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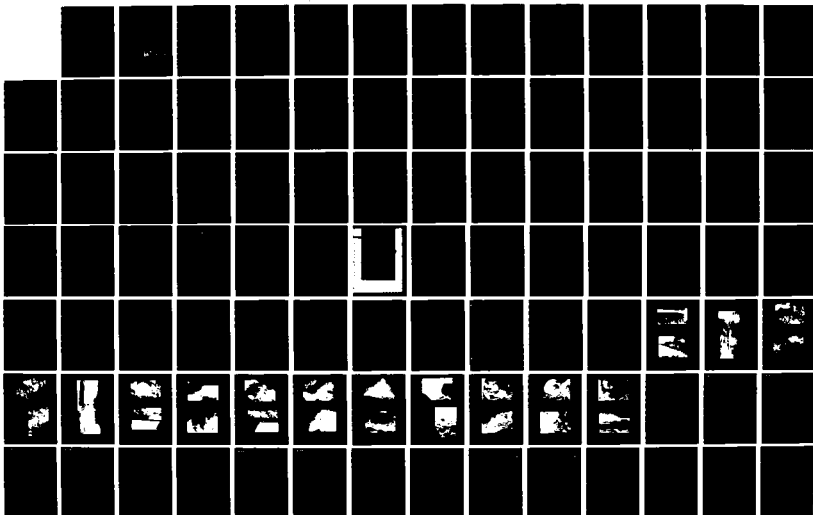
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
STILES POND DAM (VT 0... (U) CORPS OF ENGINEERS WALTHAM
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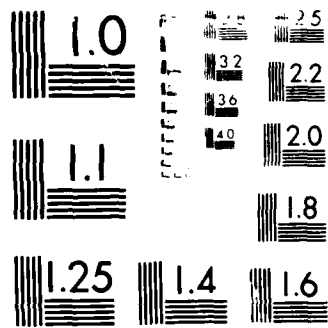
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AD-A157 515

CONNECTICUT RIVER BASIN
WATERFORD, VERMONT

STILES POND DAM
VT 00054

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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JUL 19 1985
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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

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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 Waterford, VT. Stiles Brook		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is an earth embankment structure that is 148 ft. long and 14 ft. high. The dam is in fair condition. It is intermediate in size with a significant hazard potential. There are various remedial measures and recommendations which must be undertaken by the owner.		

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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

MAR 05 1980

Honorable Richard A. Snelling
Governor of the State of Vermont
State Capitol
Montpelier, Vermont 05602

Dear Governor Snelling:

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

A copy of this report has been forwarded to the Department of Water Resources, the cooperating agency for the State of Vermont. In addition, a copy of the report has also been furnished the owner, the town of St. Johnsbury.

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

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

Sincerely,


MAX B. SCHEIDER

Colonel, Corps of Engineers
Division Engineer

Incl
As stated

LETTER OF TRANSMITTAL
FROM THE CORPS OF ENGINEERS TO THE STATE
TO BE SUPPLIED BY THE CORPS OF ENGINEERS

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
BRIEF ASSESSMENT

Identification No.: 00054
Name of Dam: Stiles Pond Dam
Town: Waterford
County and State: Caledonia, Vermont
Stream: Stiles Brook
Date of Inspection: September 11, 1979

Stiles Pond Dam is an earth embankment structure. The overall length of the dam including the spillway section is 148 feet and the embankment length is 120 feet. Maximum height of the dam is 14 feet as measured from the crest of dam to the streambed. Top width of the embankment section is 12 feet. The spillway is located at the right abutment and has a crest length of 17.9 feet. Outlet works consist of a gated 20 inch diameter pond drain and a gated 18 inch diameter water supply pipe. The dam was constructed in 1877. No original design drawings or calculations are available, although, there is a detailed report by the Vermont Department of Water Resources available, which includes drawings, hydrology and hydraulic calculations.

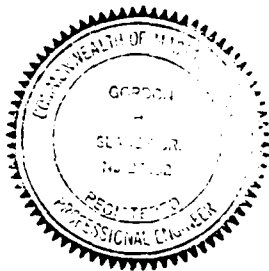
Visual inspection indicated that the dam is in fair condition. The inspection revealed; inadequate slope protection, heavy vegetation including trees on the downstream slope, local low areas on the dam crest and deterioration of the discharge channel training walls downstream of the dam.

Based on a maximum storage of 1825 acre-feet and a maximum height of 14 feet, Stiles Pond Dam falls within the intermediate size classification. The dam's hazard classification has been established as significant based on potential flooding of a camp ground. Based on the intermediate size of the dam and its significant hazard classification and in accordance with Corps of Engineers Guidelines, the test flood inflow should be of a magnitude ranging from 1/2 the Probable Maximum Flood (PMF) to the full PMF. One half the PMF was used for the test flood inflow, which is 4230 cfs. The routed test flood outflow of 2730 cfs overtops the dam by approximately 3.2 feet. With the water surface at the top of dam the spillway capacity is approximately 180 cfs (about 7 percent of the routed test flood outflow).

It is recommended that the owner engage a qualified registered professional engineer to; (1) design an acceptable means of removing the trees and their roots from the dam and spillway channel wall and backfilling the voids with appropriate material, (2) investigate a means of replacing or improving the stability of the stone training walls located immediately downstream of the spillway structure, (3) design adequate riprap protection for the upstream slope, (4) investigate the spillway adequacy and consider design modifications if necessary.

Remedial measures include the preparation of a downstream warning system in the event of emergency, and regular mowing of the downstream face of the dam.

The recommendations and remedial measures are described in Section 7 and should be addressed within 1 year after receipt of this Phase I Inspection Report by the owner.



Gordon H. Slaney, Jr.

Gordon H. Slaney, Jr., P.E.
Project Engineer

HOWARD NEEDLES TAMMEN & BERGENDOFF
Boston, Massachusetts

This Phase I Inspection Report on Stiles Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Richard J. Di Bruno

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, CHAIRMAN
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 be otherwise 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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(d) The stone training walls of the spillway discharge channel, between the spillway and roadway, are deteriorating and collapse of these walls could allow scour to occur just downstream of the embankment.

(e) The crest of the dam has local low areas which reduce the effective freeboard of the embankment.

(f) Spalling of the right spillway training wall was noted.

(g) The gates for the outlet works are located on the downstream side of the dam, thus keeping the pipes through the dam under continual pressure.

The outlet works consist of an intake structure, two conduits - a 20 inch C.I. drain pipe and an 18 inch C.I. and an underground valve chamber. The intake structure and conduits were below water and were not inspected. It was reported that the gates are operable.

The interior of the valve chamber was not inspected as access was not possible due to the heavy concrete cover. The surface of the chamber appeared to be in good condition.

c. Reservoir Area. The reservoir area is roughly oval in shape, the shoreline is wooded. Route 18 runs along the easterly shoreline of the reservoir. There are no dwellings docks or other structures on or near the banks of the pond.

d. Downstream Channel. Immediately downstream of the concrete training walls of the spillway and upstream of the roadway, the sides of the discharge channel are formed by unmortared stone walls as shown in Photos No. 21 and 22. The wall on the right side of the channel has started to collapse and the concrete cap which has fallen from the top of the wall into the channel can be seen in Photo No. 21. Trees growing between the stones continue to cause deterioration of this wall.

The stone wall on the left of the channel is shown in Photo No. 22. The wall has a very distinct bulge which may be caused by the roots of trees which are growing immediately behind the wall.

The roadway bridge over the discharge channel in Photo No. 23 consists of a steel plate pipe culvert, 8 feet in diameter. The top of the gravel surface roadway is approximately 2 feet above the top of the pipe. Both the roadway and the steel pipe appeared to be in fair condition.

3.2 Evaluation

Visual examination indicates that the dam is in fair condition. Visual examination revealed the following:

(a) Heavy vegetation is growing on the dam including several clumps of trees. If not removed, roots from these trees could cause future problems by providing shortened seepage paths through the dam.

(b) A large pile of debris has been placed at the downstream toe at the left abutment contact making it impossible to detect possible seepage in this area.

(c) The riprap slope protection is inadequate, particularly since records show that the dam was overtopped during the 1973 flood.

of the crest is uneven and has local low areas up to 1 foot deep. It appears that the crest surface has been eroded in the past causing the uneven topography.

Downstream Slope

The downstream slope is inclined at 2 horizontal to 1 vertical and is covered with tall grass and weeds as shown in Photo No. 5. Photo No. 8 is a panorama of the downstream slope and shows that several clumps of trees are growing on the slope.

No seepage or wet areas that could be attributed to seepage were observed on the slope. Earlier inspection reports indicate that surface runoff from the left abutment collects below the downstream toe of the embankment. According to personnel from the water department, drain pipes were installed to drain this area to the spillway channel below the dam. A drain pipe was observed in the channel wall and at the time of the inspection, a small amount of water was flowing out of the pipe.

Photo No. 9 shows a large pile of wood debris which has been placed at the downstream toe near the left abutment contact. This debris, from reservoir cleaning, makes it impossible to inspect this area for seepage.

c. Appurtenant Structures. Visual inspection of the concrete spillway, outlet works structure, spillway channel and service bridge did not reveal any evidence of stability problems. The concrete surface generally appeared to be in good condition except for cracks in the spillway structure and heavy spalling in the approach training walls. There was also evidence of efflorescence, a whitish crystalline deposit, on the concrete surface at the cracks.

The spillway structure, shown in Photos No. 10 thru 18, consists of two massive five foot thick concrete walls and a concrete spillway shaped as shown on the Spillway Profile in Figure 1 located in Appendix B. The concrete surface of the spillway structure has deteriorated in the form of cracks and spalling. Inspection of the training walls revealed concrete cracks and efflorescence deposit on the right walls as seen in Photo No. 16. Photos No. 13 and 14 indicate disintegration of the concrete structure at the right training wall.

Visual inspection of concrete spillway immediately downstream of the weir showed it to be in generally good condition, as seen in Photos No. 11, 12 and 19. The spillway channel consists of a rectangular concrete structure as shown on Section A-A and 'Spillway Profile', Figure 1, located in Appendix B.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Stiles Pond Dam was made on September 11, 1979. The inspection team consisted of personnel from Howard, Needles, Tammen & Bergendoff and Geotechnical Engineers, Inc. A representative of the owner was also present during the inspection. Inspection checklists, completed during the inspection, are included in Appendix A. At the time of inspection, the water level was approximately 11 inches below the crest of the spillway. The upstream face of the dam could only be inspected above this level.

b. Dam. Visual inspection of the dam indicated that it is in fair condition.

The dam is an earth embankment structure about 120 feet long and is about 14 feet above stream level. A concrete spillway passes through the dam at the right abutment.

Upstream Slope

Approximately 3 feet of the upstream slope was above the water line at the time of inspection. Based on information from previous inspection reports the upstream slope is inclined at 2 horizontal to 1 vertical. Photo No. 2 shows the entire upstream slope from the spillway training wall shown in the lower right hand corner to the left abutment. For the greatest part of its length, the upstream face has a vertical stone wall above a sloping beach. Photo No. 7 shows a portion of the vertical stone wall about 30 feet to the left of the spillway. At this point, the wall is about 2 feet high.

Photo No. 7 also shows the nature of the rip-rap slope protection on the upstream slope. As shown in Photo No. 2 slope protection extends about 30 feet from the spillway towards the left abutment. The remainder of the slope has no rip-rap.

Roots from large brush have been left in place on the slope after the brush has been cut. These roots have rotted and are easily pulled from the embankment. One of the root clumps is shown in Photo No. 6.

Crest

The crest of the dam is about 12 feet wide and is covered with tall grass and weeds as shown in Photo No. 4. The surface

SECTION 2
ENGINEERING DATA

2.1 Design

No original design data were disclosed for Stiles Pond Dam. However, a report on the dam including inspection, pertinent data and hydrologic and hydraulic analyses was prepared by the Vermont Department of Water Resources in 1977. The dam was constructed about 1877. It is reported that the spillway was reconstructed in 1947 and repaired in 1960.

2.2 Construction

No construction records are available for use in evaluating the dam.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. There is no design engineering data available for Stiles Pond Dam. However, a report prepared in 1977 by the Vermont Department of Water Resources includes an inspection report, pertinent data and a hydrologic and hydraulic analysis. In addition there are inspection reports by the Vermont Department of Water Resources on file in the Department's offices in Montpelier, Vermont.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Validity. Since no original plans of this dam are available the information shown in this report is based on the results of the visual inspection, and plans prepared by the Vermont Department of Water Resources as part of the above mentioned report.

(6) Downstream Channel - The channel downstream of the spillway has sides formed by unmortared stone. About 110 feet downstream of the spillway there is a gravel roadway crossing the channel which is enclosed in an 8 foot diameter boiler plate conduit. There is some rip-rap protection for the roadway fill. Downstream of the roadway the channel has a bottom width of 12 feet the left bank consists of an unmortared stone wall for about 200 feet. The right bank consists of rip-rap on a two horizontal to one vertical slope.

j. Regulating Outlets. The 20 inch diameter pond drain pipe has an approximate invert of 856.0. The actual intake invert is unknown. The line is gated at a location about 35 feet downstream of the dam. It is estimated that when the water surface is at the normal pool elevation the maximum discharge is 35 cfs. An 18 inch pipe to the water supply system is gated at the valve chamber located downstream of the toe of slope. There is no data regarding the intake elevation.

