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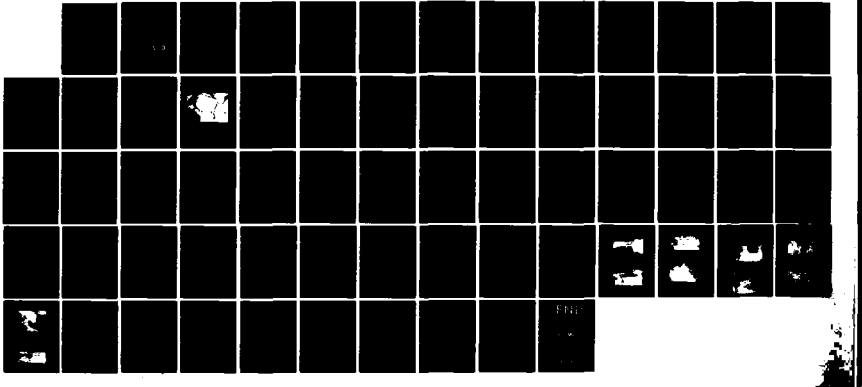

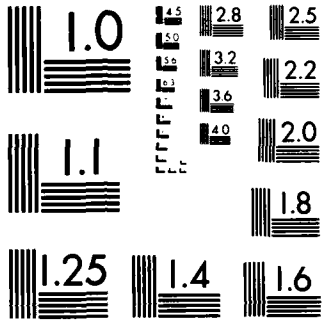

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CONNECTICUT RIVER BASIN
~~GROVETON~~, NEW HAMPSHIRE
Northumberland

LOWER GROVETON DAM
N.H. 00369

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

FEBRUARY 1979

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

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Connecticut River Basin
Groveton, New Hampshire
Upper Ammonoosuc River

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

THe dam is a run of the river timber crib stone fill dam with timber crib a-butmentments and gate works. The dam is about 210 ft. long and is 15 ft. high It is small in size with a low hazard potential. The dam was found to be in poor structural condition . There are various recommendations which should be implemented. An alternative to the recommendations would be the removal of 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 Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

I am forwarding to you a copy of the Lower Groveton 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. Michael LeBlanc, Plant Engineer, Groveton Paper Company, Groveton, New Hampshire 03582.

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 yours,

JOHN P. CHAMBERS
Colonel, Corps of Engineers
Division Engineer

Incl

LOWER GROVETON DAM

NH 00369

NORTHUMBERLAND, NEW HAMPSHIRE

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No:	NH00369
Name of Dam:	Lower Groveton Dam
Town:	Northumberland
County and State:	Coos, New Hampshire
Stream:	Upper Ammonoosuc River
Date of Inspection:	November 16, 1978

BRIEF ASSESSMENT

The Lower Groveton Dam is a run-of-the-river timber crib stone fill dam with timber crib abutments and gate works. The dam has an overall length of approximately 210 feet and is 15 feet high. Under normal flow conditions the dam impounds approximately 150 acre-feet and has a drainage area of 251 square miles.

The dam is classified as small and of low hazard in accordance with the "Recommended Guidelines for Safety Inspection of Dams, Department of the Army, November 1965" consequently a test flood of 100-year exceedance interval was utilized for this report. The test flood outflow was assumed equal to the test flood inflow of 13,500 CFS. The spillway capacity of 3426 CFS represents only 25 percent of the test flood (assuming flood gates are inoperable, see text). The test flood would result in overbank flow around the right abutment of approximately 3.5 feet deep.

The dam was found to be in poor structural condition based on a limited visual inspection. The following significant findings were determined during the investigation:

1. There are indications of settlement at the left side of the spillway.

2. An area of water boiling was found downstream of the left abutment.

3. The wooden members of both abutments and gate works are showing signs of extensive deterioration which may render the structure unstable in the near future.

4. The spillway section could not be inspected because of the water flowing over it at the time of inspection.

The Lower Groveton Dam is in poor condition and subject to continued deterioration and possible failure during major storm flows. A detailed assessment and recommendations for remedial action are contained in Section 7 of this report. In summary it is recommended that the following actions be instituted under the guidance of a qualified engineer within one year of the receipt of this report:

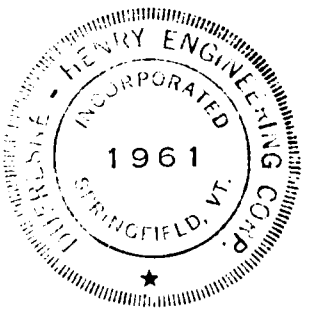
1. Repair and/or reconstruct the abutments and gate works.

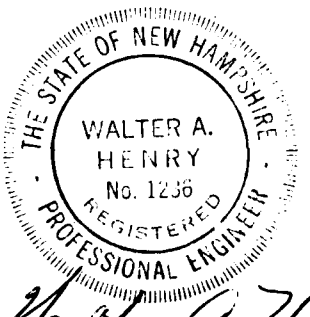
2. Perform a detailed inspection of the spillway with the reservoir dewatered. Determine the structural condition of the planking and timber members and of the foundation soils and make corrective repairs where needed.

3. Assess the significance of the water boil at the left abutment and the leakage in the right gate structure and take appropriate remedial action if required.

4. Institute a program of annual periodic technical inspections.

An alternative to the above recommendations would be the removal of the dam. Prior to considering this course of action, the utilization of the dam for ice flow regulation should be investigated.





Walter A. Henry

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This Phase I Inspection Report on Lower Groveton 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.

Joseph W. Finegan

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

Joseph A. McElroy

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

Carney M. Terzian

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

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

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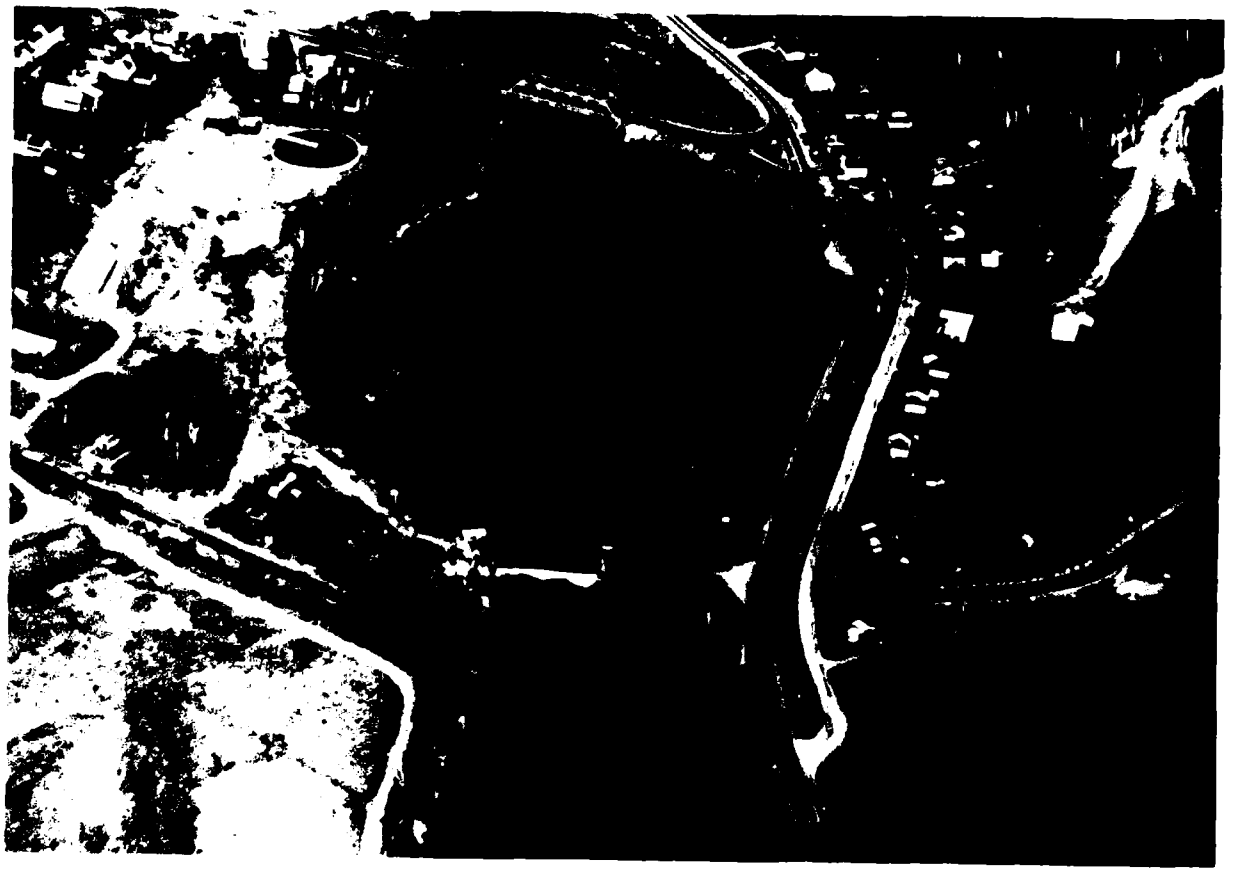
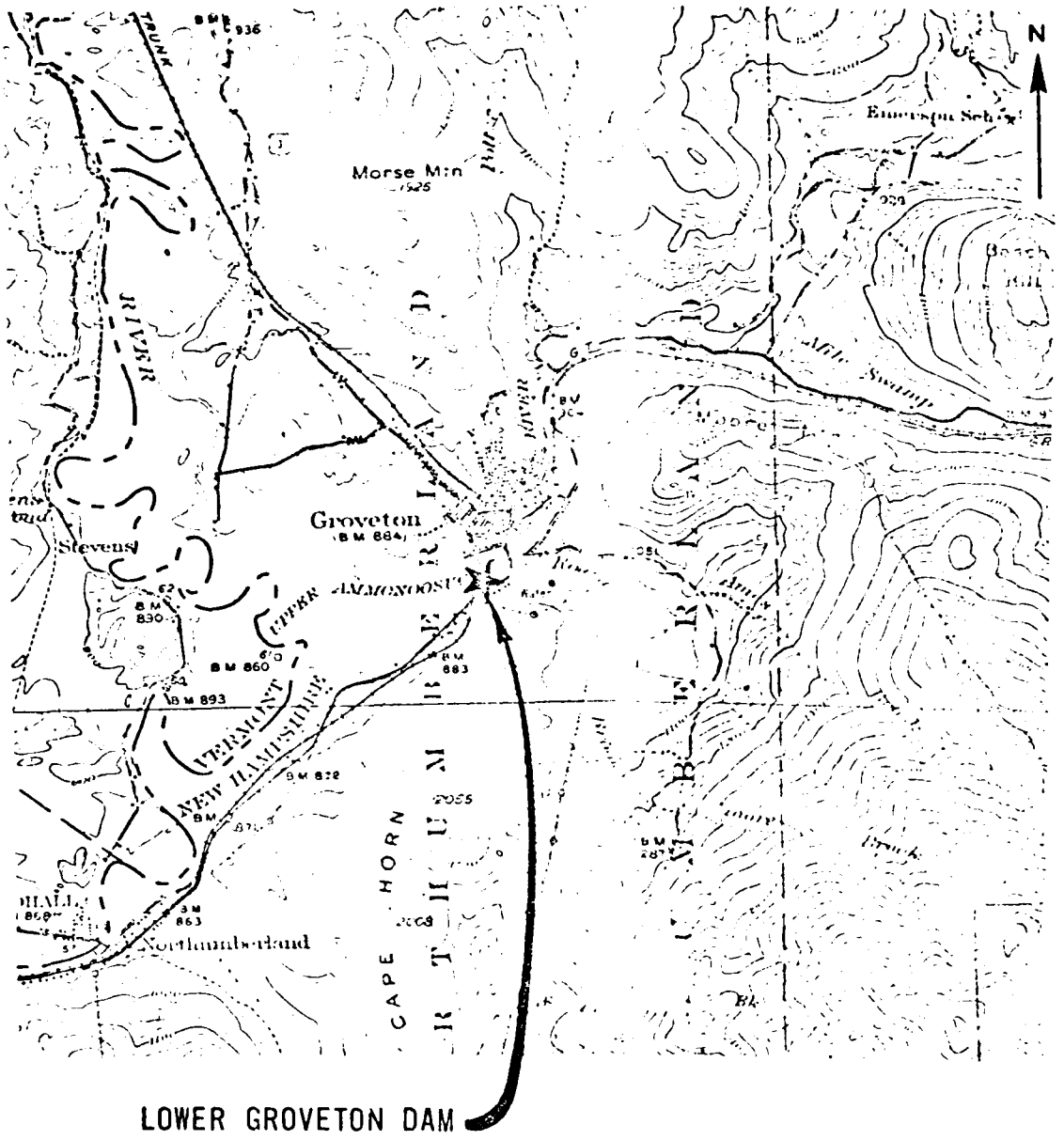


