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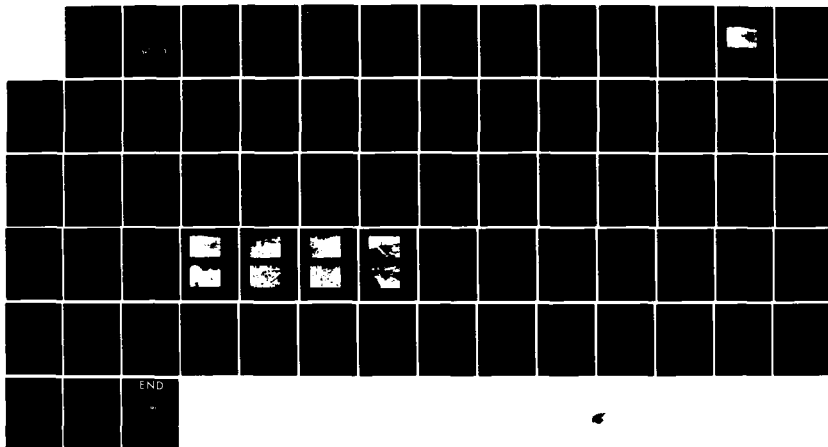
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
LAKE WHITTEMORE DAM (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV AUG 78

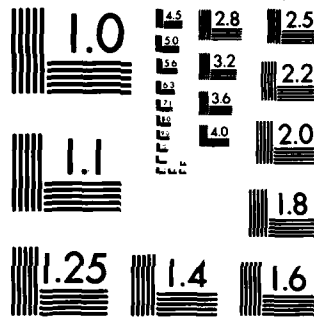
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CONNECTICUT RIVER BASIN
SPENCER, MASSACHUSETTS

LAKE WHITTEMORE DAM
MA 00699

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

AUGUST 1978

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Connecticut River Basin Spencer, Massachusetts		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is about 300 ft. long. It consists of a small earth embankment about 15 ft. high and an ungated concrete ogee spillway weir. The dam is in fair to good condition. There are no signs of failure or conditions which would warrant urgent remedial treatment. Hydraulic analyses indicated that the spillway will pass the spillway design flood without overtopping the dam.		

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

REPLY TO
ATTENTION OF:
NEDED

Honorable Michael S. Dukakis
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Accession For	
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OCT 26 1978

Dear Governor Dukakis:

I am forwarding to you a copy of the Lake Whittemore 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, the Town of Spencer, Board of Selectmen, Main Street, Spencer, Massachusetts 01562.

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 yours,

Incl
As stated


JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

LAKE WHITTEMORE DAM
MA 00699

CONNECTICUT RIVER BASIN
SPENCER, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT

PHASE I INVESTIGATION REPORT NATIONAL DAM INSPECTION PROGRAM

Identification No.: MA 00069
Name of Dam: Lake Whittemore
Town: Spencer
County: Worcester
State: Massachusetts
Stream: None
Date of Site Visit: 12 May 1978

Lake Whittemore Dam is approximately 300 ft. long. It consists of a small earth embankment approximately 15 ft. high and an ungated concrete ogee spillway weir. While the present spillway was built about 20 years ago, the dam was originally constructed before the year 1900.

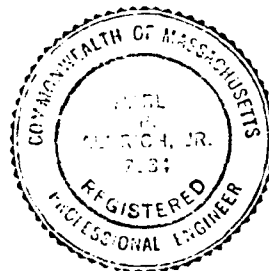
The dam is generally in fair to good condition. There are no obvious signs of failure or conditions which would warrant urgent remedial treatment.

Hydraulic analyses indicated that the spillway will pass the spillway design flood without overtopping the dam. The spillway design flood selected for this structure was the probable maximum flood.

Recommendations for remedial work include clearing of trees and brush, repair of the downstream fieldstone wall and a dry-laid stone wall adjacent to the gate valve, and minor earthwork and rip-rap repairs. This work should be undertaken as soon as practical.

HALEY & ALDRICH, INC.
by:


Harl Aldrich
President



This Phase I Inspection Report on the Lake Whittemore 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.



CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

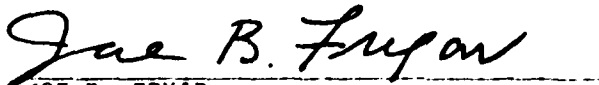


FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division



SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:



JOE B. FRYAR
Chief, Engineering Division

SEP 13 1968

PREFACE

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

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

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

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

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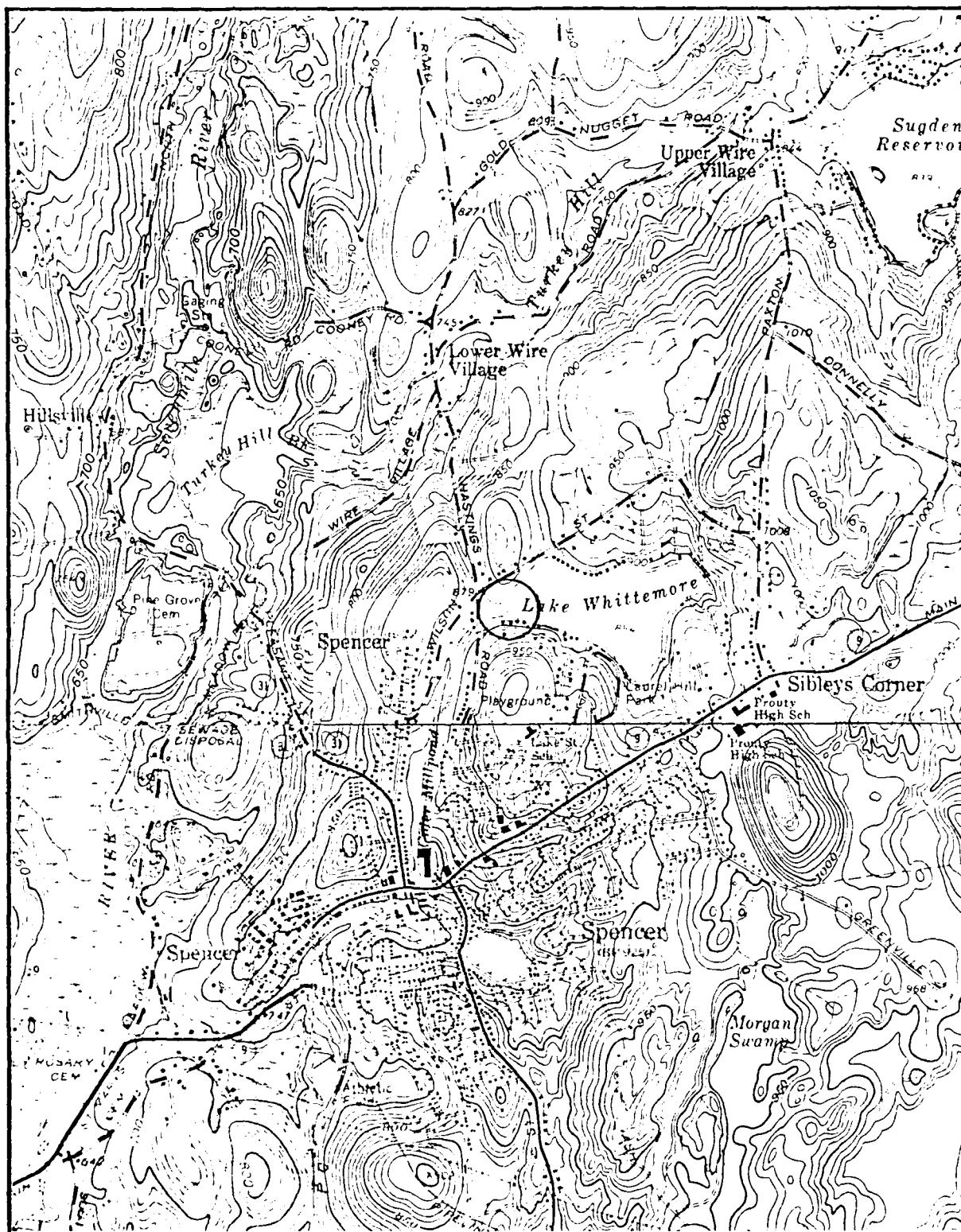
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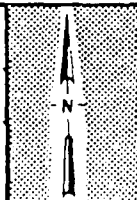


1. Overview of Spillway and Left End of Embankment



FILE NO. 4160

DAM: Lake Whittemore
 IDENTIFICATION NO. MA 00699



LOCATION MAP
 USGS QUADRANGLE
 PAXTON, MA
 APPROX. SCALE: 1" = 2000'

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAKE WHITTEMORE DAM
MA 00699

I. PROJECT INFORMATION

1.1 GENERAL

A. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

Haley & Aldrich, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed were issued to Haley & Aldrich, Inc. under a letter dated 26 April 1978 from Colonel Ralph T. Garver, Corps of Engineers. Contract No. DACW33-78-C-0301 has been assigned by the Corps of Engineers for this work. Camp, Dresser & McKee, Inc. was retained as consultant to Haley & Aldrich, Inc. on the structural, mechanical/electrical and hydraulic/hydrologic aspects of the investigation

B. Purpose. The primary purposes of the National Dam Inspection Program are to:

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

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

3. To update, verify and complete the National Inventory of Dams.

1.2 PROJECT DESCRIPTION

A. Location. The dam is located north of the Town of Spencer in Worcester County, Massachusetts as shown on the Location Map, page vi. Discharge flow from Lake Whittemore is carried by a creek which meanders through the Town of Spencer and empties into Seven-mile River to the west.

B. Dam and Appurtenances. The Lake Whittemore dam consists of an earth embankment approximately 300 ft. long and an ungated concrete spillway, as shown on a "Site Plan Sketch" included in Appendix C-1.

The maximum height of the embankment is about 15 ft. and the crest is approximately 12 ft. wide. The upstream face is sloped at about 2 horizontal to 1 vertical and is paved with large flat boulders. The downstream face is formed by a vertical fieldstone retaining wall having a maximum height of about 12 ft. Rough cross-section sketches are shown in the 1972 Massachusetts DPW Inspection Report which is included in Appendix B.

The concrete ogee spillway, located at the left abutment, is approximately 20 ft. wide.

A low level outlet pipe, shown on available drawings as a 20 in. culvert, with an old Rodney Hunt gate valve is located near the center of the embankment. The gate mechanism is no longer operable and the outlet pipe which it regulated is not visible either upstream or downstream.

C. Size Classification. Lake Whittemore Dam has an estimated maximum storage of 483.7 acre-feet and a maximum height of approximately 15 ft. Storage of less than 1000 acre-feet and a height of less than 40 ft. classifies this dam in the "small" category, according to guidelines established by the Corps of Engineers.

D. Hazard Classification. Lake Whittemore is currently classified as having a "high" hazard potential in the Corps of Engineers National Inventory of Dams. Because of the existence of approximately eleven culverts between Lake Whittemore Dam and Seven Mile River which all appear to be inadequate to carry a dam failure surge, and

the large number of inhabited structures surrounding these culverts, it is recommended that this classification be retained.

E. Ownership. The lake and dam are presently owned by the Town of Spencer. The address of the owner is: Town of Spencer, Board of Selectmen, Main St., Spencer, MA 01562 (phone: 617/886-2578). Mrs. Margaret A. Gaudette of the Board of Selectmen acted as owner representative during this investigation.

F. Operator. No individual is designated as having responsibility for operation and maintenance of the dam.

G. Purpose of the Dam. Lake Whittemore is presently used for recreational purposes.

H. Design and Construction History. The dam is believed to have been constructed before the year 1900. No records of the original design and construction are available. Modification and repairs at the dam and spillway were proposed in 1939, probably due to damage sustained in the hurricane flood of September 1938. However, the work was apparently not carried out.

The presently existing spillway was designed in 1957 by Hayden, Harding & Buchanan, Inc., Boston, MA and was constructed by Gover Bros., Millbury, MA. Drawings available from Hayden, Harding & Buchanan suggest that the Massachusetts Department of Public Works was also involved in the spillway design. However, no records of this work were located by the Massachusetts Department of Environmental Quality Engineering.

I. Normal Operational Procedures. There is no established routine for operation of the dam. The gate control mechanism for the outlet pipe is not operable.

1.3 PERTINENT DATA

All record plans for Lake Whittemore are on U. S. G. S. Mean Sea Level Datum.

A. Drainage Area. The drainage area at the outlet from Lake Whittemore is 425 acres (0.66 sq. mi.). The lake surface comprises 53 acres (12.5%) of this total. The topography of the watershed is rolling to hilly with an average slope in excess of 5 percent. Less

than 10 percent of the watershed is developed with residences and more than half of the watershed is wooded.

D. Discharge at Damsite. While the maximum known flood at the dam site is very likely that which occurred during the September 1938 hurricane (6± in. rain in 6 hours), the last known significant flood would be that with Hurricane Diane, August 19-20, 1955. This storm produced a total runoff of 10 in. in 36 hours, resulting in a peak inflow of 600 cfs. The routed peak outflow was calculated to be 260 cfs. There have been no significant floods during the past 20 years, or since the dam was reconstructed in 1957-1958.

C. Elevation (ft. above MSL)

1. Top Dam.....	Approx. 890.0
2. Maximum pool-design surcharge...	Unknown
3. Full flood control pool.....	Unknown
4. Recreation pool.....	884.5 (Est.)
5. Spillway crest.....	884.5 (Est.)
6. Upstream portal invert diversion tunnel.....	Unknown
7. Streambed at centerline of dam.....	873.5 (Est.)
8. Maximum tailwater.....	Unknown

D. Reservoir

1. Length of maximum pool.....	0.5 miles (Est.)
2. Length of recreational pool.....	0.5 miles (Est.)
3. Length of flood control pool.....	Unknown

E. Storage (acre-feet)

1. Recreation pool.....	202.4 (Est.)
2. Flood control pool.....	Unknown
3. Design surcharge.....	Unknown
4. Top of dam.....	483.7 (Est.)