- (2) Flood Control Pool - N/A
- (3) Spillway Crest - 150
- (4) Test Flood Pool - 202
- (5) Top Dam - 202

g. Dam

- (1) Type - earth
- (2) Length - 120 feet-embankment only
- (3) Height - 14 feet
- (4) Top Width - 12 feet
- (5) Side Slopes - upstream and downstream 2 horizontal to
1 vertical
- (6) Zoning - unknown
- (7) Impervious core - unknown
- (8) Cutoff - unknown
- (9) Grout Curtain - unknown
- (10) Other - unknown

h. Diversion and Regulating Tunnel

See Section j below.

i. Spillway

- (1) Type - concrete-broad crest weir
- (2) Length of Weir - 17.9 feet
- (3) Crest Elevation - 878.4
- (4) Gates - none
- (5) Upstream Channel - none

(3) The spillway capacity with the water surface at the top of the dam, elevation 880.8, is about 180 cfs.

(4) the spillway capacity with the water surface at the test flood elevation of 883.8 is about 600 cfs.

(5) The total project discharge at the test flood elevation of 883.8 is approximately 2730 cfs.

c. Elevation (feet above NGVD)

- (1) Streambed at centerline of dam - 866.5
- (2) Maximum tailwater - unknown
- (3) Upstream invert of outlet works - 866.0 Estimated
- (4) Normal pool - 878.4
- (5) Full flood control pool - N/A
- (6) Spillway crest (permanent spillway) - 878.4
- (7) Design surcharge - unknown
- (8) Top Dam - 880.8
- (9) Test Flood Surcharge - 883.8

d. Reservoir (miles)

- (1) Length of Maximum Pool - 1.3
- (2) Length of Normal Pool - 1.2
- (3) Length of Flood Control Pool - N/A

e. Storage (gross acre-feet)

- (1) Normal Pool - 1400
- (2) Flood Control Pool - unknown
- (3) Spillway Crest Pool - 1400
- (4) Top of Dam - 1825

f. Reservoir Surface (acres)

- (1) Normal Pool - 150

e. Ownership. The dam is owned by the Town of St. Johnsbury, 36 Main Street, St. Johnsbury, Vermont, 05819.

f. Operator. This dam is operated by the Town of St. Johnsbury, 36 Main Street, St. Johnsbury, Vermont, Mr. David T. Clark, Town Manager. Telephone No. 802/748-3926.

g. Purpose of Dam. The impoundment is used as a water supply for the Town of St. Johnsbury. It is a single purpose reservoir. No recreational use is allowed.

h. Design and Construction History. The present dam was built circa 1877. Prior to that time there was a sawmill at the site, however, it is not known whether or not the dam was constructed for the mill. The spillway section may have been reconstructed in 1947. In 1960 the downstream side of the dam was refaced and the wingwalls were repaired.

i. Normal Operating Procedures. The reservoir is normally left to maintain its own level. The 18 inch water supply pipe is normally open and the pond drain pipe valve closed.

1.3 Pertinent Data

a. Drainage Area. The area tributary to Stiles Pond consists of 6.08 square miles of rolling to mountainous, wooded terrain. The watershed has a length of about 3 miles and a width of 2.5 miles. Route 18 divides the drainage area, and the proposed route of the Route I-93 extension also crosses the watershed. Maximum elevation in the basin is 2017 feet NGVD at the westerly boundary, and there are five other peaks that rise above 1500 feet NGVD. The normal reservoir elevation is 878.0.

The reservoir is 150 acres in extent. The shoreline is wooded and there are no buildings in the immediate area. Route 18 runs along the easterly shore.

b. Discharge at Dam Site.

(1) The outlet works for Stiles Pond consist of a 20 inch pond drain pipe, which is gated about 35 feet downstream of the dam. It is estimated that the invert is at elevation 866.0. With the water surface at the normal water level the capacity would be about 35 cfs. The intake elevation of the 18 inch water supply line is unknown.

(2) There are no records of maximum discharge at the site. However, it was reported that in June of 1973 the dam was overtopped by about 2 feet, which would correspond to a discharge of about 1500 cfs.

b. Description of Dam and Appurtenances. Stiles Pond Dam is an earth structure with an embankment length of 120 feet and an overall length including the spillway of 148 feet. Maximum height of the dam from crest to streambed is 14 feet at the spillway, however the maximum embankment height from crest to toe of slope is seven feet. The upstream face has a stone wall for most of the embankment length, which has a vertical upstream face. The width of the crest is 12 feet. Both the upstream and downstream embankments are on a 2 horizontal to 1 vertical slope. There is rip-rap on the upstream face and the downstream face is protected with grass.

The spillway, located at the right abutment, is constructed of concrete and has a horizontal broad crest 17.9 feet long. The crest of the weir varies from 4.5 feet to 7.5 feet wide with a 20 to 1 slope. The spillway drops vertically 8.5 feet on the downstream side of the weir to a concrete apron 17.9 feet wide and 19.5 feet long. Spillway training walls are about 2.4 feet higher than the weir crest at a maximum and are stepped down both upstream and downstream of the weir crest for a total length of 50 feet. Downstream of the weir there is a railroad rail between the training walls. It is not known what purpose this railroad rail serves.

Outlet works consist of an 18 inch cast iron water supply outlet and a 20 inch pond drain pipe. The intake elevations of these pipes are unknown. The 18 inch pipe is gated at the dam in a valve chamber located downstream of the dam and near the spillway. The pond drain is gated at a point about 35 feet downstream of the dam near the outlet channel.

Figure 1 located in Appendix B, shows a plan of the dam and its appurtenant structures. Photographs of each structure are shown in Appendix C.

c. Size Classification. Intermediate (hydraulic height-14 feet, Storage 1825 acre-feet) classification based on the storage being between 1000 acre-feet and 50,000 acre-feet and the height being less than 40 feet as given in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. The potential for hazard posed by this dam is classified as significant. Failure of the dam with the water surface at the top of dam would result in a flood wave about 7.1 feet high through the reach extending from the dam to the confluence of Stiles Brook and Moose River 1 mile downstream. Two bridges 800 feet and 4200 feet downstream of the dam may be affected. At the confluence of Stiles Brook and Moose River there is a campground located 5 to 6 feet above the streambed. A portion of the campground would be flooded by one to two feet. Some tents and trailers may be in this area thus there will be some hazard to life.

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
STILES POND 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. Howard, Needles, Tammen & Bergendoff has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed were issued to Howard, Needles, Tammen & Bergendoff under a letter of August 24, 1979 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0060 has been assigned by the Corps of Engineers for this work.

b. Purpose

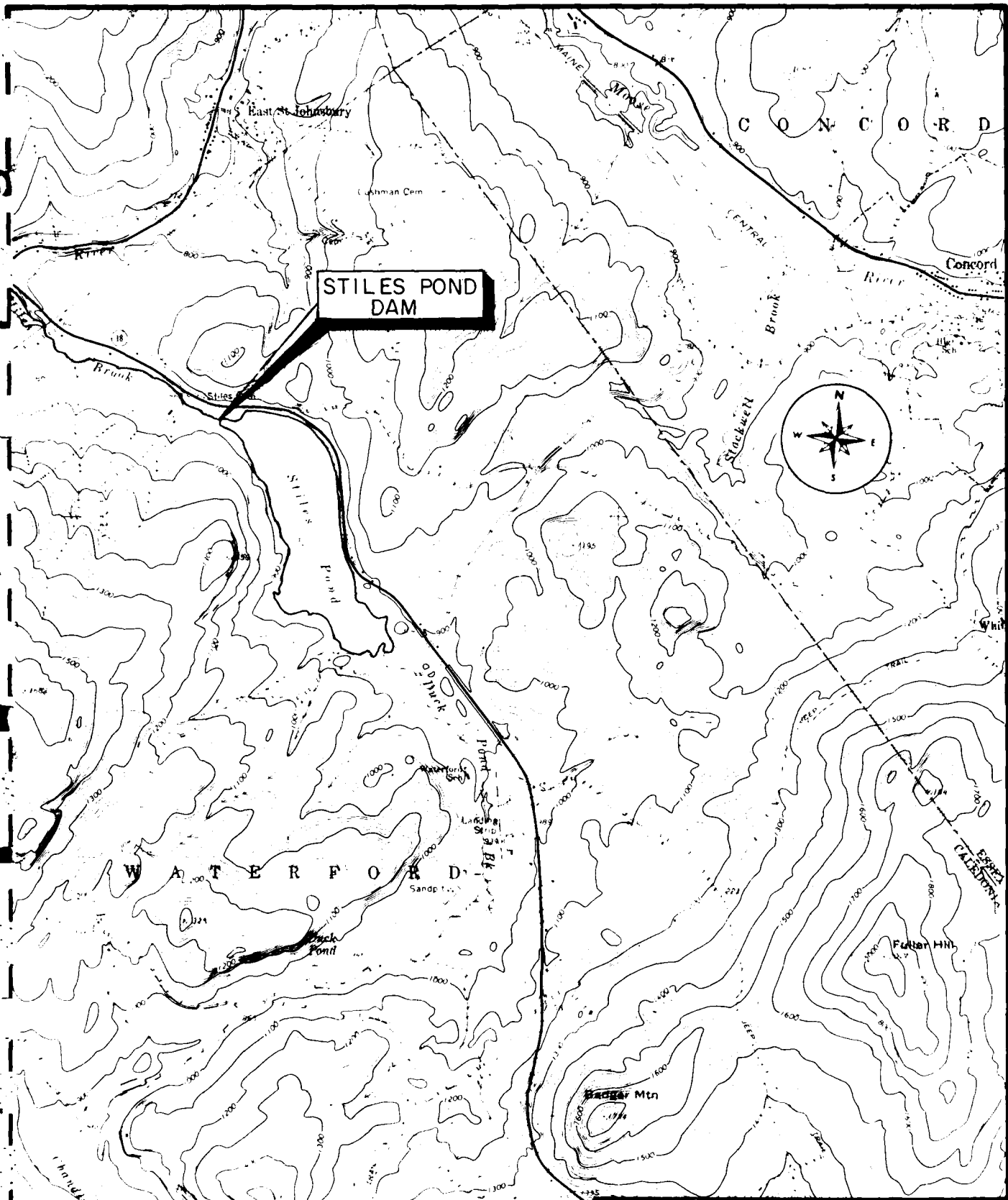
(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(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.

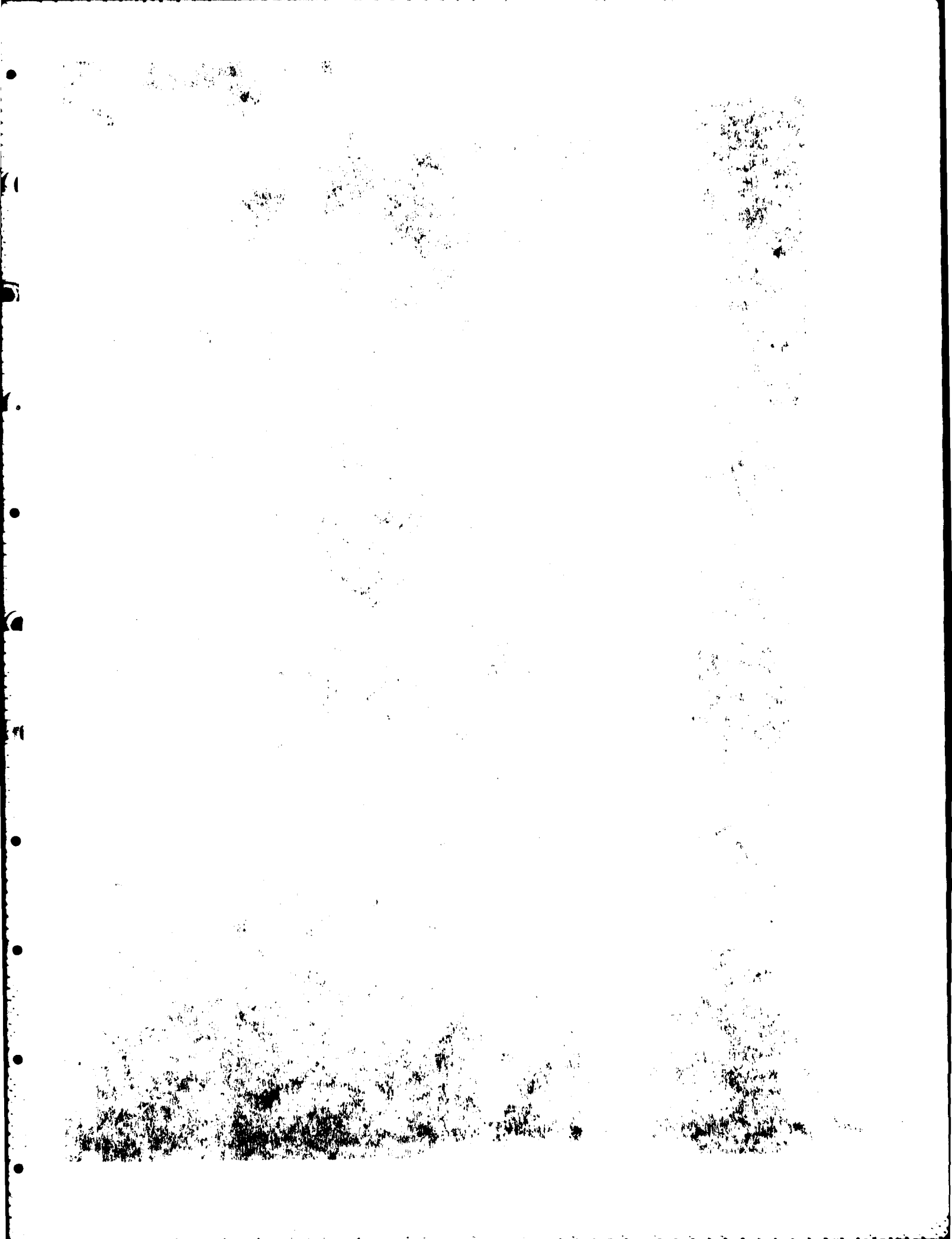
1.2 Description of Project

a. Location. Stiles Pond Dam is located along Stiles Brook tributary to Moose River about 1 mile upstream of the confluence of Stiles Brook and Moose River in the Town of Waterford, Vermont. The dam is shown on U.S.G.S. Quadrangle Concord, Vermont, with approximate coordinates N44°25'20" E71°56'49", Caledonia County, Vermont. The location of the dam is shown on the preceding page.