OVERVIEW OF
LOWER GROVETON DAM
NORTHUMBERLAND, NEW HAMPSHIRE



DUFRESNE-HENRY ENGINEERING CORP.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION MAP

LOWER GROVETON DAM

GROVETON — NEW HAMPSHIRE

CLIENT NO. 01-0083 — 1" = 1 MILE

ENGR.

SOURCE:

U.S.G.S. QUADRANGLE
GUILDHALL, VT.-N.H.
& PERCY, N.H.
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NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
NAME OF DAM: LOWER GROVETON

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. Dufresne-Henry Engineering Corporation 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 Dufresne-Henry Engineering Corporation under a letter of November 20, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0010 has been assigned by the Corps of Engineers for this work.

b. Purpose

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

(2) Encourage and prepare the states to initiate quickly effective dam safety programs for nonfederal dams.

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

1.2 Description of Project

a. Location

The Lower Groveton Dam is located on the Upper Ammonoosuc River, in the Town of Groveton, Coos County and is in the Connecticut River basin. The dam is located approximately .25 miles upstream of the junction of the Connecticut and Upper Ammonoosuc Rivers.

b. Description of Dam and Appurtenances

The Lower Groveton Dam is a run of the river dam, approximately 210 feet long with a maximum height of 15 feet.

The spillway is a 115-foot long timber crib and stone dam with complete wood planking. The dam abutments are timber crib structures which include flood gates for the dam. The left abutment includes two 11-foot wide gates and the right abutment includes one 12-foot wide gate. Gate houses are located on both abutments which contain the gate operating apparatus. Under normal conditions, the gates are closed and the water level is controlled by the main spillway. A power house originally located just upstream of the right abutment was demolished in 1969. The intake channel and outlet works were filled in and riprap was placed on the embankments.

c. Size Classification

The Lower Groveton Dam has a maximum height of 15 feet and an estimated maximum impoundment of 275 acre-feet. The USCE Guidelines place dams with maximum heights less than 25 feet and storage capacities between 50 and 1000 acre-feet in the small size category. Therefore, the size classification of the Lower Groveton Dam is small.

d. Hazard Classification

A failure of the Lower Groveton Dam would route the resulting flood waters into the downstream channel of the Upper Ammonoosuc River. This section of the river has a wide, well formed channel with a low stream gradient. The maximum flood wave would be only 5 feet high and would quickly be dissipated without overbank flow. There would be no loss of life or economic damage resulting from the failure of the Lower Groveton Dam. Therefore the hazard classification of this dam is low.

e. Ownership

The present owner of the Lower Groveton Dam is:

Groveton Papers Company
Groveton, New Hampshire 03582

f. Operator

The operation and maintenance of the dam is under the supervision of:

Mr. Michael LeDuc, Plant Engineer
Groveton Papers Company
Groveton, New Hampshire 03582

Telephone: 603-636-1154

g. Purpose

The original purpose of this dam was power generation. The power house, rated at 200 kilowatts was located adjacent to and just upstream of the right abutment. In 1969 the power house was demolished and filled in.

The reservoir pool extends upstream into the Town of Groveton. At the present time the Groveton Papers Company is maintaining the dam for aesthetic purposes and for future consideration in the event that hydropower again becomes a viable energy alternative.

h. Design and Construction History

Design, construction and maintenance records are not available for this dam. Some data has been obtained from state inspections performed in 1936 and 1972. The only significant structural change noted was the deactivation and demolition of the power house in 1969. The dam appears to be unchanged since its original construction prior to 1936.

i. Normal Operating Procedures

The flood gates are operated to suit river flow conditions.

1.3 Pertinent Data

a. Drainage Area

The drainage area above the Lower Groveton Dam contains approximately 250 square miles of rolling hills and mountainous terrain. Approximately 50 percent of the area is within the White Mountain National Forest. The Upper Ammonoosuc River, which is the main water course of the drainage area, has a length of 22 miles. Elevations vary from 1000 feet along the Upper Ammonoosuc River to 4000 feet at the ridge of the Pilot Mountain Range in the White Mountain National Forest. The soils are predominantly glacial till overlying bedrock and hardpan within 3 feet of the surface.

b. Discharge at Dam Site

(1) Outlet Works

None.

(2) Maximum Known Flood at Dam Site

The maximum recorded flood flow at the Upper Ammonoosuc gauging station, located approximately 3 miles upstream

of Groveton, occurred on May 20, 1969. This flood flow of 24,100 CFS was the result of a failure of the Nash Bog Pond Dam located on Nash Stream, a tributary to the Upper Ammonoosuc River. This flow is equivalent to a gauge height of 12.01 feet. The maximum known storm related flow occurred in March 1936, but was not recorded on the Upper Ammonoosuc because the gauge was not installed until 1940. Based on water marks from that storm compared to the existing gauge, the March 1936 flow was approximately 12,000 CFS.

(3) Spillway Capacity

The maximum spillway capacity of the timber crib spillway is approximately 3,426 CFS without the flood gates. If the flood gates were open the capacity would increase to 6,828 CFS. Based on the visual inspection, there is some question as to the future operational status of the flood gates. The timber crib abutments and gate piers are experiencing extensive deterioration due to age and erosion. Some horizontal and vertical movement has already occurred in the piers and further movement is anticipated in the future unless remedial action is taken. This movement will eventually cause misalignment of the gate channels and render the gates inoperable. The spillway capacity of 3,426 CFS represents 25 percent of the test flood of 13,500 CFS.

c. Elevations

(Based on an assumed bench mark of 96.0 at the top of the right railroad bridge abutment.)

