properties as for the preceding reach.

MASCOMA DAM NO. 2

RHF
 6/2/80

Storage in Reach vs. Outflow

$$Vol = \left(\left(\frac{A_1 + A_2}{2} \right) - A_{norm} \right) + L/43560$$

where:

$$A_1 = 985^{12}$$

$$A_2 = f(Q_2)$$

$$A_{norm} = 650^{12}$$

$$L = 3000'$$

<u>Q₂</u>	<u>D₂</u>	<u>A₂</u>	<u>Vol</u>	<u>Q_{p2}</u>
8342	8	785	16.2	2100
10455	9	925	21.0	4215
11340	9.4	985	23.1	5100

Attenuated Peak Outflow from Reach

$$Q_{p2} = 5100 \left(1 - \frac{Vol}{400} \right)$$

Volume Required for Attenuation

$$Vol = 400 \left(1 - \frac{Q_{p2}}{5100} \right)$$

MASCOMA DAM NO. 2

RHF

6/2/80

Trial & Error Solution of Q_{p2}

Guess $Q_{p2} = 4500$

$Vol = 47.1$

Guess $Q_{p2} = \underline{4800}$

$Vol = 23.5$ OK

Check $Q_{p2} = 4900$

$Vol = 15.7$

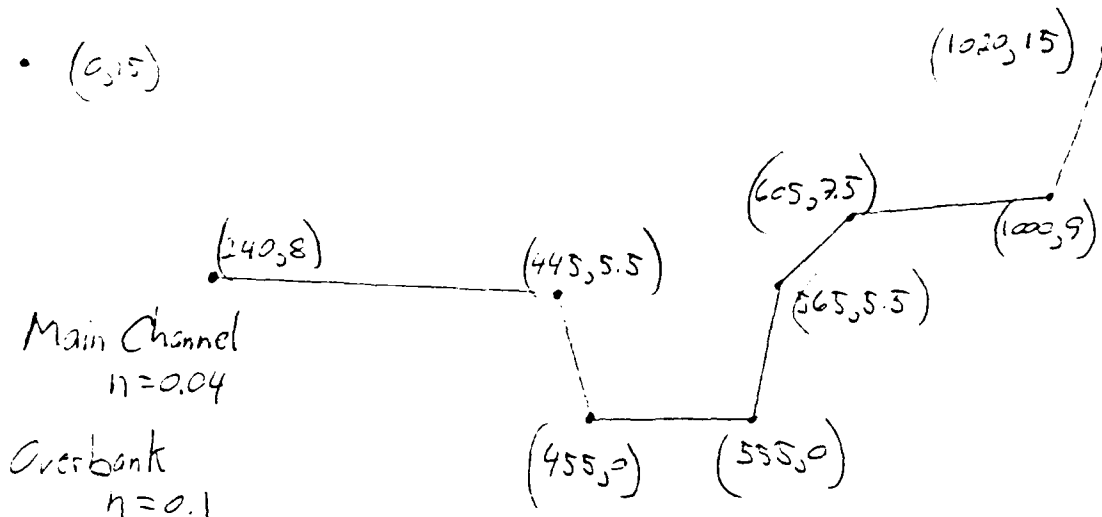
$Q_2 = 6240 + 4800 = \underline{11,040}$ cfs

Estimate Depth of Flow at Industrial/Warehouse Buildings 3000'+
Downstream of Glen Rd. Dam

A uniform flow rating table based on the approximate section
sketched below is shown on the next page.

