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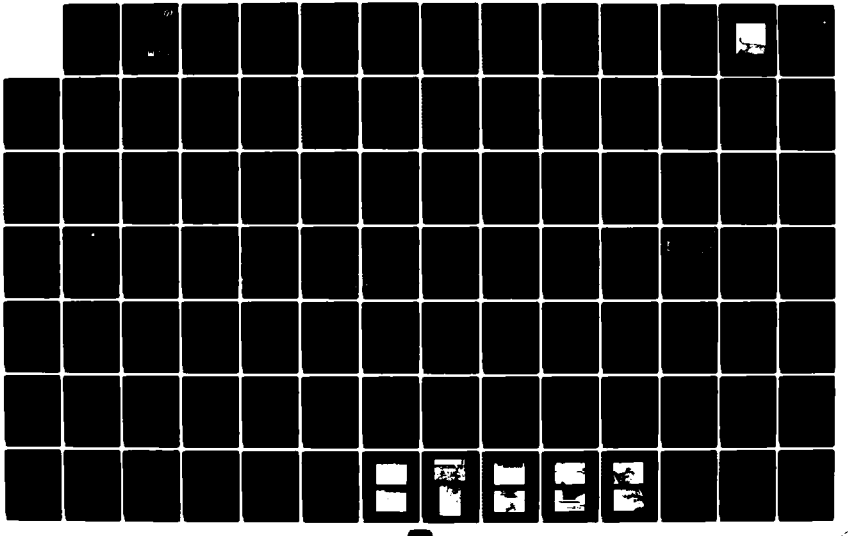

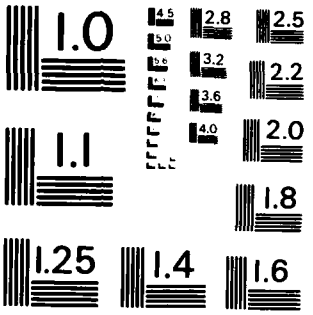

MERRIMACK RIVER BASIN
ASHBURNHAM , MASSACHUSETTS

WINNEKEAG LAKE DAM
MA 00007

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

JUNE 1980

UNCLASSIFIED

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

Winnekeag Lake Dam is a 260-foot long dry-stone masonry and earth dam. The dam has a maximum height of 21 feet and consists of a spillway and separate outlet structure. The dam is in fair condition. The dam has been classified in the intermediate size and high hazard categories. A test flood equal to the full PMF was used to evaluate the capacity of the spillway.

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

REPLY TO
ATTENTION OF:

NEDED

OCT 28 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 Winnekeag Lake Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, James River-Massachusetts, Inc., Fitchburg, Mass.

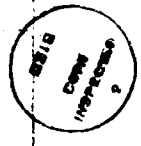
Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

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,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated



WINNEKEAG LAKE DAM

MA 00007

MERRIMACK RIVER BASIN
ASHBURNHAM, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00007

Name of Dam: Winnekeag Lake

Town: Ashburnham

County and State: Worcester County, Massachusetts

Stream: Phillips Brook, tributary of the Nashua River

Date of Inspection: May 8, 1980

Winnekeag Lake Dam is a 260-foot long dry-stone masonry and earth dam built prior to 1878. The dam has a maximum height of 21 feet and consists of a spillway and separate outlet structure. The downstream slope of the dam is a vertical dry-stone masonry wall. The top of the dam is at Elevation (El) 1132.7. The spillway is a modified broad crested weir, 27.9 feet long, with the crest at El 1126.0. The outlet is a 12-inch pipe controlled by a gate valve. The invert of the outlet is about El 1110. The outlet control is located in a wooden gatehouse on the crest of the dam.

There are deficiencies which must be corrected to assure the continued performance of this dam. This conclusion is based on the visual inspection of the site and a review of the available data. Generally the dam is in fair condition.

The following deficiencies were observed at the site: bulging of downstream stone wall; seepage discharging from the stone culvert low-level outlet; seepage downstream of the toe of the dam; several sinkholes on the crest of the dam adjacent to the downstream stone wall; animal burrows on the crest of the dam; voids between the stones on the downstream wall; erosion of the crest adjacent to the spillway right training wall; riprap missing from the upstream face of the dam; cracked concrete at the upstream end of the spillway left training wall; and an accumulation of debris in the low level outlet culvert and spillway discharge channel.

WINNEKEAG LAKE DAM

Based on Corps of Engineers' guidelines, the dam has been classified in the intermediate size and high hazard categories. A test flood equal to the full probable maximum flood (PMF) was used to evaluate the capacity of the spillway. The test flood outflow is 1860 cfs, resulting in a pond level at El 1133.1. The test flood would overtop the dam by 0.4 feet. Hydraulic analyses indicate that the spillway (without stoplogs) can discharge 1530 cfs, or 83 percent of the test flood outflow before the dam is overtopped. With stoplogs (1.4 feet high) the spillway can discharge 1,150 cfs or 57 percent of the test flood outflow before the dam is overtopped.

It is recommended that the Owner employ a qualified registered professional engineer to evaluate the stability of the dam and the spillway and to conduct a more detailed hydraulic and hydrologic study of the spillway if the stoplogs on the spillway are not removed. In addition, the Owner should repair the deficiencies listed above, as described in Section 7.3. The Owner should also implement a program of annual technical inspections, and prepare a written plan for (1) surveillance of the dam during and after periods of heavy rainfall, and (2) for notifying downstream residents in the event of an emergency at the dam.

The measures outlined above and in Section 7 should be implemented by the Owner within a period of one year after receipt of this Phase I Inspection Report.

Edward M. Greco, P.E.
Project Manager
Metcalf & Eddy, Inc.

Massachusetts Registration
No. 29800

Approved by:

Stephen L. Bishop, P.E.
Vice President
Metcalf & Eddy, Inc.

Massachusetts Registration
No. 19703

This Phase I Inspection Report on Winnekeag Lake 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.

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRIAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. 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 investigations, 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 will be detected.

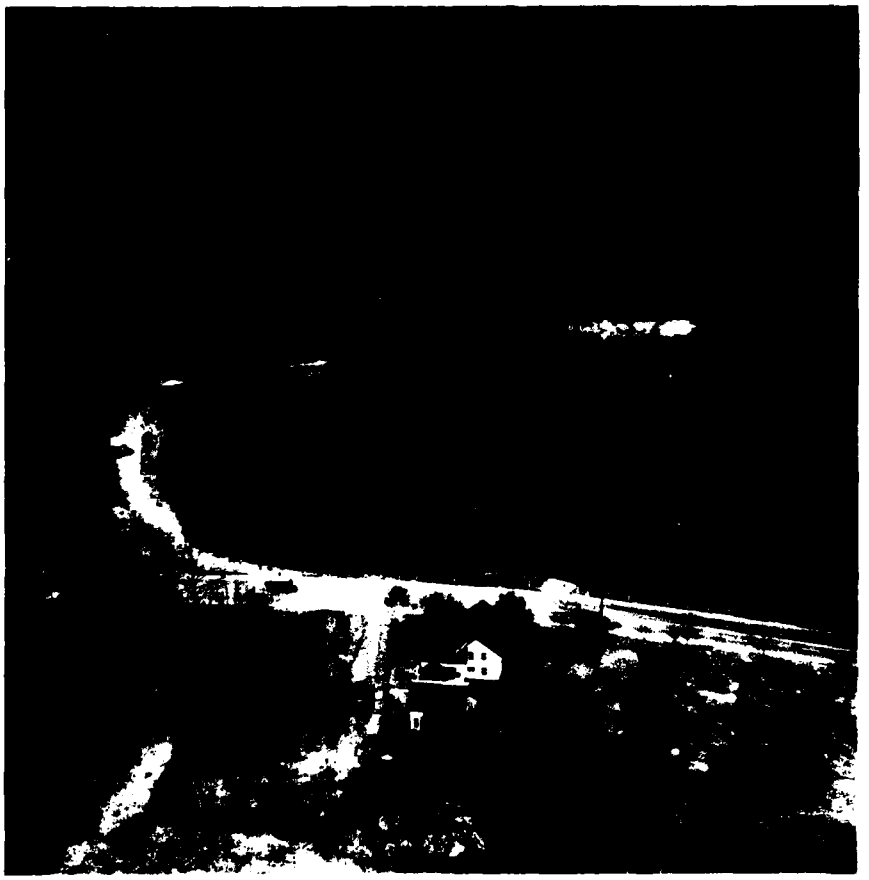
Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because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

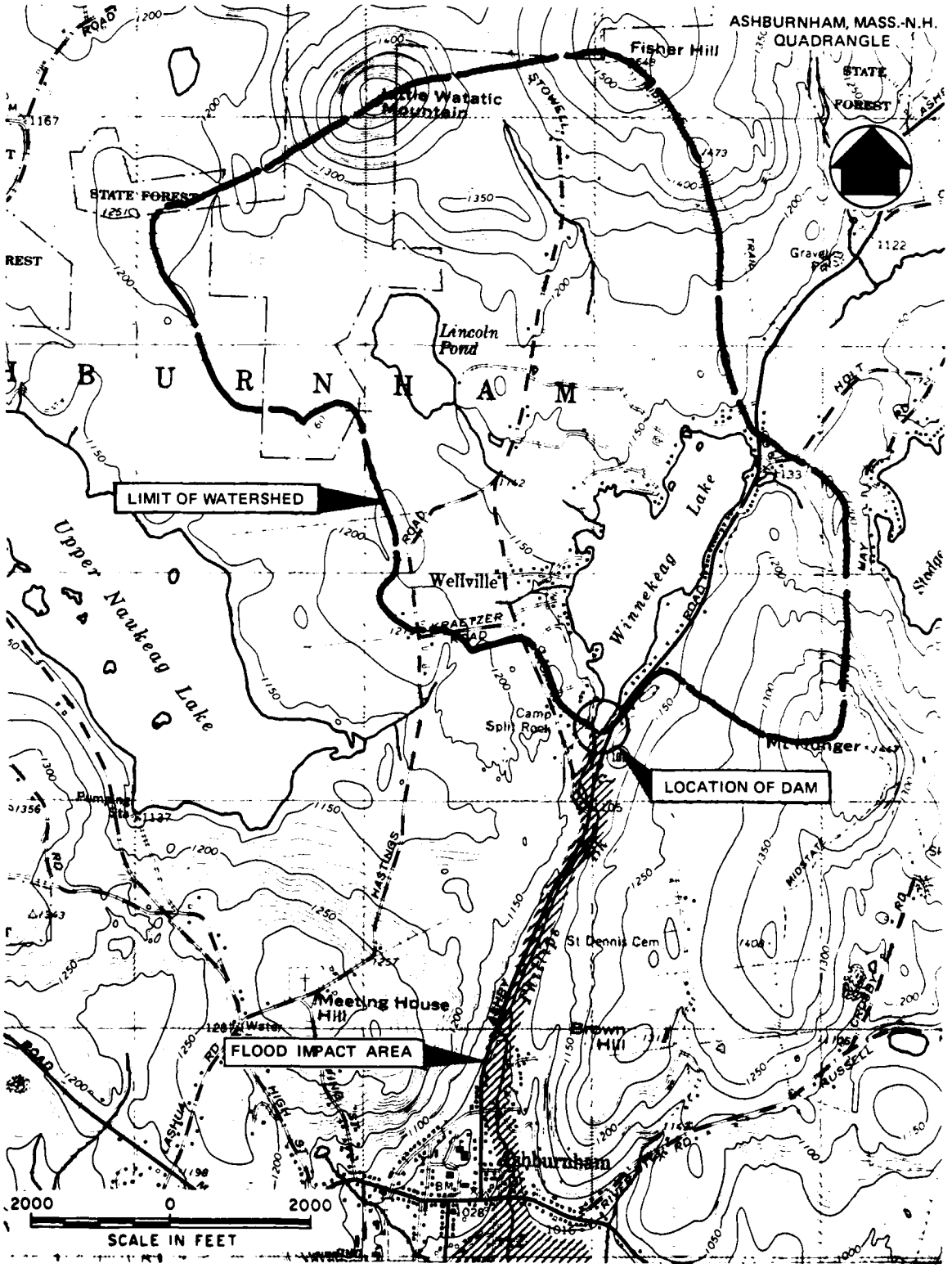
The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

OVERVIEW
WINNEKEAG LAKE DAM
ASHBURNHAM, MASSACHUSETTS





LOCATION MAP – WINNEKEAG LAKE DAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

WINNEKEAG LAKE 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. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Contract No. DACW 33-80-C-0054, dated April 18, 1980, 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 assist the States to quickly initiate effective dam safety programs for non-Federal dams.

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

1.2 Description of Project

a. Location. The dam is located on Phillips Brook in the Town of Ashburnham, Worcester County, Massachusetts (see Location Map) in the Merrimack River Basin. The coordinates of this location are Latitude 42 deg. 39.3 min. north and Longitude 71 deg. 54.3 min. west.

b. Description of Dam and Appurtenances. Winnekeag Lake Dam is a 260-foot long, dry-stone masonry and earth dam with a maximum height of 21 feet (see Plan of Dam and Sections in Appendix B and photographs in Appendix C). The top of

the dam is 28 feet wide and varies from El 1132.7 to 1132.8. A gatehouse is located on the top of the dam. The upstream face is a 1.8:1 (horizontal to vertical) slope covered with riprap. Generally, the downstream stone face is relatively vertical although the upper portion of the wall has a batter of about 1:4. Available drawings indicate that the dam is a zoned embankment with a select material central core containing a vertical timber sheet pile cutoff wall (see Figure B-3 and B-4). The drawings also show that the timber sheet pile and core extend into a cutoff trench below the base of the dam. A concrete core wall is located in the embankment west of the spillway.

The spillway, located at the right abutment of the dam, is a 27.9-foot long, broad-crested concrete weir. The approach channel consists of a timber and rock crib wall along the right shoreline. Wooden stoplogs 1.4 feet high are mounted on concrete filled steel pipe on the crest of the spillway. A steel H column is located behind one pipe.

The crest of the spillway is at El 1126.0, and the top of the stoplogs is at El 1127.4. The stoplogs are 27.9 feet long. There is a vertical drop of about 4 feet at the downstream end of the weir. The maximum training wall height is 6.7 feet above the spillway crest.

The discharge channel below the spillway is about 14 feet wide. The left side of the channel is a 10-foot high vertical concrete wall which extends 22 feet downstream and also serves as a retaining wall for the embankment. The floor of the channel is covered with rock, loose stones and debris and slopes at 13 percent.

The low-level outlet for the dam is a 12-inch pipe controlled by a gate valve. The gate valve may be operated from within the wooden gatehouse which is located 60 feet from the upstream end of the dam (see Figure B-3 and B-4). There is a cast-iron grating on the intake end of the 12-inch pipe. The invert of the downstream end of the outlet is about El 1110. The outlet pipe discharges into a stone culvert just downstream of the slide gate. The stone culvert is 3 feet wide by 2 feet high and discharges the base of the vertical stone wall which forms the downstream side of the dam.

c. Size Classification. Winnekeag Lake Dam is classified in the "intermediate" category since it has a maximum height of 21 feet and a maximum storage capacity of 1,284 acre-feet.

d. Hazard Classification. There are more than 20 houses located along the stream downstream of the dam (see Flood Impact Area shown on the Location Map). This includes three houses within 3,500 feet and the other houses within 7,000 feet downstream of the dam. The foundations of these structures are approximately 3 to 10 feet above the bed of the stream. An assumed failure of the dam could cause the possible loss of more than a few lives and an excessive amount of property damage could occur. Accordingly, the dam has been placed in the "high" hazard category.

e. Ownership. The dam is owned by James River-Massachusetts, Inc., 701 Westminister Street, P.O. Box 310, Fitchburg, Massachusetts, 01420. Mr. Norman Burt (telephone 617-343-3051) granted permission to enter the property and inspect the dam.

f. Operator. The dam is operated by personnel from James River-Massachusetts, Inc.

g. Purpose of the Dam. Winnekeag Lake is used for recreation purposes.

h. Design and Construction. Construction of Winnekeag Lake Dam was completed prior to 1878. Drawings and specifications dated October 29, 1878 and other drawings dated May 21, 1895 as prepared by Thomas C. Sheldon are available (see Figures B-3 and B-4). A drawing (see Figure B-5) dated August, 1931 shows the addition of wooden flashboards 2 feet above the spillway. The latest drawing (see Figure B-6) dated June 1, 1950, prepared by Howard M. Turner, indicates raising the elevation of the crest of the dam, addition of a concrete retaining wall on the left abutment and a concrete cut-off wall on the right embankment, removal of the existing wood flashboard structure, and addition of concrete to both spillway training walls. The drawings show that the dam was constructed essentially as it appears today. However a timber and rock crib wall now extends along the shoreline upstream of the right spillway training wall and backfill was placed behind the concrete wall west of the spillway.

Previous inspection reports (as listed in Appendix B) indicate since the first inspection in 1924 the dam has been in good condition. Repairs have been made such as filling in a hole and riprapping on the upstream embankment slope in 1948 and 1949, rebuilding the spillway in 1950, raising the dam 2 feet in 1951, placing concrete facing on the downstream end of the left spillway training wall in 1958, adding a timber crib stone retaining wall upstream of the right spillway

training wall in 1963, and adding a new concrete wall along Water Street also in 1963. A bulge in the downstream stone wall was intermittently reported during inspections from 1924 to 1963.

According to the 1949 inspection report, "the 1936 and 1938 flood could not be handled. Embankment sandbagged after each flood". In the 1936 flood the water level was reported at El 1129.7.

i. Normal Operating Procedures. Personnel from James River-Massachusetts, Inc. reportedly visit the dam once a month. At that time, they inspect the dam and appurtenances for vandalism, storm damage and deterioration. The stoplogs are normally left in place to maintain water in the reservoir for recreation purposes. Some of the stoplogs are removed to augment flow in Phillips Brook for a swimming pond located less than a mile downstream. The low-level outlet was last operated in 1979 as part of the annual inspection.