STILES POND DAM

NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS	
STILES POND DAM LOCATION MAP	
Waterford, Vermont USGS Quad. Concord, Vt	Scale 1:32,000 FEET 2000



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SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedure

Stiles Pond Dam is used to provide a water supply for the Town of St. Johnsbury. Water is released to the system through an 18 inch diameter cast iron pipe. This pipe is gated at the dam. The reservoir is left to maintain its own level and, other than drawoff for water supply, discharge would only occur when the water level is above the spillway crest. The 20 inch diameter pond drain pipe is usually closed.

4.2 Maintenance of Dam

There is no regular maintenance procedure in effect. Repairs are made on an as needed basis.

4.3 Maintenance of Operating Facilities

The gate for the pond drain pipe is operated once a year, and the water supply intake screen is also cleaned on a yearly basis. Repairs are made as needed.

4.4 Description of Warning Systems

There are no warning systems in effect for this facility.

4.5 Evaluation

The current operation and maintenance procedures for this dam are inadequate to insure that problems encountered can be remedied within a reasonable period of time.

The owner should establish a written operational procedure as well as establishing a warning system to follow in the event of emergency conditions.

SECTION 5
HYDROLOGY AND HYDRAULIC ANALYSIS

5.1 Evaluation of Features

a. General. Stiles Pond Dam is an earth structure. The embankment is 120 feet long, with a maximum embankment height of 7 feet. The dam is 14 feet high from crest of dam to the streambed. The maximum height occurs at the spillway section located at the right abutment. The spillway is a broad crest weir with a crest length of 17.9 feet. Outlet works consist of a 20 inch diameter gated pond drain and an 18 inch diameter water supply outlet pipe which is gated at a valve chamber downstream of the dam embankment.

The impoundment is used for water supply for the Town of St. Johnsbury. The dam is classified as intermediate in size with a height of 14 feet and maximum storage of 1825 acre-feet.

b. Design Data. No original hydrologic hydraulic design data were disclosed. However, a hydrologic and hydraulic study was completed as part of a report prepared by the Vermont Department of Water Resources.

c. Experience Data. There are no records of maximum discharge at the site. However, it was reported that in June of 1973 the dam was overtopped by about two feet, which would correspond to a discharge of about 1500 cfs.

d. Visual Observations. The crest of the dam has local low areas and inadequate rip-rap protection. While it is not certain, this may have been caused by the June 1973 event.

e. Test Flood Analysis. No detailed design and operational information are available for this dam. However, the study noted in paragraph 5.1.b did include hydrologic and hydraulic data. The hydrologic evaluation was performed using the above data and information gathered by field investigation, watershed characteristics, and Probable Maximum Flood (PMF) curves prepared by the Corps of Engineers. In accordance with Corps of Engineers Guidelines the significant hazard classification and intermediate size classification of this dam warrants a test flood magnitude ranging from 1/2 the PMF to the full PMF. A test flood equal to 1/2 the PMF was used. The 1/2 PMF magnitude is used as the reservoir storage of 1825 acre-feet was on the low end of the size classification range of 1000 acre-feet to 50,000 acre-feet. A test flood inflow of 4230 cfs is based on calculations by the Vermont Department of Water

Resources and the 1/2 PMF runoff of 9.5 inches. The Water Resources study includes the development of a hydrograph for a 100 year storm. The hydrograph yields an inflow to Stiles Pond of 1353 cfs with a total runoff of 3.04 inches. This was proportioned to the 1/2 PMF runoff to obtain the test flood inflow.

The routed test flood outflow was determined in accordance with Corps of Engineers Guidance for Estimating Effect of Surcharge Storage on Maximum Probable Discharge, and the hydraulic characteristics of the dam. The stage-discharge curve was developed by calculating discharge over the spillway section as a broad crest weir with a coefficient of 2.65. Discharge over the dam crest and training walls was also calculated as weir flow with a coefficient of 3.09. The routing was started with the water surface at the crest of the spillway. The routed test flood outflow was determined to be approximately 2730 cfs. As the maximum capacity of the spillway is approximately 180 cfs (about 7 percent of the routed test flood outflow) the dam will be overtopped by 3.2 feet.

f. Dam Failure Analysis. The impact of failure of the dam was assessed using the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs prepared by the Corps of Engineers. The breach discharge was estimated with the water surface at the crest of the dam and a breach width equal to 40 percent of the length of the dam at mid height. It should be noted that even though the maximum embankment height is 7 feet the failure could extend to the streambed near the spillway section. It is assumed that the spillway section would remain during a failure event. The downstream hydrograph is a sum of the breach discharge and the maximum spillway discharge. Prior to the breach of dam the downstream river stage would be about 1.5 feet with the spillway at a full capacity discharge of 180 cfs. Breach of dam would result in an additional 2110 cfs for a total of 2290 cfs. The downstream stage was estimated using an average channel cross section in the reach between the dam and the confluence of Stiles Brook and Moose River 1 mile downstream. The flood stage in this reach would be about 7.1 feet and would not vary much in height due to the small volume of channel storage. In this reach there are two bridges; one 800 feet downstream provides access to one dwelling, the bridge would probably be damaged, the other, 4200 feet downstream is a town road and may sustain some damage. Along Stiles Brook immediately upstream of the confluence is a motel set about 15 feet above the channel and about 15 feet from the top of bank. This structure would not be directly affected but may be endangered if significant erosion occurs. Opposite Stiles Brook at the confluence is a campground which is 5 to 6 feet above the channel of Moose River, see Photo No. 26. This area would be affected by the floodwave.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation. The visual inspection of Stiles Pond Dam did not reveal any immediate stability problems. However; several features, which if left unattended, could reduce the stability of the dam. These features include (1) trees growing on the downstream slope just below the crest elevation, (2) deteriorating stone spillway training walls which if allowed to collapse could result in scour at the downstream toe area of the embankment. Earlier inspection reports indicate the dam was overtopped in 1973. It was reported that no damage to the dam or spillway occurred during this event, and no repairs were required. In any case overtopping may have caused the minor erosion of the crest resulting in low areas along the crest, which may not have been noticed after the event.

b. Design and Construction Data. No design and construction data was available for review.

Two inspection reports were prepared by the New Hampshire Department of Water Resources. One report is dated April, 1975 and the second, February, 1977. These reports indicate that the dam was built in 1877 and the spillway section reconstructed in 1947. Both reports indicate that the embankment was in good condition. The reports do indicate that some riprap had been displaced and that trees were beginning to grow on the embankment. The 1977 report indicates that an 18-inch diameter water main and a 20-inch diameter pond drain pass through the embankment. It is not known if the pipes have antiseep collars.

c. Operating Records. No operating records were made available.

d. Post-Construction Changes. Previous inspection reports indicate that the present spillway structure was reconstructed in 1947. In 1960 the spillway was repaired.

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 of Stiles Pond Dam indicates that the dam is in fair condition. The inspection revealed the following:

(1) Heavy vegetation is growing on the dam including several clumps of trees. If not removed, roots from these trees could cause future problems by providing shortened seepage paths through the dam.

(2) A large pile of debris has been placed at the downstream toe at the left abutment contact making it impossible to detect possible seepage in this area.

(3) The riprap slope protection is inadequate, particularly since records show that the dam was overtopped during the 1973 flood.

(4) The stone training walls of the spillway discharge channel, between the spillway and roadway, are deteriorating and collapse of these walls could allow scour to occur just downstream of the embankment.

(5) The crest of the dam has local low areas which reduce the effective freeboard of the embankment.

(6) Spalling of the right spillway training wall was noted.

(7) Controls for the outlet works are located downstream of the dam.

The hydraulic analysis reveals that the spillway cannot pass the routed test flood without overtopping the dam.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency. This dam is in generally fair condition. The recommendations and remedial measures described in Sections 7.2

and 7.3 should be accomplished within one year after receipt of this Phase I Inspection Report by the owner.

d. Necessity of Additional Investigation. No additional investigation is needed to complete the Phase I inspection.

7.2 Recommendations

The owner should engage a qualified registered professional engineer to (1) design an acceptable means of removing the trees and their roots from the dam and spillway channel wall and backfilling the voids with appropriate material, (2) investigate a means of replacing or improving the stability of the stone training walls located immediately downstream of the spillway structure, (3) design adequate riprap protection for the upstream slope, (4) investigate the spillway adequacy and consider the design of modifications if necessary, (5) investigate the feasibility of putting controls for the outlet pipes on the upstream side of the dam.

7.3 Remedial Measures

(1) Remove the wood debris piled at the downstream toe of the embankment.

(2) Mow the slope and crest of the embankment regularly.

(3) Prepare a downstream warning system in the event of an emergency.

(4) A technical inspection program should be initiated and continued on a yearly basis.

(5) Repair the spalling concrete on the right training wall of the spillway.

7.4 Alternatives

There are no practical alternatives to the recommendations of Sections 7.2 and 7.3.

APPENDIX A
INSPECTION CHECKLIST

PERIODIC INSPECTION CHECK LIST

A-2

PROJECT Stiles Pond

DATE Sept. 11, 1979

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
Crest Elevation	880.8
Current Pool Elevation	877.5
Maximum Impoundment to Date	883 approximate June 1973
Surface Cracks	None visible - vegetation very dense.
Pavement Condition	No pavement.
Movement or Settlement of Crest	None observed - surface of crest is uneven.
Lateral Movement	No misalignment observed.
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	Deterioration of spillway upstream training wall.
Indications of Movement of Structural Items on Slopes	No structural items on slope.
Trespassing on Slopes	There is a walking path.
Sloughing or Erosion of Slopes or Abutments	None
Rock Slope Protection - Riprap Failures	Riprap near spillway only.
Unusual Movement or Cracking at or near Toes	None observed.
Unusual Embankment or Downstream Seepage	No seepage observed.
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None
Vegetation	Heavy grass, brush and small trees.

PERIODIC INSPECTION CHECK LIST

A-4

PROJECT Stiles Pond

DATE Sept. 11, 1979

PROJECT FEATURE Control Tower

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - CONTROL TOWER</u></p> <p>a. Concrete and Structural</p> <p> General Condition</p> <p> Condition of Joints</p> <p> Spalling</p> <p> Visible Reinforcing</p> <p> Rusting or Staining of Concrete</p> <p> Any Seepage or Efflorescence</p> <p> Joint Alignment</p> <p> Unusual Seepage or Leaks in Gate Chamber</p> <p> Cracks</p> <p> Rusting or Corrosion of Steel</p> <p>b. Mechanical and Electrical</p> <p> Air Vents</p> <p> Float Wells</p> <p> Crane Hoist</p> <p> Elevator</p> <p> Hydraulic System</p> <p> Service Gates</p> <p> Emergency Gates</p> <p> Lightning Protection System</p> <p> Emergency Power System</p> <p> Wiring and Lighting System</p>	<p>This facility has no tower.</p>

PERIODIC INSPECTION CHECK LIST

A-5

PROJECT Stiles Pond

DATE Sept. 11, 1979

PROJECT FEATURE Outlet Work Conduit

NAME S. Mazur

DISCIPLINE Hydraulic/Structural

NAME R. Yarsites

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - TRANSITION AND CONDUIT</u></p> <p>General Condition of Concrete</p> <p>Rust or Staining on Concrete</p> <p>Spalling</p> <p>Erosion or Cavitation</p> <p>Cracking</p> <p>Alignment of Monoliths</p> <p>Alignment of Joints</p> <p>Numbering of Monoliths</p>	<p>At the time of inspection, 20" C.I. drain and 18" C.I. main were under water. These conduits were reported to be in good condition.</p>

PERIODIC INSPECTION CHECK LIST

A-6

PROJECT Stiles Pond

DATE Sept. 11, 1979

PROJECT FEATURE Outlet Structure/Channel

NAME S. Mazur

DISCIPLINE Structural/Hydraulic/Geotechnical

NAME R. Yarsites, D. LaGatta

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Concrete	Cast iron outlet pipes and concrete control chamber appeared to be in good condition.
Rust or Staining	None
Spalling	None
Erosion or Cavitation	None
Visible Reinforcing	None
Any Seepage or Efflorescence	None
Condition at Joints	None
Drain Holes	None
Channel	Pond drain discharge to spillway discharge channel.
Loose Rock or Trees Overhanging Channel	None
Condition of Discharge Channel	None

PERIODIC INSPECTION CHECK LIST

A-7

SUBJECT Stiles Pond DATE Sept. 11, 1979

SUBJECT FEATURE Outlet Works/Spillway NAME D. LaGatta

DISCIPLINE Structural/Hydraulic/Geotechnical Engineers NAME S. Mazur, R. Yarsites

AREA EVALUATED CONDITION

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS

Approach Channel	No approach channel
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
Weir and Training Walls	Good
General Condition of Concrete	Some staining
Rust or Staining	Heavy spalling (Photo)
Spalling	None
Any Visible Reinforcing	Efflorescence at concrete cracks (Photo)
Any Seepage or Efflorescence	No drain holes in walls
Drain Holes	
Discharge Channel	Poor
General Overall Condition	Stone walls lining channel are deteriorated. Some collapse.
Loose Rock Overhanging Channel	Trees are overhanging channel boulder covered.
Trees Overhanging Channel	
Floor of Channel	
Other Obstructions	There is a steel pipe about 7 ft in diameter just downstream of spillway which forms a "bridge" across channel. This is a channel constraint.