Streambed at Centerline of Dam	74±
Maximum Tailwater	Variable
Upstream Portal Invert	Not applicable
Recreation Pool	84.7
Full Flood Control Pool	89.3
Spillway Crest	84.7
Design Surcharge	Not known
Top of Dam	89.3
Test Flood Surcharge	92.8

d. Reservoir

	Feet*
Length of Maximum Pool	3,500
Length of Recreational Pool	3,000
Length of Flood Control Pool	3,500

*Estimated based on USGS topographic maps and visual observations.

e. Storage

	Acre-Feet*
Recreation Pool	150
Flood Control Pool	275
Test Flood Pool	370
Spillway Crest Pool	150
Top of Dam	275

f. Reservoir Surface

	Acres*
Top of Dam	30
Test Flood Pool	30
Flood Control Pool	30
Recreation Pool	27
Spillway Crest	27

g. Dam

(1) Type

Timber crib and stone, run-of-river dam.

(2) Length

Overall 200 ± feet.
Spillway - 115 feet.

(3) Height

10 feet at spillway
16 feet to top of abutment.

(4) Top Width

6 feet.

(5) Side Slopes

Not applicable.

(6) Zoning

None known.

(7) Impervious Core

Not applicable.

*Estimated based on USGS topographic maps and visual observations

(8) Cutoff

Not applicable.

(9) Grout Curtain

Not applicable.

h. Diversion and Regulating Tunnel

Not applicable.

i. Spillway

(1) Type

Timber crib broad crested weir, run-of-river dam.

(2) Length

115 feet.

(3) Crest Elevation

84.7

(4) Gates

None.

(5) Upstream Channel

Upper Ammonoosuc River, approximate width - 210 feet.

(6) Downstream Channel

Upper Ammonoosuc River, approximate width - 200-300 feet, railroad bridge 200 feet downstream (see section 3.1.e).

j. Regulating Outlets

The dam contains three waste gates. Two 11' x 4' gates are located at the left abutment and one 12' x 6' gate at the right abutment. Although the gates are operational at the present time, their future operation is in doubt because of the deteriorated condition of the gate piers and abutments. The two left hand gates are equipped with electric operators while the right side gate is a hand operated mechanism.

SECTION 2 - ENGINEERING DATA

2.1 Design

A timber or log crib dam is made of wood members bolted into cribs and filled with rock. This type of dam usually leaks considerably and its resistance against sliding is reduced by buoyant forces which decrease the effective weight of the dam. A relatively long sloping approach apron is also utilized to increase the resistance to sliding and reduce leakage. The life span of a timber crib dam varies between 10 and 40 years depending upon climatic conditions, amount of maintenance performed and type of timber used. Cedar, redwood and cypress are the most durable timbers.

All design and original construction data for this dam have either been destroyed or cannot be located by the Groveton Papers Company.

2.2 Construction

According to the records, this dam was constructed between 1910 and 1920. The timber crib structure was built on an earth foundation and tied into timber crib abutments at each abutment. Figure 2 was drawn from visual observations and data obtained from the New Hampshire Water Resources Board and represents approximately the dam as it now exists.

2.3 Operation

The dam is not being operated at the present time.

2.4 Evaluation

a. Availability

The design and construction records for this dam are not available.

b. Adequacy

The lack of in-depth engineering data does not allow for a definitive review. Therefore, the adequacy of this dam, structurally and hydraulically cannot be assessed from a review of design calculations, but must be based primarily on the visual inspection and sound hydrologic and hydraulic engineering judgment.

c. Validity

Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General

The on-site inspection of the Lower Groveton Dam was performed on November 16, 1978. Water was flowing over the dam during the inspection, preventing complete visual observation of the timber crib structure. No emergency conditions were observed on the day of the inspection.

b. Dam

Because of the amount of water flowing over the dam, little can be said about the details of the structure other than general comments about alignment and overall condition.

The dam appears to be in fair condition. All portions of the dam are intact and the dam is completely covered with timber planking which is in good condition.

There appears to be some settlement on the left side of the dam. Approximately ten feet of the dam, adjacent to the left abutment is .35 feet lower than the other portions of the dam. The settlement can be seen in Photo 1.

c. Appurtenant Structures

Timber crib gate works are located at both ends of the spillway. The gate works also serve as the spillway abutments. The left gate works contains two 11-foot wide gates and sluiceways. The timber crib structure is in poor condition. The center crib is leaning at an approximate angle of 6^{o} (see Photo 3). Two steel I-beams have been placed across the top of the structure in an attempt to prevent further tilting. Rotting timbers, within the structure appear to be causing the leaning, but poor foundation material could also be a contributing factor. All sections of the crib structure are showing signs of advanced deterioration due to rotting timbers, missing planking and ice damage (see Photos 4, 5 and 6). Significant leakage is occurring around both gates (see Photo 4). The exact cause of this leakage could not be determined during the inspection because the upstream side of the gates and channels were under water.

The crib sections of the left gate works were originally covered with planking. Most of the planking is missing,

due either to natural erosion, rotting, etc., or vandalism. The remaining planking is in poor condition, especially the sluiceway walls which are rotting and are damaged by ice.

An area of water boiling was noted at the base of the far left crib section which ties the gate works to the river bank (see Photo 7). The boiling water exits the river bank below the downstream water surface. The boiling water did not appear to contain any sand or other soil particles, but this could not be confirmed by a visual inspection. Sand may be present, but may settle out before reaching the water surface.

A wood frame building spans the crib gate sections and contains the gate lifting mechanisms. The electrical lifting apparatus was reported to be in good working condition. The effect of the leaning crib on the gate operation could not be determined without actually operating the lifting mechanism.

The right gate works is similar in construction and condition to the left facility, but only one 12-foot wide gate exists. The crib sections are in poor condition with several rotted timbers and missing planking (see Photo 8). The gate house is a sheet metal building containing a hand operated lifting mechanism, which appears to be in good operating condition.

A significant amount of water is flowing around and under the right abutment (see Photo 9).

d. Reservoir Area

The impounded pool extends upstream into the Town of Groveton. The river banks are in good condition and there are no signs of recent erosion.

The original power house, located on the right bank just upstream of the dam was demolished in 1969. The foundations and intake facilities were filled in and the river banks were covered with riprap. This area is presently being used as a storage/dumping area for old miscellaneous equipment and process machinery.

e. Downstream Channel

The downstream channel consists of the natural river bed of the Upper Ammonoosuc River. A single track railroad bridge spans the river approximately 200 feet downstream of the dam. The dimensions of the bridge opening are approximately 160' x 13'. The bridge abutments and river banks are in good condition and show no signs of recent erosion (see Photo 10).

3.2 Evaluation

A complete visual evaluation of the dam was not possible because of the water flowing over the dam at the time of inspection.

From outward appearances, the dam spillway appears to be in fair condition with the exception of the left side which has settled approximately four inches. The condition of the abutments and gate works was found to be poor. Deterioration of the crib work is extensive and is beginning to have adverse effects on the structural stability. Planking of the sluiceway floor and walls is rotting and is being damaged by ice flow.

An apparent seep was observed immediately downstream of the dam next to the left abutment as evidenced by boiling of the tailwater. A leak was observed under and around the right sluice gate structure.

The leaning crib pier, the crest settlement and the leakage at both abutments indicate that there may be some problem with the foundation of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

There are no established operational procedures for the Lower Groveton Dam.

4.2 Maintenance of Dam

There is no apparent maintenance being performed on this dam.

4.3 Maintenance of Operating Facilities

The maintenance of the operating facilities consists of periodic inspection and operation of the gate lifting mechanism.

4.4 Description of Warning System

None exists for this dam.

4.5 Evaluation

The lack of a regular maintenance program could contribute to serious problems in the near future. In particular, the replacement of deteriorating planking and crib work at the abutments is essential to the integrity of the dam. If left exposed to water erosion, rotting and ice flow, the structural portions of the cribbing may fail in the future. See Section 7 for recommendations concerning operation and maintenance.

SECTION 5 - HYDRAULIC AND HYDROLOGIC EVALUATION

5.1 Evaluation of Features

a. General

The Lower Groveton Dam is a run-of-the-river dam with a relatively small storage volume. The storage has been further reduced by significant sedimentation.

b. Design Data

There is no existing design data available for this dam. The spillway capacity was determined using general dimensions obtained during the visual inspection and from file data. A spillway capacity of 3426 CFS was calculated without considering the flood gates. The flood gates would increase the capacity to 6828 CFS.

c. Experience Data

There are no records available for this dam other than the data on file with the New Hampshire Water Resources Board. The only reference to flood damage was in the October 27, 1972 inspection report which referred to the removal of the power house and some repairs to the right gate, following the 1969 Nash Bog failure. It can be safely assumed that this maximum known flood caused extensive damage to the power house and right side embankment.

d. Visual Observation

The visual inspection of the dam revealed a considerable amount of displacement of the timber crib piers which make up the left abutment and gate works. Although the lifting mechanisms appear to be in good working order, the operational status of the gates could not be assessed. The displacement of the crib piers may render the gates inoperable in the near future by disturbing the gate and gate channel alignment.

e. Test Flood Analysis

The dam is classified to be small size with a low hazard rating. In accordance with USCE Guidelines a test flood of 100-year exceedance interval was selected as a criterion for this study. The test flood outflow was assumed equal to the test flood inflow because of the limited storage available. The test flood of 13,500 CFS was calculated from past flow data from USGS Gauge 01080101 located in Groveton, 3.2 miles upstream of the dam, using the method presented

in "U. S. Water Resources Council Guidelines - Bulletin 17." (See Appendix D for computer data sheets.)

