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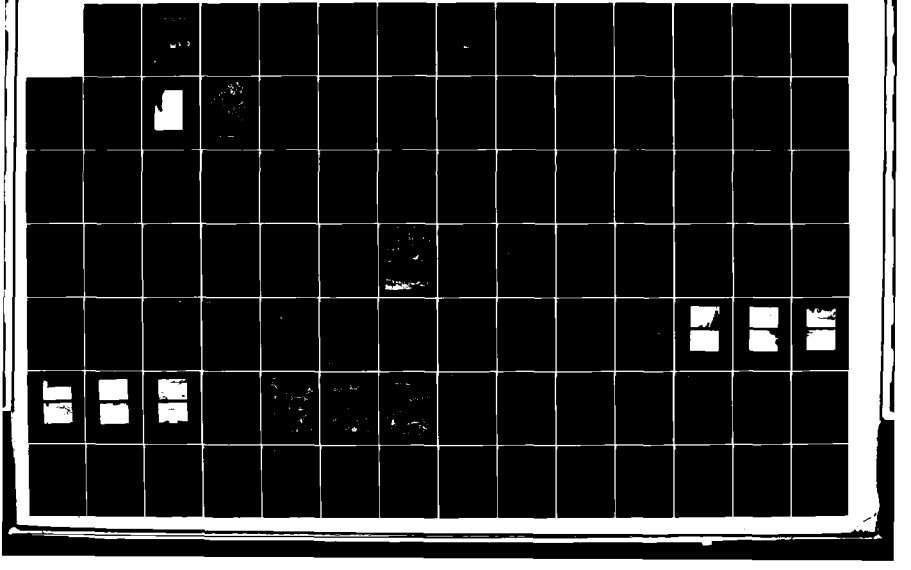

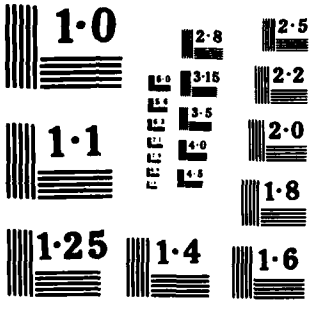
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NARRAGANSETT BAY BASIN

SMITHFIELD, RHODE ISLAND

STILLWATER RESERVOIR DAM
RI 03101

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

JANUARY 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER RI 03101	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Stillwater Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE Janusry 1981 13. NUMBER OF PAGES 45
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

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

18. SUPPLEMENTARY NOTES

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

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

DAMS, INSPECTION, DAM SAFETY,

Narragansett Bay Basin
Smithfield Rhode Island
Woonasquatucket River

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

THe dam is a concrete gravity wall with an earth embankment on its downstream side. Based upon visual inspection of the dam the project is judged to be in poor condition. There are items which require immediate attention. The dam is intermediate in size with a high hazard potnetial. The test flood is the full PMF. Filling and grading of eroded areas and removal of brush and tree growth are among remedial measures.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

JUL 21 1981

Honorable J. Joseph Garrahy
Governor of the State of Rhode Island
State House
Providence, Rhode Island 02903

Dear Governor Garrahy:

Inclosed is a copy of the Stillwater Reservoir Dam (RI-03101) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis.

The visual inspection of Stillwater Pond Dam has revealed a number of serious maintenance problems that could affect the stability of the dam. Of greatest concern is the deterioration of the spillway, the spillway channel and the low level outlet. In addition to these concerns, the preliminary hydrologic analysis indicates that the spillway capacity would likely be exceeded by floods greater than 13 percent of the Probable Maximum Flood (PMF). Our screening criteria specifies that a dam classified as high hazard with a spillway capacity insufficient to discharge fifty percent of the PMF be judged as having a seriously inadequate spillway. Because of the concerns with the stability of the dam and the serious inadequacy of the spillway, the dam is assessed as unsafe until corrective measures can be completed.

It is recommended that upon receipt of this report that the owner of the dam engage the services of a qualified registered professional engineer to:

1. perform a detail structural investigation and recommend rehabilitation of the spillway and spillway channel

2. determine the stability of the low level outlet retaining wall and the downstream slope of the dam.

In addition to the above recommendations, the engineer should within 12 months perform a detailed hydrologic and hydraulic investigation to assess further the potential of overtopping the dam and the need for and means to increase project discharge capacity. In the interim, a detailed emergency operation plan and warning system should be promptly developed and round-the-clock surveillance be provided during periods of heavy precipitation of high project discharge.

NEDED
Honorable J. Joseph Garrahy

I approve the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the program.

Copies of this report have been forwarded to the Department of Environmental Management and to the owner, Woonasquatucket Reservoir Co, Esmond, RI. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Managment for your cooperation in this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

NARRAGANSETT BAY BASIN

SMITHFIELD, RHODE ISLAND

STILLWATER RESERVOIR DAM
RI 03101

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

JANUARY 1981

BRIEF ASSESSMENT

PHASE I INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	STILLWATER RESERVOIR DAM
Inventory Number:	03101
State:	RHODE ISLAND
County:	PROVIDENCE
Town:	SMITHFIELD
Stream:	WOONASQUATUCKET RIVER
Owner:	WOONASQUATUCKET RESERVOIR CO.
Date of Inspection:	OCTOBER 9, 1980 and NOVEMBER 20, 1980
Inspection Team:	PETER M. HEYNEN, P.E.
	THEODORE STEVENS
	TIMOTHY KAVANAUGH
	HECTOR MORENO, P.E.
	FRANK SEGALINE

The dam, completed in 1910, is a concrete gravity wall with an earth embankment on its downstream side. The dam is approximately 20 feet in height and 670 feet in length, including a 100 foot long broad-crested concrete spillway at the right abutment. An earth embankment dike (left dike) adjacent to the left end of the dam has a height of approximately 8 feet and a length of approximately 462 feet. A second dike (right dike), located about 300 feet to the right of the spillway, is an earth embankment approximately 10 feet high and 590 feet long. The upstream slopes of both dikes are protected with hand placed riprap to the top of the embankments. Outlet facilities consist of two 3 foot by 3.5 foot culverts located approximately at the center of the dam and individually controlled by manually operated sluice gates. The handwheel stands, which operate the gates, are located in a concrete gatehouse which was constructed about 1940. The storage of the reservoir is approximately 3600 acre-feet with the reservoir level to the first point of overtopping of the project.

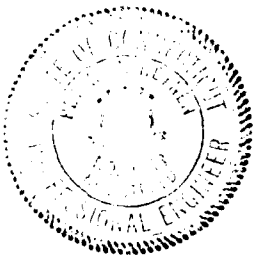
Based upon the visual inspection at the site and past performance, the project is judged to be in poor condition. There are items which require immediate maintenance and/or evaluation such as undermining of the spillway, deteriorated concrete, erosion of embankments and extensive brush and tree growth.

In accordance with Army Corps of Engineers' guidelines, Stillwater Reservoir Dam is classified as a high hazard, intermediate size project. The test flood is the full Probable Maximum Flood (PMF). Peak inflow to the reservoir at the PMF is 15,700 cubic feet per second (cfs); peak outflow is 13,800 cfs with the dam overtopped by 2.3 feet. The combined spillway capacity to the low point of the left dike is 1800 cfs, which is equivalent to 13% of the routed test flood outflow.

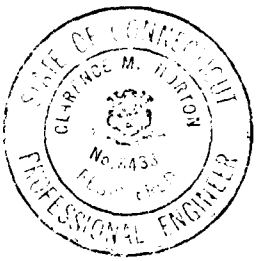
It is recommended that the owner retain the services of a registered professional engineer to perform a more detailed hydraulic/hydrologic analysis of the existing project discharge capacity. Other items of importance are restoration of the spillway, repair of deteriorated concrete, filling and grading of eroded areas and removal of brush and tree growth.

The above recommendations and the remedial operation and maintenance procedures presented in Section 7.3 should be implemented within one year of the owner's receipt of this report, or as otherwise noted.

Peter M. Heynen, P.E.
Project Manager - Geotechnical
Cahn Engineers, Inc.



C. Michael Horton, P.E.
Chief Engineer
Cahn Engineers, Inc.



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

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

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

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. 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 would necessarily 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 will 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 there of. 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 neccessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

The information contained in this report is based on the limited investigation described above and is not warranted to indicate the actual condition of the dam. The integrity of the dam can only be determined by a means of a monitoring program and/or a detailed physical investigation. The accuracy of available data is assumed where not in obvious conflict with facts observable during the visual inspection.

TABLE OF CONTENTS

Left Dike

Top of Dike - The top of the dike is irregular and near the edges it is overgrown with trees and brush. There is an approximately 3 foot wide path along the centerline where vegetation is sparse or absent, due to trespassing.

Upstream Slope - There are many large trees growing on the upstream slope. The riprap slope protection has been displaced by tree growth and by erosion, contributing to an approximately 8 foot by 8 foot by 3 foot deep depression on the slope (Photo 8).

Downstream Slope - The downstream slope is overgrown with brush and large trees. There is some erosion near the top of the slope. The ground is wet at the toe of the slope with several areas of standing water. This made it impossible to locate points of seepage.

Right Dike

Top of Dike - The top of the dike is overgrown with brush and many moderate sized trees. Ground cover is sparse or absent on the surface along the centerline of the dike, due to trespassing.

Upstream Slope - Many large trees and brush are growing on the upstream slope. The riprap slope protection is in fair condition but has been displaced at a few isolated locations by the tree growth and erosion (Photo 9).

Downstream Slope - The downstream slope is overgrown with many large trees and brush. There are areas of minor erosion along the slope and a few uprooted trees, leaving voids of up to 2 feet deep. The soil at the toe of the slope is saturated with areas of standing water (Photo 10). Seepage points could not be located because of the depth of the standing water.

c. Appurtenant Structure - The concrete masonry gatehouse is in fair condition. The concrete base is spalled. The two handwheel pedestal lifts which operate the low-level outlets are in good condition and well-lubricated. The outlet structure is in poor condition. The concrete retaining wall is badly spalled, cracked and deteriorated. The two wingwalls are deteriorated and spalled (Photos 11 and 12).

d. Reservoir Area - The area surrounding the reservoir is generally wooded and sparsely developed. There are some lakefront houses on the west and south shores and paved roads bordering the reservoir.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General - The condition of the project is poor, based upon our visual inspections on October 9, 1980 and November 20, 1980. The inspection revealed several areas requiring maintenance and monitoring. At the time of the inspections, the pond level was at elevation 201.9 and 203.1 respectively, i.e. 9.5 ft. and 7.9 ft. below the top of the dam, with water flowing through the left low-level outlet. The reservoir level is presently maintained below the spillway crest elevation of 207.0, possibly reducing seepage rates that might be observed at higher water levels.

b. Dam and Dikes

Top of Dam - A path up to 12 inches deep and 18 inches wide has been worn into the earth section of the top of dam from trespassing. At several locations along this path, erosion has carved ditches which are approximately 2 feet wide and as deep as 3 feet. These ditches are as much as 27 feet in length along the downstream side of the concrete section (Photo 1). The top of the concrete is badly spalled and decomposed.

Concrete Wall - The upstream face of the concrete wall is severely cracked and spalled, exposing the aggregates in the concrete (Photos 2 and 4). Deterioration has left impressions up to 6 inches deep and 12 inches wide along the construction joints (Photos 3 and 4).

Downstream Slope - The entire slope is overgrown with brush and trees of up to approximately 10 inches in diameter (Photo 5). Ditches, to depths of 3 feet, extend from the ditches at the top of the dam toward the low-level outlet discharge channel. Large wet areas are present along the toe of the slope. Because of the depth of water at these wet areas it was impossible to locate seepage points or monitor their flow.

Spillway - The spillway is in very poor condition. The training walls are spalled, cracked and deteriorated. The spillway apron appears to have been undermined, probably by water seeping under the concrete spillway crest. This has caused collapse of large portions of the apron, creating crater-like depressions (Photo 6). Many small trees, mostly 2 to 3 inches in diameter are growing at the edge of the spillway crest, in the approach channel, and through the concrete apron. Much debris, including many stumps of up to 5 feet in diameter, is resting at or near the spillway crest. Several small seeps approximately 1-3 gpm each were located at the downstream end of the apron. Water in all seeps was flowing clear and collecting in small pools. From the edge of the apron there is a sharp drop of approximately 2 to 3 feet to the downstream channel, exposing the gravel and cobble subbase of the apron (Photo 7), and it appears that any sand content of the subbase has been transported away by seepage. The downstream spillway channel is vegetated with many trees of up to 6 inches in diameter.

SECTION 2: ENGINEERING DATA

2. DESIGN

a. Available Data - The available data consists of construction photographs; a Yearly Report by the Commissioners of Dam and Reservoirs dated 1911; several inspection reports dated between 1940 and 1970; assorted correspondence dated between 1939 and 1979; a bathymetric map; and a "Dam Inventory Report" prepared by The State of Rhode Island Department of Environmental Management.

2.2 CONSTRUCTION DATA

Approximately seven construction photographs are on file at The State of Rhode Island Department of Environmental Management located at 83 Park Street in Providence, Rhode Island.

2.3 OPERATIONS DATA

No operation records are known to exist.

2.4 EVALUATION OF DATA

a. Availability - Existing data was provided by The State of Rhode Island Department of Environmental Management. The owner made the project available for visual inspection.

b. Adequacy - There was no detailed engineering data available; therefore, the final assessment of this project must be based on visual inspection, performance history, hydraulic computations of spillway capacity, and hydrologic judgements.

c. Validity - A comparison of record data and visual observations reveals no significant discrepancies in the record data. However, drawings of the project dated July 28, 1940 show the left dike in a position different from that observed in the field. It is thought that the dike was repositioned sometime after 1940, perhaps for improvement and/or realignment of a nearby road.

9. Grout curtain:	N/A
10. Other:	N/A
h. Diversion and Regulating Tunnel -	N/A
i. Spillway	
1. Type:	Broad crested concrete weir of trapezoidal cross-section
2. Length of weir:	100 ft.
3. Crest elevation:	207.0
4. Gates:	N/A
5. Upstream channel:	Shallow sand and gravel bottom
6. Downstream channel:	Sand and gravel spillway to river channel 400 feet from dam
7. General:	Concrete-paved spillway apron
j Regulating Outlets	
Twin Low-Level Outlets	
1. Invert:	192.0
2. Size:	3 ft. wide by 3.5 ft. high
3. Description:	Rectangular concrete culverts.
4. Control mechanism:	Manually operated sluice gates. Controlled independently
5. Other:	N/A

5. Dam and Dikes

1. Type:	
Dam:	Masonry core section with earth embankment slopes.
Left Dike:	Earth embankment
Right Dike:	Masonry core earth embankment (See Sheet B-1)
2. Length:	
Dam:	573 ft.
Left Dike:	462 ft.
Right Dike:	590 ft.
3. Height:	
Dam:	20 ft.
Left Dike:	8± ft.
Right Dike:	10± ft.
4. Top width:	
Dam:	7± ft.
Left Dike:	15.0± ft.
Right Dike:	15.0± ft.
5. Side Slopes:	
Dam:	2.0 H to 1 V (Upstream) 2.0 H to 1 V (Downstream
Left Dike:	2.0 H to 1 V (Upstream) 2.0 H to 1 V (Downstream,
Right Dike:	1.5 H to 1 V (Upstream) 1.5 H to 1 V (Downstream,
6. Zoning:	N/A
7. Impervious core:	N/A
8. Cutoff:	
Dam:	Concrete corewall
Left Dike:	N/A
Right Dike:	Concrete corewall (Shown on Sheet B-1. Was not observed in the field)

8. Top of dam:	211.0
Top of left dike:	Irregular, varies from 210.5± to 211.0±
Top of right dike:	211±
9. Test flood surcharge:	212.8

d. Reservoir Length

1. Normal pool:	3000 ft.
2. Flood control pool:	N/A
3. Spillway crest pool:	3000 ft.
4. Top of dam pool:	3100 ft.
5. Test flood pool:	3100+ ft.

e. Reservoir Storage

1. Normal pool:	1500 acre-ft.
2. Flood control pool:	N/A
3. Spillway crest pool:	2400 acre-ft.
4. Top of project pool:	
water level to low point of left dike (el. 210.5):	3600 acre-ft.
to top of dam (el. 211.0):	3900 acre-ft.
5. Test flood pool:	4700 acre-ft.

f. Reservoir Surface

1. Normal pool:	240 acres
2. Flood control pool:	N/A
3. Spillway crest pool:	300 acres
4. Top of project pool:	
water level to low point of left dike (el. 210.5):	370 acres
to top of dam (el. 211.0):	380 acres
5. Test flood pool:	410 acres

1.3 PERTINENT DATA

a. Drainage Area - The drainage area is 26.2 square miles of mostly wooded flat and costal terrain located in the Narragansett Bay Basin.

b. Discharge at Damsite - Discharge is over the spillway and through the twin low-level outlets.

1. Outlet works	
for each of the 3 ft. wide by 3.5 ft. high culvert low-level outlets:	175 cfs - (pond level at top of dam)
2. Maximum known flood at damsite:	Not known
3. Ungated spillway capacity @ low point of left dike el. 210.5:	1800 cfs
4. Ungated spillway capacity @ test flood el. 212.8:	3800 cfs
5. Gated spillway capacity @ normal pool:	N/A
6. Gated spillway capacity @ test flood:	N/A
7. Total spillway capacity @ test flood el. 212.8:	3800 cfs
8. Total project discharge @ test flood el. 212.8:	13,800 cfs

c. Elevations - (NGVD based on assumed spillway elevation, See Sheet B-1).

