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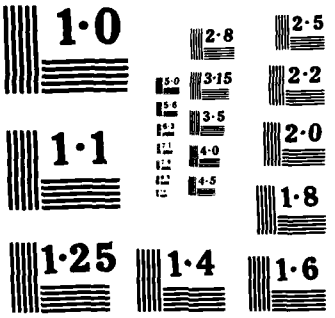


MERRIMACK RIVER BASIN

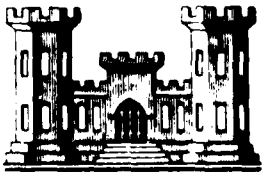
SALEM, NEW HAMPSHIRE

TAYLOR DAM

NH 00026

NHWRB NO. 209.02

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

NOVEMBER 1978

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

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

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Salem, New Hampshire
Spicket River

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

The dam is a 420 ft. long, 21 ft. high composite structure consisting of earth and stone supplemented by a concrete wall. The visual inspection did not disclose any findings that indicate an immediate unsafe condition. The condition however, is poor. The dam's spillway willnot pass the required test flood. Since the dam's spillway will pass only limited flows and will not pass the test flood, the hydraulics should be thoroughly reviewed.

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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

JAN 08 1979

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

Dear Governor Gallen:

I am forwarding to you a copy of the Taylor 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 Greater Lawrence Industrial Corp., 550 Broadway, Lawrence, Massachusetts 01840, ATTN: Mr. William Buswell, Chief Engineer.

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

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

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

TAYLOR DAM

NH 00026

NHWRB NO. 209.02

MERRIMACK RIVER BASIN
SALEM, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
BRIEF ASSESSMENT

Identification No.: 00026

Name of Dam: Taylor Dam

Town: Salem

County and State: Rockingham, New Hampshire

Stream: Spicket River

Date of Inspection: August 10, 1978

Taylor Dam is a 420 foot long, 21 foot high composite structure consisting of earth and stone supplemented by a concrete wall. Engineering data available consisted of two plans dated 1916 showing plan, elevation and typical sections of the dam. These plans were prepared for the repairs made to the dam at approximately that date. No construction specifications or design calculations were available.

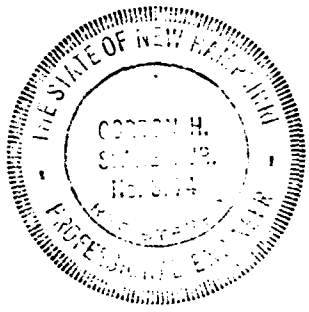
The visual inspection of Taylor Dam did not disclose any findings that indicate an immediate unsafe condition. The observed condition of the dam, however, is poor. The inspection revealed a general deteriorated condition of the concrete training walls at the spillway and outlet structures, live and dead trees on the dam embankment and the inability to drain the reservoir.

Taylor Dam's spillway will not pass the required test flood. The dam's spillway capacity is approximately 13 percent of the test flood and consequently, the dam would be overtopped by approximately 2.5 feet under test flood conditions.

It is recommended that the owner have a qualified engineer design remedial measures for the badly scoured and deteriorated concrete of the spillway and outlet works and the concrete upstream face. Also, provisions should be made by the owner to have all live and dead trees removed from the downstream face and appropriate cover planted on the slope to prevent erosion and to provide for the repair or replacement of the inoperable gate to allow for draining the reservoir.

Since the dam's spillway will pass only limited flows and will not pass the test flood without overtopping, the hydraulics of this facility should be thoroughly reviewed.

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



Gordon H. Slaney, Jr.

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

Howard, Needles, Tammen & Bergendoff
Boston, Massachusetts

This Phase I Inspection Report on Taylor 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 F. Doherty

RICHARD F. DOHERTY, MEMBER
Water Control Branch
Engineering Division

Joseph A. Mc Elroy

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

Carney M. Terzian

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

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed 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 by 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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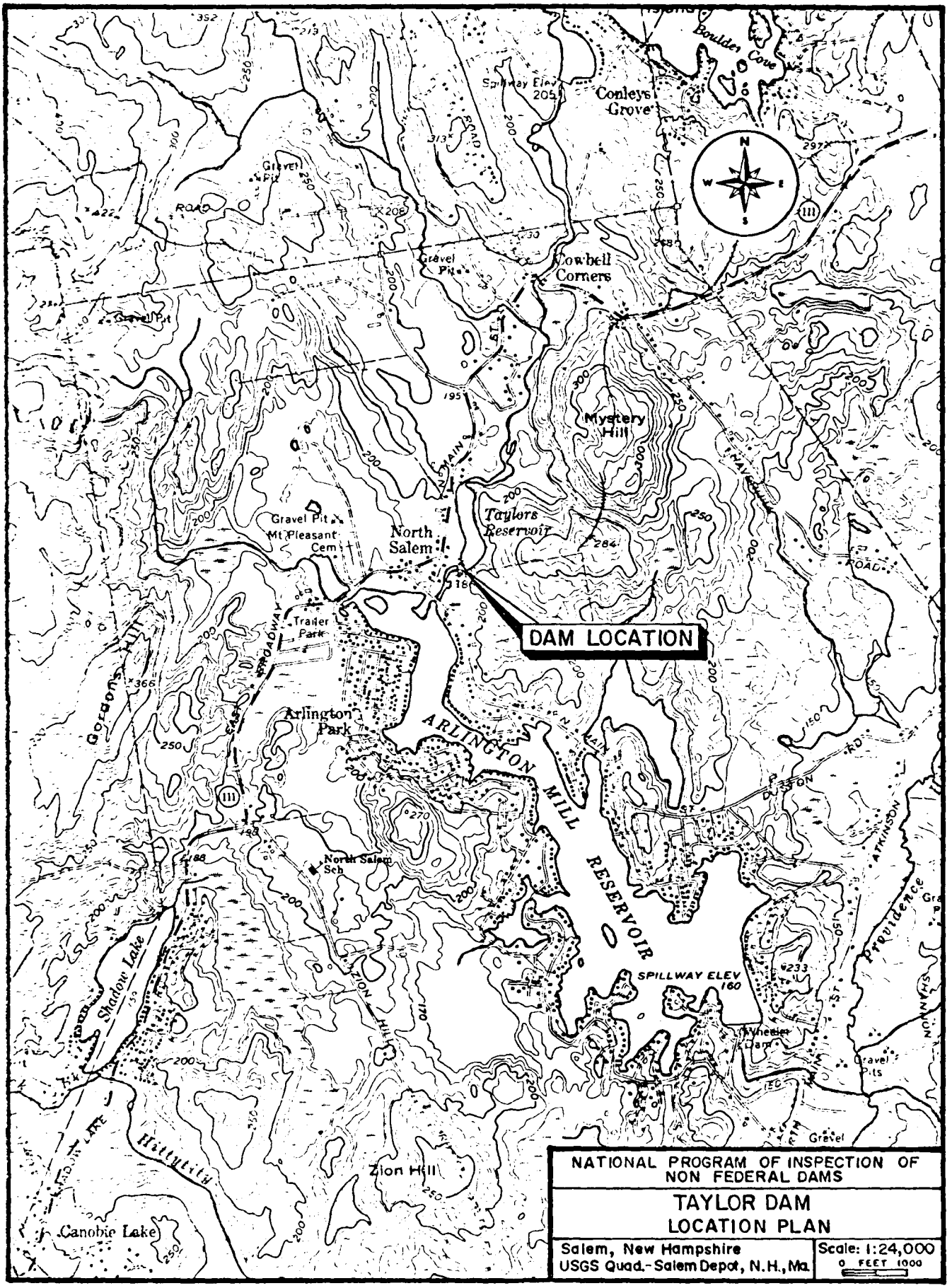
APPENDIXES



NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

TAYLOR DAM
LOCATION PLAN

Salem, New Hampshire
USGS Quad.- Salem Depot, N.H., Ma.

Scale: 1:24,000
0 FEET 1000

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
TAYLOR 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 New Hampshire. Authorization and notice to proceed were issued to Howard, Needles, Tammen & Bergendoff under a letter of July 12, 1978 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0356 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. Taylor Dam is located in the Town of Salem, New Hampshire, approximately 6 miles downstream from the headwaters of the Spicket River. Below Taylor Dam, the Spicket River flows in a generally southerly direction for a distance of approximately 12 miles to its confluence with the Merrimack River in Lawrence, Massachusetts. The dam is shown on U.S.G.S. Quadrangle, Salem Depot, New Hampshire-Massachusetts with coordinates approximately N 42°50'40", W 71°13'10", Rockingham County, New Hampshire. Taylor Dam's location is shown on the Location Map immediately preceding this page.

b. Description of Dam and Appurtenances. Taylor Dam is a composite structure consisting of earth and stone supplemented with a concrete wall. The structure is approximately 420 feet in length. The maximum structural height of the dam, according to existing plans, is about 21 feet from the base to the top of the concrete wall. The original dam constructed on the site prior to 1916 consisted of two stone walls about 25 feet apart. The type of material placed between the walls is not known. Since its construction, the downstream stone wall has collapsed in some areas and cannot be discerned in some areas. In other areas, remnants of the original wall are clear and judged to be in approximately proper position based on existing drawings dated 1916. The present downstream face has variable earth slopes. The average downstream slope is about 1 vertical to 3.5 horizontal.

The original upstream rock wall has been supplemented by a concrete wall built in about 1916. This upstream concrete fascia has a batter of 5/8 inch horizontal to one foot vertical.

The appurtenant structures consist of a spillway structure and an outlet works structure. The spillway, located to the right of the center of the dam, is constructed of concrete and has a waterway opening 12 foot wide by 4 feet high. The outlet works, located to the left of the center of the dam, consists of a 5 foot diameter drain pipe located in the original Spicket River bed and controlled by a mechanically operated gate. An additional 13.6 feet of spillway length is also available at the outlet structure.

Figure 1, located in Appendix B, shows the plan of the dam, spillway and outlet works. Photographs of each structure are shown in Appendix C.

c. Size Classification. Small (hydraulic height - 17 feet, storage - 130 acre-feet) based on both height (<40 and ≥ 25) and storage ($\geq 1{,}000$ to 50,000 acre-feet) as given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. The dam's potential for damage rates it as a significant hazard classification. A major breach could result in the loss of a few lives, damage to the roadway just downstream and damage to one or two houses.

e. Ownership. This dam is owned by the Greater Lawrence Industrial Corp., 550 Broadway, Lawrence, Massachusetts 01840.

f. Operator. This dam is maintained and operated by the Greater Lawrence Industrial Corp., 550 Broadway, Lawrence, Massachusetts 01840. Chief Engineer is Mr. William Buswell. Telephone No. (603)686-3846.

g. Purpose of Dam. This dam, once used as a source of water for Arlington Mills, is presently used primarily for recreation.

h. Design and Construction History. Little information is available regarding the original design and construction of Taylor Dam. A set of drawings (2 sheets) were prepared by J.H. Fitch, Engineer, in 1916 for repairing the dam. This repair work included supplementing the original upstream rock wall with a concrete wall and repairs to the spillway and outlet works.

The drawings for this dam are available at the New Hampshire Water Resources Board. No in-depth design or construction data were disclosed for this dam.

i. Normal Operating Procedure. No written operational procedures were disclosed. The normal operational procedure for this dam is to have the outlet gate closed and a one foot flashboard installed at the spillway crest. No adjustments to water level or other operations have been made over the past several years. The gate has not been operable for many years due to broken gear mechanism.

1.3 Pertinent Data

a. Drainage Area. The drainage area above Taylor Dam consists of approximately 19.0 square miles of gently rolling, heavily wooded terrain with three major ponds and several large swampy areas located throughout the basin. The periphery of Taylor's Reservoir is comprised of wooded area with very few residences located near the reservoir.

The reservoir area itself contains no islands and is devoid of dead trees protruding through the surface or other visible impediments to navigation. There were no private docks or piers noted along the area inspected.

The watershed supporting Taylor's Reservoir is gently rolling forested terrain with some residential development. All areas in the basin are well vegetated with a few paved roads and houses. Topographic elevation in the watershed ranges from about 540 to 180 feet MSL.

The major tributary draining into Taylor's Reservoir discharges from Island Pond, approximately 1.2 miles upstream, with a vertical drop over its length of about 25 feet.

b. Discharge at Dam Site

(1) The outlet works for Taylor Dam consist of a 60 inch diameter outlet drainpipe. This outlet drainpipe was designed to allow dewatering of the reservoir to the original river bed elevation.

(2) The maximum discharge at this dam site is unknown.

(3) The spillway capacity with a water surface at the top of the dam is approximately 760 cfs at an elevation of 186.0.

(4) The spillway capacity with the water surface at the test flood elevation is approximately 1540 cfs at an elevation of approximately 188.5.

(5) The total project discharge at the test flood elevation of 188.5 is estimated to be 5,975 cfs.

c. Elevation (feet above MSL) based on elevation of 186.0 shown on U.S.G.S. quad sheet assumed to be top dam elevation.

(1) Streambed at centerline of dam - 168.5±.

(2) Maximum tailwater - unknown.

(3) Upstream portal invert diversion tunnel - none.

(4) Recreation pool - 183.0.

(5) Full flood control pool - N/A.

(6) Spillway crest (permanent spillway) - 181.9.

(7) Design surcharge - unknown.

(8) Top Dam - 186.0.

(9) Test Flood Surcharge - 188.5.

d. Reservoir (miles)

(1) Length of Maximum Pool - 0.5±.

(2) Length of Recreational Pool - 0.45.

(3) Length of Flood Control Pool - N/A.

e. Storage (Acre-Feet)

(1) Recreation Pool - 93.

(2) Flood Control Pool - N/A.

(3) Spillway Crest Pool - 81.

(4) Top of Dam - 130.

(5) Test Flood Pool - 160.

f. Reservoir Surface (areas)

(1) Recreation pool - 12.

(2) Flood control pool - N/A. Note: Vertical sides assumed.

(3) Spillway crest - 12.

(4) Test flood pool - 12

(5) Top dam - 12.

g. Dam

(1) Type - earther dam with concrete spillway.

(2) Length - 420± feet, overall.

(3) Height - 21 feet (maximum).

(4) Top Width - 8 feet.

(5) Side Slopes - US = 1:17; DS = 3.5:1.

(6) Zoning - unknown.

(7) Impervious core - unknown.

(8) Cutoff - 3 to 5 feet concrete.

(9) Grout curtain - none.

(10) Other - none.

h. Diversion and Regulating Tunnel

See Section j below.

i. Spillway

(1) Type - concrete ogee.

(2) Length of Weir - 12' plus 13.6' = 25.6' total.

(3) Crest elevation - 181.9.

(4) Gates - none.

(5) U/S Channel - none.

(6) Downstream channel - a 50 foot reach approximately 6-12 feet wide downstream of the spillway leads to a stone walled channel about 6 feet wide. Below the stone wall channel the downstream channel continues approximately 200 feet to the natural channel which drains to Arlington Mill Reservoir.

j. Regulating Outlets. Regulating outlet consists of a 60 inch diameter steel drain pipe at elevation 168.5 which was designed to discharge into the river bed directly below the dam. The pipe inlet is controlled by a manually operated wooden slide gate. The outlet to this drain conduit is at the toe of the spillway section.