Because of the questionable operating status of the flood gates, the effective capacity of the dam is limited to the main spillway capacity of 3426 CFS, which is only 25 percent of the test flood. The test flood of 13,500 CFS would cause extensive overtopping and overbank flow around the right embankment. The overbank flow would reach an approximate depth of 3.5 feet with extensive erosion to the flat area where the power house was formerly located.

f. Dam Failure Analysis

The Lower Groveton Dam is a run-of-the-river dam located on a stretch of the Upper Ammonoosuc River approximately .25 miles upstream of its junction with the Connecticut River. This stretch of river is characterized by gentle, slow moving flow with a nearly flat gradient. Because of its proximity to the Connecticut River, flat gradient and relatively small height, the dam would be backwatered during major storm events. Any failure of the dam under major storm flow conditions would not result in any significant flow increase.

A failure during low flow conditions would release a flood wave approximately 5 feet in height. This flow would be contained within the existing river banks and no overbank flow or damage would result.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

Based on the limited visual observation, a complete stability analysis cannot be performed. There are, however, several visual indications that the abutments and gate works structures are approaching an unstable condition. Most of the problems enumerated in Section 3 are related to the deterioration of wood members and possibly to erosion or displacement of the foundation soils. Based on the file data and record photographs, it appears that these members are the original members. This would place the age of the wood between 50 and 60 years old which is considerably beyond the generally accepted life span of this type of wood structure. It can, therefore, be assumed that the deterioration of the wood will continue and an unstable structural condition will develop in the near future. The leaning crib section may have resulted from the deterioration of interior timber members. This could not be confirmed because of the sluiceway planking which prevented a direct visual observation. The condition of the exposed timbers leaves considerable question as to the condition of the spillway which was not observed. The dam should be dewatered and a thorough inspection performed or the spillway before any final evaluation is made.

b. Design and Construction Data

None available for this dam.

c. Operating Records

None available for this dam.

d. Post-Construction Changes

The only major post-construction change associated with the Lower Groveton Dam was the deactivation and demolition of the power house in 1969. The power house was completely demolished and filled in. Intake and downstream channels were filled and riprap was placed along the river banks where the channels were located. It is assumed that the four-foot high flashboards were removed at this time.

The gate house on the right side has been replaced in recent years. Originally, a wood framed structure housed the hand operated gate lifting mechanism. This has been

replaced with a sheet metal building (see Photo 8). The remaining post-construction changes were cosmetic rather than structural and related to routine maintenance or the lack thereof. The most obvious of these changes is the removal, by either natural forces or vandalism, of the planking which had covered all of the exposed crib abutment sections. Photos 3, 5 and 6 show the exposed timbers and stone fill which had been at one time totally covered with planking.

e. Seismic Stability

The dam is in seismic Zone 2 and in accordance with recommended Phase I Guidelines does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/ REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

Based on the records and visual inspection, the abutments and gate works of this dam are in poor condition and require reconstruction and/or replacement to maintain the dam's structural integrity. The structural wood members have outlived their structural life span and are deteriorating. The leaning crib section is ample evidence that the rotting timbers are causing structural problems and movement within the crib work. If this condition is allowed to continue, the gates will become inoperable and total failure may result during high flow conditions.

The spillway may be experiencing similar problems from rotting timbers but this could not be confirmed because of the planking and water flowing over the dam during the inspection.

b. Adequacy of Information

The lack of in-depth engineering data does not allow for a complete definitive evaluation. Therefore, the adequacy of this dam, structurally and hydraulically, cannot be assessed from the standpoint of review of design calculations, but must be based primarily on the visual inspection, past performance history and sound hydrologic and hydraulic engineering judgment. The visual observations provided adequate evidence that the dam is experiencing significant structural deterioration and requires remedial measures to improve its stability.

c. Urgency

The recommendations given in Section 7.2 should be carried out within one year after the receipt of this report.

d. Need for Additional Investigation

The additional investigations described in Section 7.2 should be carried out.

7.2 Recommendations

It is recommended that an Engineer experienced in the design of timber crib dams be engaged to investigate and design the

items listed below and that a contractor repair or reconstruct the dam in accordance with the engineer's recommendations:

1. Repair and/or reconstruct the abutments and gate works.

2. Assess the structural integrity of the spillway and its foundation through further observation when no water is flowing over the spillway. Perform an analysis and institute any repairs and/or reconstruction that are required.

3. Assess the significance of the apparent seep at the left abutment and the leak around the right gate structure.

7.3 Remedial Measures

a. Operation and Maintenance

Subsequent to the repair and/or reconstruction of the dam, an annual periodic technical inspection and repair program should be instituted to replace any wood members which have deteriorated or been damaged by ice action or vandalism.

7.4 Alternatives

An alternative to the above recommendation would be breaching the dam. Prior to considering this course of action, the utilization of the dam for ice flow regulation should be investigated.

The erosion of significant sediment behind the dam and the effects on downstream areas should also be investigated.

APPENDIX A

VISUAL INSPECTION CHECK LIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT LOWER GROVETON DAM

DATE November 16, 1978

TIME 10-12 A.M.

WEATHER Sunny

W.S. ELEV._____U.S.____DN.S.

PARTY:

1. James H. Maynes D-H
2. Sherward G. Farnsworth D-H
3. James A. Dohrman D-H
4. Gonzalo Castro GEI
5. Ken Stern, N.H. State
6. _____
7. _____
8. _____
9. _____
10. _____

PROJECT FEATURE	INSPECTED BY	REMARKS
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

PERIODIC INSPECTION CHECK LIST

PROJECT LOWER GROVETON DAM DATE November 16, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
EMBANKMENT - LOG CRIB WALL	
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	N/A
Pavement Condition	N/A
Movement or Settlement of Crest	See Vertical Alignment.
Laterial Movement	None observed.
Vertical Alignment	Section next to left gate works is 0.35 feet lower than right end.
Horizontal Alignment	Good.
Condition at Abutment and at Concrete Structures	N/A
Indications of Movement of Structural Items on Slopes	N/A
Trespassing on Slopes	N/A
Sloughing or Erosion of Slopes or Abutments	N/A
Rock Slope Protection - Riprap Failures	N/A
Unusual Movement or Cracking at or Near Toe	N/A
Unusual Embankment or Downstream Seepage	Apparent seepage next to left abutment.
Piping or Boils	None observed.
Foundation Drainage Features	None known.
Toe Trains	None known.
Instrumentation System	None known.
Vegetation	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT LOWER GROVETON DAM DATE November 16, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	None.
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

PERIODIC INSPECTION CHECK LIST

PROJECT LOWER GROVETON DAM DATE November 16, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Crib Walls	Poor, rotted timbers and planking, plankin missing.
Rust or Staining	N/A
Spalling	N/A
Erosion or Cavitation	N/A
Visible Reinforcing	N/A
Any Seepage or Efflorescence	N/A
Condition at Joints	N/A
Drain Holes	N/A
Channel	Natural river bed.
Loose Rock or Trees Overhanging Channel	Not significant.
Condition of Discharge Channel	Good.

PERIODIC INSPECTION CHECK LIST

PROJECT LOWER GROVETON DAM DATE November 16, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	None.
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
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	Natural river bed.
General Condition	Good.
Loose Rock Overhanging Channel	None of Significance.
Trees Overhanging Channel	None of Significance.
Floor of Channel	Not observable.
Other Obstructions	None observed.

APPENDIX B

PROJECT RECORDS AND PLANS

A. List of Design, Construction and Maintenance Records:

None.

B. Copies of Past Inspection Reports:

1. "Inspection Report by New Hampshire Water Resources Board August 10, 1936 with sketch and photos."

2. "Inspection Report by New Hampshire Water Resources Board October 27, 1972."

C. Listing of Plans:

Figure 1 - Lower Groveton Dam

Plan - Elevation

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

LOCATION AT DAM NO. 132-02

Town Northumberland : County Coos

Stream Upper Ammonoosuc

Basin-Primary Connecticut : Secondary Upper Ammonoosuc

Local Name

GENERAL DATA

Head-Max. ft.: Min. ft.: Ave. 10.7' ft.

Date of Construction : Use of Power Industrial

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 1 : Material "Flume"

Size : Length

Turbines

Number 1 : Makers Twin-Horiz.

Rating HP. per unit : Total Capacity 2.75 HP.

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

Drive

Type

Generator

Number 1

Make

Rating KW., per unit ; Total Capacity 200 K. W.

Exciter

Number : Make

Rating-per unit : Total Capacity K. W.

OUTPUT—KWHRS

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

OWNER Groveton Paper Co.