1.3 Pertinent Data

a. Drainage Area. The drainage area is approximately 1,331-acres (2.08 square mile) and consists of flat to steep hilly land (see Location Map). The drainage area includes drainage from Lincoln Pond. About 16 percent of the drainage area is ponds and swamps. In general, the undeveloped portions of the drainage area consist of 98 percent woodland, and 2 percent open fields. Moderate residential development occurs mostly around the shoreline.

b. Discharge. Discharge from Winnekeag Lake Dam flows over the wooden stoplogs on the concrete spillway and into a combination bedrock and stone discharge channel. Water also discharges from the outlet into the spillway discharge channel about 15 feet downstream of the dam.

(1) Outlet: Size - 12-inch; Invert El. - about 1,110 - Discharge capacity 15 cfs at El 1127.4.

(2) Maximum known flood at damsite: El 1129.7 in 1936.

(3) Ungated spillway capacity (without stoplogs) at top of dam: 1530 cfs at El 1132.7.

(4) Ungated spillway capacity (without stoplogs) at test flood elevation: 1670 cfs at El 1133.1.

(5) Gated spillway capacity at normal pool elevation: N/A

(6) Gated spillway capacity at test flood elevation: N/A

(7) Total spillway capacity at test flood elevation: N/A 1670 cfs at El 1133.1

(8) Total project discharge (without stoplogs) at test flood elevation: 1860 cfs at El 1133.1.

c. Elevation (feet above National Geodetic Vertical Datum of 1929 (NGVD)). A benchmark was established at El 1126.0 on the crest of the spillway. This elevation was estimated from a United States Geological Survey (U.S.G.S.) topographic map.

(1) Streambed at toe of dam: 1112.0

(2) Bottom of cutoff: unknown

(3) Maximum tailwater: unknown

(4) Normal pool: 1127.4 (stoplogs in place)

(5) Full flood control pool: N/A

(6) Spillway crest (ungated): 1126.0

(7) Design surcharge (Original Design): unknown

(8) Top of dam: 1132.7 to 1132.8

(9) Test flood surcharge: 1133.1 without stoplogs; 1133.6 with stoplogs

d. Reservoir (Length in feet)

(1) Normal pool: 4,700

(2) Flood control pool: N/A

(3) Spillway crest pool: 4,700

(4) Top of dam: 4,700

(5) Test flood pool: 4,700

e. Storage (acre-feet)

(1) Normal pool: 527

(2) Flood control pool: N/A

(3) Spillway crest pool: 527

(4) Top of dam: 1284

(5) Test flood pool: 1329

f. Reservoir Surface (acres)

(1) Normal pool: 113

(2) Flood-control pool: N/A

(3) Spillway crest: 113

*(4) Test flood pool: 113

*(5) Top of dam: 113

g. Dam

(1) Type: dry-stone masonry and earthfill

(2) Length: 260 feet including spillway

(3) Height: 21 feet

(4) Top width: 28 to 55 feet

(5) Side slopes: upstream about 1.8 to 1; downstream vertical to 1:4

(6) Zoning: select fill material containing timber sheet piling in earth embankment

(7) Impervious core: select fill material with timber sheet piling

(8) Cutoff: select fill and sheeting extend into a cutoff trench

(9) Grout curtain: unknown

(10) Other: N/A

*Based on the assumption that the surface area will not significantly increase with changes in pool elevation from 1126.0 to 1133.1.

h. Diversion and Regulating Tunnel: N/A

i. Spillway

(1) Type: concrete modified broad crested weir

(2) Length of weir: 27.9 feet

(3) Crest elevation: 1126.0 without stoplogs
1127.4 with stoplogs

(4) Gates: none

(5) Upstream channel: stone bottom except concrete for 3 feet upstream of stoplogs, right wall is timber and stone crib along shoreline

(6) Downstream channel: rock bottom, with loose stones, stumps, logs and minor debris

(7) General: a concrete culvert 8 feet wide by 6.3 feet high is located about 1,100 feet downstream beneath Water Street (State Highway 101)

j. Regulating Outlets

(1) Invert El: About 1110

(2) Size: 12-inch pipe discharges into 2 foot high by 3 foot wide stone culvert just downstream of gate valve

(3) Description: gate valve located at base of shaft below wooden gatehouse

(4) Control mechanism: the valve operating stem extends up through a 2.5 foot diameter mortared brick-lined shaft

SECTION 2

ENGINEERING DATA

2.1 General. The engineering data available for this Phase I inspection includes drawings and specifications dated October 29, 1878 and May 21, 1895 prepared by Thomas C. Sheldon (see Figures B-3 and B-4). Other drawings include one dated August, 1931 and another dated June 1, 1950 prepared by Howard M. Turner (see Figures B-5 and B-6). The drawings and specifications were obtained from the Worcester County Engineers office. There are no other drawings, specifications, or computations available from the Owner or State. Copies of previous inspection reports dated 1924 to 1969, prepared by the Worcester County Engineers office are included in Appendix B. The most recent inspection was conducted in 1971 by the Massachusetts Department of Public Works. A copy of that report is also given in Appendix B.

We acknowledge the assistance and cooperation of personnel from the Massachusetts Department of Environmental Quality Engineering, Division of Waterways; the Massachusetts Department of Public Works; and the Worcester County Engineers Office. In addition, we acknowledge the assistance of Mr. Leo Collette, Jr. of James River-Massachusetts, Inc., who provided information on the history and operation of the dam.

2.2 Construction Records. The only construction records are the 1878, 1895, 1931 and 1950 Plans referred to in Section 2.1. There are no as-built drawings available for the dam or appurtenances. Previous inspection reports by the Worcester County Engineers office provided some construction information, and a summary of repairs and post-construction changes at the site.

2.3 Operating Records. No operating records are available, and there is no daily record kept of the elevation of the pool or rainfall at the dam site.

2.4 Evaluation

a. Availability. There is limited engineering data available for this dam.

b. Adequacy. The lack of detailed hydraulic, structural and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based on the visual inspection, past performance history, and engineering judgment.

c. Validity. Comparison of the available drawings with the field survey conducted during the Phase I inspection indicates that the available information is valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I Inspection of the dam at Winnekeag Lake was performed on May 8, 1980. A copy of the inspection checklist is included in Appendix A. Previous inspections were conducted by the Worcester County Engineers office from 1924 to 1969, and by the Massachusetts Department of Public Works in 1971. Copies of those reports are given in Appendix B. Selected photographs taken during our Visual Inspection are included in Appendix C.

b. Dam. The dam is a dry-stone masonry earthfill structure with a spillway and outlet. Evidence of seepage was noted in one location and evidence of standing water was noted at a second location, each about 15 feet downstream of the downstream face of the dam (see Figure B-1). The seep is indicated by a stream of clear water flowing at approximately 1 gpm into the backwater near the left abutment. A pool of clear standing water was observed about 3 feet in diameter in line with the center of the dam.

Several minor sinkholes, some as deep as 13 inches, were observed on the crest of the dam adjacent to the downstream stone wall (see Photo No. 3). There are also several small animal burrows on the crest.

The dry stone masonry wall on the downstream face is in fair condition. Voids between the stones could be probed to as deep as 4.5 feet back into the dam. There is a bulge of the middle of the wall at the center and about halfway between the center and left abutment. There are several piles of random fill at or near the base of the stone wall (see Photo No. 4).

Moderate erosion was noted on the crest of the dam adjacent to the right spillway training wall (see Photo No. 6).

Some pieces of riprap are missing from the upstream face of the embankment (see Photo No. 7) including the area at and near the upstream end of the left training wall of the spillway. There are numerous bush and small tree stumps in the riprap.

c. Appurtenant Structures. The spillway is a broad crested weir with stoplogs (see Photo No. 8). At the time of the inspection, water was discharging over the spillway, so the weir, stoplogs, and downstream toe could not be examined. The concrete on the crest of the spillway was in fair condition, although the concrete downstream of the stoplogs is slightly spalled. The concrete and stonework of the training walls are in good condition except for missing mortar at the downstream end of the left training wall. At the upstream end of the left training wall, there is a transverse crack (less than 1/32 inch) through the concrete. Some voids exists in the riprap at this location. There is an outward tilt of the top of the timber and stone crib approach wall along the right shore line. The wooden stoplogs are in fair condition. There is no access walkway to the stoplogs which would permit removal of the boards during periods of high flow. The crest of the spillway was clear of debris.

A portion of the discharge end of the outlet was visible during inspection. As shown in Photo No. 2, the wooden gatehouse is in good condition, including a 2.5 foot diameter brick lined shaft which extends to the gate valve. A seep was observed from the mortar about 11.5 feet (El 1121.5) below the floor.

The gate valve on the outlet, located at the base of the brick shaft, is in fair operating condition. The pipe and gate are submerged in about 0.6 foot of water. Slight leakage was noted from the discharge end of the outlet pipe.

The outlet conduit is a 12-inch pipe discharging into a stone culvert, 3 feet wide by 2 feet high, within the embankment (see Photo No. 5). The discharge end of the stone culvert outlet was probed to a depth of 6 feet into the embankment, indicating some stone obstructions within the culvert. The exposed end of the outlet was partly clogged with debris, and a moderate amount of flow was discharging at the time of inspection. At the time of inspection, the gate valve was closed.

d. Reservoir Area. The reservoir area is moderately developed. Camp Split Rock is located on the west side of the reservoir abutting the dam. Residential development is located generally on the east and west sides of the reservoir. Most of the land is wooded with gentle to steep slopes. There is limited potential for future development in the reservoir area.

e. Downstream Channel. The natural floor of the spillway channel is covered with mostly stone although bedrock was evident in some areas. There is a slight accumulation of wood and debris in the floor of the channel (see Photo No. 9). Several small to large trees are overhanging the spillway channel.

The spillway channel merges with the outlet channel about 15 feet downstream of the stone wall to form the downstream channel (see Photo No. 5). The natural floor of the downstream channel contains occasional loose stones and a number of logs. There are numerous trees overhanging this channel.

About 1,100 feet downstream of the dam, a road embankment about 10 feet high crosses the channel. Water flows through the embankment in an 8-foot wide by 6.3-foot high concrete culvert (see Photo No. 10).

3.2 Evaluation. The visual inspection indicates that the dam is in fair condition. The stated deficiencies which must be corrected to assure the continued performance of this dam and measures to improve this condition are stated in Section 7.

SECTION 4

OPERATING AND MAINTENANCE
PROCEDURES

4.1 Operating Procedures

a. General. According to Mr. Leo Collette, Jr., Manager of Engineering, James River- Massachusetts, Inc. the standard procedure for operating the dam is to leave the stoplogs in place to maintain an adequate water level for recreational purposes. Discharge is regulated at the dam by adjusting the stoplogs to maintain flow, particularly in the summer when water is needed downstream in a swimming pond. Some of the stoplogs are then removed to augment flow in Phillips Brook.

b. Warning System. The Owner of the dam, in cooperation with the Office of Civil Defense, Fitchburg has devised a plan for surveillance of the dam during and after periods of heavy rainfall, and for warning local residents in case of an emergency at the structure. This written plan is presently reportedly being upgraded.

4.2 Maintenance Procedures

a. General. The dam is generally well maintained. The Manager of Engineering is responsible for maintenance of the facility. Monthly inspections by his staff have been conducted in the past. Typical annual maintenance procedures have included clearing brush and trees from the crest and upstream slopes, clearing debris from the spillway and outlet channel, and mowing grass on the crest of the dam.

b. Operating Facilities. The operating condition of the outlet works is checked monthly by the Owner. In addition, the gate valve is opened and closed each year. The last time it was opened to about 3/4 capacity was in 1979. In 1978, the extension for the gate operating mechanism was replaced.

4.3 Evaluation. There is a program for maintaining the embankment and appurtenant structures in good operating condition. There is also a program of regular technical inspections, a plan reportedly for surveillance of the embankment during and after periods of heavy rainfall, and reportedly an emergency warning system in effect. The latter two items are reportedly included in a written emergency preparedness plan, which is presently being upgraded. This written program should be implemented, as recommended in Section 7.3.

SECTION 5

EVALUATION OF HYDRAULIC/
HYDROLOGIC FEATURES

5.1 General. Winnekeag Lake Dam has a 2.08-square mile drainage area, about 16 percent of which is ponds and swamps (see Location Map). The land is combined steep hilly terrain with flat swampy areas and essentially undeveloped except for moderate development along the reservoir shoreline.

Lincoln Pond upstream of Winnekeag Lake provides additional storage within the watershed.

Winnekeag Lake has a surface area of approximately 113 acres, and a maximum storage capacity of 1,284 acre-feet at El 1132.7.

The low-level outlet can discharge a flow of 14.4 cfs when the lake is at El 1126.0 which is the crest of the spillway. At this lake elevation and with no additional inflow, the outlet can lower the lake by 1 foot in about 4 days.

5.2 Design Data. There are no hydraulic or hydrologic computations available for the design of the spillway at Winnekeag Lake Dam.

5.3 Experience Data. There is no record of overtopping of the present dam, which was constructed prior to 1878. According to records of the Worcester County Engineers office, the 1936 "flood" was at El 1129.7. This resulted in an estimated freeboard of about 0.5 foot. Subsequently, the dam was raised about 2 feet in 1951. In the 1949 inspection report, it was noted that plans had been made to "deepen spillway as 1936 and 1938 flood could not be handled. Embankment sandbagged after each flood." The low level outlet was open during the 1938 hurricane.

5.4 Test Flood Analysis. Winnekeag Lake Dam has been classified in the "intermediate" size and "high" hazard categories. According to the Corps of Engineers guidelines, a test flood equal to the full PMF (Probable Maximum Flood) should be used to evaluate the capacity of the spillway.

The PMF rate for the Winnekeag Lake watershed was calculated to be 1,450 cfs per square mile of drainage area. This calculation is based on the average slope of 3.5 percent in the drainage area, the pond-plus-swamp area to drainage area ratio of 16 percent, and the U.S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Flow Rates (dated December 1977). For this analysis, the peak flow

rate was determined to be between the guide curves for "flat and coastal" and "rolling" topography.

Applying the full PMF rate to the 2.08 square mile drainage area results in a peak test flood inflow of 3,016 cfs. By adjusting the test flood inflow for surcharge storage, the peak test flood outflow was calculated to be 1,860 cfs (900 cfs per square mile), without stoplogs and 2,020 cfs (971 cfs per square mile) with stoplogs.

Without stoplogs, the lake level would rise to El 1133.1. With stoplogs, the lake would rise to El 1133.6.

Hydraulic analyses indicate that the spillway without stoplogs can discharge 1,530 cfs or 83 percent of the test flood outflow with the pond at El 1132.7, which is the low point on the top of the dam. With stoplogs (1.4 feet high) the spillway could discharge 1,150 cfs, or 57 percent of the outflow before the dam is overtopped.

Table 5-1 below summarizes the discharge from the lake during the test flood.

TABLE 5-1.

	Stoplogs in place	Stoplogs removed
Maximum height of water above dam, ft:	0.9	0.4
Discharge over spillway, cfs:	1,450	1,670
Discharge over dam, cfs:	570	190
Depth at critical flow, ft:	0.53	0.23
Velocity at critical flow, fps:	4.1	2.7

5.5 Dam Failure Analysis. The total peak discharge rate due to failure of the dam was calculated to be 10,010 cfs with the pond at El 1132.7. This calculation is based on a maximum head of 20.7 feet and an assumed 56-foot wide breach occurring in the embankment. Failure of the dam would produce a downstream flood wave about 12.5 feet deep as compared to channel flow about 5 feet deep prior to failure. It would take about 4 hours to drain the pond.

Discharge due to failure of the dam could result in overflowing of the channel further downstream. Due to the topography, little attenuation of the flood flow is expected before it reaches residences. There are more than 20 houses located along the stream downstream of the dam. This includes three houses within 3,500 feet and the other houses within 7,000 feet downstream of the dam. The foundations of these structures are approximately 3 to 10 feet above the bed of the stream. Failure of the dam could result in excessive property damage and loss of more than a few lives in developed areas downstream of the dam. Accordingly, the dam has been placed in the "high" hazard category.

SECTION 6

STRUCTURAL STABILITY

6.1 Visual Observations. The evaluation of the structural stability of Winnekeag Lake Dam is based on a review of previous inspection reports, a review of available drawings, and the visual inspection conducted on May 8, 1980.

As discussed in Section 3, Visual Inspection, the dam is in fair condition. Seepage was observed at two locations about 15 feet downstream of the dam. There is some bulging of the dry stone masonry wall on the downstream face as well as sinkholes on the crest of the dam adjacent to the downstream stone wall. An area of erosion adjacent to the right spillway training wall was observed on the crest of the dam.

6.2 Design and Construction Data. Construction of Winnekeag Lake Dam was completed prior to 1878. Computations for design of the dam, spillway and outlet are not available.

Drawings dated October 29, 1878 and May 21, 1895 prepared by Thomas C. Sheldon, a drawing dated August, 1931, and a drawing dated June 1, 1950 prepared by Howard M. Turner show the proposed construction of the dam (see Figures B-3 through B-6). The drawings show that the dam is a stone masonry and zoned earthfill dam. An impervious core made of selected material containing a timber sheet pile cutoff wall is located near the middle of the embankment. The remaining earthfill and stone wall is shown on the drawings. A cutoff trench extends an unknown depth below the base of the dam. The side slopes of the embankment are 1.8:1 upstream and relatively vertical downstream although the upper portion of the wall has a batter of about 1:4.

Specifications dated October 29, 1878 for construction of the dam are available. They include details on the types of sheet piling, earth material, and mortar used in construction.

There is no information on the shear strength or permeability of the soil and/or rock materials of the embankment.

6.3 Post-Construction Changes. Since the original construction of the dam, the following repairs have been made: a hole was filled in and riprapped on the upstream slope in 1948 and 1949; the spillway was rebuilt in 1950; the dam was raised about 2 feet in 1951; concrete facing was added to the downstream end of the left spillway training wall in 1958; a timber stone crib retaining wall was added to the upstream approach area of the right training wall in 1963, and a new concrete wall along Water Street was constructed in 1963.

6.4 Seismic Stability. The dam is located in Seismic Zone No. 2, and in accordance with Corps of Engineers' guidelines does not warrant further seismic analysis at this time.

