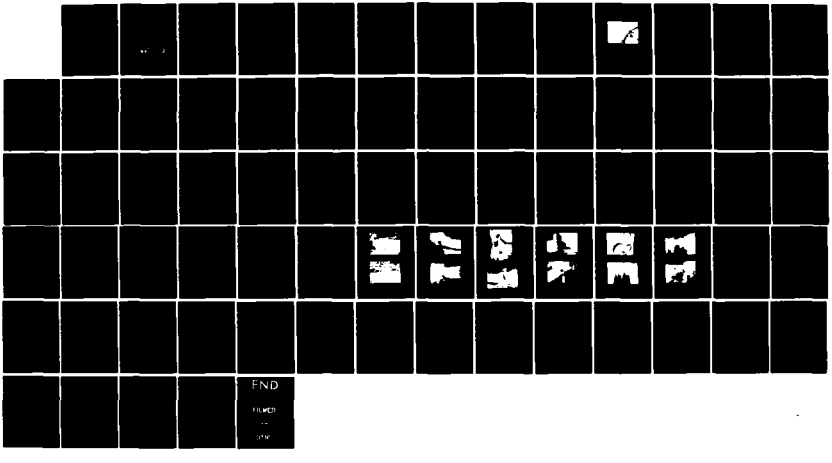
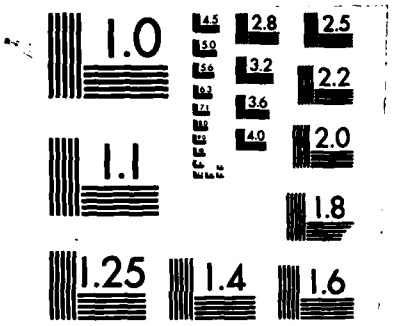
AD-A156 535 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/1
WALKER OLIVERIAN STRE..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUN 79
UNCLASSIFIED F/G 13/13 NL





CONNECTICUT RIVER BASIN
HAVERHILL, NEW HAMPSHIRE

WALKER OLIVERIAN STREAM DAM
NH 00068

STATE NO 112.02

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

JUNE 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NH 00068	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Walker Oleverian Stream Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE June 1979 13. NUMBER OF PAGES 37
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

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

18. SUPPLEMENTARY NOTES

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

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Connecticut River Basin
Haverhill, New Hampshire
Oliverian Brook

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

The dam has a hydraulic height of 19 ft. and is 74 ft. long. It is a run-of-the-river, split stone and masonry dam with one inoperable gate and a vertical drop spillway. The dam is in poor condition. Of concern is the stability of the dam under flood conditions with substantial overtopping, and the seepage that is evident over much of the downstream face of the dam. It is small in size with a significant hazard classification.

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

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

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

REPLY TO
ATTENTION OF:
NEDED

FEB 1 · 1980

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

Dear Governor Gallen:

Inclosed is a copy of the Walker Oliverian Stream 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 Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Mr. Robert V. Walker, Pike, New Hampshire.

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

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	NH00068
Name of Dam:	Walker Oliverian Stream Dam
Town:	Haverhill
County and State:	Grafton County, New Hampshire
Stream:	Oliverian Brook
Date of Inspection:	May 8, 1979

BRIEF ASSESSMENT

Walker Oliverian Stream Dam has a hydraulic height of 19 feet, is of varied topwidth, and is 74 feet long. It is a run-of-the-river, split stone and masonry, gravity dam with one inoperable gate and a vertical-drop spillway. The dam spans a reach of Oliverian Brook, and is located in northwestern New Hampshire. Maximum storage capacity is about 20 acre-feet. Walker Oliverian Stream Dam was used for small hydroelectric power generation but now acts only as a stream barrier. The pond ranges from 1700 to 2000 feet in length with a surface area of about 4 acres.

The dam is in poor condition. Of concern is: (1) the stability of the dam under flood conditions with substantial overtopping, and (2) the seepage that is evident over much of the downstream face of the dam.

Based on small size and significant hazard classifications in accordance with Corps guidelines, the test flood is ½ Probable Maximum Flood (PMF). A test flood outflow of 15,150 cfs (500 csm) would overtop the dam by about 10.5 feet (12.5 feet over spillway crest). The spillway will pass 695 cfs or about 5 percent of the test flood. A major breach at top of dam could result in the loss of 1 or 2 lives and appreciable property damage.

The owner, Robert V. Walker, should implement the results of the recommendations and remedial measures given in Sections 7.2 and 7.3 within one year after receipt of this Phase I Inspection Report.

Warren A. Guinan
Project Manager
N.H. P.E. 2339

This Phase I Inspection Report on Walker Oliverian Stream 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 judgement and practice, and is hereby submitted for approval.

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Chief, Structural Section
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

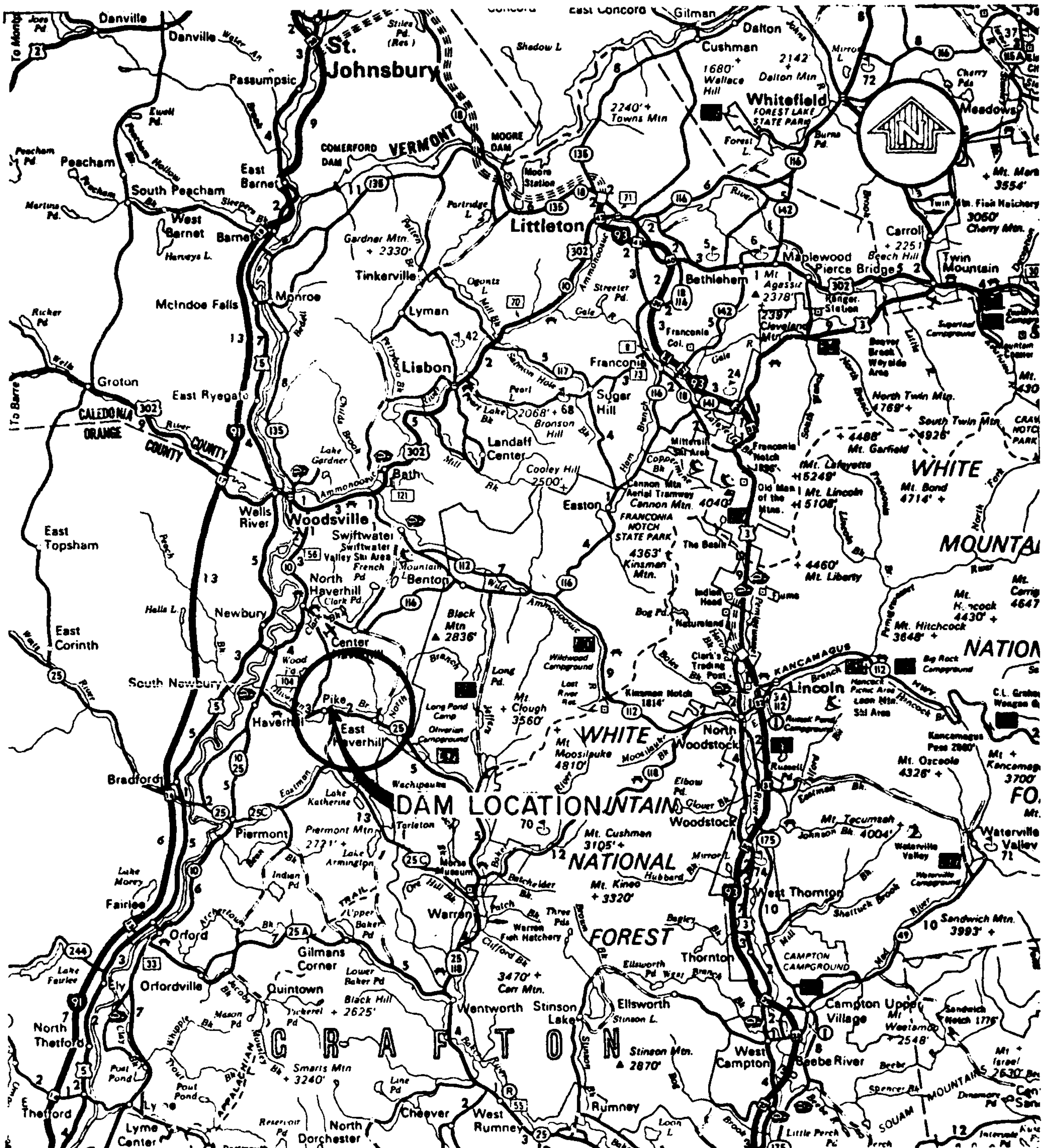
It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the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

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

TABLE OF CONTENTS

June 1979

Figure 1 - Overview of Walker Oliverian Stream Dam.



Reprinted by permission of the Department of Resources and Economic Development, Concord, N.H. 03301, and the copyright owners, The National Survey, Chester, VT. 05143. 5/18/79

SCALE IN MILES

0 5 10

MAP BASED ON STATE OF NEW HAMPSHIRE OFFICIAL HIGHWAY MAP.

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WALKER OLIVERIAN STREAM DAM LOCATION MAP

OLIVERIAN BROOK NEW HAMPSHIRE

			SCALE: SEE BAR SCALE
			DATE: JUNE, 1979

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
WALKER OLIVERIAN STREAM 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. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Anderson-Nichols under a letter of March 22, 1979 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0050 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To 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) To 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 Description of Project

a. Location. Walker Oliverian Stream Dam, also known as Norton Pike Dam, is located in Pike, New Hampshire and is a run-of-the-river dam spanning Oliverian Brook. After discharging over the dam, Oliverian Brook flows westerly for a distance of 4 miles to its confluence with the Connecticut River. Walker Oliverian Stream Dam is shown on U.S.G.S. Quadrangle, Newbury, N.H. - Vt. with coordinates approximately at N 44° 01' 54", W 72° 00' 31", Grafton County, New Hampshire. (See Location Map page vii.)

b. Description of Dam and Appurtenances. Walker Oliverian Stream Dam is a split-stone, gravity dam on ledge about 74 feet in length and about 19 feet in height. A small gatehouse (8' x 10' x 8') is located atop the northerly abutment. An opening (3.5'H x 7'W) is located directly below the gatehouse. A gate is located below this but its dimensions could not be determined. The northerly

abutment consists of a split stone wall and a concrete gatehouse footing. The split stone wall also acts as a containing wall for the dirt road located just north of the north abutment. The north side of the 20' wide road consists of natural, wooded land sloping upward. The southerly abutment is a concrete extension of the foundation of a mill building which no longer exists.

c. Size Classification. Small (hydraulic height - 19 feet; storage - 20 acre-feet) based on height and storage requirements of < 40 feet and ≥ 50 but < 1000 acre-feet, respectively, as given in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant Hazard. A major breach would probably result in the loss of 1 or 2 lives and appreciable property damage. (See Section 5.1 f.)

e. Ownership. The Walker Oliverian Stream Dam was originally owned by the Norton Pike Company. Ownership was transferred to the Moosilauke Lumber and Bobbin Company sometime during the 1930's. Ownership remained unchanged until about eight years ago when Mr. Robert V. Walker, the current owner, bought the property.

f. Operator. The current owner and operator of the Walker Oliverian Stream Dam is Robert V. Walker, Back Bay Road, Pike, New Hampshire 03780. Phone: 603/989-5670.

g. Purpose of Dam. The dam was constructed to facilitate hydroelectric power generation. The power plant is no longer functional and only the ruins of the power plant and mill building remain.

h. Design and Construction History. No information was disclosed regarding the design and construction of the dam. The dam appears to have been built in the mid or late 1800's.

i. Normal Operational Procedures. No written operational procedures were disclosed for the dam.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 30.3 square miles (19,392 acres) of rolling and mountainous, mostly forested terrain. Numerous storage areas are present in the upstream drainage basin.

b. Discharge at Damsite

(1) Outlet works - One "gate opening" at the northerly end of the spillway invert elevation 736.5' MSL. The gate itself is no longer operational and its dimensions are unknown. One penstock opening 4'x4' @ invert elevation 723.0' MSL; silt and debris block all flow through the penstock opening.

(2) The maximum discharge at the damsite is unknown.

