CONNECTICUT RIVER BASIN

OLD SAYBROOK, CONNECTICUT

OBED HEIGHTS RESERVOIR DAM
CT 00414

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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The project is approximately 465 feet in length including a 27 foot long masonry spillway. The dam is 22 feet in height and, with the reservoir level to the top of the dam, impounds approximately 250-acre-feet of water. Based upon the visual inspection at the site and past performance, the project is judged to be in poor condition. Obed Heights Reservoir Dam is classified as a high hazard, small size dam. The test flood range to be considered is from ½ to full PMF.

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

407-440

REPLY TO
ATTENTION OF:

NEDED

OCT 17 1980

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

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

A copy of this report has been forwarded to the 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, Mr. Carl Piontkowski, Old Saybrook, Conn.

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,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

CONNECTICUT RIVER BASIN

OLD SAYBROOK, CONNECTICUT

OBED HEIGHTS RESERVOIR DAM
CT 00414

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:	OBED HEIGHTS RESERVOIR DAM
Inventory Number:	CT 00414
State Located:	CONNECTICUT
County Located:	MIDDLESEX
Town Located:	OLD SAYBROOK
Stream:	RAGGED ROCK CREEK
Owner:	CARL PIONTKOWSKI
Date of Inspection:	MARCH 20, 1980
Inspection Team:	PETER HEYNEN, P.E.
	HECTOR MORENO, P.E.
	MIRON PETROVSKY
	THEODORE STEVENS
	ROBERT JAHN

The project, built in the 1880's, is approximately 465 feet in length including a 27 foot long masonry spillway. The dam is 22 feet in height and, with the reservoir level to the top of the dam, impounds approximately 250 acre-feet of water. The height of the embankment above the spillway crest varies from 3.3 feet to 4.0 feet. The embankment, which reportedly contains a concrete corewall, has a top width of approximately 10 feet, an upstream slope inclination of 2 horizontal to 1 vertical, and a downstream slope inclination varying between 2 horizontal to 1 vertical and 1 horizontal to 1 vertical. The spillway is a broad-crested weir with a crest length of 27 feet and is located at the left end of the dam. Reportedly, the outlet works consist of a submerged intake structure and an 8 inch diameter water supply main through the dam with outlet valves located approximately 1000 feet from the dam.

Based upon the visual inspection at the site and past performance, the project is judged to be in poor condition. There is seepage, which requires monitoring; areas such as the dense vegetation on the dam, the irregular shape of the embankment, erosion of the upstream slope, and deterioration of the masonry spillway, which require maintenance; and the questionable condition of the low-level outlet works which requires further investigation.

In accordance with the Army Corps of Engineers' Guidelines, Obed Heights Reservoir Dam is classified as a high hazard, small size dam. The test flood range to be considered is from one-half to full Probable Maximum Flood (PMF). The test flood for Obed Heights Reservoir Dam is equivalent to the 1/2 PMF. Peak inflow to the reservoir at the 1/2 PMF is 300 cubic feet per second (cfs); peak outflow is 180 cfs with the dam retaining a freeboard of 1.6 feet to the lowest point along the top of the dam. The spillway capacity, with the reservoir level to the low point of the top of the dam, is 480 cfs, which is equivalent to 270% 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 and brush from the dam, and regrading the dam and to investigate the origin and significance of seepage through the dam and the condition of the low-level outlet works. 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 (1) year of the owner's receipt of this report.

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

C. Michael Horton, P.E.
Department Head
Cahn Engineers, Inc.

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

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Design 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 <u>not</u> 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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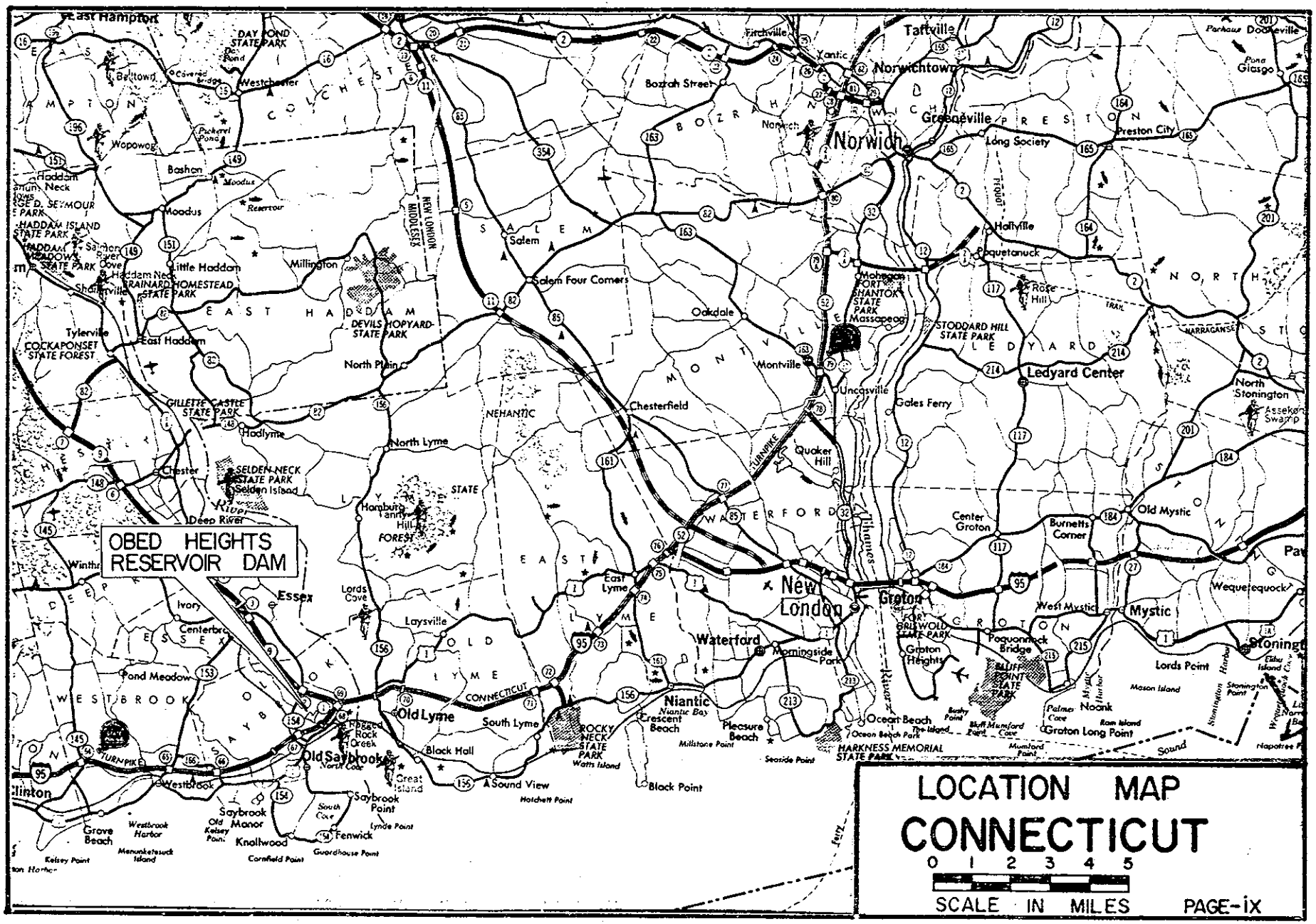
OVERVIEW PHOTO
(February, 1980)

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	Obed Heights Reservoir Dam	Old Saybrook	DATE May 1980
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED DAMS	Ragged Rock Creek	CONNECTICUT	CE # 27 785KA PAGE viii


OBED HEIGHTS
RESERVOIR DAM
LOCATION MAP
CONNECTICUT
0 1 2 3 4 5
SCALE IN MILES
East Hampton
Westchester
Bozrah Street
Taftville
Norwichtown
Greeneville
Norwich
Preston City
Long Society
Hallville
Poquetanuck
Mohegan
FORT SHANTOK STATE PARK
Massapeag
STODDARD HILL STATE PARK
Ledyard Center
North Stonington
Wopowog
Bashan
Moodus
Little Haddam
Millington
Salem
Salem Four Corners
Oakdale
Montville
Uncasville
Gales Ferry
Chesterfield
Quaker Hill
Center Groton
Burnetts Corner
Old Mystic
Mystic
Wequetequock
Stonington
Lords Point
Noank
Groton Long Point
Poquonnock Bridge
Groton Heights
Groton
New London
Waterford
Morningside Park
Niantic
Crescent Beach
Pleasure Beach
Ocean Beach
HARKNESS MEMORIAL STATE PARK
ROCKY NECK STATE PARK
Black Point
Sound View
South Lyme
East Lyme
Laysville
Old Lyme
Black Hall
Old Saybrook
Great Island
Saybrook Point
Fenwick
Knollwood
Saybrook Manor
Westbrook
Grove Beach
Pond Meadow
Ivory
Centerbrook
Essex
Lords Cove
Hadlyme
North Lyme
Chester
Deep River
Winthrop
Hamburg
Tanner Hill
Selden Island
SELDEN NECK STATE PARK
GILLETTE CASTLE STATE PARK
COCKAPONSET STATE FOREST
Tylerville
East Haddam
North Plain
DEVILS HOPYARD STATE PARK
Haddam Neck
HADDAM ISLAND STATE PARK
Shailerville
Bozrah
Yantic
Firchville
Doodleville
Giasco
Pine Island
Parkers Island
Napatree Point
Watch Hill
Stonington Point
Mason Island
Palmer Cove
Ram Island
Mumford Point
Bluff Mumford Cove
Seaside Point
Millstone Point
Niantic Bay
Watts Island
Hotchkiss Point
Lynde Point
Guardhouse Point
Cornfield Point
Menunketesuck Island
Westbrook Harbor
Kelsey Point
Old Kelsey Poin.
South Cove
North Cove
Pleasant Rock Creek
Thames River
Mystic Harbor
Stonington Harbor
Sound
Ferry
Turnpike
Connecticut
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PHASE I INSPECTION REPORT

OBED HEIGHTS 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 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 Ragged Rock Creek in a rural area in the Town of Old Saybrook, County of Middlesex, State of Connecticut. The dam is shown on the Old Lyme USGS Quadrangle Map having coordinates latitude N41°18.6' and longitude W72°22.4'.

b. Description of Dam and Appurtenances - As shown on Sheet B-1, the dam is approximately 22 feet high and has a total length of approximately 465 feet, including a 27 foot long masonry spillway section. Since no elevations were available for the project, an assumed spillway crest elevation of 100.0 was used as a datum and all other elevations are referenced to it.