F. Reservoir Surface (acres)

1. Top of dam.....	65.2 (Est.)
2. Maximum pool.....	53.0 (Est.)
3. Flood-control pool.....	Unknown
4. Recreation pool.....	53.0 (Est.)
5. Spillway crest.....	53.0 (Est.)

G. Dam

- | | |
|-------------------------|---|
| 1. Type..... | Earth |
| 2. Length..... | Approx. 300 feet |
| 3. Height..... | Approx. 15 feet |
| 4. Top Width..... | Approx. 12 feet |
| 5. Side Slopes..... | Approx. 2:1 U/S,
Vertical D/S
(Fieldstone Wall) |
| 6. Zoning..... | Unknown |
| 7. Impervious Core..... | Unknown |
| 8. Cutoff..... | Unknown |
| 9. Grout Curtain..... | Unknown |

H. Diversion and Regulating Facilities. Not applicable.

I. Spillway

- | | |
|-------------------------|---|
| 1. Type..... | Ungated concrete
ogee weir |
| 2. Length of weir..... | 20 feet |
| 3. Crest elevation..... | Approx. 884.5 (5.5
ft. below top of dam) |
| 4. Gates..... | None |
| 5. U/S Channel..... | N/A |
| 6. D/S Channel..... | 2% slope |

J. Regulating Outlets. The only outlet is a low-level reservoir drain, presently inoperable. The outlet pipe is a 20 in. culvert, according to available drawings. However, neither the inlet nor outlet end is visible.

II. ENGINEERING DATA

2.1 DESIGN AND CONSTRUCTION RECORDS

No records of original design and construction are available.

A blueprint, dated 1939, was located by the Board of Selectmen, Spencer, MA. This document shows proposed modifications and repairs to the dam and spillway. Field observations indicate discrepancies between details shown on the 1939 blueprint and the presently existing features, which suggest that the work proposed in 1939 may not have been constructed.

Some 1957 design drawings for reconstruction of the embankment, spillway and outlet works are available from Hayden, Harding & Buchanan, Boston, MA. No records of the actual construction were located. However, details shown on drawings are in good agreement with field observations.

2.2 OPERATION RECORDS

No operational records are available.

2.3 EVALUATION

A. Availability. Documents described above are available at the offices of the Board of Selectmen, Spencer, MA and Hayden, Harding & Buchanan, Inc., Boston, MA, as listed in Appendix B-1.

B. Validity. As stated above, the validity of information shown on the 1939 blueprint is questionable. Based on visual field observations, the Hayden, Harding & Buchanan design drawings appear to represent the features of presently existing dam with reasonable accuracy.

C. Adequacy. The available data, in combination with the visual evaluation described in the following section is adequate for the purposes of the Phase I Investigation.

III. VISUAL EXAMINATION

3.1 FINDINGS

A. General. The Phase I visual examination of the Lake Whittemore dam was conducted on 12 May 1978.

In general, the dam embankment was found to be in fair to good condition. The spillway concrete is in good to excellent condition. Some deficiencies which require correction were noted.

A visual inspection check list is included in Appendix A and selected photographs of the project are given in Appendix C.

B. Dam. The earth dam embankment is generally in fair to good condition. There was no evidence of settlement, lateral movement or other serious defects. The upstream slope which is "paved" with large flat boulders is in good condition.

The following deficiencies were noted:

1. The embankment is covered by small saplings and brush. In addition, large trees are growing immediately downstream of the fieldstone wall which retains the downstream slope. These conditions are shown on Photos No. 1, 2, 5 and 6.
2. The fieldstone wall itself, while generally in fair to good condition, has failed at one location between the outlet pipe and the spillway, Appendix C-1. This section of wall is shown in Photo No. 6.
3. Flat granite stones placed on each side of the gate valve to form a near-vertical wall on the upstream side, appear to be in unstable condition. Photo No. 8 shows this condition.
4. At both the left and right spillway walls, the top of the embankment is below the top of the concrete wall as shown in Photos No. 1, 2 and 3.
5. The ground is wet at the toe of the fieldstone wall in an area north of the discharge pipe. Some seepage through the embankment is indicated. The water is clear.

C. Appurtenant Structures. The spillway concrete is in good to excellent condition. A small amount of the concrete surface has eroded from the side wall surface immediately adjacent to the weir. The riprap transition at the downstream end of the side walls has been displaced on the left side and uplifted on the right side.

The gate valve for the reservoir drain, located at the highest point of the dam, is supported by cantilevered steel channels counterweighted by a poured in-place concrete block. Visible portions of the gate valve structure appeared to be in good to excellent condition. The adjacent dry masonry stone wall contains several displaced stones which require attention, Photo No. 8. The gate handle is not present and the valve is reported to be inoperative due to a broken pin. Minor rust stained seepage was noted in the area of the downstream end of the drain pipe. The drain outlet was not located and believed to be covered with soil.

D. Reservoir Area. The area around Lake Whittemore has been developed for residential purposes. Natural ground slopes toward the lake at slopes which are typically from 5 to 15 percent. There is no potential for significant landslides into the pond. There are no well-defined streams entering the lake and thus there are no conditions which could result in a sudden increase in sediment load to the reservoir.

E. Downstream Channel. Side slopes for the channel immediately downstream of the spillway weir, as well as the channel bottom, are paved with large boulders. Some brush and saplings have developed. Nevertheless, the channel is generally unobstructed and in good condition.

Farther downstream, the spillway discharge channel narrows and makes two 90 degree turns to join the old brook channel. Appendix C-1. The channel is narrow and the area is wooded.

3.2 EVALUATION

Little or no maintenance of Lake Whittemore dam has been undertaken in recent years and some deficiencies which require correction have been observed. Nevertheless, based on the visual examination, there appears to be no significant potential for failure of the dam at this time.

IV. OPERATIONAL PROCEDURES

There are no established operational procedures, maintenance programs or warning systems in effect for this dam.

For a structure of this type, which is classified in the "high" hazard category, a periodic observation and maintenance program should be established to examine the dam, control trees and brush and maintain slopes, walls and channels.

V. HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

A. Design Data. A set of plans entitled "Proposed Reconstruction of Dam at Lake Whittemore - Spencer, Mass." bearing date of April 1957 were apparently the basis for the reconstruction of this facility some 20 years ago. The plans show that the top of dam was raised approximately 1 ft. to Elev. 890.0 (U.S. G. S. datum) during the reconstruction with the new spillway crest of reinforced concrete at Elev. 884.5.

Calculations performed by Hayden, Harding & Buchanan, Inc. during the design of this facility used hydrologic data gathered from the Hurricane Diane storm, August 19 and 20, 1955 and established a peak rate of inflow based on rainfall records and recorded peak rates of runoff at U. S. G. S. gaging stations. A total storm rainfall of 14 in. at Lake Whittemore was considered to generate a total runoff of 10 in. in 36 hours with a peak rate of inflow of 600 cfs occurring 5.2 hours after the start of the storm. This flow was routed through spillways 40 ft. and 20 ft. in length. The maximum outflow for the 20 ft. spillway was 260 cfs with a head of 2.3 ft. over the spillway crest. The recommended spillway design flood (SDF), for the size (small) and hazard potential (high) classification of this dam is between one-half the probable maximum flood (1/2 PMF) and the probable maximum flood (PMF).

B. Experience Data. Because of the small magnitude of the drainage area, the "SCS-TP-149, Method For Estimating Volume and Rate of Runoff in Small Watersheds" was used as a guide for determining the inflow hydrographs into Lake Whittemore for the 100-year storm and the PMF. These two floods were routed through the spillway using the method for flood routing presented in "Water Supply and Wastewater Disposal" by Fair and Geyer. The normal pool level (at the crest of the spillway) was used as the starting point of this routing procedure. The 100-year storm was based on a 4.7 in. rainfall in 6 hours and was found to have a peak inflow rate of 395 cfs which when routed through the lake was reduced to a maximum outflow of 80 cfs. The PMF was based on a 23-in. rainfall in 6 hours and resulted in a peak inflow rate of 4150 cfs which when routed through the lake reduced to a maximum outflow rate of 730 cfs.

Although there are no known records of lake levels reached during past floods, records on gaged watersheds in the immediate area suggest that the greatest flood was very likely that which occurred with the September 1938 hurricane when more than 6 in. of rain was recorded in a 6-hr. period.

The storm associated with Hurricane Diane on August 19-20, 1955 produced a total runoff of 10 in. in 36 hours, which resulted in a peak inflow rate of 600 cfs. No other floods have occurred in the past 20 years.

C. Visual Observations. On the date of the inspection no conditions were observed that would indicate a reduction of capacity of the spillway during a flood occurrence. The condition of the concrete in the ogee crest and wingwalls as well as the downstream apron are good. The pool just upstream of the dam has a gradually sloping bottom with boulders and cobbles partially silted in that should not cause debris to collect on or adjacent to the spillway. The channel immediately downstream of the apron consists of heavy stone riprap for about 30 ft. while downstream of this point the earthen channel has a base width of 4-6 ft. and is 2-3 ft. below the adjacent terrain.

About 400-ft. downstream of the dam, flow is conveyed beneath Hastings Road in a culvert after which it flows in a deep ravine between Wilson Street and Hastings Road before passing beneath Main Street 0.8 mile downstream. There are numerous additional culverts between the dam and Seven Mile River, all of which appear to be inadequate to carry a surge from a failure of Whittemore Dam, if it were to occur. Since there are a large number of inhabited structures in the area, considerable flooding would probably occur.

D. Overtopping Potential. As stated previously, based on the size and hazard classifications published in the Guidelines, the probable maximum flood (PMF) was selected as the spillway design flood (SDF). A spillway rating curve was constructed which showed that the spillway could safely pass approximately 850 cfs. Therefore, the spillway is adequate for the PMF.

E. Evaluation. Inasmuch as the spillway capacity is in excess of the spillway design flood, a range from 1/2 PMF to PMF, the spillway capacity of Lake Whittemore Dam is deemed to be adequate based on criteria published in the Guidelines.

VI. STRUCTURAL STABILITY

6.1 EVALUATION OF EMBANKMENT STRUCTURAL STABILITY

A. Visual Observations. No visual evidence of embankment structural instability was noted during the site examination on 12 May 1978.

B. Design and Construction Data. A theoretical analysis of the structural stability of the dam embankment was not possible due to lack of pertinent design and construction data. However, the embankment cross-section in relation to lake level compares favorably with other low embankments which have proven to be safe.

C. Operating Records. Not applicable.

D. Post-Construction Changes. There have been no known structural changes to the earth embankment.

E. Seismic Stability. Since the Lake Whittemore Dam is located in Seismic Zone 2, the scope of work has not included a study of stability during earthquake events. In the event of a significant earthquake, it is probable that additional failures of the fieldstone wall at the downstream toe will occur. Nevertheless, these failures are not likely to result in failure of the dam and flooding downstream.

6.2 EVALUATION OF SPILLWAY STRUCTURAL STABILITY

A. Visual Observations. There was no visual evidence of movement or distress in the spillway concrete.

B. Design and Construction Data. A theoretical structural analysis of the spillway was not possible due to the lack of pertinent data. The present condition of the spillway after a reported 20 years of operation indicates the spillway is currently stable.

C. Operating Records. No operating records are known to exist for the spillway.

D. Post-Construction Changes. The current spillway was constructed approximately 20 years ago. This may be the third spillway constructed for the dam as 1939 plans for rehabilitation of the dam indicate a different type of spillway than that currently in existence.

E. Seismic Stability. A theoretical analysis for seismic stability of the spillway is not possible due to the lack of pertinent design data. The low height of the spillway weir, approximately four feet, the indication of continuity between side walls and weir, and the location of the structure in Zone 2 seismic risk area indicate that seismic stability should not be a problem.

VII. ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM AND ASSESSMENT

A. Condition. The visual examination of the earth embankment and spillway reveal that the Lake Whittemore Dam is generally in fair to good condition. There are no obvious signs of failure or conditions which would warrant urgent remedial treatment. Some maintenance is required, however.

Based on the results of the computations included as Appendix D, the spillway is capable of passing the probable maximum flood without overtopping the dam.

B. Adequacy of Information. The data available concerning the design and construction of the dam, is considered adequate for a Phase I Investigation when supplemented by field observations.

C. Urgency. It is recommended that remedial work outlined in Section 7.3 be undertaken as soon as practical.

D. Need for Additional Investigation. Additional investigation is not believed to be necessary.

7.2 RECOMMENDATIONS FOR ADDITIONAL INVESTIGATIONS

Not applicable.

7.3 REMEDIAL MEASURES

A. Alternatives. Not applicable.

B. Operation and Maintenance, and Procedures. It is recommended that the following remedial work be undertaken by the Town of Spencer to correct deficiencies noted during the visual examination:

1. Cut all brush and trees on the earth embankment and keep the embankment free of such growth. Grass slopes which are mowed at least once a year will allow for a more careful visual examination of the embankment.

