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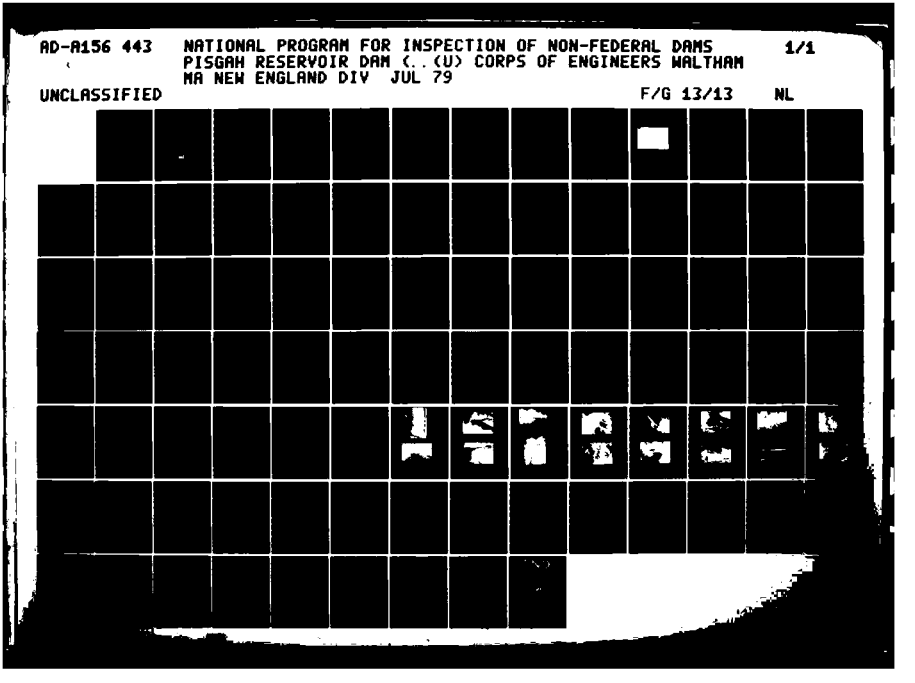

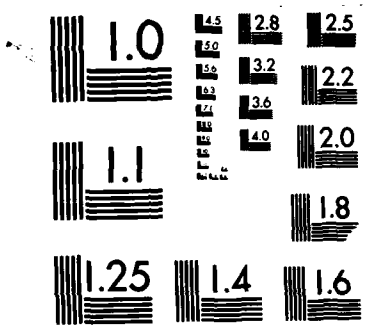

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

CONNECTICUT RIVER BASIN

WINCHESTER, NEW HAMPSHIRE

PISGAH RESERVOIR DAM
N H 00301

STATE NO 255.11

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

JULY 1979

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

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Winchester, New Hampshire
Pisgah Brook

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

The dam has a hydraulic height of 30 ft. and is 90 ft. long, The dam is in poor condition. There are some major concerns which should be implemented. The dam is small in size with a significant hazard potential. THe test flood is ½ the PMF. A major breach at top of dam probably would not result in the los of lives, but could cause appreciable property damage. s

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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

DEC 0 6 1979

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 Pisgah Reservoir 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, the New Hampshire Division of Parks and Recreation.

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.:	NH00301
Name of Dam:	Pisgah Reservoir Dam
Town:	Winchester
County and State:	Cheshire County, New Hampshire
Stream:	Pisgah Brook
Date of Inspection:	May 2, 1979

BRIEF ASSESSMENT

Pisgah Reservoir Dam has a hydraulic height f 30 feet, is of varied topwidth and is 90 feet long. It is a vertical stone masonry dam with earthfill on the upstream side which is used as a service road. There is a 60-foot long overflow spillway dike approximately 100 feet east of the dam. The dam has a drain gate located near the base of the structure which is inoperable. The dam spans a reach of Pisgah Brook, and is located in southwest New Hampshire. The pond is 1½ miles long and has a surface area of about 110 acres. The dam contains runoff from a 2.4 square mile drainage area and has a maximum storage of 950 acre-feet. Pisgah Reservoir Dam is now used for recreational purposes.

The dam is in poor condition. Major concerns are: a substantial leak or seep near the downstream toe and bulging of the dam face, irregular crest alignment of both the spillway and the dam, fallout of a large boulder from the downstream face of the dam, and debris clogged channels downstream of both the spillway and the dam.

Based on small size and significant hazard classification in accordance with Corps guidelines, the test flood is ½ the Probable Maximum Flood (PMF). The routed test flood outflow of 2100 cfs (875 csm) would overtop the dam by 1.8 feet (4.3 feet over spillway crest). The spillway capacity at the top of dam is 438 cfs, which is 21 percent of the test flood discharge. A major breach at top of dam probably would not result in the loss of lives, but could cause appreciable property damage.

The owner, New Hampshire Division of Parks and Recreation, 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 Report.

Warren A. Guinan
Project Manager
N.H. P.E. No. 2339

This Phase I Inspection Report on Pisgah Reservoir 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 A. McElroy

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

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

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

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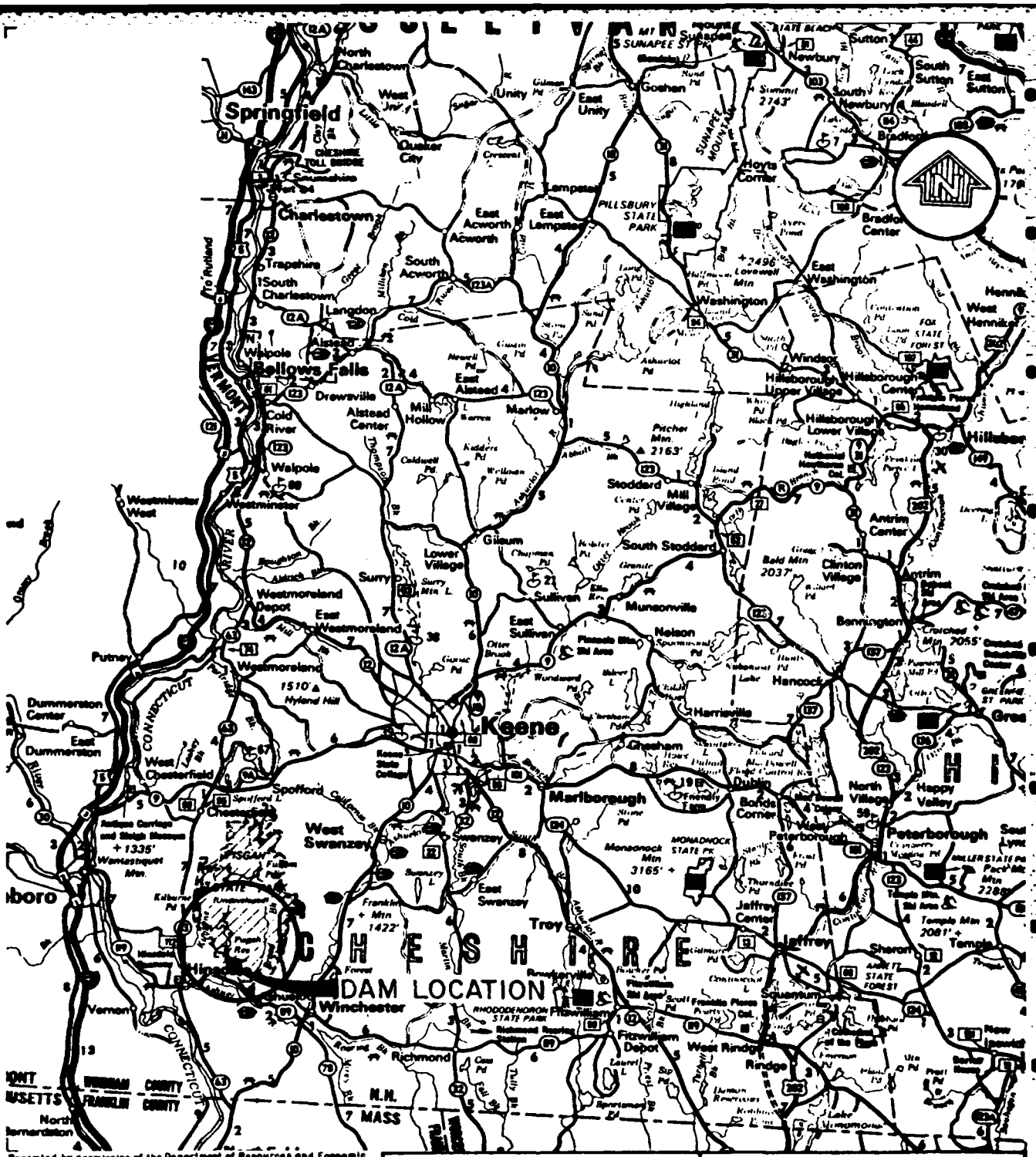
May 1979
Figure 1 - Overview of Pisgah Reservoir Dam.



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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

PISGAH RESERVOIR DAM

LOCATION MAP

PISGAH BROOK NEW HAMPSHIRE

			SCALE: SEE BAR SCALE
			DATE: JULY, 1979

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
PISGAH RESERVOIR 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 November 20, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW33-79-C0009 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. Pisgah Reservoir Dam is located in Winchester, New Hampshire and spans Pisgah Brook. After discharging over the dam, Pisgah Brook flows south to Tufts Pond ¼ mile downstream. The stream discharging from Tufts Pond is Tufts Brook, which flows southerly approximately 1.2 miles before becoming confluent with the Ashuelot River at a point approximately 3.5 miles upstream of the Ashuelot River's confluence with the Connecticut River. Pisgah Reservoir Dam is shown on U.S.G.S. Quadrangle, Keene, N.H. - Vt., with coordinates approximately at N 42° 48' 36", W 72° 26' 54", Cheshire County, New Hampshire. (See Location Map page vii.)

b. Description of Dam and Appurtenances. Pisgah Reservoir Dam is a gravity stone-masonry dam with earth (and probably some rock) fill behind it that carries a service road. The dam has a hydraulic height of 30 feet, is 90 feet long with about a 20-foot topwidth. A 60-foot side-channel overflow spillway dike is located

approximately 100 feet east of the dam. A dike, 130 feet long, blocks a saddle just west of the dam about 100 feet. The faces are masonry block; the dike is perpendicular to the dam. The low-level drain gate is reported to be blocked with earthfill.

c. Size Classification. Small (hydraulic height - 30 feet; storage - 950 acre-feet) based on height and storage ($\geq$ 25 feet to $<$ 40 feet and $\geq$ 50 to $<$1000 acre-feet as given in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant Hazard. A major breach probably would not result in the loss of lives but could cause appreciable property damage. (See Section 5.1 f.)

e. Ownership. Pisgah Reservoir Dam was constructed at some unknown date around 1870. The earliest recorded ownership found was the Dickinson Real Estate and Lumber Company prior to 1923. Ownership was passed to the New Hampshire Division of Parks and Recreation in 1969.

f. Operator. The current owner and operator of Pisgah Reservoir Dam is the New Hampshire Division of Parks and Recreation, Bos 856, Concord, New Hampshire, 03301; (603) 271-3556.

g. Purpose of Dam. The original purpose for the construction of the dam was not revealed. Under ownership by the Dickinson Real Estate and Lumber Company, the dam was utilized to provide upstream water storage for their saw mill operations. Presently, the reservoir is used for recreational purposes.

h. Design and Construction History. Little information was obtained regarding the original design and construction of the stone masonry dam. Two design plans were obtained, drawn by I.W. Jones & Co., Engineers, Milton, New Hampshire and dated September 18, 1923. One plan is entitled "Plan, Elevation & Section of Storage Dam at Pisgah Reservoir"; the other is entitled "Details of Gate and Gate Frame and Rack and Rack Frame at Pisgah Reservoir". These plans were for repairs to the dam. No construction records were found regarding these repairs.

i. Normal Operating Procedures. No written operational procedures were revealed for Pisgah Reservoir Dam. The drain gate is inoperable because of backfilling on the upstream side of the dam.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 2.4 square miles (1536 acres) of mountainous terrain. The normal surface area of Pisgah Reservoir is 110 acres, which constitutes 7 percent of the watershed.

b. Discharge at Dam Site

(1) Outlet Works (conduit) - Drain gate 2.5'H x 4'W at

invert elevation 860.4' MSL is inoperable because of fill on upstream side of the dam.

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

(3) Ungated spillway capacity at top of dam elevation - 438 cfs @ 880.5' MSL

(4) Ungated spillway capacity at test flood elevation - 1120 cfs @ 882.3' MSL

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

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

(7) Total spillway capacity at test flood elevation - 1120 cfs @ 882.3' MSL

(8) Total project discharge at test flood elevation - 2100 cfs @ 882.3' MSL

c. Elevation (feet above MSL; see (6) below)

(1) Streambed at centerline of dam - 850.3 (at downstream toe)

(2) Maximum tailwater - unknown

(3) Upstream invert drain gate - 360.4

(4) Recreational pool - 878

(5) Full flood control pool - not applicable

(6) Spillway crest - 878 (shown on U.S.G.S. Quadrangle Sheet and assumed to be spillway crest)

(7) Design Surcharge (Original Design) - unknown

(8) Top of dam - 880.5

(9) Test flood - 882.3

d. Reservoir (miles)

(1) Length of maximum pool - 1.7

(2) Length of recreational pool - 1.5

(3) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - 660

(2) Flood control pool - not applicable

(3) Spillway crest pool - 660

(4) Top of dam - 950

(5) Test flood pool - 1220

f. Reservoir Surface (acres)

(1) Recreation pool - 110

(2) Flood control pool - not applicable

(3) Spillway crest - 110

(4) Test flood pool - 210

(5) Top of dam - 190

g. Dam

(1) Type - stone masonry gravity dam on ledge with earth fill at upstream side of dam which carries a service road.

(2) Length - 90'

(3) Height - 33' (structural height)

(4) Topwidth - about 20'

(5) Side slopes - Upstream face is vertical and downstream face slope is 2.5H:8V for the dam. The spillway downstream face is vertical and the upstream face slope is 2H:1V.

(6) Zoning - not applicable

(7) Impervious core - not applicable

(8) Cutoff - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel - not applicable (See j. below.)

i. Spillway

(1) Type - stone masonry downstream and earth fill upstream

(2) Length of weir - 60'

(3) Crest elevation - 878' MSL

(4) Gates - none

(5) U/S Channel - Pisgah Brook flows downstream from the mountains into Pisgah Reservoir. No structures are upstream of the reservoir. The reservoir is of varying width.

(6) D/S Channel - Discharge over the spillway flows in a 20-foot wide steep channel with heavily wooded banks. The top of banks are approximately 75' wide. Pisgah Brook flows downstream ¼ mile to Tufts Pond. Downstream of Tufts Pond the brook is called Tufts Brook and flows south approximately 1 mile where it passes through a culvert under Rte. 119. It then flows approximately 0.2 mile to its confluence with the Ashuelot River. Two houses are located, one on either bank upstream of the Route 119 culvert. Each house has its lowest floor about 12 feet above the road at the center of the culvert. These houses are about 130 to 150 feet from the center line of the stream. The banks of Tufts Brook are quite steep and the banks supporting these houses could be undercut by a major flood in the brook.

j. Regulating Outlets. A 2.5'H x 4'W drain gate is located near the center of the dam at invert elevation 860.4' MSL. This gate is inoperable which is due to earth fill placed on the upstream side of the dam.

SECTION 2
ENGINEERING DATA

2.1 Design

No original design data were disclosed for Pisgah Reservoir Dam. Two plans, dated September 18, 1923, were disclosed for repairs. These plans were designed by I.W. Jones & Co., Engineers, Milton, New Hampshire. One plan was entitled "Plan, Elevation & Section of Storage Dam at Pisgah Reservoir"; the other was entitled "Details of Gate and Gate Frame and Rack and Rack Frame at Pisgah Reservoir".

2.2 Construction Records

No written construction records were disclosed for either the original dam or for the repairs designed in 1923.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Limited engineering data were available for Pisgah Reservoir Dam. A search of the files of the NHWRB and direct contact with the owner revealed only a limited amount of recorded information.

b. Adequacy. Because of the limited amount of detailed data available, the final assessments and recommendations of this investigation are based on the hydrologic and hydraulic calculations and the visual inspection.

c. Validity. No engineering data were disclosed to validate. A few elements of the two plans disclosed are in general conformity with the dam as noted in the visual inspection. The addition of upstream fill behind the stone masonry obscures many of the details.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Pisgah Dam is a low dam which impounds a reservoir of small size. The watershed above the reservoir is rolling and heavily wooded. The outflow from the reservoir flows about one-quarter mile downstream to Tufts Pond and then about one mile farther via Tufts Brook to the Ashuelot River.

b. Dam. Pisgah Dam has a hydraulic height of 30 feet, is 90 feet long, and 20 feet wide at the crest. The downstream face consists of dry stone masonry and has a slope of 2.5H:8V. The downstream face of the dam bulges locally and the top of the stone masonry at the crest of the dam is convex downstream. (See Appendix C - Figure 2.) One large boulder has fallen out of the downstream facing near the toe of the dam.