The top of the embankment is irregular, ranges in elevation from 103.3 to 104.0, and is approximately 10 feet wide. The downstream slope is also irregular, varying in inclination from 1:1 to 2:1. The upstream slope is at an inclination of 2:1 and is protected by riprap to the top of the embankment.

The masonry spillway section is located at the left end of the dam and is classified as a broad-crested weir of trapezoidal cross-section. The approach channel is shallow and has a stone paved bottom. The spillway crest is 27 feet in length and has a slot and brackets to accomodate flashboards. The crest is at the upstream end of a gently sloping, concrete capped, masonry apron, which has a 3 foot high (max.) vertical downstream face. The downstream channel is steeply sloping and has a bedrock bottom. The spillway training walls are of masonry construction with an inner and outer wall on each side of the spillway apron.

Reportedly, the outlet facilities consist of a submerged inlet on the upstream side of the dam leading to an 8 inch diameter conduit through the dam with valves and outlets some distance downstream near the Connecticut Turnpike.

c. Size Classification - (SMALL) - The dam impounds approximately 250 acre-feet of water with the lake level to the top of the dam which, at elevation 103.3, is approximately 22 feet above the streambed of Ragged Rock Creek. According to the Army Corps of Engineers' Recommended Guidelines, a dam with maximum storage between 50 and 1000 acre-feet is classified as small in size.

d. Hazard Classification - (HIGH) - If the dam were breached, there is potential for loss of more than a few lives and extensive damage to residential and commercial properties on both sides of the Connecticut Turnpike (See Sheet D-1 and Page D-6).

e. Ownership - Mr. Carl Piontkowski
38 Ridge Drive
Old Saybrook, Ct. 06475
(203) 388-2115 (Home)
(203) 388-3408 (Office)

The dam was originally built and owned by the Obed Water Company and at some unknown date sold to the New Haven Water Company. The Piontkowski family purchased the dam in the 1930's.

f. Operator - None

g. Purpose of Dam - Although used as a railroad and/or municipal water supply for many years, the reservoir is now used for recreational purposes.

h. Design and Construction History - Very little is known of the design and construction history of the dam. Reportedly, the dam was built in the 1880's and there is no record of any later changes to the structure.

i. Normal Operational Procedures - There are no operational procedures followed at the dam.

1.3 PERTINENT DATA

a. Drainage Area - The drainage area is 0.2 square miles of mostly undeveloped, rolling to mountainous terrain (See Sheet D-1).

b. Discharge at Damsite - Discharge is over the spillway and, if operable, through the 8 inch diameter water supply main.

1. Outlet Works (Conduits):	
8 inch supply main invert not known	Capacity not known
2. Maximum flood at damsite:	Not known
3. Ungated spillway capacity @ top of dam el. 104.0:	680 cfs
4. Ungated spillway capacity @ test flood el. 101.7:	180 cfs
5. Gated spillway capacity @ normal pool:	N/A
6. Gated spillway capacity @ test flood:	N/A
7. Total spillway capacity @ test flood el. 101.7:	180 cfs
8. Total project discharge @ top of dam el. 104.0:	N/A
9. Total project discharge @ test flood el. 101.7:	180 cfs

c. Elevations - Elevations are based on an assumed spillway crest elevation of 100.0.

1. Streambed at toe of dam:	82.0±
2. Bottom of cutoff:	N/A
3. Maximum tailwater:	Not known
4. Normal pool:	100.0±
5. Full flood control pool:	N/A
6. Spillway crest (ungated):	100.0 (Assumed datum)
7. Design surcharge (original design):	Not known
8. Top of dam:	104.0
9. Test flood surcharge:	101.8

d. Reservoir Length

1. Normal pool:	1,200± ft.
2. Flood control pool:	N/A
3. Spillway crest pool:	1,200± ft.
4. Top of dam pool:	1,400± ft.
5. Test flood pool:	1,300± ft.

e. Reservoir Storage

1. Normal pool:	175± acre-ft.
2. Flood control pool:	N/A
3. Spillway crest pool:	175± acre-ft.
4. Top of dam pool:	250± acre-ft.
5. Test flood pool:	210± acre-ft.

f. Reservoir Surface

1. Normal pool:	21± acres
2. Flood control pool:	N/A
3. Spillway crest pool:	21± acres
4. Top of dam pool:	26± acres
5. Test flood pool:	22± acres.

g. Dam

1. Type:	Earth embankment
2. Length:	465± ft.
3. Height:	22± ft.
4. Top width:	10 ± ft.
5. Side slopes:	2H to 1V (Upstream) Downstream slope varies between 1H to 1V and 2H and 1V
6. Zoning:	N/A
7. Impervious core:	Concrete corewall
8. Cutoff:	N/A
9. Grout curtain:	N/A
10. Other:	N/A

h. Diversion and Regulating Tunnel - N/A

i. Spillway

1. Type:	Broad-crested stone masonry
2. Length of weir:	27 ft.
3. Crest elevation:	100.0 (Assumed datum)
4. Gates:	N/A
5. Upstream channel:	Shallow, stone pavement
6. Downstream channel:	Bedrock
7. General:	N/A

j. Regulating Outlets

Supply main

1. Invert:	Not known
2. Size:	8" diameter
3. Description:	Not known
4. Control mechanism:	Not known
5. Other:	Intake submerged; located 200+' from right abutment 30+' from waterline on U/S slope

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 dated June, 1963.

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 hydrologic estimates.

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 many areas requiring maintenance, repair and monitoring. At the time of the inspection, the reservoir level was at elevation 100.02, i.e. 0.02 feet above the spillway crest.

b. Dam

Top of Dam - The top of the embankment is irregular and heavily wooded with large trees. There is a footpath along the entire length of the embankment (Photos 1 & 4).

Upstream Slope - There is erosion along the entire length of the upstream slope at the elevation of the normal reservoir level. Riprap is displaced and missing in many areas and there are many large trees growing on the slope.

Downstream Slope - The downstream slope is irregular, eroded and heavily wooded with brush and large trees of 12 to 18 inches in diameter (Photo 2). There is an approximately 3 foot deep depression and berm at the toe of the slope near the right abutment (See Sheet B-1). The slope is steep and varies in inclination from 1:1 to 2:1. There are a number of extensive wet, swampy areas at the toe of the embankment. Seepage was noted under several large uprooted trees with brown fine sand and silt being deposited by the flows (Photo 3). A seep on the left side of the slope near the spillway 8 to 10 feet below the top of the dam had a measured flow rate of 2 gallons per minute (gpm). A large seepage flow was observed at the left-central portion of the toe approximately 50 feet from the embankment. The flow rate in this area is approximately 50 gpm; however, it could not be determined if this flow comes from through the dam or from a natural high groundwater condition in the area.

Spillway - The riprapped floor of the spillway approach channel is in good condition with some overhanging trees on the left side. Debris, such as logs and planks, was observed in the spillway approach channel, on the spillway apron, and in the spillway discharge channel. The concrete cap of the masonry spillway apron is severely cracked and there is a 6 inch deep cavity near its downstream edge. The downstream face of the spillway apron is eroded and is seeping in several areas with flows of 2 to 4 gpm. There is extensive cracking of the concrete coping and the mortar joints of the masonry spillway training walls. Erosion of the upstream portion of the right training wall was observed over an area of 1 foot in height and 1.5 feet in length. The natural bedrock downstream channel is obstructed by wood and other debris. Approximately 20 feet of the left bank of the downstream channel is protected by large boulders; however, 10 feet of this bank, adjacent to the spillway, is unprotected and erosion has occured in this area (Photos 4, 5 & 6).

c. Appurtenant Structures - At the time of inspection, the inlet to the old water supply line was submerged and could not be inspected. Also, the water supply line and any possible outlets or blowoffs from the line could not be located or inspected.

d. Reservoir Area - The area surrounding the reservoir is generally wooded and mostly undeveloped.

e. Downstream Channel - The downstream channel is the natural streambed of Ragged Rock Creek with a steep-sided left bank and an extensive wooded, swamp to the right side.

3.2 EVALUATION

Based upon the visual inspection, the project is assessed as being in poor condition. The following features which could influence the future condition and/or stability of the project were identified:

1. The top of the dam is irregular in elevation and the downstream slope is irregular in inclination.

2. There is erosion of the upstream slope, and the riprap is not sufficient to prevent further deterioration of the slope.

3. Seepage and wet areas on the downstream slope and at the toe of the embankment could increase and lead to stability problems.

4. Large trees on the crest and downstream slope of the embankment could be uprooted, causing extensive damage to the embankment and further increasing seepage through the dam.

5. Seepage through the spillway section and deterioration of the spillway apron and training walls could cause structural failures of these portions of the dam, thus hindering the performance of the spillway.

6. The apparent absence of an operable low-level outlet for the project does not permit a drawdown of the reservoir in emergency situations.

SECTION 4: OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES

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

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 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 watershed is 0.2 square miles of mostly undeveloped, rolling to mountainous, wooded terrain. The dam impoundment is presently used for recreational purposes.

The dam is basically a high surcharge storage - low spillage type project. The available storage reduces the outflow from a Probable Maximum Flood (PMF) of 600 cubic feet per second (cfs) to 390 cfs and the ½ PMF outflow from 300 cfs to 180 cfs.

5.2 DESIGN DATA

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

5.3 EXPERIENCE DATA

To the best of the owner's knowledge, the dam has not been overtopped in the 40± years that his family has owned it. No other information is available.

5.4 VISUAL OBSERVATIONS

It was noted that first overflow of the embankment would occur at its low point of elevation 103.3. The spillway capacity includes a small amount of overflow of the lower, inner spillway training walls.

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 (rolling to mountainous) and the watershed area of 0.2 square miles, a PMF of 600 cfs or 3000 cfs per square mile is estimated at the damsite. In accordance with the size (small) and hazard (high) classification, the range of test floods to be considered is from the ½ PMF to the PMF. Based on the degree of hazard associated with a breach of the dam, the test flood for Obed Heights Reservoir Dam is equivalent to the ½ PMF. Assuming the reservoir level at the spillway crest at the beginning of the test flood, peak inflow is 300 cfs; peak outflow is 180 cfs and this flow is contained within the spillway with 1.6 feet of freeboard to the low point of the dam (Appendix D-2 & D-5). Based on hydraulics computations, the spillway capacity to the top of the dam is 480 cfs, which is equivalent to 270% of the routed test flood outflow.