Leaks near flume

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Connecticut NO. 2 — I-5428
RIVER Upper Ammonoosuc MILES FROM MOUTH 2.1± D.A.SQ.MI. 263.0
TOWN Northumberland OWNER Groveton Paper Co., Groveton N.H.
LOCAL NAME OF DAM
BUILT DESCRIPTION Crib — Timber & Stone on Earth

POND AREA-ACRES DRAWDOWN FT. POND CAPACITY-ACRE FT.
HEIGHT-TOP TO BED OF STREAM-FT. 22± MAX. MIN.
OVERALL LENGTH OF DAM-FT. 575± MAX.FLOOD HEIGHT ABOVE CREST-FT.
PERMANENT CREST ELEV.U.S.G.S. 863.1 AE LOCAL GAGE
TAILWATER ELEV.U.S.G.S. 853.71 LOCAL GAGE
SPILLWAY LENGTHS-FT. 115 FREEBOARD-FT. 6
FLASHBOARDS-TYPE, HEIGHT ABOVE CREST Fixed 2 End sections removable 2'
WASTE GATES-NO. WIDTH MAX. OPENING DEPTH SILL BELOW CREST (4 AE)

REMARKS Condition — generally Good
5C Into Connecticut Max High Water 870.1

POWER DEVELOPMENT

UNITS NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE
1	275	10.67			Twin Horizontal
1				200	Unknown
		13.8AE		150 AE	

USE Power

REMARKS Monace Height Top Flashboards to H.T.W. 12.67

DATE 8/10/36

O.K.

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 182.03

Town Northumberland ✓ : County Coos

Stream Upper Ammonoosuc River (Eastern Dam)

Basin-Primary Connecticut : Secondary Upper Ammonoosuc ✓

Local Name

Coordinates—Lat. 44° 35' + 4700 : Long. 71° 30' + 5.50

GENERAL DATA

Drainage area: Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total 233 ✓ Sq. Mi.

Overall length of dam 575 ✓ ft.: Date of Construction

Height: Stream bed to highest elev. 22 ✓ ft.: Max. Structure 16 ✓ ft.

Post—Dam : Reservoir

DESCRIPTION Crib timber and stone Foundation earth ✓

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 115' ✓ ft.: Net ft.

Height of permanent section—Max. ft.: Min. stop planks ✓ ft.

Flashboards—Type Fixed 2 end section removable Height ft.
(3' long 4' high) ✓

Elevation—Permanent Crest : Top of Flashboard

Flood Capacity 6300 cfs.: 24 cfs/sq. mi.

Abutments

Materials:

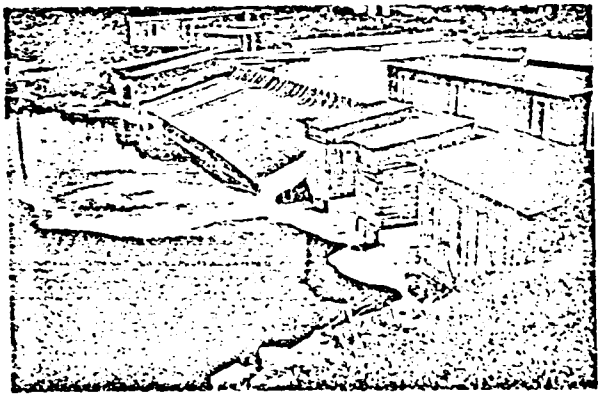
Freeboard: Max. 6.0 ✓ ft.: Min. ft.

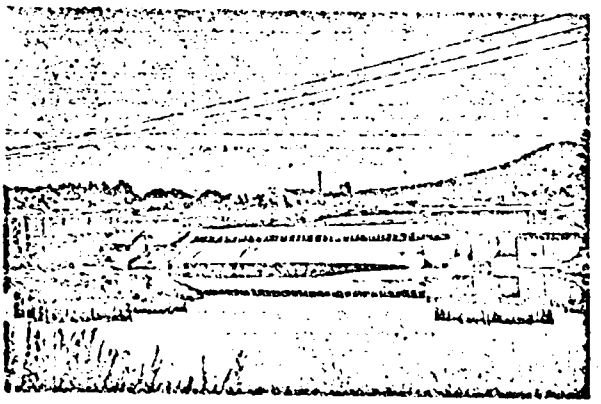
Headworks to Power Devel.—(See "Data on Power Development")

OWNER Groveton Paper Co. ✓

REMARKS Generally good leak near flume
Menance yes Subject to inspection

UPPER AMMONOOSUC RIVER IN NORTHUMBERLAND
Groveton Paper Co.
August 10, 1936





CALCULATION SHEET

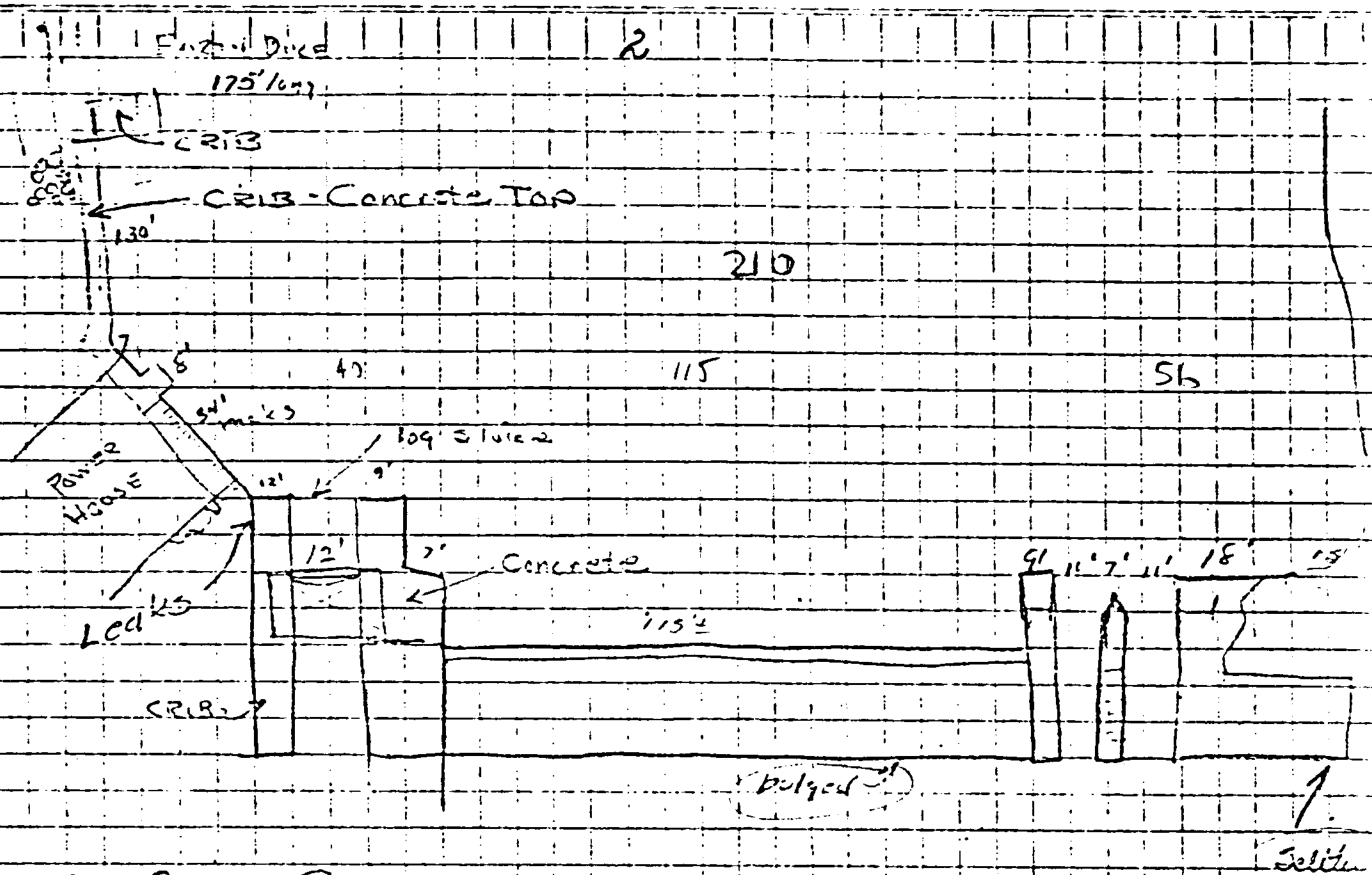
No. [illegible]

Refers to ....

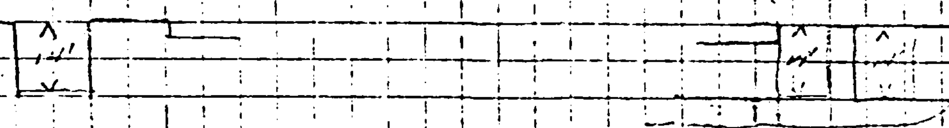
Date Aug 10, 19[illegible]

Made By [illegible]

3646



ALL CRIBS COVERED



3 PHOTOS

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

DAM SAFETY INSPECTION REPORT FORM

Town: Northumberland Dam Number: 182.02

Inspected by: Robert B. Chamberlin Date: Oct. 27 19 72

Local name of dam or water body: _____

Owner: Groveton Paper Co. Address: Groveton, N.H.

Owner was/was not interviewed during inspection.

Drainage Area: 263 sq. mi. Stream: Upper Ammonoosuc River

Pond Area: 30 Acre, Storage _____ Ac-Ft. Max. Head 10 Ft.

Foundation: Type Earth, Seepage present at toe - Yes/No, _____

Spillway: Type Crib, timber & stone, Freeboard over perm. crest: 6,

Width 115', Flashboard height None in sight,

Max. Capacity 6300 c.f.s.