- . To recommend appropriate action to be taken with regards flood hazards associated with the existing structure.
- . To recommend necessary corrective repairs and alterations.

SCOPE

This investigation included a visual inspection on September 13 and a topographic survey which was essentially completed on October 20, 1974. Office studies of the spillway capacity and the ability of the structure to pass flood flows were conducted, and the organization of the various findings have been incorporated into report.

A draft of the report was sent to the Town Manager and the local Legislative Representative on April 11, 1975 for review and comment. To date, no comments have been received.

On June 10, 1975, Department engineers conducted further field investigations to gather additional background information. They were assisted by Mr. Raymond Johnson, a retired municipal employee.

WATERSHED DESCRIPTION

The watershed for the Stiles Pond Dam lies fully within and at the northern corner of the Town of Waterford, and covers an area of 5.81 square miles (see Appendix 1). It has a subrectangular shape and is oriented roughly NW-SE with a length of about 3 miles and a maximum width of approximately 2.5 miles. The southeastern boundary of the watershed is basically defined by Hurlburt Hill, Hurlburt Mountain, and Fuller Mountain.

Stiles Pond is located at the northeastern end of the watershed and is roughly two miles east of St. Johnsbury. The pond is fed by

STILES POND DAM

INTRODUCTION

Vermont has a long history of major floods during which loss of and considerable property damage has occurred. The failure of dams has added materially to the peak flood flows and related losses. Usually, many of these failures are a result of either inadequate spillways, improper design and/or construction, or improper or inefficient maintenance.

Under Title 10, Vermont Statutes Annotated, Chapter 43, the Water Resources Board has jurisdiction over all dams impounding more than 500,000 cubic feet of water and not incident to the generation of electric energy for public use or used exclusively as an integral part of an agricultural enterprise. The Department of Water Resources assists the Board by conducting a continuing program of inspection and investigations of existing statute-size dams. These investigations serve as a means of obtaining up-to-date information on existing dams, particularly with regards to their maintenance and their safety. As a part of this program, an investigation was made of the Stiles Pond

PURPOSE

1. To summarize the findings obtained from the Department's investigation of the Stiles Pond Dam located in the Town of Waterbury, Caledonia County, Vermont.
2. To report on the present condition of the structure and on the adequacy of its maintenance.
3. To determine the capacity of the spillway and evaluate its ability to pass reasonable flood flows.

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Agency of Environmental Conservation
Department of Water Resources
Management & Engineering Division

February, 1977

INSPECTION REPORT

on

STILES POND DAM

Waterford, Vermont

Location	Town of St. Johnsbury
Year Built	1877
Type of Dam	Earth Fill with Concrete Gravity Spillway
Catchment Area	5.81 sq. mi.
Available Spillway Capacity	266 cfs (no freeboard)
Available Peak Flood Flows (100 year Storm)	Inflow - 1353 cfs Outflow - 366 cfs (existing conditions) - 297 cfs (under suggested modifications)

down because water was so high. It is very (V. 18) during
the June flooding above. There are some side dikes, but the
highest stones. It is placed there as shown on the upstream
face of the dam.

FILE COPY

ROUTING		
GENERAL		
TO	NOTED	DATE
CR		4/11/75
DMS	elm	4/11/75
JEC	GHS JEC	4-11-75
SUBPEND TO		
FILE <i>Stiles Pond Dam</i>		

MANAGEMENT & ENGINEERING DIVISION

April 11, 1975

Mr. David T. Clark
Town Manager
Town of St. Johnsbury
St. Johnsbury, Vermont 05819

Re: Stiles Pond Dam

Dear Mr. Clark:

A request was made for a safety inspection of the dam at Stiles Pond following the flood of 1973. A brief inspection was made at that time and we were satisfied that there was no immediate danger for the safety of the dam. It was noted, however, that sufficient plans showing the design and construction of the dam were not available for proper inspection. Engineering surveys were subsequently made in order to have some documentation of the condition of the dam as well as to evaluate the hydraulic capability of the structure.

Enclosed is a recently completed preliminary inspection report for Stiles Pond Dam in Waterford. I call your attention specifically to the recommendations made in Section 7 of the report. Most of the recommendations can be carried out by your available staff. Some engineering assistance may be required prior to determining the quantities and location of earth fill for preventing overtopping during high pond levels.

After you have had a chance to review this report, we would welcome an opportunity to discuss the details with you either at your office or at the site. Following such a conference and further evaluation being conducted by our staff, we would then finalize the report. Please call Donald Manning at 828-2393 for making arrangements for the joint site inspection.

Sincerely yours,

Andre J. Rouleau
Assistant Director

AJR/kmp

cc: Representative Edward T. Crane, St. Johnsbury *w/ report + plans also*

STATE OF VERMONT

TO: *Don Manning*

FROM: *ASR J*

DATE: *1/25/74*

SUBJECT: *Little Pond Dam - St. Johnsbury.*

- | | | |
|---|--|--|
| <input type="checkbox"/> APPROVAL | <input type="checkbox"/> NOTE AND SEE ME | <input type="checkbox"/> PER CONVERSATION |
| <input type="checkbox"/> SIGNATURE | <input type="checkbox"/> NOTE AND RETURN | <input type="checkbox"/> AS REQUESTED |
| <input type="checkbox"/> COMMENT | <input type="checkbox"/> NOTE AND FILE | <input type="checkbox"/> NECESSARY ACTION |
| <input type="checkbox"/> REVIEW | <input type="checkbox"/> FOR YOUR INFORMATION | <input type="checkbox"/> GIVE ME THE FACTS |
| <input type="checkbox"/> PREPARE REPLY FOR MY SIGNATURE | <input type="checkbox"/> SUGGESTIONS REQUESTED | |
| <input type="checkbox"/> YOUR ACTION REQUESTED BY THIS DATE | | |

REMARKS:

*Request from Rep. Ed. Kane - St. J.
to SEC.*

*Investigate and general inspection of
dam. Apparently had water over earth fill
portion during 73 flood - poor situation!
Recommend what action to take - raise fill?
enlarge spillway?
etc.*

*Contact ⁷³ Dave Clark - St. J. Town Manager.
can wait till spring but might be able
to research before then. Dave Clark may have plans*

and →

DEPARTMENT OF WATER RESOURCES

MEMORANDUM

TO: File
FROM: Harlan Farnsworth
RE: Stiles Pond (Res.), Waterford
DATE: July 18, 1972
FILE:

15		
T	10: D	
H/F	1/2	7/18/72 ✓
Su	(1)	
File		

Ownership of dam: Town of St. Johnsbury
Public Water Supply

Description:

Dam is located at the north end of pond. It is an earth-filled structure that is approximately 180 feet long and 15 feet high. A large concrete spillway and the east side of the dam is some 25 feet wide and has a 12 foot drop. Thirty foot abutments extend along both sides and a concrete apron extends between the two abutments on the downstream side. A large conduit leads from the dam to a filtration and chlorinating plant downstream.

The earth embankment, about 100 feet long at the top, has side slopes of about 1 on 2, its top width being 12 feet. Stone riprap is provided on the upstream face while the top and downstream face has a sod cover. A below-water intake is contained in this section.

Comments on Inspection

From the superficial examination made on April 25, 1950, the physical condition of the dam was noted as follows:

- a. General appearance of the dam is good.
- b. Earth embankment is in a stable condition.
- c. Spillway section concrete is sound except for some surface disintegration in the end walls.
- d. Proper maintenance is being provided.

Analysis

For average conditions the dam is stable enough.

For unusual flood conditions, the dam does not have spillway capacity enough to accommodate a probable maximum flood. Past record floods in the vicinity indicate a flood peak inflow of about 3500 c.f.s. being possible.

Conclusions

Although Stiles Pond dam is in a good condition, it lacks the discharge capacity generally provided with this type of structure.

Stephen H. Haybrook
Stephen H. Haybrook
Hydraulic Engineer

May 11, 1950

Report #136



STATE OF VERMONT
WATER CONSERVATION BOARD

MONTPELIER, VERMONT

REPORT ON STILES POND DAM

Stiles Pond dam is one of those now in the jurisdiction of the State Water Conservation Board. A report on its condition is made after an examination of the structure.

General Data

1. Location of dam - Town of Waterford, Vermont.
2. Stream on which located - Stiles Brook, contributing to Moose River.
3. Owner and Operator of dam - Village of St. Johnsbury.
4. Purpose of dam - Water Supply.
5. Size of Pond - At spillway crest level, the surface area is about
120 acres and the volume estimated at 21,000,000 cu. ft.
6. Drainage Area - Approximately 6 square miles.

Type of Dam

This dam is of earth with a solid concrete overflow section at the north abutment, all resting on an earth foundation. The overflow section has the greatest depth being 14 feet between top of dam and channel bottom. The spillway is 2 feet lower and has a flat crest 6 to 7 feet wide and about 18 feet long. It has vertical faces. End walls about 5 feet thick retain the embankment. A concrete splash apron is provided at the downstream toe.

PAST INSPECTION REPORTS

APPENDIX B
ENGINEERING DATA

1. LIST OF DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS - NONE AVAILABLE
2. PAST INSPECTION REPORTS
3. PLAN AND DETAILS

PERIODIC INSPECTION CHECK LIST

A-8

PROJECT Stiles Pond

DATE Sept. 11, 1979

PROJECT FEATURE Service Bridge

NAME S. Mazur

DISCIPLINE Structural Engineer

NAME _____

AREA EVALUATED	CONDITION
----------------	-----------

OUTLET WORKS - SERVICE BRIDGE

a. Super Structure

- Bearings
- Anchor Bolts
- Bridge Seat
- Longitudinal Members
- Under Side of Deck
- Secondary Bracing
- Deck
- Drainage System
- Railings
- Expansion Joints
- Paint

Service bridge over discharge channel consists of 8 feet diameter steel plate pipe culvert. The steel pipe appeared to be in generally good condition.

b. Abutment & Piers

- General Condition of Concrete
- Alignment of Abutment
- Approach to Bridge
- Condition of Seat & Backwall

two brooks and various intermittent and ephemeral streams. The first brook originates at a small pond which is located roughly 1.7 miles south-southwest of the dam and flows in a northeasterly direction, entering Stiles Pond at its southern end. The second inlet, Duck Pond Brook, also enters the pond at its southern end and has its headwaters at Duck Pond which has a surface area of 16 acres; this pond is located 2 miles south-southeast of the dam. There are several other small ponds in the watershed which lend to a total pond acreage exclusive of Stiles Pond - of roughly 28 acres. As most of the ponds are either located near the headwaters or are of small size, they have little effect in reducing peak flood flows.

The watershed is hilly and of moderate gradient. Elevations range from 877 feet m.s.l. at the shoreline of Stiles Pond to 2,017 feet m.s.l. at Fuller Hill to the southeast. Five other mountains in the periphery rise to above 1,500 feet m.s.l.

There are less than thirty dwellings in the watershed which is approximately 85 per cent forested.

V. SITE DESCRIPTION

Stiles Pond is located in the northern corner of the Town of Waterford (see Appendix 2). The pond has a surface area of approximately 150 acres and has a volume of 1,900 acre-feet at spillway crest - 1,250 acre-feet of which are realized because of the dam. The pond is roughly oval in shape with a NNW-SSE orientation. Most of the shoreline is forested, except the easterly side which borders Vermont Highway 18.

The pond drains into Stiles Brook which meets the Moose River 1.1 miles downstream.

The pond is used as a public water supply for the Village of St. Johnsbury and is, therefore, a Class A water by Title 10, Vermont Statutes Annotated, Section 1253.

VI. STRUCTURE

A. Description

Stiles Pond Dam is located at the northeastern end of the pond and is an earth-filled embankment with a concrete gravity spillway (see Appendices 3 and 4). The earth-filled portion is approximately 120 feet in length, has a maximum height of 7 feet, and has a 12-foot top width. Both faces of the dam have a slope of approximately 2 horizontal to 1 vertical. There is stone riprap on the upstream face, and the top and downstream face are grass-covered. Portions of the downstream face have tree and brush growth. There is a pile of driftwood at the downstream toe of the fill.

Two pipes are known to pass through the earth fill: a sixteen inch cast iron water main and a twenty inch cast iron pond drain. It is not known if the pipes have anti-seep collars.

The spillway structure is at the northern end of the dam and has a crest width of 17.9 feet. The approach section is from 4.5 to 7.5 feet long with a slope of about 20 horizontal to 1 vertical. The spillway drops approximately 9.5 feet to a concrete apron 19.5 feet long and 17.9 feet in width. The sidewalls are about 50 feet long and 5 feet wide. The spillway crest is at an elevation slightly above 678 feet m.s.l., and the top of the dam is roughly 2 feet

higher. A railroad tie beam was apparently installed between the spillway walls at the time of reconstruction in order to provide resistance against the walls overturning.

A limited amount of history on the Stiles Pond Dam is known. In 1806, a sawmill was built at the outlet of the pond; however, it is not clear if a dam was constructed at this time. The present dam was probably built in the late 1870's, and the spillway section was apparently reconstructed about 1947.