The dry stone masonry forms the downstream edge of the crest and the rest of the crest is earth fill which carries an access road. (See Appendix C - Figures 3 and 4.) Part of the crest is covered with grass and part consists of bare soil. It appears that vehicles have been driven along the crest.

Most of the upstream face was not visible as it was beneath the water surface. (See Appendix C - Figures 5 and 6.) In the zone between the water and the crest, brush, having a maximum diameter of about 1½ inches, appears to have been cut recently.

At the contact between the downstream face and the abutments several large trees have been cut recently and are lying against the downstream face of the dam. (See Appendix C - Figure 7.) Cut brush has been dumped on the contact between the downstream face and the abutments.

A large quantity of water is discharging from the toe of the dam at the deepest part of the valley. (Estimated discharge was 3 cfs.) (See Appendix C - Figure 8.) The discharge water was clear. The water may be from seepage or it may be leakage from the gate. Seepage was noted along the west side of the stone masonry. (See Appendix C - Figure 9.)

c. Appurtenant Structures. The available plans dated September 12, 1923 by I.W. Jones & Co. for Pisgah Dam indicate a wooden gate structure on the upstream face. The gate size is shown to be approximately 2.5 feet high by 4 feet wide which was generally confirmed by inspection of the gate outlet on the downstream face of the dam. (See Appendix C - Figure 10.) No gate structure was visible on the upstream face.

The spillway for Pisgah Dam consists of an earth dike east of the main dam. Approximately two inches of water was flowing over the spillway at the time of the inspection. (See Appendix C - Figures 11 and 12.) The downstream face of the spillway consists of a

dry stone masonry wall, the top of which has been mortared. Some cracking and deterioration of the mortared top was noted. The alignment of the crest is irregular, but it is not possible to determine from the visual inspection whether it was constructed this way or whether movements took place after the original construction. The channel upstream of the spillway is wide and unobstructed, and is filled with sand and gravel to the elevation of the upstream edge of the crest. A large pile of logs was observed at the downstream toe of the spillway; most of these logs appear to have come over the spillway. (See Appendix C - Figure 13.) There are also numerous stumps of trees and brush that have been recently cut on the downstream side of the abutments. Trees and brush have been dumped at the contact between the downstream face and the abutments.

In a saddle west of the dam is an earth dike about 3 feet high, 130 feet long, and 13 feet wide at the crest. The upstream and downstream slopes of the dike are vertical dry masonry stone walls. (See Appendix C - Figure 14.) Some bulging was noted locally of the dry masonry wall on the downstream side. The entire dike and the area immediately downstream of the dike have a dense growth of trees, up to about 14 inches in diameter. Minor seepage is occurring at one location near the downstream toe of the dike.

d. Reservoir Area. The watershed above the reservoir is rolling and heavily wooded. (See Appendix C - Figure 15.) No camps or other structures were noted on the shores of the reservoir. No evidence was detected of significant sedimentation in the reservoir.

e. Downstream Channel. The area downstream of the dam is rolling and heavily wooded. The channel downstream of the main dam is narrow. The channel bottom is covered with boulders. Trees and brush overhang the channel. (See Appendix C - Figure 16.) The channel downstream of the spillway is relatively wide and has gentle side slopes. The channel bottom is covered with sand and gravel. Trees and brush overhang the channel. There are many logs in the channel at the downstream toe of the spillway dike. (See Appendix C - Figure 17.) The two downstream channels converge approximately 300 feet downstream of the dam.

3.2 Evaluation

Based on the visual inspection Pisgah Dam appears to be in poor condition.

A major leak or seepage at the base of the main dam could result in a stability problem if not remedied. Irregular alignment of the crest, bulging of the downstream dry stone masonry face, and the fallout of a large boulder from the downstream dry stone masonry face of the main dam appear to indicate a slope stability problem. Large trees have been cut recently at the contact between the downstream face of the dam and the abutments, and the rotting roots of these trees could lead to long-term seepage

problems. Growing brush and piles of cut brush along the downstream toe of the dam make it impossible to adequately inspect the area immediately downstream of the dam.

The presence of large trees growing on the dike west of the main dam and in the area immediately downstream of the dike could lead to long-term stability problems if any of the trees blow over and pull their root masses out or if any of the trees die and their roots rot. The minor seepage downstream of the dike could lead to long-term stability problems if it is not remedied.

The poor alignment of the spillway dike may be evidence of a slope stability problem. Trees and brush have been cut recently at the contact between the downstream slope of the spillway dike and the abutments, and the rotting roots of these trees and the brush could lead to long-term seepage problems. The presence of growing brush and piles of cut brush along these contacts makes it impossible to adequately inspect the area immediately downstream of the dike. The presence of many logs against the downstream face of the dike could result in clogging and damming of the channel during peak spillway discharge, which, in turn, could result in overtopping of the main dam.

The channels downstream of both the main dam and the spillway are overhung by trees. Their presence is undesirable from the standpoint of the possibility that they could clog the channel or downstream culverts during flood discharges.

The gate has no mechanism and is inoperable providing no means of dewatering the reservoir.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures were disclosed for Pisgah Reservoir Dam. The drain gate is inoperable.

4.2 Maintenance of Dam

New Hampshire Department of Parks and Recreation is responsible for the maintenance of *Pisgah Reservoir Dam*.

4.3 Maintenance of Operating Facilities

No formal maintenance program was disclosed.

4.4 Description of Any Warning System in Effect

No written warning system was disclosed for Pisgah Reservoir Dam.

4.5 Evaluation

The owner should establish a written operation and maintenance procedure as well as establishing a warning system to follow in the event of emergency conditions. The present maintenance procedures are not adequate to ensure that all problems can be remedied within a reasonable period of time.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. General. Pisgah Reservoir Dam is a stone masonry gravity dam which impounds a reservoir of small size. Earth fill placed on the upstream side of the dam forms a roadway along the crest. This roadway has only partial vegetative cover and would be susceptible to erosion if overtopped. The spillway consists of an earth dike 100 feet east of the main dam. The downstream face of the spillway consists of a dry stone masonry wall, the top of which has been mortared. This top has undergone some cracking and deterioration. The abutments of the spillway are in natural ground.

b. Design Data. No hydrologic and hydraulic design data were disclosed.

c. Experience Data. According to a letter dated October 13, 1938, the flood of September 21-24 overtopped the main dam by about 1 foot and the wing dam (probably the spillway) by 4 feet.

d. Visual Observations. At the time of inspection, visual evidence of major leakage or seepage near the downstream toe was noted (discharge of 3 cfs estimated). This was noted previously in a memo found in files of the New Hampshire Water Resources Board (NHWRB). (See Appendix B.)

d. Test Flood Analysis. Pisgah Reservoir Dam is classified as being small in size having a hydraulic height of 30 feet and a maximum storage capacity of 950 acre-feet; the dam was determined to have a Significant Hazard Classification. Using Recommended Guidelines for Safety Inspection of Dams, the test flood was determined to be ½ the Probable Maximum Flood (PMF).

To determine the test flood inflow, a CSM value of 2510 was applied to the drainage area of 2.4 square miles. This CSM value was taken off the mountainous curve because the slope of the watershed is in excess of 200 ft/mi. Using ½ the PMF, the test flood inflow was determined to be 3010 cfs (1254 CSM). The test flood discharge after routing was determined to be 2100 cfs (875 CSM). The overtopping analysis indicates that the dam would be overtopped by 1.8 feet during test flood conditions. The maximum spillway capacity at top of dam is 438 cfs which is only 21 percent of the test flood discharge.

f. Dam Failure Analysis. The impact of failure of the dam with the reservoir at top of dam was assessed using the Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The anlaysis covered the reach extending from the dam to the confluence with the Ashuelot River, a distance of

1.5 miles. A breach at top of dam would increase the stage about 10.2 feet above the antecedent stage of 5.7 feet. The Route 119 crossing is located in this reach, about 1.5 miles downstream of the dam. An analysis of this bridge reflected that during a breach of this magnitude, the road would be overtopped by 4.8 feet. This could result in severe damage to the roadway and erosion and undermining of the land adjacent to the house on the east bank.

A major breach of Pisgah Reservoir Dam probably would not result in the loss of any lives, but could cause appreciable property damage and was therefore classified Significant Hazard.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The visual examination indicates the following evidence of potential long-term stability problems.

(1) Major seepage or leakage at downstream toe of main dam.

(2) Irregular alignment of the crest of the main dam, bulging of the dry stone masonry downstream face of the main dam, and the fallout of a large boulder from the dry stone masonry downstream face.

(3) Stumps of large trees that have recently been cut near the downstream toe of the main dam.

(4) Minor seepage at the downstream toe of the dike west of the main dam.

(5) Large trees on the dike west of the main dam and in the area immediately downstream of the dike.

(6) Poor alignment of the crest of the spillway dike.

(7) Stumps of trees and brush that have recently been cut at the contacts between the downstream slope of the spillway dike and the abutments.

(8) The absence of the gate operating mechanism and a gate buried under earth and rock fill on the upstream face.

In addition, there are logs in the discharge channel next to the spillway dike and trees overhanging the channels downstream of the main dam and the spillway dike.

Logs and piles of brush at the contact between the downstream face and abutments of both the main dam and the spillway dikes make it impossible to adequately inspect the areas immediately downstream.

b. Design and Construction Data. According to design drawings dated September 21, 1923 the dam consists entirely of stone masonry and is approximately 22 feet wide at the base and 5 feet wide at the top and has an opening 4 feet wide by 2½ feet high located about 10 feet up from the bottom for a discharge opening. According to a letter dated September 21, 1923, the "stone spillway is founded on solid ledge" and "the dam is...founded on solid ledge." The visual inspection alone does not provide information to verify the above statements.

c. Operating Records. According to a letter dated September 21, 1923, "the face of the dam was originally pointed with cement, but after many years a large portion of the pointing has worked out." According to a letter dated October 13, 1938, the flood of September 21-24 overtopped the main dam by about 1 foot and the wing dam (probably the spillway) by 4 feet.

d. Post-Construction Changes. According to a Water Resources Board memorandum dated December 10, 1975, "it would appear that... an earthfill has been placed upstream of the stone structure" (referring to the main dam); "the previous stone spillway appears to have been enlarged in the past from 20-odd feet to its present 80-90 feet;" and "the spillway area has also been backfilled with earth and these fills presently provide road access across the dam." The last statement probably refers to the main dam rather than the spillway dike.

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

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual inspection indicates that the Pisgah Reservoir Dam is in poor condition.

Major concerns with respect to the condition of the dam are:

(1) Major leakage or seepage at downstream toe of main dam.

(2) Irregular alignment of the crest of the main dam, bulging of the dry stone masonry downstream face of the main dam, and the fallout of a large boulder from the dry stone masonry downstream face.

(3) Stumps of large trees that have recently been cut near the downstream toe of the main dam.

(4) Minor seepage at the downstream toe of the dike west of the main dam.

(5) Large trees on the dike west of the main dam and in the area immediately downstream of the dike.

(6) Poor alignment of the crest of the spillway dike.

(7) Stumps of trees and brush that have recently been cut at the contacts between the downstream slope of the spillway dike and the abutments.

(8) The absence of a gate operating mechanism and the inoperable gate.

In addition, there are logs in the discharge channel next to the spillway dike and trees overhanging the channels downstream of the main dam and the spillway dike.

b. Adequacy of Information. The information available is such that the assessment of this dam must be based primarily on the visual inspection. The presence of trees, brush, logs, and cut brush at the downstream contact between the main dam and its abutments and at the downstream contact between the spillway dike and its abutments makes it impossible to inspect those areas adequately.

c. Urgency. The recommendations and remedial measures given in Sections 7.2 and 7.3 below should be implemented within one year after receipt of this Phase I inspection report.

d. Need for Additional Investigation. The information available from the visual inspection is adequate to identify the potential problems that are listed in 7.1 a. above. An inspection of the contacts between the downstream face and the abutments of the main dam and the spillway dike should be made after the trees, brush, logs, and cut brush have been removed.

7.2 Recommendations

The owner should engage a Registered Professional Engineer to:

(1) Inspect the contacts between the downstream face and the abutments of the main dam and the spillway dike.

(2) Investigate the seepage or leakage downstream of the main dam and the seepage at the westerly dike.

(3) Evaluate the slope stability of the main dam and the spillway dike.

(4) Design and install an operable drain gate.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Clear and keep the dam and dike clear of trees, brush, and remove stumps and roots of trees that have been previously cut and backfill properly.

(2) Keep the area for a distance of 25 feet downstream of the dam, westerly dike, and spillway dike free of trees, brush, and root systems and backfill properly.

(3) Keep the banks of the discharge channels downstream of the main dam and spillway dike free of trees, brush, and root systems for a distance of about 25 feet on either side of the channel for about 100 feet of channel immediately downstream of the dam and spillway dike.

(4) Visually inspect the dam and appurtenant structures once each month.

(5) Engage a Registered Professional Engineer to make a comprehensive technical inspection of the dam once every year.

(6) 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.

7.4 Alternatives

None recommended.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Pisgah Reservoir Dam, NH DATE December 1, 1978; May 2, 1979

TIME 0900; 0900

WEATHER Clear, cold; Clear, cool

	W.S. ELEV.	U.S.	DN.S.
PARTY: December 1, 1978		875.9';	850.3';
	May 2, 1979	878'	850.3'

1. Warren Guinan	6. Warren Guinan
2. Stephen Gilman	7. Stephen Gilman
3. Robert Ojendyk	8. Robert Ojendyk
4. Katherine Somerville	9. Pattu Kasavan
5. Ronald Hirschfeld	10. Ronald Hirschfeld

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

PERIODIC INSPECTION CHECKLIST

PROJECT Pisgah Reservoir Dam, NH DATE December 1, 1978 May 2, 1979

PROJECT FEATURE Dam Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	880.5' MSL
Current Pool Elevation	878' MSL
Maximum Impoundment to Date	Unknown
Surface Cracks	None apparent
Pavement Condition	Not paved
Movement or Settlement of Crest	Boulders on downstream edge of crest not aligned straight
Lateral Movement	Downstream face bulges downstream
Vertical Alignment	Good
Horizontal Alignment	See "Movement or Settlement of Crest" above
Condition at Abutment and at Concrete Structures	Large trees growing at contact between downstream face and both abutments. Trees were cut recently.
Indications of Movement of Structural Items on Slopes	None apparent
Trespassing on Slopes	None apparent
Sloughing or Erosion of Slopes or Abutments	None apparent, except for cut trees
Rock Slope Protection - Riprap Failures	Downstream rock face bulges downstream
Unusual Movement or Cracking at or Near Toe	Large rock has fallen out of downstream face near toe
Unusual Embankment or Downstream Seepage	Large seepage discharging from downstream toe
Piping or Boils	None apparent
Foundation Drainage Features	None apparent
Toe Drains	None apparent
Instrumentation System	None apparent
Vegetation	Brush up to 1½"-dia. recently cut on upstream slope; large trees up to about 12"-dia. recently cut on abutment close to contact with downstream face.

PERIODIC INSPECTION CHECKLIST

PROJECT Pisgah Reservoir Dam, NH DATE December 1, 1978 May 2, 1979

PROJECT FEATURE West Dike NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	881' MSL
Current Pool Elevation	878' MSL
Maximum Impoundment to Date	Unknown
Surface Cracks	None apparent
Pavement Condition	Not paved
Movement or Settlement of Crest	None apparent
Lateral Movement	None apparent
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	Some bulging of dry masonry on downstream face
Trespassing on Slopes	None apparent
Sloughing or Erosion of Slopes or Abutments	None apparent
Rock Slope Protection - Riprap Failures	Some bulging of dry masonry on downstream face
Unusual Movement or Cracking at or Near Toes	None
Unusual Embankment or Downstream Seepage	Seepage near downstream toe
Piping or Boils	None apparent
Foundation Drainage Features	None apparent
Toe Drains	None apparent
Instrumentation System	None apparent
Vegetation	Many trees, up to 14"-dia., on crest of dike and near downstream toe

PERIODIC INSPECTION CHECKLIST

PROJECT Pisgah Reservoir Dam, NH DATE December 1, 1978 / May 2, 1979

PROJECT FEATURE Spillway Dike NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Pisgah Reservoir
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Sand and gravel accumulated to upstream edge of crest.
b. Weir and Training Walls	D/S face - stone masonry, crest - deteriorated mortar.
General Condition of Concrete	Not applicable
Rust or Staining	Not applicable
Spalling	Not applicable
Any Visible Reinforcing	Not applicable
Any Seepage or Efflorescence	Not applicable
Drain Holes	None
c. Discharge Channel	
General Condition	Poor
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Many
Floor of Channel	Sand and gravel
Other Obstructions	Many logs and debris are deposited against downstream face of spillway and in downstream channel.