2. Cut trees which are located within 12 ft. of the fieldstone wall at the downstream toe of the dam. A severe wind-storm could uproot these trees and damage the wall.
3. Repair the failed section of the fieldstone wall.
4. Reconstruct and/or stabilize the stone wall on the upstream face of the dam adjacent to the gate valve. To properly examine and repair the wall, the lake level will probably have to be lowered.
5. Place earth fill on the embankment both sides of the spillway to restore embankment grades to an elevation which is level with the top of concrete.
6. Reset riprap at the downstream transition banks of the spillway.
7. Locate the downstream drain pipe outlet and clear area around it.

Although the dam is in fair to good condition, it is considered important that the following items also be accomplished:

1. Due to the "high" hazard potential classification, surveillance of the dam should be provided by the Town of Spencer during periods of unusually heavy precipitation. The Town of Spencer should develop a formal emergency preparedness plan and warning system in cooperation with local officials.
2. It is recommended that the Town of Spencer establish a formal program to periodically inspect the dam and to provide for routine maintenance. Responsibility for the activity should be assigned to one person or to a board reporting directly to the Board of Selectmen.
3. The low level drain for the reservoir is inoperable due to a defective valve. Although not critical, it would be highly desirable to have the gate valve repaired and properly maintained. If it became necessary during an emergency to lower the lake level before the gate is repaired, a series of siphons and/or pumps could be utilized.

APPENDIX A
INSPECTION TEAM ORGANIZATION AND CHECK LIST

	<u>Page No.</u>
<u>VISUAL INSPECTION PARTY ORGANIZATION</u>	1
<u>VISUAL INSPECTION CHECK LIST</u>	
Dam Embankment	2
Outlet Works - Spillway Weir, Approach and Discharge Channels	3
Control Works, Reservoir Drain	3

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

Dam: Lake Whittemore

Date: 12 May 1978

Time: 1520-1700

Weather: Clear and Warm (high 70's)

Water Surface Elevation Upstream: Not known (at top of spillway crest)

Stream Flow: Not known

Inspection Party:

Harl P. Aldrich, Jr.	- Soils
Haley & Aldrich, Inc.	
Allen W. Hatheway	- Geology
Haley & Aldrich, Inc.	
Roger H. Wood	- Structural/Mechanical
Camp, Dresser & McKee, Inc.	

Present During Inspection:

John W. Critchfield, Haley & Aldrich, Inc.
Roger Bemis, Town of Spencer citizen

VISUAL INSPECTION CHECK LIST NATIONAL DAM INSPECTION PROGRAM

DAM: Lake Whittemore DATE: 12 May 78

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
Crest Elevation	Not known (approximately 5.5 ft. above spillway crest)
Current Pool Elevation	Not known (at crest of spillway)
Maximum Impoundment to Date	Not known
Surface Cracks	None observed
Pavement Conditions	No pavement
Movement or Settlement of Crest	None observed; however, some settlement or loss of ground has occurred immediately behind downstream fieldstone wall
Lateral Movement	None observed
Vertical Alignment	Fairly good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Some erosion at spillway, abutments, earth somewhat below top of concrete walls
Indications of Movement of Structural Items on Slopes	No structural items on slopes
Trespassing on Slopes	Unrestricted, crest of dam has frequent human traffic
Animal Burrows in Embankment	None observed
Vegetation on Embankment	Grass, brush and small saplings; no large trees
Sloughing or Erosion of Slopes or Abutments	Some noted, not considered serious
Rock Slope Protection - Riprap Failures	From water line to top of dam, rock riprap in excellent condition. Large stones are flat to form "smooth paving"
Unusual Movement or Cracking at or near Toes	Downstream toe of dam is a dry laid fieldstone wall, in fair to good condition (see text of report)
Unusual Embankment or Downstream Seepage	Some seepage (wet spot) noted at bottom of stone wall (see text of report)
Piping or Boils	None observed
Foundation Drainage Features	None
Toe Drains	None
Instrumentation Systems	None

FILE NO. 4160

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS

APPENDIX A-2

VISUAL INSPECTION CHECK LIST NATIONAL DAM INSPECTION PROGRAM

DAM: Lake Whittemore

DATE: 12 May 78

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
<u>a. Approach Channel</u>	
General Condition	No channel present - spillway is at edge of reservoir
Floor of Approach Channel	Good - minor stones and small debris in front of weir
<u>b. Weir, Training Walls & Apron</u>	
General Condition of Concrete	Concrete in good to excellent condition, slight erosion in walls adjacent to weir
Rust or Staining	None observed
Spalling	Very minor
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	None observed
Drain Holes	4 in apron approximately 4 in. in diameter
<u>c. Discharge Channel</u>	
General Condition	Apron in good condition, no undercut noted
Loose Rock Overhanging Channel	Riprap transition displaced left side - up-lifted right side
Trees Overhanging Channel	Trees and brush occur along channel but no significant obstructions
Floor of Channel	Cobbles and boulders immediately downstream of spillway apron
Other Obstructions	None observed
<u>CONTROL WORKS, RESERVOIR DRAIN</u>	
<u>a. Concrete and Structural</u>	
General Condition	Good

FILE NO. 4160

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS

APPENDIX A-3

VISUAL INSPECTION CHECK LIST NATIONAL DAM INSPECTION PROGRAM

DAM: Lake Whittemore

DATE: 12 May 78

AREA EVALUATED	CONDITION
Unusual Seepage or Leaks	Leakage at downstream end of drain pipe, rust stained. Pipe apparently beneath soil, not visible
Rusting or Corrosion of Steel	Steel in good condition
b. <u>Mechanical and Electrical</u>	(No electrical facilities)
Reservoir Drain	No operating handle, valve reported inoperable due to broken pin. Also reported operator shaft bronze above water cast iron below water (visual indications of iron below water surface). Rust at exit end indicates iron pipe.
c. <u>Channel</u>	
Condition	Stagnant water; channel filled with rotting vegetation, stones, debris

FILE NO. 4160

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS

APPENDIX A-4

APPENDIX B
LIST OF AVAILABLE DOCUMENTS AND
PRIOR INSPECTION REPORTS

Page No.

LIST OF AVAILABLE DOCUMENTS

1

PRIOR INSPECTION REPORTS

Date

By

10 May 1972 Mass. Department of Public Works

2

LIST OF AVAILABLE DOCUMENTS
LAKE WHITTEMORE

<u>DOCUMENT</u>	<u>CONTENTS</u>	<u>LOCATION</u>
"Whittemore Lake Dam" by E. A. Chamberlin, 1939	Blue Print showing proposed repairs to dam and spillway	Board of Selectmen Spencer, MA
Design Drawings, "Proposed Reconstruction of Dam", by Hayden, Harding & Buchanan, Inc., Boston, MA April 1957	A General Plan, Cross Sections, Structural Details and Hydrologic/Hydraulic Data	Hayden, Harding & Buchanan, Inc.

OK
LST

INSPECTION REPORT - DAME AND RESERVOIRS

1. Location: City/Town SPENCER Dam No. 3-14-230-21
Name of Dam WHITTEMARE Inspected by R. NICHOLSON
Date of Inspection 5/10/72
2. Owner/s: per: Assessors ☒ Prev. Inspection _____
Reg. of Deeds _____ Pers. Contact _____
1. ~~SELECTMAN~~ TOWN OF SPENCER - Board of Selectmen
Name _____ St. & No. _____ City/Town State Tel. No. _____
2. Main St. Spencer
Name _____ St. & No. _____ City/Town State Tel. No. _____
3. _____
Name _____ St. & No. _____ City/Town State Tel. No. _____
3. Caretaker (if any) e.g. superintendant, plant manager, appointed by absentee owner, appointed by multi owners.
Names _____ St. & No. _____
City/Town: _____ States: _____ Tel. No. _____
4. No. of Pictures taken 0
5. Degree of Hazard: (if dam should fail completely)*
1. Minor _____ 2. Moderate ☒
3. Severe _____ 4. Disastrous _____
*This rating may change as land use changes (future development)
6. Outlet Control: Automatic _____ Manual ☒
Operative _____ Yes; ☒ No.

Comments:

7. Upstream Face of Dam: Conditions

1. Good ☒ 2. Minor Repairs _____
3. Major Repairs _____ 4. Urgent Repairs _____

Comments:

STONE R.I.P RAMP FACE.

8. Downstream Face of Dam:

Condition: 1. Good ✓ 2. Minor Repairs _____
 3. Major Repairs _____ 4. Urgent Repairs _____

Comments:

9. Emergency Spillway:

Condition: 1. Good ✓ 2. Minor Repairs _____
 3. Major Repairs _____ 4. Urgent Repairs _____

Comments:

10. Water Level at time of inspection: 5' ft. above _____ below ✓
 top of dam ✓ principal spillway _____
 other _____

11. Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment 2" - 12"
 Animal Burrows and Washouts NONE
 Damage to slopes or top of dam NONE
 Cracked or Damaged Masonry NO
 Evidence of Seepage NONE
 Evidence of Piping NONE
 Erosion NONE
 Leaks NONE
 Trash and/or debris impeding flow NONE
 Clogged or blocked spillway NO
 Other _____

12. Remarks and Recommendations: (Fully Explain)

13. Overall Condition:

1. Safe ☒
2. Minor repairs needed _____
3. Conditionally safe - major repairs needed _____
4. Unsafe _____
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list _____

DESCRIPTION OF DAM

DISTRICT III

Submitted by P. NICHOLSON

Dam No. 3-14-380-21

Date 5/10/72

City/Town SPEUCER

Name of Dam WHITTENDARE LAKE

1. Location: Topo Sheet No. 206

Provide 8 1/2" x 11" in clear copy of topo map with location of Dam clearly indicated.

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

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

4. Drainage Area: _____ sq. mi. _____ acres

5. Normal Ponding Area: _____ acres; Ave. depth ?

Impoundment: _____ gals; _____ acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir

20-25 i.e. summer homes, etc. SUMMER + YEAR ROUND

7. Dimensions of Dam: Length 340' ± Max. Height 12'

Slopes: Upstream Face 2:1

Downstream Face 2:1

Width across top 12' ±

8. Classification of Dam by Material:

Earth ☒ Conc. Masonry _____ Stone Masonry ☒

Timber _____ Rockfill _____ Other RIP RAP

9. A. Description of present land usage downstream of dam:

_____ % rural; 100 % urban.

B. Is there a storage area or flood plain downstream of dam which could accomodate the impoundment in the event of a complete dam failure? yes _____ no ☒.

DAM NO. 3-14-220-21

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

No. of people 20-30.

No. of homes 64.

No. of Businesses 1.

No. of industries _____ Type _____

No. of utilities _____ Type _____

Railroads _____.

Other dams 3-14-220-20.

Other _____.

11. Attach Sketch of dam to this form showing section and plan.
on 8½" x 11" sheet.

12. How To LOCATE:

NORTH ON GROVE ST FROM JCT OF RTE #9 TO
JCT OF WILSON & HASTINGS ST. EAST 100 YDS ON
WILSON ST TO OPEN FIELD ON RIGHT. DAM 100 YDS
OUT INTO FIELD.

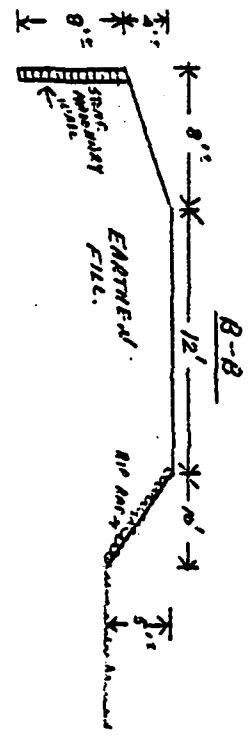
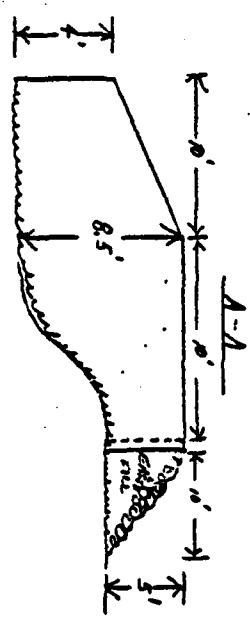
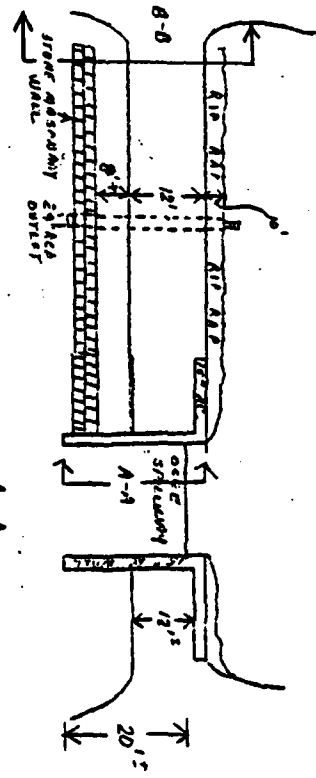


Maped, edited, and published by the Geological Survey
 Control by USGS, USC&GS, and Massachusetts Geodetic Survey
 Topography by planetable surveys 1937. Revised 1965
 Polyconic projection. 1927 North American datum
 10,000-foot grid based on Massachusetts coordinate system,
 mainland zone
 1000-meter Universal Transverse Mercator grid ticks,
 zone 19, shown in blue

260' 1' * 10' 1' * 15' 1' * 10' 1' *

DAM # 3-14-280-21

N —



APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT

LOCATION PLAN

Page No.