B. Condition

The earth fill is stable with a well-established grass cover along the entire length, except for a small portion of the downstream face near the south abutment. The grass cover has not been mowed, and small trees and brush have been allowed to become established along parts of the downstream face. Some of the riprap on the upstream face has been displaced, apparently by wave and ice action. No adverse settlement was noted; however, the top of the fill was generally depressed about midway across the dam. No seepage through the earth fill was observed, but it was noted that the type of vegetation growing along the toe is generally found in wet areas. There is some ground water seepage from the hillside below the south abutment. The earth embankment is in good condition.

The concrete spillway appears stable and shows no signs of adverse settlement. A portion of the north wall along the approach section has surface disintegration at the water

line. Below the control section this wall has a few hair-line cracks through which some leaching of cement has occurred. There are similar signs on parts of the control section. Overall, the concrete appears to be in good condition.

C. Spillway Analysis

1. Hydraulic

The spillway control section is essentially a broad-crested weir: therefore, to determine discharges, the control section was considered to be an ideal weir. The velocity head and end contraction due to the side walls were considered to be negligible. With the water level at the crest equal to the top of the north wall, the flow over the spillway is about 266 cubic feet per second (c.f.s.). In addition, under present conditions approximately 50 c.f.s. would be passing over the center section of the fill. Currently, whenever the pond level rises more than 2.25 feet above the spillway crest, there will be some flow over the embankment, exclusive of any caused by wave action.

2. Hydrologic

In order to establish an inflow hydrograph for Stiles Pond, a unit hydrograph was derived from a nearby gaged watershed. This hydrograph was then converted to a dimensionless hydrograph which was used to develop a unit hydrograph for the Stiles Pond watershed.

Runoff was determined according to a method developed

by the Soil Conservation Service which correlates runoff to rainfall by the soil types and ground cover or use of the watershed. For this analysis, the 100-year 24 hour storm was utilized.

Using the unit hydrograph and the runoff, a series of hydrographs were developed which were summated to give a total inflow hydrograph. This hydrograph had a peak of 1353 c.f.s.

The inflow was routed through the reservoir using the Storage-Indication method with the starting reservoir level at the spillway crest. Under existing conditions, the peak rise is just under three feet and the peak outflow is approximately 365 c.f.s., with some 280 c.f.s. passing over the spillway and about 85 c.f.s. passing over the embankment. Should the embankment and the spillway side walls be raised to prevent flow over the earth fill, the maximum rise would be about 3.1 feet with a peak outflow of 297 c.f.s.

For either case, the pond level will be at or over Vermont Route No. 18 near the southeasterly portion of the pond for about twelve hours. The maximum depth of water on the road would be about three inches.

D. Classification

Each dam under the jurisdiction of the Water Resources Board is classed into one of three categories according to the potential amount of downstream damage that particular dam could inflict should it fail. Class I dams are all structures, due to their size and/or location, a failure

of which would result in major downstream damage, including the destruction of buildings, major disruption of utilities and/or transportation facilities, or the possible loss of human life. Class II dams are those due to size and/or location whose failure would result in some downstream damages including damages to buildings and possible disruption of utilities and/or transportation facilities, but would probably not result in the loss of life. Dams in Class III are those, due to size and/or location, whose failure would result in only minor damage.

Approximately 800 feet downstream of the dam, Bridge No. 10 (5' ACCGMP) on Town Highway No. 25 crosses Stiles Brook. This road ends 1.8 miles southwest of the bridge and, therefore, loss of the bridge, which is likely should the dam fail, would deprive one dwelling of access to the main highway (Vermont Route 18). On Waterford Town Highway No. 24 (which becomes St. Johnsbury Town Highway No. 80), Bridge No. 11 crosses the brook about 4,200 feet downstream of the dam. This route runs roughly parallel to U. S. Route No. 2 connecting State Aid Highway No. 4 in St. Johnsbury to the west and Vermont No. 13 to the east. This structure would probably sustain minor to moderate damage upon failure of the dam. Some farmland above Town Highway 24 would be temporarily inundated, but it would most likely suffer only minor damage.

Any damage to buildings located downstream would be minor and most likely limited to those located at the confluence of Stiles Brook and the Moose River. It is unlikely

there would be a loss of life as a result of failure of the dam.

As Stiles Pond is the primary water supply for the Village of St. Johnsbury, a failure of the dam would cause an inconvenience to the water users, but would not totally deprive them of water as the Village has a well for auxiliary supply.

Therefore, on the basis of the above, Stiles Pond Dam is categorized as a Class II dam.

VII. RECOMMENDATIONS

On the basis of the office studies and the visual inspection, it is recommended:

1. All trees and brush be cut and cleared from the dam;
2. The driftwood pile be removed to provide access for maintenance and inspection;
3. The top of the earth fill be brought up to a level grade to facilitate maintenance;
4. Proper free board be provided against overtopping during major storms by either raising the earth fill about 2.5' to 3', adding spillways, or a combination of both;
5. A toe drain system be installed to carry away any internal accumulation of seepage through and/or under the earth fill;

6. A regular program of maintenance be established to include periodic inspections, mowing the grass, clearing debris from the spillway, and other work as conditions warrant. A set of emergency operating procedures be established which should include periodic operation of the pond drain valve, in order to assure it will be operable during emergencies:

7. A qualified, registered professional engineer/consultant be retained by the Town to determine the best methods for implementing Items 4 and 5, to draw up plans and specifications for the work, and to provide necessary inspection of the construction.

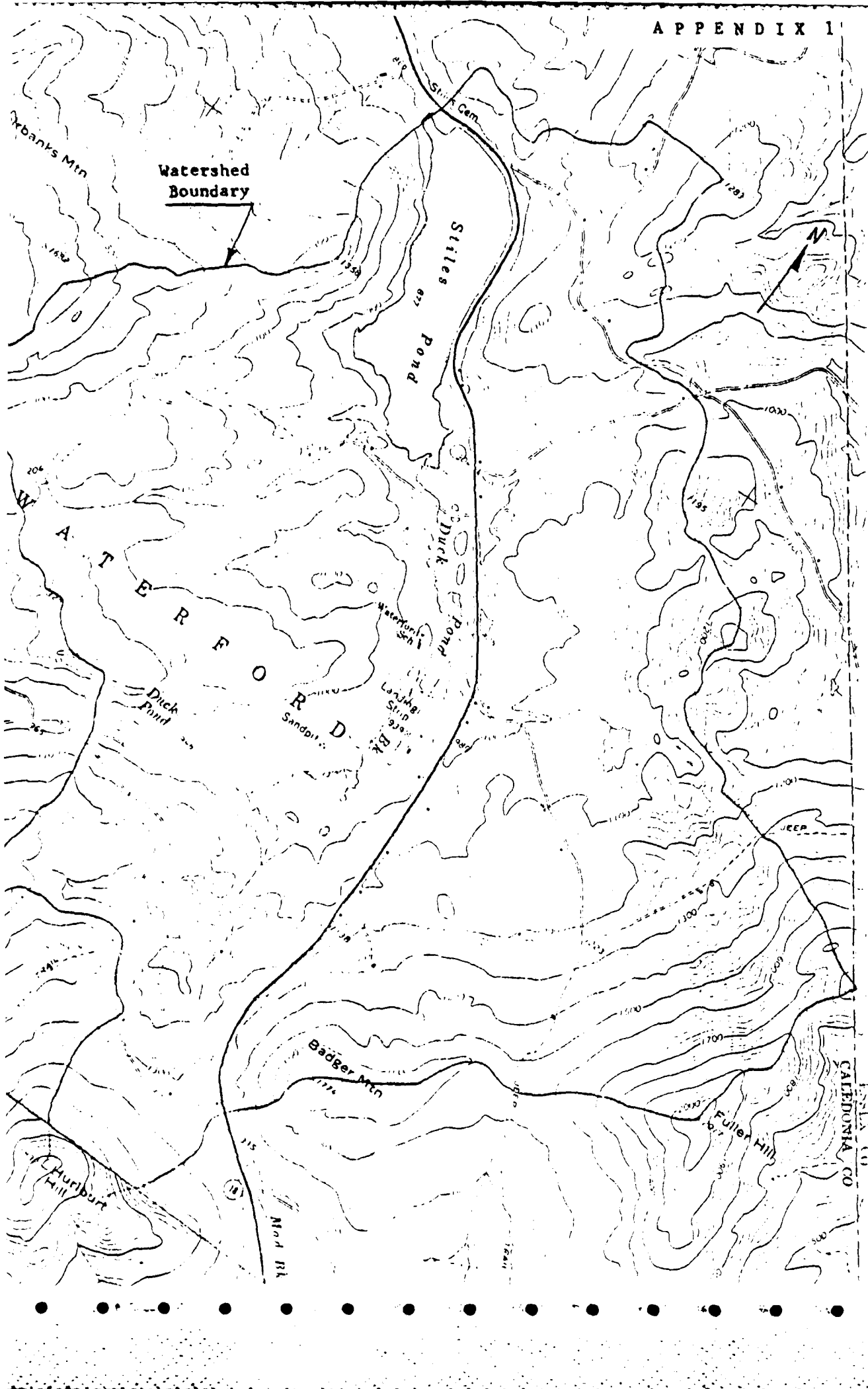
VIII. SELECTED REFERENCES

Design of Small Dams, U. S. Department of the Interior, Bureau of Reclamation, U. S. Government Printing Office, Washington: 1973.

A Method for Estimating Volume and Rate of Runoff in Small Watersheds, SCS-TP-149, U. S. Department of Agriculture, Soil Conservation Service, January, 1968.

IX. APPENDIX

1. Watershed Map
2. Location Map
3. Plans
4. Photographs



APPENDIX C

PHOTOGRAPHS

FOR LOCATION OF PHOTOS, SEE FIGURE 1
LOCATED IN APPENDIX B

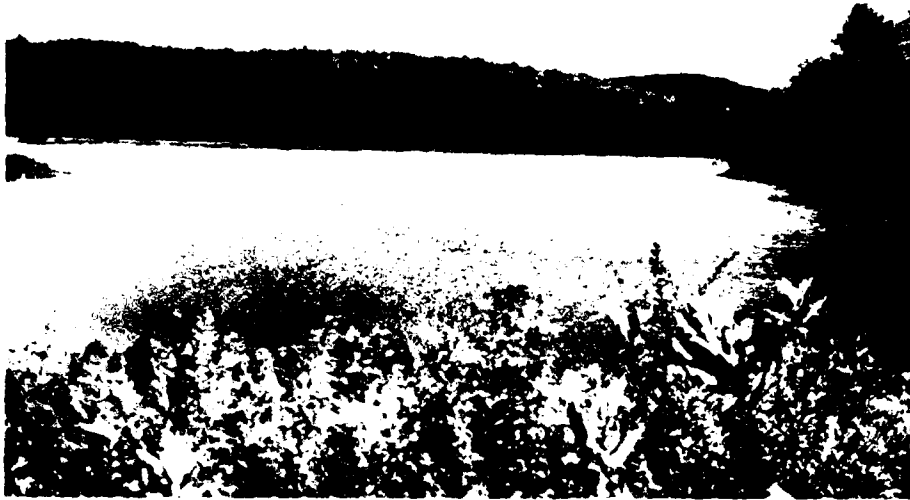


PHOTO NO. 1 - View of northerly portion of reservoir.

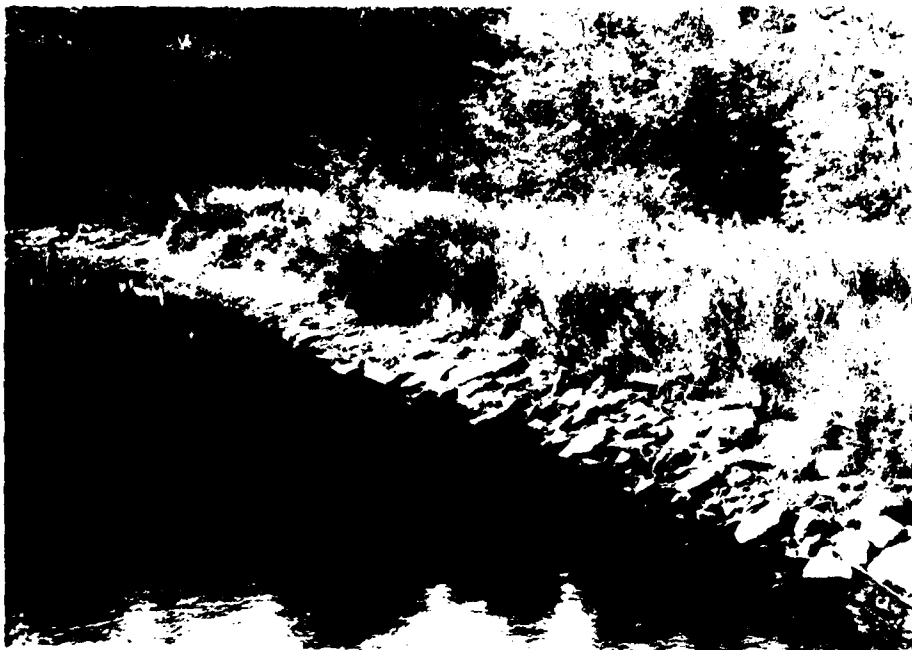


PHOTO NO. 2 - Upstream face of dam from reservoir shoreline.