PERIODIC INSPECTION CHECKLIST

PROJECT Pisgah Reservoir Dam, NH DATE December 1, 1978 May 2, 1979

PROJECT FEATURE Outlet Structure and Channel NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	None - Stone masonry discharge opening - no evidence of movement
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	None
Channel	
Loose Rock or Trees Overhanging Channel	Many trees overhanging channel
Condition of Discharge Channel	Bouldery, some logs

PROJECT Pisgah Reservoir Dam

DATE December 1, 1978
May 2, 1979

PROJECT FEATURE Reservoir

NAME K. Somerville

AREA EVALUATED	REMARKS
Stability of Shoreline	Good
Sedimentation	Not visible
Changes in Watershed Runoff Potential	None
Upstream Hazards	Many seasonal structures around perimeter of reservoir
Downstream Hazards	Several inhabited structures and Route 119
Alert Facilities	None posted
Hydrometeorological Gages	None
Operational & Maintenance Regulations	None posted

APPENDIX B

ENGINEERING DATA

Dam No. 255.11- Pisgah Reservoir, Winchester

Visual Discrepancies:

1-a Numerous large trees growing very near the dam and spillway.

b Small trees and bushes growing on top of the dam.

c Several seedling trees growing directly out of the stonework.

All tree growth within fifteen (15) feet of the dam should be removed and the stumps chemically treated to prevent regrowth. The root structures of these trees contribute to the continued deterioration of the dam. They displace stones and cause leakage. The small trees growing directly out of the dam will cause substantial damage if left to grow.

2- There is substantial leakage through the dam which exits at the very bottom on the downstream side. This leakage should be stopped to prevent ice damage to the stonework.

3- The gate is completely inoperational due to deterioration and earth backfill. This should be repaired so that the water level can be lowered for occasional maintenance of the upstream face.

KS:paf
12/17/78

NEW HAMPSHIRE WATER RESOURCES BOARD

INSPECTION REPORT

Town: WINCHESTER Dam Number: 255.11

Name of Dam, Stream and/or Water Body: PISGAH RESEVOIR

Owner: DIVISION OF PARKS Telephone Number:

Mailing Address:

Max. Height of Dam: 32' Pond Area: 64 ACRES Length of Dam: 90'

FOUNDATION: LEDGE

OUTLET WORKS: STONE SPILLWAY W/ MORTARED CREST ON D/S SIDE. LEDGE ABUTS. SEVERAL LARGE TREES GROWING JUST D/S ESPECIALLY 1 OAK & 1 MAPLE (SOME SMALL TREES ON TOP @ RIGHT END STANDING WATER AT TOE [redacted] BUT NO APPARENT SEEPAGE

~~ABUTMENTS~~: [redacted] STONE DAM W/ LEDGE ABUTS MANY SMALL TREES & BUSHES GROWING ON TOP OF DAM. SEVERAL LARGE TREES GROWING ON D/S LEDGE VERY NEAR DAM SOME SAPLINGS GROWING OUT OF STONEWORK

~~EMBANKMENT~~: GATE CLOSED OFF W/ EARTH FILL

Note: Give Sizing, Condition and detailed description for each item, if applicable.

Dam No. 255.11

SPILLWAY: Length: _____ Freeboard: _____

SEEPAGE: Location, estimated quantity, etc.

1 TO 2 CFS AT EXTREME TOE OF DAM

Changes Since Construction or Last Inspection:

TREES STILL GROWING

Tail Water Conditions:

FREE FLOWING

LOGS FROM LAKE JUST D/S OF SPILLWAY

Overall Condition of Dam: FAIR

Contact With Owner: NO

Date of Inspection: 10/2/78 Suggested Reinspection Date _____

Class of Dam: NON-MENACE

Signature Kenneth Stein

Date 10/2/78

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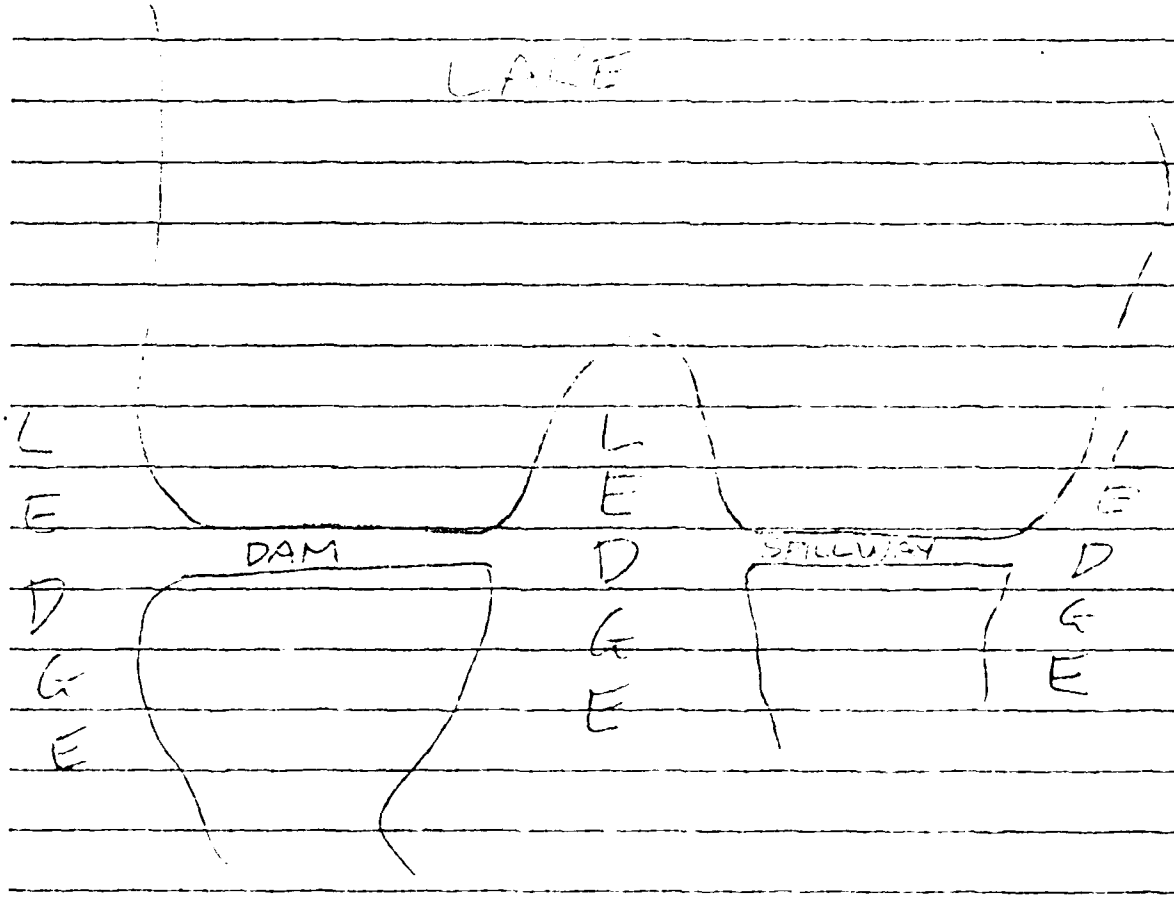
[illegible] detailed description for each item, if applicable.

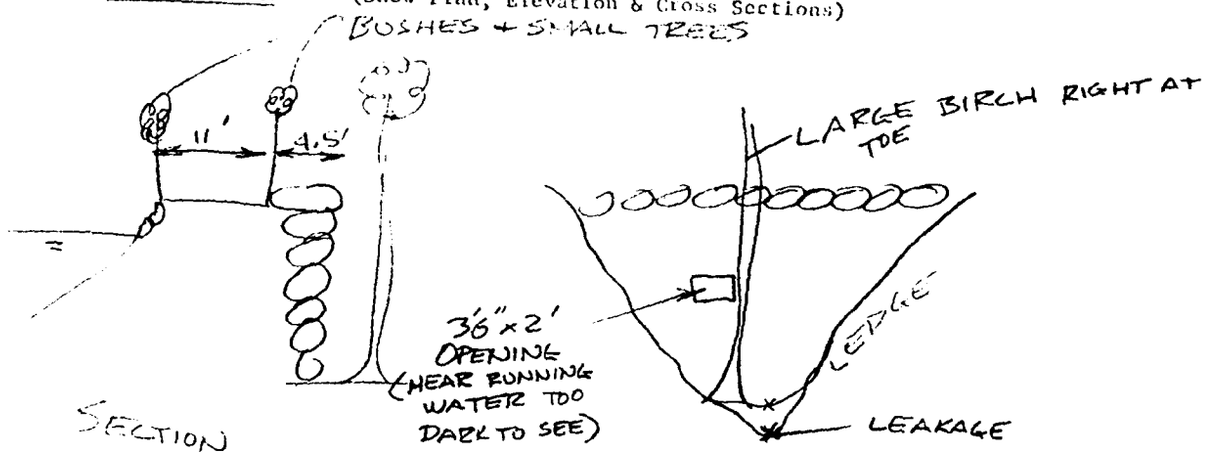
COMMENTS:

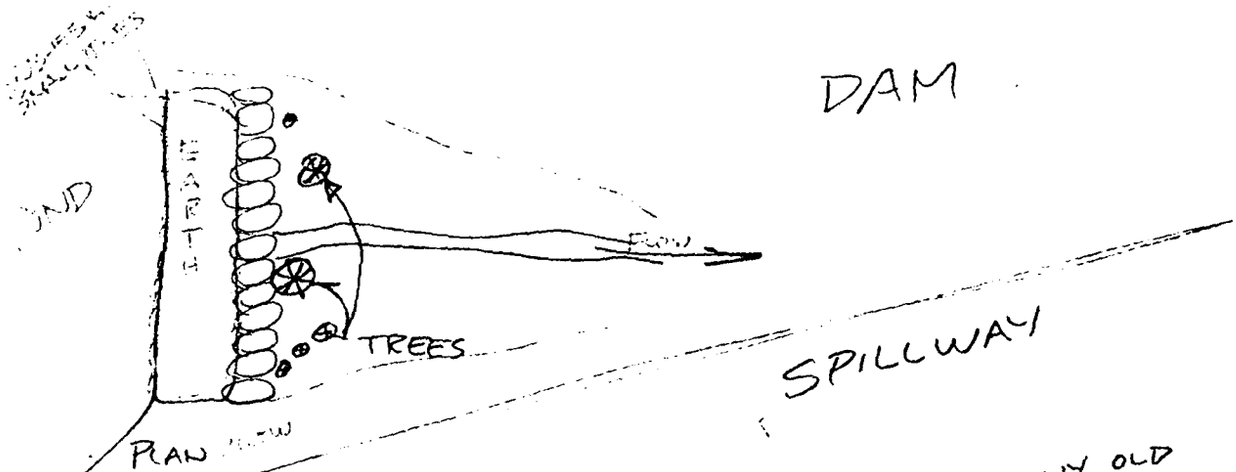
(1) CUT ALL TREES WITHIN 15' OF D/S FACE
APPROX 10 MAYBE MORE MAJOR TREES
MANY MINOR TREES

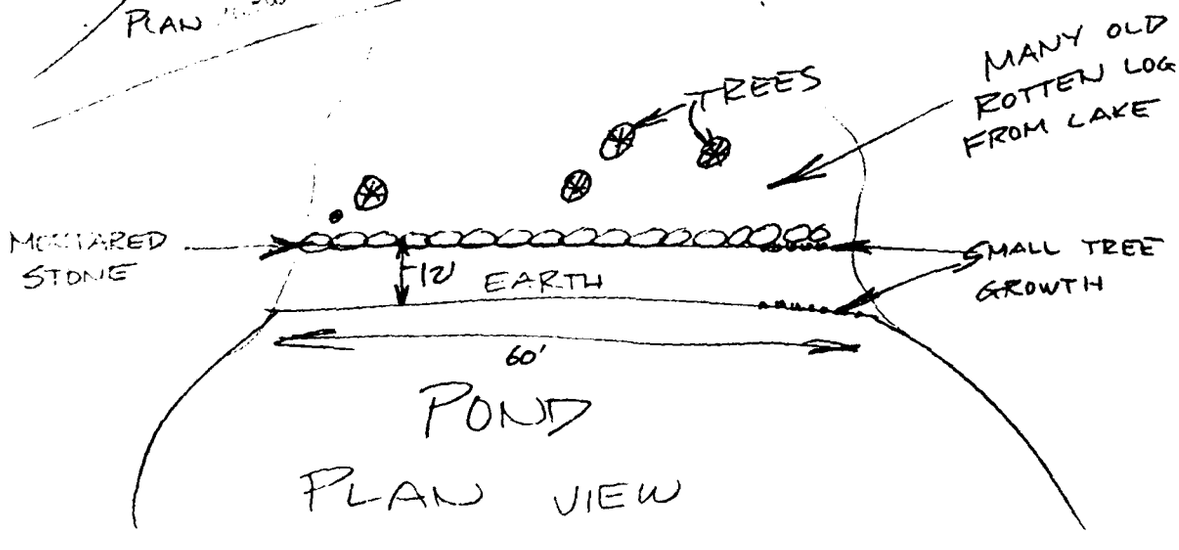
(2) ALL STREAM FLOW (1 TO 2 CFS) IS LEAKAGE AT VERY BOTTOM TOE OF DAM



SKETCH OF DAM (Show Plan, Elevation & Cross Sections)







WATER RESOURCES BOARD
37 Pleasant Street
Concord, N.H. 03301
TELEPHONE 271-3406

October 17, 1978

Mr. George T. Hamilton, Director
Division of Parks and Recreation
State House Annex
Concord, New Hampshire 03301

Dear Mr. Hamilton:

Under the provisions of RSA Chapter 482, Sections 8 through 15, the New Hampshire Water Resources Board is authorized to inspect all dams in the State which by reason of their physical condition, height and location may be a menace to the public safety.

The dam structure (No. 255.11) located in Winchester - Pisgah. Reservoir was inspected on October 2, 1978 and as a result of this inspection, certain discrepancies were found which should require corrective measures in order to protect the integrity of the structure. (See attached sheet.)

Your dam has been classified by the Board as a non-menace dam and with this classification, the State will not insist that the item(s) noted on the attached be corrected, but it is advisable that corrective measures be voluntarily initiated to protect the integrity of the structure.

Should you make the repairs and/or maintenance items on the attached sheet in the waters of the State, you will need a permit from the Special Board. Applications can be obtained by writing or calling the Special Board Office, 37 Pleasant Street, Concord, New Hampshire 03301, telephone no. 271-2147.

Please feel free to call or write if you have any questions regarding the evaluation of your structure.