(3) Ungated spillway capacity @ top of dam - 695 cfs @ 740.0' MSL

(4) Ungated spillway capacity @ test flood elevation - 8,340 cfs @ 750.5' MSL

(5) Gated spillway capacity @ top of dam elevation - not applicable

(6) Gated spillway capacity @ test flood elevation - not applicable

(7) Total spillway capacity @ test flood elevation - 8,340 cfs @ 750.5' MSL

(8) Total project discharge @ test flood elevation - 15,150 cfs @ 750.5' MSL

c. Elevation (ft. above MSL based on USGS Quadrangle)

(1) Streambed at centerline of dam - 721.3 (at downstream toe)

(2) Maximum tailwater - unknown

(3) Opening invert - (under north gatehouse) - 736.5

(4) Main spillway crest - 738.0

(5) South spillway crest - 737.5

(6) Top of dam - 740.0

(7) Test flood pool - 750.5

d. Reservoir (feet)

(1) Length of maximum pool - 2000

(2) Length of pool at spillway crest - 1700

(3) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - not applicable

(2) Flood control pool - not applicable

(3) Spillway crest pool - 16 (approximate)

(4) Top of dam pool - 20 (approximate)

(5) Test flood pool - 40 (approximate)

f. Reservoir Surface (acres)

(1) Recreation pool - not applicable

(2) Flood control pool - not applicable

(3) Spillway crest pool - 4 (approximate)

(4) Top of dam pool - 5 (approximate)

(5) Test flood pool - 10 (approximate)

g. Dam

(1) Type - split stone and masonry, gravity dam with a broad, flat spillway crest creating a nearly vertical overflow.

(2) Length - 74'

(3) Height - 19' (structural height)

(4) Top width - varied

(5) Side Slopes - Upstream: unknown
Downstream: vertical face

(6) Zoning - unknown

(7) Impervious core - unknown

(8) Cut-off - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel - not applicable

i. Spillway

(1) Type - split stone,flat, broad-crested with vertical downstream face.

(2) Length of weir - 62'; the southern 9 feet of the spillway is a weir with a crest elevation 0.5 feet lower (737.5' MSL) than that of the main spillway. This portion of the spillway was once part of a mill building foundation.

(3) Crest elevation - 738.0' MSL

(4) Gates - none

(5) U/S Channel - The approach channel to the spillway consists of Oliverian Brook which ranges in width from 75 feet to 125 feet. The banks are lined with brush and some small trees. Silt has accumulated to within approximately 2 feet of the spillway crest.

(6) D/S Channel - The channel immediately downstream of the dam is approximately 50 feet wide. There are some small trees growing in the middle of the channel immediately downstream of the dam. The channel consists of a vertical, 8' high, cut stone wall on the south side and nearly vertical ledge on the north side extending approximately 300 feet downstream. Channel overbanks are covered with grass and some small trees. Some mill building ruins remain on the south overbank immediately downstream of the dam. Oliverian Brook passes through a concrete, vertical-walled bridge opening under N.H. Route 25 approximately 400 feet downstream of the dam. A developed area located about 4000 feet downstream of the dam on the relatively flat south-western overbank consists of two mobile homes.

j. Regulating Outlets. A 3.5'H x 7' W opening is located near the north abutment immediately below the gatehouse. The opening invert is at elevation 736.5' MSL; the gate itself is inoperable and its dimensions are unknown.

A penstock opening is located near the south abutment with an invert elevation of 723.0' MSL. The opening has been blocked by debris. The penstock itself is deteriorated and inoperable.

SECTION 2
ENGINEERING DATA

2.1 Design

No data were disclosed regarding the design of Walker Oliverian Stream Dam.

2.2 Construction

No data were disclosed regarding the construction of the dam.

2.3 Operation

No operational data were disclosed.

2.4 Evaluation

a. Availability. No engineering data were available for evaluation of Walker Oliverian Stream Dam.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Walker Oliverian Stream Dam is a low dam which impounds a reservoir of small size. The drainage area above the dam is rolling, mountainous, and heavily wooded. The downstream area is rolling and partially wooded.

b. Dam. Walker Oliverian Stream Dam is a run-of-the-river split stone, gravity dam on ledge. (See Appendix C - Figure 2.) The dam has a hydraulic height of 19 feet and totals 74 feet in length. The north abutment consists of a split stone wall and a concrete gatehouse footing. A small gatehouse is located atop the north abutment. (See Appendix C - Figure 3.) The operating mechanism inside appears to have been inactive for many years. An opening 3.5'H X 7'W is located directly below the gatehouse. (See Appendix C - Figure 4.) The dirt road bed is inadequately supported just downstream of the north abutment. (See Appendix C - Figure 5.) The spillway crest is 62 feet in length and its crest is about 17 feet above the downstream toe. (See Appendix C - Figure 6.) The southern end of the crest has been damaged and allows a small amount of outflow below normal crest elevation. (See Appendix C - Figure 7.) It could not be determined if flow over the center portion of the crest was a result of construction or settling of the masonry structure at this point. (See Appendix C - Figure 2.) The southerly abutment is a concrete extension of the foundation of the mill building which no longer exists. (See Appendix C - Figure 7.) The remains of the old penstock, which formerly was located in the mill building, is located about 12 feet left of the southern abutment. (See Appendix C - Figure 8.)

c. Appurtenant Structures. A wooden gatehouse structure is located on the dam near the north abutment and is in poor condition. (See Appendix C - Figure 9.) A badly rusted wheel and gear mechanism in the gatehouse operated a wooden slide gate also in a deteriorated condition. (See Appendix C - Figure 10.) The entire mechanism appears to have been inoperable for quite some time. The cut-stone masonry gate opening and spillway showed evidence of leaking at the joints and those directly underneath the gatehouse seemed to have moved laterally, thereby giving a loose, open-joint appearance. (See Appendix C - Figure 11.) The south spillway appears to have once supported a wooden water-wheel and pit, which have since collapsed into the tailwater pool. (See Appendix C - Figure 8.)

d. Reservoir Area. The approach channel to the spillway consists of Oliverian Brook which ranges in width from 75 feet to 125 feet. The banks are lined with brush and some small trees. (See Appendix C - Figure 12.) Silt has accumulated to within approximately 2 feet of the spillway crest.

e. Downstream Channel. The channel immediately downstream of the dam is approximately 50 feet wide. There are some small trees growing in the middle of the channel immediately downstream of the dam. The channel consists of a vertical, 8' high, cut-stone wall on the south side and nearly vertical ledge on the north side extending approximately 300 feet downstream. Channel overbanks are covered with grass and some small trees. Some mill building ruins remain on the south overbank immediately downstream of the dam. Oliverian Brook passes through a concrete, vertical-walled bridge opening under N.H. Route 25 approximately 400 feet downstream of the dam. (See Appendix C - Figure 13.) A developed area located about 4000 feet downstream of the dam on the relatively flat southwestern overbank consists of two mobile homes.

3.2 Evaluation

Based on visual inspection, the Walker Oliverian Stream Dam is in poor condition.

Seepage through the masonry joints over the entire face of the dam poses a stability problem and should be monitored.

The deteriorated condition of the gatehouse structure, gate operating mechanism, and especially the gate is of increasing concern and could potentially cause the dam to breach at this location.

It could not be determined at the time of the inspection if flow below the normal crest elevation of the dam was a result of construction or caused by settlement of the masonry structure. (See Appendix C - Figure 2.)

Trees growing on both abutments and undermining of the gravel road on the north abutment immediately downstream of the dam do not appear to pose any immediate threat to the stability of the dam.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures were disclosed for Walker Oliverian Stream Dam. This small dam has served only as a stream barrier for many years.

4.2 Maintenance of Dam

Robert V. Walker is responsible for maintenance of Walker Oliverian Stream Dam.

4.3 Maintenance of Operating Facilities

It appears that little maintenance has been performed on the dam and appurtenances for many years.

4.4 Description of Any Warning System in Effect

No written warning system was disclosed for Walker Oliverian Stream Dam.

4.5 Evaluation

The current operational procedures were evaluated as poor. This evaluation is due to the observed condition of the dam and the fact that no written procedures were disclosed.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. General. Walker Oliverian Stream Dam is a low, run-of-the-river, split stone and mortar, gravity dam that impounds a reservoir of small size. The total length of the dam is 74 feet, 62 feet of which consists of the main, vertical-drop spillway. The top of dam is 2 feet above the spillway crest. Because the dam is of split stone and masonry in poor condition, large overtopping would likely result in a breach.

b. Design Data. No hydrologic design data were found.

c. Experience Data. No data were disclosed concerning flood heights, flood damage, or discharges at the dam.

d. Visual Observations. The main spillway is still intact but seepage is evident in several places on the downstream face.

e. Test Flood Analysis. Walker Oliverian Stream Dam is classified as small, having a hydraulic height of 19 feet and a maximum storage capacity of 20 acre-feet. This small reservoir contains runoff from a 30.3 square mile drainage area, characterized by rolling and mountainous, mostly forested terrain. Due to large upstream storage reservoir a csm value was obtained between the "Rolling" and "Flat and Coastal" curves. Using a csm value of 1,000, a Probable Maximum Flood (PMF) of 30,300 cfs was obtained. The Recommended Guidelines for Safety Inspection of Dams dictated use of ½ the PMF.

Using ½ PMF, the test flood discharge was determined to be 15,150 cfs. The overtopping analysis indicates that the dam would be overtopped by 10.5 feet during the test flood. The maximum spillway capacity at top of dam is 695 cfs, which is only 5% of the test flood discharge.

f. Dam Failure Analysis. The impact of failure of the dam at top of dam was assessed using the Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dam to a developed area consisting of two mobile homes on the south bank of Oliverian Brook approximately 4,000 feet downstream. A breach at top of dam would increase the stage 3.2 feet above the already high flood water surface elevation, damaging the trailers downstream. The potential for loss of life is minimal (estimated to be 1 or 2 lives). Therefore, Walker Oliverian Stream Dam was classified Significant Hazard.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The downstream face of the dam seems to have maintained a nearly vertical alignment. There appears to be minor seepage over the entire downstream face of the dam through the masonry joints. It could not be determined if flow over the center portion of the high water crest indicates settling of the masonry dam structure or is a result of construction. The visual examination indicates the following evidence of potential problems:

(1) Seepage through the cut masonry joints

(2) Possible movement of the south abutment

(3) Undermining of the gravel road on the north abutment immediately downstream of the dam

(4) Deterioration of the gatehouse structure and gate

(5) Trees growing on both abutments

In addition, the crumbling condition of the old mill structures on the south abutment, trees and stone rubble in the tailwater pool and the collapsed wooden water wheel pit near the south abutment.

b. Design and Construction Data. No design and construction data were disclosed.

c. Operating Records. No operating records pertinent to the structural stability of the dam were disclosed.

d. Post-Construction Changes. No record of post-construction changes were found.

e. Seismic Stability. This dam is located in Seismic Zone 2 and in accordance with the Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual inspection indicates that the Walker Oliverian Stream Dam is in poor condition. The major problems which, if not corrected, could lead to structural instability are:

(1) Seepage through the cut masonry joints

(2) Possible movement of the south abutment

(3) Undermining of the gravel road on the north abutment immediately downstream of the dam

(4) Deterioration of the gatehouse structure and gate.

(5) Trees growing on both abutments.

The crumbling condition of the old mill structures on the south abutment, trees and stone rubble in the tailwater pool, and the collapsed wooden water wheel pit near the south abutment are further indications of the poor condition of this dam.

b. Adequacy of Information. The information available is such that the assessment of the condition of the dam must be based primarily on the visual inspection. The visual inspection is adequate to identify problems noted in 7.1a. above and to assess the general condition of the dam.

c. Urgency. The recommendation in 7.2 below and remedial measures recommended in 7.3 below should be implemented by the owner within one year after receipt of this Phase I report.

d. Need for Additional Information. The information obtained and the visual inspection are adequate for purposes of this evaluation.

7.2. Recommendations

The owner should engage a Registered Professional Engineer to design remedial measures for elimination of the seepage along the downstream face of the dam and restore the regulating gate and gatehouse to an operable condition.

7.3 Remedial Measures

a. Operating and Maintenance Procedures

(1) Seepage through the masonry joints on the downstream face of the dam should be monitored on a monthly basis.

(2) Movements of the south abutment should be monitored on a monthly basis.

(3) Erosion underneath the cantilevered portion of the gravel roadway on the north abutment should be repaired and checked for future erosion.

(4) The north and south abutments including portions immediately downstream, the tailwater pool should be cleared and maintained free of brush, trees and rubble.

(5) Establish a surveillance program for use during and immediately following periods of heavy rainfall and also a warning program to follow in case of emergency conditions.

(6) Have the dam inspected by a Registered Professional Engineer once every year.