SECTION 2
ENGINEERING DATA

2.1 Design

No original design data were disclosed for Taylor Dam. A set of drawings (2 sheets) dated 1916 showing repairs made to the existing dam is the only design information found.

2.2 Construction

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

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Little engineering data were available for Taylor Dam. A search of the files of the New Hampshire Water Resources Board and discussions with the owner revealed only a limited amount of recorded information.

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

c. Validity. The field investigation indicated that the external features of Taylor Dam substantially agree with those shown on the available plans. It appears, however, that the downstream face of the dam has collapsed in some areas and the subsequent filling with soil has changed the original cross-section of the dam.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Taylor Dam was made on August 10, 1978. The inspection team consisted of personnel from Howard, Needles, Tammen & Bergendoff and Geotechnical Engineers, Inc. A representative of the Greater Lawrence Industrial Corp., owners of the dam, was present during portions of the inspection. Inspection checklists, completed during the visual inspection are included in Appendix A. At the time of the inspection, the water level was approximately 1½ inches above the spillway elevation and water was passing over the spillway. The upstream face of the dam could only be inspected above this water level.

b. Dam. Visual inspection of the dam embankment showed no signs of immediate distress. The original dam built on the site prior to 1916 consisted of two stone walls about 25 feet apart. The type of material placed between the walls is not known. Since its construction, the downstream stone wall has collapsed in some areas and cannot be discerned in some areas. In other areas, remnants of the original wall are clear and judged to be in approximately proper position based on existing drawings dated 1916.

Collapse of the downstream wall and filling with soil downstream of the original wall has resulted in a dam cross-section as shown in Figure 1, Appendix B.

The average downstream slope is about 1 vertical to 3.5 horizontal. No seepage or damp areas were observed on the slope or below the toe of the slope.

The original upstream rock wall has been supplemented by a concrete wall built in about 1916. This modification is shown in Figure 1, Appendix B.

The concrete training walls of the outlet works and spillway channel have been severely eroded. Erosion of the right training wall of the outlet structure is shown in Photos 10 and 13. Visual observation indicates that water may be seeping from behind the wall at a point about 10 feet below the crest of the dam. The nature and extent of this seepage cannot be determined exactly because flow over the weir of the outlet structure prevents close examination and provides a source of moisture to the entire concrete erosion

area. Visual observation from a distance of about 10 feet indicates the quantity of seepage is very small.

The downstream slope of the dam is overgrown with trees. The size and extent of the trees are shown in Photos 4, 5 and 6. In addition to live trees, there are rotting stumps, (Photo 7) and trees scattered along the entire downstream slope.

c. Appurtenant Structure. Visual inspection of the concrete wall supplementing the upstream rock wall of the dam did not reveal any evidence of instability. The condition of wing walls adjacent to the spillway structure and outlet works structure are however in poor condition and could lead to complete failure of these walls.

Visual inspection of the spillway structure showed cracks and heavy spalling to be evident throughout the entire wall surface. Concrete fascia of the training walls is undermined at the spillway surface. General view of the spillway concrete training walls is shown in Photo 8. The spillway channel is confined by rock walls which in some areas have collapsed but poses no immediate safety hazard.

Visual inspection of the outlet works structure showed cracks (vertical and horizontal) and concrete spalling to be evident throughout the wall surface. The concrete training walls and middle pier are completely undermined at the spillway surface. General view of outlet works structure is shown on Photos 9, 11 and 14. Deterioration of concrete is shown on Photos 11, 12 and 13. The outlet works gate was found to be inoperable. The discharge channel appears to be in good condition.

d. Reservoir Area. The reservoir slopes are generally covered with trees and brush. A more detailed description of the drainage area is included in Section 1.3 of this report. The amount of siltation within the reservoir is unknown.

e. Downstream Channel. The downstream channel is relatively free and clear. No riprap covers the floor of the channel immediately below the spillway but errosion appears to be no problem. Some trees are located along the side of the channel but pose no problem to continued free flow. Some erosion of the right bank was noted approximately 400 feet downstream. The channel outlets into Arlington Mill Reservoir about 800 feet downstream.

3.2 EVALUATION

Visual examination indicates no immediate safety problem. The observed condition of the dam is, however, poor. The

inspection revealed the following:

(1) Live and dead trees on the dam embankment.

(2) Deteriorated condition of the concrete walls and spillway and outlet works training walls.

(3) Inability to drain the reservoir because of an inoperable outlet works gate.

(4) From a hydraulic standpoint, the existing spillway is able to pass only limited flows.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedure

No written operational procedures were disclosed for the dam. The normal operational procedure for this dam is to have the outlet gate closed and a one foot flashboard installed at the spillway crest. No adjustments to water level or other operations have been made over the past several years. The gate has not been operable for many years due to broken gear mechanism.

4.2 Maintenance of Dam

This dam is visited by an employee of the Greater Lawrence Industrial Corp. approximately once per week. During these visits, water levels are recorded and brush on the top of the earth embankment is occasionally removed.

4.3 Maintenance of Operating Facilities

No maintenance has been performed on the operating facilities for many years.

4.4 Description of Warning Systems

There are no warning systems in effect at this facility.

4.5 Evaluation

The current operation and maintenance procedures for Taylor Dam are inadequate to insure that all problems encountered can be remedied within a reasonable period of time. The owner should establish a written operation and maintenance procedure as well as establishing a warning system to follow in event of flood flow conditions or imminent dam failure.

SECTION 5
HYDROLOGY AND HYDRAULIC ANALYSIS

5.1 Evaluation of Features

a. General. Taylor Dam is a masonry/embankment dam approximately 21 feet high and 420 feet long. The appurtenant structures consist of a spillway structure and an outlet works structure. The spillway, located to the right of the center of the dam, is constructed of concrete and has a waterway opening 12 feet wide and 4 foot in depth from the spillway crest to the top of the dam. The outlet works, located to the left of the center of the dam, consists of a 5 foot diameter drain pipe located in the original Spicket River bed and controlled by a mechanically operated gate. An additional 13.6 feet of spillway length is also available at the outlet works. Taylor Dam is classified as being small in size having a maximum storage of 130 acre-feet.

b. Design Data. No hydrologic or hydraulic design data were disclosed for Taylor Dam.

c. Experience Data. Maximum flood flows and elevations are unknown.

d. Visual Observations. No evidence of damage to any portion of the project from overtopping was visible at the time of the inspection.

e. Overtopping Potential. As no detailed design and operational information are available, hydrologic evaluation was performed using dam information gathered by field inspection watershed size and an estimated test flood equal to one-half the Probable Maximum Flood (PMF) as determined by guide curves issued by the Corps of Engineers. Based on a drainage area of 19.0 square miles, it was estimated that the test flood inflow at Taylor Dam would be 5,985 cfs. Following the guidance for Estimating Effect of Surcharge Storage on Maximum Probable Discharge results in a test flood discharge of 5,975 cfs. As the maximum spillway capacity at the top of the dam is only 760 cfs (approximately 13 percent of the test flood discharge flow), the test flood will result in the dam being overtopped by approximately 2.5 feet.

f. Dam Failure Analysis. The impact of failure of the dam at maximum pool was assessed using the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dam to Arlington Mills Reservoir.

Failure of Taylor Dam at maximum pool would probably result in a downstream channel depth of approximately 7 feet between the dam and Arlington Mills Reservoir approximately 800 feet downstream. An increase in water depth of this magnitude would probably result in the loss of less than 10 lives, sever the road downstream of the dam and might destroy one or two houses. This volume of water entering Arlington Mills Reservoir would probably create an increase in reservoir level of only about 6 inches. It should be noted that due to the small volume of impounded water behind Taylor Dam that actual test flood flows passing Taylor Dam, assuming the dam did not fail, would have the potential of creating the same, if not greater, damaging effects on the downstream channel area.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The visual observation did not disclose any apparent stability problems with the embankment section of the dam. The rock wall which formed the downstream wall of the original dam has collapsed and/or been covered by soil. This has resulted in an average downstream slope of 1 vertical to 3.5 horizontal.

The condition of the training walls of the spillway and outlet works are poor and failure of these walls would cause local failure to the embankment which could lead to more general failure by removing support from behind the concrete upstream face wall causing it to fail.

b. Design and Construction Data. Some design drawings dated 1916 are available; however, they are not sufficient, and the safety of this dam must be determined mainly from information obtained by a visual examination.

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

d. Post-Construction Changes. Major repairs were made to the existing rock wall dam in about 1916. These repairs consisted of adding a concrete upstream face to the existing dam and constructing a weir which is part of the outlet works.

e. Seismic Stability. The dam is located in Seismic Zone 2 and according to Phase I guidelines does not require special analysis for seismic stability.

SECTION 7
ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual inspection of Taylor Dam did not disclose any findings that indicate an immediate unsafe condition. The observed conditions of the dam, however, is poor. The inspection revealed the following:

(1) A general deteriorated condition of the concrete training walls at the spillway and outlet works facilities.

(2) Live and dead trees on the dam embankment.

(3) The inadequacy of the spillway.

(4) The inability to drain the reservoir.

b. Adequacy of Information. The information made available is such that the assessment of the safety of the dam must be based primarily on the visual inspection and the past performance of the structure.

c. Urgency. This dam is in poor condition and the recommendations and remedial measures described in 7.2 and 7.3 should begin within one year after receipt of this Phase I Inspection Report by the owner.

d. Need for Additional Investigation. The findings of the visual investigation indicate that the owner should engage a qualified engineer to design appropriate corrective measures to the badly eroded training walls of the spillway and outlet works.

7.2 Recommendations

It is recommended that the owner retain the services of a qualified engineer to:

(a) Design remedial measures for the badly scoured and deteriorated concrete of the spillway and outlet works and the concrete upstream face.

(b) Evaluate further the potential for overtopping and the inadequacy of the spillway.

7.3 Remedial Measures

(a) Remove all live and dead trees from the downstream face and plant appropriate cover in the slope to prevent erosion.

(b) Provide the repair or replacement of the inoperable gate to provide for reservoir draining.

(c) Develop a written operational procedure to follow in the event of flood flow conditions or imminent dam failure.

(d) Initiate a program to continue these technical inspections on an annual basis.

7.4 Alternatives

There are no practical alternatives to the recommendations made in Section 7.2 and 7.3 except that on an interim basis the owner may consider operating the reservoir at a lower level so as to provide more storage in extreme flood events.

APPENDIX A

VISUAL CHECK LIST WITH COMMENTS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Taylor Dam
Salem, New Hampshire

DATE August 10, 1978

TIME 9 a.m.

WEATHER Fair 78°

W.S. ELEV. 182.1 U.S. 169.0 ± DN.S

PARTY:

1. Gordon Slaney, HNTB
2. Stan Mazur, HNTB
3. D. P. LaGatta, GEI
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Masonry/Embankment Dam	Dan LaGatta	
2.	Spillway, Outlet Works	Stan Mazur/Gordon Slaney	
3.	Reservoir, Downstream Channel	Gordon Slaney	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Taylor Dam — DATE August 10, 1978

PROJECT FEATURE Masonry/Embankment Dam — NAME D. P. LaGatta

DISCIPLINE Geotechnical Engineer — NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	186.0
Current Pool Elevation	2+ inches of crest of spillway at outlet works, 182.1
Maximum Impoundment to Date	Unknown
Surface Cracks	
Pavement Condition	No pavement.
Movement or Settlement of Crest	No movement observed.
Lateral Movement	No movement observed.
Vertical Alignment	No misalignment of dam crest observed.
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	Concrete training walls of outlet structure cracked and eroded with seepage from right training wall of outlet works
Indications of Movement of Structural Items on Slopes	See text. None.
Trespassing on Slopes	Minor.
Sloughing or Erosion of Slopes or Abutments	Surface sloughing caused by erosion and collapse of d.s. masonry wall.
Rock Slope Protection - Riprap Failures	No riprap.
Unusual Movement or Cracking at or near Toes	Original rock wall forming d.s. face has collapsed and been covered with soil.
Unusual Embankment or Downstream Seepage	None observed.
Piping or Boils	None observed.
Foundation Drainage Features	None.
Toe Drains	None.
Instrumentation System	

PERIODIC INSPECTION CHECK LIST

PROJECT Taylor Dam DATE August 10, 1978

PROJECT FEATURE Intake Channel/Structure NAME D. P. LaGatta

DISCIPLINE Geotechnical Engineer/Structural NAME S. Mazur

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

PERIODIC INSPECTION CHECK LIST

PROJECT Taylor Dam — DATE August 10, 1978

PROJECT FEATURE Outlet Works — NAME S. Mazur

DISCIPLINE Structural — NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	None.
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

PERIODIC INSPECTION CHECK LIST

PROJECT Taylor Dam DATE August 10, 1978

PROJECT FEATURE Intake Structure NAME S. Mazur

DISCIPLINE Structural Engineer NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Control Tower and Intak Structure are one and the same.
a. Concrete and Structural	
General Condition	Poor.
Condition of Joints	Poor.
Spalling	Heavy spalling observed.
Visible Reinforcing	None observed.
Rusting or Staining of Concrete	Slight amount observed - from handrail.
Any Seepage or Efflorescence	None observed.
Joint Alignment	Right training wall slightly misaligned.
Unusual Seepage or Leaks in Gate Chamber	None observed.
Cracks	Great amount of cracking observed.
Rusting or Corrosion of Steel	None observed.
b. Mechanical and Electrical	One gate which is manually operated. Gear mechanism is broken and therefore gate is inoperable.
Air Vents	
Float Wells	
Crane Hoist	
Elevator	Gate is not checked for operation.
Hydraulic System	Only outlet is 60 inch diameter drain pipe in good condition.
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECK LIST

PROJECT Taylor Dam DATE August 10, 1978

PROJECT FEATURE Transition Conduit NAME G. Slaney

DISCIPLINE Hydraulic/Structural NAME S. Mazur

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	60 inch diameter drain pipe outlet in good condition.
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECK LIST

PROJECT Taylor Dam — DATE August 10, 1978

PROJECT FEATURE Outlet Structure/Channel — NAME D. P. LaGatta

DISCIPLINE Structural Engineer/Geotechnical Engr. — NAME S. Mazur

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	In addition to gate and drain pipe there is a spillway section at the outlet works.
General Condition of Concrete	Poor.
Rust or Staining	Slight rusting from handrail.
Spalling	Heavy spalling observed throughout.
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	Slight seepage noted in lower portion of right training wall.
Condition at Joints	
Drain Holes	None.
Channel	90 ft. of channel has masonry walls 4½ ft. high below wall channel.
Loose Rock or Trees Overhanging Channel	No loose rock.
Condition of Discharge Channel	Good.

PERIODIC INSPECTION CHECK LIST

PROJECT Taylor Dam DATE August 10, 1978

PROJECT FEATURE Spillway and Channel NAME D. P. LaGatta

DISCIPLINE Structural Engr./Geotechnical Engr. NAME S. Mazur

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	None.
General Condition	
Loose Rock Overhanding Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	12 inch flashboard in place at time of inspection. Water (½") under flashboard flowing over spillway.
General Condition of Concrete	Poor.
Rust or Staining	Slight from handrail.
Spalling	Heavy spalling observed - foundation of training walls lost.
Any Visible Reinforcing	
Any Seepage or Efflorescence	None.
Drain Holes	
c. Discharge Channel	
General Channel	Good.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None of consequence.
Floor of Channel	Good.
Other Obstructions	None.