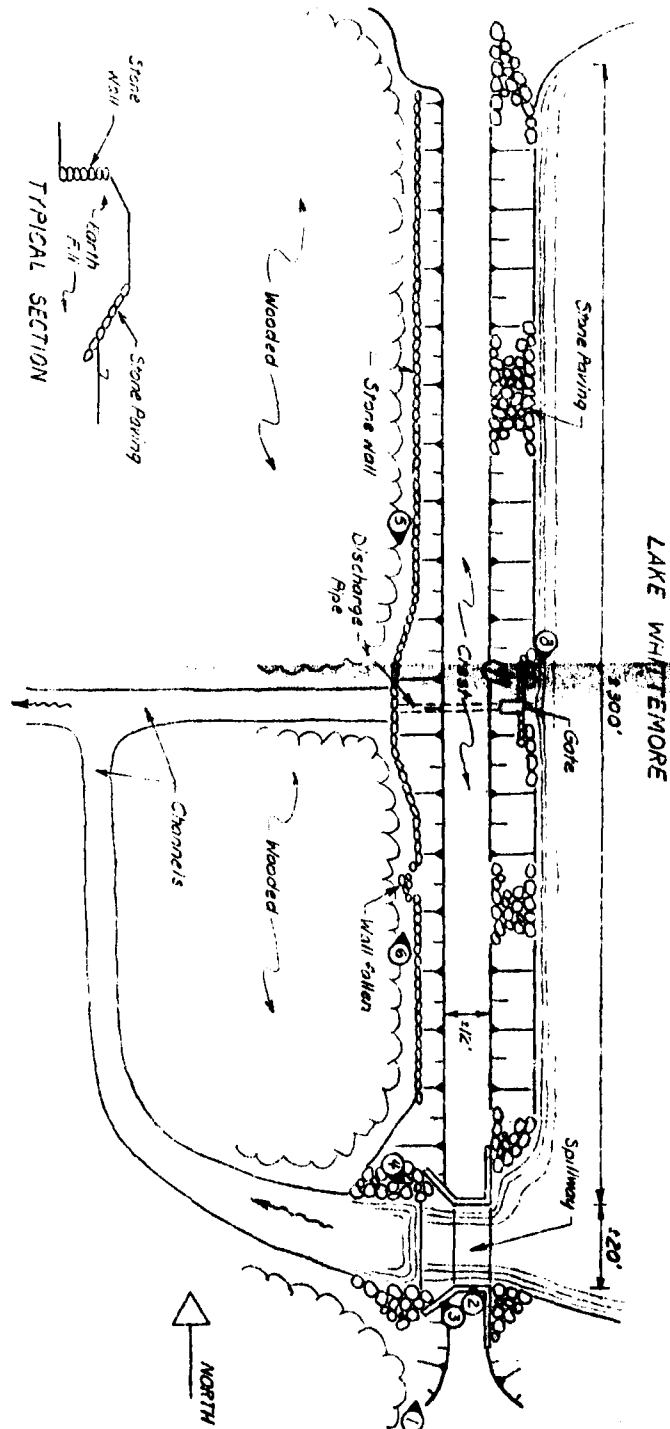
Site Plan Sketch

1

PHOTOGRAPHS

<u>No.</u>	<u>Title</u>	<u>Roll</u>	<u>Frame</u>	<u>Page No.</u>
1.	Spillway, viewed from left abutment	3	18	v, 2
2.	Embankment, viewed from left abutment	3	13	2
3.	Left spillway training wall, viewed from downstream	3	11	3
4.	Downstream channel below spillway	3	16	3
5.	Stone wall along downstream face, view toward south	3	6	4
6.	Failure of stone wall, view toward north	3	10	4
7.	Gate structure	C8	17	5
8.	Stone wall adjacent to gate struc- ture	C8	18	5

File 4160 B-1



NOTE:
1. Plan sketch and typical section developed from Holey & Aldrich, Inc. field observations

LEGEND:
③ Photograph number and direction of view.

Lake Whittemore Dam
Spencer, Massachusetts
SITE PLAN SKETCH
No Scale July 1978



1. Spillway, viewed from left abutment



2. Embankment, viewed from left abutment



3. Left spillway training wall, viewed from downstream



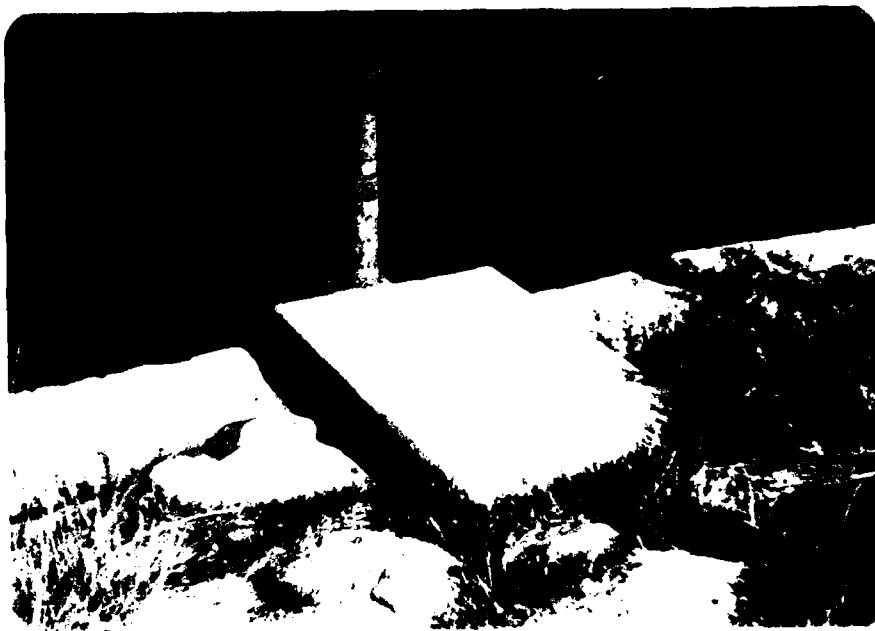
4. Downstream channel below spillway



5. Stone wall along downstream face, view toward south



6. Failure of stone wall, view toward north



7. Gate structure



8. Stone wall adjacent to gate structure

APPENDIX D
OUTLINE OF DRAINAGE AREA AND
HYDRAULIC COMPUTATIONS

COMPUTATIONS

Page No.

Drainage Area	1
SCS 100-Year Flood Spillway Rating Curve	2
Flood Routing, 100-Year Flood	5
SCS Maximum Probable Flood	8
Flood Routing, PMF	11
Dam Failure Analysis	14

OUTLINE OF DRAINAGE AREA

Drainage Area Map	20
-------------------	----

Drainage Area, Lake Whittamore

Plan. Rating: 4.63 m²

$$\frac{4.63 \text{ m}^2 \times (3200 \text{ ft})^2 \times 1 \text{ acre}}{1 \text{ m}^2 \quad 43,560 \text{ ft}^2} = 425.2 \text{ acres}$$

2.166439 mi

Length of watershed = 3200'

1.5%

480'

Elev. 930'

35%

2720'

1043'

Slope of watershed = .05044643'

O. A. Land Use Breakdown:

1. Impervious, Roads = 10 acres
 2. Residential = 26 acres (304 1/2 acre lots)
 3. Lake Whittamore = 53 acres
 4. Open spaces = 330.2 acres 304 330
- Total 425.2' 304 425

Assume Hydrologic Soil Group B/C (off 11/22/75)

	CU	ACRS	CU x A
Imp. Roads	98	10	1568
Residential	75	26	1950
Lake Whittamore	100	53	5300
Open spaces			
Meadows, etc	68	110	7480
Forest	63	220	13860
		<u>425</u>	<u>30153</u>

Wtd CU = 70.70' 304 71'

Rainfall: 100 year 6 hr rainfall = 4.7 in
Maximum probable = 2.3 in
6 hr rainfall

CU = 71

$$\frac{5 \times 1568 - 10}{20} = 4.0845$$

CAMP ORESSER & McKEE
Environmental Engineers
Boston, Mass.

CLIENT U.S. A. 4.0.1. Group
PROJECT 1000 ft. storm
DETAIL Hydrologic Calculations

JOB NO. 561-R-RT
DATE CHECKED _____
CHECKED BY _____

PAGE 2
DATE 6-22-75
COMPUTED BY ALD

$$LQ = \frac{2.8 (1.5+1)^{.7}}{1.900 \text{ FT}} \quad L = 3200'$$

$$S = 9.0845$$

$$Y = 5.044643 \%$$

$$LQ = \frac{3200^{.8} (5.0845)^{.7}}{1.900 + 5.044643} = 0.466 \text{ hrs}$$

$$T_L = \frac{LQ}{.6} = \frac{466}{.6} = .777 \text{ hrs} \quad (* 46.6 \text{ min})$$

$$LQ = 0.46 = 0.4 \times 46.6 \text{ hrs} = 0.1864 \text{ hrs}$$

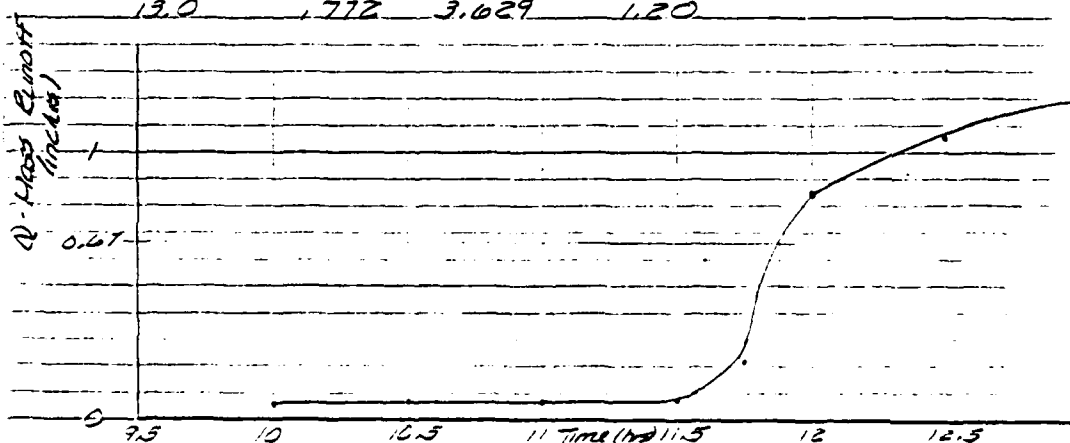
$$T_P = \frac{LQ}{2} + L = \frac{0.1864}{2} + .466 = .559 \text{ hrs}$$

Effective Peak Producing Runoff Period = 7.40

$$7.40 = 7 \times .1864 = 1.3048 \text{ hrs}$$

→ Use 5.12 Initially (100 yr. 6 hr. storm)

Time (hrs)	Mass P (inches)	Mass D (inches)
10.0	0.181	.851
10.5	.204	.959
11.0	.235	1.105
11.5	.283	1.390
11.75	.327	1.817
12.0	.463	3.116
12.5	.735	3.955
13.0	.772	3.629



$$11.88 - 3.25 (.1864) = 11.04$$

Computations For Instantaneous
Peak Discharge

Increment	Time (hours)	Peak PMF (inches)	ΔQ (inches)	Q (cfs)	Y	$Y \Delta Q$
	11.04	.217				
ΔQ_1	11.23	.248	.001	.575	0.2	.115
ΔQ_2	11.41	.267	.001	.575	0.4	.23
ΔQ_3	11.60	.13	.001	35.07	0.6	21.04
ΔQ_4	11.78	.40	.27	155.23	0.8	124.18
ΔQ_5	11.97	.81	.41	235.71	1.0	235.71
ΔQ_6	12.16	.93	.12	69	.667	46.52
ΔQ_7	12.34	1.02	.07	51.75	.333	17.23
						484.5

$$\Delta Q_p = \frac{434 \times A \times \Delta Q}{\Delta Q + L} = \frac{434 \times 100 \times \Delta Q}{\Delta Q + 559} = 574.7 \Delta Q$$

Spillway Capacity, (Allowing 6' freeboard)

$$Q = 11.43 \times 3.8 \times 20 \times 5^{3/2} = 850 \text{ cfs}$$

Will take 100 yr, 1/2 PMF, and PMF

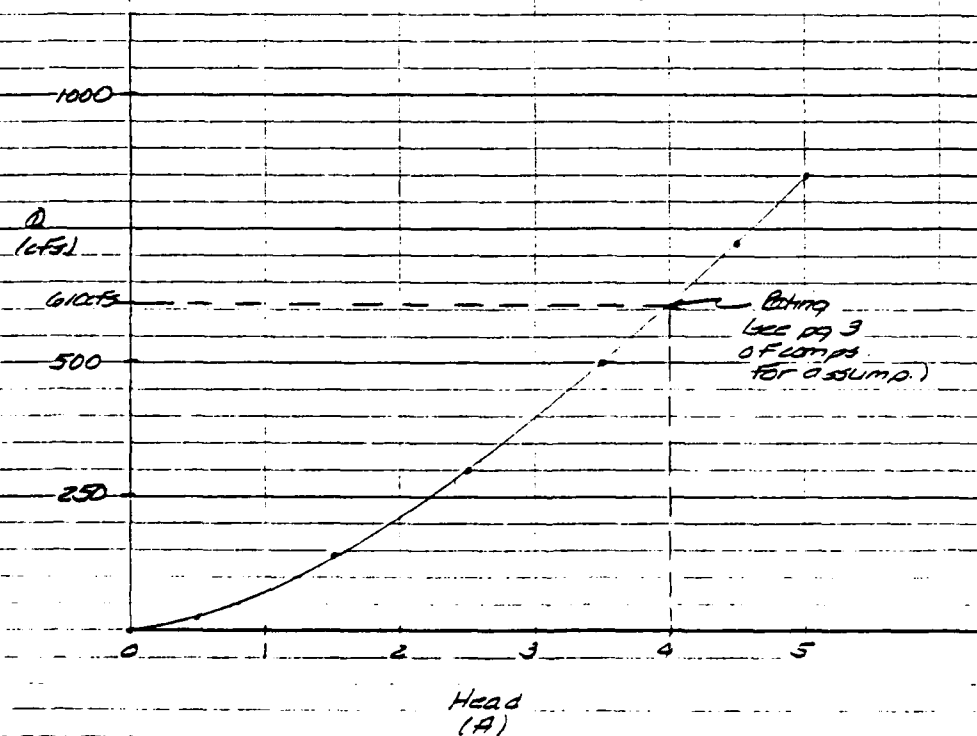
CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT H&A N.O.T. Group 1 JOB NO. 561-P-RT
PROJECT LAKE WHITEHEAD DATE CHECKED _____
DETAIL Hydrology Calculations CHECKED BY _____