C-1

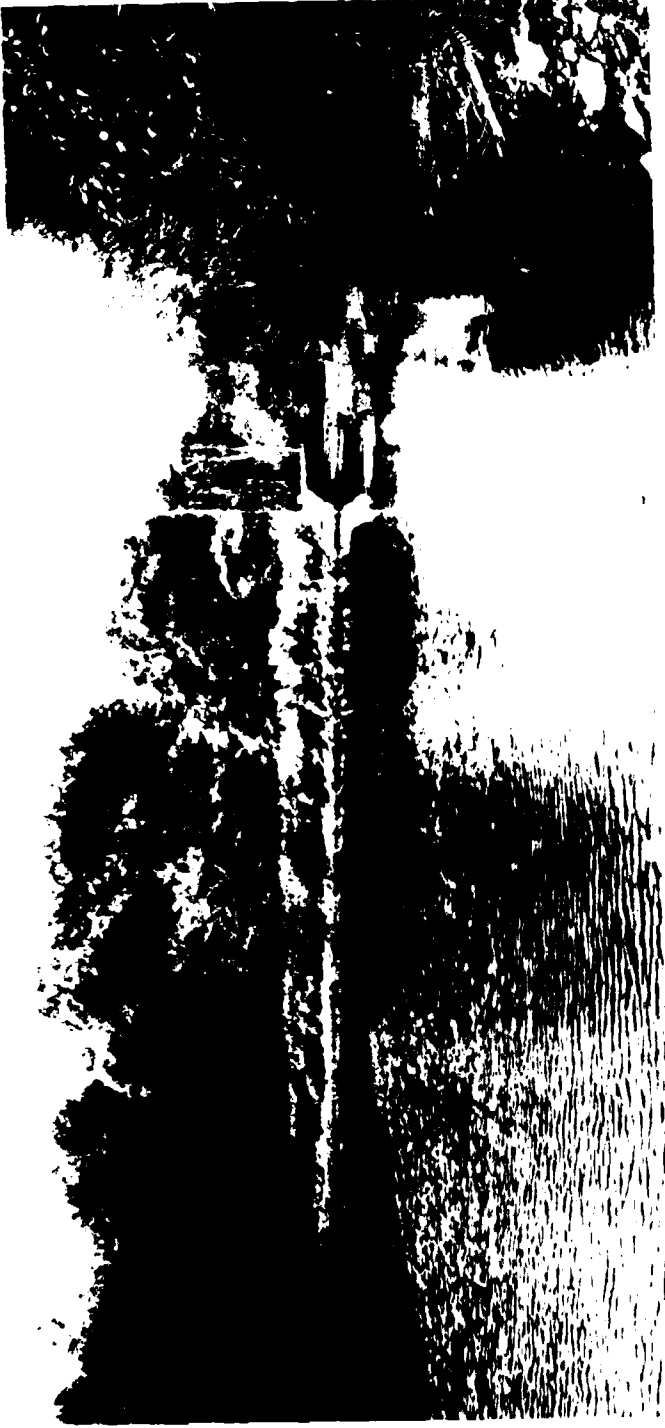


PHOTO NO. 3 - Panoramic view of upstream side of reservoir.



PHOTO NO. 4 - Crest of dam as seen from spillway. Note dense vegetation on the embankment.



PHOTO NO. 5 - Downstream slope of embankment as viewed from spillway.

B KLES TAMMEN & BERGENDOFF	Made by	RY	Date	9/20/79	Job No.	5965-11-18
	Checked by	HH	Date	10/17/79	Sheet No.	2

es Pond

1 Calculation of Test Flood Inflow

Classification : Size: Intermediate
Hazard Significant

Hydrologic Evaluation / Guideline Recommends

1/2 PMF to Full PMF

Use 1/2 PMF as storage of 1825 AF on low end of size classification range 1000 to 50,000 AF.

Hydrologic study of this Tributary area was completed by the Vermont Water Resources Dept. 1977 as part of a report on the dam. A total flow hydrograph was developed for a 100 year storm using SCS runoff curves and a unit hydrograph yield a peak flow of 1353 cfs with 3.04" of runoff.

Therefore: Runoff 1/2 PMF = $19 \frac{1}{2} = 9.5$ inch

$$\frac{1}{2} \text{ PMF Discharge} = \frac{9.5}{3.04} (1353) = 4228 \text{ cfs}$$

$$\text{use } \frac{1}{2} \text{ PMF inflow} = 4230 \text{ cfs}$$

The above referenced calculations follow Appendix "D"

FB

EDUARD TAMMEN & BERGENDOFF

Made by RY

Date 9/20/79

Job No. 5965-11-18

Checked by HM

Date 10.17.79

Sheet No. 1

les PondHydraulics & Hydrology

les Pond Dam is located on Stiles Brook tributary to the Moose River in the Town of Waterford Vermont, Caledonia County in the Connecticut River Basin.

Classification: Size: Intermediate
Hazard: Significant

Basic Data: D.A. 6.08 sq mi
Tributary Area: Wooded-Undeveloped
Rolling to Mountainous - 128'/mi
1% lakes
Reservoir Surface Area 150 acres
AL-Elev. 878.4 Normal/pool
Storage 1400 AF
Top of Dam Area 202 Ac
Elev 880.6
Stor. 1825 AF

Dam: Earth
Length - 120 feet
Embankment Height 7' at toe of slope
Max. Dam height 14 feet

Spillway Concrete-gravity
Broad Crest-weir 17.75' wide
Crest elev 878.4

D-1

APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS



PHOTO NO. 25 - Spillway discharge channel downstream of wall
in Photo No. 24.



PHOTO NO. 26 - Campground area located opposite Stiles
Brook at confluence with Moose River.



PHOTO NO. 23 - View of downstream end of culvert under roadway.



PHOTO NO. 24 - Spillway discharge channel downstream of roadway.

C-13



PHOTO NO. 21 - View of right wall of outlet channel downstream of the spillway. Note that the concrete cap has fallen to the channel floor.



PHOTO NO. 22 - Left wall of the spillway channel. Note bulge in wall.



PHOTO NO. 19 - Outlet of spillway and channel immediately downstream.



PHOTO NO. 20 - Outlet of 20 inch pond drain pipe downstream of roadway culvert.



PHOTO NO. 17 - Junction of left training wall, downstream face
of weir and apron slab.



PHOTO NO. 18 - View of top of water supply valve chamber.

C-10



PHOTO NO. 15 - Upstream end of left training wall.



PHOTO NO. 16 - Training wall at junction with downstream face of weir.



PHOTO NO. 13 - Upstream end of right training wall.



PHOTO NO. 14 - Detail of right training wall near crest of weir.

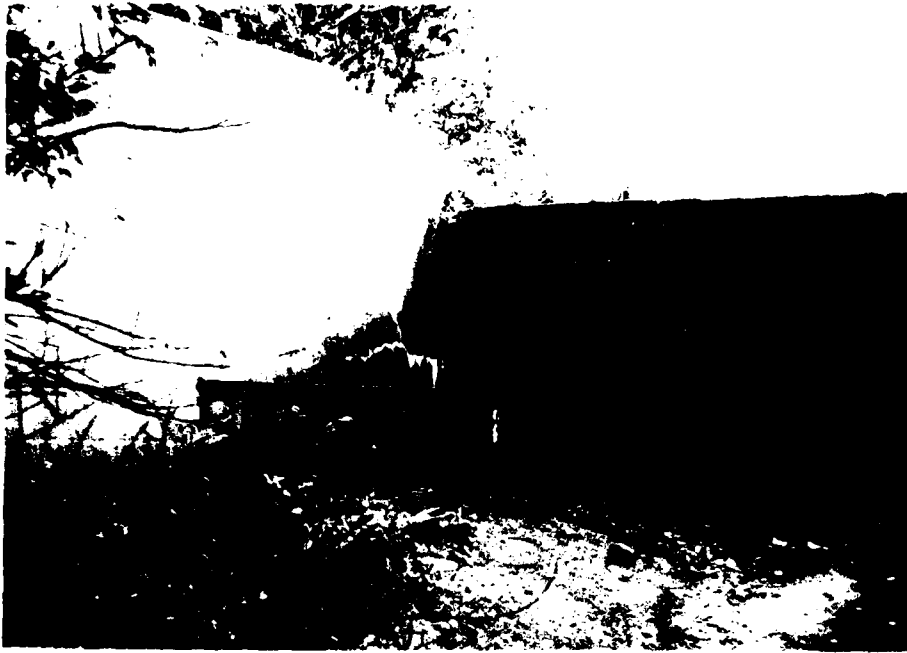


PHOTO NO. 11 - Right training wall of spillway and downstream face of spillway weir.



PHOTO NO. 12 - Left spillway training wall.



PHOTO NO. 9 - Left abutment area as viewed from dam crest.
Wood from reservoir cleaning stored at downstream toe.



PHOTO NO. 10 - Crest of spillway as seen from left
training wall.

PHOTO NO. 8 - Panorama of downstream face of dam.





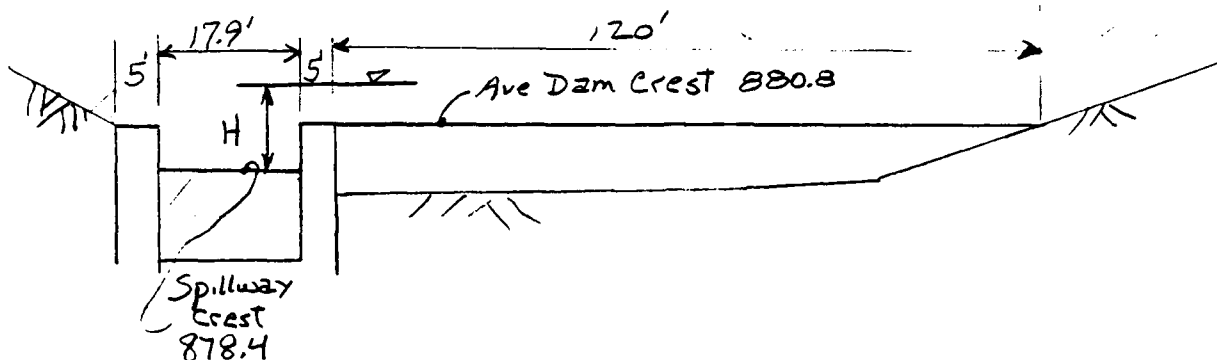
PHOTO NO. 6 - Large brush stump which has rotted in place.



PHOTO NO. 7 - Vertical
stone wall forming a
portion of the upstream
slope.

C-4

Step 2 Calculation of Test Flood Surchage



Consider: Negligible flow over abutments

Spillway Discharge Broad crest weir

$$C = 2.65$$

$$L = 17.9'$$

$$Q = CLH^{3/2}$$

$$Q = 47.44 H^{3/2}$$

Discharge Over crest of Dam

$$Q = CLH^{3/2}$$

$$C = 3.09$$

$$L = 120 + 5 + 5 = 130'$$

$$H = H_{\text{spillway}} - 2.4 \text{ ft}$$

$$Q = 401.7 (H - 2.4)^{3/2}$$

Elev.	Stage (H)	Discharge		Total
		Spillway	Dam crest	
878.4	0	0	0	0
879.4	1	47 cfs	0	47 cfs
880.8	2.4	180	0	180
882.0	3.6	320	520	850
883.0	4.6	470	1310	1780
884.0	5.6	620	2300	2930
885.0	6.6	800	3460	4260

See fig 2 for plot

D-3

Step 3 Calculation of Surcharge Effect

$$Q_A = 4230 \text{ cfs}$$

Storage from Fig. 1.
-1400 acre-ft

Re. 9.5 inch

$$Q_{P2} = Q_A \left(1 - \frac{\text{Stor(in)}}{9.5}\right)$$

$$\text{Stor(in)} = \frac{\text{Stor(acre-ft)} \times 12 \frac{\text{in}}{\text{ft}}}{640 \frac{\text{acre}}{\text{mi}^2} \times 6.08 \text{ mi}^2} = \text{Stor(acre-ft)} (.00308)$$

Routing Curve see fig 2 for Plot

<u>Elev</u>	<u>Stor(acre ft)</u>	<u>Stor(in)</u>	<u>Q_{P2}</u>
880	310	.95	3807 cfs
882	725	2.23	3235
884	1125	3.47	2687
886	1530	4.71	2131

See figure 2 for plot, and:

Outflow 2730 cfs

Stage 54 ft

Elev. 883.8 ft

3.2 ft over dam

(low point)