Embankment: Type _____, Cover _____ Width _____,

Upstream slope _____ to 1; Downstream slope _____ to 1

Abutments: Type Log cribe, Condition: Good, Fair, Poor

Gates or Pond Drain: Size 2-11' x 14' 1-12 x 14' Capacity _____ Type Lift gates

Lifting apparatus Rack & pinion Operational condition _____

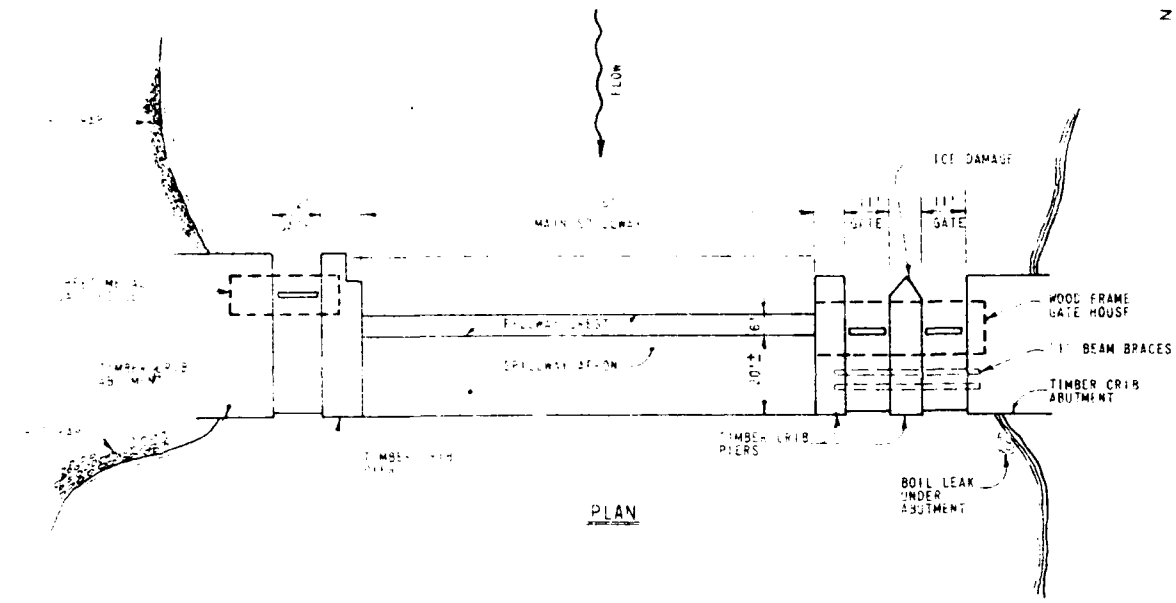
Changes since construction or last inspection: After 1969 Nash Bog failure, power house removed from right abutment and abutment filled and riprapped, sheathing in right gate repaired with 1/4" steel plate.

Downstream development: _____

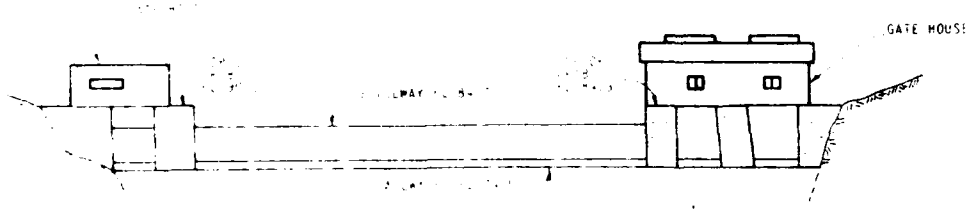
This dam would/would not be a menace if it failed.

Suggested reinspection date: _____

Remarks: Dam is in good condition.