PAGE 31
DATE 7/3/72
COMPUTED BY CLD

Spillway Rating Curve (taken from calc. pg. 16)

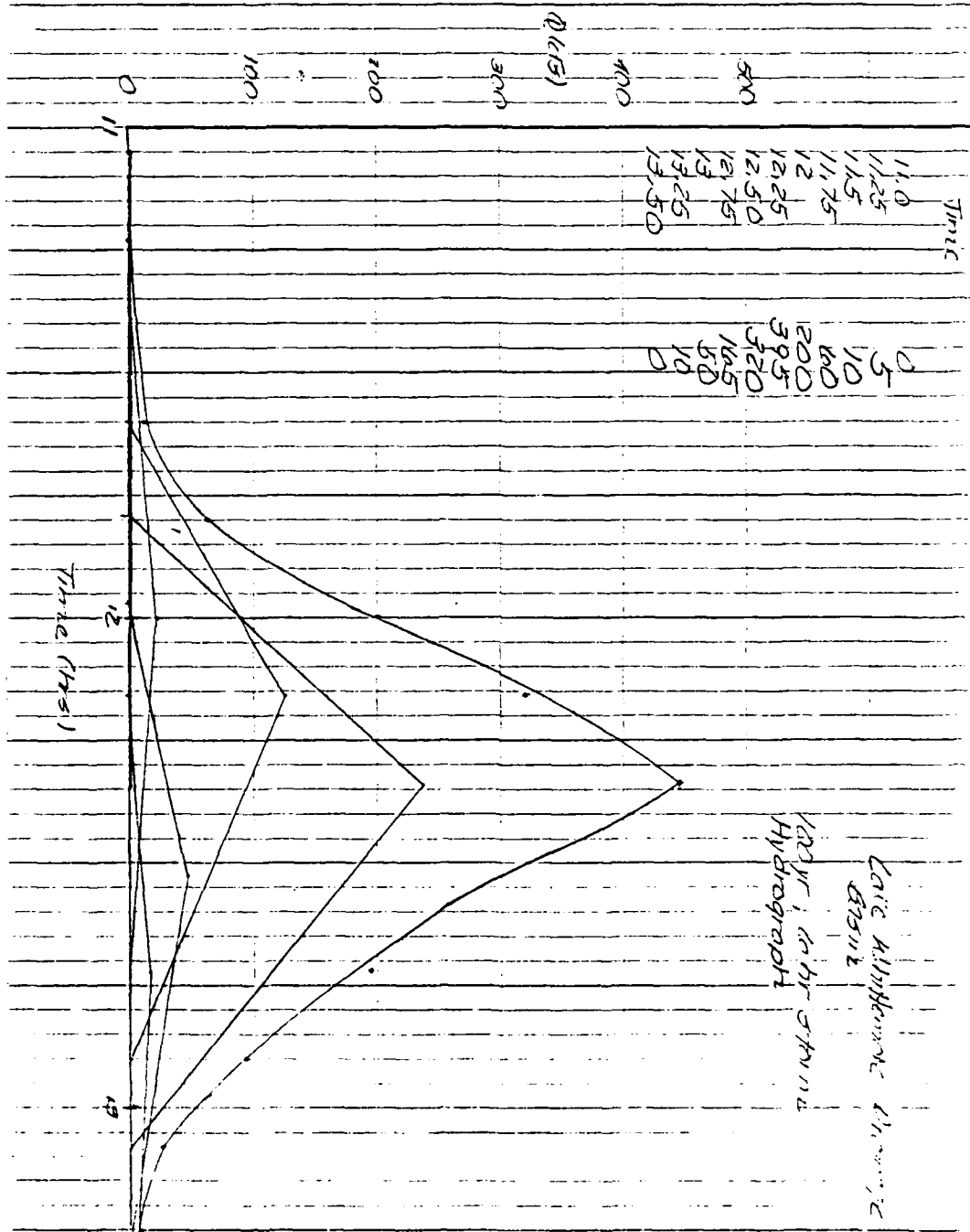
<u>Head over top Spillway</u>	<u>Elev. of water</u>	<u>Q</u>
0	884.5	0
0.5	885	27
1.5	886	140
2.5	887	300
3.5	888	478
4.5	889	725
5	889.5	850



CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT F.S.D. U.D.T. 31-1-11 JOB NO. 31-1-2-2-
PROJECT 1000' W. of 1000' DATE CHECKED _____
DETAIL Hydrograph Calculations CHECKED BY _____

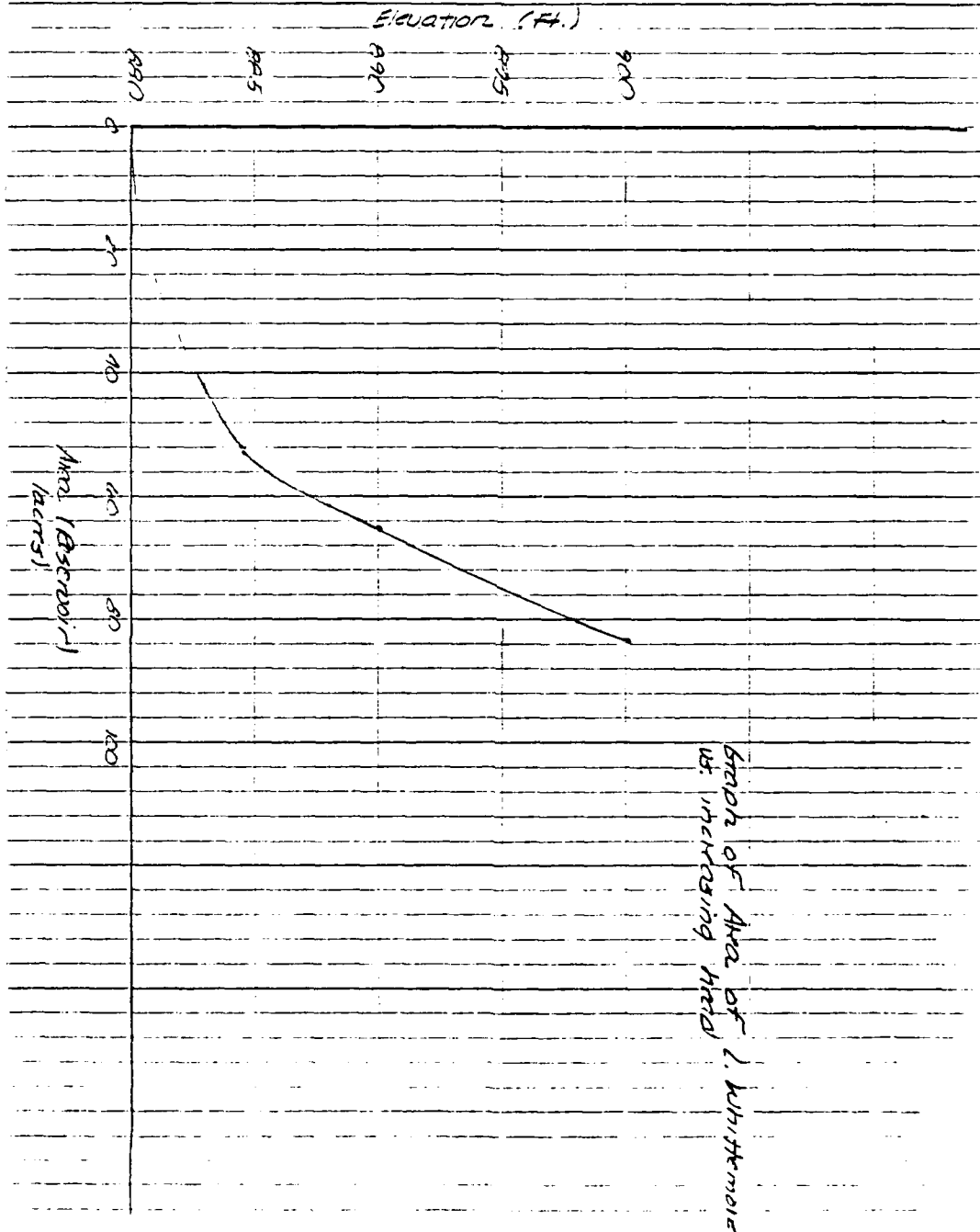
PAGE 2
DATE 11/23/78
COMPUTED BY P.D.D.



CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT H&D I.D.T. 5/11/71 JOB NO. 501-P-PT
PROJECT 1st. 2nd. 3rd. 4th DATE CHECKED _____
DETAIL Hydrology Calculations CHECKED BY _____

PAGE 5
DATE 6/23/72
COMPUTED BY W.C.



Eqn. n	Hn. n	Base d.c.	G/c	G/c	$\frac{1}{2}$	$\frac{1}{2} - \frac{2}{2}$	$\frac{3}{2} + \frac{2}{2}$
Spillway H	Spillway H	Area d.c.	Ordn (1.5)	Storage d.c. - H	LT (cfs)	LT (cfs)	LT (cfs)
224.5	0	53	0	0	0	0	0
225	.5	54	27	27	1307	1294	1321
226	1.5	57	140	83	4017	3947	4087
227	2.5	59	300	140	6776	6626	6926
228	3.5	61.5	498	201	9728	9479	9977
229	4.5	63	725	263	12729	12367	13092
230	5.5	65.2	980	327	15827	15337	16317
231	6.5	67	1260	393	19021	18391	19651

Time No	Time	Obs Intens	Avg Intens	$\frac{1}{4} - 2$	$\frac{3}{4} - 2$	Hd. or Spillage	Surf. Q (cfs)
0	11.0	0	0				0
1	11.25	5	2.5				5
2	11.5	10	7.5				10
3	11.75	40	35			0.85	40
4	12	220	130	2120	2290	0.84	425
5	12.25	395	293	2250	2493	0.92	48
6	12.5	320	358	2350	2708	1.00	76
7	12.75	165	243	2580	2823	1.04	80
8	13	50	108	2620	2728	1.02	78
9	13.25	10	30	2600	2630	0.97	73
10	13.5	0	5	2500	2505	0.92	68
11	13.75	0	0	2350	2350	0.87	61
12	14.0	0	0	2200	2200	0.81	55
13	14.25	0	0	2220	2280	0.77	51
14	14.5	0	0	1950	1950	0.72	46

NO. 21-298. LOGARITHMIC. THREE BY THREE BY 1/2 INCH CYCLES (BASE SHORT WAY). IN STOCK DIRECT FROM COAST BOOK CO. NORWOOD, MASS. 01948
 MADE IN U.S.A.

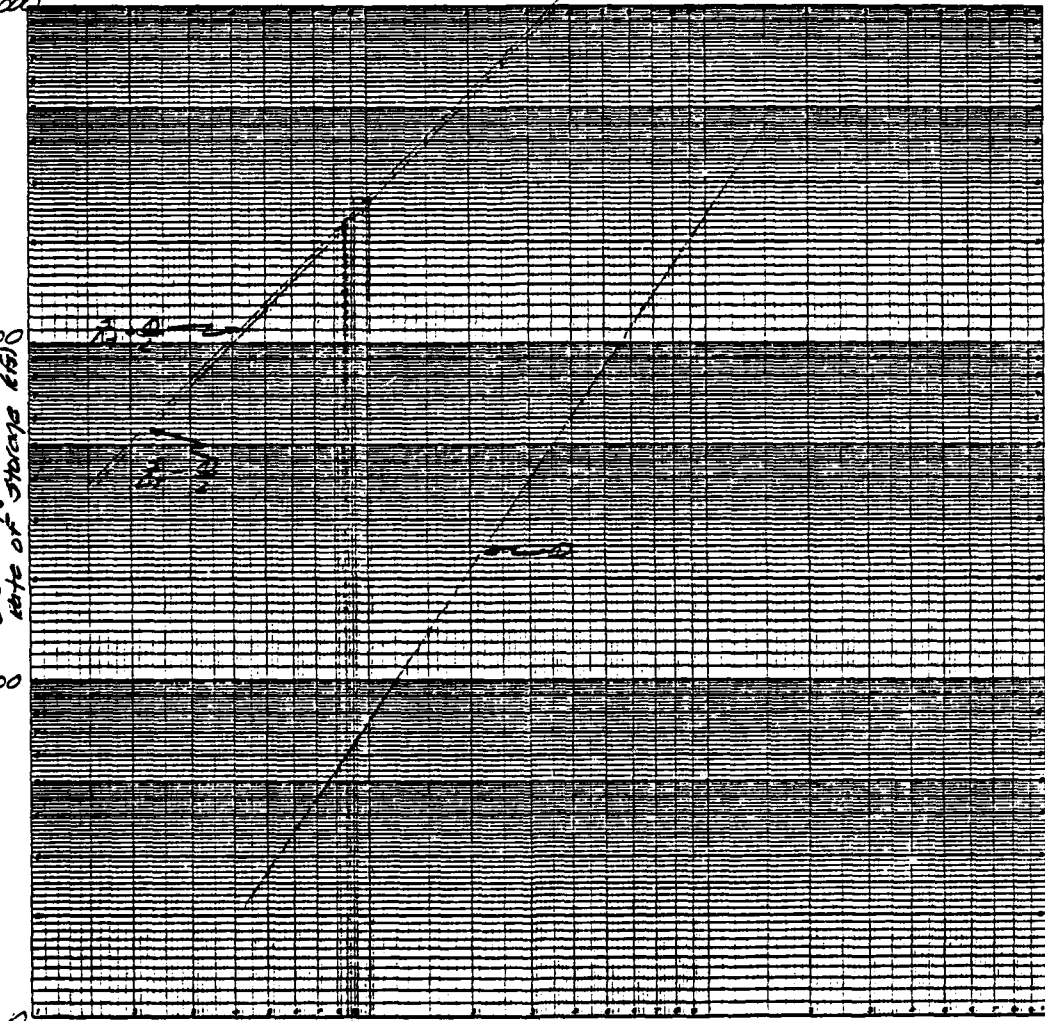
© 1948

Distance
 Rate of change
 Rate of change

10,000

1000

100



HEAD on Sallway (A)

CAMPRESSER & McKEE
Environmental Engineers
Boston, Mass.