5.6 DAM FAILURE ANALYSIS

The dam failure analysis is based on the April, 1978 Army Corps of Engineers "Rule of Thumb Guidance for Downstream Dam Failure Hydrographs". Peak outflow before failure of the dam would be about 180 cfs and the peak failure outflow from the dam breaching would total about 25,000 cfs. With the prefailure pool 1.6 feet below the top of the dam, a breach of the dam would result in a rise in the water level of the stream at the initial impact area, from a negligible depth just before the breach to a depth of about 8.7 feet shortly after the breach. Depending on the location of the breach and the stability of the I-95 highway embankment, various clusters of houses could be inundated to a depth of 7.3 feet by the rapid increase in the water level, causing severe economic loss and the loss of more than a few lives (D-9, D-10). Based on the dam failure analysis, Obed Heights Reservoir Dam is classified as a high hazard dam.

SECTION 6: EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS

The visual inspection did not reveal any indication of immediate stability problems. There are areas of erosion, seepage through the embankment, and deterioration of the spillway section, as described in Section 3. They are not considered to be stability concerns at the present time; however, if left unattended, they are potential problem areas.

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 embankment and masonry spillway are both in poor condition with areas which require maintenance, repair and monitoring.

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 reservoir at test flood is 300 cfs; peak outflow is 180 cfs with the dam maintaining 1.6 feet of freeboard to the lowest point of the embankment. The spillway capacity to the low point of the embankment is 480 cfs which is equivalent to approximately 270% 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 immediately upon 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. Removal of all trees and brush from the dam and from within 10 feet of the toe. This should include removal of root systems, proper backfilling and regrading of eroded areas.

2. Determination of the location and condition of the low-level intake structure, conduit and outlet structure(s). This study should establish whether repair or replacement of the outlet works is required.

3. Determination of the origin and significance of seepage through the spillway and embankment, particulary the origin of the seepage at the left central area of the downstream toe of the dam.

4. Based upon the findings of item 3, above, a program to monitor or eliminate seepage through the embankment and masonry spillway should be developed.

5. Detailed topographical survey of the project with preparation of a drawing for future reference.

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. Seepage quantities through the embankment and the masonry spillway should be monitored periodically to detect any possible changes in seepage. Special attention should be given to the seepage source at the left-central portion of the toe. The flow rate of this source and the turbidity of the seepage water should be monitored monthly.

5. Erosion along the upstream slope of the embankment should be filled and adequate riprap protection placed.

6. Cracked and eroded areas of the spillway apron and training walls should be repaired. These areas include the eroded area of the right training wall, the cracked spillway apron, the cracked mortar joints of the training walls, the eroded downstream face of the spillway and the 6 inch deep cavity in the spillway apron.

7. The spillway apron and spillway channel should be cleared of any debris and kept clear as part of the regular maintenance of the dam.

8. The missing boulders along the left side of the downstream spillway channel should be replaced to protect this area from soil erosion.

9. Grass cover should be established on the embankment. The cutting of grass, brush and trees on the crest, slopes, within 10 feet of the toe of the embankment, and on the masonry spillway should be performed as part of the routine maintenance procedures for the dam.

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 Obed Heights Reservoir Dam DATE: Mar. 20, 1980

TIME: 10:00 am

WEATHER: Sunny, 45°

W.S. ELEV. 100.02± U.S. _____ DN.S

PARTY:	INITIALS:	DISCIPLINE:
1. Peter Heynen	PH	Geotechnical
2. Miron Petrovsky	MP	Geotechnical
3. Theodore Stevens	TS	Geotechnical
4. Hector Moreno	HM	Hydraulics
5. Robert Jahn	RJ	Hydraulics
6. M. Norman, T. Kavanaugh		Survey

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Earth Embankment	PH, MP, TS, HM, RJ	Poor Condition
2. Masonry Spillway	PH, MP, TS, HM, RJ	Poor Condition
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

PERIODIC INSPECTION CHECK LIST

Page A-2

PROJECT Obed Heights Reservoir Dam DATE 3-20-80

PROJECT FEATURE Earth Embankment BY PH, MP, TS, HM, RJ

AREA EVALUATED		CONDITION
DAM EMBANKMENT		
Crest Elevation		Irregular; 103.3± - 104.0±
Current Pool Elevation		100.02
Maximum Impoundment to Date		Not known
Surface Cracks		None observed
Pavement Condition		N/A
Movement or Settlement of Crest		Too irregular to judge
Lateral Movement		
Vertical Alignment		
Horizontal Alignment		
Condition at Abutment and at Concrete Structures		Fair
Indications of Movement of Structural Items on Slopes		None observed
Trespassing on Slopes		yes - extensive on top & slopes
Sloughing or Erosion of Slopes or Abutments		Irregularly shaped berm at right abutment
Rock Slope Protection-Riprap Failures		yes - riprap missing & displaced
Unusual Movement or Cracking at or Near Toes		None observed other than uprooted trees
Unusual Embankment or Downstream Seepage		Substantial seepage at toe
Piping or Boils		None observed
Foundation Drainage Features		N/A
Toe Drains		N/A
Instrumentation System		N/A

PERIODIC INSPECTION CHECK LIST

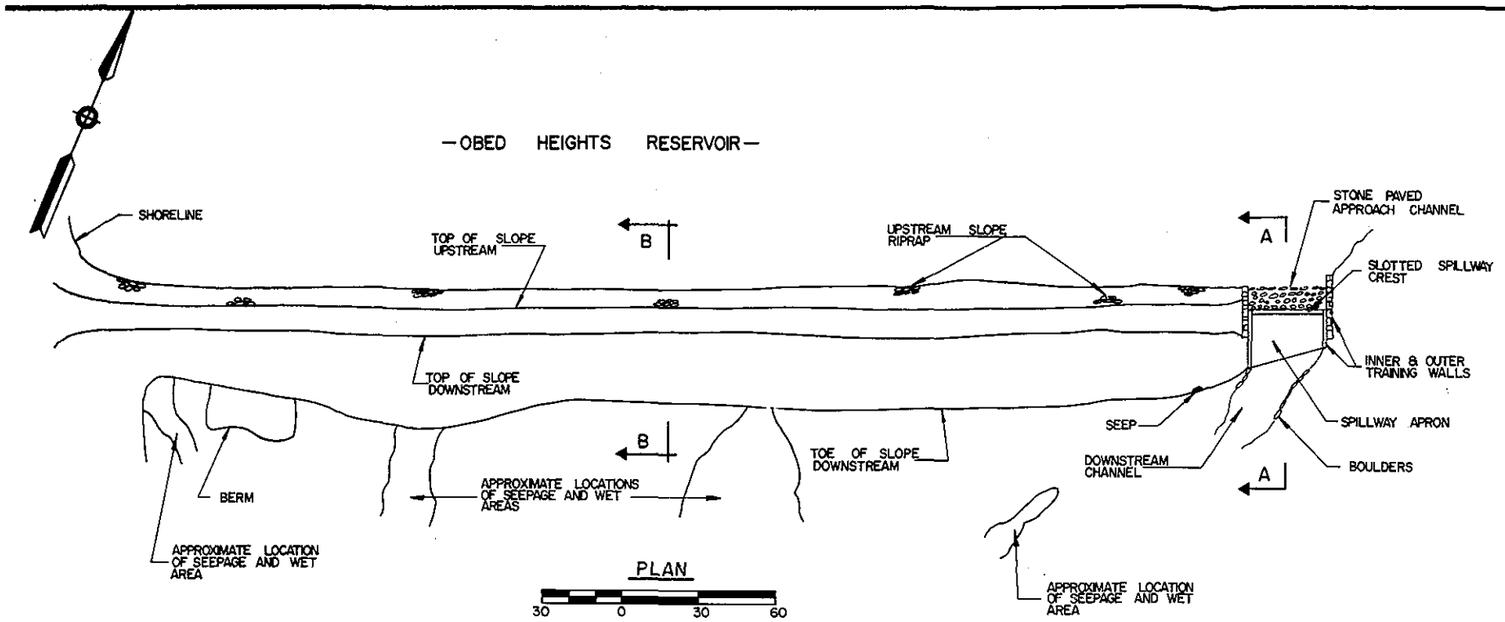
PROJECT Obed Heights Reservoir Dam DATE 3-20-80

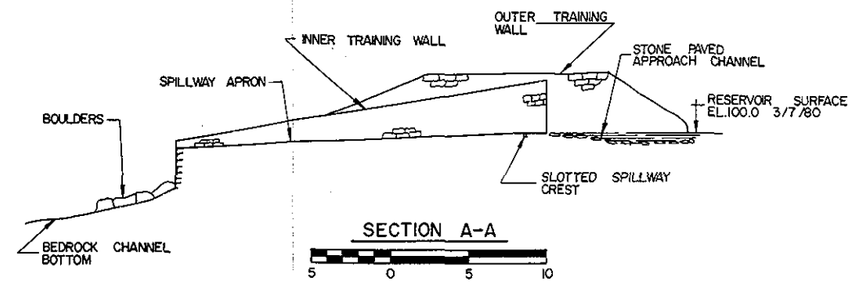
PROJECT FEATURE Masonry Spillway BY PH, MP, TS, HM, RJ

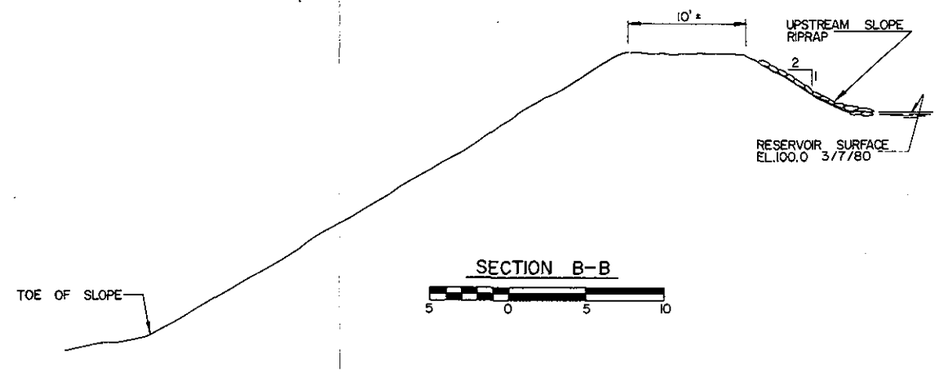
AREA EVALUATED		CONDITION
OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS		
a) Approach Channel		
General Condition		Good
Loose Rock Overhanging Channel		No
Trees Overhanging Channel		Some-not a problem
Floor of Approach Channel		Stone pavement
b) Weir and Training Walls		
General Condition of ~~Concrete~~ Masonry		Poor
Rust or Staining		None observed
Spalling		yes-training walls & apron, also extensive cracking of both
Any Visible Reinforcing		None observed
Any Seepage or Efflorescence		None observed
Drain Holes		No
c) Discharge Channel		
General Condition		Poor
Loose Rock Overhanging Channel		No
Trees Overhanging Channel		yes
Floor of Channel		Bedrock
Other Obstructions		yes-miscellaneous debris