PERIODIC INSPECTION CHECK LIST

PROJECT Taylor Dam DATE August 10, 1978

PROJECT FEATURE Service Bridge NAME

DISCIPLINE Structural Engineer NAME S. Mazur

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	There is a 2'-0" wide by 4" thick precast concrete slab with handrail traversing the right spillway and the spillway at the outlet works structure. Both are in good condition.
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

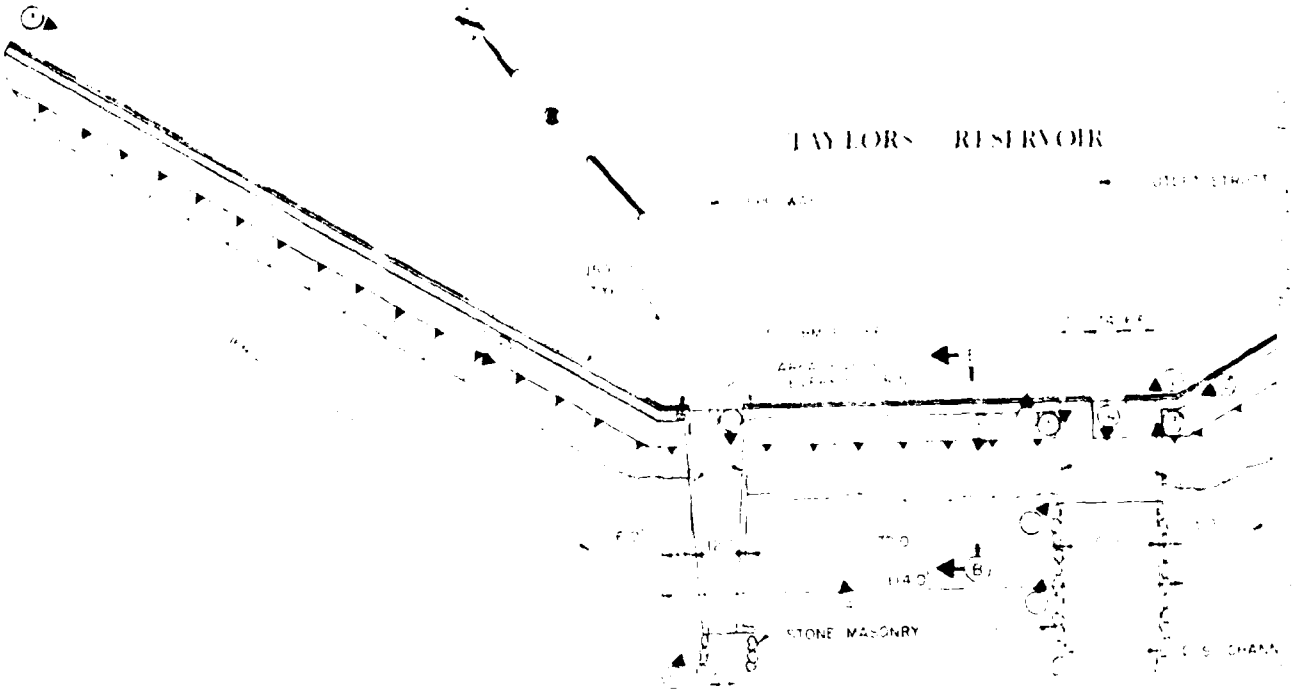
APPENDIX B

ENGINEERING DATA

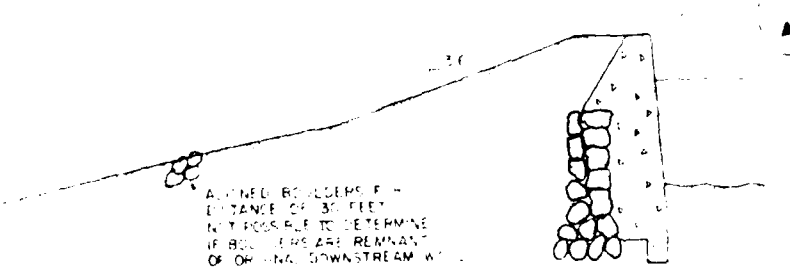
1. LIST OF DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS
2. PAST INSPECTION REPORTS
3. PLANS AND DETAILS

AVAILABLE ENGINEERING DATA

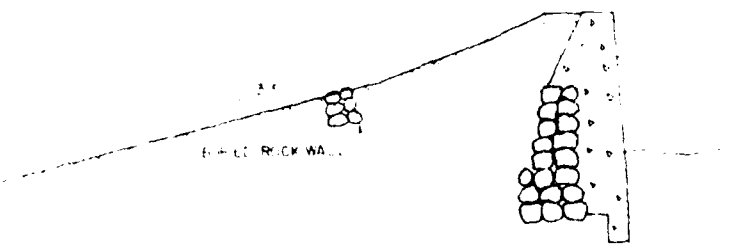
A set of drawings (2 sheets), prepared by J. H. Fitch, Engineer, dated 1916, showing repairs for the dam is available at the State of New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire 03301.



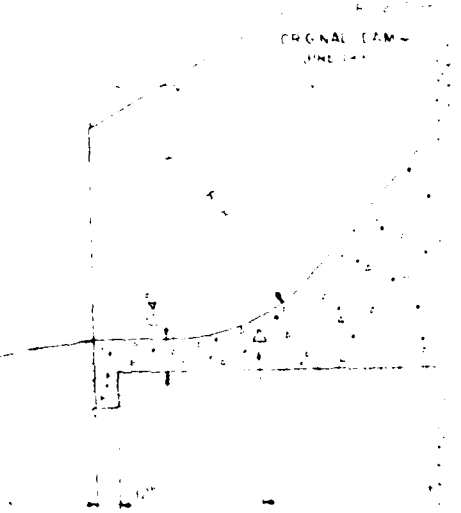
PLAN



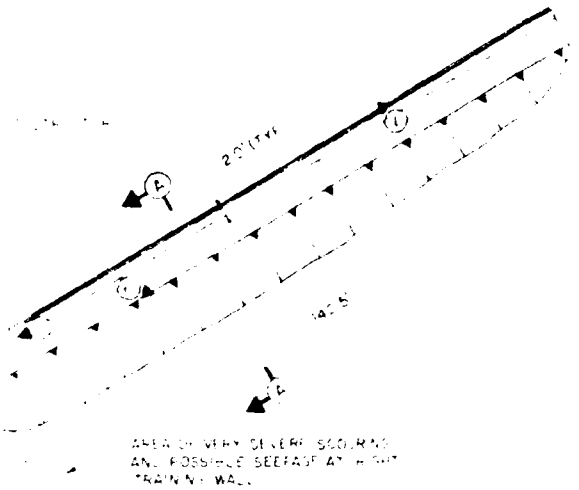
SECTION A-A

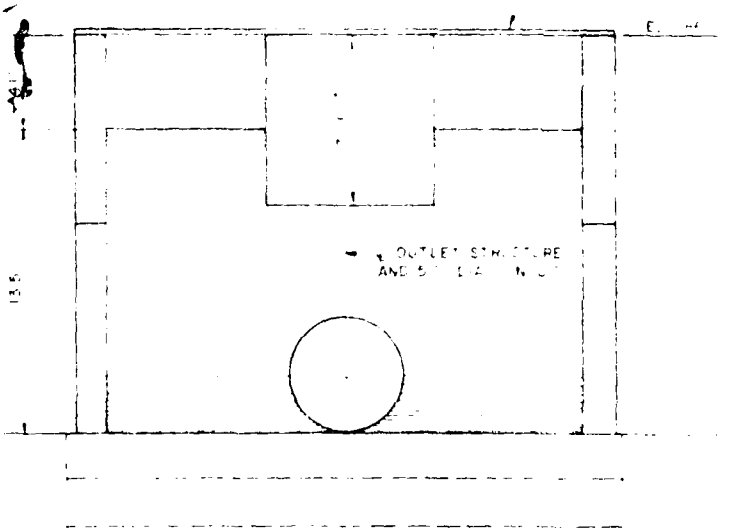


SECTION B-B

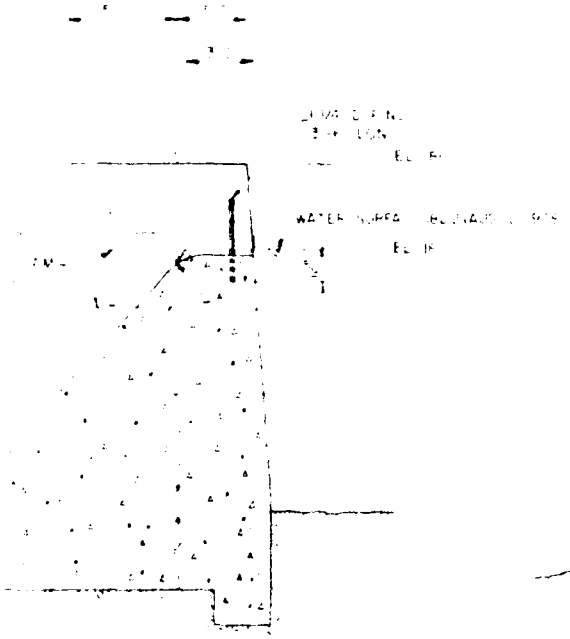


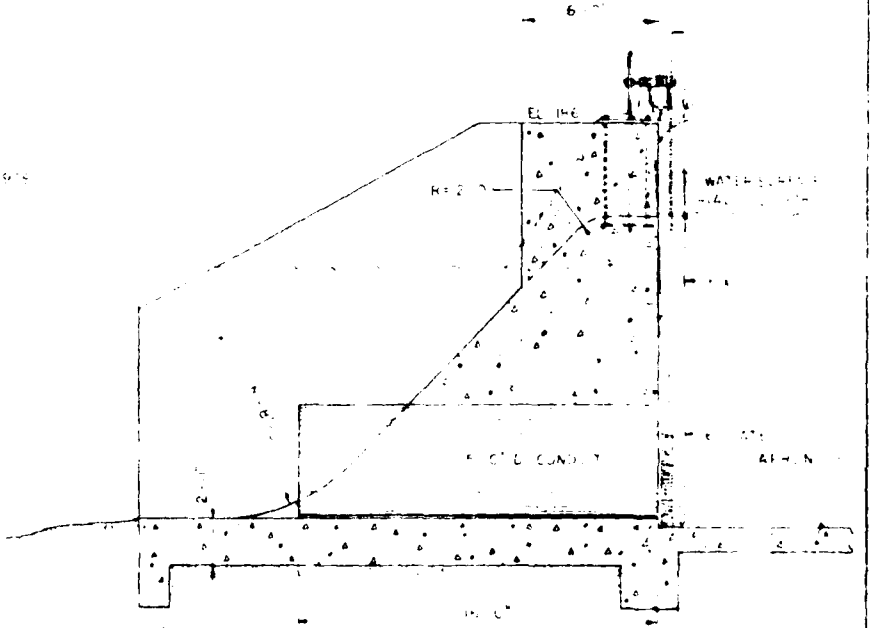
SECTION AT SPI





ELEVATION - OUTLET STRUCTURE





SECTION AT OUTLET STRUCTURE

T SPILLWAY

NOTES

1. THE ELEVATIONS SHOWN WERE OBTAINED BY USING THE USGS BENCH MARK AS SHOWN ON THE QUADRANGLE SHEET FOR THIS DAM SITE LOCATION.
2. THE INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON THE EXISTING CONSTRUCTION PLANS AND VISUAL OBSERVATIONS MADE DURING THE FIELD INSPECTION. DIMENSIONS OR MATERIALS INDICATED ON THESE DRAWINGS WHICH WERE BELOW GRADE OR WATER DURING THE TIME OF INSPECTION WERE NOT VERIFIED.
3. SPILLWAY AND OUTLET WORKS CHANNEL NOT SHOWN TO ENTIRE LENGTH.

NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS

TAYLOR DAM

SPICER RIVER

FIGURE

PAST INSPECTION REPORTS

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

DAM SAFETY INSPECTION REPORT FORM

Town: _____ Dam Number: _____

Inspected by: _____ Date: _____ / _____ / 19__

Local name of dam or water body: _____

Owner: _____ Address: _____

Owner was/was not interviewed during inspection.

Drainage Area: _____ sq. mi. Stream: _____

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

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

Spillway: Type _____, Freeboard over perm. crest: _____,

Width _____, Flashboard height _____,

Max. Capacity _____ c.f.s.

Embankment: Type _____, Cover _____ Width _____,

Upstream slope _____ to 1; Downstream slope _____ to 1

Abutments: Type _____, Condition: Good, Fair, (Poor)

Gates or Pond Drain: Size _____ Capacity _____ Type _____

Lifting apparatus _____ Operational condition _____

Changes since construction or last inspection: _____

_____

_____

Downstream development: _____

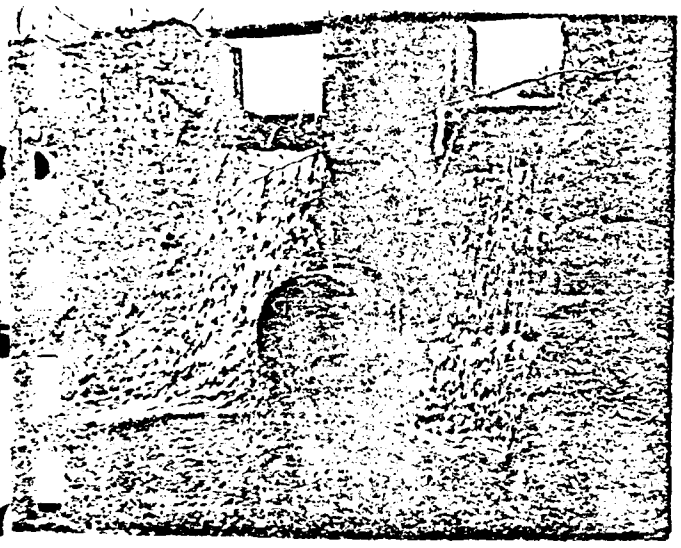
This dam (would)/would not be a menace if it failed.

