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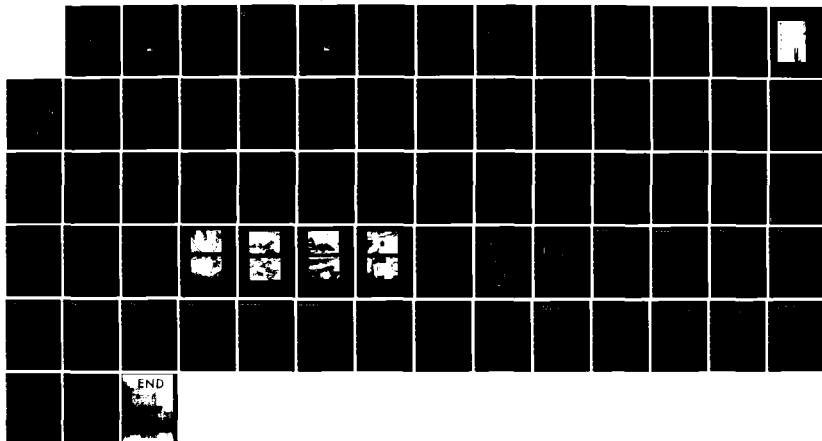
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VERSAILLES POND DAM (U) CORPS OF ENGINEERS WALTHAM
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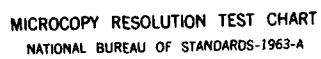
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THAMES RIVER BASIN
SPRAGUE, CONNECTICUT
VERSAILLES POND DAM
(CT 00472)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

AUGUST, 1980

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CT 00472	2. GOVT ACCESSION NO. AD A144581	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Versailles Pond Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE August 1980
		13. NUMBER OF PAGES 50
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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, Thames River Basin Sprague, Connecticut		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This project has a total length of approximately 400 feet, consisting of a 184 foot long broad-crested masonry spillway, a 190 foot long earth embankment, and a 27 foot long sluiceway. Based upon the visual inspection at the site and past performance, the project is judged to be in poor condition. It is classified as a significant hazard, intermediated size dam. The test flood range to be consid- ered is from one-half to full PMF.		



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

REPLY TO
ATTENTION OF:
NEDED

JAN 07 1981

Honorable William A. O'Neill
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor O'Neill:

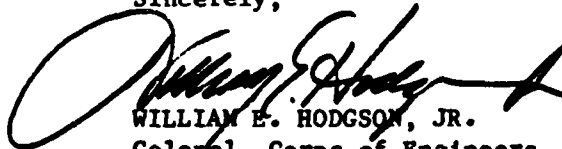
Inclosed is a copy of the Versailles Pond Dam (CT-00472) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, Federal Paper Board Co., Inc., Sprague, CT 06330.

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

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

Sincerely,



WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

Incl
As stated

THAMES RIVER BASIN
SPRAGUE, CONNECTICUT
VERSAILLES POND DAM
CT 00472

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

AUGUST, 1980

BRIEF ASSESSMENT

PHASE I INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	VERSAILLES POND DAM
Inventory Number:	CT 00472
State:	CONNECTICUT
County:	NEW LONDON
Town:	SPRAGUE
Stream:	LITTLE RIVER
Owner:	FEDERAL PAPER BOARD CO. INC.
Date of Inspection:	JUNE 2, 1980
Inspection Team:	PETER HEYNEN, P.E.
	HECTOR MORENO, P.E.
	THEODORE STEVENS
	ROBERT JAHN

This project, built around 1920, has a total length of approximately 400 feet, consisting of a 184 foot long broad-crested masonry spillway, a 190 foot long earth embankment, and a 27 foot long sluiceway (See Sheet B-1). The top of the embankment, at elevation 88.7, is approximately 20 feet wide, 8.7 feet above the spillway crest, and 23 feet above the streambed of the Little River. With the pond level to the top of the dam, the pond impounds approximately 1000 acre-feet of water. The sluiceway at the left end of the dam leads to abandoned factory buildings about 400 feet from the dam. The intake to the sluiceway is a wood bulkhead, which contains 5 gates.

Based upon the visual inspection at the site and past performance, the project is judged to be in poor condition. No evidence of instability of the project was observed. However, there are items which require maintenance, such as the dense vegetation on the embankment and the inoperable sluice gates.

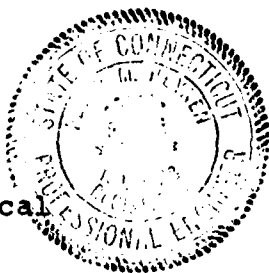
In accordance with Army Corps of Engineers' Guidelines, Versailles Pond Dam is classified as a significant hazard, intermediate size dam. The test flood range to be considered is from one-half to full Probable Maximum Flood (PMF). The test flood for Versailles Pond Dam is equivalent to the $\frac{1}{2}$ PMF. Peak inflow to the pond at the $\frac{1}{2}$ PMF is 12,000 cubic feet per second (cfs); peak outflow is 12,000 cfs with the dam maintaining 0.6 foot of freeboard. The spillway capacity with the pond level to the top of the dam is 13,000 cfs, which is equivalent to 108% of the routed test flood outflow.

It is recommended that the owner retain the services of a registered professional engineer to formulate recommendations concerning removal of trees from the embankment, restoration of the sluice gate facilities, and construction of a low-level outlet. Recommendations made by the engineer should be implemented by the owner.

The above recommendations and further remedial measures presented in Section 7 should be instituted within one year of the owner's receipt of this report.

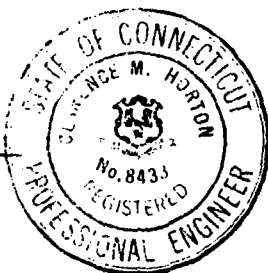
Peter M. Heynen

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



C. Michael Horton

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



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

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

Aram Mahtesian

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar
JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual 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 thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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.

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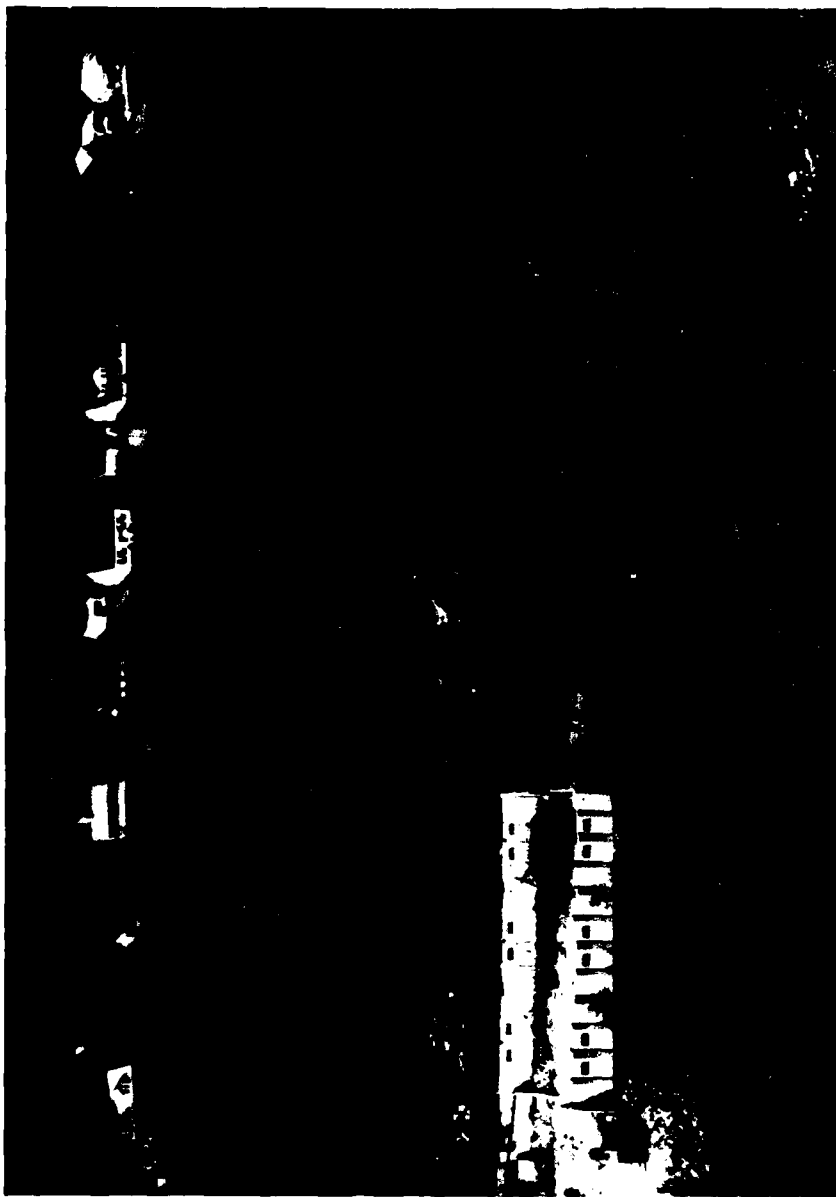
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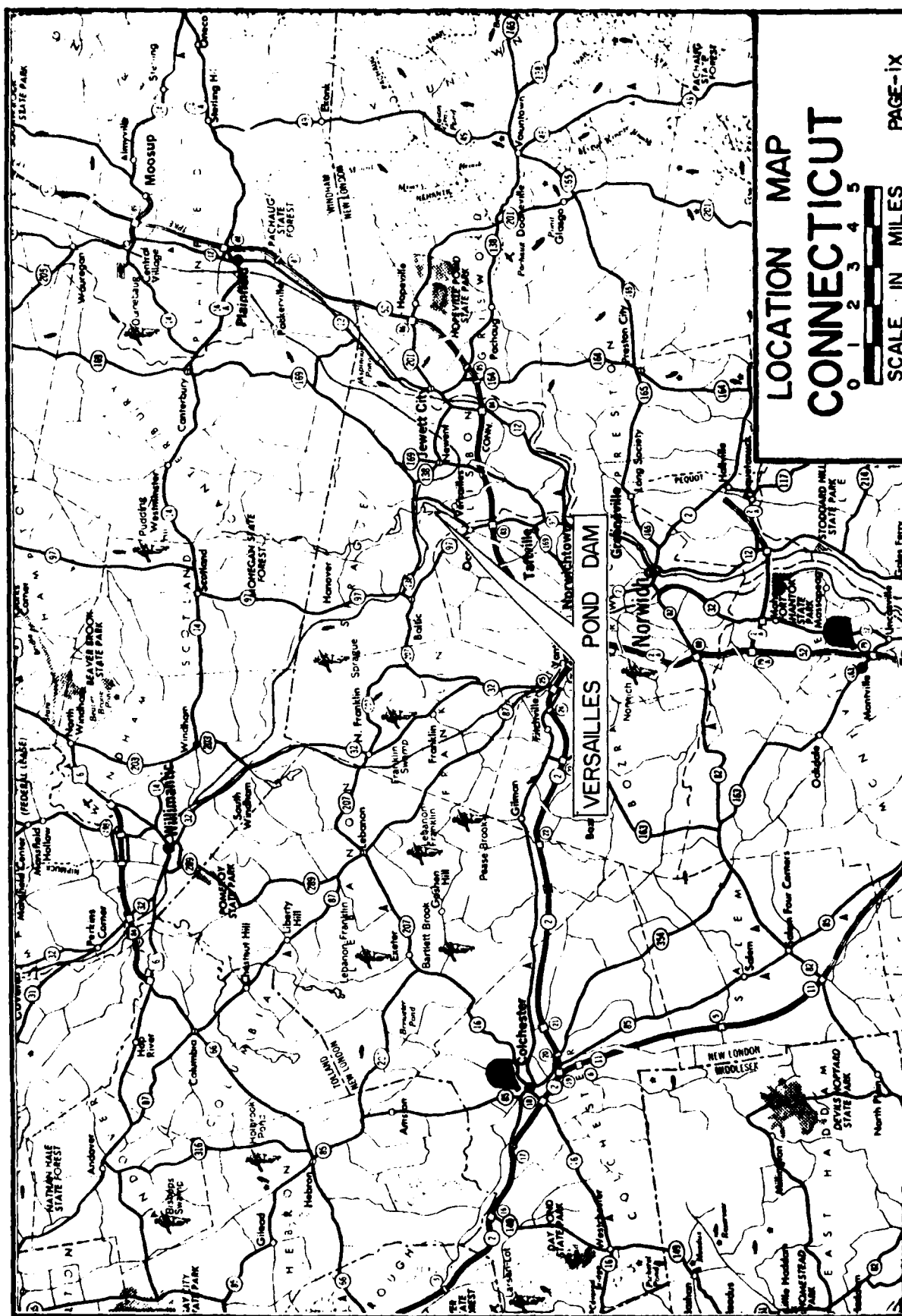
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OVERVIEW PHOTO
February, 1980

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	Versailles Pond Dam	Sprague	DATE July, '80 CE #27 785 KB PAGE viii
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER		Little River	CONNECTICUT	



PHASE I INSPECTION REPORT

VERSAILLES POND 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 Connecticut. 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 does not pass judgement on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 DESCRIPTION OF PROJECT

a. Location - The dam is located on the Little River in a rural area of the Town of Sprague, County of New London, State of Connecticut. The dam is shown on the Norwich USGS Quadrangle Map, having coordinates latitude N 41° 36.1' and longitude W 72° 02.7'.

b. Description of Dam and Appurtenances - As shown on Sheet B-1, the 23 foot tall dam is an earth embankment and masonry gravity structure. The dam is approximately 400 feet long, consisting of, from left to right, a 27 foot long sluiceway, a 184 foot long spillway and a 190 foot long embankment.