7.4 Alternatives

If the owner should determine that the expense of the repairs and upkeep are too great, recommend that the dam be removed under the direction of a Registered Professional Engineer.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Walker Oliverian Stream Dam

DATE May 8, 1979

TIME 11:30 AM

WEATHER Clear, warm

W.S. ELEV. U.S. 738 DN.S. 722

PARTY:

1. Warren Guinan
2. Stephen Gilman
3. Robert Ojendyk
4. John Regan
5. Gerry Blanchette
6. Pattu Kesavan
7. Ronald Hirschfeld
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	W. Guinan/J. Regan	
2.	Structural Stability	S. Gilman	
3.	Soils and Geology	R. Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Walker Oliverian Stream Dam DATE May 8, 1979

PROJECT FEATURE Approach Channel NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Good
Bottom Conditions	Not visible beneath water surface
Rock Slides or Falls	None
Log Boom	Not visible
Debris	None
Condition of Concrete Lining	Not applicable
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	Not applicable

PERIODIC INSPECTION CHECKLIST

PROJECT Walker Oliverian Stream Dam DATE May 8, 1979

PROJECT FEATURE Gatehouse & Mechanism NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Wooden gatehouse
a. Concrete and Structural	
General Condition	poor; deteriorated
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	Not visible
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	Mechanical gate on north side of dam not operable; gate submerged. Wheel and gear mechanism is badly rusted.
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECKLIST

PROJECT Walker Oliverian Stream Dam DATE May 8, 1979

PROJECT FEATURE ~~Outlet Channel~~ NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	Leaking at joints
Condition at Joints	Leaking at joints; masonry appears to have moved laterally.
Drain holes	None
Channel	
Loose Rock or Trees Overhanging Channel	Many trees overhanging channel
Condition of Discharge Channel	Fair; rocky with some trees growing in channel just below dam.

PERIODIC INSPECTION CHECKLIST

PROJECT Walker Oliverian Stream Dam DATE May 8, 1979

PROJECT FEATURE Spillway NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Some, but channel is moderately wide
Floor of Approach Channel	Not visible beneath water surface
b. Weir and Training Walls	
General Condition of Concrete	
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	None
c. Discharge Channel	
General Condition	Fair
Loose Rock Overhanging Channel	Dry stone masonry retaining walls support road fill on north side of channel
Trees Overhanging Channel	Many trees overhanging channel
Floor of Channel	Bedrock
Other Obstructions	None

PROJECT Walker Oliverian Stream Dam DATE May 8, 1979

PROJECT FEATURE Reservoir NAME

AREA EVALUATED	REMARKS
Stability of Shoreline	Fair
Sedimentation	Some
Changes in Watershed Runoff Potential	None
Upstream Hazards	None
Downstream Hazards	N.H. Route 25 bridge, several homes about 1 mile downstream
Alert Facilities	None
Hydrometeorological Gages	None
Operational & Maintenance Regulations	None

APPENDIX B

ENGINEERING DATA

N. H. WATER RESOURCES BOARD
Concord, N. H. 03301

DAM SAFETY INSPECTION REPORT FORM

Town: Haverhill Dam Number: 112.02 ✓

Inspected by: SCB Date: 29 Jul 1979

Local name of dam or water body: _____

Owner: _____ Address: _____

Owner was/~~was~~ not interviewed during inspection.

Drainage Area: 31 Total 20.4 sq. mi. Stream: Oliverian (Oliverian 330 CFS)

Pond Area: 15 Acre, Storage _____ Ac-Ft. Max. Head 15 Ft.

Foundation: Type _____, Seepage present at toe - Yes (No), _____

Spillway: Type Over Flow, Freeboard over perm. crest: 3 ✓,

Width 40'± ✓, Flashboard height None,

Max. Capacity _____ c.f.s.

Embankment: Type _____, Cover _____ Width _____,

Upstream slope _____ to 1; Downstream slope _____ to 1

Abutments: Type Conc & Stone ✓, Condition: Good, Fair, (Poor)

Gates or Pond Drain: Size 6'X7' ✓ Capacity _____ Type Gate

Lifting apparatus _____ Operational condition ? No

Changes since construction or last inspection: _____

Downstream development: ✓ 400' To NH #25

This dam (would)/would not be a menace if it failed.

Suggested reinspection date: _____

Remarks: _____

NEW HAMPSHIRE WATER RESOURCES BOARD

QUESTIONNAIRE

WATER POWER DEVELOPMENTS IN NEW HAMPSHIRE

Monadnock Div of Bobbins Co
Hinsdale N.H. Office at Lisbon N.H.

Gentlemen:

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

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

Very truly yours,

Walter G White
Acting Chairman

Dam No. 11202 Location Hinsdale Brook
River at Ellis River

1. Will you please check or correct:

	Our Data	Your Corrections
Head - feet	16 ✓	
Capacity		
Wheel - H.P.		
Generator - K.W.		

2. Is the power plant in operation? no
3. If not, is the equipment in operable condition? no
4. Is the dam in good repair? yes

Signed: [signature]

Date January 30 48

Oliverian Stream
Haverhill, N. H.

Dam No. 112.02

May 21, 1946

This dam was inspected on above date. Mr. Eichhorn, manager of the Moosilauke Lumber and Bobbin Company was contacted. He stated that repairs were made in 1942 which consisted of concreting the south end of the dam. This section was weakened during the 1936 Flood. The only part of the dam that appeared to be in poor repair at the time of the inspection was the gate section. The gate is inoperable and the masonry around the gate structure shows signs of disintegration, - probably due somewhat to frost action as well as high water. This was called to Mr. Eichhorn's attention and he stated that he would attempt to get it repaired in the next few years.

The dam is not being operated for power, all of the penstock and associated structures were destroyed by fire. The only being made of the present pond is as a source of ice and, Mr. Eichhorn stated, the ice company contributed to the repair of the dam.

Leonard R. Frost
Engineer

Form E80

NEW HAMPSHIRE WATER RESOURCES BOARD

QUESTIONNAIRE

WATER POWERS OF NEW HAMPSHIRE

RECEIVED
JUL 13 1942
NORTON PIKE CO.

~~WOODSIDE LUMBER & BOBBIN CO.~~
~~Norton Pike Co.~~
Pike
New Hampshire

Gentlemen:

We maintain in this office a list of the water power installations in New Hampshire. In recent months we have had several inquiries concerning the water power installations in the State and have found that our information is in some cases out of date.

We are, therefore, bringing this information up to date and request your cooperation by filling in the questionnaire below with data on your development, and return it to us in the enclosed stamped envelope.

Very truly yours,

R. S. Holmgren

RSH:GMB
Encl.

Richard S. Holmgren
Chief Engineer

Dam No. 112.02 Location: Oliverian Stream ~~River~~ at Haverhill PIKE

1. Will you please check or correct:

	Our Data	Your Corrections
Drainage Area - Sq.Mi.	31 ✓	
Head - feet	(16) ✓	
Capacity	--	
Wheel - H.P.		none
Generator - K.W.		

2. Is the power plant now in operation? no

3. If not, is the equipment in operable condition? no

4. Is the dam in good repair? no — had sloppy timber last flood 6/14/42

(Signed) [illegible] LUMBER & BOBBIN CO.

Date July 14/42

B-4

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. (112.02)

Town Haverhill ✓ : County Grafton

Stream Oliverian Stream ✓

Basin-Primary Conn R, ✓ : Secondary Oliverian Stream ✓

Local Name

Coordinates—Lat. 44° 00' + 11,600 : Long. 72° 00' + 2,000

GENERAL DATA

Drainage area: Controlled ? Sq. Mi.: Uncontrolled Sq. Mi.: Total 31 ✓ Sq. Mi.

Overall length of dam (65' 25') ft.: Date of Construction

Height: Stream bed to highest elev. 18' ✓ ft.: Max. Structure 15' ✓ ft.

Cost—Dam : Reservoir

DESCRIPTION Gravity- Split Stone on Ledge ✓

Waste Gates

Type

Number : Size ft. high x ft. wide

Elevation Invert : Total Area sq. ft.

Hoist

Waste Gates Conduit

Number : Materials

Size ft.: Length ft.: Area sq. ft.

Embankment

Type

Height—Max. ft.: Min. ft.

Top—Width : Elev. ft.

Slopes—Upstream on : Downstream on

Length—Right of Spillway : Left of Spillway

Spillway

Materials of Construction

Length—Total ft.: Net 40' ✓✓ ft.

Height of permanent section—Max. ft.: Min. ft.

Flashboards—Type : Height ft.

Elevation—Permanent Crest : Top of Flashboard

Flood Capacity cfs.: cfs/sq. mi.

Abutments

Materials:

Freeboard: Max. 3.0' ✓ ft.: Min. ft.

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

OWNER ~~Norton Pike Co~~ Pike N H

REMARKS Connecticut Lumber & Robbins Co.

Tabulation By A A N & R L T WB Date December 12, 1938. 7/14/42

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

LOCATION AT DAM NO. (112.02)

Town Haverhill : County Grafton

Stream Oliverian Stream

Basin-Primary Conn R. : Secondary Oliverian Stream

Local Name

GENERAL DATA

Head-~~Max.~~ ft.: ~~Min.~~ ft.: Ave. 16' ✓ ft.

Date of Construction : Use of Power

Pondage ac. ft.: Storage ac. ft.

DESCRIPTION

Racks

Size of Rack Opening

Size of Bar : Material

Area: Gross Sq. Ft.: Net sq. ft.

Head Gates

Type

Number : Size ft. high x ft. wide

Elevation of Invert : Total Area sq. ft.

Hoist

Penstock

Number : Material

Size : Length

Turbines

Number 2 : Makers unknown (not used)

Rating HP. per unit : Total Capacity HP.

Max. Dement C.F.S., per unit : Total cfs.

Drive

Type

Generator

Number

Make

Rating KW., per unit ; Total Capacity K. W.

Exc'ter

Number : Make

Rating-per unit : Total Capacity K. W.

OUTPUT—KWHRS

19.....	:	19.....	
19.....	:	19.....	
19.....	:	19.....	
19.....	:	19.....	
19.....	:	19.....	

OWNER ~~Norton Pike Co~~ Pike N H

Monadnock Lumber Co. Babbin Co.

B-6

Tabulation By A. A. N. & R. J. T. Date December 13. 1938.

Form E1A
4845

PUBLIC SERVICE COMMISSION OF NEW HAMPSHIRE—DAM RECORD I-5302

TOWN: HAVERHILL	TOWN NO.: 2	STATE NO.: 112.02
RIVER STREAM: Oliverian Stream		
DRAINAGE AREA: 31 Sq. Mi.	POND AREA:	
DAM TYPE: Gravity	FOUNDATION NATURE OF: Ledge	
MATERIALS OF CONSTRUCTION: Split Stone		
PURPOSE OF DAM: POWER—CONSERVATION—DOMESTIC—RECREATION—TRANSPORTATION—PUBLIC UTILITY		
HEIGHTS, TOP OF DAM TO BED OF STREAM: 18' ✓	TOP OF DAM TO SPILLWAY CRESTS: 3' ✓	
SPILLWAYS, LENGTHS DEPTHS BELOW TOP OF DAM: Approx. 40' ✓		LENGTH OF DAM: 25' Approx.
FLASHBOARDS TYPE, HEIGHT ABOVE CREST: None		
OPERATING HEAD CREST TO N. T. W.: Approx. 16' ✓	TOP OF FLASHBOARDS TO N. T. W.:	
WHEELS, NUMBER KINDS & H. P.: 2 Wheels - not used		
GENERATORS, NUMBER KINDS & K. W.:		
H. P. 90 P. C. TIME 100 P. C. EFF.:	H. P. 75 P. C. TIME 100 P. C. EFF.:	
REFERENCES, CASES, PLANS, INSPECTIONS:		

REMARKS

OWNER: Norton Pike Co.

CONDITION: Good

MENACE: Yes. Will be subject to periodic inspection.

To the Public Service Commission:

The foregoing memorandum on the above dam is submitted covering inspection made July 17, 1936, according to notification to owner dated June 23, 1936, and bill for same is enclosed.

D. Waldo White
Chief Engineer

August 6, 1936
Copy to Owner

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Connecticut NO. 2 - I-5302
RIVER Olivarian Stream MILES FROM MOUTH 4.05 D.A.SQ.MI. 31
TOWN Haverhill OWNER Norton Pike - Pike, NH.
LOCAL NAME OF DAM
BUILT DESCRIPTION Gravity - Split Stone on Ledge

POND AREA-ACRES 65 DRAWDOWN FT. POND CAPACITY-ACRE FT.
HEIGHT-TOP TO BED OF STREAM-FT. 18 MAX. MIN.
OVERALL LENGTH OF DAM-FT. 254 MAX.FLOOD HEIGHT ABOVE CREST-FT.
PERMANENT CREST ELEV.U.S.G.S. LOCAL GAGE
TAILWATER ELEV.U.S.G.S. LOCAL GAGE
SPILLWAY LENGTHS-FT. 40± FREEBOARD-FT. 3
FLASHBOARDS-TYPE, HEIGHT ABOVE CREST None

WASTE GATES-NO.	WIDTH	MAX. OPENING	DEPTH SILL BELOW CREST

REMARKS Condition Good

Mouth Connecticut R.
Mouth Olivarian Stream 247.85 mi from mouth Connecticut R.