1. Streambed at toe of dam:	191±
2. Bottom of cutoff:	N/A
3. Maximum tailwater:	N/A
4. Normal pool:	(Assumed) 203.5±
5. Full flood control pool:	N/A
6. Spillway crest (ungated):	207.0
7. Design surchage (original design):	Unknown

c. Size Classification - INTERMEDIATE - The dam impounds 3600 acre-feet of water with the reservoir level to the low point of the left dike, which at elevation 210.5, is 20 feet above the downstream channel at the toe of the dam. According to the U.S. Army Corps of Engineers' Recommended Guidelines, a dam with a storage capacity between 1,000 and 50,000 acre-feet is classified as intermediate in size.

d. Hazard Classification - HIGH - If the dam were breached, there is potential for the loss of more than a few lives and extensive property damage to industrial buildings and numerous houses downstream of the dam.

e. Ownership - Woonasquatucket Reservoir Co.
Mr. William Garriety, Secretary Treasurer
P. O. Box 5078
Esmond, RI
Tel: (401) 231-6000 (Office)
(401) 231-5725 (Home)

f. Operator - Mr. Ivan Elfgren
P. O. Box 5078
Esmond, RI
Tel: (401) 231-4500 (Office)
(401) 647-7069 (Home)

g. Purpose - Industrial water supply and recreation.

h. Design and Construction History - The following information is believed to be accurate based on the plans and correspondence available. The dam was constructed in 1910 for, and is still owned by, the Woonasquatucket Reservoir Company, which is an association of businesses including Worcester Textile, Narragansett Foundry and others, for the purpose of manufacturing and processing. The reservoir is also used for recreation. A concrete gatehouse was built about 1940 to shelter the already existing gate mechanisms. It appears as though the alignment of the left dike has been changed sometime after 1940.

There is no record of repairs or other alterations other than the addition of the gatehouse, the extension of the retaining wall to each side of the low-level outlet and the realignment of the dike.

i. Normal Operational Procedures - The following operational procedures were described during an interview with the owner. The water level in the reservoir is maintained below the spillway crest to prevent flow through the spillway because of its deteriorated condition. The left low-level sluice gate maintains flow from the reservoir to the Woonasquatucket River to provide an adequate supply of water to the factories downstream. The right sluice gate remains in the closed position unless demand requires it be opened. Both gate lifts are well lubricated and operable.

1.2 DESCRIPTION OF PROJECT

a. Location - The dam is located on the Woonasquatucket River in a rural area of the Town of Smithfield, County of Providence, State of Rhode Island. The dam is shown on the Georgiaville USGS Quadrangle Map having coordinates latitude N 41°54.5' and longitude W 71°32.5'.

b. Description of Dam, Dikes and Appurtenances - As shown on Sheet B-1, the approximately 20 foot high dam consists of a concrete wall upstream face with a downstream earth embankment. The dam is approximately 670 feet long, including the 100 foot long spillway; which is located at the right end of the dam. The dam has a base width of approximately 35 feet and a top width of approximately 7 feet. A concrete gatehouse is located near the center of the dam on the upstream side.

Adjacent to the left end of the dam there is an earth embankment dike (designated as the left dike) which is approximately 8 feet in height and 462 feet long. The dike consists of a riprap protected upstream slope with a grass covered top and downstream slope. The dike has a base width of approximately 30 feet and a top width of 15 feet.

Approximately 300 feet to the right of the spillway, separated from the spillway by a natural knoll, there is a second dike (designated as the right dike) which is approximately 10 feet high and 590 feet in length. It has a maximum base width of 80 feet and a top width of 15 feet. This dike, like the left dike, is an earth embankment with a riprap protected upstream slope and grass protection at the top and on the downstream slope. Drawings of the project indicate that the right dike contains a concrete corewall.

The 100 foot long spillway, having a crest elevation of 207.0, is a broad-crested concrete weir of trapezoidal cross-section. A sand and gravel approach channel slopes up at an approximate inclination of 6 horizontal to 1 vertical to meet the concrete spillway crest and a concrete-paved apron slopes downstream for a distance of approximately 30 feet at an approximate inclination of 7 horizontal to 1 vertical. The spillway channel connects with the original river channel approximately 400 feet downstream of the dam.

A concrete gatehouse is located near the center of the dam. Two individual 3 foot by 3.5 foot low-level conduits intake through the foundation of the gatehouse, pass through the earth embankment, and discharge into the original streambed from a concrete retaining wall located at the toe of the downstream slope. Flow through the low-level outlets is regulated by two manually operated sluice gates.

PHASE I INSPECTION REPORT

STILLWATER RESERVOIR DAM

SECTION I - 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. Cahn Engineers, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Rhode Island. Authorization and notice to proceed were issued to Cahn Engineers, Inc. under a letter of April 14, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW 33-80-C-0052 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection Program - The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dam.

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

c. Scope of Inspection Program - The scope of this Phase I inspection report includes:

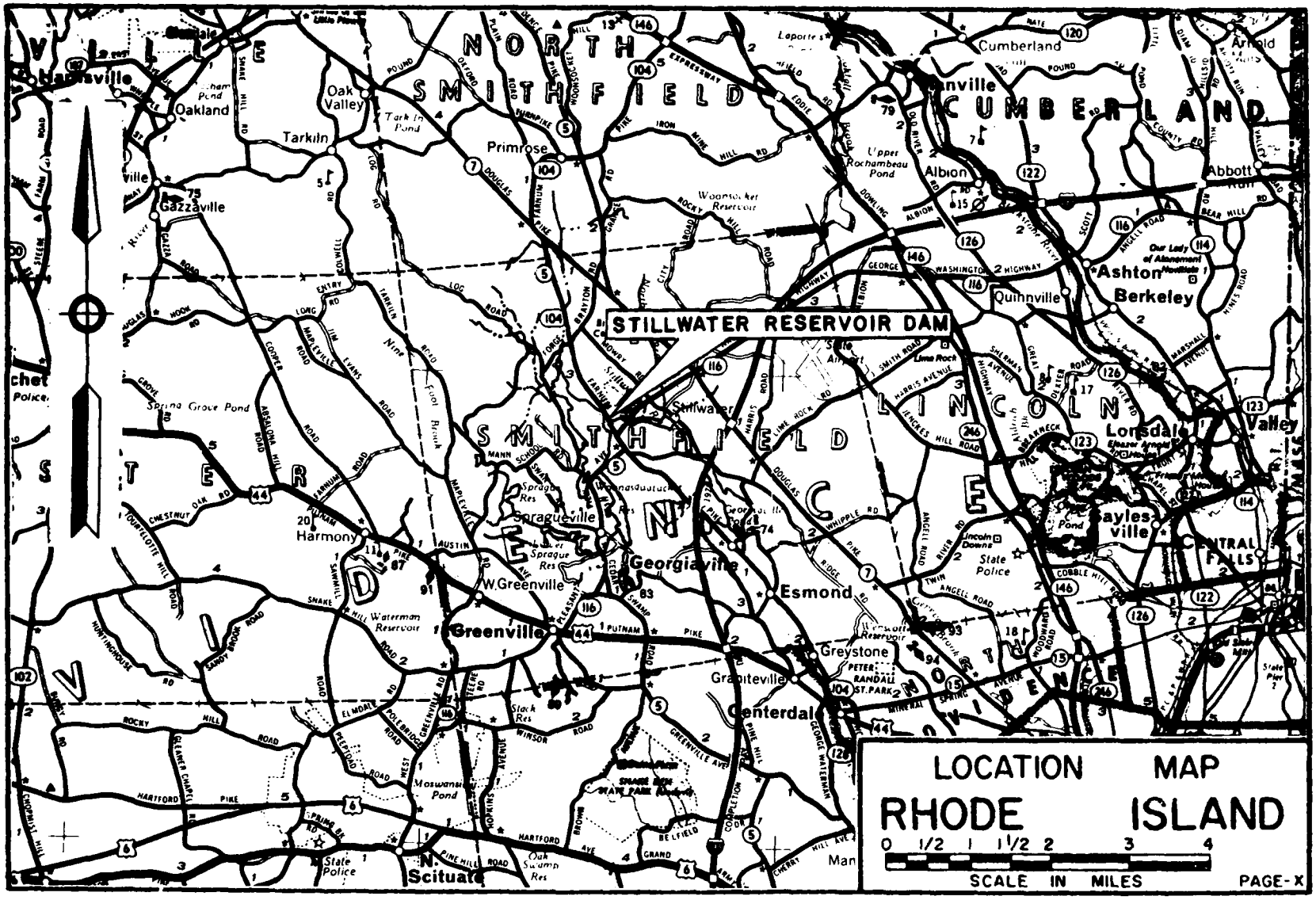
1. Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

2. A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

3. Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

4. An assessment of the condition of the facility and corrective measures required.

It should be noted that this report passes judgment only on those factors of safety and stability which can be determined by a visual surface examination. The inspection is to identify those visually apparent features of the dam which evidence the need for corrective action and/or further study and investigation.


STILLWATER RESERVOIR DAM
LOCATION MAP
RHODE ISLAND
0 1/2 1 1 1/2 2 3 4
SCALE IN MILES
PAGE-X
NORTH SMITHFIELD
SMITHFIELD
CUMBERLAND
LINCOLN
GLOCESTER
Harmony
Oakland
Oak Valley
Tarkiln
Primrose
Gazzaville
Cumberland
Albion
Ashton
Berkeley
Quinnville
Lonsdale
Valley Falls
Saylesville
Stillwater
Spragueville
Georgiaville
W.Greenville
Greenville
Esmond
Greystone
Granite ville
Centerdale
N. Scituate
State Police
Waterman Reservoir
Moswansicut Pond
Spring Grove Pond
Woonsocket Reservoir
Upper Rochambeau Pond
Sprague Res
Stack Res
Oak Swamp Res
Lincoln Downs
PETER RANDALL ST. PARK

OVERVIEW PHOTO

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	Stillwater Reservoir Dam	Smithfield	DATE Jan., 1981
CAHN ENGINEERS INC. WALLINGFORD, CONN ENGINEER	INSPECTION OF NON-FED DAMS	Woonasquatucket River	RHODE ISLAND	CE # 27 785 KG PAGE ix

APPENDICES

e. Downstream Channel - The downstream channel from the low-level outlet is the natural streambed of the Woonasquatucket River. It is 40 to 80 feet wide and unobstructed. A man-made channel from the spillway converges with the original streambed approximately 400 feet downstream of the dam. The spillway channel is vegetated with some small to medium-sized trees which could cause some obstruction of flow.

3.2 EVALUATION

Based upon the visual inspection, the project is assessed as being in poor condition. The manner in which the features identified in Section 3.1 could affect the future condition and/or stability of the project is as follows:

1. Continued trespassing along the top of the dam and dikes will cause further erosion to the embankments.

2. The ditches present on the top and slopes of the dam will continue eroding.

3. Continued spalling, cracking and deterioration of the concrete structures could weaken the dam.

4. Additional deterioration along the concrete wall construction joints will weaken the wall as well as make it more prone to freeze-thaw attack.

5. Trees on the embankments could cause seepage along their root systems and could cause extensive damage to the embankments if trees are uprooted.

6. The wet areas along the toe of the dam and the toes of the two dikes embankments may be signs of excessive seepage.

7. The spillway apron has been severely undermined. Should a storm cause water to flow through the spillway, accelerated undermining of this section could occur.

8. Trees growing through the spillway apron and in the spillway channel will cause additional damage to the spillway if they are left to grow or are uprooted by wind or flood water.

9. The trees and erosion which are displacing the riprap on the upstream slopes of the dikes will promote additional erosion.

10. Additional deterioration of the low-level outlet structure could cause the retaining wall to fail which may result in sloughing of the dam's downstream embankment and possibly lessen the stability of the dam.

SECTION 4: OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES

a. General - Operational procedures performed by the operator consist of maintaining an adequate flow of water for manufacturing to the factories downstream. The water level of the reservoir is maintained below the spillway to prevent flow over the spillway. When unusually severe storms are predicted the gates are opened and the reservoir level lowered in order to try to prevent flow over the spillway.

b. Description of Any Warning System in Effect - No formal warning system is in effect.

4.2 MAINTENANCE PROCEDURES

a. General - There is no formal program of maintenance or inspection at the dam.

b. Operating Facilities - No formal program for maintenance of operating facilities is in effect.

4.3 EVALUATION

Operation and maintenance procedures are not performed. A formal program of operation and maintenance procedures should be implemented, including documentation to provide complete records for future reference. Also, a formal downstream warning system should be developed and implemented within the time frame indicated in Section 7.1.c. Remedial operation and maintenance recommendations are presented in Section 7.3

SECTION 5: EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL

The Stillwater Reservoir Dam watershed is 26.2 square miles of flat and coastal wooded terrain, typically containing large swamps and impoundments (Waterman and Slack Reservoirs) which contribute to the sluggish runoff characteristics of the watershed (See Sheet D-1).

The dam is a concrete and earthfill dam with a concrete crest and cemented stone apron spillway, and two earth dikes. The available storage reduces the outflow from a Probable Maximum Flood (PMF) of 15,700 cubic feet per second (cfs) to 13,800 cfs and the ½ PMF outflow from 7,850 cfs to 6,200 cfs.

Both dikes are densely wooded and have irregular top profiles with elevations varying from 210.5 to 211.0 at the left dike and from 210.7 to 211.4 at the right dike. The spillway apron is in very poor condition and there are many trees, stumps and brush at both sides of the spillway crest. The reservoir water level is maintained low because of the deterioration of the spillway. The water level is controlled by operation of the low-level outlets.

5.2 DESIGN DATA

No computations could be found for the original design of the dam.

5.3 EXPERIENCE DATA

No information is available.

5.4 TEST FLOOD ANALYSIS

Based upon the U.S. Army Corps of Engineers "Preliminary Guidance for Estimating Maximum Probable Discharges" dated March, 1978; the watershed classification (Flat and Coastal), and the watershed area of 26.2 square miles, a PMF of 15,700 cfs or 600 cfs per square mile is estimated at the damsite. In accordance with the size (intermediate) and hazard (high) classification, the test flood is the PMF. The reservoir level at the start of the test flood is considered to be 3.5 feet below the spillway crest elevation 207.0. The peak outflow for the test flood is estimated at 13,800 cfs and this flow will overtop the dam by 2.3 feet. Based on hydraulics computations, the spillway capacity to the first point of overtopping of the dam/dikes (elevation 210.5) is 1,800 cfs which is equivalent to 13% of the routed test flood outflow. The peak outflow for the ½ PMF is estimated at 6200 cfs, with the project overtopped by 1.3 feet (Appendix D-6).

5.5 DAM FAILURE ANALYSIS

An approximately 15,000 foot reach along the Woonasquatucket River, extending downstream from Stillwater Reservoir would be affected in case of failure of Stillwater Reservoir Dam. Stillwater Pond Dam, Capron Pond Dam and Georgiaville Pond Dam are located within this reach at distances from Stillwater Reservoir Dam of approximately 4,500, 6,300, and 12,000 feet, respectively. The backwaters of each of these dams extend to the toe of the dam immediately upstream of each. Adjacent to the downstream face of Stillwater Pond Dam, the first floor of a large industrial building is approximately 10 feet below the normal water level of Stillwater Pond and 5.7 feet above the normal backwater level of Capron Pond. Five or more houses on the shore of Georgiaville Pond have first floors between 3 and 4.5 feet above the normal pond water level, and several other homes have first floors between 6 and 9 feet above the normal river level (See Sheet D-2). Approximately 500 feet downstream of Stillwater Reservoir Dam, there are two industrial buildings with first floors 12 and 13 feet above normal water level; however, the dam failure analysis indicated that these would not be affected by a failure of the dam.

The dam failure analysis is based on the April, 1978 Army Corps of Engineers "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs". With the reservoir level at the first point of overtopping of the dam/dikes, peak outflow before failure of the dam would be about 1,800 cfs and the peak failure outflow from the dam breaching would total about 26,400 cfs.

Prior to failure of Stillwater Reservoir Dam, the depth of flow over the spillways at Stillwater Pond, Capron Pond, and Georgiaville Pond would be 3.1 feet, 3.7 feet, and 3.1 feet respectively, and the depth of water in the channel downstream from Georgiaville Pond Dam would be approximately 3 feet. At this prefailure flow; the first floor of the industrial building just downstream of Stillwater Pond Dam will be approximately 2 feet above the backwater level of Capron Pond; the houses along the shore of Georgiaville Pond will be from 0 to 1.5 feet above the pond water level; and the homes downstream of Georgiaville Pond will be 3 to 6 feet above the river water level. A breach of the dam would result in rapid 4.6 to 7.3 foot increases in water levels throughout the impact area (Appendix D-10), to depths of 7.7, 10.7, and 7.8 feet over the spillways at Stillwater Pond Dam, Capron Pond Dam and Georgiaville Pond Dam, respectively and to a depth of 10.3 feet in the channel downstream of Georgiaville Pond. This sudden outflow will cause innundation of the industrial building and several homes by as much as 5 feet, potentially resulting in loss of more than a few lives and substantial economic loss. Based on the dam failure analysis, Stillwater Reservoir Dam is classified as a high hazard dam (Appendix D-11).

SECTION 6: EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS

The visual inspections revealed a series of maintenance and repair related problems which, if not corrected, could compromise the stability of the dam. *In summary*, these include: 1) excessive erosion of the top and downstream slope of the dam and some erosion of the dikes, 2) growth of large trees on the embankments, 3) undermining of the spillway apron 4) deterioration of concrete, 5) the possibility of excessive seepage in the vicnity of the wet areas at the toe of the dam and dike embankments.