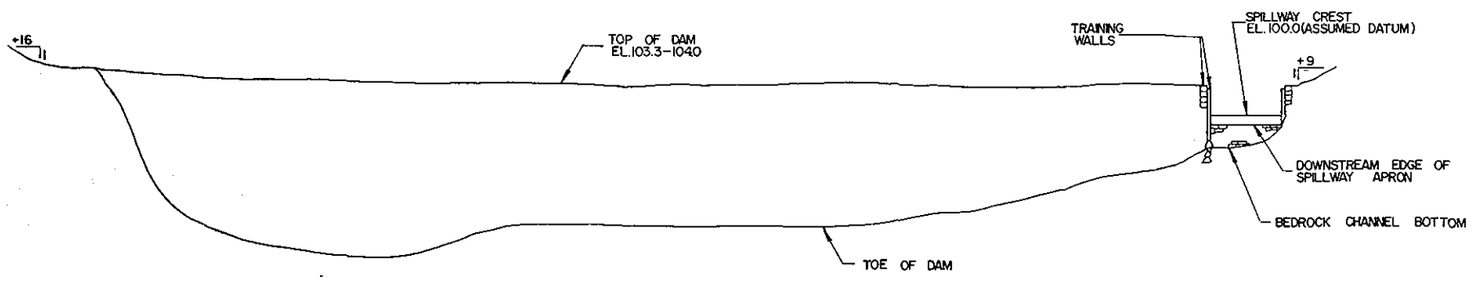
APPENDIX B

ENGINEERING DATA AND CORRESPONDENCE









NOTES

1. THIS PLAN WAS COMPILED FROM A CAHN ENGINEERS INSPECTION OF THE DAM DATED MARCH 7, 1980. DIMENSIONS SHOWN ARE APPROXIMATE. NOT ALL TOPOGRAPHIC AND/OR STRUCTURAL FEATURES ARE NECESSARILY IDENTIFIED.
2. NO ELEVATIONS WERE AVAILABLE FOR THE DAM, AND NO WATER SURFACE ELEVATION FOR THE POND IS SHOWN ON THE U.S.G.S. ESSEX OR OLD SAYBROOK QUADRANGLE MAPS. THEREFORE, 100.0 WAS ASSUMED AS THE ELEVATION OF THE SPILLWAY CREST.
   ALL OTHER ELEVATIONS SHOWN ARE REFERENCED TO THE ASSUMED SPILLWAY CREST ELEVATION.

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

PLAN, ELEVATION & SECTIONS

OBED HEIGHTS RESERVOIR DAM

RAGGED ROCK CREEK OLD SAYBROOK, CONNECTICUT

DRAWN BY	CHECKED BY	APPROVED BY	SCALE: AS NOTED	
H. Dolman	TJS	PMH	DATE: MAY 1980	SHEET B-1

JNE 1963
PS

STATE BOARD FOR THE SUPERVISION OF DAMS
INVENTORY DATA

1

CT-414

Name of Dam or Pond OBED HEIGHTS RESERVOIR

Code No. C 1 4 RR 1 5

Long 72-22 1

Location of Structure

LAT 41-18.6

Town OLD SAYBROOK

Name of Stream RAGGED ROCK CREEK

U.S.G.S. Quad. OLD LYME

Owner Spring Brook Development Corp.

Address c/o RICHARD T. O'CONNELL
29 ELM STREET
OLD SAYBROOK, CONN.

OK 1/13

Pond Used For RECREATION

DA 0.20 SM

Dimensions of Pond: Width 800 FEET Length 1100 FEET Area 20.2 ACRES

Total Length of Dam 460 FEET Length of Spillway 30 FEET

Depth of Water Below Spillway Level (Downstream) 15 FEET

Height of Abutments Above Spillway 4 FEET

Type of Spillway Construction CONCRETE APRON

Type of Dike Construction ROCK AND EARTH

Downstream Conditions WOODS, CONNECTICUT TURNPIKE AND HOUSES

Summary of File Data

Remarks LARGE DAM, FAILURE COULD CAUSE DAMAGE DOWNSTREAM. MANY TREES GROWING ON DAM.

APPENDIX C

DETAIL PHOTOGRAPHS

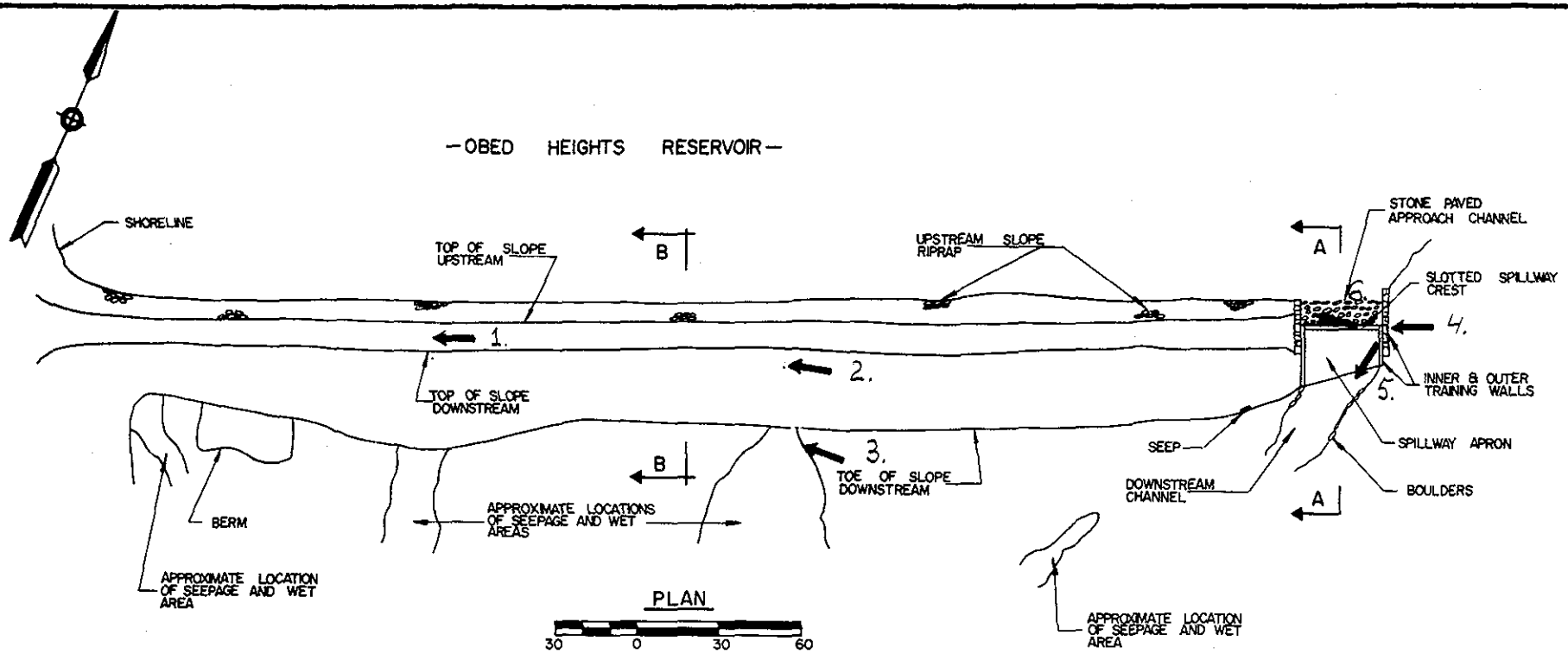


PHOTO LOCATION PLAN

OBED HEIGHTS RESERVOIR DAM

SHEET C-1

Photo 1 - Top of embankment (3/20/80).

Photo 2 - Downstream slope of embankment (3/20/80).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	Obed Heights Res. Dam Ragged Rock Creek Old Saybrook, Conn.
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED. DAMS	CE# 27 785 KA DATE May '80 PAGE C-1

Photo 3 - Seepage from under uprooted tree at toe of embankment. Note uprooted trees in background (3/20/80).

Photo 4 - View of spillway and embankment from left abutment (3/20/80).

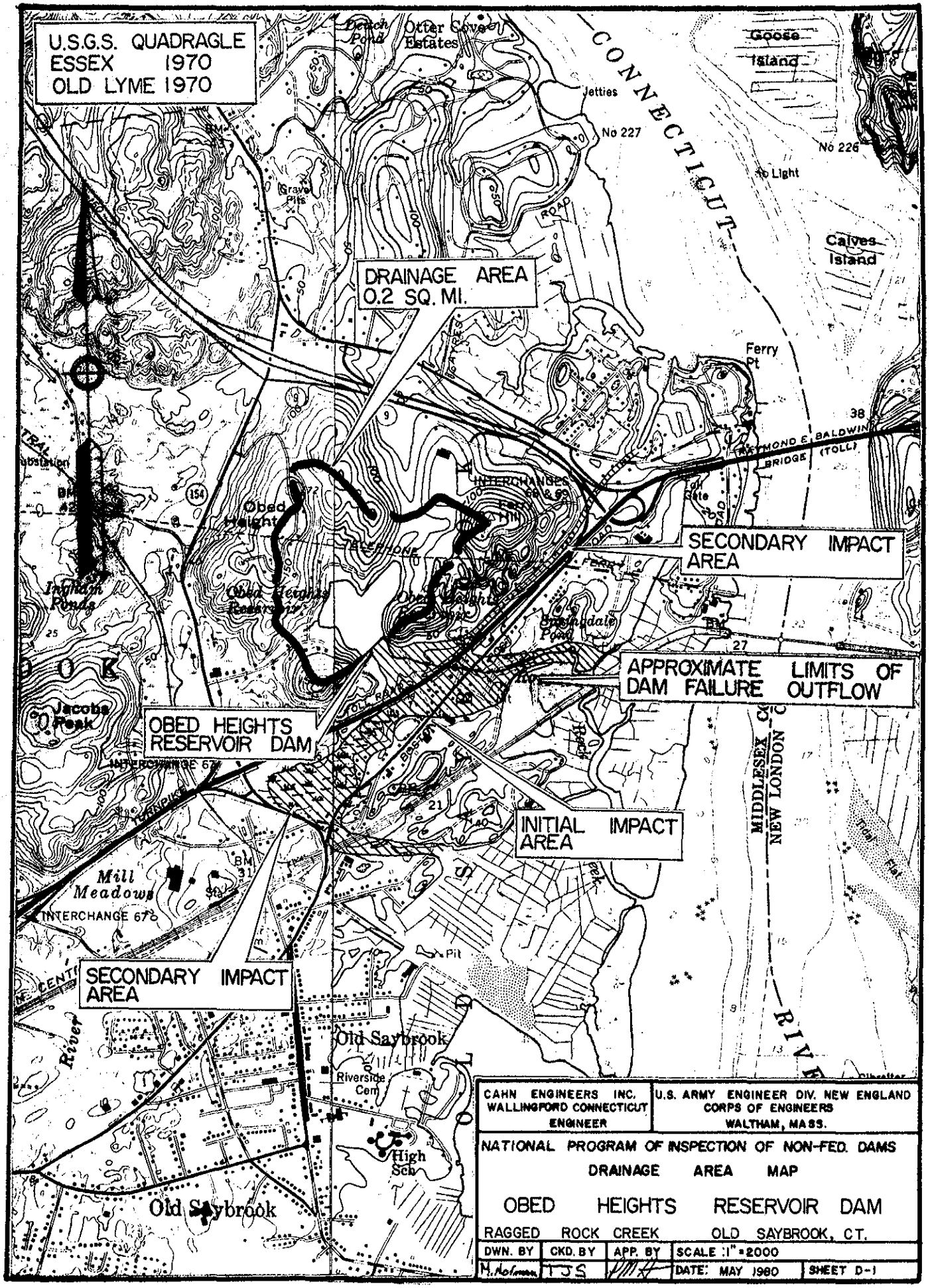
Photo 5 - Spillway discharge channel (3/20/80).