SECTION 7

ASSESSMENT, RECOMMENDATIONS,
AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. As a result of the visual inspection, the review of available data, and limited information on operation and maintenance, the dam is considered to be in fair condition. The following deficiencies must be corrected to assure the continued performance of this dam: bulging of the downstream stone wall of the dam; seepage downstream of the toe of the embankment; voids between the stones on the downstream wall; several sinkholes on the crest of the dam adjacent to the downstream stone wall; animal burrows on the crest of the dam; erosion on the crest of the dam adjacent to the spillway right training wall; missing riprap from the upstream face of the embankment including some missing stone at the upstream end of the spillway left training wall; cracked concrete at the upstream end of the spillway left training wall; minor accumulation of debris in the spillway discharge channel; and an apparent accumulation of stones and/or debris within the low level outlet culvert and outlet discharge channel.

The gate valve on the low level outlet is partially submerged and reportedly operable, and the outlet is partially blocked. It is also submerged with water seeping from the stone culvert.

The peak test flood (full PMF) outflow is estimated to be 1,860 cfs with the pond at El 1133.1 (assuming the stoplogs are removed). The test flood would overtop the low point on the dam by 0.4 feet. Hydraulic analyses indicate that the spillway (without stoplogs) can discharge 1,530 cfs or 83 percent of the test flood outflow before the dam is overtopped. With the stoplogs in place, the spillway can discharge 1,150 cfs or 57 percent of the test flood outflow before the dam is overtopped.

b. Adequacy. The lack of detailed design and construction data did not allow for a definitive review. Therefore, the evaluation of this dam is based on a review of the available data, the visual inspection, past performance and engineering judgment.

c. Urgency. The recommendations and remedial measures outlined below should be implemented by the Owner within one year after receipt of this Phase I Inspection Report.

7.2 Recommendations. It is recommended that the Owner employ a qualified registered engineer to:

a. Evaluate the stability of the dam. This should include an investigation of the seepage noted near the toe of the embankment. This should also include an inspection and evaluation of the downstream stone wall with regard to deep voids between stones, apparent outward bulging, and sinkholes on the crest just behind the wall. Consideration should be given to lowering the pond level to permit inspection of both sides of the dam. This investigation should also include an evaluation of the stability of the stone and timber crib wall along the shoreline just upstream of the spillway right training wall.

b. Evaluate the stability of the spillway. This should include an inspection of the spillway under a no flow condition. Design repairs for the spillway as required.

c. Evaluate the flow discharging from the stone culvert downstream from the gate valve to determine if the gate valve is or is not leaking, and whether or not the outlet discharge channel should be riprapped.

d. Perform a detailed hydrologic/hydraulic analysis to evaluate the discharge capability of the spillway and the low level outlet, and the overtopping potential of the dam. However, if the stoplogs from the spillway are removed, then the spillway discharge capacity need not be evaluated. Consideration should be given to increasing the discharge capacity of the low-level outlet.

The Owner should implement the recommendations of the Engineer.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. It is recommended that the Owner accomplish the following:

(1) Clear trees, brush and roots to a distance of 25 feet downstream from the toe of the dam. All stumps and roots removed should be backfilled with select material.

(2) Fill in animal burrows on the crest of the dam.

(3) Seal the seep in the brick shaft beneath the gatehouse.

(4) Replace missing riprap on the upstream face of the embankment including the area at the upstream end of the left spillway training wall.

(5) To prevent continued erosion fill in the eroded area next to the right spillway training wall.

(6) Remove all brush, trees, debris and loose stone in the floor of the spillway discharge channel.

(7) Remove debris from the downstream end of the stone culvert outlet pipe.

(8) Complete the written plan for surveillance of the dam and spillway during and after periods of heavy rainfall and a plan to warn people in downstream areas in the event of an emergency at the dam.

(9) Continue a systematic program of maintenance inspections. As a minimum, the inspection program should consist of a monthly inspection of the dam and appurtenances and be supplemented by additional inspections during and after severe storms. All repairs and maintenance should be undertaken in compliance with all applicable State regulations. The maintenance program should include removal of any debris caught on the spillway weir to prevent clogging of the spillway.

(10) Institute a program of technical inspections on an annual basis.

7.4 Alternatives. There are no recommended alternatives.

APPENDIX A

PERIODIC INSPECTION CHECKLIST

WINNEKEAG LAKE DAM

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT WINNEKEAG LAKE DATE May 8, 1980

TIME 8:00 A.M.

WEATHER Rain, about 45°F

W.S. ELEV. 1127.8 U.S. 1112.0 N.S.

PARTY:

1. Michael Larson (Metcalf & Eddy - Geotechnical)
2. Scott Nagel (Metcalf & Eddy - Geotechnical)
3. Warren Diesl (Metcalf & Eddy - Geotechnical)
4. William Checchi (Metcalf & Eddy - Geotechnical)
5. Lyle Branagan (Metcalf & Eddy - Hydraulics)

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam	M. Larson	
2.	Spillway	L. Branagan	
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT WINNEKEAG LAKE DATE May 8, 1980

PROJECT FEATURE Dam NAME M. Larson

DISCIPLINE Geotechnical NAME S. Nagel

u/s = upstream; d/s = downstream

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	Varies 1129.5 to 1132.8
Current Pool Elevation	1127.8
Maximum Impoundment to Date	1129.7
Surface Cracks	None visible
Pavement Condition	No pavement, grass covered
Movement or Settlement of Crest	None, several holes on crest just u/s of vertical stone face, as deep as 13". Also several animal burrows.
Lateral Movement	Slight bulging of middle of vertical stone wall at center and about halfway between (1)
Vertical Alignment	Two levels on crest, including a berm on the u/s portion of the crest.
Horizontal Alignment	Straight with a dogleg near left abutment.
Condition at Abutment and at Concrete Structures	Rt.abut.-earth and rock, one story wood cabin with concrete block walkout basement at base of hill. Lt. abut.-asphalt paved road at base of hill.
Indications of Movement of Structural Items on Slopes	No structural items except a 10" wideconcrete core wall on rt. abutment which shows no movement.
Trespassing on Slopes	Yes. No fences. Tire tracks on rt. abutment.
Sloughing or Erosion of Slopes or Abutments	Erosion on outside of both spillway training walls includes d/s end of right wall and u/s end of left wall.
Rock Slope Protection - Riprap Failures	Below water level, several areas have missing stone. Above water level, occasional stones missing including area near left spillway training wall. (2)
Unusual Movement or Cracking at or near Toes	None visible.
Unusual Embankment or Downstream Seepage	Two areas d/s of vertical face. One near center is small pool; no moving water. Second is backwater from discharge channel near lt. abut.,estimate flow at about 1 gpm.
Piping or Boils	None visible
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

(1) center and left abutment. (2) Numerous bush stumps between stones.

PERIODIC INSPECTION CHECK LIST

PROJECT WINNEKEAG LAKE DATE May 8, 1980

PROJECT FEATURE Outlet Works NAME M. Larson

DISCIPLINE Geotechnical NAME S. Nagel

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Not visible, submerged.
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

PERIODIC INSPECTION CHECK LIST

PROJECT WINNEKEAG LAKE DATE May 8, 1980

PROJECT FEATURE Spillway NAME M. Larson

DISCIPLINE Hydraulic NAME L. Branagan

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	Outlet structure is wood with padlock on door. A 2.5' diameter mortared brick lined shaft extends from floor to outlet pipe, about 20.6' deep. Brick is relatively dry except (1)
General Condition of Concrete	
Rust or Staining	NA
Spalling	NA
Erosion or Cavitation	None visible
Visible Reinforcing	None
Any Seepage or Efflorescence	Standing water at bottom of brick shaft. Seep from side of brick shaft.
Condition at Joints	Fair
Drain Holes	None visible
Channel	Submerged discharge through stone culvert flows into spillway discharge (2)
Loose Rock or Trees Overhanging Channel	Several trees adjacent to channel.
Condition of Discharge Channel	Fair. Some minor debris.

(1) for a seep from mortar about 11.5' (elev. 1121.5) below wooden floor of structure. Exposed pipe at base of shaft is submerged with water at elev. 1113.0. One handwheel operator extends to outlet pipe held by one bracket on timber floor.

(2) channel about 15 feet d/s of dam. Water was flowing from the outlet. The culvert was probed to a depth of 6 feet in from the stone face of the dam, indicating some stone obstructions.

PERIODIC INSPECTION CHECK LIST

PROJECT WINNEKEAG LAKE DATE May 8, 1980

PROJECT FEATURE Spillway NAME M. Larson

DISCIPLINE Hydraulic NAME L. Branagan

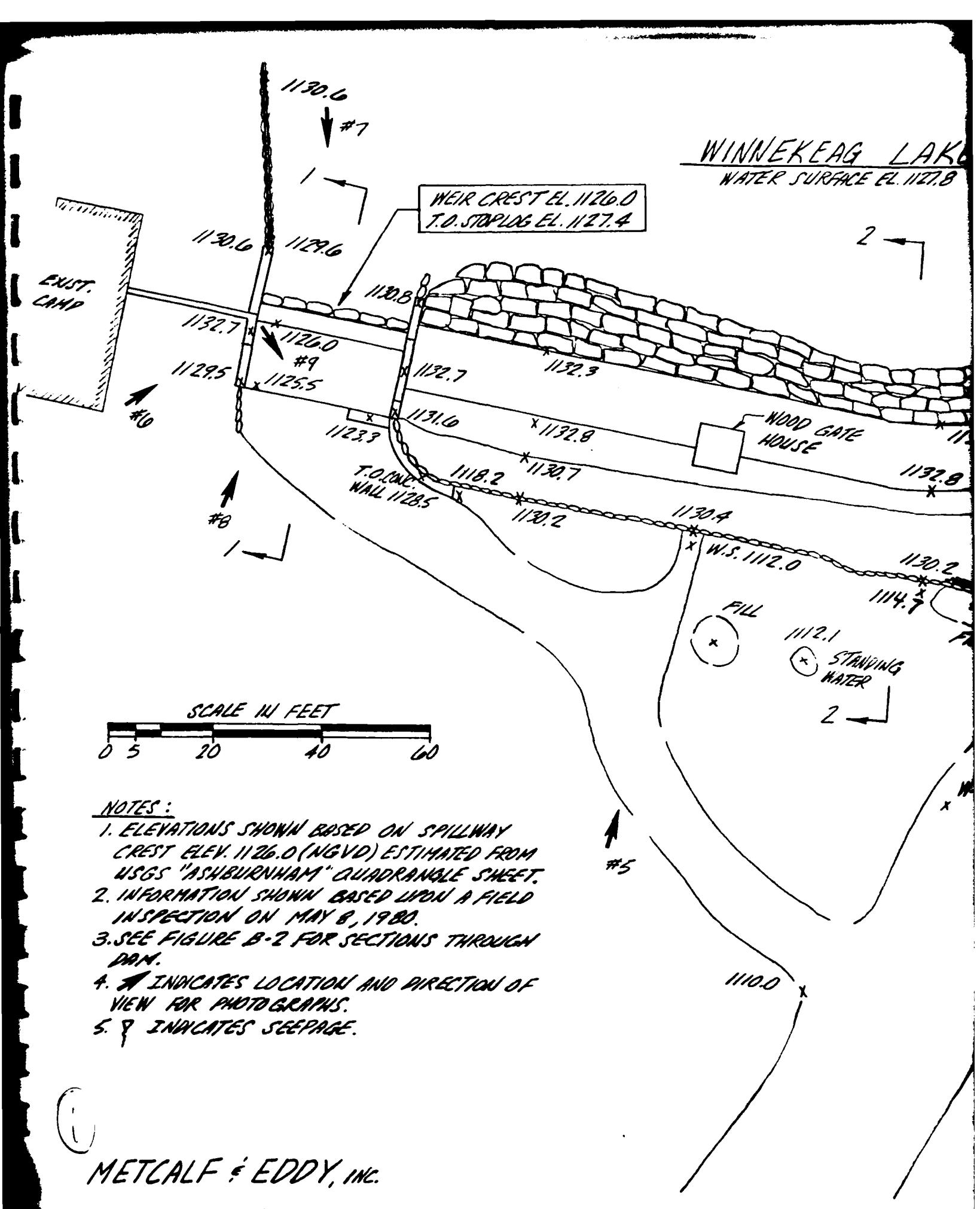
AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None. Timber and rock crib wall along right shoreline is bulging outward at top of wall.
Trees Overhanging Channel	None
Floor of Approach Channel	Submerged, stone base.
b. Weir and Training Walls	Wooden flashboards 1.4 ft.high held in place with four steel pins. Concrete weir and concrete training walls. (1)
General Condition of Concrete	Good. Two cracks on left training wall. one at each end.Crack on u/s end is full width with void underneath.
Rust or Staining	Slight stain below waterline.
Spalling	U/s end of left training wall has some spalling mostly below waterline. (2)
Any Visible Reinforcing	None
Any Seepage or Efflorescence	Slight efflorescence at crack at d/s end of left training wall.
Drain Holes	None
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	Very little
Trees Overhanging Channel	Two large trees just d/s of right training wall, several trees farther d/s.
Floor of Channel	Mostly natural rock
Other Obstructions	Loose stones, minor debris, stumps and logs.

(1) D/s end of left concrete training wall curves 90 degrees around face of embankment. D/s end of right concrete training wall terminates mortared stone. Concrete weir extends about 3 feet u/s of flashboards.

(2) Spalling of concrete weir d/s of flashboards.

APPENDIX B

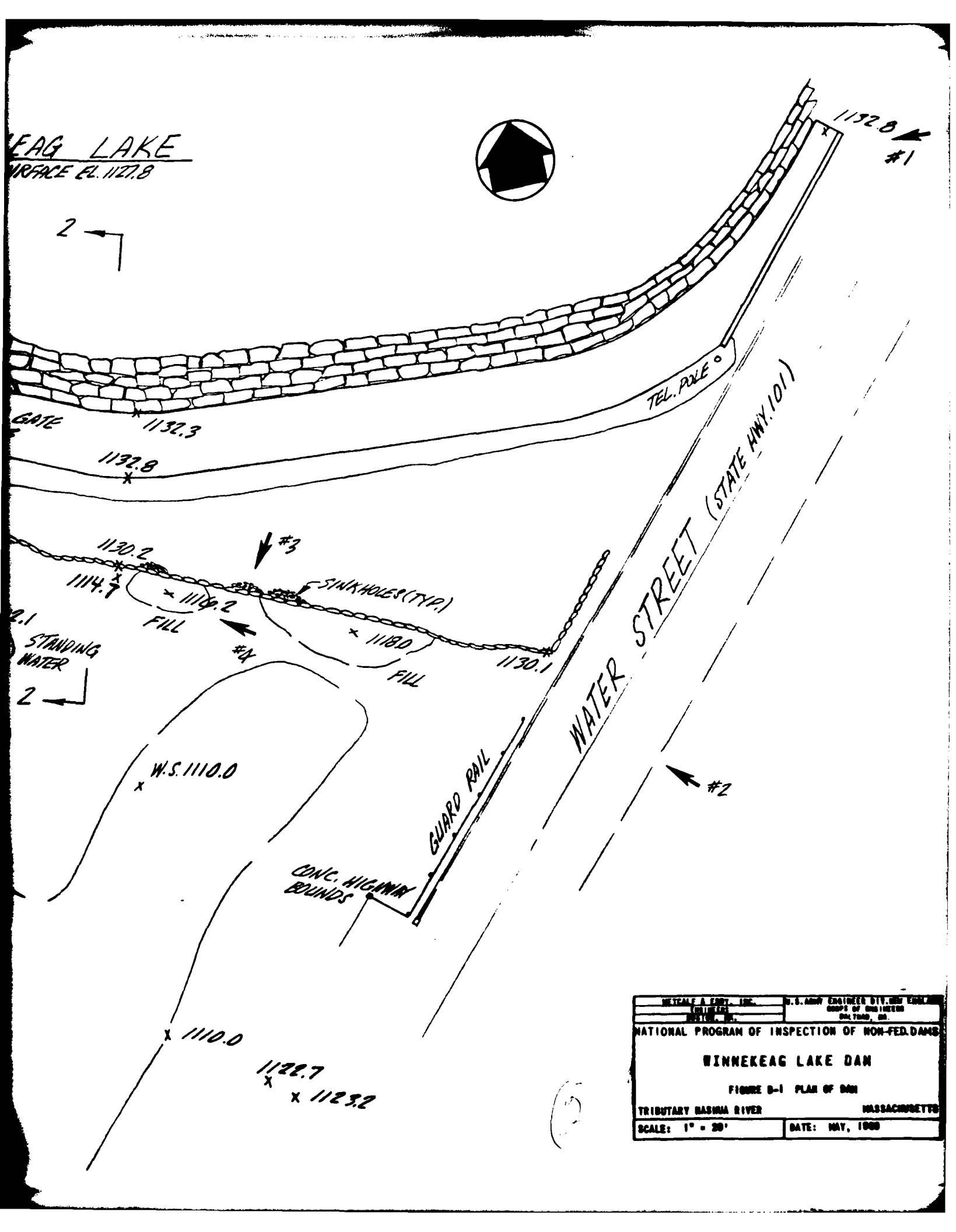
PLANS OF DAM AND PREVIOUS
INSPECTION REPORTS



NOTES:

1. ELEVATIONS SHOWN BASED ON SPILLWAY CREST ELEV. 1126.0 (NGVD) ESTIMATED FROM USGS "ASHBURNHAM" QUADRANGLE SHEET.
2. INFORMATION SHOWN BASED UPON A FIELD INSPECTION ON MAY 8, 1980.
3. SEE FIGURE B-2 FOR SECTIONS THROUGH DAM.
4. ↗ INDICATES LOCATION AND DIRECTION OF VIEW FOR PHOTOGRAPHS.
5. ? INDICATES SEEPAGE.

METCALF & EDDY, INC.