CLIENT HEA, U.D.T. Group JOB NO. 5/112-87
PROJECT Lake W. W. W. W. W. DATE CHECKED _____
DETAIL Hydrology, Inc. CHECKED BY _____

PAGE 5
DATE 11/21/87
COMPUTED BY dlg

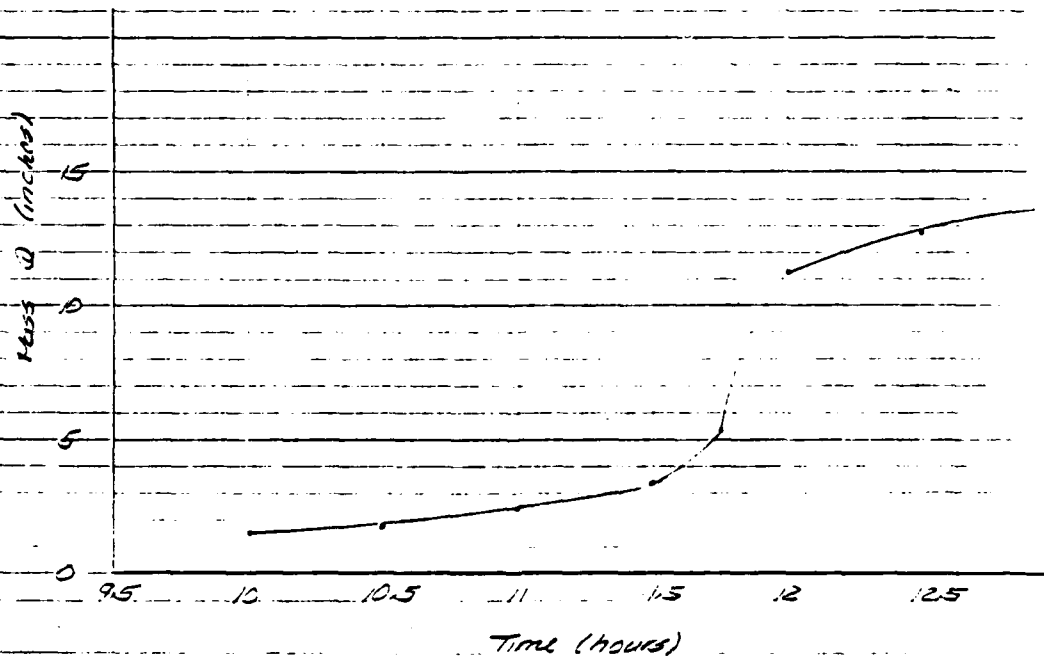
SL5 Method

→ Use 23 in. (Maximum Probable Storm)

Time (hrs)	P1/P24	Mass P (inches)	Mass Q (inches)
10.0	2.131	4.16	1.50
10.5	2.204	4.69	1.87
11.0	2.235	5.41	2.40
11.5	2.223	6.51	3.30
11.75	2.337	8.90	5.30
12.0	2.663	13.25	11.25
12.5	2.735	16.91	12.88
13.0	2.772	17.76	13.65

$$Q = \frac{(P - 0.25)^2}{P + 0.25}$$

$$11.88 - 9.5(0.1864) = 11.04$$



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Environmental Engineers
Boston, Mass.

CLIENT W&B U.D.T. Group JOB NO. 5612-RT
PROJECT 12th St. Bridge DATE CHECKED _____
DETAIL Hydrology Calc. CHECKED BY _____

PAGE 9
DATE 6/23/72
COMPUTED BY D. G.

Computations for Instantaneous Peak Discharge

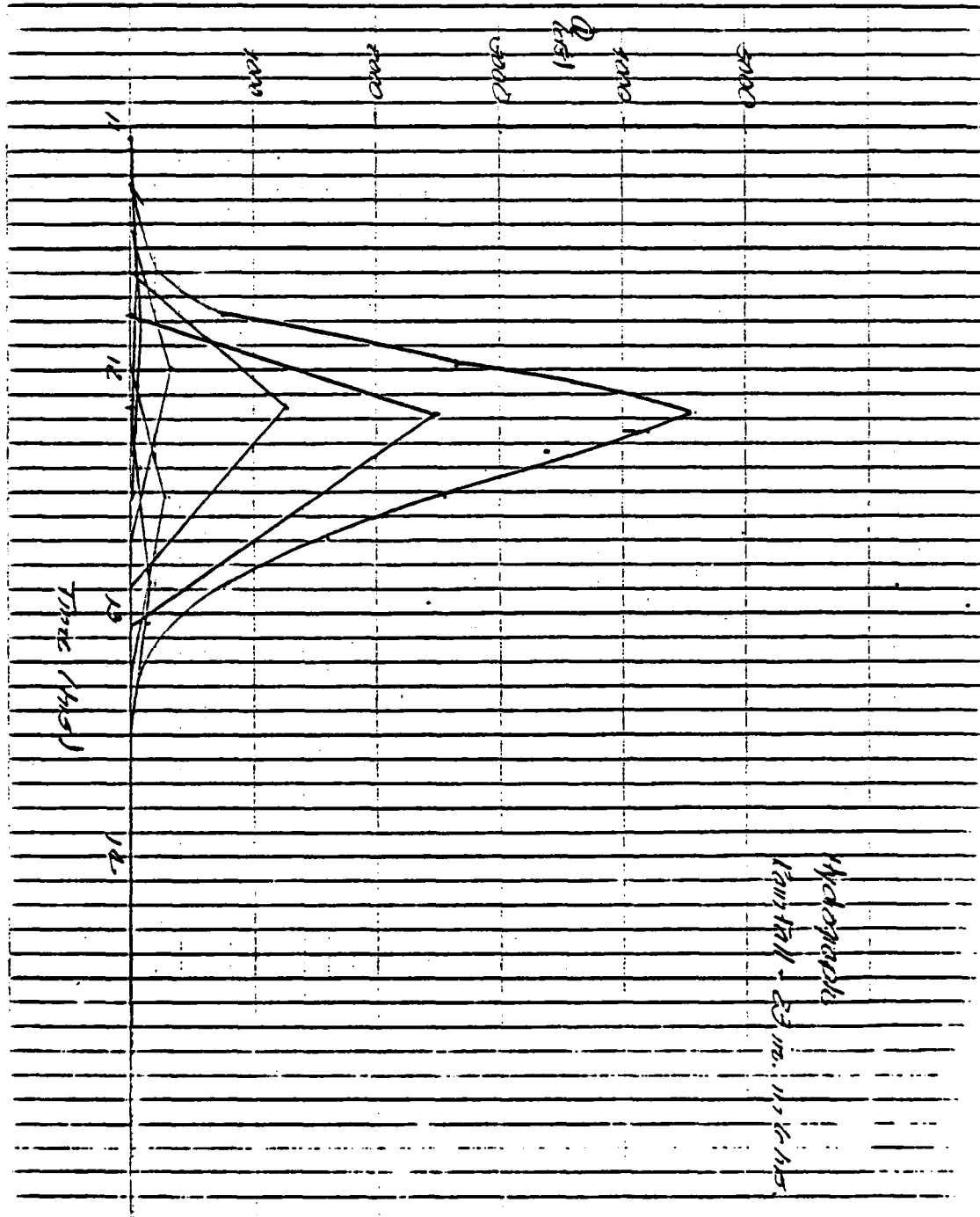
<u>Increment</u>	<u>Time</u> <u>hrs.</u>	<u>Ruoff</u> <u>(in/hr)</u>	<u>ΔQ</u> <u>(cfs)</u>	<u>Δt</u> <u>(hrs)</u>	<u>Y</u>	<u>YΔQ</u> <u>(cfs)</u>
<u>ΔQ₁</u>	<u>11.04</u>	<u>2.5</u>	<u>0.3</u>	<u>172.5</u>	<u>0.2</u>	<u>35</u>
<u>ΔQ₂</u>	<u>11.23</u>	<u>2.8</u>	<u>0.3</u>	<u>172.5</u>	<u>0.4</u>	<u>69</u>
<u>ΔQ₃</u>	<u>11.41</u>	<u>3.1</u>	<u>0.9</u>	<u>517.4</u>	<u>0.6</u>	<u>310</u>
<u>ΔQ₄</u>	<u>11.60</u>	<u>4.0</u>	<u>2.7</u>	<u>1552.2</u>	<u>0.8</u>	<u>1242</u>
<u>ΔQ₅</u>	<u>11.78</u>	<u>6.7</u>	<u>4.3</u>	<u>2472.1</u>	<u>1.0</u>	<u>2472</u>
<u>ΔQ₆</u>	<u>11.97</u>	<u>11.0</u>	<u>0.7</u>	<u>402.4</u>	<u>.667</u>	<u>268</u>
<u>ΔQ₇</u>	<u>12.16</u>	<u>11.7</u>	<u>0.8</u>	<u>459.9</u>	<u>.333</u>	<u>153</u>
	<u>12.34</u>	<u>12.5</u>				
						<u>4549</u>

$$\Delta Q_p = \frac{484 \times \text{Px} \Delta Q}{\Delta Q + L} = \frac{484 \times .667}{.559} \Delta Q = 574.7 \Delta Q$$

CAMPRESSER & MAKER
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Boston, Mass.

CLIENT USA N.D.I. LEAD 1 JOB NO. 541-A-PT
PROJECT 10% N.H. LEAD DATE CHECKED _____
DETAIL FIELD DATA CHECKED BY _____

PAGE 10
DATE 11/22/72
COMPUTED BY A. J. G.

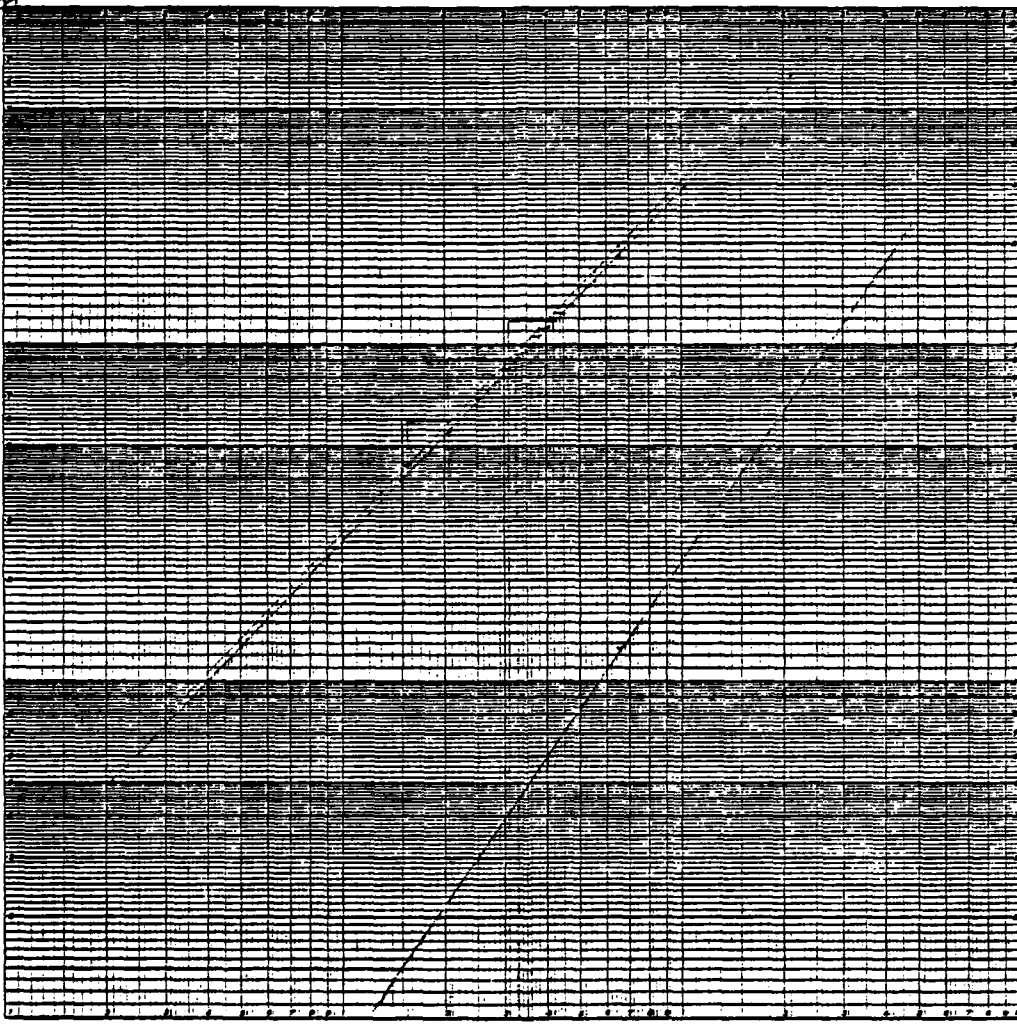


PAGE 11
DATE 6/23/72
TESTED BY D'CD

[illegible]

MO. 21. 200. LOGARITHMIC. THREE BY THREE 3/4 INCH CYCLES (BASE SHORT WAY).
 IN STOCK DIRECT FROM CONE & BOES CO. NEWBURY, MASS.
 PRINTED IN U.S.A.