Photo 6 - Erosion and cracking of right spillway training wall (3/20/80).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Obed Heights Res. Dam Ragged Rock Creek Old Saybrook, Conn. CE# 27 /85 KA
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER		DATE May '80 PAGE C-3

APPENDIX D

HYDRAULICS/HYDROLOGIC COMPUTATIONS



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

OBED HEIGHTS RESERVOIR DAM

RAGGED ROCK CREEK OLD SAYBROOK, CT.

DWN. BY	CKD. BY	APP. BY	SCALE :1" = 2000	
M. Hofman	TJS		DATE: MAY 1980	SHEET D-1

HYDROLOGIC/HYDRAULIC INSPECTION

OBED HEIGHTS RESERVOIR DAM, OLD SAYBROOK, CT.

I) PERFORMANCE AT PEAK FLOOD CONDITIONS:

1) PROBABLE MAXIMUM FLOOD (PMF):

a) WATERSHED CLASSIFIED AS "ROLLING" TO "MOUNTAINOUS"

b) WATERSHED AREA: DA = 0.2 sq mi

NOTE: D.A. FROM CONN. DEP. BULLETIN No 1, 1972 (GAZETTEER OF NATURAL DRAINAGE AREAS) p. 43.

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

i) FROM GUIDE CURVES BY EXTRAPOLATION TO D.A. < 2 sq mi:

CSM = 3000 cfs/sq mi

ii) PMF = 3000 × 0.2 = 600 cfs

iii) ½ PMF = 300 cfs

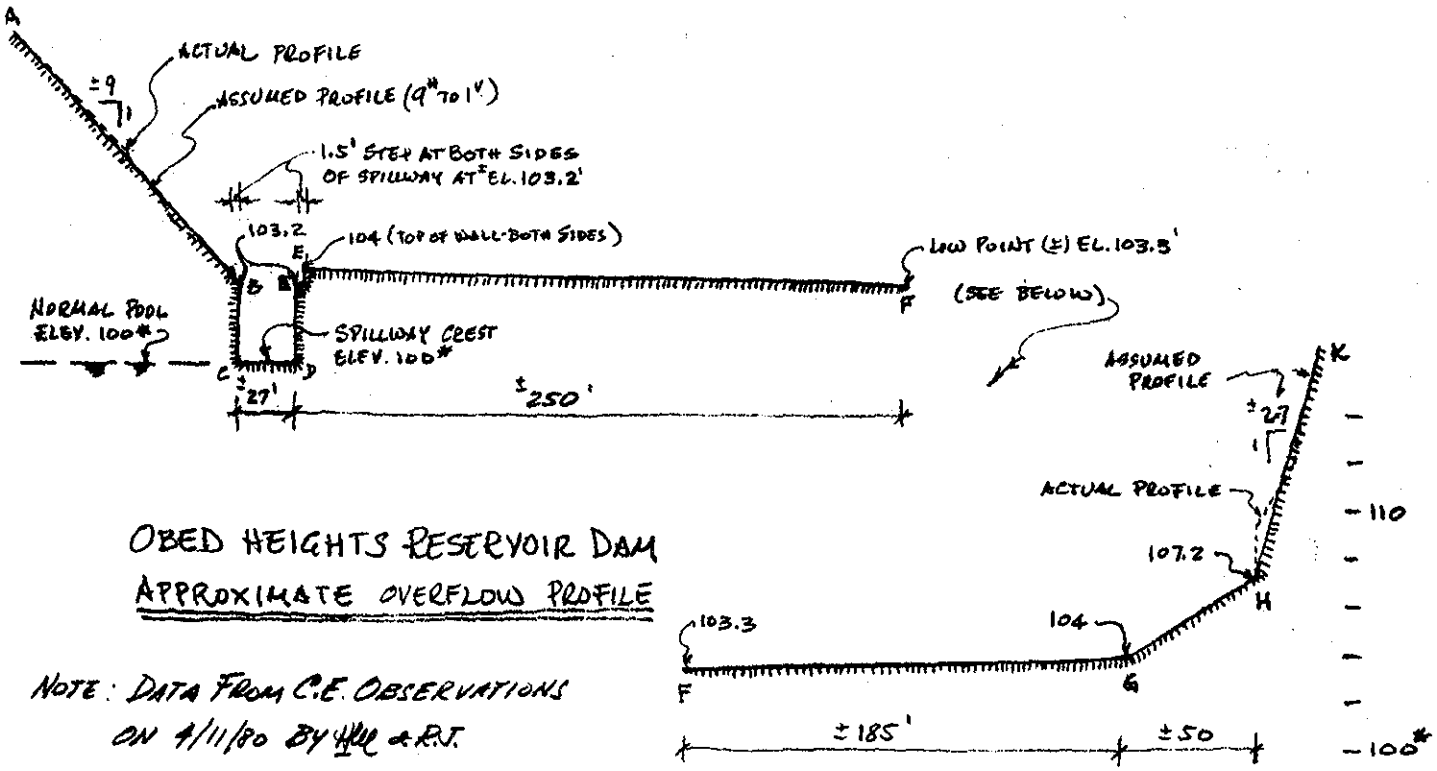
2) SURCHARGE AT PEAK INFLOWS (PMF AND ½ PMF)

a) OUTFLOW RATING CURVE

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

SPILLWAY (±) 27' LONG (SEE OVERFLOW PROFILE p. D-2), BROAD CRESTED, U/S STONE PAVED APPROACH AND D/S CONCRETE PAVED APRON, BOTH AT VERY FLAT SLOPES (± 20H TO 1V).
THE DAM AND ADJECENT TERRAIN ARE WOODED AND COVERED BY UNDERBRUSH.

ASSUME C=3.1 FOR THE SPILLWAY FLOW AND C=2.5 FOR THE DAM AND ADJACENT TERRAIN.



OBED HEIGHTS RESERVOIR DAM
APPROXIMATE OVERFLOW PROFILE

NOTE: DATA FROM C.E. OBSERVATIONS ON 4/11/80 BY HCL & R.J.

NOTE: NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF OBED HEIGHTS RESERVOIR DAM IS NOT AVAILABLE. THEREFORE, ELEV. 100' ABOVE AN ASSUMED DATUM IS USED AS SPILLWAY CREST ELEVATION. FROM THE CONTOURS ON THE U.S.G.S. OLD LYME, CT. QUAD. SHEET, THE ASSUMED ELEV. 100' CORRESPONDS TO (±) ELEV. 61' NGVD (TOP OF DAM (±) ELEV. 65' NGVD)

ii) THEREFORE, ASSUMING EQUIVALENT LENGTHS FOR THE SLOPING TERRAIN, THE OVERFLOW RATING CURVE FOR THE SURCHARGE (H) ABOVE THE SPILLWAY CREST CAN BE APPROXIMATED AS FOLLOWS:

1') SECTION AB: $Q_{AB} = \frac{2}{3} \times 9 \times 2.5 (H-3.2)^{5/2} = \underline{\underline{15(H-3.2)^{5/2}}}$

2') SPILLWAY (SECTION CD) - (NEGLECT OVERFL. EE, $\approx 3^{CFS}$)

$$Q_S = Q_{CD} = 3.1 \times 27 \times H^{3/2} \approx \underline{\underline{83.7 H^{3/2}}}$$

3') SECTION EFG (ABOVE LOW PT. AT F)

$$(Q_{EFG})_1 = \frac{2}{3} \times \frac{435}{0.7} \times 2.5 (H-3.3)^{5/2} = \underline{\underline{1036 (H-3.3)^{5/2}}} \quad H \leq 4'$$

$$(Q_{EFG})_2 = 2.5 \times 435 \times (H-3.47)^{3/2} = \underline{\underline{1088 (H-3.47)^{3/2}}} \quad H > 4'$$

4') SECTION GH:

$$(Q_{GH})_1 = \frac{2}{3} \times \frac{50}{3.2} \times 2.5 (H-4)^{5/2} = \underline{\underline{26 (H-4)^{5/2}}} \quad H \leq 7.2'$$

EQUATIONS FOR $H > 7.2'$ ARE NOT REQUIRED.