PLAN



ELEVATION

DUFRESNE-HENRY ENGINEERING CORP. ARCHITECT-ENGINEERS	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

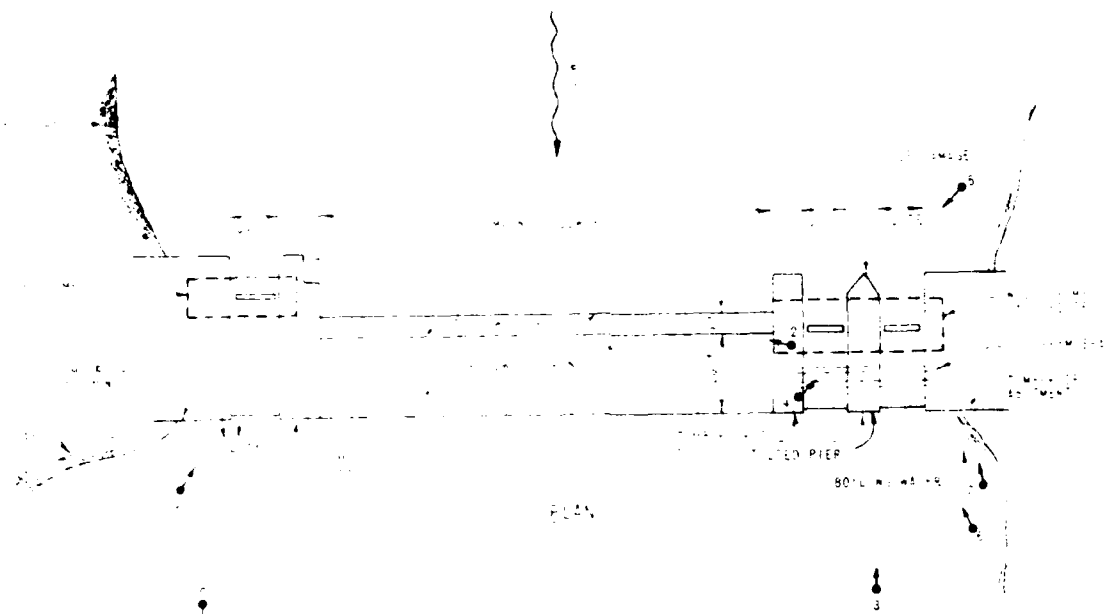
LOWER GROVETON DAM

PLAN - ELEVATION

GROVETON NEW HAMPSHIRE

APPENDIX C

PHOTOGRAPHS



U.S. ARMY ENGINEER DIV., NEW ENGLAND

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

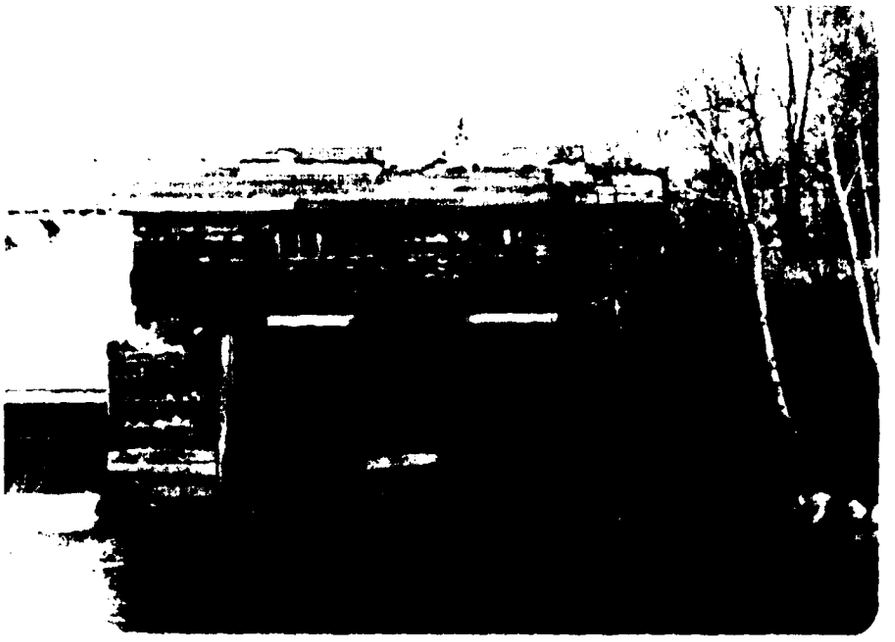
LOWER GROVETON DAM

PHOTOGRAPH LOCATION PLAN

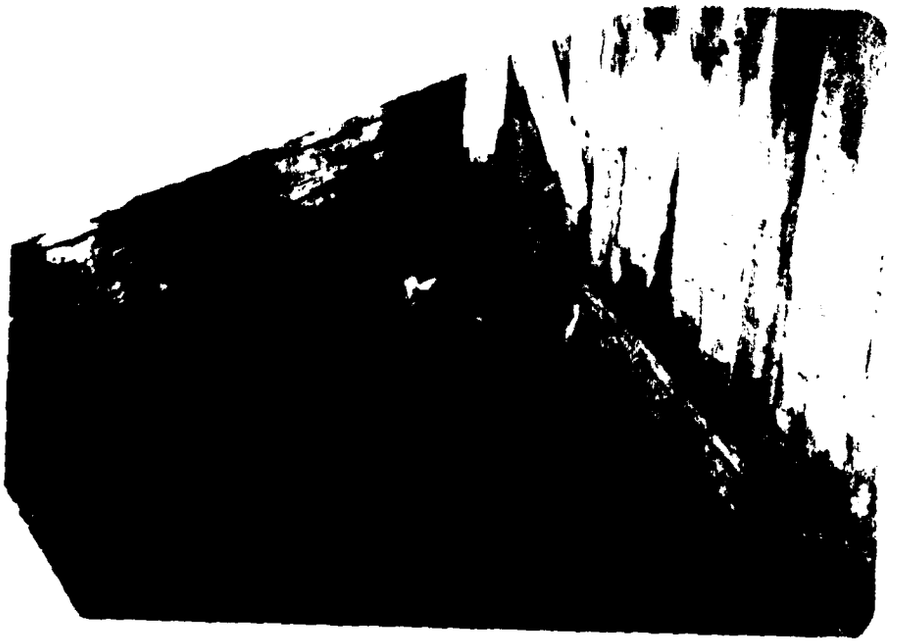
NEW HAMPSHIRE

#1. OVERALL VIEW OF DAM

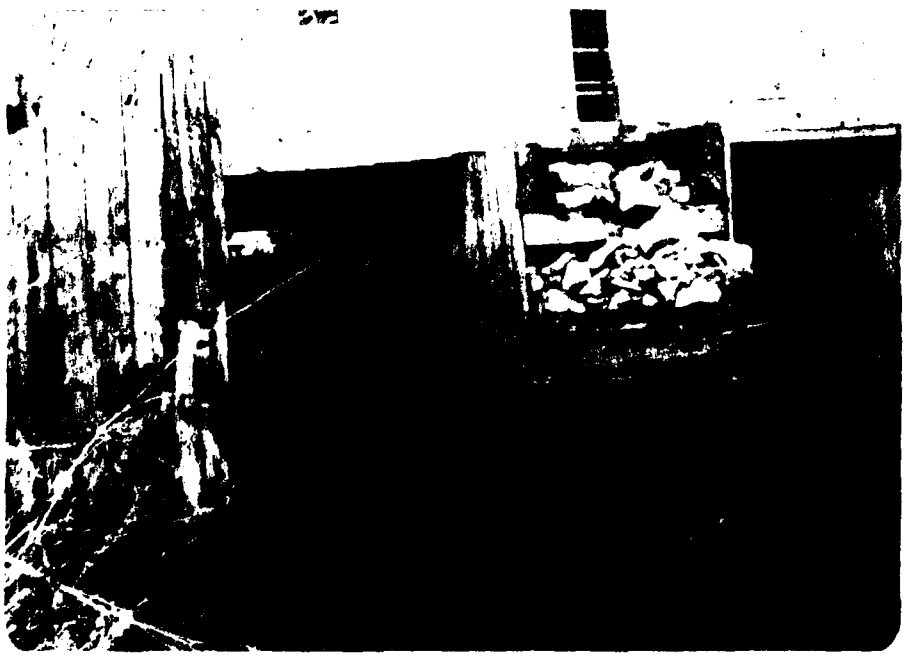
#2. VIEW OF SPILLWAY AND RIGHT GATE HOUSE



#3. VIEW OF LEFT ABUTMENT AND GATE WORKS - DOWNSTREAM SIDE

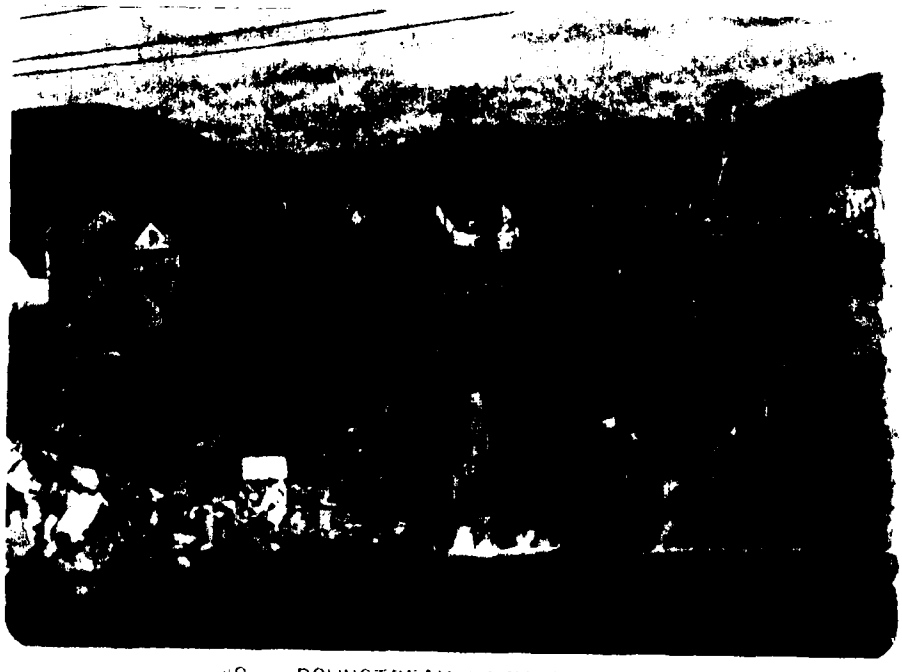


#4. VIEW OF LEAK AROUND GATE (SEE LOCATION PLAN)



#5. VIEW OF LEFT ABUTMENT AND GATE WORKS - UPSTREAM SIDE

#7. VIEW OF UNDERWATER BOIL AT LEFT ABUTMENT



#8. DOWNSTREAM VIEW OF RIGHT ABUTMENT AND GATE WORKS

#9. VIEW OF LEAK AT RIGHT ABUTMENT

#10. VIEW OF DOWNSTREAM CHANNEL AND RIGHT RAILROAD BRIDGE ABUTMENT

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

DUFRESNE-HENRY ENGINEERING CORPORATION

BY _____ SUBJECT _____ SHEET NO. ____ OF ____

DATE _____ _____ JOB NO. _____

LOWER GROUETON — STORAGE

FROM INVENTORY SHEET

MAX STORAGE
325 A-F

NORMAL STORAGE
150 A-F

POND AREA 27 ACRES

MAX POOL EL
89.3

NORMAL
84.7

PLANIMETER READING FOR NORMAL POND

SCALE = 1" = 660'

.09 SQ IN

$(.09)(.98)(640) = 25$ ACRES

USING 27 ACRES & NORMAL STORAGE OF 150 A-F

$(89.3 - 84.7)(27) = 125$

MAX STORAGE $= 150 + 125 = 275$ AC FT

TEST FLOOD = 100 YR EXCEEDANCE INTERVAL

TEST FLOOD CALCULATED FOR USGS GAUGE 01080101 LOCATED IN GROVETON, 3.2 MILES UPSTREAM OF THE DAM. TEST FLOOD CALCULATED USING METHOD PRESENTED IN "U.S WATER RESOURCES COUNCIL GUIDELINES - BULLETIN 17 (SEE COMPUTER PRINTOUT)

TEST FLOOD CALCULATED AT GAUGE = 12,700 CFS

DRAINAGE AREA TO GAUGE = 232 SQ. MI.

DRAINAGE AREA TO DAM = 251 SQ. MI.

$(251/232)^{.75} = 1.06$ $1.06 \times 12,700 = 13,462$

SAY 13,500 CFS

STORAGE ROUTING

DRAINAGE AREA = 251 SQ.MI = 160,640 ACRES

STORAGE AREA AT DAM = 27 ACRES (ESTIMATED)

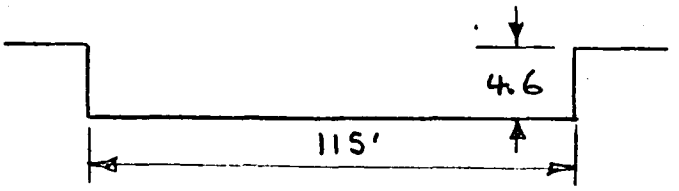
STORAGE RATIO = $27/160,640 = .0168\%$

ACCORDING U.S.D.A SOIL CONSERVATION SERVICE PRACTICES, STORAGE RATIOS BELOW .20% HAVE INSIGNIFICANT EFFECTS ON FLOW REDUCTION.

STORAGE CAPACITIES

SINCE THE DAM IS A RUN OF THE RIVER DAM, STORAGE CAPACITIES WERE NOT CALCULATED.