Sincerely,

George M. McGee, Sr.,
Chairman

CMM:paf
Enc.

cc:

NEW HAMPSHIRE WATER RESOURCES BOARD

DAM INVENTORY FOR TOWN OF WINCHESTER # 255

DAM #	OWNER'S NAME	MAILING ADDRESS	NAME OF WATERBODY
.01	Ashuelot Paper Co.	Hinsdale N. H.	Ashuelot River
.02	Public Service Co.	Manchester N. H. 1000 Elm St.	Ashuelot River - Robertson Dam
.03	Public Service Co.	1000 Elm St. Manchester N. H.	Ashuelot River Upper Robertson Dam
.04	Hampshire Woolen Co.	not known dam may be gone	Ashuelot River
.05			
.06			Roaring Brook
.07	Forest Lake Improvement Assoc. Inc. 48 Oak Grove Avenue Brattleboro, Vt.	William A. Jr. & Mrs. Smith 22 Englewood Dr. Windsor Ct. 06095	Forest Lake
.08			Broad Brook
.09	Hinsdale Water Works	Town of Hinsdale Hinsdale N. H.	Kilburn Pond
.10	Ansel Dickenson & Sons	Dunning Corp. Walpole N. H.	Ashuelot River
.11	~~XXXXXXXXXXXXXXXXXXXXXXXX~~ DRED - State of NH		Pisgah Reservoir
.12	Mr. Acilio Sandri 4 Cherry St. Greenfield, Mass.	R.F.D. 2 Winchester N. H.	
.13	Ashuelot Paper Co.	P. O. Box Hinsdale N. H. 03451	Tufts Brook
.14	Rev. Jerome H. Wood 8 Holton Street East Northfield, Mass.	Some address	
.15	Davis & Symonds Lumber Co. Bowen Street Claremont, NH	Some address	

DAMS IN WINCHESTER NHWRB # 255

M.	OWNER	ADDRESS	NAME OF DAM OR WATER BODY	CONDITION	CLASSIFICATION	DATE INSPECTED	OWNER NOTIFIED	REMARKS
1	ASHUELOT PAPER CO	HINSDALE NH	ASHUELOT R	FAIR	NON-M	9/22/78	9/25/78	
2	FANTIK SERVICE MILLS	HINSDALE NH	ASHUELOT R	FAIR	NON-M	9/22/78	9/25/78	
3	—	—		RUINS		10/4/78	N/A	
4	—	—		RUINS			N/A	
5	NO FILE	—		RUINS		10/4/78	N/A	
6	—	—		RUINS			N/A	
7	FOREST LAKE IMPROVEMENT ASSOC.	WINCHESTER NH	FOREST LAKE	GOOD	NON-M	12/8/76	N/A	Barrett
8	—	—		RUINS			N/A	
9	[illegible] Stiles	Hinsdale	Kilburn Pond					
10	TRAPPER BROWN CORP.	BOX 99 RFD 3 PLYMOUTH	ASHUELOT R.	FAIR	NON-M	9/22/78	10/3/78	
11	DIV OF PARKS		PISGAH RES	FAIR	MENACE	10/2/78	10/3/78	
12	[illegible] CANDRI	STONE MTN RD WINCHESTER	NO NAME	GOOD	NON-M	10/2/78	10/3/78	
13				NOT BUILT		10/9/78	N/A	
14	REV. JEROME WOOD	8 HOLTON ST EAST NORTHFIELD MA		GOOD	NON-M	12/1/76	N/A	Barrett
15	—	—		RUINS		10/10/78	N/A	
16	E. HERBERT MEADOW	55E87 ST NY NY 10028	Meadow Pond	GOOD	NON-M	12/1/76	N/A	Barrett
17	KENNETH SMITH	7642 LORELLO AVE PHILA PA 19111		GOOD	NON-M	12/1/76	N/A	Barrett
18	MICHAEL GALASSO	22 KELSEY ST NEWINGTON CONN	NO NAME	FAIR	NON-M	10/2/78	10/3/78	
[illegible]	AM [illegible] GARRIDO	1055 AVON BLVD [illegible] CONN 06410			NON-M			

Page ___ of ___

MENACE 1 & NON-MENACE 10 = TOTAL ACTIVE DAMS ___ RUINS 6

not built - 1 -

DAMS IN Winchester NHWRB # 255

DAM NO.	OWNER	ADDRESS	NAME OF DAM OR WATER BODY	CONDITION	CLASSIFICATION	DATE INSPECTED	OWNER NOTIFIED	REMARKS
1	Ashuelot Paper Co.		Ashuelot River					** To high to inspect
2	Ashuelot Paper Co.		Ashuelot River					** Reinspect in Summer '77
3	Ashuelot Paper Co.		Ashuelot River					**
4	Ashuelot Paper Co.		Ashuelot River	Ruins		Dec.1,'76	-	
5	Ashuelot Paper Co.		Mirey Br.	Ruins		Dec.8,'76	-	
6	Ashuelot Paper Co.		Roaring Br.	Ruins		Dec.8,'76	-	
7	Forest Lake Improvement Assoc.	Winchester	Forest Lake	Good		Dec.8,'76	-	
8	Forest Lake Improvement Assoc.	Winchester	Broad Br.	Ruins		Dec.1,'76	-	
9	Hindsdale Water Works	Hindsdale	Kilburn Road					**
10	New England Box Co.	Greenfield	Ashuelot River					Water to high
11	State of N. H. Parks Dept.	Concord	Pisgah Res.	Good				
12	Acilio Sandri	4 Clerry St. Greenfield, Ma.	No Name	-			-	-
13	Ashuelot Paper		Taft Br.					**
14	Rev. Jerome H. Wood	8 Holton Street East Northfield, Ma.		Good	Non-Menace	Dec.1,'76		

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Page ____ of ____ MENACE ____ & NON-MENACE ____ = TOTAL ACTIVE DAMS ____ RUINS ____

** To be inspected in 1977

.sion of Resources Lands .e three		for improved pond level control. 4) Concrete sill under foot bridge is deteriorated and as such probably causes leakage. 5) Several small depressior or sluff areas in the embankment need to be filled in.
Pillsbury St. Park - Carley Pond (245.13)	Ruins	Reconstruct Dam
- North Pond (245.14)	Ruins	Reconstruct Dam
May Pond - Butterfield Dam (245.10)	1) Repair concrete spillway cap which was a hole in it. 2) Reconstruct gate and lifting apparatus to operational status again.	1) Repair rock fill portion of dam betwee gate section and road This portion has settled or eroded and needs to be raised to top of concrete platform. 2) Repair concrete facin of abutments or patch as required to repair general deterioration
Pisgah Park - Reservoir (255.11)	Please refer to letter dated Dec. 10, 1975 directed to George T. Hamilton, Director	- - -
Fullam Pond (45.09)	1) Remove debris from spillway 2) Cleanout downstream channel	1) For all practical purposes reconstruct the dam and utilizing existing stone structure where possible
Russell- Abbott - Pratt Pond A. (154.01)		Transferred to Water Resources Board
Silver Lake Park - Silver Lake Dam (119.06)	1) Remove sand fill that is against the stoplogs	2) Increase length of spillway. For deta please refer to the letter dated Nov. 2 1976.

STATE OF NEW HAMPSHIRE

INTER--DEPARTMENT COMMUNICATION

FROM **GEORGE M. McGEE, SR.**
Chairman

DATE **December 10, 1975**
AT (OFFICE)

Water Resources Board
37 Pleasant Street
Concord, N. H.

SUBJECT Inspection of Dam #255.11
Pisgah Reservoir

TO
GEORGE T. HAMILTON, Director
Division of Parks

On November 21st, 1975, an engineer of this office accompanied by Mr. Parker of your staff inspected the stone dam at Pisgah Reservoir in Winchester, N. H. for the purpose of determining what repairs might be required by your department to place this dam in safe operating condition.

Following the inspection the staff reviewed the inspector's report and plans of the structure on file in this office and have found that there is considerable leakage under the 32' high stone dam. The gate section is inoperable and it would appear that an attempt to stop the leakage by an earthfill has been placed upstream of the stone structure. The previous stone spillway appears to have been enlarged in the past from 20-odd feet to its present 80 - 90 feet which improves the discharge capacity of this dam.

The spillway area has also been backfilled with earth and these fills presently provide road access across the dam.

Except for the leakage and the inoperable gate, the structure appears to be sound and has sufficient spillway capacity to handle floods of record.

We were led to believe that the leakage has resulted in a drop of water level in some instances as much as 4 to 5' which prompts us to request your office to verify this condition and to indicate whether or not such a condition during a rare drought period would be detrimental to your park operation.

A satisfactory repair of this leakage would involve draining the pond, removing the backfill material, and placing a concrete curtain wall against the original stone structure. Access to this site is quite limited and a new access road for equipment and concrete trucks might have to be constructed, all of which would indicate a sizeable cost for the reconstruction of this dam for the purpose of shutting off leakage. We anticipate no other reason for making these repairs at this time.

We would appreciate your department's position regarding the above at your earliest convenience.

GMM/VAK:Lb

DATE: August 1, 1969

FROM: Francis C. Moore
Water Resources Engineer

SUBJECT: Pisgah Reservoir, Winchester

TO: George M. McGee, Sr.
Chairman, N. H. Water Resources Board

On July 30, 1969, I inspected Pisgah Reservoir, Dam No. 255.11, with Jack Heath of Resources Development Division. This dam has a downstream masonry face about 32 feet high and 108 feet long with a earth fill upstream for a roadway at times of relatively low water.

This dam leaks considerably at two points near the base of the dam (downstream). No fines were observed in the flow. The water apparently runs through the fill and masonry from both sides of the low point. It appears to be no menace. Another considerable flow was observed coming through the toe of the masonry wall about four or five feet from top of masonry near the east end of dam. This water could be heard running through the masonry wall. This flow is clear and has little head, appearing to be no menace.

Water at time of observation was about one foot below top of masonry. There had been rain for nearly four days previous to inspection with at least 4 inches precipitation.

The gate section is located about ten to twelve feet above bottom of dam and had no flow. Apparently, the gate is completely sealed with earth. This gate is completely inoperable.

The spillway is located about 200 feet east of the east end of drain. It is masonry. Logs and debris raised the reservoir level about one foot. The water was about 18" inches above the masonry spillway. The whole spillway of dry rubble mortared is about 90 feet long with about 30 feet at the 1 1/2 foot depth from water surface with the balance just above water surface with some flow through it. There is a roadway of sorts upstream of spillway. This spillway appears safe at present.

Recommendations:

1. All trees and brush should be removed from the spillway and dam and downtream for a short distance.

2. Debris and logs upstream of the spillway should be removed.

3. The spillway should be leveled off at the elevation of the 30'± deepssection by removing higher stones. Then the surface of the 90' level spillway section should be pointed up or a concrete cap placed at the elevation of the present 30' section.

4. The dam could be, but not necessarily, capped with concrete about 12" above the lowest point in the present dam. The cap should extend down four or five feet from top of dam on the upstream face.

Actual cost of needed repairs would not be expensive. About $5,000 should accomplish the first three items listed.

This 24 ~~square~~ mile drainage area would pass 220 cfs once in 15 years and 460 cfs once in 100 years.

FCM/jb

STATE OF NEW HAMPSHIRE

INTER--DEPARTMENT COMMUNICATION

DATE July 16, 1969

FROM Russell B. Tobey, Director
Division of Parks

AT (OFFICE) Resources and Economic Development

SUBJECT

TO George McGee
Water Resources

Dear George:

The proposed Pisgah Wilderness State Park is in the land acquisition phase. One of the properties is that of the Dickinson Real Estate and Lumber Company in Winchester. They own the Pisgah Reservoir, a 100 odd acre body of water just north of Ashuelot. This body of water is maintained at its present level by two dams constructed over a hundred years ago.

I would very much like to have your engineers look these dams over from the point of view of their safety. Also I would like to have some recommendations on needed maintenance to put them in safe operating condition.

Jack Heath of the Resources Development Division can furnish you with maps and photographs, and will be willing to go with your engineers if this is desirable.

The road into the Reservoir is kept locked, and a key may be obtained from Dubriske's Store near the entrance.

Sincerely yours,

CNH/arr

Russell B. Tobey
Director of Parks

Yes!!
Schedule as soon as possible
G. M.

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 255.11

Town Winchester : County Cheshire

Stream Pisgah Reservoir

Basin-Primary Conn.R. : Secondary Ashuelot R. Tufts Brook

Local Name

Coordinates—Lat. : Long.

GENERAL DATA

Drainage area: Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total 2.5 Sq. Mi.

Overall length of dam 108 ft.: Date of Construction repaired 1923

Height: Stream bed to highest elev. 32 ft.: Max. Structure 28 ft.

Cost—Dam : Reservoir

DESCRIPTION Masonry-Granite blocks and cement

Waste Gates

Type

Number 1 : Size 2.5 ft. high x 4 ft. wide

Elevation Invert 14 : 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 natural ledge

Length—Total 26 ft.: Net ft.

Height of permanent section—Max. 28 ft.: Min. ft.

Flashboards—Type : Height ft.

Elevation—Permanent Crest : Top of Flashboard

Flood Capacity cfs.: cfs/sq. mi.

Abutments

Materials:

Freeboard: Max. 4.0 ft.: Min. ft.

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

OWNER Dickinson Land&Lumber Co.

REMARKS Use-Industrial Storage
Condition-unknown

RL B-15

Tabulation By Date 9/27/39

B&H21284

7205

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON RESERVOIRS & PONDS IN NEW HAMPSHIRE

LOCATION AT DAM NO. 255.11

Town Winchester : County Cheshire

Stream Pisgah Reservoir

Basin—Primary Conn.R. : Secondary Ashuelot R. Tufts Brook

Local Name

DRAINAGE AREA

Controlled ..... Sq. Mi.: Uncontrolled ..... Sq. Mi.: Total 2.5 Sq. Mi.

ELEVATION vs. WATER SURFACE AREA vs. VOLUME

Point	Head Feet	Surface Area Acres	Volume Acre Ft.
(1) Max. Flood Height			
(2) Top of Flashboards			
(3) Permanent Crest			
(4) Normal Drawdown		63.69	
(5) Max. Drawdown			
(6) Original Pond			

Base Used ..... : Coef. to change to U.S.G.S. Base .....

RESERVOIR CAPACITY

	Total Volume	Useable Volume
Drawdown	ft.	ft.
Volume	ac. ft.	ac. ft.
Acre ft. per sq. mi.		
Inches per sq. mi.		

USE OF WATER Industrial (Storage)

OWNER Dickinson Land&Lumber Co.

REMARKS Condition not known

Tabulation By RLT Date 9/27/39

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Connecticut NO. 855.11
RIVER Pisgah Reservoir MILES FROM MOUTH D.A.SQ.MI 2.5
TOWN Winchester OWNER Dickinson Lodge Lumber Co.
LOCAL NAME OF DAM
BUILT repairing ca 1922 DESCRIPTION Masonry on bedrock foundation
Granite blocks & cement

POND AREA-ACRES 63.69 ac. DRAWDOWN FT. 12 POND CAPACITY-ACRE FT.
HEIGHT-TOP TO BED OF STREAM-FT. 32. MAX. MIN.
OVERALL LENGTH OF DAM-FT. 108 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. natural rock 26 FREEBOARD-FT. 4.0
FLASHBOARDS-TYPE, HEIGHT ABOVE CREST
WASTE GATES-NO. WIDTH MAX.OPENING DEPTH SILL BELOW CREST

NO.	WIDTH	MAX.OPENING	DEPTH SILL BELOW CREST
1	4	2.5	14

REMARKS Concrete cutoff wall extended by timbers
12 ft. in Trout Brook, tributary

POWER DEVELOPMENT

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

ICE Storage for New England Box Co.

REMARKS Repairs under supervision of Lyn W. Jones, Engineer of Winchester

DATE

Is it inspected.

NEW HAMPSHIRE WATER CONTROL COMMISSION

Dams on Which Information is Available in the

Town of Winchester

State No.	Location Stream	Name of Body of Water Created	Owner	Condition
255.01	Ashuelot River	----	Ashuelot Paper Co.	Operable
255.02	" "	----	Pub. Ser. Co. of N.H.	"
255.03	" "	----	" " " " "	"
255.04	" "	----	" " " " "	Ruin
255.05	Mirey Brook	----	Mr. Cromby	"
255.06	Roaring Brook	----	Geo. Holton	"
255.07	Forest Lake Brook	Forest Lake	Davis & Crowley	Operable
255.08	Broad Brook	----	Dickinson Real Estate & Lumber Co.	Ruin
255.09	Kilburn Brook	Kilburn Pond	Hinsdale Water Works	Operable
255.10	Ashuelot River	----	Ansel Dickinson Sons	"
255.11	Tufts Brook	Pisgah Reservoir	Dickinson Real Estate & Lumber Co.	"

Rec'd 10/21/22

Jacobson	
Holmgren	✓
Sullivan	
Return to	
Filed	
File No.	

WATER CONTROL COMMISSION

STATE OF NEW HAMPSHIRE

Concord, New Hampshire

October 18, 1922.

Dickinson Lime & Lumber Co.,
Winchester, N H

RE: Pisgah Reservoir Dam. W. C. C. No. 255.11

Gentlemen:

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

1. Was this dam injured? Ans. No.

2. If so, to what extent? Ans.

3. Did all flashboards go out? Ans. No flashboards on dam

4. What was the maximum height of water over the permanent crest of spillway? Ans. About 1 ft over main dam and 4 ft over small wing.

5. At what day and hour did the maximum flood height reach your dam? Ans. Sept. 22 - 4 PM. Small diameter and gain 4 ft off

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

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

We thank you for your cooperation.

Very truly yours,

Richard C. Holmgren
Chief Engineer

CDC:GMB
Enc.