6.2 DESIGN AND CONSTRUCTION DATA

The drawings and data available and listed in Appendix B were not sufficient to perform an in-depth stability analysis of the dam. No engineering assumptions, data or calculations could be found for the original design of the dam.

6.3 POST-CONSTRUCTION CHANGES

Post-construction changes of the project consisted of constructing the concrete gatehouse, realignment of the left dike, and the extension of the concrete retaining wall to each side of the low-level outlet.

6.4 SEISMIC STABILITY

The project is in Seismic Zone 2 and according to the Recommended Guidelines, need not be evaluated for seismic stability.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition - Based upon the visual inspection of the site and past performance, the project appears to be in poor condition. There are areas which require maintenance, repair and monitoring.

Based upon the Army Corps of Engineers' "Preliminary Guidance for Estimating Maximum Probable Discharges" dated March, 1978, the watershed classification and hydraulic/hydrologic computations, peak inflow to the lake at the test flood is 15,700 cubic feet per second (cfs); peak outflow is 13,800 cfs with the dam overtopped by 2.3 feet. Based upon hydraulic computations, the spillway capacity to the low point of the left dike is 1800 cfs, which is equivalent to approximately 13% of the routed test flood outflow.

b. Adequacy of Information - The information available is such that an assessment of the condition and stability of the project must be based solely on visual inspection, past performance and sound engineering judgement.

c. Urgency - It is recommended that the measures presented in Section 7.2 and 7.3 be implemented within one year of the owner's receipt of this report, except for Recommendations 1 and 2 and Remedial Measure 1, all of which should be implemented upon the owner's receipt of this report.

7.2 RECOMMENDATIONS

It is recommended that further studies, pertaining to the following items be made by a registered professional engineer qualified in dam design and inspection. Recommendations made by the engineer should be implemented by the owner.

1. A detailed structural investigation and rehabilitation of the spillway and spillway channel.

2. Determination of the stability of the low-level outlet retaining wall and downstream slope of the dam.

3. Determination of the origin and significance of the wet areas at the toe of the dam and dike embankments.

4. Removal of all trees and tree stumps from the dam and dike embankments, from the spillway channel, and from within 25 feet of the toe of the embankments. This should include removal of root systems and proper backfilling.

5. A detailed hydraulic/hydrologic analysis to more accurately determine the adequacy of the existing project discharge and overtopping potential.

6. Backfilling with suitable material of the erosion ditches and footpaths on the top and slopes of the dam and dikes and any other visible erosion. Replacement of any displaced riprap slope protection.

7. Evaluation of the condition of the concrete wall of the dam and necessary repairs.

8. Inspection and evaluation of the low-level outlets, conduits and sluice gates.

7.3 REMEDIAL MEASURES

a. Operation and Maintenance Procedures - The following measures should be undertaken by the owner within the length of time indicated in Section 7.1.c, and continued on a regular basis.

1. Round-the-clock surveillance should be provided during periods of heavy precipitation or high project discharge. A formal downstream warning system should be developed to be used in case of emergencies at the dam.

2. A formal program of operation and maintenance procedures should be instituted and fully documented to provide accurate records for future reference. The maintenance procedures should include a monthly inspection by the owner or owner representative.

3. A comprehensive program of inspection by a registered professional engineer qualified in dam inspection should be instituted on an annual basis.

4. All brush should be removed from the tops and slopes of the dam and two dikes, and from the spillway and spillway channel.

5. Protective vegetation such as grass, should be established and maintained on all bare areas.

7.4 ALTERNATIVES

This study has identified no practical alternatives to the above recommendations.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT [illegible] DAM DATE: [illegible]

TIME: AFTERNOON [illegible]

WEATHER: SUNNY, RAIN SUNNY ON GROUND

W.S. ELEV. 46.1 U.S. .25 DN.S

PARTY:	INITIALS:	DISCIPLINE:
1. [illegible]	[illegible]	[illegible]
2. [illegible]	[illegible]	[illegible]
3. [illegible]	[illegible]	GEOTECHNICAL
4. [illegible]	HM	HYDRAULIC
5. FRANK SCALINE	FS	SURVEY
6.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	DAM EMBANKMENT	PH, TS, TK, HM	
2.	RIGHT DIKE	PH, TS, TK, HM	
3.	LEFT DIKE	PH, TS, TK, HM	
4.	SPILLWAY	PH, TS, TK, HM	
5.	OUTLET STRUCTURE	PH, TS, TK, HM	
6.			
7.			
8.			
9.			
10.			
11.			
12.			

PERIODIC INSPECTION CHECK LIST

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE [illegible] BY [illegible]

AREA EVALUATED		CONDITION
DAM EMBANKMENT		
Crest Elevation		±211.0
Current Pool Elevation		±203.1
Maximum Impoundment to Date		
Surface Cracks		None observed
Pavement Condition		N/A
Movement or Settlement of Crest		None observed
Lateral Movement		
Vertical Alignment		Appears good
Horizontal Alignment		
Condition at Abutment and at Concrete Structures		Heavy brush and tree ± up to 20" at both abutments. Concrete badly spalled, cracked, deteriorated
Indications of Movement of Structural Items on Slopes		None observed
Trespassing on Slopes		Heavy deep foot path worn along top of dam.
Sloughing or Erosion of Slopes or Abutments		Severe erosion of down stream slope at Top of dam. Erosion ditches ± 3 deep in some areas as 2' long
Rock Slope Protection-Riprap Failures		N/A
Unusual Movement or Cracking at or Near Toes		None observed
Unusual Embankment or Downstream Seepage		Swamp at toe of embankment
Piping or Boils		None observed
Foundation Drainage Features		N/A
Toe Drains		None observed
Instrumentation System		None

PERIODIC INSPECTION CHECK LIST

PROJECT STILLWATER RESERVOIR DAM DATE 11-30-82

PROJECT FEATURE Joint Dike BY

AREA EVALUATED		CONDITION
DIKE EMBANKMENT		
Crest Elevation		±211.0 Irregular
Current Pool Elevation		±203.1
Maximum Impoundment to Date		Not determined
Surface Cracks		N/A
Pavement Condition		Not observed
Movement or Settlement of Crest		
Lateral Movement		
Vertical Alignment		Appears Good
Horizontal Alignment		
Condition at Abutment and at Concrete Structures		Abutments covered with brush and trees up to 18" ±
Indications of Movement of Structural Items on Slopes		N/A
Sloughing or Erosion of Slopes or Abutments		Some erosion on D/S slope and slope near toe of dike
Rock Slope Protection-Riprap Failures		Some displacement of rock on upper D/S slope due to wave action from [illegible]
Unusual Movement or Cracking at or Near Toes		Not observed
Unusual Embankment or Downstream Seepage		Ponded water at toe of dike in some locations could not be observed
Piping or Boils		None observed
Foundation Drainage Features		None
Toe Drains		None
Instrumentation System		None
Trespassing on Slopes		Heavy

PERIODIC INSPECTION CHECK LIST

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE [illegible] BY _____

AREA EVALUATED		CONDITION
DIKE EMBANKMENT		
Crest Elevation		± 211.0 Irregular
Current Pool Elevation		± 203.1
Maximum Impoundment to Date		
Surface Cracks		None observed
Pavement Condition		N/A
Movement or Settlement of Crest		None observed
Lateral Movement		
Vertical Alignment		Appears good
Horizontal Alignment		
Condition at Abutment and at Concrete Structures		Left abutment covered with brush and trees up to 18" ø
Indications of Movement of Structural Items on Slopes		None observed
Sloughing or Erosion of Slopes or Abutments		Erosion on u/s and d/s slopes from top of dike.
Rock Slope Protection-Riprap Failures		N/A rip-rap on d/s slope overlayed by [illegible] and tree growth
Unusual Movement or Cracking at or Near Toes		None observed
Unusual Embankment or Downstream Seepage		[illegible] seepage [illegible] could not be observed
Piping or Boils		None observed
Foundation Drainage Features		None
Toe Drains		None
Instrumentation System		None
Trespassing on Slopes		Heavy

PERIODIC INSPECTION CHECK LIST

Page

PROJECT

PROJECT FEATURE BY

AREA EVALUATED	CONDITION
OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a) Approach Channel	
General Condition	very poor
Loose Rock Overhanging Channe	
Trees Overhanging Channel	
Floor of Approach Channel	
b) Weir and Training Walls	
General Condition of Concrete	
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	
c) Discharge Channel	
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Channel	
Other Obstructions	

A-5

PERIODIC INSPECTION CHECK LIST

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE [illegible] BY [illegible]

AREA EVALUATED		CONDITION
OUTLET WORKS-OUTLET STRUCTURE AND OUTLET CHANNEL		
General Condition of Concrete		fair to poor
Rust or Staining		
Spalling		extensive spalling and deterioration of training wall
Erosion or Cavitation		concrete training wall badly deteriorated & displaced in vertically and spalled
Visible Reinforcing		None observed
Any Seepage or Efflorescence		none observed
Condition at Joints		poor
Drain Holes		None observed
Channel		fair
Loose Rock or Trees Overhanging Channel		None
Condition of Discharge Channel		fair

OUTLET WORKS - CONTROL STRUCTURE (cont.)

GENERAL CONDITION

FOUNDATION (spalling, scouring, visible reinforcing, rusting/staining) concrete.

DOORS, ROOF, ETC. steel door, freshly painted / concrete roof

OTHER

GATES: TYPE unknown / door locked

CONDITION ~~currently~~ - left gate open and passing large quantity of wales.

OUTLET WORKS - OUTLET STRUCTURE & OUTLET CHANNEL

GENERAL CONDITION OF CONCRETE walls spalling badly.

CONDITION OF CHANNEL/SLUICEWAY generally fair condition.

LOOSE ROCK / OVERHANGING TREES none at sluiceway.

OBSTRUCTIONS IN DOWNSTREAM CHANNEL overgrown in channel w/small shrub + vegetation.

SPILLWAY WEIR

APPROACH CHANNEL - OBSTRUCTIONS currently obstructed w/trees + large stumps ~~stone embedded approach apron~~

OVERHANGING TREES / ROCKS overhanging trees on both sides of spill

FLOOR OF APPROACH CHANNEL lined w/stone

TRAINING / WING WALLS

TYPE - stone w/concrete crest. concrete spalled + scoured but not as badly as retaining wall

CONDITION (GENERAL) (spallig, scouring, visible signs of reinforcing, rusting/staining) - crest OK - apron is a broken mess

CONDITION @ ABUTMENT WALLS overgrown w/small + med trees.

CONDITION OF APRON complete broken wreck

OBSTRUCTIONS IN DOWNSTREAM CHANNEL overgrown w/ shrubs + trees.

~~OTHER~~ in great need of overall repair. compare to old photos.

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

DAM INSPECTION REPORT

DAM NO.: 108 DAM NAME: Stillwater DATE: Aug 31, '78

DAM/DIKE EMBANKMENT Built 1910

TYPE Earthen with concrete core

POOL ELEVATION very low

GENERAL CONDITION:

SLOPES erosion appx 150' N. of conc. wall on dike. w/trees. small wetland area on roadside of dike

CREST much erosion adjacent to gatehouse washing down to downstream outlet channel from gates.

@ ABUTMENTS & CONCRETE STRUCTURES concrete wall badly spalled/scoured along face and top. 6"-12" at places - worst cond is at construction joints

RIP - RAP none

INDICATIONS OF LEEKAGE/SEEPAGE no signs of any significant leaking. wet area behind dike probably caused by seepage in this area

OTHER Poorly maintained

OUTLET WORKS - INTAKE STRUCTURE

APPROACH CHANNEL - OBSTRUCTIONS, ETC. clear unobstructed

INTAKE STRUCTURE: too low & in water to be visible

WING WALLS

TRASH RACK not able to observe.

CONDITION OF CONCRETE (spalling, scouring, visible reinforcing, rusting/staining) spalling along water line

OUTLET WORKS - CONTROL STRUCTURE

TYPE OF CONSTRUCTION concrete wall construction

GENERAL CONDITION currently solid/stable condition

7.5?

DIVISION OF HARBORS AND RIVERS

SURVEY OF DAMS IN RHODE ISLAND

Woonasquatucket River Basin — [illegible]108 [illegible]

Drainage Area at the Dam — 26.2 Sq. Mi.

February 1948

Spillway - 100' x 4' deep, capacity - — 2777 c.f.s.

Estimated extreme freshet — 1127 c.f.s.

Feb. 18, 1948

R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS AND RIVERS

DAM NO. 108

SPECIAL INSPECTION REPORT

INSPECTED BY J. V. KEILY

TOWN - SMITHFIELD

DAM NO [illegible] NAME STILLWATER RESERVOIR ON RIVER MOONASQUATUCKET RIVER WATERSHED MOONASQUATUCKET

OWNER MOONASQUATUCKET RESERVOIR CO.

ADDRESS 52 VALLEY STREET, PROVIDENCE, R I C/O MR. HOLDSWORTH, PRES. PROV. D. & C. CO.

REPORT ON NEW CONSTRUCTION REPAIRS INSPECTION ONLY X

PLANS BY APPROVED CONTRACTOR

INSPECTION REPORT BY JOHN V. KEILY REASON ROUTINE DATE 11/12/46

EMERGENCY:

1. A. W. ANDERSON, Res. 90 ARNOLD RD. CRANSTON. TEL. WI-1-2023. Bus. PROVEL. & GAS. CO.
2. HENRY A. FULLER, GREENVILLE (SNAKE HILL ROAD, GLOCESTER) TEL. SCIT. 4316
3.

11/12/46

ALL IN GOOD CONDITION. LONG EMBANKMENTS PROTECTED BY 4' GRAVITY-SECTION CONCRETE WALL ON POND SIDE. ONLY SLIGHT SCALING VISIBLE ON CONCRETE; SLOPES WELL GRASSED AND RECENTLY TRIMMED. NEW GATEHOUSE. SPILLWAY CLEAR. SLIGHT SCALING ON CONCRETE GROUT ON COBBLES ON APRON. FEW TREES ON EMBANKMENT ON POND SIDE IN GROUTED RIPRAP SHOULD BE CUT BEFORE TOO LARGE. SOUTHERN SECTION OF EMBANKMENT OVERGROWN WITH BRUSH AND TREES; NEEDS CUTTING AT ONCE. SO PROMISED BY MR. ANDERSON

11/24/47 ✓

CONDITION FAIR. SOUTH EMBANKMENT STILL NEEDS CUTTING. ALSO NORTH EMBANKMENT. SOME RIPRAP DISPLACED. READING GAGE INSTALLED ON SOUTH SIDE OF GATE HOUSE READS 5½ FEET TODAY. RESERVOIR VERY LOW.

5/ 1 /48

RESERVOIR FULL AFTER RAINY SPRING- GATE CLOSED- 4" TO 5" OVER SPILLWAY TODAY.

SKEER

SPILLWAY
TYPE
CONDITION

DRAW-OFF GATES
NUMBER
CONDITION

TRENCHES & WHEELS

EMBANKMENT
TYPE
CONDITION
APPROACHES
EROSION
BRUSHES & TREES
RIPRAP

PRESENT USE

WATER CONTROLS

WHO CONTACTED AT SITE

INSTRUCTIONS LEFT

IN EMERGENCY CALL

DIVISION OF HARBORS AND RIVERS
SURVEY OF STATE DAMS.

Woonasquatucket Drainage Area. #2 Stillwater Reservoir

Drainage area at the dam 25.52 sq. mi. Spillway 100' long
4' Deep

Spillway capacity 3381 cfs. Extreme freshet 1122 cfs.

Area of the Reservoir 350 acres. Capacity about [illegible]

Waterman, Sprague Upper and Lower, Slack, Mountaindale and Hawkins are all above Stillmanville and control the flow at freshet time to such extent that 1[illegible]cfs would not reach Stillmanville unless the reservoirs were full when the freshet came on.

This dam is in fine condition.

See Commissioner of Dams Reports 1911-15

August 16, 1940.

DIVISION OF HARBORS AND RIVERS
LETTER TO
C. ROBERT LYNCH, CHIEF OF
DIVISION [illegible]
JOHN P. FARNSWORTH'S ANS. ← 3/20/39
TO LETTER
MARCH 20, 1939

These two are apparently the same. The Mountaindale Pond -#125 is controlled by the Woonasquatucket Reservoir Co. of which I am Treasurer. We also control

#111	Waterman Reservoir	Built	?
#120	Upper Sprague	"	?
✓ #115	Slack Reservoir	"	?
✓ #108	Stillwater Reservoir	"	1909/10
#121	Lower Sprague	"	?

All of these dams have been kept in the best repair possible. Mr. A. W. Anderson, Circuit Road, Edgewood, is our engineer (WI [illegible]) and George Birch in Greenville has charge of gates.

My own address is 107 Prospect Street. Tel. Plantations 652

/s/ John P. Farnsworth

All other dams on the river under control of individual mills. Will be glad to cooperate in any way.

JPF

Original of this letter [illegible] Doc # 125

Woonasquatucket 2

State of Rhode Island and Providence Plantations

DEPARTMENT OF PUBLIC WORKS
STATE OFFICE BUILDING

Frederick V. Waterman
DIRECTOR

OFFICE OF THE DIRECTOR

RECEIVED
Apr 4/39
ANSWERED

DIVISION OF HARBORS & RIVERS

DIVISION OF ROADS AND BRIDGES
DIVISION OF PUBLIC BUILDINGS
DIVISION OF STATE AIRPORTS
DIVISION OF HARBORS AND RIVERS

PROVIDENCE, March 28, 1939

Employee - gate keeper of Woonasquatucket Reservoir Co
No such Company to My knowledge

Mr. George Birch
Woonasquatucket Water Works
Smithfield, R. I.