The spillway, with an assumed NGVD elevation of 80.0 (See Notes, Sheet B-1), is a broad-crested (6 feet wide) masonry weir of trapezoidal cross-section, with a sloping, sand bottom approach channel and a stepped downstream face. The left end of the spillway curves in a 90° arc and, for a length of 93 feet, has one foot high permanent stoplogs bolted to the crest. Stoplogs are also in place for a length of 14 feet at the right end of the spillway, leaving 77 feet of the straight part of the spillway without stoplogs. Spillway discharge is onto an area of dumped boulder riprap at the toe of the spillway, then to the natural cobble bottom streambed of the Little River. There is a masonry training wall at the right end of the spillway separating it from the embankment and a masonry abutment at the left end of the spillway separating it from the sluiceway.

The top of the embankment has a width of 20 feet, is 8.7 feet above the spillway crest, and has an approximately 8 foot tall chain link fence along its axis. The upstream and downstream slopes have approximate inclinations of 2 horizontal to 1 vertical, but the downstream slope flattens somewhat near the toe.

The sluiceway at the left end of the dam is 27 feet wide and bridged by a wooden bulkhead which houses 5 sluice gates. The bottom of the channel on the upstream side of the bulkhead is approximately 6 feet below the spillway crest and vertical masonry walls line the channel. An earth cofferdam had previously blocked the intake channel, but has now been breached and appears as an island.

c. Size Classification - (INTERMEDIATE) - The dam impounds approximately 1000 acre-feet of water with the reservoir level to the top of the dam, which is 23 feet above the streambed of the Little River. According to recommended guidelines, a dam with a maximum storage of 1000 acre-feet is classified as intermediate in size.

d. Hazard Classification - (SIGNIFICANT) - If the dam were breached, there is potential for loss of a few lives and substantial property damage to four houses on the left bank of the Little River approximately 1000 feet downstream of the dam (Sheet D-2 & Appendix D-7).

- e. Ownership - Federal Paper Board Co. Inc.
Sprague Ct. 06330
(203) 822-8201

The dam was originally built, owned and operated by the Bay Company - Division of Park Davis Company. The present owner acquired the property in the early 1960's.

- f. Operator - Mr. Robert Charette
Engineering Department
Federal Paper Board Co. Inc.
(203) 822-8201

g. Purpose of Dam - The dam was originally used to provide power to the Park Davis factory. Presently, the dam has no specific purpose, other than the retention of water rights on the Little River by Federal Paper Board.

h. Design and Construction History - There is no record of the original construction or changes to the dam until 1970 when a portion of the stoplogs on the spillway crest were removed and a cofferdam blocking the sluiceway intake was constructed. The cofferdam was subsequently breached in order to provide flow beneath the old factory to the factory tailrace channel, where sewage is entering the channel and must be diluted.

i. Normal Operational Procedures - There are no operational procedures followed at the dam, other than allowing flow to go through the broken bulkhead and sluice gates, beneath the factory to the factory tailrace channel.

1.3 PERTINENT DATA

a. Drainage Area - The drainage area is 43.6 square miles of mostly undeveloped, wooded, rolling terrain. Hampton Reservoir and Pine Acres Lake are located near the headwaters of the watershed. Hanover Reservoir and Paper Mill Pond are both located on the Little River less than 4 miles upstream of Versailles Pond Dam.

b. Discharge at Damsite - Discharge at the project is over the spillway and through the 5 sluice gate openings at the left end of the dam.

- | | |
|--|---|
| 1. Outlet Works -
five 4'x6' sluices: | 2000+ cfs (with U/S water
level at top of dam) |
| 2. Maximum known flood at
damsite: | 2800 cfs
(Sept. 21, 1938) |
| 3. Ungated spillway capacity
@ top of dam el. 88.7: | 13,000 cfs |

4. Ungated spillway capacity @ test flood el. 88.1:	12,000 cfs
5. Gated spillway capacity @ normal pool:	N/A
6. Gated spillway capacity @ test flood:	N/A
7. Total spillway capacity @ test flood el. 88.1:	12,000 cfs
8. Total project discharge @ top of dam el. 88.7:	15,000 cfs
9. Total project discharge @ test flood el. 88.1:	12,000 cfs

c. Elevations - Elevations are on National Geodetic Vertical Datum (NGVD) based on assumed spillway crest elevation of 80.0 taken from Norwich USGS Quadrangle Map, 1954.

1. Streambed at toe of dam:	65.7 ₊
2. Bottom of cutoff:	Not known
3. Maximum tailwater:	Not known
4. Normal pool:	80 5 ₊
5. Full flood control pool:	N/A
6. Spillway crest (ungated):	80.0 (assumed datum)
7. Design surcharge (original design):	Not known
8. Top of dam:	88.7 ₊
9. Test flood surcharge	88.1

d. Reservoir Length

1. Normal pool:	5000 ₊ ft.
2. Flood control pool:	N/A
3. Spillway crest pool:	5000 ₊ ft.
4. Top of dam pool:	5500 ₊ ft.
5. Test flood pool:	5500 ₊ ft.

e. Reservoir Storage

- | | |
|-------------------------|----------------|
| 1. Normal pool: | 340+ acre-ft. |
| 2. Flood control pool: | N/A |
| 3. Spillway crest pool: | 340+ acre-ft. |
| 4. Top of dam pool: | 1000+ acre-ft. |
| 5. Test flood pool: | 945+ acre-ft. |

f. Reservoir Surface

- | | |
|-------------------------|------------|
| 1. Normal pool: | 60+ acres |
| 2. Flood control pool: | N/A |
| 3. Spillway crest pool: | 60+ acres |
| 4. Top of dam pool: | 92+ acres |
| 5. Test flood pool: | 90+ acres. |

g. Dam

- | | |
|---------------------|---|
| 1. Type: | Earth embankment
masonry gravity section |
| 2. Length: | 400 ft. |
| 3. Height: | 23 ft. |
| 4. Top width: | 20 ft. |
| 5. Side slopes: | 2+H to 1V Upstream and
Downstream |
| 6. Zoning: | N/A |
| 7. Impervious core: | N/A |
| 8. Cutoff: | Not known |
| 9. Grout curtain: | N/A |
| 10. Other: | N/A |

h. Diversion and Regulating Tunnel - N/A

i. Spillway

- | | |
|----------|--|
| 1. Type: | Broad-crested masonry
weir with stoplogs on
portion of crest |
|----------|--|

2. Length of weir:	107 ft. with stoplogs 77 ft. no stoplogs 184 ft. total length
3. Crest elevation:	80.0 (assumed datum) 81.0 - top of stoplogs
4. Gates:	N/A
5. Upstream channel:	Sloping, sand bottom
6. Downstream channel:	Dumped boulder riprap at toe of spillway, then cobble bottom river channel
7. General:	curved spillway section with stepped downstream face

j. Regulating Outlets - Five sluice gates in bulkhead at left end of dam.

1. Invert:	74.0 ₊
2. Size:	4'x6' ₊
3. Description:	Wood sluice gates
4. Control mechanism:	Worm gear hoists
5. Other:	N/A

SECTION 2: ENGINEERING DATA

2.1 DESIGN DATA

The available data consists of an "Inventory Data" sheet compiled by the Connecticut State Board for the Supervision of Dams.

2.2 CONSTRUCTION DATA

No information was available.

2.3 OPERATIONS DATA

No operations records are known to exist.

2.4 EVALUATION OF DATA

a. Existing Data - Existing data was provided by the State of Connecticut Department of Environmental Protection. 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 approximate hydrologic judgements.

c. Validity - A comparison of record data and visual observations reveals no significant discrepancies in the record data.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General - The condition of the project is poor. The inspection revealed several items requiring maintenance. At the time of inspection, the pond level was at elevation 80.0, i.e. at the spillway crest.

b. Dam

Top of Dam - The top of the embankment is slightly irregular in elevation and heavily wooded with large trees. The chain link fence along the top of the embankment is in poor condition, with several sections knocked over and lying flat on the ground.

Upstream Slope - The upstream slope is irregular in inclination, varying from approximately 2.7 horizontal to 1 vertical to 1.4 horizontal to 1 vertical. Although riprap is sparse to non-existent on the upstream slope, it could not be determined on the basis of visual inspection if the irregularity of the slope is the result of wave action and erosion, or sloughing. It is also possible that the embankment was not graded at a constant slope at the time of its construction. There are also many large trees and brush on the slope.

Downstream Slope - The largest trees on the embankment were noted on the downstream slope. One tree, with three main trunks, was measured to be six feet across at its base (Photo 1), and another double trunked tree is approximately four feet in diameter. The downstream slope is fairly consistent in inclination at 2 horizontal to 1 vertical, but flattens to an approximately 3 horizontal to 1 vertical inclination near the toe of the slope. There is an eroded area on the slope near the spillway training wall which is a maximum of 4.5 feet deep and 12 feet wide and extends to the top of the embankment (Photo 2 & Sheet B-1). Wet areas were noted near the toe of the left end of the embankment in close proximity to the downstream channel. No points of exit of seepage from the embankment were noted and it is probable that the wetness is due to overbank flooding of the downstream channel or a natural high groundwater condition in the area, rather than from seepage through the dam.

Spillway - The masonry spillway and training walls are in good condition. Some sedimentation of the approach channel has occurred near the right end of the spillway where stoplogs are in place and flow over the spillway only occurs at elevations of one foot or more above the spillway crest. Weedy type vegetation has taken root in these sediments and in sediments along the stoplogs on the curved, left half of the spillway crest (Photo 3). Small woody type vegetation, such as maple saplings, are growing from cracks in the masonry on the stepped downstream face of the left half of the spillway (Photo 4).

Approximately 15 feet from the left end of the spillway, a slight amount of seepage through the uppermost course of the masonry was noted (Photo 6). A minor amount of seepage was observed to be emanating from a plugged, 8 inch diameter cast iron drainpipe at about the midpoint of the curve in the spillway and 7 steps down from the spillway crest. Another minor seep was noted near the base of the right spillway training wall. All seepage appeared clear.

Displacement of much of the boulder riprap at the toe of the spillway, as located on Sheet B-1, has occurred, leaving an approximately 8 foot wide space between the toe of the spillway and the riprap. There is standing water, approximately 3 feet deep, trapped in this area (Photos 4 & 5).

c. Appurtenant Structures - The outlet facilities for the dam are in poor condition (Photos 7 & 8). The sluice gates are in the closed position, but there are gaping openings in the wood bulkhead at about the elevation of the spillway crest, allowing flow to the sluiceway channel. Two of the worm gear hoists are missing, the gate hoist platforms are rotting, and the bridge over the sluiceway is unsafe. The dry laid masonry sluiceway walls are in fair condition, with some saplings growing from the wall. There is a leak in the right channel wall approximately 200 feet downstream of the bulkhead. The mortar masonry retaining wall along the left side of the sluiceway intake channel is in good condition, with only a small amount of mortar cracked or missing.

d. Reservoir Area - The land surrounding the pond is sparsely developed meadowland with paved roads along both sides of the impoundment.

e. Downstream Channel - The channel downstream from the spillway is the natural streambed of the Little River and converges with the manmade channel from the factory approximately 1,500 feet downstream of the dam.

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 influence the future condition and/or stability of the project are as follows:

1. The lack of adequate riprap on the upstream slope of the embankment could result in erosion of the slope.
2. The root systems of the large trees on the dam embankment could provide paths for seepage through the dam. Also the trees on the embankment could become uprooted, causing damage to the embankment.
3. The embankment has slightly irregular slopes and top elevation and there is an eroded area on the downstream slope.

4. Sedimentation and the growth of vegetation on the upstream side of stoplogs on the spillway crest could eventually cause constriction of the spillway approach channel.
5. Growth of woody type vegetation from the stepped downstream face of the spillway and from the sluiceway walls could eventually cause displacement of the masonry.
6. Under high flows, water turbulence and erosion could occur at the toe of the spillway in areas where the boulder riprap has been displaced.
7. The outlet facilities are inadequate to draw down the pond level, should the need occur.
8. Leakage through either the sluiceway channel wall or through the masonry spillway section could worsen and cause instability of these structures.

SECTION 4: OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES

a. General - There are no formal operational procedures followed at the dam.

b. Description Of Any Formal 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 non-existent. A formal program of operation and maintenance procedures should be implemented, including documentation to provide complete records for future reference. Also, a formal warning system should be developed and implemented within the time frame indicated in Section 7.1c. Remedial operation and maintenance recommendations are presented in Section 7.3.

SECTION 5: EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL

The Versailles Pond Dam watershed is 43.6 square miles of flat to rolling, wooded terrain including several large swamps. The upstream impoundments listed in Section 1.3.a have a negligible to no effect in the reduction of peak inflows.

The dam is an earth embankment with a masonry spillway. It is basically a low surcharge storage - high spillage type project. The reservoir area of 59.7 acres is small in relation to the drainage area and, consequently, the surcharge storage of the project is too small to have any appreciable effect in the reduction of peak inflows.

5.2 DESIGN DATA

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

5.3 EXPERIENCE DATA

The maximum recorded discharge at the site is 2,800 cfs which occurred on September 21, 1938 (See page B-2).

5.4 VISUAL OBSERVATIONS

The top of the dam embankment varies in elevation from 88.5 at the spillway training wall to 88.7 for most of its length.

5.5 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 the watershed area of 43.6 square miles, a PMF of 24,000 cfs or 550 cfs per square mile is estimated at the damsite. In accordance with the size (intermediate) and hazard (significant) classification, the range of test floods to be considered is from the $\frac{1}{2}$ PMF to the PMF. Based on the degree of hazard associated with a breach of the dam, the test flood for Versailles Pond Dam is equivalent to the $\frac{1}{2}$ PMF. The pond level at the start of the test flood is considered to be at elevation 80.5, 0.5 foot above the spillway crest. The peak outflow for the test flood is estimated at 12,000 cfs and this flow will be accommodated by the spillway with 0.6 foot of freeboard to the top of the dam. Based on hydraulics computations, the spillway capacity to the top of the dam is 13,000 cfs which is equivalent to 108% of the routed test flood outflow (Appendix D-6).