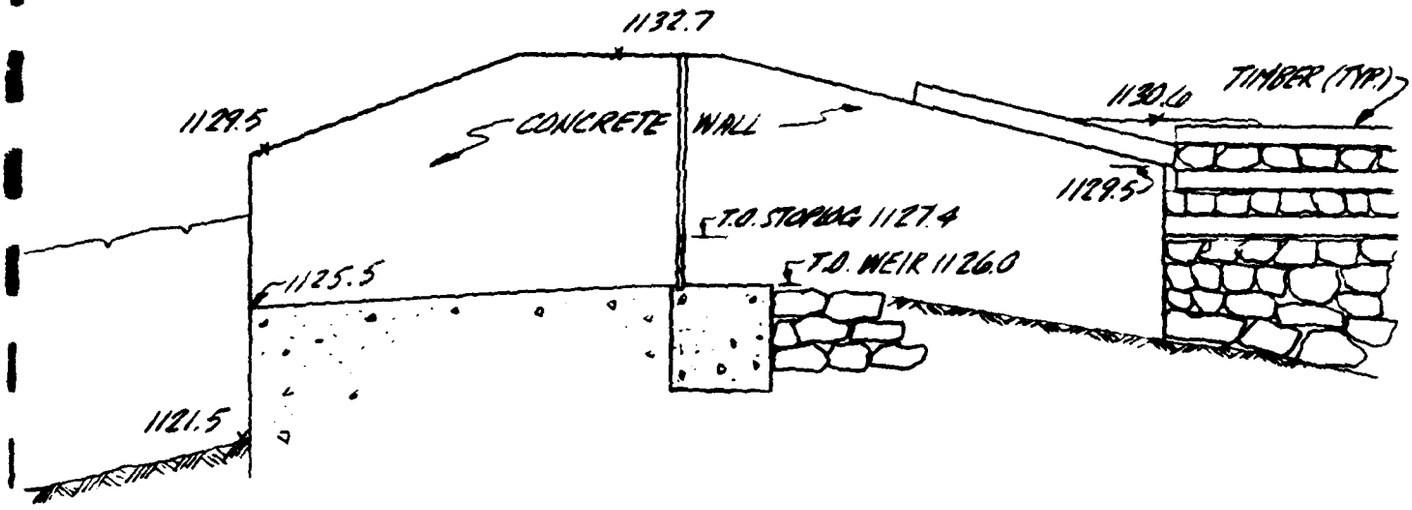
METCALF & EDDY, INC. ENGINEERS BOSTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

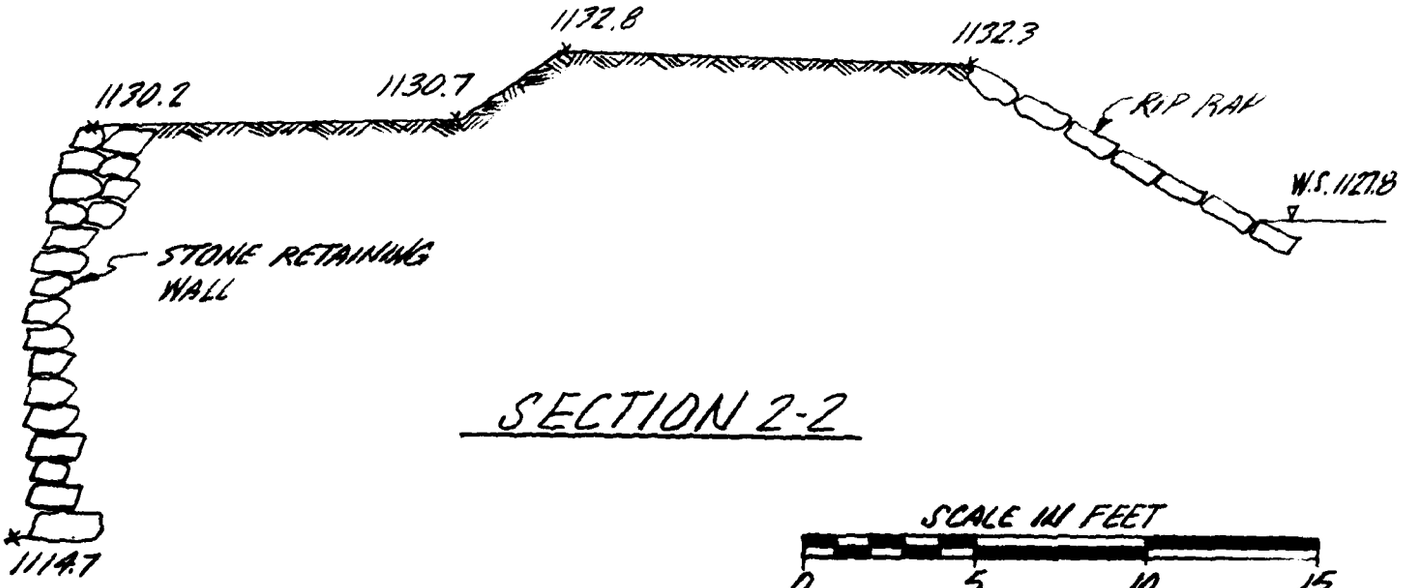
WINNEKEAG LAKE DAM

FIGURE B-1 PLAN OF DAM

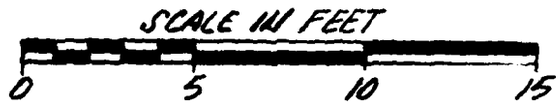
TRIBUTARY BASHUA RIVER	MASSACHUSETTS
SCALE: 1" = 20'	DATE: MAY, 1968



SECTION 1-1



SECTION 2-2



NOTES:

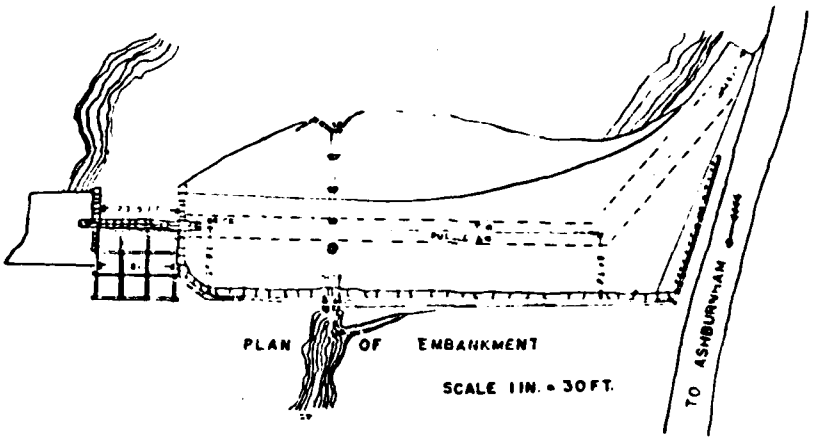
1. ELEVATIONS SHOWN BASED ON SPILLWAY CREST ELEV. 1126.0 (NGVD) ESTIMATED FROM USGS "ASHBURNHAM" QUADRANGLE" SHEET.
2. INFORMATION SHOWN BASED UPON A FIELD INSPECTION ON MAY 8, 1980.
3. SEE FIGURE 8-1 FOR PLAN OF DAM.

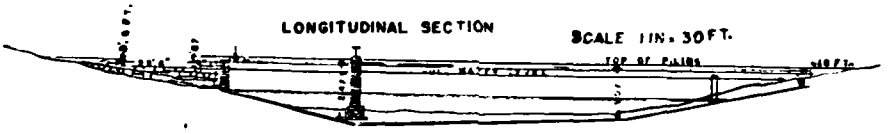
METCALF & EDDY, INC. BOSTON, MA.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	
WINNEKEAG LAKE DAM	
FIGURE 8-2 SECTIONS OF DAM	
TRIBUTARY NASHUA RIVER	MASSACHUSETTS
SCALE: 1" = 5'	DATE: MAY, 1980

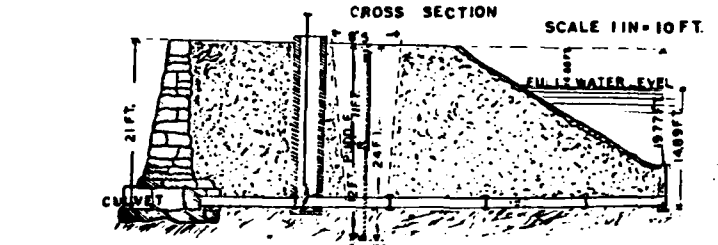
METCALF & EDDY, INC.

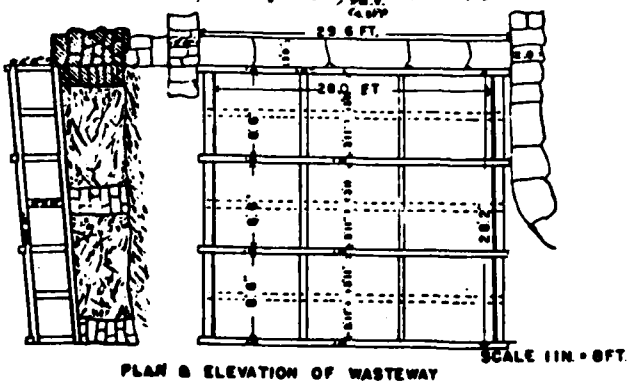
ASHBURNHAM 1 SHEET

RICE POND RESERVOIR
ASHBURNHAM MASS
OCT. 29, 1878.









PLAN & ELEVATION OF WASTEWAY

THOMAS C. SHELDON, ENGINEER
FITCHBURG, MASS

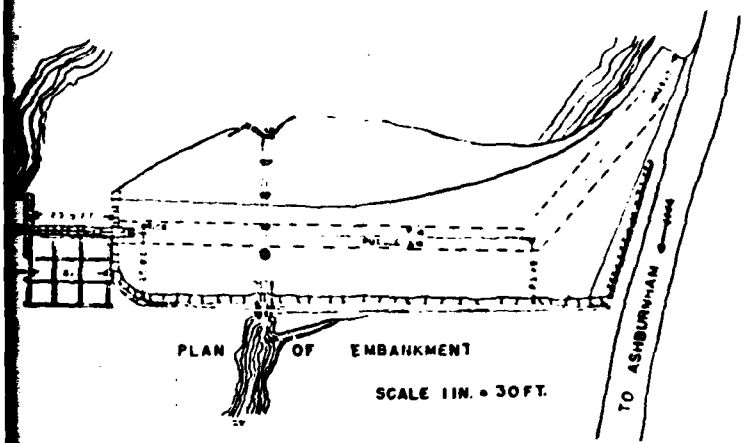
NOTE:
PLAN REDUCED
FOR THIS REPORT

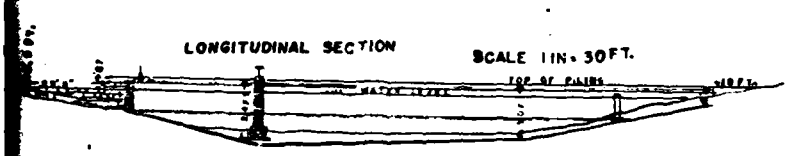
DAM NO. 0

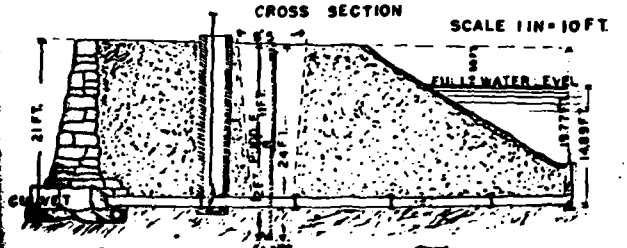
WINNEKEAG LAKE DAM

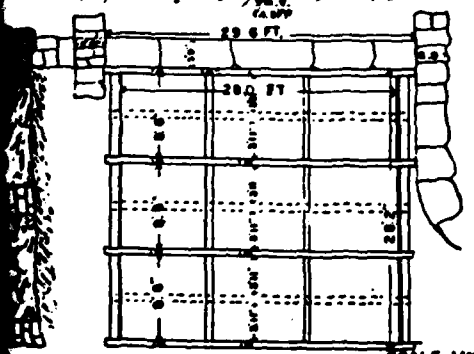
ASHBURNHAM 1 SHEET

RICE POND RESERVOIR
ASHBURNHAM MASS
OCT. 29, 1878









PLAN & ELEVATION OF WASTEWAY

THOMAS C. SHELDON, ENGINEER
FITCHBURG, MASS.

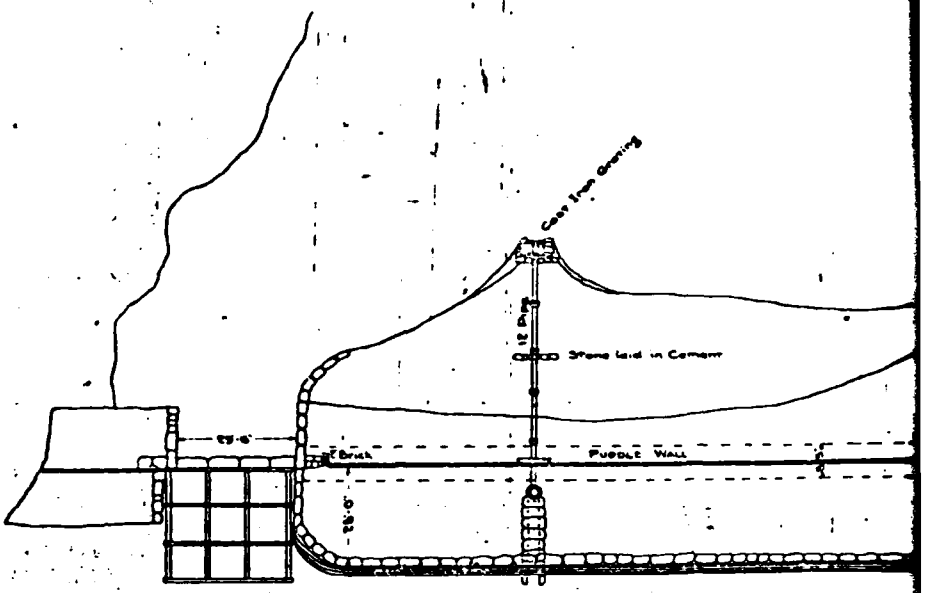
NOTE:
PLAN REDUCED
FOR THIS REPORT

WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT
PLAN OF
RICE POND RESERVOIR
ASHBURNHAM, MASS.
FOR GEORGE BLACKBURN & CO.
AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS
DEC. MEETING DOCKET
SCALES AS NOTED

TRACED BY: P PEZZELLA	DAM NO. 01-32
TRACING CHECKED BY: W.O.L.	
APPROVED: DEC. 1878 BY:	

DAM NO. 01-32

WINNEKEAG LAKE DAM FIGURE B-3

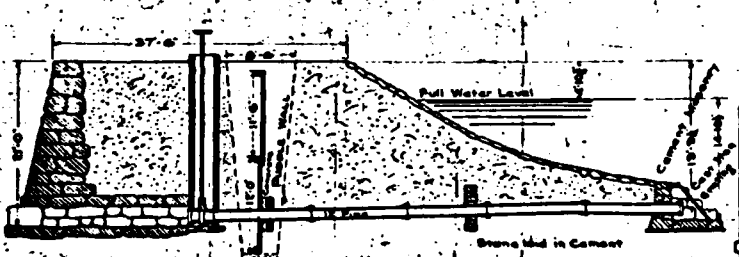


PLAN OF EMBANKMENT

Scale 1 inch = 20 Ft.

LONGITUDINAL SECTION

Scale 1 inch = 20 Ft.



CROSS SECTION

Scale 1 inch = 10 Ft

PLAN of DAM

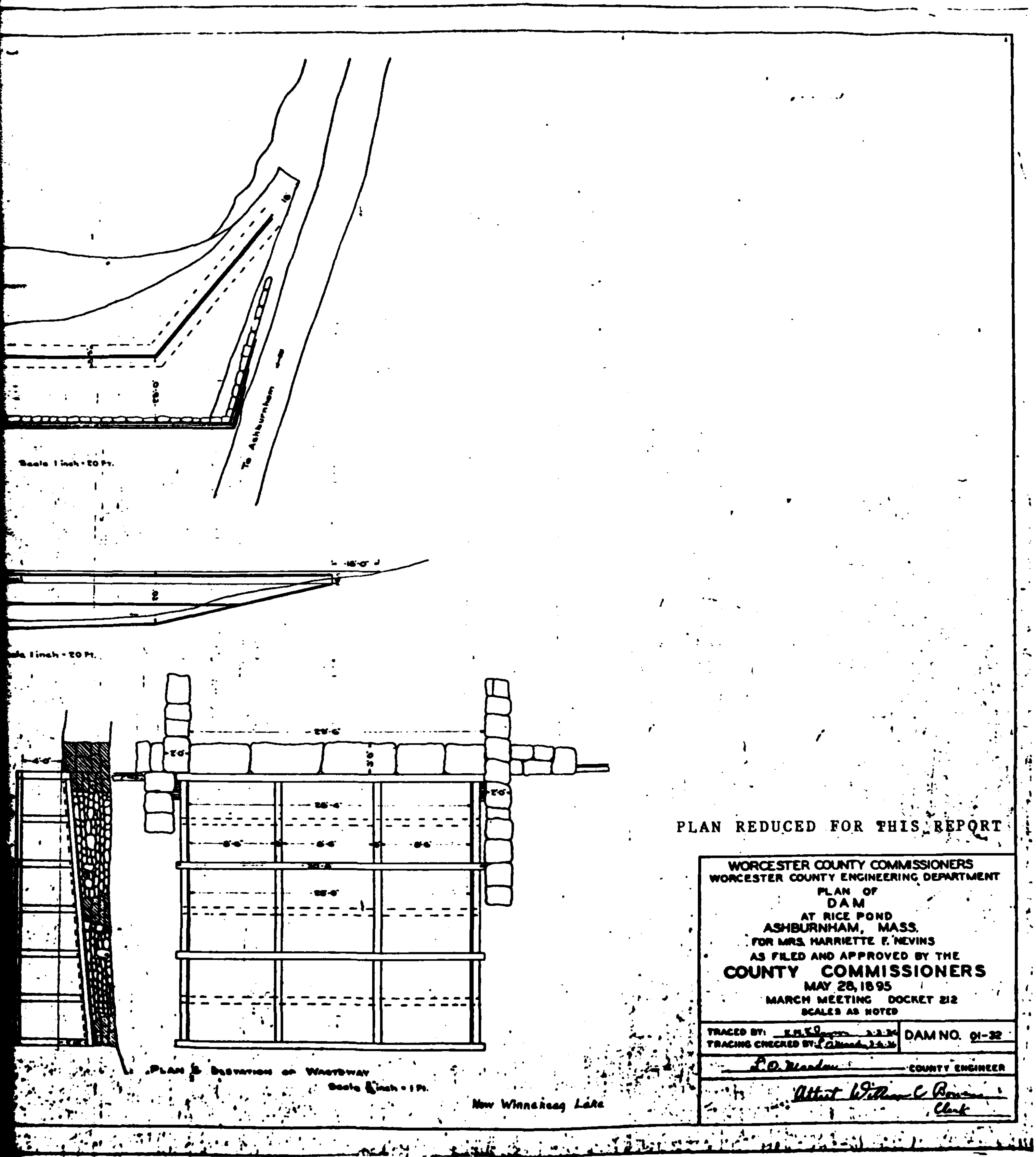
RICE POND RESERVOIR

Ashburnham Mass.