Discharge rate of 5000
 1000

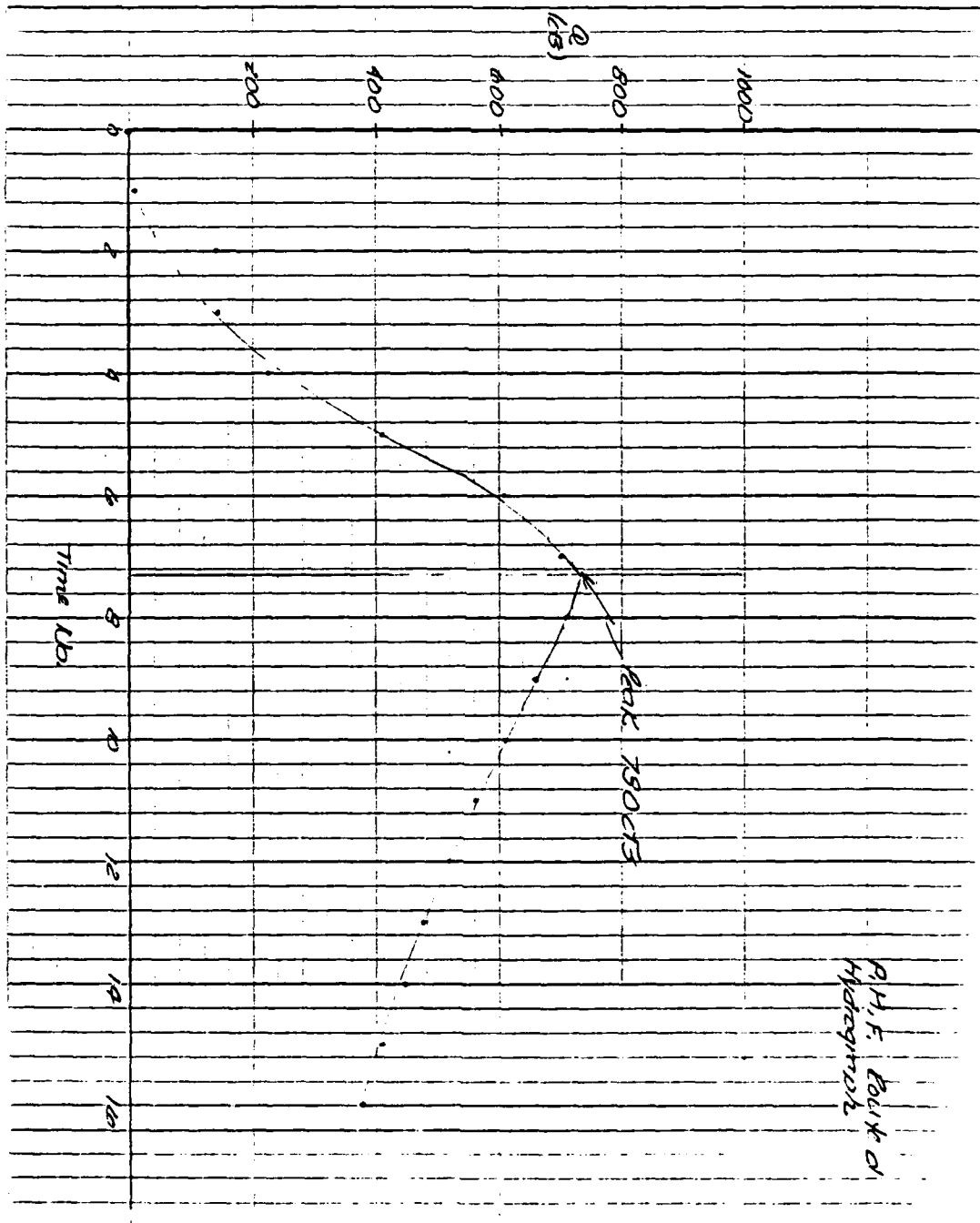


Head on Sillway (A)

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CLIENT H&A L.L.O.T. Group 1 JOB NO. 5021-A-P7
PROJECT LAKE WINDHAM DATE CHECKED _____
DETAIL Hydrology, Cole CHECKED BY _____

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DATE 7/3/78
COMPUTED BY ALB

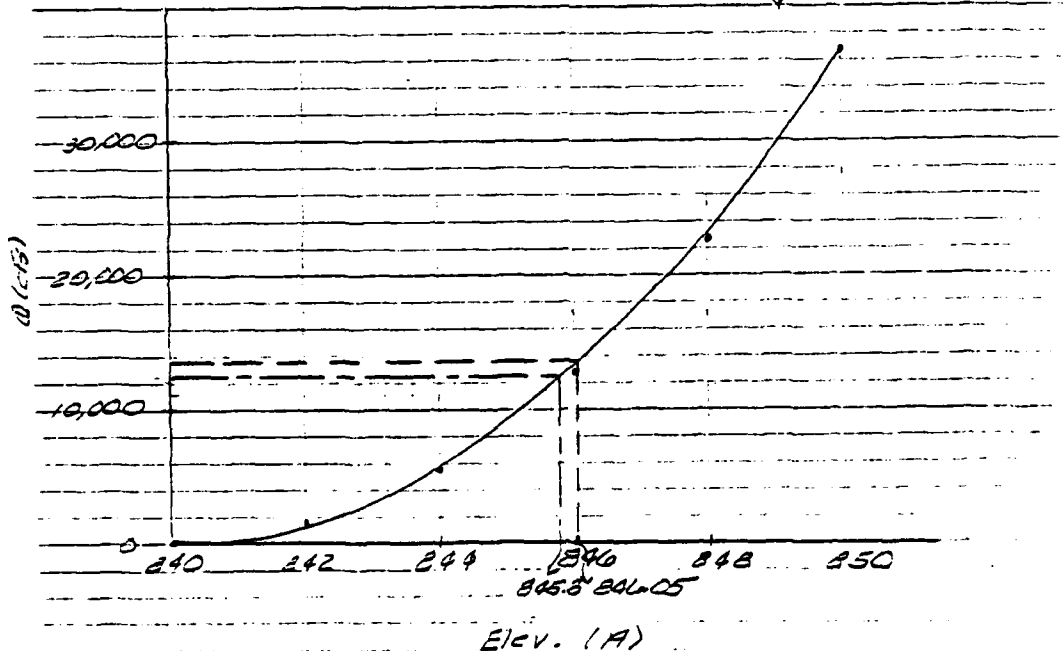


Stage-Discharge For Reach

- Say $n = .035$ For reach; heavy trees, brush
on banks, rocky stream bed.

$$Q = 4.47 A^{.848} R^{.483}$$

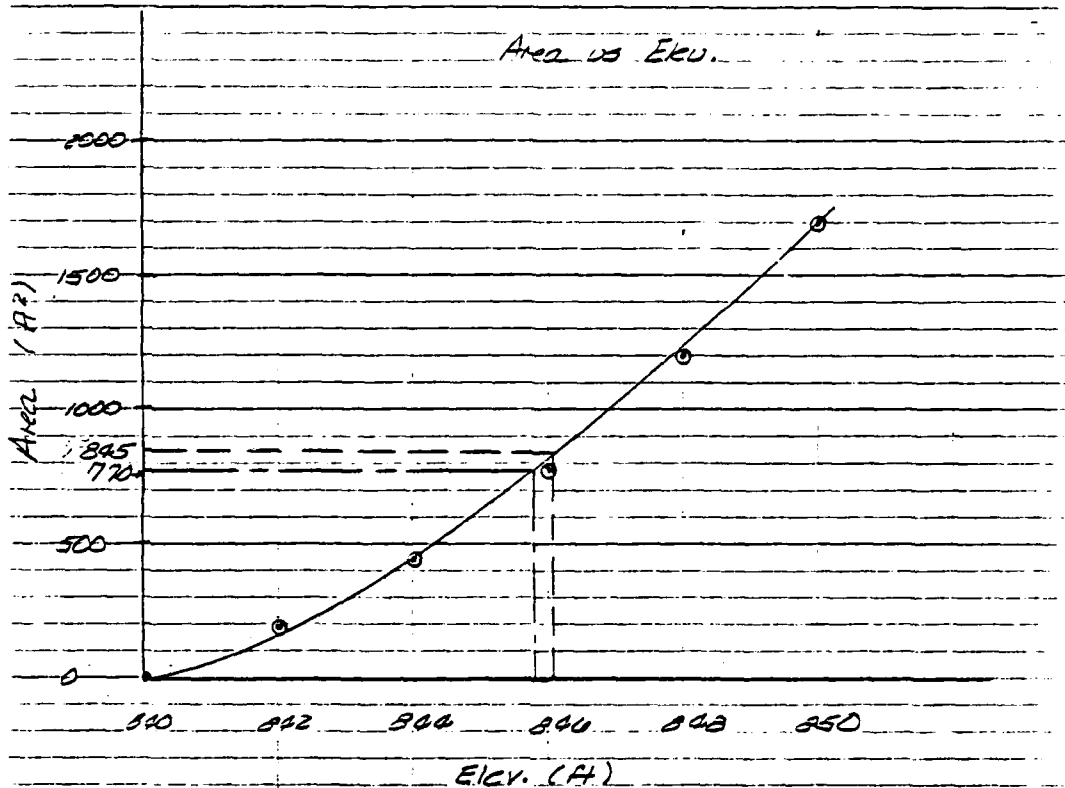
Elev.	Area	WP	R	S	Q
840	0 AC	0 ft	0	.021212	0
842	190	113	1.68		1665
844	450	150	3.00		5806
846	780	180	4.33		12855
848	1200	226	5.31		22645
850	1700	261	6.51		36764



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CLIENT Holmes & Narver, Ltd., Inc. JOB NO. 501-R-ET
PROJECT Lake Whittemore DATE CHECKED _____
DETAIL Hydrology CHECKED BY _____

PAGE 3
DATE 7/27/79
COMPUTED BY Blod



$$Q_{D1} = 13,523 \text{ cfs}$$

$$V_1 = \frac{845 \text{ ft}^2 \times 1780'}{43,560 \text{ ft}^2/\text{acre}} = 38.4 \text{ acre-ft} \quad \text{6 1/2 5 OKAY}$$

$$Q_{D2} \text{ (TRIAL)} = 13,523 \text{ cfs} \left(1 - \frac{38.4}{495.9}\right) = 12,476 \text{ cfs}$$

$$V_2 = \frac{770 \text{ ft}^2}{43,560 \text{ ft}^2/\text{acre}} \times 1780 = 35.0 \text{ acre-ft}$$

$$\frac{V_1 + V_2}{2} = \frac{38.4 + 35.0}{2} = 36.7 \text{ acre-ft}$$

$$Q_{D2} = 13,523 \left(1 - \frac{36.7}{495.9}\right) = 12,522 \text{ cfs}$$

HEAD = 5.85 ft

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Boston, Mass.