5.6 DAM FAILURE ANALYSIS

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 pond level at the top of the dam, peak outflow before failure of the dam would be about 13,000 cfs and the peak failure outflow from the dam breaching would total about 39,000 cfs. A breach of the dam would result in a rise in the water level of the stream at the initial impact area, from a depth of 6 feet just before the breach to a depth of about 11 feet shortly after the breach. This rapid, 5 foot increase in water level will flood 4 houses with less than 2 feet of water causing substantial economic loss while posing little threat to loss of life (Appendix D-8).

SECTION 6: EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS

The visual inspection did not reveal any indication of stability problems. There are minor areas of erosion, seepage, and deterioration as described in Section 3; however they are not considered to be stability concerns at the present time.

6.2 DESIGN AND CONSTRUCTION DATA

No information was available.

6.3 POST-CONSTRUCTION CHANGES

No post-construction changes to the project are known.

6.4 SEISMIC STABILITY

The project is in Seismic Zone 1 and, according to Army Corps of Engineers Recommended Guidelines, need not be evaluated for seismic stability.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 PROJECT ASSESSMENT

a. Condition - Based upon the visual inspection of the site and past performance, the project appears to be in poor condition. No evidence of immediate structural instability was observed in the embankment or spillway; however there are areas which require repair and maintenance.

Based upon "Preliminary Guidance for Estimating Maximum Probable Discharges" dated March 1978, the watershed area and classification, and hydraulic/hydrologic computations, the peak inflow to the pond at test flood is 12,000 cfs; peak outflow is 12,000 cfs with the dam maintaining 0.6 foot of freeboard. Based upon our hydraulics computations, the spillway capacity to the top of the dam is 13,000 cfs, which is equivalent to approximately 108% 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.

7.2 RECOMMENDATIONS

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

1. Renovation or replacement of the wood bulkhead, gates, gate hoists, and service bridge.
2. Construction of a low-level outlet which would allow a full drawdown of the pond.
3. Removal of all trees and brush from the embankment and from within 25 feet of the toe. This should include removal of root systems, proper backfilling and regrading of the embankment.

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.
3. A comprehensive program of inspection by a registered professional engineer qualified in dam inspection should be instituted on an annual basis.
4. After the trees have been removed and the embankment regraded, riprap should be placed on the upstream slope from several feet below the normal pond level to the top of the dam and grassy vegetation should be established on the rest of the embankment.
5. The remaining stoplogs on the spillway crest should be removed to prevent sediment build-up and vegetation in the spillway approach channel.
6. Saplings growing from the downstream masonry face of the spillway, from the masonry sluiceway walls, or from any other masonry sections of the project should be removed to prevent displacement of masonry blocks. This practice and the practice of cutting saplings and brush from the embankment should be continued as part of the routine maintenance procedures at the dam.
7. Boulder riprap should be replaced in areas where it is missing at the toe of the spillway.

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 Versailles Pond Dam

DATE: June 2, 1980

TIME: 11am

WEATHER: Overcast 65°

W.S. ELEV. _____ U.S. _____ DN.S _____

<u>PARTY:</u>	<u>INITIALS:</u>	<u>DISCIPLINE:</u>
1. <u>Peter Heynen</u>	<u>PH</u>	<u>Geotechnical</u>
2. <u>Ted Stevens</u>	<u>TS</u>	<u>Geotechnical</u>
3. <u>Hector Moreno</u>	<u>HM</u>	<u>Hydraulics</u>
4. <u>Robert Jahn</u>	<u>RJ</u>	<u>Hydraulics</u>
5. <u>Robert Charette</u>	<u>RC</u>	<u>Chief Eng.-Federal</u>
6. <u>Tim Kavanaugh, Mushé Norman</u>		<u>Survey</u>

<u>PROJECT FEATURE</u>	<u>INSPECTED BY</u>	<u>REMARKS</u>
1. <u>Dam Embankment</u>	<u>PH, TS, HM, RJ</u>	
2. <u>Intake Channel</u>	<u>PH, TS, HM, RJ</u>	
3. <u>Tailrace Channel</u>	<u>PH, TS, HM, RJ</u>	
4. <u>Masonry Spillway</u>	<u>PH, TS, HM, RJ</u>	
5. _____		
6. _____		
7. _____		
8. _____		
9. _____		
10. _____		
11. _____		
12. _____		

PERIODIC INSPECTION CHECK LIST

Page A-2PROJECT Versailles Pond DamDATE 6-2-80PROJECT FEATURE Dam EmbankmentBY PH, JS, HM, RJ

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
Crest Elevation	88.7 - 88.5
Current Pool Elevation	80.0
Maximum Impoundment to Date	Not known
Surface Cracks	None observed
Pavement Condition	N/A
Movement or Settlement of Crest	Erosion near spillway abut.
Lateral Movement	Too irregular to judge
Vertical Alignment	Poor - crest irregular
Horizontal Alignment	Too irregular to judge
Condition at Abutment and at Concrete Structures	Fair - overgrown
Indications of Movement of Structural Items on Slopes	N/A
Trespassing on Slopes	None apparent
Sloughing or Erosion of Slopes or Abutments	Possible sloughing - U/s slope
Rock Slope Protection-Riprap Failures	Riprap absent
Unusual Movement or Cracking at or Near Toes	None observed
Unusual Embankment or Downstream Seepage	
Piping or Boils	
Foundation Drainage Features	
Toe Drains	N/A
Instrumentation System	

A-2

PERIODIC INSPECTION CHECK LIST

Page A-3

PROJECT Versailles Pond Dam

DATE 6-2-00

PROJECT FEATURE Intake Channel

BY PH, TS, HM, RJ

AREA EVALUATED	CONDITION
<u>OUTLET WORKS-INTAKE CHANNEL AND INTAKE STRUCTURE</u> a) <u>Approach Channel</u> Slope Conditions Bottom Conditions Rock Slides or Falls Log Boom Debris Condition of ^{Masonry}Concrete Lining Drains or Weep Holes b) <u>Intake Structure</u> Condition of ^{Masonry}Concrete Stop Logs and Slots	Masonry lined intake to old fairtrace ±6' deep - could not see bottom None None Old coffer dam partially in place Fair - some mortar washed out None observed Wooden bridge and bulkhead Fair - some seepage Very poor condition; inoperable gates, holes in bulkhead

PERIODIC INSPECTION CHECK LIST

Page A-4

PROJECT Versailles Pond Dam

DATE 6-2-80

PROJECT FEATURE Drainage Channel

BY PHILIP L. ST

AREA EVALUATED		CONDITION
<u>OUTLET WORKS-TRANSITION AND CONDUIT</u> General Condition of Concrete ^{Masonry} Rust or Staining on Concrete ^{Masonry} Spalling Erosion or Cavitation Cracking Alignment of Monoliths Alignment of Joints Numbering of Monoliths		Fair-Poor — Some seepage noted; Heavy vegetation on wall; Partially demolished buildings adjacent to and over channel; Some demolition debris in channel.

A-4

PERIODIC INSPECTION CHECK LIST

Page A-5

PROJECT Versailles Pond Dam

DATE 6-2-80

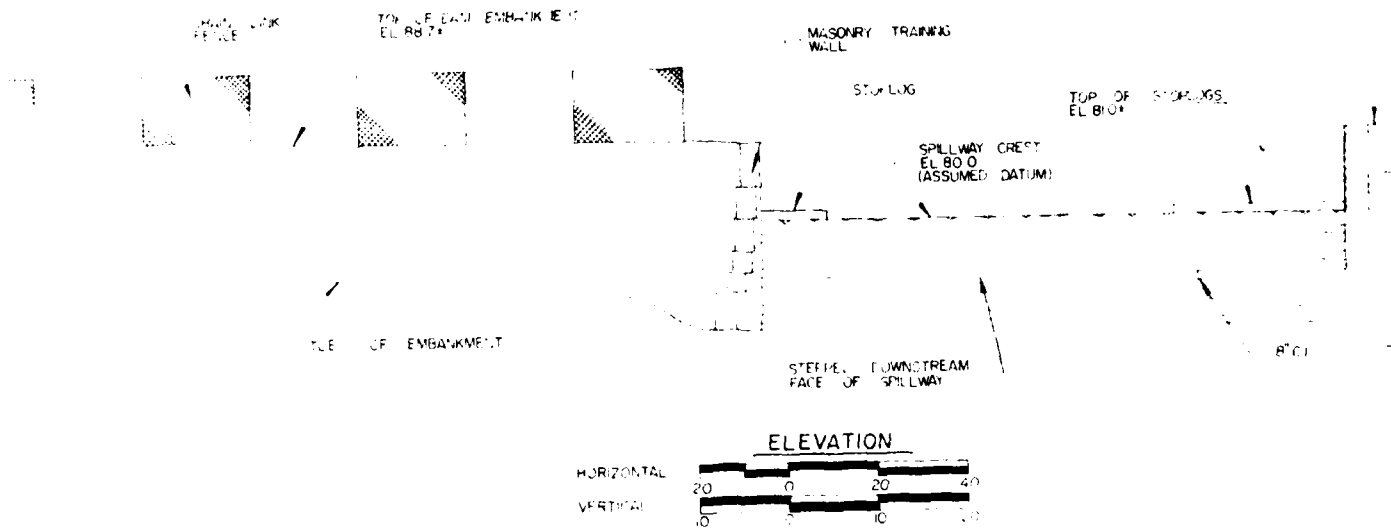
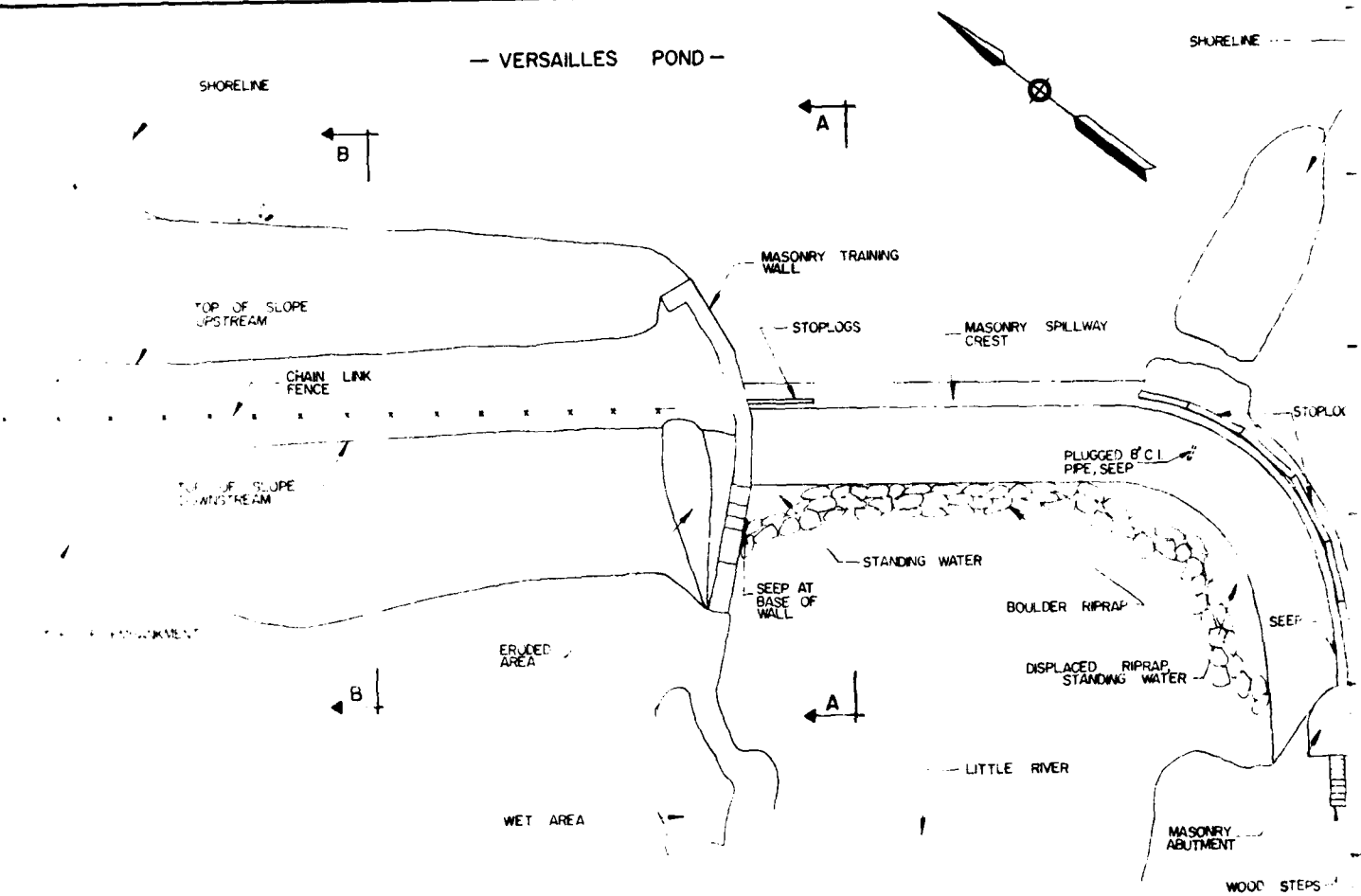
PROJECT FEATURE Masonry Spillway