Suggested reinspection date: _____

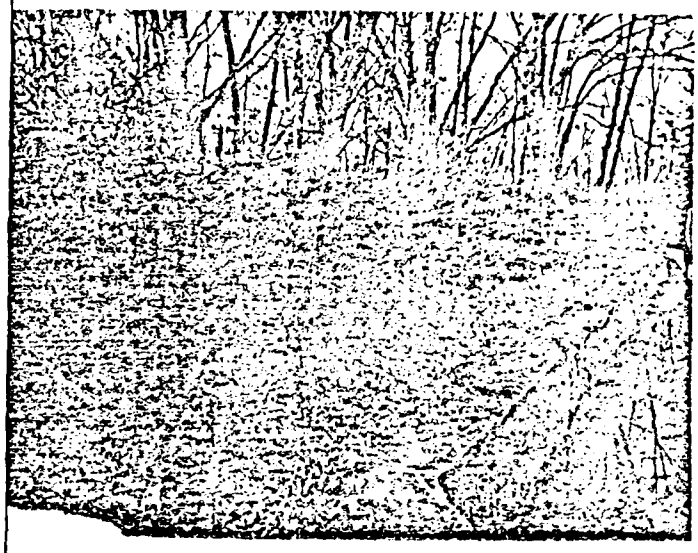
Remarks: _____

SALEM

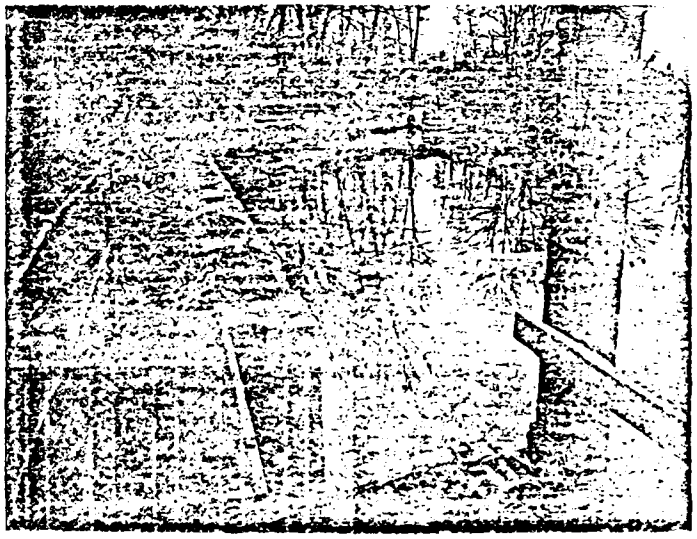
20902



Spillway #2 showing undermining of abutments.

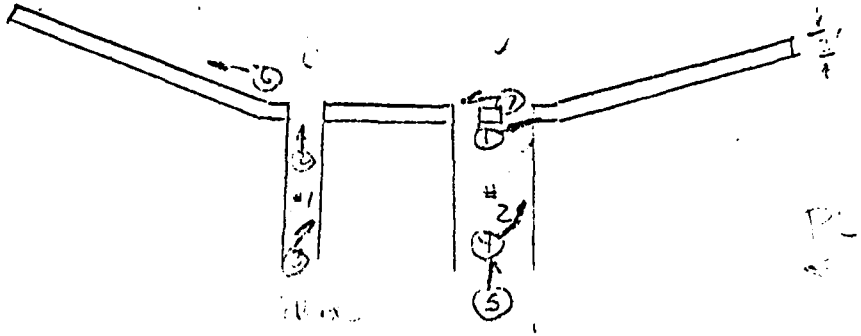


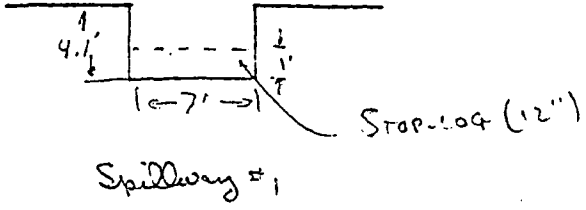
Showing erosion of concrete.



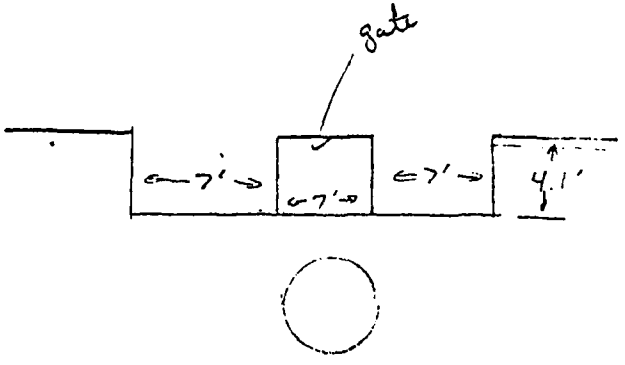
Right side of dam.

Z.J.D.
12/4/13





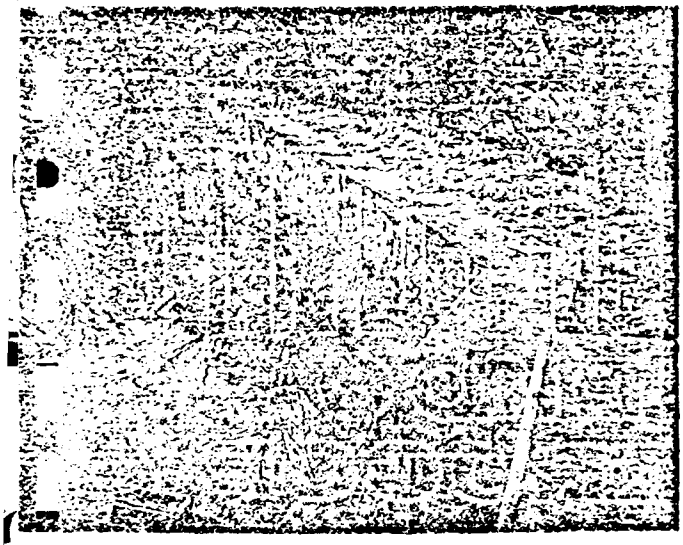
Spillway #1



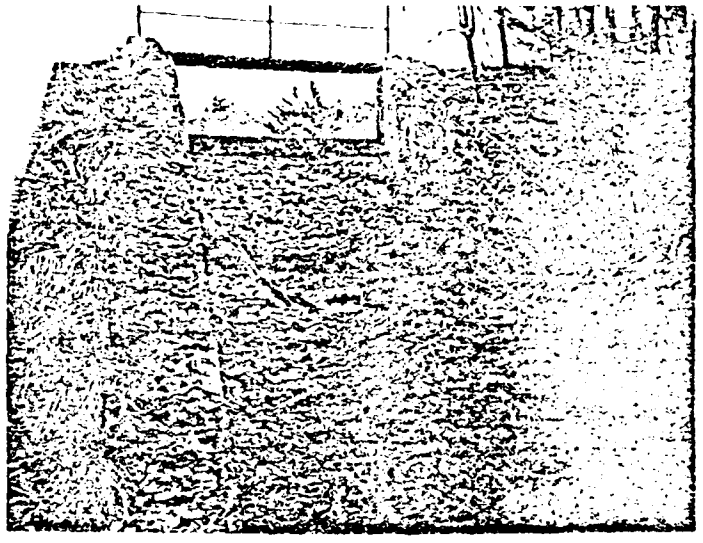
Spillway #2

SALEM

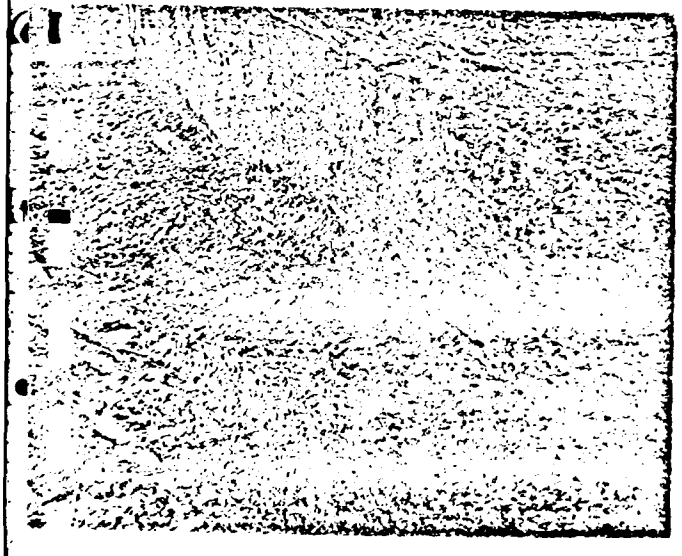
209.02



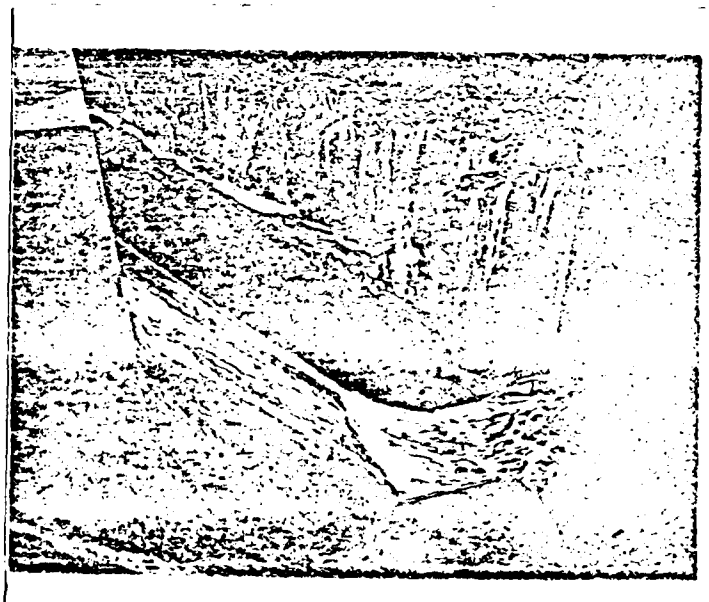
Left part of dam.



Eroded concrete of spillway#1



Spillway #1 eroded



Spillway #2 abutments undermined.

Z.J.D.
12/4/13

State of New Hampshire

WATER RESOURCES BOARD

37 Pleasant St.
Concord 03301

February 24, 1975

Greater Lawrence Industrial Corp.
550 Broadway
Lawrence, MA 01840

CERTIFIED MAIL

Dear Sirs:

On Dec. 4, 1973 - Dec. 13, 1973, an engineer of the New Hampshire Water Resources Board inspected your dam located on _____ Spickett River in the town of Salem.

These dams, ~~Xxxxxxx~~, #209.02,4,5,8,9 in the files of the New Hampshire Water Resources Board, is classified as a menace structure, and as such, must be maintained in a manner so that this structure does not endanger the safety of the public or become a "Dam in Disrepair" (RSA 428:1). Under the statutes, (copies enclosed for your review), this office is responsible for making these inspections periodically and seeking the dam owner's cooperation in making the required repairs.

Since the fall of 1972 the Legislature has attempted to meet its statutory obligations regarding the inspection of dams, and the Board on a priority basis has made inspections in those areas of the state having a history of the least number of inspections over the years. Our priority was to inspect as many dams as possible during times that weather conditions would allow; however, our dam inspector would take immediate action on any structure that was in critical condition. Consequently, we are presently sending out letters notifying owners of dams that certain repairs are required by this Board per the statutes mentioned above. We request that you notify us within 90 days upon receipt of this letter of your intentions as to the completion of these repairs and deficiencies noted on the attached sheet.

We thank you for your cooperation in this regard, and we will be glad to answer any further questions you may have regarding the above.

Very truly yours,

George M. McGee, Sr.
Chairman

gmm3/vak:js
enclosures
cc: Board of Selectmen

Greater Lawrence Industrial Corporation
550 Broadway
Lawrence, MA 01840

RE: REQUIRED REPAIRS TO THE FOLLOWING DAMS:

Dam #209.02 (Taylor Dam)

1. Repair abutments.
2. Repair badly eroded floor of chute spillway.

Dam #209.04 (Dike)

1. Remove trees which have started growing on dike.

Dam #209.05 (Wheeler Reservoir)

1. Repair leakage through dam located near gate house.
2. Repair spalling concrete before it becomes critical.

Dam #209.08 Millville)

1. Repair badly spalled and cracked abutments.
2. Repair leakage at location where new concrete has been added (Left spillway)
3. Remove trees and brush from downstream toe and dike.
4. Replace left gate stem.

Dam #209.09 (Canobie Lake)

1. Repair spillway - walls show signs of deterioration.
2. Remove trees from embankment.

zd/js

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Merrimack NO. 2 - 160 - I - 4879
RIVER Spicket MILES FROM MOUTH ____ D.A.SQ.MI. ~~20.69~~ 19.05
TOWN Salem OWNER Arlington Mills, Lawrence Mass.
LOCAL NAME OF DAM Taylor
BUILT ____ DESCRIPTION Gravity — Concrete, Boulders
Earth on Earth

POND AREA-ACRES ____ DRAWDOWN FT. ____ POND CAPACITY-ACRE FT. ____
HEIGHT-TOP TO BED OF STREAM-FT. 17.5 MAX. ____ MIN. ____
OVERALL LENGTH OF DAM-FT. 374 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. 11.167 and 2 - 2.58 FREEBOARD-FT. 4
FLASHBOARDS-TYPE, HEIGHT ABOVE CREST 2.5
WASTE GATES-NO. WIDTH MAX. OPENING DEPTH SILL BELOW CREST
— — — —
— — — —
— — — —

REMARKS Condition Fair

7.1 Into Merrimack R

POWER DEVELOPMENT

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

USE Conservation

REMARKS Menace

DATE 12/30/35

NEW HAMPSHIRE WATER CONTROL COMMISSION

REPORT ON DAM INSPECTION

TOWN Salem DAM NO. 209.02 STREAM Spickett River

OWNER Wm. Whitman Co. Inc. [illegible] Mills Div. ADDRESS Lawrence Mass.

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on 12/1/49 ~~accompanied by~~

NOTES ON PHYSICAL CONDITION

Abutments Good

Spillway [illegible] spillway [illegible] 75' [illegible] Fix concrete erosion in both gate & spillway [illegible]

Gates Excellent

Other

CHANGES SINCE LAST INSPECTION Concrete around gate & spillway repaired

FUTURE INSPECTIONS [illegible]

This dam (is) (~~is not~~) a menace because of [illegible], [illegible] & property down stream

REMARKS Suggest removal of [illegible] from spillway discharge channel, also repairing concrete on sides of spillway & gate structures.

Copy to Owner	Date

[illegible signature]
INSPECTOR

(Additional Notes Over)

NEW HAMPSHIRE WATER CONTROL COMMISSION

REPORT ON DAM INSPECTION

TOWN SALEM DAM NO. 209.02 STREAM Spickett River

OWNER Arlington Mills ADDRESS Lawrence, Mass.

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on June 25, 1940 accompanied by MR. FITCH

NOTES ON PHYSICAL CONDITION

Abutments EXCELLENT SHAPE

Spillway BOTH GOOD SHAPE, NORTH SPILL CHANNEL SHOWS SOME SCOUR AT BOTTOM EDGES - CHECK IN 1945.