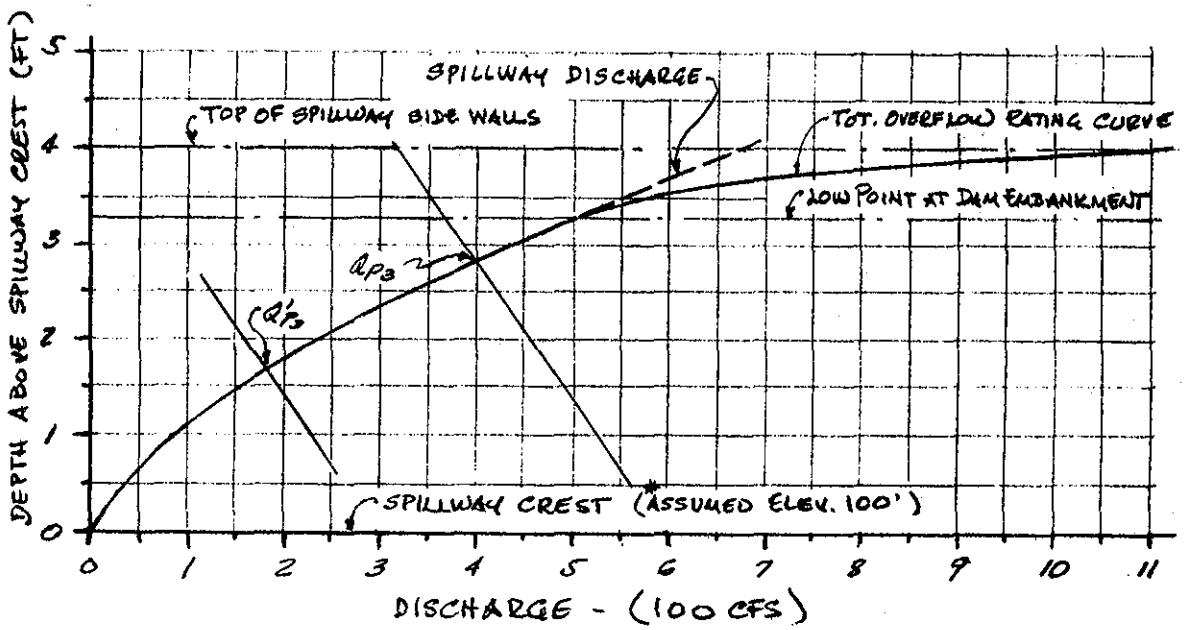
THEREFORE, THE TOTAL OVERFLOW IS APPROXIMATED BY THE SUM OF ALL THE APPLICABLE FORMULAE ON ITEMS (1') TO (4'), AND THE CORRESPONDING CURVE IS PLOTTED ON p. D-4

b) SURCHARGE HEIGHT TO PASS PEAK INFLOWS (Q_P & Q_P')

i) @ $Q_P = PMF \approx 600^{CFS}$ $(H_1)_1 \approx 3.6'$ (W/ LOW PT. OVERFLOW)
$(H_1)_2 \approx 3.7'$ (W/O LOW PT. OVERFLOW)

ii) @ $Q_P' = \frac{1}{2} PMF \approx 300^{CFS}$ $H_1' \approx 2.4'$ (BELOW LOW POINT)

OBED HEIGHTS RESERVOIR DAM - OUTFLOW RATING CURVE



*SEE NOTE p. D-2

c) EFFECT OF SURCHARGE STORAGE - PEAK OUTFLOWS:

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

1') LAKE AREA AT FLOW LINE (ASSUMED @ (±) EL. 61' NGVD): $A_{NL} \cong 21^{AC}$
2') AREA AT CONTOUR 70' NGVD (MCL)* $A_{70} \cong 34^{AC}$

∴ AVE. AREA WITHIN MAX EXPECTED SURCHARGE ((±)3.5'): $\bar{A} \cong 24^{AC}$ (BY LINEAR INTERPOLATION: (±) A@5.5' NGVD)

*NOTE: AREAS FROM USGS, ESSEX AND OLD LYME, CT. QUAD. SHEETS - SCALE 1"=2000'

ii) ASSUME NORMAL POOL AT FLOW LINE (ELEV. 100' DATUM)

iii) WATERSHED D.A. $\cong 0.2^{sq\ mi}$ (SEE p. D-1)

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

(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 R.O. IN NEW ENGLAND)

$Q_{P_3} \cong 390^{CFS}$ $H_3 \cong 2.8'$

$Q'_{P_3} \cong 180^{CFS}$ $H'_3 \cong 1.7'$

3) SPILLWAY CAPACITY RATIO TO PEAK INFLOWS AND OUTFLOWS

SPILLWAY CAPACITY TO:	SURCH.* H (FT)	W.S. ELEV. ABOVE DATUM**	SPILLWAY CAPACITY (CFS)	SPILLWAY CAPACITY AS % OF INFLOWS AND OUTFLOWS			
				Q_{P_1} (600 CFS)	Q'_{P_1} (300 CFS)	Q_{P_3} (390 CFS)	Q'_{P_3} (180 CFS)
½ PMF	1.7	101.7	180	—	60	—	100
PMF	2.8	102.8	390	65	—	100	—
LOW POINT	3.2	103.2	480	80	160	120	270
TOP OF DAM***	4.0	104.0	680	110	230	170	380

* SURCHARGE ABOVE SPILLWAY CREST
* SEE NOTE p. D-2
** SPILLWAY WALLS (PRESSUMABLY, ORIGINAL TOP OF EMBANKMENT)

OBED HEIGHTS RESERVOIR DAM

II) DOWNSTREAM FAILURE HAZARD

1) POTENTIAL IMPACT AREAS

FLOODING UPON FAILURE OF OBED HEIGHTS RESERVOIR DAM MAY AFFECT SEVERAL AREAS OF OLD SAYBROOK, CT., WHICH ARE LOCATED BOTH, U/S AND D/S FROM INTERSTATE RTE. I-95.
RTE I-95 CROSSES THE VALLEY OF RAGGED ROCK CREEK (±) 1000' D/S FROM THE DAM. 2-36"ϕ CULVERTS, (±) 700' APART, NORMALLY DRAIN THE AREA U/S RTE I-95. EXCEPT FOR A SECTION (±) 1400' LONG (MOSTLY TO THE LEFT OF THE CREEK) IN WHICH RTE I-95 "HUMPS" TO (±) ELEV. 50' (NGVD), OVER A STREET UNDERPASS, THE HIGHWAY GRADE RETAINS AT OR BELOW ELEV. 40' (NGVD)*.
U/S FROM RTE I-95, TO THE LEFT, THE TERRAIN SLOPES DOWNWARD FROM ELEV. 40' (NGVD) BOTH, THRU THE UNDERPASS AND EASTWARD, ALONG THE STREET WHICH RUNS PARALLEL TO THE HIGHWAY. SEVERAL HOMES (6 OR MORE) ARE LOCATED ALONG THE STREET IN THE POTENTIAL FLOODWAY. THE UNDERPASS LEADS D/S FROM THE HIGHWAY TO ANOTHER POTENTIAL IMPACT AREA HAVING AT LEAST ONE OR TWO HOMES AND A COMMERCIAL BUILDING.
TOWARDS THE RIGHT, OVERFLOW ACROSS RTE I-95 MAY AFFECT MANY (10 OR MORE) HOUSES LOCATED D/S, BETWEEN THIS HIGHWAY AND THE BOSTON POST ROAD.
IF, BECAUSE OF BEING A MAN-MADE STRUCTURE, THE EXISTENCE OF RTE I-95 IS IGNORED FOR THE D/S FAILURE ANALYSIS (EMBANKMENT OF UNKNOWN ABILITY TO WITHSTAND SURCHARGE, AT PLACES OVER 10' HIGH & CULVERTS THAT CAN BE MODIFIED), SEVERAL OTHER HOMES D/S FROM THE HIGHWAY'S EMBANKMENT MAY ALSO BE AFFECTED.

*NOTE: DATA FROM C.E. FIELD OBSERVATIONS ON 4/11/80 BY HLL & R.J. AND THE U.S.G.S. OLD LYME AND ESSEX, CT. QUAD. SHEETS (REV. 1970), AND FROM WHICH THE NGVD (MSL) ELEVATIONS GIVEN WERE APPROXIMATED.

2) FAILURE AT OBED HEIGHTS RESERVOIR

ASSUME SURCHARGE TO TEST FLOOD (1/2 PMF - SEE P. D-11) CONDITIONS (ELEV. 101.7' DATUM ≅ ±EL. 62.7' NGVD - SEE NOTE P. D-2).

a) HEIGHT OF DAM*: $H \cong 22'$ (TOE ELEV. ± 82' DATUM ≅ ±EL. 43' NGVD)

b) MID-HEIGHT LENGTH*: $\ell \cong 420'$

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

$W = 0.4 \times 420 = 168'$ ∴ ASSUME $W_b = 168$; SAY, $W_b = \underline{170'}$

d) ASSUMED WATER DEPTH AT TIME OF FAILURE: $y_o = 19.7'$

e) SPILLWAY DISCHARGE AT TIME OF FAILURE: $Q_s = \underline{180}$ CFS (SEE P. D-5)

f) BREACH OUTFLOW (SEE NED-ACE GUIDELINES)

$$Q_b \cong \frac{8}{27} W_b \sqrt{g}\, y_o^{3/2} = 25000 \text{ CFS}$$

g) PEAK FAILURE OUTFLOW (Q_{p_1}) TO RAGGED ROCK CREEK AND OTHER D/S IMPACT AREAS:

$$Q_{p_1} = Q_s + Q_b = 25180 \text{ CFS} \quad \text{SAY, } \underline{25000} \text{ CFS}$$

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

$$y \cong 0.44\, y_o = \underline{8.7'}$$

®(FROM RETREATING WAVE THEORY APPLIED TO DAM FAILURE)

*FROM CE FIELD MEASUREMENTS ON 4/11/60 BY HLL & R.J.

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

BECAUSE UPON FAILURE OF OBED HEIGHTS RESERVOIR DAM, THE FLOOD WILL TRAVEL A BROAD (500' TO 1000' WIDE), RELATIVELY FLAT PLAIN (± 0.4% SLOPE) TOWARDS RTE I-95, APPROXIMATELY 900' D/S, THE ANALYSIS OF THE CONDITIONS AT THE POTENTIAL IMPACT AREAS WILL BE MADE BASED ON THE FOLLOWING GENERAL ASSUMPTIONS:

a) WITH RTE I-95 EMBANKMENT SECTIONS REMAINING IN PLACE, TWO FLOODING CONDITIONS CAN BE ASSUMED:

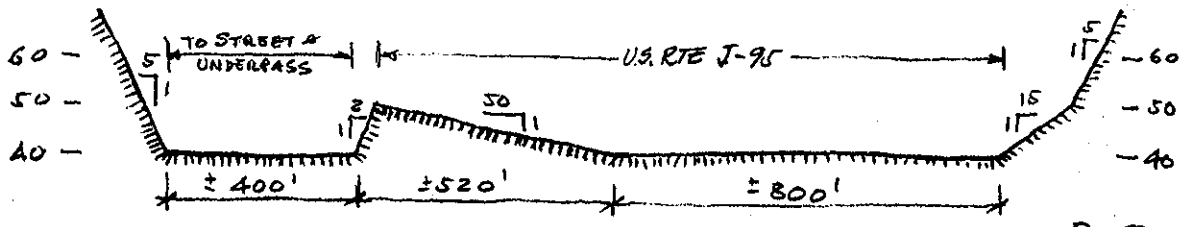
i) THE ENTIRE PLAIN IS FLOODED AND THE HIGHWAY AND ADJACENT TERRAIN FORM AN OVERFLOW SECTION WITH FLOW TOWARDS THE STREET AND UNDERPASS TO THE LEFT, AND TOWARDS THE AREA TO THE RIGHT D/S FROM THE HIGHWAY NEAR THE BOSTON POST ROAD (RTE 1)

ii) THE FLOOD DOES NOT SPREAD RAPIDLY TO FILL THE ENTIRE PLAIN, BUT TO AN ASSUMED 6 LONGITUDINAL TO 1 TRANSVERSAL GRADUAL EXPANSION. IN THIS CASE, DEPENDING ON THE LOCATION OF THE BREACH, THE AREA AT (±) ELEV. 40' NGVD BETWEEN RTE I-95 AND RTE 1, DIRECTLY D/S FROM THE DAM WILL BE MORE AFFECTED.

b) CONDITIONS ASSUMING RTE I-95 NON-EXISTING, WILL ALSO BE CRITICAL TO THE AREA BETWEEN I-95 AND RTE 1 MAINLY TO THE RIGHT OF RAGGED ROCK CREEK.