SPILLWAY CAPACITY



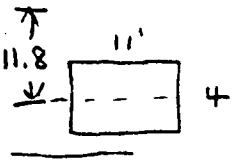
$C_w = 3.02$

$Q = C_w L h^{3/2}$

$Q = (3.02)(115)(9.866) = 3426$ CFS

GATES

LEFT SIDE ASSUME 11x4 OPG, $h = 11.8$



$Q = CA\sqrt{2gh}$ $C = .80$, $A = 44$, $h = 11.8$

$Q = (.80)(44)(27.57) = 970 \times 2 =$ 1940 CFS

RIGHT SIDE 12x6 $h = 10'$

$Q = (.80)(72)(25.38) =$ 1462 1462 CFS

TOTAL DISCHARGE CAPACITY = 6828 C

FLOOD FLOW FREQUENCY COMPUTATION

SHT 3 OF 6

0113000C UPPER AMMONOOSUC RIVER NEAR GROVETON, NEW HAMPSHIRE

N	NUM	NOUTL	IYRA	IPLOT	IEXPP	SKEW	A	B	PRELM
37	0	0	1941	1	1	0.500	0.0	0.0	0.0

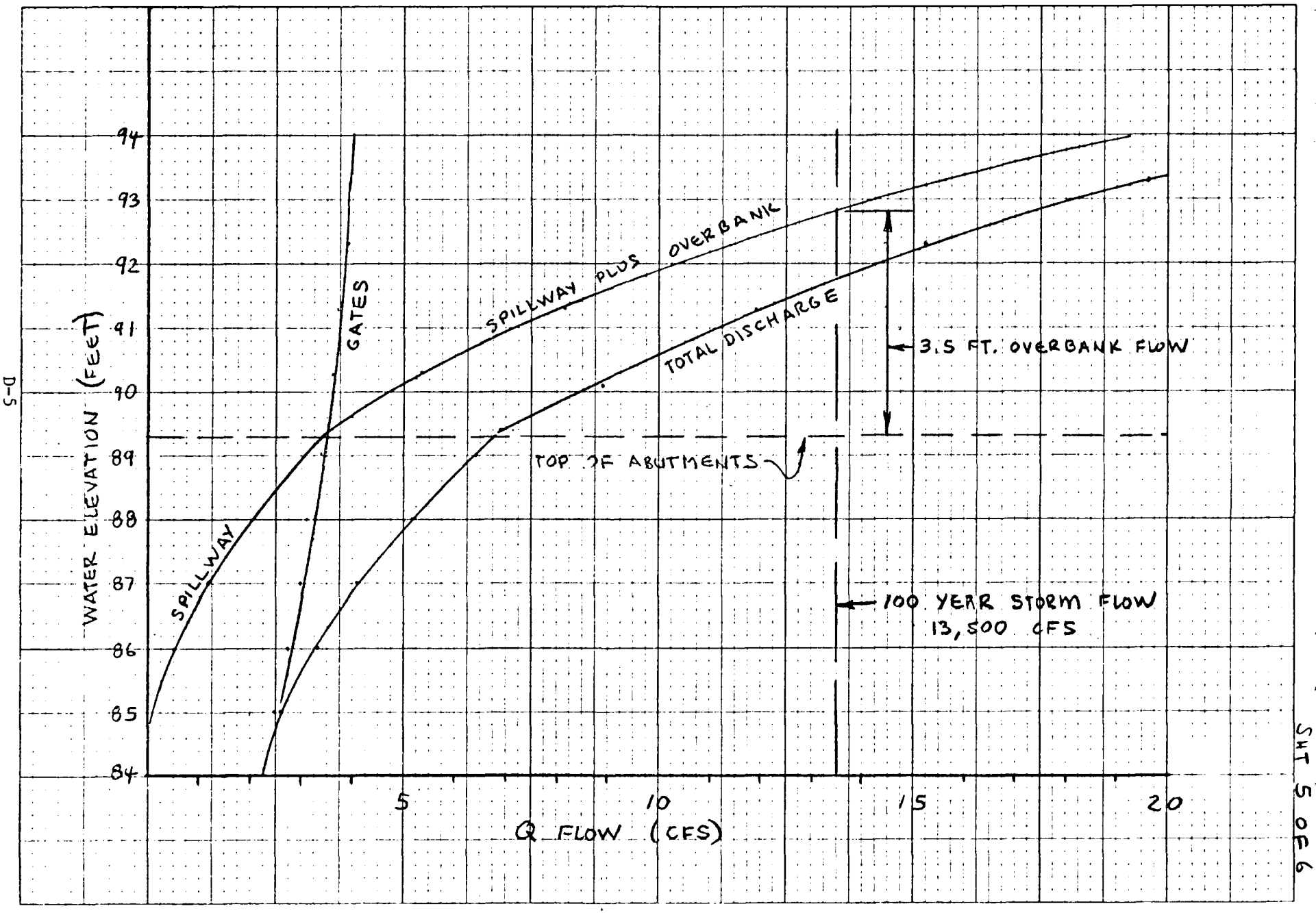
DAY	MONTH	YEAR	FLOW	ORDERED	RANK	PLOT POS
0	0	1941	5040.	9950.	1	0.0263
0	0	1942	5220.	8880.	2	0.0526
0	0	1943	4740.	7580.	3	0.0789
0	0	1944	6350.	7400.	4	0.1053
0	0	1945	6830.	6830.	5	0.1316
0	0	1946	2740.	6580.	6	0.1579
0	0	1947	7580.	6540.	7	0.1842
0	0	1948	3690.	6400.	8	0.2105
0	0	1949	3550.	6350.	9	0.2368
0	0	1950	4750.	6240.	10	0.2632
0	0	1951	5460.	5500.	11	0.2895
0	0	1952	4910.	5460.	12	0.3158
0	0	1953	9950.	5460.	13	0.3421
0	0	1954	8880.	5220.	14	0.3684
0	0	1955	6240.	5040.	15	0.3947
0	0	1956	3800.	4930.	16	0.4211
0	0	1957	3070.	4910.	17	0.4474
0	0	1958	6540.	4860.	18	0.4737
0	0	1959	2560.	4760.	19	0.5000
0	0	1960	6400.	4750.	20	0.5263
0	0	1961	3500.	4740.	21	0.5526
0	0	1962	4760.	4540.	22	0.5789
0	0	1963	4540.	4430.	23	0.6053
0	0	1964	4930.	4360.	24	0.6316
0	0	1965	1970.	4320.	25	0.6579
0	0	1966	2870.	3800.	26	0.6842
0	0	1967	3500.	3690.	27	0.7105
0	0	1968	3200.	3550.	28	0.7368
0	0	1969	5500.	3500.	29	0.7632
0	0	1970	6580.	3500.	30	0.7895
0	0	1971	4320.	3320.	31	0.8158
0	0	1972	7400.	3200.	32	0.8421
0	0	1973	4860.	3070.	33	0.8684
0	0	1974	5460.	2870.	34	0.8947
0	0	1975	3320.	2740.	35	0.9211
0	0	1976	4360.	2560.	36	0.9474
0	0	1977	4430.	1970.	37	0.9737

MEAN	3.6697
STD DEV	0.1553
COMPUTED SKEW	-0.1644
REGIONAL SKEW	0.5000
ADOPTED SKEW	0.3937

COMPUTED FLOW	EXPECTED-PROBABILITY FLOW	PROBABILITY	.05 LIMIT	.95 LIMIT
15530.	17519.	0.002	21129.	12536.
13389.	14626.	0.005	17622.	11044.
11889.	12714.	0.010	15245.	9973.
10480.	11006.	0.020	13080.	8943.
9150.	9461.	0.040	11103.	7945.
7483.	7617.	0.100	8738.	6648.
6259.	6314.	0.200	7101.	5645.
4565.	4566.	0.500	5034.	4133.
3443.	3420.	0.800	3821.	3029.
3008.	2973.	0.900	3376.	2590.
2709.	2659.	0.950	3073.	2288.
2258.	2181.	0.990	2619.	1840.

FLOOD STAGE CALCULATIONS

ELEVATION	MAIN SPILLWAY h	MAIN SPILLWAY Q (CFS)	RIGHT GATE h	RIGHT GATE Q (CFS)	LEFT GATES h	LEFT GATES Q (CFS)	TOTAL Q (CFS)
84	0	0	-	0	-	0	0
85	.3	57	5	1033	7.5	1547	2637
86	1.3	515	6	1132	8.5	1647	3294
87	2.3	1211	7	1223	9.5	1741	4175
88	3.3	2082	8	1307	10.5	1830	5219
89	4.3	3096	9	1387	11.5	1916	6399
89.3	4.6	3426	10	1462	11.8	1940	6828
	SPILLWAY PLUS OVERBANK						
90.3	5348		11	1533	12.8	2021	8902
91.3	8217		12	1601	13.8	2099	11,917
92.3	11,413		13	1667	14.8	2173	15,253
93.3	15,665		14	1730	15.8	2245	19,640


WATER ELEVATION (FEET)
94
93
92
91
90
89
88
87
86
85
84
5
10
15
20
Q FLOW (CFS)
SPILLWAY
GATES
SPILLWAY PLUS OVERBANK
TOTAL DISCHARGE
TOP OF ABUTMENTS
3.5 FT. OVERBANK FLOW
100 YEAR STORM FLOW
13,500 CFS

D-5

SHT 5 OF 6

DAM FAILURE ANALYSIS

DAM HEIGHT = 10 FEET
SPILLWAY LENGTH = 115 FEET

HIGH FLOW CONDITIONS

BECAUSE OF THE PROXIMITY OF THE CONNECTICUT RIVER (.25 MILES DOWNSTREAM) AND FLAT DOWNSTREAM GRADIENT, DAM WOULD BE PARTIALLY OR TOTALLY BACKWATERED DURING HIGH FLOW CONDITIONS. ANY FAILURE UNDER THESE CONDITIONS WOULD NOT RESULT IN ANY SIGNIFICANT FLOW INCREASE.

LOW FLOW CONDITIONS

BECAUSE OF THE HEIGHT TO LENGTH RATIO AND TYPE OF CONSTRUCTION, IT IS HIGHLY UNLIKELY THAT AN INSTANTANEOUS FAILURE WOULD OCCURR ACCROSS THE ENTIRE LENGTH OF THE DAM. A CONSERVATIVE ESTIMATE OF THE MAXIMUM PROBABLE FLOOD WAVE HEIGHT WOULD BE IN THE RANGE OF FIVE FEET.

THE RIVER BANKS IN THIS AREA VARY BETWEEN 10 AND 15 FEET ABOVE NORMAL WATER LEVEL. ANY FAILURE UNDER LOW FLOW CONDITIONS WOULD BE CONTAINED WITHIN THE RIVER BANKS.

END

FILMED

8-85

DTIC