Gates OPERABLE

Other

CHANGES SINCE LAST INSPECTION

FUTURE INSPECTIONS

This dam (is) ~~(is not)~~ a menace because LOCATION ABOVE PROPERTY AND ROAD. (PONDAGE CONSIDERABLE)

REMARKS GENERAL GOOD CONDITION

Copy to Owner	Date

C. D. Clowes
INSPECTOR

(Additional Notes Over)

CALCULATION SHEET

Date 10-30-35

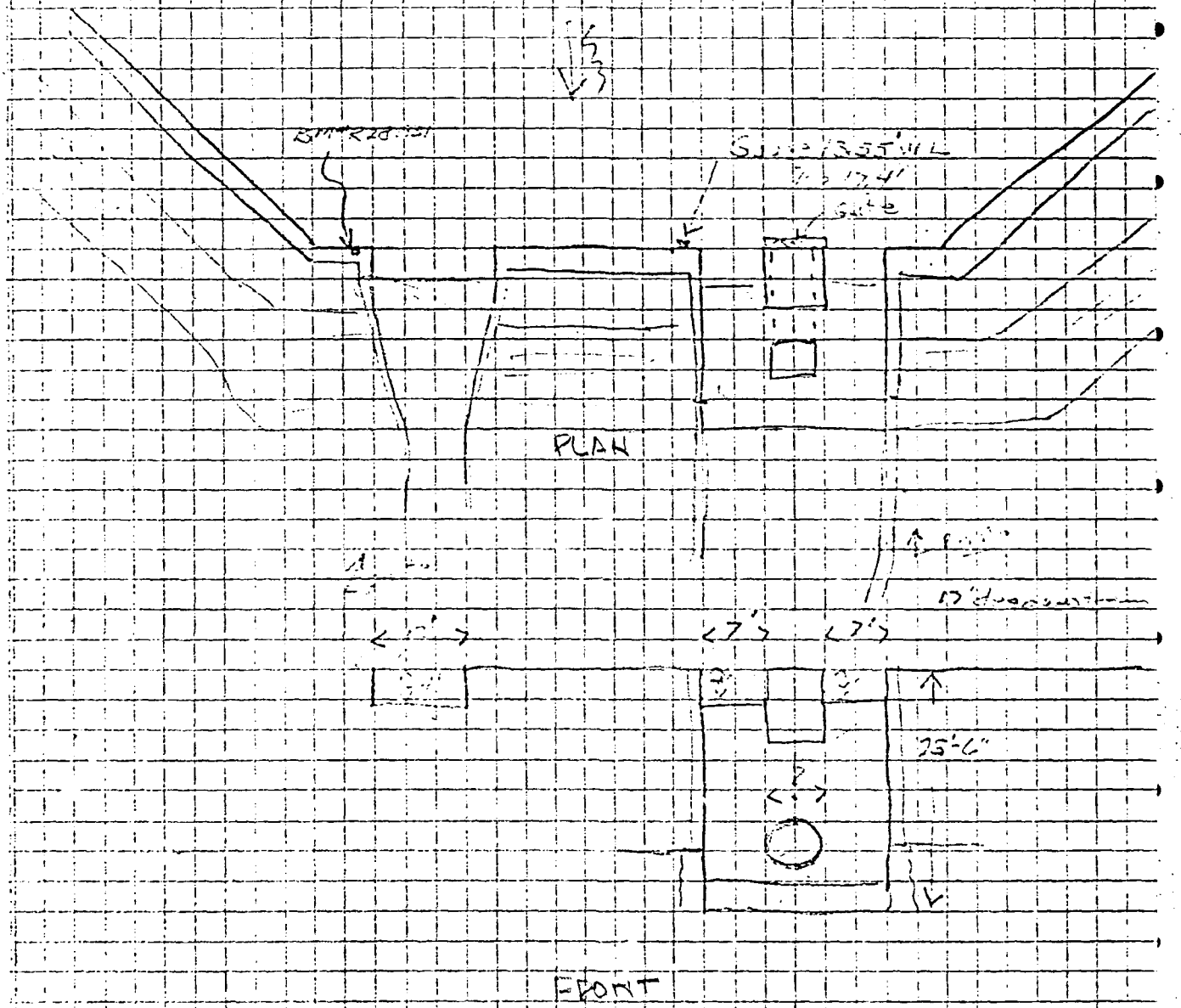
Refers to

Made By

3648

1-4879

Taylor Dam



PUBLIC SERVICE COMMISSION OF NEW HAMPSHIRE—DAM RECORD I-4873

TOWN	Salem	TOWN NO. 2	STATE NO. 209.02
RIVER STREAM	Spickett River (Taylor Dam)		
DRAINAGE AREA	[illegible]	POND AREA	
DAM TYPE	Gravity	FOUNDATION NATURE OF	Earth
MATERIALS OF CONSTRUCTION	Concrete, Boulders, Earth		
PURPOSE OF DAM	POWER—CONSERVATION—DOMESTIC—RECREATION—TRANSPORTATION—PUBLIC UTILITY		
HEIGHTS, TOP OF DAM TO BED OF STREAM	17.5' ✓	TOP OF DAM TO SPILLWAY CRESTS	4'
SPILLWAYS, LENGTHS DEPTHS BELOW TOP OF DAM	Wasteway 11'-2" long 4' Spillway 2 2 -7' long 4'	LENGTH OF DAM	374' ✓
FLASHBOARDS TYPE, HEIGHT ABOVE CREST	2.5'		
OPERATING HEAD CREST TO N. T. W.		TOP OF FLASHBOARDS TO N. T. W.	
WHEELS, NUMBER KINDS & H. P.			
GENERATORS, NUMBER KINDS & K. W			
H. P. 90 P. C. TIME 100 P. C. EFF.		H. P. 75 P.C. TIME 100 P. C. EFF.	
REFERENCES, CASES, PLANS, INSPECTIONS, REMARKS			

OWNER- Arlington Mills

CONDITION- Fair

MENACE- Yes. Will be subject to periodic inspection.

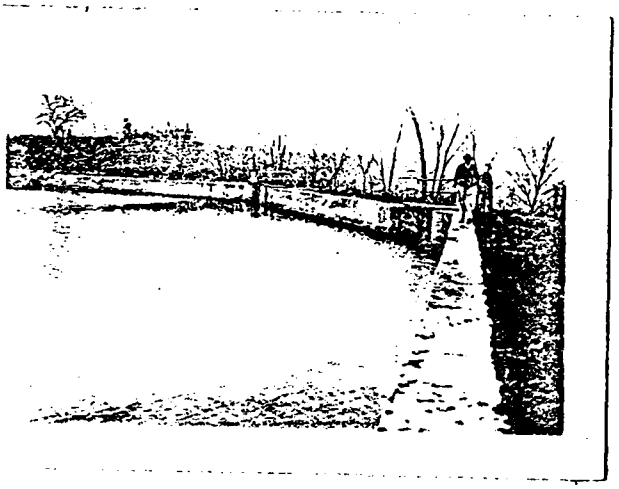
To the Public Service Commission:

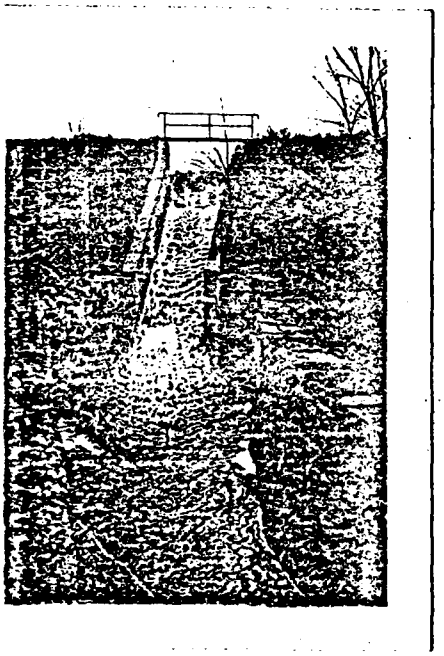
The foregoing memorandum on the above dam is submitted covering inspection made October 30, 1935, according to notification to owner dated October 26, 1935, and bill for same is enclosed.

Samuel J. Lord
Hyd. Eng.

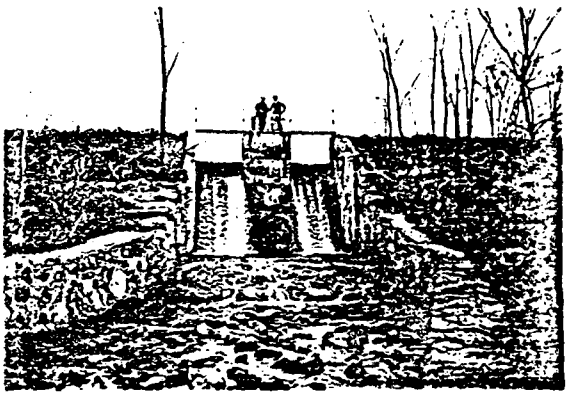
Nov. 6, 1935
Copy to Owner

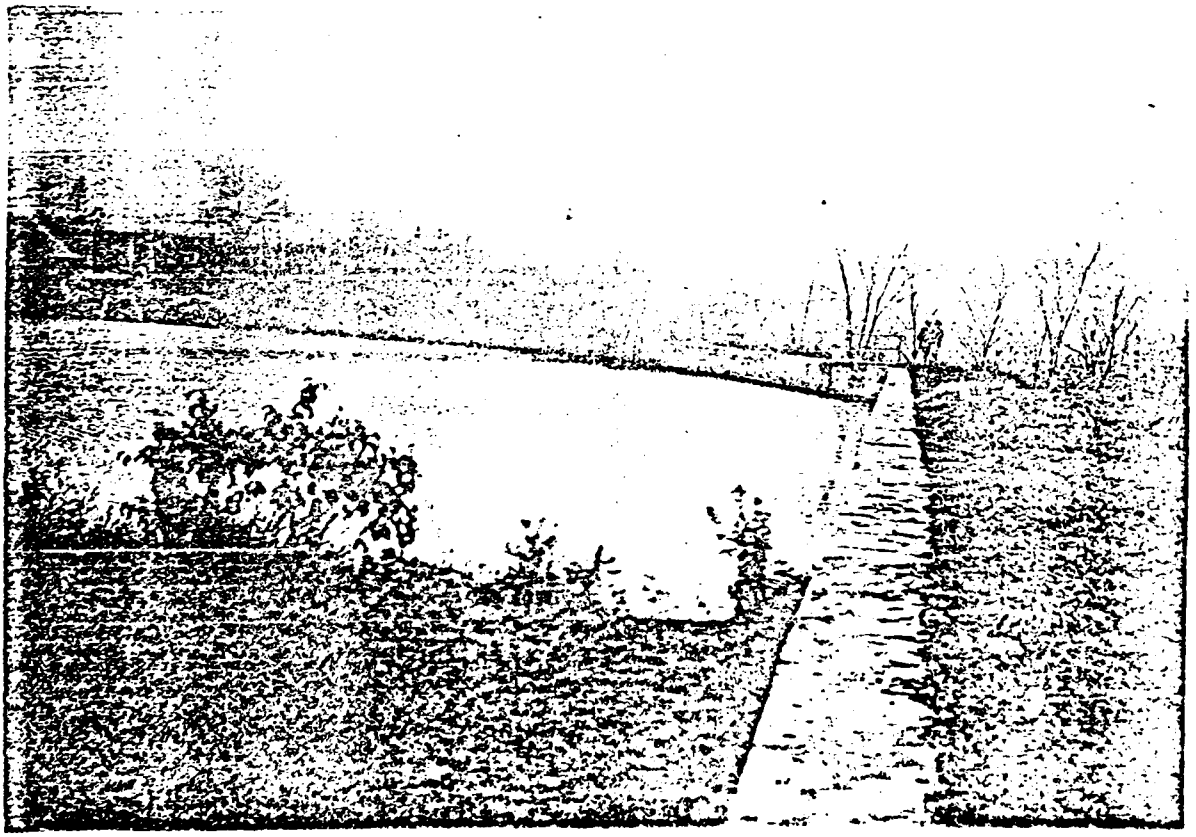
SPICKETT RIVER IN SALEM
Arlington Mills
October 30,1935





SPICKETT RIVER IN SALEM
Arlington Mills
October 30,1935





APPENDIX C

PHOTOGRAPHS

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

Photo No. 1 - General view of reservoir from left abutment.

Photo No. 2 - General view of reservoir from center of dam.

Photo No. 3 - General view of dam (upstream face) from right abutment.

Photo No. 4 - Downstream slope from crest of dam at spillway wall looking toward left abutment.

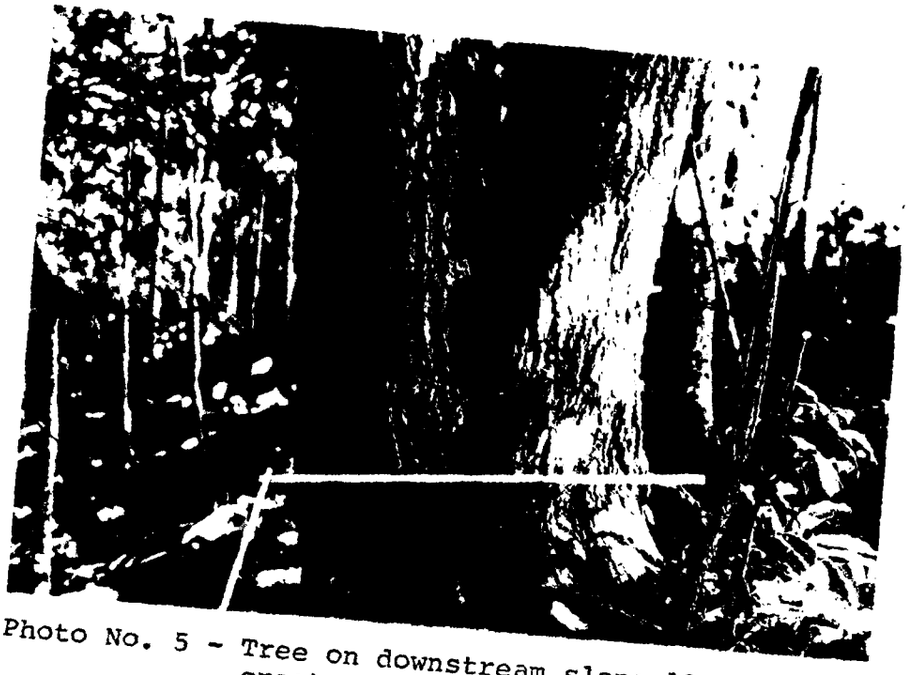


Photo No. 5 - Tree on downstream slope 12 feet from crest of dam. Horizontal rule equals 3 feet.