Mrs. Harriette F. Nevins

May 21, 1895

Hart L. Nelson



PLAN REDUCED FOR THIS REPORT

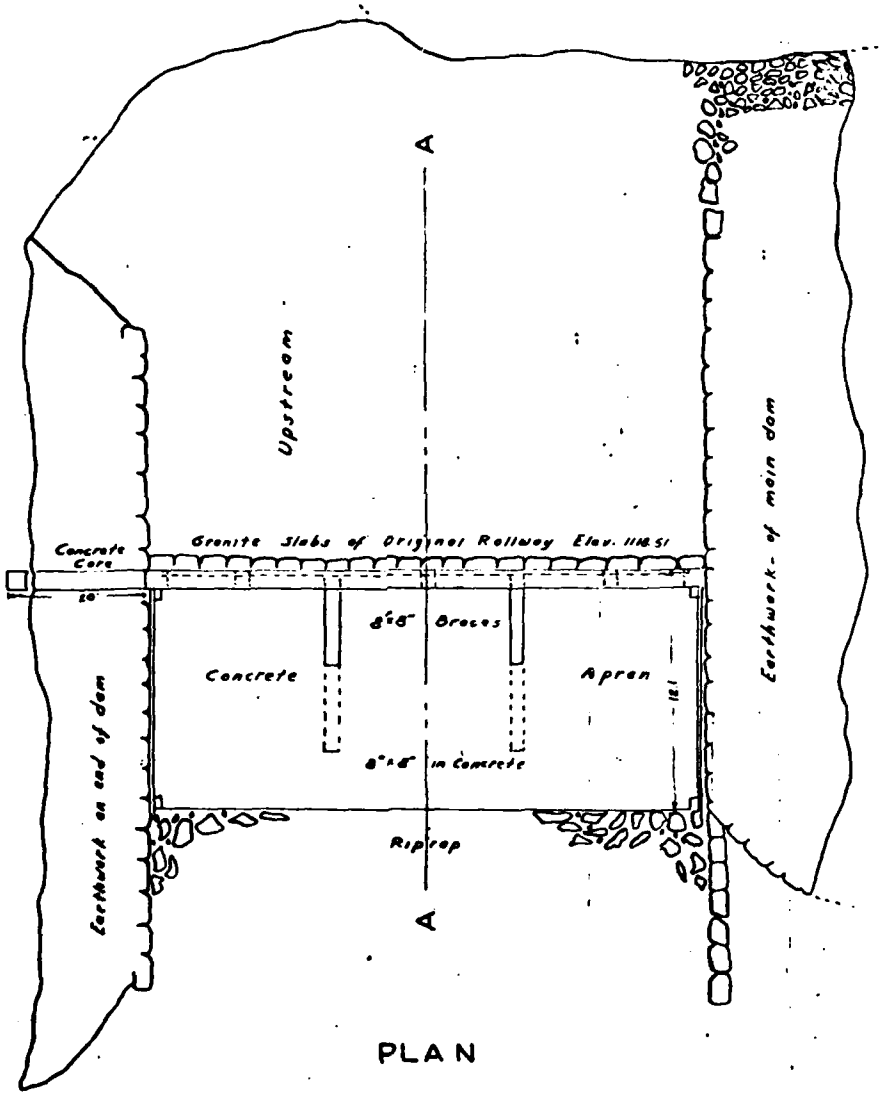
WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT
PLAN OF
DAM
AT RICE POND
ASHBURNHAM, MASS.
FOR MRS. HARRIETTE F. NEVINS
AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS
MAY 28, 1895
MARCH MEETING DOCKET 212
SCALES AS NOTED

TRACED BY: [illegible]
TRACING CHECKED BY: [illegible]
DAM NO. 01-32

L. O. Marden COUNTY ENGINEER

Attest William C. [illegible]
Clerk

WINNEKEAG LAKE DAM FIGURE B-4



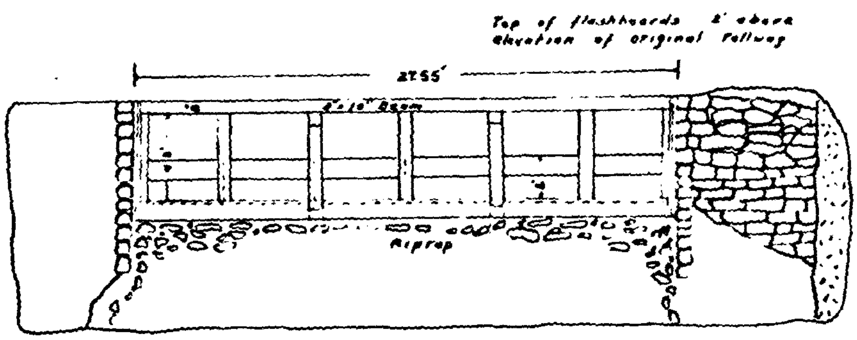
PLAN

PLAN OF ROLLWAY RICE

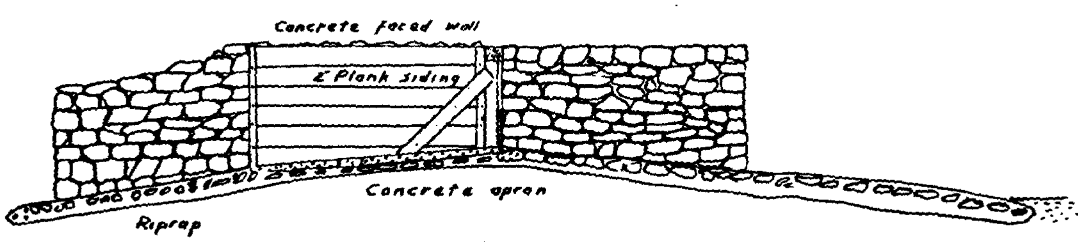
SCALE: 1" = 4'

PARKER BATEMAN AND CHA

Note: Filed and Approved Plan gives Height of Flowage 2' above Rollway or to Elev [illegible]



ELEVATION



NOTE:
PLAN REDUCED
FOR THIS REPORT

SECTION A-A

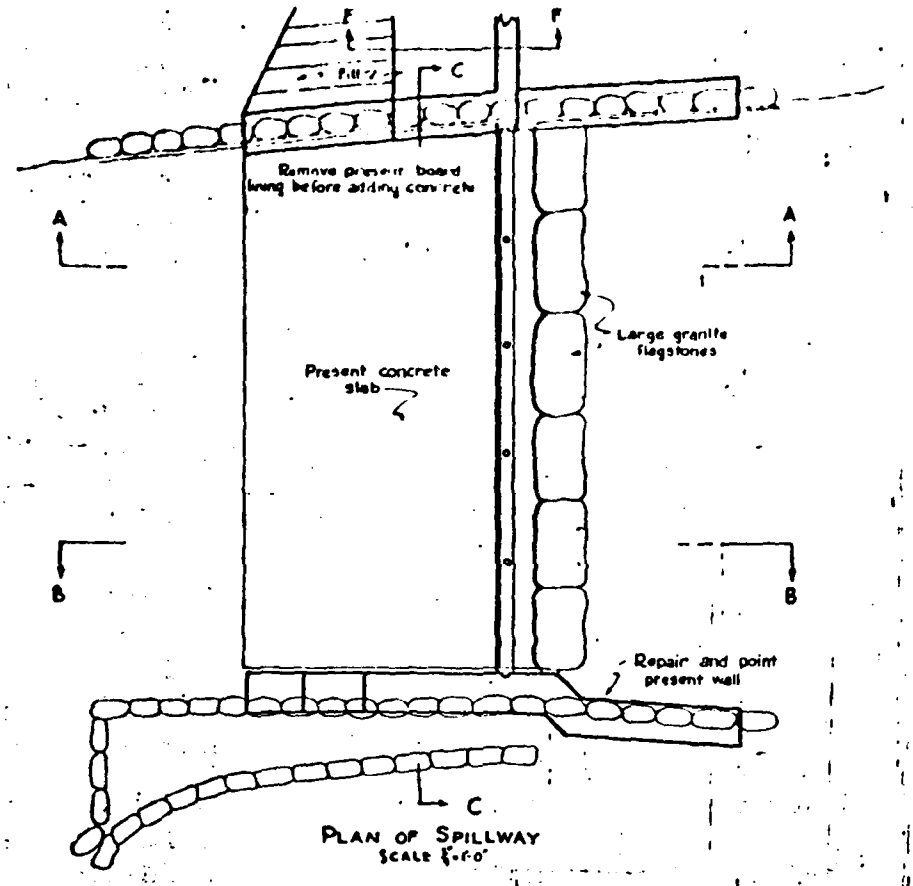
ROLLWAY RICE RESERVOIR
ALE: 1"=4' AUG. 1931
R BATEMAN AND CHASE

WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT
PLAN OF
RICE RESERVOIR

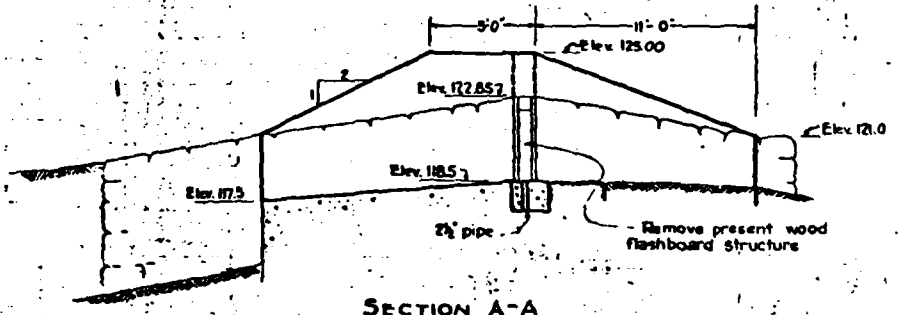
ASHBURNHAM, MASS.
FOR NASHUA RIVER RESERVOIR CO.
AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS

SCALES AS NOTED

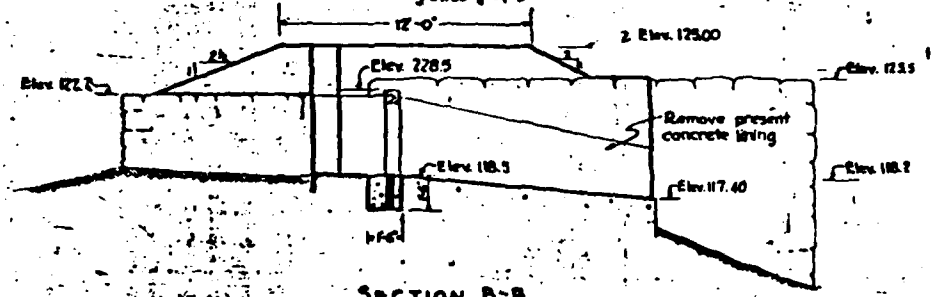
TRACED BY: S.B. TOKARZ	DAM NO. 01-32
TRACING CHECKED BY: [illegible]	
APPROVED SEPT. 1931	



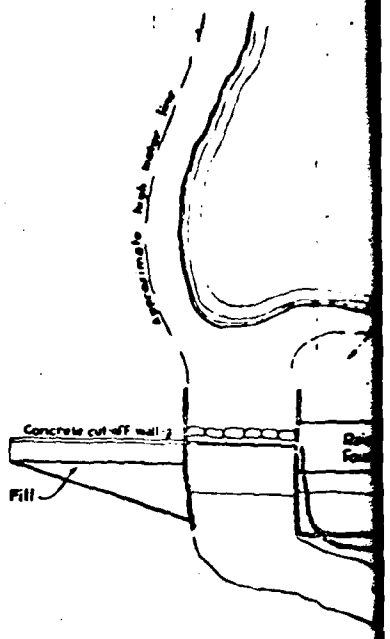
PLAN OF SPILLWAY
SCALE 1/4"=1'-0"

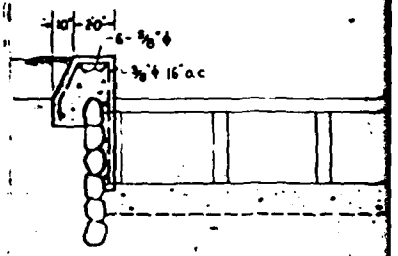


SECTION A-A
SCALE 1/4"=1'-0"

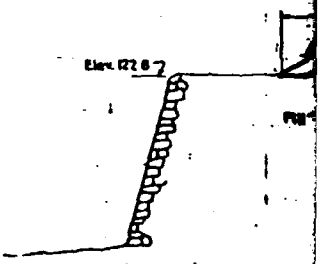


SECTION B-B
SCALE 1/4"=1'-0"

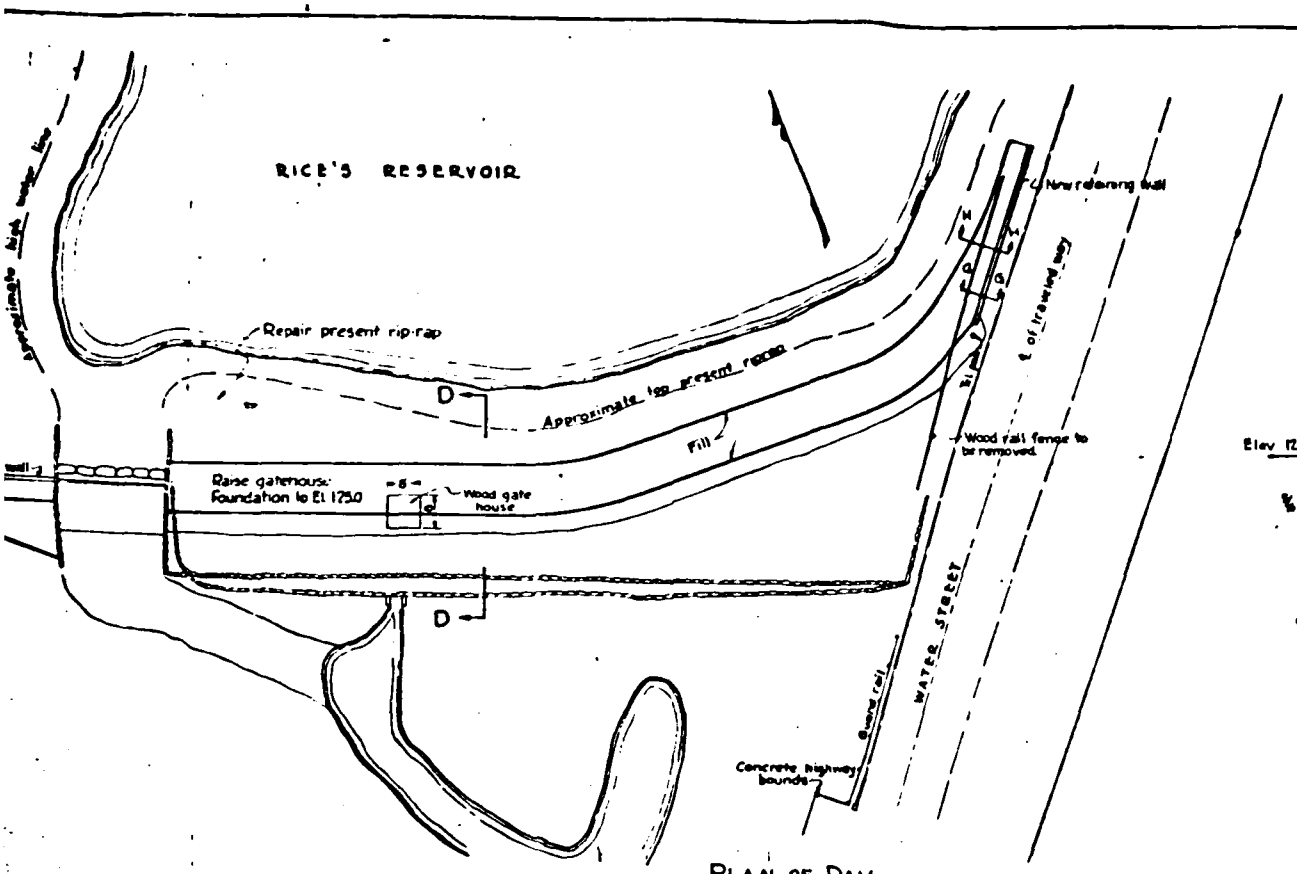




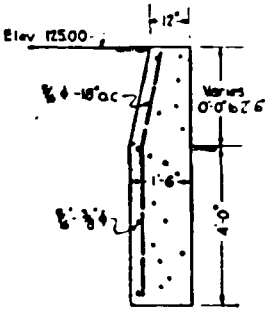
SECTIO
SCALE



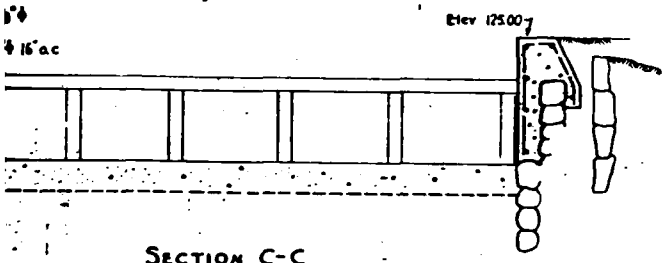
Se



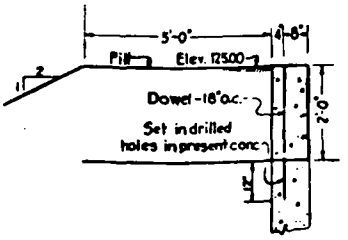
PLAN OF DAM
SCALE 1" = 20'-0"