POWER DEVELOPMENT

UNITS	NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE
	2	100	16			

USE Power

REMARKS Menace wheels not in use

DATE 7/17/36

7949

TOWN NO. 1,2 TOWN Haverhill, N. H. NO. 54 PAGE NO. 3

NAME OF COMPANY Pike Manufacturing Company

HOME ADDRESS Pike, N. H.

DRAINAGE AREA 33 SQ. MI. HEAD 16 FT.

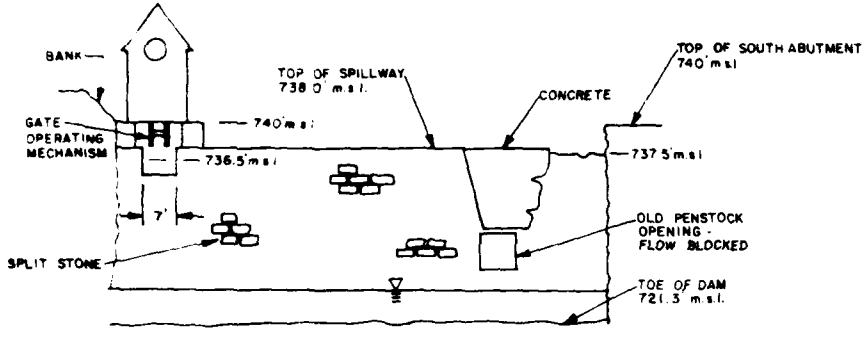
RIVER Oliverian Brook RATE SEC. FT. PER SQ. MI. 90% TIME 0.7

RESOURCES

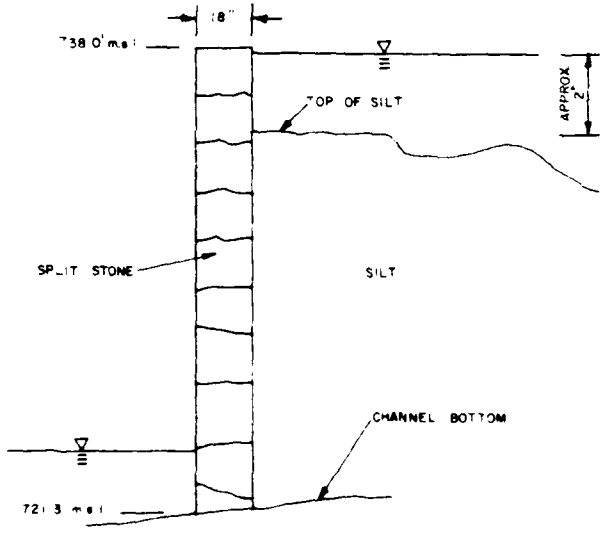
FOR CENTRAL STATIONS		FOR ISOLATED INDUSTRIAL PLANTS	
WHEEL CAP. H. P.	PRIMARY H. P. 90% TIME	WHEEL CAP. H. P.	PRIMARY H. P. 90% TIME
		100	33.59

USES

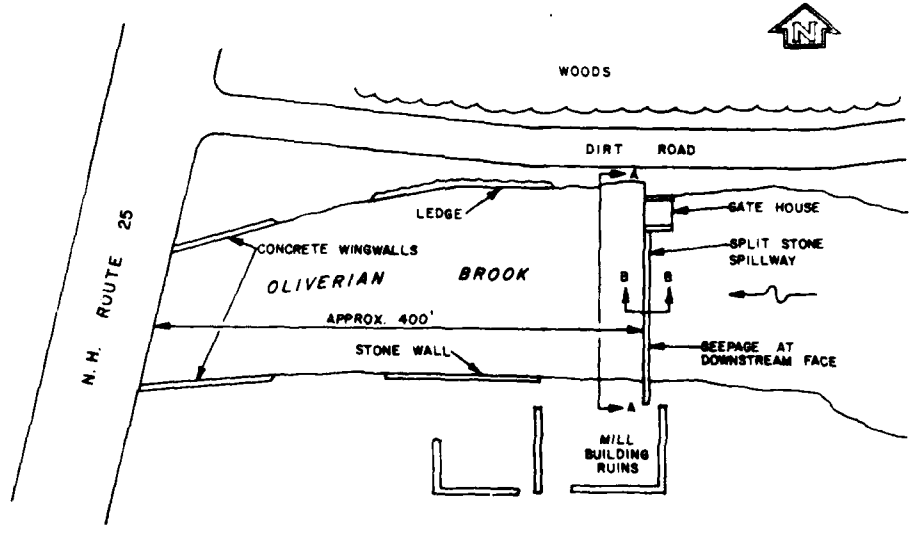
FOR CENTRAL STATIONS		FOR ISOLATED INDUSTRIAL PLANTS		
K. V. A. CAPACITY	ANNUAL KW. H. OUTPUT	K. V. A. CAPACITY	ANNUAL KW. H. PROD. AND CONS. ELECT.	ANNUAL KW. H. PROD. AND CONS. MECH.



ELEVATION A-A



SECTION B-B



PLAN

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WALKER OLIVERIAN STREAM DAM

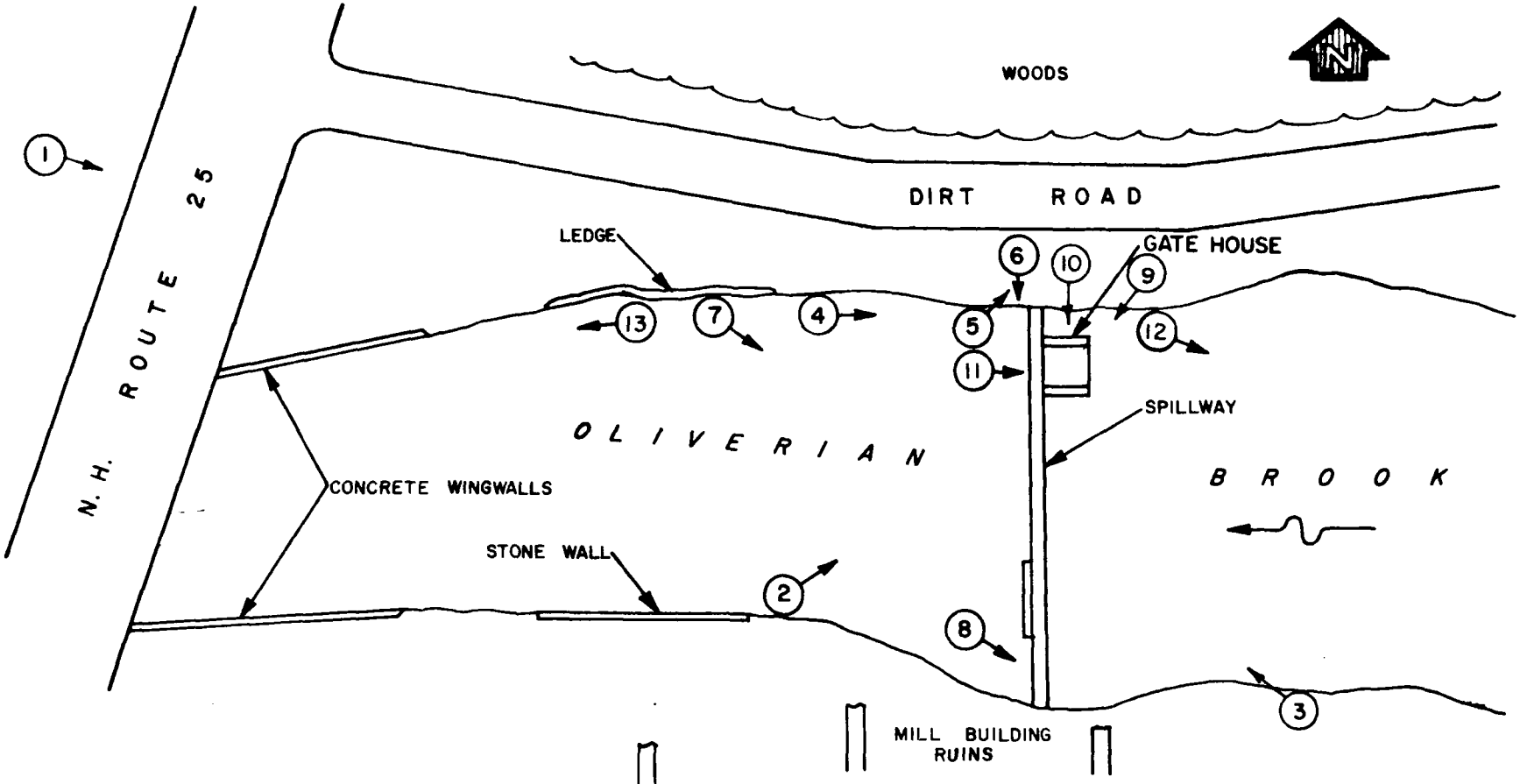
OLIVERIAN BROOK NEW HAMPSHIRE

SCALE NOT TO SCALE

DATE JUNE, 1979

APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

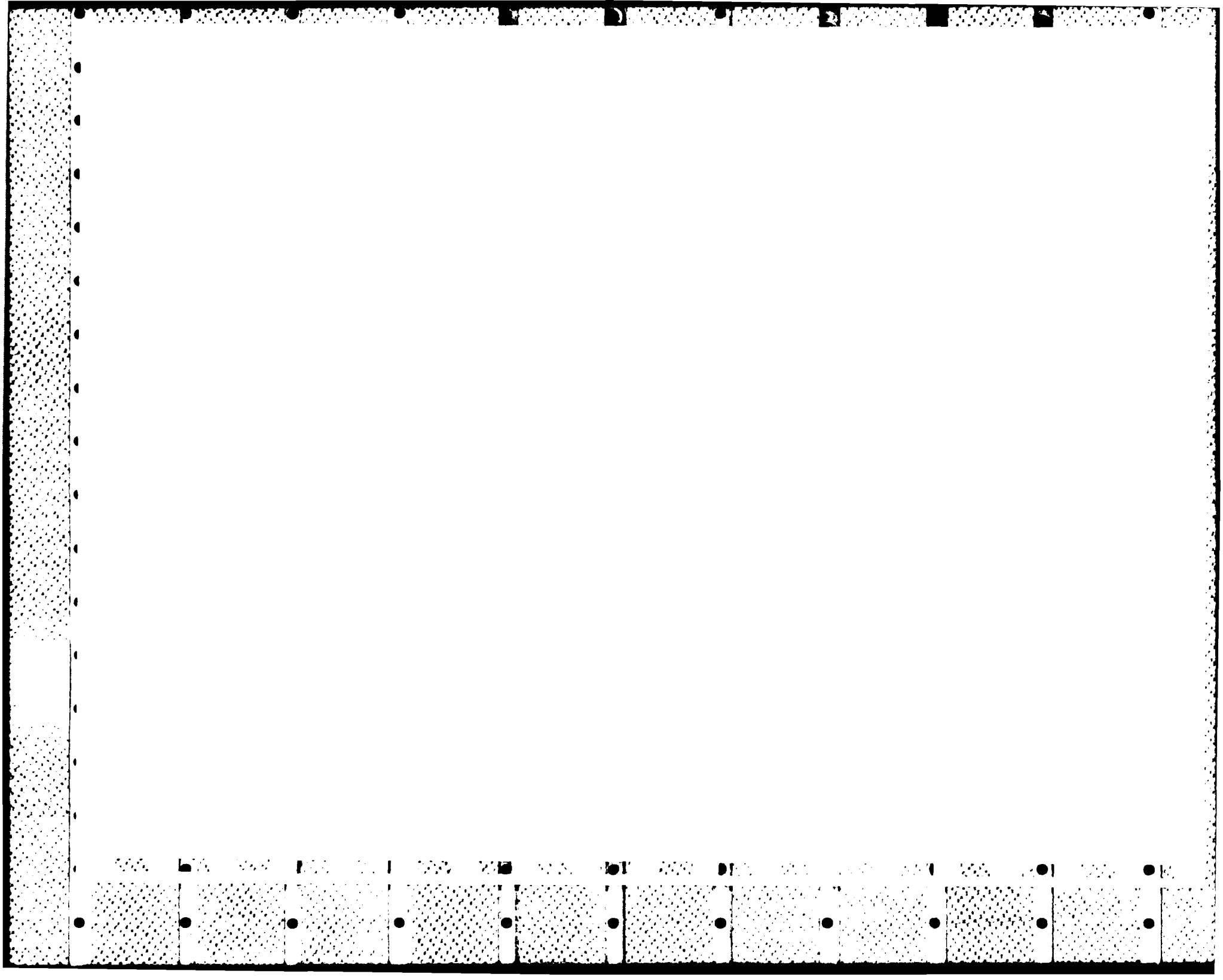
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