MASCOMA DAM NO. 2

RHF
6/2/80



Mascoma R. 3000' d/s
of Glen Fed. Dam

Prior to Failure

Depth = 5'-6' with $Q = 6240$ cfs

After Dam Failure

Depth = 7'-8' with $Q = 11000$ cfs

===== DATA FOR THE COMBINED SYSTEM =====

DEPTH ft.	ELEV ft.	AREA ft ²	WPER ft.	HYD-R ft.	AR2/3	Q cfs
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	101.8	104.2	1.0	100.3	373.6
2.00	2.0	207.3	108.3	1.9	319.5	1190.2
3.00	3.0	316.4	112.5	2.8	630.5	2348.6
4.00	4.0	429.1	116.6	3.7	1022.8	3810.0
5.00	5.0	545.5	120.8	4.5	1490.5	5552.5
6.00	6.0	677.8	173.8	3.9	1678.9	7645.8
7.00	7.0	899.8	275.9	3.3	1978.8	10212.2
8.00	8.0	1254.2	499.6	2.5	2316.7	13300.6
9.00	9.0	1899.6	797.2	2.4	3389.1	17395.7
10.00	10.0	2712.7	835.0	3.2	5950.7	22912.2
11.00	11.0	3563.5	872.8	4.1	9103.2	29554.8
12.00	12.0	4451.8	910.5	4.9	12824.1	37255.1
13.00	13.0	5377.7	948.3	5.7	17101.5	45978.5
14.00	14.0	6341.3	986.1	6.4	21929.1	55706.3
15.00	15.0	7342.5	1023.9	7.2	27305.1	66428.4

STREAM RATING

MASCOMA R. 3000+ FT. D/S OF GLEN RD. DAM

MASCOMA DAM NO. 2

RHF
6/2/80

Test Flood Analysis

Size Classification - SMALL

Storage < 1000 AF

Height < 40'

Hazard Classification - SIGNIFICANT

Failure of the dam under the assumed conditions would flood and probably seriously damage the railroad crossing 500' downstream. Severe flooding at the sewage pump station could damage the building and equipment and interrupt service.

Two industrial/warehouse buildings about 1.3 miles downstream could be flooded 1 foot as a result of dam failure.

Test Flood Selection

Per COE guidelines, a SMALL dam with SIGNIFICANT hazard potential should use a 100-year to 1/2 PMF Test Flood. Because there is little danger of loss of life and a limited number of structures is affected, select a Test Flood equal to the 100-year flood at the dam.

From the FIS, the estimated 10, 50, 100, and 500-year discharges for the Mascoma River in Lebanon are as follows:

MASCOMA DAM NO. 2

RHF
6/2/80

<u>Recurrence Interval</u>	<u>Peak Discharge</u>
10 years	3500 cfs
50	5900
100	7000
500	10000

The 100-year discharge of 7000 cfs applies at the dam, so that storage routing in the reservoir need not be considered. In any case, the surcharge storage is too small in relation to the size of the watershed to have significant effect. For these reasons a stage-storage function has not been calculated.