Dear Sir:-

Will you kindly furnish this office with any data or plans you may have; also the name, address and telephone number, if any, of the person in charge of the Stillwater Reservoir dam or gates located on the Woonasquatucket River at Smithfield, Rhode Island in order that we may notify him in case of any emergency.

Kindly return this letter with the information thereon as a means of identification.

If possible, also furnish us with date when said dam or gates were built or rebuilt.

Very truly yours,

C. Robert Rynech

CRL/T

CHIEF DIVISION HARBORS & RIVERS.

Stillwater Reservoir part of Woonasquatucket Reservoir (a Pond at Stillwater R.I controlled by Lester Waste Co (only operated by)

B-6

COPY OF FULL REPORT AS CONTAINED IN ANNUAL REPORTS

OF COMMISSIONERS OF DAMS AND RESERVOIRS.

1911 - The Woonasquatucket Water Company have completed a dam in the town of Smithfield near the village of Stillwater from which village the reservoir formed will take its name. The dam is composed of three sections and is an earthen dam with a concrete core and concrete gate chambers and spillway. It is some 2100 feet in length and 19 feet at its greatest height. The reservoir will cover an area of 350 acres and it is estimated that it will store about 120,000,000 cubic feet of water, approximately 900,000,000 gallons. In constructing the reservoir it was found necessary to raise the grade of some of the town roads and build new and substantial bridges. Plans and specifications are to be found in this report.

1932 - Mentioned in report.

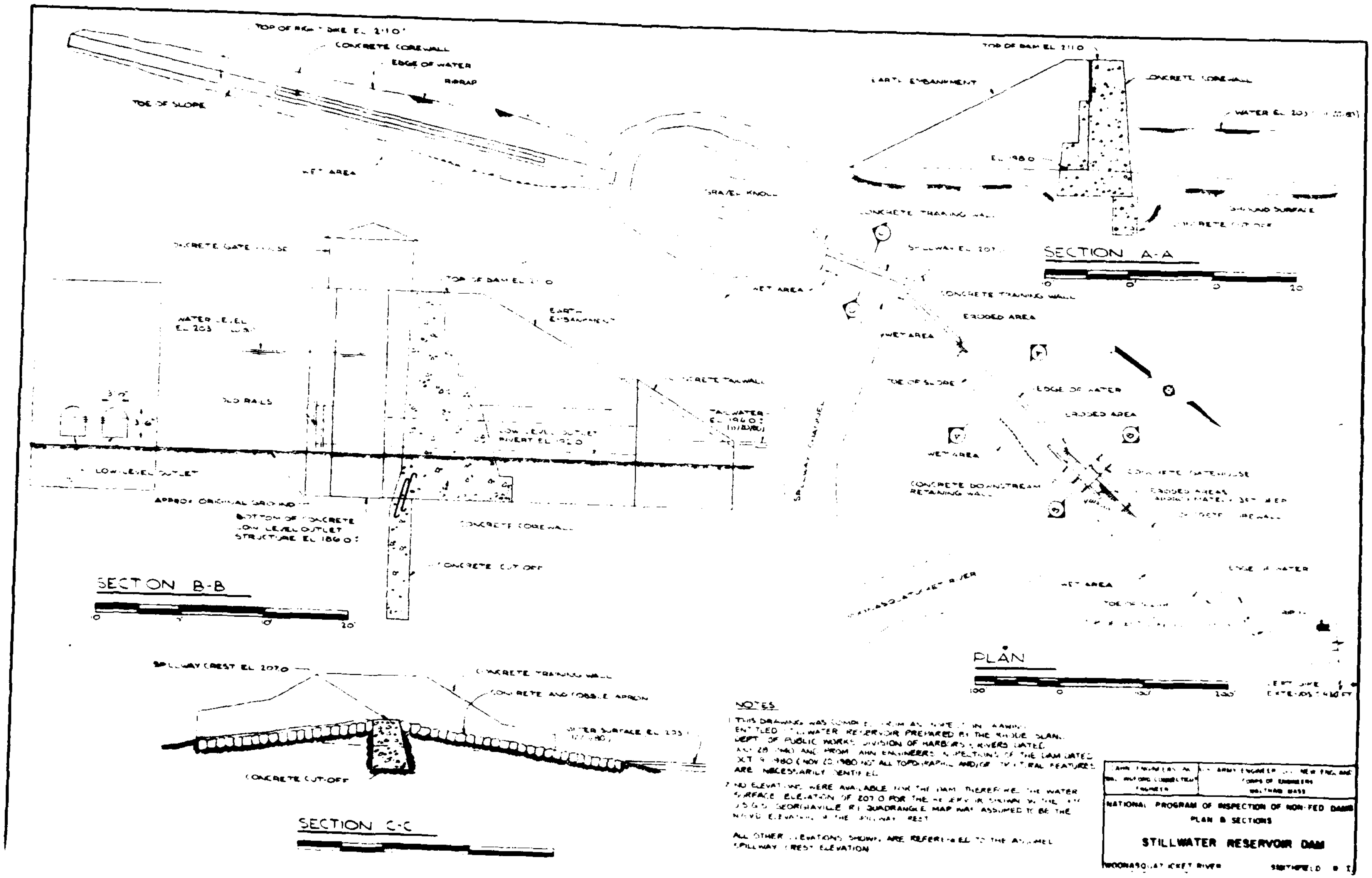
SUMMARY OF DATA AND CORRESPONDENCE

DATE	TO	FROM	SUBJECT	PAGE
1911			Copy of full report as contained in Yearly Reports of Commissioners of Dams and Reservoirs	B-4
1910			Dam Construction Photographs	B-5
March 28, 1939	Mr. George Birch Woonasquatucket Water Works	C. Robert Lynch State of Rhode Island Department of Public Works. Division of Harbors and Rivers	Request for plans and data pertaining to Stillwater Reservoir Dam	B-6
	C. Robert Lynch State of Rhode Island, Dept. of Public Works, Division of Harbors and Rivers.	John F. Farnsworth Woonasquatucket Water Works	Reply letter to the request for plans and data	B-7
Aug. 16, 1940	File	Division of Harbors and Rivers	Survey of State Dams	B-8
Nov. 12, 1946	File	Division of Harbors and Rivers	Special Inspection Report	B-9
Feb. 1948	File	Division of Harbors and Rivers	Survey of Dams in Rhode Island	B-10
Aug, 31, 1978	File	State of Rhode Island, Dept. of Environmental Management	Dam Inspection Report	B-11
Aug, 31, 1978	File	State of Rhode Island Dept. of Environmental Management	Dam Inspection Report	B-13

STILLWATER RESERVOIR DAM

EXISTING PLANS

"Stillwater Reservoir"
Plan Number 108
July 28, 1940
Rhode Island Department of Public Works
Division of Harbors and Rivers
By the Works-Projects Administration


TOP OF RIGHT DIKE EL. 211.0'
CONCRETE COREWALL
EDGE OF WATER
RIPRAP
TOE OF SLOPE
WET AREA
GRAVEL KNOLL
TOP OF DAM EL. 211.0
EARTH EMBANKMENT
CONCRETE COREWALL
EL. 198.0
GROUND SURFACE
CONCRETE TRAINING WALL
SPILLWAY EL. 207
SECTION A-A
CONCRETE GATE HOUSE
TOP OF DAM EL. 211.0
EARTH EMBANKMENT
OLD RAILS
CONCRETE TAILWALL
LOW LEVEL OUTLET INVERT EL. 192.0
LOW LEVEL OUTLET
APPROX. ORIGINAL GROUND
BOTTOM OF CONCRETE LOW LEVEL OUTLET STRUCTURE EL. 186.0'
CONCRETE COREWALL
CONCRETE CUT-OFF
SECTION B-B
ERODED AREA
TOE OF SLOPE
EDGE OF WATER
CONCRETE DOWNSTREAM RETAINING WALL
CONCRETE GATEHOUSE
EDGE OF WATER
PLAN
SPILLWAY CREST EL. 207.0
CONCRETE TRAINING WALL
CONCRETE AND COBBLE APRON
CONCRETE CUT-OFF
SECTION C-C
NOTES
1. THIS DRAWING WAS COMPILED FROM AN ... ENTITLED ... STILLWATER RESERVOIR PREPARED BY THE RHODE ISLAND DEPT. OF PUBLIC WORKS DIVISION OF HARBORS & RIVERS DATED ... 28 ... AND FROM AHN ENGINEERS INSPECTIONS OF THE DAM DATED OCT. 9, 1980 & NOV. 20, 1980. NOT ALL TOPOGRAPHIC AND/OR STRUCTURAL FEATURES ARE NECESSARILY IDENTIFIED.
2. NO ELEVATIONS WERE AVAILABLE FOR THE DAM. THEREFORE, THE WATER SURFACE ELEVATION OF 207.0 FOR THE RESERVOIR SHOWN ON THE U.S.G.S. GEORGIAVILLE, R.I. QUADRANGLE MAP WAS ASSUMED TO BE THE N.G.V.D. ELEVATION OF THE SPILLWAY CREST.
ALL OTHER ELEVATIONS SHOWN ARE REFERENCED TO THE ASSUMED SPILLWAY CREST ELEVATION.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
PLAN & SECTIONS
STILLWATER RESERVOIR DAM

APPENDIX B

ENGINEERING DATA AND CORRESPONDENCE

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Public [illegible] to [illegible] 1/3/77

DAM INSPECTION REPORT

DAM: 108 RIVER: Woonasquatucket R. WATERSHED: Woonasquatucket DATE: Aug 31, 1976

NAME: Stillwater Res. TOWN: Smithfield INSPECTED BY: Earle F. Prout, Jr.

OWNER: OTHER INTERESTED PARTY:

Woonasquatucket Res. Co.
c/o Mr. Raymond S. Gregson, President
P.O. Box 5078
Esmond, R.I. 02917

REASON FOR INSPECTION:

N.P.S.I.D. - Significant/Intermediate hazard Annual Inspection.

* * * * * * * * * *

REPORT:

General: Dam built in 1910
1947 Inspection report refers to gatehouse as "new" but [illegible] shown in photos of 1940.

Current Pool Elevation: approx. 3½' below crest of spillway

Dam Embankment: Earthen dam embankment w/ concrete [illegible] extending northward from spillway approx 600'. Concrete wall on pond side ~~forms~~ a retaining wall and downstream slope drops 12'-15' @ 3:1 in most places. Downstream slope is showing signs of serious erosion adjacent to gatehouse [illegible] and washing down to downstream discharge channel. [illegible] also appears to have become common pathway to [illegible] channel. However, there are no current signs of any [illegible] seepage/leakage through embankment. ~~[illegible]~~ [illegible] Most of downstream slopes are heavily overgrown with medium and large [illegible] trees.

Gates: Approach to gate structure is clear and unobstructed. The trash rack was too far under water to be observed. The concrete foundation and walls of gatehouse are in good

[illegible] The steel door appears to have been recently painted and locked (suggesting entire structure hasn't been completely abandoned).

Left gate is currently open and passing large volume of water (note turbulence in photo #3)

The walls of the outlet structure are spalled heavily (photo #3). Spalling of the concrete is also very severe in many areas along the concrete retaining wall of the embankments. The concrete retaining wall is spalled/scoured 6"-12" deep in some places -- the worst condition being at the construction joints.

~~The discharge channel from outlet structure is overgrown with small shrubs and other vegetation.~~

Spillway: The approach to the concrete spillway is completely ~~blocked~~ overgrown with trees and brush and obstructed w/ stumps strewn across the entire crest (photo 4). Both sides of spillway at concrete abutment walls are heavily overgrown with overhanging trees. The abutment/training walls are spalled and scoured, but not as severely as the main retaining wall on the left. Although crest is ~~completely~~ overgrown with trees & shrubs, it appears to be in fairly good condition. However, the spillway apron is a complete broken-up wreck with large areas missing.

The downstream discharge channel is overgrown with small trees and trees.

Comments & Recommendations —

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

Department of Environmental Management
DIVISION OF LAND RESOURCES
83 Park Street
Providence, R. I. 02903

February 9, 1979

Mr. Arthur Winsor
c/o Winsor Construction Company
243 Angell Road
Lincoln, Rhode Island 02865

Re: Woonasquatucket Reservoir Dam, R.I. Dam #108
(also known locally as Stump Pond Dam)

Dear Mr. Winsor;

This letter has reference to our phone conversation of this date relative to your anticipated repairs to the Woonasquatucket Reservoir Dam, R.I. Dam #108.

As mentioned in our conversation, it is requested that you furnish this office two file copies of the enclosed Application for the Approval of Plans & Specifications (the third copy is to be retained by the owner), along with a description of the proposed scope of work which details the extent of the project and the manner it is to be accomplished, prior to the commencement of any remedial work.

Thank you for contacting this office. If we can be of further assistance, do not hesitate to contact us.

Very truly yours:

Earle F. Prout, Jr.

Earle F. Prout, Jr.
Dams Section
Division of Land Resources

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

DAM INSPECTION REPORT

I.M: 108 RIVER: Woonasquatucket River WATERSHED: Woonasquatucket DATE: August 31, 1979

NAME: Woonasquatucket Dam (Stump Pond Dam) TOWN: Smithfield INSPECTED BY: Earle F Prout, Jr.

OWNER: Woonasquatucket Res. Co. OTHER INTERESTED PARTY:
c/o Mr. Raymond S. Gregson, Pres.
P.O. Box 5078
Esmond, R. I. 02917

REASON FOR INSPECTION: N.P.S.I.D. - Significant/Intermediate Hazard
Annual Inspection

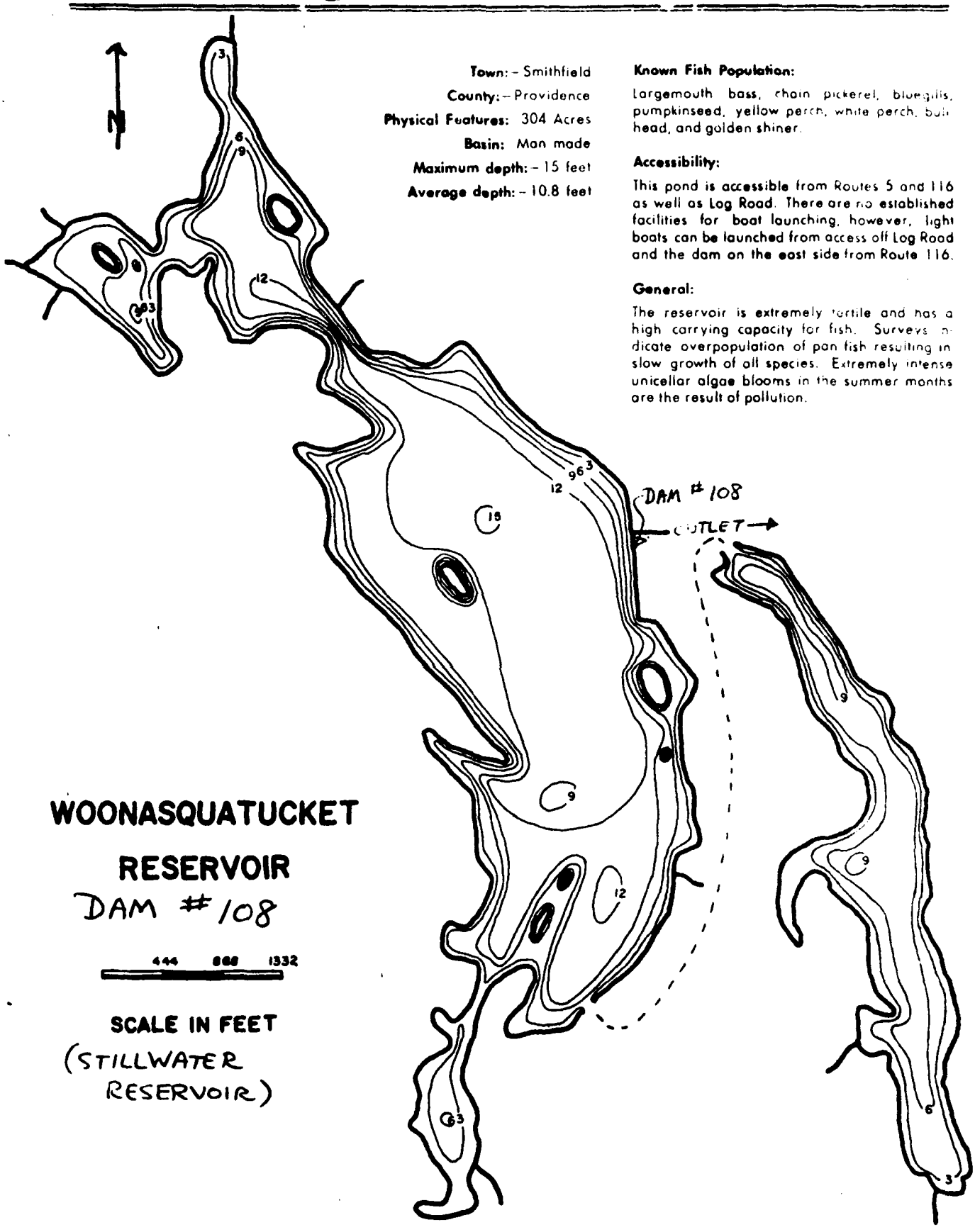
* * * * * * * * * *

REPORT:

GENERAL: Dam built in 1910
1947 Inspection report refers to gatehouse as "new" but is shown in photos of 1940.

CURRENT POOL ELEVATION: Approx. 3½' below crest of spillway.