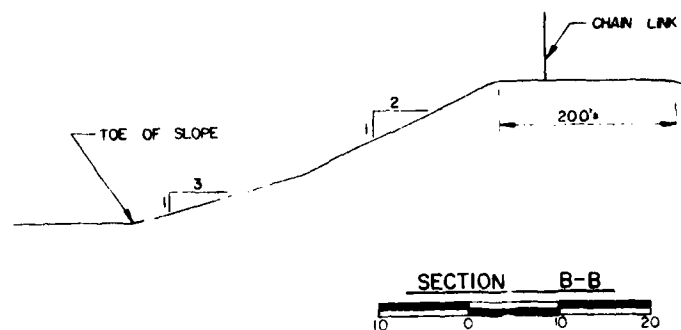
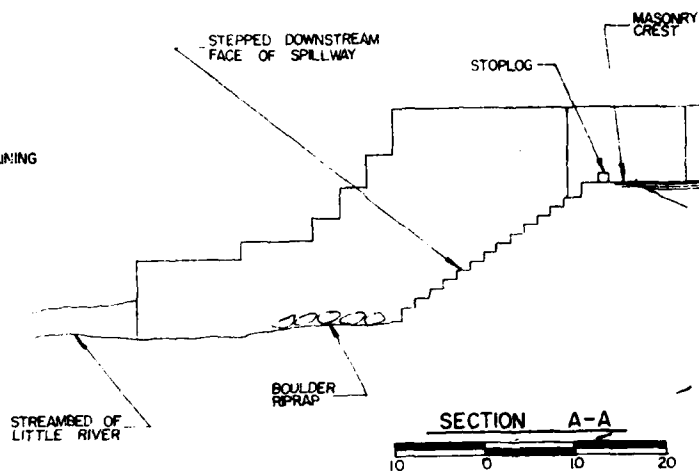
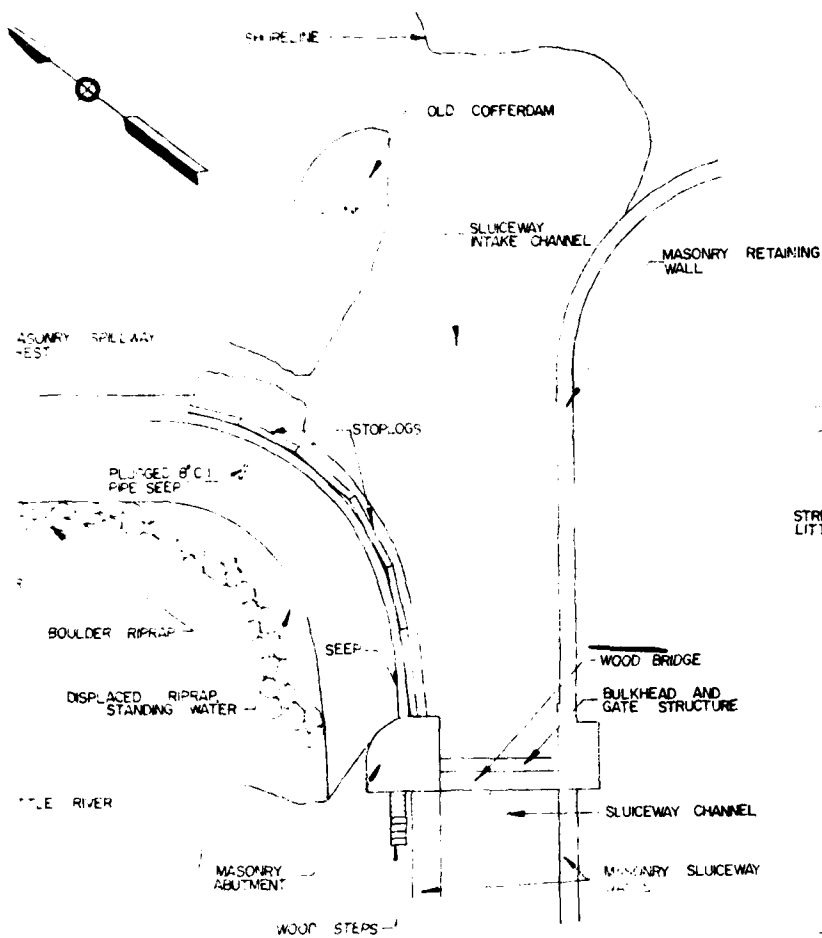
BY ELTON M. RT

AREA EVALUATED	CONDITION
<u>OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a) <u>Approach Channel</u>	
General Condition	Appears good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Yes-minor
Floor of Approach Channel	Silty, Sandy
b) <u>Weir and Training Walls</u>	
General Condition of ^{Masonry} Concrete	Good
Rust or Staining	} None observed
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	
c) <u>Discharge Channel</u>	
General Condition	Fair
Loose Rock Overhanging Channel	No
Trees Overhanging Channel	Yes
Floor of Channel	Boulders
Other Obstructions	None observed

APPENDIX B
ENGINEERING DATA AND CORRESPONDENCE

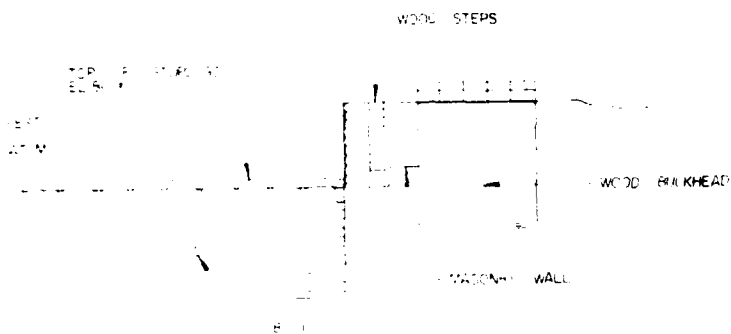
— VERSAILLES POND —



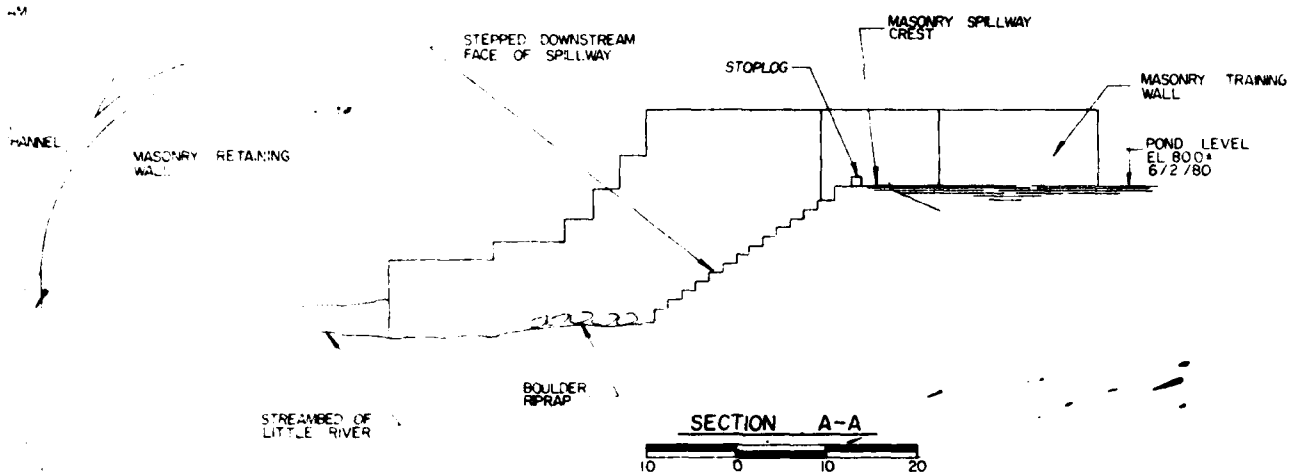


NOTES

1. THIS PLAN WAS COPIED OF THE DAM DATED DIMENSIONS SHOWN AND/OR STRUCTURAL
2. NO ELEVATIONS WERE SHOWN THE USGS ASSUMED TO BE THE ALL OTHER ELEVATIONS ASSUMED SPILLWAY

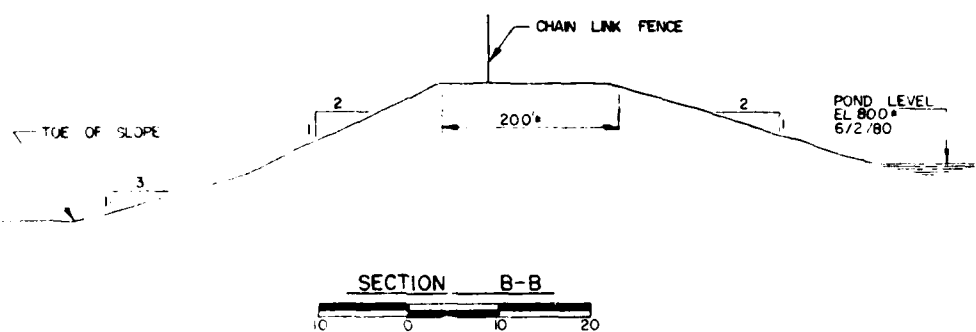


CAHN ENGINEERS W.A. CROFTS ENGINEER	
NATIONAL PROJECT PLAN	
VERSAIL	
LITTLE RIVER	
DRAWN BY M. J. J. J.	CHECKED BY M. J. J. J.



WOOD BRIDGE
BULKHEAD AND GATE STRUCTURE

SLUICeway CHANNEL
MASONRY SLUICeway



NOTES

1. THIS PLAN WAS COMPILED FROM CAHN ENGINEERS INSPECTION OF THE DAM DATED JUNE 2, 1980. DIMENSIONS SHOWN ARE APPROXIMATE. NOT ALL TOPOGRAPHIC AND/OR STRUCTURAL FEATURES ARE NECESSARILY IDENTIFIED.
2. NO ELEVATIONS WERE AVAILABLE FOR THE DAM, THEREFORE THE WATER SURFACE ELEVATION OF 800 FOR THE POND SHOWN THE USGS NORWICH QUADRANGLE MAP WAS ASSUMED TO BE THE NGVD ELEVATION OF THE SPILLWAY CREST. ALL OTHER ELEVATIONS SHOWN ARE REFERENCED TO THE ASSUMED SPILLWAY CREST ELEVATION.

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NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS PLAN, ELEVATION & SECTIONS			
VERSAILLES POND DAM			
LITTLE RIVER		SPRAGUE, CONNECTICUT	
DRAWN BY	CHECKED BY	APPROVED BY	REMARKS
		ETP	DATE: JULY 1981
SHEET 10-			

3

No. 4

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

Inventoried
By _____

Date _____

Name of Dam or Pond V. H. Pond

Code No. S 2.9 LT 0.5

Nearest Street Location _____

Town _____

U.S.G.S. Quad. N-101

Name of Stream Little River

Owner Federal Paper Board

Address 217 King St.
Abbeville, S.C.

Pond Used For PEC

Dimensions of Pond: Width _____

Length _____

Area 2.2

Total Length of Dam _____

Length of Spillway 1.2

Location of Spillway _____

Height of Pond Above Stream Bed _____

Height of Embankment Above Spillway _____

Type of Spillway Construction 1

Type of Dike Construction _____

Downstream Conditions _____

Summary of File Data _____

Remarks _____

B-1

Would Failure Cause Damage? _____

Class _____

Excerpt from report on Hanover Reservoir Dam, by
Macchi Engineers, dated Oct. 23, 1974.

HYDRAULIC CONSIDERATIONS

The total drainage area for this structure is 32.1 sq. mi. Within this area there are large storage (swamp) areas. The contributing area is a long narrow valley. Fourteen miles upstream of the Hanover Reservoir is located the Hampton Reservoir on the same valley. There is a gaging station in Little River which was established in 1951, located only 1.7 miles north of the Hanover Reservoir. The following information was obtained from the U.S. Geological Survey Office with regard to this gaging station:

Drainage area 29.1 sq. mi.

Long Term Mean Annual Flood 700 c.f.s.

Max. Recorded Flood (August 19, 1955) 1,400 c.f.s.

The U.S. Geological Service has also records at the Versailles Pond Dam located 4.2 miles downstream of the Hanover Reservoir, on the same valley. The following information was obtained from these records:

Drainage area 41.3 sq. mi.

Mean Annual Flood: 1,000 c.f.s.

Max. Recorded Flood (Sept. 21, 1938) 2,800 c.f.s.

Our hydraulic computations for the Hanover Reservoir give the following information:

Drainage area 32.1 sq. mi.

Mean Annual Flood 900 c.f.s.

100 Year Flood Frequency (5 MAF) = 4,500 c.f.s.

Spillway Capacity $Q = CxLxH^{3/2}$

$Q = 3 \times 136 \times 7^{3/2} = 7,550 \text{ c.f.s.}$

Water depth of spillway to pass the estimated 100 year flood frequency = 5 ft. approx.

APPENDIX C
DETAIL PHOTOGRAPHS

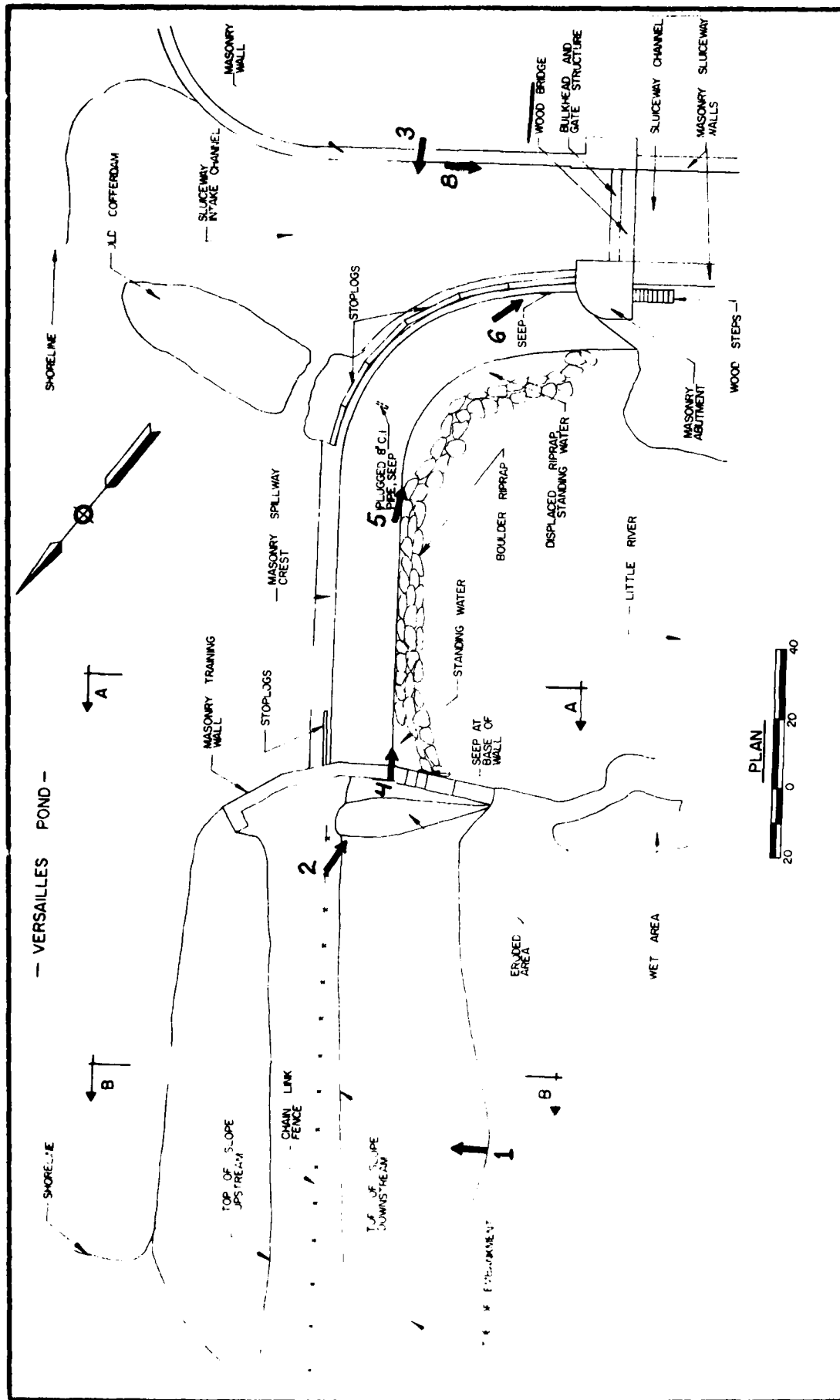


PHOTO LOCATION PLAN

VERSAILLES POND DAM

SHEET C-1



Photo 1 - Tree with six foot wide base located on downstream slope of embankment (6/2/80).