Q spillway 140 cfs

7% routed Test

Flood Outflow

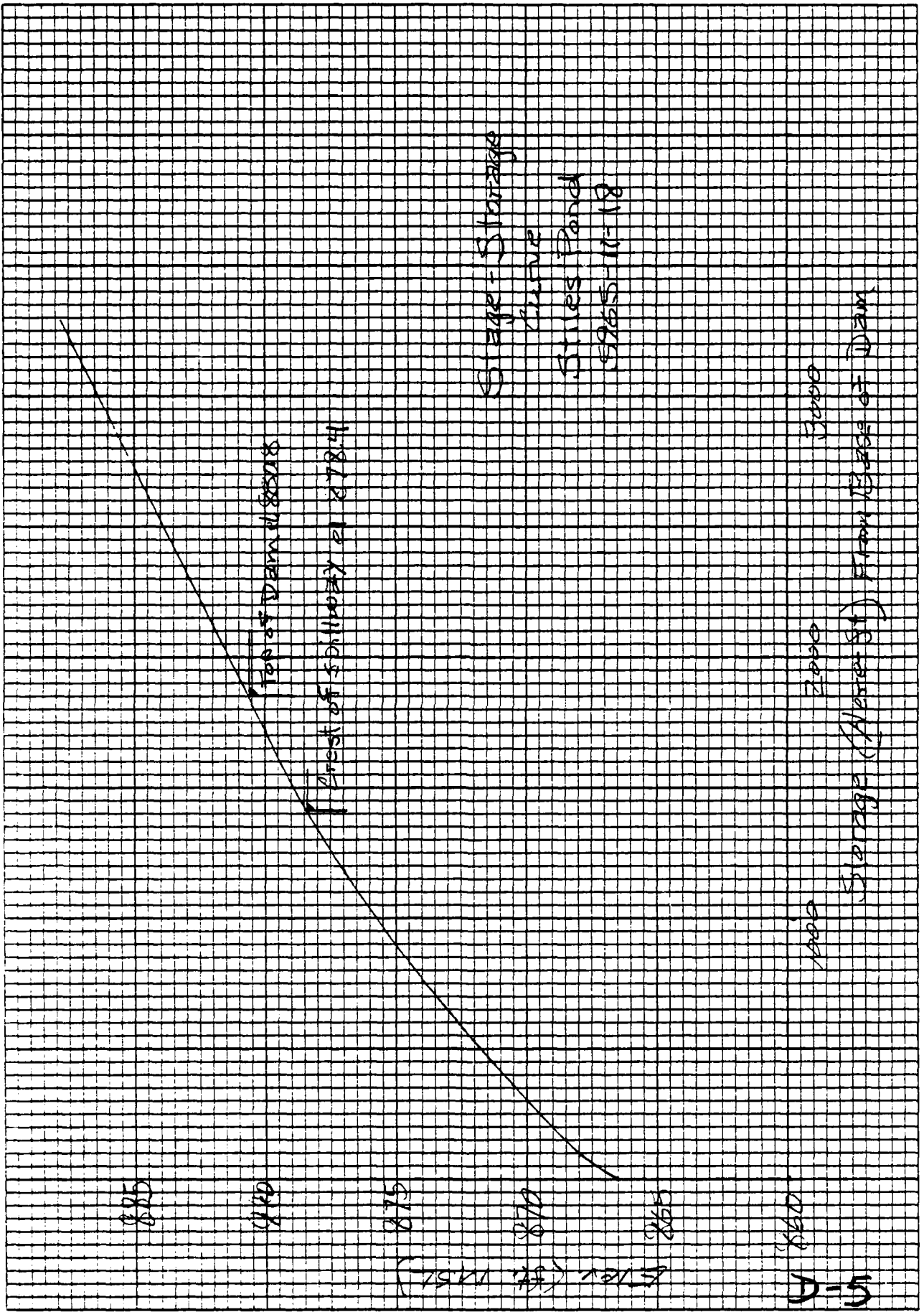


Figure 1

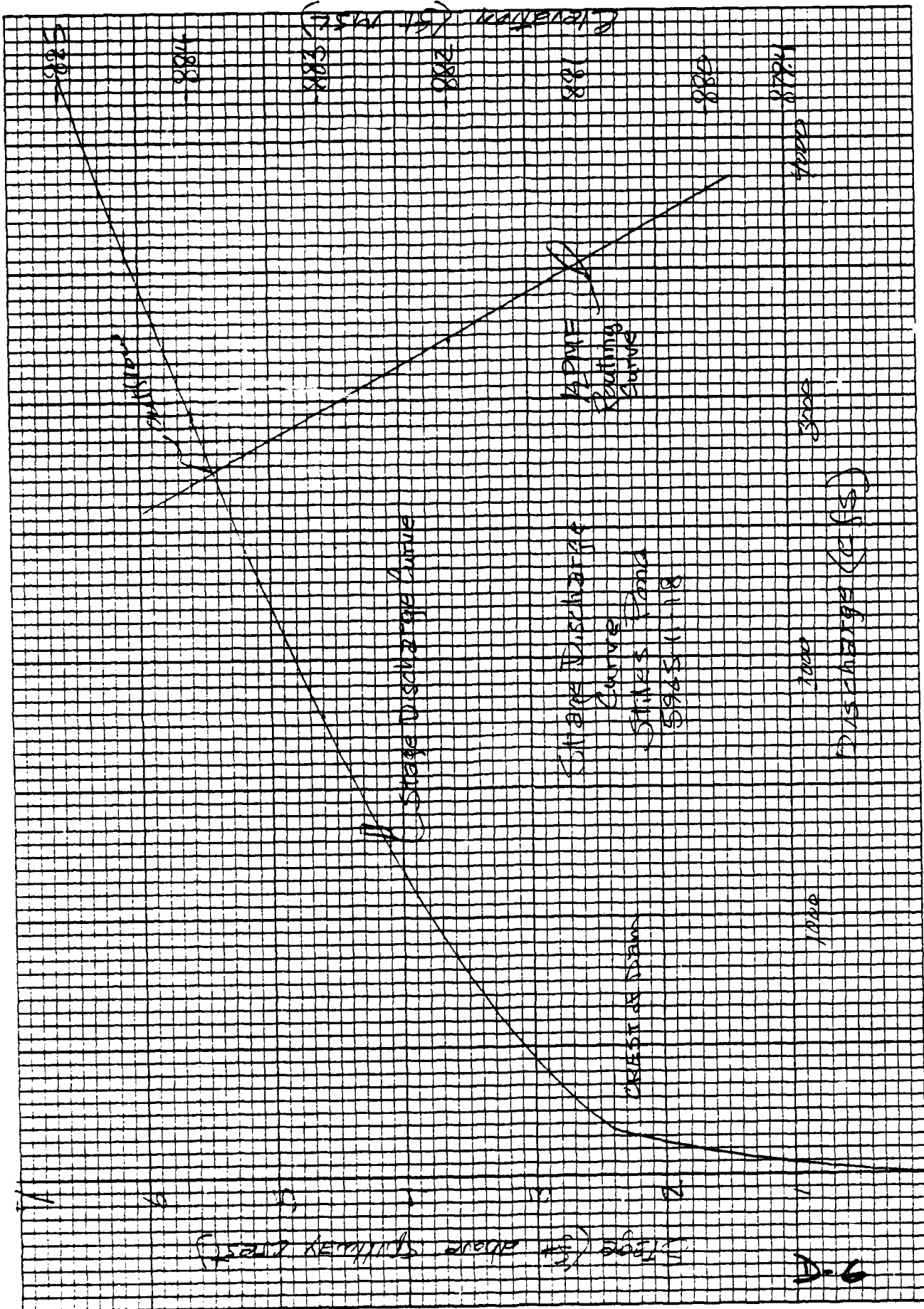


Figure 2

HNTB HOWARD NEEDLES TAMMEN & BERGENDOFF	Made by	RY	Date	9/17/79	Job No.	5965-11-18
	Checked by	HM	Date	10/17/79	Sheet No.	5
For <u>Stiles Pond</u>						

Estimate of Downstream Damage

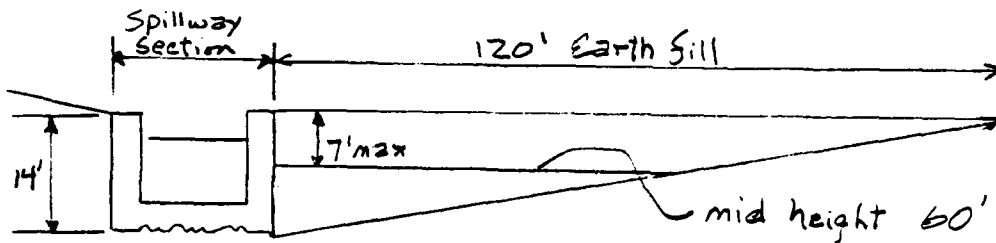
Step 1 Reservoir Storage

Normal Pool elev. 878.4 ft MSL
 Storage 1400 acre-ft
 Maximum Pool elev. 880.8 - 880.6
 Storage 1825 acre-ft

Storage volume - vertical above elev 880.0 see fig 1

Step 2 Breach Discharge

$$Q_{\text{Breach}} = \frac{8}{27} \sqrt{g} w_0 y_0^{3/2}$$



$w_0 = 40\%$ width of dam at mid-height $60' \times 40\% = 24'$

$y_0 =$ use max height of $14.0'$

$$Q_{\text{Breach}} = \frac{8}{27} \sqrt{g} (24)(14)^{3/2} = 2112 \text{ cfs}$$

$$Q_{\text{spillway}} = \text{Broad crest weir} = c L H^{3/2} \quad c = 2.65$$

$L = 17.9 \text{ ft} \quad h = 2.4 \text{ ft}$

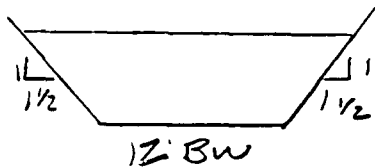
$$Q = 2.65 (17.9) 2.4^{3/2} = 180 \text{ cfs}$$

$$Q = 2290 \text{ cfs}$$

Stiles Pond

Step 3 Stage-Discharge

Reach Characteristics



Reach 1 $L = 5400'$
 $S = .0315''$
 $n = .05$

Stage	Discharge
1 ft	65 cfs
3	437
4	740
5	1130
6	1600
7	2180
7.2	2300

$$Q = \frac{K'}{n} b^{3/2} S^{1/2}$$

$$Q = K'(2681)$$

Step 4 Reach Outflow

$Q_{P1} = 2290 \text{ cfs}$ $L = 5400 \text{ cfs}$ $S = 1825 \text{ reach}$

Stage₁ = 7.15 area₁ = 162 ft²

$$V_1 = \frac{5400' \times 162 \text{ ft}^2}{43560} = 20.1 \text{ reach-ft} < \frac{1700}{2}$$

$$Q_{P2} = 2290 \left(1 - \frac{20.1}{1825}\right) = 2260 \text{ cfs}$$

Stage₂ = 7.13 ft area = 162 ft² V_{ave} = 20.1

$V_1 = V_2$ $Q_{P2} = Q_{P1}$

Reach Outflow = 7.1 ft at confluence of
 Stiles Brook and Moose River.

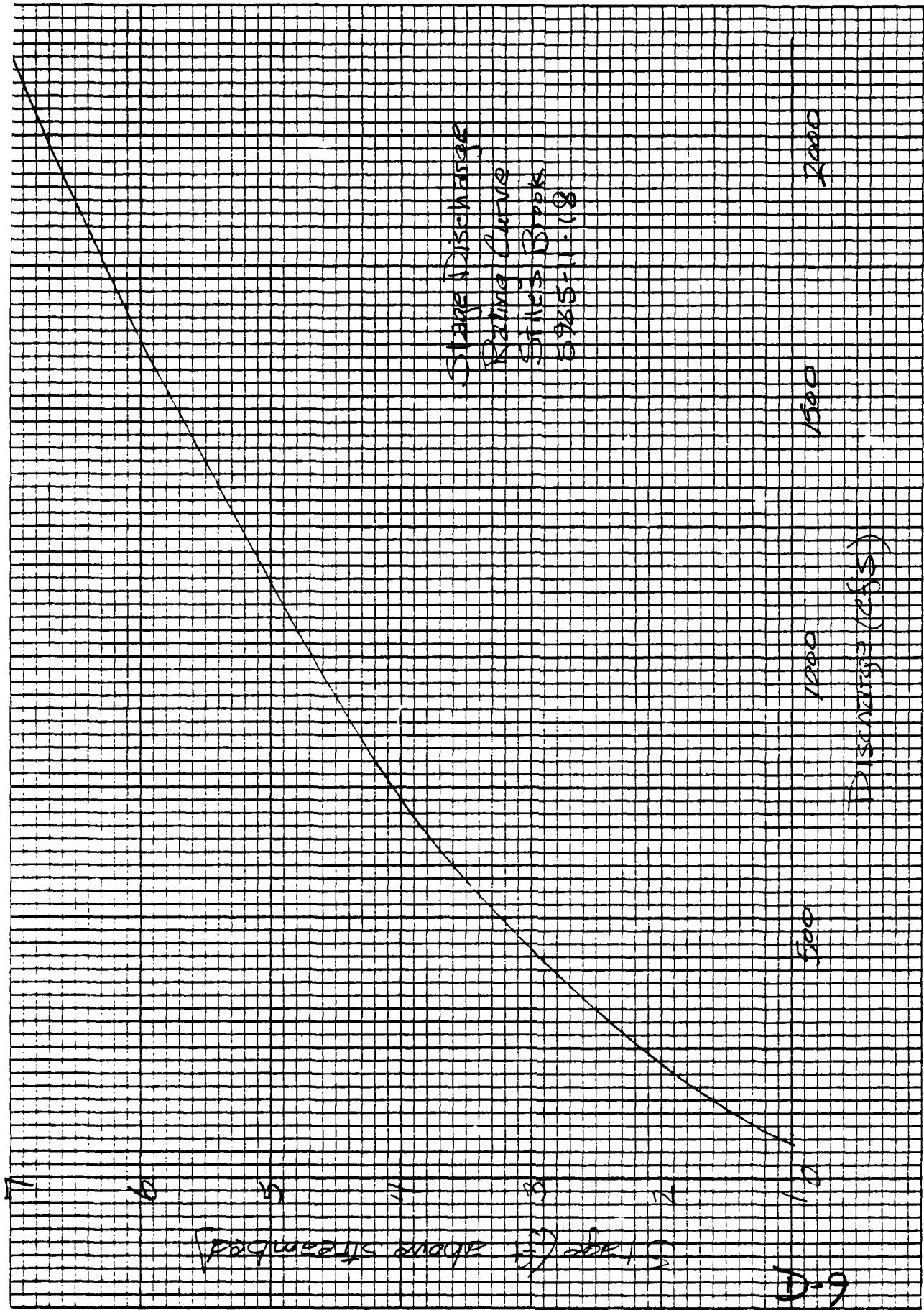


Figure 3

January 15, 1976

Assume L_g for watershed above
Stiles Pond Dam is $\frac{2}{3}$ of L_g for Sirby
Brook.