Test Flood Summary

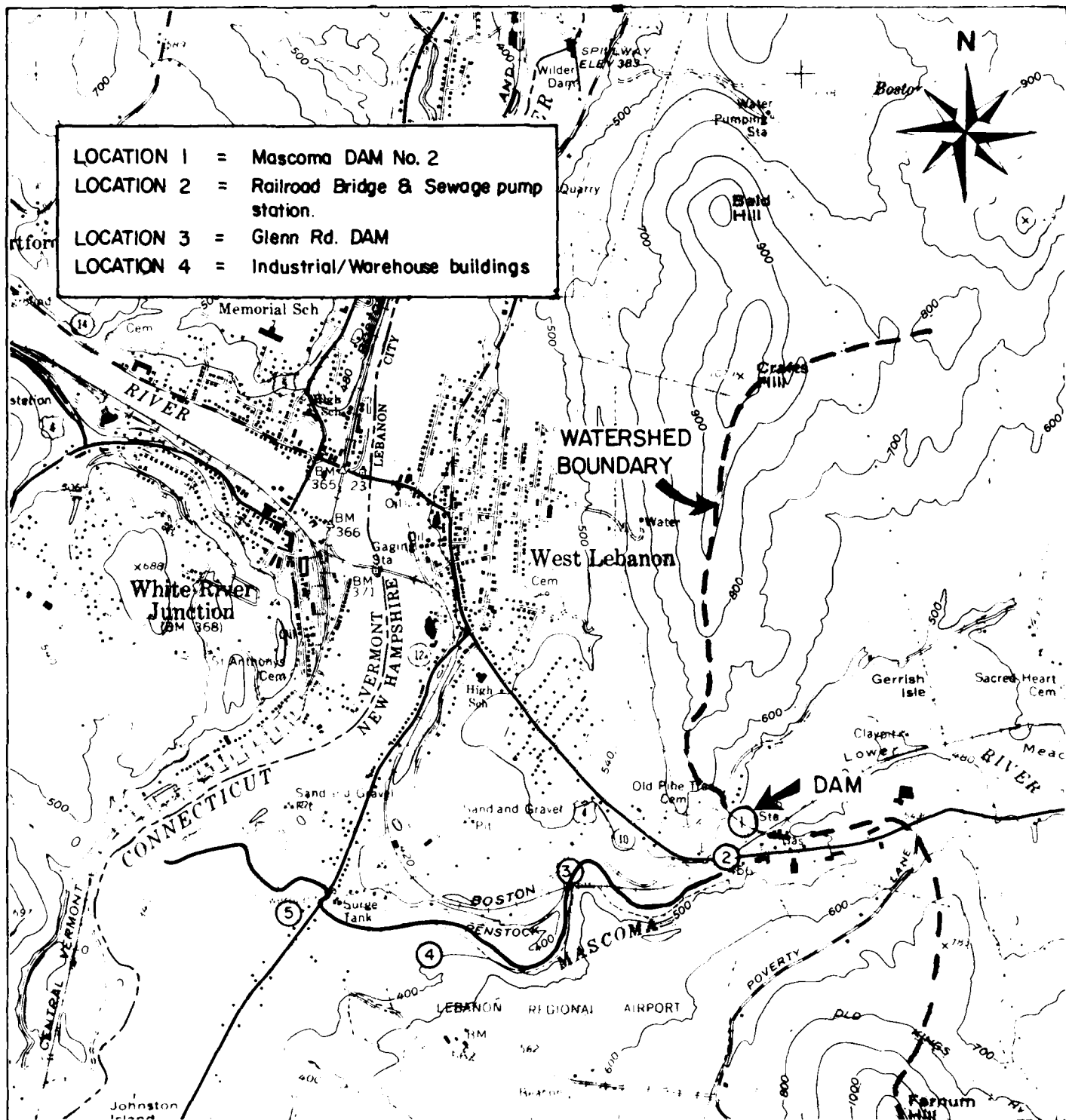
Size: SMALL

Hazard: SIGNIFICANT

Test Flood: 100-year peak discharge

 $Q_{100} = 7000$ cfsHead on Spillway = 8.3' (from Dam Rating)

The pool level will be approximately 0.5' above the top of the left abutment and 0.2' below the top of the right abutment.



0 1000 2000 4000
 FROM USGS HANOVER - N H
 QUADRANGLE MAP

GOLDBERG ZOINO & ASSOCIATES, INC
 GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
 NEWTON UPPER FALLS, MASSACHUSETTS

US ARMY ENGINEER DIV NEW ENGLAND
 CORPS OF ENGINEERS
 WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

MASCOMA DAM No. 2

NEW HAMPSHIRE

SCALE AS NOTED

DATE JUNE 1980

APPENDIX E

INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

(3)	POPULAR NAME	NAME OF IMPOUNDMENT	(4)	(5)	(6)	(7)
AL BRIDGE DAM		WASCOMA RIVER	(8)	(9)	DIST FROM DAM (MI.)	POPULATION
REAR JON BASIN						9725

(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
TYPE OF DAM	YEAR COMPLETED	PURPOSES	STILL UNDER CONSTRUCTION (Y/N)	HYDRO ELECTRIC (Y/N)	IMPOUNDING CAPACITIES MAXIMUM (ACRES)	ACROSS (Y/N)			
FOOT	1934	H.		23	15		600	170	NED N N

DIS	OWN	FED	R	PRV/FED	SCS	A	VER/DATE
NEC	N	N	N	N	N	N	

[illegible]

(a)	(b)	(c)	(d)
OWNER	ENGINEERING BY	CONSTRUCTION BY	
CITY OF LEAFHOLM, OH	NE POWER ENGINEERING (a)	NE POWER ENGINEERING (a)	

PROJECT NAME	REGULATORY AGENCY		
	DESIGN	CONSTRUCTION	OPERATION
NEW WATER RES. HD.		NEW WATER RES. HD.	NEW WATER RES. HD.

INSPECTION BY	INSPECTION DATE			AUTHORITY FOR INSPECTION
	DAY	MO	YR	
INSPECTION BY	DAY	MO	YR	AUTHORITY FOR INSPECTION

GOLDENRO ZUINO & ASSOCIATES	(4)	REMARKS

END

FILMED

8-85

DTIC