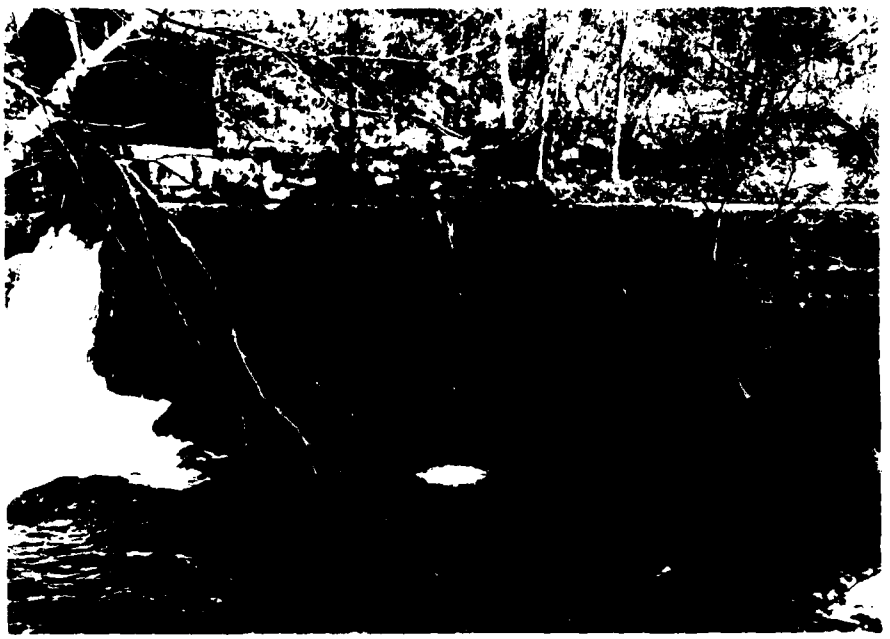
WALKER OLIVERIAN STREAM DAM
PHOTO INDEX

OLIVERIAN BROOK NEW HAMPSHIRE

SCALE: NOT TO SCALE

DATE: JUNE, 1979





May 8, 1979

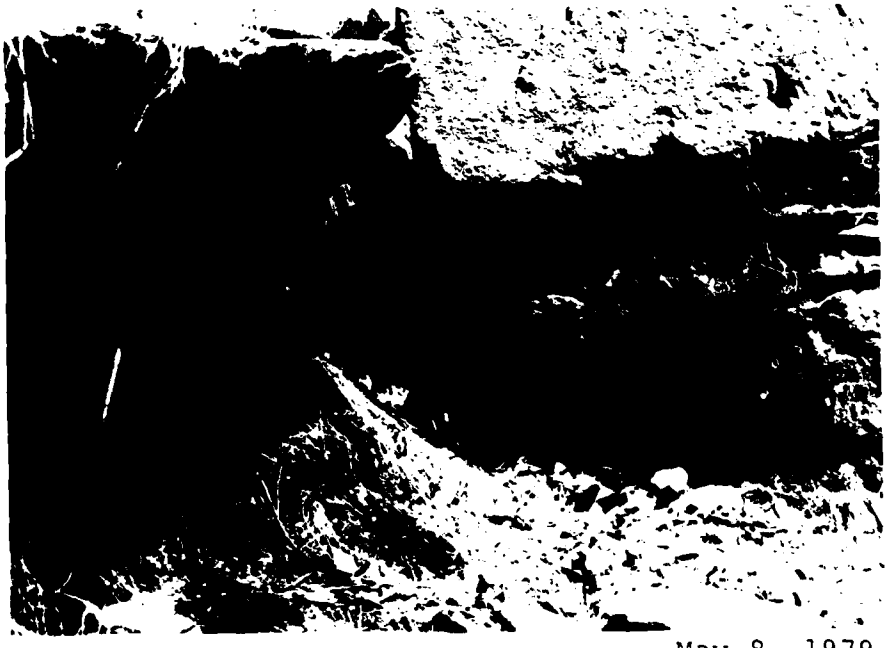
Figure 2 - Looking northeast at downstream face of dam. Note water trickling over crest at center of photo.

May 8, 1979

Figure 3 - Looking northwest at upstream face of dam.

May 8, 1979

Figure 4 - Looking upstream at gatehouse and opening. Note ledge on north bank at left.



May 8, 1979

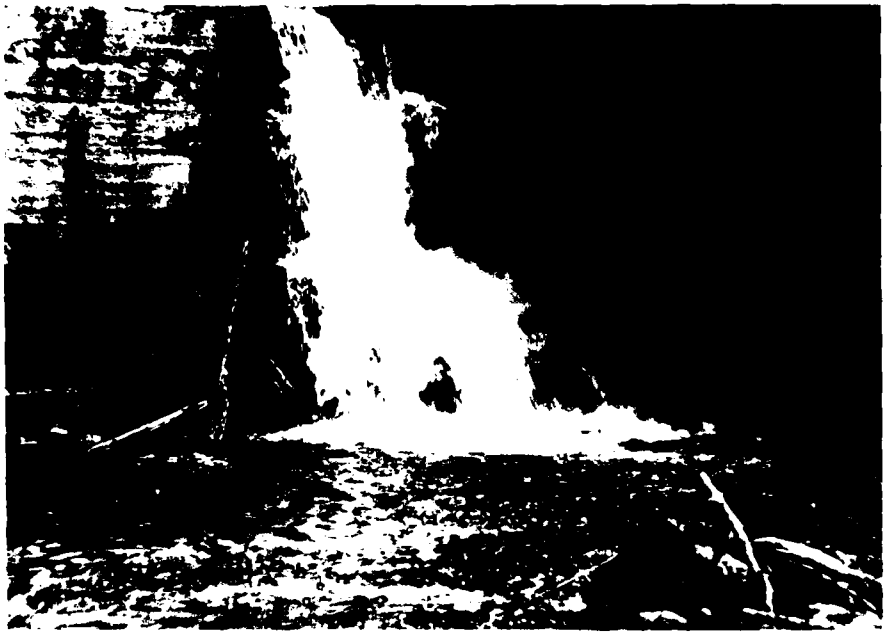
Figure 5 - Looking northeast at dirt roadbed stability pinning.

May 8, 1979

Figure 6 - Looking north-south across spillway crest.

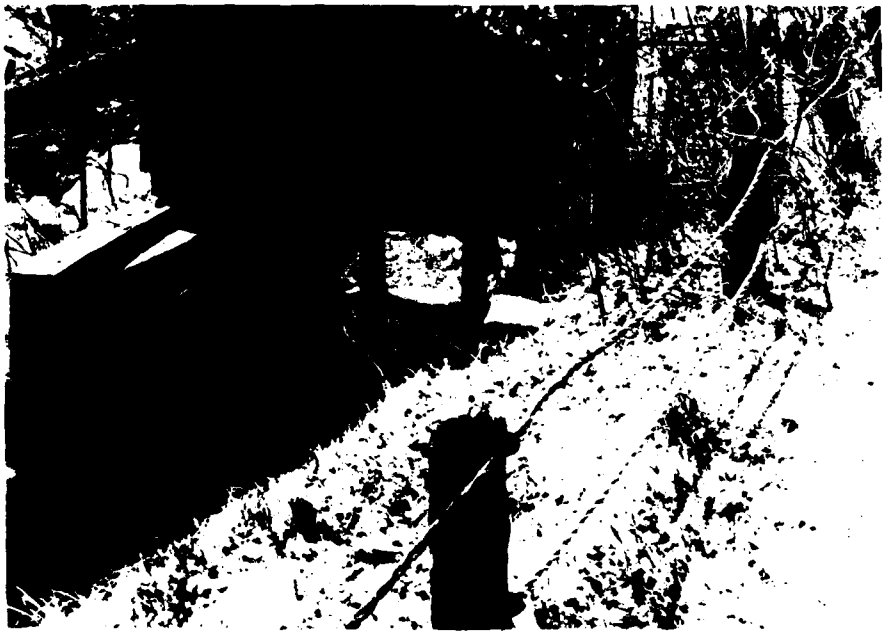
May 8, 1979

Figure 7 - Looking upstream at southerly half of spillway.



May 8, 1979

Figure 8 - Closeup looking upstream at old penstock opening at left. Note deterioration of south abutment wall (right-center).



May 8, 1979

Figure 9 - Looking at the upstream face of the deteriorated wooden gatehouse.

May 8, 1979

Figure 10 - View of the rusted wheel and gear mechanism in the gatehouse.

May 8, 1979

Figure 11 - Closeup looking upstream through gatehouse opening.

May 8, 1979

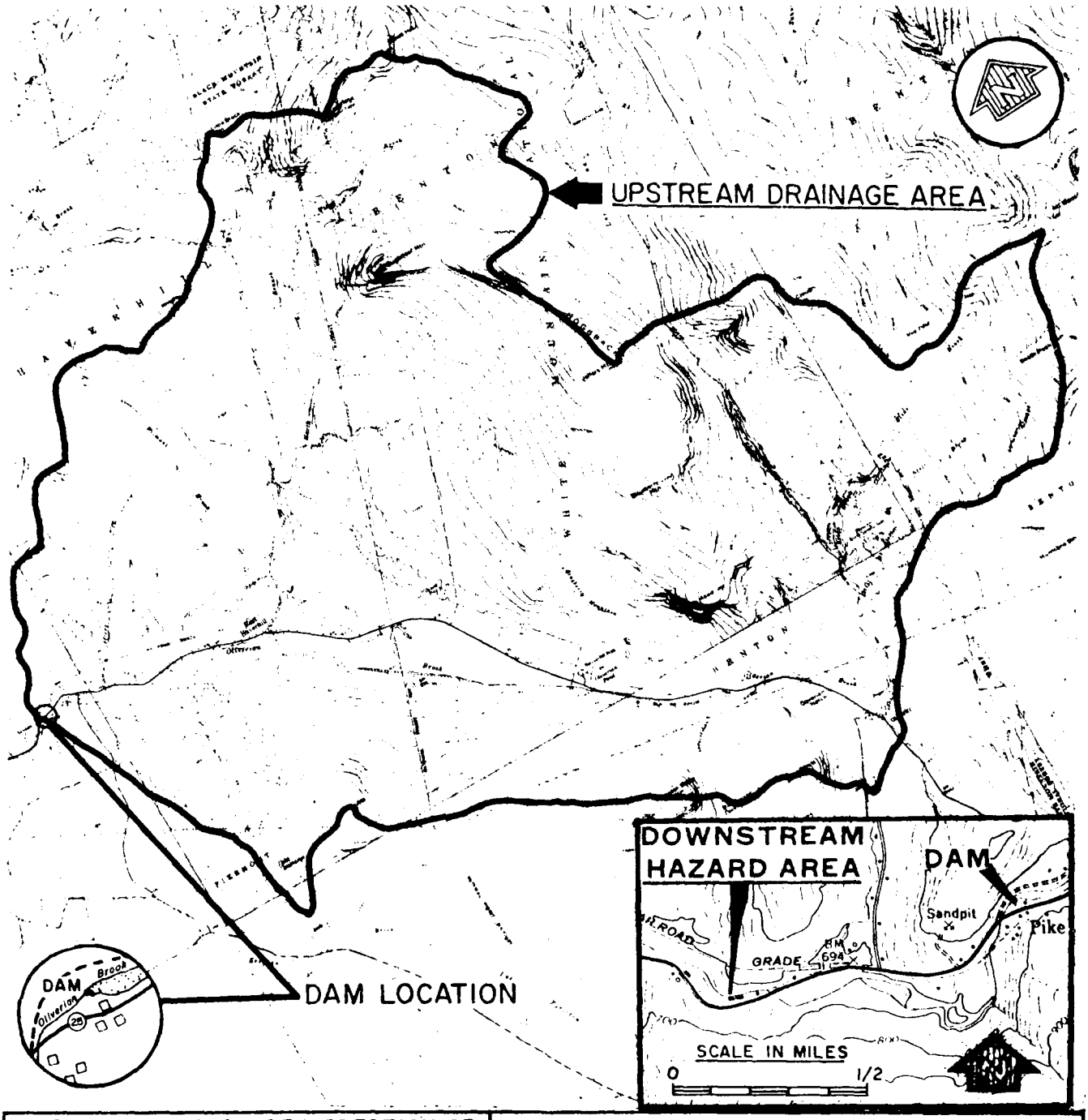
Figure 12 - Looking upstream into reservoir from north abutment.