5) ANALYSIS FOR CONDITIONS (4, a, i) ABOVE:

THE FOLLOWING OVERFLOW PROFILE (U.S.G.S. QUAD. SHEET) IS ASSUMED ABOVE ELEV. 40' NGVD:



ASSUMING $C \cong 2.7$ FOR THE ENTIRE OVERFLOW SECTION, THE OUTFLOW CONDITIONS CAN BE ESTIMATED AS FOLLOWS:

$$Q \cong Q_{STR.} + Q_{HWY} \cong (1080 H^{3/2} + 12.6 H^{5/2}) + (2160 H^{3/2} + 117 H^{5/2})$$

$\therefore$ FOR $Q_p \cong 25000^{CFS}$: $Y' \cong \underline{\underline{3.6'}}$ ($Q_{STR.} \cong 7600^{CFS}$; $Q_{HWY} \cong 17400^{CFS}$)

THESE WILL BE APPROXIMATELY THE CONDITIONS AT THE IMPACT AREA ON GROUND AT ELEV. (±) 40' NGVD, D/S FROM RTE I-95. THE PORTION OF THE FLOW DIVERTED TOWARDS THE STREET AND UNDERPASS WILL BE LESS CRITICAL AS THE FLOW DIVERTED WILL BE FURTHER DIVIDED AT THE UNDERPASS. HOWEVER, IT WILL CAUSE SIGNIFICANT FLOODING.

6) ANALYSIS FOR CONDITIONS (4, a, ii), p. D-8:

IT IS ASSUMED THAT THE FLOW WILL EXPAND IN A DIRECTION PERPENDICULAR TO THE BREACH (DAM), FROM AN INITIAL CROSS SECTION (±) 170' WIDE AND 8.7' DEEP (W_b, Y; p. D-7) TO A SECTION (±) 470' WIDE AT RTE I-95 (900' D/S) AND (±) 550' WIDE AT THE IMPACT AREA D/S FROM THE HIGHWAY (± 1100' D/S FROM THE DAM).

THE FLOOD DEPTH IS ROUGHLY ESTIMATED BY MOMENTUM BALANCE:

$$\frac{P+M}{w} = \frac{Th^2}{2} + \frac{Q^2}{gTh} \quad \text{AND} \quad \left(\frac{P+M}{w}\right)_1 = \left(\frac{P+M}{w}\right)_2$$

FOR THE ASSUMED RECTANGULAR SECTION OF WIDTH (T) AND DEPTH (h) AND INITIAL VALUES:

$T_1 \cong 170'$; $h_1 \cong 8.7'$; $Q_1 = Q_2 = 25000^{CFS}$

THE COMPUTED D/S DEPTH AT THE IMPACT AREA (1100' D/S) IS:

$$Y'' = Y_2 \cong \underline{\underline{7.3'}}$$

7) ANALYSIS FOR CONDITIONS (4,b), p. D-8:

THE RAGGED ROCK CREEK JUST U/S FROM RTE I-95 (ASSUMED NOT EXISTING) FORMS A WIDE TRAPEZOIDAL CHANNEL SECTION WITH BASE $b \approx \pm 500'$ AT ELEV. 40' NGVD AND SIDE SLOPES (TO $\pm 10'$ DEPTH) OF $\pm 35^H$ AND $\pm 20^H$ TO 1^V. ABOVE 10' DEPTH, THE SIDE SLOPES CHANGE TO $\pm 10^H$ AND $\pm 4^H$ TO 1^V. THE LONGITUDINAL SLOPE OF THIS ASSUMED CHANNEL IS ($\pm$) 0.4%. ASSUMING AN $n = 0.050$ AND THE FLOOD SPREADING TO THE ENTIRE WIDTH OF THE CHANNEL (OTHERWISE, SEE SECT. 6, p. D-9), THE DEPTH OF FLOOD AT THE IMPACT AREA IS ESTIMATED AT:

$$Q_p = 25000^{CFS} \quad \therefore \quad y''' \approx \underline{6.5'}$$

8) CONDITIONS IMMEDIATELY BEFORE FAILURE: $Q_s = 180^{CFS}$

THEREFORE, CONDITIONS BEFORE FAILURE AT ALL IMPACT AREAS ASSUME NO OR INSIGNIFICANT FLOW / DEPTH OF WATER. CONSEQUENTLY, THE RAISE IN STAGE AT IMPACT AREAS WILL PRACTICALLY CORRESPOND TO THE DEPTHS ESTIMATED ABOVE.

NOTE: ANALYSIS ASSUMING SURCHARGE AT TIME OF FAILURE TO FULL PMF CONDITIONS ($H = 2.8'$; $Q_s = 390^{CFS}$) GIVE THE FOLLOWING SIMILAR RESULTS ($y_o \approx 9.1'$; $Q_p \approx 28000^{CFS}$):

i) FOR CONDITIONS (4,a,i) p. D-8/9 $\quad y_*' \approx 3.8'$; $Q_{\pi}^* = 8500^{CFS}$; $Q_{\text{hwy}}^* = 19500^{CFS}$
ii) FOR CONDITIONS (4,a,ii) p. D-8/9 $\quad y_*'' = 7.9'$
iii) FOR CONDITIONS (4,b) p. D-8/10 $\quad y_*''' = 6.9'$

III) SELECTION OF TEST FLOOD

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

a) SIZE: *STORAGE (MAX) $\cong$ 250 AC FT ($50 < S < 1000$ AC FT)
HEIGHT $\cong$ 22' ($H < 25$ FT)

*STORAGE: C.E. ESTIMATE: STORAGE INCREMENT FROM W.L. TO TOP OF DAM $\Delta S \cong 75$ AC-FT; 1) $S \cong 0.56\,AH = 0.56 \times 21 \times 13 \cong 150 + 75 = \underline{225}$ AC FT
2) ASSUMING AVE. DEPTH $\bar{y} = 8'$ AND $A_{WL} = 21$ AC; $S = 170 + 75 = 245$; SAY $\underline{250}$ AC FT
$\therefore$ USE $S_{MAX} = 250$ AC FT.

HEIGHT: SEE P. D-7

$\therefore$ SIZE CLASSIFICATION: <u>SMALL</u>

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

HAZARD CLASSIFICATION: <u>HIGH</u>

2) TEST FLOOD: 1/2 PMF = <u>300</u> CFS

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

OBED HEIGHTS RESERVOIR DAM

IV) SUMMARY

1) TEST FLOOD = ½ PMF ≅ 300 CFS
(PARALLEL COMPUTATIONS HAVE BEEN MADE FOR PMF ≅ 600 CFS AND ARE ALSO SUMMARIZED BELOW)

2) PERFORMANCE AT PEAK FLOOD CONDITIONS:
a) PEAK INFLOWS: Q_{P_1} = PMF ≅ 600 CFS Q'_{P_1} = ½ PMF ≅ 300 CFS
b) PEAK OUTFLOWS: Q_{P_3} ≅ 390 CFS Q'_{P_3} ≅ 180 CFS
c) SPILLWAY CAPACITY (SEE TABLE p. D-5)
i) TO ½ PMF (H=1.7'): $(Q_S)_1$ = 180 CFS (100% OF Q'_{P_3})
ii) TO PMF (H=2.8'): $(Q_S)_2$ = 390 CFS (100% OF Q_{P_3})
iii) TO LOW POINT (H=3.2): $(Q_S)_3$ = 480 CFS (120% OF Q_{P_3}; 270% OF Q'_{P_3})
iv) TO TOP OF DAM (H=4.0): $(Q_S)_4$ = 680 CFS (170% OF Q_{P_3}; 380% OF Q'_{P_3})

d) PERFORMANCE:
i) AT TEST FLOOD: FREEBOARD TO LOW PT. (±) 1.6' (WS EL. 101.7' DATUM)
ii) AT PMF: FREEBOARD TO LOW PT. (±) 0.4' (WS EL. 102.8' DATUM)

3) DOWNSTREAM FAILURE CONDITIONS:
a) PEAK FAILURE OUTFLOW: Q_P ≅ 25000 CFS
b) FLOOD DEPTH IMMEDIATELY D/S FROM DAM: Y_0 ≅ 8.7'
c) CONDITIONS AT THE INITIAL IMPACT AREAS (RAGGED ROCK CREEK AREA)
i) FOR ASSUMPTIONS/CONDITIONS (4,a,i) p. D-8/9:
APPR. FLOOD DEPTH AFTER FAILURE: Y' ≅ 3.6' (Q_{ST} = 7600 CFS; Q_{INST} = 17400 CFS)
ii) FOR ASSUMPTIONS/CONDITIONS (4,a,ii) p. D-8/9
APPROX. FLOOD DEPTH AFTER FAILURE: Y'' ≅ 7.3' (Q ≅ 25000 CFS)
iii) FOR ASSUMPTIONS/CONDITIONS (4,b) p. D-8/10
APPROX. FLOOD DEPTH AFTER FAILURE: Y''' ≅ 6.5' (Q ≅ 25000 CFS)

RAISE IN STAGE CORRESPONDS APPROX. TO THE ABOVE DEPTHS FOR EACH CONDITION.