DAM EMBANKMENT: Earthen dam embankment extending northward from spillway approx. 600'. Concrete wall on pond side forms a retaining wall and downstream slope 12'-15' 2 2:1( ) in most places.



Town: – Smithfield

County: – Providence

Physical Features: 304 Acres

Basin: Man made

Maximum depth: – 15 feet

Average depth: – 10.8 feet

Known Fish Population:

Largemouth bass, chain pickerel, bluegills, pumpkinseed, yellow perch, white perch, bull head, and golden shiner.

Accessibility:

This pond is accessible from Routes 5 and 116 as well as Log Road. There are no established facilities for boat launching, however, light boats can be launched from access off Log Road and the dam on the east side from Route 116.

General:

The reservoir is extremely fertile and has a high carrying capacity for fish. Surveys indicate overpopulation of pan fish resulting in slow growth of all species. Extremely intense unicellar algae blooms in the summer months are the result of pollution.

WOONASQUATUCKET RESERVOIR

DAM #108

444 888 1332

SCALE IN FEET

(STILLWATER RESERVOIR)

CODING SHEET DAM INVENTORY Card #1 Page #1

IDENTIFICATION DATA:

1.	Dam number	1: 0108
2.	City/town	5: 31
3.	U.S.G.S. quad sheet number	7: 08
4.	Owner/operator	9:
5.	Water rights owner	13:
6.	Type of ownership--pond	17:
7.	Type of ownership--public access	18:
8.	Type of public access	19:
9.	Designed purpose of dam	20: M
10.	Current use of dam	21:

WATERSHED DATA:

11.	Drainage basin	22: WØ
12.	Stream name	24: W09
13.	Area of watershed (nearest tenth sq. mi.)	27: 026.2
14.	Design storm frequency	31:
15.	S.C.S. Hydrologic curve number	32:
16.	Peak discharge rate of watershed (C.F.S.)	35: 01127

(OVER)

CODING SHEET DAM INVENTORY Card #1 Page #2

POOL DATA:

17. Elevation--normal water level of pool . . . [40] 2 0 7 . 0

18. Elevation--pool bottom @ dike (1/10 ft.) . . [44] 0 3 4 . 0

19. Elevation--dnstream channel bed @ dike . . . [48] 0 3 4 . 0

20. Area of pool surface (nearest acre) . . . . [52] 0 3 1 2

21. Normal storage cap. of pool (nrst acre ft.) [56] 0 3 3 7 0

22. Water quality of pool . . . . . [61] C

SPILLWAY DATA:

23. Type of spillway . . . . . [63] R

24. Type of material in spillway . . . . . [64] S

25. Elevation--crest of spillway (1/10 ft.) . . [65] 0 5 0 . 0

26. Max. safe depth of flow over spillway . . . [69] 4 . 0

27. Width of spillway (nearest ft.) . . . . . [71] 1 0 0

28. Max. flow capacity of spillway (C.F.S.) . . [74] 0 2 7 7 7

29. Condition of spillway . . . . . [79]

ID:

Card number . . . . . [80] 1

CODING SHEET DAM INVENTORY Card #2 Page #1

ID:

30. Dam number . . . . . 1 [0][1][0][8]

WASTE WATER OUTLET DATA:

31. Type of waste water outlet . . . . . 5 [C]

32. Waste water outlet size (sq. ft.) . . . . . 6 [0][2][2]

33. Max. flow cap. of waste water outlet (C.F.S.). . . 9 [ ][ ][ ][ ][ ]

34. Condition of waste water outlet . . . . . 14 [ ]

DIKE DATA:

35. Elevation--top of dike (1/10 ft.) . . . . . 15 [0][5][4].[0]

36. Length of dike (excl. spillway) (nearest ft.). . . 19 [ ][ ][ ][ ]

37. Top width of dike (nearest ft.). . . . . 23 [ ][ ]

38. Type of construction of dike. . . . . 25 [Z]

39. Type of material in dike . . . . . 26 [E][C]

40. Condition of dike.. . . . . 28 [ ]

FLOOD CONTROL DATA:

41. Elevation--expected high water (1/10 ft.). . . . . 29 [ ][ ][ ].[ ]

42. Flood control storage capacity (nrst acre ft.) . . 33 [ ][ ][ ][ ][ ]

43. Max.storm discharge cap. of dam (C.F.S.) . . . . . 38 [ ][ ][ ][ ][ ]

44. Flood control structure--type . . . . . 43 [ ]

(OVER)

DATA ON ASSOCIATED STRUCTURES:

45. Drain valve type . . . . . [44]

46. Drain valve size (sq. ft. . . . . [45]

47. Drain valve location (sta. on C/L of dam) . . . [47] + [ ]

48. Draw down valve type . . . . . [50]

49. Draw down valve size (sq. ft.) . . . . . [51]

50. Draw down valve location (sta. on C/L of dam) . [53] + [ ]

51. Fish ladder--elevation of floor @ dam (1/10 ft.) [56] . [ ]

52. Fish ladder rise (nearest ft.) . . . . . [60]

53. Fish ladder width (nearest ft.) . . . . . [62]

54. Fish ladder--design depth of flow (nrst ft.) . . [63]

55. Fish ladder--general location . . . . . [64]

56. Fish ladder--type of fish . . . . . [65]

GENERAL STATUS OF DAM:

57. Year dam built . . . . . [66]

58. Date last modification completed (mo./yr.) . . . [70] / [ ]

59. Date of last inspection (mo./yr.) . . . . . [74] 05 / 48

60. General condition of dam . . . . . [78]

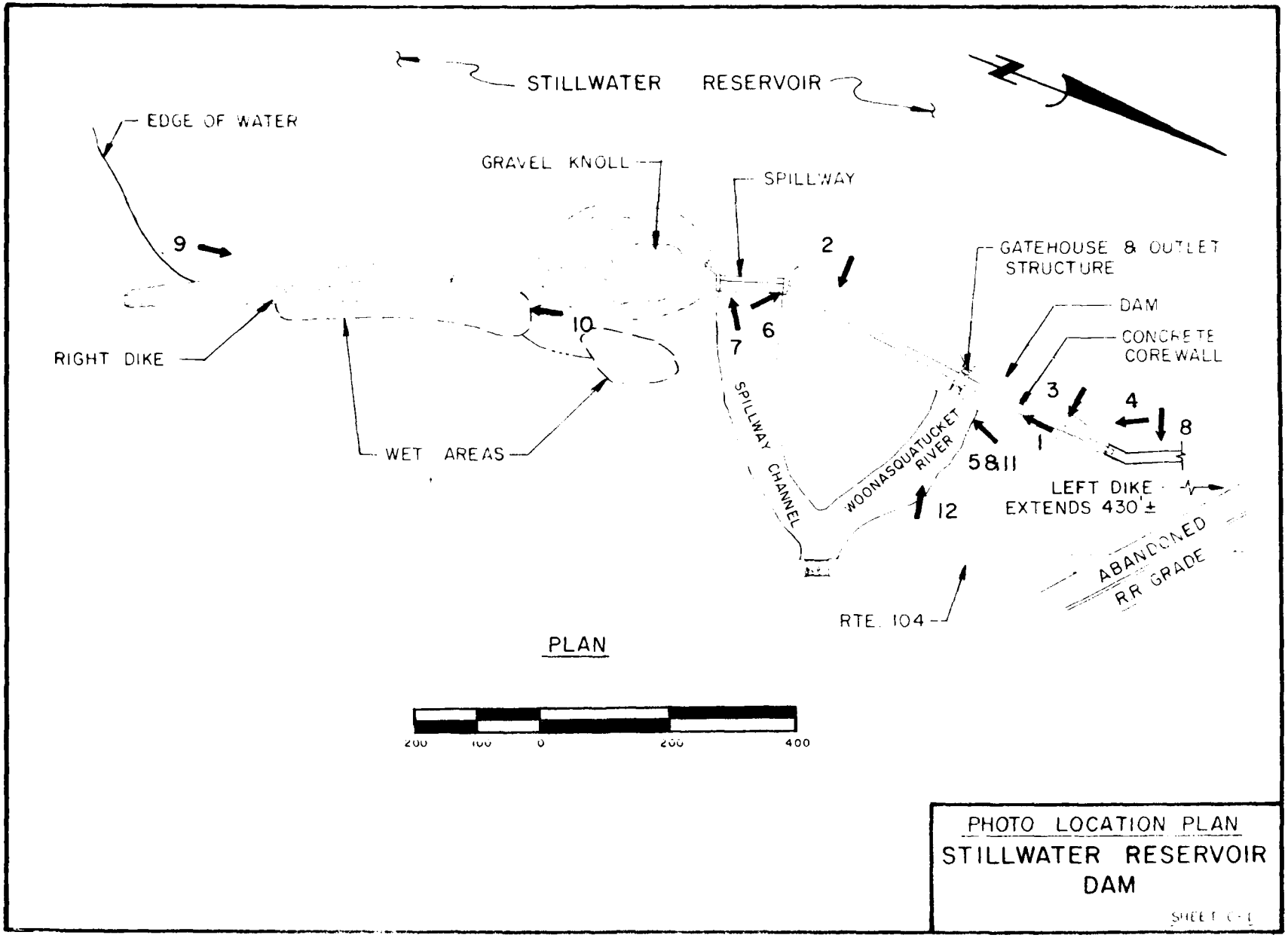
61. Note or remark . . . . . [79]

ID:

62. Card number . . . . . [80] 2

APPENDIX C

DETAIL PHOTOGRAPHS



PLAN

PHOTO LOCATION PLAN
STILLWATER RESERVOIR
DAM

SHEET C-1

Photo 1 - Top of dam and downstream embankment. Note erosion of embankment, (10/9/80).

Photo 2 - Upstream face of concrete corewall, (11/20/80).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF	Stillwater Reservoir Dam Woonasquatucket River Smithfield, R.I.
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED. DAMS	CE # 27 785 KG DATE Jan. 1981 PAGE C-1

Photo 3 - Upstream face of concrete corewall, (10/9/80).

Photo 4 - Upstream face of concrete corewall and gatehouse structure, (10/9/80).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF	Stillwater Reservoir Dam
	INSPECTION OF	Woonasquatucket River
CAHN ENGINEERS INC. WALLINGFORD, CONN ENGINEER	NON-FED. DAMS	Smithfield, R.I.
		CE # 27 785 KG
		DATE Jan. 1981 PAGE C-2

Photo 5 - Downstream slope and low-level outlet structure, (11/20/80).

Photo 6 - Masonry spillway and left training wall, (10/9/80).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF	Stillwater Reservoir Dam Woonasquatucket River Smithfield, R.I.
CAHN ENGINEERS INC. WALLINGFORD, CONN ENGINEER	INSPECTION OF NON-FED. DAMS	CE# 27 785 KG DATE Jan. 1981 PAGE C-3

STILLWATER RESERVOIR DAM

II) DOWNSTREAM FAILURE HAZARD

1) POTENTIAL IMPACT AREA

THREE DAMS (STILLWATER, APRON AND GEORGIANVILLE PONDS) ARE LOCATED WITHIN 2.5 mi D/S FROM THE STILLWATER RESERVOIR DAM, IN THE WOONASQUATUCKET RIVER. TWO INDUSTRIAL BUILDINGS WITH FIRST FLOORS (±) 12' AND 13' ABOVE THE CHANNEL ARE LOCATED JUST D/S (≈500') FROM THE STUDY DAM. THE FIRST FLOOR OF A LARGE INDUSTRIAL BUILDING AT STILLWATER POND DAM IS (±) 10' BELOW THE POND'S W.S. FIVE OR MORE HOUSES ON THE SHORE OF GEORGIANVILLE POND HAVE FIRST FLOORS BETWEEN (±) 3' AND 4.5' ABOVE THE POND'S W.S. AND SEVERAL OTHER HOMES D/S OF B. TH, APRON AND GEORGIANVILLE POND DAMS HAVE FIRST FLOORS BETWEEN 6½' AND 9' ABOVE THE RIVER CHANNEL. THESE STRUCTURES CONSTITUTE THE POTENTIAL IMPACT AREA IN CASE OF FAILURE OF STILLWATER RESERVOIR DAM.

2) FAILURE AT STILLWATER RE.. DAM.

ASSUME SURCHARGE TO FIRST POINT OF OVERTOPPING (LEFT DIKE), ELEV. 210.5 NGVD

a) HEIGHT OF DAM: $H_{max} \approx 20'$ (CE MEASURE* ± 1' EL. 192 NGVD) TO STATE "FIRST" RECORD. ASSUME STREAMBED (±) 1' BELOW. THIS DIMENSION AGREES WITH SCALE ON THE R.I. DEPARTMENT OF PUBLIC WORKS "STILLWATER RESERVOIR" #105 DWG

b) MID-HEIGHT LENGTH*: $\ell \approx 432'$

c) BREACH WIDTH (SEE NED-ACE D/S DAM FAILURE GUIDELINES)

$W = 0.4 \times 432' \approx 173'$ ∴ ASSUME $W_b \approx \underline{170'}$

d) ASSUMED WATER DEPTH AT TIME OF FAILURE: $Y_o = 19.5'$ (EL. 210.5 TO EL. 191')

*FROM CE MEASSUREMENTS ON 10/1/80 BY [illegible] C.E.I.

(c) PEAK OUTFLOWS (Q_{P_3} & Q'_{P_3})

$Q_{P_3} \doteq 13800^{cfs}$ $H_3 \doteq 5.8'$ (ELEV 212.8' NGVD)

$Q'_{P_3} \doteq 6200^{cfs}$ $H'_3 \doteq 4.8'$ (ELEV. 211.8' NGVD)

(DETERMINED* ON THE OUTFLOW RATING CURVE (P. D-4), BY USING THE APPROX. ROUTING NED-ACE GUIDELINES "SURCHARGE STORAGE ROUTING" ALTERNATE METHOD AND 19" MAX PROBABLE P.O. IN NEW ENGLAND).

*SEE EXAMPLE BELOW

3) SPILLWAY CAPACITY RATIO TO PEAK OUTFLOWS.

SPILLWAY CAPACITY TO:	SURCH* H (FT)	W.S. ELEV (FT-NGVD)	SPILLWAY CAPACITY (CFS)	SPILLWAY CAPACITY AS % OF PEAK OUTFLOWS. Q_{P_3} (13800^{cfs})	Q'_{P_3} (6200^{cfs})
LOW POINT**	3.5	210.5	1800	13	29
TOP OF DAM	4.0	211.0	3200	16	35
½ PMF	4.8	211.8	2800	—	45
PMF	5.8	212.8	3800	28	—

*SURCHARGE ABOVE SPILLWAY CREST (ELEV. 207' NGVD). NORMAL POOL ASSUMED 3.5' BELOW SPILLWAY CREST (ELEV. 203.5' NGVD - SEE P. D-5). SURCH. STORAGE TO SPWY. $\Delta V_0 \doteq 950^{AC\text{-}FT}$

**LOW POINT AT LEFT DIKE (SEE PROFILE P. D-2)

EXAMPLE OF PEAK OUTFLOW DETERMINATION

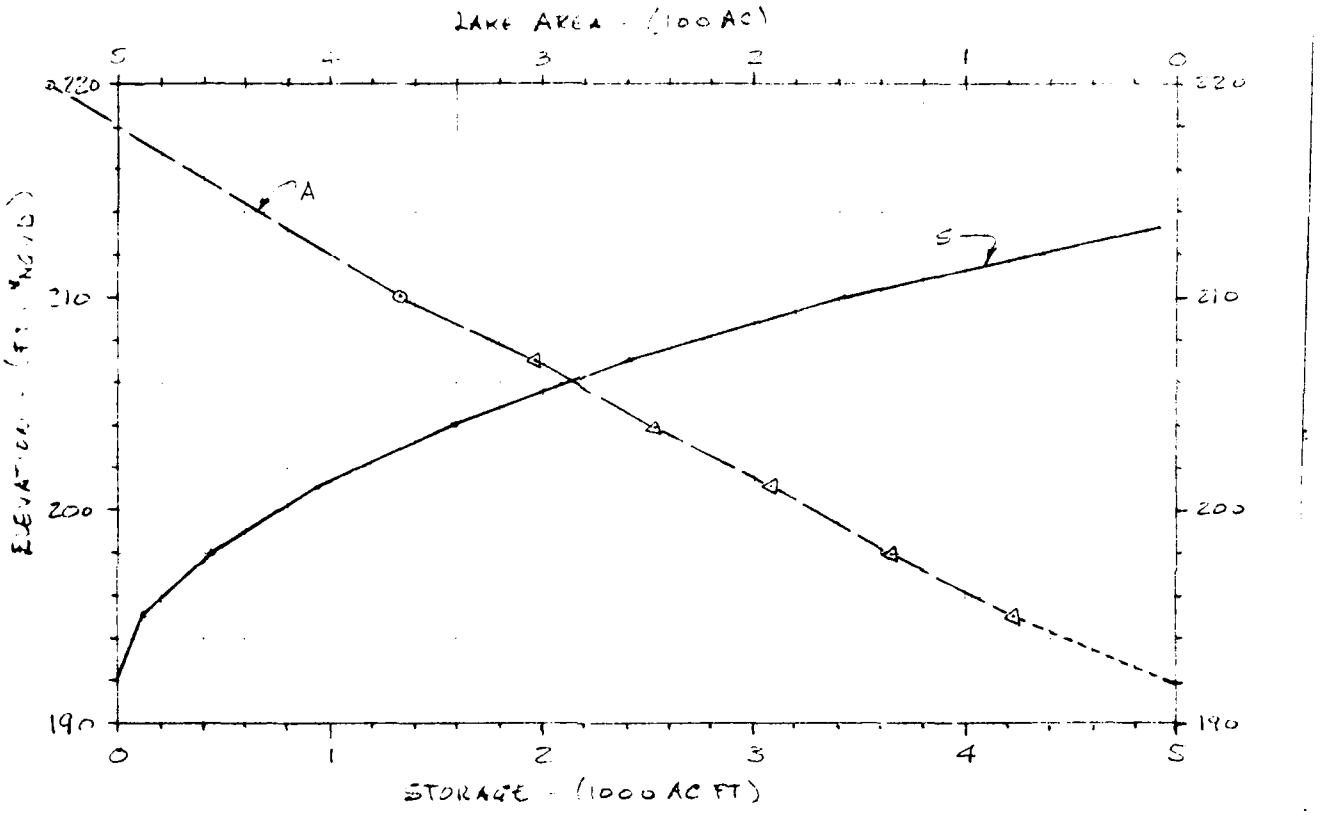
1) FOR HYPOTHETICAL SURCHARGES $H_a = 7'$ AND $H_b = 3'$:

$V_a = 3760^{AC\text{-}FT}$; $S_a = 2.69"$; $(Q_{P_3})_a \doteq 13500^{cfs}$ $\qquad Q_{P_2} = Q_{P_1}\left(1 - \frac{S}{M}\right)$

$V_b = 1950^{AC\text{-}FT}$, $S_b = 1.40"$; $(Q_{P_3})_b \doteq 11500^{cfs}$

2) INTERSECT OF LINE $(Q_{P_2})_a$ W/RATING CURVE (P. D-4) DETERMINES Q_{P_3} AND H_3

(c) LAKE AREA / STORAGE CURVE - STILLWATER RESERVOIR DAM.