May 8, 1979

Figure 13 - Looking at State Route 25 crossing located about 400 feet downstream of the dam.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WALKER OLIVERIAN STREAM DAM
HAVERHILL, NEW HAMPSHIRE

REGIONAL VICINITY MAP

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ANDERSON-NICHOLS & CO., INC. CONCORD, NH

SCALE IN MILES

0 1/2 1 2 3

MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEETS. NEWBURY, N.H., VT., 1973. EAST HAVERHILL, N.H., 1976. Mt. MOOSILAUKE, N.H., 1967. WARREN, N.H., 1973. MOUNT KIENO, N.H., 1973.

HYDROLOGY / HYDRAULICS

1/16

AFS
5 Jun 79

WALKER OLIVERIAN STREAM DAM

DA: 30.3 mi^2
Size Classification: Small
Hazard Classification: Significant
Test Flood: 1/2 PMF

Calculate PMF using "Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations," March 1978.

Slope of valley floor is ≈ 24 ft/mi. Due to the existence of a large upstream storage area, a curve located approximately 1/2-way between the "Flat and Coastal" and "Rolling" curves was used to determine the CSM value for PMF. @ DA = 30.3 mi^2, a CSM value of 1000 was obtained.

∴ PMF discharge = 30.3 mi^2 x 1000 CSM
= 30,300 cfs

1/2 PMF (Test Flood) = 15,150 cfs

Develop a dam discharge rating curve using the weir cross-section shown on page D-5.

Assumptions:
*C = 3.0 (average value used for all weirs)
Top of both abutments @ Elev. 740.0 MSL
Normal storage = 16 acre-feet
DA = 30.3 mi^2

* King & Brater Handbook was used to determine proper 'C' values.

Use weir equation, $Q = CLH^{3/2}$, to develop dam discharge rating curve... and orifice equation $Q = CAV\sqrt{2gh}$

2/16

Trial No.	Water Surface Elevation	Discharge (cfs)
1	736.5	$Q = 0$
2	737.5	$Q = 3(7)1^{3/2} = 20$
3	738.0	$Q = 3(7)1.5^{3/2} + 3(9)0.5^{3/2} = 50$
4 Top dam	740.0	$Q = 3(7)3.5^{3/2} + 3(9)2.5^{3/2} + 3(53)2.0^{3/2} = 695$
5	742.0	$Q = (0.8)(24.5)(\sqrt{2(32.2)3.75}) + 3(9)4.5^{3/2} + 3(53)4.0^{3/2} + 3(10)2.0^{3/2} + 3(6)2.0^{3/2} = 1{,}970$
6 Top road	743.0	$Q = (0.8)(24.5)(\sqrt{64.4 \times 4.75}) + 3(9)5.5^{3/2} + 3(53)(5.0)^{3/2} + 3(10)3.0^{3/2} + 3(\tfrac{1}{2}12)3.0^{3/2} = 2{,}720$
7	745.0	$Q = (0.8)(24.5)(\sqrt{64.4 \times 6.75}) + 3(9)(7.5)^{3/2} + 3(53)(7.0)^{3/2} + 3(10)(5.0)^{3/2} + 3(15)(2.0)^{3/2} + 3(4)(2.0)^{3/2} + 3(9)(5.0)^{3/2} + 3(22)(2.0)^{3/2} = 4{,}895$
8	748.0	$Q = (0.8)(24.5)(\sqrt{64.4 \times 9.75}) + 3(9)(10.5)^{3/2} + 3(53)(10)^{3/2} + 3(10)(8.0)^{3/2} + 3(15)(5.0)^{3/2} + 3(10)(5.0)^{3/2} + 3(10)(5)^{3/2} + 3(20)(5.0)^{3/2} + 3(12)(7)^{3/2} = 9{,}630$

3/16

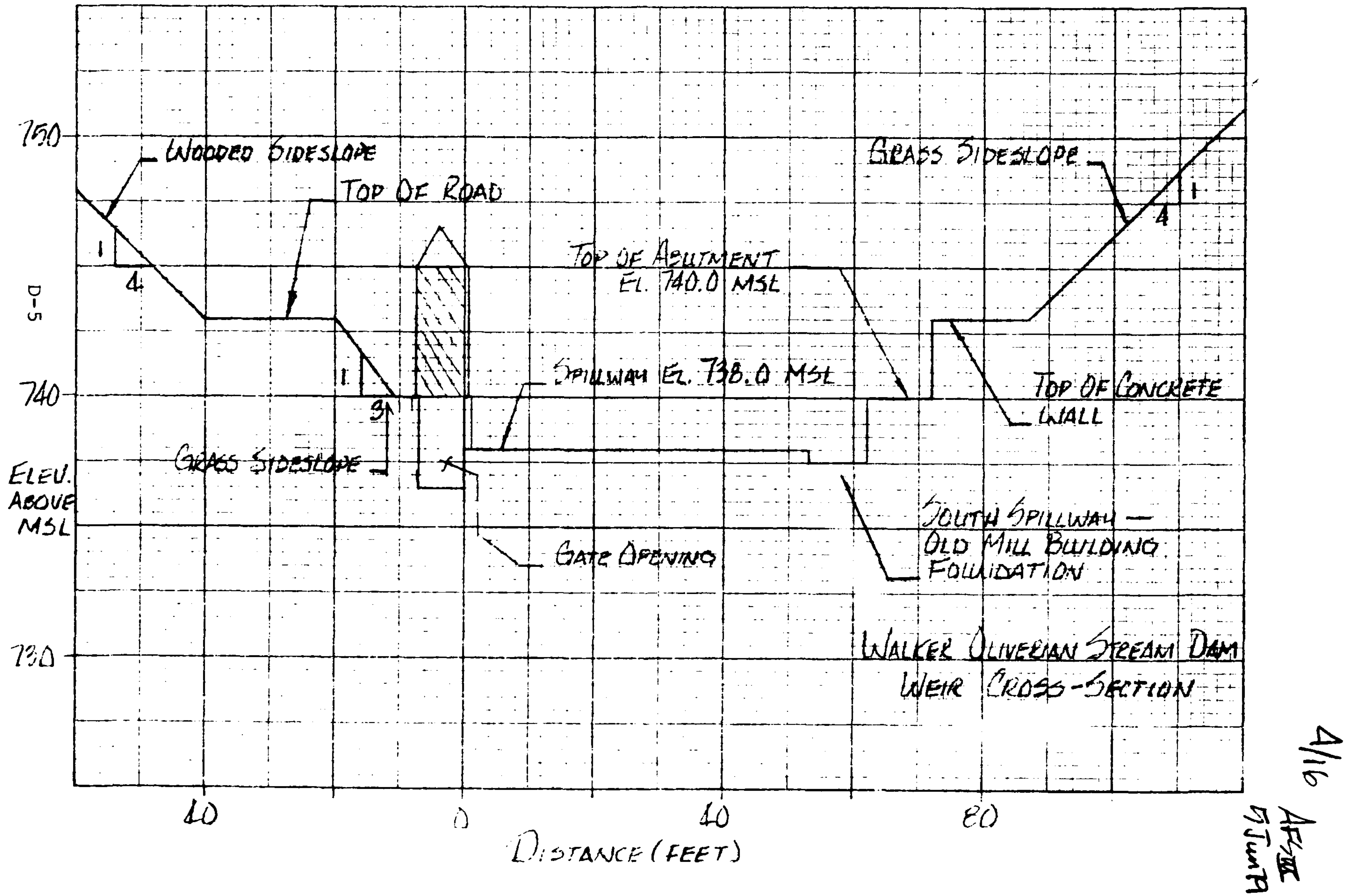
Trial No	Water Surface Elevation	Discharge (cfs)
9	752.0	$Q = (0.3)(24.5)(\sqrt{644 \times 13.75}) + 3(9)(14.5)^{3/2} + 3(53)(14.0)^{3/2} + 3(10)(12)^{3/2} + 3(15)(9)^{3/2} + 3(\tfrac{1}{2}36)(9)^{3/2} + 3(\tfrac{1}{2}36)(9)^{3/2} + 3(20)(9)^{3/2} + 3(12)(11)^{3/2} = 18,715$

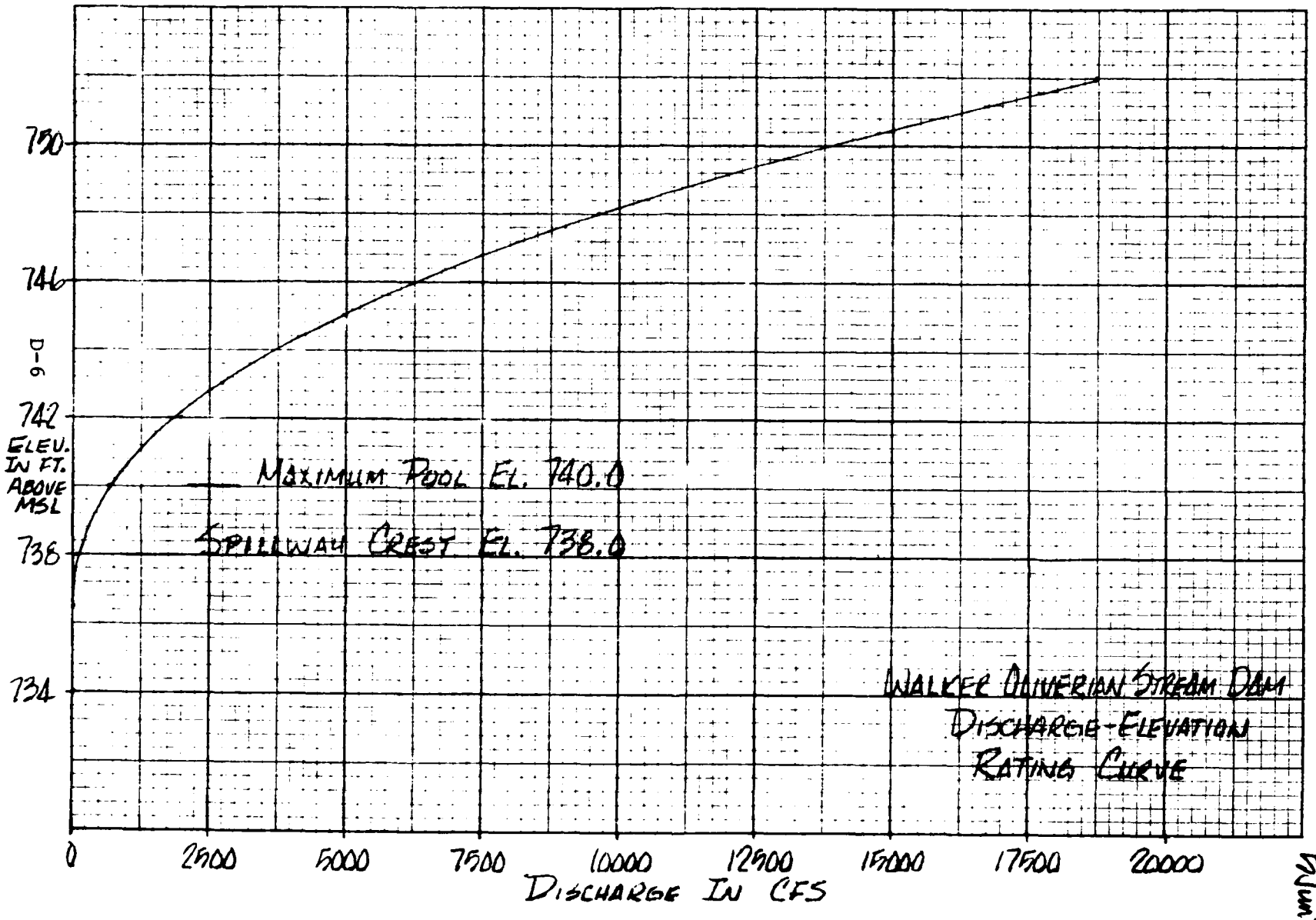
Use the above trials to obtain a discharge rating curve.

Test Flood = 15,150 cfs
Test Flood Elevation = 750.5' MSL

Walker Olivarian Stream Dam would be overtopped by about 10.5 feet (12.5 feet over spillway crest) during the test flood.

Spillway capacity @ top of dam is 695 cfs which is about 5 percent of the test flood discharge.


WOODED SIDESLOPE
TOP OF ROAD
1
4
1
3
GRASS SIDESLOPE
TOP OF ABUTMENT
EL. 740.0 MSL
SPILLWAY EL. 738.0 MSL
GATE OPENING
GRASS SIDESLOPE
1
4
TOP OF CONCRETE
WALL
SOUTH SPILLWAY —
OLD MILL BUILDING
FOUNDATION
WALKER OLIVERIAN STREAM DAM
WEIR CROSS-SECTION
750
740
730
ELEV. ABOVE MSL
40
0
40
80
DISTANCE (FEET)
4/16
AFS III
5 Jun 79



D-6

5/16

APR 1974

6/16

DOWNSTREAM CHANNEL RATING CURVE

AR/SH
5 Jun 79

Purpose: Check flow-carrying capacity of channel immediately downstream of dam.