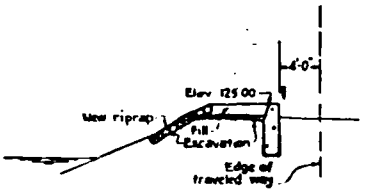
SECTION G-G
SCALE ½"-1'-0"



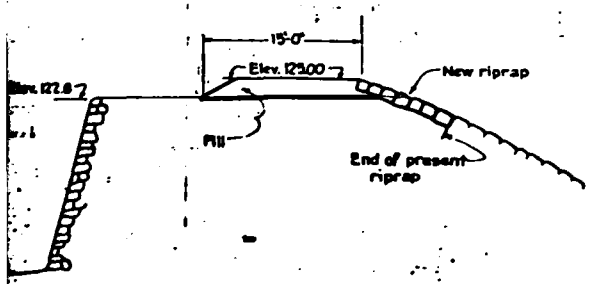
SECTION C-C
SCALE ½"-1'-0"



SECTION F-F
SCALE ½"-1'-0"



SECTION H-H
SCALE ½"-1'-0"



SECTION D-D
SCALE ½"-1'-0"

PLAN REDUCED FOR THIS REPORT

NASHUA RIVER RESERVOIR CO.
CHANGES IN
RICE'S RESERVOIR DAM
HOWARD M. TURNER
CONSULTING ENGINEER
BOSTON
JUNE 6 1930
SCALES-As shown
No. 1

WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT
PLAN OF
CHANGES IN
RICE'S RESERVOIR DAM
IN ASHBURNHAM, MASS.
FOR NASHUA RIVER RESERVOIR CO.
AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS
SCALES AS NOTED

APPROVED JUNE 16, 1930
CHAIRMAN BOARD OF COUNTY COMMRS.
COUNTY COMMISSIONER
COUNTY COMMISSIONER

FOR APPROVAL JUNE 16, 1930
COUNTY ENGINEER

DRAWN BY HOWARD TURNER CONSULTING ENGINEER, BOSTON

DAM NO. 01-32

WINNEKEAG LAKE DAM FIGURE B-6

TOWN OR CITY Ashburnham DEGREE NO. [illegible] NO. 19 DAM NO. [illegible]

LOCATION Rice Pond Reservoir [illegible] C.C. DOCKET NO.

DESCRIPTION OF DAM El. 100		DESCRIPTION OF RESERVOIR & WATERSHED	
Type	Earth dam with Rubble Face - Concrete Spillway	Name of Main Stream	Phillips Brook
Length	190'±	" " tributary Streams	
Height	24'-1"	Length of Watershed	
Thickness top	37'±	Width " "	
" bottom	70-80'	Is Watershed Cultivated	
Downstream Slope	Var.	Percent in Forests	
Upstream "	1½:1	Steepness of Slope	
Length of Spillway	22.3-El.99.4 Top Elev. 1124.0	Kind of Soil	ledge - Hardpan
Size of Gates	3x2 Stone Opening El. 80.0	No. of Acres in Watershed	(2.12 sq mi) 2.6 sq. mi.
Location of Gates	Left center 50' east spillway	" " " " Reservoir	(2.27 S.J.) 310
Flashboards used	None	Length of Reservoir	
Width Flashboards or Gates	None 1122.0 4 on El. 98.0	Width " "	Filed by George [illegible]
Designed by	Thomas C. Sheldon	Max Flow Cu. Ft. per Sec.	1180 c.f.s. Hoyer [illegible]
Constructed by		Head or Flashboards-Low Water	[illegible]
When constructed	1878	" " " -High "	Top Elev. 1126.0

GENERAL REMARKS	GENERAL REMARKS
Vol 28, P. 323 - May 29, 1895.	Foundation - Ledge
Mr. Harriette F. Howe	Recent repairs - None
Owned by Nashua Reservoir Co.	Leakage - near bulge in wall [illegible]
(Crocker-Burbank Co., Fitchburg, Mass.)	Condition - Slight bulge in wall 65 [illegible]
Docket # 212 Meeting March 1895 Filed May 29 1895	
Traced by: K.M. Finlayson - Mar. 3, 1936	Inspected: Oct. 9, 1924
Checked by: L.O. Marden - Mar. 6, 1936	" Oct. 30, 1927
Attested by: William C. Bowen C of C	" Sept. 26, 1928 1124.[illegible]
March meeting 1936	" Aug. 12, 1931 1122.[illegible]

Inspected: Dec. 3, 1931 [illegible] [illegible]
" : Sept. 17, 1933 - L.O. Marden. (Field Book X 49 - P. 68)
" : Apr. 14, 1935 - L.O. Marden
" : Oct. 14, 1938 - M. A. Casella
Jan. 6, 1939 - L. H. Spofford
" : June 6, 1939 - L.O. Marden.
" " March 1, 1939 - Br. P. St. John Patrol
Patrol " " 16, 1939 - M. F. Hunt.
Inspected : April 7, 1941 - L. O. M.
" Dec. 19, 1942 M. F. Hunt
" Feb. 28, 1944 - L. O. Marden
" Sept. 29, 1945 - LOM. + MFH
" July 8, 1948 - L.O.M
" Jan 14, 1949 L.O.M.
" Jan 26, 1950 "
" Mar. 15, 1951 "

June 1960 Repairs to Spillway 1961 1961

Inspected - Sept 26 1928 LOM, LCF - Bk 54 Pg 66 [illegible]

01-32

Decree No. Dam No. 01-21

COUNTY OF WORCESTER, MASSACHUSETTS
OFFICE OF COUNTY ENGINEER

Neg. Nos.

INSPECTION OF DAMS, RESERVOIR DAMS AND RESERVOIRS

Town Ashburnham Date Oct. 9. 1924 Dam No.

Location N. Ash. Cent. Name of Pond or Stream Phillips Brook (Blackburn Reservoir or Rice Pond or (Winnekeag Lake)

Inspected by L. O. Marden

Owner Crosker Burbank Fitchburg Use Reservoir

MATERIAL & TYPE Earth 4:1 downstream, rubble wall cone spill, stone sides

Elevations in feet: above (+) or below (–) full pond or reservoir level.

FOR DAM Bed of stream below 80 top of spillway 95.4

FOR RESERVOIR

top of dam 100 top of flashboards 98 if on ground surface below 81

level of overflow pipe 322 opening El. 6 length in feet 185'

width top in feet 38 more width bottom in feet 68- size pipe to mill

inches length spillway in feet 24.3 head in feet draft 24.

Size of wheel H. P. developed

Size of gates location of gates 50 ft east spill section

Foundation and details of construction hedge granite bleek walls laid loose

condition of embankment good cut off brush at trees

Constructed by date

Designed by location

Recent repairs and date none

Evidence of leakage possible leak near bulge wall 45' from Hy. recommend fill with gunite at this point.

Condition

Topography of country below wooded valley - med to steep slopes

Nature of buildings and roads below dam none ½ mile below

No. Acres in watershed No. Acres in pond

Plans secured Percent watershed in cultivation

Percent in forests Note: Cross out word not applicable

Decree No. Dam No.

COUNTY OF WORCESTER, MASSACHUSETTS
OFFICE OF COUNTY ENGINEER

Neg. Nos.

2nd INSPECTION OF DAMS, RESERVOIR DAMS AND RESERVOIRS

Town Ashburnham Date Oct.28, 1927 Dam No. 31 01-02

Location Ashburnham Center Name of Pond or Stream Phillips Brook Blackburn Reservoir.

Inspected by L.O.Marden

Owner Nashua Reservoir Co.,Fitchburg Use Storage reservoir.

MATERIAL & TYPE See first report.

Elevations in feet: above (+) or below (−) full pond or reservoir level.

FOR DAM Bed of stream below top of spillway

FOR RESERVOIR

top of dam top of flashboards ground surface below

level of overflow pipe length in feet

width top in feet width bottom in feet size pipe to mill

inches length spillway in feet head in feet

Size of wheel H. P. developed

Size of gates location of gates

Foundation and details of construction

condition of embankment cut off trees and brush

Constructed by date

Designed by location

Recent repairs and date none.

Evidence of leakage

Condition same bulge in wall- is no worse-has been there for years according to the Crocker-Burbank Co.

Topography of country below

Nature of buildings and roads below dam

No. Acres in watershed No. Acres in pond

Plans secured Percent watershed in cultivation

Percent in forests Note: Cross out word not applicable

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by Marden-Farrar Date 9-2 6-1928 Dam No. 01-32

Town Ashburnham Location Winnekeag Lake or Rice Res.

Owner Nashua River Res. Co. Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition clean brush out of spillway-keep flashboards off remainder of winter-

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition repair bulge in embankment with concrete retaining wall.

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by Farrar-Grover-Herholz Date 8-12-31 Dam No. 01-32

Town Ashburnham Location Winnekeag Lake or Rice Reservoir.
Owner Nashua River Res Co. Use
Material and Type measured-Field Book X49-Page 68

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed
Width top Abutment Width top Crest Width bottom Spillway
Width Flashboards carried Kind Flashboards
El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe
Kind of Foundation under Spillway
Condition

EMBANKMENT

El. Top El. Natural Ground Width Top
Width of Bottom Upstream Slope Downstream Slope
Kind of Corewall Riprap
Material in Embankment Foundation
Condition

GATES Location
Size Kind El. Flowline
Condition

WHEEL Kind Size Rated H. P.
Location Ave. Head
Evidence of Leaks in Structure

Recent Repairs and Date
Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles
Discharge in Second Feet per Square Mile
Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.Marden Date Aug.12,1951 Dam No. 01-61

Town Ashburnham Location Rice Res. or Lake Winnekeag.

Owner Nashua River Res. Use Storage.

Material and Type Conference with C.T.Crocker of Crocker-Burbank Co., re flashboards-old deed states 24 inches-will use.

Dam Designed by Constructed by Year

SPILLWAY—Length Feet. Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition east abutment wall has fallen in - will need wall relaid.

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

32

Inspected by L.O.Marden Date 8-17-1953 Dam No. 01-21

Town Ashburnham Location - Rice Reservoir.

Owner Crocker-Burbank & Co. Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet. Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition flashboards in place on dam-water at waistway level-is not flowing over boards.

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom: Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition bulge in downstream wall is no worse. brush has been cut off of embankment.

GATES Location

Size Kind El. Flowline

Condition open

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure none visible.

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.Marden Date April 14,1935 Dam No. 01-32

Town Ashburnham Location Ricer Reservoir.

Owner Nashua River Res. Co. Use storage.

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet. Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition OK

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition recommend that bulge mentioned in reports in past, be buttress by concrete wall.

GATES Location

Size Kind El. Flowline

Condition OK

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by M. H. Casella Date Oct 14, 38 Dam No. 01-32

Town Ashburnham Location Lake Winnekeag

Owner Nashua River Reservoir Co. Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY HW about 1.5' above flashboards

El. top Abutment El. Crest El. Apron El. Streambed

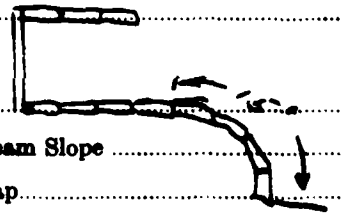
Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried 20" high Kind Flashboards Plank in 4 sects 28' total

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway Little water flows under the foundation

Condition of spillway OK



EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition 15' of stone wall is down should be repaired

GATES were open during flood Location 2'x3' box under embankment

Size Kind El. Flowline

Condition OK

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date None

Topography of Country below Dam

EXAMINED 4-10-39

P. O. Marden

COUNTY ENGINEER

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. H. Spofford **Date** 1/6/89 2 PM **Dam No.** 01-32

Town Ashburnham **Location** Lake Winnekeag

Owner Nashua River Reservoir Co **Use** Impounding

Material and Type Earth Embankment

Dam Designed by **Constructed by** **Year**

SPILLWAY

El. top Abutment **El. Crest** **El. Apron** **El. Streambed**

Width top Abutment **Width top Crest** **Width bottom Spillway**

Width Flashboards carried 20" **Kind Flashboards** Manually operated in wooden frames

El. Flowline Cleanout Pipe **Size and Kind Cleanout Pipe**

Kind of Foundation under Spillway

Condition Good condition. It is about 3 ft below crest of spillway - entire regulation by gates - Pond level has evidently been reduced about 3 feet since formation of ice.

EMBANKMENT

El. Top **El. Natural Ground** **Width Top**

Width of Bottom **Upstream Slope** **Downstream Slope**

Kind of Corewall **Riprap**

Material in Embankment **Foundation**

Condition Good

GATES **Location** In gate house

Size **Kind** **El. Flowline**

Condition Apparently good.

WHEEL **Kind** **Size** **Rated H. P.**

Location **Ave. Head**

Evidence of Leaks in Structure One very small leak mid way of the embankment - not serious

Recent Repairs and Date None

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond **Drainage Area in Square Miles**

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by B. L. Johns Date March 1-'39 Dam No. 01-32

Town Ashburnham Location Rice Reservoir

Owner Nashua River Reservoir Co Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried None Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Good. No water going over spillway. Water about 3½ or 4' below Crest.

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Water about 9 feet below top of dam.

GATES Location

Size Kind El. Flowline

Condition A small stream of water coming through gates

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by R.P.St.John Date March 1,1938 Dam No. 01-32

Town Ashburnham Location Rice Reservoir (Winnekeag Lake)

Owner Nashua River Res. Assoc. Use

SPILLWAY

El.top abutment El.Crest El.Apron El.St.Bed

Width top Abut. Width top Crest Width bottom Sp.way

Width flashboards Kind Flashboards

El.Flowline Cleanout Pipe Size and Kind Pipe

Kind of Foundation under Spillway

Condition no water passing crest of spillway

no flashboards in place.

EMBANKMENT

El. Top El.Natural Ground Width Top

Width of Borrom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES Location

Size Kind El.Flowline

Condition water going thru gategate about one-half open.

Evidence of Leaks in Structure

Recent Repairs and Date

Number Acres in Pond Drainage Area in Sq. Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by V. T. Dunn Date March 16, 1934 Dam No. 01-32

Town Ashburnham Location Pine Meadow

Owner Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Water 4 ft below spillway crest
Gate open

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by L. O. Warden Date April 7, 1941 Dam No. 01-32

Town Ashburnham Location Winnekeag Lake

Owner Nashua River Pap Co Use

SPILLWAY

El. top abutment El. Crest El. Apron El. Ct. Bed

Width top Abut. Width top Crest Width bottom Sp.way

Width flashboards Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Pipe

Kind of Foundation under Spillway

Condition Spillway not deepened as ordered by the County Com -

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Borrom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Bulged stone wall not supported by a concrete bottom as recommended - otherwise above par.

GATES Location

Size Kind El. Flowline

Condition Ok.

Evidence of Leaks in Structure

Recent Repairs and Date

Number Acres in Pond Drainage Area in Sq. Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by M.F. Hunt Date 12-19-42 Dam No. 01-32

Town Ashburnham Location Lake Winnekeag

Owner Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition O.K. 2.5' ± flashboards on - Pond full - Both Engineers recommended that spillway be deepened at least 2½ feet. Lon

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition O.K. No leaks visible - Snow

GATES Location

Size Kind El. Flowline

Condition O.K. - Rusty appearance

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by LOM D.P. TJ Date 1-3-94 Dam No. 01-32

Town Ashburnham Location

Owner Nashua River Pap Co. Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Flashboards removed - logs in spillway

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition OK

GATES Location

Size Kind El. Flowline

Condition appears OK

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure none appears

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by LOM MFH Date 9-29-45 Dam No. 01-32

Town Ashburnham Location Winnekeag Lake

Owner N.R.R. - Lus. Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition No alterations Should deepen some masonry part

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition About 30' East Gate Wash out earth & riprap fix - cut out grass and brush & mort in riprap wall & Emb

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure None visible

Recent Repairs and Date None

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

TOWN Ashburnham DAM NO. 01-22

LOCATION Winnekeag Lake STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Nashua River Reservoir Company, Fitchburg USE storage

INSPECTED BY L.O.Marden DATE July 8,1948

TYPE OF DAM earth dam CONDITION good

SPILLWAY

FLASHBOARDS IN PLACE one row RECENT REPAIRS none

CONDITION cement joints-spillway should be enlarged.

REPAIRS NEEDED enlarge spillway according to approved plans

EMBANKMENT

RECENT REPAIRS filled hole upstream side with riprap

CONDITION cut off brush and grub out roots.

REPAIRS NEEDED cut off brush and grub out roots

GATES

RECENT REPAIRS none

CONDITION gate house locked

REPAIRS NEEDED think none.

LEAKS

HOW SERIOUS some seepage

DATE

COUNTY ENGINEER

TOWN Ashburnham DAM NO. 01-32

LOCATION Winnekeag Lake STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Nashua River Res.Co. PLACE Fitchburg USE storage

INSPECTED BY L.V.M-E-Foss DATE Jan.14,1949

TYPE OF DAM Erath-downstream dry support wall CONDITION good except spillw never deepened

SPILLWAY

FLASHBOARDS IN PLACE yes RECENT REPAIRS none

CONDITION same-H-M-Turner of Boston made plans to deepen spillway as 1936 & 1938 flood could not be handled. Emb. sandbagged after each flood

REPAIRS NEEDED should rebuild spillway

EMBANKMENT

RECENT REPAIRS none, except placed two loads of stone where riprap washed out. Should have backfilled embankment, and then placed riprap.

CONDITION otherwise good

REPAIRS NEEDED none except above.