CLIENT Haley & Aldrich
PROJECT Lake Umbagog
DETAIL Hydrology

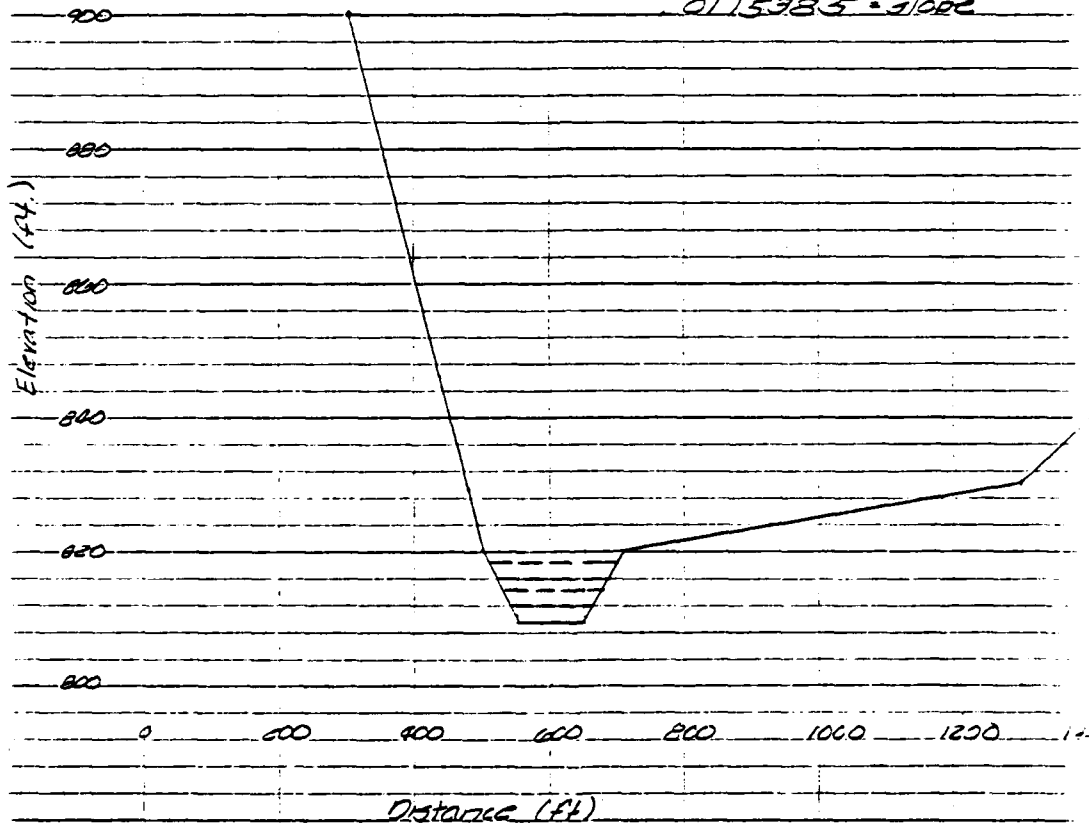
JOB NO. 5101-B-RT
DATE CHECKED 8/4/79
CHECKED BY CF

PAGE 5
DATE 7/27/78
COMPUTED BY

Reach No. 2 - 2400' to Main Street

3. Typical X-section (looking downstream)

Reach slope (840' us. to 810' at X-section)
0.015385 = 1/65



$$Q = \frac{1.47}{n} P^{2/3} A^{5/2} = \frac{1.47}{.030} \times (.015385)^{1/2} P^{2/3} A^{5/2}$$

$$Q = 5.335 P^{2/3} A^{5/2}$$

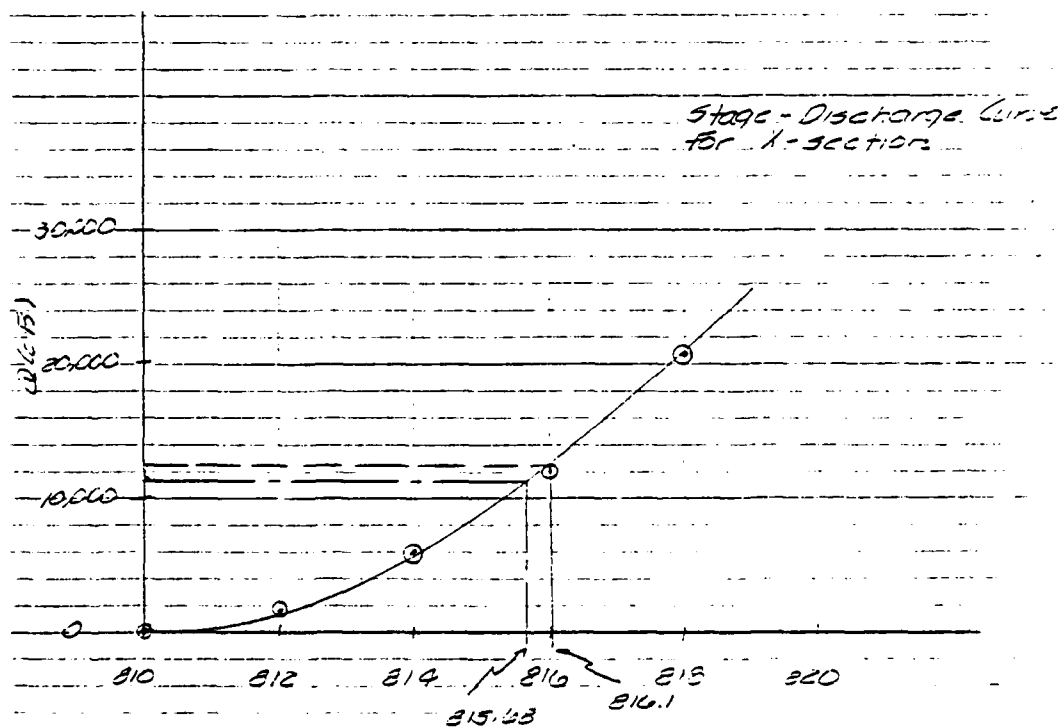
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Environmental Engineers
Boston, Mass.

CLIENT WALSH PAPER CO.
PROJECT WALSH PAPER CO.
DETAIL "WALSH PAPER CO."

JOB NO. 541-B-2
DATE CHECKED 10/15/55
CHECKED BY W. J. D.

PAGE 1
DATE 10/15/55
COMPUTED BY W. J. D.

ELY.	Area	WP	R	S	D
810	0	0	0	.015395	0
812	225	125	1.3		17.77
814	510	156	3.27		59.96
816	810	171	4.74		121.95
818	1180	196	6.22		252.26

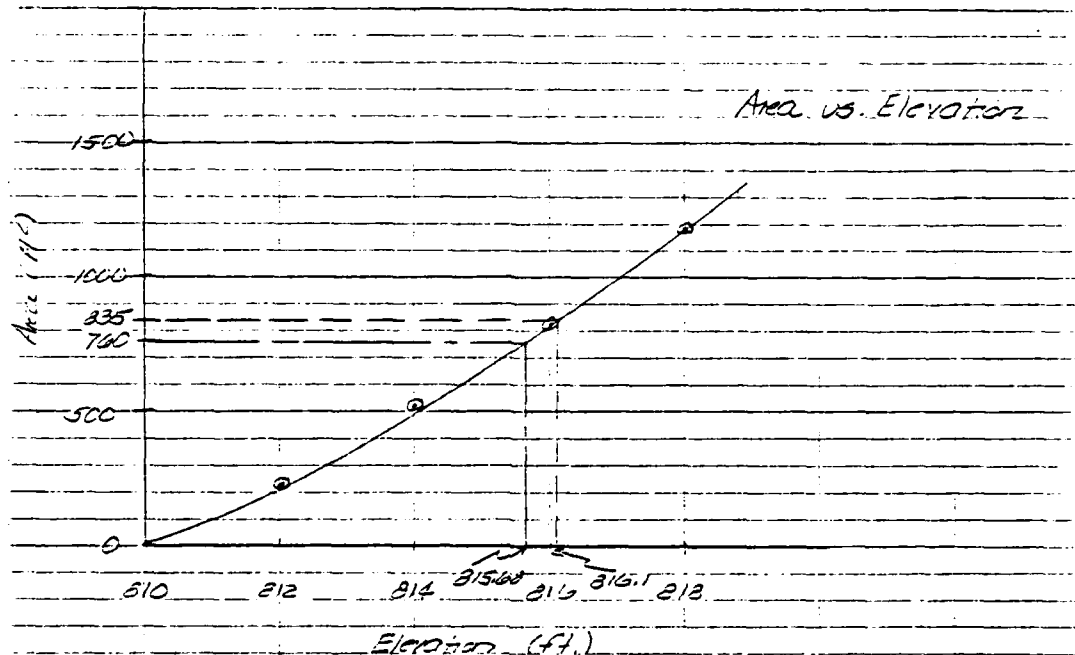


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Boston, Mass.

CLIENT WALTON AND WILSON
PROJECT WALTON AND WILSON
DETAIL WALTON AND WILSON

JOB NO. 561-P-2-
DATE CHECKED _____
CHECKED BY _____

PAGE _____
DATE 7/27/02
COMPUTED BY 7/27



$$Q_{01} = 12522 \text{ cfs}$$

$$V_1 = \frac{835 \text{ ft}^2}{43560 \text{ ft}^2/\text{acre}} \times 2400' = 47.8 \text{ acre-ft} \quad \text{at } 1/2 \text{ S. OLDY}$$

$$Q_{02} (\text{TRIAL}) = 12522 \left(1 - \frac{47.8}{495.9} \right) = 11,264 \text{ cfs}$$

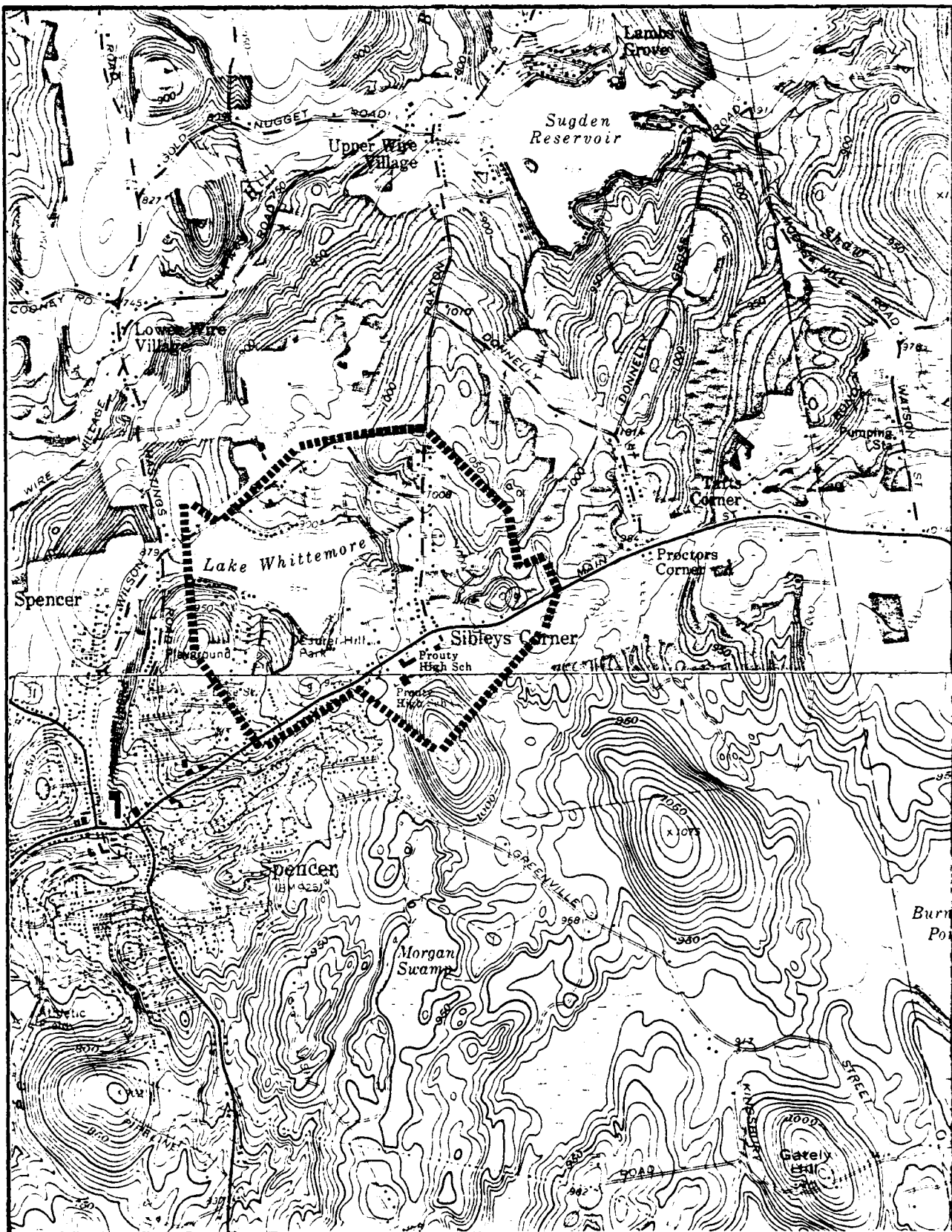
$$V_2 = \frac{760 \text{ ft}^2}{43560 \text{ ft}^2/\text{acre}} \times 2400' = 45.4 \text{ acre-ft} \quad \text{at } 1/2 \text{ S. OLDY}$$

$$\frac{V_1 + V_2}{2} = \frac{47.8 + 45.4}{2} = 47.6 \text{ acre-ft}$$

$$Q_{02} = 12522 \text{ cfs} \left(1 - \frac{47.6}{495.9} \right) = 11320 \text{ cfs}$$

$$\text{WITH } Q = 11320 \text{ cfs, Hydrom.} = 5.70$$

$$\text{Elev. at X-section} = 2.5.70$$



CAMP DRESSER & McKEE Inc.
 Consulting Engineers
 Boston, Mass.



**LAKE WHITTEMORE DAM
 DRAINAGE AREA**

SCALE 1:24 000

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS



INVENTORY OF DAMS IN THE UNITED STATES

IDENTITY NUMBER	DIVISION	STATE	COUNTY	DIST.	CORNER	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
4A 699	NED	MA	027	02		LAKE WHITTEMORE DAM	4215.3	7159.4	08SEP78

POPULAR NAME	NAME OF IMPONDMENT			
	LAKE WHITTEMORE			
REGION/DRAIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01 08	TR=SEVENMILE RIVER	SPENCER	U	9895

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STAGE-HYDRAULIC HEAD (FT.)	IMPONDING CAPACITIES (ACR.-FT.)	DIST QWN	FED R	PRV/PED	SCS A	VER/DATE	
HEC1PG	1900	R	17	11	484	202	NED	N	N	28AUG78

REMARKS

D/S HAS	SPILLWAY	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CY)	POWER CAPACITY (KW)	INSTALLED	PROPOSED	NO.	LENGTH	WIDTH	DEPTH	LENGTH	WIDTH	DEPTH
1	300 U	20	850										

OWNER	ENGINEERING BY	CONSTRUCTION BY
TOWN OF SPENCER		

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	MA DPM

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
MALEY + ALDRICH, INC.	12MAY78	PL 92-367

REMARKS

END

FILMED

7-85

DTIC