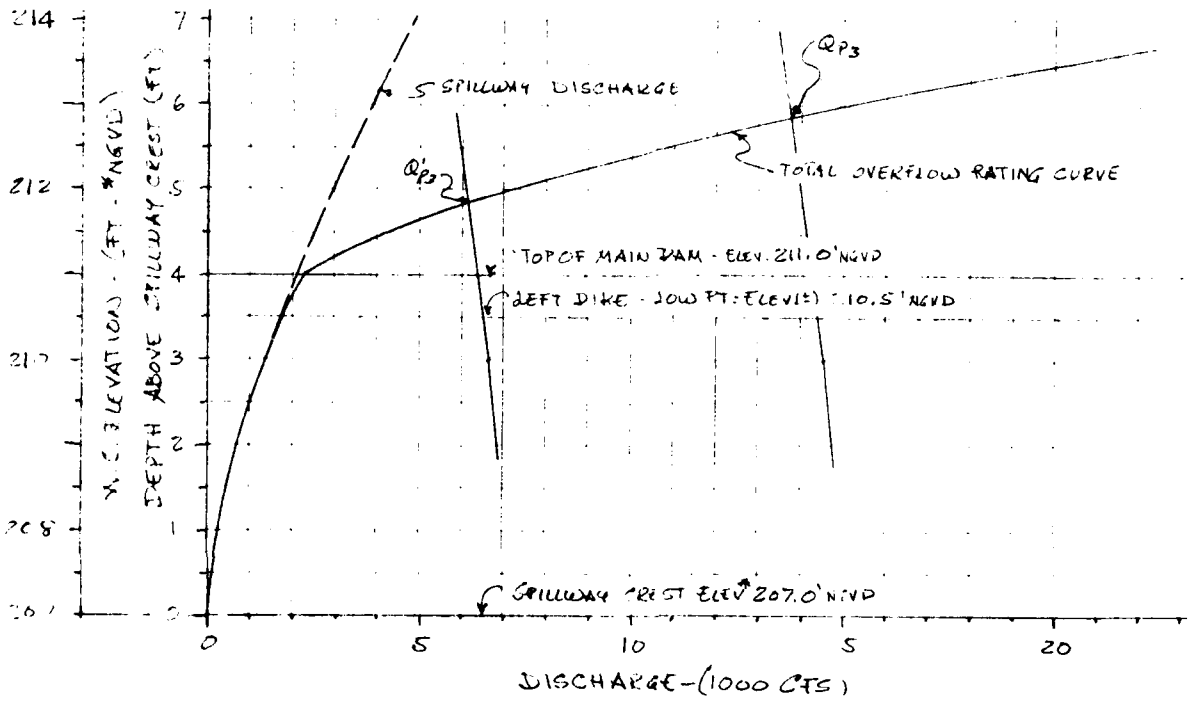
Δ - AREAS MEASURED ON THE R.I. DEPARTMENT OF ENVIRONMENTAL MANAGEMENT "WOONASQUATUCKET RESERVOIR" (DAM #108 - STILLWATER RES.) BATHYMETRIC MAP, SCALE 1"=888' ASSUMING AREA AT FLOW LINE ELEV. 207 EQUAL TO $A_{207} = 304^{AC}$ (AT CONTOUR "0" ON MAP).

S - AREAS MEASURED ON USGS GEORGIAVILLE, R.I. QUADRANGLE SHEET (REV. 1970/75)

* SEE NOTE p. D-2

(d) ASSUME NORMAL POOL AT ELEV. 203.5 NGVD OR, 3.5' BELOW SPILLWAY CREST AS RECORDED BY THE R.I. DEPARTMENT OF ENVIRONMENTAL MANAGEMENT DURING THE INSPECTIONS OF AUGUST 1978 AND 1979. THE LAKE WAS ±5.1' BELOW THE SPILLWAY CREST OBSERVED BY C.E ON 10/9/80 & 12. THEREFORE, 1.6' BELOW NORMAL POOL. (THE POOL IS KEPT LOW BECAUSE OF THE POOR CONDITION OF THE SPILLWAY)

(iii). TILLOTSON RESERVOIR DAM - OUTFLOW RATING CURVE



*See NOTE p. D-2

b). DISCHARGE DEPTHS TO PASS PEAK INFLOWS (Q_{P_1} & Q'_{P_1})

1) @ $Q_{P_1} = PMF = 15700$ CFS $\quad d_1 = 6.1'$

2) @ $Q'_{P_1} = \frac{1}{2} PMF = 7850$ CFS $\quad d'_1 = 5.1'$

c). EFFECT OF DISCHARGE VOLUME - PEAK OUTFLOWS

1) MAINSTEM D.A. = 26.2 SQ MI (SEE p. D-1)

3') SECTIONS CD AND EF (MAIN DAM):

$$Q_{CD,EF} = 2.7 \times 558 (H-4)^{3/2} \approx \underline{1510 (H-4)^{3/2}}$$

4') SPILLWAY (SECTION GH):

$$Q_{GH} = 2.7 \times 100 H^{3/2} = \underline{270 H^{3/2}}$$

5') SECTIONS JJ, KL & MN

$$Q^*_{JJ,KL,MN} = 0.4 (13+50+4) \times 2 (H-4)^{5/2} = \underline{53.6 (H-4)^{5/2}}$$

6') SECTION LM (RIGHT DIKE & ROAD):

$$Q_{LM} = 2 \times 634 (H-4)^{3/2} \approx \underline{1270 (H-4)^{3/2}}$$

THE TOTAL OVERFLOW IS APPROXIMATED BY THE SUM OF ALL THE APPLICABLE FORMULAE ON ITEMS (1') THRU (6'):

$$Q = 270 H^{3/2} + 2780 (H-4)^{3/2} - 685.4 (H-4)^{5/2} + 755.8 (H-3.-)^{5/2}$$

THE CORRESPONDING OVERFLOW RATING CURVE IS PLOTTED ON P. D-4 AND INCLUDES THE FLOW THROUGH THE BOTTOM GATED OUTLET.

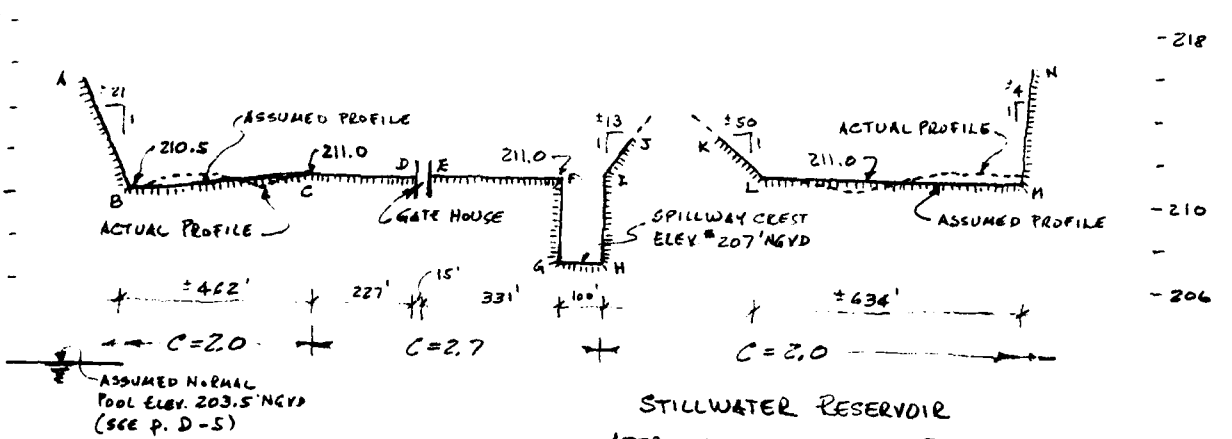
*NOTE: FLOW OVER SLOPED SECTIONS: BY APPLICATION OF FORMULA GIVEN BY THE USGS ON "MEASUREMENT OF PEAK DISCHARGE AT DAMS BY INDIRECT METHODS" BY H. HULSING (APPLICATIONS OF HYDRAULICS):

$$Q = \frac{2Cb}{5(h_a - h_b)} \left[h_b^{5/2} - h_a^{5/2} \right]$$

WHERE: Q = DISCH.; C = DISCH. COEFFICIENT; b = LENGTH; h_a & h_b = STATIC HEAD REFERED TO HIGH AND LOW ENDS OF WEIR, RESPECTIVELY.

WL IS KEPT LOW) - ASSUMED NORMAL POOL ELEV. 203.5' NGVD (SEE p. D-5)

ASSUME C=2.7 FOR THE SPILLWAY AND DAM OVERFLOW AND C=2.0 FOR THE DIKES AND ADJACENT TERRAIN OVERFLOW.



STILLWATER RESERVOIR
APPROXIMATE OVERFLOW PROFILE

NOTE. DATA FROM C.E. OBSERVATIONS ON 10/9/80 BY HLH & F.S.

(c) THEREFORE, THE OVERFLOW RATING CURVE FOR DISCHARGES (H) ABOVE THE SPILLWAY CREST CAN BE APPROXIMATED AS FOLLOWS:

1') SECTION AB: $Q_{AB}^{**} = 0.4 \times 21 \times 2 (H-3.5)^{3/2} = 16.8 (H-3.5)^{3/2}$

**SEE NOTE p. D-3

2') SECTION BC (LEFT DIKE)

$(Q_{BC})_1 = 0.4 \times 462/0.5 \times 2 (1'-3.5)^{3/2} = 739 (H-3.5)^{3/2}$ $H \leq 4'$

$(Q_{BC})_2 = 739 [(H-3.5)^{3/2} - (H-4)^{3/2}]$ $H > 4'$

*NOTE. WS ELEVATION 207' MSL ON THE U.S.G.S. GEORGIAVILLE, R.I. QUADRANGLE SHEET (REV. 1970) IS ASSUMED TO BE THE SPILLWAY CREST ELEVATION ON NATIONAL GEODETIC VERTICAL DATUM (NGVD)

HYDROLOGIC/HYDRAULIC INSPECTION

STILLWATER RESERVOIR DAM, SMITHFIELD, R.I.

1) PERFORMANCE AT PEAK FLOOD CONDITION:

1) PROBABLE MAXIMUM FLOOD (PMF)

a) WATERSHED CLASSIFIED AS "FLAT AND COASTAL", TYPICALLY CONTAINING LARGE SWAMPS AND IMPOUNDMENTS (WATERMAN AND SLACK RESERVOIRS).

b) WATERSHED AREA: D.A. = 26.2 Sq.mi

NOTE: D.A. FROM R.I. DEPARTMENT OF PUBLIC WORKS, DIVISION OF HARBORS AND RIVERS "SURVEY OF DAMS IN RHODE ISLAND" DATED FEB. 1948. PREVIOUS REPORT, AUG. 1940, GIVES D.A. = 25.52 Sq.Mi. (USE LATER FIGURE).

c) PEAK FLOODS (FROM NED-ACE GUIDELINES - GUIDE CURVES FOR PMF):

i) FROM GUIDE CURVES: $Q_{PMF} = 600$ CFS/Sq.mi.

ii) PMF = $26.2 \times 600 = \underline{15703}$ CFS

iii) ½ PMF = 7850 CFS

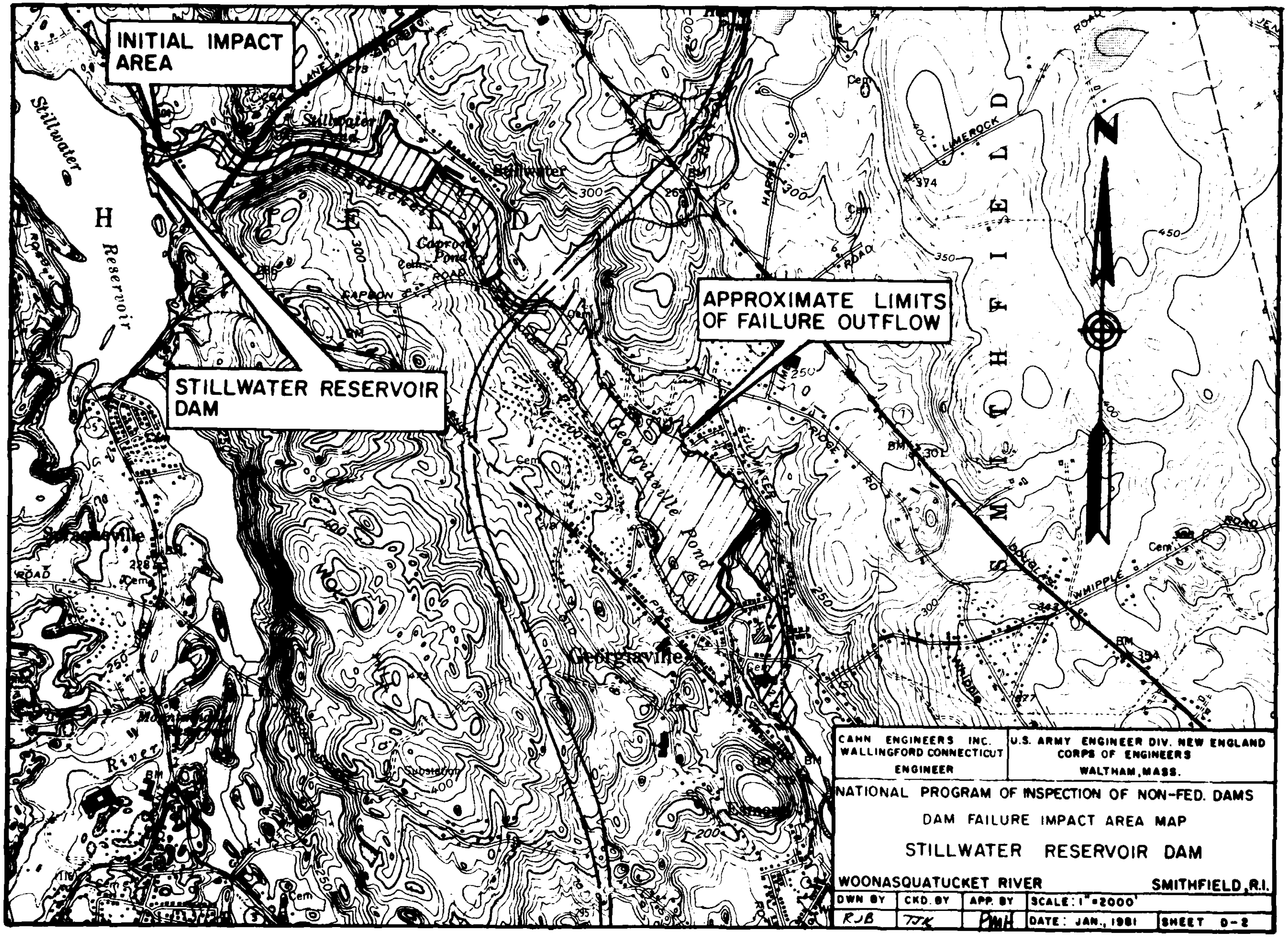
2) SURCHARGE AT PEAK INFLOWS (PMF AND ½ PMF)