GATES

RECENT REPAIRS none

CONDITION Foss says OK

REPAIRS NEEDED none

LEAKS

HOW SERIOUS None visible.

DATE

COUNTY ENGINEER

TOWN Ashburnham DAM NO. 01-32

LOCATION Winnekeag Lake STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Nashua River Res #3 Sec PLACE Fitchburg USE storage

INSPECTED BY LOM DATE Jan. 26. 1950

TYPE OF DAM Earth - downstream stone wall CONDITION Good
Rebuilt Concrete Spillway

SPILLWAY

FLASHBOARDS IN PLACE None - canvas RECENT REPAIRS Yes rebuilt

CONDITION Rebuilt deeper, so that it will handle flood of Jan 1950

REPAIRS NEEDED None

EMBANKMENT

RECENT REPAIRS None

CONDITION Covered with brush

REPAIRS NEEDED Grub out roots - - remove brush - fill holes
relay riprap where needed.

GATES

RECENT REPAIRS None

CONDITION appears good.

REPAIRS NEEDED None

LEAKS

HOW SERIOUS None visible

DATE Jan. 26 1950

L.O. Marden
COUNTY ENGINEER

TOWN Ashburnham DAM NO. 01-32

LOCATION Winnekeag Lake STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Nashua R.Res Co. PLACE Fitchburg USE storage

INSPECTED BY LOM-B-Crocker-Foss DATE March 15, 1951.

TYPE OF DAM CONDITION good

SPILLWAY

FLASHBOARDS IN PLACE RECENT REPAIRS

CONDITION

REPAIRS NEEDED spillway rebuilt from plans by H.M. Turner.

EMBANKMENT

RECENT REPAIRS

CONDITION

REPAIRS NEEDED

GATES

RECENT REPAIRS

CONDITION

REPAIRS NEEDED

LEAKS

HOW SERIOUS

DATE

COUNTY ENGINEER

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by B.Crocker -S-Foss L.O.Marden Date Mar.15,51 Dam No. 01-32

Town Winnekeag Lake Location

Owner Nashua River Res. Co. Use water supply storage

Material and Type This dam is in good condition-spillway deepened in accordance with H.M.Turner approved plan.

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition See above

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition upstream slope rebuilt. all brush cut and roots grubbed out. top regraded where necessary-re-riprapped.

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

TOWN Ashburnham DAM NO. 01-32

LOCATION _____ STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Nashua River Pap Co. PLACE Fitchburg USE _____

INSPECTED BY S Fox L O M. DATE 3-15-51

TYPE OF DAM _____ CONDITION _____

SPILLWAY

FLASHBOARDS IN PLACE 20" Flashbds per H. W. Turner RECENT REPAIRS spilling deepened

CONDITION Rebuit OK

REPAIRS NEEDED None

EMBANKMENT

RECENT REPAIRS Raised 2' New Rip rap entire slope

CONDITION Very Good

REPAIRS NEEDED None

GATES

RECENT REPAIRS None

CONDITION Good

REPAIRS NEEDED None

LEAKS

HOW SERIOUS No leaks

DATE 3-15-51

L.O. Marden
COUNTY ENGINEER

TOWN Ashburnham DAM NO. 01-32

LOCATION Ashby Rd. STREAM Phillips Brook

"Lake Winnekeag"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Crocker Burbank Co. Place Fitchburg Use Storage Pond

Inspected by W.O.C. Date Dec. 19 '54

Type of Dam Earth, stone and concrete Condition Good

SPILLWAY

Flashboards in Place 24" of boards Recent Repairs _____

Condition The piers are bent and should be repaired.

Repairs Needed New concrete work has been done at the spillway.

_____

EMBANKMENT

Recent Repairs _____

Condition Good

Repairs Needed There is a slight bulge in the upstream wall.

The present water level is 6" below the top of the bank.

GATES

Recent Repairs _____

Condition Good

Repairs Needed The gate is partly open.

_____

LEAKS

How Serious _____

DATE: _____ County Engineer

TOWN Hubbardston DAM NO. 01-32

LOCATION Rice Rd STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Nashua River Reservoir Co. PLACE USE Impounding

INSPECTED BY L H Gaylord. DATE 10/18/54

TYPE OF DAM CONDITION

SPILLWAY

FLASHBOARDS IN PLACE 2' RECENT REPAIRS none

CONDITION Good

REPAIRS NEEDED none

EMBANKMENT

RECENT REPAIRS none

CONDITION Good

REPAIRS NEEDED

GATES

RECENT REPAIRS Ingate House - apparently O/K

CONDITION

REPAIRS NEEDED

LEAKS

HOW SERIOUS

DATE

COUNTY ENGINEER

TOWN Ashburnham DAM NO. [illegible]

LOCATION Ashby [illegible] STREAM Phillips Brook

"Lake Winnekeag"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Crocker Burbank Co. Place Fitchburg Use Storage Pond

Inspected by [illegible] Date [illegible] 1959

Type of Dam Earth, stone and concrete. Condition Good

SPILLWAY

Flashboards in Place [illegible] Recent Repairs

Condition Good condition.

Repairs Needed New concrete facing work has been done on the downstream easterly wall – this work was done in [illegible]

EMBANKMENT

Recent Repairs There is a slight bulge in the [illegible]

Condition embankment wall. This bulge has remained the

Repairs Needed same for many years.

GATES

Recent Repairs

Condition Good condition

Repairs Needed

LEAKS

How Serious No leaks

DATE: County Engineer

TOWN Ashburnham DAM NO. 01-22

LOCATION Winnekeag Res. STREAM Phillips Brook

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Nashua River Res Co Place _____ Use _____

Inspected by LoM - WoL Date June 8, 1955

Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place _____ Recent Repairs _____

Condition _____

Repairs Needed — _____

_____

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed — _____

_____

GATES

Recent Repairs _____

Condition _____

Repairs Needed — _____

_____

LEAKS

How Serious — _____

DATE: _____ County Engineer

TOWN Ashburnham DAM NO. 01-32

LOCATION W'ly side of Ashby Rd STREAM Phillips Brook

"Lake Winnekeag"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Weyerhaeuser C. Co. Place Fitchburg Use Storage Reservoir

Inspected by MFH-ECC-TCM Date Oct. 5, 1962

Type of Dam Earth-Stone-Concrete Condition Good

SPILLWAY

Flashboards in Place Pin Boards in Place Recent Repairs _____

Condition _____

Repairs Needed _____

_____

EMBANKMENT

Recent Repairs _____

Condition Good

Repairs Needed _____

_____

GATES

Recent Repairs _____

Condition _____

Repairs Needed _____

_____

LEAKS

How Serious _____

DATE: _____ County Engineer

TOWN Ashburnham DAM NO. 01-32

LOCATION Westerly side Ashby Rd. STREAM Phillips Brook

"Winnekeag Lake"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Wachusett [illegible] Place [illegible] Use [illegible]

Inspected by [illegible] Date [illegible]

Type of Dam Earth, stone, concrete. Condition [illegible]

SPILLWAY

Flashboards in Place 24" of pine boards Recent Repairs

Condition This spillway is located on exposed ledge. The flat crest is made of

Repairs Needed a row of granite stones. The concrete abutment walls are

good. A new timber crib retaining wall has been built above the westerly wa[ll]

EMBANKMENT

Recent Repairs There is a slight bulge in the downstream wall

Condition The upstream riprap slope is good. There is a new

Repairs Needed concrete wall along Ashby Rd.

The present water level is about 4' below the spillway crest.

GATES

Recent Repairs

Condition The gate house is locked. The gate is open.

Repairs Needed

LEAKS

How Serious No gate

DATE: County Engineer

TOWN Ashburnham DAM NO. 01-32

LOCATION Wyside of Ashby Rd STREAM Phillips Brook

"Lake Winnekeag"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Weyerhaeuser Co. Inc Place Fitchburg Use Storage Reservoir

Inspected by FEP - ACC Tony Kubec Date Nov. 9, 1964

Type of Dam Earth - Stone - Concrete Condition Good

SPILLWAY

Flashboards in Place 22" of boards Recent Repairs _____

Condition Good - Spillway repaired a few yrs ago.

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition Good

Repairs Needed _____

GATES

Recent Repairs _____

Condition Good - Gate open

Repairs Needed _____

LEAKS

How Serious None visible

DATE: _____ County Engineer

TOWN *Ashburnham* DAM NO. *31-32*

LOCATION *Westerly side of Ashby Rd* STREAM *Phillips Brook*

"Winnekeag Lake"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by *Weyerhaeuser Co. Inc.* Place *Fitchburg* Use *Storage Reservoir*

Inspected by *[illegible]* Date *Oct 15 1967*

Type of Dam *Earth and Stone Dam* Condition *Good condition*

(Inspected Nov 3 by [illegible] same condition)

SPILLWAY

Flashboards in Place *[illegible] of planks* **Recent** Repairs *none*

Condition *Good condition, except that boards and pins are*

Repairs Needed *beginning to deteriorate and should be renewed.*

Water level is about 12" below top of boards

EMBANKMENT

Recent Repairs

Condition *Good condition*

Repairs Needed

GATES

Recent Repairs

Conditions *Good condition. Gate is located in a [illegible]*

Repairs Needed *gate house and is partly open at time of [illegible]*

LEAKS

How Serious *Seepage is visible in old stream bed just below dam*

DATE:

County Engineer

WINNEKEAG LAKE DAM

TOWN [illegible] DAM NO. 01-32

LOCATION [illegible] STREAM Phillips Brook

Lake Winnekeag

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Nashua River Res Co. Place Fitchburg Use Storage Reservoir

Inspected by E. C. Corcoran Date 3/ [illegible] /67

Type of Dam [illegible] Condition ok

SPILLWAY

Flashboards in Place ______ Recent Repairs ______

Condition ______

Repairs Needed ______

EMBANKMENT

Recent Repairs ______

Condition ______

Repairs Needed ______

GATES

Recent Repairs ______

Conditions ______

Repairs Needed ______

LEAKS

How Serious ______

DATE: ______ ______

County Engineer

WINNEKEAG LAKE DAM

TOWN Ashburnham DAM NO. 31-32

LOCATION Ashby Rd STREAM Phillips Brook

"Lake Winnekeag"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

c/o Peter Hughes. 595 Westminster St

Owned by Weyerhaeuser Co Inc. Place Fitchburg Use Storage Pond

Inspected by WGL Date Oct 17 1968

Type of Dam Earth - stone and concrete Condition Good

SPILLWAY

Flashboards in Place 2 2x12" boards - 19" Recent Repairs

Condition Good

Repairs Needed New 2" planking and new 1½" standard pipe - pin

EMBANKMENT

Recent Repairs

Condition Good

Repairs Needed Grass and brush has been recently cut.

GATES

Recent Repairs Gate is closed

Condition New paint etc on gate house

Repairs Needed

LEAKS

How Serious Small seepage

DATE: County Engineer

TOWN Ashburnham DAM NO. 01-32

LOCATION Winnekeag Lake STREAM Phillips Brook

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Nashua River Pap. Co. Place _____ Use _____

Inspected by M F Hunt Date Nov 15 1968

Type of Dam _____ Condition _____

SPILLWAY New 2- 1.5-ft. permanent flashboards in place.

Flashboards in Place _____ Recent Repairs _____

Condition Boards holding 6"±

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition ok

Repairs Needed _____

GATES

Recent Repairs _____

Condition ok

Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

TOWN Ashburnham DAM NO. Winnekeag Lake 01-32

LOCATION _____ STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Nashua River Reservoir Co. Place _____ Use _____

Inspected by _____ Date 3-6-69

Type of Dam Earthen _____ Condition _____

SPILLWAY

Flashboards in Place Yes — 2 new boards holding back 16" of water ± Recent Repairs _____

Condition clear of obstructions

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES - closed - water 2' ± from high water

Recent Repairs Re inspected 3-13-69 some conditions exist

Condition _____

Repairs Needed _____

Re-check 3 13-69

LEAKS

How Serious _____

DATE: _____ County Engineer

3-14-11-32

INSPECTION REPORT & DATA FOR DAMS

Dam No. 01-32
Town: Ashburnham
Stream: Phillips Brook
Pond: Winnekeag Lake
Date: 12-16-71
By: Eaton & Cano

Owner: Weyerhaeuser Co. Inc.
His Address: 595 Westminster Rd., Fitchburg
Function of Dam: Storage

Location & Access: 200 ft. westerly off Ashby Rd.

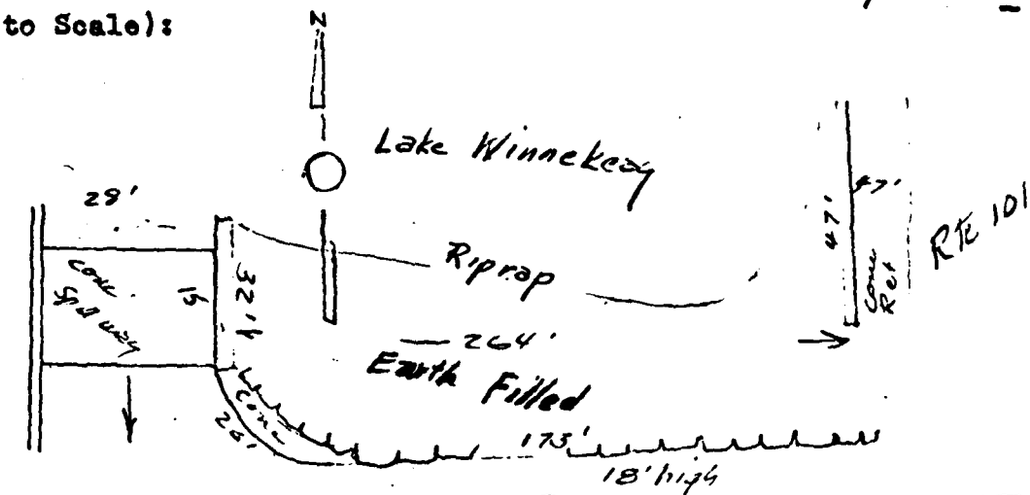
USGS Quad. Ashburnham Lat. 42°39'15" Long. 71°54'10"
Drain.Ar.: 2.6 Sq.Mi.; Ponds: 118 ac.; Res.@dam:
Character of D.A.:

CONDITION RATING
Structural: Ex
Hydraulic: 28 X 20
General: Ex
PRIORITY:

Estimated
Discharge
Capacity:

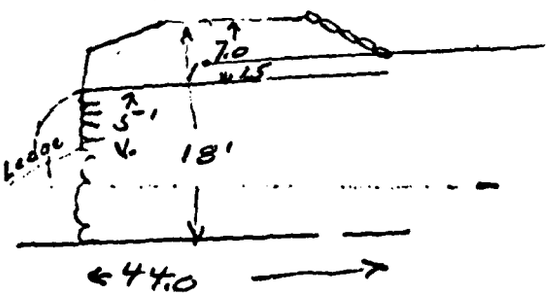
General Description of Dam and Discharge Control:
Cutstone retaining wall Earth filled with riprap on face to water, Concrete spillway with 1.5' Flashboards in place + provision for another 5' Gate mechanism in locked gatehouse

Sketch (Not to Scale):



Remarks and Recommendations:
Sign on gatehouse says Nashua River Water Co owner

Profile



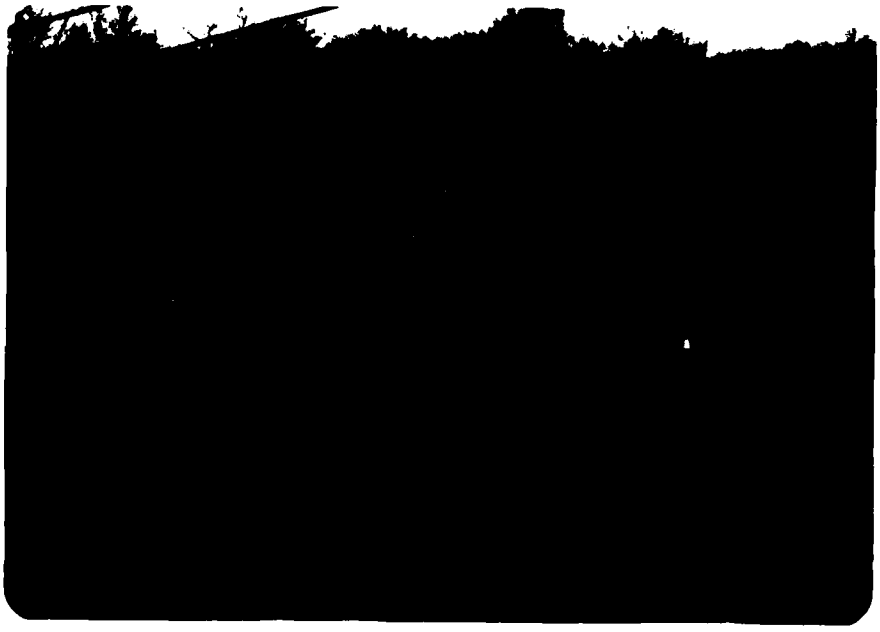
Date 12/16/71 By Eaton+Cano Comment

Dam No. 3-14-11-32

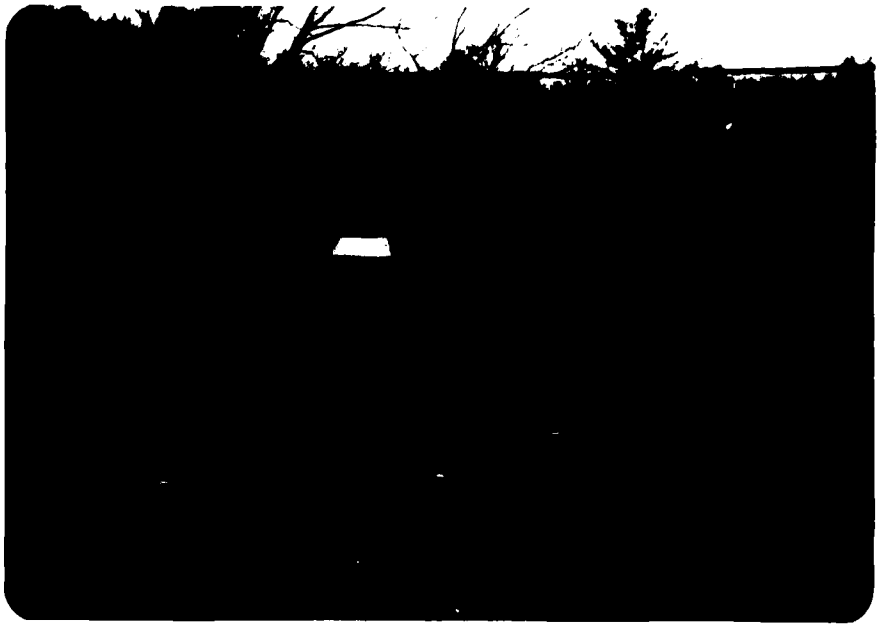
APPENDIX C

PHOTOGRAPHS

Note: Location and direction of photographs shown on Figure B-1 in Appendix B.