DAMS IN THE TOWN OF ~~Winchester~~

DAM NO.	LAST KNOWN OWNER	LAST KNOWN ADDRESS	USE	NAME OF DAM OR WATER
1	Ashuelot Paper Company	Hinsdale	Industrial	?
2	Public Service Co. of N.H. (Robertson Bros. Lessees)		"	Robertson Dam
3	"		"	Upper Robertson Dam
4	Hampshire Woolen Company		"	
5	?			
6	George Holton		Power for Mill	Holton's Dam
7	Forest Lake Improvement Assoc	Winchester	Recreation	Forest Lake
8	Dickinson Real Estate & Lumber Co.		Ruins	
9	Hinsdale Water Works		Water Supply	Kilburn Pond
10	New England Box Company	Greenfield, Mass.	Industrial	
11	Dickinson Land & Lumber Co.		"	Pisgah Pond
12	Acilio Sandri	4 Cherry St. Greenfield, MA	Recreation & Fire Prot.(SCS)	Sandri Pond
13	Ashuelot Paper	Hinsdale	Industrial	
14	Rev. Jerome H. Wood	8 Holton St. E. Northfield MA	Recreation & Fire Pond (SCS)	
15	Davis & Symonds Lumber Co.	Box 56, Claremont NH	?	
16	Dr. Herbert Meadow	Old Curtis Rd, Winchester	Recreation Pond	No name stream

SURVEYS,
PLANS AND
ESTIMATES
MADE FOR
DAMS,
PULP AND
PAPER
MILLS,
ELECTRIC
POWER
PLANTS,
ETC.

I. W. JONES & CO.

ENGINEERS AND DESIGNERS
OF WATER POWER PLANTS

MILTON, NEW HAMPSHIRE

Job

REFERENCE

, September 21, 1923

ublic Service Commission,

Concord, N.H.

entlemen:

As suggested by you recently, I visited the storage dam owned by the ~~New England Box Company xxx~~ located on "Pisgah" Mountain about two miles from Ashuelot Village on a Stream entering Ashuelot River at one mile down stream from Ashuelot Village.

The dam is approximately 108 ft. long by 22 ft. high measured at its deepest point, and is composed of split granite laid up dry in a gorge having ledge sides and bottom. The dam is approximately 22 ft. thick at the base and 5 ft. at the crest. There is an aperture 4 ft. wide by 2 1/2 ft. deep located about 10 ft. up from the bottom for a discharge opening.

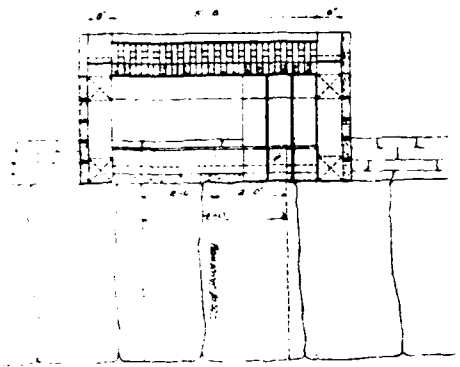
The accompanying blue print "A" shows the dam in plan, down stream elevation and in section. Blue print "B" shows the gate frame, gate and water rack which I have designed for the repair work to the dam. The face of the dam was originally pointed with cement, but after many years existence a large portion of the pointing has worked out, and I have recommended and it is the Company's purpose, to clear the entire face of the dam from top to bottom removing all loose cement and vegetable growth, and to again point all of the crevices with cement mortar.

About 200 ft. to the right of the dam, looking up stream, there is a stone spillway founded on solid ledge having a length about 26 ft., the crest of which is approximately 4 ft. below the level of the storage dam. As there is but about 2 1/2 square miles of drainage area tributary to the pond above this dam, in my opinion, the spillway is ample to take care of any run-off that may occur. Besides as the dam is built entirely of stone founded on solid ledge no harm can result, even if it was over-topped by the water in extreme cases. I, therefore, consider the dam perfectly safe and practicable for the storage of water when the above mentioned repairs are completed.

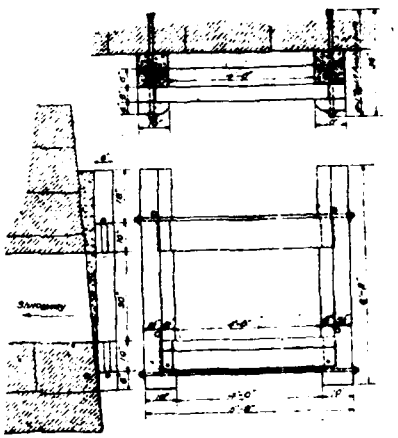
Very truly yours,

H. B. Jones

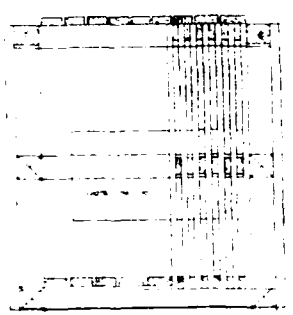
Copies:
Office
New England Box Co.

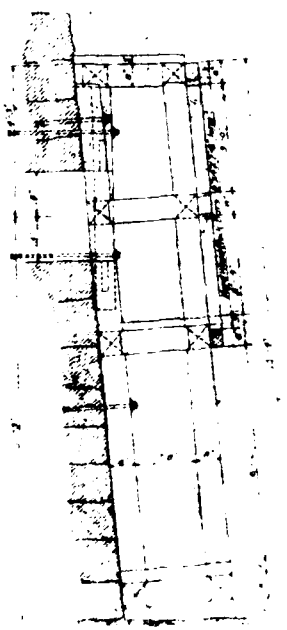


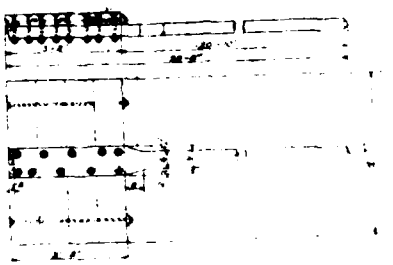
Top View Gate and Rack No 1-B



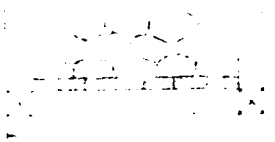
Detail of Gate Frame No 2-B





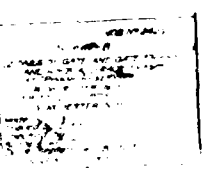


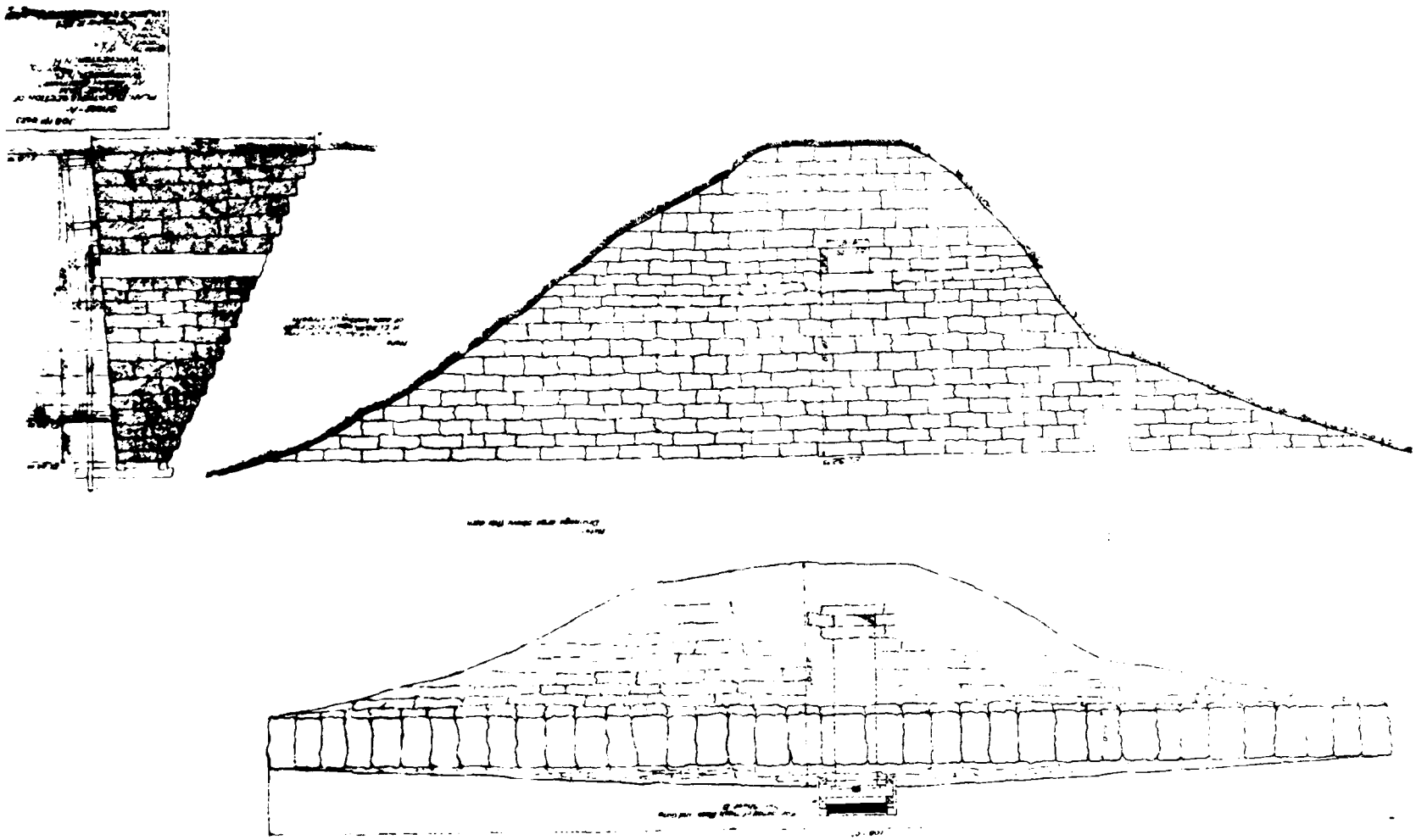
Detail of Gate No 5-B



Front View of Gate and Rack No 3-B

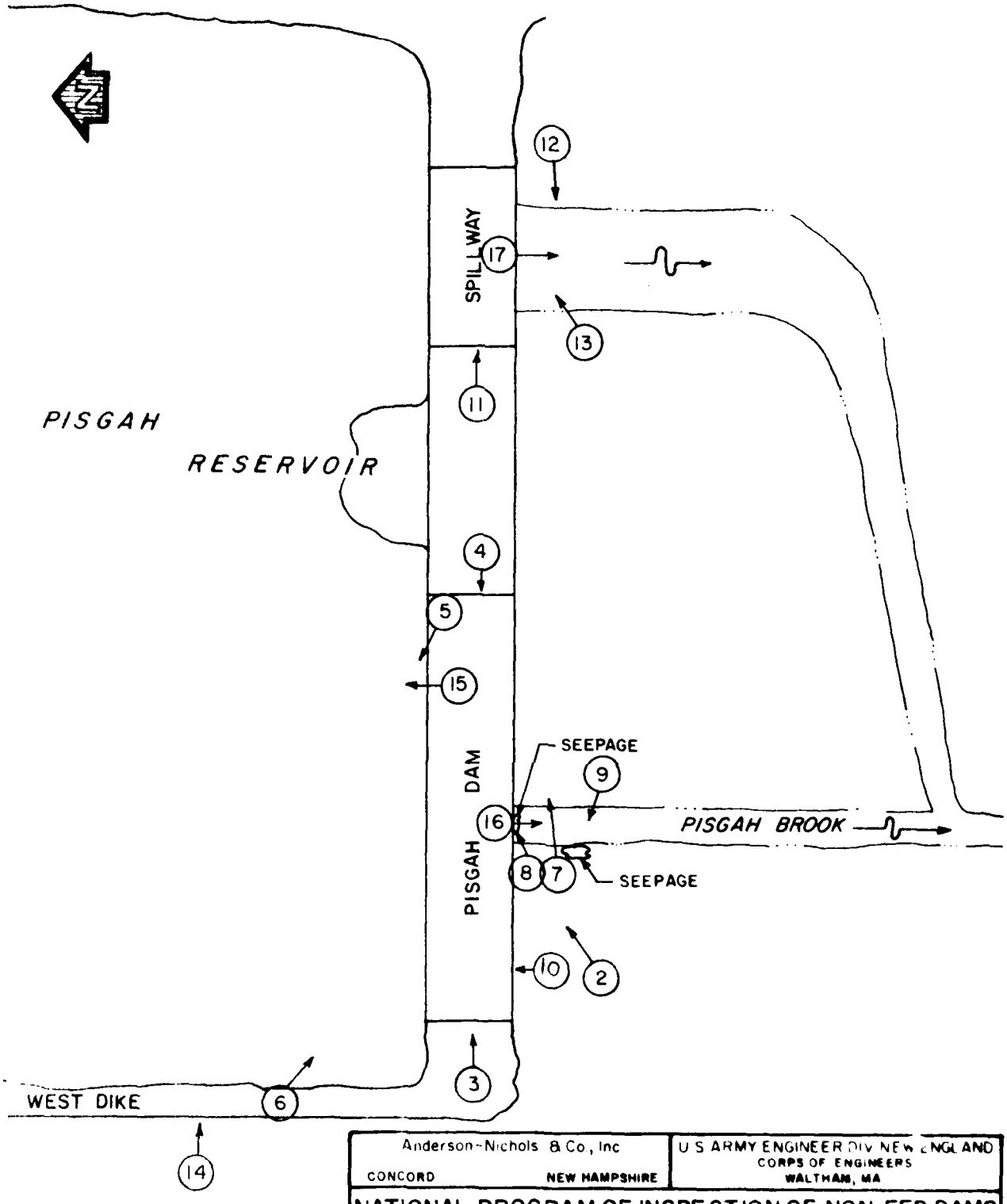
Side View of Gate and Rack No 4-B





APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co, Inc	U S ARMY ENGINEER Div NEW ENGLAND
CONCORD NEW HAMPSHIRE	CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

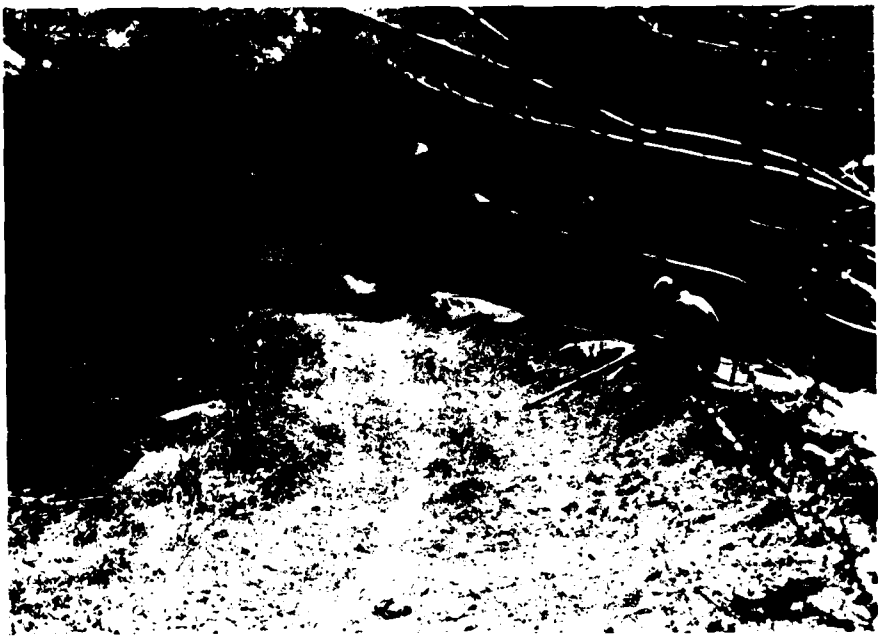
PISGAH RESERVOIR DAM
PHOTO INDEX

PISGAH BROOK NEW HAMPSHIRE

			SCALE NOT TO SCALE
			DATE JULY 1979

May 2, 1979

Figure 2 - View of bulging rock on downstream face of dam.



May 2, 1979

Figure 3 - View looking east across crest of dam.

May 2, 1979
Figure 4 - View looking west across crest of dam.

May 2, 1979
Figure 5 - Close-up view of upstream face of dam.

May 2, 1979
Figure 6 - View looking at upstream face of dam.