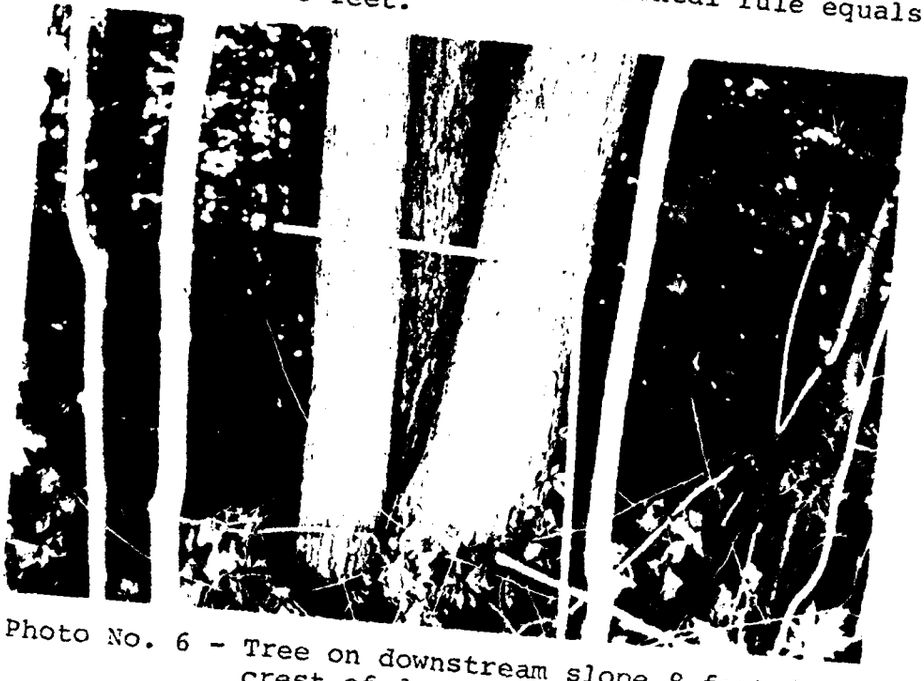


Photo No. 6 - Tree on downstream slope 8 feet from crest of dam. Horizontal rule equals 2 feet.

Photo No. 7 - Rotting tree stump 8 feet downstream of concrete face of dam.

Photo No. 8 - General view of spillway structure.

Photo No. 9 - General view of outlet works structure.

Photo No. 10 - Erosion of right training wall at outlet works through which water is seeping from embankment.

Photo No. 11 - Outlet structure, deterioration of left training wall.

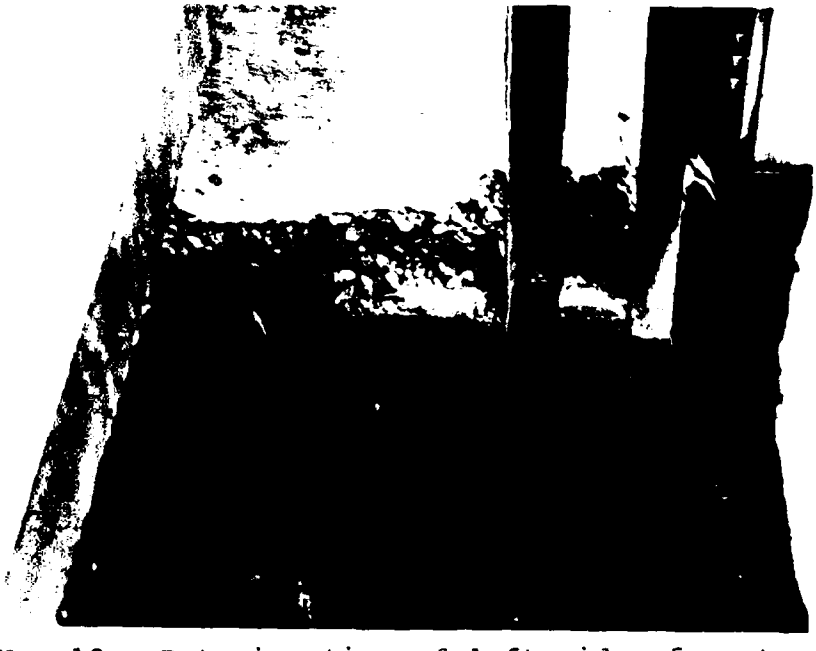


Photo No. 12 - Deterioration of left side of center piers at outlet works.

Photo No. 13 - Deterioration of right training wall at outlet structure.

Photo No. 14 - Outlet structure and outlet channel looking downstream from top of outlet structure.

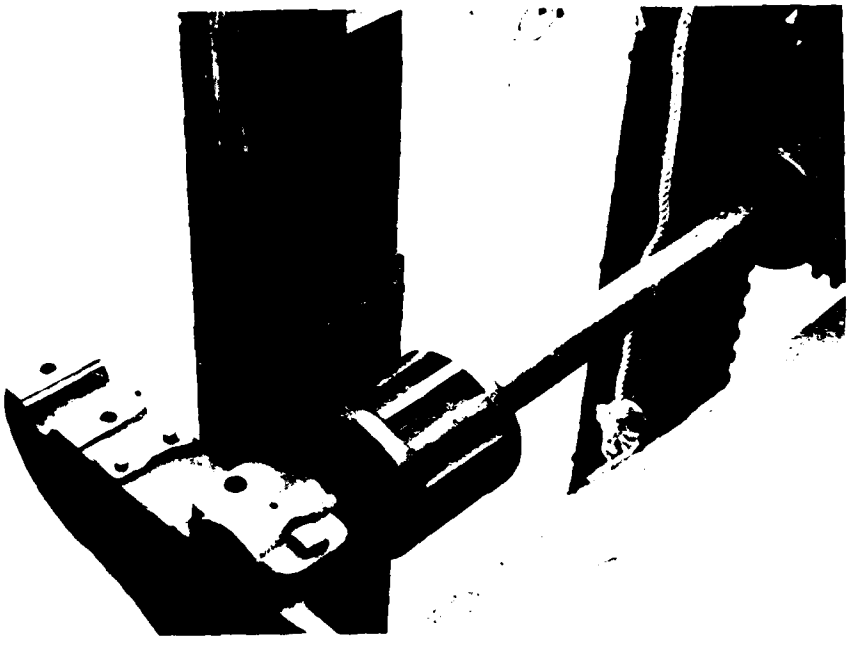


Photo No. 15 - Outlet works gate, manually operated.

Photo No. 16 - Spillway channel.

Photo No. 17 - Downstream channel.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

HNTB — HOWARD NEEDLES TAMMEN & BERGENDOFF

Made by	Date	Job No
Checked by	Date	Sheet No 1

TAYLOR DAM - SALEM N.H

BASIC DATA:

Drainage area = 19.0 S. Miles (N.H. Water Control Commission data Verified)

Based on Corps of Engineers guidelines:

SIZE CLASSIFICATION: SMALL (1) SEE BELOW

HAZARD POTENTIAL CLASSIFICATION: SIGNIFICANT (2)

For dams with a Small Size classification and significant hazard potential, a test flood equal to 1/2 PMF is indicated in the Corps of Engineers Guidelines.

ELEVATIONS VS WATER SURFACE AREA VS VOLUME

CONDITIONS	ELEVATION (FT)	SURFACE AREA (AC)	STORAGE CAPACITY (A-F)
1 Crest of Dam	* 196.0	12	130 (EST.)
2. Top of Spillway 1	181.9	12	80.8
3) Top of Spillway 2	181.8	12	79.6

* Elevation given is Mean Sea Level, taken from U.S.G.S. Bench Mark.

SIZE CLASSIFICATION (1)

CATEGORY	STORAGE (A-F)	HEIGHT
SMALL	<1000 & ≥ 50	<40.

HAZARD POTENTIAL (2)

CATEGORY	LOSS OF LIFE	ECONOMIC LOSS
SIGNIFICANT	FEW	APPRECIABLE

HOWARD NEEDLES TAMMEN & BERGENDOFF | Checked by | Date | Sheet No. 7

Of Public Trail

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES

STEP 1: Determine the peak inflow Q_{P_1} from guide curves, and Then adjust it for Test Flood criteria:

For flat zone and d.a. of 19.0 S.M. the rate obtained from the guide curve is 630 CFS/S.M. and the PMF is computed as follows:

$\therefore$ PMF = 630 CFS/S.M. × 19.0 S.M. = 11,970 C.F.S.

TEST FLOOD = 1/2 PMF = 0.5 × 11,970 = 5,985 CFS = (Q_{P_1})

STEP 2: COMPUTE THE SURCHARGE HEIGHT TO PASS THE TEST FLOOD

For calculations of the spillway capacity at maximum pool elev. (186' M.S.L.). See appendix 1

The total spillway capacity for the two spillways is equal to 760 CFS±.
The crest of the dam is assumed to be a broad-crested weir.
The surcharge height necessary to pass the remainder of Q_{P_1}, - i.e., The value of Q_{P_1} minus the spillway discharge = 760 CFS is computed by using the formula (see Appendix 1):

$$Q = C \times L \times H^{3/2}$$

C = 3.09 (Broad-Crest.)
L = Total Length = 420.5'
H = Total Head above crest.
$Q = Q_{P_1} - Q_{Spillways}$
= 5,985 - 760 CFS
= 5,225 CFS

$$\therefore H = \left[\frac{Q}{C \times L}\right]^{2/3}$$

$$H = \left[\frac{5,225}{3.09 \times 420.5'}\right]^{.0666}$$

$\therefore$ H = 2.53 Feet (Above elev. 186.0')

STEP 3. Prepare a curve showing the stage-discharge relationship. (See Figure 1) using the following table:

TABLE 1

WATER ELEVATION	HEAD OVER CREST	Q_C (CFS)	Q_S * (CFS)	TOTAL FLOW CFS
181.9	-	0	0	0
186.0	0	0	760	760
188.0	2.0	3,675	760	4,435
189.0	3.0	6,750	760	7,510
190.0	4.0	10,400	760	11,160
191.0	5.0	14,530	760	15,290
192.0	6.0	19,100	760	19,860
193.0	7.0	24,060	760	24,820
194.0	8.0	29,400	760	30,160

DATA FOR TABLE
$L = 420.5'$
$C = 3.09$
$Q_S = 760$ C.F.S.

Surcharge El. to pass $Q_{P_1} = 5,985$ CFS is equal to:
El. = 186.0' + 2.53' = 188.53'

* For calculations of flow over the spillways, see Appendix 1

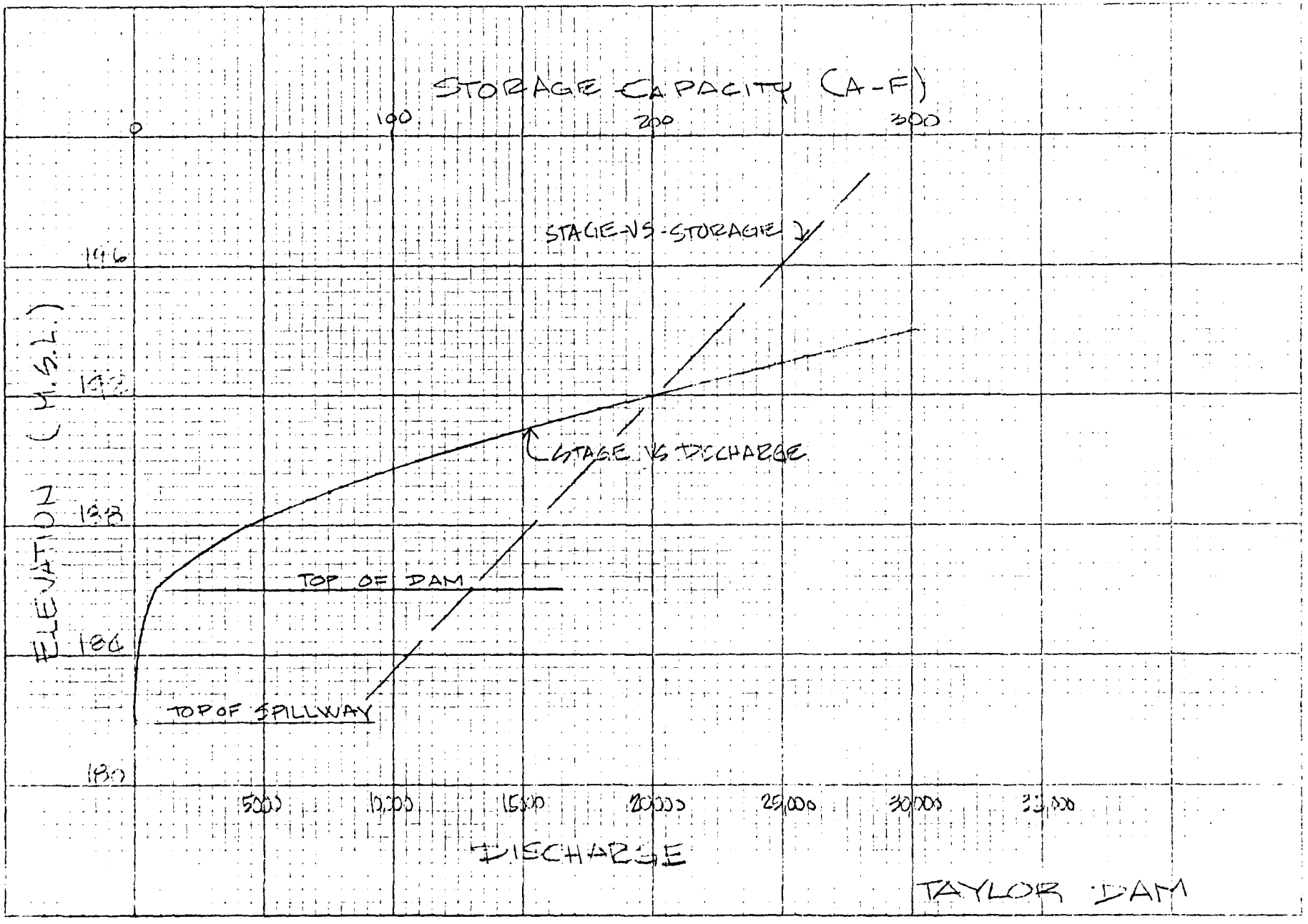
STEP 4A - Compute the volume stored above spillway weir elevation. (Elev. 181.9) up to El. 188.53'

DATA:
S.A. = Surface Area = 12 Ac. (Planimetered from USGS)

Volume = (Elev 188.53' - Elev. 181.90') x S.A =
= 79.56 A-F.

4B - Compute number of inches of runoff:

$$STOR_1 = \frac{\text{Volume}}{D.A} \times 12'' = \frac{79.56\ A\text{-}F}{195\ MK\ 640\ Ac/_{SM}} \times 12'' = 0.0785''$$


STORAGE CAPACITY (A-F)
0
100
200
300
STAGE-VS-STORAGE
STAGE VS DISCHARGE
TOP OF DAM
TOP OF SPILLWAY
ELEVATION (M.S.L.)
196
194
192
190
188
5000
10,000
15000
20000
25,000
30,000
DISCHARGE
TAYLOR DAM

STEP 4c : Compute $Q_{P_2} = Q_{P_1} \times \left(1 - \frac{STOR_1}{9.5''}\right) =$

$$Q_{P_2} = 5{,}985 \text{ CFS} \times \left[1 - \frac{0.0785''}{9.5''}\right] =$$

$$= 5{,}935 \text{ CFS}$$

STEP 5 : Determine surcharge height and $STOR_1$ to pass Q_{P_2} :

$$H = \left[\frac{Q_{P_2} - Q_S}{C \times L}\right]^{2/3} = \left[\frac{5{,}935 - 760}{3.09 \times 420.5'}\right]^{2/3} = \text{(Head above Crest of Dam)}$$

$$= 2.52 \text{ Feet} \checkmark$$

Compute $STOR_2$: Up to El. 186.0' + 2.52' = 188.52'

$$STOR_2 = \frac{\text{VOLUME ABOVE SPILLWAY El.}}{D.A} \times 12'' =$$

$$= \frac{(188.52' - 181.9') \times 12^{AC}}{19 \text{ S.M.} \times 640 \text{ AC/S.M.}} \times 12'' = 0.0784''$$

STOR AVG. = 0.07845"

Avg. Surch. Elevation $= \frac{0.07845'' \times 19 \text{ S.M.} \times 640 \text{ AC/S.M.}}{12 \text{ AC} \times 12''} + 181.9' =$

$= 188.52'$ M.S.L. (Surcharge elevation)

For elev. 188.52' read Q_{P_3} from fig. 1

$$Q_{P_3} = 5{,}973 \text{ CFS} \checkmark$$

COMMENTS : 1) The test flood (Q = 5,973 CFS) will overtop the dam by about 2.5 feet.