NO. 1 UPSTREAM VIEW OF DAM FROM LEFT ABUTMENT



NO. 2 DOWNSTREAM VIEW OF DAM FROM LEFT ABUTMENT

NO. 3 VIEW OF CREST OF DAM

NO. 4 VIEW OF DOWNSTREAM FACE FROM LEFT ABUTMENT

NO. 5 VIEW OF DOWNSTREAM FACE

NO. 6 VIEW OF RIGHT ABUTMENT

NO. 7 UPSTREAM VIEW OF SPILLWAY

NO. 8 DOWNSTREAM VIEW OF SPILLWAY

NO. 9 VIEW OF SPILLWAY DISCHARGE CHANNEL

NO. 10 VIEW OF CULVERT BENEATH STATE HIGHWAY 101

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUATIONS

Project Nat. Review of Non Fed. Dams Acct No 6426 Page 1 of 6
Subject Worcester County, Mass. Compld By LEB Date 6/5/80
Detail WINNEKEAG LAKE Ck'd By RDH Date 6/9/80

(I) Test Flood, Storage & Storage Function

1- Total Drainage Area - 2.08 mi²

2- Pond(s) Area:
Swamp(s) Area: 0.11 + .06 + .02 + .14 = 0.29 " 0.05 mi²
Total Area Pond(s) & Swamp(s): 0.34 "

% Ponds & Swamps = $\frac{0.34}{2.08}$ = 16.3%

3- $\frac{1595-1126}{8600} = .0545$; $\frac{1251-1126}{8450} = .0148$ } Say Ave Slope = 3.5%

4- Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be between "Rolling" and "Flat & Coastal" and taken at 1450 c.f.s./mi
Size Class: Interm. ; Hazard Pot.: High ; Spill. Des. Flood: Full PMF
Use: Test Flood = Full PMF

5- Test Flood Inflow = (1450) 2.08 = 3016 c.f.s.

6- Pond Storage
The pond area is .176 sq. mi. at elev.
Based on a const. area, storage increases at 113 ac. feet per foot of depth increase.

7- Spillway crest elev. is 1126.0 (no stoplogs)

8- Storage Functions are based on $Q_{out} = Q_{in}\left[1 - \frac{S_{out}}{R}\right]$

S_{out} = Storage Vol. in Reservoir related to final Q_{out} in terms of inches of rain over the drainage area.

S(in Inches) = $12\,D\left(\frac{.176}{2.08}\right) = 1.02\,D$; R = 6hr rain of Storm

D = Storage depth in feet above spillway crest in reservoir

9- Storage Functions: (Test Flood & ½ PMF - if needed)

F_{TF}	$= 3016 - 158.7\,S = 3016 - 161.2\,D$
$F_{½PMF}$	$= 1508 - 158.7\,S = 1508 - 161.2\,D$

(II) Discharge Relations

1- Spillway - No Stoplogs

Width - 29.6'; Effective Width ≈ 28.5'; Critical Depth - Sill el 1126.0

y_c	1	2	3	4	5	6
q	5.67	16.04	29.48	45.40	63.94	83.40
Q_1	160	460	840	1290	1810	2380
h_v	0.5	1.0	1.5	2.0	2.5	3.0
Lake El.	1127.5	1129.0	1130.5	1132.0	1133.5	1135.0

2- Spillway - With Stoplogs @ elev. 1127.4

Use Williams & Hazen "Hydraulic Tables"; Eff. width = 28.5'

Lake El.	1128	1129	1130	1131	1132	1133	1134	1135
q	1.57	6.69	13.80	22.45	32.53	43.83	55.87	67.66
Q_2	40	190	390	640	930	1250	1590	1930

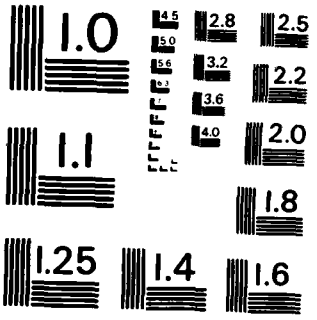
3- Crest Flow

Use $q = 2.55 H^{1.5}$; 25' @ el 1132.7, 260' @ el. 1132.8

Lake El.	1133	1134	1135	1134.5
Q_A	10	90	220	150
Q_B	60	870	2160	1470
ΣQ_3	70	960	2380	1620

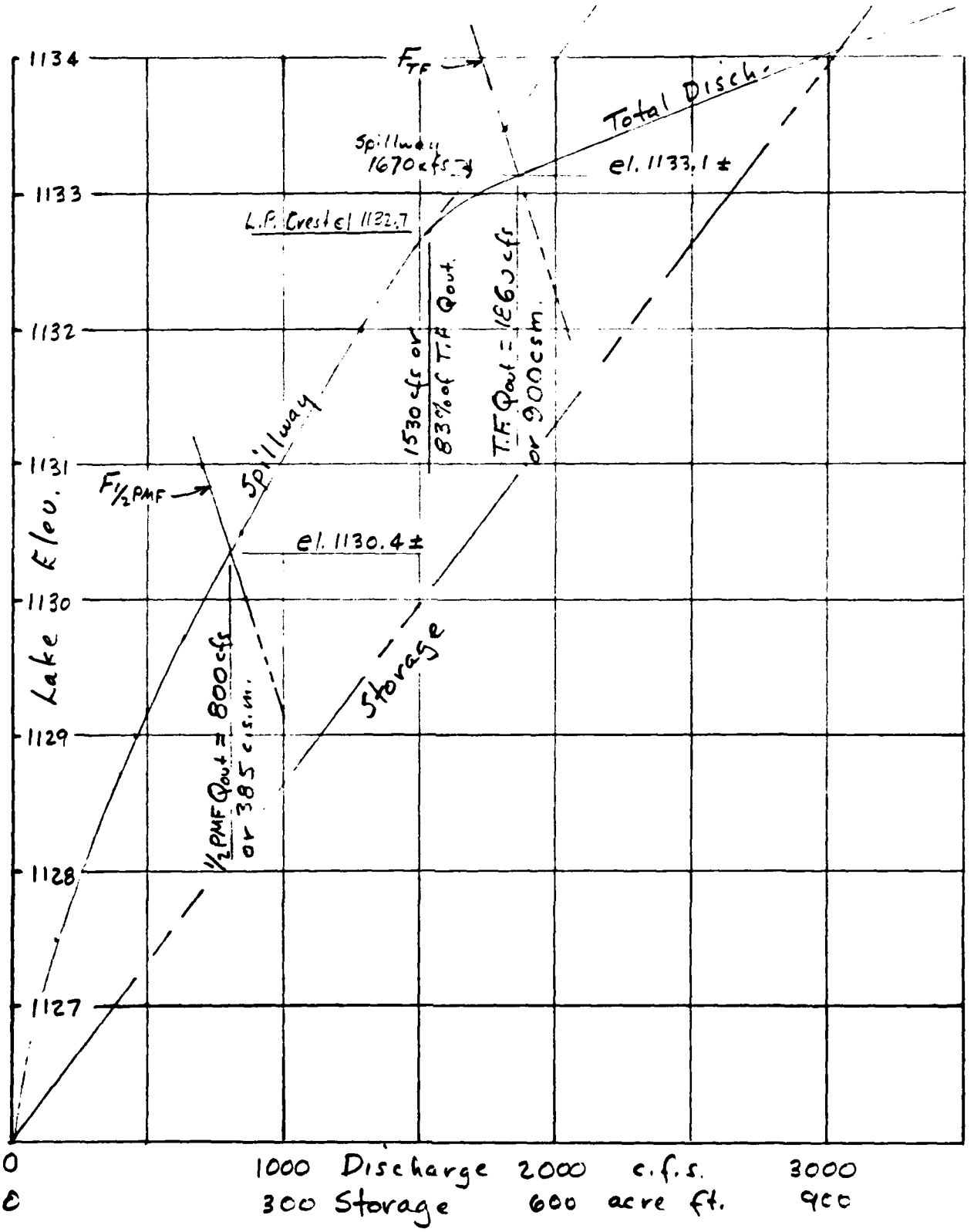
AD-A145 339 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
WINNEKEAG LAKE DAM (M..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUN 80

UNCLASSIFIED F/G 13/13 NL



Project Nat. Review of Non Federal Dams Acct No 6926 Page 3 of 6
Subject Worcester County, Mass. Comptd By LEB Date 6/5/80
Detail WINNEKEAG LAKE Ck'd By RNH Date 6/9/80

(III) Discharge, Storage & Storage Funct. vs Lake Elev - NO STOPLOGS

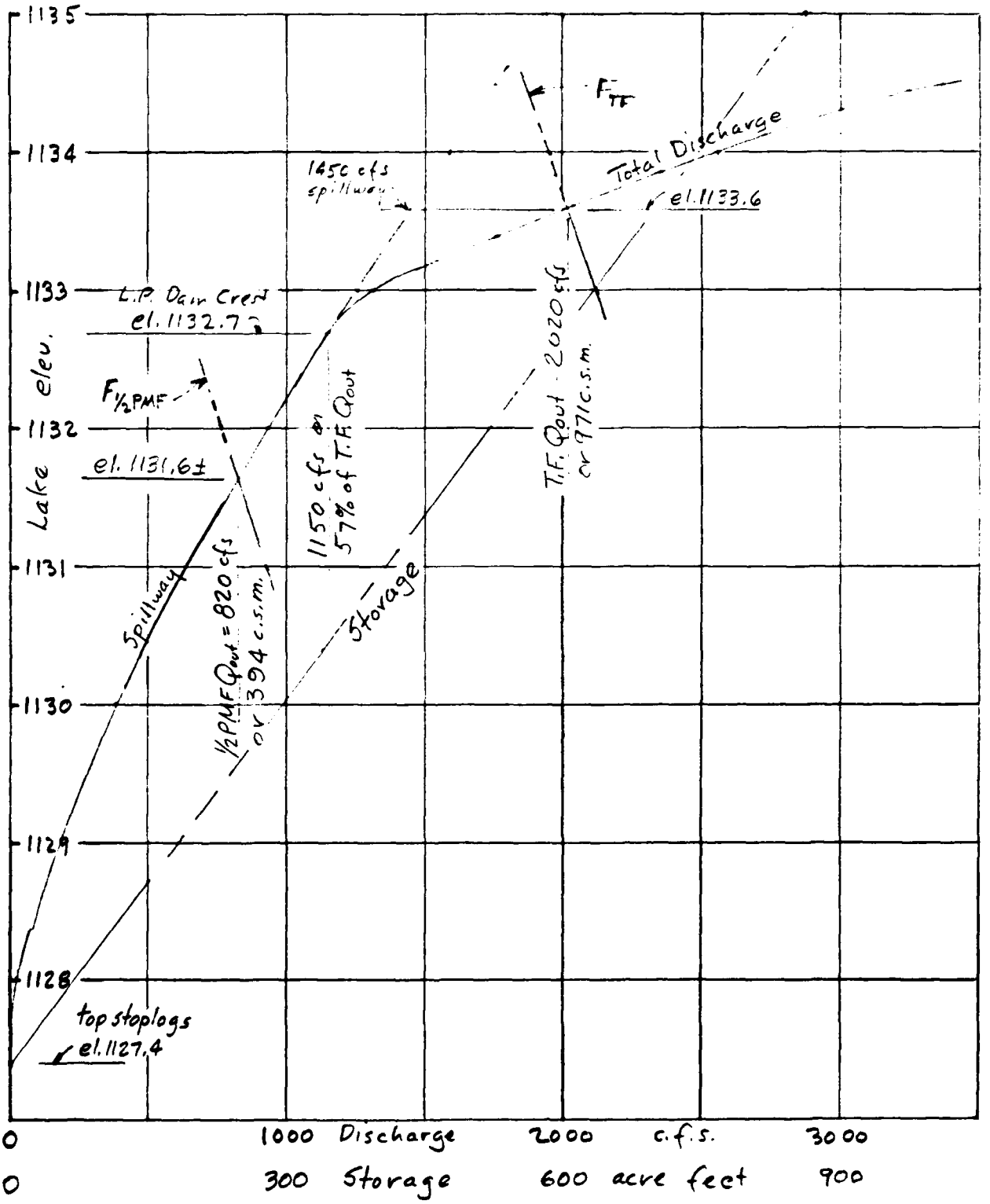


METCALF & EDDY, ENGINEERS

NONREPRODUCIBLE GRID FORM 145

Project Nat. Review of Non-Federal Dams Acct No. 6926 Page 4 of 6
Subject Worcester County, Mass. Compld By LEB Date 6.5.80
Detail WINNEKEAG LAKE Ck'd By RNH Date 6/9/80

(IV) Discharge, Storage & Storage Funct. vs Lake Elev. - WITH STOPLOGS



Project Nat. Review of Non Fed. Dams Acct No 6926 Page 5 of 6
Subject Worcester County, Mass Comptd By LEB Date 6/5/80
Detail WINNEKEAG LAKE Ck'd By RNH Date 6/9/80

(V) Test Flood Crest Flow

1- No Stoplogs

Max hd. = 1133.1 - 1132.7 = 0.4' ; Flow/ft = q = 0.645 cfs/ft

As Critical Flow : y_c = 0.23ft.; V_c = 2.7 fps

2- With Stoplogs

Max. hd = 1133.6 - 1132.7 = 0.9', Flow/ft = q = 2.18 cfs/ft

As Critical Flow : y_c = 0.53 ft. ; V_c = 4.1 fps

(VI) Low Level Outlet

12"ϕ pipe - 61' long - $\mathcal{E}$ exit el. 1,111 ± - assume no backwater

Head = $\frac{V^2}{2g}\left(0.5_{\text{for}} + 1.0_{\text{for exit}} + 0.2_{\text{for gate}} + \frac{61}{1}.019\right) = 2.86\frac{V^2}{2g}$; $V = 4.745\sqrt{H}$

Lake Level - Top of Stoplogs - el. 1127.4 - V = 19.2 fps; Q = 15.1 cfs
" " - 1' Lower - el. 1126.4 - V = 18.6 " ; Q = 14.6 "
" " - Top of Spillway - el. 1126.0 - V = 18.4 " ; Q = 14.4 "
" " - 1' Lower - el. 1125.0 - V = 17.6 " ; Q = 13.9 "

Time to Lower Lake One Foot :

No Stoplogs · $T = \frac{113(43560)}{\frac{1}{2}(28.3)3600} = 96.6$ hours or 5800 minutes

With Stoplogs · $T = \frac{113(43560)}{\frac{1}{2}(29.7)3600} = 92.1$ hours or 5520 minutes

Project	Nat. Review of Non Fed. Dams	Acct No	6926	Page	3 of 6
Subject	Worcester County, Mass.	Comptd By	LEB	Date	6/5/80
Detail	WINNEKEAG LAKE	Ck'd By	RNN	Date	6/9/80

(VII) Failure of Dam

Peak Failure Flow:

Pond Elevation - 1132.7 (L.P. [illegible])
Toe Elevation — 1112.0

Y_o = 20.7 ft

Dam Length Subject to Breaching = 140

$W_o = 40\%(140) = 56$

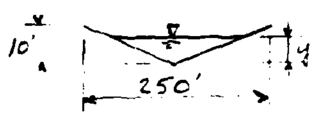
$Q_{P_1} = 1.68\, W_o (Y_o)^{1.5} = 1.68\,(56)\,(20.7)^{1.5} = 8860$ cfs

Spillway disch. = 1150 cfs ; Total disch. = 10,010 cfs

Storage Volume Released:

Storage Above Spillway	113 × 6.7	=	757 ac. ft
Storage Below Spillway	113 × 14 × 1/3	=	527 " "
S = Total Storage =			1284 ac. ft

Channel Hydraulics:



$S = \frac{20}{2400}$; $n \cong 0.125$; $R \cong \frac{1}{2} y$; $V = .9[illegible]\, y^{2/3}$

$A = 12.5 y^2$

y =	2	6	10	14	12	13
A =	50	450	1250	2450	1800	[illegible]
V =	1.54	3.20	4.50	5.63	5.08	[illegible]
Q =	80	1440	5620	13790	9140	[illegible]

Flow depth in downstream channel would raise from 5'± to 12½'±. Channel storage does not significantly reduce failure wave before it reaches Ashburnham.

Time to Drain:

$\frac{43560\ (1284)}{3600(\frac{1}{2})(8860)}$ = 3.5 Hours, or 210 Minutes

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
MA	7	NED	MA	027	02				WINNEKEAG LAKE DAM	4234.5	7154.3	08SEP80

POPULAR NAME	NAME OF IMPOUNDMENT
	WINNEKEAG LAKE

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	09	PHILLIPS BROOK	ASHBURNHAM	0	3854

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)
REPT	1875	R	21	21	1240	527

REMARKS
21=EARTH + DRY STONE MASONRY

NID'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	220	U	28	1150	7500											

OWNER	ENGINEERING BY	CONSTRUCTION BY
TAMES RIVER-MASS, INC.	THOMAS C. SHELDON	UNKNOWN

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
METCALF + EDDY INC	08MAY80	PL 92-367

REMARKS
3 STOPLOGS IN PLACE

DIST OWN FED R PRV/FED SCS A VER/DATE

NED N N N N


ATE
LME