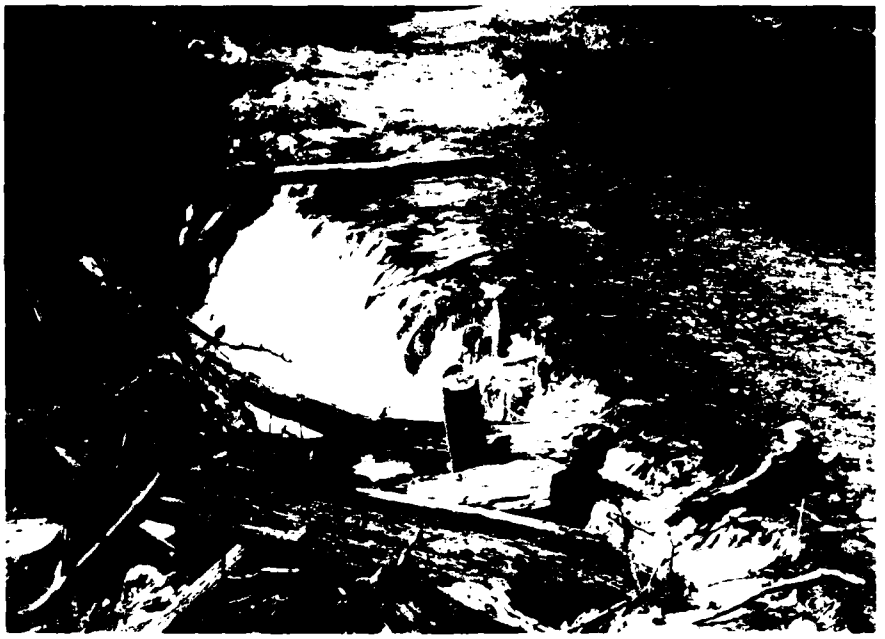
May 2, 1979
Figure 7 - View of contact between downstream face of dam and abutment showing large trees lying against the face.

May 2, 1979
Figure 8 - View of seepage discharging at downstream toe.

May 2, 1979
Figure 9 - View of seepage along west bank of downstream channel about 15 feet downstream of toe of dam.

May 2, 1979
Figure 10 - View of mid-level outlet.

May 2, 1979
Figure 11 - View looking east across spillway.

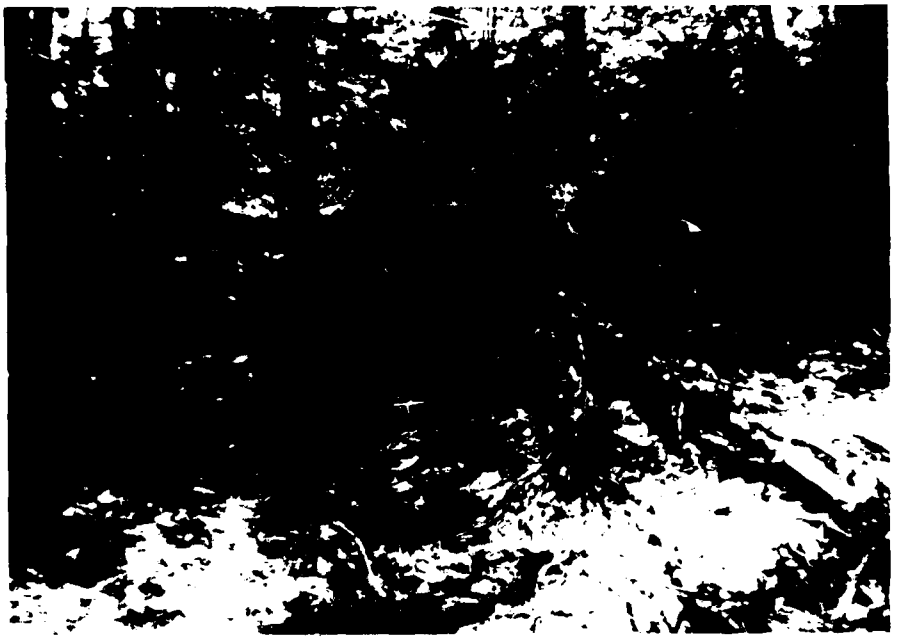


May 2, 1979

Figure 12 - View looking at debris on downstream face of spillway.

May 2, 1979

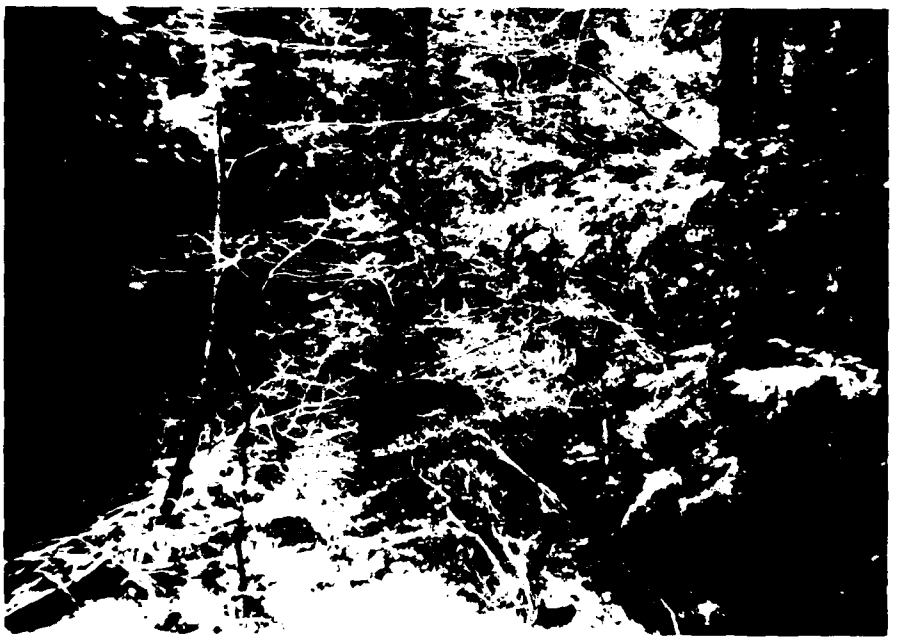
Figure 13 - View looking upstream at downstream face of spillway.



May 2, 1979
Figure 14 - Close-up view of west masonry dike.

May 2, 1979
Figure 15 - View looking upstream into reservoir from dam crest.

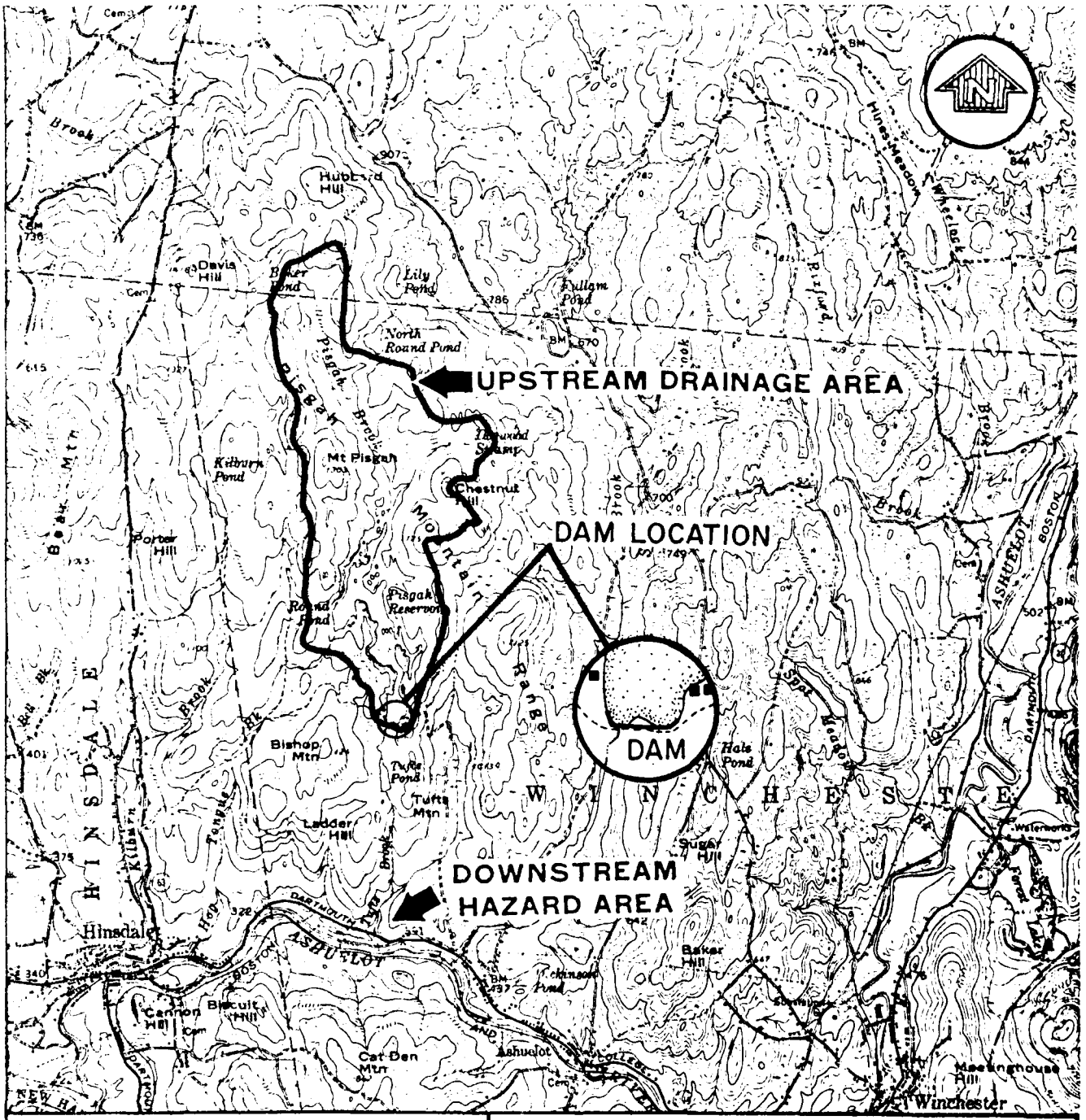
May 2, 1979
Figure 16 - View looking at channel downstream of dam.



May 2, 1979
Figure 17 - View of spillway discharge channel.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

PISGAH RESERVOIR DAM
WINCHESTER, 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

1 ½ 0 1 2

MAP BASED ON U.S.G.S. 15 MINUTE QUADRANGLE SHEET. KEENE, N.H.-VT. 1958.

HYDROLOGY / HYDRAULICS

D.A. = 2.37 mi^2 = 2.4 mi^2
Size Classification = Small
Hazard Classification = SIGNIFICANT
Test Flood = ½ PMF

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

Slope of watershed = 201'/mi so the mountainous curve was used.

@ 2.4 mi^2, PMF in cfs/mi^2 = 2510 = Qm

(2.4)(2510) = 6024 CFS.

½ PMF = 3012 CFS = Peak inflow to Pisgah Reservoir = 3010 CFS

Route inflow to Pisgah Reservoir to obtain outflow for test flood.

Invert of existing culvert for Pisgah Reservoir Dam is assumed.
Spillway elevation = 2718' MSL

Anderson-Nichols & Company, Inc.

JOB NO. 3220-15

Subject: Pisgah Reservoir

Date 5.23.79
Computed ICAS
Checked

Rating Curve at Dam

TRIAL #1 ELEVATION 878' SPILLWAY

$Q = C(0)(0)^{3/2}$

$Q = 0$

Weir EQN: $Q = CLH^{3/2}$

TRIAL #2 ELEV 879'

$Q = (2.7)(40)(.5)^{3/2} + 2.5(25)(0.5)^{3/2}$

$38 + 22 = 60$ CFS.

TRIAL #3 ELEV 880'

$Q = 2.7(70)(1)^{3/2} + 2.5(27)(1)^{3/2} + 2.5(25)(.5)^{3/2}$

$= 189 + 67.5 + 22.1 = 279$ CFS

$Q = 279$ CFS.

TRIAL #4 ELEV 881'

$Q = 2.7(60)(1.5)^{3/2} + 2.7(60)(.75)^{3/2} + 2.5(20)(.75)^{3/2} +$
$2.5(25)(.5)^{3/2} + 2.5(29)(.2)^{3/2} + 2.5(15)(.5)^{3/2} +$
$2.5(15)(.25)^{3/2} + 2.5(25)(.25)^{3/2} =$

$Q = 248 + 105 + 32 + 22 + 177 + 13 + 3 + 8 = 658$ CFS.

TRIAL #5 ELEV 880.5' TOP DAM

$Q = 2.7(60)(0.75)^{3/2} + 2.7(60)(1)^{3/2} + 2.7(12)(0.5)^{3/2} +$
$2.5(25)(.5) + 2.5(30)(1.5)^{3/2} =$

$Q = 105 + 162 + 11 + 22 + 138 = 438$ CFS.

Nelson-Nicholls & Company, Inc.

JOB NO. 3220-15 Pisgah Reservoir

Date
Computed
Checked

TRIAL # 6 ELEV 882'

$Q = 2.7(60)(.75)^{3/2} + 2.7(60)(2.5)^{3/2} + 2.5(33)(1.7)^{3/2} +$
$2.5(25)(0.5)^{3/2} + 2.5(25)(3.0)^{3/2} + 2.5(20)(1.5)^{3/2} +$
$2.5(15)(.5)^{3/2} + 2.5(30)(.75)^{3/2} + 2.5(50)(.3)^{3/2} + 2.5(40)(.25)^{3/2} +$
$2.5(25)(.25)^{3/2} + 2.5(65)(.5)^{3/2} + 2.5(20)(.5)^{3/2} + 2.5(15)(1)^{3/2} =$

$Q = 105 + 640 + 115 + 22 + 325 + 92 + 13 + 49 + 20 + 19 +$
$8 + 57 + 25 + 62 = 1553$ CFS.

TRIAL # 7 ELEV 883'

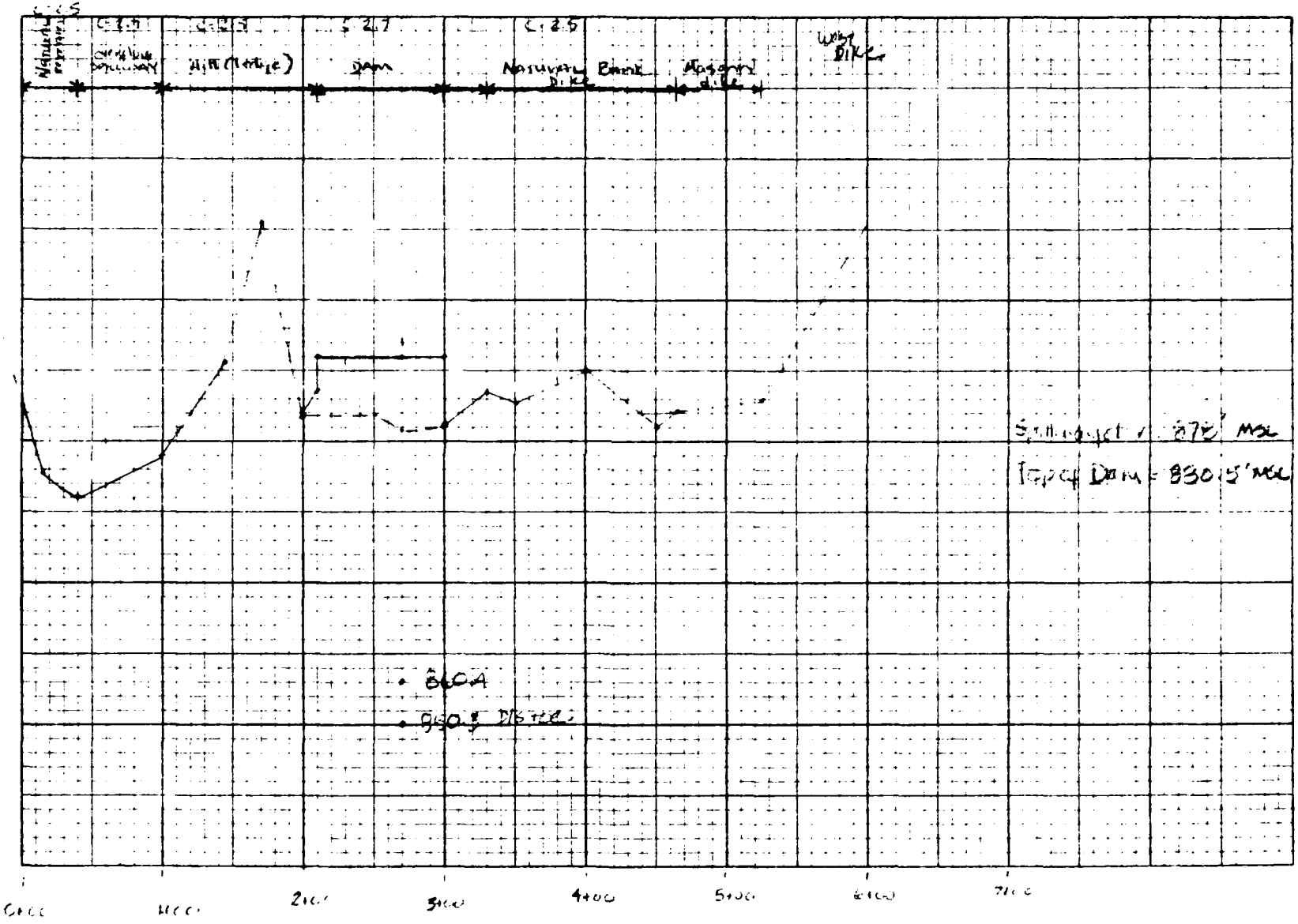
$Q = 2.7(60)(3.5)^{3/2} + 2.5(45)(3.5)^{3/2} + 2.7(60)(.75)^{3/2} +$
$2.5(25)(0.5)^{3/2} + 2.5(25)(4)^{3/2} + 2.5(25)(2)^{3/2} +$
$2.5(10)(1)^{3/2} + 2.5(10)(1.2)^{3/2} + 2.5(10)(.4)^{3/2} +$
$2.5(30)(1.3)^{3/2} + 2.5(30)(.6)^{3/2} + 2.5(50)(.3)^{3/2} +$
$2.5(50)(1)^{3/2} + 2.5(20)(.5)^{3/2} + 2.5(20)(.25)^{3/2} +$
$2.5(25)(.25)^{3/2} + 2.5(95)(1.5)^{3/2} + 2.5(20)(.75)^{3/2} +$
$2.5(60)(.25)^{3/2} + 2.5(30)(.5)^{3/2} + 2.5(30)(.5)^{3/2} +$
$2.5(30)(.5)^{3/2} =$

$Q = 1061 + 737 + 105 + 22 + 500 + 177 + 25 + 33 + 6 + 11 +$
$35 + 20 + 125 + 18 + 6 + 8 + 436 + 32 + 9$
$+ 27 + 27 + 27 = 3557$ CFS.