2) The spillway will be able to pass the 12.7% of test flood discharge. (i.e. Q_{P_3} = 5,973 cfs)

ESTIMATING DOWNSTREAM DAM FAILURE EFFECTS:

USE "RULE OF THUMB" TO ESTIMATE THE DAM FAILURE HYDROGRAPHS:

STEP 1: COMPUTE OR ESTIMATE THE STORAGE (S) IN A-F BEHIND THE DAM AT THE TIME OF FAILURE.

S = CAPACITY @ MAXIMUM POOL (El. 186.0') = 130 A-F

STEP 2: DETERMINE PEAK OUTFLOW (Q_{P_1})

$$Q_{P_1} = \frac{8}{27} \times \sqrt{g} \times W_b \times Y^{3/2}$$

W_b = Breach width (use 40% of crest length)
$W_b = 0.40 \times 420.5' = 168.2$ Feet
Y_b = Total height at time of failure = 17.5'

$$Q_{P_1} = 1.68 \times 168.2' \times (17.5')^{3/2} = 20,690 \text{ CFS}$$

STEP 3: DEVELOP A SECTION AND THE STAGE-DISCHARGE RATING CURVE.
For section see fig. 3
For curve see Fig. No 2

STEP 4: ESTIMATE REACH OUTFLOW

Channel Data: (Trapezoidal shape)
L = 700'
S_o = 0.0078'/'
Z = 15
Width of base = 200'±
n (Manning's) = 0.050

TRIAL PROCEDURE:

A: For Q_{P_1} = 20,690 CFS read from Fig. No. 2 the corresponding depth (or Stage).

d = 7.8 Feet

AREA = $7.8' \times (200 + 7.8 \times 15) = 2473$ ft²

Volume $V_1 = \frac{2473 \text{ ft}^2 \times 700'}{43{,}560} = 39.73$ A-F ±

Check $V_1 < S/2$ Reach length is OK.

B: Determine $Q_{P_2\,(Trial)} = Q_{P_1} \times \left(1 - \frac{V_1}{S}\right) =$

$= 20{,}690 \text{ CFS} \times \left(1 - \frac{39.73 \text{ A-F}}{130 \text{ A-F}}\right) =$

$= 14{,}370$ CFS.

C: Compute V_2 given $Q_{P_2\,(Trial)} = 14{,}370$ CFS

From Figure No. 2 read (d) for $Q_{P_2} = 14{,}370$ CFS

d = 6.44 Feet

A = 1,910 ft²

$V_2 = \frac{1910 \text{ ft}^2 \times 700'}{43560 \text{ ft}^2/\text{Ac}} = 30.69$ A-F

D: Compute $V_{AVG.} = (V_1 + V_2) \times \frac{1}{2} =$

$= (39.73 + 30.69) \times \frac{1}{2} = 35.21$ A-F

Compute $Q_{P_2} = Q_{P_1} \times \left(1 - \frac{V_{AVG.}}{S}\right) = 20{,}690 \text{ CFS} \times \left(1 - \frac{35.21}{130}\right) =$

$= 15{,}090$ CFS

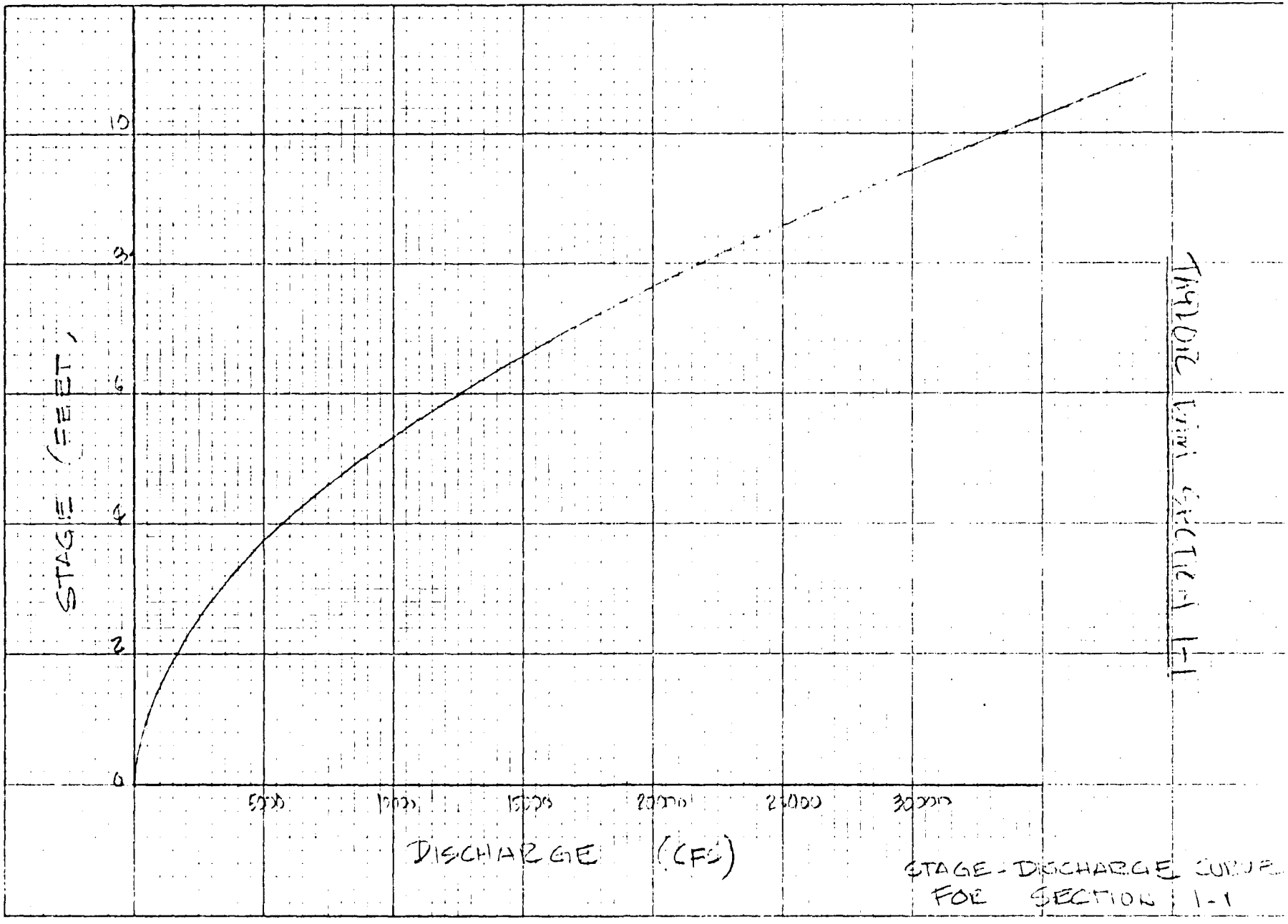
Say $Q_{P_2} = 15{,}090$ CFS.

COMMENT: No further analysis (downstream) is necessary since the Arlington Hill Reservoir (Surface Area = 266 Ac) will

HNTB HOWARD NEEDLES TAMMEN & BERGENDOFF	Made by HM	Date 10/2/13	Job No.
	Checked by VBM	Date 10/2/13	Sheet No. 8
For Taylor Dam			

accomodate the volume of water released from Taylor Dam under the preceding analysis with a 0.5 ± ft rise in water surface. The increase in water elev. in 0.5 FT ± Arlington Mill Reservoir is calculated as follows:

$$\frac{\text{Volume released from Taylor Dam}}{\text{Surface Area of Arlington Mill Res.}} = \frac{130 \text{ Ac-Ft.}}{266. \text{ Ac}} = 0.49 \text{ Ft}$$



STAGE-DISCHARGE CURVE FOR SECTION 1-1

FIG No. 2

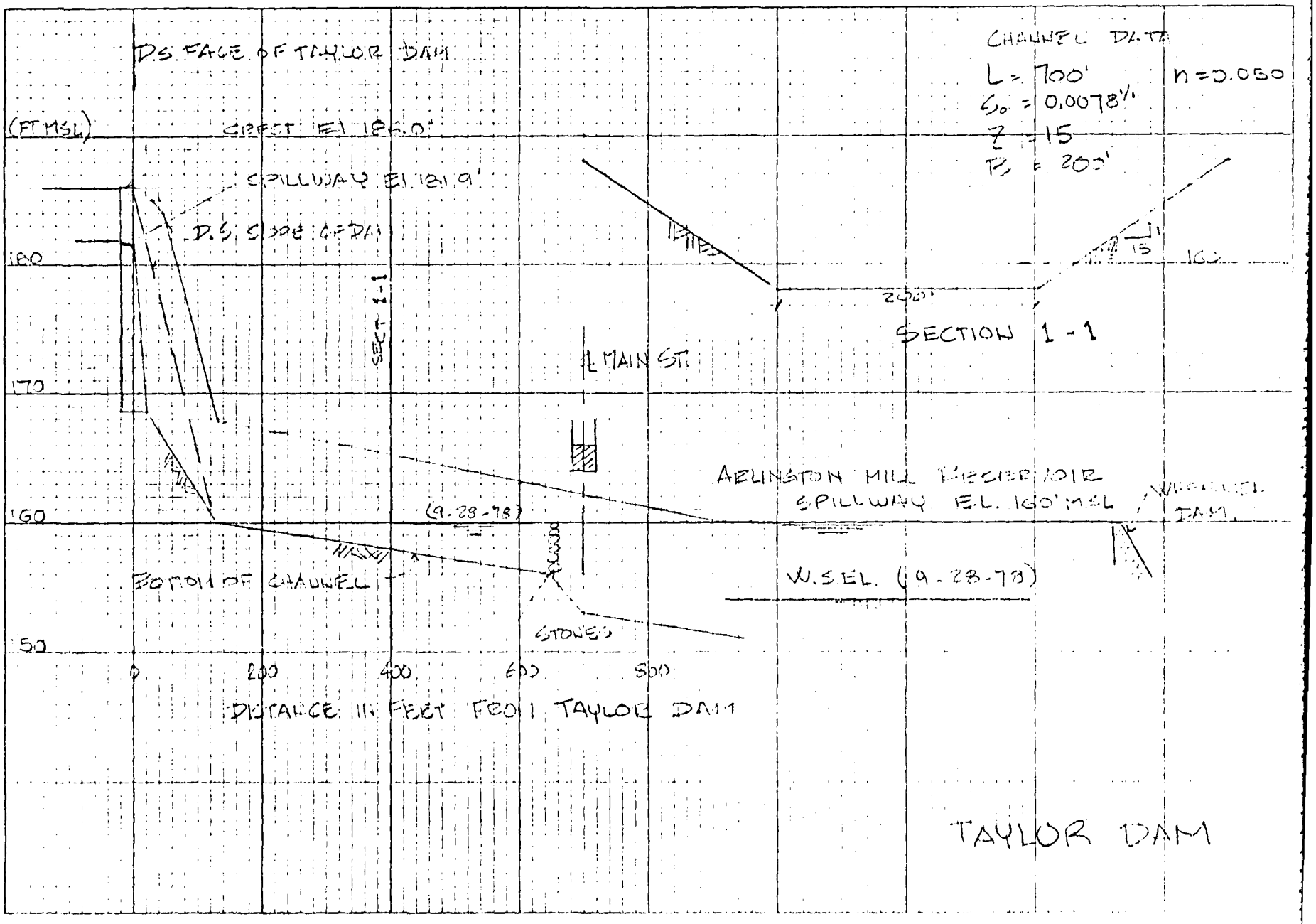

D.S. FACE OF TAYLOR DAM
(FT MSL)
CREST EL 184.0'
SPILLWAY EL. 181.9'
D.S. SLOPE OF DAM
180
170
160
150
SECT 1-1
℄ MAIN ST.
(9-28-78)
FOOT OF CHANNEL
STONES
0
200
400
600
800
DISTANCE IN FEET FROM TAYLOR DAM
CHANNEL DATA
L = 700'
n = 0.050
S₀ = 0.0078'/'
Z = 15
T = 200'
200'
1/15
160
SECTION 1-1
ARLINGTON MILL RESERVOIR
SPILLWAY EL. 160' MSL
W.S.EL. (9-28-78)
TAYLOR DAM

FIG 1-2

APPENDIX # 1

COMPUTING THE MAXIMUM SPILLWAY CAPACITY.

Discharge over a rectangular sharp-crested weir is given by

$$Q = C.L.H^{3/2} \quad (1)$$

Where Q = Discharge, cfs.
C = discharge coeff.
L = Effective length of crest, ft
H = Depth of Flow above elevation of crest, ft.

Where $C = 3.27 - 0.40 \frac{H}{P}$ (Rehbock's)

P = Height of the weir above the channel bottom
$L = L' - 0.1NH$

Where L' = measured length of crest, ft.
N = number of end contractions.
H = measured head, ft.

FOR WEIRS NOT SHARP-CRESTED.

$$Q = C.L.H_D^{3/2} \quad \text{(Ogee type)} \quad (2)$$

Where: H_D = Total head on crest including the velocity head of approach, ft.

For weirs that have approaching velocity the above formula is given.

$$Q = C.L.\left(H + \frac{V^2}{2g}\right)^{3/2}.$$

$\frac{V^2}{2g}$ = H_a, the velocity Head of approach, ft

HOWARD NEEDLES TAMMEN & BERGENDOFF | Checked by [illegible] | Date [illegible] | Sheet No 42

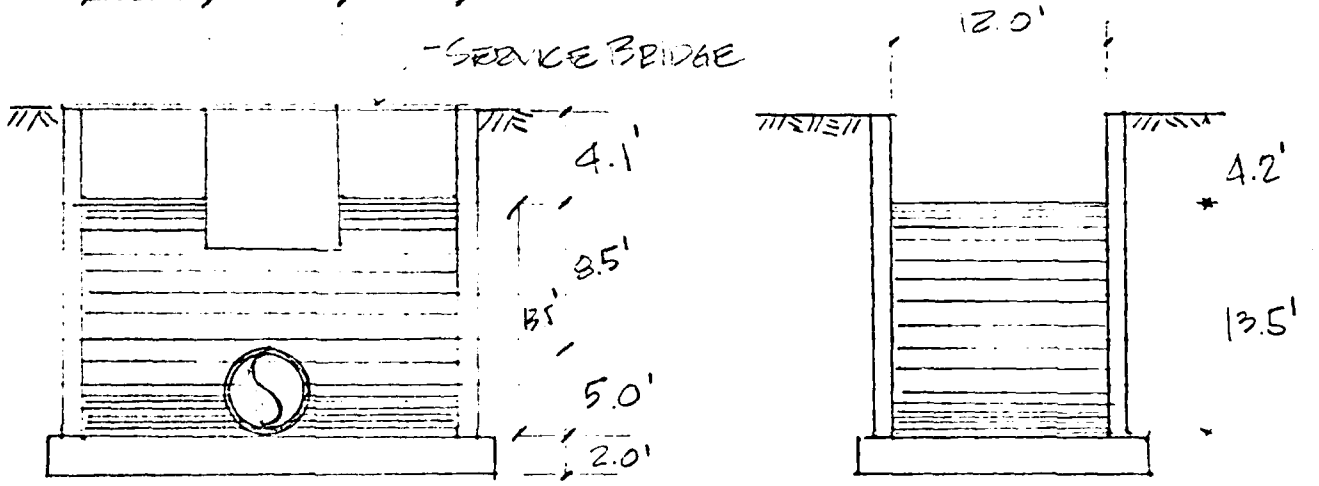
For TAYLOR'S DAM.