Photo 2 - Eroded area on downstream slope of embankment. Fully extended six foot ruler is being held parallel to the axis of the embankment (6/2/80).

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CAHN ENGINEERS INC.
WALLINGFORD, CONN.
ENGINEER

NATIONAL PROGRAM OF
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NON-FED. DAMS

Versailles Pond Dam
Little River
Sprague, Conn.

CE #27 785 KB

DATE July, '80 PAGE C-1

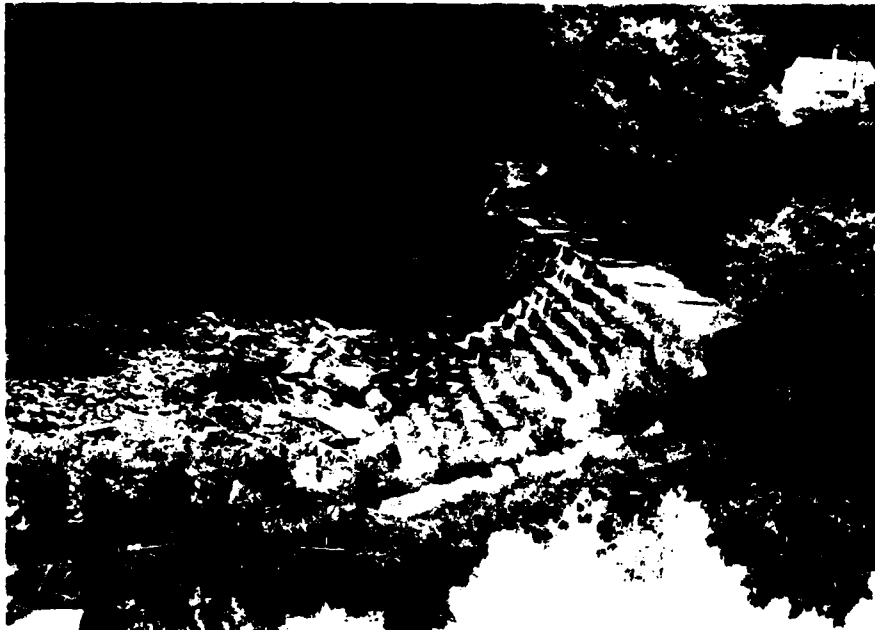


Photo 3 - View of spillway from left end. Note sedimentation and vegetation on upstream side of flashboards in foreground and in background at right end of spillway (6/2/80).



Photo 4 - View of spillway from right end. Note riprap displacement at toe and vegetation growth on downstream face (6/2/80).

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NATIONAL PROGRAM OF
INSPECTION OF
NON-FED. DAMS

Versailles Pond Dam
Little River
Sprague, Conn.
CE #27 785 KB
DATE JULY, '80 PAGE C-2

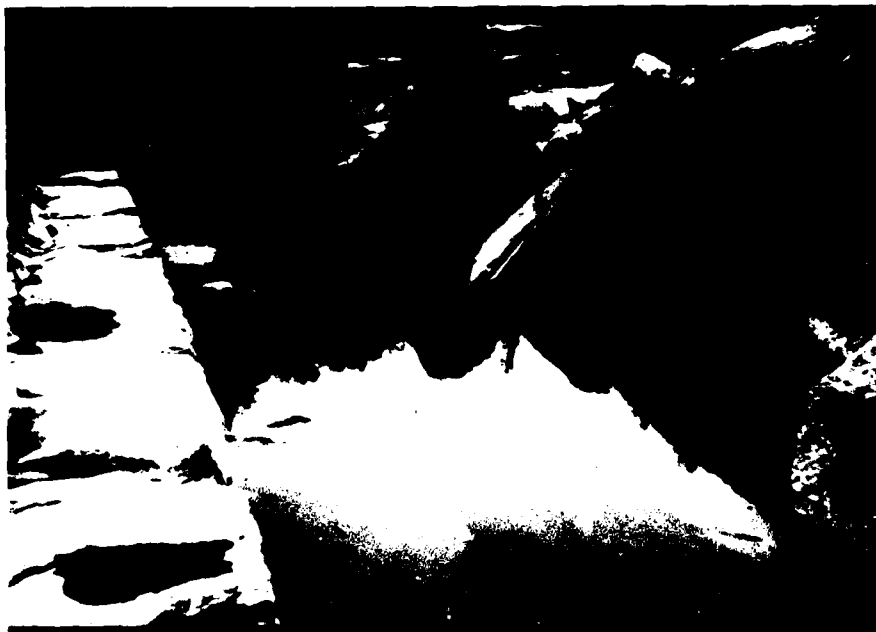


Photo 5 - Closeup of riprap displacement at toe of spillway (6/2/80).



Photo 6 - Seepage through upper course of masonry near left end of spillway (6/2/80).

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NATIONAL PROGRAM OF
INSPECTION OF
NON-FED. DAMS

Versailles Pond Dam
Little River
Sprague, Conn.
CE#27 785 KB
DATE July, '80 PAGE C-3



Photo 7 - Aerial view of spillway and sluiceway. Note breached cofferdam and partially demolished factory buildings (Feb. 1980).



Photo 8 - View from upstream of sluiceway bulkhead (6/2/80).

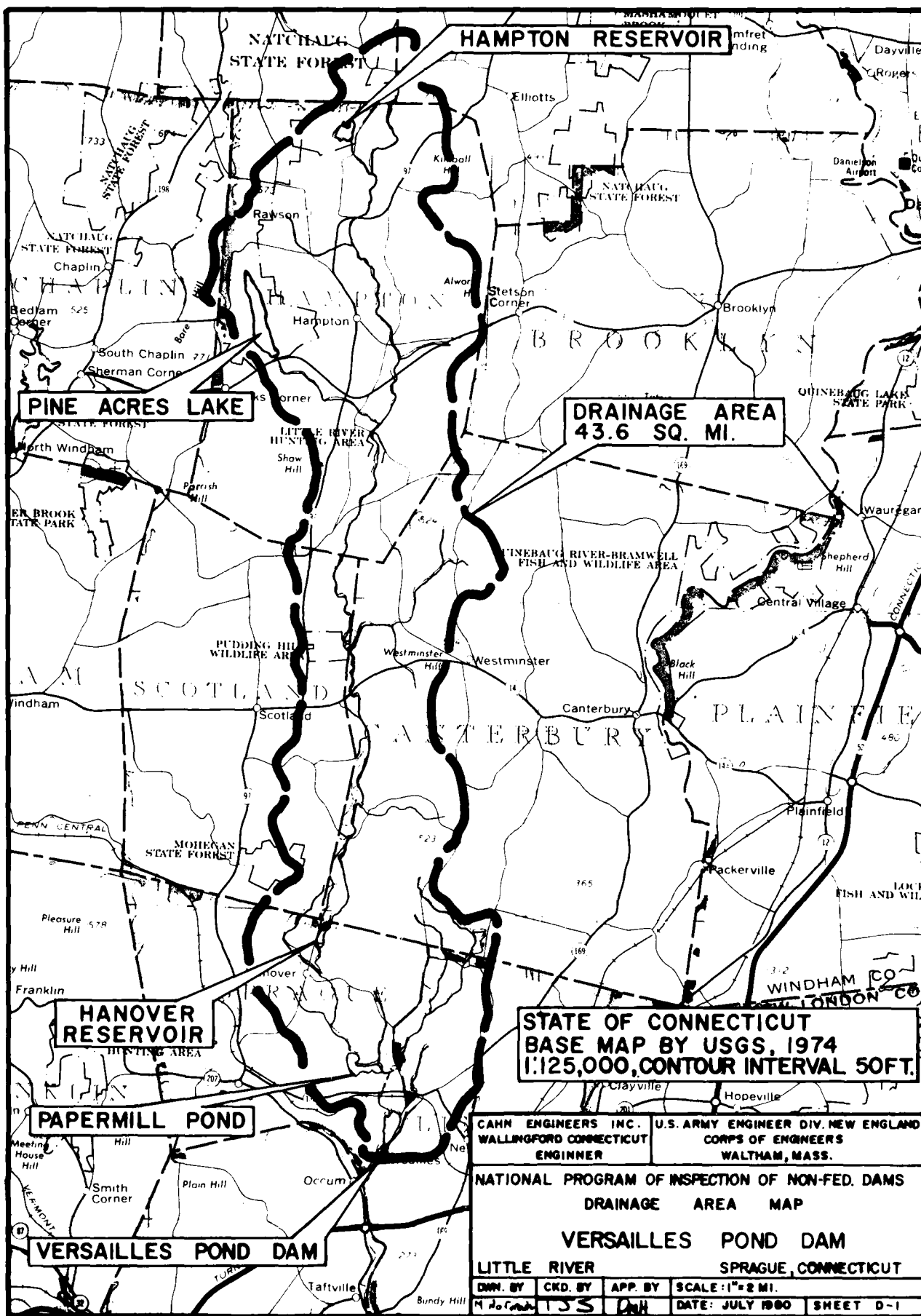
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WALTHAM, MASS.

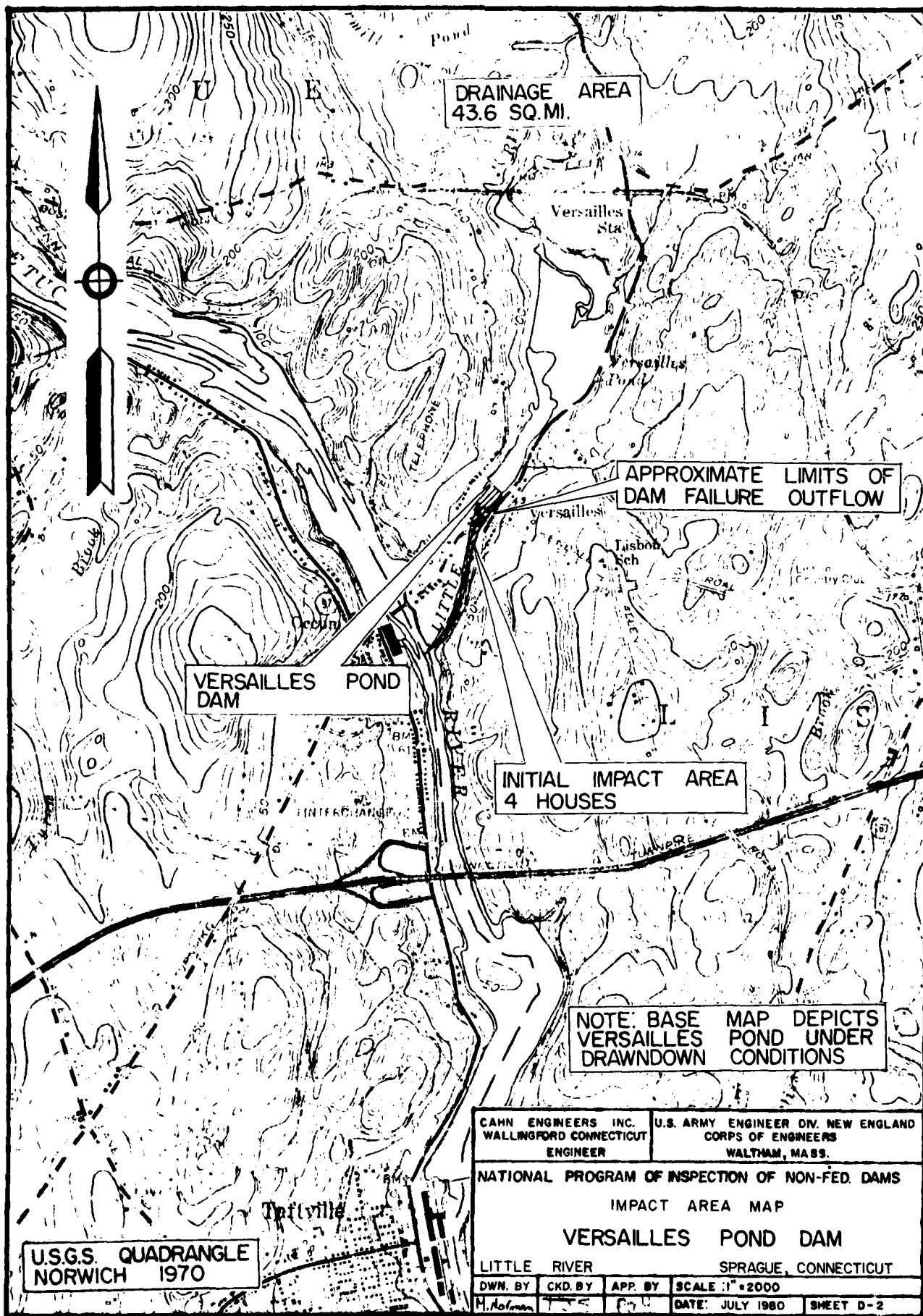
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NATIONAL PROGRAM OF
INSPECTION OF
NON-FED. DAMS

Versailles Pond Dam
Little River
Sprague, Conn.
CE#27 785 KB
DATE July, '80 PAGE C-4

APPENDIX D
HYDRAULICS/HYDROLOGIC COMPUTATIONS





U.S.G.S. QUADRANGLE
NORWICH 1970

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

IMPACT AREA MAP

VERSAILLES POND DAM

LITTLE RIVER

SPRAGUE, CONNECTICUT

DWN. BY

CKD. BY

APP. BY

SCALE: 1" = 2000

H. A. ...

...