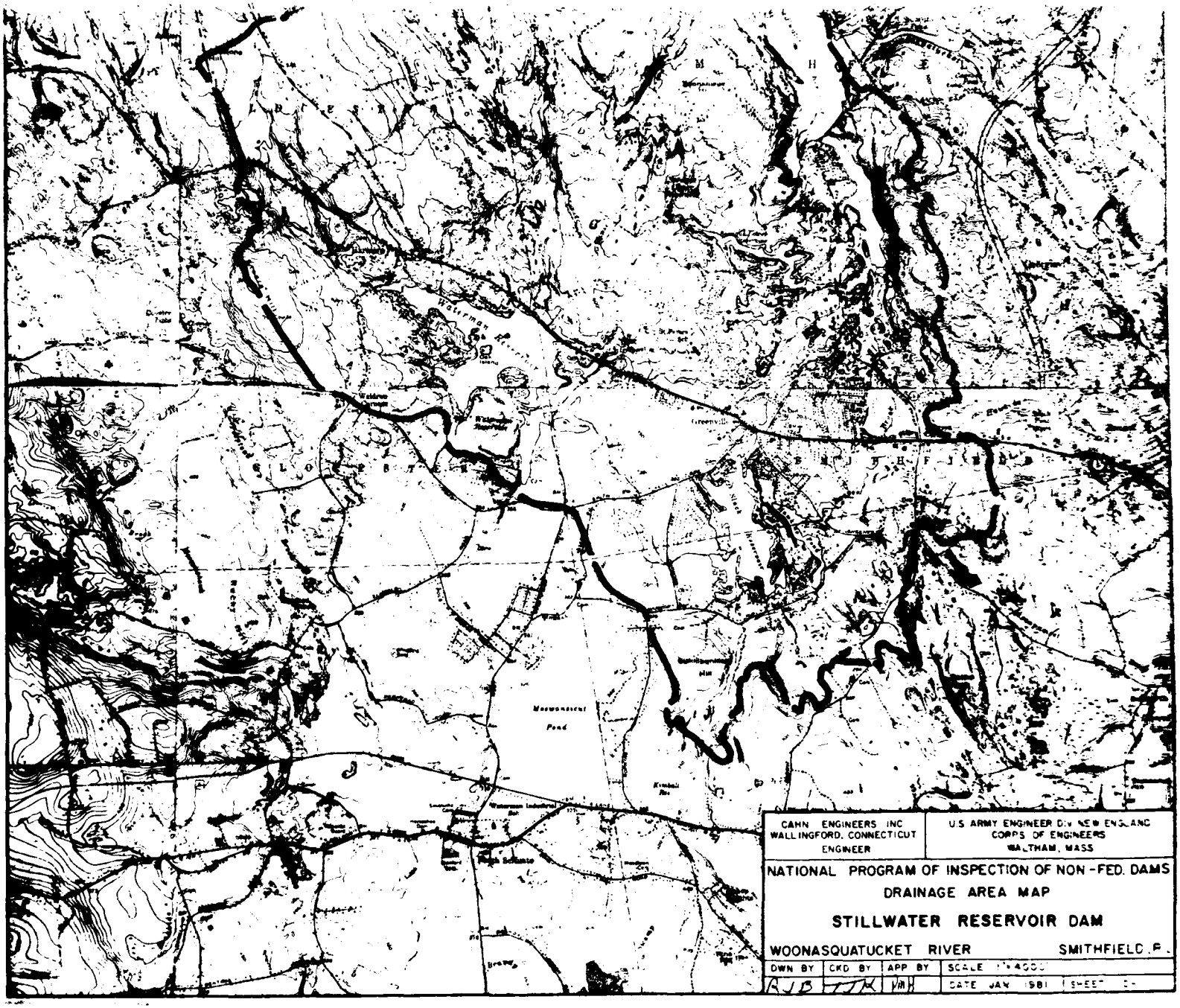
a) OUTFLOW RATING CURVE

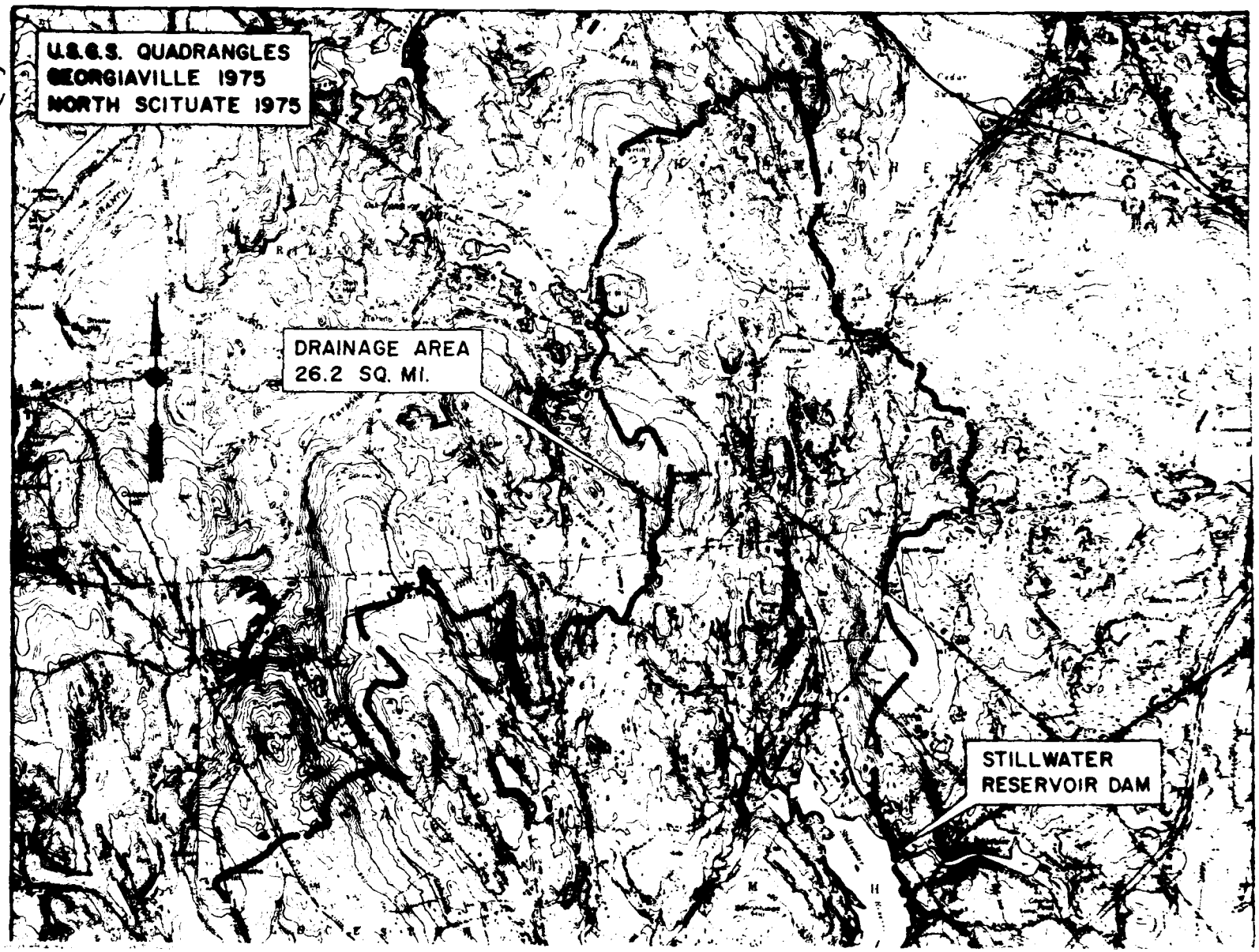
i) SPILLWAY AND OVERFLOW PROFILE OF DAM:

SPILLWAY 100' LONG IN VERY POOR CONDITION (IRON DECK, ROTTED AND LOOSE AND BRUSH GROWTH) AND ⅔ OF THE (±)3' WIDE SPILLWAY CREST) AT ELEV.* 207' NGVD. DAM (CONCRETE AND EARTH) AND DIKES (EARTH-WOODED) EXTEND THE OVERFLOW PROFILE (SEE P. D-2). BECAUSE OF THE SPILLWAY CONDITION, THE RESERVOIR

*FROM U.S.G.S. GEORGIAVILLE, R.I. QUAD SHEET (SEE NOTE P. D-2)


INITIAL IMPACT AREA
STILLWATER RESERVOIR DAM
APPROXIMATE LIMITS OF FAILURE OUTFLOW
Stillwater Reservoir
Georgiaville Pond
Georgiaville
SMITHFIELD
N
CAHN ENGINEERS INC. WALLINGFORD CONNECTICUT ENGINEER
U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
DAM FAILURE IMPACT AREA MAP
STILLWATER RESERVOIR DAM
WOONASQUATUCKET RIVER
SMITHFIELD, R.I.
DWN BY RJB
CKD. BY TJK
APP. BY PMH
SCALE: 1" = 2000'
DATE: JAN., 1981
SHEET D-2


CAHN ENGINEERS INC
WALLINGFORD, CONNECTICUT
ENGINEER
U.S ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
DRAINAGE AREA MAP
STILLWATER RESERVOIR DAM
WOONASQUATUCKET RIVER
SMITHFIELD, R.
DWN BY
CKD BY
APP BY
SCALE
DATE JAN 1981
SHEET


U.S.G.S. QUADRANGLES
GEORGIAVILLE 1975
NORTH SCITUATE 1975
DRAINAGE AREA
26.2 SQ. MI.
STILLWATER
RESERVOIR DAM

APPENDIX D

HYDRAULICS/HYDROLOGIC COMPUTATIONS

Photo 11 - Low level outlet structure. Note deterioration of concrete, (11/20/80).

Photo 12 - Low level outlet structure. Note deterioration of concrete. Note erosion of downstream slope in upper right, (11/20/80).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	Stillwater Reservoir Dam Woonasquatucket River Smithfield, R.I.
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED. DAMS	CE# 27 785 KG DATE Jan. 1981 PAGE C-6

Photo 9 - Upstream slope of right dike, (11/20/80).

Photo 10 - Downstream slope of right dike. Note standing water at toe of slope, (10/9/80).

Photo 7 - Masonry spillway and right training wall, (10/9/80).

Photo 8 - Eroded section of upstream slope of left dike, (11/20/80).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF	Stillwater Reservoir Dam Woonasquatucket River Smithfield, R.I.
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED. DAMS	CE # 27 785 KG DATE Jan. 1981 PAGE C-4

e) SPILLWAY DISCHARGE AT TIME OF FAILURE. $Q_s = 1800^{CFS}$ (Sup. D-6)

f) BREACH OUTFLOW (SEE NED-ACE GUIDELINES):

$$Q_b = \frac{8}{27} W_b \sqrt{g} y_o^{5/2} = 24600^{CFS}$$

g) PEAK FAILURE OUTFLOW (Q_{p_1}) TO WOONASQUATUCKET RIVER:

$$Q_{p_1} = Q_s + Q_b = \underline{26400^{CFS}}$$

3) FLOOD DEPTH* IMMEDIATELY D/S FROM DAM:

$$y = 0.44 y_o = \underline{8.6'}$$

*(FROM RETREATING WAVE THEORY APPLIED TO DAM FAILURE)

4) ESTIMATE OF D/S FAILURE CONDITIONS AT POTENTIAL IMPACT AREAS

(SEE NED-ACE GUIDELINES FOR ESTIMATING D/S FAILURE HYDROGRAPHS)

a) THE W.L. IN THE (±) 13000' LONG REACH FROM STILLWATER RESERVOIR TO GEORGIAVILLE POND IS CONTROLLED BY THE FOLLOWING DAMS.

c) STILLWATER POND DAM WITH AN OVERFLOW PROFILE FORMED BY A (±) 120' LONG SPILLWAY, THE TOP AND ABUTTING TERRAIN OF THE DAM, (±) 680' LONG AND (±) 3.8' ABOVE THE SPILLWAY CREST, AND CLOSED AT BOTH ENDS BY (±) 50% TO 1% SLOPING TERRAIN. THE AVERAGE SURCHARGE POND AREA IS (±) $\bar{A}_{SP} = 28^{AC}$. (DATA FROM CE. FIELD SURVEY)

ASSUMING $C = 2.8$, THE OVERFLOW CAN BE APPROXIMATED BY:

$$Q_{SP} = 336 H^{3/2} + 1900(H-3.8)^{3/2} + 112(H-3.8)^{5/2}$$

d) CAPRON POND DAM WITH AN OVERFLOW PROFILE FORMED BY A (±) 90' LONG SPILLWAY, THE TOP AND ABUTTING TERRAIN OF THE DAM, (±) 260' LONG AND (±) 4' ABOVE THE SPILLWAY CREST AND CLOSED

AT BOTH ENDS BY (±) 9H:1V SLOPING TERRAIN. THE AVERAGE UP-CHARGE POND AREA IS $\bar{A}_{cp} = 15$ AC. (DATA FROM CE. FIELD SURVEY)

∴ ASSUMING $C_c = 2.8$, THE OVERFLOW CAN BE APPROXIMATED BY:

$$Q_{cp} \doteq 252 H^{3/2} + 728 (H-4)^{3/2} + 20.2 (H-4)^{5/2}$$

(ii) GEORGIAVILLE POND DAM. DATA ON THIS DAM IS PUBLISHED IN THE ACE PHASE I INSPECTION REPORT "GEORGIAVILLE DAM" #NJ 03108, DATED APRIL 1979.

b) THE CHANNEL D/S FROM GEORGIAVILLE POND IS APPROXIMATELY TRAPEZOIDAL IN CROSS SECTION WITH (±) 200' BASE AND (±) 6H AND 17H TO 1V SIDE SLOPES. THE AVERAGE REACH SLOPE IS (±) 0.2% ASSUME $n = 0.050$.

c) RESERVOIR STORAGE AT TIME OF FAILURE:

$S \doteq 3650$ AC FT (TO FIRST PT. OF OVERTOPPING) - (SEE P. D-5)

d) APPROXIMATE STAGE AT POTENTIAL IMPACT AREAS

(i) 1ST REACH. U/S FROM SILVERWATER POND DAM:

BY APPROXIMATE ROUTING (SEE NED-ACE GUIDELINES) THE PEAK FAILURE OUTFLOW IS:

$$(Q_p)_1 \doteq Q_{P_1} \left(1 - \frac{V_3}{S}\right) \doteq \underline{\underline{24800}} \text{ CFS} \quad ; \quad (H_3)_1 \doteq 7.7' \text{ (AT SILVERWATER POND)}$$

(ii) 2ND REACH. U/S FROM CARRON POND DAM

BY APPROXIMATE ROUTING.

$$(Q_p)_2 \doteq \underline{\underline{23800}} \text{ CFS} \quad ; \quad (H_3)_2 \doteq 10.7' \text{ (AT CARRON POND)}$$

(c) 3rd REACH. U/S FROM GEORGIAVILLE POND DAM:

FROM THE SPILLWAY RATING CURVE (APPENDIX D-9) AND THE STORAGE DATA (OR $\bar{A}=130^{ac}$) (APP. D-5) OF THE ACE GEORGIAVILLE POND DAM PHASE I REPORT, BY APPROXIMATE ROUTING,

$(Q_{P_3})_3 \doteq \underline{17200}^{cfs}$; $(H_3)_2 \doteq 7.8'$ (AT GEORGIAVILLE POND)

(d) 4TH REACH. CHANNEL D/S FROM GEORGIAVILLE POND DAM.

$(Q_{P_1})_4 = 17200^{cfs}$; $^{*}Y_1 \doteq 10.4'$; $V_1 \doteq 115^{ACFT} < \frac{S}{2}$ (ON REACH OF (L) 1500'; $^{*}n=0.050$)

$Q_{P_2} \doteq 16700^{cfs}$; $Y_2 = 10.3'$; $V_2 \doteq 112^{ACFT}$; $\bar{V} = 114^{ACFT}$; $(Q_{P_3})_4 \doteq 16700^{cfs}$

$\therefore (Q_{P_3})_1 \doteq \underline{16700}^{cfs}$; $Y_3 \doteq \underline{10.3'}$

d) APPROXIMATE STAGE BEFORE FAILURE:

i) 1ST REACH: $(H_S)_1 \doteq 3.1'$ ($Q_S = 1800^{cfs}$ SEE P.P. D-6 & D-8)

ii) 2ND REACH: $(H_S)_2 \doteq 3.7'$

iii) 3RD REACH: $(H_S)_3 \doteq 3.1'$

iv) 4TH REACH $Y_S \doteq 3.0'$

NOTE: THE DAMS ARE NOT OVERTOPPED AT $Q_S = 1800^{cfs}$

e) RAISE IN STAGE D/S FROM STILLWATER RESERVOIR DAM:

i) 1ST REACH: $(\Delta H)_1 \doteq 4.6'$ (D/S FROM STILLWATER POND DAM)

ii) 2ND REACH: $(\Delta H)_2 \doteq 7.0'$ (D/S FROM CAPRON POND DAM)

iii) 3RD REACH: $(\Delta H)_3 \doteq 4.7'$ (D/S FROM GEORGIAVILLE POND DAM)

iv) 4TH REACH: $\Delta Y_3 \doteq 7.3'$ (@ 1500' D/S FROM GEORGIAVILLE POND DAM)

STILLWATER RESERVOIR DAM

III) SELECTION OF TEST FLOOD

1) CLASSIFICATION OF DAM ACCORDING TO NED-ACE GUIDELINES

2) SIZE: *STORAGE (MAX) = 3870 ACFT (1000 < S < 50000 AC-FT)
*HEIGHT (MAX) = 20' (H < 25 FT)

*STORAGE: SEE P. D-5 ; HEIGHT: SEE P. D-7

∴ SIZE CLASSIFICATION: INTERMEDIATE

6) HAZARD POTENTIAL: AS A RESULT OF THE D/S FAILURE ANALYSIS AND IN VIEW OF THE IMPACT THAT FAILURE OF STILLWATER RESERVOIR DAM MAY HAVE ON THE POTENTIAL IMPACT AREAS (P. D-7), THE DAM IS CLASSIFIED AS HAVING:

HAZARD CLASSIFICATION: HIGH

2) TEST FLOOD: PMF = 15700 CFS

THIS SELECTION IS BASED ON THE RESULTS OF THE PREVIOUS ANALYSIS AND CLASSIFICATION.