For weirs with [illegible] the effective length is given by

$$L = L' - 2(N K_p + K_a) H_D \qquad (3)$$

L = effective crest length, ft.
L' = net crest length, ft = measured length across width of all piers.
N = # of piers
K_p = pier contraction coefficient.
K_a = abutment - contraction coefficient.
H_D = total head on crest including velocity head approach, ft.
(U.S. Dept. of Int. Bureau of Stand. Wash. D.C. 20402).

7.0', 7.4', 5.6';



SPILLWAY #1 SPILLWAY #2.

SPILLWAYS CAPACITY:

1) Use formulas (2) & (3) for spillway #1 (Merrit's H/book).

$Q = C \times L \times H_D^{3/2}$ (Assume $V_0 = 0$)

C = 3.90 (For Ogee type of weir).

$\therefore L = 13.6 - 2(1 \times 0.02 + 0.2)4.1 = 11.80$

$Q = 3.90 \times 11.80 \times (4.1)^{3/2} = 382$ C.F.S.

2) Spillway discharge capacity for outlet structure No 2.

$Q = C \times L \times H_D^{3/2}$

$Q = 3.9 \times 11.16' \times 4.2^{3/2}$

$Q = 374 \text{ CFS}$

SAY 375 CFS

$\therefore C = 3.9$

$H_D = 4.2$

$L = L' - 0.1 \times 2 \times H_D$

$L = 11.16'$

Total spillway capacity w/o. overtopping the crest of the dam.

$Q_T = Q_{spill=1} + Q_{spill=2} = 385^{CFS} + 375^{CFS} = 760 \text{ CFS}$

HNTB
HOWARD NEEDLES TAMMEN & BERGENDOFF

Made by [illegible]	Date [illegible]	Job No. [illegible]
Checked by [illegible]M.	Date [illegible]	Sheet No. A-2

For Taylor Dam

Computation of Spillway Capacity @ elev. 133.52

Based on [illegible] head [illegible] 133.52 [illegible]

Spillway Capacity:

$Q = CLH^{3/2}$

C = 3.9 ([illegible])
L = effective [illegible]
H = head in feet above crest.

Taylor Dam has 2 spillways. (See sketch p. A-2)

Spillway #1 (see p. A2)

L = 11.30' (effective length [illegible] contour above [illegible])

H = 133.52 - [illegible] = 6.62'
H = [illegible] elev. - [illegible] elev.

then $Q = 3.9 \times 11.3 \times 6.62^{3/2} = 783$ cfs

Spillway #2 (see p. A2)

L = 11.16' ([illegible] spillway #1 effective length but [illegible] head)

H = 133.52 - [illegible] = 6.72'

$Q = 3.9 \times 11.16 \times 6.72^{3/2} = 758$ cfs

Total Capacity

Total spillway capacity @ 133.52 = spillway #1 + spillway #2

" " " " = 783 cfs + 758 = 1541 cfs

SAY 1540 CFS

HOWARD NEEDLES TAMMEN & BERGENDOFF | Checked by | Date 10/2/73 | Sheet No. 1/2

TAYLOR DAM.

TABLE No. 1
PERTINENT DATA

DRAINAGE AREA	Square Miles	19.0
TYPE OF TERRAIN	Flat Zone	Ave. Slope = 1%

DAM

Elevation, Crest of Dam	FT.-M.S.L.	186
Height, above channel	FT	17.6
Length	FT.	&20.5
Top width	FT	8
Type	Gravity	
Materials	Earth, Stone, Boulders & Concrete.	

RESERVOIR

Elevation, Normal pool (1)	FT-M.S.L	181.9
Area, Normal pool	AC.	12
Capacity, Normal pool	A-F	81. (Est.)
Elevation, Max. pool (2)	FT-M.S.L.	186
Area, Max. Pool	AC.	12
Capacity. Max. Pool	A-F	130. (Est.)

SPILLWAYS

No 1.		
Elevation, Top of weir	FT-M.S.L.	181.9
Weir lengths	FT	7.0' & 6.6'
Type of weir	—	Ogee
No Piers	Squared	1
No 2		
Elevation, Top of weir	FT-M.S.L	181.8
Weir Length	FT	12.0'
Type of weir	—	Ogee

(1) Based on normal operating condition.
(2) Based on top of dam elevation

HNTB
HOWARD NEEDLES TAMMEN & BERGENDOFF

Made by	HM	Date	9/26/78	Job No.	[illegible]
Checked by	[illegible]	Date	[illegible]	Sheet No.	2/2

For TAYLOR DAM

TABLE #1 CONT.

OUTLET WORKS

TYPE	5'-0" Diam conduit	
Length	Feet	16
Exit Channel	Into spillway 1 outlet channel	
Elevation, Invert U.S.	FEET	168.4
Elevation, Invert D.S	FEET	168.4
Control	Sluice Gate	6" Thick

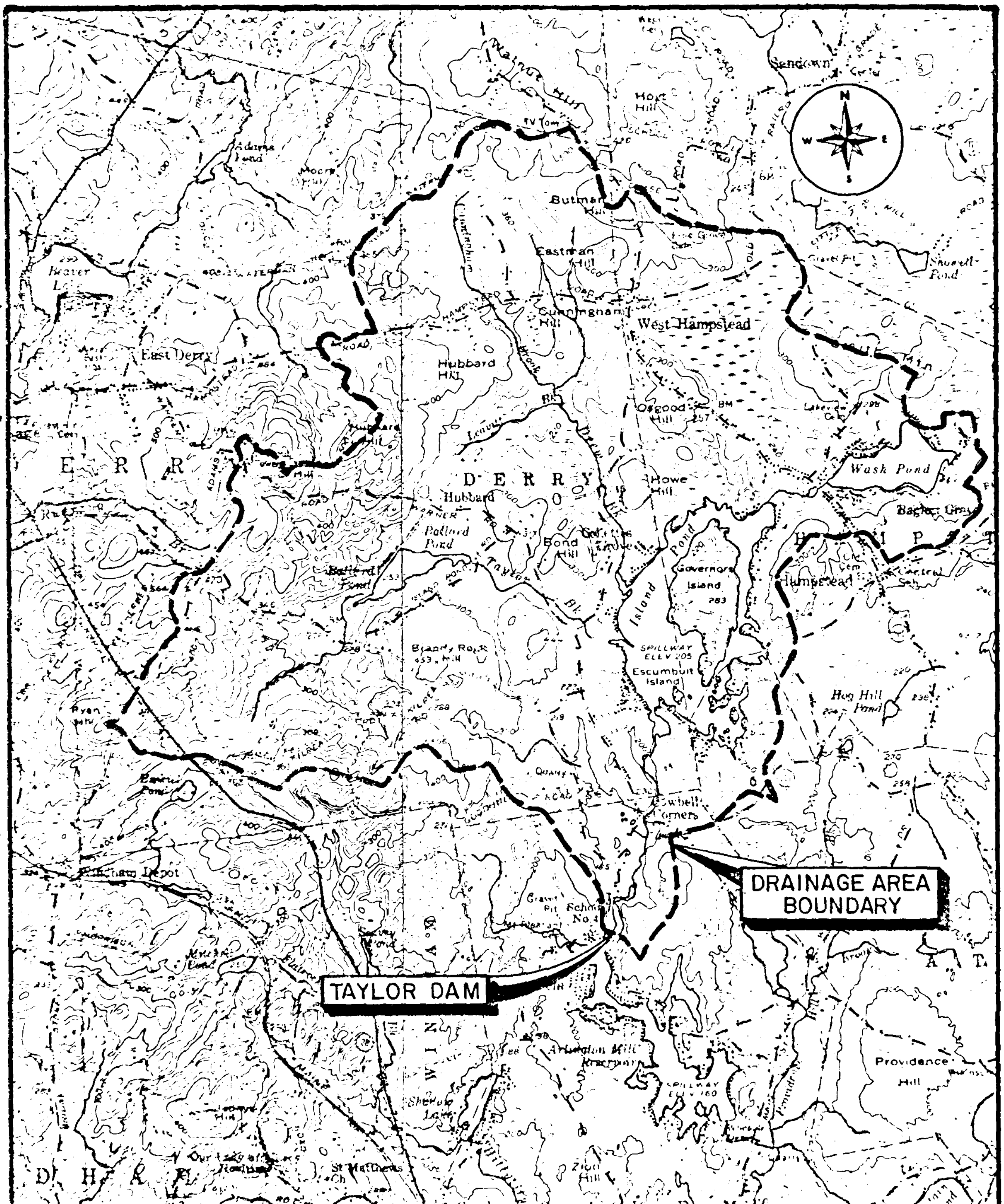
SPILLWAY CAPACITY FLOOD (W/O overtopping)

Spillway No. 1.

Capacity discharge @ Max. Pool.	CFS	385
Elev, water surface	FT-MSL.	186.

SPILLWAY No 2

Elev, water surface @ MAX. Pool	FT-MSL	186.
Capacity, @ Max. Pool	CFS	375



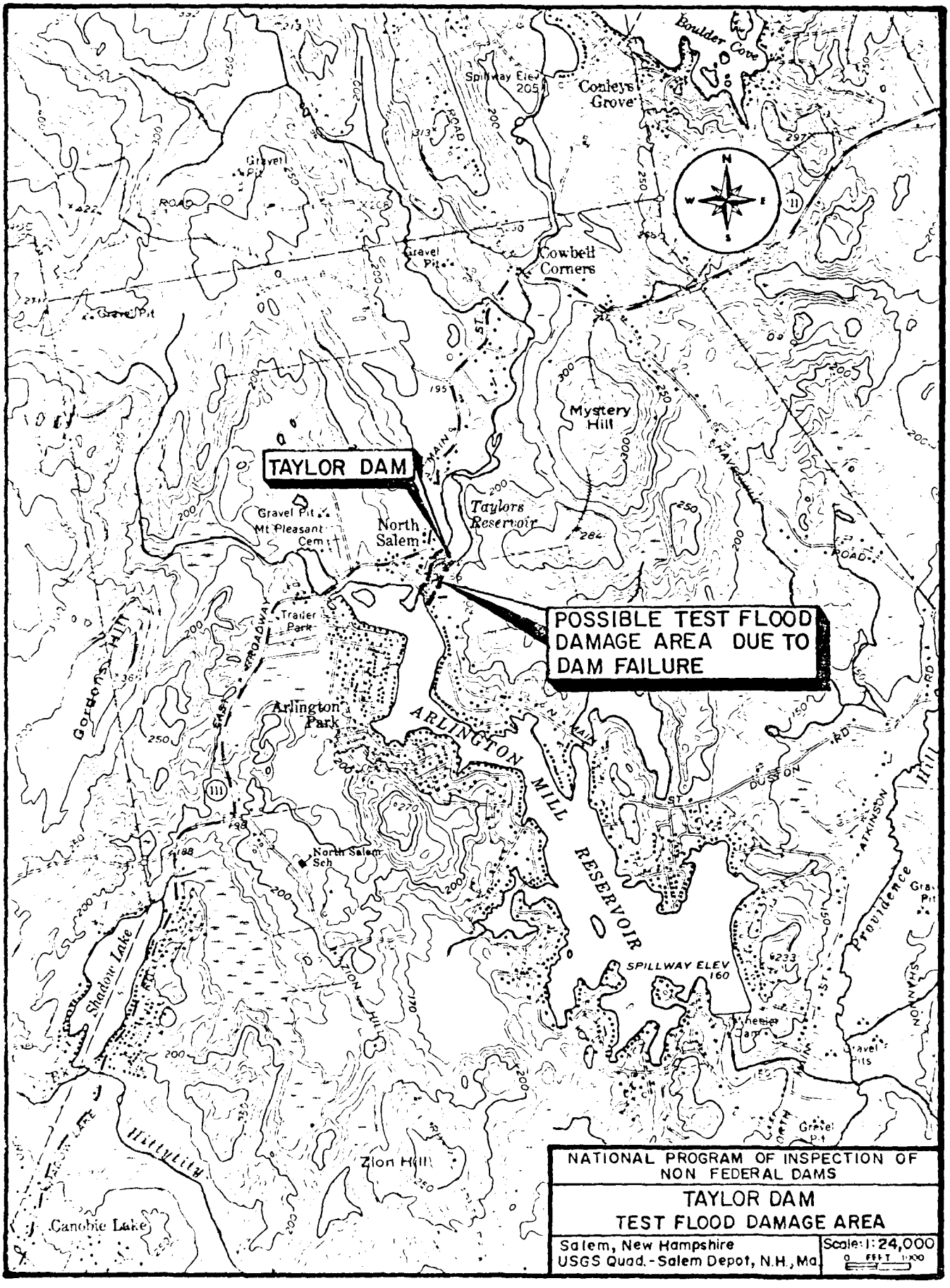
NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

TAYLOR DAM

DRAINAGE AREA

Salem, New Hampshire
USGS Quad.- Haverhill, N.H.- Mass.

Scale: 1:62,500



NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

TAYLOR DAM
TEST FLOOD DAMAGE AREA

Salem, New Hampshire
USGS Quad. - Salem Depot, N.H., Ma.

Scale: 1:24,000
0 FEET 1000

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	26	NED	NH	015	02				TAYLOR DAM	4250.7	7113.2	060CT78

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
TAYLOR DAM	TAYLOR'S RESERVOIR

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	04	SPICKETT RIVER	NORTH SALEM	1	500

(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.)
REERCTPG	1918	R	21	17	160	80

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	N	40EC78

(28) REMARKS

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(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	421	C	26	760	840											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
GREATER LAWRENCE IND CO	J H FITCH ENG	

(49) REGULATORY AGENCY			
(49) DESIGN	(50) CONSTRUCTION	(51) OPERATION	(52) MAINTENANCE
NH WATER RES BD	NH WATER RES BD	NH WATER RES BD	NH WATER RES BD

(53) INSPECTION BY	(54) INSPECTION DATE DAY | MO | YR	(55) AUTHORITY FOR INSPECTION
HOWARD NEEDLES TAMMEN + BERGENDRF	12DEC73	PL-92-367

(56) REMARKS