...

DATE: JULY 1980

SHEET D-2

Project INSPECTION OF NON-FEDERAL DAMS IN NEW ENGLAND Sheet D-1 of 10
 Computed By HMM Checked By EAB Date 5/6/80
 Field Book Ref. _____ Other Refs. CE # 27-785-HA Revisions 9/16/80 HMM

HYDROLOGIC/HYDRAULIC INSPECTION

VERSAILLES POND DAM, SPRAGUE, CT.

1) PERFORMANCE AT PEAK FLOOD CONDITIONS:

1) PROBABLE MAXIMUM FLOOD (PMF)

a) WATERSHED CLASSIFIED AS "FLAT" BECAUSE OF THE LARGE VALLEY STORAGE CAPACITY OF THE WATERSHED AND REGULATION BY $\frac{1}{2}$ RESERVOIRS.

b) WATERSHED AREA: $DA = 43.6^{sq.mi}$

NOTE: D.A. FROM CONN. DEP BULLETIN N°1, 1972 (GAZETTEER OF NATURAL DRAINAGE AREA) p. 11.

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

i) FROM GUIDE CURVES: $CSM = 550^{cfs/sq.mi}$

ii) $PMF = 550 \times 43.6 = 24000^{cfs}$

iii) $\frac{1}{2} PMF = 12000^{cfs}$

2) SURCHARGE AT PEAK INFLOWS (PMF AND $\frac{1}{2}$ PMF)

a) OUTFLOW RATING CURVE:

i) SPILLWAY AND OVERFLOW PROFILE FOR SURCHARGES OVERTOPPING THE DAM:

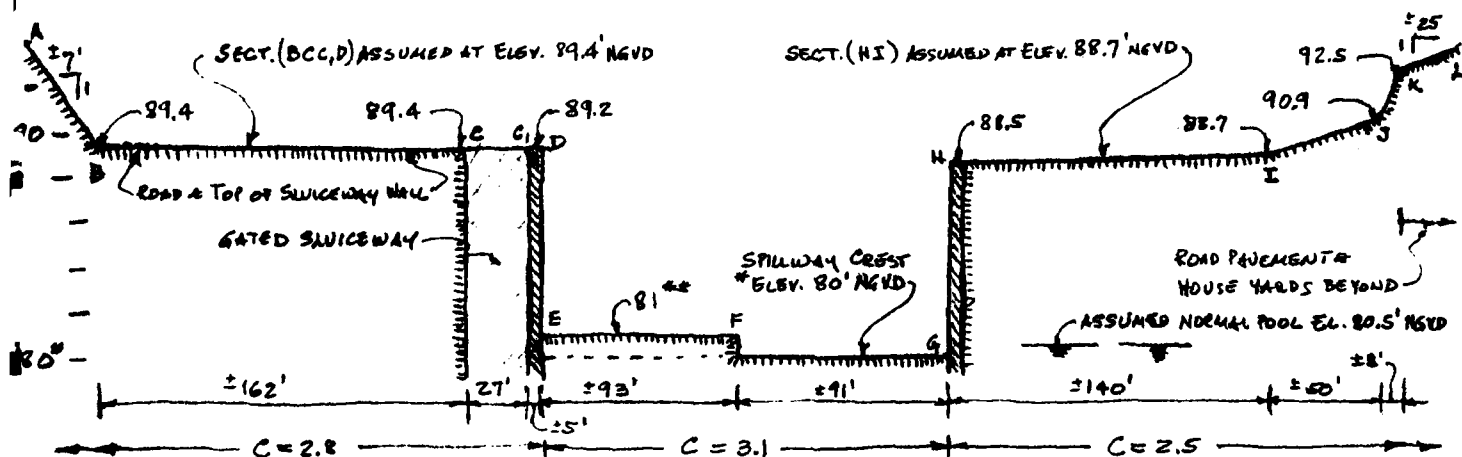
SPILLWAY ($\pm$) 184' LONG ($\pm$) 73' CURVED SECTION WITH 1' HIGH STOPLOGS AS CREST, STONE MASONRY BROADCRESTED ($\pm$ 6' WIDE), VERTICAL (STEPPED) $\frac{1}{2}$ FACE AND SLOPING $\frac{1}{2}$ FACE.

THE EARTH EMBANKMENT TO THE RIGHT, AND EXTENDING TO THE STREET ON THAT SIDE IS WOODED AND HAS A 3' 8" HIGH CHAINLINK FENCE RUNNING ITS ENTIRE LENGTH. ACROSS THE STREET PAVEMENT, THE OVERFLOW SECTION CONTINUES THROUGH THE YARDS OF THE HOMES WHICH FACE THE STREET TO THE LEFT,

Project NON-FEDERAL DAMS INSPECTION Sheet D-2 of 10
 Computed By WHR Checked By GAB Date 5/6/80
 Field Book Ref. _____ Other Refs. CE #27-785-HA Revisions _____

THE OVERFLOW SECTION EXTENDS FROM THE JOINT WALL / ABUTMENT OF THE SPILLWAY ACROSS THE SLUICeway INTAKE WORKS TO THE SLUICeway LEFT SIDE WALL AND BEYOND, TO THE ROAD AND GRASSY LAND AT THIS SIDE OF THE DAM. EXCEPT FOR SOME FENCED SECTIONS THE LEFT SIDE OVERFLOW IS CLEAR FROM MAJOR OBSTRUCTIONS.

THEREFORE ASSUME $C = 3.1$ FOR THE SPILLWAY FLOW (WITH OR W/O STOP LOGS);
 $C = 2.8$ FOR THE LEFT SIDE AND $C = 2.5$ FOR THE RIGHT SIDE OVERFLOWS.
 (SEE PROFILE)



* THE SPILLWAY SECTION (EF) HAS 1' HIGH BOLTED STOP LOGS
 W/ CONCRETE BACKING (TOTAL WIDTH 18") ABOVE THE SPILLWAY
 CREST SLABS. A SHORT DISTANCE (NEGLECTABLE) OF THE RIGHT END
 OF THE SPILLWAY ALSO HAS STOP LOGS.

DATA FROM CE OBSERVATIONS ON
 5/2/80 BY WHR & R.J.

VERSAILLES POND DAM
 APPROXIMATE OVERFLOW PROFILE

* NOTE: W.S. ELEV. 80' NGVD ON THE USGS NORWICH, CT. SLACKWATER SHEET (1954) IS
 ASSUMED TO BE SPILLWAY CREST ELEVATION ON NATIONAL GEODETIC VER-
 TICAL DATUM (NGVD).

Project NON-FEDERAL DAMS INSPECTION

Sheet D-3 of 10

Computed By WU

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Revisions _____

(c) THEREFORE, ASSUMING EQUIVALENT LENGTHS FOR THE SLOPING TERRAIN, THE OVERFLOW RATING CURVE FOR THE OVERCHASE (H) ABOVE THE SPILLWAY CREST CAN BE APPROXIMATED AS FOLLOWS (SEE PROFILE, P. D-2):

$$1') \text{ SECTION AB: } Q_{AB} = \frac{2}{3} \times 7 \times 2.8 (H-9.4)^{5/2} = \underline{13.1 (H-9.4)^{5/2}}$$

$$2') \text{ SECTION BCC,D: } Q_{BCC,D} = 2.8 \times 194 (H-9.4)^{3/2} = \underline{543 (H-9.4)^{3/2}}$$

3') SPILLWAY:

$$\text{SECTION EF: } (Q_S)_1 = Q_{EF} = 3.1 \times 93 (H-1)^{3/2} = \underline{288 (H-1)^{3/2}}$$

$$\text{SECTION FG: } (Q_S)_2 = Q_{FG} = 3.1 \times 91 H^{3/2} = \underline{282 H^{3/2}}$$

$$4') \text{ SECTION HI: } Q_{HI} = 2.5 \times 140 (H-8.7)^{3/2} = \underline{350 (H-8.7)^{3/2}}$$

5') SECTION IJ:

$$(Q_{IJ})_1 = \frac{2}{3} \times 50 \times 2.2 \times 2.5 (H-8.7)^{5/2} = \underline{37.9 (H-8.7)^{5/2}} \quad H \leq 10.9$$

$$(Q_{IJ})_2 = 50 \times 2.5 (H-9.22)^{3/2} = \underline{125 (H-9.22)^{3/2}} \quad H > 10.9$$

6') SECTION JK:

$$(Q_{JK})_1 = \frac{2}{3} \times 8 \times 1.6 \times 2.5 (H-10.9)^{5/2} = \underline{8.33 (H-10.9)^{5/2}} \quad H \leq 12.5$$

$$(Q_{JK})_2 = 8 \times 2.5 (H-11.3)^{3/2} = \underline{20 (H-11.3)^{3/2}} \quad H > 12.5$$

$$7') \text{ SECTION KL: } Q_{KL} = \frac{2}{3} \times 25 \times 2.5 (H-12.5)^{5/2} = \underline{41.7 (H-12.5)^{5/2}}$$

THEREFORE, THE TOTAL OUTFLOW IS APPROXIMATED BY THE SUM OF ALL THE APPLICABLE FORMULAE ON ITEM (1') TO (7'), AND THE CORRESPONDING CURVE IS PLOTTED ON P. D-4.

Project NON-FEDERAL DAM INSPECTION

Sheet D-4 of 10

Computed By HEU

Checked By GAH

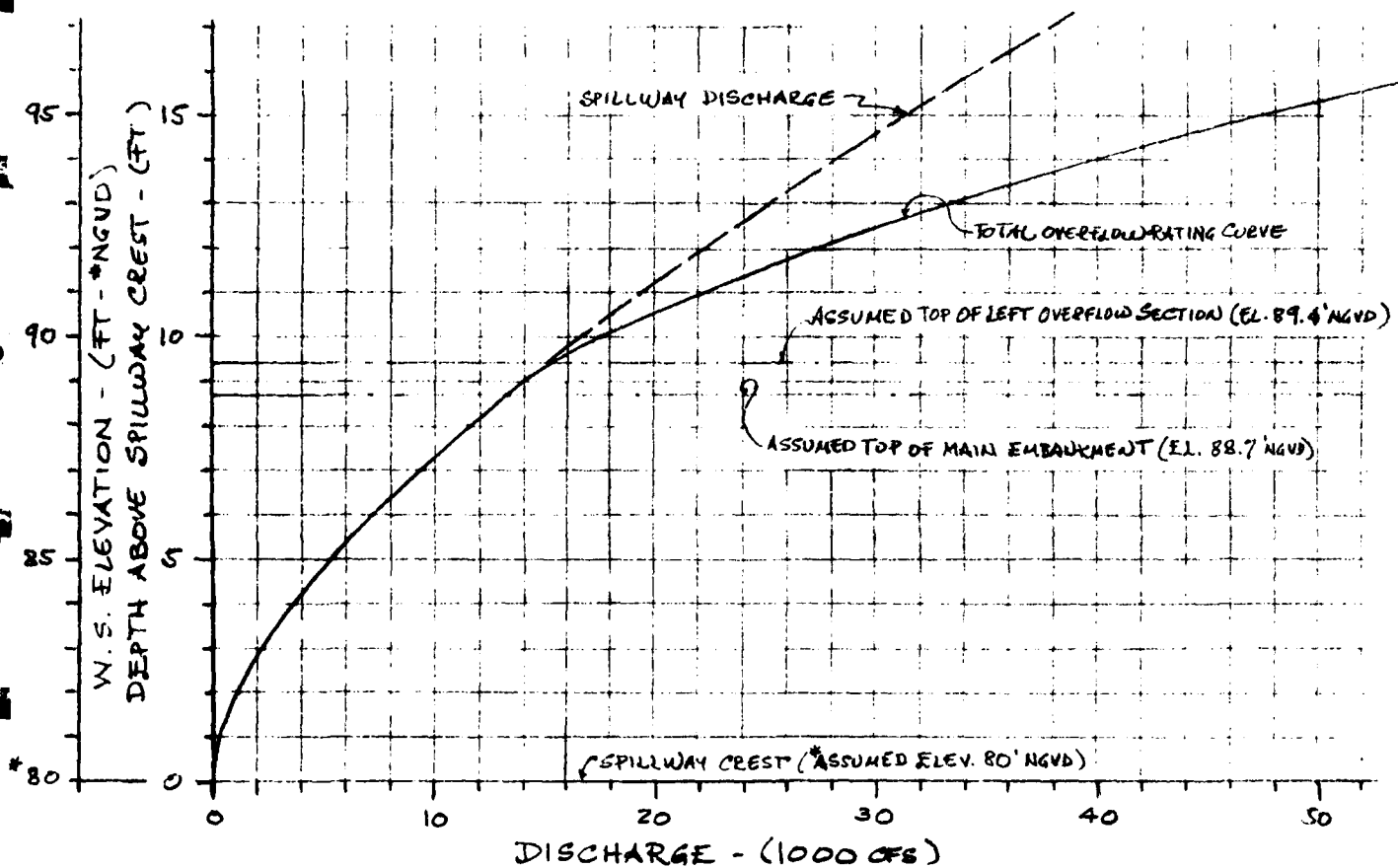
Date 5/2/80

Field Book Ref. _____

Other Refs. CE #27-205 HA

Revisions 9/16/80 HEU

(iii) VERSAILLES POND DAM - OUTFLOW RATING CURVE



*SEE NOTE P. D-2

b) SURCHARGE HEIGHT TO PASS PEAK INFLOW - ($Q_p + Q_p'$)

c) @ $Q_p = PMF = 24000 \text{ cfs}$ $H_s = 11.4'$

d) @ $Q_p' = \frac{1}{2} PMF = 12000 \text{ cfs}$ $H_s = 8.1'$

Project NON-FEDERAL DAM INSPECTION Sheet D-5 of 10
 Computed By WJH Checked By GAB Date 5/8/80
 Field Book Ref CE #27-185-1.0 Other Refs. CE #27-185-1.0 Revisions 9/16/80 HLL