$\therefore L_g = \frac{2}{3}(6.7) = 4.46$ hours; use 4.5 hours

For $D = 1$ hour: $L_g + \frac{D}{2} = 4.5 + \frac{1}{2} = 5$ hours.

From Chart 49, U.S. Weather Bureau TP-40
the 100 year 24 hour rainfall is 5.5".

Soil Type	Land Use	R CN	Acre	3 x 4
C	meadow	71	114	8094
C	woods	77	3226	248402
D	woods	79	177	13983
D	swamp	83	47	3901

Total 3564 274380

$R CN = \frac{274380}{3564} = 77$

From the Soil Conservation Service
Engineering Field Manual, the total runoff
equals 3.04". Using SCS-TP-49, the
following rainfall distribution is obtained.

D-10

Hydrograph

Time (hours)	Flow (cfs)	Time (cont.)	Flow (cont.)
0	0	19	207
1	1	20	165
2	18	21	131
3	58	22	105
4	292	23	85
5	1073	24	69
6	1353	25	55
7	1318	26	42
8	1085	27	25
9	941	28	18
10	824	29	13
11	727	30	13
12	640	31	7
13	562	32	5
14	498	33	4
15	445	34	3
16	397	35	2
17	328	36	1
18	262	37	0

D-11

Time	Ratio	Accumulated Rainfall	Accumulated Runoff	Incremental Runoff
0	0	0	0	0
2.0	0.022	0.12	0	0
4.0	0.048	0.26	0	0
6.0	0.080	0.44	0	0
8.0	0.120	0.66	0	0
9.0	0.147	0.81	0.01	0.01
9.5	0.163	0.90	0.03	0.02
10.0	0.181	1.00	0.05	0.02
10.5	0.204	1.12	0.08	0.03
11.0	0.235	1.29	0.14	0.06
11.5	0.283	1.56	0.24	0.10
11.75	0.387	2.12	0.51	0.27
12.0	0.663	3.65	1.53	1.02
12.5	0.735	4.04	1.84	0.31
13.0	0.772	4.25	2.01	0.17
13.5	0.779	4.37	2.12	0.11
14.0	0.820	4.51	2.22	0.10
15.0	0.853	4.69	2.36	0.14
16.0	0.880	4.84	2.48	0.12
18.0	0.921	5.07	2.63	0.20
20.0	0.952	5.24	2.82	0.14
22.0	0.979	5.38	2.94	0.12
24.0	1.000	5.50	3.04	0.10

8.5	0.132	0.73	0	0
-----	-------	------	---	---

Rainfall ~ Runoff

D-12

Stiles Pond - Volume Calculations

3-22-74

Don

102

Accumulated
Volume

Area

Volume

$$\frac{1}{2} (30) [150 + 100 + \sqrt{(150)(100)}]$$

$$\frac{1}{2} (352 + \sqrt{30300})$$

526.1

2266.5

$$352 + 174.1$$

150

$$\frac{1}{2} (50) [114 + 150 + \sqrt{(114)(150)}]$$

$$\frac{1}{2} (264 + \sqrt{17100})$$

658.0

1740.1

$$\frac{1}{2} (264 + 130.8)$$

114

$$\frac{1}{2} (50) [61 + 114 + \sqrt{(61)(114)}]$$

$$\frac{1}{2} (175 + \sqrt{6754})$$

430.7

1082.1

$$\frac{1}{2} (175 + 83.4)$$

61

$$\frac{1}{2} (50) [46 + 61 + \sqrt{(46)(61)}]$$

$$\frac{1}{2} (107 + \sqrt{2806})$$

266.7

651.1

$$\frac{1}{2} (107 + 53)$$

LET OF SILLWAY

46

$$\frac{1}{2} (50) [30 + 46 + \sqrt{(30)(46)}]$$

$$\frac{1}{2} (76 + \sqrt{1380})$$

188.5

385.0

$$\frac{1}{2} (76 + 57.1)$$

30

$$\frac{1}{2} (50) [21 + 30 + \sqrt{(21)(30)}]$$

$$\frac{1}{2} (51 + \sqrt{630})$$

126.3

196

$$\frac{1}{2} (51 + 25.1)$$

21

D-13

Volume Cales.

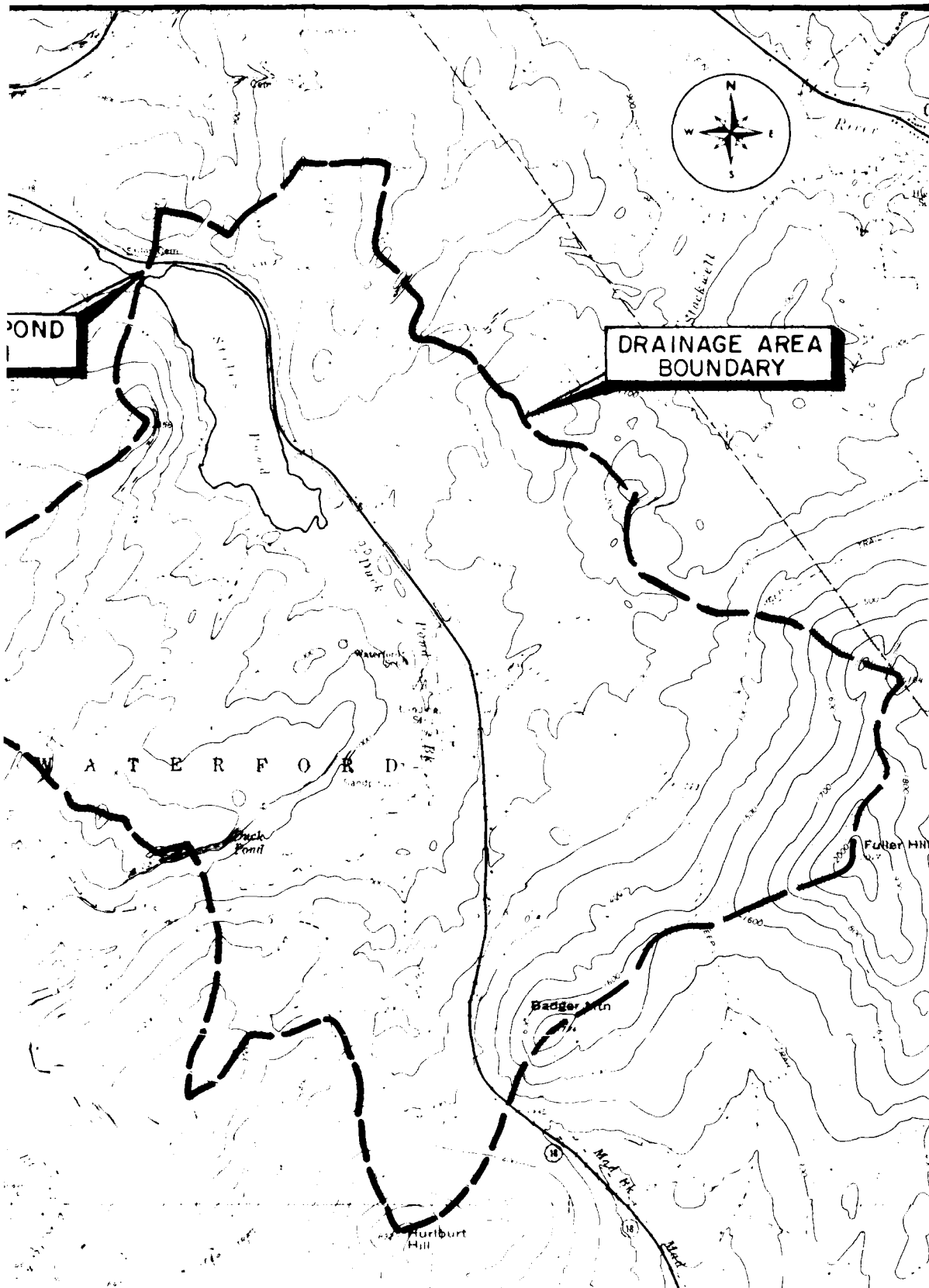
202

21	$\frac{1}{3}(5) [6 + 21 + \sqrt{(6)(21)}]$		
	$\frac{1}{3}(27 + \sqrt{126})$	63.7	69.7
	$\frac{1}{3}(27 + 11.2)$		
6	$\frac{1}{3}(3) [0 + 6 + \sqrt{(0)(6)}]$	6	6
0		0	0

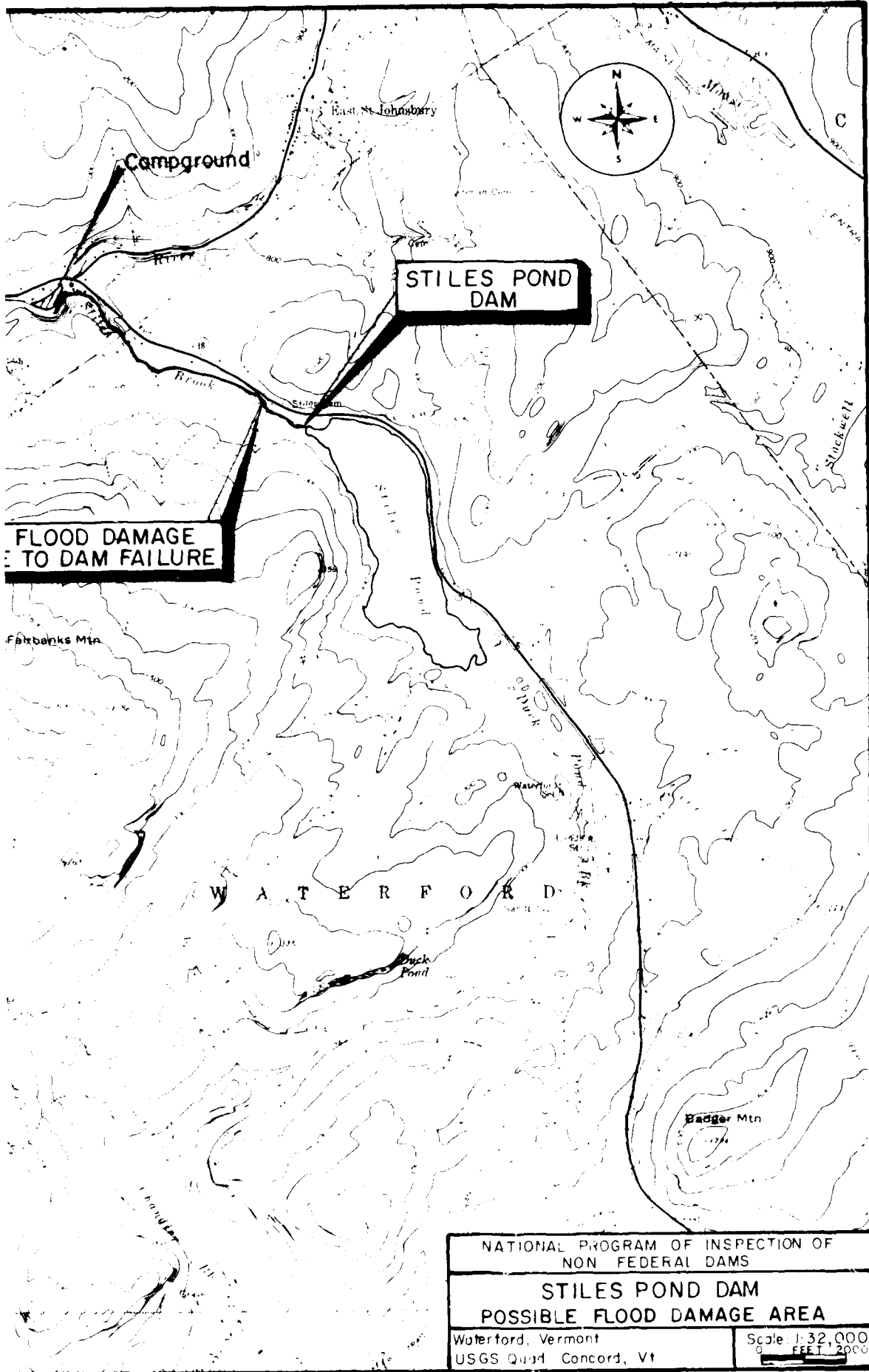
$\frac{1}{3}(3) [0 + 6 + \sqrt{(0)(6)}]$
 $\frac{1}{3}(3) [0 + 6 + 0]$
 $\frac{1}{3}(3) [6]$
 $\frac{1}{3}(18)$
 6

from H. W. ...
 Colorado State University, 1971. pp 27-11 to

D-14



NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS	
STILES POND DAM DRAINAGE AREA	
Waterford, Vermont USGS Quad Concord, Vt	Scale 1:32,000 FEET 2.00



AD-A157 515

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
STILES POND DAM (VT 0... (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV OCT 79

2/2

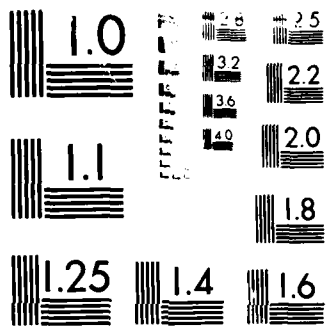
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END
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DPR



MICROCOPY RESOLUTION TEST CHART

1951-10-10

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

END

FILMED

9-85

DTIC