Use cross section 200 ft. downstream of dam (see p. D-9). Develop a discharge rating curve using the Manning Equation:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

where n = composite channel roughness coefficient
A = area of section (ft^2)
R = hydraulic radius (ft)
S = slope of reach

... length of reach = 400* ft.
elevation @ d/s toe of dam = 721.3
invert elevation @ bridge = 718.7
slope = 0.006
composite n = 0.05

The trials below refer to the downstream channel cross section shown on p. D-9.

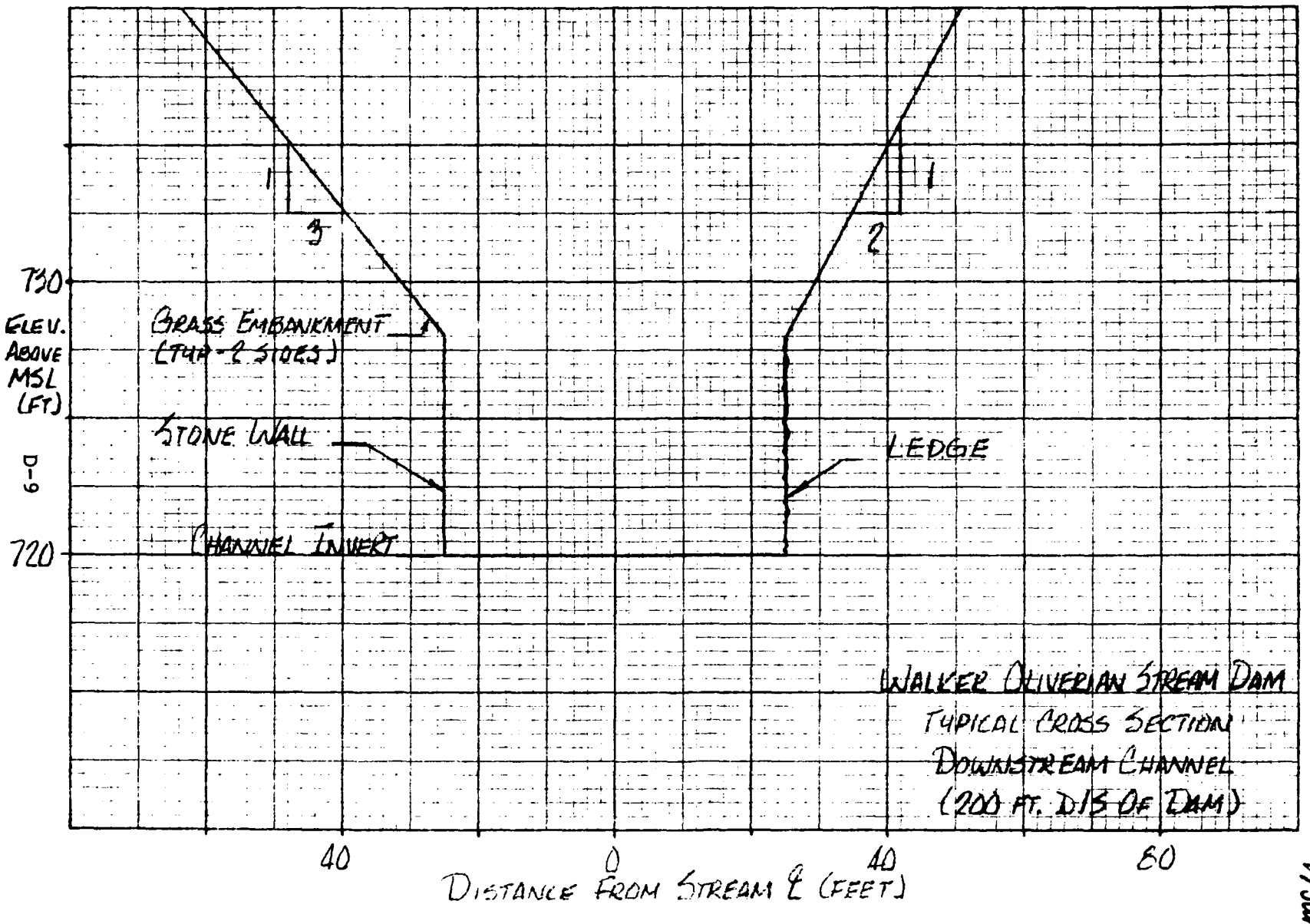
Trial No.	Stage (ft)	Discharge
1	2	$A = 2(50) = 100\ ft^2$ $WP = 50 + 4 = 54$ ft $R = A/WP = 100/54 = 1.85$ ft $Q = \frac{1.49}{0.05}(100)(1.85)^{2/3}(0.006)^{1/2}$ $\doteq 350$ cfs

* Surveying data did not provide a stream invert elevation 200 ft. d/S of the dam. The stream invert at N.H. Route 25 was used when calculating the slope of the stream bed at the subject cross section.

7/16

AFS
5 Jun 79

Trial No.	Stage (ft)	Discharge
2	5	$A = 5(50) = 250\ ft^2$ $WP = 50 + 10 = 60\ ft$ $R = A/WP = 250/60 = 4.17\ ft$ $Q = \frac{1.49}{0.05}(250)(4.17)^{2/3}(0.006)^{1/2}$ $\doteq 1500\ cfs$
3	8	$A = 8(50) = 400\ ft^2$ $WP = 50 + 16 = 66\ ft$ $R = A/WP = 400/66 = 6.06\ ft$ $Q = \frac{1.49}{0.05}(400)(6.06)^{2/3}(0.006)^{1/2}$ $\doteq 3070\ cfs$
4	10	$A = 10(50) + 1/2(2)(6)$ $+ 1/2(2)(4) = 510\ ft^2$ $WP = 66 + 2/\sin 18.4° + 2/\sin 26.6°$ $= 76.8\ ft.$ $R = A/WP = 510/76.8 = 5.34\ ft$ $Q = \frac{1.49}{0.05}(510)(5.34)^{2/3}(0.006)^{1/2}$ $\doteq 3600\ cfs$
5	12	$A = 12(50) + 1/2(4)(12)$ $+ 1/2(4)(8) = 640\ ft^2$ $WP = 66 + 4/\sin 18.4° + 4/\sin 26.6°$ $= 87.6\ ft$ $R = A/WP = 640/87.6 = 7.31\ ft$ $Q = \frac{1.49}{0.05}(640)(7.31)^{2/3}(0.006)^{1/2}$ $\doteq 5060\ cfs$

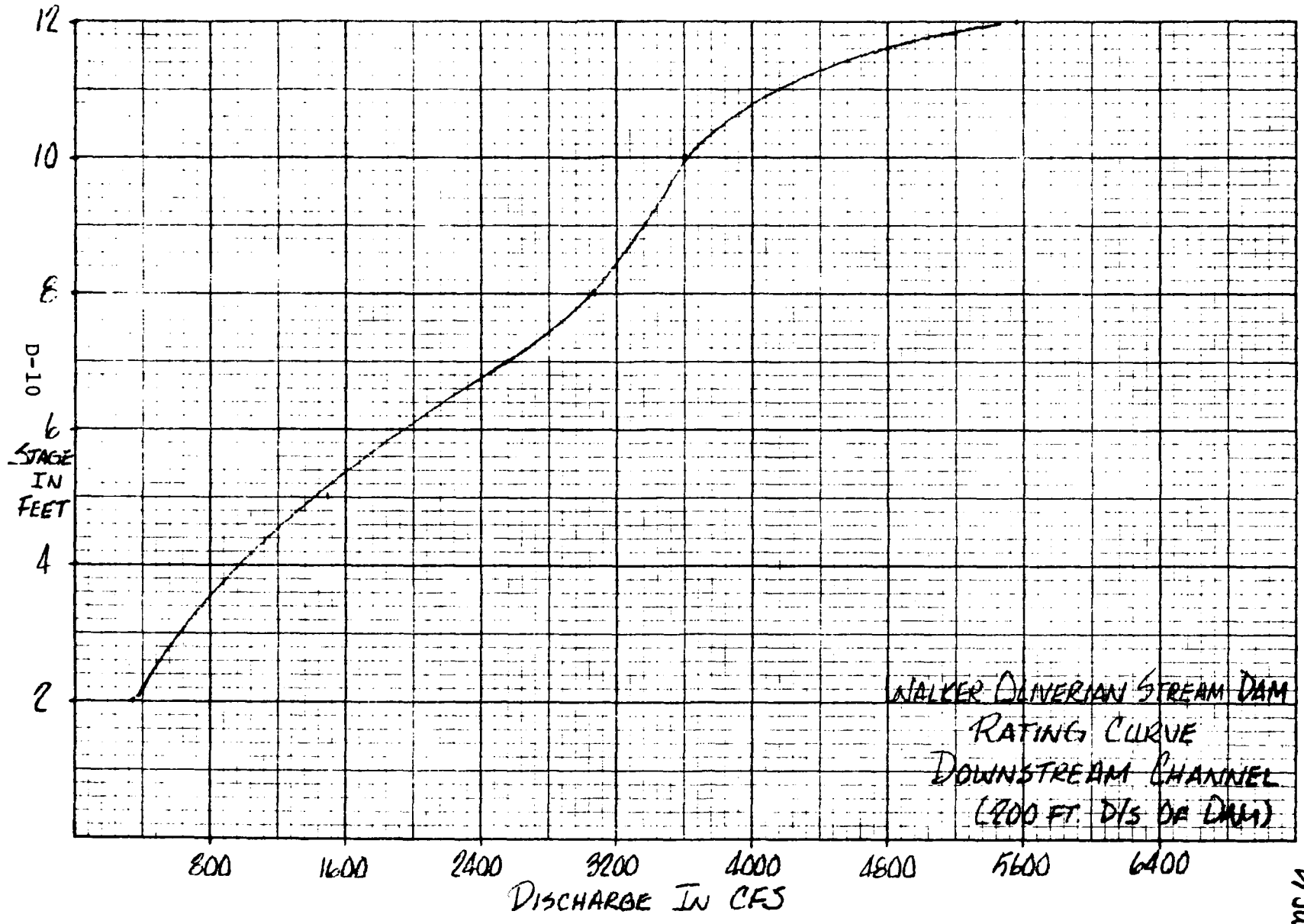


WALKER OLIVERIAN STREAM DAM
TYPICAL CROSS SECTION
DOWNSTREAM CHANNEL
(200 FT. D/S OF DAM)

D-9

6/16

AKS 5 Jun 79



D-10

9/16

AFS III
5 Jun 79

10/16

Rev. ABS/TW
18 Jul 79

BREACH ANALYSIS

Purpose: Determine degree of downstream hazard.

Assume: Pool elevation = 740.0 (top of both abutments)
Upstream riverbed elevation = 726.0* due to silt build-up.

$Q_{P_1} = 8/27\ W_b \sqrt{g}\ y_o^{3/2}$ where W_b = breach width
$g = 32.2\ ft/sec^2$
y_o = pool elev. − u/s riverbed elev.

$W_b = 0.4(74) = 30$ ft; $y_o = 740.0 - 726.0 = 14$ ft.

$Q_{P_1} = 8/27(30)(\sqrt{32.2})(14)^{3/2} = 2{,}640$ cfs

Additional flow over dam during breach...
$Q = CLH^{3/2} = 3.0\ (74-30)\ (2)^{3/2} = 373$ cfs

Total Breach Q = 2,640 + 373 = 3013 cfs

Antecedent Discharge (Q_A) = flow over dam before breach

$Q_A = 100$ cfs (see rating curve on p. D-6)

* Sketch of typical section shows a high silt elevation. In the event of a breach, it is assumed that most of the silt would be washed downstream.

11/16

Rev. AFS III
18 Jul 79

BREACH ANALYSIS (CONT)

Use a typical cross section of the stream channel adjacent to two (2) mobile homes located approximately 4000 feet downstream of the dam. Develop a discharge rating curve using the Manning Equation:

$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$ where $S = \frac{721.3 - 640.0}{4000} = 0.02$; $n = 0.05$

$K = \frac{1.49}{n} S^{1/2} = \frac{1.49}{0.05} (0.02)^{1/2} = 4.21$

The table below refers to a downstream hazard cross section shown on p. D-15.