PRELIMINARY GUIDANCE

FOR ESTIMATING

MAXIMUM PROBABLE DISCHARGES

IN

PHASE I DAM SAFETY

INVESTIGATIONS

New England Division
Corps of Engineers

March 1978

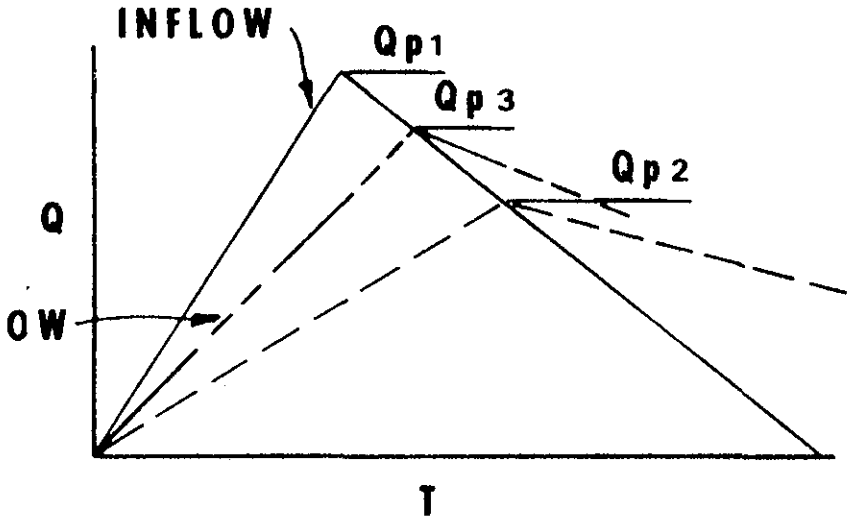
MAXIMJM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

	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



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

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

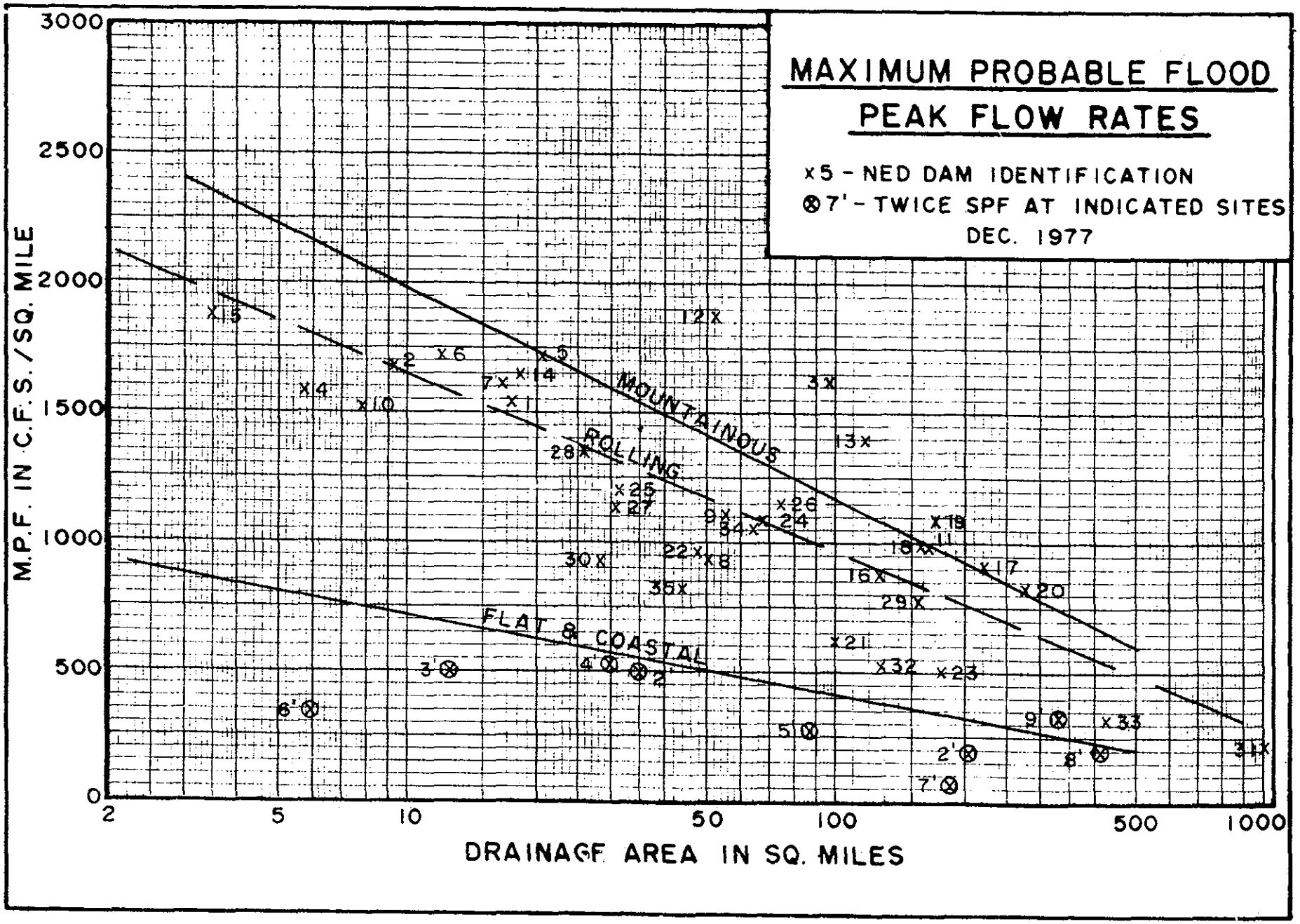
b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

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

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

TEP 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
MOUNTAINOUS
ROLLING
FLAT & COASTAL
3000
2500
2000
1500
1000
500
0
2
5
10
50
100
500
1000

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

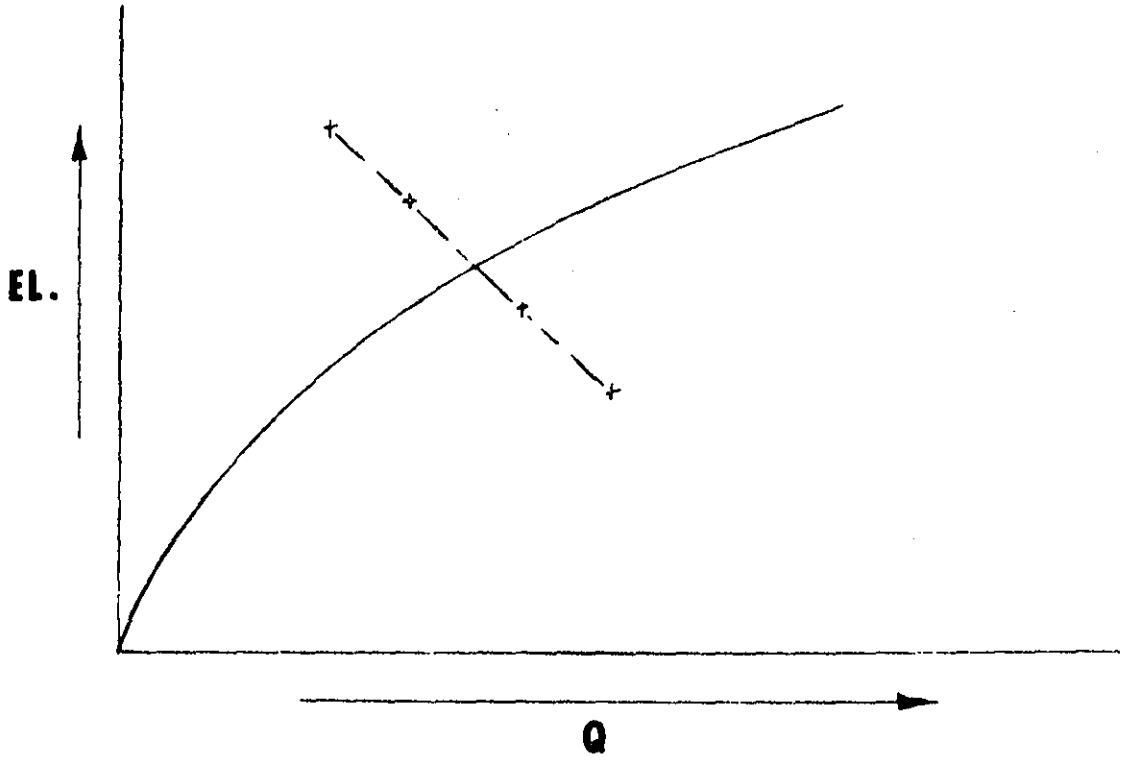
SURCHARGE STORAGE ROUTING ALTERNATE

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

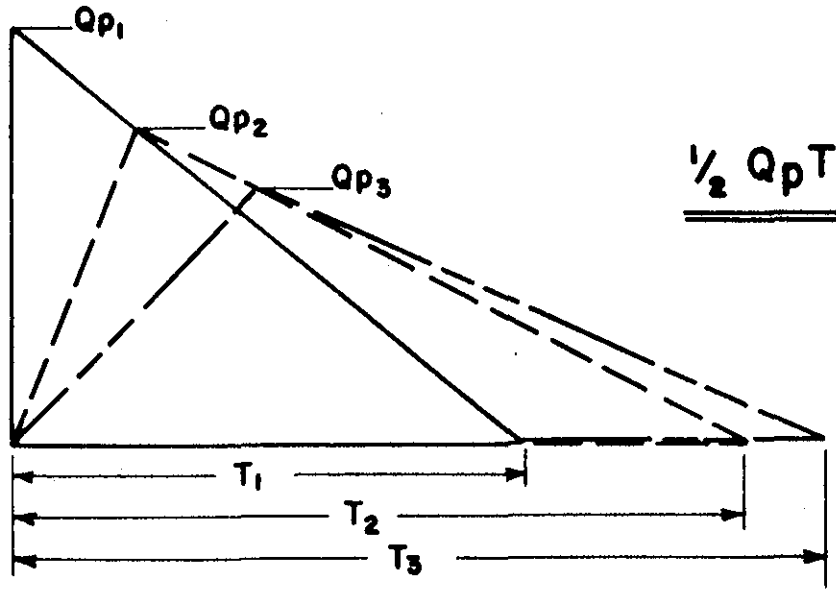
$$Q_{p2} = Q_{p1} - Q_{p1}\left(\frac{STOR}{19}\right)$$

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

Q_{p2}	STOR	EL.



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



$$\tfrac{1}{2} Q_p T = 12\,S$$

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

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

$$Q_{p1} = \tfrac{8}{27}\, W_b \sqrt{g}\, Y_o^{3/2}$$

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 ACCOPMANYING 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}.

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

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	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
CT	414	NED	CT	007	02				OBED HEIGHTS RESERVOIR DAM	4118.6	7222.4	27MAY80

POPULAR NAME	NAME OF IMPOUNDMENT
	OBED HEIGHTS RESERVOIR

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	08	RAGGED ROCK CREEK	OLD SAYBROOK	1	500

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REOT	1880	R	22	22	250	175	NED	N	N	N	N	

REMARKS
20-ESTIMATE 21-CONCRETE COREWALL 22-ESTIMATE

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	465	U	27	680												

OWNER	ENGINEERING BY	CONSTRUCTION BY
CARL PIONTKOWSKI		

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
CT WATER RESOURCES	CT WATER RESOURCES	CT WATER RESOURCES	CT WATER RESOURCES

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
CAHN ENGINEERS INC	20MAR80	PL92-367

REMARKS