TRIAL # 8 ELEV 884'

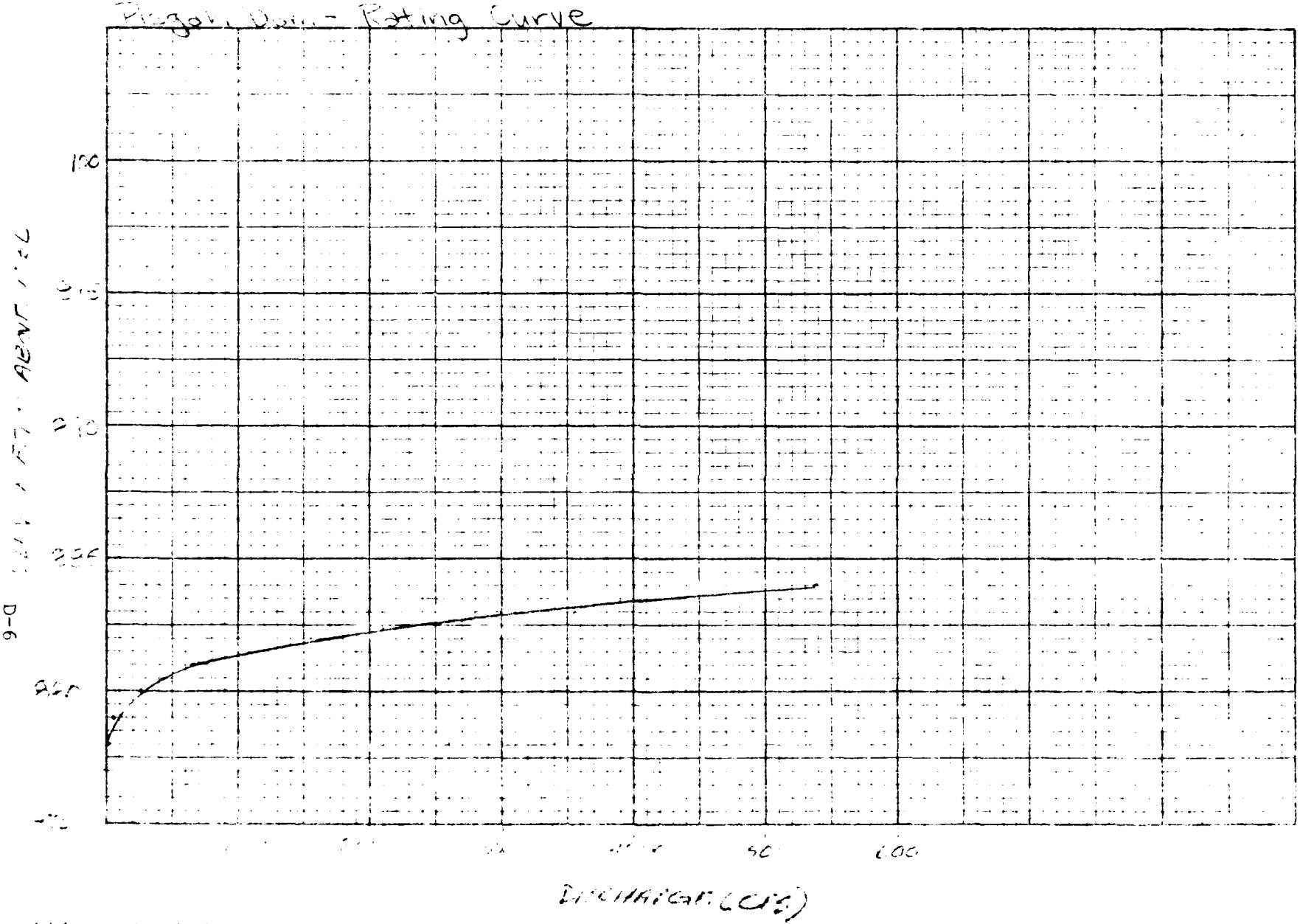
$Q = 2.7(60)(.75)^{3/2} + 2.7(60)(4.5)^{3/2} + 2.5(55)(2.25)^{3/2} +$
$2.5(25)(.5)^{3/2} + 2.5(25)(.5)^{3/2} + 2.5(30)(2.5)^{3/2} +$
$2.7(90)(1)^{3/2} + 2.7(10)(2.25)^{3/2} + 2.5(10)(.4)^{3/2} +$
$2.5(13)(1.5)^{3/2} + 2.5(30)(1.5)^{3/2} + 2.5(30)(2)^{3/2} +$
$2.5(50)(.3)^{3/2} + 2.5(50)(2)^{3/2} + 2.5(20)(.25)^{3/2} +$
$2.5(30)(.5)^{3/2} + 2.5(25)(1.5)^{3/2} + 2.5(15)(.75)^{3/2} +$
$2.5(20)(.75)^{3/2} + 2.5(95)(1)^{3/2} + 2.5(60)(.25)^{3/2} +$
$2.5(25)(.25)^{3/2} + 2.5(10)(.25)^{3/2} + 2.5(25)(.5)^{3/2} =$

$Q = 105 + 1546 + 464 + 22 + 699 + 296 + 243 + 9 +$
$6 + 60 + 138 + 212 + 21 + 354 + 6 + 27 + 758 +$
$24 + 32 + 238 + 19 + 8 + 3 + 22 = 5394$ CFS.


Natural Material
Saddle Dam
Dam
Nonoverflow Dike
West Dike
Spillway crest = 875' MSL
Top of Dam = 880.5' MSL

D-5

4 of 18


Rating Curve
100
50
10
5
1
50
100
DISCHARGE (CFS)

Determine Volume of Surcharge in Increments of Rise:

Assume Normal Storage at elevation 878' to be 660 ac-ft from inventory sheet

Surface area = 108.8 acres

"Frustrum of a pyramid" for storage-elevation curve

$V = 1/3\,h\,(b_1 + b_2 + \sqrt{b_1 b_2})$

h = elevation - normal pool
b_1 = normal pool S.A. (acres)
b_2 = enlarged S.A. (acres)

@ 880 S.A. = 192 acres

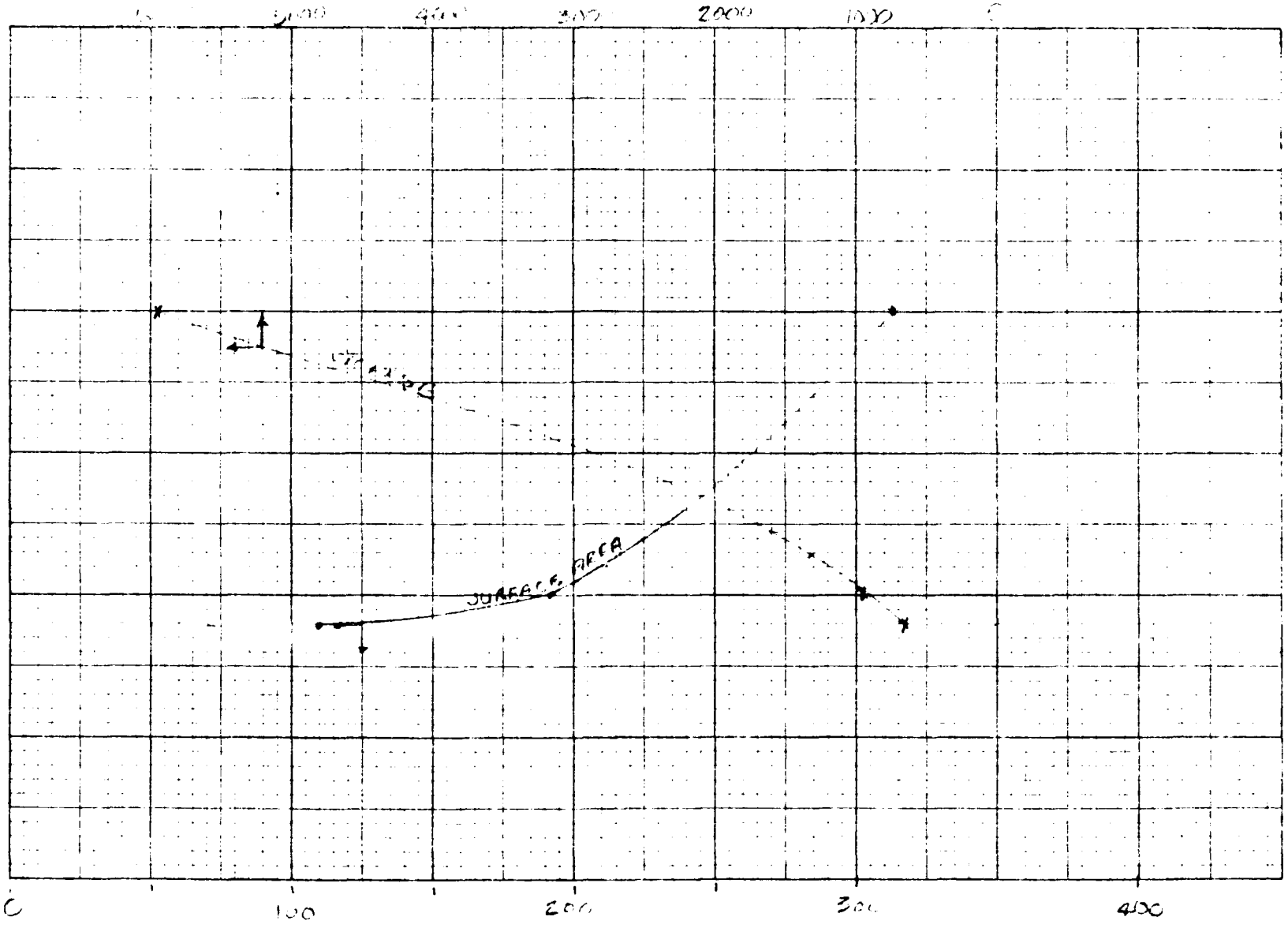
$V = 1/3\,(2)\,(108.8 + 192 + \sqrt{108.8(192)})$

V = 296 ac-ft + 660 acre-ft = 956 acre-ft

@ 900 S.A. = 313.6 acres

$V = 1/3\,(20)\,(192 + 313.6 + \sqrt{(192)(313.6)})$

V = 5006 ac-ft + 956 ac-ft = 5962 ac-ft


SURFACE AREA
0
100
200
300
400

For 1/2 PMF inflow (Qp1) at Pisgah Reservoir, an elevation of 882.9 is read from the rating curve.

Storage at 882.9' is read from the storage-elevation curve.

1320 AF
- 660 AF
660 AF

TO CONVERT TO INCHES OF RUNOFF:

$660\,AF \times \frac{1}{2.4\,mi^2} \times \frac{1\,mi^2}{640\,ac.} = 0.43\,ft$

$.43' \times 12"/FT = 5.2" = STOR\,1$

$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR\,1}{19/2}\right)$

$Q_{p2} = 3010 \times \left(1 - \frac{5.2}{9.5}\right) = 1362\,CFS = Q_{p2}$

Determine surcharge height to pass Qp2 from rating curve = 881.6' MSL

Determine storage at 881.6' from storage-elevation curve = 1100 AF

1100 AF
660
440 AF

TO CONVERT TO INCHES OF RUNOFF:

$440\,AF \times \frac{1}{2.4\,mi^2} \times \frac{1\,mi^2}{640\,AC} = 0.29' = 3.5" = STOR\,2$

STOR 1 = 5.2"
STOR 2 = 3.5"
AVG = 2 | 8.7" = 4.4" = 0.37'

$(0.37')(2.4\,mi^2)\left(\frac{640\,AC}{mi^2}\right) = 568\,AF$

@ 1228 AF

6660
568
1228 AF

From storage-elevation curve: elev. = 882.3' MSL

From rating curve: OUTFLOW Q = 2100 CFS
2100 CFS = 882.3' MSL

BREACH Analysis

STORAGE at maximum pool: 750 ac-FT

STORAGE at normal pool: 666 ac-ft

D.A. = 2.4 mi²

$Q_{p_1} = 8/27\, W_b \sqrt{g}\, y_o^{3/2}$

$Q_{p_1} = 8/27\,(36)\sqrt{32.2}\,(22A)^{3/2}$

$Q_{p_1} = 6405$ max pool

W_b = Breach width
$g = 32.2\ ft/sec^2$
y_o = pool elev - u/s river bed
Dam length = 90'
40% = 36'

880.1 - 22 = 858.1 = u/s RIVER BED

Q over spillway not breached.

$Q = CLh^{3/2}$ @ 880.5

$Q = 2.7(40)(1)^{3/2} + 2.7(15)(5)^{3/2} + 2.7(40)(5)^{3/2} + 2.7(15)(1)^{3/2} =$
$108 + 114 + 338 + 41 = 201$

880.5 MAX POOL
858.1
22.4'

TOTAL BREACH Q at MAX pool =
6405 + 201 = 6606 cfs ; 6605 CFS

6605 CFS on rating curve = 15.9 stage (Pg. D-46)
438 cfs (antecedent discharge) on rating curve = 5.7

THEREFORE, increase in stage would be
15.9 - 5.7 = 10.2 feet.

Subject

Highlander

SCALE

BREACH ANALYSIS (cont'd)

The resulting overtopping of Route 114 would be about [illegible] feet. This would result in severe damage to the roadway and undermining of the landscaping in the house on the east bank of Tiffany Brook. The [illegible] the 18.2 foot increase in stage. Inundation would cause serious damage to [illegible] as well as threaten the lives of the inhabitants.

SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

TYPICAL X-SECTION DIS

Use typical cross-section along DIS reach from the dam to mouth and establish a discharge rating curve. using Manning Equation:

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

n = composite 'n' value
A = area of section (ft^2)
R = A/WP (wetted perimeter)
S = slope of reach

Length of reach: 4435'
ELEV @ DIS TOE: 871.7
ELEV @ end reach: 600'
SLOPE = .06
Composite 'n' = 0.07

THE TRIALS BELOW REFER TO THE DIS HAZARD CROSS-SECTION ON PAGE 14.