Trial No.	Stage (ft.)	Discharge
1	2	$A = 2(20) = 40\ ft^2$ $WP = 20 + 4 = 24\ ft$ $R = A/WP = 40/24 = 1.7\ ft$ $Q = 4.21(40)(1.7)^{2/3} = 240\ cfs$
2	5	$A = 5(20) + 3^2(1/2) = 105\ ft^2$ $WP = 5 + 20 + 2 + 4.2 = 31.2\ ft$ $R = 105/31.2 = 3.4\ ft$ $Q = 4.21(105)(3.4)^{2/3} = 1000\ cfs$
3	7	$A = 7(20) + 5^2(1/2) + 2^2(100)(1/2) = 353\ ft^2$ $WP = 27 + 200 + 7.1 = 234.1\ ft$ $R = 353/234.1 = 1.51\ ft$ $Q = 4.21(353)(1.51)^{2/3} = 1956\ cfs$
4	9	$A = 9(20) + 7^2(1/2) + 4^2(100)(1/2) = 1003\ ft^2$ $WP = 27 + 400 + 9.9 = 436.9\ ft$ $R = 1003/436.9 = 2.3\ ft$ $Q = 4.21(1003)(2.3)^{2/3} = 7372\ cfs$

12/16

Rev. ATS III
18 Jul 79

BREACH ANALYSIS (CONT)

Trial No.	Stage (ft)	Discharge
5	10.5	$A = 10.5(20) + (8.5)^2(1/2) + (5.5)^2(100)(1/2)$ $= 1759\ ft^2$ $WP = 27 + 550 + 12 = 589\ ft$ $R = 1759/589 = 3.0$ $Q = 4.21(1759)(3.0)^{2/3} = 15,403\ cfs$
6	12	$A = 12(20) + 10^2(1/2) + 7^2(100)(1/2)$ $= 2740\ ft^2$ $WP = 27 + 700 + 14.1 = 741.1\ ft$ $R = 2740/741.1 = 3.7\ ft$ $Q = 4.21(2740)(3.7)^{2/3} = 27,593\ cfs$

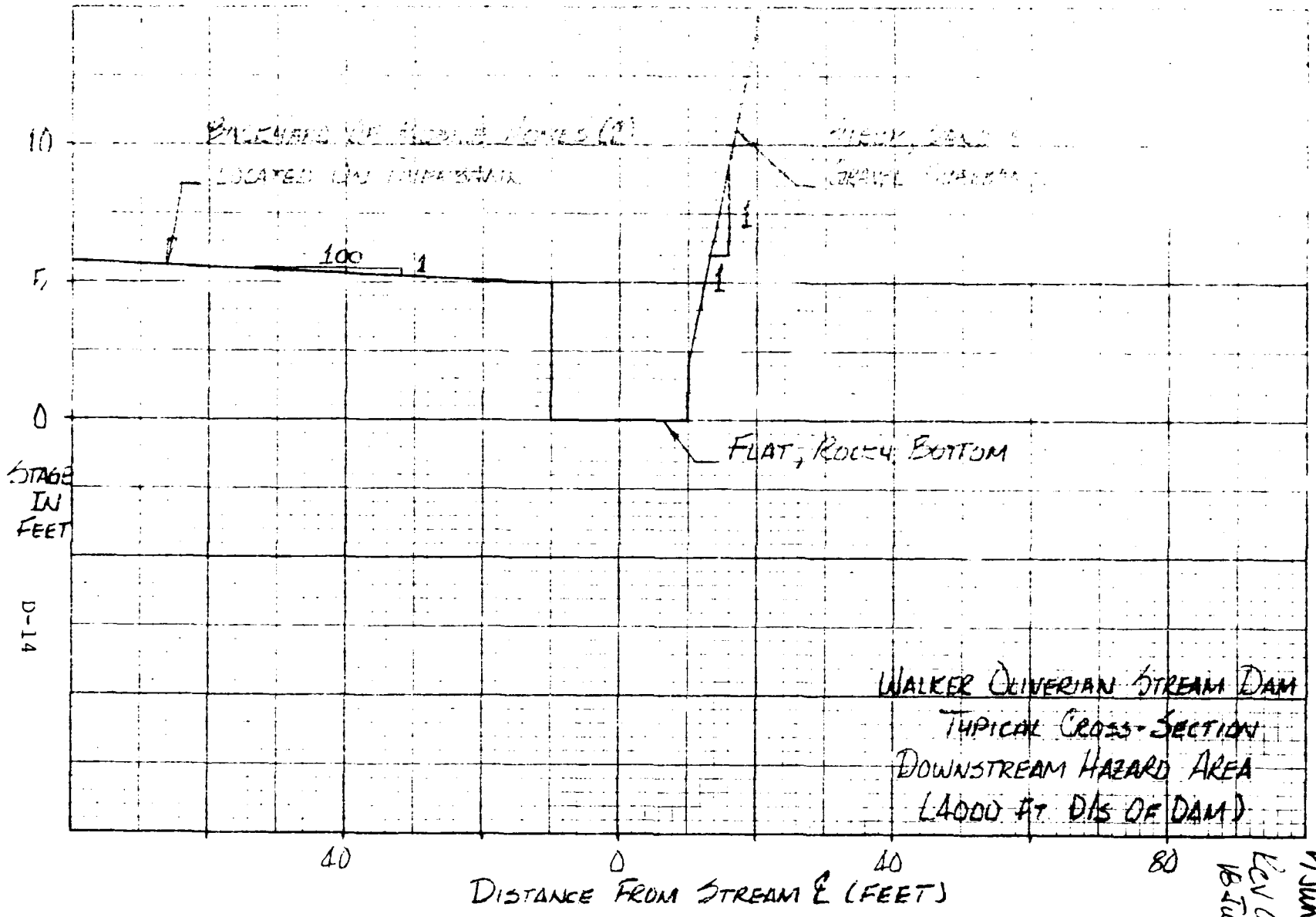
Breach at top of dam - elevation 740.0 MSL

Total breach Q = 3013 cfs (see p. D-11)
Stage = 7.6 feet @ 3013 cfs (see d/s hazard rating curve)

Antecedent discharge = 700 cfs (see p. D-11)
Stage = 4.4 feet @ 700 cfs (see d/s hazard rating curve)

Therefore, stage increase at d/s hazard area will be:

7.6 - 4.4 = 3.2 feet

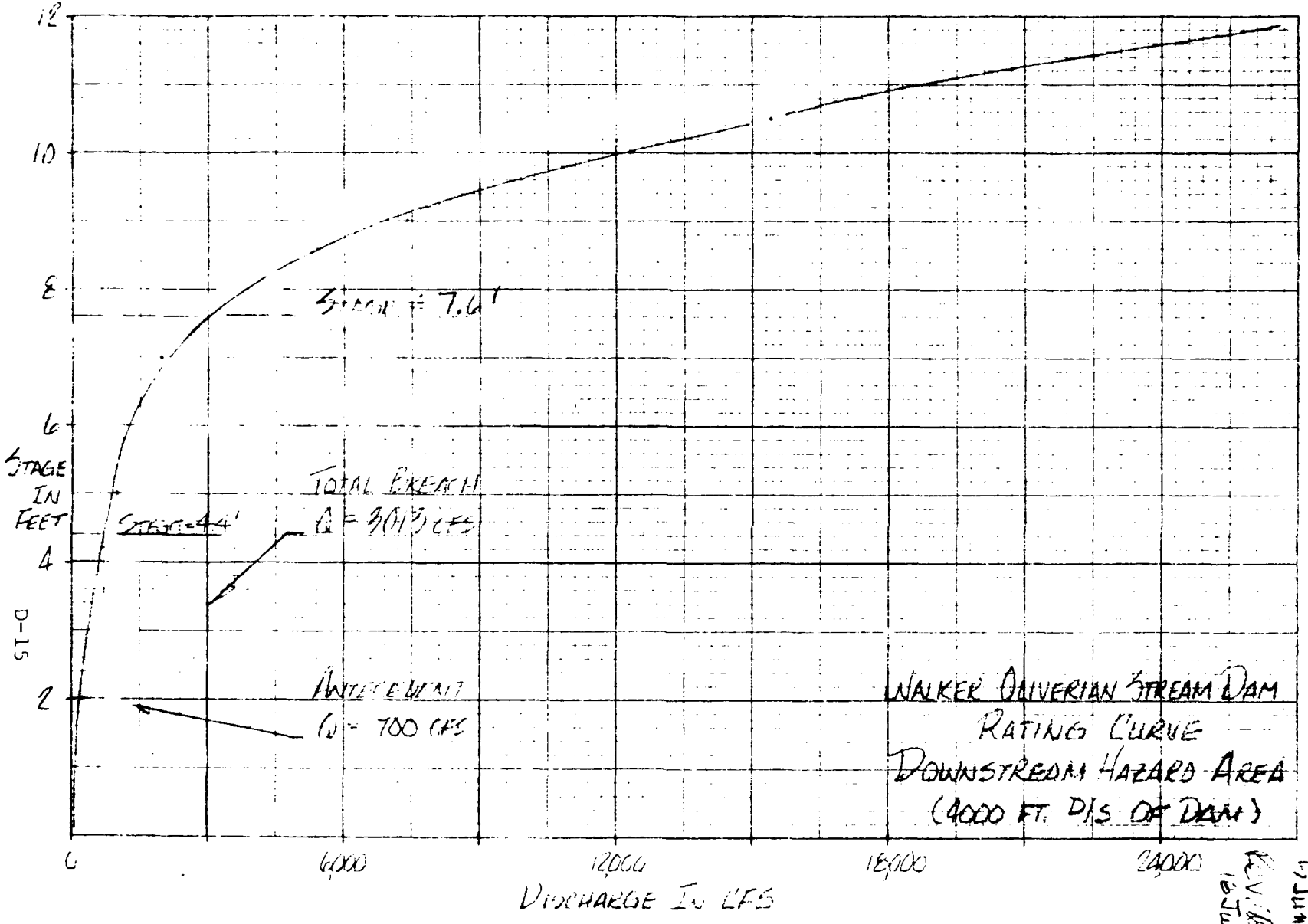


D-14

WALKER OLIVERIAN STREAM DAM
TYPICAL CROSS-SECTION
DOWNSTREAM HAZARD AREA
(4000 FT DIS OF DAM)

AFSS 5 Jun 79
ECV AFSS 18 Jun 79

13/16



D-15

14/16 AFSW 5 JUN 79

REV. 18 JUL 79

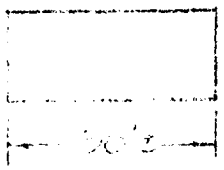
GRAPH PAPER

15/16

AFSM
6 Jun 79
Rev. AFSM
18 Jul 79

Hydraulics of Bridge Opening (400' D/S of Dam)

N.H. Rte. 25 — Low chord el. 734.2



Invert el. 716.7

50'

Problem: Discharge capacity of bridge opening (maximum flow w/o creating backwater)

Use: Manning Equation:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Where $A = 15.5(50) = 775\ ft^2$

$WP = 50 + 2(15.5) = 81\ ft.$

$R = A/WP = 775/81 = 9.6\ ft.$

$S = 0.02$, $n = 0.03$*

$$Q = \frac{1.49}{0.03}(775)(9.6)^{2/3}(0.02)^{1/2} = 34,588\ cfs$$

[illegible] >> 2810 (Total Breach Q), so flows of bridge are negligible in the [illegible] of a breach.

[illegible] with consideration given to [illegible] walls beneath bridge.

16/16
Rev. AT3aa
18 Jul 79

CONCLUSION - HAZARD CLASSIFICATION

Walker Olivenan Diversion Dam is a significant hazard dam. Two (2) mobile homes are located on the southeast bank close to Olivenan Brook about 4000 feet downstream of the dam. Appreciable damage to these homes and to industrial plant if a breach at top of dam occurred. Loss of one or two lives would be possible.

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	WATER COUNTY	COUNTY	CONGR DIST	OTHER	COUNTY	CONGR DIST	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY	MO	YR
NH	68	NED	NH	009	02				WALKER OLIVERIAN STREAM DAM	4401.9	7200.5	04	JUN	79

POPULAR NAME	NAME OF IMPOUNDMENT
NORTON PIKE DAM	OLIVERIAN BROOK

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	08	OLIVERIAN BROOK	PIKE (HAVERHILL)	0	226

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
PGOT	1900	0	19	14	50	40	NED	N	N	N	N	

REMARKS
21-SPLIT STONE ON LEDGE 22-BETWEEN 1850 TO 1900 23-STREAM BARRIER

S/S NAS	SPILLWAY LENGTH (FT.)	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (CFS)	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.)
2	74	U	62	695												

OWNER	ENGINEERING BY	CONSTRUCTION BY
ROBERT V WALKER		

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RES BD	NH WATER RES BD	NH WATER RES BD	NH WATER RES BD

INSPECTION BY	INSPECTION DATE DAY	MO	YR	AUTHORITY FOR INSPECTION
ANDERSON-NICHOLS AND COMPANY INC	08	MAY	79	PL92-367

REMARKS

END

FILMED

8-85

DTIC