C) EFFECT OF SURCHARGE STORAGE - PEAK OUTFLOWS:

i) AVE. LAKE AREA ($\bar{A}$) WITHIN EXPECTED SURCHARGE:

- 1) LAKE AREA AT FLOW LINE (EL. 80' NGVD)*: $A_{80} = 59.7^{ac}$
- 2) AREA AT CONTOUR 90' NGVD (MSL)*: $A_{90} = 97.3^{ac}$
- 3) AREA AT CONTOUR 100' NGVD (MSL)*: $A_{100} = 138^{ac}$

$\therefore$ AVE. AREA WITHIN MAX. EXPECTED SURCHARGE ($\pm 15.5'$): $\bar{A} = 81.4^{ac}$
 (LINEAR INTERPOLATION): (3) AREAS - SEE CURVE P.D.-6

*NOTE: AREAS FROM USGS, NORWICH, CT. QUAD SHEET (1954) - SCALE 1"=2000'
 REV. QUAD SHEET (1970) SHOWS LAKE DRAINED W/ A SURFACE AREA OF $A=14.2^{ac}$

ii) ASSUME NORMAL POOL AT ELEV. 80.5' NGVD ($H=0.5'$)

iii) WATERSHED D.A. $\approx 43.6^{sq\ mi}$ (SEE P. D.-1)

iv) PEAK OUTFLOWS (Q_{P_2} & Q_{P_3}')

BECAUSE THE LAKE AREA AND CONSEQUENTLY, THE SURCHARGE STORAGE OF VERSAILLES POND ARE TOO SMALL TO HAVE AN APPRECIABLE EFFECT IN THE REDUCTION OF THE PEAK INFLOW, THE PEAK OUTFLOWS ARE APPROXIMATELY,

$$Q_{P_2} \approx Q_{P_1} = 24000^{cfs} \quad H_2 \approx 11.4'$$

$$Q_{P_3}' \approx Q_{P_1}' = 12000^{cfs} \quad H_3' \approx 8.1'$$

Project NON-FEDERAL DAMS INSPECTION

Sheet D-6 of 10

Computed By WU

Checked By GRB

Date 5/8/80

Field Book Ref. _____

Other Refs. CE #27-785-HA

Revisions 9/16/80 WU

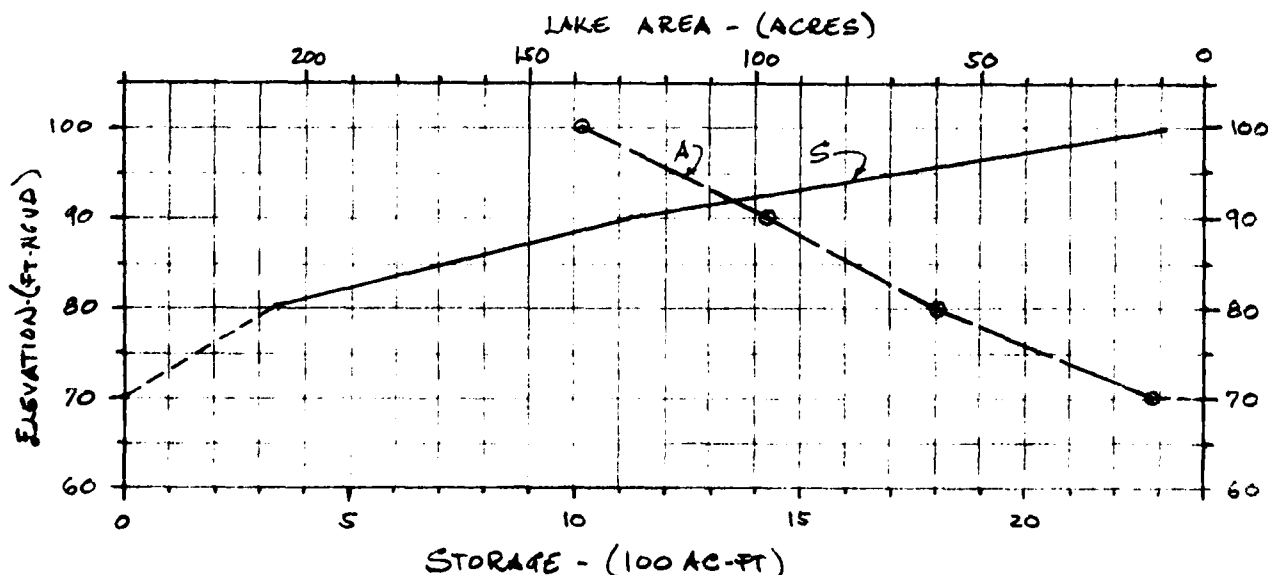
3) SPILLWAY CAPACITY RATIO TO PEAK OUTFLOW.

SPILLWAY CAPACITY TO:	SURCH.* H (FT)	W.S. ELEV. (FT-NGVD)	SPILLWAY CAPACITY (CFS)	SPILLWAY CAPACITY AS % OF PEAK OUTFLOWS	
				Q _B (24000 cfs)	Q _B (12000 cfs)
TOP OF DAM**	8.7	88.7	13000	54	108
1/2 PMF	8.1	88.1	12000	—	100
PMF	11.4	91.4	20500	85	—

* SURCHARGE ABOVE SPILLWAY CREST

** ASSUMED TOP OF MAIN EMBANKMENT (RIGHT), ELEV. 88.7' NGVD.

4) RESERVOIR AREA/STORAGE CURVES - VERSAILLES POND



AREAS MEASURED ON USGS, NORWICH, CT. QUADRANGLE SHEETS (1954 & 1970)

NOTE - SEE PP. D-5 (AREAS) AND D-8 (STORAGE)

D-6

Project 101 FEDERAL DAM INSPECTION Sheet D-7 of 10
 Computed By JPW Checked By CRB Date 5/8/80
 Field Book Ref _____ Other Refs. CE #27-785-HA Revisions _____

VERSAILLES POND DAM

II) DOWNSTREAM FAILURE AREA:

1) POTENTIAL IMPACT AREA

FOUR HOUSES ON THE LEFT BANK OF LITTLE RIVER (±) 1000' $\frac{1}{2}$ FROM VERSAILLES POND DAM, WITH FIRST FLOOR ELEVATIONS BETWEEN (±) 9' AND 11', CONSTITUTE THE POTENTIAL IMPACT AREA IN CASE OF FAILURE OF THIS DAM.

2) FAILURE AT VERSAILLES POND DAM

ASSUME DISCHARGE TO TOP OF DAM ELEV. 88.7' NGVD

a) HEIGHT OF DAM*: $H = 23'$

b) MID-HEIGHT LENGTH*: $L = 365'$

c) BREACH WIDTH (SEE NED-ACE $\frac{1}{2}$ DAM FAILURE GUIDELINES)

$$W = 0.4 \times 365 = 146' \quad \text{ASSUME } V_b = 140'$$

d) ASSUMED WATER DEPTH AT TIME OF FAILURE: $Y_0 = 23'$

e) DOWNSTREAM DISCHARGE AT TIME OF FAILURE: $Q_b = 13000 \text{ cfs (see D-6)}$

f) BREACH OUTFLOW (SEE NED-ACE GUIDELINES)

$$Q_b = \frac{8}{127} W_b \sqrt{g} Y_0^{3/2} = 26000 \text{ cfs}$$

1) PEAK FAILURE OUTFLOW (Q_p) TO LITTLE RIVER.

$$Q_p = Q_b + Q_b = 39000 \text{ cfs}$$

* FRANCE FIELD MEASUREMENTS ON 5/2/80 BY JPW & R.S.

D-7

Project NORFOLK FLOOD DAMAGE INSPECTION Sheet D-8 of 10
 Computed By WLL Checked By GAH Date 5/8/80
 Field Book Ref. _____ Other Refs. CE #27-785-HA Revisions _____

3) FLOOD DEPTH * IMMEDIATELY $\frac{1}{2}$ FROM DAM

$$y = 0.44\% = 10.1' \text{ SAY, } y = \underline{10'}$$

(*FROM THE RETREATING WAVE THEORY APPLIED TO DAM FAILURE)

A) ESTIMATE OF $\frac{1}{2}$ FAILURE CONDITIONS AT POTENTIAL IMPACT AREA:

(SEE NED-ACE GUIDELINES FOR ESTIMATING $\frac{1}{2}$ FAILURE HYDROGRAPHS)

- a) THE (+) 1000' LONG REACH OF LITTLE RIVER FROM THE DAM TO THE POTENTIAL IMPACT AREA IS GENERALLY TRAPEZOIDIC IN CROSS SECTION WITH (+) 200' BASE AND (+) 6" AND 10" TO 1' SIDE SLOPES. THE AVERAGE REACH SLOPE IS (+) 1.1%.

b) RESERVOIR STORAGE AT TIME OF FAILURE:

$$* S_{MAX} = \underline{1000 \text{ AC-FT}}$$

* C.E. ESTIMATE BASED PRIMARILY ON LAKE AREA AT FLOODLINE AND DRAWDOWN CONDITIONS FROM USGS NORWICH SAND SHEETS (SEE P. D-5) AND AN ASSUMED DEPTH OF (+) 9' : $S_{WL} \approx .37 \text{ AC} \times 9 \approx 330 \text{ AC-FT}$; ALSO, IF ESTIM. BY APPROX. FORMULA $S_{WL} = 0.42 \times A \times H = 0.42 \times 59.7 \times 14.2 \approx 360 \text{ AC-FT}$ (TO FLOODLINE); FOR SURCH. FOR $S_{SURCH} = 8.7 \times 76 \text{ AC} \approx 660 \text{ AC-FT}$... $S_{MAX} \approx 330 + 660 = 990 \text{ SAY, } S_{MAX} \approx \underline{1000}$ (SEE CURVE P. D-6)

c) APPROXIMATE STAGE AT POTENTIAL IMPACT AREA AFTER FAILURE (NEGLECT CHANNEL STORAGE):

$$Q_7 = Q_8 \approx \underline{39000 \text{ CFS}} \quad y_3 = 10.7' \text{ ; SAY, } y_3 = \underline{11'} \quad (n = 0.050)$$

d) APPROXIMATE STAGE BEFORE FAILURE. $Q_3 = \underline{13000 \text{ CFS}}$ $y_5 = 5.8'$ SAY, $y_5 = \underline{6'}$

e) RAISE IN STAGE AT IMPACT AREA: $\Delta y = \underline{5'}$

Project NON-FEDERAL DAMS INSPECTION Sheet D-9 of 10
Computed By WLL Checked By GAB Date 5/8/80
Field Book Ref. _____ Other Refs. CE#27-785-HA Revisions 9/16/80 WLL

III) SELECTION OF TEST FLOOD

1) CLASSIFICATION OF DAM ACCORDING TO NED-ACE GUIDELINES:

a) SIZE: *STORAGE (MAX) ≈ 1000 ACFT ($1000 \leq S < 50000$ ACFT)
*HEIGHT $\approx 23'$ ($H < 25'$)

*STORAGE: SEE P. D-8; HEIGHT: SEE P. D-7

$\therefore$ SIZE CLASSIFICATION: INTERMEDIATE

b) HAZARD POTENTIAL: AS A RESULT OF THE PH FAILURE ANALYSIS AND IN VIEW OF THE IMPACT THAT FAILURE OF VERSAILLES POND DAM MAY HAVE ON THE POTENTIAL IMPACT AREA (P. D-7), THE DAM IS CLASSIFIED AS HAVING:

HAZARD CLASSIFICATION: SIGNIFICANT

3) TEST FLOOD: $\frac{1}{2}$ PHF = 12000 CFS

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

Project NON-FEDERAL DAMS INSPECTION Sheet D-10 of 10
 Computed By HQ Checked By GMB Date 5/9/80
 Field Book Ref. _____ Other Refs. CE#27-785-HA Revisions 9/16/80 HQ

VERSAILLES POND DAM

IV) SUMMARY

- 1) TEST FLOOD = $\frac{1}{2} PMF = 12000 \text{ cfs}$
 (PARALLEL COMPUTATIONS HAVE BEEN MADE FOR $PMF = 24000 \text{ cfs}$ AND ARE ALSO SUMMARIZED BELOW)
- 2) PERFORMANCE AT PEAK FLOOD CONDITIONS:
 - a) PEAK INFLOWS: $Q_p = PMF = 24000 \text{ cfs}$ $Q'_p = \frac{1}{2} PMF = 12000 \text{ cfs}$
 - b) PEAK OUTFLOWS: $Q_B = Q_p = 24000 \text{ cfs}$ $Q'_B = Q'_p = 12000 \text{ cfs}$
 - c) SPILLWAY CAPACITY: (SEE TABLE P. D-6)
 - d) PERFORMANCE:
 - i) AT TEST FLOOD: FREEBOARD ($\pm$) 0.6' (U.S. EL. 88.1' NGVD)
 - ii) AT PMF: OVERTOPPED ($\pm$) 2.7' (U.S. EL. 91.4' NGVD)
- 3) DOWNSTREAM FAILURE CONDITIONS:
 - a) PEAK FAILURE OUTFLOW: $Q_p = 39000 \text{ cfs}$
 - b) FLOOD DEPTH IMMEDIATELY $\frac{1}{4}$ MILE FROM DAM: $Y_0 = 10'$
 - c) CONDITIONS AT THE INITIAL IMPACT AREA (LITTLE RIVER):
 - STAGE BEFORE FAILURE: $(Y_s) = 6'$ ($Q_s = 13000 \text{ cfs}$)
 - STAGE AFTER FAILURE: $(Y_s) = 11'$ ($Q_s = Q_p = 39000 \text{ cfs}$)
 - RAISE IN STAGE AFTER FAILURE: $\Delta Y = 5'$