TRIAL #1 ASSUME STAGE = 2'
AREA = 15
WP = 19
R = A/WP = 15/19 = 0.79
Q = 65 cfs

$$Q = \frac{1.49}{.07}(15)(.71)^{2/3}(.06)^{1/2} = 65$$

TRIAL #2 ASSUME STAGE = 4'
AREA = 25
WP = 29
R = A/WP = 25/29 = .86
Q = 116 + 65 = 181

$$Q = \frac{1.49}{.07}(25)(.86)^{2/3}(.06)^{1/2} = 116$$

TRIAL #3 ASSUME STAGE = 6'
AREA = 60
WP = 38
R = A/WP = 60/38 = 1.58
Q = 417 + 65 = 482

$$Q = \frac{1.49}{.07}(60)(1.58)^{2/3}(.06)^{1/2} = 417$$

son-Nichols & Company, Inc

Subject

Sheet No. 13 of 19
Date 6/27/21
Computed KLC
Checked

JOB NO. 3220-15

Irrigation water

(Manning's equation)

TRIAL #4 ASSUME DEPTH 9'
AREA = 106
WP = 49
R = A/WP = 106/49 = 2.2
Q = 921 x .65 = 166

$Q = \frac{1.49}{.07}(106)(2.2)^{2/3}(.06)^{1/2}$

$= 921$

TRIAL #5 ASSUME DEPTH 10'
AREA = 162
WP = 58
R = A/WP = 162/58 = 2.79
Q = 1656 x .65 = 1721

$Q = \frac{1.49}{.07}(162)(2.79)^{2/3}(.06)^{1/2}$

$= 1656$

TRIAL #6 ASSUME DEPTH 12'
AREA = 234
WP = 68
R = A/WP = 234/68 = 3.44
Q = 2731 x .65 = 1775

$Q = \frac{1.49}{.07}(234)(3.44)^{2/3}(.06)^{1/2}$

$= 2739$

TRIAL #7 ASSUME DEPTH 14'
AREA = 329
WP = 76
R = A/WP = 329/76 = 4.33
Q = 4470

$Q = \frac{1.49}{.07}(329)(4.33)^{2/3}(.06)^{1/2}$

$= 4490$

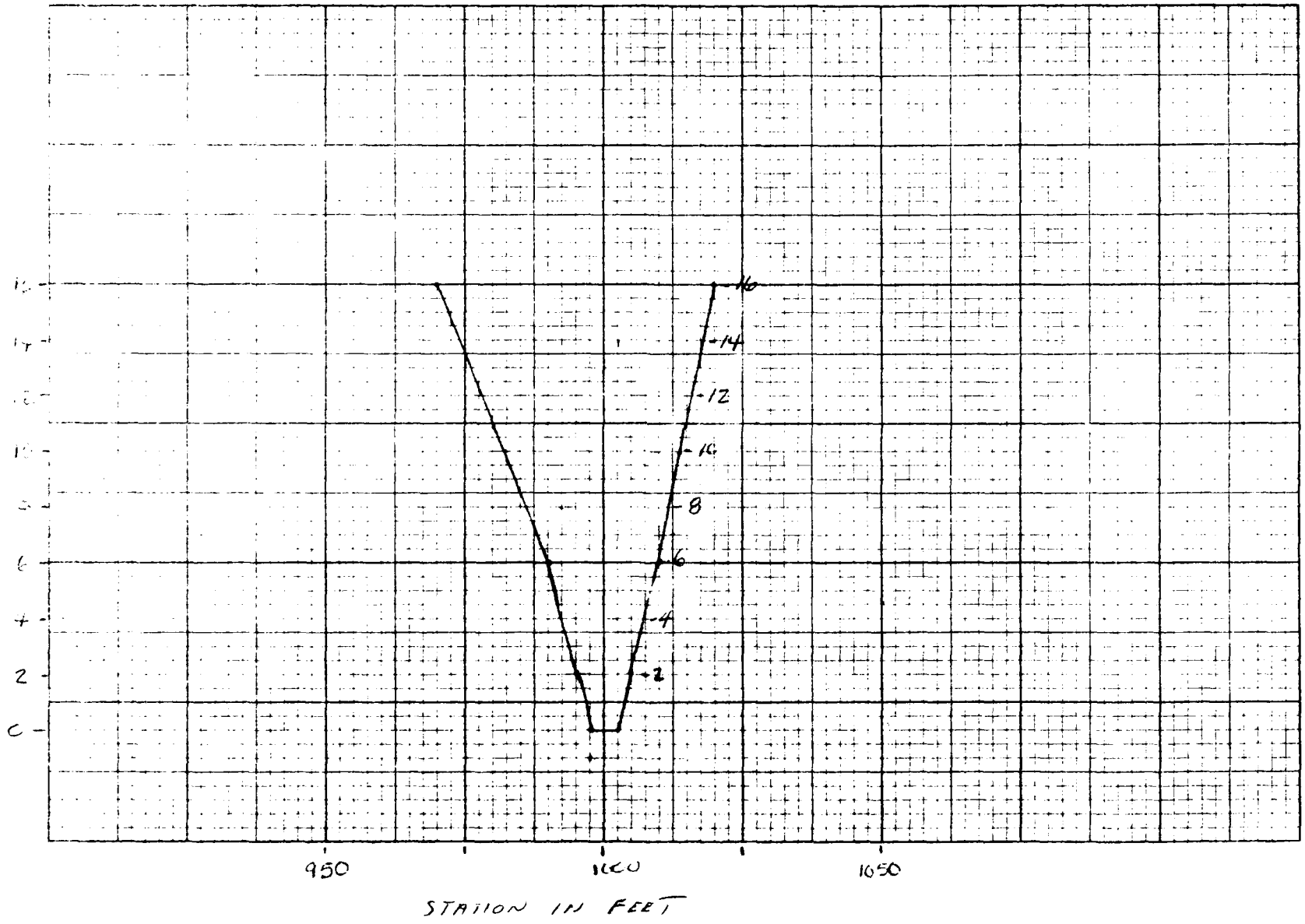
TRIAL #8 ASSUME DEPTH 15'
AREA = 440
WP = 87
R = A/WP = 440/87 = 5.06
Q = 6045

$Q = \frac{1.49}{.07}(440)(5.06)^{2/3}(.06)^{1/2}$

$= 6045$

DIS CROSS-SECTION

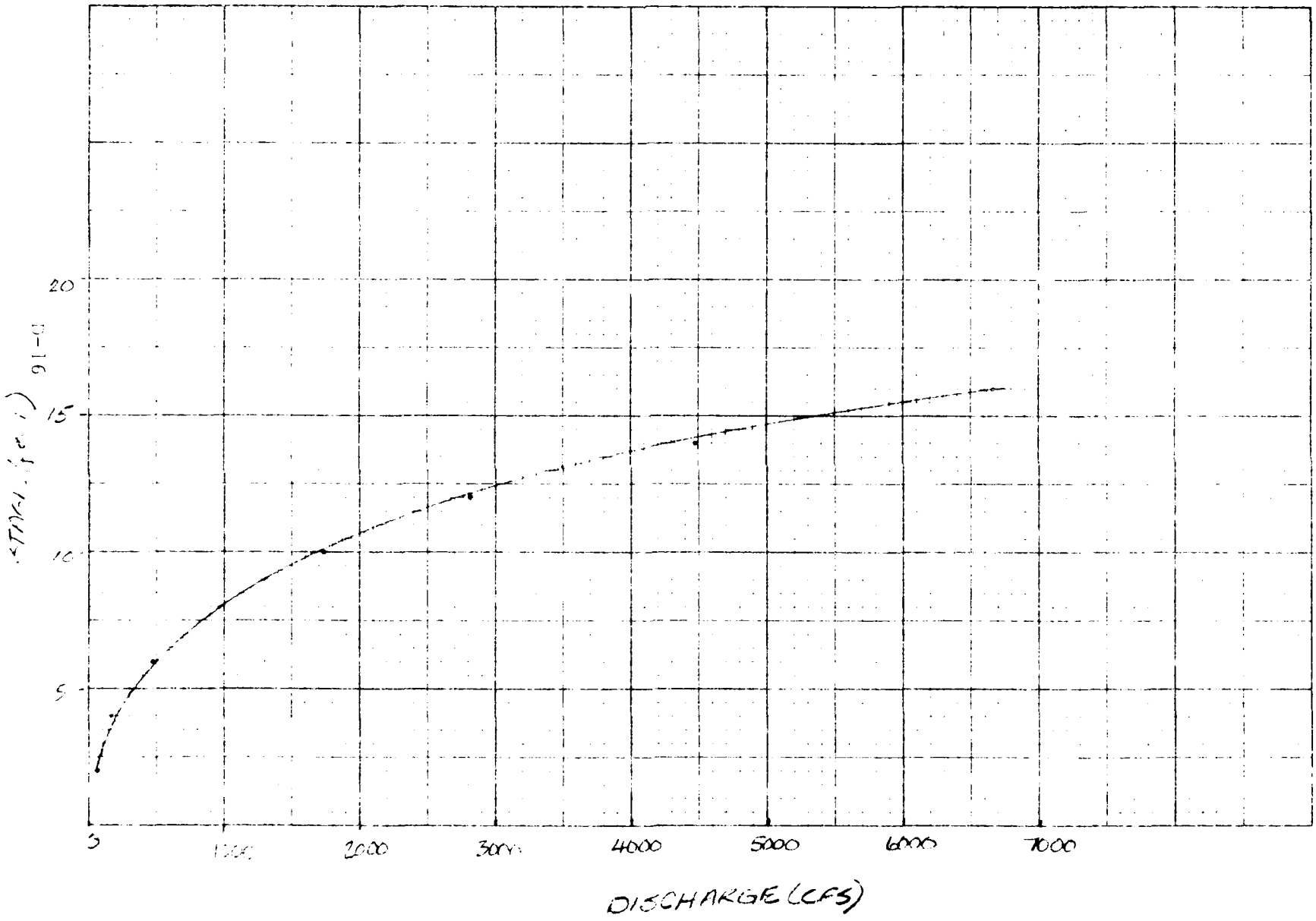
Pisgah, Reservoir
5.16.79
KBS



14 of 18

D/S HAZARD RATING CURVE

Hispan Reservoir
6-29-79
KBS



WEIR SECTION @ RTE 119
DOWNSTREAM HAZARD ANALYSIS

TRIAL #1 STAGE = 2'
$Q = (2.6)(90)(2)^{3/2} = 662$ CFS

TRIAL #2 STAGE = 4'
$Q = (2.6)(135)(4)^{3/2} = 2808$ CFS

TRIAL #3 STAGE = 5'
$Q = (2.6)(182)(5)^{3/2} = 5270$ CFS

weir eqn: $CLH^{3/2}$

CAPACITY OF ROADWAY CULVERT

$Q = (.95)(54)\sqrt{2(32.2)(20.7)}$
$Q = 1873$ CFS

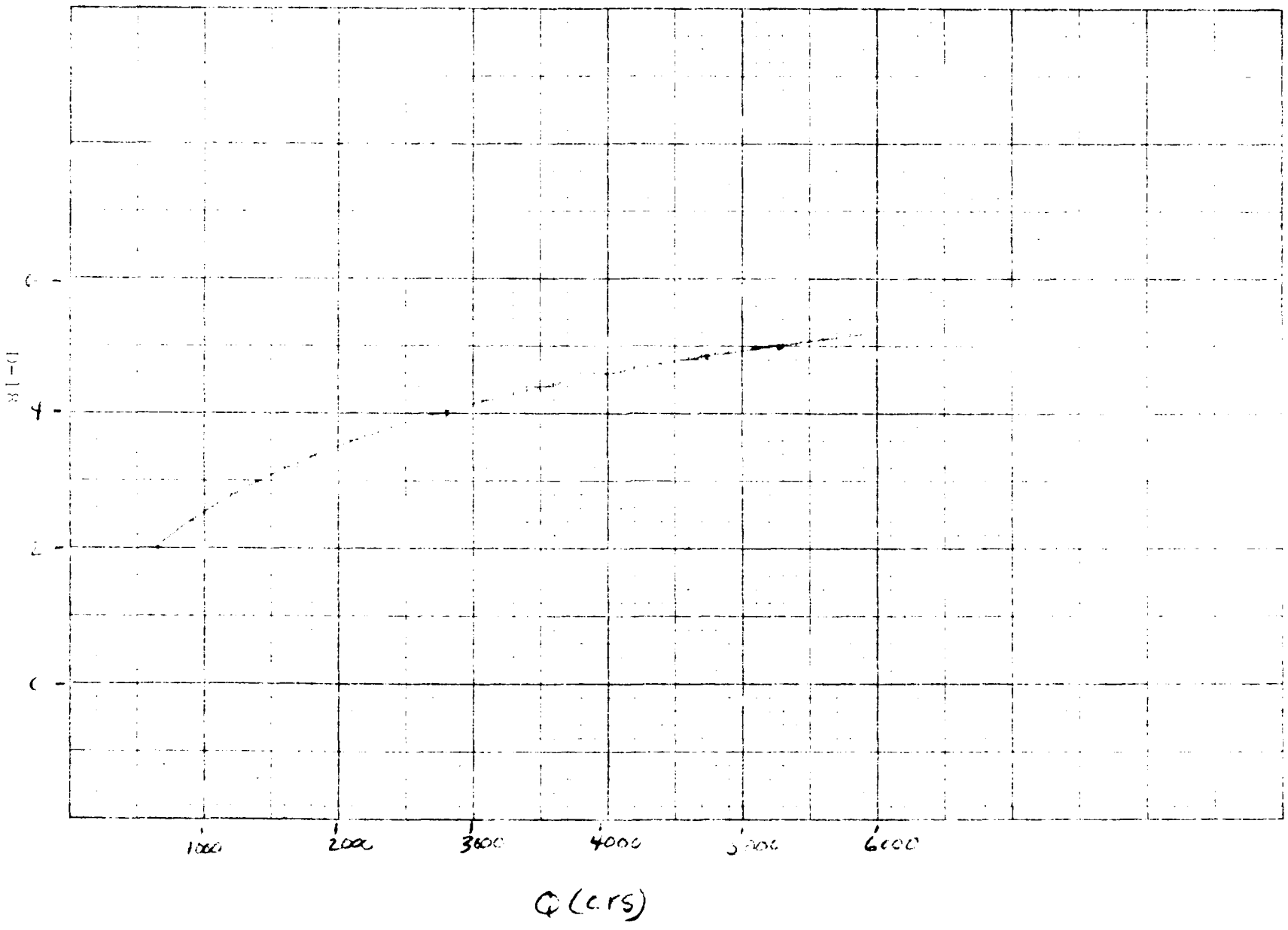
Orifice eqn.
$Q = CA\sqrt{2gh}$

BREACH Q = 6605 CFS

6605 - 1873 = 4732 CFS OVER ROAD

4732 CFS ON RATING CURVE (P. D-15) $E_A = 4.8'$ OVER ROAD

RATING CURVE AT ROUTE 119



Gate Capacities

Determine approximate discharge capacities of gates @ Elev. Min 855.0 msl

DRAIN GATE

2'6" H x 4' W = 10 ft²
INVERT of GATE = 860.4
CENTERLINE OF GATE = 861.7

Capacity at top Drain = 865.0' msl

$Q = CA\sqrt{2gh}$

$Q = .7\ (10)\sqrt{2(32.2)24.15}$

$Q = 275$ cfs.

C = 0.7
g = 32.2
A = area
h = head

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST	(7) STATE	(8) COUNTY	(9) CONGR DIST	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
NH	301	NED	NH	005	02				PISGAH RESERVOIR DAM	4248.6	7226.9	05	JUL	79

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
PISGAH DAM	PISGAH RESERVOIR

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	08	PISGAH BROOK	HINSDALE	5	3270

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(27) IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
PGOT	1870	R	33	30	950	660	NED	N	N	N	N	05JUL79

(28) REMARKS

21-OT-STONE MASONRY 22-APPROXIMATE(REPAIRS IN 1923)

(29) D/S HAS	(30) SPILLWAY CREST LENGTH (FT.)	(31) SPILLWAY TYPE	(32) SPILLWAY WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) POWER CAPACITY PROPOSED (MW)	(37) NAVIGATION LOCKS NO	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
2	90	U	60	438												

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
NH DIVISION OF PARKS	I W JONES + COMPANY	

(49) REGULATORY AGENCY

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RES BOARD	NH WATER RES BOARD	NH WATER RES BOARD	NH WATER RES BOARD

(50) INSPECTION BY	(51) INSPECTION DATE DAY	MO	YR	(52) AUTHORITY FOR INSPECTION
ANDERSON-NICHOLS AND COMPANY INC	02	MAY	79	PUBLIC LAW 92-367 8AUG1972

(53) REMARKS

47 REPAIRS

END

FILMED

8-85

DTIC