STILLWATER RESERVOIR DAM

IV) SUMMARY

1) TEST FLOOD = PMF ≈ 15700 CFS
(PARALLEL COMPUTATIONS HAVE BEEN MADE FOR ½ PMF ≈ 7850 CFS AND ARE ALSO SUMMARIZED BELOW)

2) PERFORMANCE AT PEAK FLOOD CONDITIONS:

a) PEAK INFLOWS: Q_{P_1} = PMF ≈ 15700 CFS Q'_{P_1} = ½ PMF ≈ 7850 CFS
b) PEAK OUTFLOWS: Q_{P_2} ≈ 13800 CFS Q'_{P_2} ≈ 6200 CFS
c) SPILLWAY CAPACITY: (SEE TABLE P. D-6)
d) PERFORMANCE:
i) AT TEST FLOOD: OVERTOPPED (±)2.3' (W.S. ELEV. 212.8' NGVD)
ii) AT ½ PMF: OVERTOPPED (±)1.3' (W.S. ELEV. 211.8' NGVD)

3) DOWNSTREAM FAILURE CONDITIONS:

a) PEAK FAILURE OUTFLOW Q_{P_1} ≈ 26400 CFS
b) FLOOD DEPTH IMMEDIATELY D/S FROM DAM: Y_0 ≈ 8.6'
c) CONDITIONS D/S FROM GEORGIAVILLE POND DAM:
i) STAGE BEFORE FAILURE H_S ≈ 5.1' ABOVE NORMAL POOL (Q_S ≈ 1800 CFS)
ii) STAGE AFTER FAILURE H_3 ≈ 7.8' ABOVE NORMAL POOL (Q_{P_3} ≈ 17200 CFS)
iii) RAISE IN STAGE AFTER FAILURE: ΔH ≈ 4.7'
d) CONDITIONS D/S FROM GEORGIAVILLE POND DAM.
i) STAGE BEFORE FAILURE Y_S ≈ 3.0' (Q_S ≈ 1800 CFS)
ii) STAGE AFTER FAILURE Y_3 ≈ 10.3' (Q_{P_3} ≈ 16700 CFS)
iii) RAISE IN STAGE AFTER FAILURE: ΔY ≈ 7.3'

NOTE: ALSO, UPON FAILURE OF STILLWATER RES. DAM, STILLWATER POND DAM WILL BE OVERTOPPED (±)3.9'; CAPRON POND DAM, (±)6.7'; AND, GEORGIAVILLE POND DAM, (±)2.8'.

PRELIMINARY GUIDANCE
FOR ESTIMATING
MAXIMUM PROBABLE DISCHARGES
IN
PHASE I DAM SAFETY
INVESTIGATIONS

New England Division
Corps of Engineers

March 1978

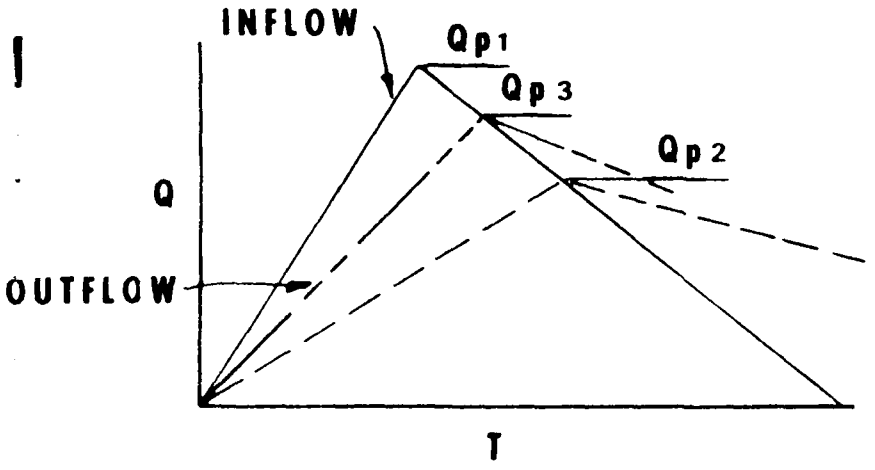
MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

	Project	Q (cfs)	D.A. (sq. mi.)	MPF cfs/sq. mi.
1.	Hall Meadow Brook	26,600	17.2	1,546
2.	East Branch	15,500	9.25	1,675
3.	Thomaston	158,000	97.2	1,625
4.	Northfield Brook	9,000	5.7	1,580
5.	Black Rock	35,000	20.4	1,715
6.	Hancock Brook	20,700	12.0	1,725
7.	Hop Brook	26,400	16.4	1,610
8.	Tully	47,000	50.0	940
9.	Barre Falls	61,000	55.0	1,109
10.	Conant Brook	11,900	7.8	1,525
11.	Knightville	160,000	162.0	987
12.	Littleville	98,000	52.3	1,870
13.	Colebrook River	165,000	118.0	1,400
14.	Mad River	30,000	18.2	1,650
15.	Sucker Brook	6,500	3.43	1,895
16.	Union Village	110,000	126.0	873
17.	North Hartland	199,000	220.0	904
18.	North Springfield	157,000	158.0	994
19.	Ball Mountain	190,000	172.0	1,105
20.	Townshend	228,000	106.0(278 total)	820
21.	Surry Mountain	63,000	100.0	630
22.	Otter Brook	45,000	47.0	957
23.	Birch Hill	88,500	175.0	505
24.	East Brimfield	73,900	67.5	1,095
25.	Westville	38,400	99.5(32 net)	1,200
26.	West Thompson	85,000	173.5(74 net)	1,150
27.	Hodges Village	35,600	31.1	1,145
28.	Buffumville	36,500	26.5	1,377
29.	Mansfield Hollow	125,000	159.0	786
30.	West Hill	26,000	28.0	928
31.	Franklin Falls	210,000	1000.0	210
32.	Blackwater	66,500	128.0	520
33.	Hopkinton	135,000	426.0	316
34.	Everett	68,000	64.0	1,062
35.	MacDowell	36,300	44.0	825

MAXIMUM PROBABLE FLOWS BASED ON TWICE THE STANDARD PROJECT FLOOD (Flat and Coastal Areas)

River	SPF (cfs)	D.A. (sq. mi.)	MPF (cfs/sq. mi.)
1. Pawtuxet River	19,000	200	190
2. Mill River (R.I.)	8,500	34	500
3. Peters River (R.I.)	3,200	13	490
4. Kettle Brook	8,000	30	530
5. Sudbury River.	11,700	86	270
6. Indian Brook (Hopk.)	1,000	5.9	340
7. Charles River.	6,000	184	65
8. Blackstone River.	43,000	416	200
9. Quinebaug River	55,000	331	330

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



STEP 1: Determine Peak Inflow (Qp_1) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Qp_1".

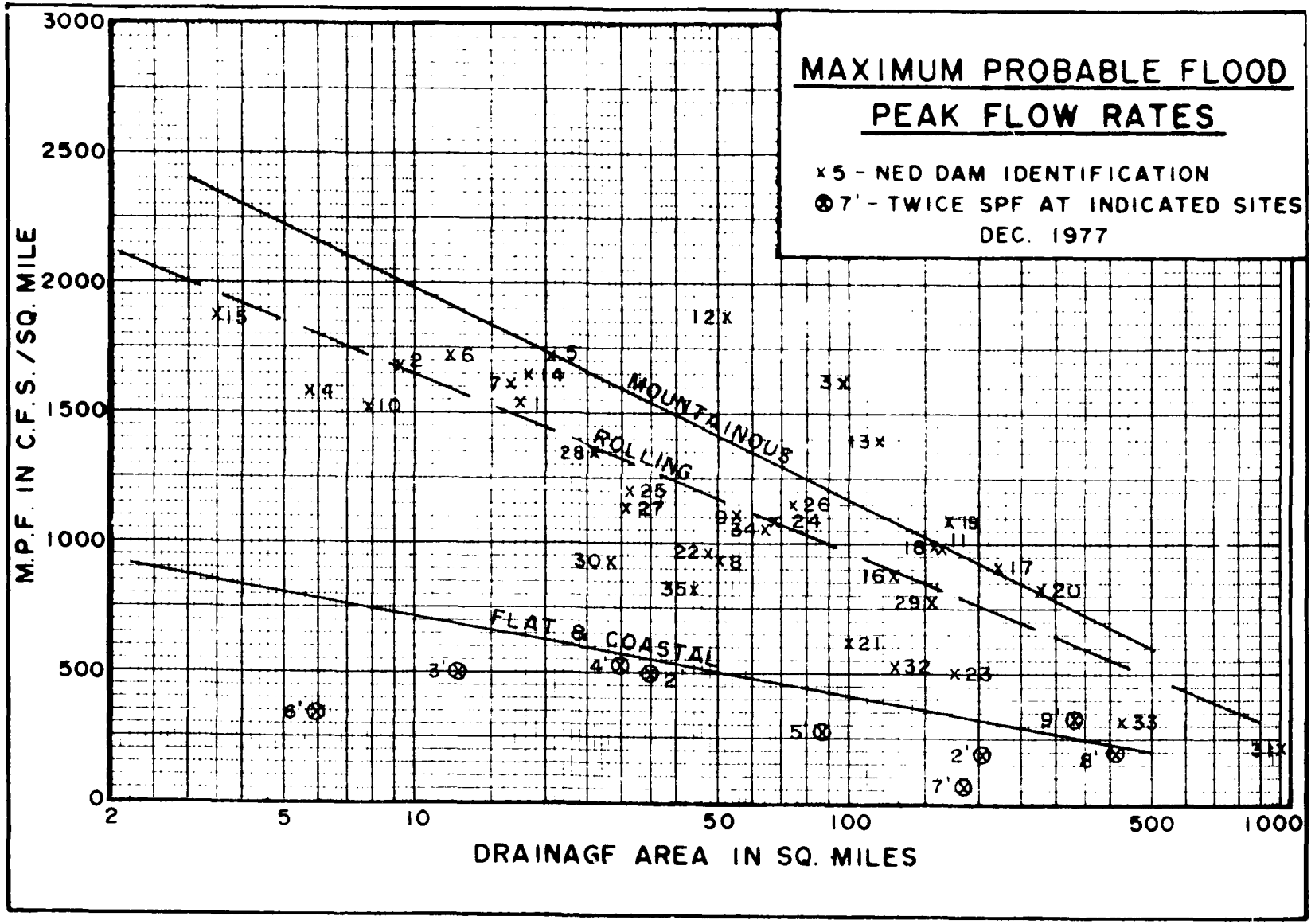
b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefore:

$$Qp_2 = Qp_1 \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Qp_3".


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
3000
2500
2000
1500
1000
500
0
2
5
10
50
100
500
1000
MOUNTAINOUS
ROLLING
FLAT & COASTAL

SURCHARGE STORAGE ROUTING SUPPLEMENT

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Avg "$STOR_1$" and "$STOR_2$" and Compute "Qp_3".

c. If Surcharge Height for Qp_3 and "$STOR_{AVG}$" agree O.K. If Not:

STEP 4: a. Determine Surcharge Height and "$STOR_3$" To Pass "Qp_3"

b. Avg. "Old $STOR_{AVG}$" and "$STOR_3$" and Compute "Qp_4"

c. Surcharge Height for Qp_4 and "New $STOR_{Avg}$" should Agree closely

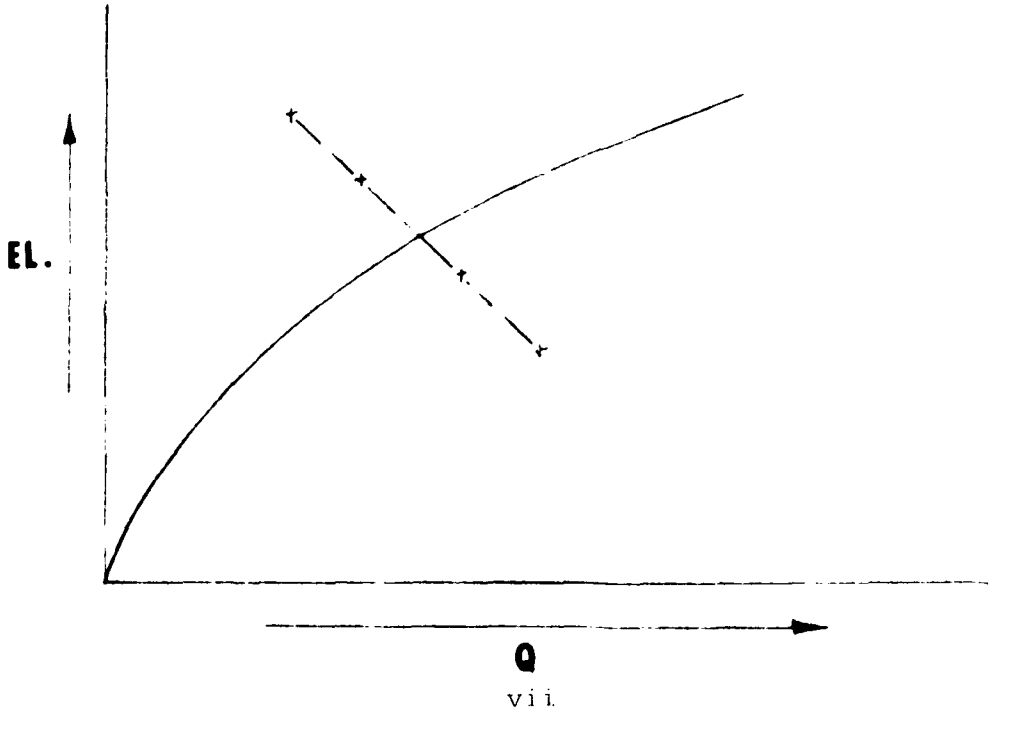
SURCHARGE STORAGE ROUTING ALTERNATE

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

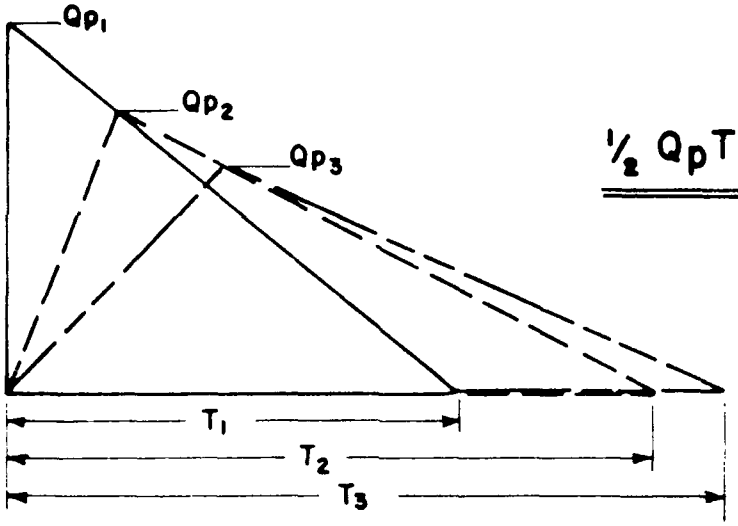
$$Q_{p2} = Q_{p1} - Q_{p1}\left(\frac{STOR}{19}\right)$$

FOR KNOWN Q_{p1} AND 19'' R.O.

Q_{p2}	STOR	EL.



"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12 S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Q_{p_1} = \frac{8}{27} W_b \sqrt{g} Y_o^{\frac{3}{2}}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOMPANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Q_{p_2}(\text{TRIAL}) = Q_{p_1}\left(1 - \frac{V_1}{S}\right)$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Q_{p_2} = Q_{p_1}\left(1 - \frac{V_{AVG}}{S}\right)$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

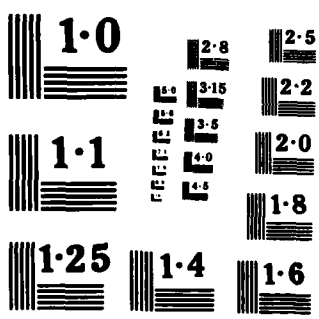
APRIL 1978

APPENDIX E

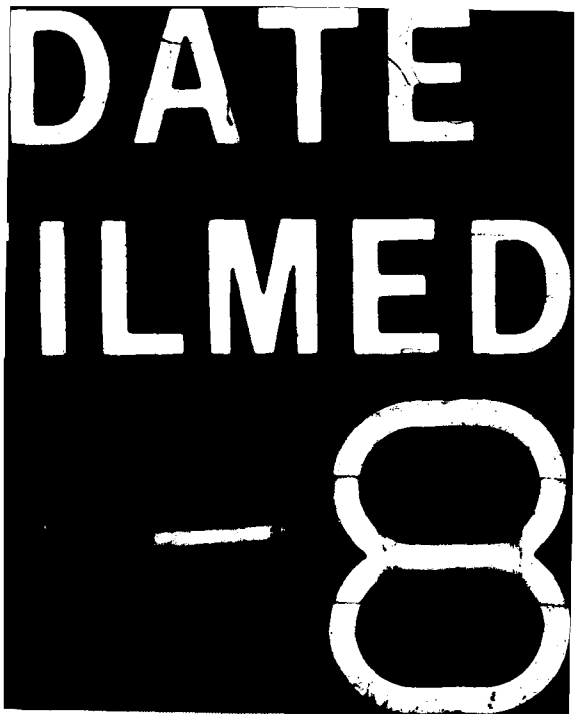
INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

AD A156 746 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS STILLWATER RESERVOIR..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV JAN 81 2/2

UNCLASSIFIED F/G 13/13 NL


1·0
1·1
1·25
2·8
3·15
3·5
4·0
4·5
1·4
2·5
2·2
2·0
1·8
1·6

NOT AVAILABLE AT THIS TIME


DATE
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-8