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

New England Division
Corps of Engineers

March 1978

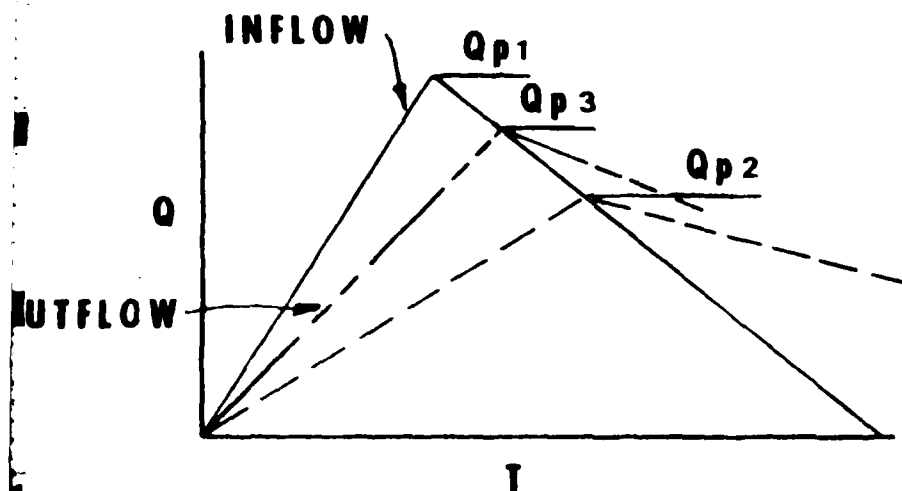
MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

<u>Project</u>	<u>Q</u> (cfs)	<u>D.A.</u> (sq. mi.)	<u>MPF</u> 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)

<u>River</u>	<u>SPF</u> (cfs)	<u>D.A.</u> (sq. mi.)	<u>MPF</u> (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 (Q_{p1}) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass " Q_{p1} ".

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

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

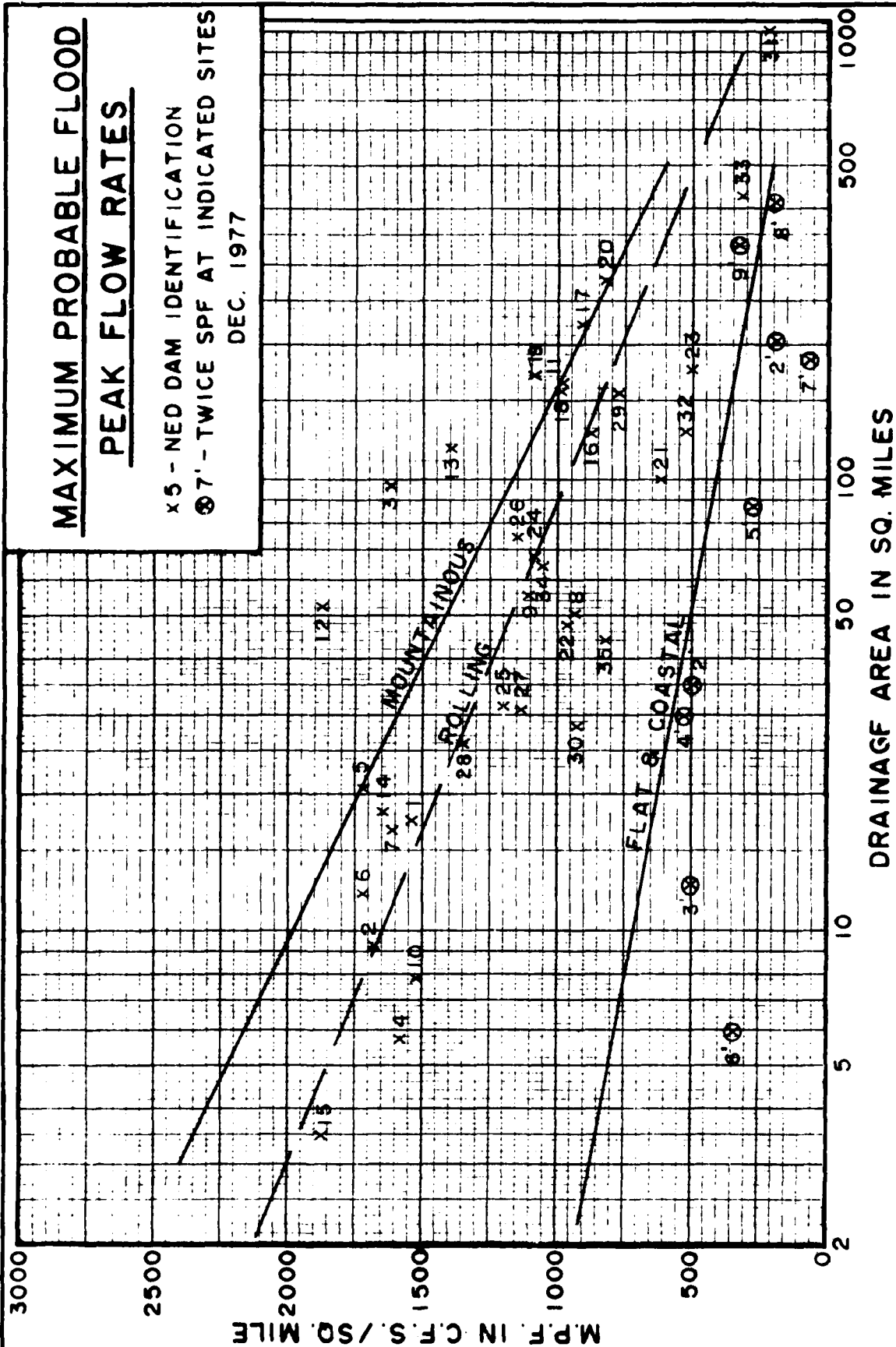
$$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and " $STOR_2$ " To Pass " Q_{p2} ".

b. Average " $STOR_1$ " and " $STOR_2$ " and Determine Average Surcharge and Resulting Peak Outflow " Q_{p3} ".

MAXIMUM PROBABLE FLOOD PEAK FLOW RATES

x 5 - NED DAM IDENTIFICATION
 ⊗ 7' - TWICE SPF AT INDICATED SITES
 DEC. 1977



SURCHARGE STORAGE ROUTING SUPPLEMENT

**STEP 3: a. Determine Surcharge Height and
"STOR₂" To Pass "Q_{p2}"**

**b. Avg "STOR₁" and "STOR₂" and
Compute "Q_{p3}".**

**c. If Surcharge Height for Q_{p3} and
"STOR_{avg}" agree O.K. If Not:**

**STEP 4: a. Determine Surcharge Height and
"STOR₃" To Pass "Q_{p3}"**

**b. Avg. "Old STOR_{avg}" and "STOR₃"
and Compute "Q_{p4}"**

**c. Surcharge Height for Q_{p4} and
"New STOR_{avg}" should Agree
closely**

SURCHARGE STORAGE ROUTING ALTERNATE

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

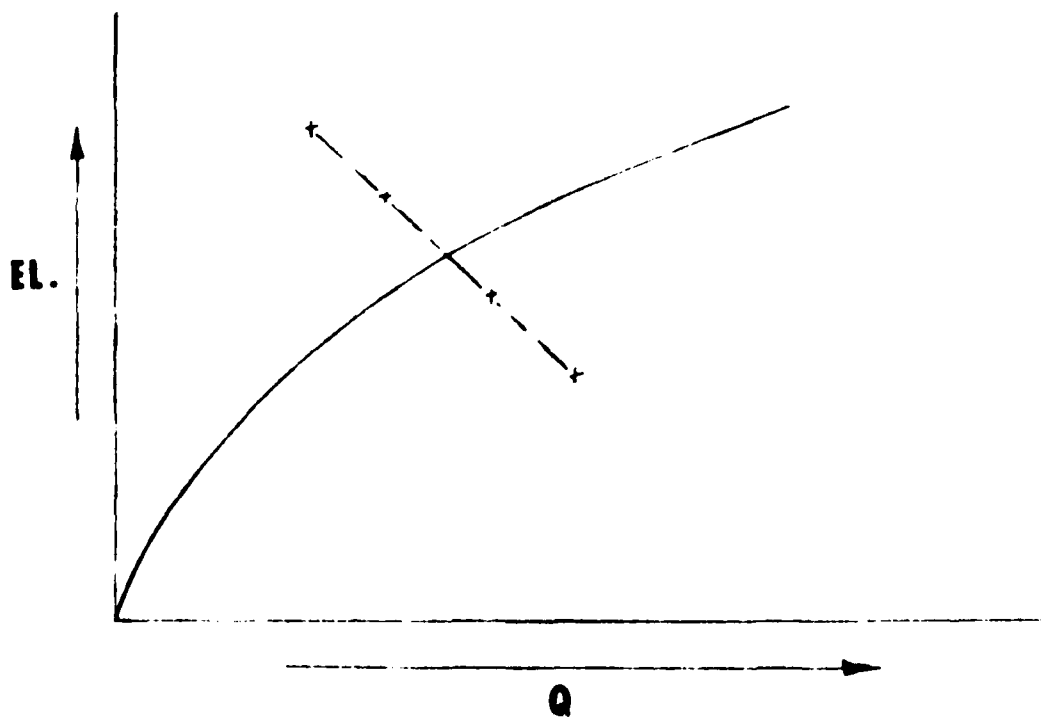
$$Q_{p2} = Q_{p1} - Q_{p1} \left(\frac{\text{STOR}}{19} \right)$$

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

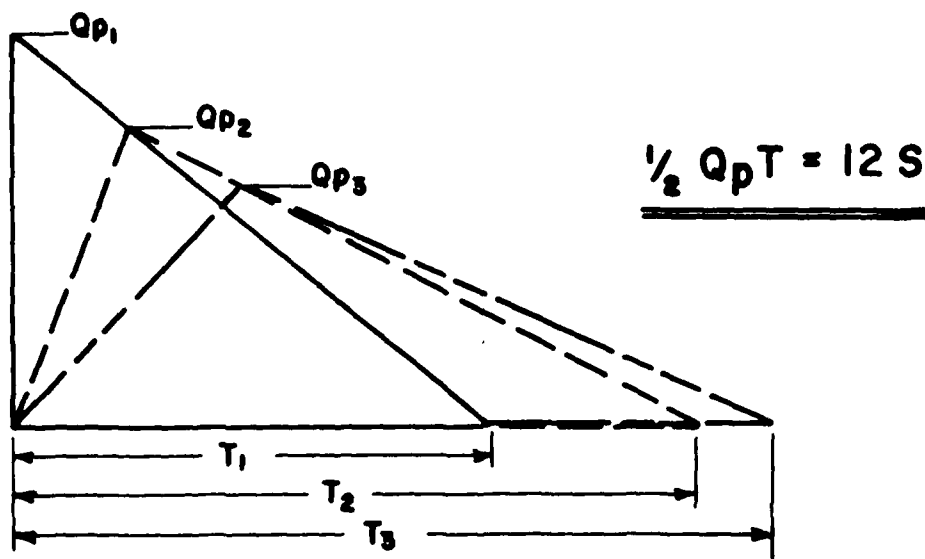
Q_{p2}
=====

STOR
=====

EL.
=====



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



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

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

$$Q_{p1} = \frac{8}{27} W_b \sqrt{g} Y_0^{3/2}$$

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

Y_0 = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPD 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} .

$$Q_{p2}(\text{TRIAL}) = Q_{p1} \left(1 - \frac{V_1}{S}\right)$$

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

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

$$Q_{p2} = Q_{p1} \left(1 - \frac{V_{\text{avg}}}{S}\right)$$

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

APRIL 1978

APPENDIX E

**INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS**



INVENTORY OF DAMS IN THE UNITED STATES

STATE	DIVISION	COUNTY	COUNTY	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE
CT	472	NFD	CT 011 02	VERSAILLES POND	4136.1	7202.7	1RSEP80

POPULAR NAME	NAME OF IMPOUNDMENT
VERSAILLES POND	VERSAILLES POND
REGION BASIN	RIVER OR STREAM
0119	LITTLE RIVER
NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	POPULATION
VERSAILLES	350

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FEET)	HYDRAULIC HEIGHT (FEET)	IMPOUNDING CAPACITIES (ACRES-FT.)
RENTPG	1920	R	23	23	1000

DIST OWN FED R PRV/FED SC2 A VER/DATE
MED N N N N

REMARKS
21-MASONRY

D/S HAS GRES LENGTH	SPILLWAY TYPE	MAXIMUM DISCHARGE (CY)	VOLUME OF DAM (CY)	POWER CAPACITY (KW)	INSTALLED PARALLEL NO.	LENGTH WIDTH LENGTH WIDTH LENGTH WIDTH	NAVIGATION LOCKS
2	400	124	13000				

OWNER	ENGINEERING BY	CONSTRUCTION BY
FEDERAL PARKWARD CO	UNKNOWN	UNKNOWN

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	CT DEP	CT DEP

INSPECTION BY	INSPECTION DATE	AUTHORITY FOR INSPECTION
CAHN ENGINEERS INC	02JUN80	PL 92-367

REMARKS

END

FILMED

DTIC